Using Kalsi Seals® in Hydraulic Swivels

Enhanced Lubrication Swivel Seals

568-Series Enhanced Lubrication seals[1] (Figure 1) reduce torque and seal-generated heat in critical applications such as hydraulic swivels, where thin viscosity lubricants are encountered, and higher hydrodynamic pumping-related leakage (compared to Standard Kalsi Seals) can be tolerated. These seals hydroplane on a thin film of hydraulic fluid to reduce wear, even in high pressure conditions.

As shown in Figure 2, Enhanced Lubrication Seals are available in Dual Durometer configurations, where the outer part of the seal is softer than the inner part. This construction further reduces breakout and running torque and seal-generated heat, while augmenting extrusion resistance.

Figure 1
568-Series Enhanced Lubrication Swivel Seals
The Enhanced Lubrication Seal hydroplanes on a thin film of hydraulic fluid to reduce torque, seal-generated heat, and wear.

Recommended Swivel Seal Implementation

Hydraulic swivels communicate hydraulic pressure between a shaft and a housing that have relative rotation with respect to one another. Kalsi Seals should be implemented into the hydraulic swivel in a manner that isolates them from reversing pressure. The schematics of Figure 2 show how to accomplish this. In the upper schematic, two Kalsi Seals are used to define each hydraulic circuit. A drain port allows the hydrodynamic pumping-related leakage of facing pairs of Kalsi Seals to escape. In the lower schematic, the pressure in Port 1 is never greater than Port 2.

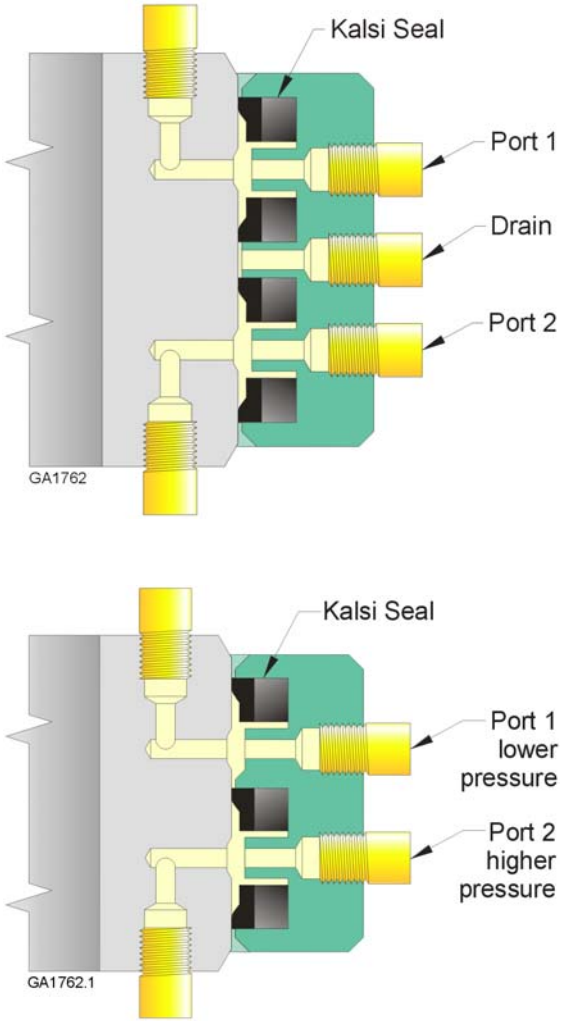

Figure 2
Recommended Hydraulic Swivel Practice
These configurations protect the Kalsi Seal from reverse △P.

Exposing swivel seals to reversing pressure is undesirable because it causes seal sliding that lubricates the static sealing interface. This makes the seal prone to circumferential slippage, which can damage the static and dynamic sealing lips.

Grit blasting the cylindrical groove wall with G50 grit further inhibits seal slippage. Grit blasting is not practical in swivel designs that expose the seals to reversing pressure, because the back and forth seal motion would abrade the seal.

[1] "Enhanced Lubrication Seals" & "Enhanced Lubrication Seal" are rotary shaft seal-related trademarks of Kalsi Engineering, Inc. Such rotary seals are covered by issued and pending U.S. and foreign patents. The products and information in this brochure are offered under the general terms and conditions that are provided in the offer of sale that is included in the current revision of the **Kalsi Seals Handbook**.

Cooling hydraulic swivel seals

Depending on differential pressure, rotary speed and duration, shaft diameter, and quantity of hydraulic circuits, coolant circulation may be needed for optimum seal performance.

Figure 3 shows a convenient way to use circulating hydraulic fluid as the seal coolant. Low pressure hydraulic fluid flows in at the coolant inlet, and reaches the bore of the swivel shaft via cross-drilled holes. A coolant sleeve guides the flow of the hydraulic fluid along the length of the shaft bore. Seal-generated heat transfers from the swivel shaft to the flowing hydraulic fluid. Cross-drilled holes guide the hydraulic fluid to a drain which returns the hydraulic fluid to the reservoir.

Cooling the swivel prevents overheating, and provides a temperature condition that is desirable from both a seal interfacial lubrication standpoint and a seal high pressure extrusion resistance standpoint.

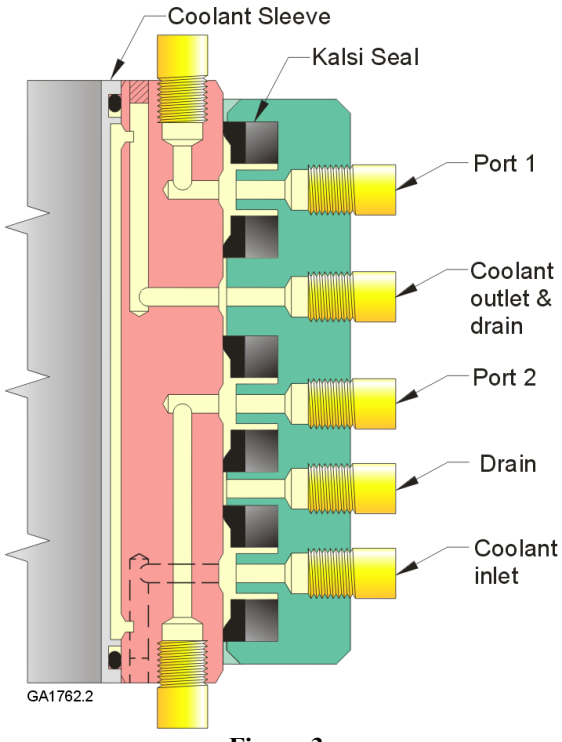

Figure 3
Circulating Coolant

Coolant circulation allows higher speed operation, and promotes better seal lubrication and extrusion resistance (Patent-pending; call Kalsi Engineering for details).

Bearing guidance

Hydraulic swivels are used in various ways, and it is incumbent on the Design Engineer to select an appropriate bearing implementation that accommodates the various forces that may be present while avoiding over-constraint. Some of these potential forces relate to:

- Weight of the swivel components
- Reaction of bearing and seal torque to prevent rotation of the housing or shaft
- Hydraulic imbalance
- Stiffness of high pressure hoses
- Hydraulic pressure within hoses
- Mechanical misalignment of mating equipment
- Weight of mating equipment that is borne by the swivel bearings
- The method of causing rotation

Extrusion Gap Clearance

The extrusion gap clearance between the swivel housing and shaft has a significant influence on high pressure rotary seal performance. For maximum performance, use the smallest extrusion gap that can be obtained without risk of housing-to-shaft contact. If heavily loaded housing-to-shaft contact occurs, the resulting friction can severely damage the seals, shaft and housing.

Proper design of the extrusion gap clearance requires a review of tolerances, bearing fit, bearing internal clearance, pressure-induced shaft and housing deformation, and the potential for differential thermal expansion between the shaft and housing.

Sealing Application Guidelines

General seal implementation guidelines are provided in the **Kalsi Seals Handbook**, available online at http://www.kalsi.com/Rotary_Seal_Literature.htm. Experienced personnel are available to provide general rotary seal technical support. These individuals can also review your design and provide application-specific recommendations on a consulting basis if desired.

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