SANDVIK

SANDVIK 5R10
TUBE AND PIPE, SEAMLESS

DATASHEET

Sandvik 5R10 is an austenitic chromium-nickel steel with a controlled carbon content in order to obtain improved strength at high temperatures.

STANDARDS

- ASTM: TP304, TP304H
- UNS: S30400, S30409
- EN Number: 1.4301, 1.4948
- EN Name: X5CrNi18-10, X6CrNi18-10
- W.Nr.: 1.4301
- DIN: X 5 CrNi 18 10
- SS: 2333
- AFNOR: Z 6 CN 18.09
- BS: 304S31, 304S51
- JIS: SUS304TP

Product standards Seamless tube and pipe

- ASTM A271 and A376
- JIS G3459
- JIS G3463
- EN 10216-5
- BS 3605, BS 3606
- DIN 17456, 17458
- NFA 49-117, 49-217
- SS 14 2333

Approval
JIS Approval for Stainless Steel Tubes

CHEMICAL COMPOSITION (NOMINAL) %

Chemical composition (nominal) %

C	Si	Mn	P	S	Cr	Ni
0.04	0.4	1.3	≤0.040	≤0.015	18.5	9.5

Subject to agreement, material with extra low Co content can be supplied.

YueTing alloy
Tel:021-61198229

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FORMS OF SUPPLY

Seamless tube and pipe

Tube and pipe are normally delivered in the solution annealed and white-pickled condition or in the bright-annealed condition. The size range can be seen from Fig. 1. U-tubes can be delivered on request.

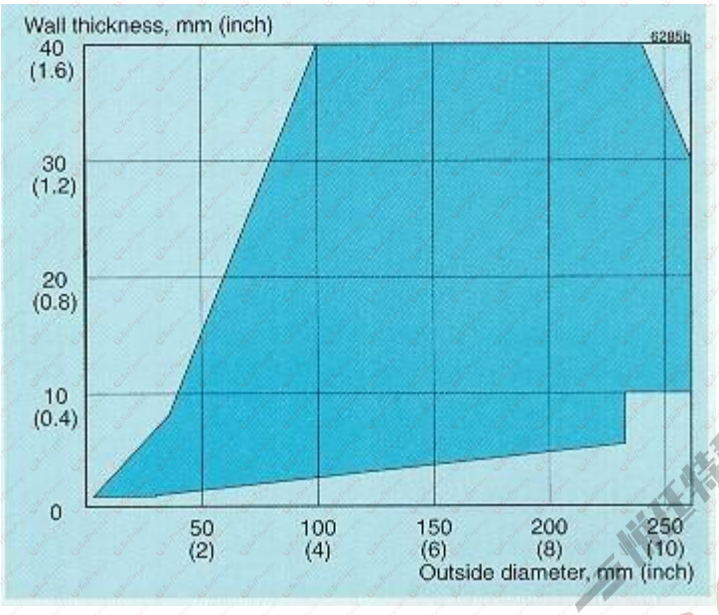

Figure 1. Principal size range for seamless tube and pipe.

MECHANICAL PROPERTIES

For tube and pipe with wall thickness greater than 10 mm (0.4 in.) the proof strength may fall short of the stated values by about 10 MPa (1.4 ksi)

At 20°C (68°F)

Metric and imperial units

Proof strength				Tensile strength		Elong.	
$R_{p0.2}$ a)		$R_{p1.0}$ a)		R_m		A_5 b)	A2"
MPa	ksi	MPa	ksi	MPa	ksi	%	%
≥210	≥30	≥240	≥35	515-690	75-100	≥45	≥35

1 MPa = 1 N/mm²

a) $R_{p0.2}$ and $R_{p1.0}$ corresponds to 0.2% offset and 1.0% offset yield strength, respectively.

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.

The hardness (Vickers) is approximately 155 Impact strength

Due to its austenitic microstructure, Sandvik 5R10 has very good impact strength both at room temperature and at cryogenic temperatures.

Tests have demonstrated that the steel fulfils the requirements (60 J (44 ft-lb) at -196 °C (-320 °F)) according to the European standards EN 13445-2 (UFPV-2) and EN 10216-5.

At high temperatures

Metric units

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Temperature	Proof strength	
	$R_{p0.2}$	$R_{p1.0}$
°C	MPa	MPa
	min	min
50	190	215
100	165	190
150	150	175
200	140	165
250	130	155
300	125	150
350	120	145
400	115	140
450	110	135
500	105	130
550	100	125
600	95	120

Imperial units

Temperature	Proof strength	
	$R_{p0.2}$	$R_{p1.0}$
°F	ksi	ksi
	min	min
200	24	28
400	20	24
600	18	22
800	16	20
1000	15	18

Creep-rupture strength (ISO-values)

Temperature		10 000 h		100 000 h	
°C	°F	MPa	ksi	MPa	ksi
		approx.	approx.	approx.	approx.
550	1020	195	28.3	115	16.6
575	1065	147	21.3	93	13.5
600	1110	122	17.6	74	10.7
625	1155	100	14.5	58	8.4
650	1200	79	11.5	45	6.5
675	1245	64	9.2	33	4.8
700	1290	48	7.0	23	3.3

PHYSICAL PROPERTIES

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

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Thermal conductivity

Temperature, °C	W/m °C	Temperature, °F	Btu/ft h °F
20	14	68	8
100	15	200	8.5
200	17	400	10
300	18	600	10.5
400	20	800	11.5
500	21	1000	12.5
600	23	1100	13

Specific heat capacity

Temperature, °C	J/kg °C	Temperature, °F	Btu/lb °F
20	485	68	0.11
100	500	200	0.12
200	515	400	0.12
300	525	600	0.13
400	540	800	0.13
500	555	1000	0.13
600	575	1100	0.14

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) ($x10^{3}$)

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CORROSION RESISTANCE

General corrosion

Sandvik 5R10 has good resistance in:

- Organic acids at moderate temperatures
- Salt solutions, e.g. sulfates, sulfides and sulfites.
- Caustic solutions at moderate temperatures

The risk of general corrosion in sulfuric acid during shut down periods has to be taken into account. Since Sandvik 5R10 is not alloyed with molybdenum, the grade can only tolerate low concentrations at limited temperatures. In naturally aerated sulfuric acid the corrosion rate is below 0.1 mm/year provided the temperature is not higher than 20°C (68°F) in 5% solution.

Intergranular corrosion

Sandvik 5R10 has a relatively high carbon content. Thus, there is a certain risk of reduced intergranular corrosion resistance if the steel has become sensitized after e.g. improper heat treatment or welding. Sandvik 3R12 has a significantly lower carbon content and is therefore more safe regarding intergranular attack.

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 and the resistance improves with increasing molybdenum content.

Stress corrosion cracking

Austenitic steel is 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 lead 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.

Gas corrosion

Sandvik 5R10 can be use 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 behavior should also be taken into account when using the steel in the creep range. In flue gases containing sulfur, 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 oxidizing or reducing, i.e. the oxygen content, and whether impurities such as sodium and vanadium are present.

HEAT TREATMENT

The tubes 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.

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

WELDING

The weldability of Sandvik 5R10 is good. Welding must be carried out without preheating and subsequent heat treatment is normally not required. 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 Sandvik 5R10, heat input of <1.5 kJ/mm and interpass temperature of <150°C (300°F) are recommended.

Recommended filler metals
TIG/GTAW or MIG/GMAW welding

ISO 14343 S 19 9 H / AWS A5.9 ER308H

MMA/SMAW welding

ISO 3581 E 19 9 H R / AWS A5.4 E308H-17

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 5R10 is used for a wide range of industrial applications with emphasis on high temperature processes. Typical examples are: heat exchangers, condensers, pipelines, cooling and heating coils in the chemical, petrochemical, fertilizer, pulp and paper and nuclear power industries, as well as in the production of pharmaceuticals, foods and beverages.

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.

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