



Standard Test Method for Evaluating the Resistance to Thermal Transmission of Materials by the Guarded Heat Flow Meter Technique¹

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1. Scope

1.1 This test method covers a steady-state technique for the determination of the resistance to thermal transmission (thermal resistance) of materials in thicknesses of less than 25 mm. For homogeneous opaque solid specimens of a representative thickness, thermal conductivity can be determined (see Note 1). This test method is useful for materials having a thermal resistance in the range from 10 to $400 \times 10^{-4} \text{ m}^2 \cdot \text{K}/\text{W}$ thermal conductivity in the approximate range, $0.1 < \lambda < 30 \text{ W}/(\text{m} \cdot \text{K})$ over the approximate temperature range from 150 to 600 K. It can be used outside these ranges with reduced accuracy for thicker specimens and for thermal conductivity values up to $60 \text{ W}/(\text{m} \cdot \text{K})$.

NOTE 1—A body is considered homogeneous when the preceding property is found by measurement to be independent of specimen dimensions.

1.2 This test method is similar in concept to Test Method C 518, but is modified to accommodate smaller test specimens, having a higher thermal conductance. In addition, significant attention has been paid to ensure that the thermal resistance of contacting surfaces is minimized and reproducible.

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

1.4 *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. Related Documents

2.1 ASTM Standards:

C 518 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus²

C 1045 Practice for Calculating Thermal Transmission Properties Under Steady-State Test Conditions²

E 220 Method for Calibration of Thermocouples by Comparison Techniques³

E 1142 Terminology Relating to Thermophysical Properties⁴

E 1225 Test Method for Thermal Conductivity of Solids by Means of the Guarded-Comparative-Longitudinal Heat Flow Technique⁴

F 104 Classification System for Nonmetallic Gasket Materials⁵

F 433 Practice for Evaluating Thermal Conductivity of Gasket Materials⁵

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *heat flux transducer (HFT)*—a device that produces an electrical output that is a function of the heat flux, in a predefined and reproducible manner.

3.1.2 *thermal conductance (C)*—the time rate of heat flux through a unit area of a body induced by unit temperature difference between the body surfaces.

3.1.2.1 *average temperature*—the average temperature of a surface is the area-weighted mean temperature of that surface.

3.1.3 *thermal conductivity (λ)*—(of a solid material)—the time rate of heat flow, under steady conditions, through unit area, per unit temperature gradient in the direction perpendicular to the area:

3.1.3.1 *apparent thermal conductivity*—When other modes of heat transfer through a material are present in addition to conduction, the results of the measurements performed in accordance with this test method will represent the apparent or effective thermal conductivity for the material tested.

3.1.4 *thermal resistance (R)*—the reciprocal of thermal conductance.

3.2 Symbols:

3.2.1 λ —thermal conductivity, $\text{W}/(\text{m} \cdot \text{K})$ ($\text{Btu} \cdot \text{in.}/\text{h} \cdot \text{ft}^2 \cdot ^\circ\text{F}$).

3.2.2 C —thermal conductance, $\text{W}/(\text{M}^2 \cdot \text{K})$ ($\text{Btu}/(\text{h} \cdot \text{ft}^2 \cdot ^\circ\text{F})$).

3.2.3 R —thermal resistance, $\text{m}^2 \cdot \text{K}/\text{W}$ ($\text{h} \cdot \text{ft}^2 \cdot ^\circ\text{F}/\text{Btu}$).

3.2.4 Δx —specimen thickness, mm (in.).

3.2.5 A —specimen cross-sectional area, $\text{m}^2 (\text{ft}^2)$

¹ This test method is under the jurisdiction of ASTM Committee E37 on Thermal Measurements and is the direct responsibility of Subcommittee E37.05 on Thermophysical Properties.

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² Annual Book of ASTM Standards, Vol 04.06.

³ Annual Book of ASTM Standards, Vol 14.03.

⁴ Annual Book of ASTM Standards, Vol 14.02.

⁵ Annual Book of ASTM Standards, Vol 09.02.