



Stainless Steel Type

Martensitic stainless steel, with Nitrogen addition.

Product Features

The high carbon and nitrogen content of UGINE 4116N leads to a very attractive corrosion resistance versus hardness properties. It can replace grades 1.4112 / 1.4125 (AISI 440B and 440C) in many applications.

- Processing similar to type 1.4034 (AISI 420) stainless steel, therefore much easier than 1.4112 / 1.4125 (AISI 440B and 440C)
- Recommended applications: pins, shafts, nozzles, wear resistant parts, etc. as a replacement of 1.4112 / 1.4125 or AISI 440B / 440C

Chemical Analysis

| C | Si | Mn | Cr | Mo | N | V | P | S |
|----------------|--------|--------|----------------|--------------|----------------|--------------|---------|---------|
| 0,480 0,550 | ≤ 1,00 | ≤ 1,00 | 14,00 15,00 | 0,50 0,80 | 0.050 0.150 | 0,10 0,15 | ≤ 0,040 | ≤ 0,015 |

In wt%

Standards

EN 10088-3 : 1.4116 X50CrMoV 15

NF A-36-74 : 1.4116

SEW 400 : 1.4110

Available Product Forms

- Bars
- Wire Rod
- Drawn wire

Physical Properties

| | |
|--|----------------------------|
| Specific Weight | 7700 kg/m ³ |
| Young's Modulus at 20°C | 215 000 N/mm ² |
| Electrical Resistivity at 20°C | 650 μΩ.mm (at 20°C) |
| Thermal Conductivity at 20°C | 30 W/m°C |
| Mean Linear Expansion Coefficient between 20°C and 300°C | 11,2 X 10 ⁻⁶ °C |

Heat Treatment

- Annealing

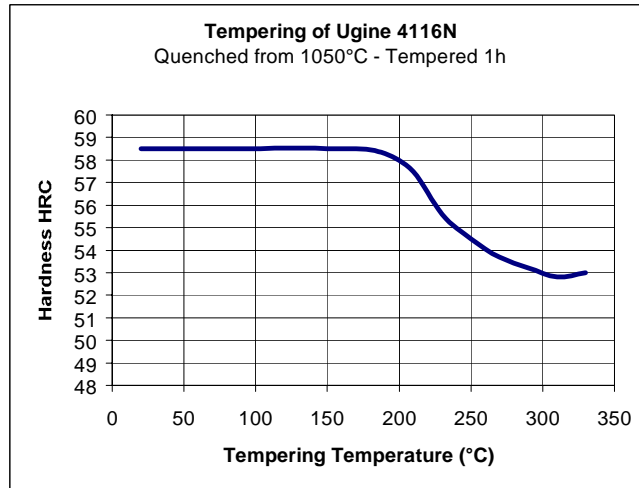
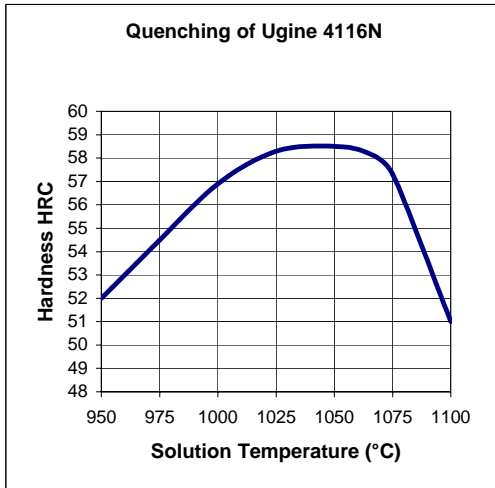
For minimum hardness, grade 4116N should be treated at about 840°C a few hours followed by very slow cooling. The hardness thus obtained lies around 210 HV_{1kg}.

- Solution Treatment and Quenching:

Oil quench or air cooling should be carried out from a recommended solution temperature of 1050°C.

- Tempering

See below the curve that was obtained after a 10 minutes solution annealing treatment at 1050°C followed by air cooling. Tempering at 200°C achieves a good hardness / toughness balance.



Mechanical Properties

The following Table summarizes the mechanical properties at room temperature which may be obtained.

| Condition | Hardness | Impact Values KCV |
|--|----------|-----------------------|
| Fully Annealed | 210 HV | - |
| Air Cooled from 1050°C + Tempered 200°C/1h | 57.5 HRC | 6.7 J/cm ² |
| Air Cooled from 1050°C + Cryogenic Cooling (-80°C/1h) + Tempering 200°C/1h | 58.1 HRC | 2.3 J/cm ² |

Comparison with higher-carbon stainless steel grades

| | UGINE 4116N | 1.4112 (AISI 440B) | 1.4125 (AISI 440C) |
|--|---------------------|---------------------|-----------------------|
| Max Hardness HRC (Solution Anneal T°) | 58.5 HRC (1050°C) | 59 HRC (1030°C) | 61 HRC (1030°C) |
| Hardness HRC (Quench + Temper 200°C / 1h) | 57.5 HRC | 57 HRC | 60 HRC |
| Impact Values KCV (Quench + Temper 200°C / 1h) | 6 J/cm ² | 2 J/cm ² | 1.5 J/cm ² |

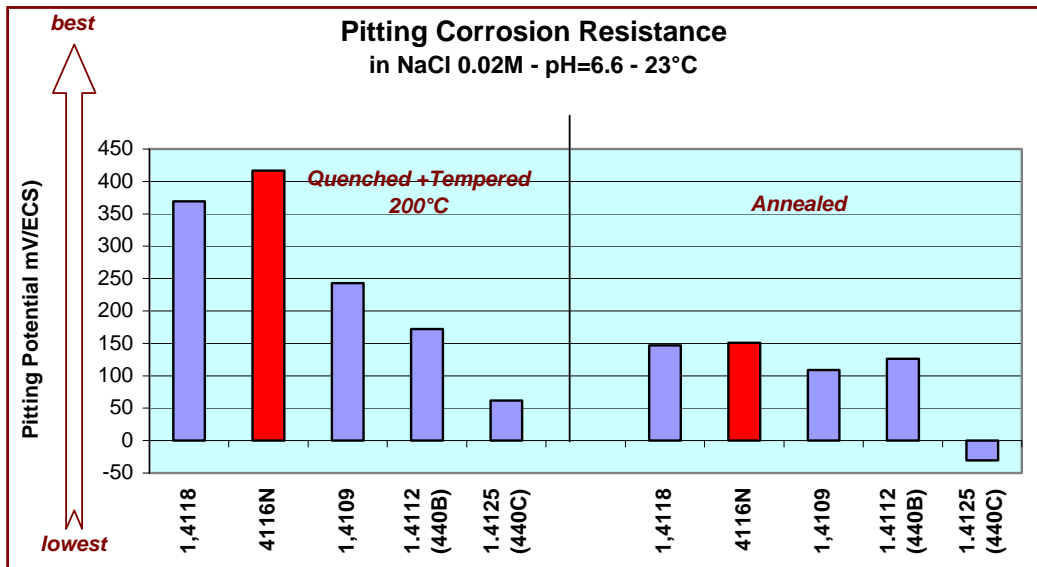
Corrosion Resistance

The corrosion behavior of UGINE 4116N is similar to that of grade 1.4021 (AISI 420), better than that of 1.4112 / 1.4125 (AISI 440B and 440C).

Pitting Corrosion

UGINE 4116N performs better than high-carbon martensitic grades such as 1.4109, 1.4112 and 1.4125.

The pitting corrosion resistance is better in the Tempered than in the Annealed condition, a feature that is similar for all high-carbon martensitic grades.



Forging

UGINE 4116N can be readily forged in the 950°C – 1200°C temperature range. Heating between 1180°C and 1200°C prior to forging is recommended, and forging temperatures should not decrease below 950°C.

After forging, a slow cooling to room temperature is necessary, followed by annealing treatment, if a minimum hardness is required.

Welding

Welding of grade UGINE 4116N is only possible with special precautions, and should be avoided whenever possible.

Machining

UGINE 4116N can be machined in the annealed condition. The machinability of UGINE 4116N is comparable to that of grade 1.4034 and significantly better than the machinability of grades 1.4112 and 1.4125 (AISI 440B / 440C).

Overall Comparison between UGINE 4116N and high-carbon Stainless Steel grades

| | UGINE 4116N | 1.4112 (AISI 440B) | 1.4125 (AISI 440C) |
|---|--|--------------------------|--------------------------|
| Chemical analysis (wt%) | | | |
| C min / max | 0.45 / 0.48 | 0.85 / 0.95 | 0.95 / 1.2 |
| Cr min / max | 14.5 / 15.0 | 17.0 / 19.0 | 16.0 / 18.0 |
| Mo min/ max | 0.45 / 0.55 | 0.9 / 1.3 | 0.4 / 0.8 |
| N min/ max | 0.08 / 0.10 | - | - |
| V min/ max | 0.10 / 0.15 | 0.07 / 0.12 | - |
| Hardness / mechanical properties | | | |
| Maximum Hardness (Solution Anneal Temperature) | 58.5 HRC (1050°C) | 59 HRC (1030°C) | 61 HRC (1030°C) |
| Hardness – Quenching + Tempering 200°C / 1h | 57,5 HRC | 57 HRC | 60 HRC |
| Impact - Quenching + Tempering 200°C / 1h | 6,7 J/cm ² | 1,8 J/cm ² | 1,3 J/cm ² |
| Pitting Potential (mV/ECS) | | | |
| Annealed specimens | Longitudinal Transverse | not tested 150 | 160 70 to 130 |
| Quenched and tempered specimens | Longitudinal Transverse | not tested 415 | not tested 330 |
| Machining | | | |
| Turning / Drilling | 4116N >> 1.4112 > 1.4125 | | |