SMITH
PUMPS

PROLONGING SERVICE LIFE OF SHAFT SEALS IN LIQUEFIED GAS PUMPS

Due to their potentially difficult handling characteristics, liquefied gases can present some rather unique problems. Smith Precision Products Company, Inc., has specialized in the manufacture of positive-displacement liquefied gas pumps since 1938, and continues improving the product line, through progressive refinement in design, materials, and technology. Even so, care must be taken in the installation and operation to avoid seal failure and other related internal wear problems. The following recommendations, based on our experience, will help prolong shaft seal life under the demanding conditions so typical of liquefied gas transfer operations.

1. **<u>Rust</u>.** Perhaps most wear problems in shaft seals are caused by chronic exposure to debris produced by seemingly inconsequential internal surface oxidation within standard steel supply tanks and related steel piping systems. This mostly occurs when contained liquefied gas pressure is regularly relieved to atmosphere, lowering temperatures especially in the immediate area of depressurization. Air then freely enters cold tanks, pipes, and hoses. Absorbed moisture condenses on internal surfaces, accumulates in the system, and eventually causes notable particulate accumulations from minor repetitive oxidation. When carried by turbulent flow rust can be finely pulverized, pass right through a typical strainer, and deposit inside the pump. Ultimately, it becomes abrasive to mechanical seals, and also affects bushings, shafting, and other functional parts. *Always leave tanks and lines pressurized; or when this is not possible, securely plug or cap all openings to prevent free internal atmospheric contact*.

2. **<u>Worn Electric Motor Bearings</u>.** Follow the motor manufacturer's recommendations, especially with regard to servicing and lubricating bearings. Motors should have minimal shaft endplay. They should turn freely by hand, without perceptible ball bearing noise. Worn ball bearings can lead to excessive motor shaft endplay, repetitive oscillation, and a noticeable "roughness" when turned by hand. Resulting functionally caused, adverse vibration effects transferred through the pump shaft eventually cause seal leaks.

3. **<u>Poor Flexible Drive Coupling Condition</u>.** A third cause of shaft leaks can be the flexible drive coupling that connects the pump and motor shafts. *This coupling should always be of the type recommended by the pump manufacturer.* Although it is a simple device, which can easily be overlooked, the coupling should never be ignored. Most couplings used with Smith pumps, such as the Smith Flexible Drive Coupling, utilize a hard rubber, or Teflon®-based insert. This insert should be periodically checked and timely replaced when necessary, or it will cause vibration, excessive coupling wear, and shaft seal leakage.

4. **<u>Pump and Motor Shaft Misalignment</u>.** These shafts may be out of alignment, especially with pumps and motors mounted separately on a common base. All units are properly aligned when shipped from the factory, but pipe fitters can put heavy strains on the pump when connecting the piping, which can force it out of alignment with the motor. This leads to seal leaks. Always check the alignment of the Smith flexible drive coupling, as per bulletins "AL-1", "AL-3", or "AL-17A". Correct it by loosening the motor mounting bolts, repositioning the motor, and retightening the motor mounting bolts.

5. **<u>Internal Carbon-Graphite Bushing Wear</u>.** With the exception of the "E" and "D-Series" units, the internal extension of the drive shaft is centered and supported by one or more carbon-graphite bushings, or "journal bearings". Regardless of the coupling type used, these bushings can wear excessively, if the pump continues to be operated with the drive shaft not properly aligned with the motor shaft to within at least 0.015". Excessive bushing wear allows the pump shaft to run off-center. Off-center drive shaft rotation leads to mechanical seal failure, and may aggravate wear in other parts as well. Under

these circumstances, replacing only the shaft-seal assembly is unsatisfactory. Seal failure will continue, unless worn bushings (and possibly other parts) are also replaced.

6. **Running Pumps Dry.** Running the pump dry for even a few minutes causes highly accelerated internal wear from total disruption of required lubrication and cooling effects, normally provided by liquefied gas flowing through the pump. Shut off the pump promptly when the supply tank is discharged. Be sure the pump is full of liquid when started. Otherwise, mechanical seals may overheat, and wear prematurely. See “AL-6”.

7. **Improper Installation and/or Adjustment of the External Differential Pressure Bypass Valve.** Positive-displacement pumps should always be installed with a proper external (“primary”) differential pressure bypass system, which provides non-damaging protection against potential development of highly excessive pressure from conditions such as but not limited to (a) running against a closed discharge valve (“dead-heading”); (b) pumping total output through long lengths of excessively small diameter pipe, hose, or tubing; or (c) discharging completely through an outlet line that is excessively restricted by a partially closed valve, a damaged hose, a clogged meter strainer, rust, debris, or other foreign substances. The primary bypass system, supplied through a non-restrictive connection as close as possible to the pump liquid outlet port, must be sized for minimal “overpressure” even when handling 100% of pump discharge flow. Bypassed liquid must return to a dedicated supply tank inlet, in such a way as to prevent immediate recirculation of handled fluid back to pump suction. *The external bypass valve should not necessarily be set at maximum allowable differential pressure. Discharge system flow rates do not necessarily improve by readjusting bypass valves for differential pressures higher than recommended by the pump manufacturer. Excessively high adjustments must be avoided.* If the bypass system does not operate properly, the pump will either develop extreme differential pressure, which overloads all working parts; or the pump will run itself dry when the “secondary”, or “internal” bypass valve opens, recirculating the handled fluid back through the pump, where it immediately vaporizes due to accumulation of absorbed heat.[1] Mechanical seal failure is probable, under continuous adverse conditions caused by inadequate bypass protection. See “AL-6”, “AL-36”, “AL-41”, service manuals, codes such as “NFPA 58”, and contact the factory for additional information.

8. **Lack of Preventive Maintenance.** The day-to-day operation of Smith pumps does not require periodic maintenance, lubricating, or servicing. However, it should be noted that mechanical shaft seals, and other related parts, are most reliable when the pump is *maintained on a preventive basis, in a well designed and operated liquefied gas transfer system*. Unfortunately, parts replacement before breakdown occurs is often overlooked. We cannot overstress the importance of pump performance record-keeping, regularly scheduled inspections, and *preventive* maintenance. Repairs made only after detecting a mechanical shaft seal leak or some other problem, may not always be satisfactory (see ”AL-1”, “AL-3”, “AL-17A”, “AL-93”, “AL-93B”, “AL-97”, “AL-200”, and “AL-201”).

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[1] ***Note: Smith Precision Products Company, Inc. is not responsible for the design, construction, or use of piping systems. The installations as literally described may not be acceptable in all areas, and could have to be modified. This bulletin, and other such literature from Smith Precision Products Company, Inc. relating to LPG, NH_3, CO_2, or similar low-pressure liquefied gases, is for concept presentation, only. All presented data, whether empirical or theoretical, are from a pump manufacturer’s standpoint. Proper system design, construction, and use require a site-specific engineering study including component manufacturer’s application data, with due regard for all of the applicable local, State, and Federal safety codes and regulations, such as, but not limited to, those promulgated by the NFPA, DOT, and ANSI.***

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