



Designation: F 104 – 00

Standard Classification System for Nonmetallic Gasket Materials¹

This standard is issued under the fixed designation F 104; 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 Department of Defense.

1. Scope

1.1 This classification system² 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 D 2000. Gasket coatings are not covered, since details thereof are intended to be given on engineering drawings or in separate specifications.

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:

D 2000 Classification System for Rubber Products in Automotive Applications²

E 11 Specification for Wire-Cloth Sieves for Testing Purposes³

F 36 Test Method for Compressibility and Recovery of Gasket Materials²

F 37 Test Methods for Sealability of Gasket Materials²

F 38 Test Methods for Creep Relaxation of a Gasket Material²

F 146 Test Methods for Fluid Resistance of Gasket Materials²

F 147 Test Method for Flexibility of Non-Metallic Gasket Materials²

F 148 Test Method for Binder Durability of Cork Composition Gasket Materials²

F 152 Test Methods for Tension Testing of Nonmetallic Gasket Materials²

F 433 Practice for Evaluating Thermal Conductivity of Gasket Materials²

F 607 Test Method for Adhesion of Gasket Materials to Metal Surfaces²

3. Significance and Use

3.1 This classification 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 It is based on the principle that nonmetallic gasket materials should be described, insofar as is possible, in terms of specific physical and mechanical characteristics, and that an infinite number of such descriptions can be formulated by use of one or more standard statements based on standard tests. Therefore, users of gasket materials can, by selecting different combinations of statements, specify different combinations of properties desired in various parts. Suppliers, likewise, can report properties available in their respective products.

4. Basis of Classification

4.1 To permit “line call-out” of the descriptions mentioned in 3.2, this classification system establishes letter or number symbols or both for various performance levels of each property or characteristic (see Table 1)⁴.

4.2 In specifying or describing gasket materials, each “line call-out” shall include the number of this system (minus date symbol) followed by the letter “F” and six numerals, for example: ASTM F104 (F125400). Since each numeral of the call-out represents a characteristic (as shown in Table 1), six

¹ 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 Oct. 10, 2000. Published November 2000. Originally issued as F 104 – 68. Last previous edition F 104 – 95.

² Annual Book of ASTM Standards, Vol 09.02.

³ Annual Book of ASTM Standards, Vol 14.02.

⁴ IRM 903 is available from R.E. Carrol, Inc. P.O. Box 5806, Trenton, NJ 08638. The user should be aware that results may differ from results using ASTM Oil No. 3. ASTM Oil No. 3 is no longer commercially available due to potential health risks associated with its use. IRM 903 has been approved by Committee D-11 as a replacement for ASTM Oil No. 3.



TABLE 1 Basic Physical and Mechanical Characteristics

Basic Six-Digit Number	Basic Characteristic										
First Numeral	<i>"Type" of material</i>(the principal fibrous or particulate reinforcement material from which the gasket is made) shall conform to the first numeral of the basic six-digit number, as follows: 0 = not specified 1 = asbestos 2 = cork 3 = cellulose 4 = fluorocarbon polymer 5 = flexible graphite 7 = nonasbestos, tested as Type 1 9 = as specified^A										
Second Numeral	<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: When <i>first</i> numeral is" 0" or "9," second numeral: 0 = not specified 9 = as specified^A When <i>first</i> numeral is" 1" or "7," second numeral: 0 = not specified 1 = compressed sheet process 2 = beater process 3 = paper and millboard 9 = as specified^A When <i>first</i> numeral is" 2," second numeral: 0 = not specified 1 = cork composition (Class 1) 2 = cork and elastomeric (Class 2) 3 = cork and cellular rubber (Class 3) 9 = as specified^A When <i>first</i> numeral is" 3," second numeral: 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^A When <i>first</i> numeral is" 4," second numeral: 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 When <i>first</i> numeral is" 5," second numeral: 0 = not specified 1 = homogeneous sheet 2 = laminated sheet 9 = as specified^A										
Third Numeral	<i>Compressibility characteristics</i>, determined in accordance with Test Method F 36, shall conform to the percent indicated by the third numeral of the basic six-digit number. (Example: 4 = 15 to 25 %) <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^A</td></tr> </table> * 7 to 17 % for compressed sheet process	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 ^A
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 ^A										
Fourth Numeral	<i>Thickness increase when immersed in IRM 903 Oil</i>^A determined in accordance with Test Method F 146, shall conform to the percent indicated by the fourth numeral of the basic six-digit number. (Example: 4 = 15 to 30 %) <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^A</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 ^A
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 ^A										
Fifth Numeral	<i>Weight increase when immersed in IRM 903 Oil</i>^A determined in accordance with Test Method F 146, shall conform to the percent indicated by the fifth numeral of the basic six-digit number. (Example: 4 = 30 % max) <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^A</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 ^A
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 ^A										
Sixth Numeral	<i>Weight increase when immersed in water</i> determined in accordance with Test Method F 146, shall conform to the percent indicated by the sixth numeral of the basic six-digit number. See left and below. (Example: 4 = 30 %, max) <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^A</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 ^A
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 ^A										

^A On engineering drawings or other supplement to this classification system.



numerals are always required. The numeral “0” is used when the description of any characteristic is not desired. 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.

4.3 To further specify or describe gasket materials, each “line call-out” may include one or more suffix letter-numeral symbols, as listed in Table 2, for example: ASTM F104 (F125400-B2M4). Various levels of definition may be established by increasing or decreasing the number of letter-numeral symbols used in the “line call-out.”

4.4 For convenience, gasket materials are referred to by Type according to the principal fibrous or particulate reinforcement or other material from which the gasket is made and by Class according to the manufacturing method, or the common trade designation. Type numbers correspond with the first numeral, and class numbers correspond with the second

numeral of the basic six-digit line call-out, as shown in Table 1.

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. Table X1.1 of this classification indicates properties, characteristics, and test methods that are normally considered applicable to each type of material.

5. Physical and Mechanical Requirements

5.1 Gasket materials identified by this classification shall have the characteristics or properties indicated by the first six numerals of the line call-out, within the limits shown in Table 1, and by additional letter-numeral symbols shown in Table 2.

6. Thickness Requirements

6.1 Gasket materials identified by this classification system

TABLE 2 Supplementary Physical and Mechanical Characteristics

Suffix Symbol	Supplementary Characteristics
A9	<i>Sealability</i> characteristics shall be determined in accordance with Test Method F 37. External load, internal pressure, other details of test, and results shall be as specified on engineering drawing or other supplement to this classification.
B1 through B9	<i>Creep relaxation</i> characteristics shall be determined in accordance with Test Method F 38. Loss of stress at end of 24 h shall not exceed the amount indicated by the numeral of the B-symbol. B1 = 10 % B5 = 30 % B2 = 15 % B6 = 40 % B3 = 20 % B7 = 50 % B4 = 25 % B8 = 60 % B9 = as specified ^A
D00 through D99	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 F 607.
E00 through E99	<i>Weight and thickness change after immersion in ASTM Fuel B</i> shall be determined in accordance with Test Method F 146. <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. Weight Increase, % Thickness Increase, % (first numeral) (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 ^A E_9 = as specified ^A
H	<i>Adhesion</i> characteristics shall be determined in accordance with Test Method F 607. Results shall be as specified on engineering drawing or other supplement to this classification.
K1 through K9	<i>Thermal conductivity</i> characteristics shall be determined in accordance with Practice F 433 using a temperature of 100 ± 2°C (212 ± 3.6°F). The <i>k</i> -factor obtained in W/(m·K) (Btu·in./h·ft ² ·°F) shall fall within the ranges indicated by the numeral of a K symbol. 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 ^A
M1 through M9	<i>Tensile strength</i> characteristics shall be determined in accordance with Test Method F 152 and 9.2. Results in MPa (psi) shall be no less than the value indicated by the numeral of the M-symbol. M1 = 0.689 (100) M5 = 10.342 (1500) M2 = 1.724 (250) M6 = 13.790 (2000) M3 = 3.447 (500) M7 = 20.684 (3000) M4 = 6.895 (1000) M8 = 27.579 (4000) M9 = as specified ^A
R	<i>Binder Durability</i> characteristics shall be determined in accordance with Test Method F 148. There shall be no evidence of disintegration at conclusion of test.
S9	<i>Volume change</i> characteristics, when immersed in ASTM No. 1 Oil, IRM 903 Oil, ⁴ and ASTM Reference Fuel A, shall be determined in accordance with Test Method F 146. Results shall be as specified on engineering drawing or other supplement to this classification.
T	<i>Flexibility</i> characteristics shall be determined in accordance with Test Method F 147. There shall be no evidence of cracks, breaks, or separation at conclusion of test.
Z	<i>Other characteristics</i> shall be as specified on engineering drawing or other supplement to this classification.

^A On engineering drawing or other supplement to this classification.