

## UGI® 4116N

Chemical composition (% weight)	C	Si	Mn	Cr	Mo	N	V	P	S
	0,48 – 0,55	≤ 1,0	≤ 1,0	14.0 – 15,0	0,50 – 0,80	0,05 – 0,15	0,10 – 0,15	≤ 0.040	< 0,015

17-02-2016 – REV 08

### General presentation:

The high carbon and nitrogen content of UGI® 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.

### Classification:

Martensitic stainless steel, with Nitrogen addition.

### Designation:

UGI® 4116N is conformed to EN 10088-3: 1.4116 X50CrMoV15, NF A-36-74 : 1.4116 and SEW 400 : 1.4110

### 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/cm²
Air Cooled from 1050°C + Cryogenic Cooling (-80°C/1h) + Tempering 200°C/1h	58.5 HRC	2.3 J/cm²

### Comparison with higher-carbon stainless steel grades:

	UGI® 4116N	1.4112 (440B)	1.4125 (440C)
% C + N	0.6	0.9	1.0
% Cr mini / maxi	14.0 / 15.0	17.0 / 19.0	16.0 / 18.0
% Mo mini / maxi	0.50 / 0.80	0.9 / 1.3	0.4 / 0.8
Max Hardness (solution anneal T°)	58.5 HRC (1050°C)	59 HRC (1030°C)	61 HRC (1030°C)
Hardness (Quench+Temp. 200°C / 1h)	57.5 HRC	57 HRC	60 HRC
Impact values KCV (Quench+Temp. 200°C / 1h)	6 J/cm²	2 J/cm²	1.5 J/cm²

### Physical properties:

Temperature	Density	Weight of round bars	Elastic modulus	Thermal conductivity	Expansion coefficient	Electrical resistivity
(°C)	(kg/m³)	Kg/m	(N/mm²)	(W/m.°C)	(/°C)	(μΩ.mm)
20	7700	0,00605 D <sup>2</sup>	215 000	30		650
Between 20 and 300					11,2 X 10 <sup>-6</sup> °C	

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### Corrosion resistance:

environment	behavior
Nitric Acid	Medium
Phosphoric Acid	Not recommended
Sulfuric Acid	Not recommended
Acetic Acid	Not recommended
Soda	Medium
NaCl (Salt Fog)	Not recommended
Humidity	<b>Excellent</b>
Seawater	Not recommended

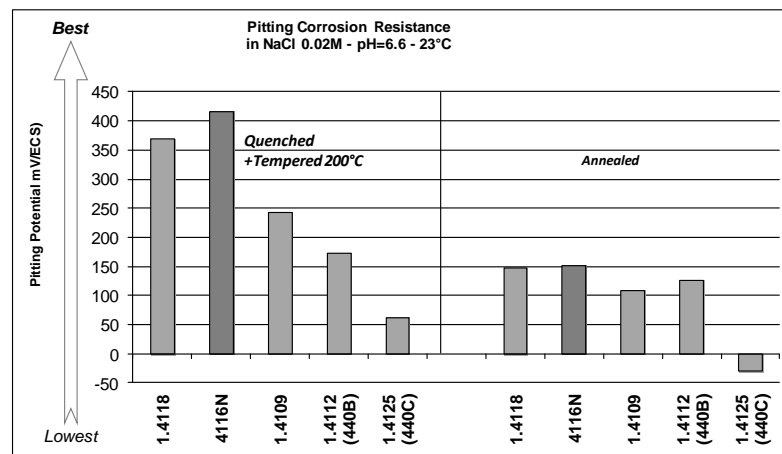
The corrosion behavior of UGI® 4116N is similar to that of grade 1.4021 (AISI 420), far better than that of 1.4112 / 1.4125 (AISI 440B and 440C).

#### Localized corrosion

##### Pitting corrosion

UGI® 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



### Hot transformation:

#### Forming

UGI® 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.

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### Machinability:

UGI® 4116N can be machined in the annealed condition. The machinability of UGI® 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 UGI 4116N and high-carbon Stainless Steel grades

	UGI® 4116N	1.4112 (AISI 440B)	1.4125 (AISI 440C)
<b>Chemical analysis (wt %)</b>			
	min / max	min / max	min / max
<b>C</b>	0.48 / 0,55	0.85 / 0.95	0.95 / 1.2
<b>Cr</b>	14.0 / 15.0	17.0 / 19.0	16.0 / 18.0
<b>Mo</b>	0.50 / 0.80	0.9 / 1.3	0.4 / 0.8
<b>N</b>	0.05 / 0.15	-	-
<b>V</b>	0.10 / 0.15	0.07 / 0.12	-
<b>Hardness / mechanical properties</b>			
Maximum Hardness (Solution Anneal Temperature)	58.5 HRC (1050°C)	59 HRC (1030°C)	61 HRC (1030°C)
Hardness – Quenching + Tempering 200°C / 1h	<b>57,5 HRC</b>	<b>57 HRC</b>	<b>60 HRC</b>
Impact - Quenching + Tempering 200°C / 1h	6,7 J/cm <sup>2</sup>	1,8 J/cm <sup>2</sup>	1,3 J/cm <sup>2</sup>
<b>Pitting corrosion (mV/ECS)</b>			
Annealed specimens	Longitudinal	-	160
	Transverse	<b>150</b>	<b>70 à 130</b>
Quenched and tempered specimens	Longitudinal	-	150
	Transverse	<b>415</b>	<b>330</b>
<b>Machining</b>			
Turning / Drilling	<b>4116N &gt; 1.4112 &gt; 1.4125</b>		

### Welding:

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



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### Heat treatment:

#### Solution annealing:

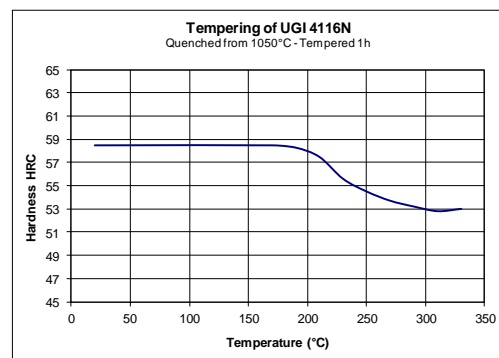
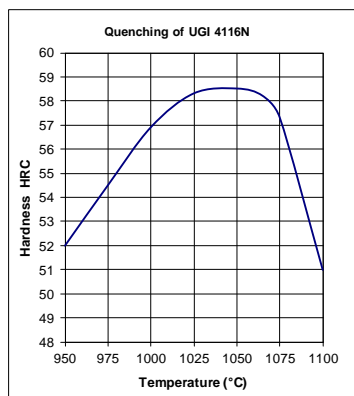
For minimum hardness, grade 4116N should be treated at about 840°C a few hours followed by very slow cooling. The hardness thus obtained lies around 210 HV<sub>1kg</sub>.

#### 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.



### Available Products:

Product	Form	Finition	Tolerance	Dimension (mm)
hot finished bars	round	Black		⊙ 23 - 115
		hot rolled descaled	K12 et K13	⊙ 22 - 115
	hexagonal	hot rolled descaled		⊙ 22 - 58
cold finished bars	round	turned & polished	ISO 9 - 10	⊙ 22 - 115
		bright drawn	ISO 9 - 10	⊙ 1,8 - 30
		ground	ISO 6 – 7 – 8 - 9	⊙ 1,5 - 70
	hexagonal	drawn		⊙ 3,0 - 60
Wire rod	round	pickled		⊙ 5,5 - 32
Drawn wire	round	matt		⊙ 1,0 - 14

Other formats: please contact us

### Applications:

- » Parts (pins, shafts, nozzles...) already made with 4112/4125 or 440B/C...High hardness requirements with a rather good corrosion resistance.

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