THORDON
NewsWORKS

ISSUE 2005-1

ENVIRONMENTALLY FRIENDLY BEARING SOLUTIONS

PRINCESS CRUISES CONTINUES TO INSTALL WATER LUBRICATED PROPELLER SHAFT BEARINGS

Princess Cruises has specified Thordon water lubricated COMPAC propeller shaft bearing systems for two new GRAND Class cruise ships (Hull No.'s 6131 and 6132) being built at Fincantieri Cantieri Navali Italiani SpA for 2007 and 2008 delivery. There is an option for a third bearing system for a follow-on ship.

Princess Cruises, part of Carnival Corporation, currently has seven vessels fitted with water lubricated COMPAC bearings after the first installation in 1998 on *Grand Princess*. "The water lubricated bearings from Thordon have been problem free," says Richard Vie, Vice President Newbuildings for Carnival Corporation. "Based on bearing wear data, we are not expecting to replace the bearings more than once in the life of the vessel, or perhaps not at all."

Thordon Bearings is supplying its unique COMPAC Single Key Design Bearings for the 116,000 GRT twin screw newbuild vessel. The tapered Single Key Design allows the bearings to be easily withdrawn from the bronze carrier, inspected and re-installed with the shaft still in place. The COMPAC elastomeric polymer alloy bearings for the 642 mm (25 in.) diameter propeller shafts are designed to promote hydrodynamic operation at low shaft speeds and provide long wear life. A flow of seawater will be provided to the bearings for efficient cooling and lubrication in this pollution free propeller shaft bearing system.

By completely eliminating oil from the stern tube and struts, Thordon's COMPAC system ensures there is no risk of

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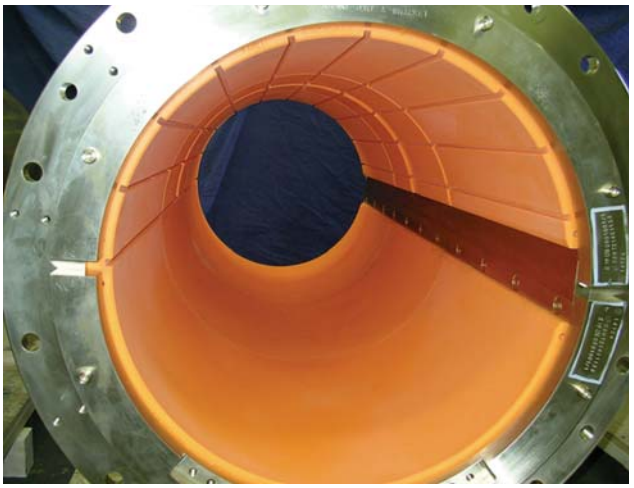
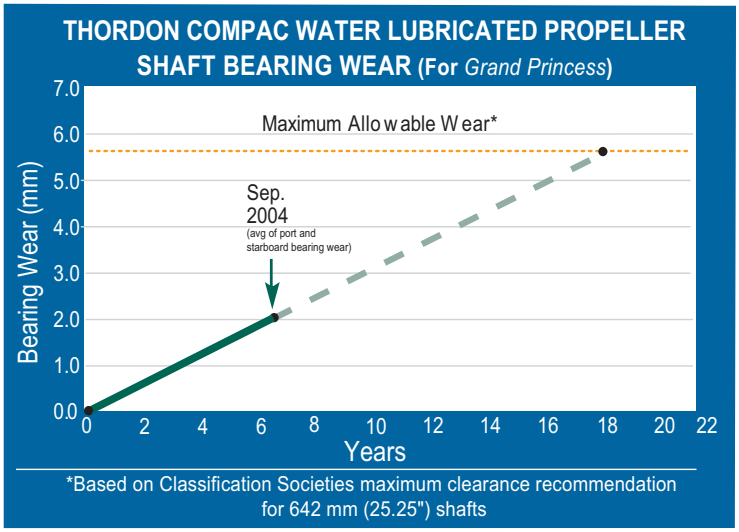


COMPAC Propeller Shaft Bearing With Single Key Design



THIS ISSUE

THORDON XL BEARINGS SHOW LITTLE WEAR AFTER 11 YEAR RUN ON *TERRY FOX*

In July 1994, the Canadian Coast Guard vessel, *Terry Fox*, converted its propeller shaft rubber bearings to Thordon XL bearings. Since that time the icebreaker has toiled in such rugged environments as the Gulf of St. Lawrence and Canada's Arctic. Recently, the starboard shaft bearings were removed and analyzed. Measurements of the bearings revealed little wear: 0.79 mm (0.031") for an icebreaker operating for approximately 1200 arduous hours.

Terry Fox was built in Vancouver in 1983. Originally operating in the Beaufort Sea, it was purchased by the Canadian Coast Guard and modified for icebreaking duties in the early 1990s. "She's one of the largest icebreakers in our fleet," says Dan Hornik, Chief Engineer. The ship has an overall length of 88 m (288 ft.), a beam of 17.8 m (58 ft.), a draft of 8.3 m (27 ft.) and propulsion power of 23,200 bhp on four engines. "The gross tonnage is 4,400."

Replacing Rubber Staves

The ship's original stern tube staves - made of rubber - had a history of problems that the Canadian Coast Guard inherited. Rubber bearings did not stand up well to the rigors of icebreaking operations. In fact, the staves had been replaced several times within just a decade, driving up maintenance costs, creating downtime incidents, and adversely affecting performance.

"That's why we approached the Canadian Coast Guard regarding Thordon XL bearings," says Chester McPherson, President of Avalon Marine, a long-time Thordon distributor located in Dartmouth, Nova Scotia. "We knew its track record of long life and trouble-free performance would greatly interest them."

Thordon Bearings has a long history of success in marine applications, with coast guard and naval ships in Canada and the United States, as well as vessels operating in a wide range of capacities around the globe. Thordon XL bearings have also been used on the U.S. Coast Guard icebreakers, *Polar Sea* and *Polar Star* since 1984.

Thordon Installed In 1994

In 1994, the Thordon XL bearings for *Terry Fox* were finish-machined prior to installation, and quickly installed by freeze fitting with liquid nitrogen. "To our knowledge," says McPherson, "these bearing tubes [measuring 792 mm (31.2") ID forward and 831 mm (32.7") ID aft] for the twin screw vessel were the largest ever installed in Eastern Canada at the time."

For more than a decade, the Canadian Coast Guard has enjoyed a range of benefits as a result of replacing the rubber bearings with Thordon XL. For example:

- The starting torque is significantly lower.
- There have been less downtime and maintenance issues, due to the long life of Thordon XL.

(...cont'd. next page)

Thordon XL Bearings

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MAINTENANCE AT INCO GENERATING PLANT NO

Frazzle ice is created when long periods of extremely cold weather, typically in the -35°C range, turn river water into a giant Slushie®. This isn't uncommon on The Spanish River in Northern Ontario, Canada, home of three Inco Hydropower Generating Stations. Frazzle ice is a regular occurrence almost every spring, pounding into the intakes and causing pumps that provide water to the turbines to ice up and shut down.

"When this occurs," says Claude Mailloux, Planner/Supervisor for Inco, "there is a risk that the turbine may run dry." As a result, the main guide bearings may overheat and need to be removed, inspected and reinstalled again.

Easier said than done. Until, that is, Inco began to use Thordon SXL.

Powering A Century Of Growth

The Spanish Riverways has an important dual role in Northern Ontario. It is one of the most breathtaking recreational waterways in the Province, attracting tourists worldwide. It is also the source of hydroelectric power that fuels the region's vast pulp and paper and nickel mining industries. Inco taps this tributary with generating plants located in Big Eddy, High Falls and Nairn Falls.

For most of the operational history of these plants, wood called *lignum vitae* was used as the main guide bearing. But as the rare source of this hard and oily timber - the guayacum tree - became even rarer, Inco was forced to look for alternatives.

"They originally switched over to phenolic bearings," said Lorne Thornton, President of Pioneer Power Industries, a long-time Thordon Bearings distributor, "But these came with maintenance headaches and other concerns."

The problem was, the river water contains a high level of particulates, making it abrasive. As a result, the phenolic bearings would wear rapidly and need to be changed approximately every two to three years. This was not a quick process. In fact, because of the hands-on lead chinking that was involved, the turnaround time to remove and install the bearings was up to four months.

"To make matters worse," says Thornton, "the phenolic bearings would constantly need adjusting to maintain performance, which only added to the workload and expense."

Thordon XL Bearings Show Little Wear... *(cont'd. from page 2)*

But the real benefit to the Canadian Coast Guard, in addition to fuel savings and lower maintenance costs, is the enhanced ability to ensure trouble-free performance of the icebreaker during critical operations in demanding environments.

Great Performance

The predicted wear life of the Thordon XL bearings for *Terry Fox* was 15 years. After 11 years the bearing wear data recorded in September 2004 show a much longer wear life than the predicted life. "We trust Thordon and have always been impressed with the performance of this exceptional product," says Hornik.

Thordon's reputation with the Canadian Coast Guard dates back to the early 1980s, and it is estimated that more than 80% of the fleet has Thordon products installed. *Terry Fox* is just one more Thordon success story that justifies why shipyards and fleet operators around the globe rely on the proven performance and reliability of Thordon bearings.

LONGER FRAZZLED BY DOWNTIME CONCERNS

Clearly, Inco needed a better solution. And they found it, in Thordon SXL.

A Track Record That Speaks For Itself

Proven in demanding hydroelectric applications around the globe, Thordon SXL has become the industry standard. An elastomeric polymer, the bearing features grease-free operation, remarkably low wear and exceptional performance in dirty water conditions. It's the bearing of choice for water lubricated main shafts and pumps in both rehabilitation and new turbine projects.

"Inco not only wanted to lower maintenance costs, but they also wanted to eliminate lead chinking. Thordon SXL was the answer to both of these issues," says Thornton.

To reduce downtime in the future, Thornton and the engineers at Thordon Bearings recommended a stave configuration. This helped reduce the time it would take to remove, service and reinstall the bearings from the current standard of three to four months to just a few days!

The new bearings were installed in Unit #3 (one of three turbines in total) at the Nairn Falls plant in 1999. After excellent performance over the next 24 months, SXL was installed in the other two units.

"So far, Thordon has lasted twice as long as the previous phenolic bearing," says Mailloux. "And the longer lifespan has kept labour and materials costs down while expanding uptime." Bearing performance is monitored continuously and has being running within acceptable parameters for more than five years. "This is remarkable considering the rough operating conditions and the fact that the turbines are nearly one hundred years old!"

Getting Frazzled Once Again

Then mother nature struck. In January 2004, frazzle ice once again formed on The Spanish River. During this inclimate period, Unit #2 started and stopped five times, each time running dry. The fear was that the bearing would be burnt and require immediate changeout, something that would be expected from a phenolic material. It wasn't. In fact, after inspection, Thordon SXL was only mildly scuffed.

"And the good news is," says Thornton, "Inco's maintenance staff was able to clean the exfoliated material from the water grooves and reinstall the bearing in the same day."

Split SXL Stave Main Guide Bearing

This allowed Inco to keep this unit on line for the upcoming spring run-off period and have a planned outage in the summer for the changeout of the bearing during the low water flow period.

Princess Cruises... *(cont'd. from cover story)*

pollution or subsequent environmental violations that could result from stern tube oil leakage, however small. There are currently over 380 Commercial and Naval vessels that are equipped with Thordon COMPAC water lubricated propeller shaft bearings plus many more on order.

Star Princess Equipped With COMPAC Water Lubricated Propeller Shaft Bearings Since 2002

THORDON HELPING TO CATCH MARLINS IN SPORTFISHING YACHTS

Trying to catch that elusive trophy fish…how many times have fisherman tried to find the reason why they couldn't land the big one. Was it the location? The bait? The line? Or maybe if the boat was quieter? Well today's Captain can have the advantage of a quieter boat…with Thordon propeller shaft bearings.

Noise has always been an Achilles' Heel in sportfishing vessels. One of the common problems is the bearing squealing that can occur when trolling at low speeds with conventional rubber propeller shaft bearings.

As any sports fishing enthusiast knows, a high pitched noise will reverberate for miles under water, chasing the big fish away - especially marlins. What's the solution? For a growing list of yacht builders, refitters and suppliers, the answer is Thordon propeller shaft bearings.

Thordon propeller shaft bearings are fast becoming the bearing of choice in a multitude of vessels from yachts to fisheries research vessels to submarines. "Thordon offers three different bearing grades (XL, SXL and COMPAC) for different sportfishing yacht operating profiles," says Ed Coppedge, Sales Manager of Coppedge Marine of Florida, a long-time Thordon Distributor. "These grades are ideal in propeller shaft applications where low acoustic noise signatures at low speeds and long wear life are critical."

Major Yacht Builders Agree

"Our customers want smooth, quiet operation at all speeds," says Thomas Glass of Donzi Yachts. A leading builder and restorer of yachts, Donzi is renowned for their serious fishing machines, as well as for pleasure crafts. The Company was introduced to Thordon COMPAC propeller shaft bearings in 1989 and, due to an exceptional track record of performance, now uses the product in all their models.

"Thordon does not get that high frequency squeal common with rubber bearings at low shaft RPM's," says Glass. But "no squeals" isn't the only reason Donzi relies on Thordon. "When it comes to maintenance, "bearing replacement is not very often, indicating long bearing life."

Retrofits And Repairs

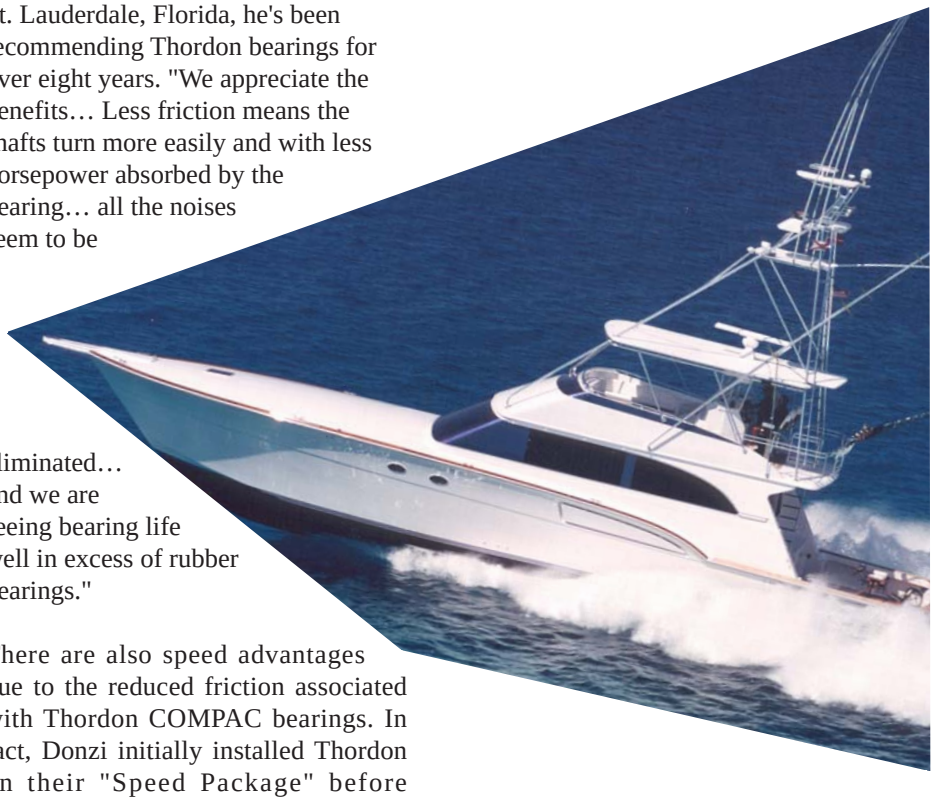
Jimmie Harrison agrees. As the owner of Frank & Jimmie's Propeller Shop in Ft. Lauderdale, Florida, he's been recommending Thordon bearings for over eight years. "We appreciate the benefits… Less friction means the shafts turn more easily and with less horsepower absorbed by the bearing… all the noises seem to be eliminated… and we are seeing bearing life well in excess of rubber bearings."

There are also speed advantages due to the reduced friction associated with Thordon COMPAC bearings. In fact, Donzi initially installed Thordon on their "Speed Package" before expanding its use into other vessels. "Early on," says Glass, "we noticed there was an increase in RPM's over rubber bearings."

The Flexible Choice

Thordon and Coppedge Marine, the Thordon distributor in Florida, Georgia and Alabama, can supply semi-finished bearings quickly, in a wide range of sizes to suit even odd-sized housing and shafts. In addition, Thordon SXL rudder bearings, which can run without water or grease lubrication and handle impact loading without permanent deformation, are also available.

Smooth. Quiet. Low maintenance. Everything the sportfishing enthusiasts need to catch the big one. That's the Thordon advantage.



THORDON SXL APPROVED FOR DEEP WELL PUMPS IN ARIZONA

Ensuring the water supply for residents of the driest desert in North America - the Sonora - isn't a task that Salt River Project (SRP) takes lightly. Through a system of reservoirs, canals, irrigation laterals and more than 250 deep wells, the organization delivers nearly 1.2 billion m^3 (1 million acre-feet) of water to central Arizona; a vast area that includes Phoenix and other surrounding cities, plus a myriad of towns and rural villages.

SRP is actually a combination of two cooperative entities: The Salt River Project Agricultural Improvement and Power District, a political subdivision of the State; and the Salt River Valley Water Users' Association, a private corporation.

"The organization is very careful when it comes to selecting components for its systems," says Mike Helfrich, President of Michael & Associates Inc., Thordon's distributor in Arizona. "Water is a huge issue in this State, and residents take quality, supply and conservation very seriously."

Oil And Water Don't Mix

Traditionally, SRP uses oil-lubricated metal bearings in their deep well pumping applications. This material works fine, but has some distinct disadvantages. Unlike oil-lubricated metal bearings, Thordon SXL would not fail catastrophically. This is significant", says Helfrich, "because the cost of pulling a pump out of the ground for repairs averages US $30,000 to $80,000! Costly maintenance and repairs, particularly unscheduled maintenance, are a big concern".

In addition, there are environmental and esthetic issues. Minute amounts of oil from the pump bearings can potentially make its way into the water supply. The oil used is mineral oil and, therefore, harmless. However, it could create an unsightly sheen if it were to find its way into the drinking glasses of Arizonians.

Fortunately, there is a solution. "We introduced the folks at SRP on the advantages of water- and product-lubricated Thordon SXL pump bearings in 2001," says Helfrich. "Three years ago they finally decided to put the product to the test."

Putting Thordon To The Test

The initial project involved replacing the metal bearings in one of the deep well pumps with Thordon SXL in March 2002. SRP worked in tandem with Michael Helfrich's team and the engineers at Thordon on the new design.

Rather than completely re-configuring the well for open spider bearings, the project team converted the enclosed tube, oil drip system, so that the existing column and coupler bearings could be used.

The results in terms of performance? After three years and almost 20,000 hours of operation, the Thordon SXL bearings are still operating within specifications. There have been no problems. And no sign that the bearings need to be replaced.

In terms of water quality and environmental concerns, Thordon SXL uses water exclusively as a lubricant. Oil has been completely taken out of the equation. It's no longer an issue.

Tom Frost, Pump Specialist at SRP, added, "…we are impressed on how well the Thordon bearings have performed. The bearings in the well installed in 2002 have over 20,000 hours of run time and are still operating with no problems."

Water Lubricated SXL Bearings Installed In SRP Deep Well Pump, Arizona, U.S.A.

Other Water Management Authorities

The performance of Thordon SXL in water supply applications has made other jurisdictions take notice.

The City of Scottsdale, for example, has specified Thordon SXL bearings for their re-charge wells and recently ordered 320 bearings. The City of El Paso has also installed Thordon SXL bearings for two water supply pumps for their new reverse osmosis system.

"Many water treatment facilities are switching from flocculating as a means to take contaminants out of the water to reverse osmosis," Helfrich points out. "But the membranes used in this process are very sensitive and cannot tolerate oil. That's what makes Thordon's oil-free bearings so attractive."

Oil and water don't mix. But oil-free Thordon SXL bearings and deep well pumping applications are fast becoming a perfect match.