



**Designation: F104 – 11**

## **Standard Classification System for Nonmetallic Gasket Materials<sup>1</sup>**

This standard is issued under the fixed designation F104; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

*This standard has been approved for use by agencies of the Department of Defense.*

### **1. Scope**

1.1 This classification system<sup>2</sup> provides a means for specifying or describing pertinent properties of commercial nonmetallic gasket materials. Materials composed of asbestos, cork, cellulose, and other organic or inorganic materials in combination with various binders or impregnants are included. Materials normally classified as rubber compounds are not included, since they are covered in Classification **D2000**. Gasket coatings are not covered, since details thereof are intended to be given on engineering drawings or in separate specifications. Facing materials for laminate composite gasket materials (LCGM) are included in Classification System F104. Assembled LCGMs are covered in Classification **F868**.

1.2 Since all of the properties that contribute to gasket performance are not included, use of the classification system as a basis for selecting materials is limited.

1.3 The values stated in SI units are to be regarded as the standard. The values 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.*

### **2. Referenced Documents**

#### **2.1 ASTM Standards:<sup>2</sup>**

**C561** Test Method for Ash in a Graphite Sample

**D1170** Specification for Nonmetallic Gasket Materials for General Automotive and Aeronautical Purposes (Withdrawn 1968)<sup>3</sup>

<sup>1</sup> This classification is under the jurisdiction of ASTM Committee **F03** on Gaskets and is the direct responsibility of Subcommittee **F03.30** on Classification.

Current edition approved April 1, 2011. Published May 2011. Originally approved in 1968. Last previous edition approved in 2009 as F104–03 (2009). DOI: 10.1520/F0104-11.

<sup>2</sup> 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.

<sup>3</sup> The last approved version of this historical standard is referenced on www.astm.org.

**D2000** Classification System for Rubber Products in Automotive Applications

**D5964** Practice for Rubber IRM 901, IRM 902, and IRM 903 Replacement Oils for ASTM No. 1, ASTM No. 2, and ASTM No. 3 Oils

**E11** Specification for Woven Wire Test Sieve Cloth and Test Sieves

**F36** Test Method for Compressibility and Recovery of Gasket Materials

**F37** Test Methods for Sealability of Gasket Materials

**F38** Test Methods for Creep Relaxation of a Gasket Material

**F146** Test Methods for Fluid Resistance of Gasket Materials

**F147** Test Method for Flexibility of Non-Metallic Gasket Materials

**F148** Test Method for Binder Durability of Cork Composition Gasket Materials

**F152** Test Methods for Tension Testing of Nonmetallic Gasket Materials

**F433** Practice for Evaluating Thermal Conductivity of Gasket Materials

**F607** Test Method for Adhesion of Gasket Materials to Metal Surfaces

**F868** Classification for Laminated Composite Gasket Materials

**F1315** Test Method for Density of a Sheet Gasket Material

**G21** Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi

### **3. Significance and Use**

3.1 This classification system is intended to encourage uniformity in reporting properties; to provide a common language for communications between suppliers and consumers; to guide engineers and designers in the test methods commonly used for commercially available materials; and to be versatile enough to cover new materials and test methods as they are introduced.

3.2 This system is based on the principle that nonmetallic gasket materials can be described in terms of specific physical and mechanical properties. This enables the user, or producer, to characterize a nonmetallic gasket based on properties that are important for the application.

#### 4. Basis of Classification

4.1 To permit “line call-out” of a material’s physical and mechanical properties, this classification system establishes letter and number symbols for various performance levels of each property or characteristic.

4.2 Each “line call out” shall include:

- ASTM F104
- In parentheses, the letter “F” followed by 6 numerals describing the required basic characteristics per 8.1.
- Within the same parentheses, a dash “-” shall follow the basic characteristics, along with any supplemental characteristics per 8.2.

All six (6) numeric fields defining the basic characteristics must be occupied. If a particular characteristic is not required, a “0” must be used as a placeholder to indicate such.

4.3 The six (6) numeric fields used in the basic characteristics define (in order):

- (1) Principal reinforcement
- (2) Manufacturing method
- (3) Compressibility
- (4) Thickness increase in IRM 903 oil
- (5) Weight increase in IRM 903 oil
- (6) Weight increase in water

Example 1:

ASTM F104 (F725400) describes a gasket material with only basic characteristics defined as follows: first numeral – 7 (non-asbestos fiber, tested as type 1); second numeral – 2 (beater process); third numeral – 5 (20 to 30 % compressibility per Test Method F36); fourth numeral – 4 (15 to 30 % thickness increase after immersion in IRM 903 Oil per Test Methods F146); fifth numeral – 0 (no Requirement for weight increase in IRM 903 oil per Test Methods F146); sixth numeral – 0 (no requirement for weight increase in water per Test Methods F146).

4.4 Supplemental characteristics may be added to line call out based on the needs of the application. The alpha numerics used to specify various supplemental characteristics are defined in 8.2.

Example 2:

ASTM F104 (F725400-B5E66M4) describes a gasket material with the same basic characteristics defined by Example 1, along with supplemental characteristics defined as follows: B5 (30 % creep relaxation per Test Methods F38); E66 (60 % weight change, and 15 to 35 % thickness change in ASTM Fuel B per Test Methods F146); M4 (no less than 6.895 MPa tensile strength per Test Methods F152).

4.5 The numeral “9” is used when the description of any characteristic (or test related thereto) is specified by some supplement to this classification system, such as notes on engineering drawings. This notation may be used to modify a test characteristic to a value not available in the tables; define gasket binder type; note use and type of a surface release agent; or note use and type of an adhesive system.

Example 3:

Using the same example and adding an L suffix requirement, ASTM F104 (F725400-B5E66M4L169), since the 9 needs to be defined on the engineering drawing, it is recommended to define the “As Specified” requirement immediately after the F104 line call out. In this case, for L169, the 1 defines the primary fiber as Aramid, the 6 indicates the secondary fiber is cellulose both per 8.2, and the 9 is defined immediately after the line call out as shown here:

ASTM F104 (F725400-B5E66M4L169); L169 (ACM Binder)

NOTE 1—While this “cell-type” format provides the means for close characterization and specification of each property and combinations of properties for a broad range of materials, it is subject to possible misapplications, since impossible property combinations can be coded if the user is not familiar with available commercial materials. Appendix X1 indicates properties, characteristics, and test methods that are normally considered applicable to each type of material.

#### 5. Thickness Requirements

5.1 Thickness tolerance guidelines for materials identified by this classification system are provided in 8.4. Use of these guidelines as a requirement must be based on an agreement between part/material provider and end user.

5.2 Unless specified by an ASTM method, default test thickness shall be:

All materials except	0.8 mm (0.030 in.)
Type 2 and Type 5 Class 1	
Type 2 materials	1.5 to 6.4 mm (0.060 to 0.25 in.)
Type 5, Class 1 materials	0.4 mm (0.015 in.)

#### 6. Sampling

6.1 Specimens shall be selected from finished gaskets or sheets of suitable size, whichever is the more practicable. If sheets are used, they shall, where applicable, be cut squarely with the grain of the stock, and the grain direction shall be noted by an arrow. If finished gaskets are used, the dimensions of sample and any variations from method must be reported.

6.2 Sufficient specimens shall be selected to provide a minimum of three determinations for each test specified. The average of the determinations shall be considered as the result.

## 7. Conditioning

7.1 Prior to all applicable tests, specimens shall be conditioned as follows:

TYPE	CLASS	CONDITIONING
1	All Except 3	Oven conditioned at 100°C (212°F) for 1 h. Cool to 21 to 30°C (70 to 85°F) in a desiccator containing anhydrous calcium chloride.
1	3	Oven condition at 100 ± 2°C (212 ± 3.6°F) for 4 h. Cool to 21 to 30°C (70 to 85°F) in a desiccator containing anhydrous calcium chloride.
2	All	Controlled humidity room or closed chamber at 21 to 30°C (70 to 85°F) and 50 to 55 % relative humidity for at least 46 h.
0, 3, or 9	All	Preconditioned at 21 to 30°C (70 to 85°F) for 4 h in a closed chamber containing anhydrous calcium chloride as a desiccant. The air in the chamber shall be circulated by gentle mechanical agitation. Specimens shall then be transferred immediately to a controlled-humidity room or closed chamber with gentle mechanical circulation of the air and conditioned at 21 to 30°C (70 to 85°F) and 50 to 55 % relative humidity for at least 20 h. If a mechanical means of maintaining 50 to 55 % relative humidity is not available, a tray containing a saturated solution of reagent grade magnesium nitrate, Mg(NO <sub>3</sub> )•6H <sub>2</sub> O, shall be placed in the chamber to provide the required relative humidity. No conditioning required.
4	All	Oven conditioned at 100°C (212°F) for 1 h. Cool to 21 to 30°C (70 to 85°F) in a desiccator containing anhydrous calcium chloride.
5, 7, or 8	All	Oven conditioned at 100°C (212°F) for 1 h. Cool to 21 to 30°C (70 to 85°F) in a desiccator containing anhydrous calcium chloride.

7.2 In all cases where testing is conducted outside the area of specified humidity, specimens shall be removed from the chamber one at a time just prior to testing.

## 8. Classification Tables

8.1 **Table 1** presents the basic 6 numeric fields and the available physical and mechanical characteristic and the definition of each placeholder in that field.

8.2 **Table 2** presents the available supplementary physical and mechanical characteristics and the defined requirements.

8.3 **Table 3** contains guideline material thickness tolerances. The tolerances in this table may not be applicable to all types of gasket materials. These values should not be used as part tolerances unless previously agreed on between producer and end user.

### 8.4 Thickness:

8.4.1 Measure the specimens with a device actuated by a dead-weight load. The device shall be capable of reading in 0.02-mm (0.001-in.) or smaller units, and readings shall be estimated to the nearest 0.002 mm (0.0001 in.). The presser foot shall be 6.40 ± 0.13 mm (0.252 ± 0.005 in.) in diameter. The anvil shall have a diameter not less than that of the presser foot. The pressure on the sample shall be as specified in **Table 4**.

8.4.2 Take the reading by lowering the presser foot gently until it is in contact with the specimen. Take a sufficient number of readings, depending on the size of the specimen, to provide a reliable average value.

## 9. Keywords

9.1 classification; description; gasket; line call-out; nonmetallic gasket; physical and mechanical properties; specification; testing

[ASTM F104-11](https://standards.iteh.ai/ASTM/F104-11)

<https://standards.iteh.ai/catalog/standards/sist/f42ad96f-7f97-482c-b209-fb5a25d050b1/astm-f104-11>

**TABLE 1 Basic Physical and Mechanical Characteristics**

Basic Six-Digit Number	Basic Characteristic																																																										
First Numeral	<p><i>"Type" of material</i> (the principal fibrous, particulate, or reinforcement material from which the gasket is made) shall conform to the first numeral of the basic six-digit number, as follows:</p> <table> <tr> <td>0 = not specified</td> <td>5 = flexible graphite</td> </tr> <tr> <td>1 = asbestos</td> <td>7 = nonasbestos fiber, tested as Type 1</td> </tr> <tr> <td>2 = cork</td> <td>8 = vermiculite</td> </tr> <tr> <td>3 = cellulose</td> <td>9 = as specified<sup>A</sup></td> </tr> <tr> <td>4 = fluorocarbon polymer</td> <td></td> </tr> </table>	0 = not specified	5 = flexible graphite	1 = asbestos	7 = nonasbestos fiber, tested as Type 1	2 = cork	8 = vermiculite	3 = cellulose	9 = as specified <sup>A</sup>	4 = fluorocarbon polymer																																																	
0 = not specified	5 = flexible graphite																																																										
1 = asbestos	7 = nonasbestos fiber, tested as Type 1																																																										
2 = cork	8 = vermiculite																																																										
3 = cellulose	9 = as specified <sup>A</sup>																																																										
4 = fluorocarbon polymer																																																											
Second Numeral	<p><i>Class of material</i> (method of manufacture or common trade designation) shall conform to the second numeral of the basic six-digit number, as follows:</p> <p>When <i>first</i> numeral is "0" or "9," second numeral:</p> <table> <tr> <td>0 = not specified</td> <td></td> </tr> <tr> <td>9 = as specified<sup>A</sup></td> <td></td> </tr> </table> <p>When <i>first</i> numeral is "1" or "7," second numeral:</p> <table> <tr> <td>0 = not specified</td> <td></td> </tr> <tr> <td>1 = compressed sheeter process</td> <td></td> </tr> <tr> <td>2 = beater process</td> <td></td> </tr> <tr> <td>3 = paper and millboard</td> <td></td> </tr> <tr> <td>9 = as specified<sup>A</sup></td> <td></td> </tr> </table> <p>When <i>first</i> numeral is "2," second numeral:</p> <table> <tr> <td>0 = not specified</td> <td></td> </tr> <tr> <td>1 = cork composition (Class 1)</td> <td></td> </tr> <tr> <td>2 = cork and elastomeric (Class 2)</td> <td></td> </tr> <tr> <td>3 = cork and cellular rubber (Class 3)</td> <td></td> </tr> <tr> <td>9 = as specified<sup>A</sup></td> <td></td> </tr> </table> <p>When <i>first</i> numeral is "3," second numeral:</p> <table> <tr> <td>0 = not specified</td> <td></td> </tr> <tr> <td>1 = untreated fiber—tag, chipboard, vulcanized fiber, etc. (Class 1)</td> <td></td> </tr> <tr> <td>2 = protein treated (Class 2)</td> <td></td> </tr> <tr> <td>3 = elastomeric treated (Class 3)</td> <td></td> </tr> <tr> <td>4 = thermosetting resin treated (Class 4)</td> <td></td> </tr> <tr> <td>9 = as specified<sup>A</sup></td> <td></td> </tr> </table> <p>When <i>first</i> numeral is "4," second numeral:</p> <table> <tr> <td>0 = not specified</td> <td></td> </tr> <tr> <td>1 = sheet PTFE</td> <td></td> </tr> <tr> <td>2 = PTFE of expanded structure</td> <td></td> </tr> <tr> <td>3 = PTFE filaments, braided, or woven</td> <td></td> </tr> <tr> <td>4 = PTFE felts</td> <td></td> </tr> <tr> <td>5 = filled PTFE</td> <td></td> </tr> <tr> <td>9 = as specified</td> <td></td> </tr> </table> <p>When <i>first</i> numeral is "5" or "8," second numeral:</p> <table> <tr> <td>0 = not specified</td> <td></td> </tr> <tr> <td>1 = homogeneous sheet</td> <td></td> </tr> <tr> <td>2 = laminated sheet</td> <td></td> </tr> <tr> <td>9 = as specified<sup>A</sup></td> <td></td> </tr> </table>	0 = not specified		9 = as specified <sup>A</sup>		0 = not specified		1 = compressed sheeter process		2 = beater process		3 = paper and millboard		9 = as specified <sup>A</sup>		0 = not specified		1 = cork composition (Class 1)		2 = cork and elastomeric (Class 2)		3 = cork and cellular rubber (Class 3)		9 = as specified <sup>A</sup>		0 = not specified		1 = untreated fiber—tag, chipboard, vulcanized fiber, etc. (Class 1)		2 = protein treated (Class 2)		3 = elastomeric treated (Class 3)		4 = thermosetting resin treated (Class 4)		9 = as specified <sup>A</sup>		0 = not specified		1 = sheet PTFE		2 = PTFE of expanded structure		3 = PTFE filaments, braided, or woven		4 = PTFE felts		5 = filled PTFE		9 = as specified		0 = not specified		1 = homogeneous sheet		2 = laminated sheet		9 = as specified <sup>A</sup>	
0 = not specified																																																											
9 = as specified <sup>A</sup>																																																											
0 = not specified																																																											
1 = compressed sheeter process																																																											
2 = beater process																																																											
3 = paper and millboard																																																											
9 = as specified <sup>A</sup>																																																											
0 = not specified																																																											
1 = cork composition (Class 1)																																																											
2 = cork and elastomeric (Class 2)																																																											
3 = cork and cellular rubber (Class 3)																																																											
9 = as specified <sup>A</sup>																																																											
0 = not specified																																																											
1 = untreated fiber—tag, chipboard, vulcanized fiber, etc. (Class 1)																																																											
2 = protein treated (Class 2)																																																											
3 = elastomeric treated (Class 3)																																																											
4 = thermosetting resin treated (Class 4)																																																											
9 = as specified <sup>A</sup>																																																											
0 = not specified																																																											
1 = sheet PTFE																																																											
2 = PTFE of expanded structure																																																											
3 = PTFE filaments, braided, or woven																																																											
4 = PTFE felts																																																											
5 = filled PTFE																																																											
9 = as specified																																																											
0 = not specified																																																											
1 = homogeneous sheet																																																											
2 = laminated sheet																																																											
9 = as specified <sup>A</sup>																																																											
Third Numeral	<p><i>Compressibility characteristics</i>, determined in accordance with Test Method <b>F36</b>, shall conform to the percent indicated by the third numeral of the basic six-digit number. (Example: 4 = 15 to 25 %)</p> <table> <tr> <td>0 = not specified</td> <td>5 = 20 to 30 %</td> </tr> <tr> <td>1 = 0 to 10 %</td> <td>6 = 25 to 40 %</td> </tr> <tr> <td>2 = 5 to 15 %*</td> <td>7 = 30 to 50 %</td> </tr> <tr> <td>3 = 10 to 20 %</td> <td>8 = 40 to 60 %</td> </tr> <tr> <td>4 = 15 to 25 %</td> <td>9 = as specified<sup>A</sup></td> </tr> </table> <p>* 7 to 17 % for compressed sheeter process</p>	0 = not specified	5 = 20 to 30 %	1 = 0 to 10 %	6 = 25 to 40 %	2 = 5 to 15 %*	7 = 30 to 50 %	3 = 10 to 20 %	8 = 40 to 60 %	4 = 15 to 25 %	9 = as specified <sup>A</sup>																																																
0 = not specified	5 = 20 to 30 %																																																										
1 = 0 to 10 %	6 = 25 to 40 %																																																										
2 = 5 to 15 %*	7 = 30 to 50 %																																																										
3 = 10 to 20 %	8 = 40 to 60 %																																																										
4 = 15 to 25 %	9 = as specified <sup>A</sup>																																																										
Fourth Numeral	<p><i>Thickness increase when immersed in IRM 903 Oil:<sup>B</sup></i> determined in accordance with Test Method <b>F146</b>, shall conform to the percent indicated by the fourth numeral of the basic six-digit number. (Example: 4 = 15 to 30 %)</p> <table> <tr> <td>0 = not specified</td> <td>5 = 20 to 40 %</td> </tr> <tr> <td>1 = 0 to 15 %</td> <td>6 = 30 to 50 %</td> </tr> <tr> <td>2 = 5 to 20 %</td> <td>7 = 40 to 60 %</td> </tr> <tr> <td>3 = 10 to 25 %</td> <td>8 = 50 to 70 %</td> </tr> <tr> <td>4 = 15 to 30 %</td> <td>9 = as specified<sup>A</sup></td> </tr> </table>	0 = not specified	5 = 20 to 40 %	1 = 0 to 15 %	6 = 30 to 50 %	2 = 5 to 20 %	7 = 40 to 60 %	3 = 10 to 25 %	8 = 50 to 70 %	4 = 15 to 30 %	9 = as specified <sup>A</sup>																																																
0 = not specified	5 = 20 to 40 %																																																										
1 = 0 to 15 %	6 = 30 to 50 %																																																										
2 = 5 to 20 %	7 = 40 to 60 %																																																										
3 = 10 to 25 %	8 = 50 to 70 %																																																										
4 = 15 to 30 %	9 = as specified <sup>A</sup>																																																										
Fifth Numeral	<p><i>Weight increase when immersed in IRM 903 Oil:<sup>B</sup></i> determined in accordance with Test Method <b>F146</b>, shall conform to the percent indicated by the fifth numeral of the basic six-digit number. (Example: 4 = 30 % max)</p> <table> <tr> <td>0 = not specified</td> <td>5 = 40 %, max</td> </tr> <tr> <td>1 = 10 %, max</td> <td>6 = 60 %, max</td> </tr> <tr> <td>2 = 15 %, max</td> <td>7 = 80 %, max</td> </tr> <tr> <td>3 = 20 %, max</td> <td>8 = 100 %, max</td> </tr> <tr> <td>4 = 30 %, max</td> <td>9 = as specified<sup>A</sup></td> </tr> </table>	0 = not specified	5 = 40 %, max	1 = 10 %, max	6 = 60 %, max	2 = 15 %, max	7 = 80 %, max	3 = 20 %, max	8 = 100 %, max	4 = 30 %, max	9 = as specified <sup>A</sup>																																																
0 = not specified	5 = 40 %, max																																																										
1 = 10 %, max	6 = 60 %, max																																																										
2 = 15 %, max	7 = 80 %, max																																																										
3 = 20 %, max	8 = 100 %, max																																																										
4 = 30 %, max	9 = as specified <sup>A</sup>																																																										

**TABLE 1** *Continued*

Basic Six-Digit Number	Basic Characteristic
Sixth Numeral	<i>Weight increase when immersed in water:</i> determined in accordance with Test Method <b>F146</b> , shall conform to the percent indicated by the sixth numeral of the basic six-digit number. See left and below. (Example: 4 = 30 %, max)
0 = not specified	5 = 40 %, max
1 = 10 %, max	6 = 60 %, max
2 = 15 %, max	7 = 80 %, max
3 = 20 %, max	8 = 100 %, max
4 = 30 %, max	9 = as specified <sup>A</sup>

<sup>A</sup> On engineering drawings or other supplement to this classification system.

<sup>B</sup> IRM 901 and IRM 903 have replaced ASTM Oils No. 1 and No. 3, respectively. ASTM Oil No. 3 was discontinued due to potential health risks associated with its use. The manufacturer of ASTM Oil No. 1 discontinued it from their product lineup. A new product was developed to meet the same specification. The user should be aware that results may differ using the IRM oils versus the corresponding obsolete ASTM Oils. IRMs 901 and 903 have been approved by Committee D11, per Practice **D5964**, as a replacement for ASTM Oils No. 1 and 3. These oils are available from R. E. Carroll, Inc. P.O. Box 5806, Trenton, NJ 08638.

**iTeh Standards**  
**(<https://standards.itih.ai>)**  
**Document Preview**

[ASTM F104-11](#)

<https://standards.itih.ai/catalog/standards/sist/f42ad96f-7f97-482c-b209-fb5a25d050b1/astm-f104-11>

**TABLE 2 Supplementary Physical and Mechanical Characteristics**

Suffix Symbol	Supplementary Characteristics																																
A9	<p><i>Sealability</i> characteristics shall be determined in accordance with Test Method F37. External load, internal pressure, other details of test, and results shall be as specified on engineering drawing or other supplement to this classification.</p>																																
B1 through B9	<p><i>Creep relaxation</i> characteristics shall be determined in accordance with Test Method F38. Loss of stress at end of 24 h shall not exceed the amount indicated by the numeral of the B-symbol.</p> <table> <tr> <td>B1 = 10 %</td> <td>B5 = 30 %</td> </tr> <tr> <td>B2 = 15 %</td> <td>B6 = 40 %</td> </tr> <tr> <td>B3 = 20 %</td> <td>B7 = 50 %</td> </tr> <tr> <td>B4 = 25 %</td> <td>B8 = 60 %</td> </tr> <tr> <td></td> <td>B9 = as specified<sup>A</sup></td> </tr> </table>			B1 = 10 %	B5 = 30 %	B2 = 15 %	B6 = 40 %	B3 = 20 %	B7 = 50 %	B4 = 25 %	B8 = 60 %		B9 = as specified <sup>A</sup>																				
B1 = 10 %	B5 = 30 %																																
B2 = 15 %	B6 = 40 %																																
B3 = 20 %	B7 = 50 %																																
B4 = 25 %	B8 = 60 %																																
	B9 = as specified <sup>A</sup>																																
D00 through D99	<p>The former ASTM standard F64, Test Method for Corrosive and Adhesive Effects of Gasket Materials on Metal Surfaces, was discontinued in 1980. The newly established test for adhesion has become Test Method F607.</p>																																
E00 through E99	<p><i>Weight and thickness change after immersion in ASTM Fuel B</i> shall be determined in accordance with Test Method F146. <i>Weight increase</i> shall not exceed the standard rating number indicated by the <i>first</i> numeral of the two-digit number of the E-symbol. <i>Thickness increase</i> shall not exceed the standard rating number indicated by the <i>second</i> numeral of the E-symbol.</p> <table> <thead> <tr> <th>Weight Increase, % (first numeral)</th> <th>Thickness Increase, % (second numeral)</th> </tr> </thead> <tbody> <tr> <td>E0_ = not specified</td> <td>E_0 = not specified</td> </tr> <tr> <td>E1_ = 10</td> <td>E_1 = 0–5</td> </tr> <tr> <td>E2_ = 15</td> <td>E_2 = 0–10</td> </tr> <tr> <td>E3_ = 20</td> <td>E_3 = 0–15</td> </tr> <tr> <td>E4_ = 30</td> <td>E_4 = 5–20</td> </tr> <tr> <td>E5_ = 40</td> <td>E_5 = 10–25</td> </tr> <tr> <td>E6_ = 60</td> <td>E_6 = 15–35</td> </tr> <tr> <td>E7_ = 80</td> <td>E_7 = 25–45</td> </tr> <tr> <td>E8_ = 100</td> <td>E_8 = 30–60</td> </tr> <tr> <td>E9_ = as specified<sup>A</sup></td> <td>E_9 = as specified<sup>A</sup></td> </tr> </tbody> </table>			Weight Increase, % (first numeral)	Thickness Increase, % (second numeral)	E0_ = not specified	E_0 = not specified	E1_ = 10	E_1 = 0–5	E2_ = 15	E_2 = 0–10	E3_ = 20	E_3 = 0–15	E4_ = 30	E_4 = 5–20	E5_ = 40	E_5 = 10–25	E6_ = 60	E_6 = 15–35	E7_ = 80	E_7 = 25–45	E8_ = 100	E_8 = 30–60	E9_ = as specified <sup>A</sup>	E_9 = as specified <sup>A</sup>								
Weight Increase, % (first numeral)	Thickness Increase, % (second numeral)																																
E0_ = not specified	E_0 = not specified																																
E1_ = 10	E_1 = 0–5																																
E2_ = 15	E_2 = 0–10																																
E3_ = 20	E_3 = 0–15																																
E4_ = 30	E_4 = 5–20																																
E5_ = 40	E_5 = 10–25																																
E6_ = 60	E_6 = 15–35																																
E7_ = 80	E_7 = 25–45																																
E8_ = 100	E_8 = 30–60																																
E9_ = as specified <sup>A</sup>	E_9 = as specified <sup>A</sup>																																
G000 through G999	<p>Flexible graphite density shall be indicated by the first numeral of the three digit number of the G-symbol as measured by Test Method F1315. Default density tolerance is <math>\pm 10</math> %.</p> <p>Ash content shall be indicated by the second numeral of the three digit number of the G-symbol as measured by Test Method C561.</p> <p>Oxidation weight loss shall be indicated by the third numeral of the three digit number of the G-symbol as measured by FSA-G-604-07 Method B (24 h at 593°C).</p> <table> <thead> <tr> <th>Density (first numeral)</th> <th>Ash Content (second numeral)</th> <th>Oxidation weight loss (third numeral)</th> </tr> </thead> <tbody> <tr> <td>G-0 = Not specified</td> <td>G-0 = Not specified</td> <td>G-0 = &lt;70 %</td> </tr> <tr> <td>G-1 = 0.1 g/cc (6.2 lb/ft<sup>3</sup>)</td> <td>G-1 = &lt;15 %</td> <td>G-1 = &lt;70 %</td> </tr> <tr> <td>G-2 = 0.2 g/cc (12.4 lb/ft<sup>3</sup>)</td> <td>G-2 = &lt;5 %</td> <td>G-2 = &lt;50 %</td> </tr> <tr> <td>G-3 = 0.7 g/cc (43.7 lb/ft<sup>3</sup>)</td> <td>G-3 = &lt;3 %</td> <td>G-3 = &lt;20 %</td> </tr> <tr> <td>G-4 = 1.0 g/cc (62.4 lb/ft<sup>3</sup>)</td> <td>G-4 = &lt;2 %</td> <td>G-4 = &lt;10 %</td> </tr> <tr> <td>G-5 = 1.12 g/cc (70.0 lb/ft<sup>3</sup>)</td> <td>G-5 = &lt;1 %</td> <td>G-5 = &lt;5 %</td> </tr> <tr> <td>G-6 = 1.4 g/cc (87.4 lb/ft<sup>3</sup>)</td> <td>G-6 = &lt;0.5 %</td> <td>G-9 = As specified<sup>A</sup></td> </tr> <tr> <td>G-9 = As specified<sup>A</sup></td> <td>G-9 = As specified<sup>A</sup></td> <td></td> </tr> </tbody> </table>			Density (first numeral)	Ash Content (second numeral)	Oxidation weight loss (third numeral)	G-0 = Not specified	G-0 = Not specified	G-0 = <70 %	G-1 = 0.1 g/cc (6.2 lb/ft <sup>3</sup> )	G-1 = <15 %	G-1 = <70 %	G-2 = 0.2 g/cc (12.4 lb/ft <sup>3</sup> )	G-2 = <5 %	G-2 = <50 %	G-3 = 0.7 g/cc (43.7 lb/ft <sup>3</sup> )	G-3 = <3 %	G-3 = <20 %	G-4 = 1.0 g/cc (62.4 lb/ft <sup>3</sup> )	G-4 = <2 %	G-4 = <10 %	G-5 = 1.12 g/cc (70.0 lb/ft <sup>3</sup> )	G-5 = <1 %	G-5 = <5 %	G-6 = 1.4 g/cc (87.4 lb/ft <sup>3</sup> )	G-6 = <0.5 %	G-9 = As specified <sup>A</sup>	G-9 = As specified <sup>A</sup>	G-9 = As specified <sup>A</sup>				
Density (first numeral)	Ash Content (second numeral)	Oxidation weight loss (third numeral)																															
G-0 = Not specified	G-0 = Not specified	G-0 = <70 %																															
G-1 = 0.1 g/cc (6.2 lb/ft <sup>3</sup> )	G-1 = <15 %	G-1 = <70 %																															
G-2 = 0.2 g/cc (12.4 lb/ft <sup>3</sup> )	G-2 = <5 %	G-2 = <50 %																															
G-3 = 0.7 g/cc (43.7 lb/ft <sup>3</sup> )	G-3 = <3 %	G-3 = <20 %																															
G-4 = 1.0 g/cc (62.4 lb/ft <sup>3</sup> )	G-4 = <2 %	G-4 = <10 %																															
G-5 = 1.12 g/cc (70.0 lb/ft <sup>3</sup> )	G-5 = <1 %	G-5 = <5 %																															
G-6 = 1.4 g/cc (87.4 lb/ft <sup>3</sup> )	G-6 = <0.5 %	G-9 = As specified <sup>A</sup>																															
G-9 = As specified <sup>A</sup>	G-9 = As specified <sup>A</sup>																																
H	<p><i>Adhesion</i> characteristics shall be determined in accordance with Test Method F607. Results shall be as specified on engineering drawing or other supplement to this classification.</p>																																
K1 through K9	<p><i>THERMAL CONDUCTIVITY</i> characteristics shall be determined in accordance with Practice F433 using a temperature of 100 <math>\pm</math> 2°C (212 <math>\pm</math> 3.6°F). The <i>k</i>-factor obtained in W/(m·K) [Btu-in./h-ft<sup>2</sup>·°F] shall fall within the ranges indicated by the numeral of a K symbol. Thermal conductivity testing is normally run as a development tool. This shall not be used as a certifiable requirement unless previously agreed on between material producer and end user.</p> <table> <tr> <td>K1 = 0 to 0.09 (0 to 0.65)</td> <td>K5 = 0.29 to 0.38 (2.00 to 2.65)</td> </tr> <tr> <td>K2 = 0.07 to 0.17 (0.50 to 1.15)</td> <td>K6 = 0.36 to 0.45 (2.50 to 3.15)</td> </tr> <tr> <td>K3 = 0.14 to 0.24 (1.00 to 1.65)</td> <td>K7 = 0.43 to 0.53 (3.00 to 3.65)</td> </tr> <tr> <td>K4 = 0.22 to 0.31 (1.50 to 2.15)</td> <td>K8 = 0.50 to 0.60 (3.50 to 4.15)</td> </tr> <tr> <td></td> <td>K9 = as specified<sup>A</sup></td> </tr> </table>			K1 = 0 to 0.09 (0 to 0.65)	K5 = 0.29 to 0.38 (2.00 to 2.65)	K2 = 0.07 to 0.17 (0.50 to 1.15)	K6 = 0.36 to 0.45 (2.50 to 3.15)	K3 = 0.14 to 0.24 (1.00 to 1.65)	K7 = 0.43 to 0.53 (3.00 to 3.65)	K4 = 0.22 to 0.31 (1.50 to 2.15)	K8 = 0.50 to 0.60 (3.50 to 4.15)		K9 = as specified <sup>A</sup>																				
K1 = 0 to 0.09 (0 to 0.65)	K5 = 0.29 to 0.38 (2.00 to 2.65)																																
K2 = 0.07 to 0.17 (0.50 to 1.15)	K6 = 0.36 to 0.45 (2.50 to 3.15)																																
K3 = 0.14 to 0.24 (1.00 to 1.65)	K7 = 0.43 to 0.53 (3.00 to 3.65)																																
K4 = 0.22 to 0.31 (1.50 to 2.15)	K8 = 0.50 to 0.60 (3.50 to 4.15)																																
	K9 = as specified <sup>A</sup>																																
L000 through L999	<p>Type 7, Class 1 or Class 2 materials. <i>First fiber</i> constituent indicated by the <i>first</i> numeral of the three-digit number of the L-symbol. <i>Second fiber</i> constituent indicated by the <i>second</i> numeral of the three-digit number of the L-symbol. <i>Binder</i> constituent indicated by the <i>third</i> numeral of the three-digit number of the L-symbol.</p> <table> <thead> <tr> <th>First Fiber (first numeral)</th> <th>Second Fiber (second numeral)</th> <th>Binder (third numeral)</th> </tr> </thead> <tbody> <tr> <td>L0 = not specified</td> <td>L0 = not specified</td> <td>L0 = not specified</td> </tr> <tr> <td>L1 = Aramid</td> <td>L1 = Aramid</td> <td>L1 = NBR</td> </tr> <tr> <td>L2 = Glass</td> <td>L2 = Glass</td> <td>L2 = SBR</td> </tr> <tr> <td>L3 = Carbon</td> <td>L3 = Carbon</td> <td>L3 = CR</td> </tr> <tr> <td>L4 = Graphite</td> <td>L4 = Graphite</td> <td>L4 = EPDM</td> </tr> <tr> <td>L5 = Mineral/Inorganic</td> <td>L5 = Mineral/Inorganic</td> <td>L5 = IR</td> </tr> <tr> <td>L6 = Cellulose</td> <td>L6 = Cellulose</td> <td>L6 = CSM</td> </tr> <tr> <td>L9 = as specified<sup>A</sup></td> <td>L7 = none</td> <td>L7 = HNBR</td> </tr> <tr> <td></td> <td>L9 = as specified<sup>A</sup></td> <td>L9 = as specified<sup>A</sup></td> </tr> </tbody> </table>			First Fiber (first numeral)	Second Fiber (second numeral)	Binder (third numeral)	L0 = not specified	L0 = not specified	L0 = not specified	L1 = Aramid	L1 = Aramid	L1 = NBR	L2 = Glass	L2 = Glass	L2 = SBR	L3 = Carbon	L3 = Carbon	L3 = CR	L4 = Graphite	L4 = Graphite	L4 = EPDM	L5 = Mineral/Inorganic	L5 = Mineral/Inorganic	L5 = IR	L6 = Cellulose	L6 = Cellulose	L6 = CSM	L9 = as specified <sup>A</sup>	L7 = none	L7 = HNBR		L9 = as specified <sup>A</sup>	L9 = as specified <sup>A</sup>
First Fiber (first numeral)	Second Fiber (second numeral)	Binder (third numeral)																															
L0 = not specified	L0 = not specified	L0 = not specified																															
L1 = Aramid	L1 = Aramid	L1 = NBR																															
L2 = Glass	L2 = Glass	L2 = SBR																															
L3 = Carbon	L3 = Carbon	L3 = CR																															
L4 = Graphite	L4 = Graphite	L4 = EPDM																															
L5 = Mineral/Inorganic	L5 = Mineral/Inorganic	L5 = IR																															
L6 = Cellulose	L6 = Cellulose	L6 = CSM																															
L9 = as specified <sup>A</sup>	L7 = none	L7 = HNBR																															
	L9 = as specified <sup>A</sup>	L9 = as specified <sup>A</sup>																															