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SUPERSEDING
(See Section 6)

MILITARY STANDARD

CLASSIFICATION SYSTEM AND TESTS FOR CELLULAR ELASTOMERIC MATERIALS

FSC 9320

DEPARTMENT OF DEFENSE
WASHINGTON 25, D.C.

Classification System and Tests for Cellular Elastomeric Materials MIL-STD-670B.

1. This standard has been approved by the Department of Defense and is mandatory for use by the Departments of the Army, the Navy, and the Air Force, effective 30 January 1968.

2. Recommended corrections, additions, or deletions should be addressed to Materials Standardization Office, U. S. Army Materials and Mechanics Research Center, Watertown, Massachusetts 02172.

FOREWORD

The primary objective of this standard is to provide information of direct usefulness to interested military personnel. The standard, in general, is based upon the latest technical specifications of ASTM, SAE-ASTM and SPI.

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TABLES

1. SCOPE

1.1 Purpose. The purpose of this standard is to establish a system for designating cellular elastomeric materials based on natural, synthetic or reclaimed rubber or rubber-like materials, alone or in combination. Cellular ebonite (hard rubber) and rigid cellular plastic materials are not included.

1.2 Coverage. This standard covers a group of significant symbols identifying specific physical properties of flexible, elastic cellular materials and the test methods for determining these physical properties.

1.3 Application. This standard shall be used to identify cellular materials for military applications. Physical property requirements are contained in tables I through VII. Basic requirements are used to classify the materials and to insure acceptable quality. Suffix letter designations given in the tables indicate additional properties not described by the basic requirements. Suffix letter designations other than those in the tables may also be obtained (see 3.2 and 4.2.1). Competent technical discrimination must be exercised in adding suffix letters in order to prevent designation of a cellular material having incompatible physical property combinations.

1.4 Classification, Types, Classes and Styles. Cellular materials shall be of the following types, classes and styles:

Type R - Nonoil resistant, useful over temperature range -55 to 100C (-67 to +212F.) (see tables I and II).
Style C - Cored.
Style E - Expanded.
Style O - Open cell.
Style U - Uncored.

Type S - Oil resistant, useful over temperature range -40 to +70C (-40 to 158F).
Class SB - Low volume swell in low aniline point 69.5 ± 1.0C (157.1 ± 1.8F) oil (see table III).
Style E - Expanded.
Style O - Open cell.
Class SC - Medium volume swell in low aniline point 69.5 ± 1.0C (157.1 ± 1.8F) oil (see table IV).
Style E - Expanded.
Style O - Open cell.

Type T - Extreme temperature resistant, useful over temperature range -75 to 175C (-103 to +347F), nonoil resistant (see table V).
Style E - Expanded.
Style O - Open cell.

Type U - Medium temperature and oil resistant useful over temperature range -40 to +125C (-40 to +257F) (see table VI).
Style C - Cored.
Style U - Uncored.

Type V - Thermoplastic (heat sealable), useful over temperature range -40 to +100C (-40 to +212F) oil resistant (see table VII).
Style C - Cored.
Style E - Expanded.
Style O - Open cell.
Style U - Uncored.

1.4.1 Classification, grade numbers and suffix letters. Cellular material shall be further classified by the applicable grade numbers and, if necessary by the applicable suffix letter or letters as defined under 3.1.1 and 3.2 respectively.

2. REFERENCED DOCUMENTS

2.1 Non-Governmental. The following documents form a part of this standard to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

ASTM STANDARDS

C177 - Method of Test for Thermal Conductivity of Materials by Means of the Guarded Hot Plate.

D395 - Methods of Test for Compression Set of Vulcanized Rubber.

D429 - Methods of Test for Adhesion of Vulcanized Rubber to Metal.

D471 - Method of Test for Change in Properties of Elastomeric Vulcanizates Resulting from Immersion in Liquids.

D518 - Method of Test for Resistance to Surface Cracking of Stretched Rubber Compounds.

D573 - Method of Test for Accelerated Aging of Vulcanized Rubber by the Oven Method.

D832 - Recommended Practice for Conditioning of Elastomeric Materials for Low-Temperature Testing.

D865 - Method of Heat Aging of Vulcanized Natural or Synthetic Rubber by Test Tube Method.

D1055 - Methods of Test for Latex Foam Rubbers.

D1056 - Methods of Testing for Sponge and Expanded Cellular Rubber Products.

D1149 - Method of Test for Accelerated Ozone Cracking of Vulcanized Rubber.

D1564 - Methods of Testing Slab for Flexible Urethane Foam.

D1565 - Specifications for Flexible Foams Made From Polymers or Copolymers of Vinyl Chloride.

D1667 - Methods of Test for Sponge Made from Closed Cell Poly(Vinyl Chloride), or Copolymers Thereof.

D1692 - Method of Test for Flammability of Plastic Foams and Sheeting.

(Copies of ASTM Standards may be obtained from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pa. 19103).

Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.

3. DEFINITIONS

3.1 Styles. Styles shall be designated by letters following the type of designation or in the case of type S, by letters following the class designation. The style shall indicate the cellular structure of the materials as follows:

C - Cored, defined as cellular elastomeric material containing a multiplicity of holes (usually but not necessarily cylindrical in shape) molded or cut into the material in some pattern normally perpendicular to the largest surface, and extending part or all the way through the piece.

E - Expanded, defined as elastomeric materials containing nonconnecting gas-tight cells (closed cells).

O - Open cell, defined as elastomeric materials containing interconnecting cells.

U - Uncored, differing from C above only in that the finished item contains no cores.

3.1.1 Grade numbers. Grade numbers shall consist of one or more digits following the style designation. The grade numbers shall correspond to the indentation load deflection values for types R and U and to compression deflection values for types R, S, T and V. In both cases, a higher number indicates a firmer material.

3.2 Suffix letters. The grade numbers as specified herein represent the cellular materials most commonly used. However, they do not sufficiently describe some compositions, thus, provision is made for added requirements which are indicated by suitable suffix letters appended to the grade numbers. Suffix letters may be added singly or in combination after any grade number to indicate additional requirements for that particular grade. Caution must be exercised in adding suffix letters in order to prevent the designation of a cellular material having incompatible physical property combinations. The significance of the approved suffix letters shall be as follows:

A1 - Resistance to heat aging, 22 hours at 100 ± 1C (212 ± 1.8F).
A2 - Resistance to heat aging, 22 hours at 125 ± 1C (257 ± 1.8F).
A4 - Resistance to heat aging, 22 hours at 175 ± 1C (347 ± 1.8F).
B - Compression set after 22 hours at 70 ± 1C (158 ± 1.8F).
C1 - Resistance to ozone at 50pphm at 40 ± 1C (104 ± 1.8F) for 70 hours.
E - Resistance to oil aging, 22 hours at 70 ± 1C (158 ± 1.8F) in ASTM No. 3 Oil.
F1 - Compression - deflection at low temperature, 5 hours at -40 ± 2C (-40 ± 3.6F).
F2 - Compression - deflection at low temperature, 5 hours at -55 ± 2C (-67 ± 3.6F).
F3 - Compression - deflection at low temperature, 5 hours at -75 ± 2C (-103 ± 3.6F).
G - Resistance to tear.

H - Resistance to flexing.
K2 - Adhesion to metal with cemented bond made after fabrication of end item.
L - Resistance to water.
M - Resistance to flame.
V - Thermal conductivity - "K" factor.
Z - Special requirements.

Examples: (1) Grade RC5F1 denotes a soft, cored, nonoil resistant foam with an indentation load deflection of 5 ± 3 lbs and requiring in addition to the basic tests a low temperature test at -40C (-40F) (2) SCE20L denotes a firm expanded oil resistant sponge with a compression deflection value of 20 ± 3-1/2 psi and requiring in addition a water absorption test.

4. GENERAL REQUIREMENTS

4.1 Materials. Cellular materials specified herein shall be of five types, two classes and four styles. These materials shall be manufactured from natural rubber, reclaimed rubber, synthetic rubber or thermoplastic rubber-like materials, alone or in combination together with the added compounding ingredients of such nature and quality that the finished products conform to the requirements of this standard.

4.1.1 Type R - Latex, sponge and expanded nonoil resistant rubber. Type R materials shall be made from natural rubber, reclaimed rubber, synthetic rubber, or rubber-like materials, alone or in combination.

4.1.2 Type S - Sponge, foam and expanded oil resistant rubber. Type S materials shall be made from synthetic rubber, reclaimed rubber, or rubber-like materials alone or in combination.

4.1.2.1 Class SB. Class SB materials shall have low volume swell (-25 to +10 percent) in oils having an aniline point of 69.5 ± 1.0C (157.1 ± 1.8F).

4.1.2.2 Class SC. Class SC materials shall have medium volume swell (+10 to +60 percent) in oils having an aniline point of 69.5 ± 1.0C (157.1 ± 1.8F).

4.1.3 Type T - High and low temperature resistant. Type T materials shall be made from synthetic rubber.

4.1.4 Type U - Medium temperature resistant foam. Type U materials shall be made from synthetic rubber.

4.1.5 Type V - Heat sealable foam. Type V materials shall be made from a thermoplastic.

4.2 Physical properties. The physical properties of cellular elastomeric materials are based on test slabs and shall conform to the values established in tables I through VII as determined by the applicable tests prescribed in section 5.

4.2.1 Special requirements designated by additional suffix letters.

4.2.1.1 Resistance to ozone (suffix C1). Specimens shall show no evidence of cracking when examined following testing in conformance with the applicable requirements of 5.1.3.1.

4.2.1.2 Resistance to tear (suffix G). Specimens shall be prepared and tested in conformance with the applicable requirements of 5.1.3.2. Unless otherwise specified, the tear resistance shall not be less than two pounds per inch of thickness of type U. Values for R, S, T and V shall be as specified in the applicable procurement document.

4.2.1.3 Adhesion to metal with cemented bond made after fabrication of end item (suffix K2). Specimens shall be prepared and tested in conformance with the applicable requirements of 5.1.3.3. Unless otherwise specified the adhesion value shall not be less than 15 pounds per inch of width. This requirement shall be considered as having been met if the rubber-to-metal test specimen fails in the rubber prior to the attainment of the 15 pounds per inch of width load.

4.2.1.4 Thermal conductivity (suffix V). Specimens shall be prepared and tested in conformance with the applicable requirements of 5.1.3.4. Unless otherwise specified, the coefficient of heat transfer (K factor) shall be no more than 0.30 BTU per hour per square foot per degree Fahrenheit per inch of thickness, measured at 70 to 90F.)

4.2.1.5 Special requirements (suffix Z). It shall be the responsibility of the procuring activity to establish a criterion for determining conformance with any special requirements that the procuring activity may require.

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.

5.1.1.1 Indentation load deflection (for types R and V).

5.1.1.1.1 Apparatus. An apparatus shall be used for this test, having a flat circular indentor foot 50 square inches in area (7.98 inch in diameter) connected to a load measuring device by means of a ball and socket, or universal joint, and mounted in such a manner that the test specimen can be deflected at a rate between 0.5 inch and 25 inches per minute for type R material, and between 0.5 inch and 20 inches per minute for type V material. A maximum radius of 2mm. (0.0787 in.) is allowable on the edge of the indentor foot.

5.1.1.1.2 Test specimens. The test specimens shall be not less than 12 inches by 12 inches. The thickness of the test specimens shall be not less than 3/4 inch for type R and not less than 1 inch for type V. For type V material, if the thickness is under 1 inch, the samples shall be plied without the use of cement to a minimum thickness of 1 inch. If the sample thickness is 1 inch or over, it shall be used as it is.

5.1.1.1.3 Procedure. The test specimen shall be placed in position on the supporting plate of the apparatus. In case the specimen has one side cored or honeycombed, this face shall rest on the perforated plate. The specimen shall be such that the indentation will be made at the center except where the contour of the specimen makes this impractical. The indentor foot shall be brought into contact with the specimen and the original height shall be determined after applying a total preload of 1 pound. The specimen shall then be compressed 25 percent of this original height. The compression shall be maintained at 25 percent deflection with automatic or manual control and the load in pounds shall be recorded 5 seconds after the 25 percent deflection is reached for type R material or 60 seconds after the 25 percent deflection is reached for type V material. Unless otherwise specified the specimens for compression readings shall be conditioned undeflected and undistorted at a temperature of 23 ± 1C (73.4 ± 1.8F) for at least 12 hours before being tested. Three specimens shall be tested and results reported as the average of the tests on the three different test specimens.

5.1.1.2 Indentation load deflection (for type U). This test method shall be the same as 5.1.1.1 except that the specimen shall be preconditioned (deflected twice to 25 ± 5 percent of original height and allowed to rest 10 ± 5 minutes) prior to testing and the minimum specimen size shall be 15 inches by 15 inches by 3/4 inch. Record load 60 seconds after the 25 percent deflection is reached.

5.1.1.3 Indentation load deflection after air oven aging. The apparatus shall be the same as described in ASTM Method D573 and the test specimens and procedures used in the aging test shall be as specified for the appropriate material. Exposure temperature and duration of test shall be as specified in the applicable table. Three specimens shall be tested and results reported as the average of the tests on the three different test specimens.

5.1.1.4 Compression set under constant deflection (for type R foam). The apparatus and test procedures shall be as prescribed in method B of ASTM Method D395 except as follows: Uncored test specimens shall be cylinders 1.129 inches in diameter and 3/4 inch minimum thickness. Cored test specimens shall have the minimum dimension on the bottom and top surfaces greater than the height of the specimen and the surface shall have a minimum area of 16 square inches. Test specimens shall be compressed 50 percent of their original thickness. Chromium-plated metal plates are not required. Results shall be expressed as percent of original height and percent of original deflection. Three specimens shall be tested and the mean value recorded.

5.1.1.5 Compression set under constant deflection (for type R-sponge and type S). This test method is the same as 5.1.1.4 except that the minimum specimen thickness shall be 1/4 inch. Only the compression set based on original deflection shall be required.

5.1.1.6 Compression set under constant deflection (for type U). This test method is the same as 5.1.1.4 except that the uncored specimens shall be 2 inch by 2 inch by 1 inch. Specimens less than 1 inch in height may be plied up, without the use of cement, to a 1 inch height. The height of cored specimens shall be no greater than 75 percent of the minimum top dimension. All measurements, conditioning and recovery shall be conducted at 23 ± 1C (73.4 ± 1.8F) and in an atmosphere of 50 ± 2 percent relative humidity. Specimens shall be conditioned for 3 hours prior to testing at 70 ± 1C (158 ± 1.8F).

5.1.1.7 Compression set under constant deflection (type V). This test method is the same as 5.1.1.4 except that the specimens shall be round or rectangular and the minimum dimension across the top shall be at least 1.0 times the thickness and at least 1 square inch in area. The minimum thickness shall be 1/2 inch. The specimen after release from clamping device shall be conditioned for 2 hours at 70 ± 1C (158 ± 1.8F) and 1 hour at 23 ± 1C (73.4 ± 1.8F) prior to making final height measurement. Only the compression set based on original height shall be required.

5.1.1.8 Compression deflection (for type R-sponge and types S and T).

5.1.1.8.1 Apparatus. Any compression machine which meets the following requirements shall be satisfactory. The machine shall be capable of compressing the specimen at a rate of 0.5 to 2 inches per minute gently without impact. The machine shall be motor or hand driven. It shall be equipped with a gage to measure the deflection caused by the increase in load. The rate of compression of the sample is specified rather than the rate of the compressing platform of the machine. This is an important consideration when scales are used, since sponges of various compression-deflection characteristics will require different times to compress 25 percent due to the travel of the scale platform under varying loads. The deflection shall be read on a dial gage graduated in thousandths of an inch. No gage is necessary if the machine automatically compresses the sample 25 percent.

5.1.1.8.2 Test specimen. The test specimens shall be disks 1.129 inch in diameter. The minimum thickness shall be 1/2 inch. Thin samples may be plied-up without the use of cement to obtain this thickness.

5.1.1.8.3 Procedure. The test specimen shall be compressed between the parallel metal plates of the machine until the thickness has been reduced 25 percent, and the reading of the load taken immediately. The test shall be repeated with the same sample until the load readings do not change more than 5 percent. The top and bottom plates shall be at least 1.5 inch in diameter. The load required to produce a 25 percent compression on a 1 square inch specimen area shall be recorded in psi. Three specimens shall be tested and the mean value recorded.

5.1.1.9 Compression deflection (for type U). This test method is the same as 5.1.1.8 except that the deflection rate is not specified. The specimen size shall be a minimum of 2 square inches in area and a minimum of 1 inch in height. The specimen shall be conditioned bytwice compressing to 25 ± 5 percent of its original height and allowing it to rest for 10 ± 5 minutes prior to testing. Original height shall be determined after applying a preload of 0.02 pound per square inch of the specimen area. Compress 25 percent and observe the load after 60 seconds.

5.1.1.10 Compression deflection (for type V). This test method is the same as 5.1.1.8 except that the deflection rate shall be between 1/2 and 20 inches per minute and the final load in pounds shall be observed 60 seconds after the 25 percent deflection is reached. The minimum thickness shall be 1/4 inch.

5.1.1.11 Compression deflection after air oven aging. The apparatus shall be the same as described in ASTM Method D573 except that the test specimen used in the test shall be as specified for the appropriate material.

5.1.1.12 Volume change in ASTM No. 3 Oil. The test method and procedure shall be the same as described in ASTM method D471 except that the specimens shall be cylinders 1.129 inches in diameter and 1/2 inch in thickness. Results of the average of three specimens shall be reported.

5.1.1.13 Steam autoclave test (for type U).

5.1.1.13.1 Test specimens. The test specimen shall be 2 inches by 2 inches by 1 inch.

5.1.1.13.2 Procedure. Dry the specimens initially for 3 hours at 70 ± 1C (158 ± 1.8F) in a mechanically converted dry-air oven. Remove the specimens from the oven and allow them to come to an equilibrium in at least 2 and no more than 24 hours at 23 ± 1C (73.4 ± 1.8F) and an atmosphere of 50 ± 2 percent relative humidity. Test the specimens for compression load deflection as prescribed in 5.1.1.9. Carry out the steam autoclave test in an autoclave or similar vessel. Fill the autoclave with fresh distilled water to a level 2 inches above the bottom of the autoclave. Set the thermostat control at the desired conditions of test (102-107C (216 to 225F) 1 to 4 psig) and allow the autoclave to heat until the water boils. Place the specimen on edge on a rack in the inside container so that one specimen does not touch another or any metal except at the supporting surface. Place the container inside the autoclave and close and tighten the top. Leave the safety valve open until all the air is out of the autoclave. This is apparent when steam begins blowing out of the ports on the safety valve. Close the valve 2 minutes after the appearance of steam and take the zero time of the test at this point. After 3 hours at test conditions, turn off the heat, release the steam pressure, and remove the specimens. Dry the specimens as initially, and allow to cool at ambient temperature and humidity. Test each specimen for compression load deflection as prescribed in 5.1.1.9 and compression set as prescribed in 5.1.1.6.

5.1.1.13.3 Calculations. Calculate the percentage compression load deflection loss, as follows:

$$\text{Compression load deflection loss} = \frac{L_o - L_1}{L_o} \times 100$$

where

L_o = original compression load deflection, and

L_1 = compression load deflection after steam autoclave test.

Calculate the compression set in accordance with 5.1.1.6 and designate it as the steam autoclave test compression set. In all cases three specimens shall be tested and the mean value recorded.

5.1.1.14 Static fatigue (for type V).

5.1.1.14.1 Apparatus. An oven as described in ASTM method D395 is required as well as two compression plates of adequate size and material approximately 3 by 6 inches to hold the sample in the correct position.

5.1.1.14.2 Test specimen. The test specimen shall be a cut strip 2 by 10 inches by not more than 1 inch thick. It may or may not have skin on one 2 by 10 inch surface.

5.1.1.14.3 Procedure. Bend the 2 by 10 inch specimen of foam parallel to the 2 inch dimension to an angle of 180 degrees, place between two compression plates, and then place in a circulating hot air oven at 70 ± 1C (158 ± 1.8F) for 22 hours. The opening between the two plates shall be equal to twice the thickness of the unfolded specimen. The folded edge of the specimen shall not extend beyond the edge of the compression plates. Fold the skin side, if present, outward for testing. The specimen shall show no cracks at the end of the test. Three specimens shall be tested. If one or more of the specimens show evidence of cracking, the test shall be cause for rejection.

5.1.1.15 Compression deflection after heat aging. The apparatus and test procedures shall be the same as described in ASTM D865 except that the test specimens shall be as required for the appropriate material.

5.1.1.16 Compression set under constant deflection (for type T). This test method is the same as 5.1.1.4 except that the exposure temperature shall be 100 ± 1C (212 ± 1.8F) and the compression set based on original deflection only is required.

5.1.1.17 Compression deflection at low temperature (for type T).

5.1.1.17.1 Apparatus. The apparatus shall consist of two parallel plates at least 1.5 inch in diameter, one of which is movable and the other stationary, a means of applying a load, and a means of accurately measuring the distance between the parallel plates. Suitable low temperature cabinets and conditioning procedures are described in ASTM Recommended Practice D832.

5.1.1.17.2 Test specimens. Cylinders 1.129 inch in diameter shall be used for this test. The minimum thickness shall be 1/2 inch. The thickness shall be measured and recorded. Specimens shall be dried in a desiccator for not less than 16 hours prior to testing.

5.1.1.17.3 Procedure. The compression deflection of the specimen shall first be measured at room temperature as prescribed in 5.1.1.8, 5.1.1.9 or 5.1.1.10, as applicable, and the load in pounds per square inch necessary to obtain a 25 percent deflection recorded. The specimen shall then be placed in the low temperature cabinet for 5 hours at the specified temperature, at the end of which time the previously determined load shall be applied as rapidly as possible. While the specimens are still in the low temperature cabinet, the deflection is recorded 30 seconds later. The result shall be expressed as the average of tests on three different test specimens.

5.1.1.17.4 Calculation. The percentage change in deflection shall be calculated as follows:

$$C = \frac{D - E}{D} \times 100$$

where:
C = percentage change in deflection.
D = deflection at room temperature.
E = deflection at temperature of test.

5.1.2 Suffix letter requirements. Testing for conformance with suffix letter requirements shall be accomplished in conformance with the following tests in order to determine compliance with the applicable requirements of section 4.

5.1.2.1 Compression deflection after heat aging (suffixes A1 and A2). The apparatus and procedure shall be the same as prescribed in ASTM Method D573 except that the test specimens used in the aging test shall be as required in 5.1.1.9. The exposure temperature and duration of test shall be as specified in 3.2.

5.1.2.2 Compression deflection after heat aging (suffix A_4). This test method shall be the same as that prescribed in 5.1.1.15 except that the exposure time and temperature shall be 22 hours at +175C ± 2C (+347 ± 3.6F).

5.1.2.3 Compression set (suffix B). This test method is the same as prescribed in 5.1.1.5.

5.1.2.4 Volume change in ASTM No. 3 Oil (Suffix E). This test method is the same as prescribed in 5.1.1.12.

5.1.2.5 Compression deflection at Low Temperature (Suffixes F1 and F2) (for types R, S and V). This test method is the same as 5.1.1.17 except that the exposure temperature shall be as specified in the applicable table and the minimum thickness shall be 1/4 inch. Plied up samples shall not be used.

5.1.2.6 Compression deflection at low temperature (Suffix F1) (for Type U). This test method is the same as 5.1.1.17 except that the specimen shall be a minimum of 2 square inches in area and a minimum of 1 inch in height. The original height shall be determined after applying a preload of 0.02 pounds per square inch of specimen area.

5.1.2.7 Compression deflection at low temperature (Suffix F3) (for Type T). This test method is the same as that prescribed in 5.1.1.17 except that the exposure temperature shall be -75 ± 2C (-103 ± 3.6F).

5.1.2.8 Dynamic flexing (Suffix H) (for Type R Foam).

5.1.2.8.1 Apparatus. The apparatus used for this test shall have two flat horizontal plates at least 1/4 inch larger on each side than the specimen. The top plate shall be suitably connected to a reciprocating mechanism that will oscillate at the rate of 60 cycles per minute in a direction normal (perpendicular) to the plate surfaces. The bottom plate shall be stationary and perforated with 0.25 inch diameter holes on 0.75 inch centers to allow the rapid escape of air during the test. The machine must be so designed that the space between the two plates can be adjusted to the height of the sample. The stroke of the machine shall be at least 50 percent of the specimen thickness.

5.1.2.8.2 Test specimen. The specimen shall have parallel upper and lower surfaces, and be at least 12 by 12 inches. It shall represent the entire article where possible. The full thickness of the article shall be used. Three specimens shall be tested and results reported as the average of the tests on three different test specimens.

5.1.2.8.3 Procedure. The indentation load deflection shall be measured in accordance with 5.1.1.1. For products having an indentation load deflection value of less than 67 pounds per 50 square inches (1.34 psi), the amplitude of compression and decompression shall be 50 percent of the original thickness. For products having an indentation load deflection value greater than 67 pounds per 50 square inches (1.34 psi) the amplitude shall be 25 percent of the original thickness. The test specimen shall be placed carefully on the stationary plate of the flexing machine. In case the product has one face cored or honeycombed that side shall rest on the perforated plate. The machine shall then be started oscillating at 60 cycles per minute and the total number of flexures recorded continuously by means of a counter. The sample shall be flexed 250,000 cycles. Failure of the specimen is evidenced by physical breakdown of the cellular structure as determined by visual examination and comparison with unflexed specimens.

5.1.2.8.4 Calculations. Compression set after flexing shall be calculated as described in 5.1.1.4.

5.1.2.9 Dynamic flexing (Suffix H) (for Type V). This test method shall be the same as prescribed in 5.1.2.8 except that after flexing, the specimen is allowed to rest for 24 hours at 23 ± 1C (73.4 ± 1.8F) and the compression set then determined as in 5.1.1.7.

5.1.2.10 Water absorption (Suffix L).

5.1.2.10.1 Test specimens. Test specimens approximately 1/2 inch in thickness and 4 square inches in area shall be used for this test. Round specimens are preferable. The test specimens shall have the natural skin on the top and bottom surfaces of the specimen.

5.1.2.10.2 Procedure. The weight shall be obtained to the nearest 0.01 gram. Specimens shall be submerged in distilled water at 23 ± 1C (73.4 ± 1.8F) 2 inches below the surface of the water, and subjected to a vacuum of 25 inches of mercury for 3 minutes. The vacuum shall be released, and the specimens allowed to remain submerged for 3 minutes at atmospheric pressure. The specimen shall then be removed, blotted dry, and the increase in weight determined. The result shall be expressed as the average of tests on three different test specimens.

5.1.2.10.3 Calculation. The results shall be expressed as the percent of water absorbed by weight. Calculate the results as follows:

$$C = \frac{A}{B} \times 100$$

where:
C = percent water absorbed.
A = increase in weight, in grams.
B = original weight, in grams.

5.1.2.11 Flammability (Suffix M). The apparatus and procedure shall be the same as that described in ASTM method D1692.

5.1.3 Additional suffix letter requirements.

5.1.3.1 Resistance to ozone (Suffix C1). Test method and procedure shall be as described in ASTM Method D1149 except as follows: Test specimen size shall be 1 inch wide, 3-3/4 inches long and 1/4 to 1/2 inch thick. Specimens shall be mounted, with molded skin side out, in accordance with the requirements of ASTM Method D518, 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. Not less than three specimens from each item being tested for conformance to this suffix letter shall be tested. Samples shall be exposed for 70 hours to an ozone concentration of 50 ± 3 parts per hundred million of air by volume at a temperature of 40 ± 1C (104 ± 1.8F). At the end of the exposure time the specimen shall be examined under a two power magnifier.

5.1.3.2 Resistance to tearing (Suffix G).

5.1.3.2.1 Apparatus. Tear resistance shall be measured on a power-driven apparatus which will indicate the final load at which rupture of the specimen takes place. An automatic machine may be used which draws the actual curve; or has an indicator which remains at the point of maximum load after rupture. The rate of travel of the power-actuated grip shall be 2 inches per minute and uniform at all times.

5.1.3.2.2 Test specimens. The test specimens shall be block shaped and 1 inch wide by 6 inches longe by 1 inch in thickness. They may be cut on a saw or die cut from sheet material so that the sides are parallel and perpendicular to each other. A 1-1/2 inch cut, parallel to the long dimension, shall be made through the full thickness of the specimen at one end in the center of the 1 inch width.

5.1.3.2.3 Procedure. Spread the block so that each tab of the specimen is held in a jaw of the testing machine. The test specimen shall be clamped across its 1/2 inch tab thickness. Care should be exercised in clamping the test specimen so that it is held firmly in the jaws without cutting the specimen surface. Apply the load with a jaw speed of 2 inches per minute. Aid the cut in the specimen with a razor blade or knife, so as to keep it in the center of the block. After rupture of the specimen, or after at least a 2 inch length is torn, record the maximum breaking load in pounds and note also the thickness of the specimen.

5.1.3.2.4 Calculation. Calculate the resistance to tear from the maximum load and the average thickness of the specimen and express it as the pull in pounds required to tear a specimen 1 inch in thickness. Three specimens shall be tested and the mean value reported.

5.1.3.3 Adhesion to metal with cemented bond made after fabrication of end item (Suffix K2). The test method shall be as described in ASTM Method D429, Method B, except that the individual standard test specimens shall be prepared by bonding the particular cellular material under test to the metal under test using the procedures and recommendations outlined by the manufacturer of the cement. The test shall be run in triplicate and the results averaged.

5.1.3.4 Thermal conductivity (Suffix V). See ASTM Method C177.

5.1.3.5 Special requirements (Suffix Z). See 4.2.1.5.

6. NOTES

6.1 Supersession data. This standard supersedes MIL-STD-670A, dated 9 January 1963. This standard and specification MIL-C-3133B also supersede MIL-C-3133. This standard establishes a classification system and tests for cellular elastomeric materials. Specification MIL-C-3133B establishes requirements for the fabricated parts of cellular elastomeric materials.

Custodians:
Army - MR
Navy - AS
Air Force - 11

Preparing Activity:
Army - MR

Review Activities:
Army - EL, GL, MI, MD, MU
Navy - AS
Air Force - 85

User Activities:
Navy - SH

(Project No. 9320-0090)

TABLE I. *Physical requirements of type R — latex foam rubber*[1]

Test:	Basic requirements				Suffix letter requirements		
	Indentation Load Deflection @ 25% Deflection	Indentation Load Deflection After Air Oven Aging	Compression Set Under Constant Deflection (50%)		Compression Deflection at Low Temperature (Suffix F1)	Dynamic Flexing (Suffix H)	
Time/Temperature:	23±3C(73±5F)	22 hours/100±1C (212±1.8F)	22 hours/70±1C (158±1.8F)		5 hours/-40±2C (-40±3.6F)	23±3C(73±5F)	
Units:	limits, lbs	Change from original indentation load deflection, (limits), %	Max. %		Change from original compression deflection Max. %	Compression Deflection at	
			C_h[2]	C_d[3]		C_h[2]	C_d[3]
Test Reference Par. No.:	5.1.1.1	5.1.1.1 and 5.1.1.8	5.1.1.4		5.1.1.8 and 5.1.1.17	5.1.1.6	
Grade numbers							
RC 5	5 ± 3	± 20	10	20	75	5	10
RC 10	10 ± 3	± 20	10	20	75	5	10
RC 15	15 ± 4	± 20	10	20	75	5	10
RC 20	20 ± 4	± 20	10	20	75	5	10
RC 25	25 ± 5	± 20	10	20	75	5	10
RC 30	30 ± 6	± 20	10	20	75	5	10
RC 40	40 ± 7	± 20	10	20	75	5	10
RC 50	50 ± 8	± 20	10	20	75	5	10
RC 60	60 ± 9	± 20	10	20	75	5	10
RC 70	70 ± 12	± 20	10	20	75	5	10
RC 90	90 ± 14	± 20	10	20	75	5	10
RU 11	11 ± 4	± 20	10	20	75	5	10
RU 20	20 ± 5	± 20	10	20	75	5	10
RU 35	35 ± 10	± 20	10	20	75	5	10
RU 55	55 ± 10	± 20	10	20	75	5	10
RU 80	80 ± 15	± 20	10	20	75	5	10
RU 150	150 ± 55	± 20	10	20	75	5	10

[1] See ASTM D 1055.

[2] C_h expressed as percent of original height.

[3] C_d expressed as percent of original deflection.

TABLE II. *Physical requirements of type R — sponge and expanded cellular rubber*

Test:	Basic requirements			Suffix letter requirements		
	Compression Deflection at 25% Deflection	Compression Deflection After Air Oven Aging	Compression Set Under Constant Deflection (50%)	Compression Deflection at Low Temperature (Suffix F1)	Compression Deflection at Low Temperature (Suffix F2)	Water Absorption (Suffix L)
Time Temperature:	23±3C(73±5F)	7 days/70±1C (158±1.8F)	22 hours/70±1C (158±1.8F)	5 hours/-40±2C (-40±3.6F)	5 hours/-55±2C (-67±3.6F)	3 min./Room Temperature
Units:	Limits, psi	Change from original compression deflection (limits), %	Max. %	Change from original compression deflection Max. %	Change from original compression deflection Max. %	Max. %
Test Reference Par. No.:	5.1.1.8	5.1.1.8 and 5.1.1.11	5.1.1.5	5.1.1.8 and 5.1.2.5	5.1.1.8 and 5.1.2.5	5.1.2.10
Grade numbers						
RO 1	1 + 1, — ½	± 20	15	25	25	.....
RO 3	3 + 2, - 1	± 20	15	25	25	.....
RO 7	7 ± 2	± 20	15	25	25	.....
RO 11	11 ± 2	± 20	15	25	25	.....
RO 15	15 ± 2	± 20	15	25	25	.....
RO 20	20 + 4, - 3	± 20	15	25	25	.....
RE 3	3 + 2, - 1	.....	.....	.....	.....	5
RE 7	7 ± 2	.....	.....	.....	.....	5
RE 11	11 ± 2	.....	.....	.....	.....	5
RE 15	15 ± 2	.....	.....	.....	.....	5
RE 20	20 + 4, - 3	.....	.....	.....	.....	5

[1] See ASTM D 1564.

TABLE III. *Physical requirements of type S, class SB — sponge, foam and expanded cellular rubber*[1]

Test:	Basic requirements				Suffix letter requirements	
	Compression Deflection at 25% Deflection	Compression Deflection After Air Oven Aging	Compression Set Under Constant Deflection (50%)	Volume Change	Compression Deflection at Low Temperature (Suffix F1)	Water Absorption (Suffix L)
Time/	23±3C(73±5F)	7 days/70±1C (158±1.8F)	22 hours/70±1C (158±1.8F)	22 hours/70±1C (158±1.8F) ASTM No. 3 Oil	5 hours/-40±2C (-40±3.6F)	3 min./Room Temperature
Immersion Media:						
Units:	limits, psi	Change from original compression deflection (limits), %	Max. %	limits, %	Change from original compression deflection Max. %	Max. %
Test Reference Par. No.:	5.1.1.8	5.1.1.8 and 5.1.1.11	5.1.1.6	5.1.1.12	5.1.1.8 and 5.1.2.5	5.1.2.10
Grade numbers						
SBO 1	1 + 1, — ½	± 20	40	— 25 to + 10	50	.....
SBO 3	3+2,-1	± 20	40	— 25 to + 10	50	.....
SBO 7	7 ± 2	± 20	40	— 25 to + 10	50	.....
SBO 11	11 ± 2	± 20	40	— 25 to + 10	50	.....
SBO 15	15 ± 2	± 20	40	— 25 to + 10	50	.....
SBO 20	20+4, -3	± 20	40	— 25 to + 10	50	.....
SBE 3	3+2, -1	.....	.....	.....	.....	5
SBE 7	7 ± 2	.....	.....	.....	.....	5
SBE 11	11 ± 2	.....	.....	.....	.....	5
SBE 15	15 ± 2	.....	.....	.....	.....	5
SBE 20	20+4, -3	.....	.....	.....	.....	5

[1] See ASTM D 1056.

TABLE IV. *Physical requirements of type S, class SC — sponge, foam and expanded cellular rubber*[1]

Test:	Basic requirements				Suffix letter requirements		
	Compression Deflection at 25% Deflection	Compression Deflection After Air Oven Aging	Compression Set Under Constant Deflection (50%)	Volume Change	Compression Set Under Constant Deflection (50%) (Suffix B)	Compression Deflection at Low Temperature (Suffix F1)	Water Absorption (Suffix L)
Time/ Temperature	23±3C(73±5F)	7 days/70±1C (158±1.8F)	22 hours/70±1C (158±1.8F)	22 hours/70±1C (158±1.8F)	22 hours/70±1C (158±1.8F)	5 hours/-40±2C (-40±3.6F)	3 min./Room Temperature
Immersion Media:				ASTM No. 3 Oil			Water
Units:	limits, psi	Change from original compression deflection, (limits), %	Max. %	limits, %	Max. %	Change from original compression deflection, Max. %	Max. %
Test Reference Par. No.:	5.1.1.3	5.1.1.3 and 5.1.1.11	5.1.1.5	5.1.1.12	5.1.1.5	5.1.1.3 and 5.1.2.5	5.1.2.10
Grade numbers							
SCO 1	1 + 1, — ½	± 20	50	+ 10 to + 60	25	50	.....
SCO 3	3+2, - 1	± 20	50	+ 10 to + 60	25	50	.....
SCO 7	7 ± 2	± 20	50	+ 10 to + 60	25	50	.....
SCO 11	11 ± 2	± 20	50	+ 10 to + 60	25	50	.....
SCO 15	15 ± 2	± 20	50	+ 10 to + 60	25	50	.....
SCO 20	20+4, - 3	± 20	50	+ 10 to + 60	25	50	.....
SCE 3	3+2, - 1	.....	.....	.....	.....	.....	5
SCE 7	7 ± 2	.....	.....	.....	.....	.....	5
SCE 11	11 ± 2	.....	.....	.....	.....	.....	5
SCE 15	15 ± 2	.....	.....	.....	.....	.....	5
SCE 20	20+4, - 3	.....	.....	.....	.....	.....	5

[1] See ASTM D 1056.

TABLE V. *Physical requirements of type T — extreme temperature resistant cellular rubber* -75 to +175C (-103 to +347F)

Test:	Basic requirements				Suffix letter requirements		
	Compression Deflection at 25% Deflection	Compression Deflection After Heat Aging	Compression Deflection at Low Temperature	Compression Set Under Constant Deflection (50%)	Compression Deflection After Heat Aging (Suffix A4)	Compression Deflection at Low Temperature (Suffix F3)	Water Absorption (Suffix L)
Time/ Temperature	23±3C(73±5F)	22 hours/150±2C (302±3.6F)	5 hours/-55±2C (-67±3.6F)	22 hours/100±1C (212±1.8F)	22 hours/175±2C (347±3.6F)	5 hours/-75±2C (-103±3.6F)	8 min./Room Temperature
Immersion Media:							Water
Units:	Limits, psi	Change from original compression deflection, (Limits), %	Change from original compression deflection, Max. %	Max. %	Change from original compression deflection, (Limits), %	Change from original compression deflection, Max. %	Max. %
Test Reference Par. No.:	5.1.1.9	5.1.1.8 and 5.1.1.15	5.1.1.8 and 5.1.1.17	5.1.1.16	5.1.1.8 and 5.1.2.2	5.1.1.8 and 5.1.2.7	5.1.2.10
Grade numbers							
TO 3	3 ±1½	±5	5	50	±25	25	- - - - - -
TO 7	7 ±2	±5	5	30	±25	25	- - - - - -
TO 12	12 ±3	±5	5	30	±25	25	- - - - - -
TO 18	18 ±3	±5	5	30	±25	25	- - - - - -
TO 25	25 ±4	±5	5	30	±25	25	- - - - - -
TE 3	3 ±1½	±5	5	80	- - - - - -	- - - - - -	5
TE 7	7 ±2	±5	5	60	- - - - - -	- - - - - -	5
TE 12	12 ±3	±5	5	60	- - - - - -	- - - - - -	5
TE 18	18 ±3	±5	5	60	- - - - - -	- - - - - -	5
TE 25	25 ±4	±5	5	60	- - - - - -	- - - - - -	5

TABLE VI. *Physical requirements of type U — medium temperature resistant foam* -40 to +125C (-40 to +257F)[1]

Test:	Basic requirements						Suffix letter requirements		
	Indentation Load Deflection at 25% Deflection	Compression Set Under Constant Deflection (50%)		Compression Deflection at 25% Deflection	Compression Set Under Constant Deflection (50%) After 3 hours		Compression Deflection After Heat Aging (Suffix A2)	Volume Change (Suffix E)	Compression Deflection at Low Temperature (Suffix F1)
Time/ Temperature:	23±3C(73±5F)	22 hours/70±1C (158±1.8F)		3 hours/ 102 To 107C (216 To 225F) Steam	In 102 To 107C (216 to 225F) Steam and 22 hours/70±1C (158±1.8F)		22 hours/125±1C (257±1.8F)	22 hours/70±1C (158±1.8F) ASTM No. 3 Oil	5 hours/-40±2C (-40±3.6F)
Immersion Media:									
Units:	Inches	Max. % C_b[2]	C_d[3]	Change from original compression deflection, Max. %	Max. % C_b[2]	C_d[3]	Change from original compression deflection, (limits), %	limits, %	Change from original compression deflection, Max. %
Test Reference Par. No.:	5.1.1.2	5.1.1.6		5.1.1.9 and 5.1.1.13	5.1.1.6 and 5.1.1.13		5.1.1.9 and 5.1.2.1	5.1.1.12	5.1.1.9 and 5.1.2.6
Grade numbers									
UC 10	10 ± 3	10	20	20	15	30	± 20	— 25 to + 10	100
UC 15	15 ± 4	10	20	20	15	30	± 20	— 25 to + 10	100
UC 20	20 ± 4	10	20	20	15	30	± 20	— 25 to + 10	100
UC 25	25 ± 5	10	20	20	15	30	± 20	— 25 to + 10	100
UC 30	30 ± 6	10	20	20	15	30	± 20	— 25 to + 10	100
UU 10	10 ± 3	10	20	20	15	30	± 20	— 25 to + 10	100
UU 15	15 ± 4	10	20	20	15	30	± 20	— 25 to + 10	100
UU 20	20 ± 4	10	20	20	15	30	± 20	— 25 to + 10	100
UU 25	25 ± 5	10	20	20	15	30	± 20	— 25 to + 10	100
UU 30	30 ± 6	10	20	20	15	30	± 20	— 25 to + 10	100

[1] See ASTM D 1564.
[2] C_b expressed as percent of original height.
[3] C_d expressed as percent of original deflection.

TABLE VII. *Physical requirements of type V — thermoplastic (heat sealable) foam*[1]

Test:	Basic requirements					Suffix letter requirements			
	Indentation Load Deflection @ 25% Deflection	Indentation Load Deflection After Air Oven Aging	Compression Deflection @ 25% Deflection	Compression Set Under Constant Deflection (50%) 22 hrs/158 F.	Static Fatigue	Volume Change (Suffix E)	Compression Deflection at Low Temperature (Suffix F1)	Compression Set Under Constant Deflection (50%) After Dynamic Flexing (Suffix H)	Flammability (Suffix M)
Time/ Temperature:	23±3C(73±5F)	22 hours/100±1C (212±1.8F)	23±3C(73±5F)	22 hours/70±1C (158±1.8F)	22 hours/ 70±1C (158± 1.8F)	22 hours/70±1C (158±1.8F) ASTM No. 3 Oil	5 hours/-40±2C (-40±3.6F)		
Immersion Media:									
Units:	Limits, lbs.	Change from original indentation load deflection, (Limits), %	Limits, psi	Max. %		Limits, %	Change from original compression deflection, Max. %	Max. %	
Test Reference Par. No.:	5.1.1.1	5.1.1.3	5.1.1.16	5.1.1.7	5.1.1.14	5.1.1.12	5.1.1.10 and 5.1.2.6	5.1.2.9	5.1.2.11
Grade numbers									
VC 5	5 ± 3	± 20	.....	15		+ 10 to + 60	100	10	
VC 10	10 ± 3	± 20	.....	15		+ 10 to + 60	100	10	
VC 15	15 ± 4	± 20	.....	15		+ 10 to + 60	100	10	
VC 20	20 ± 4	± 20	.....	15		+ 10 to + 60	100	10	
VC 25	25 ± 5	± 20	.....	15		+ 10 to + 60	100	10	
VC 30	30 ± 6	± 20	.....	15		+ 10 to + 60	100	10	
VC 40	40 ± 7	± 20	.....	15		+ 10 to + 60	100	10	
VC 50	50 ± 8	± 20	.....	15	No cracks	+ 10 to + 60	100	10	
VC 60	60 ± 9	± 20	.....	15		+ 10 to + 60	100	10	
VC 70	70 ± 12	± 20	.....	15		+ 10 to + 60	100	10	
VC 90	90 ± 14	± 20	.....	15		+ 10 to + 60	100	10	
VU 10	10 ± 4	± 20	.....	15		+ 10 to + 60	100	10	Self extinguishing
VU 20	20 ± 5	± 20	.....	15		+ 10 to + 60	100	10	
VU 35	35 ± 10	± 20	.....	15		+ 10 to + 60	100	10	
VU 55	55 ± 10	± 20	.....	15		+ 10 to + 60	100	10	
VU 80	80 ± 15	± 20	.....	15	No cracks	+ 10 to + 60	100	10	
VU 150	150 ± 55	± 20	.....	15		+ 10 to + 60	100	10	

[1] See ASTM D 1565 and ASTM D 1667.

TABLE VII. *Physical requirements of type V — thermoplastic (heat sealable) foam*[1]*—Continued*

Test:	Basic requirements					Suffix letter requirements			
	Indentation Load Deflection @ 25% Deflection	Indentation Load Deflection After Air Oven Aging	Compression Deflection @ 25% Deflection	Compression Set Under Constant Deflection (50%)	Static Fatigue	Volume Change (Suffix E)	Compression Deflection at Low Temperature (Suffix F1)	Compression Set Under Constant Deflection (50%) After Dynamic Flexing (Suffix H)	Flammability (Suffix M)
Time/ Temperature:	23±3C (73±5F)	22 hours/ 100±1C (212±1.8F)	23±3C (73±5F)	22 hours/ 70±1C (158±1.8F)	22 hours/ 70±1C (158± 1.8F)	22 hours/70±2C (158±3.6F) ASTM No. 3 Oil	5 hours/-40±2C (-40±3.6F)		
Immersion Media:									
Units:	limits, lbs.	Change from original indentation load deflection, (limits), %	limits, psi	Max. %		limits, %	Change from original compression deflection, Max. %	Max. %	
Test Reference Par. No.:	5.1.1.1	5.1.1.3	5.1.1.10	5.1.1.7	5.1.1.14	5.1.1.12	5.1.1.10 and 5.1.2.5	5.1.2.9	5.1.2.11
Grade numbers									
VO 3		± 20	3+2, -1	15	No cracks	+ 10 to + 60	100	10	Self extinguishing
VO 7		± 20	7 ± 2	15		+ 10 to + 60	100	10	
VO 11		± 20	11 ± 2	15		+ 10 to + 60	100	10	
VO 15		± 20	15 ± 2	15		+ 10 to + 60	100	10	
VE 1			1 + 1, — ½						
VE 3			3+2, -1						
VE 7			7 ± 2						
VE 11			11 ± 2						
VE 15			15 ± 2						
VE 20			20+4, -3						

[1] See ASTM D 1565 and ASTM D 1667.

TABLE VIII. *Conversion of specification MIL-C-8158 grade numbers to grade numbers under standard MIL-STD-670B*

Grade No., MIL-C-8158	Grade No., MIL-STD-670B	Grade No., MIL-C-8158	Grade No., MIL-STD-670B
RN 10	RO 1	RS 10	RO 1
RN 11	RO 3	RS 11	RO 3
RN 12	RO 7	RS 12	RO 7
RN 13	RO 11	RS 13	RO 11
RN 14	RO 15	RS 14	RO 15
RN 15	RO 20	RS 15	RO 20
RN 21	RC 10	SB 14	SBO 15
RN 22	RC 20	SB 15	SBO 20
RN 23	RC 30		
RN 24	RC 40	SB 41	SBE 3
RN 25	RC 60	SB 42	SBE 7
RN 26	RC 70	SB 43	SBE 11
RN 27	RC 90	SB 44	SBE 15
RN 28		SB 45	SBE 20
RS 21	RC 10	SC 10	SCO 1
RS 22	RC 20	SC 11	SCO 3
RS 23	RC 30	SC 12	SCO 7
RS 24	RC 40	SC 13	SCO 11
RS 25	RC 60	SC 14	SCO 15
RS 26	RC 70	SC 15	SCO 20
RS 27	RC 90		
RS 28		SC 21	
		SC 22	
RS 31	RU 11	SC 23	
RS 32	RU 20	SC 24	
RS 33	RU 35	SC 25	
RS 34	RU 55	SC 26	
		SC 27	
RS 41	RE 3	SC 28	
RS 42	RE 7		
RS 43	RE 11	SC 31	
		SC 32	
		SC 33	
SB 10	SBO 1	SC 34	
SB 11	SBO 3		
SB 12	SBO 7	SC 41	SCE 3
SB 13	SBO 11	SC 42	SCE 7
		SC 43	SCE 11
RN 31	RU 11	SC 44	SCE 15
RN 32	RU 20	SC 45	SCE 20
RN 33	RU 30		
RN 34	RU 55		
RN 41	RE 3		
RN 42	RE 7		
RN 43	RE 11		

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