

## APPENDIX 1

### TYPICAL MECHANICAL AND PHYSICAL PROPERTIES FOR ENGINEERING METALS

Material	Young's modulus of elasticity $E$ (GN/m <sup>2</sup> )	Shear modulus $G$ (GN/m <sup>2</sup> )	"Elastic" limit $\sigma_y$ (MN/m <sup>2</sup> )	Shear yield strength $\tau_y$ (MN/m <sup>2</sup> )	Tensile strength (MN/m <sup>2</sup> )	Ultimate strength in shear (MN/m <sup>2</sup> )	Percentage elongation (%)	Density (kg/m <sup>3</sup> )	Linear coefficient of thermal expansion ( $\times 10^{-6}/^{\circ}\text{C}$ )
Aluminium alloy	69	26	230	—	390	240	23	2770	23
Brass	102	38	—	—	350	—	40	8350	18.9
Bronze	115	45	210	—	310	—	20	7650	18
Cast iron: Grey	90	41	—	—	210	—	8	7640	10.5
Malleable	170	83	248	166	370	330	12	7640	12
Low carbon (mild) steel	207	80	280	175	480	350	25	7800	11.7
Nickel-chrome steel	208	82	1200	650	1700	950	12	7800	11.7
Titanium	107	40	480	—	551	—	—	4507	9.5
Magnesium	45	17	262	—	379	165	—	1791	28.8

## APPENDIX 2

### TYPICAL MECHANICAL PROPERTIES OF NON-METALS

Material	Young's modulus of elasticity $E$ (GN/m <sup>2</sup> )	Tensile strength (MN/m <sup>2</sup> )	Compressive strength (MN/m <sup>2</sup> )	Elongation (maximum) %
Acetals	—	69	124	75
Cellulose acetate	1.4	41	207	20
Cellulose nitrate	1.4	48	138	40
Epoxy (glass filler)	—	145	234	—
Hard rubber	3.0	48	—	—
Melamine	8.0	55	227	0.7
Nylon filaments	4.1	340	—	—
Polycarbonate – unreinforced Makralon	2.3	70	83	100
Reinforced Makralon	6.0	90	—	8
Polyester (unfilled)	2.0	41	—	2
Polyethylene H.D.	—	28	22	100
Polyethylene L.D.	—	10	—	800
Polypropylene	—	34	510	250
Polystyrene	3.4	20	76	1.2
Polystyrene – impact resistant	1.4	38	41	80
P.T.F.E.	—	34	248	70
P.V.C. (rigid)	3.4	50–60	69	40
P.V.C. (plasticised)	—	20	0.7	200
Rubber (natural-vulcanised)	—	7–34	—	—
Silicones (elastomeric)	—	1.5–6	—	—
Timber	9.0	70	—	—
Urea (cellulose filler)	10.0	62	241	0.7

\* Data taken in part from *Design Engineering Handbook on Plastics* (Product Journals Ltd).

APPENDIX 3

**OTHER PROPERTIES OF NON-METALS\***

Material	Chemical resistance					Max. useful temp. (°C)
	Organic Solvents	Acids		Alkalis		
		Weak	Strong	Weak	Strong	
Acetal	x	x	00	x	x	90
Acrylic	Varies	x	x-0	x	x	90
Nylon 66	x	x	00	x	x	150
Polycarbonate	Varies	x	0	x-0	00	120
Polyethylene LD	x	x	x-00	x	x	90
Polyethylene HD	x	x	x-0	x	x	120
Polypropylene	x	x	x-0	x	x	150
Polystyrene	Varies	x	x-0	x	x	95
PTFE	x	x	x	x	x	240
PVC	Varies	x	x-0	x	x	80
Epoxy	x	x	x	x	0	430
Melamine	x	x	00	x	0	100-200
Phenolic	x	x-0	0-00	0-00	00	200
Polyester/glass	x-0	0	00	0	00	250
Silicone	x-0	x-0	00	0-00	00	180
Urea	x-0	x-0	00	0-00	00	90

x - Resistant, 0 - slightly attacked, 00 - markedly attacked

\* Data taken from Design Engineering Handbook on Plastics. (Product Journals Ltd).