Sanicro® 35
Bar
Datasheet

Sanicro® 35 is a very strong nickel-molybdenum super austenitic grade for service in demanding wet corrosive environments.

This grade combines the best features of super austenitic stainless steel and nickel alloy, making it a cost-effective alternative to materials like Nickel alloys, Hyper Duplex, Super Austenitic, Duplex, and Super Duplex alloys.

Sanicro® 35 bars are semi-finished products with defined properties that can be machined to various components. These are also very suitable for cold drawing to enhance the mechanical properties, without losing the excellent corrosion resistance

Grade characteristics

Excellent resistance to

- Hydrogen Induced Stress Corrosion
- Crevice corrosion in chloride environments
- Pitting corrosion
- Chloride-induced stress corrosion cracking
- Corrosion in natural seawater (30°C / 86°F)

Good resistance to

- Hydrochloric acid environments
- Sulfuric acid and nitric acid

Extremely high

- Impact strength

Very high

- Tensile strength
- Ductility

Material designations

- UNS: N08935

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Product standards

- ASTM B649 / ASME SB649

Approvals

- Pressure Equipment Directive / PED (2014/68/EU)
- Pre-approval for PMA, D≤240 mm
- Boiler and Pressure Vessel Code, Section VIII, Division I and II.
- ASME Code case 2982-1

Compliant with

- NACE MR0175/ISO 15156-3 (Type 4a and 4c materials)
- NACE MR0103/ISO 17495 (High alloyed austenitic stainless steels and nickel alloys)

Material Test Certificate

- According to EN 10204/3.1

Chemical composition (nominal)

Chemical composition (nominal) %

C	Si	Mn	P	S	Cr	Ni	Mo	Cu	N
≤0.030	≤0.5	0.8	≤0.030	≤0.020	27	35	6.5	0.2	0.3

Applications

Due to its extremely good pitting and crevice corrosion properties, Sanicro® 35 is particularly suitable for applications in seawater and other high chloride concentration conditions.

Sanicro® 35 also has a high resistance to general corrosion in acid environments, making it suitable for a variety of applications.

The excellent mechanical and corrosion properties make Sanicro® 35 an economical choice in many applications, by reducing the life cycle cost of equipment.

Sanicro® 35 bars are semi-finished products with defined properties that can be machined to various components such as flanges, valves, fittings, couplings, rings and seals, shafts, bolts and nuts. Typical applications are:

- Oil&Gas drilling tools
- Waste heat recovery exchangers
- Heat exchangers
- Evaporators
- Off-shore piping systems

Sanicro® 35 bars are highly suitable for cold working processes, which enhances mechanical properties while preserving superior corrosion resistance. As such, they are an excellent choice for the fabrication of bolts and

similar components.

Corrosion resistance

General corrosion

Sanicro® 35 has excellent corrosion resistance for service in sea-water applications and other highly corrosive environments.

Service temperatures from cryogenic -196°C/-320.8°F up to 550°C/1022°F.

The general corrosion resistance of Sanicro® 35 in acids and alkalines is better than that of Alloy 825, SAF® 2507 and Sanicro® 28.

Sanicro® 35 is a suitable alternative to Alloy 625 / Sanicro® 625, in presence of ammonia and hydrochloric acid, if that material type is considered for service.

Hydrogen induced stress corrosion (HISC)

Sanicro® 35 shows excellent resistance to hydrogen embrittlement
due to its high austenitic phase stability. Hydrogen embrittlement testing (Constant load at -1050 mVSCE in 3% NaCl) show good results. No cracking observed after 500h after loading to 100% and 120% of yield strength. These results indicate that Sanicro® 35 is not prone to hydrogen embrittlement.

Localized corrosion

Sanicro® 35 demonstrates outstanding resistance in environments containing chlorides. Its performance in this regard surpasses that of Alloy 825, SAF® 2507, and Sanicro® 28, and is comparable to, or even exceeds, the corrosion resistance offered by Alloy 625 / Sanicro® 625

Sanicro® 35 has excellent resistance to pitting corrosion, providing enhanced durability in challenging conditions.

In natural seawater at a temperature of 30°C, Sanicro® 35 maintains exceptional resistance to pitting corrosion, while also offering better resistance to crevice corrosion than Alloy 625 / Sanicro® 625. In chlorinated seawater Sanicro® 35 is resistant to crevice corrosion at 45°C/113°F, and resistant to pitting corrosion at 80°C/176°F.

The Pitting Resistance Equivalent Value with Nitrogen included, PREN: ≥52.

Stress corrosion cracking

Sanicro® 35 has excellent stress corrosion cracking resistance (chlorides, H2S) and does not suffer from SCC in a NACE MR 0175 / ISO 15156 Test Level VI environment.

Sour service

The Sanicro® 35 resistance to cracking in the presence of H2S and chlorides is very high. Refinery sour water service – static and flowing conditions. Sanicro® 35 performs very well, at least on par with Alloy 625 / Sanicro® 625 and SAF® 2507.

Offshore sour service

Sanicro® 35 has

- Superior corrosion resistance in chloride environments, compared to Alloy 825.
- Better corrosion resistance overall in marine environments, compared to Alloy 625 / Sanicro® 625.

Forms of supply

Dimensions and finishes

Sanicro® 35 bars are available in sizes from 20 to 70 mm (0.79"–2.76"). The solid round bar is supplied in solution annealed, quenched and peel-turned condition.

Lengths

Bars are delivered in random lengths of 3-6 m (9.8–19.7 ft.).

Tolerances

Metric (mm)		Imperial (in.)	
Diameter	**Tolerance**	**Diameter**	**Tolerance**
≤25	0/+0.23	≤0.98	0/+0.009
>25-28	0/+0.25	>0.98-1.10	0/+0.010
>28-31.5:	0/+0.28	>1.10-1.24	0/+0.011
>31.5-34.5	0/+0.30	>1.24-1.36	0/+0.012
>34.5-38	0/+0.35	>1.36-1.50	0/+0.014
>38-50	0/+0.40	>1.50-1.97	0/+0.016
>50-63	0/+0.80	>1.97-2.48	0/+0.031
>63-70	0/+1.00	>2.48-2.76	0/+0.039

Straightness

Height of arch, typical values			
Diameter, mm	**mm/m**	**Diameter, in.**	**in./ft**
20-70	1	0.79-2.76	0.06" / 5 ft.

Surface condition

Diameter			
Metric (mm)	**Imperial (in.)**	**Condition**	**Typical finish (Ra)**
20-70	0.79-2.76	Peel turned	2 µm

Manufacturing

All products are manufactured at Alleima Tube AB's integrated facility in Sweden, covering every stage from raw materials to melting, processing, heat treatment, finishing, and testing.

Heat treatment

Solution annealing at 1130°C / 2066°F followed by water quenching.

Mechanical properties

Tensile strength at 20°C (68°F)

The following values apply to bar material in the solution annealed and quenched condition, size up to 70mm.

Proof/Yield strenght (min.)	**Ultimate tensile strength (min.)**
$R_{p0.2}$	**R_m**
350 MPa	**700 MPa**
50.7 Ksi	101.5 Ksi

Elongation: ≥40%

Impact strength

Sanicro® 35 has extremely high impact strength, also down to cryogenic temperatures (-196°C/-320.8°F). Typical values at room temperature are 300-500 J / 220-370 ft.lb.

Hardness

Average values: 190 HBW at half radius, 205 HBW at surface.

Physical properties

Density: 8.1 g/cm^3, 0.29 lb/in^3

Thermal conductivity

Temperature, °C	W/(m °C)	Temperature, °F	Btu/(ft h °F)
20	10.0	68	6.0
100	12.0	200	7.0
200	13.5	400	8.0
300	15.5	600	9.0
400	17.0	800	10.0

Specific heat capacity

Temperature, °C	J/(kg °C)	Temperature, °F	Btu/(lb °F)
20	450	68	0.11
100	470	200	0.11
200	500	400	0.12
300	510	600	0.12

400	530	800	0.13

Thermal expansion

Metric units, x10^{-6}/°C

Temperature, °C	30-100	30-200	30-300	30-400
Sanicro® 35	14.0	14.5	15.0	15.5
Carbon steel	12.5	13.0	13.5	14.0
ASTM 316L	16.5	17.0	17.5	18.0

Imperial units, x10^{-6}/°F

Temperature, °C	86-200	86-400	86-600	86-800
Sanicro® 35	8.0	8.0	8.5	8.5
Carbon steel	7.0	7.0	7.5	8.0
ASTM 316L	9.5	9.5	10.0	10.0

Resistivity

Temperature, °C	µΩm	Temperature, °F	µΩinch
20	1.0	68	39

Modulus of elasticity, x10^3

Temperature, °C	MPa	Temperature, °F	ksi
20	190	68	28.0
100	185	200	27.0
200	180	400	26.0
300	175	600	25.0
400	170	800	24.5

Welding

The weldability of Sanicro® 35 bars is good and as it possesses very high purity, thereby also less prone to hot cracking than most of the nickel-base alloys.

Sanicro® 35 is an alloy combining the best features of a super austenitic stainless steel and a nickel alloy and welding of fully austenitic stainless steels and nickel-base alloys often involves the risk of hot cracking in the welded joints if the weldment is under constrain. Sanicro® 35, however, possesses very high purity and is thereby less prone to hot cracking than most of the nickel-base alloys.

- Suitable method for fusion welding is the TIG welding process (GTAW/141), both with and without filler material
- Welding should be undertaken with heat input 1.2 – 1.5 kJ/mm with an interpass temperature of 100-150 °C. A stringer welding technique should be used.
- Preheating and post-weld heat treatment are not necessary.
  Ar + 2%N2 is recommended as shielding gas and backing gas with TIG-welding.

To maintain full corrosion resistance of the weldment a thorough cleaning is recommended to ensure the removal of all oxides and heat tint.

Recommended filler metals

Nickel alloy UNS N06059 / Alloy 59 (ERNiCrMo-13, NiCr23Mo16) wire or rod is recommended as filler material for gas shielded arc welding

Machining

General

Machining is an expression used for a number of subtractive manufacturing methods.

Mainly turning, milling, drilling. But also other operations like cutting, boring, grinding, reaming and tapping.

For solid bars the initial operations primarily are cutting and external turning to prepare a blank for component manufacturing.

Stainless steels

Materials within the ISO-M material area can be challenging to machine.

The materials vary a lot within the ISO-M group, but in general presents difficult chip control, high cutting forces and tool wear.

In order to get as efficient function and tool life as possible, dedicated cutting tools and strategies to be used.

Getting started

To get it right, the first thing is to know the material to be machined.

As the material properties are input to the selection of start values.

- ISO material group
- Condition/heat treatment
- Actual hardness of the material lot

Consult your cutting tool supplier for start recommendations, since the choice of cutting tools and machine tool set the direction for which start values to use.

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.

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