# CuNiSi
# C19010
# STOL® 76

## 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<br>Weight percentage | | |
|---|---|---|
| Cu | Rest | % |
| Ni | 0.8 .. 1.8 | % |
| Si | 0.15 .. 0.35 | % |
| Others | ≤ 0.8 | % |

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<br>Typical values in annealed temper at 20 °C | | |
|---|---|---|
| Density | 8.9 | g/cm³ |
| Thermal expansion coefficient -191 .. 16 °C | 14.1 | $10^{-6}$/K |
| 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 .. 200 °C) | 2.0 | $10^{-3}$/K |
| Modulus of elasticity ( 1 GPa = 1 kN/mm²) cold formed | 135 | GPa |
| annealed | 118 | GPa |

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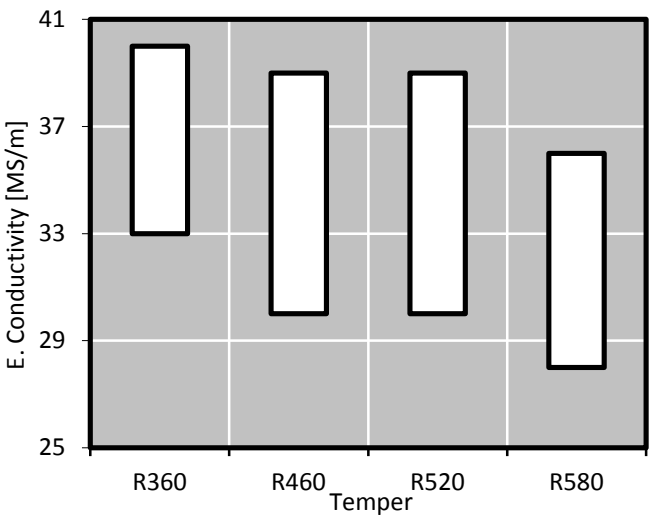
| **Mechanical Properties** | | | | |
|---|---|---|---|---|
| **Temper** | **Tensile Strength** **Rm** | **Yield Strength Minimum** **$Rp_{0.2}$** | **Elongation Minimum** **$A_{50mm}$** | **Hardness** **HV *** |
| | MPa | MPa | % | HV |
| **R360** | 360 .. 430 | 300 | 12 | 100 .. 130 |
| **R410** | 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<br>Max. 80% between annealings | Excellent |
| Hot Forming Properties<br>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:<br>STOL® 76 has good corrosion resistance. |
| The alloy is insensitive to stress corrosion cracking |

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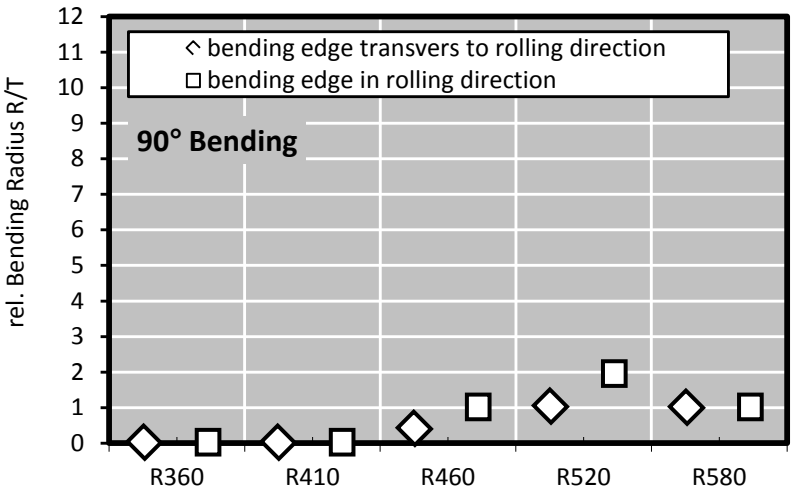
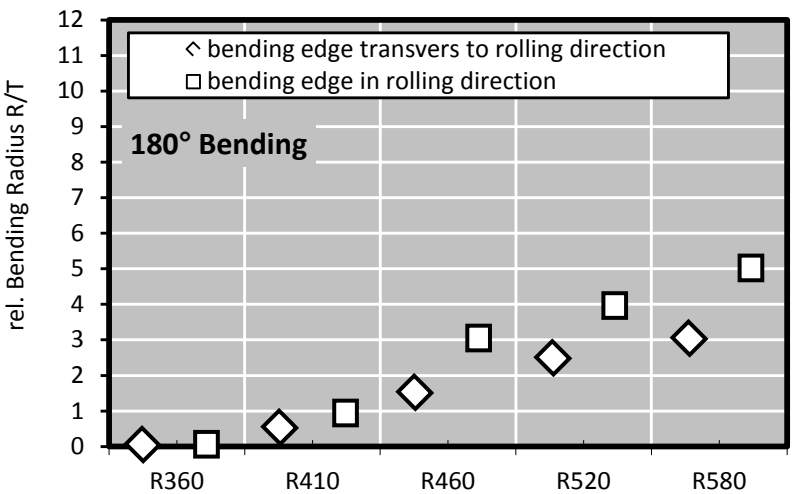
## Bending Properties  Thickness: ≤ 0.5 mm  stress relieved



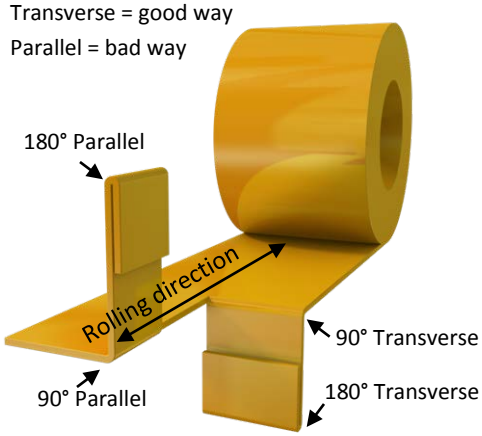

Bending test according to EN ISO 7438 is done with 10 mm wide samples. Smaller samples in general – as well as lower thickness – allow a lower bending radius without cracks. If needed we supply bending optimized temper classes that far exceed standard quality.

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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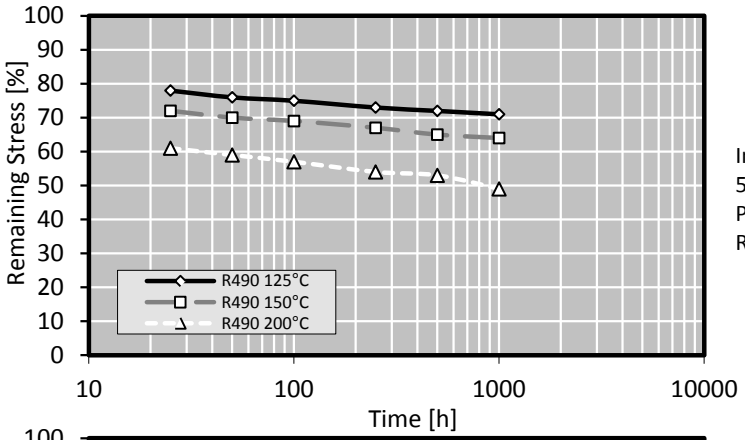
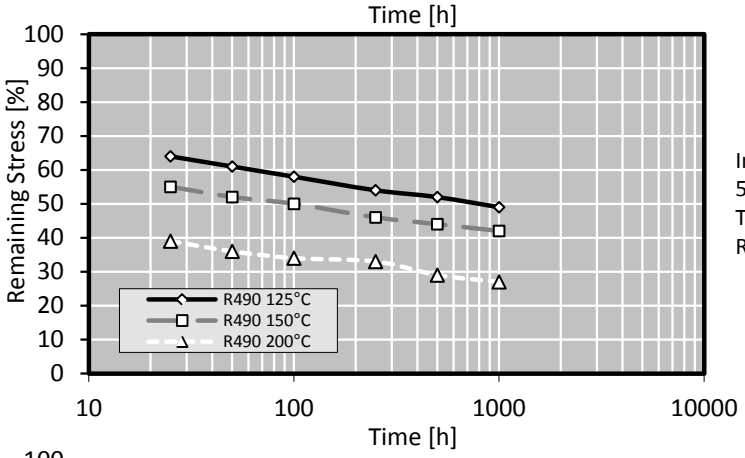
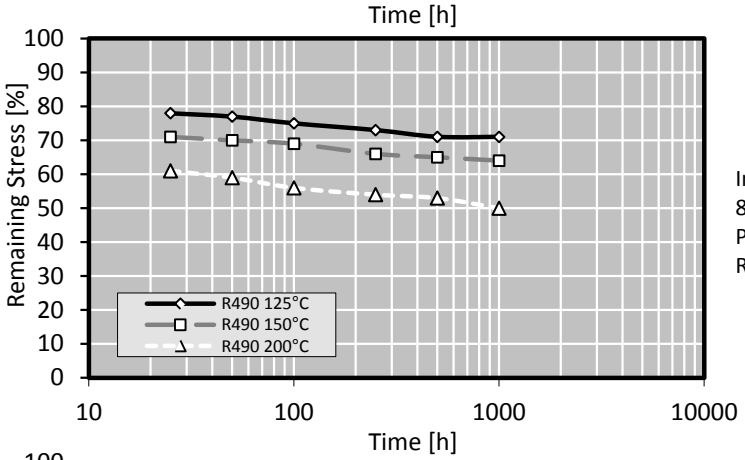
**Relaxation Properties** **Cold rolled** Thermal stress relieved



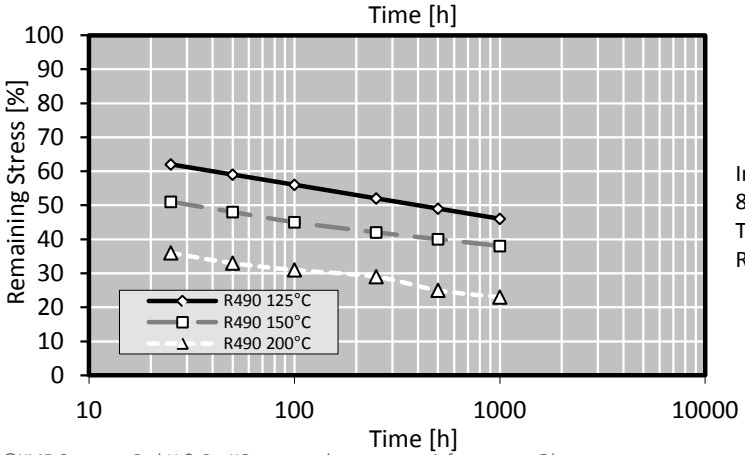

Initial Stress:
50% of Rp0.2
Parallel
Rolling Direction




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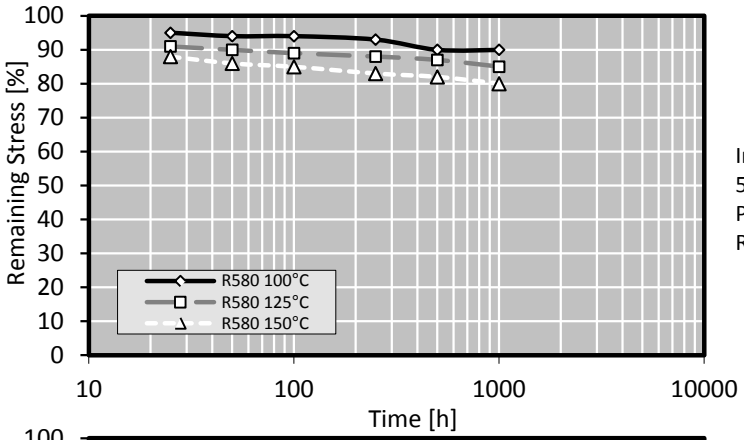
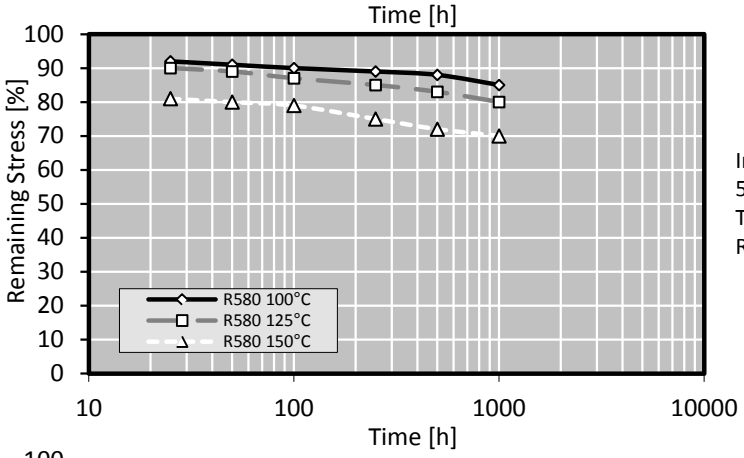
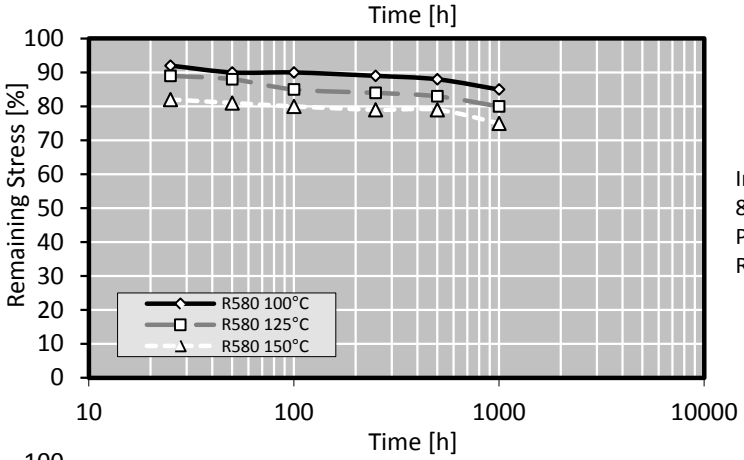
**Relaxation Properties** **Age hardened by NiSi precipitations** Thermal stress relieved



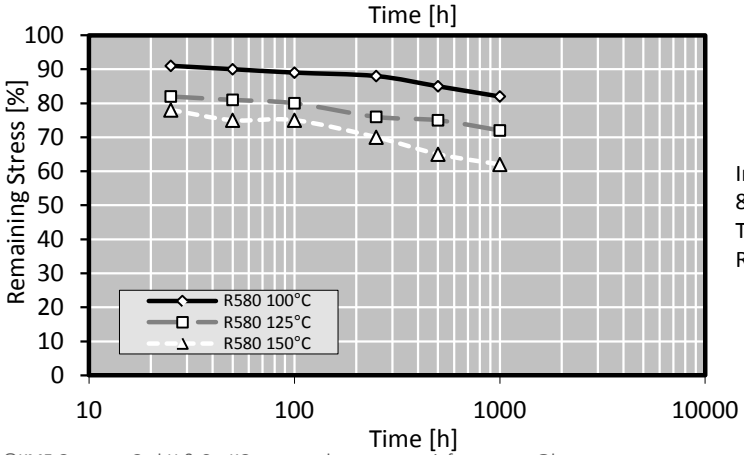

Initial Stress:
50% of Rp0.2
Parallel
Rolling Direction




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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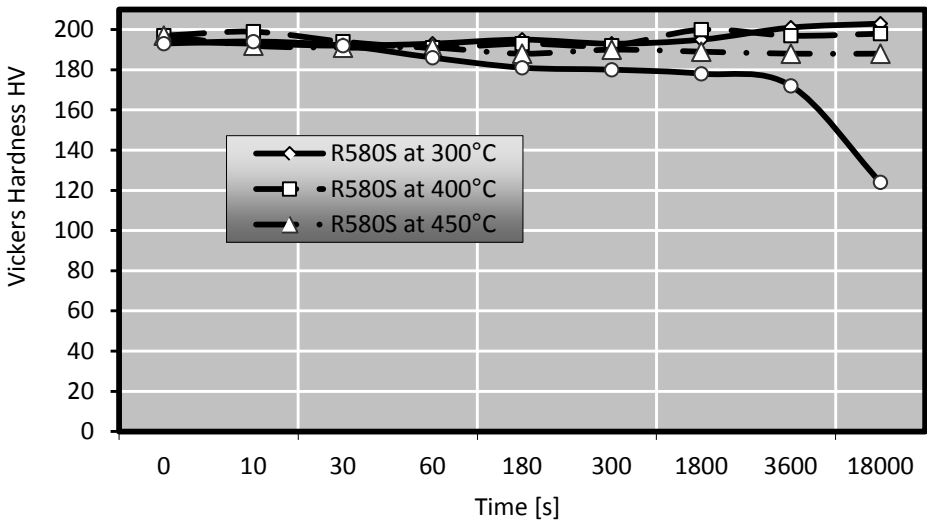
## Softening Resistance




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 $R_m$.

| 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 |

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