Application Note: AN7073

LINEAR RECIPROCATING TEST On MFT-5000 Tribometer

PIN, BALL ON PLATE WITH INLINE IMAGING

FOR FRICTION AND WEAR STUDIES

Introduction

The MFT5000 is a versatile multi-functional mechanical property tester capable of simulating a vast number of tribology and wear tests on the same platform. This application note shows how the MFT5000 can be used to study materials, coatings and lubricants using linear reciprocating test setup. This test method covers a laboratory procedure for determining the wear and friction of materials, liquid and lubricants etc. during sliding using a pin on disk or ball on disk setup.

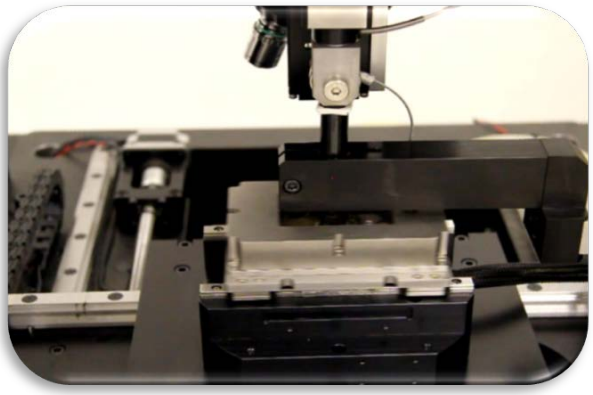

Figure 1: Linear reciprocating test setup

Material

Materials are tested in pairs under nominally non-abrasive conditions. For the pin-on-plate wear test, two specimens are required. One, a pin or ball that is positioned perpendicular to the other, usually a flat plate. The universal upper and lower sample holders are used to mount the samples. Common test specimens are 100Cr6 steel ball of 10mm diameter and a 100Cr6 plate. Samples of other materials and diameters can also be easily accomodated in the tool. The surface flatness and roughness of both materials are critical to get repeatable results.

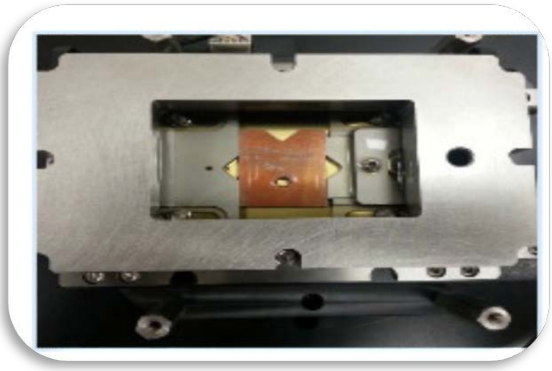

Figure 2: Liquid container for linear reciprocating test

`1810 Oakland Road, Ste B, San Jose, CA 95131 info@rtec-instuments.com +1 (408) 708 9226

Method

This test method covers a laboratory procedure for determining the wear and friction of materials, liquid, lubricants etc. during reciprocating sliding using a pin/ball-on-plate setup. The tester pushes a stationary pin/ball to press against the reciprocating plate at a pre determined force and moves it in a linear reciprocating manner at the set frequency. During the test, coefficient of friction (COF), friction force, wear and several other parameters are measured and reported. The setup for dry conditions is shown in Figure 1. This set up is ideal for characterizing tribological properties of alloys, ceramics, polymers, bulk materials, coatings, solid lubricants etc. with respect to a counter material in non-lubricated conditions. Figure 2 shows the top view of the set up for lubricant container in which samples can be tested in lubricated conditions.

Analysis

Figure 3 shows the friction curve from a typical reciprocating test. The change in friction values from negative to positive corresponds to the change in direction during the test. The data can be collected at up to 5000 points per second. Several other channels such as temperature, coefficient of friction, wear etc. can also be recorded during the test. The high-end electronics and the high data acquisition rates makes it possible to get useful insights in the test including the static to dynamic peaks as the test changes direction.

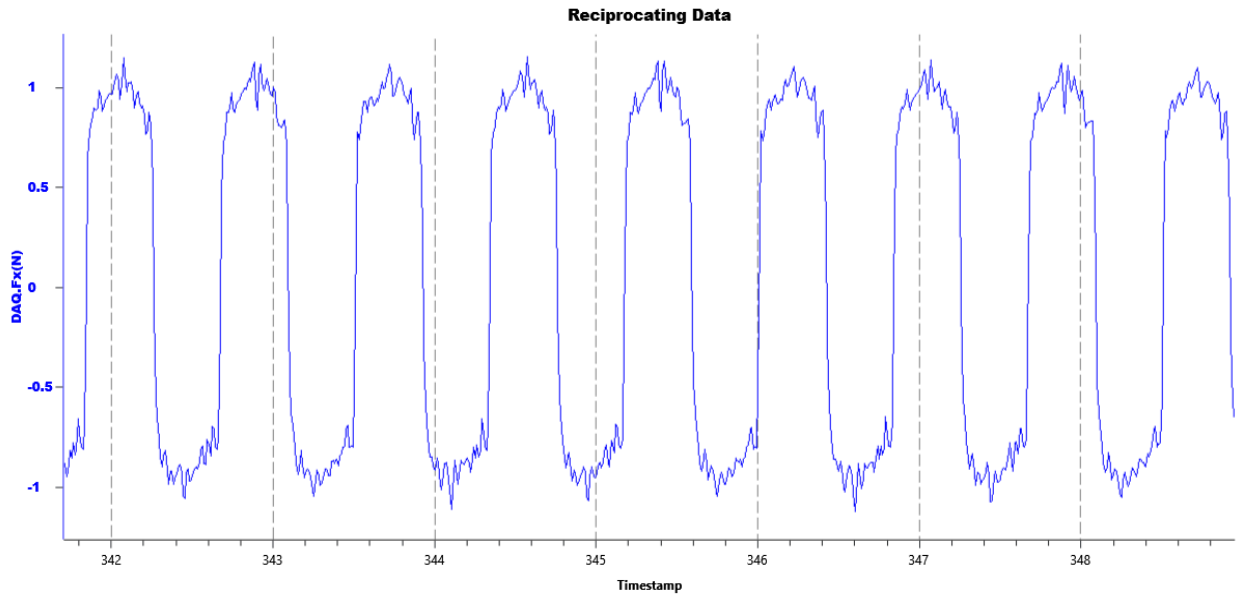

Figure 3: Representative linear reciprocating test data

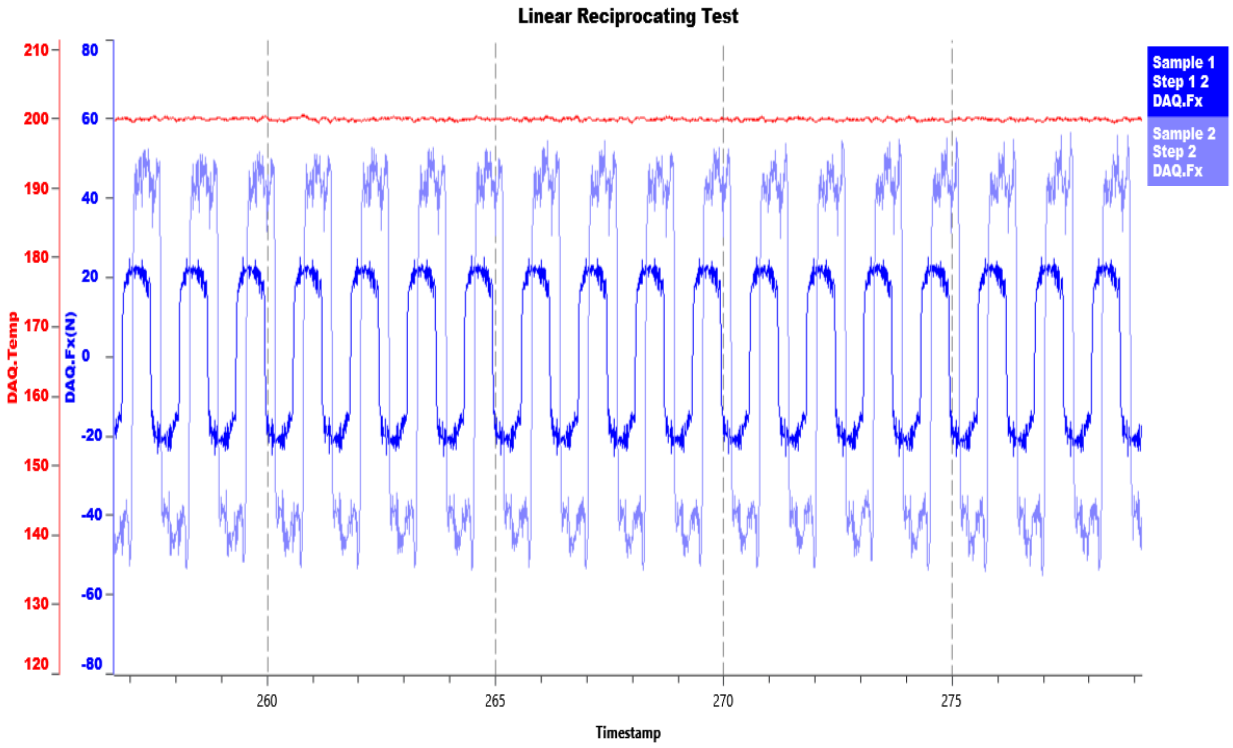

Figure 4: Data showing comparison of two different samples tested at 200C, 200N in Linear Reciprocating Test

Figure 4 shows the comparison of two different test samples tested at 200C under similar conditions of load (200N) and frequency against a 10mm Cr6 ball. It is clear from the test that the Sample 2 has higher friction compared to sample 1. This test setup can be used to evaluate lubricants, coatings, bulk materials etc.

Automatic Inline Imaging – roughness, wear, volume vs time

Rtec multi-function tribometer comes with an optional inline 3D Profilometer. The profilometer automatically measures the surface topography of the wear track at pre-set intervals defined by the user e.g. after a certain number of cycles, duration of time or at the on-set of an event such as increase in friction. The XY stage is equipped with advanced encoders to automatically move the sample between the test and image area. The ability to quantifiably characterize the change in surface topography and wear track with time and combining it with friction data makes the analyses extremely powerful.

The initial 3D image acquired using the profilometer also allows to account for machining marks, grain boundaries, orientation of the samples and other localized features in contact surfaces. This information can be useful to explain difference in friction, stick slip, wear etc. between specimens. Figure 5 shows the wear mark created vs time on an aluminum sample during a 2.5 hour ball on plate linear reciprocating test. The images were taken every 10 minutes. The entire wear scar was stitched to characterize the wear vs. time.

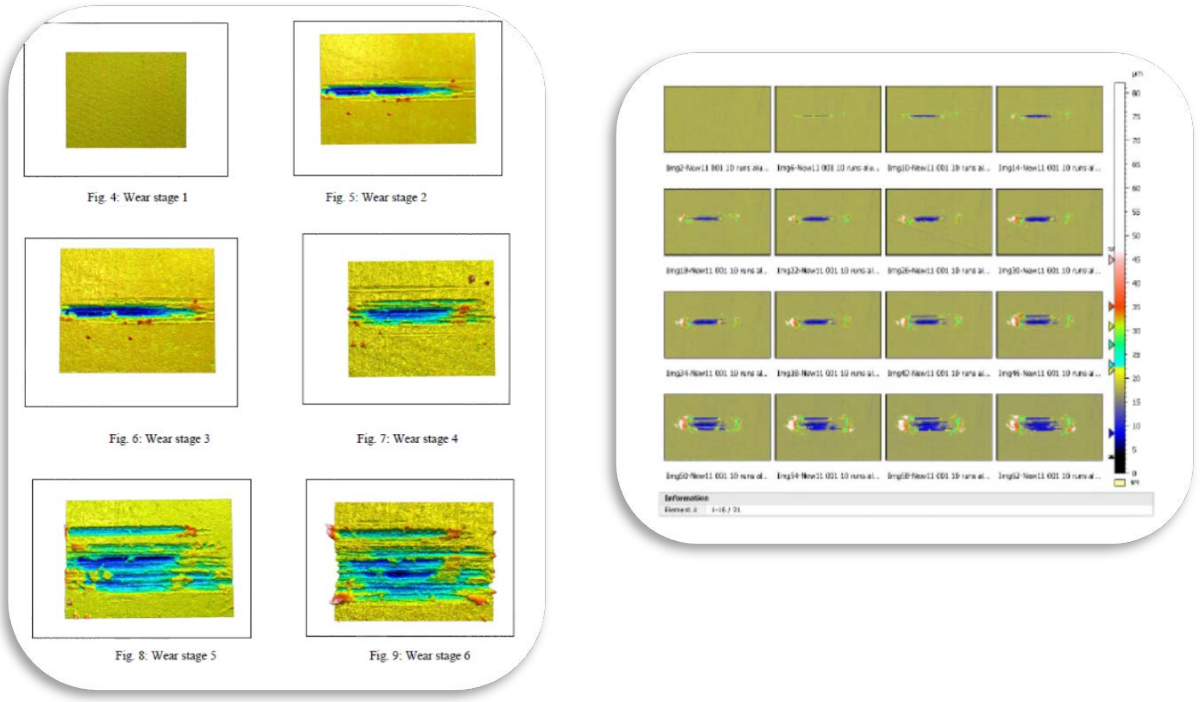

Figure 5: Wear vs time for linear reciprocating test. Every 10 minutes the sample was moved from mechanical testing area to the 3D Profilometer to characterize the progress of wear vs. time.

Conclusion

MFT5000 linear reciprocating drive is an excellent option to help run test in reciprocating mode. The tool can be operated in dry or lubricated mode with options to do the tests at high temperatures. The inline profilometer makes this tester a very powerful tool in the hand of the researcher or QC engineer.

Keywords

ASTM G133, Pin on Plate, Ball on Plate