

Thermal Properties and Testing

Thermal Conductivity

The time rate of heat flow through a unit area producing a unit temperature difference across a unit thickness.

$$k = \frac{dq \cdot z}{dt \cdot A \cdot \Delta T}$$

Thermal conductivity is an inherent or absolute property of the material.

Thermal Impedance

A property of a particular assembly measured by the ratio of the temperature difference between two surfaces to the steady-state heat flow through them.

$$Z_{\theta} = \frac{z}{k \cdot A} + R_i$$

Factors affecting thermal impedance include:

Area: Increasing the area of thermal contact decreases thermal impedance.

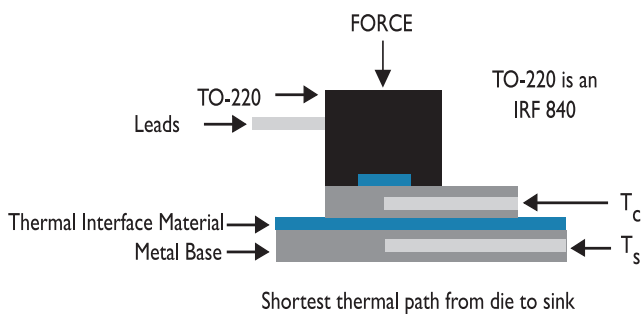
Thickness: Increasing the insulator thickness increases thermal impedance.

Pressure: Increasing mounting pressure under ideal conditions decreases thermal impedance.

Time: Thermal impedance decreases over time.

Measurement: Thermal impedance is affected by the method of temperature measurement.

Thermal Impedance Per Bergquist TO-220 Thermal Performance (25°C Cold Plate Testing)



$$Z_{\theta} = \frac{\Delta T}{P_D}$$

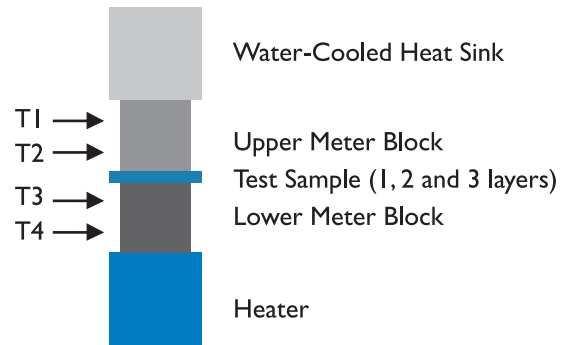
Thermal Resistance

The opposition to the flow of heat through a unit area of material across an undefined thickness.

$$R_{\theta} = \frac{z}{k}$$

Thermal resistance varies with thickness.

Test Methods – ASTM D5470



2 in. diameter stack (ref. 3.14 in²) – 10-500 psi, 1 hour per layer

