

Specification Sheet: Alloy 321/321H

(UNS S32100, S32109) W. Nr. 1.4541

A Titanium Stabilized Austenitic Stainless Steel with Excellent Resistance to Intergranular Corrosion After Exposure to Temperatures in the Chromium Carbide Precipitation Range of 800–1500°F (427–816 °C)

Alloy 321 (UNS S32100) is a titanium stabilized austenitic stainless steel with good general corrosion resistance. It has excellent resistance to intergranular corrosion after exposure to temperatures in the chromium carbide precipitation range of 800–1500°F (427–816°C). The alloy resists oxidation to 1500°F (816°C) and has higher creep and stress rupture properties than alloys 304 and 304L. It also possesses good low temperature toughness.

Alloy 321H (UNS S32109) is the higher carbon (0.04–0.10) version of the alloy. It was developed for enhanced creep resistance and for higher strength at temperatures above 1000°F (537°C). In most instances, the carbon content of the plate enables dual certification.

Alloy 321 cannot be hardened by heat treatment, only by cold working. It can be easily welded and processed by standard shop fabrication practices.

Applications

- Aerospace – piston engine manifolds
- Chemical Processing
- Expansion Joints
- Food Processing – equipment and storage
- Petroleum Refining – polythionic acid service
- Waste Treatment – thermal oxidizers

Standards

ASTM A 240
 ASME SA 240
 AMS 5510

Chemical Analysis

Weight % (all values are maximum unless a range is otherwise indicated)

| Element | 321 | 321H |
|------------|----------------------------|----------------------------|
| Chromium | 17.00 min.–19.00 max. | 17.00 min.–19.00 max. |
| Nickel | 9.00 min.–12.00 max. | 9.00 min.–12.00 max. |
| Carbon | 0.08 | 0.04 min.–0.10 max. |
| Manganese | 2.00 | 2.00 |
| Phosphorus | 0.045 | 0.045 |
| Sulfur | 0.03 | 0.03 |
| Silicon | 0.75 | 0.75 |
| Titanium | 5 x (C + N) min.–0.70 max. | 4 x (C + N) min.–0.70 max. |
| Nitrogen | 0.10 | 0.10 |
| Iron | Balance | Balance |

Physical Properties

| | |
|--|---|
| Density 0.286 lbs/in ³ 7.920 g/cm ³ | Specific Heat 0.12 BTU/lb-°F (32–212°F) 500 J/kg-°K (0–100°C) |
| Modulus of Elasticity 28.0 x 10 ⁶ psi 193 GPa | Thermal Conductivity 212°F (100°C) 9.3 BTU/hr/ft ² /ft/°F 16.0 W/m-°K |
| Melting Range 2550–2635°F 1398–1446°C | Electrical Resistivity 72 Microhm-cm at 20°C |

Mean Coefficient of Thermal Expansion

| Temperature Range | | | |
|-------------------|---------|-------------------------|-------------------------|
| °F | °C | in/in °F | cm/cm °C |
| 68–212 | 20–100 | 9.2 x 10 ⁻⁶ | 16.0 x 10 ⁻⁶ |
| 68–1112 | 20–600 | 10.5 x 10 ⁻⁶ | 18.9 x 10 ⁻⁶ |
| 68–1832 | 20–1000 | 11.4 x 10 ⁻⁶ | 20.5 x 10 ⁻⁶ |

Mechanical Properties

Typical Values at 68°F (20°C)

| Yield Strength 0.2% Offset | | Ultimate Tensile Strength | | Elongation in 2 in. | Hardness |
|-------------------------------|-------|------------------------------|-------|------------------------|-------------|
| psi (min.) | (MPa) | psi (min.) | (MPa) | % (min.) | (max.) |
| 30,000 | 205 | 75,000 | 515 | 40 | 217 Brinell |



SANDMEYER STEEL COMPANY

ONE SANDMEYER LANE • PHILADELPHIA, PA 19116-3598
 800-523-3663 • +1-215-464-7100 • FAX +1-215-677-1430

www.SandmeyerSteel.com

Providing Solutions, With Materials and
 Value Added Products, for Process Industries

Corrosion Resistance

Alloy 321 exhibits good general corrosion resistance that is comparable to 304. It was developed for use in the chromium carbide precipitation range of 1800–1500°F (427–816°C) where un-stabilized alloys such as 304 are subject to intergranular attack.

The alloy can be used in most diluted organic acids at moderate temperatures and in pure phosphoric acid at lower temperatures and up to 10% diluted solutions at elevated temperatures. Alloy 321 resists polythionic acid stress corrosion cracking in hydrocarbon service. It can also be utilized in chloride or fluoride free caustic solutions at moderate temperatures.

Alloy 321 does not perform well in chloride solutions, even in small concentrations, or in sulfuric acid service.

Fabrication Data

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

Machining

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

The information and data in this product data sheet are accurate to the best of our knowledge and belief, but are intended for informational purposes only, and may be revised at any time without notice. Applications suggested for the materials are described only to help readers make their own evaluations and decisions, and are neither guarantees nor to be construed as express or implied warranties of suitability for these or other applications.

| Operation | Tool | Lubrication | CONDITIONS | | | | | |
|-------------------|------------------|--------------------|----------------|-----------------|-----------|-------------|-------------|--------------|
| | | | Depth-mm | Depth-in | Feed-mm/t | Feed-in/t | Speed-m/min | Speed-ft/min |
| Turning | High Speed Steel | Cutting Oil | 6 | .23 | 0.5 | .019 | 12–16 | 39–52 |
| | | | 3 | .11 | 0.4 | .016 | 18–23 | 59–75 |
| | | | 1 | .04 | 0.2 | .008 | 23–28 | 75–92 |
| | Carbide | Dry or Cutting Oil | 6 | .23 | 0.5 | .019 | 67–76 | 220–249 |
| | | | 3 | .11 | 0.4 | .016 | 81–90 | 266–295 |
| | | | 1 | .04 | 0.2 | .008 | 99–108 | 325–354 |
| | | | Depth of cut-m | Depth of cut-in | Feed-mm/t | Feed-in/t | Speed-m/min | Speed-ft/min |
| Cutting | High Speed Steel | Cutting Oil | 1.5 | .06 | 0.03–0.05 | .0012–.0020 | 16–21 | 52–69 |
| | | | 3 | .11 | 0.04–0.06 | .0016–.0024 | 17–22 | 56–72 |
| | | | 6 | .23 | 0.05–0.07 | .0020–.0027 | 18–23 | 59–75 |
| | | | Drill Ø mm | Drill Ø in | Feed-mm/t | Feed-in/t | Speed-m/min | Speed-ft/min |
| Drilling | High Speed Steel | Cutting Oil | 1.5 | .06 | 0.02–0.03 | .0007–.0012 | 9–13 | 29–42 |
| | | | 3 | .11 | 0.05–0.06 | .0020–.0024 | 11–15 | 36–49 |
| | | | 6 | .23 | 0.08–0.09 | .0031–.0035 | 11–15 | 36–49 |
| | | | 12 | .48 | 0.09–0.10 | .0035–.0039 | 11–15 | 36–49 |
| | | | | | Feed-mm/t | Feed-in/t | Speed-m/min | Speed-ft/min |
| Milling Profiling | High Speed Steel | Cutting Oil | | | 0.05–0.10 | .002–.004 | 11–21 | 36–69 |

Hot Forming

Working temperatures of 2100–2300°F (1149–1260°C) are recommended for forging, upsetting and other hot working processes. Do not work this alloy at temperatures below 1700°F (927°C). Material must be water quenched or fully annealed after working to re-attain maximum corrosion resistance.

Cold Forming

The alloy is quite ductile and forms easily.

Welding

Alloy 321 can be readily welded by most standard processes. A post weld heat treatment is not necessary.



**SANDMEYER
STEEL COMPANY**