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**Designation: ~~D1776 – 08ε1~~ D1776/D1776M – 15**

# Standard Practice for Conditioning and Testing Textiles[1]

This standard is issued under the fixed designation ~~D1776;~~D1776/D1776M; 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.*~~

~~ε[1] NOTE—Table 1 was corrected editorially in July 2009.~~

## 1. Scope

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

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

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:*[2]

D123 Terminology Relating to Textiles

D618 Practice for Conditioning Plastics for Testing

D885 Test Methods for Tire Cords, Tire Cord Fabrics, and Industrial Filament Yarns Made from Manufactured Organic-Base Fibers

~~D1776 Practice for Conditioning and Testing Textiles~~

D4920 Terminology Relating to Conditioning, Chemical, and Thermal Properties

D5867 Test Methods for Measurement of Physical Properties of Raw Cotton by Cotton Classification Instruments

D7269 Test Methods for Tensile Testing of Aramid Yarns

D7744 Test Methods for Tensile Testing of High Performance Polyethylene Tapes

E337 Test Method for Measuring Humidity with a Psychrometer (the Measurement of Wet- and Dry-Bulb Temperatures)

2.2 *ISO Standard:*

ISO 139 Textiles Standard Atmosphere for Conditioning and Testing[3]

## 3. Terminology

~~3.1 *Definitions:*~~

~~3.1.1 *accelerated conditioning, n*— a process that uses humidity generation and precise temperature controls to rapidly bring a textile to equilibrium in a standard atmosphere.~~

~~3.1.1.1 *Discussion*—~~

[1] This practice is under the jurisdiction of ASTM Committee D13 on Textiles and is the direct responsibility of Subcommittee D13.51 on ~~Conditioning and,~~ Conditioning, Chemical and Thermal Properties.

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[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 tot he standard's Document summary page on the ASTM website.

[3] Available from American National Standards Institute, 11 W. 42nd Street, 13th Floor, New York, NY 10036.

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~~Accelerated conditioning may be achieved in closed cabinets, rooms or process lines designed such that equilibrium can be achieved in a much shorter time, such as 2 to 10 minutes, compared to typical conditioning times.~~

~~3.1.2 *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.~~

~~3.1.2.1 *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 $H_2O$. 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 matter.~~

~~3.1.3 *moisture equilibrium, n*— the state of condition a textile reaches when it no longer takes up moisture from, or gives up moisture to, the surrounding atmosphere.~~

~~3.1.3.1 *Discussion*—~~

~~Superficial equilibrium is reached very rapidly when air comes into contact with the outer surfaces of a textile. 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 air temperature (in motion) and relative humidity controlled to prescribed levels, is achieved when successive weighings do not show a progressive change in mass greater than the tolerance established for the textile.~~

~~3.1.4 *moisture equilibrium, for preconditioning, n*—the moisture state of a textile sample(s) or specimen(s) reached after exposure to moving air in the standard atmosphere for preconditioning.~~

~~3.1.5 *moisture equilibrium, for testing, n*— the state of a textile sample(s) or specimen (s) reaches after exposure to moving air and relative humidity in selected standard atmospheres for conditioning and testing, when its mass does not change the after successive weighings.~~

~~3.1.5.1 *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.~~

~~3.1.6 *precondition, v*—to bring a sample or specimen of a textile to a relatively low moisture content (approximate equilibrium an atmosphere between 5 and 25% relative humidity) prior to conditioning in a controlled atmosphere for testing.~~

~~3.1.7 *standard atmosphere for preconditioning textiles, n*—a set of controlled conditions having a temperature not over 50°C (122°F), with respective tolerances of ±1°C (±2°F), and a relative humidity of 5-25% ± 2 % for the selected humidity that drying can be achieved prior to conditioning in the standard atmosphere for testing textiles.~~

~~3.1.8 *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.~~

~~3.1.8.1 *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 D1776.~~

~~3.1.9 For additional terms, see Terminologies D123 and D4920.~~

3.1 For terminology related to conditioning see Terminology D4920.

3.2 The following terms are relevant to this standard: accelerated conditioning, moisture content, moisture equilibrium, moisture equilibrium for preconditioning, moisture equilibrium for testing, precondition, standard atmosphere for preconditioning textiles, standard atmosphere for testing textiles, uncertainty of (in) measurement.

3.3 For definitions of other textile terms used in this standard see Terminology D123.

## 4. Summary of Practice

4.1 Samples or specimens requiring preconditioning are brought to relatively low moisture content in a specified atmosphere. Samples or specimen not requiring pre-conditioning are brought to moisture equilibrium (specific to fiber-content) according to the standard atmosphere for testing textiles as shown in Table 1.

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**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 ± 1°C (70 ± 2°F)~~ | ~~65 ± 2~~ | ~~D1776~~ |
| ~~Nonwovens (includes paper)~~ | ~~23 ± 1°C (73.4 ± 1.8°F)~~ | ~~50 ± 2~~ | ~~D1776~~ |
| ~~Plastics and electrical insulating materials~~ | ~~23 ± 2°C (73.4 ± 3.6°F)~~ | ~~50 ± 5~~ | ~~D618~~ |
| ~~Glass fiber products:~~ | | | |
| ~~Plastic applications~~ | ~~23 ± 2°C (73.4 ± 3.6°F)~~ | ~~50 ± 5~~ | ~~D618~~ |
| ~~Textile applications~~ | ~~21 ± 1°C (70 ± 2°F)~~ | ~~65 ± 5~~ | ~~D1776~~ |
| ~~Tire cords:~~ | | | |
| ~~Rayon, Polyester, Polyamide~~ | ~~20 ± 2°C (68 ± 2°F)~~ | ~~65 ± 2~~ | ~~D885~~ |
| ~~Aramid~~ | ~~20 ± 2°C (68 ± 2°F)~~ | ~~65 ± 5~~ | ~~D7269~~ |

**TABLE 1 Standard Atmospheres for Conditioning and Testing General Textiles**

| Material | Preconditioning[A] Time (h), min | Temperature, °C [°F] | Relative Humidity % | Time (h), min | ASTM Standard |
|---|---|---|---|---|---|
| | | Conditioning | | | |
| Textiles, general[B] Textiles, specific[C] | | 20 ± 2 [68 ± 4] | 65 ± 5 | | D1776 |
| Cotton fiber classification and testing | 4 | 21 ± 1 [70 ± 2] | 65 ± 2 | | D1776, D5867 |
| Tire cords: | | | | | |
| Polyamide | Not applicable | 20 ± 2 [68 ± 4] | 65 ± 5 | 16 | D885 |
| Polyester | Not applicable | 20 ± 2 [68 ± 4] | 65 ± 5 | 2 | D885 |
| Rayon | | 20 ± 2 [68 ± 4] | 65 ± 5 | 8 | |
| Aramid[D] | | 20 ± 2 [68 ± 4] | 65 ± 5 | | D7269 |
| Option 1 | 3 | 20 ± 2 [68 ± 4] | 65 ± 5 | 14 | D7269 |
| Option 2 | 3 | 24 ± 2 [75 ± 4] | 55 ± 5 | 14 | D7744 |
| High Performance Polyethylene | Not applicable | 20 ± 2 [68 ± 4] | 65 ± 5 | 4 | |
| Glass fiber products: | | | | | D618 |
| Plastic applications | | 23 ± 2 [73 ± 4] | 50 ± 5 | | D1776 |
| Textile applications | | 21 ± 1 [70 ± 2] | 65 ± 5 | | D1776 |
| Nonwovens | | 23 ± 2 [73 ± 4] | 50 ± 5 | | D1776 |
| Plastics and electrical insulation | | 23 ± 2 [73 ± 4] | 50 ± 5 | | D618 |

[A] Preconditioning is an option and may be employed when samples are being brought to equilibrium moisture content from an extreme high or low moisture content.
[B] Previous publications of this standard cited tolerances for general textiles without consideration of the uncertainty of measurement of the temperature and humidity controllers or the measurement devices used in textile laboratories. Changes in ISO 139 broadened tolerances to account for the uncertainty of measurement of controller and measurement devices have also been incorporated into the tolerances for the general textile category.
[C] Specific textiles' conditioning tolerances and their associated standards do not account for the uncertainty of measurement of controllers or devices.
[D] Report the standard atmosphere used.

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4.2 Understanding of tolerance and uncertainty of measurement has evolved since the creation of the original version of this standard. Due to this new understanding, uncertainty of measurement has been taken into account in determining acceptable tolerances for the standard atmosphere for testing textiles 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~~ atmospheres 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 for conditioning and during~~ that standard atmospheres be utilized during conditioning and testing.

5.2 The documentation of standard atmospheres for preconditioning (if necessary), conditioning, testing settings and tolerances including the determination of the uncertainty of measurement of temperature and relative humidity recording devices may be necessary for laboratory accreditation. See Appendix X1.

## 6. Apparatus

6.1 *Conditioning Room or Chamber, consisting of:*

6.1.1 Equipment for ~~maintaining the standard atmosphere~~the generation of heated or cooled air, moisture, and air circulation with control devices to maintain standard atmospheres for testing textiles throughout ~~the~~ a laboratory space, 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, chamber, or area.~~

NOTE 1—Temperature and relative humidity recording devices used in a testing laboratory are separate ones from those cited in 6.1.1

6.2 *Psychrometer, Ventilated by Aspiration,* or a similar measuring device, which is accurate to ±1°C ~~(±2°F),~~[±2°F], for checking the recorded relative humidity, as directed in Test Method E337.

6.3 *Preconditioning Cabinet, Room, or Space,* equipped for maintaining the standard atmosphere for ~~preconditioning within the tolerance given in 3.1.6.~~ preconditioning.

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

6.5 *Multiple Shelf Conditioning Rack,*[4,5] ~~for~~ for spreading out samples and specimens. See Fig. 1.

## 7. Preparation of Test Apparatus and Calibration

7.1 Verify the uncertainty of measurement of the temperature and relative humidity devices being used to produce standard atmospheres and those recording temperature and relative humidity in laboratories as this factor should be included in the tolerances prescribed in Table 1. It is recommended that devices with the smallest uncertainty of measurement be used. See Appendix X1 and Bibliography.

7.2 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~~manufacturer's instructions.

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

7.3.1 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.

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[4] 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.

[5] 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.

**FIG. 1 Multiple Shelf Conditioning Rack**