Designation: G143 – 23

Standard Test Method for Measurement of Web/Roller Friction Characteristics[1]

This standard is issued under the fixed designation G143; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers the simulation of a roller/web transport tribosystem and the measurement of the static and kinetic coefficient of friction of the web/roller couple when sliding occurs between the two. The objective of this test method is to provide users with web/roller friction information that can be used for process control, design calculations, and for any other function where web/roller friction needs to be known.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D883 Terminology Relating to Plastics

D1894 Test Method for Static and Kinetic Coefficients of Friction of Plastic Film and Sheeting (Withdrawn 2023)[3]

D3108/D3108M Test Method for Coefficient of Friction, Yarn to Solid Material

E8/E8M Test Methods for Tension Testing of Metallic Materials

E122 Practice for Calculating Sample Size to Estimate, With Specified Precision, the Average for a Characteristic of a Lot or Process

E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

G40 Terminology Relating to Wear and Erosion

G115 Guide for Measuring and Reporting Friction Coefficients

G117 Guide for Calculating and Reporting Measures of Precision Using Data from Interlaboratory Wear or Erosion Tests (Withdrawn 2016)[3]

G163 Guide for Digital Data Acquisition in Wear and Friction Measurements (Withdrawn 2016)[3]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *blocking, n*—unintentional adhesion between plastic films or between a film and another surface. **D883**

3.1.2 *coefficient of friction, μ, n—in tribology*, the dimensionless ratio of the friction force (*F*) between two bodies to the normal force (*N*) pressing these bodies together. **G40**

3.1.3 *friction force, n*—the resisting force tangential to the interface between two bodies when, under the action of external force, one body moves or tends to move relative to the other. **G40**

3.1.4 *kinetic coefficient of friction, n*—the coefficient of friction under conditions of macroscopic relative motion between two bodies. **G40**

3.1.5 *stick-slip, n*—a cyclic fluctuation in the magnitudes of friction force and relative velocity between two elements in sliding contact, usually associated with a relaxation oscillation dependent on elasticity in the tribosystem and on a decrease of the coefficient of friction with onset of sliding or with increase of sliding velocity. **G40**

3.1.5.1 *Discussion*—Classical or true stick-slip, in which each cycle consists of a stage of actual stick followed by a stage of overshoot slip, requires that the kinetic coefficient is lower than the static coefficient. A modified form of relaxation oscillation, with near-harmonic fluctuation in motion, can occur when the kinetic coefficient of friction decreases gradually with increasing velocity within a certain velocity range. A

[1] This test method is under the jurisdiction of ASTM Committee G02 on Wear and Erosion and is the direct responsibility of Subcommittee G02.50 on Friction.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] The last approved version of this historical standard is referenced on www.astm.org.

third type of stick-slip can be due to spatial periodicity of the friction coefficient along the path of contact. Random variations in friction force measurement do not constitute stick-slip.

3.1.6 *triboelement, n*—one of two or more solid bodies which comprise a sliding, rolling, or abrasive contact, or a body subjected to impingement or cavitation. G40

3.1.6.1 *Discussion*—Contacting triboelements may be in direct contact, or may be separated by an intervening lubricant, oxide, or other film that affects tribological interactions between them.

3.1.7 *tribosystem, n*—any system that contains one or more triboelements, including all mechanical, chemical, and environmental factors relevant to tribological behavior. G40

4. Summary of Test Method

4.1 This test method can be used to measure the friction characteristics of a flexible web as it slides on a cylindrical surface. The web conforms to the cylindrical surface in the area of wrap.

4.2 The test method is conducted on a narrow web or strip taken from a web of interest. One end of the strip is draped over a stationary cylinder and the other end is affixed to a force measuring device. A mass is applied to the free end of the strip and the strip is pulled by a mechanism that moves the force transducer perpendicular to the long axis of the cylindrical surface. The force encountered in pulling the strip in contact with the stationary cylinder (roller) is continuously measured and recorded. The static and kinetic coefficients of friction are calculated from the force measured by the force transducer.

5. Significance and Use

5.1 This test method is intended to simulate the slip of a flexible web on a roller in a machine or tribosystem that conveys web materials. Flexible webs such as plastic sheeting, paper, elastomers, metal foils, and cloth are often transported in manufacturing processes by combinations of driving and idler rollers. The friction characteristics of the web/roller interface often affects the web transport process. If the web/roller friction is too low, the web can slip on the rollers and be damaged or damage the roller. High friction on the other hand, can lead to steering problems and overloading of driving motors.

5.2 This test method can be used to rank rollers for their ability to resist slip versus a particular web material (high friction). Conversely this test method can assess web materials or web surface coatings such as waxes and lubricants. In this latter case, the goal may be a low-friction product made from a web (film, magnetic media, paper, and so forth).

5.3 If a tribosystem involves transport of a flexible web on a roller, this is an appropriate test to use to measure the friction characteristics of the roller/web couple.

6. Apparatus

6.1 Two possible configurations of the test are shown in Figs. 1 and 2. The essential features of the apparatus are:

6.1.1 A force measuring device attached to one member of the friction couple,

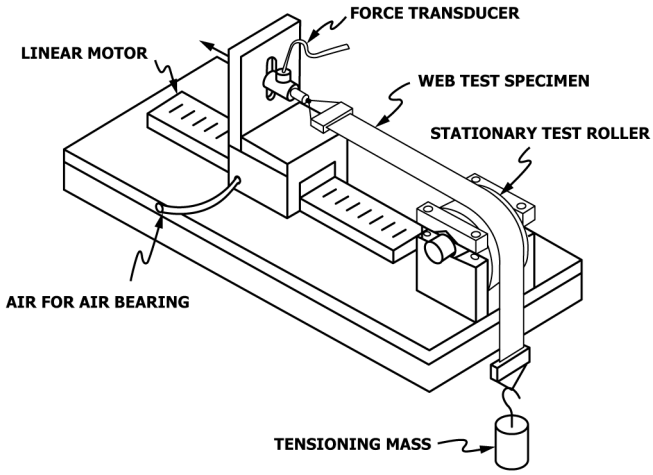

FIG. 1 Schematic of Capstan Friction Test

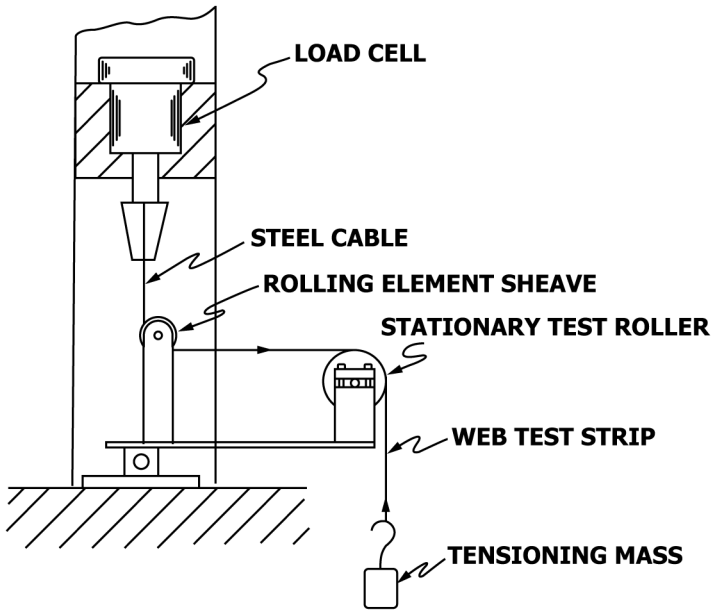

FIG. 2 Use of Tensile Test Machine to Perform the Capstan Friction Test

6.1.2 A stationary cylindrical surface to be used as one member of the friction couple,

6.1.3 A system to move the flexible strip (web) member of the friction couple, and

6.1.4 Masses to be used to tension the free end of the test strip.

6.2 *Force Measurement*—Commercially available or home-made strain gage or similar force transducers are acceptable. The device should be linear in the force range anticipated in testing and the transducer shall be calibrated with known masses or a similar system for each use.

6.2.1 Force transducers shall be accurate within 1 % of the rated scale of the device and should have overload protection. The friction force during the entire test should be recorded. (**Warning—**Digital filters can alter the force data to the point where the data are not valid. Analog strip chart recorders have