THORDON

THORDON BEARINGS INC.

SXL Axial and Radial Segmented Shaft Seals for Hydro-Turbines

SXL SEGMENTED SHAFT SEALS FOR HYDRO-TURBINES

With over 25 years experience supplying main shaft guide, wicket gate and operating mechanism bearings to the hydro power industry, Thordon is the proven choice for performance and value in both rehabilitation and new turbine projects. In addition to supplying bearings, Thordon has also been supplying segmented shaft seals to the hydro power industry for more than 25 years. Thordon SXL has a proven track record as a segmented shaft seal material replacing carbon graphite seals.

In addition to proven product performance, Thordon is also an industry leader in polymer research and development, and in application engineering. As part of its ongoing research and development program, Thordon has built its own test facility for segmented shaft seals. This facility duplicates the operating environment of turbine shaft seals and enables Thordon to test various design and configuration options. The results of this program have enabled Thordon to investigate the design of Thordon SXL segmented shaft seals, to determine the performance parameters of the material and to work on the development of new design options to improve the performance of Thordon SXL seals.

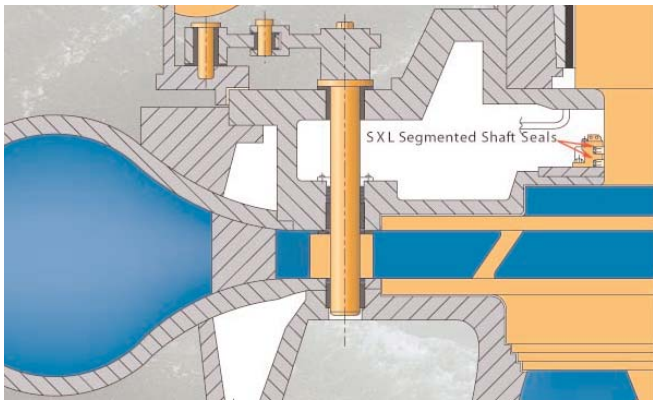
Thordon SXL Segmented Shaft Seal Systems

Operating parameters for Thordon SXL segmented shaft seals are generally similar to those for carbon graphite seals in terms of maximum interface pressure and minimum leakage rate. Thordon segmented shaft seals have been designed for shafts up to 2000mm (80") diameter. They can be designed for use in either radial or axial sealing systems.

The main shaft seal of a turbine usually operates under high PV-value conditions and may also be frequently exposed to abrasives in the water. Thordon segmented shaft seals are a proven solution working in both clean and abrasive laden water. The seal may be located below (see Figure 1) or above the main shaft guide bearing depending on the system arrangement.

Based on Thordon's R&D testing and field experience, Thordon segmented shaft seals are able to operate in a wide range of PV-values with the maximum water pressure tested up to 0.7 MPa (100 psi).

Figure 1. SXL Segmented Shaft Seals



Depending on the shaft size, number of segments, machining precision of segments, sealed water pressure and shaft speed, the amount of leakage can vary widely. It is difficult to predict the leakage rate accurately at the design stage. However, R&D testing has confirmed that for a radial segmented seal consisting of 6 segments running on a 400 mm (15.75") diameter shaft, the leakage rate would be from 10 to 40 l/min (2.6 to 10.6 US gal./min).

Additional advantages of the segmented seal design include easy installation and replacement without removing the shaft. Disassembly of other machine parts may not be required.

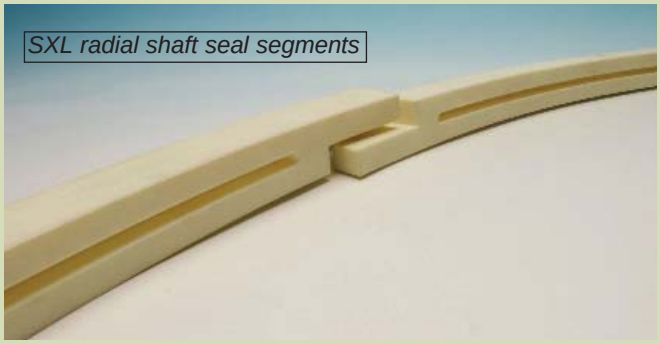
Thordon SXL vs. Carbon Graphite

Segmented shaft seals for turbines have traditionally been made from carbon graphite. These seals have low friction and can accept a significant amount of heat. Carbon graphite is, however, very fragile. It is not unusual to damage several segments during installation. Carbon graphite also does not resist the abrasion which can often be present in the water flowing through a turbine. The elastomeric nature of Thordon SXL gives it superb impact or shock resistance. SXL offers the advantages of being almost unbreakable and also of being much more abrasion resistant. Optimal sealing performance for SXL can be achieved with an injection of clean water between the first and second rings of the seal. Thordon SXL seals can normally replace existing carbon seals without any significant changes to the system design.

Radial Seals

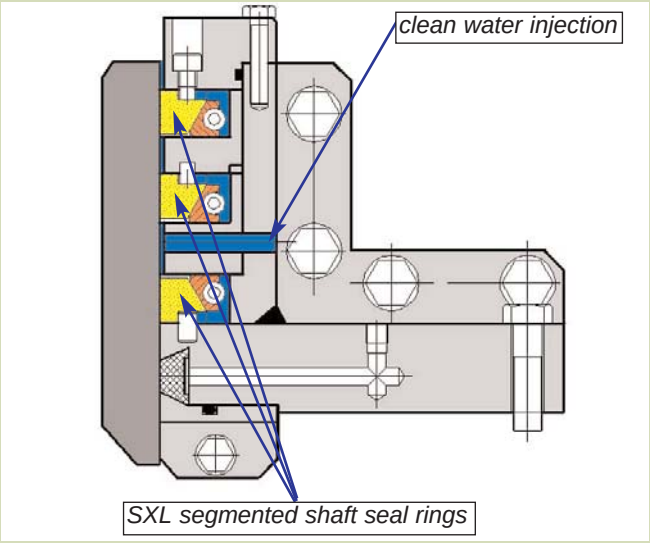
Typical radial segmented seals comprise three stages (rings) of interlocking segments (Figure 2). Each ring has both dynamic (against the shaft) and static (against the housing) sealing actions.

Figure 2. SXL Radial Shaft Seal Segments



First stage seals are normally reversed compared with the two upper rings, to allow introduction of a higher-pressure injection flow between the first and second rings. (see Figure 3) This higher pressure flow (1.10 to 1.15 times turbine pressure) functions as a seal lubricant, coolant and a barrier preventing abrasives in the turbine water from entering the seal faces. A garter spring functions to hold the segments with a nominal light force against the shaft during periods of shutdown and low pressure and also to maintain the integrity of the seal ring within the housing cavity. In normal operation, the seal ring is pressed against the shaft by the force of the water in the turbine.

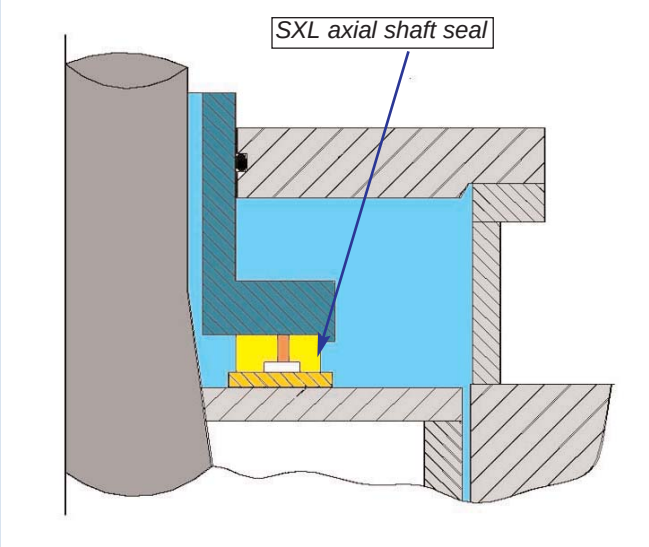
Figure 3. Radial Segmented Shaft Seal Design



Axial Seals

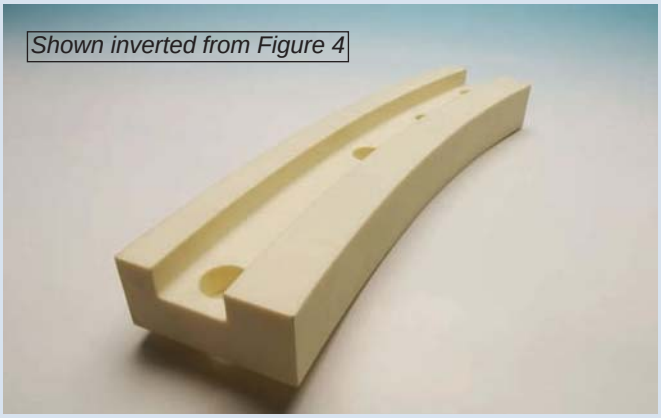
An axial segmented shaft seal works in a similar fashion to conventional mechanical seals. The Thordon axial seal design provides the injection water into the central groove of the seal ring (Figure 4). The seal segments are normally attached to the stationary tubine casing.

Figure 4. Axial Segmented Shaft Seal Design



Thordon axial segmented shaft seals are particularly suitable for extremely large diameter shafts. It is not unusual for Thordon to install an axial seal with ring diameter 4000mm (160") or larger. Figure 5 shows one section from a whole sealing ring of an SXL axial segmented shaft seal.

Figure 5. SXL Axial Shaft Seal Segment



Application Information and Design Parameters

Although Thordon SXL segmented shaft seals can normally be used as a direct replacement for carbon graphite, it is recommended to review the prospective application with Thordon Bearings.

When evaluating an installation, as much as possible of the information and design parameters listed below should be supplied to Thordon for review.

- Water pressure being sealed (water pressure inside turbine)
- Shaft diameter
- Shaft rotating speed (rpm)
- Water quality (clean or abrasive) over the year (i.e. is there spring run-off with abrasives?)
- Environmental (water) temperature
- Maximum leakage flow allowed
- Turbine arrangement (Vertical or Horizontal)
- Existing seal design, if application is retrofit
- Is a clean, pressurized flush available?

Customer Focused To Support Your Immediate And Future Needs

Supply and Service: Geared to provide response to customer needs, Thordon Bearings understands the importance of fast delivery and reduced down time. Thordon marine and industrial bearings can be designed to accommodate the requirements of the customer and shipped quickly.

Application Engineering: Thordon Bearing's engineers work closely with customers to provide innovative bearing and seal system designs that meet or exceed the technical requirements of the application.

Quality: Thordon Bearings Inc. is a Canadian company manufacturing to ISO 9001:2000 Quality System requirements. With over 35 years experience in polymer bearing design, application engineering and manufacturing, Thordon marine and industrial bearings are recognized worldwide for both quality and performance.

Your Local Thordon Distributor

THORDON

THORDON BEARINGS INC.

ZERO POLLUTION | HIGH PERFORMANCE | BEARING SYSTEMS

3225 Mainway Drive, Burlington, Ontario L7M 1A6 Canada
Tel: +1.905.335.1440 Fax: +1.905.335.4033
www.ThordonBearings.com

ISO 9001:2008
CGSB
Registration #93649