TECHNICAL DATA SHEET

Stainless Steel: 1.4401 (316) and Sheet Plate (Quarto Plate & CPP)

ORION ALLOYS

Description

Continuously Produced Plate, is plate material up to 12mm thick that undergoes coiling during the rolling process. Sheets are produced through cold rolling.

Stainless steel types 1.4401 and 1.4404, known as grades 316 and 316L respectively, are crucial in various applications. Grade 316, an austenitic alloy ranked second only to 304 in commercial significance, contains molybdenum for enhanced corrosion resistance, especially against pitting and crevice corrosion in chloride-rich environments.

Grade 316L, the low carbon version, is resistant to grain boundary carbide precipitation (sensitization), making it suitable for heavy gauge welded components, typically exceeding 6mm. For applications involving elevated temperatures, the high carbon variant, 316H stainless steel, and the stabilized grade, 316Ti stainless steel, are recommended.

The austenitic structure of 316 stainless steel imparts excellent toughness, even at cryogenic temperatures. Property data presented here pertains to flat rolled products under the scope of EN 10088-2:2005. While ASTM, EN, or other standards may cover the entire range of products, specifications are expected to align closely but may not be identical to those provided in this datasheet.

Stainless steel grade 316Ti, containing a small amount of titanium (typically around 0.5%), is designed to stabilize the structure at temperatures exceeding 800°C. This prevents carbide precipitation at grain boundaries, offering protection against corrosion. The key advantage of 316Ti lies in its ability to endure higher temperatures for extended periods without undergoing sensitization (precipitation). Furthermore, 316Ti retains physical and mechanical properties akin to standard grades of 316.

Designations

Stainless Steel Grade 1.4401/316 is also identified by the following designations, but it may not be an exact equivalent: UNS S31600, 316S31, EN 58H

Supplied Forms

- Sheet
- Strip
- Tube
- Bar
- Pipe
- Plate
- Fittings & Flanges

Applications

Initially developed for use in paper mills, 316 stainless steel is now commonly utilized in various applications such as:

- Food processing equipment
- Brewery equipment
- Chemical and petrochemical equipment
- Laboratory benches & equipment
- Coastal architectural panelling
- Coastal balustrading
- Boat fittings
- Chemical transportation containers
- Heat exchangers
- Mining screens
- Nuts and bolts
- Springs
- Medical implants

Corrosion Resistance

Grade 316 exhibits excellent corrosion resistance in various corrosive environments and media. While often considered “marine grade” stainless steel, it is not resistant to warm sea water. Warm chloride environments can lead to pitting and crevice corrosion. Grade 316 is also susceptible to stress corrosion cracking above approximately 60°C.

Heat Resistance

316 demonstrates good resistance to oxidation in intermittent service up to 870°C and continuous service up to 925°C. However, continuous use at 425-860°C is not recommended for applications requiring corrosion resistance in water. In such cases, 316L is recommended due to its resistance to carbide precipitation. For high-strength requirements at temperatures above 500°C, grade 316H is recommended.

Fabrication

Fabrication of stainless steels, including 316, should be carried out with tools dedicated to stainless steel materials. Thorough cleaning of tooling and work surfaces before use is crucial to prevent cross-contamination that may discolor the fabricated product.

Cold Working

Grade 316 can be readily brake or roll formed into various parts. It is also suitable for stamping, heading, and drawing, but post-work annealing is advised to relieve internal stresses. Cold working enhances both strength and hardness of 316 stainless steel.

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Hot Working

All common hot working processes can be performed on 316 stainless steel. Hot working should be avoided below 927°C, and the ideal temperature range is 1149-1260°C. Post-work annealing is recommended for optimum corrosion resistance.

Machinability

316 stainless steel has good machinability, and machining can be improved by adhering to specific guidelines:

- Keep cutting edges sharp to avoid excess work hardening.
- Ensure light cuts, deep enough to prevent work hardening.
- Use chip breakers to help clear swarf from the work.
- Due to low thermal conductivity, use coolants and lubricants in significant quantities to dissipate heat at cutting edges.

Heat Treatment

316 stainless steel does not respond to hardening through heat treatment. Solution treatment or annealing can be performed by rapidly cooling the material after heating to the range of 1010-1120°C.

Weldability

Fusion welding performance for 316 stainless steel is excellent, both with and without fillers. The recommended filler rods and electrodes for 316 and 316L are the same as the base metals, 316 and 316L, respectively. Heavy welded sections may necessitate post-weld annealing. Grade 316Ti can be used as an alternative to 316 in heavy section welds.

Oxyacetylene welding has not been proven successful for joining 316 stainless steel.

Physical Properties

Property	Value
Density	8.00 g/cm^3
Melting Point	1400 °C
Thermal Expansion	15.9 x10-6 /K
Modulus of Elasticity	193 GPa
Thermal Conductivity	16.3 W/m.K
Electrical Resistivity	0.74 x10^{-6} Ω .m

Chemical Composition

EN 10088-2:2005. 1.4401 Steel

Element	% Present
Chromium (Cr)	16.50 - 18.50
Nickel (Ni)	10.00 - 13.00
Molybdenum (Mo)	2.00 - 2.50
Manganese (Mn)	0.0 - 2.00
Silicon (Si)	0.0 - 1.00
Nitrogen (N)	0.0 - 0.11
Carbon (C)	0.0 - 0.07
Phosphorous (P)	0.0 - 0.05
Sulphur (S)	0.0 - 0.02
Iron (Fe)	Balance

Mechanical Properties

EN 10088-2:2005. Sheet Up to 8mm Thick

Property	Value
Proof Stress	240 Min MPa
Tensile Strength	530 to 680 MPa
Elongation A50 mm	40 Min %

EN 10088-2:2005. Plate From 8mm to 75mm Thick

Property	Value
Proof Stress	220 Min MPa
Tensile Strength	520 to 670 MPa
Elongation A50 mm	45 Min %

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