Designation: D 1456 – 86 (Reapproved 2001)

Standard Test Method for Rubber Property—Elongation at Specific Stress[1]

This standard is issued under the fixed designation D 1456; 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 Department of Defense.

1. Scope

1.1 This test method covers determination of the elongation of soft vulcanized rubber compounds under a specified stress.

1.2 *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 1349 Practice for Rubber—Standard Temperatures for Testing[2]

D 3182 Practice for Rubber—Materials, Equipment, and Procedures for Mixing Standard Compounds and Preparing Standard Vulcanized Sheets[2]

D 3183 Practice for Rubber—Preparation of Pieces for Test Purposes from Products[2]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *piece*—the portion of the sample that is prepared for testing.

3.1.2 *specific stress*—force divided by the cross-sectional area of the original specimen.

4. Summary of Test Method

4.1 The test method starts with a piece taken from the sample and includes: (*1*) the preparation of the specimen and (*2*) measurement of the elongation of the specimen subjected to a prescribed stress for a specified period of time. The stress is applied by suspension of a known mass which, under gravity, gives the desired stress.

5. Significance and Use

5.1 This test method is useful for determining the variability in material and the influence of parameters affecting the stress-strain properties of rubber vulcanizates, for example, temperature, relative humidity, preconditioning of rubber, and so forth. This test method is particularly useful for the evaluation of compounding materials used for reference purposes.

6. Apparatus

6.1 *Testing Machine*—Tests shall be made on a power-driven machine complying with the following requirements: The machine shall be capable of extending the specimen at a uniform speed of between 75 and 90 mm/s (15 and 18 ft/min) until the mass is freely suspended. It shall be equipped with a timing device that automatically starts the instant the mass is freely suspended by the specimen and signals the operator when the elongation is to be measured. The machine shall have a millimetre scale and an indicating device so that elongation measurements to the nearest millimetre can be made without parallax. A holder shall be attached to the lower grip so that masses may be added, preferably by an automatic device, to obtain the desired stress. The masses shall correspond to multiples of the force required for 0.01-mm thickness of the specimen and shall be accurate within the force required for 0.002-mm thickness of the specimen. The grips that hold the specimen in the tester shall be of a type that tightens automatically as the applied tension increases and exerts a uniform pressure across the gripping surfaces. A satisfactory tester, including die and thickness gage, is shown in Fig. 1.

6.2 *Die*—The die shall be capable of cutting straight specimens with parallel sides, approximately 150 mm (6 in.) long and within ±0.02 mm (±0.001 in.) of the specified width for the specimens (see 7.1) at any point along their length. A suitable die is shown in Fig. 2. This die consists of six strips of razor-blade steel, sharpened on one edge, and clamped in a rigid mounting. The blades are approximately 150 mm (6 in.) long, 19 mm (0.75 in.) wide, and 0.25 mm (0.010 in.) thick; they are clamped rigidly between metal spacers to produce the desired width of specimen and project approximately 3 mm (0.12 in.) above the spacers. The blades can easily be replaced when they become dull or nicked.

6.3 *Bench Marker*—The bench marker shall have two parallel knife edges that are ground smooth and true, and that are between 0.05 and 0.08 mm (0.002 and 0.003 in.) in width at the edge and beveled at an angle of not more than 15°. The distances between the centers of the knife edges shall be 100 ±

[1] This test method is under the jurisdiction of ASTM Committee D11 on Rubber and is the direct responsibility of Subcommittee D11.10 on Physical Testing.

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[2] *Annual Book of ASTM Standards*, Vol 09.01.

FIG. 1 Strain Testing Machine

0.10 mm (3.937 ± 0.004 in.). A suitable bench marker is shown in Fig. 3.

6.4 *Stamp Pad*—The stamp pad shall have a plane unyielding surface such as hardwood, plate glass, or plastic covered with a pad containing ink of the desired color and quality for marking the specimen. The ink shall have no deteriorating effect on the specimen and shall be of a contrasting color to that of the specimen.

6.5 *Thickness Gage*—The thickness gage shall measure the average thickness of the specimen between bench marks accurately to 0.01 mm under a pressure of 22 ± 5 kPa (3.2 ± 0.7 psi). It shall be equipped with a dial indicator having 0.01-mm graduations, where one revolution of the dial corresponds to 1 mm, and the total range is 2.5 mm. The indicator shall be mounted above a specially constructed base equipped with a pressure bar 100 mm long and slightly wider than the specimen. The pressure bar is pressed upon the surface of the specimen by means of an adjustable spring. The bar is attached to a ball joint that possesses sufficient freedom of movement to permit the dial gage to indicate the average thickness of the specimen. A schematic diagram of the gage is shown in Fig. 4. When the knurled disk, *D*, is turned so that the handle, *H*, rests against the pin, *P*, the notch, *N*, in the rod, *R*, is at the top, allowing the spring to pull the pressure bar against the specimen.

6.6 *Cutting Support*—The cutting surface shall be a smooth, slightly yielding surface for supporting a portion of the test piece from which the specimen is to be cut so that the blade of the die is not damaged during the cutting of the specimen. It is recommended that the cutting support have three parts: (*1*) a solid foundation, such as hardwood or plate glass; (*2*) a semihard pad such as vinyl plastic or Masonite;[3] and (*3*) a smooth cutting surface such as rubber belting, leather belting, or light cardboard.

7. Test Specimens

7.1 *Preparation of Specimen*—If the material is too thick or has an uneven surface that may interfere with the test, the material shall be buffed and prepared as described in Practices D 3182 and D 3183. The portion of the test piece from which the specimen is to be taken shall be buffed in a strip form before cutting with the die. The width of the specimen depends upon the testing machine used.

NOTE 1—*Example*: For machines supplied with masses in increments of 0.01 lb for each 0.01-mm thickness of specimen, the width of the specimen shall be 8.90 ± 0.02 mm (0.357 ± 0.001 in.) when the stress is a multiple of 0.5 kPa and shall be 6.45 ± 0.02 mm (0.254 ± 0.001 in.) when the stress is a multiple of 100 psi. This dimension permits the following combinations of stresses to be applied with the four sets of masses supplied with these machines:

Mass Set	Stress, MPa	Specimen Width, mm
A	0.25	8.90
B	0.50	8.90
C	1.00	8.90
D	2.00	8.90

Similarly, masses in increments of 5 g for each 0.01 mm of specimen thickness give stresses in multiples of 0.5 MPa when the specimen width is 9.80 ± 0.02 mm.

7.2 *Cutting Specimens*—The specimen shall be cut with a single stroke of the die, if possible, so as to obtain smooth-cut surfaces. To facilitate cutting, the edges of the die may be lubricated with water containing a wetting agent and a corrosion inhibitor such as 0.5 % sodium chromate or with silicone mold release emulsion before each specimen is cut. Bench marks 100.0 ± 0.1 mm apart shall be placed on the straight uniform section of the specimen perpendicular to the longitudinal axis by means of the bench marker and ink. The specimen shall be free of mechanical damage.

7.3 *Measuring Specimens*—The average thickness of the specimen between bench marks shall be determined to the nearest 0.01 mm by means of the thickness gage as described in 6.5. The width of the specimen shall be taken as the distance between the cutting edges of the blades of the die. The cross-sectional area of the specimen shall be calculated by multiplying the width by the thickness of the specimen.

8. Procedure

8.1 *Test Temperature*—The standard temperature (Note 2) for testing shall be 23 ± 2°C (73.4 ± 3.6°F). Condition specimens for at least 3 h. Where this temperature condition cannot be adhered to, the report shall include a statement of the

[3] Masonite is a registered trademark of the Masonite Corp.

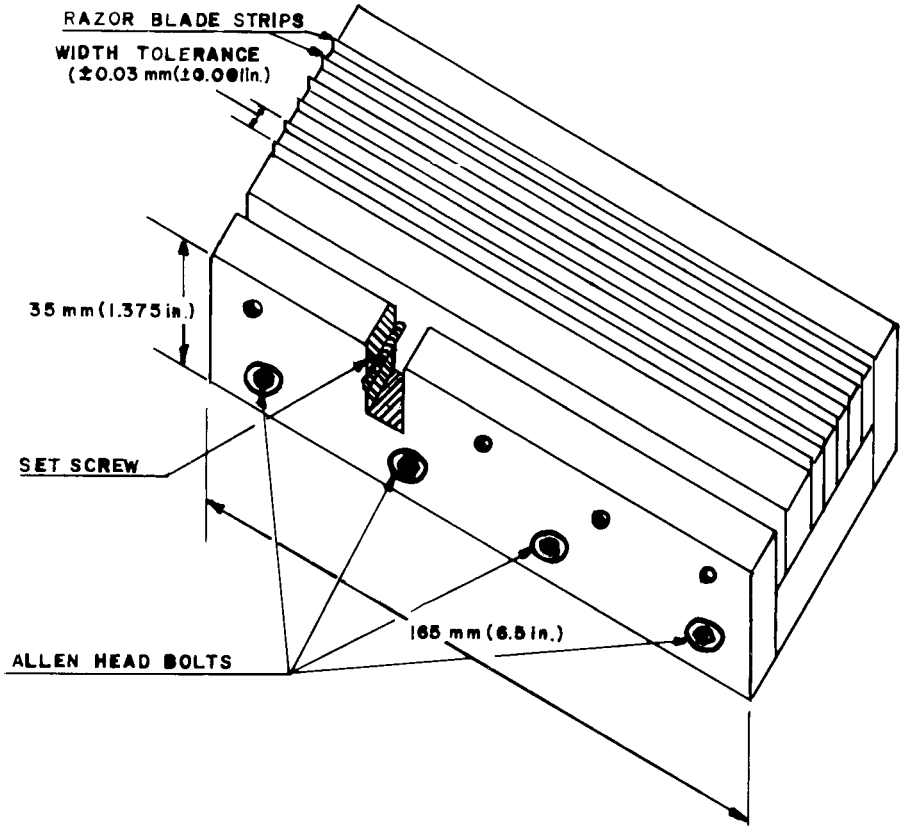

FIG. 2 Die for Cutting Specimens

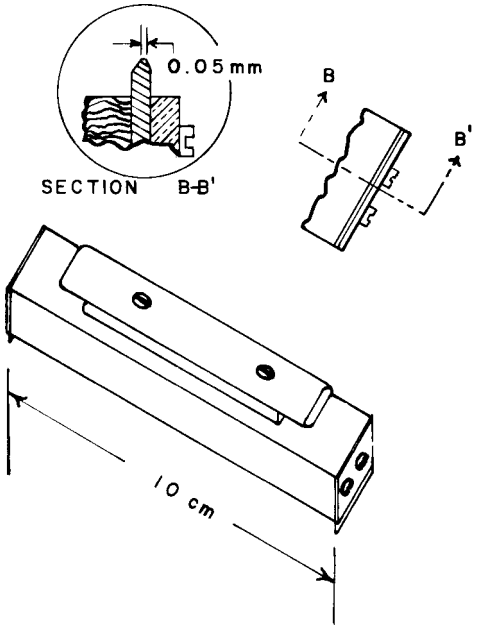

FIG. 3 Bench Marker

actual temperature at the time of test. If the material is affected by moisture, the specimen shall be conditioned at least 24 h before testing in an atmosphere in which the relative humidity is maintained at 50 ± 5 %.

NOTE 2—This standard temperature is the same as that prescribed in Practice D 1349.

8.2 *Determination of Force to Be Applied*—The stress applied to the specimen shall be as specified in the detail specifications. Determine the force to be applied by multiplying the specified stress by the cross-sectional area. When specimens of the proper width are used in machines equipped with an automatic device for adding the masses, measure only the thickness of the specimen to apply the proper masses. Apply the masses to the holder attached to the lower grip.

8.3 *Measurement of Elongation*—Place the specimen in the grips of the testing machine with the bench marks facing the operator. Extend the specimen at a uniform speed of between 75 and 90 mm/s (15 and 18 ft/min) until the masses on the lower grip are freely suspended. Measure the distance between the bench marks 60 ± 3 s after the masses are freely suspended, and record the value to the nearest 1 mm.

9. Calculations

9.1 Calculate the elongation on the specimen as follows:

$$\text{Elongation, \%} = E - 100 \quad (1)$$

where:

E = the length in millimetres between bench marks when the specimen is under stress.

NOTE 3—If a millimetre scale is used, with the zero at 100 mm from the index for the upper bench mark, the elongation is then given directly on the scale at the index for the lower bench mark.

10. Characteristics of Piece Tested

10.1 The median of the values for three specimens shall be taken as the characteristics of the piece of rubber tested, except

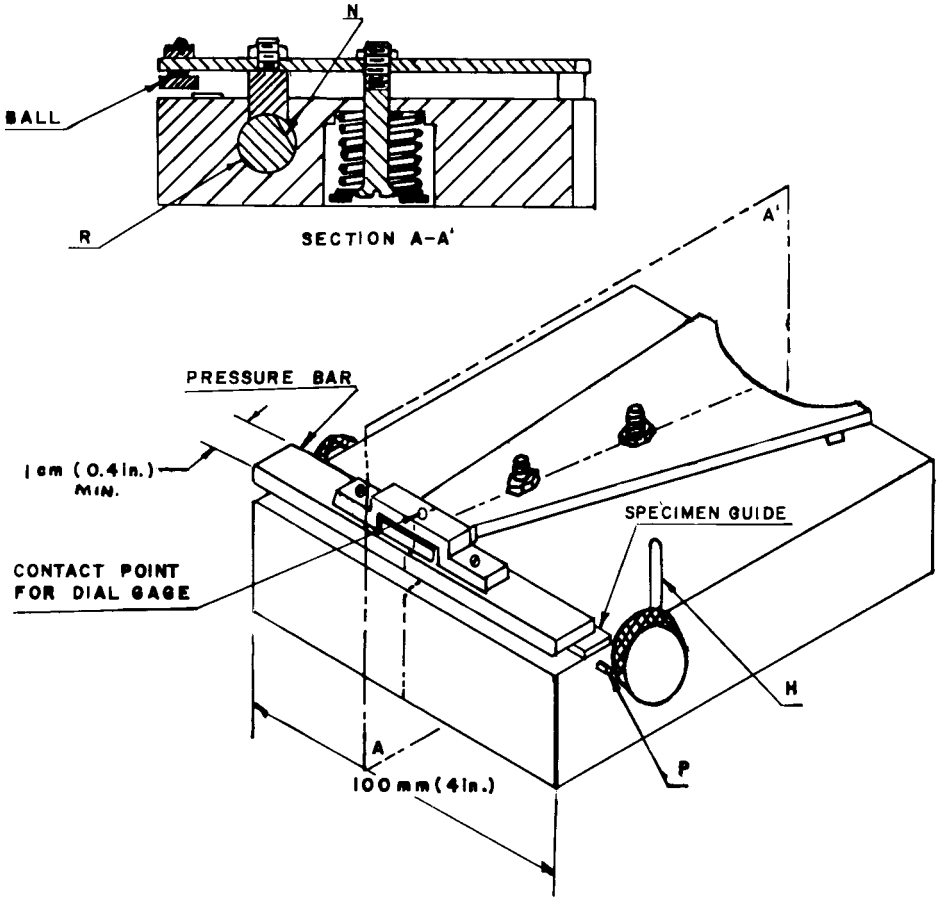

FIG. 4 Base for Thickness Gage

that under the following conditions the median of the values for five specimens shall be used:

10.1.1 If one or more values do not meet the specified requirements when testing for compliance with specifications and

10.1.2 If referee tests are being made.

11. Report

11.1 The report shall include the following:

11.1.1 The elongation calculated in accordance with Section 9,

11.1.2 Stress applied to the specimen,

11.1.3 Width of specimen,

11.1.4 Data of vulcanization of the rubber, if known,

11.1.5 Date of test,

11.1.6 Temperature of the test room if it is other than as provided for in 5.1, and

11.1.7 Type of testing machine used.

12. Precision

12.1 Because of a lack of laboratories willing to participate in round robin testing, no precision data are available for this standard.

13. Keywords

13.1 elongation