



Standard Test Method for Thermal Transmittance of Textile Materials¹

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1. Scope

1.1 This test method covers the determination of the overall thermal transmission coefficients due to the combined action of conduction, convection, and radiation for dry specimens of textile fabrics, battings, and other materials within the limits specified in 1.2. It measures the time rate of heat transfer from a warm, dry, constant-temperature, horizontal flat-plate up through a layer of the test material to a relatively calm, cool atmosphere.

1.2 For practical purposes, this test method is limited to determinations on specimens of fabrics, layered fabric assemblies, and battings having thermal transmittances (U_2 , as defined in 3.1.2) within a range of 0.7 to 14 W/m²·K and thicknesses not in excess of 50 mm.

1.3 The coefficients obtained apply strictly only to the particular specimens tested and for the specified thermal and environmental conditions of each test. This test method gives values that are valid for comparison under the same conditions of test, that is, with the specified air velocity, temperature difference between the warm plate and the cool air, and air gap for measuring cool air temperature.

1.4 The values stated in metric units are to be regarded as the standard. Conversion factors, for thermal conductance and conductivity and thermal resistance and resistivity, to other units in common use are given in Tables 1-5

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:

D 123 Terminology Relating to Textiles²

D 1777 Method for Measuring Thickness of Textile Materials²

3. Terminology

3.1 Definitions:

3.1.1 *bulk density, n*—apparent mass per unit volume.

3.1.1.1 *Discussion*—In testing the thermal transmittance of fabrics, bulk density is calculated from the fabric weight per unit area and the thickness value used to calculate thermal conductivity.

3.1.2 *clo, n*—unit of thermal resistance defined as the insulation required to keep a resting man (producing heat at the rate of 58 W/m²) comfortable in an environment at 21°C, air movement 0.1 m/s, or roughly the insulation value of typical indoor clothing.^{3,4} (Syn. intrinsic clo).

3.1.2.1 *Discussion*—Numerically the clo is equal to 0.155 K·m²/W.

3.1.3 *heat transfer coefficient, n*—see *thermal transmittance*.

3.1.4 *intrinsic clo, n*—see *clo*.

3.1.5 *specific clo, n*—the specific thermal resistance in clo units per unit thickness.

3.1.6 *thermal conductance, n*—see *thermal transmittance*.

3.1.7 *thermal conductivity, n*—time rate of unidirectional heat transfer per unit area, in the steady-state, between parallel planes separated by unit distance, per unit difference of temperature of the planes.

3.1.7.1 *Discussion*—Numerically, thermal conductivity equals the product of the heat transfer coefficient and the distance separating the planes. Thus, k , the thermal conductivity of the fabric only, is the product of U_2 and the fabric thickness. Units of thermal conductivity are W/m·K.

3.1.8 *thermal resistance, n*—reciprocal of thermal transmittance.

3.1.9 *thermal resistivity, n*—reciprocal of thermal conductivity.

3.1.10 *thermal transmittance, n*—time rate of unidirectional heat transfer per unit area, in the steady-state, between parallel planes, per unit difference of temperature of the planes (Syn. thermal conductance, heat transfer coefficient).

¹ This test method is under the jurisdiction of ASTM Committee D13 on Textiles and is the direct responsibility of Subcommittee D13.51 on Chemical Conditioning and Performance.

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² *Annual Book of ASTM Standards*, Vol 07.01.

³ American Society of Heating, Refrigerating, and Air-Conditioning Engineers.

⁴ Gagge, A. P., Burton, A. C., Bazett, H. C., *Science*, Vol 94, Nov. 7, 1941, pp. 428–430.