

NIROSTA® and THERMAX®

Stainless and heat-resistant
flat products of wide strip



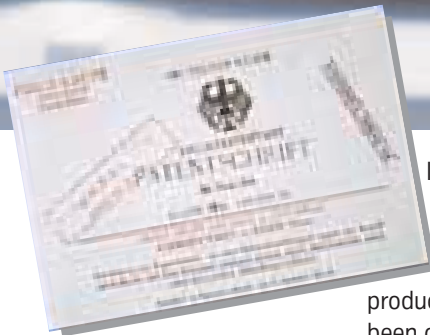
A company
of ThyssenKrupp
Stainless

ThyssenKrupp Nirosta



ThyssenKrupp

ThyssenKrupp Nirosta – a young company with tradition.



In the roughly 5,000 year history of iron use, from the Iron Age to the present day, the production of iron and steel has been one long success story.

And yet despite all scientific efforts one problem remained unresolved until the beginning of the 20th century: corrosion.

Objects made of iron and steel could not be adequately protected against corrosion, and because of rusting they quickly became unattractive, or even irreparably damaged. Even today the cost of corrosion damage still runs into the billions. On October 17, 1912 the firm of Fried. Krupp, Essen, registered a patent application with the Imperial Patent Office in Berlin relating to the “manufacture of objects requiring high resistance to corrosion ...”



1920s NIROSTA® beer keg

By adding to the steel higher amounts (over 12%) of chromium on its own or in combination with nickel it became possible to develop and control a new and vitally important steel property: corrosion resistance.

Just a few years after the start of production the name NIROSTA® (derived from the German for stainless steel “**n**ichtrostender **S**tahl”) was registered as a trademark of Fried. Krupp in 1922.

Thyssen had also begun producing stainless steels by this time and in 1927 was involved in the establishment of a special steel company “Deutsche Edelstahlwerke AG”. In 1956 Thyssen built Germany’s first Sendzimir mill for making stainless cold-rolled wide strip in Krefeld. The introduction of this cold rolling process led to the widespread use of stainless and heat-resistant flat products in numerous market sectors.

With effect from January 1, 1995 – a good 80 years after the patent application – Krupp and Thyssen merged their stainless flat activities to form ThyssenKrupp Nirosta GmbH.

The spire of the Chrysler Building in New York, built with stainless steel at the end of the 1920s.

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Responsible for contents:
Marketing and Materials and Applications Development departments.

Today ThyssenKrupp Nirosta together with affiliated companies ThyssenKrupp Acciai Speciali Terni, ThyssenKrupp Mexinox and Shanghai Krupp Stainless is one of the world's leading manufacturers of stainless flat products with a broad range of grades, sizes and finishes.

The breadth and diversity of the range allows us to offer solutions that will guarantee growth and progress well into the future.

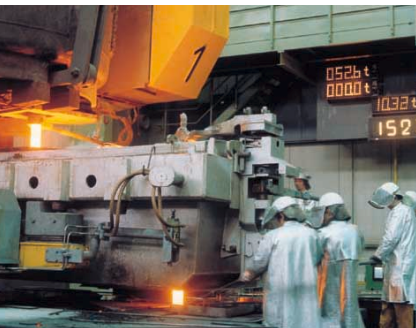
From melting to finished product.



140-t UHP electric arc furnace



Converter shop



Continuous caster



20-roll cold rolling mill

ThyssenKrupp Nirosta's production line for hot- and cold-rolled products of stainless NIROSTA® and heat-resistant THERMAX® steels covers all stages of manufacture from melting to the finished product.

Raw steel and slabs are produced:

- at the Krefeld plant in an 80-t UHP arc furnace and two 80-t AOD converters, secondary steelmaking facilities and a continuous caster,
- at the Bochum plant in a 140-t UHP arc furnace and two 80-t KCB-S converters, secondary steelmaking facilities and a continuous caster.

With only few exceptions, all output is continuously cast.

Hot wide strip is produced at the ThyssenKrupp Stahl AG Bochum plant on a wide strip hot-rolling mill including roughing stand, coilbox and seven-stand finishing train.

The rolling equipment is kept constantly up to date through continuous modernization aimed at achieving closest dimensional tolerances and consistent material properties over the length and width of the strip.

In terms of surface condition, edges, crown and amenability to pickling, the hot-rolled strip meets the high quality standards essential to produce top-quality cold rolled strip and sheet. Maximum coil weight is 30 metric tons.

Hot strip processing begins with annealing. Hot strips of ferritic and martensitic chromium steel are treated in a batch annealing unit and then descaled in a pickling line; hot strips of austenitic chromium-nickel steel pass through continuous annealing and pickling lines. Annealing and pickling are followed by cold rolling on 20-roll cold reduction mills.

Cold strip annealing then takes place either in continuous annealing and pickling lines or in a bright annealing unit. Bright annealing produces an excellent surface gloss and eliminates the need for grinding and polishing.

After cold strip annealing the material is rerolled on a skin pass mill to improve flatness, surface structure and gloss.

Very demanding flatness requirements can be met by tension leveling.

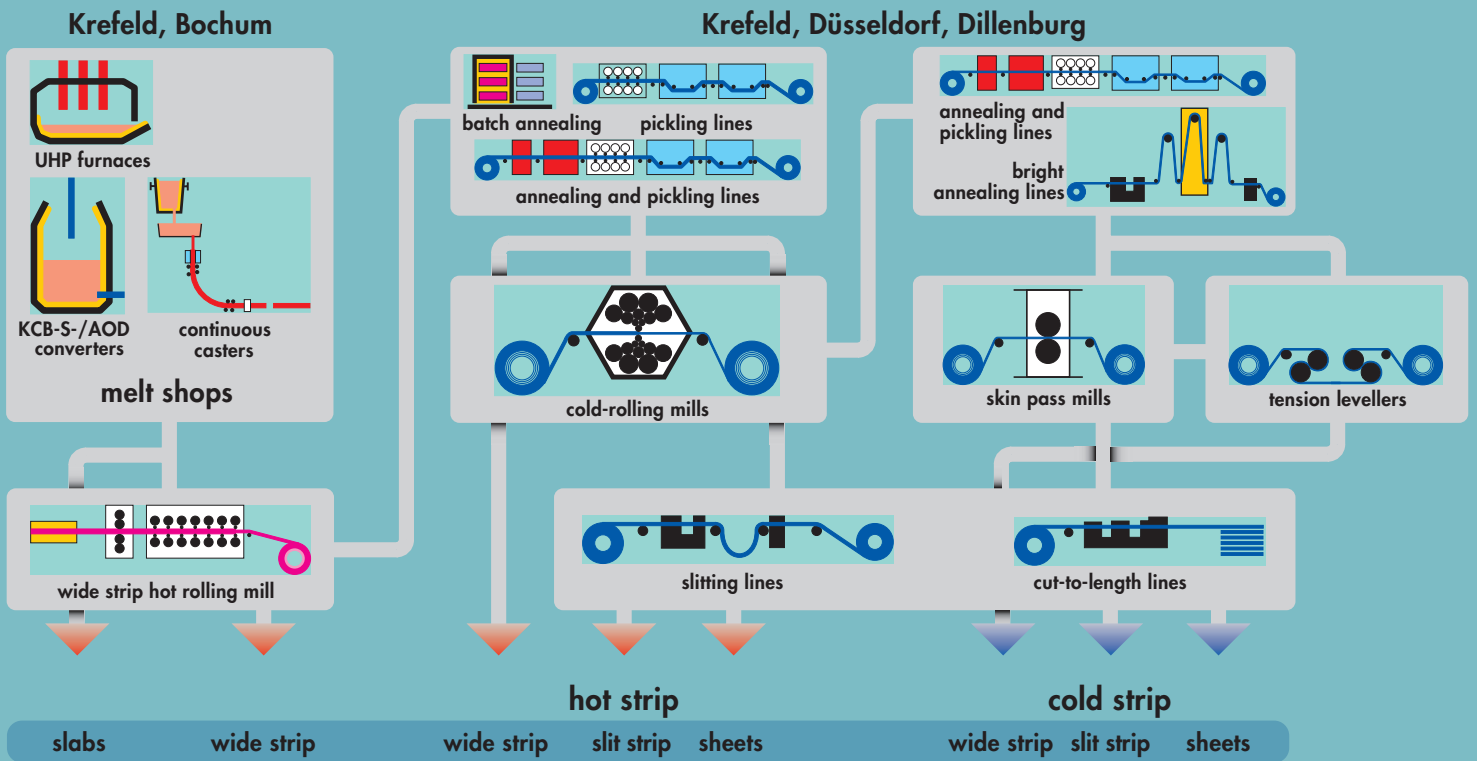
To cover the wide variety of product finishes and forms required, high-performance finishing facilities are available, including slitting and cut-to-length lines, designed to protect the sensitive surfaces and operate to the closest tolerances.

In addition, facilities are available for coating products with adhesive film. Special decorative finishes such as ground or patterned textures can be applied to strip and sheet.

Cold-rolled strip and sheet is produced in thicknesses of 0.25 to 6.00 mm and widths up to 1,550 mm.

In numerous applications, e.g. chemical process equipment, the direct use of a hot-rolled surface is more expedient and cost-effective. From annealed and pickled hot strip we produce slit strip in thicknesses of 2.0 to 8.0 mm and widths of 40 to 1,600 mm.

Flat-rolled products: Stainless and heat-resistant steels



Strip caster

In addition to the conventional production route, ThyssenKrupp Nirosta as part of an international development consortium (Eurostrip®) also operates in Krefeld the first pre-industrial facility for strip casting of stainless steel. In the coming years it will be expanded into a fully integrated production plant.

The plant is designed to produce stainless hot strip in thicknesses from 1.5 to 4.5 mm and maximum widths of 1,450 mm. The capacity in phase one will be around 100,000 tpy, increasing to 400,000 tpy in phase two.



Bright annealing line

In downstream processes too, facilities are being linked to permit continuous operation and significantly shorten processing times.



Finishing center

ThyssenKrupp Nirosta has considerably extended its services for customers with a finishing center at Krefeld where coils can be cut to required dimensions, automatically packaged and stored ready for just-in-time delivery.

Quality management at ThyssenKrupp Nirosta.



Certifications:

ISO 9001
 Rheinisch Westfälischer TÜV 2000
 AD WO/TRD 100
 TÜV Rheinland 1995*
 UDT
 URZAD DOZOU TECHNICZNEGO 1997
 ISO/TS 16949
 (intended)
 Shipbuilding
 ABS, DNV, LRoS, RINA 1995*
 Aerospace
 LBA, CAA, RR 1995*
 MLC 101, MSRR 9920, MSRR 9969,
 RPS 953
 Rolls Royce 1995*
 Ü-Zeichen
 MPA 1995*
 * updated with establishing the company
 in 1995

The framework for ensuring the high quality standards of our processes and products is provided by ISO 9001.

All ThyssenKrupp Nirosta plants are ISO 9001 certified. This standard comprises an integral set of quality rules covering all relevant order processing, procurement, production, inspection, sales and development processes. Through regular internal and external audits the effectiveness of the quality system is continuously monitored and improved.

To maintain consistently high quality, ultra-modern computer-controlled production processes and advanced quality control procedures are applied. Increasingly, quality inspections are being integrated into production online, with the results being used directly to optimize process control.

Sophisticated equipment is available for in-process and final quality control and is also used for research and development. The conditions are thus in place to meet tomorrow's needs today.

X-ray fluorescence analyzers make it possible to determine steel compositions in only a few seconds. They form the basis for computer-assisted control of the melting process. Analysis-dependent material properties such as welding behavior can be controlled within very narrow limits.

The scanning electron microscope allows microstructures and segregations to be examined which cannot be seen through an optical microscope.

To assess the forming behavior of materials during fabrication the usual strength and elongation values determined with conventional universal testing machines are not enough on their own. Electronically controlled and computer-assisted testing machines quickly and precisely determine important parameters such as the strain hardening exponent n and the vertical anisotropy r . These results also play a role in checking our products for uniform quality. The main test results are stored for materials development and documentation; they can be printed out online in the material certificates.

The corrosion resistance of NIROSTA® steels is checked in standardized tests. In addition, electrochemical processes such as the formation of the passive layer which prevents corrosion can be accurately visualized using our highly sensitive potentiostats to produce current density potential curves. The surface of NIROSTA® and THERMAX® strip and sheet is of course also subjected to continuous checks. The gloss and mirror-like surface of cold-rolled and bright-annealed strip are continually tested.

In our welding and forming laboratory the properties of our materials are tested by experienced specialists under simulated processing conditions and in cooperation with our customers.

Data transfer is based on a highly developed computer network, which includes the process computers installed to control the production facilities.

All data important to process control and documentation is input, evaluated and stored in the network.

Support for our customers at home and abroad is provided by our sales departments and the Group's branch offices and steel service centers. The engineers in our materials and applications development team are specialists in all aspects of using and processing NIROSTA® and THERMAX® steels. With their experience and the personnel and technical resources of our applications engineering department they can offer our customers practical answers to questions concerning material selection and processing.



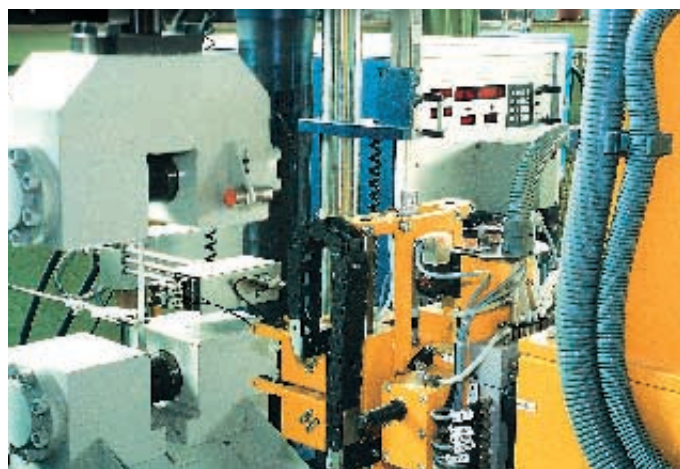
Automatic surface inspection in a cold strip line.



Thickness and flatness measurement on the 20-roll cold rolling mill.



Scanning electron microscope for sophisticated material analysis.



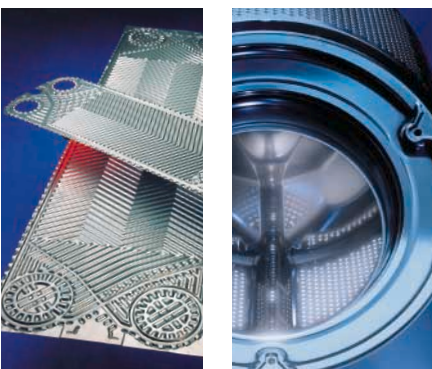
Fully automatic test center for measuring mechanical properties.

Applications



Stainless and heat-resistant flat products are indispensable in many areas of application. Thanks to their outstanding service properties they have proved their value in meeting the very highest technical and aesthetic requirements.

NIROSTA® and THERMAX® steels are used successfully in chemical process equipment, the construction sector, transport, medicine, the food and drink industry, domestic appliances, environmental protection and many other areas.



Quality standards		Notes
DIN EN 10088-2	Stainless steels August 1995	This standard governs general applications.
DIN EN 10028-7	Flat products of pressure vessel steels Part 7: Stainless steels June 2000	Requirements to be met by flat products for pressure vessels of stainless steels including high-temperature steels. Applies in conjunction with DIN EN 10028-1.
DIN EN 10095	Heat-resistant steels and nickel alloys May 1999	
Tolerance standards ¹⁾		
DIN EN 10259	Wide cold-rolled strip and sheet of stainless steel July 1997	
DIN EN 10051	Continuously hot-rolled sheet and strip without coating of unalloyed and alloy steels November 1997	

1) Closer tolerances on request.

Designation	DIN EN 10088-2 Material Code name No.		Chemical composition						
			C	Si	Mn	Cr	Mo	Ni	Other
			%	%	%	%	%	%	%
			max.	max.	max.				
Ferritic and martensitic steels									
NIROSTA 4003	1.4003	X2CrNi12	0.03	1.00	1.50	10.50–12.50		0.30–1.00	N: ≤0.030
NIROSTA 4512	1.4512	X2CrTi12	0.03	1.00	1.00	10.50–12.50			6x(C+N) ≤ Ti ≤ 0.65
NIROSTA 4000	1.4000	X6Cr13	0.08	1.00	1.00	12.00–14.00			
NIROSTA 4002	1.4002	X6CrAl13	0.08	1.00	1.00	12.00–14.00			Al: 0.10–0.30
NIROSTA 4006	1.4006	X12Cr13	0.08–0.15	1.00	1.50	11.50–13.50		≤0.75	
NIROSTA 4021	1.4021	X20Cr13	0.16–0.25	1.00	1.50	12.00–14.00			
NIROSTA 4031	1.4031	X39Cr13	0.36–0.42	1.00	1.00	12.50–14.50			
NIROSTA 4034	1.4034	X46Cr13	0.43–0.50	1.00	1.00	12.50–14.50			
NIROSTA 4016	1.4016	X6Cr17	0.08	1.00	1.00	16.00–18.00			
NIROSTA 4520	1.4520	X2CrTi17	0.025	0.50	0.50	16.00–18.00			Ti: 0.30–0.60 N: ≤0.015
NIROSTA 4510	1.4510	X3CrTi17	0.05	1.00	1.00	16.00–18.00			4x(C+N)+0.15 ≤ Ti ≤ 0.80
NIROSTA 4113	1.4113	X6CrMo17-1	0.08	1.00	1.00	16.00–18.00	0.90–1.40		
NIROSTA 4509	1.4509	X2CrTiNb18	0.03	1.00	1.00	17.50–18.50			Ti: 0.10–0.60 3x(C+N) ≤ Ti ≤ 1.00
NIROSTA 4521	1.4521	X2CrMoTi18-2	0.025	1.00	1.00	17.00–20.00	1.80–2.50		4x(C+N)+0.15 ≤ Ti ≤ 0.80 N: ≤0.030
NIROSTA 4589	1.4589	X5CrNiMoTi15-2	0.08	1.00	1.00	13.50–15.50	0.20–1.20	1.00–2.50	Ti: 0.30–0.50

Other steels and special analyses on request.

X5CrNi

X6Cr17

Mechanical properties at room temperature						Comparison with different standards				
As-delivered condition C = cold-rolled H = hot-rolled	Hardness		0.2% - proof stress Rp0.2 N/mm ² min.	Tensile strength Rm N/mm ²	Elongation at fracture		USA ASTM	JAPAN JIS	CIS GOST	Designation
	HRB	HB or HV			A 80 < 3 mm thickness %	A ¹⁾ ≥ 3 mm thickness %				
C			320	450–650	20	20	S 40977			NIROSTA 4003
H			320	450–650	20	20				
C			220	380–560	25	25	409	SUS 409		NIROSTA 4512
H			220	380–560	25	25				
C			250	400–600	19	19	410 S	SUS 410 S	08 Ch13	NIROSTA 4000
H			230	400–600	19	19				
C			250	400–600	17	17	405	SUS 405		NIROSTA 4002
H			230	400–600	17	17				
C	90	200		max. 600	20	20	410	SUS 410	12 Ch13	NIROSTA 4006
H	90	200		max. 600	20	20				
C		225		max. 700	15	15	(420)	SUS 420 J1	20 Ch13	NIROSTA 4021
H	95	225		max. 700	15	15				
C	98	240		max. 760	12	12		SUS 420 J2	40 Ch13	NIROSTA 4031
H	98	240		max. 760	12	12				
C	99	245		max. 780	12	12	(420)		40 Ch13	NIROSTA 4034
H		245		max. 780	12	12				
C			280	450–600	20	20	430	SUS 430	12 Ch17	NIROSTA 4016
H			260	450–600	18	18				
C		180	200	380–530	24	24				NIROSTA 4520
H		180	200	380–530	24	24				
C			240	420–600	23	23	439	SUS 430 LX	08 Ch 17 T	NIROSTA 4510
H		185	240	420–600	23	23				
C			280	450–630	18	18	434	SUS 434		NIROSTA 4113
H			280	450–630	18	18				
C			250	430–630	18	18	S 43940			NIROSTA 4509
H										
C			320	420–640	20	20	444	SUS 444		NIROSTA 4521
H			300	400–600	20	20				
C			420	420–750	16	16	S 42035			NIROSTA 4589
H			420	550–750	16	16				

¹⁾ The values apply to specimens with a gauge length of 5.65 $\sqrt{a_0}$

MoTi15-2

X2CrTiNb18

Designation	DIN EN 10088-2		Chemical composition						
	Material No.	Code name	C %	Si %	Mn %	Cr %	Mo %	Ni %	Other %
			max.	max.	max.				
Austenitic steels									
NIROSTA 4310	1.4310	X10CrNi18-8	0.05-0.15	2.00	2.00	16.00–19.00	< 0.80	6.00– 9.50	
NIROSTA 4318	1.4318	X2CrNi18-7	0.03	1.00	2.00	16.50–18.50		6.00– 8.00	N:0.10–0.20
NIROSTA 4307	1.4307	X2CrNi18-9	0.03	1.00	2.00	17.50–19.50		8.00–10.00	N:≤0.11
NIROSTA 4301	1.4301	X5CrNi18-10	0.07	1.00	2.00	17.00–19.50		8.00–10.50	N:≤0.11
NIROSTA 4303	1.4303	X4CrNi18-12	0.06	1.00	2.00	17.00–19.00		11.00–13.00	N:≤0.11
NIROSTA 4306	1.4306	X2CrNi19-11	0.03	1.00	2.00	18.00–20.00		10.00–12.00	N:≤0.11
NIROSTA 4541	1.4541	X6CrNiTi18-10	0.08	1.00	2.00	17.00–19.00		9.00–12.00	5xC<Ti<0.70
NIROSTA 4550	1.4550	X6CrNiNb18-10	0.08	1.00	2.00	17.00–19.00		9.00–12.00	10xC<Nb<1.00
NIROSTA 4401	1.4401	X5CrNiMo17-12-2	0.07	1.00	2.00	16.50–18.50	2.00–2.50	10.00–13.00	
NIROSTA 4404	1.4404	X2CrNiMo17-12-2	0.03	1.00	2.00	16.50–18.50	2.00–2.50	10.00–13.00	N:≤0.11
NIROSTA 4571	1.4571	X6CrNiMoTi17-12-2	0.08	1.00	2.00	16.50–18.50	2.00–2.50	10.50–13.50	5xC<Ti<0.70
NIROSTA 4561	1.4561	X1CrNiMoTi18-13-2	0.02	0.50	2.00	17.00–18.50	2.00–2.50	11.50–13.50	Ti:0.40–0.60
NIROSTA 4435	1.4435	X2CrNiMo18-14-3	0.03	1.00	2.00	17.00–19.00	2.50–3.00	12.50–15.00	N:≤0.11
NIROSTA 4439	1.4439	X2CrNiMoN17-13-5	0.03	1.00	2.00	16.50–18.50	4.00–5.00	12.50–14.50	N:0.12–0.22
NIROSTA 4539	1.4539	X1NiCrMoCu25-20-5	0.02	0.70	2.00	19.00–21.00	4.00–5.00	24.00–26.00	N:≤0.15 Cu:1.20–2.00
NIROSTA 4565	1.4565	X2CrNiMnMoNbN 25-18-5-4	0.03	1.00	3.5–6.5	23.00–26.00	3.50–5.00	16.00–19.00	Nb:≤0.30 N:0.30–0.60
Ferritic-austenitic steel									
NIROSTA 4462	1.4462	X2CrNiMoN22-5-3	0.03	1.00	2.00	21.00–23.00	2.50–3.50	4.50– 6.50	N:0.10–0.22

Other steels and special analyses on request.

X2CrNi18-7

X4CrNi18-12

CrNiMo17-12-2

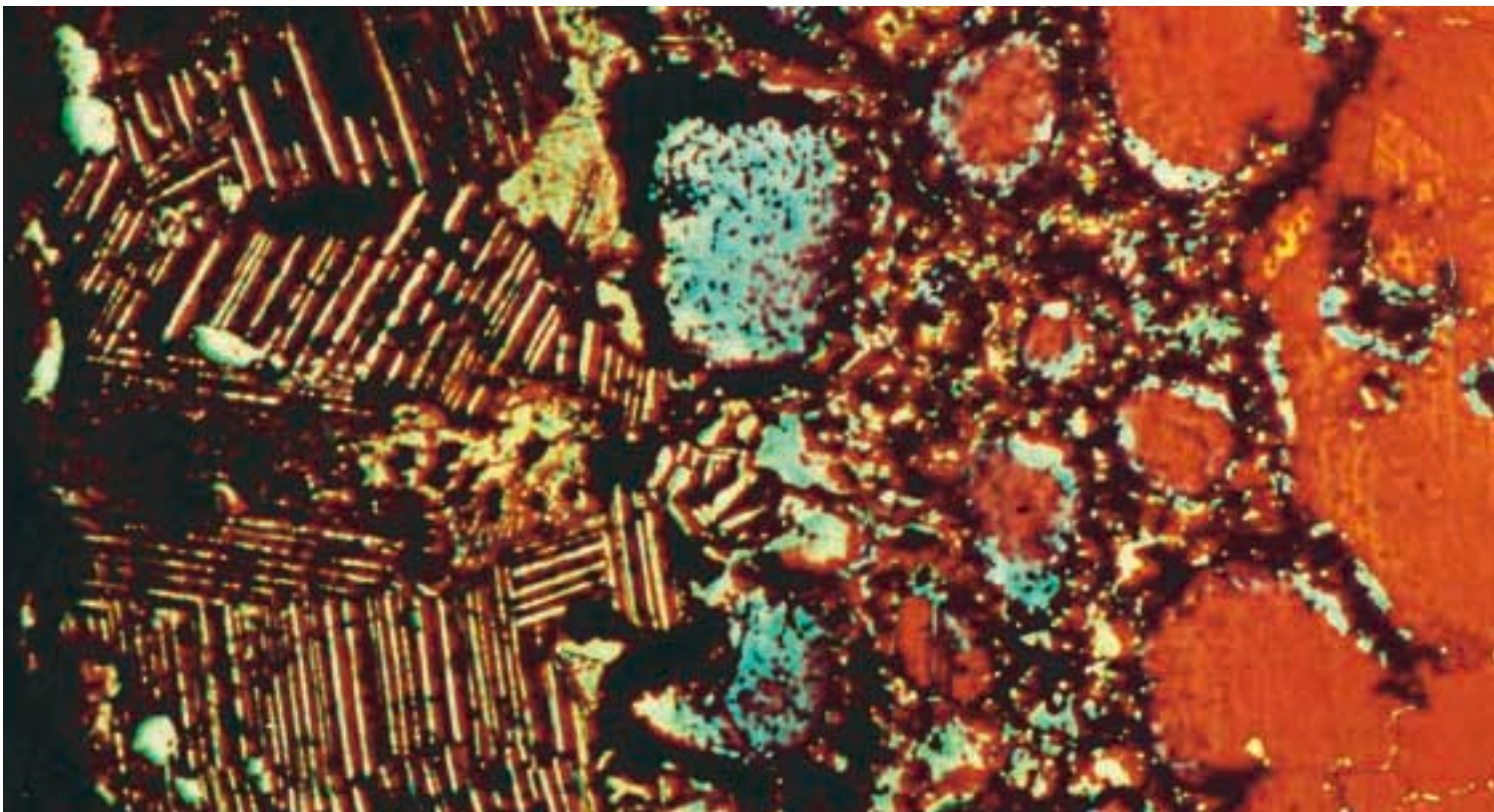
Mechanical properties at room temperature					Comparison with different standards			
As-delivered condition C = cold-rolled H = hot-rolled	0.2% - proof-stress Rp0.2 N/mm ² min.	Tensile strength Rm N/mm ²	Elongation at fracture		USA ASTM	JAPAN JIS	CIS GOST	Designation
			A 80 < 3 mm thickness %	A ¹⁾ ≥ 3 mm thickness %				
C H	250	600–950	40	40	(301)	SUS 301		NIROSTA 4310
C H	350 330	650–850 650–850	35 35	40 40	301 LN	SUS 301 LN		NIROSTA 4318
C H	220 200	520–670 520–670	45 45	45 45	304 L	SUS 304 L	04 Ch 18 N 10	NIROSTA 4307
C H	230 210	540–750 520–720	45 45	45 45	304	SUS 304	08 Ch 18 N 10	NIROSTA 4301
C H	220	500–650	45	45	(305)	SUS 305	06 Ch 18 N 11	NIROSTA 4303
V H	220 200	520–670 520–670	45 45	45 45	304 L	SUS 304 L	03 Ch 18 N 11	NIROSTA 4306
V H	220 200	520–720 520–720	40 40	40 40	321	SUS 321	08 Ch 18 N 10 T	NIROSTA 4541
C H	220 200	520–720 520–720	40 40	40 40	347	SUS 347	08 Ch 18 N 12 B	NIROSTA 4550
C H	240 220	530–680 530–680	40 40	40 40	316	SUS 316	03 Ch 17 M 13 M 2	NIROSTA 4401
C H	240 220	530–680 530–680	40 40	40 40	316 L	SUS 316 L	03 Ch 17 N 13 M 2	NIROSTA 4404
C H	240 220	540–690 540–690	40 40	40 40	316 Ti	SUS 316 Ti	10 Ch 17 N 13 M 2 T	NIROSTA 4571
C H	190 190	490–690 490–690	40 40	40 40				NIROSTA 4561
C H	240 220	550–700 550–700	40 40	40 40	316 L	SUS 316 L	03 Ch 17 N 14 M 2	NIROSTA 4435
C H	290 270	580–780 580–780	35 35	35 35	S 31726	SUS 317		NIROSTA 4439
C H	240 220	530–730 530–730	35 35	35 35	N 08904			NIROSTA 4539
C H	420 420	800–950 800–950	30 30	30 30	S 34565			NIROSTA 4565
C H	480 460	660–950 660–950	20 25	20 25	S 31803	SUS 329 J 3 L		NIROSTA 4462

¹⁾ The values apply to specimens with a gauge length of 5.65 $\sqrt{a_0}$

X6CrNiNb18-10

Designation	DIN EN 10 095		Chemical composition					
	Material No.	Code name	C %	Si %	Al %	Cr %	Ni %	Other %
			max.					
Ferritic steels								
THERMAX 4713	1.4713	X10CrAlSi7	0.12	0.5–1.0	0.5–1.0	6.0– 8.0		
THERMAX 4724	1.4724	X10CrAlSi13	0.12	0.7–1.4	0.7–1.2	12.0–14.0		
THERMAX 4742	1.4742	X10CrAlSi18	0.12	0.7–1.4	0.7–1.2	17.0–19.0		
THERMAX 4762	1.4762	X10CrAlSi25	0.12	0.7–1.4	1.2–1.7	23.0–26.0		
Austenitic steels								
THERMAX 4878	1.4878	X8CrNiTi18-10	0.10	≤1.0		17.0–19.0	9.0–12.0	5xC _s ≤Ti≤0.8
THERMAX 4828	1.4828	X15CrNiSi20-12	0.20	1.5–2.0		19.0–21.0	11.0–13.0	
THERMAX 4845	1.4845	X8CrNi25-21	0.10	≤1.5		24.0–26.0	19.0–22.0	
THERMAX 4841	1.4841	X15CrNiSi25-21	0.20	1.5–2.5		24.0–26.0	19.0–22.0	

Other steels and special analyses on request.



Micrograph of a heat-resistant THERMAX[®] steel after many years' service in an aggressive flue gas atmosphere.

Mechanical properties at room temperature					Comparison with different standards			
Hardness HB or HV max.	0.2%- proof- stress Rp0.2 N/mm ² min.	Tensile strength Rm N/mm ²	Elongation at fracture A ¹⁾ % min.	Non- scaling in air up to approx. ...°C	USA ASTM	JAPAN JIS	CIS GOST	Designation
192	220	420–620	15	800				THERMAX 4713
192	250	450–650	15	850				THERMAX 4724
212	270	500–700	15	1000				THERMAX 4742
223	280	520–720	15	1150				THERMAX 4762
215	190	500–720	40	850	321H		12 Ch 18 N 10 T	THERMAX 4878
223	230	550–750	28	1000				THERMAX 4828
192	210	500–700	35	1050	310/310S			THERMAX 4845
223	230	550–750	30	1150				THERMAX 4841

¹⁾ The values apply to specimens with a gauge length of $5.65 \sqrt{a_0}$

For cold-rolled flat products <3mm thickness
the stated values are also guaranteed for A 80.

1000°C

900°C

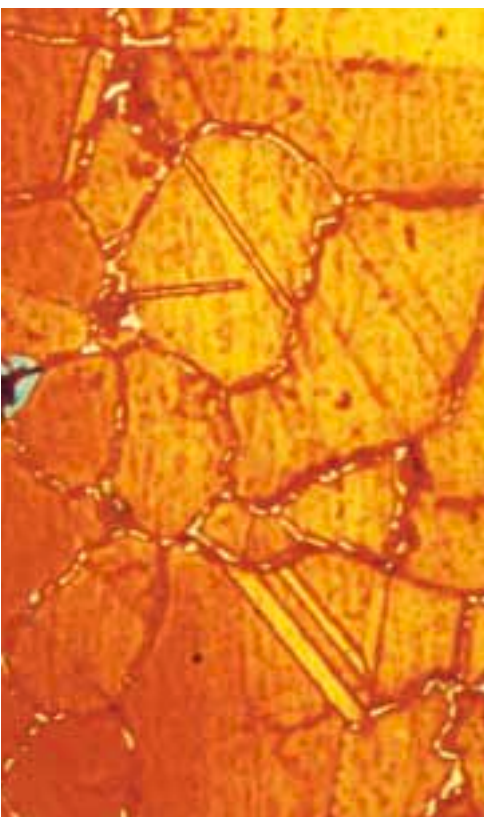
850°C

800°C

700°C

600°C

500°C



Finish and surface condition for sheet and strip¹⁾

DIN EN 10088-2

Symbol ²⁾	Finish	Surface condition	Notes	Previous symbol
Hot-rolled				
1U	Hot-rolled, not heat-treated, not descaled	Covered with mill scale	Suitable for products which are further processed, e.g. strip for rerolling.	
1C	Hot-rolled, heat-treated, not descaled	Covered with mill scale	Suitable for parts which are subsequently descaled or machined, or for certain heat-resistant applications.	I c
1E	Hot-rolled, heat-treated, mechanically descaled	Free of scale	The type of mechanical descaling, e.g. rough grinding or blast cleaning, depends on steel grade and product form and, unless otherwise agreed, is left to the discretion of the manufacturer.	II a
1D	Hot-rolled, heat-treated, pickled	Free of scale	Normal standard for most steel grades to guarantee good corrosion resistance; also usual finish for further processing. Not as smooth as 2D or 2B.	II a
Cold-rolled				
2H	Work-hardened	Bright	Cold worked to achieve higher strength levels.	III a
2C	Cold-rolled, heat-treated, not descaled	Smooth, with scale from heat treatment	Suitable for parts which are subsequently descaled or machined, or for certain heat-resistant applications.	III s
2D	Cold-rolled, heat-treated, pickled	Smooth	Finish for good formability, but not as smooth as 2B or 2R.	III b
2B	Cold-rolled, heat-treated, pickled, skin passed	Smother than 2D	Most common finish for most steel grades to ensure good corrosion resistance, smoothness and flatness. Also usual finish for further processing. Rerolling can be by tension leveling.	III c
2R	Cold-rolled, bright annealed ³⁾	Smooth, bright, reflecting	Smother and brighter than 2B. Also usual finish for further processing.	III d

Symbol ²⁾	Finish	Surface condition	Notes	Previous symbol
Special finishes				
1G or 2G	Ground ⁴⁾	See footnote 5.	Grit size or surface roughness can be fixed. Equiaxed texture, low-reflecting.	IV
2J	Brushed ⁴⁾ or matt-polished ⁴⁾	Smoother than ground. See footnote 5.	Brush type or polishing belt or surface roughness can be fixed. Equiaxed texture, low-reflecting.	
2M	Patterned	Design to be agreed; second surface smooth. See page 21.	Excellent textured finish mainly for architectural applications.	

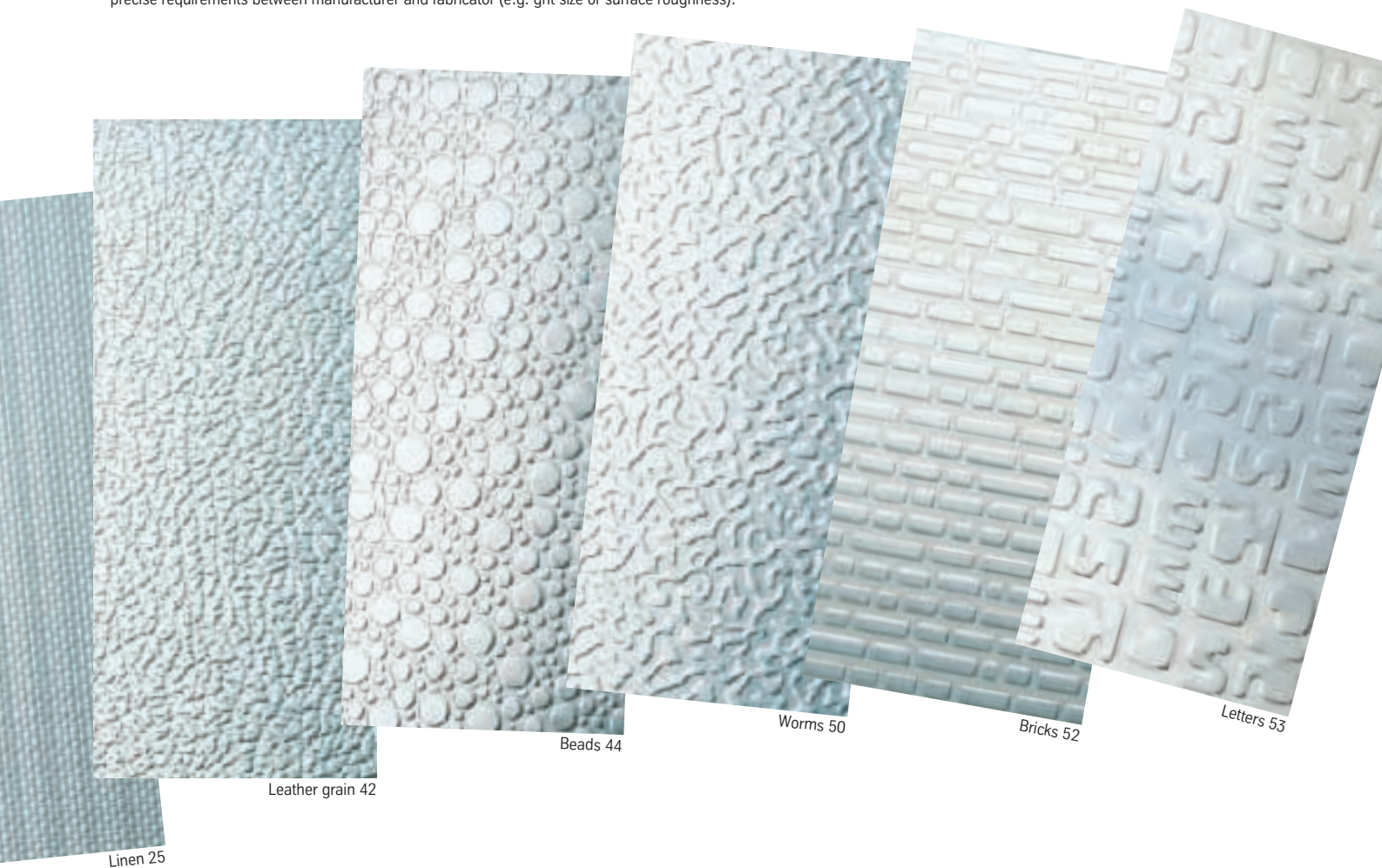
¹⁾ Not all finishes available for all steels.

²⁾ First digit: 1 = hot-rolled, 2 = cold-rolled.

³⁾ May be rerolled.

⁴⁾ One surface only unless expressly agreed when ordering.

⁵⁾ Within each finish the surface properties may vary and it may be necessary to agree more precise requirements between manufacturer and fabricator (e.g. grit size or surface roughness).



Range of cold-rolled strip products

Surface finish/Product thickness					
Material	Finish/Thickness in mm				
	2 H	2 D	2 B	2 R	2 C
NIROSTA					
ferritic ¹⁾	see page 21	0.30–4.00	0.30–4.00	0.25–3.50	
martensitic			0.50–5.50		
austenitic ²⁾		0.30–6.00	0.30–6.00	0.25–3.50	
THERMAX					
ferritic			0.50–3.50		0.50–3.50 ³⁾
austenitic			0.50–6.00		0.50–6.00
¹⁾ NIROSTA 4113 only finish 2R and only 0.30-1.50 mm thickness.				With special materials restrictions of this range are possible.	
²⁾ NIROSTA 4310 finish 2B/2R only up to 3.0 mm thickness.					
³⁾ THERMAX 4742 and THERMAX 4762 only >0.80 mm thickness.					

Coil weights for slit and wide strip		Coil inside diameter: 610 and 508 mm; for slit strip widths of 10 to ≤ 400 mm and thickness ≤ 1.5 mm a coil inside diameter of 400 mm is possible.
Width mm	Coil weight kg/mm strip width	
10 < 50	incremental from 1.0 ≤ 8.0	
≥ 50 ≤ 1,550	incremental from 2.0 ≤ 16.5	

Minimum weights for sheet packs										
Sheet mm	width	Minimum pack weights in kg for sheet lengths in mm from								
		300	500	1,000	2,000	2,500	3,000	4,000	6,000	12,000
100		500	500	500	500	500	600	600	1,000	
> 100 ≤ 200		600	600	600	600	600	1,200	1,200	1,200	
> 200 ≤ 400		600	600	600	1,200	1,200	1,200	1,200	1,200	
> 400 ≤ 650			600	1,200	1,500	1,500	1,500	1,500	1,500	2,500
> 650 ≤ 1,000			1,200	1,200	1,500	1,500	1,500	1,500	2,500	5,000
> 1,000 ≤ 1,250			1,000	1,500	1,500	2,000	2,000	2,500	4,000	5,000
> 1,250 ≤ 1,500				1,500	2,000	2,000	2,500	3,000	4,000	5,000
> 1,500 ≤ 1,550				1,500	2,000	2,000	2,500	3,000	4,000	5,000
<div style="border: 1px solid black; width: 60px; height: 20px; display: inline-block;"></div> Standard dimensions available ex stock (width x length) small format KF 1,000 x 2,000 mm, minimum pack weight 1,500 kg; medium format MF 1,250 x 2,500 mm, minimum pack weight 2,000 kg; large format GF 1,500 x 3,000 mm, minimum pack weight 2,500 kg.		Standard pack weights are higher; they are selected according to transport criteria.				Packaging: Based on our experience we issue reliable recommendations. The most suitable type of packaging for transport and use is offered in each case.				

Cold-rolled strip (wide and slit strip)

Steel group	Thickness mm		Width mm	
	from	to	from	to
Austenitic	0.25	<0.30	10	1,000
	0.30	<0.80	10	1,300
	0.80	1.50	10	1,550
	> 1.50	2.50	20	1,550
	> 2.50	4.00	40	1,550
	> 4.00	5.00	50	1,550
Ferritic	> 5.00	6.00	60	1,550
	0.25	<0.30	10	1,000
	0.30	<0.80	10	1,300
	0.80	1.50	10	1,550
	> 1.50	2.50	20	1,550
	> 2.50	4.00	40	1,550
Martensitic	0.70	1.50	10	1,300
	> 1.50	2.50	20	1,300
	> 2.50	4.00	40	1,300
Austenitic-ferritic	> 1.50	4.00	50	1,450

Cold-rolled sheet

Width mm	Thickness		Length	
	from	to	from	to
100– 300	0.25	2.00	500	4,000
300– 1,300	0.25	<0.80	500	6,000
	0.80	<1.25	500	7,000
	1.25	<2.00	500	10,000
	2.00	6.00	500	12,000
1,300– 1,550	0.80	<1.25	600	7,000
	1.25	<2.00	600	10,000
	2.00	6.00	600	12,000

Tolerances: For thickness, width and length tolerances see "Dimensional and shape deviations" (page 20).
For available finishes and thicknesses see page 18.

Ground sheet of ferritic and austenitic NIROSTA® steels

Width mm	Thickness mm		Length mm	
	from	to	from	to
100– 300	0.50	2.00	500	4,000
300– 1,300	0.50	<0.80	500	6,000
	0.80	<1.25	500	7,000
	1.25	<2.00	500	10,000
	2.00	6.00	500	12,000
1,300– 1,550	1.25	<2.00	600	10,000
	2.00	6.00	600	12,000

**Ground strip of ferritic and austenitic NIROSTA® steels**

Thickness mm		Width mm	
from	to	from	to
0.50	<0.80	10	1,300
0.80	1.50	10	1,550
>1.50	2.50	20	1,550
>2.50	4.00	40	1,550
>4.00	5.00	50	1,550
>5.00	6.00	60	1,550

Surface finish for ground strip and sheet

Grit size ¹⁾	Designation
80	2 G 80
120	2 G 120
180	2 G 180
240	2 G 240
Mikrolon	2 G Mik

Strip ground on both sides by special agreement.

¹⁾ The indication of these grit sizes alone does not precisely define the grinding pattern. If within these grit sizes a match to an already existing grinding pattern is required, our samples should be requested at the inquiry stage or before the order is placed.

Range of cold-rolled strip products

Dimensional and shape variations for cold-rolled strip and sheet based on DIN EN 10259

Thickness variations		Measurements in millimeters					
Nominal thickness greater or equal to	smaller than	Normal tolerances for a nominal width w of			Special tolerances (S) for a nominal width w of		
		w ≤ 1,000	1,000 < w ≤ 1,300	1,300 < w ≤ 2,100	w ≤ 1,000	1,000 < w ≤ 1,300	1,300 < w ≤ 2,100
–	0.30	± 0.03			± 0.020		
0.30	0.50	± 0.04	± 0.04		± 0.025	± 0.030	
0.50	0.60	± 0.045	± 0.05		± 0.030	± 0.035	
0.60	0.80	± 0.05	± 0.05		± 0.035	± 0.040	
0.80	1.00	± 0.055	± 0.06	± 0.06	± 0.040	± 0.045	± 0.050
1.00	1.20	± 0.06	± 0.07	± 0.07	± 0.045	± 0.045	± 0.050
1.20	1.50	± 0.07	± 0.08	± 0.08	± 0.050	± 0.055	± 0.06
1.50	2.00	± 0.08	± 0.09	± 0.10	± 0.055	± 0.06	± 0.07
2.00	2.50	± 0.09	± 0.10	± 0.11			
2.50	3.00	± 0.11	± 0.12	± 0.12			
3.00	4.00	± 0.13	± 0.14	± 0.14			
4.00	5.00	± 0.14	± 0.15	± 0.15			
5.00	6.50 ¹⁾	± 0.15	± 0.15	± 0.16			

¹⁾ including 6.50 mm.

Width variations		Measurements in millimeters							
Nominal thickness greater or equal to	smaller than	Normal tolerances ¹⁾ for a nominal width w of					Special tolerances (S) ¹⁾ for a nominal width w of		
		w ≤ 125 ²⁾	125 < w ≤ 250 ²⁾	250 < w ≤ 600 ²⁾	600 < w ≤ 1,000 ²⁾	1,000 < w ≤ 2,100 ²⁾	w ≤ 125	125 < w ≤ 250	250 < w ≤ 600
–	1.00	+0.5 –0	+0.5 –0	+0.7 –0	+1.5 –0	+2.0 –0	+0.3 –0	+0.3 –0	+0.6 –0
1.00	1.50	+0.7 –0	+0.7 –0	+1.0 –0	+1.5 –0	+2.0 –0	+0.4 –0	+0.5 –0	+0.7 –0
1.50	2.50	+1.0 –0	+1.0 –0	+1.2 –0	+2.0 –0	+2.5 –0	+0.6 –0	+0.7 –0	+0.9 –0
2.50	3.50	+1.2 –0	+1.2 –0	+1.5 –0	+3.0 –0	+3.0 –0	+0.8 –0	+0.9 –0	+1.0 –0
3.50	6.50 ³⁾	+2.0 –0	+2.0 –0	+2.0 –0	+4.0 –0	+4.0 –0			

¹⁾ By special agreement products may be supplied with negative tolerances on nominal width.

In this case the values in table are the sum of positive and negative tolerances.

²⁾ For products with trimmed edges, tolerances on width may increase to 5mm by arrangement.

³⁾ Including 6.50 mm.

Length variations

Nominal length mm	Standard variation	Special tolerances (S)
≤ 2,000	– 0 + 5 mm	– 0 + 3 mm
> 2,000	– 0 + 0.25 %	– 0 + 0.15 %

Dimensions below nominal width and length not permissible; only positive tolerances on width and length can be supplied.

Shape variations

Deviations from straightness of longitudinal edges, flatness and rectangularity with finishes 2B and 2R in line with DIN EN 10259, but not with finishes 2H, 2D and 2C.

Closer permissible variations may be agreed, particularly if tension-leveled product is ordered.

Work-hardened strip and sheet of austenitic NIROSTA® steels with finish 2H¹⁾

Designation	Tensile strength N/mm ²	Available thickness mm	Maximum width mm
C 700	700 – 850	0.40 – 1.50	1,000
		> 1.50 – 3.00	1,300
C 850	850 – 1,000	0.40 – 1.50	1,000
		> 1.50 – 3.00	1,300
C 1000	1,000 – 1,150	0.40 – 1.50	1,000
		> 1.50 – 2.50	1,300
C 1150	1,150 – 1,300 ²⁾	> 0.40 – 1.50	1,000
C 1300	1,300 – 1,500 ²⁾	> 0.40 – 1.50	1,000

For flat products in work-hardened condition the values stated in standard DIN EN 10259 for flatness are not applicable; also, for dimensional deviations only regular tolerances under the above standard are possible.

¹⁾ for ferritic and martensitic NIROSTA® steels see special range.
²⁾ NIROSTA 4310 only.

**NIROSTA® strip and sheet with Polirrolled surface
Dimensions available**

Form	Thickness mm	Width mm	Length mm
Strip	0.50 < 0.80	10–1,250	
	0.80 ≤ 1.20	50–1,500	
Sheet	0.50 < 0.80	100–1,250	300–6,000
	0.80 ≤ 1.20	100–1,500	300–6,000

Minimum quantity = coil yield

**Patterned NIROSTA® strip and sheet
Dimensions available**

Form	Thickness mm	Width mm	Length mm
Strip	0.50 < 0.80	10–1,250	
	0.80 ≤ 2.00	50–1,500	
Sheet	0.50 < 0.80	100–1,250	300–6,000
	0.80 ≤ 2.00	100–1,500	300–6,000

Minimum quantity = coil yield

Our production program includes the following surface patterns for finish 2 M:

Pattern	Ordering No.	
Diamonds	21	Please refer to our special brochure. If required other patterns can be supplied depending on quantities.
Rhombus	22	
Linen	25	
Leather grain	42	
Beads	44	
Worms	50	
Bricks	52	
Letters	53	

Surface protection

Strip and sheet with finishes 1 U, C, E, D are usually supplied without paper interleaving, but strip and sheet with finish 2 and special finishes are always packed with paper interleaving for surface protection.

To protect the particularly sensitive surfaces during handling and processing, protective coatings of adhesive film can also be applied.

We can supply the following coating types:

Coating type	Base material	Film thickness	Color	Use
Type I	PE	90	white with blue stripes	low deformation, high mechanical loading.
Type II	PE	100	black/white	like type 1 with increased UV stability.
Type III	PE	70	blue transparent	low deformation, low mechanical loading.
Type IV	PVC	80	blue transparent	high deformation, high mechanical loading.
Type V	PE	80	green transparent	for sensitive surfaces. Particularly suitable for ground and brushed surfaces. High deformation, high mechanical loading.
Type VI	PVC	130	white	high deformation, very high mechanical loading.
Type VII	PE	60	blue transparent	medium deformation, low stripping forces. Not suitable for ground, brushed or patterned surfaces.
Type VIII	PE	100	black/white	specially designed for patterned sheets intended for laser cutting. Very good weather-resistance, high adhesion.
Type IX	PE	60	blue transparent	medium deformation, medium mechanical loading.

Range of hot-rolled strip products

Steel group	Hot strip thicknesses (mm) in hot strip widths		
	1,000 mm	1,250 mm	1,500 mm
Ferritic and martensitic steels			
NIROSTA 4000, 4002, 4006, 4016	2.0 – 7.0	2.5 – 7.0	3.5 – 7.0
NIROSTA 4003	1.8 – 7.0	2.0 – 7.0	3.0 – 7.0
NIROSTA 4021, 4031, 4034	2.0 – 5.5	2.5 – 5.5	4.0 – 5.5
NIROSTA 4510, 4520	2.0 – 7.0	2.5 – 7.0	3.5 – 7.0
NIROSTA 4512, 4589	1.8 – 7.0	1.8 – 7.0	2.0 – 7.0
Austenitic steels			
NIROSTA 4301, 4303, 4306, 4307, 4310, 4541, 4550	2.0 – 8.0	2.5 – 8.0	4.0 – 8.0
NIROSTA 4318, 4401, 4404, 4571	2.5 – 8.0	3.5 – 8.0	5.0 – 8.0
NIROSTA 4435, 4439, 4539	3.5 – 8.0	4.5 – 8.0	6.0 – 8.0
Ferritic-austenitic steel			
NIROSTA 4462	4.0 – 8.0	5.0 – 8.0	6.0 – 7.0 ¹⁾
			¹⁾ max. 1,450 mm
Heat-resistant steels			
THERMAX 4713, 4724, 4742, 4762	3.5 – 6.0	3.8 – 6.0	4.0 – 6.0
THERMAX 4828, 4878	2.0 – 8.0	2.5 – 8.0	4.0 – 8.0
THERMAX 4845, 4841	2.5 – 8.0	3.5 – 8.0	5.0 – 8.0
Non-listed steels and different sizes available on request.	Tolerances:	For thickness and width variations see page 23. Shape variations, straightness in line with DIN EN 10 051.	
Finish to DIN EN 10 088-2: 1C hot-rolled, heat-treated, not descaled, available in thicknesses upwards of 2.5 mm 1D hot-rolled, heat-treated, pickled	Coil weights:	up to 17.5 kg/mm strip width.	
	Coil inside diameters:	610 mm (508 mm possible only on request).	



Sheets from cut-to-length hot strip

Width mm	Thickness		Length	
	from mm	to mm	from mm	to mm
400 – 1,250	2	3	500	12,000
400 – 1,600	2	6	800	12,000
650 – 1,600	6	8	800	8,000

Other dimensions on request.

Finish to DIN EN 10 088-2

IC hot-rolled, heat-treated, not descaled,
available in thicknesses upwards of 2.5 mm
ID hot-rolled, heat-treated, pickled

Tolerances:

For thickness and width variations see tables
below for hot strip. For length and shape
tolerances (straightness, flatness, rectangularity)
see DIN EN 10 051.

Thickness variations for hot strip¹⁾

Nominal thicknesses mm	Thickness variations for nominal widths ²⁾ based on DIN EN 10 051		
	mm ≤ 1,200	mm 1,200 ≤ 1,500	mm > 1,500
> 1.5 ≤ 2.0	± 0.17	± 0.19	± 0.21
> 2.0 ≤ 2.5	± 0.18	± 0.21	± 0.23
> 2.5 ≤ 3.0	± 0.20	± 0.22	± 0.24
> 3.0 ≤ 4.0	± 0.22	± 0.24	± 0.26
> 4.0 ≤ 5.0	± 0.24	± 0.26	± 0.28
> 5.0 ≤ 6.0	± 0.26	± 0.28	± 0.29
> 6.0 ≤ 8.0	± 0.29	± 0.30	± 0.31

¹⁾ also applies to sheet up to <3.0 mm
thickness from cut-to-length hot strip.

²⁾ For NIROSTA® 4512 see narrower
thickness tolerances.

Width variations for hot strip¹⁾

Nominal thickness mm	Permissible overrun on nominal width
< 6.5	in line with DIN EN 10259 (cf. cold-rolled strip products, page 20)
≥ 6.5	in line with DIN EN 10051

¹⁾ also applies to sheet up to <3.0 mm
thickness from cut-to-length hot strip.

Narrower thickness tolerances NIROS- TA 4512

Nominal thickness mm	Thickness variation mm
1.5	± 0.15
1.8	± 0.15
2.0	± 0.18
2.5	± 0.20
3.0	± 0.20



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Cold- and hot-rolled strip products

Via head office in Krefeld you can contact:

Sales Western Europe

- Trading/Steel service centers
- Automotive/Pipes and tubes/ Apparatus construction
- Domestic appliances/ Kitchens/Kegs
- Cold rollers/Hollow-ware/ Civil construction

Logistics-center

Technical product service

Marketing

Four-high mill plate profit-center

Sales and Technical product service can also be reached via head office in Krefeld.

Precision strip profit-center

Sales and Technical product service
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Range of products

- Cold-rolled strip and sheet
- Hot-rolled strip and sheet
- Four high mill and checker plate
- Precision strip

in the steel grades

- NIROSTA® stainless
- THERMAX® heat-resistant
- CRONIDUR® high-temperature
- AMANOX® non-magnetic
- RADIONOX® radiation-absorbing

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