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AMERICAN SOCIETY FOR TESTING AND MATERIALS
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Standard Practice for Determining Permanent Effect of Heat on Plastics[1]

This standard is issued under the fixed designation D 794; 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.

1. Scope

1.1 This practice is intended to define the conditions for testing the resistance of plastic sheet, plastic laminated materials, and molded plastics to changes in properties due to exposure at elevated temperatures. Only the procedure for heat exposure is specified, and not the test method or specimen. The effect of heat on any property may be determined by selection of an appropriate test method and specimen.

1.2 *This standard does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

NOTE 1—There is no similar or comparable ISO standard.

2. Referenced Documents

2.1 *ASTM Standards:*

D 495 Test Method for High-Voltage, Low-Current, Dry Arc Resistance of Solid Electrical Insulation[2]

D 618 Practice for Conditioning Plastics and Electrical Insulating Materials for Testing[3]

D 756 Practice for Determination of Weight and Shape Changes of Plastics Under Accelerated Service Conditions[3]

D 790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials[3]

D 883 Terminology Relating to Plastics[3]

D 1870 Practice for Elevated Temperature Aging Using a Tubular Oven[4]

E 145 Specification for Gravity-Convection and Forced-Ventilation Ovens[5]

3. Terminology

3.1 *Definitions:* Definitions of terms applying to this practice appear in Terminology D 883.

4. Significance and Use

4.1 Plastic materials exposed to heat may be subject to many types of physical and chemical changes. The severity of the exposures in both time and temperature determines the extent and type of change that takes place. A plastic material is not necessarily degraded by exposure to elevated temperatures, but may be unchanged or improved. However, extended periods of exposure of plastics to elevated temperatures will generally cause some degradation, with progressive change in physical properties.

4.2 Generally, short exposures at elevated temperatures may drive out volatiles such as moisture, solvents, or plasticizers, relieve molding stresses, advance the cure of thermosets, and may cause some change in color of the plastic or coloring agent, or both. Normally, additional shrinkage should be expected with loss of volatiles or advance in polymerization.

4.3 Some plastic materials may become brittle due to loss of plasticizers after exposure at elevated temperatures. Other types of plastics may become soft and sticky, either due to sorption of volatilized plasticiser or due to breakdown of the polymer.

4.4 The degree of change observed will depend on the property measured. Mechanical or electrical properties may not change at the same rate. For instance, the arc resistance, see Test Method D 495, of thermosetting compounds improves up to the carbonization point of the material. Mechanical properties, such as flexural properties, see Test Methods D 790, are sensitive to heat degradation and should be included in the test program.

4.5 Effects of exposure may be quite variable, especially when specimens are exposed for long intervals of time. Factors that affect the reproducibility of data are the degree of temperature control of the enclosure, the type of molding, cure, humidity of the oven room, air velocity over the specimen, and period of exposure. Errors in exposure are cumulative with time. Unless the effect of the molding procedure is a variable under investigation, transfer or injection molding is recommended as the trapped air and volatiles have a better chance to escape. Incompletely cured thermosets tend to blister or crack when exposed to high temperatures. Certain materials are susceptible to degradation due to the influence of humidity in long-term heat resistance tests. Materials susceptible to hydrolysis may undergo degradation when subjected to long-term heat resistance tests.

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[1] This practice is under the jurisdiction of ASTM Committee D-20 on Plastics and is the direct responsibility of Subcommittee D20.50 on Permanence Properties.

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[2] *Annual Book of ASTM Standards*, Vols 08.01 and 10.02.

[3] *Annual Book of ASTM Standards*, Vol 08.01.

[4] *Annual Book of ASTM Standards*, Vols 08.02 and 09.01.

[5] *Annual Book of ASTM Standards*, Vol 14.02.