

# Technical Data Sheet

## UGI® 4404FGX3

### Chemical composition (%)

C	Si	Mn	Ni	Cr	Mo	Cu	P	S
≤ 0.03	≤ 1.0	≤ 2.0	11 - 13	16.5 - 18.5	2 - 2.5	≤ 0.6	≤ 0.04	0.010 - 0.020

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### General presentation

UGI® 4404FGX3 is a molybdenum austenitic stainless steel belonging to the 316L family. Its low carbon content provides good corrosion resistance on welded areas. In addition, UGI® 4404FGX3 has good machinability properties.

### Classification

Molybdenum austenitic stainless steel.

### Standards

#### Material No.

Europe EN	USA UNS	Japan JIS	ISO
1.4401 X5CrNiMo17-12-2	S31600	SUS316	4401-316-00-I X5CrNiMo17-12-2
1.4404 X2CrNiMo17-12-2	S31603	SUS316L	4404-316-03-I X2CrNiMo17-12-2

#### Other Material Description

USA	France	Germany	UK	Sweden
AISI	AFNOR	DIN	BS	S.S
316	Z7CND 17-11-02	1.4401	316S11	2347
316L	Z3CND 17-11-02	1.4404	316S31	2348

### Microstructure

UGI® 4404FGX3 has a mainly austenitic microstructure with traces of residual ferrite (1 to 3%).

### Mechanical properties

#### Tensile data

Condition	Tensile strength	Yield strength	Ultimate elongation	Reduction of area
	R <sub>m</sub> (MPa)	R <sub>p0.2%</sub> (MPa)	A (%)	Z (%)
Turned bars	500 - 700	≥ 200	≥ 40	≥ 70
Drawn bars	550 - 800	≥ 350	≥ 30	≥ 60

#### Impact strength data

Temperature	Absorbed energy
T	KV
(°C)	(J)
20	≥ 100

#### Hardness data

Condition	Temperature	Brinell hardness
	(°C)	(HB)
Turned bars	20	130 - 200
Drawn bars	20	150 - 220



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### Physical properties

Temperature	Density	Elasticity modulus	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	7.9	200	15	-	750	500
100	-	194		16.0		
200	-	186		16.5		
300	-	179		17.0		

UGI® 4404FGX3 is an austenitic grade and therefore practically non-magnetic after annealing treatment (relative permeability close to 1). Slight ferromagnetic behavior can however be observed due to the presence of residual ferrite and/or strain-induced martensite after cold working the metal (for example after drawing).

### Corrosion resistance

UGI® 4404FGX3 has very good corrosion resistance, as is the case with the entire 316 family; it can be used:

- in the water industry (valves, etc.),
- for outdoor exposure in rural, urban and industrial environments, even in the known presence of chloride ions (near the sea),
- in the food processing and agri-food industries (compatibility with cleaning and disinfectant liquids),
- and in the chemical industry (sulphuric, phosphoric and organic acids) under certain temperature and concentration conditions.

UGI® 4404FGX3 withstands intergranular corrosion well, even after welding, and passes standard tests:

- AFNOR NFA05-159,
- ASTM A262 – 75 PRACTICE E,
- DIN 50914,

and, on request, specific tests.

Optimum corrosion resistance is obtained where a surface is free from all traces of machining oil or foreign particles (of iron for example).

UGI® 4404FGX3 is pickled and decontaminated in the same way as 1.4404 grade steel (316L).

Reminder: the corrosion resistance of a stainless steel depends on many factors related to the composition of the corrosive atmosphere (chloride concentration, presence or absence of oxidizing agents, temperature, pH, agitation or no agitation, and so on), as well as to the preparation of the material (surfaces free from metal particles, surface finish such as hardening, polishing, and so on). Experimental precautionary measures should also be taken for certain tests, such as the salt spray test (ISO 9227): for example marking labels that might cause corrosion run-outs and reduce the test resistance time should not be used on the sample.

### Hot working Forging

There are no particular problems associated with forging UGI® 4404FGX3.

Heating without any special precautions up to 1150°-1200°C.

Forging between 1200°C and 950°C (the best behavior being obtained between 1100 and 1200°C).

Air or water cooling, if no deformation is feared (priority will be given to WATER cooling for large charges; avoid cooling stacked forgings in air).

### Machinability

With a sulphur percentage of approximately 0.015% and a controlled sulphide inclusion population, UGI® 4404FGX3 offers good machining performance, but without achieving the exceptional machinability levels of UGIMA-X® 4404.



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### Welding

There are no particular difficulties with welding UGI® 4404FGX3 by electric arc processes (MIG, TIG, coated electrodes, plasma, submerged arc, etc.), resistance welding, friction welding, electron beam welding, etc.

In addition, thanks to an analytical balance allowing primary ferritic solidification under standard arc welding conditions, the risk of thermal cracking inherent in austenitic stainless steels is very low. Only LASER welding can, under certain conditions, cause a phenomenon of thermal cracking of heat-affected zones (HAZ).

If a filler metal is used, the following filler grades are recommended: E316L (coated electrodes), ER316L (TIG), ER316LSi (MIG).

No heat treatment is necessary after welding. However, if a guaranteed non-magnetic property is required when welding UGI® 4404FGX3 without the use of filler material, ferrite regression heat treatment in the HAZ could be advantageous.

### Heat treatment

#### Annealing

Heat treatment of UGI® 4404FGX3 consists in quenching the metal in water or air after keeping it for a long time at a high temperature of between 1000 and 1100°C. This heat treatment which is known as annealing removes all traces of work-hardening and prevents chromium carbide precipitation, whilst giving the steel its lowest level of mechanical properties (Rm between 500 and 650 MPa) and good corrosion resistance.

### Available products

Product	Shape	Finishing	Tolerance	Dimension
Bar	Round	Rolled descaled	k13	Ø 13 to 130 mm
		Turned	10 + 11	Ø 22 to 130 mm
		Ground	7 + 8 + 9 + options	Ø 2 to 130 mm
		Drawn	9	Ø 2 to 30 mm
		Black bar	+/- 1% of Ø	Ø 23 to 135 mm
Wire rod	Hexagonal	Drawn	10 + 11	Hex 3 to 55 mm
	Round	Rolled		Ø 5 to 32 mm
		Rolled pickled		Ø 5 to 32 mm
	Hexagonal	Rolled pickled		Hex 12.4 to 28 mm
Billet	Square	As rolled or as-heat-treated		50 to 120 mm

Other requests: Please contact us

### Applications

- Mechanical industry
- Chemical industry
- Oil and petrochemical industry
- Food-processing and agri-food industries
- Medicine, Pharmaceuticals
- Decorating and household equipment
- Building
- Etc.



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