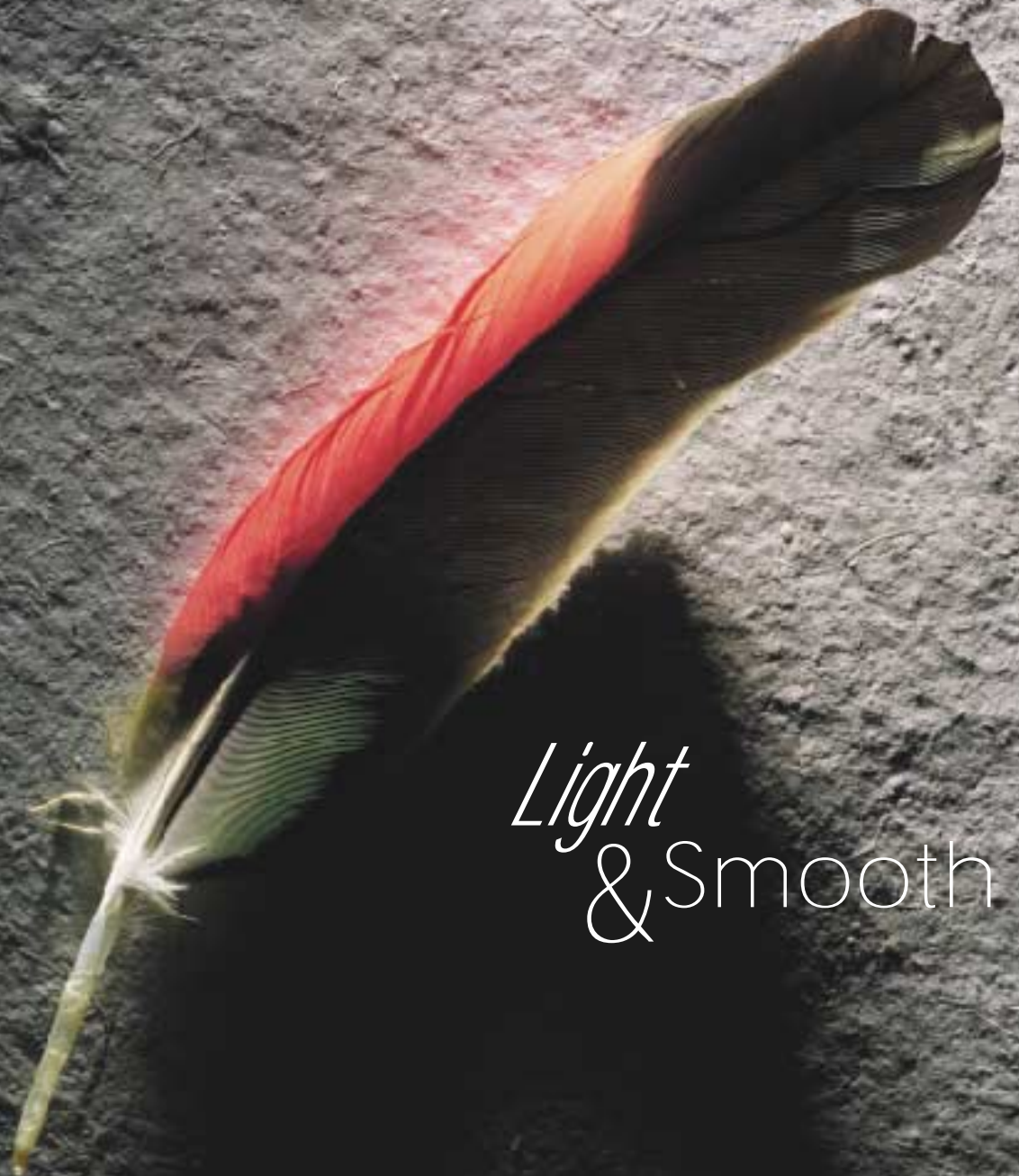


NICLAFOR® 1000



Light
& Smooth





Niclafor® 1000

General features

Mechanical properties/temper

Heat treatment

Temperature resistance

Welding and Brazability

Today, the Industry is looking at a new generation of high technical parts with the following properties : reduction in sections, high mechanical properties even at high temperature, high spring properties, high conductivity, good resistance to corrosion, low permeability, good formability, long life duration. Whilst designing

Niclafor® 1000, CLAL-MSX has taken

Light & Smooth into consideration those elements adding a sense of environmental concern by developing a material without Beryllium, Cadmium nor Titanium

CLAL-MSX offers the next century generation of alloys for the next century generation of metallic parts.

CLAL-MSX has been investing up to 10% of its total annual investment program in environmental improvement on site over the past five years.



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Temper designation

- TB Quenched
- TF Quenched Precipitation heat treated
- TD Quenched cold rolled
- TH Quenched cold rolled Precipitation heat treated

GENERAL FEATURES

Niclafor® 1000

General features

Chemical composition
Physical properties
Temper designation

Mechanical properties/temper

Heat treatment

Temperature resistance

Welding and Brazability

Chemical composition

	Ni	Sn	Mn	Pb	Zn	Fe	P	Cu
Min %	8.5	5.5	0.05					
Max %	9.5	6.5	0.3	0.03	0.5	0.5	0.02	Balance

Physical properties

Density	8.9	(g/cm ³)
Melting range	968-1078	(°C)
Coefficient of thermal expansion from 20 to 200 °C	17.25	(x 10 ⁻⁶ /°C)
Modulus of elasticity	120	(GPa)
Resistivity at 20 °C :		(μΩ.cm)
- quenched	≤ 19.5	
- precipitation hardened	≤ 15	
Electrical conductivity % IACS :		(% IACS)
- quenched	≥ 9	
- precipitation hardened (3h)	≥ 12	
Modulus of torsion	50	(GPa)
Thermal conductivity at 20 °C	53.6	(W/m.K)
Bending fatigue strength at 10 ⁸ cycles	450	(MPa)

Temper designation

Quenched	Quenched precipitation heat treated	Quenched cold rolled	Quenched cold rolled precipitation heat treated
TB	TF	TD	TH

Tempers

TB	Maximum plasticity (drawing, stamping, bending)
TD1-2	Formability, bending possible
TD3-4-X	Less formability, bending with a radius, stamping.
TF	Increasing elasticity up to the maximum
TH1-2-3-4-X	Better conductivity Very good fatigue properties Less formability

From these standard precipitation heat treated tempers, some compromises can be obtained by adapting the temperature or the duration of the heat treatment.

NICLAFOR® 1000

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MECHANICAL PROPERTIES/TEMPER

Mechanical properties/temper

Rolled products
Drawn products

Heat treatment

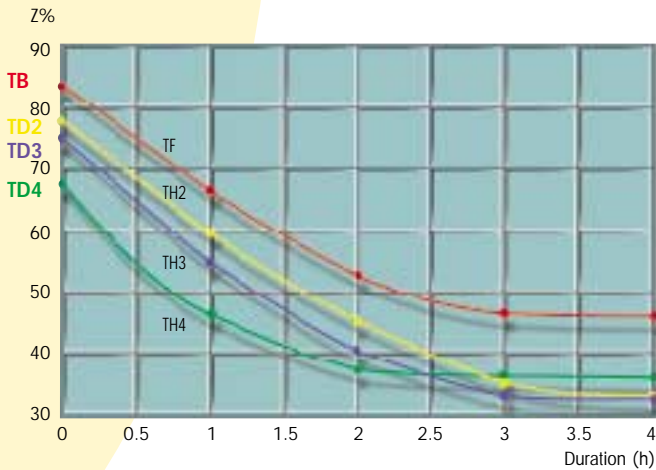
Temperature resistance

Welding and Brazability

Rolled products

Temper	Hardness HV	Tensile Strength Rm (MPa)	Yield Strength Rp 0.2 (MPa)	Elongation A _{50 mm} (%)	Bending*		Rigidity, Elasticity bending fatigue (MPa)	
					longitudinal //	transverse ⊥	longitudinal //	transverse ⊥
QUENCHED								
TB	90 to 125	420 to 500	≥ 200	≥ 30	0.2	0.2	302	220
QUENCHED/COLD ROLLED								
TD1	140 to 180	460 to 560	≥ 300	≥ 15	0.2	0.2	216	359
TD2	160 to 200	540 to 640	≥ 400	≥ 10	0.2	0.2	275	390
TD3	200 to 240	620 to 720	≥ 550	≥ 3	0.5	0.5	444	523
TD4	220 to 260	700 to 820	≥ 600	≈ 1	4	1	467	568
TDX	≤ 320	≥ 780	≥ 650	≈ 1	10	2	472	613
QUENCHED/PRECIPITATION HEAT TREATED								
TF	230 to 270	740 to 860	≥ 510	≥ 10	0.5	0.5	566	634
QUENCHED/COLD ROLLED/PRECIPITATION HEAT TREATED								
TH1	270 to 310	850 to 950	≥ 650	≥ 8	2	2	684	724
TH2	290 to 320	880 to 980	≥ 720	≥ 8	2	2	730	770
TH3	310 to 340	950 to 1050	≥ 800	≥ 4	5	5	829	≥ 840
TH4	320 to 360	1000 to 1100	≥ 900	≈ 3	10	5	≥ 830	≥ 840
THX	≤ 390	≥ 1050	≥ 950	≈ 1	15	5	≥ 830	≥ 840

* 90° bending accross and in the rolling direction.
According to DIN 5011 dated 25/10/85
Figures represent min $\frac{\text{bending radius}}{\text{thickness}}$



NICLAFOR® 1000 drawn products - temper TF-TH at 350°C

Striction coefficient chart with regards to heat treatment duration.

Drawn products

Tempers	Hardness HV	Tensile Strength Rm (MPa)	Yield Strength Rp 0.2 (MPa)	Elongation A _{50 mm} (%)	Striction Coeff. Z%
TB	≤ 150	400 to 500	≥ 200	≥ 30	≥ 80
QUENCHED COLD ROLLED					
TD1	150 to 180	500 to 580	≥ 300	≥ 10	≥ 75
TD2	180 to 230	550 to 720	≥ 500	≥ 3	≥ 70
TD3	220 to 260	700 to 800	≥ 600	≥ 2	≥ 65
TD4	230 to 300	780 to 880	≥ 700	≥ 1.5	≥ 60
TDX	250 to 320	880 to 1000	≥ 800	≥ 0.1	≥ 50

Drawn products

Tempers	HV	Rm (MPa)	Rp 0.2 (MPa)	A _{50 mm} (%)	Z%
TF	≤ 260	770 to 870	≥ 500	≥ 20	≥ 40
QUENCHED COLD ROLLED PRECIPITATION HEAT TREATED					
TH1	260 to 300	870 to 970	≥ 700	≥ 13	≥ 30
TH2	290 to 310	930 to 1030	≥ 800	≥ 8	≥ 30
TH3	310 to 330	1000 to 1100	≥ 900	≥ 5	≥ 30
TH4	330 to 360	1100 to 1200	≥ 1000	≥ 2	≥ 30
THX	≥ 350	1175 to 1300	≥ 1100	≥ 0.5	≥ 30

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HEAT TREATMENT

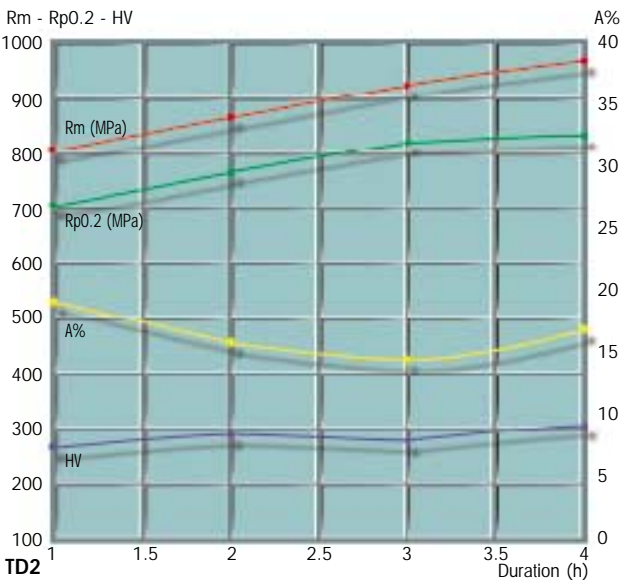
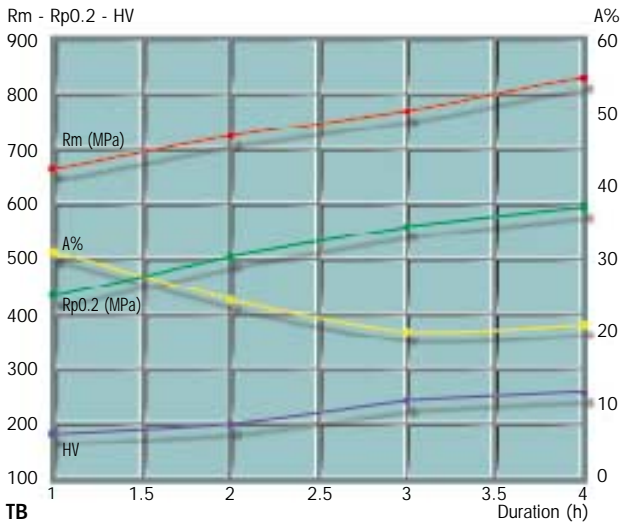
Mechanical properties/temper

Heat treatment

Annealed and quenched tempers

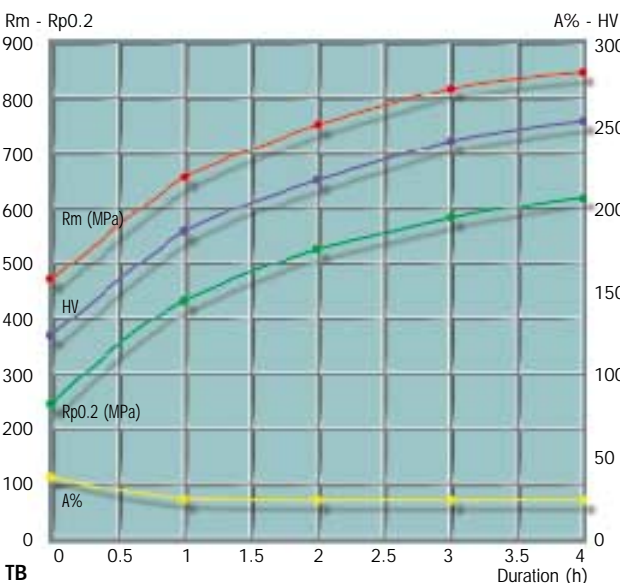
Temperature resistance

Welding and Brazability



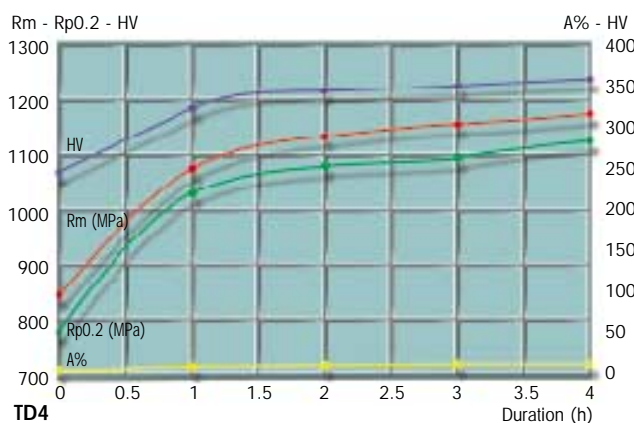
NICLAFOR® 1000 drawn products TF temper at 350°C.

Mechanical properties chart depending on heat treatment duration based on TB material.



NICLAFOR® 1000 drawn products TH4 temper at 350°C.

Mechanical properties chart depending on heat treatment duration based on TD4 material.



Precipitation heat treated tempers

To obtain temper : **TF TH1 TH2 TH3 TH4 THX**
from temper : **TB TD1 TD2 TD3 TD4 TDX**

Temperature of the precipitation heat treatment	350 °C ± 5°C
Duration (hours)	3h
Cooling	Fast in air

The best process in order to obtain better surface quality :

- make the heat treatment in protective atmosphere
- load the metal when the furnace is at temperature
- ideal cooling : after 3 hours, removal of the protective gas and injection of a cold inert gas (argon, nitrogen)

Quenched tempers

The quenching can be made on any temper to come back to initial temper TB

- make the heat treatment in protective atmosphere
- load the metal when the furnace is at temperature
- Temperature : 780° - 830° C
Duration : 5 to 20 mn according to the section and load
- **Fast** cooling in water
Quenching speed >5°C/second

Mechanical properties/temper

Heat treatment

Temperature resistance

Ageing for 1000 H at 260°C

Thermal shock at 400°C for 30 mn

Welding and Brazability

TEMPERATURE RESISTANCE

Ageing for 1000 H at 260°C

Niclafor® 1000 was tested at TH4 temper.

(See below).

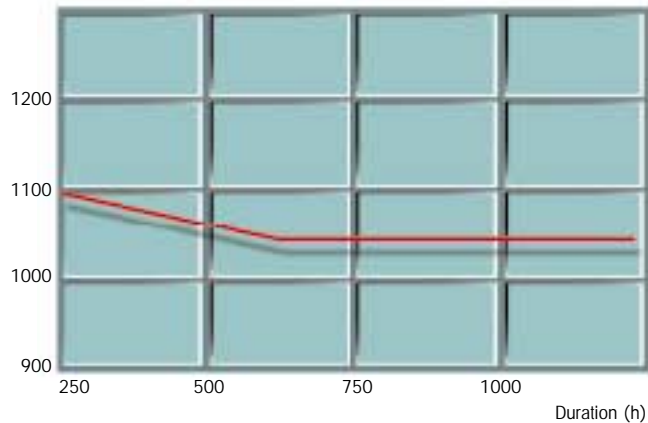
The traction properties are about stable in time.

Ageing test 1000 H at 260°C

	Tensile Strength Rm (MPa)	Yield Strength Rp 0.2 % (MPa)	Elongation A %
TH4 Temper	1150	1070	6-7
Ageing 250 H - 260°C	1150	1080	6-7
Ageing 500 H - 260°C	1100	1050	6-7
Ageing 750 H - 260°C	1125	1060	6-7
Ageing 1000 H - 260°C	1160	1060	5-6

Graph 1

Rp0.2 % (MPa)



Thermal shock at 400°C for 30 mn

The mechanical properties decrease by about 10 %.

Thermal shock 30 mn at 400°C

	Tensile Strength Rm (MPa)	Yield Strength Rp 0.2 % (MPa)	Elongation A %
TH4 Temper	1150	1070	6-7
Thermal shock 1/2 H - 400°C	1050	970	7-8
Reduction of properties in %	≈ 10 %	≈ 10 %	≈ 15 %

These two tests show the **very good temperature resistance of Niclafor® 1000.**

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Temper designation

TB Quenched

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TD Quenched cold rolled

TH Quenched cold rolled Precipitation heat treated

WELDING AND BRAZABILITY



Mechanical
properties/temper

Heat
treatment

Temperature
resistance

Welding
and Brazability

Brazability

Availability

Applications

Brazability

Wettability :

- TEST
 - observation of the spreading on a piece of **Niclafor® 1000**
 - observation of the migration in T shaped joint.
- CONDITIONS
 - brazing alloys tested
 - Ref. : CS 111 - (Ag 55 - Cu 21 - Zn 22 - Sn 2)
 - Melting range : 630-660°C
 - Mechanical properties : Rm : 510 MPa - A % : 11
 - Ref. : CS 77 - (Ag 38 - Cu 31 - Zn 28.8 - Sn 2.2)
 - Melting range : 660-700°C
 - Mechanical properties : Rm : 520 MPa - A % : 18
 - flux U1 (recommended temperature : 500-800°C)
 - heating with a torch
- RESULTS
 - Good wettability for both brazing alloys**

Mechanical properties of the brazed joint :

- CONDITIONS
 - (brazing alloys CS 111 and CS 77 - Flux U1)
 - 5 mm simple overlapping sample
- RESULTS
 - Average shearstress by traction :
 - CS 77 : 108 MPa
 - CS 111 : 116 MPa
- CONCLUSION
 - Good mechanical strength of the brazed joint with both brazing alloys**

Availability

- Wire, rod, strip in coils.
- Sheet, plate, special profiles.

Applications

- Electrotechnic
- Electromechanic
- Electronic
- Connectic
- Automotive
- Domestic appliances
- Spectacle industry
- Turned parts.

NICLAFOR® 1000

Temper designation

TB Quenched
TF Quenched Precipitation
heat treated
TD Quenched cold rolled
TH Quenched cold rolled
Precipitation
heat treated

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