ASTM D2000

Rubber Classification System

Tutorial

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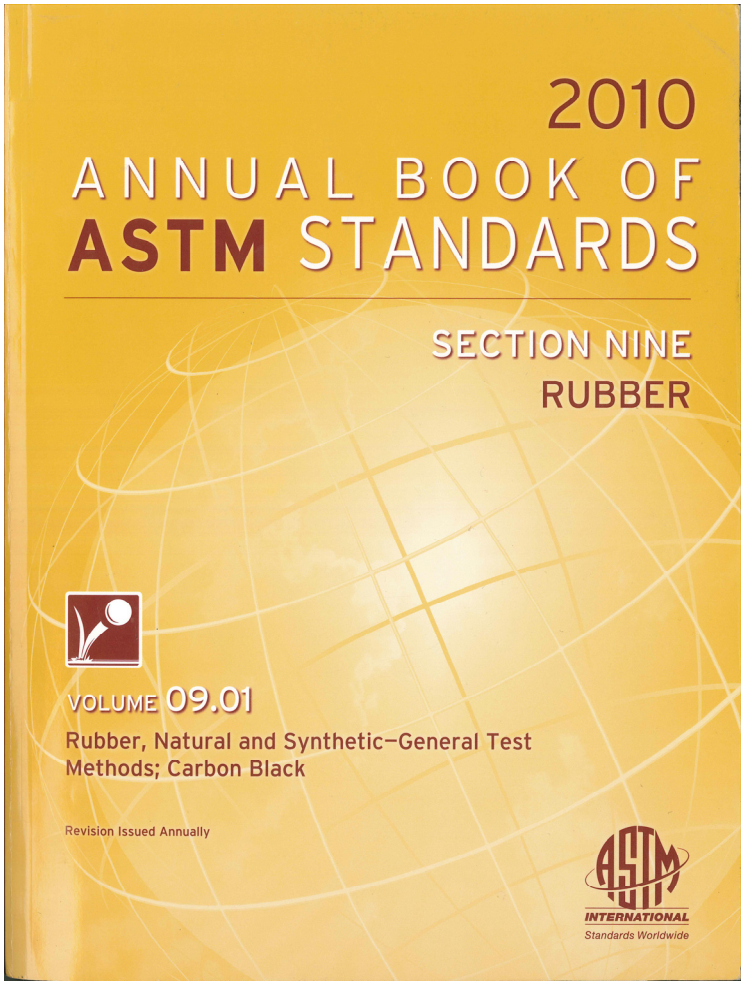
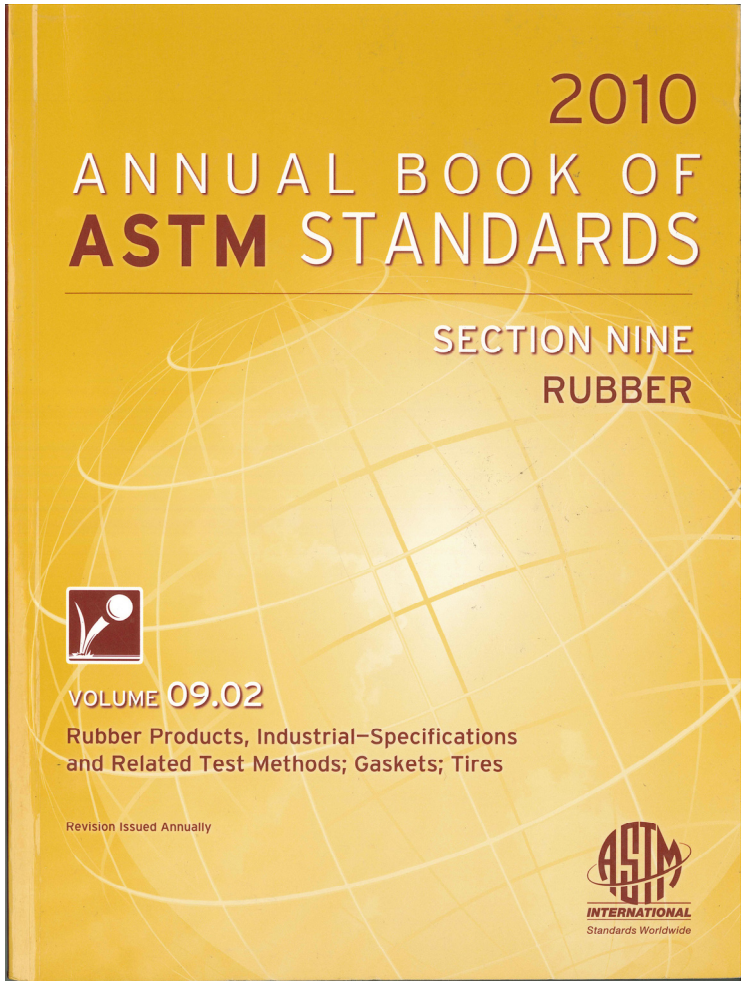
Version 2012

ASTM D 2000

- A standardized system for classifying rubber physical properties.
- The basis for most of our testing methods.
- The backbone of our Product Data Sheets

ASTM Book of Standards
Section 9





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Alphabet Soup?

2 BG 725 B14 B34 EO14 EO34 EF21 EA14

4 CA 720 A25 B35 EA14 F19 G21

7 GE 707 A19 B37 EO16 EO36 EA14 G11 F19

M 6 HK 710 A1-10 A1-11 B31 B38 EO88

These Numbers & Letters are a code

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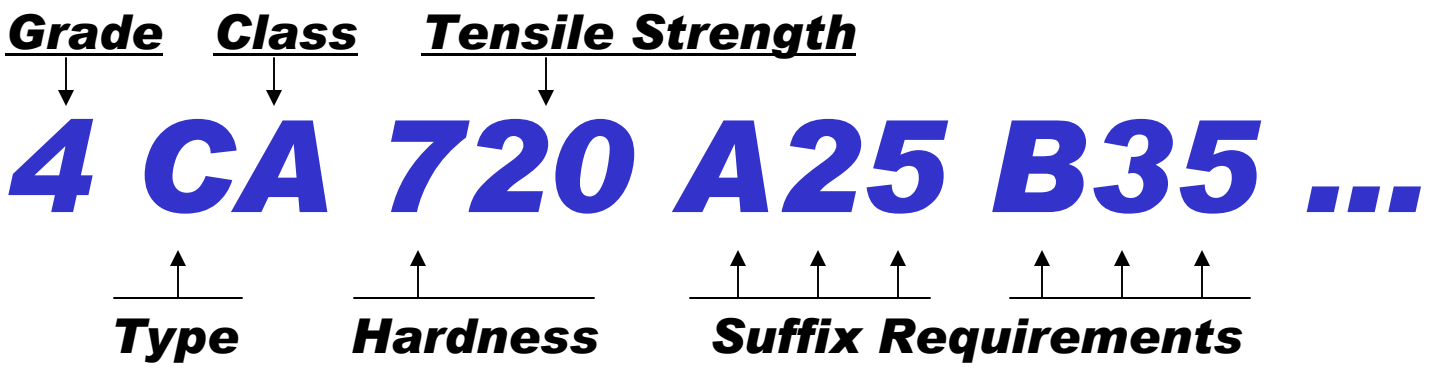
4 CA 720 A25 B35 EA14 F19 G21



M 6 HK 710 A1-10 A1-11 B31 B38 EO88

SI (Indicates MPa Tensile Designation)

M 6 HK 710 A1-10 ...

Basic Requirements for Establishing Type by Temperature

4 CA 720 A25 B35 ...

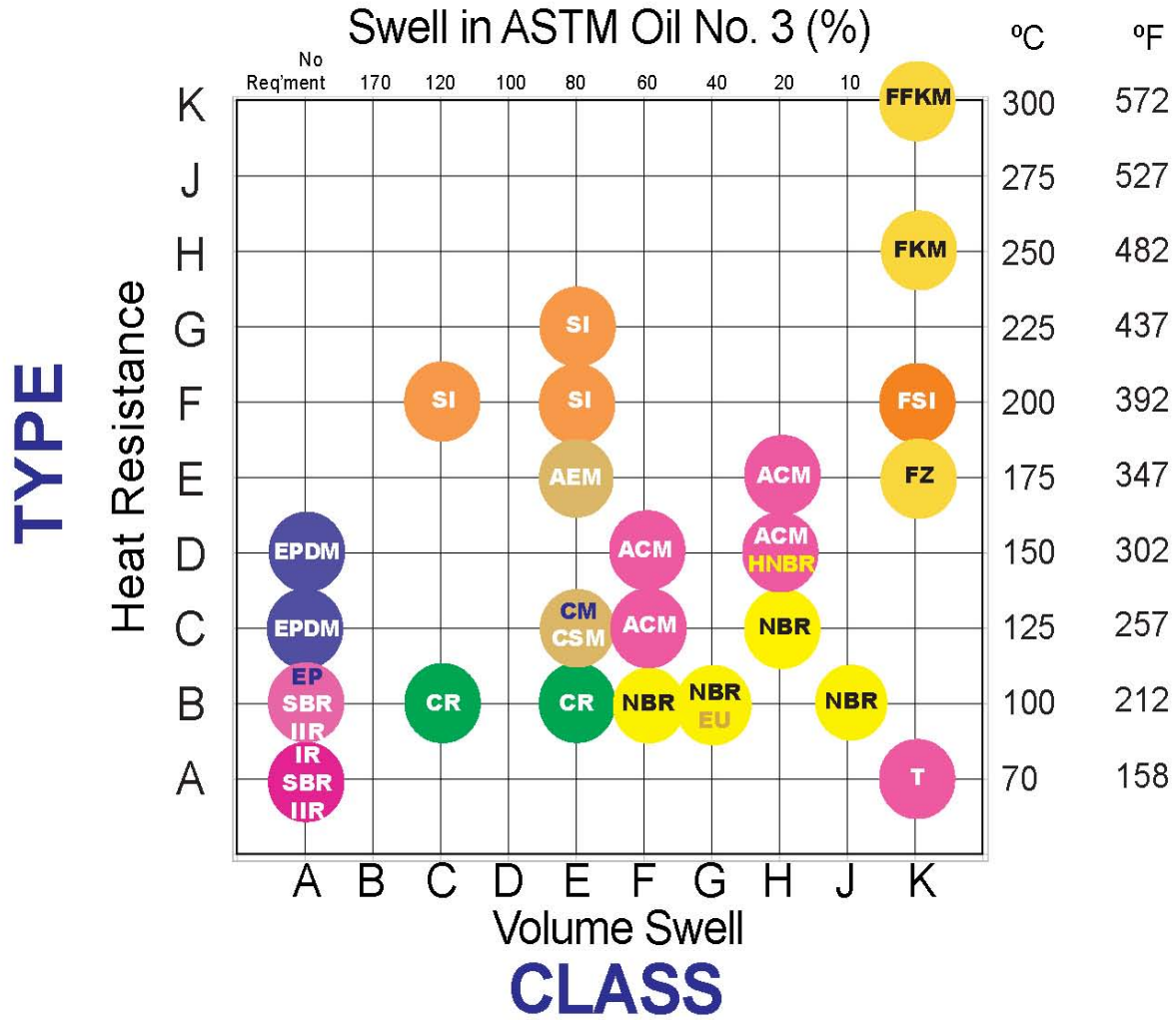
Type	Test Temperature °C	Test Temperature °F
A	70	158
B	100	212
C	125	257
D	150	302
E	175	347
F	200	392
G	225	437
H	250	482
J	275	527

Basic Requirements for Establishing Class by Volume Swell

4 CA 720 A25 B35 ...

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

Polymers Most Often Used In Meeting Material Requirements



Hardness is indicated by a single digit which corresponds to the Durometer

4 CA 720 A25 B35 ...

	Duro			Duro
2	20		6	60
3	30		7	70
4	40		8	80
5	50		9	90

The specification recognizes Duro in multiples of 10 only unless called out specifically

Tensile is indicated by two digits that specify minimum strength at break in psi or MPa

4 CA 720 A25 B35 ...

MPa Designation	MPa	psi	psi Designation	psi
03	3	435	04	400
06	6	870	09	900
07	7	1015	10	1000
08	8	1160	12	1200
10	10	1450	15	1500
12	12	1740	17	1700
14	14	2031	20	2000
17	17	2466	25	2500
21	21	3046	30	3000
24	24	3481	35	3500
28	28	4061	41	4100

Grade Numbers

↓ 4 CA 720 A25 B35 ...

- Grade Numbers are added to specify deviation from, or additions to the basic requirements.

- Only “Available” Grade Numbers may be specified for each Material, Tensile & Hardness

Suffix Requirements

4 CA 720 A25 B35 ...

- Suffixes may be added to indicate additional requirements
- Each suffix indicates a test ***method*** that is consistent for all materials
- The allowable ***result*** for these tests vary by Type, Class, and Grade

MATERIAL TABLE

Basic Requirements

Durometer Hardness, ±5 Points	Tensile Strength, minum Mpa	Tensile Strength, minum psi	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
20	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%			8
60	6	870	250				8
60	7	1015	300				2,8
60	10	1450	350	Change in Ultimate Elongation, -50% max	No Requirement	Compression Set, 50% max	2,3,4,5,6
60	14	2031	400				2,3,4,5,6
60	17	2466	400	Change in Durometer Hardness, ±15 points			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

	Suffix Requirements	Grade 1	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			+10	+10				
	Change in Tensile Strength. Max, %			-25	-25				
	Change in Ultimate Elongation, max, %			-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 A, 9.3.2, nonbrittle after 3 min at -40° C		pass	pass	pass	pass			
F19	Low-Temperature Resistance, Test Methods D2137, Method A, 9.3.2, 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, MPA			7	7	7			
Z	(Special Requirements) Shall cover only special rubber material requirements specidfied in detail, including test methods and aging parameters								

Material Table - Basic Requirements

BA Materials

Basic Requirements

Durometer Hardness, ±5 Points	Tensile Strength, minum		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	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%			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				2,3,4,5,6
60	17	2466	400	Change in Durometer Hardness, ±15 points			2,3,4,5,6
70	3	435	150				8
70	6	870	150				8
70	7	1015	200				2,8

Material Table
Suffix Requirements

		BA Materials							
	Suffix Requirements	**Grade 1**	**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			+10	+10				
	Change in Tensile Strength. Max, %			-25	-25				
	Change in Ultimate Elongation, max, %			-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 A, 9.3.2, nonbrittle after 3 min at -40° C		pass	pass	pass	pass			
F19	Low-Temperature Resistance, Test Methods D2137, Method A, 9.3.2, 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, MPA			7	7	7			
Z	(Special Requirements) Shall cover only special rubber material requirements specidfied in detail, including test methods and aging parameters								

Suffix Letters (Part 1)

4 CA 720 A25 B35 ...

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 & Lubes)
F	Low-Temperature Resistance
G	Tear Resistance

Suffix Letters (Part 2)

Suffix Letter	Test Required
H	Flex Resistance
J	Abrasion Resistance
K	Adhesion
M	Flammability Resistance
N	Impact Resistance
P	Staining Resistance
R	Resilience
Z	Any special requirement, which will be specified in detail

Test Methods

A

Heat Resistance

B

Compression Set

Test Methods

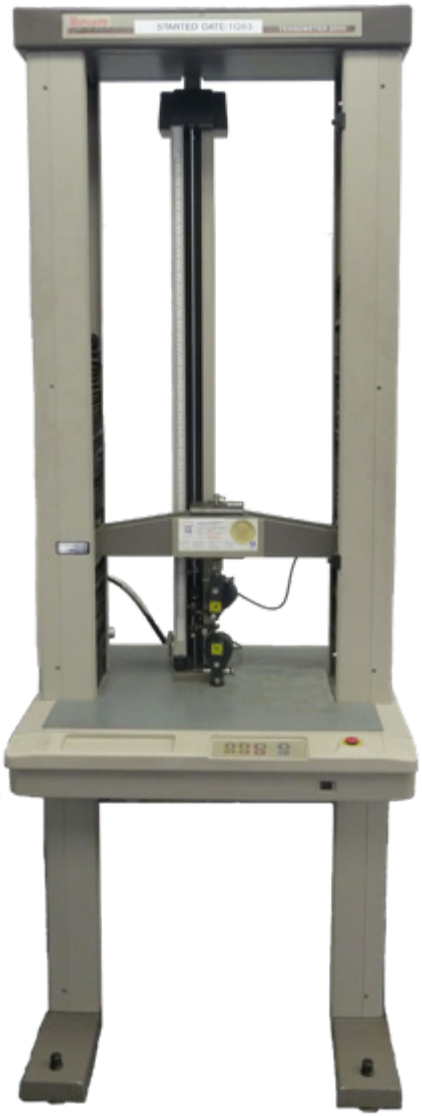
EA, EF, EO

Fluid Resistance

Low Temperature Resistance F

Test Methods

- Change -



Tensile & Elongation

Volume

Suffix Numbers – 1st Number

4 CA 720 A25 B35 ...

The first number defines a specific test and duration dependant on the Suffix Letter and the Grade designated.

The example below is for Suffix Letter A – Heat Resistance

Grade	1	2	3	4	5	6
Suffix A Heat Resistance	D 573 70 hrs	D 865 70 hrs	D 865 168 hrs	D 573 168 hrs	D 573 1000 hrs	D 865 1000 hrs

Suffix Numbers – 2nd Number

4 CA 720 A25 B35 ...

Each number specifies the test temperature dependant on the Suffix Letter designated.

Temperatures applicable to Suffix Designations A, B, C, EA, EF, EO, G, & K												
No	0	1	2	3	4	5	6	7	8	9	10	11
°C	*	23	38	70	100	125	150	175	200	225	250	275
°F	*	70	100	158	212	257	302	347	392	437	482	527

* Ambient Temperature in case of outdoor testing

Suffix Numbers – 2nd Number Continued

4 CA 720 A25 B35 ... F19

Temperatures applicable to Suffix Designation F												
No	1	2	3	4	5	6	7	8	9	10	11	12
°C	23	0	-10	-18	-25	-35	-40	-50	-55	-65	-75	-80
°F	70	32	14	0	-13	-31	-40	-58	-67	-85	-103	-112

Suffix Designations

A19 always equals

Heat Resistance

Test Method D573

70 hours at 225°C

A Suffix without a Type, Class, & Grade is only Test – Not a Result

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Suffix Requirements may Vary by Grade

FE Materials

	Suffix Requirements	Grade 1	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
B13	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 10°C					
	Change in Hardness Points		±5	±5	±5	±5
	Change in Volume %		±5	±5	±5	±5
EO16	Fluid Resistance, Test Method D471 No. 1 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 No. 1 Oil, 70 h at 150°C					
	Change in Hardness, max, points			†	-40	
	Change in Volume, %			+80	+80	+65
F19	Low-Temp. Resistance, Methods D2137, A, 9.3.2, 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, Tst Methods D925, Method B, control panel		pass	pass	pass	

Z Call-Outs

4 CA 720 A25 B35 EA14 F19 G21 Z1 Z2 Z3

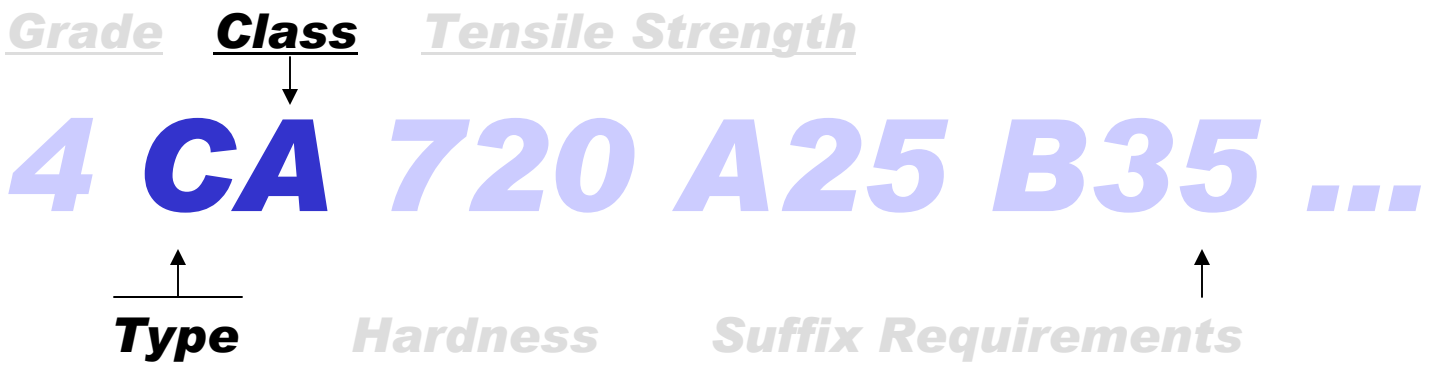
Z1 = EPDM Compound

Z2 = 75 Durometer

Z3 = 10% Max volume swell in DOT 3 Break Fluid, 70 hrs @ 125°C

Review

4 CA 720 A25 B35 EA14 F19 G21



Review

4 CA 720 A25 B35 EA14 F19 G21

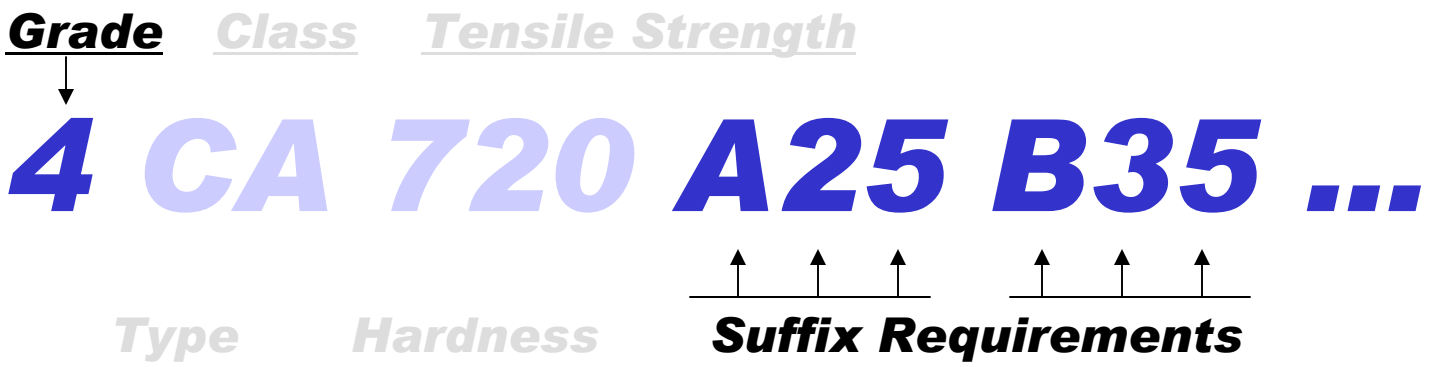
Si — Grade — Class — Tensile Strength

(M) 4 CA 720 A25 B35 ...

Type — Hardness — Suffix Requirements

Review

4 CA 720 A25 B35 EA14 F19 G21



Product Data Sheets

PAI & most other rubber companies report these same test methods on their test reports

Other Considerations

4 BG 830 B14 EO14 F19

will also cover

M 4 BG 821 B14 EO14 F19

4 BG 820 B14 EO14 F19

4 BG 830 B14 EO14

4 BG 830

For compounds that meet many Callouts,
we may not be able to list all of the possible combinations

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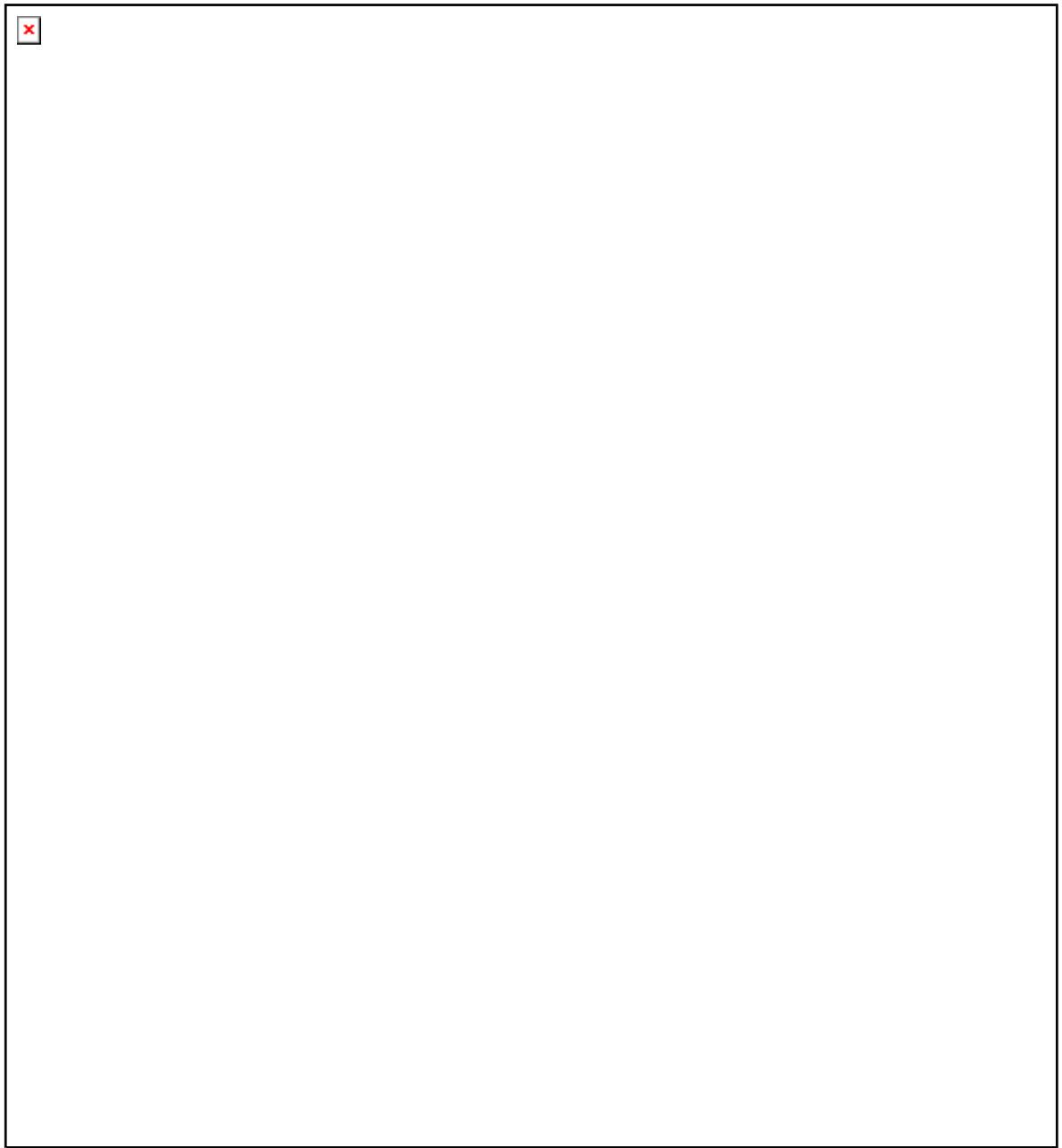

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