Grease Lubrication of FAG Spindle Bearings

Longer grease operating life for peak speeds

SCHAEFFLER

Grease lubrication of FAG spindle bearings

Figure 1: HCRS spindle bearing, sealed and greased "for life"

For high speeds, oil lubrication of spindle bearings has proved effective. In order that the advantages of grease lubrication can be used even at high speeds, permanent relubrication must be provided.

Advantages of grease lubrication

In comparison with pneumatic oil lubrication, grease lubrication of spindle bearings has many advantages:

- no requirement for oil or compressed air equipment
- economical lubrication
- simplified design
- conservation of resources
- clean and reliable
- absolutely maintenance-free
- sealed versions already filled "for life" with the correct amount of the correct grease, *Figure 1*.

Minimal friction

Grease lubrication provides the bearing with a quantity of lubricant that is at a minimum but sufficient for operation. This results in very low friction and high energy efficiency, *Figure 3*. Since the bearings can be operated reliably and without maintenance, grease lubrication is the type of maintenance most frequently used for spindle bearings.

For a combination of high speeds and loads, the grease operating life is not sufficient in many cases. Through the selection of the correct materials and an internal construction with optimised friction (series RS), speeds that currently can only be achieved using pneumatic oil lubrication are now also possible with grease lubrication.

This has been confirmed in the interdisciplinary research project EnergieMSP, *Figure 2*.

Notwithstanding the benefit of bearings with pneumatic oil lubrication, the increase in lifetime of grease lubricated bearings is imposing itself through the perspectives of sustainability and cost-efficiency. This is accommodated by Schaeffler through the development and implementation of suitable relubrication concepts.

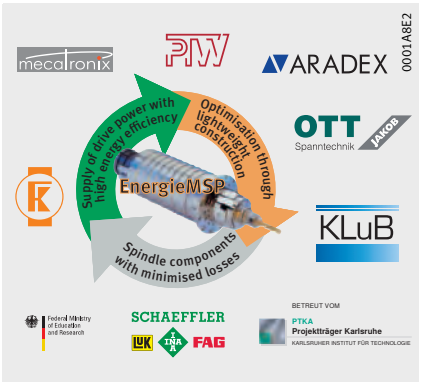

Figure 2: Project partner EnergieMSP

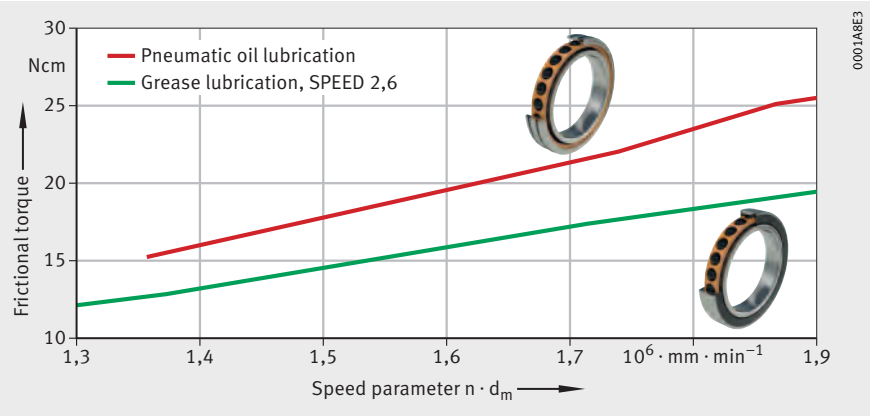

Figure 3: Spindle bearings with grease lubrication have lower friction, as shown in the example of HCB (25°)

Reduction in friction and increase in grease operating life

The grease operating life can be increased by a range of measures:

- One option is the use of sealed bearings. Due to sealing, the grease remains at the rolling contact, which means that almost all the oil present in the grease can contribute to lubrication. This means a significantly longer grease operating life in comparison with open bearings.
- As an alternative, higher specification materials can be used. The use of balls made from ceramic instead of steel in hybrid bearings gives a tribologically superior material pair at the rolling contact. As a result, the operating temperature is reduced. Less base oil is consumed and there is a drastic increase in the grease operating life of the grease lubricated bearing, *Figure 4*.
- The combination of rolling elements made from ceramic with rings made from the high performance steel Cronidur®, for example in the FAG X-life ultra bearings, leads to a further increase in the grease operating life.
- The grease operating life can be increased further by the use of high performance bearings of the series RS. Since the internal construction has optimised friction characteristics, this gives lower operating temperatures.

Grease relubrication for main spindle bearings

If a spindle is run continuously at very high speeds, lubricant must be regularly added to the bearing in order to ensure adequate lubrication reliably over a long period. One possibility for achieving this, apart from cost-intensive pneumatic oil lubrication, lies in the use of suitable grease relubrication.

With the relubrication devices from Industrial Aftermarket, Schaeffler has for a long time offered grease relubrication devices for a wide variety of applications. The new device ARCALUB-X, *Figure 5*, is highly suitable for the relubrication of high precision bearings running at high speeds.

The unit is easily mounted in the vicinity of the spindle and integrated in the machine controller.

The smallest dispensing quantity is 0,025 cm^3/stroke. The grease reservoir carrier can be easily replaced.

The grease is handled in a highly sparing manner and is only under pressure during the relubrication process.

This principle allows the use of high speed greases and ensures optimum grease performance.

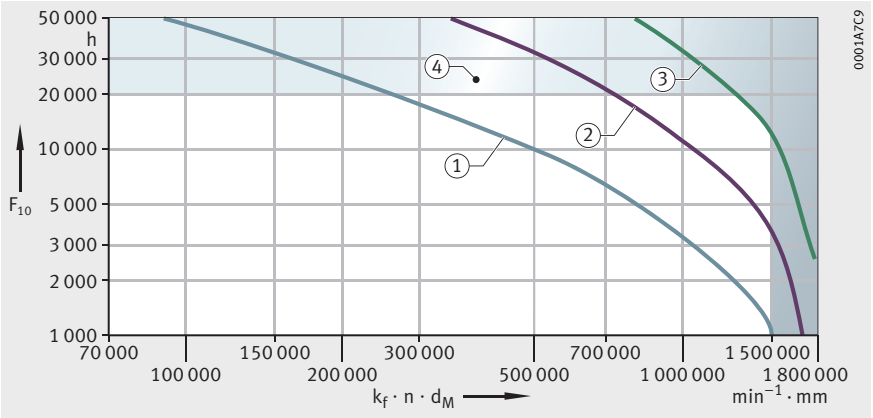

Figure 4: Grease operating life F_{10}, as a function of the bearing-specific speed parameter $k_f \cdot n \cdot d_m$
① steel/steel, ② steel/ceramic, ③ Cronidur®/ceramic, ④ grease relubrication using ARCALUB-X

Figure 5: Relubrication device FAG ARCALUB-X

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