CuNiSi
C19010
STOL® 76

KME

Industrial Rolled

Alloy Designation	STOL® 76
EN	CuNiSi
DIN CEN/TS 13388	
UNS	C19010

High Performance STOL® Alloys

We have developed a wide range of high performance alloys with excellent properties regarding conductivity, strength, corrosion behaviour, bendability and relaxation properties. STOL® alloys are the first choice materials for high-end applications and products.

Chemical Composition Weight percentage		
Cu	Rest	%
Ni	1.3	%
Si	0.25	%
P	0.03	%

This alloy is in accordance with RoHS 2002/96/CE for electric & electronic equipments and 2002/53/CE for automotive industry.

Characteristics

STOL® 76 is a CuNiSi alloy that can be hardened by cold forming and by precipitation of NiSi-phases during a heat treatment. It has excellent bendability, excellent hot and cold forming properties, a high strength and a good corrosion resistance.

Due to the NiSi-precipitations the relaxation properties, even at temperatures up to 150°C are excellent. The electrical and thermal conductivity is good. Welding, soldering and brazing properties are good too.

Main Applications

Automotive Switches and Relays, Contacts, Connectors, Terminals

Electrical Switches and Relays, Contacts, Connectors, Terminals, Components for the electrical industry, Stamped parts, Semiconductor Components,

Preferred Applications

Spring Contact	Switches and Relays	High Temperature Range >130°C	Current Carrying Capacity
xx	x	xx	xx

x = well suited xx = particularly well suited

Physical Properties Typical values in annealed temper at 20 °C				
Density			8.9	g/cm³
Thermal expansion coefficient		20 .. 300 °C	16.8	10^{-6}/K
Specific heat capacity			0.377	J/(g·K)
Thermal conductivity			260	W/(m·K)
Electrical conductivity		(1 MS/m = 1 m/(Ω mm²))	35	MS/m
Electrical conductivity		(IACS)	60	%
Thermal coefficient of electrical resistance		(0 .. 100 °C)	2	10^{-3}/K
Modulus of elasticity	(1 GPa = 1 kN/mm²)	cold formed	135	GPa
		annealed	118	GPa

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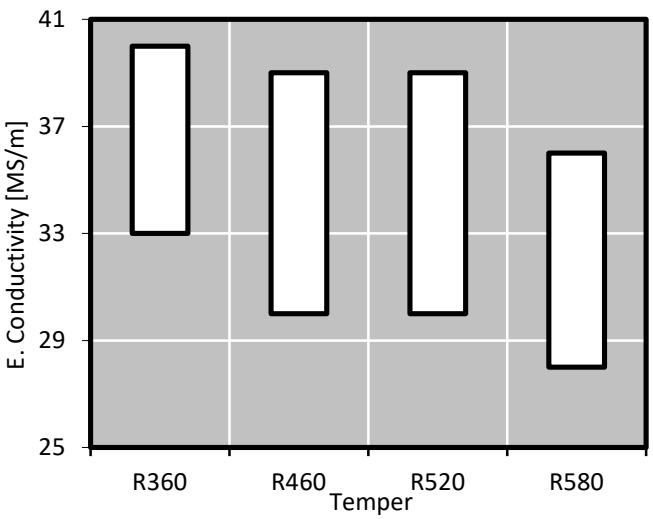
Mechanical Properties				
Temper	**Tensile Strength** **Rm**	**Yield Strength Minimum** **$Rp_{0.2}$**	**Elongation Minimum** **A_{50mm}**	**Hardness** **HV ***
	MPa	MPa	%	HV
R360	360 .. 430	300	12	100 .. 130
R410	410 .. 470	360	9	125 .. 155
R460	460 .. 520	410	7	135 .. 165
R520	520 .. 580	460	5	145 .. 175
R580 precipitation hardening	580 .. 660	520	9	160 .. 210

*only for information

Electrical Conductivity



Electrical conductivity is strongly influenced by chemical composition. A high level of cold deformation and small grain size decrease the electrical conductivity moderately. Minimum conductivity level can be specified.

Fabrication Properties*	
Cold Forming Properties Max. 80% between annealings	Excellent
Hot Forming Properties at 750 .. 950°C	Excellent
Machinability (Rating 20)	Less suitable
Electroplating Properties	Excellent
Hot Tinning Properties	Excellent
Soft Soldering, Brazing	Excellent
Resistance Welding	Less suitable
Gas Shielded Arc Welding	Excellent
Laser Welding	Fair
Soft Annealing	250 .. 650°C, 1 .. 3h
Stress Relieving Annealing	150 .. 200°C, 1 .. 3h

* For more details call our technical service

Corrosion Resistance*
Resistant to: STOL® 76 has good corrosion resistance.
The alloy is insensitive to stress corrosion cracking

* For more details call our technical service

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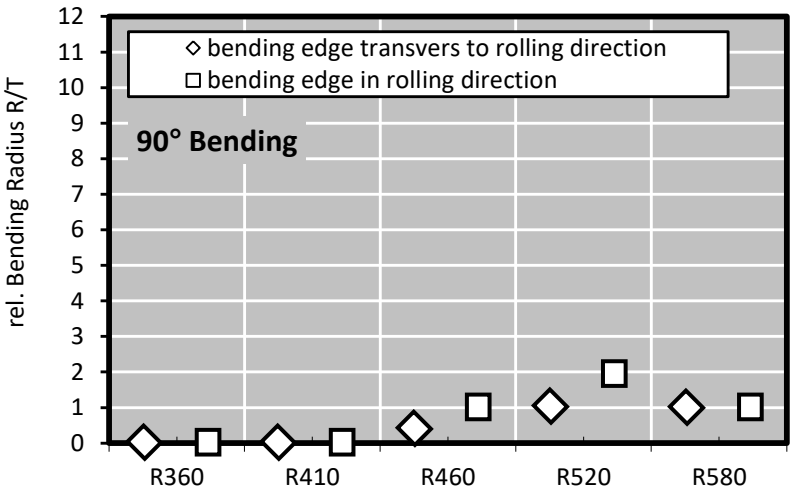
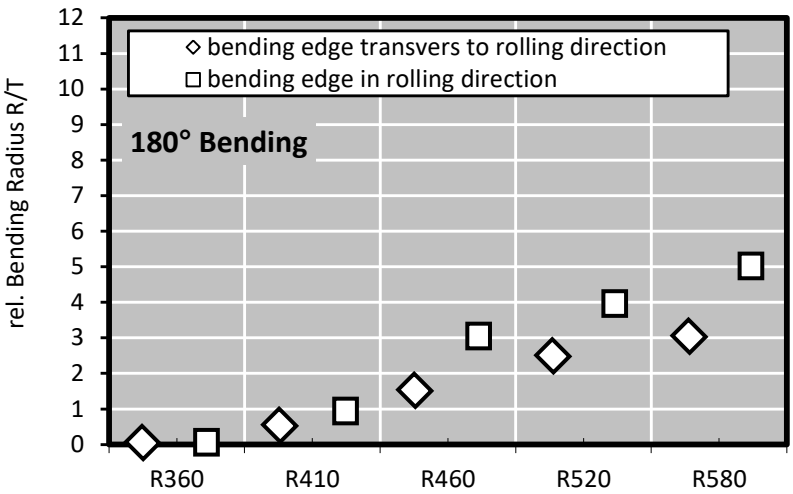
Bending Properties **Thickness: ≤ 0.5 mm** **stress relieved**





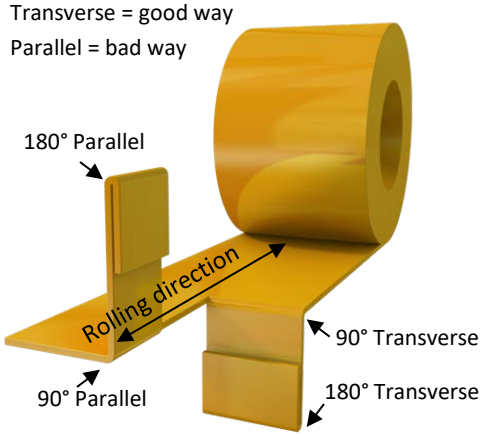
Bending test according to EN ISO 7438 is done with 10 mm wide samples. Smaller samples in general – as well as lower thickness – allow a lower bending radius without cracks. If needed we supply bending optimized temper classes that far exceed standard quality.

Please take care when comparing with ASTM E 290 results, there the bend definition direction is contradictory.

Bending Definition

Transverse = good way

Parallel = bad way



Bending Properties*

Temper	Thickness Range	Bending 90°		Bending 180°	
		Trans-vers	Parallel	Trans-vers	Parallel
	mm	R/T	R/T	R/T	R/T
R360	≤ 0.5	0	0	0	0
R410	≤ 0.5	0	0	0,5	1
R460	≤ 0.5	0,5	1	1,5	3
R520	≤ 0.5	1	2	2,5	4
R580	≤ 0.5	1	1	3	5

* Measured at sample width 10 mm according to EN 1654

Possible bending radius = (R/T) x thickness

Minimum Bending Radius Calculation

To find out the minimum possible bending radius take the R/T value from the list.

Example: R/T = 0.5 and thickness 0.3 mm

Minimum radius = (R/T) x thickness

= 0.5 x 0.3 mm = 0.15 mm

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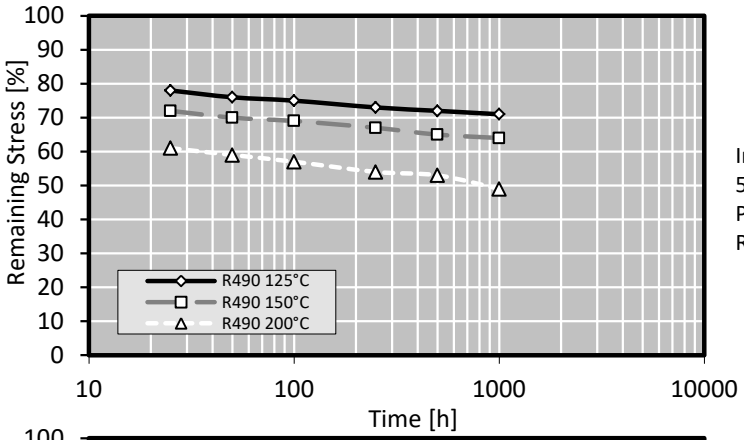
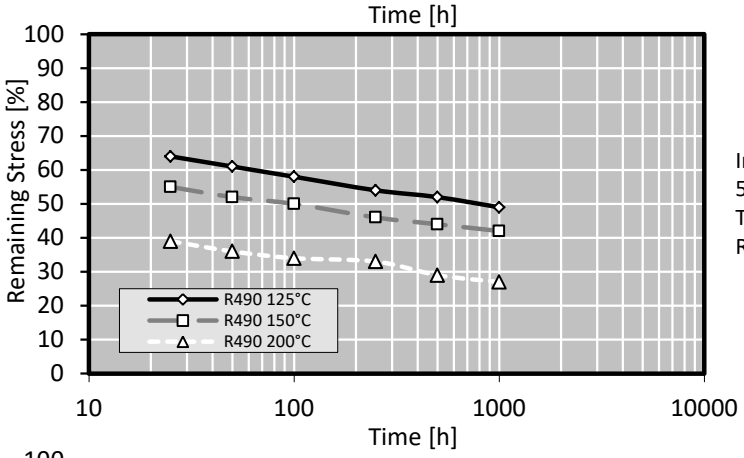
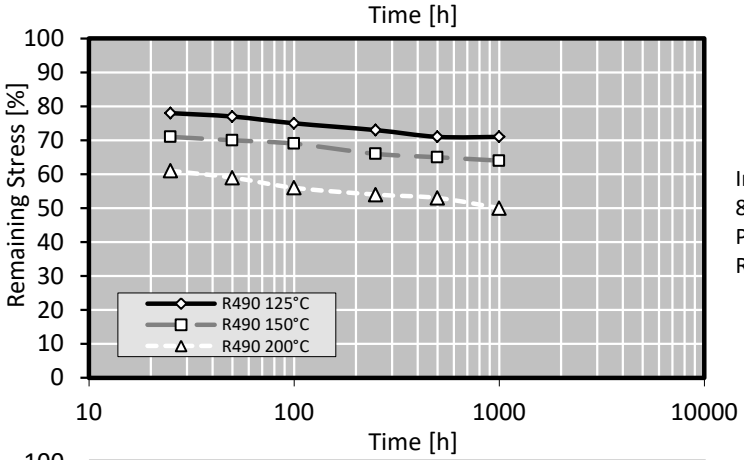
Relaxation Properties **Cold rolled** Thermal stress relieved



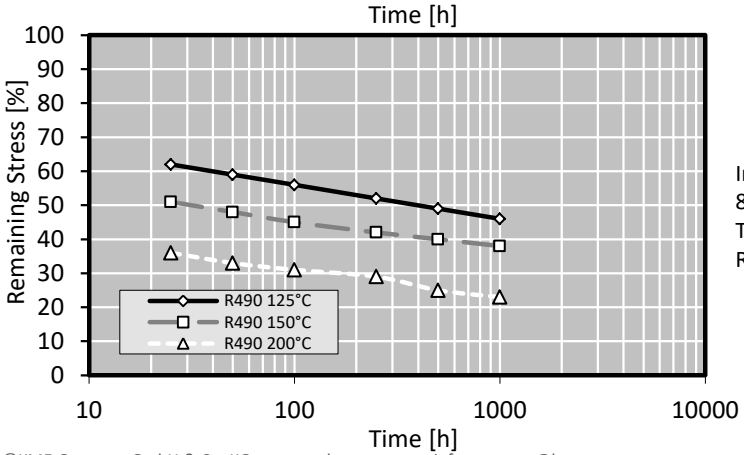
Initial Stress:
50% of Rp0.2
Parallel
Rolling Direction



Initial Stress:
50% of Rp0.2
Transverse
Rolling Direction



Initial Stress:
80% of Rp0.2
Parallel
Rolling Direction



Initial Stress:
80% of Rp0.2
Transverse
Rolling Direction

Stress relaxation is tested with cantilever bending test equipment. This method is taking short time relaxation into account. so that the values achieved are very realistic, while other test methods like tube test pretend better properties from the achieved values. Relaxation values give an indication about stress relieve of strip under tension for a certain time and temperature. As it is measured on plain strip. the behaviour of deformed parts may differ. nevertheless the ratio between the different tempers remains the same.

Typical test sample thickness is 0.3 – 0.6 mm.

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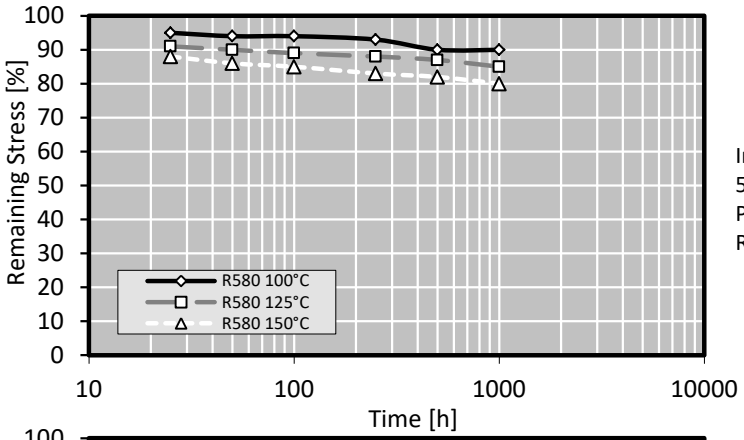
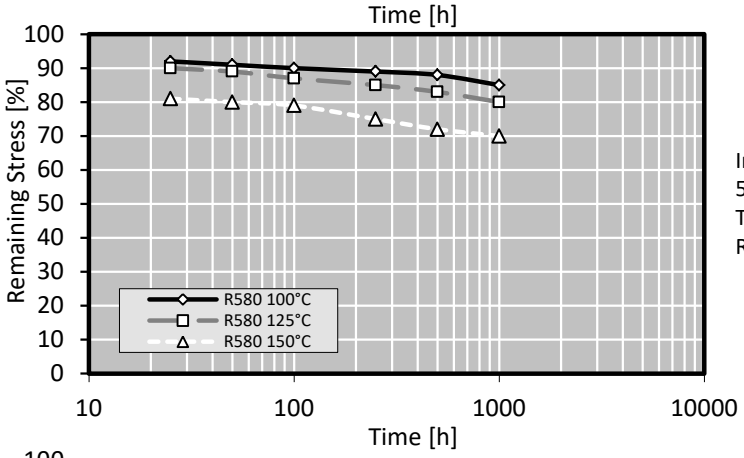
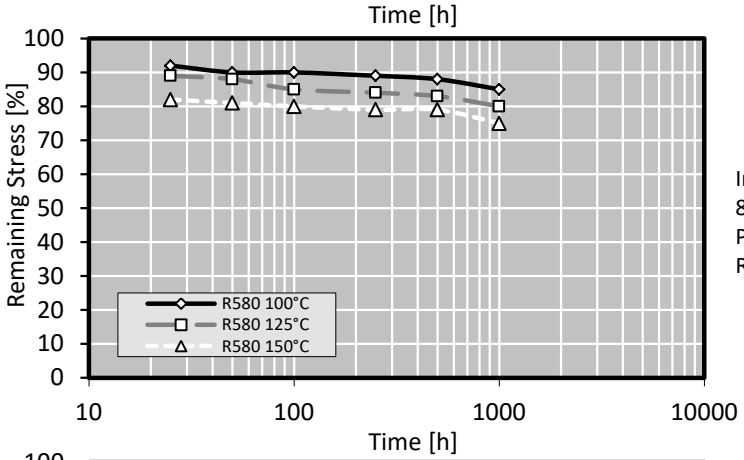
Relaxation Properties **Age hardened by NiSi precipitations** Thermal stress relieved



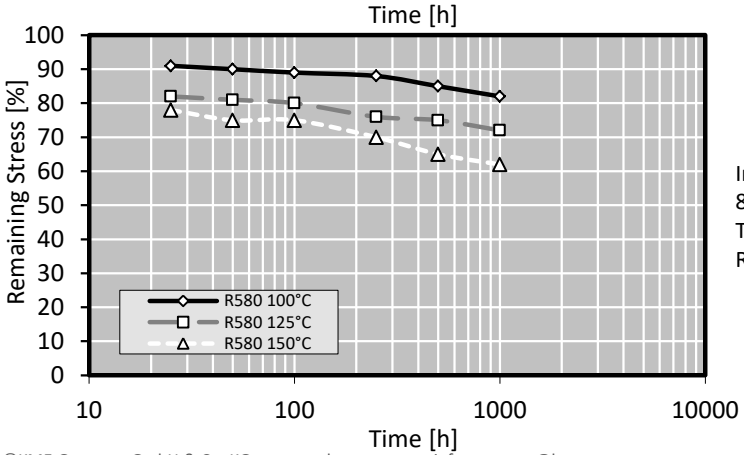
Initial Stress:
50% of Rp0.2
Parallel
Rolling Direction



Initial Stress:
50% of Rp0.2
Transverse
Rolling Direction



Initial Stress:
80% of Rp0.2
Parallel
Rolling Direction



Initial Stress:
80% of Rp0.2
Transverse
Rolling Direction

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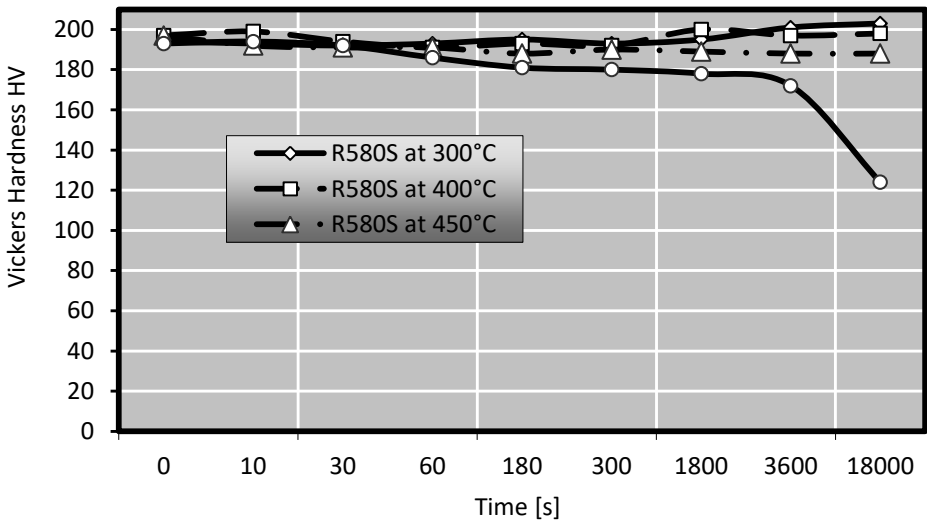
Softening Resistance



After short time heat treatment Vickers Hardness is measured. The diagram shows typical values.

Bend Fatigue (at room temperature)

The fatigue strength gives an indication about the resistance to variations in applied tension. It is measured under symmetrical alternating load. The maximum bending load for 10^7 load cycles without crack is measured. Dependent on the temper class it is approximately 1/3 of the tensile strength R_m.

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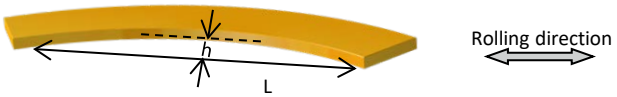
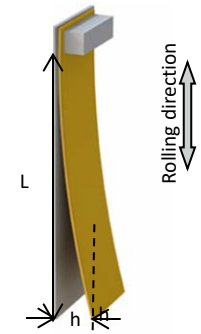
Camber

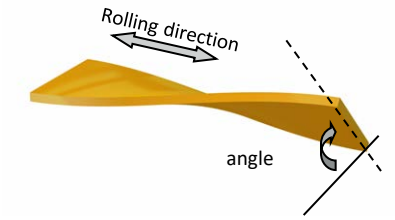


Evenness

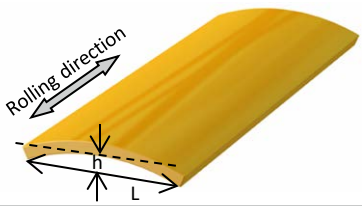
Coil set



Twist



Transverse Flatness



Customized Tolerances

Our products are produced in accordance with relevant norms EN 1652 / EN 1654. Customer specific tolerances for Thickness, Width, Camber, Transverse Flatness, Evenness, Twist and Coil set can be defined. We will be happy to meet your demands. EN 1652 defines only camber.

Thickness Tolerance

Thickness Range [mm]	EN 1652 ≤350 mm [mm]	KME Standard [mm]	KME Precision [mm]
0.05 .. 0.20	± 0.018	± 0.005	± 0.004
0.21 .. 0.30	± 0.022	± 0.007	± 0.005
0.31 .. 0.40	± 0.025	± 0.015	± 0.006
0.41 .. 0.50	± 0.030	± 0.015	± 0.008
0.51 .. 0.60	± 0.040	± 0.017	± 0.010
0.61 .. 0.70	± 0.040	± 0.020	± 0.010
0.71 .. 0.85	± 0.040	± 0.022	± 0.012
0.86 .. 1.30	± 0.050	± 0.025	± 0.015
1.31 .. 2.00	± 0.060	± 0.030	± 0.020
2.01 .. 3.00	± 0.070	± 0.045	± 0.025
3.00 .. 4.00	± 0.100	± 0.050	± 0.025
4.00 .. 6.00	± 0.120	± 0.060	± 0.030

Roughness

Ra [µm]	Thickness [mm]
0.13 .. 0.18	0.1 .. 2.0
0.20 .. 0.30	0.1 .. 2.0
0.35 .. 0.46	0.1 .. 2.0
On request	> 2.0

Evenness Tolerance

Thickness Range [mm]	Width Range [mm]		
	7 .. 20	21 .. 50	51 .. 100
0.10 .. 0.50	+0.10	+0.20	+0.30
0.50 .. 1.00	+0.15	+0.25	+0.35

Width Tolerance Standard / Precision

Thickness Range [mm]	Width Range [mm]					
	10 .. 50	51 .. 100	101 .. 200	201 .. 350	351 .. 700	700 .. 1,000
0.10 .. 1.00	+0.2 / +0.1	+0.3 / +0.2	+0.4 / +0.3	+0.6 / +0.4	+1.0 / +0.5	-
0.20 .. 1.00	+0.2 / +0.1	+0.3 / +0.2	+0.4 / +0.3	+0.6 / +0.4	+1.0 / +0.5	+2.0
1.01 .. 2.00	+0.3 / +0.2	+0.4 / +0.2	+0.5 / +0.4	+1.0 / +0.6	+1.5 / +0.7	+2.0
2.01 .. 3.00	+0.5 / +0.3	+0.6 / +0.3	+0.7 / +0.5	+1.2 / +0.7	+2.0 / +0.9	+3.0
3.01 .. 6.00	+2.0 / -	+2.3 / -	+2.5 / -	+3.0 / -	+4.0 / -	+6.0

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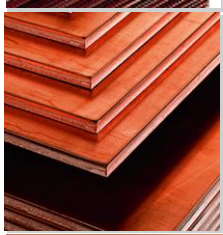
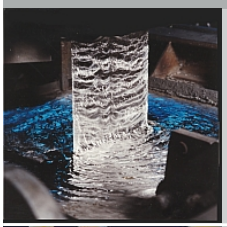
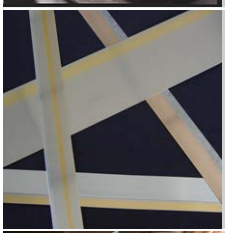
Formats		Dimension*		
	Coil	Strip thickness (other thicknesses on request)	≥ 0.1 .. 6.00	mm
		Strip width	≥ 3 .. 1.250	mm
		Outside diameter	≤ 1.400	mm
		Weight (Standard)	≤ 8.400	kg
		Weight (Deep-Drawing Quality)	≤ 8.000	kg
		Weight per mm	≤ 12.0	kg
	Traverse wound strip	Thickness	≥ 0.2 .. ≤ 1.50	mm
		Width	≥ 8 .. ≤ 60.0	mm
		Weight	300 .. 1.500	kg
		Drums: wood, plastic, metal, flangeless		
	**TEC**STRIP® _multicoil	Thickness	0.18 .. 0.80	mm
		Width	15 .. 50	mm
		Inner diameter 300 mm for thickness	0.15 .. 0.80	mm
		Inner diameter 400 mm for thickness	0.41 .. 0.80	mm
		Maximum weight	5.000	kg
		Outer diameter maximum	1.600	mm
	Sheet ≤ 6.35 mm	Thickness	0.3 .. 6.35	mm
		Width	50 ..1.250	mm
		Length	200 .. 6.500	mm
		Weight	2.800 .. 8.000	kg
		Sheets in standard dimensions e.g. 1,000 x 2,000 mm on stock		
	Sheet > 6.35 mm	Thickness	6.35 .. 9.50	mm
		Width	50 .. 2.450	mm
		Length	200 .. 7.500	mm
		Weight	≤ 10.000	kg
		Sheets in standard dimensions e.g. 1,000 x 2,000 mm		
	Plate	Thickness	9.5 .. 150	mm
		Width	≤ 4.500	mm
		Length	≤ 15.000	mm
		Weight	≤ 8.000	kg
	Disc	Thickness	0.3 .. 150	mm
		Diameter	20 .. 3.100	mm
		Weight	≤ 10.000	kg

* Some combinations might not be possible

Surface coatings & Special Treatments *		Dimension		
	Hot-Dip tinned and STOL®28M Tin-Silver STOL®13 Thermic Sn Different thickness per side possible	Width Thickness Tin Layer Thickness	≤ 330 ≤ 1.5 0.4 .. 20	mm mm µm
	Electroplating Tin, Silver, Gold, Cu-Flash, Ni-Flash, Selective plating	Width Thickness Other coatings on request	≤ 400 ≤ 2.5	mm mm
	Profiled strips STOL®Multigauge	Width Thickness Other width on request	15 .. 90 0.23 .. 1	mm mm
	Surface with extra low residual carbon content possible. Protection with oil or adhesive foil on request			

* Further details you find at www.kme.com

Standards for copper and copper alloys	
EN 1652	Plate, sheet, strip and circles for general purposes
EN 1654	Strip for springs and connectors
EN 1758	Strip for lead frames
EN 13148	Hot-dip tinned strip
EN 13599	Copper plate, sheet and strip for electrical purposes
EN 14436	Electrolytically tinned strip