BEARING SELECTION GUIDE

WAUKESHA BEARINGS

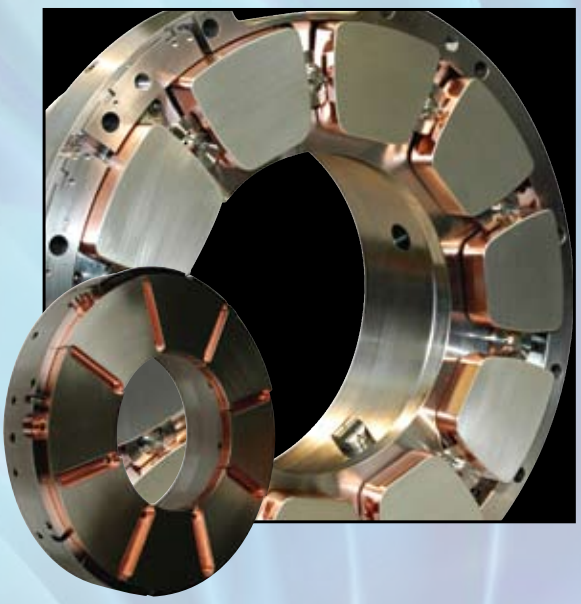
A DOVER COMPANY

WAUKESHA BEARINGS: A GLOBAL LEADER

Waukesha Bearings is a world leader in technology, size and application experience for the rotating equipment industry. Our highly specialized hydrodynamic and magnetic bearing systems reflect more than 50 years of expert engineering and refinement, delivering superior results for the most demanding high-performing turbomachinery.

We anticipate and assess the challenges facing our industry and develop advanced technology to best serve the needs of our customers in oil & gas, power generation, and marine and industrial markets around the globe.

Our custom-engineered bearings allow for optimized performance in a broad range of rotating equipment, including: gas, steam and hydro turbines, compressors, gearboxes, motors and pumping systems.



TILTING PAD THRUST BEARINGS

Tilting pad thrust bearings are available with a variety of design features including directed lubrication, specially engineered pivot types and offsets, pad backing material and several different styles of thrust retainers, all designed to optimize performance and meet unique requirements in turbomachinery. The CQ compact equalized and MS non-equalized bearings are of similar size and offer unprecedented choice and flexibility to machine builders. Custom solutions are also available that offer reduced power losses, oil flows and pad temperatures, and address industry-wide issues such as axial vibration.

For use with: pumps, motors, compressors, turbines, generators and gearboxes

TILTING PAD JOURNAL BEARINGS

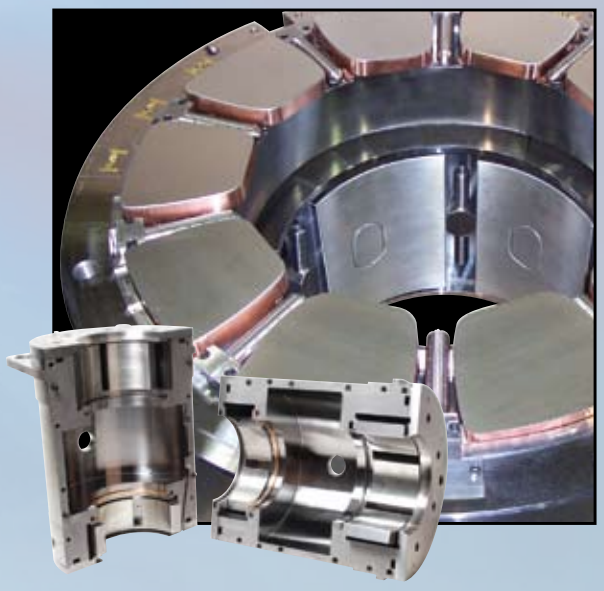
Tilting pad journal bearings are available with a broad range of design features that ensure high performance and optimal compatibility with a variety of turbomachinery. Available options include hydrostatic jacking, combined single or double acting thrust capability, spherical seats and electrical insulation, engineered by Waukesha Bearings to meet the unique challenges of every application. To achieve varying degrees of alignment capability, a wide selection of pad pivot types and pad geometries are also available.

For use with: pumps, motors, compressors, turbines, generators and gearboxes

POLYMER-LINED & SOLID POLYMER BEARINGS

Polymer-lined and solid polymer bearings feature proprietary bearing-grade polymers used in combination with a variety of custom-engineered mating surfaces. Polymer-lined bearings are suitable for both oil and clean product lubrication. In applications where the bearing material needs to be both chemically resistant to the clean fluid and able to support thin films, solid polymer bearings provide a high load capacity and inert solution. These specially engineered polymers are used on both journal and thrust bearings and provide exceptional temperature capabilities (beyond 250° C or 482° F), thin film operation, high fatigue strength, insulating properties and the ability to withstand a continuous high load.

For use with: pumps, motors, compressors and turbines



HORIZONTAL BEARING ASSEMBLIES

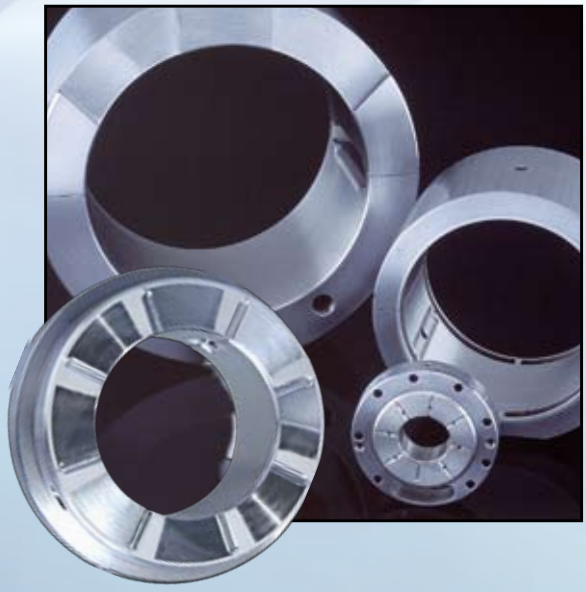
Horizontal bearing assemblies include highly customized journal or combined journal and thrust units designed to interface with an external pressurized oil system. Expertly engineered to meet each customer's specifications, proven arrangements can be fitted with an external casing or engineered to interface with the customer's own housing. The extent of supply, including hydraulic jacking systems, can be varied to suit application requirements and customer specifications.

For use with: pumps, motors, compressors, turbines and generators

ACTIVE MAGNETIC BEARINGS

Active magnetic bearing systems offer a proven "oil-free" solution for the unique challenges associated with large turbomachinery. Energy efficient and requiring less maintenance by eliminating supporting oil systems, active magnetic bearings may be implemented to be emission-free and provide increased machine availability and uptime. Bearing systems are custom designed with controllable rotor-dynamics, a unique auxiliary bearing technology, remote monitoring and control, and the security of an advanced controller with proven field experience in the most challenging turbomachinery applications.

For use with: pumps, motors, compressors, turbines and generators



FIXED PROFILE BEARINGS

Fixed profile bearings are optimized to meet the changing demands of various applications operating at a wide range of speeds. Specially engineered designs of multi-lobe bore versions are ideal for high-speed applications. Design options include thrust load capacity on the end faces, hydrostatic jacking for use at start-up and run-down and machining for instrumentation. In addition to standard steel, other material linings are readily available to meet individual customer or application requirements.

For use with: pumps, motors, compressors, turbines, generators and gearboxes

CERAMIC BEARINGS

Ceramic bearings can be used with virtually any liquid lubricant, making them the ideal solution for many challenging field conditions. Liquefied gas, hydrocarbon condensates and seawater are commonly used. Pads and mating sleeves, or collars are matched to suit the specific application and lubricant, even if it contains abrasives. Ceramic bearings are primarily used in pumps to provide more compact, lower cost machines; saving weight, space, sealing and the expense involved with an oil lubrication system.

For use with: pumps and motors

VERTICAL BEARING ASSEMBLIES

Vertical bearing assemblies are available in a wide range of sizes and include a variety of design options, including electrical insulation, hydrostatic jacking, and instrumentation. Proven designs range from large, self-contained combined journal and thrust units for primary coolant pumps and motors used in nuclear power stations to small, self-contained air cooled units for LNG pumps. Air cooling has been increasingly used as it avoids the complications associated with water-filled coils and allows operation on remote sites where water may not be available.

For use with: pumps, motors and generators

INNOVATION: ENGINEERED SOLUTIONS

Waukesha Bearings remains unmatched in the level of knowledge and engineering expertise we consistently demonstrate on the most challenging applications. Our engineers apply a collection of patented design features and advanced materials knowledge to an already extensive range of fixed profile and tilting pad products, resulting in customized bearings that can support high speed, high temperature and high load applications.

Our hydrodynamic bearing technology is considered the most extensive and advanced in the industry, and our active magnetic bearing systems offer superior performance without the need for lubrication, exceeding the demands of high-performing rotating equipment.

To ensure peak performance in every application, Waukesha Bearings combines years of field experience with empirical data obtained from unmatched internal testing capabilities and external technology alliances.

The world's leading manufacturers of rotating machinery trust Waukesha Bearings to deliver proven solutions and superior technology that keeps them ahead of the competition.

GLOBAL ENGAGEMENT: LOCALIZED SUPPORT

With locations worldwide and an increasingly global customer base, Waukesha Bearings is equipped to meet the unique challenges presented across a range of markets and applications. Manufacturing locations in the US, UK and Mexico allow us to serve our customers around the world. With sales & engineering locations in the US, Europe, Japan and Russia, customers are assured of intimate and knowledgeable support in several different languages. If you're looking for the leader in fluid film and active magnetic bearing technology, choose the benchmark.

Choose Waukesha Bearings.

PRODUCT – APPLICATION KEY

PUMPS

Pumps are built in a wide variety of sizes and types, from nuclear primary to electric submersible. As a result they may employ the whole range of products from Waukesha Bearings, including active magnetic bearings. Pumps also utilize polymer-lined and solid polymer bearings with oil and water lubrication as well as process lubricated ceramic bearings.

MOTORS

Similar to pumps, motors make use of the entire range of products from Waukesha Bearings, including active magnetic bearings. This is partly due to the fact that pumps and motors are often matched together as a motor/pump set. Smaller motors, particularly in vertical submersible motor/pump sets use polymer or ceramic bearings for load carrying capability and long life.

GENERATORS

Depending on size and orientation, generators use the full range of Waukesha Bearings products as internal bearings or complete assemblies with a housing. With steady weight loading and modest synchronous speeds, generators tend to use the conventional material combination of white metal and steel backing. Hydrostatic jacking for start-up and run-down is common on larger machines.

TURBINES

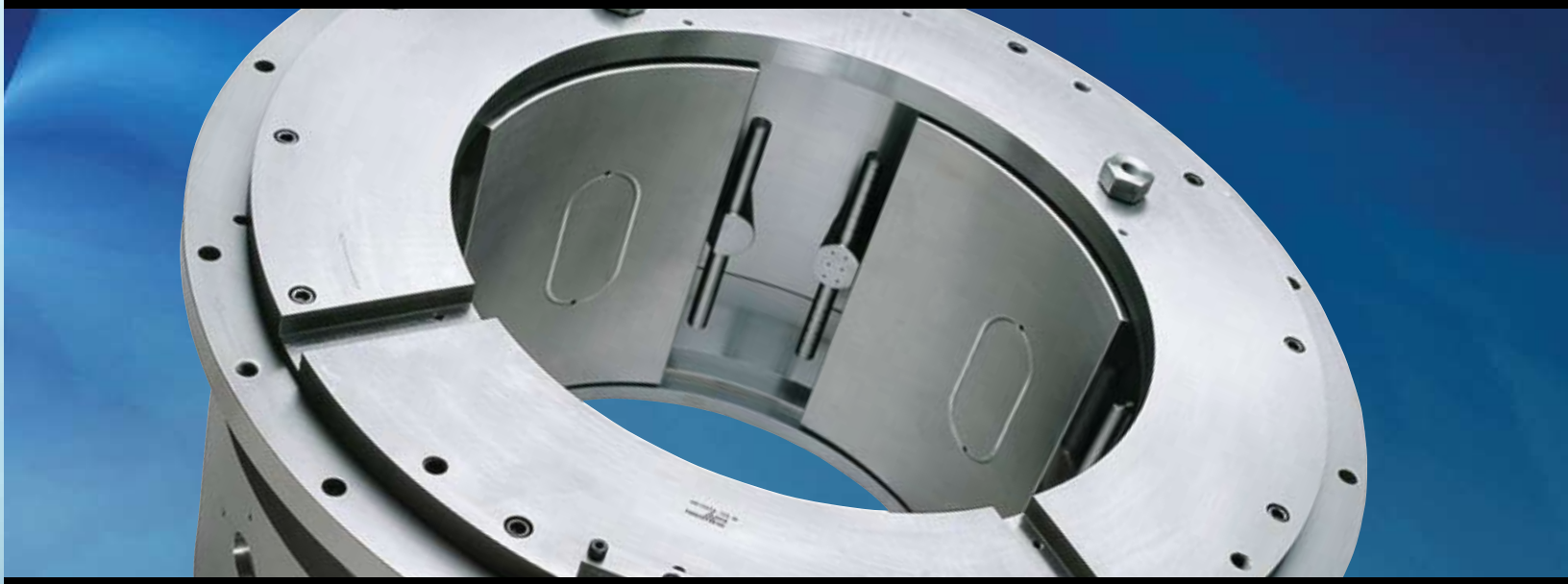
Depending on size, gas and steam turbines normally use tilting pad journal and thrust bearings; sometimes in combined assemblies. Directed lubrication is usually employed to minimize power losses and oil flows, and to reduce pad surface temperatures. Gas turbine thrust bearings are high-speed and high-load, often requiring the use of Cu/Cr backing material.

COMPRESSORS

High-speed compressors can be very demanding of journal bearings due to their dynamic properties; 4 or 5 pad tilting pad journal bearings are commonly used. Thrust bearings are normally the tilting pad type with directed lubrication to minimize power losses, and often utilize Cu/Cr backing material to reduce pad surface temperatures. Compressors often use active magnetic bearings as well.

GEARBOXES

Low speed shafts of gearboxes normally use fixed profile journal bearings, often with simple cylindrical bores; and high speed shafts use either multi-lobe fixed profile or, increasingly, tilting pad journal bearings. Very high-speed applications can require special material combinations and may utilize directed lubrication to reduce pad surface temperatures and improve efficiency.



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