

Ball-on-disc instrument for measuring the frictional properties of lubricated and unlubricated contacts under a wide range of rolling and sliding conditions.

versatility

Compact and fully automated, the MTM measures frictional properties under a wide range of speeds, loads and temperatures enabling quick characterisation of lubricants, materials and formulations.

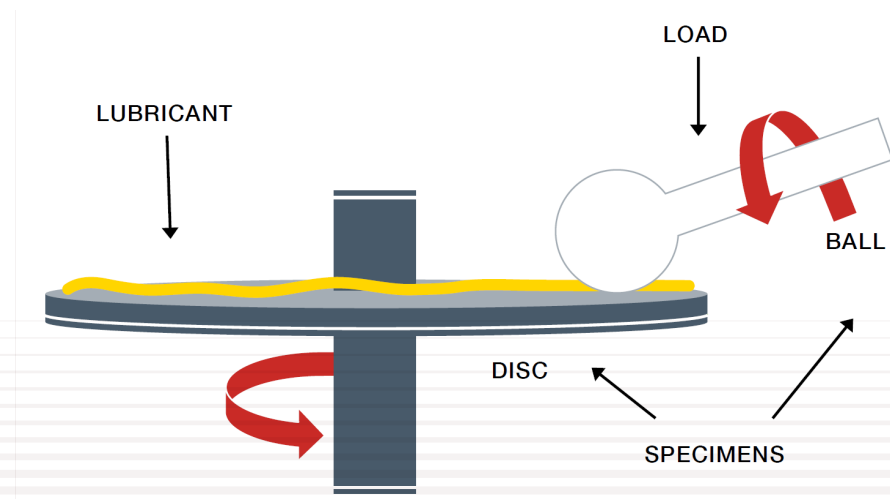
The unique ball-on-disc configuration enables any combination of rolling and sliding conditions to be replicated, spanning all three lubrication regimes (boundary, mixed and EHL). This capability makes the MTM suitable for testing in an unrivaled number of application areas, across a wide range of industries.

The MTM2 is the latest edition in the MTM product range. The operational capabilities have been expanded by the wide range of available accessories, and the integrated mechanical and electronics unit saves valuable lab space. Improved load and motor control ensures excellent repeatability and reproducibility of results for increased confidence in your data.

The novel configuration and the optional 3D SLIM accessory has made the MTM2 a de-facto industry standard instrument amongst OEMs, lubricant manufacturers and additive suppliers.

Optimising the friction and wear properties of a system can significantly improve performance and reduce operating costs. Testing lubricants and materials under realistic contact conditions is imperative for understanding where improvements can be made.

#### Contact Area Schematic



#### Features & Benefits

Independently driven specimens enable a wide range of contact conditions to be replicated across all three lubrication regimes

Unique configuration eliminates induced spin in the contact improving accuracy of results

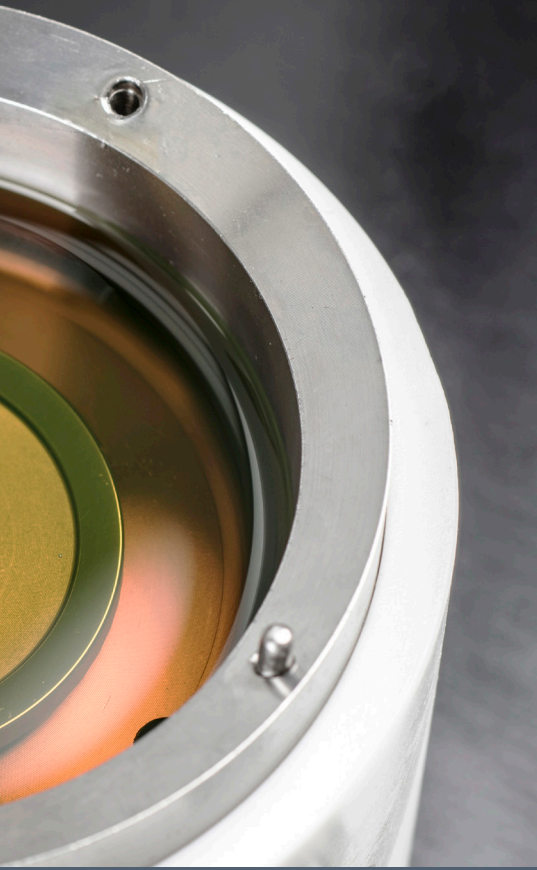
A wide range of available specimen geometries and materials expands the application range

Combined with the SLIM, the MTM2 can automatically measure tribofilm build up throughout the test, analysing the performance of additive packages

Compact and fully automated, the MTM2 requires minimal lab space and user intervention

Simple test setup and calibration procedures enable users to produce fast, repeatable results and reduces training time

Cited in over 500 technical papers covering all aspects of tribology, enabling knowledge sharing between researchers across many fields



## Principle

The specimens are fitted to the instrument and a small sample of lubricant is added to the pot. The ball is loaded against the face of the disc and both specimens are driven independently. The frictional force between the two specimens is measured and recorded automatically throughout the test.

The test profile including the range of speeds, temperatures and loads is defined in an intuitive, stand-alone software application. The MTM2 automatically runs through the sequence of profile steps, recording data without any intervention by the user.

Data is displayed graphically in real time and is available after the test for in-depth analysis and comparison between samples.

## Applications include:

- Fuel economy modeling
- Industrial lubricant screening
- Railway grease development
- Reduction of wear in artificial joints
- Optimisation of mouth and skin feel
- Green Tribology research

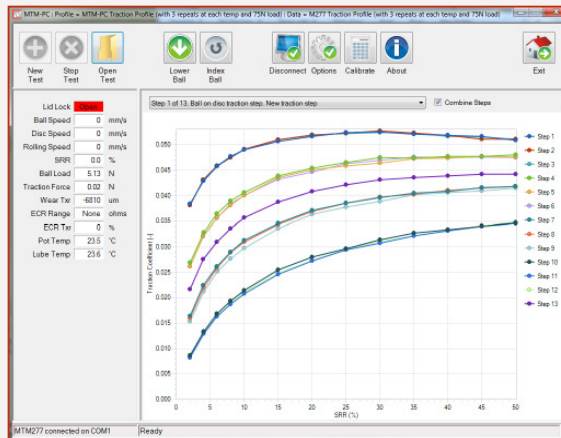
## Specimens

The standard ball and disc specimens can be made from almost any combination of materials, including metals, ceramics, polymers, elastomers and coated substrates. The simple specimen geometry and small size means that the specimens are relatively inexpensive and can be treated as single-use.

Specimen	Usage
3/4" Ball	Standard specimen
1/2" Ball	Small volume testing (8 ml per test). Requires mini pot option
Low Pressure Barrel	Contact pressures down to 0.31 GPa
O-Ring	Test seal materials
Pin	Wear measurement testing. Requires pin-on-disc option

## Results

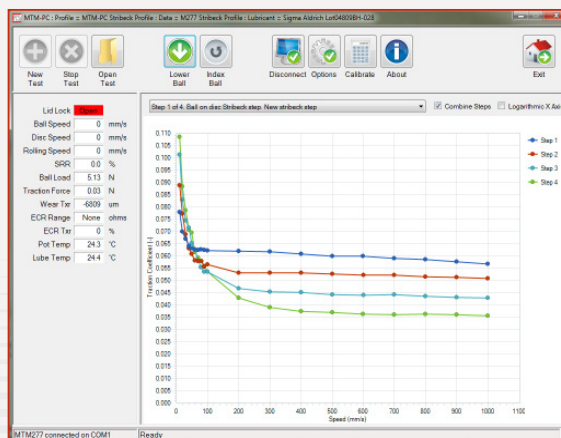
### Traction test performed using mineral oil



#### Test conditions:

- STEP 1-3: Load 30 N, speed 2 m/s, slide/roll ratio (SRR) 0-50 %, temperature 40 C
- STEP 4-6: Load 30 N, speed 2 m/s, slide/roll ratio (SRR) 0-50 %, temperature 60 C
- STEP 7-9: Load 30 N, speed 2 m/s, slide/roll ratio (SRR) 0-50 %, temperature 80 C
- STEP 10-12: Load 30 N, speed 2 m/s, slide/roll ratio (SRR) 0-50 %, temperature 100 C
- STEP 13: Load 75 N, speed 2 m/s, slide/roll ratio (SRR) 0-50 %, temperature 135 C

### Stirbeck test performed using mineral oil



#### Test conditions:

- STEP 1: Load 30 N, speed 0-1 m/s, slide/roll ratio (SRR) 50 %, temperature 40 C
- STEP 2: Load 30 N, speed 0-1 m/s, slide/roll ratio (SRR) 50 %, temperature 60 C
- STEP 3: Load 30 N, speed 0-1 m/s, slide/roll ratio (SRR) 50 %, temperature 80 C
- STEP 4: Load 30 N, speed 0-1 m/s, slide/roll ratio (SRR) 50 %, temperature 100 C

To further expand the capabilities of the MTM2, we have developed a wide range of additional accessories. All accessories can be easily retrofitted to the instrument.



**Cooler**

Speeds up turn-around between tests, and enables testing at temperatures lower than ambient by automatically switching on during and after a test to rapidly cool the pot.



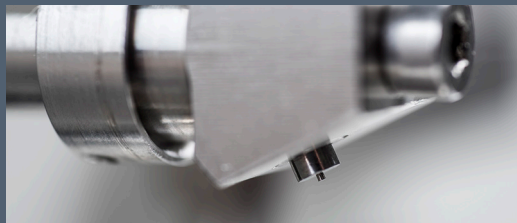
**Reciprocating Option**

Enables the disc to be driven with a sinusoidal (reciprocating) motion, further expanding the range of contact conditions. Commonly used for simulating cam and follower interaction.



**ECR**

Gives an indication of surface interaction during the test. The disc drive is electrically insulated from the ball and the electrical contact resistance between the two specimens is logged during the test.



**Pin-on-Disc**

Substitutes the upper specimen for a fixed pin. This set up is commonly used for wear evaluation. Wear is measured throughout the test using a high precision, on-line wear measurement system.



**Mini Pot**

Contains the sample in a smaller pot during the test, reducing cleaning time and allowing contaminated samples (e.g. with sand, soot etc.) to be examined.



**Pot Filler**

Reduces sample volume from 30 ml to 10 ml.



**Glass Lid**

To observe the contact area during testing.



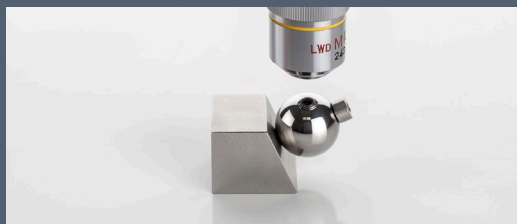
**Grease Scoop**

Ensures a constant supply of grease to the contact throughout the test, eliminating the possibility of starvation.



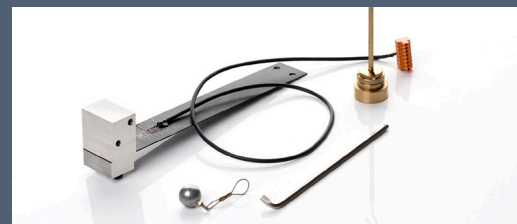
**Grease Applicator**

Applies a consistent amount of grease onto the disc at twelve evenly distributed points, to ensure excellent repeatability between tests.



**Specimen Holder**

Positions the upper specimens at the correct angle ensuring correct alignment of the contact track / wear scar when focusing the microscope, speeding up post test analysis.



**Low Load Kit**

Enables load between 1 - 8 N to be applied consistently with minimal fluctuation. Commonly used for soft contact applications and clutch testing.

# MTM

## Options: 3D SLIM

Systems operating in the boundary and mixed regimes may have high levels of asperity interaction, leading to accelerated wear and potential system failure. Introducing anti-wear additives into the lubricant is imperative for protecting the surfaces, however they can be expensive and harmful to the environment.

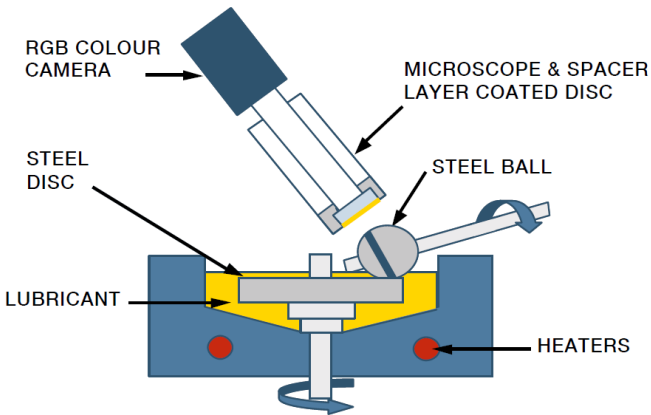
Formulators are continuously striving to develop more cost effective, greener alternatives without compromising the lubricant performance.

The SLIM accurately and automatically measures additive film formation during the course of a test, enabling direct comparisons to be drawn between additive packages.

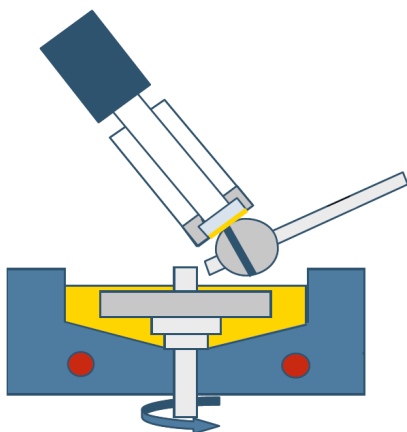
### Principle

The upper specimen is loaded against the disc and run under preset conditions for a fixed duration. Periodically throughout the test, the ball is stopped, loaded in reverse against a glass window and a film thickness map of the complete contact area is captured.

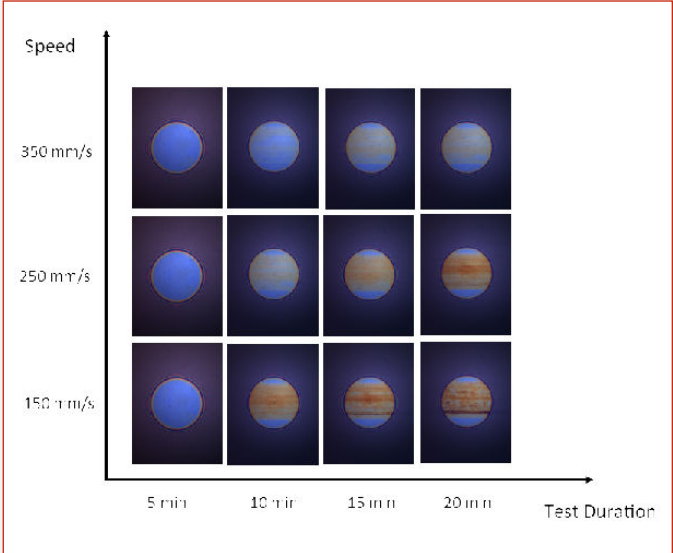
STEP 1: The test ball is run against a steel disc for a predefined time



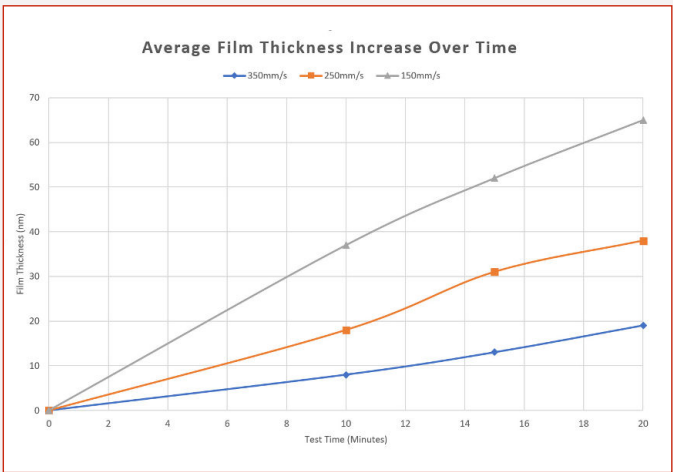
STEP 2: The test ball is reverse loaded against a coated glass window and an image is captured. The ball is then lowered and the test continues



Once the test is complete, the images are analysed using a stand-alone program. This program matches colours in the image to the calibration data supplied with the instrument to determine the film thickness at every point in the image up to 250 nm. This allows the user to generate a complete film thickness map of the contact area, or point and line measurements of a specific area of interest. The data can be easily transferred into a visualisation package to produce 3D plots of the area.



- ▲ Effect of sliding speed against time during an MTM SLIM test
- ▼ In situ measurement of anti wear film thickness over a range of different entrainment speeds



## Technical Specification

The MTM2 system comprises a single integrated mechanical and electronic control unit and a PC with data logging software.

### TEST PARAMETERS

Load	0 to 75 N
Contact Pressure	0 to 1.25 GPa with standard specimens Up to 3.1 GPa with alternative specimens
Speed	-4 to 4 m/s
Temperature Range	Ambient to 150 C (below ambient with optional oil cooler)
Test Sample Volume	30 ml (10 ml with optional pot filler)

### CONTROL SYSTEM

PC	Custom software running on Windows 10
Safety Checks	Dual platinum RTDs for temperature measurement, safety lock on pot cover
Power Supply	100-240 V, 50/60 Hz, 750 VA

### DIMENSIONS & WEIGHT

Weight (Main Unit)	30 kg - 66 lb
Size (h x w x d)	400mm/18in x 400mm/18in x 600mm/24in

### Industries



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