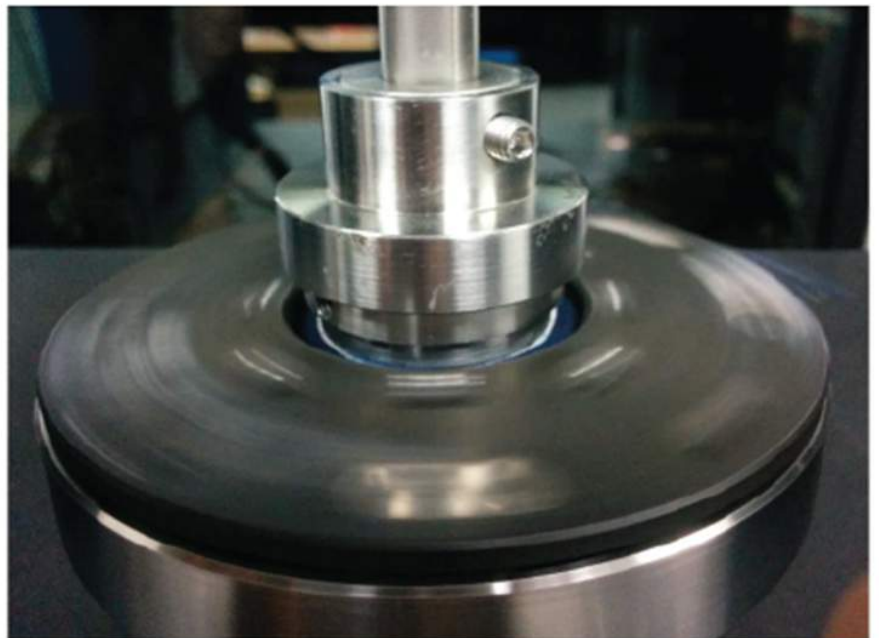
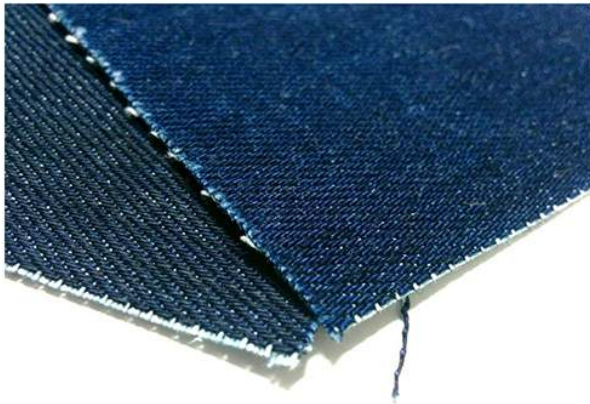


## *TEXTILE ABRASION*

— *USING* —

## *THE NANOVEA TRIBOMETER*



Prepared by  
**Duanjie Li and Pierre Leroux**



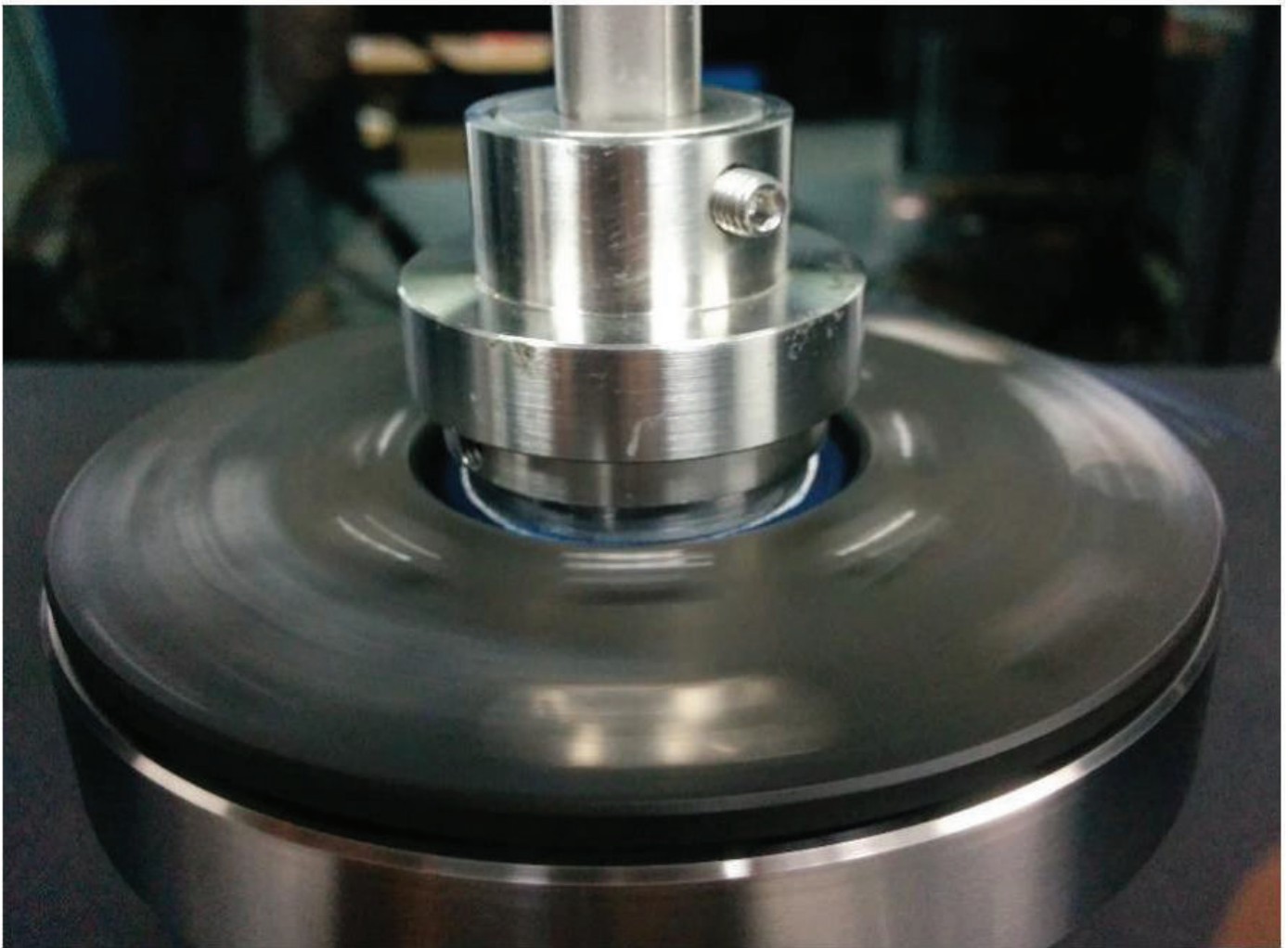
## Introduction

The serviceability and functionality of a fabric is usually determined by its quality and durability. Pilling, fuzzing, discoloration and other types of damages to the fabrics can be caused by wear and tear during daily usage. The clothing made of bad quality fabrics often results in consumer dissatisfaction and brand damage.

The measurement of the abrasion resistance of the fabrics is very challenging. Many factors play a role during the test, including the mechanical properties of the fibers, the structure of the yarns and the weave of the fabrics. This may result in poor reproducibility of test results and create difficulty in comparing values reported from different laboratories. Wear performance of the fabrics is critical to the manufacturers, distributors, and retailers in the textile production chain. A well-controlled quantifiable and reproducible wear resistance measurement is crucial to ensure reliable quality control of the fabric production.

# MEASUREMENT OBJECTIVES

The abrasion wear process of two denim samples, i.e. raw and dark washed, is simulated in a controlled and monitored manner using the Nanovea Tribometer. In this study, we would like to showcase that the Nanovea Tribometer is a reliable tool for evaluation and quality control of different fabrics.



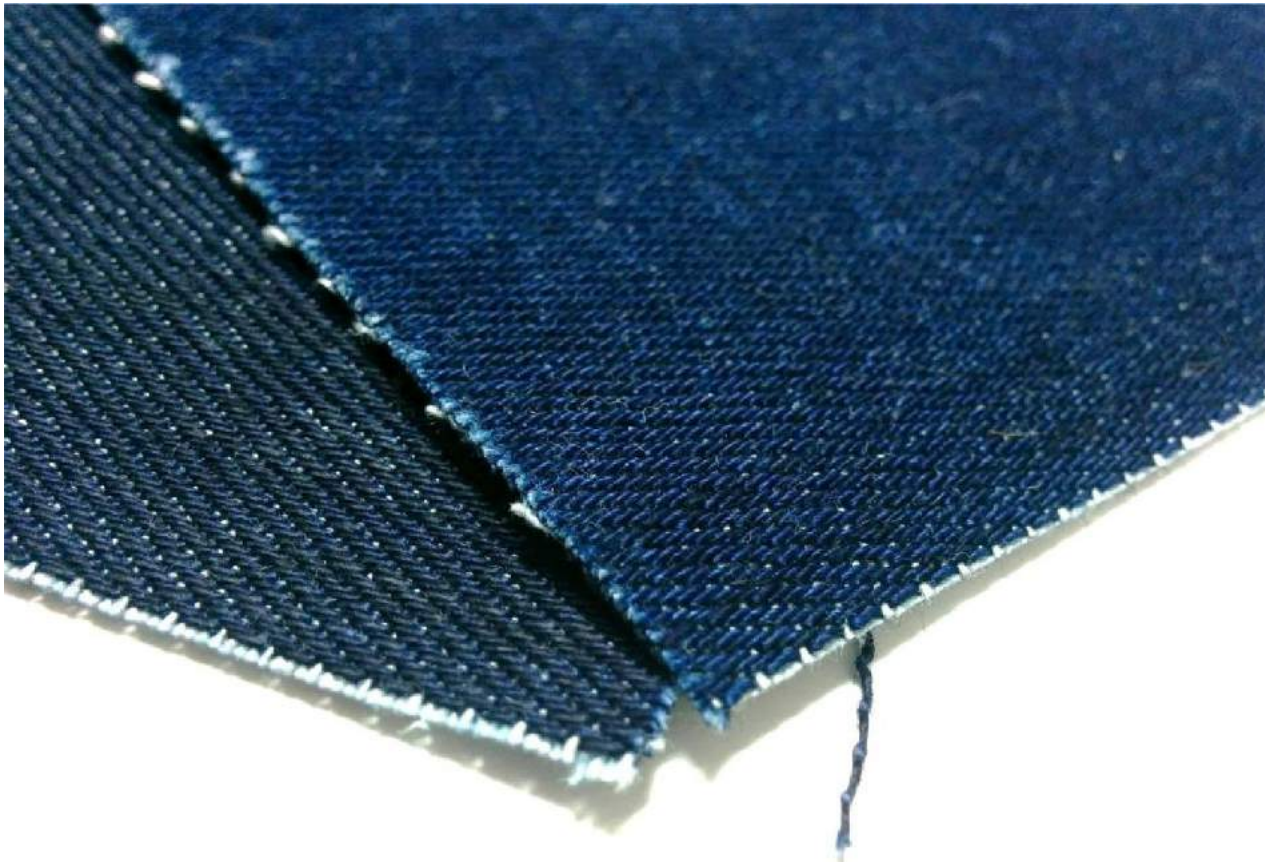
**Fig. 1: Abrasion wear test on fabric.**

# TESTING CONDITIONS

The samples for this study are two pieces of denim fabric, namely raw denim and dark washed denim. The Nanovea Tribometer was applied to evaluate the abrasion wear resistance. The denim sample was mounted on the rotational stage of the tribometer. The load was applied by a 120 grit sandpaper attached to the tip holder against the tested denim samples. The test parameters are summarized in Table 2. The evolution of the wear scar was recorded by a Dino-Lite microscope, and the 3D wear track morphology was examined using the Nanovea 3D non-contact profilometer after the wear test.

| Test parameters  | Value  |
|------------------|--|
| Normal force     | 5N   |
| Rotational Speed | 100 rpm  |
| Duration of test | 200, 400, 600, 800, 1000, 2000 and 3000 cycles |

Table 1: Test parameters of the abrasion wear measurement.



# RESULTS AND DISCUSSION

The abrasion wear tests at different numbers of revolutions (200, 400, 600, 800, 1000, 2000 and 3000 cycles) were performed on the raw and dark washed denim samples to monitor the evolution of wear process as displayed in Fig. 2 and Fig. 3. The wear scars of the raw denim and the dark washed denim are compared after the 3000-cycle abrasion wear tests as shown in Fig. 4 and Fig. 5.

Both the raw and dark washed denim samples show signs of wear and tear at the beginning of the wear test for 200 cycles. Known as a sturdy and durable fabric, denim possesses a directional floating set of thick yarns to absorb the abrasion. Even if wear and tear takes place on the floating yarns, there are more yarns underneath that keep the strength of the fabric. As the abrasion test progresses, this layer of floating set of blue yarns get worn and discolored.

Raw denim is the denim that hasn't gone through the pre-wash process. The starch in the raw denim used in the manufacturing process makes the fabric feel stiff and rigid. The washed denim feels soft on the surface after the starch is removed by the washing process. This leads to different abrasion wear behavior during the wear tests. The starch in the denim fiber of the raw denim holds the shape of the denim fibers during the wear test. This may have resulted in smaller contact area and higher pressure on the surface denim fibers during the abrasion test. The combination of the higher pressure and stiff texture leads to the accelerated wear process for the raw denim sample. Holes are created in the raw denim after the abrasion wear test as shown in Fig. 4a and Fig. 5a. In comparison, the yarns of the dark washed denim are deformed under the contact pressure. The fibers are progressively broken off the yarns and align in the direction of the sliding wear contact as shown in Fig. 5b. The wear scar shows less severe damages for the dark washed denim compared to the raw denim. Pilling of cotton fibers can be observed during the wear tests of both the raw and dark washed denim.

# RESULTS AND DISCUSSION



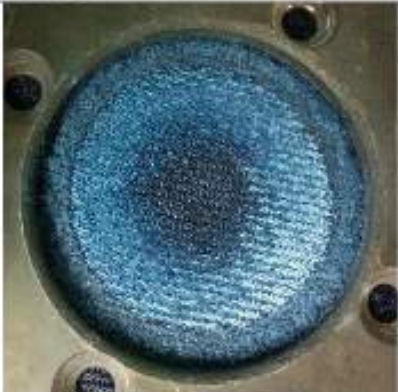
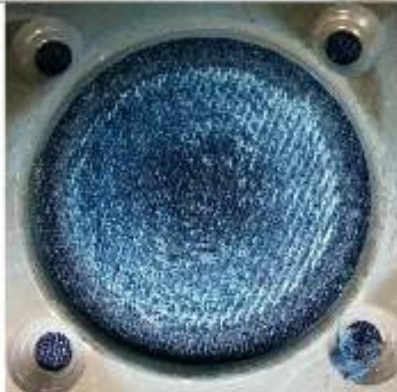
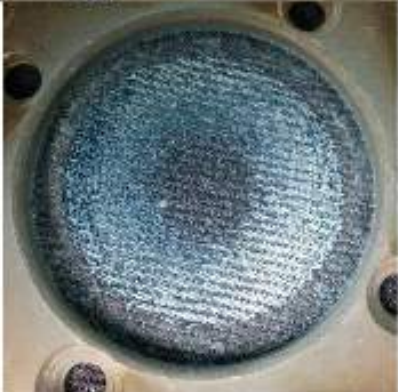
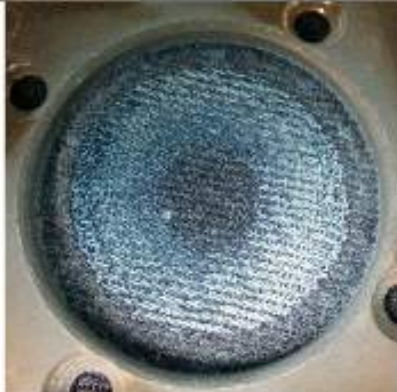
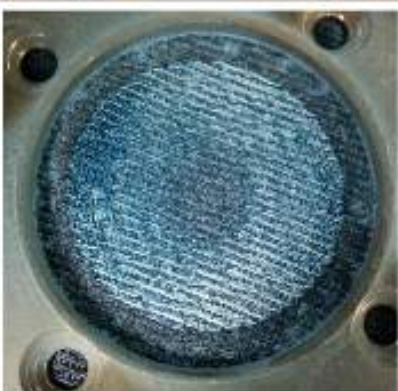













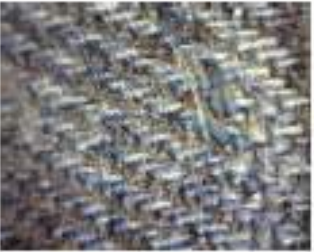

| Cycle | (a) Raw Denim:  | (b) Dark Washed Denim:   |
|-------|---|--|
| 0     |    |    |
| 200   |   |   |
| 1000  |  |  |
| 3000  |  |  |

Fig. 2: Evolution of the wear scars for the (a) raw denim and (b) dark washed denim during the abrasion wear tests.

# RESULTS AND DISCUSSION

|     |   |   |  |   |
|-----|---|---|--|---|
| (a) | 0 cycles  | 200 cycles  | 400 cycles   | 600 cycles  |
|     |    |    |    |    |
|     | 800 cycles  | 1000 cycles   | 2000 cycles  | 3000 cycles   |
|     |   |   |   |   |
| (b) | 0 cycles  | 200 cycles  | 400 cycles   | 600 cycles  |
|     |  |  |  |  |
|     | 800 cycles  | 1000 cycles   | 2000 cycles  | 3000 cycles   |
|     |  |  |  |  |

**Fig. 2: Evolution of the wear scars for the (a) raw denim and (b) dark washed denim during the abrasion wear tests at a larger magnification.**

# RESULTS AND DISCUSSION

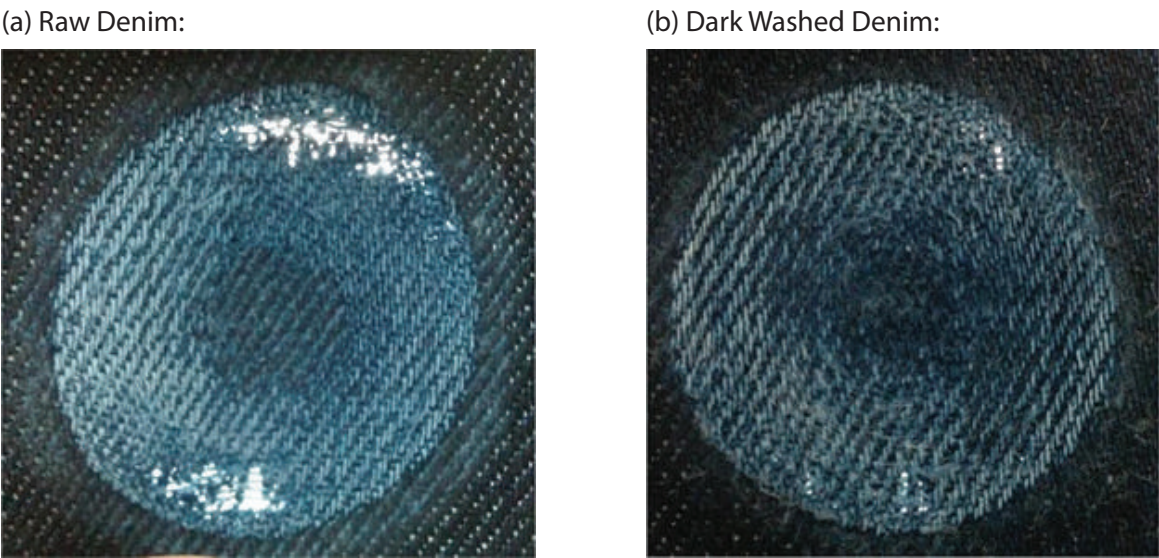


Fig. 4: Wear scars of the (a) raw denim and (b) dark washed denim after the abrasion wear tests.

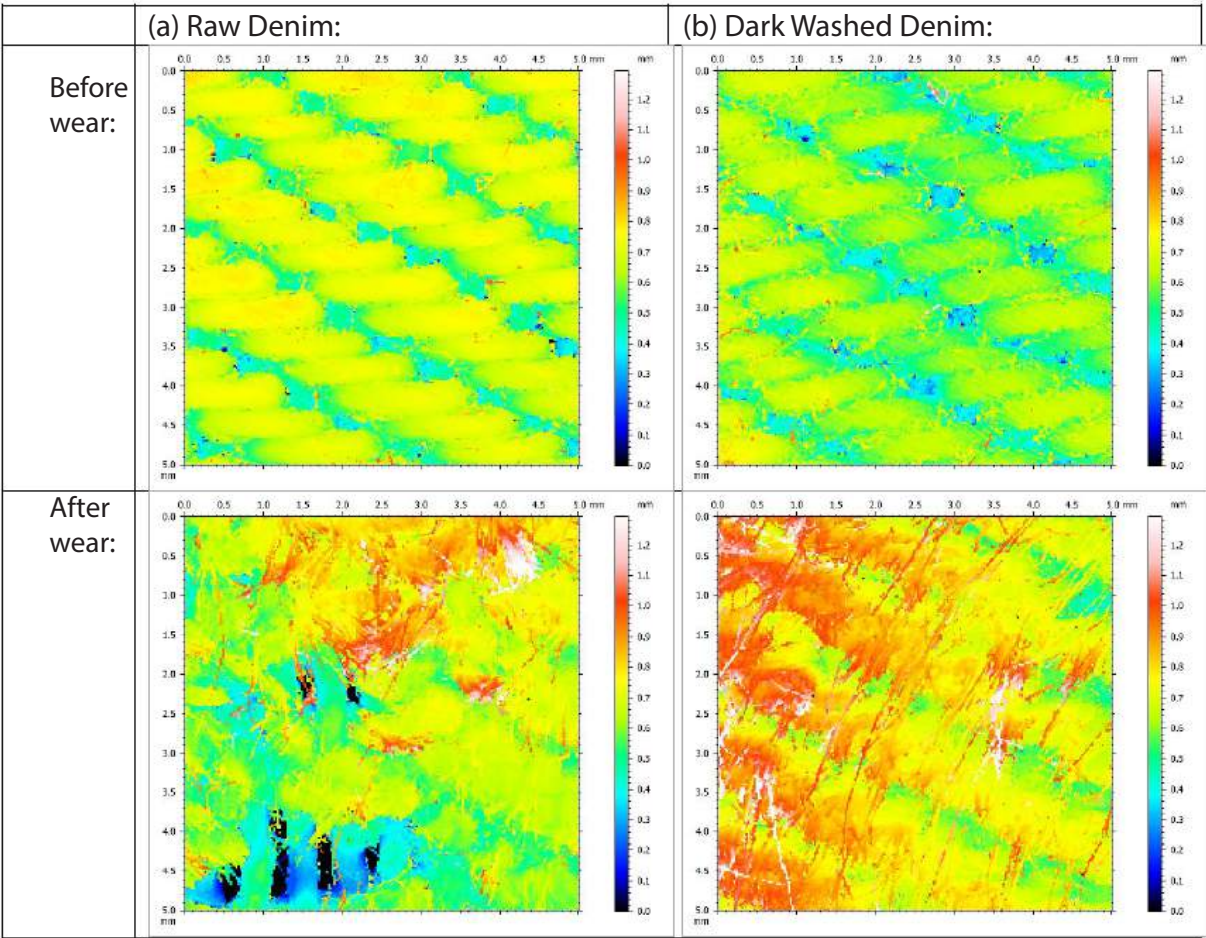


Fig. 5: False color views of (a) raw denim and (b) dark washed denim before and after the abrasion wear tests.



## Conclusion

The Nanovea Tribometer is a reliable tool to evaluate the wear performance of textiles. In this study, we showcase that the Nanovea Tribometer provides well-controlled quantifiable and repeatable measurements on the abrasion resistance of denims of different finish. Based on the tribological analysis on the raw and washed denims tested in this study, we show that the raw denim exhibits a higher wear rate compared to the dark washed one.

Nanovea Tribometers offer precise and repeatable wear and friction testing using ISO and ASTM compliant rotative and linear modes, with optional high-temperature wear, lubrication and tribo-corrosion modules available in one pre-integrated system. Nanovea's unmatched range is an ideal solution for determining the full range of tribological properties of thin or thick, soft or hard coatings, films, and substrates.

## T50 Tribometer



### **Versatile Wear & Friction Tester**

Multi-Module System

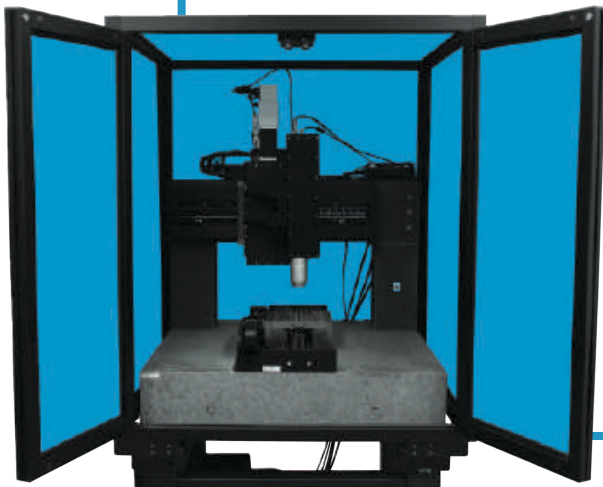
Speed Control from 0.01-5000 RPM

Robust with Open Platform

Wide Range of Environmental Conditions

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Advanced Automation with customizable options

High Speeds up to 384,000 points per second

Designed for large area flatness measurement

Full granite base with integrated anti-vibration table

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Call to Schedule a demo today!

If you have any questions please email us at [info@nanovea.com](mailto:info@nanovea.com)

## Recommended Reading

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