

# SAF™ 3007 for umbilicals

## Tube and pipe, seamless

### Datasheet

SAF™ 3007 is a super-duplex (austenitic-ferritic) stainless steel optimized for service in highly corrosive chloride environments where a high strength material is required.

The grade is characterized by:

- Excellent resistance to stress corrosion cracking (SCC) in chloride-bearing environments
- Excellent resistance to pitting and crevice corrosion
- Excellent mechanical strength
- Physical properties that offer design advantages
- Good weldability

### Standards

- ASTM: A789, A790
- UNS: S83072

### Chemical composition (nominal)

#### Chemical composition (nominal) %

C	Si	Mn	P	S	Cr	Ni	W	Mo	Cu	N
≤0.030	0.2	1.0	≤0.030	≤0.030	30	7	3.4	1.0	≤0.30	0.40

### Applications

SAF™ 3007, with its excellent strength, pitting and crevice corrosion resistance, and good weldability, is an optimal choice for umbilical tubing in subsea applications. Its unique properties make it highly effective in handling seawater and operating in high-pressure environments.

### Corrosion resistance

#### Pitting and crevice corrosion

SAF™ 3007 is designed for demanding environments where a high mechanical strength in combination with high corrosion resistance is desired and where, additionally, welding is not tolerable to impair the well-adjusted properties.

A parameter for comparing the resistance to pitting in chloride environments is the PRE number (Pitting Resistance Equivalent).

A modified PRE formula for stainless steel containing tungsten is defined as (in weight %):

$$\text{PRE} = \%Cr + 3.3 \times (\%Mo + \frac{1}{2} \times \%W) + 16 \times \%N$$

The minimum PRE value for SAF™ 3007 is 43.

SAF™ 3007 has excellent resistance to both pitting and crevice corrosion. The tables below specify the resistance to localized corrosion induced by chlorides by the critical pitting temperature (CPT) and the critical crevice temperature (CCT).

The CPT and CCT have been determined according to ASTM G48 method E and method F respectively, in acidified 6 % ferric solution (FeCl<sub>3</sub>) and according to ASTM G150 in 1 M sodium chloride (NaCl).

In the measurements of CPT, test coupons with surface wet ground with P120 grit paper were tested by the ASTM G48 method E. For ASTM G150, test coupons with surface wet ground with P600 were tested, applied potential was 700 mV vs. SCE.

Alloy	PRE	CPT	CPT
		°C	°C
		ASTM G48 E	ASTM G150
SAF™ 3007	≥ 43.0	70	81

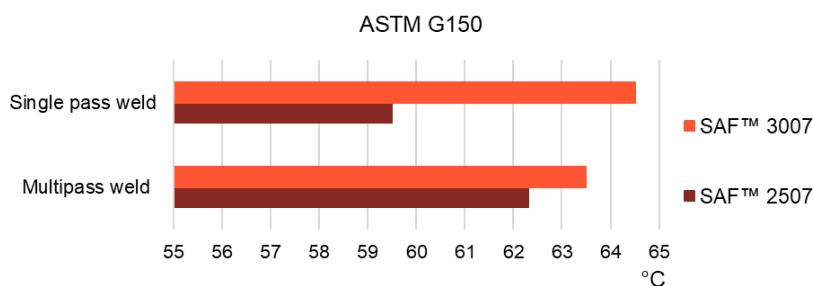
In the measurements of CCT, test coupons wet ground with P120 were tested in ASTM G48 method F. For ASTM G150, test coupons wet ground with P600 were tested, applied potential was 700 mV vs. SCE.

Alloy	PRE	CCT	CCT
		°C	°C
		ASTM G48 F <sup>a)</sup>	ASTM G150 <sup>b)</sup>
SAF™ 3007	≥ 43.0	30	79

<sup>a)</sup> Applied momentum of 1.58 Nm

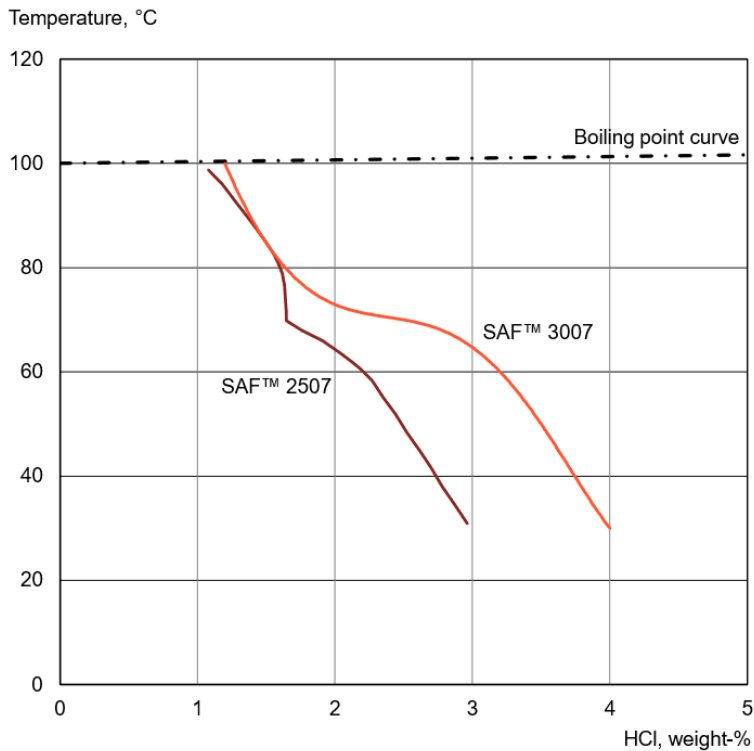
<sup>b)</sup> Crevice formers according to ISO 18070 with applied momentum of 3 Nm

Orbitally welded tubes of SAF™ 3007 pass the ASTM G48 method A requirements with a CPT greater than 40 °C. SAF™ 3007, part of Alleima's duplex stainless steel family, is alloyed with tungsten (W) instead of molybdenum (Mo) to maintain corrosion resistance after welding, crucial for the umbilical application. The CPT of SAF™ 3007 orbitally welded tubes is compared to SAF™ 2507 in a sodium chloride (NaCl) environment.



## General corrosion

SAF™ 3007 has high resistance to hydrochloric acid (HCl), exceeding the resistance of SAF™ 2507. The graph below shows the iso-corrosion rate in hydrochloric acid, the curves represent a corrosion rate of 0.1 mm/year (4 mpy) in stagnant test solution.



## Forms of supply

SAF™ 3007 can be supplied as seamless straight tubes or tubes coiled on reels, in bright annealed condition. SAF™ 3007 is supplied in dimensions from inner diameter 9.53 mm ( $\frac{3}{8}$  ") up to 63.5 mm ( $2\frac{1}{2}$  "), outer diameter 13 mm ( $\frac{1}{2}$  ") to 73 mm ( $2\frac{7}{8}$  "). Please contact Alleima for more information regarding other product forms.

## Heat treatment

Tubes are delivered in solution annealed condition. If additional heat treatment is needed after further processing, please contact Alleima.

## Mechanical properties

The following tables apply to material in cold pilgered and solution annealed condition. The listed values are guaranteed for tubes.

### At 20 °C (68 °F)

#### Metric units

Inner diameter	Wall thickness	Proof strength
from	to	$R_{p0.2}^{a)}$

mm	mm	mm	MPa
			min.
≥ 9.53	≤ 15.88	≤ 3	800
		> 3	780
> 15.88	≤ 25.40	≤ 5	780
		> 5	760
> 25.40	≤ 63.50	≤ 5	760
		> 5	740

1 MPa = 1 N/mm<sup>2</sup>

<sup>a)</sup> R<sub>p0.2</sub> corresponds to 0.2% offset yield strength

## BR

Tensile strength	Yield / Tensile strength ration	Elong.	Hardness
R <sub>m</sub>	R <sub>p0.2</sub> <sup>a)</sup> / R <sub>m</sub>	A <sub>2</sub> <sup>n</sup>	HRC
MPa		%	
min.	max.	min.	max.
950	0.9	25	35

1 MPa = 1 N/mm<sup>2</sup>

<sup>a)</sup> R<sub>p0.2</sub> corresponds to 0.2% offset yield strength

## Imperial units

Inner diameter	Wall thickness	Proof strength
from	to	R <sub>p0.2</sub> <sup>a)</sup>
inch	inch	ksi
		min.
≥ 3/8	≤ 5/8	≤ 0.12
		> 0.12
> 5/8	≤ 1	≤ 0.20
		> 0.20
> 1	≤ 2½	≤ 0.20
		> 0.20

<sup>a)</sup> R<sub>p0.2</sub> corresponds to 0.2% offset yield strength

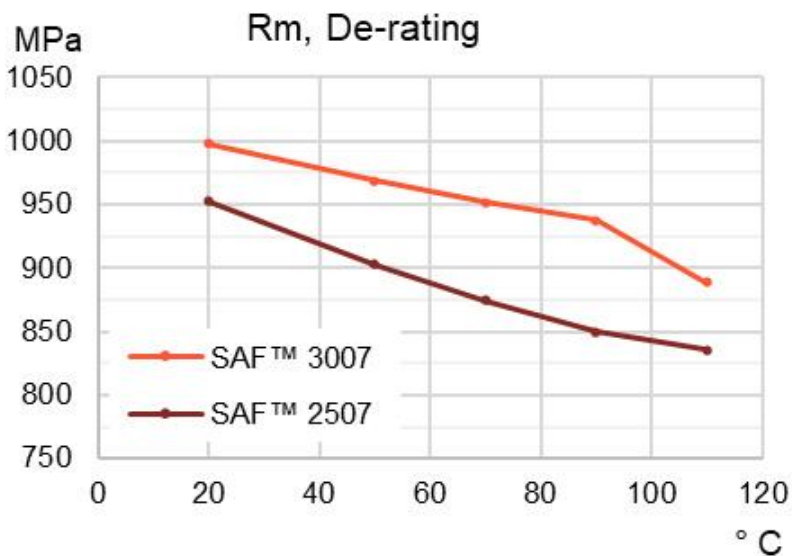
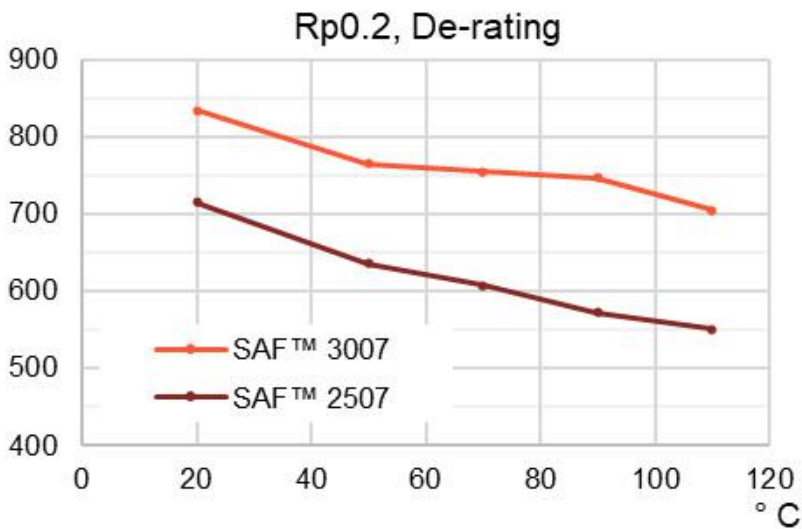
## BR

Tensile strength	Yield / Tensile strength ratio, max	Elong.	Hardness
$R_m$	$R_{p0.2}^{a)} / R_m$	$A_{2\%}$	HRC
ksi		%	
min.	min.	min.	max.
138	0.9	25	35

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

### At high temperatures

De-rating curves comparing SAF™ 3007 with SAF™ 2507. The curves are based on measured values, not representing guaranteed minimum values, on seamless tubes in final condition.



## Physical properties

### Density

7.9 g/cm<sup>3</sup>, 0.28 lb/in<sup>3</sup>

### Permeability

	$\mu_r$ (max)	Hc	Br
		A/m	T
SAF™ 3007	35	700	0.04

### Thermal conductivity

#### Metric units

Temperature, °C	20	100	200	300	400
	W/(m °C)				
SAF™ 3007	12	13	15	16	18

#### Imperial units

Temperature, °F	68	200	400	600	700
	Btu/(ft h °F)				
SAF™ 3007	7	7	8	10	10

### Specific heat capacity

#### Metric units

Temperature, °C	20	100	200	300	400
	J/(kg °C)				
SAF™ 3007	460	490	520	560	600

#### Imperial units

Temperature, °F	68	200	400	600	700
	Btu/(lb °F)				
SAF™ 3007	0.11	0.12	0.13	0.13	0.14

## Thermal expansion

Metric units,  $\times 10^{-6}/^{\circ}\text{C}$

Temperature, $^{\circ}\text{C}$	30-100	30-200	30-300	30-400
SAF™ 3007	12.5	13.0	13.0	13.5

Imperial units,  $\times 10^{-6}/^{\circ}\text{F}$

Temperature, $^{\circ}\text{F}$	86-200	86-400	86-600	86-700
SAF™ 3007	7.0	7.0	7.5	7.5

## Resistivity

Metric units

Temperature, $^{\circ}\text{C}$	0	20	100	200	300
	$\mu\Omega\text{m}$				
SAF™ 3007	0.85	0.86	0.89	0.89	0.92

Imperial units

Temperature, $^{\circ}\text{F}$	32	68	200	400	600
	$\mu\Omega\text{in}$				
SAF™ 3007	33.3	33.8	34.8	35.2	36.4

## Modulus of elasticity

Metric units  $\times 10^3$

Temperature, $^{\circ}\text{C}$	20	100	200	300
	MPa			
SAF™ 3007	195	190	182	173

Imperial units,  $\times 10^3$

Temperature, $^{\circ}\text{F}$	68	200	400	500
	ksi			
SAF™ 3007	28	28	26	26

## Poisson Ratio

0.35-0.37

## Welding

The weldability of SAF™ 3007 is good. Welding is preferably performed with the TIG/GTAW method and a shielding gas mixture of argon with 2% nitrogen. Preheating and subsequent heat treatment is normally not necessary.

For SAF™ 3007 heat input of 0.2-1.5 kJ/mm and inter-pass temperature of <150 °C (300 °F) are recommended.

Matching filler metals are recommended to obtain a weld metal with optimum corrosion resistance and mechanical properties. For TIG/GTAW welding the use of Alleima 30.8.1.LW (UNS S83072) is recommended.

All-weld metal of Alleima 30.8.1.LW give tensile properties of  $R_{p0.2} > 800$  MPa,  $R_m > 950$  MPa and A 20% Impact toughness at -46 °C (-51 °F) > 55 J.

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### 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.