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Foreword…

Mission™ Sandmaster™ 12x12x 15 Centrifugal Pump

Mission is introducing a new member of the Magnum™ Sandmaster pump line.

INTRODUCTION

National Oilwell Varco's (NOV) latest addition to the Magnum centrifugal pump line is a 12 x 12 x 15 Sandmaster single stage centrifugal pump, capable of providing flow rates up to 155 BPM and pressure heads to 100 feet, offering solutions to those high flow-low head applications in the oilfield service industry. This unit is an extension of the Magnum pump line offering NOV's quality manufacturing and a distribution network to increase solutions to pumping requirements in the oilfield industry from an industry specific partner.

APPLICATIONS

Applications include suction pump on blender units to maintain liquid level in blender tub, mixing and blending applications, high volume mixing and transfer of drilling and completion fluids, additional oilfield pump applications offering high pump efficiencies requiring reduced input power resulting in saving space, fuel and initial acquisition costs on engine drives, and hydraulic motor drives and electric motor driven equipment.

FEATURES

Pump features a 200 horsepower rated grease lubricated ball bearing power frame similar to the current Mission Magnum line and is provided with the Mission Hard Iron alloy liquid end construction and fitted with single spring-inside mounted mechanical shaft seal in a replaceable stuffing box providing leak-free operation and ease of replacement; nozzles furnished with 12" – ANSI class 150 flat face flange connections; standard clockwise rotation as viewed facing pump shaft. Additional features include replaceable Hard Iron suction stand; renewable wear rings installed in suction stand and on eye side of impeller; discharge nozzle can be rotated to positions other than vertical; pump power frame fitted with an optional outboard bearing housing capable of accepting hydraulic motor adapters for S.A.E size B, C and D hydraulic motor mounts; straight, keyed input shaft for use with standard flexible couplings to connect pump shaft to driver of choice.

Contact Mission Products for additional information and sizing assistance for any of the extensive line of single stage centrifugal pumps offered in low pressure mud systems and other oilfield pump applications.

GENERAL INSTRUCTIONS

1. Operate the pump only in the performance range for which it was designed.
2. The pump driver must drive the pump **CLOCKWISE** when viewed from the coupling end. Reversing the rotation will damage the pump.
3. Do not operate the pump with the suction or discharge valves closed.
4. Adjust the packing so that a small amount of leakage remains for lubrication and cooling (not applicable for pumps equipped with mechanical seal).
5. When operating in drilling mud, prevent packing drippage from clogging the drip area and hardening around the slinger and front seal.
6. See Section E for mechanical seal installation.

⚠ ! 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.

⚠! 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 LINES PRIOR TO REMOVING PIPING.

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

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MISCELLANEOUS INFORMATION

Installation…

I. GENERAL

A. LOCATION

The pump should be located near the liquid source so that the suction line may be short and direct. The pump should be located below the level of the liquid to eliminate the necessity of priming.

B. FOUNDATION

The foundation should be sufficiently rigid (rigid structure for vibration analysis purposes means that it has the first fundamental natural frequency 15% or more above operating rotating frequency of the motor) and substantial to absorb any vibration and to permanently support the base plate at all points. A concrete foundation, poured on a solid footing of adequate thickness to support the pumping unit, provides the most satisfactory foundation. The base plate should be installed in a level position. Figure 1 shows a typical arrangement for bolting channel bases.

When fabricated skid bases are utilized, the foundation should be sufficiently rigid and leveled properly to absorb any vibration and to permanently support the base at all points. The vibration should be under 4.2 mils peak to peak at 1800 rpm as notes in the Hydraulic Institute Standards 9.6 4-2009.

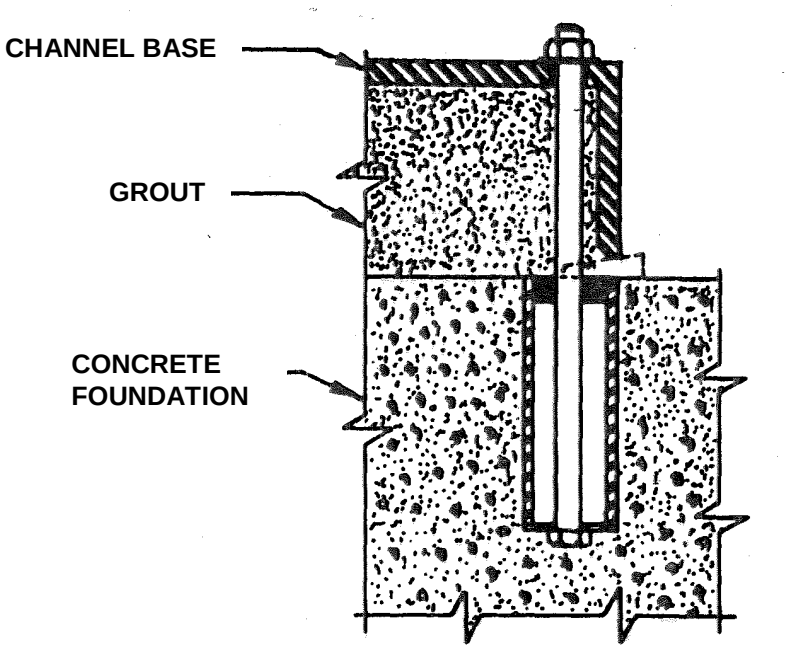


Figure 1

NOTE: A detailed description of proper Procedures for grouting base plates may be found in the Hydraulic Institute Standards, 1.3-2009 page 94-108.

Installation…

I. GENERAL (Continued)…

D. COUPLING ALIGNMENT

Good service life of the pump and driver depends upon good alignment through the flexible coupling. If the electric motor was mounted at the factory, the pump and motor were in alignment when shipped. **The alignment between the pump and driver should be inspected after installation to ensure that transportation or other handling has not caused misalignment of the unit.** Poor alignment may cause failure of the coupling, pump, motor, or bearings.

Alignment must not be attempted until the base is in position and the mounting and flange bolts have been tightened.

The recommended procedure for coupling alignment is with the use of a dial indicator, as illustrated in Figures 2 and 3. The dial indicator is attached to one coupling half with the indicator button resting on the O.D. of the other coupling half to measure offset misalignment. To measure angular misalignment, the indicator is positioned so that the buttons rest on the face, near the O.D., of the other coupling half. Rotate the shaft and dial indicator one revolution while the other shaft remains stationary and note the T.I.R. Unless otherwise specified by the coupling manufacturer, offset misalignment should be limited to 0.005 inches T.I.R. Adjust the alignment by loosening the pump or driver mounting bolts and retighten or shim as required.

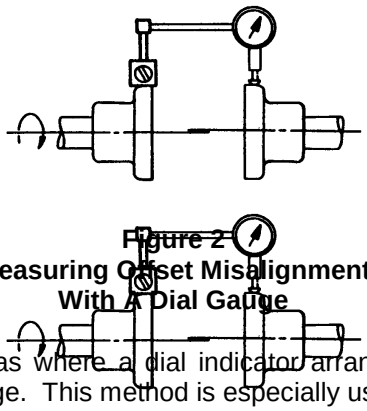


Figure 2
Measuring Offset Misalignment
With A Dial Gauge

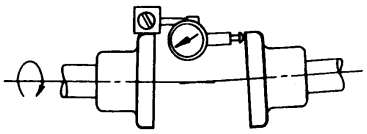


Figure 3
Measuring Angular Misalignment
With A Dial Gauge

In areas where a dial indicator arrangement is not available, an adequate job of alignment can be done with a straightedge. This method is especially useful if the coupling used contains a rubber drive element.

To check offset misalignment, lay the straightedge in line with the shafts on the O.D.'s of the coupling halves. There should be no gaps under the straightedge. Check two locations 90 degrees apart. Angular misalignment can be checked by measuring the gap between coupling half faces. There should be no more than a 1/64 inch gap under the straightedge or a 1/64 inch variation in the gap between the coupling halves. See Figures 2A and 3A.

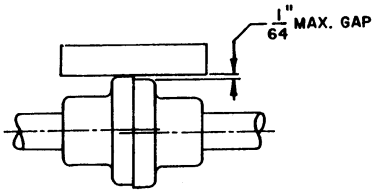


Figure 2A
Measuring Offset Misalignment
Using a Straightedge

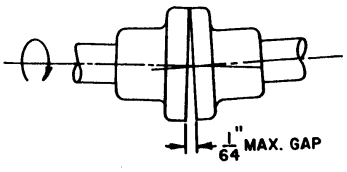


Figure 3A
Measuring Angular Misalignment
Using a Straightedge

NOTE: Further reference on coupling alignment can be found in ANSI/HI 1.1-1.5-1994, Pages 114 through 117.

Installation…

I. GENERAL (Continued)…

E. PIPING

1. General

Piping must not be connected to the pump until the grout has hardened and the foundation and pump hold down bolts have been tightened.

Piping should be anchored independently of the pump and as near to it as possible. Pipe companion flanges should line up naturally with pump flanges. ***Do not draw the pipe to the pump with flange bolts.***

2. Suction

Properly selected and installed suction piping is extremely important to eliminate vibration and cavitation in the pump. Vibration can cause packing problems, mechanical seal damage, or undue bearing loads.

The suction line should be equal to or larger than the pump suction. ***The capacity of a centrifugal pump should never be adjusted by throttling the suction line.*** A positive shut-off valve of a type to cause minimal turbulence should be installed in the suction line to permit the closing of the line for removal of the pump for inspection and maintenance.

The suction line should be designed to eliminate any air pockets. The piping should gradually slope downwards to the supply source to eliminate air pockets.

The suction line should have a straight section into the pump of a length equivalent to at least two times its diameter; i.e. a 4-inch suction line should have a minimum 8-inch straight run.

For temporary hook-up when flexible hose is used, a non-collapsing hose is essential since the suction line pressure is often below atmospheric pressure. A collapsed suction line will result in below average or complete loss of flow.

3. Discharge

A positive shut-off valve should be located in the discharge piping to permit the closing of the line for removal of the pump for inspection and maintenance.

All piping should be independently supported and accurately aligned. ***The pump must not support the weight of the pipe or compensate for misalignment.***

If operating conditions are not known with sufficient accuracy, it will be necessary to provide a throttle valve in the discharge line to ensure that the pump operates at the design point.

If the pump is connected to a pressurized system, it is important to install a check valve between the pump discharge and the throttling valve. The check valve will prevent back flow through the pump. Back flow may cause the impeller to become loose on the shaft. A loose impeller will likely result in mechanical damage and fluid leakage beneath the shaft sleeve.

Preparation for Operation…

I. GENERAL

A. INITIAL LUBRICATION

Standard pumps are shipped Grease Lubricated with Mystic JT-6 Hi-Temp No. 2 Grease. See "Lubrication" section for lubrication instructions.

The air vent should be kept clean to prevent pressure build-up due to heating that occurs in normal operation.

Oil lubrication is available upon request. There is a dipstick available that indicates the correct oil level.

B. MECHANICAL SEALS

When mechanical seals are furnished they are installed and adjusted at the factory. The H22451-1 tungsten carbide mechanical seal normally used in drilling mud environments do not require external flush.

To properly prepare special or industrial mechanical seals for operation, various cooling and flushing flows may have to be connected. Liquid from an outside source may be required. If outside flushing is required, connect the necessary cooling or flushing lines to the seal and be sure they are operating before starting the pump. See seal drawings and instructions if special seals are used.

! WARNING ! WARNING ! WARNING !

NEVER OPERATE A PUMP "DRY" WITH MECHANICAL SEALS. MECHANICAL SEAL FAILURE WILL OCCUR!

C. CHECK PUMP ROTATION

Most pumps manufactured have clockwise rotation when viewed from the coupling end. The correct rotation can be found by an arrow on the casing.

It is very important that the pump rotation is determined before starting the pump. If the **12X12X15 SANDMASTER** is turned backwards the impeller may unscrew causing severe damage to the pump.

The best way to check rotation is to disconnect the coupling, but it can be checked without disconnecting the coupling. One person should be at the pump watching the shaft while a second person starts and then immediately stops the pump so the shaft barely turns over.

D. PRIMING THE PUMP

Be sure the pump has fluid in the casing before running. If the pump is operated without fluid, the mechanical seal or packing can be destroyed. Vent air from the suction line and fill it with liquid. Start the pump with the discharge valve cracked open. After discharge pressure stabilizes, gradually open the discharge valve to the required position. If flow is lost, close the discharge valve and wait a few seconds for the discharge pressure to build. Continued flow difficulty indicates improper pump selection or installation.

Running the pump with improper priming may destroy the sealing faces of the mechanical seal due to overheating or mechanical damage from pulsation between stationary and rotating components. Do not run the pump with the suction valve closed **AT ANY TIME!** Thermal shock can crack the stationary seat if the temperature is raised from room temperature to 250°F. in less than 30 seconds. Run the pump with the discharge valves closed only for short periods of time. The energy going into the pump heats the fluid in the casing. If the pump needs to operate shut in some of the time, be sure to install a small line (1/4 or 1/2 inch) back to the suction tank between the discharge valve and the pump for cooling.

Preparation for Operation…

I. GENERAL (Continued)…

E. MECHANICAL SEAL PUMPS

Be sure the pump is never started dry. Seal faces will heat check in less then a minute if run dry. The backup packing should not be tightened until seal failure occurs. The packing can then be installed and the pump run normally until the mechanical seal is repaired.

F. START-UP CHECKLIST

! WARNING ! WARNING ! WARNING !

IT IS ABSOLUTELY ESSENTIAL THAT THE ROTATION OF THE MOTOR BE CHECKED BEFORE CONNECTING THE SHAFT COUPLING. INCORRECT ROTATION OF THE PUMP FOR EVEN A SHORT TIME WILL DISLODGE THE IMPELLER AND DAMAGE THE IMPELLER, SHAFT OR BEARING HOUSING. THE PUMP SHAFT MUST TURN CLOCKWISE WHEN VIEWED FROM THE MOTOR END.

Check the following items before starting the pump:

1. Pump rotates freely by hand.
2. Pump rotates in proper direction.
3. Coupling aligned.
4. Oiler full and oil level correct (oil lube pumps).
5. Suction valve fully open.
6. Pump and suction line full of fluid.
7. Discharge valve is slightly open, not fully open. Fully open the discharge valve after the pump is running.

Operation…

I. GENERAL

A. MAXIMUM OPERATING CONDITIONS

Note: These maximum operating conditions apply to pumps that are exposed to room temperatures without external insulation.

1. Cast Iron: Maximum working pressure is 175 psig at 150°F or 150 psig at 250°F. Interpolate for pressure between 150° and 250°F maximum.

2. Steel: Maximum working pressure and test pressure in accordance with ANSI B 16.5-1973, Tables 2.1 through 2.23 and Table 3.

3. For H-30 and SUPREME HARD alloy, contact NATIONAL OILWELL VARCO distributor.

4. Cooling water through the lantern ring is required when fluid being pumped is between 150° and 250°F. In addition, it may be necessary to run water over the exposed shaft to prevent excessive heat build up at the bearings.

5. Maximum hydraulic performance is in accordance with published performance curves.

B. PUMP RECORDS

Maintain data cards or pump records whenever possible. ***This will provide ready access to information for ordering spare parts and for evaluating pump and mechanical seal performance.***

Information to be included in these records should be:

1. Pump size and serial number.

2. Pump model number, impeller diameter, material of construction.

3. Mechanical seal manufacturer, type, code and drawing number.

4. Motor horsepower and speed of operation.

5. Service conditions.

6. Frequency of operation.

7. Record of maintenance, including parts usage and general pump conditions.

8. Nomenclature and part number of replacement items.

Operation…

I. GENERAL (Continued)…

C. LUBRICATION

1. Bearings

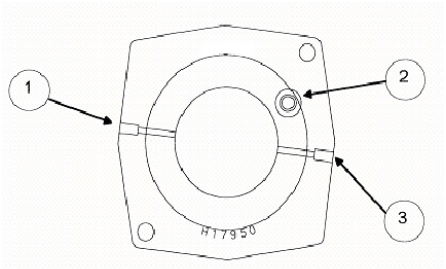
Grease

Grease lubricated centrifugal pumps should be included in the customer's lubrication maintenance program. It is recommended that grease lubricated pumps have five shots from a standard hand operated grease gun injected into the inboard and outboard bearing lubrication ports every three (3) months. The shaft should be rotated 1/4 turn between each shot of grease. Mystic JT-6 Hi-Temp No. 2 is used during assembly at the factory. It is important that the same or a compatible NLGI No. 2 certified for GC-LB high temperature grease be utilized. Grease available in sealed tubes is recommended. If grease from other type containers is used, ensure the grease is clean and free from water or other contamination.

2. Lip Seals

The inboard bearing cover is supplied with a grease zerk fitting between the 10 and 11 o'clock position facing the suction. This is designed to create a grease barrier between the inboard lip seal and should be greased prior to wash-down and at least once a week with 5 shots of general purpose or water pump grease (SEE Fig. 4)

Front View of Inboard Bearing Cover
Figure 4



Inboard Bearing Cover
1. Oil seal inlet grease port
2. Bearing grease port
3. Oil seal relief port

Maintenance…

I. GENERAL

Refer to Cross Section Drawing Fig. 6, Pg. 27, and Parts List on page 28 for materials and location.

II. DISASSEMBLY

A. GENERAL

1. Loosen packing gland bolts (22) and swing gland bolts to side. Remove packing gland halves.
2. Remove suction stand nuts (1)
3. Remove suction stand(3)
4. Remove casing nuts(9)
5. Remove casing(7)
6. Remove nose cone(13)
7. Remove impeller (15) If the impeller is hard to remove you can use a wedge and place it behind the impeller to assist with removal.
8. Remove the stuffing box cover bolts (26).
9. Remove the stuffing box cover (22) from the frame by hammering on the back side of the cover in the area that the box fits into the frame. **Note: If the disassembly being performed does not require the replacement of the mechanical seal, the seal and stuffing box should not be removed from the pump. Once the seal faces have separated it is virtually impossible to re-mate the seal faces and obtain a positive seal.** Pull the packing (25) from the stuffing box bore.
10. Remove the shaft sleeve (18). A wedge may be driven between the end of the sleeve and the shoulder of the shaft to free the sleeve. Note: if the disassembly is being performed to replace or install a mechanical seal and/or shaft sleeve only, no further disassembly is required. See mechanical seal installation instructions below.
11. Remove the deflector (27) (no deflector is used on pumps with labyrinth seals).
12. Remove the two through bolts (36) on the outboard bearing housing. **These are bolts threaded into the frame (34).**
13. The complete shaft and bearing sub-assembly can now be pulled from the frame.
14. Remove the outboard bearing cover (48).
15. Bend the tab on the lockwasher (45) back and remove the locknut (46) and lockwasher.
16. Remove the bearing housing (43) and bearings (44) from the shaft. **Note: Impacting of the entire shaft assembly against a board on the ground will remove the outboard bearing assembly.**

17. The inboard bearing (37) may now be pressed off the shaft. **Note: A piece of 3" standard wall pipe slipped over the shaft and impacted against the inner race of the bearing works exceptionally well.**

Maintenance (Continued)…

III. INSPECTION

A. IMPELLER

Replace if impeller shows excessive erosion (especially on the pump-out vanes on the back of the impeller), corrosion, extreme wear, or vane breakage.

B. SHAFT

Check for runout to see that the shaft has not been bent. If runout exceeds 0.002 inch, replace the shaft. Bearing seats and oil seal area must be smooth and free of scratches or grooves. Shaft threads must be in good condition. Replace shaft, if necessary.

C. SHAFT SLEEVE

Sleeve surface in the stuffing box must be smooth and free of grooves. If grooved, replace.

D. MECHANICAL SEAL

Seal faces, gaskets, and shaft sealing members must be in perfect condition or excessive leakage may result. Replace worn or damaged parts.

E. BEARINGS

Replace if worn, loose, or rough and noisy when rotated. New bearings should not be unwrapped until ready for use. Replacement bearings must be of the proper size and type as supplied with the original equipment.

F. SEALS

It is recommended that all O-ring and gasket seals be removed during disassembly and replaced. In those cases where new seals are not available, the old ones can be reused if they are not torn or otherwise damaged.

G. GENERAL

All parts should be clean before assembly. This is especially important for retaining rings and O-ring grooves, threads, gasket surfaces, bearings, and bearing surfaces. Any burrs should be removed with crocus cloth.

Maintenance (Continued)…

IV. ASSEMBLY

A. GENERAL

Numbers following part names refer to the part as shown on the exploded view drawing (Pg. 28).

B. SHAFT and BEARING SUBASSEMBLY

NOTE: Installation of the bearings with a press is an acceptable substitute for the following method. ***Apply the load to the inner race only, when pressing the bearings onto the shaft.***

1. Heat the bearings to 400ºF. **NOTE: 45 minutes in an oven at 400ºF will work nicely.**

2. Slip the inboard bearing spacer and then the roller bearing (37) onto the shaft. **CAUTION: Bearings and spacer must shoulder against the shaft. Take care to ensure these pieces do not separate.**

3. With bearing housing seal (42) in place, slide the bearing housing (43) onto the shaft from the coupling end. The large O.D. of the bearing housing should be facing the coupling end.

4. Slip the outboard bearings (44) onto the shaft. **Note: Outboard bearings are to be mounted back-to -back (that is, the sides of the bearings with the manufacturer's name and the bearing number are placed together). Improper bearing orientation will result in bearing failure. These bearings are a matched set and sets should not be mixed and matched. Check the installation requirements provided with the pump, and the markings on the bearings to help identify the "back-to-back" arrangement. Caution: Bearings must shoulder against the shaft.** Allow the bearings to cool. With lockwasher (45) in place, tighten locknut (46) with the bevel positioned against the bearings. Tighten the locknut to 250 ft./lb. of torque. Bend one tab of the lockwasher into the nut.

5. Pack the bearings (37 & 44) full with grease, preferably Chevron Unirex N2 or compatible greases.

6. Grease outboard bearing (44) O.D's and pull the bearing housing over them into place. The outer races may be pushed in with a hand push or with a light tapping on the bearing housing with a rubber mallet. Install lip seal (50) in outboard bearing cover (48) with the lip aimed in toward the bearings. Generously lubricate the rubber lip and the shaft in the sealing area. Fill the space behind the lip on the seal and half of the bearing cover with grease.

7. Put cover seal O-ring (47) in place. Slide the outboard bearing cover over the shaft. **Caution: Be careful not to cut the oil seal on the edge of the shaft keyway.** Secure two bolts (49) and tighten evenly to approximately 20 ft./lb. of torque.

Maintenance…

IV. ASSEMBLY (Continued)…

C. POWER FRAME SUB-ASSEMBLY

1. Install inboard bearing cover seal (29) into the inboard bearing cover (32) flush with the backside of the cover. Install exclusion seal (29) flush with the outside of the cover. **The sealing lips on both seals should be pointed outward (away) from the bearings for grease lubrication, while the lip of (10C) points inward for oil lubrication.** Pack the area between the lip seals full with grease. If equipped with a labyrinth seal in lieu of lip seal lightly oil o-ring and press lip seal squarely into bearing cap. Using grease to hold it in place put the inboard bearing cover gasket (33) on the cover.

2. The bores of the bearing frame must be clean. Lightly oil the bores to facilitate the insertion of the bearing train. Insert the shaft and bearing sub-assembly into the frame (34) until the threaded end of the shaft extends approximately halfway into the drip pan area.

3. The bearing train will slip in relatively easy by pushing the coupling end with one hand and pulling the opposite hand with the other. A rubber mallet may be used to tap on the end of the shaft assembly to help it align. **DO NOT USE EXCESSIVE FORCE.** If installation is difficult it indicates lack of concentricity between the bearings and frame. Excessive pounding will damage the bearings.

4. Slip inboard bearing cover assembly over the end of the shaft. Continue installing the shaft and bearing assembly in the frame until the gap between the frame and outboard bearing housing flange is approximately 1/4 inch.

5. Install two bolts (36) with jam nuts (35) in the threaded holes in the bearing housing. Install the remaining two bolts (12B) through the unthreaded holes in the bearing housing and thread them into the frame. **Do not tighten any bolts.**

6. Bolt the inboard cover to the frame with bolts (49).

7. Lubricate I.D. of deflector (27) (not utilized on pumps with labyrinth seals). Slip the deflector on the shaft with the cup side facing away from the bearing cover.

8. Slip shaft sleeve seal (21) onto the shaft and push it to the shoulder where the seal will seat. For pumps with a mechanical seal, see mechanical seal installation instructions on the next page for assembling the remainder of the pump.

9. The sleeved area of the shaft must be lightly coated with an anti-seize compound before installing the sleeve. Install sleeve (18) with a twisting motion to spread the anti-seize compound. The gap between the sleeve and the shaft shoulder will be approximately 1/32 inch.

D. ASSEMBLY OF WEAR RING FOR IMPELLER AND SUCTION STAND

1. Lay impeller on the 2x4 wood blocks (hub facing down) then align the impeller wear ring to O.D. at the top of the impeller. Use a rubber mallet to press down the wear ring evenly until flush with the top of the impeller.

2. To stake the impeller wear ring use a 7/32” drill bit to drill 3 holes 120 degrees apart on the parting line of the wear ring and impeller .75” deep. Use a ¼”-20 tap for the set screws to stake the wear ring.

3. Insert set screws to stake the wear ring down.

4. Lay suction stand flat on working table. Align suction wear ring(#) to the I.D. of the suction stand(#) then use a rubber mallet to press down the sear ring evenly until flush with the top of the suction stand.

5. To stake the suction stand wear ring use a 7/32” drill bit to drill 3 holes 120 degrees apart on the parting line of the wear ring and suction stand .75” deep. Use a ¼”-20 tap for the set screws to stake the wear ring.

6. Insert set screws to stake the wear ring down.

1. Maintenance…

IV. ASSEMBLY (Continued)…

E. ASSEMBLY OF FLUID END TO POWER FRAME

1. Lubricate the inside of the frame where the stuffing box cover slips in with an anti-seize compound. Install stuffing box cover (24) and secure with two bolts (26).
2. Lubricate the O.D. of shaft where impeller slides on, and the face of the shaft sleeve with an anti-seize compound. Wash the O-ring with clean shop solvent and pat dry with a clean cloth. Install the O-ring into the impeller (15).
3. Install key on the keyway of the shaft (39)
4. Slip impeller(15) on O.D. of the shaft (line up keyways on the impeller and shaft)
5. Apply blue Loctite to the shaft threads
6. Install O-ring(16) in the O-ring groove of the nose cone
7. Install nose cone(13) on the shaft threads and tighten to 200ft-lbs
8. Loosen the two through bolts (36).
9. Draw the bearing housing rearward with the jam bolts (36) while rotating the impeller. Stop when the impeller just touches the stuffing box cover.
10. Bring the through bolts up finger tight.
11. Loosen the jam bolts.
12. Tighten the through bolts until a clearance of 0.025 inch exists between the impeller back vanes and stuffing box cover (24). A hacksaw blade is approximately 0.020 inch thick and can be used as a gauge when no better tooling is available.
13. Advance both jam bolts until they touch the frame finger tight, and then tighten the jam nuts (35).
14. Now tighten the through bolts down evenly. Rotate the shaft. **The impeller should turn freely without rubbing.**
15. Install casing gasket (10). Hold in place with grease if necessary.
16. Apply a coat of anti-seize on all of the stuffing box cover diameters.
17. Install case studs(8) on the case(7) using a ¾”-10 stud driver
18. Stab the case assembly on the frame and tighten down the case nuts(9) to approximately 120 ft./lbs. using a star tightening pattern

F. ASSEMBLY OF PUMP TO SUCTION STAND

1. Install suction stand studs(2) to the front of the case(7) using a 5/8”-11 stud driver
2. Install suction stand gasket(4) to the front of the case(7) (use suction stand studs(2) to hold gasket in place)
3. Stab suction stand assembly to the case(7)and tighten down the suction stand nuts(1) to approximately 140 ft./lbs. using a star tightening pattern

1.

Maintenance ...

IV. ASSEMBLY (Continued)...

F. MECHANICAL SEAL
648414308.....see below

1. 648414308

a. If the impeller and/or stuffing box are being replaced adjust the impeller clearance BEFORE installing the seal. Back the through bolts (36) out approximately ¼ inch. Tighten the jam bolts (36) until a clearance of 0.025 inch between the back of the impeller (15) and the stuffing box (24) is obtained. Alternately tighten the through bolts and jam bolts making sure that the clearance set above is maintained. Tighten the jam nuts and recheck the clearance.

b. Make sure the shoulder where the stationary will sit and the inside of the stuffing box (24) is clean and that the 30° bevel on the 3-3/8 inch I.D. is free from burrs and sharp edges. Coat the I.D. of the stuffing box stationary seat packet with oil. Place the stuffing box on a table or other flat surface with the impeller side facing up.

c. The slotted side must be installed away from the impeller or down when the stuffing box is positioned as described in step 2 (above). Coat the O.D. of the stationary seat and O-ring with a thin film of oil.

d. Carefully install the stationary seat into the stuffing box. Be sure the groove of the stationary fits properly over the drive pin. Be sure that the stationary seats evenly against the stuffing box shoulder. **Hint: Wrap the end of a wooden hammer handle with a rag. Press firmly on the face of the stationary. Do not strike. Push gently on one side, alternating sides until the stationary is completely down.** Coat the stationary seat face with light oil, then wipe off the majority of the oil with a clean cloth, leaving only a light film.

e. Lubricate the inside of the frame (34) where the stuffing box (24) slips in with an anti-seize compound. Install the stuffing box and secure with bolts (3A-1/2D x 1-1/4 inch). Care should be taken to prevent bumping of the stationary seal on the shaft end.

f. Remove the rotating seal ring (4A of Figure 6) if it is not glued into position and store it in a safe place. Gluing can be determined by pulling on it gently. Coat the O.D. of the shaft sleeve (7A) and the I.D. of the rubber bellows (Item 4B of Figure 6) with a thin coat of oil.

g. Place the sleeve (7A) with the impeller end up on a table. The impeller end is the end with the smallest I.D. With the sealing face of the rotary unit facing down and the rubber end up, gently ease the rubber bellows over the sleeve and push it to the bottom half of the sleeve. (It is not necessary to push it all the way to the bottom). If the rotating seal ring (4A) has been removed, lightly coat the face of the bellows (Item 4B of Figure 6) with grease. (This is necessary to hold the rotating seal ring in place during assembly). Reinstall the rotating seal ring into the cage assembly (Item 4C of Figure 6).

h. Make sure no foreign material is present on the seal faces. Make sure the shaft (40) is free of nicks and burrs and is clean and dry. The sleeve area of the shaft, the shaft threads and the shaft face must be lightly coated with anti-seize compound before installing the sleeve (7A). Install the sleeve with a twisting motion. As the seal faces make contact, continue to push the sleeve through the I.D. of the rotary seal element until the gap between the sleeve and the shaft shoulder is approximately 1/32 inch.

Maintenance ...

IV. ASSEMBLY

F. MECHANICAL SEAL

1. 648414308 (Continued)...

i. Install the spring retainer (Item 9 of Figure 6) and the impeller O-ring (16) in its groove and coat with anti-seize compound. Place the mechanical seal spring (Item 6 of Figure 6) over the rotary unit of the seal (which is inside the stuffing box cover).

j. Install the nose cone and tighten to approximately 160 ft./lb. of torque.

k. Install the casing gasket (10). Hold it in place with grease if necessary. Apply a light coat of anti-seize compound on the 14-1/8 inch diameter of the stuffing box cover. Install the casing on the frame using studs (8) and nuts (9). Put a small quantity of anti-seize compound on the threads on the nut end of the studs. Tighten the nuts to 140 ft./lb. of torque using a criss-cross tightening pattern.

l. We recommend that the three shaft packing rings (25) are not installed until the seal fails. The rings are for emergency backup until the mechanical seal can be replaced. When they are installed, first grease them. Insert all packing rings alternating the splits from top to bottom starting with the split on the first ring at the bottom.

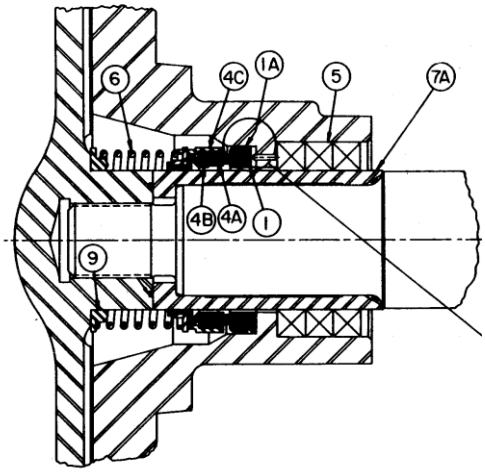


Figure 5
Arrangement for 2500 Supreme

Item	Qty.	Part Name
1	1	Stationary Seat
1A	1	Seat O-Ring
4A	1	Rotating Seal Ring
4B	1	Bellows
4C	1	Cage Assembly
5	3	Packing
6	1	Spring
7A	1	Sleeve**
9	1	Spring Retainer
15	1	Spring Pin

**These items are not included with seal.

Maintenance...

IV. ASSEMBLY

F. MECHANICAL SEAL (Continued)...

2. 648414308

a. Follow steps 1 through 5 above to install the stationary.

b. Place the impeller suction side down and hub side up.

c. Lubricate the inside of rubber bellows of the seal. Firmly slide the entire rotating seal assembly onto the impeller hub until the rubber bellows butts against the back of the impeller.

d. Make sure no foreign material is present on the seal faces.

e. Insert key(39) on impeller side of the shaft(40)

f. Line up key(39) and impeller(15) key way then slide the impeller (15) onto the shaft (40).

g. Install the nose cone and tighten to approximately 160 ft./lb. of torque. It is easiest with a NATIONAL OILWELL VARCO Impeller Wrench

h. Install the casing gasket (1A). Hold it in place with grease if necessary. Apply a light coat of anti-seize compound on the 14-1/8 diameter of the stuffing box cover. Install the casing (7) on the frame using studs (8) and nuts (9). Put a small quantity of anti-seize compound on the threads on the nut end of the studs. Tighten nuts to 140 ft./lb. of torque using a criss-cross tightening pattern.

Maintenance (Continued)…

VI. INSTALLING WATER FLUSH SYSTEM TO BE ACCEPTABLE BY OIL COMPANIES

A. GENERAL

Many oil operators will not allow water to be put on the packing because of excess water getting into the mud, a result of poorly designed and maintained systems. Two major problems cause this complaint:

1. Too much line pressure

2. Not turning water off when pump is not in use.

B. CONTROLLING WATER PRESSURE TO THE PACKING

The water pressure is usually too high. The brake cooling pump is normally used which operates at pressures from 50 to 75 psi. Only 5 to 10 psi water is needed to cool and lubricate the packing. A pressure regulator should be installed to reduce the pressure on the packing. One regulator can supply all centrifugal pumps from a central system.

VII. BEARING FAILURES and HOW TO IMPROVE BEARING LIFE

A. GENERAL

Except for cavitation problems, bearing failure is the greatest cause of increased pump operating cost. If you continue to run a pump when bearing failures occur, there is an excellent chance the entire pump will be destroyed. Therefore it is very important to change the bearings when failure **starts.** If you wait for complete failure other fluid end parts will be damaged. Bearing failure is more often caused by **lubrication failure** than by normal bearing wear.

B. MISALIGNMENT BETWEEN PUMP and DRIVER

A major cause of bearing failures is misalignment. Alignment between the pump and motor should always be checked after shipment and periodically rechecked.

C. DETECTION OF BEARING FAILURE WHEN PUMP IS RUNNNING

The first indication of lubricant and bearing failure is a rapid rise in operating temperature. You should feel the frame once a week to get a feel for how hot the bearings normally run. A sudden high increase in temperature normally means the bearings are beginning to fail and need changing.

You cannot hold your hand for very long on unsatisfactory temperatures. If you can keep your hand on the housing for 5 seconds the temperature is about 160°F. which is suitable for most pumps. If you cannot hold your hand on the housing for five seconds or if the bearing housing is so hot you do not want to touch it, there is most likely lubricant and/or bearing failure.

Miscellaneous Information…

VI. LONG TERM PUMP and MOTOR STORAGE

Pump packages should be stored indoors in a clean, dry and protected environment.

1. The storage area is to be free from any vibration and temperature extremes.

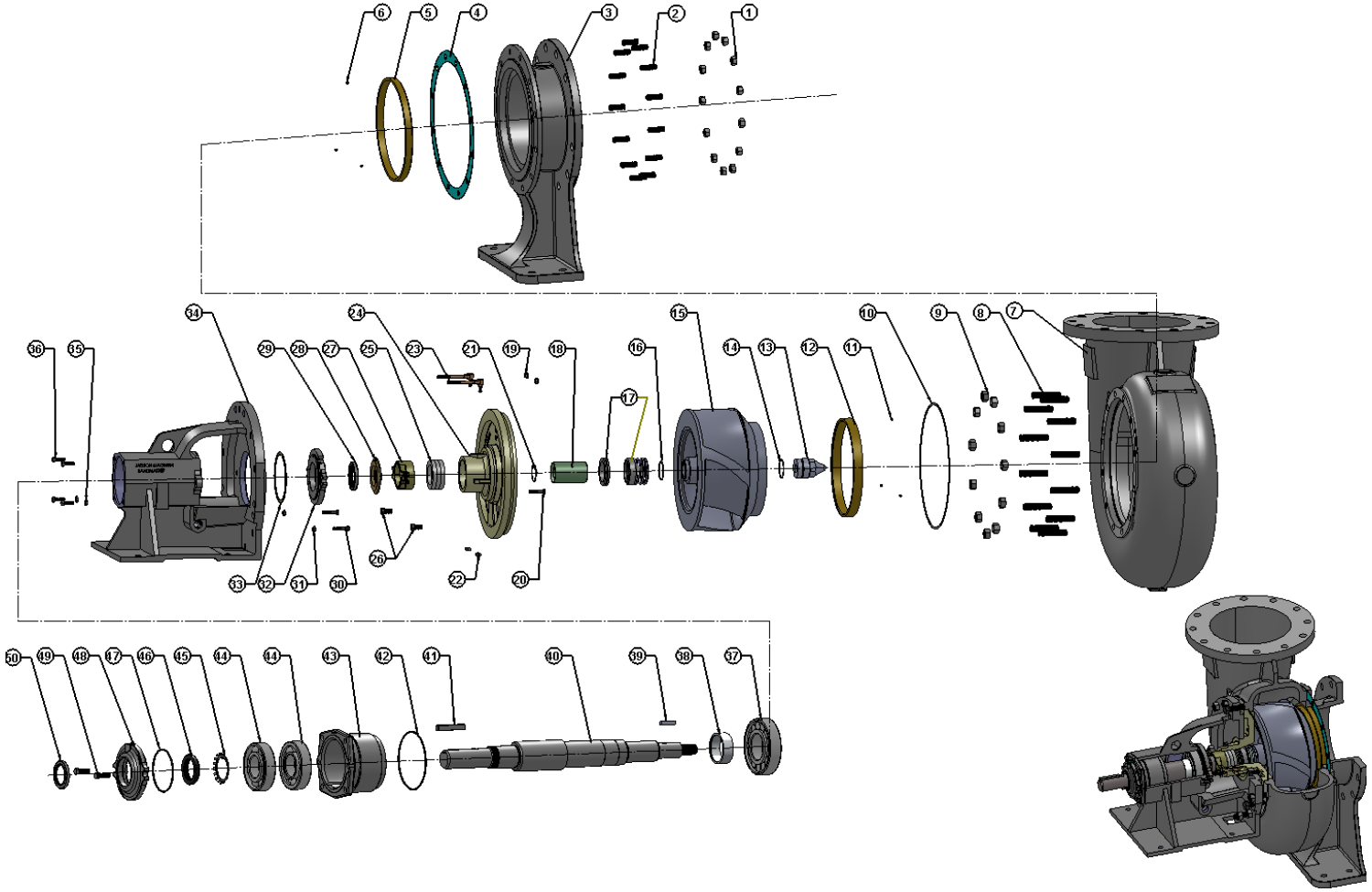
2. Motor and pump shafts are to be rotated manually every two months. A record of the rotation should be made.

3. Grease in the motor and the pump bearings is to be purged at the time of removal from storage and replaced with an ample supply of fresh grease in each grease cavity.

4. Motor windings should be megged at the time the equipment is placed in storage. At the time of removal from storage the resistance reading must not have dropped more than 50% from the initial reading. Any drop below this point necessitates electrical or mechanical drying of the motor windings. Condensation from hot days and cool nights can fill the motor half full with water. This is a greater potential problem in damp areas.

5. If the pumps are to be stored outdoors, the pump suction and discharge openings should be sealed to prevent any water from entering the pump housing. This will prevent rust and corrosion.

Exploded view 12x12x15 Sandmaster…



Parts List…

ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL	ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL
1	12	662010119	CASE NUTS TO SUCTION STAND	STEEL	26	2	648401016	STUFFING BOX BOLTS	STEEL
2	12	662010117	CASE STUDS TO SUCTION STAND	STEEL	27	2	647492354	PACKING GLAND	BRONZE
3	1	662014427	SUCTION STAND	HARD IRON	28	1	641116108	DEFLECTOR	BRONZE
4	1	662010113	SUCTION STAND GASKET	VEGTABLE FIBER	29	1	648408300	LIP SEAL	BUNA
5	1	662014435	SUCTION STAND WEAR RING	BRASS	30	2	601407505	INBOARD BEARING BOLT	STEEL
6	3	662014459	SUCTION STAND SET SREWS	STEEL	31	2	601408560	INBOARD BEARING NUT	STEEL
7	1	662002108	12X12X15 CASE	HARD IRON	32	1	644303109	INBOARD BEARING COVER	HARD IRON
8	12	662010118	CASE NUTS TO FRAME	STEEL	33	1	648408706	GASKET	VEGTABLE FIBER
9	12	662010119	CASE STUDS TO FRAME	STEEL	34	1	662014432	FRAME	HARD IRON
10	1	662010112	CASE GASKET	VEGTABLE FIBER	35	2	658404702	NUT, OUTBOARD BEARING HOUSING	STEEL
11	3	662014459	SUCTION STAND SET SREWS	STEEL	36	4	648401057	SCREW, OUTBOARD BEARING HOUSING	STEEL
12	1	662014434	IMPELLER WEAR RING	BRASS	37	1	661009010	INBOARD BEARING HOUSING	VENDOR
13	1	662014431	NOSE CONE		38	1	663005068	SPACER ROLLOR BEARING	STEEL
14	1	662010114	NOSE CONE O-RING	VITON	39	1	662014458	IMPELLER KEY	416 SS
15	1	662014428	12X12X15 IMPELLLER	HARD IRON	40	1	662014430	SHAFT	AISI 4140
16	1	662010116	IMPELLER O-RING	VITON	41	1	601212392	SHAFT KEY	416 SS
17	1	648414308	MECHANICAL SEAL	TUNGSTEN	42	1	648402295	BEARING HOUSING O-RING	VITON
18	1	646492505	SHAFT SLEEVE	416 SS	43	1	644308504	BEARING HOUSING	HARD IRON
19		648414506	ASSY, NUT AND CONE	STEEL	44	1	648408201S	SET, THRUST BEARINGS	VENDOR
20	1	662014440	SUCTION SPOOL (NOT SHOWN)	HARD IRON	45	1	648402105	LOCKWASHER	STEEL
21	1	648405082	IMPELLER O-RING	VITON	46	1	648402055	LOCKNUT	STEEL
22		601408560	NUT, BEARING CAP	STEEL	47	1	72200017	O-RING OUTBOARD BEARING COVER	VITON
23	2	648408763	GLAND BOLTS		48	1	641103296	BEARING HOUSING COVER	HARD IRON
24	1	662014429	STUFFING BOX 12X12X15	HARD IRON	49	1	648401081	BOLT OUTBOARD BEARING COVER	STEEL
25	1	N/A	BACKUP PACKING	TEFLON	50	1	648408359	LIP SEAL	BUNA

Appendix A…

I. TORQUE VALUES FOR BOLTS

DESCRIPTION	BOLT SIZE	TORQUE(FT-LB)	ADDITIONAL INFORMATION
CASE BOLTS	3/4" -10	80	TIGHTEN IN STAR PATTERN
STUFFING BOX BOLTS	1/2"-13	32	NONE
BEARING CAP	3/8"-16	13	NONE
WEAR PAD BOLTS	1/2”-13	70	TIGHTEN IN ALTERNATING PATTERN