INTERNATIONAL

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StandardTest Method for Steady State and Dynamic Thermal Performance of Textile Materials[1,2]

This standard is issued under the fixed designation D7024; 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.

1. Scope

1.1 This test method covers the determination of the overall thermal transmission coefficient due to conduction for dry specimens of textile fabrics, battings, and other materials and the determination of the temperature regulating factor (TRF) defined below.

1.2 *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:*[3]

D123 Terminology Relating to Textiles

D1518 Test Method for Thermal Resistance of Batting Systems Using a Hot Plate

D1776 Practice for Conditioning and Testing Textiles

D1777 Test Method for Thickness of Textile Materials

3. Terminology

3.1 *Definitions:*

3.1.1 *temperature difference, ΔT*—temperature difference between two surfaces of a fabric, °C.

3.1.2 *temperature regulating factor, TRF*—amplitude of the temperature variation of the hot plate divided by the product of the amplitude of the hot plate flux variation and the steady state R-value, all determined according to the test protocol described below. The temperature regulating factor is useful in comparing fabrics that store and release energy and thereby regulate their surface temperature.

3.2 For definitions of other textile terms used in this method refer to Terminology D123.

4. Summary of Test Method

4.1 In order to determine the steady state R-value and the temperature regulating for a sample fabric, the apparatus of Fig. 1 is used. Fabric is sandwiched between a hot plate and two cold plates, one on either side of the hot plate. A controlled flux, either constant or varying, is maintained for the hot plate while the cold plates are maintained at constant temperature. To measure the steady state thermal resistance (R-value) of the fabric, the controlled flux is constant and the test proceeds until steady state is reached. To measure the temperature regulating factor (TRF), the flux is varied sinusoidally with time.

5. Significance and Use

5.1 This method provides for the determination of the steady state thermal resistance of a fabric or layers of fabrics and for the determination of the temperature regulating factor (TRF) as defined below. This test method is considered satisfactory for acceptance testing of commercial shipments because the round robin testing shows high precision and no bias for testing of textile fabrics and foams.

5.1.1 If there are differences of practical significance between reported test results for two laboratories (or more), comparative test should be performed to determine if there is a statistical bias between them, using competent statistical assistance. As a minimum, use the samples for such a comparative test that are as homogeneous as possible, drawn from the same lot of material as the samples that resulted in disparate results during initial testing and randomly assigned in equal numbers to each laboratory. The test results from the laboratories involved should be compared using a statistical test for unpaired data, a probability level chosen prior to the testing series. If bias is found, either its cause must be found and corrected, or future test results for that material must be adjusted in consideration of the known bias.

5.2 This test method is useful in quality and cost control during manufacture. It can be used to establish criteria for

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

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[2] The test apparatus described below is covered by a patent. Interested parties are invited to submit information regarding the identification of an alternative(s) to this patented item to the ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend.

[3] 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.

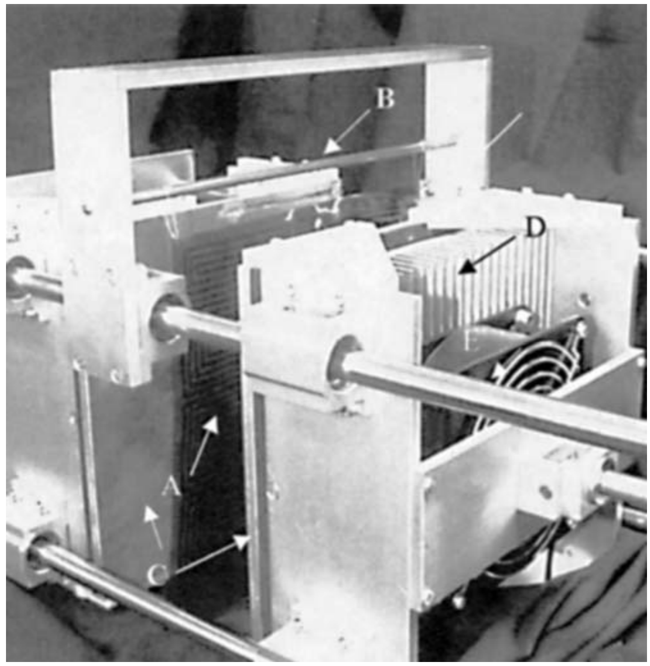

FIG. 1 Major Components of the Test Apparatus

establishing thermal and comfort parameters for textiles particularly used in the clothing industry.

6. Apparatus

NOTE 1—The drawings and illustrations are intended as suggested designs only. The final design of equipment, including necessary wiring, will be dictated by the choice of the electrical measuring and control equipment. The apparatus is shown in Fig. 1.

6.1 The test instrument, with major components labeled, is shown in Fig. 1. In the center of the device is a flexible heater (A) that is made of a sturdy polymer material (Kapton®) that is pliable due to the heater's thinness (0.25 mm). A thin etched metal foil is contained inside the polymer sheet to provide resistance heating. Since the heater is very thin and light, the time constant of the heater is negligible compared to the cycle time of the tests performed (see Test Protocol below). Above the heater is a metal rod (B) from which the textile specimen is hung. The specimen is large enough to cover the heater on both sides. On both sides of the heater are aluminum cold plates (C). These plates are cooled to a specified temperature using thermoelectric coolers sandwiched between the cold plates and heat sinks. Heat from the cooled plates is rejected via the aluminum heat sinks (D) and attached fans (E). The hot and cold plates are both 205 by 205 mm (8 by 8 in.). The cold plates are 4.76 mm (3⁄16 in.) thick. The hot plate and cold plates are suspended on linear bearings so that during operation, the cold plates can be pressed against the textile specimen at constant pressure provided by a compression spring. The pressure used should be a common pressure used when measuring fabric thickness. Temperatures are measured by thermocouples attached to the surfaces of the heater and cold plates. All energy inputs and temperatures are recorded by a computer data acquisition system.

6.2 Fig. 2 shows an exploded drawing of the apparatus.

7. Sampling

7.1 *Lot Sample*—For acceptance testing take a lot sample as directed in the applicable material specification, or as agreed upon between purchaser and supplier. In the absence of such a specification or other agreement, take a laboratory sample as directed in 7.2.

7.2 Take a laboratory sample from each roll or piece of fabric in the lot sample. The laboratory sample should be full width and at least 600 mm (24 in.) long and should not be taken any closer to the end of the roll or piece of fabric than 1 m (1 yd).

7.3 Sample shipments of garments or other textile materials as agreed upon between purchaser and supplier.

7.4 Test three specimens from each laboratory sample, unless otherwise specified in the material specification.

8. Preparation of Test Specimens

8.1 *Specimen Preparation*—Cut the test specimens large enough to cover completely the entire surface of both sides of the hot plate, or at least 460 mm (18 in.) by 205 mm (8 in).

8.2 *Room Condition*—The room is which testing occurs is to be maintained at 21 ± 1°C (72 ± 2°F) and 65 % relative humidity ±2 %.

8.3 *Conditioning*—Allow the test specimens to come into equilibrium with the atmosphere of the testing room. 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.

8.3.1 In the absence of a specified rate, an increase of less than 0.1 % of the specimen mass after a 2-h exposure is considered satisfactory.