

2010-01-04 | 000-002-146 GB-EN  
SCHAEFFLER (UK) LTD, SUTTON COLDFIELD

## Protective materials and coatings for extreme environments

In harsh operating environments, selecting the appropriate special coating or corrosion-resistant material for a rolling bearing can prolong the life of the bearing, reduce maintenance costs and minimise production downtime.

Demand for rolling bearings that are able to withstand extreme operating conditions is on the increase. This is being fuelled by tighter legal requirements in many industries, an increased awareness of scarce resources and the need for companies to become more energy-efficient. The Schaeffler Group has developed a range of materials and corrosion-resistant coatings for rolling bearings that satisfy these growing demands.

While standard steel bearing materials provide satisfactory corrosion resistance in many applications, for higher performance requirements, highly corrosion-resistant, nitrogen alloyed martensitic HNS (high nitrogen) steels – such as Schaeffler's Cronidur® and Cronitect® steels – are available.

Cronitect®, for example, is a high performance stainless steel that provides maximum corrosion resistance under extreme operating conditions, including dry running applications or when bearings come into contact with aggressive media such as water, salt spray, acids and cleaning chemicals.

Cronitect® is a high-grade martensitic hardening steel based on the consistent refinement of high-grade NIROsteels. Through its unique composition and new thermo-chemical surface layer treatment process that optimises the surface zone and core properties of the base material, Cronitect® achieves an extremely high hardness, providing excellent corrosion-resistance. Even after 600 hours of salt spray testing, the material shows no signs of corrosion.

Cronitect® is suitable for a wide range of applications, including food processing, materials handling, heavy machinery, power transmission systems (gearboxes), hydraulic and pneumatic systems, consumer products and packaging.

In the food industry, Cronitect® can be used across most of Schaeffler's product range, including rolling bearings, linear guides and plain bearings. Here, the use of Cronitect® significantly increases the availability of machinery, providing extended maintenance intervals. For example, bottling plants typically need to replace all their AISI440C rolling bearings that come into contact with cleaning detergents, every four months. With Cronitect® bearings, this interval can now be doubled.

Other food processing applications that already use Cronitect® on rolling bearings and linear guides include meat processing, filling plants, packaging machines, fish processing and poultry production.

In sports and fitness equipment, rolling bearings must provide excellent corrosion resistance, for example, in fishing reels, inline roller skates, cycle fitness machines, sailing equipment and for the wheel

hub bearing supports on racing cycles. On fitness machines, friction has to be minimised to ensure smooth running properties. Here, the use of Cronitect® eliminates the need for grease lubrication and complex, high friction seals.

#### Bearing coatings for wind turbine gearboxes

Rolling bearings are a critical component in wind turbines and more recently in wave and tidal stream systems. Used predominantly to support the turbine rotor, these bearings are typically designed to have at least a 20-year operational service life.

A suitably designed bearing can reduce wind turbine operator costs. For example, the design of low friction bearings for the wind turbine rotor shaft and gearbox is a key consideration, as are the associated lubrication methods for the bearings, mounting and maintenance, to ensure maintenance costs are minimised and service life is increased.

In a typical wind turbine drive train, rolling bearings are used to support the rotor, gearbox and generator. Plain bearings can also be found in blade adjusters in pitch-controlled wind turbines and in geared motors that drive the tower slewing ring and pitch control. The significance of these rolling bearings will increase as larger, multi-Megawatt class turbines are developed.

However, with increased Megawatt wind turbines, higher capacity gearboxes are now required. The operating conditions for rolling bearings therefore involve highly dynamic forces with extremes of peak and minimal loads, sudden load reversals and widely differing operating temperatures. Schaeffler offers a wide range of rolling bearings with high static and dynamic load safety factors, including tapered roller bearings, cylindrical roller bearings, spherical roller bearings, deep groove ball bearings and four-point contact ball bearings.

FAG spherical roller bearings are also playing a key role in several high profile European tidal stream energy systems currently in development. Here, FAG double row spherical roller bearings are used to support main turbine rotors with diameters up to 750mm. Schaeffler UK is also supplying spherical roller bearings and radial ball bearings for use on drive train gearboxes for tidal energy systems.

Developed specifically for wind turbine gearboxes, Schaeffler's Durotect® B is a black oxide coating for the FAG range of cylindrical roller bearings. Field tests have demonstrated that significantly lower failure rates in wind turbine gearboxes are experienced if these units are fitted with Durotect® B coated cylindrical roller bearings.

Durotect® B is a matt black, mixed iron oxide layer that is produced in a dip solution. The surface structure, magnetic and electrical characteristics of the base material are maintained. The coating is highly resistant to bending and stress.

As well as excellent anti-corrosion protection, Durotect® B also offers increased resistance of the bearing during slippage and sliding, as well as during alternating, low load conditions that are common in

wind turbine and tidal stream energy applications. The coating also provides improved run-in behaviour of the bearings.

In a wind turbine, virtually all forces and moments induced by the wind act directly on the rotor shaft. The rolling bearings are therefore subjected to highly dynamic loads and often-harsh operating conditions.

This means that the design of the rotor shaft, as well as the bearings that support it, are critical.

A rolling bearing solution will typically comprise a locating/floating bearing design with spherical, cylindrical and tapered roller bearings. Spherical roller bearings, for example, can now be protected with another Schaeffler coating, Durotect® P.

This is a 10-20 micrometre thick PTFE coating that reduces friction and provides improved anti-wear protection of main rotor bearings in wind turbines. The coating provides improved sliding capacity of the bearing outer ring, with a corresponding reduction in the friction factor to less than 0.1 under axial displacement of the bearing rings.

#### Large Electric Motors

Rolling bearings used in large AC or DC motors are normally prone to damage from the passage of electrical current. Due to the increasing use of frequency converters, this potential problem is increasing. Around 3% of all electrical machines manufactured worldwide are now controlled by a frequency converter, with this figure expected to rise to 10 per cent over the next few years.

Schaeffler has therefore developed a new surface coating that insulates the rolling bearings from this type of damage. Isotect® is an insulating layer for rolling element bearings that is applied to the outer or inner ring external surfaces. The layer acts like a resistor and capacitor connected in parallel.

With DC voltage and low frequency AC voltage, the ohmic resistance of the bearing is important. With higher frequency AC voltage, often found in frequency converters, to ensure good insulation, the ohmic resistance should be high and the capacitance as low as possible.

Depending on the operating temperature, Isotect® A has a high resistance. To allow for the capacitive resistance of bearings used with a frequency converter, Schaeffler has selected not only the appropriate material for the insulating layer, but also the most suitable layer thickness. Both are key in ensuring optimum protection.

For more information on Schaeffler Group's range of materials and coatings for rolling bearings, please visit [www.schaeffler.co.uk](http://www.schaeffler.co.uk) or telephone the marketing department on 0121 313 5870 or email [info.uk@schaeffler.com](mailto:info.uk@schaeffler.com)

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The Schaeffler Group with its product brands INA, LuK and FAG is a leading manufacturer of rolling bearings and linear products as well as a renowned supplier to the automotive industry of high-precision products and systems for engines, transmissions and chassis applications. The group of companies stands for exceptional customer focus, innovative ability and the highest possible level of quality. Sales of over € 9.5 billion were generated at over 180 locations in more than 50 countries in 2010. With around 70,000 employees worldwide, the Schaeffler Group is one of the largest German and European industrial companies in family ownership.

CONTACT:

Schaeffler (UK) Ltd, Forge Lane  
Minworth  
Sutton Coldfield West Midlands B76 1AP  
Tel. +44 121 313 5881  
Fax +44 121 313 0080  
E-Mail: [Karen.Preston@schaeffler.com](mailto:Karen.Preston@schaeffler.com)