The final mounting and horizontal preheat of a large bearing for a New York bridge application (courtesy of SKF).

A Recipe For QUALITY BIG BEARINGS

Matthew Jaster, Associate Editor

Slewing or swing bearings are used for heavy industrial projects in construction, mining, marine and defense. They have been utilized in space observatories and giant shovels. Spherical roller thrust bearings are fairly common in turning bridges (SKF has installed one on the 3rd Avenue Bridge in New York City). Both spherical roller bearings and swing bearings are key components in windmills. If the project involves heavy machinery, you can bet the components usually match both the size and scope of the operation.

"In newer windmill designs, the shaft support function is integrated into the gearbox; these bearings are large 'unitized' taper roller bearings," says Victoria Wikstrom, marketing manager general industry at SKF. "Large bearings are also used in the power transmission and wheel reduction gears of huge mining trucks."

Customers purchasing bearings look at application data including loads, speeds, orientations, and the component's intended environment before selecting the right type. In the case of big bearings, other factors might include delivery, installation, lubrication, inspection and re-manufacture. With large manufacturing projects come bigger costs; executives tend to feel better about purchase decisions if service life, safety, maintenance and engineering aspects are top of the line.

A rumored big bearing boom could be in the works if global infrastructure projects and alternative energy advancements continue to make noise in the industrial market. SKF Worldwide, NTN Bearing Corporation of America and Kaydon Bearing are three companies that handle the demands of these heavy industrial applications.

Design and Engineering Considerations

Many power transmission components require a certain level of customization for each individual project. The big bearing market is no exception. Construction, mining, steel, marine and wind applications aren't exactly areas where customers buy bearings in bulk.

"These bearings are an integral part of the structure, and therefore they are selected—a better word is 'designed'—simultaneously with the entire project," Wikstrom says. "Looking up a giant bearing in a catalogue and finding the right designation is not possible—the work is done in close cooperation between the bearing company and the design firm/contractor/machine builder."

This may be the most significant difference between the small bearings typically found in general industrial applications and the big bearings used in heavy equipment. These are custom-made pieces that have to follow strict design, safety and maintenance regulations in order to provide the proper service life for multi-million dollar operations.

"The smaller applications don't have as much visibility from the higher-ups," says Todd Franiuk, market specialist at NTN Bearing. "These heavy-duty

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applications rely on higher standards, more personnel and a lot more investment. They tend to get the most interest from management for obvious reasons."

Chris McGovern, a market analyst in the construction segment at NTN, adds that big bearings use more complex materials and require much more design and engineering. "These bearings typically need special materials and service treatments that you don't find in the smaller sizes."

The extra attention given to design is due to the unique set of parameters for each individual market segment.

"For marine applications, you're dealing with a salt spray environment. With steel applications, you have to have special design capabilities to handle the heat," says Rick Shaw, business manager for heavy equipment at Kaydon. "Mining is all about cleanliness. How can we keep these components clean and working properly? It's an interesting dilemma for each market. Experience helps."

Small or large, quality is an important consideration in custom bearings. "Material specifications and initial quality control are crucial," Wikstrom says. "So are a highly skilled workforce, production equipment, process control and the inspection of the final product to specification."

But safety tops the list when an engineering team sets out to design a new bearing. "When you're dealing with critical applications—whether it's a wind tower hundreds of feet up in the air or a mining facility underground—the focal point is always safety," Franiuk says.

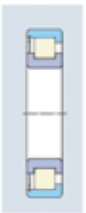
"Our engineering review team is very conservative whenever we look at applications with a human operator," Shaw says. "This is the most significant concern for the heavy industrial market. It's a premium at Kaydon."

The safety of shovel operators or engineers replacing components in a wind turbine is always discussed with large bearing manufacturers during the design phase. They also come up with some form of a maintenance strategy.

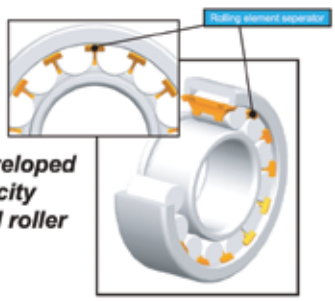
"Because these bearings are unique, there's usually not a spare. One exception would be bridges. If, worst case, a ship would hit the bridge pivot pillar, road authorities cannot afford to reroute traffic until a new bearing has been produced. Therefore, there is normally a spare bearing nearby the turning bridge," says Johan Ander, product manager for spherical roller bearings at SKF. "For wind energy, the number of mills is growing rapidly, implying that the production of large bearings will grow, too. Some users might find it attractive to keep bearings on stock. Still, replacing the nacelle bearing, for example, is a big project, and designers make sure service life is not the limiting factor."

One key to service life is the remanufacturing process where companies like Kaydon assess the remanufacturing potential of bearings between 10 to 240 inches in outside diameter (OD). "We get first-hand knowledge of what is and what isn't working in the field as these bearings come back to us," Shaw says. "Improvements can immediately

Cylindrical Roller Bearings



In addition to standard cylindrical roller bearings, NTN has developed technology that combines the high load capacity of a full complement bearing with the high rotational speed capabilities of a caged design. Placing the rolling element separator between the rollers, the high capacity cylindrical roller bearing attained a rated life 1.5 times longer than a conventional bearing.



Newly developed high capacity cylindrical roller bearing

Cylindrical Roller Bearing Comparison

	Standard Bearing	Full Complement Bearing	High Capacity Bearing
High Speed Capability	✓		✓
High Load Capability			

be made once we examine the working conditions the component has been through."

It's also an added benefit when dealing with the costly components found in the larger market. "For the more expensive bearings, remanufacturing is a viable alternative. You might need a $250,000 bearing that we can remanufacture for $100,000 with warranties equal to a brand new bearing," Shaw says. "We have dedicated personnel and equipment specifically for this process."

Kaydon works with construction manufacturers, the U.S. Navy and the U.S. Air Force on a regular basis to remanufacture bearings. "We have programs in place with several organizations for remanufacturing, particularly those that need a spare bearing on the shelf," Shaw says.

NTN Bearing provides bearing inspection and engineering field support that also assists with design and maintenance issues. "We inspect every single aspect of the product," Franiuk says. "If something goes wrong, our engineering team can go back and identify the problem, offer solutions and use this knowledge in the future."

Adds McGovern at NTN, "For construction and steel applications, the right design decisions can make sure an entire production line doesn't shut down."

Delivery, Installation and Lubrication

When discussing what separates big bearings from their smaller counterparts, delivery, installation and lubrication present a series of challenges.

"We have bearings between 60 and 220 inches for the marine industry, 120 to 240 inches in steel and 200 inch bearings in above-ground mining applications," Shaw says. "You'll find them in off-shore cranes, mooring systems on large ships and in ladle turrets and large pails."

The delivery of equipment this size can be a problem if the company is not equipped with the necessary resources for the global bearing market.

"We're finding, particularly in wind, that everyone wants local delivery right now, which presents a challenge for us," Franiuk says. "We have to expand local production to ensure that our global customers are taken care of."

"Even though Kaydon has four different production facilities and a great deal of flexibility, you'll still find customers that needed the bearing two weeks ago," Shaw adds. "Customers will always want the product sooner than later. It's just a part of the business."

Mounting and lubrication of large bearings offer additional obstacles.

"Installation is a very difficult and time-consuming process, particularly for steel mill and mining operations," McGovern at NTN says.

Wikstrom at SKF adds, "Since the bearing is a key part of the entire structure, mounting is very important and difficult due to the size. Also, achieving proper sealing can also be a challenge—because of high circumferential speed of the large shaft—as well as ensuring constant and well controlled lubrication. This is usually done on these large structures through a central lubrication system that pumps grease or oil to the locations where it is needed."

SKF strongly relies on experience and testing for lubricant models, and by nature, this experience is greater in smaller applications since there are more of them.

"With continuously improved understanding and computer modeling of lubricant behavior inside a bearing, the need for lengthy testing in one-off or few-off projects will reduce further, and our ability to predict service life with greater precision will increase," Wikstrom says.

Franiuk thinks the industry might be able to solve lubrication issues with more communication between bearing manufacturers.

"Communication in this industry seems to hold everyone back. Nobody really shares any information on individual experiences. If companies started talking to each other about the variety of lubrication problems they've encountered and how they've handled them, a lot of these problems could be avoided in the future."

Recent advancements in material science have allowed bearings to last longer and perform better thanks to special coatings and materials. The Bearing Specialist Association (BSA) provides a wealth of information and literature online (*www.bsahome.org*) regarding corrosion, wear, friction and

Kaydon offers a variety of bearings for heavy industrial applications including the geared, non-geared and catalog items pictured above (courtesy of Kaydon).

skidding protection.

The Big Bearing Boom

Though plenty of analysts wax poetic about economic relief, the truth is nobody knows what's really going to happen in the future. There are plenty of infrastructure projects in development, especially overseas. Wind is still an area of great growth and potential, but it's not happening as fast as many people in the market initially hoped. The alternative energy market, in general, might yet play a role in the resurgence of the heavy industrial segment.

"Most industrial markets are not growing right now and wind is, but it's not as enormous as people thought it would be," Franiuk says. "With the right incentives, we're still going to eventually see the boom they've been talking about."

"Wind energy, together with general investments in heavy industry, has slowed down as a result of the economic downturn, but it is coming back strong. Government stimulus packages combined with legislation have supported the rapid comeback. Ocean energy (wave and tidal) is emerging and is expected to become an interesting business in a couple of years," Wikstrom says.

"NTN is absolutely ready for these markets as they continue to gain some ground, especially ocean tide and direct drive wind," Franiuk says. "We're also getting more work in the solar market."

NTN is also seeing some improvements in construction. "Our construction customers have posted some good numbers in the last quarter," McGovern says. "A lot of that has to do with the work being done in the Chinese, Indian and Russian markets."

Shaw also sees some growth potential in China and India that Kaydon will be keeping a close eye on. "One area in particular is tunnel boring. There's a demand in China and India right now for water treatment, water supply and transportation hubs. Most of this activity is going to be done underground, and we see it as a potential long-term growth market."

"All over the world, the growing population is driving infrastructure and energy projects like wind power, hydro-

Product Spotlight

Unique SKF solutions in wind turbines

Increasing the functional safety of wind turbines has typically required design decisions that add weight—and cost—to the nacelle. For owners and operators, this added weight increases total load on the tower, resulting in safety and insurance issues. The SKF Nautilus bearing is a large-diameter, double-row taper roller bearing unit developed to directly support the wind turbine hub as a compact unit taking all the external loads. This so-called "moment bearing" design concept results in reduced drivetrain weight and length, and a high torsional stiffness of the drivetrain. The Nautilus bearing is designed to operate under preload conditions. "The SKF self-aligning bearing solution (CARB and spherical roller bearing) for wind turbine main shafts gives turbine designers an effective alternative that reduces nacelle weight and production costs while improving both functional and operational safety," says Johan Ander, product manager, SKF Self Aligning Bearings, Sweden.

High capacity cylindrical roller bearings from SKF

Applications like industrial gearboxes, gearboxes in wind turbines or machines for mining applications require components that can provide high operational reliability and long service life. In these applications, load carrying capacity is particularly important, which is why full complement bearings are frequently used. Full complement bearings do not have a cage separating the rollers, enabling them to accommodate much heavier loads than same-sized bearings with a cage. However, direct roller-to-roller contact in a full complement bearing increases friction, heat generation and the risk for wear. Consequently, the permissible speed is reduced. To achieve the maximum load carrying capacity of a full complement bearing and the robust performance of a bearing with a cage, SKF developed high-capacity cylindrical roller bearings. These bearings combine the advantages of both bearing types.

Traditionally, higher load carrying capacities have been achieved by incorporating larger rollers. However, to do this within the ISO standardized boundary dimensions requires thinner rings. Thinner rings increase the risk of ring creep, ring or flange cracks, and fretting corrosion. Also, larger rollers are more prone to smearing due to increased inertial forces. The new SKF high-capacity cylindrical roller bearings, which contain more rollers than EC design cylindrical roller bearings, not only maintain the original ISO boundary dimensions, they also maintain the internal geometry of the EC design. The result: increased dynamic and static load carrying capacities and consequently longer bearing service life. For more information, visit *www.skf.com*.

power, tunnels, bridges and roads," Ander says. "With this come large bearings in the constructions themselves and in the machinery required to build them. In turn, this drives growth in steel production and mining, two other areas where large bearings are used. We believe that the integration of our five platforms (bearings, seals, mechatronics, lubrication and services) will be our major driver for growth."

But if there is a manufacturing boom in heavy industries, Shaw says it won't be here as quick as some market analysts think.

"We're noticing pockets of recovery in some segments of the industry while other segments remain pretty flat. I believe it's going to stay this way for some time."

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