Have a Pump, Motor, Generator, Turbine, Compressor or Gearbox? *There's a Bearing for That!*

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Waukesha Bearings is known internationally for its capabilities, technology, size and application experience in the rotating (turbo) equipment industry. Following is a brief selection guide intended to assist engineers, specifiers, integrators and others in choosing the right bearing—and bearing technology—for the application. (Ed.'s note: the predominant applications for the following products are: pumps; motors; compressors; turbines; generators; and gearboxes.)

Tilting-pad thrust bearings. Tilting-pad thrust bearings (Fig. 1) 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. Custom solutions are also available that offer reduced power losses, oil flow and pad temperatures, and address industry-wide issues such as axial vibration.

Tilting-pad journal bearings. Tilting-pad journal bearings (Fig. 2) help ensure high performance and optimal compatibility with a variety of turbo-machinery. Available options include hydrostatic jacking, combined single- or double-acting thrust capability, spherical seats and electrical insulation. To achieve varying degrees of alignment capability, a number of pad pivot types and pad geometries are available.

Polymer-lined and solid-polymer bearings. Polymer-lined and solid-polymer bearings (Fig. 3) feature 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 must be 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 continuous high load.

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.

Horizontal bearing assemblies. Horizontal bearing assemblies (Fig. 4)

Figure 1 Tilting-pad thrust bearings.

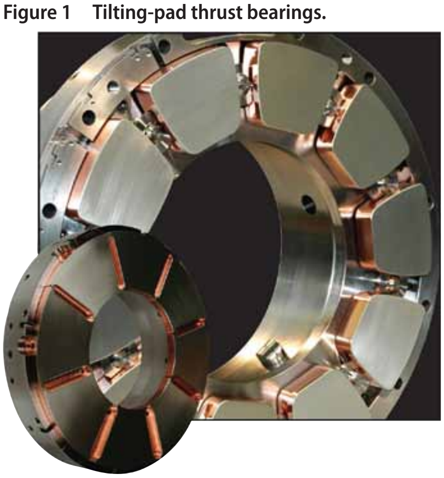

Figure 2 Tilting-pad journal bearings.

Figure 3 Polymer-lined and solid-polymer bearings.

include highly customized journal—or combined journal and thrust—units designed to interface with an external pressurized oil system. 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.

Active-magnetic bearings. Active-magnetic bearing systems (Fig. 5) offer a proven "oil-free" solution for the unique challenges associated with large turbo-machinery. Energy-efficient and requiring less maintenance by eliminating supporting oil systems, active-magnetic bearings may be implemented to be emission-free and to provide increased machine availability and uptime. Bearing systems are custom-designed with controllable rotor-dynamics—an auxiliary bearing technology—remote monitoring and control, and the security of an advanced controller for challenging turbo-machinery applications.

Fixed-profile bearings. Fixed-profile bearings (Fig. 6) 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 may be used to meet differing application requirements.

Figure 4 Horizontal bearing assemblies.

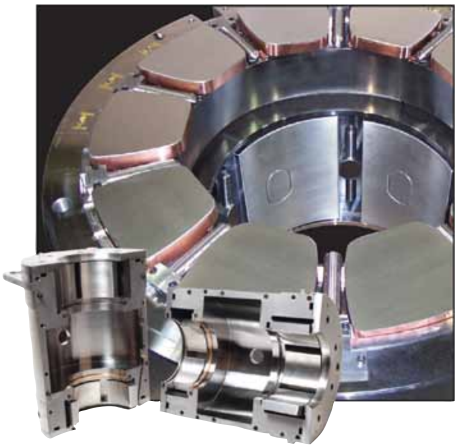

Figure 5 Active-magnetic bearings.

Figure 6 Fixed-profile bearings.

Figure 7 Ceramic bearings.

Figure 8 Vertical bearing assemblies.

Ceramic bearings. Ceramic bearings (Fig. 7) 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, thus saving weight, space, sealing and the expense involved with an oil lubrication system.

Vertical bearing assemblies. Vertical bearing assemblies (Fig. 8) 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. **PTE**

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 magnetic bearings. Pumps also use polymer-lined and solid-polymer bearings with oil and water lubrication, as well as process-lubricated ceramic bearings.

Motors. Motors are also good candidates for active magnetic bearings, due in part to the fact that pumps and motors are often matched together. 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, bearing products are used in generators 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; four or five tilting-pad journal bearings are commonly used. Thrust bearings are normally the tilting-pad type, with directed lubrication to minimize power losses, and they often utilize Cu/Cr backing material to reduce pad surface temperatures. Compressors often use active magnetic bearings as well.

Gearboxes. Low-speed shafts for 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 may require special material combinations and directed lubrication to reduce pad surface temperatures and improve efficiency.

For more information

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