

Alleima® SX

Tube and pipe, seamless

Datasheet

Alleima® SX is a high silicon containing austenitic stainless steel developed for use in concentrated sulfuric acid. The grade is characterized by:

- Excellent corrosion resistance in concentrated sulfuric acid
- Excellent corrosion resistance in high concentrated nitric acid
- Good mechanical properties and ductility
- Good weldability
- Product standards
- ASTM A213, A312, and A479

Approvals

- Approved by the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section VIII, div. 1 construction

Standards

- UNS: S32615

Chemical composition (nominal)

Chemical composition (nominal) %

C	Si	Mn	P	S	Cr	Ni	Mo	Cu
---	----	----	---	---	----	----	----	----

Chemical composition (nominal) %

C	Si	Mn	P	S	Cr	Ni	Mo	Cu
≤0.025	5.0	0.5	≤0.045	≤0.030	17.5	19.5	0.4	2.0

Applications

Alleima® SX is particularly suitable for use in the following applications:

- Acid coolers
- Acid piping systems
- Acid distributors
- Acid towers and tanks
- Pumps, nozzles, internals, strainers, mesh pads etc.

Corrosion resistance

General corrosion

Alleima® SX has excellent corrosion resistance in concentrated sulfuric acid, both in static and dynamic conditions. This is illustrated by the isocorrosion diagram, Figure 1, and by the comparative test data for different alloys, Figure 2.

Temperature, °C

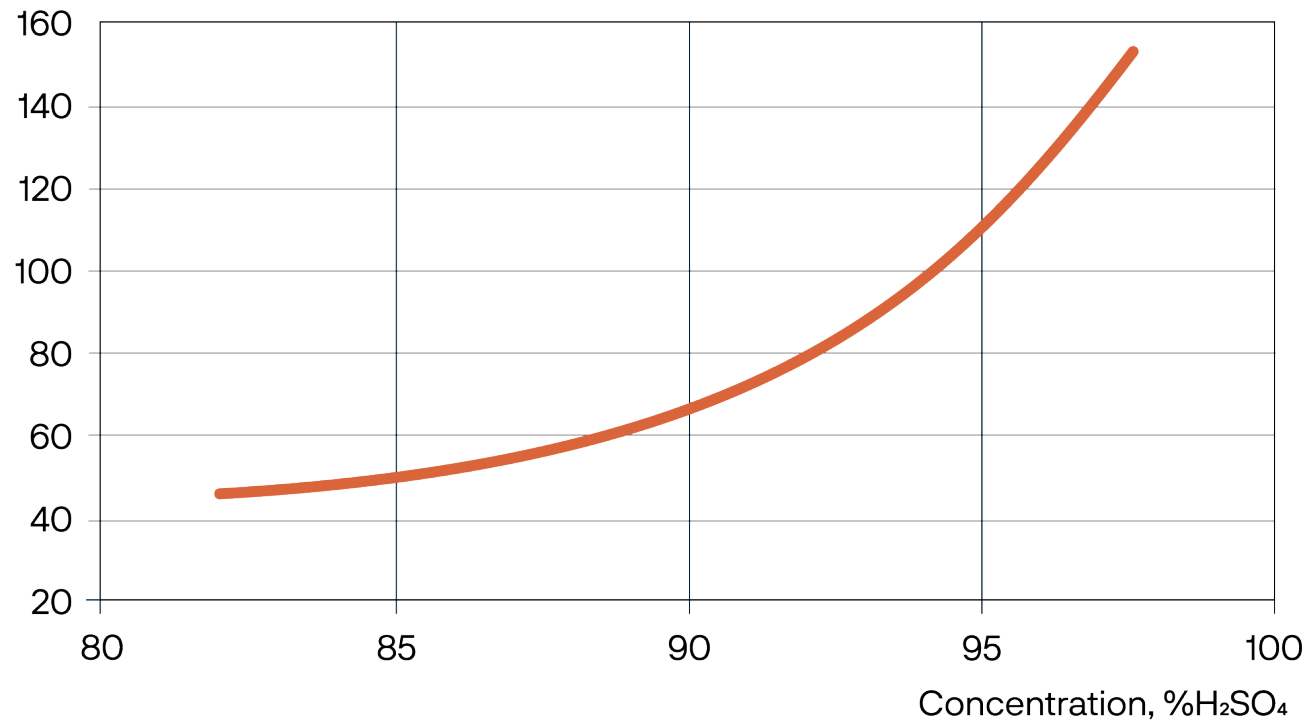


Figure 1. Isocorrosion diagram, 0.1 mm/year, for Alleima® SX in concentrated sulfuric acid at static conditions.

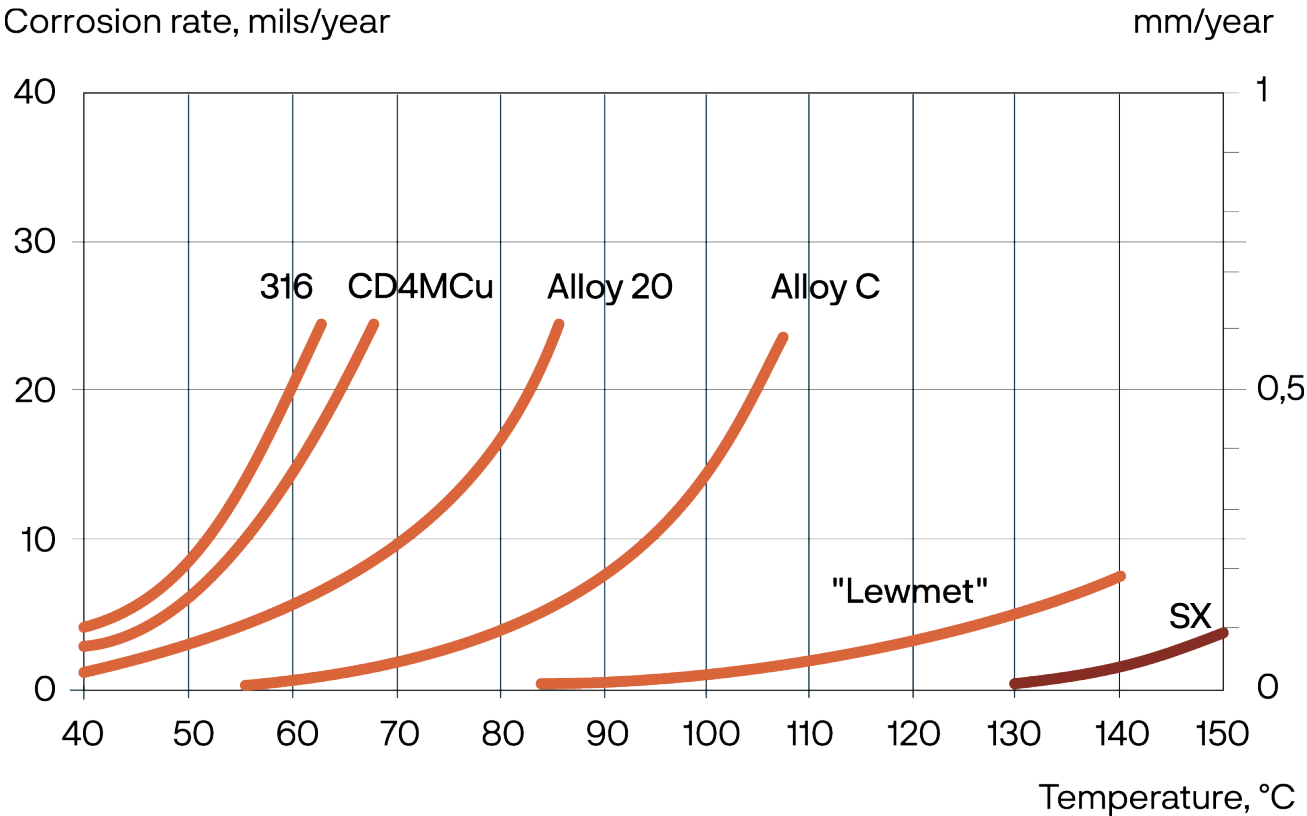


Figure 2. Approximate corrosion rate curves for various alloys in 98% H₂SO₄ at static conditions.

Alleima® SX has excellent corrosion resistance in high concentrated nitric acid. The material has been tested with good results in both 90 and 100% nitric acid. The corrosion properties in nitric acid can be seen in the isocorrosion diagram in Figure 3, and in the corrosion rate diagram in Figure 4.

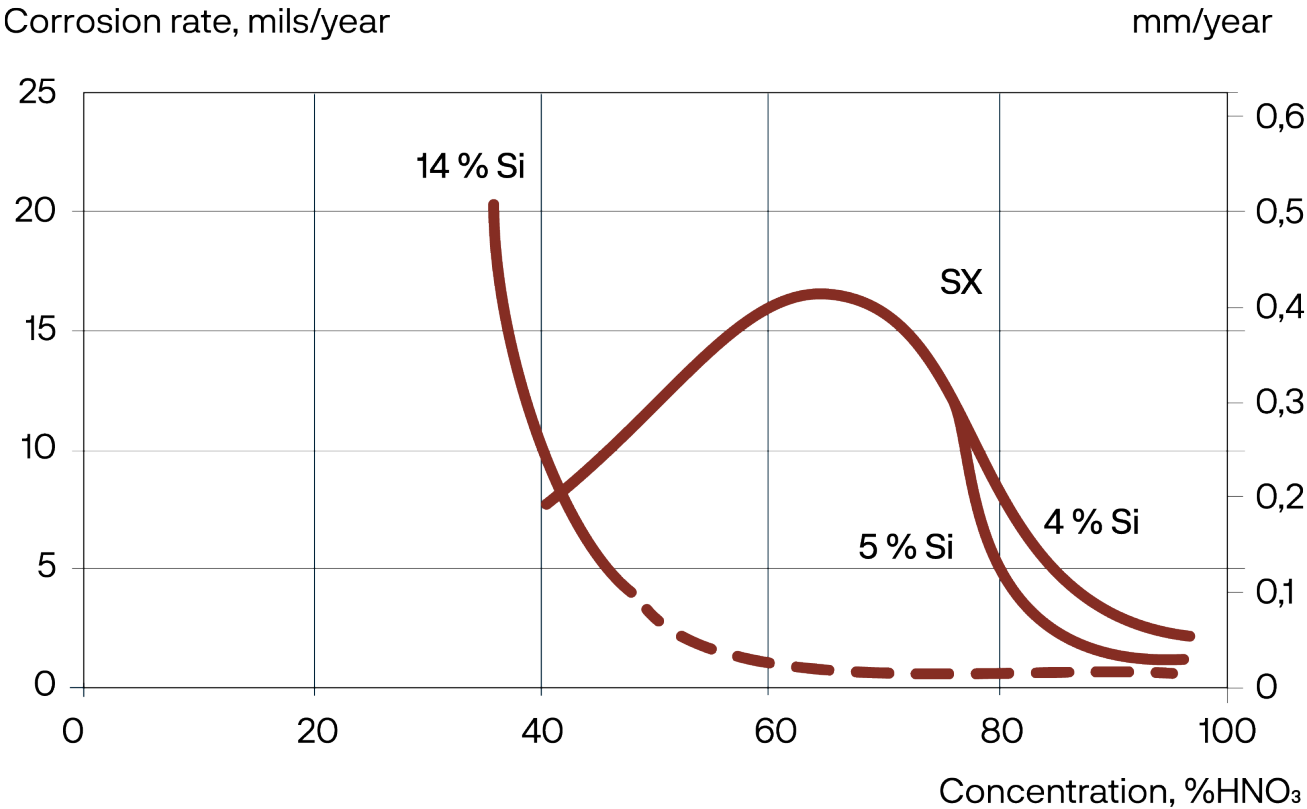


Figure 3. Effect of silicon content in Fe-Cr-Ni alloys on corrosion resistance in HNO₃.

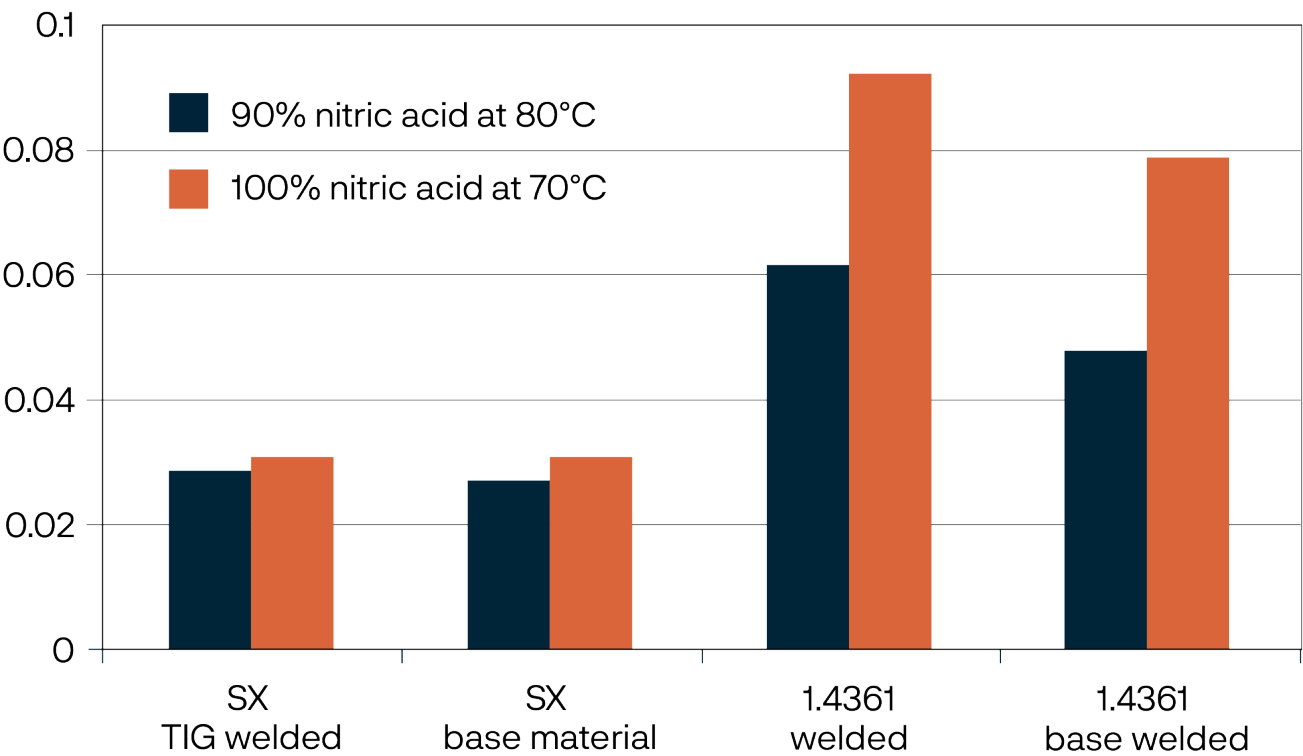


Figure 4. Results from tests in 90% and 100% HNO₃ at 80°C and 70°C respectively.

Pitting and crevice corrosion

The steel may be sensitive to pitting and crevice corrosion even in solutions of relatively low chloride content. Alleima® SX is used in acid coolers with demi-water or chloride containing cooling water. The corrosivity of the cooling water needs to be evaluated in every particular case taking different factors, such as metal temperature, pH, and chlorination practice into account.

Stress corrosion and cracking

Austenitic steels are susceptible to stress corrosion cracking (SCC). This may occur at temperatures above 60°C (140°F) if the steel is subjected to tensile stresses and at the same time comes into contact with certain solutions, particularly those containing chlorides. Such service conditions should therefore be avoided. Conditions when plants are shut down must also be considered, as the condensates which are then formed can develop conditions that lead to both SCC and pitting.

Forms of supply

Seamless tube and pipe in Alleima® SX is available in the solution-annealed and white-pickled condition or as solution annealed by a bright-annealing process. Solution annealed bar is also available.

Mechanical properties

Metric units, at 20°C

Proof strength		Tensile strength	Elong.	Hardness
Rp0.2 ^a	Rp1.0 ^a	Rm	A2"	HRB
MPa	MPa	MPa	%	
≥220	≥250	≥550	≥25	≤90

Imperial units, at 68°F

Proof strength		Tensile strength	Elong.	Hardness
Rp0.2 ^a	Rp1.0 ^a	Rm	A2"	HRB
ksi	ksi	ksi	%	
≥32	≥36	≥80	≥25	≤90

1 MPa = 1 N/mm²

a) Rp_{0.2} and Rp_{1.0} correspond to 0.2% offset and 1.0% offset yield strength, respectively.

b) Based on $L_0 = 5.65 \sqrt{S_0}$ where L_0 is the original gauge length and S_0 the original cross-sectional area.

At high temperatures

Metric units

Temperature	Proof strength
°C	Rp0.2
	MPa
50	≥205
100	≥180
150	≥170
200	≥160

Imperial units

Temperature	Proof strength
°F	Rp0.2
	ksi
100	≥32
200	≥26.4
300	≥24.8
400	≥23.1

Impact strength

Due to its austenitic microstructure, Alleima® SX has very good impact strength, both at room temperature and at cryogenic temperatures.

Physical properties

Density: 7.9 g/cm³, 0.28 lb/in³

Specific heat capacity

Temperature, °C	J/kg °C	Temperature, °F	Btu/lb °F
50-100	500	122-212	0.12

Thermal conductivity

Temperature, °C	20	100	200
	W/m °C		
Alleima® SX	11	13	14
ASTM 304L	15	16	18

Temperature, °F	68	200	400
	Btu/(ft h °F)		
Alleima® SX	6.5	7.5	8.0
ASTM 304L	8.5	9.5	10.5

Thermal expansion ¹⁾

Temperature, °C	30-100	30-200	30-300
	Per °C		
Alleima® SX	15.0	15.5	16.0
Carbon steel	12.5	13.0	13.5
ASTM 304L	16.5	17.0	17.5
Temperature, °F	86-200	86-400	86-600
	Per °F		
Alleima® SX	8.5	8.5	9.0
Carbon steel	7.0	7.0	7.5
ASTM 304L	9.5	9.5	10.0

1) Mean values in temperature ranges ($\times 10^{-6}$)

Modulus of elasticity ¹⁾

Temperature, °C	MPa	Temperature, °F	ksi
20	200	68	29.0
400	170	752	24.7

1) ($\times 10^3$)

Welding

The weldability of Alleima® SX is good. Welding must be carried out without preheating, and normally there is no need for any subsequent heat treatment. Suitable method of fusion welding is gas tungsten arc welding GTAW/TIG.

For Alleima® SX, heat-input of <1.0 kJ/mm and interpass temperature of <50°C (120°F) are recommended. A string bead welding technique should be used.

Recommended filler metals

GTAW/TIG

EN ISO 14343-A: W Z 18 13 Si Cu L (e.g. Exaton SX)

Disclaimer: Recommendations are for guidance only, and the suitability of a material for a specific application can be confirmed only when we know the actual service conditions. Continuous development may necessitate changes in technical data without notice. This datasheet is only valid for Alleima materials.