ATI

Technical Data Sheet

JS700®

Stainless Steel: Superaustenitic

(UNS N08700)

GENERAL PROPERTIES

ATI corrosion resistant engineering alloy, JS700®, is a high-alloy, fully austenitic, superaustenitic stainless steel. This alloy is a proven problem-solver in many applications where corrosive conditions are too severe for standard grades of stainless steel. It has also provided a cost-effective alternative to more expensive nickel-base and titanium-base alloys.

JS700 stainless steel is more highly alloyed than standard stainless steels. It contains nominally 25% nickel, 20% chromium and 4.5% molybdenum. The high molybdenum content is particularly important to the corrosion resistant properties. Molybdenum is used in many stainless steels to improve resistance to both localized and general corrosion. It enhances development of the passive film responsible for the corrosion resistance of stainless, and makes the alloy more noble so that corrosion resistance is improved even under conditions which tend to destroy passivity. The molybdenum content of JS700 steel, at 4.3 to 5.0%, is more than twice the level usually found in the widely-used Type 316 stainless steel.

The chromium content of the JS700 alloy is essential to corrosion resistance. Since chromium contributes to sigma formation, the 20% level was chosen as a satisfactory compromise. The high nickel content not only minimizes sigma, but also contributes markedly to corrosion resistance. The effects of higher nickel are believed to relate more to corrosion propagation than to initiation. As shown in the tabulated corrosion test results, JS700 steel far outperforms Type 317LM, a steel with similar molybdenum content and only slightly lower chromium, but much lower nickel.

The combination of the three major alloying elements gives JS700 stainless steel a high degree of resistance to stress corrosion cracking. No field service failures from stress corrosion cracking in JS700 alloy have been reported to date.

JS700 steel has a relatively low carbon content, plus columbium stabilization to tie up the remaining carbon. This stabilization guards against intergranular corrosion due to carbide precipitation (sensitization) in areas such as weld heat affected zones even more effectively than with a 0.020% carbon level without stabilization. JS700 alloy will, in fact, pass a demanding Huey test in the furnace sensitized condition.

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TYPICAL COMPOSITION

Element	Weight %
Nickel	24.0-26.0%
Chromium	19.0-23.0
Molybdenum	4.3-5.0
Columbium	8 x carbon min-0.40 max
Carbon	0.04 max.
Silicon	1.00 max.
Manganese	2.00 max.
Phosphorus	0.04 max.
Sulfur	0.03 max.
Copper	0.50 max.
Iron	Balance

SPECIFICATIONS & CERTIFICATES

ASTM B599

ASTM B672

ASTM SB-599

ASTM SB-672

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CORROSION RESISTANCE

Corrosion Data(48 Hour Laboratory Tests - All concentrations are by weight percent).

Environment	Temperature °F (°C)	Corrosion Rate Inches/Year (mm/y)		
		JS700®	ATI 317LM™	ATI 317L™
20% Phosphoric Acid	Boiling Point	<0.002 (<0.05)		<0.002 (<0.05)
20% Phosphoric Acid	Boiling Point	<0.002 (<.05)		<0.002 (<.05)
54% Phosphoric Acid	250 (121)	0.0024 (0.06)		
60% Phosphoric Acid	Boiling Point	0.059 (1.50)		
85% Phosphoric Acid	Boiling Point	0.122 (3.10)	0.294 (7.47)	0.196 (4.98)
Sensitized Material	Boiling Point	0.124 (3.15)		
25% Phosphoric 2% HF	167 (75)	0.008 (0.20)		
60% Acetic Acid	Boiling Point	<0.002 (<.05)		<0.002 (<.05)
1:1 Acetic Acid/Anhydride	Boiling Point	0.001 (0.02)		
5% Nitric Acid + 3% HF	155 (68)	<0.002 (<.05)		
25% Nitric Acid	Boiling Point	<0.002 (<.05)		<0.002 (<.05)
65% Nitric Acid (Huey)	Boiling Point	<0.020 (<.05)		
5% Hydrochloric Acid	Boiling Point	1.491 (37.87)	1.454 (36.93)	1.691 (42.95)
10% Hydrochloric Acid	Room Temp.	0.018 (0.46)		
10% Hydrochloric Acid	140 (60)	0.150 (3.81)		
10% Hydrochloric Acid	Boiling Point	4.51 (114.55)		
10% HCl in EDA [1]	Boiling Point	<0.001 (<.02)		
30% Sulfuric Acid	Boiling Point	0.150 (3.81)		
Sensitized Material	Boiling Point	0.160 (4.06)		
50% Sulfuric Acid	Boiling Point	0.247 (6.27)	[4]	[4]
50% Sulfuric Acid + 1/2% HCl	Boiling Point	0.880 (22.35)	0.962 (24.43)	0.540 (13.72)
70% Sulfuric Acid	Boiling Point	57.6 (1463.)		
Butyl Acetate Mixture [2]	Boiling Point	0.264		
Streicher Test [3]	Boiling Point	0.096		

[1] 1 Volume conc. HCl in 9 volumes Ethylene Diamine.

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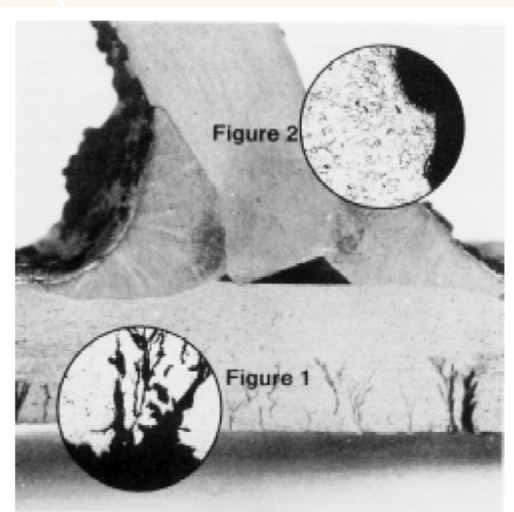
[2] 75% Ester-11% Butenol—10% Acetic Acid—4% Water—0.3% H_2SO_4
[3] 50% Sulfuric Acid + 0.6% Fe + as 3 as ferric sulfate inhibitor.
[4] Dissolved completely in 48 hours.

Pitting and Crevice Corrosion Tests

Critical temperature for crevice corrosion (CCCT) in ferric chloride under laboratory test conditions is approximately 20°C (68°F). This CCCT is higher than that of the ATI 904L™ or ATI 317LM™ alloys.

APPLICATIONS

This high-performance engineering alloy can perform satisfactorily in environments which will quickly and dramatically destroy standard stainless steels. A good example of a difficult corrosive environment is the wet scrubber on a municipal incinerator of a major southern U.S. city. Here, the gases were high in chlorides due to fumes from burning plastics, and the salt water used for scrubbing was high in chlorides as well. Type 316L became totally ineffective in just seven weeks (Fig. 1). On the other hand, JS700 stainless steel was essentially unaffected by the same exposure (Fig. 2). It remained in service for over eight years in this scrubber.



Similarly dramatic differences in service life have been reported in wet-process phosphoric acid plants. This application represents the first major use of JS700 stainless steel, beginning in the late 1960s. Corrosion coupons exposed under plant conditions show the life of JS700 alloy to be on the order of ten times that of ATI 317L™ stainless steel. Positive service records for this superaustenitic stainless grade have been reported in other difficult applications, among them handling impure organic acids and chlorine dioxide pulp bleaching.

FABRICATION CHARACTERISTICS

Forming characteristics are similar to that of austenitic stainless steels.

Thermal Treatment	
Initial forging	2000/2200°F
Solution annealing	2025/2100°F plus rapid cool
Hardening	Hardenable by cold work only.

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Welding

JS700 steel may be welded with electrodes or filler metals having the same composition as the basic metal. Use of an over-matched filler having about 1.5 times or greater Mo content than the JS 700 alloy will counter the normal Mo segregation which occurs during solidification. Alloy 625 filler metal is frequently used. JS700 alloy is somewhat susceptible to hot cracking in welding, like other high-alloy austenitic grades. Use the lowest heat input that will still maintain a stable arc. Weld by stringer bead technique, with weaving limited to two electrode diameters maximum. Minimize crater cracking by reducing weld amperage to the lowest sustainable level to reduce the size of the weld pool before extinguishing arc. If crater cracks are formed, they may be carefully removed by grinding. Repair welding by TGA with foot control of amperage is feasible, but requires careful technique. Do not use oxygen to stabilize the arc in Gas Metal-Arc or Gas Tungsten-Arc welding. Argon is usually preferred over helium for shielding.

MECHANICAL PROPERTIES

Tensile Strength, psi, (minimum)	80,000
0.2% Yield Strength, psi, (minimum)	35,000
Elongation, % in 2" (minimum)	30
Reduction in Area, %, (minimum)	40
Brinell Hardness (maximum)	212

PHYSICAL PROPERTIES

Density	0.287 lb/in^3
	(7.95 g/cm^3)
Microstructure	Fully Austenitic
Thermal Conductivity	101.5 Btu•in/hr•ft^2•°F
	(14.7 W/m•K)
Coefficient of Linear Thermal Expansion	
32 to 212°F	9.1 x 10^{-6} in/in·°F
(0 to 100°C)	(16.4 x 10^{-6} cm/cm·°C)

PRODUCT FORMS

Plate	3/16" and thicker 96 x 360" max., depending on thickness
Plate Shapes	Variety of plate shapes available, including plasma and abrasive cut
Sheet	Availability on application to the mill
Bar Products and Castings	Refer to the mill

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