This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

Designation: D573 – 04 (Reapproved 2019)

Standard Test Method for Rubber—Deterioration in an Air Oven[1]

This standard is issued under the fixed designation D573; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 This test method covers a procedure to determine the influence of elevated temperature on the physical properties of vulcanized rubber. The results of this test method may not give an exact correlation with service performance since performance conditions vary widely. This test method may, however, be used to evaluate rubber compounds on a laboratory comparison basis.

1.2 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.* (For specific precautionary statement, see Note 1.)

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D15 Method of Compound and Sample Preparation for Physical Testing of Rubber Products (Withdrawn 1975)[3]

D412 Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension

D1349 Practice for Rubber—Standard Conditions for Testing

D3182 Practice for Rubber—Materials, Equipment, and Procedures for Mixing Standard Compounds and Preparing Standard Vulcanized Sheets

D3183 Practice for Rubber—Preparation of Pieces for Test Purposes from Products

D3184 Practice for Rubber—Evaluation of NR (Natural Rubber)

D3185 Test Methods for Rubber—Evaluation of SBR (Styrene-Butadiene Rubber) Including Mixtures With Oil

D4483 Practice for Evaluating Precision for Test Method Standards in the Rubber and Carbon Black Manufacturing Industries

E145 Specification for Gravity-Convection and Forced-Ventilation Ovens

3. Summary of Test Method

3.1 Specimens of vulcanized rubber are exposed to the deteriorating influence of air at specified elevated temperatures for known periods of time, after which their physical properties are determined. These are compared with the properties determined on the original specimens and the changes noted.

3.2 Unless otherwise specified, the determination of the physical properties shall be carried out in accordance with Test Methods D412.

3.3 Except as may be otherwise specified in this test method, the requirements of Practices D3182 and D3183 shall be complied with and are made part of this test method.

3.4 In case of conflict between the provisions of this test method and those of detailed specifications or test methods for a particular material, the latter shall take precedence.

4. Significance and Use

4.1 Rubber and rubber products must resist the deterioration of physical properties with time caused by oxidative and thermal aging. This test method provides a way to assess these performance characteristics of rubber, under certain accelerated conditions as specified.

4.2 Please refer to Annex A1 for important information on standard compounds used for precision testing for accelerated test aging evaluation.

[1] This test method is under the jurisdiction of ASTM Committee D11 on Rubber and Rubber-like Materials and is the direct responsibility of Subcommittee D11.15 on Degradation Tests.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] The last approved version of this historical standard is referenced on www.astm.org.

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5. Apparatus

5.1 Type IIB ovens specified in Test Method E145 are satisfactory for use through 70°C. For higher temperatures, Type IIA ovens are necessary.

5.1.1 The interior size shall be as follows or of an equivalent volume:

Interior size of air oven:	
min	300 by 300 by 300 mm (12 by 12 by 12 in.)
max	900 by 900 by 1200 mm (36 by 36 by 48 in.)

5.1.2 Provision shall be made for suspending specimens vertically without touching each other or the sides of the aging chamber.

5.1.3 The heating medium for the aging chamber shall be air circulated within it at atmospheric pressure.

5.1.4 The source of heat is optional but shall be located in the air supply outside of the aging chamber proper.

5.1.5 The temperature should be automatically recorded over the entire test period using a temperature-measuring device capable of measuring at the specified temperature to within ±1°C. Located in the upper central portion of the chamber near the center of the aging specimens. For apparatus not equipped with automatic recording capabilities, temperature shall be measured with sufficient frequency to ascertain that the temperature limits specified in 10.2 are adhered to.

5.1.6 Automatic temperature control by means of thermostatic regulation shall be used.

5.1.7 The following special precautions shall be taken in order that accurate, uniform heating is obtained in all parts of the aging chamber:

5.1.7.1 The heated air shall be thoroughly circulated in the oven by means of mechanical agitation. When a motor-driven fan is used, the air must not come in contact with the fan motor brush discharge because of danger of ozone formation.

5.1.7.2 Baffles shall be used as required to prevent local overheating and dead spots.

5.1.7.3 The thermostatic control device shall be so located as to give accurate temperature control of the heating medium. The preferred location is adjacent to the recording thermometer.

5.1.7.4 An actual check shall be made by means of maximum reading thermometers placed in various parts of the oven to verify the uniformity of the heating.

6. Sampling

6.1 The sample size shall be sufficient to allow for the determination of the original properties on three specimens and also on three or more specimens for each exposure period of the test. At least 24 h must elapse between completion of the vulcanization of the samples and the start of the aging test.

6.2 When minimum requirements are specified, one test on three dumbbells shall be considered sufficient. But if the results are below the specified requirements, two additional specimens shall be prepared from the original sample and tested. Should the results of either of these tests be below the specified requirements, the sample shall be considered to have failed to meet the specifications.

7. Test Specimens

7.1 Dumbbell-shaped specimens prepared as described in Test Methods D412 shall be considered standard. Their form shall be such that no mechanical, chemical, or heat treatment will be required after exposure. If any adjustments (for example, to thickness) are necessary, they should be performed prior to exposure.

7.2 The cross-sectional dimensions of test specimens for calculating the physical properties shall be measured prior to exposure in the aging chamber. Gage lines used for measuring elongation shall be applied after the specimens have been aged. Only specimens of similar dimensions having approximately the same exposed areas may be compared with each other.

8. Number of Test Specimens

8.1 At least three test specimens shall be used to determine the original physical properties of each sample and also three or more specimens of the same material for each exposure period of the test.

8.2 When minimum requirements are specified, one test shall be made for tensile strength and elongation. If the results are below the specified requirements, two additional specimens shall be prepared from the original sample and tested. Should the results of either of these tests be below the specified requirements, the samples shall be considered to have failed to meet the specifications.

9. Tests of Unaged Specimens

9.1 The stress-strain properties or tensile strength and ultimate elongation and any other required properties of the original unaged specimens shall be determined within 96 h of the start of the aging period. Results on specimens that are found to be imperfect shall be discarded and retests shall be made.

9.2 When rubber compounds are to be tested for the purpose of determining compliance with specifications, it shall be permissible to determine the original properties required in 9.1 simultaneously with the determination of the values after the first aging period even though the elapsed time exceeds 96 h.

10. Procedure for Accelerated Aging

10.1 Place the specimens for aging in the oven after it has been preheated to the operating temperature. If possible, avoid simultaneous aging of a mixed group of different compounds. For instance, high-sulfur compounds should not be aged with low-sulfur compounds and those containing antioxidants shall not be aged with those having no antioxidants. Some migration is known to occur.

10.2 The operating temperature may be any elevated standard temperature as shown in Practice D1349, as agreed upon.

NOTE 1—**Caution:** It should be noted that, for each 10°C increase in temperature, the rate of oxidation may be approximately double. With rapid aging types of rubber or those containing or contaminated by certain oxidizing chemicals, the rate of oxidation may be catalyzed to such an extent as to become violent with increasing temperatures.

10.3 Start the aging interval at the time the specimens are placed in the oven and continue for a measured time interval.

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