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Standard Practice for Conditioning and Testing Textiles[1]

This standard is issued under the fixed designation 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.

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

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 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 specimens not requiring preconditioning are brought to moisture equilibrium (specific to fiber-content) according to the standard atmospheres for testing textiles as shown in Table 1.

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 atmospheres 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 atmospheres may not be comparable with each other. In

[1] This practice is under the jurisdiction of ASTM Committee D13 on Textiles and is the direct responsibility of Subcommittee D13.51 on 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.

TABLE 1 Standard Atmospheres for Conditioning and Testing Textiles

Material	Preconditioning[A] Time (h), minimum	Temperature, °C [°F]	Relative Humidity %	Time (h), minimum	ASTM Standard
Textiles, general[B]		21 ± 2 [70 ± 4]	65 ± 5		D1776
Textiles, specific[C]					
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]					
Option 1	3	20 ± 2 [68 ± 4]	65 ± 5	14	D7269
Option 2	3	24 ± 2 [75 ± 4]	55 ± 5	14	D7269
High Performance Polyethylene	Not applicable	20 ± 2 [68 ± 4]	65 ± 5	4	D7744
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.

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 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 the generation of heated or cooled air, moisture, and air circulation with control devices to maintain standard atmospheres for testing textiles throughout a laboratory space, room or chamber within the tolerances given in Table 1.

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], 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.

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 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 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

[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., *Advancements in USDA Cotton Classing Facilities, Proceedings 1996,* Beltwide Cotton Conferences, pp. 1651–1654," and "Knowiton, J. I., and Alldredge, R. K., *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

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.

7.4 Determine the temperature and relative humidity of the air in the preconditioning cabinet if preconditioning is required (see 6.3), the conditioning room (see 6.1) and the testing room as directed in Test Method E337. If necessary, adjust the conditions to meet the specified limits for the standard atmospheres for preconditioning, conditioning, and testing, as applicable.

7.4.1 If the standard atmosphere for testing is found to be out of tolerance, use the guidelines in Note 3 and Table 2 to establish the equalization time after adjustments have been made and the required tolerances have been attained before any further testing is conducted.

7.4.2 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. For large conditioning rooms or testing laboratories, multiple sensors may be needed.

TABLE 2 Recommended Textile Fabric Conditioning Times by Fiber Source

Fiber Source	Minimum Conditioning Period, h
Animal fibers (ex. wool, cashmere) and regenerated proteins	8
Vegetable fibers (ex. cotton, flax)	6
Acetate	4
Textiles from any fiber having moisture regain of less than 5.0 % at 65 % relative humidity	2

8. Procedure

8.1 *Sample or Specimen Configuration for Preconditioning or Conditioning:*

8.1.1 All samples or specimens shall be exposed to the applicable standard atmospheres in such a manner that the air will have free access to all surfaces of the textile.

8.1.2 Fiber samples or specimens shall be in their loose or open state for conditioning.

8.1.3 Yarns, threads and other light cordage shall be in skein form, unless otherwise specified in an applicable ASTM test method or specification.

8.1.4 Fabric samples or specimens shall be spread in a single layer on the shelves of a conditioning rack.

8.1.5 For test methods that require preconditioning or conditioning of samples before specimen preparation, a clothes line may be used to hang multiple samples, except in cases where stretching the textile material may affect certain testing parameters, in which case, samples should be placed on conditioning rack shelves.

8.2 *Preconditioning:*

8.2.1 For textile materials known to be sensitive to variations in temperature or humidity, preconditioning samples or specimens before exposing them to the selected standard atmosphere for conditioning and testing may be required.

8.2.2 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.

8.2.3 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 weighing of specimens at intervals of not less than 2 h until the change in mass does not exceed 0.2 %.

8.2.3.1 If exposure to oven heat in preconditioning could have a detrimental effect on a physical attribute to be measured, lower the moisture level to exposure using the low end of the humidity range and room temperature which is 20 to 30°C [68 to 86°F] (see Note 3).

8.2.4 Sufficient preconditioning usually can be achieved after 4 h at 45 ± 5°C [113 ± 9°F] and 15 ± 5 % relative humidity. Because the standard atmosphere for preconditioning textiles covers a wide range of relative humidity, a close approach to equilibrium is in general warranted only at the upper end of the relative humidity range.

8.3 *Conditioning:*

8.3.1 After preconditioning, if required, transfer the samples or specimens to the conditioning room set at the standard atmosphere for testing textiles according to material type selected from Table 1 for a specified time or until they attain moisture equilibrium for testing.

NOTE 2—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.

8.3.2 Moisture equilibrium is considered to be reached when the change in mass of a specimen in successive weighing does not exceed 0.2 % of the mass of the specimen made in intervals of not less than 2 h for specimens in a conditioning space, room or chamber. When accelerated conditioning is employed, the user may find that equilibrium is reached in substantially shorter intervals, such as 2-10 min. In these cases, successive weighing of the specimen at intervals of 2 min may be done to determine that the change in mass does not exceed 0.2 %.

NOTE 3—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 atmosphere for testing for a reasonable period of time before specimens are tested.

8.3.3 Textile material should be exposed to standard atmosphere for testing according to type as follows or according to an applicable ASTM test method or specification.

8.3.3.1 *Fabric*—Samples or specimens should be laid flat in a single thickness on perforated shelves to allow for exposure to freely moving air. The conditioning periods for textile fabrics stated in Table 2 are approximate and apply only to fabrics spread out in single thickness. Heavy fabrics may require longer conditioning periods than those cited in Table 2. If a fabric contains more than one fiber, it should be conditioned for the longest period for its components (for example, condition 8 h for fabric blends containing wool or viscose).

8.3.3.2 *Fiber*—Samples or specimens should be exposed in their open or loose state.

8.3.3.3 *Yarns, Threads or Light Cordage*—Samples or specimens should be exposed in skein form.

8.3.3.4 *Yarn Packages or Bobbins*—Remain on packages or bobbins.

NOTE 4—Due to the density of yarn wound on packages or bobbins, conditioning periods will be longer than those for fabrics.

8.3.4 Test conditioned specimens in the standard atmosphere for testing.

9. Keywords

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

APPENDIX

Nonmandatory Information

X1. EXPLANATION OF MEASUREMENT UNCERTAINTY

X1.1 Measurement Uncertainty, *Form and Style for ASTM Standards*,[6] A22, pg. A-12, October 2013

X1.1.1 (A22.1) Measurement uncertainty is an estimate of the magnitude of systematic and random measurement errors that my be reported along with the measurement result. An uncertainty statement relates to a particular result obtained in a laboratory carrying out the test method, as opposed to precision and bias statements which are mandatory parts of the method itself and normally derived from an interlaboratory study conducted during development of the test method.

X1.1.2 (A22.2) It is neither appropriate for, nor the responsibility of, the test method to provide explicit values that a user would quote as their estimate of uncertainty. Uncertainty values must be based on data generated by a laboratory reporting results using the test method.

X1.1.3 (A22.3) A tolerance of ±5 % for relative humidity reflects the current uncertainty commonly available for relative humidity calibrations while maintaining an acceptable tolerance/uncertainty ratio (TUR). In cases of a tighter tolerance on relative humidity, the user must investigate the TUR and determine the acceptable risk of relative humidity measurements being out of tolerance. The acceptable TUR is at the discretion of the user.

[6] Available on the ASTM website, www.astm.org

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(2) International Organization for Standardization (ISO) *Guide to the Expression of Uncertainty in Measurement*, U.S. version entitled *American National Standard for Expressing Uncertainty in Measurement*, ANSI/NCSL 2540-2-1997, info@ansi.org

(3) ISO/IEC Guide 99:2007, *International vocabulary of metrology – Basic and general concepts and associated terms*, info@ansi.org

(4) *Handbook for the Application of ANSI/NCSL Z540.3-2006*; NCSL International, Boulder, CO, 2009.

(5) *Metrology Concepts: Understanding Test Uncertainty Ratio (TUR)*, http://www.transcat.com/PDF/TUR.pdf

(6) ILAC-G8:08/2009 *Guidelines on the reporting of compliance with specification*, International Laboratory Accreditation Cooperation, http://www.ilac.org/documents/ILAC_G8_08_2009.pdf

(7) *"Calibration Risk Analysis,"*NCSL International (http://www.ncsli.org/)

(8) ASTM E1488 Guide for Statistical Procedures to use in Developing and Applying Test Methods

(9) ASTM Manual 7A, Manual on Presentation of Data and Control Charts Analysis, Seventh Edition, ASTM Committee E11 on Quality and Statistics