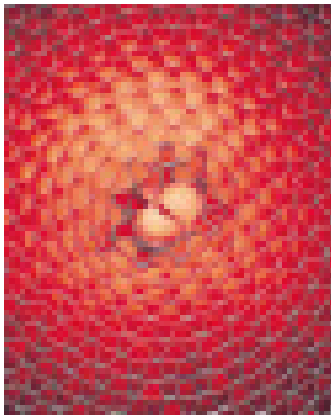
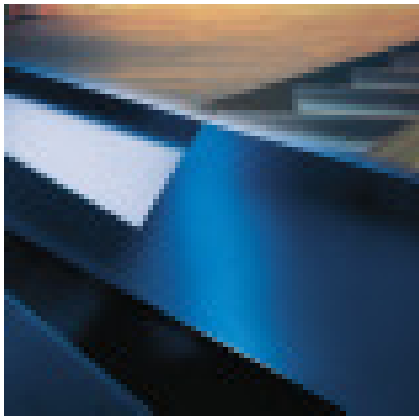
High-performance alloys:
The key to innovative solutions.



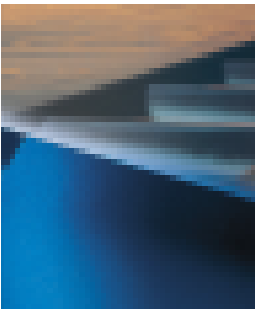


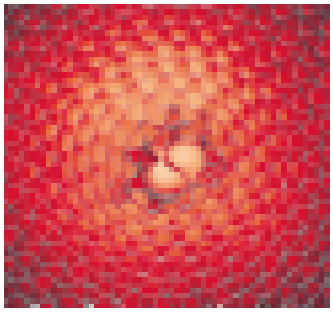
A company of
ThyssenKrupp
Stainless

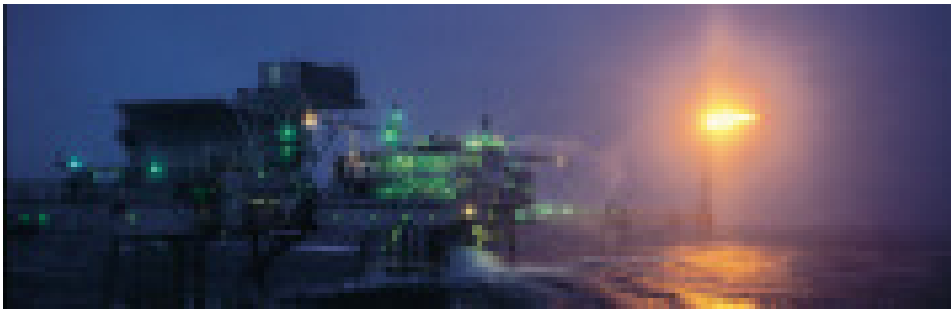
ThyssenKrupp VDM

ThyssenKrupp

Welcome to ThyssenKrupp VDM.







Wherever established technologies are stretched to their limits and new ones created, is the world of ThyssenKrupp VDM. High-performance alloys play vital roles in our industrial society, guaranteeing that technological innovation will be both practically and economically viable. Now more than ever, advances in leading-edge materials are the precondition for all progress.

Creativity and innovation are the raw ingredients for developments that are eagerly awaited around the world. The quality of ideas is demonstrated not only in the form of products, but also in sophisticated processes and organizational procedures. Corporate policies put the customer at the very center of all decision-making processes at ThyssenKrupp VDM.
This philosophy makes uncompromising quality the focus of all activities, the ultimate stimulus to technological development.

ThyssenKrupp VDM.
New ideas start here.

We've been developing materials for the most demanding applications for many decades. This experience has made us one of the world's leading suppliers of high-performance alloys.
Our product range is correspondingly broad and varied. It includes semi-finished items in nickel alloys and special stainless steels, finished components in soft magnetic alloys, punched and shaped components. They meet the specific needs of a diverse range of industries.

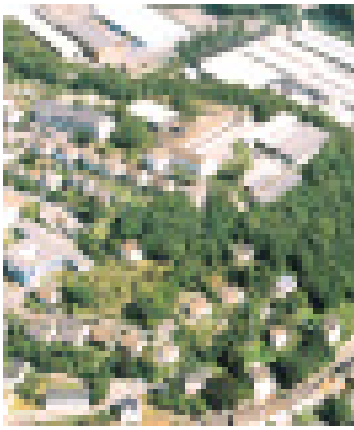
Our special strengths are in the development of tailor-made material concepts and new manufacturing technologies. ThyssenKrupp VDM materials are key elements of many branches of industry, vital to the feasibility and practical implementation of entire technologies. ThyssenKrupp VDM supplies allround packages to energy and environmental engineering, electronics and electrical engineering, the automotive industry, aerospace, chemicals and petrochemicals, agrichemicals, pharmaceuticals, pulp and paper, offshore and marine engineering, and the construction of industrial furnaces.

There are many convincing arguments in favor of classical metals. Cost-benefit analyses are frequently decisive, in addition to the service properties required, in a decision for or against a particular material. Metals win on both counts. They will continue to play a dominant role in modern industry, especially when, as at ThyssenKrupp VDM, they are developed in close cooperation with users, focusing on cost-effectiveness. In today's complex market environment, with enormously diverse requirements and expectations, our principle is to tread new paths alongside our customers, making them the shortest routes to success.

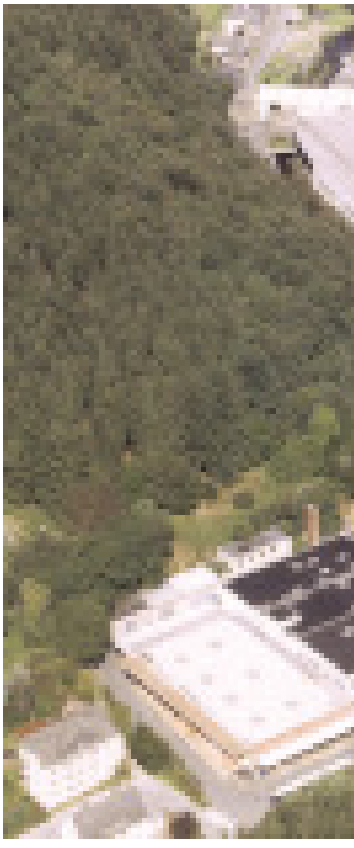
ThyssenKrupp VDM experience covers more than a century of high-performance alloy making. Through constant research and innovation, coupled with modern manufacturing methods in which integrated quality control is foremost, ThyssenKrupp VDM provides a complete range of high-performance corrosion and heat resisting alloys. ThyssenKrupp VDM controls the whole production process, from the melting and alloying right through to the finishing operation.

Unna plant

Altena plant

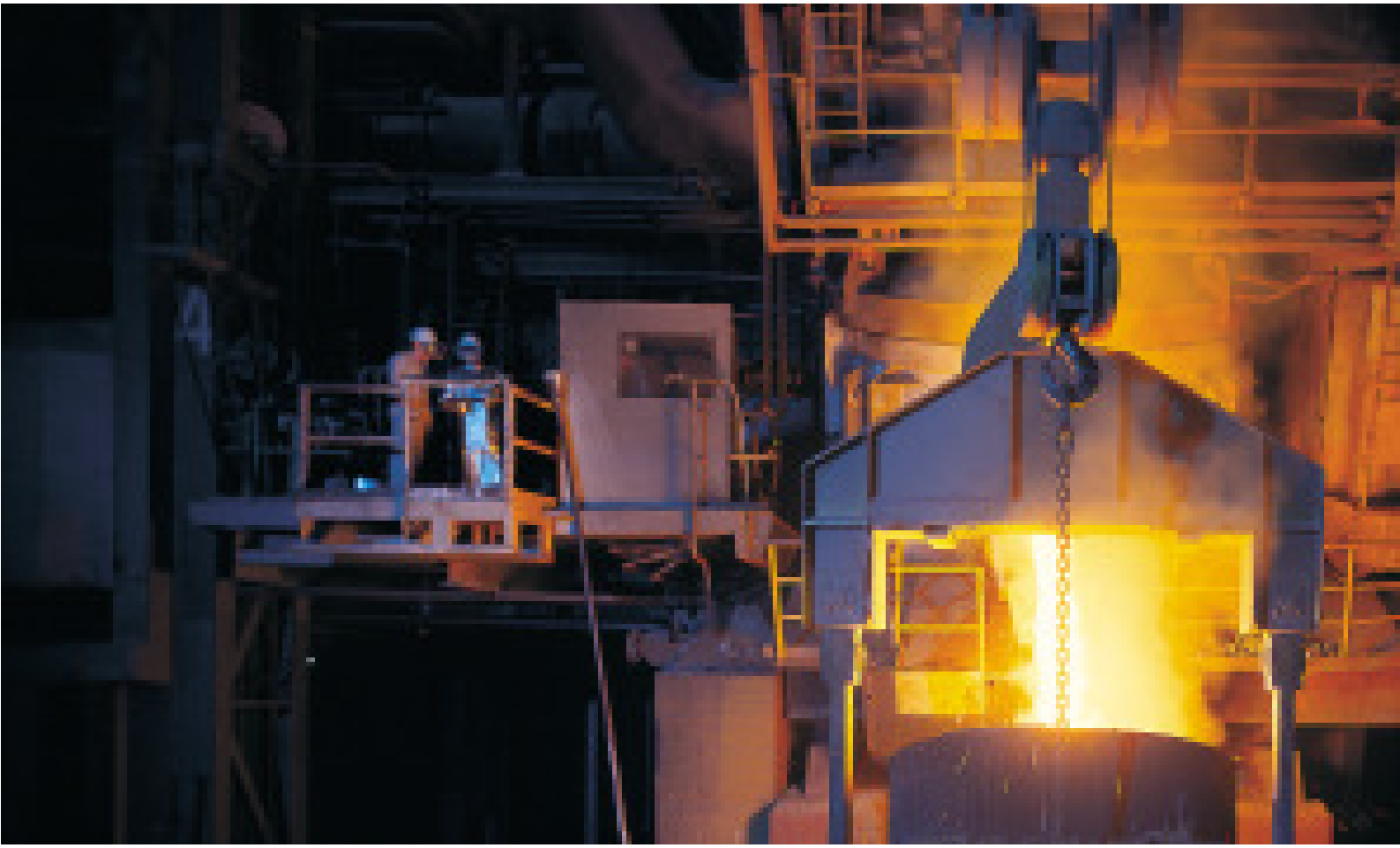


Werdohl plant



Bärenstein plant

Melting and refining.



All ThyssenKrupp VDM alloys have their origin in the company's ultra-modern melting plant at Unna near Dortmund. The Unna plant is equipped for the melting and ladle treatment of high-nickel superalloys, high-alloy special stainless steels and copper-nickel alloys.
The sizes and arrangement of buildings, furnaces and materials handling facilities were designed for maximum efficiency in material flow and easy enlargement.

Melting processes
The duplex melting process of electric-arc primary melting followed by VOD refining was specially developed by Thyssen Krupp VDM for the production of nickel alloys and high-alloy special stainless steels.
A 30-tonne arc furnace as well as three 16-tonne induction furnaces are available for primary melting, alloying and refining. Secondary metallurgical treatments and fine adjustment of chemical composition are performed in the VOD facility. The operation takes place in a vacuum vessel using argon or nitrogen as stirring gas. Carefully controlled pressure reduction enables the carbon content to be reduced below 0.005 per cent. Hydrogen and nitrogen contents are simultaneously reduced to extremely low residual values. Metallurgical treatment follows in a ladle furnace.

In 2003 a new VIM furnace was installed and became operational. This furnace located in a separate shop beside the two remelting facilities (ESR and VAR) is fitted with 20/30-tonne interchangeable vessels. Unlike most other VIM furnaces, this one will allow liquid charging, thereby providing ThyssenKrupp VDM with an integrated melting shop for nickel alloys.

Remelting
Certain materials for special applications require exceptionally high purity with segregation levels reduced to an absolute minimum. To this end, electrodes produced at the Unna plant are refined by electro-slag or vacuum-arc remelting.

Casting
After a final check of the chemical composition, the molten metal is released for casting. The majority of heats are cast by bottom pouring into ingot molds, with an argon shield to protect the metal stream from oxygen and nitrogen pick-up.

Quality assurance and control
By means of systematic quality checks, a continuous record is created for every heat. Such records are based on a comprehensive program of quality-assurance measures, such as chemical analyses, ultrasonic tests and surface inspection at defined production steps. Only when all results have been found satisfactory is material released for the next stage of processing. Quality assurance personnel are free to make any decision required in pursuit of their responsibilities and are totally independent of the production departments.

Product forms.

Flat rolled products
Sheet and strip in all their forms and variants are standard in our manufacturing program. The production center for cold-rolled sheet is our Altena plant. Slab is the starting point, carefully ground then sawn or plasma-cut to length prior to hot rolling.
Cold rolling is performed on a computer-controlled six-roll Sendzimir cold rolling mill, the world's-largest single-sheet reversing mill for widths up to 2500 mm. Even difficult-to-deform materials can be processed to exceptionally large sheets using these methods, to tight tolerances and outstanding surface quality. Computer control is used at all stages of intermediate and final treatment, making it possible to meet even exceptional requirements quickly and easily.

Cut-outs and drilled holes are made to customers' precise specifications. Flat products clad by explosive and roll-bonding processes are produced by associated companies.

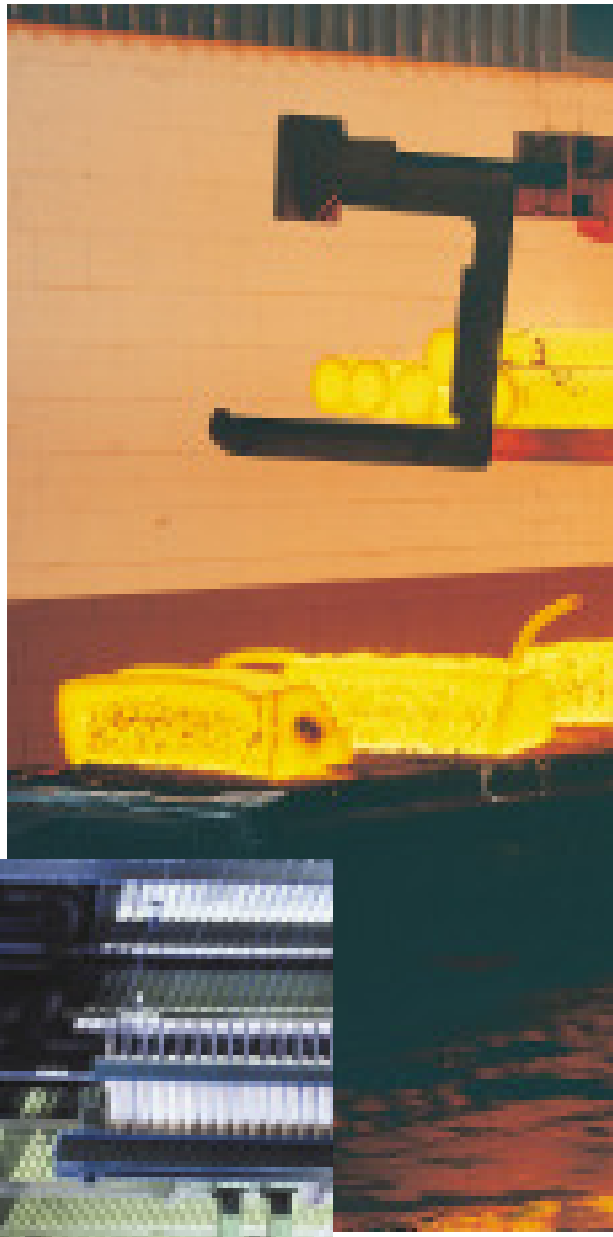
Strip is produced in our Werdohl plant from rolled ingots or continuously cast slabs, reduced on a wide-strip hot-rolling mill. Cold rolling is performed on modern four-high mills or on a six-roll high-precision reversing mill, making it possible to produce wide strip up to 800 mm width and narrow strip up to 400 mm width and 0.06 mm thickness to the tightest tolerances.

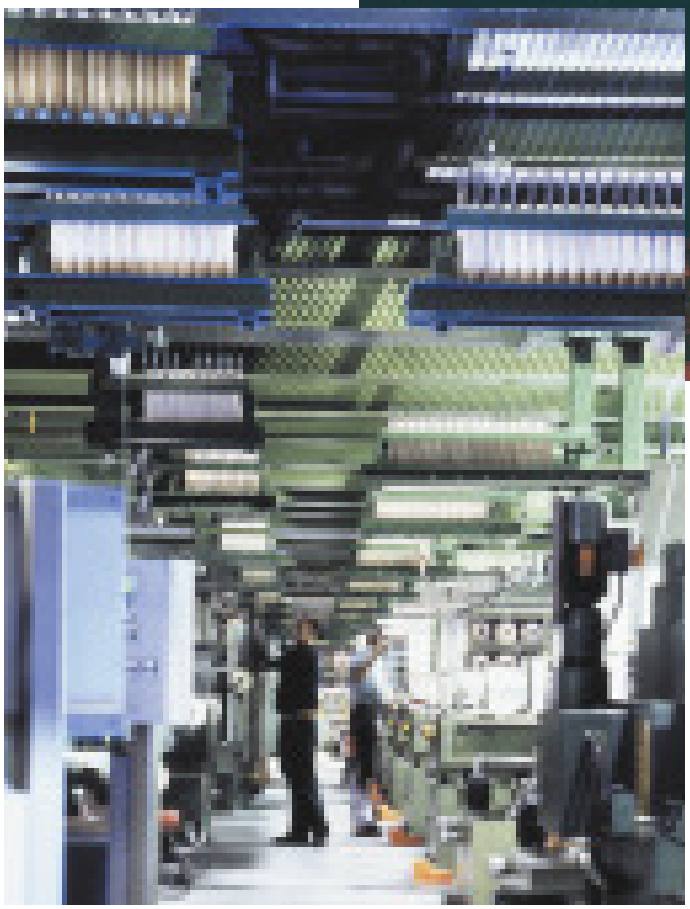
Foil is manufactured on a 20-roll mill, using ultramodern control electronics, in widths between 350 and 750 mm and thicknesses down to 0.02 mm.

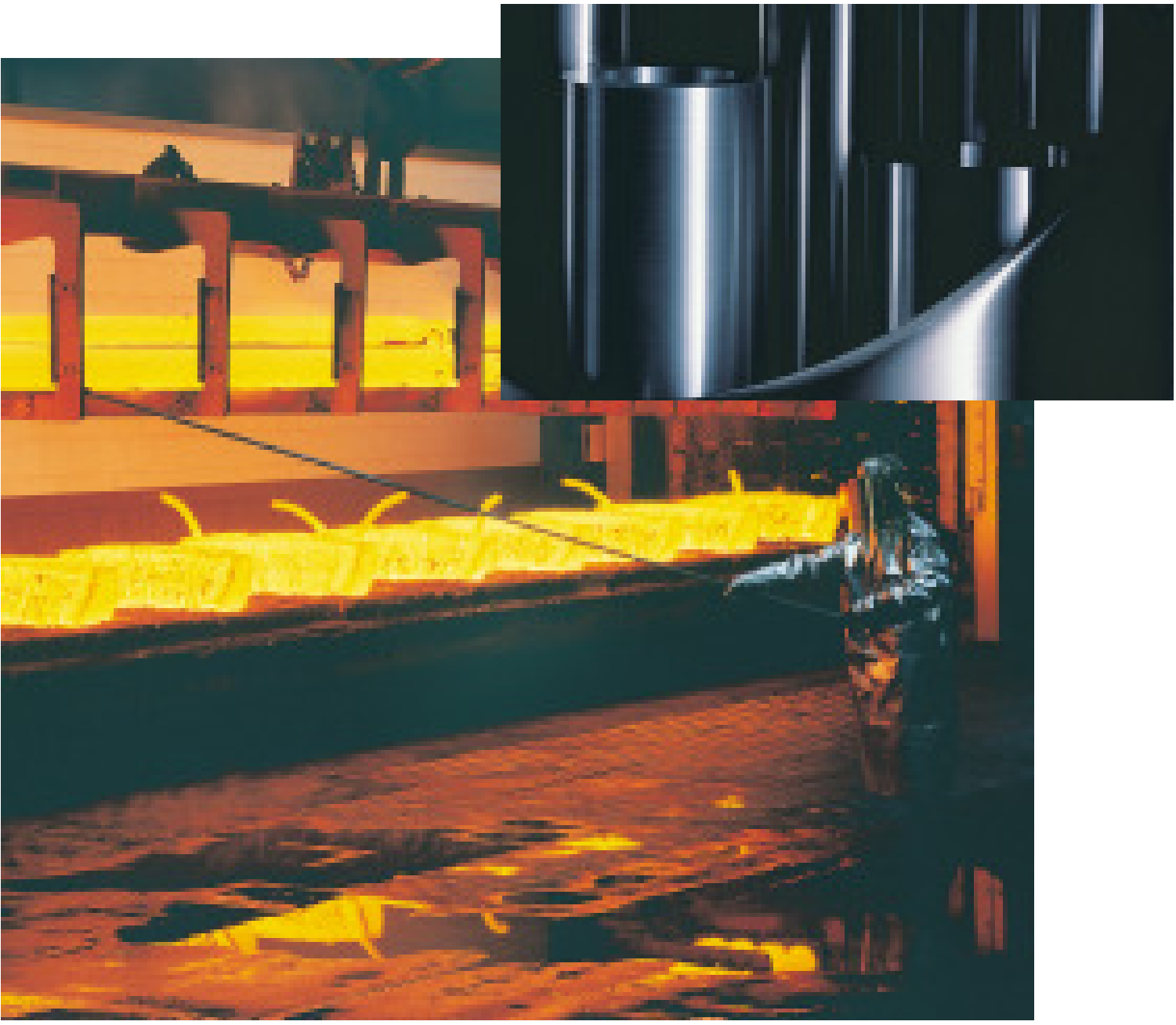
Product forms.

Wire, rod and bar, welding consumables, seamless and welded tubes and pipes
Wire, rod and bar, forgings and material for seamless tube production, in every shape and size, are part of our standard range. We work closely with customers to achieve exactly the right solution for their needs. State-of-art production equipment enable us to achieve results that meet or exceed the requirements for national and international certification.
Continuous development of new process engineering materials requires corresponding progress in welding processes and filler metals. Our welding laboratory performs pathfinding work in this field, and has already solved welding problems encountered by many users of high-performance alloys. We are now one of the leading manufacturers of welding filler metals, with a range that includes wire, rod and strip-type electrodes as well as electrode core wire.

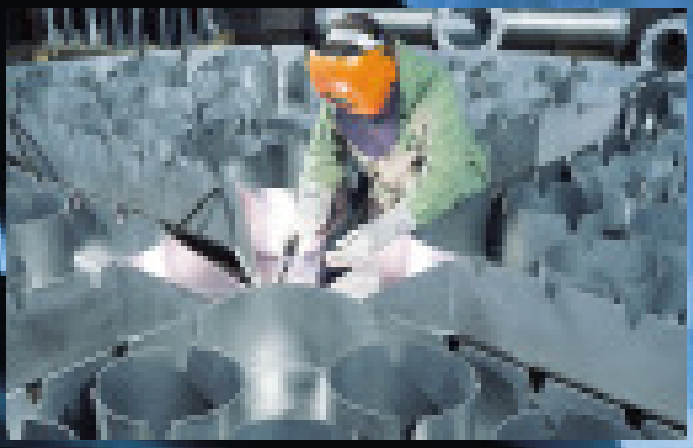
Bar, rod and forged materials are produced from cast and remelted ingots by hot rolling or forging. The special products range includes hammer forgings produced in varied shapes and sizes to customers' drawings, then finished to final dimensions.
Seamless and longitudinally welded tubes made from ThyssenKrupp VDM high-performance alloys are produced and marketed via a network of national and international alliances.
In the field of seamless tubing, we have an internationally distinguished associate in DMV STAINLESS Deutschland GmbH.







Chemical and petrochemical industries.



Raw materials and sources of energy are becoming ever scarcer and more expensive, environmental legislation ever more stringent. At the same time, the demands made on processes and technologies are continually growing, and hence the standards set for materials and operating parameters. The close interaction between new chemical processes and advances in high-performance alloys is particularly apparent.

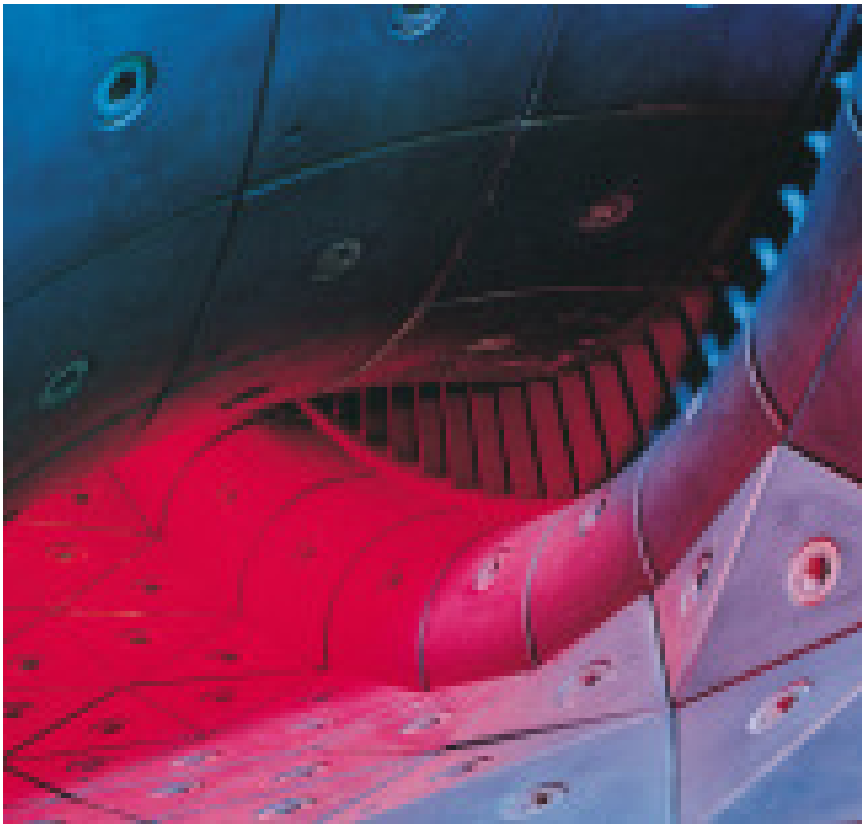
The chemicals industry is by tradition one of the largest users of high-quality corrosion- and heat-resistant materials. Our environmentally safe, process-oriented solutions put us at the forefront of development. ThyssenKrupp VDM alloys are used in many chemical industry applications, in plants for mineral and organic acids, in cellulose and paper production, in the fertilizer industry and in pharmaceuticals. They also play a vital role in the safe and efficient recycling of chemical wastes.

In petrochemicals, nickel alloys and high-temperature, creep-resistant stainless steels are needed for the production of plastics and synthetic fibers. The alloys' function is to extend the service-life of plant systems and individual components, prevent corrosion damage and ensure the purity of manufactured products.
Novel chemical and petrochemical processes rely on parallel developments in materials. Alloys such as Nicrofer 3127 hMo - alloy 31, a high-performance material displaying outstanding resistance in highly chloride containing media, or Nicrofer 3033 - alloy 33, a material developed in close cooperation with Bayer AG for oxidizing media. Nicrofer 5923 hMo - alloy 59, the most advanced alloy in the Ni-Cr-Mo family, exhibits superior versatility in handling both oxidizing and reducing corrosive media and has replaced other "C" family alloys in many applications.

New corrosion-resistant materials for chemical and petrochemical industries

ThyssenKrupp VDM alloy designation	W.-Nr.	UNS designation
Nicrofer 3033 - alloy 33	1.4591	R20033
Nicrofer 3127 hMo - alloy 31	1.4562	N08031
Nicrofer 5923 hMo - alloy 59	2.4605	N06059

Energy and the environment.



New ideas for environmental technology and the energy industry are more in demand than ever, and metallic materials are playing a decisive role. In the energy industry, they help both in enhancing efficiency and in achieving environmentally safe conversion of fossil fuels.
Our materials are no less in their element in the field of environmental technology. Based on hard-acquired know-how, alloys must fulfill exceptionally high demands.

Energy technology
High-efficiency heat-exchanger systems, gas turbine housings and the gasifier modules of combined-cycle power generating plants are vital components of these evolving technologies. Materials crucial for such developments, remain strong even at elevated temperatures, are resistant to corrosion and heat, are easy to work and, above all, are readily available.

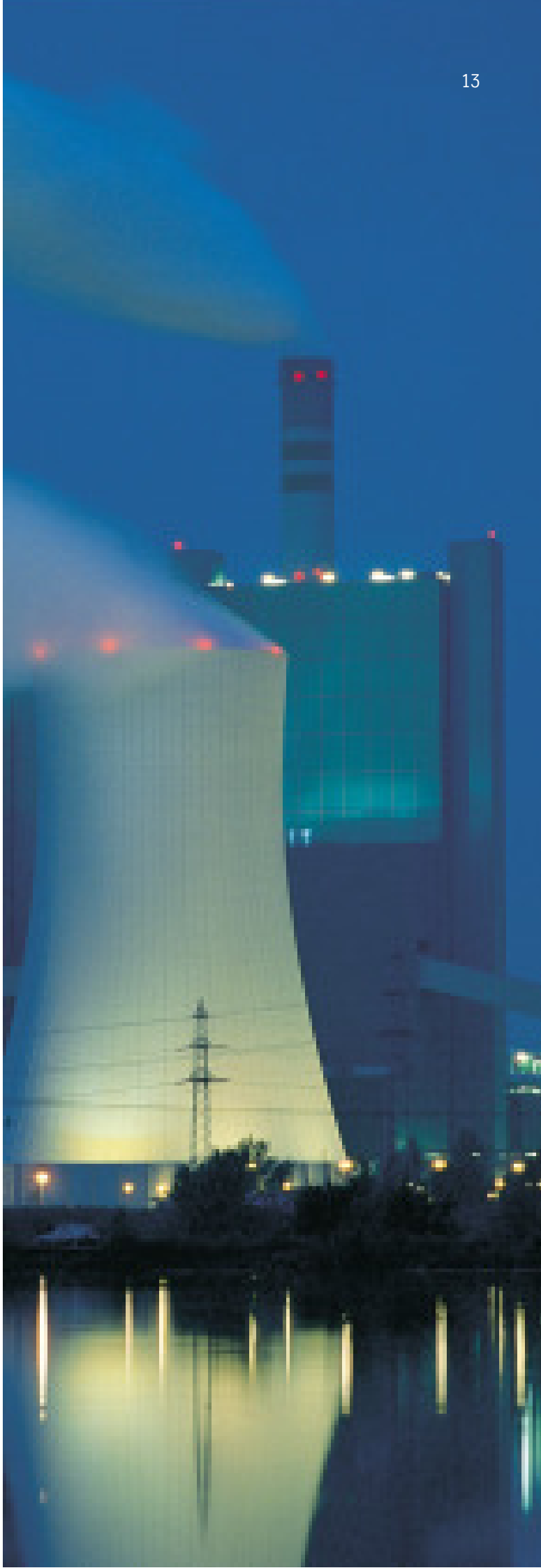
New and proven materials for energy and environmental technology

ThyssenKrupp VDM alloy designation	W.-Nr.	UNS designation
Nicrofer 3228 NbCe - alloy AC 66	1.4877	S33228
Nicrofer 5520 Co - alloy 617	2.4663	N06617
Nicrofer 6025 HT - alloy 602 CA	2.4633	N06025
Nicrofer 3127 hMo - alloy 31	1.4562	N08031
Nicrofer 5716 hMoW - alloy C-276	2.4819	N10276
Nicrofer 5923 hMo - alloy 59	2.4605	N06059

Flue-gas desulfurization
Flue-gas desulfurization systems are intrinsic parts of modern power-generating plants and, around the world, incorporate ThyssenKrupp VDM materials. Our alloys ensure environmentally safe operation, resisting corrosion at operating temperature and the aggressive attack of circulating fluids. They enhance not only system service life but also efficiency, even in retrofitted and converted plants. All Thyssen Krupp VDM alloys are completely recyclable.

Waste incineration
Incineration of waste materials is set to gain ever more importance, as space for landfill sites becomes prohibitively expensive and capacity scarcer. As a result of the miscellaneous range of waste materials processed, incineration produces complex and highly corrosive gases at temperatures up to 1000 °C. The need here is for materials with good high-temperature strength and exceptional resistance to hydrogen chloride attack. ThyssenKrupp VDM has developed special alloys for protection against environmental problems in this field.

Waste-water treatment
To safeguard the human environment, the discharge of effluents into the world's seas and rivers is subject to limits. These cannot be met using conventional systems but are achievable using technologies such as evaporative concentration. End products are highly concentrated solutions and crystallized salts. Operating conditions are exceptionally corrosive. This is a field in which nickel alloys, Nicrofer 5923 hMo - alloy 59 in particular, and special stainless steels have proven their outstanding capabilities time and time again.

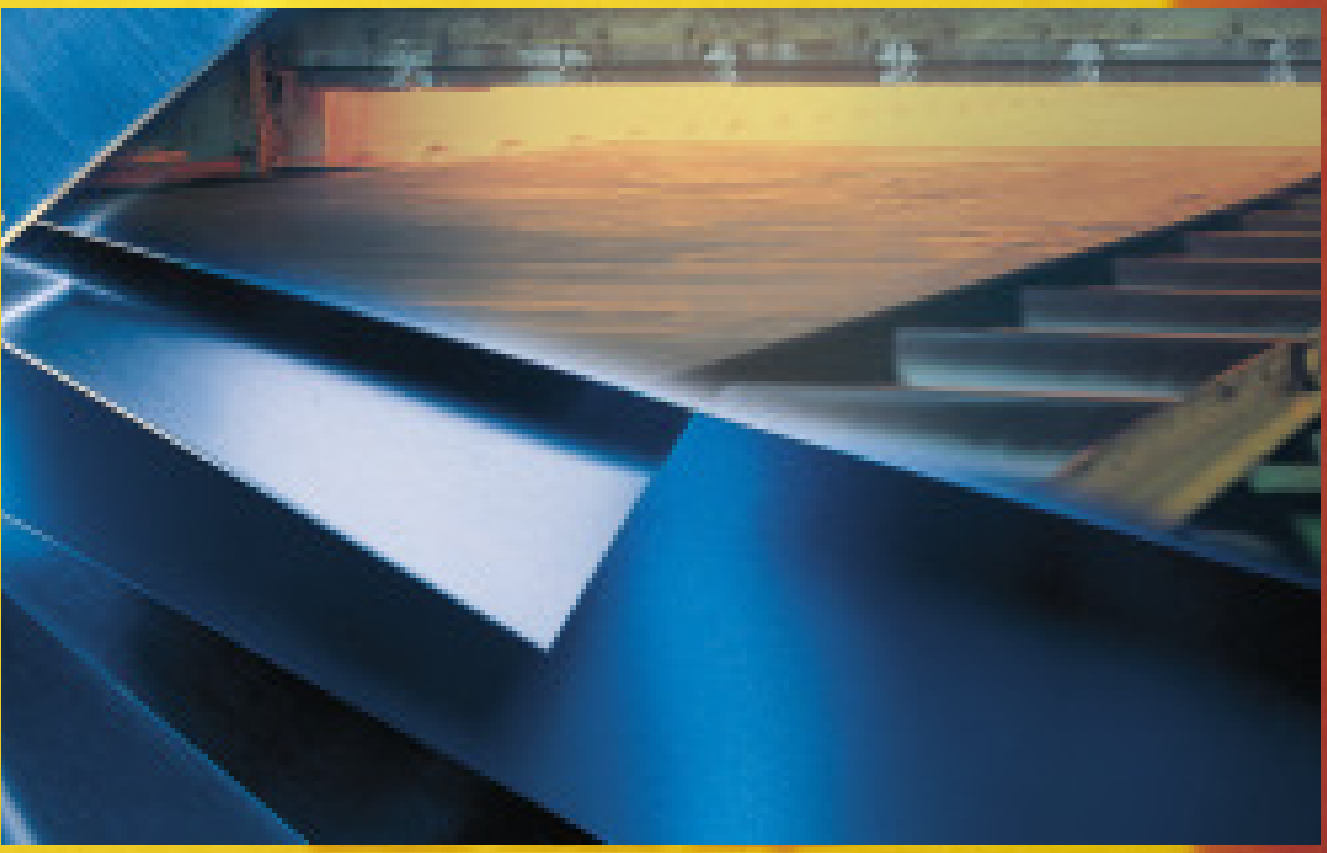


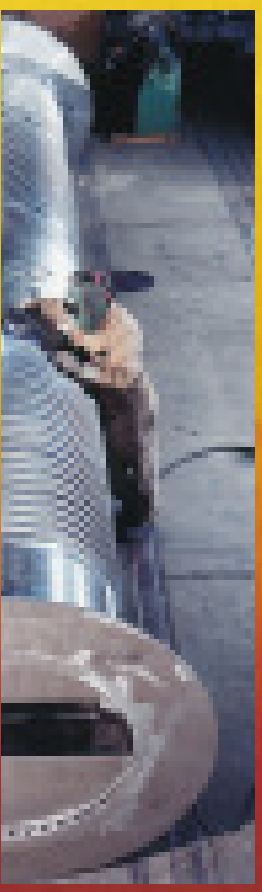
Industrial furnace construction.

Industrial furnace process conditions make enormous demands on constructional materials. The reasons include exposure to extreme operating temperatures under highly oxidizing conditions, in contact with aggressive compounds such as halogens. High-nickel alloys from Krupp VDM cover a broad range of requirements, and are certified suitable for exacting applications. High-alloy, austenitic special stainless steels can be used at temperatures below 850 °C, high-performance nickel alloys for temperatures above 850 °C up to approx. 1200 °C. Furnace constructional materials must not only assure strength at high temperatures, but also have necessary resistance to corrosive attack. They must also be easily fabricable. In addition, many applications involve a need for welding operations. For high-nickel alloys, a range of weld filler materials is available with appropriate welding guidelines.

New high-temperature, high-strength material for industrial furnace construction

ThyssenKrupp VDM alloy designation	W.-Nr.	UNS designation
Nicrofer 6025 HT - alloy 602 CA	2.4633	N06025





Transportation.

Travel nowadays has many different aspects. It's no longer just a question of the fastest way from A to B. Instead, that primary need must be reconciled with safety and urgent ecological priorities. Our alloys make convincing contributions to modern transport, by road, rail and in the air.

In the automotive industry, Aluchrom and Nicrofer alloys are used primarily in exhaust-gas catalytic converters. Examples are the support structures of metal units and the wire mesh in ceramic designs. In addition, we supply high-temperature creep-resistant alloys for exhaust manifolds, high-nickel wire for spark plugs, and the stems for diesel-engine exhaust valves. A more recent development is a Crofer alloy for use in solid oxide fuel cells.

In electric rail traction, Thyssen Krupp VDM products are present as the resistance-alloy wire and strip used in starting and braking resistors.

Our alloys are also in international demand for the aerospace industry, for instance: in jet engine combustors and the liquid-fuel tanks of Europe's Ariane launch vehicle. Our US subsidiary, Precision Rolled Products, Inc., with plants in Reno, Nevada, and Florham Park, New Jersey, supplies semi-finished starting materials for internal components and rings, especially high-temperature creep-resistant alloys for aircraft gas turbines and space exploration.

New and proven materials for the automotive industry

ThyssenKrupp VDM alloy designation	W.-Nr.	UNS designation
Aluchrom Y	1.4767	-
Aluchrom I SE	(1.4767)	-
Aluchrom YHf	(1.4767)	-
Crofer 22 APU	1.4760	S44535

Oil and gas production, offshore engineering.

The exploitation of oil and natural gas reserves is one of the 20th century's greatest technological challenges - particularly at extreme depths and under highly adverse climatic conditions. Structural materials must withstand especially severe corrosive attack. Uncompromising quality assurance is a major factor in the construction and operation of off-shore facilities: Reduced risk of failure and enhancement of assured function also depend decisively on the materials used.
For this reason, physical and mechanical properties, and resistance to various types of corrosive media are critical to material selection.

ThyssenKrupp VDM corrosion-resistant alloys are used in safety, fire-fighting and product piping systems on oil and gas production platforms and for oilfield equipment. They are also employed in the sheathing of platform colums and riser pipes in wave-exposed and tidal zones, as well as in flare stacks.
There is also a substantial demand for corrosion-resistant materials in seawater desalination plants. Our high-performance alloys are standard equipment in heat exchangers and other system components, such as water jackets and tubes containing the membranes of reverse osmosis plants.

New and proven corrosion-resistant materials for oil and gas production, offshore engineering

ThyssenKrupp VDM alloy designation	W.-Nr.	UNS designation
Nicrofer 3127 hMo - alloy 31	1.4562	N08031
Nicrofer 4221 - alloy 825	2.4858	N08825
Nicrofer 5923 hMo - alloy 59	2.4605	N06059
Nicrofer 6020 hMo - alloy 625	2.4856	N06625
Nicrofer 4320 Ti	2.4852	N09925
Nicrofer 5219 Nb - alloy 718	2.4668	N07718
Cronifer 1925 hMo - alloy 926	1.4529	N08926

Selected ThyssenKrupp VDM high-performance alloys.

ThyssenKrupp VDM alloy designation Werkstoff-Nr. *Designation* *UNS* *BS*	**Chemical composition, wt.-%**												Note: Compositional limits of some elements may vary slightly from one specification to another.
	Ni	Cr	Fe	C	Mn	Si	Cu	Mo	Co	Al	Ti	Nb	Others
Corrosion-resistant alloys													
Cronifer 1925 hMo – alloy 926 1.4529 *X1NiCrMoCuN25-20-7* *N08926* –	24.0–26.0	20.0–21.0	balance	≤ 0.02	≤ 1.0	≤ 0.5	0.5–1.5	6.0–7.0	–	–	–	–	N: 0.15–0.25
Cronifer 2525 LCN 1.4465 *X1CrNiMoN25-25-2* *(N08310)* –	22.0–25.0	24.0–26.0	balance	≤ 0.02	≤ 2.0	≤ 0.7	–	2.0–2.5	–	–	–	–	N: 0.08–0.16
Cunifer 10 – alloy CuNi 90/10 CW 352 H *CuNi10Fe1Mn* *C70600* *CN 102*	9.0–11.0	–	1.0–1.8	≤ 0.05	≤ 1.0	–	balance	–	–	–	–	–	Pb: ≤ 0.05 Zn: ≤ 0.5
Cunifer 30 – alloy CuNi 70/30 CW 354 H *CuNi30Mn1Fe* *C71500* *CN 107*	30.0–32.0	–	0.4–1.0	≤ 0.02	≤ 1.0	–	balance	–	–	–	–	–	Pb: ≤ 0.05 Zn: ≤ 0.5
LC-Nickel 99.2 – alloy 201 2.4068 *LC-Ni 99* *N02201* *NA 12*	≥ 99.0	–	≤ 0.4	≤ 0.02	≤ 0.35	≤ 0.2	≤ 0.25	–	–	–	≤ 0.10	–	Mg: ≤ 0.15
LC-Nickel 99.6 – alloy 205 2.4061 *LC-Ni 99.6* *N02205* –	≥ 99.6	–	≤ 0.25	≤ 0.02	≤ 0.35	≤ 0.15	≤ 0.15	–	–	–	≤ 0.10	–	Mg: ≤ 0.15
Nickel 99.2 – alloy 200 2.4066 *Ni 99.2* *N02200* *NA 11*	≥ 99.0	–	≤ 0.4	≤ 0.15	≤ 0.35	≤ 0.1	≤ 0.25	–	–	–	–	–	Mg: ≤ 0.15
Nicorros – alloy 400 2.4360 *NiCu30Fe* *N04400* *NA 13*	≥ 63.0	–	1.0 – 2.5	≤ 0.16	≤ 2.00	≤ 0.5	28.0–34.0	–	–	≤ 0.5	–	–	–
Nicorros Al – alloy K-500 2.4375 *NiCu30Al* *N05500* *NA 18*	≥ 63.0	–	≤ 2.0	≤ 0.18	≤ 1.5	≤ 0.5	27.0–33.0	–	–	2.30–3.15	0.35–0.85	–	–
Nicrofer 3033 – alloy 33 1.4591 *X1CrNiMoCuN33-32-1* *R20033* –	30.0–33.0	31.0–35.0	balance	≤ 0.015	≤ 2.0	≤ 0.5	0.3–1.2	0.5–2.0	–	–	–	–	N: 0.35–0.60
Nicrofer 3127 hMo – alloy 31 1.4562 *X1NiCrMoCu32-28-7* *N08031* –	30.0–32.0	26.0–28.0	balance	≤ 0.015	≤ 2.0	≤ 0.3	1.0–1.4	6.0–7.0	–	–	–	–	N: 0.15–0.25
Nicrofer 3127 LC – alloy 28 1.4563 *X1NiCrMoCuN31-27-4* *N08028* –	30.0–32.0	26.0–28.0	balance	≤ 0.020	≤ 2.0	≤ 0.7	0.7–1.5	3.0–4.0	–	–	–	–	N: ≤ 0.11
Nicrofer 3620 Nb – alloy 20 2.4660 *NiCr20CuMo* *N08020* –	32.0–38.0	19.0–21.0	balance	≤ 0.07	≤ 2.0	≤ 1.0	3.0–4.0	2.0–3.0	≤ 1.5	–	–	refer to others	Nb+Ta: > (8xC) ≤ 1.0
Nicrofer 4221 – alloy 825 2.4858 *NiCr21Mo* *N08825* *NA 16*	38.0–46.0	19.5–23.5	balance	≤ 0.025	≤ 1.0	≤ 0.5	1.5–3.0	2.5–3.5	–	≤ 0.2	0.6–1.2	–	–
Nicrofer 4320 Ti 2.4852 *NiCr20FeMo3TiCuAl* *N09925* –	42.0–46.0	19.5–22.5	≤ 22.0	≤ 0.03	≤ 1.0	≤ 0.5	1.5–3.0	2.5–3.5	–	0.1–0.5	1.9–2.4	≤ 0.5	–

Available product forms				Filler Metal for GTAW (TIG/TIG Hot Wire) and GMAW (MIG/MAG) Note: For specific applications consultation with the ThyssenKrupp VDM Welding Laboratory is recommended.	**Major applications**
Sheet, plate	Strip	Wire	Rod, bar		
●	●	●	●	Nicrofer S 5923 – FM 59 (2.4607)	Sulfuric and phosphoric acid production, processing and handling, pulp and paper industry, seawater cooling, offshore oil and gas production, flue-gas scrubbers and other pollution-control equipment.
●				matching	Urea and sulfuric acid production and processing.
●				Cunifer S 7030 – FM 67 (2.0837)	Seawater piping systems on ships, offshore oil and gas production platforms, seawater desalination plants.
●	●			Cunifer S 7030 – FM 67 (2.0837)	Seawater piping systems on ships, offshore oil and gas production platforms, seawater desalination plants.
●	●	●	●	Nickel S 9604 – FM 61 (2.4155)	Caustic evaporators operating above 315 °C (600 °F), synthetic fiber production.
●	●	●	●	Nickel S 9604 – FM 61 (2.4155)	Magnetostrictive devices.
●	●	●	●	Nickel S 9604 – FM 61 (2.4155)	Caustic production and storage equipment, VCM production equipment, food processing equipment.
●	●	●	●	Nicorros S 6530 – FM 60 (2.4377)	Chemical processing equipment, petroleum refining and production equipment, feedwater heaters, salt production equipment.
	●	●	●	Nicorros S 6530 – FM 60 (2.4377)	Pump and propeller shafts, doctor blades, oil well drill collars.
●	●	●	●	Nicrofer S 3033 – FM 33 (1.4591)	Sulfuric, phosphoric, nitric and fluoric acid production and processing, caustic production and handling, pulp and paper industry.
●	●	●	●	Nicrofer S 5923 – FM 59 (2.4607) or Nicrofer S 3127 – FM 31 (1.4562)	Flue-gas scrubbers and other pollution-control equipment for fossil-fired power stations and waste incineration plants, pulp and paper industry, marine and offshore engineering.
●	●	●	●	Nicrofer S 6020 – FM 625 (2.4831) or Nicrofer S 3028 – FM 28 (1.4563)	Nitric, sulfuric and phosphoric acid production and processing, seawater cooling.
●	●	●	●	Nicrofer S 5923 – FM 59 (2.4807) or Nicrofer S 6020 – FM 625 (2.4831)	Sulfuric and phosphoric acid production and processing, crude oil distillation, pharmaceuticals and plastics.
●	●	●	●	Nicrofer S 6020 – FM 625 (2.4831)	Sulfuric and phosphoric acid production and handling, pickling equipment, offshore oil and gas production and processing.
			●	matching	Pump shafts and other components in oil and gas exploration and production equipment particularly in marine environment.

Selected ThyssenKrupp VDM high-performance alloys.

ThyssenKrupp VDM alloy designation Werkstoff-Nr. *Designation* *UNS* *BS*	**Chemical composition, wt.-%**												Note: Compositional limits of some elements may vary slightly from one specification to another.
	Ni	Cr	Fe	C	Mn	Si	Cu	Mo	Co	Al	Ti	Nb	Others
Corrosion-resistant alloys													
Nicrofer 4823 hMo – alloy G-3 2.4619 *NiCr22Mo7Cu* *N06985* –	balance	21.0–23.5	18.0–21.0	≤ 0.015	≤ 1.0	≤ 1.0	1.5–2.5	6.0–8.0	≤ 5.0	–	–	refer to others	Nb+Ta: ≤ 0.5 W: ≤ 1.5
Nicrofer 5219 Nb – alloy 718 2.4668 *NiCr19Fe19Nb5Mo3* *N07718* –	50.0–55.0	17.0–21.0	balance	0.02–0.08	≤ 0.35	≤ 0.35	≤ 0.30	2.8–3.3	≤ 1.0	0.30–0.70	0.60–1.20	refer to others	B: ≤ 0.006 Nb+Ta: 4.7–5.5
Nicrofer 5621 hMoW – alloy 22 2.4602 *NiCr21Mo14W* *N06022* –	balance	20.0–22.5	2.0–6.0	≤ 0.010	≤ 0.50	≤ 0.08	–	12.5–14.5	≤ 2.5	–	–	–	V: ≤ 0.35 W: 2.5–3.5
Nicrofer 5716 hMoW – alloy C-276 2.4819 *NiMo16Cr15W* *N10276* –	balance	14.5–16.5	4.0–7.0	≤ 0.010	≤ 1.0	≤ 0.08	≤ 0.50	15.0–17.0	≤ 2.5	–	–	–	V: ≤ 0.35 W: 3.0–4.5
Nicrofer 5923 hMo – alloy 59 2.4605 *NiCr23Mo16Al* *N06059* –	balance	22.0–24.0	≤ 1.5	≤ 0.010	≤ 0.5	≤ 0.10	–	15.0–16.5	≤ 0.3	0.1–0.4	–	–	–
Nicrofer 6020 hMo – alloy 625 2.4856 *NiCr22Mo9Nb* *N06625* *NA 21*	≥ 58.0	20.0–23.0	≤ 5.0	≤ 0.10	≤ 0.50	≤ 0.50	–	8.0–10.0	≤ 1.0	≤ 0.40	≤ 0.40	3.15–4.15	–
Nicrofer 6030 – alloy 690 2.4642 *NiCr29Fe* *N06690* –	balance	27.0–31.0	7.0–11.0	≤ 0.05	≤ 0.50	≤ 0.50	≤ 0.50	–	–	≤ 0.50	–	–	–
Nicrofer 6616 hMo – alloy C-4 2.4610 *NiMo16Cr16Ti* *N06455* –	balance	14.5–17.5	≤ 3.0	≤ 0.009	≤ 1.0	≤ 0.05	–	14.0–17.0	≤ 2.0	–	≤ 0.7	–	–
Nicrofer 7216 LC – alloy 600 L 2.4817 *LC-NiCr15Fe* *N06602* *NA 14*	≥ 72.0	14.0–17.0	6.0–10.0	≤ 0.025	≤ 1.0	≤ 0.5	≤ 0.5	–	–	≤ 0.3	≤ 0.3	–	B: ≤ 0.006
Nimofer 6928 – alloy B-2 2.4617 *NiMo28* *N10665* –	balance	≤ 1.0	≤ 2.0	≤ 0.01	≤ 1.0	≤ 0.08	≤ 0.5	26.0–30.0	≤ 1.0	–	–	–	–
High-temperature alloys													
Aluchrom Hf (1.4725) – – –	≤ 0.30	18.0–20.0	balance	≤ 0.05	≤ 0.5	≤ 0.5	–	–	–	3.0–4.5	–	–	Hf: 0.01–0.10 Y: 0.01–0.10 Zr: ≤ 0.02
Aluchrom I SE (1.4767) *(CrAl20-5)SE* – –	≤ 0.30	19.0–21.0	balance	≤ 0.10	≤ 0.5	≤ 0.5	–	–	–	4.5–5.5	≤ 0.10	–	N: ≤ 0.02 RE: 0.01–0.10
Aluchrom Y 1.4767 *X8 CrAl 20-5* – –	≤ 0.30	20.0–22.0	balance	0.01–0.10	≤ 0.5	≤ 0.3	–	–	–	5.0–6.0	0.01–0.10	–	Y: 0.05–0.15 Zr: 0.01–0.10
Aluchrom YHf (1.4767) *(CrAl22-5)YHf* – –	≤ 0.30	19.0–22.0	balance	≤ 0.05	≤ 0.5	≤ 0.5	–	–	–	5.5–6.5	–	–	Hf: ≤ 0.10 N: ≤ 0.01 Y: ≤ 0.10 Zr: ≤ 0.07

Available product form				Filler Metal for GTAW (TIG/TIG Hot Wire) and GMAW (MIG/MAG) Note: For specific applications consultation with the ThyssenKrupp VDM Welding Laboratory is recommended.	**Major applications**
Sheet, plate	Strip	Wire	Rod, bar		
●		●	●	Nicrofer S 6020 – FM 625 (2.4831)	Sulfuric and phosphoric acid production and handling equipment,
●		●	●	Nicrofer S 5219 – FM 718 (2.4667)	Pump shafts and other components in oil and gas exploration and production equipment particularly in marine environment.
●	●	●	●	Nicrofer S 5923 – FM 59 (2.4607)	Pollution-control equipment for fossil-fired power stations. Chemical and petrochemical processing equipment.
●	●	●	●	Nicrofer S 5923 – FM 59 (2.4607)	Chemical and petrochemical processing equipment, pulp and paper industry, pollution-control equipment.
●	●	●	●	Nicrofer S 5923 – FM 59 (2.4607)	Flue-gas scrubbers and other pollution-control equipment for fossil-fired power stations and waste incineration plants, chemical processing equipment, pulp and paper industry. Marine/offshore environment, waste water treatment.
●	●	●	●	Nicrofer S 6020 – FM 625 (2.4831)	Chemical and petrochemical processing equipment, offshore oil and gas production equipment. Marine environment.
●		●	●	Nicrofer S 7020 – FM 82 (2.4806) or Nicrofer S 6030 – FM 690 (2.4642)	Nuclear engineering. Steam generators in pressurized water reactors.
●	●	●	●	Nicrofer S 6616 – FM C-4	Acetic acid production equipment. Fertilizer and pesticide production equipment.
●	●	●	●	Nicrofer S 7020 – FM 82 (2.4806)	Caustic and VCM production and processing. Pulp and paper industry. Nuclear engineering.
●	●	●	●	Nimofer S 6928 – FM B-2 (2.4615)	Chemical processing equipment handling hydrochloric, sulfuric, acetic and phosphoric acids.
	●	●		Fusion welding not recommended	Metal supports for automotive diesel exhaust gas catalytic converters.
	●	●		Fusion welding not recommended	Metal supports for automotive exhaust gas catalytic converters. Industrial electric furnaces.
	●	●		Fusion welding not recommended	Metal supports for automotive exhaust gas catalytic converters. Industrial electric furnaces.
	●	●		Fusion welding not recommended	Metal supports for automotive exhaust gas catalytic converters. Heating wire and cable

Selected ThyssenKrupp VDM high-performance alloys.

ThyssenKrupp VDM alloy designation Werkstoff-Nr. *Designation* *UNS* *BS*	**Chemical composition, wt.-%** Note: Compositional limits of some elements may vary slightly from one specification to another.												
	Ni	Cr	Fe	C	Mn	Si	Cu	Mo	Co	Al	Ti	Nb	Others
High-temperature alloys													
Crofer 22 APU 1.4760 *X1CrTiLa22* *S44535* –	–	20.0–24.0	balance	≤ 0.03	0.30–0.80	≤ 0.50	≤ 0.50	–	–	≤ 0.50	0.03–0.20	–	La: 0.04–0.20
Cronix 70 2.4658 *NiCr 70 30* *N06008* –	≥ 60	29.0–32.0	≤ 5.0	≤ 0.10	≤ 1.0	0.5–2.0	≤ 0.5	–	–	≤ 0.3	–	–	RE: 0.01–0.04 S: ≤ 0.015
Cronix 80 2.4869 *NiCr 80 20* *N06003* –	≥ 75	19.0–21.0	≤ 1.0	≤ 0.08	≤ 1.0	1.0–1.5	≤ 0.5	–	–	≤ 0.3	–	–	RE: 0.01–0.04 S: ≤ 0.015
Nicrofer 3220 – alloy 800 1.4876 *X10NiCrAlTi32-21* *N08800* *NA 15*	30.0–34.0	19.0–23.0	balance	≤ 0.08	≤ 2.0	≤ 1.0	–	–	–	0.15–0.60	0.15–0.60	–	Al+Ti: ≤ 0.8
Nicrofer 3220 H – alloy 800 H 1.4876 / 1.4958 *X10NiCrAlTi32-21* / *X5NiCrAlTi31-20* *N08810* / *N08810* *NA 15 (H)* / *NA 15 (H)*	30.0–32.5	19.0–22.0	balance	0.03–0.08	≤ 1.5	≤ 0.70	≤ 0.5	–	–	0.20–0.50	0.20–0.50	–	–
Nicrofer 3220 HP – alloy 800 HP 1.4959 *X8NiCrAlTi32-21* *N08811* –	30.0–32.0	19.0–22.0	balance	0.05–0.10	≤ 1.5	≤ 0.7	≤ 0.5	–	–	0.20–0.65	0.25–0.60	–	–
Nicrofer 3228 NbCe – alloy AC 66 1.4877 *X6NiCrNbCe32-27* *S 33228* –	31.0–33.0	26.0–28.0	balance	0.04–0.08	≤ 1.0	≤ 0.30	–	–	–	≤ 0.025		0.6–1.0	Ce: 0.05–0.10
Nicrofer 3718 – (alloy 330) 1.4864 *X12NiCrSi35-16* *(N08330)* –	33.0–37.0	15.0–17.0	balance	≤ 0.15	≤ 2.0	1.0–2.0	–	–	–	–	≤ 0.20	–	–
Nicrofer 3718 So – alloy DS 1.4862 *X8NiCrSi38-18* – *NA 17*	35.0–39.0	17.0–19.0	balance	≤ 0.10	0.8–1.5	1.9–2.5	≤ 0.5	–	–	–	≤ 0.20	–	–
Nicrofer 5020 hMo – alloy 50 PLUS 2.4850 *NiCr20Fe14Mo11WN*	balance	18.0–21.0	12.0–16.0	≤ 0.03	≤ 0.5	≤ 0.5	–	9.5–12.5	–	0.05–0.50	≤ 0.1	0.05–0.50	Ca: 0.001–0.010 Mg: 0.005–0.030 N: 0.05–0.20 W: 0.05–2.5 Zr: 0.001–0.030
Nicrofer 6020 hMo – alloy 625 2.4856 *NiCr22Mo9Nb* *N06625* *NA 21*	≥ 58	20.0–23.0	≤ 5.0	≤ 0.10	≤ 0.50	≤ 0.50	–	8.0–10.0	≤ 1.0	≤ 0.40	≤ 0.40	3.15–4.15	–
Nicrofer 6023 H – alloy 601 H 2.4851 *NiCr23Fe* *N06601* –	58.0–63.0	21.0–25.0	≤ 18.0	≤ 0.10	≤ 1.0	≤ 0.50	≤ 0.50	–	–	1.0–1.7	≤ 0.50	–	B: ≤ 0.006
Nicrofer 6025 HT – alloy 602 CA 2.4633 *NiCr25FeAlY* *N06025* –	balance	24.0–26.0	8.0–11.0	0.15–0.25	≤ 0.5	≤ 0.5	≤ 0.1	–	–	1.8–2.4	0.1–0.2	–	Y: 0.05–0.12 Zr: 0.01–0.10
Nicrofer 6030 – alloy 690 2.4642 *NiCr29Fe* *N06690* –	balance	27.0–31.0	7.0–11.0	≤ 0.05	≤ 0.50	≤ 0.50	≤ 0.50	–	–	≤ 0.50	–	–	–
Nicrofer 7216 – alloy 600 2.4816 *NiCr15Fe* *N06600* *NA 14*	≥ 72.0	14.0–17.0	6.0–10.0	≤ 0.15	≤ 1.0	≤ 0.5	≤ 0.5	–	–	≤ 0.3	≤ 0.3	–	B: ≤ 0.006
Nicrofer 7216 H – alloy 600 H 2.4816 *NiCr15Fe* *N06600* *NA 14 (H)*	≥ 72.0	14.0–17.0	6.0–10.0	0.05–0.08	≤ 1.0	≤ 0.5	≤ 0.5	–	–	≤ 0.3	≤ 0.3	–	B: ≤ 0.006

Available product form				Filler Metal for GTAW (TIG/TIG Hot Wire) and GMAW (MIG/MAG) Note: For specific applications consultation with the ThyssenKrupp VDM Welding Laboratory is recommended.	**Major applications**
Sheet, plate	Strip	Wire	Rod, bar		
●	●	●		GTAW without filler metal	Interconnector and separator plates in solid oxide fuel cells (SOFC).
●	●	●	●	matching and Nicrofer S 7020 – FM 82 (2.4806)	Industrial electric furnaces.
●	●	●	●	matching	Industrial electric furnaces, enamelling furnaces. Heating wire and cable. Precision resistors, multipliers and load resistors, potentiometers.
●	●	●	●	Nicrofer S 7020 – FM 82 (2.4806)	Acetic anhydrite production. Chemical process piping and heat-exchanger tubes. Nuclear engineering.
●	●	●	●	Nicrofer S 7020 – FM 82 (2.4806) or matching (≈1.4850)	Heat-treatment furnace components such as radiant heat tubes, fans, conveyors. Chemical and power plant superheater and reheater tubes.
●			●	Nicrofer S 7020 – FM 82 (2.4806), matching (≈1.4850) or Nicrofer S 5520 – FM 617 (2.4627)	Heat-treatment furnace components such as radiant heat tubes, fans, conveyors. Chemical and power plant superheater tubes.
●	●	●	●	Nicrofer S 6020 – FM 625 (2.4831)	Coal gasification and waste incineration plant components. Heat-treatment furnace components. Chemical process industry.
●			●	Nicrofer S 7020 – FM 82 (2.4806)	Furnace components such as muffles, conveyor systems, baskets, radiant heat tubes.
●	●	●	●	Nicrofer S 7020 – FM 82 (2.4806)	High-temperature carburizing or carbonitriding furnace components, radiant heat tubes, thermocouple tubes. Flare-stack tips.
	●	●		Nicrofer S 5020 – FM 50 (2.4849)	Chemical processing equipment. As weld metal Nicrofer S 5020 in fabrication and plant and equipment construction, e.g. for weld-cladding of boiler tubes in waste incineration plants.
●	●	●	●	Nicrofer S 6020 – FM 625 (2.4831)	Chemical and petrochemical processing equipment. Offshore oil and gas production equipment. Marine environment.
●	●	●	●	Nicrofer S 6025 – FM 602 (2.4649)	Heat-treatment furnace components such as muffles, rollers, waste incinerators, gas-turbine components, flare-stack tips.
●	●	●	●	Nicrofer S 6025 – FM 602 (2.4649)	Radiant heat tubes, furnace rollers, furnace muffles and other components. Pigtails in reformer furnaces. Components for the detoxification of exhaust gases (catalytic support systems). Nuclear waste vitrification units.
●		●	●	Nicrofer S 7020 – FM 82 (2.4806) or Nicrofer S 6030 – FM 690 (2.4642)	PWA steam generators. Heavy-oil fired furnace components.
●	●	●	●	Nicrofer S 7020 – FM 82 (2.4806)	Furnace components. Production of VCM, titanium dioxide, aluminium fluoride and chloride.
●	●		●	Nicrofer S 7020 – FM 82 (2.4806)	Bright-annealing furnace components such as muffles, radiant heat tubes, baskets. Catalyst regenerators in petrochemical processes.

Selected ThyssenKrupp VDM high-performance alloys.

ThyssenKrupp VDM alloy designation Werkstoff-Nr. *Designation* *UNS* *BS*	**Chemical composition, wt.-%**												Note: Compositional limits of some elements may vary slightly from one specification to another.
	Ni	Cr	Fe	C	Mn	Si	Cu	Mo	Co	Al	Ti	Nb	Others
High-temperature alloys													
Nicrofer 7520 – alloy 75 2.4951 *NiCr20Ti* *N06075* *HR 203*	balance	18.0–21.0	≤ 5.0	0.08–0.15	≤ 1.0	≤ 1.0	≤ 0.5	–	≤ 5.0	≤ 0.3	0.2–0.6	–	–
Superalloys													
Conicro 4023 W – alloy 188 2.4683 *CoCr22NiW* *R30188* –	20.0–24.0	20.0–24.0	≤ 3.0	0.05–0.15	≤ 1.25	0.2–0.4	–	–	balance	≤ 0.20	–	–	La: 0.02–0.12 W: 13.0–16.0
Conicro 5010 W – alloy 25 2.4964 *CoCr20W15Ni* *R30605* *HR 240*	9.0–11.0	19.0–21.0	≤ 3.0	0.05–0.15	≤ 2.0	≤ 0.40	–	–	balance	–	–	–	W: 14.0–16.0
Nicrofer 4626 MoW – alloy 333 2.4608 *NiCr26MoW* *N06333* –	44.0–47.0	24.0–26.0	balance	0.03–0.08	≤ 2.0	0.7–1.5	–	2.5–4.0	2.5–4.0	–	–	–	W: 2.5–4.0
Nicrofer 4722 Co – alloy X 2.4665 *NiCr22Fe18Mo* *N06002* *HR 204*	balance	20.5–23.0	17.0–20.0	0.05–0.15	≤ 1.0	≤ 1.0	≤ 0.5	8.0–10.0	0.5–2.5	≤ 0.50	–	–	B: ≤ 0.010 W: 0.2–1.0
Nicrofer 5120 CoTi – alloy C-263 2.4650 *NiCo20Cr20MoTi* *N07263* *HR 206*	balance	19.0–21.0	≤ 0.7	0.04–0.08	≤ 0.60	≤ 0.40	≤ 0.20	5.6–6.1	19.0–21.0	0.30–0.60	1.90–2.40	–	(Al+Ti): 2.40–2.80 B: ≤ 0.005
Nicrofer 5219 Nb – alloy 718 2.4668 *NiCr19NbMo* *N07718* –	50.0–55.0	17.0–21.0	balance	0.02–0.08	≤ 0.35	≤ 0.35	≤ 0.30	2.8–3.3	≤ 1.0	0.30–0.70	0.60–1.20	refer to others	B: ≤ 0.006 Nb+Ta: 4.7–5.5
Nicrofer 5520 Co – alloy 617 2.4663 *NiCr23Co12Mo* *N06617* –	balance	20.0–23.0	≤ 2.0	0.05–0.10	≤ 0.70	≤ 0.70	≤ 0.50	8.0–10.0	10.0–13.0	0.60–1.50	0.20–0.50	–	–
Nicrofer 7016 TiAl – alloy 751 2.4694 *NiCr16Fe7TiAl* *N07751* –	≥ 70.0	14.0–17.0	5.0–9.0	≤ 0.08	≤ 1.00	≤ 0.50	≤ 0.50	–	–	0.90–1.50	2.00–2.50	0.70–1.20	–
Nicrofer 7016 TiNb – alloy X-750 2.4669 *NiCr15Fe7TiAl* *N07750* –	≥ 70.0	14.0–17.0	5.0–9.0	≤ 0.08	≤ 1.0	≤ 0.50	≤ 0.50	–	–	0.40–1.00	2.25–2.75	0.70–1.20	–
Nicrofer 7520 Ti – alloy 80 A 2.4631/2.4952 *NiCr20TiAl* *N07080* *NA 20*	≥ 65.0	18.0–21.0	≤ 1.5	0.04–0.10	≤ 1.0	≤ 1.0	≤ 0.2	–	≤ 1.0	1.0–1.8	1.8–2.7	–	B: ≤ 0.008
Expansion special alloys													
Pernifer 36 – alloy 36 1.3912 *Ni36* *K 93600-K 93603* –	35.0–37.0	≤ 0.2	balance	≤ 0.02	≤ 0.5	≤ 0.30	–	–	–	–	–	–	–
Pernifer 2918 1.3981 *NiCo29-18* *K 94610* –	28.0–30.0	≤ 0.10	balance	≤ 0.05	≤ 0.50	≤ 0.30	–	–	16.0–18.0	–	–	–	–

Available product form				Filler Metal for GTAW (TIG/TIG Hot Wire) and GMAW (MIG/MAG) Note: For specific applications consultation with the ThyssenKrupp VDM Welding Laboratory is recommended.	**Major applications**
Sheet, plate	Strip	Wire	Rod, bar		
●	●	●		Nicrofer S 7020 – FM 82 (2.4806)	Sheet-metal fabrication for gas turbines, flame tubes and other components in heat-treatment furnaces.
●	●	●	●	Conicro S 4023 – FM 188 (2.4683)	Gas-turbine components. Furnace rollers and muffles. High-temperature valves and springs.
●	●	●	●	Conicro S 5010 – FM 25 (2.4964)	Gas-turbine components. Furnace rollers, muffles and radiant heat tubes. High-temperature valves and springs.
●		●	●	Nicrofer S 4626 – FM 333 (2.4608)	Non-rotating, high-temperature gas turbine components. Heat-treatment furnace components such as muffles, rollers, radiant heat tubes.
●	●		●	Nicrofer S 4722 – FM X (2.4613)	Gas turbine components such as combustion chambers, rings. Heat-treatment furnace components such as rollers, fasteners. Nitric acid catalyst supports.
●	●	●	●	Nicrofer S 5120 – FM 263 (2.4650)	Non-rotating, high temperature gas turbine components such as rings, casings, transition liners, combustion chambers.
●		●	●	Nicrofer S 5219 – FM 718 (2.4667)	Highly stressed parts in gas turbines and rocket engines. Springs, bolts and 'egg crates' in nuclear reactors.
●	●	●	●	Nicrofer S 5520 – FM 617 (2.4627)	Non-rotating, high-temperature gas-turbine components. Furnace components, radiant heat tubes. Nitric acid catalyst supports.
		●	●	Nicrofer S 7020 – FM 82 (2.4806)	Internal combustion engine exhaust valves.
	●	●	●	Nicrofer S 7020 – FM 82 (2.4806)	Gas turbine components. Extrusion dies and forming tools. Springs and bolts in nuclear reactors.
	●	●	●	Nicrofer S 7020 – FM 82 (2.4806)	Gas turbine components. Steam turbine bolting. Diesel engine exhaust valves.
●	●	●	●	Pernifer S 6436 (1.3912) or Nicrofer S 7020 – FM 82 (2.4806)	Measuring instruments. Passiv thermostat bimetal component. Laser welding equipment. Tanks for liquefied natural gas.
●	●	●		matching	Glass seals especially with hard glasses and for metal to ceramic sealing applications. Lead wires and frames, transistor caps, X-ray tubes.

Availability.

ThyssenKrupp VDM materials are available in the following standard product forms:

Sheet & plate
Conditions:
cold rolled, (for cut-to-length availability, refer to strip)

Conditions:
hot or cold rolled (hr, cr), thermally treated and pickled

Thickness mm	hr / cr	Width[1] mm	Length[1] mm
1.10 – < 1.50	cr	2000	8000
1.50 – < 3.00	cr	2500	8000
3.00 – < 7.50	cr / hr	2500	8000
7.50 – < 25.00	hr	2500	8000[2]
> 25.00[1]	hr	2500[2]	8000[2]

inches		inches	inches
0.043 – < 0.060	cr	80	320
0.060 – < 0.120	cr	100	320
0.120 – < 0.300	cr / hr	100	320
0.300 – < 1.000	hr	100	320[2]
> 1.000[1]	hr	100[1]	320[2]

[1] other sizes subject to special enquiry
[2] depending on piece weight

Discs and rings
Conditions:
hot rolled or forged, thermally treated,
descaled or pickled or machined;
some high-temperature alloys are
also available on request in the oxidized condition.

Available up to a maximum piece weight of 6 t for discs and 3 t for rings in accordance to drawings and technical feasability.

Rod & bar and billet
Conditions:
forged, rolled, drawn, thermally treated,
descaled or pickled, machined, peeled or ground;
some high-temperature alloys are
also available in the oxidized condition.

Product	Forged[1] mm	Rolled[1] mm	Drawn[1] mm
Rod (o. d.)	≤ 600	8 – 60	12 – 50
Bar, square (a)	40 – 600	15 – 280	Not standard
Bar, flat (a x b)	(40 – 80) x (200 – 600)	(5 – 20) x (120 – 600)	(10 – 20) x (30 – 80)
Bar, hexagonal (s)	40 – 80	13 – 41	≤ 50

	inches	inches	inches
Rod (o. d.)	≤ 24	$^{5}/_{16}$ – 2 $^{3}/_{8}$	$^{1}/_{2}$ – 2
Bar, square (a)	$1^{5}/_{8}$ – 24	10/16 – 11	Not standard
Bar, flat (a x b)	($1^{5}/_{8}$ – $3^{1}/_{8}$) x (8 – 24)	($^{3}/_{16}$ – $^{3}/_{4}$) x ($4^{3}/_{4}$ – 24)	($^{3}/_{8}$ – $^{3}/_{4}$) x ($1^{1}/_{4}$ – $3^{1}/_{8}$)
Bar, hexagonal (s)	$1^{5}/_{8}$ – $3^{1}/_{8}$	$^{1}/_{2}$ – $1^{5}/_{8}$	≤ 2

[1] other sizes subject to special enquiry

Forgings
Shapes other than discs, rings, rod and bar are subject to special enquiry. Flanges and hollow shafts may be available up to a piece weight of 10 t.

Wire
Conditions:
bright drawn, 1/4 hard to hard, bright annealed;
some high-temperature alloys are
also available on request in the oxidized condition.

Dimensions:
0.1 – 12.0 mm (0.004 – 0.47 in.) diameter,
in coils, pay-off packs, on spools and spiders.

Welding filler metals
Suitable welding rods, wire, strip electrodes and electrode core wire are available in standard sizes.

Seamless tube and pipe
Using ThyssenKrupp VDM cast materials seamless tubes and pipes are produced and available from DMV STAINLESS Deutschland GmbH, Wiesenstr. 36, D-45473 Mülheim/Ruhr; (Tel.: +49 208 458-2611; Fax: +49 208 458-2641; Email: salesgermany@dmv-stainless.com).

Welded tube and pipe
Welded tubes and pipes are obtainable from qualified manufacturers using ThyssenKrupp VDM semi-fabricated products.

Strip[1)]
Conditions:
cold rolled, thermally treated and pickled or bright annealed[2)].

Thickness mm	Width[3)] mm	Coil I.D. mm			
0.02 – ≤ 0.10	4 – 200[4)]	300	400		
> 0.10 – ≤ 0.20	4 – 350[4)]	300	400	500	
> 0.20 – ≤ 0.25	4 – 750		400	500	600
> 0.25 – ≤ 0.60	6 – 750		400	500	600
> 0.60 – ≤ 1.0	8 – 750		400	500	600
> 1.0 – ≤ 2.0	15 – 750		400	500	600
> 2.0 – ≤ 3.0[2)] – ≤ 3.5[2)]	25 – 750		400	500	600

inches	inches	inches			
0.0008 – ≤ 0.004	0.16 – 8[4)]	12	16		
> 0.004 – ≤ 0.008	0.16 – 14[4)]	12	16	20	
> 0.008 – ≤ 0.010	0.16 – 30		16	20	24
> 0.010 – ≤ 0.024	0.20 – 30		16	20	24
> 0.024 – ≤ 0.040	0.32 – 30		16	20	24
> 0.040 – ≤ 0.080	0.60 – 30		16	20	24
> 0.080 – ≤ 0.120[2)] – ≤ 0.140[2)]	1.0 – 30		16	20	24

[1)] cut-to-length available in lengths from 250 to 4000 mm (10 to 158 in.)
[2)] Maximum thickness: bright annealed – 3 mm (0.120 in.), cold rolled only – 3.5 mm (0.140 in.)
[3)] Wider widths are subject to special enquiry
[4)] Wider widths up to 730 mm (29 in.) are subject to special enquiry

Comparison according to UNS designations.

UNS designation	ThyssenKrupp VDM designation	Alloy	Material No.	Alloy type*	Page
C70600	Cunifer 10	CuNi 90/10	CW 352 H	CRA	18
C71500	Cunifer 30	CuNi 70/30	CW 354 H	CRA	18
K93600-K93603	Pernifer 36	36	1.3912	SPA	24
K94610	Pernifer 2918	–	1.3981	SPA	24
N02200	Nickel 99.2	200	2.4066	CRA	18
N02201	LC-Nickel 99.2	201	2.4068	CRA	18
N02205	LC-Nickel 99.6	205	2.4061	CRA	18
N04400	Nicorros	400	2.4360	CRA	18
N05500	Nicorros Al	K-500	2.4375	CRA	18
N06002	Nicrofer 4722 Co	X	2.4665	SA	24
N06003	Cronix 80	–	2.4869	HT	22
N06008	Cronix 70	–	2.4658	HT	22
N06022	Nicrofer 5621 hMoW	22	2.4602	CRA	20
N06025	Nicrofer 6025 HT	602 CA	2.4633	HT	22
N06059	Nicrofer 5923 hMo	59	2.4605	CRA	20
N06075	Nicrofer 7520	75	2.4951	HT	24
N06333	Nicrofer 4626 MoW	333	2.4608	SA	24
N06455	Nicrofer 6616 hMo	C-4	2.4610	CRA	20
N06600	Nicrofer 7216	600	2.4816	HT	22
N06600	Nicrofer 7216 H	600 H	2.4816	HT	22
N06601	Nicrofer 6023 H	601 H	2.4851	HT	22
N06602	Nicrofer 7216 LC	600 L	2.4817	CRA	20
N06617	Nicrofer 5520 Co	617	2.4663	SA	24
N06625	Nicrofer 6020 hMo	625	2.4856	CRA / HT	20 /22
N06650	Nicrofer 5020 hMo	50 PLUS	2.4850	HT	22
N06690	Nicrofer 6030	690	2.4642	CRA / HT	20 / 22
N06985	Nicrofer 4823 hMo	G-3	2.4619	CRA	20
N07080	Nicrofer 7520 Ti	80 A	2.4631 / 2.4952	SA	24
N07263	Nicrofer 5120 CoTi	C-263	2.4650	SA	24
N07718	Nicrofer 5219 Nb	718	2.4668	CRA / SA	20 / 24
N07750	Nicrofer 7016 TiNb	X-750	2.4669	SA	24
N07751	Nicrofer 7016 TiAl	751	2.4694	SA	24
N08020	Nicrofer 3620 Nb	20	2.4660	CRA	18
N08028	Nicrofer 3127 LC	28	1.4563	CRA	18
N08031	Nicrofer 3127 hMo	31	1.4562	CRA	18
(N08310)	Cronifer 2525 LCN	–	1.4465	CRA	18
(N08330)	Nicrofer 3718	(330)	1.4864	HT	22
N08800	Nicrofer 3220	800	1.4876	HT	22
N08810	Nicrofer 3220 H	800 H	1.4876 / 1.4958	HT	22
N08811	Nicrofer 3220 HP	800 HP	1.4959	HT	22
N08825	Nicrofer 4221	825	2.4858	CRA	18
N08926	Cronifer 1925 hMo	926	1.4529	CRA	18
N09925	Nicrofer 4320 Ti	–	2.4852	CRA	18
N10276	Nicrofer 5716 hMoW	C-276	2.4819	CRA	20
N10665	Nimofer 6928	B-2	2.4617	CRA	20
R20033	Nicrofer 3033	33	1.4591	CRA	18
R30188	Conicro 4023 W	188	2.4683	SA	24
R30605	Conicro 5010 W	25	2.4964	SA	24
S33228	Nicrofer 3228 NbCe	AC 66	1.4877	HT	22
S44535	Crofer 22 APU	–	1.4760	HT	22

* CRA = Corrosion-resistant alloys; HT = High-temperature alloys; SA = Superalloys; SPA = Special alloys

Comparison according to Material Numbers.

Material No.	ThyssenKrupp VDM designation	Alloy	UNS designation	Alloy type*	Page
1.3912	Pernifer 36	36	K93600-K93603	SPA	24
1.3981	Pernifer 2918	–	K94610	SPA	24
1.4465	Cronifer 2525 LCN	–	(N08310)	CRA	18
1.4529	Cronifer 1925 hMo	926	N08926	CRA	18
1.4562	Nicrofer 3127 hMo	31	N08031	CRA	18
1.4563	Nicrofer 3127 LC	28	N08028	CRA	18
1.4591	Nicrofer 3033	33	R20033	CRA	18
(1.4725)	Aluchrom Hf	–	–	HT	20
1.4760	Crofer 22 APU	–	S44535	HT	22
(1.4767)	Aluchrom I SE	–	–	HT	20
1.4767	Aluchrom Y	–	–	HT	20
(1.4767)	Aluchrom YHf	–	–	HT	20
1.4862	Nicrofer 3718 So	DS	(N08330)	HT	22
1.4864	Nicrofer 3718	(330)	(N08330)	HT	22
1.4876	Nicrofer 3220	800	N08800	HT	22
1.4876 / 1.4958	Nicrofer 3220 H	800 H	N08810	HT	22
1.4877	Nicrofer 3228 NbCe	AC 66	S33228	HT	22
1.4958 / 1.4876	Nicrofer 3220 H	800 H	N08810	HT	22
1.4959	Nicrofer 3220 HP	800 HP	N08811	HT	22
2.4061	LC-Nickel 99.6	205	N02205	CRA	18
2.4066	Nickel 99.2	200	N02200	CRA	18
2.4068	LC-Nickel 99.2	201	N02201	CRA	18
2.4360	Nicorros	400	N04400	CRA	18
2.4375	Nicorros Al	K-500	N05500	CRA	18
2.4602	Nicrofer 5621 hMoW	22	N06022	CRA	20
2.4605	Nicrofer 5923 hMo	59	N06059	CRA	20
2.4608	Nicrofer 4626 MoW	333	N06333	SA	24
2.4610	Nicrofer 6616 hMo	C-4	N06455	CRA	20
2.4617	Nimofer 6928	B-2	N10665	CRA	20
2.4619	Nicrofer 4823 hMo	G-3	N06985	CRA	20
2.4631 / 2.4952	Nicrofer 7520 Ti	80 A	N07080	SA	24
2.4633	Nicrofer 6025 HT	602 CA	N06025	HT	22
2.4642	Nicrofer 6030	690	N06690	CRA / HT	20 / 22
2.4650	Nicrofer 5120 CoTi	C-263	N07263	SA	24
2.4658	Cronix 70	–	N06008	HT	22
2.4660	Nicrofer 3620 Nb	20	N08020	CRA	18
2.4663	Nicrofer 5520 Co	617	N06617	SA	24
2.4665	Nicrofer 4722 Co	X	N06002	SA	24
2.4668	Nicrofer 5219 Nb	718	N07718	CRA / SA	20 / 24
2.4669	Nicrofer 7016 TiNb	X-750	N07750	SA	24
2.4683	Conicro 4023 W	188	R30188	SA	24
2.4694	Nicrofer 7016 TiAl	751	N07751	SA	24
2.4816	Nicrofer 7216	600	N06600	HT	22
2.4816	Nicrofer 7216 H	600 H	N06600	HT	22
2.4817	Nicrofer 7216 LC	600 L	N06602	CRA	20
2.4819	Nicrofer 5716 hMoW	C-276	N10276	CRA	20
2.4850	Nicrofer 5020 hMo	50 PLUS	N06650	HT	22
2.4851	Nicrofer 6023 H	601 H	N06601	HT	22
2.4852	Nicrofer 4320 Ti	–	N09925	CRA	18
2.4856	Nicrofer 6020 hMo	625	N06625	CRA / HT	20 / 22
2.4858	Nicrofer 4221	825	N08825	CRA	18
2.4869	Cronix 80	–	N06003	HT	22
2.4951	Nicrofer 7520	75	N06075	HT	24
2.4952 / 2.4631	Nicrofer 7520 Ti	80 A	N07080	SA	24
2.4964	Conicro 5010 W	25	R30605	SA	24
CW 352 H	Cunifer 10	CuNi 90/10	C70600	CRA	18
CW 354 H	Cunifer 30	CuNi 70/30	C71500	CRA	18

* CRA = Corrosion-resistant alloys; HT = High-temperature alloys; SA = Superalloys; SPA = Special alloys

Filler metal specifications and corresponding designations.

ThyssenKrupp VDM designation	Material No.	UNS designation	Classification in welding specifications	
Conicro S 4023-FM 188	2.4683	R30188		
Conicro S 5010-FM 25	2.4964	R30605		
			DIN 1733 Welding filler metals for copper and copper alloys; composition, application and technical delivery conditions.	**AWS A5.7 & ASME SFA-5.7** Specification for Copper and Copper Alloy Bare Welding Rods and Electrodes.
Cunifer S 7030-FM 67	2.0837	C71581	SG-CuNi30Fe	ERCuNi
			DIN EN 12072 Welding consumables - Wire electrodes, wires and rods for arc welding of stainless and heat-resisting steels	**AWS A5.9 & ASME SFA-5.9** Specification for Bare Stainless Steel Welding Electrodes and Rods.
Nicrofer S 3028-FM 28	1.4563		27 31 4 Cu L	ER 383
Nicrofer S 3033-FM 33	1.4591	R20033		ER33-31
			DIN EN ISO 18274 Solid wires, strips and rods for fusion welding of nickel and nickel alloys.*	**AWS A5.14 & ASME SFA-5.14** Specification for Nickel Alloy Bare Welding Rods and Electrodes.
Nickel S 9604-FM 61	2.4155	N02061	Ni 2061	ERNi-1
Nicorros S 6530-FM 60	2.4377	N04060	Ni 4060	ERNiCu-7
Nicrofer S 3127-FM 31	1.4562	N08031		
Nicrofer S 4626-FM 333	2.4608	N06333		
Nicrofer S 4722-FM X	2.4613	N06002	Ni 6002	ERNiCrMo-2
Nicrofer S 5020-FM 50	2.4849	N06650	Ni 6650	ERNiCrMo-18
Nicrofer S 5120-FM 263	2.4650	N07263	Ni 7263	
Nicrofer S 5219-FM 718	2.4667	N07718	Ni 7718	ERNiFeCr-2
Nicrofer S 5520-FM 617	2.4627	N06617	Ni 6617	ERNiCrCoMo-1
Nicrofer S 5644-FM 72		N06072		ERNiCr-4
Nicrofer S 5716-FM C-276	2.4886	N10276	Ni 6276	ERNiCrMo-4
Nicrofer S 5923-FM 59	2.4607	N06059	Ni 6059	ERNiCrMo-13
Nicrofer S 6020-FM 625	2.4831	N06625	Ni 6625	ERNiCrMo-3
Nicrofer S 6025-FM 602	2.4649	N06025	Ni 6025	ERNiCrFe-12
Nicrofer S 6030-FM 690	2.4642	N06690	Ni 6030	ERNiCrMo-11
Nicrofer S 6616-FM C-4	2.4611	N06455	Ni 6455	ERNiCrMo-7
Nicrofer S 7020-FM 82	2.4806	N06082	Ni 6082	ERNiCr-3
Nimofer S 6928-FM B-2	2.4615	N10665	Ni 1066	ERNiMo-7
Pernifer S 6436	1.3912	K93603		

* In DIN EN ISO 18274 designations for welding strip carry the prefix 'B', whereas welding wire or rods carry the prefix 'S' (e.g. B Ni 6059 or S Ni 6059).

Imprint

High-performance alloys:
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solutions

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Publication no. N 565 E
January 2006 Edition

This brochure supersedes publication
no. N 565, dated November 2002.

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