Institute of Refractories Engineers

Properties of Refractories

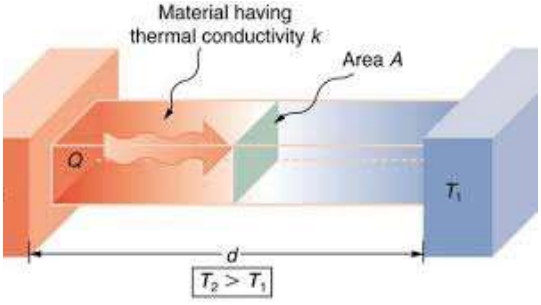
Thermal Conductivity Testing

Thermal conductivity, k, is defined by the equation

$$P = k \cdot \frac{d}{A} \cdot \Delta T$$

Where P is rate of heat flow, d is the length of the material, A is its area and ΔT is the temperature difference

k is a material property but
- it can vary with test temperature
- direction through the material (anisotropic)

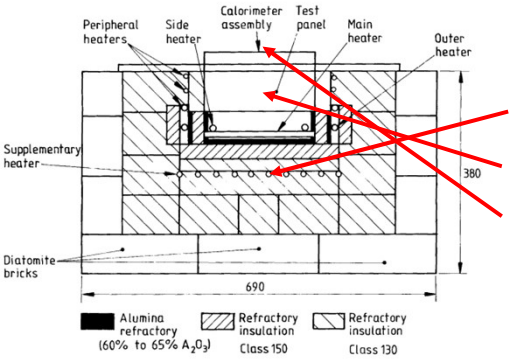


Measuring Conductivity

- Steady State
  - Panel Calorimeter – BS1902 5.5
  - Split Column – BS1902 5.8
- Transient Methods
  - Hot Wire Methods
    - Parallel Wire Method – EN 993-15
    - Cross Array Method – ISO 8894
  - Laser Flash Method

Direct Methods

Panel Method

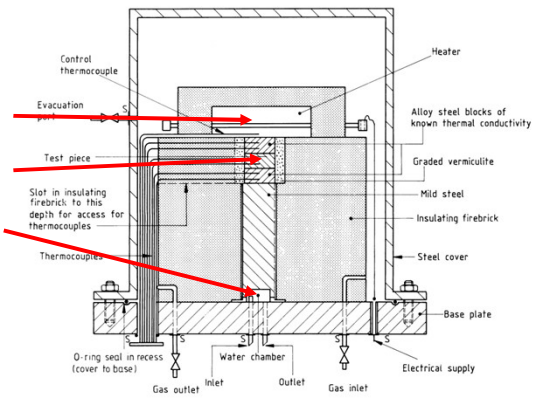


Heating Element

Sample

Cooling Water

Split Column Method



Direct Methods

	Panel Method	Split Column Method
Applicable Conductivity	0.5-20 W/mK	3-80 W/mK
Applicable Temp	300-1400℃	300-800℃
Test atmosphere	Air	Air or reducing
Limitations	Large sample – joints Slow	Need to drill fine hole to TC in sample Slow

Hot Wire Methods

3 Principle

The hot-wire method (parallel) is a dynamic measuring procedure based on the determination of the temperature increase against time at a certain location and at a specified distance from a linear heat source embedded between two test pieces.

Sample is heated by electric current in an wire and heat rise in surrounding sample is monitored

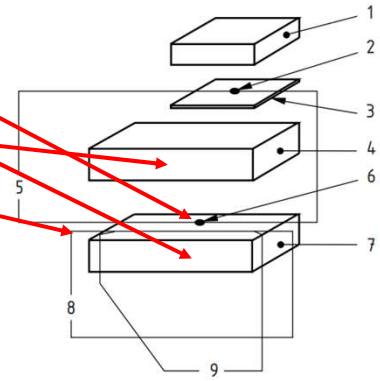
Sample can be heated to constant temperature first to measure TC at elevated temperature

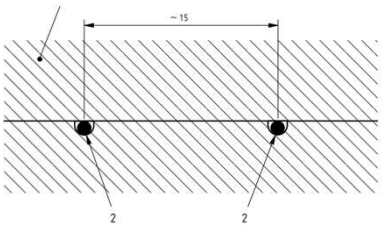
Cannot be used on elec conductive materials (carbon, SiC, magnesia carbon etc)

Hot Wire Methods

Parallel Wires

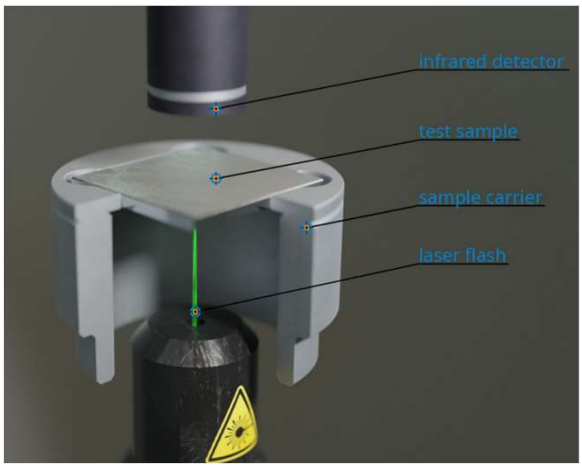
Measuring TC
Sample
Heating Wire





Grooves for wires

Laser Flash Methods



Suitable for most materials
Quick result
Can be carried out at elevated temperatures

Reliability
Sample size vs grain size?

Summary

- Different methods with different characteristics
- RESULT DEPENDS ON METHOD USED
  - Difference up to 30% between methods

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Questions

https://irengineers.co.uk/