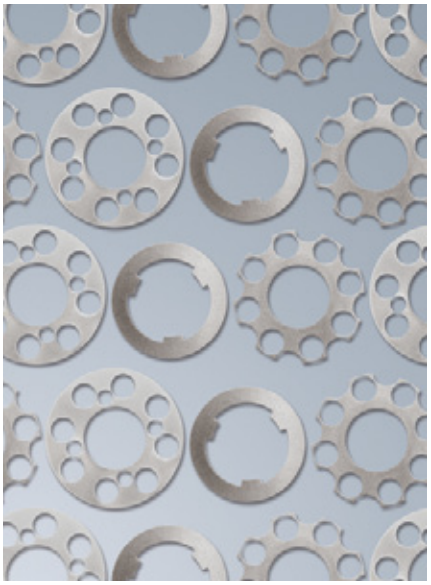
EKagrip® FRICTION SHIMS FOR AUTOMOTIVE APPLICATIONS

Applying EKagrip® friction enhancing shims creates possibilities for lightweight compact designs whilst increasing potential load and peak torque in single bolt applications.



EKagrip® friction shim according to customers' specification – it's paid off thirty million times

EKagrip® friction shim in the GM L5 crankshaft application

Properties

Especially in the automotive industry, there is a general move toward compact, lightweight designs that must nevertheless be totally reliable. Typical applications are central bolt designs in crankshaft and camshaft applications, continuous variable timing, balancer shaft modules, as well as shaft-to-collar connections. The demand for maximum power density, i.e. the transmission of ever greater forces and torque in increasingly compact designs, poses a major challenge to engineers. In friction joints, the given coefficient of static friction imposes definite physical limits on power transmission capabilities. These limits can be overcome with friction-enhancing coatings.

When friction joints are designed, physical parameters such as overall size and surface pressure usually can only be varied in a tight window. Load transmission capability in friction joints is thus limited by the friction coefficient of the mating materials. But many applications require higher levels of power transmission. Therefore new ways of enhancing power transmission capability need to be found. One approach is to apply a nickel diamond coating either to the actual parts of the joints or to friction shims for installation in the joint. Depending on other application parameters, the coefficient of static friction can even exceed 0.5, resulting in a greatly increased load transmission capacity.

Processing

EKagrip® nickel diamond coatings consist of an electroless nickel matrix in which a specified quantity of diamond particles of defined size is embedded. These coatings can be applied either to the joint components directly or to thin shims for installation in the joint. After coating, the parts are heat-treated to relieve inherent tensile stresses and to impart sufficient diamond retention strength.

Diagram of an EKagrip® friction shim

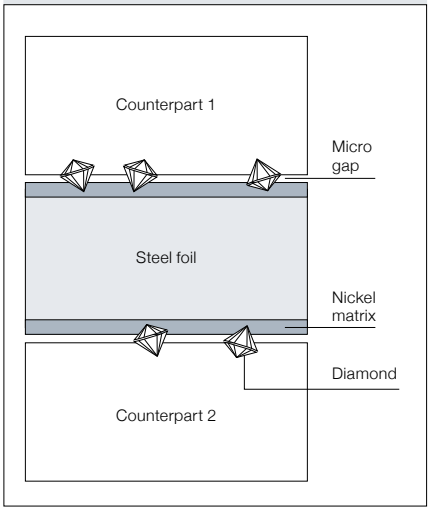


Fig. 1: Tribosystem with EKagrip® friction enhancing shim

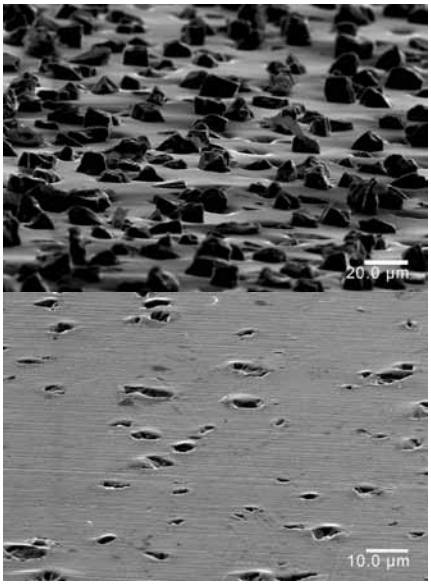


Fig. 2: Contact surface of friction joint with EKagrip® friction enhancing shim after assembly and disassembly

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

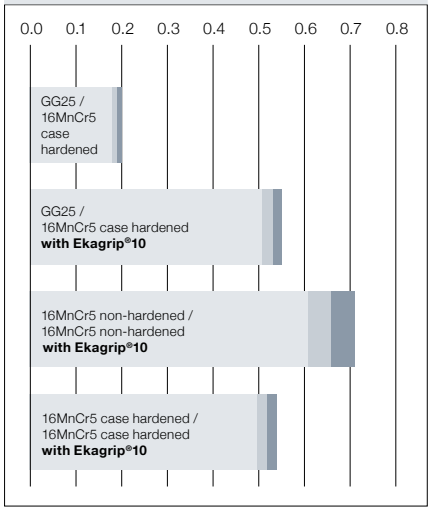


Fig. 3: Results of series of tests on the coefficient of static friction (the shaded areas of the bars show the variation)

Assembly

Assembly, i.e. applying the bolt preload on a crankshaft with a central bolt design, causes the diamond particles to press into the softer surface of the counterpart. As a result, a micro scale form fit is created between the base part and its counterpart (Fig. 1 and Fig. 2).

The key parameters influencing the extent of micro scale form fit are the counterpart material, the counterpart surface roughness and the applied surface pressure. Figure 3 shows typical coefficients of static friction for various material combinations with and without an EKagrip® friction shim.

Applications

EKagrip® friction shims offer a simple but very cost effective way to transmit up to three times as much load as conventional systems. And there is no need to modify the joint design.

In production are a variety of engine applications mainly focusing on crankshaft, camshaft and balancer shaft module. Several fastener applications are in test program status, and there are potentials in steering, suspension, transmission, chassis and body applications.

Many car manufacturers, such as Audi, BMW, DaimlerChrysler, Ford, GM, Mazda, Porsche and VW are relying on EKagrip® friction shims in their designs. By now there are already more than 50 million friction shims on the road. In addition to automotive applications, EKagrip® friction shims and coatings are widely used in demanding motor sports applications.

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