



# Standard Practice for Conditioning Plastics for Testing<sup>1</sup>

This standard is issued under the fixed designation D 618; 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 approval. 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 In general, the physical and electrical properties of plastics are influenced by temperature and relative humidity in a manner that materially affects test results. In order that reliable comparisons may be made of different materials and between different laboratories, it is necessary to standardize the humidity conditions, as well as the temperature, to which specimens of these materials are subjected prior to and during testing. This practice defines procedures for conditioning plastics (although not necessarily to equilibrium) prior to testing, and the conditions under which they shall be tested.

1.2 For some materials, there may be a material specification that requires the use of this practice, but with some procedural modifications. The material specification takes precedence over this practice. Refer to the material specification before using this practice. Table 1 in Classification D 4000 lists the ASTM material specifications that currently exist.

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 1—ISO 291 is related to this practice; however, ISO 291 describes only two temperature and humidity conditions for conditioning or testing, or both.

## 2. Referenced Documents

### 2.1 ASTM Standards:

- D 709 Specification for Laminated Thermosetting Materials<sup>2</sup>
- D 756 Practice for Determination of Weight and Shape Changes of Plastics Under Accelerated Service Conditions<sup>3</sup>
- D 4000 Classification System for Specifying Plastic Materials<sup>4</sup>

D 5032 Practice for Maintaining Constant Relative Humidity by Means of Aqueous Glycerin Solutions<sup>5</sup>

E 104 Practice for Maintaining Constant Relative Humidity by Means of Aqueous Solutions<sup>6</sup>

### 2.2 ISO Standard:

ISO 291 Plastics—Standard Atmospheres for Conditioning and Testing<sup>7</sup>

## 3. Terminology

### 3.1 Definitions:

3.1.1 *room temperature*—a temperature in the range from 20 to 30°C (68 to 85°F).

3.1.2 *standard laboratory atmosphere*—an atmosphere having a temperature of 23°C (73.4°F) and a relative humidity of 50 % with standard tolerances as specified in 3.2 shall be the standard laboratory atmosphere.

3.1.3 *standard laboratory temperature*—a temperature of 23°C (73.4°F) with standard tolerance as specified in 3.2 shall be the standard laboratory temperature.

### 3.2 Tolerances:

3.3 *relative humidity*—standard tolerance shall be ± 5 %.

3.3.1 *Discussion*—Where the closer tolerance ± 2 % is required, it may be specified and the tolerance used reported.

3.4 *standard test temperatures other than standard laboratory temperature*—when data are to be obtained for comparison purposes at a specific temperature either above or below the standard laboratory temperature, the temperature should be selected from the following:

Test Temperatures, °C (°F)	Tolerance, plus or minus, °C (°F)
-70 (-94)	2.0 (3.6)
-55 (-67)	2.0 (3.6)
-40 (-40)	2.0 (3.6)
-25 (-13)	2.0 (3.6)
0 (32)	2.0 (3.6)
35 (95)	1.0 (1.8)
50 (122)	2.0 (3.6)
70 (158)	2.0 (3.6)
90 (194)	2.0 (3.6)
105 (221)	2.0 (3.6)
120 (248)	2.0 (3.6)

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<sup>2</sup> *Annual Book of ASTM Standards*, Vol 10.01.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 08.01.

<sup>4</sup> *Annual Book of ASTM Standards*, Vol 08.02.

<sup>5</sup> *Annual Book of ASTM Standards*, Vol 10.02.

<sup>6</sup> *Annual Book of ASTM Standards*, Vol 11.03.

<sup>7</sup> Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.

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

Test Temperatures, °C (°F)	Tolerance, plus or minus, °C (°F)
130 (266)	2.0 (3.6)
155 (311)	2.0 (3.6)
180 (356)	2.0 (3.6)
200 (392)	3.0 (5.4)
225 (437)	3.0 (5.4)
250 (482)	3.0 (5.4)
275 (527)	3.0 (5.4)
300 (572)	3.0 (5.4)
325 (617)	4.0 (7.2)
350 (662)	5.0 (9.0)
400 (752)	6.0 (10.8)
450 (842)	8.0 (14.4)
500 (932)	10.0 (18.0)
600 (1112)	12.0 (21.6)

3.5 *temperature*—standard tolerance shall be  $\pm 2^{\circ}\text{C}$  ( $\pm 3.6^{\circ}\text{F}$ ).

3.5.1 *Discussion*—Where the closer tolerance  $\pm 1^{\circ}\text{C}$  ( $\pm 1.8^{\circ}\text{F}$ ) is required, it may be specified and the tolerance used reported.

3.6 *temperature and relative humidity measurement*—measurements shall be made as close as possible to the center of the room or chamber.

3.6.1 *Discussion*—The temperature and relative humidity indicated at the control point, or on a recorder, may not be representative of a condition elsewhere in an enclosure or room because of local effects or deficiency in circulation of air. Additional measurements shall be made throughout the area to show compliance to the temperature and relative humidity required.

#### 4. Significance and Use

4.1 Conditioning of specimens may be undertaken: (1) for the purpose of bringing the material into equilibrium with normal or average room conditions, (2) simply to obtain reproducible results, regardless of previous history of exposure, or (3) to subject the material to abnormal conditions of temperature or humidity in order to predict its service behavior.

4.2 The conditioning procedures prescribed in this practice are designed to obtain reproducible results and may give physical values somewhat higher or somewhat lower than values under equilibrium at normal conditions, depending upon the particular material and test. To ensure substantial equilibrium under normal conditions of humidity and temperature, however, may require from 20 to 100 days or more depending upon thickness and type of material and its previous history. Consequently, conditioning for reproducibility must of necessity be used for general purchase specifications and product control tests.

#### 5. Sampling

5.1 Sampling shall be in accordance with the ASTM test methods for the specific properties to be determined.

#### 6. Test Specimens

6.1 The numbers and types of test specimens shall be in accordance with the ASTM test methods for the specific properties to be determined.

#### 7. Designations for Conditioning

7.1 *Designation for Conditioning Prior to Test:*

7.1.1 Conditioning of test specimens may be designated as follows:

7.1.1.1 A number indicating in hours the duration of the conditioning,

7.1.1.2 A number indicating in degrees Celsius the conditioning temperature, or

7.1.1.3 A number indicating relative humidity, whenever relative humidity is controlled, or a word to indicate immersion in a liquid.

7.1.2 The numbers shall be separated from each other by slant marks. A sequence of conditions shall be denoted by use of a plus (+) sign between successive conditions. “Des” shall be used to indicate desiccation over anhydrous calcium chloride. Temperature and relative humidity tolerances shall be in accordance with Section 3, unless otherwise specified.

NOTE 2—*Examples:*

Condition 96/23/50—Condition 96 h at 23°C and 50 % relative humidity.

Condition 48/50/water—Condition 48 h at 50°C in water.

Condition 48/50 + 96/23/50—Condition 48 h at 50°C; then condition 96 h at 23°C and 50 % relative humidity.

Condition 48/50 + Des—Condition 48 h at 50°C followed by desiccation.

7.2 *Designation for Test Condition:*

7.2.1 Test condition may be designated as follows:

7.2.1.1 A capital letter “T” following the prior conditioning designation and separated therefrom by a colon.

7.2.1.2 A number indicating in degrees Celsius the test temperature;

7.2.1.3 A number indicating the relative humidity in the test whenever relative humidity is controlled.

7.2.2 The numbers shall be separated from each other by a slant mark, and from the “T” by a dash. Temperature and relative humidity tolerances shall be in accordance with Section 3, unless otherwise specified.

NOTE 3—*Examples:*

Condition 24/180: T—180—Condition 24 h at 180°C: Test at 180°C.

Condition 96/35/90: T—35—90—Condition 96 h at 35°C and 90 % relative humidity: Test at 35°C and 90 % relative humidity.

#### 8. Standard Procedures for Conditioning Prior to Test

8.1 *Procedure A*—Condition 40/23/50 for specimens 7 mm (0.25 in.) or under in thickness, 88/23/50 for specimens over 7 mm—Condition test specimens 7 mm or under in thickness in the standard laboratory atmosphere for a minimum of 40 h immediately prior to testing. Treat test specimens over 7 mm in thickness as above, except that the minimum time shall be 88 h. Provide adequate air circulation on all sides of the test specimens by placing them in suitable racks, hanging them from metal clips or laying them on wide-mesh, wire screen frames with at least 25 mm (1 in.) between the screen and the surface of the bench.

NOTE 4—*Procedure A* is generally satisfactory and is recommended unless other methods are specified. Note that *Procedure A* of Practice D 618 differs from Condition A of Specification D 709 and of the Military Specifications MIL-P designation in that Condition A means “as received, no special conditioning.”

NOTE 5—If for any particular material or test, a specific longer time of conditioning is required, the time shall be agreed upon by the interested

parties. Shorter conditioning times may be used for thin specimens provided equilibrium is substantially obtained.

**8.2 Procedure B**—Condition 48/50 + Des—Condition the specimens for a period of 48 h in a circulating-air oven at a temperature of  $50 \pm 2^\circ\text{C}$  ( $122 \pm 3.6^\circ\text{F}$ ). Remove the specimens from the oven and cool to the room temperature in a desiccator over anhydrous calcium chloride for a period of at least 5 h for specimens 7 mm (0.25 in.) or under in thickness, and at least 15 h for specimens over 7 mm in thickness, immediately prior to testing.

**NOTE 6**—Procedure B is commonly used for the purpose of obtaining reproducible test results on the thermosetting materials by means of a short-time conditioning period, or where the specific effects of moderate drying are to be determined. Other enclosures, desiccants, or desiccating techniques may be used that produce and maintain an atmosphere equivalent to that over anhydrous calcium chloride. Note that Procedure B of Practice D 618 is the same as Condition E-48/50 of Specifications D 709 and of the Military Specifications MIL-P designation.

**8.3 Procedure C**—Condition 96/35/90—Condition the specimens for a period of 96 h in an atmosphere of 90 % relative humidity at a temperature of  $35^\circ\text{C}$  ( $95^\circ\text{F}$ ). The tolerances for this procedure shall be as follows:

Time, h	$\pm 2$
Temperature, $^\circ\text{C}$ ( $^\circ\text{F}$ )	$\pm 1$ (1.8)
Humidity, %	$\pm 2$

**NOTE 7**—Procedure C is recommended wherever the specific effects of exposure to severe atmospheric moisture are to be determined.

**NOTE 8**—It has been found that, for certain tests and materials, more reliable data are obtained in enclosures with circulating air rather than still air. In such cases enclosures with circulating air should be used.

**8.4 Procedure D**—Condition 24/23/water—Condition the specimens by immersion in distilled water for  $24 \pm \frac{1}{2}$  h at  $23 \pm 1^\circ\text{C}$  ( $73.4 \pm 1.8^\circ\text{F}$ ).

**8.5 Procedure E**—Condition 48/50/water + 1/23/water—Condition the specimens by immersion in distilled water for  $48 \pm \frac{1}{2}$  h at  $50 \pm 1^\circ\text{C}$  ( $122 \pm 1.8^\circ\text{F}$ ), and cool them by immersion in a sufficient quantity of distilled water to reduce the temperature to  $23^\circ\text{C}$  ( $73.4^\circ\text{F}$ ) within 1 h.

**NOTE 9**—Procedures D and E have been found useful in ASTM electrical and mechanical tests, and are used extensively in Military Specifications MIL-P designation.

**8.6 Procedure F**—Condition /23/96 (time as specified in applicable materials specification)—Condition the specimens in an atmosphere of  $96 \pm 1$  % relative humidity at a temperature of  $23 \pm 1^\circ\text{C}$  ( $73.4 \pm 1.8^\circ\text{F}$ ) for a period of time as specified in the applicable materials specification.

**NOTE 10**—Constant relative humidity can be obtained only by careful temperature control. Procedures for maintaining close tolerances are described in Practice E 104. When use of acid or salt solutions has a deleterious effect on materials being tested, use glycerin solutions in accordance with Practice D 5032 to control relative humidity.

**NOTE 11**—A considerable number of other procedures that might be considered as functional are outlined in Practice D 756.

**NOTE 12**—It has been found that, for certain tests and materials, more reliable data are obtained in enclosures with circulating air rather than still air. In such cases enclosures with circulating air should be used.

## 9. Tests at Normal Temperatures

9.1 Unless otherwise specified, test materials conditioned in the standard laboratory atmosphere in the same atmosphere.

9.2 Unless otherwise specified, test materials conditioned in accordance with Procedure B at room temperature conditions. Start the test as soon as possible, but do not allow more than  $\frac{1}{2}$  h to elapse between removal of the specimens from the desiccator and the start of the tests.

9.3 Unless otherwise specified, test materials conditioned in accordance with Procedures C and F in the same atmosphere.

9.4 Unless otherwise specified, wipe materials conditioned in accordance with Procedures D and E immediately with a damp cloth, then with a dry cloth, and test them at room temperature. Specimens should only be removed from the water as the tests are ready to be conducted. Start the tests immediately and complete them as soon as possible.

## 10. Tests at Other Standard Test Temperatures

10.1 When tests are desired at standard test temperatures prescribed in 3.4, transfer materials to the test conditions within  $\frac{1}{2}$  h, preferably immediately, after completion of the preconditioning (in accordance with Procedure A or B). Hold the specimens at the test temperature for no more than 5 h prior to test, and in no case for less than the time required to ensure thermal equilibrium.

## 11. Selection of Conditioning Procedure

11.1 In the case of materials covered by ASTM specifications, reference should be made thereto to determine the conditioning procedures to be used.

11.2 In the case of all other materials, the choice between procedures should preferably be based on the one that gives the most reproducible test results.

## 12. Report

12.1 The report of any test referencing this practice shall state:

12.1.1 Conditioning procedure used,

12.1.2 Conditioning time used, to the nearest  $\frac{1}{2}$  h, if not specified in the procedure,

12.1.3 Temperature, to the nearest degree Celsius, and the relative humidity, to the nearest percent, of the atmosphere in the vicinity of the specimen during the test, except that where the test extends longer than 30 min, the actual ranges of temperature and relative humidity shall be reported, and

12.1.4 Actual range of temperature and relative humidity if the standard tolerances are not used.

**NOTE 13**—The abbreviated nomenclature of Sections 7 and 8 should be used wherever practicable.

## 13. Precision and Bias

13.1 No statements of precision and bias are applicable to this practice; these are dependent upon the ASTM test methods for the specific properties to be determined.

## 14. Keywords

14.1 conditioning; humidity; plastics; temperature

**SUMMARY OF CHANGES**

This section identifies the location of selected changes to this practice. For the convenience of the user, Committee D20 has highlighted those changes that may impact the use of this practice. This section may also include descriptions of the changes or reasons for the changes, or both.

*D 618–96:*

(1) This revision includes the addition of an ISO equivalency statement, a keywords section, and provides for the use of Practice D 5032 in instances where acid or salt solutions have a deleterious effect on materials being tested.

*D 618–99:*

(1) Revised 3.6.

*D 618–00:*

(1) Added 1.2.

(2) Added Classification System D 4000 to Section 2, Referenced Documents.

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