Current-insulating SLF rolling bearings
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prevent damage by current passage

Electric voltage which is internally generated between the motor and the stator, especially in electric motors, may diminish over the rolling element due to design.

The voltage can be induced along the shaft due to the asymmetrical distribution of the magnetic flux in the motor. On the other hand voltages between shaft and housing can be built up particularly for inverter operation.

The resulting current flow over the rolling elements can cause damage to the running surfaces in the form of craters, slugs and ripples which could lead to early failure of the bearing.

The first sign of a damage is an increased bearing noise.

![Fig. Inner ring with running track damages due to current flow](image)

Electrical insulation between housing and shaft prevents this damage.

A solution is a factory-made coating of the inner or outer ring with an insulating layer (suffix J20A-).

An alternative solution is the use of rolling elements made of ceramic, which is usually more cost-effective for smaller rolling bearings.

![Deep groove ball bearing with coated outer ring](image)
Coated rolling bearings with the suffix J20A..

Electrically insulated rolling bearings are coated on the outer diameter or the inner diameter and on both plane surfaces with a non-conductive oxide ceramic layer using the plasma spraying process. The stronger the coating, the higher the corresponding voltage can be.

The insulation layer is dimensioned in such a way that the dielectric strength is guaranteed up to

- 500V (J20A) and
- 1000V (J20A1)

of direct current voltage in built-in condition.

The main dimensions and tolerance of the bearings (outer diameter, bore diameter and width) correspond to the dimensions of an uncoated bearing.

They can be used instead of uncoated bearings without taking any additional measures. When installing, please avoid shock and impact loads to the ceramic coating.

### Suffixes

<table>
<thead>
<tr>
<th>Symbols</th>
<th>Description</th>
<th>Dielectric Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>J20A</td>
<td>The outer ring is coated with a non-conductive oxide ceramic layer</td>
<td>up to 500 V</td>
</tr>
<tr>
<td>J20AB</td>
<td>The inner ring is coated with a non-conductive oxide ceramic layer</td>
<td>up to 500 V</td>
</tr>
<tr>
<td>J20A1</td>
<td>The outer ring is coated with a non-conductive oxide ceramic layer</td>
<td>up to 1000 V</td>
</tr>
<tr>
<td>J20A1B</td>
<td>The inner ring is coated with a non-conductive oxide ceramic layer</td>
<td>up to 1000 V</td>
</tr>
</tbody>
</table>

### Characteristic values

<table>
<thead>
<tr>
<th></th>
<th>J20A(B)</th>
<th>J20A1(B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breakdown voltage, direct current voltage</td>
<td>500 V</td>
<td>1000 V</td>
</tr>
<tr>
<td>Minimum layer thickness outer diameter</td>
<td>70 µm</td>
<td>140 µm</td>
</tr>
<tr>
<td>Minimum layer thickness plane side</td>
<td>60 µm</td>
<td>120 µm</td>
</tr>
<tr>
<td>Dimension range outer diameter D</td>
<td>70 mm to 400 mm</td>
<td>70 mm to 400 mm</td>
</tr>
</tbody>
</table>

Order example:

Deep groove ball bearing 6213 with coated outer ring
- Breakdown voltage 500 V
- Tolerance class P6
- Bearing clearance C3 (larger than normal)


Order example:

Cylindrical roller bearing NU316 with coated inner ring, brass cage
- Breakdown voltage 1000 V
- Tolerance class P6
- Bearing clearance CN (normal)

NU316E.M1.J20A1B
Rolling elements made of ceramic (Hybrid bearing)

Rolling elements made of ceramic (silicon nitride) take over the current-insulating function. Therefore they provide the highest resistance against current passage. Furthermore they have very favourable running characteristics for most applications:

- higher rotational speed
- same dynamic load rating, approx. 30% less static load rating
- less friction
- better fail-safe characteristics
- longer grease service life
- less weight
- higher bearing rigidity

Three-phase motor installation example

The voltage induced along the shaft would trigger a current flow over the rolling elements. By using a current-insulating bearing on the mostly less-loaded floating bearing side, the current flow is interrupted. This leads to the prevention of early bearing failure.

Technical data:

- Power: 5 kW
- Fixed bearing side: B7016C.T.P4S.UL
- Floating bearing side: HCB7008C.T.P4S.UL

Order example:

Deep groove ball bearing 6018 with ceramic balls

- Tolerance class P6
- Bearing clearance C3 (larger than normal)

CS018M.P6.C3

Comparison of steel and ceramic material data

<table>
<thead>
<tr>
<th></th>
<th>Steel ball</th>
<th>Ceramic ball</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material</td>
<td>100Cr6</td>
<td>Si₃N₄ silicon nitride</td>
</tr>
<tr>
<td>Specific electrical resistance in Ohm-mm²/m</td>
<td>0.22</td>
<td>(10^{10} \ldots 10^{16})</td>
</tr>
<tr>
<td>Density in g/cm³</td>
<td>7.8</td>
<td>3.2</td>
</tr>
<tr>
<td>E-module in N/mm²</td>
<td>210,000</td>
<td>300,000</td>
</tr>
<tr>
<td>Hardness</td>
<td>150 – 700 HV10</td>
<td>1300 – 1500 HV10</td>
</tr>
<tr>
<td>Heat conductivity in W/(m-K)</td>
<td>45</td>
<td>29</td>
</tr>
<tr>
<td>Thermal expansion coefficient in 1/(10²-K)</td>
<td>12</td>
<td>2.9</td>
</tr>
</tbody>
</table>