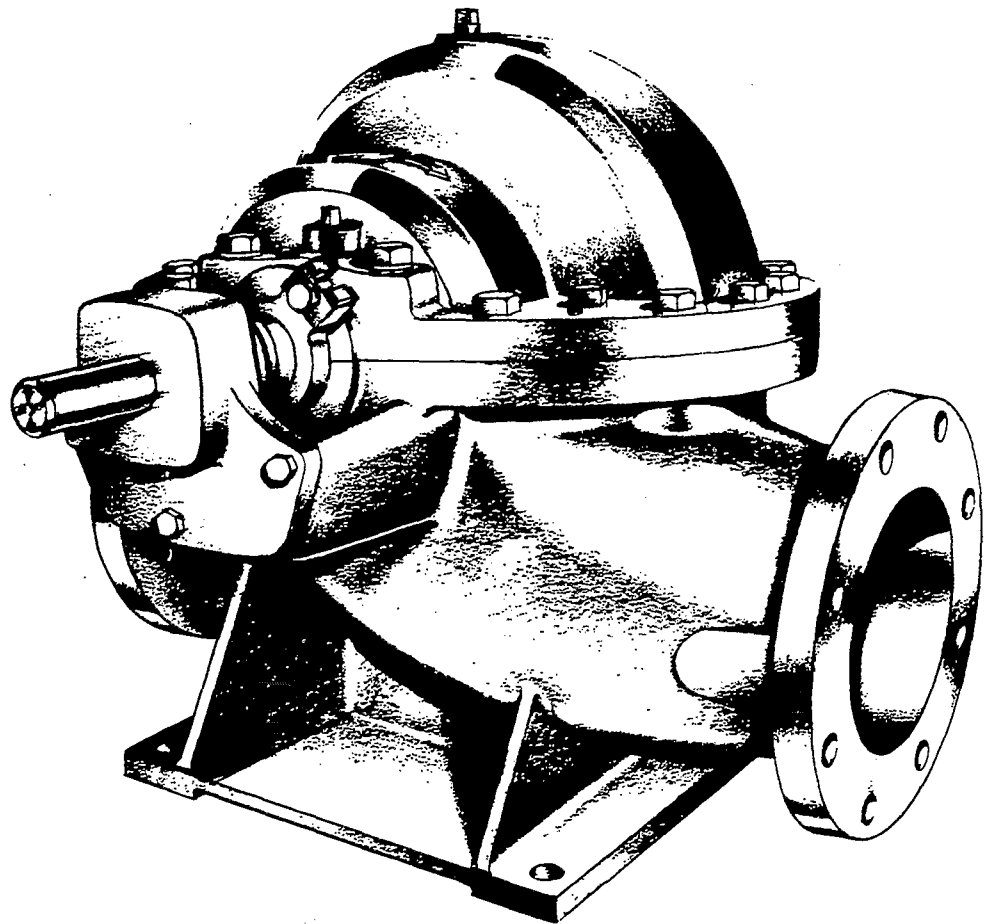




FAIRBANKS NIJHUIS™



MODEL 2800 HORIZONTAL SPLIT-CASE PUMPS

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.

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PUMP IDENTIFICATION

Congratulations! You are the owner of one of the finest pumps 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 ...

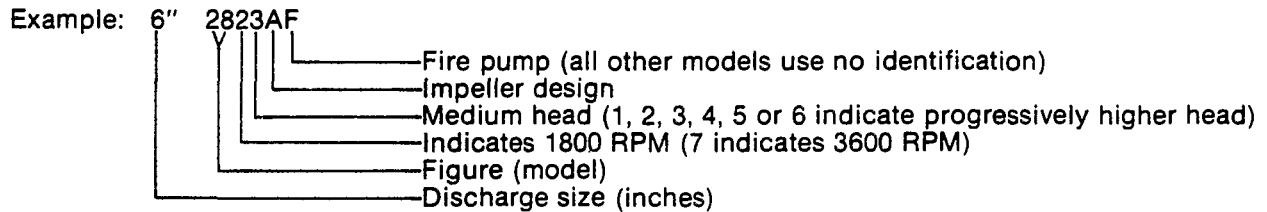
2800 and 2800F SPLIT CASE PUMPS

Your Fairbanks Nijhuis™ 2800 is a split-case pump with the casing split on the horizontal centerline. This new compact design, with a shorter bearing span, has less deflection under hydraulic load, which results in less wear on the sleeves, bearings and packing. It is ideally suited for applications such as water systems, boosters, liquid transfer, irrigation and fire protection systems. These pumps are available with a variety of options, including mechanical seals, impeller wear rings, oil lubricated and water cooled bearings.

This manual applies to:

28XX Horizontal pumps with removable bearing arms

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.

PUMP

FIGURE (MODEL): _____	SERIAL NUMBER: _____
IMPELLER DIAMETER: _____	SIZE: _____
CAPACITY: _____ GPM, TOTAL HEAD: _____ FT., RPM: _____	

DRIVER

H.P.: _____	SERIAL NUMBER: _____
FRAME: _____	SPEED: _____ VOLTAGE: _____

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

1. Fairbanks Nijhuis "Hydraulic Handbook", available from the factory.
2. Hydraulic Institute Standards

Hydraulic Institute
1230 Keith Building
Cleveland, Ohio 44115

THESE INSTRUCTIONS APPLY TO THE PUMP ONLY. 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 OTHER EQUIPMENT FOR THEIR SEPARATE INSTRUCTIONS.

**CALIFORNIA PROPOSITION 65 WARNING:
WARNING:**

THIS PRODUCT AND RELATED ACCESSORIES CONTAIN CHEMICALS KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER, BIRTH DEFECTS OR OTHER REPRODUCTIVE HARM.

**CAUTION
IMPORTANT SAFETY NOTICE**

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.

STORAGE OF PUMPS

IF THE EQUIPMENT IS NOT TO BE IMMEDIATELY INSTALLED AND OPERATED, STORE IT IN A CLEAN, DRY, WELL VENTILATED PLACE, FREE FROM VIBRATIONS, MOISTURE, AND RAPID OR WIDE VARIATIONS IN TEMPERATURE.

SPECIAL INSTRUCTIONS FOR:

OIL LUBRICATED PUMPS: FILL THE BEARING RESERVOIRS WITH OIL. PRIOR TO START UP, DRAIN THE STORAGE OIL AND FILL THE RESERVOIRS TO THE PROPER LEVEL WITH NEW OIL.

GREASE LUBRICATED PUMPS: ROTATE THE SHAFT FOR SEVERAL REVOLUTIONS AT LEAST ONCE EVERY TWO WEEKS TO:

1. COAT THE BEARING WITH LUBRICANT,
2. RETARD OXIDATION OR CORROSION AND,
3. PREVENT POSSIBLE FALSE BRINELLING.

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 CONSTRUCTION.
3. THERE ARE LONG (30 DAYS OR MORE) PERIODS BETWEEN OPERATION CYCLES.
4. THE PLANT (OR DEPARTMENT) IS SHUT DOWN FOR PERIODS OF LONGER THAN 30 DAYS.

NOTE: STORAGE REQUIREMENTS VARY DEPENDING ON THE LENGTH OF STORAGE, THE CLIMATIC ENVIRONMENT AND THE EQUIPMENT. FOR STORAGE PERIODS OF THREE MONTHS OR LONGER, CONTACT THE MANUFACTURER FOR SPECIFIC INSTRUCTIONS. IMPROPER STORAGE COULD DAMAGE THE EQUIPMENT WHICH WOULD RESULT IN NON-WARRANTY COVERED RESTORATION REQUIREMENTS OR NON-WARRANTY COVERED PRODUCT FAILURES.

STANDARD WARRANTY: Seller warrants products of its own manufacture against defects in materials and workmanship under normal use, and service for one (1) year from date of installation or startup, but not more than eighteen (18) months after date of shipment. Accessories and components not manufactured by Seller are warranted only to the extent of the original manufacturer's warranty. Notice of the alleged defect must be given to Seller in writing with all identifying details including serial number, type of equipment and date of purchase within thirty (30) days of the discovery of same during the warranty period. Seller's sole obligation on this warranty shall be, at its option, to repair or replace or refund the purchase price of any product or part thereof which proves to be defective as alleged. No allowances will be made for repairs or alterations effected without specific written authorization from Seller.

If requested by Seller, such product or part thereof must be promptly returned to the manufacturer prior to any attempted repair; or sent to an authorized service station designated by the manufacturer. All shipping expenses are to be prepaid by the buyer. Seller accepts no responsibility for loss or damage in transit of goods, nor will any warranty claim be considered 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. the manufacturer's factory.

Seller warrants repaired or replaced parts of its own manufacture against defects in materials and workmanship under normal use and service for ninety (90) days or for the remainder of the warranty on the product being repaired. 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.

Under the terms of this warranty, Seller shall not be responsible nor liable for:

- a. Consequential, collateral or special losses or damages.
- b. Equipment conditions caused by fair wear and tear, abnormal conditions of use, accident, neglect, or misuse of said equipment.
- c. Labor charges, loss or damage resulting from the supplying of defective part(s) or improper repairs by unauthorized person(s).
- d. Damage caused by abrasive materials, chemicals, scale deposits, corrosion, lightning, improper voltage or mishandling.

Seller reserves the right to substitute new equipment and/or improve the part(s) on any equipment judged defective without further liability. All repairs and/or services performed by Seller, not adjusted as covered by this warranty, will be charged in accordance with the current equipment and service prices.

This warranty is VOID unless the purchaser provides protective storage, installs and maintains the equipment in accordance with manufacturer's instructions.

Credit will NOT be allowed nor shipment accepted on any part(s) or equipment returned unless prior approval in writing has been obtained.

THIS WARRANTY IS THE SOLE WARRANTY OF SELLER AND ANY OTHER WARRANTIES EXPRESS, IMPLIED IN LAW OR IMPLIED IN FACT, INCLUDING ANY WARRANTIES OR MERCHANTABILITY AND FITNESS FOR USE, ARE HEREBY SPECIFICALLY EXCLUDED.

No employee of the Seller and no agent, dealer or distributor has any authority to change or enlarge the terms of this warranty to obligate the Seller to other than strictly the terms of this written warranty.

LIABILITY LIMITATIONS: Under no circumstances shall the Seller have any liability 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, whether resulting from delays in delivery or performance, breach of warranty, negligent manufacture or otherwise. The aggregate total liability of Seller in connection with the performance of this order, whether for breach of contract or warranty, negligence, or otherwise shall in no event exceed the contract price. Buyer agrees to indemnify and hold harmless Seller from all claims by third parties in excess of these limitations.

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 the Seller has no control, the Seller assumes no responsibility for compliance with those laws and regulations, whether by way of indemnity, warranty or otherwise.

INTRODUCTION

This manual contains information which is the result of carefully conducted engineering and research efforts. It is designed to supply adequate instructions for the safe and efficient 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.

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.

Observe all caution or danger tags attached to the equipment or included in this manual.

INSTALLATION

1. GENERAL

CAUTION: CAREFULLY READ ALL SECTIONS OF THIS MANUAL AND ALL OTHER INSTRUCTION MANUALS PROVIDED BY MANUFACTURERS OF OTHER EQUIPMENT SUPPLIED WITH THIS PUMP.

Upon receipt of the shipment, unpack and inspect the pump and driver assemblies and individual parts to insure none are missing or damaged. Carefully inspect all boxes and packing material for loose parts before discarding them. Report immediately to the factory, and to the transportation company involved, any missing parts or damage incurred during shipment, and file your "damaged and/or lost in shipment" claim with the carrier.

Horizontal pump and driver assemblies mounted on a structural steel base are aligned at the factory. However, alignment may be disturbed in transit or during installation. It must be checked after the unit is leveled on the foundation, after the grouting has set and the foundation bolts are tightened, and after piping is completed.

Tapped mounting blocks are furnished with horizontal pumps when the driver is to be field mounted. After the alignment of the driver is completed, the mounting blocks must be welded to the base and the alignment rechecked.

When the pump and driver are mounted on separate base structures, the pump should be leveled and aligned first, and then the driver leveled and lined up with the pump. With separate bases, a flexible shaft between pump and driver must be used.

2. NET POSITIVE SUCTION HEAD (NPSH)

NPSH can be defined as the head (energy) that causes liquid to flow through the suction pipe and enter the eye of the impeller.

NPSH is expressed in two values: (1) NPSH required (NPSHR) and, (2) NPSH available (NPSHA). It is essential that NPSHA always be greater than NPSHR to prevent cavitation, vibration, wear and unstable operation.

NPSHR is a function of the pump design and therefore varies with the make, size, capacity and speed of the pump. The value for your pump can be obtained from your pump performance curve or the factory.

NPSHA is a function of your system and may be calculated as follows:

- A. When the source of liquid is above the pump:

$$\text{NPSHA} = \text{barometric pressure (feet)} + \text{static suction head (feet)} - \text{friction losses in suction piping (feet)} - \text{vapor pressure of liquid (feet)}$$

- B. When the source of liquid is below the pump:

$$\text{NPSHA} = \text{barometric pressure (feet)} - \text{static suction lift (feet)} - \text{friction losses in suction piping (feet)} - \text{vapor pressure of liquid (feet)}$$

3. MINIMUM SUBMERGENCE OF SUCTION PIPE AND PIT DESIGN

For installations where the pump draws the fluid from a sump, the hydraulic characteristics of the pump, the suction inlet submergence and NPSH must be considered. Generally, it is required that an evenly distributed flow of non-aerated water be supplied to the suction bell. Improper pit design or insufficient suction pipe submergence can result in intake vortexing which reduces the pump's performance and can result in severe damage to the pump.

We recommend that you secure the advice of a qualified Consulting Engineer for the analysis and design of the suction pit. Significant engineering data on design is provided in the Hydraulic Institute Standards.

Upon request, Fairbanks Morse will review plans and give general comments on the installation, but will not approve such plans for a specific installation and will accept no responsibility or liability for the performance of the pump intake structure.

4. LOCATION AND HANDLING

The pump should be installed as near the fluid as possible so a short direct suction pipe can be used to keep suction losses at a minimum. If possible, locate the pump so the fluid will flow to the suction opening by gravity. The discharge piping should be direct and with as few elbows and fittings as possible. The total net positive suction head available (NPSHA), which includes the suction lift and pipe friction losses, must be equal to or greater than the net positive suction head required (NPSHR) by the pump.

The pump and driver should be located in an area that will permit periodic inspection and maintenance. Head room and access should be provided and all units should be installed in a dry location with adequate drainage.

WARNING: DO NOT PICK UP THE COMPLETE UNIT BY THE DRIVER OR PUMP SHAFTS OR EYE BOLTS.

To lift a horizontal mounted unit, a chain or suitable lifting device should be attached to each corner of the base structure. The individual driver may be lifted using the proper eye bolts provided by the manufacturer, but these should not be used to lift the assembled unit.

5. FOUNDATION

The foundation should have a level surface and be of sufficient mass to prevent vibration and form a permanent rigid support for the unit. The most satisfactory foundations are concrete with anchor bolts of adequate size imbedded in the foundation in pipe sleeves with an inside diameter $2\frac{1}{2}$ times larger than the bolt diameter. This will allow for final accurate positioning of the unit.

6. LEVELING OF THE UNIT

Lower the unit onto the foundation, positioning it so the anchor bolts are aligned in the middle of the mounting holes in the base. On all units, always disconnect the coupling halves and never reconnect them until all the alignment operations are complete.

The base should be supported on metal shims or metal wedges placed directly under the part of the base carrying the greatest weight, and spaced close enough to give uniform support and stability (see Figure 1).

Adjust the metal supports or wedges until the shaft of the pump and driver are level. Alignment corrections can be accomplished by adjusting the supports under the base. When proper alignment is obtained, tighten the foundation bolts snugly, but not too firmly, and recheck the alignment before grouting.

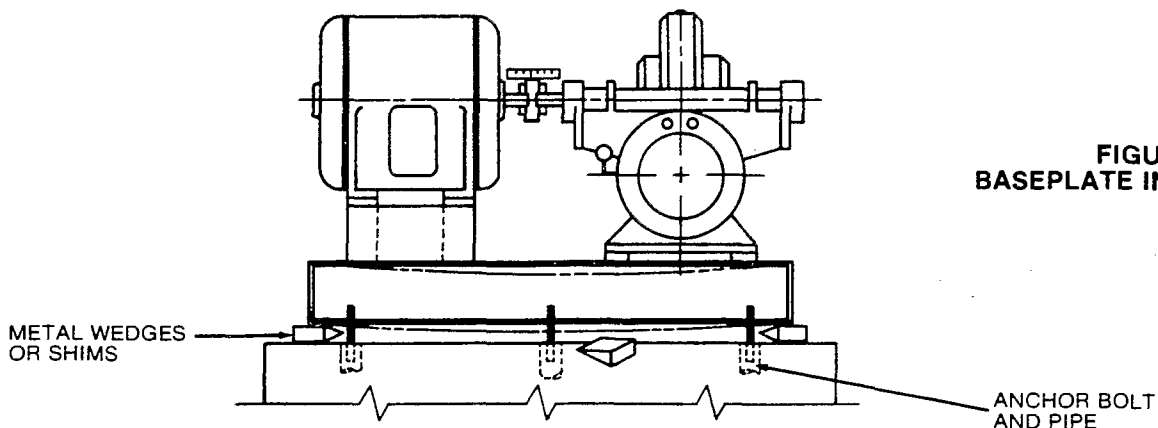


FIGURE 1
BASEPLATE INSTALLATION

7. GROUTING

When the alignment is correct, the unit should be grouted using a high grade nonshrinking grout. The entire base should be filled with grout. Be sure to fill all gaps and voids. **Allow the grout to fully cure before firmly tightening the foundation bolts. Then recheck the alignment before connecting the piping.**

8. PIPING

CAUTION: ALL PIPING CONNECTIONS MUST BE MADE WITH THE PIPE IN A FREE SUPPORTED STATE, AND WITHOUT THE NEED TO APPLY VERTICAL OR SIDE PRESSURE TO OBTAIN ALIGNMENT OF THE PIPING WITH THE PUMP FLANGE.

CAUTION: AFTER ALL THE PIPING IS CONNECTED, THE PUMP AND DRIVER ALIGNMENT MUST BE RECHECKED.

All piping should be independently supported near the pump so that pipe strain will not be transmitted to the pump casing. The suction and discharge piping should be one or two sizes larger than the pump flange sizes, especially where the piping is of considerable length. Any flexible joints installed in the piping must be equipped with tension rods to absorb piping axial thrust. Care must be exercised in arranging elbows not to generate vortexing in the pump inlet.

The suction pipe must be air tight and sloped upward to the pump flange to avoid air pockets which will impair satisfactory pump operation. The discharge pipe should be as direct as possible with a minimum of valves to reduce pipe friction losses.

A check valve and closing valve should be installed in the discharge line and a closing valve in the suction line. The check valve, between the pump and closing valve, protects the pump from water hammer and prevents reverse rotation in the event of power failure. The closing valves are used in priming, starting and when the pump is shut down. The pump must never be throttled by the use of a valve in the suction line.

9. AUXILIARY PIPING CONNECTIONS AND GAUGES

In addition to the primary piping connections, your pump may require mechanical seal and seal filter connections, connections to the lantern ring (see the "stuffing box" and "mechanical seal" sections of this manual), stuffing box drain, discharge and suction flange gauges, or baseplate drain connections. All these lines and gauges should now be installed.

10. CONSTANT LEVEL OILERS — Oil Lubricated Pumps

If your pump has oil lubricated bearings, it will be equipped with constant level oilers which will be shipped loose to prevent damage in shipment. The oilers must be installed in the tapped holes in the side of the bearing housings. To provide proper lubrication, the pipe connecting the oiler to the bearing housing must be level (see Figure 2).

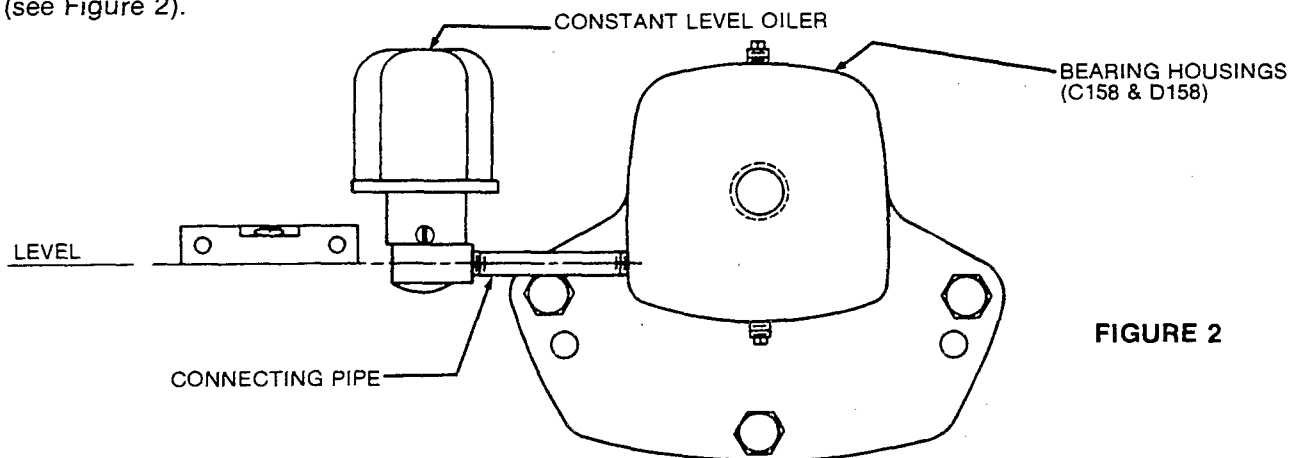


FIGURE 2

When the oiler is level, fill the bottle and screw it onto the lower reservoir of the oiler. Allow the oil to flow into the bearing reservoir. Several fillings of the bottle may be required before the oil level for which the oiler is set is reached and the oil stops flowing. After filling the bearing reservoir, check the oil level to make sure it is as specified in the following table (see page 7).

BEARING HOUSING OIL LEVEL CHART

PUMP FIGURE (Model)	2" 2873	3" 2823 3" 2874	4" 2823	5" 2824	5" 2876 6" 2825 8" 2824 10" 2824 10" 2823
			4" 2874	5" 2874	
			4" 2876	6" 2823	
			5" 2823	6" 2824	
			6" 2821	8" 2822	
			6" 2822	8" 2823	
			8" 2821	10" 2822	
			Q OF SHAFT TO OIL LEVEL	3/4	

Adjust the oil level, if necessary, by loosening the set screws on the side of the dust cap, raising the bottle, and tightening the screws. Refer to the manufacturer's instructions supplied with this manual for specific instructions.

11. FINAL COUPLING ALIGNMENT

The alignment of the coupling must be carefully checked during the installation and as the last step before starting the pump. If realignment is required, the piping should be disconnected first. After aligning, reconnect the piping in accordance with the previous instructions and again recheck the alignment.

A flexible coupling must not be used to compensate for misalignment resulting from poor installation or temperature changes.

Fairbanks Nijhuis™ pumps are supplied with several different types of commercial couplings. The following instructions apply to units supplied with a Woods coupling. If your unit has a different make coupling, a loose leaf instruction sheet will be attached to this manual and should be thoroughly studied before proceeding.

NOTE: FOR MAXIMUM LIFE, KEEP MISALIGNMENT VALUES AS NEAR TO ZERO AS POSSIBLE.

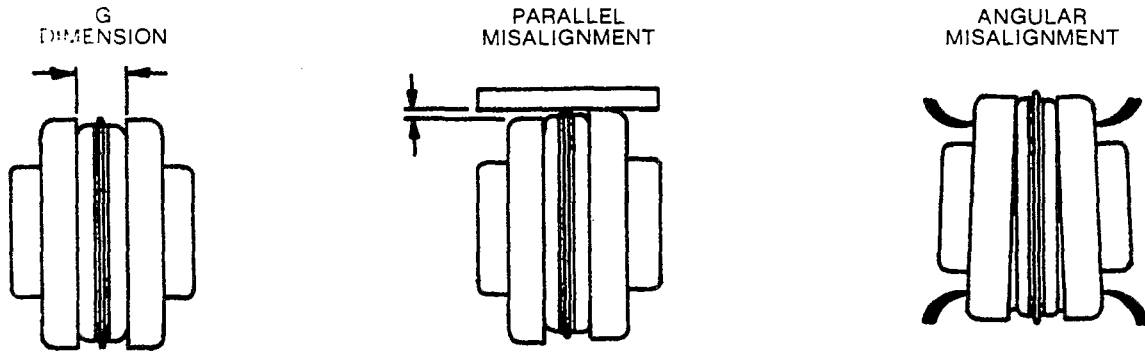
MAXIMUM ALLOWABLE MISALIGNMENT — WOODS COUPLINGS (Dimensions In Inches)

Sleeve Size	G Dimension	Types E & N		Type H*	
		Parallel	Angular	Parallel	Angular
4	5/8	.005	.021	—	—
5	3/4	.007	.028	—	—
6	7/8	.007	.035	.005	.008
7	1	.010	.040	.006	.010
8	1 1/8	.010	.047	.007	.012
9	1 7/16	.012	.054	.008	.014
10	1 5/8	.012	.064	.010	.016
11	1 7/8	.016	.075	.011	.018
12	2 5/16	.016	.087	.012	.021
13	2 11/16	.020	.092	.015	.025
14	3 1/2	.022	.121	.017	.030
16	4 3/4	.031	.165	—	—

The coupling type is printed on the sleeve.

*Type H sleeves SHOULD NOT be used as direct replacements for EPDM or Hytrel sleeves.

- A. Use a blunt screwdriver to slip the wire ring out of its groove and remove the two piece sleeve. Check the G dimension. If it is not as listed in the preceding table, loosen one flange of the coupling and reposition it to achieve the specified G dimension.
NOTE: On a sleeve bearing electric motor, the armature should be at it's electrical center when the G dimension is measured.
- B. Check parallel alignment by placing a straightedge across the two coupling flanges and measuring the maximum offset at various points around the periphery of the coupling. **DO NOT ROTATE THE COUPLING.** If the maximum offset exceeds the figure shown under "Parallel" in the preceding table, realign the coupling.



11. FINAL COUPLING ALIGNMENT (continued)

- C. Check angular alignment with a micrometer or caliper. Measure from the outside of one flange to the outside of the other at intervals around the periphery of the coupling. Determine the maximum and minimum dimensions. **DO NOT ROTATE THE COUPLING.** The difference between the maximum and minimum must not exceed the figure shown under "Angular" in the preceding table. If a correction is required, you must recheck the parallel alignment.
- D. If the coupling employs the two-piece sleeve with the wire ring, force the ring into its groove in the center of the sleeve. It may be necessary to pry the ring into position with a blunt screwdriver.

WARNING: CHECK SAFETY CODES, AND ALWAYS INSTALL PROTECTIVE GUARD OR SHIELD AS REQUIRED BY THE VARIOUS FEDERAL, STATE, AND LOCAL LAWS AND THE REGULATIONS CONCERNING OSHA.

WARNING: COUPLING SLEEVES MAY BE THROWN FROM THE ASSEMBLY WHEN SUBJECTED TO A SERVICE SHOCK LOAD.

12. DOWELLING

After the piping is connected and the final coupling alignment completed, the pump and driver should be drilled, reamed and dowelled to the baseplate using a minimum of two dowels each for the pump and driver.

13. FLEXIBLE SHAFTING ALIGNMENT

For installation and alignment of intermediate flexible shafting, refer to the manufacturer's manual.

14. ROTATION

Before connecting the coupling halves, bump start the driver and verify rotation is in the proper direction. The correct pump rotation is indicated by a directional arrow on the pump casing.

15. MECHANICAL SEALS

CAUTION: DRY OPERATION OF THE PUMP MAY CAUSE DAMAGE TO THE MECHANICAL SEAL AND IMPELLER.

These pumps can be supplied with optional single face mechanical seals. Mechanical seals are installed and adjusted in the factory and require no further adjustments in the field.

For further information, refer to the seal manufacturer's instructions supplied with this manual.

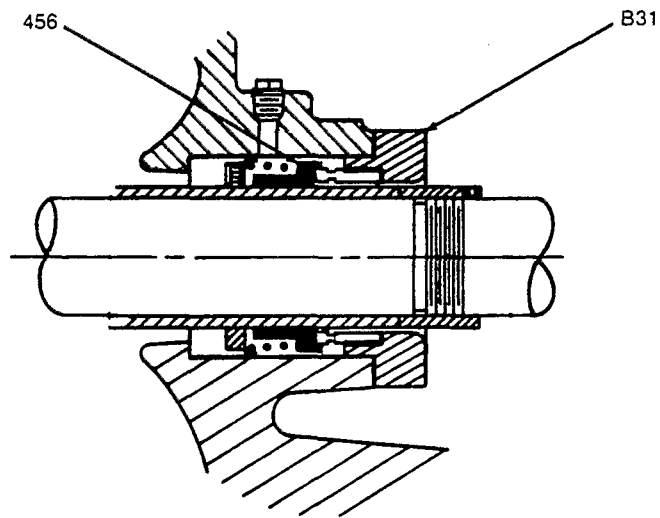


FIGURE 6
TYPICAL MECHANICAL SEAL

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:

- A. BEFORE STARTING THE PUMP, INSTALL CLOSED GUARDS AROUND THE COUPLING.**
- B. BEFORE STARTING THE PUMP, ROTATE THE UNIT OR ASSEMBLY BY HAND TO ASSURE ALL MOVING PARTS ARE FREE.**
- C. OBSERVE ALL CAUTION OR DANGER TAGS ATTACHED TO THE EQUIPMENT.**
- D. NEVER RUN THE PUMP DRY AS THE CLOSE RUNNING FITS WITHIN THE PUMP ARE WATER LUBRICATED. RUNNING DRY MAY RESULT IN PUMP SEIZURE.**
- E. BEFORE STARTING THE PUMP, FILL THE CASING AND SUCTION LINE WITH LIQUID. THE PUMP MAY BE PRIMED BY USING AN EJECTOR OR VACUUM PUMP.**
- F. BEFORE STARTING A PACKED BOX PUMP, ADJUST THE PACKING GLAND SO THERE IS SUFFICIENT LEAKAGE TO LUBRICATE THE PACKING AND ASSURE A COOL STUFFING BOX (SEE MAINTENANCE INSTRUCTIONS).**
- G. IF EXCESSIVE VIBRATIONS OR NOISE OCCURS DURING OPERATION, SHUT THE PUMP DOWN AND CONSULT A FAIRBANKS NIJHUIS™ REPRESENTATIVE.**

1. OPERATING AT REDUCED CAPACITY

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

2. PRIMING

Since the pumped medium is used to lubricate various internal parts, running a centrifugal pump dry can result in extensive damage and possible seizing. It is therefore imperative that the pump be primed prior to initial start up and that that prime be maintained through subsequent start-stop cycles.

The priming procedure is different for positive and negative suction head systems and the following procedures should be followed:

A. Positive suction head —

1. Open the vent on the highest point on the pump casing.
2. Open all suction valves.
3. Allow the liquid to flow from the vent hole until all air bubbles are vented, and then close the vent.
4. The pump is now primed.

B. Negative suction head —

1. Install an ejector or vacuum pump on the vent on the highest point on the pump casing.
2. Close the discharge valve.
3. Open the suction valve.
4. Start ejector or vacuum pump.
5. Allow the liquid to flow until a continuous flow is exhausted from the ejector, and then close the valve to the vent.
6. The pump is now primed.

3. STARTING THE PUMP

- A. After the pump is primed, and with the discharge valve closed and the suction valve open, start the driver according to the driver manufacturer's instructions.
- B. Open the discharge valve slowly to prevent water hammer.

3. STARTING THE PUMP (continued)

- C. After the pump has been started, check bearing temperature, stuffing box lubrication and operation and pump noise level for a period of several hours.

CAUTION: START THESE CHECKS IMMEDIATELY ON STARTING THE PUMP AND CONTINUOUSLY MONITOR THEM FOR THE FIRST SEVERAL HOURS OF OPERATION.

4. BEARING OPERATING TEMPERATURE

These pumps are designed to operate over a wide ambient temperature range. The bearing temperature, when measured on the outside surface of the bearing housing, should not exceed 190°F. Temperatures in excess of 190°F may indicate a lack of lubricant, bearing overload or incipient bearing failure. If the temperature exceeds this limit, the pump should be stopped and the cause investigated and corrected.

5. TROUBLESHOOTING OPERATING PROBLEMS

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 do 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 DISCHARGE PRESSURE OR FLOW

1. Pump not primed.
2. Speed too low. Check driver.
3. Discharge head too high.
4. Suction lift too high.
5. Wrong direction of rotation.
6. Air leaks into suction piping, stuffing box or gaskets.
7. Impeller passage partially plugged
8. Impeller damaged.
9. Impeller running clearance too large.
10. Insufficient suction line submergence.
11. Air in liquid.
12. Impeller diameter too small.
13. Insufficient net positive suction head.

LOSS OF SUCTION DURING OPERATION

1. Suction line leaks.
2. Water seal line plugged.
3. Suction lift too high.
4. Air or gases in liquid.
5. Air leaks into suction piping, stuffing box or gaskets.
6. Wrong direction of rotation.
7. Insufficient suction line submergence.

EXCESSIVE POWER CONSUMPTION

1. Speed too high.
2. Head lower than rating, pumps too much liquid.
3. Specific gravity or viscosity of liquid pumped is too high.
4. Mechanical defects:
 - *Shaft bent.
 - *Rotating element binds.
5. Misalignment.
6. System head lower than design.
7. Incorrect diameter impeller.

VIBRATION OR NOISE

1. Misalignment between driver and pump.
2. Foundation bolts loose or defect in grouting.
3. Mechanical defects:
 - *Shaft bent.
 - *Rotating element binds.
4. Head lower than rating, pumps too much liquid.
5. Pipe strain -- improperly supported or aligned.
6. Pump running at shut-off condition.
7. Insufficient suction line submergence
8. Air in liquid.

OVER-HEATING

1. Bearings:
 - *Excessive grease.
 - *Shaft bent.
 - *Rotating element binds.
 - *Pipe strain.
 - *Insufficient bearing lubrication.
 - *Incorrect type grease.
2. Packing box:
 - *Packing gland too tight.
 - *Water seal line plugged.
 - *Air not vented out of mechanical seal.
 - *Flushing water not circulating for mechanical seal.

2. INSPECTIONS AND PREVENTATIVE MAINTENANCE REQUIREMENTS

To assure satisfactory operation of the pump, daily inspections and periodic maintenance are required. We suggest that an inspection and maintenance log be kept and that the inspector immediately report any problems. A guide for preventative maintenance for normal applications is given below. Unusual applications with abnormal heat, moisture, dust, etc., may require more frequent inspections and service.

ITEM	ACTION REQUIRED	FREQUENCY (HOURS OF OPERATION)
Packing Box	Adjust gland, inspect packing for possible replacement	150 hours
Pump Alignment	Check for change in alignment	ANNUALLY
Vibration	Check for change in vibration	ANNUALLY
Bearings	Lubricate	Every 2,000 hours of operation, but at least once a year
Grease lubricated		As required to maintain proper level — drain & replace oil every 2,000 hours of operation, but at least once a year.
Oil lubricated		

3. BEARING LUBRICATION

A. Grease Lubricated Bearings

Under normal operating conditions, the bearings must be lubricated after every 2,000 hours of running time, but at least once a year regardless of total operating hours.

CAUTION: ANY APPLICATION WITH ABNORMAL HEAT, MOISTURE, DUST, ETC., MAY REQUIRE A CHANGE IN THIS SCHEDULE AND YOU SHOULD REFER TO A LUBRICATION ENGINEER OR THE FACTORY FOR SPECIFIC INSTRUCTIONS.

CAUTION: THE GREASES RECOMMENDED IN THIS MANUAL WILL PROVIDE SATISFACTORY LUBRICATION OVER A WIDE TEMPERATURE RANGE. THERE IS, HOWEVER, A PRACTICAL LIMIT, AND OPERATION OF THE PUMP SHOULD BE DISCONTINUED AND THE FACTORY CONSULTED IF THE TEMPERATURE, WHEN MEASURED ON THE OUTSIDE OF THE BEARING HOUSING, EXCEEDS 190°F.

RECOMMENDED GREASE: N.L.G.I. No. 2 lithium base multi-purpose with a mineral oil viscosity of 950-1250 SUS at 100°F., and 80-82 SUS at 210°F.

Proceed as follows for bearing lubrication:

WARNING: KEEP HANDS, FINGERS, CLOTHING AND ANY TOOLS AWAY FROM THE COUPLING. FAILURE TO DO SO COULD RESULT IN SERIOUS PERSONAL INJURY.

1. Stop the pump and remove the pipe plug at the bottom of the bearing housing.
2. Connect a grease gun to the lubrication fittings.
3. Inject grease until it relieves at the bearing housing cover and drain hole.
4. Remove the grease gun.
5. Start the pump. NOTE: Immediately after lubrication, bearing temperatures may rise above the normal level. Continue running the unit until bearing temperatures stabilize at the normal level.
6. Stop the unit, wipe off the relieved grease and replace the drain plug.
7. Start the unit and resume normal operation.

B. Oil Lubricated Bearings

Fill the constant level oiler and add additional oil as required. Replace the old oil with new every 2,000 hours, but at least once a year. Drain the oil by removing the plug at the bottom of the bearing housings (C158 and D158).

3. BEARING LUBRICATION (continued)

Check the oiler setting periodically to insure the setting is correct. Refer to the following table for correct setting.

BEARING HOUSING OIL LEVEL CHART

PUMP FIGURE (Model)	2" 2873	3" 2823 3" 2874	4" 2823	5" 2824	5" 2876 6" 2825 8" 2824 10" 2824 10" 2823					
			4" 2874	5" 2874						
			4" 2876	6" 2823						
			5" 2823	6" 2824						
			6" 2821	8" 2822						
			6" 2822	8" 2823						
			8" 2821	10" 2822						
			Q OF SHAFT TO OIL LEVEL			3/4	7/8	1 3/16	1 1/2	1 13/16

RECOMMENDED OILS: The oil used should be a non-detergent type containing rust and oxidation inhibitors, supplied by a reputable manufacturer.

Depending on bearing/pump operating temperature, the grade and viscosity should be as follows:

- Below 120°F — ISO Vg Grade 40-70 (SAE 20)
- 120°F to 250°F — ISO Vg Grade 70-100 (SAE 30)
- Above 250°F — Consult the factory for a recommendation.

4. STUFFING BOX

CAUTION: DO NOT TIGHTEN THE GLAND TO STOP ALL LEAKAGE. LEAKAGE IS NECESSARY TO INSURE THE COOLING, FLUSHING AND LUBRICATION OF THE PACKING AND TO PREVENT SHAFT SLEEVE DAMAGE.

The stuffing boxes on Fairbanks Nijhuis™ pumps are packed at the factory. All packing is subject to wear and should be given regular inspections and, if necessary, periodic adjustments. Generally, packed box pumps require inspection of the packing and adjustment of the gland after each 150 hours of operation.

Adjustment is accomplished by lightly tightening the gland nuts, and then loosening them so they can be adjusted with finger pressure to allow a small flow of liquid to lubricate the packings. If the flow of liquid has increased and cannot be reduced by a slight tightening of the gland, add one ring of packing to the stuffing box and readjust the gland. If this fails to reduce the flow, replace the packing and/or shaft sleeve.

The stuffing boxes may be fitted with water seal rings. When a seal ring is furnished, the sealing chamber should be connected to a source of clear, fresh water.

5. PACKING REPLACEMENT

Use a good grade of soft, square, long fiber packing, thoroughly graphited. The replacement procedure should be as follows:

- A. Stop the pump.
- B. Unbolt and remove the glands away from the packing.
- C. Use a packing hook to remove the worn packing and water seal rings. Note the location of the water seal rings relative to the amount of packing on each side of the rings. (See sectional drawings, page 25.)
- D. Clean the packing boxes and shaft sleeves.
- E. Inspect the shaft sleeves for wear or rough finish and replace if necessary.
- F. Install the new packing and water seal rings.

CAUTION: STAGGER THE PACKING END JOINTS 180° AND FIRMLY SEAT THE PACKING. THE FOLLOWING TABLE GIVES THE PERTINENT STUFFING BOX, SEAL CAGE AND PACKING DIMENSIONS (see page 14).

5. PACKING REPLACEMENT (continued)

	PUMP FIGURE (Model)					
	2" 2873	3" 2823	3" 2874	4" 2823 4" 2874 4" 2876 5" 2823 6" 2821 6" 2822 8" 2821	5" 2824 5" 2874 6" 2823 6" 2824 8" 2822 10" 2822	5" 2876 6" 2825 8" 2824 10" 2823
STUFFING BOX						
O.D. Sleeve	1 ⁵ / ₈	2	2	2 ¹ / ₂	3	3 ¹ / ₂
I.D. Box	2 ⁷ / ₁₆	2 ¹⁵ / ₁₆	2 ¹⁵ / ₁₆	3 ⁹ / ₁₆	4 ⁷ / ₁₆	4 ¹¹ / ₁₆
Box Depth	2 ¹⁵ / ₁₆	3 ³ / ₈	2 ¹⁵ / ₁₆	3 ⁷ / ₈	4 ⁷ / ₁₆	4 ³ / ₄
PACKING SIZE	³ / ₈	⁷ / ₁₆	⁷ / ₁₆ X ³ / ₈	¹ / ₂	⁹ / ₁₆	⁵ / ₈
RINGS OF PACKING PER BOX (No Seal Cage)	7	7	7	7	7	7
SEAL CAGE WIDTH	³ / ₄	³ / ₄	³ / ₄	1	1 ¹ / ₈	1 ¹ / ₄
PACKING ARRANGEMENT WITH WATER SEAL RING (Packing Rings-Seal Cage-Packing Rings)*	2-C-3	2-C-3	2-C-3	2-C-3	2-C-3	2-C-3

*(See sectional drawings on page 25.)

- G. Reinstall the gland and tighten the gland nuts.
- H. Loosen the gland nuts so they can be adjusted with finger pressure to obtain correct leakage for lubrication after start-up.

6. PUMP DISASSEMBLY

CAUTION: READ THIS ENTIRE DISASSEMBLY PROCEDURE AND REFER TO THE SECTIONAL DRAWINGS IN THIS MANUAL BEFORE PROCEEDING.

Major maintenance will require disassembly of the pump. The following are step by step instructions.

- A. Lock out the power to the driver and close the suction and discharge valves. Drain the pump, disconnect and remove the coupling or flexible shafting. Disconnect and remove all auxiliary piping to the upper casing (3) and bearing housings (C158 and D158) (stuffing box injection line, lubricators on oil lubricated pumps, cooling water lines on pumps with cooled bearings, etc.).
- B. Remove the capscrews (2A) securing the upper casing half (3) to the lower half (2). Remove the gland nuts (31B) and slide the glands (A31 or B31) off the gland studs (31A). Install jackscrews in the tapped holes in the upper half casing flange and use them to separate the flanges. Carefully lift the upper casing half using the long shank eyebolts in the tapped holes in the upper casing half.

CAUTION: THE USE OF A CRANE OR HOIST OF ADEQUATE CAPACITY IS RECOMMENDED. THE LIFTING HOOK SHOULD BE NO LESS THAN 3-4 FEET ABOVE THE EYE OF THE EYEBOLTS TO AVOID BENDING OF THE BOLTS. THE USE OF THE SHORT EYEBOLTS IS NOT RECOMMENDED SINCE THE UPPER CASING HALF WILL TEND TO TIP WHILE BEING LIFTED, RESULTING IN POSSIBLE DAMAGE.

- C. Remove the capscrews (158B) and pins (158A) that secure the bearing housings (158) to the lower casing. The pins may be removed using the threaded holes in the pins.
- D. Lift the rotor assembly from the lower casing using a double rope sling.

WARNING: BE CAREFUL WHEN POSITIONING THE ROPES TO AVOID THE ROTOR SLIPPING AND CAUSING POSSIBLE SERIOUS PERSONAL INJURY.

6. PUMP DISASSEMBLY (continued)

- E. Remove the capscrews (159D) that secure the bearing housing covers (159) to the bearing housings and remove the housings from the rotating assembly.
- F. Remove the outer snap ring (345) from the outboard bearing end of the rotating assembly, and use a wheel/bearing puller to remove the outboard (168) and inboard (163) bearings.

WARNING: TO PREVENT POSSIBLE SERIOUS PERSONAL INJURY, EXTREME CARE SHOULD BE EXERCISED TO SELECT THE PROPER PULLER AND APPROVED SAFETY GLASSES SHOULD BE WORN.

CAUTION: BECAUSE OF POSSIBLE DAMAGE OR CONTAMINATION DURING REMOVAL, BEARINGS SHOULD NOT BE REUSED AND NEW BEARINGS SHOULD ALWAYS BE INSTALLED.

- G. Remove bearing housing covers (159), water deflectors (126), casing wearing rings (16), water seal rings (10) and packing (212). If the pump is equipped with mechanical seals (456), refer to the seal manufacturer's instructions supplied with the pump.

If the pump is equipped with an oil lubrication system, remove the lip seals (158C) from the inboard and outboard bearing housing covers and the inboard bearing housing.

- H. Remove the shaft sleeves (A14 or B14). Depending on the pump service, shaft sleeves are supplied in two different configurations. The removal procedure for each configuration differs:

Sleeves Affixed With Loctite: Remove the shaft sleeve nuts (213) (if they are provided), heat the sleeves to approximately 450°F to break the bond and then tap them with a brass or copper mallet.

WARNING: TO PREVENT POSSIBLE SERIOUS PERSONAL INJURY, HEAT RESISTANT GLOVES MUST BE WORN WHEN HANDLING HEATED PARTS.

Sleeves Keyed To Shaft: Remove the shaft sleeve nuts (213), shaft sleeves (B14) and the shaft sleeve o-rings (452).

CAUTION: BECAUSE OF POSSIBLE DAMAGE DURING DISASSEMBLY, O-RINGS SHOULD NOT BE REUSED AND NEW O-RINGS SHOULD ALWAYS BE INSTALLED.

- I. Slide the impeller (1) off the shaft (4) and remove the impeller key (102).
- J. If your pump has impeller wear rings (17) and if they require replacement, they will be secured by one of two methods, and you should proceed as follows:

Wearing Rings Secured With Loctite: Heat the rings to approximately 450°F to break the bond and then tap them with a brass or copper mallet. If heating fails to affect removal, the rings may be ground off.

Wearing Rings Secured With Set Screws: Remove the set screws (17A) and chisel cut or grind the rings in two at the set screw hole location.

WARNING: TO PREVENT POSSIBLE SERIOUS PERSONAL INJURY, HEAT RESISTANT GLOVES MUST BE WORN WHEN HANDLING HEATED PARTS.

WARNING: TO PREVENT POSSIBLE SERIOUS PERSONAL INJURY, EXTREME CARE SHOULD BE EXERCISED TO SELECT THE PROPER GRINDING EQUIPMENT AND APPROVED SAFETY GLASSES SHOULD BE WORN WHEN GRINDING.

- K. The pump disassembly is now complete. All parts should be thoroughly cleaned and inspected for wear or damage and replaced if required.

7. PUMP ASSEMBLY

CAUTION: READ THIS ENTIRE PROCEDURE BEFORE PROCEEDING.

The following are step by step instructions for assembly of the pump and are essentially the reverse order of the instructions for disassembly.

- A. Thoroughly clean all parts to remove all oil, grease and any foreign material, and inspect for wear or damage and replace if required. Remove all parts to a clean and dust-free location for assembly. Gaskets, grease seals and bearings should not be reused and should always be replaced with new parts.
- B. If the impeller wear rings (17) require replacement, they are a light press fit and will be secured by one of the following methods. You should proceed as follows:

Rings Secured With Loctite: Apply a light film of Loctite No. 290 to the impeller part of the impeller/wear ring fit and install the rings.

Rings Secured With Set Screws: Press the rings in place and drill and tap them using the same size and number of set screws as originally provided. The new holes should be 15° to 20° from the old holes. Install and tighten the set screws.

CAUTION: BE CAREFUL NOT TO DRILL THROUGH THE IMPELLER AND BE SURE TO PRESS THE WEAR RINGS COMPLETELY IN PLACE. THEY SHOULD BE FIRMLY BUTTED AGAINST THE CORRESPONDING IMPELLER SHOULDER.

- C. Install the impeller key (102) in the shaft (4) and slide the impeller (1) over the key centering it between the shaft shoulders as shown in Figure 7.

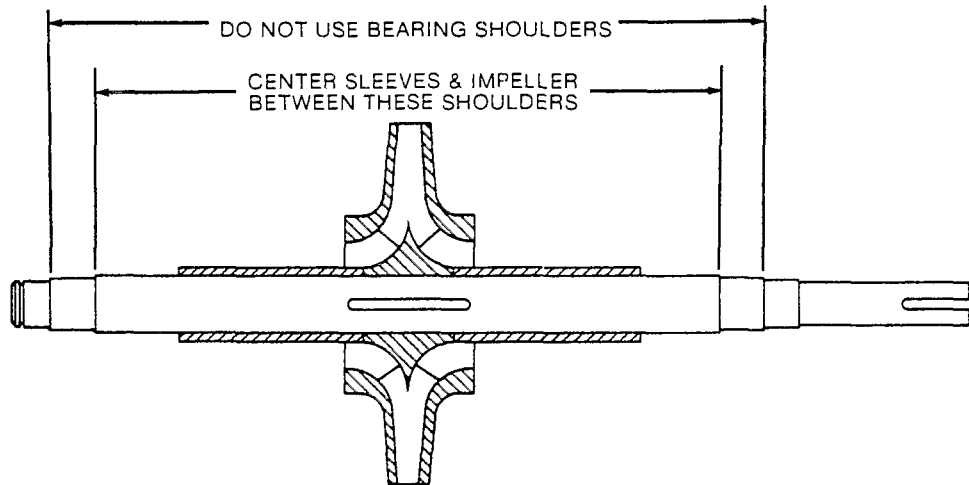


FIGURE 7

CAUTION: IF THE SHAFT SLEEVES ON YOUR PUMP ARE SECURED WITH LOCTITE ONLY, REFER TO THE SHAFT SLEEVE INSTALLATION INSTRUCTIONS BEFORE INSTALLING THE IMPELLER.

- D. Install the shaft sleeves (A14 or B14), shaft sleeve nuts (213) and o-rings (452), if your pump uses them, on the shaft. The shaft sleeves will be secured by one of three methods and you should proceed as follows:

Sleeves Secured With Loctite And Sleeve Nuts: Apply two beads of Loctite No. 601 around the shaft on the shaft/shaft sleeve fit, one approximately 2 inches from the impeller hub and the second at the threaded end. Slide the shaft sleeves part way onto the shaft and rotate them at least one full revolution to evenly spread the Loctite, then slide the sleeves over the shaft until they butt firmly against the impeller hub. Install and tighten the shaft sleeve nuts (213) and the set screws (213A).

7. PUMP ASSEMBLY (continued)

Sleeves Secured With Loctite Only: Clean the shaft, the bore of the sleeves and the bore of the impeller with Loctite "Safety Solvent" #75559.

Install the impeller key in the shaft and coat the impeller area of the shaft with Loctite 601 and press the impeller onto the shaft, centering it between the shoulders as shown in Figure 7.

Coat the shaft on the shaft/shaft sleeve fit and the bore of the sleeves with Loctite 601. Slide the sleeves part way onto the shaft and rotate them at least one full revolution to evenly spread the Loctite, then slide the sleeves over the shaft until they butt firmly against the impeller hub. Check the sleeve location again and let the Loctite cure for 8 hours before completing the pump assembly.

Sleeves Installed With O-Rings: Slide the shaft sleeves over the shaft until they engage the key and butt firmly against the impeller hub. Install the o-rings in the outboard shaft sleeve nut end of the sleeve and tighten the shaft sleeve nuts and set screws.

CAUTION: THE LINEAR POSITION OF THE IMPELLER MUST BE OBTAINED AND THE SHAFT SLEEVES MUST BE PROPERLY LOCATED. REFER TO FIGURE 7 ON PAGE 17 OF THIS MANUAL. IF PROVIDED, SHAFT SLEEVE NUTS MUST BE TIGHTENED WITHIN 10 MINUTES AFTER THE LOCTITE IS APPLIED. TO ACCOMPLISH LINEAR POSITIONING OF THE IMPELLER, LEAVE AN EQUAL AMOUNT OF SHAFT OR SHAFT THREADS EXPOSED ON EACH END OF THE SHAFT AFTER THE ASSEMBLY IS COMPLETED. ALLOW 4 HOURS FOR THE LOCTITE TO CURE BEFORE COMPLETING THE PUMP ASSEMBLY.

CAUTION: THIS PUMP MAY BE SUPPLIED IN SEVERAL DIFFERENT CONFIGURATIONS. EACH USES DIFFERENT BEARING COVERS AND HOUSINGS WITH DIFFERENT DRAWING REFERENCE NUMBERS. DESPITE THE FOLLOWING INSTRUCTIONS, ALWAYS REFER TO THE SECTIONAL DRAWINGS CONTAINED IN THIS MANUAL BEFORE PROCEEDING, TO INSURE YOU HAVE INSTALLED ALL REQUIRED LIP SEALS, O-RINGS, ETC.

- E. If your pump is oil lubricated, install the lip seals (159C) in the outboard and inboard bearing covers (B159) and the lip seal (158C) in the inboard bearing housing (C158). Assemble the o-rings (159A) on the bearing covers prior to installing the bearings.
- F. If your pump is equipped with mechanical seals or solid packing glands, install the seals (156) and mechanical seal glands (B31) or solid packing glands before proceeding. Refer to the seal manufacturer's instructions supplied with your pump.
- G. Install the water deflectors (126) on each end of the shaft.
- H. Install the outboard and inboard bearing covers (A159 or B159) on the shaft.
- I. Install the outboard (168) and inboard bearings (163).

WARNING: TO PREVENT POSSIBLE SERIOUS PERSONAL INJURY AND DAMAGE TO THE BEARINGS, PRESSURE SHOULD BE APPLIED TO THE INNER BEARING RACE ONLY.

NOTE: The pump is designed to have a .000 to .001 interference fit between the bearings and the shaft.

- J. Install the snap ring (345) on the outboard end of the shaft. Pack both bearings approximately one-half full of a lithium base NGLI2 all-purpose bearing grease.
- K. Install the bearing housings (A158 and B158 if grease lubricated, or C158 and D158 or E158 and F158) over the bearings and securely bolt the bearing covers to the bearing housings using the appropriate capscrews (159D).
- L. Using a double rope sling, carefully lower the rotor assembly into position in the lower casing (2).

WARNING: BE CAREFUL WHEN POSITIONING THE ROPES TO AVOID THE ROTOR SLIPPING AND CAUSING POSSIBLE SERIOUS PERSONAL INJURY.

CAUTION: WHEN LOWERING THE ROTOR, BE CAREFUL TO PROPERLY POSITION THE WEARING RINGS. FAILURE TO DO SO COULD SERIOUSLY DAMAGE THE RINGS.

7. PUMP ASSEMBLY (continued)

- M. Attach the bearing housings to the lower casing, using the appropriate dowel pins (158A) and capscrews (158B).

CAUTION: BE SURE THE BEARING HOUSING/CASING MATING SURFACES ARE CLEAN AND FREE FROM BURRS, AS THIS WILL AFFECT ALIGNMENT OF THE ROTOR/CASING.

- N. Inspect the upper casing (3) to assure the water passage is clean and free from foreign material. Apply a light coat of grease to the upper and lower casing mating surfaces and install a new casing gasket (157) on the lower casing, making sure the holes are aligned. Position the pins in the casing wearing rings to align with the slots in the lower casing. Lower the upper casing into position, install the casing alignment pins (2B) and securely bolt the upper and lower casing together using the capscrews (2A).
- O. Install the packing (212), water seal rings (10), split glands (19), and gland nuts (31B).

The pump assembly is now complete except for packing adjustment, which should be accomplished after the pump is installed, primed and started up. Refer to the maintenance section of this manual for specific packing adjustment instructions.

ORDERING PARTS

There are a variety of options available for this pump. When ordering parts, give pump serial number, size and figure number and 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 Fairbanks Nijhuis™ Distributor or directly from the factory. Consult your local telephone yellow pages for the office nearest you.

RETURNING PARTS

Unnecessary delays and wasted effort will be avoided if you use the proper procedure to return parts or equipment. All materials or parts returned to the factory must have prior approval and a "Returned Goods Tag"

Contact your nearest Fairbanks Morse distributor, listing the material to be returned and the reasons for the return. He will contact the factory to obtain the required approval and "Returned Goods Tag". All material to be returned should be carefully packed to avoid damage in route from rough handling or exposure to weather. The "Returned Goods Tag" will give shipping instructions. All material to be returned freight prepaid.

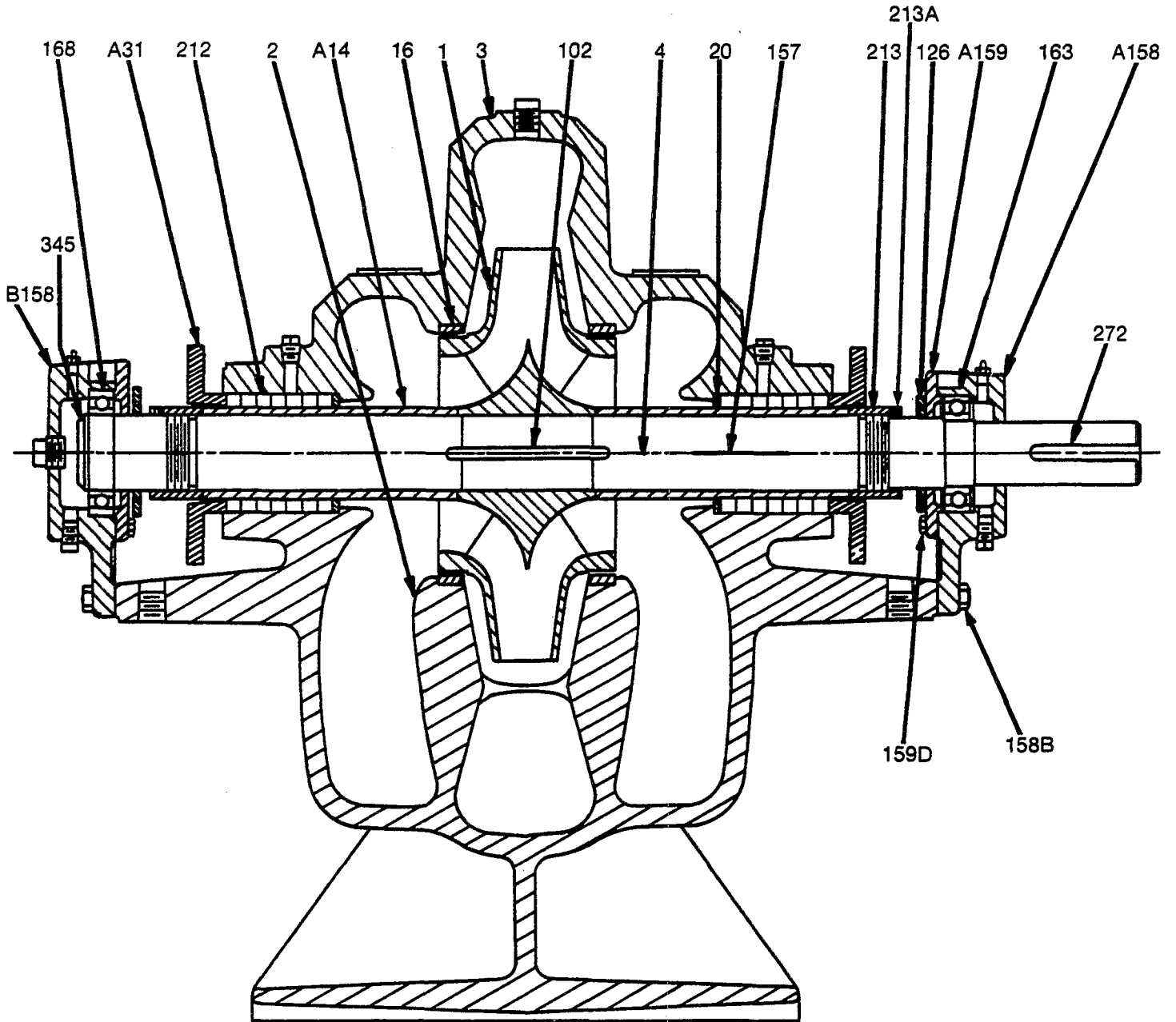
Fairbanks Nijhuis makes improvements on its products from time to time and reserves the right to furnish improved parts for repairs. A part that is received and is not identical in appearance, or has a different symbol from the original part, may be interchangeable. Examine the part carefully before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

**RECOMMENDED SPARE PARTS
For Normal Duty:**

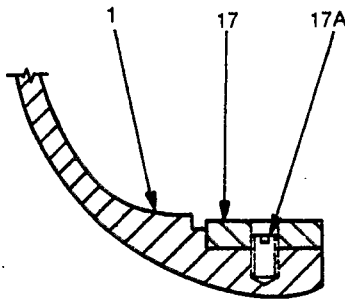
REF. NO.	DESCRIPTION
10	SLEEVE, SHAFT
14	SLEEVE SHAFT
16	WEAR RINGS, CASING
17	WEAR RINGS, IMPELLER (IF ON ORIGINAL CONSTRUCTION)
163	BEARING, INNER
168	BEARING, OUTER
212	PACKING (OR MECHANICAL SEAL)
	GASKETS, COMPLETE SET

For Severe Duty, Add The Following:

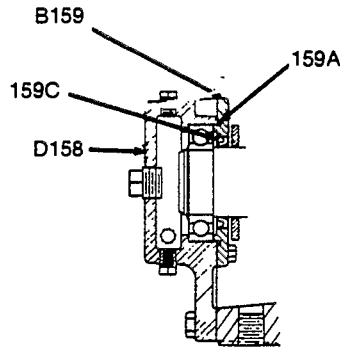
REF. NO.	DESCRIPTION
	COMPLETE ROTATING ASSEMBLY



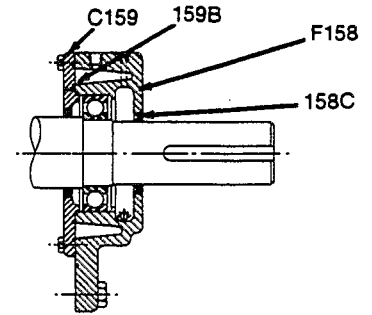
STANDARD CONSTRUCTION



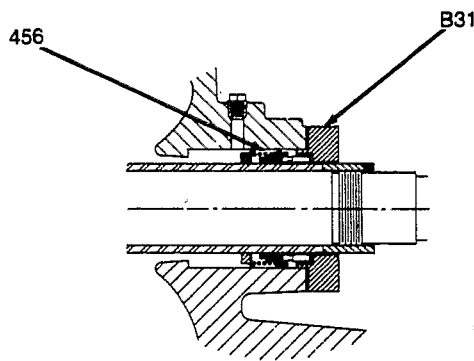
**"OPTIONAL" MECHANICALLY LOCKED
IMPELLER WEAR RING**



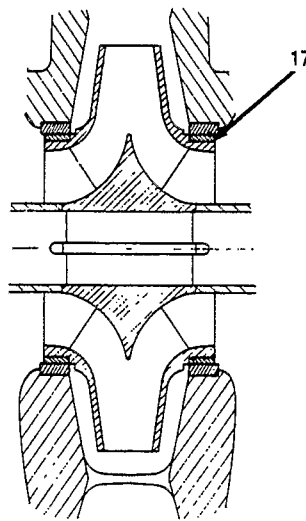
**OIL LUBRICATED
BEARING HOUSING**



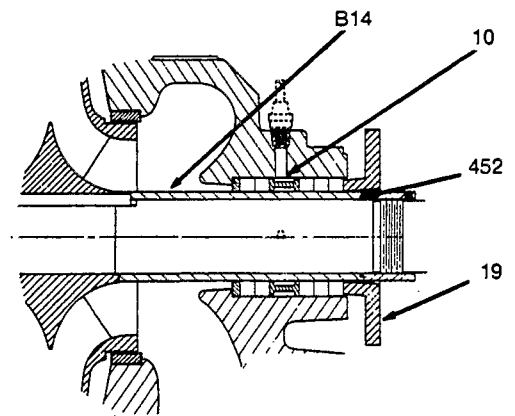
**WATER COOLED
BEARING HOUSING**



TYPICAL MECHANICAL SEAL



**IMPELLER WITH
WEAR RINGS**



**KEY DRIVEN SHAFT SLEEVE
WITH O-RING SEAL, ALSO
WATER SEAL RING WITH
EXTERNAL FLUSH CONNECTION**

REF. NO.	DESCRIPTION	REF. NO.	DESCRIPTION
1	IMPELLER	*C158	HOUSING, INBOARD OIL LUBE BEARING
2	CASING, LOWER HALF	D158	HOUSING, OUTBOARD OIL LUBE BEARING
*2A	CAPSCREWS, CASING	*E158	HOUSING, INBOARD WATER COOLED BEARING
*2B	PIN, CASING ALIGNMENT	F158	HOUSING, OUTBOARD WATER COOLED BEARING
*2C	PLUGS, CASING PIPE	*158A	PIN, BEARING HOUSING ALIGNMENT
3	CASING, UPPER HALF	*158B	CAPSCREW, HOUSING
4	SHAFT	158C	LIPSEAL
10	RING, WATER SEAL	*158D	PLUG, HOUSING PIPE
A14	SLEEVE, SHAFT	A159	COVER, GREASE LUBE BEARING HOUSING
B14	SLEEVE, SHAFT, KEYED	B159	COVER, OIL LUBE BEARING HOUSING
16	RING, CASING WEAR	C159	COVER, WATER COOLED BEARING HOUSING
17	RING, IMPELLER WEAR	159A	O-RING, OIL LUBE COVER
17A	SET SCREW	159B	O-RING, WATER COOLED COVER
19	GLAND, SPLIT PACKING	159C	LIPSEAL
20	WASHER, STUFFING BOX	*159D	CAPSCREW, HOUSING COVER
A31	GLAND, SOLID PACKING	163	BEARING, INBOARD
B31	GLAND, SOLID MECHANICAL SEAL	168	BEARING, OUTBOARD
*31A	STUD, GLAND	212	PACKING
*31B	NUT, GLAND	213	NUT, SHAFT SLEEVE
102	KEY, IMPELLER	213A	SET SCREW
126	WATER DEFLECTOR	272	KEY, COUPLING
157	GASKET, CASING	345	RING, SNAP
A158	HOUSING, INBOARD GREASE LUBE BEARING	452	O-RING, SHAFT SLEEVE
B158	HOUSING, OUTBOARD GREASE LUBE BEARING	456	SEAL, MECHANICAL

*Not Shown

