

SAF™ 2507 for OCTG

Tube and pipe, seamless

Datasheet

SAFTM 2507 is a super-duplex (austenitic-ferritic) stainless steel for OCTG downhole applications.

The grade is characterized by:

- High resistance to stress corrosion cracking (SCC) in chloride-bearing environments
- Moderate resistance to SCC in sour (H₂S/Cl⁻) environments
- Excellent resistance to pitting and crevice corrosion
- High resistance to general corrosion
- Very high mechanical strength
- High resistance to erosion corrosion and corrosion fatigue
- UNS: S32750
- EN Number: 1.4410
- EN Name: X 2 CrNiMoN 25-7-4
- SS: 2328

Product standards

Seamless tubes used as casing, tubing and coupling stock:

- ISO 13680, PSL-1 and PSL-2
- API spec 5CRA, PSL-1 and PSL-2

Approvals

- NACE MR0175/ISO 15156 (Petroleum and natural gas industries - Materials for use in H₂S-containing Environments in oil and gas production - Part 3: Cracking-resistant CRAs (corrosion resistant alloys and other alloys) (Published:2015)
- SAF 2507 grade 80 ksi, 90 ksi, 110 ksi, and 125 ksi, (PSL-1 or PSL-2) and grade 140 ksi (PSL-1) can be delivered with API-5CRA Monogram (License Number 5CRA-0016)

Chemical composition (nominal)

Chemical composition (nominal) %

C	Si	Mn	P	S	Cr	Ni	Mo	N
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≤ 0.03
 ≤ 0.8
 ≤ 1.2
 ≤ 0.025
 ≤ 0.015
25
7
4
0.3

Applications

SAF™ 2507 is used for high strength downhole production tubing, casing, and liners in sour gas wells. This includes environments with high temperatures, high partial pressures of CO₂ and H₂S, and high chloride concentrations. The material is suitable for use in production tubing and flowlines for the extraction of oil and gas from sour wells, in refineries and in process solutions contaminated with chlorides.

The high strength of SAF™ 2507 makes the material an attractive alternative to the austenitic steels in structures subjected to heavy loads.

Corrosion resistance

Pitting Corrosion

SAF™ 2507 can withstand high temperatures in aggressive environments without pitting. A recognized method of ranking a material's susceptibility to localized corrosion is by means of the PRE number (Pitting Resistance Equivalent). This PRE number is based on the contents of chromium, molybdenum and nitrogen in the alloy according to the following formula:

$$\text{PRE} = \% \text{Cr} + 3.3 \times \% \text{Mo} + 16 \times \% \text{N}$$

A PRE number is the relative measure of a material's ability to resist pitting corrosion in chloride containing environments. The PRE number for SAF™ 2507 is compared with other materials in the following table:

Grade	% Cr	% Mo	% N	PRE
SAF™ 2507	25	4	0.3	>42.5
UNS S31803	21.0 - 23.0	2.50 - 3.50	0.08 - 0.20	>30
Alloy 825	20	2.6	-	29
ASTM TP317L	18	3.5	-	30
ASTM TP316L	17	2.2	-	24

SAF™ 2507 has a minimum PRE number of 42.5, which confirms its high resistance to pitting corrosion when chlorides are present.

Stress Corrosion Cracking (SCC)

SAF™ 2507 has excellent resistance to chloride induced stress corrosion cracking (SCC). The SCC resistance of SAF™ 2507 in chloride solutions at high temperatures is illustrated in Figure 13. There were no signs of SCC up to 1000 ppm Cl⁻/300°C and 10000 ppm Cl⁻/250°C. SAF™ 2507 U-bend specimens exposed for 1000 hours in hot brine (108°C, 226°F, 25% NaCl) showed no cracking.

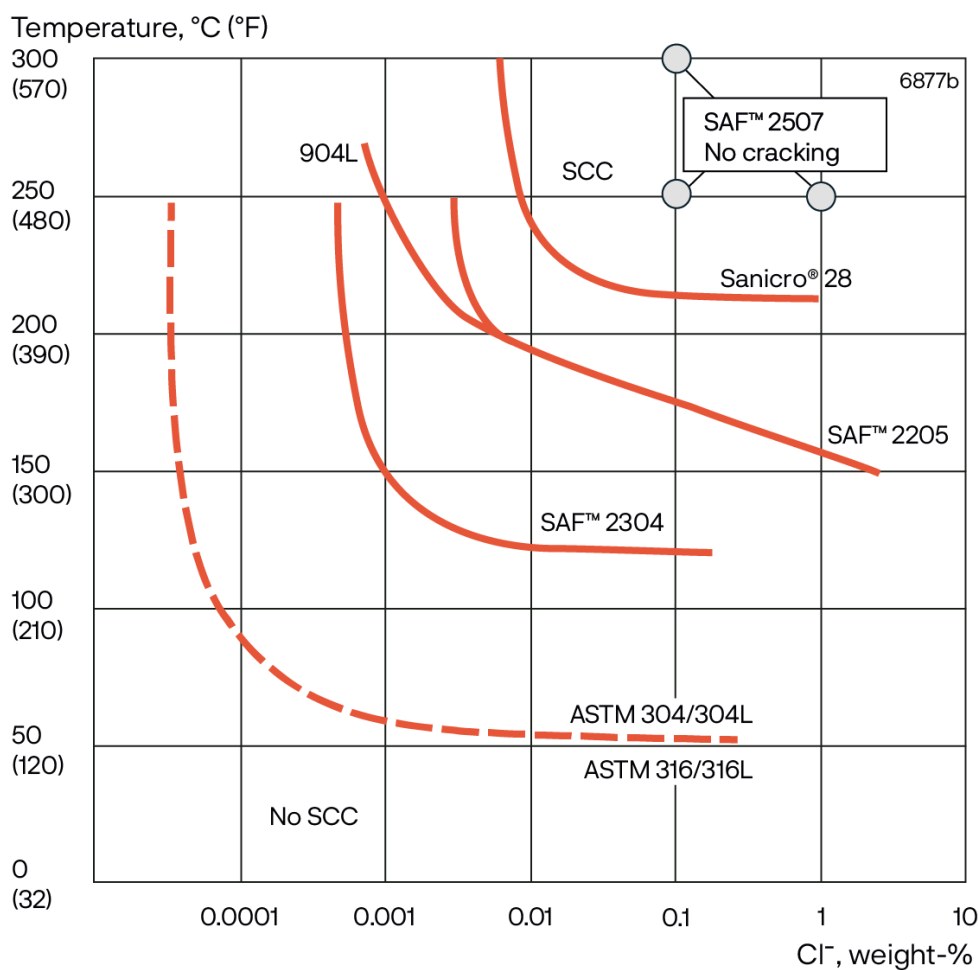


Figure 13. SCC resistance in oxygen-bearing (abt. 8 ppm) neutral chloride solutions. Testing time 1000 hours. Applied stress equal to proof strength at testing temperature.

Fabrication

SAF™ 2507 tubes are supplied in the cold worked condition and are intended for use with threaded connections.

Forms of supply

Materials for oil and gas production

For production tubing, casing, liner, and coupling stock for downhole oil and gas applications, SAF™ 2507 is supplied solution annealed (80 ksi, 90 ksi) or cold hardened with high strength properties (110 ksi, 125 ksi, 140 ksi).

Full details on sizes, finishes and mechanical properties are available on request. Email: stog.smt@alleima.com

Mechanical properties

At 20°C (68°F)

Metric and imperial units

Grade	Proof strength		Tensile Strength		Elongation	Hardness
	$R_{p0.2}^{a)}$		R_m		$A_{2''}$	HRC
	MPa	ksi	MPa min	ksi min	% min	% max
PSL-1 SAF2507-80	552 - 724	80 - 105	758	110	20	28
PSL-1 SAF2507-90	621 - 724	90 - 105	793	115	20	30
PSL-1 SAF2507-110	758 - 965	110 - 140	862	125	12	36
PSL-1 SAF2507-125	862 - 1034	125 - 150	896	130	10	37
PSL-1 SAF2507-140	965 - 1103	140 - 160	1000	145	9	38
PSL-2 SAF2507-80	552 - 724	80 - 105	758	110	20	28
PSL-2 SAF2507-80	621 - 724	90 - 105	793	115	20	30
PSL-2 SAF2507-110	758 - 965	110 - 140	862	125	12	36
PSL-2 SAF2507-125	862 - 1000	125 - 145	896	130	10	36

1 MPa = 1 N/mm²

a) $R_{p0.2}$ corresponds to 0.2% offset yield strength.

At high temperatures

SAF™ 2507 shows very good mechanical properties at higher temperatures. Further information is available on request. Email: stmo.smt@alleima.com

Metric units / Imperial units

Temperature °C	De-rating factor*	Temperature °F	De-rating factor*
20	1.00	68	1.00
50	0.96	122	0.96
100	0.87	212	0.87

150	0.81	302	0.81
200	0.76	392	0.76

Physical properties

Density, at 7.8 g/cm³, 0.28 lb/in³

Thermal conductivity

Metric units

Temperature,°C	20	100	200	300	400
	W/(m °C)				
SAF™ 2507	14	15	17	18	20
ASTM TP316L	14	15	17	18	20

Imperial Units

Temperature,°F	68	200	400	600	800
	Btu/(ft h °F)				
SAF™ 2507	8	9	10	11	12
ASTM TP316L	8	9	10	10	12

Specific Heat Capacity

Metric units

Temperature,°C	20	100	200	300	400
	J/(kg °C)				
SAF™ 2507	490	505	520	550	585

Imperial Units

Temperature,°F	68	200	400	600	800
	Btu/(lb °F)				
SAF™ 2507	0.12	0.12	0.13	0.13	0.14

Thermal Expansion

Metric units, x10⁻⁶/°C

Temperature, °C	30-100	30-200	30-300	30-400
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	Per °C			
SAF™ 2507	13.5	14.0	14.0	14.5
Carbon steel	12.5	13.0	13.5	14.0
ASTM TP316L	16.5	17.0	17.5	18.0

Imperial units, x10⁻⁶/°F

Temperature, °F	86-200	86-400	86-600	86-800
	Per °F			
SAF™ 2507	7.5	7.5	8.0	8.0
Carbon steel	6.8	7.0	7.5	7.8
ASTM TP316L	9.0	9.5	9.8	10.0

Resistivity

Metric units

Temperature, °C	20	100	200	300
	μΩm			
SAF™ 2507	0.83	0.89	0.96	1.03

Imperial units

Temperature, °F	68	200	400	600
	μΩin			
SAF™ 2507	32.7	34.9	37.9	40.7

Modulus of elasticity

Metric units, x10³

Temperature, °C	20	100	200	300
	MPa			
SAF™ 2507	200	194	186	180

Imperial units, x10³

Temperature, °F	68	200	400	600
	ksi			
SAF™ 2507	29.0	28.2	27.0	26.2

Impact Strength

SAF™ 2507 possesses good impact strength. The ductile brittle transition temperature is below -50°C (-58°F).

Impact energy, KCV

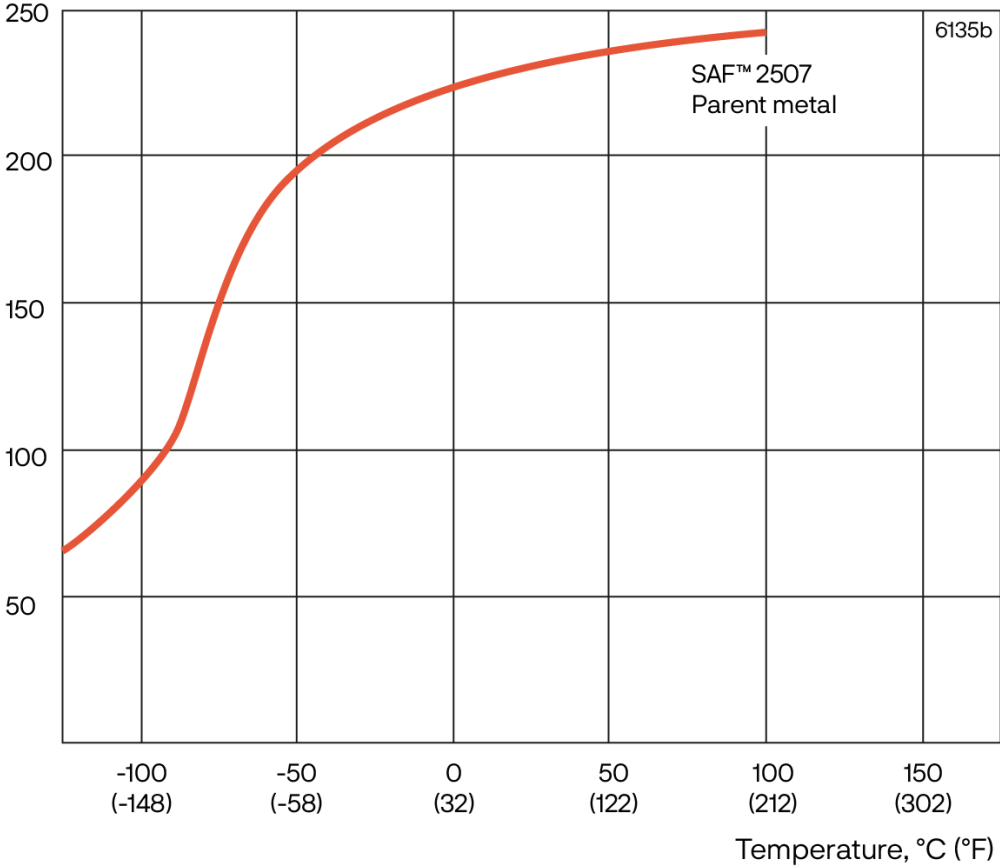


Figure 2. Typical impact energy curve for SAF™ 2507 using Charpy V specimens (average of 3 at each temp.). Parent metal samples taken in the longitudinal direction from 260 x 12mm hot extruded and solution annealed (1075°C / 1965°F) tube.

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.