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Table 7.7 The coefficient of linear expansivity α for various solids at temperatures around room temperature. (*Kaye & Laby*). The volume expansivity of the elements is given by β = 3α as shown in Example 7.4.

Elemental metals	**α (°C^{-1})**	**Miscellaneous**	**α (°C^{-1})**	**Alloys**	**α (°C^{-1})**
Aluminium (Al)	23	Brick	3–10	Brass (68% Cu/32% Zn)	18–19
Antimony (Sb)	≈ 11	Cement and concrete	10–14	Bronze (80% Cu/20% Sn)	17–18
Bismuth (Bi)	≈ 13	Marble	3–15	Constantan (60% Cu/40% Ni)	15–17
Cadmium (Cd)	≈ 30	Lead glass (46% pbo)	≈ 8	Duralumin (95% Al/4% Cu)	23
Chromium (Cr)	≈ 7	Typical glass	≈ 8–10	Magnalium (90% Al/10% Mg)	≈ 23
Cobalt (Co)	≈ 12	Porcelain	2–6	Nickel steel(10% Ni/90%Fe)	13
Copper (Cu)	16.7	Silica	0.4	Nickel steel(36% Ni/64%Fe)	0–1.5
Gold (Au)	13	Typical wood (along grain)	3–5	Nickel steel(43% Ni/57%Fe)	7.9
Iridium (Ir)	6.5	Typical wood (across grain)	35–60	Nickel steel(58% Ni/42%Fe)	11.4
Iron (Fe)	11.7			Carbon steel	≈11
Lead (Pb)	29	**Plastics**		Stainless steel (74%Fe/18%Cr/8%Ni)	29
Magnesium (Mg)	25	Epoxy resins	45–65	Phosphor-bronze	17
Nickel (Ni)	12.8	Epoxy resins	45–65	Platinum–Iridium (90% Pt/10% Ir)	8.7
Palladium (Pd)	≈ 11	Polycarbonates	66		
Platinum (Pt)	8.9	Low-density polyethylene	40–150	**Carbon**	
Rhodium (Rh)	8.4	Medium-density polyethylene	80–220	Diamond	1.0
Silver (Ag)	19	High density polyethylene	200–360	Graphite (polycrystalline)	7.1
Tantalum (Ta)	6.5	Natural rubber	220		
Thallium (Tl)	≈ 28	Hard rubber	60		
Tin (Sn)	≈ 21	Perspex	50–90		
Titanium (Ti)	≈ 9	Nylon	80–280		
Tungsten (W)	4.5	Polystyrene	34–210		
Vanadium (V)	≈ 8	Polyvinyl chloride (pvc)	70–80		
Zinc (Zn)	≈ 30				

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Table 7.8 Expected and experimentally determined values the coefficient of linear expansivity thermal expansivity α for some alloys and their component metals.

Alloy composition	Expected (see text)	Experimental α (°C^{-1})
Aluminium alloys		
Duralumin (95% Al/4% Cu)	22.5×10^{-6}	23×10^{-6}
Magnalium (90% Al/10% Mg)	23.2×10^{-6}	$\approx 23 \times 10^{-6}$
Aluminium	—	23×10^{-6}
Copper	—	16.7×10^{-6}
Magnesium	—	$\approx 25 \times 10^{-6}$
Copper alloys		
Brass (68% Cu/32% Zn)	21×10^{-6}	18-19 $\times 10^{-6}$
Bronze (80% Cu/20% Sn)	17.6×10^{-6}	17-18 $\times 10^{-6}$
Constantan (60% Cu/40% Ni)	15.1×10^{-6}	15-17 $\times 10^{-6}$
Copper	—	16.7×10^{-6}
Zinc	—	$\approx 30 \times 10^{-6}$
Tin	—	$\approx 21 \times 10^{-6}$
Ni	—	12.8×10^{-6}
Platinum alloys		
Platinum-Iridium (90% Pt/10% Ir)	8.66×10^{-6}	8.7×10^{-6}
Platinum	—	8.9×10^{-6}
Iridium	—	6.5×10^{-6}
Iron alloys		
Nickel steel (10% Ni/90%Fe)	11.8×10^{-6}	13×10^{-6}
Nickel steel(36% Ni/64%Fe)	12.1×10^{-6}	$0–1.5 \times 10^{-6}$
Nickel steel(43% Ni/57%Fe)	12.2×10^{-6}	7.9×10^{-6}
Nickel steel(58% Ni/42%Fe)	12.3×10^{-6}	11.4×10^{-6}
Stainless steel (74%Fe/18% Cr/8%Ni)	10.9×10^{-6}	29×10^{-6}
Iron	—	11.7×10^{-6}
Nickel	—	12.8×10^{-6}
Chromium	—	7×10^{-6}

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Table 7.19 Thermal conductivity κ of solid elements (W K^{-1} m^{-1}) as a function of absolute temperature. The shaded entries refer to data above the melting temperature of the element. The labels M, I and SC stand for metal, insulator and semiconductor respectively. The two results for phosphorus at 173.2 K correspond to different crystal structures known as 'black' and 'yellow' phosphorus respectively.

Element and type of material		Temperature (K) 73.2 K	173.2 K	273.2 K	373.2 K	1273 K
Lithium, Li	M	94	86	82	47	59
Beryllium, Be	M	367	218	168	129	93
Boron, B	I	72	32	19	11	10
Carbon (Graphite), C	I	70–220	80–230	75–195	50–130	35–70
Carbon (Diamond), C	I	1700–4900	1000–2600	700–1700	—	—
Sodium, Na	M	141	142	88	78	60
Magnesium, Mg	M	160	157	154	150	—
Aluminium, Al	M	241	236	240	233	92
Silicon, Si	SC	330	168	108	65	32
Phosphorous, P	I	20	13/0.25	0.18	0.16	—
Sulphur, S	I	0.39	0.29	0.15	0.17	—
Potassium, K	M	105	104	53	45	32
Scandium, Sc	M	15	16			
Titanium, Ti	M	26	22	21	19	21
Vanadium, V	M	32	31	31	33	38
Chromium, Cr	M	120	96.5	92	82	66
Manganese, Mn	M	7	8	—	—	—
Iron, Fe	M	99	83.5	72	56	34
Cobalt, Co	M	130	105	89	69	53
Nickel, Ni	M	113	94	83	67	71
Copper, Cu	M	420	403	395	381	354
Zinc, Zn	M	117	117	112	104	66
Gallium, Ga	M	43	41	33	45	—
Germanium, Ge	SC	113	67	46.5	29	17.5
Selenium (*c*-axis), Se	I	6.8	4.8	4.8	—	—
Rubidium, Rb	M	59	58	32	29	22
Yttrium, Y	M	16.5	17	—	—	—
Zirconium, Zr	M	26	23	22	21	23
Niobium, Nb	M	53	53	55	58	64
Molybdenum, Mo	M	145	139	135	127	113
Technetium, Tc	M	—	51	50	50	—
Ruthenium, Ru	M	123	117	115	108	98
Rhodium, Rh	M	156	151	147	137	—
Palladium, Pd	M	72	72	73	79	93
Silver, Ag	M	432	428	422	407	377
Cadmium, Cd	M	100	97	95	89	445
Indium, In	M	92	84	76	42	—
Tin, Sn	M	76	68	63	32	40
Antimony, Sb	M	33	25.5	22	19	27
Tellurium(*c*-axis), Te	I	5.1	3.6	2.9	2.4	6.3

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Table 7.20 Thermal conductivity of a variety materials (WK^{-1} m^{-1}). The tables refer to metallic alloys, refractory materials, i.e. those suitable for use in high temperatures without degradation, and a selection of everyday materials.

	173.2K	273.2K	373.2K	573.2K	873.2K	973.2K	1473.2K
Brass (Cu70%,Zn30%)	89	106	128	146	—	—	—
Bronze (Cu90%,Sn10%)	—	53	60	80	—	—	—
Carbon steel	48	50	48.5	54.5	—	30.5	—
Silicon steel	—	25	28.5	31	—	28	—
Stainless steel	—	24.5	25	25.5	—	24.8	—
Alumina (Al_2O_3)	—	40	28	—	9.2	—	5.7
Beryllia (BeO)	—	300	213	—	61	—	22
Fire brick	—	—	—	—	1.1	—	1.3
Silica (SiO_2) fused quartz	—	1.33	1.48	—	2.4	—	—
Zirconia (ZrO_2)	—	—	1.8	—	2.0	—	2.2

Substance	κ (WK^{-1} m^{-1})	Substance	κ (WK^{-1} m^{-1})	Substance	κ (WK^{-1} m^{-1})
Brick wall	≈1	Porcelain	1.5	Glass wool	0.037
Plaster	≈0.13	Rubber	≈0.2	Cotton wool	0.03
Timber	≈ 0.15	Polystyrene	≈0.1	Sheep's wool	0.05
Balsa wood	≈0.06	Glass (crown)	1.1	Nylon	0.25
Paper	0.06	Glass (flint)	0.85	Epoxy resins	≈0.2
Cardboard	0.21	Glass (pyrex)	1.1	Cellular polystyrene	≈0.04