



Standard Test Method for Thermal Transmission Properties of Thermally Conductive Electrical Insulation Materials¹

This standard is issued under the fixed designation D5470; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope*

1.1 This standard covers a test method for measurement of thermal impedance and calculation of an apparent thermal conductivity for thermally conductive electrical insulation materials ranging from liquid compounds to hard solid materials.

1.2 The term “thermal conductivity” applies only to homogeneous materials. Thermally conductive electrical insulating materials are usually heterogeneous and to avoid confusion this test method uses “apparent thermal conductivity” for determining thermal transmission properties of both homogeneous and heterogeneous materials.

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. Referenced Documents

2.1 ASTM Standards:²

D374 Test Methods for Thickness of Solid Electrical Insulation (Withdrawn 2013)³

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

E1225 Test Method for Thermal Conductivity of Solids Using the Guarded-Comparative-Longitudinal Heat Flow Technique

¹ This test method is under the jurisdiction of ASTM Committee D09 on Electrical and Electronic Insulating Materials and is the direct responsibility of Subcommittee D09.19 on Dielectric Sheet and Roll Products.

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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.

³ The last approved version of this historical standard is referenced on www.astm.org.

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *apparent thermal conductivity* (λ), n —the time rate of heat flow, under steady conditions, through unit area of a heterogeneous material, per unit temperature gradient in the direction perpendicular to the area.

3.1.2 *average temperature (of a surface)*, n —the area-weighted mean temperature.

3.1.3 *composite*, n —a material made up of distinct parts which contribute, either proportionally or synergistically, to the properties of the combination.

3.1.4 *homogeneous material*, n —a material in which relevant properties are not a function of the position within the material.

3.1.5 *thermal impedance* (θ), n —the total opposition that an assembly (material, material interfaces) presents to the flow of heat.

3.1.6 *thermal interfacial resistance (contact resistance)*, n —the temperature difference required to produce a unit of heat flux at the contact planes between the specimen surfaces and the hot and cold surfaces in contact with the specimen under test. The symbol for contact resistance is R_f .

3.1.7 *thermal resistivity*, n —the reciprocal of thermal conductivity. Under steady-state conditions, the temperature gradient, in the direction perpendicular to the isothermal surface per unit of heat flux.

3.2 Symbols Used in This Standard:

3.2.1 λ = apparent thermal conductivity, W/m·K.

3.2.2 A = area of a specimen, m².

3.2.3 d = thickness of specimen, m.

3.2.4 Q = time rate of heat flow, W or J/s.

3.2.5 q = heat flux, or time rate of heat flow per unit area, W/m².

3.2.6 θ = thermal impedance, temperature difference per unit of heat flux, (K·m²)/W.

4. Summary of Test Method

4.1 This standard is based on idealized heat conduction between two parallel, isothermal surfaces separated by a test