FAG RS – Robust and Fast

High performance series for main spindles

SCHAEFFLER

FAG RS – Robust and Fast

Ordering example: HCRS71914-DDLR-T-P4S-UL

Figure 1 · HCRS spindle bearing in Direct Lube design

The new FAG spindle bearing series RS combines the robust design and load carrying capacity of spindle bearings based on large ball sizes with the suitability for high speeds of high speed series based on small ball sizes, *Figure 2*.
Bearing arrangements with the new RS spindle bearings are less sensitive to operational and environmental influences and present the user with new possibilities for the design of high speed spindles for high machining forces.

With RS bearings, it is possible to achieve a significant increase in the productivity of the system, especially through:

- higher speeds together with cost savings
- highly robust design of bearings and increased system availability
- new design options.

Bearing designs

RS spindle bearings are fitted with large ball sizes, have a uniform nominal contact angle of 20° and are produced, like all FAG spindle bearings, an accuracy to the FAG standard P4S with running tolerances to the standard P2.
The bearings are fitted as standard with a phenolic resin cage guided on the outer ring. The universal matching allows individual bearings to be used in any arrangement.
Through the combination of graded individual bearings, sets suitable for universal mounting can be configured.

In addition, RS spindle are available like the other series in a wide range of designs. In addition to steel and hybrid bearings, designs in the form of Cronidur bearings are also possible. The bearings can be designed in open versions as well as in sealed and greased versions, or as Direct Lube bearings with lubrication holes and seals on the outer ring.

The possible bore diameters range in dimension series 719 from 10 mm to 240 mm and in dimension series 70 from 6 mm to 160 mm.

Suitability for very high speeds at reduced cost

In the design with steel rolling elements, the speed capacity of RS bearings is at the same level as that of the existing bearings with ceramic rolling elements (HC) based on small ball sizes.
The hybrid design HCRS achieves the speed level of hybrid bearings with Cronidur rings (XC) based on small ball sizes.
A further increase in speed is possible through a combination of the RS design with ceramic rolling elements and rings made from Cronidur (XCRS).

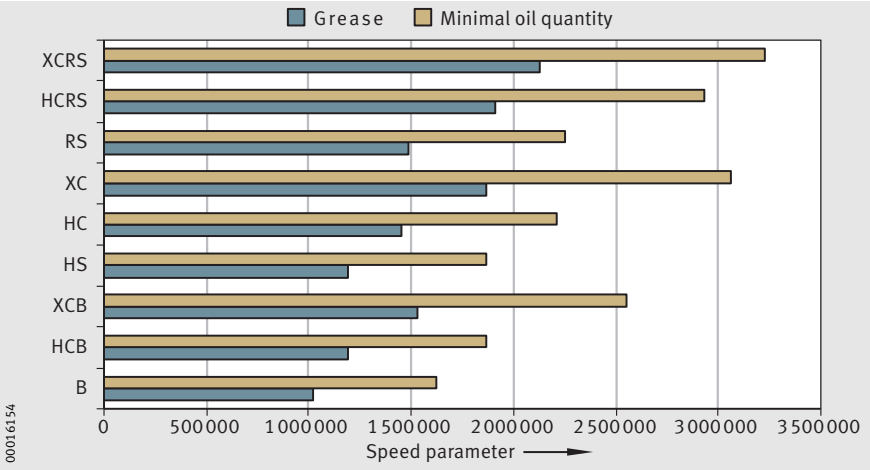

Figure 2 · Comparison – speed parameters

In those applications where the high load carrying capacity of X-life ultra bearings with Cronidur rings is not required, the RS series offers an economical alternative for achieving high speed parameters.

Extraordinarily robust design

A comparison of the increase in preload due to a reduction in radial internal clearance in three bearing arrangement variants demonstrates clearly the advantages of the new RS series, *Figure 3*.

Due to the optimised internal design, large ball cross-section and the contact angle of 20°, RS bearings are robust in resistance to changes in radial internal clearance. When rigidly adjusted, HCRS bearings for example react with less sensitivity to influences arising from interference, speed and temperature than conventional high speed bearings with ceramic balls.

In individual cases, the use of RS bearings even makes it possible to dispense with the costly spring adjustment mechanism provided in relation to an uncontrollable increase in preload. An RS bearing arrangement thus offers greater design freedom.

Less sensitive to tilting

Comparison of B, High Speed and RS bearings:

- Advance and retardation due to radial load on an example spindle with a 105 mm jib in the bearing in the bearing that is closest to the load, *Figure 4*.

In the case of the HCB bearing, the advance and retardation increases on an almost linear basis with the radial load. In the case of the HC bearing, there is an significantly flatter increase initially due to the higher rigidity but a progressively steeper increase with increasing load due to the lower load carrying capacity of the bearing.

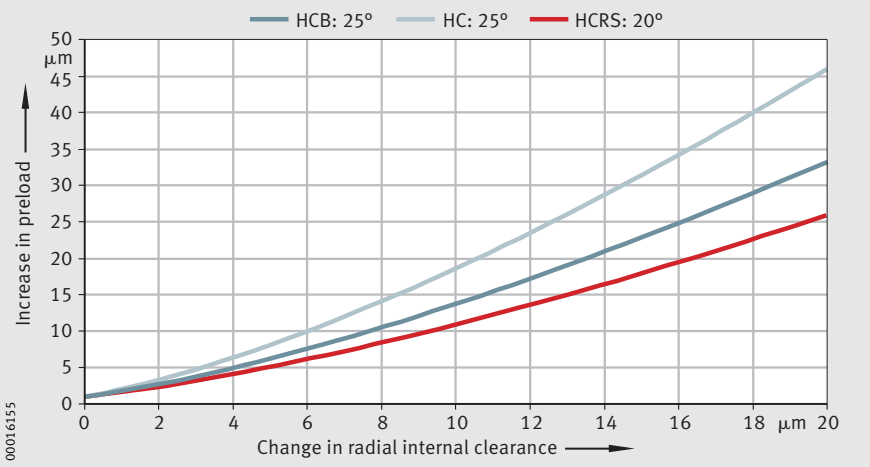

Figure 3 · Increase in preload with changes in radial internal clearance

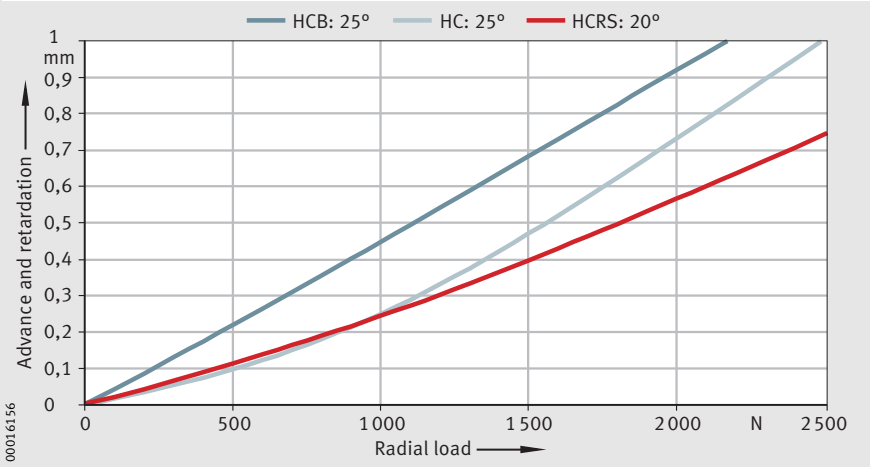

Figure 4 · Advance and retardation due to radial load

The HCRS bearing also shows an almost linear progression, but with a significantly smaller increase than in the case of the B spindle bearing with ceramic rolling elements.

HCRS bearings are thus significantly less sensitive to tilting due to load or defects in the adjacent components than HC or HCB bearings. The risk of cage failures due to slippage and impermissible lubrication conditions is reduced through the use of RS bearings.

High radial and combined load carrying capacity: ideal for milling spindles

HCRS bearings exhibit a 20% higher axial load carrying capacity before reaching the fatigue limit of 2 000 MPa compared to HC bearings based on small sizes, *Figure 5*.

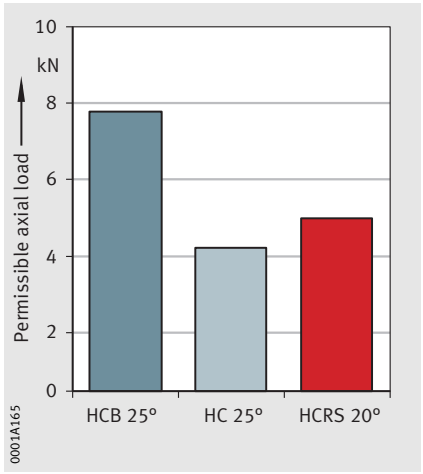

Figure 5 · Permissible loading under axial load

Under radial load and combined loading, the kinematics in the bearing are principally the determining factor. Under pure radial load, the permissible radial load of the HCRS bearing in the application being considered is 8% higher than that of the HC bearing and 70% higher than that of the HCB bearing, *Figure 6*.

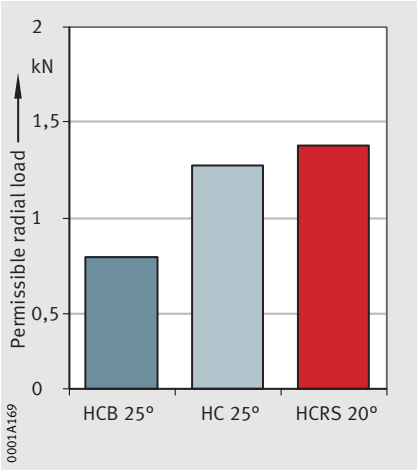

Figure 6 · Permissible loading under radial load

Under combined axial and radial load, the difference is respectively 43% and 100%, *Figure 7*.

HCRS bearings are thus ideally suitable for high radial loads and the combined loads that are typical in milling.

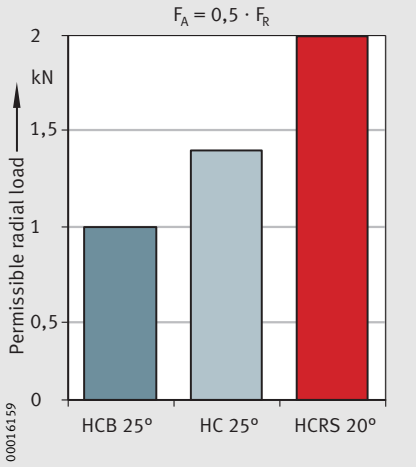

Figure 7 · Permissible loading under combined load

High rigidity

Studies of the load carrying capacity of bearing arrangements in a hypothetical milling spindle with four HCB71914 and HC71914 bearings rigidly adjusted in a tandem-O-tandem arrangement (thermally optimum bearing spacing 210 mm) under axial, radial and combined loading demonstrate clearly the advantages of the new high performance series, *Figure 8*.

The RS variant of the HC bearing has only slightly lower axial rigidity due to the smaller contact angle of 20° than the HCB bearing with a contact angle of 25°. It achieves almost the same radial rigidity as the HC bearing, *Figure 9*.

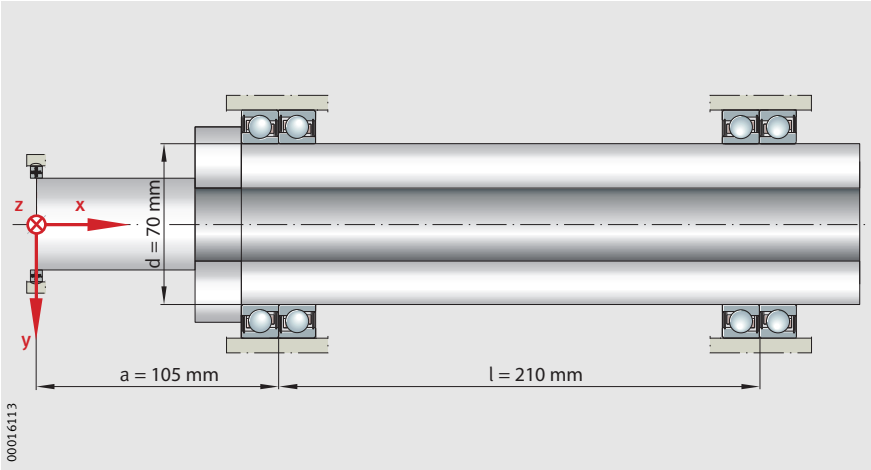

Figure 8 · Application example

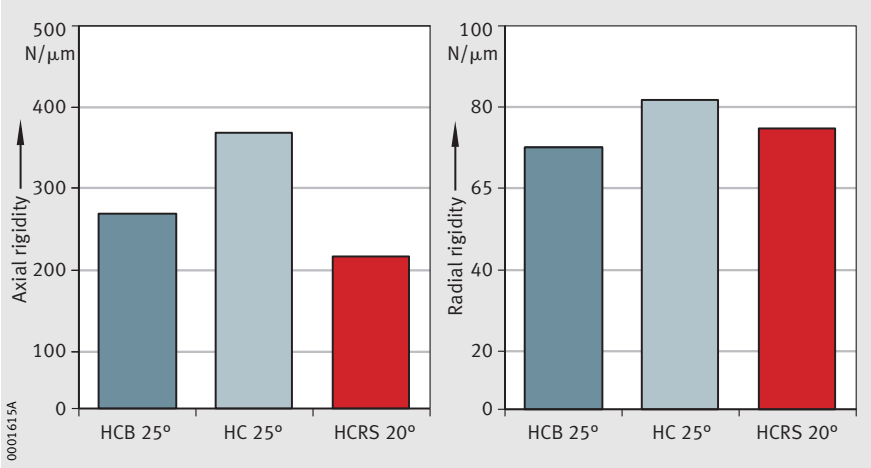

Figure 9 · Rigidity comparison

Summary

The new FAG high performance series for spindle bearings RS is characterised by its particularly robust design as well as by its suitability for very high speeds. The use of these bearings based on large ball sizes and fundamentally with a 20° contact angle provides sustainable cost savings in main spindles due to significantly longer life and new design options.

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