SURFACE VEHICLE STANDARD

J2884™	JUN2023
Issued 2009-09 Revised 2023-06 Superseding J2884 JUN2014	

Thermoset Elastomer Specification System

RATIONALE

Routine scheduled review. Minor edits to reflect current materials and specification names.

FOREWORD

An alternate to SAE J200. No global equivalent standard exists.

1. SCOPE

This document provides a method/procedure for specifying the properties of vulcanized elastomeric materials (natural rubber or synthetic rubbers, alone or in combination) that are intended for, but not limited to, use in rubber products for automotive applications.

This document covers materials that do not contain any re-use, recycled, or regrind materials unless otherwise agreed to by manufacturer and end user. The use of such materials, including maximum percent, must be specified using a “Z” suffix.

This classification system covers thermoset High Consistency Elastomers (HCEs) only. Thermoplastic Elastomer (TPE) materials are classified using SAE J2558. Silicone Formed-in Place Gasket (FIPG) systems such as Room Temperature Vulcanized (RTV) Silicones, and Liquid Silicone Rubber (LSR) systems are classified using ASTM F2468.

1.1 Purpose

This classification system is an alternative document to SAE J200.

This document utilizes certain elements of SAE J200, SAE J2236, and SAE J2558 along with new elements to build a line call out without the need for laboratory round robins to generate data for table creation/modification.

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: **http://www.sae.org**

For more information on this standard, visit
https://www.sae.org/standards/content/J2884_202306/

1.2 Document Basis

The basis for a line call out for any material using this document includes:

Elastomer Chemistry
Material Hardness
Tensile Strength
Elongation
Continuous Upper Temperature Resistance (CUTR)
IRM 903 Oil Volume Change

1.3 Requirements and Recommendations

The creator of a line call out, prior to material testing, must have a good grasp of the application requirements and elastomeric material principles.

Certain polymer description and physical property characteristics are required in a line call out and are covered in 1.2 and Section 3. Additional physical property characteristics are discretionary based on the needs of the application and are covered in Section 4.

It is recommended to utilize this document to classify elastomeric materials for specific applications in order to maintain a minimum length line call out.

It is recommended the material manufacturer and the user develop a final line call out for a functioning material based on 30 data points (minimum for statistical analysis) per requirement from six different production batch runs minimum for large scale production.

Development of a line call out for low volume/small scale production in which six different production batch runs may not be feasible. In these cases, development may be based on 20 data points per requirement from at least one production batch and three laboratory lots (or any combination totaling four lots, as long as one production lot is included). If using this alternative, it is recommended that each production lot be validated to the full line call out prior to use.

Production batch runs must be prepared using the production intent equipment parameters (type, size, and other compounding parameters).

Test plaques used for physical property evaluations should, as close as possible, mimic the production process, including state of cure.

1.4 Example Format

The format of examples used in each section/subsection lists the basic requirements along with the applicable suffix requirement. The examples shall resemble as close as possible, real life materials. The portion of the example to be defined for each subsection are shown in bold print.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J200 Classification System for Rubber Materials

SAE J369 Flammability of Polymeric Interior Materials - Horizontal Test Method

SAE J1681 Gasoline, Alcohol, and Diesel Fuel Surrogates for Materials Testing

SAE J2236 Standard Method for Determining Continuous Upper Temperature Resistance of Elastomers

SAE J2558 Classification System for Thermoplastic Elastomers

SAE J2665 Test Procedure to Measure the Fuel Permeability of Materials by the Cup Weight Loss Method

SAE J2979 Test Method for Vulcanized Rubber and Thermoplastic Elastomer Determination of Compressive Stress Relaxation (CSR) Response

2.1.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org

ASTM D297 Test Methods for Rubber Products - Chemical Analysis

ASTM D395 Test Methods for Rubber Property - Compression Set

ASTM D412 Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension

ASTM D430 Test Methods for Rubber Deterioration - Dynamic Fatigue

ASTM D471 Test Method for Rubber Property - Effects of Liquids

ASTM D573 Test Method for Rubber Property - Deterioration in Air Oven

ASTM D624 Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers

ASTM D865 Test Method for Rubber - Deterioration by Heating in Air (Test Tube Enclosure)

ASTM D925 Test Methods for Rubber Property - Staining of Surfaces (Contact, Migration, and Diffusion)

ASTM D1053 Test Methods for Rubber Property - Stiffening at Low Temperatures: Flexible Polymers and Coated Fabrics

ASTM D1149 Test Method for Rubber Deterioration - Surface Ozone Cracking in a Chamber

ASTM D1329 Test Method for Evaluating Rubber Property - Retraction at Lower Temperatures (TR Test)

ASTM D1349 Practice for Rubber - Standard Temperatures for Testing

ASTM D1418 Practice for Rubber and Rubber Latices - Nomenclature

ASTM D2240 Test Method for Rubber Property - Durometer Hardness

ASTM D2632 Test Method for Rubber Property - Resilience by Vertical Rebound

ASTM D6147 Test Method for Vulcanized Rubber and Thermoplastic Elastomer - Determination of Force Decay (Stress Relaxation) in Compression

ASTM D7426 Standard Test Method for Assignment of the DSC Procedure for Determining T_g of a Polymer or an Elastomeric Compound

ASTM F2468 Specifying Silicone Adhesives and Sealants Transportation Applications

2.1.3 ISO Publications

Copies of these documents are available online at https://webstore.ansi.org/.

ISO 3795 Road vehicles, and tractors and machinery for agriculture and forestry—Determination of burning behaviour of interior materials

2.1.4 FMVSS Publications

Available from the Superintendent of Documents, U.S. Government Printing Office, Mail Stop: SSOP, Washington, DC 20402-9320.

FMVSS 302 Flammability of Interior Materials

3. BASIC REQUIREMENTS

Basic requirements must be specified in all line call outs. The basic requirements of a line call out contain a series of letters to describe the Elastomer Chemistry followed by ten numbers to describe the various basic physical properties of the elastomer system. A space must be left between the acronym(s) and 1st number set, and each subsequent number set that is used in describing a property.

3.1 Specifying Basic Physical Properties

Basic requirements must be specified as *Non-Zero* letters/values.

IRM 903 is the only exception since non-polar materials are *not* expected to have resistance to volume swell in non-polar oils such as the IRM 903 (also the Fluid Aging Property Change Table in 4.4.3 *does* allow a “0” indicating “No Requirement”). Polar materials will have a measure of IRM 903 oil resistance and must contain a non-zero value.

No zeros (0s) may be used as place holders for any other basic requirement.

In a line call out, the aged portion (168 hour volume change in IRM 903 Oil) cannot be modified by suffix requirements (EOC). If used, an EOC suffix requirement is in *addition* to the basic requirements.

3.1.1 Elastomer Chemistry

This is specified using the appropriate acronym(s) as listed in the table in 3.2.

3.1.2 Hardness, Type A Durometer

Expressed as Points ± 5 per ASTM D2240 – 1st and 2nd numbers.

NOTE: *Delay used in readings is a common source of correlation between laboratories. Materials tested and specified using this document must follow ASTM D2240, which specifies a delay of 1 second ± 0.1 second as the default delay, unless an alternate delay is agreed on between supplier and user, and specified using a “Z” (i.e., Z_n = ASTM D2240 determined using a 5 second delay).*

3.1.3 Tensile Strength

Expressed as MPa minimum per ASTM D412 Die C – 3rd and 4th numbers. For this basic requirement only, tensile requirements less than 10 MPa may be expressed using a decimal. As such as a tensile requirement of 8.5 MPa would be allowable, but 11.7 MPa would not, unless done so using a “Z” Special Requirements modifier.

3.1.4 Ultimate Elongation

Expressed as % minimum per ASTM D412 Die C – 5th, 6th, and 7th numbers.

3.1.5 Continuous Upper Temperature Resistance (CUTR) as Determined per SAE J2236

8th and 9th number representing temperature from the “Aging Duration and Temperature” table in Section 4.

3.1.6 IRM 903 Oil Aged Volume Change

Expressed as % maximum taken from the “Fluid Aging Property Change Table - Volume Change” column in 4.4.3. Material aged for 168 hours at 150 °C. If the material CUTR is less than 150 °C, the aging shall be done at the CUTR - 10th number.

3.2 Specifying Elastomer Chemistry

Table 1 lists the elastomer acronyms per ASTM D1418 with the corresponding reference to their generic material names.

Table 1 - ASTM D1418 acronyms and generic material description

Acronym	Elastomer Generic Name	Acronym	Elastomer Generic Name
ACM	Polyacrylate	FKM (3)	Vinylidene Fluoride – Tetrafluoroethylene – Fluorinated Vinyl Ether Terpolymer
AEM	Ethylene Acrylate	FKM (4)	Vinylidene Fluoride – Tetrafluoroethylene – Propylene Terpolymer
AFMU	Tetrafluoroethylene – Trifluoronitrosomethane – Nitrosoperfluorobutyric Acid Terpolymer	FKM (5)	Hexafluoropropylene – Vinylidene Fluoride – Tetrafluoroethylene – Fluorinated Vinyl Ether – Ethylene Pentapolymer
ANR	Acrylonitrile Acrylate (Ethyl or other) Co-polymer	FVMQ	Fluoro Vinyl Methyl Silicone (Fluorosilicone Rubber)
AU	Polyester Urethane	FZ	Fluoroalkoxyphosphazene
BIIR	Bromo-Isobutene-Isoprene Rubber	GECO	Epichlorohydrin – Ethylene Oxide – Allyl Glycidyl Ether Terpolymer
BIMSM	Brominated Isobutylene p-Methylstyrene Copolymer	GPO	Propylene Oxide – Allyl Glycidyl Ether Copolymer
BR	Butadiene Rubber	HNBR	Hydrogenated Acrylonitrile Butadiene Rubber
CFM	Polychloro-Trifluoro-Ethylene	IIR	Isobutene – Isoprene Rubber
CIIR	Chloro-Isobutene-Isoprene Rubber	IR	Isoprene Rubber
CM	Chloro-Polyethylene	MQ	Methyl Silicone Rubber
CO	Polychloromethyl Oxirane (Epichlorohydrin)	NBR	Acrylonitrile Butadiene Rubber
CR	Chloroprene Rubber	NIR	Acrylonitrile – Isoprene Copolymer
CSM	Chloro-Sulfonyl-Polyethylene	NR	Natural rubber
ECO	Ethylene Oxide-Chloromethyl Oxirane (Epichlorohydrin Copolymer)	NRG	Guayule Natural Rubber
ENR	Epoxidized Natural Rubber	PBR	Vinylpyridine – Butadiene Copolymer
ENRG	Epoxidized Guayule Natural Rubber	PMQ	Phenyl Methyl Silicone Rubber
EOM	Ethylene Octene Copolymer	PSBR	Vinylpyridine – Styrene - Butadiene Terpolymer
EOT	Ethylene Polysulfide Ether	PVMQ	Phenyl Vinyl Methyl Silicone Rubber
EPDM	Ethylene Propylene Diene Terpolymer	PZ	Phenoxyphosphazene Rubber
EPM	Ethylene Propylene Copolymer	RBR	Reclaim
EU	Polyether Urethane	SBR	Styrene Butadiene Rubber
EVM	Ethylene Vinyl Acetate Copolymer	SIR	Styrene – Isoprene Rubber
FEPM	Tetrafluoroethylene – Propylene Copolymer, or Tetrafluoroethylene – Perfluorinated Vinyl Ether – Ethylene Terpolymer	T	Polysulfide Rubber
FMQ	Fluoromethyl Silicone	VMQ	Methyl Silicone Rubber
FFKM	Perfluoroelastomer	XBR	Carboxylic – Butadiene Rubber
FKM (1)	Hexafluoropropylene – Vinylidene Fluoride Copolymer	XNBR	Carboxylic – Acrylonitrile - Butadiene Rubber
FKM (2)	Hexafluoropropylene – Vinylidene Fluoride – Tetrafluoroethylene Terpolymer	XSBR	Carboxylic – Styrene - Butadiene Rubber

3.2.1 Single Elastomer Systems

Single Elastomer Chemistry Systems are designated by use of one acronym at the beginning of a line call out.

Example:

EPDM 58 10 275 10 0

EPDM = Ethylene Propylene Diene Terpolymer (per Table 1).
58 = 58 ± 5 points Type A Hardness ASTM D2240 Type A.
10 = 10 MPa Tensile Strength minimum ASTM D412 Die C.
275 = 275% Ultimate Elongation minimum ASTM D412 Die C.
10 = 150 °C CUTR (per the “Aging Duration and Temperature” table in Section 4) SAE J2236.
0 = No Requirement (per the “Fluid Aging Property Change Table - Volume Change” column in 4.4.3).

Example (Showing Tensile less than 10 MPa):

EPDM 58 8.5 275 10 0

EPDM = Ethylene Propylene Diene Terpolymer (per Table 1).
58 = 58 ± 5 points Type A Hardness ASTM D2240 Type A.
8.5 = 8.5 MPa Tensile Strength minimum ASTM D412 Die C.
275 = 275% Ultimate Elongation minimum ASTM D412 Die C.
10 = 150 °C CUTR (per the “Aging Duration and Temperature” table in Section 4) SAE J2236.
0 = No Requirement (per the “Fluid Aging Property Change Table - Volume Change” column in 4.4.3).

Example:

ACM 55 07 175 10 5

ACM = Polyacrylate (per Table 1).
55 = 55 ± 5 points Type A Hardness ASTM D2240 Type A.
07 = 7 MPa Tensile Strength minimum ASTM D412 Die C.
175 = 175% Ultimate Elongation minimum ASTM D412 Die C.
10 = 150 °C CUTR (per the “Aging Duration and Temperature” table in Section 4) SAE J2236.
5 = 25% Volume Change maximum in IRM 903 oil after 168 hours at 150 °C (per the “Fluid Aging Property Change Table - Volume Change” column in 4.4.3) ASTM D471.

3.2.1.1 Single Elastomer System – Fluorocarbon Elastomers

Fluorocarbon elastomers are sub-divided into five types. The type shall be included in the line call out in parentheses immediately following the acronym.

NOTE: All basic requirement fields must be occupied. Only the bolded portion of the line call out pertinent to this section is defined in the following examples.

Example:

FKM(3) *75 10 140 14 1*

FKM = Fluorocarbon (per Table 1).
(3) = Chemistry based on Vinylidene Fluoride – Tetrafluoroethylene – Fluorinated Vinyl Ether Terpolymer (per Table 1).

3.2.2 Multiple Elastomer Systems – Blends

The elastomers shall be listed in order of highest to lowest ratio.

A formulation must contain at least 7 Parts per Hundred Rubber (PHR) of any component, based on total elastomer content, to be considered a blend.

Example – Compound Ingredient versus Blend:

SBR (95 PHR) and BR (5 PHR) per definition within this document ***is not*** considered a blend, only as a compound ingredient, and is not to be indicated in the line call out. The call out would be written as:

SBR *70 07 200 05 0*

If the BR level was adjusted to 7 PHR or higher, it would be considered a blend and would be shown as:

SBR/BR *70 07 200 05 0*

3.2.2.1 Two Elastomer Systems

Example – Blend of Two Elastomers of Differing Ratios:

Blend of NR (60 PHR) and BR (40 PHR) shall be shown in the line call out as:

NR/BR *50 10 400 05 0*

NR/BR = Natural Rubber (highest ratio)/Butadiene Rubber (Lowest ratio).

In the case of an elastomer blend of the same ratio, the elastomers shall be listed in alphabetical order with a forward slash (“/”) separating them.

Example – Blend of Two Elastomers of the Same Ratio:

Blend of NR (50 PHR) and BR (50 PHR) shall be shown in the line call out as:

BR:NR *50 10 400 05 0*

BR:NR = Butadiene Rubber, Natural Rubber blend of equal ratio.

3.2.2.2 Three or More Elastomer Systems

Systems that are a blend of three or more elastomers follow the same ratio rules as *Two Elastomer Systems.*

Example – Blend of Three Elastomers:

Blend of NR (60 PHR), SBR (30 PHR), BR (10 PHR), shall be shown in the line call out as:

NR/SBR/BR *50 10 400 05 0*

NR/SBR/BR = Natural Rubber (highest ratio)/Styrene Butadiene Rubber (next highest ratio)/Butadiene Rubber (lowest ratio).

4. SUFFIX REQUIREMENTS

All additional desired physical property change requirements must be specified by a suffix.

All suffix requirements are *optional*. It is recommended to use ***only*** those suffix requirements that relate to the component application to avoid excessively large line call outs.

The examples shown in the following subsections represent actual production materials. To keep the examples concise, they contain the basic requirements and the suffix requirement applicable to that subsection. Only the suffix requirement (shown in bold print) is defined by each example.

Table 2 presents available optional suffix requirements along with the applicable subsections.

Table 2 - Suffix requirements

Physical Property Parameter	Suffix Letter	Subsection
Elevated Temperature Aging	AV/AT	4.1
Compression Set	BP/BS	4.2
Ozone Resistance	C	4.3
Fluid Resistance – Aqueous	EA	4.4
Fluid Resistance – Fuel	EF	4.4
Fluid Resistance – Fuel Permeation	EP	4.4
Fluid Resistance – Oils	EO	4.4
Low Temperature Properties	F	4.5
Tear Strength	GB/GC/GT	4.6
Flammability Resistance	M	4.7
Staining Resistance	P	4.8
Dynamic Fatigue	QA/QB/QC	4.9
Resilience	R	4.10
Specific Gravity	SG	4.I1
Compression Stress Relaxation	SR	4.12
Tensile Stress/Modulus	TM	4.13
Special Requirements	Z	4.14

Table 3 provides generic time and temperature definitions used in room temperature or elevated temperature sample aging (suffix's starting with "A," "B," "C," "E," or "SR"). The 1st number defines aging duration. Section 4.12 explains method to indicate additional intermittent data points for Suffix "SR". The 2nd and 3rd numbers define aging temperature with a ±2 °C tolerance per ASTM D1349.

Table 3 - Aging duration and temperature

1st Number	Aging Duration (Hours)(1)		2nd and 3rd Number	Temperature (°C)
1	22		01	23
2	70		02	40
3	168		03	55
4	336		04	60
5	504		05	70
6	1008		06	85
7	2016		07	100
8	3024		08	125
9	As Specified		09	135
			10	150
			11	160
			12	175
			13	200
			14	225
			15	250
			16	275
			17	300
			99	As Specified(2)

(1) Durations of 70 hours or less are typically used for continued conformance testing. Durations longer than 70 hours are typically used as an R&D tool to develop material degradation versus time charts, not continued conformance certification, and shall not be used as such unless agreed to by manufacturer and user. 1008 hour elevated temperature aging is required for in order to classify basic requirements of a material per Section 3.

(2) A 99 shall be used to indicate “EA” suffix agings done at reflux unless otherwise specified by use of a different standard temperature or a “Z” suffix.

4.1 Elevated Temperature Aging (Suffix Letters AV and AT)

An “A” as the first letter of a suffix sequence indicates a requirement for physical properties after elevated temperature aging. The second letter represents the ASTM aging method.

“V” as the second letter indicates ASTM D573 as the aging method, which is based on circulating the hot air directly on and around the test sample. For example, “**AV**” would be defined as:

A = Elevated Temperature Aging (per Table 2).
V = Method is ASTM D573.

“T” as the second letter indicates ASTM D865 as the aging method, which is based on the elevated temperature aging done with the samples in a test tube. For example, “**AT**” would be defined as:

A = Elevated Temperature Aging (per Table 2).
T = Method is ASTM D865.

More than one aging duration, or temperature classification may be used in a line call out.

The fourth, fifth, and sixth numbers used to designate the actual temperature aging property change limits appear in Table 4.

Table 4 - Temperature aging property change table

Number	Property	0	1	2	3	4	5	6	7	8	9
4th	Hardness Change, points, Type A	No Requirement	±5	±10	±15	±20					As Specified
5th	Tensile Strength Change, %	No Requirement	-10	-15	-20	-25	-30	-35	-40	-50	As Specified
6th	Elongation Change, %	No Requirement	-15	-20	-25	-30	-35	-40	-45	-50	As Specified

NOTE: *All basic requirement fields must be occupied. Only the bolded portion of the line call out pertinent to this section is defined in the following examples.*

Example:

EPDM 58 10 275 10 0 ***AV 2 10 2 2 2***

A = Elevated Temperature aging (per Table 2).
V = Method is ASTM D573 (per Table 2).
2 = 70 hours Aging Duration (per Table 3).
10 = 150 °C Aging Temperature (per Table 3).
2 = ±10 points Type A Durometer Hardness change (per Table 4).
2 = -15% Tensile Change Maximum (per Table 4).
2 = -20% Elongation Change Maximum (per Table 4).

Example:

ACM 55 07 175 10 5 ***AV 3 10 2 1 1***

A = Elevated Temperature aging (per Table 2).
V = Method is ASTM D573 (per Table 2).
3 = 168 hours Aging Duration (per Table 3).
10 = 150 °C Aging Temperature (per Table 3).
2 = ±10 points Type A Durometer Hardness change (per Table 4).
1 = -10% Tensile Change Maximum (per Table 4).
1 = -15% Elongation Change Maximum (per Table 4).

4.2 Compression Set (Suffix Letter BP and BS)

The letter “B” used in the first in a suffix sequence indicates a compression set requirement per ASTM D395 Method B. The second letter indicates the type of sample to be tested:

“P” as the second letter indicates compression set evaluations are to be conducted using plied specimens cut from ASTM tensile plaques, or if possible, directly from the production part (i.e., skived hose). For example, “**BP**” would be defined as:

B = Compression Set per ASTM D395, Method B.
P = Use Plied Specimens.

“S” as the second letter indicates compression set evaluations are to be conducted using solid specimens. For example, “**BS**” would be defined as:

B = Compression Set per ASTM D395 Method B.
S = Use Solid Specimens.

The suffix letters shall be followed by five numbers.

The 1st number shall identify the aging duration and the 2nd and 3rd numbers shall indicate the aging temperature per Table 3.

The 4th and 5th numbers shall directly indicate the maximum % compression set.

NOTE: All basic requirement fields must be occupied. Only the bolded portion of the line call out pertinent to this section is defined in the following examples.

Example:

EPDM 58 10 275 10 0 ***BP 2 08 25***

B = Compression Set (per Table 2).
P = Use Plied Specimens.
2 = 70 hours Aging Duration (per Table 3).
08 = 125 °C Aging Temperature (per Table 3).
25 = 25% Compression Set Maximum.

Example:

NR 40 18 550 05 0 ***BS 1 05 25***

B = Compression Set (per Table 2).
S = Use Solid Specimens.
1 = 22 hours Aging Duration (per Table 3).
05 = 70 °C Aging Temperature (per Table 3).
25 = 25% Compression Set Maximum.

4.3 Ozone (Suffix Letter C)

Resistance to ozone shall begin with a “C” followed by two numbers. The 1st number indicates the exposure duration per Table 3. The 2nd number indicates the ASTM D1149 method and procedure per Table 5.

Table 5 - ASTM D1149 ozone

Number	Method and Procedure
1	Method B, Procedure B4
2	Method B, Procedure B2

All ozone testing, unless agreed to by manufacturer and user, shall be done at a default partial pressure of 50 MPa at a chamber temperature of 38 °C.

Typical exposure periods are 70 and 336 hours. 568 hours is the exposure period to certify fuel components supplied under the California Air and Resources Board regulations, but is not a standard ASTM test duration, and must be specified by use of a “Z” (see 4.14).

The requirement for all methods shall be “No Visible Cracks” and shall be based on a 2X magnification.

NOTE: All basic requirement fields must be occupied. Only the bolded portion of the line call out pertinent to this section is defined in the following examples.

Example:

EPDM 58 10 275 10 0 ***C 3 2***

C = Ozone (per Table 2).
3 = 168 hours Aging Duration (per Table 3).
2 = Method B, Procedure B2 of ASTM D1149 (per Table 5).

Example:

CPE 70 9.7 200 08 8 ***C 2 2***

C = Ozone (per Table 2).
2 = 70 hours Aging Duration (per Table 3).
2 = Method B, Procedure B2 of ASTM D1149 (per Table 5).

4.4 Fluid Resistance (Suffix Letters EA, EF, EO, EP, ER)

NOTE: Aging oils, fuels, coolants, and refrigerants at elevated temperatures can create dangerous situations due to fire hazards or high pressures. It is the responsibility of the user of this standard to refer to proper safety procedures based on fluid SDS and data sheets, equipment, and surrounding test environments when setting up, aging and preparation for property evaluation. SAE International and members of the Committee on Automotive Rubber Specifications do not provide these procedures and do not assume any liability for equipment and/or facility damage, injury or death when aging materials for evaluation to this or any other section of this elastomer classification system.

4.4.1 Designating Aging Fluid – Oils, Lubes, Friction Modifiers, Refrigerants, and Coolants (Suffix Letters EA, EO, and ER)

Fluid resistance (EA, EO, and ER) shall be defined by three letters to indicate the method, the media category, and the specific fluid type.

The first two letters are defined as follows:

EA = Aqueous media aging per ASTM D471.
EO = Oil or Lubricant media aging per ASTM D471.
ER = Air Conditioning refrigerant aging per ASTM D471.

The third letter indicates the specific fluid within the media category. In all cases the “OEM” is defined as the applicable Original Equipment Manufacturers factory fill fluid type.

Aging in refrigerants will require pressure vessels.

Fluids are defined in Table 6:

Table 6 - Fluid type

	SUFFIX LETTERS		
Letter[1]	EA	EO	ER
A	Distilled Water	IRM 901 Oil	OEM Refrigerant[3]
B	Distilled Water 50%/ Ethylene Glycol 50%	IRM 902 Oil	
C	Distilled Water 50%/ OEM Coolant 50%[2],[3]	IRM 903 Oil	
D		Service Liquid 107	
E		OEM Engine Oil[3]	
F		OEM Transmission Oil[3]	
G		OEM Power Steering Oil[3]	
H		OEM A/C Compressor Oil[3]	
I	Not Used	Not Used	Not Used
J		OEM Gear Lubricant[3]	
K		OEM Gear Lubricant[3] + OEM Friction Modifier[4]	
L		OEM Brake Fluid[3]	
M		OEM Grease[3]	
Z			

1. Each letter designating for OEM fluids must include a number subscript, in case of multiple fluids of the same letter designation used in the call out.
2. Ratio can be varied by use of a “Z” Suffix, such as: Z=EAC coolant 45%/water 55%.
3. Type of fluid or lubricant to be as specified by OEM.
4. Level and type of Friction Modifier shall be as specified by OEM.

These suffix letters are followed by seven numbers indicating the aging duration, temperature, and physical property change limits defined in 4.4.3.

Unless otherwise specified, “EA” suffix agings shall be done at reflux and shall be indicated by use of a “99” per Table 3, footnote 2.

NOTE: All basic requirement fields must be occupied. Only the bolded portion of the line call out pertinent to this section is defined in the following examples.

Example:

EPDM 58 10 275 10 0 ***EA C_1 3 99 3 5 7 4; C_1 = MS.90032***

EA = Fluid Aging, Aqueous (per Table 2).
C_1 = Distilled Water/OEM Coolant at 50/50 Ratio (per Table 6). Coolant is defined as Chrysler MS-9769 per line call out.
3 = 168 hours Aging Duration (per Table 3).
99 = As specified, at Reflux (per Table 3, footnote 2).
3 = ±10 points Durometer Hardness Change (see 4.4.3).
5 = -30% Tensile Change Maximum (see 4.4.3).
7 = -40% Elongation Change Maximum (see 4.4.3).
4 = +20% Volume Change Maximum (see 4.4.3).

4.4.2 Designating Aging Fluid – Fuels (Suffix Letters EF and EP)

Aging of fuels above 23 °C can utilize approved reflux apparatus or pressure vessels. Consult your company safety officer for direction.

“EF” suffix uses physical property changes in hardness, tensile strength, elongation, and volume change as characteristic property limits.

“EP” suffix requires fuel permeation characterization per SAE J2665.

Fuels and fuel blends shall use designations from SAE J1681.

A given test fuel shall be designated in a line call out using the formula:

$$X\ (Y_1\%)\ (Y_2\%)\ (Y_n\%)\ S \qquad \text{(Eq. 1)}$$

where:

“X” = base hydrocarbon fuel

“Y_1” through “Y_n” = oxygenate (use and number of oxygenates is optional)

“S” = optional minor constituents

Available “X,” “Y,” and “S” constituents are defined in Table 7.

Table 7 - Fuel constituents

Formula Letter	Line Call Out Designation	Fuel Definition
X	A	ASTM Fuel A
	B	ASTM Fuel B
	C	ASTM Fuel C
	D_{EPA2}	EPA Certification No. 2 low sulfur reference diesel fuel.
Y	M	Methanol
	E	Ethanol
	ME	Methyl Tertiary-Butyl Ether
	EE	Ethyl Tertiary-Butyl Ether
	TE	Tertiary-Amyl Methyl Ether
	RME(1)	Rapeseed Methyl Esters
	SME(1)	Soybean Methyl Esters
S	P -	Organic Peroxide – Tertiary-Butyl Hydro Peroxide (TBHP) – 50 mMol per liter of test fluid (i.e., would require 6.43 grams of a 70% TBHP solution). 0.01 mg of $Copper^{+1}$ Ion should be added to the solution to facilitate decomposition of the peroxide into free radicals. Cuprous ion should be added after adequately blending the TBHP into the fuel. Mixing the Cuprous ion into the concentrated TBHP is ***NOT*** recommended.

(1) Source of RME and SME for characterization in a line specification must be agreed to by material manufacturer and end user.

NOTE: *All basic requirement fields must be occupied. Only the bolded portion of the line call out pertinent to this section is defined in the following examples.*

Example:

FKM(3) 75 10 140 14 1 ***EF CE15 3 04 3 5 7 4***

EF = Fuel Resistance (see Table 2).
C = Reference Fuel C, 85% by volume, based on the oxygenate specified as 15% (see Table 7).
E(15) = Ethanol, 15% by volume (see Table 7).
3 = 168 hours Aging Duration (see Table 3).
04 = 60 °C (see Table 3).
3 = ±10 points Durometer Hardness Change (see 4.4.3).
5 = -30% Tensile Change Maximum (see 4.4.3).
7 = -40% Elongation Change Maximum (see 4.4.3).
4 = -5 to +20% Volume Change Maximum (see 4.4.3).

4.4.3 Physical Properties

All fluid resistance physical property change evaluations are per ASTM D471. Following the suffix letters, the numbers represent:

Defined in Table 3 --
1st number indicates Aging Duration
2nd and 3rd numbers indicate Aging Temperature

Defined in Table 8 --
4th number indicates Hardness Change
5th number indicates Tensile Strength Change
6th number indicates Elongation Change
7th number indicates Volume Change

Table 8 - Fluid aging property change table

Number	4th Number Hardness Change, Points, Type A	5th Number Tensile Strength Change, %	6th Number Elongation Change, %	7th Number Volume Change, %
0	No Requirement	No Requirement	No Requirement	No Requirement
1	±3	±10	±10	±5
2	±5	±15	±15	-5 to +10
3	±10	-20 to +10	-20 to +10	-5 to +15
4	0 to +15	-25 to +5	-25 to +5	-5 to +20
5	+5 to +20	-30 Max	-30 Max	+25 Max
6	+10 to +25	-35 Max	-35 Max	+30 Max
7	+15 to +30	-40 Max	-40 Max	+40 Max
8		-50 Max	-50 Max	+50 Max
9	As Specified	As Specified	As Specified	As Specified

4.5 Low Temperature Properties (Suffix F)

Low temperature properties shall be designated by an F followed by one number defining the applicable method per Table 9. The actual temperature or temperatures based on the chosen method shall appear in parentheses immediately following the F-number (see 4.5.1 and 4.5.2).

Numerous materials exist that are used as heat transfer media in low temperature evaluations (Suffix F2 through F9). The user and supplier must choose/agree on the media that is compatible with the material being evaluated and specify such media using a “Z” at the end of the line call out (i.e., “Z_n = F7 Media, Methanol”).

Table 9 - Low temperature properties - Suffix F

1st Number	ASTM Method
1	D7426, Tg – DSC Method(1)
2	D1329, 50% Elongation, TR-10(1)
3	D1329, 50% Elongation, TR-30(1)
4	D1329, 50% Elongation, TR-50(1)
5	D1329, 50% Elongation, TR-70(1)
6	D1053, 5 minutes, Type A Specimen; T_2, or T_5, or T_{10}, or T_{50}, or T_{100}(2)
7	D1053, 5 minutes, Type B Specimen; T_2, or T_5, or T_{10}, or T_{50}, or T_{100}(2)
8	D1053, 5 minutes, Type A Specimen; T_5, T_{10} and $\lvert T_{10}-T_5 \rvert$ Degree of separation Maximum(3)
9	D1053, 5 minutes, Type B Specimen; T_5, T_{10} and $\lvert T_{10}-T_5 \rvert$ Degree of separation Maximum(3)

(1) Use of F1 through F5 to define low temperature requirements by Glass Transition Temperature via DSC method, and Temperature of Retraction, further explained in 4.5.1.
(2) Use of F6 or F7 to define low temperature requirements further explained in 4.5.2.1.
(3) Maximum T-values for defining a curve for dynamic seal materials. Use of F8 or F9 to define low temperature requirements by torsional stiffness method further explained in 4.5.2.2.

4.5.1 Defining Low Temperature Properties by Glass Transition Temperature or Temperature of Retraction, F1 through F5

For F1 through F5, the nominal temperature shall be specified in parentheses following the F-number, with a tolerance of ±3 °C. A sign must be used to indicate negative temperatures only.

NOTE: All basic requirement fields must be occupied. Only the bolded portion of the line call out pertinent to this section is defined in the following examples.

Example:

VMQ 60 06 450 12 0 **F2(-70)**

F = Low Temperature Property (per Table 2).
2 = Method based on D1329 Temperature of Retraction at 10% retraction (TR-10, per Table 9).
-70 = Requirement for TR-10 is -70 °C maximum.

4.5.2 Defining Low Temperature Properties by Torsional Stiffness, D1053, F6 through F9

Torsional stiffness per ASTM D1053 can be at a single, or several temperatures and is dependent on the needs of the application.

Temperature requirements for F6 and F7 can include any of the following T-values:

T_2
T_5
T_{10}
T_{50}
T_{100}

Use of F6 and F7 with examples are found in 4.5.2.1.

Temperature requirements for F8 and F9 are typically used to define requirements for dynamic shaft seals and must include two T-values and the maximum degrees of separation between these values.

Use of F8 and F9 with examples are found in 4.5.2.2.

4.5.2.1 Torsional Stiffness, F6 and F7

Suffix F6 or F7 shall define the desired T-value within the line call out. It is not necessary to define all T-values, just those desired. The line call out shall have the form:

F6 (T_x:a, T_y:b…) where “x” and “y” represent the desired T-value (2, 5, 10, 50, or 100) while “a” and “b” represent the maximum temperature in °C.

NOTE: All basic requirement fields must be occupied. Only the bolded portion of the line call out pertinent to this section is defined in the following examples.

Example:

NBR 80 07 100 08 3 ***F6(T_5: -23, T_{10}: -26, T_{100}: -34) Z_1***
Z_1 = F6 Media, Methanol

F = Low Temperature Properties (per Table 2).
6 = Torsional Stiffness, ASTM D1053, 5 minutes, Type A Specimen (per Table 9).
T_5: -23 = T_5 is equal to or less than -23 °C.
T_{10}: -26 = T_{10} is equal to or less than -26 °C.
T_{100}: -34 = T_{100} is equal to or less than -34 °C.

4.5.2.2 Torsional Stiffness, F8 and F9

F8 and F9 are typically use for dynamic shaft seal applications.

Suffix F8 or F9 shall define in °C: T_5, T_{10}, and the absolute value of the difference T_{10}-T_5 to define the maximum allowed degrees of separation. The line call out shall have the form:

F8(a,b,d) where “a” represents T_5, “b” represents T_{10}, and “d” represents the absolute value of T_{10}-T_5 (Maximum) all in °C.

NOTE: All basic requirement fields must be occupied. Only the bolded portion of the line call out pertinent to this section is defined in the following examples.

Example:

NBR 80 07 100 08 3 ***F8(-23, -26, 8) Z_1***
Z_1 = F6 Media, 100 Cs Silicone Fluid

F = Low Temperature Property (per Table 2).
8 = Torsional Stiffness, ASTM D1053, 5 minutes, Type A Specimen; T_5, T_{10} and $|T_{10}-T_5|$ Degree of separation Maximum (per Table 9).
-23 = T_5 is equal to or less than -23 °C.
-26 = T_{10} is equal to or less than -26 °C.
8 = The difference between T_5 and T_{10} can be no greater than 8 °C.

4.6 Tear Strength (Suffix GB, GC, and GT)

Tear Strength is based on ASTM D624. Three different die types may be specified:

GB = Indicates ASTM D624 Die B.
GC = Indicates ASTM D624 Die C.
GT = Indicates ASTM D624 Die T.

The minimum tear value is designated within the line call out in kN/m. In the case of low tear materials, a decimal point may be used. No more than two significant figures (numbers) shall be used to indicate the tear strength requirement. If the tear requirement is 10 kN/m or greater, then only two numbers to the left of the decimal shall be used. If the tear requirement is less than 10 kN/m, then one number each side of a decimal is required.

NOTE: All basic requirement fields must be occupied. Only the bolded portion of the line call out pertinent to this section is defined in the following examples.

Example:

CIIR 60 14 450 08 5 ***GB8.5***

G = Tear Strength (per Table 2).
B = Die B.
8.5 = 8.5 kN/m minimum requirement.

Example:

CR 65 12 325 07 6 ***GC20***

G = Tear Strength (per Table 2).
C = Die C.
20 = 20 kN/m minimum.

4.7 Flammability Resistance (Suffix M)

Default maximum burn rate shall be 100 mm/min maximum. Method shall be designated by the letter following the M:

A = ISO 3795.
B = FMVSS 302.
C = SAE J369.

Burn rate requirement of less than 100 mm/min shall be specified by two numbers following the suffix letters.

NOTE: All basic requirement fields must be occupied. Only the bolded portion of the line call out pertinent to this section is defined in the following examples.

Example:

EPDM 70 08 250 10 0 ***MB***

M = Burn Rate.
B = Method per FMVSS 302, Default burn rate of 100 mm/min maximum.

or if the desired requirement was for a lower burn rate:

EPDM 70 08 250 10 0 ***MB50***

M = Burn Rate.
B = Method per FMVSS 302.
50 = 50 mm/min maximum.

4.8 Staining Resistance (Suffix P)

Staining resistance evaluations are based on ASTM D925, Method A for contact stain, Method B for Migration Stain, and Method C for diffusion stain. Default exposure is 48 hours per ASTM D945. Requirement is “non-staining” unless the degree of stain and method of determination are fully defined by use of a “Z” suffix (see 4.14). Deviations to the “non-staining” requirement as well as to the exposure period are per agreement by manufacturer and user, and as defined by use of a “Z” suffix.

Table 10 - ASTM D925 stain

Number	Method and Type
1	Method A, Contact Stain
2	Method B, Migration Stain
3	Method C, Diffusion Stain

NOTE: All basic requirement fields must be occupied. Only the bolded portion of the line call out pertinent to this section is defined in the following examples.

Example:

EPDM 70 08 250 10 0 ***P1 P2***

P = Stain Resistance ASTM D925 (per Table 2).
1 = Method A, Contact Stain (per Table 10).
P = Stain Resistance (per Table 2).
2 = Method B, Migration Stain (per Table 10).
Requirement in both cases is the default, non-staining.

4.9 Dynamic Fatigue (Suffix QA, QB, QC)

Dynamic fatigue evaluations are based on ASTM D430 and shall be indicated by a three letter suffix and one to three numbers. The suffix Q shall be followed by a letter based on the test type and method desired:

A = Type I test, Method A.
B = Type II test, Method B.
C = Type I or II test, Method C.

Following the test type/method designation either a “T” or an “M” which are defined as:

T = Requirement expressed as “Thousand” cycles minimum.
M = Requirement is expressed as “Million” cycles minimum.

The letters are followed by one to three numbers indicating the minimum requirement to failure. Failure is defined as Ply or adhesion separation for Type I evaluation, and crack initiation for Type II.

Users of this document can, using a “Z” suffix, modify the definition of “failure” based on crack growth severity, as discussed in ASTM D430.

NOTE: All basic requirement fields must be occupied. Only the bolded portion of the line call out pertinent to this section is defined in the following examples.