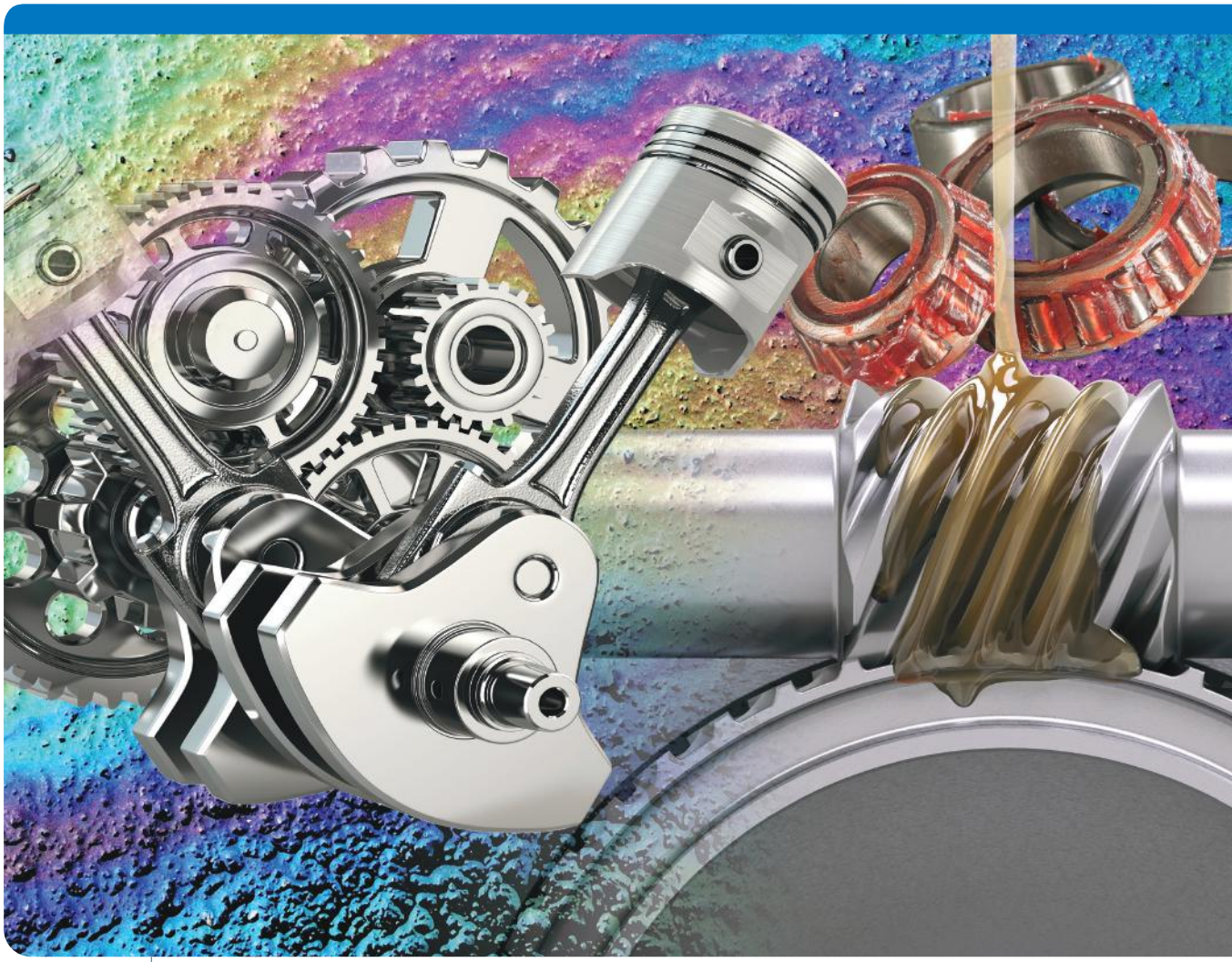


UMT TriboLab

Mechanical Tester and Tribometer

- Versatility Without Compromise

Innovation with Integrity

Tribology & Mechanical Testing

UMT TriboLab

The Most Versatile Tribology System Ever Designed

Bruker's Universal Mechanical Tester (UMT) platform has been the most versatile and widely used tribometer on the market since the first model debuted in 2000. Now, newly designed from the ground up, the UMT TriboLab™ builds on that legacy of versatility with a unique modular concept that harnesses more functionality than ever before — all without any compromise in performance. In fact, the UMT TriboLab offers higher speeds, more torque, and better force measurement than any of its competitors, plus it introduces powerful new features for improved efficiency and ease-of-use.

Exceptional Modularity

- A single high-torque motor integrated into the base system accommodates the full range of speeds and torques.
- Interchangeable lower drives power the motion for nearly every possible tribology test on one compact platform.
- Tribo ID™ "intelligent" components automate system configurations.

Broadest Capabilities

- A single motor produces speeds from zero to 5,000rpm, at high torque, to accommodate a full range of tests — no need for multiple tools.
- Eleven different force sensors from µN to kN enable an unprecedented breadth of testing.
- Heating chambers to 400°C or 1000°C, cooling modules to -25°C, and humidity chambers can be added at any time for a full range of environmental testing.

Unmatched Ease of Use

- New TriboScript™ software uses action blocks to build scripts, removing the need to learn complex scripting languages or conventions.
- The unique Tribo ID feature recognizes all attached components to automatically reconfigure user menus based on configuration, and uploads appropriate sensor calibration data and serial numbers.
- Quick-connects and blind-mate electrical connections provide easy, tool-free drive changeover — no tools, no screws, no cables needed.

"Our work at a university research laboratory places a very high premium on the universal nature of the UMT. The reconfigurable nature of the platform, along with the extensive options and accessories, allows for specialized testing and operation."

– Professor John A. Patten, West Michigan University

Solid Testing Begins with a Solid Base

The Bruker UMT platform has become the standard for tribology and mechanical test labs around the world. There are now more than six hundred systems, encompassing three generations of development and product improvements, in use globally in the research laboratories of industry leaders, top universities, and national labs.

Today, most instruments available for tribology testing are single-function testers, and none are designed with the same range of versatile modularity as the UMT TriboLab. Within minutes the platform can be transformed from rotary to reciprocating motion, from sub-newton to kilo-newton force measurement, or from room temperature up to 1000°C for environmental testing.

The key element in TriboLab's new design is a high-performance motor mounted in the center of a proprietary vibration-dampened column. This motor accommodates the full range of speeds and torques. Four interchangeable mechanical drives translate this power into linear and rotary motion to enable a comprehensive array of rotary, reciprocating, block-on-ring, and linear tribology and scratch-test configurations. With mechanical testers from other manufacturers, this much flexibility would require having multiple testers on site.

Other unique features, such as tool-less drive changeover, blind-mate electrical connections, Tribo ID automated component identification, and TriboScript software, make UMT TriboLab the simplest and most efficient tester available.

TriboLab delivers:

- Broader test capabilities
- Faster changeover between configurations
- Higher accuracy and repeatability
- Real-time control and data analysis

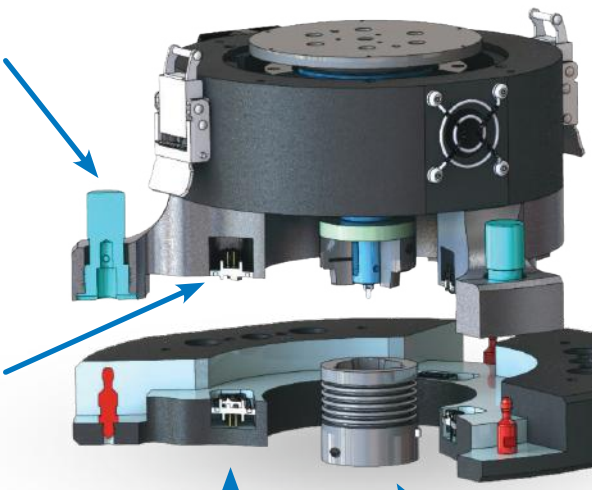
"We are actively involved in collaborative projects that are funded by government as well as private industry partners. Having the Bruker UMT in our lab has enabled us to perform various tribological tests precisely and efficiently, giving us confidence in reporting our results in archival journals."

– Michael M. Khonsari,
Dow Chemical Endowed Chair and Professor and Director of the Center for Rotating Machinery (CeRoM), Department of Mechanical Engineering, Louisiana State University

Modular Drives for Maximum Versatility

Quick changeover of drives using tool-less clamping allows the user to position the drive easily, then lock it into place in seconds.

Each hardware component includes a Tribo ID chip. Software interrogates the system, interprets the chip and "understands" the configuration without operator-entered commands. Software menus are customized based on configuration, highlighting the most useful commands and hiding the irrelevant ones.



Precision-machined base ring keeps testing planes aligned and maximizes accuracy.

No cable connections are required for standard drives. Blind-mate connectors on the mounting ring automatically connect fans, sensors, and other electronics.

Self-centering, high-torque coupler ensures superior reliability and high performance.

Rotary Drive

Designed for ball-on-disk, pin-on-disk, four ball, and thrust washer testing with speeds from 0.1 to 5,000 rpm and torque up to 5 Nm, this drive also generates Stribeck curves for lubricant comparisons. It is for ASTM standard tests such as ASTM G99, ASTM G132, ASTM D3702, ASTM D4172, and others.

Reciprocating Drive

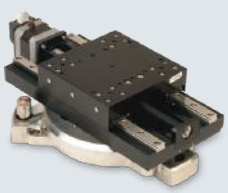
Designed for ball-on-plate, pin-on-plate, high-frequency reciprocating, and abrasive testing with speeds up to 60 Hz, stroke from 0.1 to 25 mm, this drive is used for ASTM standard tests such as ASTM G133, ASTM G203, ASTM D6425, ASTM G206, and others.

Block-on-Ring Drive

Designed for block-on-ring testing with speeds from 0.1 to 5,000 rpm and torque up to 5 Nm, this drive is used for ASTM standard tests such as ASTM G77, ASTM D3704, ASTM D2981, and others.

Linear Drive

Ideal for low-speed wear studies and scratch testing, with speeds from 0.002 to 10 mm/sec and stroke up to 120 mm, this drive is used for scratch-test coating characterization and ASTM standard tests such as ASTM C1624, ASTM G132, and others.



Complete, Uncompromised Testing

The ultimate goal of tribology testing is to understand how materials, surfaces, and lubricants will perform under real-world conditions. Of course, the real world presents an endless variety of environments. UMT TriboLab is designed to closely mimic the widest array of real-world environments through its flexible accessories.

Following the efficiency principles of modularity and versatility, TriboLab accessories can be added to standard drives as needed for the maximum possible flexibility.

Recirculating Liquid Containers

Rotary and reciprocating drives are provided with specially designed liquid containers for testing surfaces immersed in fluids, such as lubricants. The fluid recirculates naturally as the motion of the test surface forces the fluid through apertures in a specially designed chamber, and then back to the top of the sample.

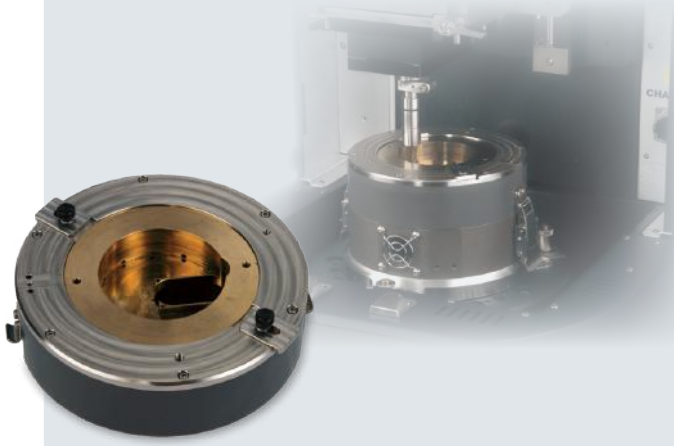
Temperature and Humidity Chambers

Chambers for heating up to 400°C and 1000°C are available for both the rotary and reciprocating drives. Temperatures can be programmed from within the TriboScript software and can be maintained at a temperature set-point, set as a gradual increase or decrease in temperature, or even cycled through a series of steps.

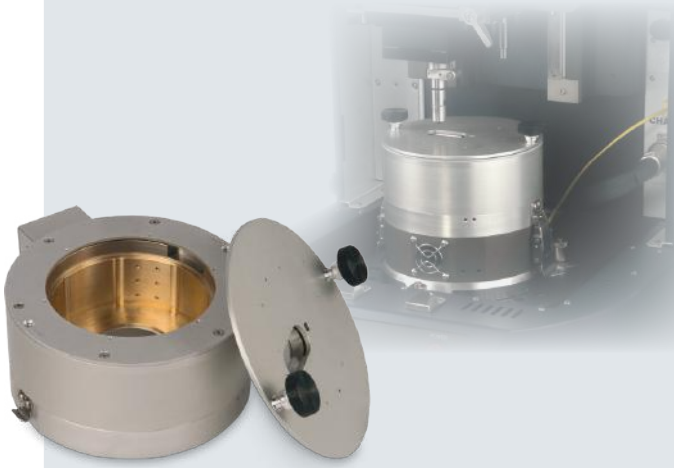
Adding the optional cooling/humidity accessory provides the capability for cooling and/or humidity testing. The chiller provides chilled air to the cooling ring and is capable of reducing the chamber temperature to -25°C. The humidity accessory can be added to test in conditions up to 85% RH. Both the cooling and the humidity are fully controlled from the TriboScript software to make environmental conditions an easily integrated part of any test protocol.

Block-on-Ring Liquid Immersion, Heating, and Humidity Chamber

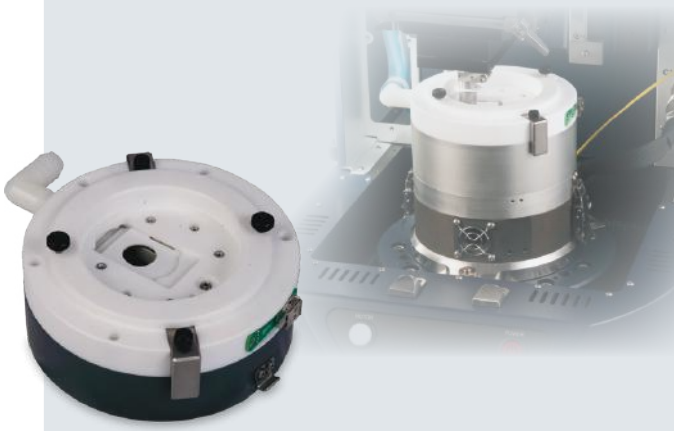
The block-on-ring drive has its own uniquely designed chamber that has the capability to provide lubrication of the rotating ring during a test. This chamber also has a built-in heating capability of up to 150°C and can be connected to the humidity controller for testing up to 99% RH. As with the other environmental chambers and controllers, all set points are established within the test scripts and environmental control is fully integrated into the test procedure.



Rotary Drive
Liquid Recirculation Container



Rotary Drive
Temperature Chamber



Rotary Drive
Humidity Chamber

High-Load, High-Performance Sensors

Unparalleled Force Measurement at Lowest Noise Levels

The flexibility, range of test capabilities, and high- and low-temperature testing accessories are all huge benefits, but without good data they all mean nothing. UMT TriboLab excels at producing highly accurate and repeatable test data. The system utilizes the latest developments in sensor technology from Bruker, featuring circuitry completely redesigned to reduce noise to an absolute minimum. These new "Gold Series" sensors offer noise levels at an industry-leading 0.02% of full-scale values. The range of sensors has been extended to eleven sensors spanning forces from 1 mN to 2 kN.

Complex Motion Measurements Around Multiple Axes

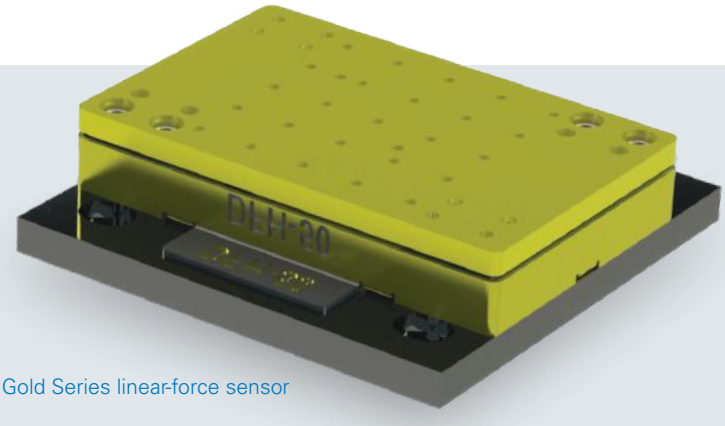
With the broad testing capability of UMT TriboLab, complex combinations of motions can be configured to exert compound forces on the surface being examined. To measure these forces, Bruker offers a full range of torque and multi-axis sensors for use with the TriboLab. These torque sensors can be used alone or in combination with the Gold Series linear-force sensors.

Additional Advanced Sensors for Complete Dynamics Characterization

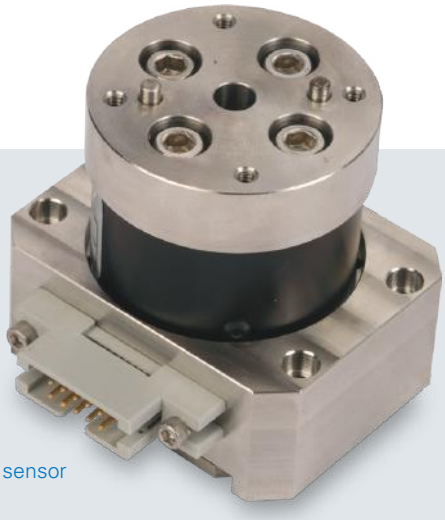
Sometimes measuring force alone does not provide the complete picture needed to fully understand the dynamics around friction, wear, or coating failure. Adding advanced sensors can fill this gap. Bruker offers a range of sensors that can be integrated into the test procedures using any of the six available sensor ports. For example, acoustic-emission sensors can detect the sound waves created by micro-fractures in coating materials before an obvious spike in lateral force is detected by the force sensor. Similarly, lubricant layers can show high electrical resistance that decreases as the layer becomes thinner. Measurements of these additional variables, in concert with changes in lateral forces, give researchers a deeper understanding of the dynamics around the regime being explored.

Fully Integrated Test Data for Comprehensive Answers

Regardless of which combination of sensors is selected, all data collected by the sensors are synchronized and seamlessly integrated, and the data are then presented in tables and graphs to provide a complete picture of the entire test procedure.



Gold Series linear-force sensor



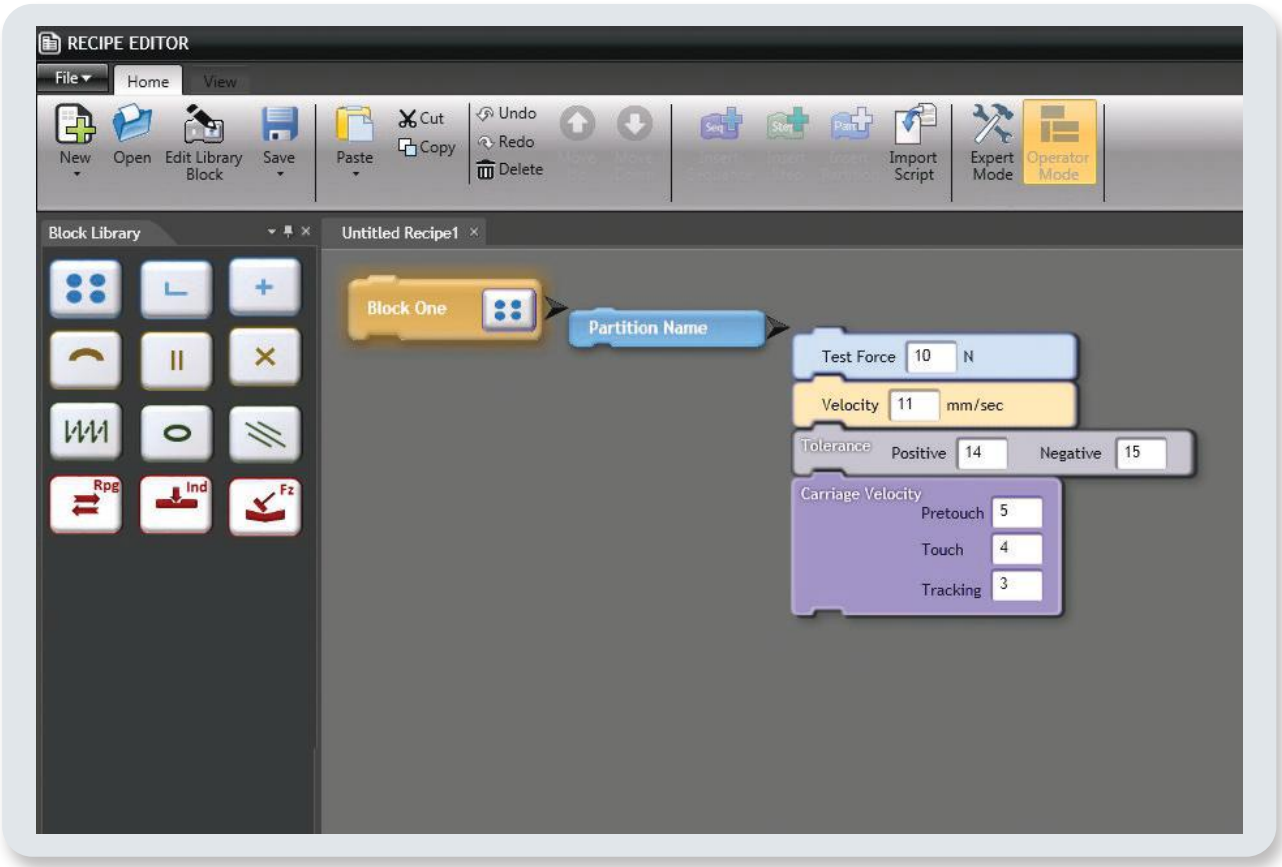
Torque sensor

"For us, Bruker's Universal Mechanical Tester and new sensors have come precisely on time. We are impressed by the sensitivity and robustness of these sensors, which enable us to perform novel friction experiments in a largely unexplored force regime."

– Professor Joost W. M. Frenken, University of Leiden

Simple… Better… Simply Better!

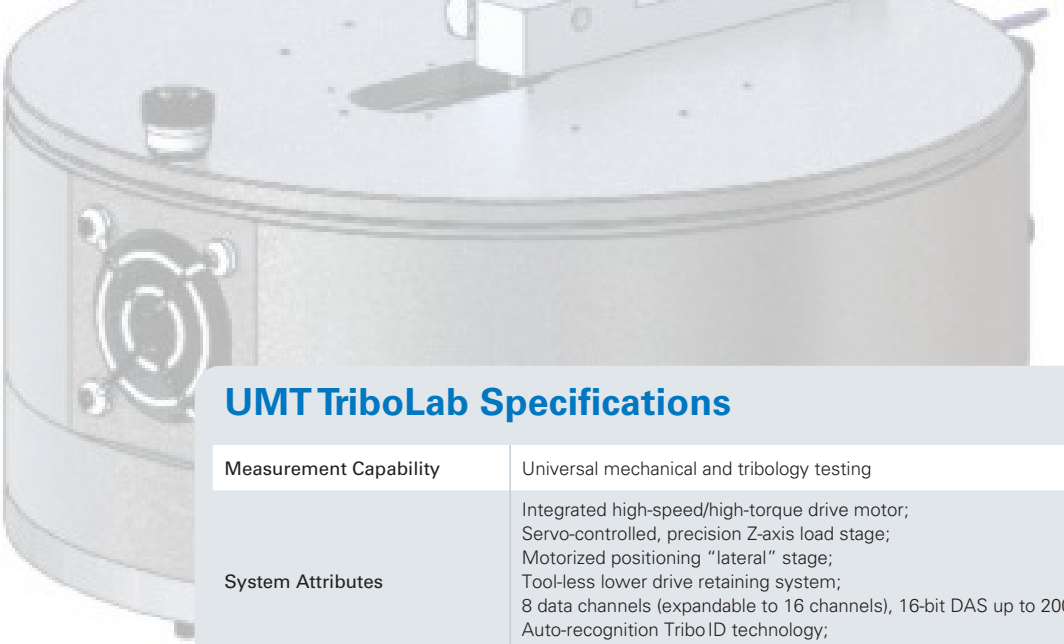
When it comes to conducting tribology tests, whether for academic research or for new product development, the key factor is "output." TriboScript was developed specifically to improve output by simplifying test scripting, analysis, and reporting. Through interaction with the Tribo ID chips on the test hardware, the software "understands" the configuration and optimizes the menus to show only the active features. Instead of the laborious scripting requirements typical of similar test tools, TriboScript employs a simple, icon-based user interface. Simply drag and drop icons into the workspace. Nest several icons together and you have completed a full test script. It's virtually impossible to make fatal errors because only compatible icons interlock together, and the system prompts for any needed variables, such as speed or force.



TriboScript user interface showing Recipe Editor window.

With decades of experience in tribology testing we have learned that most tests are performed either to standards such as ASTM, DIN, JIS, etc., or to modifications of these well-defined test methods, and TriboScript is pre-loaded with many of these frequently used standards. Simply select the standard test from a list, and either use the pre-loaded variables or enter your own to optimize the test for your specific materials and conditions.

We also understand that the work is not over when the physical testing is complete. There is the final test requirement of analyzing the data produced. To help with this, TriboLab post-test analysis and reporting have been optimized and simplified. Select the data channels you wish to consider, and the software will synchronize and display multiple data sets simultaneously to provide a complete understanding of what occurred during the test.



UMT TriboLab Specifications

Measurement Capability	Universal mechanical and tribology testing
System Attributes	Integrated high-speed/high-torque drive motor; Servo-controlled, precision Z-axis load stage; Motorized positioning "lateral" stage; Tool-less lower drive retaining system; 8 data channels (expandable to 16 channels), 16-bit DAS up to 200 kHz; Auto-recognition TriboID technology; Built-in temperature controller
Software	TriboScript tribology scripting software; Viewer data analysis package
Computer System	64-bit Professional PC with MS Windows OS, 16GB SDRAM, 500GB HDD, wireless keyboard and mouse
Vertical Travel	Distance: 150 mm; Encoder resolution: 0.5 µm; Speed: 0.002 to 10 mm/s
Lateral Travel	Distance: 120 mm; Encoder resolution: 0.25 µm; Speed: 0.002 to 10 mm/s
Load Range	1 mN to 2,000 N
Torque Capability	5 Nm @ 100 rpm, 2.5 Nm @ 5,000 rpm
Temperature Control	-25°C to 1000°C
Power Requirement	220VAC, 8kW recommended
Footprint	W: 15.5" x D: 24" x H: 30.5"

Optional Features

Humidity Control	5% to 85% RH
Optical Microscope	5X, 10X, 25X optical objectives; 1280 x 1024 digital camera
Linear Stage	Speed: 0.002 mm/s to 10 mm/s; Position resolution: 1 µm; Max. travel: 120 mm
Rotary Stage	Speed: 0.1 to 5,000 rpm
Reciprocating Stage	Speed: 0.1 to 60 Hz
Block-on-Ring Stage	Speed: 0.1 to 5,000 rpm
Acoustic Emmision	Frequency response: 0.2 to 5 MHz
Electrical Contact Resistance	5 mOhm to 1 MOhm
Power Supply	Current Range: ±1µA up to ±1A; Resolution: 10nA; Voltage Range: ±200mV up to ±10V; Resolution 6.1µV
Programmable Pump	Flow rate: 2.2 to 480 mL/min

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