



Designation: ~~D1518-11~~ Designation: D1518 – 11a

## Standard Test Method for Thermal Resistance of Batting Systems Using a Hot Plate<sup>1</sup>

This standard is issued under the fixed designation D1518; 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.

### INTRODUCTION

This standard replaces D1518-85, Thermal Transmittance of Textile Materials. This standard provides a method for measuring the thermal resistance (insulation) provided by battings and batting/fabric systems under still air conditions or an air flow condition. Other hot plate standards F1868 and ISO 11092 provide a method for measuring the thermal resistance and evaporative resistance of fabrics and fabric systems. The method for measuring fabric insulation in these standards is comparable to Option 2: Air Velocity Condition in D1518. These standards can be used to compare the thermal properties of textile materials. Manikin standards F1291 and F2370 can be used to measure and compare the thermal resistance and evaporative resistance of clothing systems, respectively. Manikin standard F1720 can be used to measure the insulation provided by sleeping bag systems.

### 1. Scope

1.1 This test method covers the measurement of the thermal resistance, under steady-state conditions, of battings and batting/fabric systems, and other materials within the limits specified in 1.2. It measures the heat transfer from a warm, dry, constant-temperature, horizontal flat-plate up through a layer of the test material to a cool atmosphere and calculates the resistance of the material. The measurements are made under still air conditions (Option #1) or with a horizontal air flow over the specimen (Option #2).

1.2 For practical purposes, this test method is limited to determinations on specimens of battings and layered batting/fabric assemblies having an intrinsic thermal resistance from 0.1 to 1.5 K·m<sup>2</sup>/W and thicknesses not in excess of 50 mm.

1.3 This test method also provides a method for determining the bulk density of the material, the insulation per unit thickness, and the insulation per unit weight.

1.4 The values stated in SI units are to be regarded as standard.

1.5 *This standard does not purport to address the safety concerns associated with its use. It is the responsibility of whoever uses this standard to consult and 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>

D123 Terminology Relating to Textiles

D3776 Test Methods for Mass Per Unit Area (Weight) of Fabric

E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

F1291 Test Method for Measuring the Thermal Insulation of Clothing Using a Heated Manikin

F1494 Terminology Relating to Protective Clothing

F1720 Test Method for Measuring Thermal Insulation of Sleeping Bags Using a Heated Manikin

F1868 Test Method for Thermal and Evaporative Resistance of Clothing Materials Using a Sweating Hot Plate

F2370 Test Method for Measuring the Evaporative Resistance of Clothing Using a Sweating Manikin

<sup>1</sup> 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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<sup>2</sup> 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.

2.2 ISO Standards:<sup>3</sup>

ISO 11092 Textiles—Physiological Effects—Measurement of Thermal and Water-Vapour Resistance Under Steady-State Conditions (Sweating Guarded-Hotplate Test)

ISO 9073-2 Textile—Test Methods for Nonwovens—Part 2: Determination of Thickness

3. Terminology

3.1 The following terms are relevant to this standard: bulk density, clo, thermal resistance, thermal insulation.

3.2 For terminology relating to thermal resistance and insulation see Terminology F1494.

3.3 For terminology relating to textiles see Terminology D123.

4. Significance and Use

4.1 The thermal resistance of a batting or batting/fabric system is of considerable importance in determining its suitability for use in fabricating cold weather protective clothing, sleeping bags, and bedding systems. The thermal interchange between man and his environment is, however, an extremely complicated subject which involves many factors in addition to the insulation values of fabrics and battings. Therefore, measured thermal insulation values can only indicate relative merit of a particular material.

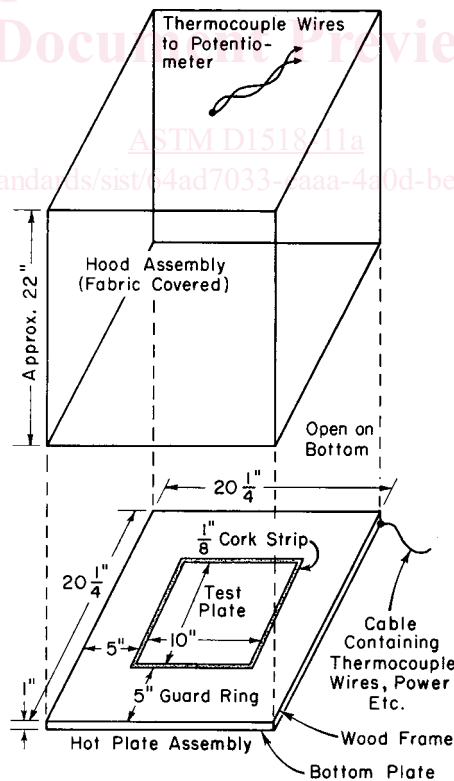
5. Interferences

5.1 Departures from the instructions of this test method may lead to significantly different test results. Technical knowledge concerning the theory of heat transfer, temperature measurement, and testing practices is needed to evaluate which departures from the instructions are significant. Standardization of the method reduces, but does not eliminate the need for such technical knowledge. Report any departures from the instructions of Test Method D1518 with the results.

6. Apparatus (Fig. 1, Fig. 2, and Fig. 3)

NOTE 1—The drawings, illustrations, and captions are provided as possible design concepts only. The final design of equipment, including necessary wiring, will be dictated by the choice of the electrical measuring and control equipment.

<sup>3</sup> Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.



Entire Assembly to be Located in a Calm Atmosphere, 40 to 70F Temperature Fluctuations Less Than  $\pm 2.5$  F

FIG. 1 Hot Plate with Guard Ring and Hood (No Air Velocity Method)

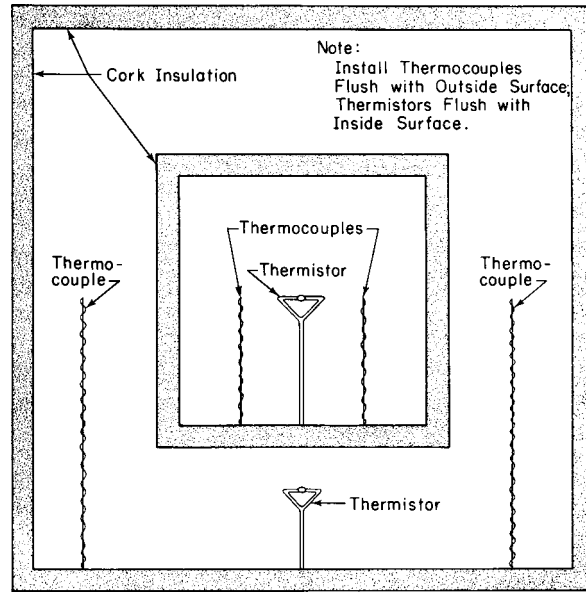


FIG. 2 Hot Plate, Top View, Showing Location of Thermistors and Thermocouples on Test Section and Guard Ring

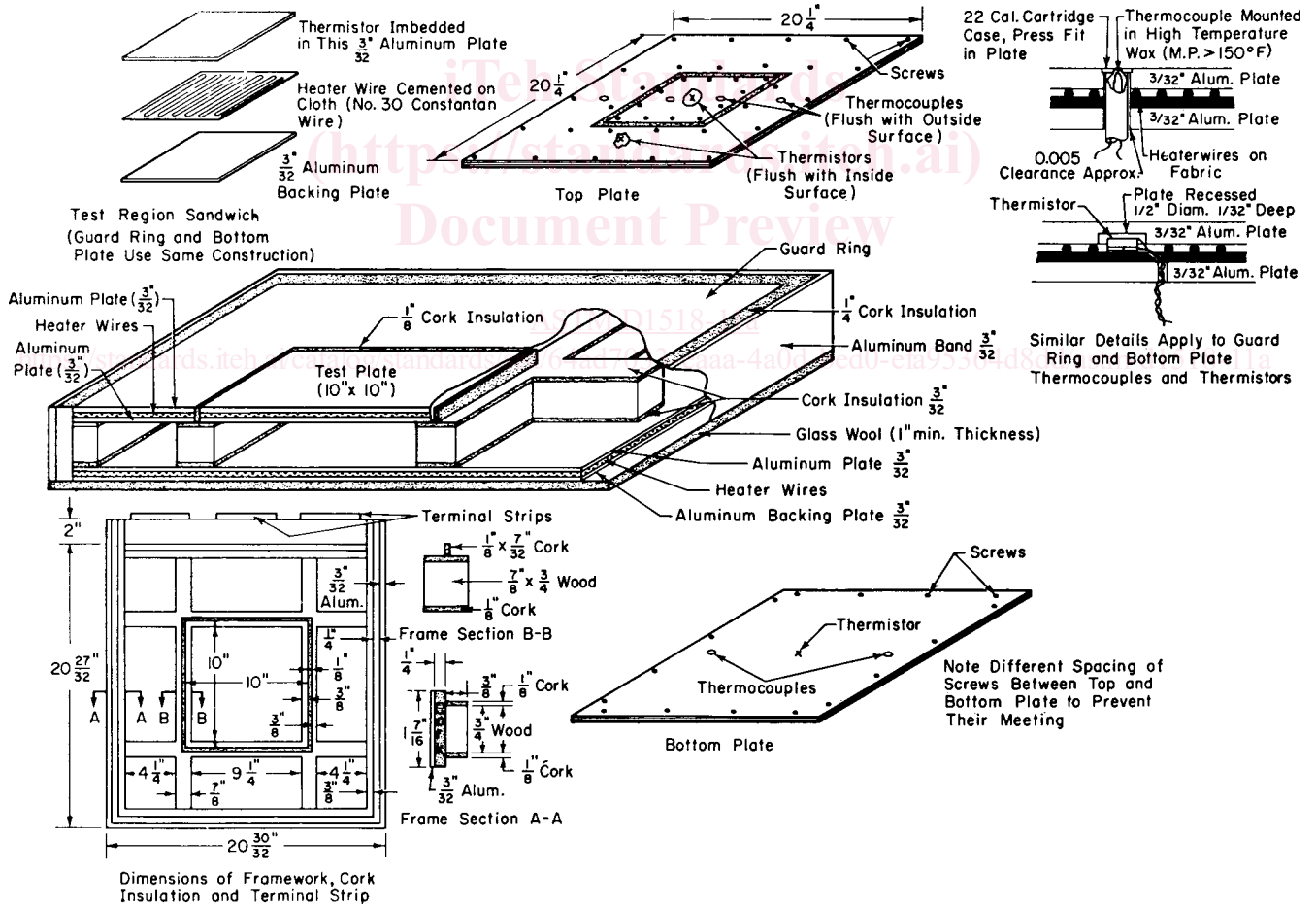


FIG. 3 Hot Plate Apparatus, Showing Dimensions

6.1 *Hot Plate*—A guarded flat plate composed of a test plate, guard ring, and bottom plate as follows, each electrically maintained at a constant temperature in the range of human skin temperature (33 to 38°C).

6.1.1 *Test Plate*—The test plate portion of the hot plate shall be at least 254 mm (10.0 in.) square and shall be placed at the center of the upper surface of the hot-plate assembly. It shall be made of aluminum or copper with a dull black coating to