FOSTER®

VANE PUMPS

Installation
Operation
Maintenance
Instructions

Bulletin No. IOM 5-84

PULSAFEEDER

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General Information

The general information contained in this manual relates to standard Foster Vane Pumps. Specific information applicable to pumps of a special type of design is furnished supplemental to this manual.

To achieve successful installation and maintain efficient operation of this equipment, it is imperative that this manual be understood and followed by personnel responsible for the equipment.

WARNING:

ANY DEVIATION FROM THIS MANUAL CAN RESULT IN EQUIPMENT DAMAGE AND/OR PERSONAL INJURY.

Installation

When received, pump shipments should be immediately inspected, and any damage or shortage should be reported to the carrier who delivered the equipment.

Storage

After inspection, equipment should be repacked or recrated for storage in a dry location. Appropriate protective measures should be taken to prevent damage from adverse environmental conditions or extended storage periods.

Location

The pump installation point should be as close as possible to the liquid supply, and the suction line should be direct and preferably larger than the pump suction port. The installation site should be a clean, dry area with adequate light and sufficient space for inspection and maintenance

Foundation and Grouting

Concrete and epoxy foundations provide the most rigid unit support; they should be six to eight inches thick, and four to six inches longer and wider than the pump baseplate.

Care must be taken to precisely level the baseplate. Shims or wedges placed under the baseplate near foundation bolts should be used for leveling. (Ref. Fig. #1)

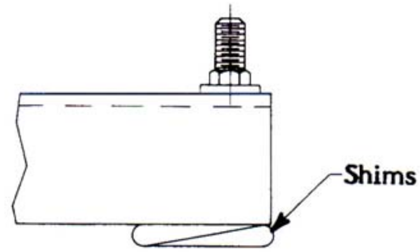


Fig. 1

Foundation bolts should be positioned with a template and set in pipe to provide position adjustment. (Ref. Fig. #2).

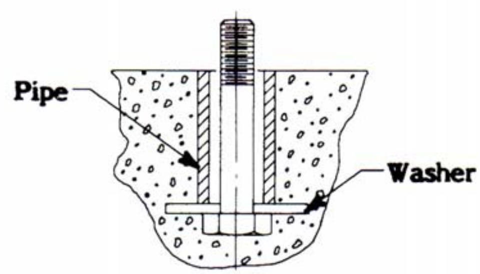


Fig. 2

The baseplate should be carefully secured by evenly tightening the foundation bolts and checking to insure the unit remains level on the foundation. It is most important that the foundation support the entire pumping unit and that no torsion be applied to the baseplate when the foundation bolts are secured.

Prior to making pipe connections, a grouting compound should be worked in under the baseplate to support the weight of the components evenly.

Alignment

All pump units are aligned at the factory during assembly, and in accordance with standard manufacturing practice, shims are used to perfect the alignment between the pump and each of the driving components. Since alignment is extremely critical to proper pump performance, and it is frequently disturbed during shipment, handing, and installation, factory alignment should be reproduced in the field after installation, as outlined below.

Pump shafts fitted with pillow block bearings should be aligned with the pillow block bearing completely removed from its head. After alignment is established, then the bearing should be secured to its stand while carefully checking to see that alignment is not disturbed.

NOTE:

FLEXIBLE COUPLINGS ARE NOT INTENDED TO COMPENSATE FOR MISALIGNMENT BUT CORRECTLY FUNCTION TO RESIST THE TRANSMISSION OF SHOCK, END-THRUS, AND ONLY VERY SLIGHT CHANGES IN ALIGNMENT WHICH OCCUR DURING OPERATION OF THE EQUIPMENT.

Flexible Couplings

1) Flexible Couplings

a) Parallel Alignment-Check parallel alignment with a straight edge placed across the rim of both coupling halves at four locations, 90 degrees apart. (Ref. Fig. #3).

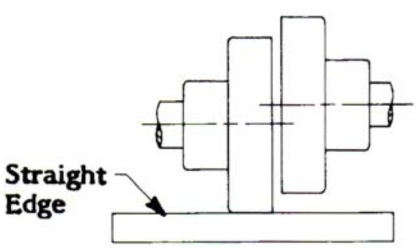


Fig. 3

b) Angular Alignment-Check angular alignment by gauging the coupling gap at several points around the periphery. (Ref. Fig. #4). Adjust the driving component to remove any variations in the gap.

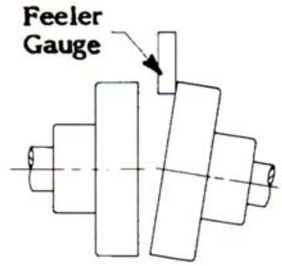


Fig. 4

These alignment procedures apply to most pump and driver combinations using flexible couplings. If the pump is driven through a speed reduction gear with separate driver and first aligns the gear reducer relative to the pump and then aligns the driver relative to the gear reducer. The runout of the driver/reducer couplings should not exceed the limit established by the drier manufacturer. After the pumping unit is properly leveled, secured, and aligned, the pipe connections should be made. The suction and discharge line connections should precisely match the pump ports, thereby eliminating the possibility of induced stress in the pump when the pipe connections are secured. Recheck the alignment after securing the pipe connections. Pipe strain frequently is the cause for misalignment, excessive bearing loads, and vibration. Alignment should again be checked six months after installation to ensure against misalignment caused by settling.

c) Allowance for Temperature Variations-Temperature extremes must be considered when aligning pumping equipment. The equipment should either be aligned in its normal operating temperature, or allowances must be made for variations in shaft height and length caused by thermal expansion of heated components. First determine the temperature differences between the heated and cooler components to be aligned, and multiply this difference by the thermal coefficient of expansion of the heated material. Next multiply this product by the overall length of the heated components shaft to determine the increase in shaft length. Similarly multiply the product by the overall shaft height of the heated component to determine the total increase in shaft height. Make necessary allowances for the increase when aligning the equipment.

Suction Piping

Faulty suction piping design is probably the leading cause of pumping problems. The suction line must be perfectly air tight and designed to afford minimum resistance to liquid flow.

Although Foster Vane Pumps are widely known for their high suction lift capability, it is generally recommended that they not be operated more than 20" Hg vacuum. When pumping liquids which high vapor pressures, sufficient suction head must be provided to prevent liquid vaporization within the suction line. The suction line should also include a strainer to protect the pump form damage caused by solid materials.

Discharge Piping

Discharge pipe should be sized large enough to prevent excessive friction losses and damaging high pressures from developing at the pump. The discharge piping should always be designed to vertically rise a minimum of five times the diameter of the pipe. This will prevent gas or air pockets from developing within the pump. Discharge piping should always incorporate pressure limiting devices to prevent pump damage caused by a closed discharge line valve. If an integral Pressure Limiting Valve is furnished with the pump, it should not be set greater than 10 PSI above the pressure differential between the pump suction and discharge ports.

Protective Equipment

Although Foster Vane Pumps have been known over the years for their uncomplicated design and rugged construction enabling them to operate well even under extremely adverse conditions, it is recommended that the following protective equipment is used in each installation to insure against downtime, loss of production, or damage to the pump or any other component in the system.

1) A Foster Strainer, Basket, or Y-Type, should be installed in the suction line near the pump to prevent solid materials from entering the pumping system. Care must be exercised to suitably size-select the strainer to insure that the pressure loss through the strainer does not exceed the maximum recommended vacuum condition to the pump suction line. (Ref. Fig. #5)

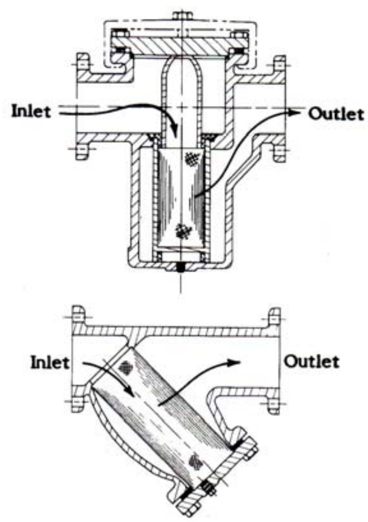
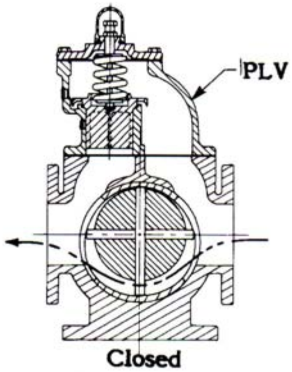


Fig. 5

2) An integral Foster pressure limiting valve, or external pressure relief valve (PRV) from the pump, should be installed in each pumping system to protect equipment from damage caused by excess pressure. The pressure limiting valve should be pressure-set 5-10 PSI above the maximum differential pressure between the pump

suction and discharge ports. (Ref. Fig #6 and #7)



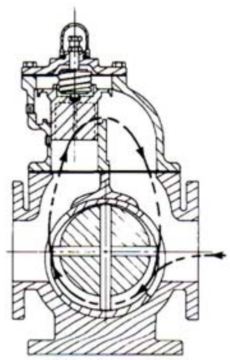


Fig 6

3) A Foster pressure limiting coupling should be used whenever a pressure limiting valve cannot be installed in the pumping system or as a secondary protective device in addition to the pressure limiting valve. The coupling provides protection from excess pressure by limiting the torque and resultant horsepower transmittable from the driver to the pump. In addition, they also protect the pump from damage should the pump become jammed by solid material.

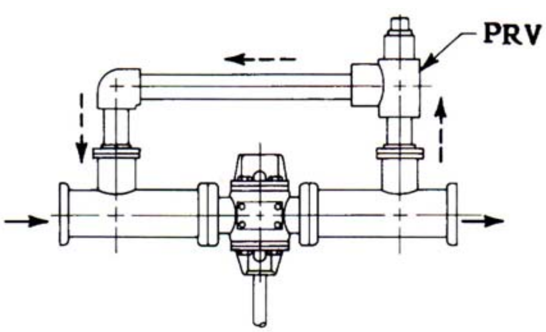


Fig. 7

WARNING:

SINCE IT IS NOT PRACTICAL TO PRE-ADJUST PRESSURE LIMITING VALVES OR PRESSURE COUPLINGS AT THE FACTORY TO SIMULATE ALL POSSIBLE FIELD CONDITIONS, THEY MUST BE FIELD ADJUSTED AFTER INSTALLATION. COUPLING READJUSTMENT MAY BE NECESSARY IF THE COUPLING HAS BEEN OPERATING FOR EXTENDING PERIODS WHILE SLIPPING. REFER TO SPECIFIC ADJUSTMENT INSTRUCTIONS FURNISHED WITH THE COUPLING BEFORE ATTEMPTING TO ADJUST THE SLIP SETTING. SPEEDDROP SWITCHES CAN BE FURNISHED IN CONJUCTION WITH PRESSURE LIMITING COUPLINGS. THEY AFFORD PROTECTION TO THE COUPLINGS BY PREVENTING THEM FROM OPEATING IN A RELATIVELY RAPID SLIPPING CONDITION. SHOULD A PUMP BECOME JAMMED AND THE COUPLING BEGINS SLIPPING, THE SPEED DROP SWITCH WILL ELECTICALLY STOP THE DRIVER.

4) Electric motors should be provided with thermal overload protective devices. Refer to motor manufacturer’s instructions regarding recommended protective equipment.

5) Jacketed equipment should be used in systems where slight temperature variations can result in extreme changes in the pumped liquid’s physical characteristics. Consult the factory for additional information regarding jacketed equipment.

OPERATION

Lubrication

All pump bearings are lubricated at the factory before shipment. Journal bearings are designed to be lubricated by the pumped liquid; therefore, journal bearings pumps should not be operated dry. All lubrication points are provided with lubrication fittings and should be lubricated with a high-grade grease, preferably with an oxidation inhibitor. ***CAUTION: To avoid packing displacement or damage, use only low pressure lubricating devices when***

lubricating stuffing boxes. Grease should be replenished at least every thirty days. For unusual operating temperatures or environmental conditions, special lubricating procedures may be necessary. Consult factory for special instructions.

<u>Gear reducers and other power transmission equipment supplied with pumps are shipped without oil.</u> Fill oil reservoirs as indicated on the instruction tags or nameplate attached to the equipment and follow any lubricating instructions furnished with the equipment.

Pre-start Checks

1) Disconnect driver coupling and start driver momentarily to insure correct rotation.

2) Check the pressure limiting valve to be sure it is installed properly relative to the pump's rotation and liquid flow direction. (Ref. Fig. #7)

3) While the driver is disconnected, turn the pump's rotating assembly to be sure that it turns freely. (New pumps may rotate rather stiffly, but should not seize. If necessary, a shaft "dog" or other torque multiplying device may be used to rotate pump shaft).

4) Install a vacuum gauge on the suction side and a pressure gauge on the discharge side of the pump.

5) To guard against seizing, severe wear, and galling within the pump, prime the pump with liquid before starting.

Starting

After compiling pre-start checks and determining that the pump is ready for starting:

1) Be certain all the valves are correctly positioned in the suction and discharge lines.

2) Jog start the pump to insure that the equipment operates freely without noise or vibration.

3) Start the pump again, checking for noise and vibration; in addition check for localized heating. Record suction and discharge gauge readings.

4) Check the liquid flow rate to be sure full flow is being delivered. If not, check gauge readings against data calculated prior to pump installation and refer to Section III-Trouble. If full flow is delivered, check power consumption to be sure driver is not overloaded.

5) Periodically check pump to be sure localized heating does not develop and that the equipment is free from noise and vibration.

Shaft Sealing

Controlled but measureable leakage is to be expected from pumps furnished with packed stuffing boxes. Initially, allow for liberal leakage until packing wears in, then gradually adjust packing gland until just enough leakage occurs to lubricate packing. When leakage can no longer be controlled, replace packing. Refer to Section IV-Maintenance.

Mechanical seal fitted pumps may initially leak after starting. This leakage should gradually diminish, however, until no leakage is observed.

TROUBLE

Symptoms and Cause

1) No Flow

(a) Incorrect rotation.

(b) Inadequate prime. ***Vent air at pump discharge until liquid begins flowing.***

(c) Blocked or clogged suction line. ***Check all valves in suction line and check for clogged strainer.***

(d) Liquid bypassing through integral pressure limiting valve or separate relief valve. ***Check for closed discharge line valve, blocked or clogged discharge line; adjust relief valve setting.***

(e) Air entering suction line. ***Check loose pipe connections, suction line submerged in liquid, and air entry through stuffing box.***

(f) Severely worn pump. ***Check for abrasives in liquid, excessive pressure, misalignment, or pump misapplications.***

(g) Excessive liquid slippage. ***Check for excessive pressure and liquid viscosity thinner than expected.***

2) Low Capacity

(a) Air entering suction line. ***Check as above.***

(b) Blocked or clogged suction line. ***Check as above.***

(c) Liquid bypassing Pressure Limiting Valve. ***Check as above.***

(d) Worn Pump. ***Check as above.***

(e) Excessive liquid slippage. ***Check as above.***

(f) Liquid vaporizing in suction line. ***Check vacuum gauge reading, liquid temperature, and vapor pressure.***

(g) Liquid viscosity greater than expected.

(h) Incorrect pump speed.

(i) Vortex formation in suction line.

(j) Liquid flow characteristics different than expected.

3) ***Pump Starts, then looses Prime***. ***Causes such as above.***

4) Pump Requires Excessive Power

(a) Misalignment. ***Refer to Section 1-Installation.***

(b) Rotating elements binding. ***Check for solid material entering and jamming pump and mechanical defects in pump or drive equipment.***

(c) Excessive pressure. Check as above.

(d) Packing adjusted too tightly. ***Loosen packing gland.***

(e) Incorrect pump speed.

(f) Liquid viscosity greater than expected.

5) Noise

(a) Liquid vaporizing in suction line. ***Check as above.***

(b) Air entering suction line. ***Check as above.***

(c) Misalignment. ***Check as above.***

(d) Rotating elements binding. ***Check as above.***

(e) Liquid bypassing through pressure limiting valve. ***Check as above.***

(f) Excessive pressure. ***Check as above.***

(g) Air entrainment in liquid.

6) Rapid Pump Wear

(a) Abrasives in liquid

(b) Misalignment. ***Check as above.***

(c) Corrosion. ***Check compatibility of pump materials with liquids being pumped.***

(d) Excessive pressure. ***Check as above.***

(e) Pump runs dry.

(f) Pump misapplied, handling liquids with no lubricity. ***Consult local Foster representative for assistance.***

7) Shaft Leakage

(a) Worn packing. ***Replace with new packing.***

(b) Worn shaft. ***Check for improper packing gland adjustment, abrasives***.

(c) Stuffing box wear.

(d) Improperly cut packing rings.

(e) Improper packing materials for application.

(f) Incorrectly sized packing rings

(g) Worn or damaged mechanical seal.

8) Excessive Heat

(a) Pump running dry.

(b) Misalignment. ***Check as above.***

(c) Rotating elements binding. ***Check as above.***

(d) Packing gland adjusted too tightly.

(e) Excessive pressure. ***Check as above.***

(f) Liquid by-passing through integral pressure limiting valve or separate relief valve. Check as above.

MAINTENANCE

Shaft Packing

1) Selection- Select only the best quality packing for the application. The initial, higher cost of quality packing is more than offset by the labor and lost production costs which accrue from short packing life. Consult either a local Foster representative or packing distributor for assistance.

2) Repacking

(a) Remove all old packing from the stuffing box.

(b) Clean the pump shaft and stuffing box thoroughly, examining for wear and scoring. Smooth any score marks with an emery cloth.

(c) Check for excessive bearing wear and replace if necessary.

(d) Select proper size, type, and style of packing for the application and cut each packing ring to fit properly.

(e) Lubricate each ring individually with clean compatible oil before installing the rings one at a time. Carefully avoid contact with dirt or grit.

(f) Lubricate shaft and stuffing box with oil.

(g) Install each ring in stuffing box and tamp each ring to insure that each ring is properly in place. Joints of successive rings should be alternated at least 90 degrees apart.

WARNING:

A common shortcut incorrectly used is to install all rings first before tamping. This will frequently cause the outer rings to become too tight and result in short packing life, shaft wear, and poor shaft sealing.

(h) With all rings properly installed and tamped, slide packing follower into place over packing studs and install stud nuts loosely. Gradually tighten stud nuts and start the pump. Continue slowly and equally tightening the stud nuts until shaft leakage diminishes to approximately 1 or 2 drops per second.

(i) Allow for free and liberal leakage for an hour or more. Then gradually tighten packing follower until just enough leakage occurs to lubricate packing. A few drops per minute should suffice to lubricate shaft and packing. If this occasional leakage cannot be tolerated, a mechanical seal may be used in place of the packing. Consult your local Foster representative or mechanical seal manufacturer for assistance.

(j) Lantern rings provide an excellent means of lubricating the shaft and packing with grease, oil, water, or the liquid being pumped. Grease fittings, automatic lubricators, or supply lines can be used to furnish the lubricant.

(k) If a lantern ring is used, be sure it is installed slightly behind the lubricant fitting or connection so that the ring will be oriented beneath the fitting when the packing gland is tightened.

Packing replacement is again necessary when leakage can no longer be controlled by adjusting the packing gland.

Mechanical Seals

1) Use -Since mechanical seals reduce product leakage to microscopic quantities, and while controlled but measurable leakage is characteristic of compression packing performance, seals are used to a primary advantage where no product leakage can be tolerated (e.g., hazardous, or costly liquids). They also offer advantages in high pressure and high temperature applications which severely impair packing life. In additional, shaft or sleeve wear, periodic maintenance, and housekeeping (emptying drip pans) are virtually eliminated with the use of mechanical seals.

2) Selection-Generally, the following environmental characteristics must be considered for proper seal selection.

(a)

1) Corrosion characteristics-Seal materials must remain unaffected by corrosion

2) Viscosity-External seal face lubrication, flushing provision, and in higher viscosity liquids, two seals back to back with a thinner viscosity barrier lubricant between the seal elements may be required.

3) Abrasives-Liquids containing abrasive solids require abrasion resistant face materials, flushing provisions with a liquid/solids separator, and/or double seal designs as above.

4) Lubricity-Liquids with little or no lubricating value require self lubricating seal face materials or designs providing for external seal face lubrication.

b) Operating pressure-High pressures require more sophisticated seal designs (multiseals, balanced, or semi-balanced seals).

c) Shaft speed-Seal face materials should have low friction characteristics. High speeds also require more sophisticated designs.

d) Operating temperature-Temperature must have no adverse effect on seal materials. Quenching provisions may be necessary in high temperature applications.

e) Finally, since the performance of a mechanical seal depends upon the precision smooth flat finish of its mating faces, it is essential to the life and performance of a seal that the accuracy of the sealing faces be maintained by selection of proper materials and designs to neutralize or greatly reduce the effects of environmental conditions which could impair the precision finish and flatness of the seal faces.

NOTE:

Before initial operation of seal fitted pumps, be sure liquid is present at the seal faces. A dry running seal can destroy itself in minutes.

3) Trouble-Symptoms and Causes

a) Seal exhibits sputter noise while operating. Product vaporization across seal faces. ***Take steps to maintain product in a definite liquid state.***

b) Leakage accompanied by gland plate icing-***evaporation as above. In additionally, seal faces may be scored.***

c) Continuous Leakage

i) Warped seal faces.

ii) Damaged static sealing elements, “O” rings, “V” rings, or gaskets.

iii) Scored faces. Check for abrasives.

iv) Cracked or chipped faces.

v) Solids wedged under static sealing elements.

d) Seal exhibits squalling noise while operating***-inadequate liquid supply at faces. Bypass flush may be required.***

e) Short Seal Life

1) Abrasive liquid. Evidenced by scored seal faces.

2) Mechanical misalignment.

3) Excessive heat developed at seal faces.

4) Inadequate liquid supplied to seal faces.

5) Incorrect selection of seal materials

6) Incorrect seal design for application.

f) Seal leaks for no apparent reason.

1) Faces not flat.

2) Distortion of sealing faces during operation.

3) Misalignment.

4) Mechanical defects in seal or pump.

4) Maintenance-Since seals are manufactured to extremely close precision tolerance and finishes, exercise extreme care in fitting and removing seals from pumping equipment.

a) Removal

1) Thoroughly clean shaft and housing bore and remove burrs, nicks, and sharp edges which could damage tight fitting seal elements (“O” rings, “V” rings, or wedges).

2) Lubricate shaft and housing with clean oil before attempting removal of the seal assembly

b) Inspection

1) Thoroughly clean oil and product for seal faces and wipe with a clean soft cloth.

2) Examine mating faces for:

   a) High spots-Indicative of out-of-flatness

   b) Small thin surface cracks-Indicative of excessive heat developed at seal faces.

   c) Elliptical wear pattern- Indicative of shaft wobble.

   d) Discontinuous wear pattern-Indicative of out-of-flatness. (Contact line not maintained 360 degrees). Misalignment between faces (not parallel to each other).

   e) Scratched, cracked, or scored faces (if extending radially and breaking 360 degrees wear pattern seal will leak)- ***Indicative of improper installation or abrasives in liquid.***

   f) Convex or concave face profile- ***Indicative of nonparallel face mating.***

3) Examine drive pins for wear and straightness

4) Examine springs for flexibility.

5) Examine "O" rings, "V" rings, Wedges, and gaskets for scratches, nicks, grooves, and brittle or spongy consistency.

6) Examine setscrews for wear caused by tightening.

7) Examine shaft for axial wear caused by sliding seal between seal ring and shaft, and examine for radial wear caused by shaft running against bore of seat or gland plate.

8) Examine stationary seat and gland plate bore for wear caused by running contact between seal ring and shaft.

9) Examine housing bore for wear marks caused by running contact between seal ring and bore.

10) Examine seal ring assembly for wear marks caused as above.

11) Check location of setscrew marks on the shaft against dimension indicated on seal assembly drawing. Examine marks for evidence of slippage.

a) Refitting

   1) Thoroughly clean shaft and housing bore and remove any sharp burrs or edges which could damage tight fitting seal parts.

   2) Lubricate shaft, housing, and seal assembly with clean oil.

WARNING:

BE SURE OIL LUBRICANT IS COMPATIBLE WITH ANY ELASTOMER SEAL COMPONENTS.

   3) Exercise extreme care to protect precision mating faces.

   4) If the condition of a part is doubtful, replace it with a new part.

   5) <u>NEVER</u> mate used faces with new ones.

   6) Handle "O" rings, "V" rings and wedges, especially those made of PTFE with

utmost care to avoid scratching, nicking, or pinching during assembly.

7) Using a clean soft cloth, wipe oil from mating faces before bringing them together.

8) Secure locking devices at positions indicated on seal assembly drawings.

9) Be sure liquid is present at seal faces before starting pumps.

Since extreme precision is required to repair and rebuild mechanical seals, we recommend that mechanical seal assemblies and components be returned to our factory or a mechanical seal manufacturer for rebuilding or replacement.

PARTS INSPECTION

The selection of clearances between sliding parts within rotary vane pumps is based upon the anticipated pumping conditions. The most important determinants generally include viscosity, pressure, pump speed, suction conditions and temperature. The clearances therefore vary between pumps and it is difficult to establish a specific part's replacement point.

Generally, noise, vibration, loss of pumping capacity, and excessive heat are indicative of the necessity to replace worn parts. Operational experience will provide information to establish an effective preventative maintenance program.

SPARE PARTS ORDERING

Always include the pump model number and serial number along with the required quantity, part name, material of construction, part number, and drawing reference number when ordering replacement parts.

Order Check List

1) **Pump Model Number**
2) **Pump Serial Number**
3) **Part Description**
4) **Material of Construction**
5) **Item Number**
6) **Quantity**
7) **Reference Drawing**
8) **Preferred Shipping Method**

RETURNS

All parts or pumps returned to the factory must have a Returned Material Authorization (RMA) tag attached. This tag may be obtained from a local Foster representative or the factory directly.

Delays in handling can be avoided by contacting the local Foster or factory office and detailing the material to be returned and the reasons for returning the equipment.

Attach the completed tag to the equipment, tearing off the portion indicated to be sent to the factory office. If more than one package is involved, number each consecutively and print identification marks on each. Carefully wrap and pack each item to include weather or handling damage.