Technical Data Sheet
UGI® 4062

Chemical composition (%)

C	Si	Mn	Ni	Cr	Cu	Mo	N	P	S
≤0.03	≤ 1.0	≤ 2.0	2.0 – 2.8	22.0 – 23.8	≤0.50	≤0.45	0.16 – 0.26	≤ 0.040	‹ 0.010

Type analysis (weight %) - The analysis complies with a PREN (%Cr+3.3 %Mo + 16 %N) ≥ 25

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General presentation

UGI® 4062 is an austenitic-ferritic or duplex stainless steel with a minimum content of 22 % chromium and 2 % nickel, specially designed as an economically interesting alternative to the grades of the types 1.4301/1.4307 (AISI 304/304L) and 1.4310 (AISI 302/301).

This grade has high mechanical properties and its corrosion resistance is comparable to that of grades 1.4301/1.4310.

Classification Austenitic-ferritic / Duplex stainless steel

Standards

Material No.

Europe EN	USA UNS	Japan SUS
1.4062	S32202	

Other Material Description

USA	France	Germany	UK	Sweden
AISI	AFNOR	DIN	BS	S.S
	X2CrNiN22-2			

Microstructure

After "solution annealing" in the temperature range 980 °C – 1,050 °C, with water, oil or air cooling, UGI® 4062 is composed of ferrite and austenite in comparable quantities. As a result, it is partially ferromagnetic (it can be "magnetised").

During strong cold deformation (wire drawing, etc.), one part of the austenite is transformed into martensite and UGI® 4062 becomes more magnetic.

It is not advised to use UGI® 4062 above 300 °C in order to keep all its properties (refer to hot working paragraph).

Mechanical properties

As all austenitic-ferritic stainless steels, the solution annealed UGI® 4062 has a higher mechanical strength than the solution annealed 1.4301/1.4307 and 1.4310 type austenitic stainless steels.

Tensile strength and hardness at ambient temperature

Product	Condition*	Diameter (mm)	Tensile strength Rm (MPa)	Yield strength $Rp_{0,2}$ (MPa)	Elongation A (%)	Hardness HB
Bars and wires	Solution heat treated 1C 1E 1D 1X 1G	≤ 120	650-900	>380	> 30	< 290
Cold transformed bars	Solution heat treated 2H, 2B, 2G, 2P	<16	750-1,200	> 600	> 12	-
		16-40	650-1,100	>380	> 13	-
		40-63	650-1,100	>380	> 13	-
		63-120	650-1,000	>380	> 20	-
Drawn wires	Solution heat treated, cold-worked 2H	1.5-10**	900-1,500	-	-	-
		0.2-10 ***	1,200-2,500	-	-	-
	Cold transformed and annealed 2D	1-3	< 1,000	> 380	> 20	-
		3-5	< 950	> 380	> 20	-
		5-10	< 900	> 380	> 20	-

* as per EN10088 designations
**forming application
*** spring application in accordance with EN 10270-3

Swiss Steel Group

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

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Impact strength data

This grade is partially ferritic and has a ductile-brittle transition temperature which restricts its use in the case of large size bars at low temperature.

Temperature	Kv (J/cm²)
20 °C	> 50
-46 °C	> 10

Physical properties

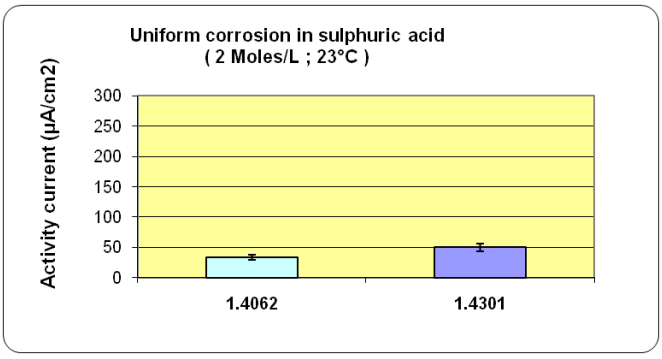
Temperature	Density	Modulus of elasticity	Thermal conductivity	Expansion coefficient (between 20 °C and T°)	Electrical resistivity	Specific heat
(°C)	(g/cm³)	(GPa)	(W/m. °C)	(10^{-6}/ °C)	(µΩ.mm)	(J/Kg. °C)
20	7.8	200	15	-	800	500
100	-	194	16	13.0	850	530
200	-	186	17	13.5	900	560
300	-	180	18	14.0	1000	590

* Duplex stainless steel data, for information

Corrosion resistance

Uniform corrosion

This corrosion mode mainly occurs in the chemical industry during manufacturing of sulphuric or phosphoric acids. An accelerated test to simulate this type of corrosion is carried out by measuring the density of dissolution or activity current density on a polarisation curve in a sulphuric acid environment of 2 moles/liter (200 g/liter) at 23 °C. The graph below gives the values of dissolution current in µA/cm² of the UGI® 4062 and the 1.4301 on wire rod (after mechanical polishing with SiC 1200 paper). The lower the values, the better the uniform corrosion resistance



The UGI® 4062 grade has a uniform corrosion resistance comparable to that of the 1.4301 grade (in the above-mentioned accelerated corrosion test conditions).

Localised corrosion

– Pitting corrosion

This mode of corrosion is the most common one. It is mainly due to the adverse effect of chloride ions on sulphur inclusions; it visually results in small corrosion stains. The formula *PREN (Pitting Index) = %Cr +3.3 %Mo + 16 %N* makes it possible to roughly approach the local pitting corrosion behaviour: the average is approximately 27 for duplex UGI® 4062 while it is approximately 20 for a composition of the 1.4301 type. Two accelerated tests to simulate this mode of corrosion were selected: salt spray test and pitting potential test.

- NEUTRAL SALT SPRAY / Standard ASTM B117

  This test consists in spraying within an enclosure a sodium chloride solution concentrated to 5 % in weight (0.86 moles/litre of NaCl à 35 °C; neutral pH). The duration of exposure from which the first corrosion pits appear is visually determined. The result of this test is strongly dependent on the grade but also on the tested surface condition. We exposed 10 cm of wire rod, diameter 5.5 mm, machined to 5 mm, then wet polished with SiC 1200 paper; the samples were degreased with a mixture of acetone and ethyl alcohol. Resin is applied to the ends of the wire rods in order to protect them.

Swiss Steel Group

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

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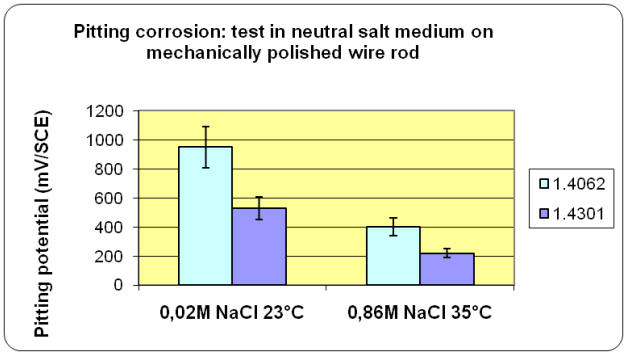
In these preparation conditions, the first corrosion pits appeared after 1,000 hours for the 1.4301 and after 2,000 hours for UGI® 4062 duplex.

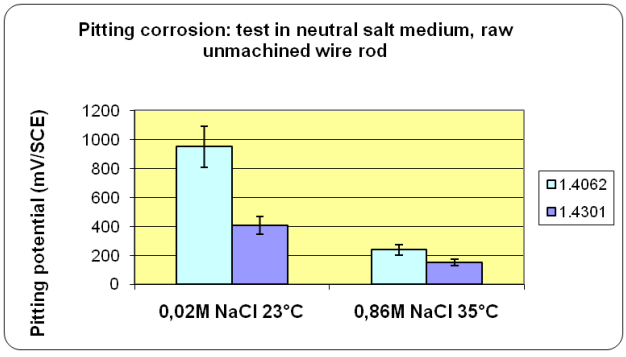
- PITTING POTENTIAL

The purpose is to determine, on a polarisation curve, the potential from which corrosion pitting will appear; the higher the potential, the better the pitting corrosion resistance.

Two media with neutral pH were tested: 0.02 moles/litre of NaCl (0.71 g/L of chlorides) at 23 °C; 0.86 moles/litre of NaCl (30.4 g/L of chlorides) at 35 °C.

The graphs below give the values of the pitting potential in the two above-mentioned media in mV/SCE (Saturated Calomel Electrode) for two surface conditions: wire rod mechanically polished with SiC1200 paper and raw unpolished wire rod.



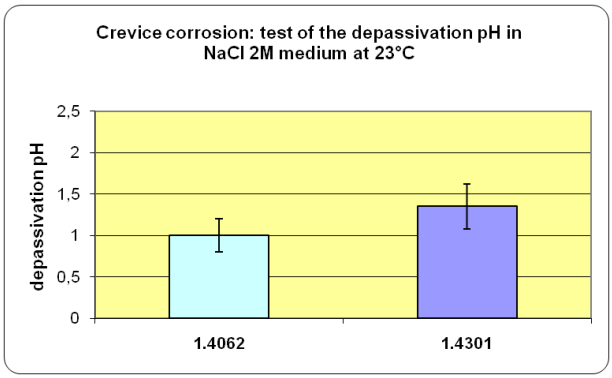


The UGI® 4062 grade provides better pitting corrosion resistance when compared to the 1.4301 grade (in the above-mentioned accelerated corrosion test conditions).

– Crevice corrosion

This mode of corrosion appears in confined environments whose main characteristic is to become acid during the corrosion process; one of the parameters which simulate this mode of corrosion is represented by the depassivation pH, that is to say the pH of dissolution of the passive film. This pH is determined by an electrochemical test, by plotting a polarisation curve in a sodium chloride medium at 2 moles/liter at 23 °C. The lower the depassivation pH, the better the crevice corrosion resistance. The graph below gives the values of the depassivation pH:

UGI® 4062 provides better crevice corrosion resistance than the 1.4301 grade (in the above-mentioned accelerated corrosion test conditions).



– Intergranular corrosion

UGI® 4062 gives a conforming result in the Strauss test (ASTM A262 practice E).

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Stress corrosion cracking

The austenitic-ferritic grades have better resistance to this mode of corrosion than austenitic grades.

In the EFC 17 medium of the European Federation of Corrosion (165 g/L of sodium chloride; pH = 4.5) for a hydrogen sulphide pressure varying from 0.05 to 0.5 bar and at 80 °C, no cracks were detected on UGI® 4062 test specimens loaded to 100 % Rp0.2, after 720 hours of test.

Typical stress corrosion test cell

Hot working

UGI® 4062 has satisfactory workability between 1,000 °C and 1,200 °C. At equal temperature, the forging loads of UGI® 4062 are lower than those of austenitic stainless steels, and its ductility is slightly lower. It is recommended to heat it up between 1,150 and 1,200 °C and, after hot transformation, to cool it down quickly (with oil or water) to avoid brittling precipitations which may appear between 850 °C and 400 °C, this being the reason why operating temperatures above 300 °C are not recommended.

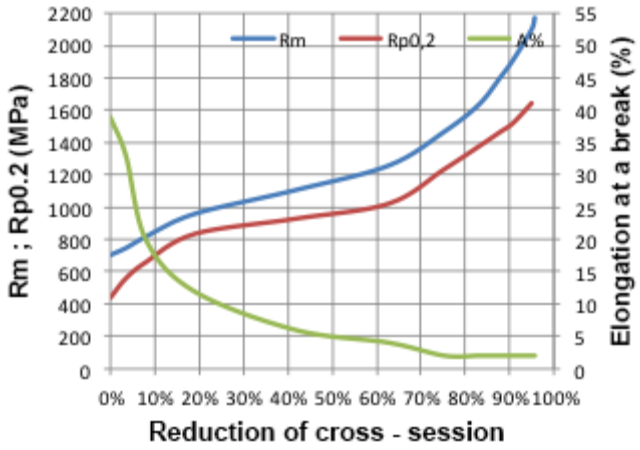
Cold working

UGI® 4062 is suitable for cold transformation by means of conventional methods.

UGI® 4062 can be cold work hardened more than the 1.4301 austenitic grade (AISI 304) which is more stable; on the contrary, UGI® 4062 can be cold work hardened similarly to the 1.4310 austenitic grade (AISI 302). As from 40 % cold deformation approximately, one part of the austenite gradually transforms into martensite, which thus increases the magnetic characteristic of the grade. A new solution heat treatment between 950 and 1,050 °C allows the ductility of UGI® 4062 to be restored.

Wire drawing

– Typical work hardening curve:



Bending – Forming

The cold transformed wire, in 2D condition, is suitable for bending. For instance, wires with ∅10 mm were bent to 180° degrees on a radius which was 2.5 times bigger than the diameter of the wire. We observed correct appearance, with low roughness, of the extended face, without orange peel surface, when compared to 1.4307 (304L).

Spring manufacturing

UGI® 4062 can be used in cold work hardened wire to manufacture springs. The stiffness of these springs exceeds that of the springs made of 1.4310 by 20 to 25 %.

A stabilisation heat treatment will be carried out on the springs after rolling, preferably for 5 minutes between 450 °C and 480 °C. This heat treatment, when applied to UGI® 4062 makes it possible to obtain better slackening resistance between 20 and 300 °C than that of the 1.4310 grade.

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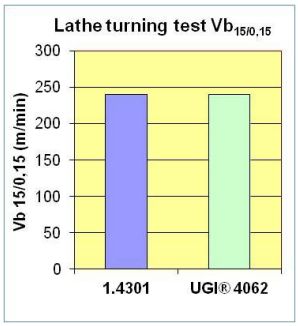
Machinability

Lathe turning

In lathe turning operations, UGI® 4062 is at the same level as the 1.4301 grade (AISI 304) in terms of cutting tool wear (Vb15/0.15 test with tool SECO TM2000 CNMG 120408-MF4).

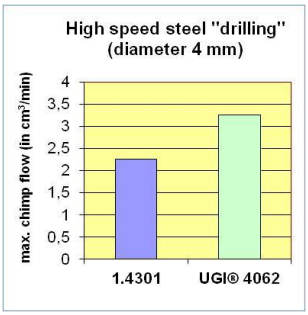
However, adaptation of the cutting tips may become necessary to maintain the same productivity as with the 1.4301 grade (AISI 304), in particular because the UGI® 4062 chips brake less easily, which can generate bar turning difficulties.

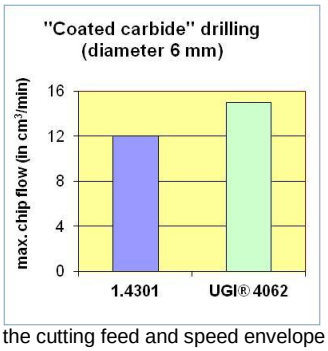


Drilling

When drilling with high speed steel drill bits with diameter 4 mm (Perfor HSS 6-5-2) without central liquid cooling, UGI® 4062 allows maximum chip flows 40 % greater than those obtained with 1.4301 (AISI 304) thanks to a widened Optimum Operating Zone (OOZ*) towards high feed speeds.

When drilling with 6 mm one-piece coated carbide drill bits (Gühring RT100F) with central liquid cooling, UGI® 4062 allows maximum chip flows greater by 25 % than those obtained with the 1.4301 grade thanks to a widened Optimum Operating Zone (OOZ*).





* Optimum operating zone defined as the cutting feed and speed envelope within which a drill bit can be used to drill more than 1,000 holes (HSS drill bit) or 500 holes (carbide drill bit) without breaking

Welding

UGI® 4062 can be welded using the following processes: friction welding, resistance welding, arc welding with or without filler metal wire (MIG, TIG, covered electrode, plasma, flux, etc.), LASER beam welding electron beam welding, etc.

As there is no molybdenum in UGI® 4062, this grade does not generate any risks of formation of brittle phase (sigma phase) during welding operations. Its weldability is close to that of the 1.4307 grade (AISI 304L). When compared with this grade, UGI® 4062 even provides better warranty as regards to hot cracking during welding.

However, in order to optimise the impact strength of the welds, it is highly recommended to select a linear welding energy high enough to limit the quantity of ferrite in the weld metal zone (WMZ) and in the Heat Affected Zone (HAZ) below 70 %.

Different filler metal wires can be used to weld UGI® 4062, depending on the required mechanical characteristics and corrosion resistance of the welds. The main types of filler metals are:

- ER2307 / 23.7NL / A35N
- ER2209 / 22.9.3NL / A45N
- ER309LSi / 23.12LSi / A309LM

Preheating of the parts before welding is not recommended. No heat treatment must be carried out after welding, except, if necessary, quenching from T° > 950 °C.

Heat treatment

Solution annealing

To decrease the hardness and restore the ductility of UGI® 4062 after cold working, a heat treatment can be carried out for 30 to 60 minutes between 950 °C and 1,050 °C, followed with quick cooling.

Surface treatment

Pickling / Passivation / Electro-polishing

The operation conditions generally used for a 1.4301 austenitic stainless steel need to be adapted on a case by case basis (please consult us).

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Available products

Product	Form	Finish	Tolerance	Dimension	
Bars	Round	Cold transformed by drawing	h9	5.0 – 28	mm
Wire rod	Round			5.5 - 32	mm
Drawn wire	Round			0.2 - 10	mm
Bars	Round	Cold transformed by machining	h9	20 - 120	mm

Other presentations: please consult us
For flat product please contact Insdusteel
Arcelor Mittal Group: http://www.industeel.info/

Applications

UGI® can be used in most of the applications where the following grade types are used 1.4301 (AISI 304), 1.4307 (AISI 304L) or 1.4310 (AISI 302/301). These applications are:

- Forming
- Cold formed profiles
- Spot welded assemblies
- Braiding, springs
- Filtration,
- Decoration
- Threaded rods,
- Axles,
- Forged parts,
- Steel construction,
- Concrete reinforcing frames…