BLACKMER POWER PUMPS

INSTALLATION, OPERATION, AND MAINTENANCE INSTRUCTIONS

MODELS: NP, NPJ

1½, 2, 2½, 3B, 4A

960240
INSTRUCTIONS NO. 185/ZF

Section	100
Effective	August 1990
Replaces	June 1984

DISCONTINUED MODELS

WARNING

THIS PRODUCT MUST ONLY BE INSTALLED IN SYSTEMS WHICH HAVE BEEN DESIGNED BY THOSE QUALIFIED TO ENGINEER SUCH SYSTEMS. THE SYSTEM MUST BE IN ACCORDANCE WITH ALL APPLICABLE REGULATIONS AND SAFETY CODES AND WARN OF ANY HAZARDS UNIQUE TO THE PARTICULAR SYSTEM.

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INSTALLATION

CLEANING PRECAUTIONS

Foreign matter entering the pump can cause extensive damage. The suction tank and piping should be cleaned and flushed before installing the pump.

LOCATION AND PIPING

Pump life and performance can be significantly reduced when installed in an improperly designed system. Before starting the layout and installation of the piping system, consider the following suggestions:

1. Locate the pump as near as possible to the source of supply to avoid excessive inlet pipe friction.
2. The inlet line should be at least as large as the intake port on the pump. It should slope downward to the pump, and should not contain any upward loops. Eliminate restrictions such as sharp bends, globe valves, unnecessary elbows, and undersized strainers.
3. It is recommended a strainer be installed in the inlet line to protect the pump from foreign matter. The strainer should be located at least 24" (0.6 m) from the pump, and have a net open area of at least four times the area of the intake piping. Strainers must be cleaned regularly to avoid pump starvation.
4. The intake system must not contain any air leaks. If practical, this should be verified by applying air pressure to the system.
5. Expansion joints, placed at least 36" (0.9 m) from the pump, will compensate for expansion and contraction of the pipes.
6. The use of a check valve or foot valve at the supply tank is generally not recommended with a self-priming, positive displacement pump. If this type of valve is to be used, it should be located near the pump on the discharge side.

MOUNTING THE PUMPING UNIT

A solid foundation reduces noise and vibration, and will improve pump performance. On permanent installations it is recommended the pumping unit be secured by anchor bolts as shown in Figure 1. This arrangement allows for slight shifting of position to accommodate alignment with the mounting holes in the base plate.

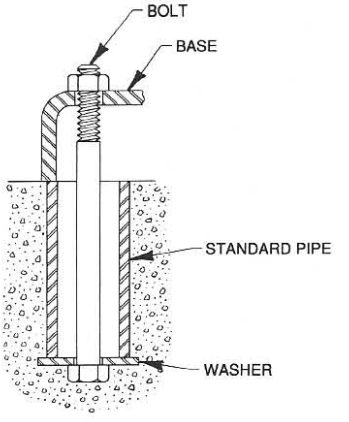

Figure 1 - Pipe Type Anchor Bolt Box

For new foundations, it is suggested that the anchor bolts be set in concrete. When pumps are to be located on existing concrete floors, holes should be drilled into the concrete to hold the anchor bolts.

JACKETED PUMPS - NPJ MODELS

Hot oil or steam can be circulated through jacketed heads by connections at the ⅜" NPT pipe plugs directly above and below the shaft for heating highly viscous liquids, or to "thaw out" liquids which have congealed in the pumping chamber and packing area. Maximum recommended steam pressure is 150 psi (1034 kPa).

Make sure heat is applied early enough to sufficiently thin the liquid before starting the pump. Liquids that congeal in the relief valve chamber will make the valve inoperative. Insulation of the pump with sufficient heat to the jackets will usually thin the liquid in the relief valve chamber. However, precautions should be taken to ensure the valve has free movement. It is advisable to start the pump with an open discharge.

OPERATION

PRE-START UP CHECK LIST

1. Check the alignment of the pipes to the pump. Pipes should be supported so that they do not spring away or drop down when pump flanges or union joints are disconnected.
2. Check the alignment of the motor, gear reducer, and the pump. Where flexible couplings are used, remove the coupling cover and lay a straight edge across the two hubs of the coupling (see Figure 2). The maximum offset should be less than .015" (.381 mm).

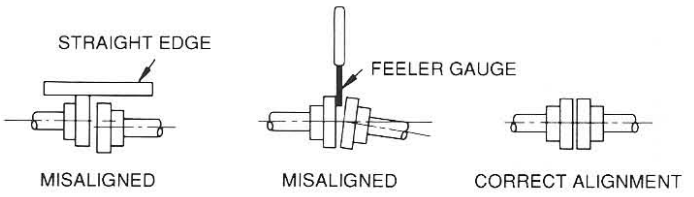

Figure 2 - Alignment Check

Check for angular misalignment of the coupling halves with the use of a feeler gauge, or a piece of flat steel. Check in four places around the coupling. Maximum variation should not exceed .020" (.508 mm).

NOTE: After the pump has been in operation for a week or two, completely recheck alignment.

3. Couplings with rubber inserts do not require lubrication. All other couplings are pre-lubricated at the factory, but require frequent lubrication to prevent excessive wear.
4. **Blackmer helical gear reducers are shipped from the factory without oil in the gearcase.** Fill with the grade of oil indicated on the reducer tag. For more specific instructions on Blackmer gear reducers, refer to Parts Lists 186/B1 through 186/B8.
5. Check the entire pumping system to verify that the proper inlet and discharge valves are fully open, and that the drain valves and other auxiliary valves are closed.
6. It is recommended to install vacuum and pressure gauges on the pump in the threaded connections provided. These can be used to check actual suction and discharge conditions after pump start-up.
7. Check the wiring of the motor, and briefly turn on the power to make sure that the pump rotates in the direction of the rotation arrow.

START UP PROCEDURE

NOTE: If there is a problem with any of the following items, or if the pump is abnormally noisy, see "General Pump Troubleshooting" for possible causes.

1. Start the motor. Priming should occur within one minute.
2. Check the vacuum and pressure gauges to see if the pump is operating within the expected conditions.
3. Check for leakage from the piping and equipment.
4. Check for overheating of the pump, reducer, and motor.
5. If possible, check the flow rate.
6. Check the pressure setting of the relief valve by briefly closing a valve in the discharge line and reading the pressure gauge. This pressure should be 15 - 20 psi (103 - 138 kPa) higher than the maximum operating pressure. **CAUTION: Do not run the pump for more than 10 - 15 seconds with the discharge valve completely closed.** If adjustments need to be made, refer to "Relief Valve Setting and Adjustment."

RUNNING THE PUMP IN REVERSE

It is sometimes desirable to run the pump in reverse to drain a line. The pump is satisfactory for this type of operation, but the flow rate will decrease depending on the system conditions and the pump speed. When running the pump in reverse, a separate relief valve is recommended in order to protect the pump from excessive pressures.

FLUSHING THE PUMP

1. To flush the pump, run the pump with the discharge valve open and the intake valve closed. Bleed air into the pump through the intake gauge plug hole or through the larger auxiliary fitting on the intake line. Pump air for 30 second intervals to clean out most of the pumpage.
2. Run cleaning fluid through the pump for one minute to clean out the remainder of the original pumpage. It is recommended to keep the pump full of cleaning fluid until the pump is used again. **NOTE:** The cleaning fluid must be compatible with the vane material if the fluid is to be left in the pump for an extended period of time.
3. Flush out the cleaning fluid using the same procedure as in step 1.

PUMP ROTATION

To determine pump rotation:

If the intake port and the relief valve are on the right, with the drive end of the shaft pointing towards the observer, the pump is right-hand (clockwise rotation).

If the intake port and the relief valve are on the left, with the drive end of the shaft pointing towards the observer, the pump is left-hand (counterclockwise rotation).

TO REVERSE PUMP ROTATION

To reverse the pump rotation, both heads must be removed and the cylinder reversed (rotated 180 degrees). The vanes must also be reversed so that the relief grooves face in the direction of rotation. See "Maintenance" for removal and replacement of the pump parts.

RELIEF VALVE

Blackmer relief valves are designed for satisfactory operation with a partially closed discharge line on most types of installations. This allows for reduction of the flow without slowing down the speed of the pump–for a limited time.

The purpose of the relief valve is to protect the pump or pumping system from excessive pressure. The valve is not meant to be used for prolonged recirculation.

When pumping highly volatile liquids under a high suction lift, and cavitation or starving of the pump exists, partial closing of the discharge valve will result in excessive noise in the relief valve. A separate bypass valve, piped back to the storage tank, is recommended when operating under these conditions.

RELIEF VALVE SETTING AND ADJUSTMENT

The relief valve pressure setting is marked on a metal tag attached to the valve cover. Generally, the relief valve should be set at least 15 - 20 psi (103 - 138 kPa) higher than the operating pressure.

1. **To increase the pressure setting**, remove the relief valve cap, loosen the locknut, and turn the adjusting screw inward, or clockwise.
2. **To reduce the pressure setting**, remove the relief valve cap, loosen the locknut, and turn the adjusting screw outward, or counterclockwise.

Refer to the individual pump parts lists for various spring pressure ranges.

MAINTENANCE

MAINTENANCE AND TROUBLESHOOTING MUST BE DONE BY AN INDIVIDUAL EXPERIENCED WITH PUMP MAINTENANCE AND THE TYPE OF SYSTEM INVOLVED.

LUBRICATION

Sleeve bearings (bushings) are lubricated by the liquid being pumped, and additional lubrication is not required.

Blackmer helical gear reducers are shipped from the factory without oil in the gearcase. Fill with the grade of oil indicated on the reducer tag. The oil should be changed after the first 48 hours of use, and approximately every 500 hours of use thereafter.

REPLACING VANES ONLY

1. Remove the head assembly from the **outboard** (non-driven) side of the pump. (Refer to "Pump Disassembly" step 9.)
2. Turn the shaft by hand until a vane comes to the top (12 o'clock) position of the rotor.
3. Remove and replace the vane, making sure the rounded edge is outward to contact the liner, and the relief grooves are facing in the direction of rotation (see Figure 3).
4. Rotate the shaft until the next rotor slot is in the top position, and replace the vane.
5. Continue this procedure until all new vanes are in place. This method of vane replacement prevents the push rods from falling out.

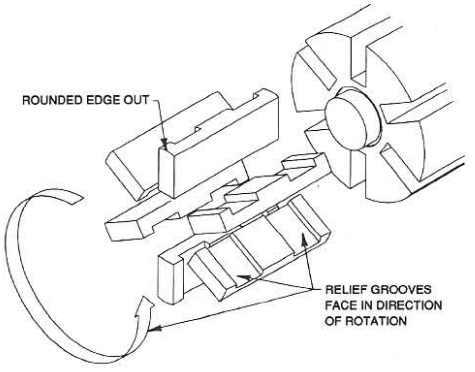

Figure 3 - Vane Installation*

*1-1/2 and 2 - inch models use only four vanes.

PUMP DISASSEMBLY

Before work is started on the pump, make sure the pressure is relieved, and the liquid is drained. During disassembly, be careful of sharp edges on worn or damaged parts.

NOTE: The numbers in parentheses following individual parts indicate reference numbers on the parts list.

1. On the inboard (driven) end of the pump, clean the pump shaft thoroughly, making sure the shaft is free of nicks and burrs. This will prevent damage to the packing or mechanical seal when the inboard head assembly is removed.

   NOTE: If the pump is equipped with an optional shaft support bearing, it is easiest to take apart the assembly before removing the inboard head. See "Optional Shaft Support Bearing" for disassembly and assembly instructions.
2. Remove the packing follower stud nuts (18) and slide the packing follower (75) out of the stuffing box. A slight pry with a screwdriver may be necessary.
3. The packing rings (19) and the pack washer (58) can be pulled from the stuffing box with the use of a corkscrew tool or screwdriver. Be careful not to scratch the shaft.
4. If the pump is equipped with a mechanical seal, remove the ¼" pipe plug from the head and loosen all of the mechanical seal setscrews.
5. Remove the inboard head capscrews (21) and slide the entire inboard head assembly (20 or 20A) from the shaft (including the mechanical seal, if equipped). It may be necessary to use two large screwdrivers to pry the head away from the cylinder.
   a. If the pump is equipped with a mechanical seal, be careful not to drop or damage any of the seal components when removing the head.
   b. The sleeve bearing (24) is press fit into the head and should not be removed unless replacement is necessary (see "Sleeve Bearings").
6. **Mechanical Seal Removal (when equipped)**
   a. Remove the seal retainer capscrews (16).
   b. Remove the seal retainer (126) and the mechanical seal (153) from the head, being careful not to drop any of the individual seal components.
7. Gently pull the rotor and shaft (13) out of the cylinder. While one hand is pulling the shaft, the other hand should be cupped underneath to prevent the vanes and push rods from falling out.
8. On the opposite (outboard) side of the pump, remove the bearing cover capscrews (28). Remove the bearing cover (27) and the bearing cover gasket (26) from the outboard head.
9. Remove the outboard head capscrews (21) and the outboard head assembly (23 or 23A). The sleeve bearing (24) is press fit into the head and should not be removed unless replacement is necessary (see "Sleeve Bearings").

OPTIONAL SHAFT SUPPORT BEARING

Disassembly

1. Remove the bearing flange capscrews (106D) and the bearing flange cover (106C).
2. Loosen the setscrew in the lock collar (106B).
3. Using a punch tool and hammer, turn the lock collar in the opposite direction of pump rotation (see Figure 4). Once the collar is removed, the bearing can be pulled from the bearing flange and off the shaft.
4. Remove the locknuts (106A) from the hex flange rods and remove the bearing flange (106).
5. Proceed with steps 2 through 8 of "Pump Disassembly."

Assembly

1. Screw the short threaded ends of the two (2) hex flange rods (106E) firmly into the tapped holes in the head.
2. Place the bearing flange (106) on the studs and tighten the locknuts (106A).
3. Slide the bearing (106B) on the shaft until it is firmly seated in the bearing flange. Install the lock collar over the shoulder on the bearing.
4. Push inward on the bearing and lock collar assembly (106B) while turning the lock collar by hand in the direction of shaft rotation. Lock the collar to the shaft with a punch tool and hammer (see Figure 4).
5. Attach the bearing flange cover (106C) and install the bearing flange capscrews (106D). NOTE: After installation of the support bearing, the rotor and shaft should turn freely when rotated by hand. If it does not turn freely, loosen the lock collar and make sure the bearing is firmly seated in the flange. Retighten the lock collar.

MAINTENANCE

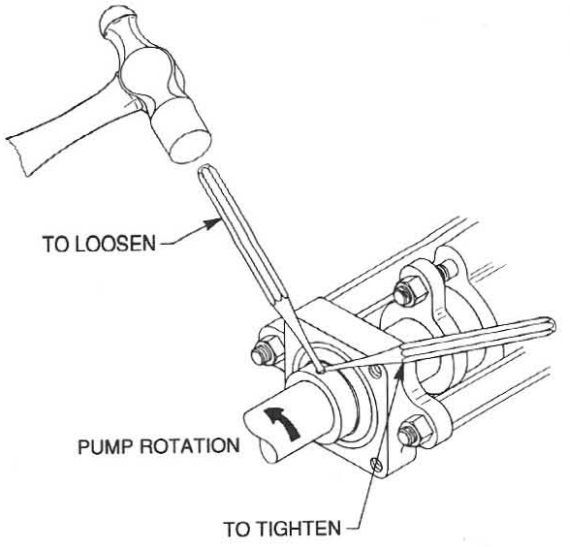

Figure 4 - Bearing Lock Collar

PARTS REPLACEMENT

Excessive or continuous leakage from the stuffing box in the head or around the pump shaft may be an indication of worn packing, a damaged mechanical seal, or a damaged or worn sleeve bearing.

1. If the packing is leaking excessively refer to "Packing Adjustment." If this does not solve the problem, a complete new set of packing rings should be installed. (See "Pump Assembly" steps 7 and 8.)
2. If the mechanical seal has been leaking it is recommended the entire seal be replaced. Refer to "General Pump Troubleshooting" for possible causes of seal leakage.
3. If the pump shaft indicates an excessive amount of radial "play," the sleeve bearing in the head should be replaced. (See "Pump Assembly" step 1.)

PUMP ASSEMBLY

Pump assembly is generally the opposite of pump disassembly. Before reassembling the pump, clean each part thoroughly. Wash out the stuffing box and remove any burrs from the rotor and shaft.

1. SLEEVE BEARINGS

If the sleeve bearing has been removed from either head, a new bearing must be installed before reattaching the heads to the cylinder.

- **a.** To aid installation and prevent bearing damage, heat the head in an oven at 200°F (93°C) before installing the bearing.
- **b.** Coat the bearing with grease and place it in the bearing bore on the inside face of the head. Align the notch in the bearing with the groove in the head.
- **c.** Using an arbor press, press the bearing into the head in one continuous motion, until it is flush with the inside face of the head. Starting and stopping the pressing motion may result in a cracked bearing.

2. OUTBOARD HEAD ASSEMBLY

If both head assemblies have been removed, it is easiest to install the outboard head assembly first. **NOTE:** When installing the outboard head, the relief valve and intake port on the cylinder should be towards the left for clockwise (right-hand) rotation, or towards the right for counterclockwise (left-hand) rotation.

- **a.** Apply a uniform coat of sealing compound (e.g. Thred Gard or Gasoila) to the face of the cylinder (12). Avoid excess coverage which could squeeze into the pumping chamber.
- **b.** Place the outboard head (23 or 23A) on the cylinder with the hole and groove (located on the inside face of the head) towards the intake side of the pump. In this position, the word "INTAKE" (cast on the head) will also be towards the intake side of the pump.
- **c.** Install the head capscrews (21) and uniformly tighten.

3. BEARING COVER

Attach the bearing cover gasket (26) and the bearing cover (27) to the outboard head. Install and uniformly tighten the bearing cover capscrews (28).

4. VANES AND PUSH RODS

It is necessary to install the bottom vanes and push rods prior to inserting the rotor and shaft into the pump.

- **a.** Insert vanes (14) into the bottom three rotor slots with the rounded edge facing outward, and the relief grooves facing in the direction of rotor rotation. (Refer back to Figure 3.)
- **b.** Hold the vanes in place while inserting the push rods (77) from the top, as shown in Figure 5.

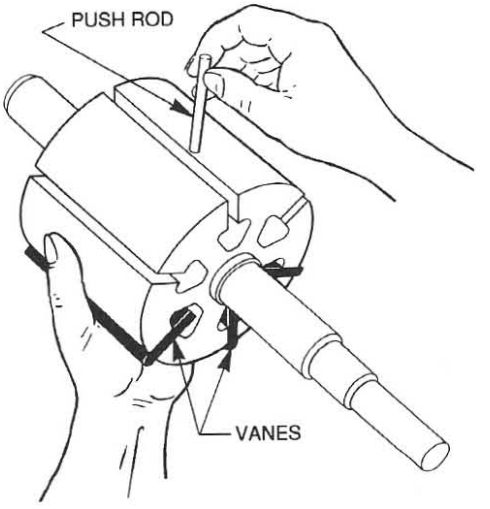

Figure 5 - Push Rod Installation*

*1-1/2 and 2 - inch models use four vanes and two push rods.

5. ROTOR AND SHAFT

- **a.** While holding the vanes in place, carefully slide the non-driven end (shorter end) of the pump shaft into the open end of the pump cylinder and into the installed outboard head.
- **b.** Install the remaining vanes into the top slots of the rotor with the relief grooves facing in the direction of rotation and with the rounded edges outward.

6. INBOARD HEAD ASSEMBLY

- **a.** Apply a uniform coat of sealing compound (e.g. Thred Gard or Gasoila) to the face of the cylinder. Avoid excess coverage which could squeeze into the pumping chamber.
- **b.** Attach the inboard head (20 or 20A) to the cylinder with the hole and groove (located on the inside face of the head) towards the intake side of the pump.
- **c.** Install and uniformly tighten the head capscrews (21).

7. PACKING AND PACKING FOLLOWER

When necessary to re-pack, use a full set of new packing rings. Packing is furnished in sets with the correct number of rings. Never add new rings to an old set of packing.

- **a.** Insert the pack washer (58) into the stuffing box of the inboard head (20 or 20A).
- **b.** Insert each of the packing rings (19) separately into the stuffing box, staggering the split joints 180 degrees so that they are not overlapping or near the joint of the preceding ring. Use the packing follower to properly seat each ring after placement.
- **c.** After all of the packing rings are in place, slide the packing follower (75) against the packing. Install and hand-tighten the stud nuts (18) evenly.

NOTE: Adjustment to the packing follower should be made while pumping liquid (see "Packing Adjustment").

MAINTENANCE

8. PACKING ADJUSTMENT

It is important that the packing be properly adjusted to prevent overheating.

a. While the liquid is being pumped, uniformly tighten the packing follower stud nuts (18) a very small amount at a time.

b. Check the stuffing box temperature several minutes after each adjustment for signs of overheating.

c. Adjust the nuts until leakage is controlled, and no excess heat develops.

NOTE: Some leakage is desirable to lubricate the packing, but in some cases it is unacceptable, depending on the application.

9. OPTIONAL LIP SEALS

a. Insert the pack washer (58) into the stuffing box of the inboard head. Apply a small amount of grease to the pump shaft to facilitate installation of the teflon lip seals.

b. Slide one gasket, then one lip seal (19A), lip inward, into the stuffing box of the inboard head. Follow this procedure until the entire set of lip seals is installed. Use the packing follower to properly seat each ring against the previous ring.

c. After the entire set is installed, slide the packing follower (75) against the lip seals and tighten the stud nuts (18) evenly.

NOTE: Once installed and clamped properly with the packing follower, teflon lip seals should require no adjustment. If leaking occurs, tighten the packing follower slightly. Do not overtighten. If leakage becomes excessive, replace the entire set of lip seals.

10. COMMERCIAL MECHANICAL SEAL

On pumps equipped with a commercial mechanical seal, refer to the separate literature accompanying the mechanical seal for installation instructions.

GENERAL PUMP TROUBLESHOOTING

SYMPTOM	PROBABLE CAUSE
Pump Not Priming	1. Pump not wetted. 2. Suction valve closed. 3. Air leaks in the suction line. 4. Suction line or valves clogged or too restrictive. 5. Wrong rotation on motor. 6. Broken drive train. 7. Pump vapor-locked. 8. Pump speed too low for priming. 9. Worn vanes.
Reduced Capacity	1. Suction valves not fully open. 2. Air leaks in the suction line. 3. Excessive restriction in the suction line (i.e.; undersized piping, too may elbows & fittings, etc.). 4. Damaged or worn parts (refer to "Parts Replacement"). 5. Excessive restriction in the discharge line causing partial flow through the relief valve. 6. Relief valve worn, set too low, or not seating properly. 7. Vanes installed backwards (see "Replacing Vanes Only").
Noise	1. Excessive vacuum on the pump due to: a. Undersized piping or restrictive fittings in the suction line. b. Pump speed too fast for the viscosity being handled. c. Pump too far from the fluid source. 2. Running the pump for extended periods with a closed discharge line. 3. Misalignment of the pump, reducer, or motor. 4. Sleeve Bearings worn or damaged (refer to "Parts Replacement"). 5. Vibration from improperly anchored piping. 6. Baseplate not securely mounted. 7. Bent shaft. 8. Excessively worn rotor. 9. Malfunctioning valve in the system. 10. Insufficient oil in the gear reducer. 11. Damaged vanes (see the following category).

GENERAL PUMP TROUBLESHOOTING

SYMPTOM	PROBABLE CAUSE
Damaged Vanes	1. Foreign objects entering the pump. 2. Running the pump dry for extended periods. 3. Cavitation. 4. Viscosity too high for the vanes and/or the pump speed. 5. Incompatibility with the liquids pumped. 6. Excessive heat. 7. Worn or bent push rods, or worn push rod holes. 8. Settled or solidified material in the pump at start-up. 9. Hydraulic hammer - pressure spikes.
Broken Shaft	1. Foreign objects entering the pump. 2. Viscosity too high for the pump speed. 3. Relief valve not opening. 4. Hydraulic hammer - pressure spikes. 5. Pump-driver misalignment. 6. Overtightened V-belts, if used. 7. Excessively worn vanes or vane slots. 8. Settled or solidified material in the pump at start-up.
Mechanical Seal Leakage (when applicable)	1. Seal faces cracked, scratched, nicked, dirty, or worn. 2. O-rings not compatible with the liquids pumped. 3. Shaft at seal area damaged, worn, or dirty. 4. Seal faces pitted due to corrosion or cavitation. 5. O-rings nicked, cut, or twisted. 6. Pump sleeve bearings (bushings) worn excessively.
Overload on Motor	1. Horsepower of motor not sufficient for application. 2. Improper wire size or wiring. 3. Misalignment. 4. Excessive viscosity, pressure, or speed. 5. Faulty or worn sleeve bearings. 6. Rotor rubbing into head. 7. Dirty seal faces, if equipped with a mechanical seal. 8. Excessively tight packing (see "Packing Adjustment"). 9. Unevenly tightened stud nuts causing shaft interference with the packing follower.

NOTES

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blackmer
A DOVER RESOURCES COMPANY
1809 Century Avenue, Grand Rapids, Michigan 49509, U.S.A.
(616) 241-1611 • Telex: 4320148 • Fax: (616) 241-3752