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Standard Test Methods for Tension Testing of Nonmetallic Gasket Materials[1]

This standard is issued under the fixed designation F152; 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 These test methods cover the determination of tensile strength of certain nonmetallic gasketing materials at room temperature. The types of materials covered are those containing asbestos and other inorganic fibers (Type 1), cork (Type 2), cellulose or other organic fiber (Type 3), and flexible graphite (Type 5) as described in Classification F104. These test methods are not applicable to the testing of vulcanized rubber, a method for which is described in Test Methods D412 nor for rubber O-rings, a method for which is described in Test Methods D1414.

1.2 The values stated in SI units are to be regarded as the standard. The values 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 and health 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

D1414 Test Methods for Rubber O-Rings

E4 Practices for Force Verification of Testing Machines

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

F104 Classification System for Nonmetallic Gasket Materials

3. Terminology

3.1 *Definitions:*

3.1.1 *sample*—a unit or section of a unit taken from a sampling lot.

3.1.2 *specimen*—a piece of material appropriately shaped and prepared so that it is ready for a test.

3.1.3 *tensile strength*—the maximum tensile stress applied during stretching a specimen to rupture.

3.1.4 *tensile stress*—the applied force per unit or original cross-sectional area of the specimen.

4. Significance and Use

4.1 These test methods are described in order to standardize procedures for determining the tensile strength of nonmetallic gasket materials. The measurement of this property characterizes various classes and grades of materials of a given type and in so doing, it will give the manufacturer a measurement of the quality of his product. It also will aid the purchaser of the gasketing materials to be able to determine whether the gasket material that he has approved for a given application is being manufactured in acceptable quality.

4.2 The measurement of this property should not be misconstrued as to give the purchaser of the gasket material an indication of the performance of that material in application.

4.3 The property may be useful in establishing material specifications.

4.4 Various procedures are given for the different types of materials, and in order to compare the results from one laboratory to another, it is imperative that the applicable procedure be selected.

4.5 Various types of tension-testing apparatus are allowed to be used. These types of equipment can produce different indicated results. Laboratories having different equipment may have to establish correlations between each other; otherwise, misinterpretation of the test data could result.

[1] These test methods are under the jurisdiction of ASTM Committee F03 on Gaskets and are the direct responsibility of Subcommittee F03.20 on Mechanical Test Methods.

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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.

5. Apparatus

5.1 *Dies*—The inside faces of the dies shall be polished and be perpendicular to the plane formed by the cutting edges for a depth of at least 5 mm (0.2 in.). The dies shall be sharp and free of nicks in order to prevent ragged edges on the specimen.

5.2 *Dial Micrometers*—In accordance with 9.1 of Classification F104.

5.3 *Testing Machine*—Tension tests shall be made on a power-driven machine, so equipped that a constant rate of grip separation shall be maintained, and with an indicating or recording device for measuring the resulting force within ±2 %. The tester shall have two grips and a mechanism for separating the grips at a uniform rate, which will be maintained during the test within ±5 % of the desired rate of separation. The grips shall be either wedged or toggle type, designed to transmit the applied force over a large surface area of the specimen.

5.3.1 Calibrate the testing machine in accordance with Procedure A of Practices E4.

6. Conditioning

6.1 Prior to testing, specimens shall be conditioned as follows:

6.1.1 *Type 1*—Specimens shall be conditioned in an oven at 100 ± 1°C (212 ± 2°F) for 1 h and allowed to cool to 21 to 29°C (70 to 85°F) in a desiccator containing a suitable desiccant,[3] except that asbestos millboard shall be conditioned in an oven for 4 h at 100 ± 1°C (212 ± 2°F).

6.1.2 *Type 2*—Specimens shall be conditioned at least 46 h in a controlled cabinet or room with gentle circulation of the air at 21 to 30°C (70 to 85°F) and 50 to 55 % relative humidity.

6.1.3 *Type 3*—Specimens shall be preconditioned for 4 h at 21 to 29°C (70 to 85°F) in a desiccator containing anhydrous calcium chloride. Specimens shall then be transferred to a controlled humidity cabinet or room with gentle circulation of the air and conditioned for at least 20 h at 21 to 29°C (70 to 85°F) and from 50 to 55 % relative humidity.

7. Procedure

7.1 *Method A, for Asbestos and Other Inorganic Fiber-Containing Nonmetallic Gasket Materials:*

7.1.1 Prepare the specimens from the sample using Die A (12.7-mm (0.50-in.) width) in accordance with Test Methods D412. The lengthwise direction shall be perpendicular to the grain of the material.

7.1.2 Clamp the specimens in the testing jaws so that a 116-mm (4-in.) spacing between jaws is used and drive the jaw at 305 ± 25 mm (12 ± 1 in.)/min. Specimens cut with Die B (6.4-mm (0.25-in.) width) in accordance with Test Methods D412, or one 25.4 by 152.4-mm (1 by 6-in.) strip cut by a die in accordance with 7.3.1 may be used when these 12.7-mm (0.50-in.) specimens break at more than 85 % or less than 15 % of the rated capacity when pendulum-type testing machines are used.

7.2 *Method B, for Cork Compositions and Cork-Rubber Gasket Materials:*

7.2.1 Prepare the specimens from the sample using a 50.8 by 101.5-mm (2 by 4-in.) die.

7.2.2 Place the specimens in the jaws so that a 25.4-mm (1-in.) length is gripped and drive the jaw at 305 ± 25 mm (12 ± 1 in.)/min.

7.3 *Method C, for Cellulosic or Other Organic Fiber-Containing Gasket Materials:*

7.3.1 The specimens shall be 25.4 by 152.4 mm (1 by 6 in.). The lengthwise dimension shall be perpendicular to the grain direction of the material.

7.3.2 Place them in the machine with a 102-mm (4-in.) distance between the jaws and drive the jaw at 305 ± 25 mm (12 ± 1 in.)/min. Specimens of 12.7-mm (0.50-in.) width may be used where necessary to fall within the range of the load indicator.

7.4 *Method D, for Flexible Graphite Gasket Materials:*

7.4.1 The specimens shall be 25.4 by 152.4 mm (1 by 6 in.). The lengthwise dimension shall be parallel to the length of the coil material.

7.4.2 Place the specimen in the machine with a 102-mm (4-in.) distance between the jaws and drive the jaw at 12 ± 5 mm (0.5 ± 0.2 in.)/min.

8. Calculation

8.1 Calculate the tensile strength by dividing the peak load by the original cross-sectional area of the specimen and expressing the results in megapascals or pounds per square inch.

9. Report

9.1 Report the following information:

9.1.1 Complete sample identification, including commercial designation,

9.1.2 Source,

9.1.3 Manufacturer,

9.1.4 Date of production, if known,

9.1.5 Procedure used (whether A, B, or C),

9.1.6 Number of specimens tested from each sample,

9.1.7 Type of testing apparatus conditioning, if other than recommended,

9.1.8 Conditioning, if other than recommended, and

9.1.9 Results, reported as the average of all the test specimens tested per sample, accompanied by the date of testing.

10. Precision and Bias[4]

10.1 An interlaboratory test program was conducted on 2 types of machines, 5 fixed and 5 movable heads, using 5 specimens each of 7 differing materials on 2 different days. The data from this program analyzed in accordance with Practice E691 is tabulated in Table 1.

[3] Anhydrous calcium chloride and silica gel have been determined to be suitable desiccants.

[4] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:F03-1010.

TABLE 1 Precision and Bias Data

NOTE 1—Examination of this data demonstrates the differing test results between the 2 types of machines to be statistically significant, at a 95 % confidence level, for only Materials *F* and *E* when 10 specimens were tested at 5 different laboratories. There likely would be no statistically significant difference if 3 specimens were tested at 2 laboratories.

Material	Average	Repeatability	Reproducibility	Test Method Precision
		Movable Head		
F	513	29.1	24.2	37.8
G	2780	86.5	17.7	88.3
D	3085	269.8	103.6	289.0
A	3195	161.7	271.1	315.6
B	3396	214.9	279.4	352.5
C	4089	318.0	510.4	601.4
E	7712	287.5	229.4	367.8
		Fixed Head		
F	559	29.6	25.5	39.1
G	2863	68.7	76.2	102.6
D	3142	258.0	217.5	337.4
A	3317	148.0	353.1	382.9
B	3566	247.2	402.7	472.5
C	4155	319.0	277.8	423.0
E	8062	389.0	225.0	449.0

11. Keywords

11.1 cross-section area; peakload; tensile strength; tensile stress