

## Product Information Sheet: Four Ball Tester (FBT-3)



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# BASIC INSTRUMENT

The Ducom Four Ball Tester (see Fig. 1) is designed to characterize the wear preventive (WP), extreme pressure (EP), frictional and fatigue properties of lubricants.

As shown in Figure 2, the instrument uses four balls, three at the bottom and one on top. The bottom three balls are held firmly in a ball pot containing the lubricant under test and pressed against the top ball. The top ball is made to rotate at the desired speed while the bottom three balls are pressed against it. The lubricant under test is characterized by measuring the wear scar diameter on the balls after the test and evaluating the load at which the lubricant fails and the four balls weld together.

Ducom FBT-3 is compatible to achieve a maximum load of 10000 N, maximum speed of 3000 rpm and maximum temperature of 200°C. It can comply with ASTM, DIN and IP test standards for WP and EP behavior of any lubricants.

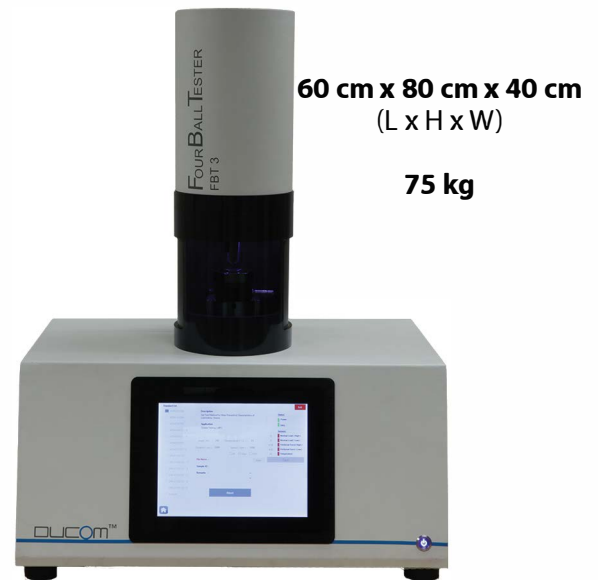


Figure 1. Ducom Four Ball Tester (new design)

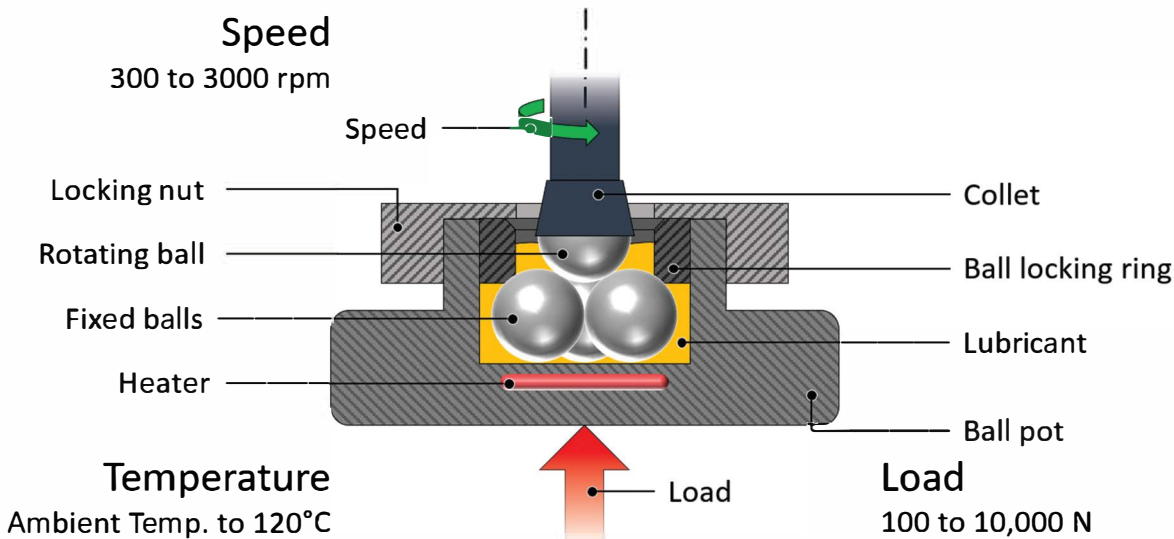
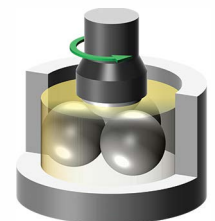


Figure 2. Schematic of the test area in FBT3



Four Ball Arrangement



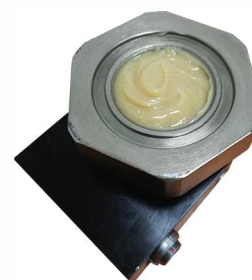
Welded Balls



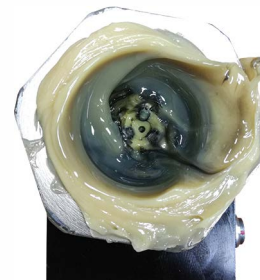
Wear Scar on Steel Ball

## APPLICATIONS

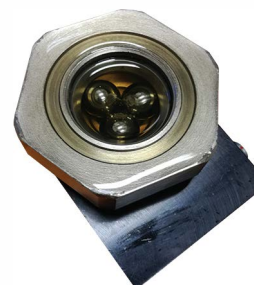
- Determine extreme pressure (EP), wear preventive (WP), frictional and fatigue behavior of lubricants.
- Bench mark the lubricants against the competitors in the market.
- Measure and compare the WP / EP of nanoparticles derived from carbon, metal oxide, sulfides and nanocomposites.
- Compare the performance of lubricants at different loads, temperatures, base oils, additives, suppliers, etc.
- Compare and estimate the deterioration of lubricant quality by comparing fresh and used oil.
- Investigate the performance of polymeric materials in lubricants used to achieve better shear stability and minimize viscosity loss.
- Lubrication efficacy of biodegradable/vegetable oils compared to mineral/synthetic base oils.



Before test in grease



After test in grease



Before test in oil



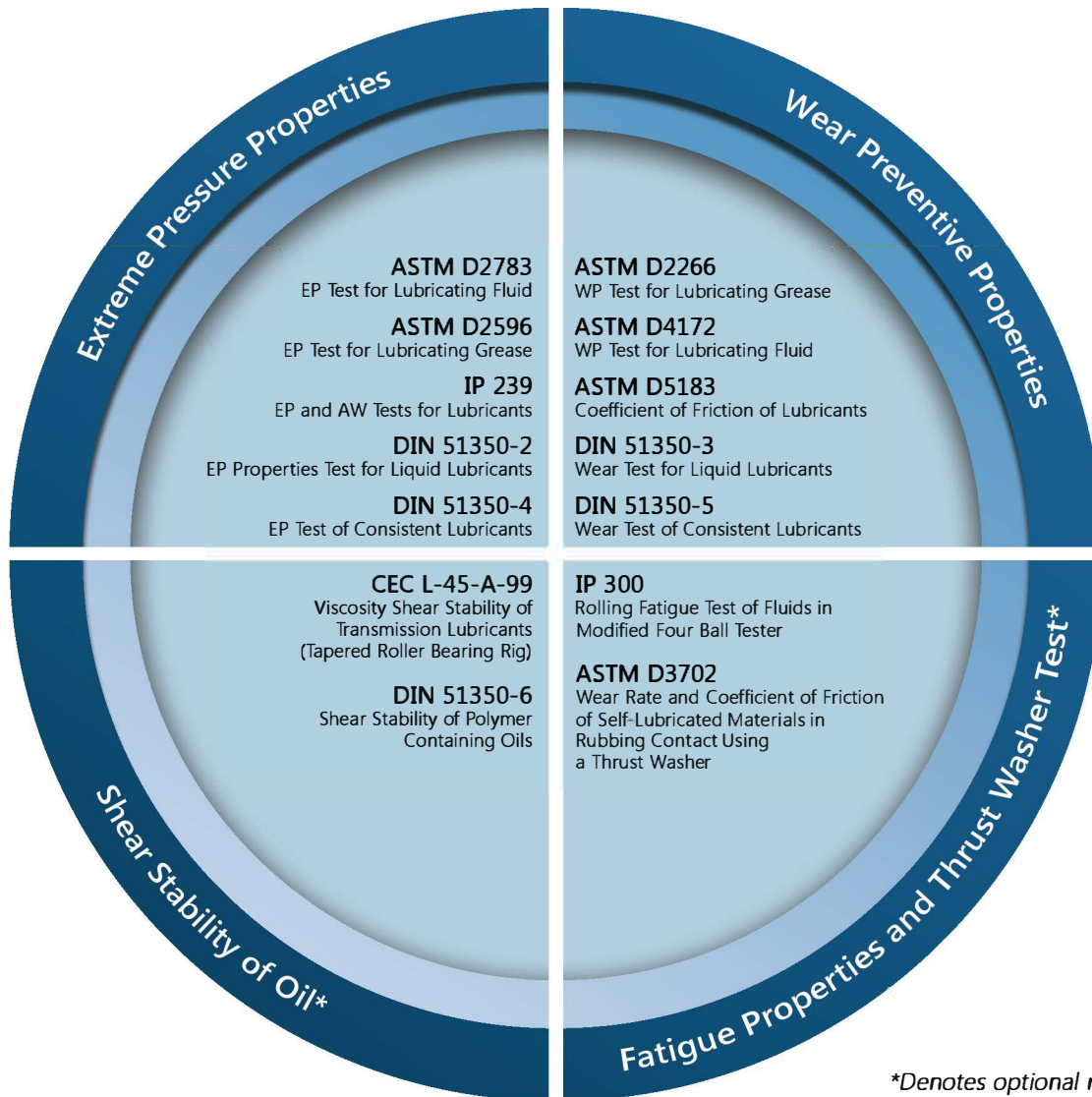
After test in oil

## FUNCTIONAL FEATURES

- A compact table-top device occupies a space that of a coffee machine in your kitchen.
- A single unit for EP and WP testing of lubricants using computer controlling loading system.
- Ducom Image Acquisition System (see Fig. 3C) is designed to improve the user convenience, as the traditional trial and error method to find the wear scar on the ball is made obsolete. It images the wear scar on the ball in its nature state and recovers the time lost during trial/error.
- WinDucom software has a built in fool proof user interface architecture. It means *only 5 clicks* to start a test according to ASTM / DIN / IP standards.
- 85 % of the testing process is automated. It can allow up to 15 EP tests per hour.
- Modular design enables the features such as KRL shear stability of oils, rolling contact fatigue of lubricants and pin on disk.\*

\*They are not a part of the basic unit. Please discuss with us about these features before placing an order.

# STANDARDS

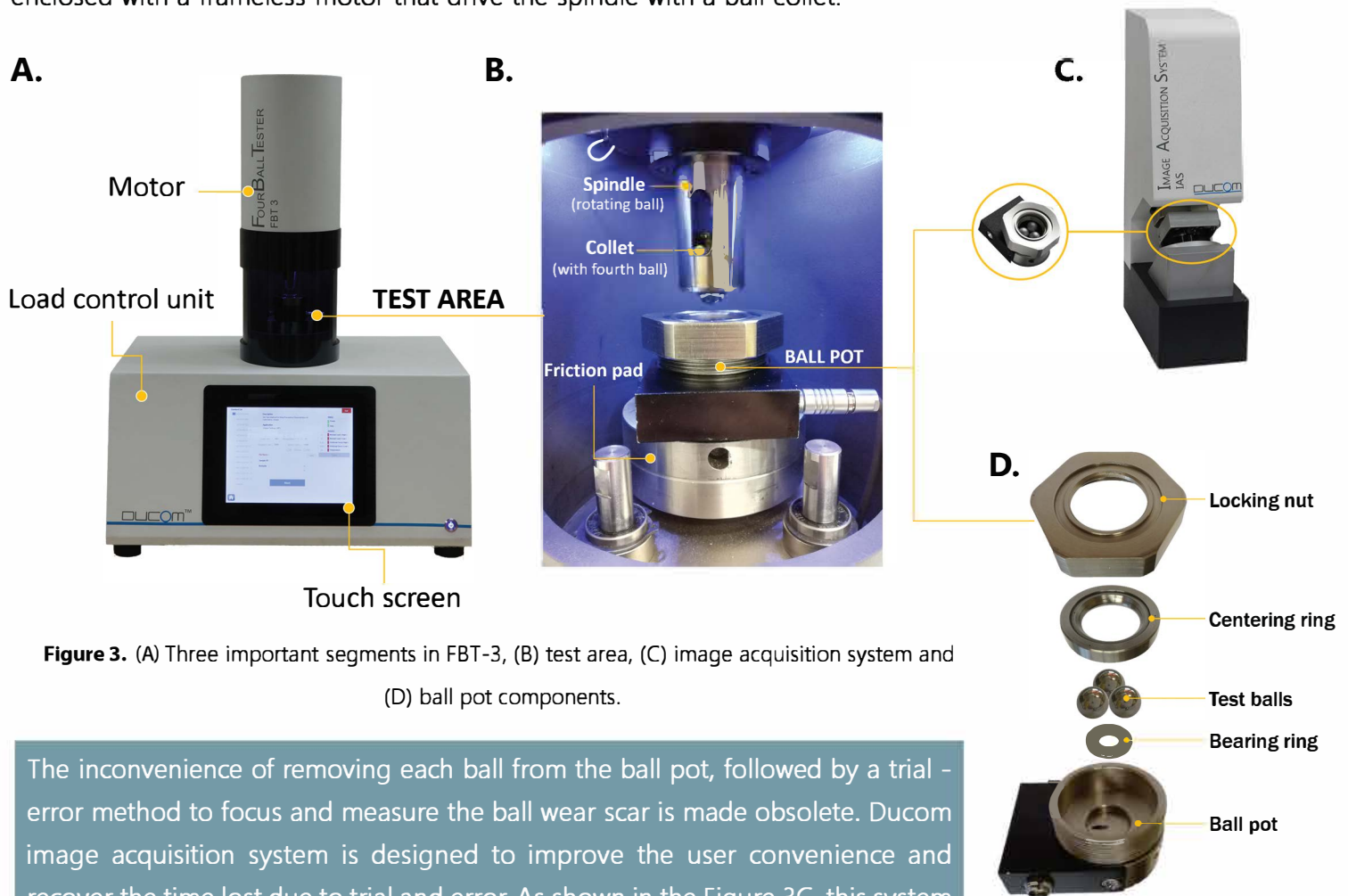


*\*Denotes optional modules*



# PRINCIPLE OF OPERATION

Ducom Four Ball Tester (FBT-3) is an automated table-top device that can control the load, speed and heating of the lubricant. Figure 3A shows the three important segments within the four ball tester. The **bottom segment** carries a load control unit. It is comprised of pneumatic chambers, piston and normal load sensor, they work in tandem to achieve the user defined load controls. The lubricant test area (see Figure 3B) is at the **center** of FBT-3. It has a ball pot sitting on an antifriction pad connected to the loading unit. As shown in Figure 3D, the ball pot has several components like three test balls, locknut and a ring, that must be arranged manually. The ball pot is filled with lubricant and ready to test. There is a sliding door in the test area to contain any lubricants from leakage. It must be closed during the test for user's safety. The **top segment** is enclosed with a frameless motor that drive the spindle with a ball collet.



**Figure 3.** (A) Three important segments in FBT-3, (B) test area, (C) image acquisition system and (D) ball pot components.

The inconvenience of removing each ball from the ball pot, followed by a trial - error method to focus and measure the ball wear scar is made obsolete. Ducom image acquisition system is designed to improve the user convenience and recover the time lost due to trial and error. As shown in the Figure 3C, this system can house the entire ball pot after the EP or WP test. The proprietary imaging system can locate the wear scar and capture the wear scar on each ball in the ball pot, using the Scar View 2016 software. The analytical tools in the software helps the user to quickly measure the wear scar diameter and wear scar area.

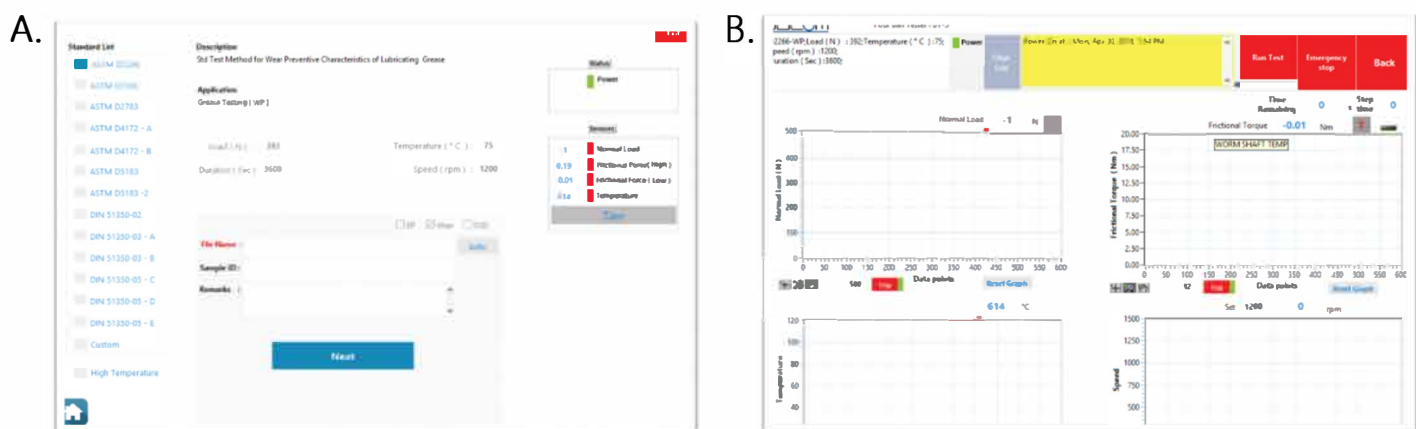
There are four important sensing systems in the FBT-3. The load sensor is used to transmit fluctuations in the applied load during the test. The friction force sensor connected to the ball pot can transmit the friction force experienced by the lubricant in the ball pot, in real time. The thermocouple and heaters in the ball pot can heat the lubricant to the user defined temperature and transmit the temperature profile of the lubricant during the test. The motion sensor can transmit the fluctuations in the spindle rotation in real time, during the test. All the sensing system is controlled, and its data being displayed/recorded using a Labview based WinDucom software.

## OPTIONAL

- KRL Shear Stability
- Rolling Fatigue
- Pin on Disk
- High-Temperature Ball Pot (ambient to 200°C)
- Image Acquisition System

## INSTRUMENT CONTROL AND DATA ACQUISITION

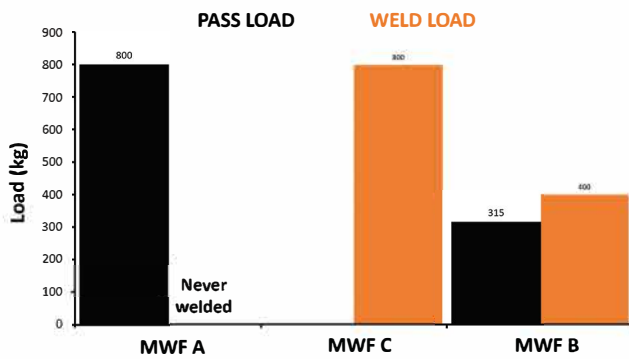
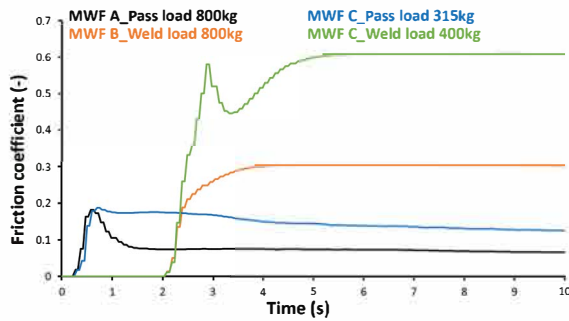
Labview based WinDucom software is used for controlling the load, speed and temperature of the lubricant in FBT-3. The architecture of the software is fool proof. As shown in the Figure 4A, the interface allows the user to select any standards by a click. It will automatically reproduce the test parameters relevant to the selected standard. User will take ONLY 5 clicks to start an EP or WP test according to any test standards. The data acquisition screen shows a live data for friction torque, load, speed and temperature (see Fig. 4B). The post test analysis is possible using compare data feature in the software. It allows the user to compare test results. The test results can be exported in .CSV, .XLS or .TXT format.



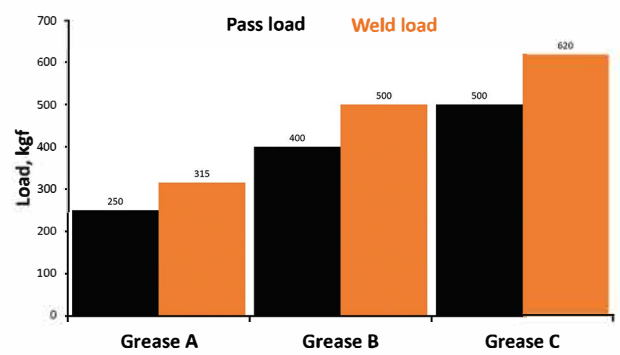
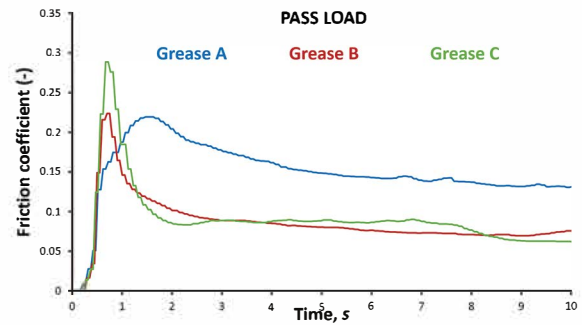
**Figure 4.** Labview based WinDucom software in FBT-3

# RESULTS

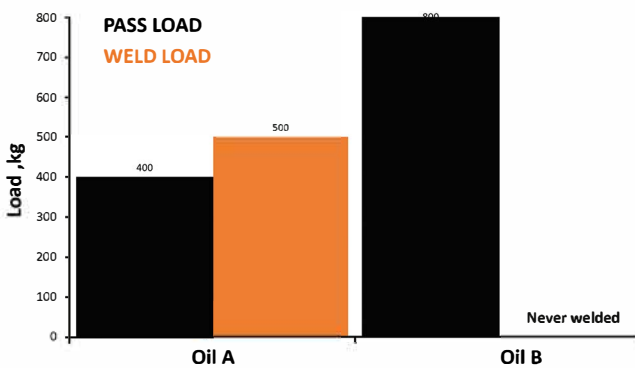
## Metal Working Fluids (ASTM D2783)



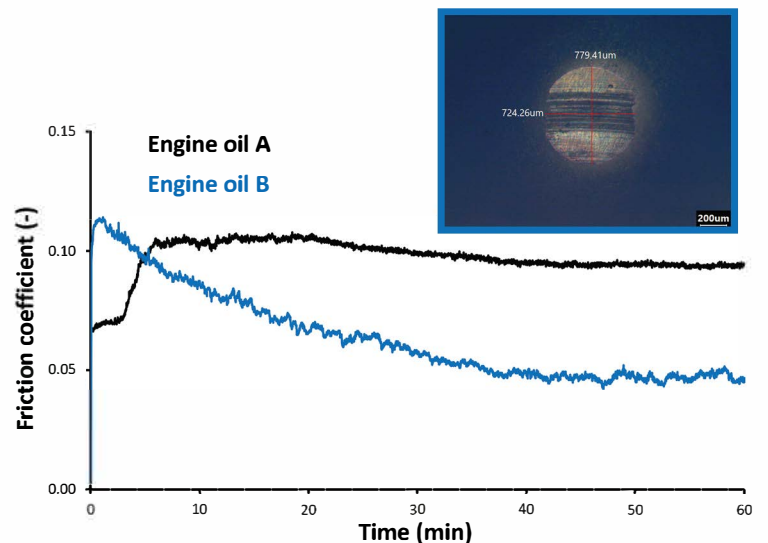
## Greases (ASTM D2783)



## Biologic oils (ASTM D2783)



## Engine oils (ASTM D4172)



## ABOUT DUCOM

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Founded in 1978, Ducom Instruments has led the way in designing and manufacturing advanced materials testing instruments with a specialization in tribology. Applying cutting-edge technology and strong design principles to its products, Ducom focuses on providing customers with an excellent ownership experience starting with ease of use and maintenance.

Our locations in the United States, Netherlands and India each have an in-house Research and Development initiative coupled with development partnerships with world renowned institutions. As a result, Ducom holds several proprietary technologies, copyrights and patents with additional filings every year. Many of these technologies are applied to our instruments, and work in the background so users can enjoy better results.



Our instruments are operational all over the world: from research labs that require advanced and highly configurable test systems, to facilities with standardized quality control requirements, Ducom is a trusted solutions partner with decades of experience in a multitude of industries.

### **Certifications:**

ISO 9001:2008 Certified Organization

AS9100:2009 Certified Manufacturing Organization