

## Modulus of Elasticity - Young Modulus for some common Materials

Material	Young's Modulus (Modulus of Elasticity) - E -		Ultimate Tensile Strength - S <sub>u</sub> - (10 <sup>6</sup> N/m <sup>2</sup> , MPa)	Yield Strength - S <sub>y</sub> - (10 <sup>6</sup> N/m <sup>2</sup> , MPa)
	(10 <sup>6</sup> psi)	(10 <sup>9</sup> N/m <sup>2</sup> , GPa)		
ABS plastics		2.3	40	
Acrylic		3.2	70	
Aluminum	10.0	69	110	95
Aluminium Bronze		120		
Antimony	11.3			
Aramid		70 - 112		
Beryllium (Be)	42	287		
Bismuth	4.6			
Bone, compact		18	170 (compression)	
Bone, spongy		76		
Boron				3100
Brass		102 - 125	250	
Brass, Naval		100		
Bronze		96 - 120		
Cadmium	4.6			
Carbon Fiber Reinforced Plastic		150		
Carbon nanotube, single-walled		1000+		
Cast Iron 4.5% C, ASTM A-48			170	
Chromium	36			
Cobalt	30			
Concrete		17		
Concrete, High Strength (compression)		30	40 (compression)	
Copper	17	117	220	70
Diamond (C)		1220		
Douglas fir Wood		13	50 (compression)	
Fiberboard, Medium Density		4		
Flax fiber		58		
Glass		50 - 90	50 (compression)	
Glass reinforced polyester matrix		17		
Graphene		1000		
Grey Cast Iron		130		
Gold	10.8	74		
Granite		52		
Hemp fiber		35		
Iridium	75			
Iron	28.5	210		
Lead	2.0			
Magnesium metal (Mg)	6.4	45		
Manganese	23			
Marble			15	
MDF - Medium-density fiberboard		4		
Mercury				
Molybdenum (Mo)	40	329		

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	(10 <sup>6</sup> psi)	(10 <sup>9</sup> N/m <sup>2</sup> , GPa)		
Nickel	31	170		
Niobium (Columbium)	15			
Nylon		2 - 4	75	45
Oak Wood (along grain)		11		
Osmium (Os)	80	550		
Phosphor Bronze		116		
Pine Wood (along grain)		9	40	
Platinum	21.3			
Plutonium	14	97		
Polycarbonate		2.6	70	
Polyethylene HDPE (high density)		0.8	15	
Polyethylene, LDPE (low density)		0.11 - 0.45		
Polyethylene Terephthalate, PET		2 - 2.7	55	
Polyimide		2.5	85	
Polypropylene, PP		1.5 - 2	40	
Polystyrene, PS		3 - 3.5	40	
Potassium				
Rhodium	42			
Rubber, small strain		0.01 - 0.1		
Sapphire		435		
Selenium	8.4			
Silicon	16	130 - 185		
Silicon Carbide		450		3440
Silver	10.5			
Sodium				
Steel, stainless AISI 302		180	860	502
Steel, Structural ASTM-A36		200	400	250
Steel, High Strength Alloy ASTM A-514			760	690
Tantalum	27			
Teflon, PTFE		0.5		
Thorium	8.5			
Tin		47		
Titanium	16			
Titanium Alloy		105 - 120	900	730
Tooth enamel		83		
Tungsten (W)		400 - 410		
Tungsten Carbide (WC)		450 - 650		
Uranium	24	170		
Vanadium	19			
Wrought Iron		190 - 210		
Zinc	12			

- $1 \text{ N/m}^2 = 1 \times 10^{-9} \text{ N/mm}^2 = 1 \text{ Pa} = 1.4504 \times 10^{-4} \text{ psi}$
- $1 \text{ psi (lb/in}^2) = 144 \text{ psf (lb/ft}^2) = 6,894.8 \text{ Pa (N/m}^2) = 6.895 \times 10^{-3} \text{ N/mm}^2$