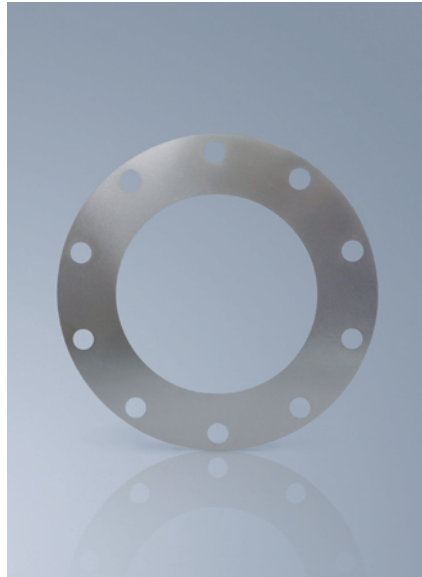


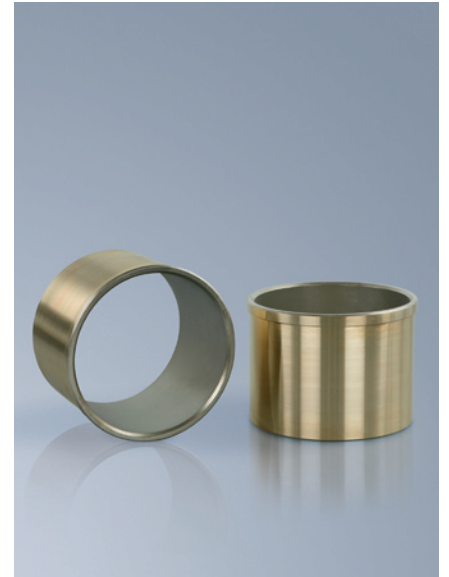


EKagrip® FRICTION SHIMS AND COATINGS FOR WIND ENERGY APPLICATIONS

EKagrip® friction shims and coatings provide a reliable solution to increase the coefficient of friction in bolted or hub-collar connections. They enable higher potential loads and torque rates with a compact and light-weight design.



Typical EKagrip® friction shim design for a flange connection according to customer specification



Direct coating with EKagrip® on a hub-collar connection

Technical and economic demands

In the wind energy sector, as in many other industries, there is a trend towards higher power density, which means increasing loads on all components despite space and weight restrictions. Other requirements include easy installation, maintenance-free operation or corrosion resistance. At the same time, safety, reliability and cost are crucial factors too.

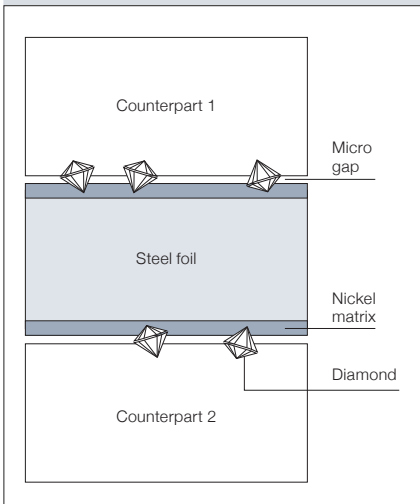
In friction joints, such as flanges or hub-collar connections, the coefficient of friction between the mating components and the transmittable forces are directly related. A higher load level usually requires scaling up components or fastening devices, which has a negative impact on size, weight and cost for the entire unit. A better approach for transmitting higher loads is to increase the coefficient of friction in the joint using a nickel-diamond coated intermediate shim or a directly coated component.

Functional principle

The functionality of EKagrip® is the result of diamond particles with defined size and distribution protruding from a nickel coating. The coating is applied on thin steel foils or directly on the surface of one of the mating parts. During assembly of the components, the diamonds penetrate the counter surfaces and create a micro-scale interlock. This method allows higher loads to be transmitted through the connection in a reliable and reproducible way. The resulting coefficient of static friction can reach a value of 0.5 or even higher, depending on the application parameters.



Diagram of an EKagrip® friction shim

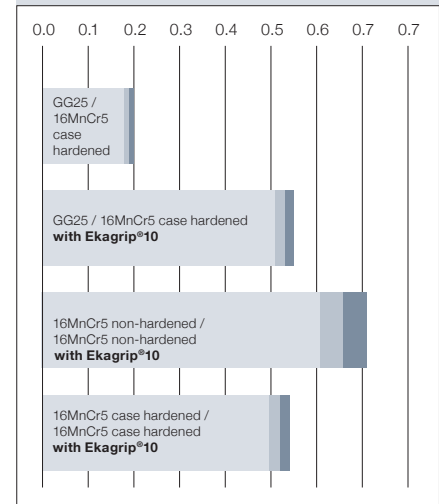


Tribosystem with EKagrip® friction enhancing shim



Contact surface of friction joint with EKagrip® friction enhancing shim after assembly and disassembly

Typical coefficients of static friction with and without EKagrip® friction shim



Results of series of tests on the coefficient of static friction (the shaded areas of the bars show the variation)

Advantages

EKagrip® shims and coatings increase the friction in the joint surface between two components. This technology allows higher torque or shear loads to be transmitted for the same or even reduced component size, thus providing a simple but very effective solution to such apparently contradictory requirements. EKagrip® can be used in bolted or hub-collar connections with a variety of materials and within a wide range of surface pressures.

Reducing the size and the weight of the fastening elements also enables a more compact design for other components, such as bearings, supports or housings. This can lead to a further reduction of overall size and weight of the complete

system, which results not only in a superior technical solution but also an overall cost reduction. Other positive side effects of this technology: EKagrip® shims are easy to handle, the function is not affected by lubricants; they are reusable in case of dis- and reassembly; the remaining micro gap in the joint prevents fretting corrosion. For new development of systems, EKagrip® friction shims allow more design flexibility, while in existing technical solutions, they help expand the application for a higher power range. Since the shims are very thin, they can easily be retrofitted in an existing technical concept without a design change of the components.

Applications

In wind energy applications, typical examples are flange and other bolt connections in the powertrain, supports and mounts. Direct coating of components is common in hub-collar connections and torque-limiting devices.

The production process is certified under ISO TS 16949, the strict regulations for automotive applications. Until now, ESK has sold more than 30 million shims for automotive and various industrial applications worldwide.

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The management system has been certified according to ISO TS 16949, DIN EN ISO 14001. EKagrip® is a registered trademark of ESK Ceramics GmbH & Co. KG.

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