Designation: F806 – 99a (Reapproved 2017)

Standard Test Method for Compressibility and Recovery of Laminated Composite Gasket Materials[1]

This standard is issued under the fixed designation F806; 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 determination of the short-time compressibility and recovery at room temperature of laminated composite gasket materials.

1.2 This test method is not intended as a test for compressibility under prolonged stress application, that is "creep," or for recovery following such prolonged stress application, the inverse of which is generally referred to as "compression set." Also, it is only intended for tests at room temperature.

1.3 The values stated in SI units are to be regarded as the standard. The inch-pound units given in parentheses are for information only.

1.4 *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.*

1.5 *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]

F104 Classification System for Nonmetallic Gasket Materials

2.2 *ASTM Adjuncts:*

Testing Machine Drawings[3]

3. Significance and Use

3.1 This test method is designed to compare related laminated composite gasket materials under controlled conditions and their short-time compressibility and recovery at room temperature. It measures compressibility with a matched pair of opposing upper and lower penetrators which provide better precision and bias than methods using an upper penetrator and a lower anvil. It is difficult to prepare undistorted test specimens from laminated composite gasket materials which will lay flat on an anvil. Also, with many composites having rigid inner layers the load on the upper penetrator is distributed over the bottom anvil area resulting in a lower than actual compressibility reading. This test method may be used as a routine test method when agreed upon between the purchaser and the producer.

4. Apparatus

4.1 The testing machine[4] shall consist of the following components.

4.1.1 *Penetrators*—A matched pair of opposing steel cylinders (within ± 0.025 mm (0.001 in.)) specified for the type of material being tested, with the cylinder ends hardened and ground. Penetrator diameters for various types of laminated composite gasket materials are shown in Table 1.

4.1.2 *Dial*—An indicating dial, or dials, graduated in 0.025 mm (0.001 in.) to show the thickness of the specimen during the test. Readings shall be estimated to the nearest 0.0025 mm (0.0001 in.).

4.1.3 *Preload,* shall include the weight of the penetrator itself and added weights to give the value specified within ± 1 %. A 22.2-N (5-lbf) preload shall be used.

4.1.4 *Loading Device*—A device for applying a specified major load to the upper end of the penetrator, which may consist of an arrangement of dead weights, a hydraulic cylinder, an air cylinder, or any other device capable of applying the major load at a slow uniform rate and to an accuracy of ± 1 %. The major load shall be in addition to the specified preload. Major loads for various types of laminated composite gasket materials are shown in Table 1.

[1] This test method is under the jurisdiction of ASTM Committee F03 on Gaskets and is 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.

[3] Available from ASTM International Headquarters. Order Adjunct No. ADJF0806. Original adjunct produced in 1983.

[4] A list of recommended suppliers, by Subcommittee F03.20, is available through ASTM.

TABLE 1 Conditioning and Test Loads for Laminated Composite Gasket Materials

NOTE 1—If the nonmetallic layers of the laminated composite are not all the same material, then the test loads may be as agreed upon between the producer and user.

Procedure	Type of Gasket Material in the Nonmetallic Layers	F104 Identification[A] First Two Numerals of Six-Digit Number	Conditioning Procedure	Penetrator Diameter, mm (in.)	Preload, N (lbf)	Major Load, N (lbf)	Total Load (sum of Major Load and Preload)	
							N (lbf)	MPa (psi)
A	compressed asbestos sheet; asbestos beater sheet; flexible graphite	F11, F12, F51, F52	1 h at 100 ± 2°C (212 ± 3.6°F); cool in desiccator over anhydrous calcium chloride 21 to 30°C (70 to 85°F)	6.4 (0.252)	22.2 (5)	1090 (245)	1112 (250)	34.5 (5000)
H	asbestos paper and millboard	F13	4 h at 100 ± 2°C (212± 3.6°F); cool as in Procedure A	6.4 (0.252)	22.2 (5)	1090 (245)	1112 (250)	34.5 (5000)
F	cork composition, cork and cellular rubber	F21, F23	At least 46 h at 21 to 30°C (70 to 85°F) and 50 to 55 % relative humidity	28.7 (1.129)	22.2 (5)	423 (95)	445 (100)	0.69 (100)
B	cork and rubber	F22	At least 46 h at 21 to 30°C (70 to 85°F) and 50 to 55 % relative humidity	12.8 (0.504)	22.2 (5)	334 (75)	356 (80)	2.76 (400)
G	treated and untreated papers from cellulose or other organic fibers	F31, F32, F33, F34	4 h at 21 to 30°C (70 to 85°F) over anhydrous calcium chloride followed immediately by at least 20 h at 21 to 30°C (70 to 85°F) and 50 to 55 % relative humidity	6.4 (0.252)	22.2 (5)	1090 (245)	1112 (250)	34.5 (5000)
J	compressed nonasbestos sheet; nonasbestos beater sheet	F71, F72	1 h at 100± 2°C (212 ± 3.6°F); cool in desiccator over anhydrous calcium chloride 21 to 30°C (70 to 85°F)	6.4 (0.252)	22.2 (5)	1090 (245)	1112 (250)	34.5 (5000)
K	nonasbestos paper and millboard	F73	4 h at 100 ± 2°C (212± 3.6°F); cool as in Procedure A	6.4 (0.252)	22.2 (5)	1090 (245)	1112 (250)	34.5 (5000)

[A] Refers to Classification F104.

5. Test Specimen

5.1 The test specimen may be either circular or rectangular in shape. The minimum size shall be 12.7 mm (0.5 in.) larger than the penetrator diameter being used, and the maximum size shall be 38.1 mm (1.5 in.) larger than it. The thickness shall be that of the laminated composite gasket. Take care that the specimen is flat, especially around the planned contact point of the opposing penetrators.

6. Conditioning

6.1 When all nonmetallic layers of the laminated composite are the same type, condition in accordance with that type as shown in Table 1.

6.2 When the nonmetallic layers of the laminated composite are of different types, the specimen shall be conditioned for 22 h in a controlled-humidity room or in a closed chamber of air at 21 to 30°C (70 to 85°F) and 50 to 55 % relative humidity. In all cases where testing is conducted outside the area of specified humidity, specimens shall be removed from the chamber one at a time as needed.

6.3 Other conditioning may be as agreed upon between the producer and the user.

7. Temperature of Test

7.1 The test shall be conducted with both the specimen and the apparatus at a temperature of 21 to 30°C (70 to 85°F).

8. Procedure

8.1 Determine the amount of deflection of the penetrator at each of the loads used in the test with no specimens present. Add the absolute value of this penetrator deflection to the thickness under total load *M* in 10.1 to obtain a corrected reading. The values are machine constants which may vary for different instrument designs.

8.2 Center the test specimen upon the bottom penetrator, and apply the preload, guiding the top penetrator in its descent so that it remains parallel to the surface of the bottom penetrator. Maintain for a period of 15 s, and record the preloaded thickness of the specimen. Immediately apply the major load in a slow uniform manner so that the total load is attained within 10 s. Maintain the total load for 60 s, and record the thickness of the specimen. Immediately remove the major load, and after a period of 60 s, record the thickness of the specimen under the original preload. This is the recovered thickness.

9. Number of Tests

9.1 A minimum of three tests shall be run on separate specimens taken from the same sample and the results averaged.

10. Calculation

10.1 Calculate the compressibility, *C*, and recovery, *D*, in percent as follows:

$$C = (P - M)/P \times 100$$

$$D = (R - M)/(P - M) \times 100$$

where:

P = thickness under preload, mm (in.),
M = thickness under total load, mm (in.), and

R = recovered thickness, mm (in.).

10.2 When desired, the resiliency shall be calculated as follows:

$$\textit{Resiliency}, \% = \left[(R - M)/M\right] \times 100$$

11. Precision and Bias[5]

11.1 This precision data is based on tests of four different material samples by six laboratories in 2 days. The compressibility of the samples studied ranged from 3 to 16 %. Precision is expressed in absolute terms, in this case, percent compressibility points.

11.2 *Repeatability*—The repeatability has been estimated to be ± 0.71 %. Two test results do not differ significantly unless their difference exceeds 1.0 %.

11.3 *Reproducibility*—The reproducibility has been estimated to be ±2.1 %. Two test results do not differ significantly unless their difference exceeds 2.9 %.

12. Keywords

12.1 compressibility; gasket material composites; gasket material laminates; recovery; resiliency

[5] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:F03-1013.