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: D1424 – 21

# Standard Test Method for Tearing Strength of Fabrics by Falling-Pendulum (Elmendorf-Type) Apparatus[1]

This standard is issued under the fixed designation D1424; 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 covers the determination of the force required to propagate a single-rip tear starting from a cut in a fabric and using a falling-pendulum (Elmendorf-Type) apparatus.

1.2 This test method applies to most fabrics including woven, layered blankets, napped pile, blanket, and air bag fabrics, provided the fabric does not tear in the direction crosswise to the direction of the force application during the test. The fabrics may be untreated, heavily sized, coated, resin-treated, or otherwise treated. Instructions are provided for testing specimens with, or without, wetting.

1.3 This test method is suitable only for the warp direction tests of warp-knit fabrics. It is not suited for the course direction of warp knit fabrics or either direction of most other knitted fabrics.

1.4 The values stated in either SI units or U.S. customary units are to be regarded as standard, but must be used independently of each other. The U.S. customary units may be approximate.

1.5 *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.*

1.6 *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]

D123 Terminology Relating to Textiles

D629 Test Methods for Quantitative Analysis of Textiles

D1776 Practice for Conditioning and Testing Textiles

D2261 Test Method for Tearing Strength of Fabrics by the Tongue (Single Rip) Procedure (Constant-Rate-of-Extension Tensile Testing Machine)

D2904 Practice for Interlaboratory Testing of a Textile Test Method that Produces Normally Distributed Data (Withdrawn 2008)[3]

D2906 Practice for Statements on Precision and Bias for Textiles (Withdrawn 2008)[3]

D4848 Terminology Related to Force, Deformation and Related Properties of Textiles

D4850 Terminology Relating to Fabrics and Fabric Test Methods

D5587 Test Method for Tearing Strength of Fabrics by Trapezoid Procedure

## 3. Terminology

3.1 For all terminology relating to D13.59, Fabric Test Methods, General, refer to Terminology D4850.

3.2 For all terminology relating to Force, Deformation and Related Properties in Textiles, refer to Terminology D4848.

3.2.1 The following terms are relevant to this standard: cross-machine direction, CD, length of tear, machine direction, MD, tearing energy, tearing force, tear resistance, tearing strength, fabric.

3.3 For all other terminology related to textiles, refer to Terminology D123.

## 4. Summary of Test Method

4.1 A slit is centrally precut in a test specimen held between two clamps and the specimen is torn through a fixed distance.

[1] This test method is under the jurisdiction of ASTM Committee D13 on Textiles and is the direct responsibility of Subcommittee D13.60 on Fabric Test Methods, Specific.

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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] The last approved version of this historical standard is referenced on www.astm.org.

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The resistance to tearing is in part factored into the scale reading of the instrument and is computed from this reading and the pendulum capacity.

## 5. Significance and Use

5.1 This test method for the determination of tearing strength by the falling pendulum type apparatus is used in the trade for the acceptance testing of commercial shipments of fabrics, but caution is advised since technicians may fail to get good agreement between results on certain fabrics. Comparative tests as directed in 5.1.1 may be needed.

5.1.1 In case of a dispute arising from differences in reported test results when using this test method for acceptance testing of commercial shipments, the purchaser and the supplier should conduct comparative tests to determine if there is a statistical bias between their laboratories. Statistical assistance is recommended for the investigation of bias. As a minimum, the two parties should take a group of test specimens that are as homogeneous as possible and that are from a lot of fabric of the type in question. The test specimens should then be randomly assigned in equal numbers to each laboratory for testing. The average results from the two laboratories should be compared using appropriate statistical analysis and an acceptable probability level chosen by the two parties before the testing began. If a bias is found, either its cause must be found and corrected or the purchaser and the supplier must agree to interpret future test results with consideration to the known bias.

5.2 Microprocessor systems for automatic collection of data can provide economical and reliable results when properly calibrated. See Test Methods D2261 and D5587.

## 6. Apparatus

6.1 *Falling-Pendulum (Elmendorf-Type) Tester*[4]—The tester includes: a stationary clamp, a clamp carried on a pendulum that is free to swing on a bearing, means for leveling as applicable, means for holding the pendulum in a raised position, means for instantly releasing the pendulum, and means for measuring the force to tear the test specimen.

6.1.1 A knife can be mounted on a stationary post for initial slitting of the specimens centered between the clamps and adjusted in height to give a tearing distance of 43.0 ± 0.15 mm (1.69 ± 0.005 in.); that is, the distance between the end of the slit made by the knife and the upper edge of the specimen is 43.0 ± 0.15 mm (1.69 ± 0.005 in.) when the lower edge of the 63.0 mm (2.5 ± 0.005 in.) wide specimen rests against the bottom of the clamp.

6.1.2 With the pendulum in its initial position ready for a test, the two clamps are separated by a distance of 3.0 ± 0.5 mm (0.12 ± 0.02 in.) and are aligned such that the clamped specimen lies in a plane parallel to the axis of the pendulum, the plane making an angle of 0.480 rad (27.5 ± 0.5°) with the perpendicular line joining the axis and the horizontal line formed by the top edges of the clamping jaws. The distance between the axis and the top edges of the clamping jaws is 104 ± 1 mm (4.09 ± 0.02 in.). The clamping surface in each jaw is at least 25 mm (1.0 in.) wide and 15.9 ± 0.1 mm (0.625 ± 0.004 in.) deep.

6.1.3 The tester may have a pointer mounted on the same axis as the pendulum to register the tearing force, or it may be substituted by means of calculating and displaying the required results without the use of a pointer, such as digital display and computer driven systems. Preferably the clamps may be air actuated, but manual clamping is permitted.

6.1.4 The test instrument should be equipped to provide interchangeable full scale force ranges. Typical full scale ranges are shown in Table A3.1.

6.2 *Calibration Weight(s)* for graduation of 50 % of the full scale force range, or other means as described by the manufacturer of the test apparatus.

6.3 *Cutting Die* having essentially the shape and dimensions shown in Fig. 1(a) or (b). Either die provides the basic rectangular test specimen 100 ± 2 mm (4 ± 0.05 in.) long by 63 ± 0.15 mm (2.5 ± 0.005 in.) wide, along with additional fabric at the top edge of the specimen to help ensure the bottom portion of specimen will be torn during the test. The critical dimension of the test specimen is the distance 43.0 ± 0.15 mm (1.69 ± 0.005 in.) which is to be torn during the test.

NOTE 1—The improved die model shown in Fig. 1(a) has two new features not found in the original model, Fig. 1(b), namely a cutout for the bottom of the specimen to aid in centering it in the clamps, and (optional) provision for cutting the 20.0 mm (0.75 in.) slit prior to inserting the specimen in the tester. These dies can be made to order by most die manufacturers.

6.4 *Air Pressure Regulator,* capable of controlling gauge air pressure between 410 kPa and 620 kPa (60 psi and 90 psi), when applicable, for air clamps.

6.5 *Setting Gauge for Cutting Blade* that will provide a cut slit that leaves a 43 ± 0.15 mm (1.69 ± 0.005 in.) specimen tearing distance for a 63 ± 0.15 mm (2.5 ± 0.005 in.) wide specimen, or equivalent.

6.6 *Jaw Spacing Gauge* 2.5 ± 0.25 mm (0.1 ± 0.01 in.) width, or equivalent.

6.7 *Oil,* light weight, non-gumming clock type.

6.8 *Silicone Grease,* when applicable, for air clamp lubrication.

6.9 *Vacuum Cleaner,* when applicable, for cleaning dust and fiber from sensor, or equivalent.

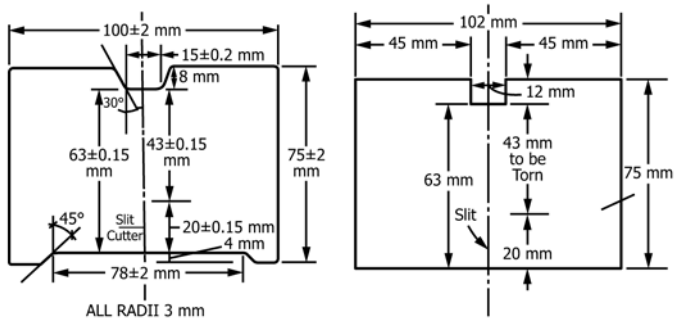


**FIG. 1 Die Diagram for Cutting Notched Specimens**

[4] Apparatus is commercially available.