

THERMAL CONDUCTIVITY DEFINED & COMPARED

Thermal conductivity, usually represented by the letters λ or k , is the ability of a material to conduct heat, and is an intensive property of that material.

Thermal conductivity can be calculated from a number of measured quantities, but is normally defined as: the quantity of heat, Q , transmitted through a thickness L , in a direction normal to a surface of area A , due to a temperature difference ΔT , under steady state conditions and when the heat transfer is dependent only on the temperature gradient.

Thermal conductivity = Heat flow rate × distance / (area × temperature difference)

$$k = Q \times L / (A \times \Delta T)$$

A comparison of thermal conductivity values (at one atmosphere of pressure and 20°C) for common materials is given below along with some other related intensive properties (density, heat capacity and thermal diffusivity). Thermal conductivity is the product of density (ρ) x volumetric heat capacity x thermal diffusivity (α): $k = \rho * C_v * \alpha$

MATERIAL	CLASS	THERMAL CONDUCTIVITY (W/m-K)	DENSITY kg/m ³	VOLUMETRIC HEAT CAPACITY 10 ⁶ J/m ³ K	THERMAL DIFFUSIVITY 10 ⁻⁸ m ² /s
Aerogel	Insulation	0.012	120	0.125	12
Air	Insulation	0.025	1	0.001	1938
Cotton	Insulation	0.030	--	0.001	--
Plastic insulation materials	Insulation	0.030	50	0.100	30
Mineral insulation materials	Insulation	0.040	100	0.090	44
Foam glass	Insulation	0.045	120	0.092	49
Cork	Insulation	0.070	200	0.047	150
Silicone oil	Fluid	0.100	760	1.370	7
Leather	Structural material	0.140	--	0.001	59
Gasoline	Fluid	0.150	720	2.100	7
PVC	Structural material	0.160	1300	1.950	8
Olive oil	Fluid	0.170	920	1.650	10
Alcohol	Fluid	0.170	800	2.430	7
Glass pearls (dry)	Insulation	0.180	1800	1.140	16
Methanol	Fluid	0.210	790	2.500	8
PTFE	Structural material	0.250	2200	2.200	11
Nylon 6	Structural material	0.250	1140	1.938	13
Glycerol	Fluid	0.290	1260	3.073	9
Sand (dry)	Insulation material	0.350	1600	1.270	28
Wood	Structural material	0.400	780	0.187	214
Water	Fluid	0.600	1000	4.180	14
Glass pearls (saturated)	Structural material	0.760	2100	2.710	28
Glass	Structural material	0.930	2600	2.184	43
Pyrex 7740	Structural material	1.005	2230	1.681	60
Corian (ceramic filled)	Structural material	1.06	1800	2.307	46
Concrete	Structural material	1.28	2200	1.94	66
Ice	Structural material	2.1	917	2.017	104
Sand (saturated)	Structural material	2.7	2100	2.64	102
Quartz	Structural material	3	2600	2.13	141
Marble	Structural material	3	2700	2.376	126
Stainless Steel	Structural material	16	7900	3.95	405
Aluminium Oxide	Structural material	30	3900	3.413	879
Aluminium	Structural material	237	2700	2.376	9975
Copper	Structural material	390	8960	3.494	11161

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