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Applied to Life.™

3M Advanced Materials Division

3M™ Friction Shims

3M™ Friction Shims and SEM microphoto of nickel-diamond coating

Introduction

The demand for maximum power density, i.e. the transmission of greater force and torque in increasingly compact designs, poses a major challenge to engineers across a variety of industries. 3M Technical Ceramics manufactures friction-enhancing solutions for joining components to withstand higher shear forces or transmit higher torque in bolt connections. 3M™ Friction Shims offer a simple and cost-effective way to reliably transmit up to 4x higher torques or forces than conventional systems without requiring modifications to the joint design.

3M friction shims are metal foils with a coating of electroless nickel embedded with diamond particles. The diamonds indent into the metal mating surface and create a micro-scale interlock. The shims themselves are easy to assemble and can be reused after disassembly. 3M friction shims are thin enough to fit within close engineering tolerances, creating possibilities for lightweight compact design while increasing maximum load and peak torque in bolt connections.

3M friction shims have proven effective in a wide variety of industries, including general mechanical engineering, machine tools, marine engineering, wind and water power generators, turbines, automotive engineering and motor sports. Our technical specialists have many years of application experience, and conduct in-house laboratory and bench tests to ensure that 3M friction shims meet our customers' specific requirements.

Features

- Increases the coefficient of static friction
- Function of 3M friction shims is not affected by an oil film
- Can be easily retrofitted
- Prevents fretting
- Highly reproducible
- Color option for distinctive appearance
- Shim geometries can be tailored to customer specification

Application

- Frictional joints
- Flange joints
- Joints with central bolt
- Bolt connections
- Fastener systems

Application Notes

When 3M friction shims are used please note:

- For maximum performance, the mating surfaces must have roughness values Rz as given in the technical data sheet.
- Contact pressure of at least 50 MPa is recommended.
- When designing the joint, ensure that the counterparts to be joined are in full contact.
- Only use in applications with static friction in the contact area.
- The coefficient of static friction depends on a large number of different parameters. It is therefore always advisable to carry out application tests with assistance from 3M Technical Ceramics.
- 3M Technical Ceramics offers support in defining a suitable assembly concept.

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.
- Dry storage recommended.
- 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.
- Check correct quantity during assembly.
- Avoid relative movement of shims on surface.

3M™ Friction Shim Diagram

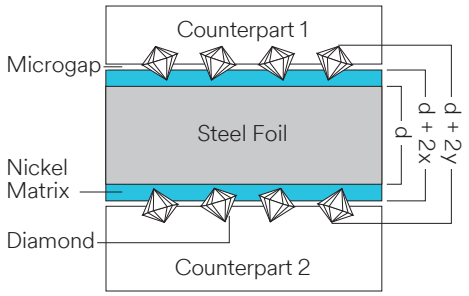

Figure 1. Tribosystem with 3M friction shim. (This figure is intended as a guide. On request, we can provide you with a drawing frame for your specification.)

Typical Coefficient of Friction

(Not for specification purposes)

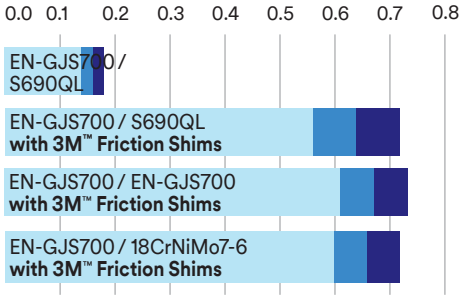

Figure 2. Results of a series of tests on the coefficient of static friction with and without 3M™ Friction Shims. The shaded areas of the bar show the variation.

Variables influencing the coefficient of static friction

Counterpart	• Surface roughness • Surface flatness
Coating	• Diamond grain size • Diamond concentration • Shim / direct coating
Load	• Type of load • Static / dynamic
Environment	• Dry / lubricated
Assembly	• Surface pressure

Typical Physical Properties (Not for specification purposes)

Property	3M™ Friction Shims		
	Grade 10	Grade 25	Grade 35
Form	Coated shim with Grade 10	Coated shim with Grade 25	Coated shim with Grade 35
Color	Silver gray metallic	Silver gray metallic	Silver gray metallic
Shim Material (preferred)	C75 S (acc. to EN10132-4)	C75 S (acc. to EN10132-4)	C75 S (acc. to EN10132-4)
Thickness of Shim (d)	Standard 0.1 mm ± 0.01 mm (others upon request)	Standard 0.1 mm ± 0.01 mm (others upon request)	Standard 0.1 mm ± 0.01 mm (others upon request)
Processing of Base Part	Laser cutting or stamping	Laser cutting or stamping	Laser cutting or stamping
Matrix Material	Electroless nickel phosphorus	Electroless nickel phosphorus	Electroless nickel phosphorus
Hard Particle Type	Diamond	Diamond	Diamond
Mean Particle Size	10 µm	25 µm	35 µm
Diamond Concentration on the Surface (avg.)	8 – 16 %	8 – 25 %	10 – 30 %
Hardness of Nickel-phosphorus matrix	400-600 HV 0.025	400-600 HV 0.025	400-600 HV 0.025
Thickness of Matrix (x)	5 – 9 µm	13 – 17 µm	14 – 22 µm
Total Layer Thickness (y)	10 – 20 µm	25 – 35 µm	35 – 50 µm
Total thickness of coated shim (d + 2y) (Uncoated shim: 0.1 mm ± 0.01 mm)	0.13 mm ± 0.02 mm	0.16 mm ± 0.02 mm	0.19 mm ± 0.03 mm
Application Requirements			
Surface Roughness R_z or Average Surface Finish R_a of Counterpart - (transversal to direction of machining)	R_z < 5.0 µm R_a < 1.0 µm	R_z < 12.5 µm R_a < 2.5 µm	R_z < 17.0 µm R_a < 3.5 µm
Property -Waviness height Wt (total height of W-profile)	Should be smaller than R_z	Should be smaller than R_z	Should be smaller than R_z
Minimum Contact Pressure	p > 50 MPa	p > 50 MPa	p > 50 MPa
Maximum Service Temperature	400°C	400°C	400°C

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