SAF 32760™

Bar

Datasheet

SAF™ 32760 is a high alloy super-duplex (austenitic-ferritic) stainless steel for service in highly corrosive conditions.

The grade is characterized by:

Excellent resistance to stress corrosion cracking in chloride-bearing environments
Excellent resistance to pitting and crevice corrosion
High resistance to general corrosion
Very high mechanical strength
Physical properties that offer design advantages
High resistance to erosion corrosion and corrosion fatigue
Good weldability
Excellent mechanical properties that allow for lighter constructions, more compact design and less welding

Standards

- UNS: S32760
- EN Number: 1.4501
- EN Name: X2CrNiMoCuWN25-7-4

Product standards

- EN 10088-3, (dimensions up to 160 mm)
- EN 10272
- ISO 17781
- ASTM A479, ASTM A276
- NORSOK MDS D57 Rev 5
- Suitable for manufacturing of components in accordance with ASTM A182

Approvals

- Pressure Equipment Directive (2014/68/EU)

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– NORSOK M650 Ed. 4, NORSOK M630 Ed. 6
– DNV, dimensions up to 250 mm

Certificate

– Status according to EN 10 204/3.1

Chemical composition (nominal)

Chemical composition (nominal) %

C	Si	Mn	P	S	Cr	Ni	Mo	N	W	Cu
≤0.030	≤1.0	≤1.0	≤0.030	≤0.010	25.5	7	3.8	0.26	0.7	0.8

Applications

SAF™ 32760 is a super-duplex stainless steel especially designed for service in aggressive chloride-containing environments. Some typical applicational areas are:

Oil and gas industry
Seawater cooling
Salt evaporation industry
Desalination plants
Geothermal wells
Refineries and petrochemical plants
Mechanical components requiring high strength
Pulp and paper industry
Chemical processing

Corrosion resistance

General corrosion

SAF™ 32760 is highly resistant to corrosion by organic acids, e.g. formic and acetic acid. It is suitable for use at high concentrations and temperatures, where austenitic stainless steels corrode at a high rate.

Resistance to inorganic acids is comparable to that of high alloy austenitic stainless steels in certain concentration ranges.

Pitting and crevice corrosion

The pitting and crevice corrosion resistance of a stainless steel is primarily determined by the content of chromium, molybdenum and nitrogen. An index for comparing the resistance to pitting and crevice corrosion is the PRE number (Pitting Resistance Equivalent).

The PRE is defined as, in weight-% PRE = %Cr + 3.3x%Mo +16x%N

For duplex stainless steels the pitting corrosion resistance is dependent on the PRE-value in both the ferrite phase and the austenite phase, so that the phase with the lowest PRE-value will be limiting for the actual pitting corrosion resistance.

The minimum PRE-value for SAF™ 32760 is 40. This is significantly higher than e.g. the PRE-values for other duplex stainless steels of the 25Cr type which are not "super-duplex". As an example UNS S31260

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(25Cr3Mo0.2N) has a PRE-value of typically 38.

Stress corrosion cracking

SAF™ 32760 has excellent resistance to chloride-induced stress corrosion cracking.

Erosion corrosion and corrosion fatigue

The superior mechanical properties combined with the improved corrosion resistance of SAF™ 32760 result in excellent resistance to both erosion corrosion and corrosion fatigue compared to standard austenitic stainless steels.

Forms of supply

Finishes and dimensions

SAF™ 32760 bar steel is stocked in a large number of sizes. Round bar is supplied in solution annealed and water quenched condition. The surface is peel turned and burnished.

Lengths

Bars are delivered in random lengths of 3-7 m, depending on diameter.

Straightness

Diameter mm	Height of arch, mm/m Typical value
> 70	2

Tolerances, mm-sizes

Diameter, mm	Tolerances, mm
80-95	-0/+1.00
100-250	-0/+1.50

Surface conditions

Surface conditions	Ra, µm Typical value	Size, mm dia
Peeled and burnished	1	80-250

Mechanical properties

Bar steel is tested in delivery condition.

The following figures apply to material in the solution annealed and quenched condition.

More detailed information can be supplied on request.

At 20°C (68°F)

Metric units

Proof strength	Tensile strength	Elong.	HB
$R_{p0.2}$[a)]	R_m	A[b)]	
MPa	MPa	%	
≥550	750-930	≥25	≤290

Imperial units

Proof strength	Tensile strength	Elong.	Hardness
$R_{p0.2}$[a)]	R_m	A[b)]	HB
ksi	ksi	%	
≥80	109-135	≥25	≤290

1 MPa = 1 N/mm^2

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

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

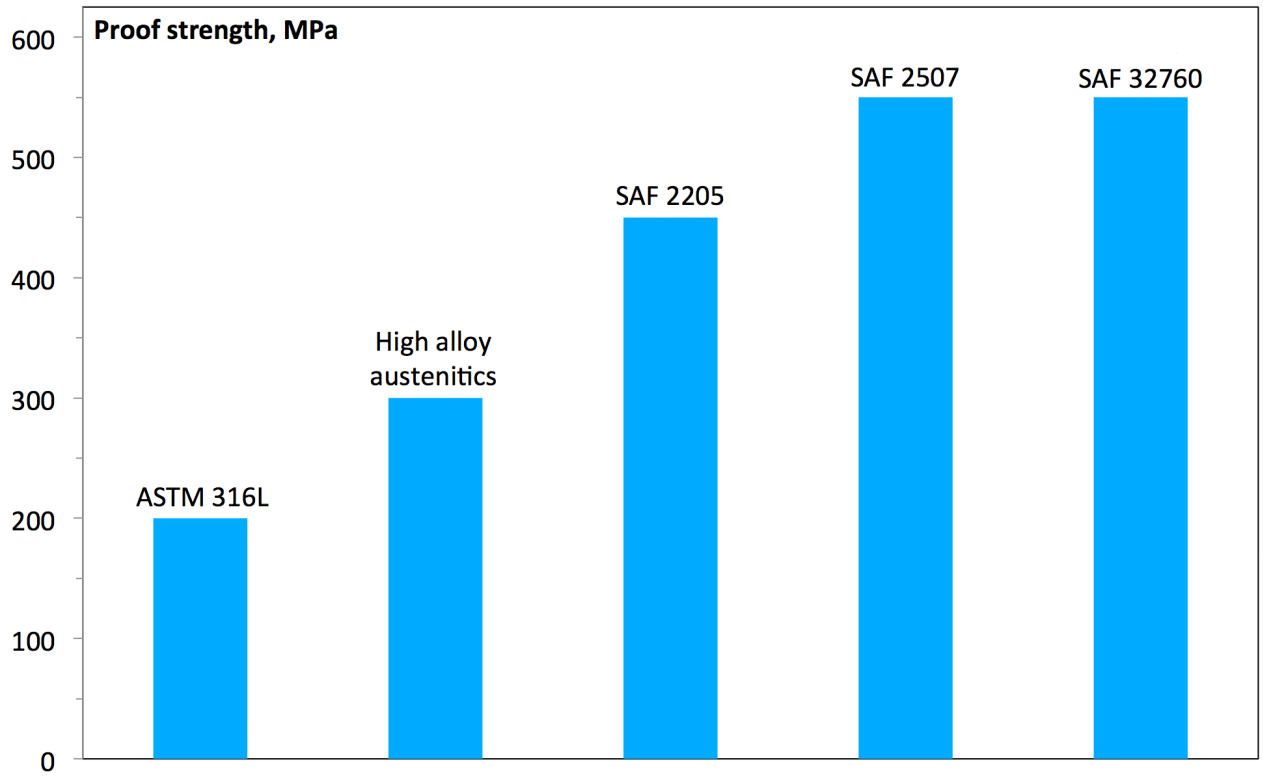

Figure 1. Comparison of proof strength.

At high temperatures

If SAF™ 32760 is exposed for prolonged periods to temperatures exceeding 250°C (480°F), the microstructure changes which results in a reduction in impact strength. This effect does not necessarily affect the behavior of the material at the operating temperature.

Metric units

Temperature, °C	Proof strength $R_{p0.2}$, MPa
	min.
100	450
150	420
200	400
250	380

Imperial units

Temperature, °F	Proof strength $R_{p0.2}$, ksi
	min.
200	67
300	61
400	58
480	55

Impact strength

SAF™ 32760 possesses good impact strength. Figure 2 shows typical impact energy values for SAF™ 32760 in different sizes at -46°C (-50°F), using standard Charpy V specimens. Samples are taken in the longitudinal direction and the impact strength (Charpy V) at -46°C (-50°F) is min 45 J (74 ft-lb).

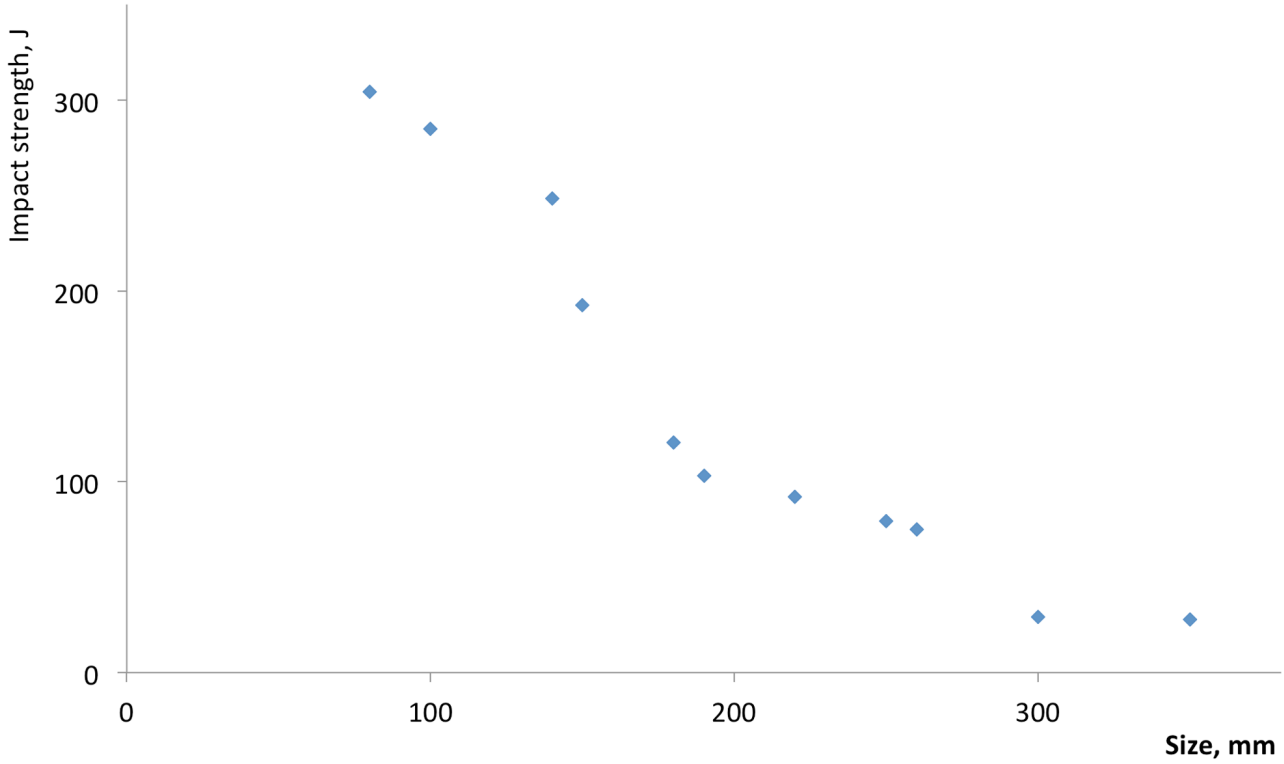

Figure 2. Typical impact energy values for SAF™ 32760 in different sizes at -46°C (-50°F), using standard Charpy V specimens.

Physical properties

Density

7.8 g/cm^3, 0.28 lb/in^3

Specific heat capacity

500 J/(kg °C) at 20°C, 0.12 Btu/(lb °F) at 68°F

Thermal conductivity

Temperature	20°C	68°F
SAF 32760	15 W/(m °C)	9 Btu/(ft h °F)
ASTM 316L	14 W/(m °C)	9 Btu/(ft h °F)

Thermal expansion

SAF™ 32760 has a coefficient of thermal expansion close to that of carbon steel. This gives SAF™ 32760 definite design advantages over austenitic stainless steels in equipment comprising both carbon steel and stainless steel. The values given below are average values in the temperature ranges.

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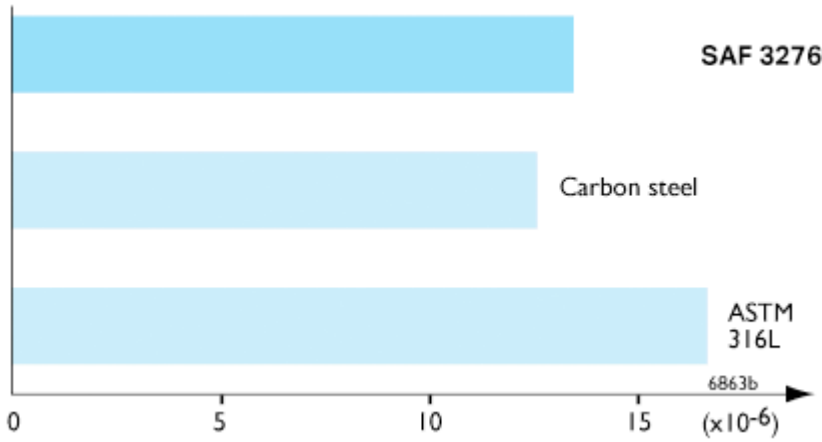
Metric units, $x10^{-6}$/°C

Temperature, °C	30-100	30-200	30-300
SAF™ 32760	13.0	13.5	14.0
Carbon Steel	12.5	13.0	13.5
ASTM 316L	16.5	17.0	17.5

Imperial units, $x10^{-6}$/°F

Temperature, °F	86-200	86-400	86-600
SAF™ 32760	7.0	7.5	7.5
Carbon Steel	6.8	7.0	7.5
ASTM 316L	9.0	9.5	10.0



Resistivity

0.8 µΩm at 20°C, 31.5 µΩin. at 68°F

Modulus of elasticity, ($x10^3$)

Metric units; Imperial units

Temperature, °C	MPa	Temperature, °F	ksi
20	200	68	29.0
100	194	200	28.2
200	186	400	27.0
300	180	600	26.2

Machining

Being a two-phase material (austenitic-ferritic) SAF™ 32760 will present a different wear picture from that of single-phase steels of type ASTM 304L. The cutting speed must therefore be lower than that recommended for ASTM 304L. It is recommended that a tougher insert grade is used than when machining austenitic stainless steels, e.g. ASTM 304L. Also in comparison with Sanmac® 2205 lower speed and tougher insert grade is

recommended. Machining recommendations available on request.

Welding

The weldability of SAF™ 32760 is good. Suitable methods of fusion welding are manual metal-arc welding (MMA/SMAW) and gas-shielded arc welding, with the TIG/GTAW method as first choice.

For SAF™ 32760, heat input of 0.2-1.5 kJ/mm and interpass temperature of <150°C (300°F) are recommended. Preheating and post-weld heat treatment is normally not necessary.

Recommended filler metals

GTAW/TIG welding

ISO 14343 S 25 9 4 N L / AWS A5.9 ER2594 (e.g. Exaton 25.10.4.L)

MMA/SMAW welding

ISO 3581 E 25 9 4 N L R / AWS A5.4 E2594-16 (e.g. Exaton 25.10.4.LR)

ISO 3581 E 25 9 4 N L B / AWS A5.4 E2594-15 (e.g. Exaton 25.10.4.LB)

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