CuNi7.5Sn5 – Hardenable spinodal Cu-Ni based alloy

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.

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

Material number DECLAFOR 1015
This alloy has no standard

Chemical composition (%wt.)

<table>
<thead>
<tr>
<th></th>
<th>Ni</th>
<th>Sn</th>
<th>others</th>
<th>Cu</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7.5</td>
<td>5</td>
<td>max. 0.50</td>
<td>87</td>
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</tbody>
</table>

Executions and Delivery conditions

- 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

| Condition: annealed 780-800°C + quenched + cold deformed | Bars, diameter 1-5 mm |
|---|---|---|---|
| Condition: annealed 780-800°C + quenched + cold deformed + aging 365 (+0/-5)°C/3h |
| TH1 | 230–280 | 780–840 | 550–750 | ≥ 10 |
| THX | 300–330 | 950–1100 | 910–1000 | ≤ 11 |

Machinability index: 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 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
CuNi7.5Sn5 – Hardenable spinodal Cu-Ni based alloy

Figure 1
Mechanical properties
Rm und R$_{0.2}$
Wires: 1-5 mm

Figure 2
Mechanical properties
Hv$_{20}$
Wires: 1-5 mm

Figure 3
Mechanical properties
A$_{100}$ (%)
Wires: 1-5 mm
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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>
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<tr>
<th>Anneal</th>
<th>+ cold working</th>
<th>Designation</th>
<th>+ Hardening</th>
<th>Designation</th>
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<td>TD1</td>
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<td>ca.24% estimate</td>
<td>TD2</td>
<td>365°C/3h</td>
<td>TH2</td>
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<tr>
<td>790°C</td>
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<td>TD3</td>
<td>365°C/3h</td>
<td>TH3</td>
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<td>365°C/3h</td>
<td>THX</td>
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</table>

**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 $(\text{Cu},\text{Ni},\text{Sn})_3$ type during the spinodal hardening. This thermal decomposition reaction is optimal at 365°C.

**Cold working and Forming**
- Warm: 750-950°C can be cold worked to high deformation rates ≥75%.
- 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**
- Hard: well adapted
- Soft: well adapted

**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
DECLAFOR 1015

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<table>
<thead>
<tr>
<th>Properties</th>
<th>Unit</th>
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<th>100</th>
<th>200</th>
<th>300</th>
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<td>Young modulus E</td>
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<td>- cold worked</td>
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<td>Electrical resistance</td>
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<td>Specific electrical</td>
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