TECHNICAL DATA SHEET

Stainless Steel: 1.4401 (316) Bar and Section

ORION ALLOYS

Description

Stainless steel types 1.4401 and 1.4404 are recognized as grades 316 and 316L, respectively. Grade 316, an austenitic grade, holds the second position in commercial importance after 304.

316 stainless steel is enhanced with the addition of molybdenum, providing improved corrosion resistance, particularly against pitting and crevice corrosion in chloride environments. The low carbon version, 316L, is resistant to grain boundary carbide precipitation (sensitization), making it suitable for heavy gauge welded components, especially those over approximately 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 in this document is typical for bar and section products as per EN 10088-3:2005. While ASTM, EN, or other standards may cover all sold products, it is reasonable to expect specifications in these standards to be similar but not necessarily identical to those provided in this datasheet.

Stainless steel grade 316Ti, containing a small amount of titanium (typically around 0.5%), stabilizes the structure of 316 at temperatures exceeding 800°C. This stabilization prevents carbide precipitation at grain boundaries, safeguarding the metal from corrosion. The primary advantage of 316Ti is its ability to withstand higher temperatures for a prolonged period without experiencing sensitization (precipitation). Moreover, 316Ti retains physical and mechanical properties similar to standard grades of 316.

Alloy Designations

Stainless Steel Grade 1.4401/316 is associated with the following designations, but it may not be a direct equivalent:

- UNS S31600
- 316S31
- EN 58H

Supplied Forms

This stainless steel grade is available in various forms:

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

Weldability

The weldability of 316 stainless steel is excellent, both with and without fillers, when subjected to fusion welding. The recommended filler rods and electrodes for 316 and 316L are the same as those for the base metal, namely 316 and 316L, respectively. In the case of heavy welded sections, post-weld annealing might be necessary. Alternatively, Grade 316Ti can be considered as a substitute for 316 in heavy section welds.

It's worth noting that oxyacetylene welding has not proven to be successful for joining 316 stainless steel. Other welding methods, such as fusion welding, are more suitable for achieving successful welds in this material.

Applications

Stainless steel types 1.4401 and 1.4404, known as grades 316 and 316L respectively, have various applications, initially developed for use in paper mills. They are commonly employed in:

- 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. Often considered "marine grade" stainless steel, it is not resistant to warm seawater. Pitting and crevice corrosion can occur in warm chloride environments, and the grade is susceptible to stress corrosion cracking above approximately 60°C.

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

Fabrication
Fabrication of stainless steels, including Grade 316, should be performed using tools dedicated to stainless steel materials. Thorough cleaning of tooling and work surfaces is essential to avoid cross-contamination that could 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 recommended to relieve internal stresses. Cold working increases both the strength and hardness of 316 stainless steel.

Hot Working
Common hot working processes can be applied to 316 stainless steel. Hot working should be avoided below 927°C. The ideal temperature range for hot working is 1149-1260°C. Post-work annealing is advisable to ensure optimal corrosion resistance.

Machinability
316 stainless steel exhibits good machinability. Machining can be improved by adhering to specific guidelines:

- Keeping cutting edges sharp to prevent excess work hardening
- Ensuring cuts are light but deep enough to prevent work hardening
- Employing chip breakers to help clear swarf from the work
- Using coolants and lubricants generously due to the low thermal conductivity of austenitic alloys

Heat Treatment
316 stainless steel cannot be hardened by heat treatment. Solution treatment or annealing can be achieved by rapid cooling after heating to 1010-1120°C.

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

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

Mechanical Properties
EN 10088-2:2005. Bar & Section. Up to 160mm Dia / Thickness

Property	Value
Proof Stress	200 Min MPa
Tensile Strength	500 to 700 MPa
Elongation A50 mm	40 Min %
Hardness Brinell	215 Max HB

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