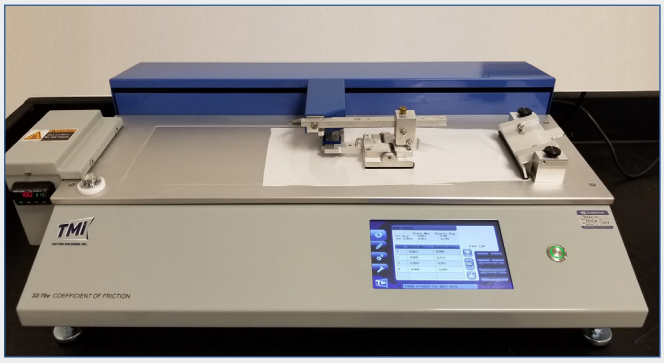
TESTING MACHINES, INC.

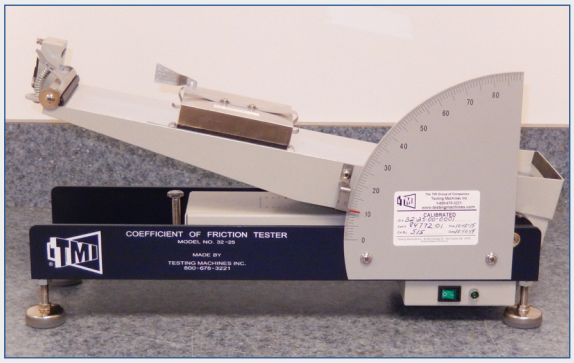
Tester Tech Tips

Packaging Series #001

Is it possible to correlate slide angle static friction with static/kinetic horizontal plane COF?

Comparing slide angle static friction and static/kinetic COF Horizontal Plane.





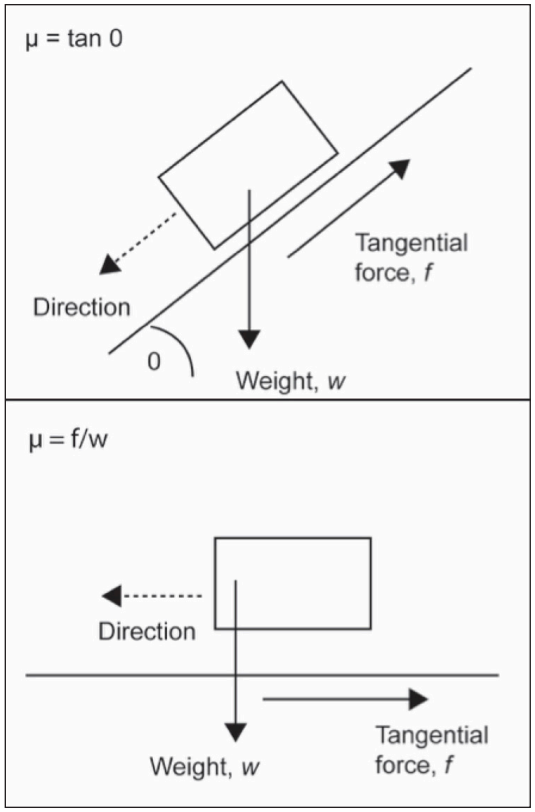
TMI offers two instruments and methods to measure static friction: The horizontal plane method and slide angle static friction method, shown above.

Slide Angle or Inclined Plane Method

TMI's Model 32-25 measures the angle at which a sliding block or sled begins to move when one end of a base plate is tilted upward. The angle is recorded at the moment when the sled begins to slide due to the gravitational forces. The inclined plane method is convenient, durable, inexpensive and is suitable for many applications where controlling the surface friction in stacking applications specifically corrugated containers. However, it lacks the precision of the horizontal plane COF method which uses a sensitive load cell to measure and record the actual force during a test.

Coefficient of Friction by Horizontal Plane

TMI's Model 32-76e Friction/Peel measures both the static and kinetic friction of a sliding block in a horizontal plane. Typically, a 1000 gram load cell is used on most instruments for this test. There are a number of factors that influence static friction such as dwell time, operator positioning and condition of the sled. It should be noted that a higher degree of variability is generally reported for the static friction about 4-15%. Kinetic/dynamic friction is the preferred measurement and generally has a variability of 2-8%.



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Comparing Slide Angle to Horizontal Plane

Friction measurements are empirical and dynamic. The test data is based on the surface properties of the material at the time of the measurement and subject to change. Many other factors including surface roughness and surface energy make it difficult to obtain a direct correlation. Although a chart exists to convert slide angle data to static friction by horizontal plane method, changes in material surface conditions of the substrates make this correlation difficult to reproduce.

Factors Which Affect Test Data

Is it possible to compare slide angle COF to static COF-horizontal plane?

The sample preparation procedure of attaching the specimen to the sled and placing the sled on the base of the instrument may influence the test result.

After the sled is placed on the sheet blocking, adhesion occurs between the sample mounted to the sled and the sample mounted on the plate.

When mounting the sled on the test strip, air gaps exist between the two sheets. Over time the air dissipates which increases the bond between the two surfaces. The longer the sled rests on the test sheet the higher the static friction result.

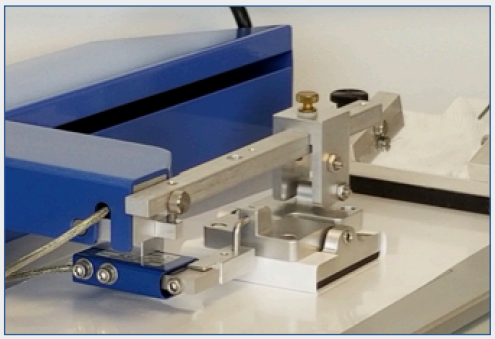
As mentioned, static COF data has a higher degree of variability than kinetic. For this reason, when measuring friction by the horizontal plane method, many labs rely completely on kinetic friction for material control.

Also, due to the variations in static COF as mentioned above, comparing the data between slide angle and horizontal plane measurements may not be meaningful.

Factors Affecting Static CoF Reproducibility

- Differences in the speed of the sampling rate or number of force data points per second captured during static test time
- Differences in the dwell time or seconds from the time the sled is placed on the sample until the sled movement begins. The longer the time the sled is resting on the sample, the higher the static COF.
- Applying too much positive or negative force against the load cell when placing the sled on the sample before testing
- Zeroing the instrument after placing the sled on the substrate before testing. Do not adjust the zero reading after placing the sled on the sample.
- Condition of the rubber surface area of the sled. Check the outer edges of the rubber, evaluate if the edges are worn. If the area of the rubber is reduced from wear, then the static kinetic friction result will be lower.
- Changes in durometer hardness of the rubber between sleds
- Differences in the surface topography/roughness of the base plate
- Sample pressure and placement of the sled before the test begins
- Rubbing the sled and sample against each other before the test begins
- Differences in the acceleration speed at the start of the test
- Ageing of the material

Friction Testers Offered by TMI



Testing Machines offers Model 32-25 Slide Angle and Model 32-76e Horizontal plane method for static and kinetic COF. Model 32-76 can be interfaced to GraphMaster PC software to record static/kinetic curve analysis and data storage.

A new magnetic sled Model 32-76-02 was recently introduced to improve sample preparation and reduce operator influence.