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MILITARY STANDARD

CLASSIFICATION SYSTEM AND TESTS FOR SOLID ELASTOMERIC MATERIALS

(Symbols and Tests)

FSC 9320

Army Materials and Mechanics Research Center
Watertown, Massachusetts 02172

Classification System and Tests
For Solid Elastomeric Materials

MIL-STD-417A(MR)

1. This limited coordination Military Standard has been prepared by the Army Materials and Mechanics Research Center based upon currently available information, and has been approved by the Army Materiel Command.

2. Recommended corrections, additions, or deletions should be addressed to the Director, Army Materials and Mechanics Research Center, Watertown, Mass. 02172.

FOREWORD

This standard was revised to reference the latest industry test methods and to include metric equivalents.

The rubber materials covered by this standard can be associated with rubber materials classified in ASTM D2000 entitled "Elastomeric Materials for Automotive Applications."

When specifications and drawings referencing materials listed in this standard are updated, they shall be changed to reference ASTM D2000.

CONTENTS

TABLES

MILITARY STANDARD

CLASSIFICATION SYSTEM AND TESTS FOR SOLID ELASTOMERIC MATERIALS

1. SCOPE

1.1 Scope. This standard covers a group of significant symbols identifying performance characteristics of rubber compositions; and, when practicable, test methods for use in determining compliance with the identifying characteristics.

1.2 Applications. This standard shall be used to identify rubber compositions for military applications. Competent technical discrimination shall be applied, prior to issuance of a procurement document designating a particular grade, to insure that compatible suffix combinations have been selected.

1.3 Classification. Rubber compositions shall be of the following types and classes:

Type R - Non-oil-resistant

Class RN - Natural or synthetic natural (Cis 1-4 polyisoprene) (see table III)

Class RS - Synthetic (see table IV)

Type S - Oil resistant

Class SA - Very low volume swell (see table V)

Class SB - Low volume swell (see table VI)

Class SC - Medium volume swell (see table VII)

Type T - Temperature resistant

Class TA - Low and high temperature resistant (see table VIII)

Class TB - High temperature and oil resistant (see table IX)

2. REFERENCED DOCUMENTS

2.1 The following documents of the issue in effect on date of invitation for bids, form a part of this standard.

SPECIFICATIONS

MILITARY

TT-E-529 - Enamel, Alkyd, Semi-Gloss

(Copies of specifications and standards required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this standard. Unless otherwise indicated, the issue in effect on date of invitation for bids shall apply.

American Society for T sting and Materials (ASTM) Standards:

D 395 - Compression Set of Vulcanized Rubber
D 412 - Tension Testing of Vulcanized Rubber
D 429 - Adhesion of Vulcanized Rubber to Metal
D 471 - Change in Properties of Elastomeric Vulcanizates Resulting from Immersion in Liquids
D 518 - Surface Cracking Resistance of Stretched Rubber Compounds
D 531 - Indentation of Rubber by Means of the Pusey and Jones Plastometer
D 573 - Accelerated Aging of Vulcanized Rubber by the Oven Method
D 575 - Compression-Deflection Characteristics of Vulcanized Rubber
D 624 - Tear Resistance of Vulcanized Rubber
D 813 - Crack Growth of Rubber
D 832 - Conditioning of Elastomeric Materials for Low-Temperature Testing
D 865 - Heat Aging of Vulcanized Rubber by Test Tube Method
D 925 - Diffusion Strain of Rubber and Migration Strain of Vulcanized Rubber in Contact with Organic Finishes
D 945 - Mechanical Properties of Elastomeric Vulcanizates Under Compressive or Shear Strains by Mechanical Oscillograph
D 1053 - Low-Temperature of Stiffening of Rubber and Rubber-like Materials by Means of a Torsional Wire Apparatus
D 1149 - Accelerated Ozone Cracking of Vulcanized Rubber
D 1229 - Low-Temperature Compression Set of Vulcanized Elastomers
D 2137 - Low-Temperature Impact Test for Brittleness Determination for Flexible Polymeric Materials or Fabrics Coated Therewith, or Both
D 2240 - Indentation Hardness of Rubber and Plastics by Means of a Durometer
D 2228 - Abrasion Resistance of Rubber by the Pico Method

(Applications for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

3. DEFINITIONS

3.1 Grades. The grades are designated by numbers following the prefix letters (RN, RS, SA etc.) (see tables III through IX). These grade numbers consist of three digits, the first indicating Shore A durometer hardness range. For example, 3 for 30 ± 5, 4 for 40 ± 5, etc. The second and third digits indicate the minimum tensile strength. For example, 10 for 1000 psi (7.0 MPa), 15 for 1,500 psi (10.5 MPa), etc.

3.2 Suffixes. It is recognized that basic requirements used mainly to classify compositions do not sufficiently describe some compositions, thus, provision is made for added requirements which are indicated by suitable suffixes to the grade number.

3.2.1 Suffix Numbers. Suffix numbers are used only in those cases where one composition has the same tensile strength requirements as another composition, but the ultimate elongation requirement differs. The suffix number is expressed by a single digit preceded by a hyphen and appended to the grade designation indicating the required elongation. For example, -4 for 400 percent, -7 for 700 percent, etc.

3.2.2 Suffix Letters[1/]. Suffix letters are added singly or in combination after any grade number to indicate additional requirements for that particular grade (see tables III through IX).

A - Resistance to heat aging 70 hours at 158°F (70°C)
A_1 - Resistance to heat aging 70 hours at 212°F (100°C)
A_4 - Resistance to heat aging 70 hours at 347°F (175°C)
A_6 - Resistance to heat aging 70 hours at 447°F (230.9°C)
B - Compression set after 22 hours at 158°F (70°C)
B_1 - Compression set after 70 hours at 212°F (100°C)
B_3 - Compression set after 70 hours at 302°F (150°C)
B_7 - Compression set after low temperature, 22 hours at -67°F (-55°C)
C_1 - Resistance to ozone at 50 pphm at 100°F (38°C) for 7 days
C_2 - Resistance to ozone at 50 pphm at 100°F (38°C) for 7 days after oven exposure for 70 hours at 158°F (70°C)
D - Compression-deflection
E_1 - Resistance to oil aging, ASTM D 471, ASTM Oil No. 1
E_3 - Resistance to oil aging, ASTM D 471, ASTM Oil No. 3
E_4 - Resistance to oil aging, (compounded petroleum oil)
E_5 - Resistance to fuel aging (ASTM D471, ASTM Fuel B)
F_1 - Low temperature brittleness at -40°F (-40°C)
F_2 - Low temperature brittleness at -67°F (-55°C)
F_3 - Low temperature brittleness at -103°F (-75°C)
F_7 - Low temperature brittleness - 22 hours at -67°F (-55°C)
F_{13} - Low temperature brittleness - 7 days at -103°F (-75°C)
G - Resistance to tear

[1/] Subscript numbers are used to indicate different time, temperature and/or other conditions for the same suffix letter. Numbers are not necessarily used in sequence since some are held in reserve for future requirements.

H - Resistance to flexing
J - Resistance to abrasion
K_1 - Adhesion to metal with bond made during vulcanization
K_2 - Adhesion - cemented bonds made after vulcanization
L - Resistance to water
M - Resistance to flame
N - Resistance to repeated impact
P - Resistance to staining
R - Resiliency
S_1 - Low temperature torsional stiffness at -40°F (-40°C)
S_2 - Low temperature torsional stiffness at -67°F (-55°C)
S_{11} - Low temperature torsional stiffness - 7 days at -40°F (-40°C)
Z - Special requirements

4. GENERAL REQUIREMENTS

4.1 Materials. Rubber compositions specified herein shall be of three types and seven calsses. These compositions shall be manufactured from natural rubber, reclaimed rubber, synthetic rubber or rubber-like materials, together with added compounding ingredients of such nature and quality as to produce vulcanized rubber conforming to the requirements of this standard. These vulcanized compositions shall show no objectionable bloom nor bleeding. Unless otherwise specified, color shall be black except for the TA compositions whose color is dependent on the filler used.

4.1.1 Type R. Type R composition shall be made from natural rubber, reclaimed rubber, synthetic rubber or rubber-like materials, alone or in combination, for services where specific resistance to the action of petroleum based fluids is not required.

4.1.1.1 Class RN. Class RN composition shall be based on natural rubber in the form of crude rubber or reclaimed rubber or synthetic natural rubber (Cis 1-4 polyisoprene).

4.1.1.2 Class RS. Class RS composition shall contain synthetic rubber or rubber-like materials for general purpose use where oil resistance is not required.

4.1.2 Type S. Type S compositions shall be made from synthetic rubber or rubber-like materials for services where specific resistance to the action of petroleum base fluids is required.

4.1.2.1 Class SA. Class SA compositions shall have very low volume swell in low-aniline point oils or fuels.

4.1.2.2 Class SB. Class SB compositions shall have low volume swell in low-aniline point oils or fuels.

4.1.2.3 Class SC. Class SC compositions shall have medium volume swell in low-aniline point oils or fules.

4.1.3 Type T. Type T composition shall be made from synthetic rubber or rubber-like materials which shall be suitable for services where specific resistance to the effects of high or low temperatures is required.

4.1.3.1 Class TA. Class TA compositions shall be made from materials having maximum resistance to the effects of both high and low temperatures.

4.1.3.2 Class TB. Class TB compositions shall be made from materials having outstanding resistance to both dry heat and oils at high temperature.

4.2 Physical Properties. The physical properties of rubber compositions shall conform to the values established in tables III through IX as determined by the applicable tests prescribed in 5.1.1 and table II. Physical properties contained in this specification are not applicable to rubber compositions used as a binder for material such as cork to form a uniform and homogeneous material.

4.3 Commonly used grades. The compositions fo tables III through VII marked with an asterisk are those most commonly used. It is suggested that these grades be specified when practicable.

4.4 Basic requirements.

4.4.1 Durometer hardness. The durometer hardness of samples tested shall not exceed the limits established in the applicable table when samples are prepared and tested in conformance to 5.1.2.

4.4.2 Tensile strength. Tensile strength of samples tested shall not be below the minimum value established in the applicable table when samples are prepared and tested in conformance to 5.1.3.

4.4.3 Ultimate elongation. Ultimate elongation of samples tested shall not be below the minimum value established in the applicable table when samples are prepared and tested in compliance with 5.1.4.

4.4.4 Oil aging. The changes in physical properties shall not exceed the limits established in the applicable table when samples are prepared and tested in accordance with paragraph 5.1.5.

4.4.5 Compression set. Compression set values shall not exceed the percentages established in the applicable table when the samples are prepared and tested in conformance with 5.1.6.

4.4.6 Heat aging. The change in physical properties shall not exceed the limits established in the applicable table when samples are prepared and tested in conformance to 5.1.7.

4.5 Special requirements added by suffix letter.

4.5.1 Resistance to heat aging. Suffixes A, A_1, A_4, and A_6. Physical properties (durometer hardness, tensile strength, ultimate elongation) shall not exceed the maximum limits established in the applicable table when prepared and tested in conformance to the applicable requirements of table II. The aged specimens shall show no evidence of cracking when bent back 180 degrees upon themselves.

4.5.2 Compression set - Suffixes B, B_1, B_3 and B_7. Compression set values shall not exceed percentages established in the applicable table when samples are prepared and tested in conformance to the applicable requirements of table II. For Suffix B_7 (22 hours at -67°F (-55°C)) compression set shall not exceed 70 percent after 30 minutes recovery at -67°F (-55°C).

4.5.3 Resistance to ozone - Suffixes C_1 and C_2. The specimens shall show no evidence of cracking when examined following testing in conformance with the applicable requirements of table II. Compositions that are being tested for conformance to the requirements for C_1 suffix shall show no cracks after exposure to an ozone concentration of 50 parts per hundred million of air. Compositions that are being tested for conformance to the requirements for C_2 suffix shall show no cracks after exposure to an ozone concentration of 50 parts per hundred million of air after oven exposure for 70 hours at 158°F (70°C).

4.5.4 Compression deflection - Suffix D. Compression deflection values shall not exceed the limits established in the RN and RS tables when samples are prepared and tested in conformance with the applicable requirements of table II.

4.5.5 Resistance to oil and fuel aging - Suffixes E_1, E_3, E_4, and E_5. The change in physical properties, following testing in conformance with the applicable requirements of table II, shall not exceed the limits established within the applicable table.

4.5.6 Low temperature brittleness - Suffixes F_1, F_2, F_3, F_7, and F_{13}. There shall be no evidence of any break, crack, fissure or hole visible to the naked eye after testing in conformance with the applicable requirements of table II. Compositions that are being tested for conformance with the requirements of F_1 compounds shall not fail at -40°F (-40°C) while compositions being tested for conformance to the requirements of F_2 and F_7 shall not fail at -67°F (-55°C), and those for F_3 and F_{13} shall not fail at -103°F (-75°C).

4.5.7 Resistance to tear - Suffix G. Specimens shall be prepared and tested in conformance with the applicable requirements of table II. Unless otherwise specified, the tear resistance shall not be less than 200 pounds per inch (35.02 kN/m) of thickness for compositions having a tensile of 2000 psi (14.0 MPa) or 150 pounds per inch of thickness (26.26 kN/m) if tensile is under 2000 psi (14.0 MPa).

4.5.8 Resistance to flexing - Suffix H. Specimens shall be prepared and tested in conformance with the applicable requirements of table II. It shall be the responsibility of the procuring activity to establish acceptance values for compounds when tested as specified herein.

4.5.9 Resistance to abrasion - Suffix J. Specimens shall be prepared and tested in conformance with the applicable requirements of table II. Unless otherwise specified, the loss in weight of the specimens after testing shall not exceed 5 percent.

4.5.10 Adhesion to metal, bond made during vulcanization - Suffix K_1. Specimens shall be prepared and tested in conformance with the applicable requirements of table II. Unless otherwise specified, the adhesion value shall not be less than 40 pounds per inch (7.00 kN/m) of width.

4.5.11 Adhesion, cemented bond made after vulcanization - Suffix K_2. It shall be the responsibility of the procuring activity to establish the test method and the adhesion value.

4.5.12 Resistance to water - Suffix L. Specimens shall be prepared and tested in conformance with the applicable requirements of table II. Durometer hardness shall not change more than ± 10 points, and volume shall not increase more than +10 percent for RS and SB compounds only.

4.5.13 Resistance to flame - Suffix M. Specimens shall be prepared and tested in conformance with the applicable requirements of table II. Unless otherwise specified, the flame propagation rate of the specimen shall not exceed 1/2 inch (12.7 mm) per minute, and the specimen shall show no evidence of separation of burning particles.

4.5.14 Resistance to repeated impact - Suffix N. It shall be the responsibility of the procuring activity to establish the test method and the number and magnitude of foot pound blows the specimen must be capable of withstanding.

4.5.15 Resistance to staining of organic finishes - Suffix P. Specimens shall be prepared and tested in conformance with the applicable requirements of table II. The enameled surface shall show no evidence of staining.

4.5.16 Resilience - Suffix R. Specimens shall have a Yerzley resilience of not less than that shown on the applicable table for the grade specified, when tested in conformance with the applicable requirements of table II.

4.5.17 Low temperature torsional stiffness - Suffixes S_1, S_2, and S_{11}. Specimens shall be prepared and tested for conformance with the applicable requirements of table II. Specimens being tested for conformance with the requirements of these suffixes shall meet the minimum twist requirements of table I. Compositions that are being tested for conformance with the requirements for S_1 and S_{11} compositions shall be tested at -40°F (-40°C) while those being tested for conformance with the requirements for S_2 compositions shall be tested at -67°F (-55°C).

Table I - Specimen thickness - Degree twist relationship[1/]

Torsional stiffness test		
Thickness		
Inches	(mm)	Twist, angular degrees, minimum
.060	1.5	98
.070	1.8	80
.080	2.0	66
.090	2.3	55
.100	2.5	46
.110	2.8	40

[1/] Interpolation shall be used for those thicknesses not contained within this table. These values are based on a modulus of elasticity of 10,000 psi (70 M for a specimen having a free span length of 1.0 inch (25.4 mm) and 0.125 inch (3.175 mm) wide.

4.5.18 Special requirements - Suffix Z. It shall be the responsibility of the procuring activity to establish a criterion for determining conformance to any special requirements that the procuring activity may require.

4.6 Workmanship. Compositions shall be uniform in construction and appearance and shall be free of porous areas, weak sections, bubbles, foreign matter and other defects affecting serviceability of the finished item.

5. DETAIL REQUIREMENTS

5.1 Tests.

5.1.1 Basic requirements. Testing for conformance with the basic requirements shall be performed in accordance with the following tests in order to determine compliance with the applicable requirements of section 4.

5.1.2 Durometer hardness. Determination shall conform to ASTM D 2240 using a Shore A durometer. ASTM D 531 shall be used as a referee method.

5.1.3 Tensile strength. Determination shall be in conformance with ASTM D 412 using a dumbbell shaped specimen, cut with a die conforming with the dimensions of die C.

5.1.4 Ultimate elongation. Determination shall be in conformance with ASTM D 412 using a dumbbell shaped specimen cut with a die conforming to the dimensions of die C.

5.1.5 Oil aging. Testing shall be done in conformance with ASTM D 471 using ASTM Oil No. 3 as the test fluid. Temperature of oven and duration of test shall be as specified in the applicable table.

5.1.6 Compression set. Testing shall be in conformance with ASTM D 395, method B.

5.1.7 Heat aging. Testing shall be in accordance with ASTM D865 for TA compounds. Test specimens shall be cut with a die conforming to die C of ASTM D412.

5.2 Suffix letter requirements. Testing for conformance with suffix letter requirements shall be accomplished in conformance with the applicable requirements of table II, in order to determine compliance with the applicable requirements of section 4.

Table II - Testing for suffix letter requirements

Suffix letter	Test method
A, A_1, A_4, and A_6	Use ASTM D 573 at 158 or 212°F (70°C or 100°C) or ASTM D 865 at 250°F (121°C) or over. Test specimens shall be cut with a die conforming to die C of ASTM D 412. Subsequent to testing for change in durometer hardness, tensile strength and ultimate elongation of the aged specimens, one part of the broken specimen shall be bent back upon itself and be held in that position for 30 seconds. Temperature of the oven or tube and duration of the test shall be as specified in the applicable table.
B, B_1 and B_3	ASTM D 395, method B
B_7	ASTM D 1229 - 22 hours at -67°F (-55°C)
C_1 and C_2	ASTM D 1149 - Test specimen size shall be 1 inch (25.4 mm) wide, 3-3/4 inches (95.25 mm) long and 0.075 (1.91 mm) to 0.125 (3.175 mm) inch thick. Specimens shall be mounted in accordance with the requirements of ASTM D 518, method B, except that the length of the clamping strips shall be such as to facilitate placement within the test chamber of the ozone cabinet. Duplicate specimens from each composition or item being tested for conformance to this suffix letter shall be tested for conformance to suffix letter C_1 shall be exposed for 7 days to an ozone concentration of 50 ± 5 parts per hundred million of air at a temperature of 100 ± 2°F (38 ± 1°C). At the end of the exposure time the specimens shall be examined under a seven power magnifier. Samples being tested for conformance with suffix letter C_2 shall be exposed for 7 days to an ozone concentration of 50 ± 3 parts per hundred million of air at a temperature of 100 ± 2°F (38 ± 1°C) after oven exposure for 70 hours at 158°F (70°C). At the end of the exposure time, the specimen shall be examined under a seven power magnifier.
D	ASTM D 575

E_1, E_3, E_4, and E_5	ASTM D471. Specimens that are being tested for conformance with the requirements of Suffix E_1 shall be tested in ASTM Oil No. 1; those with Suffix E_3 in ASTM Oil No. 3; those with Suffix E_4 in ASTM Service Fluid 100; those with Suffix E_5 in ASTM Reference Fuel B.
F_1, F_2, F_3, F_7, & F_{13}	ASTM D2137, Method A. Five type B specimens shall be tested at one time. Paragraph 9.3.2 of ASTM D2137 shall be used to determine acceptance or failure of compositions tested. Specimens being tested for conformance to Suffix F_1 requirements shall be conditioned for 3.0 ± 0.5 minutes in liquid at -40° ± 2°F (-40 ± 1°C) and then tested. Specimens being tested for conformance to Suffix F_2 requirements shall be conditioned for 3.0 ± 0.5 minutes in liquid at -67 ± 2°F (-55 ± 1°C) and then tested. Specimens being tested for conformance to Suffix F_3 requirements shall be conditioned for 3 minutes in liquid at -103 ± 3°F (-75 ± 2°C) and then tested. Specimens being tested for conformance to Suffix F_7 requirements shall be conditioned for 22 hours in air at -67 ± 2°F (-55 ± 1°C) and then tested. Specimens being tested for conformance to Suffix F_{13} requirements shall be conditioned for 7 days in air at -103 ± 3°F (-75 ± 2°C) and then tested.
G	ASTM D 624 - The specimen shall be cut with a die conforming to die B.
H	ASTM D 813
J	ASTM D 2228
K_1	ASTM D 429, Method B
K_2	The procuring activity shall determine the method of testing for conformance to this suffix letter.
L	ASTM D 471
M	The testing apparatus shall consist of (1) a metal chamber, 12 inches (304.8 mm) wide by 14 inches (355 mm) deep by 24 inches (609.6 mm) tall, open at the top and front; (2) a Tirrell burner with a 3/8 inch (9.53 mm) bore and 4 inches (101.6 mm) long above the primary air inlets; (3) a watch or clock with a sweep second hand; and (4) a supply of illuminating gas at normal pressure. The specimens shall be 10 inches (254 mm) long, 1/2 inch (12.7 mm) wide and 1/4 inch (6.35 mm) thick. Not less than three specimens shall be tested. The specimen shall be marked at a distance of 2 inches (50.8 mm) from each end,

	and centered in a horizontal position in the test chamber, on supports 8 inches (203 mm) apart and clamped at each end. The burner shall be adjusted to provide a flame approximately 5 inches (127 mm) high, having an inner blue cone approximately 1.5 inches (38.1 mm) high. The burner shall be placed beneath the specimen midway between the supports in such a manner that the flame of the core just touches the underside of the specimen. The burner shall be left in this position for 30 seconds, then removed and the flame extinguished. The rate of flame travel (total inches divided by time of test) along the 6 inch (152.4 mm) test length shall then be calculated and the average of the three specimens shall be reported as the flame propagation time.
N	The procuring activity shall determine the method of testing for conformance to this suffix letter.
P	ASTM D 925, method B - The metal panels shall be finished with olive drab enamel conforming to Specification TT-E-529 and shall be aged 48 hours prior to the test. Exposure shall be 24 hours at 140 ± 5°F (60 ± 3°C).
R	ASTM D 945, part A
S_1, S_2, and S_{11}	ASTM D 1053 - The general procedures of this method shall be used, with the exception of those sections that are in conflict with the following. The angle of specimen twist shall be determined at only one temperature (-40°F) (-40°C) for testing samples for compliance with S_1 or S_{11} requirements or -67°F (-55°C) for testing samples for compliance with S_2 requirements. Test specimen dimensions shall be as follows: Thickness -- 0.085 ± .025 inch (2.16 ± 0.64 mm); free span specimen length--1.0 ± .10 inch (25.4 ± 2.54 mm); width--0.125 ± .005 inch (3.175 ± 0.13 mm). Only one wire shall be used for the test. The wire shall be 2.6 ± .3 inches (66 ± 7.62 mm) long and have a torsional constant of 0.500 gram-force-centimeter per degrees of twist (color code yellow). For liquid heat transfer media the temperature of the bath surrounding the entire test specimens shall be controlled to within ± 1.8°F (± 1.0°C) and the specimen shall be conditioned 5 ± 0.5 minutes. (The liquid heat transfer media and temperature control as described within ASTM D 2137 are suitable.) For gaseous media the temperature of the bath surrounding the entire test specimens shall be controlled to within ± 2°F (± 1°C) and specimens shall be conditioned one hour for S_1 or S_2 and 7 days for S_{11} requirements. Not less than three specimens shall be tested from each sample submitted, for conformance with the twist requirements of table I. If one of the three specimens tested fails to meet the minimum twist requirements for its thickness, three additional specimens shall be tested. Failure of any one of the second set of specimens shall constitute failure of the sample.

Z	See 4.5.18

5.3 Acceptance tests. The requirements for rejections and retesting shall be established by the procuring activity. It is recognized that deviations by the purchaser may be permitted to the extent of 10 percent tensile and elongation only when test specimens are cut from parts instead of test slabs due to variations in shape factor, grain effect and knitting of the rubber composition.

Custodian:

Army - MR

Review interest:

Army - ML

Preparing Activity:

Army - MR

Project Number 9320-A162

Table III - Physical Requirements of Rubber Compositions - Type R, Class RN

Basic Requirements					Requirements Added by Suffix Letter						
					Suffix A Heat aged 70 hr. at 158 F (70 C)			Suffix B	Suffix D		Suffix R
Grade number	Durometer hardness number	Tensile strength min. psi	Tensile strength min. MPa	Ultimate elongation, min., %	Compression set after 22 hr. at 158 F (70 C) max., %	Hardness change, Max.	Tensile change, max. %	Elongation change, max. %	Compression set after 22 hr. at 158 F (70 C) max., %	load at 20% deflection psi	load at 20% deflection MPa	Yerzley resilience at 20% deformation min., %
RN 310	30 ± 5	1000	7.0	400	50	+10	-20	-30	25	70 ± 10	0.483 ± 0.069	80
315		1500	10.5	500	"	"	"	"	"			
320		2000	14.0	600	"	"	"	"	"			
325		2500	17.5	600	"	"	"	"	"			
RN 410	40 ± 5	1000	7.0	500	"	"	"	"	"	100 ± 15	0.689 ± 0.103	75
*415		1500	10.5	500	"	"	"	"	"			
*420		2000	14.0	500	"	"	"	"	"			
425		2500	17.5	600	"	"	"	"	"			
430		3000	21.0	600	"	"	"	"	"			
RN *510	50 ± 5	1000	7.0	400	"	"	"	"	"	140 ± 20	0.965 ± 0.138	70
*515		1500	10.5	400	"	"	"	"	"			
*520		2000	14.0	500	"	"	"	"	"			
*525		2500	17.5	500	"	"	"	"	"			
530		3000	21.0	600	"	"	"	"	"			
535		3500	24.5	600	"	"	"	"	"			
RN *610	60 ± 5	1000	7.0	300	"	"	"	"	"	195 ± 30	1.344 ± 0.207	60
*615		1500	10.5	350	"	"	"	"	"			
*620		2000	14.0	400	"	"	"	"	"			
*625		2500	17.5	450	"	"	"	"	"			
630		3000	21.0	450	"	"	"	"	"			
635		3500	24.5	500	"	"	"	"	"			
RN *710	70 ± 5	1000	7.0	200	"	"	"	"	"	300 ± 70	2.068 ± 0.483	50
*715		1500	10.5	250	"	"	"	"	"			
*720		2000	14.0	300	"	"	"	"	"			
725		2500	17.5	300	"	"	"	"	"			
RN 810	80 ± 5	1000	7.0	150	"	"	"	"	"	475 ± 100	3.275 ± 0.70	
815		1500	10.5	150	"	"	"	"	"			
820		2000	14.0	200	"	"	"	"	"			
RN 910	90 ± 5	1000	7.0	100	"	"	"	"	"			
915		1500	10.5	150	"	"	"	"	"			

*Grades most commonly used.

Table IV - Physical Requirement of Rubber Compositions - Type R, Class RS

Grade number	Basic requirements: Durometer hardness number	Basic requirements: Tensile strength min. psi	Basic requirements: Tensile strength min. MPa	Basic requirements: Ultimate elongation, min., %	Basic requirements: Compression set after 22 hr. at 158 F (70 C) max., %	Basic requirements: Heat aged 70 hrs at 158 F (70 C): Hardness change, max.	Basic requirements: Heat aged 70 hrs at 158 F (70 C): Tensile change, max. %	Basic requirements: Heat aged 70 hrs at 158 F (70 C): Elongation change, max. %	Suffix A1 (heat aged 70 hrs at 212 F (100 C)): Hardness change, max.	Suffix A1: Tensile change max. %	Suffix A1: Elongation change, max. %	Suffix B: Compression set after 22 hr. at 158 F (70 C) max., %	Suffix D: Load at 20% deflection psi	Suffix D: Load at 20% deflection kPa
RS 310	30 ± 5	1000	7.0	400	50	+10	-25	-35	+10	-25	-35	25	70 ± 10	0.483 ± 0.069
315		1500	10.5	400	"	"	"	-25	"	"	"	"		
320		2000	14.0	400	"	"	"	"	"	"	"	"		
RS 410	40 ± 5	1000	7.0	400	"	"	"	-35	"	"	"	"	100 ± 15	0.689 ± 0.103
*415		1500	10.5	400	"	+7	"	-25	"	"	"	"		
*420		2000	14.0	400	"	"	"	"	"	"	"	"		
RS *510	50 ± 5	1000	7.0	400	"	+10	"	-35	"	"	"	"	140 ± 20	0.965 ± 0.138
*515		1500	10.5	400	"	+7	"	-25	"	"	"	"		
*520		2000	14.0	400	"	"	"	"	"	"	"	"		
*525		2500	17.5	400	"	"	"	"	"	"	"	"		
RS *610	60 ± 5	1000	7.0	500	"	+10	"	-35	"	"	"	"	195 ± 30	1.344 ± 0.207
*615		1500	10.5	350	"	+7	"	-25	"	"	"	"		
*620		2000	14.0	400	"	"	"	"	"	"	"	"		
*625		2500	17.5	400	"	"	"	"	"	"	"	"		
RS *710	70 ± 5	1000	7.0	200	"	+10	"	-35	"	"	"	"	300 ± 70	2.068 ± 0.483
*715		1500	10.5	250	"	+7	"	-25	"	"	"	"		
*720		2000	14.0	300	"	"	"	"	"	"	"	"		
725		2500	17.5	300	"	"	"	"	"	"	"	"		
RS 810	80 ± 5	1000	7.0	150	"	+10	"	-35	"	"	"	"	475 ± 100	3.275 ± 0.690
815		1500	10.5	150	"	+7	"	-25	"	"	"	"		
820		2000	14.0	200	"	"	"	"	"	"	"	"		
RS 910	90 ± 5	1000	7.0	100	"	+10	"	-35	"	"	"	"		
915		1500	10.5	150	"	+7	"	-25	"	"	"	"		

*[illegible]

Table V - Physical Requirements of Rubber Compositions - Type S, Class SA

Grade number	Basic requirements: Durometer hardness number	Tensile strength min. psi	Tensile strength min. MPa	Ultimate elongation, min., %	Oil aged 70 hr. at 212 F (100 C) ASTM Oil #3 Volume change %	Compression set after 22 hr. at 158 F (70 C) max., %	Requirements added by suffix letter: Suffix A_1 Heat aged 70 at 212 F (100 C) Hardness change, max.	Suffix A_1 Tensile change, max., %	Suffix A_1 Elongation change, max. %	Suffix B_1 Compression set after 70 hr. at 212 F (100 C) max., %	Suffix E_3 Oil aged 70 Hr. at 212 F (100 C) ASTM Oil #3 Hardness change (limits)	Suffix E_3 Tensile change max., %	Suffix E_3 Elongation change max. %
SA 405	40 ± 5	500	3.5	400	0 to +10	60	+10	-15	-30		-5 to +10	-20	-40
SA 505	50 ± 5	500	3.5	400	"	"	"	"	"		"	"	"
SA 605	60 ± 5	500	3.5	300	"	"	"	"	"		"	"	"
610		1000	7.0	300	"	"	"	"	"		"	"	"
620		2000	14.0	300	"	"	"	"	"	50	"	"	"
SA 705	70 ± 5	500	3.5	250	"	"	"	"	"		"	"	"
710		1000	7.0	250	"	"	"	"	"		"	"	"
720		2000	14.0	300	"	"	"	"	"	50	"	"	"
SA 805	80 ± 5	500	3.5	150	"	"	"	"	"		"	"	"
810		1000	7.0	150	"	"	"	"	"		"	"	"
SA 905	90 ± 5	500	3.5	100	"	"	"	"	"		"	"	"
910		1000	7.0	100	"	"	"	"	"		"	"	"

Table VI - Physical Requirements of Rubber Compositions - Type S, Class SB

Grade number	Durometer hardness number	Basic requirements: Tensile strength min. psi	Tensile strength min. MPa	Ultimate elongation min., %	Oil aged 70 hr. at 212 F (100 F) ASTM Oil #3	Compression set 70 hr. at 212 F (100 C), max., %	Suffix A_1: Heat aged 70 hr. at 212 F (100 C) Hardness change, max.	Suffix A_1: Tensile change, max. %	Suffix A_1: Elongation change, max. %	Suffix B_1: Compression set after 70 hr at 212 F (100 C), max., %	Suffix B_3: 70 hr. at 212 F (100 C) ASTM Oil #3 Tensile change, max. %	Suffix B_3: Elongation change, max., %	Suffix B_3: Change in durometer hardness	Suffix B_3: Volume change %	Suffix E_5: 7 days at room temp. ASTM Fuel B Volume change %, max.
SB 410	40 ± 5	1000	7.0	450	0 to +40	60	+15	-20	-40	35	-45	-45	-10 to +5	0 to 25	+50
415		1500	10.5	450	"	"	"	"	"	"	"	"	"	"	"
SB 505	50 ± 5	500	3.5	300	"	"	"	"	"	"	"	"	"	"	"
510		1000	7.0	350	"	"	"	"	"	"	"	"	"	"	"
*515		1500	10.5	400	"	"	"	"	"	"	"	"	"	"	"
520		2000	14.0	400	"	"	"	"	"	"	"	"	"	"	"
SB 605	60 ± 5	500	3.5	200	"	"	"	"	"	"	"	"	"	"	"
*610		1000	7.0	250	"	"	"	"	"	"	"	"	"	"	"
*615		1500	10.5	300	"	"	"	"	"	"	"	"	"	"	"
620		2000	14.0	350	"	"	"	"	"	"	"	"	"	"	"
SB 705	70 ± 5	500	3.5	150	"	"	"	"	"	"	"	"	"	"	"
710		1000	7.0	200	"	"	"	"	"	"	"	"	"	"	"
*715		1500	10.5	250	"	"	"	"	"	"	"	"	"	"	"
720		2000	14.0	250	"	"	"	"	"	"	"	"	"	"	"
725		2500	17.5	300	"	"	"	"	"	"	"	"	"	"	"
SB 805	80 ± 5	500	3.5	100	"	"	"	"	"	"	"	"	"	"	"
810		1000	7.0	100	"	"	"	"	"	"	"	"	"	"	"
815		1500	10.5	125	"	"	"	"	"	"	"	"	"	"	"
820		2000	14.0	125	"	"	"	"	"	"	"	"	"	"	"
SB 905	90 ± 5	500	3.5	50	"	"	"	"	"	"	"	"	"	"	"
910		1000	7.0	100	"	"	"	"	"	"	"	"	"	"	"
915		1500	10.5	100	"	"	"	"	"	"	"	"	"	"	"

*Grades most commonly used.

Table VII - Physical Requirements of Synthetic Rubber Compositions - Type S, Class SC

Grade number	Durometer hardness number	Tensile strength min. psi	Tensile strength min. MPa	Ultimate elongation min., %	Basic requirements: Oil aged 70 hr. at 212 F (100 C) ASTM Oil #3 Volume change %	Basic requirements: Compression set after 22 hr. at 158 F (70 C) max., %	Suffix A_1: Heat aged 70 hr. at 212 F (100 C) Hardness change, max.	Suffix A_1: Heat aged 70 hr. at 212 F (100 C) Tensile change, max. %	Suffix A_1: Heat aged 70 hr. at 212 F (100 C) Elongation change, max. %	Suffix B_1: Compression set after 70 hr. at 212 F (100 C) max., %	Suffix E_3: 70 hr. at 212 F (100 C) ASTM Oil #3 Tensile change, max. %	Suffix E_3: 70 hr. at 212 F (100 C) ASTM Oil #3 Elongation change max., %	Suffix R: Yerzley resilience at 20% deformation min., %	Suffix E_5: 7 days at room temp. ASTM Fuel B Volume change %, max.
SC 305	30 + 5	500	3.5	300	0 to + 120	50	+15	-15	-35	35	-65	-50	70	60
310		1000	7.0	400	"	"	"	"	"	"	"	"	"	"
315		1500	10.5	400	"	"	"	"	"	"	"	"	"	"
320		2000	14.0	400	"	"	"	"	"	"	"	"	"	"
SC 405	40 ± 5	500	3.5	300	"	"	"	"	"	"	"	"	65	65
410		1000	7.0	400	"	"	"	"	"	"	"	"	"	"
*415		1500	10.5	400	"	"	"	"	"	"	"	"	"	"
*420		2000	14.0	400	"	"	"	"	"	"	"	"	"	"
SC 505	50 + 5	500	3.5	300	"	"	"	"	"	"	"	"	"	"
510		1000	7.0	300	"	"	"	"	"	"	"	"	"	"
*515		1500	10.5	350	"	"	"	"	"	"	"	"	"	"
*520		2000	14.0	400	"	"	"	"	"	"	"	"	"	"
525		2500	17.5	400	"	"	"	"	"	"	"	"	"	"
SC 605	60 ± 5	500	3.5	300	"	"	"	"	"	"	"	"	55	55
*610		1000	7.0	300	"	"	"	"	"	"	"	"	"	"
*615		1500	10.5	300	"	"	"	"	"	"	"	"	"	"
*620		2000	14.0	350	"	"	"	"	"	"	"	"	"	"
625		2500	17.5	400	"	"	"	"	"	"	"	"	"	"
SC 705	70 ± 5	500	3.5	200	"	"	"	"	"	"	"	"	50	50
*710		1000	7.0	200	"	"	"	"	"	"	"	"	"	"
*715		1500	10.5	250	"	"	"	"	"	"	"	"	"	"
720		2000	14.0	300	"	"	"	"	"	"	"	"	"	"
725		2500	17.5	300	"	"	"	"	"	"	"	"	"	"

*Grades most commonly used.

Table VII - Physical Requirements of Synthetic Rubber Compositions - Type S, Class SC (cont'd)

	Basic requirements				Requirements added by suffix letter															
SC 805	80 ± 5	500	3.5	100	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
810		1000	7.0	100	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
815		1500	10.5	100	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
820		2000	14.0	100	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
SC 905	90 ± 5	500	3.5	100	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
910		1000	7.0	100	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
915		1500	10.5	100	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"

TABLE VIII

Physical Requirements Of Synthetic Rubber Compositions Type T, Class TA

Grade Number	Durometer Hardness Number	Basic Requirements: Tensile strength min. psi	Tensile strength min. MPa	Elongation, min. %	Heat aged 70 hrs. at 437 °F (225 °C): Tensile, Change, max. %	Heat aged 70 hrs. at 437 °F (225 °C): Elongation, Change, max. %	Heat aged 70 hrs. at 437 °F (225 °C): Hardness, Change, max.	Low temp. brittleness ASTM D 746 Procedure B at -67 °F (-55 °C)	Suffix B: Compression set after 70 hr. at 302 °F (150 °C), max. %	Suffix B: 70 hrs at 302 °F (150 °C) ASTM 011 #1: Tensile, Change, max. %	Elongation, Change, max. %	Volume Change, Limits, %	Hardness, Change, max.	Suffix B: 70 hr. at 302 °F (150 °C) ASTM 011 #1: Volume Change, max. %	Suffix F: Low temp. brittleness ASTM D 746 Procedure B at -103 °F (-75 °C)	Suffix G: Tear strength min. lb/in.	Suffix G: Tear strength min. kN/m	Suffix J: Water absorption after 70 hr. in boiling water, max. % volume change
TA405	40 ± 5	500	3.5	200	-40	-25	+10	Pass	30	-20	-20	0 to +20	-15	60	-	-	-	±5
TA406	50 ± 5	500	3.5	200	-40	-25	+10	-	30	-20	-20	0 to +20	-15	60	-	-	-	±5
TA407	60 ± 5	700	5.0	150	-40	-25	+10	-	30	-20	-20	0 to +20	-15	60	-	-	-	±5
TA505	50 ± 5	500	3.5	200	-30	-25	+10	Pass	30	-20	-20	0 to +20	-15	60	Pass	40	7.00	±5
TA506	60 ± 5	600	4.5	175	-30	-30	+10	-	30	-20	-20	0 to +20	-15	60	Pass	50	8.76	±5
TA507	70 ± 5	700	5.0	150	-30	-30	+10	-	30	-20	-20	0 to +20	-15	60	-	-	-	±5
TA508	80 ± 5	800	5.5	125	-40	-35	+10	-	30	-20	-20	0 to +20	-15	60	Pass	80	14.00	±5
TA510	90 ± 5	1000	7.0	100	-50	-40	+10	-	30	-20	-20	0 to +20	-15	60	Pass	100	17.51	±5
TA512	100 ± 5	1200	8.5	50	-50	-50	+15	-	30	-20	-20	0 to +20	-15	60	Pass	150	26.27	±5
TA605	40 ± 5	500	3.5	100	-30	-25	+10	Pass	25	-20	-20	0 to +20	-15	60	Pass	40	7.00	±5
TA606	50 ± 5	600	4.5	150	-30	-30	+10	-	25	-20	-20	0 to +20	-15	60	Pass	50	8.76	±5
TA607	60 ± 5	700	5.0	100	-30	-30	+10	-	25	-20	-20	0 to +20	-15	60	-	-	-	±5
TA608	70 ± 5	800	5.5	125	-40	-35	+10	-	25	-20	-20	0 to +20	-15	60	Pass	80	14.00	±5
TA610	80 ± 5	1000	7.0	100	-40	-40	+10	-	25	-20	-20	0 to +20	-15	60	Pass	100	17.51	±5
TA612	90 ± 5	1200	8.5	50	-50	-50	+15	-	25	-20	-20	0 to +20	-15	60	Pass	150	26.27	±5
TA705	60 ± 5	600	4.5	125	-30	-30	+10	Pass	40	-20	-20	0 to +20	-15	60	Pass	50	8.75	±5
TA706	70 ± 5	800	5.5	125	-40	-35	+10	-	40	-20	-20	0 to +20	-15	60	-	-	-	±5
TA707	80 ± 5	1000	7.0	100	-40	-40	+10	-	40	-20	-20	0 to +20	-15	60	-	50	8.76	±5
TA710	90 ± 5	1200	8.5	50	-50	-50	+15	-	40	-20	-20	0 to +20	-15	60	-	100	17.51	±5
TA805	60 ± 5	600	4.5	150	-30	-30	+10	Pass	30	-20	-20	0 to +20	-15	60	Pass	-	-	±5
TA806	70 ± 5	800	5.5	125	-40	-35	+10	-	30	-20	-20	0 to +20	-15	60	-	-	-	±5
TA807	80 ± 5	1000	7.0	100	-40	-40	+10	-	30	-20	-20	0 to +20	-15	60	-	50	8.76	±5
TA810	90 ± 5	1200	8.5	50	-50	-50	+15	-	30	-20	-20	0 to +20	-15	60	-	80	14.00	±5

Table IX - Physical Requirements of Synthetic Rubber Compositions - Type T, Class TB

Basic requirements						Requirements added by suffix letter											
						Suffix A_4: Heat aged 70 hr. at 347 F (175 C)			Suffix E_3: 70 hr. at 302 F (150 C) ASTM Oil #3				Suffix E_4: 70 hr. at 302 F (150 C) ASTM Service Fluid #100				
Grade number	Durometer hardness number	Tensile strength min. psi	Tensile strength min. MPa	Ultimate elongation min., %	Compression set after 70 hr at 302 F (150 C), max., %	Hardness change	Tensile change max. %	Elongation change max. %	Hardness change max.	Tensile change max.%	Elongation change max. %	Volume change %	Hardness change	Tensile change max., %	Elongation change, max.,%	Volume change %
TB 405	40 ± 5	500	3.5	200	60	0 to +10	-30	-50	-10	-30	-20	0 to +20	-5 to +10	-10	-10	-3 to +5
TB 510	50 ± 5	1000	7.0	200	"	"	"	"	"	"	"	"	"	"	"	"
TB 610	60 ± 5	1000	7.0	200	"	"	"	"	"	"	"	"	"	"	"	"
615		1500	10.5	200	"	"	"	"	"	"	"	"	"	"	"	"
TB 710	70 ± 5	1000	7.0	150	"	"	"	"	"	"	"	"	"	"	"	"
715		1500	10.5	150	"	"	"	"	"	"	"	"	"	"	"	"
TB 810	80 ± 5	1000	7.0	100	"	"	"	"	"	"	"	"	"	"	"	"
815		1500	10.5	100	"	"	"	"	"	"	"	"	"	"	"	"

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5. PROBLEM AREAS

a. Paragraph Number and Wording

b. Recommended Wording

c. Reason/Rationale for Recommendation

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* - Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* - Optional
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