CuSn0,15

UNS:C14415
EN:CW117C

Manufactures list:
Aurubis (http://www.aurubis.com/en/) - AURUBIS LS15, AURUBIS STOLBERG, PNA 216
Luvata (http://www.luvata.com/) - LUVATA SM0702
Mitsubishi Materials Corporation (http://www.mmc.co.jp/) - TAMAC-2
Wieland-Werke AG (http://www.wieland.de/) - K81

CuSn0,15 alloy is a tin bearing copper with higher than pure copper softening temperature and good creep, stress relaxation and fatigue resistance. The alloy permits good corrosion resistance and has no stress cracking corrosion. Material has good formability at medium strength and good conductivity. Hot dip tinning, soldering and electroplating properties are excellent.

Basic properties

Basic properties	Value	Comments
Density [g/cm^3]	8,9	
Specific heat capacity [J/(kg*K)]	385	
Temperature coefficient of electrical resistance (0...100°C) [10^{-3}/K]	3,2-3,3	
Electrical conductivity [T=20°C, (% IACS)]	81-95	
Thermal conductivity [W/(m*K)]	300-360	
Thermal expansion coefficient 20...300°C [10^{-6}/K]	17-18	
[Ref: 112, 113, 568, 115, 116, 118, 119, 122, 123, 124, 125, 128, 143]		

Applications

Main applications

Main applications are connected with heat and electric current transfer in electro-industry, electronics and automotive. Possible applications: heat exchangers, radiator fins, connectors and connector pins, fuse/ relay boxes, punch screen, stamped and bent parts in electro-industry, electric terminals and micro-terminals, electric clamps, different carriers, electronic parts carriers, leadframes, electrical springs for lower loads, contacts and sliding contacts parts, electrical switches, high current capacity electrical wires, conductors and cables (especially automotive cables, super fine coaxial cables, busbars and other solid and multi-wire conductors), semiconductor devices, different electro-automotive parts, chemical and medical equipment, wire electro discharge cutting systems.
Literature: [Ref: 111, 112, 113, 114, 568, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 143, 144]

Kinds of semi-finished products/final products

Rolled plates, sheets, strips and folis, rolled tinned strips, rolled profiles with different height, extruded round or polygonal rods, extruded sections, extruded tubes, drawn round or polygonal wires, drawn tubes

Chemical composition

Chemical composition	Value	Comments
Cu [wt.%]	99,595-99,9	Calculated
Fe [wt.%]	0-0,02	
Ni [wt.%]	0-0,02	
P [wt.%]	0-0,015	
Sn [wt.%]	0,10-0,15	
Zn [wt.%]	0-0,1	
Others [wt.%]	0-0,1	
[Ref: 111]		

Chemical composition, wt. %						
Sn	Ni	Fe	P	Zn	Others	Cu
0,10-0,15	-	-	-	-	max. 0.04	Cu+Ag+Sn min. 99,96
Literature: [Ref: 112]						

Mechanical properties

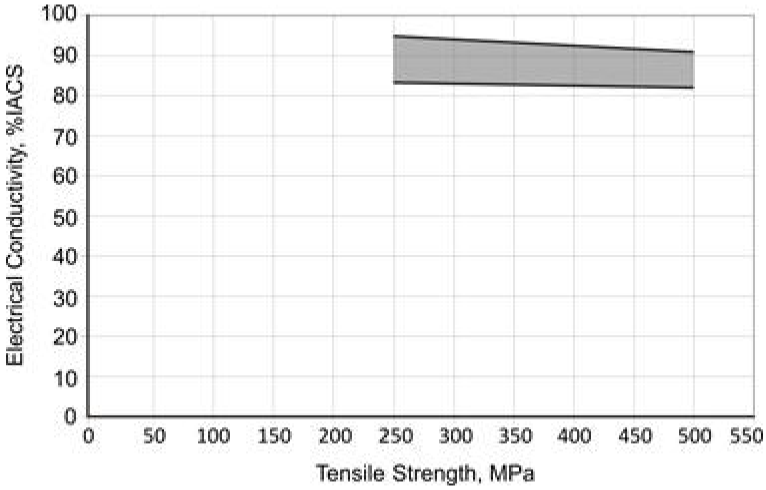
Mechanical properties	Value	Comments	Literature
UTS [MPa]	220-460		
YS [MPa]	100-410		
Elongation [%]	2-25		
Hardness	60-135	HV	
Young's modulus [GPa]	110-130		
Kirchhoff's modulus [GPa]	45		
Poisson ratio	0,34		

Material's mechanical and electrical properties in different tempers

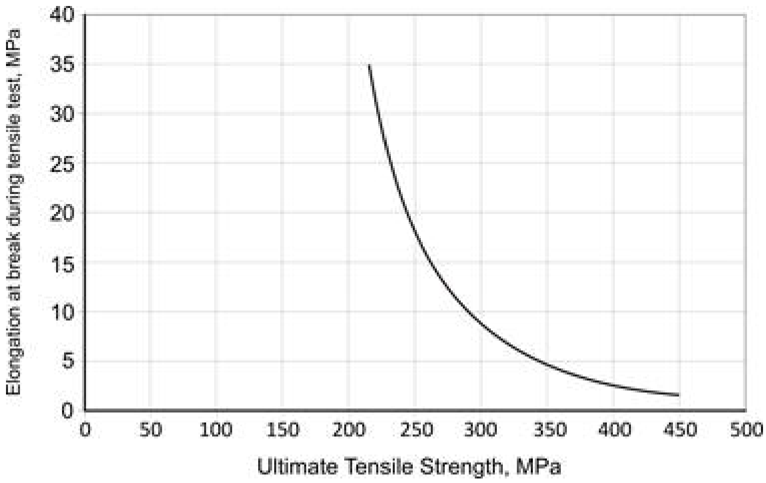
Temper	Ultimate Tensile Strength UTS [MPa]	0,2%Yield Strength YS[MPa]	Elongation at break during tensile test A50[%]	Hardness [HV]	Electrical conductivity [%IACS]	Literature
R250 H60	250-320	min. 140	9	60-90	min. 83	[Ref: 111, 113, 114, 568, 116, 119, 122]
R300 H85	300-370	min. 250	4	85-110	min. 83	
R360 H105	360-430	min. 320	3	105-130	min. 82	
R420 H120	420-490	min. 350	2	120-140	min. 82	
R460 H135	>460	min. 410	2	>135	min. 82	

Material's mechanical and electrical properties in different tempers (non European standards)

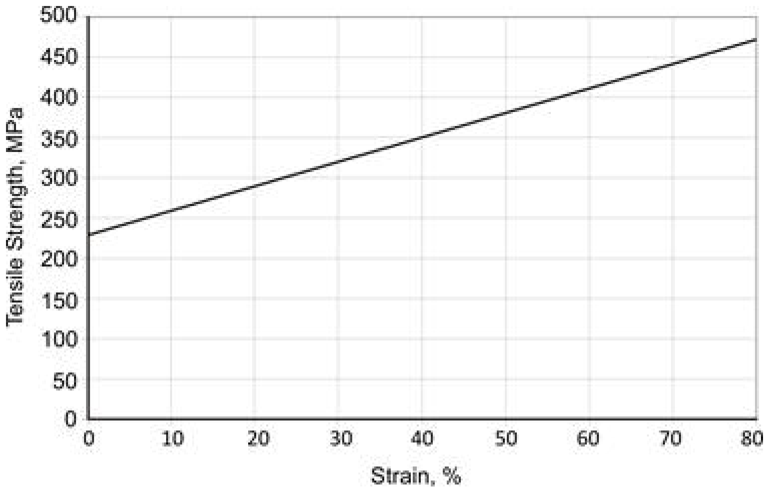
Temper	Ultimate Tensile Strength UTS [MPa]	0,2%Yield Strength YS [MPa]	Elongation at break during tensile test A [%]	Hardness [HV]	Literature
O	195-245	-	min. 35	min. 55	[Ref: 142]
1/4H	215-275	-	min.25	55-75	
1/2H	245-315	-	min.15	75-90	
H	275-345	-	min.4	90-105	
EH	min. 315	-	min. 2	min. 100	



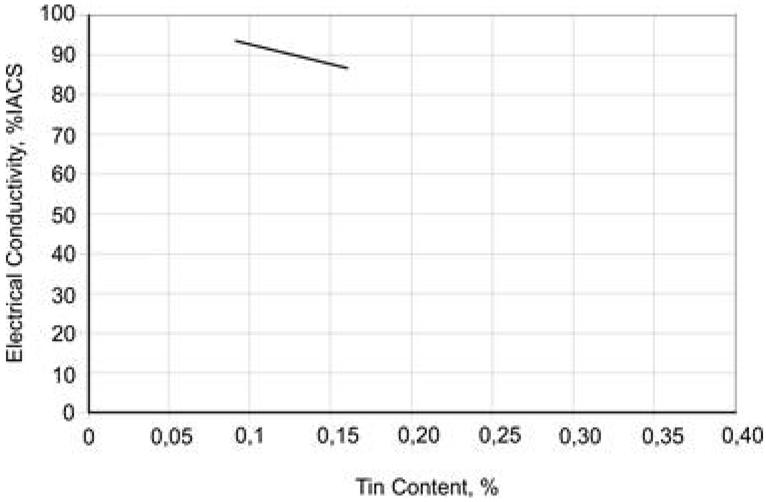
Levels of electrical and mechanical properties of material in different tempers [Ref: 2]



Elongation at break vs ultimate tensile strength at ambient temperature for material in different temper [Ref: 2]



Ultimate tensile strength of material as a function of cold working strain calculated via formula based on approximation of different experimental data [Ref: 2]

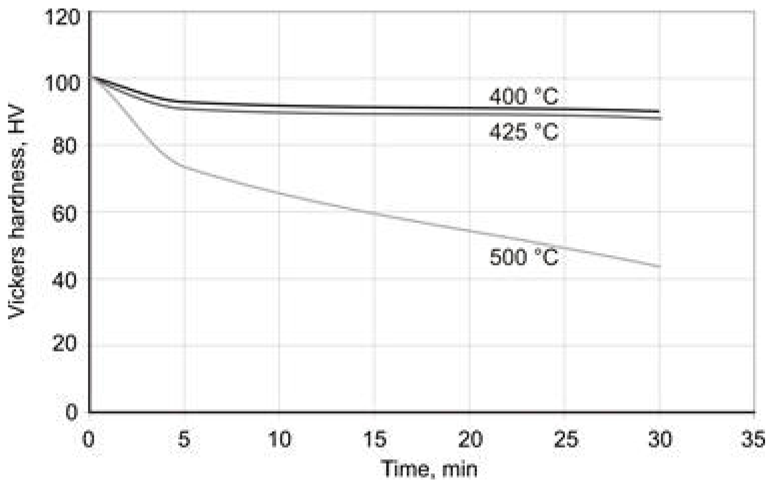


Effect of tin content on electrical conductivity of copper [Ref: 128]

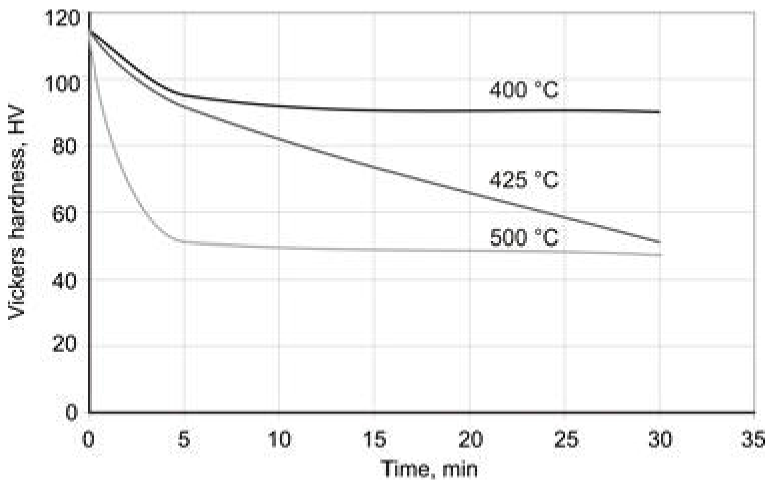
Exploitation properties

Heat resistance

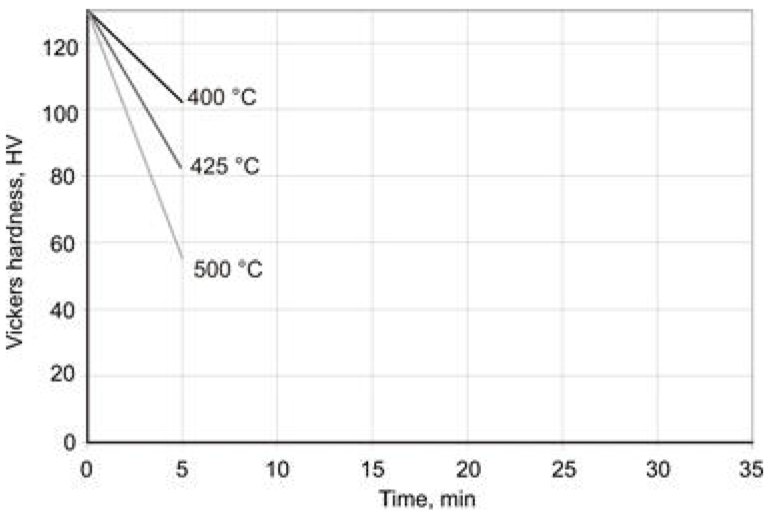
Mechanical and electrical properties vs temperatures



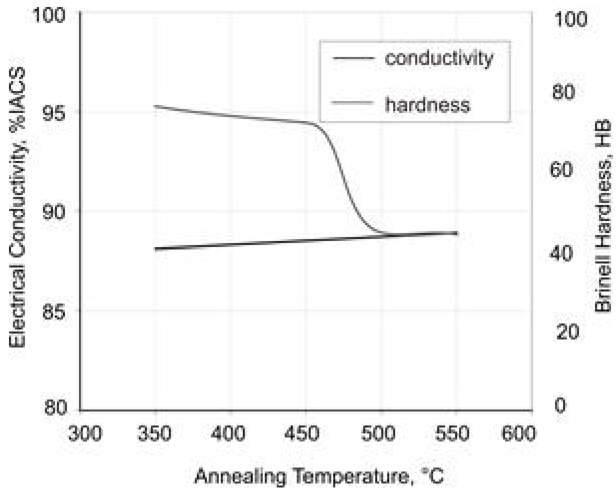
Vickers hardness as a function of heating time in different temperatures (hardness test at ambient temperature after heating), material in R300 temper



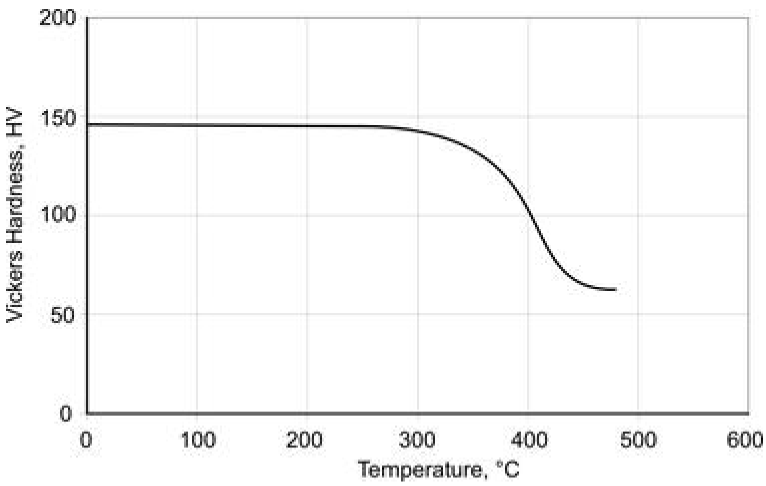
Vickers hardness as a function of heating time in different temperatures (hardness test at ambient temperature after heating), material in R360 temper



Vickers hardness as a function of heating time in different temperatures (hardness test at ambient temperature after heating), material in R420 temper



Variation of electrical conductivity and hardness with annealing temperature of material (conductivity and hardness tests at ambient temperature after heating)



Hardness changes as a function of heating temperature with 1h time, material cold worked 60% (hardness test at ambient temperature after heating)

Literature: [Ref: 109, 114, 568, 115, 118]

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

NO DATA AVAILABLE

Half- softening temperature

Softening temperature: 350-450°C [Ref: 112, 114]

Corrosion resistance

Hydrogen embrittlement resistance

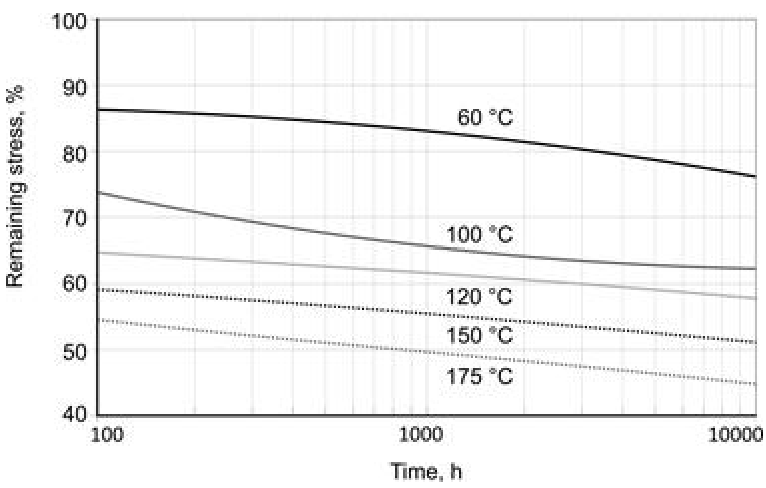
NO DATA AVAILABLE

Other kind of corrosion elements

Type of corrosion	Suitability	Literature
Atmospheric	Excellent	[Ref: 115]
Marine environment	Excellent	[Ref: 115]
Stress crack	Resistant	[Ref: 115, 119]
Hydrogen embrittlement	no data	-
Electrolytic	good	[Ref: 114]
Other - oxidizing acids	bad	[Ref: 114]

Rheological resistance

Stress relaxation



Residual stress during stress relaxation in different temperatures, material temper R 420, initial stress 50%YS [Ref: 114, 568]

Creep

NO DATA AVAILABLE

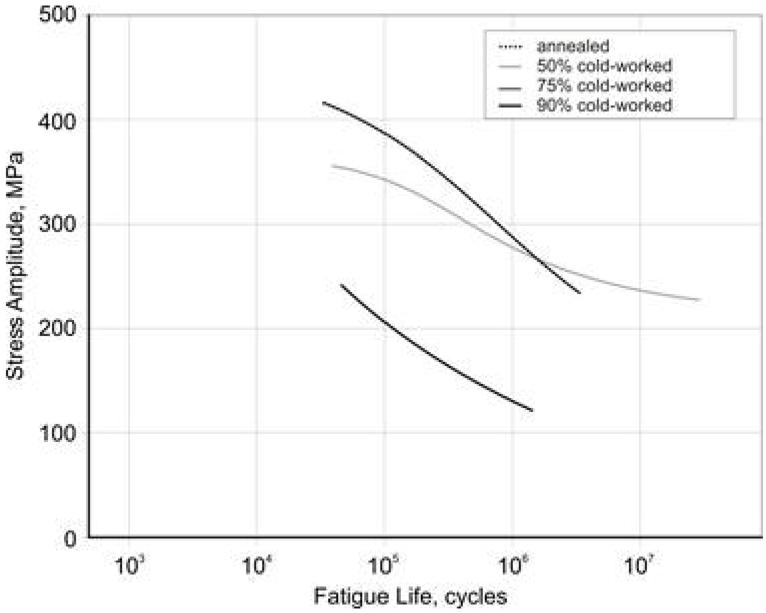
Wear resistance

Friction resistance

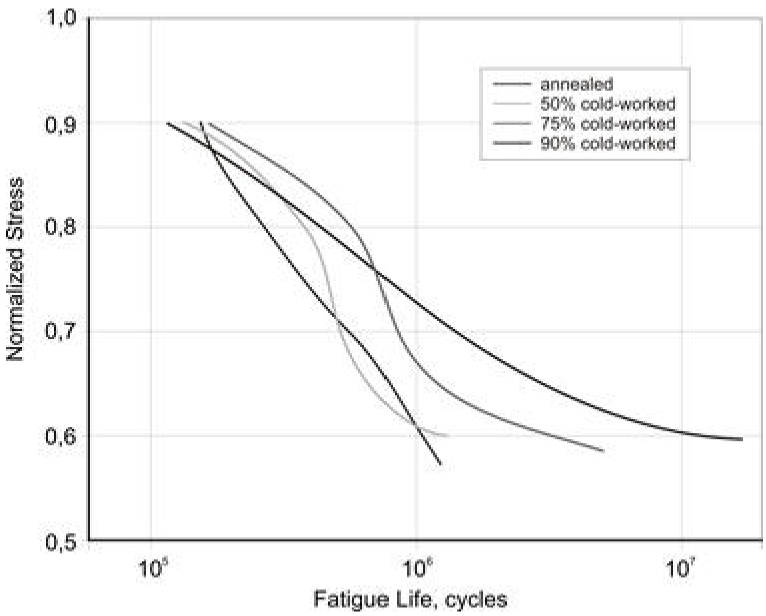
NO DATA AVAILABLE

Fatigue resistance

Fatigue cracking



Variation of fatigue life with respect to stress amplitude for material with different tempers [Ref: 131]



Variation of fatigue life with respect to normalized stress amplitude for material with different tempers [Ref: 131]

Impact strength

NO DATA AVAILABLE

Fabrication properties

Fabrication properties	Value	Comments	Literature
Soldering	excellent		[Ref: 568, 115, 116, 119, 125, 127]
Hot dip tinning	good		[Ref: 568, 116]
Electrolytic tinning	good		[Ref: 568, 116]
Electrolytic silvering	good		[Ref: 115, 116]
Laser welding	good		[Ref: 114, 568, 116]
Oxyacetylene Welding	fair		
Gas Shielded Arc Welding	good		[Ref: 114, 568, 115, 116]
Capacity for Being Cold Worked	excellent		[Ref: 115, 116, 123]
Capacity for Being Hot Formed	excellent		[Ref: 115]
Machinability Rating	20		[Ref: 114]

Formability properties [Ref: 111, 568, 116]

Thickness t [mm]	Direction	Temper				
		R250 H60	R300 H85	R360 H105	R420 H120	R460 H135
0,10mm<>	transverse	0xt	0xt	0xt	1xt	1,5xt
	parallel	0xt	0xt	0xt	1xt	1,5xt
0,25mm<>	transverse	0xt	0xt	0,5xt	1xt	-
	parallel	0xt	0xt	0,5xt	1,5xt	-

Technological properties

Technological properties	Value	Comments	Literature
Melting temperature [°C]	1065-1075		[Ref: 115]
Casting temperature [°C]	1140-1200		
Annealling temperature [°C]	250-650	Annealling time: 1-3h	[Ref: 115]
Stress relievieng temperature [°C]	150-200	Stress relievieng time: 1-3h	[Ref: 115]
Hot working temperature [°C]	800-950		[Ref: 115, 114]

References:

2. **Properties of copper and copper alloys at cryogenic temperatures** - Simon N. J., Drexler E.S., Reed R. P., NIST Monograph 177, National Institute of Standards and Technology, U.S. Department of Commerce, Washington, D.C., Feb 1992

109. **Influence of alloying elements on thermal conductivity and high temperature strength of copper based alloys** - K. T. Kim, W. J. Jung, and C. S. Choi, Materials Science and Technology April 2001 Vol. 17 455

111. **Copper and copper alloys – Strip for lead frames EN 1758:1997** -

112. **Application datasheet – C10100-C12099** -

113. **Data sheet - CuSn015** - Altek

114. **CuSn0,15** - Deutsche Kupferinstitut

115. **Data sheet - High-copper alloy** - Wieland-K81

116. **Data sheet - High-Performance Alloys BB01** - Diehl Metall

117. **Data sheet - Extruded/drown product** - Wieland

118. **Data sheet** - HitachiCable

119. **Data sheet - KHP15 CuSn0,15** - Kemper

120. **Data sheet** - Aurubis Slitting Centre

121. **Data sheet - Walzprodukte** - Prymetall GmgH and Co. KG

122. **Data sheet - PNA216** - Aurubis

123. **Data sheet - Semi-finished products in copper and copper alloys for power engineering** - Wieland

124. **Copper-Tin** - Diehl Metall

125. **Data sheet - Strips of Copper and Copper Alloys** - Kemper

126. **Data sheet - Strip for connectors** - Wieland

127. **Copper Alloys for Connectors, Springs and Lead Frames** - Diehl Metall

128. **Sustainability in the Development and Production of Alloys** - Ralf Hojda, Dr. Michael Köhler, James Schraml, International Wire & Cable Symposium Proceedings of the 58th IWCS/IICIT

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