Designation: D624 – 00 (Reapproved 2020)

Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers[1]

This standard is issued under the fixed designation D624; 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 procedures for measuring a property of conventional vulcanized rubber and thermoplastic elastomers called tear strength.

1.2 The values stated in SI units are to be regarded as the standard. The values given in parentheses are 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]

D412 Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension

D1349 Practice for Rubber—Standard Conditions for Testing

D3182 Practice for Rubber—Materials, Equipment, and Procedures for Mixing Standard Compounds and Preparing Standard Vulcanized Sheets

D3183 Practice for Rubber—Preparation of Pieces for Test Purposes from Products

D3767 Practice for Rubber—Measurement of Dimensions

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

2.2 *ISO Standard:*

ISO/34 Rubber, Vulcanized – Determination of Tear Strength (Trouser, Angle, and Crescent Tear Pieces)[3]

3. Terminology

3.1 The tear of rubber is a mechanical rupture process initiated and propagated at a site of high stress concentration caused a cut, defect, or localized deformation. The following definitions define different techniques for measuring the resistance to tear, i.e. the tear strength, required for use with this standard.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *Type A tear strength*—the maximum force required to cause a nick or cut in a Type A (nicked crescent) test piece to grow by tearing the rubber, divided by the thickness of the test piece.

3.2.2 *Type B tear strength*—the maximum force required to cause a nick or cut in a Type B (nicked tab end) test piece to grow by tearing the rubber, divided by the thickness of the test piece.

3.2.3 *Type C tear strength*—the maximum force required to cause a rupture of a Type C (right angle) test piece, divided by the thickness of the test piece.

3.2.4 *Type T or trouser tear strength*—the mean or median force, calculated in accordance with procedures in this method, required to propagate a tear in a Type T (trouser) test piece, divided by the thickness of the test piece.

3.2.5 *Type CP or constrained path tear strength*—the mean or median force, calculated in accordance with procedures in this method, required to propagate a tear in a type CP (constrained path) test piece, divided by the thickness of the torn section.

[1] This test method is under the jurisdiction of ASTM Committee D11 on Rubber and Rubber-like Materials and is 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 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 American National Standards Institute, 11 West 42 nd St., 13th Floor, New York, NY 10036.

3.2.6 *complete trace*—the section of a graphical plot of force versus jaw separation distance between the point at which the first peak occurs and the point at which the test is terminated.

3.2.7 *peak*—a point at which the slope of a trace changes from positive to negative.

3.2.8 *range*—the difference between the greatest and the smallest observed test values.

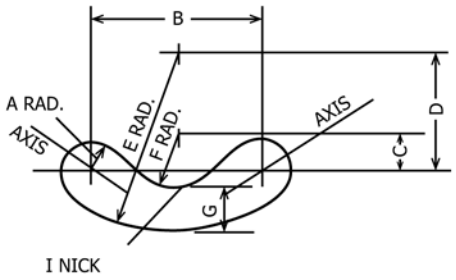
3.2.9 *valley*—a point at which the slope of a trace changes from negative to positive.

4. Summary of Test Method

4.1 A tearing strain (and stress) is applied to a test specimen by means of a tensile testing machine operated without interruption at a constant rate of crosshead traverse until the specimen is completely torn.

4.2 This test method measures the force per unit thickness required to rupture, initiate, or propagate a tear through a sheet of rubber in the form of one of several test piece geometries:

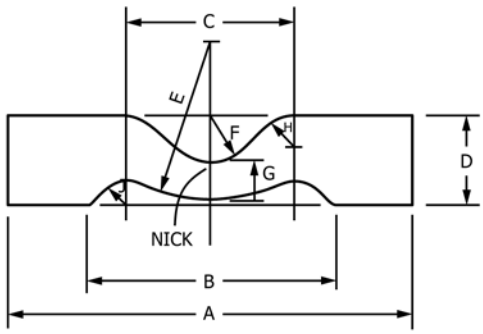
4.2.1 Type A, a razor-nicked test piece with a crescent shape, as shown in Fig. 1, Die A. The force in this test piece



DIE A

Dimension	Millimetres		Inches	
	Value	Tolerance	Value	Tolerance
A	7.6	±0.05	0.3	±0.002
B	42	±0.50	1.65	±0.02
C	8.6	±0.05	0.34	±0.002
D	29	±0.05	1.14	±0.002
E	43.2	±0.05	1.7	±0.002
F	12.7	±0.05	0.5	±0.002
G	10.2	±0.05	0.4	±0.002
Nick[A]	0.50	±0.05	0.02	±0.002

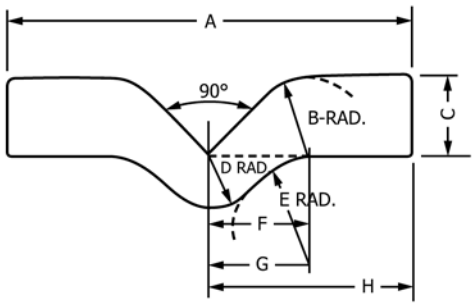
[A] Nick to be cut in specimen with a razor.



DIE B (ISO/34 CONFIGURATION)

Dimension	Millimetres		Inches	
	Value	Tolerance	Value	Tolerance
A	110	±0.50	4.3	±0.02
B	68	±0.50	2.7	±0.02
C	45	±0.05	1.8	±0.002
D	25	±0.05	1	±0.002
E	43	±0.05	1.7	±0.002
F	12.5	±0.05	0.5	±0.002
G	10.2	±0.05	0.4	±0.002
H	9	±0.05	0.375	±0.002
J	7.5	±0.05	0.3	±0.002
Nick[A]	0.5	±0.05	0.02	±0.002

[A] Nick to be cut in specimen with a razor.



DIE C

Dimension	Millimetres		Inches	
	Value	Tolerance	Value	Tolerance
A	102	±0.50	4.0	±0.02
B	19	±0.05	0.75	±0.002
C	19	±0.05	0.75	±0.002
D	12.7	±0.05	0.5	±0.002
E	25	±0.05	1.0	±0.002
F	27	±0.05	1.061	±0.002
G	28	±0.05	1.118	±0.002
H	51	±0.25	2.0	±0.01

FIG. 1 Type A, B and C Tear Test Specimen Cutting Dies

acts in a direction substantially along the major axis (length) and perpendicular to the "nick", or razor cut. Type A is used to measure tear propagation and is normally cut from smaller test specimens that can not accommodate other test types.

4.2.2 Type B, a razor-nicked test piece with a crescent shape and with tab ends, as shown in Fig. 1, Die B. The force in this test piece acts in a direction substantially along the major axis (length) and perpendicular to the "nick", or razor cut. Type B also measures tear propagation and is preferred over Type A when the test sample allows.

4.2.3 Type C, an un-nicked test piece with a 90° angle on one side and with tab ends, as shown in Fig. 1, Die C. The force acts on the test piece in a direction substantially parallel to the tab ends of the specimen (45° to the 90° center angle) in the direction of grip separation. Type C measures rupture, or tear initiation strength at the stress concentration located at the 90° apex. If tear initiation does not occur at the apex, the results are more indicative of tensile strength than tear strength.

4.2.4 Type T, a trouser tear test piece, as shown in Fig. 2. Type T measures tear propagation in a direction parallel to the length of both legs.

4.2.5 Type CP, a test piece described in Fig. 3, which is a modified trouser tear test piece with a constrained path for the tear. Type CP also measures tear propagation in a direction parallel to the length of both legs, but the constrained path prevents the tear from propagating away from this path, and the thicker legs eliminate the influence of leg extension which may occur with Type T test pieces. See (1) for more information on CP tear testing.

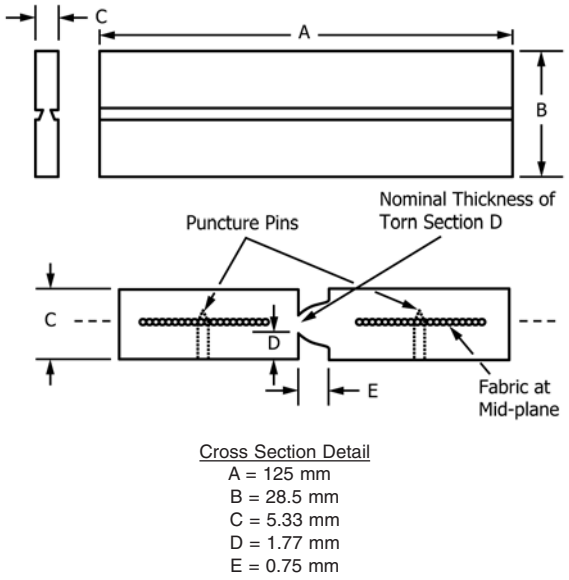
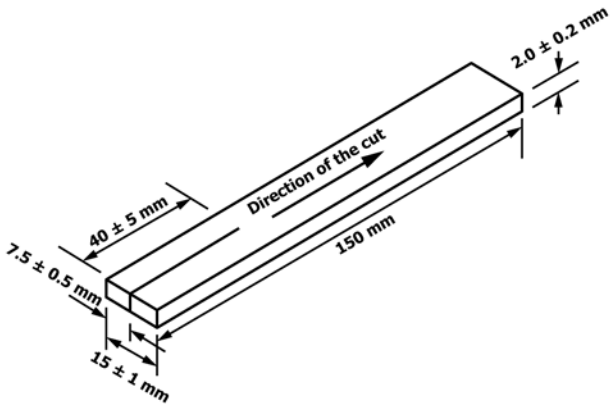


FIG. 3 Schematic diagram of "Constrained Path" tear test piece (1)



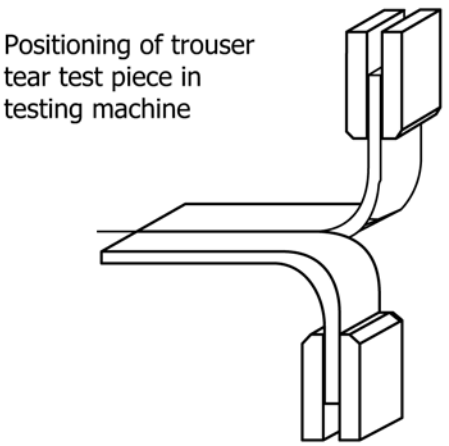


FIG. 2 Trouser Tear Test Specimen

4.3 No Correlation of results from one test type to another should be expected, as each test type measures tear strength for a different tear specimen geometry.

5. Significance and Use

5.1 Vulcanized rubber and thermoplastic elastomers (TPE) often fail in service due to the generation and propagation of a special type of rupture called a tear. This test method measures the resistance to tearing action.

5.2 Tear strength may be influenced to a large degree by stress-induced anisotropy (mechanical fibering), stress distribution, strain rate, and test piece size. The results obtained in a tear strength test can only be regarded as a measure under the conditions of that particular test and may not have any direct relation to service performance. The significance of tear testing must be determined on an individual application or product performance basis.

6. Apparatus

6.1 *Testing Machine*—The testing machine shall conform to the requirements as specified in Test Methods D412. It shall be capable of registering the applied forces within ± 2 % of the total force range or capacity during the test while maintaining the specified rate of jaw separation:

6.1.1 For Type A, B or C test pieces, the rate of jaw separation shall be 500 ± 50 mm/min. (20 ± 2.0 in./min.).

6.1.2 For Type T and Type CP test pieces, the rate of jaw separation shall be 50 ± 5 mm/min. (2 ± 0.2 in./min.).