



Designation: D1053 – 92a (Reapproved 2024)

Standard Test Methods for Rubber Property—Stiffening at Low Temperatures: Flexible Polymers and Coated Fabrics¹

This standard is issued under the fixed designation D1053; 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 These test methods describe the use of a torsional apparatus for measuring the relative low temperature stiffening of flexible polymeric materials and fabrics coated therewith. A routine inspection and acceptance procedure, to be used as a pass-fail test at a specified temperature, is also described.

1.2 These test methods yield comparative data to assess the low temperature performance of flexible polymers and fabrics coated therewith.

1.3 The values stated in SI units are to be regarded as 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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *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

D832 Practice for Rubber Conditioning For Low Temperature Testing

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

¹ These test methods are under the jurisdiction of ASTM Committee D11 on Rubber and Rubber-like Materials and are 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 www.astm.org/contact. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

3. Summary of Test Method

3.1 Test Method A describes the measurement, at low temperatures, of the stiffening of flexible polymers.

3.2 Test Method B describes the measurement, at low temperatures, of the stiffening of fabrics coated with flexible polymers.

3.3 In these test methods, a specimen of flexible polymer or fabric coated with flexible polymer is secured and connected in series to a wire of known torsional constant; the other end of the wire is fastened to a torsion head to impart a twist to the wire. The specimen is immersed in a chamber filled with a heat transfer medium at a specified uniform subnormal temperature. The torsion head is then twisted 180° and in turn twists the specimen by an amount (less than 180°) that is dependent on specimen compliance or inverse stiffness. After a specified elapsed time, the amount of specimen twist is measured with a mounted protractor. The angle of twist, which is inversely related to the stiffness, is plotted versus the specified temperature. The temperature is then systematically increased in prescribed increments and the measurements repeated at each temperature, yielding a twist or inverse stiffness versus temperature profile for the test specimen. The torsional modulus of the specimen at any temperature is proportional to the quantity (180-twist)/twist.

4. Significance and Use

4.1 These test methods may be used to determine the subnormal temperature stiffening of flexible polymers or fabrics coated with flexible polymers. Temperatures at which the low temperature modulus is a specified multiple or ratio of the modulus at room temperature are interpolated from the twist versus temperature curve. These specified ratios of low-temperature modulus to room-temperature modulus are called *relative moduli*. These temperatures at the relative moduli encompass the transition region between the glassy and rubbery states of the materials tested.

4.2 These test methods offer only a general guide to stiffness characterization as service conditions of experimental materials may differ greatly from the test conditions.