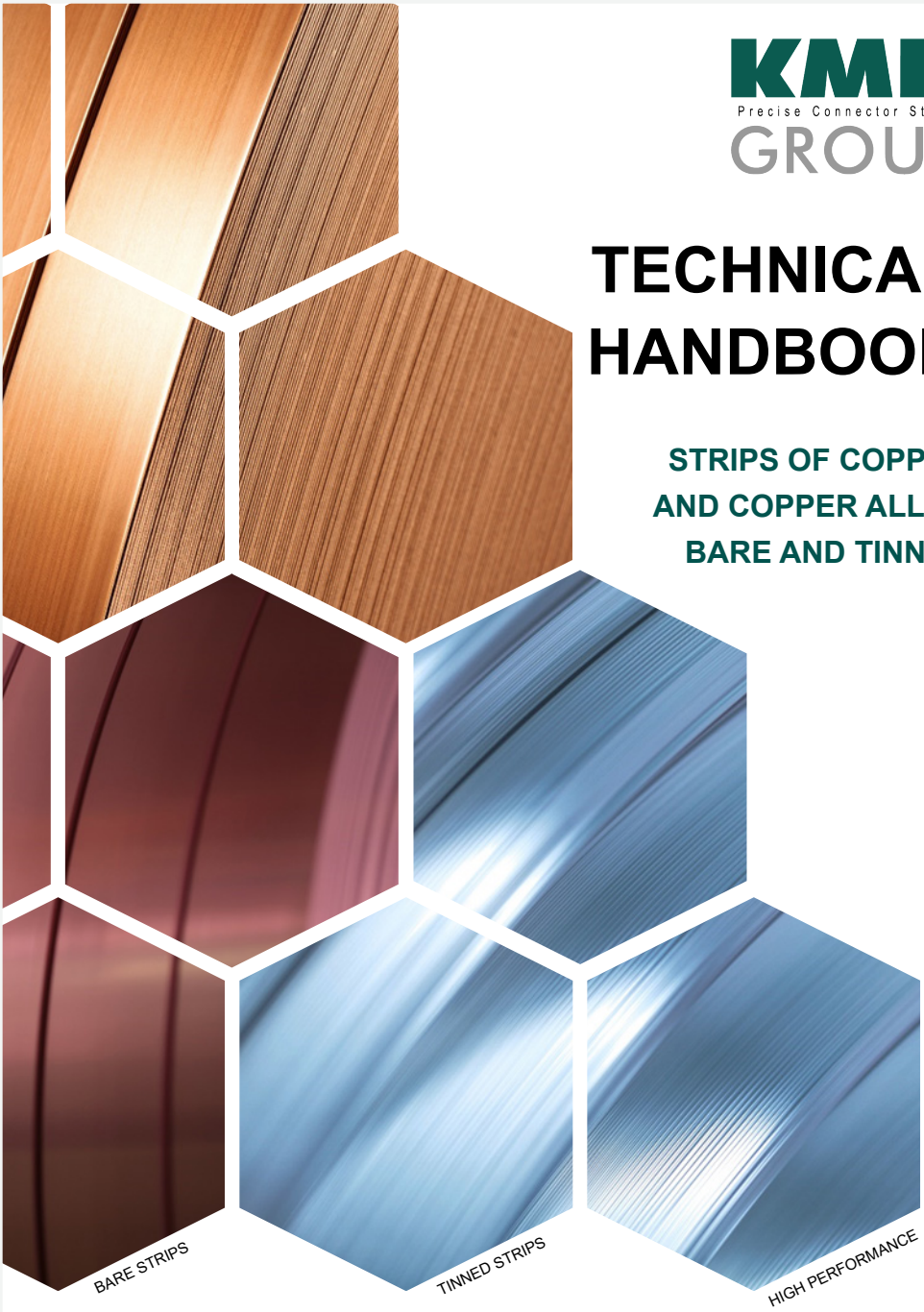
KMD
Precise Connector Strips
GROUP

TECHNICAL HANDBOOK

STRIPS OF COPPER AND COPPER ALLOY BARE AND TINNED



KMD Precise Copper Strip (Henan) Co., Ltd.

KMD Technical Marketing Team is proud to announce that the new version of KMD Technical Manual is now available!

The Manual covers all products and services globally offered by KMD. It exposes all grades of high performance copper alloys and standard copper alloys with details and charts on mechanical properties, chemical composition and much more. The Manual is enriched with key data and charts on stress relaxation resistance, bend fatigue and other critical-to-quality features of connector strips. KMD Technical Manual is an indispensable tool for connector designers, materials engineers and procurement personnel in automotive, electronic, data communications and electrical industries.

KMD Technical Manual is now available in 2 versions:

Chinese and English. Please book your copy now by contacting KMD team at the following email address：

info-china@kmdgroup.com

KMD Technical Marketing team of metal scientists and application engineers. They support customers to choose the best technical solutions, to solve performance challenges and to save costs. Please contact KMD anytime if you would like to book a consultancy with one of our Technical Marketing Engineers.

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1.1 KMD in Short

KMD Group is a global producer of high quality copper and copper alloy strips used in particular for electric and electronic connector applications.

We produce a wide range of copper alloys specifically tailored to the requirements of connector manufacturing, electrical and electronic components, and other high-end applications.

KMD Group was wholly acquired by Golden Dragon Group on May 31, 2023. Golden Dragon Group is a leader in China's copper processing industry, with three business units of copper tube, copper strip and copper wire, and several factories in the United States, Mexico and China.

KMD is committed to becoming the world's leading producer of high-quality strips for numerous connector market segments. KMD is a customer-centric main supplier of high-quality connector strip. We have long-term relationships with leaders and innovation drivers in the global connector industry.

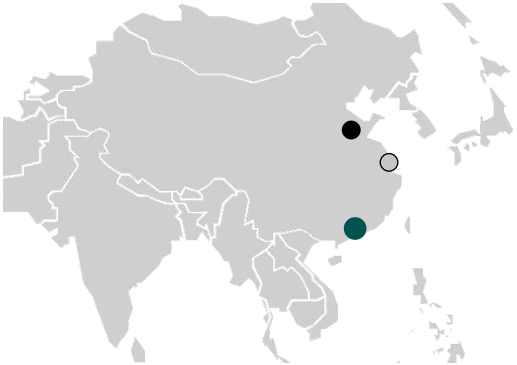
Our high-performance alloy strips are popular all over the world.

The KMD website, now available in Chinese and English, caters to the requirements of the entire customer base: from providing up-to-date metal price information for centralized sourcing and individual purchases, to allowing designers and technicians to retrieve up-to-date product data sheets.

Welcome to visit our website

EN www.kmdgroup.com\en

CN www.kmdgroup.com



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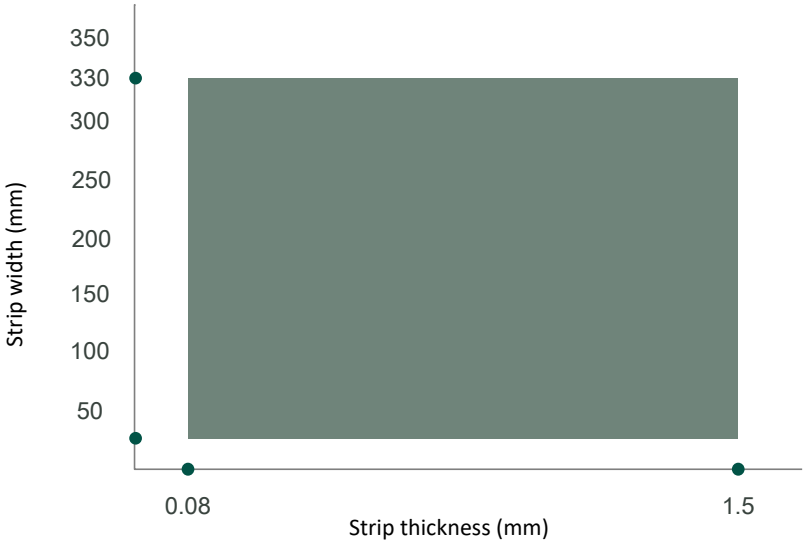
2.1. 1 Manufacturing Programme



Other thicknesses and widths upon request

Bare strips

Pre-tinned strips
Hot dip tinned
Electrolytic tinned

Special qualities
Narrow tolerances
Stress levelled
Stress annealed

Traverse wound strips
Drum weight（kg）300-1500
Strip width (mm) 20 - 35
Strip thickness (mm) 0.25 - 0.60
Wooden, plastic and metal drums
Flange less

Multilayer
Strip thickness（mm）0.15-0.80
Strip width（mm）15-50
Max. pallet weight（kg）2500*
* Higher pallet weight on request

Width Tolenrance Standard				
Strip Thickness (mm)	Strip Width (mm)			
	12-50	51-100	101-200	201-330
0.08 - 1.00	+ 0.20	+ 0.30	+ 0.40	+ 0.60
1.01 - 1.50	+ 0.30	+ 0.40	+ 0.50	+ 1.00

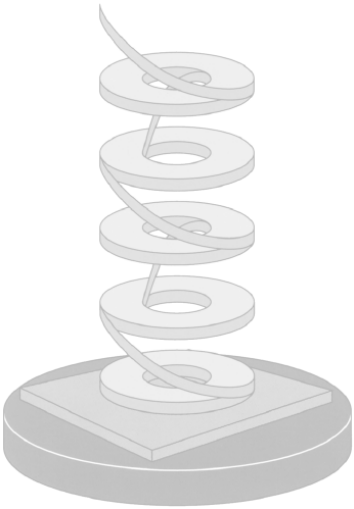
Width Tolenrance Precision				
Strip Thickness (mm)	Strip Width (mm)			
	12-50	51-100	101-200	201-330
0.08 - 1.00	+ 0.10	+ 0.20	+ 0.30	+ 0.40
1.01 - 1.50	+ 0.20	+ 0.20	+ 0.40	+ 0.60

Strip Thickness (mm)	Thickness Tolerance	
	Standard	Precision
0.08 - 0.20	± 0.005	± 0.004
0.21 - 0.30	± 0.007	± 0.005
0.31 - 0.40	± 0.015	± 0.006
0.41 - 0.50	± 0.015	± 0.008
0.51 - 0.60	± 0.017	± 0.010
0.61 - 0.70	± 0.020	± 0.010
0.71 - 0.85	± 0.022	± 0.012
0.86 - 1.20	± 0.025	± 0.015
1.21 - 1.50	± 0.030	± 0.020

2.2.1 Multilayer

The economical coil of Copper, Bronze and High Performance Alloys. Multilayer is a system where several large pancake coils are joined together by resistance welding and supplied palletised for use on pallet de-coilers.

The coil ends are joined by welding the outer to outer and inner to inner ends, forming one continous strip. The multilayer is then unreeled in the opposite direction during processing.



Multilayer

Standard width (mm):	15-50
Standard thickness (mm):	0.15-0.80

Delivery format:

■ Height of pallet:	max. 490 mm
■ Circular pallet ø:	max. 1,600 mm
■ Minimum order quantity:	min. 1,000 kg
■ Pallet weight:	max. 2,500 kg *
■ Outer diameter ø:	max. 1,500 mm

Inner diameter ø 300 mm for thickness:	0.15 - 0.40 mm
Inner diameter ø 400 mm for thickness:	0.15 - 0.80 mm

* Higher pallet weights on request

Your advantage:

Increased efficiency = increase of the productivity = cost savings
when processing KMD alloys.

The use of multilayer optimises production, reduces coil changes and labour costs and keeps scrap to the minimum.

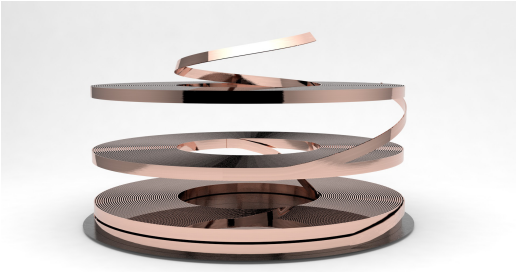
Potential savings using multilayer
Example for strip dimension:
0. 25 x 25 mm = 12 Single coils

Strip material
■ up to 44 m strip

Tooling time
■ up to 165 minutes longer machine running capacity, through multilayer in comparison to 12 single coils, without stamping starts of single coils
= productivity increase of approx. 13 %.

Tool capacity
■ up to 25 % less tooling breaks caused by starting single coils.

De-coiler system of KMD own machinery manufacture
■ customer designed conception
■ reduction of investment spending by customer-orientated accounting system



3.1 Overview of Standard Alloy

Page	ASTM	DIN-EN	CEN	Application
3.4	C11000	Cu-ETP	CW 004 A	Basic material for electrical parts.
3.5	C26000	CuZn30	CW 505 L	Basic material for electrical components, installation parts in the electrical industry. Zinc content proportionally reduces metall costs.
3.6	C26800	CuZn33	CW 506 L	
3.7	C27000	CuZn36	CW 507 L	
3.8	C27200	CuZn37	CW 508 L	
3.9	C51100	CuSn4	CW 450 K	Contact springs; connectors; membranes; switch elements; fixed contacts. Ultra-high strength spring elements.
3.10	C51000	CuSn5	CW 451 K	
3.11	C51910	CuSn6	CW 452 K	
3.12	C52100	CuSn8	CW 453 K	
3.13	C42500	CuSn3Zn9 - CuSn2Zn10	CW454K	Good compromise between alloy properties, lower metal cost and better scrap value assessment conditions.

The KMD alloys are RoHS conform.

3. 2 Chemical Composition

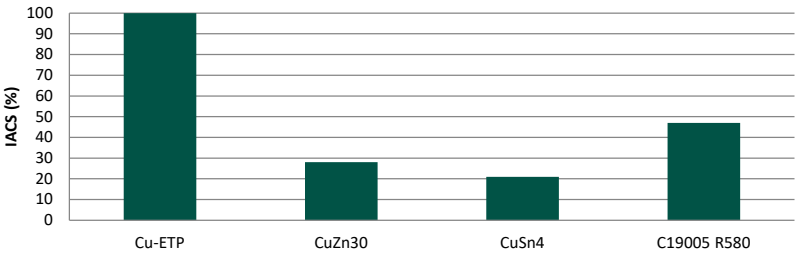
Page	Alloy	Cu (%)	O (%)	P (%)	Zn (%)	Ni (%)	Sn (%)	Fe (%)	Mn (%)	Si (%)	Mg (%)	Zr (%)	Other (%)
3.4	Cu-ETP-C11000	99.9	⩽ 0.040										
3.5	CuZn30-C26000	69-71			Rest	max. 0.3	max. 0.1	max. 0.05					
3.6	CuZn33-C26800	66-68			Rest	max. 0.3	max. 0.1	max. 0.05					
3.7	CuZn36-C27000	63.5-65.5			Rest	max. 0.3	max. 0.1	max. 0.05					
3.8	CuZn37-C27200	62-64			Rest	max. 0.3	max. 0.1	max. 0.10					
3.9	CuSn4-C51100	Rest		0.01-0.4			3.5-4.5						
3.10	CuSn5-C51000	Rest		0.01-0.4			4.5-5.5						
3.11	CuSn6-C51900	Rest		0.01-0.4			5.5-7.0						
3.12	CuSn8-C52100	Rest		0.01-0.4			7.5-8.5						
3.13	CuSn3Zn9/ CuSn2Zn10 - C42500	87-90			Rest		1.5-3.0						

3.3 Physical Properties

Page	Alloy	Density*	Therm. expansion coefficient **	Thermal conductivity *	Electr. Conductivity ***	Electr. Conductivity ***	Modulus of elasticity*
		g/cm³	10^{-6} K	W/(m·K)	MS/m	IACS(%)	GPa
3.4	Cu-ETP-C11000	8.9	17.7	394	58	100	127
3.5	CuZn30-C26000	8.5	19.7	126	14	24	115
3.6	CuZn33-C26800	8.5	19.9	121	14	24	112
3.7	CuZn36-C27000	8.45	20.2	121	14	24	110
3.8	CuZn37-C27200	8.45	20.2	121	14	24	110
3.9	CuSn4-C51100	8.85	17.8	100	11	19	120
3.10	CuSn5-C51000	8.85	17.8	96	9	15	120
3.11	CuSn6-C51900	8.8	18.5	75	7.5	13	118
3.12	CuSn8-C52100	8.8	18.5	67	6.5	11	115
3.13	CuSn3Zn9/ CuSn2Zn10 - C42500	8.75	18.4	120	14	24	126

* Reference values at room temperature ** Between 20 and 300 °C
*** Values for the lowest temper class

Application Range		
Basic material for electrical parts.		
Physical Properties		
Density *	g/cm³	8.9
Thermal conductivity *	W/(m·k)	394
Electr. conductivity ***	MS/m	58/57
Electr. conductivity ***	IACS (%)	100/98.3
Thermal expansion c. **	10^{-6} K	17.7
Modulus of elasticity *	GPa	127



Chemical Position （reference value） %	
Cu	99.9
O	≤ 0.040

Condition	Temper class	Tensile strength T.S. min. - max. MPa	Yield strength $Rp_{0.2}$ min. MPa ( ) only information	Elongation A50 min. %	Hardness （reference value） HV	Electr. conductivity MS/m	Bendability R/t 1) 2) 90° GW Strip thickness ≤0.5mm	Bendability R/t 1) 2) 90° BW Strip thickness ≤0.5mm
Cold rolled	R220	220 - 260	(max. 140)	33	40 - 65	58	0	0
Cold rolled	R240	240 - 330	180	10	65 - 95	57	0	0
Cold rolled	R290	290 - 360	250	4	90 - 110	57	0	0.5
Cold rolled	R360	min. 360	320	2	min. 110	57	1	2

*Reference values at room temperature

**Between 20 and 300 °C

*** Values for the lowest temper class

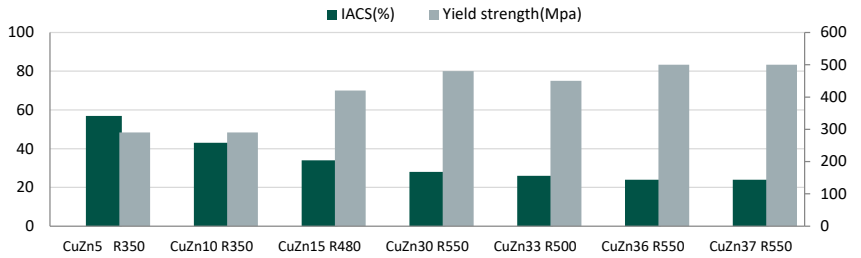
1) r = x · t (strips up to t = 0.50 mm)

2) Sample width = 10 mm / bending at smaller bending widths on request (Evaluation according to page 5.4.2. of Hand-Out)

3.5 CuZn30 - C26000 - CW505L

Application Range
Basic material for electrical components, installation parts in the electrical industry. Zinc content proportionally reduces metall costs.

Physical Properties		
Density *	g/cm³	8.5
Thermal conductivity *	W/(m·k)	126
Electr. conductivity ***	MS/m	14
Electr. conductivity ***	IACS (%)	24
Thermal expansion c. **	10^{-6} K	19.7
Modulus of elasticity *	GPa	115



Chemical Position （reference value） %					
Cu	69 - 71	Ni	max. 0.3	Fe	max. 0.05
Zn	Rest	Sn	max. 0.1		

Condition	Temper class	Tensile strength T.S. min. - max. MPa	Yield strength $Rp_{0.2}$ min. MPa ( ) only information	Elongation A50 min. %	Hardness （reference value） HV	Electr. conductivity MS/m	Bendability R/t [1) 2) 3)] 90° GW Strip thickness ≤0.5mm	Bendability R/t [1) 2) 3)] 90° BW Strip thickness ≤0.5mm
Cold rolled	R270	270 - 350	(max. 160)	40	55 - 105	14	0	0
Cold rolled	R350	350 - 430	(170)	21	95 - 145	14	0	0
Cold rolled	R410	410 - 490	(350)	9	120 - 160	14	0	1
Cold rolled	R480	480 - 570	(430)	4	150 - 190	14	0.5	2
Cold rolled	R550	550 - 640	(480)	2	170 - 210	14	1	3
Cold rolled	R630	min. 630	(560)	-	min. 190	14	-	-

*Reference values at room temperature

**Between 20 and 300 °C

*** Values for the lowest temper class

1) r = x · t (strips up to t = 0.50 mm)

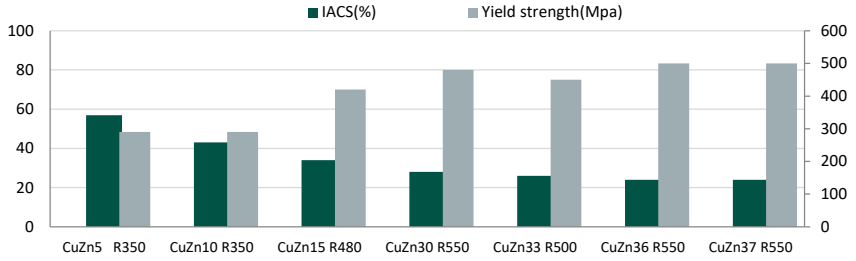
2) Sample width = 10 mm / bending at smaller bending widths on request (Evaluation according to page 5.4.2. of Hand-Out)

3) valid only as thermal stress relieved qualities

Application Range
Basic material for electrical components, installation parts in the electrical industry. Zinc content proportionally reduces metall costs.

Physical Properties		
Density *	g/cm³	8.5
Thermal conductivity *	W/(m·k)	121
Electr. conductivity ***	MS/m	14
Electr. conductivity ***	IACS (%)	24
Thermal expansion c. **	10^{-6} K	19.9
Modulus of elasticity *	GPa	112

Comparison of yield strength and electrical conductivity (IACS%) of selected brass alloys



Chemical Position （reference value） %					
Cu	66 - 68	Ni	max. 0.3	Fe	max. 0.05
Zn	Rest	Sn	max. 0.1		

Condition	Temper class	Tensile strength T.S. min. - max. MPa	Yield strength $Rp_{0.2}$ min. MPa ( ) only information	Elongation A50 min. %	Hardness （reference value） HV	Electr. conductivity MS/m	Bendability R/t 1) 2) 3) 90° GW Strip thickness ≤0.5mm	Bendability R/t 1) 2) 3) 90° BW Strip thickness ≤0.5mm
Cold rolled	R280	280 - 380	(max. 170)	40	55 - 95	14	0	0
Cold rolled	R350	350 - 430	(170)	23	95 - 125	14	0	0
Cold rolled	R420	420 - 500	(300)	6	125 - 155	14	0	0
Cold rolled	R500	min. 500	(450)	3	min. 155	14	0.5	0.5

*Reference values at room temperature

**Between 20 and 300 °C

*** Values for the lowest temper class

1) r = x · t (strips up to t = 0.50 mm)

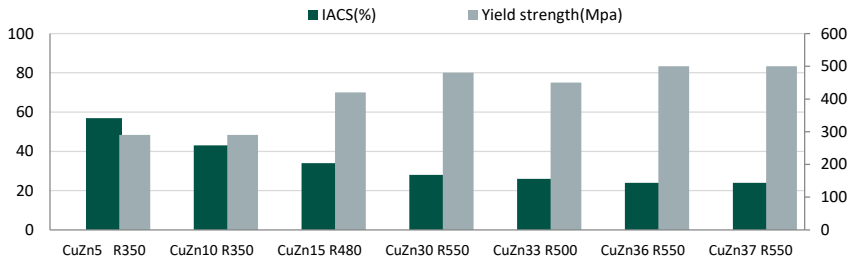
2) Sample width = 10 mm / bending at smaller bending widths on request (Evaluation according to page 5.4.2. of Hand-Out)

3) valid only as thermal stress relieved qualities

3.7 CuZn36 - C27000 - CW507L

Application Range
Basic material for electrical components, installation parts in the electrical industry. Zinc content proportionally reduces metall costs.

Physical Properties		
Density *	g/cm³	8.45
Thermal conductivity *	W/(m·k)	121
Electr. conductivity ***	MS/m	14
Electr. conductivity ***	IACS (%)	24
Thermal expansion c. **	10^{-6} K	20.2
Modulus of elasticity *	GPa	110



Chemical Position （reference value） %					
Cu	63.5 - 65.5	Ni	max. 0.3	Fe	max. 0.05
Zn	Rest	Sn	max. 0.1		

Condition	Temper class	Tensile strength T.S. min. - max. MPa	Yield strength $Rp_{0.2}$ min. MPa ( ) only information	Elongation A50 min. %	Hardness （reference value） HV	Electr. conductivity MS/m	Bendability R/t 1) 2) 3) 90° GW Strip thickness ≤0.5mm	Bendability R/t 1) 2) 3) 90° BW Strip thickness ≤0.5mm
Cold rolled	R300	300 - 370	(max. 180)	38	55 - 105	14	0	0
Cold rolled	R350	350 - 430	(170)	19	95 - 125	14	0	0
Cold rolled	R410	410 - 490	(300)	8	120 - 155	14	0	0
Cold rolled	R480	480 - 560	(430)	3	150 - 180	14	0.5	2
Cold rolled	R550	min. 550	(500)	-	min. 170	14	1	3
Cold rolled	R630	min. 630	(600)	-	min. 190	14	-	-

*Reference values at room temperature

**Between 20 and 300 °C

*** Values for the lowest temper class

1) r = x · t (strips up to t = 0.50 mm)

2) Sample width = 10 mm / bending at smaller bending widths on request (Evaluation according to page 5.4.2. of Hand-Out)

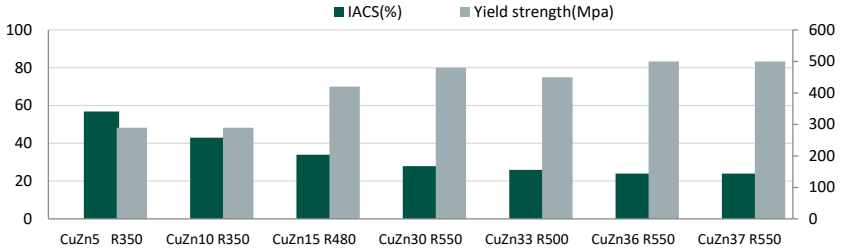
3) valid only as thermal stress relieved qualities

3.8 CuZn37 - C27200 - CW508L

Application Range
Basic material for electrical components, installation parts in the electrical industry. Zinc content proportionally reduces metall costs.

Physical Properties		
Density *	g/cm³	8.45
Thermal conductivity *	W/(m·k)	121
Electr. conductivity ***	MS/m	14
Electr. conductivity ***	IACS (%)	24
Thermal expansion c. **	10^{-6} K	20.2
Modulus of elasticity *	GPa	110

Comparison of yield strength and electrical conductivity (IACS%) of selected brass alloys



Chemical Position （reference value） %								
Cu	62 - 64	Ni	max. 0.3	Fe	max. 0.10			
Zn	Rest	Sn	max. 0.1					

Condition	Temper class	Tensile strength T.S. min. - max. MPa	Yield strength $Rp_{0.2}$ min. MPa ( ) only information	Elongation A50 min. %	Hardness （reference value） HV	Electr. conductivity MS/m	Bendability R/t 1) 2) 3) 90° GW thickness ≤0.5mm	Bendability R/t 1) 2) 3) 90° BW thickness ≤0.5mm
Cold rolled	R300	300 - 370	(max. 180)	38	55 - 105	14	0	0
Cold rolled	R350	350 - 430	(170)	19	95 - 125	14	0	0
Cold rolled	R410	410 - 490	(300)	8	120 - 155	14	0	0
Cold rolled	R480	480 - 560	(430)	3	150 - 180	14	0.5	2
Cold rolled	R550	min. 550	(500)	-	min. 170	14	1	3
Cold rolled	R630	min. 630	(600)	-	min. 190	14	-	-

*Reference values at room temperature

**Between 20 and 300 °C

*** Values for the lowest temper class

1) r = x · t (strips up to t = 0.50 mm)

2) Sample width = 10 mm / bending at smaller bending widths on request (Evaluation according to page 5.4.2. of Hand-Out)

3) valid only as thermal stress relieved qualities

3.9 CuSn4 - C51100 - CW450K

Application Range		
Contact springs; connectors; membranes; switch elements; fixed contacts. Ultra-high strength spring elements.		
Physical Properties		
Density *	g/cm³	8.85
Thermal conductivity *	W/(m·k)	100
Electr. conductivity ***	MS/m	11
Electr. conductivity ***	IACS (%)	19
Thermal expansion c. **	10^{-6} K	17.8
Modulus of elasticity *	GPa	120

Chemical Position （reference value） %

Cu	Rest	P	0.01 - 0.4
Sn	3.5 - 4.5		

Condition	Temper class	Tensile strength T.S. min. - max. MPa	Yield strength Rp 0.2 min. MPa 3）	4）	Elongation A50 min. % 3）	4）	Hardness （reference value） HV	Electr. conductivity MS/m	Bendability 90° 1) 2) 3) Strip thickness≤0.5mm R/t GW Stretch leveled	GW Thermal stress relieved	BW Stretch leveled	BW Thermal stress relieved
Cold rolled	R290	290 - 390	max. 190		40		70 - 105	11	0	0	0	0
Cold rolled	R390	390 - 490	320	250	17	20	115 - 155	11	0	0	0	0
Cold rolled	R480	480 - 570	440	400	8	13	150 - 180	11	0	0	0	0
Cold rolled	R540	540 - 630	480	450	6	12	160 - 200	11	0	0	0.5	0
Cold rolled	R600	600 - 660	560	530	5	12	min. 180	11	0	0	1	0
Cold rolled	R660	660 - 720	620	590		7	min. 180	11	-	-	-	-
Cold rolled	R700	700 - 800		640		3	min. 180	11	-	-	-	-

*Reference values at room temperature **Between 20 and 300 °C *** Values for the lowest temper class

1） r = x · t (strips up to t = 0.50 mm)

2） Sample width = 10 mm / bending at smaller bending widths on request (Evaluation according to page 5.4.2. of Hand-Out)

3） valid only as thermal stress relieved qualities

4) Thermal stress relieved

Application Range		
Contact springs; connectors; membranes; switch elements; fixed contacts. Ultra-high strength spring elements.		
Physical Properties		
Density *	g/cm³	8.85
Thermal conductivity *	W/(m·k)	96
Electr. conductivity ***	MS/m	9
Electr. conductivity ***	IACS (%)	15
Thermal expansion c. **	10^{-6} K	17.8
Modulus of elasticity *	GPa	120

Chemical Position （reference value） %

Cu	Rest	P	0.01 - 0.4
Sn	4.5 - 5.5		

Condition	Temper class	Tensile strength T.S. min. - max. MPa	Yield strength Rp 0.2 min. MPa		Elongation A50 min. %		Hardness （reference value） HV	Electr. conductivity MS/m	Bendability 90°1) 2) 3) Strip thickness≤0.5mm R/t GW Stretch leveled	GW Thermal stress relieved	BW Stretch leveled	BW Thermal stress relieved
			3）	4）	3）	4）						
Cold rolled	R310	310 - 390	max. 250		45		70 - 105	9	0	0	-	-
Cold rolled	R400	400 - 500	340	-	17	-	120 - 160	9	0	0	-	-
Cold rolled	R490	490 - 580	450	440	12	19	160 - 190	9	0	0	0	0
Cold rolled	R550	550 - 640	500	480	5	13	180 - 210	9	0	0	1	0.5
Cold rolled	R630	630 - 720	570	560	3	7	200 - 230	9	1	0	2	1
Cold rolled	R690	min. 690	630	600	2	4	min. 220	9	2.5	2	3.5	3

*Reference values at room temperature　　**Between 20 and 300 °C　　*** Values for the lowest temper class

1） r = x · t (strips up to t = 0.50 mm)

2） Sample width = 10 mm / bending at smaller bending widths on request (Evaluation according to page 5.4.2. of Hand-Out)

3） valid only as thermal stress relieved qualities

4) Thermal stress relieved

3.11 CuSn6 - C51900 - CW452K

Application Range		
Contact springs; connectors; membranes; switch elements; fixed contacts. Ultra-high strength spring elements.		
Physical Properties		
Density *	g/cm³	8.8
Thermal conductivity *	W/(m·k)	75
Electr. conductivity ***	MS/m	7.5
Electr. conductivity ***	IACS (%)	13
Thermal expansion c. **	10^{-6} K	18.5
Modulus of elasticity *	GPa	118

Chemical Position （reference value） %

Cu	Rest	P	0.01 - 0.4
Sn	5.5 - 7.0		

Condition	Temper class	Tensile strength T.S. min. - max. MPa	Yield strength $Rp_{0.2}$ min. MPa		Elongation A50 min. %		Hardness （reference value） HV	Electr. conductivity MS/m	Bendability 90°[1) 2) 3)] Strip thickness≤0.5mm R/t GW Stretch leveled	GW Thermal stress relieved	BW Stretch leveled	BW Thermal stress relieved
			3）	4）	3）	4）						
Cold rolled	R350	350 - 420	max. 300		45		80 - 120	7.5	0	0	0	0
Cold rolled	R420	420 - 520	350	340	22	29	120 - 170	7.5	0	0	0	0
Cold rolled	R500	500 - 590	450	410	15	22	160 - 190	7.5	0	0	0	0
Cold rolled	R560	560 - 650	520	490	10	15	180 - 210	7.5	0	0	0	0
Cold rolled	R640	640 - 730	590	570	5	12	200 - 230	7.5	0	0	1	0.5
Cold rolled	R720	min. 720	650	620	-	4	min. 210	7.5	-	1	-	-

*Reference values at room temperature

**Between 20 and 300 °C

*** Values for the lowest temper class

1） r = x · t (strips up to t = 0.50 mm)

2） Sample width = 10 mm / bending at smaller bending widths on request (Evaluation according to page 5.4.2. of Hand-Out)

3） valid only as thermal stress relieved qualities

4) Thermal stress relieved

Application Range		
Contact springs; connectors; membranes; switch elements; fixed contacts. Ultra-high strength spring elements.		
Physical Properties		
Density *	g/cm³	8.8
Thermal conductivity *	W/(m·k)	67
Electr. conductivity ***	MS/m	6.5
Electr. conductivity ***	IACS (%)	11
Thermal expansion c. **	10^{-6} K	18.5
Modulus of elasticity *	GPa	115

Chemical Position （reference value） %			
Cu	Rest	P	0.01 - 0.4
Sn	7.5 - 8.5		

Condition	Temper class	Tensile strength T.S. min. - max. MPa	Yield strength $Rp_{0.2}$ min. MPa		Elongation A50 min. %		Hardness （reference value） HV	Electr. conductivity MS/m	Bendability 90° 1) 2) 3) Strip thickness≤0.5mm R/t			
			3）	4）	3）	4）			GW		BW	
									Stretch leveled	Thermal stress relieved	Stretch leveled	Thermal stress relieved
Cold rolled	R370	370 - 450	max. 300		50		80 - 120	6.5	0	0	0	0
Cold rolled	R450	450 - 550	370	350	28	35	120 - 175	6.5	0	0	0	0
Cold rolled	R540	540 - 630	460	440	22	27	170 - 200	6.5	0	0	0	0
Cold rolled	R600	600 - 690	520	480	16	20	180 - 220	6.5	0	0	1	0
Cold rolled	R660	660 - 750	600	580	10	14	210 - 240	6.5	0	0	3	2
Cold rolled	R740	740 - 810	680	660	5	8	220 - 260	6.5	-	2	-	3
Cold rolled	R800 5)	800 - 930	720	700	-	4	230 - 290	6.5	-	-	-	-
Cold rolled	R850 5)	min. 850	-	800	-	1.5	min. 240	6.5	-	-	-	-

On request in fine grain size version

*Reference values at room temperature **Between 20 and 300 °C *** Values for the lowest temper class

1） r = x · t (strips up to t = 0.50 mm)

2） Sample width = 10 mm / bending at smaller bending widths on request (Evaluation according to page 5.4.2. of Hand-Out)

3） valid only as thermal stress relieved qualities

4) Thermal stress relieved

5) Thickness range: 0,15 - 0,60 mm

3.13 CuSn3Zn9 / CuSn2Zn10 - C42500 - CW454K

Application Range
Good compromise between alloy properties, lower metall cost and better scrap value assessment conditions.

Physical Properties		
Density *	g/cm³	8.75
Thermal conductivity *	W/(m·k)	120
Electr. conductivity ***	MS/m	14
Electr. conductivity ***	IACS (%)	24
Thermal expansion c. **	10^{-6} K	18.4
Modulus of elasticity *	GPa	126

Chemical Position （reference value） %			
CuSn3Zn9 - CW 454K		CuSn3Zn10 - C42500	
Cu	Rest	Cu	87 -90
Sn	1.5 - 3.5	Sn	1.5 - 3.0
Zn	7.5 - 10	Zn	Rest

Condition	**Temper class**	**Tensile strength** T.S. min. - max. MPa	**Yield strength** $Rp_{0.2}$ min. MPa ( ) only information	**Elongation** A50 min. %		**Hardness** （reference value） HV	**Electr. conductivity** MS/m	**Bendability** R/t [1) 2) 3)] 90° GW Strip thickness ≤0.5mm	**Bendability** R/t [1) 2) 3)] 90° BW Strip thickness ≤0.5mm	**Bendability** R/t [1) 2) 3)] 180° GW Strip thickness ≤0.5mm	**Bendability** R/t [1) 2) 3)] 180° BW Strip thickness ≤0.5mm
Cold rolled	R320	320 - 380	max. 230	25		80 - 100	14	0	0	0	0
Cold rolled	R380	380 - 430	(200)	16	20 [3)]	110 - 140	14	0	0	0.5	1
Cold rolled	R430	430 - 520	(330)	6	10 [3)]	140 - 170	14	0	0	1	1.5
Cold rolled	R510	510 - 600	(430)	3	8 [3)]	160 - 190	14	0	1	2	2.5
Cold rolled	R580	580 - 690	(520)	-	-	180 - 220	14	1	2	2.5	4
Cold rolled	R660	min. 660	(610)	-	-	min. 200	14	-	-	-	-

*Reference values at room temperature

**Between 20 and 300 °C

*** Values for the lowest temper class

1) r = x · t (strips up to t = 0.50 mm)

2) Sample width = 10 mm / bending at smaller bending widths on request (Evaluation according to page 5.4.2. of Hand-Out)

3) valid only as thermal stress relieved qualities

Page	ASTM	DIN EN	CEN	Application
4.6	C19010	CuNiSi		Hardenable Cu-Ni-Si alloy preferred in automotive, electrical and electronic industries. The alloy is especially suitable for components with middle level strength requirements (up to 620 MPa) in combination with good electrical conductivity and resistance to relaxation.
4.7	C19005 (C19002) ****	CuNiSi		Modified C19005 (Cu-Ni-Si) alloy, as a tinned version, which has reduced peeling-off effects depending on the conditions of use
4.8	C70250	CuNi3Si		Connectors, bent parts, relays
4.90	C70310	CuNiSi		Hardenable, higher alloyed Cu-Ni-Si alloys for high strength requirements up to 800 MPa in combination with good electrical conductivity, bendability and for the Cu-Ni-Si alloys typical good relaxation resistance. Partly suitable as substitution for beryllium alloys. Good resistance against stress corrosion cracking.
4.10	C14410	CuSn	CW 117C ****	Current carrying springs, blade contacts, relay boxes, busbars; very good scrap conditions of tinned scrap, advantageous price.
4.11	C14415	CuSn	CW117C	Current carrying springs, blade contacts, relay boxes, busbars; very good scrap conditions of tinned scrap, advantageous price. International version of C14410
4.12	C18665	CuMg		Connectors for automotive, electric and electronic applications, relais, current carrying springs, busbars and relay boxes with spring properties; combined high electrical conductivity at highest strength and relaxation resistance; excellent bending at middle strength.
4.13	C19400	CuFe2P	CW 107C	Hardenable Cu-Fe alloy with good electrical conductivity for components with low and medium strength requirements. "Senior" (oldest) special alloy. Good resistance against relaxation. Classical material for terminals, lead-frames and power transistors.

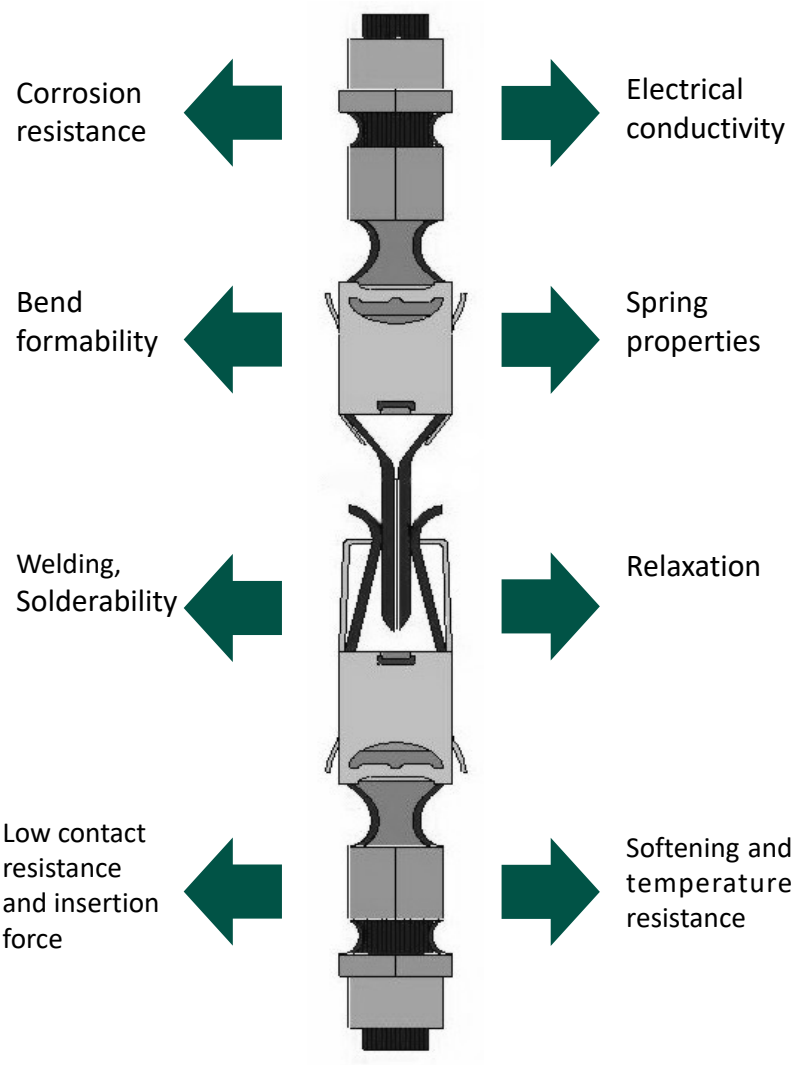
**** Deviation in the chemical composition

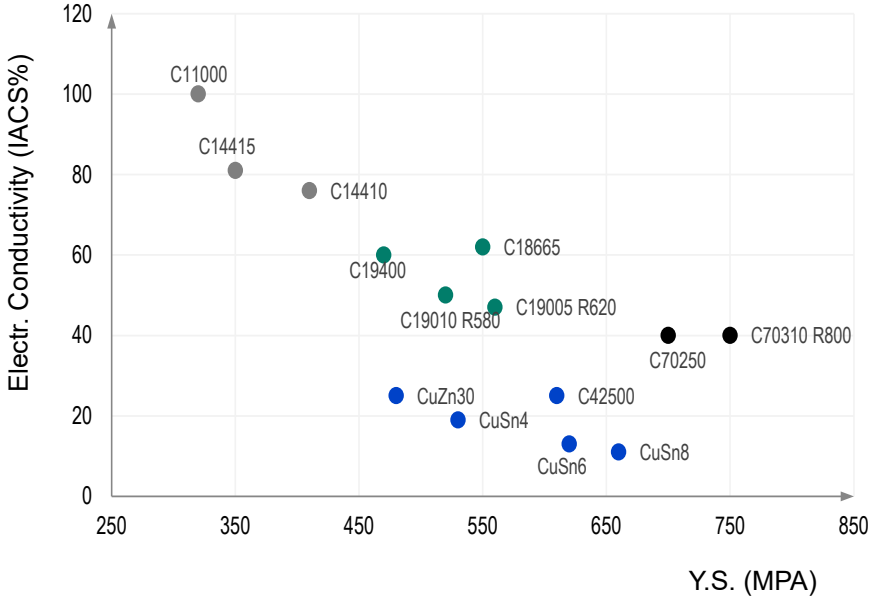
4.2 Chemical Composition

Page	Alloy	Cu (%)	Cr (%)	Fe (%)	Mg (%)	Ni (%)	Ag (%)	Sn (%)	Si (%)	Zn (%)	Zr (%)	Ti (%)	Other (%)
4.6	C19010	Rest				0.8-1.8			0.15-0.35				max. 0.8
4.7	C19005	Rest				1.4-1.7		0.02-0.3	0.2-0.35	0.20-0.70			max. 0.5
4.8	C70250	min. 96.2			0.05-0.30	2.2-4.2			0.25-1.2				Rest
4.9	C70310	Rest				1.0-4.0		max. 1.00	0.08-1.00	max. 2.00			max. 0.5
4.10	C14410	min.99.90 incl. Ag+Sn						0.10-0.20					max. 0.1
4.11	C14415	min.99.6 incl. Ag+Sn						0.10-0.15					max. 0.1
4.12	C18665	min. 99.0			0.4-0.9								
4.13	C19400	Rest		2.1-2.6						0.05-0.20			max. 0.2

Page	Alloy	Density*	Therm. expansion coefficient **	Thermal conductivity *	Electr. Conductivity ***	Electr. Conductivity ***	Modulus of elasticity *
		g/cm³	10^{-6} K	W/(m·K)	MS/m	IACS (%)	GPa
4.6	C19010	8.9	16.8	260	35 / 29	60 / 50	135
4.7	C19005	8.9	16.8	260	33 / 27	57 / 47	135
4.8	C70250	8.8	17.6	190	23	40	130
4.9	C70310	8.85	17	185	25 / 23	43 / 40	132
4.10	C14410	8.9	17.3	330	44	76	120
4.11	C14415	8.9	18	350	47	81	120
4.12	C18665	8.8	17.3	270	34	58	130
4.13	C19400	8.9	16.3	260	35	60	125

* Reference values at room temperature ** Between 20 and 300 °C
*** Values for the lowest temper class





Segment A
Basic applications
= Low conductivity,
medium to exceptional strength

Segment B
Electronics applications
= Medium conductivity,
medium to high strength

Segment C
Automotive applications
= Medium conductivity,
medium to high strength

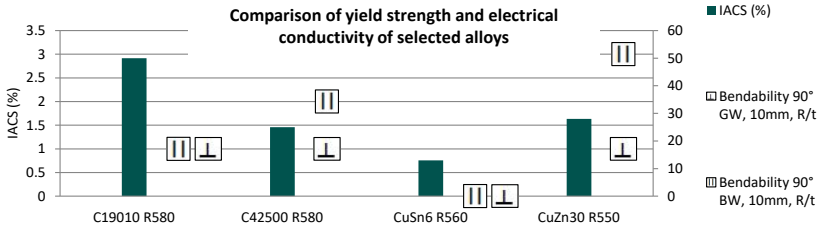
Segment D
Electric vehicles and high-voltage applications
= Low to medium strength, high conductivity

4.6 C19010

Application Range
Hardenable Cu-Ni-Si alloy preferred in automotive, electrical and electronic industries. The alloy is especially suitable for components with middle level strength requirements (up to 620 MPa) in combination with good electrical conductivity and resistance to relaxation.

Physical Properties		
Density *	g/cm³	8.9
Thermal conductivity *	W/(m·k)	260
Electr. conductivity ***	MS/m	35/29
Electr. conductivity ***	IACS (%)	60/50
Thermal expansion c. **	10^{-6} K	16.8
Modulus of elasticity *	GPa	135

R/t: Bending 90° @ 10 mm bending width



Chemical Position （reference value） %			
Cu	Rest	Other	max. 0.8
Ni	0.8 - 1.8		
Si	0.15 - 0.35		

Condition	Temper class	Tensile strength T.S. min. - max. MPa	Yield strength Rp 0.2 min. MPa	Elongation A50 min. %		Hardness （reference value） HV	Electr. conductivity MS/m	Bendability R/t 1) 2) 90° GW Strip thickness ≤0.5mm	Bendability R/t 1) 2) 90° BW Strip thickness ≤0.5mm	Bendability R/t 1) 2) 180° GW Strip thickness ≤0.5mm	Bendability R/t 1) 2) 180° BW Strip thickness ≤0.5mm
Cold rolled	R360	360 - 430	300	12	14 3)	100 - 130	35	0	0	0	0
	R410	410 - 470	360	9	11 3)	125 - 155	35	0	0	0.5	1
	R460	460 - 520	410	7	9 3)	135 - 165	35	0.5	1	1.5	3
	R520	520 - 580	460	5	7 3)	145 - 175	35	1	2	2.5	4
	R580	580 - 650	520	9		160 - 210	29	1	1	3	5

*Reference values at room temperature

**Between 20 and 300 °C

*** Values for the lowest temper class

1) r = x · t (strips up to t = 0.50 mm)

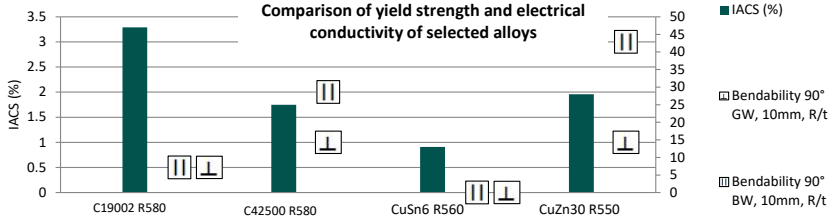
2) Sample width = 10 mm / bending at smaller bending widths on request (Evaluation according to page 5.4.2. of Hand-Out)

3) valid only as thermal stress relieved qualities

Application Range
Modified Cu-Ni-Si alloy, which in tinned version does not exhibit peeling-off of the coating during long-time temperature exposure of up to 130°C. The further material characteristics are mostly identical to those of C19010 with the exception of electrical conductivity, which is slightly lower.

Physical Properties		
Density *	g/cm³	8.9
Thermal conductivity *	W/(m·k)	260
Electr. conductivity ***	MS/m	33/27
Electr. conductivity ***	IACS (%)	57/47
Thermal expansion c. **	10^{-6} K	16.8
Modulus of elasticity *	GPa	135

R/t: Bending 90° @ 10 mm bending width



Chemical Position （reference value） %			
Cu	Rest	Sn	0.02 - 0.3
Ni	1.40 - 1.70	Zn	0.20 - 0.70
Si	0.2 - 0.35	Other	max. 0.5

Condition	Temper class	Tensile strength T.S. min. - max. MPa	Yield strength $Rp_{0.2}$ min. MPa	Elongation A50 min. %		Hardness （reference value） HV	Electr. conductivity MS/m	Bendability R/t 1) 2) 90° GW Strip thickness ≤0.5mm	Bendability R/t 1) 2) 90° BW Strip thickness ≤0.5mm	Bendability R/t 1) 2) 180° GW Strip thickness ≤0.5mm	Bendability R/t 1) 2) 180° BW Strip thickness ≤0.5mm
Cold rolled	R360	360 - 430	300	12	14 3)	100 - 130	33	0	0	0	0.5
	R410	410 - 470	360	9	11 3)	125 - 155	33	0	0.5	0.5	1
	R460	460 - 520	410	7	9 3)	135 - 165	33	0.5	1	1.5	3
	R520	520 - 580	460	5	7 3)	145 - 175	33	1	2	2.5	4
Precipitation hardened	R530 4)	530 - 630	430	14		150 -190	27	0	0	1	2
	R580	580 - 660	540	8		170 - 210	27	1	1	3	5
	R580 S	580 - 660	520	9		170 - 210	27	1	1	2	3
	R620 5)	620 - 700	560	7		180 - 210	27	1	1.5	3	5

*Reference values at room temperature

**Between 20 and 300 °C

*** Values for the lowest temper class

1) r = x · t (strips up to t = 0.50 mm)

2) Sample width = 10 mm / bending at smaller bending widths on request (Evaluation according to page 5.4.2. of Hand-Out)

3) valid only as thermal stress relieved qualities

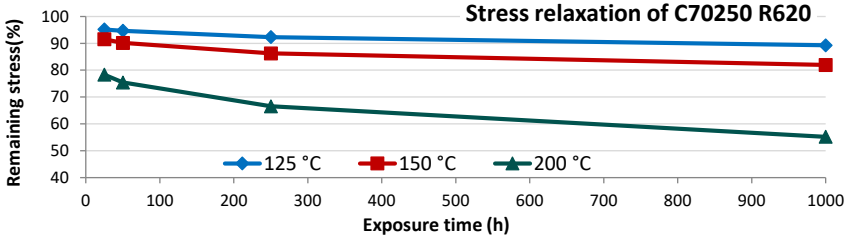
4) Thickness on request

5) Thickness range: 0,15 - 0,60 mm

**** Deviation in the chemical composition

4.8 C70250

Application Range		
Connectors, bent parts, relays		
Physical Properties		
Density *	g/cm³	8.8
Thermal conductivity *	W/(m·k)	190
Electr. conductivity ***	MS/m	23
Electr. conductivity ***	IACS (%)	40
Thermal expansion c. **	10^{-6} K	17.6
Modulus of elasticity *	GPa	130



Chemical Position （reference value） %					
Cu	min. 96.2	Si	0.25 - 1.2	Other	Rest
Ni	2.2 - 4.2	Mg	0.05 - 0.30		

Condition	**Temper class**	**Tensile strength** T.S. min. - max. MPa	**Yield strength** $Rp_{0.2}$ min. MPa ( ) only information	**Elongation** A50 min. %	**Hardness** （reference value） HV	**Electr. conductivity** MS/m	**Bendability** R/t 1) 2) 3) 90° GW Strip thickness ≤0.5mm	**Bendability** R/t 1) 2) 3) 90° BW Strip thickness ≤0.5mm
Cold rolled	R620	620 - 760	500	10	180 - 240	23	0	0
Cold rolled	R655	655 - 825	585	7	190 - 250	23	1	1
Cold rolled	R690	690 - 860	655	5	220 - 260	23	1.5	1.5
Cold rolled	R750	750 - 860	700	4	230 - 260	23	2	2

*Reference values at room temperature **Between 20 and 300 °C *** Values for the lowest temper class

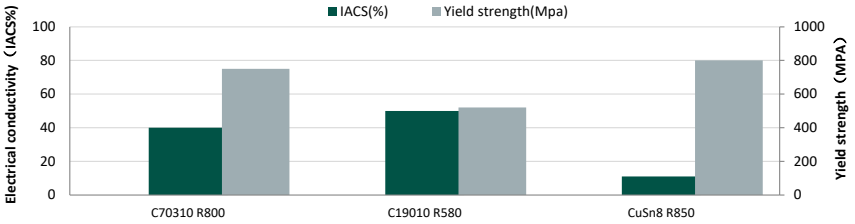
1） r = x · t (strips up to t = 0.50 mm)

2） Sample width = 10 mm / bending at smaller bending widths on request (Evaluation according to page 5.4.2. of Hand-Out)

Application Range
Hardenable, higher alloyed Cu-Ni-Si alloys for high strength requirements up to 800 MPa in combination with good electrical conductivity, bendability and for the Cu-Ni-Si alloys typical good relaxation resistance. Partly suitable as substitution for beryllium alloys. Good resistance against stress corrosion cracking.

Physical Properties		
Density *	g/cm³	8.85
Thermal conductivity *	W/(m·k)	185
Electr. conductivity ***	MS/m	25/23
Electr. conductivity ***	IACS (%)	43/40
Thermal expansion c. **	10^{-6} K	17
Modulus of elasticity *	GPa	132

Comparison of yield strength and electrical conductivity (IACS%) of selected alloys



Chemical Position （reference value） %			
Cu	Rest	Sn	max. 1.00
Ni	1.0 - 4.0	Zn	max. 2.00
Si	0.08 - 1.00	Other	max. 0.5

Condition	Temper class	Tensile strength T.S. min. - max. MPa	Yield strength $Rp_{0.2}$ min. MPa	Elongation A50 min. %		Hardness （reference value） HV	Electr. conductivity MS/m	Bendability R/t 1) 2) 90° GW Strip thickness ≤0.5mm	Bendability R/t 1) 2) 90° BW Strip thickness ≤0.5mm	Bendability R/t 1) 2) 180° GW Strip thickness ≤0.5mm	Bendability R/t 1) 2) 180° BW Strip thickness ≤0.5mm
Cold rolled	R360	360 - 430	250	14	16 3)	100 - 130	25	0	0	0	0.5
	R410	410 - 470	360	9	12 3)	125 - 155	25	0	0.5	0.5	1
	R460	460 - 520	410	7	10 3)	135 - 165	25	0.5	1	1.5	3
	R520	520 - 580	460	5	8 3)	145 - 175	25	1	2	2.5	3.5
	R580	580 - 650	520	4	6 3)	170 - 200	25	1	2.5	3	5
Precipitation hardened	R620	620 - 720	540	16		180 - 240	23	0	0	1	1.5
	R660	660 - 750	590	10		200 - 250	23	1	1	1.5	2
	R750	750 - 830	680	8		210 - 260	22	2	2	3	4
	R800	>800	750	5		> 210	22	2	3	4	5

*Reference values at room temperature

**Between 20 and 300 °C

*** Values for the lowest temper class

1) r = x · t (strips up to t = 0.50 mm)

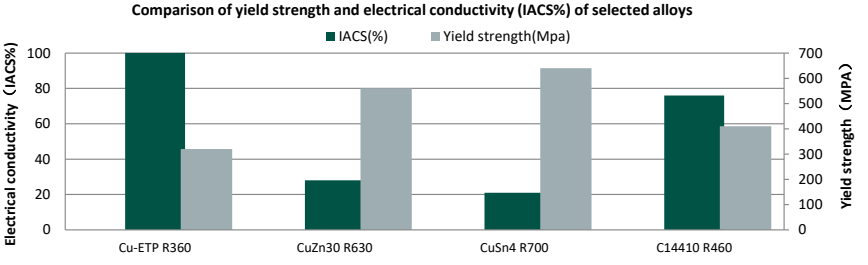
2) Sample width = 10 mm / bending at smaller bending widths on request (Evaluation according to page 5.4.2. of Hand-Out)

3) valid only as thermal stress relieved qualities

4.10 C14410

Application Range
Current carrying springs, blade contacts, relay boxes, busbars; very good scrap conditions of tinned scrap, advantageous price.

Physical Properties		
Density *	g/cm³	8.9
Thermal conductivity *	W/(m·k)	330
Electr. conductivity ***	MS/m	44
Electr. conductivity ***	IACS (%)	76
Thermal expansion c. **	10^{-6} K	17.3
Modulus of elasticity *	GPa	120



Chemical Position （reference value） %			
Cu (incl. Ag+Sn)	min. 99.0	Other	max. 0.1
Sn	0.10 - 0.20		

Condition	Temper class	Tensile strength T.S. min. - max. MPa	Yield strength $R_{p\,0.2}$ min. MPa	Elongation A50 min. % [3]	Hardness （reference value） HV	Electr. conductivity MS/m	Bendability R/t [1) 2)] 90° GW Strip thickness ≤0.5mm	Bendability R/t [1) 2)] 90° BW Strip thickness ≤0.5mm	Bendability R/t [1) 2)] 180° GW Strip thickness ≤0.5mm	Bendability R/t [1) 2)] 180° BW Strip thickness ≤0.5mm
Cold rolled	R250	min. 250	max. 140	20	60 - 85	44	0	0	0	0
Cold rolled	R300	300 - 370	270	10	80 - 110	44	0	0	0	0
Cold rolled	R360	360 - 430	310	7	110 - 130	44	0	0	0.5	1
Cold rolled	R420	420 - 490	370	5	120 - 150	44	1	1	2	2.5
Cold rolled	R460	min. 460	410	4	min. 135	44	1	1.5	2.5	3

*Reference values at room temperature

**Between 20 and 300 °C

*** Values for the lowest temper class

1) r = x · t (strips up to t = 0.50 mm)

2) Sample width = 10 mm / bending at smaller bending widths on request (Evaluation according to page 5.4.2. of Hand-Out)

3) valid only as thermal stress relieved qualities

**** Deviation in the chemical composition

Application Range		
Current carrying springs, blade contacts, relay boxes, busbars; very good scrap conditions of tinned scrap, advantageous price. International version of C14410		
Physical Properties		
Density *	g/cm³	8.9
Thermal conductivity *	W/(m·k)	350
Electr. conductivity ***	MS/m	47
Electr. conductivity ***	IACS (%)	81
Thermal expansion c. **	10^{-6} K	18
Modulus of elasticity *	GPa	120

Chemical Position （reference value） %

Cu (incl. Ag+Sn)	min. 99.6
Sn	0.10 - 0.15
Other	max. 0.1

Condition	Temper class	Tensile strength T.S. min. - max. MPa	Yield strength $Rp_{0.2}$ min. MPa	Elongation A50 min. %	Hardness （reference value） HV	Electr. conductivity MS/m	Bendability R/t 1) 2) 90° GW Strip thickness ≤0.5mm	Bendability R/t 1) 2) 90° BW Strip thickness ≤0.5mm
			*					
Cold rolled	R250	250 - 320	200	9	60 - 90	47	0	0
Cold rolled	R300	300 - 370	250	4	85 - 120	47	0	0
Cold rolled	R360	360 - 430	300	3	105 - 135	47	0	0
Cold rolled	R420	420 - 490	350	2	120 - 150	47	1	1

*Reference values at room temperature **Between 20 and 300 °C *** Values for the lowest temper class

1) r = x · t (strips up to t = 0.50 mm)

2) Sample width = 10 mm / bending at smaller bending widths on request (Evaluation according to page 5.4.2. of Hand-Out)

3) valid only as thermal stress relieved qualities

4.12 C18665

Application Range
Connectors for automotive, electric and electronic applications, relais, current carrying springs, busbars and relay boxes with spring properties; combined high electrical conductivity at highest strength and relaxation resistance; excellent bending at middle strength.

Physical Properties		
Density *	g/cm³	8.8
Thermal conductivity *	W/(m·k)	270
Electr. conductivity ***	MS/m	34
Electr. conductivity ***	IACS (%)	58
Thermal expansion c. **	10^{-6} K	17.3
Modulus of elasticity *	GPa	130

Chemical Position （reference value） %	
Cu (incl. Ag)	min. 99.0
Mg	0.4 - 0.9

Condition	Temper class	Tensile strength T.S. min. - max. MPa	Yield strength $Rp_{0.2}$ min. MPa	Elongation A50 min. %		Hardness （reference value） HV	Electr. conductivity MS/m	Bendability R/t 1) 90° GW Strip thickness ≤0.5mm	Bendability R/t 1) 90° BW Strip thickness ≤0.5mm	Bendability R/t 1) 180° GW Strip thickness ≤0.5mm	Bendability R/t 1) 180° BW Strip thickness ≤0.5mm
Cold rolled	R380	380 - 460	330	14	17 3)	115 - 145	34	0	0	0	0.5
	R460	460 - 520	410	10	12 3)	140 - 165	34	0.5	1	1.5	3
	R520	520 - 570	460	8	10 3)	160 - 180	34	1	2.5	2	5
	R570	570 - 620	500	6	8 3)	175 - 195	34	2.5	5	3.5	8
	R620 4)	min. 620	550	3	4 3)	min. 190	34	3	6	5	10

*Reference values at room temperature

**Between 20 and 300 °C

*** Values for the lowest temper class

1) r = x · t (strips up to t = 0.50 mm)

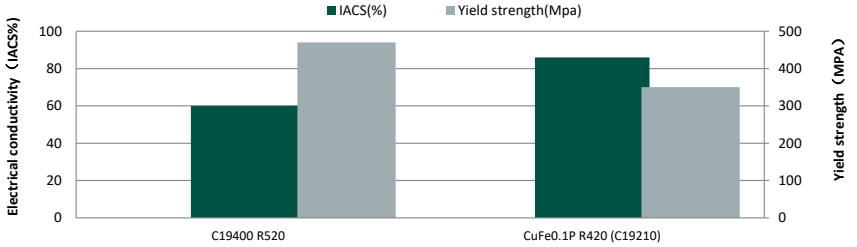
2) Sample width = 10 mm / bending at smaller bending widths on request (Evaluation according to page 5.4.2. of Hand-Out)

3) valid only as thermal stress relieved qualities

4) Thickness on request

Application Range
Hardenable Cu-Fe alloy with good electrical conductivity for components with low and medium strength requirements. "Senior" (oldest) special alloy. Good resistance against relaxation. Classical material for terminals, lead-frames and power transistors.

Physical Properties		
Density *	g/cm³	8.9
Thermal conductivity *	W/(m·k)	260
Electr. conductivity ***	MS/m	35
Electr. conductivity ***	IACS (%)	60
Thermal expansion c. **	10^{-6} K	16.3
Modulus of elasticity *	GPa	125



Chemical Position （reference value） %			
Cu	Rest	Other	max. 0.2
Fe	2.1 - 2.6		
Zn	0.05 - 0.20		

Condition	Temper class	Tensile strength T.S. min. - max. MPa	Yield strength $Rp_{0.2}$ min. MPa	Elongation A50 min. % [3]	Hardness （reference value） HV	Electr. conductivity MS/m	Bendability R/t [1) 2)] 90° GW thickness ≤0.5mm	Bendability R/t [1) 2)] 90° BW thickness ≤0.5mm	Bendability R/t [1) 2)] 180° GW thickness ≤0.5mm	Bendability R/t [1) 2)] 180° BW thickness ≤0.5mm
Cold rolled	R300	300 - 360	max. 240	18	80 - 100	35	0	0	0	0
Cold rolled	R360	360 - 430	270	15	110 - 135	35	0	0	0	0.5
Cold rolled	R420	420 - 480	380	9	130 - 150	35	0.5	0.5	1	1
Cold rolled	R480	480 - 540	430	6	140 - 160	35	1	1	1.5	1.5
Cold rolled	R520	520 - 580	470	4	min. 140	35	2.5	3.5	3	4.5

*Reference values at room temperature **Between 20 and 300 °C *** Values for the lowest temper class

1) r = x · t (strips up to t = 0.50 mm)

2) Sample width = 10 mm / bending at smaller bending widths on request (Evaluation according to page 5.4.2. of Hand-Out)

3) valid only as thermal stress relieved qualities

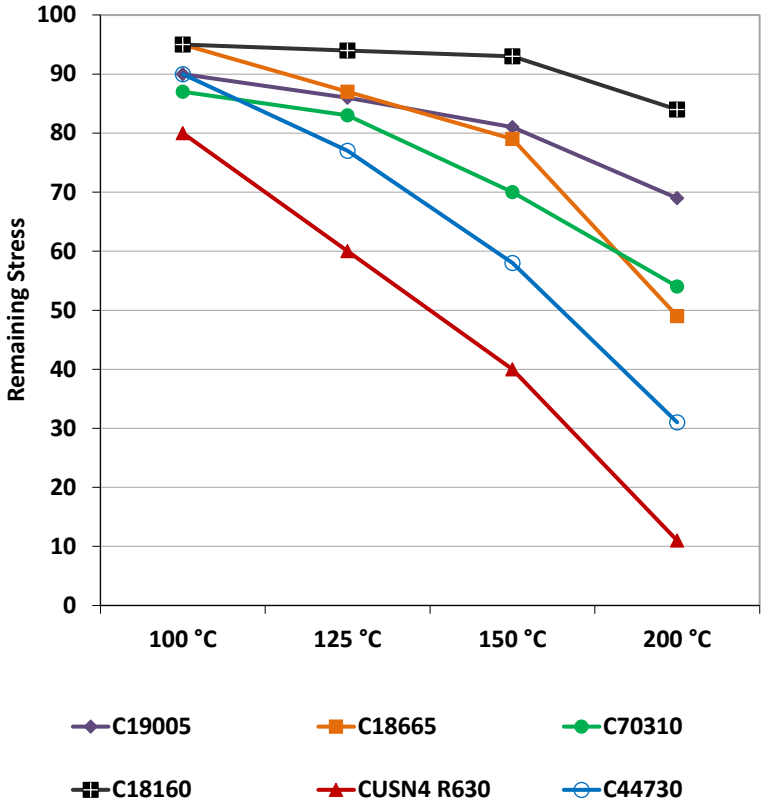
5.1.1 Relaxation Parameter

- **Definition:**
- » Gradual decrease of stress under constant elongation
- » Remaining stress (contact force) which is the result of the loss of initial stress, depending on the test method and conditions

- **Methods:**
- » Three point bending test
- » Four point bending test
- » Tube bending
- » Cantilever - bending test (discontinuous / continuous)

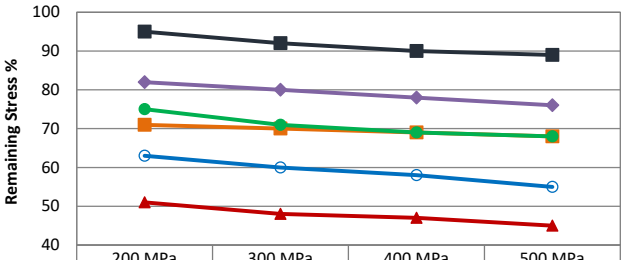
- **Test conditions (standard practice):**
- » Temperature (100 / 125 / 150 / 200 °C)
- » Time (50 / 100 / 250 / 500 / 1000 / 3000 h)
- » Initial stress (50 or 80 % of yield strength (Rp0,2/ Y.S.))

Initial stress 0.5 Rp (0.5 Y.S.); 1000h; bad way



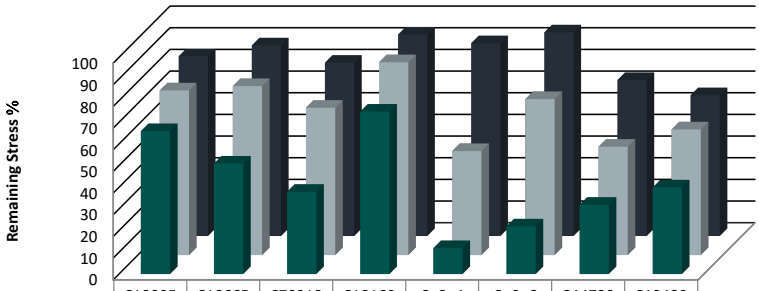
5.1.3 Relaxation (Different Initial Stresses)

1000h; 150℃ ; bad way



	200 MPa	300 MPa	400 MPa	500 MPa
C19005 R580	82	80	78	76
C18665 R570	71	70	69	68
C70310 R750	75	71	69	68
C18160 R540	95	92	90	89
CUSN4 R630	51	48	47	45
C44730 R600	63	60	58	55

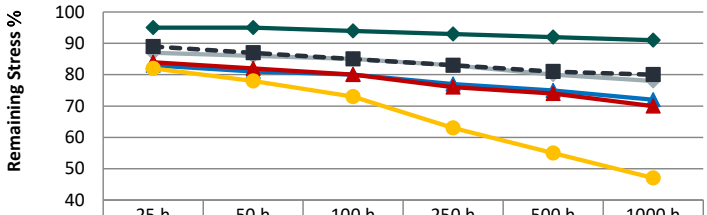
500Mpa/1000hr



	C19005 R580	C18665 R520	C70310 R750	C18160 R540	CuSn4 R610	CuSn6 R550	C44730 R600	C19400 R530
200 °C	66	51	38	75	12	22	32	40
150 °C	76	78	68	89	48	72	50	58
125 °C	83	88	80	93	89	94	72	65

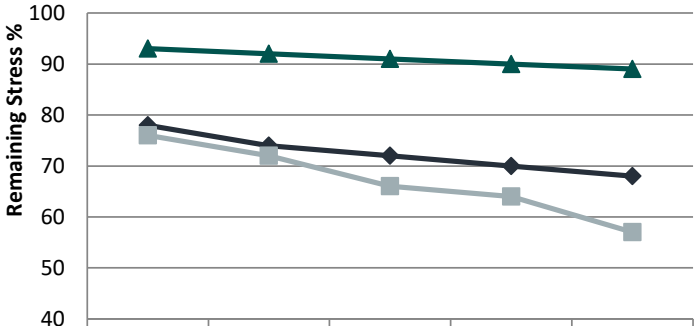
5.1.3 Important Material Data

Short time: initial stress 400Mpa; 150℃ ; bad way



	25 h	50 h	100 h	250 h	500 h	1000 h
C19005 R500	87	86	85	83	80	78
C19005 R580	89	87	85	83	81	80
C18665 R520	83	81	80	77	75	72
C70310 R750	84	82	80	76	74	70
C18160 R540	95	95	94	93	92	91
CUSN4 R610	82	78	73	63	55	47

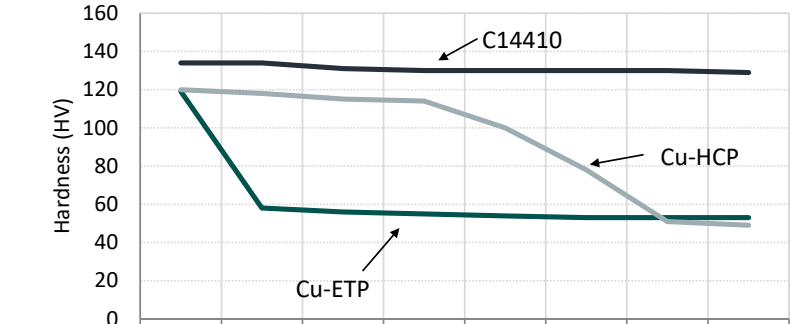
Long time: initial stress 400Mpa; 150℃ ; bad way



	500 h	1000 h	2000 h	5000 h	10000 h
C19010 R580	78	74	72	70	68
C18665 R520	76	72	66	64	57
C18160 R540	93	92	91	90	89

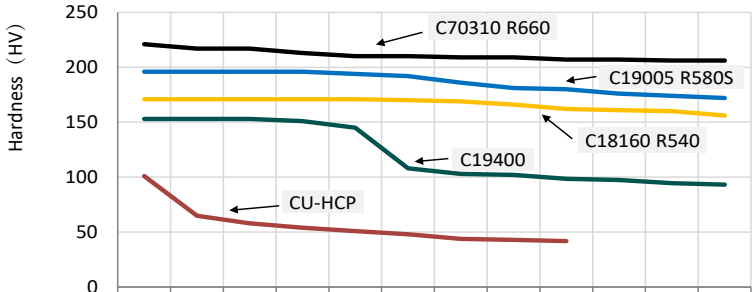
5.2 Softening Characteristic

Softening Characteristic at 300℃



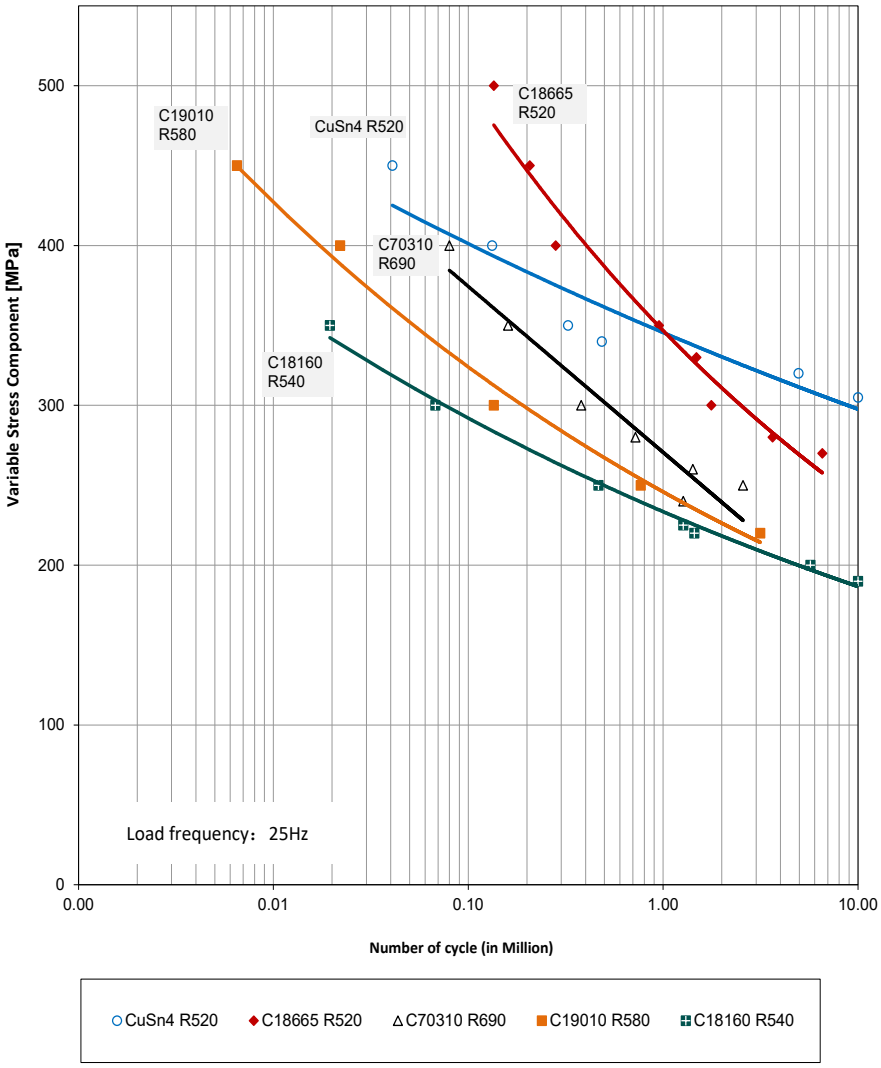
	0	10 sec.	30 sec.	1 min.	3 min.	5 min.	30 min.	1 h
CU-ETP	119	58	56	55	54	53	53	53
CU-HCP	120	118	115	114	100	78	51	49
C14410	134	134	131	130	130	130	130	129

Softening Characteristic at 500℃

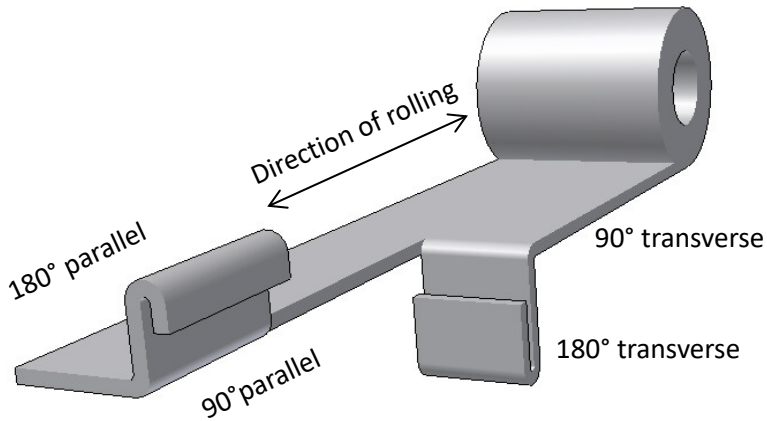


	0	1 sec	3 sec	5 sec	10 sec	30 sec	1 min	3 min	5 min	10 min	30 min	1 h
CU-HCP	101	65	58	54	51	48	44	43	42			
C19400	153	153	153	151	145	108	103	102	98.5	97.4	94.6	93.3
C19005	196	196	196	196	194	192	186	181	180	176	174	172
C70310	221	217	217	213	210	210	209	209	207	207	206	206
C18160	171	171	171	171	171	170	169	166	162	161	160	156

5.3 Bend Fatigue at Room Temperature



5.4 Definition Bending Axle



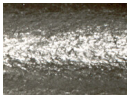
Parallel = bw (bad way)

Transverse = gw (good way)

Evaluation of Bending

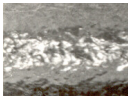
Condition 1: smooth, no cracks (no orange skin, no rough grain)

Condition 2: rough, no cracks (no orange skin, no rough grain)



Condition 3: slight orange skin, no cracks

Condition 4: orange skin, no cracks

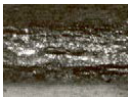


Condition 5: strong orange skin, no cracks

Condition 6: very sligth cracks

Condition 7: slight cracks

Condition 8: cracks

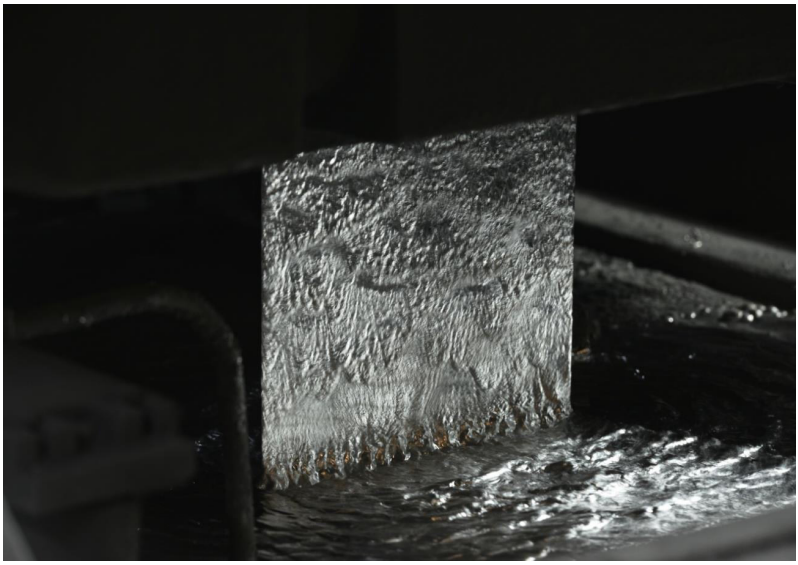


Condition 9: strong cracks

Condition 10: very strong cracks, nearly broken

Test condition, in accordance with DIN ISO 7438, scale in accordance with DIN EN 1654 plus addititionally valid for 180° bending.
(sample width = 10 mm, 90 ° testmethod with V-block and punch, 180 ° testmethod with 180 ° bend test machine.)

- Good corrosion and oxidation protection
- Formation from an intermetallic phase
- Reduction from insertion and drawing force
- Good solderability
- Good layer adhesion and formability
- Reduced occurrence of tin whisker
- Application of tin-alloys, for example tin-silver
- Efficient and cost-efficient procedure

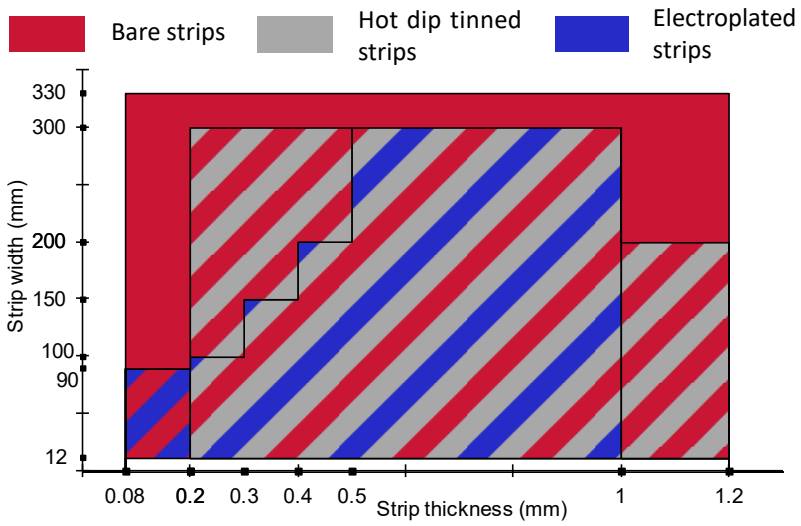


6.2 Coating Programme

Hot dip tinning acc. to DIN EN 13148 (RoHS conform)

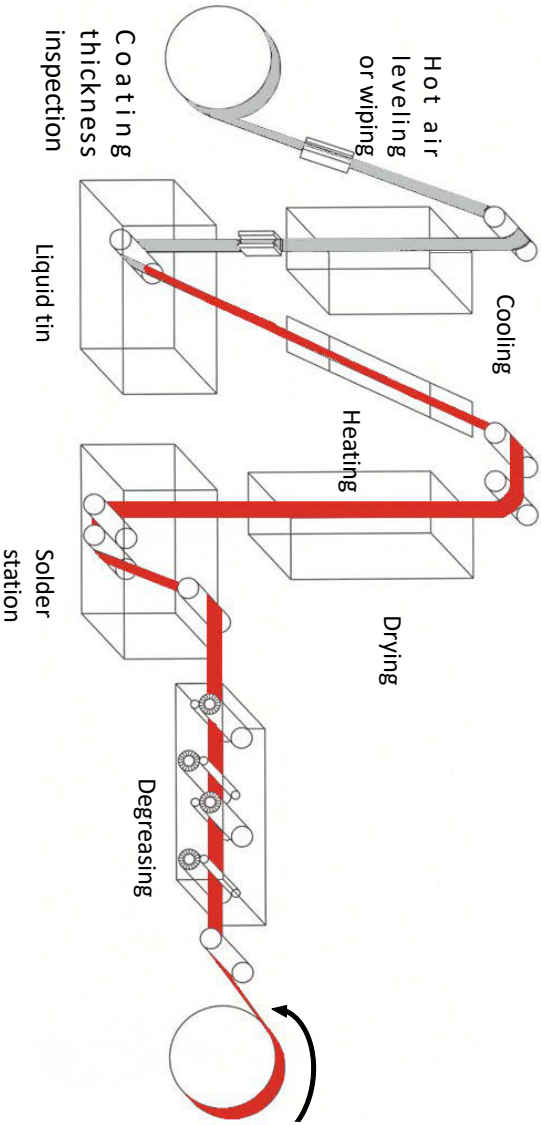
- Strip thickness: 0.20 – 1.20 mm (Coating thickness for the strip thickness >1.2 mm on request)
- Strip width: up to 330 mm
- Coatings: pure tin, tin-silver, Thermic tin
- Coating thickness*: 1.0 - 3.0 µm
  2.0 - 5.0 µm
  4.0 - 10.0 µm
  10.0 - 20.0 µm

* Max. coating thickness ≤ 2,0 µm on request



Electroplating acc. to DIN EN 14436 (RoHS conform)
Provided by KMD outsourcing vendors

6.3 Hot Dip Tinning Facility



6.4 Hot Dip Tinning

Two Methods

- By mechanical wiping
- Hot Air Level Tinning (airknife) (HALT method)

0.8 - 1.5	µm	lowest mating and unmating forces
1.0 – 2.0	µm	reduced mating and unmating forces
1 – 3	µm	standard coating for connectors
2 – 5	µm	good protection against corrosion
4 – 10	µm	good storage and solderability
10 – 20	µm	soldering depot

Other coatings on request

Strip thickness: 0.15 mm – 1.20 mm

Strip width: 10 – 330 mm with untinned edges

Tin Layers

Sn10 - standard tin	standard hot-dip tinning tin layer thickness 1-3 µm; pure tin
Sn11 - thin-prec	reduced mating and unmating forces, reduced fretting corrosion tin layer thickness 0.8-1.5µm; pure tin
Sn12 - Sn Sold	improved solderability tin layer thickness 3-6 µm; pure tin
Sn13 - thermic-tin	lowest mating and unmating forces, abrasion resistant, IMP =
Sn20 - thick-tinning	optimised contacting for the electrical connecting technology tin layer thickness 10-20 µm; pure tin
Sn28M - tin-silver	temperature-application > 130 °C., improved electrical properties compared to pure tin, compatible to lead-free solder.

(IMP = Inter Metallic Phase)

Test conditions (done with strips or according to connector standard tests)

- Microhardness (by Fischerscope)
- Soldering by dip-test (without aging)
- Mating and unmating force (Tab: CuSn base material; Hot Dipped with pure tin)
- Contact normal force (direct measurement, 10N pre and 7N after stresstest)
- Electrical stresstest
  - » 1. 100 cycles at 6 hours -40° C + 160° C (with voltage)
  - » 2. 21 days humid heat (without voltage), after same as 1.
- Electrical Stresstest at 30 Ampere (derating curve)
- Fretting corrosion (length 50 µm, amount of cycles below Rk < 10 Ω)

Results:

Coating	Pure Tin = Sn10 (C19400)	SnAg = Sn28M (C19010)	100 % IMP = Sn13 (C19010)
Microhardness	low	**high**	very high
Soldertest	good	**very good**	bad
Mating and unmating	high	**up to 50 % less**	up to 60 % less
Electrical stresstest	bad	**very good**	good
Electrical stresstest (30 Amp.)	medium	**reduced**	medium
	power dissipation	**power dissipation**	power dissipation
	(Derating)	**(Derating)**	(Derating)
fretting corrosion	little	**considerably better**	little better

6.6 Evaluation of Tinned Surfaces

	Requirement	Sn11	Sn10	Sn10	Sn10	Sn10	Sn28M	Sn13 *
		thin-prec	pure tin	pure tin	pure tin	pure tin	tin-silver	thermic-tin
		0.8 - 1.5 µm	1 - 2 µm	1 - 3 µm	2 - 5 µm	4 - 10 µm	1 - 3 µm	0.8 - 1.5 µm
micro hardness	high	2	2-3	3	3-4	4	2	1
mating and unmating forces	low	1-2	2	2-3	3	4	2	1
number of mating	high	3	3	3	2-3	2	2-3	1
abrasion	low	2	2	2-3	3	4	2	1
coefficient of friction	low	2	2-3	2-3	3	3-4	3	1
fretting corrosion	low	2-3	2-3	2-3	3	4	2	2
bendability	small radius	3	2-3	2-3	2	2	2	4
contact resistance	minimum	2	2	2	2	2	1	2
corrosion resistance		2	2	1-2	1-2	1	2	3
whisker resistance	none	2	2	2	2	2-3	1	2
solderability	good	3	3	2-3	2	1	2	4
softening resistance	high	2-3	3	3	3-4	4	2	1

1 = very good 2 = good 3 = suitable 4 = less suitable

* Interconnection of male- and female- Terminal on basis soft/hard

Period of storage

Bare Strips

Degree of protection	**max. period of storage**
Passivator: benzotriazole:	3 months

* Storage conditions: 18-20°C and max. 60% relative humidity

Tinned bands (Hot Air Level Tinning)

Degree of protection	maximum storage ***	
Tinning	max. 6 months	zinc-bearing base material
	max. 6 months	thin coating layer like 0.8-1.5µm and 1-2µm
	max. 12 months	low-alloyed copper materials
	max. 12 months	bronze material (CuSnXX)

** Storage conditions: 18-20°C and max. 60% relative humidity. Different storage conditions can modify and product characteristics. For example the solderability can be reduced

*** Maximum storage includes the period that stays in KMD inventory

Reference:

In principle the details of the chemical composition of the tin layer relate exclusively to the bath composition of the molten tin crucible. Characteristic of the structure of a molten tin layer are the phases: Pure tin, Cu6Sn5 and Cu35n, whose chemical composition inevitably deviates from the tin crucible.

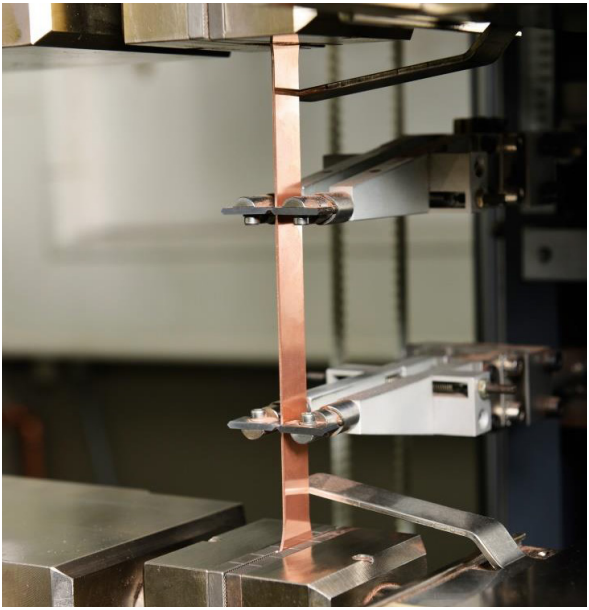
7.1 The Normal Force and Its Influence Factors

The normal force and its influence factors

– fretting force
– mating and unmating force
– contact spring force
– fixing force in the plastic box
– contact spring force

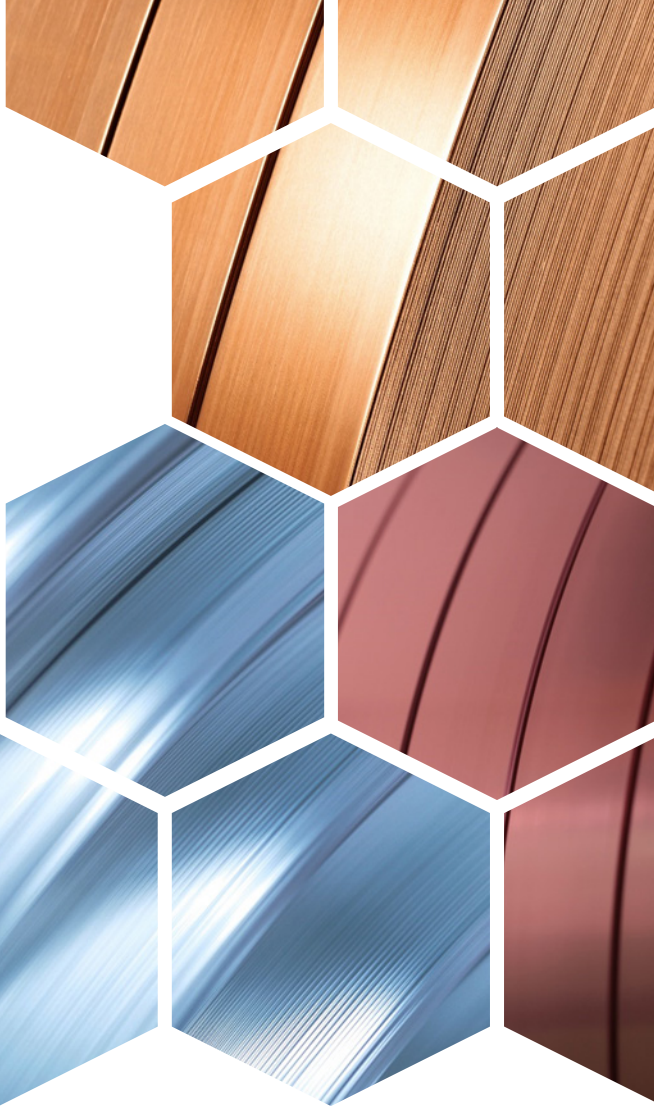
Influence the normal force

– number of matings
– initial stress
– spring deflection
– scragging
– relaxation



Requirement	Property	Proposal
Base material: Cu		
Strength and high contact force	Tensile Strength and Modulus of Elasticity	C19005, C18665, C70310, C18160, C51900, C52100, C70250
Maintain a low contact resistance	Relaxation and Corrosion resistance	Precipitation hardened qualities of C19005, C70310, C18160
Form / bend parts	Bendability	C19005, C18665, C70310, C51900, C52100, C70250
Avoid temperature increase	Electrical Conductivity	C18665, C14410, C18160
Dissipate heat	Thermal Conductivity	C18665, C14410, C18160
No decrease of hardness due to heat	Softening Temperature	C19005, C70310, C18160, C70250
Surfaces:		
Low insertion force and withdrawal forces	Thinner layers, harder tin	Sn11, Sn13, Sn28M
High temperature use	Thermal stability	Sn13, Sn28M
Solderability, assemble to PCB	Solderability	Sn28M

KMD
Precise Connector Strips
GROUP



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