

3M Advanced Materials Division

3M™ Friction Shims for Automotive Applications

3M™ Friction Shims create possibilities for lightweight and compact design while increasing potential load and peak torque in bolt connections.

Introduction

Especially in the automotive industry, there is a general trend toward compact, lightweight designs that nevertheless must be highly reliable. Typical applications include central bolt designs in crankshaft and camshaft applications, continuous variable timing, balancer shaft modules, and 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 by enhancing friction in the joint. When friction joints are designed, physical parameters such as overall size and surface pressure typically can only be varied within a tight window. Load transmission capability in friction joints is thus limited by the friction coefficient of the mating materials. However, many applications require higher levels of power transmission. One way to achieve this is to apply a nickel diamond coating to friction shims for installation in the joint. Depending on other application parameters, the coefficient of static friction can be increased to 0.6 or even higher, resulting in a greatly increased load transmission capacity.

3M™ Friction Shim Diagram

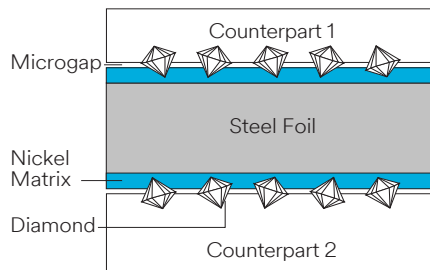


Figure 1. Tribosystem with 3M™ Friction Shim. (This figure is intended as a guide. On request, we can provide you with a drawing frame for your specification.)

Processing

3M friction shims are metal foils with a coating of electroless nickel matrix embedded with a specified quantity of diamond particles of defined size. 3M friction shims are thin enough to fit within close engineering tolerances, creating possibilities for lightweight compact design while increasing potential load and peak torque in bolt connections.

Assembly

Assembly, i.e. applying the bolt pre load 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 (Figures 1 and 2). The key parameters influencing the extent of micro scale form fit are the

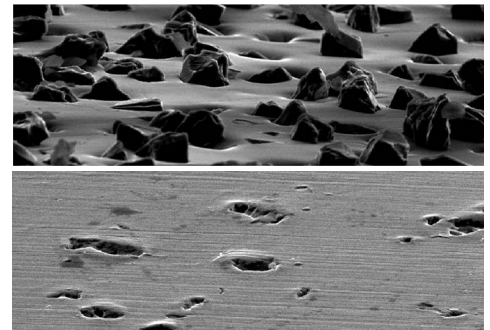


Figure 2. Contact surface of friction joint with 3M™ Friction Shim after assembly and disassembly

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 a 3M friction shim.

Typical Coefficient of Friction

(Not for specification purposes)

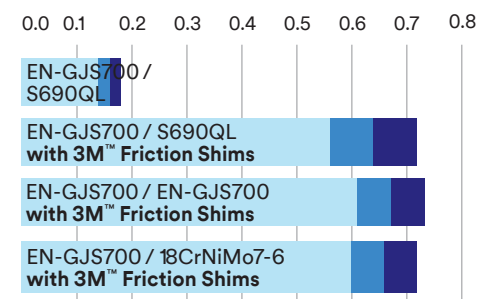


Figure 3. Results of a series of tests on the coefficient of static friction with and without 3M™ Friction Shims. The shaded areas of the bar show the variation.

Handling Instructions

- Store 3M™ Friction Shims only in original packaging.
- Don't handle 3M friction shims as bulk unless a clip variant is used that has been specifically designed for bulk storage.
- Don't expose 3M friction shims to temperatures above 400°C.
- Avoid contact of 3M friction shims with corrosive substances unless a stainless steel substrate is used.
- Don't bend 3M friction shims.
- No mechanical treatment of 3M friction shims.
- Before assembling 3M friction shims, make sure no dirt residue is present.
- Ensure a minimum contact pressure of 50 MPa.
- Check correct quantity during assembly.
- Avoid relative movement of shims on surface when disassembling.
- 3M Technical Ceramics offers support in defining a suitable assembly concept.

Applications

3M friction shims offer a simple but very cost-effective way to transmit up to four times higher torques than conventional systems – with no need to modify the joint design. We currently produce parts for a variety of engine applications, mainly focusing on crankshafts, camshafts and balancer shaft modules. Further applications include steering, suspension, transmission, chassis and body.

A significant number of car manufacturers have incorporated 3M friction shims into their designs. There are millions of 3M friction shims on the road today, both in automotive and demanding motor sports applications.

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98-0212-4256-9 Rev. C