Tech Talk

Pump Maintenance Procedures

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In today's over-capacity North American industrial environment many plants and paper mills are being consolidated or closed. Many of the lower seniority maintenance personnel have moved on to other opportunities. The remaining MRO veterans have a great deal of experience, but they are rapidly approaching retirement age. When they start retiring, there will be a void of maintenance knowledge surrounding the proper installation, maintenance, and operation of pumping equipment.

Combine this "brain drain" with shrinking maintenance budgets and you can see how critical it is to properly train new maintenance personnel to perform high quality maintenance on your pumping equipment. Their primary focus should be to increase pump reliability, thereby decreasing maintenance time and costs. The result is improved uptime and profits.

Installation
The process of improving reliability and decreasing maintenance costs starts with the initial pump installation. Any effort to improve reliability through rebuilds down the road can be negated by an improperly installed pump.

First, the baseplate must be leveled and grouted such that there are no air pockets in the grout under the baseplate. This will provide a rigid foundation for the pump and will minimize any vibrations that could occur. By minimizing the vibrations, you minimize the pounding the bearings are taking and consequently, extending their lives.

Next, the pump should be mounted on the baseplate and aligned. Then, and only then should the piping be run to the pump. When done in this manner, piping loads on the pump are minimized. Piping loads, both thermal and static can deform the casing to the point of throwing the pump and motor out of alignment. This will add radial loads to the bearings and eventually shorten their lives. Once the piping is complete, the alignment should be re-checked to ensure the resulting static loads did not change the alignment.

It is always worth noting that most pumps in North America are oil lubricated. Most pump manufacturers do not ship pumps with oil installed in the bearing frames. Oil must be added prior to starting the pumps. Oil should be changed after the first 200 hours of operation and every 2,000 hours (or three months) thereafter. Check your maintenance manual for oil type, viscosity, and grade. Without the oil, the bearings will burn themselves up quickly.

Inspection
If/When the pump fails, we now need to move into the rebuild phase of pump maintenance. This is where most maintenance departments concentrate their time and efforts.

The first step is to fully disassemble the unit and inspect all the components. Of particular interest should be the pump's casing, impeller, stuffing box cover/seal chamber, shaft, sleeve, frame, and thrust bearing housing.

The casing and stuffing box cover/seal chamber should be inspected for cracks, excessive wear, and pitting. It should be repaired or replaced if there are any cracks, localized wear or grooving in excess of 0.125 inches (3.2 mm), or pitting in excess of 0.125 inches (3.2 mm) deep. The gasket surface should also be checked for any irregularities.

The impeller should be inspected for the same type of damage. The impeller should be repaired or replaced if there are any cracks, if there is any major damage to the vanes, if there is any grooving or pitting in excess of 0.062 inches (1.6 mm), or if there is general wear on the face of the impeller (open design only) in excess of 0.031 inches (0.8 mm). If the impeller has back pumpout vanes, they should also be checked for grooving, pitting, and general wear.

The frame adapter, if applicable, should be checked for any cracks or corrosion. The gasket surfaces, machined bores, and turned fits are of particular interest. Insure they are clean and free from any debris.

The shaft sleeve should be checked for any cracks or, especially in the case of a packed pump, wear along the sleeve outside diameter. The sleeve should be replaced if any wear is found greater than 0.062 inches (0.002 mm). The inside diameter of the sleeve also needs to be checked to ensure a proper seat on the shaft. Excess tolerance between the shaft and sleeve, especially when using mechanical seals, can lead to premature seal failure.

The shaft should be checked for straightness. Anything that exceeds the manufacturer's shaft runout limit should be replaced. In addition, the shaft bearing fits need to be checked. Any shaft with an undersized bearing fit should be replaced. Undersized bearing fits can lead to loose bearings, increased loads on the bearings, and increased vibration possibly resulting in early seal failure, early bearing failure, and coupling failure.

Finally, the thrust bearing housing needs to be inspected. It should be free of any corrosion and physical defect such as cracks and pitting. The bearing bore should be check to ensure it conforms to the manufacturer's designed tolerances. If the bore is enlarged beyond the maximum allowable, the housing should be replaced. Using a bearing housing with improper fits can result in early bearing failure.

Reassembly
Once all the parts have been cleaned, inspected, and replaced if required, it is time to reassemble the unit. Care should be used to keep the parts clean and free from debris during the reassembly process. Any foreign matter that gets into the bearing frame can cause a catastrophic bearing failure.

In years gone by, the standard design to seal the bearing housing used lip seals and deflectors. The advantage lip seals provide is that they are inexpensive and easy to install. However, they have a limited life, approximately 2,000 hours, and will wear the shaft. Once the shaft and seals are worn, they are ineffective at sealing the bearing frame and provide an opportunity for debris to enter the frame. Contamination in the bearings and lubrication is the leading cause of bearing failure.

Many current pump designs offered today include a labyrinth style oil seal that is non-contacting, and much more effective at sealing the bearing frame. Since the labyrinth seal is non-contacting, it does not wear and can be re-used when a pump is rebuilt. It is recommended, though, that the seal elastomers or o-rings be replaced during the rebuild. In most cases, current labyrinth seal designs are directly interchangeable and fully compatible with the older design pumps. To provide a better operating environment for the bearings and consequently extended pump life, lip seals should always be replaced with a current design, labyrinth-type oil seal.

To ensure an OEM quality rebuild, it is imperative to perform several runout checks during reassembly. These checks will indicate whether or not proper assembly techniques were used and whether or not the components used in the rebuild are correct. All of the readings/ measurements discussed below need to be compared to the pump manufacturer's standards. You will need to have this data prior to starting the rebuild. This information can be acquired from the manufacturer. As a matter of fact, most reputable manufacturers publish this data in their Installation, Operation, and Maintenance manuals and/or on Maintenance Cards with other maintenance specific data.

Check List

The following checks are based on an end suction pump design and apply to both ANSI standard units and large end suction stock pumps. Some of this information can be applied to double suction or split case pumps as well.

First, after the basic bearing frame/power end has been assembled, three specific readings should be taken. Secure the dial indicator to the frame and position it on the end of the shaft. See Figure A [Measuring shaft endplay]. Check the shaft endplay. It should be within the manufacturer's limits. If assembled properly, this is determined by the bearings' internal clearances.

The second check is shaft/sleeve runout. If the pump uses a shaft sleeve, the sleeve will need to be mounted along with the impeller to hold it in place. Secure the dial indicator to the frame and check the runout on the shaft/sleeve. See Figure B [Checking shaft / sleeve runout]. If this reading is outside of the limits, it indicates that the shaft is bent or the sleeve is worn or out of round.

Once completed, remove the impeller, and sleeve if used above, and secure the dial indicator to the shaft and sweep the frame face. This only applies to pumps with frame adapters. See Figure C [Checking frame face runout]. Once complete; continue the back pullout assembly with the frame adapter and the stuffing box cover/seal chamber.

The next set of measurements involves the stuffing box cover or seal chamber. Secure the indicator to the shaft and sweep the gland register, checking the outside diameter. See Figure D [Checking seal chamber register concentricity]. Typically, the gland register should not exceed 0.005 in.

Then relocate the indicator and secure it to the impeller end of the shaft. Sweep the casing gasket face and then the outside diameter of the casing lock. In most cases, these measurements also should not exceed 0.005 in. Finally, sweep the seal chamber face at the OD. Typically, this should not exceed 0.003 in.

When the seal chamber measurements are complete, finish the back pullout assembly with the sleeve and impeller, to include all keys, bolts, nuts, etc. The final set of measurements is the impeller face and outside diameter. Secure the indicator to the seal chamber and set the indicator on the impeller. Rotate the impeller measuring the OD runout. Reset the indicator and repeat for the impeller face. For enclosed impellers, you will also need to check the ring or nose outside diameter on the suction side of the impeller. The limits for these two readings will be pump model and size specific and will need to be given to you by the pump manufacturer.

To assist maintenance technicians and millwrights capture and record this data; a sample Pump Checklist is provided (Figure E). It can be customized to each maintenance department's needs.

Impeller Balancing

It is worth noting that any discussion on improved pump maintenance and pump life would not be complete without discussing impeller balancing. As a minimum, all impellers should be balanced to ISO 1940 G6.3 with either a single or two-plane balance, depending on the size of the impeller. Many users have moved to an even tighter unbalance limit based on their own maintenance practices and experiences.

A proper balance will reduce vibration and provide a smoother running pump. This will in turn reduce the loads on the bearings, providing a longer life. Theoretically, the tighter the balance, the smoother the unit will run, but this does not account for hydraulically induced vibrations. Depending on the pump's operating point on the curve, the hydraulically induced vibrations can far exceed that caused by the mechanical unbalance.

It is now time to complete the pump assembly. Reinstall the pump back pullout. Check the lubrication level to ensure proper lubrication. You are now ready to restart the pump and enjoy the performance an OEM quality rebuild can provide.

Although bearings and seals were mentioned above, they were not covered in detail. Yet, they are an integral part of any pump. For further details surrounding bearing or seal specific maintenance and life extending practices, contact your local supplier or the manufacturer directly. They can offer you many simple ideas to improve their component's operating environment and life.

Many industries such as chemical and paper are very pump intensive. When a maintenance procedure such as this is implemented, your plant or mill should experience an significant improvement in pump life and immediate bottom line dividends. Mean Time Between Failure (MTFB) should be dramatically increased. In turn, the longer pump life should allow your maintenance technicians and engineers to focus on other production enhancing issues.

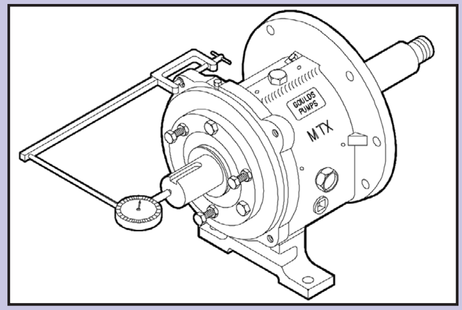

Figure A. Measuring Shaft Endplay

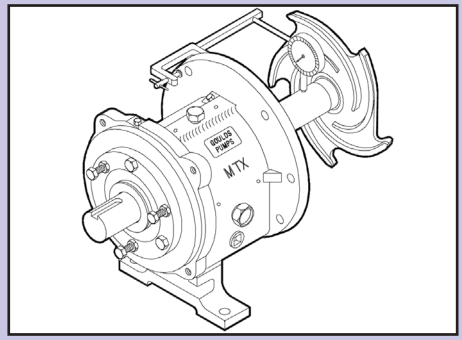

Figure B. Checking Shaft / Sleeve Runout

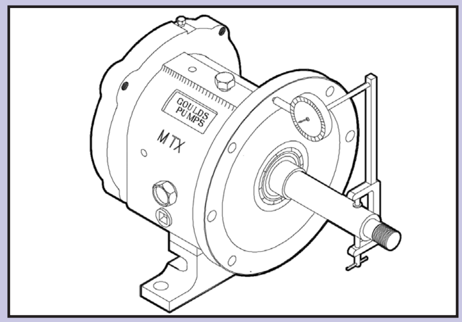

Figure C. Checking Frame Face Runout

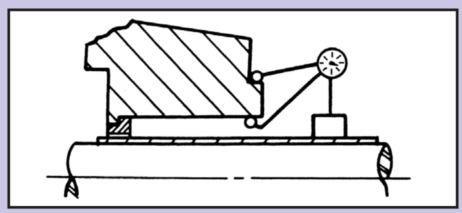

Figure D. Checking Seal Chamber Register Concentricity

Model **Pump Size** **Material**
Work Order #/SN **Pump #**

Assembly Requirements

Shaft Sleeve Material ________________________
(Shaft or Shaft Sleve)

Runout at Seal Chamber Face (Max .0)* .00____*
S.B Cover Case Gasket Face (Max .005 FIM) .00____*
S.B. OD Casing Lock (Max .005 FIM) .00____*
OD Gland Register Fit (Max .005)* .00____*
Seal Chamber Face (Max .003)* .00____*
Impeller Diameter ______*
Impeller Angle Face (Max .005 FIM) .00____*

Figure Total Travel (.035 to .060) ____________________
Front Clearance set to ____________________
Free Turning ____________________

Assembled By: ____________________
Date ____________________

Notes: All requirements are measured in inch dim.
* Mfr. Specifications

Figure E. Sample Pump Checklist