



## Standard Test Method for Laboratory Aging of Sandwich Constructions<sup>1</sup>

This standard is issued under the fixed designation C 481; 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 Department of Defense.*

### 1. Scope

1.1 This test method covers the determination of the resistance of sandwich panels to severe exposure conditions as measured by the change in selected properties of the material after exposure. The exposure cycle to which the specimen is subjected is an arbitrary test having no correlation with natural weathering conditions.

1.2 The values stated in SI units are to be regarded as the standard. The inch-pound units given may be approximate.

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.*

### 2. Referenced Documents

#### 2.1 ASTM Standards:

C 273 Test Method for Shear Properties in Flatwise Plane of Flat Sandwich Constructions or Sandwich Cores<sup>2</sup>

C 297 Test Method for Tensile Strength of Flat Sandwich Constructions in Flatwise Plane<sup>2</sup>

C 363 Test Method for Delamination Strength of Honeycomb Type Core Material<sup>2</sup>

C 364 Test Method for Edgewise Compressive Strength of Flat Sandwich Constructions<sup>2</sup>

C 365 Test Methods for Flatwise Compressive Strength of Sandwich Cores<sup>2</sup>

C 393 Test Method of Flexural Properties of Flat Sandwich Constructions<sup>2</sup>

D 1781 Test Method for Climbing Drum Peel Test for Adhesives<sup>3</sup>

### 3. Significance and Use

3.1 Most sandwich panels are subjected to various temperature and humidity environments. This laboratory aging test

determines the selected panel property degradation under simulated conditions.

3.2 These test methods provide a standard method of obtaining simulated environmental degradation data for quality control, acceptance specification testing, and research and development; however, these laboratory aging test procedures do not have any correlation with natural weathering conditions.

### 4. Apparatus

4.1 *Water tank, steam sprayer, oven, and freezer*, all capable of maintaining the required environment.

4.2 *Test apparatus*, shall conform to the appropriate ASTM Test Method listed in Section 2.

### 5. Test Specimens

5.1 The test specimens shall conform to the appropriate ASTM Test Method listed in Section 2.

### 6. Aging Test Procedures

6.1 Subject each specimen to six complete cycles of laboratory aging, using either Cycle A (more severe) or Cycle B (milder). The time interval between cycles shall not exceed 30 min.

#### 6.2 Cycle A:

6.2.1 Totally immerse the specimen horizontally in water at  $50 \pm 2^\circ\text{C}$  ( $120 \pm 3^\circ\text{F}$ ) for 1 h.

6.2.2 Spray with steam and water vapor at  $95 \pm 3^\circ\text{C}$  ( $200 \pm 5^\circ\text{F}$ ) for 3 h.

6.2.3 Store at  $-12 \pm 3^\circ\text{C}$  ( $10 \pm 5^\circ\text{F}$ ) for 20 h.

6.2.4 Heat at  $100 \pm 2^\circ\text{C}$  ( $210 \pm 3^\circ\text{F}$ ) in dry air for 3 h.

6.2.5 Spray again with steam and water vapor at  $95 \pm 3^\circ\text{C}$  ( $200 \pm 5^\circ\text{F}$ ) for 3 h.

6.2.6 Heat in dry air at  $100 \pm 2^\circ\text{C}$  ( $210 \pm 3^\circ\text{F}$ ) for 18 h.

#### 6.3 Cycle B:

6.3.1 Totally immerse the specimen horizontally in water at  $50 \pm 3^\circ\text{C}$  ( $120 \pm 5^\circ\text{F}$ ) for 1 h.

6.3.2 Heat in dry air at  $70 \pm 3^\circ\text{C}$  ( $160 \pm 5^\circ\text{F}$ ) for 3 h.

6.3.3 Spray with hot water at  $70 \pm 3^\circ\text{F}$  ( $160 \pm 5^\circ\text{F}$ ) for 3 h.

6.3.4 Heat in dry air at  $70 \pm 3^\circ\text{C}$  ( $160 \pm 5^\circ\text{F}$ ) for 18 h.

#### 6.4 Test Conditions:

6.4.1 Steam shall be diffused so as to contact both faces and all edges of panel.

6.4.2 The maximum relative humidity of the air shall be

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<sup>2</sup> *Annual Book of ASTM Standards*, Vol 15.03.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 15.06.

10 %; air shall be circulated by means of a fan to heat all surfaces uniformly.

6.4.3 Water shall be sprayed so as to contact all panel surfaces.

6.5 After completion of the six cycles of exposure, further condition the specimen at a temperature of  $23 \pm 3^{\circ}\text{C}$  ( $73 \pm 5^{\circ}\text{F}$ ) and a relative humidity of  $50 \pm 5\%$  and bring it back to constant weight ( $\pm 1\%$ ) before testing. Report the time required to attain constant weight.

## 7. Procedure

7.1 Make frequent inspections of the material during the aging cycles for any signs of delamination or other disintegration. If there is any apparent damage to the material, describe it in the report as well as the stage of the cycle in which the damage became apparent.

7.2 Test specimens of the material is received and after aging, in accordance with procedures selected from the following:

Shear Test	Test Method C 273
Compressive Strength	Test Methods C 364 and C 365
Delamination Strength	Test Method C 363
Tension Test	Test Method C 297
Flatwise Flexure Test	Test Method C 393
Climbing Drum Peel	Test Method D 1781

## 8. Calculations

8.1 After the tests following the laboratory aging treatment are completed, calculate the results as specified in the appropriate method and compare them with the corresponding values

obtained from the tests made on material as received.

8.2 Calculate the degradation percentages from Eq 1.

$$\text{Degradation Percentage} = \frac{\text{conditioned test value}}{\text{as received test value}} \times 100 \quad (1)$$

## 9. Report

9.1 The report shall include the following:

9.1.1 Description of the test specimens as required by the test method used,

9.1.2 Dimensions of the test specimens, core orientation,

9.1.3 Number of specimens tested,

9.1.4 The cycle (A or B) the specimens were subjected,

9.1.5 The “as received” test results,

9.1.6 The “conditioned” test results, and

9.1.7 The specimen degradation percentage; individual values and average.

## 10. Precision and Bias

10.1 *Precision*—It is not possible to specify the precision of the procedure in Test Method C 481 for conducting sandwich construction laboratory aging because of the unavailability of consistent samples for testing.

10.2 *Bias*—Since there is no accepted reference material suitable for determining the bias for the procedures in this test method, bias has not been determined.

## 11. Keywords

11.1 aging; degradation; sandwich; sandwich construction

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