



**AGH**



## **CuDLP**

**UNS:C12000**

**EN:CW023A**

CuDLP is a phosphorus-deoxidized copper in which the residual phosphorus is maintained at a low level to achieve a good electrical conductivity. CuDLP also known as C12000 copper has a good electrical conductivity and excellent welding and soldering properties. It is not readily susceptible to hydrogen embrittlement and its electrical conductivity is slightly lower than that of electrolytic tough pitch copper. It has excellent hot and cold workability and can be readily joined by soldering. It is used in a variety of architectural, electrical and hardware applications.

Phosphorus deoxidized coppers for general and chemical engineering applications, particularly when brazing or welding is involved. The alloy can be cold worked by conventional processes such as forming and bending, drawing, spinning, stamping, coining, heading and upsetting. Can be joined by soldering with excellent results and good results are achieved by brazing. Good results are obtained with resistance butt welding but the alloy is not suitable for joining by other resistance welding methods. Fair results are achieved by using oxyacetylene welding, gas shielded arc welding and carbon arc welding. Use of coated metal arc welding is not recommended.

## Basic properties

Basic properties	Value	Comments
Density [g/cm <sup>3</sup> ]	8,78-8,94	
Specific heat capacity [J/(kg*K)]	380	
Temperature coefficient of electrical resistance (0...100°C) [10 <sup>-3</sup> /K]	3,6 3,3	0-100°C 20-300°C
Electrical conductivity [T=20°C, (% IACS)]	89-99	
Thermal conductivity [W/(m*K)]	385	
Thermal expansion coefficient 20...300°C [10 <sup>-6</sup> /K]	17,6	
[Ref: 311, 312, 313, 314, 315, 257, 252, 268, 267, 254, 255, 256]		

# Applications

## Main applications

*Electrical components such as bus bar, contacts, switches, terminals, conductors, cable strip, lead frames for power semiconductors. Hardware applications such as ball floats, cotter pins, nails, rivets, soldering copper, tacks, architectural uses for downspouts, flashings, building fronts, gutters, screening; chemical process equipment, anodes, printing rolls, vats, tubing, LP gas service, resistance welding equipment, welded tube, medical gas- oxygen, coverings, gutters, drain pipes, food recipients, autoclaves and heat exchangers, moulded and drawn parts. Literature: [Ref: 311, 312, 313, 314, 315, 257, 252, 268, 267, 254, 255, 256, 91]*

## Kinds of semi-finished products/final products

Forms Available: Plate, sheet, strip, bar, rod, wire, tube, pipe, extrusions and forgings.

Bar, Bus	ASTM B187	Literature
Fittings	ASME B16.22	[Ref: 254, 267, 268, 315, 314]
Foil, Printed Circuits	ASTM B451	
Nipples	ASTM B687	
Pipe	ASME SB42	
	ASTM B698, B42	
Pipe, Bus	ASTM B188	
Plate	ASTM B152	
	SAE J461, J463	
Rod	ASME SB133	
Rod, Bus	ASTM B187	
Shapes, Bus	ASTM B187	
Sheet	ASTM B152	
	SAE J463, J461	
Sheet, Clad	ASTM B506	
Sheet, Printed Circuits	ASTM B451	
Strip	ASTM B152	
	SAE J463, J461	
Strip, Clad	ASTM B506	
Strip, Printed Circuits	ASTM B451	
Tube	ASTM B360, B698	
Tube, Bus	ASTM B188	
Tube, Coils	ASTM B743	
Tube, Condenser	ASME SB111	
	ASTM B111	
Tube, Finned	ASME SB359	
	ASTM B359	
Tube, Seamless Bright Annealed	ASTM B68	
Tube, U-Bend	ASME SB395	
	ASTM B395	
Tube, Welded	ASTM B716, B447, B641	
Tube, Welded for Air Conditioning and Refrigeration Service	ASTM B640	



## Chemical composition

Chemical composition	Value	Comments
Cu [wt.%]	99,4963-99,995	Calculated
P [wt.%]	0,0013-0,005	
Pb [wt.%]	0-0,005	
Others [wt.%]	0-0,5	
[Ref: 268, 267]		

*Chemical composition of CuDLP according ASTM [Ref: 312]*

Chemical composition, wt.%												
Ag	Mg	Sn	Ni	Si	Cr	Zr	Fe	P	Pb	Zn	other	Cu
-	-	-	-	-	-	-	-	0.004- 0.012	-	-	-	min. 99,90

## Mechanical properties

Mechanical properties	Value	Comments	Literature
UTS [MPa]	200-400		
YS [MPa]	70-380		
Elongation [%]	2-45		
Hardness	40-110		
Young's modulus [GPa]	115		
Kirchhoff's modulus [GPa]	45		
Poisson ratio	0,33		

*Mechanical properties of plates, sheets and coils Cu DLP for general usings according EN1652 standard*

State	Thickness		Tensile strength UTS,		Hardness HV	
	From mm	to mm	min. MPa	max. MPa	min.	max.
R200	more than 5		200	250	-	-
H040			-	-	40	65
R220	0,2	5	220	260	-	-
H040	0,2	5	-	-	40	65
R240	0,2	15	240	300	-	-
H065	0,2	15	-	-	65	95
R290	0,2	15	290	360	-	-
H090	0,2	15	-	-	90	110
R360	0,2	2	360	-	-	-
H110	0,2	2	-	-	110	-

*Mechanical properties of sections and rectangular bars CuDLP according EN 12167*

Temper	Section	Sizes		Tensile strength UTS min. MPa	Elongation A %	Hardness	
		Retangular bars thickness				HB min.	m
		> at mm	< or = mm				
R280	-	-	6	280	-10	-	-
H085	-	-	6	-	-	85	90
R240	-	6	60	240	-18	-	-
H065	-	6	60	-	-	65	70

*Mechanical properties of Cu-DLP [Ref: 312]*

Section, mm	Temper	Tenisle strength,	Yield strength,	Elongation %	Hardness, Rockwell HRB	Shear strength MPa
		MPa	MPa			

1	0,050mm	218	68	45	F40	150
	0,025mm	231	75	45	F45	156
	1/8hard	245	190	30	B10	170
	1/4hard	258	204	25	B25	170
	1/2hard	286	245	14	B40	177
	hard	340	306	6	B50	190
	spring	374	340	4	B60	197
	extra spring	388	360	4	B62	197
	hot rolled	231	68	45	F45	156
6,25	0,05	218	68	50	F40	150
	1/8hard	245	190	40	B10	170
	quarter hard	258	204	35	B25	170
	hard	340	306	12	B50	190
	as hot rolled	218	68	50	F40	150
	hard	306	272	20	B45	177



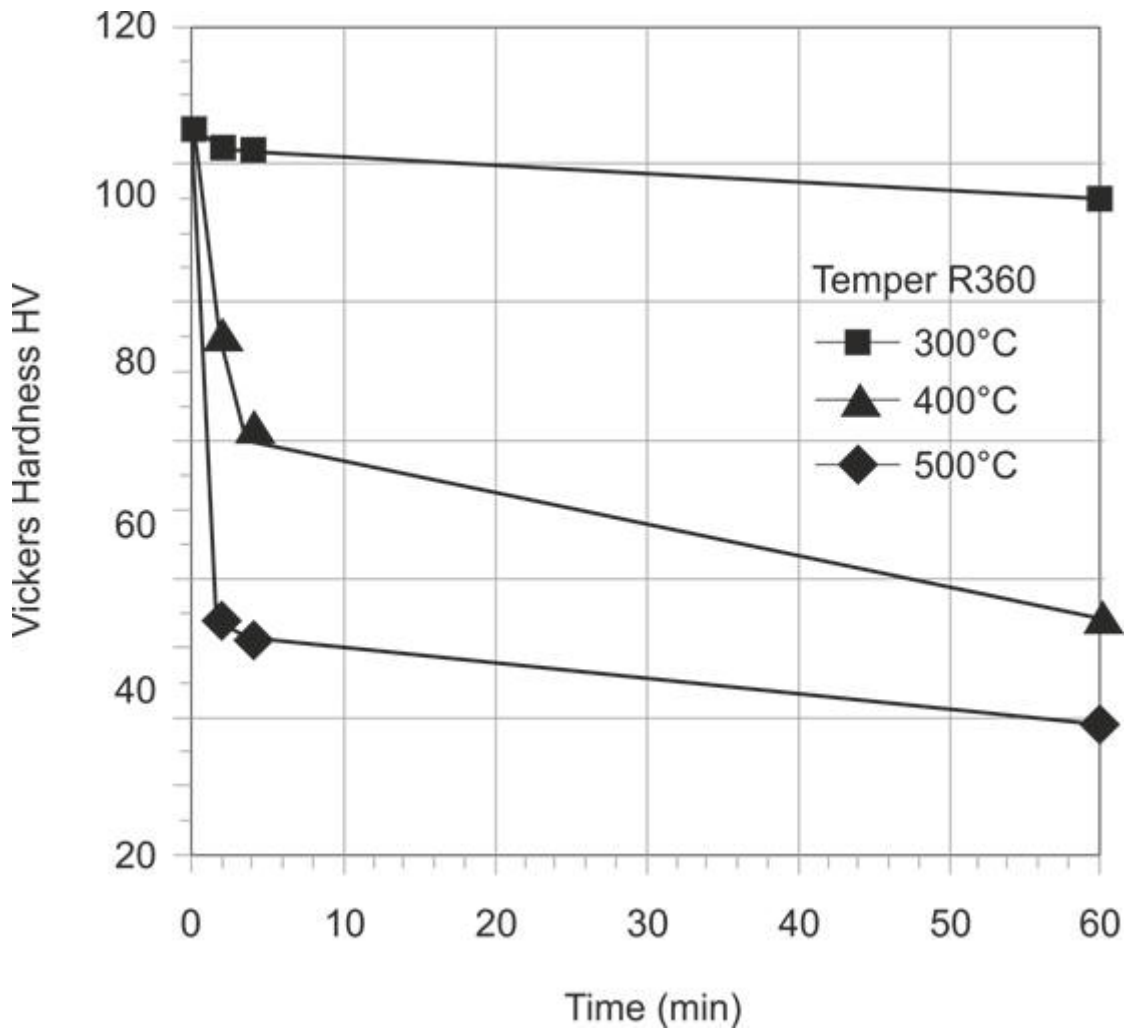
Mechanical properties of CuDLP bars for general usings according EN 12163 standard

State	Diameter or size/flats mm			Tensile strength UTS min. MPa	Elongation			Hardness			
	from mm	more than mm	until mm		A <sub>100</sub> min. %	A <sub>11,3</sub> min. %	A min. %	HB min.	HB max.	HV min.	HV max.
R200	2	-	80	200	25	30	35	-	-	-	-
H035	2	-	80	-	-	-	-	35	65	35	65
R250	2	-	10	250	8	10	12	-	-	-	-
R250	-	10	30	250	-	-	15	-	-	-	-
R230	-	30	80	230	-	-	18	-	-	-	-
H065	2	-	80	-	-	-	-	65	90	70	95
R300	2	-	20	300	5	6	8	-	-	-	-
R280	-	20	40	280	-	-	10	-	-	-	-
H085	2	-	40	-	-	-	-	85	110	90	115
R260	-	40	80	260	-	-	12	-	-	-	-
H075	-	40	80	-	-	-	-	75	100	80	105
R350	2	-	10	350	-3	-4	5	-	-	-	-
H100	2	-	10	-	-	-	-	100	-	110	-

## Exploitation properties

### Heat resistance

#### Mechanical and electrical properties vs temperatures



*Softening resistance of Cu-DLP [Ref: 311]*

#### Long-term heat resistance, e.g. Arrhenius curve

NO DATA AVAILABLE

#### Half- softening temperature

NO DATA AVAILABLE

#### Corrosion resistance

#### Hydrogen embrittlement resistance

Excellent hydrogen embrittlement resistance [Ref: 254, 257]

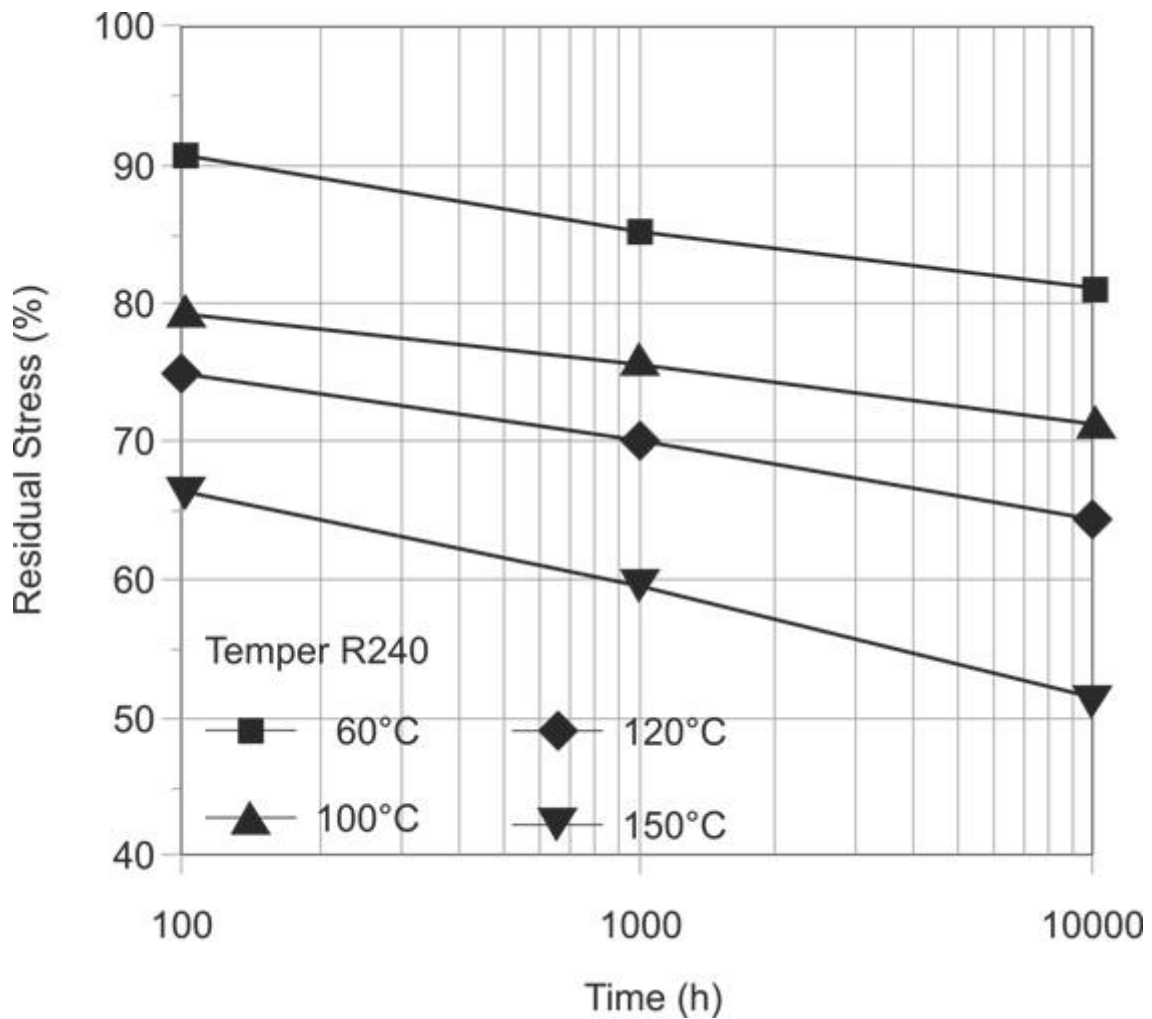
## Other kind of corrosion elements

Cu DLP is resistant to industrial atmosphere. Cu-PHC is not resistant to oxidizing acids, hydrous ammonia and halogenated gases, hydrogen sulfide.

Type of corrosion	Suitability	Literature
Atmospheric	Good	[Ref: 254, 257]
Marine environment	No data	
Stress crack	Good	[Ref: 254, 257]
Hydrogen embrittlement	Excellent	
Electrolytic	No data	

## Rheological resistance

### Stress relaxation



Stress relaxation resistance of Cu-DLP [Ref: 311]

### Creep

NO DATA AVAILABLE

## **Wear resistance**

### **Friction resistance**

NO DATA AVAILABLE

## **Fatigue resistance**

### **Fatigue cracking**

NO DATA AVAILABLE

### **Impact strength**

NO DATA AVAILABLE

## Fabrication properties

Fabrication properties	Value	Comments
Soldering	Excellent	
Brazing	Excellent	
Oxyacetylene Welding	Fair	
Gas Shielded Arc Welding	Excellent	
Coated Metal Arc Welding	Not recommended	
Spot Weld	Not recommended	
Seam Weld	Not recommended	
Butt Weld	Good	
Capacity for Being Cold Worked	Excellent	
Capacity for Being Hot Formed	Excellent	
Forgeability Rating	65	
Machinability Rating	20	
[Ref: 252, 268, 254, 91]		

## Technological properties

Technological properties	Value	Comments
Melting temperature [°C]	1083	
Casting temperature [°C]	1140-1200	
Annealing temperature [°C]	225-650	
Stress relieving temperature [°C]	175-225	
Hot working temperature [°C]	750-950	
[Ref: 252, 268, 254, 91]		

## References:

91. **Key to Metals - Data Base** - [www.keytometals.com](http://www.keytometals.com)
252. **Electronic Materials Handbook, vol.1 Packaging** - ASM International
254. **Copper and copper alloys** - J.Davis, ASM International, 2001
255. **Electrical and magnetic properties of metals** - Ch.Moosrigger, ASM International, 2000
256. **Thermal properties of metals** - F.Cverna, ASM International ASM, 2002
257. **Concise Metals** - Engineering Data Book, ASM International, 2004
267. **MatWeb - Data Base** - [www.matweb.com](http://www.matweb.com)
268. **Copper Development Association Inc.** - [www.copper.org](http://www.copper.org)
311. **Data sheet - K-15** - Wieland
312. **Data sheet - Copper no 120** - october 1972
313. **Data sheet - Cu-DLP** - Forintrade LCC
314. **Data sheet - KME 160** - KME
315. **Data sheet - C120 (DLP)** - Luvata