



TRIBOLOGY AND MECHANICAL TESTING

# **TriboLab HD** **High-Torque Friction Material Tester**

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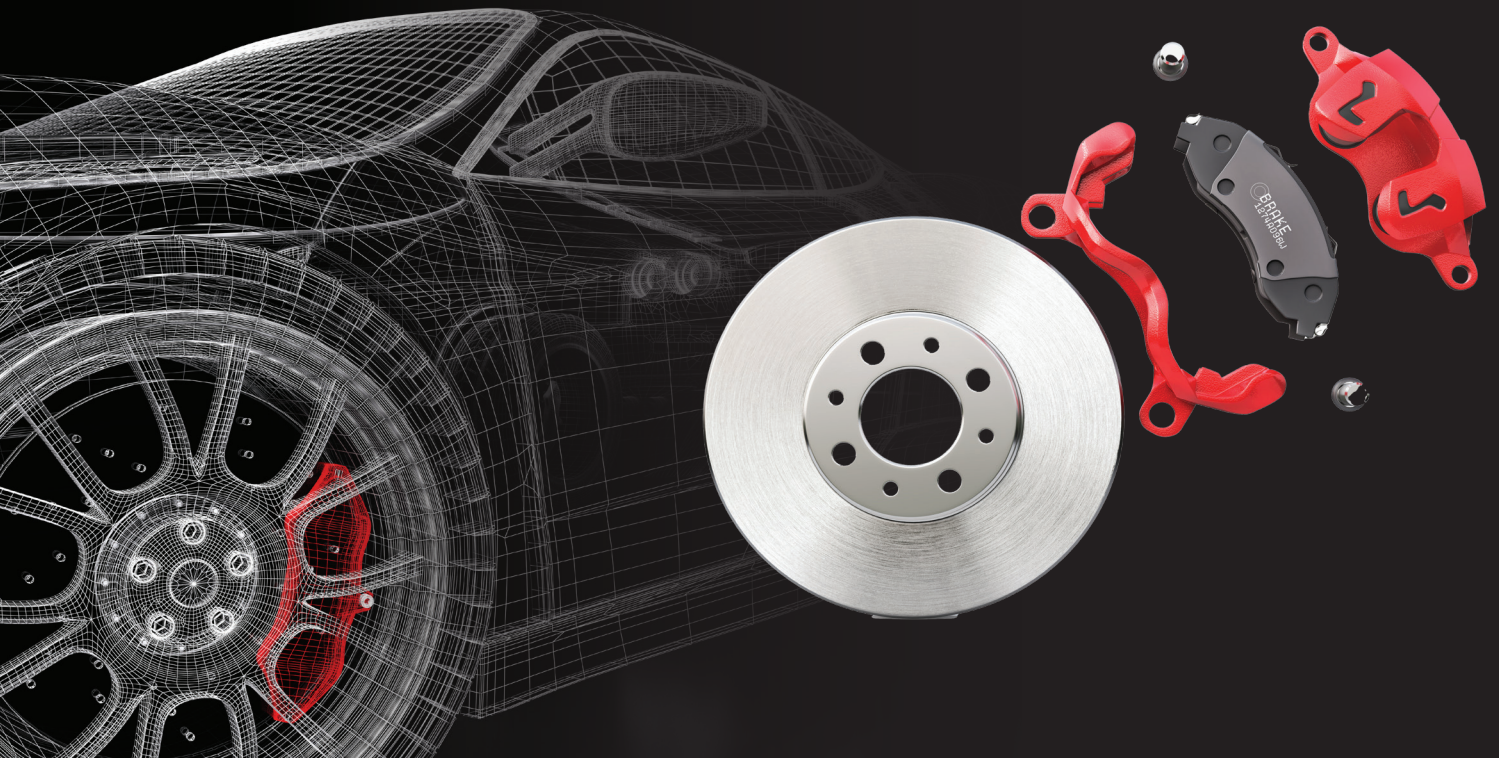
Fast and Cost-Effective In-Lab  
Rapid Screening of New Friction Materials

# Breaking Barriers for Material Screening Performance and Cost

Brake pads for automotive vehicles require rigorous testing prior to receiving the certification that consumers and safety and environmental regulators require. New brake formulations are continuously required to stay competitive, meet new engine-type demands, and respond to environmental concerns. Each of these new formulations needs to meet extremely stringent standards of performance, comfort, cost, and safety, and typically can take up to five years to bring to market. The new TriboLab HD high-torque friction material tester is specifically designed to meet these requirements and help reduce development time with the high-torque, in-situ heating, and containment capabilities to rank friction material performance in the lab. In-lab ranking enables developers to better focus their efforts on driving only the best formulations to market, providing TriboLab HD owners an extreme advantage in this highly competitive field.

## Only TriboLab HD Delivers:

- A unique range of tests and capabilities to support emerging brake development needs
- The most force torque in a research testing system to meet existing and future automotive vehicle requirements
- Particle matter collection support for microscale R&D improvements and green regulations
- Extremely versatile operator ease of use with modularity and pre-set push-button tests to expedite operation, test development, and reporting



# Meeting New Challenges for Brake Systems

Stringent requirements for continual improvement and new passenger vehicle engine types, such as those found in electronic vehicles (EV), are creating additional challenges for brake developers. Currently, the industry is using brake assemblies developed for the internal combustion engine, even though the new EV engines are heavier and have higher torque, causing brake pads to wear at a higher rate. In addition, regenerative braking increases time between braking events, which allows the pads and rotors to build up oxide layers that create undesired squeals and vibrations. These events can prompt an increase in service visits, and a corresponding increase in OEM warranty costs. Most importantly, non-exhaust emissions are emerging as a health concern and are requiring environmental regulations. New brake materials must cut particulate emissions without compromising safety. Never before have so many challenges faced the brake industry.

## TriboLab HD Bridges the Gap Between Drawing Board and Dynamometer

Currently, full-scale dynamometer testing is the standard benchmark test prior to full-scale on-road vehicle testing. Besides being expensive and time-consuming, dynamometer testing provides limited ability to study particle emissions, and if the test fails, formulators do not necessarily gain insight into causes. Faced with these challenges, industry leaders reached out to Bruker to develop a solution to help bridge the gap between the lab and the dynamometer.

Cost-effective friction material testing must become available to the many companies and entities engaged in new product development, materials R&D, and regulation. Bruker's solution is a system that can perform a wider range of pad and rotor material qualification tests under a greater variety of conditions. During constant deceleration (stopping) or speed (drag) testing, TriboLab HD monitors coefficient of friction (COF) between pad and rotor while precisely controlling key parameters, such as velocity, temperature, and contact pressure. This combination of variables enables researchers to accurately and repeatably simulate cycles, such as burnish, fade, recovery, and much more.

## TriboLab HD Advantages

Bruker's new TriboLab HD provides significant enhancements beyond what is currently available for in-lab testing:

- Up to 50 Nm torque to accurately measure COF at high loads and speeds
- Reduced cost of material testing with coupons
- Ability to simulate SAE J2522 test scenarios for all-purpose roads
- Direct heating to maintain temperature during fade testing
- Seamless integration for third-party particle analyzers
- Dedicated braking materials software package for operation and analysis

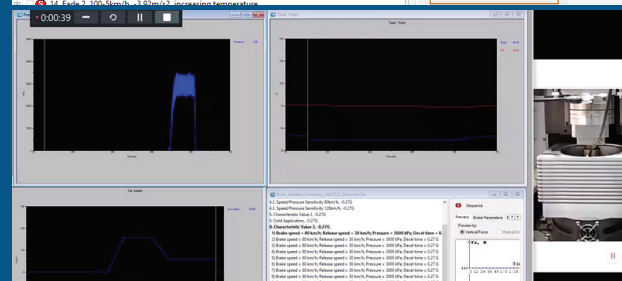
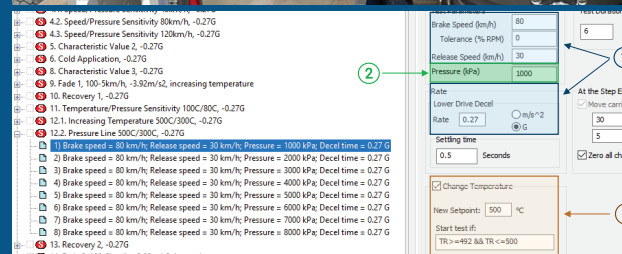
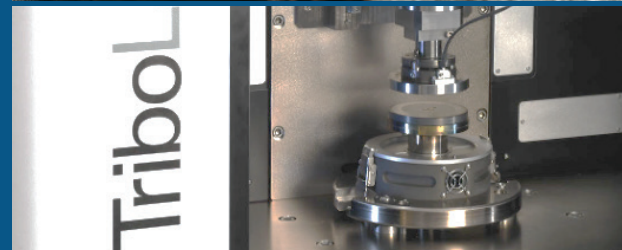
Enables customization of friction materials

Incorporates advanced sensors and a high-performance motor

Allows for easy integration of particle collection systems

Simulates wide variety of driving scenarios

Provides complete test reporting within seconds



# Simulating Driving Scenarios

**Test Scenarios List:**

- Zero force sensor
- 1. Green mu, -0.27G
- 2. Burnish, -0.27G
- 3. Characteristic Value 1, -0.27G
- 4.1. Speed/Pressure Sensitivity 40km/h, -0.27G
- 4.2. Speed/Pressure Sensitivity 80km/h, -0.27G
- 4.3. Speed/Pressure Sensitivity 120km/h, -0.27G
- 5. Characteristic Value 2, -0.27G
- 6. Cold Application, -0.27G
- 8. Characteristic Value 3, -0.27G
- 9. Fade 1, 100-5km/h, -3.92m/s<sup>2</sup>, increasing temperature
- 10. Recovery 1, -0.27G
- 11. Temperature/Pressure Sensitivity 100C/80C, -0.27G
- 12.1. Increasing Temperature 500C/300C, -0.27G
- 12.2. Pressure Line 500C/300C, -0.27G
- 13. Recovery 2, -0.27G
- 14. Fade 2, 100-5km/h, -3.92m/s<sup>2</sup>, increasing temperature
- 15. Recovery 3, -0.27G

**Brake Test Configuration:**

**Test Parameters:**

Brake Speed (km/h)	80
Tolerance (% RPM)	0
Release Speed (km/h)	30
Pressure (kPa)	1000

**Test Duration:** 6  Seconds  Minutes  Hours

**At the Step End:**

- Move carriage up
- Rate: 30 mm
- 5 mm/sec
- Zero all channels

**Setting time:** 0.5 Seconds

**Change Temperature:**

- New Setpoint: 500 °C
- Start test if: TR >= 492 && TR <= 500

**Break the Snub Execution if:**

Bruker's software has a unique user interface that enables operators to control motion, loading, and environment parameters. This provides the capability to seamlessly simulate a host of driving scenarios.

## 1 Motion

- Unidirectional sliding with conversion for speed values based on vehicle wheel diameter and rotor disc diameter.
- Provide artificial "deceleration" based on dynamometer tests.

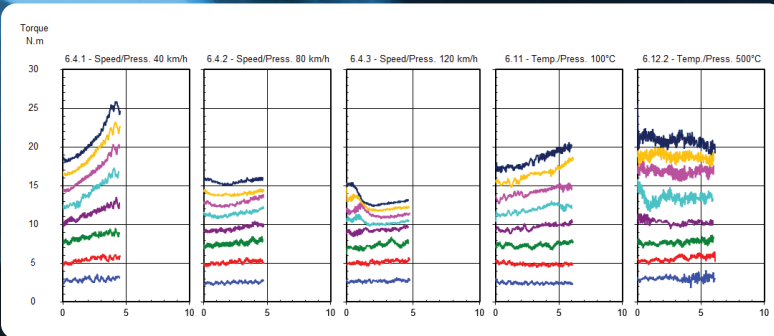
## 2 Loading

- Calculate same contact stress applied on brake pads during dynamometer testing based on hydraulic line pressure, piston size and brake areas.

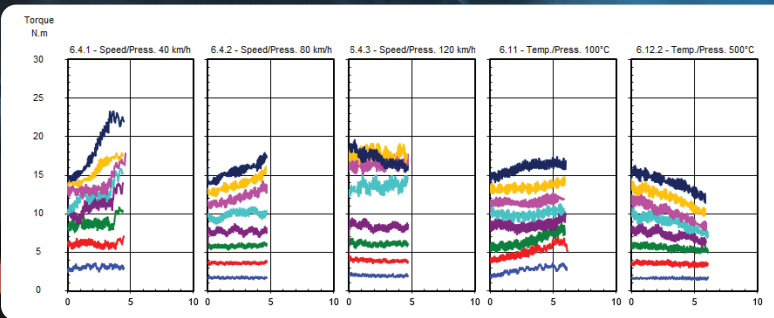
## 3 Environment

- In-situ heating up to 550°C.
- Temperature of pad and rotor monitor.
- Test initiation determined by rotor temperature.

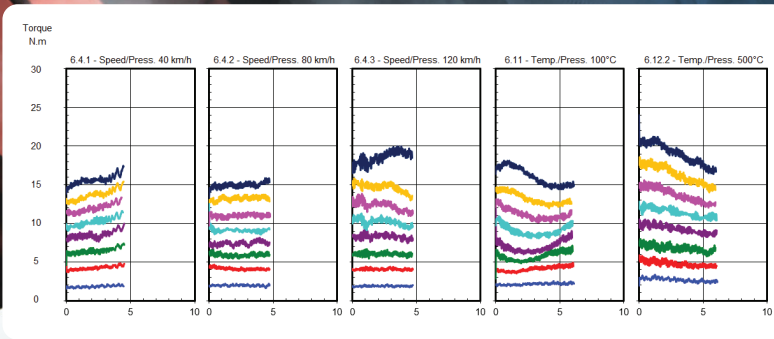
# Making Testing Easy



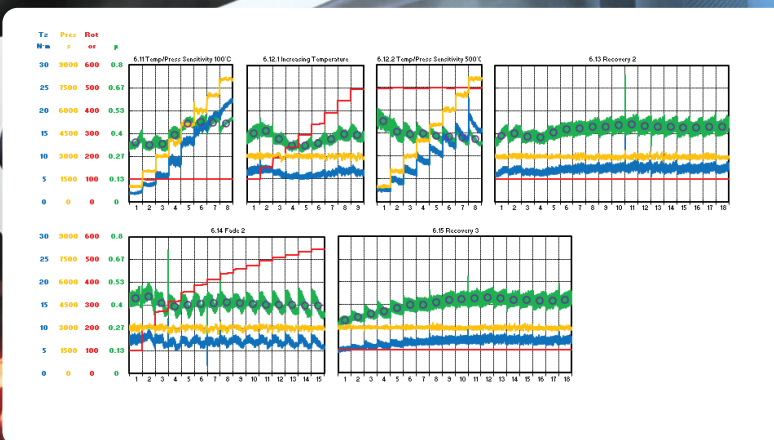
NAO-type brake pad.



Semi-metallic brake pad.



Ceramic-type brake pad.



From start to finish, TriboLab HD makes it easy to get meaningful results. Critical decisions can be made earlier in the development process, saving time and money. Pre-programmed scripts based on simulated SAE J2522 or "AK Master" standards are available so productive testing can start on day one. Test specimen parameters are automatically converted from vehicle parameters, which then updates the 100+ pre-programmed test scripts. Whether running a single section or the full suite of SAE J2522 tests, results are easily processed. What previously took days can now be done with just a few clicks. The reporting capability also makes it easy to compare data between runs since it is always presented in the same format. While offering this ease of use, the ability to modify test scripts is retained so that unique tests can be created to meet customized requirements and bring critical information to the development team.

## More Power for In-Lab Friction Testing

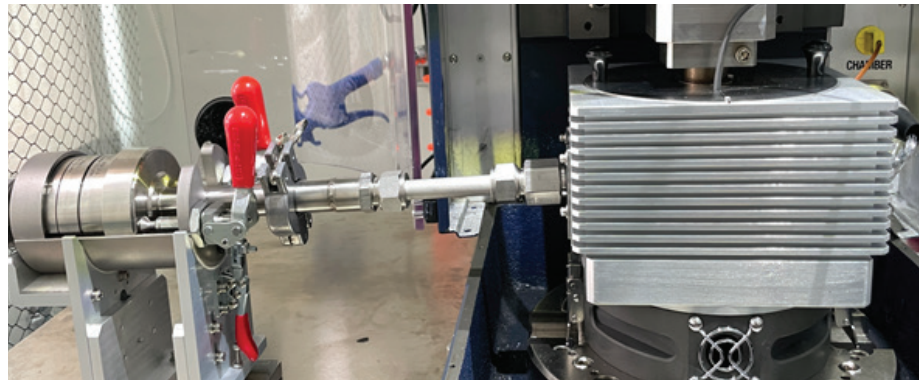
TriboLab HD's heavy-duty motor enables up to 8.5 MPa of pressure applied at 120 km/hr. Never before has this capability been available in the lab. The full range of test capabilities can be accurately and repeatably monitored with Bruker's new, high-precision, low-noise, all-in-one load/torque sensor. In-situ heating helps to maintain temperature in between snubs. This also provides flexibility to externally heat the rotor to reduce or eliminate warm-up snubs, which can prematurely wear specimens (e.g., doing fade or pressure line tests). Thermocouples are attached to the rotor as well as the backside of the brake coupon.

Intelligent data analysis software for complete test reporting.



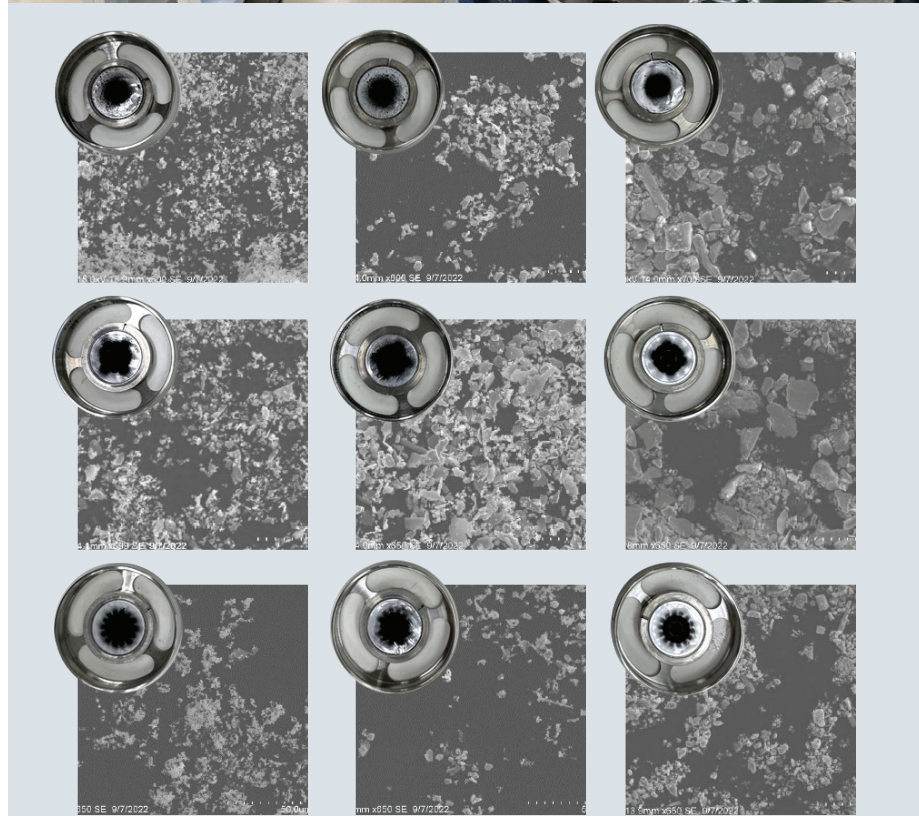
# Enabling Next-Generation Compliance Testing

Worldwide, scientists are studying how the air-borne particles created as brake pads wear are affecting human health and safety. The focus of studies can vary based on regional concerns, but they can focus on particle size, quantity of particles, or even particle composition. Bruker has made it very easy to add a particle analyzer to the TriboLab HD particle collection chamber by incorporating ports that can be connected to a particle collection system and external vacuum pump. The ports are positioned right at the contact point of rotor and pad specimens. With these and other features, TriboLab HD enables next-generation environmental compliance testing with precise and repeatable in-lab wear studies.



## Brake Particle Collection

To exhibit how TriboLab HD could be employed to study particle emissions, Bruker integrated a third party 3-filter impactor with vacuum pump to collect PM of 1, 2.5, and 10  $\mu\text{m}$ . The filters were then analyzed externally using SEM to provide chemical composition of the particles collected. To reduce cross-contamination between runs, the particle collection chamber is designed to be easily cleaned.



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# Benefiting from Bruker's Industry-Best Service and Support

## Experienced Support Staff with Broad Applications Knowledge

Solutions to complex challenges are never just a happy accident. They require innovative problem-solving through advanced research, intelligent design, and precision engineering. The TriboLab family of products combines more than four decades of industry-leading design and functionality with dramatic advances to deliver the best combined tribo-testing solution. And Bruker's value does not end there. Across a very large and varied base of installed systems, Bruker enjoys a strong reputation for having highly trained and experienced support staff, most of whom have one or more advanced degrees in science or engineering, with many years of experience solving real-world application problems.



## Proven Performance

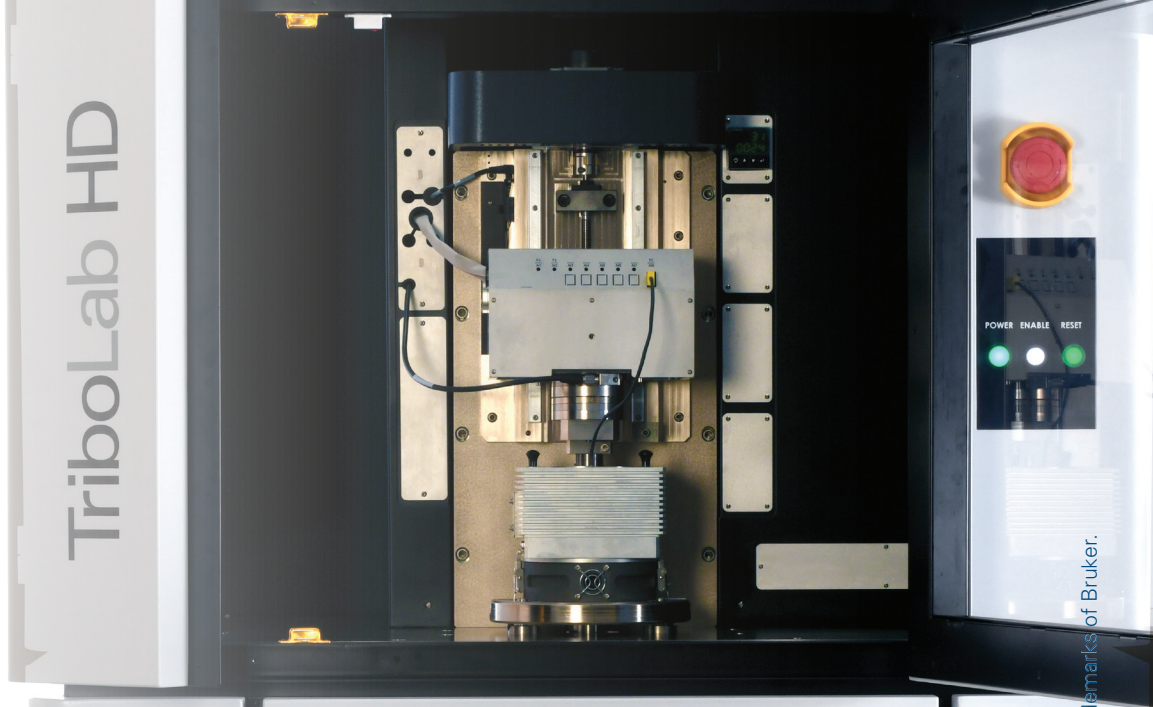
Our tribology and mechanical testing instruments have a proven track record of robust performance in a wide variety of applications and settings, including universities, and commercial and government research laboratories worldwide. Bruker products, support, and service options are designed to work together to help you with your particular challenges and demands for success and growth. It's what sets Bruker apart. We provide the best support and technical expertise.

## Worldwide Service and Training Facilities

Today, the Bruker family comprises more than 6,000 employees, across 90 worldwide locations, all guided by a single purpose: provide the very best products, service, and support to each and every customer. With training and service centers around the globe, every Bruker customer is ensured of receiving timely and personalized user and system support.

“ Bruker service personnel are extremely knowledgeable, responsive, and solution oriented. Their expertise in the science, applications, and Bruker products is always helpful. ”

– Matt Kipper, Colorado State University, USA.



## Specifications

Measurement Capability	High-torque brake material friction testing
System Attributes	Integrated high-speed/high-torque drive servo motor; Servo-controlled, precision Z-axis load stage; High-performance load/torque sensor; Built-in temperature controller; Fully integrated test data and analysis
Software	Test scripting software; Viewer data analysis package; Microsoft Office 2022
Computer System	64-bit Professional PC with MS Windows OS; 16 GB SDRAM; 500 GB HDD; wireless keyboard and mouse
Vertical Travel	Distance: 150 mm; Speed: 0.002 to 10 mm/s
Load Range	Maximum up to 2 kN
Rotary Stage	Speed up to 3,300 rpm
Torque Capability	Maximum up to 50 Nm
Temperature Control	Room temperature to 550° C
Power Requirement	480 VAC, 50 Hz/60 Hz 3-Phase
Footprint	881 x 1217 x 1858 mm (34.7 x 47.9 x 73.1 in)
Weight	2200 lb (1000 kg)

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