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Standard Practice for Rubber—Measurement of Dimensions[1]

This standard is issued under the fixed designation D3767; 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 practice is intended for use in determining the geometrical dimensions of rubber products and specimens for physical tests. This practice describes procedures for determining length, width, thickness, diameter, and circumference. This practice does not cover sampling of materials or products, or locations where a sample is to be taken.

1.2 The values stated in either acceptable metric units or in other units shall be regarded separately as a standard. The values stated in each system may not be exact equivalents; therefore, each system must be used independently of the other, without combining values in any other way.

1.3 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D1415 Test Method for Rubber Property—International Hardness

D3183 Practice for Rubber—Preparation of Pieces for Test Purposes from Products

3. Summary of Practice

3.1 Specific procedures are outlined depending upon size, texture, and shape of the test specimens undergoing measurement.

3.1.1 Procedure A encompasses linear dimensions up to 30 mm using a flat-footed micrometer on flat sheets and test specimens.

3.1.2 Procedure A1 encompasses thickness dimensions up to 30 mm using a micrometer with contact members that are domed surfaces. This procedure is employed on irregularly shaped test specimens and compression set test specimens.

3.1.3 Procedure A2 encompasses thickness measurements of flexible cellular test specimens up to 30 mm using a micrometer with large area flat contact members.

3.1.4 Procedure B encompasses linear dimensions between 30 and 100 mm using a vernier caliper.

3.1.5 Procedure C encompasses linear dimensions above 100 mm using a tape or linear scale.

3.1.6 Procedure D encompasses thickness measurements on soft thin materials using a microscope.

3.1.7 Procedure E encompasses circumference measurements by cone.

4. Significance and Use

4.1 Dimensional measurements specified in this practice are made for one of the following purposes: (*1*) to determine conformance with specification requirements regarding geometrical properties of whole units, such as the size of rubber gloves, or the diameter and circumference of rubber hose, (*2*) to determine conformance with specification requirements regarding particular functional parts of units, such as the thickness of the soles of boots, or (*3*) to determine geometrical values that are necessary in the calculation of test results for physical properties for which requirements are specified, such as the thickness of a test specimen for tensile strength. The method to be used shall be as specified in the detail specification or appropriate test method.

4.2 Pressure applied by measuring instruments has a significant effect on the observed thickness of soft flexible materials, and it is therefore necessary to specify the pressure imposed by the foot of the instrument on the test piece for accurate comparative measurements of such materials.

[1] This practice is under the jurisdiction of ASTM Committee D11 on Rubber and Rubber-like Materials and is the direct responsibility of Subcommittee D11.10 on Physical Testing.

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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.

5. Test Specimens

5.1 Test specimens shall consist of a product, in whole or in part, for which the geometric dimensions are sought, as described in a detail specification or test method. Material, as referenced herein, shall be interpreted as the substance(s) of which a product is comprised.

6. Number of Measurements

6.1 Unless otherwise specified in the detail specification or test method, three measurements shall be made on each test specimen or product and the median value taken.

7. Buffing

7.1 If the test specimen has uneven surfaces, such as fabric impression or corrugations, that may interfere with the test, for example, on the tube or cover of hose, the material may be buffed lightly so that the surface is smooth and of uniform thickness. Buffing shall be performed in accordance with the sections on Buffing Techniques, Abrasive Wheels, and Abrasive Flexible Bands in Practice D3183.

8. Conditioning

8.1 Unless otherwise specified in the detail specifications or test method, geometrical measurements shall be made after conditioning test specimens for 24 h at 23 ± 5°C (73.4 ± 9°F). If Procedure D (see Section 12) is used, the relative humidity of 50 ± 5 % at 23 ± 2°C (73.4 ± 3.6°F) should be maintained.

PROCEDURES

9. Procedures A, A1, and A2 (Dimensions of 30 mm or Less)

9.1 *Procedure A:*

9.1.1 *Scope*—Dimensions of length, width, thickness, and diameters of test specimens less than 30 mm (1.2 in.) shall be measured with a micrometer instrument.

9.1.2 *Apparatus*—The apparatus shall consist of the following parts (an example of suitable apparatus is shown in Fig. 1 and Fig. 2):

9.1.2.1 *Anvil,* at least 35 mm (1.4 in.) in diameter, that is attached to a rigid base plate.

(1) Flat Rigid Base Plate, at least 140 mm (5.5 in.) in diameter, that is attached to a rigid frame.

(2) Solid Platform Base (see Fig. 2), granite, at least 5 by 5 in. square and 1.75 in. in height. The top surface is ground flat and perpendicular to the guide post and micrometer assembly, at the operating height, to a tolerance of ±0.002 in.

9.1.2.2 *Micrometer* (such as a dial or digital-electronic), capable of measuring dimensions to an accuracy within 1 % of the dimension being measured or 0.001 mm, whichever is greater.

9.1.2.3 *Rigid Rod:*

(*1*) terminating in its lower end in a flat circular foot 3 to 10 mm (0.12 to 0.39 in.) in diameter (see Fig. 1). The rod design shall allow various masses to be attached in order to give the operator the capability of varying the pressure exerted on the test specimen, by the presser foot, from 10 to 22 kPa (1.55 to 3.2 psi) (refer to Table 1).

(*2*) terminating in its upper and lower ends in a threaded orifice. The lower orifice will accommodate the connection of a flat circular foot 3 to 10 mm (0.12 to 0.39 in.) in diameter. The upper orifice will accommodate the attachment of a mass corresponding to the presser foot attached (refer to Table 1 and Fig. 2) in order to give the operator the capability of varying the pressure exerted on the test specimen by the presser foot from 10 to 22 kPa (1.55 to 3.2 psi) (refer to Table 1).

9.1.3 *Procedure A:*

9.1.3.1 When using an instrument equivalent to the one shown in Fig. 1:

Place the test specimen between the base plate and the circular presser foot. Lower the presser foot until it is resting freely on the test specimen.

Read the micrometer to an accuracy within 1 % of the dimension being measured.

Repeat the procedure again with the test specimen removed, and the difference between readings is the dimension of the test specimen.

The pressure exerted by the presser foot shall be:

22 ± 5 kPa (3.2 ± 0.7 psi) (refer to Table 1) for solid rubber having a hardness equal to or greater than 35 IRHD and

10 ± 2 kPa (1.5 ± 0.3 psi) for solid rubber having a hardness less than 35 IRHD (see Test Method D1415). The presser foot shall not extend over the edge of the area of the test specimen (see Note 1).

9.1.3.2 When using an instrument equivalent to the one shown in Fig. 2, the micrometer is adjusted so that the presser foot is resting freely on the (polished granite) base.

The micrometer is then reset to a "zero" reading. The presser foot is then raised with the lifting lever mechanism.

The test specimen is placed beneath the presser foot.

The presser foot is lowered gently to the test specimen.

Read and record the thickness from the micrometer to an accuracy within 1 % of the dimension being measured immediately after the presser foot contacts the test specimen.

The reading displayed digitally is the dimension of the test specimen to within the tolerance (resolution) of the instrument.

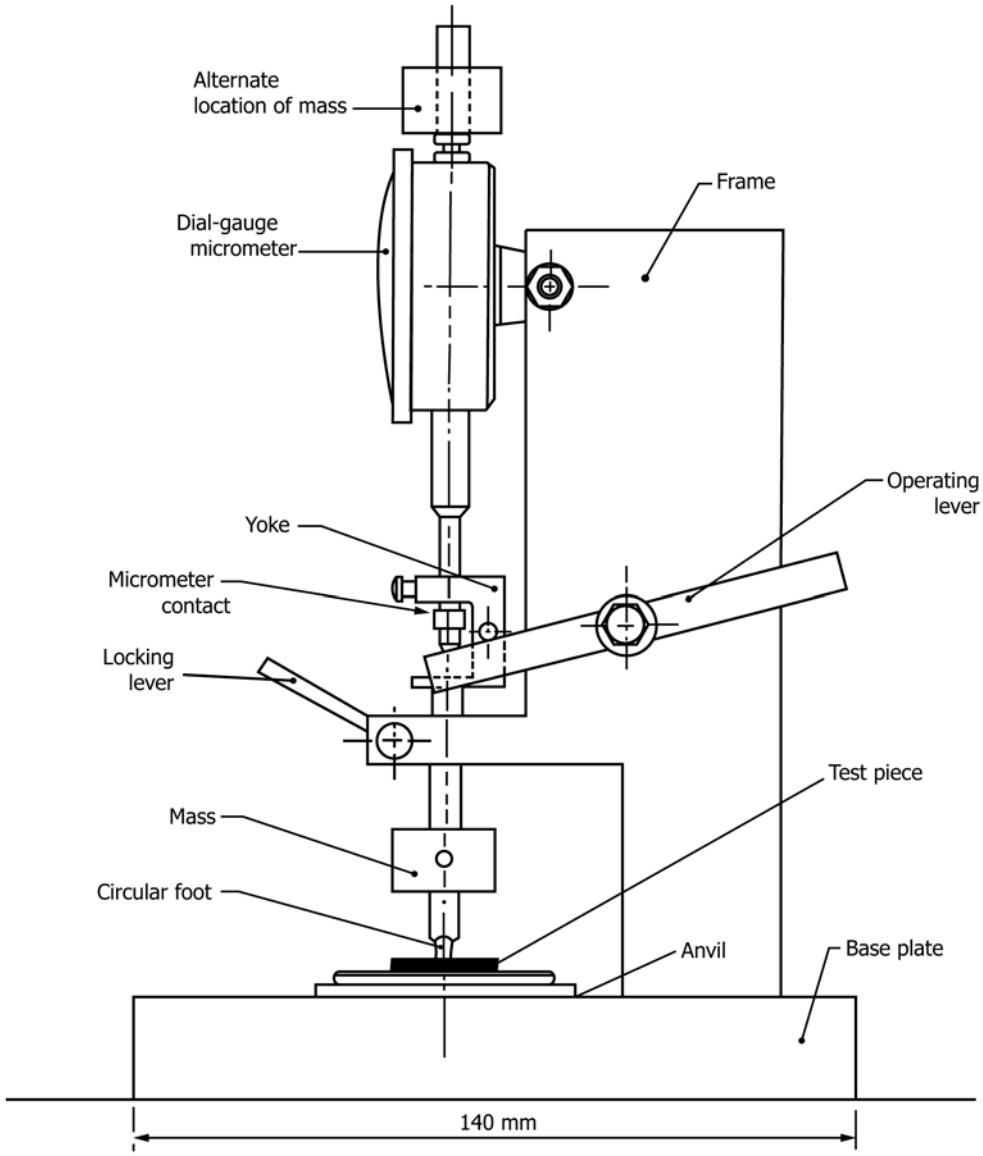
The pressure exerted by the presser foot shall be 22 ± 5 kPa (3.2 ± 0.7 psi) (refer to Table 1) for solid rubber having a hardness equal to or greater than 35 IRHD, and 10 ± 2 kPa (1.5 ± 0.3 psi) for solid rubber having a hardness of less than 35 IRHD.

The presser foot shall not extend beyond the edge of the test specimen (see Note 1).

9.1.3.3 This practice allows for a range of masses to be used in concert with a foot of a given diameter (Ø). This is to accommodate the inherent frictional resistance of the gage mechanism, as well as the additional force introduced by the mass of the gage assembly.

9.1.3.4 In Table 1, the "Optimal Mass" may be consider that which would cause the force (kPa / psi) to be applied by a foot of the stated diameter with no gage or mechanism involved, as if by gravity. The "maximum" and "minimum" values shown in Table 1 are those that are defined by the upper and lower limits, for example, 22 ± 5 kPa / 3.2 ± 0.7 psi and 10 ± 2 kPa / 1.5 ± 0.3 psi.

NOTE 1—The operator should take care to ensure that the micrometer



Note—*Procedure*: Lift the yoke to the raised position and place the specimen between the base plate and circular presser foot. Lower the presser foot and yoke until the rod is resting freely on the test specimen, but with the dial-gage stem still supported. Lock the clamp and then lower the yoke fully. Read the micrometer.

FIG. 1 Example of a Suitable Measuring Apparatus for Procedure A

and guide post assembly is perpendicular to the granite base or other test specimen support surface to within a tolerance of ±0.002 in. The perpendicularity should be ascertained with the micrometer at the operating height.

9.2 *Procedure A1:*

9.2.1 *Scope*—This procedure is intended for use in determining the thickness of test specimens with irregular, convex, or concave surfaces, using a micrometer with a spherical foot. It is particularly suitable for compression set test specimens.

9.2.2 *Apparatus*—The apparatus shall consist of a micrometer (such as dial or digital-electronic) of one of the following configurations:

9.2.2.1 Two contact members with domed surfaces of spherical radius 12.5 ± 0.1 mm or 0.5 ± 0.005 in. formed on rods 9.5 to 10 mm (0.38 to 0.4 in.) in diameter. The contact members shall exert a force of 0.8 ± 0.1 N (0.18 ± 0.02 lbf) and shall have a scale capable of measuring dimensions to an accuracy within 1 % of the dimension being measured. The reading, if displayed digitally, is the dimension of the test specimen to within the tolerance (resolution) of the instrument.

9.2.2.2 Two contact members with domed surfaces of spherical radius 12.5 ± 0.1 mm or 0.5 ± 0.005 in. in diameter, one as an anvil insert, the other connected to the micrometer. The contact members shall exert a force of 0.8 ± 0.1 N (0.18 ± 0.02 lbf) and shall have a scale capable of measuring dimensions to an accuracy within 1 % of the dimension being measured. The reading displayed digitally is the dimension of the test specimen to within the tolerance (resolution) of the instrument. The anvil is a solid insert with an integral or replaceable contact foot placed in the Bradnick-Warner fixture (see Fig. 3). The contact foot with a domed surface of spherical radius is placed in the micrometer.

NOTE 2—The fixture depicted in Fig. 3 bears the names of its designers