

FAG



FAG Hybrid Deep Groove Ball Bearings

Technical Information

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FAG Hybrid Deep Groove Ball Bearings

Application · Silicon nitride – a suitable ceramic material

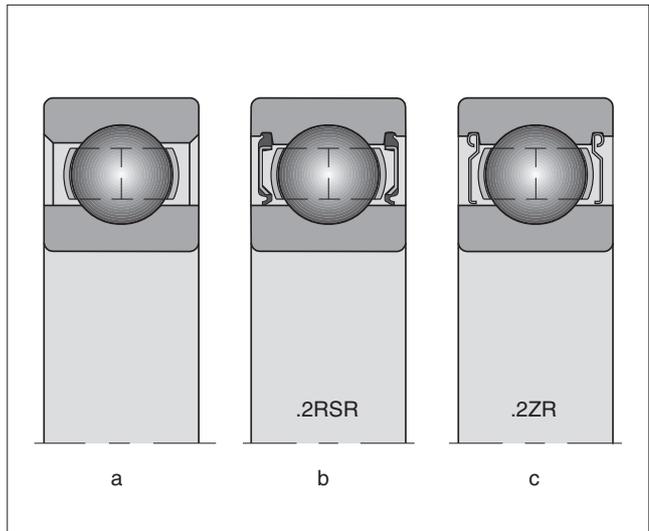
Application of FAG hybrid ball bearings

Hybrid bearings – usually bearings with ceramic rolling elements and steel rings – have become the standard in machine tools as well as in aerospace engineering many years ago. The best-known example are hybrid spindle bearings.

Today, hybrid bearings are increasingly being used in general machine construction applications as well. This applies especially to applications where problems arise with conventional bearings, e.g. with regard to lubrication, speed, temperature or current passage.

Conventional bearings with steel balls (steel bearings) can be replaced with hybrid bearings of the same main dimensions and tolerances.

FAG hybrid bearings are marked with the prefix HC. They are available in the same designs as steel bearings, i.e. also with seals and shields, figure 1.



1: Hybrid deep groove ball bearings; a) open; b) with two seals; c) with two shields

Silicon nitride – a suitable ceramic material

About 30 years ago, FAG began studying the use of ceramic materials in rolling bearings. Out of a number of different ceramic materials, silicon nitride (Si_3N_4) is almost exclusively being used in rolling bearings. Sili-

con nitride is the material which offers the best performance by combining typical properties of ceramic materials, figure 2.

2: Comparison of typical material parameters of silicon nitride and rolling bearing steel 100Cr6

Material parameters		Silicon nitride Si_3N_4	Rolling bearing steel 100Cr6
Density	g/cm^3	3.2	7.8
Coefficient of linear thermal expansion	$10^{-6}/\text{K}$	3.2	11.5
Modulus of elasticity	MPa	315 000	210 000
Poisson's ratio		0.26	0.3
Resistivity	$\Omega \cdot \text{mm}^2/\text{m}$	10^{17}	10^1
Hardness	HV10	1600 to 800 °C	700 to 150 °C

FAG Hybrid Deep Groove Ball Bearings

Service life · Electrical properties · High speed suitability

Service life of hybrid bearings

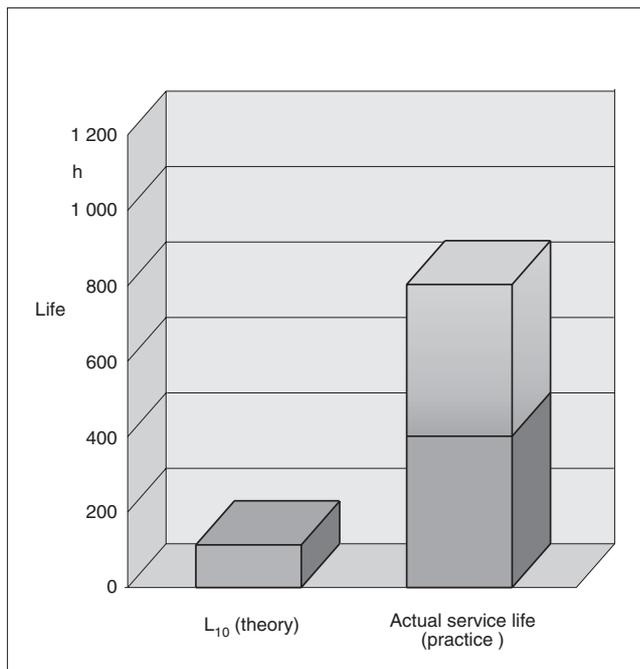
The service life of the hybrid bearings, both with grease and oil lubrication, is several times that achieved by bearings with steel balls. Under starved lubrication conditions, it is many times longer. Friction and adhesion between ceramic and steel (and, consequently, wear) are very low, especially at cold starts. In sealed bearings, the high degree of cleanliness in the rolling contact areas is maintained – a precondition for a long service life. Due to the additional sealing effect in both directions (inside and outside), the grease is retained in the contact area, and the ingress of contaminants into the bearing is prevented. Good dry running properties, thanks to their low adhesion and friction, prevent hybrid bearings from seizing under starved lubrication or dry running conditions. In many applications for hybrid bearings, the grease life (see also “lubrication”) is a more decisive factor in the designing of the bearings than the fatigue life L_{10} .

Electrical properties

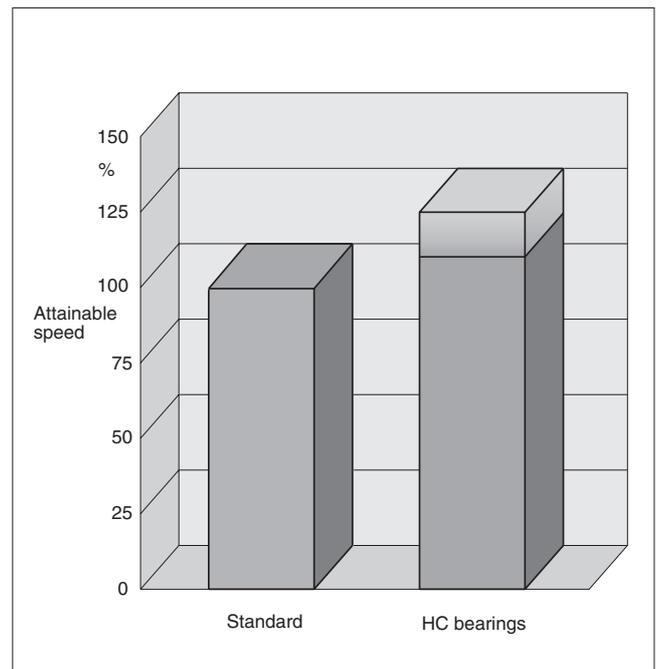
Due to their high electrical resistance, HC bearings act like insulators, see table 2. Moreover, they are insensitive to capacitive currents. This means that they can be used for all applications where there is a risk of passage of current.

High speed suitability

The attainable speed of HC bearings can be estimated to be more than 10 % higher than that of standard bearings. If the other factors besides the ball material that influence a bearing’s attainable speed (radial clearance, lubrication, mating part precision, etc.) are adapted, even higher speeds are possible, figure 4.



3: Service life of HC bearings



4: High speed suitability of HC bearings and standard bearings

FAG Hybrid Deep Groove Ball Bearings

Lubrication · Friction and temperature · Dry running properties · Other useful properties

Lubrication

Hybrid bearings - like steel bearings – must be lubricated; but they require less lubricant. They can be lubricated with all commonly used rolling bearing lubricants.

Due to these bearings' favourable material combination and smaller contact area, the grease with which they are lubricated can be expected to achieve a significantly longer life (at least twice the life achieved in standard deep groove ball bearings), figure 5.

Friction and temperature

The operating temperature of hybrid bearings at any given speed is lower than that of bearings with steel balls at the same speed. Heating results from friction, and friction in ceramic/steel combinations is low.

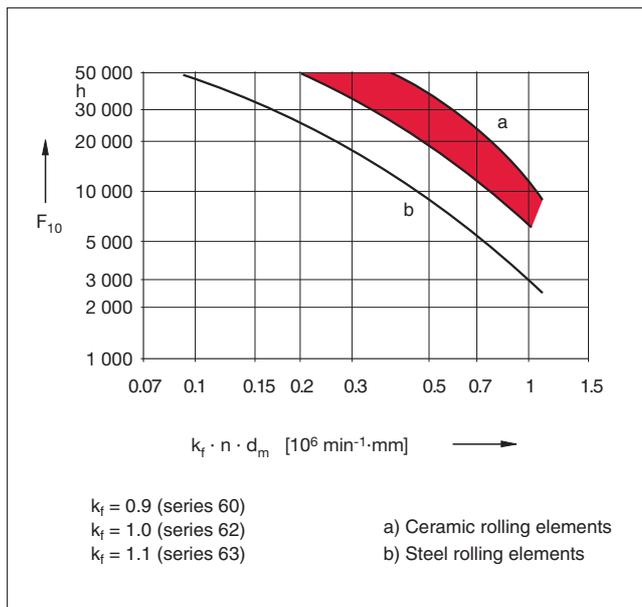
Due to the low operating temperature and the good tribological properties of this material combination, the bearings can be lubricated with grease even in high speed ranges.

Dry running properties

Hybrid bearings have a longer remaining service life in case of a lubrication breakdown. This has been proved in oil-off tests.

Other useful properties

- Ceramic is nonmagnetic.
- Ceramic is very stable chemically.
- Hybrid bearings are significantly less sensitive to the effects of slippage than steel bearings.
- Due to the smaller ball mass, higher start up and braking accelerations are permissible.
- Less wear in the running areas.



5: Grease life F_{10} for hybrid bearings and steel bearings, valid for high-speed greases

FAG Hybrid Deep Groove Ball Bearings

Cost effectiveness · Order designation · Other hybrid ball bearings

Cost effectiveness

The cost of hybrid bearings is clearly higher than that of bearings with steel balls. However, the cost effectiveness of the bearings is determined by their amortization period. Due to their favourable cost-benefit ratio, hybrid bearings usually pay off within a short time.

Other hybrid ball bearings

FAG angular contact ball bearings, four point bearings and self-aligning ball bearings are also available as hybrid bearings with ceramic balls.

Order designation

Hybrid bearings are marked with the prefix HC.

Example: **FAG HC6202.2ZR.C3.L69**

Deep groove ball bearing with ceramic balls
(dimensions 15x35x11 mm)

Sealed on both sides with 2 dust shields

Increased bearing clearance to C3

Greased with a high-temperature grease

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