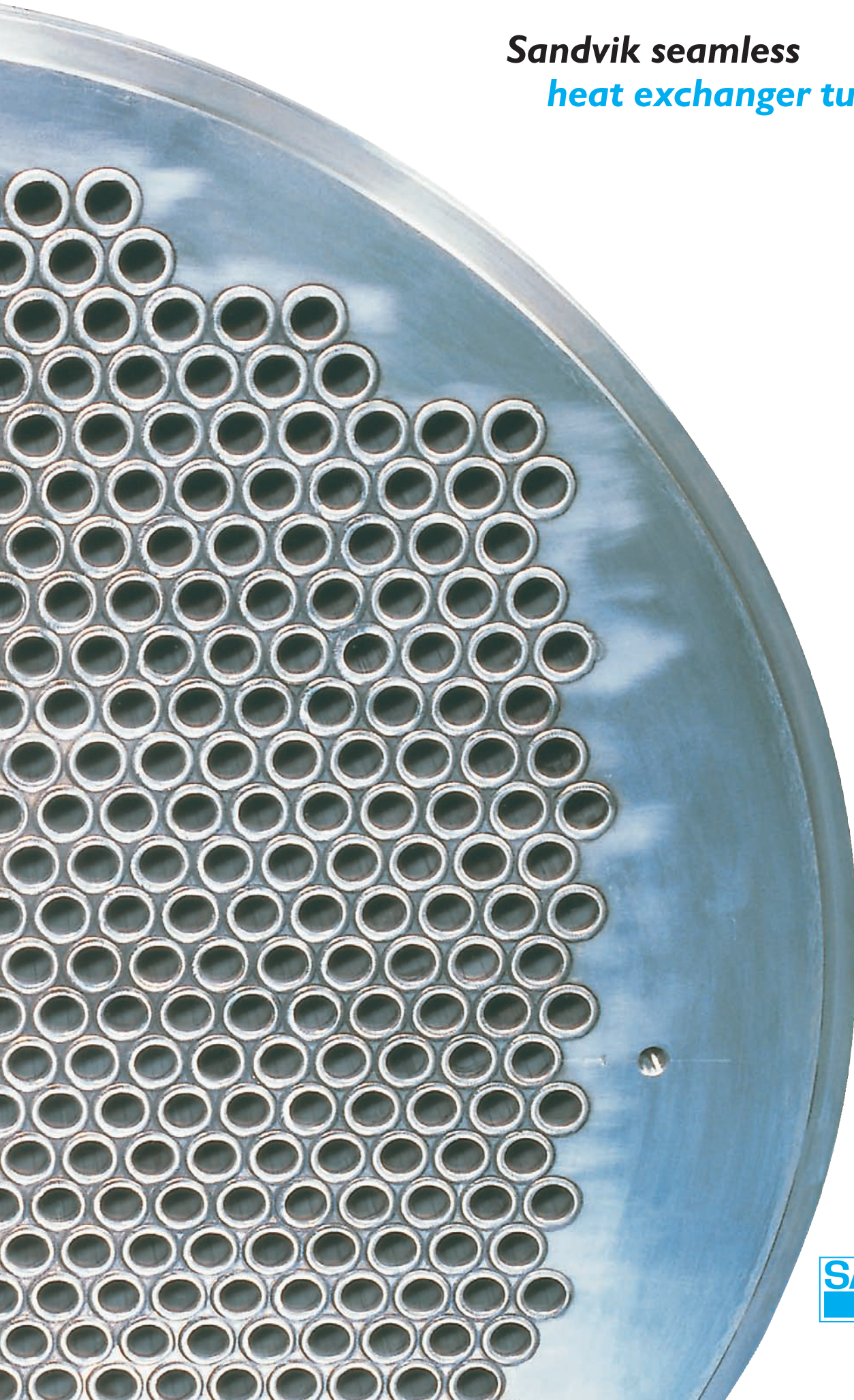


Sandvik seamless
heat exchanger tubing



SANDVIK




Contents

Uptime specialist	3
Make the right choice	4
Complementary products	4
Grades, standards and size range	5
From melt to finished product	6
Application areas	8
Cut costs	10
Pitting corrosion	11
Effect of alloying elements	11
Titanium and zirconium tubing	12
U-bent tubes for heat exchangers	13
Welding	14
Location map	16
Manufacturing program	18



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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.



When you order from Sandvik, you are not only getting material with excellent corrosion resistance, high mechanical strength and good weldability, you also gain access to our:

Uptime specialists

A worldwide network of sales engineers, backed up by metallurgists and research engineers from our R&D center, is available to support you in your technical material challenges.

Integrated production

Our integrated production facilities ensure the consistency and quality of our materials, from delivery to delivery.

Leading-edge R&D

A world-leading R&D program is committed to developing new and superior products and innovative, pro-active solutions in close cooperation with our customers.

One stop shopping

A worldwide local network of sales units is available to address your needs with a wide range of grades and sizes to cover most material requirements.



Make the right choice

Compared to a complete plant, the cost of a heat exchanger is relatively low. However, reliability can have a significant impact on operating costs.

For this reason, it's vital that fabricators and end users have access to seamless tubes developed and produced for specific service conditions. This requires that suppliers provide a range of tube grades and flexibility in production processes that meet specific requirements.

That's why many choose Sandvik stainless steel tubes. Our extensive experience in the production of special stainless steels and tubes, our flexibility in raw material sourcing, our willingness and ability to find materials solutions result in special steel grades with chemical compositions tailored to specific applications, customers, markets or country requirements.

Our tubes are suitable for all types of heat exchangers: coolers, condensers, evaporators, preheaters, reheaters, reboilers, steam generators and air coolers.

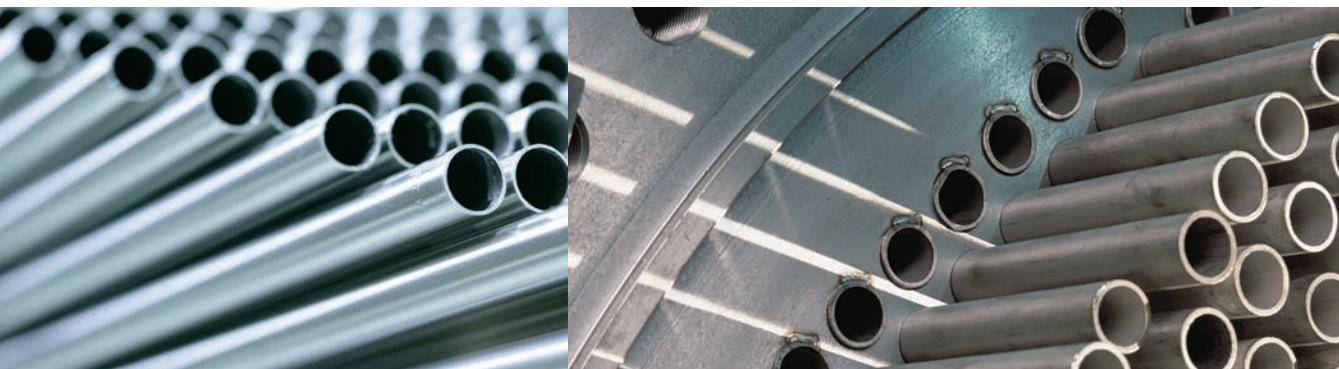
Extreme conditions can be handled by developing competitive and innovative solutions through close cooperation with our customers. Together, we can achieve lower operating costs and increase long-term operating reliability.

Sandvik's assets are many: Product delivery and advanced communication systems. Strategic production locations worldwide. Sophisticated plant programming capabilities that ensure reliable and efficient product supply. Advanced logistics that provide global distribution.

A wide range of complementary products

The Sandvik heat exchanger tubes supply package includes standard stainless steel and special grade complementary products. These are: welded tubes, sheet and plate, tube fittings for butt welding and socket welding, threaded joints and flanges.





Grades, standards and size range

Sandvik has an extensive manufacturing program for seamless heat exchanger tubes covering most types of standard austenitic, duplex (austenitic-ferritic) and high alloy austenitic stainless steels as well as titanium and zirconium.

Our main size range, produced in imperial and metric dimensions ranges from 12 mm up to 40 mm

outside diameter. Special sizes can be made to order. Tubes are supplied in straight lengths up to 30 meters, or as U-bends.

In the table below, you can find the most common standards and grades for heat exchangers.

Product standards

Sandvik Grade	American standards		European standards			
	ASTM	ASME	EN	DIN/VD TÜV	AFNOR	SS
Duplex						
SAF 2707 HD	A-789	SA-789				
SAF 2507	A-789	SA-789	10216-5	VD TÜV Blatt 508		
SAF 2205	A-789	SA-789	10216-5	VD TÜV Blatt 418	NFA 49-217	
SAF 2304	A-789	SA-789	10216-5			
3RE60	A-789	SA-789			NFA 49-217	
Ni-Alloy						
254 SMO	A-213	A-269	10216-5			
2RK65	A-269	SB-677	10216-5	VD TÜV Blatt 421	NFA 49-217	219711 219713
Sanicro 28	B-668	SB-668	10216-5	VD TÜV Blatt 483		
Sanicro 30	B-163	B-407	SB-163	SB-407	10216-5	
Sanicro 41	B-163	B-423	SB-163	SB-423		
Sanicro 69	B-163	B-167	SB-163	SB-167		
Sanicro 70	B-163	B-167	SB-163	SB-167	VD TÜV Blatt 305	
Austenitic						
3R12	A-213	A-269	SA-213	10216-5	DIN 17458	NFA 49-217 219711 219713
3R19	A-213					
6R35	A-213	A-269	SA-213	10216-5	DIN 17458	NFA 49-217 219711 219713
3R60	A-213	A-269	SA-213	10216-5	DIN 17458	NFA 49-217 219711 219713
3R64	A-213		SA-213			219711 219713
3R65	A-213	A-269	SA-213	10216-5	DIN 17458	NFA 49-217 219711 219713
5R75	A-213			10216-5	DIN 17458	NFA 49-117 219711 219713
8R40	A-213		SA-213	10216-5	DIN 17458	219711 219713



From melt to finished product

Our customers know that trouble-free production, reduced maintenance costs and less downtime depend on the correct choice of construction materials.

To obtain safe and reliable materials, customers need a supplier known for their attention to every detail in the manufacturing process. That is why many users turn to Sandvik. We have built our reputation on quality and product reliability and earned the trust of our customers by producing quality products and providing the best possible levels of technical and after-sales service.

Sandvik controls the whole production process, from melting and alloying in the electric arc and high frequency furnaces, the AOD converter and continuous casting plant to the finishing operations such as cold rolling, cold drawing or heat treatment.

Research and development

Sandvik has one of the largest steel research centers in Europe. New materials are constantly being developed and existing materials and production processes improved. In addition, we have a comprehensive program of liaison and cooperation with universities, research institutions and specialised companies that have particular expertise.



Environment

Environmental awareness is an integral part of our business and is at the forefront of all activities within our operation. Sandvik strives for high efficiency in the use of energy and natural resources and meets the requirements of ISO 14001:1996.

Stainless steel can be 100% recycled, and our steel plant in Sandviken operates a full materials recovery process.

Ethics

Our core values include promoting equality in all respects and operating in a highly ethical manner in relation to employees, customers, suppliers and all other industry contacts.

Quality

Our fully integrated steel mill ensures close control of the entire production process, from melting of the steel to the finished product. Sandvik Materials Technology has Quality Management Systems approved by internationally recognized organizations. We hold for example: the ASME Quality Systems Certificate as a Materials Organization, approval to ISO 9001, ISO/TS 16949, ISO 17025, and PED 97/23/EC, as well as product approvals from TÜV, JIS and Lloyd's Register. Quality, both in products and services, is a major objective for us and this is described in the company's Quality Policy. All employees are involved and committed to continuous improvement.

Production facilities

Sandvik tube manufacturing facilities are located strategically around the world. Our combined resources, connected through a worldwide electronic network of information and planning systems, enable us to offer a reliable supply of high quality products – no matter where in the world our customers are located. For more information, see pages 16–17.

Sandvik around the world

Within Sandvik Materials Technology's global operation, all disciplines work together – sales representatives, engineers, researchers and production, in order to satisfy customer demands.



Sandvik is taking material technology into the next generation and offers end-user industries even better properties, improved efficiencies and lower life cycle costs.





Application areas for Sandvik heat exchanger tubes

Sandvik's global technical sales network can help to select the optimum grade for the application – based on extensive service experience from installations worldwide.

When selecting a material grade for a heat exchanger operating under certain conditions, a number of considerations have to be made. The grade needs to have sufficient corrosion resistance combined with suitable mechanical and physical properties.

Seawater coolers

Selecting the right tube material for heat exchangers operating in seawater used as a cooling medium is critical. Seawater contains large amounts of sodium chlorides and solid particles such as sand silt and organic solids. In such a severe environment, you need to select a grade with high resistance against both localized corrosion and erosion corrosion. Sandvik SAF 2707 HD is a grade specifically developed for these severe environments.

Oil refining

Refinery process streams involve many corrosive elements, which can shorten the life span of low alloyed steels. Today, refining consists of many complex stages. To recover heat in the different processes, heat exchangers are deployed in plants where they typically operate under severe corrosion conditions. Most leakage in heat exchangers is attributed to corrosion on the tubing. Stainless steel and, in particular, duplex grades, including Sandvik SAF 2205, SAF 2507 or SAF 2707 HD, can overcome such problems.



Petrochemicals

Corrosion in petrochemical plants can lead to contamination of manufactured products. Sandvik's quality, high corrosion resistant stainless steels include a wide range of grades, from high-alloyed austenitic grades to hyper-duplex Sandvik SAF 2707 HD.

Chemicals

Sandvik's special grades are used in heat exchangers in many demanding chemical processes, including the production of inorganic acids and caustics. Sandvik seamless tubes offer the required high reliability in these often critical applications.

Salt evaporation

Salt production process involves severe environments for tubular products, where high levels of chlorides are present. It is important to choose materials with high resistance to localized corrosion. Sandvik manufactures a number of suitable grades for these severe environments, such as Sandvik SAF 2707 HD, SAF 2507, Sanicro 28 and 254 SMO.

Power generation

Sandvik heat exchanger tubes can be found in condensers, feedwater heaters and wastewater handling equipment. Sandvik steel grades fulfil the high quality standards for use in both conventional fossil fuelled power plants as well as nuclear power stations.

Gas processing

Reliable operation is essential in gas processing equipment. For offshore equipment, duplex stainless steels have been shown to provide weight saving benefits due to the wall thickness reductions possible from these high strength materials.

Flue gas cleaning/desulphurisation

Environmental demands call for effective gas cleaning equipment. For heat exchangers handling sour gas under condensing conditions, high alloyed austenitic grades such as Sandvik Sanicro 41 and, in particular, Sandvik Sanicro 28 and 254 SMO should be considered. The higher alloyed duplex stainless steels can also be suitable.

Hydrometallurgy

Slurry processing under high pressures and temperatures may give rise to severely corrosive conditions. Duplex stainless steels such as Sandvik SAF 2304 with their combination of corrosion resistance, high strength and erosion resistance, are particularly suited to this type of service.



Cut costs by using duplex stainless steels

Cost savings can be achieved when designing a heat exchanger in duplex material. The cost-effective combination of high mechanical strength, superior corrosion resistance and fabricating compatibility of duplex stainless steels means that it is possible to reduce tube wall thickness and, therefore, design lighter equipment.



Life-cycle cost considerations

The two different ways of looking at the cost of products depend on whether the next best alternative grade (for example, carbon steel) or a stainless steel/special grade, specifically designed for the application is chosen.

Short-term carbon steel option

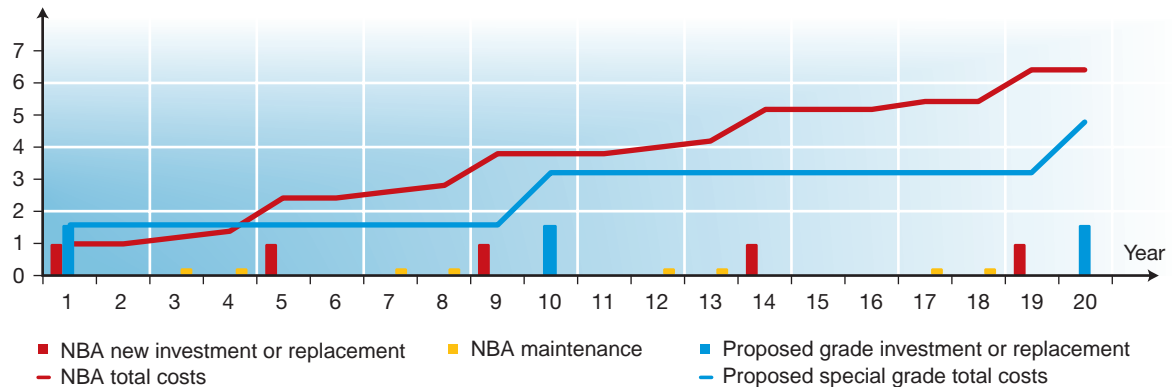
- Low initial cost
- Increased inspection cost
- More frequent maintenance required
- More frequent replacement required
- Greater risk of production stoppages

Long-term stainless steel/special grades option

- Higher initial cost
- Less maintenance required
- Less frequent replacement required
- More reliable operation
- Lower life cycle cost

Sandvik proposed special grade vers. next best alternative grade (NBA)

Million Euro, €



Grade Sandvik	UNS	Chemical compositions					Mechanical properties		
		C max	Cr	Ni	Mo	N	Proof strength R _{p0.2} MPa, min.	Tensile strength R _m MPa	Elongation A% min.
Duplex									
SAF 2707 HD	S32707	0.030	27	6.5	5	0.3	700	920-1100	25
SAF 2507	S32750	0.030	25	7	4	0.3	550	800-1000	25
SAF 2205	S32205/ S31803	0.030	22	5	3.2	0.2	485	680-880	25
SAF 2304	S32304	0.030	23	4.5	-	0.1	400	600-820	25
Ni-Alloy									
Sanicro 28	N08028	0.020	27	31	3.5	-	220	550-750	40
Sanicro 41	N08825	0.030	20	38.5	2.6	-	240	590-750	30
Austenitic									
3R65 (316L)	S31603	0.030	17	11.5	2.1	-	220	515-690	45
2RK65 (904L)	N08904	0.020	20	25	4.5	-	230	520-720	35
254 SMO	S31254	0.020	20	18	6.1	0.2	300	650-850	35

Additional grades: 304/L, 321, UNS: N04400, N02200, N06600, N08800



Sandvik 316L



Sandvik SAF 2205



Sandvik 254 SMO



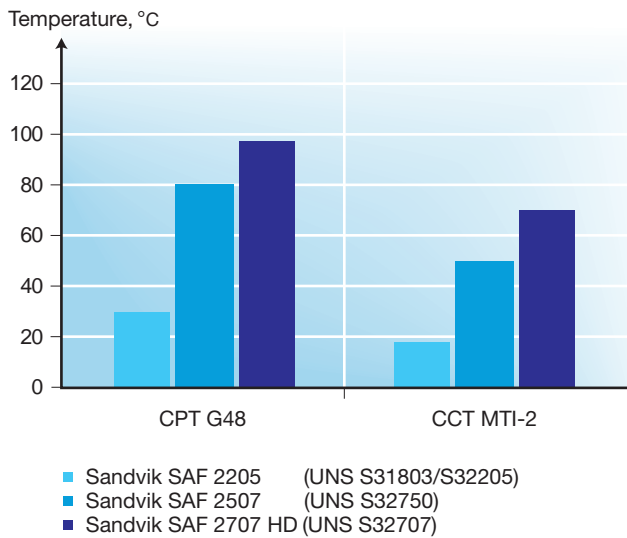
Sandvik SAF 2507



Sandvik SAF 2707 HD

Specimens of various stainless steels after G48 testing at 85°C for 24 hours.

Critical pitting temperature (CPT) and critical crevice corrosion temperature (CCT) in standardised 6% FeCl₃ testing.



Effect of alloying elements

The main alloying elements in stainless steel, which contribute to improving pitting and crevice corrosion resistance, are chromium, molybdenum and nitrogen. Chromium is the most important element for forming a protective oxide layer. In general, the higher the chromium content the better the corrosion resistance. A common reason for corrosion is the presence of chlorides in a process. In that situation, molybdenum and nitrogen also contribute strongly to improved corrosion resistance.

The pitting resistance of stainless steels can be defined with the PRE. The PRE number is calculated from the chemistry of the steel according to the following formula: $PRE = \%Cr + 3.3\%Mo + 16\%N$.

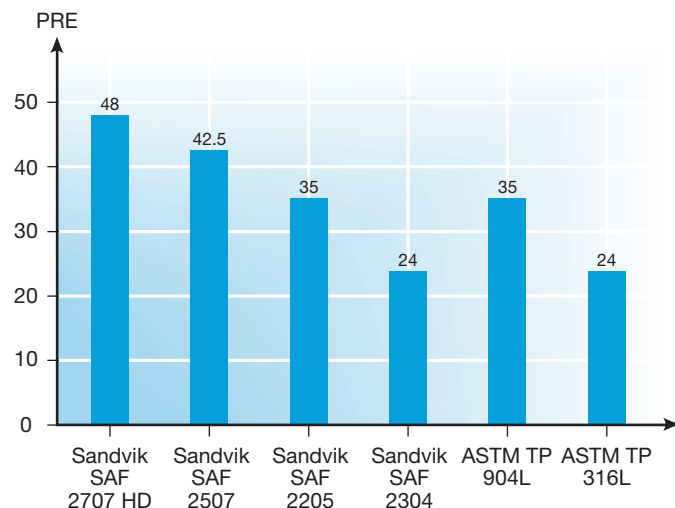
Pitting corrosion

There are many tests that can determine approximate ranking according to the Pitting Resistance Equivalent (PRE) formula. A popular test method for determining the performance of intermediate and high alloy grades, in particular, is ASTM G48A.

ASTM G48, practice A (6% FeCl₃), is one of the toughest pitting corrosion tests for stainless steels. It gives the same ranking order for the steels as in slightly chlorinated seawater. In Sandvik's laboratory, a modified version of the G48 is used, raising the temperature step-by-step. This allows the determination of the critical pitting temperature. The results from such a test are shown at the top of this page.

The graph shows that Sandvik SAF 2707 HD and Sandvik SAF 2507 have the highest PRE values while Sandvik SAF 2205 and 904L represent an intermediate level. Sandvik SAF 2304 has a PRE value at the same level as 316L.

Minimum PRE values for duplex stainless steels and some other alloys.





Titanium and zirconium tubing

In environments where not even the best stainless steels meet the corrosion resistance requirements, titanium and zirconium can be used.

The manufacture of seamless titanium and zirconium heat exchanger tubes at Sandvik Materials Technology in Sandviken, Sweden, is carried out through a completely integrated process. It starts with melting of raw materials in high vacuum furnaces and ends with the finished seamless tubes. The manufacturing process is specially designed to work with non-ferrous metals like titanium and zirconium.

The Sandvik group has been the world's largest independent manufacturer of seamless zirconium and titanium tubing for over 40 years, supplying to a wide range of industries including chemical, petrochemical, aerospace and nuclear.

Titanium

Titanium has a unique set of properties that makes it suitable for a variety of applications. It has a high environmental resistance, relying primarily on a very thin, tenacious and highly protective surface oxide film. Titanium is highly resistant to wet chlorine chemicals, practically all salt solutions, seawater, a range of acids, organic and inorganic chemicals and gases. The same oxide film provides a high resistance to erosion in high velocity process streams. The corrosion and erosion resistance makes titanium a preferred heat transfer material for shell/tube heat exchangers, since it permits the use of thin heat transfer walls and high fluid flow rates. In addition, titanium has only half the weight of steel. It is non-magnetic and is characterized by a high melting point, high strength-to-weight ratio and a low modulus of elasticity.

Available Sandvik ASTM/ASME defined grades: 1, 2, 3, 4, 9, 11, 12, 16, 17, 26, 28.

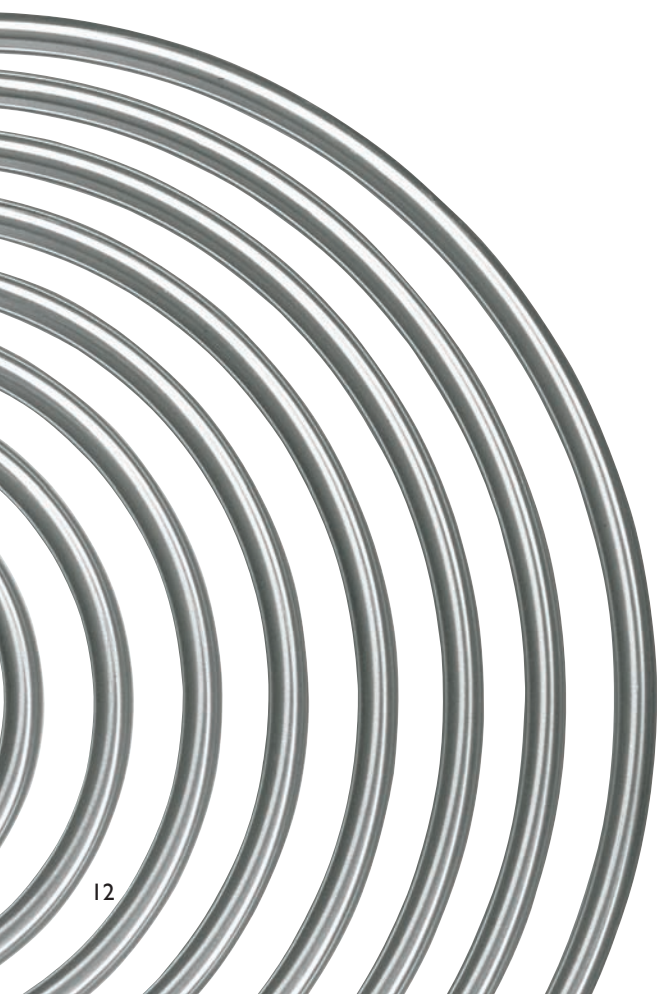
Other grades can be offered on request

- The range of dimensions cover outside diameters from 8 mm up to 40 mm and 16 metres with certain OD/L and OD/Wt limitations
- All tubing can be supplied as straight lengths or as U-tubes.
- Non-destructive testing facilities include ultrasonic testing, Eddy Current testing and hydropressure testing.
- Tubes are normally supplied as cold pilgered, vacuum annealed and cleaned with the OD in the as polished condition.

Zirconium

Zirconium is highly resistant to a wide range of acids and bases, both organic and inorganic, which makes it an interesting and exceptional long life alternative to other materials in highly demanding applications. The seamless tube zirconium grade, produced for heat exchanger applications, is Sandvik Zirconium 702*, which offers the process industry a high quality and competitive product concept.

* As per ASTM/ASME B, SB523 or equivalent.





U-bent tubes for heat exchangers

Sandvik is one of the world's leading suppliers of U-bent tubes. U-bends are manufactured from Sandvik precision straight tubes and are produced by the cold-pilgering method with a bright annealed surface. Production is strictly controlled, step-by-step, in order to fulfill all the technical demands from our customers.

Description of U-bend

- a..... difference in length of legs
- c..... distance between points of tangency
- d_a nominal outside diameter of tube
- e..... distance between legs measured on OD
- f..... distance between legs
- l..... leg length
- l_g developed length
- r_m nominal bend radius
- s..... nominal wall thickness
- s_{min} minimum wall thickness at the back of the bend
- t..... deviation from plane of the bend
- s_0 minimum wall thickness defined by specification

Heat treatment

If specified, we are equipped to carry out heat treatment of bends plus min. 150 mm of leg.

- Furnace is computer controlled and all data is recorded.
- We use an argon protective atmosphere inside the tubes.
- We can provide all types of annealing:
 - Solution
 - Stress relieving
 - Stabilization

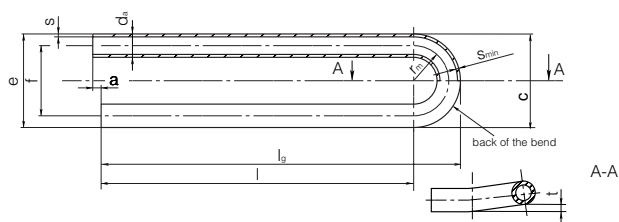
Technical parameters

OD 12.7-38 mm
 Bending radii from 1.5xOD up to 1250 mm. Minimum bending radii for OD's over 28 mm after agreement.
 Leg length min. 1,000 mm
 Leg length max. 12,000 mm
 Heat treatment for radii up to 1,000 mm

Technical standards for bending

Sandvik standard specification 7-2-1179
 DIN 28179, TEMA RCB 2.31
 Other specifications or special requirements available upon request. Copies of common standard specifications are available on request.

U-bend definitions



Hydrotesting

- After heat treatment all U-tubes are hydrotested.
- Minimum holding time at the required pressure is 5 sec.
- All tubes are dried and carefully cleaned after testing.

Measuring, cutting, deburring, cleaning

- U-bends are measured exactly in accordance with relevant standards, or to customer's specification.
- All tubes are cut to the specified leg lengths, ends are deburred and the tubes are internally cleaned with air.
- Before packing, both ends are capped with plastic caps.

Packing

- In strong, open or closed, wooden boxes depending on destination - max. 8,000 kg.
- Ends of tubes protected by plastic caps.
- Vertical separators for each radius.
- Chloride free plastic separators between each row, every 2 meters.
- Each bundle is covered with plastic.
- Customers can provide a packing drawing or Sandvik can prepare a packing plan.
- Packing lists, covered with plastic, are placed on each wooden box for easy identification of order details – including exact list of radii and lengths inside.



Welding of stainless and duplex steel is our speciality

Sandvik SAF 2707 HD

Sandvik SAF 2707 HD is characterized by good weldability. The austenite reformation in the heat affected zone is good, which gives the welded joint excellent toughness, strength and corrosion resistance.

Matching filler metal is recommended, in order to obtain a weld metal with optimum corrosion resistance and mechanical properties. For this purpose the filler wire Sandvik 27.9.5.L should be used.

TIG welding is recommended. Welding should be undertaken within the heat input range 0.2–1.5 kJ/mm and with an interpass temperature of 100°C (212°F) maximum. Preheating or post-weld heat treatment is not necessary. Shielding gas should consist of Ar + 2–3% N₂ and root gas should consist of pure welding grade N₂. For tube to tubesheet welding on duplex tubesheets, Ar + 3% N₂ is recommended to obtain the optimum microstructure of the weld metal.

Sandvik SAF 2205, 2304 and 2507

Sandvik SAF 2205, 2304 and 2507 duplex grades offer good weldability. Suitable welding methods include manual metal arc welding (MMA/SMAW) with covered electrodes, submerged arc welding (SAW), gas metal arc welding (MIG/GMAW) and gas tungsten arc welding (TIG/GTAW). For Sandvik SAF 2304 and 2205, welding should be performed with a heat input of 0.5–2.5 kJ/mm (10–65 kJ/inch) and for SAF 2507 0.2–1.5 kJ/mm (5–40 kJ/inch).

The interpass temperature should be kept below 250°C (400°F) for Sandvik SAF 2304 and 2205 and below 150°C (300°F) for Sandvik SAF 2507. Preheating or post-weld heat treatment is normally not necessary or recommended. If there is a risk of condensed moisture on the joint surfaces, a preheat of 50–70°C (90–150°F) can be introduced to avoid porosity. Preheating with an open flame should be avoided. Careful cleaning of the joint, before and after welding, is important for optimum corrosion resistance. Local deformation due to welding stresses will not be as pronounced as for austenitic stainless steels, but a proper welding plan is still recommended. Welding without filler metal is not recommended. Recommended welding consumables are listed in the table.

Sandvik Sanicro 41

The weldability of Sandvik Sanicro 41 is good. Suitable methods of fusion welding are manual metal-arc welding, (MMA), tungsten inert gas welding, TIG, and metal inert gas welding, MIG. Preheating and post-weld heat treatment are normally not necessary.

The standard of cleanliness required, when welding fully austenitic stainless steels, is particularly strict. Joint surfaces and filler metals must be free from grease, paint and other contaminants. The weld zone should be cleaned, as required, using a suitable solvent such as acetone or alcohol.

Sandvik Sanicro 41, like other austenitic materials, has a high coefficient of thermal expansion. Welding should, therefore, be carried out with low heat input, using well-prepared welding procedures to control distortion of the welded construction.



Product program

Parent metal	Recommended filler metal				
		MIG/GMAW	TIG/GTAW	SAW	MMA/SMAW
	Sandvik	Sandvik	Sandvik	Sandvik	Sandvik
UNS S32707	SAF 2707 HD	27.9.5.L	27.9.5.L	27.9.5.L	27.9.5.LR
UNS S32750	SAF 2507	25.10.4.L	25.10.4.L	25.10.4.L ¹⁾	25.10.4.LR
UNS S31803	SAF 2205	22.8.3.L	22.8.3.L	22.8.3.L ¹⁾	22.9.3.LR
UNS S32304	SAF 2304	22.8.3.L	22.8.3.L	22.8.3.L ¹⁾	22.9.3.LR
UNS S08825	Sanicro 41	27.31.4.LCu	27.31.4.LCu	27.31.4.LCu	27.31.4.LCur
UNS N08028	Sanicro 28	27.31.4.LCu	27.31.4.LCu	27.31.4.LCu ²⁾	27.31.4.LCuR
UNS N08904	2RK65	20.25.5.LCu	20.25.5.LCu	20.25.5.LCu ²⁾	20.25.5.LCuR
UNS S31254	254 SMO	Sanicro 60	Sanicro 60	Sanicro 60 ²⁾	Sanicro 60

1) Flux Sandvik 15W. 2) Flux Sandvik 50SW.

As fully austenitic materials are rather sensitive to hot cracking, welding shall be carried out with the lowest practical heat input, <1.0kJ/mm and an interpass temperature of <100°C.

The recommended filler metal for TIG and MIG welding is Sandvik 27.31.4.LCu. For both TIG and MIG/MAG welding, pure argon should be used as the shielding gas. For MIG/MAG welding, pulsed current is suggested. For manual metal-arc welding (MMA), Sandvik 27.31.4.LCuR is the first choice.

Sandvik Sanicro 28 and Sandvik 2RK65

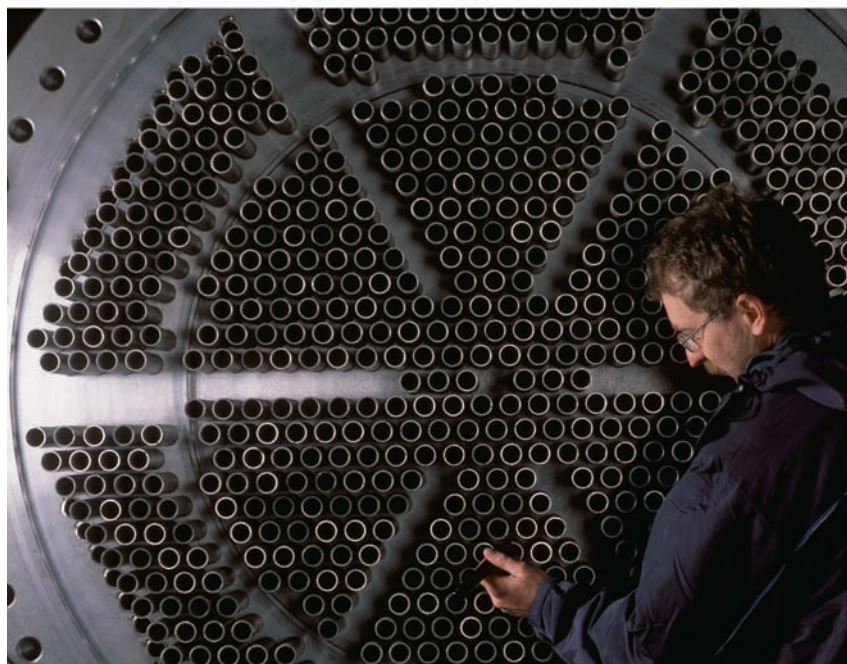
The weldability of both Sandvik Sanicro 28 and 2RK65 is good. Suitable welding methods include manual metal arc welding (MMA/SMAW) with covered electrodes, submerged arc welding (SAW) and gas shielded arc welding (MIG/GMAW and TIG GTAW). Welding should be performed with a low heat input, maximum 1 kJ/mm (25 kJ/inch) and the interpass temperature should not exceed 150°C (300°F). A stringer bead welding technique should be used. Preheating or post-weld heat treatment are normally not necessary or recommended. Since both alloys are intended for use under severely corrosive conditions, thorough cleaning, before and after welding, is important for achieving a fully corrosion resistant joint. In common with all austenitic stainless steels, these alloys have low thermal conductivity and high thermal expansion. Welding should therefore be carefully planned in advance for minimum distortion of the welded joint. The welding of fully austenitic stainless steels usually involves the risk of hot cracking in the weld metal, particularly if the weldment is under constraint. However, Sandvik Sanicro 28 and 2RK65 are less prone to this type of cracking, due to their very low impurity content. Recommended welding consumables are listed in the table.

Sandvik 254 SMO

Sandvik 254 SMO also has good weldability. The conventional welding methods for stainless steels can be used, including manual metal arc welding (MMA/SMAW) with covered electrode, submerged arc welding (SAW) and gas shielded arc welding (MIG/

GMAW and TIG/GTAW). Welding should be carried out with a maximum heat input of 1.5 kJ/mm (40 kJ/inch) and the interpass temperature should be kept below 100°C (210°F). Stringer beads should be used. Preheating or post weld heat treatment is normally not necessary or recommended. Careful cleaning of the joint, before and after welding, are important for the best corrosion resistance. Welding without filler metal is not recommended. If autogeneous welding with TIG or plasma arc is necessary, solution annealing at 1150–1200°C (2100–2200°F) followed by cooling is recommended to restore the microstructure of the joint.

Recommended welding consumables are listed in the table above. Whenever there are questions or advice is needed in connection with welding, Sandvik's welding experts can assist with state-of-the-art solutions.



Production on three continents



Arnprior, Canada



Scranton, USA





Chomutov, Czech Republic



Sandviken, Sweden



Mehsana, India



Manufacturing program selected grades

Designation Sandvik	Chemical composition (nominal), %					Standards* UNS	ASTM TP
	C	Cr	Ni	Mo	Others		
<i>Duplex stainless steels</i>							
SAF 2707 HD	≤0.030	27	6.5	4.8	N, Si	S32707	–
SAF 2507	≤0.030	25	7	4	N	S32750	–
SAF 2205	≤0.030	22	5	3.2	N	S31803/S32205	–
SAF 2304	≤0.030	23	4.5	–	N	S32304	–
3RE60	≤0.030	18.5	4.5	2.6	Si, N	S31500	–
<i>High-alloy austenitic stainless steels and nickel alloys</i>							
254 SMO	≤0.020	20	18	6.1	N, Cu	S31254	–
2RK65	≤0.020	20	25	4.5	Cu	N08904	–
Sanicro 28	≤0.020	27	31	3.5	Cu	N08028	–
Sanicro 30	≤0.030	20	32	–	Ti,Al	N08800	Alloy 800
Sanicro 41	≤0.030	20	38.5	2.6	Cu,Ti	N08825	Alloy 825
Sanicro 69	≤0.020	30	60	–	Si, N	N06690	Alloy 690
Sanicro 70	≤0.050	16.5	72.5	–	Cu, N	N06600	Alloy 600
<i>Austenitic stainless steels</i>							
3R12	≤0.030	18.5	10	–	–	S30403	304/304L
3R60	≤0.030	17.5	13	2.6	–	S31603	316/316L
3R65	≤0.030	17	11.5	2.1	–	S31603	316/316L
6R35	0.05	17.5	10.5	–	Ti	S32100/S32109	321/321H
5R75	0.05	17	12	2.1	Ti	S31635	316Ti
3R19	≤0.030	18.5	9	–	N	S30453	304LN
3R64	≤0.030	18.5	14.5	3.1	–	S31703	317L
8R40	0.06	17.5	11	–	Nb	S34700/S34709	347/347H

¹⁾ Valid for SEW 470

²⁾ Pressure Equipment Directive 97/23/EC

³⁾ Also Code Case exist

* In brackets, nearest equivalent steel grade.

EN Steel number	W.-Nr.	AFNOR	Pressure purpose		Mechanical properties		Elongation A %, min.
			PED ²⁾ prEN 10216-5	ASME	Proof strength R _{p0.2} MPa min.	Tensile strength R _m MPa	
–	–	–	X	X	700	920–1100	25
1.4410	–	–	X	X	550	800–1000	25
1.4462	1.4462	Z2CND22-05-03	X	X	485	680–880	25
1.4362	1.4362	Z2NC23-04AZ	X	X	400	600–820	25
1.4424	1.4417	Z2CND18-05-03	X	X	450	700–800	30
1.4547	(1.4529)*	Z1CNDU20-18-06AZ	X	X	310	655–850	35
1.4539	1.4539	Z1NCDU25-20-04	X	X	230	520–720	35
1.4563	1.4563	Z1NCDU31-27-03	X	X ³⁾	220	550–750	40
1.4558	1.4558	–	X	X ³⁾	205	520–690	30
–	2.4858	–	–	X	240	590–750	30
–	2.4642	NC 30FE (RCCM)	X	X	240	585	30
–	2.4816	–	X	X	245	>560	35
1.4306/1.4301	1.4306/1.4301	Z2CN18-10	X	X	210	515–680	45
1.4435	1.4435/1.4436	Z2CND17-13	X	X	220	515–690	45
1.4404	1.4404/1.4401	Z2CND17-12	X	X	220	515–690	45
1.4541/1.4940	1.4541/1.4878 ¹⁾	Z6CNT18-10	X	X	210	515–690	35
1.4571	1.4571	Z6CNDT17-12	X	–	220	510–710	35
1.4311	1.4311	(Z2NC18-10AZ)*	X	X	275	550–750	40
–	(1.4438)*	–	–	X	220	515–690	35
1.4550/1.4912	1.4550	Z6CNNb18-10	X	–	220	515–690	35

Other selected brochures

S-1542-ENG, Sandvik U-bent tubes for heat exchangers
S-120-ENG, Sandvik duplex stainless steels
S-1541-ENG, The role of duplex stainless steels in oil refinery heat exchanger applications
S-156-ENG, The role of duplex stainless steels in petrochemical heat exchanger applications
S-158-ENG, Cool comfort for seawater coolers
S-236-ENG, Stainless welding products
S-110-ENG, Pipe-tube-hollow bar - seamless standard programme in stainless
S-130-ENG, Stainless tubes for high temperature applications
S-1131-ENG, Fittings, flanges, welded pipes

Selected material datasheets

S-1877-ENG, Sandvik SAF 2707 HD
S-8701-ENG, Sandvik SAF 2507
S-1874-ENG, Sandvik SAF 2205
S-1871-ENG, Sandvik SAF 2304
S-1884-ENG, Sandvik 254 SMO
S-1892-ENG, Sandvik Sanicro 41
S-1885-ENG, Sandvik Sanicro 28

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Sandvik Materials Technology
SE-811 81 Sandviken, Sweden, Phone +46 26 26 39 00, Fax +46 26 26 02 20
www.smt.sandvik.com