Thermal conductivity

**Thermal conductivity:**
- Measures the ability of a material to conduct heat.
- Defines thermal insulation characteristics.
- Basic data for heat transfer calculations.
- Important in any design that must function in a thermal environment.
- Controls the rate of cooling in injection and blowmolding tools.
- Controls the rate at which a plastic “sets up” during extrusion.
- Thermal input for moldfilling programs.

**Thermal conductivity (k)**
The rate of heat transfer by conduction. As an example, frying pans and kettles are made of high thermal conductivity materials such as copper, aluminum, or iron; the insulating handles are constructed of low thermal conductivity materials such as wood or plastic.

The standard unit, W/m°K, is read as Watt/per meter degrees Kelvin.

| 1 W/m°K | = 2.37 BTU/hr ft°F |
|         | = 0.576 BTU/hr ft°F |
|         | = 0.0024 Cal/sec cm°C |
|         | = 0.859 kcal/hr m°C |
|         | = 10 mW/cm°K |

**Units of thermal conductivity**

**R-Value**
A term commonly used in the building and construction industry that indicates the insulation value of a structure (i.e. wall or window).

**The RR-value is related to the thermal conductivity by:**
- RR-value = thickness/thermal conductivity
- Low thermal conductivity = high RR-value
- High thermal conductivity = low RR-value
- The type of polymer. Different polymers have different thermal conductivities. This affects their cooling rates. Crystalline polymers cool faster than amorphous polymers (see figure 1)

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**The effect of density**
Heat transfer decreases as density decreases. This is illustrated by this foamed Noryl® resin example.

**Figure 1**

**Figure 2**
Thermal conductivity* of Noryl® FN215X resin

Based on SABIC Innovative Plastics test data.
The effect of fillers
Thermal conductivity increases with glass content. This is because glass has a higher thermal conductivity than plastic.

Figure 3
Temp. (°C)

The effect of temperature
For heat transfer calculations at processing conditions, thermal conductivity should be measured in the melt state.

Figure 4

Figure 5
Relative thermal conductivity (at 25°C)