PROPERTIES OF TYPICAL ENGINEERING MATERIALS

Material		Alloy constituents	0.1% proof (yield) stress	Young's modulus	Density	Specific heat capacity	Coefficient of linear thermal expansion	Thermal conduct-ivity	Electrical resistivity (per cube)	Relative cost	
METALS AND ALLOYS		**% by mass**	σ_y (MPa)	E (GPa)	ρ x 10^3 (kg·m^{-3})	c (10^3 J·kg^{-1}·K^{-1})	α (10^{-6}·K^{-1})	λ (W·m^{-1}·K^{-1})	ρ_e (Ω·m)	(k£·m^{-3})	**Notes**
CAST IRON	grey	3.5C	100-250	100-150	7.0-7.4	0.52	11	50	700x10^{-9}	0.8	
	malleable	2.5C	250-500	170	7.3	0.52	11	40	340x10^{-9}	1.0	
STEEL	mild	0.06-0.25C	250-500	210	7.9	0.45	11	50	120x10^{-9}	1.2	
	medium carbon	0.25-0.6C	250-700	210	7.9	0.45	11	50	230x10^{-9}	1.5	
	alloy	Ni Cr Mo	700-1000	215	7.9	0.45	11	30	300x10^{-9}	2	
	stainless	0.2C 16Cr	500-1000	215	7.8	0.5	10	25	720x10^{-9}	4-7	Martensitic
		0.1C 18Cr 8Ni	200-800	215	7.8	0.5	16	16	740x10^{-9}	4-7	Austenitic
MAGNESIUM	alloy	8Al 0.5Zn	150-250	40	1.8	1.0	25	100	600x10^{-9}	7	
ALUMINIUM	pure		30-140	70	2.7	0.88	27	240	36x10^{-9}	2.2	
	alloy	4Cu 1Mg	125-400	70	2.8	0.9	27	180	38x10^{-9}	3.4	"Duralumin"
TITANIUM	alloy	4Al 4Mn	1000	110	4.5	0.5	9	17 (1)	500x10^{-9} (1)	80	(1) Pure metal
ZINC	alloy	4Al 1Cu	250	108	7	0.4	30	100	700x10^{-9}	3.2	"Mazak"
NICKEL	alloy	Cr Co	100-800	190	8.5	0.4	13	15	1200x10^{-9}	30	"Inconel"/"Nimonic"
COPPER	pure		50-300	130	8.9	0.38	17	400	17x10^{-9}	8	
	bronze	7.5 Sn	150-750	100	8.9	0.38	18	60	140x10^{-9}	20	
	brass	30-40 Zn	150-500	100	8.5	0.37	18-23	130	65x10^{-9}	9	

THERMOPLASTIC POLYMERS	Ultimate tensile stress (MPa)								
Polyethylene PE	5-25	0.1-1.0	0.9-0.95	2.3	100-200	0.4	>10^{14}	0.6	
Polypropylene PP (g)	25-35	1-1.5	0.9		110-170	0.2	>10^{14}	0.7	
Polyvinyl chloride PVC	60	2.5	1.4	1-2	50	0.15	>10^{14}	1	
Polytetrafluoroethylene PTFE	15-40	4-6	2.2	1	100-200	0.25	>10^{17}	22	"Fluon"/"Teflon"
Polystyrene PS	50	1-3	1.1	1.3	60-80	0.15	>10^{11}	0.7	
Polymethylmethacrylate PMMA	50-70	3	1.2	1.5	50-90	0.2	>10^{12}	1.6	"Perspex"
Polyamide (nylon) PA (g)	50-90	1-3	1.1	1.6	80-150	0.22	>10^{10}	2.5	
Polyacetal (Polyoxymethylene) POM	65	3	1.4	1.4	30-35	0.25	>10^{11}	2.0	"Kematal"
Acrylonitrile-butadiene styrene ABS	20-40	2	1-1.1		60-100		>10^{15}	1.2	
Polyethylene terephthalate PET (g)	70-170 (1)	2.3	1.3	1.3	20 (1)		>10^{19}	2.2	"Melinex"/"Mylar" (1) Oriented film
Polycarbonate PC (g)	60-70	2.8	1.2		70	0.15	10^{16}	2.4	
THERMOSETTING POLYMERS									
Epoxy and polyester: 'GRP', 'DMC', 'SMC'	90-130	20-30	1.5-2.0	1.7	15-30	0.2-0.4	>10^{16}	1.7	'Glass fibre reinforced plastics'
Phenol, urea, melamine- formaldehyde (g)	30-50	5-8	1.4-2.0	1.7	30-45	0.2	>10^{12}	1.1-2.4	

(g) With glass fibre filler, UTS and E increased by x2 to x3, density by +0.2

Note: Polymers exhibit creep at room temperature. The given values for σ and E are for short-term loading only.

RUBBERS					Max usable temp. (°C)				
Natural (polyisoprene)	20		0.9-1.2	1.9-1.4	85	0.13-0.16	10^{6}-10^{16}	0.5	Soft →Hard
Polyurethane	25	0.001 to	1.1		85			3.0	
Neoprene (polychloroprene)	20	1.0 as	1.2		95			2.0	
Nitrile	15	required	1		115			1.0	
Fluorocarbon	15		1.8		290			35.0	

WOOD pine	20-100	15 (1) 1 (2)	0.5	2.8	3-5 (1) 35-60 (2)	0.15	10^{10} (dry)	0.4	(1)along grain (2)across grain
GLASS crown	30-90	70	2.5	0.7	8.5	1	>10^{9}	1.0	
CONCRETE	15-70(1)	15-40	2-2.5	0.8-1.2	10-20	1.5-2.5	10^{2}-10^{9}	0.25	(1) compressive (cube)

FLUIDS	Viscosity	Bulk Modulus			Coefficient of volumetric expansion			Relative cost	
	η (10^{-3} Pa·s)	k (Pa)			β (10^{-3} K^{-1})			(£·m^{-3})	
WATER pure	1 (1)	2.2x10^{9}	1	4.19	0.2	0.67	5x10^{3}	0.2	(1) tap water at 20°C
sea	1		1.03	3.9			1		
OIL engine (10W50)	300 (1) 20 (2)	1.7x10^{9}	0.9	2	1	0.15	>10^{10}	400	(1)at 20°C (2)at 100°C
AIR at 20°C, 10^{5} Pa	0.02	10^{5}	1.2x10^{-3}	1	3.7	0.032	→∞		
HYDROGEN at 20°C, 10^{5} Pa	0.009	10^{5}	0.084x10^{-3}	14	3.7	0.14	→∞	2	

ACOUSTIC PROPERTIES*	Density (kg·m^{-3})	Longitudinal velocity (m·s^{-1})	Shear velocity (m·s^{-1})		ACOUSTIC PROPERTIES*	Density (kg·m^{-3})	Longitudinal velocity (m·s^{-1})	Shear velocity (m·s^{-1})	
ALUMINIUM ("Duralumin")	2790	6320	3130		CARBON (Pressed graphite)	1800	2400		
BRASS (70Cu 30Zn)	8640	4700	2100		EPOXY RESIN	1100	2440		
COPPER	8930	5010	2270		GLASS	2240	5100	2800	
IRON (Cast)	7220	4600	2600		NYLON	1120	2600	1100	
LEAD	11200	200	700		PERSPEX (PMMA)	1180	2700	1300	
MAGNESIUM	1738	5800	3000		POLYETHYLENE	900	1950	540	
NICKEL	8840	5600	3000		POLYPROPYLENE	880	2660		
STEEL mild	7800	5900	3200		RUBBER (Neoprene)	1310	1600		
STEEL stainless	7890	5790	3100		SILICON NITRIDE	3270	11000	6250	
TITANIUM	4510	6100	3100		WOOD pine	450	3500		
TUNGSTEN	19400	5200	2900		**PIEZOELECTRIC MATERIALS**			**Piezoelectric pressure (V·m·N^{-1})**	
ZINC	7000	4200	2400		LITHIUM NIOBATE	4700	7080	0.37	
AIR (@20°C and 1 atm)	1.2 x 10^{-3}	344	-		LEAD-ZIRCONATE-TITANATE (PZT)	7500	4440	0.24	
OIL	880	1700	-		PVDF	1800	2300	0.23	
WATER (@20°C)	1000	1480	-		QUARTZ	2650	5750	0.58	

*Shear velocity may be approximated to one half of the longitudinal velocity. All values shown vary with exact material composition. Many materials exhibit significant anisotropy.