Designation: G 137 – 97 (Reapproved 2003)

Standard Test Method for Ranking Resistance of Plastic Materials to Sliding Wear Using a Block-On-Ring Configuration[1]

This standard is issued under the fixed designation G 137; 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 a laboratory procedure to measure the resistance of plastic materials under dry sliding conditions. The test utilizes a block-on-ring geometry to rank materials according to their sliding wear characteristics under various conditions.

1.2 The test specimens are small so that they can be molded or cut from fabricated plastic parts. The test may be run at the load, velocity, and temperature which simulate the service condition.

1.3 Wear test results are reported as specific wear rates calculated from volume loss, sliding distance, and load. Materials with superior wear resistance have lower specific wear rates.

1.4 This test method allows the use of both single- and multi-station apparatus to determine the specific wear rates.

1.5 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.6 *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:*

D 618 Practice for Conditioning Plastics for Testing[2]

D 3702 Test Method for Wear Rate and Coefficient of Materials in Self-Lubricated Rubbing Contact Using a Thrust Washer Testing Machine[3]

E 122 Practice for Calculating Sample Size to Estimate, With a Specified Tolerable Error, the Average for Characteristic of a Lot or Process[4]

E 177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods[4]

G 40 Terminology Relating to Wear and Erosion[5]

G 77 Test Method for Ranking Resistance of Materials to Sliding Wear Using Block-on-Ring Wear Test[5]

G 117 Guide for Calculating and Reporting Measures of Precision Using Data from Interlaboratory Wear or Erosion Tests[5]

3. Terminology

3.1 *Definitions:*

3.1.1 *wear*—damage to a solid surface, generally involving progressive loss of material, due to relative motion between that surface and a contacting substance or substances.

3.1.2 Additional definitions relating to wear are found in Terminology G 40.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *specific wear rate*—the volume loss per unit sliding distance, divided by the load. It can be calculated as the volume loss per unit time, divided by the load and the sliding velocity.

3.2.2 *steady state specific wear rate*—the specific wear rate that is established during that part of the test when the specific wear rate remains substantially constant (the specific wear rate versus sliding distance curve flattens out considerably with less than 30 % difference between the specific wear rates) during a minimum of three time intervals spanning a total time duration of at least 18 h, with ideally no single interval exceeding 8 h. However, one time interval during the steady state can be as long as 16 h.

4. Summary of Test Method

4.1 A plastic block of known dimensions is brought into contact with a counterface ring (usually metal) under controlled conditions of contact pressure and relative velocity. This is achieved using a block-on-ring configuration as illustrated in Fig. 1. Periodic weighing of the polymer block results in a number of mass-time data points where the time relates to the time of sliding. The test is continued until the steady state wear rate is established. Mass loss measurements made after the steady state is established are used to determine the steady state specific wear rate, which is the volume loss per unit sliding distance per unit load. The frictional torque may also be

[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] *Annual Book of ASTM Standards*, Vol 08.01.

[3] *Annual Book of ASTM Standards*, Vol 05.02.

[4] *Annual Book of ASTM Standards*, Vol 14.02.

[5] *Annual Book of ASTM Standards*, Vol 03.02.

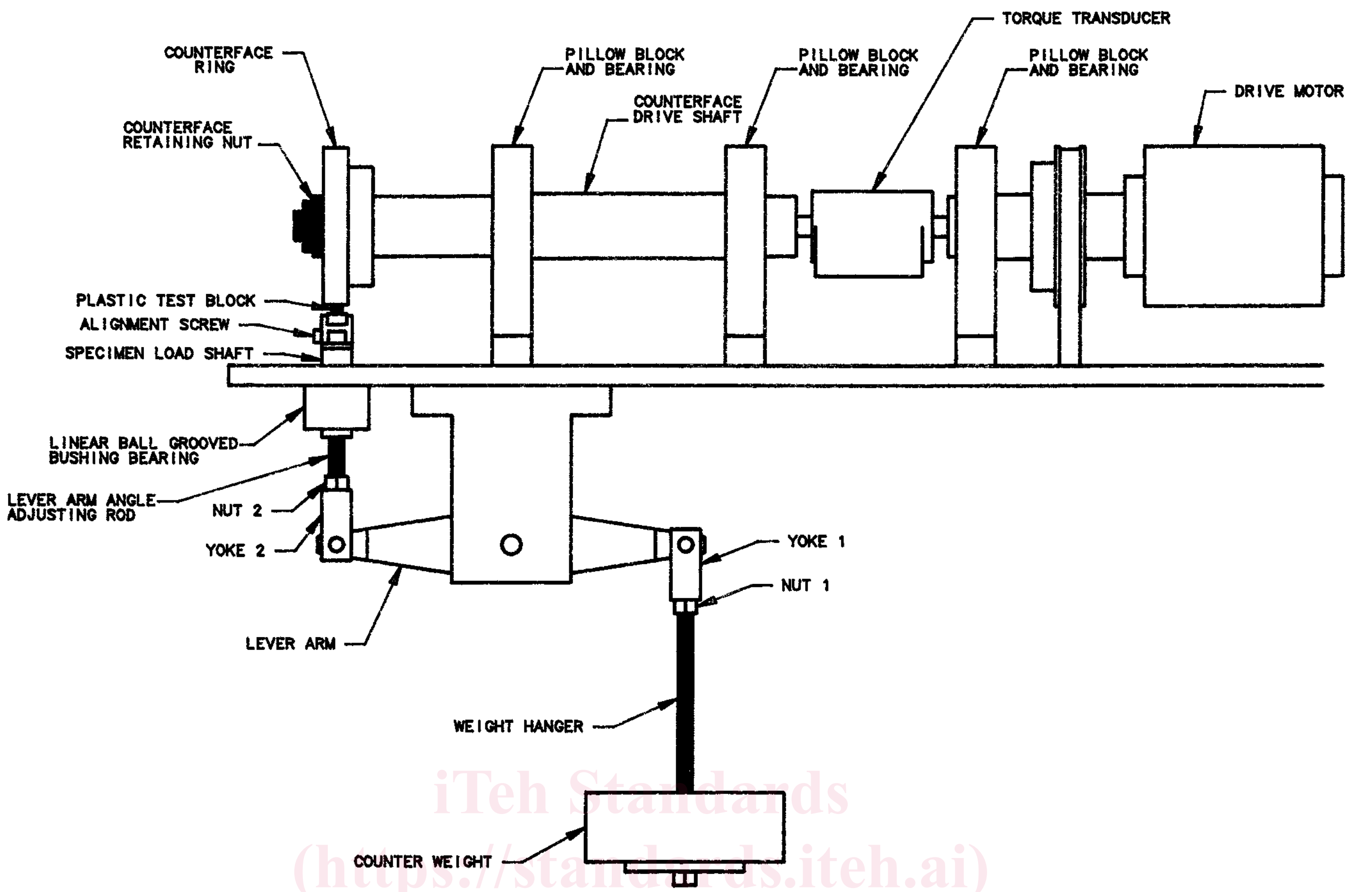


FIG. 1 Single Station Block-on-Ring Arrangement

measured during the steady state using a load cell. These data can be used to evaluate the coefficiency of friction for the test combination.

NOTE 1—Another test method that utilizes a block-on-ring test configuration for the evaluation of plastics is Test Method G 77.

5. Significance and Use

5.1 The specific wear rates determined by this test method can be used as a guide in ranking the wear resistance of plastic materials. The specific wear rate is not a material property and will therefore differ with test conditions and test geometries. The significance of this test will depend on the relative similarity to the actual service conditions.

5.2 This test method seeks only to describe the general test procedure and the procedure for calculating and reporting data.

NOTE 2—This test configuration allows steady state specific wear rates to be achieved very quickly through the use of high loads and speeds. The thrust washer configuration described in Test Method D 3702 does not allow for the use of such high speeds and loads because of possible overheating (which may cause degradation or melting, or both) of the specimen. Despite the differences in testing configurations, a good correlation in the ranking of wear resistance is achieved between the two tests (Table X2.1).

6. Apparatus and Materials

6.1 *Test Setup*—An example of the basic test configuration and part names are shown in Fig. 1. The recommended dimensions of the test apparatus are shown in Fig. 2. The figures shown in this test method represent one example of a block-on-ring test apparatus. The mandatory elements are: the capability to change load and sliding speed, the ability to reposition the specimen after weighing as before, and a counterface ring with acceptable eccentricity. All other design elements can be varied according to the user preference.

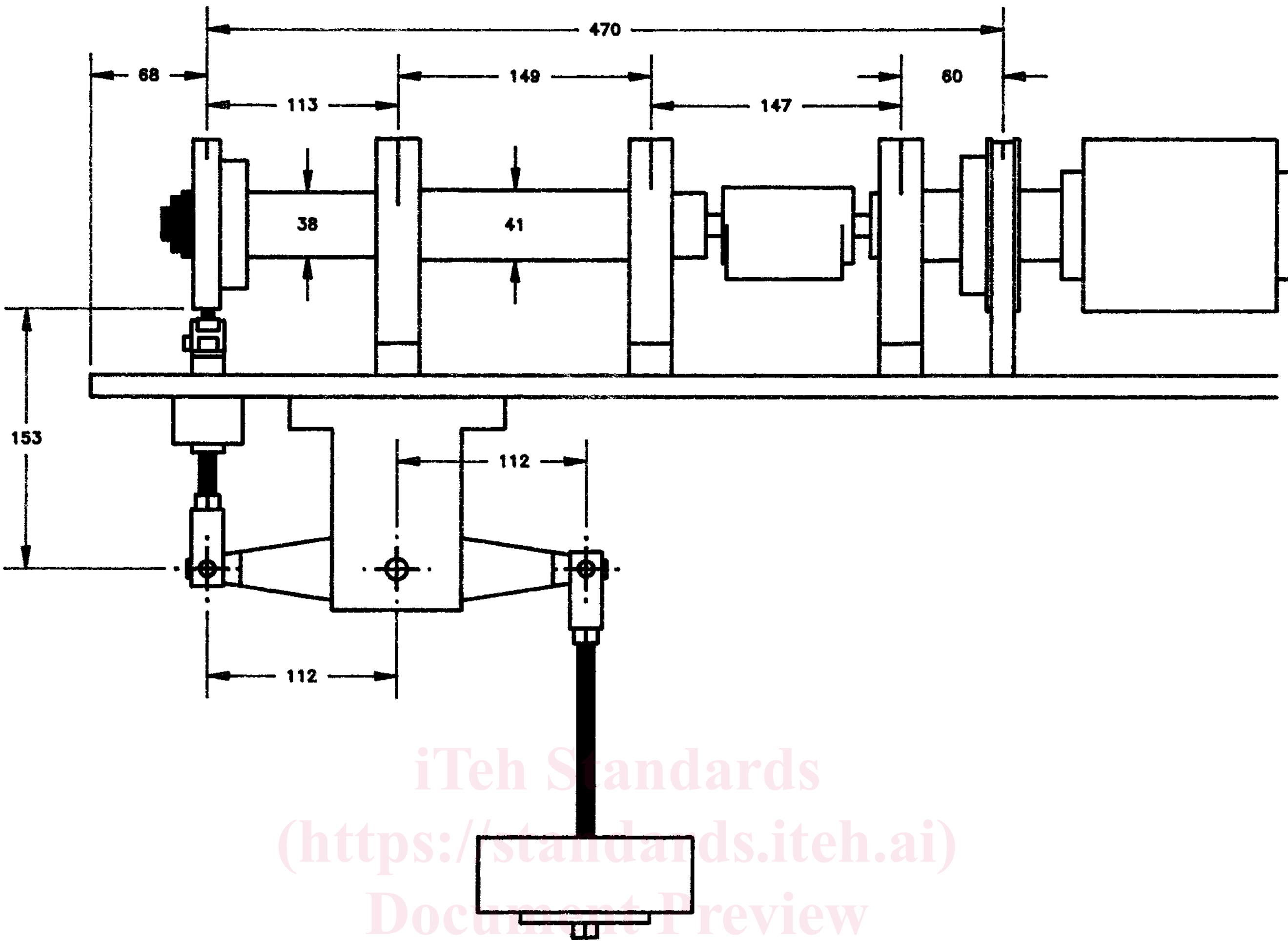
6.1.1 Bearings recommended for counterface drive shafts are industrial-grade tapered roller bearings.

6.1.2 Required centerline alignment limits of the counterface drive shafts are ±0.41 mm (±0.016 in.) from the center of a counterface ring. Allowable eccentricity of the counterface ring is no greater than ±0.06 mm (±0.002 in.).

6.1.3 Bearings recommended for the linear ball grooved bushing bearing are industrial-grade linear bearings.

6.2 *Counterface Ring*—The recommended dimensions for the counterface ring are 100 + 0.05, – 0.00-mm diameter and 15.88 + 0.30, – 0.13-mm width. Often a hardened tool steel ring with a hardness of 50 to 60 HRC and a surface roughness of 0.102 to 0.203 µm (4 to 8 µin.) R_a in the direction of sliding is used for the general evaluation of plastics. The requirement for the ring material is that it should not wear appreciably or change dimensions during the course of the test. Therefore, other materials and surface conditions may also be used. It should be noted that test results will be influenced by the choice of ring material and surface roughness.

6.3 *Test Block*—The recommended dimensions of the test block are 6.35 + 0.00, – 0.03-mm (0.250 + 0.000, – 0.001-in.)



NOTE—All dimensions are given in millimetres.

FIG. 2 Recommended Dimensions of Block-on-Ring Apparatus

width, $6.00 + 0.00, - 0.03$-mm ($0.236 + 0.000, - 0.001$-in.) depth, and 12.70 ± 0.2-mm height. For materials where surface condition is not a parameter under study, a ground surface with the grinding marks running parallel to the depth direction of the block and a roughness of 0.102 to 0.203 µm (4 to 8 µin.) R_a in the direction of motion is recommended. However, other surface conditions may be evaluated as desired.

6.4 *Test Parameters*:

6.4.1 The recommended range for the normal load is from 20 to 40 N.

6.4.2 The recommended range for the velocity is from 0.5 to 1 m/s.

6.5 *Apparatus*:

6.5.1 *Analytical Balance*, capable of measuring to the nearest 0.01 mg.

7. Reagents

7.1 Suitable cleaning procedures should be used to clean counterface ring and test block. Reagents proven suitable for some materials are:

7.1.1 *Acetone*, for steel rings, and

7.1.2 *Methanol*, for test block surface and specimen holder.

7.2 Both solvents are flammable and toxic. Refer to the relevant Material Safety Data Sheet (MSDS) before using the solvents.

8. Preparation and Calibration of Apparatus

8.1 Perform calibration of torque transducers by applying NIST traceable dead weight standards and using a reference load cell.[6]

8.2 Perform calibration of tachometer by comparison to a hand-held tachometer which has been calibrated with NIST traceable standards.

9. Conditioning

9.1 *Conditioning*—Condition the test specimens at 23 ± 2°C (73.4 ± 3.6°F) and 50 ± 5 % relative humidity for not less than 40 h prior to testing in accordance with Procedure A of Practice D 618 for those samples where conditioning is required.

[6] The interlaboratory tests were conducted using the torque transducers manufactured by Key Transducers, Inc., Sterling Heights, MI.