CuZr0,1

UNS:C15000
EN:CW120C

Manufactures list:
KM Europa Metal AG (http://www.kme.com/) - CuZr0.1(CuZr0.1)
Luvata (http://www.luvata.com/) - CuZr0.1

CuZr0,1 is a alloy that can be hardened by cold forming and moderately by precipitation of CuZr during a heat treatment. It has excellent hot and cold workability, soldering and good brazing. Fabricated by swaging, bending, heading or forging.

Basic properties

Basic properties	Value	Comments
Density [g/cm^3]	8,89	
Specific heat capacity [J/(kg*K)]	393,5	
Temperature coefficient of electrical resistance (0...100°C) [10^{-3}/K]	3	for CuZr0,15
Electrical conductivity [T=20°C, (% IACS)]	93	
Thermal conductivity [W/(m*K)]	367	
Thermal expansion coefficient 20...300°C [10^{-6}/K]	20,2	
[Ref: 168, 169, 170, 171, 172, 173, 174, 176, 183]		

Applications

Main applications

Stud bases for power transmitters and rectifiers, switches and circuit breakers for high-temperature service, commutators, resistance welding tips and wheels, diodes, solderless wrapped connectors, pencil-type and light soldering guns: tips, rod extension.
Literature: [Ref: 168, 169, 170, 171, 172, 173, 174, 183]

Kinds of semi-finished products/final products

Switches and relays, connectors, terminals, electronic circuits, leadframe, commutators for power, transmitters, basses for power transmitters, rectifiers, soldering and welding tips, circuit breakers.

Chemical composition

Chemical composition	Value	Comments
Cu [wt.%]	99,8-99,9	Calculated
Zr [wt.%]	0,1-0,2	
Others [wt.%]	0,1	
[Ref: 570]		

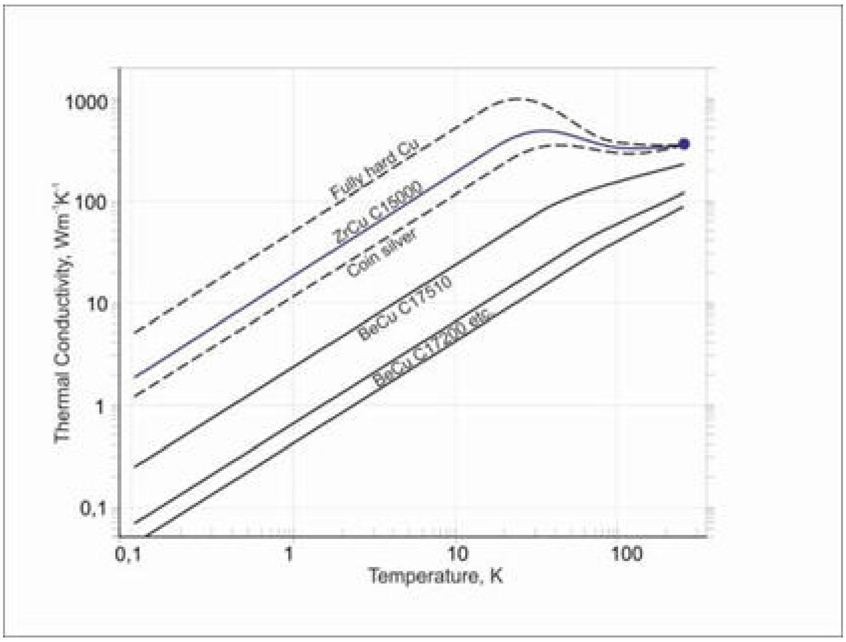
Mechanical properties

Mechanical properties	Value	Comments	Literature
UTS [MPa]	200-525		
YS [MPa]	40-495		
Elongation [%]	1-54		
Hardness	40-90	HRF	
Young's modulus [GPa]	129		
Kirchhoff's modulus [GPa]	50,3		
Poisson ratio	0,28	Calculated	

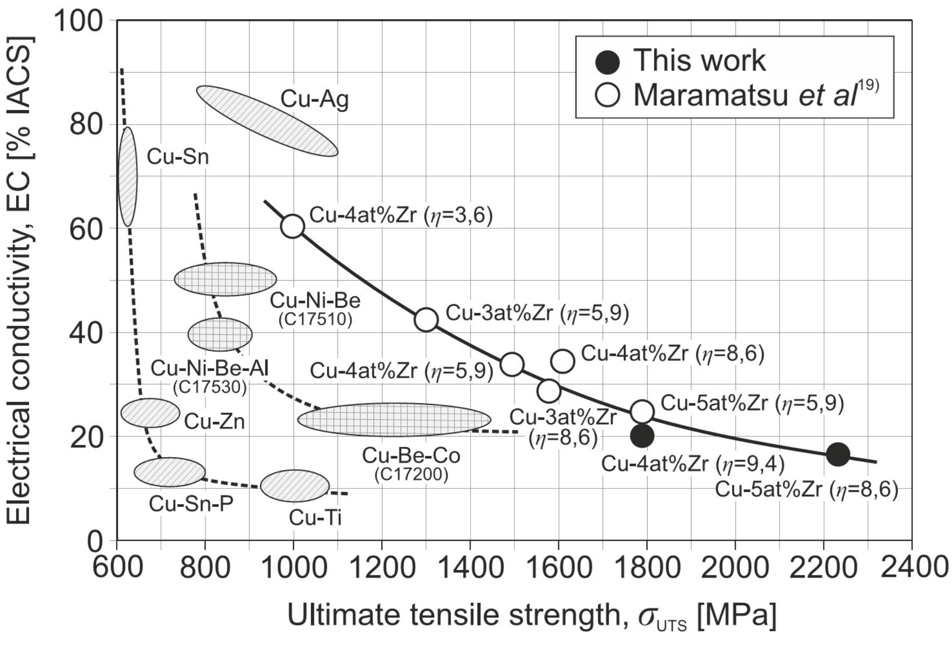
Material's mechanical and electrical properties in different tempers

Temper	Section size, mm	Cold work, %	Tensile strength, MPa	Yield strength (min), MPa	Elongation (min) A50mm	Hardness	Literature
cold worked 0% after solution treatment at 900-925°C, 2.3mm wire	-	0	205	90	49	-	[Ref: 172]
cold worked 0% after solution treatment at 900-925°C, mill annealed, 6mm rod, OS025	-	0	255	75	50	40 Rockwell B	[Ref: 173]
cold worked 0% after aged (1 hour or more at 400-425°C), 2.3mm wire	-	0	200	40	54	-	[Ref: 171]
Cold worked 84% and aged (5mm rod)	-	84	430	385	8	72 Rockwell B	[Ref: 168]
solution treated (at 900-925°C) cold worked 62% and aged (1 hour or more at 400-425°C)	-	62	495	470	3	-	[Ref: 170]

solution treated (at 900-925°C) cold worked 98% and aged (1 hour or more at 400-425°C)	-	98	525	495	1,5	-	[Ref: 169]
Solution annealed cold worked, participation hardened	-	-	300-500	320-475	3-20	60-80 HB	[Ref: 210]
Rod							
TL01	31,8	17	414	400	18	-	[Ref: 183]
TL02	19	34	434	421	15	-	
TL02	9,53	44	469		441	72 Rockwell B	
TL02	16	31	441	427	15	72 Rockwell B	
TL03	25,4	47	427	414	15	-	
TL03	12,7	47	462	434	15	72 Rockwell B	
TL03	22	52	427	414	15	-	
TL06	5,18	76	427	386	8	-	
Wire							
H02	12,7	30	365	338	23	90 Rockwell F	[Ref: 183]
061	6,35	-	255	76	50	40 Rockwell F	
TB00	2,29	-	200	41	54	-	
TF00	2,29	-	207	90	49	-	
TH04	1	98	524	496	1	-	
TH04	2,29	92	496	469	3	-	
R280			280-320	250	13		[Ref: 624]
R300			300-360	310	9		
R330			330-390	340	6		
R370			370-440	380	4		
R410			410-460	420	3		
R450			450-500	450	2		



Recommended conductivity values for CuZr0,1 (C15000) and other copper alloys [Ref: 182]

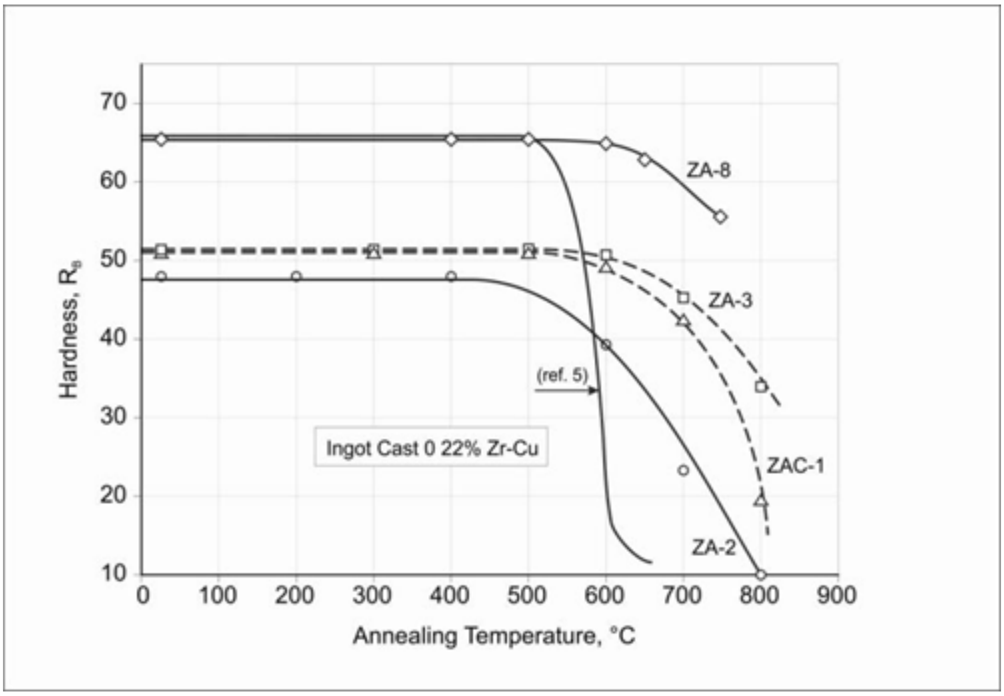


Relationship between the ultimate tensile strength (·UTS) and the electrical conductivity (EC) for the drawn CuZr binary alloy wires and other conventional copper alloys [Ref: 623]

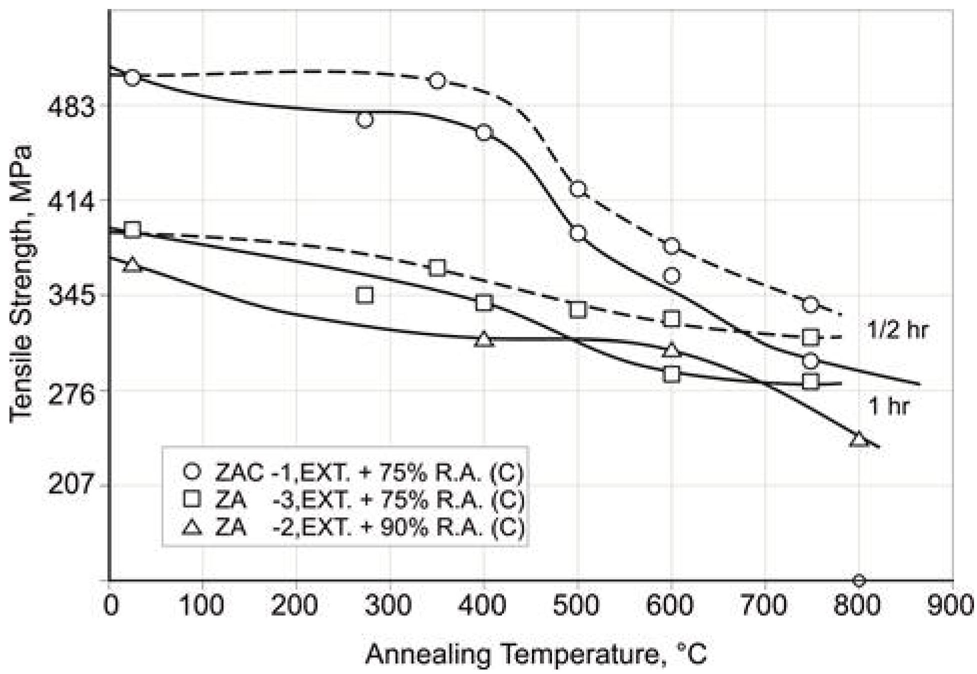
Exploitation properties

Heat resistance

Mechanical and electrical properties vs temperatures

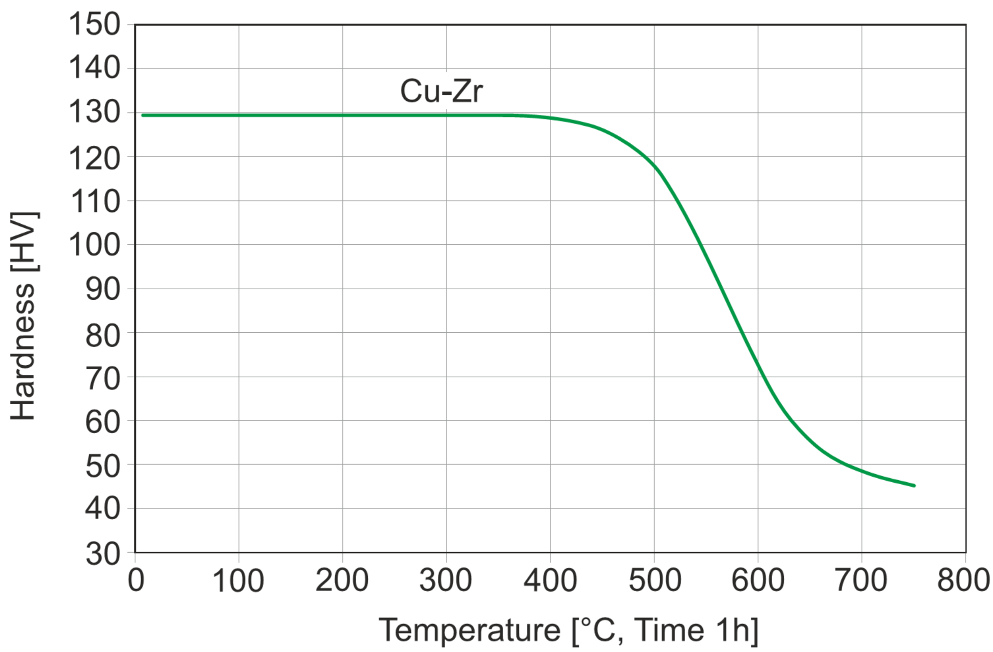


Hardness at 20°C as a function of annealing temperature (1 hour at temperature) of as-extruded alloys (ZA-2 - CuZr0,2, ZA-3 - CuZr0,37, ZA-8 - CuZr0,8, ZAC-1 - CuCr0,32Zr0,1) - (powder metallurgical alloys) [Ref: 175]



Tensile strength at 20°C as a function of annealing temperature of alloys (ZA-2 - CuZr0,2, ZA-3 - CuZr0,37, ZA-8 - CuZr0,8, ZAC-1 - CuCr0,32Zr0,1) for 0,5 hour and 1 hour periods at temperature - (powder metallurgical alloys) [Ref: 175]

Note: A - as-extruded, 300°C anneal for 1 hour after each 10% strain increment at RT., continued to the desired degree of reduction. B - As-extruded, solution treated at 980°C for 30 min, water quenched, followed by 50% reduction in area (R.A.) at 20°C, then aged at 500°C for 3 hours, air cooled and further reduced to 75% R.A. C - As-extruded, solution treated at 980°C for 30 min, water quenched, followed by 50% R.A. at 20°C, then aged 450°C for 1 hour, water quenched and further reduced do desired thickness.



Room temperature hardness as a function of annealing temperature. Material at hard temper [Ref: 622]

Long-therm heat resistance, e.g. Arrhenius curve

NO DATA AVAILABLE

Half- softening temperature

NO DATA AVAILABLE

Corrosion resistance

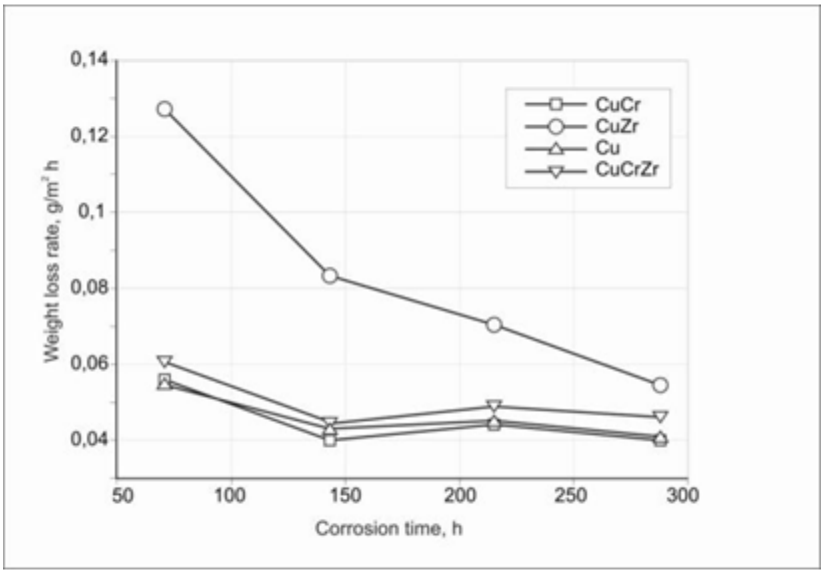
Hydrogen embrittlement resistance

NO DATA AVAILABLE

Other kind of corrosion elements

Corrosion parameters Cu0.25Zr in the solutions at various pH with NaCl. [Ref: 188]

0,6 M NaCl				
	OCP, V	Icorr, μA/cm2	Epit, V	Ipass, μA/cm2
pH1	-0,23	0,152	-	-
pH12	-0,17	0,243	0,04	10



Weight-loss of specimens exposed in NaCl solution atmosphere of Cu0.36Cr, Cu, Cu0.36Cr0.11Zr , CuZr0.15, (Note: NaCl atmospheric corrosion test in salt spray chamber (in salt mist of 50 g NaCl/l) in the temperature of 35°C, in accordance with ISO 3768-1976 standard) [Ref: 225].

Type of corrosion	Suitability	Literature
Atmospheric	Good	[Ref: 176]
Marine environment	Good	[Ref: 176]
Stress crack	Resistant	[Ref: 176]
Hydrogen embrittlement	No data	-

Electrolytic	No data	-
Other	No data	-

Rheological resistance

Stress relaxation

NO DATA AVAILABLE

Creep

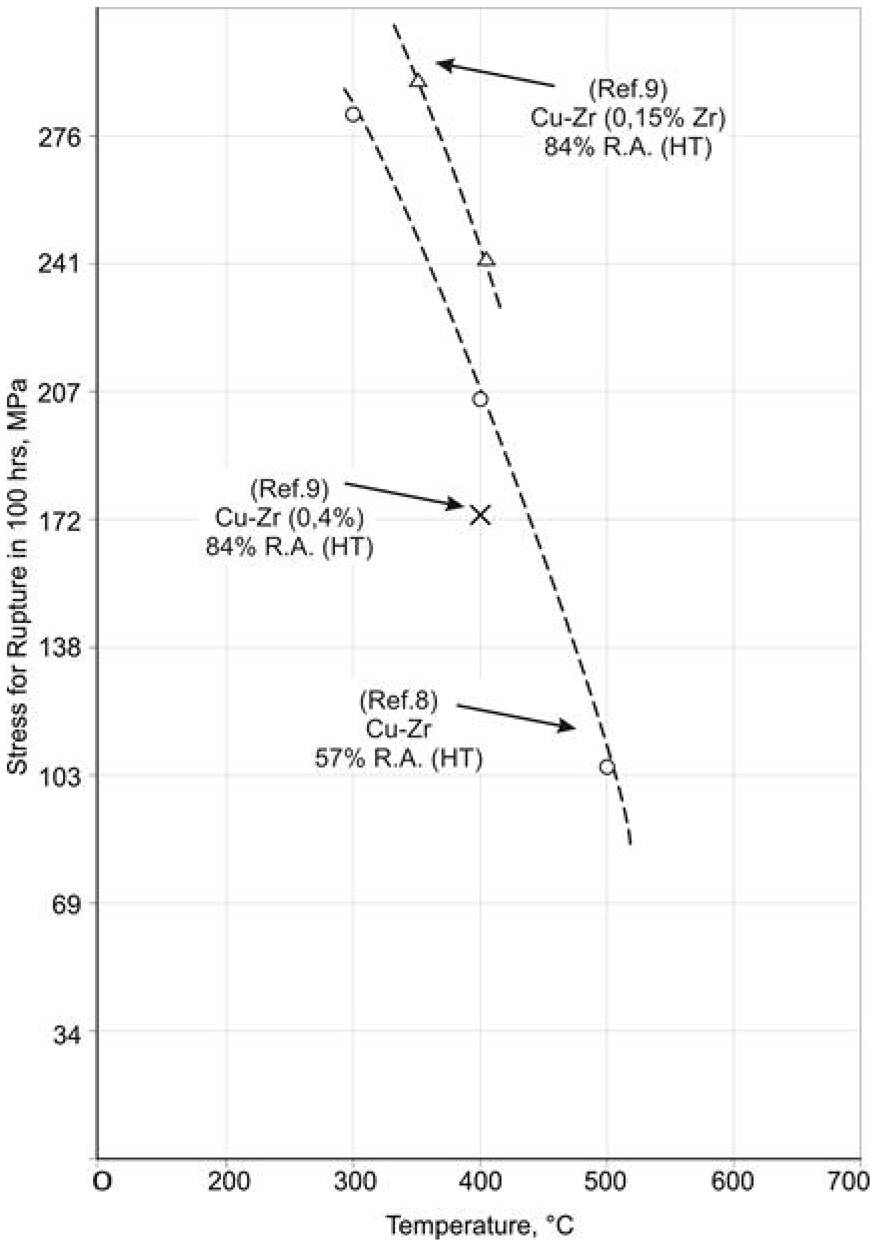
Creep strength (17% cold work, 1% creep) [Ref: 174]

Stress, MPa	Temperature, ?C	Time, h
7,5	600	100000
15	600	10000
16	500	100000
28	600	1000
39	500	10000
51	450	100000
70	450	10000
88	500	1000
98	450	1000
102	400	100000
123	400	10000
150	400	1000
166	350	10000
185	350	100000
208	300	100000
217	350	1000
241	300	10000
277	300	1000

Creep strength (82% cold work, 1% creep) [Ref: 168]

Stress, MPa	Temperature, ?C	Time, h
1	650	100000
1,5	600	100000
1,7	650	10000
2,8	600	10000
3	650	1000
5,2	600	1000
28	500	100000
41	500	10000
44	450	100000
53	450	10000
63	500	1000
77	450	1000
139	400	100000
161	400	10000
201	400	1000
219	350	100000

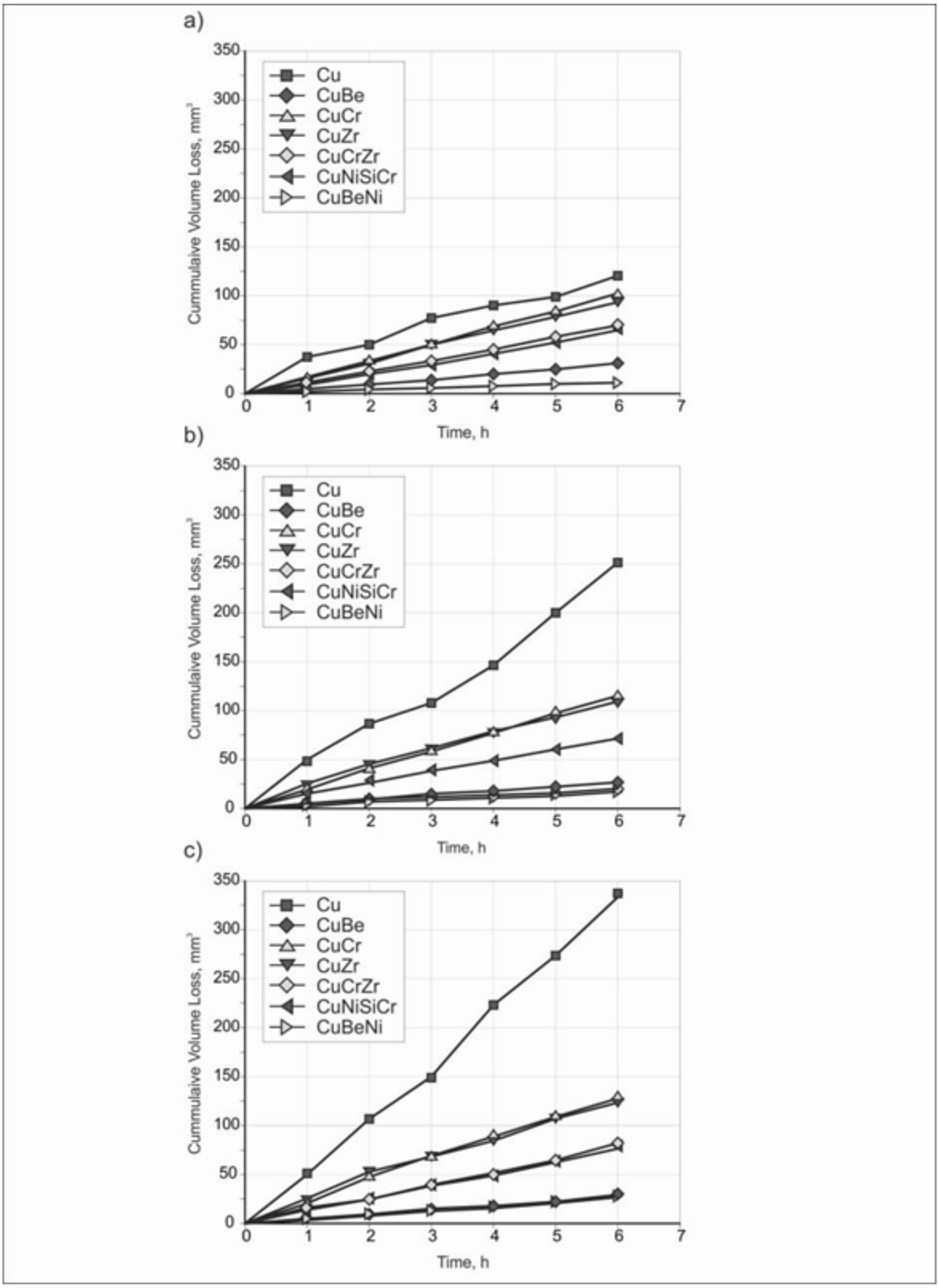
238	350	10000
240	300	100000
257	350	1000
271	300	10000
303	250	100000
305	300	1000
312	250	10000
321	250	1000



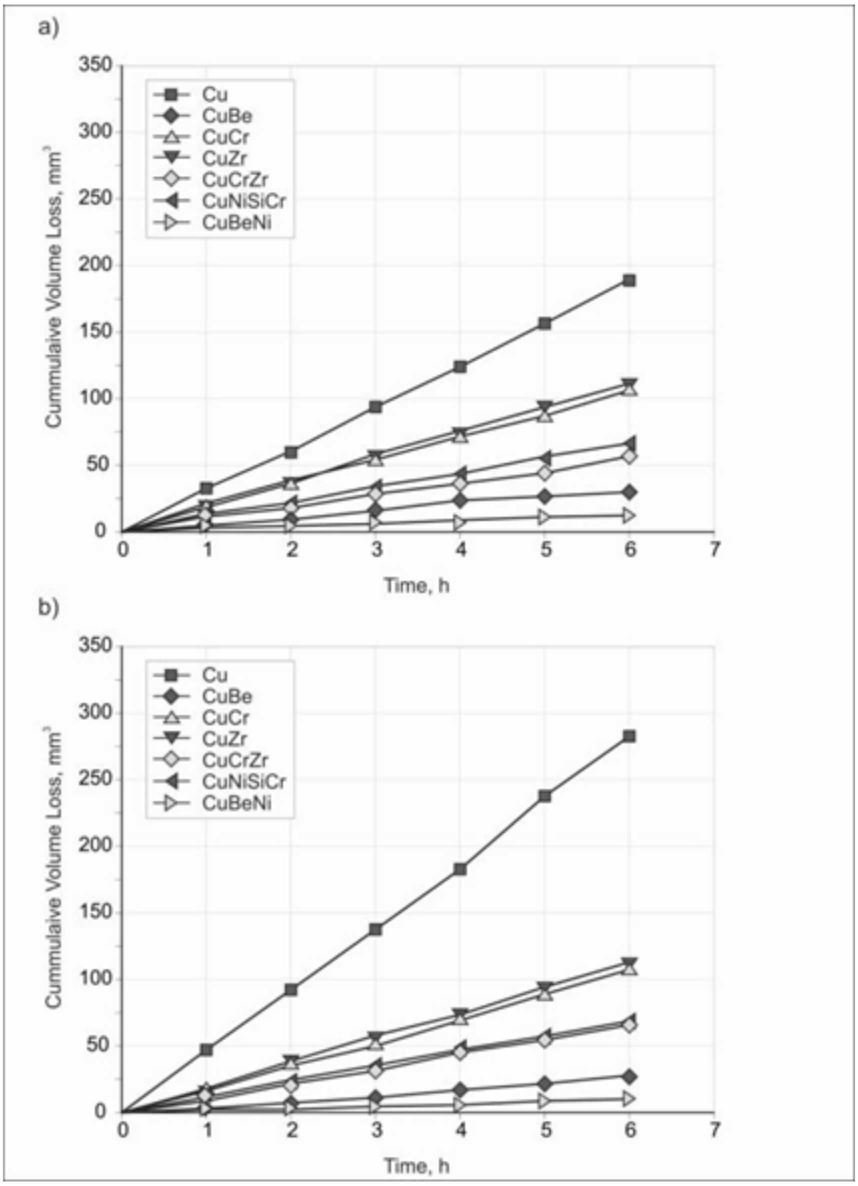
Plot showing stress for 100 hour rupture life at several temperature - powder metallurgical alloy [Ref: 175]

Wear resistance

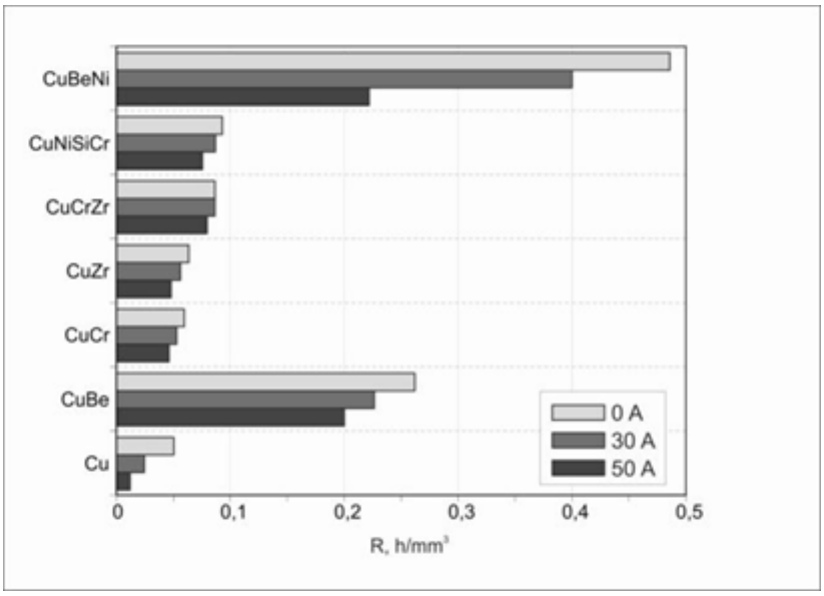
Friction resistance



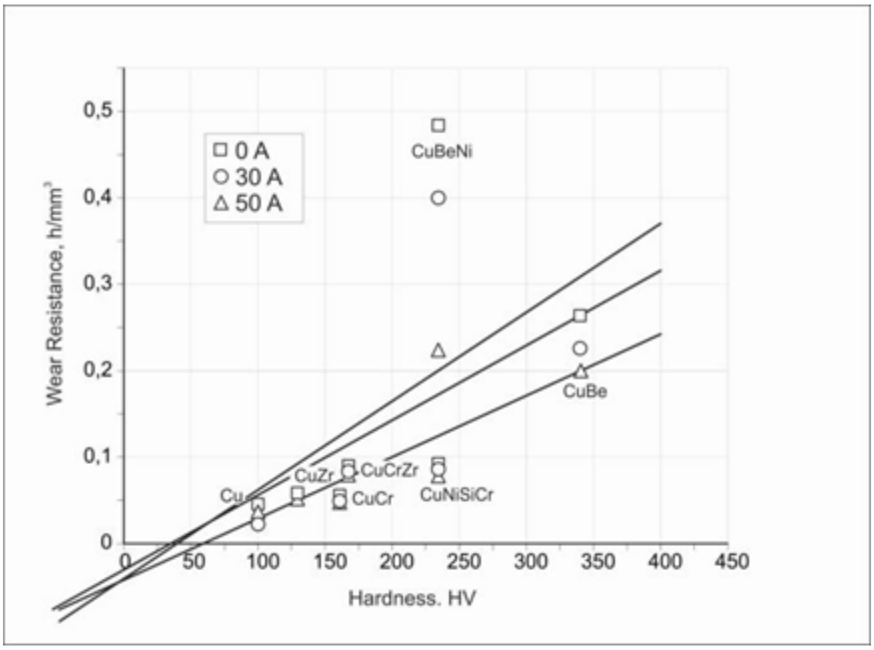
Plots of cumulative volume loss vs time for copper and its alloys under 20 N at (a) 0 A, (b) 30 A and (c) 50 A. (Note: Cu-wire cold drawn, copper alloys - age hardened). Examinations were performed by pin-on-disc tribometer. The negative sample was the S30400 disc made of stainless steel. Examinations were carried out in an air atmosphere with the velocity of 31 km/h and under loading of 10 - 20 N on a roll sample at the diameter of 13 mm and length of 13 mm) [Ref: 216]*.*



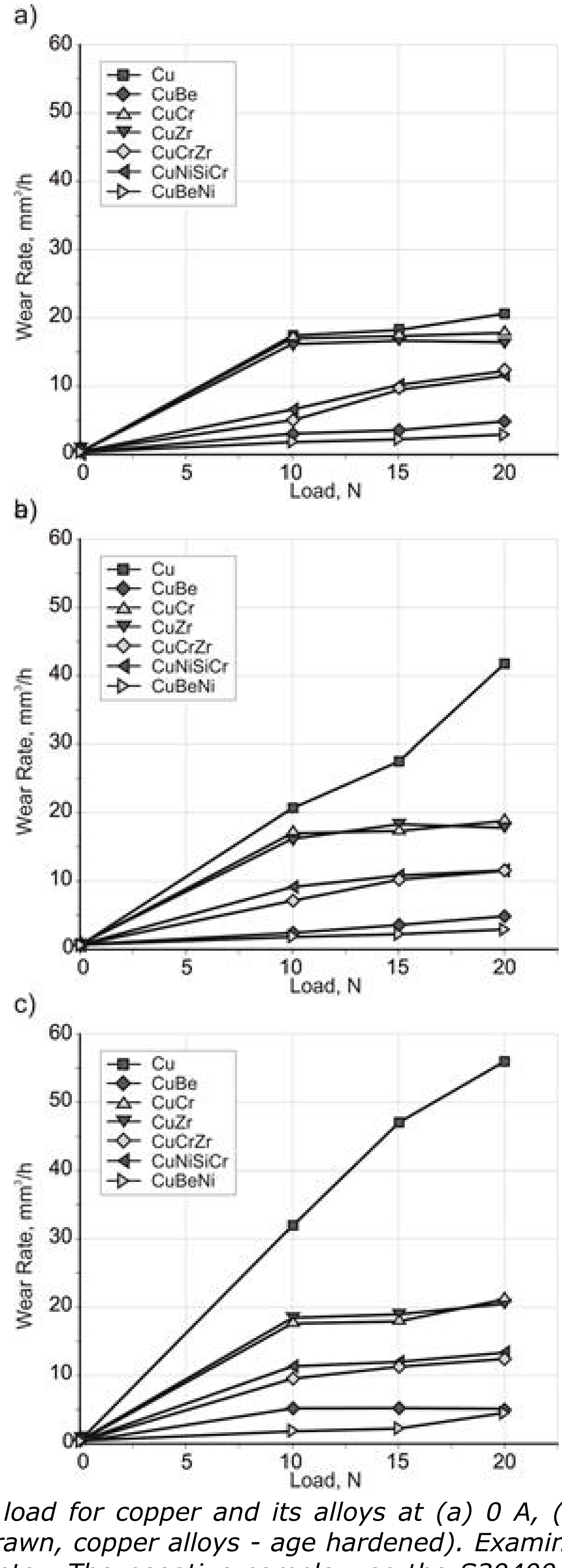
Plots of cumulative volume loss vs time for copper and its alloys under load of (a) 10 N and (b) 15 N at 50 A. (Note: Cu-wire cold drawn, copper alloys - age hardened). Examinations were performed by pin-on-disc tribometer. The negative sample was the S30400 disc made of stainless steel. Examinations were carried out in an air atmosphere with the velocity of 31 km/h and under loading of 10 - 20 N on a roll sample at the diameter of 13 mm and length of 13 mm) [Ref: 216]*.*



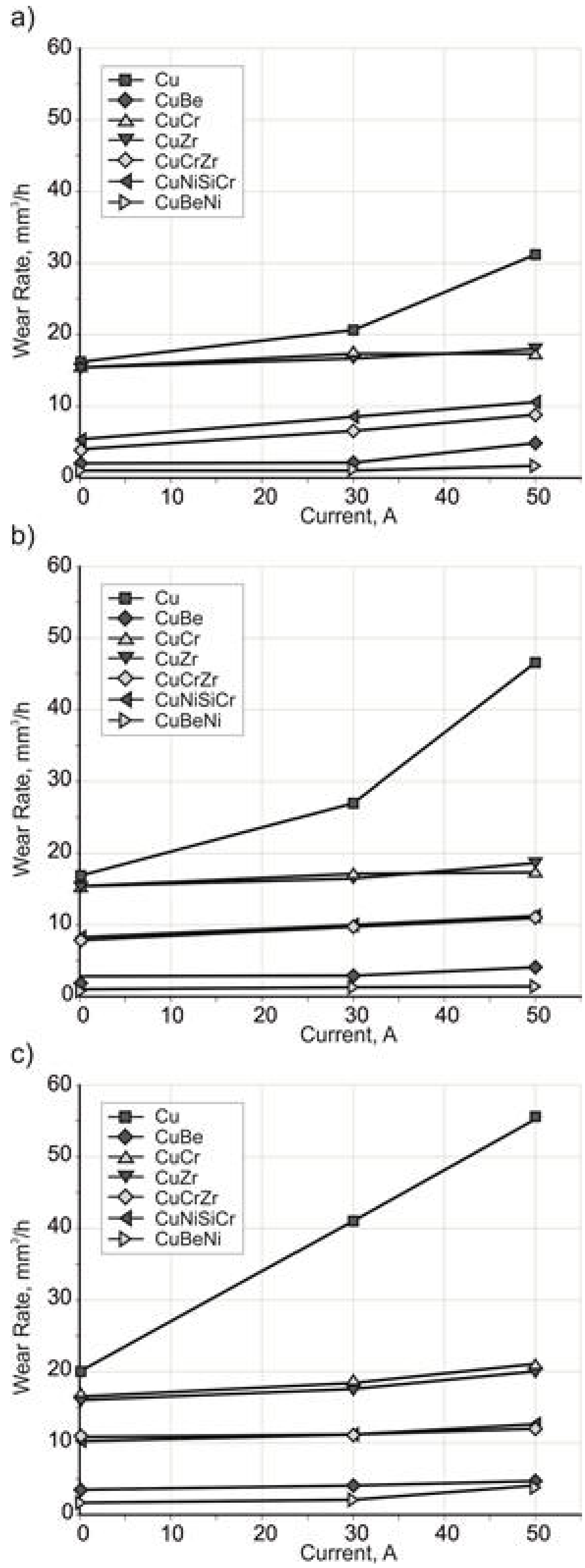
Sliding wear resistance for copper and its alloys under 20 N with and without current. (Note: Cu-wire cold drawn, copper alloys - age hardened). Examinations were performed by pin-on-disc tribometer. The negative sample was the S30400 disc made of stainless steel. Examinations were carried out in an air atmosphere with the velocity of 31 km/h and under loading of 10 - 20 N on a roll sample at the diameter of 13 mm and length of 13 mm) [Ref: 216].



Sliding wear resistance vs hardness for various alloys under 20 N with and without current. (Note: Cu-wire cold drawn, copper alloys - age hardened). Examinations were performed by pin-on-disc tribometer. The negative sample was the S30400 disc made of stainless steel. Examinations were carried out in an air atmosphere with the velocity of 31 km/h and under loading of 10 - 20 N on a roll sample at the diameter of 13 mm and length of 13 mm) [Ref: 216].



Plots of wear rate vs load for copper and its alloys at (a) 0 A, (b) 30 A and (c) 50 A. (Note: Cu-wire cold drawn, copper alloys - age hardened). Examinations were performed by pin-on-disc tribometer. The negative sample was the S30400 disc made of stainless steel. Examinations were carried out in an air atmosphere with the velocity of 31 km/h and under loading of 10 - 20 N on a roll sample at the diameter of 13 mm and length of 13 mm) [Ref: 216].



Plots of wear rate vs current for copper and its alloys under (a) 10 N, (b) 15 N and (c) 20 N. (Note: Cu-wire cold drawn, copper alloys - age hardened). Examinations were performed by pin-on-disc tribometer. The negative sample was the S30400 disc made of stainless steel. Examinations were carried out in an air atmosphere with the velocity of 31 km/h and under loading of 10 - 20 N on a roll sample at the diameter of 13 mm and length of 13 mm) [Ref: 216].

Fatigue resistance

Fatigue cracking

NO DATA AVAILABLE

Impact strength

NO DATA AVAILABLE

Fabrication properties

Fabrication properties	Value	Comments	Literature
Soldering	Excellent		[Ref: 183]
Brazing	Good		[Ref: 183]
Hot dip tinning	Good		[Ref: 176]
Electrolytic tinning	Good		[Ref: 176]
Electrolytic silvering	Good		[Ref: 176]
Electrolytic nickel coating	Good		[Ref: 176]
Laser welding	Fair		[Ref: 176]
Oxyacetylene Welding	Not recommended		[Ref: 183]
Gas Shielded Arc Welding	Not recommended		[Ref: 183]
Coated Metal Arc Welding	Not recommended		[Ref: 183]
Spot Weld	Not recommended		[Ref: 183]
Seam Weld	Not recommended		[Ref: 183]
Butt Weld	Good		[Ref: 183]
Capacity for Being Cold Worked	Excellent		[Ref: 183]
Capacity for Being Hot Formed	Excellent		[Ref: 183]
Machinability Rating	20	20% (UNS C36000 (free-cutting brass) = 100%)	[Ref: 183, 168]

Technological properties

Technological properties	Value	Comments	Literature
Melting temperature [°C]	980-1080		[Ref: 168, 169, 170, 172, 171, 173, 174]
Annealling temperature [°C]	600-700		[Ref: 168, 169, 170, 172, 171, 173, 174]
Homogenization temperature [°C]	900-925		[Ref: 169, 170, 173]
Quenching temperature [°C]	900-925		[Ref: 169, 170, 173]
Ageing temperature [°C]	400-425 527	min. 1h 2h	[Ref: 169, 170, 171, 268] [Ref: 169, 170, 171, 268]
Hot working temperature [°C]	900-950		[Ref: 168, 169, 170, 172, 171, 173, 174]

References:

168. **Zirconium Copper (Amzirc Brand Copper), UNS C15000, 5 mm rod** - www.MatWeb.com

169. **Zirconium Copper (Amzirc Brand Copper), UNS C15000, 1 mm wire** - www.MatWeb.com

170. **Zirconium Copper (Amzirc Brand Copper), UNS C15000, 2.3 mm wire, aged** - www.MatWeb.com

171. **Zirconium Copper (Amzirc Brand Copper), UNS C15000, 2.3 mm wire, no solution treatment** - www.MatWeb.com

172. **Zirconium Copper (Amzirc Brand Copper), UNS C15000, 2.3 mm wire, no aging** - www.MatWeb.com

173. **Zirconium Copper (Amzirc Brand Copper), UNS C15000, 6 mm wire** - www.MatWeb.com

174. **Zirconium Copper (Amzirc Brand Copper), UNS C15000, 13 mm wire** - www.MatWeb.com

175. **Cu-Zr and Cu-Zr-Cr alloys produced from rapidly quenched powders** - V.K.Sarin, N.J.Grant, Metallurgical Transactions vol.3, april 1972-875

176. **Data Sheet - CuZr0,1 Industrial rolled** - KME

182. **Zirconium Copper - a New Material for Use at Low Temperatures** - Adam L. Woodcraft , 24th International Conference on Low Temperature Physics, Orlando, Florida, USA,10-17th August 2005. ©American Institute of Physics, Suite 1N01, 2 Huntingdon Quadrangle, Melville, NY, USA

183. **Data Sheet - C15000 (Zirconium Copper)** - www.copper.org

188. **Effect of pH on corrosion behavior of CuCrZr in solution without and with NaCl** - C.T. Kwok, P.K. Wong, H.C. Man, F.T. Cheng, Journal of Nuclear Materials 394 (2009) 52–62

210. **Copper Zirconium alloys** - Lars Bergqvist-Technical Raport 2/2011 Lesjofors

216. **Sliding Wear and Corrosion Resistance of Copper-based Overhead Catenary for Traction Systems** - C.T. Kwok, P.K. Wong, H.C. Man and F.T. Cheng, IJR International Journal of Railway Vol. 3, No. 1 / March 2010, pp. 19-27

225. **Efect of Cr And Zr Addition on the Corrosion Behavior of Copper in the Chloride Solution** - Y. N. Zhang, M. S. Zheng and J. W. Zhu, Advanced Materials Research Vols. 194-196 (2011) pp 1253-1256

268. **Copper Development Association Inc.** - www.copper.org

570. **EN 12163 (2011) Copper and copper alloys. Rod for general purposes.** -

622. **Data sheet - Chromium Zirconium Copper CuCrZr** - Luvata KrK101

623. **Development and Microstructure of Cu¬Zr Alloy Wire with Ultimate Tensile Strength of 2.2 GPa** - N. Muramats, H. Kimura, A. Inoue, Materials Transactions, Vol. 53, No. 6 (2012) pp. 1062 to 1068

624. **Data Sheet - CuZr0,1** - Aurubis