CUSTOMER REFERENCE CASE

Industrial air-conditioning compressors

Centrifugal compressor for large capacity chiller

Pure refrigerant lubricated bearings from SKF

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Enables oil-free bearing lubrication for refrigerant compressors in low-pressure, water-cooled chillers

Working closely with a leading refrigerant compressor manufacturer, SKF developed a unique bearing lubrication solution for centrifugal compressors that does not require oil lubrication. Featuring hybrid bearings with high nitrogen stainless steel rings, silicon nitride rolling elements and a glass fibre reinforced PEEK cage, this proven media-lubricated design is helping to pave the way for a new generation of high efficiency, low-maintenance compressors used in low-pressure, water-cooled chillers.

High nitrogen stainless steel rings, PEEK cage and silicon nitride balls made to high quality SKF specifications

The challenges of going oil-free

Large capacity chillers used to cool large buildings or industrial processes are typically equipped with centrifugal compressors. Traditionally, these compressors have used hydrodynamic bearings lubricated with an oil-refrigerant mixture.

Rolling bearings, however, can improve energy efficiency by 2-4%, compared to traditional hydrodynamic bearings. Lubricating the bearing with pure refrigerant rather than oil can boost energy efficiency even more as SKF determined while developing bearings for pure refrigerant lubrication in the 1990s.

With pure refrigerant lubrication, system energy efficiency improves not only because of reduced friction in the bearings, but through improved heat transfer in the condenser and the evaporator heat exchangers. Eliminating oil lubrication for the bearings also eliminates the need for oil maintenance and oil costs.

Interested in developing a more eco-friendly, oil-free chiller compressor technology, a leading manufacturer began working with SKF on a new bearing arrangement that would use the refrigerant itself as a lubricant.

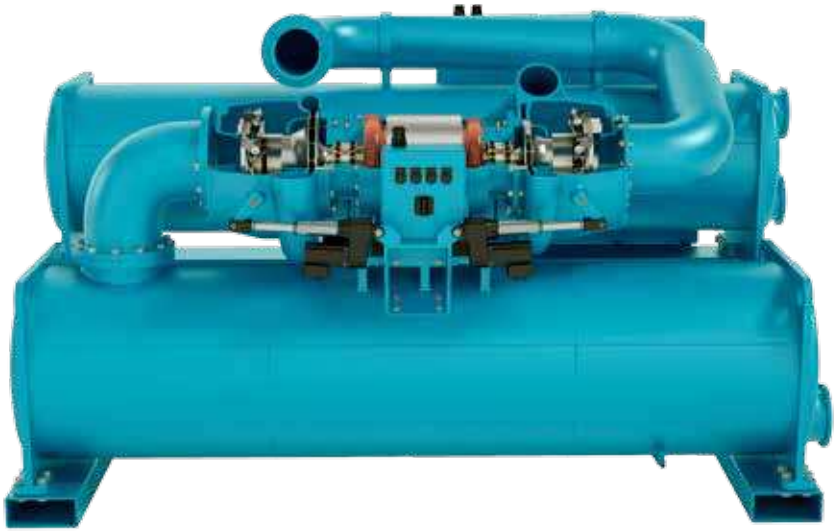
A hybrid bearing solution

SKF hybrid bearings are made from a new generation of high-nitrogen steel (also known as VC444 steel) with superior corrosion resistance, enhanced fatigue properties and a high degree of toughness. The bearings also feature silicon nitride (Si_3N_4) rolling elements, a ceramic with a density that is just 40% that of steel rolling elements, and a glass fibre reinforced PEEK cage.

These characteristics suggest that SKF hybrid bearings would be an ideal candidate for a pure refrigerant lubricated solution, since hybrid bearings with ceramic rolling elements could withstand exposure to oil-refrigerant mixtures that all-steel bearings could not.

Once the project development team began testing SKF hybrid bearings, they discovered that the viscosity of chiller refrigerants increases under the extremely high pressures produced between the ceramic rolling elements and the steel bearing raceways. The increase is not as significant as it is with lubricating oils, but it is enough to produce a thin lubricant film that sufficiently lubricates the hybrid bearings.

Encouraged by these findings, the OEM next put the SKF hybrid bearings through an extended field trial, replacing the all-steel compressor bearings in direct drive industrial chillers with the pure refrigerant lubricated bearings from SKF.



The long-term results

The field-trial chillers have been operating successfully for more than 10 years, logging a combined operating time of 150 000 hours. In 2013, the OEM launched the pure refrigerant lubricated bearing technology from SKF in an all-new chiller that also includes a variable speed drive and other high efficiency, low-maintenance features.

Ultimately, eliminating the need for oil lubrication enabled a more sustainable system design and eliminated many chiller failure modes associated with oil-based systems.

The number of components was also reduced, simplifying chiller design and contributing to a more efficient, cost-effective operation.

Benefits of pure refrigerant lubricated bearings from SKF

- Reduced CO_2 emissions
- Oil-free operation
- Increased energy efficiency
- Extended bearing service life
- Reduced maintenance
- Improved reliability
- Lower lifecycle costs

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PUB 52/S6 15640 EN · March 2015

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