

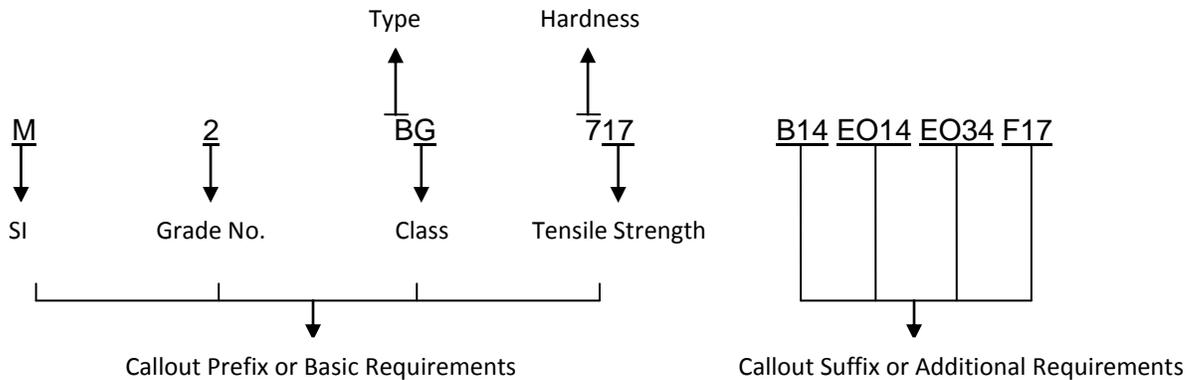


JET Rubber, Inc.

WI-72-02-06	How to Read ASTM D2000 Call-Outs		
Process Owner: Engineering / Quality	Effective Date: 7/14/2015	Rev. A	Pg. 1 of 7
Approved: 7/14/2015 4:28 PM - Maria Alejandra Medina, Operations Engineer			

The ASTM D2000-12 callout format and the meaning of each of its character elements will be explained using, ASTM D2000-03 M2BG 717 B14EO14EO34F17, the ASTM callout for one of our Low Temp Buna 70 compounds:

Format Breakdown



Breakdown of the Alpha and Numeric Character Elements

ASTM D2000-03 M2 BG 717 B14 EO14 EO34 F17

- **ASTM D2000** is the specification standard reference number.
- **-03** represents the year that the ASTM D2000 standard was last revised.

Our material callout was last revised in **2003**.

ASTM D2000-03 **M2 BG 717 B14 EO14 EO34 F17**

- The remaining alpha and numeric characters detail and specify the **“Physical Property Requirements”** for the rubber compound.
- **M2 BG 717**, is known as the callout prefix. It details the “Basic” physical property Requirements for the material.
- When “Basic” physical property requirements are not sufficient to describe the requirements that a rubber elastomer will need for its end-use application or environment, the callout suffix **B14 EO14 EO34**, will list those additional requirements.



ASTM D2000-03 M2 BG 717 B14 EO14 EO34 F17

- The presence of the alpha-character **M** indicates that **SI-Metric units** for tensile (**MPa**) and temperature (**°C**) will be used.
- The absence of the alpha-character **M** indicates that **English units** for tensile (**psi**) and temperature (**°F**) will be used.

Our callout test data will use **SI-Metric units**.

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- The next numeric-character specifies the “**Grade**” of the material and the **scope of test requirements** that will apply to the specification.
- When the Grade is the numeric-character 1, only Callout Prefix or “Basic Requirements” apply.
- When the Grade is a numeric-character 2-9, “Callout “Suffix Requirements” or “Additional Requirements” apply.

Our callout **2** indicates that **additional tests are required**. These requirements are detailed below.

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- The next pair of alpha-characters, **BG**, designates material “Type and Class”.
- The alpha-character, **B**, represents the material “**Type**”.
- ASTM D2000-12 categorizes material Types **based on Temperature Resistance**.
- To determine Temperature Resistance for each Type, specimens are “heat aged” for 70 hours to the test temperatures listed in Table 1.

Table 1 Basic Requirements for Establishing Type by Temperature

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

* Taken from ASTM D2000-12 Standard



- After “heat aging”, test specimens must meet the following criteria:
 - Change in tensile strength: $\pm 30\%$
 - Change in elongation: -50% max
 - Change in hardness: ± 15 points

Our callout **B** indicates that heat aging testing will be conducted at **100°C**.

- The next alpha-character, **G**, represents material “Class”.
- ASTM D2000 categorizes material “Class” based on Oil Resistance. Test specimens are immersed in IRM 903 oil at temperatures listed in “Table 1” for 70 hours, to a maximum testing temperature of 150 °C - as IRM oil will degrade above this temperature.
- After “oil aging”, test specimens must meet the “Volume Swell” criteria listed in Table 2.

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

* Taken From ASTM D2000-12 Standard

Our callout **G** indicates that the Test will be run at **100°C** and have a Maximum Volume Swell after oil aging is **40%**.

- ASTM D2000-12 does not specify rubber compounds by the base materials names of Neoprene, Buna-n, etc.
- Instead, ASTM D2000-12 groups these base materials by “Type and Class” (or Temperature and Oil Resistance) criterion.
- Table X1.1 references the type of polymers most often used for meeting Type and Class material requirements.



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
AA	Natural Rubber, Reclaimed Rubber, SBR, Butyl, EP Polybutadiene, Polyisoprene,
AK	Polysulfides
BA	Ethylene Propylene (EPM), High-Temperature SBR and Butyl Compounds
BC	Chloroprene Polymers (Neoprene)
BE	Chloroprene Polymers (Neoprene)
BF	NBR Polymers (Nitrile)
BG	NBR Polymers (Nitrile), Urethanes
BK	NBR
CA	Ethylene Propylene (EPM)
CE	Chlorosulfonated Polyethylene (Hypalon)
CH	NBR Polymers (Nitrile), Epichlorohydrin Polymers (ECO)
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

* Taken From ASTM D2000-12 Standard

ASTM D2000-12 references **Nitrile** for our material callout **BG**.

ASTM D2000-03 M2 BG **7**17 B14 EO14 EO34 F17

- The numeric character, **7** indicates material hardness or durometer-measured in the Shore A scale +/- 5 points.
- To calculate hardness or durometer, this number is multiplied by 10.

Our callout, **7**, indicates a 65-75 durometer material.

ASTM D2000-03 M2 BG **7****17** B14 EO14 EO34 F17

- The numeric characters, **17**, indicate material tensile strength-stated in MPa (Megapascals).

Our callout **17** indicates a Tensile of **17 MPa**.

To convert MPa to psi multiply by 145.0377. Using this formula: 17 MPa = 2466 psi.



For English unit callouts, these two digits would be multiplied by 100. Using this formula: 17 = 1700 psi.

The Callout Prefix or “Basic Requirements” are finished for our callout.

ASTM D2000-03 M2 BG 717 **B14 EO14 EO34 F17**

B14 EO14 EO34 F17 , our callout suffix, describes the additional requirements that our rubber elastomer will require for its end-use application or environment.

- Callout suffixes are composed of a letter and two-digit number grouping. (Suffix letter followed by two suffix numbers).
- Suffix letters indicate a requirement that is listed in Table 3.

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
J	Abrasion Resistance
K	Adhesion
M	Flammability Resistance
N	Impact Resistance
P	Staining Resistance
R	Resilience
Z	Special Requirements (which shall be specified in detail)

* Taken From ASTM D2000-12 Standard

Our callout **B** indicates a **Compression Set requirement**.

ASTM D2000-03 M2 BG 717 **B14 EO14 EO34 F17**

- The **first suffix “number”**, in our grouping, specifies the **test method and duration of the test**.
- “Table 5 ASTM Methods” in ASTM D2000-12 details all suffix callout compositions and the respective requirements for each grade of polymer. *Only the table portions used to illustrate our callout are included in our illustration.



Table 5 ASTM Methods									
Basic Requirements and First Suffix No.	Basic	1	2	3	4	5	6	7	8
Requirement or Suffix Letter									
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	-	-

*Taken from ASTM D2000-12 Standard

Our first suffix number **1** specifies that the test be run in accordance with **Test D395 Method B for 22 h**, and that the material to be tested is a **solid piece**.

ASTM D2000-03 M2 BG 717 B**14** EO14 EO34 F17

- The second suffix number in our grouping indicates the temperature at which the test is to be run. These temperatures are listed in Table 4.

Applicable Suffix Requirements	Second Suffix Number	Test Temperature, °C
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	Ambient Temp. (Outdoor Testing)
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

* Taken From ASTM D2000-12 Standard



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Our callout 4 indicates that suffix B polymers require a 100°C test temperature.

All callout suffix elements test requirement “criteria” is listed in Table 6.

Table 6 Basic and Supplementary (Suffix) Requirements for Classification of Elastomeric Material									
BG Materials									
Suffix Requirements		Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8
B14	Compression Set, Test Methods D 395, Method B, max, %, 22 h at 100°C	-	25	50	50	25	25	25	-

*Taken From ASTM D2000-12 Standard

Our callout B14 has a 25 % max Compression Set requirement.

Additional Requirements for EO14EO34F17, suffix element grouping:

EO	Fluid Resistance
1	Method D471, IRM 901 Oil, 70 h
4	100°C
Requirements	Change in hardness: -5 to +10 Change in tensile strength, max: -25% Change in ultimate elongation, max: -45% Change in Volume: -10 to +5 %

EO	Fluid Resistance
3	Method D471, IRM 903 Oil, 70 h
4	100°C
Requirements	Change in hardness: -10 to +5 Change in tensile strength, max: -45% Change in ultimate elongation, max: -45% Change in Volume: 0 to +25 %

F	Low-Temperature Resistance
1	D2137, Method C, 9.3.3, 3 min.
7	-40°C
Requirements	Nonbrittle after 3 min.

Our callout lists no “Z” requirements.

“Z” requirements are user defined and should always be clearly specified, and agreed upon by the customer, compounder and the molder.