



Designation: D618 – 21

Standard Practice for Conditioning Plastics for Testing¹

This standard is issued under the fixed designation D618; 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 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 to make reliable comparisons between 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, it is possible that a material specification exists 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 **D4000** 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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

NOTE 1—This standard and ISO 291 address the same subject matter, but differ in technical content. ISO 291 describes only two temperature and humidity conditions for conditioning or testing, or both.

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.*

¹ This practice is under the jurisdiction of ASTM Committee **D20** on Plastics and is the direct responsibility of Subcommittee **D20.50** on Durability of Plastics.

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2. Referenced Documents

2.1 ASTM Standards:²

- D709** Specification for Laminated Thermosetting Materials
- D756** Practice for Determination of Weight and Shape Changes of Plastics Under Accelerated Service Conditions (Withdrawn 1998)³
- D883** Terminology Relating to Plastics
- D4000** Classification System for Specifying Plastic Materials
- D5032** Practice for Maintaining Constant Relative Humidity by Means of Aqueous Glycerin Solutions
- E104** Practice for Maintaining Constant Relative Humidity by Means of Aqueous Solutions

2.2 ISO Standard:

- ISO 291** Plastics—Standard Atmospheres for Conditioning and Testing⁴

3. Terminology

3.1 Definitions:

- 3.1.1 For definitions related to plastics, see Terminology **D883**.
- 3.1.2 *room temperature, n*—a temperature in the range from 20 to 30°C (68 to 86°F).
- 3.1.3 *standard laboratory atmosphere, n*—an atmosphere having a temperature of 23°C (73.4°F) and a relative humidity of 50 % with standard tolerances as specified in Section 8 shall be the standard laboratory atmosphere.
- 3.1.4 *standard laboratory temperature, n*—a temperature of 23°C (73.4°F) with standard tolerance as specified in Section 7 shall be the standard laboratory temperature.

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.

⁴ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

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

4. Significance and Use

4.1 Conditioning of specimens is typically conducted: (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 have the potential to give physical values somewhat higher or somewhat lower than values under equilibrium at normal conditions, depending upon the particular material and test. Depending on the thickness, type of material and its previous history, it is possible that it would take 20 to 100 days or more to ensure substantial equilibrium under normal conditions of humidity and temperature. 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. Requirements for Conditioning Atmospheres

7.1 When data are to be obtained for comparison purposes at a specific temperature, select the test temperature and associated tolerance from **Table 1**.

7.1.1 Unless otherwise specified, tolerance for temperature shall be as given in **Table 1**.

7.1.2 When a tolerance of $\pm 1^\circ\text{C}$ ($\pm 1.8^\circ\text{F}$) is required, it shall be specified and shall be reported.

7.1.3 The position for measurement of temperature and relative humidity measurement—measurements shall be made as close as possible to the center of the room or chamber.

7.1.3.1 It is possible that the temperature and relative humidity measured are not representative of a condition elsewhere in an enclosure or room because of local effects or deficiency in circulation of air. If required, additional measurements shall be made throughout the area to show compliance to the temperature and relative humidity conditions specified.

7.2 Relative Humidity:

7.2.1 When tolerance for temperature is $\pm 2^\circ\text{C}$, the tolerance for relative humidity shall be $\pm 10\%$.

7.2.2 When tolerance for temperature is $\pm 1^\circ\text{C}$, the tolerance for relative humidity shall be $\pm 5\%$.

NOTE 2—Annex B of ISO 291 provides background information on the calculation of tolerance for relative humidity based on the allowed fluctuation in set point temperature.

8. Designations for Conditioning

8.1 Designation for Conditioning Prior to Test:

8.1.1 Designate conditioning of test specimens as follows:

TABLE 1 Test Temperatures and Tolerances

Test Temperatures, $^\circ\text{C}$ ($^\circ\text{F}$) ^A	Tolerance, plus or minus, $^\circ\text{C}$ ($^\circ\text{F}$)
-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)
23 (73) ^B	2.0 (3.6)
35 (95)	2.0 (3.6)
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)
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)

^AThe test temperature is the temperature at which the chamber or room is controlled. The tolerance is the maximum allowable variation of the temperature indicated by the temperature output device during equilibrium conditions. If the indicated temperature is outside the limit defined by the test temperature plus or minus the tolerance, immediately implement procedures to correct the problem.

^BStandard Laboratory Temperature.

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

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

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

8.1.2 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 7, unless otherwise specified.

NOTE 3—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.

8.2 Designation for Test Condition:

8.2.1 Designate test conditions as follows:

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

8.2.1.2 A number indicating in degrees Celsius the test temperature;

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

8.2.2 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 7, unless otherwise specified.

NOTE 4—*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.

9. Standard Procedures for Conditioning Prior to Test

9.1 *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 5—Procedure A is generally satisfactory and is recommended unless other methods are specified. Note that Procedure A of Practice D618 differs from Condition A of Specification D709 and of the Military Specifications MIL-P designation in that Condition A means “as received, no special conditioning.”

NOTE 6—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. It is acceptable to use shorter conditioning times for thin specimens provided equilibrium is substantially obtained.

9.2 *Procedure B*—Condition 48/50 + Des—Condition 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 7—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. The use of other enclosures, desiccants, or desiccating techniques that produce and maintain an atmosphere equivalent to that over anhydrous calcium chloride is acceptable. Note that Procedure B of Practice D618 is the same as Condition E-48/50 of Specifications D709 and of the Military Specifications MIL-P designation.

9.3 *Procedure C*—Condition 96/35/90—Condition specimens for a period of 96 h in an atmosphere of 90 % relative humidity at a temperature of 35°C (95°F). The tolerances for this procedure shall be as follows:

Time, h	± 2
Temperature, °C (°F)	± 1 (1.8)
Humidity, %	± 2

NOTE 8—Procedure C is recommended wherever the specific effects of exposure to severe atmospheric moisture are to be determined.

NOTE 9—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 use enclosures with circulating air.

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

9.5 *Procedure E*—Condition 48/50/water + 1/23/water—Condition 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°C (73.4°F) within 1 h.

NOTE 10—*Procedures D* and *E* have been found useful in ASTM electrical and mechanical tests, and are used extensively in Military Specifications MIL-P designation.

9.6 *Procedure F*—Condition /23/96 (time as specified in applicable materials specification)—Condition specimens in an atmosphere of 96 ± 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.

9.7 *Procedure G*—Condition 40/27/65 for specimens 7 mm (0.25 in.) or under in thickness, 88/27/65 for specimens over 7 mm—Condition test specimens in the standard laboratory atmosphere for the minimum of 40 or 88 hours prior to testing.

NOTE 11—Procedure G has been found useful in tropical climates.

9.8 Constant relative humidity can be obtained only by careful temperature control. Procedures for maintaining close tolerances are described in Practice E104. When use of acid or salt solutions has a deleterious effect on materials being tested, use glycerin solutions in accordance with Practice D5032 to control relative humidity.

NOTE 12—A considerable number of other procedures that might be considered as functional are outlined in Practice D756.

NOTE 13—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.

10. Tests at Normal Temperatures

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

10.2 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.

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

10.4 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.

11. Tests at Other Standard Test Temperatures

11.1 When tests are desired at standard test temperatures prescribed in Section 7, 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.