

INSTALLATION, OPERATION AND MAINTENANCE MANUAL

VERTICAL TURBINE PUMPS

10VT Series/12VT Series

ENGLISH: PAGES 1-64

Installation, Operation and Maintenance Manual

NOTE! To the installer: Please make sure you provide this manual to the owner of the equipment or to the responsible party who maintains the system.



PENTAIR
BERKELEY

THIS PAGE INTENTIONALLY LEFT BLANK

Pump Identification

Carefully record all of the following data from your pump nameplate. It will aid in obtaining the correct replacement parts for your pump. In addition to the nameplate, the pump serial number is also stamped on the discharge flange.

Pump:

Serial Number _____

Model Number _____

Pump Size _____

Number of Stages _____

GPM _____

Head (feet) _____

Motor:

Manufacturer _____

Horsepower _____

Serial Number _____

Motor Frame _____

Full Load Speed _____

Full Load Amps _____

Phase/Hz/Volts _____ / _____ / _____

Date Placed In Service _____

Gear:

Manufacturer _____

Serial Number _____

Model Number _____

Ratio _____

Rotation Figure _____

CALIFORNIA PROPOSITION 65 WARNING:

[Warning ICON] This product and related accessories contain chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.

Introduction

Congratulations! You are the owner of the finest pump commercially available. If you give it the proper care as outlined and recommended by this manual, it will provide you with reliable service and long life.

IMPORTANT

- **Read this complete manual and manuals for all component equipment before assembly or installation is started. It contains information which is the result of engineering and research efforts. It is designed to supply adequate instructions for the installation, operation and maintenance of your pump. Failure or neglect to properly install, operate or maintain your pump may result in personal injury, property damage or unnecessary damage to the pump.**

This manual applies to the pump installation, operation and maintenance. They are intended to be general and not specific. If your operating conditions ever change, always refer to the factory for reapplication. Always refer to the manuals provided by manufacturers of the accessory equipment for their separate instructions.
Fairbanks Nijhuis Pump Corporation

Variations exist in both the equipment used with these pumps and in the particular installation of the pump and driver. Therefore, specific operating instructions are not within the scope of this manual. The manual contains general rules for installation, operation and maintenance of the pump. If there are questions regarding the pump or its application which are not covered in this manual, please contact the factory as follows:

PENTAIR
Fresno Service Center
5661 North Golden State Blvd
Fresno, California 93722
(559) 266-0516

To obtain additional data on hydraulics and pump selection and operation, we suggest you purchase both of the following reference books:

1. Fairbanks Nijhuis "Hydraulic Handbook" available from the Kansas City factory.

Fairbanks Nijhuis
3601 Fairbanks Avenue
P.O. Box 6999
Kansas City, KS 66106-0999

2. Hydraulic Institute Standards
Hydraulic Institute
9 Sylvan Way
Parsippany, NJ 07054-38025



Turbine and Propeller Pump Prestart-up and Start-up Checklist

Customer _____

Pump Serial Number _____

Project Name _____

Pump Model Number _____

Note: this is a generic form and all questions may not apply. Items listed below do not cover all potential problems that may arise during installation and start-up. If you have any questions please consult your O & M manual or consult the manufacturer.

Procedure	Yes	No	N/A	Comments
1. Shipment				
Was there any damage in transit?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Were all items received?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
2. Storage				
Has equipment been protected from inclement weather?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Was equipment subject to flooding?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Has motor been protected from moisture?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
3. Installation				
Were retaining fasteners, used in shipping, removed prior to installation?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
For oil lube pumps, were discharge case plugs removed?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Is grouting under base properly compacted?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Is grouting of the non-shrink type?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Have proper anchor bolts been used?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Have all bolts been properly tightened?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Has discharge piping been checked for pipe strain?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Are lube lines and seal water lines properly installed?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
- Water flush pumps - water flush line	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
- Oil lube pumps - oil reservoir line	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
- Mechanical Seal - vent line	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
- 400 PSI packing box - bypass line	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Are accessory items, RTD's, bearing temperature detectors, vibration sensors, etc. mounted and properly installed?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Are lube lines purged of air and lubricant added?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Has driver been properly lubricated?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Are all safety guards in place?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Have impellers been checked for proper axial running clearance?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
4. Rotation				
Has the rotation of the drives been checked for correctness?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Has the shaft/coupling been rotated to assure free rotation of pump and motor?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
5. System				
Has the system been flushed and checked to insure that it is free of foreign matter which could be damaging to the pump?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Is liquid available to the pump?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Has assurance been obtained from responsible parties that all piping is secure and that the routing of flow has been established and is correct?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
6. Start-Up				
Has flow been established? Flow rate: _____ GPM	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Have gauge readings been taken? Discharge pressure: _____ PSI	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Has packing been adjusted to insure proper lubrication of packing?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
If pumps are equipped with water flush or seal water piping, is pressure set to at least 10 psi above pump discharge pressure?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Is excessive vibration present?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
What is recorded line voltage? _____ volts	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
What is motor amp draw on each leg? 1.) _____ 2.) _____ 3.) _____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
7. Safety				
Have all safety warning labels been read and understood?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

THIS PAGE INTENTIONALLY LEFT BLANK

10VT SERIES/12VT SERIES

Vertical Turbine Pumps

Installation, Operation and Maintenance

TABLE OF CONTENTS

Pump Identification	iii	3. Initial Start-Up	19
Introduction	iv	4. Normal Operation	19
Prestart-Up and Start-Up Check List	v	5. Shutdown	20
Safety	2	6. Seasonal Operation	20
Storage of Pumps	4	7. Emergency Procedures	20
General Description	5	Troubleshooting	
Installation		1. Insufficient Pressure or Flow	20
1. General	6	2. Loss of Suction Operation	21
2. Foundation	6	3. Excessive Power Consumption	21
3. Well and Pit Inspection	6	4. Vibration or Noise	21
4. Bowl Assembly	6	5. Excessive Packing Box Leakage	21
5. Suction Strainer	7	6. Over-Heating	21
6. Hoisting, Leveling, Grouting & Piping	7	Maintenance	
7. Pump Assembly	7	1. Preventive Maintenance	22
8. Product Lubricated, Open Lineshaft, Flanged Column	8	2. Pump Disassembly	24
9. Product Lubricated, Open Lineshaft, Threaded Column	9	3. Pump Bowl Disassembly	27
10. Oil Lube, Enclosed Lineshaft, Flanged Column	10	4. Inspection for Replacement	28
11. Water Flush, Enclosed Lineshaft, Flanged Column	11	5. Pump Assembly	29
12. Oil Lube, Enclosed Lineshaft, Threaded Column	12	6. Bowl Assembly (Reassembly)	30
13. Water Flush, Enclosed Lineshaft, Threaded Column	14	7. Wear Rings	31
14. Driver Installation	16	8. Mechanical Seals	31
15. Hollow Shaft Drivers; General	16	9. Maintenance History	34
16. Installation, Hollow Shaft Drivers	16	Repair Parts	
17. Solid Shaft Drivers; General	17	1. Ordering Parts	36
18. Installation, Solid Shaft Drivers	17	2. Returning Parts	36
Operation		Service	
1. General	19	1. Warranty Service	37
2. Operating at Reduced Capacity	19	2. Service After Warranty	37
		Reference Information	
		1. Technical Data	38
		2. Drawings and Diagrams	41

Safety should be of utmost importance when in close proximity of this pumping equipment. Before attempting to operate this equipment, you should read this manual in its entirety, taking special notice of all CAUTIONS, WARNINGS and/or DANGER notifications. These warnings apply to pumps supplied by Fairbanks Nijhuis. Refer to the manuals supplied by the driver and control manufacturer for additional warnings before operating this equipment.

The words DANGER, WARNING and CAUTION have different connotations and are generally defined as follows:

DANGER

- **DANGER** indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

- **WARNING** indicates a potentially hazardous situation which, if not avoided, will result in serious injury.

CAUTION

- **CAUTION** indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury or may indicate that improper practices will result in equipment malfunction or failure. It may also be used to alert against unsafe practices.

IMPORTANT

- Another notation will appear throughout this manual. **IMPORTANT** indicates the highlight or accent of specific information.

The installation, use and operation of this type of equipment is affected by various Federal, State and Local Laws and the regulations concerning OSHA. Compliance with such laws relating to the proper installation and safe operation of this type of equipment is the responsibility of the equipment Owner and all necessary steps should be taken by the Owner to assure compliance with such laws before operating the equipment.

⚠ DANGER

Do not attempt to service the pump until the electrical power has been disconnected and it has been verified that the pump cannot start. Because many installations utilize automatic starting equipment, the pump unit may start at any time without warning. Proper Precautions should be taken to avoid injury as a result of automatic starting of the equipment.

⚠ DANGER

Do not operate the pump without the protective guards in place over the rotating parts. Exposed rotating parts can catch clothing, fingers, or tools, causing severe injury to personnel. Any operation of this machine without a protective guard can result in severe bodily injury. The responsibility for the installation of protective guards is that of the equipment owner.

⚠ DANGER

This pump is designed for the exclusive use of pumping water. It should not be used for pumping other media unless a specific Purchase/Buyer agreement is negotiated.

⚠ WARNING

Do not attempt to try to clean the pump with bare hands. The pumped material may contain items that may present health hazards such as needles, and other sharp objects. Always wear heavy puncture resistant gloves.

⚠ WARNING

- Before attempting to service this pump:
 1. Familiarize yourself with this manual.
 2. Disconnect or lock out the power source to insure the pump will not start. Confirm power source disconnect with appropriate electrical test equipment.
 3. Close the discharge valve.

After the pump has been installed, make certain that the pump and all piping connections are tight and are properly supported prior to start-up and operation.

⚠ WARNING

- Certain procedures in disassembly and assembly require parts be heated to high temperatures. Heat resistant gloves must be worn when handling heated parts. Heated parts can cause severe personal injury.

⚠ CAUTION

- For pumps used in potable water service, all thread lubrication, grease, cleaning materials and paint must be suitable for potable water.

⚠ CAUTION

- On deep set open lineshaft turbines (where static water level is 50' or greater) it is recommended that the lineshaft bearings be pre-lubricated prior to the start of the pump. The discharge head is provided with a port to accommodate pre-lubrication piping. Refer to the factory for specific prelubrication instructions.

Storage of Pumps**⚠ CAUTION**

- **If the equipment is not to be immediately installed and operated, THE FOLLOWING INSTRUCTIONS SHOULD BE ADHERED TO AS A MINIMUM.**

Consider a unit in storage when:

- 1. It has been delivered to the jobsite and is awaiting installation.**
- 2. It has been installed but operation is delayed pending completion of plant construction.**
- 3. There are long (30 days or more) periods between operation cycles.**
- 4. The plant (or facility) is shut down.**

NOTE: Improper storage could result in product failures or restoration not covered by warranty.

Unassembled Pumps:

1. Store the unassembled components in a clean, dry well-ventilated place free from vibrations, moisture, and temperature variation.
2. Wipe clean all exposed machined surfaces and coat with a heavy layer of grease or other equivalent rust preventative material.
3. Cover the suction and discharge of the pump with cardboard or wood to prevent entry of foreign material or varmints. This also applies to column sections.
4. The enclosing tube, bearings, shaft, and couplings should be stored as components, i.e. shaft with couplings installed on lower ends inserted into enclosing tubes with bearings installed in upper ends. The ends should then be wrapped with heavy plastic or protective material and secured tightly to prevent entry of foreign matter and varmints.

Assembled Pumps:

1. Remove the gland halves, packing and seal water rings from the stuffing box if the pump is so equipped. If the pump is equipped with inside mechanical seal, remove the pipe plug in the stuffing box cover, and coat the seal with light oil. This may be done by using an oil can, squirting the seal through the tapped opening while rotating the pump shaft. If equipped with outside seal, oil and cover for protection.
2. When pumps with rubber bearings are stored assembled in horizontal position, it is necessary to rotate the entire pump and column assembly 90 degrees once per month. This practice will help prevent the weight of the shafts from deforming the rubber bearings.

Pumps with metal bearings stored in horizontal positions are to have shafts rotated once per month to prevent lineshafts from deforming or bowing under their own weight.
3. Pumps stored fully assembled and installed are to be rotated once per week to prevent brinelling of motor thrust bearings. Packing or mechanical seals are to be serviced as noted above.

General Description

A vertical lineshaft turbine pump consists of five basic components. These components are the pump bowl assembly, column pipe, lineshafting, discharge head, and driver.

Refer to the Technical Data section for general arrangement drawings.

Bowl Assembly

The VT series single stage bowl assembly is made up of a suction bell (or suction case), a top intermediate bowl and impeller, and a discharge case. Units of two or more stages include a suction bell (or suction case), multiple intermediate bowls and impellers. Multiple stage open lineshaft construction does not require a discharge case. Multiple stage enclosed lineshaft construction will be furnished with a discharge case. For more detailed information and descriptions, refer to the bowl assembly section of this manual.

Column Pipe

Column pipe for the pumps covered in this manual can be either threaded or flanged.

Threaded column features straight threads on both column ends and butt solidly together within the coupling. Standard nominal column lengths for threaded column are 5 foot, 10 foot or 20 foot (enclosed lineshaft only).

Flanged column includes registered fits for accurate column alignment and are bolted together. Flanged column pipe is available in standard lengths of 10 foot or 5 foot; or can be provided in any special length up to 10 foot.

Lineshafting

The turbine lineshaft transmits torque from the pump driver to the pump bowl assembly and rotates inside the column pipe. Both ends of the shaft are precision machined, and are secured together with couplings. This shafting is supported by bearings at specific intervals; the types of bearings used and how they are lubricated are described as follows:

A. Open Lineshaft -- Product Lubricated

This design is such that the lineshaft and bearings are exposed to and lubricated by the liquid being pumped. The lineshaft is supported at intervals of not more than 10' by bearings that run on shaft sleeves. Support for these bearings is supplied by bearing retainers. The outer hub of the retainer is seated

between the two column ends. (See the Technical Data Section).

B. Enclosed Lineshaft

In the enclosed lineshaft design the shafting is surrounded by tubing. This tubing protects both the shaft and bearings from the pumped liquid and provides a channel for lubricating the shaft bearings. The bearings have machined grooves on their I.D. to allow lubrication to flow from one bearing to the next. These bearings are also threaded on the outside diameter and are used to connect the five foot enclosing tube sections. Lubrication is normally oil or water from a separate source. The enclosing tube may be supported by spiders unequally spaced to reduce the risk of vibration. (See the Technical Data Section).

Discharge Heads

Discharge heads perform multiple functions: direct the pump flow from the pump column to the discharge piping system, provide a method for sealing the lineshaft or enclosing tube, provide a base from which the pump is suspended, and provides a mounting surface for the driver.

Surface discharge heads incorporate both the discharge elbow and driver pedestal in one piece. An underground discharge elbow can also be provided in which case a separate driver pedestal is provided. Either design can be supplied with a flanged or plain end discharge connection. The bottom surface of the discharge head or pedestal is machined when furnished with a sole plate.

Drivers

A variety of driver sizes and types can be supplied based on the specific job requirements. Drivers may be either vertical hollow or vertical solid shaft motors, or right angle gears coupled to horizontal shaft drivers.

Normally a vertical hollow shaft driver is used. In this configuration the lineshaft passes through the driver, positioned with an adjusting nut to accommodate impeller adjustment and is connected to the top of the driver by a keyed drive hub or coupling.

Solid shaft drivers require special adjustable couplings in order to attach to the pump shaft and to accommodate impeller adjustment. Refer to your submittal package for your specific pump driver configuration.

INSTALLATION

General

CAUTION

- Turbine Pumps are shipped with a shaft retention bolt installed in the suction bell to protect the pump from damaging shaft movement during transit. It is imperative that the retaining bolt be removed, and grease added to the lower bearing cavity. Install the suction bell plug prior to pump installation. Failure to follow these instructions will result in serious damage to the pump. Read and heed all warning tags and labels.

Prior to assembly and/or installation, the pump and loose parts are to be inspected for completeness, correctness and cleanliness. During this inspection, all parts are to be thoroughly cleaned and any burrs removed by filing. The pump bowl assembly, including the lineshaft coupling, is normally shipped completely assembled. Both the suction and discharge openings should be inspected for damage and for foreign materials. Rotate the shaft by hand, and move in and out to check for end play. Place all parts in an orderly arrangement for convenient assembly.

WARNING

- Extreme caution is to be exercised when hoisting components with open lifting lugs. Precautions should be taken to prevent hoisting slings from coming out of the lugs.
- Never attempt to mount the driver on the discharge head prior to installation of the pump.
- Never attempt to hoist the entire pump by the driver lifting lugs or eyes. These lifting points are designed only to hoist the weight of the driver, not other attached components.

IMPORTANT

- All shafting has been pre-straightened to a tolerance of 0.005" in 10 feet prior to leaving the factory or assembly plant. Care in handling must be taken to insure that the shafting is not bent prior to and during installation.

Foundation

A foundation must be supplied consisting of any material that will provide a permanent, rigid support. This support is to be of sufficient size and depth to fully carry the weight of the pump (full of water) and rigid enough to prevent vibration.

Anchor bolts are to be supplied and set in place by the installing contractor. Anchor bolts of appropriate size, length and configuration are required to adequately secure the discharge head/pedestal to the foundation.

When the pump is to be mounted over a pit on structural steel framing, it should be located as close to the main structure or wall as possible. Cross members are to be used to prevent distortion and vibration of structural mounting frame.

Well and Pit Inspection

Prior to installation and start-up, the well or pit must be cleaned of all loose material and debris.

CAUTION

- Reduced performance and possible equipment damage may result from ingestion of foreign material by the pump.

Bowl Assembly

CAUTION

- Turbine Pumps are shipped with a shaft retention bolt installed in the suction bell to protect the pump from damaging shaft movement during transit. It is imperative that the retaining bolt be removed, and grease added to lower bearing cavity. Install the suction bell plug prior to pump installation. Failure to follow these instructions will result in serious damage to the pump. Read and heed all warning tags and labels.

NOTE: Before proceeding, measure and record the pump bowl assembly end play. This information will be needed later.

Shaft projection can be defined as the distance from the discharge bowl mounting surface (flange seat for flanged column, thread seat for threaded column) to the end of the pump shaft. Nominal standard shaft projection for VT series is 17"-1/2". Since all applicable VT series bowl assemblies are shipped with the pump shaft bolted in its lowermost position, standard

projection is measured with the impellers resting at the bottom of their axial travel. Always remove the shaft retaining bolt before installing or operating the pump.

Shaft end play is the amount of axial movement available in the pump bowl assembly. After removing the shaft retaining bolt, measure and record the pump bowl end play. This can most easily be accomplished with the bowl assembly in a horizontal position. Grasp the pump shaft and move the shaft through its maximum axial travel. Consult Table #1 in the Technical Data Section to assure that the distance measured complies with the specifications for your pump model.

A discharge case is included for: a.) single-stage open-lineshaft bowl assemblies, b.) single or multi-stage oil lubricated enclosed lineshaft bowl assemblies, or c.) single or multi-stage water-flushed enclosed lineshaft bowl assemblies.

Discharge cases for enclosed lineshaft water-flushed and open lineshaft units are shipped with two pipe plugs installed.

Plugs must be left in place for discharge cases used with enclosed lineshaft water-flushed and open lineshaft units.

Enclosed lineshaft oil lubricated discharge cases are shipped WITHOUT two pipe plugs.

CAUTION

- Should you receive a bowl assembly for enclosed lineshaft oil lubricated construction that has two pipe plugs installed in the discharge case, **THESE PIPE PLUGS MUST BE REMOVED PRIOR TO INSTALLATION.** Failure to remove the plugs will cause water to enter the enclosing tube and leak out at the discharge head. Bearing failure may result.

Suction Strainer

If a suction strainer is to be used, it is to be either threaded into the suction case or clipped onto the suction bell as required.

Hoisting, Leveling, Grouting & Piping

If your pump was shipped completely assembled, it is now ready to install.

WARNING

- **The pump is to always be lifted using adequate crane and sling capacity. All applicable safe hoisting practices should be employed.**

The pump is to be hoisted by the discharge head. Pumps thirty feet or more in overall length should also be supported at the column midpoint to avoid column/shaft distortion and possible pump damage.

The pump is to be lowered onto the anchor bolts and leveled. This can be achieved by applying a good quality machinists spirit level to the machined motor mounting surface or to the below-grade pump column, if accessible.

After leveling, the base plate is to be grouted in place with a good quality non-shrinking grout. After the grout is fully dry, the base plate is to be nutted solidly in place against the grout bed.

Leveling devices are to be removed or backed off and the pump base plate tightened solidly against the grout bed. All pockets and/or holes left by removal of leveling devices are to be filled with grout.

IMPORTANT

- **Damaging vibration may result if the base plate is not solidly in contact with the grout bed. Even the highest quality non-shrink grouts contract slightly during drying. All leveling wedges, nuts or jackscrews are to be removed or backed off prior to final torquing of the base plate fasteners. Failure to do so will result in the pump base plate resting on the leveling devices rather than the grout bed.**

Piping is to be brought in direct axial alignment with the pump discharge. Flange faces are to fit closely and squarely. The pump discharge is to have no strain imposed upon it by piping misalignment.

Pump Assembly

If the pump has been shipped disassembled, the following instructions are to be employed to assemble the unit vertically in the well.

Determine if the pump to be assembled is Product Lubricated Open Lineshaft, Oil Lube Enclosed Lineshaft or Water Flush Enclosed Lineshaft. Prior to assembly, all components are to be identified and laid out in order of assembly. Standard length (10' or 20') intermediate

column, enclosing tube and shaft are interchangeable and can be assembled in any order. However, shorter non-standard column, enclosing tube and shaft sections are provided to accomplish the required overall pump length, and must be installed at the top of the pump directly under the discharge head. The top enclosing tube also has longer threads to engage the top tube tension nut.

On threaded column, all column couplings are to be installed on the upper end of the column prior to lifting. This will provide a stop for pipe clamps during the hoisting process.

Product Lubricated Open Lineshaft, Flanged Column

1. Using an appropriate hoisting system, lift the bowl assembly into position over the well. Lower the bowl partially into the well. Attach a pipe clamp (see Figure #1) to the upper most bowl directly under the bowl discharge flange. Lower the assembly, allowing it to be supported on the foundation via the pipe clamp.
2. Lift the first section of preassembled column/shaft assembly into position over the suspended bowl assembly (See Figure #2). Care is to be taken not to damage the threads on the pump shaft or lineshafts. Clean the threads and lubricate with appropriate thread lubricant.

A lineshaft coupling should already be in place on the pump shaft. Thread the lineshaft into the coupling.

IMPORTANT

- **Lineshaft threads are left hand. Tighten shafts and couplings securely with pipe wrenches.**

Assure that no burrs or foreign matter exists on the coupling or on the shaft threads. The threaded shafts are to butt together solidly and squarely in the center of the coupling. Both shafts are to be equally engaged in the coupling threads. Threads should be exposed on both ends of the coupling.

NOTE: Shafts with replaceable wear sleeves must be positioned to engage lineshaft bearings. The presence of any foreign material between the shaft ends will cause shaft misalignment and will result in vibration or accelerated bearing wear.

3. Hoist the first section of column into position over the assembled lineshaft. Lower the column onto the bowl discharge flange. All column joints should be coated with non-hardening gasket sealant such as

Loctite P.S.T. #567, Permatex No. 2 or equal. Silicon sealants are also permissible. Install bolts and nuts and tighten.

IMPORTANT

- **Measure the shaft projection. It should conform to the shaft projection measurement taken and recorded previously on the bowl assembly.**

4. The lineshaft is to project out beyond the end of the installed column. Install the bearing retainer assembly over the shaft projection. Seat the retainer OD in the column flange counterbore.

NOTE: Coat the column counterbore with sealant prior to a retainer installation.

NOTE: Bronze lineshaft bearings are to be lubricated with grease prior to installation. Rubber lineshaft bearings should NOT be lubricated. Lubrication of rubber bearings may cause distortion or swelling.

5. Lift the column/bowl assembly slightly and remove the pipe clamp from the bowl. Lower the assembly and reinstall the pipe clamp below the upper column flange. Lower the assembly so the pipe clamp suspends the assembly on the foundation.
6. Install the next shaft/column segment as previously instructed assuring that its lower flange counterbore engages the top of the bearing retainer OD. Coat the column counterbores with sealant prior to installation.

Install bolts and nuts and tighten. A slight gap will remain between the two column flanges. The condition allows the flanges to clamp the bearing retainer securely between them.

7. Continue subsequent shaft and column assembly until complete. Continue to measure the shaft projection after assembly of each shaft/column section.

NOTE: Standard shaft and column lengths are 10 feet. Nonstandard lengths of shafts and column may be used to accomplish the required overall pump length. Nonstandard shaft/column sections will always be assembled at the top of the pump, directly under the discharge head. The shaft segment which protrudes through the packing box will always have a replaceable wear sleeve unless otherwise specified and submitted.

Assembly procedure for underground discharge (U.G.D.) units closely parallels that of standard pumps with above ground discharge heads. Always refer to the Fairbanks Nijhuis submittal drawings and setting plan to determine the proper location of discharge elbow centerline.

If the packing box of the U.G.D. pump is lubed by the pumped media, it will be necessary to provide an air release valve in the top column. This will prevent air from becoming trapped in the column above the discharge elbow, therefore allowing the media to lubricate the packing box bushing and packing. If the pump's total dynamic head is not sufficient to raise the media to the altitude of the packing box, an alternate method of lubrication must be provided (i.e., grease lube).

8. For ease of installation, remove the packing box if shipped assembled to the discharge head.
9. Install column flange gasket (when used) and secure the discharge head to the last column flange. When attaching the column to the discharge head, make sure the register fit is fully engaging the head.
10. After attaching the column to the discharge head and removing the column clamp, lower the unit to the foundation and tighten mounting bolts. Check the shaft to see if it is centered in the packing box opening in the head. If the shaft is not centered, it could be an indication of a bent shaft, column not seated properly, or the unit is not properly plumbed. Any or all of these problems must be corrected before proceeding with the installation of the unit.
11. Apply lubricant to the packing box bushing and install the packing box on the discharge head.
12. Install the packing and glands into the packing box. Install gland bolts and nuts. Allow the gland nuts to remain loose. Packing adjustment will be performed later with the pump operating. If a mechanical seal is employed, refer to the Mechanical Seal section of this manual.

Product Lubricated Open Lineshaft, Threaded Column

1. Using an appropriate hoisting system, lift the pre-assembled bowl assembly into position over the well. Lower the bowl partially into the well. Attach a pipe clamp (see Figure #1) to the upper most bowl directly under the bowl threads. Lower the assembly, allowing it to be supported on the foundation via the pipe clamp.
2. Lift the first section of shaft/column assembly into position over the suspended bowl assembly (See Figure #2). Care is to be taken not to damage threads on the pump shaft or lineshafts. Clean the threads and lubricate with appropriate thread lubricant.

A lineshaft coupling should already be in place on the pump shaft. Thread the lineshaft into the coupling and tighten.

IMPORTANT

- **Lineshaft threads are left hand. Tighten shafts and couplings securely with pipe wrenches.**

Assure that no burrs or foreign matter exists on the coupling or on the shaft threads. The threaded shafts are to butt together solidly and squarely in the center of the coupling. Both shafts are to be equally engaged in the coupling threads. Threads should be exposed on both ends of the coupling.

NOTE: Shafts with replaceable wear sleeves must be positioned to engage lineshaft bearings. The presence of any foreign material between the shaft ends will cause shaft misalignment and will result in vibration or accelerated bearing wear.

IMPORTANT

- **Assure that no burrs or foreign matter exists on the column coupling threads or on the column threads prior to assembly. All joints are to be coated with sealant prior to assembly. The column sections should butt together solidly and squarely in the middle of the column coupling. Secure each joint firmly with appropriate wrenches. ALL COLUMN THREADS ARE RIGHT HAND.**

3. Lower the column and thread it into the bowl assembly until it solidly and squarely butts together with the bowl, tightening it firmly with appropriate wrenches.
4. Lift the column/bowl assembly slightly and remove the pipe clamp from the bowl. Lower the assembly and reinstall the pipe clamp below the upper column threads. Lower the assembly so the pipe clamp suspends the assembly on the foundation.

The lineshaft is to project out beyond the end of the installed column.

IMPORTANT

- **Measure the shaft projection. It should conform to the shaft projection measurement taken and recorded previously on the bowl assembly.**
5. Slide the bearing retainer with bearing over the shaft projection and lower into the column coupling. Install the shaft coupling and next section of shaft/column assembly as previously outlined.

6. Continue subsequent shaft and column assembly until complete. Continue to measure the shaft projection after assembly of each shaft/column section.

NOTE: Standard shaft and column lengths are 10 feet. Nonstandard lengths of shafts and column may be used to accomplish the required overall pump length. Nonstandard shaft/column sections will always be assembled at the top of the pump, directly under the discharge head. The shaft segment which protrudes through the packing box will always have a replaceable wear sleeve unless otherwise specified and submitted.

Assembly procedure for underground discharge (U.G.D.) units closely parallels that of standard pumps with above ground discharge heads. Always refer to the Berkeley/Fairbanks Nijhuis submittal drawings and setting plan to determine the proper location of discharge elbow centerline.

If the packing box of the U.G.D. pump is lubed by the pumped media, it will be necessary to provide an air release valve in the top column. This will prevent air from becoming trapped in the column above the discharge elbow, therefore allowing the media to lubricate the packing box bushing and packing. If the pump's total dynamic head is not sufficient to raise the media to the altitude of the packing box, an alternate method of lubrication must be provided (i.e., grease lube).

7. For ease of installation, remove the packing box if shipped assembled to the discharge head.
8. Thread the top column adapter flange onto the top column and tighten with appropriate wrenches. Install column flange gasket and secure the discharge head to the column adapter flange. When attaching the column to the discharge head, make sure the register fit is fully engaging the head and the flange is timed with the pipe tapped hole of the discharge head.
9. After attaching the column to the discharge head and removing column clamp, lower the unit to the foundation and tighten mounting bolts. Check the shaft to see if it is centered in the packing box opening in the head. If the shaft is not centered, it could be an indication of a bent shaft, column not seated properly, or the unit is not properly plumbed. Any or all of these problems must be corrected before proceeding with the installation of the unit.
10. Apply lubricant to the packing box bushing and install the packing box on the discharge head.

11. Install the packing and glands into the packing box. Install gland bolts and nuts. Allow the gland nuts to remain loose. Packing adjustment will be performed later with the pump operating. If a mechanical seal is employed, refer to the Mechanical Seal section of this manual.

Oil Lube Enclosed Lineshaft, Flanged Column

1. Using an appropriate hoisting system, lift the preassembled bowl assembly and position it above the well. Lower the bowl assembly partially into the well and attach a pipe clamp (see Figure #1) to the uppermost bowl directly under the bowl discharge flange. Lower the assembly, allowing it to be suspended on the foundation via the pipe clamp.
2. Before proceeding with assembly, lay out all lineshaft, enclosing tube, column and connectors. Inspect and identify all items and arrange them in the order in which they will be assembled. Oversized diameter enclosing tube sections (if used) must be installed at the bottom of the assembly, directly above the pump discharge bowl. When oversized tube sections are used, special stepped connector bearings are provided in order to adapt them to the remaining standard diameter enclosing tube sections.

Preassemble matching sets of shaft, enclosing tube and column by sliding them inside each other and attaching connectors and couplings. This will allow each set of column/enclosing tube/shaft to be hoisted into place and assembled as demonstrated in Figure #3.

Non-standard lengths of column, enclosing tube and line shafting must be assembled at the top of the pump as previously outlined.

Using an appropriate hoisting system, lift the shaft/tube/column assembly and position it above the suspended bowl. Slide the lower end of the shaft out of the enclosing tube about one foot. Refer to Figure #4 for lifting of this assembly.

3. Lower the shaft/tube/column assembly into position. A lineshaft coupling is to already be in place on the pump shaft. Assure that the threaded shafts and coupling are clean and free of burrs. Lubricate threads with light oil. Thread the shafts into the coupling so that both shafts engage the coupling equally. The shafts should butt together solidly in the center of the coupling. Threads should be exposed on both ends of the coupling. Assure that no foreign matter exists between the shaft ends. Such a condition will cause shaft misalignment and will result in vibration and accelerated bearing wear.

IMPORTANT

- **Lineshaft threads and enclosing tube threads are left hand rotation. Tighten shafts, enclosing tubes and couplings securely with pipe wrenches.**
4. Assure that all enclosing tube threads and connector bearing threads are clean and free of burrs. Coat all connector bearing threads with a sealant such as Loctite P.S.T. #567, Permatex No. 2 Non-hardening Gasket Sealant prior to assembly. Silicone sealants are also permissible. This step is very important in preventing entry of the pressurized pumped media into the enclosing tube. Thread the enclosing tube onto the connector bearing and secure with chain wrenches.
 5. Clean all coating or foreign materials from the column flange faces prior to assembly. Lower the shaft/tube/column assembly into position and coat the flange faces with sealant. Assure that the flange faces engage squarely and that all bolt holes align. Install bolts and nuts and tighten.
 6. Lift the column and bowl assembly slightly. Remove the pipe clamp from the bowl and lower the assembly into the well. Reinstall the pipe clamp on the upper end of the column directly below the upper flange. Lower the assembly until the pipe clamp supports the assembly on the foundation.

IMPORTANT

- **Measure the shaft projection. It should conform to the shaft projection measurement taken and recorded previously on the bowl assembly.**
7. Repeat the above steps until complete. Continue to measure the shaft projection after assembly of each shaft/tube/column section. Before installing the discharge head, prelubricate the connector bearings by pouring oil down the enclosing tube. Approximately one pint of oil should be added for every 20 ft. of pump length.

NOTE: Although standard column length is 10 feet, some nonstandard lengths of column, enclosing tube and shaft may be required to accomplish the specified overall length of the pump. These nonstandard lengths should be installed at the top of the column, directly under the discharge head.

Assembly procedure for underground discharge units closely parallels that of standard pumps with

above ground discharge heads. Always refer to the Fairbanks Nijhuis submittal drawings and setting plan to determine the proper location of discharge elbow centerline.

8. Install column flange gasket (when used) to the upper column flange and secure to the discharge head being sure it is timed with the pipe tapped hole of the discharge head.
9. Coat both sides of the copper gasket and the tension nut threads with sealant prior to installation. Install the bronze top tube tension nut gasket onto the top tube tension nut.
10. Install the top tube tension nut over the projecting lineshaft and slide into position in the discharge head. Remembering that the tension nut threads are left handed, thread it into the top enclosing tube. The threads should engage the tube smoothly and allow the washer and nut to seat squarely in the counter-bore of the discharge head. Torque the top tube tension nut (refer to Table #2).

Water Flush Enclosed Lineshaft, Flanged Column

1. Using an appropriate hoisting system, lift the preassembled bowl assembly and position it above the well. Lower the bowl assembly partially into the well and attach a pipe clamp (see Figure #1) to the uppermost bowl directly under the bowl discharge flange. Lower the assembly, allowing it to be suspended on the foundation via the pipe clamp.
2. Before proceeding with assembly, lay out all lineshaft, enclosing tube, column and connectors. Inspect and identify all items and arrange them in the order in which they will be assembled. Oversized diameter enclosing tube sections (if used) must be installed at the bottom of the assembly, directly above the pump discharge bowl. When oversized tube sections are used, special stepped connector bearings are provided in order to adapt them to the remaining standard diameter enclosing tube sections.

Preassemble matching sets of shaft, enclosing tube and column by sliding them inside each other and attaching connectors and couplings. This will allow each set of column/enclosing tube/shaft to be hoisted into place and assembled as demonstrated in Figure #3.

Non-standard lengths of column, enclosing tube and line shafting must be assembled at the top of the pump as previously outlined.

Using an appropriate hoisting system, lift the shaft/tube/column assembly and position it above the suspended bowl. Slide the lower end of the shaft out of the enclosing tube about one foot. Refer to Figure #4 for lifting of this assembly.

3. Lower the shaft/tube/column assembly into position. A lineshaft coupling is to already be in place on the pump shaft. Assure that the threaded shafts and coupling are clean and free of burrs. Lubricate threads with light oil. Thread the shafts into the coupling so that both shafts engage the coupling equally. Threads should be exposed on both ends of the coupling. The shafts should butt together solidly in the center of the coupling. Assure that no foreign matter exists between the shaft ends. Such a condition will cause shaft misalignment and will result in vibration and accelerated bearing wear.

IMPORTANT

- **Lineshaft threads and enclosing tube threads are left hand rotation. Tighten shafts, enclosing tubes and couplings securely with pipe wrenches.**
4. Assure that all enclosing tube threads and connector bearing threads are clean and free of burrs. Coat all connector bearing threads with a sealant such as Loctite P.S.T. #567, or Permatex No. 2 Non-hardening Gasket Sealant prior to assembly. Silicone sealants are also permissible. This step is very important in preventing entry of the pressurized pumped media into the enclosing tube. Thread the enclosing tube onto the connector bearing and secure with chain wrenches.
 5. Clean all coating or foreign materials from the column flange faces prior to assembly. Lower the shaft/tube/column assembly into position and coat the flange faces with sealant. Assure that the flange faces engage squarely and that all bolt holes align. Install bolts and nuts and tighten.
 6. Lift the column and bowl assembly slightly. Remove the pipe clamp from the bowl and lower the assembly into the well. Reinstall the pipe clamp on the upper end of the column directly below the upper flange. Lower the assembly until the pipe clamp supports the assembly on the foundation.

IMPORTANT

- **Measure the shaft projection. It should conform to the shaft projection measurement taken and recorded previously on the bowl assembly.**

7. Repeat the above steps until complete. Continue to measure the shaft projection after assembly of each shaft/tube/column section.

NOTE: Although standard column length is 10 feet, some nonstandard lengths of column, enclosing tube and shaft may be required to accomplish the specified overall length of the pump. These non-standard lengths will always be installed at the top of the column, directly under the discharge head.

NOTE: The segment of the lineshaft which protrudes through the combination top tube tension nut/packing box will always have a replaceable wear sleeve. This shaft must be installed so that the sleeve engages the top tube tension nut bushing.

Assembly procedure for underground discharge units closely parallels that of standard pumps with above ground discharge heads. Always refer to the Berkeley or Fairbanks Nijhuis submittal drawings and setting plan to determine the proper location of discharge elbow centerline.

8. Install column flange gasket (when used) to the upper column flange and secure to the discharge head being sure it is timed with the pipe tapped hole of the discharge head:
9. Coat both sides of the copper gasket and the tension nut threads with sealant prior to installation. Install the bronze top tube tension nut gasket onto the combination top tube tension nut/packing box.
10. Install the combination top tube tension nut/packing box over the projecting lineshaft and slide into position in the discharge head. Remembering that the tension nut threads are left handed, thread it into the top enclosing tube. The threads should engage the tube smoothly and allow the washer and nut to seat squarely in the counter bore of the discharge head. Torque the combination top tube tension nut/packing box (refer to Table #3).
11. Install the packing and glands into the packing box. Install gland bolts and nuts. Allow the gland nuts to remain loose. Packing adjustment will be performed later with the pump operating. If a mechanical seal is employed, refer to the Mechanical Seal section of this manual.

Oil Lube Enclosed Lineshaft, Threaded Column

1. Using an appropriate hoisting system, lift the pre-assembled bowl assembly and position it above the well. Lower the bowl assembly partially into the well and attach a pipe clamp (see Figure #1) to the

upper most bowl directly under the bowl threads. Lower the assembly, allowing it to be supported on the foundation via the pipe clamp.

2. Before proceeding with assembly, lay out all lineshaft, enclosing tube, column and connectors. Inspect and identify all items and arrange them in the order in which they will be assembled. Oversized diameter enclosing tube sections (if used) must be installed at the bottom of the assembly, directly above the pump discharge bowl. When oversized tube sections are used, special stepped connector bearings are provided in order to adapt them to the remaining standard diameter enclosing tube sections.

Preassemble matching sets of shaft, enclosing tube and column by sliding them inside each other and attaching connectors and couplings. This will allow each set of column/enclosing tube/shaft to be hoisted into place and assembled as demonstrated in Figure #3.

Non-standard lengths of column, enclosing tube and line shafting must be assembled at the top of the pump as previously outlined.

Using appropriate hoisting system, lift the shaft/tube/column assembly and position it above the suspended bowl. Refer to Figure #4 for lifting of this assembly. Slide the lower end of the shaft out of the enclosing tube.

3. Lower the shaft/tube/column assembly into position. A lineshaft coupling is to already be in place on the pump shaft. Assure that the threaded shafts and coupling are clean and free of burrs. Lubricate threads with light oil. Thread the shafts into the coupling so that both shafts engage the coupling equally. The shafts should butt together solidly in the center of the coupling. Threads should be exposed on both ends of the coupling. Assure that no foreign matter exists between the shaft ends. Such a condition will cause shaft misalignment and will result in vibration and accelerated bearing wear.

IMPORTANT

- **Lineshaft threads and enclosing tube threads are left hand rotation. Tighten shafts, enclosing tubes and couplings securely with pipe wrenches.**
4. Assure that all enclosing tube threads and connector bearing threads are clean and free of burrs. Coat all connector bearing threads with a sealant such as Loctite P.S.T. #567, Permatex No. 2 Non-hardening Gasket Sealant prior to assembly. Silicone sealants are also permissible. This step is very important in preventing entry of the pressurized pumped media into the enclosing tube. Thread the enclosing tube

onto the connector bearing and secure with chain wrenches.

IMPORTANT

- **Assure that no burrs or foreign matter exists on the column coupling threads or on the column threads prior to assembly. All joints are to be coated with sealant prior to assembly. The column sections should butt together solidly and squarely in the middle of the column coupling. Secure each joint firmly with appropriate wrenches. ALL COLUMN THREADS ARE RIGHT HAND.**
5. Lower the column and thread it into the bowl assembly until it solidly and squarely butts together with the bowl, tightening it firmly with appropriate wrenches.

The lineshaft and enclosing tube is to project out beyond the end of the installed column.
 6. Lift the column/bowl assembly slightly and remove the pipe clamp from the bowl. Lower the assembly and reinstall the pipe clamp below the upper column threads. Lower the assembly so the pipe clamp suspends the assembly on the foundation.

IMPORTANT

- **Measure the shaft projection. It should conform to the shaft projection measurement taken and recorded previously on the bowl assembly.**
7. Repeat the above steps until complete. Continue to measure the shaft projection after assembly of each shaft/tube/column section. Before installing the discharge head, prelubricate the connector bearings by pouring oil down the enclosing tube approximately one pint of oil should be added for every 20 feet of pump length.

NOTE: Standard shaft and column lengths are 10 feet. Nonstandard lengths of shafts and column may be used to accomplish the required overall pump length. Nonstandard shaft/column sections will always be assembled at the top of the pump, directly under the discharge head.

Assembly procedure for underground discharge units closely parallels that of standard pumps with above ground discharge heads. Always refer to the Fairbanks Nijhuis submittal drawings and setting plan to determine the proper location of discharge elbow centerline.

8. Thread the top column adapter flange onto the top column and tighten with appropriate wrenches.

Install column flange gasket and secure the discharge head to the column adapter flange. When attaching the column to the discharge head, make sure the flange is timed with the pipe tapped hole of the discharge head.

9. Install the bronze top tube tension nut washer onto the top tube tension nut. Coat both sides of the washer and the tension nut threads with sealant prior to installation.
10. Install the top tube tension nut over the projecting lineshaft and slide into position in the discharge head. Remembering that the tension nut threads are left handed, thread it into the top enclosing tube. The threads should engage the tube smoothly and allow the washer and nut to seat squarely in the counter bore of the discharge head. Torque the top tube tension nut (refer to Table #2).
3. Lower the shaft/tube/column assembly into position. A lineshaft coupling is to already be in place on the pump shaft. Assure that the threaded shafts and coupling are clean and free of burrs. Lubricate threads with light oil. Thread the shafts into the coupling so that both shafts engage the coupling equally. The shafts should butt together solidly in the center of the coupling. Threads should be exposed on both ends of the coupling. Assure that no foreign matter exists between the shaft ends. Such a condition will cause shaft misalignment and will result in vibration and accelerated bearing wear.

Water Flush, Enclosed Lineshaft, Threaded Column

1. Using an appropriate hoisting system, lift the pre-assembled bowl assembly and position it above the well. Lower the bowl assembly partially into the well and attach a pipe clamp (see Figure #1) to the uppermost bowl directly under the bowl threads. Lower the assembly, allowing it to be supported on the foundation via the pipe clamp.
2. Before proceeding with assembly, lay out all lineshaft, enclosing tube, column and connectors. Inspect and identify all items and arrange them in the order in which they will be assembled. Oversized diameter enclosing tube sections (if used) must be installed at the bottom of the assembly, directly above the pump discharge bowl. When oversized tube sections are used, special stepped connector bearings are provided in order to adapt them to the remaining standard diameter enclosing tube sections.

Preassemble matching sets of shaft, enclosing tube and column by sliding them inside each other and attaching connectors and couplings. This will allow each set of column/enclosing tube/shaft to be hoisted into place and assembled as demonstrated in Figure #3.

Non-standard lengths of column, enclosing tube and line shafting must be assembled at the top of the pump as previously outlined.

Using an appropriate hoisting system, lift the shaft/tube/column assembly and position it above the suspended bowl. Slide the lower end of the shaft out of the enclosing tube. Refer to Figure #4 for lifting of this assembly.

IMPORTANT

- **Lineshaft threads and enclosing tube threads are left hand rotation. Tighten shafts, enclosing tubes and couplings securely with pipe wrenches.**
- 4. Assure that all enclosing tube threads and connector bearing threads are clean and free of burrs. Coat all connector bearing threads with a sealant such as Loctite P.S.T. #567, or Permatex No. 2 Non-hardening Gasket Sealant prior to assembly. Silicone sealants are also permissible. This step is very important in preventing entry of the pressurized pumped media into the enclosing tube. Thread the enclosing tube onto the connector bearing and secure with chain wrenches.

IMPORTANT

- **Assure that no burrs or foreign matter exists on the column coupling threads or on the column threads prior to assembly. All joints are to be coated with sealant prior to assembly. The column sections should butt together solidly and squarely in the middle of the column coupling. Secure each joint firmly with appropriate wrenches. ALL COLUMN THREADS ARE RIGHT HAND.**
- 5. Lower the column and thread it into the bowl assembly until it solidly and squarely butts together with the bowl, tightening it firmly with appropriate wrenches.

The lineshaft and enclosing tube is to project out beyond the end of the installed column.
- 6. Lift the column/bowl assembly slightly and remove the pipe clamp from the bowl. Lower the assembly and reinstall the pipe clamp below the upper column threads. Lower the assembly so the pipe clamp suspends the assembly on the foundation.

IMPORTANT

- **Measure the shaft projection. It should conform to the shaft projection measurement taken and recorded previously on the bowl assembly.**

7. Repeat the above steps until complete. Continue to measure the shaft projection after assembly of each shaft/tube/column section.

NOTE: Standard shaft and column lengths are 10 feet. Nonstandard lengths of shafts and column may be used to accomplish the required overall pump length. Nonstandard shaft/column sections will always be assembled at the top of the pump, directly under the discharge head.

NOTE: The segment of lineshaft which protrudes through the top tube tension nut will always have a replaceable wear sleeve. This shaft must be installed so that the sleeve engages the top tube tension nut bushing.

Assembly procedure for underground discharge units closely parallels that of standard pumps with above ground discharge heads. Always refer to the Fairbanks Nijhuis submittal drawings and setting plan to determine the proper location of discharge elbow centerline.

8. Thread the top column adapter flange onto the top column and tighten with appropriate wrenches. Install column flange gasket and secure the discharge head to the column adapter flange. When attaching the column to the discharge head, make sure the flange is timed with the pipe tapped hole of the discharge head.
9. Install the bronze top tube tension nut washer onto the top tube tension nut. Coat both sides of the washer and the tension nut threads with sealant prior to installation.
10. Install the top tube tension nut over the projecting lineshaft and slide into position in the discharge head. Remembering that the tension nut threads are left handed, thread it into the top enclosing tube. The thread should engage the tube smoothly and allow the washer and nut to seat squarely in the counter bore of the discharge head. Torque the combination top tube tension nut/packing box (refer to Table #3).
11. Install the packing and glands into the packing box. Install gland bolts and nuts. Allow the gland nuts to remain loose. Packing adjustment will be performed later with the pump operating. If a mechanical seal is employed, refer to the Mechanical Seal section of this manual.

DRIVER INSTALLATION

IMPORTANT

- Read and understand the driver manufacturer's manual before proceeding. Determine if the driver to be installed is a vertical hollow shaft electric motor, a solid shaft motor or a right angle gear. Refer to the appropriate instructions.

Hollow Shaft Drivers; General

Hollow shaft drivers provide a hollow quill tube through the rotor. The pump shaft passes through the quill tube and attaches at the top of the driver. Most turbine pump designs provide a shaft coupling above the packing box or tube tension nut. This allows the motor to be set in place and the top section of shaft installed later, through the top of the driver. Other shaft/head designs have no such coupling and require that the motor be lowered over the projecting top shaft.

CAUTION

- Care should be taken to avoid motor/shaft contact during this process as a bent top shaft could result.

Register fits on the bottom of the driver base and on the top of the discharge head (motor pedestal) will facilitate approximate driver positioning. The fits are generally loose enough to accommodate the additional movement required for precision alignment. After precision alignment is achieved, the driver is permanently held in position by the clamping force of the mounting bolts. Doweling or pinning of the driver is not required, but may be implemented at the owner's option.

Installation, Hollow Shaft Drivers

1. Before installation, remove the driver top cover. Remove the driver clutch coupling (or non-reverse ratchet if so equipped). This will facilitate top shaft installation and rotation check.
2. Using an appropriate hoisting system, lift the driver over the discharge head mounting surface and carefully lower into position. Engage the driver base over the register fit of the mounting surface.
3. Bolt the driver down. If an electric motor is used, now is the time to connect it to the electrical source and to verify correct rotation. If a right angle gear is used proceed to step 4.

DANGER

- Electrical motors must be installed and operated only by qualified, trained electrical technicians. Consult the motor manufacturer or the motor manual to assure that all installation and operation safety procedures are fully understood and implemented. Always lock out all controls and or power supplies and verify driver can not be started before installing or servicing electrical apparatus.
- Oil lubricated drivers and right angle gears are shipped dry and require an initial fill of the manufacturer's recommended lubricant prior to bump-start.

With non-reverse ratchets (if so equipped) removed or disabled, "bump" the motor for rotation. This is generally accomplished on three-phase motors by engaging and **immediately** disengaging the power switch. It is seldom necessary to engage the power source for more than one second to determine motor rotation.

Note the direction of motor rotation. If the motor rotates counter clockwise as viewed from the top, the rotation is correct and installation may proceed. If the motor rotates clockwise as viewed from the top, reverse any two of the three power leads and motor rotation will be reversed.

CAUTION

- Lineshaft threads are left hand.
 - Operation of the pump in a clockwise (as viewed from the top) direction will cause the lineshaft couplings to unthread, causing serious damage to the pump.
 - Assure that no burrs or foreign matter exists on the shaft threads.
4. Install the pump's driver top shaft through the top of the driver and tighten into the lineshaft coupling. Make sure that the top shaft is centered in the quill tube.
 5. Install the driver coupling and/or non-reverse ratchet. Install the gib key (supplied with the driver) into the driver/shaft keyway. The key should be a close slip fit in the keyways. It may be necessary to deburr or file the key to achieve the proper fit. **Never** drive or wedge the key into an overly tight keyway.

6. Install the top shaft adjusting nut. The adjusting nut will be used to lift the shaft/impeller assembly in order to achieve proper impeller clearance. Adjusting nut threads are right hand.

NOTE: Before installation of the nut, the weight of the shaft/impeller assembly rests on the bottom of the pump bowls. This condition makes the shaft almost impossible to rotate until the nut is installed and the shaft/impellers are raised off the bottom of the bowls. In running position, the shaft, impellers and hydraulic downthrust are supported by the driver thrust bearing.

7. Tighten the nut on the shaft until the impellers are raised very slightly off the bowl bottoms. This will be evident when resistance to shaft rotation disappears as the impellers are lifted off the bottom.
8. With the impellers very slightly off the bottom, add the additional nut turns required to achieve the specified clearance. Determine the correct impeller setting from the Technical Data section, Table #4 and Table #5.

NOTE: Extremely long pumps (deep settings) may require additional nut adjustment to accommodate lineshaft stretch. Extra adjustment is not generally required for pumps less than 150 feet in length. For pumps over 150 feet long, consult the Factory for instructions.

9. After impeller adjustment, place the adjusting nut lock screw through the nut and thread into the driver clutch coupling and secure. If the nut must be rotated to align with the clutch coupling hole, always move to the next higher adjustment position.
10. Replace the driver cover.
11. Refer to the driver manual to assure that all lubrication instructions have been followed completely.
12. Consult the driver manufacturer's manual to assure that all safety procedures are completely understood and implemented prior to operation.

IMPORTANT

- **Grease lubricated drivers are shipped prelubricated. Oil lubricated drivers and right angle gears are shipped dry and require an initial fill of the manufacturer's recommended lubricant prior to startup. See driver manufacturer's manual for lube specifications. Initial start-up lubricants are not supplied by the manufacturer.**

Solid Shaft Drivers; General

Solid shaft drivers have a vertical main shaft projecting from the bottom of the driver base. The shaft projection

has a vertical keyway to transmit torque and an annular groove to suspend the pump shaft/impeller assembly. Solid shaft drivers require the use of rigid adjustable couplings to facilitate pump impeller adjustment.

Register fits on the bottom of the driver base and on the top of the discharge head (motor pedestal) will facilitate approximate driver positioning. The fits are generally loose enough to accommodate the additional movement required for precision alignment. After precision alignment is achieved, the driver is permanently held in position by the clamping force of the mounting bolts. Doweling or pinning of the driver is not required, but may be implemented at the owner's option.

Installation, Solid Shaft Drivers

CAUTION

- **Before installing the driver, read and understand the driver manufacturer's instruction manual.**

- **Electric motors must be installed and operated only by qualified, trained electrical technicians. Consult the motor manufacturer or the motor manual to assure that all installation and operation safety procedures are fully understood and implemented. Always lock out all controls and/or power supplies before installing or servicing.**

1. Check both driver and pump shafts for burrs or dirt, cleaning as necessary. Also check the coupling parts for burrs and dirt, cleaning as required. If force is required to position the couplings on the shafts, non-metallic dead blow hammers should be used to prevent damage to the machined surfaces.
2. Install the coupling hubs on the driver shaft and top shaft prior to installing the driver according to the following procedure:

NOTE: It is generally most convenient to install the driver coupling hub on the driver shaft before hoisting the driver into position.

- A. Insert the square key into the driver shaft keyway and slide the driver coupling hub onto the driver shaft until the circular keyseat is exposed. Install the thrust rings. When a spacer is used, pilot the spacer in to the driver hub and secure with the short bolts (see drawing #7000A091).
- B. Install a dowel pin into the hole provided in the pump coupling hub. Drive the pin through the coupling hub until it protrudes slightly into the coupling keyway. The purpose of this pin is to prevent the key from falling out of the hub until

the setscrew has been secured. Slide pump coupling half hub over top shaft threads.

- C. Align the keyway in the shaft with the keyway in the coupling hub and insert the key.
- D. Thread the coupling adjusting nut onto the top lineshaft.
- E. Using an appropriate hoisting system, lift the driver over the discharge head mounting surface and carefully lower into position. Engage the driver base over the register fit of the mounting surface. Temporarily bolt the driver down. If an electric motor is used, now is the time to connect to the electrical source per manufacturer's instructions and verify correct rotation. If a right angle gear is used proceed to step 4.

DANGER

- **Make sure the main power source is locked off before any electrical connections are made and verify driver can not be started. After the start has been performed, again lock off the main power source to guard against accidental starting and electrical shock.**
 - **Oil lubricated drivers and right angle gears are shipped dry and require an initial fill of the manufacturer's recommended lubricant prior to bump-start.**
 - **Make sure all loose coupling parts are off the motor half coupling, and that no part of one coupling half will contact the other half during the bump start, otherwise personal injury could occur.**
 - **Make sure the protective guard is in place on the discharge head before the bump start is done. Do not operate this machine, even to check rotation, without protective guards in place.**
3. With non-reverse ratchets (if so equipped) removed or disabled, "bump" the motor for rotation. Bump Start is generally accomplished on three-phase motors by engaging and immediately disengaging the power switch. It is seldom necessary to engage the power source for more than one second to determine motor rotation.

Note the direction of motor rotation. If the motor rotates counter clockwise as viewed from the top, the rotation is correct and installation may proceed. If the motor rotates clockwise as viewed from the top, reverse any two of the three power leads and motor rotation will be reversed.

CAUTION

- **Operation of the pump in a clockwise (as viewed from the top) direction will cause the lineshaft couplings to unthread, causing serious damage to the pump.**
4. Impeller adjustment is required to achieve the preferred running position of the impeller within the pump bowl. Also, the impeller must not rub on the bowl seat.
 - A. Determine the correct impeller position from the Technical Data section, Table #4 and Table #5.
 - B. Thread the adjusting nut upwards toward the driver half coupling until the correct amount of gap is reached.
 - C. Adjust to the position that bolt holes line up and insert coupling bolts. Torque to the values as shown in Table #6. Install the set screw in the pump coupling hub and secure.
 - D. Install protective guards.

WARNING

- **Make sure the protective guard is in place on the discharge head before operating the pump.**

NOTE: Extremely long pumps (deep settings) may require additional nut adjustment to accommodate lineshaft stretch. Extra adjustment is not generally required for pumps less than 150 feet in length. For pumps over 150 feet long, consult the Factory for instructions.

Refer to the driver manual to assure that all lubrication instructions have been followed completely.

Consult the driver manufacturer's manual to assure that all safety procedures are completely understood and implemented prior to operation.

CAUTION

- **Grease lubricated drivers are shipped prelubricated. Oil lubricated drivers and right angle gears are shipped dry and require an initial fill of the manufacturer's recommended lubricant prior to start-up. See driver manufacturer's manual for lube specifications. Initial start-up lubricants are not supplied by the manufacturer.**

OPERATION

General

Because variations may exist in both the equipment used with these pumps, and in the particular installation of the pump and driver, specific operating instructions are not within the scope of this manual. However, there are general rules and practices that apply to all pump installations and operation.

CAUTION

- **Before starting or operating the pump, read this entire manual, especially the following instructions.**

Before starting the pump:

1. Rotate the unit or assembly by hand to assure all moving parts are free.
2. Install coupling guards around all exposed rotating parts. Guards are mandatory on discharge head (motor pedestal) openings if the pump is equipped with an adjustable coupling.
3. Install packing (or mechanical seal).
4. Install oiler and fill with oil (if pump is oil lubricated) and ensure oil lines are properly installed.
5. Install water line to packing box (for water flush or mechanical seals).
6. Observe all danger, warning and caution tags attached to this equipment.
7. Ensure water in sump is at the specified level for adequate submergence.
8. If pump has a packed box, adjust the packing gland finger tight. Refer to PACKING ADJUSTMENT in the maintenance section to properly adjust packing.

If excessive vibration or noise occurs during operation, shut the pump down and review the **TROUBLE SHOOTING** section. If the problem cannot be corrected, consult a Fairbanks Nijhuis representative.

Operating at Reduced Capacity

In a typical application covering a wide range of flow rates, a variable speed driver is often used to adjust pump capacity, and this is taken into consideration by Berkeley when selecting the pump and impeller trim. Although these pumps are applicable over a wide range of operating conditions, care should be exercised when doing so, especially when the actual conditions differ from

the sold conditions. You should always contact your nearest Berkeley or Fairbanks Nijhuis distributor or factory before operating the pumps at any condition other than that for which they were sold.

Generally, these pumps can be operated continuously at a capacity equal to 60% of the pump capacity at the best efficiency point, and at higher capacities.

Initial Startup

Inspect the complete installation to ensure that the installation instructions of this manual, and the manuals of all the related equipment, have been followed and that the installation is complete. Use the "Prestart-up and Start-Up Check List" found in this manual as a guide.

Ensure that the driver is properly serviced, and that the proper pump rotation is obtained.

Rotate the pump shaft by hand. It should rotate freely on all motor driven installations.

Ensure the discharge valve is open.

Start the pump according to the following procedure:

- A. Start the driver according to the driver manufacturer's instructions.
- B. Immediately after the pump has been started, check lubrication system, stuffing box lubrication and operation, and pump noise level. Continue to monitor these for the first several hours of operation.
- C. Check the driver and other necessary equipment for satisfactory operation following their manuals.
- D. Check the foundation for integrity.
- E. After the first shutdown, repeat the impeller adjustment. Running may have tightened up some of the shaft joints, changing the original setting.

Normal Operation

Monitor the following during running cycles:

- A. Unit vibration or noise.
- B. Driver lubrication levels and flow.
- C. Packing box leakage.

Check the following before normal startup:

- A. Driver lubrication levels and flow.
- B. General condition of all equipment.

Shutdown

Pump stations are usually designed to have the pumps started and stopped automatically. Since this is a function of station design, the operators should be familiar with the systems operating parameters. The general procedure to shut down the pump is as follows:

- A. Disconnect the electrical power source.
- B. If the pump is to be removed for repair, close the discharge valve.

WARNING

- **After removal of pump, ensure pump opening is adequately covered and secured.**

Seasonal Operating Instructions

If the pump is located in an area that is subject to below freezing temperatures and will not be operated enough to prevent freezing, it should be drained to prevent damage to the casing caused by freezing.

Emergency Procedures

Many installations are equipped with emergency shut off switches near the pump location. These locations should be plainly marked and readily accessible at all times.

The control panel (if used) may be equipped with an emergency start/stop button or switch.

IMPORTANT

- **The operator or persons working around the equipment should be familiar with locations of emergency start-up & shut off points.**

Start-Up

- A. Open the suction valve.
- B. Start the driver.
- C. Open the discharge valve.

Shut-Down

Shut off the power at the nearest switch.

TROUBLESHOOTING

If you have followed the installation and start up procedures outlined in this manual, your pump should provide reliable service and long life. However, if operating problems occur, significant time and expense can be saved if you use the following check list to eliminate the most common causes of those problems.

Insufficient Pressure or Flow

Symptom	Remedy
1. Wrong direction of rotation.	Reverse any two motor lead connections. Check driver O & M.
2. Discharge head too high.	Change system. Raise wet well level. Install larger impeller & driver.
3. Impeller running clearance too great.	Reset impeller clearance per O & M manual.
4. Insufficient suction bell submergence.	Raise wet well level.
5. Speed too low.	Check driver speed and voltage.
6. Bowl passage partially plugged.	Clean bowl passages.
7. Impeller passage partially blocked.	Clean impeller passages.
8. Clogged suction.	Clean suction passages.
9. Low water level.	Raise wet well level.
10. Air in liquid.	Deaerate liquid. Increase submergence to prevent vortexing.
11. Improper sump design.	Change sump design. Increase submergence to prevent vortexing.
12. Impeller damaged.	Check and repair or replace.
13. Impeller diameter too small.	Replace impeller with larger diameter. Check driver HP.

Loss of Suction Operation

Symptom	Remedy
1. Low water level.	Raise wet well level.
2. Insufficient suction bell submergence.	Raise wet well level.
3. Wrong direction of rotation.	Reverse any two motor lead connections. Check driver O & M.
4. Air or gases in liquid.	Deaerate liquid. Increase submergence to prevent vortexing.

Excessive Power Consumption

Symptom	Remedy
1. Improper impeller adjustment causing rubbing.	Readjust impeller clearance setting as outlined in this manual.
2. Head lower than rating, pumps operating over capacity.	Change system. Reduce pump speed. Trim impeller.
3. Speed too high.	Check driver speed and voltage.
4. Improper voltage to driver.	Check driver voltage. Change power source or driver.
5. Misalignment.	Check motor/pump to base connections. Realign coupling.
6. Packing box gland too tight.	Readjust packing gland.
7. Incorrect impeller diameter.	Determine correct impeller diameter and replace or trim impeller.
8. Shaft bent.	Replace shaft.
9. Specific gravity or viscosity of liquid pumped is too high.	Reduce pump capacity.

Vibration or Noise

Symptom	Remedy
1. Foundation bolts loose or defect in grouting.	Tighten foundation bolts and/or regrout.
2. Worn pump bearings.	Replace pump bearings.
3. Pipe strain- improperly supported or aligned.	Improperly supported or aligned. Check pipe supports and adjust or realign.
4. Head lower than rating, pumps too much liquid.	Increase system head. Reduce pump speed. Trim impeller.
5. Misalignment between driver and pump.	Realign driver and pump.
6. Shaft bent.	Replace shaft.
7. Pump running at shut-off condition.	Open discharge valve. Check for obstructions.
8. Insufficient suction bell submergence.	Increase submergence.
9. Low water level.	Increase wet well level.
10. Air in liquid.	Increase submergence to prevent vortexing.
11. Impeller passages plugged.	Clean impeller passages.
12. Foreign object in pump.	Remove foreign object. Check for damage.
13. Bad driver bearing.	Replace driver bearing.
14. Improper sump design.	Change sump design. Increase submergence to prevent vortexing.

Excessive Packing Box Leakage

Symptom	Remedy
1. Gland not properly tightened.	Adjust packing gland.
2. Worn packing or sleeve.	Replace packing and/or sleeve.
3. Ends of packing not staggered.	Repack to stagger packing ends.
4. Bypass is plugged or restricted.	Clean by-pass line.

Over-Heating

Symptom	Remedy
1. Packing gland too tight.	Adjust packing gland.
2. Water flush line plugged.	Clean water flush line.
3. Shaft bent.	Replace shaft.

MAINTENANCE

Preventive Maintenance

To assure satisfactory operation of the pump, scheduled inspection and periodic maintenance are required. We suggest an inspection and maintenance log be kept and the inspector immediately report any problems.

Open Lineshaft

This Berkeley VT Series vertical turbine pump is supplied with product lubricated column and bowl bearings. The suction bell bearing is grease packed at the factory. It is not necessary to relubricate this bearing except when the pump is to be torn down for maintenance and the bowl assembly is to be disassembled.

A guide for preventive maintenance for normal applications is given below. Unusual applications with abnormal heat, moisture, dust, etc., may require more frequent inspection and service.

Item	Action Required
1. Packing box	a
2. Alignment	b
3. Vibration	b
4. Noise level	b
5. Driver bearings	c

Action Code

- a. Should be checked on a weekly basis.
- b. Should be monitored for changes on a yearly basis.
- c. Follow driver manufacturer's instructions for driver bearing lubrication.

Grease Recommendation

Refer to the Technical Data section of this manual (Table #7) for grease recommendations.

Packing Adjustment

Generally, packed box pumps should be checked every 150 hours of operation and the glands should be readjusted if necessary.

Initial adjustment is accomplished by tightening the gland nuts finger tight.

⚠ CAUTION

- Excessive tightening of the glands may cause shaft sleeve damage.

Packing Replacement

For general service application with pump temperature (0° C to 93° C), use a good grade of soft, square, long fibre packing thoroughly lubricated and graphited.

For best results use only genuine Berkeley/Fairbanks Nijhuis replacement packing. The replacement procedure should be as follows:

A. Stop the pump.

⚠ DANGER

- Lock out electrical power to prevent accidental starting and causing possible personal injury.

B. Unbolt and remove the gland.

C. Use a flexible packing tool * with a hook attachment for removal of the packing.

*The packing tool can be purchased from the factory or local supply house.

D. Clean the packing box and shaft sleeve.

E. Inspect the shaft sleeve for wear or rough finish and replace the sleeve with a genuine Berkeley/Fairbanks Nijhuis sleeve if necessary.

F. Install the new packing.

IMPORTANT

- Stagger the packing end joints 180° and firmly seat each ring of packing as you install it.

Refer to the technical data section for pertinent stuffing box, and packing dimensions.

G. Reinstall the gland and tighten the gland nuts finger tight. After the pump has been started, adjust the glands so that there is a steady stream, approximately 1/8" diameter, from the packing box.

Oil Lubricated Enclosed Lineshaft

This Berkeley VT Series vertical turbine pump is supplied with oil lubricated lineshaft bearings and product lubricated bowl bearings. The suction bearing is grease packed at the factory and only requires repacking when the unit is torn down for maintenance.

A guide for preventive maintenance for normal applications is given below. Unusual applications with abnormal heat, moisture, dust, etc., may require more frequent inspection and service.

<u>Item</u>	<u>Action Required</u>
Lubricator	a
Pump alignment	b
Vibration	b
Bearings	c
Driver Bearings	d

Action Code

- a. Check for adequate lubricant on a daily basis.
- b. Check for changes on an annual basis.
- c. Check to see that bearings are lubricated on a continuous basis.
- d. Follow driver manufacturer's instructions for driver bearing lubrication.

Oil Recommendation

Refer to the Technical Data section of this manual (Table #7) for oil recommendations.

Grease Recommendation

Refer to the Technical Data section of this manual (Table #7) for grease recommendations.

Water Flush Enclosed Lineshaft

This Berkeley VT Series pump is supplied with water flush lubricated column and bowl bearings. The suction bearing is grease packed at the factory and only requires repacking when the unit is torn down for maintenance.

A guide for preventative maintenance for normal applications is given below. Unusual applications with abnormal heat, moisture, dust, etc., may require more frequent inspection and service.

<u>Item</u>	<u>Action Required</u>
Packing box	a
Pump alignment	b
Vibration	b
Lube System	c
Driver Bearings	d

Action Code

- a. Check for proper operation and excess leakage every 150 hours. Adjust packing gland or replace packing as required.
- b. Check for changes on an annual basis.
- c. Check lube system for proper operation on a daily basis.
- d. Follow driver manufacturer's instructions for driver bearing lubrication

Packing Box

All packing is subject to wear and should be given regular inspection. Generally, packed box pumps should be checked every 150 hours of operation and the glands should be readjusted if necessary.

Initial adjustment is accomplished by tightening the gland nuts finger tight.

 CAUTION

- **Excessive tightening of the glands may cause shaft sleeve damage.**

Packing Replacement

For general service application with pump temperature 32° F to 200° F (0°C- 93°C) use a good grade of soft, square, long fiber packing thoroughly lubricated and graphited.

For best results use only genuine Berkeley/Fairbanks Nijhuis replacement packing. The replacement procedure should be as follows:

- A. Stop the pump.

 DANGER

- **Lock out electrical power to prevent accidental starting and causing possible personal injury.**

- B. Unbolt and remove the gland.

C. Use a flexible packing tool* with a hook attachment for removal of the packing.

*The packing tool can be purchased from the factory or local supply house.

D. Clean the packing box and shaft sleeve.

E. Inspect the shaft sleeve for wear or rough finish and replace the sleeve with a genuine Berkeley/Fairbanks Nijhuis sleeve if necessary.

F. Install the new packing.

IMPORTANT

- **Stagger the packing end joints 180° and firmly seat each ring of packing as you install it.**

Refer to the technical data page for pertinent stuffing box, and packing dimensions.

G. Reinstall the gland and tighten the gland nuts finger tight. After the pump has been started, adjust the glands so that there is a steady stream, approximately 1/8" diameter, from the packing box. Refer to Figure #7 for flush water requirements.

Grease Recommendation

Refer to the Technical Data section of this manual (Table #7) for grease recommendations.

Pump Disassembly

⚠ WARNING

- **Read this entire disassembly procedure and refer to the sectional drawings in this manual before starting.**

Major maintenance beyond lubrication, adjustment of impeller or wear ring clearance, and replacement or adjustment of the packing will require disassembly of the pump. The following are step-by-step instructions and are essentially the reverse of the installation procedure.

Vertical Hollow Shaft (VHS) Driver

A. Stop the pump and lock out the power to the driver. Close the discharge valve. Disconnect the electrical cables from the driver. Disconnect and remove gauges and all other auxiliary piping. (Stuffing box lubrication, oil, or grease lines, etc.)

⚠ DANGER

- **Check with proper electrical testing equipment to be certain all electrical power to the driver and accessories associated with the pump is disconnected.**

B. Remove the driver cover, adjusting nut lock screw, and gib key. Lower the shaft until the impeller rests on the bowl seat. Remove the adjusting nut and driver coupling.

C. Disconnect the shaft coupling under the driver (if used) and remove the top shaft. Remove the capscrews holding driver to discharge head or pedestal.

D. Lift the driver from the head and set aside.

Vertical Solid Shaft (VSS) Driver

A. Stop the pump and lock out the power to the driver. Close the discharge valve. Disconnect the electrical cables from the driver. Disconnect and remove gauges and all other auxiliary piping. (Stuffing box lubrication, oil, or grease lines, etc.)

⚠ DANGER

- **Check with proper electrical testing equipment to be certain all electrical power to the driver and accessories associated with the pump is disconnected.**

B. Remove the bolts holding the coupling halves together slowly so that the impeller does not drop.

C. Remove the capscrews holding driver to discharge head or pedestal.

D. Lift the driver from the head and set aside.

Open Lineshaft (Refer to drawing on page 53)

A. Remove and disassemble the pump head, the column, packing box and shafting according to the following procedure which is essentially the reverse of the installation procedure.

B. Remove the packing gland bolts (8, 8A), glands (9), water slinger (6) and packing (15).

C. Loosen and remove all the discharge piping flange bolts.

WARNING

- Use a guide rope going from the sling joint, above the head, attached to the discharge flange. This will keep the head from tipping over, possibly causing personal injury.
- D. Remove the packing box bolts and remove the packing box from the head and shaft to a work area for inspection & cleaning.

The packing box bearing (17A) is an interference fit in the packing box. The removal of this bearing will require the use of a mechanical press or the bearing may be removed by machining or other similar methods. Use care when removing bearings to not damage bores or hubs.

CAUTION

- Always use protective eyewear.
- E. Lift entire unit with the lifting lugs and install a column clamp just below the upper column flange leaving room to remove the flange bolting. Lower unit so that the column clamp rests on adequate supports.

DANGER

- Use a crane or hoist of adequate capacity to prevent serious personal injury.
- F. Remove the bolts holding the column to the discharge head. Lift the discharge head off the unit and set aside.

Flanged Column

- A. Install eyebolts of sufficient size in the column flange holes and lift the unit and reposition the clamp below the next column flange.
- B. Use column and shaft clamps (or other acceptable method) to safely support and lift this assembly.
- C. Unbolt column flange and lift column enough to loosen the shaft coupling. When all components are loose, carefully lift this assembly from the pump unit. With soft skid boards under the column to protect the flange, slowly lower the column and shaft assembly onto the floor and move to a convenient work area.

IMPORTANT

- Shaft threads are left-hand.
- D. Repeat above steps A, B, and C until all column and shaft sections have been removed from the unit.
- E. Remove the bearing retainer assembly for inspection and cleaning.
- F. Remove shaft section from column pipe. Remove couplings from shafts and inspect for wear or damage.
- G. Inspect bearings and retainers for damage.
- H. If the top and intermediate drive shaft sleeves (13 & 29) show wear or damage remove the sleeve by heating it to 350°F-400°F to break the Loctite® bond.

IMPORTANT

- Measure and record the position of the sleeves (13 & 29) on the shafts before removal. They must be put back in exactly the same place.

CAUTION

- To prevent possible serious personal injury always wear heat resistant gloves when handling heated parts.
- I. Refer to Pump Bowl Disassembly for detailed bowl disassembly procedures.

Threaded Column

- A. Install eyebolts of sufficient size in the column flange holes and lift the unit and reposition the clamp below the next column coupling.
- B. Use column and shaft clamps (or other acceptable method) to safely support and lift this assembly.
- C. Unscrew the column coupling and lift column enough to loosen the shaft coupling. When all components are loose, carefully lift this assembly from the pump unit. With soft skid boards under the column to protect the threads, slowly lower the column and shaft assembly onto the floor and move to a convenient work area.

IMPORTANT

- **Shaft threads are left-hand.**
 - **Column threads are right-hand.**
- D. Repeat above steps A, B, and C until all column and shaft sections have been removed from the unit.
- E. Remove the bearing retainer assembly for inspection and cleaning.
- F. Remove shaft section from column pipe. Remove couplings from shafts and inspect for wear or damage.
- G. Inspect bearings and retainers for damage.
- H. If the top and intermediate drive shaft sleeves (13 & 29) show wear or damage remove the sleeve by heating it to 350°-400° F to break the Loctite bond.

⚠ CAUTION

- **To prevent possible serious personal injury always wear heat resistant gloves when handling heated parts.**

IMPORTANT

- **Measure and record the position of the sleeves (13 & 29) on the shafts before removal. They must be put back in exactly the same place.**
- I. Refer to **Pump Bowl Disassembly** for detailed bowl disassembly procedures.

Enclosed Lineshaft

Oil Lubricated (Refer to drawing on page 52)

- A. Remove and disassemble the pump head, the column, tension nut and shafting according to the following procedure which is essentially the reverse of the installation procedure.
- B. Loosen and remove the tube tension nut (63) and set aside for inspection.
- C. Loosen and remove all the discharge piping flange bolts.

⚠ DANGER

- **Use a guide rope going from the sling joint, above the head, attached to the discharge flange. This will keep the head from tipping over, possibly causing personal injury.**

- D. Lift entire unit with the lifting lugs and install a column clamp just below the upper column flange leaving room to remove the flange bolting. Lower unit so that the column clamp rests on adequate supports.

⚠ DANGER

- **Use a crane or hoist of adequate capacity to prevent serious personal injury.**
- E. Remove the bolts holding the column to the discharge head. Lift the discharge head off the unit and set aside.
- F. Refer to **Pump Bowl Disassembly** for detailed bowl disassembly procedures.

Enclosed Lineshaft

Water Flush (Refer to drawing on page 51)

- A. Remove the packing gland bolts (8, 8A), glands (9), water slinger (6) and packing (15).
- B. Disconnect the water flush supply line.
- C. Loosen and remove the packing box (17) and connector bearing (50). Set aside for inspection.
- D. Loosen and remove all the discharge piping flange bolts.

⚠ DANGER

- **Use a guide rope going from the sling joint, above the head, attached to the discharge flange. This will keep the head from tipping over, possibly causing personal injury.**
- E. Lift entire unit with the lifting lugs and install a column clamp just below the upper column flange, leaving room to remove the flange bolting. Lower unit so that the column clamp rests on adequate supports.

⚠ DANGER

- **Use a crane or hoist of adequate capacity to prevent serious personal injury.**
- F. Remove the bolts holding the column to the discharge head. Lift the discharge head off the unit and set aside.
- G. Refer to **Pump Bowl Disassembly** for detailed bowl disassembly procedure.

Flanged Column

- A. Install eyebolts of sufficient size in the column flange holes and lift the unit and reposition the clamp below the next column flange.
- B. Use column and shaft clamps (or other acceptable method) to safely support and lift this assembly.
- C. Unbolt column flange and lift column enough to loosen the enclosing tube. Continue to lift the assembly until the shaft coupling can be loosened . When all components are loose, carefully lift this assembly from the pump unit. With soft skid boards under the column to protect the flange, slowly lower the column, tube and shaft assembly onto the floor and move to a convenient work area.

IMPORTANT

- **Shaft threads are left-hand.**
 - **Enclosing tube threads are left-hand.**
- D. Repeat above steps A, B, and C until all column and shaft sections have been removed from the unit.
 - E. Remove shaft and tube section from column pipe. Remove the shaft from the tube section. Remove couplings from shafts and inspect for wear or damage.
 - F. Inspect connector bearings (50) for wear or damage.
 - G. Refer to **Pump Bowl Disassembly** for detailed bowl disassembly procedures.

Threaded Column

- A. Install eyebolts of sufficient size in the column flange holes. Lift the unit and reposition the clamp below the next column coupling.
- B. Use column and shaft clamps (or other acceptable method) to safely support and lift this assembly.
- C. Unscrew the column coupling and lift column enough to loosen the enclosing tube. Continue to lift the assembly until the shaft coupling can be loosened . When all components are loose, carefully lift this assembly from the pump unit. With soft skid boards under the column to protect the threads, slowly lower the column, tube and shaft assembly onto the floor and move to a convenient work area.

IMPORTANT

- **Shaft threads are left-hand.**
 - **Enclosing tube threads are left-hand.**
- D. Repeat above steps A, B, and C until all column and shaft sections have been removed from the unit.
 - E. Remove shaft and tube section from column pipe. Remove the shaft from the tube section. Remove couplings from shafts and inspect for wear or damage.
 - F. Inspect connector bearings (50) for wear or damage.
 - G. Refer to Pump Bowl Disassembly for detailed bowl disassembly procedures.

Pump Bowl Disassembly

For disassembly of the pump bowls, proceed in accordance with steps listed below. Select a clean area for work. Refer to assembly drawing and parts list for part identification.

Flanged Bowls

(Refer to pages 51 thru 54)

- A. Place the bowl assembly in a horizontal position, blocked to prevent rolling.
- B. Measure and record the axial end play of the shaft. This must be checked on reassembly of the bowls.
- C. Remove the shaft coupling(31).
- D. Remove the capscrews holding the discharge case (54) and top intermediate bowl (55) and remove from the pump shaft (32) and set aside for inspection. It is not necessary to disassemble these two bowls unless bearings are to be replaced.
- E. Remove the impeller (38) and collet (39) from the pump shaft according to the following procedure:
 1. To remove the collet from the impeller, pull the shaft upwards until the impeller is in its upmost position. Using a collet driver (See Figure #5) drive the impeller off the collet.
 2. To remove the collet, insert a screwdriver in the collet slit and wedge apart; the collet will slide easily off of the shaft.
 3. If impellers are to be reused, they should be marked so that they are re-installed in the same bowl.

- F. Remove the capscrews holding the next intermediate bowl (36). Remove the intermediate bowl from the pump shaft and set aside for inspection.
- G. Repeat steps E & F until all bowls and impellers have been removed.
- H. Remove the shaft from the suction bell (40), or suction case.
- I. Measure and record the location of the sand collar (58). Remove the sand collar only if it is damaged and replacement is required.
- J. This pump may be fitted with wear rings by machining the bowls (or impellers) for a ring seat. Refer to WEAR RINGS section of this manual for instructions on adding wear rings or replacing existing rings.

Inspection for Replacement

After the components are disassembled, each part should be thoroughly cleaned and inspected for wear and physical damage. During cleaning, do not allow any petroleum-based solvents on the rubber bearings.

It is not necessary to remove bearings unless inspection indicates replacement is necessary. If it is necessary to remove bearings, they should be pressed from their seats and discarded.

CAUTION

- **Use care not to damage bores or hubs during bearing removal.**

Any parts showing signs of excessive wear or damage should be replaced with genuine Fairbanks Nijhuis parts. Maximum clearances are shown in the technical data section of this manual.

- A. Inspect the shafting (32) at each bearing location for damage or excessive wear and replace shaft if not salvageable.
- B. Inspect all lineshaft bearings (26), packing box bushing (17A), and all bowl bearings (34, 35, 41, 50) for wear and excessive clearance. If the diametral bearing clearance exceeds the limits shown in Table #8, the bearings must be replaced.

- C. Inspect the bowl and/or impeller wear ring (if so equipped) for wear and excessive clearance. The correct clearance is shown in Table #8. The ring should be replaced with a genuine Fairbanks Nijhuis replacement part.
- D. Inspect the shaft sleeves for wear. Replace as necessary. If the sleeves (13 & 29) show wear or damage, remove the sleeve(s) by heating it to 350°-400° F to break the Loctite bond.

⚠ CAUTION

- If it is found that any of the bearings or sleeves have excessive wear, it is recommended that all bearings and sleeves be replaced (including bowl bearings).
- Measure and record the position of the sleeve(13) on the shaft(19) before removal.

⚠ WARNING

- To prevent possible serious personal injury, heat resistant gloves must be worn when handling heated parts.

Shaft Straightness

Prior to installation or reassembly, bowl shafts and lineshafts should be checked for straightness. The maximum allowable total indicated runout must be less than .005".

Figures A & B below outline the proper positions at which dial indicator readings should be taken. The shaft should be supported in V-blocks or on rollers as shown. Position the dial indicator and zero the dial face. Slowly rotate the shaft and observe the maximum runout.

If the shafts exceed the .005" maximum limit, straightening will be required. Consult the Fairbanks Nijhuis factory for straightening recommendations, or a local qualified machine shop.

Pump Assembly

Prior to the start of reassembling the pump bowl the following is to be done:

- A. **Note:** apply grease to the bowl registers to improve assembly alignment.
- B. Clean all components before starting the assembly. Do not apply any petroleum based solvents to rubber bearings.

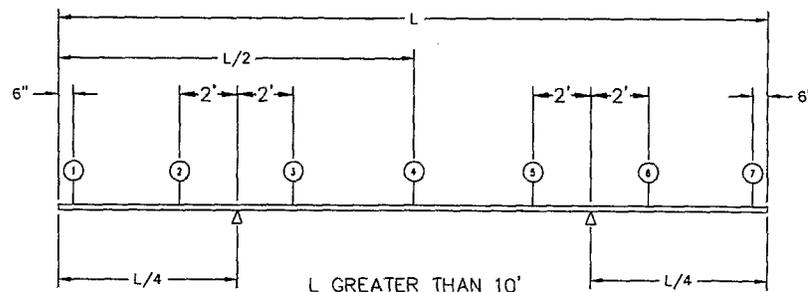
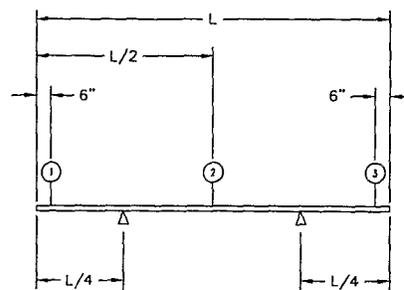


FIGURE A



L = 10' OR LESS

FIGURE B

- C. Install bearings in their respective bowls if they have been removed. If they have not been replaced, they should be thoroughly cleaned and lubricated with a thin film of grease (except rubber bearings).
- D. Install new wear rings if they are to be replaced in all bowls. Refer to WEAR RINGS section of this manual for instructions.
- E. Remove the pipe plug from the suction bell and remove old grease. Apply a thin film of multi-purpose grease to the shaft and the suction bowl bearing. See GREASE RECOMMENDATION in Table #7.
- F. Lay out the parts in the order in which they will be assembled. Reused impellers are to be re-installed in the same bowl in which it was originally installed.
- G. Install shaft sleeves as required according to the following procedure:
 1. Refer to the previously recorded sleeve locations and scribe or mark shaft accordingly.
 2. Thoroughly clean the sleeve and shaft in the sleeve area using a cleaner as recommended by Loctite.
 3. Apply a coat of Loctite 609 on the shaft in the correct sleeve location area. Slide the sleeve over the shaft, rotating it several times while at the same time moving the sleeve axially on the shaft. This will spread the Loctite evenly.
- H. Proceed with the assembly of the pump bowl as follows:

Bowl Assembly (Reassembly)

Flanged Bowls

- A. Put the suction bell (case) in a horizontal position and block from rolling. Insert the pump shaft into the bearing as far as it will go. Insert a shaft locating tool (See Figure #6) through the pipe tap in the suction bell and fasten to the pump shaft. Tighten securely.
- B. Install the sand collar if it has been removed and secure with setscrews.
- C. Install the first impeller over the pump shaft and into position in the suction bell (case) seat. The impeller should rotate freely in the bowl. If it binds, remove and determine the cause.
- D. Open a lock collet slightly and slide over the pump shaft and into the impeller. Using a collet drive tool (See Figure #5) drive the lock collet into place in the impeller bore. This will require substantial force to make sure the collet is properly seated. An experienced mechanic will be able to detect the change in sound when the collet has properly seated.

CAUTION

- **Failure to properly seat the impeller drive collet will result in damage to the pump.**
- E. Install the intermediate bowl and tighten capscrews.
- F. Repeat steps C, D and E to install all additional stages until all pump bowls have been reassembled.
- G. Install the top intermediate bowl (55) and discharge case (54) over the pump shaft and bolt in place with capscrews and nuts.
- H. Remove the shaft locating tool holding the pump shaft in place. Check the bowl end play. It should be the same as previously recorded (or very close). If it is not, the bowl assembly should be disassembled to determine the reason. Pack the cavity with grease and replace the pipe plug in the suction bell (case) hub.
- I. Install the coupling (31) on the pump shaft.
- J. The bowl assembly is now complete.
- K. Refer to WEAR RINGS SECTION for instructions on wear ring replacement, if wear ring replacement is required.
- L. Refer to the INSTALLATION SECTION of this manual to complete pump assembly and reinstallation.

Wear Rings

If the pump is equipped with wear rings and replacement is required, refer to WEAR RING REMOVAL below.

Wear Ring Removal

- A. If the wear ring requires replacement it can be more easily removed by heating it to 250° - 400° F.

⚠ WARNING

- To prevent possible serious personal injury, heat resistant gloves must be worn when handling heated parts.
- B. The ring may also be removed by splitting with a chisel and removed or machined.

⚠ CAUTION

- Care should be used to avoid damage to the bowl ring seat.

⚠ CAUTION

- To prevent possible serious personal injury, approved safety glasses must be worn when grinding.

Installing New Wear Ring

IMPORTANT

- If this bowl assembly is to be fitted with wear rings, and was not equipped with wear rings at the factory, contact the factory for correct dimensions.

⚠ CAUTION

- Machine work should be done by a qualified machinist experienced in similar machining work.
- If the wear rings are to be replaced they should be replaced with genuine Fairbanks Nijhuis wear rings. Install the wear rings as follows.
 - A. To ensure proper bonding, thoroughly clean all mating parts with solvent to remove all grease, oil, dirt, etc.
 - B. Apply a bead of Loctite 290 completely around the middle of the impeller or bowl wear ring fit, and press the wear ring(s) in place.

IMPORTANT

- To avoid distortion and ensure proper installation, be careful to press the wear rings evenly and completely in place. They should be firmly butted against the corresponding impeller or bowl shoulder at the bottom of the wear ring fit.

Mechanical Seals

(Refer to Drawing #7000A081)

The mechanical seal covered by these instructions, when properly installed, will give satisfactory performance. To ensure the proper installation these instructions should be read carefully.

Description

Several types of mechanical seals are used. The most common types are the single inside seal, single outside seal and a cartridge type seal. Since seals supplied by different vendors may vary slightly these instructions are general in nature. Refer to any specific seal installation

instructions that may be supplied with your pump or contact the factory.

General Application

The seals described in these instructions are acceptable for use in pumps handling water. It is not recommended for handling fluids which are highly acidic, highly alkaline, or contain gritty or dissolved substances that tend to crystalize.

Installation

Prior to installation inspect the seal, seal housing and sleeve to make sure they are clean and free from burrs, nicks, dirt, rust, or any foreign material. Apply a light coat of liquid soap or liquid detergent to the shaft sleeve (13).

IMPORTANT

- **Seal faces are lapped and polished to a mirror finish. It is imperative that sealing faces be handled with care and kept perfectly clean. DO NOT touch the sealing faces.**

Inside Single Seal

Use the following general procedure to install this type of seal prior to installing the motor.:

- Remove the packing box capscrews (431A) which hold the seal housing (17B) to the discharge head (or the driver pedestal).
- Install the seal box gasket (11) onto the seal housing.
- Adjust the impellers per instructions in this manual.
- With scribe or marker, place a mark on the sleeve that is level with the seal housing (17B) face.
- Position the end of the rotating seal (456) flush with the mark on the sleeve and tighten the locking screw.
- Install the stationary seat (456A) into the seal gland (431) using an o-ring lubricant or liquid soap on the o-ring.
- Pull the seal gland (431) down and secure with capscrews (431A).
- Connect piping to seal gland (431).

IMPORTANT

- **The seal gland must be piped to purge all air out of the seal housing cavity.**

Outside Single Seal

Use the following general procedure to install this type of seal prior to installing the motor.

- Remove the packing box capscrews (431A) which hold the seal housing (17B) to the discharge head (or driver pedestal).
- Install the seal box gasket (11) onto the seal housing.
- Install the seal gland (431) containing the stationary seat (456A) on the seal housing face and secure with packing box capscrews.
- Install the rotating seat (456) and retainer (456B) over the sleeve. Do not fasten the retainer to the sleeve until impellers have been properly adjusted.
- Refer to Table #4 and Table #5 and adjust the impellers.
- Compress the retainer and rotating assembly until the correct spring gap is attained. The gap is stamped on the seal retainer or may be included with the seal manufacturers printed instructions.
- Secure the retainer ring with setscrews.

Cartridge Seal

Use the following general procedure to install this type of seal prior to installing the motor:

- Remove the packing box capscrews (431A) which hold the seal housing (17B) to the discharge head (or driver pedestal).
- Install the seal box gasket (11) onto the seal housing.
- Install the seal (456), gland (431) and retainer (456B) over the sleeve and into position on the seal housing and secure with packing box capscrews.
- Refer to Table #4 and Table #5 and adjust the impellers.
- After the impellers have been adjusted, fasten the seal lock ring to the sleeve using setscrews provided.
- Loosen the retainer clips and rotate 90° and retighten the clip setscrews. These clips will be used if the seal is removed for any reason.

Operation

Special operating techniques are involved when using pumps equipped with mechanical seals. Certain precautions should be taken as follows:

- A. The seal should never be operated dry, even to check for rotation. A water source must be provided to cool and lubricate the seal faces during pump operation. The lube water can be either the pumped media or an external water source (refer to Figure #8 and Figure #9).
- B. If the pumped media is used for seal cooling and lubrication, a vent line must be provided to prevent air entrapment in the seal cavity (refer to the Technical Data Section). If an outside water source is used, a solenoid valve should be set to introduce seal water at or slightly before each motor start.

Lubrication via the pumped media is not recommended for extremely deep-set turbines as the time required for the media to reach the seal at each start is excessive. This can result in premature seal failure.
- C. Some seals may leak slightly at initial start-up. This condition should cease after a short period as the seal faces lap together. Operate and monitor the seal until leakage subsides.

Routine Maintenance

Routine maintenance is minimal and is as follows:

- A. Periodically (150 hours of operation) check to see that pumped liquid is going through stuffing box and out to wet well or drain.
- B. Check that the gland bolts have not loosened.

Seal Removal

General

Stop the driver and lock out the power so that the driver can not accidentally start.



- Check with proper electrical testing equipment to be certain all electrical power to the driver and accessories associated with the pump is disconnected.

Single Inside Seal

- A. Loosen the packing box capscrews (431A).
- B. Raise the gland (431) and loosen the setscrews securing the retaining ring to the sleeve.
- C. Use the adjusting nut and lower the impellers until they rest on the bowl seats.

- D. Loosen the shaft coupling. Remove the driver shaft (19), (or the VSS motor).
- E. Remove the seal gland (431).
- F. Remove the seal rotating seat and retainer.
- G. Inspect all parts of the seal. If any parts show signs of wear, the complete seal should be replaced.

Single Outside Seal

- A. Loosen the retainer ring setscrews.
- B. Use the adjusting nut and lower the impellers until they rest on the bowl seats.
- C. Loosen the shaft coupling. Remove the driver shaft (19), (or the VSS motor), (or VHS motor if one-piece headshaft).
- D. Loosen the capscrews securing the gland (431) to the seal housing. Remove the seal rotating assembly and the gland which contains the stationary seat.
- E. Inspect all parts of the seal. If any parts show signs of wear, the complete seal should be replaced.

Cartridge Seal

- A. Loosen the retainer clips and rotate 90° to secure the seal lock ring. Retighten the setscrews.
- B. Loosen the setscrews securing the lock ring to the sleeve.
- C. Use the adjusting nut and lower the impellers until they rest on the bowl seats.
- D. Loosen the shaft coupling. Remove the driver shaft (19), (or the VSS motor).
- E. Loosen the capscrews securing the gland (431) to the seal housing. Remove the seal assembly.
- F. Inspect all parts of the seal. If any parts show signs of wear, the complete seal should be replaced.

The O-rings may be replaced if necessary. Refer to the manufacturer's printed instructions shipped with the seal.

REPAIR PARTS

Ordering Parts

When ordering parts, give pump serial number, size, model number, a complete description, and item number of each part. Refer to the drawing and parts list in the back of this manual. You may order parts from your local Berkeley or Fairbanks Nijhuis distributor. Consult your local telephone yellow pages under "Pumps" for the office nearest you.

You may also contact Fairbanks Nijhuis directly as follows.

PENTAIR
Fresno Service Center
5661 North Golden State Blvd
Fresno, California 93722
(559) 266-0516

Returning Parts

All materials or parts returned to the factory must have prior approval and a "Returned Goods Tag", listing the material to be returned and the reasons for the return. All material to be returned should be carefully packed to avoid damage in route from rough handling or exposure to weather. Contact the factory for shipping instructions. All material is to be returned freight prepaid.

Berkeley makes improvements on its products from time to time and reserves the right to furnish improved parts for repairs. A part that is received and is not identical in appearance, or has a different symbol from the original part, may be interchangeable. Examine the part carefully before contacting your Berkeley representative. The parts should never be returned to the factory without first obtaining proper authorization from your Berkeley representative.

SERVICE

Warranty Service

For Warranty Service contact the facility from which your pump was shipped.

Shipping facilities addresses:

PENTAIR
Fresno Service Center
5661 North Golden State Blvd
Fresno, California 93722
(559) 266-0516

PENTAIR
West Texas Service Center
9010 FM1585
Wolfforth, Texas 79382

Service After Warranty

For service after warranty on this pump or any other pumping equipment contact your local Fairbanks Nijhuis distributor or by contacting:

Pump Services Group, 1-800-648-PUMP

Or Write:

Pump Services Group
Fairbanks Nijhuis
P.O.Box 6999
3601 Fairbanks Ave.
Kansas City, Ks. 66106-0999
(913) 371-5000
Fax: (913) 371-2272

Table #1

Shaft Endplay	
Bowl Size	At Full Diameter
10VT250/300	.85
12VT500/600	.85
10VT275	1.15
10VT460	1.25
10VT550	1.25
10VT700	1.25
10VT900	1.23
10VT1150	1.25
10VT1500	1.25
12VT550	1.25
12VT650	1.24
12VT900	1.47
12VT1100	1.28
12VT1350	1.56
12VT1650	1.25
12VT2000	1.58
12VT2500	1.58

Table #2

Tube Tension Torque Values For Oil Lube Tension Nut	
Enclosing Tube Size	Required Torque (Ft/Lbs)
2"	400 ft. lbs.
2-1/2"	400 ft. lbs.
3"	800 ft. lbs.
3-1/2"	800 ft. lbs.
4"	1200 ft. lbs.
5"	1200 ft. lbs.

Table #4

Impeller Position

10VT	.20
12VT	.20

Table #3

Tube Tension Torque Values For Water Flush Packing Box		
Enclosing Tube Size	Installation and Removal Tool	Required Torque (Foot-Pounds)
2"	MS1380A	400 ft. lbs.
2-1/2"	MS1380A	400 ft. lbs.
3"	MS1380B	800 ft. lbs.
3-1/2"	MS1380B	800 ft. lbs.
4"	MS1380C	1200 ft. lbs.
5"	MS1380C	1200 ft. lbs.

Note: Dimension shown are the inches impeller is to be raised from bowl seat

(1) Indicates inches to be lowered from top most position.

Table #5

Shaft Movement

The following table gives the amount of vertical movement of the shaft according to the number of turns of the adjusting nut.

Number Turns	Shaft Diameter					
	1	1 - 1/4	1 - 1/2	1 - 11/16	1 - 15/16	2 - 3/16
1	.07	.10	.10	.10	.10	.10
2	.14	.20	.20	.20	.20	.20
3	.21	.30	.30	.30	.30	.30
4	.28	.40	.40	.40	.40	.40
5	.35	.50	.50	.50	.50	.50

Table #6

Coupling Size	Torque (Ft. Lbs.)
1125	13
1625	26
2125	115
2625	115
2875	115
3125	115
3875	400
4000	550
6000	835
7200	835

Table #7

System Type	Grease	Oil
Non-Potable	N.L.G.I. #2 Lithium base multi-purpose grease with a mineral-based oil, viscosity of 750-1050 SSU at 100° F and 75-82 SSU at 210° F.	High quality grade of non-detergent oil with an API/SAE 10W Rating
	Suggested Manufacturer's: Atlantic RichfieldARCO MP#2 GulfGulfcrown #2 SinclairLitholine MP#2 Texaco Marfak #958, MP12	Suggested Manufacturer: Mobile Sinclair Texaco
Potable	N.L.G.I. #2 meeting FDA Regulation 178.3570 and has USDA Type H-1 and FDA approvals for lubricants with incidental food contact.	USDA and FDA approved.
	Suggested Manufacturer's: Chevron..... FM Grade 2 Ideal FG #2 Keystone Nevastone HT/AW2 Lubriplate FGL-2 Mobile FM Grade 2	Suggested Manufacturer's: AMOCOWhite Mineral Oil No. 5 NF

Table #8

Bowl Size	Bowl/Wear ring Clearance		Bearing Clearance Bronze		Bearing Clearance Rubber	
	Nominal	Replacement	Nominal	Replacement	Nominal	Replacement
10VT250/300	.013	N/A	.012	.012	.020	.020
10VT	.013	N/A	.012	.016	.020	.025
12VT	.013	N/A	.014	.018	.015	.020

TECHNICAL DATA

Table #9

Product Lubricated (Rubber Bearings)						
Lineshaft Diameter	1	1 - 1/4	1 - 1/2	1 - 11/16	1 - 15/16	2 - 3/16
Sleeve OD	1 - 3/16	1 - 7/16	1 - 11/16	1 - 7/8	2 - 1/8	2 - 3/8
Box ID	1 - 15/16	2 - 3/16	2 - 7/16	2 - 5/8	2 - 7/8	3 - 1/8
Box Depth	1 - 5/8	1 - 5/8	1 - 5/8	1 - 5/8	1 - 5/8	1 - 5/8
No. Rings Packing	4	4	4	4	4	4
Size Packing	3/8	3/8	3/8	3/8	3/8	3/8
Enclosed Lineshaft-Oil Lubricated						
Lineshaft Diameter	1	1 - 1/4	1 - 1/2	1 - 11/16	1 - 15/16	2 - 3/16
Tube Size	1 - 1/2	2	2 - 1/2	2 - 1/2	3	3
Enclosed Lineshaft Water - Flush Lubricated (Bronze Bearings)						
Lineshaft Diameter	1	1 - 1/4	1 - 1/2	1 - 11/16	1 - 15/16	2 - 3/16
Sleeve OD	1 - 3/16	1 - 7/16	1 - 11/16	1 - 7/8	2 - 1/8	2 - 3/8
Box ID	1 - 15/16	2 - 3/16	2 - 7/16	2 - 5/8	2 - 7/8	3 - 1/8
Box Depth	1 - 5/8	1 - 5/8	1 - 5/8	1 - 5/8	1 - 5/8	1 - 5/8
No. Rings Packing	4	4	4	4	4	4
Size Packing	3/8	3/8	3/8	3/8	3/8	3/8

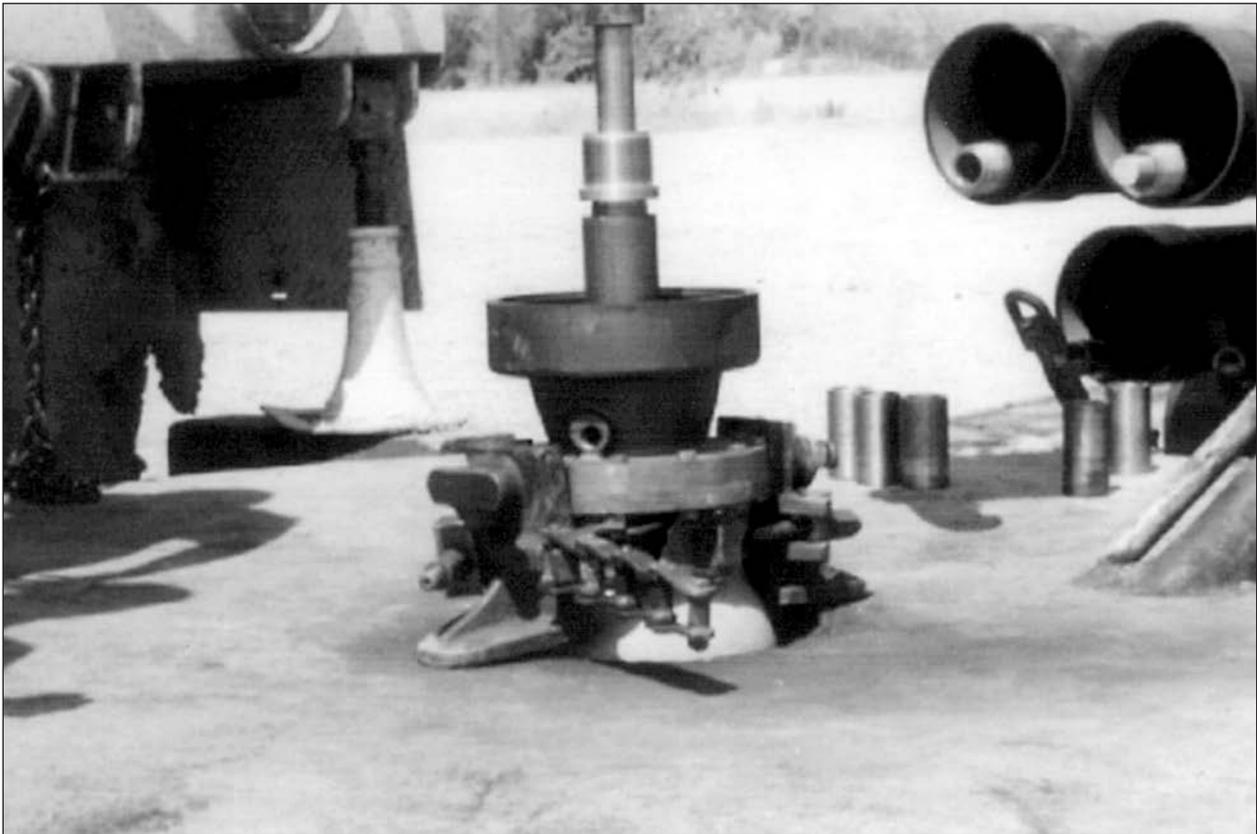


Fig. #1



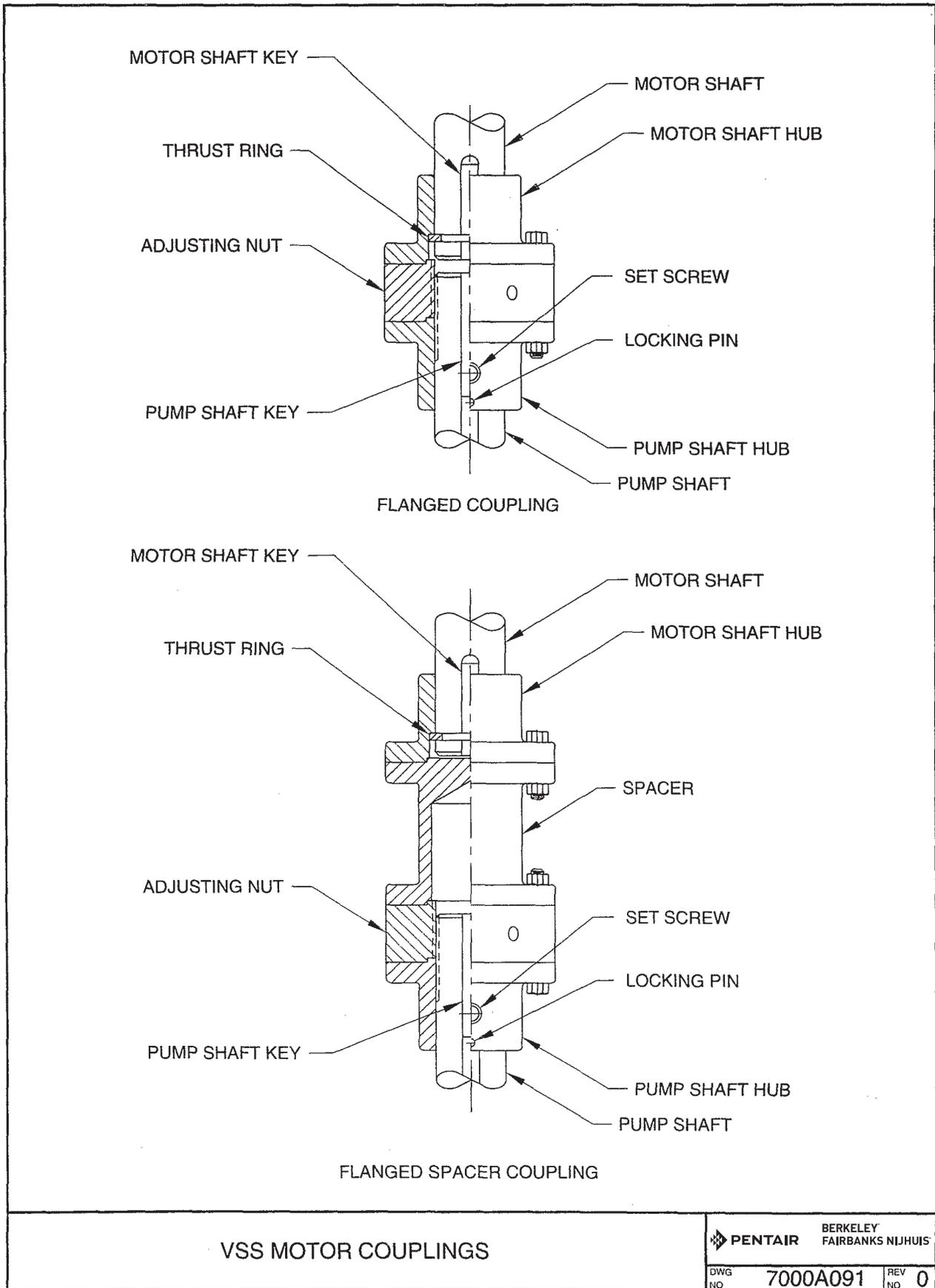
Fig. #2

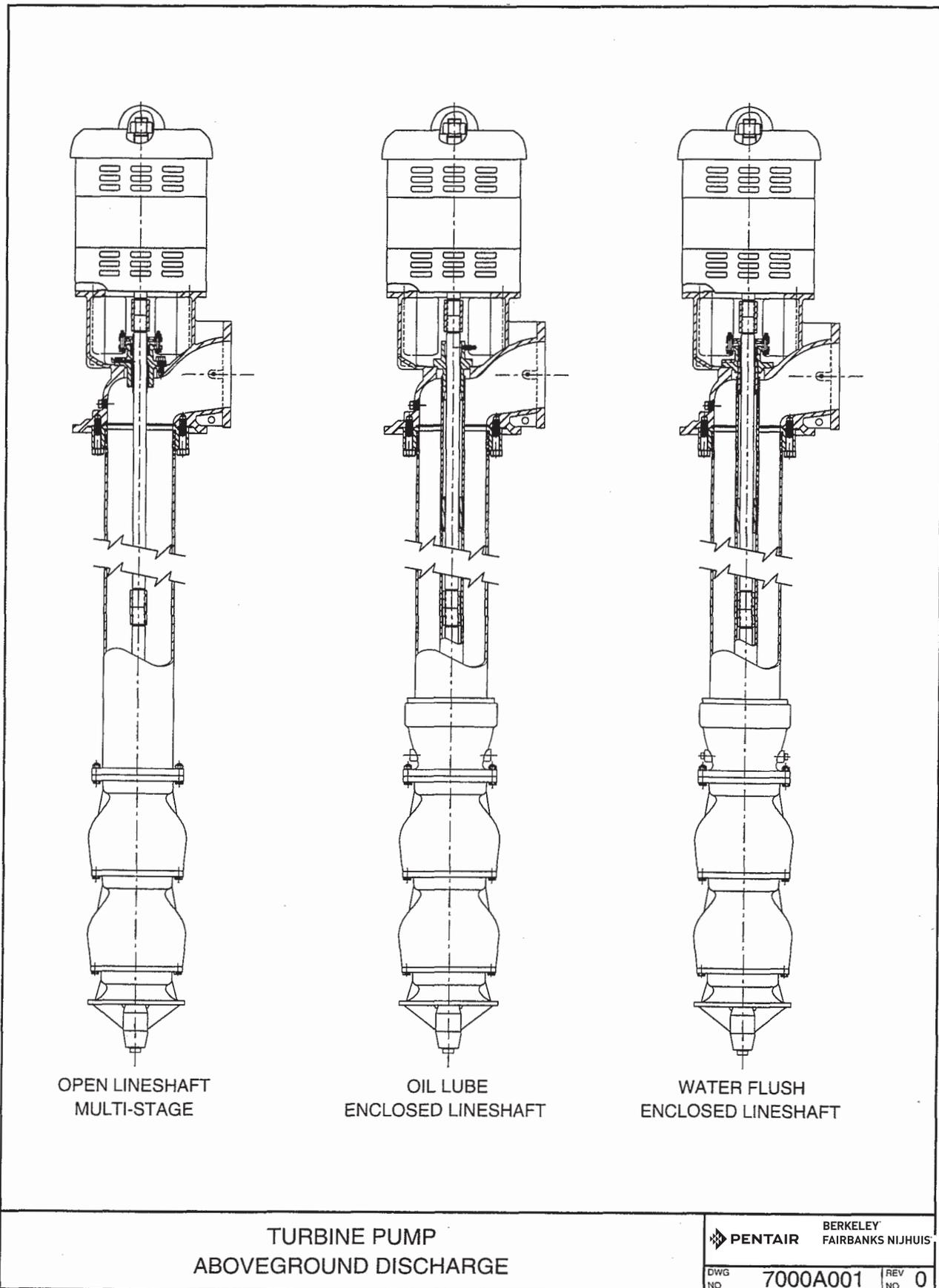


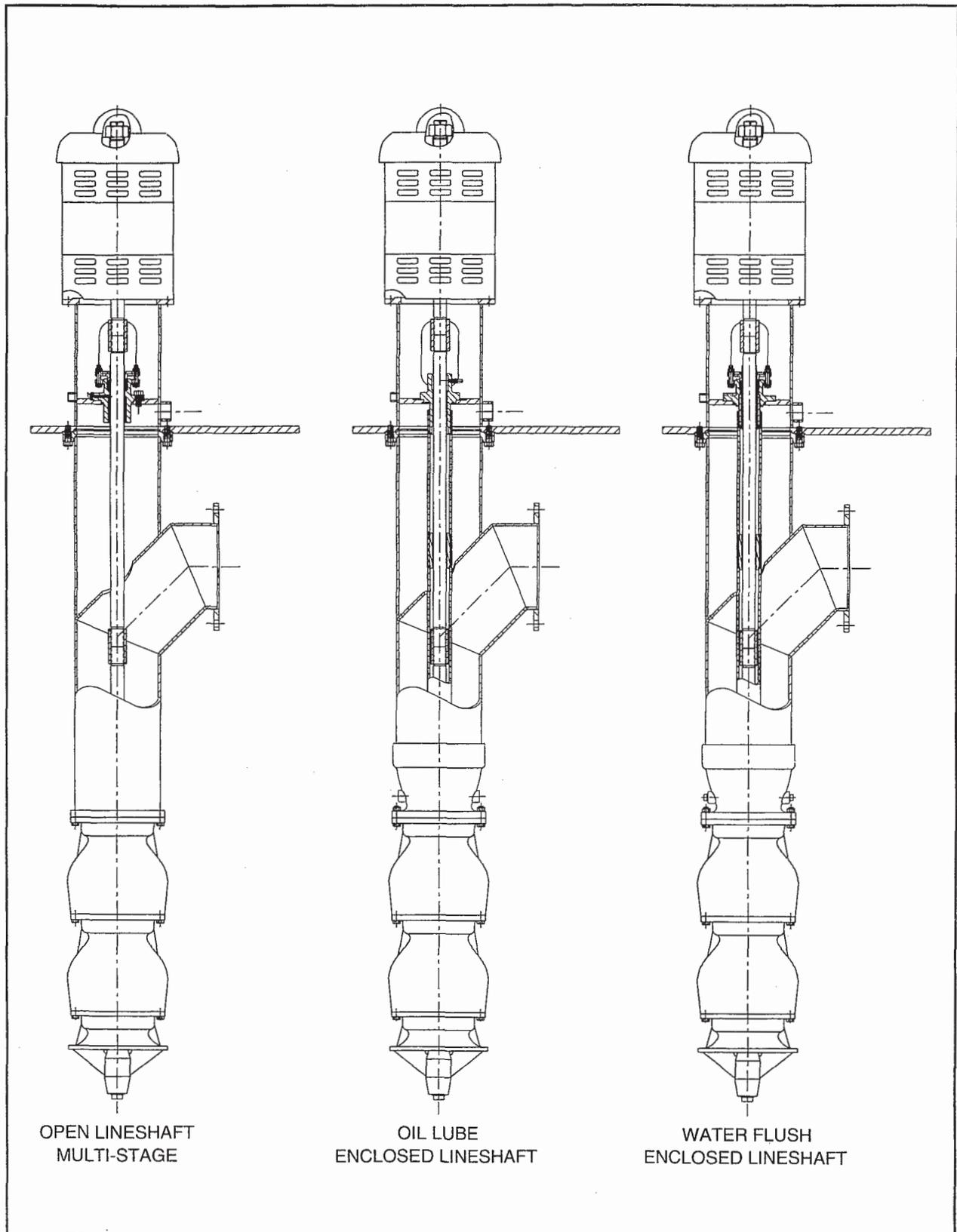
Fig. #3



Fig. #4







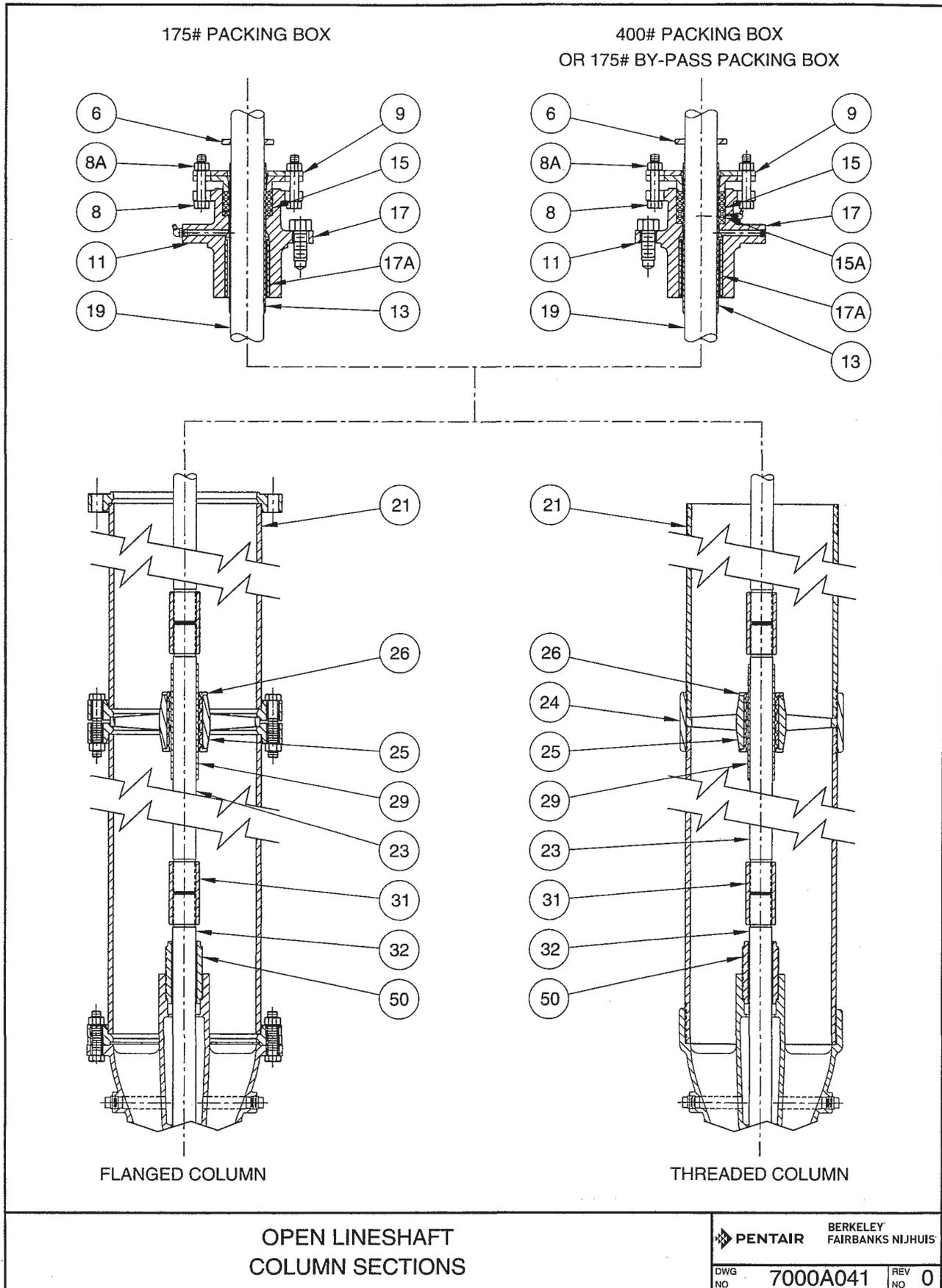
OPEN LINESHAFT
MULTI-STAGE

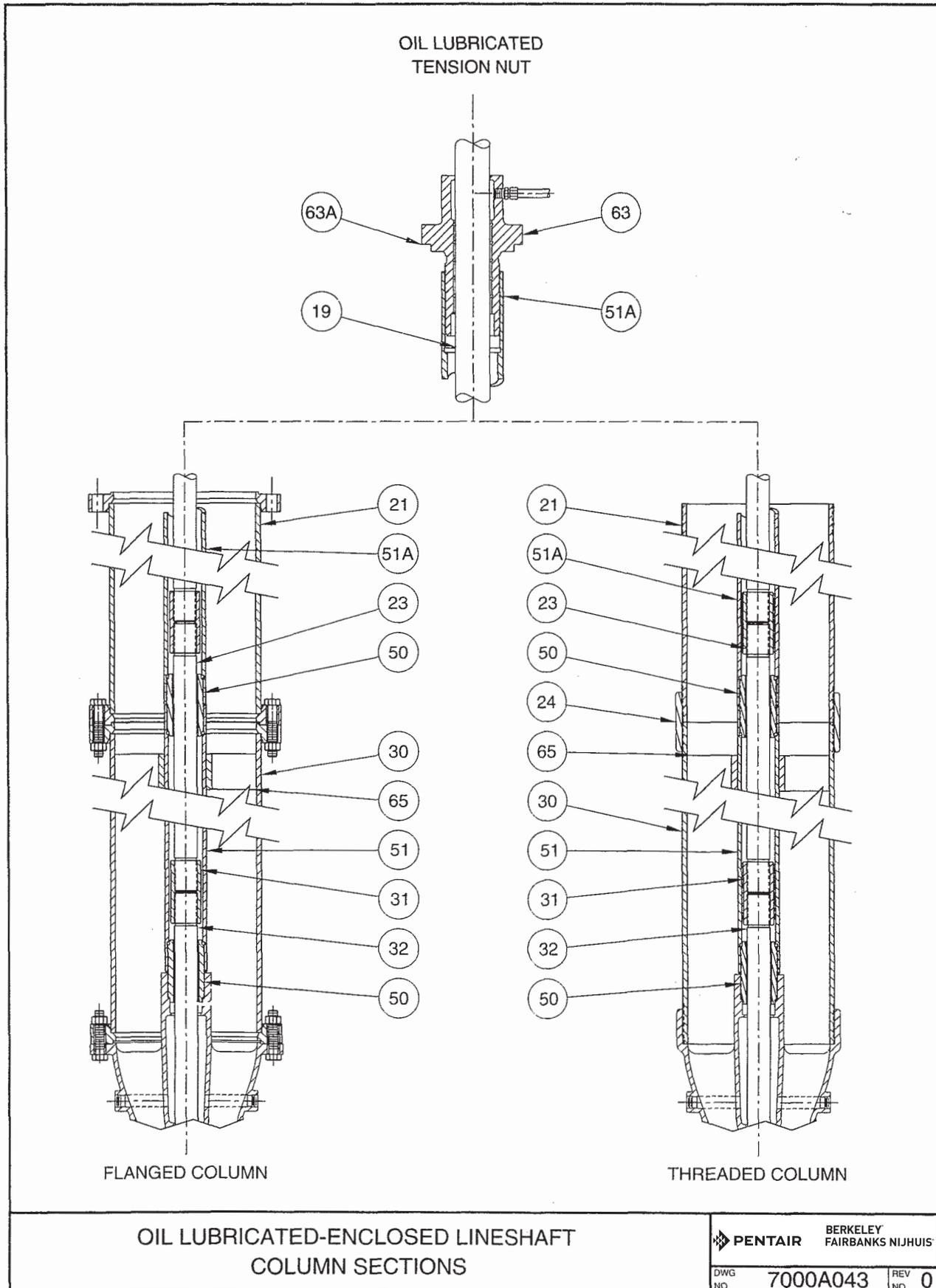
OIL LUBE
ENCLOSED LINESHAFT

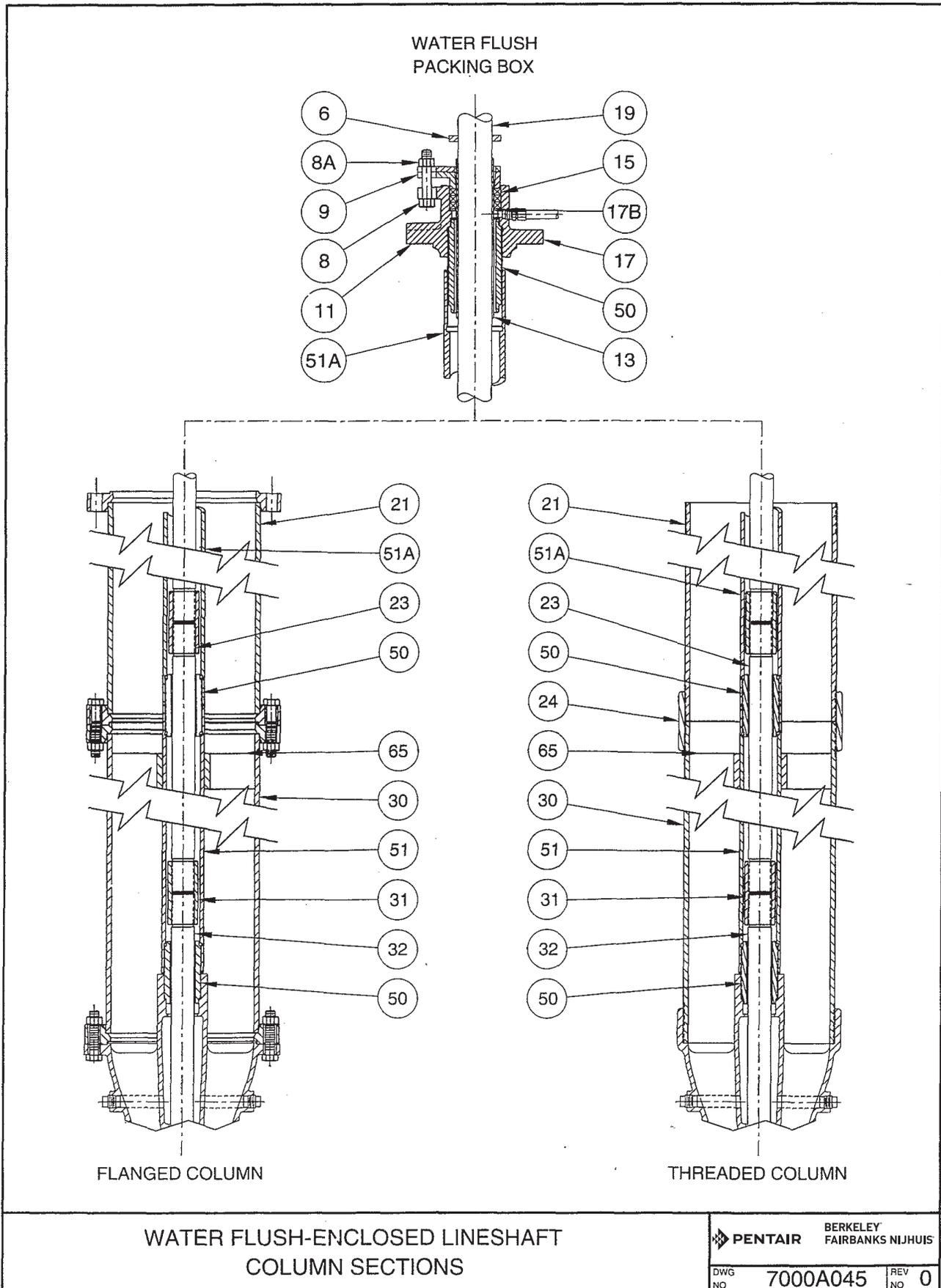
WATER FLUSH
ENCLOSED LINESHAFT

**TURBINE PUMP
BELOW GROUND DISCHARGE**

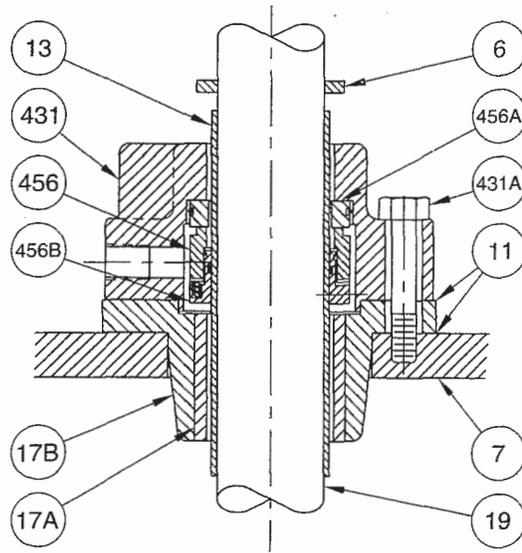
 PENTAIR		BERKELEY FAIRBANKS NIJHUIS
DWG NO	7000A002	REV NO 0



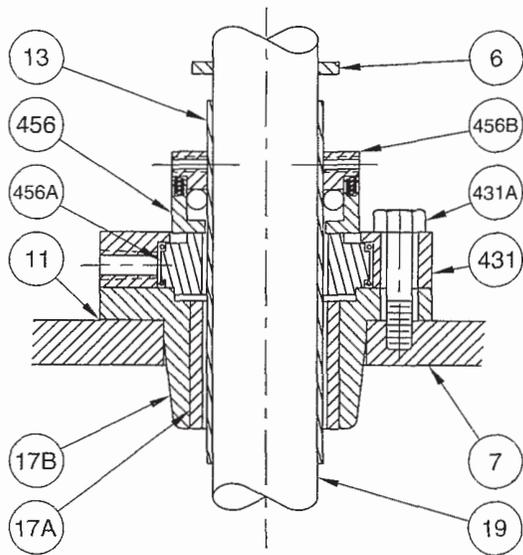




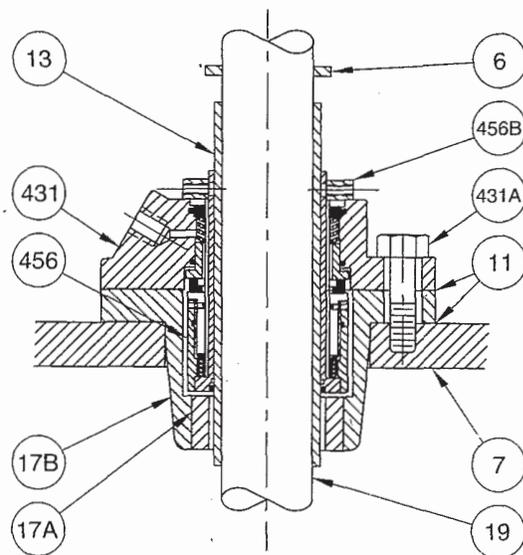
THIS PAGE INTENTIONALLY LEFT BLANK



BASIC MECHANICAL SEAL ASSEMBLY



OUTSIDE MECHANICAL SEAL ASSEMBLY



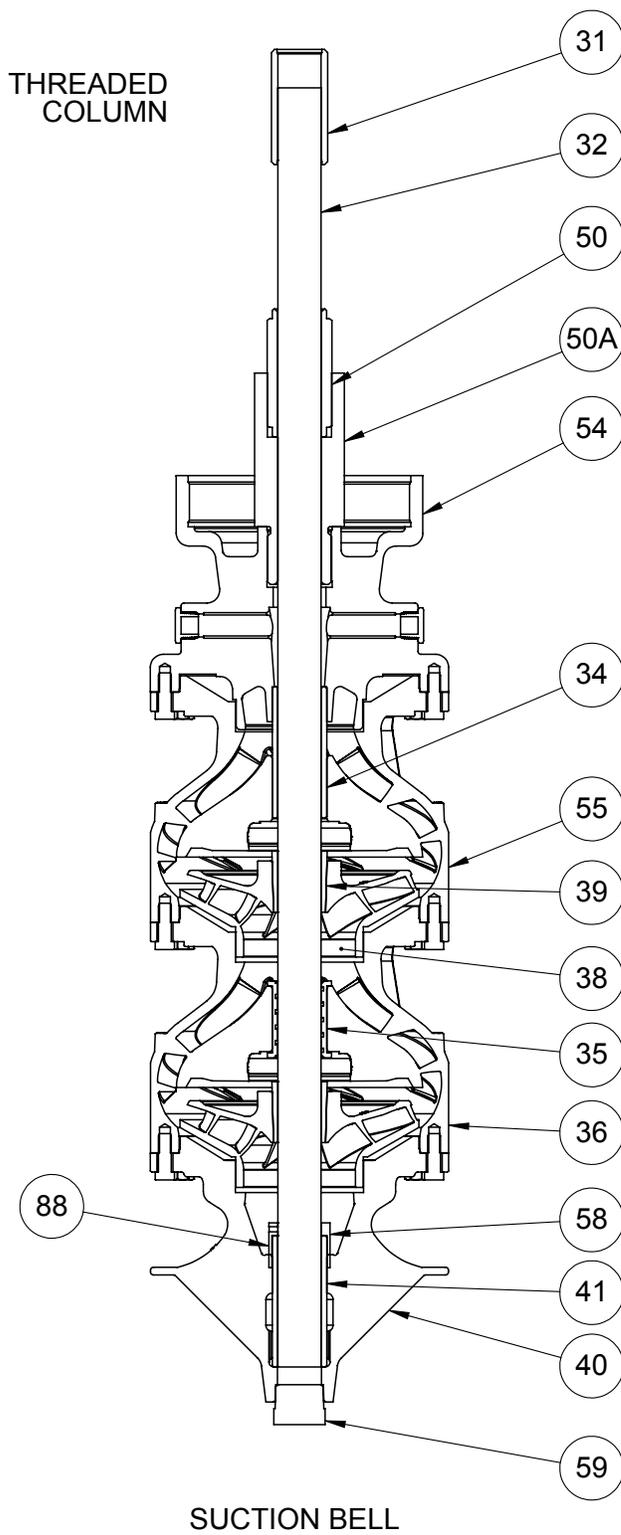
CARTRIDGE MECHANICAL SEAL ASSEMBLY

MECHANICAL SEALS

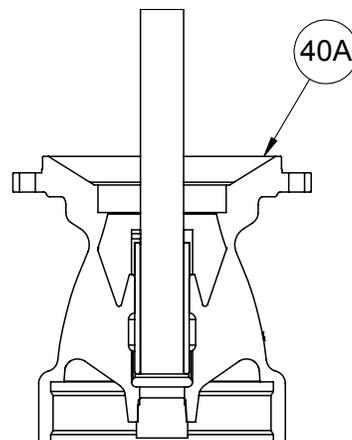
 PENTAIR		BERKELEY FAIRBANKS NIJHUIS
DWG NO	7000A081	REV NO 0

Column / Lineshaft / Seal Box Parts List

Part No.	Description
6	Slinger, Water
7	Discharge Head
8	Bolt, Gland
8A	Nut, Gland
9	Gland, Packing Box
11	Gasket, Packing Box
13	Sleeve, Top Shaft
15	Packing
15A	Ring, Water Seal
17	Packing Box
17A	Bushing, Packing Box
17B	Seal Housing
19	Shaft, Top
21	Column, Top
23	Lineshaft
24	Coupling, Threaded Column
25	Retainer, Bearing
26	Bearing, Lineshaft
29	Sleeve, Lineshaft
30	Column, Bottom
31	Coupling, Shaft
32	Shaft, Bowl
50	Bearing, Connector
51	Enclosing Tube, Bottom
51A	Enclosing Tube
63	Tension Nut, Enclosing Tube
63A	Gasket, Tension Nut
65	Stabilizer, Enclosing Tube
431	Gland, Mechanical Seal
431A	Capscrews, Packing Box
456	Seat, Mechanical Seal Rotating
456A	Seat, Mechanical Seal Stationary
456B	Retainer, Mechanical Seal



10VT250/300
12VT500/600



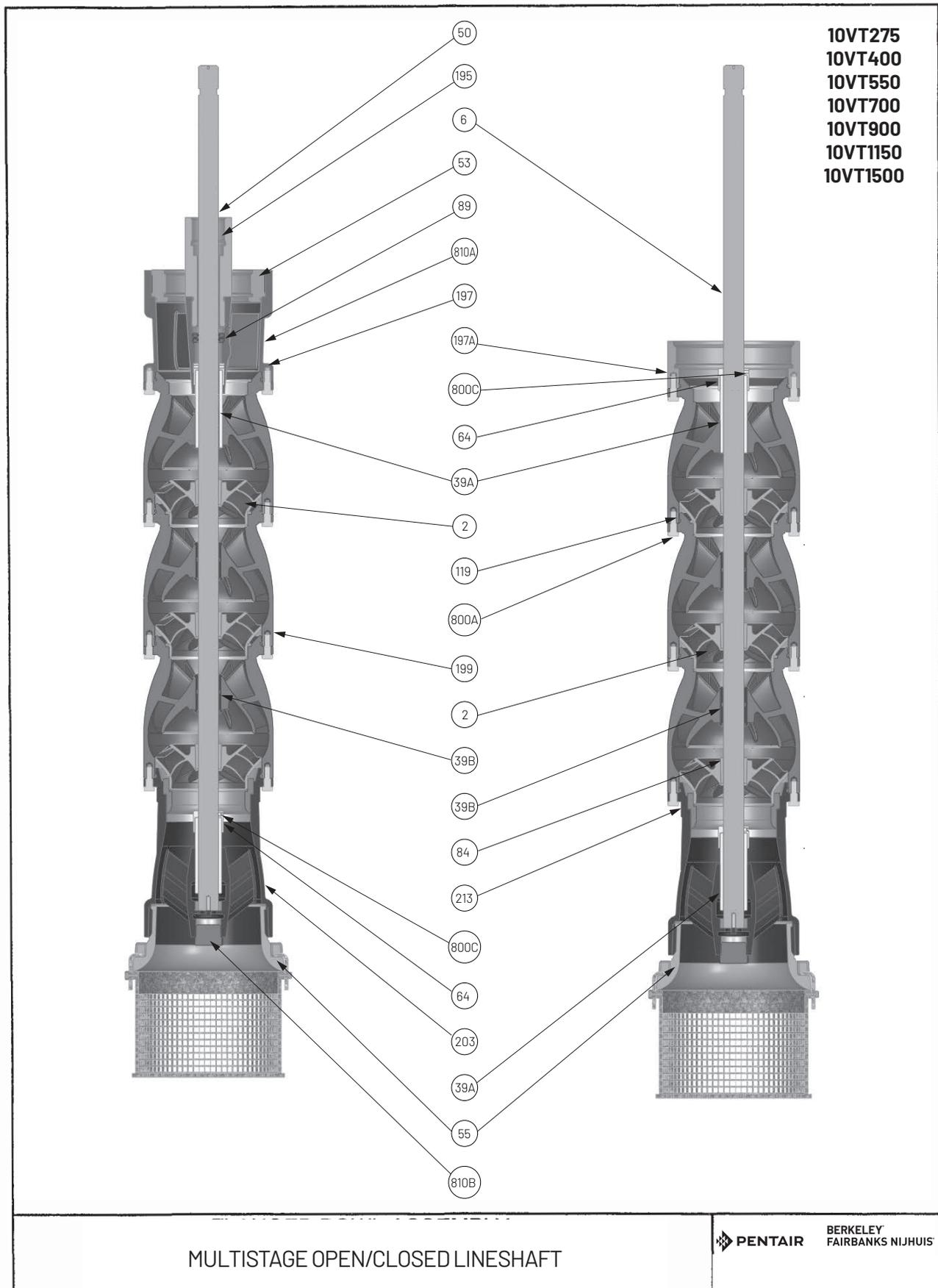
SUCTION CASE

MULTISTAGE WATERFLUSH

10VT250/300
12VT500/600

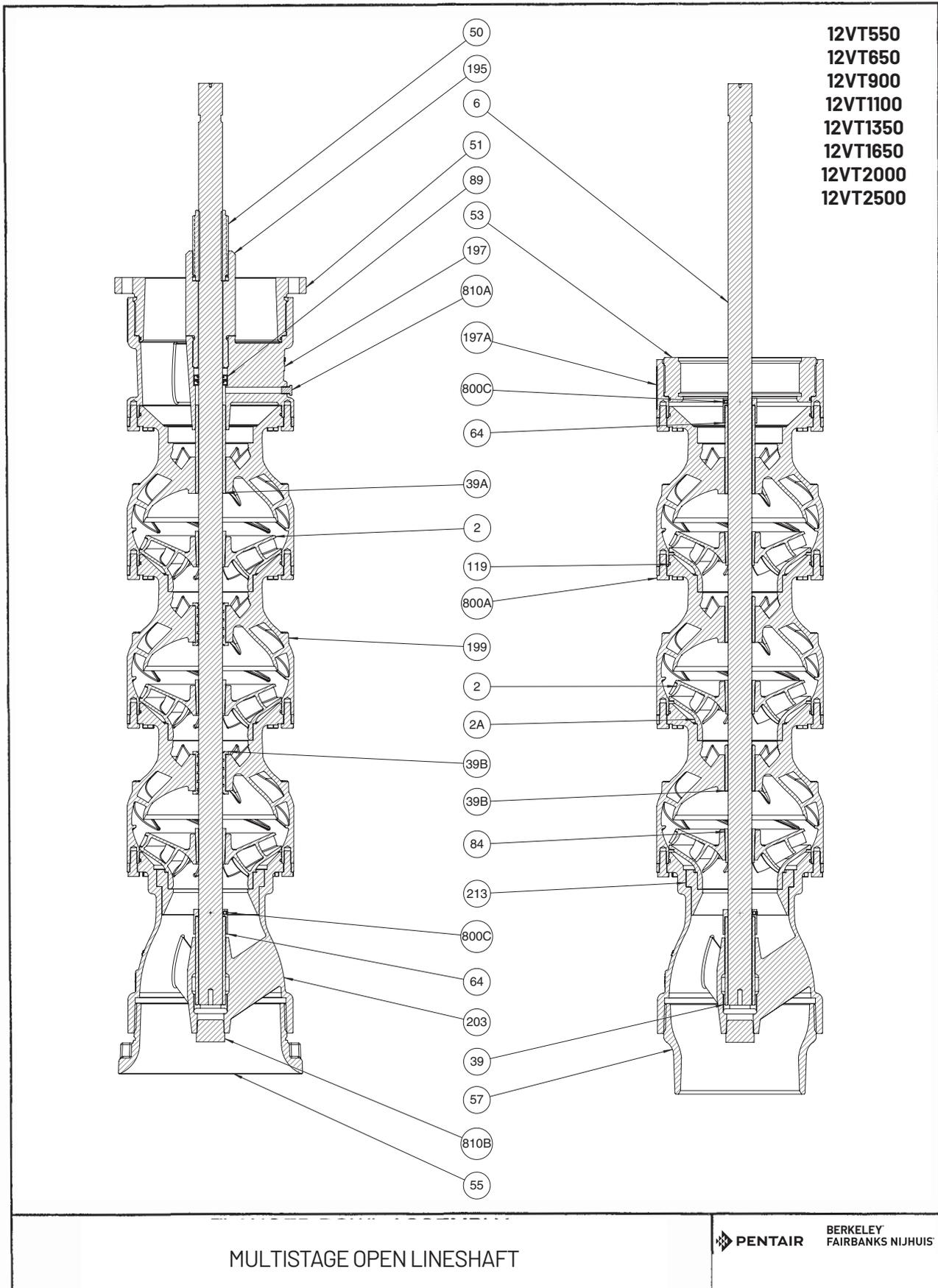
Bowl Assembly Parts List

Part No.	Description
6	Deflector, Water
31	Coupling, Shaft
32	Shaft, Bowl
34	Bearing, Top Bowl
35	Bearing, Intermediate Bowl
36	Bowl, Intermediate
38	Impeller
39	Collet, Impeller
40	Suction Bell
40A	Suction Case
41	Bearing, Suction Bowl
50	Bearing, Connector
50A	Tube Adapter
54	Discharge Case
54A	Lip Seal
55	Bowl, Top Intermediate
58	Sand Collar
59	Plug, Suction Bowl
88	Set Screw, Sand Collar



**10VT275, 10VT400, 10VT550, 10VT700,
 10VT900, 10VT1150, 10VT1500**

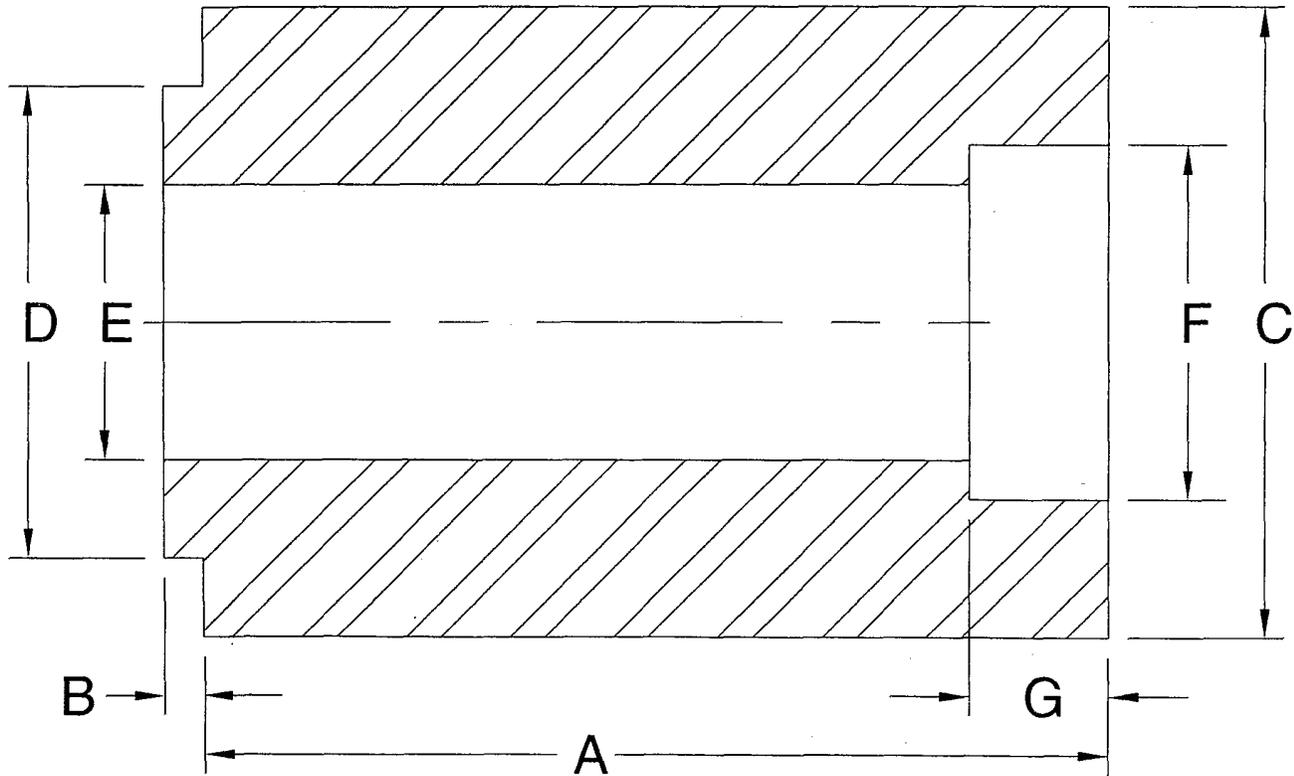
Item number	Description
2	IMPELLER CLOSED OR OPEN
NOT SHOWN	OPEN IMPELLER ADAPTER
6	1-1/2 DIAMETER SHAFT
50	CONNECTOR BEARING
NOT SHOWN	DISCHARGE ADAPTER 8"X6" FLNG
53	DISCHARGE ADAPTER 8"X6" STRT
55	SUCTION BELL APAPTER
NOT SHOWN	SUCTION ADAPTER 8"X6" NPT
64	SAND COLLAR
84	COLLET
89	LIP SEAL
119	O-RING
195	OIL LUBE ADAPTER
197	DISCHARGE CASE 10VT MACH LEFT 8"
199	BOWL DIFFUSER 10VT MACH CI 400
203	SUCTION CASE 10VT MACH CI 30
213	SUCTION ADAPTER MACH 10VT
0197A	WATERLUBE ADAPTER 10VT MACH 8"
39A	BEARING TOP BOWL AND SUCTION BOWL
39B	BEARING INTERMEDIATE BOWL
800A	CAPSCREW, HEX HD 1/2-13NC X 1-1/2
800C	SET SCREW 1/4-20 X 5/16LG
810A	PIPE PLUG 1/4" SQ HD
810B	PIPE PLUG 1-1/2" SQ HD



**12VT550, 12VT650, 12VT900, 12VT1100
 12VT1350, 12VT1650, 12VT2000, 12VT2500**

Item number	Description
2	IMPELLER CLOSED OR OPEN
2a	OPEN IMPELLER ADAPTER
50	CONNECTOR BEARING
51	DISCHARGE ADAPTER 10"X8" FLNG
53	DISCHARGE ADAPTER 10"X8" STRT
55	SUCTION BELL APAPTER
57	SUCTION ADAPTER 10"X8" NPT
64	SAND COLLAR
84	COLLET
89	LIP SEAL
119	O-RING
195	OIL LUBE ADAPTER
197	DISCHARGE CASE 12VT MACH LEFT 10"
199	BOWL DIFFUSER 12VT MACH CI 550/650
203	SUCTION CASE 12VT MACH CI 30
213	SUCTION ADAPTER MACH 12VT550/650/900
0197A	WATERLUBE ADAPTER 12VT MACH 10"
39A	BEARING TOP BOWL AND SUCTION BOWL
39B	BEARING INTERMEDIATE BOWL
800A	CAPSCREW, HEX HD 1/2-13NC X 1-1/2
800C	SET SCREW 1/4-20 X 5/16LG
810A	PIPE PLUG 1/4" SQ HD
810B	PIPE PLUG 1-1/2" SQ HD

TECHNICAL DATA

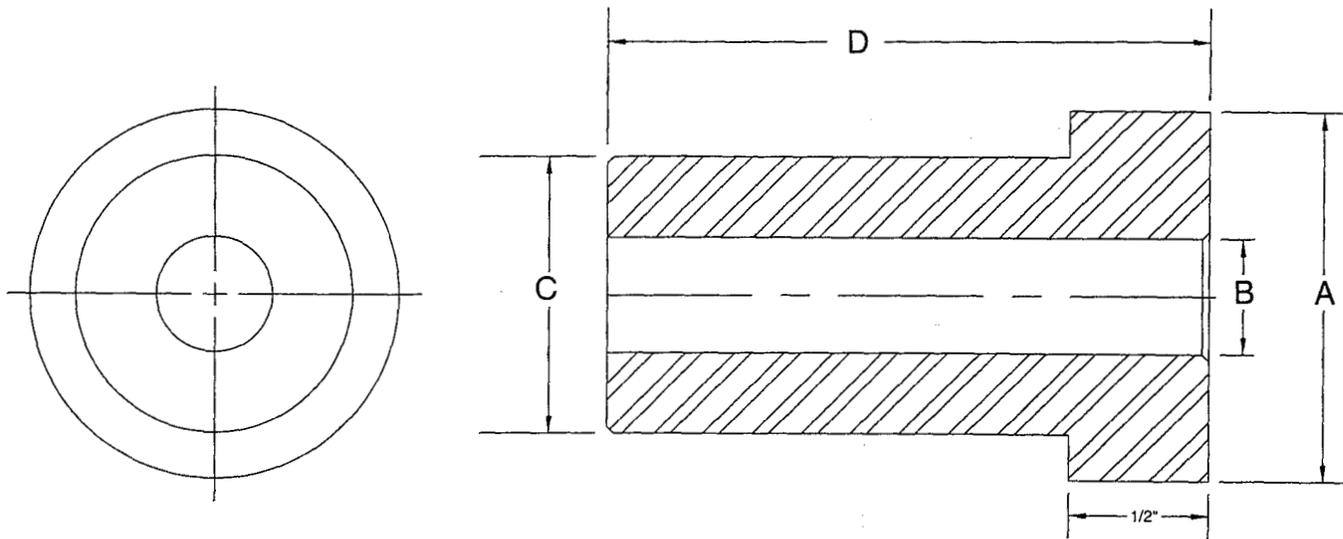


Shaft Size	A	B	C	D	E	F	G
1	2 ³ / ₄	1/4	2 ¹ / ₄	1 ⁵ / ₃₂	1 ¹ / ₃₂	1 ¹¹ / ₃₂	1
1-1/2	3	5/16	2-7/8	1-3/4	1-17/32	2-1/32	3/4
1 ³ / ₁₆	2 ³ / ₄	1/4	2 ¹ / ₄	1 ¹¹ / ₃₂	1 ⁷ / ₃₂	1 ¹⁷ / ₃₂	3/4
1 ⁷ / ₁₆	3	5/16	2 ⁷ / ₈	1 ²¹ / ₃₂	1 ¹⁵ / ₃₂	2 ¹ / ₃₂	3/4
1 ¹¹ / ₁₆	3	5/16	3	1 ²⁹ / ₃₂	1 ²³ / ₃₂	2 ⁷ / ₃₂	1
1 ¹⁵ / ₁₆	3	5/16	3 ¹ / ₄	2 ¹ / ₄	1 ³¹ / ₃₂	2 ³¹ / ₃₂	3/4
2 ³ / ₁₆	6	5/16	4	2 ¹ / ₂	2 ⁷ / ₃₂	2 ¹³ / ₁₆	3/4

Collet Driver/Impeller Removal Tool
 Berkeley 10VT, 12VT Series
 Fairbanks Nijhuis 6M-17H 7000 Series

Figure #5

TECHNICAL DATA

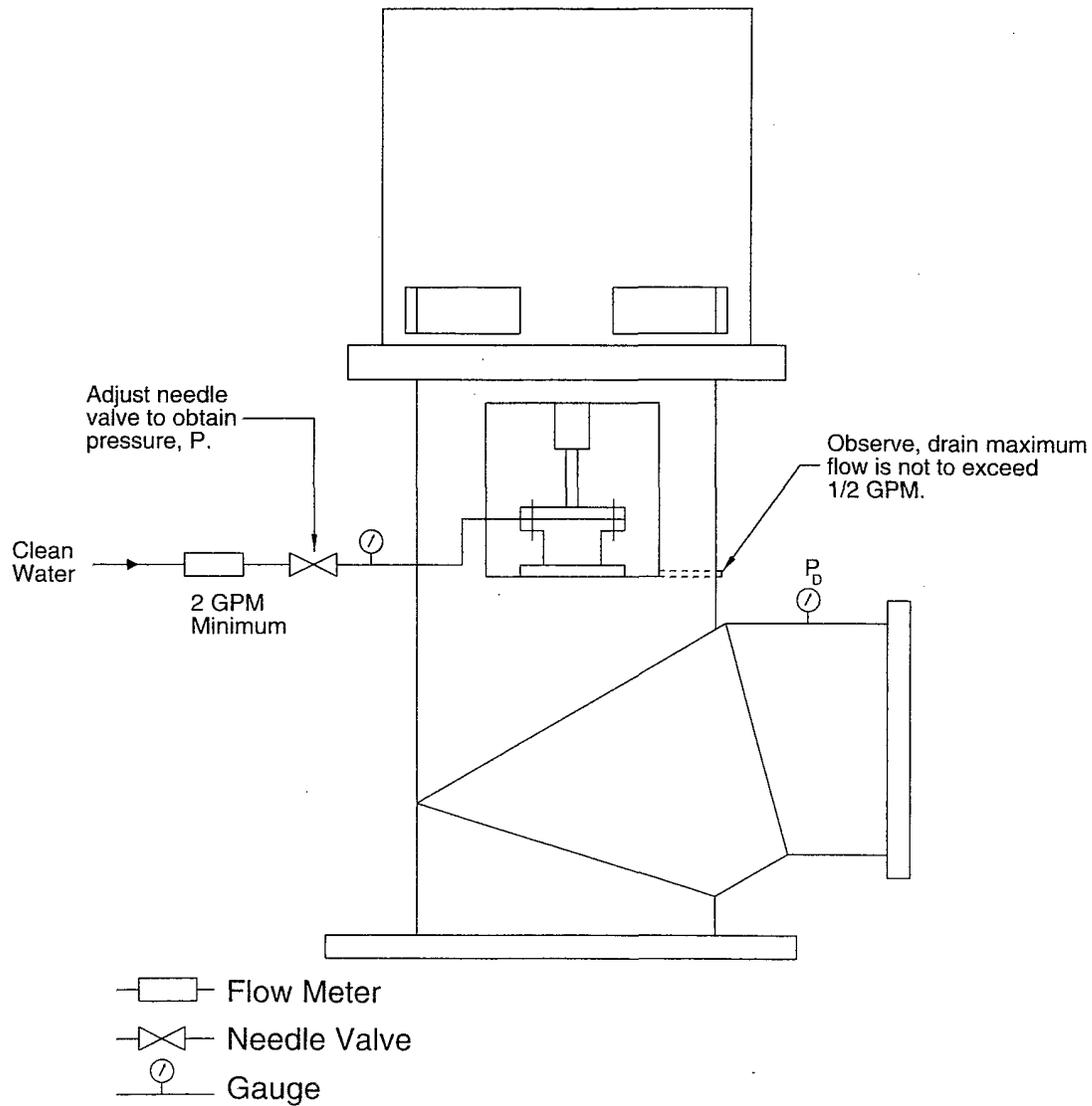


Pump Size	Shaft Dia.	Bolt Size	A	B	C	D
6M	1	3/8 x 1 3/4	2 1/2	7/16	7/8	1 3/16
7M	1	3/8 x 2	2 1/2	7/16	7/8	1 7/16
8H	1 3/16	3/8 x 2	2 1/2	7/16	7/8	1 1/2
10VT250 10VT300	1 7/16	3/8 x 2 1/4	2 1/2	7/16	1 11/16	1 3/4
10XH	1 7/16	3/8 x 3 3/4	2 1/2	7/16	1 7/16	3 1/4
10XHH	1 11/16	3/8 x 2 1/2	2 1/2	7/16	1 11/16	2 1/8
11M 11H	1 7/16	3/8 x 2 1/2	2 1/2	7/16	1 11/16	1 15/16
12HC	1 11/16	3/8 x 2 7/8	2 1/2	7/16	1 11/16	3 1/8
12MC	1 11/16	3/8 x 5 1/2	2 1/2	7/16	1 5/8	4 1/8
12L 12M 12H 13H	1 11/16	3/8 x 2 1/2	2 1/2	7/16	1 11/16	2 1/8
12VT500 12VT600	1 11/16	3/8 x 2 1/2	2 1/2	7/16	1 11/16	2 1/8
12XH 14MC 14XH	1 15/16	3/8 x 4 1/2	3	7/16	2	4 1/8
14M 15H	1 15/16	3/8 x 3 1/2	2 1/2	7/16	1 11/16	2 5/16
17M 17H	2 3/16	3/8 x 2 1/2	2 1/2	7/16	1 1/2	2 1/8

Shaft Locating Tool
 Berkeley 10VT, 12VT Series
 Fairbanks Nijhuis 6M-17H 7000 Series
 Fig. #6

Water Flush System

(Only for pump with packing)



P_D = Pressure at discharge

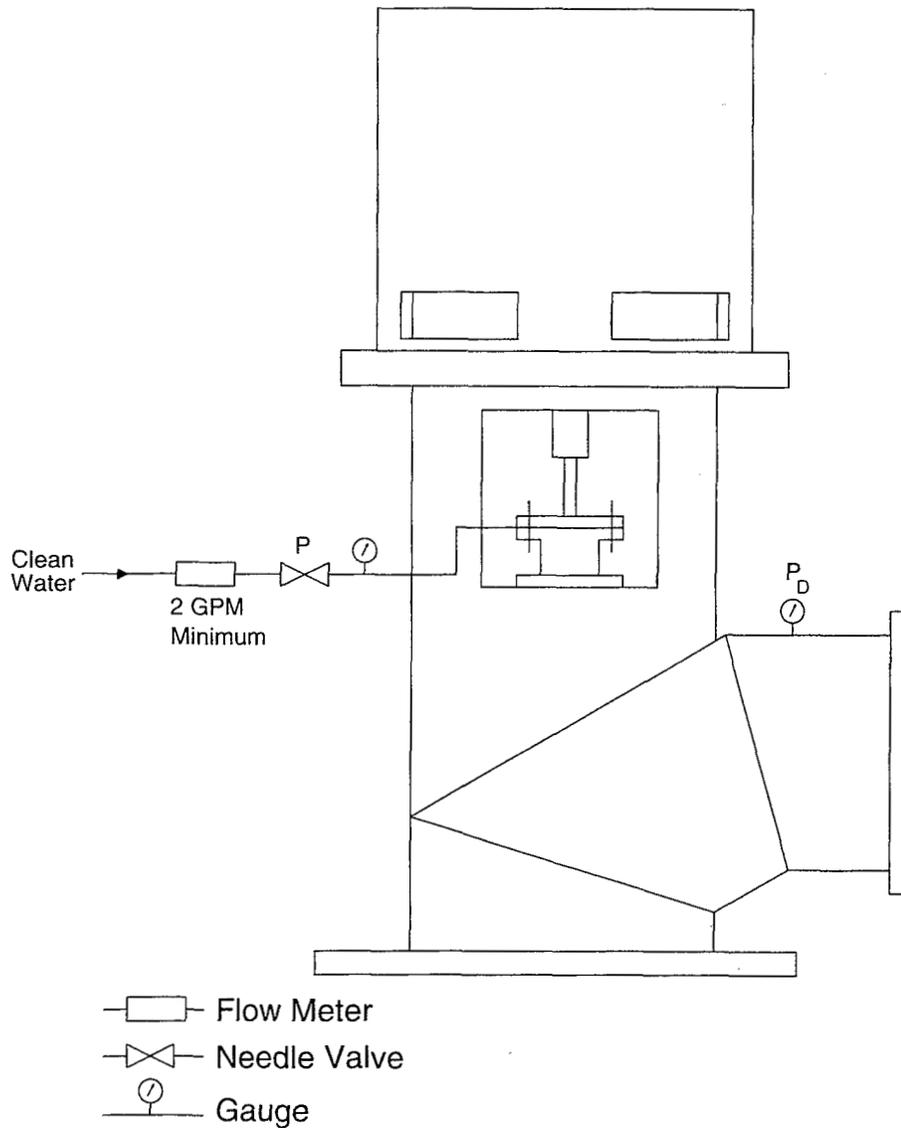
$P = 3 \text{ psi for each } 10 \text{ ft. of pump setting} + P_D + 5 \text{ psi}$

Example: 70 ft. setting
 $P_D = 52 \text{ psi}$
 $P = 3 \times \frac{70}{10} + 52 + 5$
 $= 78 \text{ psi}$

- Note: (1) Flush water is recommended at pump at all times, whether pump is operating or not.
 (2) Solenoid valves are not recommended.

Fig. #7

Water Flush System (Only for pump with mechanical seal)



P_D = Pressure at discharge

$P = 3 \text{ psi for each 10 ft. of pump setting} + P_D + 5 \text{ psi}$

Example: 70 ft. setting

$$P = 3 \times \frac{70}{10} + 52 + 5$$
$$= 78 \text{ psi}$$

- Note: (1) Flush water is recommended at pump at all times, whether pump is operating or not.
(2) Solenoid valves are not recommended.

Fig. # 8

Open Lineshaft Water Vent System

(Only for pump with mechanical seal)

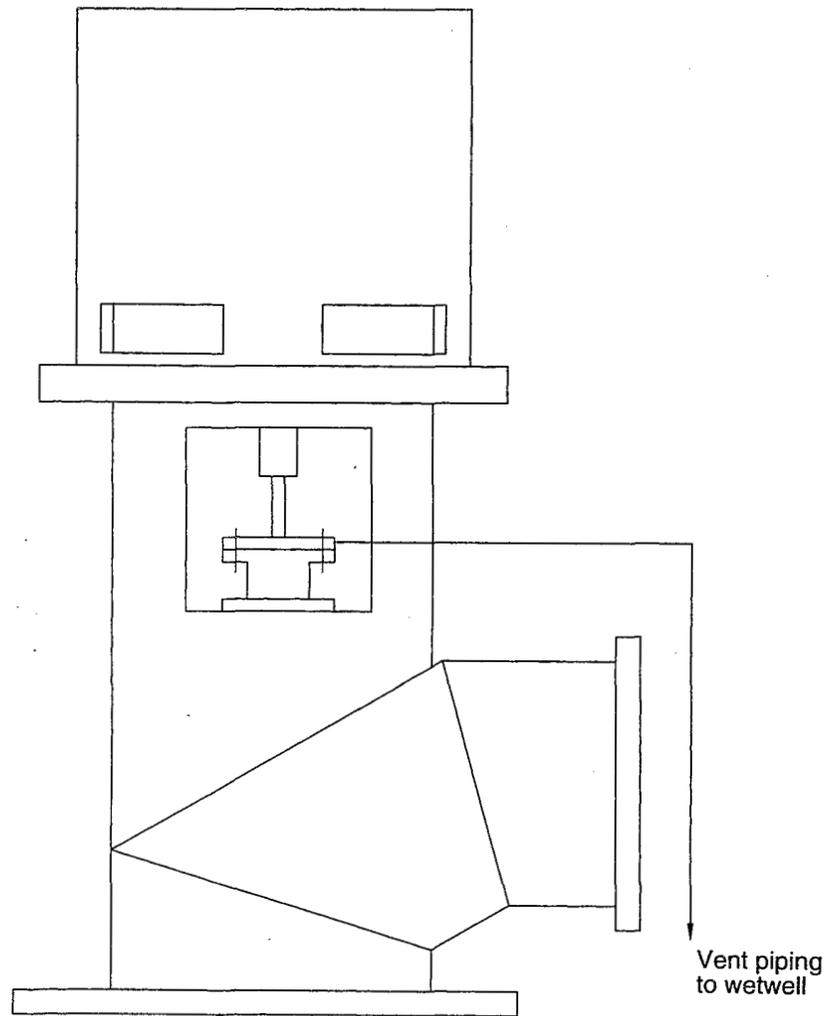


Fig. #9

DELIVERY: Buyer agrees to inspect all deliveries immediately. Any claim or shortages must be made in writing within ten (10) days after Buyer receives a shipment, and if not made, shall be deemed waived. Any other claim by Buyer, other than claims under the warranty stated in Paragraph 13, shall be made within thirty(30) days after Buyer receives shipment, and if not made shall be deemed waived. Seller is not responsible for loss or damage in transit after having received an "In Good Order" receipt from the carrier. Buyer will make claims for loss or damage in transit against the carrier.

Buyer is fully responsible for (including payment of the cost of installation and start-up of all equipment sold under the Order.

PATENT INFRINGEMENT: Seller will defend Buyer and the user of the equipment against any claim that any equipment and parts of Seller's manufacture furnished under the Order infringe upon any published United States patent, and Seller will pay all damages and costs awarded by a court of competent jurisdiction with respect to such claim. The Buyer or user must promptly notify Seller of any such claim, and cooperate fully with Seller in the defense of such claim, or Seller will have no duty under this paragraph. Buyer will defend and indemnify Seller against patent infringement claims relating to equipment and parts that are not manufactured by Seller to the same extent as seller agrees to defend and indemnify Buyer with respect to patent infringement claims relating to equipment and parts of seller's manufacture.

Warranty: Seller warrants equipment (and its component parts) of its own manufacture against defects in materials and workmanship under normal use and service for one (1) year from the date of installation or start-up, or for eighteen (18) months after the date of shipment, whichever occurs first. Seller does not warrant accessories or components that are not manufactured by Seller however, to the extent possible, Seller agrees to assign to Buyer its rights under the original manufacturer's warranty, without recourse to Seller.

Buyer must give Seller notice in writing of any alleged defect covered by this warranty (together with all identifying details, including the serial number, the type of equipment, and the date of purchase) within thirty (30) days of the discovery of such defect during the warranty period. No claim made more than 30 days after the expiration of the warranty period shall be valid.

Guarantees of performance and warranties are based on the use of original equipment manufactured (OEM) replacement parts. Fairbanks Morse Pump Corporation assumes no responsibility or liability if alterations, non-authorized design modifications and/or non-OEM replacement parts are incorporated.

If requested by Seller, any equipment (or its component parts) must be promptly returned to Seller any attempted repair, or sent an authorized service station designated by Seller, and Buyer shall prepay all shipping expenses. Seller shall not be liable for any loss or damage to goods in transit nor will any warranty claim be valid unless the returned goods are received intact and undamaged as a result of shipment. Repaired or replaced material returned to customer will be shipped F.O.B., Seller's factory. Seller will not give Buyer credit for parts or equipment returned to Seller, and will not accept delivery of any such parts or equipment, unless Buyer has obtained Seller's approval in writing.

The warranty extends to repaired or replaced parts of Seller's manufacture for ninety (90) days or for the remainder of the original warranty period applicable to the equipment or parts being repaired or replaced. This warranty applies to the repaired or replaced part and is not extended to the product or any other component of the product being repaired. Repair parts of its own manufacture sold after the original warranty period are warranted for a period of one (1) year from shipment against defects in materials and workmanship under normal use and

service. This warranty applies to the replacement part only and is not extended to the product or any other component of the product being repaired.

Seller may substitute new equipment or improve parts(s) of any equipment judged defective without further liability. All repairs or services performed by Seller, which are not covered by this warranty, will be charged in accordance with Seller's standard prices then in effect.

THIS WARRANTY IS THE SOLE WARRANTY OF SELLER AND SELLER HEREBY EXPRESSLY DISCLAIMS AND BUYER WAIVES ALL OTHER WARRANTIES EXPRESSED, IMPLIED IN LAW OR IMPLIED IN FACT, INCLUDING ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Seller's sole obligation under this warranty shall be, at its option, to repair or replace any equipment (or its component parts) which has a defect covered by this warranty, or to refund the purchase price of such equipment or part. Under the terms of this warranty, Seller shall not be liable for (a) consequential, collateral, special or liquidated damages; (b) equipment conditions caused by normal wear and tear, abnormal conditions of use, accident, neglect, or misuse of said equipment; (c) the expense of, and loss or damage caused by, repairs or alterations made by anyone other than the Seller; (d) damage caused by abrasive materials, chemicals, scale deposits, corrosion, lightning; improper voltage, mishandling, or other similar conditions; (e) any loss, damage, or expense relating to or resulting from installation, removal or reinstallation of equipment (f) any labor costs or charges incurred in repairing or replacing defective equipment or parts, including the cost of reinstalling parts that are repaired or replaced by Seller; (g) any expense of shipment of equipment or repaired or replacement parts; or (h) any other loss, damage or expense of any nature.

This Section 13 shall not apply to any equipment which may be separately covered by one of the following warranties: KC6B5 5-Year Prorated warranty, KCB85 15-Month Prorated Warranty, KC985 9-Month Warranty. All other provisions of KC585 shall remain effective.

CONDITION TO WARRANTY WORK: If Buyer is in default including, but not limited to, the failure of Buyer to maintain a current account with Seller) under the Order or any other agreement between Buyer and Seller, Buyer's rights under the warranty shall be suspended and the original warranty period will not be extended.

PERFORMANCE: Equipment performance is not warranted or guaranteed unless separately agreed to by Seller in accordance with its guarantee policy. Performance curves and other information submitted to Buyer are approximate and no warranty or guarantee shall be deemed to arise as a result of such submittal. All testing shall be done in accordance with Seller's standard policy.

LIABILITY LIMITATIONS: Under circumstances shall the Seller have any liability under the Order or otherwise for liquidated damages or for collateral, consequential or special damages or for loss of profits, or for actual losses or for loss of production or progress of construction, regardless of the cause of such damages or losses. In any event Seller's aggregate total liability under the Order or otherwise shall not exceed the contract price. Buyer agrees to indemnify and hold harmless Seller from all claims by third parties in excess of these limitations.

COMPLIANCE WITH LAW: Since the compliance with the various Federal, State, and Local laws and regulations concerning occupational health and safety and pollution are affected by the use, installation and operation of the equipment and other matters over which Seller has no control, Seller assumes no responsibility for compliance with those laws and regulations, whether by way of indemnity, warranty, or otherwise.

