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SURFACE VEHICLE STANDARD

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Submitted for recognition as an American National Standard

Standard Method for Determining Continuous Upper Temperature Resistance of Elastomers

1. ***Scope—***This method is intended to define the continuous upper temperature resistance (CUTR) of thermoplastic elastomers and thermoset rubber with durometer hardness ≤90 Shore A, to oxidation or other degradation when exposed solely to hot air for an extended period of time.

1.1 This method established the upper thermal aging limits of commercially available compounds as measured at 23 °C by retention of at least 50% original elongation and tensile at break after 1008 h of heat aging. This method does not take into account nor measure the effects of stress, environment, or temperature variations on the thermal aging characteristics of the materials tested.

1.2 This method may involve hazardous materials, operations, and equipment. This SAE Standard does not address the safety problems associated with its use. It is the responsibility of the user of this document to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

1.3 This test method is based on SI units.

2. ***References***

2.1 **Applicable Publications—**The following publications form a part of this specification to the extent specified herein. Unless otherwise indicate, the latest issue of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J200—Classification System for Rubber Materials
SAE J1344—Marking of Plastic Parts
SAE J3000—Standard Classification System for Thermoplastic Elastomers

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2.1.2 ASTM PUBLICATIONS—Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM D 412—Standard Test Methods for Rubber Properties in Tension, Method A
ASTM D 573—Standard Test Method for Rubber—Deterioration in an Air Oven
ASTM D 1418—Standard Practice for Rubber and Rubber Lattices—Nomenclature
ASTM D 1972—Practice for Generic Marking of Plastic Products
ASTM D 2240—Standard Test Method for Rubber Property—Durometer Hardness

3. Terms Specific to this Standard

3.1 Continuous Upper Temperature Limit (CUTL)—The temperature at which the material retains a 50% minimum of both the original elongation and tensile at break after 1008 h in an air circulating oven per ASTM D 573, Type IIA or IIB. Note per ASTM D 573: Type IIB ovens are not suitable for test temperatures above 70 °C.

3.2 Test Method—A definitive procedure for identification, measurement, and evaluation of one or more qualities, characteristics, or properties of a material, product system, or service that produces a test result.

3.3 Production Compound—An identifiable, homogeneous quantity of material from a standard production period, with a consistency and properties demonstrated through testing and use.

3.4 Commercial Material—A finished compound developed primarily, but not exclusively for heat resistance, from readily available ingredients and processed on conventional industry equipment.

4. Significance and Use

4.1 Data obtained by this method are applicable to the material under conditions of this test and are not necessarily the same as those obtained in end use applications. The information can be used for comparison, selection, or qualification of commercially available compounds where a level of proficiency is desired beyond short time quality control tests.

4.2 Ultimate elongation was selected over other physical property measurements because of its greater sensitivity to the various effects of air oven aging on elastomers. Tensile Strength is also used since some compounds maintain more than 50% of their original elongation while losing considerable tensile strength after heat aging.

4.3 A material classification CUTL represents the highest temperature value the best compound(s) can achieve per Table A1 guidelines (see Appendix A). The materials are classified according to ASTM D 1418, ASTM D 1972, or SAE J1344. Not all compounds within a material category can reach the listed maximum temperature.

4.4 This document requires aging at elevated temperatures in a hot air circulating oven per ASTM D 573, regardless of what is used in SAE J200. Care must be taken to test only similar generic compounds (i.e., silicone to silicone) in order to avoid cross contamination from volatile products and subsequent variation in test data.

5. General Test Conditions

5.1 Unless otherwise specified, the material shall be tested to ASTM D 412, Method A requirements at 23 °C.

5.2 Aging Temperatures—Variation around a specified temperature shall be within ±2 °C.

5.3 Aging Temperature Increments—Unless otherwise specified, test new materials (per SAE J200 Table 1, plus 135 °C and 165 °C) to establish the upper continuous temperature limit to the definition in 3.1. Material tables shall be established using this criterion to minimize testing burden.

5.4 Aging Time—1008 h ± 2 h

5.5 Uniform Aging Conditions—Tests of samples shall ensure that all surfaces be exposed and the temperature uniform.

6. Sample Requirements

6.1 Thermoplastic elastomer and thermoset rubber elongation and tensile at break data used to establish tables or qualify new materials shall be the median of a minimum of five samples per batch from five batches.

6.2 Sample Dimensions for Thermoset Rubber—Follow ASTM D 412 requirements.

6.3 Thermoplastic Elastomers (from SAE J3000)—Unless otherwise noted, samples are to be die-cut from injection molded rectangular plaques 3.0 mm ± 0.4 mm thick. Specimens of other thickness will not necessarily give comparable results. Plaque dimensions must be sufficient to permit this. Five samples are to be tested in the direction of highest tensile strength and the median value is reported for both elongation and tensile at break.

6.4 Certain elastomers may require post curing or conditions to achieve optimum heat resistance properties.

7. Table Requirements

7.1 The material heat resistance table (Table A1) in the appendix shall be developed using temperatures from SAE J200 Table 1, and additional temperatures (135 °C and 165 °C) appropriate to industry needs. If a material meets a temperature requirements, it is presumed that it will meet all lower temperatures.

7.2 Test commercially available compounds to Section 5 conditions for 1008 h. Determine the percent elongation and tensile at break prior to and immediately after the test period per ASTM D 412 for thermoset and thermoplastic materials with durometer hardness of ≤90 Shore A hardness or less.

7.3 Report the results at 23 °C for the number of samples stated in 6.1 and 6.3 per ASTM D 412.

7.4 A material will qualify for inclusion in the temperature classification table (Table A1) when test data satisfies the requirements of 3.1.

8. Precision and Bias

8.1 No precision statement exists for 1008-h oven aging per ASTM D 573. See ASTM D 573 for the precision of oven aging after 48 and 96 h and ASTM D 412 for precision of tensile testing.

9. Notes

9.1 Marginal Indicia—The change bar (|) located in the left margin is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. An (R) symbol to the left of the document title indicates a complete revision of the report.

PREPARED BY THE SAE COMMITTEE ON AUTOMOTIVE
RUBBER SPECIFICATIONS

APPENDIX A

(MANDATORY INFORMATION)
TABLE A1 FORMAT REQUIREMENTS

A.1 Table A1 Requirements

a. To qualify for a temperature type, the material must be a commercially available material, developed primarily, but not exclusively for heat resistance. Rubber materials listed in Table A1 are not blends, they contain 100% of the designated polymer. This does not apply to TPEs which are often blends or multi-phase materials.

b. In order to appear on the table, a material must have a ASTM D 1418, ASTM D 1600, ASTM D 1972, or SAE J1344 nomenclature designation. If a TPE material's nomenclature is designated by more than one code, SAE J1344 shall be the preferred usage code and the additional material designation code shall be listed in Table A1 in parenthesis ().

   1. A prospective command must meet or have a current SAE J200 or J3000 type and class designation.

c. To meet the temperature type defined by Table A1, the material's elongation and tensile strength must retain a minimum of 50% of the original values after 1008 h at that temperature. The temperature classification of a material is based on the median of test results obtained from a minimum of 5 samples from each of 5 batches (see 6.1) from one laboratory. Labs submitting data need not be accredited (see A.1.d.(2)).

d. Challenges to test results will be handled as follows:

   1. Labs or companies wanting to verify test results should make a written request to SAE CARS.
   2. SAE CARS will request the compound originator to send samples, or may take custody of the samples for distribution, to two designated independent, third party labs. The labs must be accredited by a recognized firm such as the American Association of Laboratory Accreditation or Standards Council of Canada. Disclosure of the labs is at the discretion of SAE CARS.
   3. Sample testing will be paid for by the challenger. The challenger cannot access the material directly, nor request material left over from the third party testing.
   4. The challenger and SAE CARS will receive the test results and render a decision.
   5. CARS will be the final arbiter of any disputes and decisions.

e. Thermoplastic Elastomer (TPE) temperature selection is based on the median in the direction of highest tensile strength (see 6.3). Please report all data points, along with the median values.

f. Table temperatures are 70 °C, 100 °C, 125 °C, 135 °C, 150 °C, 165 °C, 175 °C, 200 °C, 225 °C, 250 °C, and 275 °C.

TABLE A1—CUTL OF ELASTOMERS

Nomenclature/Classification	Temperature °C
Rubber	
IR, NR, SBR	70
IIR, CR	100
BIIR, CIIR, CO, ECO, NBR	125
ACM, AEM, EPDM, EVM, HNBr(1)	150
VMQ	175
FKM	225
Thermoplastic Elastomers (≤90A)	
TEO, TES	135

1. Degree of saturation must be 96% or more.