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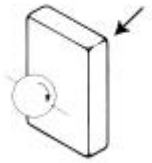
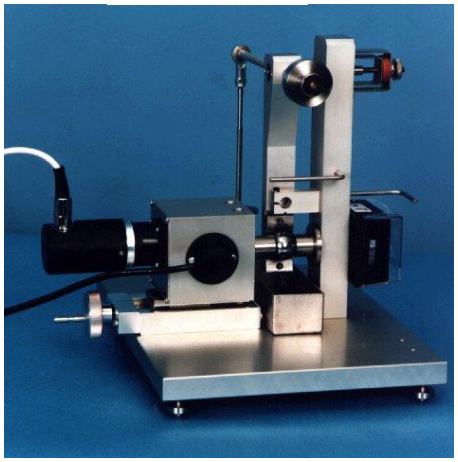
from Phoenix Tribology Ltd

TE 66 MICRO-SCALE ABRASION TESTER





Background:

The Micro-Scale Abrasion Tester is based on an experimental technique developed by I M Hutchings and K L Rutherford of Cambridge University Department of Materials Science and Metallurgy and is manufactured by Phoenix Tribology under license.

The TE 66 may be used to determine the wear coefficient of hard and soft coatings and monolithic materials by abrasive wear in a ball on plate contact configuration. The machine may also be used as a crater-generating tool on coated surfaces for coating thickness determination.

The TE 66 may be used for tests in accordance with BS EN 1071-6: 2007: Advanced technical ceramics. Methods of test for ceramic coatings. Determination of the abrasion resistance of coatings by a micro-abrasion wear test.

Description:

The rotation of a ball against a coated plate in the presence of an abrasive slurry results in the production of a circular depression. Eventually the coating is worn through and a "bulls-eye" depression is seen where the substrate shows through. Measurements of the inner and outer diameters of this bulls-eye are easily made and provide an accurate and low cost method of determining coating thickness. This is an established coating thickness measurement technique.

In order to use this configuration for wear coefficient determination it is necessary to measure precisely ball rotational speed, applied load and number of rotations completed (for sliding distance determination). The aim of such a test is to measure progressive wear over an extended number of cycles and thus determine wear rates and wear coefficients of the material (and coating).

The progressive measurement of wear by interrupting the test for microscopic observation is cumbersome and results in errors in replacing the specimens.

Existing ball-cratering devices all use a free ball that rests on the coated surface and at two points on a rotating shaft. The static load on the surface is determined by the size of the ball and the tilt angle of the coated surface. The ball is driven by friction against the shaft and abrasive slurry is fed into the wearing contact. Since the ball is free and the friction conditions variable, the rotational speed, number of rotations and applied load are both uncertain.

In the TE 66 Micro-Scale Abrasion Tester the ball is fixed into the rotating shaft and the test surface is mounted on a counterbalanced beam that hangs vertically from a pivot. This configuration offers the following advantages over the free ball:

1. The load can be defined precisely without interaction with the friction force.
2. A wide range of loads can be applied precisely and repeatably, without the need for variable ball sizes.
3. The rotational speed of the ball and the number of cycles completed can be measured precisely.
4. Means can be provided for continuous measurement of the relative displacement of the specimens to indicate wear.

A 25 mm ball is clamped between two coaxial shafts each carried in support bearings. One shaft is driven by a variable speed dc geared motor. A batch counter is provided to measure and control the number of shaft revolutions.

A peristaltic pump head is connected to the end of the other shaft and this is used for providing slurry feed to the contact. The test sample is clamped onto a platform on a vertical beam. The beam is in balance when the samples are just in contact and the load is applied by adding dead weights to a cantilever arm.

Slurry is stored in a container that can be agitated on a laboratory magnetic stirrer (available as option TE 66/S). The slurry is pumped by the integral peristaltic pump. It is fed to a position just above the contact point and collected in a waste tray underneath.

A non-contacting displacement transducer (TE 66/WEAR) may be used to monitor the position of the beam relative the ball axis and wear is determined from this measurement. Output from the transducer amplifier may be fed to a chart recorder or PC based recording device for on-line wear monitoring and wear rate evaluation.

Wear measurements should also be made with a microscope (TE 66/M) by viewing the plate directly. Access to the plate is made either by rotating the beam out of contact until it rests against the stop or by removing the ball and locking the beam in the vertical position with a retractable rod.

An optional friction force transducer (TE 66/F) is available allowing the friction between the test ball and test sample to be measured. This adapter allows the unit to be used for simple adhesive friction and wear tests in the absence of abrasive slurry.

A further option is the provision of electrical insulation (TE 66/E), which may be used either in conjunction with a simple electrical resistance circuit for detection of break through on non-conducting coatings or in conjunction with a potentiostat for electro-chemical measurement in processes involving combined erosion and corrosion.

A chart recorder is required for measurement of test parameters when used in conjunction with the wear, friction force or contact resistance sensors.

TE 66/W On-Line Wear Monitor:

This non-contacting displacement transducer may be used to monitor the position of the beam relative the ball axis during a test. Wear depth and wear rates may determined from this measurement.

Output from the transducer amplifier may be fed to a chart recorder or PC based recording device for on-line wear monitoring and wear rate evaluation.

The use of the TE 66/W system is recommended only for tests where the coating or substrate will be wearing more than 10 µm.

TE 66/F Friction Force Measuring System for Adhesion Testing:

This adapter is in the form of a modified specimen load beam incorporating a strain gauge force transducer for friction force measurement.

TE 66/E Electrical Insulation and Slip Ring:

The adapter incorporates electrical isolation of the specimen mounting and the provision of an electrical slip ring on the ball drive shaft.

TE 66/LC Line Contact Adapter:

This item of tooling allows tests to be run with a line contact specimen in a non-conforming block on ring configuration. The tooling allows a disc specimen to be mounted in place of the standard ball specimen.

TE 66/M Wear Measuring Microscope:

A microscope may be used to view the contact crater and make measurements of the wear scar width. The crater is viewed by rotating the load arm to bring the sample out of contact with the ball, thus avoiding disturbance to the contact by removal of the ball.

The microscope system includes a rack and pinion focus, two lenses and a precision filar micrometer eyepiece. The eyepiece may be rotated 90° in order to record the major and minor diameters of the crater. A freestanding illuminator is provided to aid viewing of the crater.

The use of the TE 66/M is strongly recommended for all TE 66 installations. The reporting of wear scar measurements is considered an essential part of the use of the ball-cratering test. The TE 66 is provided with the necessary support for the TE 66/M to view the test plate mounted on the loading beam.

TE 66/S Laboratory Magnetic Stirrer:

Slurry is stored in a container that is agitated on the laboratory magnetic stirrer. The slurry is pumped by the integral peristaltic pump on the TE 66. It is fed to a position just above the contact point and collected in a waste tray underneath. 3 metres of pump tubing is provided with the TE 66/S.

Technical Specifications:

Ball Speed Range:	30 to 150 rpm
Load Range:	0.05 to 5 N
Ball Diameter:	25 mm
Pump Feed Rate:	up to 60 ml/hour

TE 66/W On-Line Wear Monitor:

Displacement Range:	0 to 1 mm
Resolution:	0.2 µm
Accuracy:	within 3 %
Output Range:	1 V = 100 µm

TE 66/F Friction Force Measuring System for Adhesion Testing:

Friction Force Range:	0 - 10 N

TE 66/LC Line Contact Adapter:

Disc Diameter:	25 mm
Disc Width:	Up to 10 mm

TE 66/M Wear Measuring Microscope:

Range:	0 to 2 mm at 2 µm resolution
	0 to 4 mm at 4 µm resolution

Services:

Electricity:	220/240V, single phase, 50 Hz, 120 W
	110/120 V, single phase, 60 Hz, 120 W

Installation:

Bench-mounting machine:	720 mm x 440 mm x 570 mm high, 15 kg
Bench-mounting cabinet:	530 mm x 420 mm x 320 mm high, 10 kg
Packing specifications:	0.21 m^3, GW 50 kg, NW 25 kg

Order As:

TE 66	Micro-Scale Abrasion Tester
TE 66/W	On-Line Wear Monitor
TE 66/F	Friction Force Measuring System for Adhesion Testing
TE 66/LC	Line Contact Adapter
TE 66/E	Electrical Insulation and Slip Ring
TE 66/M	Wear Measuring Microscope
TE 66/A	SiC abrasive powder
TE 66/B	Five 25 mm diameter test balls
TE 66/S	Laboratory Magnetic Stirrer