



TECHNICAL SERVICE MANUAL

HEAVY-DUTY STEEL EXTERNAL PUMPS
 SERIES 333 AND 4333
 SIZES N AND R

| | |
|---------|---------|
| SECTION | TSM 153 |
| PAGE | 1 OF 16 |
| ISSUE | D |

CONTENTS

| | |
|--|----|
| Introduction | 1 |
| Special Information | 1 |
| Maintenance | 2 |
| Packed Pumps | 4 |
| Mechanical Seal Pumps | 8 |
| Optional PTFE Seal. | 13 |
| Thrust Bearing Adjustment | 14 |
| Installation of Carbon Graphite Bushings | 14 |
| Pressure Relief Valve Instructions | 15 |



FIGURE 1
 R333 SIZE SHOWN

INTRODUCTION

The illustrations used in this manual are for identification purposes only and cannot be used for ordering parts. Obtain a parts list from the factory or a Viking® representative. Always give complete name of part, part number and material with model number and serial number of pump when ordering repair parts. The unmounted pump or pump unit model number and serial number are on the nameplate.

In the Viking model number system, basic size letters are combined with series number (333 and 4333) are used to indicate either an unmounted pump or mounted pump unit.

Model Chart Number

| UNMOUNTED PUMP | | UNITS |
|----------------|------------|--|
| PACKED | MECH. SEAL | |
| N333 | N4333 | Units are designated by the unmounted pump model numbers followed by a letter(s) indicating drive style. P = Commercial Speed Reducer |
| R333 | R4333 | |

This manual deals only with Series 333 and 4333 Heavy Duty Steel External Pumps. Refer to Figures 1 through 20 for general configuration and nomenclature used in this manual. Pump specifications and recommendations are listed in Catalog Section 153, Series 333 and 4333 Heavy Duty Steel External Pumps.

SPECIAL INFORMATION

DANGER !

Before opening any Viking pump liquid chamber (pumping chamber, reservoir, relief valve adjusting cap fitting, etc.) Be sure:

1. That any pressure in the chamber has been completely vented through the suction or discharge lines or other appropriate openings or connections.
2. That the driving means (motor, turbine, engine, etc.) has been "locked out" or made non-operational so that it cannot be started while work is being done on pump.
3. That you know what liquid the pump has been handling and the precautions necessary to safely handle the liquid. Obtain a material safety data sheet (MSDS) for the liquid to be sure these precautions are understood.

Failure to follow above listed precautionary measures may result in serious injury or death.

SAFETY INFORMATION AND INSTRUCTIONS

IMPROPER INSTALLATION, OPERATION OR MAINTENANCE OF PUMP MAY CAUSE SERIOUS INJURY OR DEATH AND/OR RESULT IN DAMAGE TO PUMP AND/OR OTHER EQUIPMENT. VIKING'S WARRANTY DOES NOT COVER FAILURE DUE TO IMPROPER INSTALLATION, OPERATION OR MAINTENANCE.

THIS INFORMATION MUST BE FULLY READ BEFORE BEGINNING INSTALLATION, OPERATION OR MAINTENANCE OF PUMP AND MUST BE KEPT WITH PUMP. PUMP MUST BE INSTALLED, OPERATED AND MAINTAINED ONLY BY SUITABLY TRAINED AND QUALIFIED PERSONS.

THE FOLLOWING SAFETY INSTRUCTIONS MUST BE FOLLOWED AND ADHERED TO AT ALL TIMES.

Symbol Legend :



Danger - Failure to follow the indicated instruction may result in serious injury or death.

WARNING

Warning - In addition to possible serious injury or death, failure to follow the indicated instruction may cause damage to pump and/or other equipment.



BEFORE opening any liquid chamber (pumping chamber, reservoir, relief valve adjusting cap fitting, etc.) be sure that :

- Any pressure in the chamber has been completely vented through the suction or discharge lines or other appropriate openings or connections.
- The pump drive system means (motor, turbine, engine, etc.) has been "locked out" or otherwise been made non-operational so that it cannot be started while work is being done on the pump.
- You know what material the pump has been handling, have obtained a material safety data sheet (MSDS) for the material, and understand and follow all precautions appropriate for the safe handling of the material.

WARNING

INSTALL pressure gauges/sensors next to the pump suction and discharge connections to monitor pressures.



WARNING

USE extreme caution when lifting the pump. Suitable lifting devices should be used when appropriate. Lifting eyes installed on the pump must be used **only** to lift the pump, **not** the pump with drive and/or base plate. If the pump is mounted on a base plate, the base plate must be used for all lifting purposes. If slings are used for lifting, they must be safely and securely attached. For weight of the pump alone (which does not include the drive and/or base plate) refer to the Viking Pump product catalog.



BEFORE operating the pump, be sure all drive guards are in place.



DO NOT attempt to dismantle a pressure relief valve that has not had the spring pressure relieved or is mounted on a pump that is operating.



DO NOT operate pump if the suction or discharge piping is not connected.



AVOID contact with hot areas of the pump and/or drive. Certain operating conditions, temperature control devices (jackets, heat-tracing, etc.), improper installation, improper operation, and improper maintenance can all cause high temperatures on the pump and/or drive.



DO NOT place fingers into the pumping chamber or its connection ports or into any part of the drive train if there is **any possibility** of the pump shafts being rotated.



WARNING

THE PUMP must be provided with pressure protection. This may be provided through a relief valve mounted directly on the pump, an in-line pressure relief valve, a torque limiting device, or a rupture disk. If pump rotation may be reversed during operation, pressure protection must be provided on **both** sides of pump. Relief valve adjusting screw caps must always point towards suction side of the pump. If pump rotation is reversed, position of the relief valve must be changed. Pressure relief valves cannot be used to control pump flow or regulate discharge pressure. For additional information, refer to Viking Pump's Technical Service Manual TSM 000 and Engineering Service Bulletin ESB-31.

WARNING

DO NOT exceed the pumps rated pressure, speed, and temperature, or change the system/duty parameters from those the pump was originally supplied, without confirming its suitability for the new service.



WARNING

BEFORE operating the pump, be sure that:

- It is clean and free from debris
- all valves in the suction and discharge pipelines are fully opened.
- All piping connected to the pump is fully supported and correctly aligned with the pump.
- Pump rotation is correct for the desired direction of flow.



WARNING

THE PUMP must be installed in a matter that allows safe access for routine maintenance and for inspection during operation to check for leakage and monitor pump operation.

SPECIAL INFORMATION

ROTATION: Viking pumps operate equally well in a clockwise or counterclockwise rotation. Shaft rotation determines which port is suction and which is discharge. Port in area where pumping elements (gear teeth) come out of mesh is suction port.

FLUSH LINES: are standard equipment and must be hooked up properly. Packed pumps have a flush connection from packing chamber to **suction** port. Mechanical seal pumps have a flush connection from seal chamber to discharge port. If pump rotation is reversed be sure flush connections are hooked up to the suction or discharge port as noted above to avoid excessive leakage or damage to pump. If pump is handling heated product be sure flush line is insulated to assure continued flow.

Jacketed head (R only, optional on N size) and rotor bearing sleeve provide large chambers at both ends of pumping chamber for temperature control of product in pump. These features do not alter basic steps in disassembly and assembly of your pump.

PRESSURE RELIEF VALVES:

1. Viking pumps are positive placement pumps and must be provided with some sort of pressure protection. This may be a relief valve mounted directly on the pump, an inline pressure relief valve, a torque limiting device or a rupture disk.
2. There are relief valve options available on these pumps. Options include a jacketed relief valve. Pumps equipped with a jacketed head plate are generally not available with a relief valve.
3. If pump rotation is to be reversed during operation, pressure protection must be provided on both sides of pump.
4. Relief valve adjusting screw cap must always point towards suction side of pump. If pump rotation is reversed, remove pressure relief valve and turn end for end. **Refer to Figures 1 and 2.**
5. Pressure relief valves cannot be used to control pump flow or regulate discharge pressure. For additional information on pressure relief valves, refer to Technical Service Manual TSM000 and Engineering Service Bulletin ESB-31.

SPECIAL MECHANICAL SEALS: can be installed in a modified stuffing box.

Extra care must be taken in repair of pumps with mechanical seals. Read and follow all special information supplied with the pump.

MAINTENANCE

Series 333 and 4333 pumps are designed for long trouble free life under a wide variety of application conditions with a minimum of maintenance. The points listed below will help provide long service life.

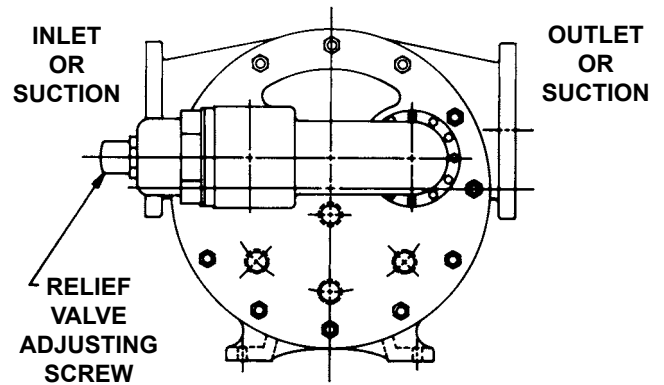


FIGURE 2

LUBRICATION: External lubrication must be applied slowly with a handgun to all lubrication fittings every 500 hours of operation with multi-purpose grease, NLGI # 2. Do not over-grease. Applications involving very high or low temperatures will require other types of lubrication. **Refer to Engineering Service Bulletin ESB-515.** Consult factory with specific lubrication questions.

PACKING ADJUSTMENT: New packed pumps require initial packing adjustment to control leakage as packing "runs in". Make initial adjustments carefully and do not over-tighten packing gland. After initial adjustment, inspection will reveal need for packing gland adjustment or packing replacement. **Refer to instructions under DISASSEMBLY, page 5, and Assembly, page 7,** regarding repacking pump.

CLEANING PUMP: Keep pump as clean as possible. This will facilitate inspection; adjustment and repair work and help prevent overlooking a dirt covered grease fitting.

STORAGE: If pump is to be stored, or not used for six months or more, pump must be drained and a light coat of non-detergent SAE 30 weight oil must be applied to all internal pump parts. Lubricate fittings and apply grease to pump shaft extension. Viking suggests rotating pump shaft by hand one complete revolution every 30 days to circulate the oil.

SUGGESTED REPAIR TOOLS: The following tools must be available to properly repair Series 333 and 4333 pumps. These tools are in addition to standard mechanics' tools such as open end wrenches, pliers, screwdrivers etc. Most of the items can be obtained from an industrial supply house.

1. Soft Headed Hammer
2. Allen Wrenches (some mechanical seals and set collars)
3. Packing hooks, flexible (packed pumps)
Large for 0.375 inch and up cross section packing
4. Mechanical seal installation sleeve
5. Bearing locknut spanner wrench
(Source: #471 J.H. Williams & Co. or equal)
6. Spanner wrench (Supplied with pump)
Viking Part Number 3-810-009-631
7. Brass Bar
8. Arbor Press

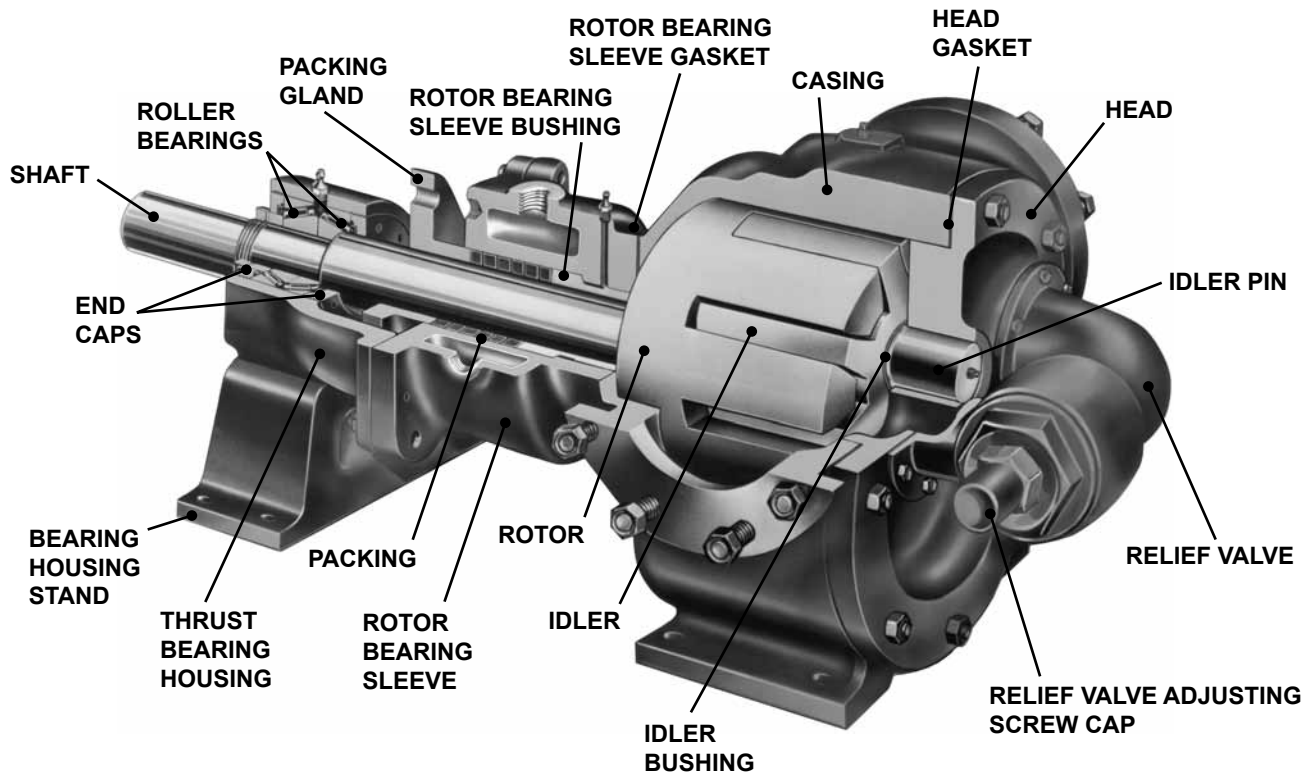


FIGURE 3
 CUTAWAY FROM PACKED PUMP
 MODEL N333

PACKED PUMPS
Model N and R333

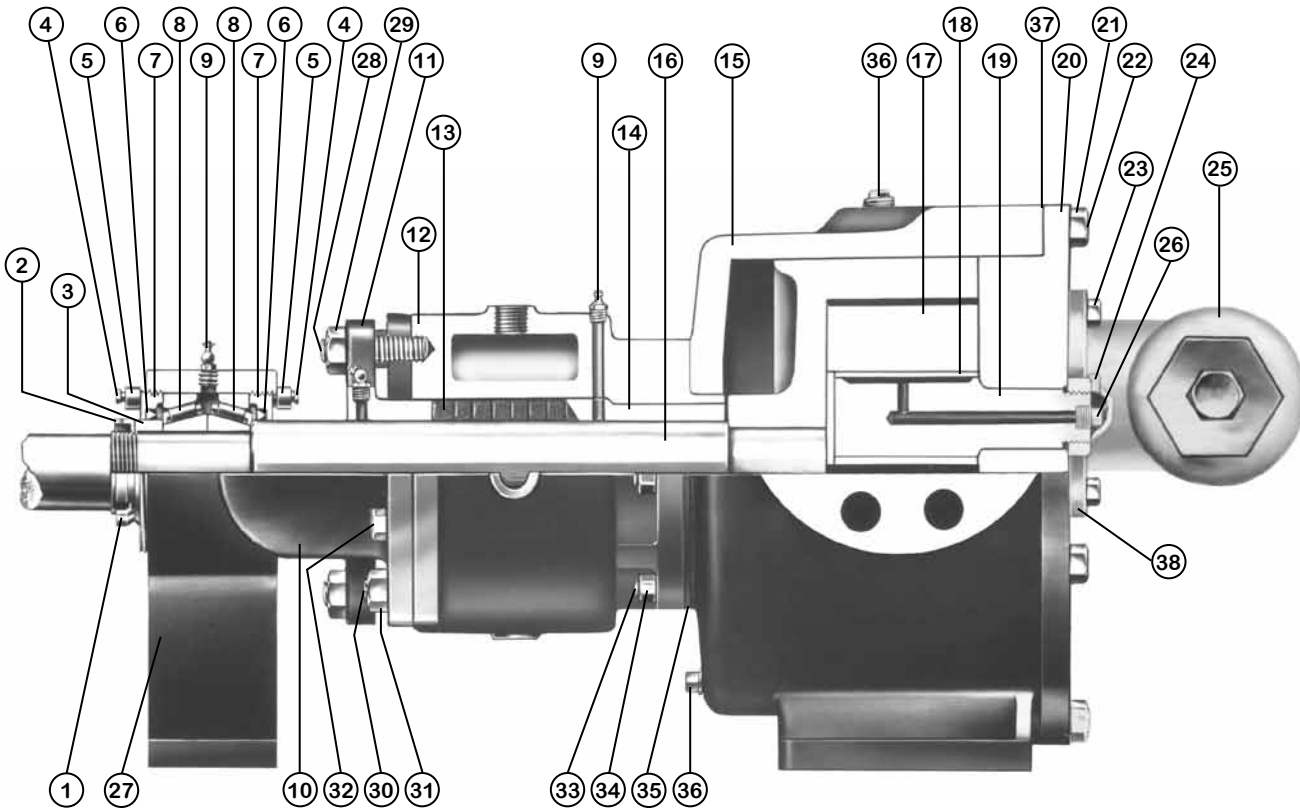


FIGURE 4
 SECTIONAL VIEW MODELS N AND R333

| ITEM | NAME OF PART | ITEM | NAME OF PART | ITEM | NAME OF PART |
|------|--------------------------------|------|-------------------------------|------|---------------------------------|
| 1 | Locknut | 14 | Bushing, Rotor Bearing Sleeve | 27 | Bearing Housing Stand |
| 2 | Lockwasher | 15 | Casing | 28 | Packing Gland Stud |
| 3 | Bearing Spacer Collar | 16 | Rotor and Shaft | 29 | Packing Gland Nut |
| 4 | Capscrew for End Cap Lock | 17 | Idler and Bushing | 30 | Bearing Housing Stud |
| 5 | End Cap Lock | 18 | Idler Bushing | 31 | Bearing Housing Nut |
| 6 | Lip Seal | 19 | Idler Pin | 32 | Bearing Housing Capscrew |
| 7 | End Cap | 20 | Head and Idler Pin | 33 | Stud for Rotor Bearing Sleeve |
| 8 | Roller Bearing | 21 | Nut for Head | 34 | Nut for Rotor Bearing Sleeve |
| 9 | Grease Fitting | 22 | Stud for Head | 35 | Rotor Bearing Sleeve Gasket |
| 10 | Thrust Bearing Housing | 23 | Capscrew for Valve | 36 | Pipe Plug |
| 11 | Packing Gland | 24 | Idler Pin Nut (Not N) | 37 | Head Gasket |
| 12 | Rotor Bearing Sleeve & Bushing | 25 | Internal Relief Valve | 38 | Relief Valve Gasket |
| 13 | Packing | 26 | Pipe Plug | * | Suckback Line (Not Illustrated) |

DETAILS FOR SECTIONAL VIEW - MODELS N AND R333

DISASSEMBLY

DANGER !

Before opening any Viking pump liquid chamber (pumping chamber, reservoir, relief valve adjusting cap fitting, etc.) Be sure:

1. That any pressure in the chamber has been completely vented through the suction or discharge lines or other appropriate openings or connections.
2. That the driving means (motor, turbine, engine, etc.) has been "locked out" or made non-operational so that it cannot be started while work is being done on pump.
3. That you know what liquid the pump has been handling and the precautions necessary to safely handle the liquid. Obtain a material safety data sheet (MSDS) for the liquid to be sure these precautions are understood.

Failure to follow above listed precautionary measures may result in serious injury or death.

1. Mark head and casing before disassembly to ensure proper reassembly. The idler pin, which is offset in pump head, must be positioned towards and equal distance between port connections to allow for proper flow of liquid through pump.

It is not necessary to remove relief valve to take head off pump; however, removing relief valve will lessen total weight of part. Do not use chain or cable around relief valve body to support the head during removal. **For Pressure Relief Instructions, refer to page 14.**

Remove nuts from head. Jackscrews should be used to back head away from casing. **Refer to figure 5.** Proper size and length of jackscrews for pump size are shown in **figure 6.** The use of a hoist to support head will facilitate its removal.

Back head away from casing. Remove head from pump. Do not allow idler to fall from idler pin. To prevent this, tilt top of head back when removing. A lifting hook will provide adequate connection for hoisting head. If a hoist is not available, cribbing or blocking can be used to support head. This will eliminate having to lift head into position when reassembling pump.

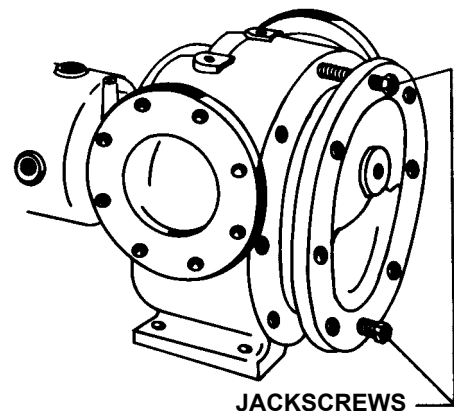
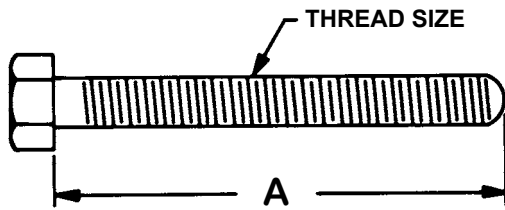


FIGURE 5



MINIMUM LENGTH OF JACK SCREWS

| PUMP SIZE | NO. SCREWS USED | A | THREAD SIZE (INCH) |
|-----------|-----------------|------|--------------------|
| N | 2 | 4.00 | 0.50" - 13 NC |
| R | 2 | 4.50 | 0.63" - 11 NC |
| P | 3 | 5.00 | 0.50" - 13 NC |

FIGURE 6

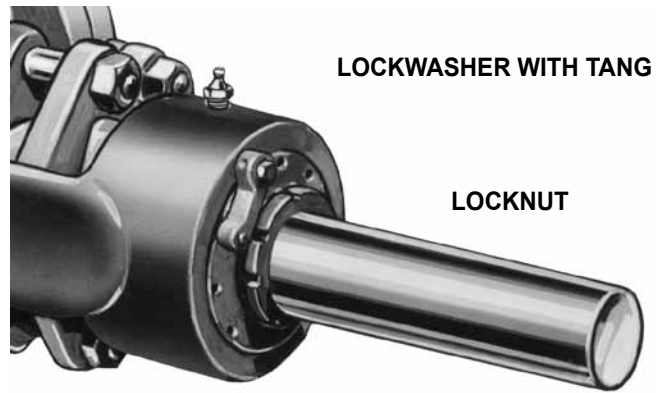


FIGURE 7

2. Remove head gasket, idler and bushing assembly.
3. Remove pipe plug from drain hole in casing, this breaks vacuum behind rotor.
4. Remove packing gland nuts and slide gland out of rotor bearing sleeve.
5. Insert length of hard wood or brass bar through port opening between rotor teeth to keep shaft from turning.
6. Bend up tang on lock washer and with a spanner wrench; remove locknut and lockwasher from shaft. **Refer to figure 7.**
7. Remove length of hardwood or brass bar from port opening.
8. Cushion end of shaft with a hardwood block or piece of block and drive rotor out of casing, being careful to avoid damaging rotor bearing sleeve bushing. Support weight of rotor with a hoist. A cable sling can be used around shaft, or around rotor teeth, to carry weight of part.
9. Loosen end cap lockscrews, disengage end cap locks and with a spanner wrench remove end caps. Remove roller bearings.
10. Remove nuts and capscrews and take off thrust bearing housing. Remove packing from rotor bearing sleeve.
11. Check rotor bearing sleeve bushing while rotor bearing sleeve is mounted on casing. If worn, bushing must be replaced.

Disconnect suck back line and remove rotor bearing sleeve from casing. A press must be used to remove old bushing. If bushing has a shoulder on the stuffing box end, it must be pressed out packing end of rotor bearing sleeve. If bushing is carbon graphite, **refer to INSTALLATION OF CARBON GRAPHITE BUSHINGS, page 14**

12. Clean all parts thoroughly and examine for wear and damage. Check idler bushing and idler pin, replace if necessary.

If idler pin is to be replaced, oil must be installed facing center of crescent head.

If lipseals need replacement, press in end cap with lip facing end of shaft.

If idler bushing is to be replaced, a press must be used to remove old bushing and install new. Bushing position after being pressed in should be flush with face of idler. For carbon graphite idler bushing, **refer to INSTALLATION OF CARBON GRAPHITE BUSHINGS, page 14.**

Wash anti-friction bearings (roller bearings) in clean solvent. Blow out bearings with compressed air. Do not allow bearings to spin; turn bearing slowly by hand. Spinning bearings will damage race and rollers. Make sure bearings are clean, then lubricate with non-detergent SAE 30 weight oil and check for roughness. Roughness can be determined by turning outer race by hand. **CAUTION:** do not intermix inner and outer races for roller bearings. Replace bearings if they have roughness.

Examine casing for wear. Check condition of casing at seal area (surface between suction and discharge port). If surface is in good condition, casing need not be replaced.

When making major repairs, such as replacement of a rotor, it is usually considered advisable to install a new head and idler. When making minor repairs, where only an idler bushing and idler pin are required, other new parts are usually not necessary.

ASSEMBLY

1. Install rotor bearing sleeve and gasket on casing. Coat both sides of gasket with thread sealant (pipe dope) and quickly install gasket and rotor bearing sleeve on casing. Place a support under rotor bearing sleeve to prevent casing and rotor bearing sleeve from tilting down while rotor is being installed.
2. Check casing to be sure drain plug has been removed.
3. Carefully check shaft, remove any burrs or rough surfaces to avoid damaging rotor bearing sleeve bushing while installing rotor and shaft into casing. Coat inner diameter of rotor bearing sleeve bushing and shaft with a thin coat of non-detergent SAE 30 weight oil.

Support weight of rotor with a hoist. A cable sling can be used around shaft, or around rotor teeth, to carry weight of part while being assembled into casing.

Place end of rotor shaft through casing, into bushing slowly turn rotor from right to left while pushing into casing. When shaft first protrudes from stuffing box, stop pushing. Check to see if large diameter of shaft has protruded far enough into rotor bearing sleeve to permit installing packing rings.

Use packing suitable for liquid being pumped. Lubricate packing rings with oil, grease or graphite to aid assembly.

Packing ring joints should be staggered from one side of shaft to the other. A length of pipe will help set each packing ring.

4. Place packing gland and inner end cap (spanner wrench holes on side next to packing gland) with lip seal (lip facing away from packing gland) over end of shaft.
5. Push rotor far into casing as far as it will go.
6. Prior to installing head, coat casing face with thread sealant (pipe dope) and place a new .015" head gasket on mounting studs. Coat dry side of gasket with thread sealant (pipe dope) and prepare to mount head on idler assembly.

Pump head and casing were marked before disassembly to ensure proper reassembly. If not, be sure idler pin, which is offset in pump head, is positioned toward and equal distance between port connections to allow for proper flow of liquid through pump. Place head on pump, slightly tilting top of head away from casing until crescent enters inside diameter of rotor. Rotate idler on idler pin until idler teeth mesh with rotor teeth. Raise head until face of head is parallel with face of casing and work into position. Care must be taken to avoid damaging head gasket. Fasten head to casing with nuts and tighten evenly.

If relief valve was not removed from head, install on head with adjusting screw cap pointed toward such port. **Refer to Figure 2, page 2. For PRESSURE RELIEF INSTRUCTIONS, REFER TO PAGE 14.**

7. Push rotor back against head.
8. Install drain plug in casing.

9. Pack pump with new packing. **Refer to Figure 8.** Models N and R333 have 6 rings of packing.
10. Install thrust bearing housing on end of rotor ring sleeve and tighten nuts and capscrews securely. It is not necessary to use gasket between these parts.

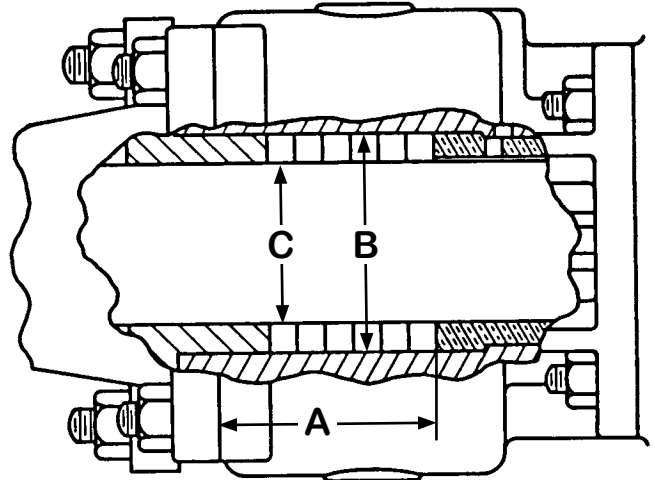


FIGURE 8
STUFFING BOX DIMENSIONS

| PUMP MODEL | A (INCH) | B (INCH) | C (INCH) |
|------------|----------|----------|----------|
| N333 | 4.625" | 4.688" | 3.438" |
| R333 | 4.625" | 4.688" | 3.438" |

11. Insert both tapered roller bearings in thrust bearing housing, large end of inner races together. It is possible to install bearings incorrectly, for proper assembly refer to **Figure 9**.

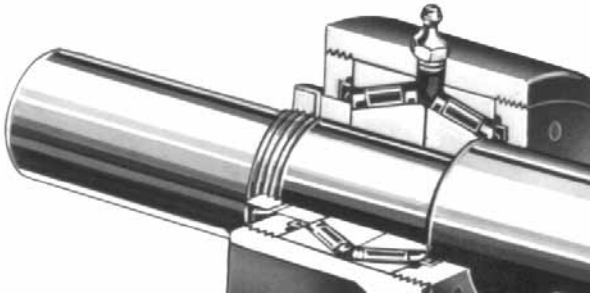


FIGURE 9

12. Install bearing spacer collar on shaft next to Inner race of roller bearing.
13. Turn inner end cap into thrust bearing housing just far enough to hold in place.
Install outer end cap and turn in approximately half way.
14. Insert length of hardwood or brass bar through port opening between rotor teeth to keep rotor from turning.
15. Install lockwasher with tang in keyway on shaft. Tighten locknut to 170-190 ft – lbs. Torque. Bend one tang of lock washer into slot of locknut. If tang does not line up with slot tighten lock until it does. Failure to tighten locknut or engage lock washer tang could result in early bearing failure or cause damage to rest of pump. Bend one tang of lock nut into slot of locknut.
16. Remove length of hardwood or brass bar from port opening.
17. Install nuts on packing glands studs and tighten. Do not over tighten, may cause bind on rotor shaft.
18. Reinstall suckback tubing to casing and rotor bearing sleeve.
19. Lubricate all grease fittings with multi-purpose grease, NLGI #2.
20. Adjust pump end clearance. Refer to **THRUST BEARING ADJUSTMENT**, page 14.

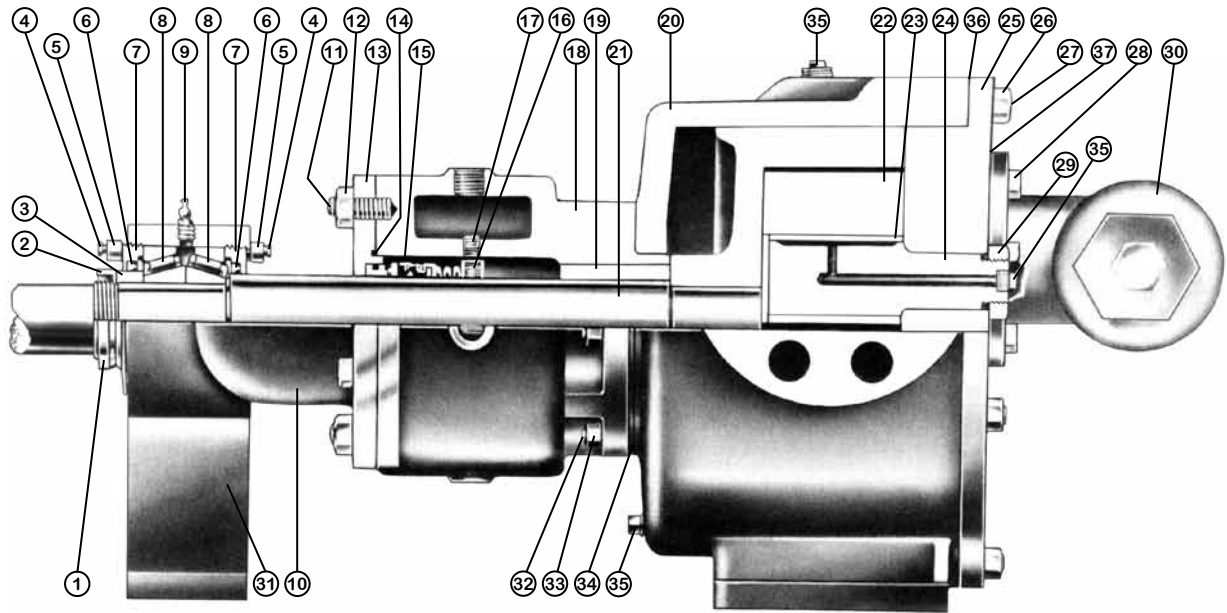
DANGER !

Before starting pump, be sure all drive equipment guards are in place.

Failure to properly mount guards may result in serious injury or death.

MECHANICAL SEAL PUMPS

Models N and R4333



SECTIONAL VIEW MODELS N AND R4333
FIGURE 10

| ITEM | NAME OF PART | ITEM | NAME OF PART | ITEM | NAME OF PART |
|------|---------------------------|------|----------------------------------|------|-------------------------------|
| 1 | Locknut | 14 | O-Ring Gasket | 27 | Stud for Head |
| 2 | Lockwasher | 15 | Mechanical Seal (Complete) | 28 | Capscrew for Valve |
| 3 | Bearing Spacer Collar | 16 | Set Collar with Set Screws | 29 | Idler Pin Nut (Not N) |
| 4 | Capscrew for End Cap Lock | 17 | Pipe Plug ¼ Socket Head | 30 | Internal Relief Valve |
| 5 | End Cap Lock | 18 | Rotor Bearing Sleeve and Bushing | 31 | Bearing Housing Stand |
| 6 | Lip Seal | 19 | Bushing, Rotor Bearing Sleeve | 32 | Stud for Rotor Bearing Sleeve |
| 7 | End Cap | 20 | Casing | 33 | Nut for Rotor Bearing Sleeve |
| 8 | Roller Bearing | 21 | Rotor and Shaft | 34 | Rotor Bearing Sleeve Gasket |
| 9 | Grease Fitting | 22 | Idler and Bushing | 35 | Pipe Plug |
| 10 | Thrust Bearing Housing | 23 | Idler Bushing | 36 | Head Gasket |
| 11 | Stud for Seal Plate | 24 | Idler Pin | 37 | Relief Valve Gasket |
| 12 | Nut for Seal Plate | 25 | Head and Idler Pin | * | Flush Line Not Illustrated |
| 13 | Seal Plate | 26 | Nut for Head | | |

DISASSEMBLY

DANGER !

Before opening any Viking pump liquid chamber (pumping chamber, reservoir, relief valve adjusting cap fitting, etc.)

Be sure:

- 1. That any pressure in the chamber has been completely vented through the suction or discharge lines or other appropriate openings or connections.**
- 2. That the driving means (motor, turbine, engine, etc.) has been "locked out" or made non-operational so that it cannot be started while work is being done on pump.**
- 3. That you know what liquid the pump has been handling and the precautions necessary to safely handle the liquid. Obtain a material safety data sheet (MSDS) for the liquid to be sure these precautions are understood.**

Failure to follow above listed precautionary measures may result in serious injury or death.

1. Mark head and casing before disassembly to ensure proper reassembly. The idler pin, which is offset in pump head, must be positioned toward and equal distance between port connections to allow for proper flow of liquid through pump.

It is not necessary to remove relief valve to take head off pump; however, removing removing relief valve will lessen total weight of part. Do not use chain or cable around relief valve body to support head during removal.

Remove nuts from head. Jackscrews should be used to back head away from casing. **Refer to figure 11.** Proper size and length of jackscrews for pump size are shown in **figure 12.** The use of a hoist to support head will facilitate its removal.

Back head away from casing, Remove head from pump. Do not allow idler to fall from idler pin. To prevent this, Tilt top of head back when removing.

2. Remove head gasket, idler and bushing assembly.
3. To remove rotor, loosen set collar behind mechanical seal. Through the one inch jacket connection on top of rotor bearing sleeve, remove 0.25" socket head pipe plug.

Through the same hole loosen the 0.313" socket head setscrews which lock collar to shaft. Rotate shaft to be sure all setscrews have been loosened. **Refer to figure 10, page 8, items 16 and 17,** for pipe plug to remove the setscrews to loosen.

4. Remove casing drain plug to break vacuum between back of rotor and casing. Remove any deposit of material from exposed portion of shaft between seal plate and thrust bearing assembly.
5. Insert length of hardwood or brass through port opening between rotor teeth to keep shaft from turning.
6. Bend up tang on lockwasher and with a spanner wrench, remove locknut and lockwasher from shaft. **Refer to figure 13.**
7. Remove length of hardwood or brass bar from port opening.
8. Cushion end of shaft with a hardwood block or piece of brass and drive rotor out of casing being careful to avoid damaging rotor bearing sleeve bushing.
9. Loosen end cap lockscrews, disengage end cap locks and with a spanner wrench, remove end caps. Examine lipseal and replace if worn.
10. Remove nuts and capscrews and take off thrust bearing housing.
11. Remove nuts holding seal plate and remove seal plate. The stationary seal seat can be removed from seal plate and rotating portion of seal from rotor bearing sleeve, remove spring and set collar from bottom of seal chamber.
12. Check rotor bearing sleeve bushing while rotor bearing sleeve is mounted on casing. If worn bushing must be replaced.

Support weight of rotor with a hoist. A cable sling can be used around shaft, or around rotor teeth to carry weight of part.

Remove roller bearings.

Disconnect flush line and remove rotor bearing sleeve from casing.

A press must be used to remove old bushing. If bushing has a shoulder on stuffing box end, it must be pressed out mechanical seal end of rotor bearing sleeve. Carbon graphite bushings are standard for Model 4333 pumps. To replace carbon graphite bushings, **refer to INSTALLATION CARBON GRAPHITE BUSHINGS, page 14.**

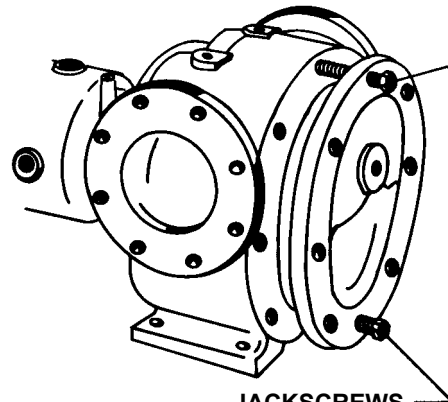
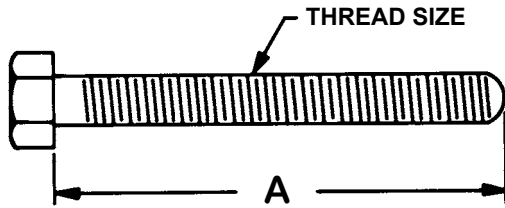


FIGURE 11 JACKSCREWS



MINIMUM LENGTH OF JACK SCREWS

| PUMP SIZE | NO. SCREWS USED | A | THREAD SIZE (INCH) |
|-----------|-----------------|------|--------------------|
| N | 2 | 4.00 | 0.50" - 13 NC |
| R | 2 | 4.50 | 0.63" - 11 NC |
| P | 3 | 5.00 | 0.50" - 13 NC |

FIGURE 12

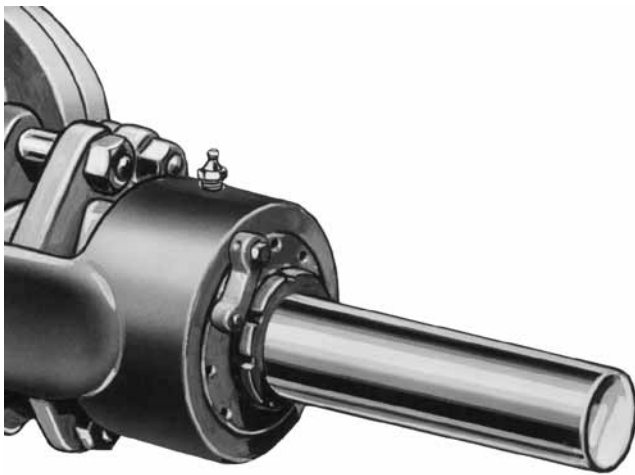


FIGURE 13

13. Clean all parts thoroughly and examine for damage. If lipseal replacement is needed, press in end cap with lip facing end of shaft. Check idler bushing and idler pin, replace if necessary.

If idler pin is to be replaced, oil groove on pin must be installed facing center of crescent on head.

If idler bushing is to be replaced, a press must be used to remove old bushing and install new. Bushing position after being pressed in should be flush with face of idler. For carbon graphite idler bushing, refer to **INSTALLATION OF CARBON GRAPHITE BUSHINGS**, page 14.

14. Wash bearing in clean solvent. Blow out bearings with compressed air. Do not allow bearings to spin; turn bearing slowly by hand. Spinning bearings will damage race and rollers. Make sure bearings are clean, then lubricate with non-detergent SAE 30 weight oil and check for roughness. Roughness can be determined by turning outer race by hand. **CAUTION:** do not intermix inner and outer races for roller bearings.

15. Examine casing for wear. Check condition of casing at seal area (surface between suction and discharge ports). If surface is in good condition, casing need not be replaced. When making major repairs, such as replacement of a rotor, it is usually considered advisable to install a new head and idler. When making minor repairs, when only an idler bushing and idler pin are required, other new parts are usually not necessary.

16. Inspect the mechanical seal for wear or damage. Refer to figure 14 for mechanical seal list of parts. In general, if the pump has been operated long enough to exhibit other worn parts, it is likely the seal will have to be replaced. Replacing individual seal parts is not recommended, i.e., a used seal washer will not perform satisfactorily when run against a new stationary seat.

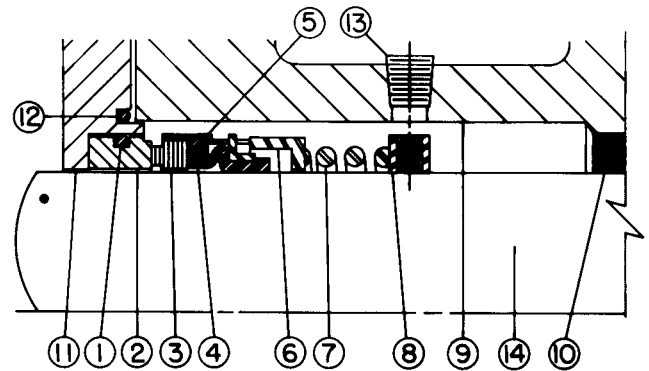


FIGURE 14
MECHANICAL SEAL

| LIST OF PARTS | |
|---------------------------------------|---|
| 1. O-Ring Seat Gasket | 8. Set Collar with Setscrews |
| 2. Stationary Seat | 9. Rotor Bearing Sleeve |
| 3. Rotating Face (Washer) | 10. Rotor Bearing Sleeve Bushing |
| 4. Bellows | 11. Seal Holder Plate |
| 5. Metal Parts (Retainer, drive band) | 12. O-Ring Gasket for seal holder plate |
| 6. Spring Adapter | 13. Pipe Plug |
| 7. Spring | 14. Shaft |

Note: Items 1 through 7 comprise the complete mechanical seal.

ASSEMBLY

Standard Mechanical Seal (Synthetic Rubber Bellows Type)

Prepare all parts for reassembly ahead of time. Pack roller bearings with multi-purpose grease, NLGI # 2 and have all new gaskets on hand.

Be especially careful to keep mechanical seal parts clean. Minute dirt particles especially on seal fences, will cause leakage. Never touch seal fences with anything except clean hands or clean cloth.

Once rotating position of mechanical seal is installed on rotor shaft, it is necessary to assemble parts as quickly as possible to ensure seal does not stick to shaft in the wrong axial position. The seal should be expected to stick to shaft after several minutes setting time.

1. Deburr threads on rotor shaft with a fine file and place a layer of tape over threads to protect rotor bearing sleeve bushing during assembly. Gently radius leading edge of largest diameter on shaft (.03 inch is sufficient to aid in seal installation). Smooth radius with crocus cloth. Polish rotor shaft from leading edge through mechanical seal area with crocus cloth. Any scratches left on shaft in seal area will provide leakage paths under mechanical seal.
2. Install rotor bearing sleeve and gasket on casing. Coat both sides of gasket with thread sealant (pipe dope) and quickly install gasket and rotor bearing on casing. Place a support under rotor bearing sleeve to prevent casing and rotor bearing sleeve from tilting down while rotor is being installed.
3. Check casing to be sure drain plug has been removed.
4. Coat inner diameter of rotor bearing sleeve bushing with a thin coat of non-detergent SAE30 weight oil.

Support weight of rotor with a hoist. A cable sling can be used around shaft, or around rotor teeth, to carry weight of part while being assembled into casing.

Place end of rotor shaft through casing into bushing. Do not allow any portion of shaft to strike bushing. A carbon graphite bushing can be severely damaged if struck. Slowly turn rotor from right to left while pushing into casing. Push rotor as far into casing as it will go.

5. Prior to installing head, coat casing face with thread sealant (pipe dope) and place new .015 inch head gasket on mounting studs. Coat dry side of gasket with thread sealant (pipe dope) and prepare to mount the head and idler assembly.

6. Pump head and casing were marked before disassembly to ensure proper reassembly. If not, be sure idler pin, which is off set in pump head, is positioned toward an equal distance between port connections to allow for an even flow of liquid through pump.

Place head on pump, slightly tilting top of head back away from casing until crescent enters inside diameter of rotor. Rotate idler on idler pin until idler teeth mesh with rotor teeth. Raise head until face of head is parallel with face of casing and then work into position. Care must be taken to avoid damaging head gasket. Fasten head to casing with head nuts and tighten evenly.

If relief valve was removed from head, install on head with adjusting screw cap pointed toward suction port. **Refer to figure 19 for PRESSURE RELIEF VALVE INSTRUCTIONS, page 14.**

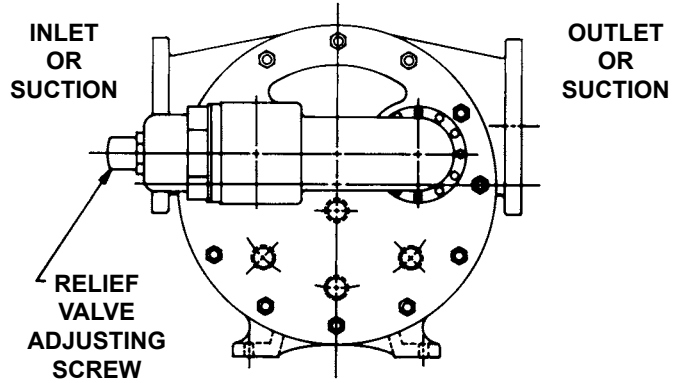


FIGURE 15

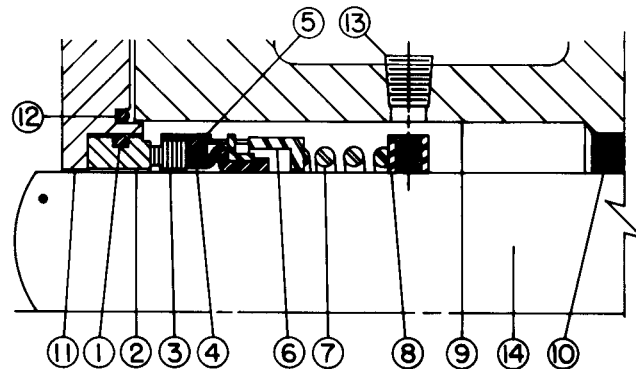


FIGURE 16
MECHANICAL SEAL

| LIST OF PARTS | |
|---------------------------------------|---|
| 1. O-Ring Seat Gasket | 8. Set Collar with Setscrews |
| 2. Stationary Seat | 9. Rotor Bearing Sleeve |
| 3. Rotating Face (Washer) | 10. Rotor Bearing Sleeve Bushing |
| 4. Bellows | 11. Seal Holder Plate |
| 5. Metal Parts (Retainer, drive band) | 12. O-Ring Gasket for seal holder plate |
| 6. Spring Adapter | 13. Pipe Plug |
| 7. Spring | 14. Shaft |

Note: Items 1 through 7 comprise the complete mechanical seal.

7. Push rotor back against head.
8. Install drain plug in casing.
9. Wipe shaft clean in seal area and thoroughly coat with non-detergent SAE 30 weight oil.

Before installing parts contained in the mechanical seal, **refer to figure 20** to become familiar with part name and location in rotor bearing sleeve.

10. Install set collar on shaft in rotor bearing sleeve directly under tapped access hole. Center line of collar set screws (5/16" socket head) must line up with center line of access hole. Rotate shaft and tighten all setscrews.
Replace pipe plug in seal access hole.

11. Slide seal spring on shaft and into seal chamber against set collar. Place spring adapter, open side facing end of shaft against spring. Place tapered installation sleeve on shaft.

NOTE: Tapered installation sleeve available from factory, at additional cost, for N & R size pumps.

12. Apply generous amount of non-detergent SAE 30 weight oil to large diameter of shaft, tapered installation sleeve and inner diameter of mechanical seal rubber parts.
13. Coat seal holder chamber and O-ring seat gasket with non-detergent SAE 30 weight oil and press in seal seat with lapped faced out. Protect face of seal seat with a clean piece of cardboard while pressing into place.
14. Coat seal holder plate O-ring gasket with non-detergent SAE 30 weight oil and install over pilot of plate.
15. Coat inside diameter of rotating face of seal with non-detergent SAE 30 weight oil and start tail of bellows over installation sleeve on shaft. A twisting motion while pushing will aid in sliding seal on sleeve. Push seal against seal adapter. Do not touch carbon rotating face with anything except clean hands or clean cloth.

Check to make sure adapter is not cocked.

16. Install seal holder plate over shaft on mounting studs until seal faces touch.

Start nuts on mounting studs. Pull seal holder plate evenly against face of seal chamber with nuts, alternately tightening one and then the other. This will compress mechanical seal to correct operating length and compress plate gasket to seal off seal chamber.

17. Remove tapered installation sleeve.
18. Place inner end cap with lipseal (lip facing end of shaft) on shaft.
19. Install thrust bearing housing on end of rotor bearing sleeve and tighten nuts and capscrews securely.

It is not necessary to use gasket between these parts.

20. Insert both tapered roller bearings in thrust bearing housing, large end of inner races together.

CAUTION: It is possible to install bearings incorrectly. For proper assembly, refer to **Figure 17**.
21. Install bearing spacer collar on shaft next to inner race of roller bearing.
22. Turn inner end cap into thrust bearing housing just far enough to hold in place.
23. Insert length of hardwood or brass bar through port opening between rotor teeth, to keep rotor from turning.
24. Install lockwasher with tang in keyway on shaft. Tighten locknut to 170-190 ft.-lbs. Torque. Bend one tang of lockwasher into slot of locknut. If tang does not line up with slot, tighten locknut until it does. Failure to tighten locknut or engage lockwasher tang could result in early bearing failure and cause damage to rest of pump. Bend one tang of lock washer into slot of locknut.

25. Remove length of hardwood or brass bar from port opening.
26. Reinstall flush tubing from casing discharge port gage hole to rotor bearing sleeve.

27. Lubricate all grease fittings with multi-purpose grease, NLGI # 2.
28. Adjust pump end clearance. Refer to **THRUST BEARING ADJUSTMENT**, page 14.

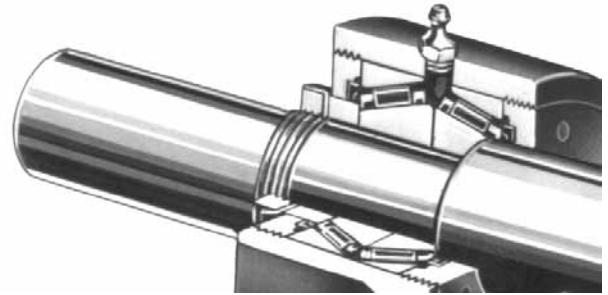


FIGURE 17

DANGER !

Before starting pump, be sure all drive equipment guards are in place.

Failure to properly mount guards may result in serious injury or death.

OPTIONAL MECHANICAL SEAL (PTFE Fitted Type)

Three components are furnished in mechanical seal assembly: Refer to **figure 18**, item numbers 1 thru 6.

1. Rotating assembly in which a retainer cartridge encloses a spring loaded PTFE shaft ring and polished rotating face. Set screws located around the outside of retainer cartridge are provided for securing rotating assembly to pump shaft.
2. Stationary seal seat.
3. Two seal seat gaskets.

Three pump parts necessary for mounting PTFE mechanical seal are illustrated in **figure 18**, item letters A, B, C and D.

1. Packing box extension. Has machine pilot on end for installation in rotor bearing sleeve and two tapped holes for seal flush.
2. Packing box extension gasket.
3. Seal plate. Machined to accept seal seat and gasket.

DISASSEMBLY

1. Disassemble pump per steps 1 thru 10 on page 9, under **MECHANICAL SEAL DISASSEMBLY**.
2. Remove seal plate nuts from studs and remove seal plate, gaskets and stationary seat.
3. If pump is equipped with a flush line, disconnect from packing box extension.
4. Remove packing box extension and gasket.
5. Loosen set screws in mechanical seal retainer cartridge and remove from rotor shaft. Refer to figure 18.

ASSEMBLY

1. Reassemble pump per steps 1 thru 9 on pages 11 & 12, under **Assembly, Standard Mechanical Seal**. Step 1 (deburring shaft) is very critical prior to seal assembly.
2. A tapered seal installation sleeve for N & R size pumps is available, at no extra cost, from Viking Pump.
3. Coat large diameter of shaft, tapered sleeve, and inside diameter of seal with non-detergent SAE 30 weight oil.
4. Place tapered installation sleeve (if on hand) and install seal on shaft over tapered sleeve. Position seal inside rotor bearing sleeve bore with end of seal located .19 inch inside machined face of rotor bearing sleeve. **Refer to Figure 18.**
5. Tighten all seal drive set screws securely to shaft.
6. Remove tapered installation sleeve.
7. Place gasket on packing box extension and install extension with machined pilot inside rotor bearing sleeve bore.
8. Place seat gasket over shoulder of stationary seal seat and insert set into seal plate. Place remaining seat gasket over shoulder of polished surface of stationary seat. **Refer to Figure 18.**
9. Place seal plate with stationary seat over mounting studs and push shoulder of stationary seat into packing box extension, polished face against carbon rotating face.
10. Install nuts on mounting studs and against seal holder. Tighten nuts evenly so seal plate and stationary seat will not be distorted when seal is compressed.
11. Reassemble flush line to packing box extension.

AT THIS POINT, FINISH ASSEMBLY PROCEDURES STARTING AT STEP 18, page 12.

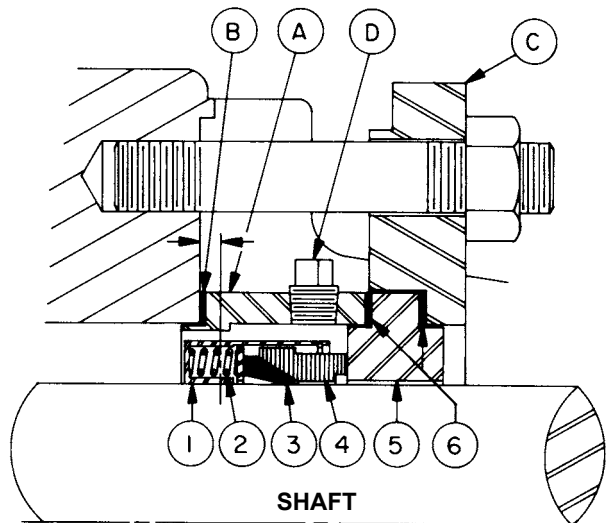


FIGURE 18

PTFE Fitted Mechanical Seal Assembly For Models N-R4333, 4335 & 4337

1. Retainer Cartridge
2. Springs
3. PTFE Shaft Ring (wedge)
4. Rotating Face (washer)
5. Stationary Seal Seat
6. Seat Gaskets

Seal Mounting Parts

- A. Packing box extension
- B. Packing box extension gasket
- C. Seal plate
- D. Flush openings

THRUST BEARING ADJUSTMENT

Use spanner wrench (provided with pump) and turn outer end cap until rotor is tight against head and rotor shaft cannot be turned.

With pencil or chalk, make reference mark on bearing housing and outer end cap. Back off outer end cap approximately 4 holes. One hole is equivalent to .005" end of clearance. Tighten inner end cap. Check rotor to determine if it turns freely in the casing. If not, make further adjustment until rotor does turn in casing.

Standard catalogue pumps require the following end clearance settings; N, .015", R, .020" minimum. Pumps built for viscous liquid or high temperatures service may require extra end clearance. Consult factory.

Lock both end caps securely in position with end cap locks and screws.

INSTALLATION OF CARBON GRAPHITE BUSHINGS

When installing carbon graphite bushings, extreme care must be taken to prevent breaking. Carbon graphite is a brittle material and easily cracked. If cracked, the bushing will quickly disintegrate. Using a lubricant and adding a chamfer on the bushing and the matting part will help in installation. The additional precautions listed below must be followed for proper installation.

1. A press must be used for installation.
2. Be certain bushing is started straight.
3. Do not stop pressing operation until bushing is in proper position, starting and stopping will result in a cracked bushing.
4. Check bushing for cracks after installation.

Carbon graphite bushings with extra interference fits are frequently furnished for high temperature operation. These bushings must be installed by a shrink fit.

1. Heat rotor bearing sleeve or idler to 750° F.
2. Install cool bushings with a press.
3. If facilities are not available to reach 750° F. temperature, it is possible to install with 450° F. temperature; however, the lowering the temperature, the greater the possibility of cracking bushing.

Consult factory with specific questions on high temperature applications. Refer to Engineering Service Bulletin ESB-3.

PRESSURE RELIEF VALVE INSTRUCTIONS

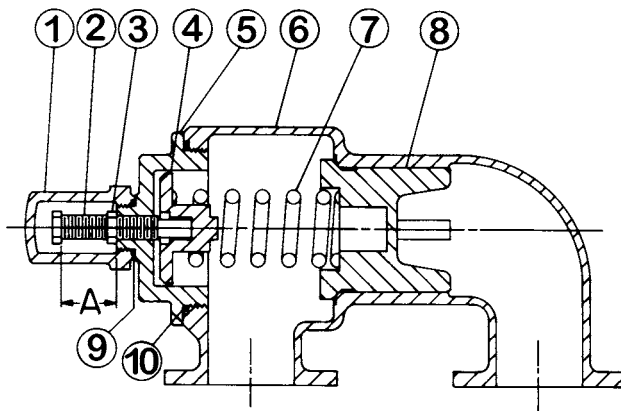


FIGURE 19
N AND R SIZE

| VALVE - LIST OF PARTS | |
|-----------------------|-------------------|
| 1. Valve Cap | 6. Valve Body |
| 2. Adjusting Screw | 7. Valve Spring |
| 3. Lock Nut | 8. Poppet |
| 4. Spring Guide | 9. Cap Gasket |
| 5. Bonnet | 10. Bonnet Gasket |

DISASSEMBLY

DANGER !

Before opening any Viking pump liquid chamber (pumping chamber, reservoir, relief valve adjusting cap fitting, etc.) Be sure:

1. That any pressure in the chamber has been completely vented through the suction or discharge lines or other appropriate openings or connections.
2. That the driving means (motor, turbine, engine, etc.) has been "locked out" or made non-operational so that it cannot be started while work is being done on pump.
3. That you know what liquid the pump has been handling and the precautions necessary to safely handle the liquid. Obtain a material safety data sheet (MSDS) for the liquid to be sure these precautions are understood.

Failure to follow above listed precautionary measures may result in serious injury or death.

Mark valve and head before disassembly to ensure proper reassembly.

1. Remove valve cap.
2. Measure a record length of extension of adjusting screw.
Refer to "A" on Figure 19.
3. Loosen locknut and back out adjusting screw until spring pressure is being released.
4. Remove bonnet, spring guide, spring and poppet from valve body. Clean and inspect all parts for wear and damage and replace as necessary.

ASSEMBLY

Reverse procedures outlined under Disassembly. If valve is removed for repairs, be sure to replace in same position. Relief valve adjusting screw cap must always point towards suction valve of pump. If pump rotation is reserved, remove relief valve and turn end for end. Refer to Figure 20.

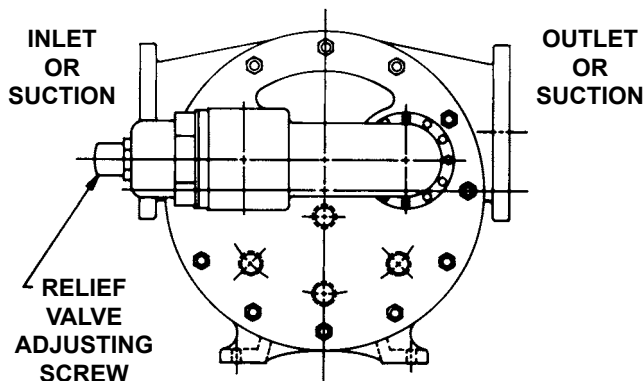


FIGURE 20

DANGER !

Before starting pump, be sure all drive equipment guards are in place.

Failure to properly mount guards may result in serious injury or death.

PRESSURE ADJUSTMENT

If a new spring is installed or if pressure setting of pressure relief valve is to be changed from that which the factory has set, the following instructions must be carefully followed.

1. Carefully remove valve cap which covers adjusting screw.
Loosen locknut which locks adjusting screw so pressure setting will not change during operation of pump.
2. Install a pressure gauge in discharge line for actual adjustment operation.
3. Turn adjusting screw in to increase pressure and out to decrease pressure.
4. With discharge line closed at a point beyond pressure gauge, gauge will show maximum pressure valve will allow while pump is in operation.

VIKING PUMP

IDEX
CORPORATION

WARRANTY

Viking warrants all products manufactured by it to be free from defects in workmanship or material for a period of one (1) year from date of startup, provided that in no event shall this warranty extend more than eighteen (18) months from the date of shipment from Viking. The warranty period for Universal Seal series pumps ONLY (Universal Seal models listed below) is three (3) years from date of startup, provided that in no event shall this warranty extend more than forty-two (42) months from the date of shipment from Viking.

UNDER NO CIRCUMSTANCES SHALL VIKING BE LIABLE UNDER THIS WARRANTY OR OTHERWISE FOR SPECIAL, INCIDENTAL, INDIRECT, CONSEQUENTIAL OR PUNITIVE DAMAGES OF ANY KIND, INCLUDING, BUT NOT LIMITED TO, LOST OR UNREALIZED SALES, REVENUES, PROFITS, INCOME, COST SAVINGS OR BUSINESS, LOST OR UNREALIZED CONTRACTS, LOSS OF GOODWILL, DAMAGE TO REPUTATION, LOSS OF PROPERTY, LOSS OF INFORMATION OR DATA, LOSS OF PRODUCTION, DOWNTIME, OR INCREASED COSTS, IN CONNECTION WITH ANY PRODUCT, EVEN IF VIKING HAS BEEN ADVISED OR PLACED ON NOTICE OF THE POSSIBILITY OF SUCH DAMAGES AND NOTWITHSTANDING THE FAILURE OF ANY ESSENTIAL PURPOSE OF ANY PRODUCT.

THIS WARRANTY IS AND SHALL BE VIKING'S SOLE AND EXCLUSIVE WARRANTY AND SHALL BE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ALL WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NON-INFRINGEMENT ALL OF WHICH OTHER WARRANTIES ARE EXPRESSLY EXCLUDED.

See complete warranty at www.vikingpump.com.

IMPORTANT

In ordering parts for pressure relief valve, always give model number and serial number of pump as it appears on nameplate and name of part wanted. When ordering springs, be sure to give pressure setting desired.