



Designation: G204 – 10

Standard Test Method for Damage to Contacting Solid Surfaces under Fretting Conditions¹

This standard is issued under the fixed designation G204; 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.

INTRODUCTION

Fretting is small amplitude oscillating motion usually in the range of 10 to 300 μm . Contacting solid surfaces subjected to this type of motion can develop significant damage in the form of mass loss, pitting, debris generation, etc. Frequently, pitting damage caused by fretting creates stress concentrations that contribute to mechanical failures. Most material couples are susceptible to fretting damage and this test method is intended to assess a tribocouple's relative susceptibility to damage under fretting conditions.

When tribocouples experience oscillating relative motion less than about 10 μm , gross slip (all points in a contact experience relative slip over a complete cycle) may not occur. The elastic behavior of the real contacts may accommodate this motion and fretting damage may not occur.

When metal couples are subjected to fretting motion, there is a potential for chemical reaction with the ambient environment to be a component of the damage. In metals rubbing in air, oxidation of freshly fractured surfaces can occur. When chemical reaction is conjoint with the mechanical damage produced by fretting, it is called fretting corrosion. When most plastic couples are damaged by fretting motion, the fractured surfaces may not react with the environment and fretting wear occurs as opposed to fretting corrosion.

1. Scope

1.1 This test method covers the studying or ranking the susceptibility of candidate materials to fretting corrosion or fretting wear for the purposes of material selection for applications where fretting corrosion or fretting wear can limit serviceability.

1.2 This test method uses a tribological bench test apparatus with a mechanism or device that will produce the necessary relative motion between a contacting hemispherical rider and a flat counterface. The rider is pressed against the flat counterface with a loading mass. The test method is intended for use in room temperature air, but future editions could include fretting in the presence of lubricants or other environments.

1.3 The purpose of this test method is to rub two solid surfaces together under controlled fretting conditions and to quantify the damage to both surfaces in units of volume loss for the test method.

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](#)

[G99 Test Method for Wear Testing with a Pin-on-Disk Apparatus](#)

[G133 Test Method for Linearly Reciprocating Ball-on-Flat Sliding Wear](#)

3. Terminology

3.1 *Definitions:*

¹ This test method is under the jurisdiction of ASTM Committee [G02](#) on Wear and Erosion and is the direct responsibility of Subcommittee [G02.40](#) on Non-Abrasive Wear.

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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.

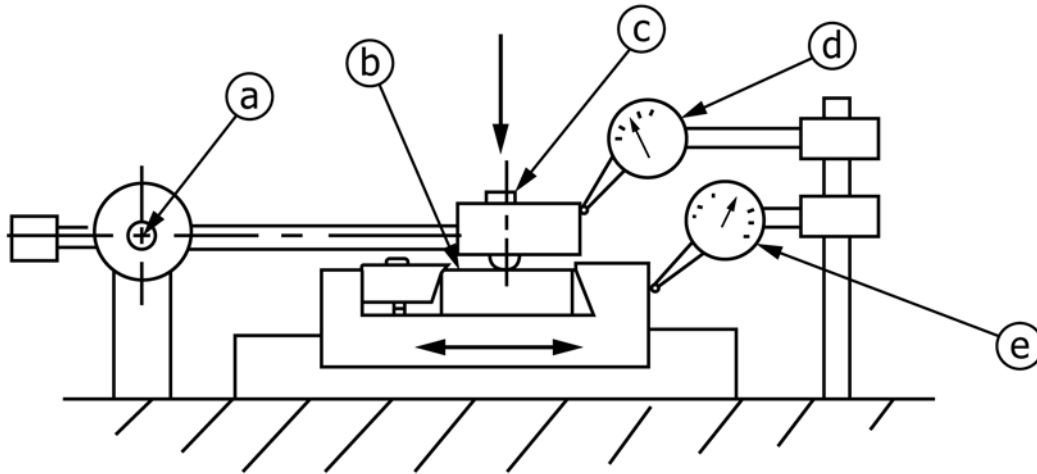


FIG. 1 Schematic of a Suitable Fretting Testing Rig

- a* = loading arm pivot
- b* = counterface test specimen
- c* = rider test specimen
- d* = device to measure rider movement
- e* = device to measure counterface movement

3.1.1 *fretting*, *n*—in tribology, small amplitude oscillating motion usually tangential between two solid surfaces in contact. **G40**

3.1.2 *fretting corrosion*, *n*—form of fretting wear in which corrosion plays a significant role. **G40**

3.1.3 *fretting wear*, *n*—wear arising as a result of fretting. **G40**

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *coefficient of variation (COV)*, *n*—test standard deviation divided by the test mean.

3.2.2 *counterface*, *n*—flat surface that the rider rubs on in this test.

3.2.3 *crater*, *n*—counterface damage in a fretting test from a hemispherical or spherical rider characterized by loss of material in the form of a surface depression.

3.2.4 *fretting amplitude*, *n*—sliding distance between direction reversals (for example, if a dial indicator is used to measure stroke, the amplitude is the indicator movement on the dial).

3.2.5 *rider*, *n*—ball or hemisphere that oscillates on another surface to produce fretting damage.

3.2.6 *scar*, *n*—damage to either rider or counterface in a fretting test.

4. Summary of Test Method

4.1 This test method rubs a spherical or hemispherical solid rider on a solid flat under prescribed conditions to produce fretting damage on one or both surfaces. If damage occurs, it is quantified as a wear volume on each member and as system wear, the sum of the rider and counterface wear.

4.2 Friction forces can be measured during the fretting test, but these measurements, as well as reporting these data, is optional.

5. Significance and Use

5.1 Fretting wear and corrosion are potential serviceability factors in many machines. They have always been factors in shipping finished goods by truck or rail. Packing materials rubbing on a product in transit can make the product unsalable. Beverage cans and food cans can lose their trade dress and consumers often equate container damage to content damage.

5.2 Clamping surfaces on injection molds are damaged by fretting motions on clamping. This damage is a significant cause for mold replacement.

5.3 Machines in shipment are subject to fretting damage in the real area of contact of the bearings on the machines.

5.4 Operating vibration and movement of mechanically clamped components, like screwed assemblies, can produce damage on the clamped faces and other faces that affects machine function or use. Many times fretting damage appears in the form of pits, which are stress concentrators that can lead to mechanical fractures.

5.5 Electrical contacts in any device that is subject to vibration are susceptible to failure (open circuit) due to fretting damage at real areas of contact.

5.6 This test method is intended to be used to identify mating couples that may be less prone to fretting damage than others. This information in turn is used to select materials of construction or surface treatments that are less prone to fretting damage for applications where fretting conditions are known or perceived to exist.