SANDVIK 5R75
TUBE AND PIPE, SEAMLESS

DATASHEET

Sandvik 5R75 is an austenitic, titanium-stabilized stainless chromium–nickel–molybdenum steel.

STANDARDS

- ASTM: TP316Ti
- UNS: S31635
- EN Number: 1.4571
- EN Name: X6CrNiMoTi17-12-2
- W.Nr.: 1.4571
- DIN: X 6 CrNiMoTi 17 12 2
- SS: 2350
- AFNOR: Z6CNDT17-12

Product standards

Seamless tube and pipe:

- ASTM A312
- EN 10216-5
- DIN 17456, 17458
- SS 14 23 50
- NFA 49-117
- ASTM A213, A269 and A312

CHEMICAL COMPOSITION (NOMINAL)

Chemical composition (nominal) %

C	Si	Mn	P	S	Cr	Ni	Mo
0.05	0.5	1.3	≤0.030	≤0.030	17	12	2.1

Ti=>5xC

APPLICATIONS

Sandvik 5R75 is used for a variety of industrial applications. Typical examples are heat exchangers, condensers, pipelines, cooling and heating coils in the chemical, petrochemical and pulp and paper industries.

CORROSION RESISTANCE

General corrosion

Sandvik 5R75 has good resistance to

- Organic acids at high concentrations and temperatures

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– Inorganic acids, e.g. phosphoric and sulfuric acids, at moderate concentrations and temperatures. The steels can also be used in sulfuric acid of concentrations above 90% at low temperature.
– Salt solutions, e.g. sulfates, sulfides and sulfites
– Caustic environments

Intergranular corrosion

Sandvik 5R75 has better resistance to intergranular corrosion than unstabilized steels. The addition of titanium prevents precipitation of chromium carbides in the grain boundaries after prolonged heating in the temperature range 450- 850°C (840-1560°F).

Pitting and crevice corrosion

Resistance to these types of corrosion improves with increasing molybdenum content and Sandvik 5R75 with about 2.1% Mo has substantially higher resistance than steels of type AISI 304/304L.

Stress corrosion cracking

Austenitic stainless 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 a chloride content that leads to both stress corrosion cracking and pitting.

In applications demanding high resistance to stress corrosion cracking, austenitic- ferritic steels, e.g. Sandvik SAF 2304 or SAF 2205, are recommended. See data sheets S-1871-ENG and S-1874-ENG.

Gas corrosion

Sandvik 5R75 can be used in

– Air up to 850°C (1560°F)
– Steam up to 750°C (1380°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 these steels 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.

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.

FORMS OF SUPPLY

Seamless tube and pipe

Tube and pipe are normally delivered in the solution-annealed and white-pickled condition. Smaller sizes may be bright-annealed. The size range can be seen from the principal size range can be seen from Fig. 1.

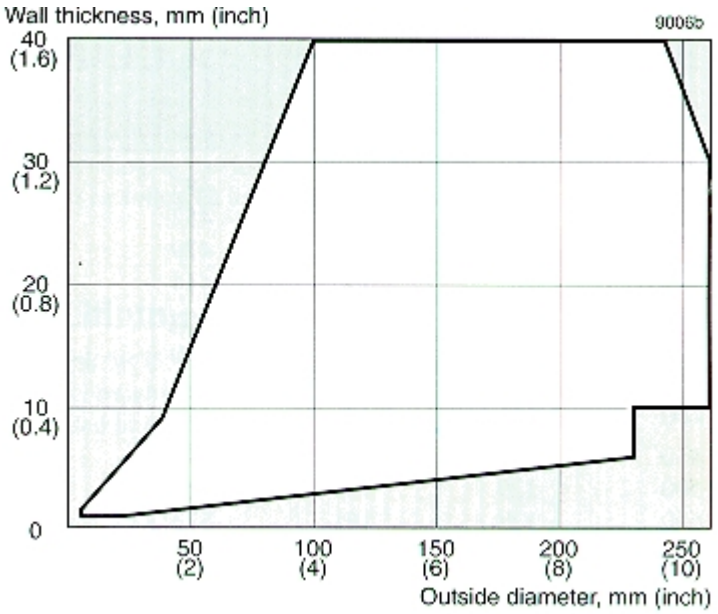

Figure 1. Principal size range for seamless tube and pipe.

Hollow bar

Hollow bar is supplied solution-annealed and white-pickled.

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), 10-15 minutes, cooling in air.

Solution annealing

1000-1100°C (1830-2010°F), 5-20 minutes, rapid cooling in air or water.

MECHANICAL PROPERTIES

At 20°C (68°F)

Proof strength				Tensile strength		Elong	Hardness
$R_{p0.2}$[a) c)]		$R_{p1.0}$[a) c)]		R_m[c)]		A[b)]	Vickers
MPa	ksi	MPa	ksi	MPa	ksi	%	
							approx.
≥220	≥32	≥250	≥36	510-710	74-103	≥35[d)]	155

1 MPa = 1 N/mm²
a) $R_{p0.2}$ and $R_{p1.0}$ correspond 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.
c) For hot finished tube and pipe with wall thickness greater than 10 mm (0.4 in.) the minimum values for proof strength may fall short of the stated values by 20 MPa (2.9 ksi) and the range for the tensile strength is 490-690 MPa.
d) NFA 49-117 with min 45% can be fulfilled.

Impact strength

Due to its austenitic microstructure, Sandvik 5R75 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

Temperature	Proof strength	
	$R_{p0.2}$[c)]	$R_{p1.0}$[c)]
°C	MPa	MPa
	min	min
50	202	234
100	185	218
150	177	206
200	167	196
250	157	186
300	145	180
350	140	175
400	136	171
450	132	167
500	129	164
550	127	157

Imperial units

Temperature	Proof strength	
	$R_{p0.2}$[d)]	$R_{p1.0}$[d)]
°F	ksi	ksi
	min	min
200	27.0	32.0
400	24.0	28.5
600	21.0	26.0
800	19.5	24.5
1000	18.5	23.5

d) For hot finished tube and pipe with wall thicknesses greater than 10 mm (0.4 in.) the proof strength values may be slightly lower but still fulfill the requirements according to DIN 17458 and SS 14 23 50.

PHYSICAL PROPERTIES

Density: 8.0 g/cm^3, 0.29 lb/in^3

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

Thermal conductivity

Temperature, °C	W/m °C	Temperature, °F	Btu/ft h °F
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) ($x10^{3}$)

WELDING

The weldability of Sandvik 5R75 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 5R75, 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 12 3 Nb / AWS A5.9 ER318 (e.g. Exaton 19.12.3.Nb)

MMA/SMAW welding

ISO 3581 E 19 12 3 Nb R / AWS A5.4 E318-17

MACHINING

Sandvik 5R75 has good machining properties. Detailed recommendations for the choice of tools and cutting data are provided in brochures S-0291-ENG and S-1492-ENG.

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