Technical Data Sheet
UGI® 4313

Chemical analysis (%)

C	Si	Mn	Ni	Cr	Mo	P	S	N
≤ 0.050	≤ 0.7	≤ 1.5	3.5 - 4.5	12.0 - 14.0	0.3 - 0.7	≤ 0.040	≤ 0.015	≥ 0.020

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General presentation

The UGI® 4313 grade is a low-carbon nickel-alloyed martensitic stainless steel which combines high mechanical properties, good impact strength and a corrosion resistance superior to that of conventional martensitic stainless steel grades with a high C content. It can be used between -60°C and +300°C.

Classification

Martensitic stainless steel.

Designation

Standardized material designation

Europe EN		USA	Japan	ISO 15510	
Number	Symbol	UNS	JIS	Number	Symbol
1.4313	X3CrNiMo13-4	S41500	SUSF6NM	4313-415-00-I	X3CrNiMo13-4

Microstructure

In the heat-treated condition (quenching + tempering), the microstructure of UGI® 4313 consists of tempered martensite. It may possibly contain traces of ferrite and residual austenite. Depending on the tempering temperature chosen, UGI® 4313 may contain up to about 15% of residual austenite.

Microstructure of UGI® 4313
(condition +QT780 lengthwise micrograph on bar)

Mechanical properties

Tensile data

On bars and wires in conditions 1C, 1E, 1D, 1X, 1G and 2D (terminology of the EN10088-3 standard):

Heat Treatment	Diameter d (mm)	Temperature T (°C)	Tensile strength UTS (MPa)	Yield strength $Rp_{0.2}$ (MPa)	Elongation at rupture E (%)
+A	≤ 160	20	≤ 1100	-	-
+QT700	≤ 160	20	700-850	≥ 520	≥ 15
+QT780	≤ 160	20	780-980	≥ 620	≥ 15
		100		≥ 590	
		200		≥ 560	
		300		≥ 530	
+QT900	≤ 160	20	900-1100	≥ 800	≥ 12
		100		≥ 720	
		200		≥ 665	
		300		≥ 620	

Swiss Steel Group

Production sites: Ugitech SA
www.swisssteel-group.com

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For typical mechanical values on quenched and tempered bars (QT), refer to the tempering curve in the Heat Treatment section.

In the drawn condition (cold-worked), the mechanical strength is higher and can typically be as high as UTS = 1200 MPa.

Impact strength data

On bars and wires in conditions 1C, 1E, 1D, 1X, 1G and 2D (Charpy tests):

Heat Treatment	Temperature T (°C)	Absorbed energy KV (J)
+QT700	20	≥ 70
+QT780	20	≥ 70
	-60	≥ 50
+QT900	20	≥ 50
	-60	≥ 40

Physical properties

Temperature (°C)	Density (kg/dm³)	Modulus of elasticity (GPa)	Thermal conductivity ($W.m^{-1}.K^{-1}$)	Coefficient of expansion (between 20°C and T°) ($10^{-6}.K^{-1}$)	Electrical resistivity (µΩ.mm)	Specific heat ($J.kg^{-1}.K^{-1}$)	Magnetism
20°C	7.7	200	25		600	430	Yes*
100°C		195		10.5			
200°C		185		10.9			
300°C		175		11.3			
400°C		170		11.6			

*: UGI® 4313 is ferromagnetic (it attracts the magnet), irrespective of its metallurgical condition. However, its magnetic properties (permeability, coercive force, remanence and polarization at saturation) depend on the conditions of heat treatment. It is a good candidate for applications where a compromise between mechanical strength, corrosion resistance and magnetism is required, for example for fuel injectors in the automotive sector. For more information, please consult us.

Corrosion resistance

Localized pitting corrosion

The resistance to localized pitting corrosion largely depends on the composition of the grade; calculation of the PREN pitting index (=%Cr + 3.3x%Mo +16x%N) gives us an indication of the pitting corrosion resistance. With a calculated average PREN of 15, UGI® 4313 has a better corrosion resistance than that of the AISI 420 series (1.4034; average calculated PREN of 13.5); but it remains less satisfactory than that of the AISI 431 series (1.4057; average calculated PREN of 17).

The pitting corrosion resistance of UGI® 4313 is therefore satisfactory in moderately aggressive environments, i.e. containing less than 100 ppm of chloride ions. It is improved with a surface condition having low roughness, obtained for example by electropolishing.

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Hot working
Forging
Heating to between 1150°C and 1200°C is recommended. Hot working (forging) of UGI® 4313 should preferably be performed in the temperature range between 1200°C and 900°C and be followed by air cooling. The behaviour of the UGI® 4313 grade during forging is similar to that of a 1.4301 type austenitic grade. After hot working, a complete heat treatment, consisting of austenitizing and quenching and then tempering, is recommended.

Cold working
Wire drawing – Shaping
UGI® 4313 is suitable for cold working by conventional methods.

Machinability
UGI® 4313 can be machined both in annealed condition (A) and in quenched and tempered conditions (QT). The annealed condition, due to its low mechanical properties, is more subject to chip sticking to the tools, which could accelerate tool wear and adversely affect post-machining surface conditions. The quenched and tempered conditions (QT) cause tool wear that is all the faster when they have high mechanical properties. Accordingly, the QT700 condition has the best machinability of the 4 available conditions.

The machinability of UGI® 4313 is similar to that of nickel-containing martensitic grade of the UGI® 4418 type. Our technical support department is at your disposal for any requests on the subject.

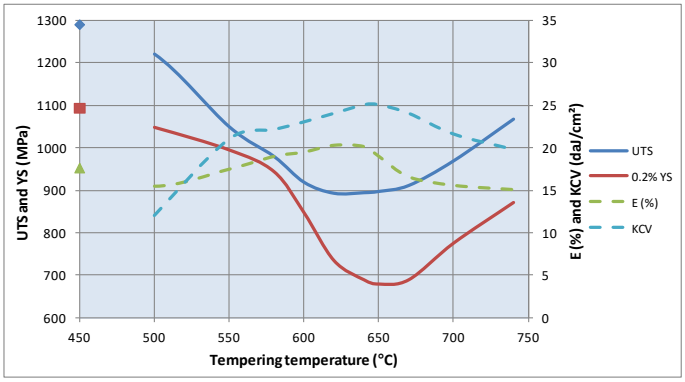
Heat treatment
Annealing
Annealing between 600°C and 650°C with cooling in air or in furnace, to be performed after martensitic transformation.

Quenching
Quenching should be performed maintaining a temperature in a range between 900°C and 1150°C followed by cooling in air or in oil.

Tempering
The choice of the post-quenching tempering temperature depends on the required mechanical properties. The temperatures recommended by EN 10088-3 are:

- +QT700: double tempering between 650°C and 700°C and between 600°C and 620°C
- +QT780: single tempering between 550°C and 620°C
- +QT900: single tempering between 520°C and 580°C

The following chart gives an example of a tempering curve on bars:



Example of tempering curve for UGI® 4313

Welding
UGI® 4313 can be welded by arc welding processes (GMAW, GTAW, SMAW, etc.) and by most other processes (spot, seam, laser, etc.). Thanks to its low carbon content and the nickel that it contains, UGI® 4313 is easier to weld than most martensitic stainless steels.

The martensite, poor in carbon, combined with the finely dispersed residual austenite, confers on the heat affected zones (HAZ) of UGI® 4313 good impact strength in the as-welded condition. UGI® 4313 is therefore relatively insensitive to cold cracking and preheating of the parts is normally not required, unless you have to weld very thick parts or parts having a shape that could engender high post-cooling weld stress concentrations (in such cases, preheating is recommended between 100°C and 200°C).

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For welding with a filler, if the Weld Metal (WM) does not require mechanical properties on a par with those of UGI® 4313, it is possible to use as filler wire an austenitic grade such as UGIWELD™ 316LM. In that case a post-welding heat treatment is generally not necessary.
If the WM has to ensure mechanical properties identical to those of UGI® 4313, a homogeneous filler wire can be used. In that case, a post-welding tempering heat treatment at 540-580°C is recommended. In MIG welding with homogeneous filler wire, choose a relatively non-oxidizing protective gas such as Ar + 1-2% CO_2 to avoid an excessively high rate of oxygen in the WM, thus ensuring good impact strength for these WMs.

Available products

Product	Form	Finish	Tolerance	Dimension	
Descaled rolled bars	Round		12 to 13	22 to 115	mm
Bars cold-worked by drawing, turning and grinding	Round		6 to 11	2 to 115	mm
Wire rod	Round	Pickled		5 to 32	mm

Other products: please consult us

Applications

UGI® 4313 is intended for the following applications (non-exhaustive list):

- Couplings, pumps, valves and compressors for chemical and petrochemical industries;
- Aerospace, automotive and engine applications (especially injection);
- Parts for power generation turbines;
- Medical instrumentation;
- Building, structures;
- Military and defense applications.