



Standard Guide for Determining Friction Energy Dissipation in Reciprocating Tribosystems¹

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1. Scope

1.1 This guide covers and is intended for use in interpreting the friction forces recorded in reciprocating tribosystems. The guide applies to any reciprocating tribosystem, whether it is a wear or fretting test or an actual machine or device.

1.2 The energy dissipation guide was developed in analyzing friction results in the Test Method **G133** reciprocating ball-on-flat test, but it applies to other ASTM or ISO reciprocating tests. This technique is frequently used to record the friction response in fretting tribosystems.

1.3 Specimen material may play some role in the results if the materials under test display viscoelastic behavior. This guide as written is for metals, plastics, and ceramics that do not display viscoelastic behavior. It also applies to lubricated and non-lubricated contacts.

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

1.5 *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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*²

G40 Terminology Relating to Wear and Erosion

G115 Guide for Measuring and Reporting Friction Coefficients

G133 Test Method for Linearly Reciprocating Ball-on-Flat Sliding Wear

G163 Guide for Digital Data Acquisition in Wear and

Friction Measurements

3. Terminology

3.1 *Definitions:*

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

3.1.2 *fretting*—small amplitude oscillatory motion, usually tangential between two solid surfaces in contact. **G40**

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *friction envelope*—when making friction energy loss measurements, the graphic representation of the cyclic friction force versus time history of a tribosystem in which the boundaries surrounding these variations in time produces a shape with a measurable area.

3.2.2 *reciprocating tribosystem*—sliding system where the direction of motion of the moving member periodically reverses (for example, piston in a cylinder).

3.3 *Acronyms:*

3.3.1 *DAS, n* —data acquisition system.

3.3.2 *FED, n* —friction energy dissipated. The work required to overcome the resistance to motion encountered in sliding one solid on another expressed in energy units (joules).

3.3.3 *RFED, n* —relative friction energy dissipated. The work required to overcome the resistance to motion encountered in sliding one solid on another solid expressed in arbitrary units for comparison studies on candidate tribocouples.

4. Summary of Guide

4.1 Frictional effects can be a concern in many tribosystems so it is common to monitor friction force in laboratory tests and even field evaluations of machines. There are many ways of reporting the recorded friction forces: friction force (see Guide **G115**), average friction force for a test, average coefficient of friction, static and kinetic coefficient of friction, coefficient of friction at periodic time intervals, etc. This guide presents a methodology to convert friction forces monitored throughout a test cycle into a test metric called *friction energy dissipated* (FED). For within-lab tests the metric is *relative friction energy*

¹ This guide 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.