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# ASTM G99 Tip's Perspective
# Continuous Wear Contact

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## INTRO

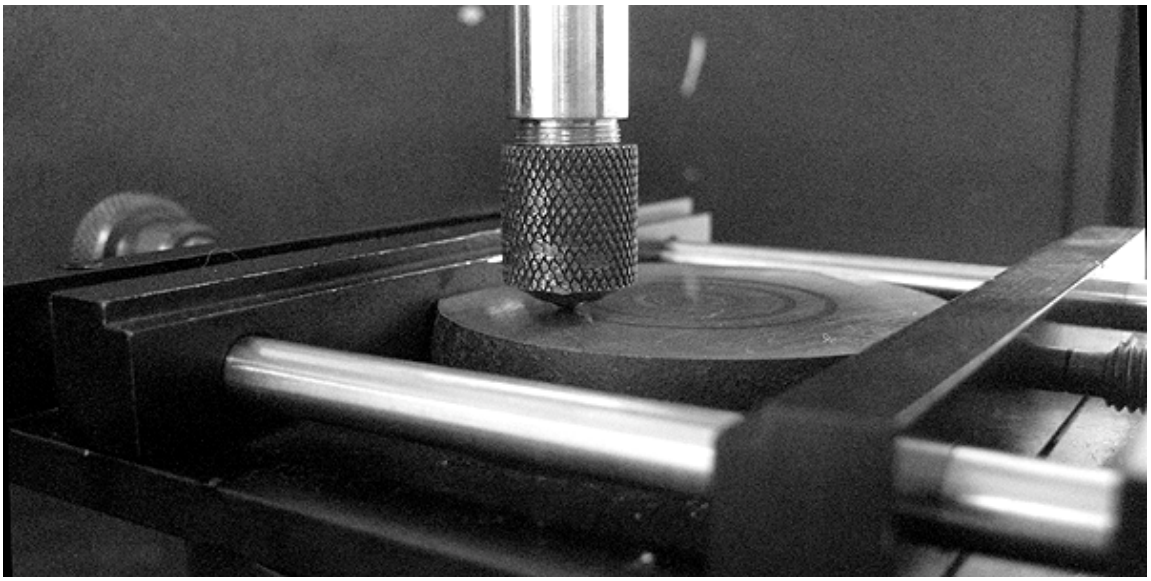
To study the wear of materials, we must simulate the process of wear in a controlled manner and study the effect on different samples with the same test conditions. One way to perform the wear test is with a ball or pin on disk Tribometer (ASTM G99 or G133). With this test, a reference sample is mounted on a rotating stage and a pin or ball (object of study) comes in contact with the sample surface with a known applied load. Typically the interest of wear would be on the reference sample at the bottom but another alternative testing method is to evaluate the wear of the ball or pin tip. In this case, while the reference sample rotates, the contact pressure gradually wears the ball or the pin.

### IMPORTANCE OF TRIBOMETER ASTM G99 FROM TIPS PERSPECTIVE WEAR RATE

A ball or pin for the evaluation of wear loss provides several distinct advantages. Balls of a wide variety of materials are readily available from many suppliers. Their reproducibility and quality can be excellent ensuring easy accurate comparisons. Also, many materials are provided in bulk as cylindrical rods. Therefore, it is easy and very affordable to make many pins of the same diameter. Rounded pins are also a useful option because it is easier to mount them in various CVD coating tools. This allows depositing of uniform coatings of various thickness and material types. The rounded shape adds stresses that affect the reliability of many coatings that can be deposited. This information can be critical in evaluating performance in applications where curvature exists. Evaluating the wear of the ball or pin provides wear information at the contact point which stays under load during the full duration of the test. This compared to the base material that only experiences wear during a comparatively short period of time.

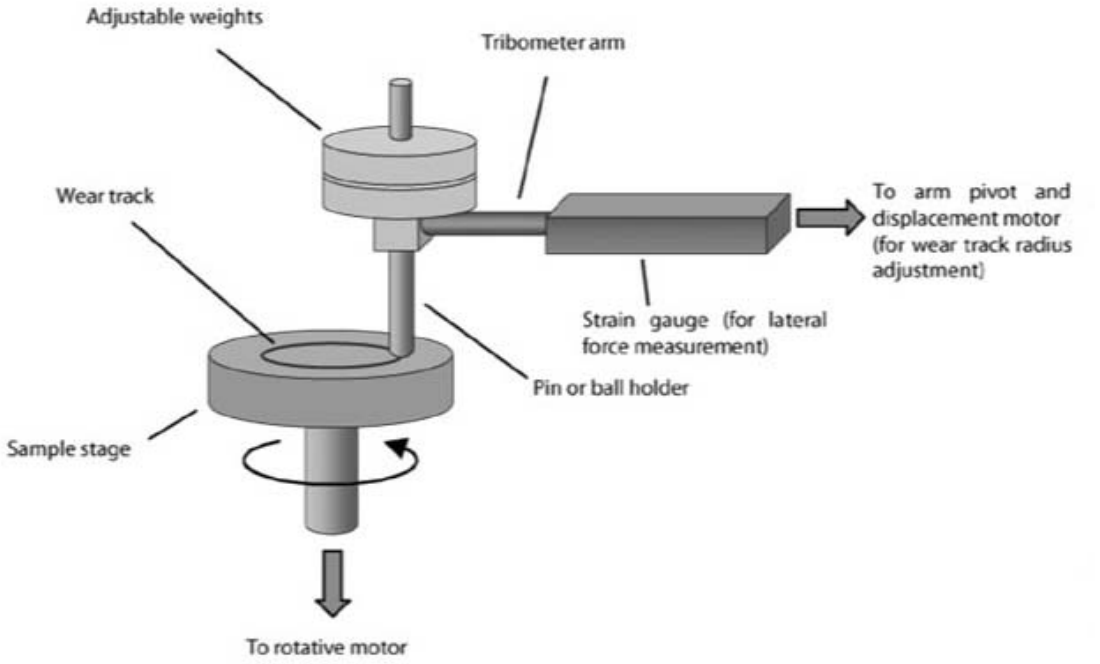
### MEASUREMENT OBJECTIVE

In this application, the Nanovea Tribometer is used to measure the wear rate of a 6mm diameter Stainless Steel and Tungsten Carbide ball tip; many other custom materials and or sizes can be used. The rotative wear test (ASTM G99) was used for a 1hour duration. Then a surface profile was measured using the PS50 Profilometer and micrograph was taken to evaluate surface wear loss between each ball tip for comparison.



## MEASUREMENT PRINCIPLE:

A flat or sphere (many materials possible) shaped indenter is loaded on to the test sample with a precisely known force. The indenter (a pin or a ball) is mounted on a stiff lever, designed as a frictionless force transducer. As the plate moves in a rotational motion the resulting frictional forces acting between the ball or pin and the plate are measured by very small deflections of the arm using a strain gage sensor. Wear rate values for both the pin and sample may also be calculated from the volume of material lost during a specific friction run. This simple method facilitates the determination & study of friction & wear behavior of almost every solid state material combination, with varying time, contact pressure, velocity, temperature, humidity, lubrication, etc.




The instrument base is first leveled in the horizontal position by screwing or unscrewing the adjustable rubber pads at each corner. A ball-holder containing a 3 or 6 mm diameter ball is held in the load arm and placed at a height that allow the tribometer arm to be leveled horizontally when resting on the sample to ensure that normal load will be applied vertically. The arm is then balanced with counter weights to ensure that the arm and ball holder initially apply no force on the sample surface. Finally, weights corresponding to the load required for the test are finely placed on the arm over the ball holder. Through software, the test is then launched and the test is performed at a specified speed for a specified duration, and the frictional force is recorded over time.

## TEST CONDITIONS

### Test parameters

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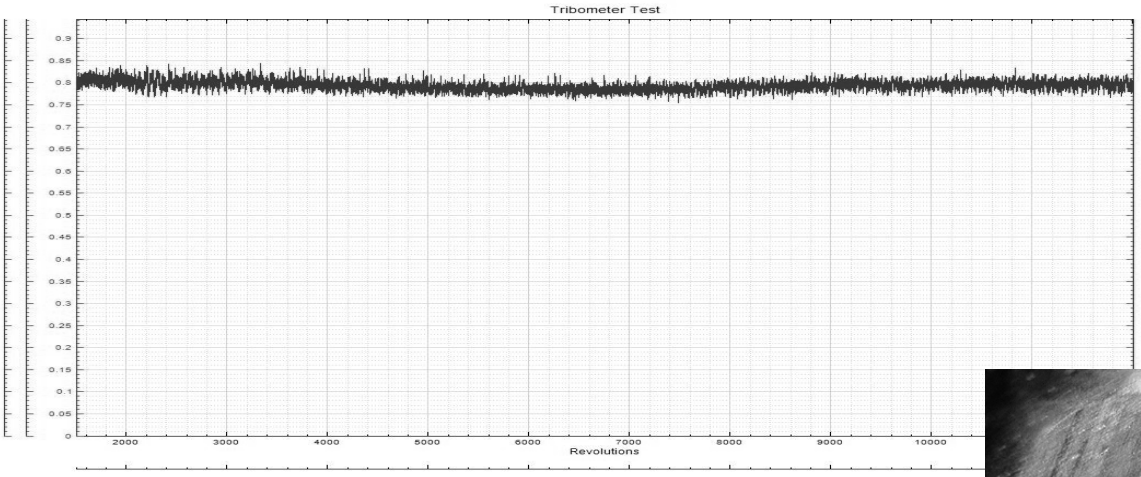
|---|---|
| Load | **10 N** |
| Duration of Test | **1h** |
| Rotative Rate | **200 rpm** |
| Radius of Track | **14 mm** |
| Ball Diameter | **6 mm** |
| Ball Material | **Stainless Steel, Tungsten Carbide** |

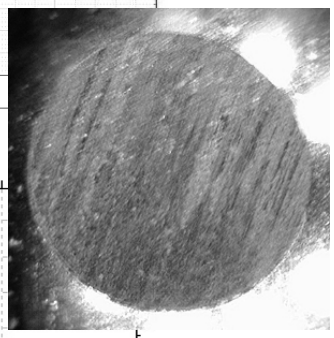
### Environmental conditions

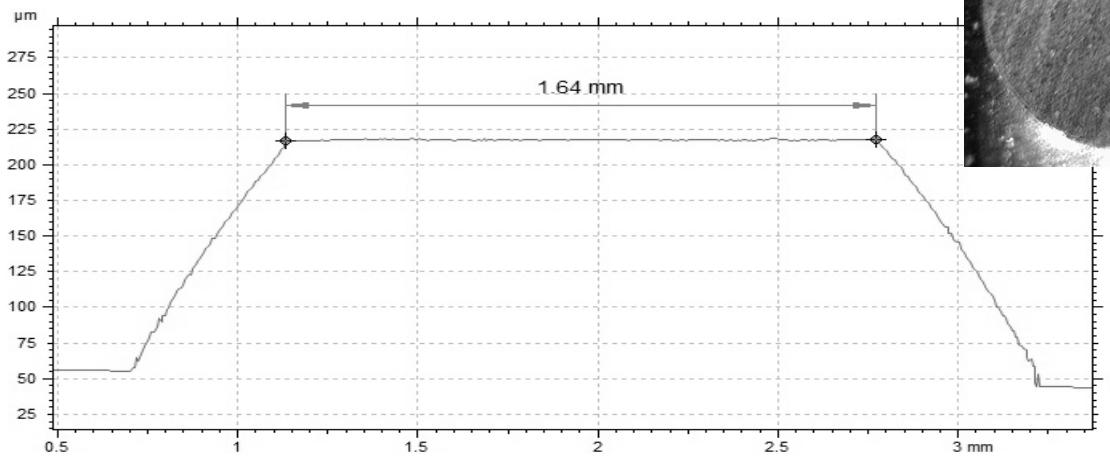
| | |
|---|---|
| Lubricant | **None** |
| Atmosphere | **Air** |
| Temperature | **23°C (room)** |
| Humidity | **35%** |

## RESULTS

**TEST 1:** Stainless Steel | Wear Rate (mm3/Nm) 1.150E-05





## RESULTS

**TEST 2:** Tungsten Carbide | Wear Rate (mm3/Nm) 1.119E-07

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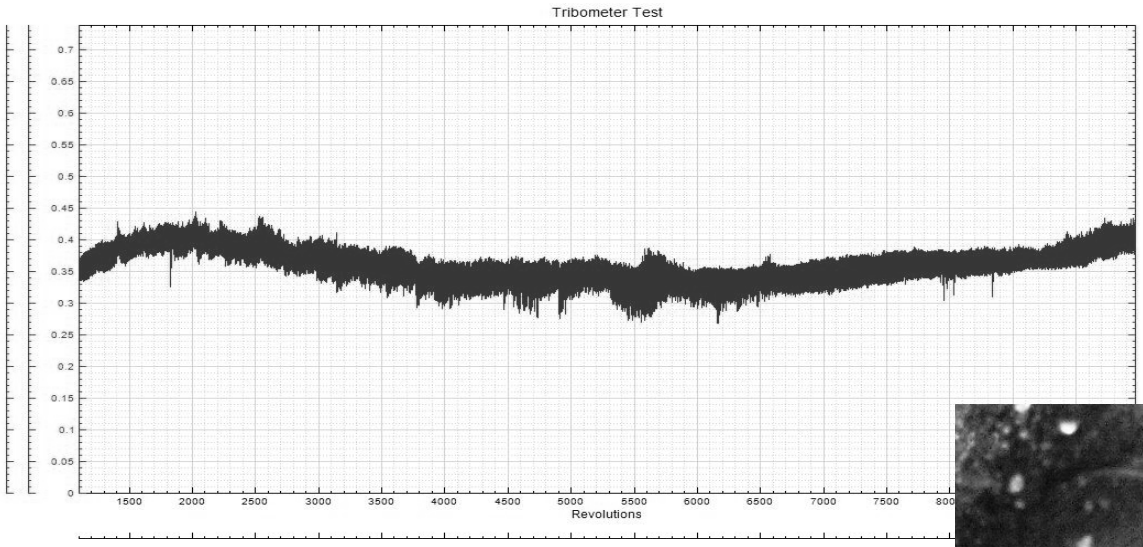


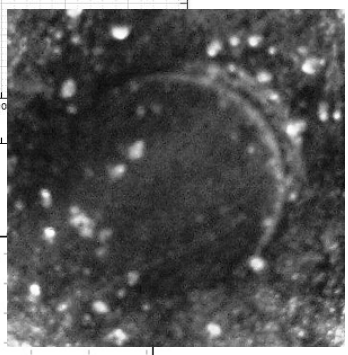

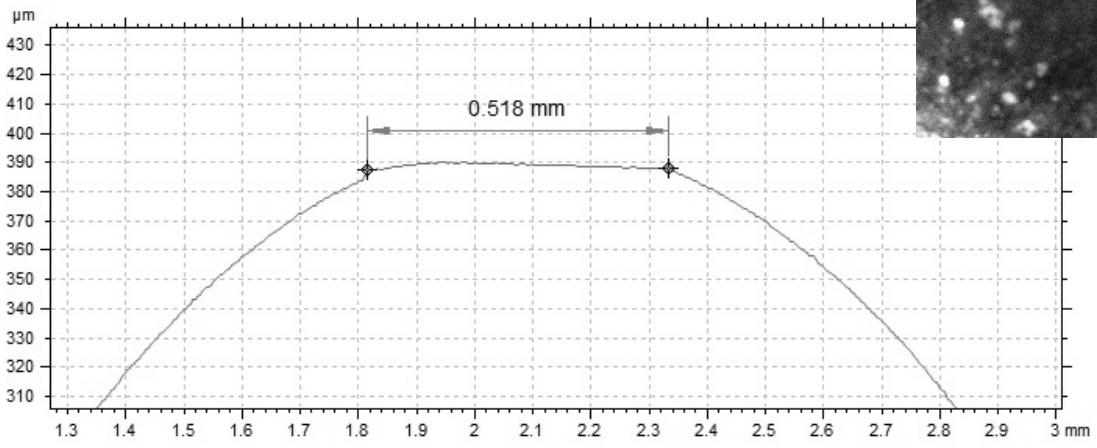


## CONCLUSION

The Nanovea Tribometer allowed for precision wear rate testing of a stainless steel and tungsten carbide ball tip performed through a rotative test method (ASTM G99). As expected, the tungsten carbide ball wore at a much lower rate than the steel ball. It was calculated that the wear rate was 100 times slower for the tungsten carbide ball. Test parameters can be adjusted, such as changing the load or adding liquids, to better simulate real-life applications. In conclusion, the Nanovea Tribometer with the PS50 Profilometer can be used to accurately measure wear rates on balls or pins which provide continuous contact wear. Doing this test on coated balls or pins would allow to clearly identify a variation of coefficient of friction at the exact point when the coating would fail.

To learn more about the Nanovea Tribometer or Lab Services