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.

Designation: F2992 – 23

Standard Test Method for Measuring Cut Resistance of Materials Used in Protective Clothing with Tomodynamometer Test Equipment[1]

This standard is issued under the fixed designation F2992; 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.

1. Scope

1.1 This test method covers the measurement of the cut resistance of a material when mounted on a specimen holder and subjected to a cutting edge under a specified load using a tomodynamometer.[2]

1.1.1 This procedure is not valid for high-porosity materials which allow cutting edge contact with the mounting surface prior to cutting.

1.1.2 Test apparatus may have limitations in testing materials with a thickness greater than 20 mm.

1.2 The values stated in SI units are to be regarded as standard. The values given in parentheses after SI units are provided for information only and are not considered standard.

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:*[3]

D123 Terminology Relating to Textiles

D1000 Test Methods for Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications

D1776/D1776M Practice for Conditioning and Testing Textiles

E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

F1494 Terminology Relating to Protective Clothing

2.2 *ISO Standards:*[4]

ISO 13997 Protective Clothing—Mechanical Properties—Determination of Resistance to Cutting by Sharp Objects

3. Terminology

3.1 *Definitions:*

3.1.1 *calculated cutting load, n*—in cut resistance testing, the load required to cause a cutting edge to produce a cut-through when it traverses the reference distance across the material being tested.

3.1.1.1 *Discussion*—The calculated cutting load is determined by performing a series of tests at three or more loads as described in Section 11. A material with a higher calculated cutting load is considered to be more cut resistant.

3.1.2 *cut resistance, n*—in blade cut testing, the property that hinders cut-through when a material or a combination of materials is exposed to a sharp-edged device.

3.1.3 *cut-through, n*—in blade cut resistance tests, the penetration of the cutting edge entirely through material as indicated by electrical contact of the cutting edge and the conductive strip or substrate.

3.1.4 *cut-through distance, n*—in cut resistance testing, the distance of required travel by the cutting edge to cut through the specimen.

3.1.5 *cutting edge, n*—in cut resistance tests, a sharp-edged device used to initiate cut-through of a planar structure.

3.1.6 *no cut, n*—in cut resistance testing, a trial for which the load used is insufficient to cause a cut-through in the maximum allowable blade travel of the apparatus.

[1] This test method is under the jurisdiction of ASTM Committee F23 on Personal Protective Clothing and Equipment and is the direct responsibility of Subcommittee F23.20 on Physical.

Current edition approved March 1, 2023. Published April 2023. Originally approved in 2015. Last previous edition approved in 2015 as F2992/F2992M – 15. DOI: 10.1520/F2992-23.

[2] Derived from the Greek *tomo*, to cut or slice, *dynamo*, force or energy, and *meter*, to measure. From Masse, S., Lara, J., Sirard, C., and Daigle, R., "Basic Principles Used in the Development of a New Cut-Test Machine for Standardization," ASTM Special Technical Publication No. 1273, 1997, pp. 66–83.

[3] 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.

[4] Available from International Organization for Standardization (ISO), ISO Central Secretariat, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, http://www.iso.org.

Copyright © ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959. United States

3.1.6.1 *Discussion*—For this test method, the maximum allowable blade travel is 50 mm (1.97 in.).

3.1.7 *protective clothing, n*—an item of clothing that is specifically designed and constructed for the intended purpose of isolating all or part of the body from a potential hazard; or, isolating the external environment from contamination by the wearer of the clothing.

3.1.7.1 *Discussion*—In this test method, the potential hazard is cutting.

3.1.8 *reference distance, n*—in cut resistance testing, a standardized distance for a blade to travel across a material to produce a cut-through.

3.1.8.1 *Discussion*—For this test method, the reference distance is 20 mm (0.8 in.).

3.2 *Additional Terminology*—Terms relevant to textiles are defined in Terminology D123. Terms relevant to protective clothing are defined in Terminology F1494.

4. Summary of Test Method

4.1 A cutting edge under a specified load is moved one time across a specimen mounted on a specimen holder.

4.2 The cut-through distance from initial contact to cut-through is determined for each load.

4.2.1 A series of tests, at a minimum of three different loads, must be performed to establish a range of cut distance at these different loads.

4.3 The test method is repeated using multiple loads to determine the calculated cutting load for the material.

5. Significance and Use

5.1 This test method assesses the cut resistance of a material when exposed to a cutting edge under specified loads. Data obtained from this test method can be used to compare the cut resistance of different materials.

5.2 This test method only addresses that range of cutting hazards that are related to a cutting action by a smooth sharp edge across the surface of the material. It is not representative of any other cutting hazard to which the material may be subjected, such as serrated edges, saw blades, or motorized cutting tools. Nor is it representative of puncture, tear, or other modes of fabric failure.

6. Apparatus

6.1 *Test Principle*—The principle of the cut test is to measure the distance traveled by a cutting edge as it is maintained under a load during the test. The cut test apparatus consists of the following primary components (see Fig. 1): blade holder (A) and straight line mechanism, a cutting edge (B), a specimen (C) with conductive strip (D), and double-sided mounting tape (E) mounted to a fixed specimen holder (F). The apparatus should propel the cutting edge across the specimen until sufficient work is applied to cause the specimen to cut through.

6.2 *Test Apparatus*—A tomodynamometer is capable of measuring the entire range of cut-resistant materials through a horizontal constant speed of blade movement. The maximum linear displacement of the blade is 70 mm (2.75 in.) for the cutting edge. A constant perpendicular force is applied to the specimen throughout blade movement. The test apparatus (see Fig. 2) consists of a motor and gearhead (*1*) with slide system (*2*) and blade support/clamp mechanism (*3*) and blade (*4*) in contact with the specimen mounted on a cantilevered specimen holder and specimen holder mount (*5*). The beam (*6*) is connected to the specimen holder mount. Cutting edge displacement is measured by a distance meter (*7*) capable of measuring to 0.1 mm (0.004 in.). Weights are placed on the platen (*8*). These weights generate the load needed to penetrate the moving edge into the specimen and produce a cut-through. In this example, the resulting load applied to the specimen against the blade equals twice the total weight placed on the platen. The calibration weights (*9*) are used to balance the beam with sample prior to adding weight to the lever arm. Movement of the specimen holder and specimen holder mount mechanism is facilitated by use of the loading/unloading handle (*10*). Leveling adjustment is facilitated by the level mechanism (*11*). The apparatus should be capable of loads ranging from 10 g to 15 kg (0.35 oz to 33 lb).

6.2.1 *Cutting Speed*—The apparatus shall propel the cutting edge across the specimen at a constant speed of 2.5 ± 0.5 mm/s (0.10 in./s).

6.2.2 *Cut-Through Distance*—Cut-through is detected by an electrical contact between the cutting edge and conductive strip.

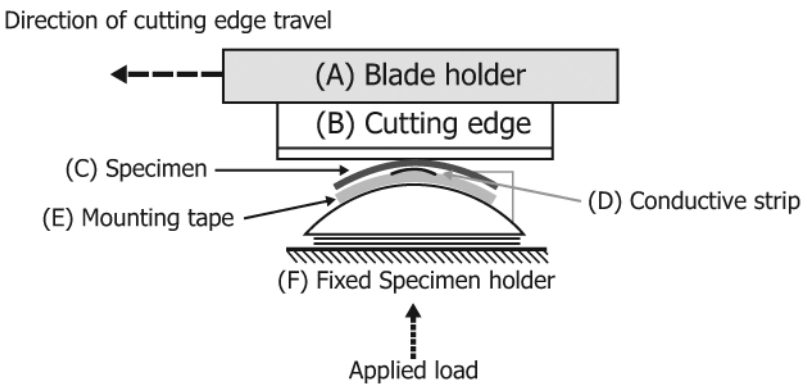

FIG. 1 Schematic of Cut Test Principle