THORDON
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ENVIRONMENTALLY FRIENDLY BEARING SOLUTIONS

THORDON BEARINGS HELP ENSURE RELIABLE PERFORMANCE OF NEW AHTS VESSELS

Anchor Handling Tug Supply (AHTS) vessels are the toughest tugs in the sea. These hardy ships perform the challenging job of towing oil platforms to location and anchoring them into position. Often working dozens of miles offshore, the consequences of a propeller shaft or stern roller failure can be dire. Reliability is a must. That's why Bender Shipbuilding selected Thordon bearings for the new AHTS's they are currently constructing.

"We needed proven, reliable bearings for the propeller shafts and stern rollers," says Ryan Roth, Project Engineer at Bender Shipbuilding. "We considered the alternatives and Thordon emerged as the best choice based on price and performance."

Six New Vessels

Located in Alabama, along the Gulf of Mexico, Bender has been a leader in shipbuilding and repair for more than 75 years. At its state-of-the-art facilities, the company has built all types of vessels, from shrimp boats and passenger ships to factory trawlers and offshore supply vessels. In fact, there are more than 800 Bender-built ships in operation around the globe.

The six AHTS vessels that Bender is currently building are 81m(265') long twin-screw ships with 286mm (11.25") diameter propeller shafts. The stern rollers - the large drums fitted onto the open stern to allow for the setting of heavy anchors - each have a shaft size of 254mm (10") diameter.

Long Wear Life Required

AHTS vessels often work in rough seas and all-weather conditions. When metal bearings are used on the slow rotation stern rollers, the performance and life cycles tend to be erratic. To ensure reliability, Bender needed a bearing material with an exceptional track record of success.

Thordon SXL bearings were the obvious choice.

AHTS John Coghill equipped with seawater lubricated COMPAC propeller shaft bearings and SXL stern roller bearings

"Bender had already used Thordon on three previous AHTS vessels with excellent results," says Ed Coppedge of Coppedge Marine, a company with 25 years experience in marine and industrial equipment and a valued Thordon Distributor. "So they were well aware of all the advantages."

Track Record Of Success

Thordon Bearings has a long history of outstanding performance in just about every kind of demanding marine application.

The Thordon COMPAC propeller shaft bearings installed in the AHTS vessels feature water lubrication, no

(continued back page)

THIS ISSUE

THORDON SOLVES USCG STERN TUBE

Thordon XL propeller shaft bearings have helped solve a stern tube problem that has plagued the U.S. Coast Guard Ice-Breaker *Polar Sea* since 1992.

Due to the harsh arctic environment in which it operates, the 13,500-ton displacement *Polar Sea*, one of the world's most powerful non-nuclear powered triple screw icebreakers, suffered repeated corrosion and fretting wear within the shafts. This resulted in damage to the support lands for the stern tube bearing carriers.

Easy installation of split XL propeller shaft bearings with tapered double key design allows bearings to be removed without shaft withdrawal

The U.S. Coast Guard effected repairs and repeatedly 'built up' the support rings using a metallic polymer to improve the fit of the bronze carriers to the stern tubes. But this method of repair proved to be only temporary - short lived and expensive to maintain.

So in an effort to find a solution, the USCG hired engineering consulting firm LamaLo Technology to investigate the problem. And a project was undertaken to develop a permanent repair to prevent the 'loss of fit' between the bearing housings and the stern frame castings.

"We commissioned the study because we had a problem with maintaining the bronze carriers fit," said USCG staff engineer James Happe. "Ice-breaking operations and ice impact pounded the carrier shells and when they are loose, this can be a real problem."

The original arrangement consisted of a bearing housing with dovetail slots in which Thordon XL bearing staves were inserted. The study concluded that the best approach would be to permanently fix the bronze carrier shells into the frame of the stern tube, so they effectively became part of the ship's structure. Such a change would, however, still have to facilitate bearing removal with the shaft still in place. After investigating various alternative arrangements a shortened, double keyed, segmented, split tube, fully grooved type bearing was recommended.

These bearing types offer a larger surface area that supports the shafting, resulting in better distribution of the ice loads to the bearing housing and bossing. In addition, these bearing designs provide for a much better condition for hydrodynamic lift than the existing dovetail slot design.

122 m (399 ft.) U.S. Coast Guard ice with Thordon pollution-free XL p

"This would provide the required high ratio of bearing surface to water groove and provide more support for the shaft," said LamaLo's Bruce Cowper. "We also shortened the housing/bearing length in the bossing to ease alignment requirements. But it was Thordon who came up with the double-key bearing design."

Based on over 20 years experience with the existing Thordon XL staves on the Polar vessels and acceptable performance in other applications in the USCG fleet, XL was chosen as the preferred material for the new bearings. Thordon XL is approved down to 2:1 L/D ratio and comes in a variety of configurations including staves, full form tube and split tube. Thordon also provided the bronze double key sets for this project.

"The USCG is a very important customer with a long history of successful Thordon bearing installations so we brought in all

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3225 Mainway,
Burlington, Ontario L7M 1A6
Canada
Tel: (905) 335-1440 Fax: (905) 335-4033
info@thordonbearings.com
www.thordonbearings.com

Editor: Craig Carter

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PROBLEM WITH A SOLUTION FOR THE FUTURE

e breaker Polar Sea first equipped propeller shaft bearings in 1983

our resources to quickly assist in coming up with a solution to this problem," said Todd Terry of Pacific Marine Equipment, the authorised US-based distributor of Thordon Bearings in the vessels' home port of Seattle. "We used the same Thordon XL material in a completely different configuration. This configuration is unusual in that it is a segmented split tube bearing with a double key arrangement so that the upper and lower tube halves can remain secured or be released independently. We provided a flexible bearing solution that allowed the Coast Guard to solve their bearing carrier interface problems."

James Happe said: "The Thordon element went pretty much like clockwork and the sea trials in April went well, showing no signs of problems. Underwater divers were also positive about the installation. We are now considering the same system for *Polar Sea's* sister ship *Polar Star*."

Since no work on the new bearings is expected for 8 to 10 years, annual savings in repair/maintenance costs of about $230,000 per bearing are expected. In addition, there will be a reduced risk of unscheduled dockings due to premature bearing or seal failures.

Thordon estimates that over a 20-year period, potential savings of $13 million can realistically be gained by implementing the proposed modifications.

"It's a definite solution for the future," said James Happe.

"The Thordon element went pretty much like clockwork and the sea trials in April went well, showing no signs of problems. Underwater divers were also positive about the installation. We are now considering the same system for *Polar Sea's* sister ship *Polar Star*."

James Happe
U.S. Coast Guard

Polar Sea with triple screw shaft diameters of 922 mm (36.2")
in drydock at Todd Pacific Shipyards, Seattle, WA, U.S.A.

TECHO-BLOC SWITCHES TO THORDON SXL AND SAVES THOUSANDS OF DOLLARS

In the masonry block manufacturing industry, time is, quite literally, money. When a machine goes down for maintenance, each second that ticks by is like a dollar sign eating away at the bottom line. In fact, it's not uncommon for downtime costs per hour to be well into the four digits. So when Techo-Bloc replaced bronze bushings with Thordon SXL — and, subsequently, increased uptime by more than 90% — the Company couldn't have been more delighted.

"I can't say enough about Thordon SXL," says Ian Havill, Director of R&D for Techo-Bloc. "The product has saved us a lot of money."

Thordon SXL bearings replaced bronze and eliminated grease

Founded in 1990 and based in St. Hubert, Québec, Canada, Techo-Bloc designs and manufacturers high quality landscaping products such as paving stones, retaining wall systems, and masonry stones. Their products have a reputation for blending seamlessly and harmoniously with the natural environment — enhancing the visual appeal and durability of both residential and commercial buildings.

Manufacturing of the paving stones utilizes a specialized press that forms the concrete mixture into molds. The operation involves a central trunnion and an arm on two hydraulic cylinders that moves a filler box filled with a concrete mixture back and forth over the mold filling the cavities inside. The trunnion operates continually, moving, starting, and stopping, in tens of thousands of cycles per month.

Downtime is Expensive

For years, the company used 660 bronze as the bearing material for the trunnion, greasing it every three days or so. But there were problems: "Every three or four weeks we had to shut the machine down for servicing," says Havill. "The bushing would need to be changed. And this took at least two hours."

If the trunnion housing was found to be worn, even more time would need to be spent refitting the housing with a hardened sleeve.

A few hours of maintenance per month doesn't seem like much. However, in masonry block manufacturing industry, downtime costs are enormous. "We work at a corrected factor of several thousand dollars per hour," says Havill.

What Techo-Bloc needed was a bushing material that would withstand the rigors of a 24/7 manufacturing environment and run reliably for months at a time without the need for maintenance.

A tall order. Fortunately, Thordon SXL more than fit the bill.

Tough. Long-Running. Reliable.

Thordon SXL is an elastomeric polymer bearing material. It has earned a reputation for unparalleled reliability in some of the most demanding industrial, marine, and hydro-turbine applications in the world. SXL features grease-free operation, low coefficient of friction, and a remarkably long wear life. It's easy to work with, too.

Grease free Thordon SXL installed in press for paving stone manufacturing

Techo-Bloc replaced their 660 bronze bushing with SXL in the fall of 2006. "So far it has been working on over one million cycles. More than a year," Havill raves. "With minimal downtime."

In fact, the Company has reduced downtime on the machine by 30 to 36 hours per year. And since downtime costs thousands of dollars per hour, "The savings are huge."

To say that Techo-Bloc is a happy Thordon customer would be an understatement. "I'm so impressed with Thordon SXL that I've become almost evangelistic about it! It's really an impressive product." In fact, Havill is so impressed he is working with Thordon's Québec distributor, DMA-LCI, to test SXL and other Thordon products in other plant applications.

In many ways, Thordon and Techo-Bloc are an ideal fit. Both companies produce innovative products that are rugged, reliable and long-lasting!

MARCO POLO FITTED WITH THORDON AT MALTA SHIPYARDS

Marco Polo is a 180m (591ft.) cruise liner propelled by two 563.5mm (22.185") diameter tailshafts running on a water lubricated stern tube bearing system. She entered Malta Shipyards on the 19th March, 2007 for a 21-day refit which included the replacement of the two tailshafts with reconditioned ones, installation of two new propellers, conversion of stern tube bearings system to Thordon COMPAC from *lignum vitae*, installation of a Thordon Water Quality Package for each shaft and last but not least, renewal of the tailshaft coating system from conventional fibreglass to Thordon's Thor-Coat shaft coating. The Classification Society was DNV.

Each tailshaft hosted a forward and a two-piece aft bronze liner positioned to correspond with the existing stern tube bearing configuration. One of the spare tailshafts that were to replace the working shaft was sent to the shipyard before the vessel entered drydock. The job consisted of removing the old shaft coating, repairing any defects and coating the shaft with Thor-Coat. As soon as the tailshaft arrived at the shipyard it was mounted on one of the heavy lathes at the Malta Shipyards main machine shop and the old coating was removed by machining. It was noted that due to the coating failure, local pitting corrosion was detected. These were smoothed out by local grinding until sound material was exposed. The cavity was then filled with Belzona to restore the original profile.

The bronze liners transition area had to be machined in order to create a profile for a resultant strong bond between the Thor-Coat material, shaft steel and bronze liner. This was carried out according to Thordon's recommendations from the Thor-Coat Application Manual. Once the machining was complete, the shaft was sent to be grit blasted, returned immediately and put on the lathe where it was cleaned with isopropanol alcohol. Since the tailshaft had quite a large area to cover, only one Thor-Coat kit was mixed at a time, which allowed the shipyard enough time for proper application. The application was done in sections by means of brushes and consequently finished by a doctor blade mounted onto the lathe tool post, which ensured a uniform thickness and a smooth finish throughout. The liner transition areas were given particular attention since from our previous experience with applying Thor-Coat, we noted that this area is more liable for defects than the parallel areas. The application was carried out with the lathe turning at 3.4 rpm for brushing of adhesive and 5.8 rpm for towelling. **The application time of Thor-Coat was approximately 2.5 hours from start to finish.** After application, the first 24 hrs of the curing occurred while the shaft was turning on the lathe in order to avoid any possible sagging of the material. Several 500W lamps were rigged up on both sides of the shaft to accelerate curing time. After 24 hours, the Thor-Coat material, although not fully cured, was tough enough to touch and handle. A holiday detector was used to test the coating and occasional pinholes were detected and repaired locally.

Finally, any Thor-Coat on the liner surface in the transition areas was finished properly by means of a fine iron file and the tailshaft was ready for installation. The whole process was witnessed by the attending DNV surveyor.

Soon after, the whole process was repeated for the second tailshaft. The only difference during the coating application was that for some reason that was not readily apparent, the pot life of one particular Thor-Coat kit did not give us enough time to apply it as it hardened during the application. This resulted in a lot of concentrated defects in one particular area and it was decided to re-machine the particular area and apply another coating of Thor-Coat. This gave us the first experience of machining Thor-Coat, which was done quite easily. The final product was very satisfactory both for us as well as for the attending DNV surveyor.

Eventually, the tailshafts where transported to the vessel, where the Thordon COMPAC propeller shaft bearings were installed ready to host the tailshafts in place.

The re-fitted *Marco Polo* is equipped with a renovated propulsion stern tube system, which definitely reflects its character of durability!

Written by Geoffrey Azzopardi
Engineering Production Manager
Malta Shipyards Ltd., Malta

Thor-Coat propeller shaft coating for 563.5 mm (22.185") shafts of Marco Polo cruise ship

THORDON BEARINGS HELP ENSURE RELIABLE PERFORMANCE OF NEW AHTS VESSELS *(continued from page 1)*

oil required (and, therefore, no risk of stern tube oil pollution), no AFT seals and exceptionally long wear life.

"From an engineering standpoint COMPAC is very easy to work with," Coppedge points out. "It can be machined to accept various shaft and housing tolerances and, therefore, you get a much tighter running bearing." Bender Shipbuilding machines a dummy plug to the desired housing I.D. This dummy plug is coated with a releasing agent and carefully aligned. Once aligned, Bender pumps a chocking compound around the dummy plug and allows the chock to set up. Once the dummy plug is removed, Bender measures the housing and machines the COMPAC bearing for an interference fit. The result is a nice, clean, aligned bearing installation!

Seawater lubricated COMPAC propeller shaft bearings eliminate stern tube oil pollution

For the stern rollers, Thordon SXL was chosen for its excellent performance under demanding marine conditions, and - like the COMPAC bearings - long life.

Both COMPAC and SXL bearings are less expensive than their metal counterparts. And, because of the outstanding performance over a very long life cycle, the maintenance costs are significantly lower, too.

"Overall, we expect great results from the Thordon propeller shaft and stern roller bearings on these AHTS vessels," says Roth.

As previously mentioned, Bender Shipbuilding has chosen Thordon COMPAC propeller shaft bearings on three AHTS. This order brings the total to nine vessels. Based on experience, pricing and reliability, Bender currently has a bid for three tugs utilizing Thordon Composite EF propeller shaft bearings that offer extended wear life in very abrasive water environments.

The Wave Of The Future

As oil production increasingly goes to sea, AHTS vessels will play an increasingly important role in towing and securing oil platforms into position. And Thordon will be there with bearings that help keep these rough tugs operating smoothly. To date, more than 80 AHTS vessels worldwide use Thordon SXL bearings in stern roller applications and over 500 ships are equipped with COMPAC propeller shaft bearings.

Seacor Marine stern roller installed with Thordon SXL bearing

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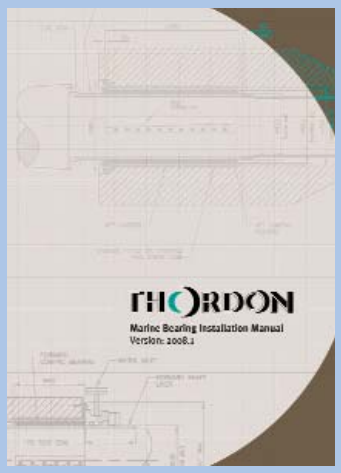

New Marine Bearing Installation Manual Version 2008.1

Thordon Bearings has released its new Marine Bearing Installation Manual covering propeller shaft bearings, rudder bearings and other marine bearings. The installation manual includes operational requirements, dimensioning, machining and installation methods.

If you do not have your copy, please contact your local Thordon distributor or visit our website to order or download it: www.thordonbearings.com

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