

## PRESS RELEASE

### September 2019 – Shaft grounding rings for electric vehicle propulsion systems



Source: KACO GmbH + Co. KG

The electrification of powertrains is in full progress. Besides systematically applying established sealing technology in hybrids and e-drives, KACO is offering innovative e-mobility products since a couple of years. For reliable operation of electric engines, KACO developed a product portfolio for shaft grounding rings. KACO shaft grounding rings are providing an excellent bearing protection over lifetime. The specifically dedicated, high-performing test facilities ensure functionality of the shaft grounding rings under real life conditions for already established and future e-mobility specifications.

The increasing power density within high voltage systems for electrical and hybrid vehicles requires solutions for the electrical traction machines, that guarantee a constant and stable electrical connection of the rotor shaft to the grounded housing. Besides interference frequency for the radio there is a considerable risk for bearing destruction caused by induced shaft voltage. If no proper grounding system is installed, an undefined current flow may result in bearing currents,. The potential differences may have different reasons, as for instance an asymmetrical design of the stator sheet package or the stimulation of the frequency converter. Unintended bearing currents result in local destructions of the bearing surfaces like pittings, white etching cracks and washboard like structures, ending up in a complete bearing failure. As experience shows, the application of isolated bearings (e.g. ceramic) does not solve the problem. This measure redirects unintended current flow to the gearwheels of reductor transmission, which gradually will destroy their metal surfaces. Furthermore, critical interference noise for mid frequency can not be avoided isolated bearings. Depending on the vehicle's registration country, this is even a safety topic when traffic broadcast is affected.

KACO shaft grounding rings have been developed for electric vehicle propulsion systems. They are ensuring a permanent electrical connection between rotor shaft and grounded housing for preventing metallic bearings from unintended harming currents. Grounding rings protect metallic bearings from damage and prevent from interference noise for mid frequency. This was made possible by using a highly conductive PTFE disc with special coating. KACO shaft grounding rings are intentionally optimized in line with the specifications of electric propulsion systems. They are in series application designed for circumferential speeds of up to 45 m/s within a temperature range between -40 and 140 °C. Even though this covers nearly all currently known series applications, further optimizations and alternative solutions for higher circumferential speeds are already at testing stage. Within a dry running system, the electrical impedance is around 5Ω between rotor shaft and housing. In summary

KACO's specifically designed solution offers effective protection for bearings and gear wheels, a significant reduction of impedance over lifetime, being fully independent from the rotation direction of the shaft. Recent development for new shaft grounding systems with a purpose design for electric motors of highly integrated e-drive systems using oil mist for cooling is shortly before market introduction. Due to the specialization of development and production of shaft grounding rings, KACO is first choice for system engineering of grounding applications.

### **Use case tested under real life conditions**

In close cooperation with OEMs and automotive system suppliers KACO has proven the performance of its shaft grounding ring portfolio by developing specific test rigs. Measurement methods and analysis algorithms have been developed for the specific requirements of e-mobility. Available test programs for KACO shaft grounding rings are application specific tests as well as various mechanical, chemical and climatic tests. Based on the investment in specific test benches, KACO is able to evaluate load profiles of the shaft grounding rings in consideration of high speed, minimum and maximum temperature or dynamic runout of the system. Based on the specific KACO competences material pairing and friction optimization, application-oriented design for radial force, temperature behavior and related wear for the contact zone can be engineered. This is the reason why KACO is your preferred choice in developing and applying shaft grounding solutions for e-mobility.

„Solution-oriented material and product engineering supported by specifically created test facilities have been the success factors for the development of our shaft grounding rings. Analytical deep dive on existing solutions for shaft grounding products systematically lead us to the creation of a robust, compact and cost optimized product portfolio. The new material combination of highly conductive PTFE with silver coating is overcoming known disadvantages of alternative solutions for shaft grounding. Depending on the application, a specific running sleeve can further improve the low impedance connection. It has proven to be right that we allocated dedicated resources for the development and testing of our shaft grounding rings years ago. This engineering and testing setup gives us the position to significantly add value to our customers' development of electric propulsion systems” explains Vice President Research & Development Andreas Genesisius.

### **The Expert for Sealing Systems**

KACO GmbH + Co. KG, a subsidiary of the Zhongding Group, is one of the world's leading developers and manufacturers of high-precision, practical sealing solutions for the automotive and mechanical engineering sectors. The company, with its headquarters in Germany, has earned a reputation for the highest quality sealing solutions and innovative power as well as for expertise in development and production. KACO has six production facilities in Germany, Austria, Hungary, China and the USA and delivers products across the globe. A trusted partner of the automotive and supplier industry, the company has been keeping pace with the high demands and technical changes of the industry for decades.