



# Standard Practice for Conditioning and Testing Textiles<sup>1</sup>

This standard is issued under the fixed designation D 1776; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This practice covers the conditioning and testing of textiles in those instances where such conditioning is specified in a test method. Because prior exposure of textiles to high or low humidity may affect the equilibrium moisture pick-up, a procedure also is given for preconditioning the material when specified.

1.2 The values stated in either SI units or inch-pound units are to be regarded separately as the standard. Within the text, the inch-pound units are shown in parentheses. The values stated in each system are not exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the specification.

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:<sup>2</sup>

- D 123 Terminology Relating to Textiles
  - D 578 Specification for Glass Fiber Strands
  - D 618 Practice for Conditioning Plastics and Electrical Insulating Materials for Testing
  - D 885 Test Methods for Tire Cords, Tire Cord Fabrics, and Industrial Filament Yarns and Cords Made from Man-Made Organic-Base Fibers
  - D 1776 Practice for Conditioning Textiles for Testing
  - D 4920 Terminology Relating to Moisture in Textiles
  - E 337 Test Method for Measuring Humidity With a Psychrometer (the Measurement of Wet- and Dry-Bulb Temperature)
- 2.2 *ISO Standard:*

ISO 139 Textiles Standard Atmosphere for Conditioning and Testing<sup>3</sup>

## 3. Terminology

### 3.1 Definitions:

3.1.1 *moisture content, n*—that part of the total mass of a material that is absorbed or adsorbed water, expressed as a percentage of the total mass.

3.1.1.1 *Discussion*—The total mass is the original mass comprising the dry substance plus any water present. The word *water* as used in these definitions refers to the compound chemically defined as H<sub>2</sub>O. The terms *water* and *moisture* frequently are used interchangeably in the literature and the trade, but the term *moisture* is sometimes considered to include other volatile material.

3.1.2 *moisture equilibrium, n*—the condition reached by a material when it no longer takes up moisture from, or gives up moisture to, the surrounding atmosphere.

3.1.2.1 *Discussion*—Superficial equilibrium with the film of air in contact with the textile material is reached very rapidly. Moisture equilibrium can be reached in a reasonable time only if the air to which the sample is exposed is in motion. Moisture equilibrium with the air in motion is considered to be realized when successive weighings do not show a progressive change in mass greater than the tolerance established for various textile materials.

3.1.3 *moisture equilibrium, for preconditioning, n*—the moisture condition reached by a sample or specimen after exposure to moving air in the standard atmosphere for preconditioning.

3.1.4 *moisture equilibrium, for testing, n*—the condition reached by a sample or specimen during free exposure to moving air controlled at specified conditions.

3.1.4.1 *Discussion*—For test purposes, moisture equilibrium must be reached by adsorption, starting from a relatively moisture content. Moisture equilibrium for testing is considered as having been reached when the rate of increase in mass of a sample or specimen does not exceed that specified for the material being tested.

3.1.5 *precondition, v*—to bring a sample or specimen of a textile to a relatively low moisture content (approximate

<sup>1</sup> This practice is under the jurisdiction of ASTM Committee D13 on Textiles and is the direct responsibility of Subcommittee D13.51 on Chemical Conditioning and Performance.

Current edition approved March 1, 2004. Published March 2004. Originally approved in 1998. Last previous edition approved in 1998 as D1776–98.

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document summary page on the ASTM website.

<sup>3</sup> Available from American National Standards Institute, 11 W. 42nd Street, 13th Floor, New York, NY 10036.

equilibrium an atmosphere between 5 and 25% relative humidity) prior to conditioning in a controlled atmosphere for testing.

3.1.6 *standard atmosphere for preconditioning textiles, n*—a set of controlled conditions having a temperature not over 50°C (122°F), with respective tolerances of  $\pm 1^\circ\text{C}$  ( $\pm 2^\circ\text{F}$ ), and a relative humidity of 5-25%  $\pm 2\%$  for the selected humidity that drying can be achieved prior to conditioning in the standard atmosphere for testing textiles.

3.1.7 *standard atmosphere for testing textiles, n*—laboratory conditions for testing fibers, yarns, and fabrics in which air temperature and relative humidity are maintained at specific levels with established tolerances. See Table 1.

3.1.7.1 *Discussion*—Textile materials are used in a number of specific end use application that frequently require different testing temperatures and relative humidities. Specific conditioning and testing of textiles for end product requirements can be carried out using Table 1 in Practice D 1776.

#### 4. Summary of Practice

4.1 Samples or specimens requiring preconditioning are brought to a relatively low moisture content in a specified atmosphere. Samples or specimens requiring conditioning are brought to moisture equilibrium for testing in the standard atmosphere for testing textiles, or when required, as shown in Table 1.

#### 5. Significance and Use

5.1 The conditioning prescribed in this practice is designed to obtain reproducible results on textiles and textile products. Results of tests obtained on these materials under uncontrolled atmosphere conditions may not be comparable with each other. In general, many of the physical properties of textiles and textile products are influenced by relative humidity and temperature in a manner that affects the results of the tests. To make reliable comparisons among different textile materials and products, and among different laboratories, it is necessary to standardize the humidity and temperature conditions to which the textile material or product is subjected prior to, and during, testing.

#### 6. Apparatus

6.1 *Conditioning Room or Chamber, consisting of:*

6.1.1 Equipment for maintaining the standard atmosphere for testing textiles throughout the room or chamber within the tolerances given in Table 1 and including facilities for circulating air over all surfaces of the exposed sample or specimen and

6.1.2 Equipment for recording the temperature and relative humidity of the air in the conditioning room or chamber.

6.2 *Psychrometer, Ventilated by Aspiration*, or a similar measuring device, which is accurate to  $\pm 1^\circ\text{C}$  ( $\pm 2^\circ\text{F}$ ), for checking the recorded relative humidity, as directed in Test Method E 337.

6.3 *Preconditioning Cabinet, Room, or Suitable Container*, equipped with apparatus for maintaining the standard atmosphere for preconditioning throughout the cabinet, room, or other container within the tolerance given in 3.1.6.

6.4 *Balance*, having a sensitivity of one part in 1000 of the mass of the specimen.

6.5 *Multiple Shelf Conditioning Rack*,<sup>4,5</sup> for spreading out samples and specimens.

#### 7. Preparation of Test Apparatus and Calibration

7.1 Set-up procedures for the preconditioning and conditioning room or chamber from different manufacturers may vary. Prepare and verify calibration of the temperature and relative humidity recording devices as directed in the manufacturer's instructions.

7.2 Verify calibration of the temperature and relative humidity recording devices in the testing room as directed in the equipment manufacturer's instructions.

7.2.1 The temperature and relative humidity indicated on the control point or on a recorder located away from the specimen may not be representative of a localized condition at the specimen because of local effects or deficiency in circulation of air that may take place in an enclosure or room. Tolerances at a controller usually must be smaller than those required at the specimen.

7.3 Determine the temperature and relative humidity of the air in the preconditioning cabinet (6.3) if required, the conditioning room (6.1) and the testing room as directed in Test Method E 337. If necessary, adjust the conditions to meet the specified limits for the standard atmospheres for preconditioning, conditioning, and testing, as applicable.

<sup>4</sup> Drawings of the passive conditioning rack may be obtained from the American Association of Chemists and Colorists, P. O. Box 12215, Research Triangle Park, NC 27709-2215.

<sup>5</sup> A suitable rapid conditioning system may be constructed in the laboratory. See "Earnest, D. W., 1996, *Advancements in USDA Cotton Classing Facilities, Proceedings 1996*, Beltwide Cotton Conferences, pp. 1651-1654," and "Knowiton, J. I., and Alldredge, R. K., 1994, *A New Method for Accelerating Cotton Sample Conditioning in Cotton Classing Offices, Proceedings 1994*, Beltwide Cotton Conferences, pp. 582-584." Suitable self-contained rapid conditioning units are available from at least two commercial sources.

**TABLE 1 Standard Atmospheres for Testing Various Materials**

Material	Temperature	Relative Humidity %	ASTM Standard
Textiles, general, other than nonwoven, tire cords and glass fiber	21 $\pm$ 1°C (70 $\pm$ 2°F)	65 $\pm$ 2	D 1776
Nonwovens (includes paper)	23 $\pm$ 1°C (73.4 $\pm$ 1.8°F)	50 $\pm$ 2	D 1776
Plastics and electrical insulating materials	23 $\pm$ 2°C (73.4 $\pm$ 3.6°F)	50 $\pm$ 5	D 618
Glass fiber products:			
Plastic applications	23 $\pm$ 2°C (73.4 $\pm$ 3.6°F)	50 $\pm$ 5	D 618
Textile applications	21 $\pm$ 1°C (70 $\pm$ 2°C)	65 $\pm$ 5	D 1776
Tire cords:			
Rayon	24 $\pm$ 2°C (75 $\pm$ 3.6°F)	55 $\pm$ 2	D 885
Polyester, Aramid, Nylon	24 $\pm$ 2°C (75 $\pm$ 3.6°F)	55 $\pm$ 5	D 885

7.3.1 If the standard atmosphere for testing is found to be out of tolerance, use the guidelines in Note 2 to establish the equalization time after adjustments have been made and the required tolerances have been attained before any further testing is conducted.

7.3.2 Make temperature and relative humidity measurements in an atmosphere as close as possible to the specimen being conditioned or tested; however, it should not differ significantly from the room monitoring systems.

**8. Procedure**

8.1 Unless otherwise specified, condition and test materials known to be sensitive to variations in temperature or relative humidity in an atmosphere defined in 3.1.7 after preconditioning as defined in 3.1.6, if required.

8.1.1 Textile materials are used in a number of specific end-use applications that frequently require different testing atmospheres (temperature and humidity). Condition and test textiles as described in respective test methods. In the absence of a conditioning and testing requirement, refer to 3.1.7 and use Table 1 as applicable.

8.2 Expose the samples or specimens in either the preconditioning or conditioning atmosphere in such a manner that the air will have free access to all surfaces.

8.2.1 Unless otherwise specified in an applicable ASTM test method or specification, expose yarns, threads and other light cordage in skein form.

8.2.2 Spread out fabric samples or specimens singly on the shelves of a conditioning rack to facilitate proper exposure of all sides of the fabric, particularly when testing large volumes of fabric.

8.2.3 For test methods that allow preconditioning and conditioning of samples before cutting out test specimens, a line may be used to hang multiple samples. This is satisfactory except in cases where stretching of the fabric may affect certain testing parameters, in which case the conditioning rack shall be used.

8.3 If preconditioning is required, place the samples or specimens in the preconditioning cabinet (See 6.3) and keep them in the standard atmosphere for preconditioning for a specified period of time, or until they have attained moisture equilibrium for preconditioning as defined in 3.1.3.

8.3.1 If preconditioning is carried out in an oven, to ensure that the material does not become moisture-free, it may be advisable to perform successive weighings of the specimen at intervals of not less than 2 h until the change in mass does not exceed 0.2 %. Sufficient preconditioning usually can be achieved after 4 h at 50°C (122°F) and 25 % relative humidity.

NOTE 1—The rate for reaching moisture equilibrium may vary depending on the temperature, relative humidity, fiber content, treatments, or condition of the material prior to preconditioning. Because the standard atmosphere for preconditioning textiles covers a wide range of relative humidities, a close approach to equilibrium is in general warranted only at the top of the range. Exposure for several hours at lower humidities is usually sufficient to lower the humidity for preconditioning.

8.3.2 If exposure to oven heat in preconditioning could have a detrimental effect on a property to be measured, lower the moisture level by exposure using the low end of the humidity range and room temperature which is 20 to 30°C (68 to 86°F) (see Note 1).

8.4 Transfer the samples or specimens to the conditioning room set at the standard atmosphere for testing textiles, or when specified, other atmosphere from Table 1 (see 8.1) for a specified time or until they attain moisture equilibrium for testing. Moisture equilibrium is considered to have been reached when the change in mass of the specimen in successive weighings, made in intervals of not less than 2 h, does not exceed 0.2 % of the mass of the specimen.

NOTE 2—It is recognized that in practice textile materials frequently are not weighed to determine when moisture equilibrium has been reached. While such practice cannot be accepted in cases of dispute, it may be sufficient in routine testing to expose the material to the standard



FIG. 1 Multiple Shelf Conditioning Rack

atmosphere for testing for a reasonable period of time before the specimens are tested. As a guide, the following conditioning periods are suggested.

Fiber	Minimum Conditioning Period, h
Animal fibers (for example, wool) and regenerated proteins	8
Vegetable Fibers (for example, cotton)	6
Viscose	8
Acetate	4
Fibers having a regain less than 5 % at 65 % relative humidity	2

8.5 The condition periods stated above are approximate and apply only to fabrics spread out in single thickness, which are exposed freely to moving air in the standard atmosphere for testing. Heavy fabrics may require condition periods longer than those suggested above. If a fabric contains more than one

fiber, it should be conditioned for the longest period of time by any of its components (for example, 8 h for blends containing wool or viscose).

8.6 When the testing room is a different area than the conditioning room, the conditioned samples shall be transferred to the testing room and shall be tested within 4 min after removal from the standard atmosphere or placed in a desiccator without desiccant, or equivalent, after conditioning for storage.

NOTE 3—The conditioning room and the testing room may often be the same room.

8.7 Test the specimens in the standard atmosphere used in 8.5.

## 9. Keywords

9.1 conditioning; humidity; preconditioning; temperature; testing; textiles

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