Thermal conductivity and CLTE

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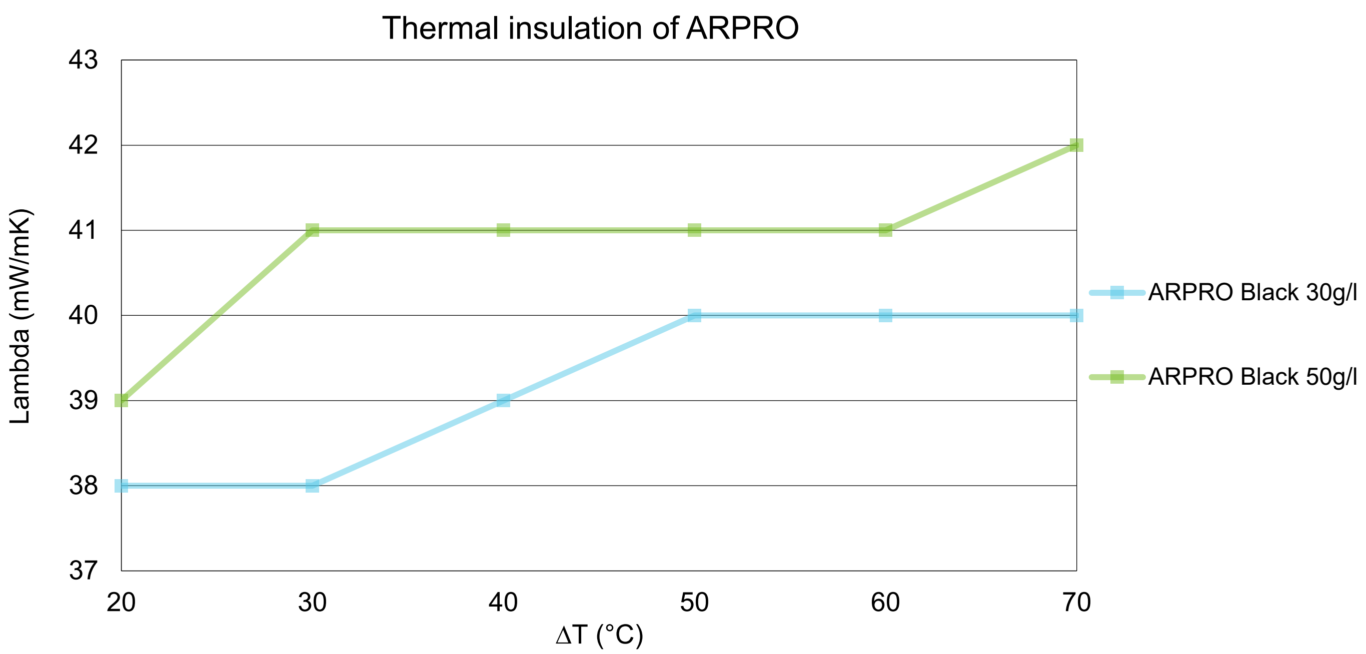
1. Thermal insulation

This value characterises the material behaviour to act as thermal barrier during heat transfer in conduction. It represents the energy transferred per unit and time under a temperature gradient of 1°C/m (degree per meter).

The data below is obtained from 2 different tests, it gives the thermal conductivity (λ) of a material. The smaller the λ, the better the insulation.

Test method A: ISO 8301. These results are obtained by applying an increasing temperature difference between two plates. The difference between the cold and the hot temperature (ΔT) goes from 20 to 70°C. The cold plate temperature is kept at 21°C, while the hot plate temperature is variable. Here, λ characterises the function of the temperature gradient.

Tested densities: ARPRO Black at 30 and 50g/l



Test method B: ISO 8301 and ISO 8302. A guarded heater is placed between two moulded samples that are in contact with a heat flow meter and a cooling plate. The value is determined by the heat flow, the mean temperature difference between the sample surface and the dimensions of the sample. Here, λ characterises the energy transferred per unit area and time under a temperature gradient of 1°C/m.

Note: Some additives can influence the thermal insulation. For example, carbon black pigment allows the reflection of some radiation, and so ARPRO Grey insulates better than ARPRO White.

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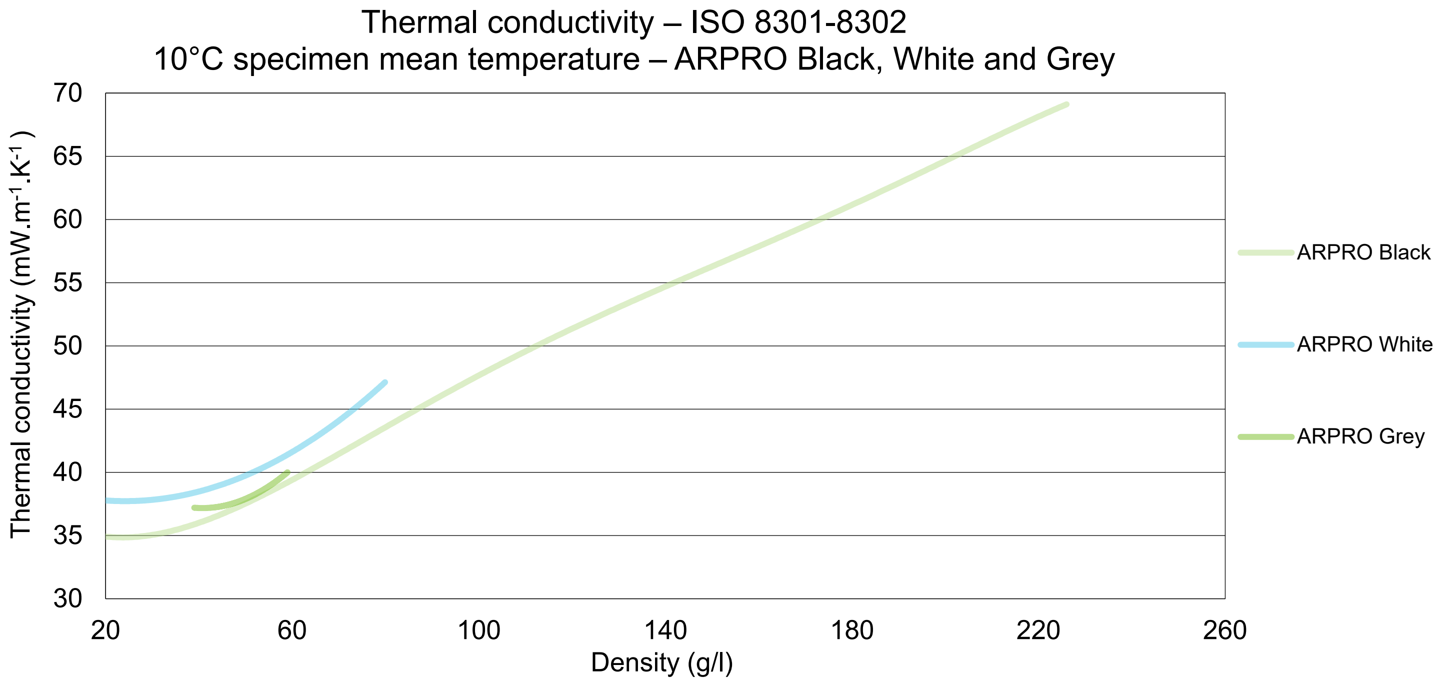

Property	Test	Unit	Density (g/l)											
			20	30	40	50	60	80	100	120	140	160	180	200
λ - thermal conductivity	ISO 8301-8302 10°C	$mW.m^{-1}.K^{-1}$												
Black			35	35	36	37	39	44	47	51	54	58	61	65
Grey			-	37	37	38	40	43	-	-	-	-	-	-
White			38	38	38	40	42	47	55	-	-	-	-	-

ARPRO provides effective thermal insulation while offering structural resistance.

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2. Dimensional stability / in use

The coefficient of linear thermal expansion (CLTE) of a material is its tendency to expand (or shrink) due to temperature variation (heat or cold).

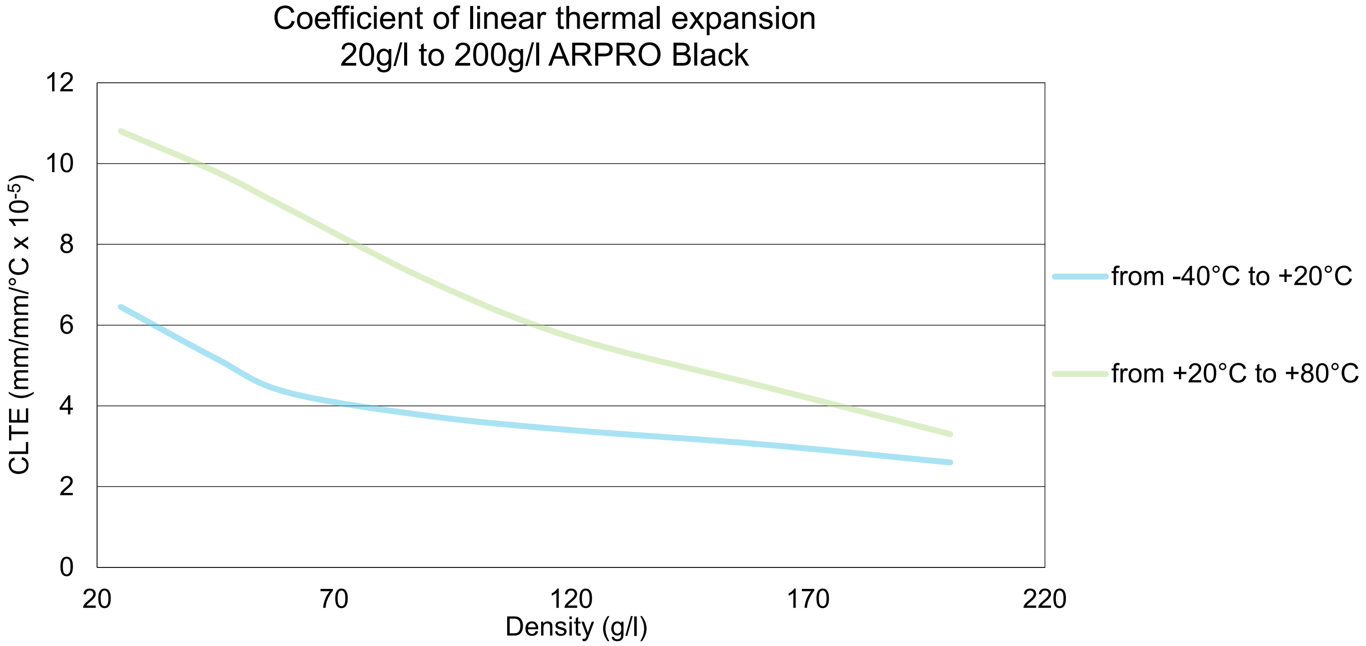
Test method: Gauge marks are placed at 25mm intervals lengthwise in the sample in a thermostatic chamber at an initial temperature for 24 hours. The gauge length is measured immediately after removing from the thermostatic chamber. Then, the sample is placed at a final temperature for 24 hours. The gauge length is measured once more, immediately after this temperature treatment.

The CLTE, expressed as K, is calculated by the equation:

$$K = \frac{L_1 - L_0}{\Delta T^* L_0}$$

Where: L_1 = sample length at final exposure temperature, L_0 = sample length at the initial exposure temperature, ΔT = final temperature – initial temperature.

Tested densities: ARPRO Black from 20 to 200g/l



Note: The final results might slightly vary according to the specific moulded part geometry.

Test result use: CLTE of ARPRO at 160g/l from +20°C to +80°C ARPRO is 4.5*10^{-5}mm/mm/°C. This means that if a 160g/l ARPRO part has an original length of 100mm, after 24 hours conditioning at +80°C the final length of the part will be:

$$L_1 = L_0 + K^* \Delta T^* L_0 = 100 + 4.5*10^{-5}*60*100 = 100.27\text{mm}$$

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