

METAL HARDNESS

Hardness is a characteristic of metal that determines a material's wear and abrasive resistance. Various degrees of hardness may be achieved in many metals by tempering, a heat treatment process used in cold rolled and cold worked metals. As the grain structure of the metal undergoes cold forming, the grains are stretched and altered. The surface becomes harder, resisting deformation from contact. Tempering heats the worked metal to temperatures at which the grains begin to dissolve. The stress relaxes slightly and the metal becomes more ductile.

Comparative Hardness of Various Metal Alloys

Metal	Alloy and Temper	Hardness	Yield		Ductility
		Rockwell B-scale	ksi	MPa	1-very ductile 5-stiff
Aluminum	A93003-H14	20-25	21	145	1
Aluminum	A93004-H34	35-40	29	200	1
Aluminum	A95005-H34	20-25	20	138	1
Aluminum	A96061-T6	60	40	275	4
Copper	1/8 hard (cold roll)	10	28	193	1
Gilding Metal	1/4 hard	32	32	221	1
Commercial Bronze	1/4 hard	42	35	241	2
Jewelry Bronze	1/4 hard	47	37	255	2
Red Brass	1/4 hard	65	49	338	2
Cartridge Brass	1/4 hard	55	40	276	1
Yellow Brass	1/4 hard	55	40	276	2
Muntz Metal	1/8 hard	55	35	241	3
Architectural Bronze	as extruded	65	20	138	4
Phosphor Bronze	1/2 hard	78	55	379	3
Silicon Bronze	1/4 hard	75	35	241	3
Aluminum Bronze	as cast	77	27	186	5
Nickel Silver	1/8 hard	60	35	241	3
Steel-low carbon	cold rolled	60	25	170	2
Cast Iron	as cast	86	50	344	5
Stainless Steel-304	temper pass	88	30	207	2
Lead	sheet lead	5	0.81	5	1
Monel	temper pass	60	27	186	3
Zinc-Cu, Tn Alloy	rolled	40	14	97	1
Titanium	Annealed	80	37	255	3

(Reference: Zahner, L. Architectural Metals: A Guide to the Selection, Specification and Performance. New York: John Wiley, 1995, Pages 14-15)