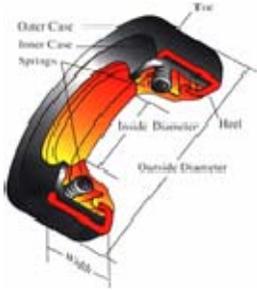


Understanding an ASTM D 2000 “Call Out”



The ASTM D 2000 classification provides a system to standardize the properties of rubber materials. This classification was originally developed for use in the automotive industry but has since become the accepted specification for a variety of industries. The American Society of Testing and Materials (ASTM) “call out” is a useful tool because it ensures rubber material qualities and performance remain consistent across manufacturers. This is advantageous as it gives buyers the flexibility to source elastomeric materials from different manufacturers without compromising quality.

Initially, an ASTM 2000 “call out” may look like a chaotic alphanumeric code, but it can be simplified and broken down into manageable pieces. At the basic level, ASTM D 2000 identifies rubber products based on their resistance to heat ageing and resistance to swelling in oil. In addition to the elastomeric types determined by heat resistance and oil swell, the “call out” also identifies grades or levels of test requirements, hardness and tensile strength. These characteristics will typically help identify the base rubber material. The “call out” will also include a combination of alphanumeric characters at the end of the code, called a suffix, that further define the elastomeric properties.

The following example will assist you in understanding an ASTM “call out”.

ASTM D 2000 - M 5BG 407 A14 B14 E014 E034 F17

The first part of the code identifies the document name. There will typically be a two digit code after the dash that indicates the revision year.

ASTM D 2000 M 5 BG 407 A14 B14 E014 E034 F17

M – the letter “M” indicates the unit of measure, in this case is metric. If no M is present then the standard unit of measure is English units. In this example, for instance, the tensile strength would be measured in megapascals (Mpa) as opposed to the English standard pounds per square inch (psi).

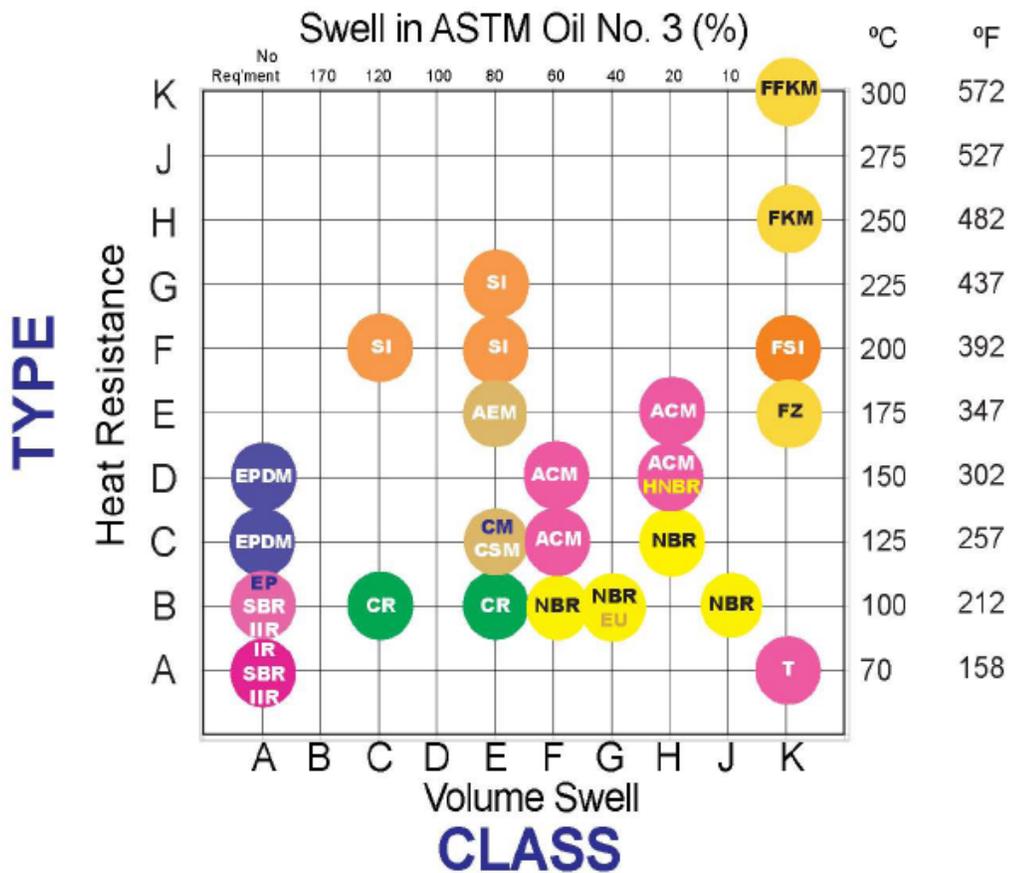
ASTM D 2000 M 5 BG 407 A14 B14 E014 E034 F17

Grade Number – this position in the call out indicates the grade of the material required. A 1 in this position means that only the basic minimum test requirements are needed. Any number 2, 3, ... 8 in this position indicates that additional tests are required. In the above example, the grade requirement is 5, indicating that more tests are required to ensure the correct material is supplied. These tests are outlined in Table 6 of the ASTM document.

ASTM D 2000 M 5 BG 407 A14 B14 E014 E034 F17

Type and Class – the letters in this position indicate the type and class of elastomer. The first letter, in this example **B**, identifies the heat resistance properties of the elastomer. The second letter, in this case **G**, identifies the elastomer based on its oil resistance as measured by percentage volume swell in ASTM Oil # 3. Therefore, in the example above, BG represents an elastomer with heat resistance up to 100C / 212F, and a max volume swell of 40%.

The chart below shows approximately where the basic rubber materials fall based on heat resistance and volume swell. From this chart, the BG code in the example above identifies a nitrile elastomer.

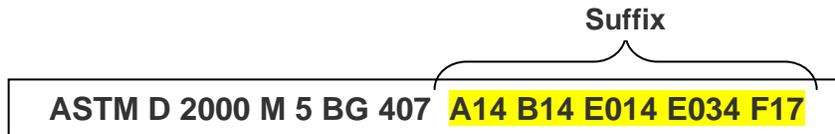


ASTM D 2000 M 5 BG 407 A14 B14 E014 E034 F17

Hardness / Tensile Strength - The next three digits indicates the hardness and minimum tensile strength requirements for the elastomer. The first digit, **4**, identifies the hardness measured in Shore A units +/- 5. The next two digits, **07**, are used to identify

the minimum tensile strength of the elastomer. In the example, the call out identifies an elastomer with an initial Durometer of 40 +/- 5, and minimum tensile strength of 7 MPa. Note, since the unit of measuring for the call out is metric as indicated by the “M” the tensile strength unit of measure is megapascals. If there was no “M” present then the unit of measure would be the English unit PSI (pounds per square inch). The psi conversion is roughly MPa x 145. In the above example 07MPa = 1,015 psi.

The first three codes, Grade, Type/Class and Hardness/Tensile Strength are all that is needed to identify a general material type such as nitrile(NBR) or viton(FKM). Additional requirements and/or performance characteristics of the elastomer will be identified by a suffix appended to the end of the code after the hardness/ tensile strength code. We will continue to use the following example to highlight the additional test requirements.



The test codes are comprised of a suffix letter and two suffix number combinations, e.g **A14**. The suffix letters indicate the property being tested i.e. heat resistance, compression set etc. The first number calls out which ASTM test method to use and second number indicates the temperature the test should be conducted under. If the suffix ends in a Z, this indicates there are special testing requirements called out by the user or third party. Typically, these special requirements indicate a skewed hardness range, more robust criteria than outlined in the ASTM test call out, or simply a color change. Note, the default color code in the call out will be black.

The table below shows the suffix letters used and the test associated with it.

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

The following table shows the test temperature for each test requirement.

Applicable Suffix Requirements	Second Suffix Number	Test Temperature, °C ⁴
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
	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	

⁴ These test temperatures are based on Practice D 1349.

[#] Ambient temperature in the case of outdoor testing.

Using the example above we can broadly define the first suffix call out, **A14** as a heat resistance test “**A**”, per ASTM test method D573 for 70 hrs “**1**”, performed at 100 C “**4**”. For specifics on the suffix test grade, refer to the D 2000 document Table 5.

TABLE 5 ASTM Test Methods

Basic Requirements and First Suffix No.	Basic	1	2	3	4	5	6	7	8	9
Requirement or Suffix Letter										
Tensile Strength, Elongation	D 412, die C	...	...	...	...	...	...	...	...	...
Durometer Hardness, Type A	D 2240	...	...	...	...	...	...	...	...	...
Suffix A, Heat Resistance	...	D 573, 70 h	D 865, 70 h	D 865, 168 h	D 573, 168 h	D 573, 1000 h	D 865, 1000 h	...	...	...

TABLE 5 Continued

Basic Requirements and First Suffix No.	Basic	1	2	3	4	5	6	7	8	9
Suffix B, Compression Set, Standard Test Specimen Cut from a Slab	...	D 395, 22 h, Method B, solid	D 395, 70 h, Method B, solid	D 395, 22 h, Method B, plied	D 395, 70 h, Method B, plied	D 395, 1000 h, Method B, solid	D 395, 1000 h, Method B, plied	...	...	...
Suffix C, Ozone or Weather Resistance	...	D 1171, ozone ^A , exposure, Method A	D 1171, ^B weather	D 1171, ozone ^C , exposure, Method B	...	...	...	...	...	...
Suffix D, Compression-Deflection Resistance	...	D 575, Method A	D 575, Method B	...	...	...	...	...	...	...
Suffix EO, Oil Resistance	...	D 471, ASTM Oil No. 1, ^D 70 h	D 471, ASTM Oil No. 2 ^D , 70 h	D 471, ASTM Oil No. 3 ^D , 70 h	D 471, ASTM Oil No. 1, 168 h	D 471, ASTM Oil No. 2, 168 h	D 471, ASTM Oil No. 3, 168 h	D 471, Service Liquid No. 101, 70 h	D 471, Oil as specifically designated in Table 6, 70 h	...
Suffix EF, Fluid Resistance	...	D 471, Reference Fuel A, 70 h	D 471, Reference Fuel B, 70 h	D 471, Reference Fuel C, 70 h	D 471, Reference Fuel D, 70 h	D 471, Volume Percent Reference Fuel D Plus 15 Volume Percent Denatured Ethanol, 70 h	...	...	...	...
Suffix EA, Aqueous Fluid Resistance	...	D 471, Distilled Water, 70 h ^E	D 471, Equal Parts by Volume Distilled Water-Reagent Grade Ethylene Glycol, 70 h ^F	...	...	...	...	...	...	...
Suffix F, Low-Temperature Resistance	...	D 2137, Method A, 9.3.2, 3 min	D 1053, 5 min, T ₂ , T ₅ , T ₁₀ , T ₅₀ , or T ₁₀₀	D 2137, Method A 9.3.2, 22 h	D 1329, 38.1 mm die, 50 % elongation, retraction 10 % min	D 1329, 38.1 mm die, 50 % elongation, retraction 50 % min	...	...	...	...
Suffix G, Tear Resistance	...	D 624, die B	D 624, die C	...	...	...	...	...	...	...
Suffix H, Flex Resistance	...	D 430, Method A	D 430, Method B	D 430, Method C	...	...	...	...	...	...
Suffix J, Abrasion Resistance
Suffix K, Adhesion	...	D 429, Method A	D 429, Method B	Bond made after vulcanization	...	...	...	...	...	...
Suffix M, Flammability Resistance ^G
Suffix N, Impact Resistance ^G
Suffix P, Staining Resistance	...	D 925, Method A	D 925, Method B Control Panel	...	...	...	...	...	...	...
Suffix R, Resilience	...	D 945	...	...	...	...	...	...	...	...
Suffix Z, Special Requirement ^G

^A Use ozone chamber exposure method of Test Method D 1171, Method A.

^B Test Method D 1171, 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 Method D 1171, Method B.

^D ASTM No. 2 and No. 3 Oils are no longer commercially available. They have been replaced by IRM 902 and 903 Oils, respectively. See 4.4.1. ASTM Oil No. 1, IRM 902 and IRM 903 may be ordered from Penreco, 4426 East Washington Blvd., Los Angeles, CA 90023-4476. They are also distributed by R. E. Carroll, Inc., P.O. Box 5806, Trenton, NJ 08638-0806.

^E 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 ¾ full after specimens are immersed. Determination to be made after 30 min. Cool in distilled water, acetone dip to be omitted.

^F 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 ¾ full after specimens are immersed. Determination to be made after 30 min. Cool in distilled water, acetone dip to be omitted.

^G Test method to be specified.

Again, using the sample call out the following suffix **B14** would refer to a compression set test (suffix B), run in accordance with test method D 395, for 22 hrs (suffix 1), at a temperature of 100C (suffix 4).

Conclusion

The ASTM D2000 is a good gauge to determine the compatibility of materials and ensure consistency across different manufacturers. However, care must be taken because ASTM D 2000 does not identify material compatibility when exposed to aggressive media and environments such as those typically found in the chemical industry. These applications may typically require thermoplastics which are not addressed by the ASTM D 2000 call out. In addition, care must also be taken when

identifying a particular material, as significant performance differences exist between different elastomers. For example, NBRs, CRs and EPDMs have limited performance when compared to high performance elastomers such as fluoroelastomers and perfluoroelastomers. Contact your Colonial Seal Co. at sales@colonialseal.com if you are unsure of the type of material to use for your seal.