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Sandvik 304

(Plate and sheet)

Sandvik 304 is an austenitic chromium-nickel steel.

STANDARDS

- ASTM 304
- UNS S30400
- EN number 1.4301*
- W.Nr. 1.4301
- DIN X 5 CrNi 18 10
- SS 2333
- AFNOR Z 6 CN 18.09
- BS 304S31
- JIS 304

Product standards

- ASTM A240/A480

CHEMICAL COMPOSITION (NOMINAL) %

C	Si	Mn	P	S	Cr	Ni	N
				max.			
0.08	0.75	2.0	0.045	0.03	18.0-20.0	8.0-10.5	0.10

FORMS OF SUPPLY-FINISHES AND DIMENSIONS

Plate & sheet
Plate & sheet are delivered in the solution annealed and pickled condition.

Sheet may be supplied as annealed and pickled, polished or in the bright-annealed condition

The size ranges available are given below Sizes in Stock.

MECHANICAL PROPERTIES

At 20°C (68°F)

METRIC AND IMPERIAL UNITS

Proof strength		Tensile Strength		Elong.
$R_{p0.2}$ [a)]		R_m		A [b)]
MPa	ksi	MPa	ksi	%
≥205	≥30	515	75	≥40

1 MPa = 1 N/mm^2
Hardness 201 (Brinell), 92 (Rockwell B)

PHYSICAL PROPERTIES

Density: 7.9 g/cm^3, 0.29 lb/in^3

THERMAL CONDUCTIVITY

Temperature, °C	W/m °C	Temperature, °F	Btu/ft h °F
20	15	68	8.5
100	16	200	9.5
200	18	400	10.5
300	20	600	12
400	22	800	13
500	23	1000	14
600	25	1200	15
700	26	1300	15

SPECIFIC HEAT CAPACITY

Temperature, °C	J/kg °C	Temperature, °F	Btu/lb °F
20	475	68	0.11
100	500	200	0.12
200	530	400	0.13
300	560	600	0.13
400	580	800	0.14
500	600	1000	0.14
600	615	1200	0.15
700	625	1300	0.15

THERMAL EXPANSION [1)]

Temperature °C	Per °C	Temperature °F	Per °F
30-100	16.5	86-200	9.5
30-200	17	86-400	9.5
30-300	17.5	86-600	10
30-400	18	86-800	10
30-500	18.5	86-1000	10
30-600	18.5	86-1200	10.5
30-700	19	86-1400	10.5

1) Mean values in temperature ranges ($x10^{-6}$)

MODULUS OF ELASTICITY [1)]

Temperature °C	MPa	Temperature °F	ksi
20	200	68	29.0
100	194	200	28.2
200	186	400	26.9
300	179	600	25.8
400	172	800	24.7
500	165	1000	23.5

1) $x10^3$

CORROSION RESISTANCE

General corrosion
Sandvik 304 has good resistance in

- Organic acids at moderate temperatures
- Salt solutions, e.g. sulphates, sulphides and sulphites.
- Caustic solutions at moderate temperatures

Pitting and crevice corrosion
The steel may be sensitive to pitting and crevice corrosion even in solutions of relatively low chloride content. Molybdenum-alloyed steels have better resistance improves with increasing molybdenum content.

Stress corrosion cracking
Austenitic steels are susceptible to stress corrosion cracking. This may occur at temperatures above about 60°C (140°F) if the steel is subjected to tensile stresses and at the same time comes into contact with certain solutions, particularly those containing chlorides. Such service conditions should therefore be avoided. Conditions when plants are shut down must also be considered, as the condensates which are then formed can develop conditions that leads to both stress corrosion cracking and pitting.

In applications demanding high resistance to stress corrosion cracking we recommend the austenitic-ferritic steel Sandvik SAF 2304. See data sheet S-1871-ENG.

Gas corrosion
Sandvik 304 can be used in

- Air up to 850°C (1560°F)
- Steam up to 750°C (1380°F)
- Synthesis gas (ammonia synthesis) up to about 550°C (1020°F).

Creep behaviour should also be taken into account when using the steel in the creep range.

In flue gases containing sulphur, the corrosion resistance is reduced. In such environments the steel can be used at temperatures up to 600-750°C (1110-1380°F) depending on service conditions. Factors to consider are whether the atmosphere is oxidising or reducing, i.e. the oxygen content, and whether impurities such as sodium and vanadium are present.

HEAT TREATMENT

Plates are normally delivered in heat treated condition. If additional heat treatment is needed after further processing the following is recommended.

Stress relieving
850-950°C (1560-1740°F), cooling in air.

Solution annealing
1000-1100°C (1830-2010°F), rapid cooling in air or water.

WELDING

The weldability of Grade 304 is good. Suitable welding methods are manual metal-arc welding with covered electrodes and gas-shielded arc welding with the TIG and MIG methods as first choice. Preheating and post-weld heat treatment are not normally necessary.

Since the material 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 the deformation of the welded joint can be kept under control. If, despite these precautions, it is foreseen that the residual stresses might impair the function of the weldment, we recommend that the entire structure be stress relieved. See under Heat treatment.

As filler material for gas-shielded arc welding we recommend wire electrodes and rods Sandvik 19.9.L or 19.9.LSi. In manual metal-arc welding covered electrodes Sandvik 19.9.LR or 19.9.LRHD are recommended. If flux cored arc welding is preferred, electrodes Sandvik 19.9.LT or 19.9.LVT should be used.

BENDING

Annealing after cold bending is not normally necessary, but this point must be decided with regard to the degree of bending and the operating conditions. Heat treatment, if any, should take the form of stress relieving or solution annealing, see under heat treatment.

Hot bending is carried out at 1100-850°C (2010-1560°F) and should be followed by solution annealing.

APPLICATIONS

Sandvik 304 is used for a wide range of industrial applications. Typical examples are: tanks, reactors, hoppers, rail wagons, structural members, food processing and medical equipment etc. in the transport, chemical, petrochemical, fertilizer, pulp and

paper and nuclear power industries, as well as in the production of pharmaceuticals, foods and beverages.
