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Plain Bearings

Plain bearings were first used 4,500 years ago and made of wood. Engineers now have a wide variety of materials and configurations to choose from offering a range of benefits over conventional rolling-element bearings. Today plain bearing materials include bronze, cast iron, bi-metals, many alloys including powdered metals, and the whole world of plastic and metal-polymer bearings with the advent of PTFE along with fiber-reinforced composites.

Technologically complex, yet simple in design and function, plain bearings can improve the performance, reliability and operational cost of equipment in countless applications around the world. Industries in which plain bearings are replacing rolling element bearings include:

• Aerospace • Agriculture • Automotive• Construction • Energy • Fluid Power• Industrial • Oil & Gas • Primary Metals • Recreation

For many applications plain bearings can save space and weight, carry more load, require less maintenance and dampen noise and vibration better than rolling-element bearings. Plain bearings also better accommodate small dimensional changes in housings and shafts compared to rolling-element bearings. Of course, plain bearings won't be right for every application — extremely precise shaft-location or ultra-low friction requirements could preclude the use of plain bearings, for example.

In automotive applications, for example, plain bearings offer superior performance in pumps, steering systems, air-conditioning compressors, throttle butterfly valves, gearboxes and transmissions. Advances in plain bearing technology will soon make their use prevalent in redesigned brakes, universal joints, alternators and starter motors. Agricultural construction equipment makers use plain bearings because they require little maintenance and tolerate the misalignments common in uneven terrain. Designers of wind turbines equipment have already made similar changes.

MORE FAVORABLE ECONOMICS

Because of their simple one-piece construction plain bearings can hold a significant cost advantage over rolling-element bearings. The complex multi-component design and precision construction of rolling-element bearings can make them 25% to 400% more expensive than plain bearings. The tooling needed to install precision rolling element bearings represents another substantial cost since tooling for plain bearings can be 50% to 75% less.

In the automotive and aerospace industries, weight savings has a monetary value as well. A typical plain bearing weighs less than half that of a similar-sized drawn-cup needle-roller bearing, and a deep-groove ball bearing can weigh up to 14 times as much. Apart from the weight of the bearings themselves, plain bearings can also significantly reduce the weight and complexity of the housing. Typical plain bearing wall thicknesses of 1 mm to 2.5 mm allow for smaller housings, resulting in weight and raw material cost savings. Moving to single-part plain bearings also eliminates the need for snap rings, machined shoulders and other rolling-element retention devices, all of which further add to the weight reduction.

LARGER CONTACT AREA & PERFORMANCE

Because plain bearings have a much larger surface contact area than rolling-element bearings designers can save space and cost by using smaller plain bearings that accommodate greater loads. In the same way that snowshoes allow one to walk on top of snow, the load-spreading dynamic of plain bearings gives them a significant advantage over the point-loads of rolling-element bearings, especially needle, roller and ball bearings. For example, a typical 20 × 23 × 15 mm plain bearing might have a dynamic capacity of 42 kN and a static capacity of 75 kN while a comparable 20 × 26 × 16 mm drawn-cup needle bearing would have typical capacities of 12.7 kN and 20.1 kN respectively.

The conformability of plain bearings also tolerates more shaft misalignment. Unless a rolling-element bearing is specifically designed to compensate for it, misalignment can increase wear and shorten bearing and equipment life as the load is concentrated on a narrow contact area. By contrast, plain bearings distribute loads more evenly, even when slightly misaligned. However, minimizing the contact area reduces friction, so rolling-element bearings have been traditionally specified for applications requiring extremely low friction.

Therefore a key consideration in selecting a plain bearing is to know the PV rating of a plain bearing, which is the P (pressure) x V (velocity) expressed in PSI*fpm or N/mm2*m/s, compared to the PV value of the application. In addition it is important to know as much additional information about the application as possible to determine which of the many plain bearing materials available are best suited for the application since the capacity of materials can vary by over 100 percent.