Specification Sheet: 2507 (UNS S32750)

A 25Cr Duplex Stainless Steel

Alloy 2507 is a super duplex stainless steel with 25% Chromium, 4% Molybdenum, and 7% Nickel designed for demanding applications which require exceptional strength and corrosion resistance, such as chemical process, petrochemical, and seawater equipment. The steel has excellent resistance to chloride stress corrosion and high thermal conductivity, with a low coefficient of thermal expansion. The high chromium, molybdenum, and nitrogen levels provide excellent resistance to pitting, crevice, and general corrosion.

The impact strength is also high. Alloy 2507 is not recommended for applications which require long exposures to temperatures above 570ºF because of the risk of a reduction in toughness.

Applications

- Oil and gas industry equipment
- Offshore platforms, heat exchangers, process and service water systems, fire-fighting systems, injection and ballast water systems
- Chemical process industries, heat exchangers, vessels, and piping
- Desalination plants, high pressure RO-plant and seawater piping
- Mechanical and structural components, high strength, corrosion-resistant parts
- Power industry FGD systems, utility and industrial scrubber systems, absorber towers, ducting, and piping

Standards

ASTM/ASME .. A240 - UNS S32750

EURONORM .. 1.4410 - X2 Cr Ni MoN 25.7.4

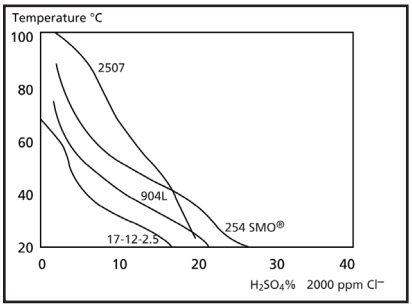
AFNOR..... Z3 CN 25.06 Az

Corrosion Resistance

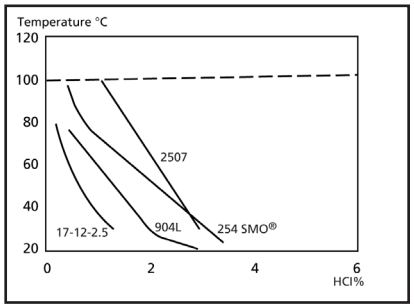
General Corrosion

The high chromium and molybdenum content of 2507 make it extremely resistant to uniform corrosion by organic acids like formic and acetic acid. 2507 also provides excellent resistance to inorganic acids, especially those containing chlorides.

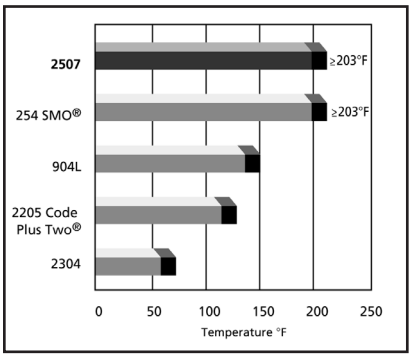
In dilute sulfuric acid contaminated with chloride ions, 2507 has better corrosion resistance than 904L, which is a highly alloyed austenitic steel grade specially designed to resist pure sulfuric acid.



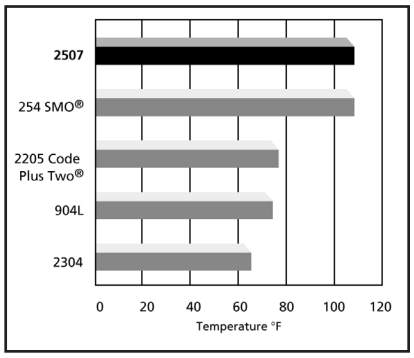
Isocorrosion curves, 0.1 mm/year, in sulfuric acid with an addition of 2000 ppm chloride ions



Isocorrosion curves, 0.1 mm/year, in hydrochloric acid. Broken line curve represents the boiling point



Critical Pitting Temperature (CPT) range for various alloys in 1M NACl



Critical Crevice Corrosion Temperature (CCT) for various alloys in 10% $FeCl_3$

Stainless steel of type 316L (2.5%Mo) cannot be used in hydrochloric acid due to the risk of localized and uniform corrosion. However, 2507 can be used in dilute hydrochloric acid. Pitting need not be a risk in the zone below the borderline in this figure, but crevices must be avoided.

Intergranular Corrosion

2507's low carbon content greatly lowers the risk of carbide precipitation at the grain boundaries during heat treatment; therefore, the alloy is highly resistant to carbide-related intergranular corrosion.

Stress Corrosion Cracking

The duplex structure of 2507 provides excellent resistance to chloride stress corrosion cracking (SCC).

Because of its higher alloy content, 2507 is superior to 2205 in corrosion resistance and strength. 2507 is especially useful in offshore oil and gas applications and in wells with either naturally high brine levels or where brine has been injected to enhance recovery.

Pitting Corrosion

Different testing methods can be used to establish the pitting resistance of steels in chloride-containing solutions. The data above were measured by an electrochemical technique based on ASTM G 61. The critical pitting temperatures (CPT) of several high-performance steels in a 1M sodium chloride solution were determined. The results illustrate the excellent resistance of 2507 to pitting corrosion. The normal data spread for each grade is indicated by the dark gray portion of the bar.

Crevice Corrosion

The presence of crevices, almost unavoidable in practical constructions and operations, makes stainless steels more susceptible to corrosion in chloride environments. 2507 is highly resistant to crevice corrosion. The critical crevice corrosion temperature of 2507 and several other high-performance stainless steels are shown above.

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

Chemical Analysis

Typical Values (Weight %)

C	Cr	Ni	Mo	N	Others
0.020	25	7	4.0	0.27	S = 0.001
PREN = [Cr %] + 3.3 [Mo %] + 16 [N %] ≥ 40					

Mechanical Properties

Mechanical and Physical Properties

2507 combines high tensile and impact strength with a low coefficient of thermal expansion and high thermal conductivity. These properties are suitable for many structural and mechanical components. The low, ambient, and elevated temperature mechanical properties of 2507 sheet and plate are shown below. All of the test data shown are for samples in the annealed and quenched condition.

2507 is not recommended for applications which require long exposures to temperatures in excess of 570ºF because of the increased risk of a reduction in toughness. The data listed in this document are typical for wrought products and should not be regarded as a maximum or minimum value unless specifically stated.

Mechanical Properties

Ultimate Tensile Strength, ksi	116 min.
0.2% Offset Yield Strength, ksi	80 min.
1% Offset Yield Strength, ksi	91 min.
Elongation in 2 inches, %	15 min.
Hardness, Rockwell C	32 max.
Impact Energy, ft-lbs	74 min.

Low Temperature Impact Properties

Temperature ºF	RT	32	-4	-40
Ft-lbs	162	162	155	140
Temperature ºF	**-76**	**-112**	**-148**	**-320**
Ft-lbs	110	44	30	7

Elevated Temperature Tensile Properties

Temperature ºF	68	212	302	392	482
0.2% Offset Yield Strength, ksi	80	65	61	58	55
Ultimate Tensile Strength, ksi	116	101	98	95	94

Physical Properties

Density	lb/in^3	0.28
Modulus of Elasticity	psi x 10^6	29
Coefficient of Thermal Expansion 68-212ºF/ºF	x10^{-6}/ºF	7.2
Thermal Conductivity	Btu/h ft ºF	8.7
Heat Capacity	Btu/lb ºF	0.12
Electrical Resistivity	Ω-in x 10^{-6}	31.5

Processing

Hot Forming

2507 should be hot worked between 1875ºF and 2250ºF. This should be followed by a solution anneal at 1925ºF minimum and a rapid air or water quench.

Cold Forming

Most of the common stainless steel forming methods can be used for cold working 2507. The alloy has a higher yield strength and lower ductility than the austenitic steels so fabricators may find that higher forming forces, increased radius of bending, and increased allowance for springback are necessary. Deep drawing, stretch forming, and similar processes are more difficult to perform on 2507 than on an austenitic stainless steel. When forming requires more than 10% cold deformation, a solution anneal and quench are recommended.

Heat Treatment

2507 should be solution annealed and quenched after either hot or cold forming. Solution annealing should be done at a minimum of 1925ºF Annealing should be followed immediately by a rapid air or water quench. To obtain maximum corrosion resistance, heat treated products should be pickled and rinsed.

Welding

2507 possesses good weldability and can be joined to itself or other materials by shielded metal arc welding (SMAW), gas tungsten arc welding (GTAW), plasma arc welding (PAW), flux cored wire (FCW), or submerged arc welding (SAW). 2507/P100 filler metal is suggested when welding 2507 because it will produce the appropriate duplex weld structure.

Preheating of 2507 is not necessary except to prevent condensation on cold metal. The interpass weld temperature should not exceed 300ºF or the weld integrity can be adversely affected. The root should be shielded with argon or 90% N_2/10% H_2 purging gas for maximum corrosion resistance. The latter provides better corrosion resistance.

If welding is to be done on only one surface and post weld cleaning is not possible, GTAW is suggested for root passes. GTAW or PAW should not be done without a filler metal unless post weld cleanup is possible. A heat input of 5-38 kJ/in. should be used for SMAW or GTAW. A heat input of about 50kJ/in. can be used for SAW.

NOTE

This technical data and information represents our best knowledge at the time of printing. However, it may be subject to some slight variations due to our ongoing research program on corrosion resistant grades.

We, therefore, suggest that information be verified at time of inquiry or order. Furthermore, in service, real conditions are specific for each application. The data presented here is only for the purpose of description and may only be considered as guarantees when our Company has given formal written approval.

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