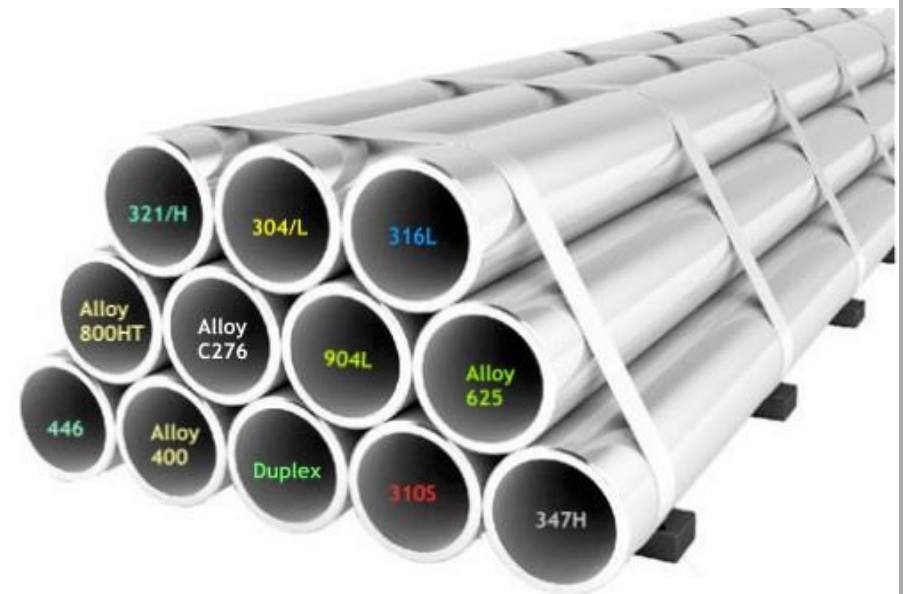


# 316/316L STAINLESS STEEL

## Datasheet for Stainless Steel 316/316L

- Pipes & Tubes
- Sheets & Plates
- Bars & Rods, Forgings
- Fittings & Flanges
- Nuts & Bolts
- Valves



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# Datasheet for Stainless Steel 316/316L

## UNS S31600 (1.4401), UNS S31603 (1.4404)

### What is 316/316L Stainless Steel?

- Stainless Steel 316 is a chromium-nickel based, molybdenum-bearing austenitic stainless steel that possesses increased levels of resistance against several substances, due to the addition of molybdenum in its composition to help resist corrosion to chlorides (like sea water and de-icing salts). Grade 316 is an improved version of SS 304 because of slightly higher molybdenum and nickel content. SS 316 is also found to be more applicable in areas with high or elevated temperatures compared to other stainless steels. It has more heat resistance than Type 304 but otherwise possesses many of the same general characteristics.
- 316's corrosion resistance is especially effective against chemicals, such as those used in the paper and textile industries. The metal finds other common applications in food processing equipment, chemical processing, nuts and bolts, and medical implants. While the metal is pliable under hot and cold-working techniques, it cannot be work hardened with heat treatment.
- The letter L in 316L stands for low carbon. L-grades have 0.035% carbon maximum. L-grades are resistant to sensitization in short-term exposures or heat treatments. L-grade often have slightly lower (typically 5,000 psi less) minimum strengths than standard stainless steel.
- Austenitic stainless steels can be welded together using many different welding processes. Some are more preferred for welding than others, such as 304, 316, 321, and 347 which are all austenitic grades that are weldable.

### Product Forms and Standards of 316/316L Stainless Steel

Product Forms	Material Standards
Plates, Sheets & Strips	ASTM A240, A666
Billets, Bars & Rods	ASTM A276, A484, A479
Forgings (Flanges & Fittings)	ASTM A182, A473
Wires	ASTM A313, A368, A478, A492, A493, A580.
Seamless and Welded Pipes	ASTM A312, A358, A270, A269, A249, A213, A813, A814.

Wrought Pipe Fittings	ASTM A403
Castings (Cast Fittings & Valve Parts)	ASTM A351, A743, A744

## Fabrication Data for Stainless Steel 316/316L

Alloy 316/316L can be easily welded and processed by standard shop fabrication practices.

### Hot Forming

- Working temperatures of 1700–2200°F (927–1204°C) are recommended for most hot working processes. For maximum corrosion resistance, the material should be annealed at 1900°F (1038°C) minimum and water quenched or rapidly cooled by other means after hot working.

### Cold Forming

- The alloy is quite ductile and forms easily. Cold working operations will increase the strength and hardness of the alloy and might leave it slightly magnetic.

### Welding

- Alloy 316/316L can be readily welded by most standard processes. A post weld heat treatment is not necessary.

### Machining

- Alloy 316/316L is subject to work hardening during deformation and is subject to chip breaking. The best machining results are achieved with slower speeds, heavier feeds, excellent lubrication, sharp tooling and powerful rigid equipment.

## Heat Treatment & Resistance Information for Stainless Steel 316/316L

### Annealing

- The austenitic stainless steel are provided in the mill annealed condition ready for use. Heat treatment may be necessary during or after fabrication to remove the effects of cold forming or to dissolve precipitated chromium carbides resulting from thermal exposures.

- For the Alloys 316 and 317L the solution anneal is accomplished by heating in the 1900 to 2150°F (1040 to 1175°C) temperature range followed by air cooling or a water quench, depending on section thickness.
- Cooling should be sufficiently rapid through the 1500 to 800°F (816 to 427°C) range to avoid reprecipitation of chromium carbides and provide optimum corrosion resistance. In every case, the metal should be cooled from the annealing temperature to black heat in less than three minutes.
- Alloys 316 and 317L stainless steel tube cannot be hardened by heat treatment.

#### Heat Resistance

- Good oxidation resistance in intermittent service to 1600°F (870°C) and in continuous service to 1700°F (925°C)
- Grade 316L is more resistant to carbide precipitation.

#### Corrosion Resistance of Stainless Steel 316/316L

- SS 316/ 316L are subject to pitting and crevice corrosion in warm chloride environments, and to stress corrosion cracking above about 122°F (50°C). Generally more resistant than 304 in range of atmospheric environments and many corrosive media due to the increased chromium and molybdenum content. Considered resistant to potable water with up to about 1000mg/L chlorides at ambient temperatures, reducing to about 500mg/L at 140°F (60°C). Usually regarded as the “marine grade stainless steel” – but is not resistant to warm sea water.

#### Equivalents of Stainless Steel 316/316L

STANDARD	316	316L	316Ti
UNS	S31600	S31603	S31635
WERKSTOFF NR.	1.4401	1.4404	1.4571

## Chemical, Mechanical and Physical Properties of Stainless Steel 316/316L

### Chemical Composition of SS 316/316L

ELEMENT	316	316L	316TI
NI	11.0 – 14.0	10.0 – 14.0	10.0 – 14.0
C	0.08 max	0.035 max	0.08 max
MN	2.0 max	2.0 max	2.0 max
P	0.045 max	0.045 max	0.045 max
S	0.30 max	0.30 max	0.30 max
SI	1.0 max	1.0 max	0.75 max
CR	16.0 – 18.0	16.0 – 18.0	16.0 – 18.0
MO	2.0 – 3.0	2.0 – 3.0	2.0 – 3.0
TI			5x(C+N) – 0.70
N			0.10 max

### Physical Properties of SS 316/316L

DENSITY	7.99 g/cm <sup>3</sup> / 0.29 lb/in <sup>3</sup>
MELTING POINT	1371 – 1399 (°C) / 2500 – 2550 (°F)
ANNEALED	1040 (°C) / 1900 (°F)

QUENCH	Rapid Air/Water
ELECTRICAL RESISTIVITY	74 microhm-cm (20 degrees Celsius)
SPECIFIC HEAT	0.50 kJ/kg-K (0–100 degrees Celsius)
THERMAL CONDUCTIVITY	16.2 W/m-k (100 degrees Celsius)
MODULUS OF ELASTICITY	193 x 103 in tension

#### Mechanical Properties of SS 316/316L

Alloy	UNS	Tensile Strength		Yield Strength		Elongation in 2 inch (min.) %	Grain Size Req.	Max. Hardness HRB Rockwell
		MPa	ksi	ksi	MPa			
316	S31600	515	75	30	205	35	—	90 HRB
316L	S31603	485	70	25	170	35	—	90 HRB
316H	S31609	515	75	30	205	35	7 or coarser	90 HRB

#### Stainless Steel 316/316L Product Specification

Product	Stainless Steel 316/316L
Equivalents	AISI 316, UNS S31600, 1.4401, AISI 316L, UNS S31603, 1.4404
Items	Pipe, Tubes, Tubing, Fittings, Flanges, Valves, Fasteners, Sheet, Square Bar, Threaded Bar, Plate, Hexagon Bar, Fasteners and Fixings, Round Bar, Flat Bar, Rebar, Angle, Tube & Pipe, Wire
Size	1/4" - 60"
Pipe Type	Seamless, Welded, ERW, Fabricated, Custom Size Pipes

Specifications	ASTM, ASME, DIN, GOST, JIS
Certification	EN 10204 3.1
Fittings Type	Butt Weld, Screwed & Socket Weld, Flanges, Instrumentation
Other Fittings	Elbows, Tees, Reducers, Caps, Stub Ends, Flanges (ANSI, Table E, D and H), Nuts, Bolts, Screws, Threaded Bars

### Our Key Products

<a href="#">Stainless Steel 316/316L Sheet</a>	<a href="#">Stainless Steel 316/316L Plate Cuttings/Profiles</a>	<a href="#">Stainless Steel 316/316L Nuts, Bolts and Fasteners</a>
<a href="#">Stainless Steel 316/316L Plate</a>	<a href="#">Stainless Steel 316/316L Foil, Coil</a>	<a href="#">Stainless Steel 316/316L Wire</a>
<a href="#">Stainless Steel 316/316L Blocks/Slabs</a>	<a href="#">Stainless Steel 316/316L Strip</a>	<a href="#">Stainless Steel 316/316L Ingot</a>
<a href="#">Stainless Steel 316/316L Rod/Bar</a>	<a href="#">Stainless Steel 316/316L Pipes and Tubes</a>	<a href="#">Stainless Steel 316/316L Forgings and Castings</a>
<a href="#">Stainless Steel 316/316L Flanges</a>	<a href="#">Stainless Steel 316/316L Forged Fittings</a>	<a href="#">Stainless Steel 316/316L Buttweld Fittings</a>

### About Metallica Metals – The Steel Pipes Factory

- Established in 1975, the Metallica Metals Group (The Steel Pipes Factory) has its operations spread across major cities in India. We are a pioneer in the stainless steel pipes, nickel alloy products, titanium products, carbon steel pipes and alloy steel pipes manufacturing and processing industry. Our products including pipe fittings, flanges, pipes, sheet plates and valves are exported to over 70 countries across the world, while in India we have supplied to even the remote areas. With over 250 tons of sale in stainless steel and carbon steel pipes every day, Metallica has emerged as a prominent vendor for many buyers in India and Overseas
- More than 3000 tons ready from stock and new production ready in just a few weeks.
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## Our Key Products

### STAINLESS STEEL & NICKEL ALLOYS

Pure Nickel Alloys

Monel Alloys (Ni-Cu Alloys)

Inconel (Ni-Cr-Mo) Alloys

Incoloy Alloys (Ni-Cr-Fe)

Hastelloy Alloys

Stainless Steel 304/304L

Stainless Steel 309S/309H

Stainless Steel 310/310S

Stainless Steel 316/316L

Stainless Steel 316Ti

Stainless Steel 317/317L

Stainless Steel 321/321H

Stainless Steel 347/347H

Stainless Steel 904L

Duplex Steels (UNS S32205, UNS S31803)

Super Duplex Steels (UNS S32760 / UNS S32750)

Stainless Steel 254 SMO (UNS S31254 / 1.4547)

### INSTRUMENTATION TUBES & FITTINGS

Instrumentation Tube

Hydraulic Tubing

Seamless Tubing

Instrumentation Tube Fittings

Double Compression Tube Fittings

Precision Pipe Fittings

Needle & Gauge Valves

Manifold Valves

### PRODUCTS

Steel Sheet & Plate

Steel Coil & Strip

Steel Pipes

Steel Tubes

Electropolish Tube

Heat Exchanger Tubes

Steel Bars/Rods & Wire

Fasteners (Nut, Bolt, Washer)

Steel Angle Bars

Hex Steel Bars

Round Steel Bars & Rod

Flat Steel Bars

Forgings, Rings & Forged Blocks

Stainless Steel Pipe

Stainless Steel Seamless Pipe

Stainless Steel Welded Pipe

Stainless Steel Tubes

Stainless Steel Furnace Tubes

Stainless Steel Seamless Tubing

Stainless Steel Heat Exchanger Tubes

Large Diameter Pipe

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