

Strength and Physical Properties of Various Metals

Metals and Alloys	Stress in Thousands of Pounds per Sq. Inch				Modulus of Elasticity Millions of PSI	Elongation%
	Tension Ultimate	Tension Yield Point	Compression Ultimate	Shear Ultimate		
Aluminum, Type 1100-0, Annealed	13	5	.....	9	10	45
Aluminum, Type 1100-H18, Hard	24	22	.....	13	10	15
Aluminum, Type 3003-0, Annealed	16	6	.....	11	10	40
Aluminum, Type 3003-H18, Hard	29	27	.....	16	10	10
Aluminum, Type 5052-0, Annealed	28	13	.....	18	10.20	30
Aluminum, Type 5052-H38, Hard	42	37	.....	24	10.20	8
Aluminum, Type 5056-0, Annealed	42	22	.....	26	10.30	35
Aluminum, Type 2014-0, Annealed	27	14	.....	18	10.60	18
Aluminum, Type 2014-T4, Heat Treated	62	42	.....	38	10.60	20
Aluminum, Type C4A, Casting, Solution Heat Treat	32	16	16▲	24	.....	8.50
Aluminum, Type S5C, As Die Cast	30	16	16▲	19	.....	9
Brass, Admiralty, Annealed	53	22	.....	.....	16	65
Brass, Aluminum, Annealed	60	27	.....	.....	16	55
Brass, Cartridge, 30% Zn, Annealed	44	11	.....	32	16	66
Brass, Cartridge, 30% Zn, Hard	76	63	.....	44	16	8
Brass, Naval, Annealed	57†	25†	.....	40 †	15	47†
Brass, Naval, Leaded, Annealed	57†	25†	.....	36 †	15	40†
Brass, Red, 15% Zn, Annealed	39	10	.....	31	17	48
Brass, Red, 15% Zn, Hard	70	57	.....	42	17	5
Brass, Red, Leaded, Cast, Grade 4A	33-46	17-24	10-12▲	.....	9.1-14.8	20-35
Brass, Red, Leaded, Cast, Grade 4B	30-38	12-17	11-12▲	.....	.....	15-27
Brass, Semi-Red, Leaded, Cast, Grade 5A	29-39	13-17	.....	.....	7.7-14.3	18-30
Brass, Semi-Red, Leaded, Cast, Grade 5B	30-40	12-16	8-10▲	.....	10-14	20-35
Brass, Yellow, 35% Zn, Annealed	46	14	.....	32	15	65
Brass, Yellow, 35% Zn, Hard	74	60	.....	43	15	8
Bronze, Aluminum, As Cast	67-95	27-45	.....	.....	15-18	5-35
Bronze, Commercial, 10% Zn, Annealed	37†	10†	.....	28 †	17	45†
Bronze, Manganese, Annealed	65†	30†	.....	42 †	15	33†
Bronze, Phosphor, Annealed	40-66	14-24	.....	.....	16-17	48-70
Bronze, Tin, High Leaded, Cast	23-38	11-22	12-16▲	.....	8.5-13	7-20
Bronze, Tin, Leaded, Cast	33-48	16-26	9-15s▲	.....	10.6-16	15-40
Copper, Beryllium, Annealed	60-80	25-35†	.....	50-60 †	19	35-50†
Copper, Electrolytic, Tough Pitch, Annealed	32†	10†	.....	22 †	17	45†
Inconel, Cast	65-90	.....	.....	.....	23	10-20
Inconel, S, Cast	90-120	80-100	.....	.....	25	1-3
Inconel, Shapes, Plate, Etc., Annealed	80-100†	30-45†	.....	.....	31	35-55†
Inconel, X, Shapes, Plate, Etc., Annealed	110-130†	45-65†	.....	.....	31	40-55†
Iron, Cast, Class 30	30-34	.....	115	44	15	.....
Iron, Cast, Class 35	35-40	.....	125	43	16	.....
Iron, Ingot, Hot Rolled	44	23	.....	.....	29.80	47
Iron, Malleable, Class 32510	50	33	90	46	25	10-18
Iron, Malleable, Class 35018	55	37	90	51	25	18-25
Iron, Nodular (Ductile) Class 60-45-10	60	45	120	.....	22-25	10-25
Iron, Nodular (Ductile) Class 80-60-3	80	60	160	.....	22-25	3-10
Iron, Pearlitic, Malleable	60-90	40-70	.....	.....	28	3-12
Iron, Wrought, Hot Rolled	34-47	23-24	.....	.....	29	7-35
Lead, Hard, Rolled	4.0-4.6	.....	.....	.....	.....	31-48
Magnesium Alloy, Extruded, ASTM M1A	26-28	23-28	10-13	16	6.50	8-11
Magnesium Alloy, Extruded, ASTM AZ61A-F	40-45	22-32	15-21	21	6.50	15-16
Magnesium Alloy, Cast, ASTM M1B	14	4.50	.....	11	6.50	5
Magnesium Alloy, Cast, ASTM AZ92A	24	14	.....	19	6.50	2
Magnesium Alloy, Cast, ASTM AZ91A	36	23	.....	20	6.50	4
Monel, Cast	65-90	32-45	.....	.....	23	20-50
Monel, S, Cast	120-145	80-130	.....	.....	24.20	1.4
Monel, Shapes, Plate, Etc., Annealed	70-85†	25-45†	.....	.....	26	35-50†
Monel, K, Shapes, Plate, Etc., Annealed	90-105†	40-65†	.....	.....	26	25-45
Muntz Metal, Cu 59.63%, Zn balance	54	21	.....	40	15	45
Nickel, Cast	50-65	15-30	.....	.....	21.50	15-30
Nickel, Silver, Annealed	49-63†	18-30†	.....	.....	17-18	35-60†
Steel, Cast Carbon, Class 70,000 Normalized	70	38	.....	.....	30	28
Steel, Cast Low Alloy, Class 100,000, Normalized and Tempered	100	68	.....	.....	29-30	20
Steel, Cast Low Alloy, Class 120,000, Quenched and Tempered	120	95	.....	.....	29-30	16
Steel, Cast Low Alloy, Class 200,000, Quenched and Tempered	200	170	.....	.....	29-30	5
Steel, Sheets	48	25	.....	.....	29-30	18-27
Steel, Stainless, Austenitic, Types 304, 316	85	35	.....	.....	28	55-60
Steel, Stainless, Martensitic, Type 416	75	40	.....	.....	29	30
Steel, Structural, Bridge and Building, ASTM A7	60-72	33	.....	.....	29	21
Steel, Structural, High Strength, Low Alloy, ASTM A242	63-70	42-50	42-50▲	47-53	29-30	18-24
Zinc, Die Cast Alloy XXIII	41	.....	60▲	31	.....	10

† When hardened, strength values are higher, elongation less

▲ Compression yield point