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Standard Test Methods for Rubber Property—Young's Modulus at Normal and Subnormal Temperatures¹

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These test methods have been approved for use by agencies of the Department of Defense. Consult the DoD Index of Specifications and Standards for the specific year of issue which has been adopted by the Department of Defense.

^{ε1} NOTE—Editorial changes were made throughout in March 1989.

1. Scope

1.1 These test methods cover the procedures for determining Young's modulus (in flexure) of rubbers at normal and subnormal temperatures.

2. Referenced Documents

2.1 ASTM Standards:

D 832 Practice for Rubber Conditioning for Low-Temperature Testing²

D 2240 Test Method for Rubber Property—Durometer Hardness²

D 4483 Practice for Rubber—Determining Precision for Test Methods³

3. Terminology

3.1 Description of Terms Specific to This Standard:

3.1.1 *loading*—in this standard, the application of a force. The word *force* will be used in place of load.

3.1.2 *normal temperature*— $23 \pm 2^\circ\text{C}$.

4. Significance and Use

4.1 Increases in Young's modulus of rubbers upon exposure to progressively lower temperatures are attributable to either or both of two distinct low-temperature effects, the glass transition and crystallization (see Annex A1).

4.2 Test Method A is concerned with effects on Young's modulus due to the glass transition. These effects are relatively independent of time of exposure to low temperatures.

4.3 Test Method B is concerned with crystallization and other effects that are strongly dependent on time of exposure to low temperature.

5. Apparatus

5.1 *Cooling Chamber*, of sufficient size to contain the test apparatus with openings or ducts appropriately placed for remote control and capable of attaining and holding the desired test temperatures. All specified temperatures shall be

maintained within 0.5°C ($\pm 0.9^\circ\text{F}$), preferably by automatic regulation. Uniformity of temperature throughout the cooling chamber should be assured by means of a suitable air-mixing fan.

5.2 *Support for Specimens*—Supports for the simple beam test specimens made in the form of a saddle as shown in Fig. 1. The curved surfaces of the supports shall be cylindrical with a radius of 4.75 ± 0.08 mm (0.187 ± 0.003 in.) and at least 25 mm (1.01 in.) in length. The distance between the center lines of the specimen supports shall be 50.00 ± 0.05 mm (2.000 ± 0.002 in.). Retaining pins shall be placed at each end and side of the specimen supports as shown in Fig. 1, to assist in correctly aligning the specimens and to prevent accidental dislodging of test specimens.

5.3 *Liquid Containers*—A means for completely immersing in a liquid the specimen supports described in 5.2. All referee or normal tests shall be made in a gas (air, carbon dioxide, or nitrogen) atmosphere, but where required by particular service conditions, tests may be run in the standard manner submerged in the specified liquid.

5.4 *Loading Foot*—The surface of the cylindrical loading foot that contacts the specimen shall have a radius of 4.75 ± 0.08 mm and, like the saddle supports, a length of not less than 25.65 mm (1.01 in.). The loading foot shall be aligned with its cylindrical axis parallel to those of the saddle supports and shall contact the specimen midway between the saddle supports.

5.5 *Loading Rod*—A loading rod shall be attached to the loading foot and shall extend outside the cooling chamber. The bearing in which the loading rod slides (whether it be inside or outside the cooling chamber) shall be as nearly friction-free as possible. (Polished rods and tubes machined from canvas-base phenolic plastic laminates and hard rubber and lapped with graphite are recommended.)

5.6 *Loading Method*—A means for raising and lowering the loading foot and for applying the required force.

5.7 *Deflection Indicator*—A dial micrometer gage calibrated to 0.02 mm (0.001 in.) mounted directly over the top end of the loading rod.

5.8 *Force Counterbalance*—If the total force (loading foot, loading rod, weight pan, and dial gage reaction) exceeds 0.49 N (0.11 lbf); a counterbalance system supported on agate V's and hardened steel knife edges shall be attached to the loading rod in order to reduce the total force to between 0.39

¹ These test methods are under the jurisdiction of ASTM Committee D-11 on Rubber and are the direct responsibility of Subcommittee D11.14 on Time and Temperature-Dependent Physical Properties.

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² Annual Book of ASTM Standards, Vol 09.01.

³ Annual Book of ASTM Standards, Vols 09.01 and 09.02.