

Current-insulating SLF rolling bearings



**SPINDEL- UND LAGERUNGSTECHNIK
FRAUREUTH GMBH**



Current-insulating SLF rolling bearings

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.

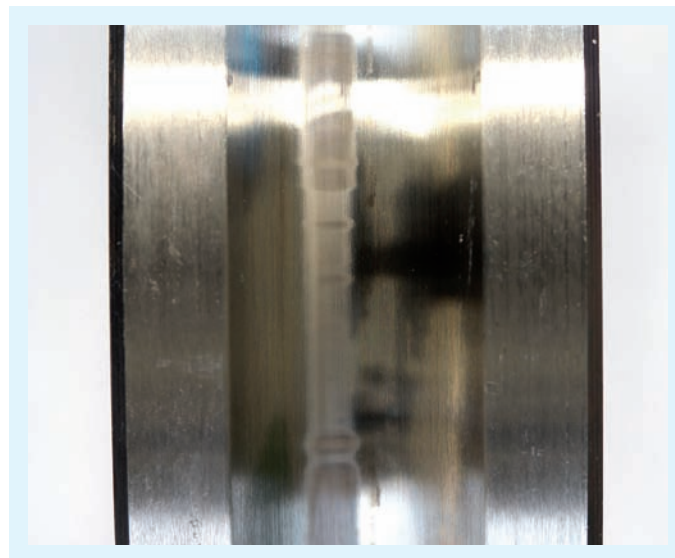
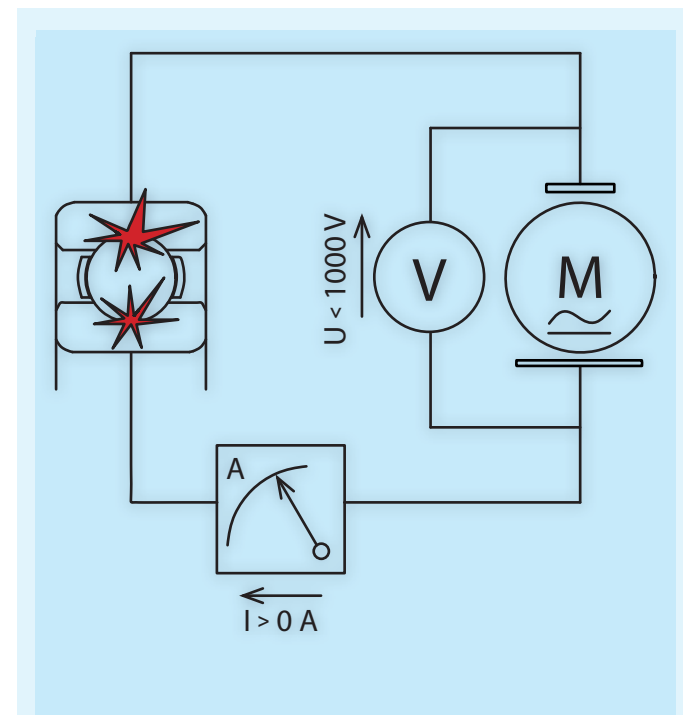
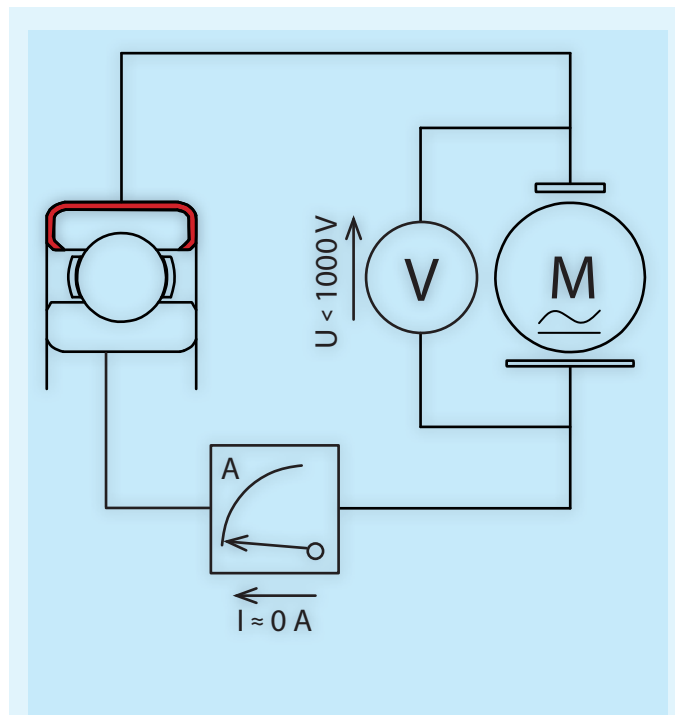


Fig: Inner ring with running track damages due to current flow



Standard bearing - early failure

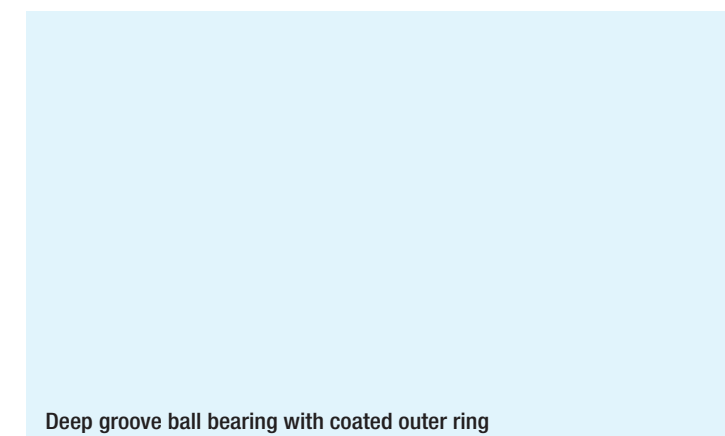
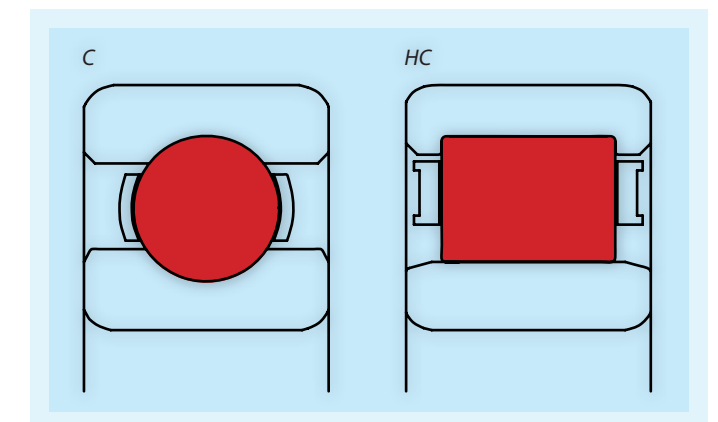
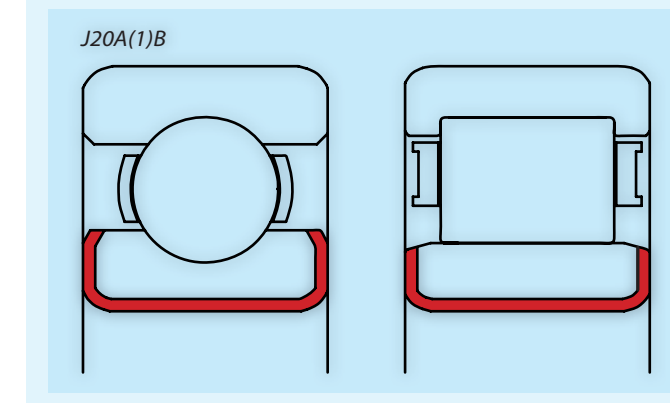
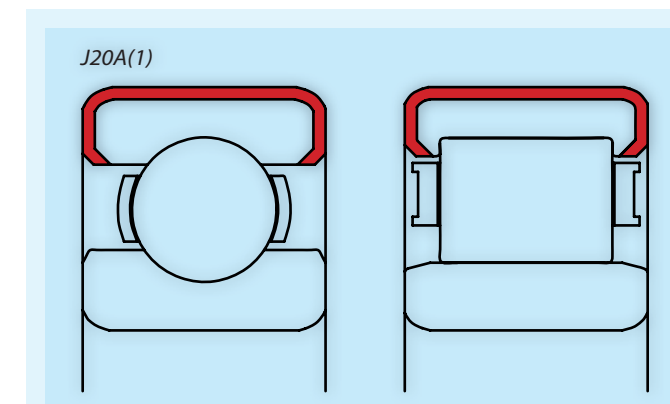


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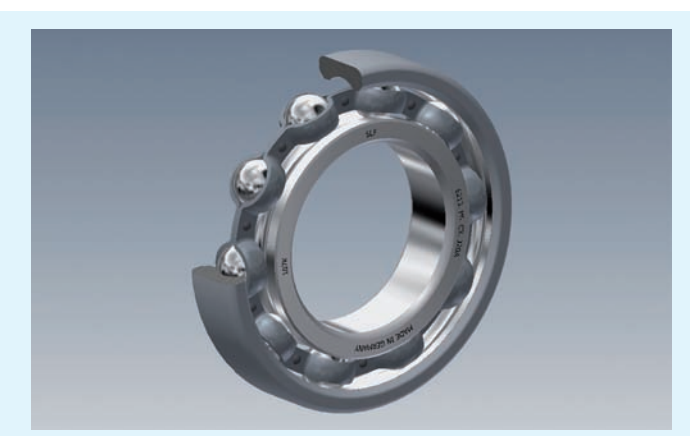
Electrical insulation between housing and shaft prevents this damage.

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



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.

Suffixes		
Symbols	Description	Dielectric Strength
J20A	The outer ring is coated with a non-conductive oxide ceramic layer	up to 500 V
J20AB	The inner ring is coated with a non-conductive oxide ceramic layer	up to 500 V
J20A1	The outer ring is coated with a non-conductive oxide ceramic layer	up to 1000 V
J20A1B	The inner ring is coated with a non-conductive oxide ceramic layer	up to 1000 V

Characteristic values		
	J20A(B)	J20A1(B)
Breakdown voltage, direct current voltage	500 V	1000 V
Minimum layer thickness outer diameter	70 µm	140 µm
Minimum layer thickness plane side	60 µm	120 µm
Dimension range outer diameter D	70 mm to 400 mm	70 mm to 400 mm

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

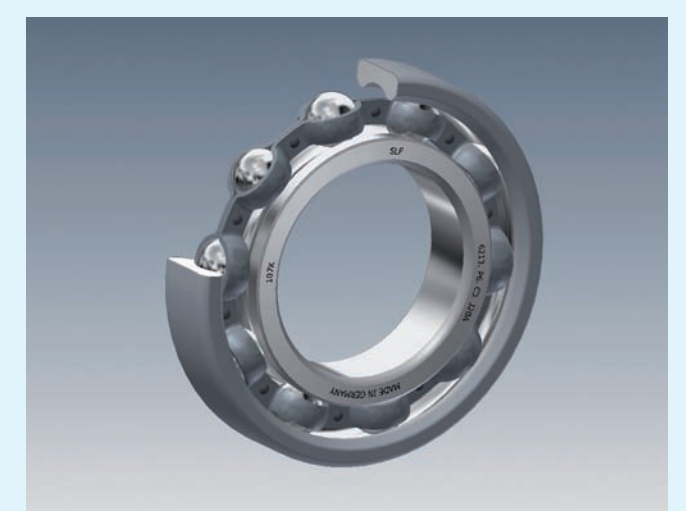
They can be used instead of uncoated bearings without taking any additional measures. When installing, please avoid shock and impact loads to the ceramic coating.

Order example:

Deep groove ball bearing 6213 with coated outer ring

- Breakdown voltage 500 V
- Tolerance class P6
- Bearing clearance C3 (larger than normal)

6213.P6.C3.J20A

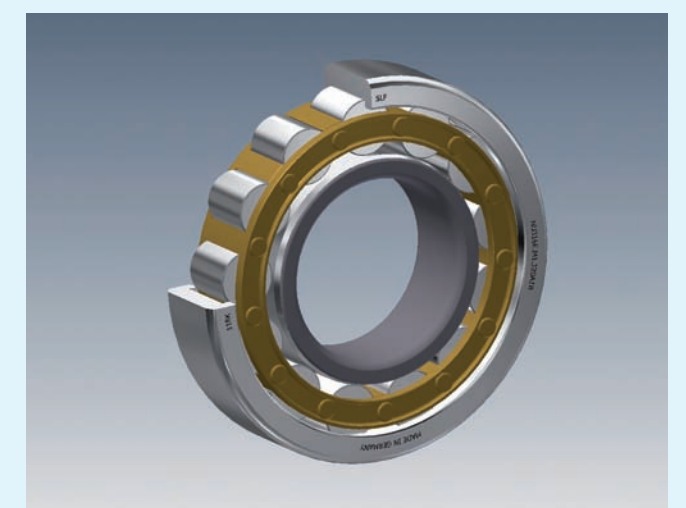


Order example:

Cylindrical roller bearing NU316 with coated inner ring, brass cage

- Breakdown voltage 1000 V
- Tolerance class PN
- 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

Prefixes	
Symbol	Description
C	Rolling element made of ceramic instead of steel for deep groove ball bearings, angular contact ball bearings and cylindrical roller bearings (Ex. C6208; C7210B; CNU206E)
HC	Rolling element made of ceramic instead of steel for spindle bearings and high-precision cylindrical roller bearings (Ex. HCB71907C; HC7012E; HCN1008)

Comparison of steel and ceramic material data

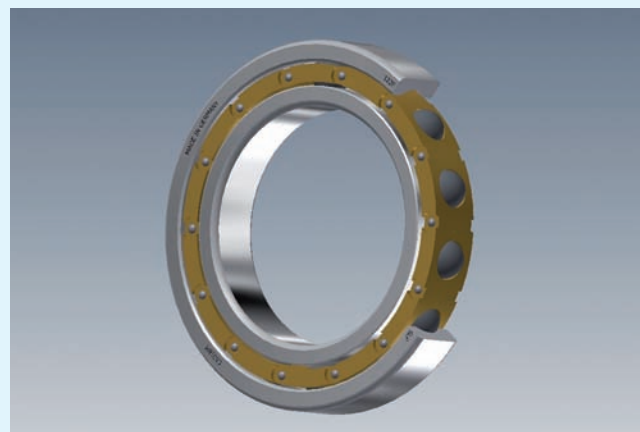
	Steel ball	Ceramic ball
Material	100Cr6	Si ₃ N ₄ silicon nitride
Specific electrical resistance in Ω · mm ² /m	0,22	10 ¹⁰ ... 10 ¹⁶
Density in g/cm ³	7,8	3,2
E-module in N/mm ²	210.000	300.000
Hardness	150 – 700 HV10	1300 - 1500 HV10
Heat conductivity in W/(m · °K)	45	29
Thermal expansion coefficient in 1/(10 ⁶ · °K)	12	2,9

Order example:

Deep groove ball bearing 6018 with ceramic balls

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

C6018M.P6.C3



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.2RSD.T.P4S.UL
- Floating bearing side: HCB7008C.T.P4S.UL

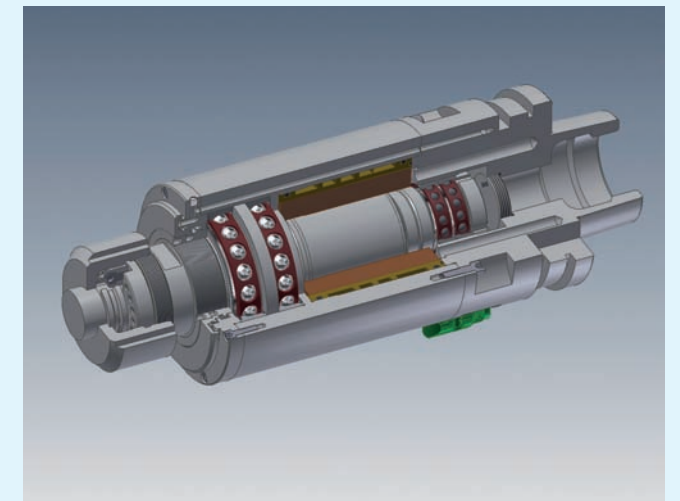


Fig: Milling spindle with insulating rolling bearings

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