

DECLAFOR 1015

CuNi8Sn5Te – Hardenable spinodal Cu-Ni based alloy

Features and Particularities

The DECLAFOR 1015 is a hardenable Cu-Ni based spinodal alloy. The spinodal hardening reaction is a decomposition of the matrix into coherent phases of composition and properties depending on the prior composition and condition of the matrix and of the treatment temperature and holding time. The spinodal reaction permits to cover a large range of properties, it is optimal at 365°C. This alloy exhibits high mechanical properties and has a moderate fair machinability.

Uses

The DECLAFOR 1015 alloy is used to produce fittings, spectacle frames, wear resistant parts and turned parts for numerous industrial applications.

Standards

Material number: DECLAFOR 1015
This alloy has no standard

Chemical composition (%wt.)

Ni	Sn	others	Cu
7.5	5	max. 0.50	87

**Executions and Delivery conditions
Caractéristiques et Particularités**

- Round bars: ISO h6 (h9)
- Delivery condition: Thermally stress relieved
- Round bars: 3 m +50/0 pointed and chamfered
- Straightness: 0.5 mm/m
- Other executions on request

Availability

Standard dimensions on stock, see: [Delivery program](#)

**Table 1
Mechanical properties**

Standard condition of delivery:	Bars, diameter 1-5 mm			
Condition: annealed 780-800°C	Hv	Rm (MPa)	R _{0.2} (MPa)	A ₁₀₀ (%)
+ quenched + cold deformed				
TD1	140–160	460–500	370–480	≥ 7
TDX	>200	>630	>550	>2
Condition: annealed 780-800°C				
+ quenched + cold deformed + aging 365 (+0/5)°C/3h				
TH1	230–280	780–840	550–750	≥ 10
THX	280–320	950–1100	910–1000	≤ 11

Machining

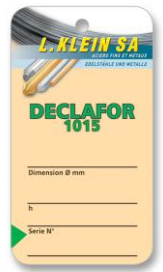
- Machinability indice: 20 average to difficult (CuZn39Pb3 = 100)
Cutting speed: 40 up to 100 m/min
Lubricant-coolant: individual choice
- The optimal cutting conditions depend on the machine tool, the cutting tools, the chip dimensions, the lubricant-cooling fluid, as well as the tolerances and surface the roughness to be achieved.

Annealing

- soft: 780-800°C
- stress relieve: bis 250°C

Hardening

- Typical hardening: 365(+0/-5)°C/3h/cooling ≥8°C/min



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Figure 1
Mechanical properties
Rm und R_{0.2}

Wires: 1- 5 mm

UTS/Rm and YS_{0.2}/R_{0.2} (Mpa)

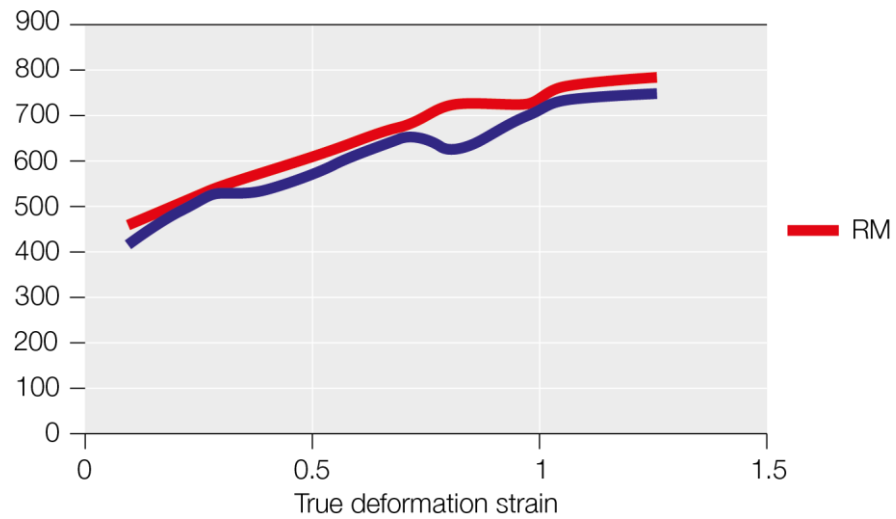


Figure 2
Mechanical properties
Hv₂₀

Wires: 1- 5 mm

Hardness Hv₂₀

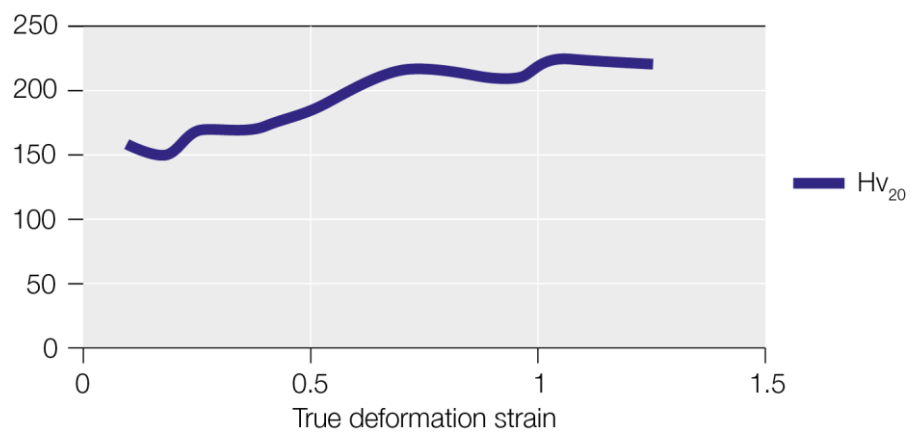
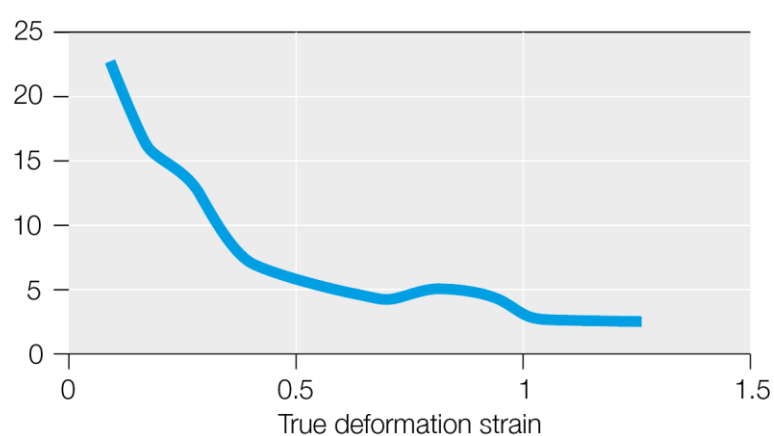
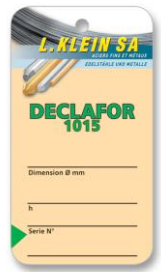


Figure 3
Mechanical properties
A₁₀₀ (%)

Wires: 1- 5 mm

Elongation A (%)





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Figure 4
 Values of Hv
 TD: annealed
 + cold worked
 TH: annealed
 + cold worked
 + aged
 Difference: TH-TD

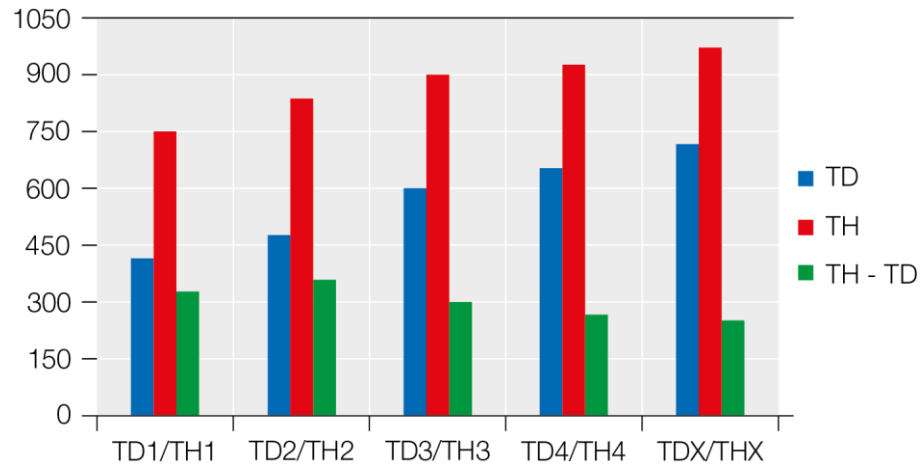


Figure 5
 Values of UTS/Rm
 TD: annealed
 + cold worked
 TH: annealed
 + cold worked
 + aged
 Difference: TH-TD

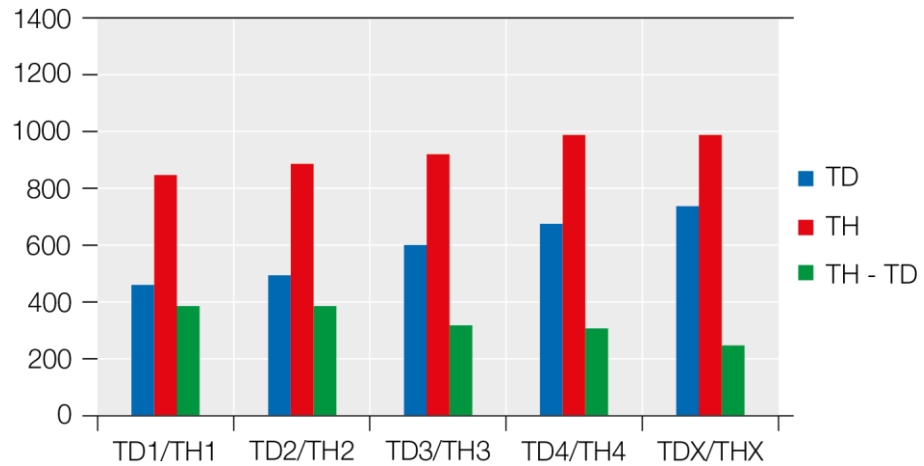
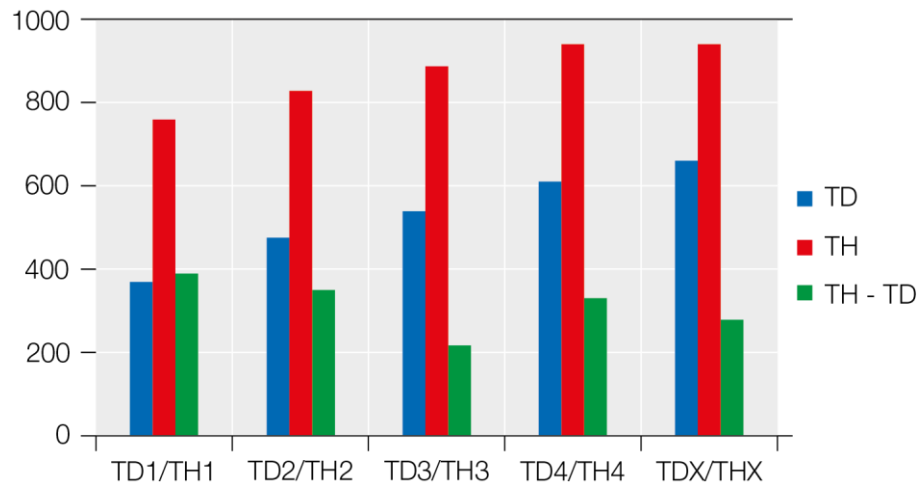
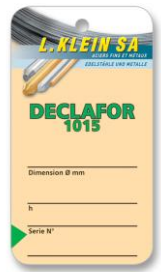


Abbildung 6
 Values of YS_{0.2}/R_{0.2}
 TD: annealed
 + cold worked
 TH: annealed
 + cold worked
 + aged
 Difference: TH-TD





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Spinodal hardening

- As shown by the Figures 4, 5 and 6, the spinodal hardening - TH - 365°C/3h – of the DECLAFOR 1015 spinodal alloy, is neither activated nor dependent on a prior cold deformation before hardening.
- The metallurgical conditions related to Figures 4, 5 and 6 are given in Table 1:

Table 2

Anneal	+ cold working	Designation	+ Hardening	Designation
790°C	ca.13% estimate	TD1	365°C/3h	TH1
790°C	ca.24% estimate	TD2	365°C/3h	TH2
790°C	ca.36% estimate	TD3	365°C/3h	TH3
790°C	ca.45% estimate	TD4	365°C/3h	TH4
790°C	ca.>50% estimate	TDX	365°C/3h	THX

Microstructure

- The DECLAFOR 1015 alloy is generally machine in the annealed + cold deformed TD condition.
- In the annealed condition, this alloy is single-phase cubic face centered.
- The single phase of the matrix decomposes into coherent phases of nanometric sizes of the (Cu_xNi_{1-x})₃Sn type during the spinodal hardening. This thermal decomposition reaction is optimal at 365°C.

Cold working and Forming

Warm: 750-950°C
Cold: can be cold worked to high deformation rates ≥75%.

Hardening

- The DECLAFOR 1015 alloy can be hardened by heat treatment

Cold working

- Cold working can easily strengthen the DECLAFOR 1015 alloy.

Marking

Laser well adapted

Welding

Gas: average
Arc: average
Au Laser: very well adapted
Electron beam: very well adapted
WIG: very well adapted
MIG: sufficient
Resistance: well adapted

Brazing Soldering

- Hard: well adapted
- Soft: well adapted

Gluing

Very well adapted

Electroplating

- Generally well adapted

Polishing

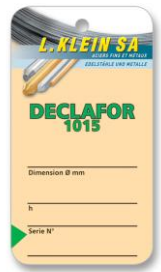
- Mechanical: well adapted
- Electrolytic: well adapted

Potential distortions

- The coherent spinodal hardening of the DECLAFOR 1015 alloy is de facto isotropic. It means that no dimensional changes or distortion occurs.

Color

- Rosa



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Table 3
Corrosion resistance

Atmosphere	Resistance	Medium	Resistance
Country side	resistant *	Non-oxidizing acids	resistant
Industry	resistant *	Dry gases O ₂ , Cl, Chlorinated water	resistant
Marine	resistant *	Water	resistant
Humidity	resistant *	Human sweat	non-resistant
High halogenes containing Gas	non-resistant	Cyanides	non-resistant
Hydrogen disulfide and sulfides	non-resistant	Halogens	non-resistant
Ammoniac	non-resistant	Oxidizing acids	non-resistant
Stress corrosion cracking	not-sensitive	Ammoniac solutions	non-resistant

* can build up an auto-adhering protection layer

Table 4
Physical Properties

Properties	Unit	Temperature (°C)			
		20	100	200	300
Density	g.cm ⁻³	8.8			
Young modulus E	GPa	115			
- cold worked		117			
Electrical resistance	μΩ.cm	13			
Specific electrical conductivity	% IACS	13		7.8	
Coefficient of thermal expansion	m.m ⁻¹ .K ⁻¹ 10 ⁻⁶		20–100°C	20–200°C	20–300°C
Thermal conductivity	W.m ⁻¹ .K ⁻¹	55			
Melting Solidus	°C	960			
Magnetism	non-ferromagnetic				

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