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Designation: F1790/F1790M – 14

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

This standard is issued under the fixed designation F1790/F1790M; 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.

INTRODUCTION

Cut resistance is an important property for protective clothing and equipment, and several standard testing devices have been adopted across different industries to measure this property. A common practice in cut resistance testing is to subject a material specimen to a transversely moving blade under an applied load and measure the distance of blade travel required to cut through the specimen. This test method calculates the load required to cut through different specimens at 25.4 mm [1 in.] blade travel. This calculated load, defined as a rating load, can be used to compare the cut resistance of materials.

The original F1790-97 test method defined a commercially-available apparatus known as the Cut Protection Performance Tester (CPP). In an attempt to harmonize F1790/F1790M with ISO 13996 (another international testing standards for measuring cut resistance) and improve the test method, the scope of the test method was changed in F1790-05 to allow the use of other cut testing equipment, specifically the Tomodynamometer (TDM-100) and a modification to the CPP arm called the Modified CPP (mCPP). The revision addressed issues related to measurement of high frictional coefficient materials like elastomers, specimen mounting, rating load calculation, and other procedures to harmonize with ISO 13997:1999. After further round-robin evaluation by the subcommittee, it was demonstrated that the revisions to the test method result in a bias between the original F1790-97 test method and the revised F1790-05 test method when using the CPP. F1790-05 was not widely adopted in North America because of this bias and large amount of data and experience accumulated with F1790-97. F1790-97 continues to be the test method predominately practiced when using the CPP device. To reduce confusion for end-users of F1790/F1790M and to allow for differences between testing devices, the subcommittee has decided to limit the scope of F1790/F1790M to include only the CPP device and create a separate test method for use of the TDM-100.

1. Scope

1.1 This test method covers the measurement of the cut resistance of a material when mounted on a mandrel and subjected to a cutting edge under a specified load using the Cut Protection Performance (CPP) Tester.

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 3 mm or having a high frictional coefficient such as elastomers.

1.2 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the 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 and health practices and determine the applicability of regulatory limitations prior to use.*

[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 Jan. 1, 2014. Published February 2014. Originally approved in 1997. Last previous edition approved in 2005 as F1790 - 05. DOI: 10.1520/F1790_F1790M-14.

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2. Referenced Documents

2.1 *ASTM Standards:*[2]

D123 Terminology Relating to Textiles

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

D1776 Practice for Conditioning and Testing Textiles

F1494 Terminology Relating to Protective Clothing

2.2 *ISO Standards:*[3]

ISO 13996 Protective Clothing—Mechanical Properties—Determination of Resistance to Puncture

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

2.3 *ASTM Adjuncts:*

Cut Test Video Demonstration[4]

3. Terminology

3.1 *Definitions:*

3.1.1 *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.

3.1.2 *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.

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

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

3.1.5 *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.

3.1.5.1 *Discussion*—For this test method, the maximum allowable blade travel is 50.8 mm [2.0 in.].

3.1.6 *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.

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

3.1.7 *rating 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.

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

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 25.4 mm [1.0 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 mandrel.

4.2 The cut through distance from initial contact to cut through, for each load.

4.2.1 A series of tests, at a minimum of three different loadings must be performed to establish a range and to determine the rating force.

4.3 The test method is repeated using multiple loads to calculate a rating 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 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): (A) a pivoting motor-driven balance arm to hold the cutting edge and to which the load is applied, (B) a cutting edge; and (C) a fixed supporting mandrel on which the specimen is to be mounted. The apparatus should propel the cutting edge across the specimen until sufficient work is applied to cause the specimen to cut through.

6.2 *CPP Test Apparatus*[5]—The CPP test apparatus (see Fig. 2) consists of a motor-driven balance arm (A) that holds the cutting edge (B) in contact with the specimen mounted on a fixed supporting mandrel (C). The balance arm is connected to the motor using a drive wheel (D) and a connection arm

[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] Available from International Organization for Standardization (ISO), 1, ch. de la Voie-Creuse, CP 56, CH-1211 Geneva 20, Switzerland, http://www.iso.org.

[4] Available from ASTM Headquarters. Request Adjunct No. ADJF1790.

[5] The sole source of supply of the CPP Tester known to the committee at this time is Red Clay, Inc., 2388 Brackenville Rd., Hockessin, DE 19707, E-mail: redclay@magpage.com. 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,[1] which you may attend.

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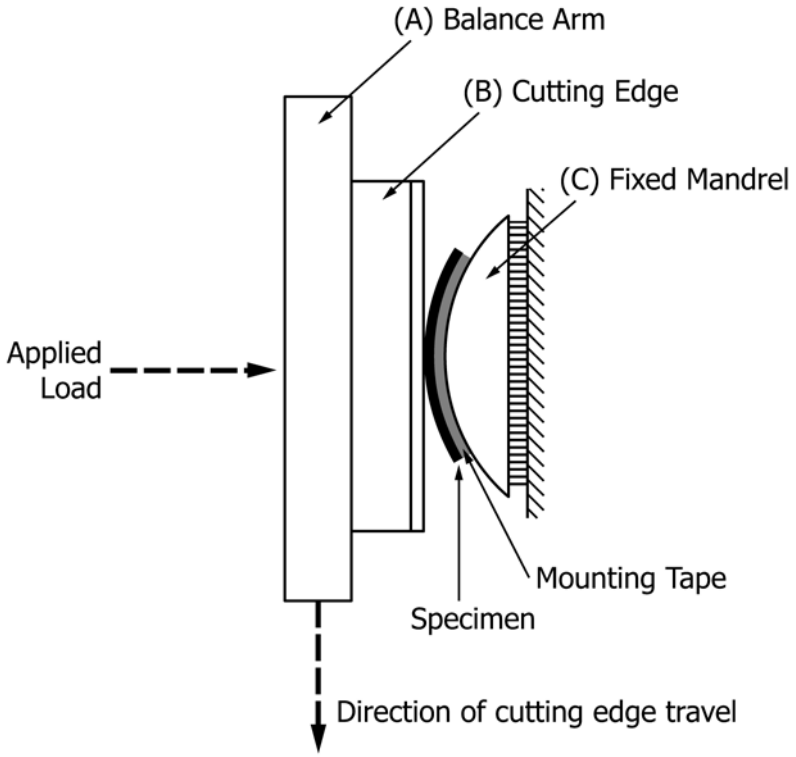

FIG. 1 Schematic of Cut Test Principle

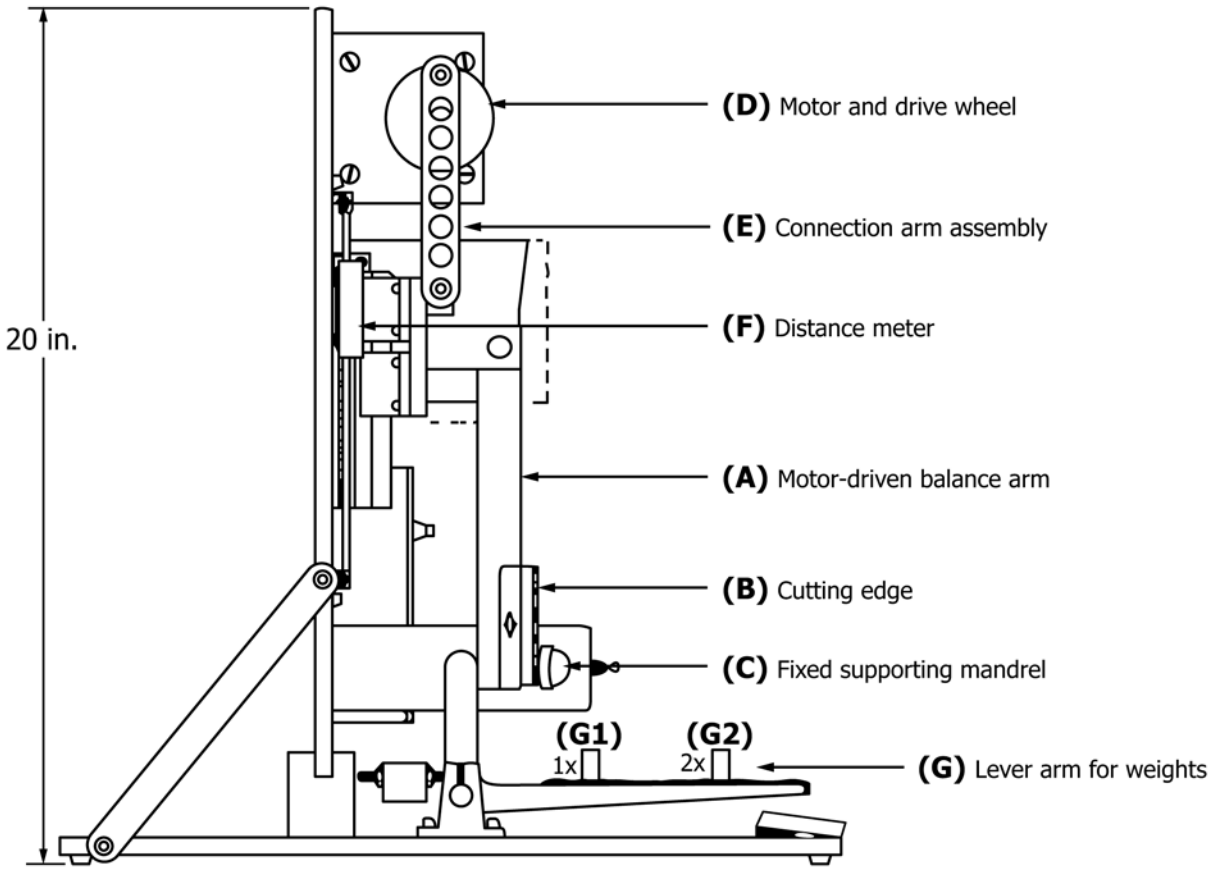

FIG. 2 Schematic of the CPP Tester (Side View)

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