



Standard Practice for Thermal Conductivity of Materials Using a Thermal Capacitance (Slug) Calorimeter¹

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1. Scope

1.1 This practice describes a technique for the determination of the apparent thermal conductivity, λ_a , of materials. It is for solid materials with apparent thermal conductivities in the approximate range $0.02 < \lambda_a < 2 \text{ W/(m}\cdot\text{K)}$ over the approximate temperature range between 300 K and 1100 K.

NOTE 1—While the practice should also be applicable to determining the thermal conductivity of non-reactive materials, it has been found specifically useful in testing fire resistive materials that are both reactive and undergo significant dimensional changes during a high temperature exposure.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

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

C1113 Test Method for Thermal Conductivity of Refractories by Hot Wire (Platinum Resistance Thermometer Technique)

D2214 Test Method for Estimating the Thermal Conductivity of Leather with the Cenco-Fitch Apparatus (Withdrawn 2008)³

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

E220 Test Method for Calibration of Thermocouples By

¹ This practice 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 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.

Comparison Techniques

E230 Specification and Temperature-Electromotive Force (EMF) Tables for Standardized Thermocouples

E457 Test Method for Measuring Heat-Transfer Rate Using a Thermal Capacitance (Slug) Calorimeter

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

3. Terminology

3.1 Definitions:

3.1.1 *thermal conductivity*, λ —the time rate of heat flow, under steady conditions, through unit area, per unit temperature gradient in the direction perpendicular to the area.

3.1.2 *apparent thermal conductivity*, λ_a —when other modes of heat transfer (and mass transfer) through a material are present in addition to thermal conduction, the results of the measurements performed according to this practice will represent the apparent or effective thermal conductivity for the material tested.

3.2 Symbols:

A = specimen area normal to heat flux direction, m^2

C_p = specific heat capacity, $\text{J/(kg}\cdot\text{K)}$

F = heating or cooling rate, (K/s)

L = thickness of a specimen (slab) in heat transfer direction, m

M = mass, kg

Q = heat flow, W

T = absolute temperature, K

T_{inner}^{SSS} = mean temperature of the stainless steel slug, K

T_{outer}^{SPEC} = mean temperature of outer (exposed) specimen surfaces, K

T_{mean}^{SPEC} = mean temperature of specimen, K

ΔT = temperature difference across the specimen, given by $(T_{outer}^{SPEC} - T_{inner}^{SSS})$, K

λ = thermal conductivity, $\text{W/(m}\cdot\text{K)}$

λ_a = apparent thermal conductivity, $\text{W/(m}\cdot\text{K)}$

ρ^{SPEC} = bulk density of specimen being tested, kg/m^3

3.3 Subscripts/Superscripts:

$SPEC$ = material specimen being evaluated

SSS = stainless steel slug (thermal capacitance transducer)