Electrically insulated bearings prevent damage by electro corrosion

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Equipment failures by electro corrosion could cause significant problems for modern electrical machines with high degrees of performance and demanding reliability and service life. Under unfavourable operating conditions, bearings in electrical machines could be damaged by the passage of electrical currents. Such a passage of current can be caused by faulty or damaged insulation of the bearing shields or an ineffective earth connection of the machine.

The appearance and the degree of electrical damage of bearings depend on the individual operating conditions, e.g. the actual effective voltage. The machinery user may notice this process only by symptoms, such as increased running noise or vibrations, until the bearing fails prematurely. The appearance of the damage may vary from visually detectable single craters and to fluting with discolorations around the affected areas.

In most cases, the effective electrical insulation of the end shields entails extra costs and efforts. For existing designs, the improvement of electrical insulation could be technically complicated. The simplest solution is to use electrically insulated rolling bearings, which are integrated with an efficient electrical insulation that prevents the passage of electric currents

Two deep groove ball bearings and a cylindrical roller bearing with separated inner ring.

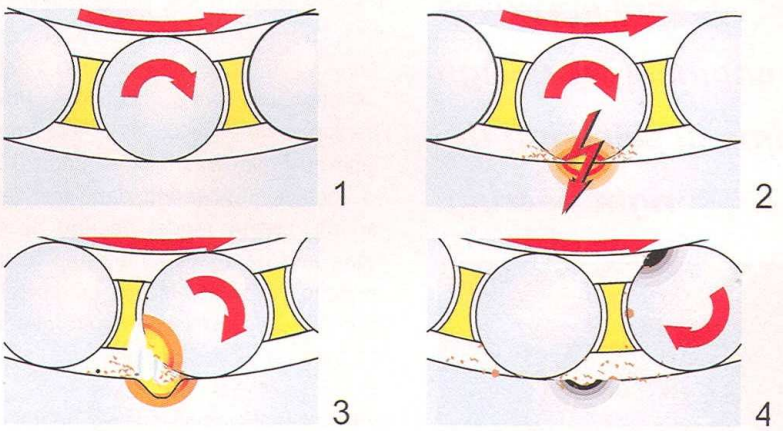
through the bearings. Consequently, the additional electrical insulation of the end covers can be omitted. Besides saving costs, this means for the user also an increase in reliability and service life of the machines.

To combat the electro corrosion problem, Bearing manufacturer NKE Austria offers electrically insulated rolling bearings in standard sizes with outer ring diameters between 80 mm and 400 mm, special sizes made available upon request.

The electrically insulated bearings are available in different design variations. Bearings with an oxide ceramic insulating layer have a guaranteed minimum breakdown voltage of 1000 V alternating or direct current. The insulation coating is applied to the outer rings by plasma spraying method. For smaller bearings, rolling elements made of oxide ceramic (silicon nitride) can be used.

The load ratings, boundary dimensions and tolerances of NKE electrically insulated bearings are identical to those of standard bearings, and therefore completely interchangeable with conventional bearings. Electrically insulated bearings provide optimal protection against bearing damage caused by electro corrosion, and therefore enable significantly improved reliability of electrical machines compared to conventional bearings. **NKE Austria** @ **SLI: 00173**

Defect mechanism step by step



The amount and appearance of bearing damage, due to passage of electrical currents, is dependant upon the individual operating conditions, e.g. the actual effective voltage. The appearance of the damage may vary between single craters (that can be easily identified by a visual inspection), and a continuous row of shallow flutes with discolorations around the actual areas.

In a somewhat simplified form, the development of damage caused by electro corrosion may be described as follows:

1) A potential difference caused by a defect in the electric system develops between the shaft (i.e. inner ring) and the housing (i.e. outer ring) of the rotating bearing. Since the lubricating film between the bearing parts does not normally conduct electric current, the voltage builds up similarly to that of a simple electric capacitor.

2) As soon as the voltage has reached a certain level, the current brakes through the lubricating layer. Such a breakthrough occurs usually where microscopic (small roughness) peaks are evident. Due to the transmission of the electric current, via such very small areas, the current density increases rapidly in these very limited areas. This may cause a «welding together» of the roughness peaks of rolling elements and raceways. There are a number of complex and subsequent processes that accompany such an event; there are metallurgical processes, e.g. changes of grain structure in the bearing steel, also chemical reactions with components of the lubricants, etc.

3) The subsequent rolling motion of the affected rolling elements causes a renewed separation of the surface peaks. This movement may cause the development of electrical arcs that cause new craters. Such craters, similar to regular welding puddles, always represent areas with destroyed (molten) material structure. Also the surface quality of a bearing is destroyed as small material particles enter the contact areas.

4) As a consequence any subsequent over rolling of the damaged areas causes more material particles to enter the contacting zone. Due to defects in both contact geometry and bearing material structure, a localised overloading of the bearing material occurs. This again causes an accelerated fatigue of the bearing steel.

The user may notice this process only by symptoms such as an increase in the levels of running noise and/ or vibrations, until the bearing fails prematurely.