



Designation: C653 – 17

Standard Guide for Determination of the Thermal Resistance of Low-Density Blanket-Type Mineral Fiber Insulation¹

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1. Scope

1.1 This guide describes the calculation and interpolation of a thermal resistance value for low-density blanket-type insulation material at a particular density and thickness having been selected as representative of the product. It requires measured values of this average density and thickness, as well as apparent thermal conductivity values determined by either Test Method C177, C518, or C1114.

1.2 This guide applies to a density range for mineral-fiber material of roughly 6.4 to 48 kg/m³ (0.4 to 3.0 lb/ft³). It is primarily intended to apply to low-density, mineral-fiber mass insulation batts and blankets, exclusive of any membrane facings. Apparent thermal conductivity data for these products are commonly reported at a mean temperature of 23.9°C (75°F) and a hot-to-cold plate temperature difference of 27.8°C (50°F) or 22.2°C (40°F).

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

- C167 Test Methods for Thickness and Density of Blanket or Batt Thermal Insulations
- C168 Terminology Relating to Thermal Insulation
- C177 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
- C518 Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus

¹ This guide is under the jurisdiction of ASTM Committee C16 on Thermal Insulation and is the direct responsibility of Subcommittee C16.30 on Thermal Measurement.

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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 to the standard's Document Summary page on the ASTM website.

- C687 Practice for Determination of Thermal Resistance of Loose-Fill Building Insulation
- C1045 Practice for Calculating Thermal Transmission Properties Under Steady-State Conditions
- C1114 Test Method for Steady-State Thermal Transmission Properties by Means of the Thin-Heater Apparatus

3. Terminology

3.1 *Definitions*—For definitions used in this guide, refer to Terminology C168.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *apparent thermal conductivity*, λ —the ratio of the specimen thickness to thermal resistance of the specimen. It is calculated as follows:

$$\lambda = L/R \text{ (W/m}\cdot\text{K) or (Btu}\cdot\text{in./ft}^2\cdot\text{h}\cdot\text{F)} \quad (1)$$

3.2.1.1 *Discussion*—For this type of material an expression for the apparent thermal conductivity as a function of density is:

$$\lambda = a + bD + c/D \quad (2)$$

where a , b , c = parameters characteristic of a product, and related to the conductivity of the gas, the conductivity of the solid and the conductivity due to radiation (1).³

3.3 Symbols:

- R = thermal resistance, (m² K/W) or (h·ft² F/Btu)
- λ = apparent thermal conductivity, (W/m·K) or (Btu·in./h·ft²F)
- Q/A = heat flow per unit area, (W/m²) or (Btu/h·ft²)
- D = bulk density of a specimen, (kg/m³) or (lb/ft³)
- L = measured specimen thickness, (m) or (in.)
- T = apparatus plate temperature, (K) or (F)
- L' = specimen thickness if the sample from which the specimen is selected does not recover to label thickness, (m) or (in.)
- s = estimate of the standard deviation for a set of data points
- Δ = apparatus systematic error
- Ψ = overall uncertainty in a measured R -value

³ The boldface numbers in parentheses refer to a list of references at the end of this standard.