

## SXL Axial and Radial Segmented Shaft Seals for Hydro-Turbines

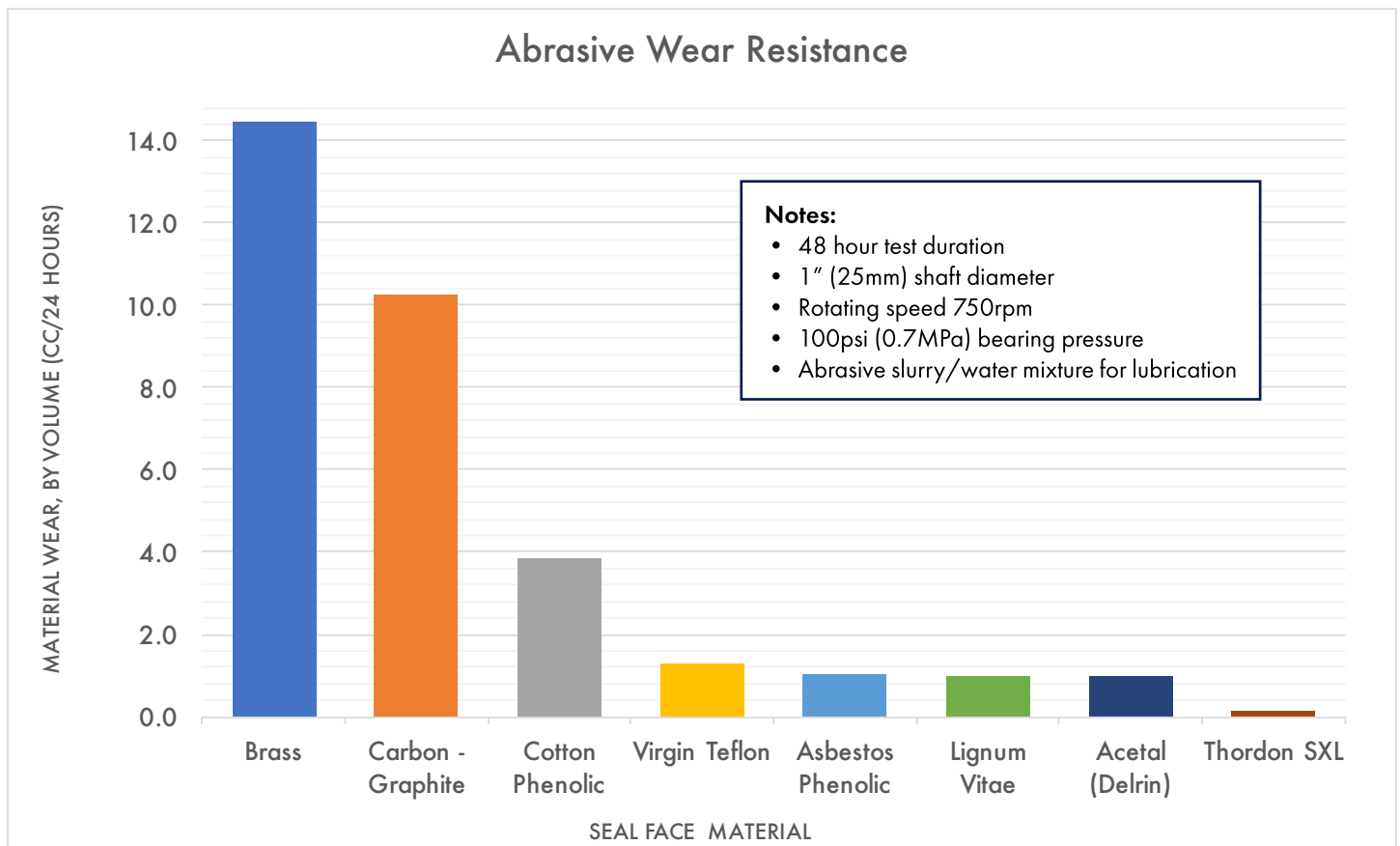
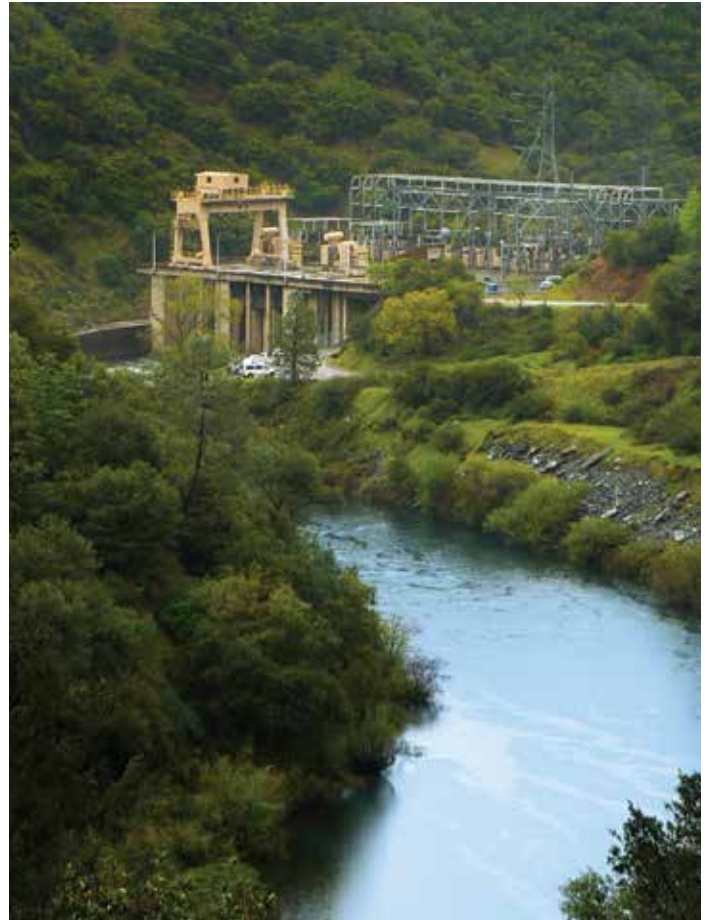
**THORNDON**

ZERO POLLUTION | HIGH PERFORMANCE | BEARING & SEAL SYSTEMS

# SXL SEGMENTED SHAFT SEALS FOR HYDRO-TURBINES

With over 35 years of experience supplying water lubricated turbine main guide bearings, and self lubricated wicket gate 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. Thordon SXL has a proven track record as a segmented shaft seal material replacing carbon graphite and phenolic seal segments.

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 duplicated the operating environment of turbine shaft seals and enabled Thordon to test various design and configuration options. The results of this program have allowed Thordon to optimize the design of Thordon SXL segmented shaft seals, to determine the performance parameters of the material and to work on the development of new designs 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 or phenolic seals in terms of maximum interface pressure and minimum leakage rate. Thordon segmented shaft seals have been designed for shafts up to 2000 mm (80") diameter. They can be designed for use in either radial or axial sealing systems.

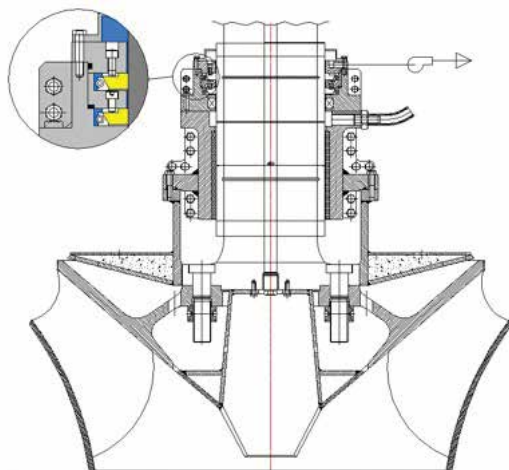
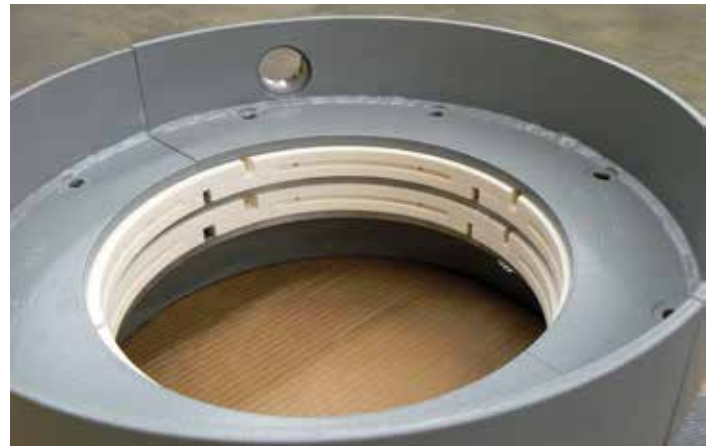
The main shaft seal of a hydro turbine usually operates under high PV-value conditions and may also be frequently exposed to abrasives in the water. Thordon segmented shaft seals are a proven solution working in both clean and abrasive laden water.

The shaft seal may be located below or above the turbine guide bearing depending if a water lubricated (Figure 1) or oil lubricated (Figure 2) bearing solution is used.

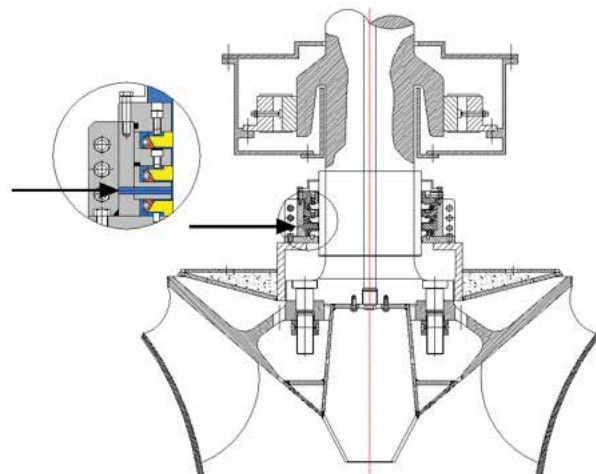
Thordon radial segmented shaft seals are able to operate with the maximum sealed water pressure up to 0.7 MPa (100 psi). An axial seal solution would typically be recommended for sealed water pressures greater than 0.7MPa (100 psi).

Depending on the shaft size, number of segments, machining precision of segments, sealed water pressure and shaft speed, the amount of leakage can vary but will be lower than an equivalent carbon graphite segmented seal. For instance, a radial segmented seal consisting of 6 segments running on a 400 mm (15.75") diameter shaft, the leakage rate would be normally in the range of 10 - 20 L/min (2.6 to 5.2 US gal./min).

Additional advantages of the SXL segmented seal design include easy installation and replacement of all seal components without removing the shaft or disassembly of any major structural components.



**Figure 1.** Typical configuration of segmented shaft seals when used with a water lubricated turbine guide bearing.



**Figure 2.** Typical configuration of segmented shaft seals when used with an oil lubricated turbine guide bearing.





## RADIAL SEALS

Typical radial segmented seals comprise two or three stages (rings) of interlocking segments (Figure 3) depending on the sealed water pressure.

Each ring has both dynamic (against the shaft) and static (against the housing) sealing actions.

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. This higher pressure flow (1.10 to 1.15 times expected water pressure below the seal assembly) functions as a seal lubricant, coolant, and a barrier preventing abrasives in the turbine water from entering the seal. A stainless steel garter spring functions to hold the segments with a 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 (Figure 4). In normal operation, the seal ring is pressed against the shaft by the force of the injection water.



**Figure 3.** SXL Radial Shaft Seal Segments



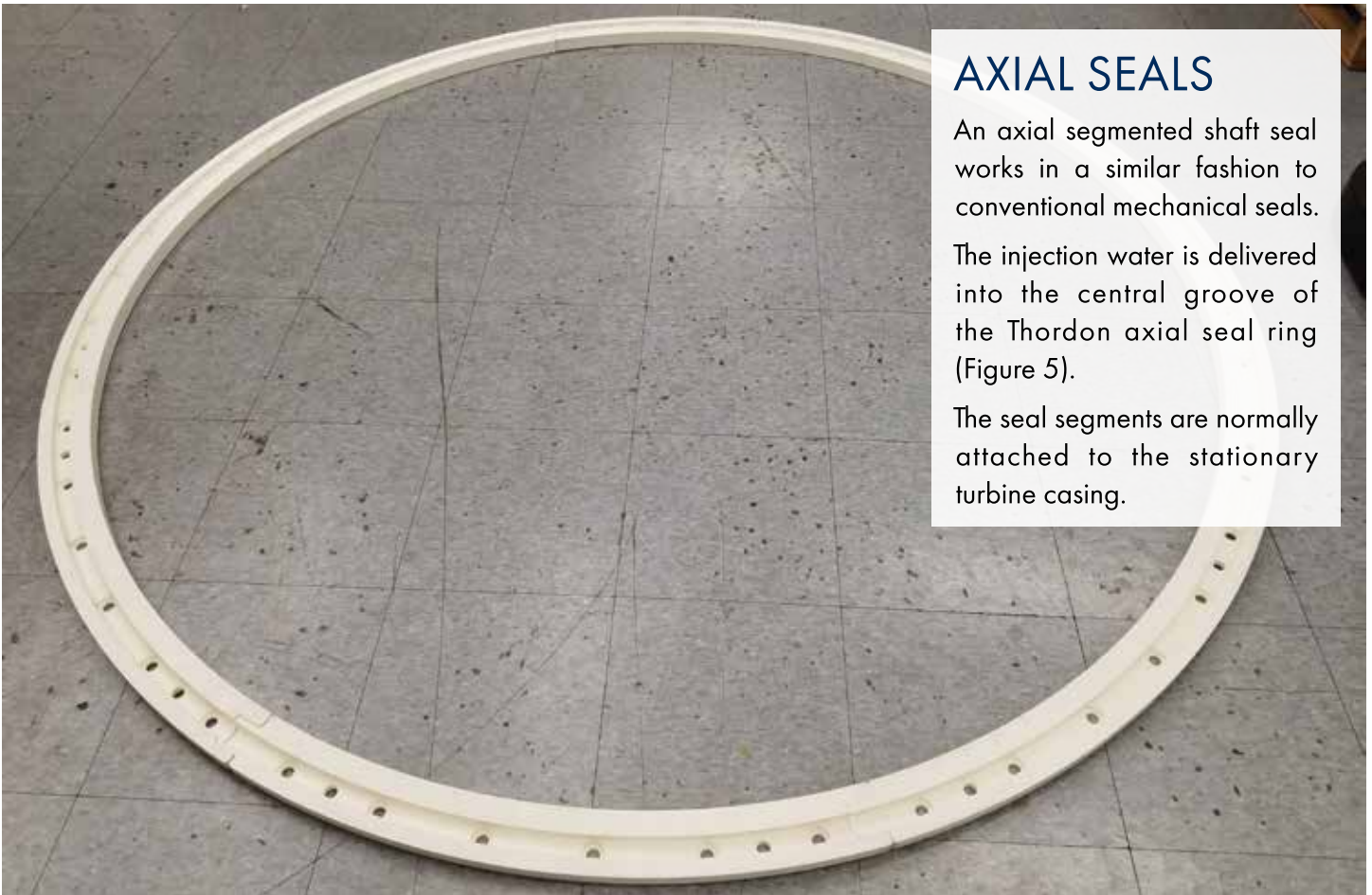
**Figure 4.** Segmented Shaft Seal With Backing and Spring

## AXIAL SEALS

An axial segmented shaft seal works in a similar fashion to conventional mechanical seals.

The injection water is delivered into the central groove of the Thordon axial seal ring (Figure 5).

The seal segments are normally attached to the stationary turbine casing.



Thordon axial segmented shaft seals are particularly suitable for extremely large diameter shafts and sealed water pressures above 0.7MPa (100 psi). It is not unusual for Thordon to install an axial seal with ring diameter 4000 mm (160") or larger. Figure 6 shows sections from a whole sealing ring of an SXL axial segmented shaft seal.

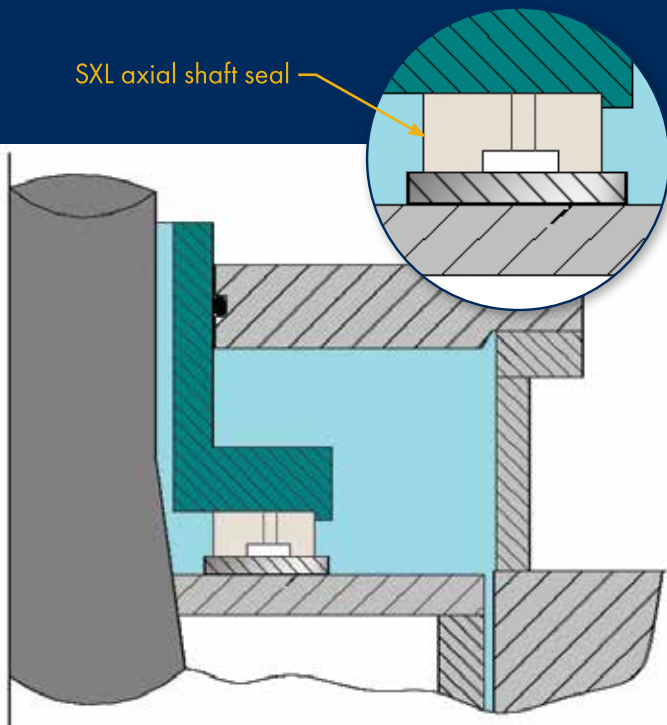


Figure 5. Axial Segmented Shaft Seal Design



Figure 6. SXL Axial Seal Segments

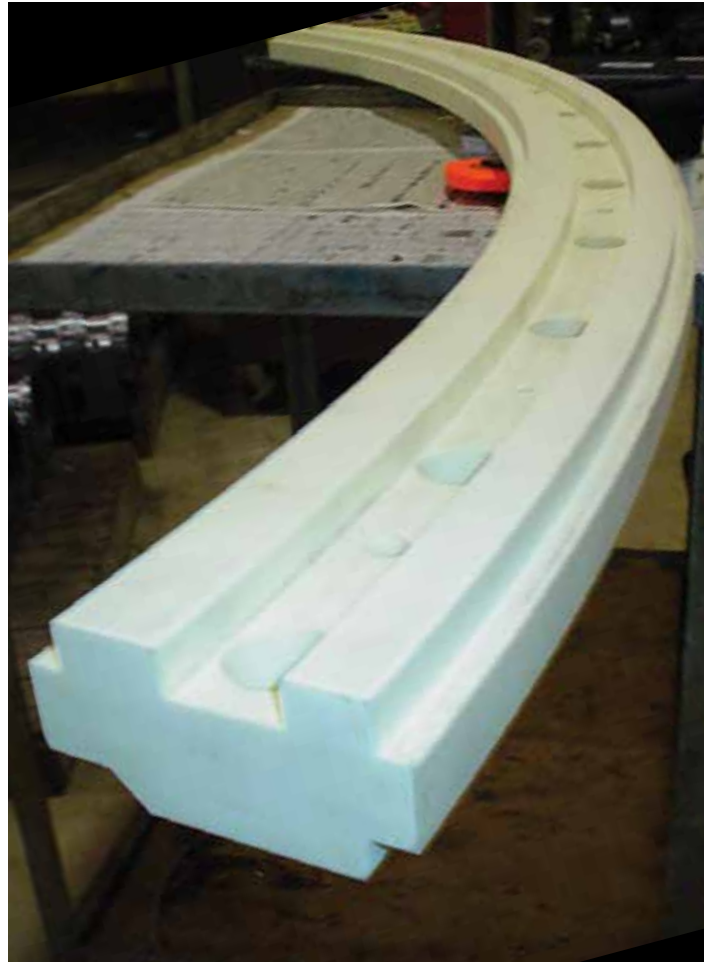


# APPLICATION INFORMATION AND DESIGN PARAMETERS

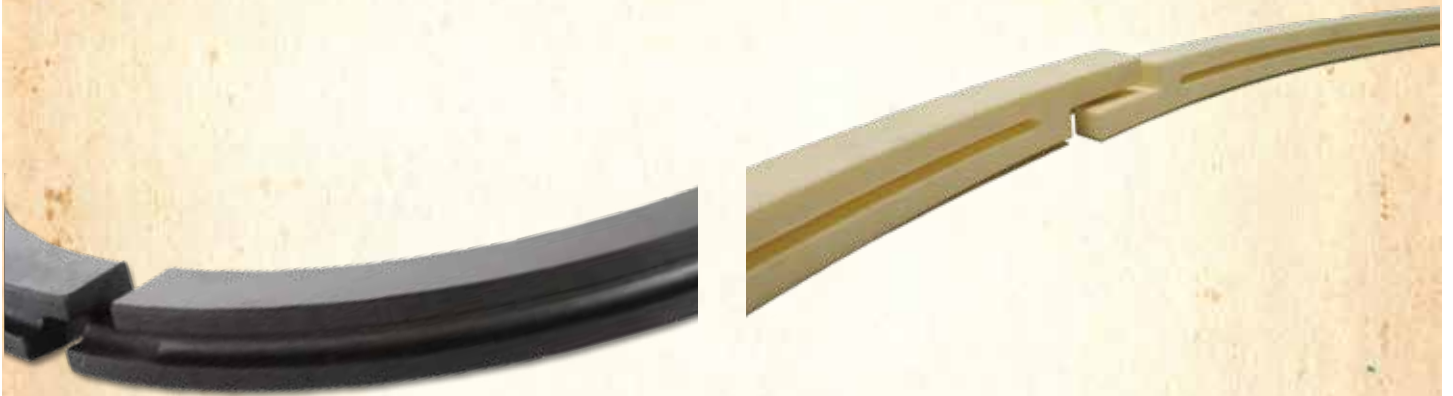
Although Thordon SXL segmented shaft seals can normally be used as a direct replacement for carbon graphite or phenolic, it is recommended to review the prospective application with Thordon Bearings.

When evaluating an installation, 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 water flush available?



# SEGMENTED



**CARBON  
GRAPHITE**  
CHALLENGER

VS.

**THORDON  
SXL**  
CHAMPION

Segmented shaft seals for turbines have traditionally been made from carbon graphite.

- Low friction; high hardness
- Resistant to overheating
- Very fragile

It is not unusual to damage several segments during installation. Carbon graphite also does not resist the abrasion from silt and dirt particles which can often be present in the water flowing through a turbine.

The elastomeric nature of Thordon SXL gives it superb impact resistance which eliminates the risk of cracking segments due to shaft misalignment or vibration. Optimal sealing performance and segment life for SXL can be achieved with an injection of clean water between the first and second rings of the seal. Thordon SXL seals are custom engineered and CNC machined, hence can normally replace any existing carbon seal designs without any significant changes to the system design.

# CUSTOMER FOCUSED TO QUICKLY MEET YOUR NEEDS

## **Quick and Responsive Service**

It takes quality products to be globally successful in the water lubricated bearing and shaft seal industry. It also takes great service to keep customers coming back.

Thordon Bearings Inc. is geared to respond quickly to supply high performance bearing solutions. Thordon bearings arrive quickly, fit correctly and they last!

## **Extensive Distribution Network**

Thordon Bearings has an extensive distribution network of more than 85 distributors to supply and service our global customer base.

Non-standard requests are met with responsive design, quick machining and speedy delivery.

## **Application Engineering**

Thordon engineers work closely with customers to provide innovative bearing and shaft seal system designs and solutions. We offer in-house design, CAD and the proprietary Thordon Bearing Sizing Calculation Program to help correctly size our bearings.

Our decades of experience mean that we offer the right technical support during design, machining, installation and operation.

## **Manufacturing Quality**

Thordon Bearings Inc. is a family-owned company founded in 1911 that operates a state-of-the-art polymer processing plant, machine shop and new product development facilities in Burlington, Ontario, Canada.

In addition, we own a leading edge machining and polymer production plant in Slupsk, Poland.

We manufacture to ISO 9001:2008 Quality System requirements. Contact us for our installation references.

## **High Performance Bearings; Industry-Leading Service**

Thordon Bearings is an industry leader in the design, manufacture, supply and installation of high performance, pollution-free, bearing and shaft seal systems.

**Your Authorized Thordon Distributor**

**THORDON**  
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