



Standard Classification System for Rubber Products in Automotive Applications¹

This standard is issued under the fixed designation D2000; 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 classification system covers the properties of vulcanized rubber materials (natural rubber, reclaimed rubber, synthetic rubbers, alone or in combination) that are intended for, but not limited to, use in rubber products for automotive applications.

NOTE 1—This classification system may serve many of the needs of other industries in much the same manner as SAE numbered steels. It must be remembered, however, that this system is subject to revision when required by automotive needs. It is recommended that the latest revision always be used.

1.2 This classification system is based on the premise that the properties of all rubber products can be arranged into characteristic material designations. These designations are determined by *types*, based on resistance to heat aging, and *classes*, based on resistance to swelling in oil. Basic levels are thus established which, together with values describing additional requirements, permit complete description of the quality of all elastomeric materials.

1.3 In all cases where the provisions of this classification system would conflict with those of the detailed specifications for a particular product, the latter shall take precedence.

NOTE 2—When the rubber product is to be used for purposes where the requirements are too specific to be completely prescribed by this classification system, it is necessary for the purchaser to consult the supplier in advance, to establish the appropriate properties, test methods, and specification test limits.

1.4 The values stated in SI units are to be regarded as standard.

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

- D395 Test Methods for Rubber Property—Compression Set
- D412 Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension
- D429 Test Methods for Rubber Property—Adhesion to Rigid Substrates
- D430 Test Methods for Rubber Deterioration—Dynamic Fatigue
- D471 Test Method for Rubber Property—Effect of Liquids
- D573 Test Method for Rubber—Deterioration in an Air Oven
- D575 Test Methods for Rubber Properties in Compression
- D624 Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
- D865 Test Method for Rubber—Deterioration by Heating in Air (Test Tube Enclosure)
- D925 Test Methods for Rubber Property—Staining of Surfaces (Contact, Migration, and Diffusion)
- D945 Test Methods for Rubber Properties in Compression or Shear (Mechanical Oscillograph)
- D1053 Test Methods for Rubber Property—Stiffening at Low Temperatures: Flexible Polymers and Coated Fabrics
- D1149 Test Methods for Rubber Deterioration—Cracking in an Ozone Controlled Environment
- D1171 Test Method for Rubber Deterioration—Surface Ozone Cracking Outdoors (Triangular Specimens)
- D1329 Test Method for Evaluating Rubber Property—Retraction at Lower Temperatures (TR Test)
- D1349 Practice for Rubber—Standard Conditions for Testing
- D1418 Practice for Rubber and Rubber Latices—Nomenclature

¹ This classification system is under the jurisdiction of ASTM Committee D11 on Rubber and Rubber-like Materials and is the direct responsibility of Subcommittee D11.30 on Classification of Rubber Compounds.

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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.

- [D2137 Test Methods for Rubber Property—Brittleness Point of Flexible Polymers and Coated Fabrics](#)
- [D2240 Test Method for Rubber Property—Durometer Hardness](#)
- [D3183 Practice for Rubber—Preparation of Pieces for Test Purposes from Products](#)
- [D5964 Practice for Rubber IRM 901, IRM 902, and IRM 903 Replacement Oils for ASTM No. 1, ASTM No. 2, ASTM No. 3 Oils, and IRM 905 formerly ASTM No. 5 Oil](#)

TABLE 2 Basic Requirements for Establishing Class by Volume Swell

Class	Volume Swell, max, %
A	no requirement
B	140
C	120
D	100
E	80
F	60
G	40
H	30
J	20
K	10

3. Purpose

3.1 The purpose of this classification system is to provide guidance to the engineer in the selection of practical, commercially available rubber materials, and further to provide a method for specifying these materials by the use of a simple “line call-out” designation.

3.2 This classification system was developed to permit the addition of descriptive values for future rubber materials without complete reorganization of the classification system and to facilitate the incorporation of future new test methods to keep pace with changing industry requirements.

4. Type and Class

4.1 The prefix letter “M” shall be used to indicate that the classification system is based on SI units.

NOTE 3—Call outs not prefixed by the letter M refer to an earlier classification system based on inch-pound units. This was published in editions up to 1980.

4.2 Rubber materials shall be designated on the basis of *type* (heat resistance) and *class* (oil resistance). Type and class are indicated by letter designations as shown in [Table 1](#) and [Table 2](#) and illustrated in [9.1](#).

4.3 *Type* is based on changes in tensile strength of not more than $\pm 30\%$, elongation of not more than -50% , and hardness of not more than ± 15 points after heat aging for 70 h at an appropriate temperature. The temperatures at which these materials shall be tested for determining type are listed in [Table 1](#).

4.4 *Class* is based on the resistance of the material to swelling in IRM 903 Oil (most tables were originally developed using ASTM Oil No. 3) after 70-h immersion at a temperature determined from [Table 1](#), except that a maximum

TABLE 3 Meaning of Suffix Letters

Suffix Letter	Test Required
A	Heat Resistance
B	Compression Set
C	Ozone or Weather Resistance
D	Compression-Deflection Resistance
EA	Fluid Resistance (Aqueous)
EF	Fluid Resistance (Fuels)
EO	Fluid Resistance (Oils and Lubricants)
F	Low-Temperature Resistance
G	Tear Resistance
H	Flex Resistance
J	Abrasion Resistance
K	Adhesion
M	Flammability Resistance
N	Impact Resistance
P	Staining Resistance
R	Resilience
Z	Any special requirement, which shall be specified in detail

TABLE 4 Suffix Numbers to Indicate Temperature of Test

Applicable Suffix Requirements	Second Suffix Number	Test Temperature, °C ^A
A, B, C, EA, EF, EO, G, K	11	275
	10	250
	9	225
	8	200
	7	175
	6	150
	5	125
	4	100
	3	70
	2	38
	1	23
	0	^B
F	1	23
	2	0
	3	-10
	4	-18
	5	-25
	6	-35
	7	-40
	8	-50
	9	-55
	10	-65
	11	-75
	12	-80

^A These test temperatures are based on Practice [D1349](#).

^B Ambient temperature in the case of outdoor testing.

TABLE 1 Basic Requirements for Establishing Type by Temperature

Type	Test Temperature, °C
A	70
B	100
C	125
D	150
E	175
F	200
G	225
H	250
J	275
K	300

temperature of 150°C (the upper limit of oil stability) shall be used. Limits of swelling for each class are shown in [Table 2](#).

4.4.1 ASTM No. 1, No. 2, and No. 3 Oils have been replaced by IRM 901, 902, and 903 Oils, respectively, under

Practice **D5964**. These oils are similar but not identical to ASTM No. 1, No. 2, and No. 3 Oils.

4.4.2 Substitutability of IRM 901, 902, and 903 Oils for ASTM No. 1, No. 2, and No. 3 Oils has not been established, as their swelling characteristics are different and may affect compound classification.

NOTE 4—The selection of type based on heat resistance is understood to be indicative of the inherent heat resistance that can be normally expected from commercial compositions. Likewise, choice of class is based on the range of volume swell normally expected from such commercial compositions as established by type. *The fact that a type and class of material is listed in Table 6, under Basic Requirements, indicates that materials that meet these requirements for heat and oil resistance are commercially available.*

4.5 The letter designations shall always be followed by a three-digit number to specify the hardness and the tensile strength—for example, 505. The first digit indicates durometer hardness, Type A, for example, 5 for 50 ± 5 , 6 for 60 ± 5 . The next two digits indicate the minimum tensile strength—for example, 05 for 5 MPa, 14 for 14 MPa. *Correlation of available materials for desired hardness and tensile strength is obtained through the elongation values in Table 6. See 7.2.*

5. Grade Numbers, Suffix Letters, and Number

5.1 *Grade Numbers*—Since the basic requirements do not always describe sufficiently all the necessary qualities, provision is made for deviation or adding requirements through a system of prefix grade numbers. Grade No. 1 indicates that only the basic requirements are compulsory, and no suffix requirements are permitted. Grades other than No. 1 are used for expressing deviation or additional requirements and are listed as “Available Suffix Grade Numbers” in the last column under Basic Requirements in Table 6. A grade number is written as a material prefix number preceding the letters for type and class (see 9.1). Grade No. 1 is always an available suffix grade number, and thus is not referenced in the last column of each basic requirement table.

5.2 *Suffix Letters*—The suffix letters that may be used, together with their meaning, appear in Table 3.

5.3 *Suffix Numbers*—Each suffix letter should preferably be followed by two suffix numbers (see Note 6 in 8.1). *The first suffix number always indicates the test method; time of test is part of the method and is taken from the listings in Table 5. The second suffix number, if used, always indicates the temperature of test and is taken from Table 4. Where three-digit numbers are required, they are separated by a dash—for example: –10; B4–10; F1–11.*

6. Composition and Manufacture

6.1 This classification system is predicated upon materials furnished under a specification based thereon being manufactured from natural rubber, reclaimed rubber, synthetic rubber, alone or in combination, together with added compounding ingredients of such nature and quantity as to produce vulcanizates that comply with the specified requirements. All materials and workmanship shall be in accordance with good commercial practice, and the resulting product shall be free of porous

areas, weak sections, bubbles, foreign matter, or other defects affecting serviceability.

6.2 *Color*—With the exception of FC, FE, FK, and GE materials, the values in the material tables are based on black compounds and comparable values may not be available in color.

7. Basic Requirements

7.1 The basic requirements for physical properties specified in Table 6³ are based on values obtained from standard laboratory test specimens prepared and tested in accordance with the applicable ASTM test methods. *Test results from specimens prepared from finished products may not duplicate values obtained from standard test specimens.*

NOTE 5—When standard test specimens are cut from finished parts in accordance with Practice **D3183**, a deviation to the extent of 10 % (on tensile strength and elongation values only) is permissible when agreed upon by the purchaser and the supplier. This deviation is permissible *only* because of the recognized effects of knitting, grain, and buffing on the material when test specimens are prepared from finished parts and tested for tensile strength and elongation. When differences due to the method of processing or to the difficulty in obtaining suitable test specimens from the finished part arise, the purchaser and the supplier may agree on acceptable deviations. This can be done by comparing results of standard test specimens with those obtained on actual parts.

7.2 The available materials are listed in the appropriate material section of the table, giving each hardness and tensile strength with its appropriate elongation value. Also, there is a repetition of the values for the basic heat and oil aging requirements for the material resulting from the assignment of type and class. In addition, values for compression set, normally a basic requirement to ensure proper vulcanization, are specified.

7.3 Unless a suffix requirement is used to override an existing basic requirement, the basic requirement applies.

8. Suffix Requirements

8.1 Suffix requirements shall be specified *only as needed* to define qualities necessary to meet service requirements. These suffix requirements are set forth for the various grade numbers. Suffix letters and suffix numbers describing these suffix requirements may be used singly or in combination, *but not all suffix values available for a given material need be specified.*

NOTE 6—Examples of the use of suffix letters and numbers would be A14 and EO34. Suffix A (Table 3) stands for heat resistance, Suffix 1 (Table 5) specifies that the test be run in accordance with Test Method **D573** for 70 h, and Suffix 4 (Table 4) indicates the temperature of test as 100°C. Similarly, Suffix EO34 indicates resistance in IRM 903 Oil in accordance with Test Method **D471** for 70 h at 100°C.

8.2 Basic requirements are always in effect, unless superseded by specific suffix requirements in the “line call-out.”

8.3 Use of Test Methods **D1053** as a Suffix Requirement: When specifying an F2 or F6 requirement, the line specification must define which T-values are required, along with the

³ Tensile values are shown as pounds per square inch in Table 6 for information only.

TABLE 5 ASTM Test Methods

Basic Requirements and First Suffix No.	Basic	1	2	3	4	5	6	7	8	9
Tensile Strength, Elongation	D412, die C	...	...	...	...	...	...	...	...	...
Durometer Hardness, Type A	D2240	...	...	...	...	...	...	...	...	...
Suffix A, Heat Resistance	...	D573, 70 h	D865, 70 h	D865, 168 h	D573, 168 h	D573, 1000 h	D865, 1000 h	...	...	...
Suffix B, Compression Set, Standard Test Specimen Cut from a Slab	...	D395, 22 h, Method B, solid	D395, 70 h, Method B, solid	D395, 22 h, Method B, plied	D395, 70 h, Method B, plied	D395, 1000 h, Method B, solid	D395, 1000 h, Method B, plied	...	...	...
Suffix C, Ozone or Weather Resistance	...	D1171, ozone ^A exposure, Method A	D1171, ^B weather	D1171, ozone ^C exposure, Method B	...	...	...	...	...	...
Suffix D, Compression-Deflection Resistance	...	D575, Method A	D575, Method B	...	...	...	...	...	...	...
Suffix EO, Oil Resistance	...	D471, IRM 901 Oil, ^{D,E} 70 h	D471, IRM 902 Oil, ^{D,E} 70 h	D471, IRM 903 Oil, ^{D,E} 70 h	D471, IRM 901 Oil, ^{D,E} 168 h	D471, IRM 902 Oil, ^{D,E} 168 h	D471, IRM 903 Oil, ^{D,E} 168 h	D471, Service Fluid No. 101, ^{E,F} 70 h	D471, Oil as specifically designated in Table 6, 70 h	...
Suffix EF, Fluid Resistance	...	D471, Reference Fuel A, 70 h	D471, Reference Fuel B, 70 h	D471, Reference Fuel C, 70 h	D471, Reference Fuel D, 70 h	D471, 85 Volume Percent Reference Fuel D Plus 15 Volume Percent Denatured Ethanol, 70 h	...	...	...	...
Suffix EA, Aqueous Fluid Resistance	...	D471, Distilled Water, 70 h ^G	D471, Equal Parts by Volume Distilled Water-Reagent Grade Ethylene Glycol, 70 h ^H	...	...	...	...	...	...	...
Suffix F, Low-Temperature Resistance	...	D2137, Method C, 9.3.3, 3 min	D1053, 5 min, T ₂ , T ₅ , T ₁₀ , T ₅₀ , or T ₁₀₀	D2137, Method C 9.3.3, 22 h	D1329, 38 mm die, 50 % elongation, retraction 10 % min	D1329, 38 mm die, 50 % elongation, retraction 50 % min	D1053, 5 min, T ₅ , T ₁₀ , and T ₁₀ – T ₅ . Degrees of separation max. ^I	D1329, 38 mm die, 50 % elongation, retraction 70 % min	...	...
Suffix G, Tear Resistance	...	D624, die B	D624, die C	...	...	...	...	...	...	...
Suffix H, Flex Resistance	...	D430, Method A	D430, Method B	D430, Method C	...	...	...	...	...	...
Suffix J, Abrasion Resistance	...	^J	...	...	...	...	...	...	...	...
Suffix K, Adhesion	...	D429, Method A	D429, Method B	Bond made after vulcanization ^J	...	...	...	...	...	...
Suffix M, Flammability Resistance ^J
Suffix N, Impact Resistance ^J
Suffix P, Staining Resistance	...	D925, Method A	D925, Method B Control Panel	...	...	...	...	...	...	...
Suffix R, Resilience	...	D945	...	...	...	...	...	...	...	...
Suffix Z, Special Requirement ^K

^A Use ozone chamber exposure method of Test Methods D1149, Method B, Procedure B4.

^B Test Method D1171, Weather Test, is 6 weeks duration. Test area and time of year to be agreed upon by the purchaser and the manufacturer

^C Use ozone chamber exposure method of Test Methods D1149, Method B, Procedure B2.

^D The sole source of supply of IRM 901, IRM 902, and IRM 903 Oils known to the committee at this time is Penreco, 4426 East Washington Blvd., Los Angeles, CA 90023-4476 (distributed by R. E. Carroll, Inc., P.O. Box 5806, Trenton, NJ 08638-0806).

^E If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,¹ which you may attend.

^F The sole source of supply of Service Fluid 101 (available as Andersol 774) known to the committee at this time is Hulls AG Division, P.O. Box 2, Turner Place, Piscataway, NJ 08854.

^G Distilled water shall be used. Volume increase by water displacement method, except alcohol dip omitted. When determining changes in tensile strength, elongation, and hardness, test tube to be $\frac{3}{4}$ full after specimens are immersed. Determination to be made after 30 min. Cool in distilled water, acetone dip to be omitted.

^H Equal parts by volume of distilled water and reagent grade ethylene glycol. Volume increase by displacement method, except alcohol dip omitted. When determining changes in tensile strength, elongation, and hardness, test tube to be $\frac{3}{4}$ full after specimens are immersed. Determination to be made after 30 min. Cool in distilled water, acetone dip to be omitted.

^I Maximum T-values used for defining a curve for dynamic seal materials. See example in 9.2.

^J Test method to be specified.

^K Test method to be specified in detail, or via using information in **Tables 3-5**; for example, “Z1 = C12, rating 85 % retention minimum.”

maximum allowed temperature. Test Methods **D1053** properties must then be less than or equal to the specified temperature for the corresponding T-value.

9. Line Call-Outs

9.1 A “line call-out,” *which is a specification*, shall contain: the document’s names, the prefix letter M, the grade number, the material designation (type and class), and the hardness and tensile strength, followed by the appropriate suffix requirements. Following is an example of a “line call-out” or specification:

ASTM D2000 M2BC 507 A14 EO34

ASTM D2000 = Standards Organization and Document Number

Basic Requirements:

M = Requirements are in SI Units.

2 = Applicable Suffix Grade.

B = Material Type based on Temperature Resistance.

C = Material Class based on IRM 903 Oil Volume Swell.

5 = x 10 is Type A Hardness (i.e., 5 indicates requirement is 50).

07 = Tensile Strength (“M” in line call out indicates units are in MPa).

Suffix Requirements:

A14 = A - Heat Resistance; 1 – **D573**, 70 h; 4 – 100°C

EO34 = EO – Fluid Resistance in Oils and Lubricants; 3 – **D471**, IRM 903 Oil, 70 h; 4 – 100°C

In this example, basic requirements for heat resistance and fluid resistance are superseded by suffix requirements. However, the basic requirement of 80 % for compression set, which is not included as a suffix requirement, is not superseded and therefore shall be met as specified in **Table 6**.

9.2 Incorporation of Test Methods **D1053** F2 or F6 suffix into a line call out.

ASTM D2000 M3HK810 A1-10 B37 EO78 Z1; Z1 = F2 (T5:-27, T10:-29, T100:-37)

In this example the numbers following F2 represent the user desired T-values (T2, T5, T10, T50, and T100 are typical). In this case T5, T10, and T100 are the desired “T’s” to be reported. This example has an “M” denoting that all data is in metric, so the T-values are represented in degrees Centigrade (maximum temperature).

ASTM D2000 M3HK810 A1-10 B37 EO78 Z1; Z1 = F6 (-12,-14,2)

In this example the numbers following F6 represent T5, T10, and the maximum degrees of separation allowed between T10 and T5. This example has an “M” denoting that all data is in metric, so the T-values are represented in degrees Centigrade (maximum temperature).

10. Test Methods

10.1 The applicable test methods are listed in **Table 5**.

11. Sampling and Inspection

11.1 A lot, unless otherwise specified, shall consist of all products of the same material submitted for inspection at the same time.

11.2 When proof of conformance with a specification based on this classification system is required, the supplier shall, upon request of the purchaser at the time of ordering, furnish a sufficient number of samples to permit the performance of the required tests. Test specimens shall be prepared as prescribed in **7.1**. The samples shall be warranted to have equivalent cure and to be from the same run or batch of compound used in the lot.

TABLE 6 Basic and Supplementary (Suffix) Requirements for Classification of Elastomeric Materials
AA MATERIALS

Basic Requirements							Available Suffix Grade Numbers
Durometer Hardness, ±5 Points	Tensile Strength, min		Ultimate Elongation, min, %	Heat Aged, Test Method D573 , 70 h at 70°C	Oil Immersion, Test Method D471 , IRM 903 Oil, 70 h at 70°C	Compression Set, Test Methods D395 , Solid, max, %, 22 h at 70°C	
	MPa	psi					
30	7	1015	400				2, 4
30	10	1450	400				2, 4
30	14	2031	400				2, 4
40	7	1015	400				2, 4
40	10	1450	400				2, 4
40	14	2031	400				2, 4
40	17	2466	500				2, 4
40	21	3046	600				2, 4
50	3	435	250				2
50	6	870	250				2
50	7	1015	400				2, 3
50	8	1160	400				2, 3
50	10	1450	400				2, 3, 4, 5
50	14	2031	400				2, 3, 4, 5
50	17	2466	400				2, 3, 4, 5
50	21	3046	500				2, 3, 4, 5
60	3	435	250				2
60	6	870	250				2
60	7	1015	300	Change in tensile strength, ±30 %			2, 3
60	8	1160	300				2, 3
60	10	1450	350	Change in ultimate elonga- tion, -50 % max	No requirement	Compression set, 50 % max	2, 3, 4, 5
60	14	2031	400	Change in durometer hard- ness, ±15 points			2, 3, 4, 5
60	17	2466	400				2, 3, 4, 5
60	21	3046	400				2, 3, 4, 5
60	24	3481	500				2, 3, 4, 5
70	3	435	150				2
70	6	870	150				2
70	7	1015	200				2, 3
70	8	1160	200				2, 3
70	10	1450	250				2, 3, 4, 5
70	14	2031	300				2, 3, 4, 5
70	17	2466	300				2, 3, 4, 5
70	21	3046	350				2, 3, 4, 5
80	3	435	100				2
80	7	1015	100				2
80	10	1450	150				2
80	14	2031	200				2
80	17	2466	200				2
90	3	435	75				2
90	7	1015	100				2
90	10	1450	125				2

Suffix Requirements		Grade 1 ^A	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8
A13	Heat resistance, Test Method D573 , 70 h at 70°C: Change in hardness, max, points		±15		+10	+10			
	Change in tensile strength, max, %		±30		-25	-25			
	Change in ultimate elongation, max, %		-50		-25	-25			
B13	Compression set, Test Methods D395 , Method B, max, %, 22 h at 70°C			25	25	25			
B33	Compression set, Test Methods D395 , Method B, max, %, 22 h at 70°C			35	35	35			
C12	Resistance to ozone, Test Method D1171 , quality retention rating, min, %		85		85				
C20	Resistance to outdoor aging, Test Method D1171 , quality retention rating, min, %		85	85	85	85			
EA14	Water resistance, Test Method D471 , 70 h at 100°C, volume change, max, %		10	10	10	10			
F17	Low-temperature resistance, Test Methods D2137 , Method C, 9.3.3, nonbrittle after 3 min at -40°C		pass	pass	pass	pass			
G21	Tear resistance, Test Method D624 , Die C: under 7.0 MPa tensile strength, min, kN/m			22	22	22			
	7.0 MPa tensile strength and over, min, kN/m			26	26	26			
K11	Adhesion, Test Methods D429 , min: Method A, min, MPa		1.4	2.8	1.4	2.8			
K21	Adhesion, Test Methods D429 , Method B, min, kN/m		7	7	7	9			
P2	Staining resistance, Test Methods D925 , Method B, control panel		pass	pass	pass	pass			
Z	(Special requirements) Shall cover only special rubber material requirements specified in detail, including test methods and aging parameters.								

^A Basic properties only—no suffix requirements for Grade No. 1.

Basic Requirements

Durometer Hardness, ±5 Points	Tensile Strength, min		Ultimate Elongation, min, %	Heat Aged, Test Method D573 , 70 h at 70°C	Oil Immersion, Test Method D471 , IRM 903 Oil, 70 h at 70°C	Compression Set, Test Methods D395 , Solid, max, %, 22 h at 70°C	Available Suffix Grade Numbers
	MPa	psi					
40	3	435	400	Change in tensile strength, ±30 %	Volume change, + 10 % max	Compression set, 50 % max	2
50	3	435	400				2
60	5	725	300	Change in ultimate elonga- tion, -50 % max	Volume change, + 10 % max	Compression set, 50 % max	2
70	7	1015	250				2
80	7	1015	150	Change in durometer hard- ness, ±15 points	Volume change, + 10 % max	Compression set, 50 % max	3
90	7	1015	100				3

Suffix Requirements		Grade 1 ^A	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8
A14	Heat resistance, Test Method D573 , 70 h at 100°C: Change in durometer hardness, max, points		+15	+15					
	Change in tensile strength, max, %		-15	-15					
	Change in ultimate elongation, max, %		-40	-40					
B33	Compression set, Test Methods D395 , Method B, 22 h at 70°C max, %		50	50					
EO14	Fluid resistance, Test Method D471 , IRM 901 Oil, 70 h at 100°C: Change in volume, max, %		-3 to +5	-3 to +5					
EO34	Fluid resistance, Test Method D471 , IRM 903 Oil, 70 h at 100°C: Change in durometer hardness, points		-5 to +10	-5 to +10					
	Change in tensile strength, max, %		-30	-30					
	Change in ultimate elongation, max, %		-50	-50					
F17	Low-temperature resistance, Test Methods D2137 , Method C, 9.3.3, nonbrittle after 3 min at - 40°C		pass						
Z	(Special requirements) Shall cover only special rubber material requirements specified in detail, including test methods and aging parameters.								

^A Basic properties only—no suffix requirements for Grade No. 1.

Basic Requirements							
Durometer Hardness, ±5 Points	Tensile Strength, min		Ultimate Elongation, min, %	Heat Aged, Test Method D573 , 70 h at 100°C	Oil Immersion, Test Method D471 , IRM 903 Oil, 70 h at 100°C	Compression Set, Test Methods D395 , Solid, max, %, 22 h at 70°C	Available Suffix Grade Numbers
	MPa	psi					
20 ^A	6	870	400				3
30	7	1015	400				2
30	10	1450	400				2, 3, 4, 5
30	14	2031	400				2, 3, 4, 5
40	3	435	300				2, 8
40	7	1015	300				2, 8
40	10	1450	400				2, 3, 4, 5, 6
40	14	2031	400				2, 3, 4, 5
50	7	1015	300				2, 8
50	10	1450	400				2, 3, 4, 5, 6
50	14	2031	400				2, 3, 4, 5
50	17	2466	400				2, 3, 4, 5
60	3	435	250	Change in tensile strength, ±30 %	No requirement	Compression set, 50 % max	8
60	6	870	250				8
60	7	1015	300	Change in ultimate elongation, -50 % max	No requirement	Compression set, 50 % max	2, 8
60	10	1450	350				2, 3, 4, 5, 6
60	14	2031	400	Change in durometer hardness, ±15 points	No requirement	Compression set, 50 % max	2, 3, 4, 5, 6
60	17	2466	400				2, 3, 4, 5, 6
70	3	435	150				8
70	6	870	150				8
70	7	1015	200				2, 8
70	8	1160	200				8
70	10	1450	250				2, 3, 4, 5, 6
70	14	2031	300				2, 3, 4, 5
70	17	2466	300				2, 3, 4, 5
80	7	1015	100				2, 7
80	10	1450	150				2, 4
80	14	2031	200				2, 4
90	3	435	75				7
90	7	1015	100				2, 7
90	10	1450	125				2, 4

^A Materials would typically be 20 to 25 durometer based upon current capability.

Suffix Requirements		Grade 1 ^A	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8
A14	Heat resistance, Test Method D573 , 70 h at 100°C: Change in hardness, max, points Change in tensile strength, max, % Change in ultimate elongation, max, %			+10 -25 -25	+10 -25 -25				
B13	Compression set, Test Methods D395 , Method B, max, %, 22 h at 70°C			25			25		25
C12	Resistance to ozone, Test Method D1171 , quality retention rating, min, %		100	100	100	100	100	100	100
F17	Low-temperature resistance, Test Methods D2137 , Method C, 9.3.3, nonbrittle after 3 min at -40°C		pass	pass	pass	pass			
F19	Low-temperature resistance, Test Methods D2137 , Method C, 9.3.3, nonbrittle after 3 min at -55°C			pass		pass			
K11	Adhesion, Test Methods D429 , min: Method A, min, MPa			1.4	1.4	1.4	1.4		
K21	Adhesion, Test Methods D429 , min: Method B, min, kN/m			7	7	7			
Z	(Special requirements) Shall cover only special rubber material requirements specified in detail, including test methods and aging parameters.								

^A Basic properties only—no suffix requirements for Grade No. 1.

Basic Requirements							
Durometer Hardness, ± 5 Points	Tensile Strength, min		Ultimate Elongation, min, %	Heat Aged, Test Method D573 , 70 h at 100°C	Oil Immersion, Test Method D471 , IRM 903 Oil, 70 h at 100°C	Compression Set, Test Methods D395 , Solid, max, %, 22 h at 100°C	Available Suffix Grade Numbers
	MPa	psi					
30	3	435	300				2, 5
30	7	1015	400				2, 5
30	10	1450	500				2, 5
30	14	2031	500				2
40	3	435	300				2
40	7	1015	400				2, 5
40	10	1450	500				2, 5
40	14	2031	500				2, 5
40	17	2466	500				2
50	3	435	300				2, 5
50	7	1015	300				2, 5
50	10	1450	350				2, 5, 6
50	14	2031	400				2, 5, 6
50	17	2466	450				2, 6
50	21	3046	500				2, 6
50	24	3481	500				2, 6
60	3	435	300	Change in tensile strength, ± 30 %			3, 5
60	7	1015	300	Change in ultimate elongation, -50 % max			3, 5
60	10	1450	350	Change in durometer hardness, ± 15 points	Volume change, $+120$ % max	Compression set, 80 % max	3, 5, 6
60	14	2031	350				3, 6
60	17	2466	400				3, 6
60	21	3046	400				3, 6
60	24	3481	400				3, 6
70	3	435	200				3, 5
70	7	1015	200				3, 5
70	10	1450	250				3, 5, 6
70	14	2031	300				3, 5, 6
70	17	2466	300				3, 6
70	21	3046	300				3, 6
80	3	435	100				4
80	7	1015	100				4
80	10	1450	100				4
80	14	2031	150				4
90	3	435	50				4
90	7	1015	100				4
90	10	1450	150				4
90	14	2031	150				4

Suffix Requirements		Grade 1 ^A	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8
A14	Heat resistance, Test Method D573 , 70 h at 100°C:								
	Change in hardness, max points		+15	+15	+15	+15	+15		
	Change in tensile strength, max, %		-15	-15	-15	-15	-15		
	Change in ultimate elongation, max, %		-40	-40	-40	-40	-40		
B14	Compression set, Test Methods D395 , Method B, 22 h at 100°C, max, %		35	35	35	35	35		
C12	Resistance to ozone, Test Method D1171		100	100	100	100	100		
EO14	Fluid resistance, Test Method D471 , IRM 901 Oil, 70 h at 100°C:								
	Change in hardness, points		±10	±10	±10	±10	±10		
	Change in tensile strength, max, %		-30	-30	-30	-30	-30		
	Change in ultimate elongation, max, %		-30	-30	-30	-30	-30		
	Change in volume, %		-10 to +15	-10 to +15	-10 to +15	-10 to +15	-10 to +15		
EO34	Fluid resistance, Test Method D471 , IRM 903 Oil, 70 h at 100°C:								
	Change in tensile strength, max, %		-70	-60	-45	-60	-60		
	Change in ultimate elongation, max, %		-55	-50	-30	-60	-50		
	Change in volume, %		+120	+100	+80	+100	+100		
F17	Low-temperature resistance, Test Methods D2137 , Method C, 9.3.3, nonbrittle after 3 min at -40°C		pass	pass	pass				
F19	Low-temperature resistance, Test Methods D2137 , Method C, 9.3.3, nonbrittle after 3 min at -55°C					pass			
G21	Tear resistance, Test Method D624 , Die C:								
	Under 7.0 MPa tensile load, min, kN/m		22	22	22				
	7.0 to 10 MPa tensile load, min, kN/m		26	26	26				
	10 MPa tensile load and over, min, kN/m		26	26	26	26	26		
K11	Adhesion, Test Methods D429								
	Method A, min, MPa		1.4	1.4	1.4	1.4	2.8		
P2	Staining resistance, Test Methods D925 , Method B, control panel, nonstaining		pass	pass	pass				
Z	(Special requirements) Shall cover only special rubber material requirements specified in detail, including test methods and aging parameters.								

^A Basic properties only—no suffix requirements for Grade No. 1.

Basic Requirements							
Durometer Hardness, ±5 Points	Tensile Strength, min		Ultimate Elongation, min, %	Heat Aged, Test Method D573 , 70 h at 100°C	Oil Immersion, Test Method D471 , IRM 903 Oil, 70 h at 100°C	Compression Set, Test Methods D395 , Solid, max, %, 22 h at 100°C	Available Suffix Grade Numbers
	MPa	psi					
40	3	435	500			40	2
40	7	1015	500			40	2
50	3	435	350			40	2
50	6	870	350			40	2
50	7	1015	400			40	2
50	10	1450	400			40	2, 3
50	14	2031	400			40	2
60	3	435	300			40	2
60	6	870	300			40	2
60	7	1015	350			40	2
60	10	1450	350	Change in tensile strength, ±30 %	Volume change, +80 % max	40	2, 3
60	14	2031	350			40	2
70	3	435	200	Change in ultimate elongation, -50 % max		50	2
70	6	870	200			50	2
70	7	1015	200	Change in durometer hardness, ±15 points		50	2
70	10	1450	250			50	2, 3
70	14	2031	250			50	2
70	17	2466	250			50	2
80	7	1015	100			50	2
80	10	1450	100	50	2		
80	14	2031	150	50	2		
80	17	2466	150	50	2		
90	7	1015	100			50	2
90	10	1450	100			50	2
90	14	2931	150			50	2

BE MATERIALS

Suffix Requirements		Grade 1 ^A	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8
A14	Heat resistance, Test Method D573 , 70 h at 100°C:								
	Change in hardness, max, points		+15	+15					
	Change in tensile strength, max, %		-15	-15					
	Change in ultimate elongation, max, %		-40	-40					
B14	Compression set, Test Methods D395 , Method B, max, %, 22 h at 100°C		25	25					
C12	Resistance to ozone, Test Method D1171 , quality retention rating, min, %		100	100					
EO14	Fluid resistance, Test Method D471 , IRM 901 Oil, 70 h at 100°C:								
	Change in hardness, points		±10	±10					
	Change in tensile strength, max, %		-30	-30					
	Change in ultimate elongation, max, %		-30	-30					
	Change in volume, %		-10 to +15	-10 to +15					
EO34	Fluid resistance, Test Method D471 , IRM 903 Oil, 70 h at 100°C:								
	Change in tensile strength, max, %		-50	-50					
	Change in ultimate elongation, max, %		-40	-40					
F17	Low-temperature resistance, Test Methods D2137 , Method C, 9.3.3, nonbrittle after 3 min at -40°C		pass						
F19	Low-temperature resistance, Test Methods D2137 , Method C, 9.3.3, nonbrittle after 3 min at -55°C			pass					
G21	Tear resistance, Test Method D624 , Die C: 10 MPa tensile load and over, min, kN/m			26					
K11	Adhesion, Test Methods D429 , Method A, min, MPa			1.4					
Z	(Special requirements) Shall cover only special rubber material requirements specified in detail, including test methods and aging parameters.								

^A Basic properties only—no suffix requirements for Grade No. 1.

Basic Requirements							
Durometer Hardness, ±5 Points	Tensile Strength, min		Ultimate Elongation, min, %	Heat Aged, Test Method D573 , 70 h at 100°C	Oil Immersion, Test Method D471 , IRM 903 Oil, 70 h at 100°C	Compression Set, Test Methods D395 , Solid, max, %, 22 h at 100°C	Available Suffix Grade Numbers
	MPa	psi					
60	3	435	200				2
60	6	870	200				2
60	7	1015	250				2
60	8	1160	250				2
60	10	1450	300				2
60	14	2031	350				2
60	17	2466	350				2
70	3	435	150	Change in tensile strength, ±30 %			2
70	6	870	150	Change in ultimate elongation, -50 % max	Volume change, +60 % max	Compression set, 50 % max	2
70	7	1015	200	Change in durometer hardness, ±15 points			2
70	8	1160	200				2
70	10	1450	250				2
70	14	2031	250				2
70	17	2466	300				2
80	3	435	100				2
80	7	1015	100				2
80	10	1450	125				2
80	14	2031	125				2

BF MATERIALS

Suffix Requirements		Grade 1 ^A	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8
B14	Compression set, Test Methods D395 , Method B, max, %, 22 h at 100°C		25						
B34	Compression set, Test Methods D395 , Method B, max, %, 22 h at 100°C		25						
EO14	Fluid resistance, Test Method D471 , IRM 901 Oil, 70 h at 100°C:								
	Change in hardness, points		±10						
	Change in tensile strength, max, %		-25						
	Change in ultimate elongation, max, %		-45						
	Change in volume, %		-10 to +10						
EO34	Fluid resistance, Test Method D471 , IRM 903 Oil, 70 h at 100°C:								
	Change in hardness, max, points		-20						
	Change in tensile strength, max, %		-45						
	Change in ultimate elongation, max, %		-45						
	Change in volume, %		0 to +60						
F19	Low-temperature resistance, Test Methods D2137 , Method C, 9.3.3, nonbrittle after 3 min at -55°C		pass						
Z	(Special requirements) Shall cover only special rubber material requirements specified in detail, including test methods and aging parameters.								

^A Basic properties only—no suffix requirements for Grade No. 1.

Basic Requirements

Durometer Hardness, ±5 Points	Tensile Strength, min		Ultimate Elongation, min, %	Heat Aged, Test Method D573 , 70 h at 100°C	Oil Immersion, Test Method D471 , IRM 903 Oil, 70 h at 100°C	Compression Set, Test Methods D395 , Solid, max, %, 22 h at 100°C	Available Suffix Grade Numbers
	MPa	psi					
40	7	1015	450				2, 5
40	10	1450	450				2, 5
50	3	435	300				2, 5
50	6	870	300				2
50	7	1015	350				2, 5
50	8	1160	350				2
50	10	1450	300				2, 3, 4, 5
50	14	2031	350				2, 3, 4, 5
50	21	3046	400				3, 4
60	3	435	200				2, 5
60	6	870	200				2
60	7	1015	250				2, 5
60	8	1160	250				2
60	10	1450	300				2, 5
60	14	2031	300				2, 3, 4, 5
60	17	2466	350				2
60	21	3046	350	Change in tensile strength, ±30 %			3, 4
60	28	4061	400				3, 4
70	3	435	150	Change in ultimate elongation, -50 % max	Volume change, +40 % max	Compression set, 50 % max	2, 5
70	6	870	150						2
70	7	1015	200	Change in durometer hardness, ±15 points			2, 5
70	8	1160	200				2
70	10	1450	250				2, 5
70	14	2031	250				2, 3, 4, 5
70	17	2466	300				2, 3
70	21	3046	350				3, 4
70	28	4061	400				3, 4
80	3	435	100				6, 7
80	7	1015	100				6, 7
80	10	1450	125				6, 7
80	14	2031	125				3, 4, 6, 7
80	21	3046	300				3, 4
80	28	4061	350				3, 4
90	3	435	50				6, 7
90	7	1015	100				6, 7
90	10	1450	100				6, 7

Suffix Requirements		Grade 1 ^A	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8
A14	Heat resistance, Test Method D573 , 70 h at 100°C: Change in hardness, max, points				±5	±15	±15		
	Change in tensile strength, max, %				±15	-20	-20		
	Change in ultimate elongation, max, %				-15	-40	-40		
B14	Compression set, Test Methods D395 , Method B, max, %, 22 h at 100°C		25	50	50	25	25	25	
B34	Compression set, Test Methods D395 , Method B, max, %, 22 h at 100°C		25			25	25		
EA14	Water resistance, Test Method D471 , 70 h at 100°C: Change in hardness, points		±10					±10	
	Change in volume, %		±15					±15	
EF11	Fluid resistance, Test Method D471 , Reference Fuel A, 70 h at 23°C: Change in hardness, points		±10					±10	
	Change in tensile strength, max, %		-25					-25	
	Change in ultimate elongation, max, %		-25					-25	
	Change in volume, %		-5 to +10					-5 to +10	
EF21	Fluid resistance, Test Method D471 , Reference Fuel B, 70 h at 23°C: Change in hardness, points		0 to -30					0 to -30	
	Change in tensile strength, max, %		-60					-60	
	Change in ultimate elongation, max, %		-60					-60	
	Change in volume, %		0 to +40					0 to +40	
EO14	Fluid resistance, Test Method D471 , IRM 901 Oil, 70 h at 100°C: Change in hardness, max, points		-5 to +10	-7 to +5	-7 to +5	-5 to +15	-5 to +15	-5 to +5	
	Change in tensile strength, max, %		-25	-20	-20	-25	-25	-25	
	Change in ultimate elongation, max, %		-45	-40	-40	-45	-45	-45	
	Change in volume, %		-10 to +5	-5 to +10	-5 to +5	-10 to +5	-10 to +5	-10 to +5	
EO34	Fluid resistance, Test Method D471 , IRM 903 Oil, 70 h at 100°C: Change in hardness, points		-10 to +5	-10 to +5	-10 to +5	0 to -15	0 to -20	-10 to +5	
	Change in tensile strength, max, %		-45	-35	-35	-45	-45	-45	
	Change in ultimate elongation, max, %		-45	-40	-40	-45	-45	-45	
	Change in volume, %		0 to +25	+16 to +35	0 to +6	0 to +35	0 to +35	0 to +25	
F16	Low-temperature resistance, Test Methods D2137 , Method C, 9.3.3, nonbrittle after 3 min at -35°C								pass
F17	Low-temperature resistance, Test Methods D2137 , Method C, 9.3.3, nonbrittle after 3 min at -40°C		pass					pass	
F19	Low-temperature resistance, Test Methods D2137 , Method C, 9.3.3, nonbrittle after 3 min at -55°C			pass	pass	pass			
P2	Staining resistance, Test Methods D925 , Method B, control panel			pass	pass				
Z	(Special requirements) Shall cover only special rubber material requirements specified in detail, including test methods and aging parameters.								

^A Basic properties only—no suffix requirements for Grade No. 1.

Basic Requirements

Durometer Hardness, ±5 Points	Tensile Strength, min		Ultimate Elongation, min, %	Heat Aged, Test Method D573 , 70 h at 100°C	Oil Immersion, Test Method D471 , IRM 903 Oil, 70 h at 100°C	Compression Set, Test Methods D395 , Solid, max, %, 22 h at 100°C	Available Suffix Grade Numbers
	MPa	psi					
60	3	435	200				4
60	6	870	200				4
60	7	1015	250				4
60	8	1160	250				4
60	10	1450	300				4
60	14	2031	350				4
60	17	2466	350				4
70	3	435	150				4
70	6	870	150	Change in tensile strength, ±30 %	Volume change, +10 % max	Compression set, 50 % max	4
70	7	1015	200				4
70	8	1160	200	Change in ultimate elonga- tion, -50 % max			4
70	10	1450	250		4		
70	14	2031	250	Change in durometer hard- ness, ±15 points			4
70	17	2466	300		4		
80	3	435	100				4
80	7	1015	100				4
80	10	1450	125				4
80	14	2031	125				4
90	3	435	50				4
90	7	1015	100				4
90	10	1450	100				4

Suffix Requirements		Grade 1 ^A	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8
A24	Heat resistance, Test Method D865 , 70 h at 100°C: Change in hardness, points Change in tensile strength, max, % Change in ultimate elongation, max, %								
B14	Compression set, Test Methods D395 , Method B, max, %, 22 h at 100°C				±10 -20 -30				
B34	Compression set, Test Methods D395 , Method B, max, %, 22 h at 100°C				25				
EF11	Fluid resistance, Test Method D471 , Reference Fuel A, 70 h at 23°C: Change in hardness, points Change in tensile strength, max, % Change in ultimate elongation, max, % Change in volume, %								
EF21	Fluid resistance, Test Method D471 , Reference Fuel B, 70 h at 23°C: Change in hardness, max, points Change in tensile strength, max, % Change in ultimate elongation, max, % Change in volume, %								
EO14	Fluid resistance, Test Method D471 , IRM 901 Oil, 70 h at 100°C: Change in hardness, points Change in tensile strength, max, % Change in ultimate elongation, max, % Change in volume, %								
EO34	Fluid resistance, Test Method D471 , IRM 903 Oil, 70 h at 100°C: Change in hardness, points Change in tensile strength, max, % Change in ultimate elongation, max, % Change in volume, %								
Z	(Special requirements) Shall cover only special rubber material requirements specified in detail, including test methods and aging parameters.								

^A Basic properties only—no suffix requirements for Grade No. 1.

Basic Requirements							
Durometer Hardness, ±5 Points	Tensile Strength, min		Ultimate Elongation, min, %	Heat Aged, Test Method D573 , 70 h at 125°C	Oil Immersion, Test Method D471 , IRM 903 Oil, 70 h at 150°C	Compression Set, Test Methods D395 , Solid, max, %, 22 h at 100°C	Available Suffix Grade Numbers
	MPa	psi					
30	7	1015	500				2
30	10	1450	500				2
40	7	1015	400				2
40	10	1450	400				2
40	14	2031	400				2
50	7	1015	300				3
50	10	1450	300				4
50	14	2031	350				4
50	17	2466	350	Change in tensile strength, ± 30 %			4
60	7	1015	250	Change in ultimate elongation, –50 % max	No requirements	Compression set, 60 % max	3
60	10	1450	250	Change in durometer hardness, ±15 points			4
60	14	2031	250				4
70	7	1015	200				3
70	10	1450	200				4, 5
70	14	2031	200				4, 5
80	7	1015	150				6
80	10	1450	150				7, 8
80	14	2031	150				7, 8
90	7	1015	100				6
90	10	1450	100				7, 8

CA MATERIALS

	Suffix Requirements	Grade 1 ^A	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8
A25	Heat resistance, Test Method D865 , 70 h at 125°C:								
	Change in hardness, max, points		+10	+10	+10	+10	+10	+10	+10
	Change in tensile strength, max, %		-20	-20	-20	-20	-20	-20	-20
	Change in ultimate elongation, max, %		-40	-40	-40	-40	-40	-40	-40
B44	Compression set, Test Methods D395 , Method B, 70 h at 100°C, plied specimen, max, %		35	50					
B35	Compression set, Test Methods D395 , Method B, 22 h at 125°C, plied specimen, max, %		70	70	70	50	70	70	50
C32	Resistance to ozone, Test Method D1171 , exposure Method B		pass	pass	pass	pass	pass	pass	pass
EA14	Water resistance, Test Method D471 , 70 h at 100°C, volume change, %		±5	±5	±5	±5	±5	±5	±5
F17	Low-temperature resistance, Test Methods D2137 , Method C, 9.3.3, nonbrittle after 3 min at -40°C		pass	pass	pass	pass	pass	pass	pass
F18	Low-temperature resistance, Test Methods D2137 , Method C, 9.3.3, nonbrittle after 3 min at -50°C		pass	pass	pass	pass		pass	
F19	Low-temperature resistance, Test Methods D2137 , Method C, 9.3.3, nonbrittle after 3 min at -55°C				pass				
G11	Tear resistance, Test Method D624 , Die B, min, kN/m		17	26	26	26	26	26	26
G21	Tear resistance, Test Method D624 , Die C, min, kN/m		17	26	26	26	26	26	26
K11	Adhesion, Test Methods D429 , Method A, min, MPa			1.4	2.8	2.8	1.4	2.8	2.8
P2	Staining resistance, Test Methods D925 , Method B, control panel		pass	pass	pass	pass	pass	pass	pass
R11	Resilience in compression, Test Methods D945 , min, %		70	50	60				
Z	(Special requirements) Shall cover only special rubber material requirements specified in detail, including test methods and aging parameters.								

^A Basic properties only—no suffix requirements for Grade No. 1.

Basic Requirements

Durometer Hardness, ±5 Points	Tensile Strength, min		Ultimate Elongation, min, %	Heat Aged, Test Method D573 , 70 h at 125°C	Oil Immersion, Test Method D471 , IRM 903 Oil, 70 h at 125°C	Compression Set, Test Methods D395 , Solid, max, %, 22 h at 70°C	Available Suffix Grade Numbers
	MPa	psi					
50	14	2031	400				2, 3
60	10	1450	350				2, 3
60	14	2031	400				2, 3
60	17	2466	400	Change in tensile strength, ±30 %			2, 3
70	7	1015	200		Change in ultimate elongation, -50 % max	Volume change, +80 % max	Compression set, 80 % max	2, 3
70	10	1450	250	Change in durometer hardness, ±15 points						2, 3
70	14	2031	300				
70	17	2466	300				2, 3
80	7	1015	200				2, 3
80	10	1450	250				2, 3
80	14	2031	250				2, 3

CE MATERIALS

Suffix Requirements		Grade 1 ^A	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8
A16	Heat resistance, Test Method D573 , 70 h at 150°C: Change in hardness, points Change in tensile strength, % Change in ultimate elongation, max, %		±20						
B15	Compression set, Test Methods D395 , Method B, max, %, 22 h at 125°C		60	80					
F19	Low-temperature resistance, Test Methods D2137 , Method C, 9.3.3, nonbrittle after 3 min at -55°C		pass	pass					
P2	Staining resistance, Test Methods D925 , Method B, control panel		pass	pass					
Z	(Special requirements) Shall cover only special rubber material requirements specified in detail, including test methods and aging parameters.								

^A Basic properties only—no suffix requirements for Grade No. 1.

Basic Requirements							
Durometer Hardness, ±5 Points	Tensile Strength, min		Ultimate Elongation, min, %	Heat Aged, Test Method D865 , 70 h at 125°C	Oil Immersion, Test Method D471 , IRM 903 Oil, 70 h at 125°C	Compression Set, Test Methods D395 , Solid, max, %, 22 h at 100°C	Available Suffix Grade Numbers
	MPa	psi					
60	3	435	200				2, 3
60	6	870	200				2, 3
60	7	1015	250				2, 3
60	8	1160	250				2, 3
60	10	1450	300				2, 3, 5, 6
60	14	2031	350				2, 3
60	17	2466	350				2, 3
70	3	435	150				2, 3
70	6	870	150	Change in tensile strength, ±30 %			2, 3
70	7	1015	200				2, 3
70	8	1160	200	Change in ultimate elongation, -50 % max	Volume change, +30 % max	Compression set, 50 % max	2, 3
70	10	1450	250						2, 3
70	14	2031	250	Change in durometer hardness, ±15 points			2, 3, 5, 6
70	17	2466	300				2, 3
80	3	435	100				3, 4
80	7	1015	100				3, 4
80	10	1450	125				3, 4
80	14	2031	125				3, 4, 5, 6
90	3	435	50				3, 4
90	7	1015	100				3, 4
90	10	1450	100				3, 4, 5, 6

Suffix Requirements		Grade 1 ^A	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8
A25	Heat resistance, Test Method D865 , 70 h 125°C:								
	Change in hardness, points		0 to +15	0 to +15	0 to +15	0 to +10	0 to +10		
	Change in tensile strength, max, %		-25	-25	-25	-10	-20		
	Change in ultimate elongation, max, %		-50	-50	-50	-40	-30		
B14	Compression set, Test Methods D395 , Method B, max, %, 22 h at 100°C		25	25	25	30	25		
B34	Compression set, Test Methods D395 , Method B, max, %, 22 h at 100°C		25	25		30	25		
C12	Resistance to ozone retention rating, Test Method D1171					100	100		
EF31	Fluid resistance, Test Method D471 , Refer- ence Fuel C, 70 h at 23°C:								
	Change in hardness, points		0 to -30		0 to -30	0 to -20	0 to -20		
	Change in tensile strength, max, %		-60		-60	-50	-50		
	Change in ultimate elongation, max, %		-60		-60	-60	-50		
	Change in volume, %		0 to +50		0 to +50	0 to +40	0 to +40		
EO15	Fluid resistance, Test Method D471 , IRM 901 Oil, 70 h at 125°C:								
	Change in hardness, points		0 to +10		0 to +10				
	Change in tensile strength, max, %		-20		-20				
	Change in ultimate elongation, max, %		-35		-35				
	Change in volume, %		-15 to +5		-15 to +5				
EO16	Fluid resistance, Test Method D471 , IRM 901 Oil, 70 h at 150°C:								
	Change in hardness, points			0 to +10					
	Change in tensile strength, max, %			-20					
	Change in ultimate elongation, max, %			-40					
	Change in volume, %			-15 to +5					
EO35	Fluid resistance, Test Method D471 , IRM 903 Oil, 70 h at 125°C:								
	Change in hardness, points		±10		±10				
	Change in tensile strength, max, %		-15		-15				
	Change in ultimate elongation, max, %		-30		-30				
	Change in volume, %		0 to +25		0 to +25				
EO36	Fluid resistance, Test Method D471 , IRM 903 Oil, 70 h at 150°C:								
	Change in hardness, points			±10		-5 to +10	-5 to +10		
	Change in tensile strength, max, %			-35		-10	-15		
	Change in ultimate elongation, max, %			-35		-50	-40		
	Change in volume, %			0 to +25		0 to +10	0 to +15		
F14	Low-temperature resistance, Test Methods D2137 , Method C, 9.3.3, nonbrittle after 3 min at -18°C					pass			
F16	Low-temperature resistance, Test Methods D2137 , Method C, 9.3.3, nonbrittle after 3 min at -35°C					pass			
F17	Low-temperature resistance, Test Methods D2137 , Method C, 9.3.3, nonbrittle after 3 min at -40°C		pass				pass		
Z	(Special requirements) Shall cover only special rubber material requirements specified in detail, including test methods and aging parameters.								

^A Basic properties only—no suffix requirements for Grade No. 1

Basic Requirements							
Durometer Hardness, ±5 Points	Tensile Strength, min		Ultimate Elongation, min, %	Heat Aged, Test Method D573 , 70 h at 150°C	Oil Immersion, Test Method D471 , IRM 903 Oil, 70 h at 150°C	Compression Set, Test Methods D395 , Plied, max, %, 22 h at 150°C	Available Suffix Grade Numbers
	MPa	psi					
50	7	1015	300				2
50	10	1450	300				2
50	14	2031	350				2
60	7	1015	250				2, 3
60	10	1450	250	Change in tensile strength, ±30 % Change in ultimate elongation, -50 % max Change in durometer hardness, ±15 points		Compression set, 50 % max	2, 3
60	14	2031	300				2, 3
70	7	1015	200		No requirement		2, 3
70	10	1450	200				2, 3
70	14	2031	200				2, 3
80	7	1015	150				2, 3
80	10	1450	150				2, 3
80	14	2031	150				2, 3

Suffix Requirements		Grade 1 ^A	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8
A26	Heat resistance, Test Methods D865 , 70 h at 150°C: Change in hardness, max, points Change in tensile strength, max, % Change in ultimate elongation, max, %		+10 -20 -20	+10 -20					
B36	Compression set, Test Methods D395 , Method B, 22 h at 150°C, plied, max, %		40	25					
C32	Resistance to ozone, Test Method D1171 , Exposure, Method B		pass	pass					
EA14	Water resistance, Test Method D471 , 70 h at 100°C, volume change, %		±5	±5					
F19	Low-temperature resistance, Test Methods D2137 , Method C, 9.3.3, nonbrittle after 3 min at -55°C		pass	pass					
G11	Tear resistance, Test Method D624 , Die B, min, kN/m		17	17					
G21	Tear resistance, Test Method D624 , Die C, min, kN/m		17	17					
K11	Adhesion, Test Methods D429 , Method A, min, MPa			1.4					
P2	Staining resistance, Test Methods D925 , Method B, control panel		pass	pass					
R11	Resilience in compression, Test Methods D945 , min, %		60	60					
Z	(Special requirements) Shall cover only special rubber material requirements specified in detail, including test methods and aging parameters.								

^A Basic properties only—no suffix requirements for Grade No. 1

Basic Requirements

Durometer Hardness, ±5 Points	Tensile Strength, min		Ultimate Elongation, min, %	Heat Aged, Test Method D573 , 70 h at 150°C	Oil Immersion, Test Method D471 , IRM 903 Oil, 70 h at 150°C	Compression Set, Test Methods D395 , Method B, Solid, max, %, 22 h at 125°C	Available Suffix Grade Numbers
	MPa	psi					
60	10	1450	350				2
60	14	2031	400				2, 3
60	17	2466	400				2, 3, 4
70	7	1015	200	Change in durometer hardness, ±15 points Change in tensile strength, ±30 % Change in ultimate elongation, -50 % max	Volume change, +80 % max	Compression set, +80 % max	2
70	10	1450	250				5
70	14	2031	300				6
70	17	2466	300				
80	7	1015	200				
80	10	1450	200				2
80	14	2031	250				
90	10	1450	150				
90	14	2031	150				5

DE MATERIALS

Suffix Requirements		Grade 1 ^A	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6
A16	Heat resistance, Test Method D573 , 70 h at 150°C:		15	15	15		15
	Change in hardness, points		30	30	30		30
	Change in tensile strength, %		-30	-30	-30		-30
	Change in ultimate elongation, max, %						
B15	Compression set, Test Methods D395 , Method B, 22 h at 125°C, max, %		55	35	25	35	30
EO36	Fluid resistance, Test Method D471 , IRM 903 Oil, 70 h at 150°C:						
	Volume change, max, %		+70	+70		+60	
F16	Low-temperature resistance, Test Methods D2137 , Method C, 9.3.3, nonbrittle after 3 min at -35°C		pass			pass	
F17	Low-temperature resistance, Test Methods D2137 , Method C, 9.3.3, nonbrittle after 3 min at -40°C			pass	pass		pass
Z	(Special requirements) Shall cover only special rubber material requirements specified in detail, including test methods and aging parameters.						

^A Basic properties only—no suffix requirements for Grade No. 1.

Basic Requirements							
Durometer Hardness, ±5 Points	Tensile Strength, min		Ultimate Elongation, min, %	Heat Aged, Test Method D865 , 70 h at 150°C	Oil Immersion, Test Method D471 , IRM 903 Oil, 70 h at 150°C	Compression Set, Test Methods D395 , Solid, max, %, 22 h at 150°C	Available Suffix Grade Numbers
	MPa	psi					
40	6	870	225			80	2
50	7	1015	225			80	2
60	8	1160	175	Change in tensile strength, ±30 %		80	2
70	6	870	100	Change in ultimate elongation, -50 % max	Volume change, +60 % max	90	5
70	8	1160	150	Change in durometer hardness, ±15 points		80	2
80	6	870	100			90	5
80	8	1160	150			80	3
90	7	1015	125			85	4

Suffix Requirements		Grade 1 ^A	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8
A26	Heat resistance, Test Method D865 , 70 h at 150°C:								
	Change in hardness, max, points		+10	+10	+10	+10			
	Change in tensile strength, max, %		-25	-25	-25	-25			
	Change in ultimate elongation, max, %		-30	-30	-30	-30			
B16	Compression set, Test Methods D395 , Method B, max, %, 22 h at 150°C		50	60	75	80			
B36	Compression set, Test Methods D395 , Method B, max, %, 22 h at 150°C		75	80	85				
EO16	Fluid resistance, Test Method D471 , IRM 901 Oil, 70 h at 150°C:								
	Change in hardness, points		-8 to +15	-8 to +10	-8 to +10	-8 to +10			
	Change in tensile strength, max, %		-20	-20	-20	-30			
	Change in ultimate elongation, max, %		-30	-30	-30	-50			
	Change in volume, %		-5 to +10	-5 to +10	-5 to +10	-5 to +10			
EO36	Fluid resistance, Test Method D471 , IRM 903 Oil, 70 h at 150°C:								
	Change in hardness, max, points		-30	-30	-30	-30			
	Change in tensile strength, max, %		-60	-60	-60	-60			
	Change in ultimate elongation, max, %		-40	-30	-30	-50			
	Change in volume, %		+50	+50	+50	+50			
F14	Low-temperature resistance, Test Methods D2137 , Method C, 9.3.3, nonbrittle after 3 min at -18°C			pass	pass	pass			
F15	Low-temperature resistance, Test Methods D2137 , Method C, 9.3.3, nonbrittle after 3 min at -25°C		pass						
K11	Adhesion, Test Methods D429 , Method A, min, MPa		1.4	1.4	1.4	1.4			
Z	(Special requirements) Shall cover only special rubber material requirements specified in detail, including test methods and aging parameters.								

^A Basic properties only—no suffix requirements for Grade No. 1.

Basic Requirements

Durometer Hardness, ±5 Points	Tensile Strength, min		Ultimate Elongation, min, %	Heat Aged, Test Method D865 , 70 h at 150°C	Oil Immersion, Test Method D471 , IRM 903 Oil, 70 h at 150°C	Compression Set, Test Methods D395 , Solid, max, %, 22 h at 150°C	Available Suffix Grade Numbers
	MPa	psi					
40	7	1015	300			60	2
50	8	1160	250			60	2
60	8	1160	200	Change in tensile strength, ±30 %		60	2
60	9	1450	200			60	2
60	14	2031	250			40	4
70	6	870	100	Change in ultimate elongation, -50 % max	Volume change, +30 % max	75	5
70	8	1160	200			60	3
70	10	1450	200	Change in durometer hardness, ±15 points		60	3
70	16	2321	250			40	4
80	6	870	100			75	5
80	8	1160	175			60	3
80	10	1450	175			60	3
80	20	2900	150			40	4
90	10	1450	100			60	4
90	20	2900	100			45	

Suffix Requirements		Grade 1 ^A	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8
A26	Heat resistance, Test Method D865 , 70 h at 150°C: Change in hardness, max, points		+10	+10	+10	+10			
	Change in tensile strength, max, %		-25	-25	-15	-25			
	Change in ultimate elongation, max, %		-30	-30	-25	-30			
B16	Compression set, Test Methods D395 , Method B, max, %, 22 h at 150°C		30	30		60			
B36	Compression set, Test Methods D395 , Method B, max, %, 22 h at 150°C		50	50	35				
EO16	Fluid resistance, Test Method D471 , IRM 901 Oil, 70 h at 150°C: Change in hardness, points		-5 to +10	-5 to +10	-5 to +10	-5 to +10			
	Change in tensile strength, max, %		-20	-20	-20	-20			
	Change in ultimate elongation, max, %		-30	-30	-30	-40			
	Change in volume, %		±5	±5	-10 to +5	±5			
EO36	Fluid resistance, Test Method D471 , IRM 903 Oil, 70 h at 150°C: Change in hardness, max, points		-15	-15	-15	-15			
	Change in tensile strength, max, %		-40	-30	-40	-40			
	Change in ultimate elongation, max, %		-40	-30	-30	-40			
	Change in volume, %		+25	+25	+25	+25			
F13	Low-temperature resistance, Test Methods D2137 , Method C, 9.3.3, nonbrittle after 3 min at -10°C			pass		pass			
F14	Low-temperature resistance, Test Methods D2137 , Method C, 9.3.3, nonbrittle after 3 min at -18°C		pass						
F17	Low-temperature resistance, Test Method D2137 , Method C, 9.3.3, nonbrittle after 3 min at -40°C				pass				
K11	Adhesion, Test Methods D429 , Method A, bonded dur- ing vulcanization, min, MPa		1.4	1.4		1.4			
Z	(Special requirements) Shall cover only special rubber material requirements specified in detail, including test methods and aging parameters.								

^A Basic properties only—no suffix requirements for Grade No. 1.

Basic Requirements							
Durometer Hardness, ±5 Points	Tensile Strength, min		Ultimate Elongation, min, %	Heat Aged, Test Method D865 , 70 h at 175°C	Oil Immersion, Test Method D471 , IRM 903 Oil, 70 h at 150°C	Compression Set, Test Methods D395 , Method B, Solid, max, %, 22 h at 150°C	Available Suffix Grade Numbers
	MPa	psi					
50	8	1160	400				3
50	10	1450	500				3
50	12	1740	500				
50	14	2031	500				
60	6	870	200				4
60	8	1160	300				3, 4, 5
60	12	1740	300				3
60	14	2031	400	Change in durometer hardness, ±15 points			3
70	8	1160	200	Change in tensile strength, ±30 %	Volume change, +80 % max	Compression set, 75 % max	3, 4, 5
70	10	1450	200				4
70	12	1740	300	Change in ultimate elongation, -50 % max			3
80	10	1450	200				4
80	12	1740	200				3, 4
80	14	2031	200				3, 4, 5
80	16	2320	200				3
90	6	870	100				4
90	10	1450	100				3
90	14	2031	100				

Suffix Requirements		Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8
A47	Heat resistance, Test Method D573 , 168 h at 175°C:								
	Change in hardness, max, points	Basic requirements only		+10	+20	+10			
	Change in tensile strength, max, %	Basic requirements only		-30	-30	-30			
	Change in ultimate elongation, max, %	Basic requirements only		-50	-65	-50			
B46	Compression set, Test Methods D395 , Method B, 70 h at 150°C, max, %	Basic requirements only		50	75	50			
B37	Compression set, Test Methods D395 , Method B, 22 h at 175°C, max, %	Basic requirements only		50	75	50			
EO16	Fluid resistance, Test Method D471 , IRM 901 Oil, 70 h at 150°C:								
	Change in hardness, max, points	Basic requirements only		-10 to +5	-10 to +5	-10 to +5			
	Change in tensile strength, max, %	Basic requirements only		-25	-25	-25			
	Change in ultimate elongation, max, %	Basic requirements only		-35	-35	-35			
	Change in volume, %	Basic requirements only		±15	±10	±10			
EO36	Fluid resistance, Test Method D471 , IRM 903 Oil, ^A 70 h at 150°C:								
	Change in tensile strength, max, %	Basic requirements only		-60	-50	-50			
	Change in ultimate elongation, max, %	Basic requirements only		-55	-50	-50			
	Change in volume, max, %	Basic requirements only		+70	+60	+50			
EA14	Water resistance, Test Method D471 , 70 h at 100°C:								
	Change in volume, max, %	Basic requirements only		+15	+15	+15			
F17	Low-temperature resistance, Test Methods D2137 , Method C, 9.3.3, nonbrittle after 3 min at -40°C	Basic requirements only		pass	pass	pass			
G21	Tear resistance, Test Method D624 , Die C, min, kN/M	Basic requirements only		20	20	20			
Z	(Special requirements) Shall cover only special rubber material requirements specified in detail, including test methods and aging parameters.								

^A Change in Hardness values are omitted because the round robin data did not support them statistically.

Basic Requirements

Durometer Hardness, ±5 Points	Tensile Strength, min		Ultimate Elongation, min, %	Heat Aged, Test Method D865 , 70 h at 175°C	Oil Immersion, Test Method D471 , IRM 903 Oil, 70 h at 150°C	Compression Set, Test Methods D395 , Solid, max, %, 22 h at 150°C	Available Suffix Grade Numbers
	MPa	psi					
40	7	1015	250			75	3
50	8	1160	175			75	3
60	6	870	100	Change in durometer hardness, ±15 points	Volume change, 30 % max	75	3
60	9	1306	150			75	3
				Change in tensile strength, ±30 %			
70	6	870	100	Change in ultimate elonga- tion, -50 % max		75	3
70	9	1306	125		75	3	
80	7	1015	100			75	3

Suffix Requirements		Grade 1 ^A	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8
A27	Heat resistance, Test Method D865 , 70 h at 175°C: Change in hardness, max, points Change in tensile strength, max, % Change in ultimate elongation, max, %								
				+10	-30				
B17	Compression set, Test Methods D395 , Method B, 22 h at 175°C, max, %			60					
B37	Compression set, Test Methods D395 , Method B, 22 h at 175°C, max, %			60					
E016	Fluid resistance, Test Method D471 , IRM 901 Oil, 70 h at 150°C: Change in hardness, points Change in tensile strength, max, % Change in ultimate elongation, max, % Change in volume, %								
				±5	-20				
					-30				
					±5				
E036	Fluid resistance, Test Method D471 , IRM 903 Oil, 70 h at 150°C: Change in hardness, points Change in tensile strength, max, % Change in ultimate elongation, max, % Change in volume, %								
					-20				
					-40				
					-30				
					+25				
F14	Low-temperature resistance, Test Methods D2137 , Method C, 9.3.3, non-brittle after 3 min at -18°C								pass
F25	Low-temperature resistance, Test Methods D1053 , T100, 25° C								pass
K11	Adhesion, Test Methods D429 , Method A, min, MPa				1.4				
Z	(Special requirements) Shall cover only special rubber material requirements specified in detail, including test methods and aging parameters.								

^A Basic properties only—no suffix requirements for Grade No. 1

Basic Requirements							
Durometer Hardness, ±5 Points	Tensile Strength, min		Ultimate Elongation, min, %	Heat Aged, Test Method D573 , 70 h at 175°C	Oil Immersion, Test Method D471 , IRM 903 Oil, 70 h at 150°C	Compression Set, Test Method D395 , Solid, max, %, 22 h at 150°C	Available Suffix Grade Numbers
	MPa	psi					
50	9	1305	125	Change in durometer hardness, ±15 points		60	2
70	10	1450	125	Change in tensile strength, ±30 %	Volume change, ±10 % max	60	2
80	10	1450	100	Change in ultimate elongation, -50 % max		60	2

Suffix Requirements		Grade 1 ^A	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8
A17	Heat resistance, Test Method D573 , 70 h at 175°C: Change in hardness, points Change in tensile strength, % Change in ultimate elongation, max, %		±10 -25 -20 to +30						
A18	Heat aging resistance, Test Method D573 , 70 h at 200°C: Change in hardness, points Change in tensile strength, max, % Change in ultimate elongation, %		-15 to +10 -60 -10 to +40						
B17	Compression set, Test Methods D395 , Method B, solid, 22 h at 175°C, max, %		60						
B26	Compression set, Test Methods D395 , Method B, solid, 70 h at 150°C, max %		50						
C32	Resistance to ozone, Test Method D1171 , Method B		pass						
EA14	Fluid resistance to Test Method D471 , water, 70 g at 100°C Change in hardness, points Change in volume		-5 to +10 0 to +20						
EF31	Fluid resistance, Test Method D471 , Reference Fuel C, 70 h at 23°C Change in hardness, points Change in tensile strength, max, % Change in ultimate elongation, max, % Change in volume, max, %		-20 to +5 -50 -50 +40						
EO16	Fluid resistance, Test Method D471 , IRM 901 Oil, 70 h at 150°C: Change in hardness, points Change in tensile strength, max, % Change in ultimate elongation, max, % Change in volume, max %		-10 to +5 -10 -20 +10						
E036	Fluid resistance, Test Method D471 , IRM 903 Oil, 70 h at 150°C: Change in hardness, points Change in tensile strength, max, % Change in ultimate elongation, max, % Change in volume, max, %		-15 to 0 -20 -20 +10						
F19	Low-temperature resistance, Test Methods D2137 , Method C, 9.3.3, nonbrittle after 3 min at -55°C		pass						
F49	Low-temperature resistance, Test Method D1329 , after 10 min at -55°C, 10 % retraction, min		pass						
Z	(Special requirements) Shall cover only special rubber material requirements specified in detail, including test methods and aging parameters.								

^A Basic properties only—no suffix requirements for Grade No. 1.

Basic Requirements							
Durometer Hardness, ±5 Points	Tensile Strength, min		Ultimate Elongation, min, %	Heat Aged, Test Method D573 , 70 h at 200°C	Oil Immersion, Test Method D471 , IRM 903 Oil, 70 h at 150°C	Compression Set, Test Methods D395 , Plieed, max, %, 22 h at 175°C	Available Suffix Grade Numbers
	MPa	psi					
30	3	435	350			60	2
30	5	725	400			60	2
40	7	1015	400	Change in tensile strength, ±30 %		60	3
50	7	1015	400	Change in ultimate elongation, -50 % max	Volume change, +120 % max	60	3
50	8	1160	500	Change in durometer hardness, ±15 points		80	4
60	7	1015	300			60	3
60	8	1160	400			80	4
70	7	1015	200			60	3

Suffix Requirements		Grade 1 ^A	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8
A19	Heat resistance, Test Method D573 , 70 h at 225°C:								
	Change in hardness, max, points		+10	+10	+15				
	Change in tensile strength, max, %		-40	-40	-50				
	Change in ultimate elongation, max, %		-40	-40	-50				
B37	Compression set, Test Methods D395 , Method B, max, %, 22 h at 175°C		40	45	60				
EA14	Water resistance, Test Method D471 , 70 h at 100°C:								
	Change in hardness, points		±5	±5	±5				
	Change in volume, %		±5	±5	±5				
EO16	Fluid resistance, Test Method D471 , IRM 901 Oil, 70 h at 150°C:								
	Change in hardness, points		0 to -10	0 to -15	0 to -15				
	Change in tensile strength, max, %		-50	-50	-50				
	Change in ultimate elongation, max, %		-30	-50	-50				
	Change in volume, %		0 to +20	0 to +20	0 to +20				
F1-11	Low-temperature resistance, Test Methods D2137 , Method C, 9.3.3, nonbrittle after 3 min at -75°C		pass	pass	pass				
G11	Tear resistance, Test Method D624 , Die B:								
	Under 7.0 MPa load, min, kN/m		5						
	7.0 to 10.5 MPa load, min, kN/m			17	26				
Z	(Special requirements) Shall cover only special rubber material requirements specified in detail, including test methods and aging parameters.								

^A Basic properties only—no suffix requirements for Grade No. 1.

Basic Requirements

Durometer Hardness, ±5 Points	Tensile Strength, min		Ultimate Elongation, min, %	Heat Aged, Test Method D573 , 70 h at 200°C	Oil Immersion, Test Method D471 , IRM 903 Oil, 70 h at 150°C	Compression Set, Test Methods D395 , Solid, max, %, 22 h at 175°C	Available Suffix Grade Numbers
	MPa	psi					
30	3	435	400	Change in tensile strength, ±30 % Change in ultimate elongation, -50 % max Change in durometer hardness, ±15 points	Volume change, +80 % max	60	2
30	7	1015	500				5
40	8	1160	500				3
50	8	1160	500				4

FE MATERIALS

Suffix Requirements		Grade 1 ^A	Grade 2	Grade 3	Grade 4	Grade 5
A19	Heat resistance, Test Method D573 , 70 h at 225°C: Change in hardness, max, points		+10	+10	+15	±10
	Change in tensile strength, max, %		-60	-40	-40	-50
	Change in ultimate elongation, max, %		-60	-60	-60	-50
B37	Compression set, Test Methods D395 , Method B, max, %, 22 h at 175°C		45	50	65	35
EA14	Water resistance, Test Method D471 , 70 h at 100°C: Change in hardness, points		±5	±5	±5	±5
	Change in volume, %		±5	±5	±5	±5
EO16	Fluid resistance, Test Method D471 , IRM 901 Oil, 70 h at 150°C: Change in hardness, points		0 to -10	0 to -10	0 to -10	0 to -10
	Change in tensile strength, max, %		-50	-50	-50	-40
	Change in ultimate elongation, max, %		-50	-50	-50	-40
	Change in volume, %		0 to +20	0 to +20	0 to +20	0 to +20
EO36	Fluid resistance, Test Method D471 IRM 903 Oil, 70 h at 150°C: Change in hardness, max, points				-40	
	Change in volume, %			+ 80	+80	+65
F19	Low-temperature resistance, Test Methods D2137 , Method C, 9.3.3, nonbrittle after 3 min at -55°C		pass	pass	pass	
G11	Tear resistance, Test Method D624 , Die B: Under 7.0 MPa load, min, kN/m		9			
	7.0 to 10.5 MPa load, min, kN/m			22	26	25
P2	Staining resistance, Test Methods D925 , Method B, control panel		pass	pass	pass	
Z	(Special requirements) Shall cover only special rubber material requirements specified in detail, including test methods and aging parameters.					

^A Basic properties only—no suffix requirements for Grade No. 1.

Basic Requirements							
Durometer Hardness, ±5 Points	Tensile Strength, min		Ultimate Elongation, min, %	Heat Aged, Test Method D573 , 70 h at 200°C	Oil Immersion, Test Method D471 , IRM 903 Oil, 70 h at 150°C	Compression Set, Test Methods D395 , Plied, max, %, 22 h at 175°C	Available Suffix Grade Numbers
	MPa	psi					
60	6	870	150	Change in tensile strength, ±30 % Change in ultimate elonga- tion, -50 % max Change in durometer hard- ness, ±15 points	Volume change, +10 % max	50	2

Suffix Requirements		Grade 1 ^A	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8
A19	Heat resistance, Test Method D573 , 70 h at 225°C: Change in hardness, max, points Change in tensile strength, max, % Change in ultimate elongation, max, %		+15 -45 -45						
EF31	Fluid resistance, Test Method D471 , Reference Fuel C, 70 h at 23°C: Change in hardness, points Change in tensile strength, max, % Change in ultimate elongation, max, % Change in volume, %		0 to -15 -60 -50 0 to +25						
EO36	Fluid resistance, Test Method D471 , IRM 903 Oil, 70 h at 150°C: Change in hardness, points Change in tensile strength, max, % Change in ultimate elongation, max, % Change in volume, %		0 to -10 -35 -30 0 to +10						
F19	Low-temperature resistance, Test Methods D2137 , Method C, 9.3.3, nonbrittle after 3 min at -55°C		pass						
Z	(Special requirements) Shall cover only special rubber material requirements specified in detail, including test methods and aging parameters.								

^A Basic properties only—no suffix requirements for Grade No. 1.

Basic Requirements

Durometer Hardness, ±5 Points	Tensile Strength, min		Ultimate Elongation, min, %	Heat Aged, Test Method D573 , 70 h at 225°C	Oil Immersion, Test Method D471 , IRM 903 Oil, 70 h at 150°C	Compression Set, Test Methods D395 , Plied, max, %, 22 h at 175°C	Available Suffix Grade Numbers
	MPa	psi					
30	3	435	300			50	2
30	5	725	400			50	2
30	6	870	400			50	8
40	3	435	200			50	2
40	5	725	300			50	2
40	6	870	300			50	8
50	3	435	200			50	3
50	5	725	250	Change in tensile strength, ±30 %		70	4, 5
50	6	870	250			50	5
50	8	1160	400	Change in ultimate elonga- tion, -50 % max	Volume change, +80 % max	60	9
60	3	435	100				50	3
60	5	725	200	Change in durometer hard- ness, ±15 points		70	4, 5
60	6	870	200			50	5
70	3	435	60			50	6
70	5	725	150			50	7
70	6	870	150			50	5
80	3	435	50			50	6
80	5	725	150			50	7
80	6	870	100			50	5

Suffix Requirements		Grade 1 ^A	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8	Grade 9
A19	Heat resistance, Test Method D573 , 70 h at 225°C:									
	Change in hardness, max, points		+10	+10	+10	+10	+10	+10	+10	+10
	Change in tensile strength, max, %		-25	-25	-30	-25	-25	-25	-25	-30
	Change in ultimate elongation, max, %		-30	-30	-30	-30	-30	-30	-25	-30
B37	Compression set, Test Methods D395 , Method B, max, %, 22 h at 175°C		25	30	50	25	30	30	25	40
EA14	Water resistance, Test Method D471 , 70 h at 100°C:									
	Change in hardness, points		±5	±5	±5	±5	±5	±5	±5	±5
	Change in volume, %		±5	±5	±5	±5	±5	±5	±5	±5
EO16	Fluid resistance, Test Method D471 , IRM 901 Oil, 70 h at 150°C:									
	Change in hardness, points		0 to -10	0 to -15	0 to -15	0 to -15	0 to -15	0 to -15	0 to -10	0 to -10
	Change in tensile strength, max, %		-30	-20	-20	-20	-20	-20	-30	-30
	Change in ultimate elongation, max, %		-30	-20	-20	-20	-20	-20	-20	-30
	Change in volume, %		0 to +15	0 to +10	0 to +15	0 to +10	0 to +10	0 to +15	0 to +15	0 to +10
EO36	Fluid Resistance, Test Method D471 , IRM 903 Oil, 70 h at 150°C:									
	Change in hardness, max, points			-30	-35	-30	-40	-40		-30
	Change in volume, %		+60	+60	+60	+60	+60	+60	+60	+60
F19	Low-temperature resistance, Test Methods D2137 , Method C, 9.3.3, nonbrittle after 3 min at -55°C		pass	pass	pass	pass	pass	pass	pass	pass
G11	Tear resistance, Test Method D624 , Die B: Under 7.0 MPa load, min, kN/m 7.0 to 10.5 MPa load, min, kN/m		5	6	9	9	5	9	9	25
P2	Staining resistance, Test Methods D925 , Method B, control panel		pass	pass	pass	pass	pass	pass	pass	pass
Z	(Special requirements) Shall cover only special rubber material requirements specified in detail, including test methods and aging parameters.									

^A Basic properties only—no suffix requirements for Grade No. 1.

Basic Requirements

Durometer Hardness, ±5 Points	Tensile Strength, min		Ultimate Elongation, min, %	Heat Aged, Test Method D573 , 70 h at 250°C	Oil Immersion, Test Method D471 , IRM 903 Oil, 70 h at 150°C	Compression Set, Test Methods D395 , Plieed, max, %, 22 h at 175°C	Available Suffix Grade Numbers
	MPa	psi					
60	7	1015	200				2, 4, 6
60	10	1450	200				2, 4, 6
60	14	2031	200				2, 4, 6
70	7	1015	175	Change in durometer hardness, ±15 points Change in tensile strength, ±30 % Change in ultimate elongation, -50 % max	Volume change, +10 % max	Compression set, 35 % max	2, 4, 6
70	10	1450	175				2, 4, 6
70	14	2031	175				2, 4, 6
80	7	1015	150				2, 4, 6
80	10	1450	150				2, 4, 6
80	14	2031	150				2, 4, 6
90	7	1015	100				3, 5, 7
90	10	1450	100				3, 5, 7
90	14	2031	100				3, 5, 7

Suffix Requirements		Grade 1 ^A	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8
A1-10	Heat resistance, Test Method D573 , 70 h at 250°C: Change in hardness, max, points Change in tensile strength, max, % Change in ultimate elongation, max, %		+10 -25 -25	+10 -25 -25			+10 -25 -25	+10 -25 -25	
A1-11	Heat resistance, Test Method D573 , 70 h at 275°C: Change in hardness, max, points Change in tensile strength, max, % Change in ultimate elongation, max, %				+10 -40 -20	+10 -40 -20	-5 to +10 -40 -20	-5 to +10 -40 -20	
B31	Compression set, Test Methods D395 , Method B, 22 h at 23°C						15	20	
B37	Compression, set, Test Methods D395 , Method B, max, %, 22 h at 175°C		50	30					
B38	Compression set, Test Methods D395 , Method B, max, %, 22 h at 200°C		50	50	50	50	15	20	
C12	Resistance to ozone, Test Method D1171 , quality retention rating, min, %		no cracks	no cracks	no cracks	no cracks	no cracks	no cracks	
C20	Resistance to outdoor aging, Test Method D1171		no cracks	no cracks	no cracks	no cracks	no cracks	no cracks	
EF31	Fluid resistance, Test Method D471 , Reference Fuel C, 70 h at 23°C: Change in hardness, points Change in tensile strength, max, % Change in ultimate elongation, max, % Change in volume, %		±5 -25 -20 0 to +10	±5 -25 -20 0 to +10	±5 -25 -20 0 to +10	±5 -25 -20 0 to +10	±5 -25 -20 0 to +10	±5 -25 -20 0 to +10	
EO78	Fluid resistance, Test Method D471 , Service Liquid ^B No. 101, 70 h at 200°C: Change in hardness, points Change in tensile strength, max, % Change in ultimate elongation, max, % Change in volume, %		-15 to +5 -40 -20 0 to +15	-15 to +5 -40 -20 0 to +15	-15 to +5 -40 -20 0 to +15	-15 to +5 -40 -20 0 to +15			
EO88	Fluid resistance, Test Method D471 Hatco 7700 ^C 70 h at 200°C: Change in hardness, points Change in tensile strength, max, % Change in ultimate elongation, max, % Change in volume, %						-15 to +5 -40 -20 +25	-15 to +5 -40 -20 +25	
F15	Low-temperature resistance, Test Methods D2137 , Method C, 9.3.3, nonbrittle after 3 min at -25°C		pass			pass	pass		
F17	Low-temperature resistance, Test Methods D2137 , Method C, 9.3.3, nonbrittle after 3 min at -40°C				pass				
Z	(Special requirements) Shall cover only special rubber material requirements specified in detail, including test methods and aging parameters.								

^A Basic properties only—no suffix requirements for Grade No. 1.

^B Service Liquid No. 101—di-2 ethyl hexyl Sebacate (C.A.S. 122-62-3), 99.5 mass %; Phenothiazine (C.A.S. 92-84-2), 0.5 mass %.

^C SAE Fluid No. 2, Stauffer 7700 has been replaced by Hatco 7700.

Basic Requirements						
Durometer Hardness, ±5 Points	Tensile Strength, min		Ultimate Elongation, min, %	Heat Aged, Test Method D573 , 70 h at 300°C	Oil Immersion, Test Method D471 , IRM 903 Oil, 70 h at 150°C	Compression Set, Test Methods D395 , Method B, Plied max, %, 22 h at 200°C
	MPa	psi				
80	11	1595	125	Change in durometer hardness, ±15 points Change in tensile strength, ±30% Change in ultimate elongation, -50% max	Volume change, (+10 % max)	Compression set, 25 % max

^A Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D11-1090.

12. Keywords

12.1 automotive applications; elastomer; rubber

ANNEX

(Mandatory Information)

A1. Statement of Understanding between SAE CARS and ASTM D11.30

A1.1 The SAE Committee on Automotive Rubber Specifications, (CARS), and the ASTM D11.30 committee affirm that we will work together to maintain the SAE J200 and ASTM D2000 specification systems. It is our goal to keep the tables in these two documents equivalent. As such, the SAE CARS will be the gatekeeper of any changes and additions to the tables in these specification systems. They will consider, as necessary, the expansion of current tables or the addition of

new tables based on new rubber materials that will better serve both the rubber industry and their customers. SAE CARS may ask for assistance from ASTM D11.30 to provide the necessary laboratories for performing the required interlaboratory testing. In the unlikely event that SAE CARS declines to make any additions or changes to the tables, then ASTM D11.30 may choose to proceed with making those changes or additions if they deem them as additive for the rubber industry.

APPENDIX

(Nonmandatory Information)

X1. TYPE AND CLASS OF POLYMER USAGE

X1.1 This appendix is intended to assist the users of Classification System D 2000-SAE J200 and is not to be considered as part of the system. **Table X1.1** lists the Classification System D 2000-SAE J200 material designations (type

and class) and the type of polymer most often used in meeting the material requirements (type and class). This table is not intended to be limiting; other polymers may be used to meet the same specification.

TABLE X1.1 Polymers Most Often Used in Meeting Material Requirements

Classification System D2000- SAE J200 Material Designation (Type and Class)	Type of Polymer Most Often Used ^A
AA	Natural rubber, reclaimed rubber, SBR, butyl, EP polybutadiene, polyisoprene
AK	Polysulfides
BA	Ethylene propylene, high-temperature SBR and butyl compounds
BC	Chloroprene polymers (neoprene), cm
BE	Chloroprene polymers (neoprene), cm
BF	NBR polymers
BG	NBR polymers, urethanes
BK	NBR
CA	Ethylene propylene
CE	Chlorosulfonated polyethylene (Hypalon), cm
CH	NBR polymers, epichlorohydrin polymers
DA	Ethylene propylene polymers
DE	CM, CSM
DF	Polyacrylic (butyl-acrylate type)
DH	Polyacrylic polymers, HNBR
EE	AEM
EH	ACM
EK	FZ
FC	Silicones (high strength)
FE	Silicones
FK	Fluorinated silicones
GE	Silicones
HK	Fluorinated elastomers (Viton, Fluorel, etc.)
KK	Perfluoroelastomers

^A Refer to Practice **D1418**.

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