BLACKMER POWER PUMPS

INSTALLATION, OPERATION, AND MAINTENANCE INSTRUCTIONS

MODELS: HXL10C-N, HXLS10C-N

967600
INSTRUCTIONS NO. 185/EE

Section	100
Effective	February 1988
Replaces	June 1984

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.

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

DISCONTINUED MODELS

PARTS AVAILITBILITY MAY BE LIMITED

GENERAL INFORMATION

RECOMMENDED USES AND LIMITATIONS

The HXL10C-N is equipped with mechanical seals using synthetic rubber parts. Laminate vanes are standard on these models. Bronze, and cast iron vanes are available. These seals and non-metallic vanes are suitable for use on most petroleum products and many other liquids which will not adversely affect the vanes and seals.

The HXLS10C-N may be equipped with mechanical seals using viton or teflon parts.

These options are suitable for handling most neutral solvents. They are recommended for esters, ketones, halogenated hydrocarbons (such as carbon tetrachloride, perchlorethylene, etc.), xylol, tuluol, etc. Extra-clearance laminate vanes should be used for caustic soda.

The HXL10C-N is recommended for applications requiring vertical as well as horizontal installations, such as barges where space for mounting and maintenance are very limited. The HXL10C-N is equipped with additional features such as removable hub for ease of service to bearing and seal, flushing passage for seal chamber, drain plug for pump and seal chamber, and thrust collars on shaft.

A space type coupling is recommended between the pump and the speed reducer for easier and quicker servicing of the seals.

The HXL pumps are designed for handling Non-Abrasive Liquids.

Pump Part	Maximum Temperature	Maximum Viscosity
Bearings	400 °F	
Mechanical Seals:		
Carbon Fitted		20,000 SSU
Bronze Fitted		100,000 SSU
Buna-N O-Rings	240 °F	
Viton or Teflon O-Rings	400 °F	
Vanes:		
Laminate	240 °F	20,000 SSU
Laminate (Extra-Clearance)	400 °F	40,000 SSU
Iron	240 °F	20,000 SSU
Iron (Extra-Clearance)	400 °F	100,000 SSU
Bronze	180 °F	20,000 SSU
Bronze (Extra-Clearance)	400 °	100,000 SSU

*Maximum Recommended Speed:

Pump Size	Laminate Vanes	Bronze or Cast Iron Vanes
10	230 RPM	190 RPM

*Maximums will vary, depending on viscosities and pressures.

PRACTICAL SUCTION LIFTS

A positive displacement rotary pump is classed as a self-priming pump but has certain physical limitations. A pump will lift liquids to a lesser height when it has dry working parts than when it is primed, or the pumping elements are wet with the liquid.

All liquids will vaporize or boil at room temperature at some specific pressure. The absolute pressure at which liquids boil for any certain temperature is known as the vapor pressure. This vapor pressure limits the height to which liquids can be lifted.

The pressure of liquids flowing through a pipe line gradually decreases because of pipe friction.

If the pressure in a suction line is lowered by the pump vacuum to a point less than the vapor pressure of liquid, vapors are given off by the liquid and both liquid and vapors enter the pump. This is known as cavitation, or incomplete filling of the pump chamber. Bubbles of vapors passing through the pump are subjected to pressures from the discharge side of the pump, causing them to collapse suddenly. The intensity of cavitation noise and vibration increases as the discharge pressure increases. It is important to design a pump installation in such a manner that cavitation does not exist in the pump.

Cavitation will occur in a pump, to cite a few examples, on lube oil when the vacuum is about 18″ of mercury, on light fuel oil when the vacuum is 12″ or more, and on most gasolines when the vacuum is 8″ or more, all at room temperatures. As the temperature goes up, the permissible vacuum on the pump is lowered.

Note: The Blackmer 10-inch pump is designed with cavitation supression, which reduces cavitation noise.

When heavy liquids such as molasses, corn syrup, asphalt, etc., are to be pumped it is very important that pipe friction losses be calculated accurately before the pipe lines are installed.

INSTALLATION

LOCATION

The pump should be installed as near the source of supply as possible to have the minimum suction lift. It is much easier for a pump to push a liquid through a discharge pipe than to pull it through a suction pipe.

FOUNDATION

A good solid foundation reduces vibration and noise and improves the pump performance. On permanent installations, it is recommended that the pumping units be securely bolted to a concrete foundation.

On new concrete foundations, it is suggested that anchor bolts of the type shown in Fig. 1 be used. Such a bolt allows for slight shifting of position to better line up with mounting holes in the base plate. When pumps are to be located on existing concrete floors, holes should be drilled into the concrete and foundation bolts anchored therein.

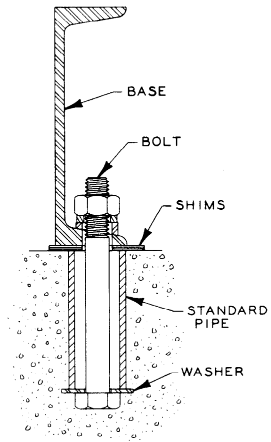

Fig. 1—Anchor Bolt Box

When installing units built on channel or structural steel type bases, care should be taken that the base is not twisted out of shape when anchor bolts are tightened. Shims should be used under the edges of the base prior to tightening of the anchor bolts to prevent distortion.

It is recommended that after this type of unit is securely bolted down, and the alignment is checked, a dam be built around the base and filled with concrete. Tamp it up under the sides of the base so that the final level of concrete comes up onto the side of the base structure.

PIPING

Restrictions in the pipe line such as elbows, sharp bends, globe valves, certain restricted type plug valves, and undersize strainers, should be avoided. Suction lines in particular must be straight and as short as possible, and sized sufficiently to sustain pump flow.

It is very important that there be no air leaks in the line. If practical to do so, apply air pressure to the completed pipe line to check for leaks.

When pumping liquids of high temperature, provisions should be made to compensate for expansion and contraction of the pipes, especially when long pipe lines are necessary. Steel pipe expands approximately 3/4″ per 100 feet per 100°F rise in temperature. When pipes are located out of doors and are subject to wide variation in temperature, provisions should also be made to compensate for pipe expansion and contraction. The use of a section of flexible pipe near the pump is highly recommended.

Piping should be well supported so as not to impart any strain to the pump body. Do not suspend piping on loose, strap-like supports. It should be well anchored to solid supports at frequent intervals to prevent vibration.

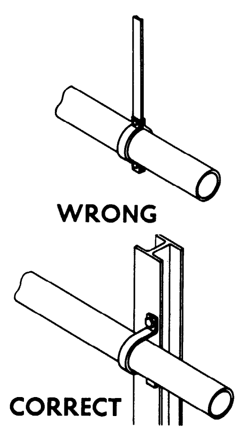

Fig. 2—Pipe Support

CHECK VALVES

If a check valve must be used, install it at the pump discharge. The use of check valves or foot valves in the supply tank is not generally recommended with self-priming, positive-displacement pumps, and can cause considerable trouble.

If a valve in the discharge line is closed while the pump is operating, it causes liquid to recirculate through the pressure relief valve. The liquid heats up and expands from recirculation. A check valve in the suction line will prevent the expanding liquid from returning to the supply tank, causing a build-up of pressure on the pump and in the piping system. The result can be excessive leakage at the pump or pipe joints.

A 'delayed closing' check valve can damage the pump if it suddenly closes while the pump is spinning backward.

MANUAL BYPASS VALVE

A bypass line from the pump discharge to the pump suction with a manual shut-off valve is recommended when handling volatile liquids or viscous liquids at a high lift, or when delivering to piping too small to take the full flow from the pump.

The following size of manual bypass valve and recirculating lines are normally recommended:

10″ pump.................4″ valve and piping

When handling very viscous liquids, excessive pressures may develop when starting up. To avoid possible damage to the pump, open the valve before starting. After the pressure stabilizes and the pump is running smoothly, close the valve slowly.

As heavy liquids with 'light ends' are heated to a high temperature to lower the viscosity, the amount of volatile product given off is increased. The resulting cavitation may cause the pump to become very noisy and begin vibrating. By cracking the manual bypass valve open and permitting some of the liquid to recirculate, the noise and vibration can be reduced to an acceptable level.

If pump noises and vibration cannot be controlled with the manual bypass valve, look for other causes under "Noise."

STRAINER

A strainer should be installed in the intake line to protect the pump and the entire discharge system from damage by foreign matter. Otherwise, the pump may become clogged or subjected to unnecessary and damaging wear which would seriously affect the performance and maintenance cost. In general, the strainer basket should have a net open area of at least four times the area of the suction pipe opening. For viscosities over 1,000 SSU, use a strainer one or two sizes larger than normal for greater area. Consult strainer pressure drop curves when available. Inspect the basket regularly and clean when necessary.

CHECKING ALIGNMENT

The alignment of motor, gear reducer and pump is very carefully adjusted and checked at the Blackmer factory before shipment. In the process of transportation, handling, tying down to a foundation, attaching pipes, etc., the alignment is often disturbed and must be checked before the unit is put in operation.

Where flexible couplings are used, the coupling cover should be removed and a straight edge laid across the two hubs of the coupling as shown in Fig. 3. The maximum offset should be less than .015″.

With a feeler gauge or piece of flat steel of the proper thickness, check the space between the two coupling halves. Insert a gauge at a point on the coupling, and then again at 90 degree intervals around the coupling. The space should not vary more than .020 of an inch. Misalignment is not desirable. If it does exist, it must not exceed the above limits.

After installation and before starting the pump, be sure to check for piping strain.

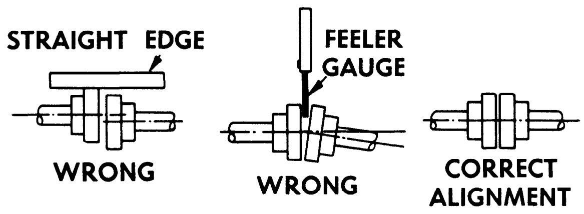

Fig. 3—Alignment Check

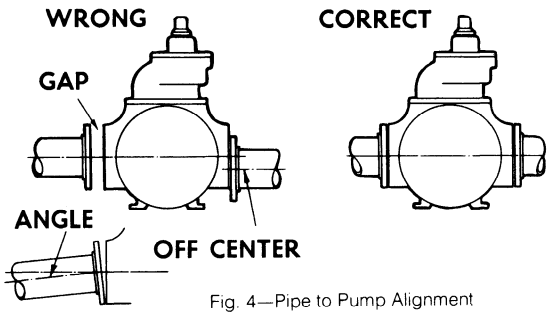

Fig. 4—Pipe to Pump Alignment

OPERATION

PUMP PERFORMANCE CHECK

Before starting a pump, it is advisable to install pressure and vaccum gauges at the fittings provided on the pump. When operating normally at full capacity, the differential pressure should be at least 25 pounds less than the pressure control setting. If the differential pressure is less than 25 pounds under the control setting, there may be a reduced flow due to partial bypassing. If there is a vacuum on the suction side of pump, the differential pressure is equal to the discharge pressure in PSI plus about one-half the vacuum reading in inches of mercury.

Check the rotation of the pump shaft to be sure it will turn in the same direction as the indicating arrow on the pump towards the discharge port.

When a new pump is first started, it should be watched carefully for several hours and checked for signs of malfunction. If trouble develops, refer to "Pump Troubles and Their Cures."

Do not exceed the maximum recommended speeds. The inlet vacuum, for best efficiency, normally should not exceed 20″ Hg. on Non-Volatile Liquids, or 8-12″ Hg. on Volatile Liquids. However, when stripping or pumping a very viscous liquid, a higher vacuum will not damage the equipment.

RUNNING PUMP IN REVERSE

It is sometimes desirable to run the pump in reverse to pump out a tank or drain a pipe line. The pump is satisfactory for this operation with certain limitations. It is recommended that a separate relief valve be piped from the suction line to the discharge line to provide protection during reverse operation. Operation in reverse may cause a slight increase in noise and vibration, especially at higher pressures.

TO CHANGE ROTATION

To rebuild a pump from right-hand to left-hand, or vice versa, it is necessary that the vanes be reversed in the rotor slots so that the pressure-relief grooves in the vane face in the direction of rotation (see Fig. 5). On 10 inch pumps it is also necessary to reverse the liner. Cavitation suppression built into the porting (partially closed ports) must always be on the discharge side of the pump.

The relief valve assembly, if supplied, must be reversed.

RELIEF VALVE

The HXL10C-N is offered with an optional relief valve assembly which is bolted onto the pump body. Its purpose is to protect the pump and discharge system from excessive high pressures.

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. When it is necessary to operate under these conditions, the optional manual bypass valve should be used, or a separate bypass valve piped back to the tank is recommended as an alternative.

Relief valves should be set at about 25 pounds higher than the operating pressure to insure full capacity at normal operating conditions. To increase the pressure setting, remove the cap, loosen the locknut and turn the adjusting screw inward, or clockwise. To reduce the pressure setting, turn the screw outward or counterclockwise. To check the pressure setting of the relief valve, install a pressure gauge at the gauge hole on the discharge side of the pump and check its reading with a valve completely closed in the discharge line.

MAINTENANCE

MAINTENANCE INSTRUCTIONS

The spherical roller bearings are completely protected from the pumpage. For average service, they need lubrication about every two or three months. Use a light #2 lithium base, bearing type grease for temperatures up to 300°F. For temperature service above 300°F, a lubricant must be selected which will not melt. A good general purpose grease is:

Standard Oil—Amolith All Weather Grease
(must be paraffinic base)

DRAINING PUMP

If the pump is to be used with more than one type of liquid, it may be desirable to completely drain the pump to prevent contamination. To "blow out" pump, run pump with discharge pipe open and intake valve closed, and bleed air into the pump intake through gage plug hole. Two holes through the disc permit drainage of the rotor cavities on the HXL10C-N.

MECHANICAL SEALS

If the mechanical seal has been damaged, evidence of leakage will appear around the shaft. If the seal has been leaking, it is advisable to replace the entire seal assembly (including the stationary seat and its O-ring).

On the HXL10C-N model, first drain the pump by removing the 3/4″ pipe plug located in the head. Then remove the bearing cover and locknut. The locknut can be removed by bending the tang on the lockwasher back away from the locknut. Remove the locknut by using a spanner wrench and turning the nut counterclockwise.

Remove the capscrews from the hub. The stationary seat of the seal and its O-ring will slide off the shaft with the hub as a unit. An improvised hook tool made from a piece of stiff wire may be used to withdraw the rest of the seal assembly.

All parts of the seal must be kept clean. Before installing a new seal, remove all shaft and hub burrs and smooth all rough spots with a very fine emery cloth. The sealing components are delicate and should be handled carefully to avoid damage to the highly polished surfaces. Note: Wrapping the pump shaft threads with tape before assembly can help prevent O-ring damage within the mechanical seal assembly. Place a small amount of grease on the O-rings so that the seal will slide on the shaft easily. Bronze seal faces should be oiled during assembly. Place the rotating half of the seal on the shaft and engage the two seal jacket drive prongs in the notches in the rotor. Place the stationary seat of the seal in the recess in the hub with the polished face in view. Slide the hub over the shaft. Avoid striking the end of the shaft against the face of the seat. Tighten the hub capscrews.

See also, the "Pump Assembly" instructions for bearing locknut adjustment.

DISASSEMBLY

Most of all repairs can be made by removing only one head and without removing pump from its mounting. If complete disassembly is necessary, use the following procedures:

First drain the pump by removing the plugs in the heads.

Note: Eyebolts may be used on the large pumps to serve with the aid of a hoist in handling the heavier parts of the pump. The eyebolt may be used in the threaded holes provided in the liner, the heads, the casing, the discs and the rotor.

If complete disassembly is intended, it is advantageous to have the pump laying on its inboard side—shaft down. Otherwise, proceed as follows with the pump on its feet.

To remove the outboard head assembly of the HXL10C-N, first drain the pump by removing the 3/4″ gage plug located in the head. Remove the bearing covers and bearing cover gaskets. The locknuts can be removed by bending up the engaged lockwasher tang and rotating the nut counterclockwise. Remove the capscrews from the hub. The stationary seat of the seal and its O-ring will slide off the shaft with the hub as a unit.

Next, remove two (2) head capscrews and screw them into the tapped holes near the outer rim of the head. (Insert an eyebolt into the top of the heads and use a hoist for support.) Remove the remaining head capscrews and tighten the two capscrews in the tapped holes until the head separates from the casing. Remove the head, being careful not to scrape or nick the shaft.

The disc will come off with the head, and is attached with six (6) counter-sunk set screws and lockwashers.

Pin-lok vanes can usually be removed or replaced by sliding them out the rotor ends. This should be done with the vane seated in the bottom of its slot in the rotor. To accomplish this, simply rotate the shaft until a vane comes to the position at the top of the rotor. Remove and replace the vane, then rotate to the next slot. New vanes must be installed with the rounded or beveled edge outward from the shaft, and with the relief grooves facing in the direction of rotation.

After the head assembly has been removed from the pump, the liner can usually be withdrawn from the rotor with the use of a pry bar. First, remove the four (4) retaining screws located between the relief valve ports, and then by prying with a bar against the rotor, the liner can be partly removed. The use of a block under the bar against the rotor will assist in bringing the liner the rest of the way out.

If the liner cannot be removed with a bar, it will be necessary to remove the rotor and shaft and the other head. Then, using a block of wood or a piece of brass against the end of the liner, drive it out with a hammer. Also, if the vanes are swollen or jammed in their slots, it may be necessary to remove either the remaining head or the rotor-and-shaft in order to drive out the vanes. Removal of the push rods requires removal of the rotor-and-shaft.

If the rotor-and-shaft assembly is to be removed while the pump is on its feet, a shim must be placed between the rotor and the liner to prevent the rotor from dropping onto the liner when it is pulled clear of the inboard bearing. Wood blocks will serve this purpose and also make it easier to pull the rotor-and-shaft.

ASSEMBLY—Pump Casing Installed in the System

1. Inspect everything for cleanliness. The shaft must be free from nicks or burrs in the mechanical seal area. If any exist, polish the shaft to remove the imperfections.
2. Install the liner into the pump casing with the cast word "INTAKE" towards the inlet side of the pump. After installation, double check to make sure that the cavitation suppression ports (partially closed ports) are on the discharge side of the pump.
3. Install three push rods and three vanes into the bottom of the rotor. The rounded edge of the vane should face outward away from the shaft, and the vane relief grooves should face the direction of rotation when installed. See Fig. 5. This rotor assembly should then be set on a block, which serves as a shim when set inside the liner. Ideally, this wooden shim will hold the rotor up against the top of the pump liner during assembly.
4. With a hoist, place the disc on the head with the counterbored screw holes face out. The word "INTAKE" on the disc should point towards the intake side of the pump when the head is attached to the casing. Note, the head drainhole should be at the bottom of the pump when properly installed. Install the six (6) lockwashers and set screws to hold the disc in place.
5. The outboard head (non-drive end) with the appropriate O-rings may now be hoisted into position and secured to the pump casing. NOTE: It is vital that the polished seal surfaces of the shaft and mechanical seal components be kept clean and free from surface defects.
6. Install the seal jacket assembly so that the drive tangs engage the notches in the rotor assembly. Lightly grease the shaft to help the seal O-rings slide into place.
7. The hub assembly is to be constructed next. First install the bearing into its cavity in the hub. Then install the bearing cover gasket and attach the bearing cover, leaving the bolts loose. Install the stationary seat with its O-ring into the hub recess. Lightly greasing the recess will help the stationary seat slide into place. The polished side of the stationary seat should be in view. The stationary seat is retained by flat washers, lockwashers, and screws.
8. The hub assembly, with the hub O-ring can now be installed over the shaft and bolted up to the pump head. Remove the bearing cover and loosely install the bearing locknut and lockwasher.
9. Support the drive end of the shaft with a hoist and remove the wooden rotor shim block. Snugging the nut on the bearing previously installed will help square the rotor with the outboard head. Do not over-tighten the nut and damage the bearing. The hoist on the drive end may now be slackened.
10. Install the remaining vanes at this time, noting their position so that the relief grooves correspond to the other vanes about the rotor.

11. The remaining head with its O-ring may now be installed, but the head bolts should be left loose. Next, install the mechanical seal and hub assembly in the same manner as previously instructed.
12. Loosen the bearing nut on the non-drive end of the pump. Hoist the loose head, and with a lead hammer, tap the rim of the head within the pump casing dowel until the rotor turns freely. Secure the head to the pump casing by tightening all head capscrews.
13. The bearing locknuts should now be adjusted. The following is the proper method of adjustment:
    a. To adjust the bearing locknuts, tighten one until the rotor starts to drag. Avoid over-tightening which may preload the bearings excessively.
    b. Find one of the four notches on the nut that is most closely aligned with a tang on the lockwasher. Back the nut off to the next tang (approximately 15/16 inch). Bend the tang down to lock the nut.
    c. Tighten the other locknut until it is snug against the bearing, with the bearing seated firmly in its recess.
    d. The pump should turn freely. Bend down the remaining bearing nut lockwasher tang. Assemble the bearing covers with gaskets and grease the bearings. Pump the grease slowly until grease flows from the grease relief fitting.

ASSEMBLY—
Pump removed from the system (preferred method)

1. Review the assembly instruction above. The outboard head, seal assembly, hub and bearing are assembled to the casing. Upend the pump. The open end should be up.
2. Install the liner with the word "intake" toward the suction side of the pump. Use forged steel eye bolts in the holes tapped in the liner, for hoisting.
3. Lift the rotor and shaft assembly with suitable forged steel eye bolts and lightly grease the shaft so it will slide into the seal O-rings.
4. Install the push rods and then lower the rotor assembly into the casing, taking special precautions not to damage any of the sealing components. After the rotor bottoms, rotate the rotor until a "click" is heard, this is the seal jacket drive tangs engaging the rotor drive holes.
5. Now, install the vanes with the relief grooves facing in the direction of pump rotation and the rounded edges outward against the liner. Remove the lifting eyes and proceed with assembly as before.
6. The bearings locknuts are now adjusted as before.
    a. To adjust the bearing locknuts, tighten the upper locknut until the rotor starts to drag.
    b. Find the notch which most closely aligns with the tang on the lockwasher. Back the nut off to the next tang (approximately 15/16 inch). Bend the tang down to lock the nut.
    c. Tighten the other locknut until it is snug against the bearing with the bearing seated firmly in its recess. Bend the tang down to lock the nut.
    d. The pump should turn freely. Assemble the bearing covers with gaskets, and grease as before.

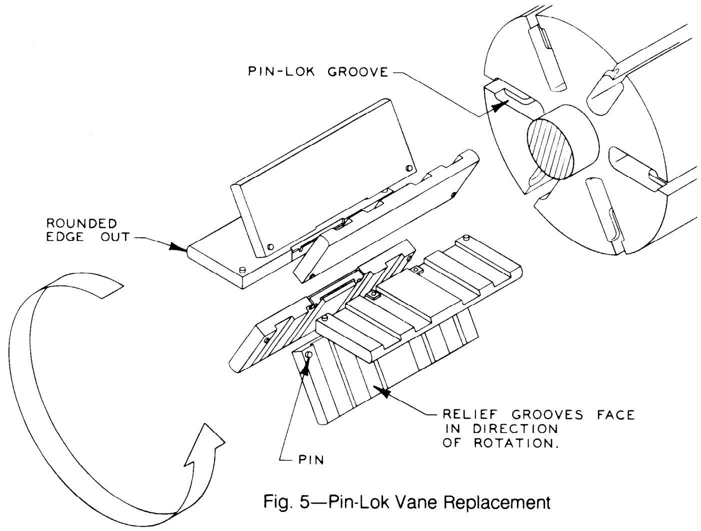

Fig. 5—Pin-Lok Vane Replacement

PUMP TROUBLES AND THEIR CURES

LEAKAGE
If the mechanical seals leak, the leakage will appear around the shaft. Refer to the section on "Mechanical Seals."

If leakage appears between the cylinder and head, the head should be removed. Inspect for burrs, dirt or a defective O-ring.

NOISE
Noise can be caused by an excessive vacuum on the pump resulting in a "starved suction," causing cavitation or vaporization of the liquid. This can be caused by the piping being too long, or too small in diameter, plugged or dirty strainer, use of plug or globe valves, or the speed being too high for the viscosity of the liquid being pumped. The point of vacuum where noise becomes critical (accompanied by rapidly decreasing delivery) depends largely on the volatility of the liquid being handled (see section — "Low Delivery Rate").

If the pump is run at speeds exceeding the recommended maximum, the noise may be abnormal. If the pump is run for extended periods of time with a closed discharge on a vaporous liquid, the liquid will begin to vaporize (because it becomes heated by the bypass recirculation) causing increased noise. Partial bypassing through the relief valve with air in the system may cause noise.

Entrained air or vapors in the liquid entering the pump is another cause. Pipe joints should be checked for leakage of air. Sometimes when recirculating liquid in a tank, the returning liquid falling through the air carries air down into the tank which eventually gets back into the pump, causing noise and vibration.

Occasionally foreign materials will lodge in a suction line causing starvation of the pump. Sometimes valve gates will come loose from valve stems and close. Pipe lines improperly supported will magnify vibrations due to slight pump pulsations. If the vacuum is not excessive, and the pump is still abnormally noisy, the vanes or the liner are either improperly installed or worn excessively. Pin-Lok vanes will make a clicking sound when worn out.

LOW DELIVERY RATE
Slow pumping rate may be caused by too slow an operating speed, low pressure control valve setting, dirty strainer, a restriction in the suction line, resistance in the discharge line, an air leak in the suction line or by damaged or worn parts in the pump.

If some of the liquid is recirculating through the valve, increase the setting by turning the adjusting screw inward, or clockwise.

In this case, power input to the motor should be checked to avoid the overload.

The lift may also be too great. On cold, non-volatile liquids such as lube oil, the delivery rate will decrease when the vacuum exceeds about 18″Hg. On hot liquids with volatile light ends, such as Bunker C and asphalt, the delivery rate may decrease when the vacuum exceeds about 7-10″ Hg. Usually cavitation noise and vibration is noticeable at this point.

DAMAGED VANES

Laminate vanes can be damaged by pumping abrasive liquids, by foreign objects entering the pump, or by pumping liquids of too high viscosity. Swelling of the vanes may be caused by excessive heat (result of over-speeding), or by liquids which attack the vane materials.

Metallic vanes can also be damaged by foreign objects entering the pump or by excessive wear if used for handling non-lubricating liquids. Excessive speed can also cause damage to metallic vanes. See section on ''Recommended Uses and Limitations.''

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