



# Standard Test Method for Galling Resistance of Material Couples<sup>1</sup>

This standard is issued under the fixed designation G 196; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This test method covers a laboratory test that ranks the galling resistance of material couples using a quantitative measure. Bare metals, alloys, nonmetallic materials, coatings, and surface modified materials may be evaluated by this test method.

1.2 This test method is not designed for evaluating the galling resistance of material couples sliding under lubricated conditions, because galling usually will not occur under lubricated sliding conditions using this test method.

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

1.4 *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:*<sup>2</sup>

**G 40** Terminology Relating to Wear and Erosion

**G 98** Test Method for Galling Resistance of Materials

## 3. Terminology

3.1 Definitions used in this test method given in Terminology **G 40**.

3.2 *Definitions:*

3.2.1 *apparent area of contact*—area of contact between two solid surfaces defined by the boundaries of their macroscopic interface.

3.2.2 *galling*—form of surface damage arising between sliding solids, distinguished by macroscopic, usually localized, roughening and creation of protrusions above the original surface; it often includes plastic flow or material transfer, or both.

3.2.3 *triboelement*—one of two or more solid bodies that comprise a sliding, rolling, or abrasive contact, or a body subjected to impingement or cavitation. (Each triboelement contains one or more tribosurfaces.)

3.2.4 *tribosurfaces*—any surface (of a solid body) that is in moving contact with another surface or is subjected to impingement or cavitation.

3.2.5 *tribosystem*—any system that contains one or more triboelements, including all mechanical, chemical, and environmental factors relevant to the tribological behavior. (See also *triboelement*.)

3.3 *Definitions of Terms Specific to This Standard:*

3.3.1 *galling<sub>50</sub>*—stress at which the probability of galling occurring on one or both of the test specimens is 50%.

## 4. Summary of Test Method

4.1 This test method uses available laboratory equipment capable of maintaining a constant, compressive load between two flat specimens, such as hydraulic compression testing machines. One specimen is slowly rotated one complete revolution relative to the other specimen. The surfaces are examined for galling after sliding. The criterion for whether galling occurs is the appearance of the specimens based on unassisted visual examination.

4.2 Appropriate load intervals are chosen to determine the threshold galling stress within an acceptable range.

4.3 The higher the Galling<sub>50</sub> value, the more galling resistant is the test couple.

<sup>1</sup> 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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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

## 5. Significance and Use

5.1 This test method is designed to rank material couples in their resistance to the failure mode caused by galling and not merely to classify the surface appearance of sliding surfaces.

5.2 This test method has been shown to have higher repeatability than Test Method **G 98** in determining the galling resistance. Test Method **G 98** can be used for initial ranking of galling resistance.

5.3 This test method should be considered when damaged (galled) surfaces render components non-serviceable. Experience has shown that galling is most prevalent in sliding systems that are slow moving and operate intermittently. The galling and seizure of threaded components is a classic example that this test method most closely simulates.

5.4 Other galling-prone examples include: sealing surfaces of valves that may leak excessively due to galling and pump wear rings that may function ineffectively due to galling.

5.5 If the equipment continues to operate satisfactorily and loses dimension gradually, then galling is not present, and the wear should be evaluated by a different test method.

5.6 This test method should not be used for quantitative or final design purposes, since many environmental factors influence the galling performance of materials in service. Lubrication, alignment, stiffness, and geometry are only some of the factors that can affect how materials perform. This test method has proven valuable in screening materials for prototypical testing that more closely simulates actual service conditions.

## 6. Apparatus

6.1 Commonly available laboratory equipment has been used to conduct galling tests. Any apparatus that can apply and maintain a constant compressive load should be acceptable. The use of a displacement controlled machines is generally not acceptable for this test because small variations in displacement of the specimens leads to large changes in the applied load.

6.2 The alignment of the specimens is accomplished via the alignment pin shown in **Fig. 1**. This pin is readily fabricated by press fit of a tooling ball into a drill rod or similar shaft with an appropriately sized hole machined into the end of the pin. Tooling balls are relatively inexpensive and readily available from industrial suppliers.

6.3 A hardened steel ball with a diameter of 9.53 mm is required for the testing procedure.

## 7. Test Specimen

7.1 This test method uses two concentric hollow cylindrical specimens with the ends mated. This results in area contact in the shape of an annulus. One specimen is rotated about its axis and the other is held fixed.

7.2 A typical geometry of the specimen is shown in **Fig. 2**.

7.3 The critical dimensions of the specimens are the 12.70-mm outer diameter and the 6.375-mm hole. All other dimensions may be varied to the user's convenience. The hex shape shown on the specimen is not required, however, it does provide a convenient means of gripping the specimens during testing.

7.4 A critical feature of the specimens is the flatness. The contact surface of the specimen shall be flat within 0.005 mm to ensure area contact. Flatness can be measured using a dial indicator.

## 8. Procedure

8.1 An overall view of the galling test setup is shown in **Fig. 3**.

8.2 *Cleaning*—Immediately prior to testing, clean the test surfaces of the new specimens using a procedure that will remove any scale, oil film, or foreign matter. The following cleaning technique is suggested for metallic specimens:

8.2.1 Clean the specimens in an ultrasonic cleaner using mild ultrasonic cleaning detergent and warm water for 10 min.

8.2.2 Rinse the specimens thoroughly with water.

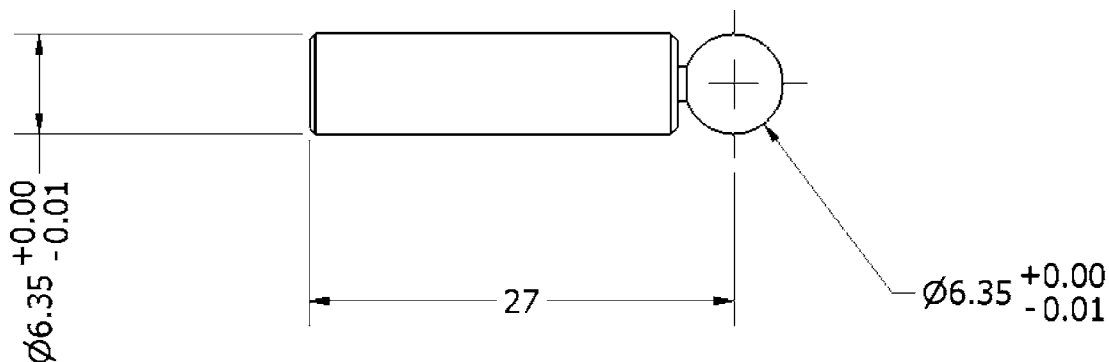
8.2.3 Repeat this process using fresh solution.

8.2.4 After the final cleaning, dry the specimens with a lint-free wipe.

8.2.5 Remove any spotting with acetone and a lint-free wipe.

8.3 Mount the new specimens in the loading device. Lightly load the specimens. Twist the specimens relative to each other approximately 45° to ensure proper seating of the wear surfaces.

8.4 Apply the selected load and rotate one specimen one revolution using an open-end wrench or other tool in order to grip the specimens. A mechanized system may also be used to



**FIG. 1** Geometry of Alignment Pin (all dimensions are in mm)