Chapter C17

KLS high pressure lip seals

Revision 1 January 13, 2017

Individual chapters of the Kalsi Seals Handbook are periodically updated. To determine if a newer revision of this chapter exists, please visit www.kalsi.com/seal-handbook.htm.

1. Introduction to KLS lip seals

KLS® spring-loaded lip seals (Figure 1) are polymeric lip seals for applications having unidirectional rotation. They have a composite body construction consisting of rubber and extrusion resistant plastic. The dynamic lip is loaded against the shaft by a V-spring. The seals were designed and successfully tested for service conditions where the pressure acting from the spring side of the seal is up to 1,000 psi (6.89 MPa) greater than the pressure of the seal lubricant. Qualification testing was performed at a surface speed of 543 feet per minute (2.76 m/s).

The high pressure performance of the KLS seal is remarkable for a spring-loaded lip seal. This performance is the result of hydrodynamic interfacial lubrication that is provided by a patented wave geometry on the low pressure end of the seal. As rotation occurs, this geometry wedges a film of lubricant between the shaft and the plastic dynamic surfaces. Similar seals without the unique hydrodynamic waves failed in only a few hours at the same surface speed, and only 500 psi (3.45 MPa) differential pressure.

Figure 1
KLS high pressure lip seals

The KLS seal is a spring-loaded hydrodynamic lip seal for applications with unidirectional rotation and differential pressures up to 1,000 psi (6.89 MPa) acting from the spring side. No lubricant overpressure is required; the seals can be used with a simple gravity fed lubricant reservoir. The seals have been tested at a rotary surface speed of 543 feet per minute. The high pressure capacity is the result of the hydrodynamic lubrication of the extrusion resistant plastic portion of the seal.

2. The lubricant supply configuration for KLS seals

Pressure retaining service — non-abrasive fluids

When KLS seals are used to retain a pressurized non-abrasive fluid, only one seal is required, and the seal lubricant can be supplied from a simple unpressurized gravity fed lubricator. For example, if the seal is located below the bearings, the seal can simply utilize the bearing lubricant to lubricate the dynamic sealing interface. The need for the

pressure of the seal lubricant to be greater than or equal to the pressure of the environment is eliminated.

Pressure retaining service —abrasive fluids

The abrasive exclusion performance of lip seals, such as the KLS seal, decreases in reliability as differential pressure increases. When KLS seals are used to retain an abrasive process fluid, two seals are recommended, with the region between them being filled with a barrier lubricant that is balanced to the pressure of the process fluid. In this arrangement, the outboard seal excludes the abrasive fluid and is exposed to zero differential pressure, and the inboard seal retains the pressure of the barrier lubricant, and is isolated from abrasives. The recommended way to balance the pressure of the barrier lubricant to the pressure of the process fluid is with a diaphragm or bladder.

Our abrasive exclusion tests were performed with water based drilling fluid that is produced to our specifications for rotary testing. The surface speed was 543 feet per minute (2.76 m/s), and the bulk lubricant temperature was controlled to approximately 162°F (72.2°C).

Most of the tests that have been performed to date have been with nominally concentric running conditions, and were terminated at approximately 260 hours to inspect seal condition. One test was performed with 0.010” runout, zero differential pressure, and drilling fluid. The test was disassembled after 261 hours of rotation, and although the PN 668-4 seal had wear on the plastic portion of the dynamic lip, it was in overall good condition. The hydrodynamic pumping rate was greater in the test with runout.

3. Breakout torque

Although specific breakout torque data is presently unavailable for KLS-brand rotary shaft seals, the breakout torque will be similar to other plastic-lined lip seals in zero differential pressure conditions. The breakout torque will be far less than that of an all-elastomer Kalsi Seal because of the low friction characteristics of the dynamic lip material, and because of the reduced lip load associated with spring loading. This reduced torque may be beneficial in oilfield RCD sealing applications.

4. Miscellaneous

Available seal sizes

A table of available sizes and gland dimensions is available on our website. Smaller diameters require a removable gland wall for assembly due to the stiffness of the seal material.

For available seal sizes, visit kalsiseals.com.

Sealing directionality

KLS lip seals retain differential pressure acting from the spring side of the seal. In the opposite direction, the presence of sufficient differential pressure will cause the seal to vent. In a bench test with a submerged 3.375" diameter KLS seal, we saw bubbles venting past the lip at about 50 psi. The venting pressure will vary depending on factors such as seal diameter, cross-sectional size, and seal temperature.