# ATI 31™

## Stainless Steel: Superaustenitic

(UNS N08031)

## General Properties

ATI 31™ alloy is a superaustenitic stainless steel designed to have a high level of corrosion resistance, equalling that of some Ni-based alloys. The alloy contains high levels of chromium and nickel with additions of molybdenum and copper, which provide excellent corrosion resistance in many environments. The carbon content is kept low to promote good properties in the welded condition.

ATI 31™ alloy is suitable for use in a variety of service environments, such as in chemical and petrochemical plants, oil & gas production, and in flue gas desulfurization units in power plants and aboard marine vessels.

## Composition

ATI 31™ alloy has been assigned UNS Number N08031. The composition range for this alloy is shown in the table.

| Element | Weight% |
|---|---|
| C | 0.015 max |
| Mn | 2.0 max |
| P | 0.020 max |
| S | 0.010 max |
| Si | 0.3 max |
| Cr | 26.0 – 28.0 |
| Ni | 30.0 – 32.0 |
| Mo | 6.0 – 7.0 |
| N | 0.15 – 0.25 |
| Cu | 1.0 – 1.4 |
| Fe | Balance |

## Specifications

ATI 31™ alloy is covered by the following specifications: UNS N08031; EN 1.4562; ASTM B625; NACE MR0175/ISO 15156; and ASME BPVC Section VIII.

## Physical Properties

| Room Temperature Properties | |
|---|---|
| **Density** | 0.291 lb/in$^3$ (8.06 g/cm$^3$) |
| **Elastic Modulus** | 28.7 x 10$^6$ psi (198 GPa) |
| **Electrical Resistivity** | 41 μΩ in (104 μΩ cm) |

## Mechanical Properties

| Minimum Properties in Solution Annealed Condition | |
|---|---|
| **0.2% Yield Strength** | 40 ksi (276 MPa) |
| **Tensile Strength** | 94 ksi (650 MPa) |
| **Elongation** | 40% in 2” (51mm) |

ATI 31™ alloy is covered in Section VIII of the ASME Boiler and Pressure Vessel Code. The stresses allowed for Section VIII, Division 1 use are shown in the table below.

| Temperature °F (°C) | Maximum Stress ksi (MPa) |
|---|---|
| 100 (38) | 26.7 (184) |
| 200 (93) | 22.0 (152) |
| 300 (149) | 19.8 (137) |
| 400 (204) | 18.3 (126) |
| 500 (260) | 17.3 (119) |
| 600 (316) | 16.4 (113) |
| 700 (371) | 15.8 (109) |
| 800 (427) | 15.2 (105) |

## Corrosion Properties

One of the most important properties for an alloy exposed to chloride-containing solutions, such as seawater or flue-gas condensate, is its resistance to pitting and crevice attack. The pitting and crevice corrosion resistance of an alloy in a chloride environment can be correlated to its composition by using the Pitting Resistance Equivalent (PREN) equation, which is commonly defined as PREN = % Cr + 3.3% Mo + 30% N, where chromium, molybdenum and nitrogen are in weight %. For ATI 31™ alloy, the PREN is typically about 53. The table below shows the PREN values and critical pitting temperatures of several alloys compared to ATI 31™ alloy.

**PREN values and Critical Pitting Temperatures (per ASTM G48 A)**

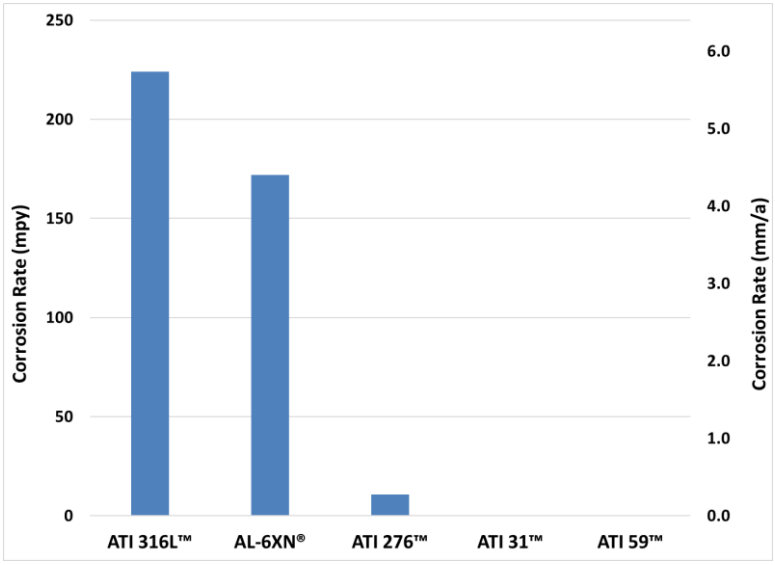
| Alloy | PREN | CPT |
|---|---|---|
| ATI 316™ | 24 | 59°F (15°C) |
| ATI 317™ | 30 | 77°F (25°C) |
| ATI 904L™ | 36 | 113°F (45°C) |
| AL-6XN® | 45 | 167°F (75°C) |
| ATI 31™ | 53 | 185°F (85°C) |

The table below lists the corrosion rates of ATI 31™ alloy from immersion tests conducted according to ASTM G31 and ASTM A262 B. Duplicate samples were exposed for the times shown and an average corrosion rate was determined.

**Corrosion Rates of ATI 31™ Alloy in Various Solutions**

| Solution | Time | Mils per year | mm / a |
|---|---|---|---|
| Boiling 10% $HSO_4$ | Five 48-hr Periods | 28.8 | 0.732 |
| Boiling 1% HCl | Five 48-hr Periods | 9.6 | 0.244 |
| Boiling 65% $HN0_3$ | Five 48-hr Periods | 10.8 | 0.274 |
| ASTM A262 B | 120 hours | 14.3 | 0.364 |

ATI 31™ alloy was tested, along with other alloys, for one week in a simulated marine exhaust scrubber environment[1]. The results shown below indicate that ATI 31™ alloy performs very well in this test.




Weight loss after 168 hours in a in simulated scrubber environment (pH 0.5, 110,000 ppm $Cl^-$, 80°C)

## Formability

ATI 31™ alloy can be formed like other austenitic stainless steels. This alloy is somewhat stronger than common stainless steels like ATI 304 and ATI 316, so more force will be required when forming ATI 31 alloy.

## Weldability

ATI 31™ alloy can be welded using most conventional welding processes, including GTAW (TIG), GMAW (MIG) and plasma welding. A filler metal that has a matching composition to ATI 31™ alloy is commercially available. However, the use of a more highly alloyed austenitic filler metal, such as Alloy 59, should be considered if it is critical to achieve high corrosion resistance in the welds. Overmatched fillers are often used in applications such as fabricated scrubber components.

## Heat Treatment

The ATI 31™ alloy should be solution annealed between 2100 and 2150°F (1149 and 1177°C) and quickly cooled.

## Product Forms

**Plate** – Width: Up to 96” (2,438mm)
Thickness: 0.187” - 0.500” (4.75 mm – 12.70 mm)

Please inquire for sizes outside of this range.

[1] *Evaluation of Alloys for Marine Exhaust Scrubbers – Effect of Welding and a Crevice,* NACE Corrosion 2018 Conference, Paper 10617, J. F. Grubb and B. S. DeForce.