Designation: D2228 – 04 (Reapproved 2009)

Standard Test Method for Rubber Property—Relative Abrasion Resistance by Pico Abrader Method[1]

This standard is issued under the fixed designation D2228; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 This test method covers the determination of the abrasion resistance of vulcanized (thermoset) rubbers, thermoplastic elastomers, and elastomeric and similar materials to a standardized reference system. A standardized set of reference compounds is used to calculate relative abrasion resistance. These reference compounds are also used to determine the relative performance, within a permissible range, of the cutting knives used in performing the test.

1.2 All materials, instruments, or equipment used for the determination of mass, force, or dimension shall have traceability to the National Institute for Standards and Technology,[2] or other internationally recognized organization parallel in nature.

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

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:*[3]

D618 Practice for Conditioning Plastics for Testing

D3182 Practice for Rubber—Materials, Equipment, and Procedures for Mixing Standard Compounds and Preparing Standard Vulcanized Sheets

D4483 Practice for Evaluating Precision for Test Method Standards in the Rubber and Carbon Black Manufacturing Industries

3. Summary of Test Method

3.1 In this test method, a pair of tungsten carbide cutting knives of a specified geometry and configuration are used to abrade the surface of the specimen. The knives are lowered onto a circular test specimen, or button, which is rotated under controlled conditions of speed, time, and force on the cutting knives. A dusting powder is used as an interface between the cutting knives and the specimen to engulf the abraded rubber particles and to maintain the cutting knives relatively free from oils, resins, and the like, which may be present in the specimen and may interfere with the abrasion assessment. A series of five calibration compounds are used to determine that the sharpness of the knives and hence, the calibration of the instrument, are within the specified limits, and additionally, as reference standards to which the abrasion resistance, determined by volumetric loss, of a subject material may be compared.

4. Significance and Use

4.1 This test method may be used to estimate the relative abrasion resistance of subject materials as described in 1.1. No correlation between this accelerated test and service performance is given or implied, due, in part, to the widely varying nature of service conditions.

4.2 The formulas, for which the mixing and curing specifications are given in Annex A1, once prepared, are referred to as calibration compounds. These calibration compounds may be used to determine the performance status of the cutting knives as described in this test method.

4.3 The performance of the cutting knives may also be determined by periodically determining their dimensions as described in 6.1.7.

4.4 The calibration compounds are used as reference standards to which the abrasion resistance, determined by volume loss of a subject material, may be compared.

4.5 Once the resistance to abrasion is established, using this methodology, for a specific material, the results achieved may

[1] This test method is under the jurisdiction of ASTM Committee D11 on Rubber and is the direct responsibility of Subcommittee D11.15 on Degradation Tests.

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[2] Available from National Institute of Standards and Technology (NIST), 100 Bureau Dr., Stop 3460, Gaithersburg, MD 20899-3460.

[3] 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.

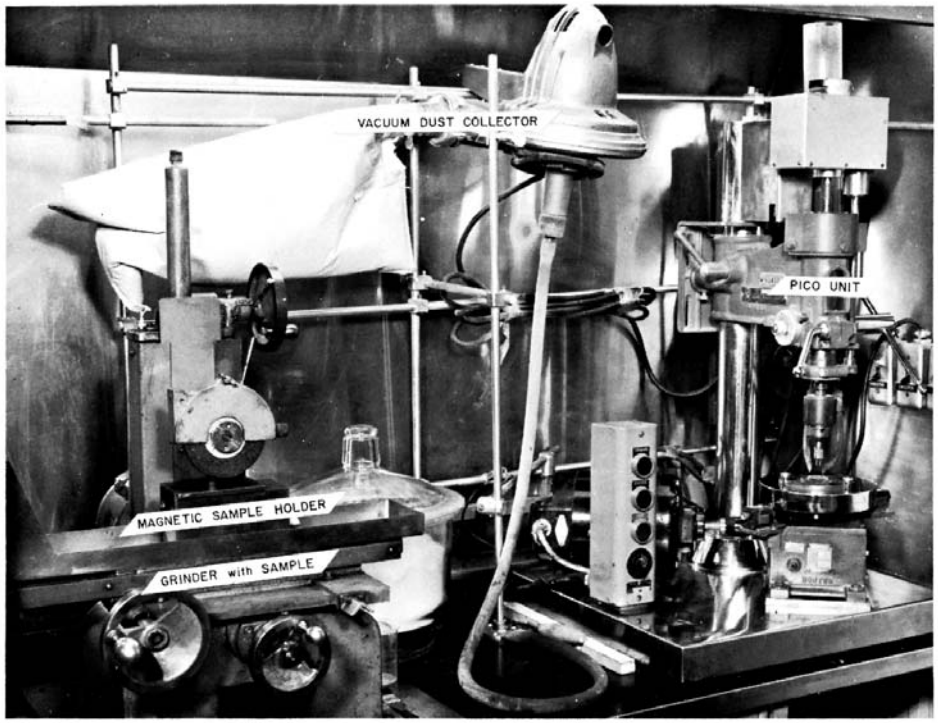

FIG. 1 Typical Pico Tester

be used as a basis for future comparative analysis of identical materials, either as agreed upon between laboratories, or between customer and supplier.

5. Interference

5.1 This test method is conducted under controlled conditions, except for the sharpness of the cutting knives. The behavior of the materials, as described in 1.1, yield varying results with respect to the cutting knives. This variation can be minimized by maintaining the knives in accordance with recommendations outlined in Section 9.

6. Apparatus

6.1 *Pico Tester,* the apparatus is illustrated in Fig. 1.

6.1.1 *Turntable,* on which the test specimen is mounted and rotated, having the capability of maintaining 1.00 ± 0.03 Hz (rps) throughout the duration of a test cycle (see Section 10).

6.1.2 *Instrument Frame,* with armature assembly that holds and lifts the cutting knives. Mounted on top of the assembly is a "dead-weight load box" in which masses (weights) may be placed to regulate the force on the cutting knives (see Section). The assembly moves freely in a bearing housing that permits vertical motion but counteracts the reaction torque on the cutting knives, thus preventing rotation. Vertical travel, once knives have been lowered onto the test specimen, is restricted by an arm lock.

6.1.3 *Drive Motor,* with forward, reverse, and stop controls to govern the operation of the turntable.

6.1.4 *Dusting Powder Reservoir* and *Feeder Tubes*, capable of supplying a uniform flow of dusting powder at the rate of 5 mg/s to the interface of the cutting knives and test specimen during operation (see Section 10).

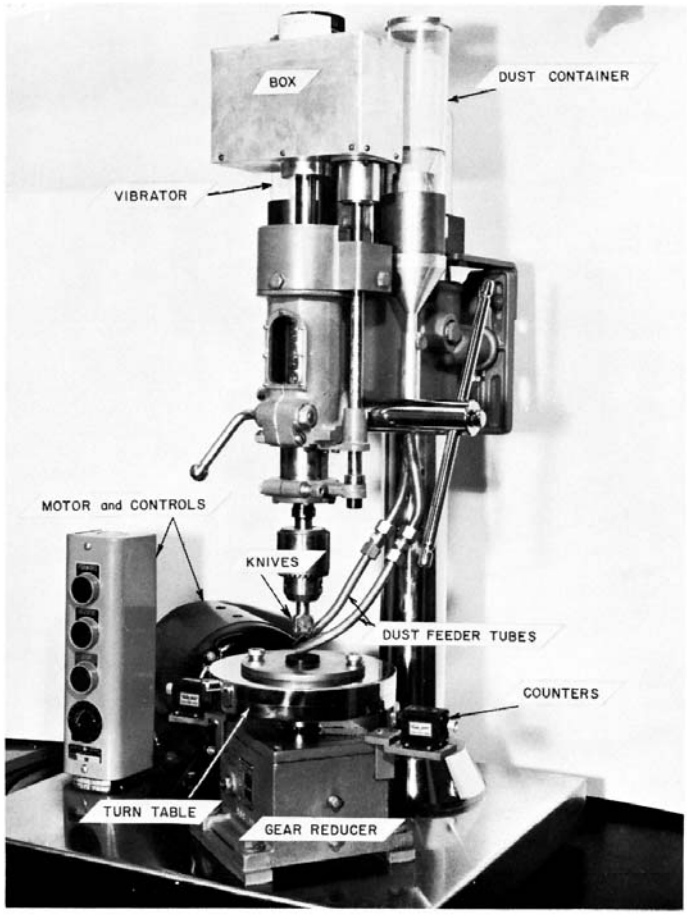

FIG. 1 Typical Pico Tester *(continued)*

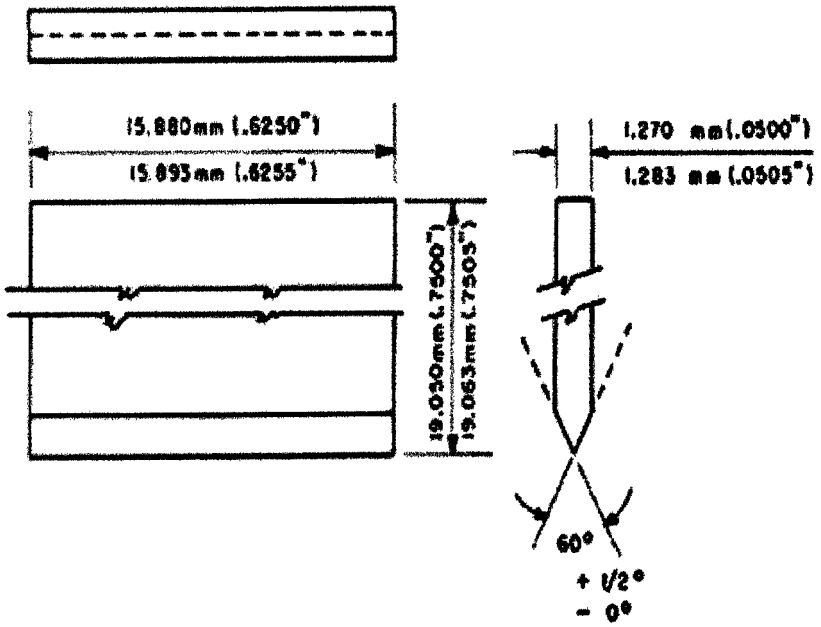

FIG. 2 Pico Cutting Knives

6.1.5 *Vacuum Dust Collector,* with vacuum sweeper hose of rubber tubing capable of rapid removal of the dusting powder and debris from the specimen and cutting knife interface.

6.1.6 *Digital Counters,* a pair mounted diametrically opposed to one another on the turntable support, capable of displaying a total count of no less than 80 and determining the rotations of the turntable to within 1.00 ± 0.03 Hz (rps) throughout the duration of a test cycle (see Section 10).

6.1.7 *Cutting Knives,* tungsten carbide knives manufactured to the specifications in Fig. 2 of Grade 831 Carboloy or an equivalent material, at the time of manufacture or resharpening.

6.1.7.1 The cutting knives shall have a "cutting edge" formed by the angle of the two bevels. The apex of the angle shall have a blunted edge, or "flat," with a width of 10 ± 5 µm.

6.1.7.2 At the time of manufacture or resharpening, the "cutting edge" may be less than 10 ± 5 µm. The blunted edge, or "flat," shall then be produced by the end user, manufacturer, or resharpening service supplier, by dulling with a diamond dust, or other suitable method to 10 ± 5 µm prior to first use.

NOTE 1—The supplier shall notify the end user of new or resharpened cutting knives of the final specifications of the cutting edges and other dimensional specifications.

6.1.7.3 The width of the blunted edge, or "flat," shall be verified either by standard microscopy techniques or scanning electron microscopy.[4,5]

6.1.7.4 The beveled surfaces shall have a finish equivalent to a No. 4-µm finish at the time of manufacture or resharpening.

6.1.7.5 The cutting knives, at the time of manufacture or resharpening, shall be matched in pairs so that the overall dimensions of each of the three major axes have a difference between them individually no greater than 0.013 mm (0.0005 in.) and that they are parallel to within ±0.0065 mm (0.00025 in.).

6.2 *Grinder,* for preparing the surfaces of test specimens. The grinder shall be equipped with:

6.2.1 A magnetic plate for holding the specimen in place,

6.2.2 A micrometer adjustment capable of controlling the vertical movement of the abrasive wheel in 0.025-mm (0.001-in.) increments,

6.2.3 A handwheel for traversing the specimen,

6.2.4 An electric motor with a spindle having a rotational frequency of 95 ± 3 Hz (rps) and equipped with an arbor to secure the abrasive wheel (see Section 10), and

6.2.5 An abrasive wheel with a diameter of no less than 100 mm (4 in.) and 12.5 mm (0.5 in.) in width, when new, and a center mounting hole of 12.7 mm (0.5 in.) in diameter. The grit of the wheel shall be equivalent to Carborundum C30LB.

6.3 *Balance,* accurate to ±0.0001 g.

7. Auxiliary Materials

7.1 *Dusting Powder:*

7.1.1 The dusting powder used shall be a blend of equal parts by weight of aluminum oxide and diatomaceous earth. The diatomaceous earth should first be passed through a No. 200 (75-µm) screen and the retained material discarded.[5,6]

7.1.2 A mixture of the two materials, in equal parts, shall be thoroughly blended, densed, and screened. When preparing small quantities, the following procedure is satisfactory:

[4] The sole source of supply of the scanning electron microscopy (SEM) verification of cutting knife dimensions known to the committee at this time is BF Goodrich Research and Development, Brecksville, OH.

[5] If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,[1] which you may attend.

[6] The sole source of supply of the Alon-C undensed aluminum oxide known to the committee at this time is Cabot Corp., Boston, MA.