



SURFACE VEHICLE INFORMATION REPORT

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Thermal Transport Properties Germane to Friction Materials and Brakes

RATIONALE

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1. Scope

This SAE Information report defines the thermal transport properties important in the assessment of heat management capability of brake lining, shoe, disc and drum materials. The report discusses thermal diffusivity, specific heat capacity, thermal conductivity and thermal expansion. Measurement techniques for the appropriate ASTM standards are identified. The thermal transport properties discussed are material sample properties, not the properties of entire components such as pad assemblies.

2. References

2.1 Applicable Publications

The following publications form a part of this information report to the extent specified herein. Unless otherwise specified, the latest issue of SAE and ASTM publications shall apply.

2.1.1 SAE PUBLICATIONS

None.

2.1.2 ASTM INTERNATIONAL PUBLICATIONS

Available for purchase from: ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, Pennsylvania, USA 19428-2959. www.astm.org.

ASTM E 1461—Standard Test Method for Thermal Diffusivity of Solids by the Flash Method

ASTM C 1114—Steady-State Thermal Transmission Properties by Means of the Thin-Heater Apparatus

ASTM E 1225—Thermal Conductivity of Solids by Means of the Guarded-Comparative-Longitudinal Heat Flow Technique

ASTM E 1269—Determining Specific Heat Capacity by Differential Scanning Calorimetry

ASTM E 228—Linear Thermal Expansion of Solid Materials With a Vitreous Silica Dilatometer

2.2 Related Publications

The following publications are for information purposes only and are not a required part of this document.

2.2.1 SAE PUBLICATIONS

SAE J160—Swell, Growth and Dimensional Stability of Brake Linings

2.2.2 OTHER PUBLICATIONS

JIS D4416—Test procedure of thermal expansion for brake linings and pads of automobiles

ISO 6313—Effects of heat on dimensions and form of disc brake pads

3. Definitions

3.1 Symbols Used

α	Thermal diffusivity
λ	Thermal conductivity
C_p	Heat capacity per unit mass at constant pressure
CTE	Coefficient of thermal expansion
D	Specimen thickness
t	Time
ΔQ	Heat energy
M	Specimen mass
ΔT	Temperature rise
H	Rate of heat transfer across the area A
A	Sample area
$\frac{dT}{dx}$	Temperature gradient
ρ	Sample density
L_o	Sample original length

3.2 Summary of Thermal Transport Materials Properties

Thermal properties of disc, drum and friction materials are typically required to assess the heat management of brake components. These properties are often used to perform computer-aided design of brakes and computer simulations or modeling of brake performance. This document defines several standard thermal transport material properties: thermal diffusivity, specific heat capacity, thermal conductivity and thermal expansion, and describes the techniques used to measure them. Table 1 is included below listing the equipment used to measure the material properties and the applicable ASTM International standards.