



Standard Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging¹

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

1. Scope *

1.1 This test method covers procedures for the thermal and humid exposure of rigid cellular plastics. Conditions used shall be agreed upon between the purchaser and the supplier.

NOTE 1—A list of commonly used exposure conditions can be found in Table 1.

1.2 The values stated in SI units are to be regarded as the standard. The values 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 and health practices and determine the applicability of regulatory limitations prior to use.*

NOTE 2—This test method resembles ISO 2796 in title only. The content is significantly different. This test method is equivalent to ISO 2796 in the sampling and calculation sections. It is not equivalent to ISO 2796 in the procedure section.

2. Referenced Documents

2.1 ASTM Standards:

D 883 Terminology Relating to Plastics²

D 1037 Test Methods for Evaluating the Properties of Wood-Base Fiber and Particle Panel Materials³

2.2 ISO Standard:

ISO 2796 Cellular Plastics Rigid—Test for Dimensional Stability⁴

3. Terminology

3.1 The terms given in Terminology D 883 are applicable to this test method.

¹ This test method is under the jurisdiction of ASTM Committee D-20 on Plastics and is the direct responsibility of Subcommittee D20.22 on Cellular Materials—Plastics and Elastomers.

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² Annual Book of ASTM Standards, Vol 08.01.

³ Annual Book of ASTM Standards, Vol 04.09.

⁴ Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.

TABLE 1 Temperature and Relative Humidity Conditions

Temperature, °C (°F)	Relative Humidity, %
-73 ± 3 (-100 ± 6)	ambient
-40 ± 3 (-40 ± 6)	ambient
70 ± 2 (158 ± 4)	ambient
100 ± 2 (212 ± 4)	ambient
150 ± 2 (302 ± 4)	ambient
23 ± 2 (73 ± 4)	50 ± 5
38 ± 2 (100.0 ± 4)	97 ± 3
70 ± 2 (158 ± 4)	97 ± 3
other temperatures and humidities selected for individual needs	

4. Significance and Use

4.1 Because of the wide variety of potential uses of rigid cellular plastics, artificial exposure to estimate the effective behavior of these materials must be based, to a great extent, on the intended application. Toward this end, this test method is intended to recommend a variety of conditions from which one or more of the desired exposure conditions can be selected. (Note 3)

4.2 The conditions recommended in this test method have been widely used in artificially exposing rigid cellular plastics and in determining the effects of various temperatures and humidities on these materials. Final test measurements are determined after the specimens return to room temperature. Where specified, the specimens may be tested at the exposure condition, but must be reported as such.

4.3 Dimensional changes measured by this test method can be used to compare the performance of materials in a particular environment, to assess the relative stability of two or more cellular plastics, or to specify an acceptance criterion for a particular material. The results of this test method are not suitable for predicting end-use product performance or characteristics, nor are they adequate for engineering or design calculations.

NOTE 3—Where thermal shock is known or suspected to occur due to rapid heating to (or cooling from) a particular temperature, guidance on the permissible heating or cooling rates, or both, should be obtained from the manufacturer of the material concerned.

NOTE 4—The dimensional change of a specimen may vary depending upon the age of the sample or the length of time between specimen

*A Summary of Changes section appears at the end of this standard.

preparation and the beginning of the test, or both.

4.4 Before proceeding with this test method, reference should be made to the specification of the material being tested. Any test specimen preparation, conditioning, dimensions, or testing parameters covered in the materials specification, or combination thereof, shall take precedence over those mentioned in this test method. If there are no specifications, then the default conditions apply.

5. Apparatus

5.1 *Balance*, capable of weighing, to 0.05 %, a test specimen having a mass of 100 g or less.

5.2 *Oven*, circulating-air, capable of holding the required temperature of exposure within $\pm 2^{\circ}\text{C}$ (4°F).

5.3 *Cold Box*, capable of maintaining the required temperature of exposure within $\pm 3^{\circ}\text{C}$ (5°F).

5.4 *Gage*, dial-type, with a minimum foot area of 6.5 cm^2 (1 in.^2) (Note 5). A vernier caliper having graduations not larger than 0.1 mm (0.005 in.) may also be used. Care shall be taken that the specimen is not crushed in any way, regardless of which instrument is used.

NOTE 5—A dial gage comparator for determining linear variations is illustrated in Test Methods D 1037.

5.5 *Humidity Oven*, suitable for maintaining $\pm 3\%$ humidity, and the required temperature within $\pm 2^{\circ}\text{C}$ (4°F).

6. Sampling, Test Specimens, and Test Units

6.1 Test specimens shall be machined or sawed from the sample so as to have smooth edges free of cracks. All faces of the specimen shall be smooth. Finishing with No. 0 or finer sandpaper is permitted. Dust shall be blown off the specimens.

6.2 Test specimens shall have minimum dimensions of 100 by 100 mm by thickness supplied (4 by 4 in. by thickness supplied). Materials with and intended for use with natural or laminated skin surfaces shall be tested with skins intact.

6.3 A minimum of two specimens, but preferably three or more specimens, shall be used for each exposure condition.

6.4 Where destructive tests are to be made, several sets of specimens shall be used at the specified conditions.

7. Conditioning

7.1 Unless otherwise specified, by the contract or relevant material specification, condition specimens at least to a constant mass at $23 \pm 2^{\circ}\text{C}$ ($73.4 \pm 4^{\circ}\text{F}$) and $50 \pm 5\%$ relative humidity before exposure.

8. Procedure

8.1 Make the following measurements after conditioning.

8.1.1 *Mass*—Determine mass, when specified, within 0.05 %.

8.1.2 *Dimensions*—Determine the dimensions of the three principal axes to the nearest $\pm 0.1\%$. For standard-size specimens, make two measurements per dimension. If larger specimens are used, make three measurements of length and width, and five measurements of thickness. If specimens distort, report them as distorting under the specified aging conditions.

8.2 Expose the test specimens conditioned in accordance with 7.1 in a circulating air oven, humidity oven, or cold box

maintained at one of the combinations of temperature and relative humidity shown in Table 1. Care shall be taken such that substantially free air circulation around the test specimens occur.

8.2.1 Expose the specimen at this condition for 24 h (one day) $\pm 1\text{ h}$, 168 h (one week) $\pm 2\text{ h}$, and 336 h (two weeks) $\pm 2\text{ h}$. Intermediate observations are recommended to serve as a guide to full-term performance. A round-robin study has shown that there is no significant difference between continuous exposure and exposure interrupted for up to 4 h for measuring purposes.

8.2.2 After exposure, allow the specimens to come to room temperature for 2 h before measuring and testing.

8.2.3 Measure specimen dimensions as described in section 8.1.

8.3 *Visual Examination*—Record change in general appearance at each stage of the testing procedure. (Use the terms defined in Terminology D 883 to describe defects.)

9. Calculation

9.1 Calculate the changes in dimensions (and mass, when specified), expressed as a percentage of the original measurement, as follows:

$$\text{change, \%} = [(m_f - m_o)/m_o] \times 100 \quad (1)$$

where:

m_f = final measurement, and

m_o = original measurement.

10. Report

10.1 Report the following information:

10.1.1 Description of specimens, including type of material, anisotropy, and history if known,

10.1.2 Specific conditions used,

10.1.3 If two specimens were tested:

10.1.3.1 The individual percentage changes to the nearest 0.1 % of length, width, thickness, and mass (when specified) of each test specimen at each exposure period.

10.1.4 If three or more specimens were tested:

10.1.4.1 The mean percentage changes to the nearest 0.1 % of length, width, thickness, and mass (when specified), and the respective standard deviation at each exposure period.

10.1.5 Description of changes in appearance.

11. Precision and Bias

11.1 *Precision*—The interlaboratory and intralaboratory precision of this test method can be expected to vary with material, test condition, and sample direction. Results of a five-laboratory round robin at three different test conditions showed that for certain materials, percent linear change measurements can be expected to agree within 0.9 % linear change (at 95 % confidence), both within a single laboratory and between laboratories. Percent mass change can be expected to agree within 1.1 % for the same material and conditions. Other materials may show substantially greater variability not related to the test procedure. Percent linear change for one round-robin material differed by as much as 1.5 % linear change within a laboratory, and by up to 5.6 % linear change between laboratories (95 % confidence). Percent change in mass differed by

3.9 % mass change within laboratories and 5.1 % mass change between laboratories for the most variable material (95 % confidence).

11.2 *Bias*—The bias for this test method has not yet been determined.

12. Keywords

12.1 dimensional change; humid aging; rigid cellular plastics; thermal aging

SUMMARY OF CHANGES

This section identifies the location of selected changes to this test method. For the convenience of the user, Committee D-20 has highlighted those changes that may impact the use of this test method. This section may also include descriptions of the changes or reasons for the changes, or both.

D 2126 – 99:

- (1) Changed the name of the ASTM subcommittee that has responsibility for the standard.
- (2) Changed ISO equivalency statement.
- (3) Added 4.4, reference to material specifications.
- (4) Renamed Section 6.
- (5) Changed the wording in 7.1 to include- “by the contract or relevant material specification” and replace “overnight” with “16 h.”

- (6) Combined sections for Measurements and Procedure into one section.
- (7) Reformatted Table 1.
- (8) Added a new Section 9—Calculations.
- (9) Added a keyword—dimensional stability.
- (10) Added a Summary of Changes section.

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