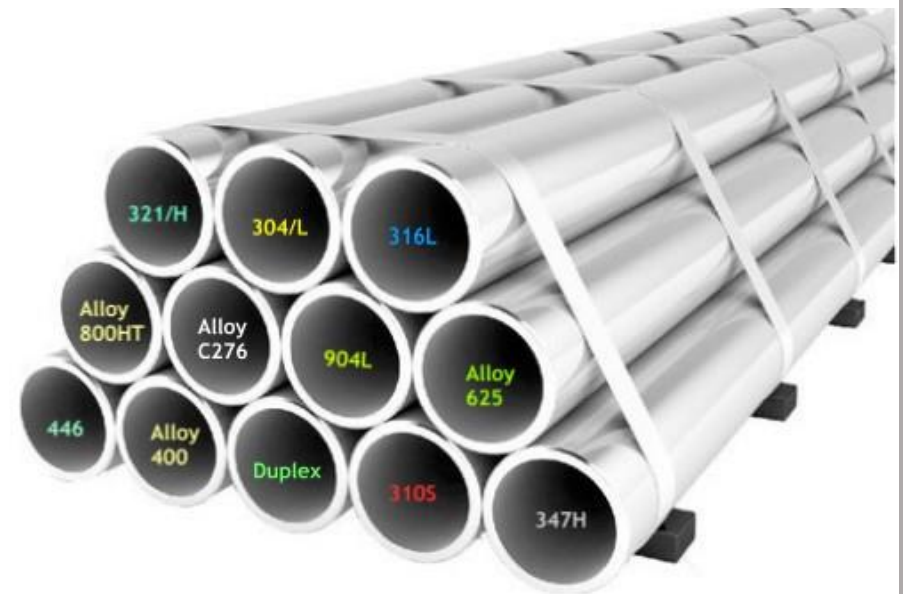


321/321H STAINLESS STEEL

Datasheet for Stainless Steel 321/321H

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



WWW.STEELPIPESFACTORY.COM – METALLICA METALS

We are a metal supplier of Hastelloy, Monel, Inconel, Incoloy, Stainless Steel, Duplex, Super Duplex, Nickel Alloys and more.

Email: info@metallcametals.com | Tel: +91 8928722715 | +91-22-66581538, +91-22-67436694, +91-22-66109768

Datasheet for Stainless Steel 321/321H

UNS S32100 (1.4541), UNS S32109 (1.4878)

What is 321/321H Stainless Steel?

Stainless Steel 321 is a basic austenitic 18/8 steel (Grade 304) blend of chromium and nickel is stabilised by Titanium (321) addition. SS 321 is used because they are not sensitive to intergranular corrosion after heating within the carbide precipitation range of 425-850°C.

Stainless Steel 321 is the grade of choice for applications in the temperature range of up to about 900°C, combining high strength, resistance to scaling, embrittlement and phase stability with resistance to subsequent aqueous corrosion. It is protected from temperatures ranging from 800 to 1500° F. The metal displays high strength and resistance to various forms of corrosions, including that from aqueous environments.

Type 321 finds application in heavy welding components, along with dynamic environments that are subject to changes.

Beyond this, stainless steel 321 has excellent forming characteristics, does not require annealing after being welded, and displays toughness in a range of temperatures. The metal shows strength even when exposed to cryogenic temperatures.

Additionally, it is often chosen over Type 304 for its increased resistance to creep and rupture. Both metals may be susceptible to stress corrosion cracking. It is used to manufacture high quality carbon structural steel seamless steel tubes for hot rolling and cold drawing (rolling) of superheated steam pipe, boiling water pipe and locomotive boiler superheated steam pipe, large smoke pipe, small smoke pipe and arch brick.

SS 321H is a modification of SS 321 with a higher carbon content, to provide improved high temperature strength. In addition, 321H is stabilized by an addition of niobium to resist intergranular corrosion. It is also able to withstand higher temperatures than type 321, due to its elevated carbon levels. While 321H displays the same welding and forming characteristics of type 321, the metal cannot be hardened by heat treatment. It is utilized in situations where type 321 cannot withstand the high temperatures, typically those exceeding 1000° F. Type 321H displays better resistance against creep than both 321 and 304 stainless steels. 321H also shows resistance against acid corrosion in a variety of environments. Lower temperatures provide better resistance, but the metal is able to withstand up to a 10% acid solution, that has been diluted, at elevated temperatures. However, the metal shows very little resistance against chlorine or sulfuric solutions at any given temperature. Given their similar composition and characteristics, it is possible for stainless steels 321 and 321H to become dually certified.

Product Forms and Standards of 321/321H Stainless Steel

Product Forms	Material Standards
Plates, Sheets & Strips	ASTM A240
Billets, Bars & Rods	ASTM A276, A484, A479

Forgings (Flanges & Fittings)	ASTM A182
Wires	ASTM A313, A580.
Seamless and Welded Pipes	ASTM A312, A358, A213, A269, A270
Wrought Pipe Fittings	ASTM A403

- Metallica supplies SS321 in various grades such as ASTM A312 TP321 (Pipes), ASTM A182 F321(Forgings), ASTM A403 WP321(Buttweld Fittings, ASTM A240 TP321 (Sheets & Plates).

What is the Difference Between 321 Stainless Steel and Other Grades?

The main variant of 321 is 321H which contains a higher quantity of carbon. 321 may contain up to 0.08% while 321H must contain between 0.04% and 0.08% carbon. The higher quantity of carbon confers greater strength at elevated temperatures. It is often chosen over Type 304 for its increased resistance to creep and rupture. 321 stainless steel is basically from 304 stainless steel. They differ by a very very small addition of Titanium. The real difference is their carbon content. The higher the carbon content the greater the yield strength. 321 stainless steel has advantages in high temperature environment due to its excellent mechanical properties. Compared with 304 alloy, 321 stainless steel has better ductility and resistance to stress fracture. In addition, 304L can also be used for anti-sensitization and intergranular corrosion.

Difference between 321 and other grades:

Type 304	The most common of austenitic grades, containing approximately 18% chromium and 8% nickel. It is used for chemical processing equipment, for food, dairy, and beverage industries, for heat exchangers, and for the milder chemicals.
Type 316	Contains 16% to 18% chromium and 11% to 14% nickel. It also has molybdenum added to the nickel and chrome of the 304. The molybdenum is used to control pit type attack. Type 316 is used in chemical processing, the pulp and paper industry, for food and beverage processing and dispensing and in the more corrosive environments. The molybdenum must be a minimum of 2%.
Type 317	Contains a higher percentage of molybdenum than 316 for highly corrosive environments. It must have a minimum of 3% "moly". It is often used in stacks which contain scrubbers.

Type <u>317L</u>	Restricts maximum carbon content to 0.030% max. and silicon to 0.75% max. for extra corrosion resistance.
Type 317LM	Requires molybdenum content of 4.00% min.
Type 317LMN	Requires molybdenum content of 4.00% min. and nitrogen of .15% min.
Type 321 Type 347	These types have been developed for corrosive resistance for repeated intermittent exposure to temperature above 800 degrees F. Type 321 is made by the addition of titanium and Type 347 is made by the addition of tantalum/columbium. These grades are primarily used in the aircraft industry.

Applications of Stainless Steel 321/321H

- For construction parts which should be resistant to scaling up to about 850°C and extensively inured to the effect of sulphurous gases. Inclination to carbonisation in reduced gases is very low.
- Expansion joints
- Chemical and Petrochemical processing
- Pharmaceutical production
- Waste treatment including thermal oxidizers
- Equipment and storage units for Food processing
- Aerospace Applications– piston engine manifolds
- Food Processing – equipment and storage
- Petroleum Refining – polythionic acid service
- Exhaust Systems
- Manifolds
- Heat Exchangers
- Piping
- Furnace Parts
- Chimney and Stack Liners
- Storage Tanks
- Bellows

Equivalents of Stainless Steel 321/321H

Standard	321	321H
UNS	S32100	S32109
WERKSTOFF NR.	1.4878	1.4541

Chemical, Mechanical & Physical Properties of Stainless Steel 321/321H

Chemical Composition

ELEMENT	321	321H
NI	9.0 – 12.0	9.0 – 12.0
C	0.08 max	0.04 – 0.10
MN	2.0 max	2.0 max
P	0.045 max	0.045 max
S	0.030 max	0.030 max
SI	1.0 max	1.0 max
CR	17.0 – 19.0	17.0 – 19.0
TI	5(C+N) – 0.70 max	4(C+N) – 0.70
N	0.10 max	0.10 max

Physical Properties

DENSITY	7.92 g/cm ³ / 0.286 lb/in ³	
MELTING POINT	1398 – 1446 (°C) / 2550 – 2635 (°F)	
ANNEALED	1040 – 1100 (°C) / 1900 – 2000 (°F)	
QUENCH	Rapid Air/Water	
Coefficient of Thermal Expansion (min/in)-°F	at 68 – 212°F	9.2
	at 68 – 1832°F	20.5
Thermal Conductivity BTU/hr-ft-°F	at 200°F	9.3
Specific Heat BTU/lbm -°F	at 32 – 212°F	0.12
Modules of Elasticity (annealed)2-psi	in tension (E)	28 x 10 ⁶

Mechanical Properties

Grade	Tensile Strength	Yield Strength 0.2%	Elongation -	Hardness
	Mpa (min.)	Offset Mpa (min.)	% in 50 mm (min.)	(Brinell) MAX
321/321H	515	205	40	217

Creep Properties

Temperature °C	1% Elongation (1) for		Rupture(2) for		
	1,000 h N/mm ²	10,000 h N/mm ²	1,000 h N/mm ²	10,000 h N/mm ²	100,000 h N/mm ²

600	110	85	200	142	65
700	45	30	88	48	22
800	15	10	30	15	10

Properties, Limitations and Processing Characteristics of Stainless Steel 321/321H

Properties

- Oxidation resistant to 1600°F
- Stabilized against weld heat affected zone (HAZ) intergranular corrosion
- Resists polythionic acid stress corrosion cracking
- Excellent resistance oxidation to 1500°F (816°C)
- Good low temperature toughness
- Comparable corrosion resistance and machinability to Type 304
- Readily welded by most standard processes
- It is malleable and ductile and has good weldability.
- Its austenitic structure allows it to be deep drawn without intermediate annealing. It is also unnecessary to anneal it following welding thin sections.
- It is generally recommended that Stainless 347 is used for welding rods and electrodes. (347 employs niobium and tantalum in preference to titanium)
- In its annealed state it is virtually non-magnetic even when cold worked, unlike 304 which can be significantly attracted to a magnet after cold working. This may make it more suitable in some applications.
- It also maintains its strength down to cryogenic temperatures.
- The key element that differentiates it from most other stainless steels is the inclusion of molybdenum, between 2% and 3%, which enhances its resistance corrosion in general and pitting corrosion in particular.

Limitation

It is protected from temperatures ranging from 800 to 1500° F. The metal displays high strength and resistance to various forms of corrosions, including that from aqueous environments. Type 321 finds application in heavy welding components, along with dynamic environments that are subject to changes. The inclusion of molybdenum may have some adverse effects on its formability.

Processing / Welding

Alloy 321 stainless steel plate can be readily welded by most standard processes. A post weld heat treatment is not necessary. Standard welding processes for this steel grade are:

- TIG-Welding
- MAG-Welding Solid Wire
- Arc Welding (E)
- Laser Beam Welding

In quenched condition the material can be slightly magnetizable. With increasing cold forming the magnetizability increases.

Stainless Steel 321/321H Product Specification

Product	Stainless Steel 321/321H
Equivalents	AISI 321, UNS S32100, 1.4541, AISI 321H, UNS S32109, 1.4878
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

Fabrication Data and Other Properties of 321/321H Stainless Steels

Alloy 321 stainless steel plate can be easily welded and processed by standard shop fabrication practices.

Cold Forming

- The alloy is quite ductile and forms easily.

Hot Forming

- The high sulfur content of Alloy 303 also has a detrimental impact on hot workability. If hot forming is required, once again, 304 should be considered as an alternate selection.

Machining

- The cold work hardening rate of 321 stainless steel plate makes it less machinable than 410 stainless steel, but similar to 304. The table below provides relevant machining data.

Heat Treatment and Resistance of Stainless Steel 321

321 resists oxidation up to 900oC in intermittent use and to 925oC in continuous use. It also avoids intergranular corrosion in the range 425 and 850oC.

Annealing

- Annealing at 1800-2000 F (928-1093 C) air cool. This process will result in maximum ductility. For maximum corrosion resistance, see the note on settled anneal under corrosion.

Hardening

- This alloy doesn't harden by heat treating. High properties may only be obtained through cold reduction.

Corrosion Resistance of Stainless Steel 321

- Exhibits good general corrosion resistance that is comparable to 304.
- Developed for use in the chromium carbide precipitation range of 1800 – 1500°F (427 – 816°C) .
- Can be used in most diluted organic acids at moderate temperatures.

- Can be used in pure phosphoric acid at lower temperatures.
- Can be used in up to 10% diluted solutions at elevated temperatures.
- Resists polythionic acid stress corrosion cracking in hydrocarbon service.
- Utilized in chloride or fluoride free caustic solutions at moderate temperatures.
- Does not perform well in chloride solutions, even in small concentrations, or in sulfuric acid service.

Our Key Products

Stainless Steel 321/321H Sheet	Stainless Steel 321/321H Plate Cuttings/Profiles	Stainless Steel 321/321H Nuts, Bolts and Fasteners
Stainless Steel 321/321H Plate	Stainless Steel 321/321H Foil, Coil	Stainless Steel 321/321H Wire
Stainless Steel 321/321H Blocks/Slabs	Stainless Steel 321/321H Strip	Stainless Steel 321/321H Ingot
Stainless Steel 321/321H Rod/Bar	Stainless Steel 321/321H Pipes and Tubes	Stainless Steel 321/321H Forgings and Castings
Stainless Steel 321/321H Flanges	Stainless Steel 321/321H Forged Fittings	Stainless Steel 321/321H Buttweld Fittings

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.**
- Feel free to contact us on - Email: info@metallicametals.com | Tel: +91 8928722715 | +91-22-66581538, +91-22-67436694, +91-22-66109768

Our Key Products

STAINLESS STEEL & NICKEL ALLOYS

Pure Nickel Alloys
Monel Alloys (Ni-Cu Alloys)

INSTRUMENTATION TUBES & FITTINGS

Instrumentation Tube
Hydraulic Tubing

PRODUCTS

Steel Sheet & Plate
Steel Coil & Strip

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)

Seamless Tubing

Instrumentation Tube Fittings

Double Compression Tube Fittings

Precision Pipe Fittings

Needle & Gauge Valves

Manifold Valves

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

Trademarks Notice

- The nickel alloy trade names, trademarks, and registered trademarks which are mentioned in this article are the property of their respective owners. Hastelloy® is a registered trademark of Haynes International. Monel®, Inconel®, Incoloy®, and are registered trademarks of Special Metals Corporation.