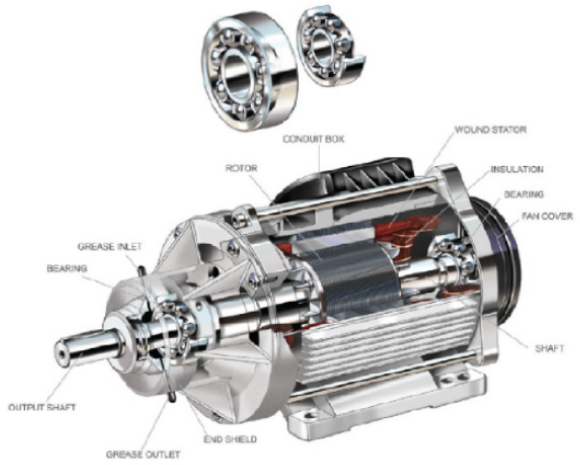
High Speed roll bearings for EV motors

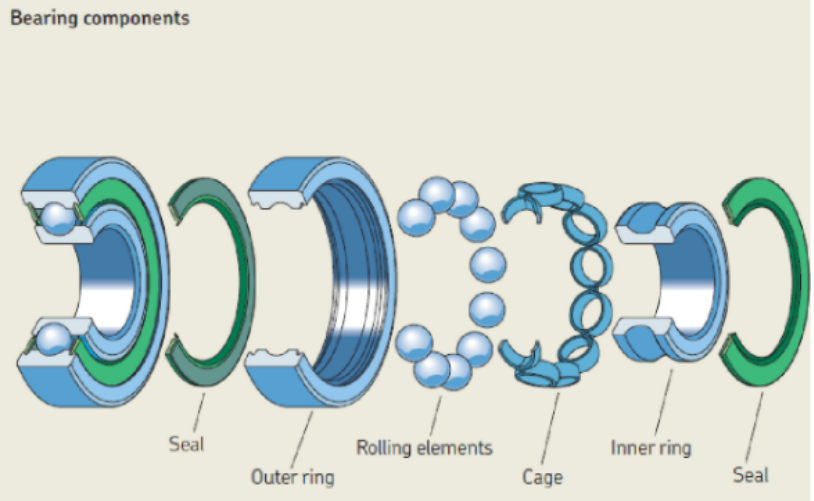
Rolling bearings support and guide with minimum friction, rotating elements (shafts, axles or wheels).

They enable high rotation speed, while reducing noise, heat, energy consumption and wear.



The moving surface is separated from the stationary surface by rolling elements that can roll in a controlled manner.

The inner ring fits the shaft, the outer ring fits a housing, the rolling elements are held apart from each other by a cage.



The primary functions of an electric motor bearing grease are to:

- Reduce friction and prevent wear
- Protect bearings against corrosion
- Act as a seal to prevent entry of contaminants

Electrical erosion in rolling bearings is a challenge in e-mobility. The inverter control systems can lead to complex shaft voltages. EDM bearing currents occur when the bearing voltage exceeds the threshold voltage of the insulating lubricating film. The energy of the capacitor is released by destructive currents and arcing. The discharge currents can damage the bearing surface and degrade the lubricating grease (radical formation, overheating..).

To avoid the electrical bearing failures, there are several approaches.

One approach is to **reduce the electrical field.** For instance by using a grounding ring on the shaft and outside the bearing, by reducing the switching frequency of the inverter (but limit performance of speed control system)….

Another approach is to **suppress the electrical breakdown**. To do so, one can build an insulation layer on the bearing (insulating the inner or outer ring, using ceramic rolling elements…), so that the impedance will be high between the bearings and the ground. However the cost is high and the heat dissipation decreases. Another and easier way is to **enhance the conductivity of the lubricating grease.** In that case soluble additives are preferred to keep smooth running.

Ionic liquids are an interesting class of additives to reach both high conductivity and stability. **New Fomblin additives** (anti-rust, conductivity) are under development to find a promising solution. Also a new grease life test rig that can run at high speed and temperature has been ordered to perform meaningful applicative tests.

Some references:

Performance characteristics of lubricants in electric and hybrid vehicles : a review of current and future needs

Ionic liquids - innovative lightning conductor in e-mobility (Klueber article)

Guide to electric motor bearing lubrication (Mobil)

Electrical bearing failures in electric vehicles

Newgate Simms - Grease Bearing Electrical Resistance Test