



Designation: **D2821 – 14** **D2821 – 19**

Standard Test Method for Measuring the Relative Stiffness of Leather by Means of a Torsional Wire Apparatus¹

This standard is issued under the fixed designation D2821; 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 describes the use of a torsional apparatus for measuring the relative stiffness of gloving leathers. This test method does not apply to wet blue.

1.2 The values stated in SI units are to be regarded as the standard. The values shown in parentheses are provided for information only.

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

D1053 Test Methods for Rubber Property—Stiffening at Low Temperatures: Flexible Polymers and Coated Fabrics

D1610 Practice for Conditioning Leather and Leather Products for Testing

3. Significance and Use

3.1 This test method is designed to measure the apparent torsional modulus³ of a leather specimen. Experience has shown that the torsion modulus of leather is directly related to the characteristic known as stiffness when felt in a glove.⁴

4. Apparatus

4.1 *Torsion Apparatus*⁵— The torsional apparatus, **Fig. 1**, shall consist of a torsion head, *A*, capable of being turned through a complete circle in a plane normal to the torsion wire, *N*. The torsion head is equipped with an upper dial or protractor, *K*, graduated from 0 to 360° in increments not greater than 5°, and a fixed index pointer, *L*. The protractor is attached to the torsion head by

¹ This test method is under the jurisdiction of ASTM Committee **D31** on Leather and is the direct responsibility of Subcommittee **D31.04** on Apparel. This test method was developed in cooperation with the American Leather Chemists Assn.

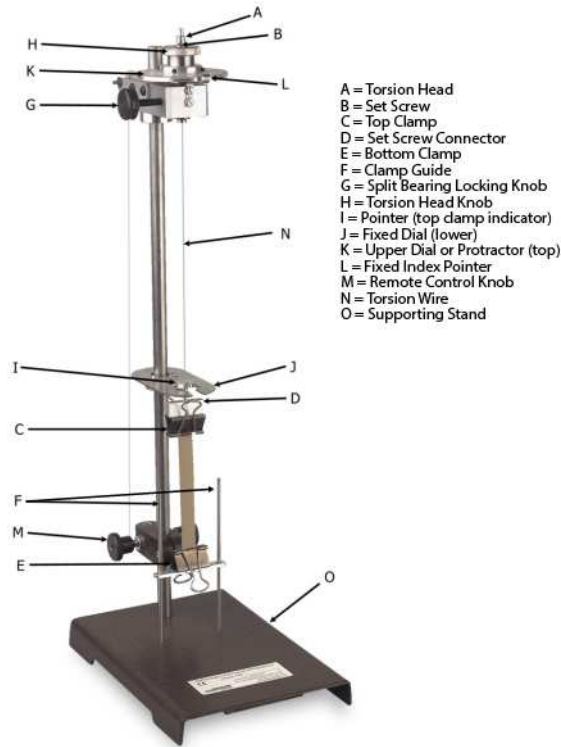
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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ This test method is similar to Test Method **D1053**. The original apparatus was described by Williamson, I., *British Plastics*, Vol 23, 1950, pp 87-90, 102; and typical examples of the results of its use on leather were given in a paper by Witnauer, L. PA, and Palm, W.E., *Journal*, American Leather Chemist's Assn., JALCA, Vol 59, 1964, pp. 246-258.

⁴ Gloves were made from the neck and butt areas of cattlehide work-glove leather selected for 3° of softness varying from soft to firm. These were ranked from softest to firmest by 20 individuals. Since there was some overlapping of rank as assigned by individual observers, the final rank was assigned according to highest number of selections. Specimens of leather cut from the sides in the area from which each glove was cut were tested for stiffness according to this test method. At 90° of twist, the stiffness values gave a ranking similar to that obtained by feel. Specimens cut parallel to the backbone gave more consistent ranking than specimens cut perpendicular to the backbone. This undoubtedly reflects the fact that work gloves are cut from a side with the fingers parallel to the backbone. ~~A report of these experiments and data used for calculation of precision and accuracy are on file at ASTM Headquarters.~~

⁵ The sole source of supply of the apparatus known to the committee at this time is Taber Industries, 455 Bryant Street, North Tonawanda, NY, 14120. 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, which you may attend.



- A = Torsion Head
- B = Set Screw
- C = Top Clamp
- D = Set Screw Connector
- E = Bottom Clamp
- F = Clamp Guide
- G = Split Bearing Locking Knob
- H = Torsion Head Knob
- I = Pointer (top clamp indicator)
- J = Fixed Dial (lower)
- K = Upper Dial or Protractor (top)
- L = Fixed Index Pointer
- M = Remote Control Knob
- N = Torsion Wire
- O = Supporting Stand

FIG. 1 Torsion Apparatus

means of a friction bearing to permit movement for adjusting the zero point. The top of the torsion wire is attached to the torsion head at knob *H* by set screw *B* and passes through the center of a loosely fitting sleeve gripped by the friction bearing. The torsion head support carries a split bearing which can be activated by knob *G*, thus locking the sleeve carrying the wire and permitting adjustment of the zero point of the protractor without disturbing the position of the torsion wire. The bottom of the wire shall be fastened to the test specimen top clamp, *C*, by means of a set screw connector, *D*. A pointer, *I*, mounted above a fixed dial, *J*, shall be provided to indicate the twist applied to the specimen. Torsion is applied by manually turning ~~knob~~ torsion head knob, *H*, or the remote control knob, *M*.

4.2 *Stand*—The torsion apparatus shall be mounted on a rigid supporting stand, *O*.

4.3 *Torsion Wires*⁶—Torsion wires shall be made of tempered spring wire 315 mm (12.5 in.) long, with each end firmly affixed within a rod measuring 5 mm ($\frac{3}{16}$ in.) in diameter and 12.5 mm ($\frac{1}{2}$ in.) long so as to give a free length between the rods of 290 mm \pm 2.5 mm (11.5 in. \pm 0.1 in.).

4.4 *Specimen Clamps*—Two clamps shall be provided for holding each test specimen. The top clamp, *C*, shall be mounted at the bottom of the torsion wire. The bottom clamp, *E*, shall be fashioned to move up and down without binding within clamp guides, *F*, mounted in the base. The weight of bottom clamp, *E*, shall be 15 g \pm 0.01 g.

5. Test Specimens

5.1 Unless otherwise specified in the detailed specification, cut the specimen using a sharp die measuring 12.70 mm \pm 0.03 mm (0.500 ± 0.001 in.) wide and 114 mm \pm 2 mm (4.5 in. \pm 0.1 in.) long. When known, the direction to the backbone shall be indicated. It is good practice, however, practice to include a control specimen with known twiststiffness characteristics.

5.2 Condition the specimen as specified in Practice **D1610**.

6. Preparation of Apparatus

6.1 Clamp the specimen in the testing apparatus as described below so that ~~89~~ it is centered and 89 mm \pm 2 mm (3.5 in. \pm 0.1 in.) of the specimen is free between the clamps. It is advisable to mark this distance on the specimen using a bench marker:specimen.

⁶ The original torsion wire was a stainless steel rocket wire, Type NS-302, 0.010 in. \pm 0.0025 in. (0.025 mm \pm 0.06 mm) in diameter, bright finish, with chemical composition of 0.08 to ~~0.12~~ 0.12 % carbon, 8 to ~~10~~ 10 % nickel, and 17 to ~~19~~ 19 % chromium, from National Standard Co., <http://www.nationalstandard.com>. If other wire is used, it should be calibrated as described in Test Method **D1053** and have a constant of 0.0182 g-cm/deg.