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http://conductivity-app.org

CuNi3Si

UNS:C70250, C70320
EN:CW112C

Manufactures list:
Diehl Metall Stiftung & CO.KG (http://www.diehlmetall.de) - CuNi3Si (SB26)
KM Europa Metal AG (http://www.kme.com/) - CuNi3Si(CuNi3Si)
Wieland-Werke AG (http://www.wieland.de/) - CuNi3Si (K55)

CuNi3Si is an age-hardening copper alloy. It has high mechanical properties, high electrical and thermal conductivity, good corrosion resistance, good fatigue strength and thermal resistance, good spring properties.

Basic properties

Basic properties	Value	Comments
Density [g/cm^3]	8,8	
Specific heat capacity [J/(kg*K)]	377	
Temperature coefficient of electrical resistance (0...100°C) [10^{-3}/K]	No data	
Electrical conductivity [T=20°C, (% IACS)]	35-45	
Thermal conductivity [W/(m*K)]	190	
Thermal expansion coefficient 20...300°C [10^{-6}/K]	17,6	
[Ref: 235, 236, 243]		

Applications

Main applications

Connectors, leadframe, electrical equipment. CuNi3Si alloy con also be used for current-carrying formed parts and contact springs. Literature: [Ref: 235]

Kinds of semi-finished products/final products

Electrical industry components, stamped parts, connectors, relay springs, semiconductor components.

Chemical composition

Chemical composition	Value	Comments
Cu [wt.%]	93,38-96,1	Calculated
Fe [wt.%]	0-0,2	
Mn [wt.%]	0-0,1	
Ni [wt.%]	2,6-4,5	
Pb [wt.%]	0-0,02	
Si [wt.%]	0,8-1,3	
Others [wt.%]	0,5	
[Ref: 570]		

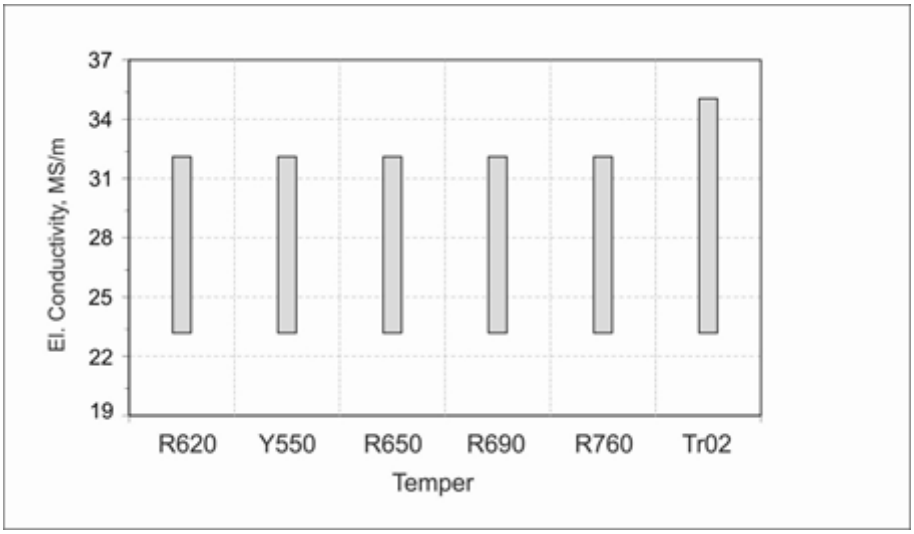
Mechanical properties

Mechanical properties	Value	Comments	Literature
UTS [MPa]	590-830		
YS [MPa]	440-780		
Elongation [%]	5-12		
Hardness	180-220	HB, heat treated	
Young's modulus [GPa]	135		
Kirchhoff's modulus [GPa]	50,4		
Poisson ratio	0,34		

Material's mechanical and electrical properties in different tempers

Temper	Tensile strength, MPa	Yield strength (min), MPa	Elongation (min) A5 (%)	Hardness	Electrical conductivity % IACS	Literature
Bars, squares hexagonals, solution heat treated, artificially aged	690	540	8	200 HB		DIN 17672-1 (1969)
Bars, squares hexagonals; solution heat treated, strain-hardened	610	550	8	180 HB		
Bars, squares hexagonals; solution heat treated, strain-hardened, artificially aged;	830	780	10	220 HB		
Flats; solution heat treated, artificially aged	690	540	8	200		
R620	620-760	500	10 (A_{50})	180-240 HV	40	[Ref: 236]
R690	690-860	655	5 (A_{50})	220-260 HV	40	

R610 (H180)	610-720	570	>8 (A_{50})	180-230 HV	45	[Ref: 235]
R650 (H190)	650-740	550	>12 (A_{50})	190-230 HV	40	
R690 (H210)	690-800	660	>5 (A_{50})	200-240 HV	40	
R720 (H220)	720-810	690	>7 (A_{50})	210-250 HV	45	
R740 (H225)	740-850	690	>5(A_{50})	225-250 HV	35	
Rod 10-30mm	650	590	10	195 HB		[Ref: 625]
Rod 30-50mm	650	500	10	195 HB		
Rod >50	590	440	10	190 HB		

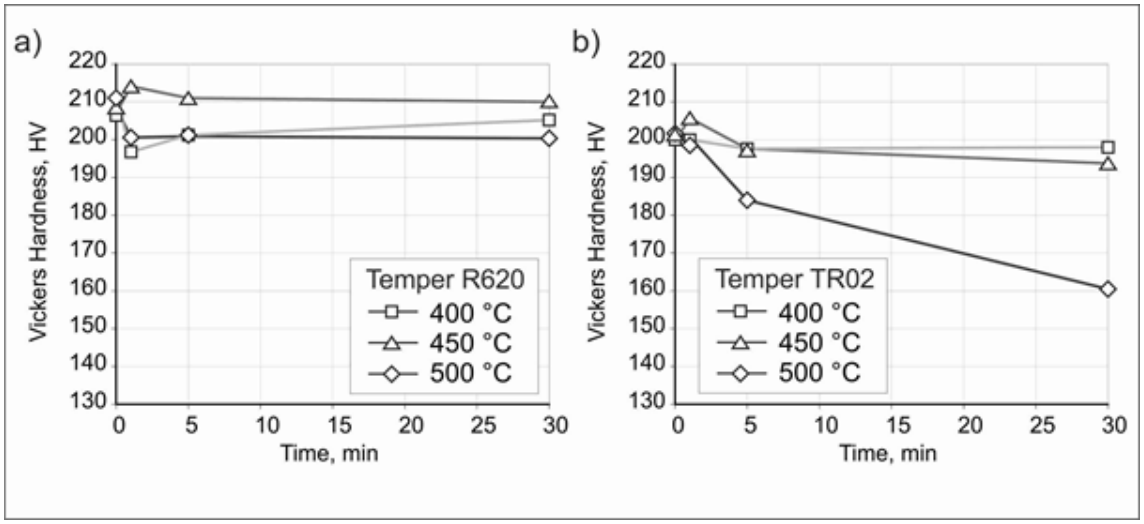


Electrical conductivity vs. temper [Ref: 569]

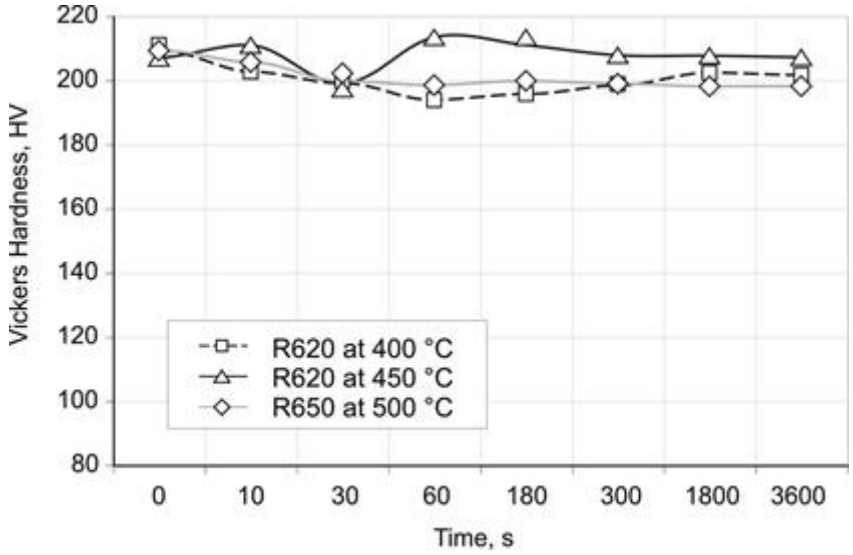
Exploitation properties

Heat resistance

Mechanical and electrical properties vs temperatures



Resistance to softening of CuNi3Si [Ref: 569]



Softening resistance of CuNi3Si for different temper [Ref: 243]

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

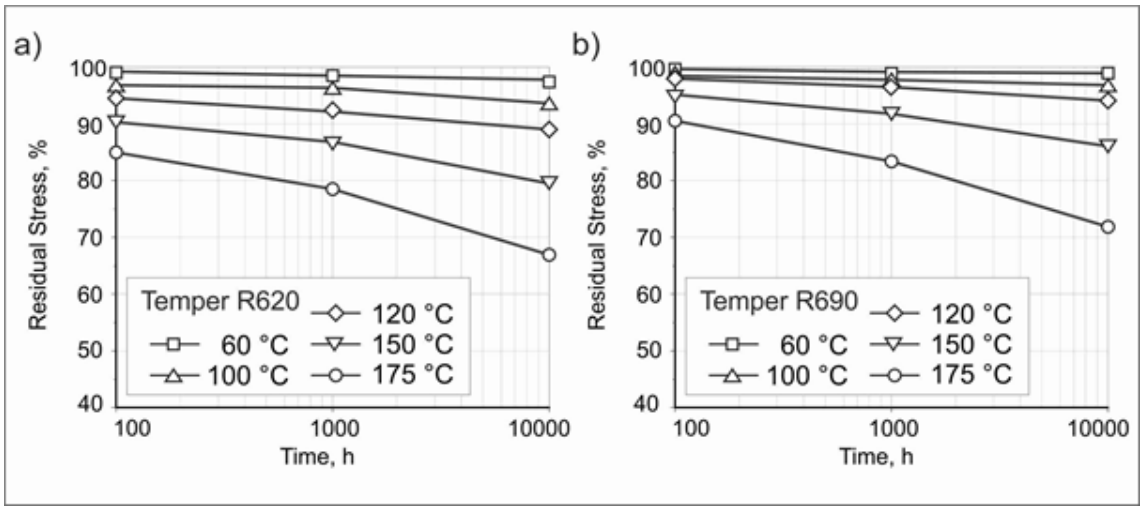
Other kind of corrosion elements

Type of corrosion	Suitability	Literature
Atmospheric	Good	[Ref: 569, 243]
Marine environment	No data	-
Stress crack	Resistant	[Ref: 569, 243]
Hydrogen embrittlement	No data	-
Electrolytic	No data	-
Other	No data	-

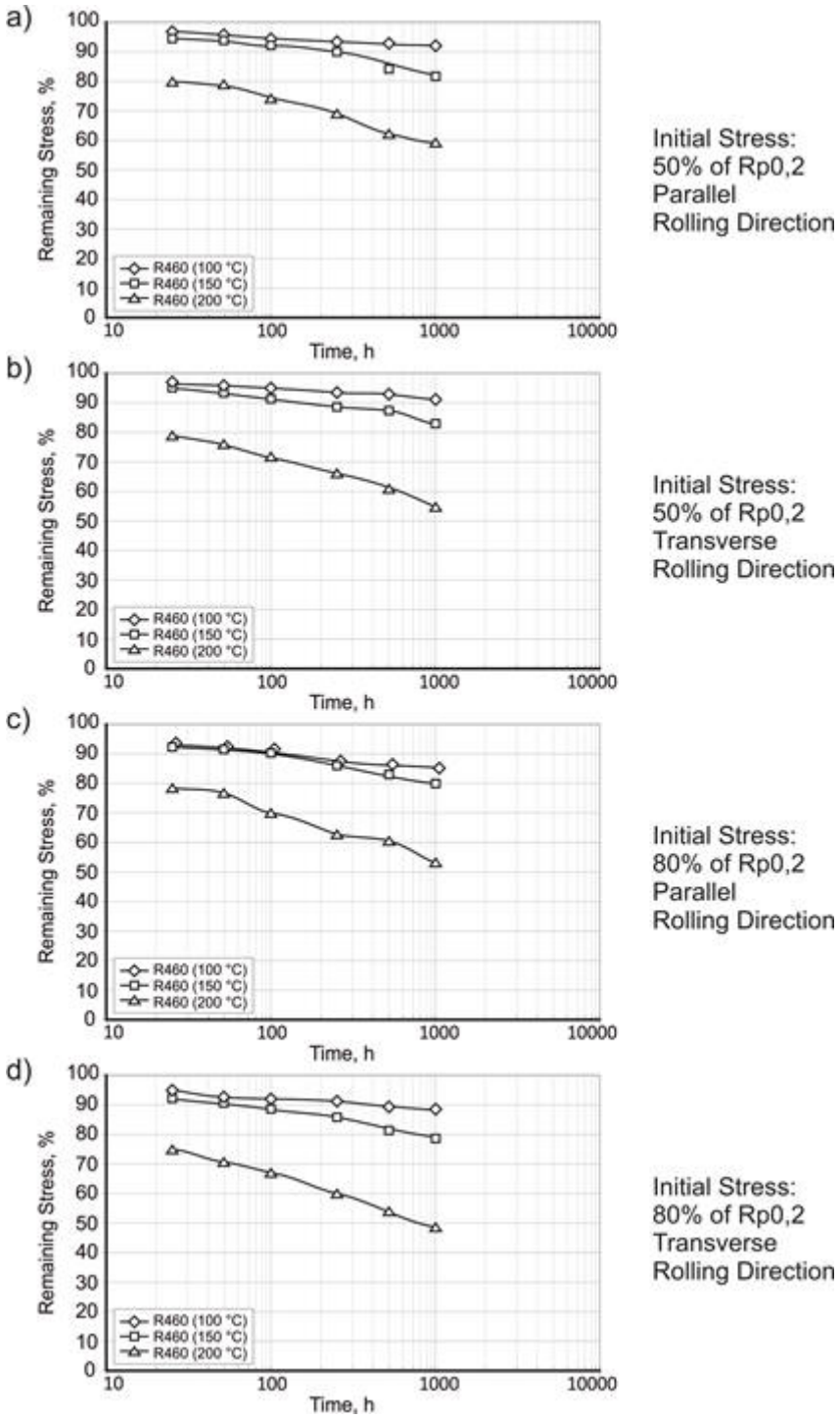
Rheological resistance

Stress relaxation

H temper condition up to 175□C - fair [Ref: 235]



Stress relaxation of CuNi3Si [Ref: 569]



Stress relaxation of CuNi3Si at different temperature and temper [Ref: 243]

Creep

NO DATA AVAILABLE

Wear resistance

Friction resistance

NO DATA AVAILABLE

Fatigue resistance

Fatigue cracking

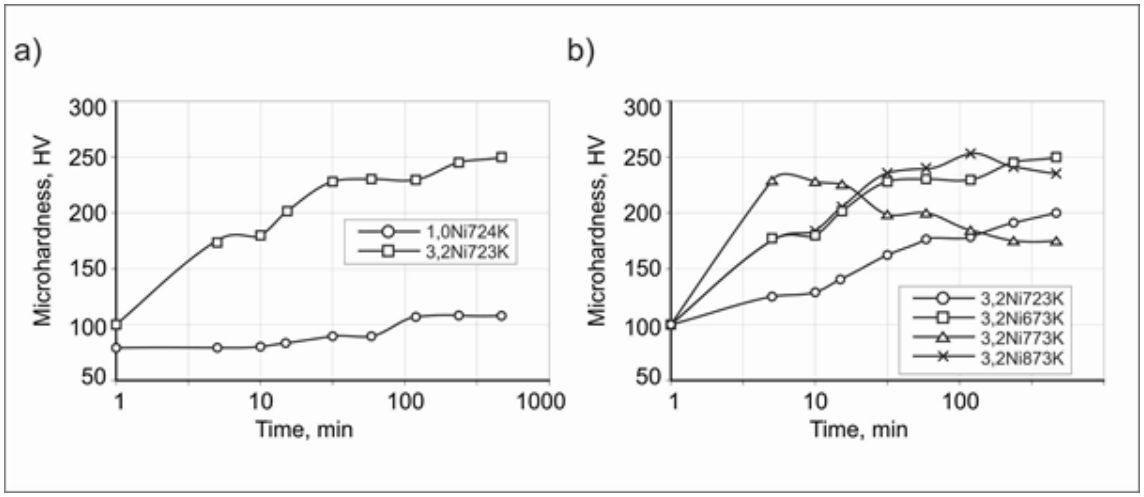
The fatigue strength is defined as the maximum bending stress amplitude witch a material withstands for 107 load cycles under symmetrical alternate load without breaking. It is dependent on the temper tested and is about 1/3 of the tensile strength [Ref: 569].

Impact strength

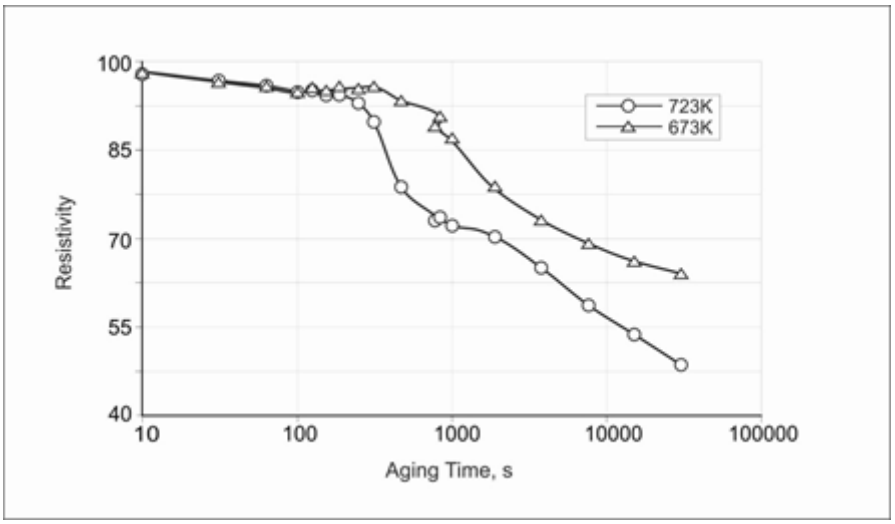
NO DATA AVAILABLE

Fabrication properties

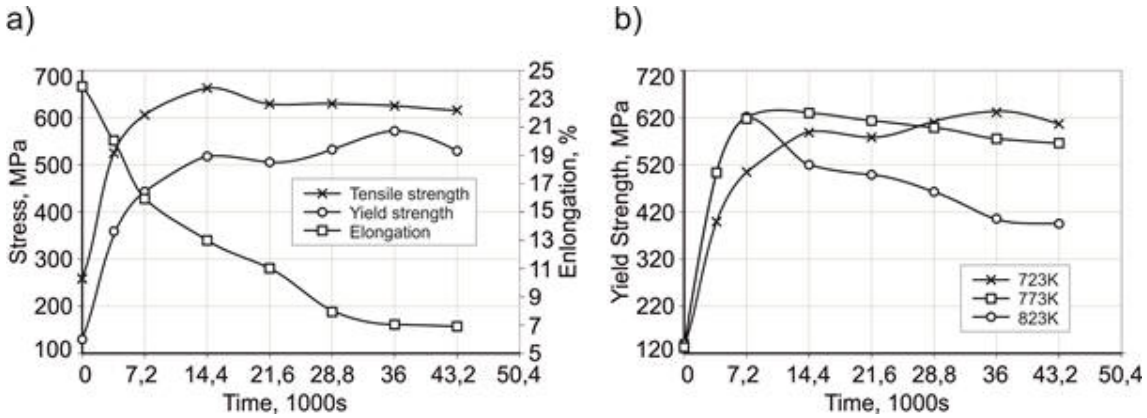
Fabrication properties	Value	Comments	Literature
Soldering	good		[Ref: 569]
Brazing	good		[Ref: 243]
Hot dip tinning	good		[Ref: 569]
Electrolytic tinning	good		[Ref: 569]
Electrolytic silvering	good		[Ref: 569]
Electrolytic nickel coating	good		[Ref: 569]
Laser welding	not recommended		[Ref: 569]
Oxyacetylene Welding	good		[Ref: 268]
Gas Shielded Arc Welding	good		[Ref: 569]
Coated Metal Arc Welding	fair		[Ref: 268]
Resistance welding	fair		[Ref: 243]
Capacity for Being Cold Worked	good		[Ref: 569]
Capacity for Being Hot Formed	excellent		[Ref: 268]
Forgeability Rating	40		[Ref: 268]
Machinability Rating	30		[Ref: 268]



The dependence of the microhardness on the aging time of CuNi3Si and CuNi1Si. (Note: Samples (strip) was solution heat-treated for 1h at 1173 K in an argon atmosphere and water quenched) [Ref: 229]



Variation of the electrical resistivity with time at 673 and 723 K for the CuNi3Si alloy, showing the onset of spinodal decomposition. (Note: Samples (strip) was solution heat-treated for 1 h at 1173 K in an argon atmosphere and water quenched) [Ref: 229]



(a) Yield strength, tensile strength and elongation of CuNi3Si as a function of aging time at 723 K; (b) yield strength of CuNi3Si as a function of aging time from 723 to 823 K. (Note: The strip was solution heat treated for 1 h at 1173K in an argon atmosphere and water quenched) [Ref: 242]

Technological properties

Technological properties	Value	Comments	Literature
Melting temperature [°C]	1040-1075		[Ref: 268, 625]
Annealling temperature [°C]	250-650	1-3h	[Ref: 243]
Homogenization temperature [°C]	900		[Ref: 229]
Quenching temperature [°C]	900	1h	[Ref: 229]
Ageing temperature [°C]	450-500		[Ref: 229]
Stress relievieng temperature [°C]	150-200	1-3h	[Ref: 243]

References:

229. **Aging behavior of Cu–Ni–Si alloy** - Dongmei Zhao, Q.M. Dong, P. Liu, B.X. Kang, J.L. Huang, Z.H. Jin, Materials Science and Engineering A361 (2003) 93–99

235. **Copper-Nickel-Silicon (CuNi3Si)** - Diehl Metall

236. **Data sheet - CuNi3Si** - KME

242. **Structure and strength of the age hardened Cu–Ni–Si alloy** - D.M. Zhao, Q.M. Dong, P. Liu, B.X. Kang, J.L. Huang, Z.H. Jin, Materials Chemistry and Physics 79 (2003) 81–86

243. **Data sheet - CuNi3Si1Mg** - KME

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

569. **Data sheet - CuNi3Si1Mg** - Wieland-K55

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

625. **Data sheet – CuNi3Si** - Busby Metals