

SICLANIC S[®]

Strategic
& Elastic



About
Siclanic S®

General Features

Mechanicals properties

Heats treatments

Production process

Ex-Works condition

For centuries man has attempted to scale unattainable heights. To the climber, his handgrip is that all-important link between man and the rock face. The hand's strenght and elasticity are matched only by the roughness and steep incline of the summits he tries to reach. In the modern world, resistance to fatigue combined with excellent conductivity are also required qualities for electrical applications. To obtain such a result, today, **CLAL-MSX** propose an hardenable alloy by heat treatment :

Siclanic S®. Thanks to its electrical conductivity higher, to 43% IACS, to its astonishing mechanicals properties, the **Siclanic S®**

Strategic & Elastic

is particularly adapted for the manufacture of relay springs, connectors or any pieces which are strongly deformed before treatment.

The composition of the **Siclanic S®** without beryllium and without cobalt improve the price of the final cost price for difficult pieces.



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SICLANIC S®

Ex-works condition :

- TB Quenched
- TF Quenched and precipitation treated
- TD Quenched, Cold-hammered
- TH Quenched-Cold-hammered and precipitation treated

GENERAL FEATURES

About
Siclanic S®

General Features

Nominal composition
Physical properties at 20°

Mechanicals properties

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Nominal composition

	Copper	Nickel	Silicon
% Weight	96.9	2.5	0.6

Physical properties at 20°C

Mass per Unit Volume	8.9	(g/cm ³)
Melting range	1040-1060	(°C)
Coefficient of linear expansion (20 to 300 °C)	19 (x 10 ⁻⁶ /°C)	
Specific heat	0.37	J(g°C)
Thermal Conductivity :	–	W/m.°K
- solid solution (or quenched) state	≈ 84	
- quenched state	188.4	
Electrical Conductivity :	% IACS	
- quenched state	≈ 22	
- precipitation hardened state	43 minimum	
Electrical resistivity :		μΩ.cm
- quenched state	7.8	
- precipitation hardened state	4.1 maxi	
Modulus of elasticity, longitudinal :		Gpa
- quenched state TB	120	
- precipitation hardened state TF	130	
Non-magnetic alloy		

Ex-Works condition

CLAL-MSX offer two categories of metallurgical condition :

Solution Treated Condition SICLANIC S® possesses a high deformation capacity for difficult forming application. Subsequent heat treatment gives the components the required elasticity and conductivity. These states are recommended if brazing is to be carried out on the component.

Factory Heat Treated Condition SICLANIC S® offers the best compromise of properties. It may be used directly provided the forming of the components does not involve a great amount of elongation.

This leaflet gives the characteristics and the heats treatments for SICLANIC S® rolled products. As far as drawn products (wire, rod...) are concerned, please consult CLAL-MSX.

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MECHANICALS PROPERTIES

Condition

	Tensile Strength Mpa	0.2 % proof stress Mpa	Elongation $L_0 = 5.65 \sqrt{S_0}$ A (5) A%	Vickers Hardness HV ₁₀	Limit of elasticity in Bending* (mini) Mpa
SOLUTION TREATED & COLD WORKED					
TB Quenched	270-300	140-170	30-47	70-85	
TD3 Quenched - 1/2 hard	320-400	290-380	10-20	105-125	
TD4 Quenched - 4/4 hard	400-470	390-450	3-9	195-250	
FACTORY HEAT TREATED					
TF Quenched and precipitation treated	580-680	450-550	10-20	170-190	430
TH3 Quenched 1/2 hard precipitation treated	600-700	530-630	10-15	190-215	500
TH4 Quenched 4/4 hard precipitation treated	630-800	590-700	8-20	195-250	560

The remarkable limit of elasticity in Bending of **SICLANIC S®** must be emphasised.

* DIN 50151

Bending ability

In the **TB** and **TF** states, **SICLANIC S®** possesses excellent bending ability.

Condition

90° minimum bending radius as a function of the thickness, t

	Bend across rolling direction	Bend along rolling direction
TB	0 x t	0 x t
TD 3	0 x t	1 x t
TD 4	3 x t	3 x t
TF	0 x t	0 x t
TH 3	1 x t	1 x t
TH 4	1 x t	2 x t

Fatigue Performance

Cyclic bending strenght (**TH4** Condition) : 245 Mpa at 10⁸ cycles.

Comparative characteristics of SICLANIC S® and other cupreous materials.

SICLANIC S® is particularly recommended for the production of conductive contact blades.

The following table compares it with the principal alloy for this type of application.

SICLANIC S® offers :

- electrical conductivity greatly superior to that of bronzes, brasses and nickelsilver,
- mechanicals properties on a par with those of copper-cobalt-beryllium and of bronze,
- excellent fatigue strenght,
- very competitive cost compared with copper-cobalt-beryllium.

	Tensile Strength Mpa	0,2 % proof stress Mpa	Vickers Hardness HV ₁₀	Electrical conductivity % IACS	Fatigue Strenght (*) Mpa	Limit of elasticity in Bending (mini) Mpa
Siclanic S® (TH4)	630-800	590-700	195-250	≥ 43	245	560
Cu Sn8 (H14)	700-780	≥ 680	210-230	13	210	440
Bronze 158						
CuNi18Zn20 (H15)	≥ 680	≥ 650	≥ 215	5,4	200	510
Niclal 180						

* Cyclic bending, 10⁸ cycles.

HEATS TREATMENTS



Mechanicals properties

Heats treatments

Temperature performance
Precipitation heat treatment

Production process

Ex-Works condition

Temperature Performance

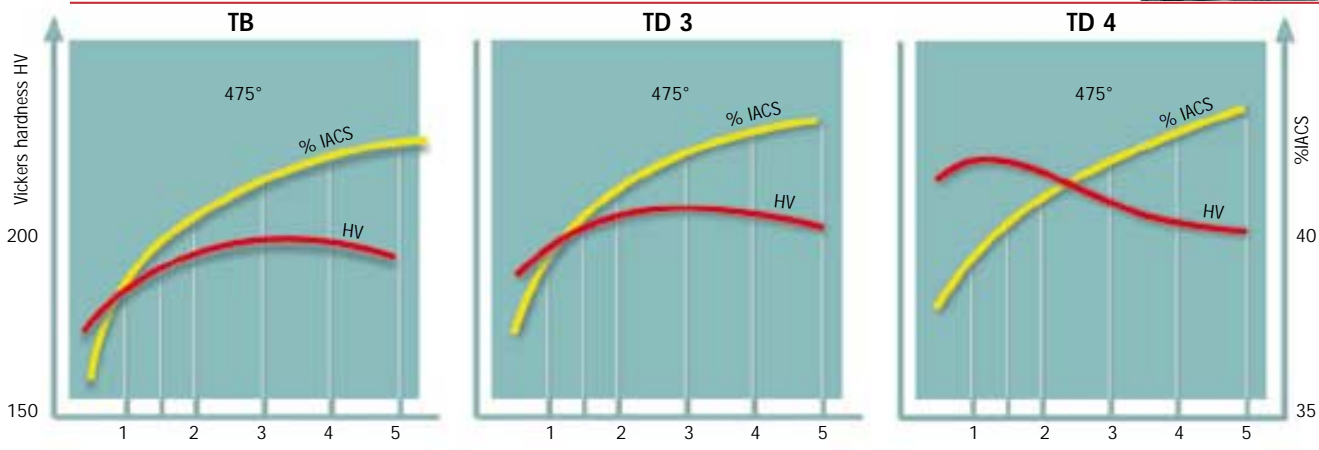
Since **SICLANIC S®** is a precipitation hardening alloy, heat treatment ensures :

- excellent resistance to stress relaxation, the contact pressure applied by a contact blade thus remains stable respect to time,
- remarkable stability to mechanicals characteristics, even after prolonged use at temperatures of up to 400°C.

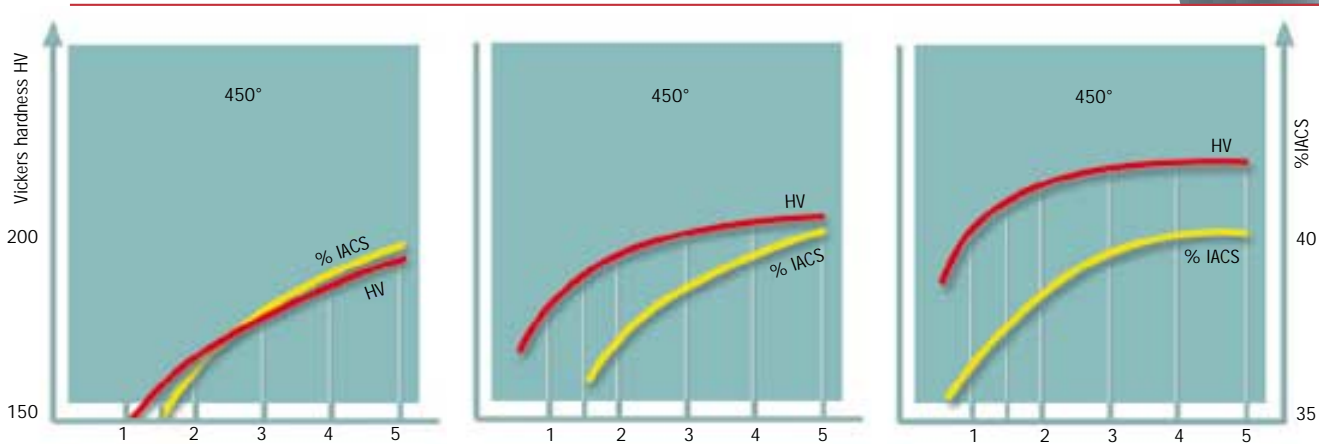
Precipitation heat treatment

If **SICLANIC S®** is delivered in the untempered state, the formed components must undergo a precipitation heat treatment whose parameters are summarised in the following graphs :

From condition :



Time in hours



Variations of HV hardness and of % IACS conductivity as a function of time at the treatment temperatures (+/- 10°C)

Recommended treatment conditions :

- In general, the best results will be achieved by applying the following conditions.
- Degreasing the components before treatment is recommended,
- it is preferable to operate in a neutral or reducing atmosphere in order to prevent oxidation. However if the heat treatment has been carried out in an oxidizing atmosphere pickling in 10% sulphuric acid solution with the addition of 2% potassium or sodium bichromate will restore the components to satisfactory appearance.

From state :	TB	TD3	TD4
Temperature (°C)	475	475	450
Time (T)	2	2	2
Final state	TF	TH3	TH4

PRODUCTION PROCESS

Mechanicals properties

Heats treatments

Production process

Brazing, soldering
Surface treatment

Wear and corrosion
resistance

Ex-Works condition

As already stated, **SICLANIC S®** is highly suitable in the hardened state for bending and forming, and in particular for drawing and drop forging ...

Brazing, soldering

The assembly possibilities are numerous. **SICLANIC S®** can be brazed or soldered however copper phosphorous brazes are to be avoided because of their high melting ranges.

Surface treatment

SICLANIC S® is equally as suitable as copper for silver, nickel or rhodium plating.

Wear and corrosion resistance

SICLANIC S® possesses high wear resistance when in sliding contact with ferrous metals making it suitable for use in the manufacture of bearings. Moreover, thanks to the presence of nickel and silicon its corrosion resistance is greater than that of pure copper.

In contrast with brass alloys, **SICLANIC S®** is insensitive to stress corrosion cracking.

Normal production possibilities and limits.

Dimensions in mm

Coiled strip : thickness according to as delivered condition

CONDITION/THICKNESS	TB - TF	maximum width	TD 3 - TH 3	maximum width	TD 4 - TH 4	maximum width
Minimum thickness	0.1	120	0.08	300	0.05	300
	0.2	300	0.16	370	0.10	370
Maximum thickness	3.2	360	2.0	360	1.60	360

Coiled diameters and normal coil weights

INTERNAL DIAMETER	Coil diameters		Normal coil weight kg/mm of width
	Strip width	Strip thickness	
100 - 125 300 - 400	/ ≤ 10	≤ 0,7	1
400	10 < / < 370	0,1 < e ≤ 1,5	2
400 - 500	20 < / < 360	1,5 < e ≤ 3,2	3*

* 7 kg max

High length of flat coil feed

Thickness 0.2 to 0.8 mm - Width 5 to 40 mm. Coil weight 450 kg.
According to section, length 1.5 to 50 km. Supplying of unwinding device.

Profiles strip

Thickness 0.5 to 1.50 mm. Width 10 to 140 mm.
Minimum thickness of the machined part 0.15 mm.

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EX-WORKS CONDITION/APPLICATIONS

Mechanicals properties

Heats treatments

Production process

Ex-Works condition



Connectors
for phone industry



Switches/circuit
breakers



Pieces
for railway
application



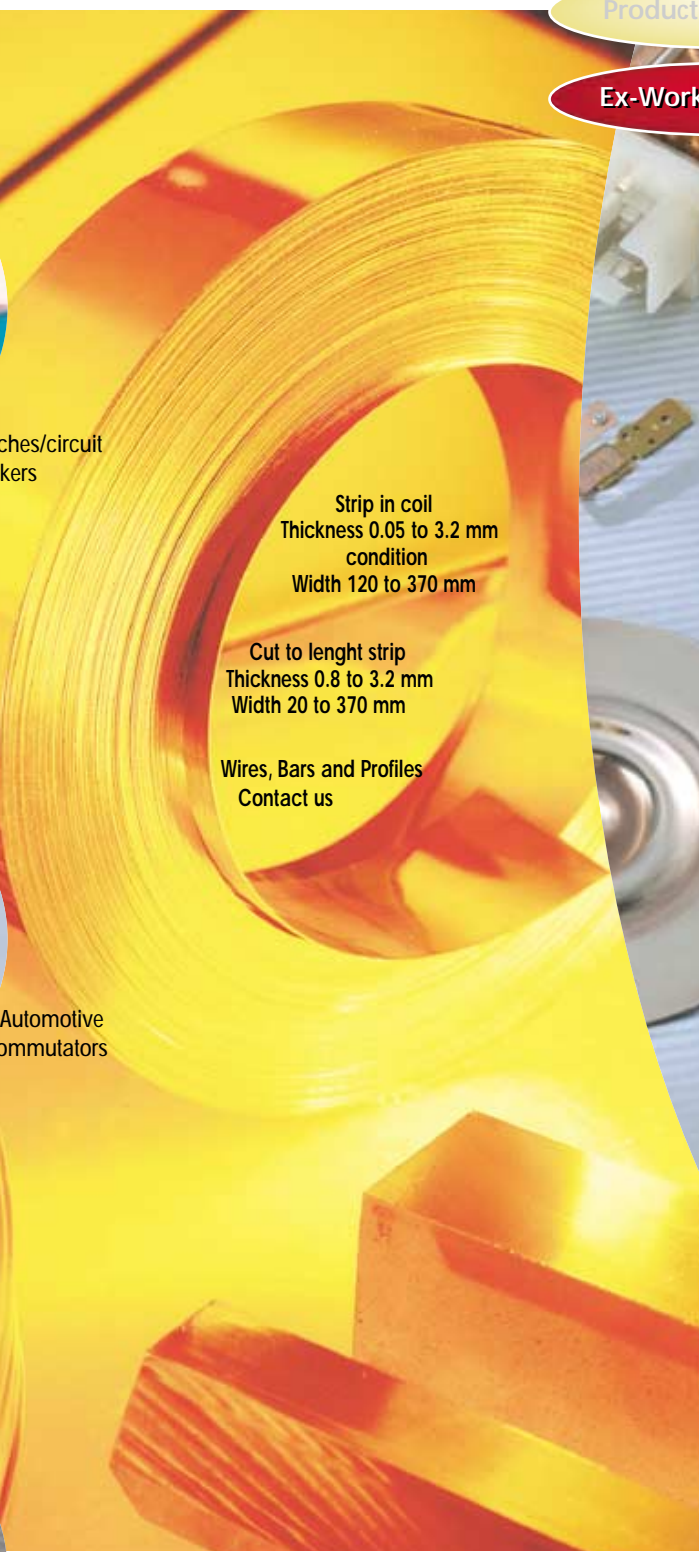
Automotive
commutators



Bars,
forged blocks
for plastics
technology.
Contact us



Relay springs
Washers for pressure / washers
for pressure sensitive switch



Strip in coil
Thickness 0.05 to 3.2 mm
condition
Width 120 to 370 mm

Cut to lenght strip
Thickness 0.8 to 3.2 mm
Width 20 to 370 mm

Wires, Bars and Profiles
Contact us

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