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Sanicro 70

(Billets)

Sanicro 70, commonly known as Alloy 600, is an austenitic nickel-chromium-iron alloy. It is characterized by:

- Very good resistance to carburization and nitrogen absorption
- Good structural stability at high temperatures
- Good resistance to stress corrosion cracking

STANDARDS

- UNS N06600
- W.Nr. 2.4816
- BS HR208

Product standards
Suitable for production of flanges etc. according to ASTM B564

Certificates
Status according to EN 10 204 3.1

CHEMICAL COMPOSITION (NOMINAL) %

C	Si	Mn	P max	S max	Cr	Ni	Others
0.06	0.4	0.8	0.015	0.015	16.5	72.5	Ti=0.15 Fe=9.5

FORMS OF SUPPLY

Sizes and tolerances
Round-cornered square, as well as round billets, are produced in a wide range of sizes according to the following tables. Larger sizes offered on request.

Surface conditions
Square billets
Unground, spot ground or fully ground condition.

Round billets
Peel turned or black condition.

SQUARE BILLETS

Size mm	Tolerance mm	Length m
80	+/-2	4 - 6.3
100, 114, 126, 140, 150	+/-3	4 - 6.3
160, 180, 195, 200	+/-4	4 - 6.3
>200 - 350	+/-5	3 - 5.3

Sizes and tolerances apply to the rolled/forged condition.

PEEL TURNED ROUND BILLETS

Size mm	Tolerance mm	Length m
75 - 200 (5 mm interval)	+/-1	max 10
>200 - 450	+/-3	3 - 8

UNGROUND ROUND BILLETS

Size	Tolerance	Length
mm	mm	m
77 - 112 (5 mm interval)	+/-2	max 10
124, 134	+/-2	max 10
127, 147, 157	+/-2	max 10
142, 152, 163	+/-2	max 10
168, 178, 188	+/-2	max 10
183, 193	+/-2	max 10

Other products
- Welding wire
- Covered electrodes
- Seamless tube and pipe
- Hollow bar

MECHANICAL PROPERTIES

Sanicro 70 conforms to the required mechanical properties according to specification ASTM B564. Testing is performed on separately solution annealed and quenched test pieces.

At 20 °C

METRIC UNITS

Proof strength	Tensile strength	Elongation
$R_{p0.2}$ 1)	R_m	A
MPa	MPa	%
min.	min.	min.
241	552	30

At 68 °F

IMPERIAL UNITS

Proof strength	Tensile strength	Elongation
$R_{p0.2}$ 1)	R_m	A
ksi	ksi	%
min.	min.	min.
35	80	30

1) Corresponds to 0.2 % offset yield strength

At high temperatures
Fig. 1 shows indicative values for tensile strength properties of Sanicro 70 at high temperatures.

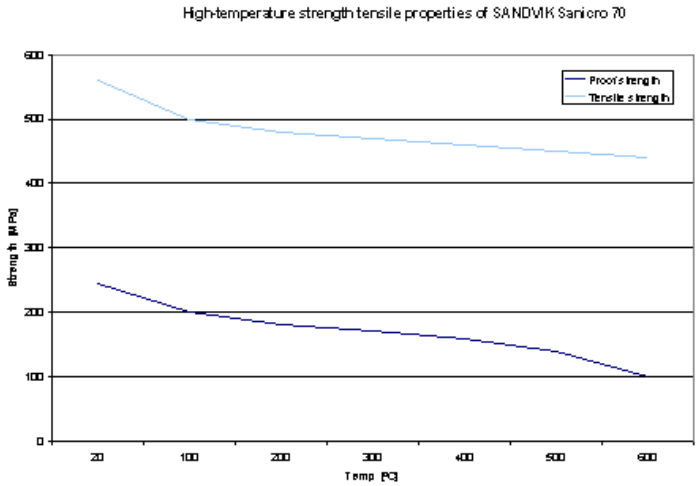

Figure 1. Minimum high temperature tensile strength properties for Sanicro 70 are based on datasheets seamless tube and pipe. Since the tubes have thin walls the values should only be used as indicative values for forgings. (Proof strength corresponds to 0.2% offset yield strength.)

PHYSICAL PROPERTIES

Density: 8.4 g/cm^3, 0.30 lb/in^3
Scaling temperature in air: 1175 °C, 2145 °F

SPECIFIC HEAT CAPACITY [1)]

Temperature, °C	J/kg °C	Temperature, °F	Bru/lb °F
20	460	68	0.11
200	495	400	0.12
400	515	800	0.12
600	590	1100	0.14

1) typical values

THERMAL CONDUCTIVITY [1)]

Temperature, °C	W/m °C	Temperature, °F	Btu/ft h °F
20	13	68	7.5
200	16	400	9
400	19	800	11
600	25	1100	15

1) typical values

THERMAL EXPANSION [1)]

Temperature, C	Per °C	Temperature, °F	Per F
30-200	14	86-400	7.5
30-400	14.5	86-800	8
30-600	15.5	86-1100	8.5

1) typical values (x10^{-6})

MODULUS OF ELASTICITY [1)]

Temperature, °C	MPa	Temperature, °F	ksi
20	214	68	31.0
200	202	400	29.3
400	190	800	27.4
600	180	1200	25.5
800	161	1600	22.1
1000	135		

1) typical values($x10^3$)

CORROSION RESISTANCE

General corrosion
Sanicro 70 has approximately the same resistance to organic and inorganic acids as steel of the ASTM 304 type. Its resistance to sodium hydroxide is very good even at high concentrations and temperatures.

Pitting
Resistance to pitting is equal to that of steel of the ASTM 304 type.

Stress corrosion cracking
Sanicro 70 has very good resistance to stress corrosion cracking, particularly in chloride-bearing solution.

Gas corrosion
Sanicro 70 has very good oxidation resistance. It can be used in:

- air up to 1175°C (2145°F)
- dry chlorine and hydrogen chloride up to about 550°C (1020°F)
- synthesis gas (ammonia synthesis) up to 600°C (1110°F). The resistance to nitrogen absorption, e.g. cracked ammonia at high temperatures, is very good.

Due to the high nickel content, the material should not be used in reducing, sulphurous atmospheres (containing hydrogen sulphide), at temperatures above 550°C (1020°F).

HOT WORKING

Hot working should be carried out at a material temperature of 900-1200°C (1650-2200°F), followed by cooling in water. If additional heat treatment is needed, it should be carried out in accordance with the recommendations given for heat treatment.

HEAT TREATMENT

Billets are delivered in hot worked condition. Depending on the properties required the recommendations for heat treatment differ.

For a combination of the optimum tensile and fatigue properties, a low annealing temperature range of 870-980°C (1600-1800°F) should be used.

For an optimum combination of fatigue resistance and creep rupture properties at high temperatures, the material should be annealed at 1120-1200°C (2050-2200°F). Both treatments are followed by quenching in water.

WELDING

The weldability of Sanicro 70 is good. Suitable fusion welding methods are manual metal-arc (MMA) and gas shielded arc welding, with the TIG and MIG methods as first choices. Preheating and post-weld heat treatment are normally not necessary.

The welding of fully austenitic materials calls for high standards of cleanliness. Joint surfaces and filler metals must be free from grease, dirt, colour (pigments) and other impurities. If necessary, the joint area should be cleaned with a suitable solvent, e.g. acetone or alcohol.

Since Sanicro 70 has low thermal conductivity and high thermal expansion, welding must be carried out with a low heat input and with welding plans well thought out in advance, so that deformation can be kept under control.

The welding of fully austenitic grades often entails the risk of hot cracking in the weld metal, particularly if the weldment is under constraint. To reduce the cracking risk, welding should be carried out with the lowest practical heat input, <1.0 kJ/mm and interpass temperature <150°C (300 °F).

Recommended filler metals for:

MIG and TIG: Sanicro 72HP or Sanicro 68HP (wire electrodes and filler wire/rods).
MMA: Sanicro 71 or Sanicro 69 (covered electrodes).

MACHINING

Machining Sanicro 70, as with stainless steels, requires an adjustment to tooling data and machining method, in order to achieve satisfactory results. Compared to Sanmac 316/316L, the cutting speed must be reduced by approximately 15-20%, when turning Sanicro 70 with coated, cemented carbide tools. Much the same applies to other operations. Feeds should only be reduced slightly and with care.

Detailed recommendations for the choice of tools and cutting data are provided in the data sheet for Sanmac 316/316L.

APPLICATIONS

Sanicro 70 is used in a variety of applications in the chemical industry, which require high strength and good corrosion resistance .
High strength, combined with oxidation resistance at high temperatures, makes the material useful also for different components in heating furnaces.
The material can also be used in wet corrosive conditions, where austenitic 18Cr/8Ni steels would be susceptible to stress corrosion cracking.

Industrial categories	Typical applications
Chemical industry	Flanges
Food industry	Valves and discs
Petrochemical industry	Fittings
Pulp and paper industry	Couplings
Pickling equipment	Rings and seals
Oil & Gas industry	Bolts and nuts
Nuclear plants	Shafts
	Forgings
	Piping
	Pumps
	Tanks

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 Sandvik materials.