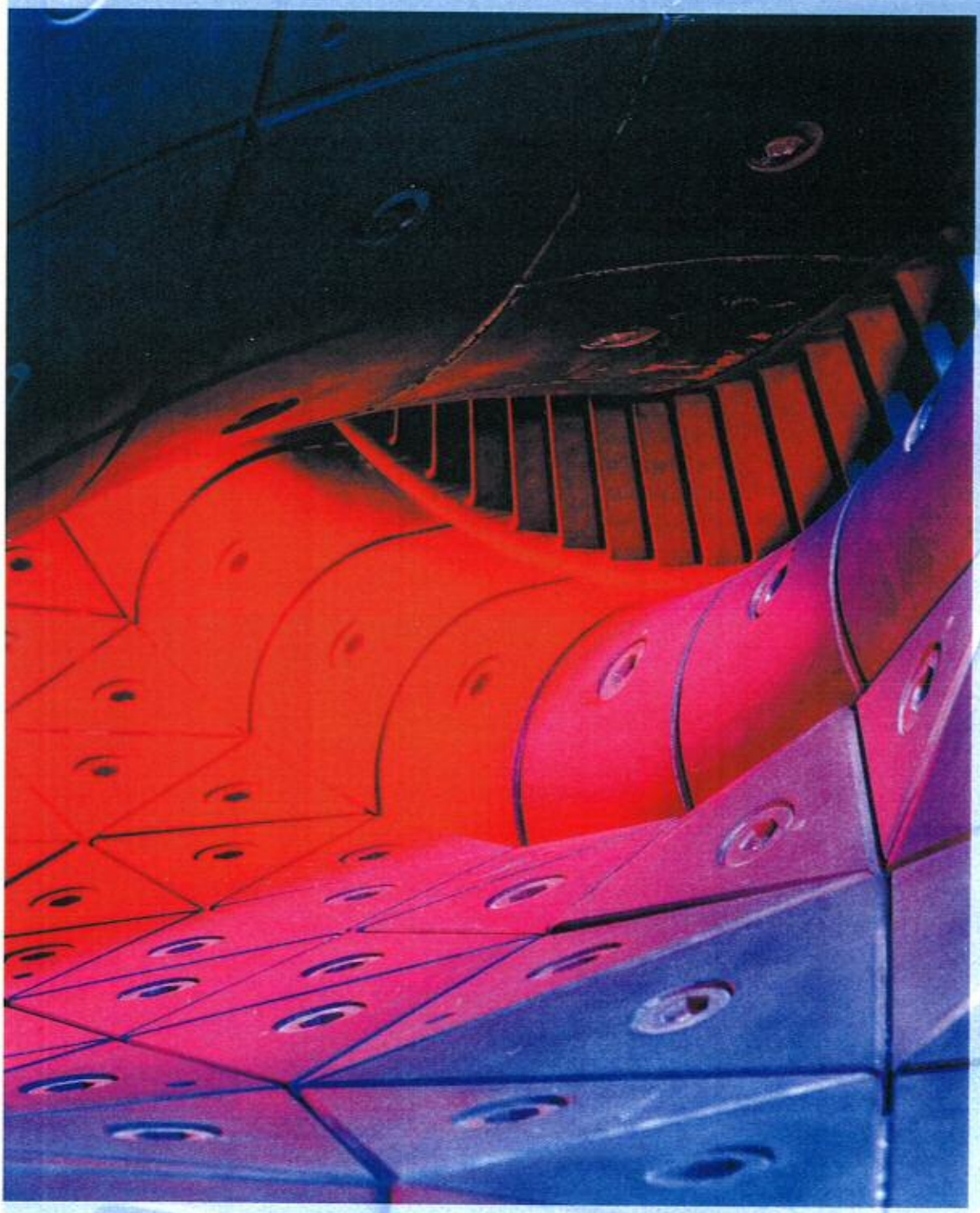
ThyssenKrupp VDM

Sheet and Plate
High-Performance Materials



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ThyssenKrupp VDM

ThyssenKrupp

Cover: Hot-gas duct in a Siemens gas turbine

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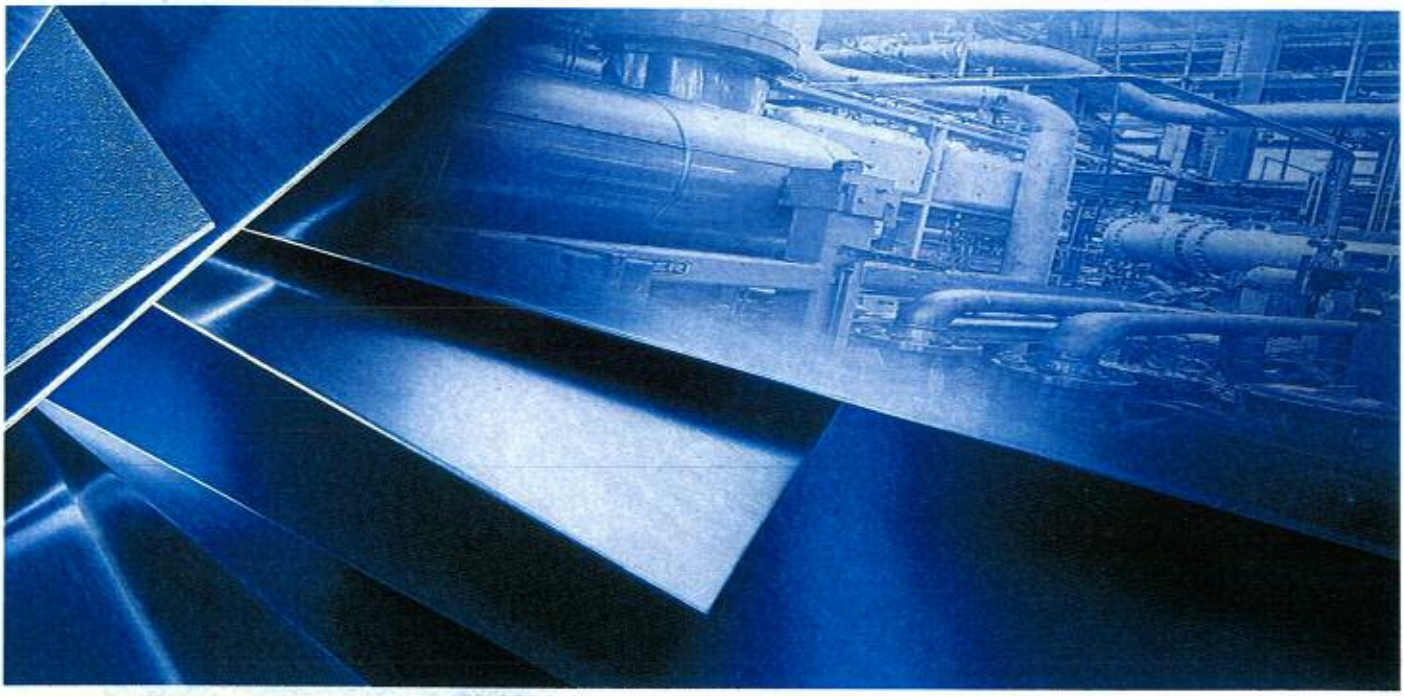
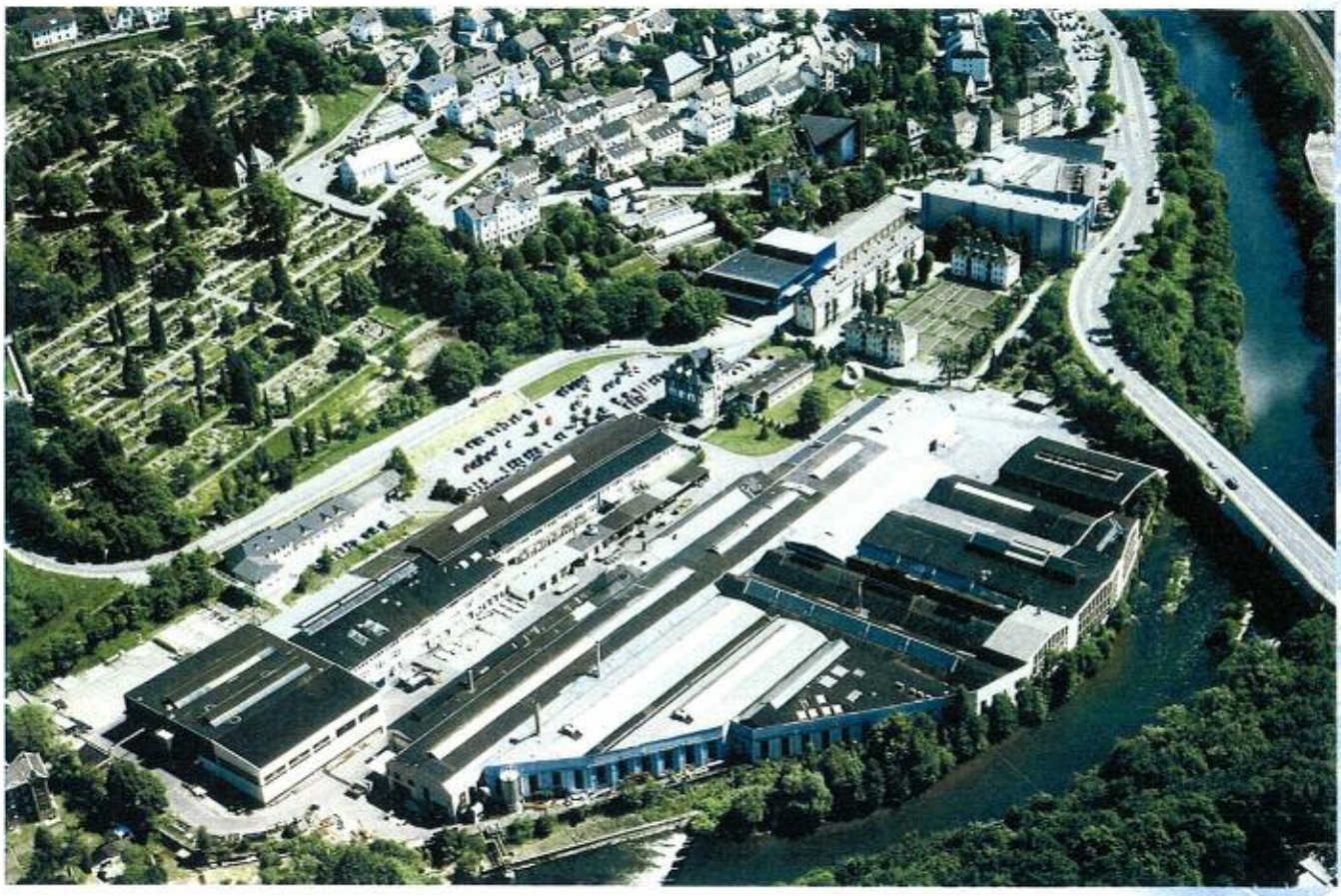


Krupp VDM GmbH

High-performance materials for special applications



Krupp VDM's sheet and plate center at Altena

The outstanding importance of modern high-performance materials is due to their superior properties: excellent corrosion resistance, high mechanical strength at extreme temperatures and extended life even under the most severe service conditions.

Within the framework of current technology, nickel alloys and high-alloy special stainless steels from Krupp VDM create state-of-the-art solutions to the most varied application problems. Examples are found in the chemical industry, where complex processes must be reliably controlled and media safely contained, in the offshore sector, where oil and gas are produced from reservoirs far below the seabed, and in pollution control, such as the desulfurization of flue gases from fossil-fired power stations and the catalytic detoxification of exhaust gases from internal combustion engines.

Krupp VDM GmbH

For over a century, Krupp VDM has been committed to the development and production of materials for special requirements. The company is based at Werdohl, south of Dortmund, with further production centers located at Altena, Unna and Werdohl-Bärenstein.

As a leading international manufacturer of metallic materials, Krupp VDM concentrates on customized corrosion-resistant and high-strength, high-temperature nickel alloys, superalloys and high-alloy special stainless steels. This is backed by intensive research and development, exemplary quality standards, continuous exchange of information with customers, and a reliable global sales and service network.

The Altena plant

Internationally, the demand for extra-wide thin sheets of nickel alloys, superalloys and high-alloy special stainless steels has shown a continuous upward trend in recent years.

Because of the large variety of alloys and specified dimensions and the relatively small production batches required, manufacture of these sheets by hot or cold rolling wide strip is usually ruled out by economic factors. In order to serve this market successfully despite the associated technical problems, Krupp VDM established a special production center for the manufacture of exceptionally large hot- and cold-rolled single sheets.

The heart of this production center, which commenced operation at the Altena works in 1983, is a computer-controlled six-roll Sendzimir-type reversing mill. Reflecting current cold-rolling technology, it is the widest plant of its kind in the world.

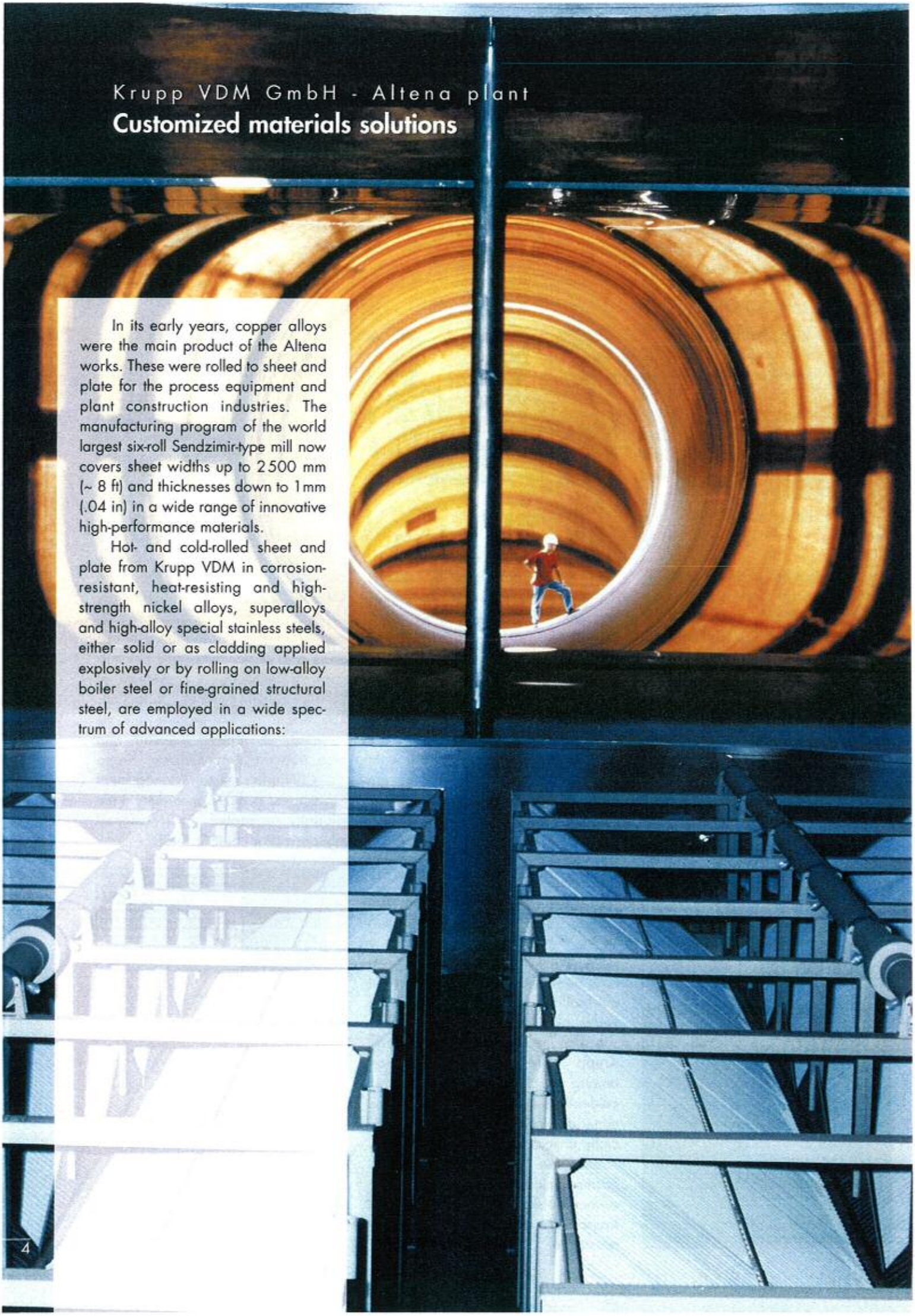
This rolling mill has earned Krupp VDM a leading position among suppliers of extra-wide thin cold-rolled sheet in high-performance materials, including alloys with especially critical forming characteristics. Thanks to process-related fine-grained microstructure and superior surface finish, cold-rolled sheet from Krupp VDM offers excellent corrosion resistance.

Environmental protection at the Altena plant

With the publication of an Environmental Statement for its Altena site under the European Union`s Eco-Management and Audit Scheme, Krupp VDM has inaugurated a new era in its internal environmental protection. In the Statement, which was audited by the Dusseldorf-based environmental verifiers' organization KPMG Certification and was published on October 22, 1997, the company discloses all the environmental data and information relating to the Altena plant and at the same time commits itself to continuous improvement of internal environmental protection. The results of this process will be reviewed at regular intervals and also published. In addition, Krupp VDM's Environmental Management System was certified according to the globally accepted environmental standard DIN EN ISO 14001.

Krupp VDM GmbH - Altena plant

Customized materials solutions



In its early years, copper alloys were the main product of the Altena works. These were rolled to sheet and plate for the process equipment and plant construction industries. The manufacturing program of the world largest six-roll Sendzimir-type mill now covers sheet widths up to 2500 mm (~ 8 ft) and thicknesses down to 1 mm (.04 in) in a wide range of innovative high-performance materials.

Hot- and cold-rolled sheet and plate from Krupp VDM in corrosion-resistant, heat-resisting and high-strength nickel alloys, superalloys and high-alloy special stainless steels, either solid or as cladding applied explosively or by rolling on low-alloy boiler steel or fine-grained structural steel, are employed in a wide spectrum of advanced applications:

Condensate tanks, acid piping and low-pressure evaporator bundles in Cronifer 2803 Mo resist highly concentrated sulfuric acid at temperatures up to 200°C (392°F)

as heat exchangers, columns, reactors, tube sheets, mixers, welded pipe systems and other components in chemical and petrochemical plants;

as corrosion-resistant liners for flue-gas scrubbers, ducts, stacks and other components in desulfurization plants, which extract sulfur dioxide and other harmful substances from flue gases in fossil-fired power stations and waste incineration plants;

as jackets for the columns and as product piping systems on offshore oil and gas production platforms;

as welded-tube pipeline systems for the transportation of oil, gas and seawater; and as fuel tanks for the Ariane 4 European launcher rocket.

In these and in many other applications, large-size sheets from Krupp VDM help reduce welding and inspection requirements and their associated costs.

In addition, when compared with hot-rolled products, cold-rolled sheet offers the advantage of tighter tolerances and resultant savings in weight. The decisive factor, however, is the superior corrosion behavior of cold-rolled sheet, due to its optimal microstructure.

The range of hot- and cold-rolled sheet and plate is completed by appropriate welding materials and methods.

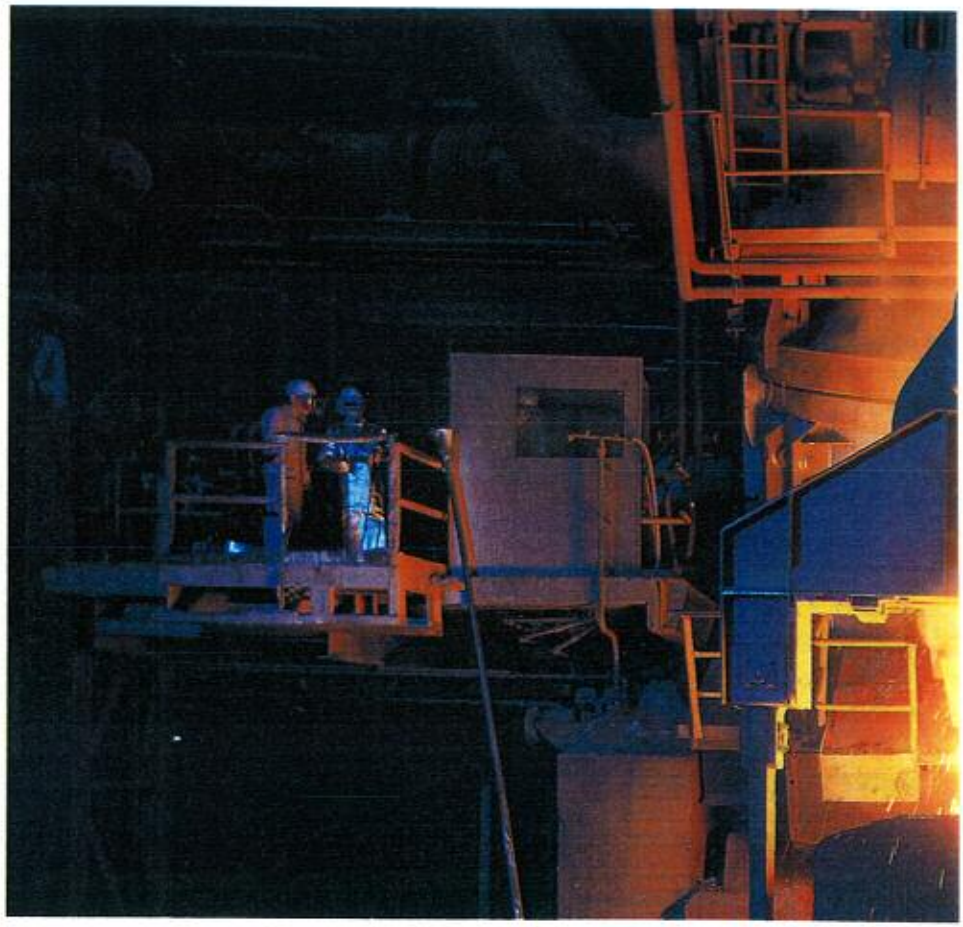
Distributor system of a sulfuric acid plant in Nicrofer 3033-alloy 33. Operator: Norddeutsche Affinerie, Hamburg. Process equipment manufacturer: Franken GmbH, Oberhausen

Krupp VDM supplied over 550 tonnes of Nicrofer 5923 hMo - alloy 59 as solid sheet and roll-clad plate for the construction of four flue-gas scrubbers in the 2x 500MW brown-coal-fired power station Boxberg III, operated by VEAG, Vereinigte Energiewerke AG, Berlin.

Melting and refining

Plate, hot-rolled from forged or continuously cast slabs from Krupp VDM's ultra-modern melting plant at Unna near Dortmund, serves as starting material for the Altena cold-rolling mill. 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 Unna works occupy over 260 000 m². The sizes and arrangement of buildings, furnaces and materials handling facilities were designed for maximum efficiency in material flow and easy enlargement. The current annual melting capacity is 50 000 tonnes.



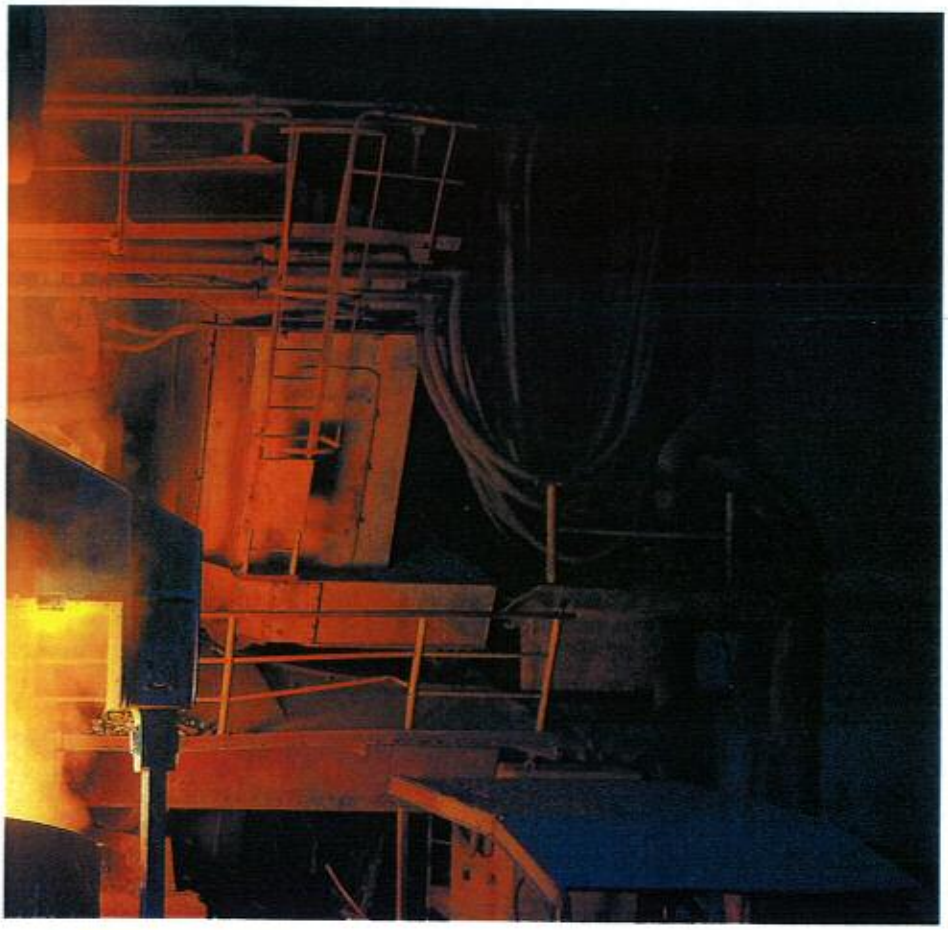
Melting processes

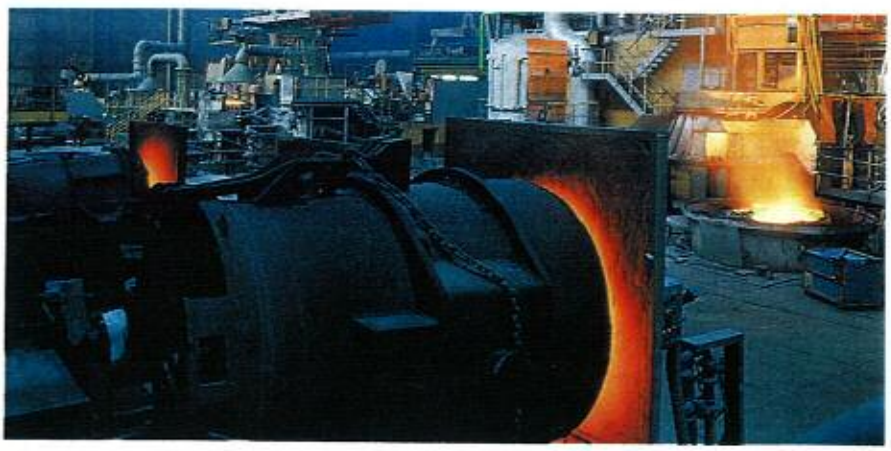
The duplex melting process of electric-arc primary melting followed by VOD refining was specially developed by Krupp VDM for the production of nickel alloys and high-alloy special stainless steels.

A 30-tonne arc furnace as well as three 16-tonne induction furnaces are available for primary melting, alloying and refining.

Secondary metallurgical processes and fine adjustment of chemical composition take place 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.

Tapping of the 30 t electric arc furnace at the Unna melting shop.





Krupp VDM's Unna melting plant, commissioned in 1972 was the first European plant to be equipped with a shop dedusting system.

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 electroslag or vacuum-arc remelting.

Casting

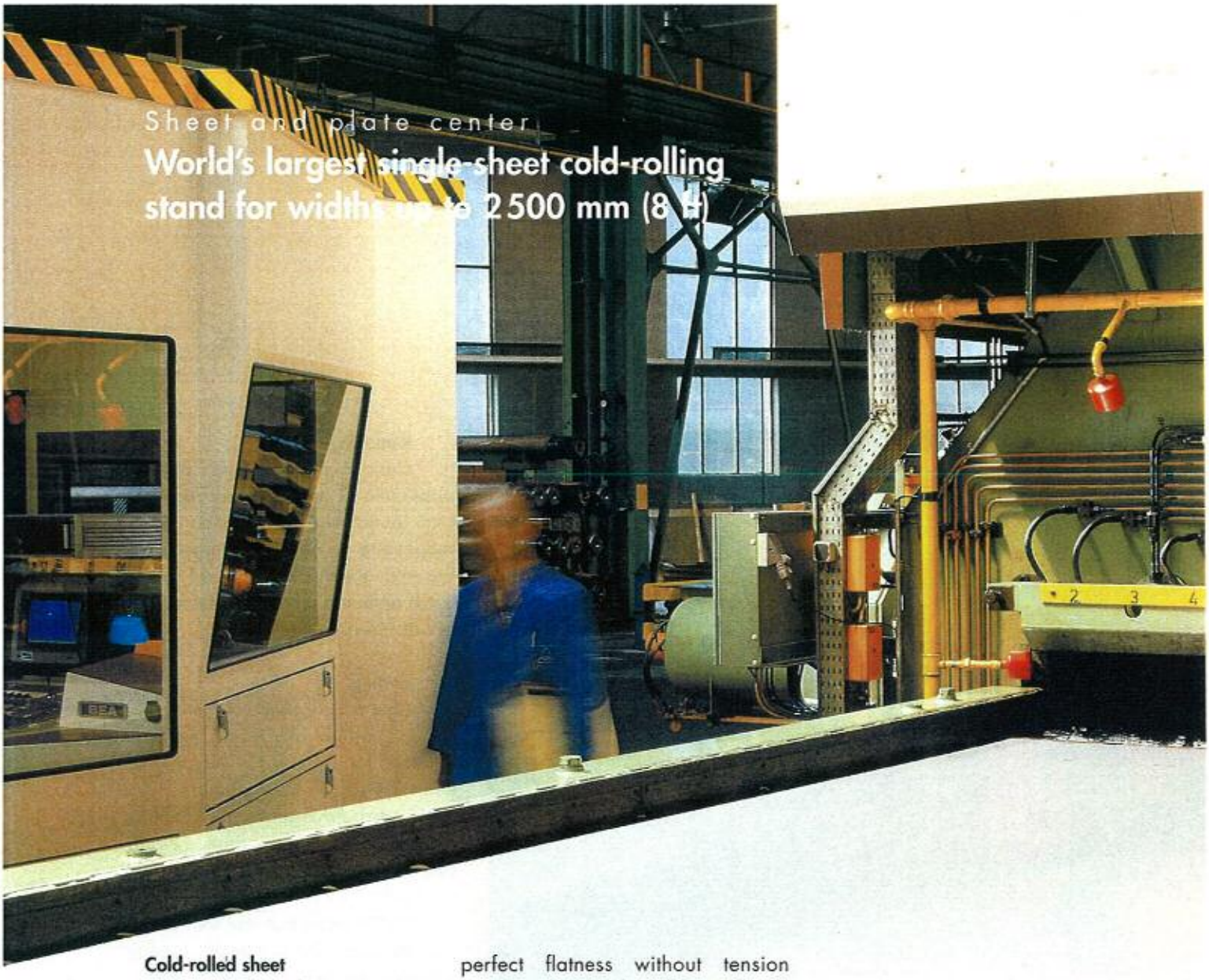
After a final check of the chemical composition, the molten metal is released for casting. The majority of heats are cast by bottom pouring into ingot molds, with an argon shield to protect the metal stream from oxygen and nitrogen pick-up.

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.

Pollution control

Fumes generated during melting and casting are cleaned in a filter system which reduces dust level below 1 mg/m³. Metals in slag and dust are recycled.



Sheet and plate center

World's largest single-sheet cold-rolling stand for widths up to 2500 mm (8 ft)

Cold-rolled sheet

Inaugurated at Altena in 1983, the heart of the sheet and plate center is a computer-controlled six-roll Sendzimir-type ZS 07 B-103 in single-sheet cold reversing mill.

The need for processing difficult-to-work high-performance materials - nickel alloys and high-alloy special stainless steels - to large, very thin sheets tilted the balance towards a multi-roll stand. This can accommodate much smaller work-roll diameters than a four-high mill.

With increasing sheet width and decreasing thickness, maintaining perfect flatness without tension support is extremely difficult. The roll-gap geometry must be optimally matched to the sheet the cross-section across the width. The six-roll Sendzimir-type cold reversing mill at Altena meets this requirement ideally, since it permits adjustment across the entire sheet width at very close intervals.

The cold rolling of single sheets as thin as 1mm (.04 in), in maximum widths of 2650 mm (8.7 ft), is unparalleled anywhere in the world. Nickel-alloy sheets in this thickness made from strip can only be rolled

elsewhere to a maximum width of 1 220 mm (48 in).

Rolling 1 mm (.04 in) sheet to a finished width of 2500 mm (8 ft) requires special provisions in the mechanical and electrical design of the rolling stand, to ensure adequate flatness and close-tolerance thickness plus the highest possible draft. The stand is designed as a zero-crown housing with minimal cross-head spring. The automated pass-sequence optimization and flatness control communicates interactively with the main computer. This supports the stand operation, which features automatic roll-force distribution control. The roll gap is adjusted continuously by superimposed spring corrections, determined as a function of the rolling force. At the same time, because roll gap geometry is precisely matched to material cross-section, pass sequences maintain reproducible thickness and flatness. The main control adjusts the bottom work roll to the preset draft. With the aid of the 2x13 crowning attachments in the upper back-up roll assembly, the roll gap is simultaneously adjusted to the desired sheet cross-section and monitored by a process computer. Cross-sectional profile and crown adjustments, with other roll-pass data, are displayed on a monitor, and the computer automatically converts the draft settings into 13 different traverse distances. This ensures a uniform roll force across the entire sheet width.

This unique roll gap control strategy has made a decisive contribution to the elimination of uneven areas in the rolling of large-sized thin sheets.

Roller tables allocated to the cold-rolling stand accommodate sheet lengths up to 12 meters (40 ft). To protect sheet surfaces and avoid excessive noise, reversing roller tables on either side of the stand are fitted with rubber-coated rollers.

Hot-rolled plate

Hot-formed or continuously cast slabs from Krupp VDM's Unna melting plant are hot rolled on four-high mills within the Fried. Krupp AG Hoesch-Krupp Group.

Clad plate

For many applications in processing equipment, vessels and tank construction, as well as in flue-gas desulfurizing plants, sheet and plate from Krupp VDM in nickel alloys, superalloys and high-alloyed special stainless steels are employed as

Krupp VDM supplied more than 55 tonnes of cut-to-size sheets in Nicrofer 5923 hMo - alloy 59 for lining the four flue-gas scrubbers at the Essen-Karnap waste-fired cogeneration plant operated by RWE Energie AG, Essen.

Roll-clad boiler end

cladding materials, applied either explosively or by rolling on a base material - usually low-alloy boiler steel or fine-grained structural steel.

For production of roll-clad plate, we work together with the Austrian company VOEST ALPINE STAHL LINZ, which manufactures this product according to a process developed by this company. Roll-clad plates are a cost-effective alternative to expensive high-alloy solid plate and substitute products such as rubber linings and plastics.

Manufacturing program			Hot-rolled sheet and plate		Cold-rolled sheet and plate	
Width	mm	(ft)	up to 3 000	(10)	up to 2 500	(8)
Thickness	mm	(in)	4 - 100	(.16-4.0)	1 - 8	(.04 - .32)
Length	mm	(ft)	up to 8 200/10 000	(27/33)	up to 8 200	(27)
Finish			hot rolled, annealed and pickled (certain alloys solution-annealed only) ; cut to size on a computer-controlled cutting machine; thicknesses above 15mm (.59 in) by an NC plasma cutting installation.		cold rolled, annealed and pickled (certain alloys solution-annealed only); cut to size on a computer-controlled cutting machine.	

Finishing line

Gas-fired continuous roller hearth furnace with integrated programmable air/water cooling line.

The largely automated finishing line is designed for large-size sheet and plate in thicknesses up to 30 mm (1.2 in), widths up to 3 000 mm (10 ft), lengths up to 10 000 mm (33 ft), and unit weights up to 6 500 kg (14 300 lbs). In special cases, 100 mm (4 in) thick plate weighing up to 10 000 kg (22 000 lbs) can be processed.

Annealing

During the first finishing step, sheets are heat treated in a gas-fired continuous roller hearth furnace. Computer-controlled and approximately 22 meters (72 ft) long, the furnace features six heating zones for open annealing in the temperature range from 680 to 1 200 °C (1 260 – 2 200 °F). The maximum treatable sheet size is 3 200 x 10 500 mm (10.5 x 34.5 ft).

After annealing, the sheets pass through an upstream air/water cooling line. The entire treatment is computer-controlled. After the material number, sheet dimensions and surface condition (bright or oxidized) have been entered, the computer optimizes furnace utilization, charging parameters and sheet movement through each treatment zone. The staggered arrangement of roller table and furnace rollers allows operating speed to vary at different stages. This means that sheet charging and discharging can take place at a much higher speed than heat treatment.

At furnace temperatures up to 1 200 °C (2 200 °F), the previously used water-cooled asbestos rollers were replaced with non-cooled longitudinally welded rollers in Nicrofer 6025 HT – alloy 602 CA.

The production cycle can be modified to meet the requirements of a given material, especially with respect to cooling parameters. Thus, to cool a sheet 25 mm (1 in) in thickness from 1000 °C (1830 °F) to a core temperature of 450 °C (840 °F) takes less than four minutes. Thicknesses below 10 mm (.4 in) are cooled over the same temperature range in less than 20 seconds.

Shot blasting and leveling

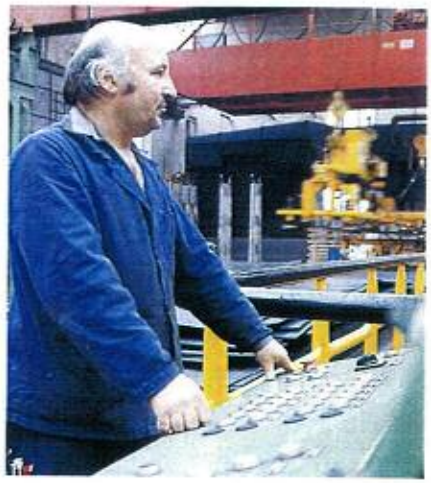
During initial pre-descaling in the shot-blasting machine, the sheets are angled at 40 degrees to ensure that the shot is completely removed. This inclination is effected by pivoting drag conveyors at the run-in and run-out ends of the machine. Following blasting, annealed sheets pass through two multiroll levelers.

Pickling and inspection

During the next step, the sheets pass through a vertical continuous spray-pickling line with integrated inspection. The most important advantages of vertical spray pickling over immersion pickling include shorter pickling times, reduced acid consumption and less harmful chemicals. In addition, use of the four-step cascade system leads to an appreciable reduction in rinse-water consumption. Complete enclosure of the pickling installation allows its integration into the production flow without polluting the shop atmosphere. The treatment line is computer controlled and fully automatic.

After passing through a rinsing and drying zone, the sheets finally reach the inspection line. Here they are inspected on both sides and minor surface defects eliminated.

This vertical spray pickling plant has been rebuilt with solid metal segments in Nicrofer 3127 hMo - alloy 31 in highly stressed areas.



Computer-controlled continuous belt-type surface grinding machine for large sheets in sizes up to 3000 x 8200 mm (10 x 27 ft).

Cutting center

This computer-controlled underwater plasma cutter employs an electric arc for cutting sheet and plate to size. The water not only eliminates dust and noise but also reduces the heat-affected zone to a minimum.

At the cutting center, sheets are cut to the specified finished size. All formats are available: rectangular, square, circular, rings or segments, with or without holes or recesses.

The key unit of the cutting center is a hydraulic shear with 8200 mm (27 ft) knives for cutting sheet up to 25 mm (1in) thick. The cutting precision is 1mm (.04 in) over a cut length of 8000 mm (26 ft). With sheet sizes up to 8000 x 2500 mm (26 x ~ 8 ft), the maximum diagonal deviation is 3 mm (.12 in). A special feature permits cutting of even greater lengths.

The feed table is equipped with electrohydraulic clamp and feed systems. Sheet movement follows the computer-set path with outstanding accuracy. For sheet thicknesses greater than 25 mm (1in), a plasma machine cuts thicknesses up to 40 mm (1.6 in) under water and larger thicknesses in air. Circular blanks, rings and other shapes are punched or cut from sheets using plasma equipment.

For finish machining of disks and rings, a facing lathe can accommodate diameters up to 4000 mm (13 ft)

The Key unit of the cutting center is a hydraulic shear with knives 8200 mm (27 ft) long.

Inspection

and unit weights up to 8 tonnes. When required, parts can be machined all over.

Hot- and cold-finished sheet and plate from Krupp VDM are supplied with certificates indicating the scope of materials testing, as follows:

Test report according to DIN 50 049 / EN 10 204 - 2.2, for verification of heat analysis;

Inspection certificate according to DIN 50 049 / EN 10 204 - 3.1A, 3.1B or 3.1C, issued by an internal quality inspector independent of the production departments, or by a third-party inspector commissioned by the customer;

Inspection report according to DIN 50 049 / EN 10 204 - 3.2A or 3.2C, issued by an official inspector or by a third-party expert commissioned by the customer, with additional certification by the works inspector.

In addition to these, other national or international standards can be used as the basis of acceptance inspections.

For instance, Krupp VDM deliveries to pressure-vessel manufacturers in Germany are subject to AD-Merkblatt W-2, whilst supplies to the USA are according to the ASME Boiler and Pressure Vessel Code.

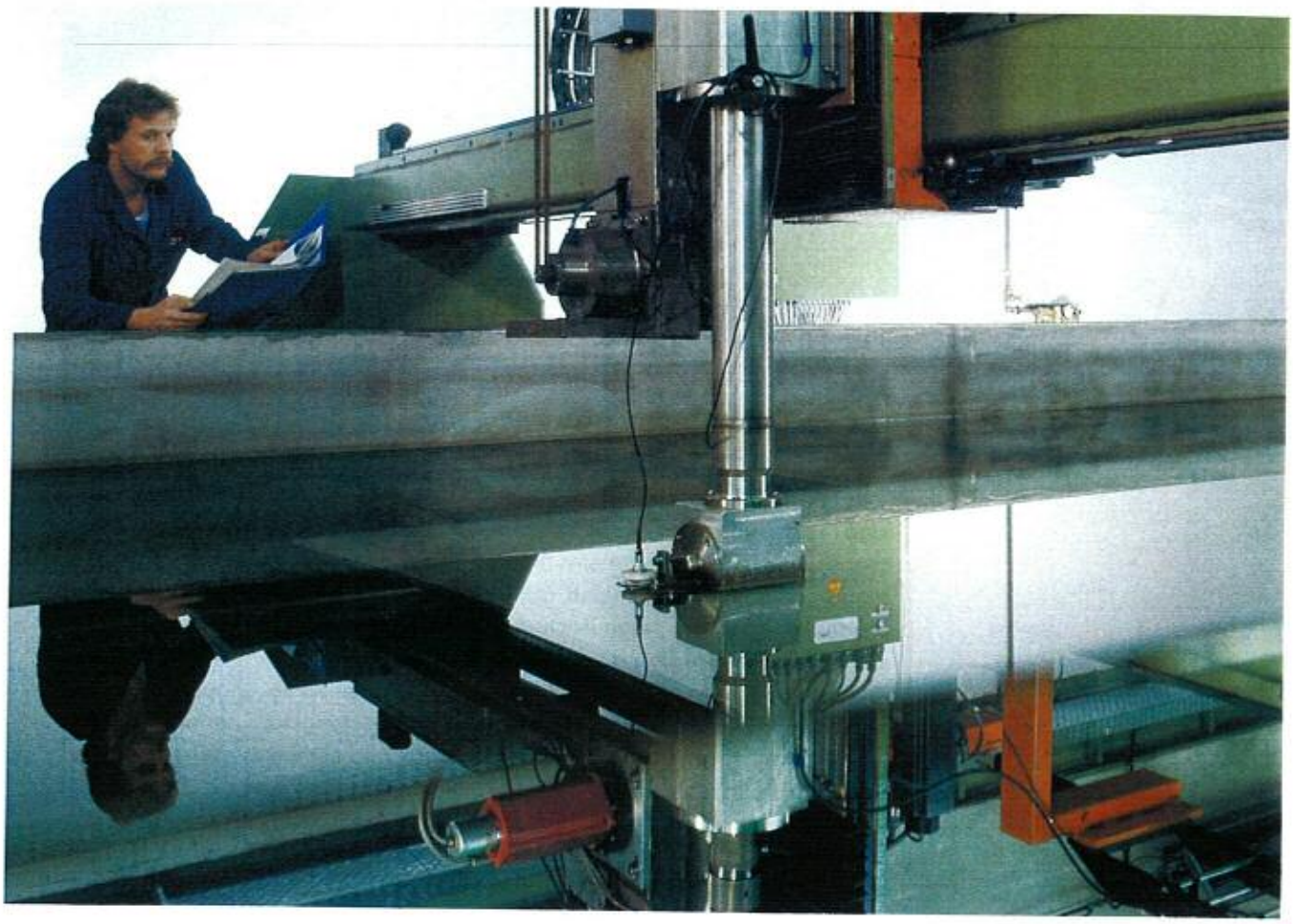
Marking

Every sheet or plate is paint or stamp marked, to confirm compliance with the quality-assurance guidelines of national and international standards.

Products inspected by independent experts or institutions are additionally identified by an acceptance stamp.

Other marking techniques, such as roller stamping, low-stress stamping and color coding, can be carried out by special agreement.

Computer-controlled ultrasonic testing plant.



Stockholding

In close cooperation with authorized stockholders at home and abroad, Krupp VDM maintains large stocks of sheet, plate and other products from its manufacturing program, to ensure prompt deliveries to customers relying on short-term planning.

A selection of authorized stockholders' addresses is listed on page 82 of this brochure. Information on other supply sources is readily available from Krupp VDM's marketing and sales departments. Ultra-modern machining facilities at the Altena production center, such as an NC plasma cutting machine, ensure a swift and precise response to special customer requests.

All possible shapes are available: rectangular, square, circular, rings and segments. When required, these products can be supplied with holes and recesses cut to the customer's specification.

Application engineering

In a period of rapidly advancing technology, materials selection can be a particularly difficult task. Krupp VDM's Application Engineering Department, a proven team of highly qualified engineers, metallurgists and technicians, with state-of-the-art equipment and access to the latest technology, is an important aid to decision-making and provides a link between customer and supplier. As expert consultants to the industrial plant construction sector, they have accompanied numerous projects from planning stage to start-up.

Krupp VDM's application engineers are totally familiar with industries and technologies such as:

- chemicals and petrochemicals
- pulp and paper
- oil and gas production
- marine engineering
- aerospace engineering
- power generation
- environmental engineering
- high-temperature technology
- industrial furnace construction
- electrical and electronic engineering

The Application Engineering Department offers unrivaled experience in one of the widest ranges of high-performance materials. With related know-how in application profiles and fabrication techniques, the department provides optimized material concepts for specific applications. At the same time, accumulated in-depth knowledge of market trends and their evaluation helps to guide the company's own product development.

Research and development

Krupp VDM's intensive R&D efforts concentrate on two major areas: production technology and product development. The activities involved in the latter are briefly outlined below. They comprise both the development and qualification of materials.

Material development

Nicrofer 5923 hMo - alloy 59 and Nicrofer 3127 hMo - alloy 31 are two excellent examples of innovative products for environmental and energy engineering. For desulfurization of coal-fired power stations, the market demanded corrosion-resistant, high-alloy materials with requirements similar to those in the chemical industry as regards high safety and long life. This sparked the development of nickel-chromium-molybdenum-base materials with even longer life expectancies than existing alloys under highly corrosive conditions. Since it proved possible to produce and process both alloys on a commercial scale from the outset, their success was practically guaranteed. Both alloys, but particularly alloy 59, have been the materials of choice in recent years when building new flue-gas desulfurization systems or modernising existing units both in western and eastern Germany and in many other European countries.

Nicrofer 3033 - alloy 33, another example of our research and development work, was jointly developed with Bayer AG. Alloy 33 is a prime example of a customized project which was completed in the shortest possible period thanks to efficient time management. From the outset of our cooperation with Bayer AG, the objectives were crystal clear: the new material was to display the highest possible resistance to corrosion by highly oxidizing media such as highly concentrated sulfuric and nitric acids. A chromium content of over 30 % was required to meet this specification. Moreover, the material was to have an austenitic microstructure so that its processing properties differed little from those of austenitic stainless steels and nickel-base alloys.

Preliminary theoretical investigations came up with a chromium-iron-nickel material containing a certain amount of nitrogen to stabilise the austenitic microstructure. Laboratory melts carried out as part of a feasibility study proved this concept to be realistic. In quick succession there then followed a patent application, an initial commercial-scale heat at the Unna meltshop, and the production of sheets, billets, welding wires and seamless tubes. The development of Nicrofer 3033 - alloy 33 concluded with a material inspection carried out by the German TÜV technical inspectorate on the basis of three commercial-scale heats each of 30 tonnes. The results are documented in "VdTÜV-data sheet 516" and ASME Code Case 2227. Practical experience has been obtained with the use of this chromium-iron-nickel alloy in pressurized components at a multi-purpose plant of Bayer AG and also in sulfuric acid technology with heat recovery.

Nimofer 6224 - alloy B-10 is the first metallic material to display excellent resistance to corrosion in hot, highly acidic media with a low concentration of oxidizing agents such as heavy metal ions or dissolved

oxygen.

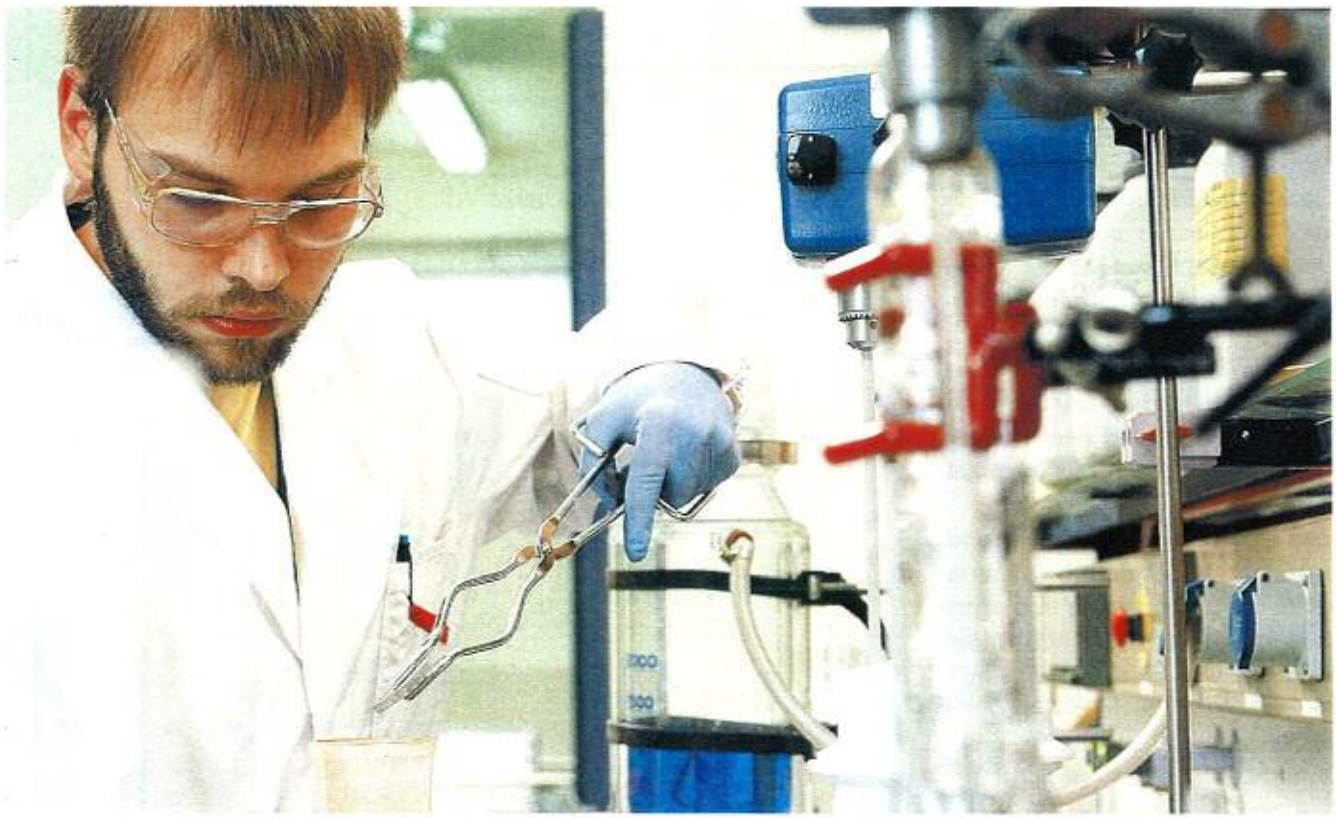
Nimofer 6224 - alloy B-10 is a nickel-molybdenum-chromium-iron-solid solution alloy and was developed with chemical process technology, energy technology and pollution control applications in mind. In the chemical sector, Nimofer 6224 - alloy B-10 is intended for use in reprocessing plants for waste sulfuric acid, while applications for energy and pollution control technology center on flue-gas scrubbers and heat transfer systems in flue-gas desulfurization plants.

In comparison with graphite and ceramics - the materials hitherto used for plant components in contact with highly acidic media with a low concentration of oxidizing agents - our customers will be delighted by the distinctly improved processing properties of Nimofer 6224 - alloy B-10.

A material specially developed for industrial furnace construction and the petrochemical industry is Nicrofer 6025 HT - alloy 602 CA. Typical applications include rollers, radiant tubes, bright-annealing muffles and other furnace internals. Due to its high carbon content and added zirconium, this material exhibits outstanding high-temperature strength in the range 1000 to 1200 °C (1830 - 2200 °F), as well as excellent resistance to oxidizing and carburizing load cycles.

Another material for high-temperature service, the newly developed Nicrofer 45 TM - alloy 45 TM, exhibits excellent corrosion resistance to typical waste-incineration atmospheres (oxidizing, sulfidizing and chloridizing gas mixtures) in the temperature range 500 to 850 °C (930 - 1560 °F). In addition, the material's superior resistance to sulfidizing and carburizing atmospheres opens up a host of other applications, including pulverized coal burners, heat-exchanger tubes in coal gasification processes, constructional components for afterburning equipment, and furnace internals required to withstand aggressive media at high temperatures.

The new corrosion laboratory at Krupp VDM's Altena plant.



Material qualification

High-performance materials from Krupp VDM are used for example in the chemical industry, in power generation, environmental protection and in offshore engineering, where maximum resistance to specific corrosive attack or high-temperature stress is essential. Exact and comprehensive knowledge of the properties of these alloys is an indispensable software package for their application which can only be developed by intensive R&D effort.

A wide, varied and continuously updated research program is dedicated to the wet-corrosion characteristics of Krupp VDM high-performance materials.

Since the behavior of a material is governed by a large number of parameters, a computerized database has been established at Krupp VDM's corrosion laboratory in Altena. From this, precise recommendations can be derived regarding the best material for a given application. Users of Krupp VDM high-temperature materials require reliable resistance to high temperatures at designated levels. For materials used in the manufacture of chemical processing equipment, a minimum test period of 30 000 hours is usually specified.

A large number of materials have been subjected to long-time creep tests in the temperature range 650 to 1 200 °C (1 200 - 2 200 °F). Most of the relevant data contained in this brochure have been obtained from these measurements.

Joining technology

In the chemical industry, as well as in energy production and offshore engineering, almost every application involves the use of an appropriate joining technique, the most important of which is welding.

Welding engineering therefore plays an important part in Krupp VDM's R&D activity. Test results provide an indispensable technical resource, made available to the user as an integral part of his order.

Welding technology comprises the weldability of base materials, development and testing of suitable filler metals, and the testing of new welding techniques and their suitability for welding high-performance Krupp VDM alloys.

Quality management

The Krupp VDM Quality Assurance System guarantees strict compliance with the company's internal quality specifications from receipt of an inquiry to the delivery of the finished product. All production centers and departments have their own quality assurance manuals, in which all the process steps and related requirements are described. These manuals are aimed at winning and maintaining customers' trust.

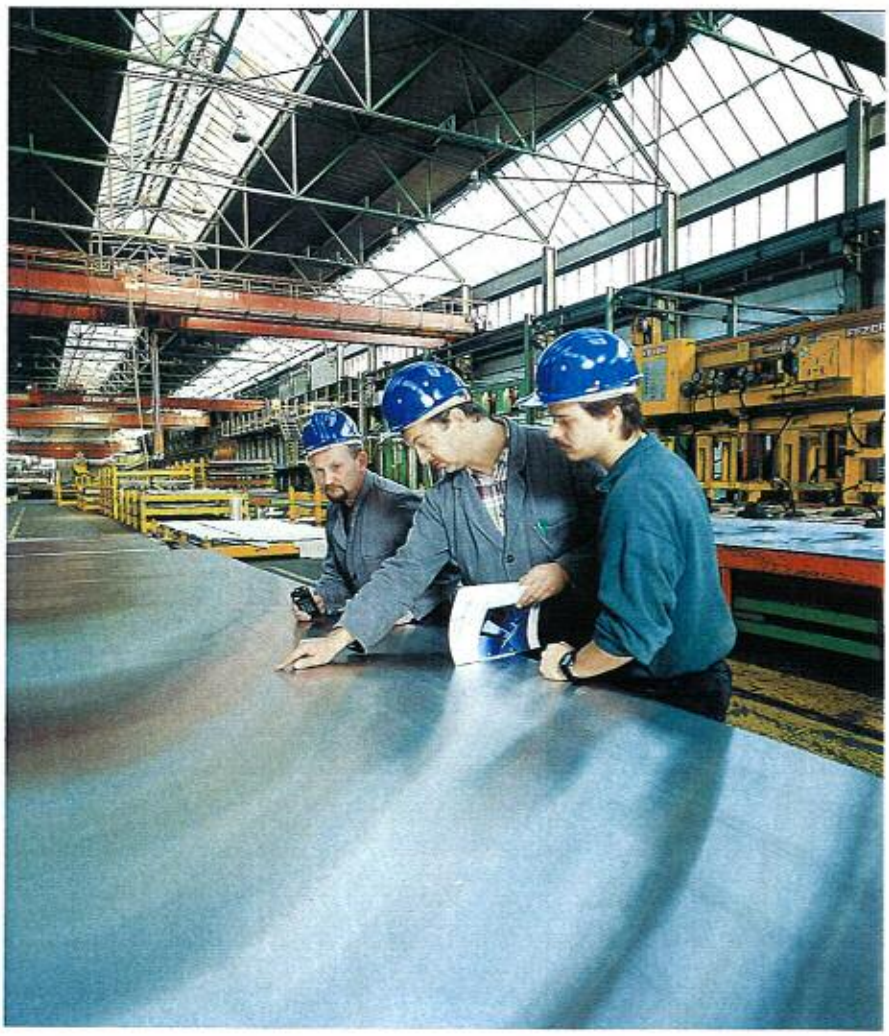
Quality assurance is a basic precondition for economic production;

Quality assurance is the overriding principle for all Krupp VDM products and services;

Quality assurance is the key to maximum productivity, leading to optimized delivery capacity at favorable prices.

The validity of these principles has been confirmed by the numerous approvals which Krupp VDM GmbH has received for its Quality Assurance System from national and international authorities and classification societies. They include:
TÜV according to AD-W0/TRD 100,
ASME according to NCA 3800,
LRQA according to DIN/ISO 9002,
MOD/BWB according to AQAP-4,
CAA, KWU according to QSP 4 C,
AVS D 100/50 and KTA 1401.

The Quality Assurance System is documented in manufacturing and test procedures. These also include qualification requirements for suppliers as well as the control of special processes, personnel training, quality documentation and the monitoring and treatment of non-conforming items. Each production lot is checked for dimensional accuracy, unacceptable surface imperfections and internal defects using a variety of non-destructive techniques appropriate to the product. In addition, compliance with customer specifications is verified with regard to mechanical properties, corrosion behavior, weldability and other parameters. Many of these tests are carried out in the manufacturing plants' own laboratories. The chemical laboratories at Unna (fluorescence spectroscopy) and Werdohl (atomic absorption spectroscopy and conventional wet techniques), and the corrosion and welding laboratories at Altena work for all Krupp VDM's plants.



Material data

The following tables have been prepared to assist in selecting the most suitable Krupp VDM high-performance alloys for specific corrosion and/or high-temperature applications.

Specifications and designations

The materials are available in conformity with the standards indicated. Standards in brackets indicate that the standard is only valid in part or the Krupp VDM data deviate from those specified in the standard. When placing an order, standards (DIN, ASTM, BS, etc.) stipulated by the customer will form the basis of the contract following our approval.

Chemical composition

When an element is reported as the "balance" of a composition, this only means that this element predominates; other elements may be present in minimal amounts.

Physical properties

Physical properties are determined using Krupp VDM material or conform to SEW 310.

EN specifications are not taken into consideration.

Mechanical properties

The stated mechanical properties are typical values, except those reported as minimum (≥). The given data are generally applicable to sheet and plate products. For properties applicable to other product forms, please refer to the respective data sheets available on request or contact Krupp VDM.

Creep properties

The values correspond to the best-fit curve fitted to the scatterband of results. Minimum values are approximately 20% below the listed averages.

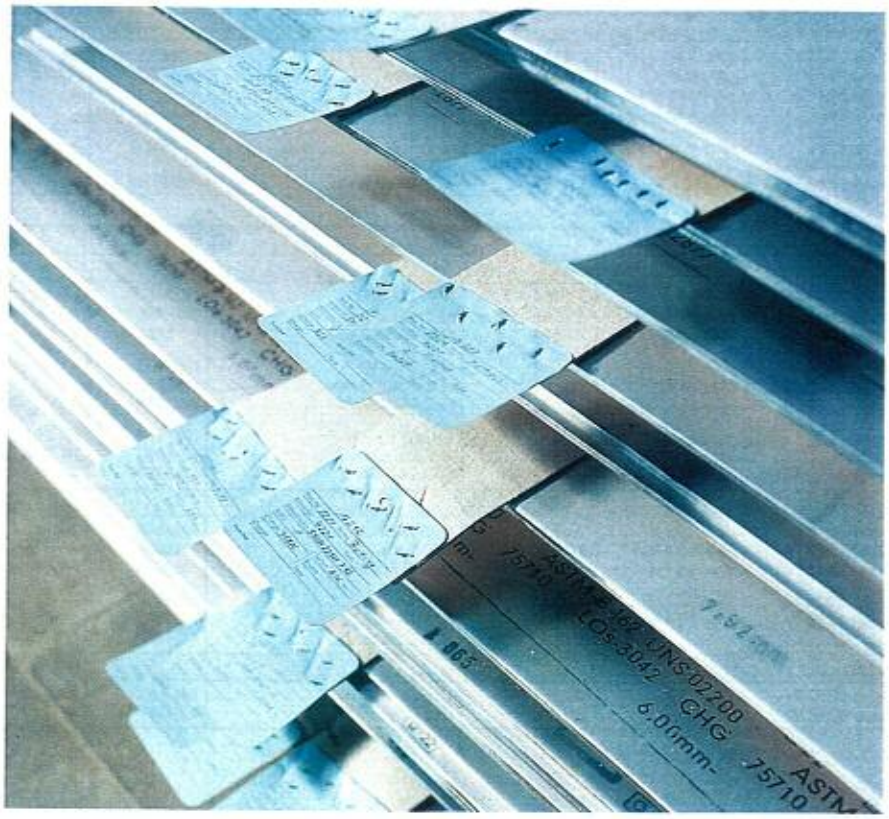
Welding

Krupp VDM nickel base alloys and special stainless steels are readily and easily weldable by using filler metals shown on pages 78–81.

Abbreviations used

SEW = STAHL-EISEN data sheet
WL = Werkstoff-Leistungsblatt
EN = European Standard
EN pr = European Standard project
– = no data available

All data and information are as accurate and as complete as possible at the time of going to press, but are not guaranteed. Changes arising from development work to improve materials may have occurred in the meantime. More extensive data are given in the individual data sheets or can be supplied by Krupp VDM GmbH on request.



Krupp VDM high-performance materials and products

Krupp VDM alloy designation	Werkst.-Nr.	Designation	UNS-designation	BS-designation	Available product form				
					Sheet, plate	Strip	Rod, bar	Forgings	Wire
Corrosion-resistant alloys									
Ni – NiCu									
VDM Nickel 99.2 – alloy 200	2.4066	Ni 99.2	N02200	NA 11					
VDM LC-Nickel 99.2 – alloy 201	2.4068	LC-Ni 99	N02201	NA 12					
VDM LC-Nickel 99.6 – alloy 205	2.4061	LC-Ni 99.6	N02205	–					
Nicorros – alloy 400	2.4360	NiCu30Fe	N04400	NA 13					
Nicorros Al – alloy K-500	2.4375	NiCu30Al	N05500	NA 18					
NiMo – NiCrMo – NiCrFeMo – superalloys									
Nimofer 6928 – alloy B-2	2.4617	NiMo28	N10665	–					
Nimofer 6629 – alloy B-4	2.4600	NiMo29Cr	N10629	–					
Nimofer 6224 – alloy B-10	2.4710	NiMo23Cr8Fe	–	–					
Nicrofer 6616 hMo – alloy C-4	2.4610	NiMo16Cr16Ti	N06455	–					
Nicrofer 6020 hMo – alloy 625	2.4856	NiCr22Mo9Nb	N06625	NA 21					
Nicrofer 5923 hMo – alloy 59	2.4605	NiCr23Mo16Al	N06059	–					
Nicrofer 5716 hMoW – alloy C-276	2.4819	NiMo16Cr15W	N10276	–					
Nicrofer 5219 Nb – alloy 718	2.4668	NiCr19NbMo	N07718	–					
Nicrofer 4823 hMo – alloy G-3	2.4619	NiCr22Mo7Cu	N06985	–					
NiCrFe – FeNiCrMo – standard alloys									
Nicrofer 7216 LC – alloy 600 L	2.4817	LC-NiCr15Fe	N06602	NA 14					
Nicrofer 6030 – alloy 690	2.4642	NiCr29Fe	N06690	–					
Nicrofer 4221 – alloy 825	2.4858	NiCr21Mo	N08825	NA 16					
Nicrofer 3620 Nb – alloy 20	2.4660	NiCr20CuMo	N08020	–					
Nicrofer 3220 – alloy 800	1.4876	X10NiCrAlTi32-20	N08800	NA 15					
	1.4958 RK	X5NiCrAlTi31-20 RK							
Nicrofer 3127 hMo – alloy 31	1.4562	X1NiCrMoCu32-28-7	N08031	–					
Nicrofer 3127 LC – alloy 28	1.4563	X1NiCrMoCuN31-27-4	N08028	–					
FeNiCr – special stainless steels									
Nicrofer 3033 – alloy 33	1.4591	X1CrNiMoCuN33-32-1	R20033	–					
Cronifer 2525 LCN	1.4465	X1CrNiMoN25-25-2	(N08310)	–					
Cronifer 1925 hMo – alloy 926	1.4529	X1NiCrMoCuN25-20-7	N08926	–					
CuNi									
Cunifer 30 – alloy CuNi 70/30	2.0882	CuNi30Mn1Fe	C71500	CN 107					
Cunifer 10 – alloy CuNi 90/10	2.0872	CuNi10Fe1Mn	C70600	CN 102					
Heat-resistant alloys									
NiCrFe – FeNiCr									
Nicrofer 7520 – alloy 75	2.4951	NiCr20Ti	N06075	HR 203					
Nicrofer 7216 – alloy 600	2.4816	NiCr15Fe	N06600	NA 14					
Nicrofer 6219 Si – alloy 626 Si	2.4855	NiCr19Mo9Si	–	–					
Nicrofer 6030 – alloy 690	2.4642	NiCr29Fe	N06690	–					
Nicrofer 6023 – alloy 601	2.4851	NiCr23Fe	N06601	–					
Nicrofer 3718 So – alloy DS	1.4862	X8NiCrSi 38-18	–	NA 17					
Nicrofer 3718 – (alloy 330)	1.4864	X12NiCrSi 36-16	(N08330)	–					
High-temperature, high-strength alloys									
NiCr – NiCrFe – NiCrMo – NiCrCoMo – superalloys									
Nicrofer 7520 Ti – alloy 80 A	2.4952	NiCr20TiAl	N07080	NA 20					
Nicrofer 7016 TiNb – alloy X-750	2.4669	NiCr15Fe7TiAl	N07750	–					
Nicrofer 7016 TiAl – alloy 751	2.4694	NiCr16Fe7TiAl	N07751	–					
Nicrofer 6025 HT – alloy 602 CA	2.4633	NiCr25FeAlY	N06025	–					
Nicrofer 5520 Co – alloy 617	2.4663	NiCr23Co12Mo	N06617	–					
Nicrofer 5219 Nb – alloy 718	2.4668	NiCr19NbMo	N07718	–					
Nicrofer 5120 CoTi – alloy C-263	2.4650	NiCo20Cr20MoTi	N07263	HR 206					
Nicrofer 4722 Co – alloy X	2.4665	NiCr22Fe18Mo	N06002	HR 204					
Nicrofer 4626 MoW – alloy 333	2.4608	NiCr26MoW	N06333	–					
NiCrFe – FeNiCr – standard alloys									
Nicrofer 7216 H – alloy 600 H	2.4816	NiCr15Fe	N06600	NA14(H)					
Nicrofer 6023 H – alloy 601 H	2.4851	NiCr23Fe	N06601	–					
Nicrofer 45 TM – alloy 45 TM	2.4889	NiCr28FeSiCe	N06045	–					
Nicrofer 3220 HT – alloy 800 HP	1.4959	X8NiCrAlTi32-21	N08811	–					
Nicrofer 3220 H – alloy 800 H	1.4876	X10NiCrAlTi32-20	N08810	NA15(H)					
	1.4958	X5NiCrAlTi31-20	N08810	NA15(H)					
CoCrNiW									
Conicro 5010 W – alloy 25	2.4964	CoCr20W15Ni	R30605	HR 240					
Conicro 4023 W – alloy 188	2.4683	CoCr22NiW	R30188	–					

Krupp VDM high-performance materials and products

Krupp VDM alloy designation		Werkst.-Nr.	Designation	UNS-designation	BS-designation	Available product form				
						Sheet, plate	Strip	Rod, bar	Forgings	Wire
Heating-element and resistance alloys										
NiCr – FeCrAl										
Cronix 80	– alloy NiCr 80/20	2.4869	NiCr80-20	N 06003	–					
Cronix 70	– alloy NiCr 70/30	2.4658	NiCr70-30	N 06008	–					
Controlled expansion and glass-sealing alloys										
FeNi – FeNiCo										
Pernifer 36	– alloy 36	1.3912	Ni36	K 93600/601	–					
Pernifer 2918		1.3981	NiCo29-18	K 94610	–					

Production of seamless tubes and pipes is carried out at DMV Stainless BV using stock supplied by Krupp VDM.

Seam-welded tubes and pipes are obtainable from reputed manufacturers and are produced from stock supplied by Krupp VDM.

Krupp VDM alloy designation		Werkst.-Nr.	Designation	UNS	AWS	Classification	BS 2901 Type	Available product form		
								Filler Metal		Weld Strip
								Rod	Wire	
High-performance alloys for welding products										
Ni – NiCu – CuNi – NiMoCrFe – NiCrFe – FeNiCr										
Nickel S 9604	– FM 61	2.4155	SG-NiTi4	N02061	A 5.14	ERNi-1	NA 32			
Nicorros S 6530	– FM 60	2.4377	SG-NiCu30MnTi	N04060	A 5.14	ERNiCu-7	NA 33			
Nicorros B 6530	– WS 60	2.4377	UP-NiCu30MnTi	(N04060)	–	(ERNiCu-7)	(NA 33)			
Cunifer S 7030	– FM 67	2.0837	SG-CuNi30Fe	C71581	A 5.7	ERCuNi	C 18			
Cunifer B 7030	– WS 67	2.0837	UP-CuNi30Fe	(C71581)	–	(ERCuNi)	(C 18)			
Cunifer S 9010		2.0873	SG-CuNi10Fe	–	–	–	C 16			
Nickel-Iron S 6040		2.4560	S-NiFe40	–	–	–	–			
Nimofer S 6928	– FM B-2	2.4615	SG-NiMo27	N10665	A 5.14	ERNiMo-7	NA 44			
Nimofer B 6928	– WS B-2	2.4615	UP-NiMo27	(N10665)	–	(ERNiMo-7)	(NA 44)			
Nimofer S 6629	– FM B-4	2.4701	SG-NiMo28Cr	–	–	–	–			
Nimofer S 6224	– FM B-10	2.4702	SG-NiMo24Cr8Fe	–	–	–	–			
Nicrofer S 7020	– FM 82	2.4806	SG-NiCr20Nb	N06082	A 5.14	ERNiCr-3	NA 35			
Nicrofer B 7020	– WS 82	2.4806	UP-NiCr20Nb	(N06082)	–	(ERNiCr-3)	(NA 35)			
Nicrofer S 6616	– FM C-4	2.4611	SG-NiMo16Cr16Ti	N06455	A 5.14	ERNiCrMo-7	NA 45			
Nicrofer B 6616	– WS C-4	2.4611	UP-NiMo16Cr16Ti	(N06455)	–	(ERNiCrMo-7)	(NA 45)			
Nicrofer S 6219	– FM 626	2.4832	SG-NiCr19MoSi	–	–	–	–			
Nicrofer S 6030	– FM 690	2.4642	NiCr29Fe	N06690	–	–	–			
Nicrofer S 6025	– FM 602	2.4649	SG-NiCr25FeAlY	(N06025)	–	–	–			
Nicrofer S 6020	– FM 625	2.4831	SG-NiCr21Mo9Nb	N06625	A 5.14	ERNiCrMo-3	NA 43			
Nicrofer B 6020	– WS 625	2.4831	UP-NiCr21Mo9Nb	(N06625)	–	(ERNiCrMo-3)	(NA 43)			
Nicrofer S 5923	– FM 59	2.4607	SG-NiCr23Mo16	N06059	A 5.14	ERNiCrMo-13	–			
Nicrofer B 5923	– WS 59	2.4607	UP-NiCr23Mo16	(N06059)	–	(ERNiCrMo-13)	–			
Nicrofer S 5716	– FM C-276	2.4886	SG-NiMo16Cr16W	N10276	A 5.14	ERNiCrMo-4	NA 48			
Nicrofer B 5716	– WS C-276	2.4886	UP-NiMo16Cr16W	(N10276)	–	(ERNiCrMo-4)	(NA 48)			
Nicrofer S 5520	– FM 617	2.4627	SG-NiCr22Co12Mo	N06617	A 5.14	ERNiCrCoMo-1	NA 50			
Nicrofer S 5219	– FM 718	2.4667	SG-NiCr19NbMoTi	N07718	A 5.14	ERNiFeCr-2	–			
Nicrofer S 5120	– FM 263	2.4650	NiCo20Cr20MoTi	N07263	–	–	NA 38			
Nicrofer S 4722	– FM X	2.4613	SG-NiCr21Fe18Mo	N06002	A 5.14	ERNiCrMo-2	NA 40			
Nicrofer S 4626	– FM 333	2.4608	NiCr26MoW	N06333	–	–	–			
Nicrofer S 3127	– FM 31	1.4562	X1NiCrMoCu32-28-7	N08031	–	–	–			
Nicrofer S 3033	– FM 33	1.4591	X1CrNiMoCuN33-32-1	R20033	–	–	–			
Nicrofer S 3028	– FM 28	1.4563	X1NiCrMoCuN31-27-4	–	–	–	–			
Conicro S 5010	– FM 25	2.4964	CoCr20W15Ni	R30605	–	–	–			
Conicro S 4023	– FM 188	2.4683	CoCr22NiW	R30188	–	–	–			

FM = Filler Metal / WS = Weld Strip

Summary of Krupp VDM high-performance materials
UNS-Designations

UNS-designation	Werkst.-Nr.	Krupp VDM alloy designation	
High-performance alloys			
C70600	2.0872	Cunifer 10	– alloy CuNi 90/10
C71500	2.0882	Cunifer 30	– alloy CuNi 70/30
K93600/601	1.3912	Pernifer 36	– alloy 36
K94610	1.3981	Pernifer 2918	
N02200	2.4066	VDM Nickel 99.2	– alloy 200
N02201	2.4068	VDM LC-Nickel 99.2	– alloy 201
N02205	2.4061	VDM LC-Nickel 99.6	– alloy 205
N04400	2.4360	Nicorros	– alloy 400
N05500	2.4375	Nicorros Al	– alloy K-500
N06002	2.4665	Nicrofer 4722 Co	– alloy X
N06003	2.4869	Cronix 80	– alloy NiCr 80/20
N06008	2.4658	Cronix 70	– alloy NiCr 70/30
N06025	2.4633	Nicrofer 6025 HT	– alloy 602 CA
N06045	2.4889	Nicrofer 45 TM	– alloy 45 TM
N06059	2.4605	Nicrofer 5923 hMo	– alloy 59
N06075	2.4951	Nicrofer 7520	– alloy 75
N06333	2.4608	Nicrofer 4626 MoW	– alloy 333
N06455	2.4610	Nicrofer 6616 hMo	– alloy C-4
N06600	2.4816	Nicrofer 7216	– alloy 600
N06600	2.4816	Nicrofer 7216 H	– alloy 600 H
N06601	2.4851	Nicrofer 6023	– alloy 601
N06601	2.4851	Nicrofer 6023 H	– alloy 601 H
N06602	2.4817	Nicrofer 7216 LC	– alloy 600 L
N06617	2.4663	Nicrofer 5520 Co	– alloy 617
N06625	2.4856	Nicrofer 6020 hMo	– alloy 625
N06690	2.4642	Nicrofer 6030	– alloy 690
N06985	2.4619	Nicrofer 4823 hMo	– alloy G-3
N07080	2.4952	Nicrofer 7520 Ti	– alloy 80 A
N07263	2.4650	Nicrofer 5120 CoTi	– alloy C-263
N07718	2.4668	Nicrofer 5219 Nb	– alloy 718
N07750	2.4669	Nicrofer 7016 TiNb	– alloy X-750
N07751	2.4694	Nicrofer 7016 TiAl	– alloy 751
N08020	2.4660	Nicrofer 3620 Nb	– alloy 20
N08028	1.4563	Nicrofer 3127 LC	– alloy 28
N08031	1.4562	Nicrofer 3127 hMo	– alloy 31
(N08310)	1.4465	Cronifer 2525 LCN	
(N08330)	1.4864	Nicrofer 3718	– alloy (330)
N08800	1.4876/1.4958 RK	Nicrofer 3220	– alloy 800
N08810	1.4876/1.4958	Nicrofer 3220 H	– alloy 800 H
N08811	1.4959	Nicrofer 3220 HT	– alloy 800 HP
N08825	2.4858	Nicrofer 4221	– alloy 825
N08926	1.4529	Cronifer 1925 hMo	– alloy 926
N10276	2.4819	Nicrofer 5716 hMoW	– alloy C-276
N10629	2.4600	Nimofer 6629	– alloy B-4
N10665	2.4617	Nimofer 6928	– alloy B-2

UNS-designation	Werkst.-Nr.	Krupp VDM alloy designation	
High-performance alloys			
R20033	1.4591	Nicrofer 3033	– alloy 33
R30188	2.4683	Conicro 4023 W	– alloy 188
R30605	2.4964	Conicro 5010 W	– alloy 25
–	2.4710	Nimofer 6224	– alloy B-10
–	1.4862	Nicrofer 3718 So	– alloy DS
–	2.4855	Nicrofer 6219 Si	– alloy 626 Si
High-performance alloys for welding products			
N02061	2.4155	VDM Nickel S 9604	– FM 61
N04060	2.4377	Nicorros S 6530	– FM 60
(N04060)	2.4377	Nicorros B 6530	– WS 60
N06002	2.4613	Nicrofer S 4722	– FM X
N06025	2.4649	Nicrofer S 6025	– FM 602
N06059	2.4607	Nicrofer S 5923	– FM 59
(N06059)	2.4607	Nicrofer B 5923	– WS 59
N06082	2.4806	Nicrofer S 7020	– FM 82
(N06082)	2.4806	Nicrofer B 7020	– WS 82
N06333	2.4608	Nicrofer S 4626	– FM 333
N06455	2.4611	Nicrofer S 6616	– FM C-4
(N06455)	2.4611	Nicrofer B 6616	– WS C-4
N06617	2.4627	Nicrofer S 5520	– FM 617
N06625	2.4831	Nicrofer S 6020	– FM 625
(N06625)	2.4831	Nicrofer B 6020	– WS 625
N06690	2.4642	Nicrofer S 6030	– FM 690
N07263	2.4650	Nicrofer S 5120	– FM 263
N07718	2.4667	Nicrofer S 5219	– FM 718
N08028	1.4563	Nicrofer S 3028	– FM 28
N08031	1.4562	Nicrofer S 3127	– FM 31
N10276	2.4886	Nicrofer S 5716	– FM C-276
(N10276)	2.4886	Nicrofer B 5716	– WS C-276
N10665	2.4615	Nimofer S 6928	– FM B-2
(N10665)	2.4615	Nimofer B 6928	– WS B-2
C71581	2.0837	Cunifer S 7030	– FM 67
(C71581)	2.0837	Cunifer B 7030	– WS 67
R20033	1.4591	Nicrofer S 3033	– FM 33
R30188	2.4683	Conicro S 4023	– FM 188
R30605	2.4964	Conicro S 5010	– FM 25
–	2.4832	Nicrofer S 6219	– FM 626 Si
–	1.4563	Nicrofer S 3028	– FM 28
–	2.4701	Nimofer S 6629	– FM B-4
–	2.4702	Nimofer S 6224	– FM B-10
–	2.4560	Nickel-Iron S 6040	
–	2.0873	Cunifer S 9010	

Summary of Krupp VDM high-performance materials
Alloy-Designations

Alloy designation	Werkst.-Nr.	Krupp VDM alloy designation	
High-performance alloys			
B-2	2.4617	Nimofer 6928 – alloy B-2	
G-3	2.4619	Nicrofer 4823 hMo – alloy G-3	
B-4	2.4600	Nimofer 6629 – alloy B-4	
C-4	2.4610	Nicrofer 6616 hMo – alloy C-4	
B-10	2.4710	Nimofer 6224 – alloy B-10	
20	2.4660	Nicrofer 3620 Nb – alloy 20	
25	2.4964	Conicro 5010 W – alloy 25	
28	1.4563	Nicrofer 3127 LC – alloy 28	
31	1.4562	Nicrofer 3127 hMo – alloy 31	
33	1.4591	Nicrofer 3033 hMo – alloy 33	
36	1.3912	Pernifer 36 – alloy 36	
45 TM	2.4889	Nicrofer 45 TM – alloy 45TM	
59	2.4605	Nicrofer 5923 hMo – alloy 59	
CuNi 70/30	2.0882	Cunifer 30 – alloy CuNi 70/30	
NiCr 70/30	2.4658	Cronix 70 – alloy NiCr 70/30	
75	2.4951	Nicrofer 7520 – alloy 75	
NiCr 80/20	2.4869	Cronix 80 – alloy NiCr 80/20	
80 A	2.4952	Nicrofer 7520 Ti – alloy 80 A	
CuNi 90/10	2.0872	Cunifer 10 – alloy CuNi 90/10	
188	2.4683	Conicro 4023 W – alloy 188	
200	2.4066	VDM Nickel 99.2 – alloy 200	
201	2.4068	VDM LC-Nickel 99.2 – alloy 201	
205	2.4061	VDM LC-Nickel 99.6 – alloy 205	
C-263	2.4650	Nicrofer 5120 CoTi – alloy C-263	
C-276	2.4819	Nicrofer 5716 hMoW – alloy C-276	
(330)	1.4864	Nicrofer 3718 – (alloy 330)	
333	2.4608	Nicrofer 4626 MoW – alloy 333	
400	2.4360	Nicorros – alloy 400	
K-500	2.4375	Nicorros Al – alloy K-500	
600	2.4816	Nicrofer 7216 – alloy 600	
600 H	2.4816	Nicrofer 7216 H – alloy 600 H	
600 L	2.4817	Nicrofer 7216 LC – alloy 600 L	
601	2.4851	Nicrofer 6023 – alloy 601	
601 H	2.4851	Nicrofer 6023 H – alloy 601 H	
602 CA	2.4633	Nicrofer 6025 HT – alloy 602 CA	
617	2.4663	Nicrofer 5520 Co – alloy 617	
625	2.4856	Nicrofer 6020 hMo – alloy 625	
626 Si	2.4855	Nicrofer 6219 Si – alloy 626 Si	
690	2.4642	Nicrofer 6030 – alloy 690	
718	2.4668	Nicrofer 5219 Nb – alloy 718	
X-750	2.4669	Nicrofer 7016 TiNb – alloy X-750	
751	2.4694	Nicrofer 7016 TiAl – alloy 751	
800	1.4876/1.4958 RK	Nicrofer 3220 – alloy 800	
800 H	1.4876/1.4958	Nicrofer 3220 H – alloy 800 H	
800 HP	1.4959	Nicrofer 3220 HT – alloy 800 HP	
825	2.4858	Nicrofer 4221 – alloy 825	

Alloy designation	Werkst.-Nr.	Krupp VDM alloy designation	
High-performance alloys			
926	1.4529	Cronifer 1925 hMo – alloy 926	
DS	1.4862	Nicrofer 3718 So – alloy DS	
X	2.4665	Nicrofer 4722 Co – alloy X	
–	1.3981	Pernifer 2918	
–	1.4465	Cronifer 2525 LCN	
High-performance alloys for welding products			
FM B-2	2.4615	Nimofer S 6928 – FM B-2	
WS B-2	2.4615	Nimofer B 6928 – WS B-2	
FM B-4	2.4701	Nimofer S 6629 – FM B-4	
FM B-10	2.4702	Nimofer S 6224 – FM B-10	
FM C-4	2.4611	Nicrofer S 6616 – FM C-4	
WS C-4	2.4611	Nicrofer B 6616 – WS C-4	
FM 25	2.4964	Conicro S 5010 – FM 25	
FM 28	1.4563	Nicrofer S 3028 – FM 28	
FM 31	1.4562	Nicrofer S 3127 – FM 31	
FM 33	1.4591	Nicrofer S 3033 – FM 33	
FM 59	2.4607	Nicrofer S 5923 – FM 59	
WS 59	2.4607	Nicrofer B 5923 – WS 59	
FM 60	2.4377	Nicorros S 6530 – FM 60	
WS 60	2.4377	Nicorros B 6530 – WS 60	
FM 61	2.4155	Nickel S 9604 – FM 61	
FM 67	2.0837	Cunifer S 7030 – FM 67	
WS 67	2.0837	Cunifer B 7030 – WS 67	
FM 82	2.4806	Nicrofer S 7020 – FM 82	
WS 82	2.4896	Nicrofer B 7020 – WS 82	
FM 188	2.4683	Conicro S 4023 – FM 188	
FM 263	2.4650	Nicrofer S 5120 – FM 263	
FM C-276	2.4886	Nicrofer S 5716 – FM C-276	
WS C-276	2.4886	Nicrofer B 5716 – WS C-276	
FM 333	2.4608	Nicrofer S 4626 – FM 333	
FM 602 CA	2.4649	Nicrofer S 6025 – FM 602	
FM 617	2.4627	Nicrofer S 5520 – FM 617	
FM 625	2.4831	Nicrofer S 6020 – FM 625	
WS 625	2.4831	Nicrofer B 6020 – WS 625	
FM 626	2.4832	Nicrofer S 6219 – FM 626	
FM 690	2.4642	Nicrofer S 6030 – FM 690	
FM X	2.4613	Nicrofer S 4722 – FM X	
FM 718	2.4667	Nicrofer S 5219 – FM 718	
–	2.0873	Cunifer S 9010	
–	2.4560	Nickel-Iron S 6040	

Summary of Krupp VDM high-performance materials
Werkstoff-Nummern

Werkst.-Nr.	UNS-designation	Krupp VDM alloy designation	
High-performance alloys			
1.3912	K93600/601	Pernifer 36	– alloy 36
1.3981	K94610	Pernifer 2918	
1.4465	(N08310)	Cronifer 2525 LCN	
1.4529	N08926	Cronifer 1925 hMo	– alloy 926
1.4562	N08031	Nicrofer 3127 hMo	– alloy 31
1.4563	N08028	Nicrofer 3127 LC	– alloy 28
1.4591	R20033	Nicrofer 3033	– alloy 33
1.4862	–	Nicrofer 3718 So	– alloy DS
1.4864	(N08330)	Nicrofer 3718	– (alloy 330)
1.4876	N08800	Nicrofer 3220	– alloy 800
1.4876	N08810	Nicrofer 3220 H	– alloy 800 H
1.4958	N08810	Nicrofer 3220 H	– alloy 800 H
1.4958 RK	N08800	Nicrofer 3220	– alloy 800
1.4959	N08811	Nicrofer 3220 HT	– alloy 800 HP
2.0872	C70600	Cunifer 10	– CuNi 90/10
2.0882	C71500	Cunifer 30	– CuNi 70/30
2.4061	N02205	VDM LC-Nickel 99.6	– alloy 205
2.4066	N02200	VDM Nickel 99.2	– alloy 200
2.4068	N02201	VDM LC-Nickel 99.2	– alloy 201
2.4360	N04400	Nicorros	– alloy 400
2.4375	N05500	Nicorros Al	– alloy K-500
2.4600	N10629	Nimofer 6629	– alloy B-4
2.4605	N06059	Nicrofer 5923 hMo	– alloy 59
2.4608	N06333	Nicrofer 4626 MoW	– alloy 333
2.4610	N06455	Nicrofer 6616 hMo	– alloy C-4
2.4617	N10665	Nimofer 6928	– alloy B-2
2.4619	N06985	Nicrofer 4823 hMo	– alloy G-3
2.4633	N06025	Nicrofer 6025 HT	– alloy 602 CA
2.4642	N06690	Nicrofer 6030	– alloy 690
2.4650	N07263	Nicrofer 5120 CoTi	– alloy C-263
2.4658	N06008	Cronix 70	– alloy NiCr 70/30
2.4660	N08020	Nicrofer 3620 Nb	– alloy 20
2.4663	N06617	Nicrofer 5520 Co	– alloy 617
2.4665	N06002	Nicrofer 4722 Co	– alloy X
2.4668	N07718	Nicrofer 5219 Nb	– alloy 718
2.4669	N07750	Nicrofer 7016 TiNb	– alloy X-750
2.4683	R30188	Conicro 4023 W	– alloy 188
2.4710	–	Nimofer 6224	– alloy B-10
2.4816	N06600	Nicrofer 7216	– alloy 600
2.4816	N06600	Nicrofer 7216 H	– alloy 600 H
2.4817	N06602	Nicrofer 7216 LC	– alloy 600 L
2.4819	N10276	Nicrofer 5716 hMoW	– alloy C-276
2.4851	N06601	Nicrofer 6023	– alloy 601
2.4851	N06601	Nicrofer 6023 H	– alloy 601 H
2.4855	–	Nicrofer 6219 Si	– alloy 626 Si

Werkst.-Nr.	UNS-designation	Krupp VDM alloy designation	
High-performance alloys			
2.4856	N06625	Nicrofer 6020 hMo	– alloy 625
2.4858	N08825	Nicrofer 4221	– alloy 825
2.4869	N06003	Cronix 80	– alloy NiCr 80/20
2.4889	N06045	Nicrofer 45 TM	– alloy 45 TM
2.4951	N06075	Nicrofer 7520	– alloy 75
2.4952	N07080	Nicrofer 7520 Ti	– alloy 80 A
2.4964	R30605	Conicro 5010 W	– alloy 25
High-performance alloys for welding products			
1.4562	N08031	Nicrofer S 3127	– FM 31
1.4563	–	Nicrofer S 3028	– FM 28
1.4591	R20033	Nicrofer S 3033	– FM 33
2.0837	C71581	Cunifer S 7030	– FM 67
2.0837	(C71581)	Cunifer B 7030	– WS 67
2.0873	–	Cunifer S 9010	
2.4155	N02061	Nickel S 9604	– FM 61
2.4377	N04060	Nicorros S 6530	– FM 60
2.4377	(N04060)	Nicorros B 6530	– WS 60
2.4560	–	Nickel-Iron S 6040	
2.4607	N06059	Nicrofer S 5923	– FM 59
2.4607	(N06059)	Nicrofer B 5923	– WS 59
2.4608	N06333	Nicrofer S 4626	– FM 333
2.4611	N06455	Nicrofer S 6616	– FM C-4
2.4611	(N06455)	Nicrofer B 6616	– WS C-4
2.4613	N06002	Nicrofer S 4722	– FM X
2.4615	N10665	Nimofer S 6928	– FM B-2
2.4615	(N10665)	Nimofer B 6928	– WS B-2
2.4627	N06617	Nicrofer S 5520	– FM 617
2.4642	N06690	Nicrofer S 6030	– FM 690
2.4649	N06025	Nicrofer S 6025	– FM 602
2.4650	N07263	Nicrofer S 5120	– FM 263
2.4667	N07718	Nicrofer S 5219	– FM 718
2.4683	R30188	Conicro S 4023	– FM 188
2.4701	–	Nimofer S 6629	– FM B-4
2.4702	–	Nimofer S 6224	– FM B-10
2.4806	N06082	Nicrofer S 7020	– FM 82
2.4806	(N06082)	Nicrofer B 7020	– WS 82
2.4831	N 06625	Nicrofer S 6020	– FM 625
2.4831	(N06625)	Nicrofer B 6020	– WS 625
2.4832	–	Nicrofer S 6219	– FM 626
2.4886	N10276	Nicrofer S 5716	– FM C-276
2.4886	(N10276)	Nicrofer B 5716	– WS C-276
2.4964	R30605	Conicro S 5010	– FM 25

Corrosion-resistant alloys
Sheet and plate

High-performance materials: sheet and plate
Designations and specifications

Krupp VDM alloy designation		Designations and specifications					
		Werkst.-Nr.	Designation	UNS	ISO 9722, 6208	BS	AFNOR
Corrosion-resistant alloys							
Ni – NiCu							
VDM Nickel 99.2	– alloy 200	2.4066	Ni 99.2	N02200	NW2200	NA 11	–
VDM LC-Nickel 99.2	– alloy 201	2.4068	LC-Ni 99	N02201	NW2201	NA 12	–
VDM LC-Nickel 99.6	– alloy 205	2.4061	LC-Ni 99.6	N02205	–	–	–
Nicorros	– alloy 400	2.4360	NiCu30Fe	N04400	NW4400	NA 13	NU 30
NiMo – NiCrMo – NiCrFeMo – superalloys							
Nimofer 6928	– alloy B-2	2.4617	NiMo28	N10665	NW0665	–	NiMo28
Nimofer 6629	– alloy B-4	2.4600	NiMo29Cr	N10629	NW0629	–	–
Nimofer 6624	– alloy B-10	2.4710	NiMo23Cr8Fe	–	–	–	–
Nicrofer 6616 hMo	– alloy C-4	2.4610	NiMo16Cr16Ti	N06455	NW6455	–	–
Nicrofer 6020 hMo	– alloy 625	2.4856	NiCr22Mo9Nb	N06625	NW6625	NA 21	NC22DNb
Nicrofer 5923 hMo	– alloy 59	2.4605	NiCr23Mo16Al	N06059	–	–	–
Nicrofer 5716 hMoW	– C-276	2.4819	NiMo16Cr15W	N10276	NW 0276	–	NC17D
Nicrofer 5219 Nb	– alloy 718	2.4668	NiCr19NbMo	N07718	NW7718	–	NC19FeNb
Nicrofer 4823 hMo	– alloy G-3	2.4619	NiCr22Mo7Cu	N06985	NW6985	–	–
NiCrFe – FeNiCrMo – standard alloys							
Nicrofer 7216 LC	– alloy 600 L	2.4817	LC-NiCr15Fe	N06602	NW6602	NA 14	NC15Fe
Nicrofer 6030	– alloy 690	2.4642	NiCr29Fe	N06690	NW6690	–	NC30Fe
Nicrofer 4221	– alloy 825	2.4858	NiCr21Mo	N08825	NW8825	NA 16	NC21FeDU
Nicrofer 3620 Nb	– alloy 20	2.4660	NiCr20CuMo	N08020	NW8020	–	–
Nicrofer 3220	– alloy 800	1.4876	X10NiCrAlTi32-20	N08800	NW8800	NA 15	Z 8 NC 32.21
		1.4958 RK	X5NiCrAlTi31-20 RK	–	–	–	–
Nicrofer 3127 hMo	– alloy 31	1.4562	X1NiCrMoCu32-28-7	N08031	–	–	–
Nicrofer 3127 LC	– alloy 28	1.4563	X1NiCrMoCu31-27-4	N08028	NW8028	–	Z 1 NCDU 31.27
FeNiCr – special stainless steels							
Nicrofer 3033	– alloy 33	1.4591	X1CrNiMoCuN33-32-1	R20033	–	–	–
Cronifer 2525 LCN		1.4465	X1CrNiMoN25-25-2	(N08310)	–	–	(Z 1 CND 25.22 Az)
Cronifer 1925 hMo	– alloy 926	1.4529	X1NiCrMoCuN25-20-7	N08926	–	–	–
CuNi							
Cunifer 30	– alloy CuNi70/30	2.0882	CuNi30Mn1Fe	C71500	R 429	CN 107	CuNi30Mn1Fe
Cunifer 10	– alloy CuNi90/10	2.0872	CuNi10Fe1Mn	C70600	R 429	CN 102	CuNi10Fe1Mn

High-performance materials: sheet and plate
Designations and specifications

Designations and specifications							Krupp VDM alloy designation
DIN, EN	DIN, SEW, WL Chemical composition	DIN, SEW, WL Technical delivery conditions	VdTÜV data sheet	ASTM	ASME	AMS	
Corrosion-resistant alloys							
Ni – NiCu							
–	17740	17750	–	B162	SB162	–	VDM Nickel 99.2 – alloy 200
–	17740	17750	345	B162	SB162	55531	VDM LC-Nickel 99.2 – alloy 201
–	17740	17750	–	–	–	–	VDM LC-Nickel 99.6 – alloy 205
–	17743	17750	263	B127	SB127	4544	Nicorros – alloy 400
NiMo – NiCrMo – NiCrFeMo – superalloys							
–	17744	17750	436	B333	SB333	–	Nimofer 6928 – alloy B-2
–	–	–	512	B333	–	–	Nimofer 6629 – alloy B-4
–	–	–	–	–	–	–	Nimofer 6624 – alloy B-10
–	17744	17750	424	B575	SB575	–	Nicrofer 6616 hMo – alloy C-4
–	17744	17750	499	B443	SB443	5599	Nicrofer 6020 hMo – alloy 625
–	–	–	505	B575	SB575	–	Nicrofer 5923 hMo – alloy 59
–	17744	17750	400	B575	SB575	–	Nicrofer 5716 hMoW – alloy C-276
–	WL 2.4668	WL Teil 1	–	B670	–	5596, 5597	Nicrofer 5219 Nb – alloy 718
–	17744	17750	–	B582	SB582	–	Nicrofer 4823 hMo – alloy G-3
NiCrFe – FeNiCrMo – standard alloys							
–	17742	17750	–	B168	SB168	–	Nicrofer 7216 LC – alloy 600 L
–	–	–	–	B168	SB168	–	Nicrofer 6030 – alloy 690
–	17744	17750	432/1	B424	SB424	–	Nicrofer 4221 – alloy 825
–	–	–	–	B463	SB463	–	Nicrofer 3620 Nb – alloy 20
10095	17460	SEW 310	412	B409	SB409	5871	Nicrofer 3220 – alloy 800
–	–	–	509	B625	SB625	–	Nicrofer 3127 hMo – alloy 31
10088-2	SEW 400	SEW 310	(483)	B709	SB709	–	Nicrofer 3127 LC – alloy 28
FeNiCr – special stainless steels							
	–	–	516	B 625	–	–	Nicrofer 3033 – alloy 33
	SEW 400	SEW 310, 400	486	–	–	–	Cronifer 2525 LCN
10088-2	–	–	502	B 625	SB 625	–	Cronifer 1925 hMo – alloy 926
CuNi							
–	17664	17670, 17675	(AD-W6/2)	B 122, 171	SB 171	–	Cunifer 30 – alloy CuNi70/30
–	17664	17670, 17675	(AD-W6/2)	B 122, 171	SB 171	–	Cunifer 10 – alloy CuNi90/10

High-performance materials: sheet and plate
Chemical composition

Krupp VDM alloy designation		Chemical composition, %						
		Ni	Cr	Fe	C	Mn	Si	Cu
Corrosion-resistant alloys								
Ni – NiCu								
VDM Nickel 99.2	– alloy 200	≥ 99.2	–	≤ 0.4	≤ 0.10	≤ 0.3	≤ 0.1	≤ 0.2
VDM LC-Nickel 99	– alloy 201	≥ 99.0	–	≤ 0.4	≤ 0.02	≤ 0.3	≤ 0.1	≤ 0.2
VDM LC-Nickel 99.6	– alloy 205	≥ 99.6	–	≤ 0.2	≤ 0.02	≤ 0.3	≤ 0.1	≤ 0.1
Nicorros	– alloy 400	≥ 63	–	1.0 – 2.5	≤ 0.15	≤ 1.25	≤ 0.5	28.0 – 34.0
NiMo – NiCrMo – NiCrFeMo – superalloys								
Nimofer 6928	– alloy B-2	balance	0.4 – 1.0	1.6 – 2.0	≤ 0.01	≤ 1.0	≤ 0.08	≤ 0.5
Nimofer 6629	– alloy B-4	≥ 65.0	0.5 – 1.5	2.0 – 6.0	≤ 0.01	≤ 1.5	≤ 0.05	≤ 0.5
Nimofer 6224	– alloy B-10	≥ 58.0	6.0 – 10.0	5.0 – 8.0	≤ 0.01	≤ 1.0	≤ 0.1	≤ 0.5
Nicrofer 6616 hMo	– alloy C-4	balance	14.5 – 17.5	≤ 3.0	≤ 0.009	≤ 1.0	≤ 0.05	–
Nicrofer 6020 hMo	– alloy 625	balance	21.0 – 23.0	≤ 3.0	≤ 0.025	≤ 0.40	≤ 0.40	–
Nicrofer 5923 hMo	– alloy 59	balance	22.0 – 24.0	≤ 1.5	≤ 0.010	≤ 0.5	≤ 0.10	–
Nicrofer 5716 hMoW	– alloy C-276	balance	15.0 – 16.5	4.0 – 7.0	≤ 0.010	≤ 1.0	≤ 0.08	–
Nicrofer 5219 Nb	– alloy 718	50.0 – 55.0	17.0 – 21.0	balance	0.02 – 0.08	≤ 0.35	≤ 0.35	≤ 0.20
Nicrofer 4823 hMo	– alloy G-3	balance	21.5 – 23.5	18.0 – 21.0	≤ 0.015	≤ 1.0	≤ 1.0	1.5 – 2.5
NiCrFe – FeNiCrMo – standard alloys								
Nicrofer 7216 LC	– alloy 600 L	≥ 72.0	14.0 – 17.0	6.0 – 10.0	≤ 0.025*	≤ 1.0	≤ 0.5	≤ 0.5
Nicrofer 6030	– alloy 690	≥ 60.0	27.0 – 30.0	8.0 – 10.0	≤ 0.02	≤ 0.3	≤ 0.3	≤ 0.5
Nicrofer 4221	– alloy 825	38.0 – 46.0	19.5 – 23.5	balance	≤ 0.025	≤ 1.0	≤ 0.5	1.5 – 3.0
Nicrofer 3620 Nb	– alloy 20	36.5 – 38.0	19.0 – 21.0	balance	≤ 0.02	1.0 – 2.0	≤ 0.7	3.0 – 4.0
Nicrofer 3220	– alloy 800	30.0 – 32.0	19.0 – 21.5	balance	0.04 – 0.08	0.5 – 1.0	0.2 – 0.6	≤ 0.5
Nicrofer 3127 hMo	– alloy 31	30.0 – 32.0	26.0 – 28.0	balance	≤ 0.015	≤ 2.0	≤ 0.3	1.0 – 1.4
Nicrofer 3127 LC	– alloy 28	30.0 – 32.0	26.0 – 28.0	balance	≤ 0.015	≤ 2.0	≤ 0.7	1.0 – 1.4
FeNiCr – special stainless steels								
Nicrofer 3033	– alloy 33	30.0 – 33.0	31.0 – 35.0	balance	≤ 0.015	≤ 2.0	≤ 0.5	0.3 – 1.2
Cronifer 2525 LCN		24.0 – 25.0	24.0 – 25.5	balance	≤ 0.02	1.5 – 2.0	≤ 0.5	≤ 1.0
Cronifer 1925 hMo	– alloy 926	24.5 – 25.5	20.0 – 21.0	balance	≤ 0.020	≤ 1.0	≤ 0.5	0.8 – 1.0
CuNi								
Cunifer 30	– alloy CuNi70/30	30.0 – 32.0	–	0.4 – 1.0	≤ 0.02	0.5 – 1.0	–	balance
Cunifer 10	– alloy CuNi90/10	9.0 – 11.0	–	1.0 – 1.8	≤ 0.05	0.5 – 1.0	–	balance

High-performance materials: sheet and plate
Chemical composition

Chemical composition, %						Krupp VDM alloy designation	
Mo	Co	Al	Ti	Nb	others		
Corrosion-resistant alloys							
Ni – NiCu							
–	–	–	–	–	Mg ≤ 0.05	VDM Nickel 99.2	– alloy 200
–	–	–	0.01 – 0.10	–	Mg ≤ 0.05	VDM LC-Nickel 99.2	– alloy 201
–	–	–	0.01 – 0.10	–	Mg ≤ 0.05	VDM LC-Nickel 99.6	– alloy 205
–	–	≤ 0.5	≤ 0.3	–	Mg ≤ 0.05	Nicorros	– alloy 400
NiMo – NiCrMo – NiCrFeMo – superalloys							
26.0 – 30.0	≤ 1.0	–	–	–	–	Nimofer 6928	– alloy B-2
26.0 – 30.0	≤ 2.5	≤ 0.1 – 0.5	–	–	–	Nimofer 6629	– alloy B-4
21.0 – 25.0	–	≤ 0.5	–	–	–	Nimofer 6624	– alloy B-10
14.0 – 17.0	≤ 2.0	–	≤ 0.7	–	–	Nicrofer 6616 hMo	– alloy C-4
8.0 – 10.0	≤ 1.0	≤ 0.40	≤ 0.4	3.2 – 3.8	–	Nicrofer 6020 hMo	– alloy 625
15.0 – 16.5	≤ 0.3	0.1 – 0.4	–	–	–	Nicrofer 5923 hMo	– alloy 59
15.0 – 17.0	≤ 2.5	–	–	–	W = 3.0 – 4.5, V = 0.1 – 0.3	Nicrofer 5716 hMoW	– alloy C-276
2.8 – 3.3	≤ 1.0	0.3 – 0.7	0.7 – 1.15	4.8 – 5.5	B = 0.002 – 0.006	Nicrofer 5219 Nb	– alloy 718
6.0 – 8.0	≤ 5.0	–	–	0.2 – 0.5	W ≤ 1.5	Nicrofer 4823 hMo	– alloy G-3
NiCrFe – FeNiCrMo – standard alloys							
–	–	≤ 0.3	≤ 0.3	–	B ≤ 0.006	Nicrofer 7216 LC	– alloy 600 L
–	–	≤ 0.3	≤ 0.3	–	–	Nicrofer 6020	– alloy 690
2.5 – 3.5	–	≤ 0.2	0.6 – 1.2	–	(C = 0.04 – 0.06 available on request)	Nicrofer 4221	– alloy 825
–	–	0.15 – 0.40	0.35 – 0.60	–	Al+Ti ≤ 1.0	Nicrofer 3220 LC	– alloy 800 L
–	–	0.20 – 0.40	0.20 – 0.50	–	Al+Ti ≤ 1.0	Nicrofer 3220	– alloy 800
6.0 – 7.0	–	–	–	–	N = 0.15 – 0.25	Nicrofer 3127 hMo	– alloy 31
3.0 – 4.0	–	–	–	–	N = 0.04 – 0.07	Nicrofer 3127 LC	– alloy 28
FeNiCr – special stainless steels							
0.5 – 2.0	–	–	–	–	N = 0.35 – 0.60 P ≤ 0.02 S ≤ 0.01	Nicrofer 3033	– alloy 33
2.0 – 2.5	–	–	–	–	N = 0.10 – 0.16	Cronifer 2525 LCN	
6.0 – 6.8	–	–	–	–	N = 0.18 – 0.20	Cronifer 1925 hMo	– alloy 926
CuNi							
–	–	–	–	–	Zn ≤ 0.5, Pb ≤ 0.02	Cunifer 30	– alloy CuNi70/30
–	–	–	–	–	Zn ≤ 0.5, Pb ≤ 0.01	Cunifer 10	– alloy CuNi90/10

High-performance materials: sheet and plate
Physical properties

Krupp VDM alloy designation		Physical properties at room temperature					Thermal expansion between 20 °C and T, 10^{-6}/K							
		Density g/cm³	Specific heat J/kg K	Thermal conductivity W/m K	Electrical resistivity μ Ω cm	Modulus of elasticity kN/mm²	100	200	300	400	500	600	700	800
Corrosion-resistant alloys														
Ni – NiCu														
VDM Nickel 99.2	– alloy 200	8.9	456	70.5	9	205	13.3	13.9	14.3	14.8	15.2	15.6	15.8	16.2
VDM LC-Nickel 99.2	– alloy 201	8.9	456	79	9	207	13.3	13.9	14.3	14.8	15.2	15.6	15.8	16.2
VDM LC-Nickel 99.6	– alloy 205	8.9	456	79	9.5	208	13.4	14.0	14.5	14.8	15.2	15.5	15.8	16.2
Nicorros	– alloy 400	8.8	430	26	51.3	182	13.9	15.5	15.8	16.0	16.3	16.6	17.0	17.4
NiMo – NiCrMo – NiCrFeMo – superalloys														
Nimofer 6928	– alloy B-2	9.2	377	11.4	137	217	10.3	10.8	11.1	11.4	11.6	11.8	–	–
Nimofer 6629	– alloy B-4	9.2	377	11.4	137	217	10.3	10.8	11.1	11.4	11.6	11.8	–	–
Nimofer 6224	– alloy B-10	8.9	374	13.1	130	213	10.6	11.1	11.5	11.9	12.1	–	–	–
Nicrofer 6616 hMo	– alloy C-4	8.6	408	10.1	124	211	10.9	11.9	12.5	12.9	13.2	13.6	14.0	14.5
Nicrofer 6020 hMo	– alloy 625	8.5	415	9.8	128	209	12.8	13.1	13.4	13.7	14.1	14.6	15.2	15.8
Nicrofer 5923 hMo	– alloy 59	8.6	414	10.4	126	210	11.9	12.2	12.5	12.7	12.9	13.1	–	–
Nicrofer 5716 hMoW	– alloy C-276	8.9	407	10.6	125	208	11.7	12.1	12.8	13.1	13.5	14.0	14.7	15.5
Nicrofer 5219 Nb	– alloy 718	8.2	432	11.1	123	205	12.6	13.4	13.8	14.1	14.4	14.8	15.4	16.1
Nicrofer 4823 hMo	– alloy G-3	8.3	441	11.1	115	211	14.3	14.7	15.0	15.3	15.7	16.1	(16.5)	–
NiCrFe – FeNiCrMo – standard alloys														
Nicrofer 7216 LC	– alloy 600 L	8.4	455	14.8	103	214	13.7	14.1	14.4	14.8	15.1	15.4	15.8	16.1
Nicrofer 6030	– alloy 690	8.2	450	12.0	115	215	14.1	14.3	14.5	14.8	15.2	15.7	16.2	16.6
Nicrofer 4221	– alloy 825	8.1	440	10.8	112	195	14.1	14.9	15.2	15.6	15.8	16.0	16.7	17.2
Nicrofer 3620 Nb	– alloy 20	8.1	456	11.5	107	202	15.0	15.6	16.0	16.4	16.7	17.1	(17.4)	–
Nicrofer 3220	– alloy 800	8.0	472	11.5	101	194	15.1	15.7	16.2	16.6	17.0	17.4	17.7	18.0
Nicrofer 3127 hMo	– alloy 31	8.1	452	11.7	103	198	14.3	14.7	15.1	15.5	15.7	15.9	–	–
Nicrofer 3127 LC	– alloy 28	8.0	452	11.7	104	191	15.1	15.5	15.8	16.2	16.6	17.2	–	–
FeNiCr – special stainless steels														
Nicrofer 3033	– alloy 33	7.9	~ 500	13.4	104	195	14.5	15.3	15.3	15.7	16.1	16.5	–	–
Cronifer 2525 LCN		8.0	472	11.9	96	196	16.7	17.2	17.7	18.1	18.4	18.8	19.1	19.4
Cronifer 1925 hMo	– alloy 926	8.1	415	12.0	96	193	15.0	15.7	16.1	16.4	16.7	–	–	–
CuNi														
Cunifer 30	– alloy CuNi70/30	8.9	370	25.7	39	150	15.4	15.9	16.3	16.7	17.1	17.6	18.1	18.6
Cunifer 10	– alloy CuNi90/10	8.9	380	45	19	135	16.4	16.8	17.1	17.5	17.9	18.4	19.0	19.6

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High-performance materials: sheet and plate
Mechanical properties

Mechanical properties at room temperature										
Heat-treatment condition and temperature		annealed/solution treated				age hardened				Krupp VDM alloy designation
		Rp 0.2 N/mm²	Rp 1.0 N/mm²	Rm N/mm²	A5 %	Rp 0.2 N/mm²	Rp 1.0 N/mm²	Rm N/mm²	A5 %	
Corrosion-resistant alloys										
Ni – NiCu										
annealed	700 – 800 °C	≥ 80	≥ 105	≥ 340	≥ 40	–	–	–	–	VDM LC-Nickel 99.6 – alloy 205
annealed	700 – 850 °C	≥ 100	≥ 125	≥ 380	≥ 40	–	–	–	–	VDM Nickel 99.2 – alloy 200
annealed	700 – 850 °C	≥ 80	≥ 105	≥ 340	≥ 40	–	–	–	–	VDM LC-Nickel 99.2 – alloy 201
annealed	700 – 900 °C	≥ 175	≥ 205	≥ 450	≥ 30	–	–	–	–	Nicorros – alloy 400
NiMo – NiCrMo – NiCrFeMo – superalloys										
solution treated	1060 – 1080 °C	≥ 350	≥ 380	≥ 760	≥ 40	–	–	–	–	Nimofer 6928 – alloy B-2
solution treated	1060 – 1120 °C	≥ 340	≥ 380	≥ 755	≥ 40	–	–	–	–	Nimofer 6629 – alloy B-4
solution treated	1150 – 1200 °C	≥ 320	≥ 360	≥ 720	≥ 40	–	–	–	–	Nimofer 6224 – alloy B-10
solution treated	1050 – 1100 °C	≥ 305	≥ 340	≥ 700	≥ 40	–	–	–	–	Nicrofer 6616 hMo – alloy C-4
annealed	950 – 1050 °C	≥ 415	≥ 445	≥ 830	≥ 35	–	–	–	–	Nicrofer 6020 hMo – alloy 625
solution treated	1100 – 1180 °C	≥ 340	≥ 380	≥ 690	≥ 40	–	–	–	–	Nicrofer 5923 hMo – alloy 59
solution treated	1100 – 1160 °C	≥ 310	≥ 330	≥ 750	≥ 30	–	–	–	–	Nicrofer 5716 hMoW – alloy C-276
solution treated 960 °C / age hardened 720/620 °C		≥ 550	–	≥ 965	≥ 30	≥ 1035	–	≥ 1240	≥ 12	Nicrofer 5219 Nb – alloy 718
solution treated	1100 – 1150 °C	≥ 240	≥ 260	≥ 620	≥ 45	–	–	–	–	Nicrofer 4823 hMo – alloy G-3
NiCrFe – FeNiCrMo – standard alloys										
annealed	920 – 980 °C	≥ 180	≥ 210	≥ 550	≥ 30	–	–	–	–	Nicrofer 7216 LC – alloy 600 L
annealed	1020 – 1070 °C	≥ 240	≥ 270	≥ 586	≥ 30	–	–	–	–	Nicrofer 6030 – alloy 690
annealed	920 – 980 °C	≥ 240	≥ 265	≥ 585	≥ 30	–	–	–	–	Nicrofer 4221 – alloy 825
annealed	920 – 960 °C	≥ 240	≥ 280	≥ 550	≥ 30	–	–	–	–	Nicrofer 3620 Nb – alloy 20
annealed	920 – 980 °C	≥ 210	≥ 240	≥ 500	≥ 30	–	–	–	–	Nicrofer 3220 – alloy 800
solution treated	1150 – 1180 °C	≥ 280	≥ 310	≥ 650	≥ 40	–	–	–	–	Nicrofer 3127 hMo – alloy 31
solution treated	1100 – 1160 °C	≥ 215	≥ 245	≥ 500	≥ 35	–	–	–	–	Nicrofer 3127 LC – alloy 28
FeNiCr – special stainless steels										
solution treated	1100 – 1150 °C	≥ 380	≥ 420	≥ 720	≥ 40	–	–	–	–	Nicrofer 3033 – alloy 33
solution treated	1050 – 1150 °C	≥ 260	≥ 295	≥ 540	≥ 35	–	–	–	–	Cronifer 2525 LCN
solution treated	1150 – 1180 °C	≥ 300	≥ 340	≥ 650	≥ 40	–	–	–	–	Cronifer 1925 hMo – alloy 926
CuNi										
annealed	700 – 800 °C	≥ 120	≥ 140	≥ 350	≥ 35	–	–	–	–	Cunifer 30 – alloy CuNi70/30
annealed	750 – 800 °C	≥ 100	≥ 125	≥ 300	≥ 30	–	–	–	–	Cunifer 10 – alloy CuNi90/10

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High-performance materials: sheet and plate
Mechanical properties

Krupp VDM alloy designation		Heat treatment	Mechanical properties at elevated temperatures, °C														
			Yield strength Rp 0.2, N/mm²							Yield strength Rp 1.0, N/mm²							
			100	200	300	400	450	500	600	100	200	300	400	450	500	600
Corrosion-resistant alloys																	
Ni – NiCu																	
VDM LC-Nickel 99.6	– alloy 205	annealed	70	65	60	55	–	–	–	95	90	85	80	–	–	–
VDM Nickel 99.2	– alloy 200	annealed	150	130	140	130	–	100	80	180	160	170	160	–	130	105
VDM LC-Nickel 99.2	– alloy 201	annealed	≥ 70	≥ 65	≥ 60	≥ 55	–	(≥ 50)[1]	(≥ 40)[1]	≥ 95	≥ 90	≥ 85	(≥ 80)[1]	–	(≥ 75)[1]	(≥ 65)[1]
Nicorros	– alloy 400	annealed	≥ 150	≥ 135	≥ 130	≥ 130	–	–	–	220	210	190	180	–	–	–
NiMo – NiCrMo – NiCrFeMo– superalloys																	
Nimofer 6928	– alloy B-2	solution treated	≥ 315	≥ 285	≥ 270	≥ 255	–	–	–	≥ 355	≥ 325	≥ 310	≥ 295	–	–	–
Nimofer 6629	– alloy B-4	solution treated	≥ 315	≥ 285	≥ 270	≥ 255	–	–	–	≥ 355	≥ 325	≥ 310	≥ 295	–	–	–
Nimofer 6224	– alloy B-10	solution treated	≥ 300	≥ 260	≥ 230	≥ 200	≥ 190	–	–	≥ 340	≥ 300	≥ 270	≥ 240	≥ 230	–	–
Nicrofer 6616 hMo	– alloy C-4	solution treated	≥ 285	≥ 255	≥ 245	≥ 225	–	–	–	≥ 315	≥ 285	≥ 270	≥ 260	–	–	–
Nicrofer 6020 hMo	– alloy 625	annealed	≥ 350	≥ 320	≥ 300	≥ 280	≥ 270	–	–	–	–	–	–	–	–	–
Nicrofer 5923 hMo	– alloy 59	solution treated	≥ 290	≥ 250	≥ 220	≥ 190	≥ 175	–	–	≥ 330	≥ 290	≥ 260	≥ 230	≥ 215	–	–
Nicrofer 5716 hMoW	– alloy C-276	solution treated	≥ 280	≥ 240	≥ 220	≥ 195	–	–	–	≥ 305	≥ 275	≥ 245	≥ 230	–	–	–
Nicrofer 5219 Nb	– alloy 718	sol. tr. + age h.	1060	1040	1020	1000	–	980	950	–	–	–	–	–	–	–
Nicrofer 4823 hMo	– alloy G-3	solution treated	270	230	210	190	–	180	170	290	260	240	220	–	210	200
NiCrFe – FeNiCrMo – standard alloys																	
Nicrofer 7216 LC	– alloy 600 L	annealed	≥ 150	≥ 140	≥ 130	≥ 125	–	–	–	≥ 180	≥ 170	≥ 160	≥ 150	–	–	–
Nicrofer 6030	– alloy 690	annealed	260	220	200	180	–	170	160	290	260	240	220	–	200	190
Nicrofer 4221	– alloy 825	annealed	≥ 205	≥ 180	≥ 170	≥ 160	≥ 155	–	–	≥ 235	≥ 205	≥ 195	≥ 185	≥ 180	–	–
Nicrofer 3620 Nb	– alloy 20	annealed	≥ 210	≥ 180	≥ 160	–	–	–	–	≥ 250	≥ 220	≥ 200	–	–	–	–
Nicrofer 3220	– alloy 800	annealed	≥ 185	≥ 160	≥ 145	≥ 130	–	≥ 125	≥ 115	≥ 205	≥ 180	≥ 165	≥ 150	–	≥ 145	≥ 135
Nicrofer 3127 hMo	– alloy 31	solution treated	≥ 210	≥ 180	≥ 165	≥ 150	–	≥ 135	–	≥ 240	≥ 210	≥ 195	≥ 180	–	≥ 165	–
Nicrofer 3127 LC	– alloy 28	solution treated	≥ 190	≥ 165	≥ 150	≥ 135	–	≥ 120	–	≥ 220	≥ 195	≥ 180	≥ 165	–	≥ 150	–
FeNiCr – special stainless steels																	
Nicrofer 3033	– alloy 33	solution treated	≥ 320	≥ 270	≥ 240	≥ 220	–	≥ 210	–	≥ 350	≥ 300	≥ 270	≥ 250	–	≥ 240	–
Cronifer 2525 LCN		solution treated	≥ 195	≥ 155	≥ 135	≥ 125	–	≥ 115	–	≥ 225	≥ 185	≥ 160	≥ 150	–	≥ 140	–
Cronifer 1925 hMo	– alloy 926	solution treated	≥ 230	≥ 190	≥ 170	≥ 160	–	–	–	≥ 270	≥ 225	≥ 205	≥ 190	–	–	–
CuNi																	
Cunifer 30	– alloy CuNi70/30	annealed	–	–	–	–	–	–	–	≥ 130	≥ 123	≥ 117	–	–	–	–
Cunifer 10	– alloy CuNi90/10	annealed	–	–	–	–	–	–	–	≥ 118	≥ 109	≥ 99	–	–	–	–

[1] Values in brackets lie above the point of intersection with the long-time yield strength for 10^5 hrs.

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High-performance materials: sheet and plate
Mechanical properties

Mechanical properties at elevated temperatures, °C												Heat treatment	Krupp VDM alloy designation	
Tensile strength Rm, N/mm²						Elongation A5, %								
100	200	300	400	500	600	100	200	300	400	500	600			
Corrosion-resistant alloys														
Ni – NiCu														
–	–	–	–	–	–	–	–	–	–	–	–	annealed	VDM LC-Nickel 99.6	– alloy 205
390	360	370	330	255	200	40	40	45	40	35	30	annealed	VDM Nickel 99.2	– alloy 200
290	275	260	240	210	150	40	40	45	55	60	75	annealed	VDM LC-Nickel 99.2	– alloy 201
420	390	380	370	–	–	30	30	30	30	–	–	annealed	Nicorros	– alloy 400
NiMo – NiCrMo – NiCrFeMo – superalloys														
–	–	–	–	–	–	–	–	–	–	–	–	solution treated	Nimofer 6928	– alloy B-2
–	–	–	–	–	–	–	–	–	–	–	–	solution treated	Nimofer 6629	– alloy B-4
–	–	–	–	–	–	–	–	–	–	–	–	solution treated	Nimofer 6224	– alloy B-10
740	690	670	660	–	–	–	–	–	–	–	–	solution treated	Nicrofer 6616 hMo	– alloy C-4
740	700	685	670	–	–	–	–	–	–	–	–	annealed	Nicrofer 6020 hMo	– alloy 625
650	615	580	545	–	–	50	50	50	50	50	–	solution treated	Nicrofer 5923 hMo	– alloy 59
685	680	650	630	–	–	50	60	65	60	–	–	solution treated	Nicrofer 5716 hMoW	– alloy C-276
1340	1290	1270	1240	1210	1150	26	25	24	23	23	24	sol. tr. + age h.	Nicrofer 5219 Nb	– alloy 718
640	590	570	550	530	500	60	60	65	65	65	65	solution treated	Nicrofer 4823 hMo	– alloy G-3
NiCrFe – FeNiCrMo – standard alloys														
530	500	485	480	470	460	≥ 45	≥ 45	≥ 45	≥ 45	–	–	annealed	Nicrofer 7216 LC	– alloy 600 L
580	550	520	500	490	470	45	45	45	45	45	35	annealed	Nicrofer 6030	– alloy 690
530	515	500	490	480	–	40	40	45	45	45	–	annealed	Nicrofer 4221	– alloy 825
≥ 520	≥ 495	≥ 470	–	–	–	≥ 30	≥ 30	≥ 30	–	–	–	annealed	Nicrofer 3620 Nb	– alloy 20
425	400	390	380	360	300	–	–	–	–	–	–	annealed	Nicrofer 3220	– alloy 800
630	580	530	500	470	–	50	50	50	50	50	–	solution treated	Nicrofer 3127 hMo	– alloy 31
500	490	480	465	–	–	40	40	40	40	–	–	solution treated	Nicrofer 3127 LC	– alloy 28
FeNiCr– special stainless steels														
–	–	–	–	–	–	–	–	–	–	–	–	solution treated	Nicrofer 3033	– alloy 33
530	500	480	–	–	–	–	–	–	–	–	–	solution treated	Cronifer 2525 LCN	
610	550	510	500	–	–	–	–	–	–	–	–	solution treated	Cronifer 1925 hMo	– alloy 926
CuNi														
–	–	–	–	–	–	–	–	–	–	–	–	annealed	Cunifer 30	– alloy CuNi70/30
310	290	270	–	–	–	–	–	–	–	–	–	annealed	Cunifer 10	– alloy CuNi90/10

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High-performance materials: sheet and plate
Mechanical properties

Krupp VDM alloy designation		Heat treatment	Creep properties, N/mm² at elevated temperatures, °C													
			Creep strength Rp 1.0/10⁴ hrs							Creep-rupture strength Rm/10⁴ hrs						
			300	350	400	450	500	550	600	300	350	400	450	500	550	600
Corrosion-resistant alloys																
Ni – NiCu																
VDM LC-Nickel 99.6	– alloy 205	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
VDM Nickel 99.2	– alloy 200	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
VDM LC-Nickel 99.2	– alloy 201	annealed	110	–	75	(55)	35	(19)	10	260	–	159	–	85	–	45
Nicorros	– alloy 400	annealed	–	–	150	110	75	45	17	–	(400)	280	190	125	80	45
NiMo – NiCrMo – NiCrFeMo – superalloys																
Nimofer 6928	– alloy B-2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Nimofer 6629	– alloy B-4	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Nimofer 6224	– alloy B-10	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Nicrofer 6616 hMo	– alloy C-4	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Nicrofer 6020 hMo	– alloy 625	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Nicrofer 5923 hMo	– alloy 59	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Nicrofer 5716 hMoW	– alloy C-276	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Nicrofer 5219 Nb	– alloy 718	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Nicrofer 4823 hMo	– alloy G-3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
NiCrFe – FeNiCrMo – standard alloys																
Nicrofer 7216 LC	– alloy 600 L	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Nicrofer 6030	– alloy 690	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Nicrofer 4221	– alloy 825	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Nicrofer 3620 Nb	– alloy 20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Nicrofer 3220	– alloy 800	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Nicrofer 3127 hMo	– alloy 31	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Nicrofer 3127 LC	– alloy 28	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
FeNiCr – special stainless steels																
Nicrofer 3033	– alloy 33	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Cronifer 2525 LCN		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Cronifer 1925 hMo	– alloy 926	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CuNi																
Cunifer 30	– alloy CuNi70/30	annealed	92	84	–	–	–	–	–	–	–	–	–	–	–	–
Cunifer 10	– alloy CuNi90/10	annealed	74	65	45	–	–	–	–	–	–	–	–	–	–	–

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High-performance materials: sheet and plate
Mechanical properties

Creep properties, N/mm² at elevated temperatures, °C														Heat treatment	Krupp VDM alloy designation	
Creep strength Rp 1.0/10⁵ hrs							Creep-rupture strength Rm/10⁵ hrs									
300	350	400	450	500	550	600	300	350	400	450	500	550	600			
Corrosion-resistant alloys																
Ni – NiCu																
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Nickel 99.2	– alloy 200
95	(85)	60	(40)	23	(11)	6	238	–	145	–	55	–	25	annealed	LC-Nickel 99.2	– alloy 201
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	LC-Nickel 99.6	– alloy 205
–	–	130	90	62	35	8	–	(350)	240	140	75	40	20	annealed	Nicorros	– alloy 400
NiMo – NiCrMo – NiCrFeMo – superalloys																
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Nimofer 6928	– alloy B-2
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Nimofer 6629	– alloy B-4
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Nimofer 6224	– alloy B-10
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Nicrofer 6616 hMo	– alloy C-4
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Nicrofer 6020 hMo	– alloy 625
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Nicrofer 5923 hMo	– alloy 59
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Nicrofer 5716 hMoW	– alloy C-276
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Nicrofer 5219 Nb	– alloy 718
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Nicrofer 4823 hMo	– alloy G-3
NiCrFe – FeNiCrMo – standard alloys																
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Nicrofer 7216 LC	– alloy 600 L
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Nicrofer 6030	– alloy 690
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Nicrofer 4221	– alloy 825
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Nicrofer 3620 Nb	– alloy 20
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Nicrofer 3220	– alloy 800
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Nicrofer 3127 hMo	– alloy 31
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Nicrofer 3127 LC	– alloy 28
FeNiCr– special stainless steels																
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Nicrofer 3033	– alloy 33
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Cronifer 2525 LCN	
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Cronifer 1925 hMo	– alloy 926
CuNi																
86	78	–	–	–	–	–	–	–	–	–	–	–	–	–	Cunifer 30	– alloy CuNi70/30
62	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Cunifer 10	– alloy CuNi90/10

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High-performance materials: sheet and plate
Fabrication characteristics

Krupp VDM alloy designation		Fabrication characteristics		Welding processes and weldability					Inter-pass temperature max °C	Filler Metal for GTAW TIG/TIG Hot Wire and GMAW MIG/MAG
		Melting temperature °C	Hot-working temperature °C	GTAW TIG/TIG Hot Wire	GMAW MIG/MAG[1]	SMAW MMA	Plasma	SAW		
Corrosion-resistant alloys										
Ni – NiCu										
VDM Nickel 99.2	– alloy 200	1445	1200 – 800	+	•	•	+	–	150	VDM Nickel S 9604 – FM 61
VDM LC-Nickel 99.2	– alloy 201	1445	1200 – 800	+	•	•	+	–	150	VDM Nickel S 9604 – FM 61
VDM LC-Nickel 99.6	– alloy 205	1445	1200 – 800	+	•	•	+	–	150	VDM Nickel S 9604 – FM 61
Nicorros	– alloy 400	1350	1200 – 800	+	+	+	+	•	150	Nicorros S 6530 – FM 60
NiMo – NiCrMo – NiCrFeMo – superalloys										
Nimofer 6928	– alloy B-2	1380	1160 – 900	+	+[2]	•	+	–	120	Nimofer S 6928 – FM B-2
Nimofer 6629	– alloy B-4	1380	1160 – 900	+	+[2]	•	+	–	120	Nimofer S 6629 – FM B-4
Nimofer 6224	– alloy B-10	1380	1160 – 900	+	+[2]	•	+	–	120	Nimofer S 6224 – FM B-10
Nicrofer 6616 hMo	– alloy C-4	1380	1080 – 900	+	•	•	+	•	150	Nicrofer S 6616 – FM C-4
Nicrofer 6020 hMo	– alloy 625	1350	1150 – 900	+	+	+	+	+	150	Nicrofer S 6020 – FM 625
Nicrofer 5923 hMo	– alloy 59	1360	1180 – 950	+	+	•	+	–	150	Nicrofer S 5923 – FM 59
Nicrofer 5716 hMoW	– alloy C-276	1370	1200 – 950	+	+	•	+	–	120	Nicrofer S 5923 – FM 59 or
				+	•	•	+	–	120	Nicrofer S 5716 – FM C-276
Nicrofer 5219 Nb	– alloy 718[3]	1340	1120 – 900	+	–	–	–	–	120	Nicrofer S 5219 – FM 718
Nicrofer 4823 hMo	– alloy G-3	1340	1150 – 900	+	+	+	+	•	150	Nicrofer S 6020 – FM 625
NiCrFe – FeNiCrMo – standard alloys										
Nicrofer 7216 LC	– alloy 600 L	1425	1200 – 870	+	•	+	+	•	150	Nicrofer S 7020 – FM 82
Nicrofer 6030	– alloy 690	1375	1230 – 900	+	•	•	•	–	120	Nicrofer S 7020 – FM 82 or
				+	–	–	–	–	120	Nicrofer S 6030 – FM 690
Nicrofer 4221	– alloy 825	1400	1150 – 900	+	•	+	+	•	120	Nicrofer S 6020 – FM 625
Nicrofer 3620 Nb	– alloy 20	1420	1150 – 1000	+	•	+	+	•	120	Nicrofer S 5923 – FM 59 or
				+	+	+	+	–	120	Nicrofer S 6020 – FM 625
Nicrofer 3220	– alloy 800	1400	1200 – 900	+	•	+	•	•	120	Nicrofer S 7020 – FM 82
Nicrofer 3127 hMo	– alloy 31	1370	1200 – 1050	+	+	•	+	–	120	Nicrofer S 5923 – FM 59 or
				+	•	•	•	–	120	Nicrofer S 3127 – FM 31
Nicrofer 3127 LC	– alloy 28	1370	1200 – 1050	+	+	+	+	•	150	Nicrofer S 6020 – FM 625 or
				+	+	+	+	•	150	Nicrofer S 3028 – FM 28
FeNiCr – special stainless steels										
Nicrofer 3033	– alloy 33	1370	1200 – 1000	+	–	–	–	–	120	Nicrofer S 3033
Cronifer 2525 LCN		1410	1200 – 950	+	•	+	+	–	150	matching
Cronifer 1925 hMo	– alloy 926	1390	1200 – 900	+	+	+	+	•	120	Nicrofer S 5923 – FM 59
CuNi										
Cunifer 30	– alloy CuNi70/30	1240	1030 – 900	+	•	•	+	•	150	Cunifer S 7030 – FM 67
Cunifer 10	– alloy CuNi90/10	1140	950 – 750	+	•	•	+	•	120	Cunifer S 7030 – FM 67

[1] MAG welding is to be carried out using the shielding gas CRONIGON He30S.
We recommend to consult our Welding Laboratory.

[2] MAG welding is to be carried out using the gas shielding CRONIGON He50S.

[3] annealed

\+ readily and easily weldable

• please contact our Welding Laboratory

– not recommended

GTAW = Gas Tungsten Arc Welding
GMAW = Gas Metal Arc Welding
SMAW = Shielded Metal Arc Welding
SAW = Submerged Arc Welding

High-performance materials: sheet and plate
Fabrication characteristics

				Covered electrodes for SMAW/MMA				Krupp VDM alloy designation	
Werkst.-Nr.	Designation	AWS	Classification	Werkst.-Nr.	Designation	AWS	Classification		
Corrosion-resistant alloys									
Ni – NiCu									
2.4155	SG-NiTi 4	A5.14	ERNi-1	2.4156	EL-NiTi3	A5.11	ENi-1	VDM Nickel 99.2	– alloy 200
2.4155	SG-NiTi 4	A5.14	ERNi-1	2.4156	EL-NiTi3	A5.11	ENi-1	VDM LC-Nickel 99.2	– alloy 201
2.4155	SG-NiTi 4	A5.14	ERNi-1	2.4156	EL-NiTi3	A5.11	ENi-1	VDM LC-Nickel 99.6	– alloy 205
2.4377	SG-NiCu30MnTi	A5.14	ERNiCu-7	2.4366	EL-NiCu30Mn	A5.11	ENiCu-7	Nicorros	– alloy 400
NiMo – NiCrMo – NiCrFeMo – superalloys									
2.4615	SG-NiMo27	A5.14	ERNiMo-7	2.4616	EL-NiMo29	A5.11	ENiMo-7	Nimofer 6928	– alloy B-2
2.4701	SG-NiMo28Cr	A5.14	ERNiMo-7	2.4616	EL-NiMo29	A5.11	ENiMo-7	Nimofer 6629	– alloy B-4
2.4702	SG-NiMo24Cr8Fe	–	–	–	–	–	–	Nimofer 6224	– alloy B-10
2.4611	SG-NiMo16Cr16Ti	A5.14	ERNiCrMo-7	2.4612	EL-NiMo15Cr15Ti	A5.11	ENiCrMo-7	Nicrofer 6616 hMo	– alloy C-4
2.4831	SG-NiCr21Mo9Nb	A5.14	ERNiCrMo-3	2.4621	EL-NiCr20Mo9Nb	A5.11	ENiCrMo-3	Nicrofer 6020 hMo	– alloy 625
2.4607	SG-NiCr23Mo16	A5.14	ERNiCrMo-13	2.4609	EL-NiCr22Mo16	A5.11	ENiCrMo-13	Nicrofer 5923 hMo	– alloy 59
2.4607	SG-NiCr23Mo16	A5.14	ERNiCrMo-13	2.4609	EL-NiCr22Mo16	A5.11	ENiCrMo-13	Nicrofer 5716 hMoW	– alloy C-276
2.4886	SG-NiMo16Cr16W	A5.14	ERNiCrMo-4	2.4887	EL-NiMo15Cr15W	A5.11	ENiCrMo-4		
2.4667	SG-NiCr19NbMoTi	A5.14	ERNiFeCr-2	–	–	–	–	Nicrofer 5219 Nb	– alloy 718[*]
2.4831	SG-NiCr21Mo9Nb	A5.14	ERNiCrMo-3	2.4621	EL-NiCr20Mo9Nb	A5.11	ENiCrMo-3	Nicrofer 4823 hMo	– alloy G-3
NiCrFe – FeNiCrMo – standard alloys									
2.4806	SG-NiCr20Nb	A5.14	ERNiCr-3	2.4648	EL-NiCr19Nb	(A5.11)	(ENiCrFe-3)	Nicrofer 7216 LC	– alloy 600 L
2.4806	SG-NiCr20Nb	A5.14	ERNiCr-3	2.4648	EL-NiCr19Nb	(A5.11)	(ENiCrFe-3)	Nicrofer 6030	– alloy 690
2.4642	NiCr29Fe	A5.14	ERNiCr-3	2.4648	EL-NiCr19Nb	(A5.11)	(ENiCrFe-3)		
2.4831	SG-NiCr21Mo9Nb	A5.14	ERNiCrMo-3	2.4621	EL-NiCr20Mo9Nb	A5.11	ENiCrMo-3	Nicrofer 4221	– alloy 825
2.4607	SG-NiCr23Mo16	A5.14	ERNiCrMo-13	2.4609	EL-NiCr22Mo16	A5.11	ENiCrMo13	Nicrofer 3620 Nb	– alloy 20
2.4831	SG-NiCr21Mo9Nb	A5.14	ERNiCrMo-3	2.4621	EL-NiCr20Mo9Nb	A5.11	ENiCrMo-3		
2.4806	SG-NiCr20Nb	A5.14	ERNiCr-3	2.4648	EL-NiCr19Nb	(A5.11)	(ENiCrFe-3)	Nicrofer 3220	– alloy 800
2.4607	SG-NiCr23Mo16	A5.14	ERNiCrMo-13	2.4609	EL-NiCr22Mo16	(A5.11)	ENiCrMo-13	Nicrofer 3127 hMo	– alloy 31
1.4562	X1NiCrMoCu32-28-7	A5.14	ERNiCrMo	1.4562	X1NiCrMoCu32-28-7	A5.11	ENiCrMo		
2.4831	SG-NiCr21Mo9Nb	A5.14	ERNiCrMo-3	2.4621	EL-NiCr20Mo9Nb	A5.11	ENiCrMo-3	Nicrofer 3127 LC	– alloy 28
1.4563	X1NiCrMoCuN31-27-4	–	–	1.4563	X1NiCrMoCuN31-27-4	–	–		
FeNiCr – special stainless steels									
1.4591	X1CrNiMoCuN33-32-1	–	–	1.4591	X1CrNiMoCuN33-32-1	–	–	Nicrofer 3033	– alloy 33
1.4466	X2CrNiMoN25-25	–	–	1.4466	EL-25-20-2	A5.11	E310Mo	Cronifer 2525 LCN	
2.4607	SG-NiCr23Mo16	A5.14	ERNiCrMo-13	2.4609	EL-NiCr22Mo16	A5.11	ENiCrMo-13	Cronifer 1925 hMo	– alloy 926
CuNi									
2.0837	SG-CuNi30Fe	A5.7	ERCuNi	2.0838	EL-CuNi30Mn	A5.7	ECuNi	Cunifer 30	– alloy CuNi70/30
2.0837	SG-CuNi30Fe	A5.7	ERCuNi	2.0838	EL-CuNi30Mn	A5.7	ECuNi	Cunifer 10	– alloy CuNi90/10

Imperial values see page 48

High-performance materials: sheet and plate
Physical properties (Imperial Values)

Krupp VDM alloy designation		Physical properties at room temperature (RT)					Thermal expansion coefficient between RT and T, 10^{-6}/°F								
		Density $\frac{lb}{in^3}$	Specific heat $\frac{Btu}{lb\ °F}$	Thermal conductivity $\frac{Btu\ in}{ft^2\ h\ °F}$	Electrical resistivity $\frac{\Omega\ circ\ mil}{ft}$	Modulus of elasticity 10^3 ksi	200	400	600	800	1000	1200	1400	1600	1800
Corrosion-resistant alloys															
Ni – NiCu															
VDM Nickel 99.2	– alloy 200	0.322	0.109	490	54	29.7	7.4	7.7	8.0	8.3	8.5	8.7	8.9	9.1	9.3
VDM LC-Nickel 99.2	– alloy 201	0.322	0.109	550	54	30.0	7.4	7.7	8.0	8.3	8.5	8.7	8.9	9.1	9.3
VDM LC-Nickel 99.6	– alloy 205	0.322	0.109	550	57	30.2	7.5	7.8	8.1	8.3	8.5	8.7	8.9	9.1	9.3
Nicorros	– alloy 400	0.318	0.102	150	310	26.4	7.7	8.6	8.8	8.9	9.1	9.3	9.6	9.8	–
NiMo – NiCrMo – NiCrFeMo – superalloys															
Nimofer 6928	– alloy B-2	0.332	0.090	77	825	31.4	5.7	6.0	6.2	6.4	6.5	6.6	–	–	–
Nimofer 6629	– alloy B-4	0.332	0.090	77	825	31.4	5.7	6.0	6.2	6.4	6.5	6.6	–	–	–
Nimofer 6224	– alloy B-10	0.322	0.095	80	780	30.8	5.9	6.2	6.5	6.6	6.7	–	–	–	–
Nicrofer 6616 hMo	– alloy C-4	0.311	0.097	70	750	30.8	6.0	6.6	7.0	7.2	7.4	7.7	8.0	8.3	8.7
Nicrofer 6020 hMo	– alloy 625	0.307	0.099	68	770	30.3	7.0	7.3	7.5	7.6	7.9	8.3	8.6	9.0	9.4
Nicrofer 5923 hMo	– alloy 59	0.311	0.099	72	758	30.5	6.6	6.8	7.0	7.1	7.2	–	–	–	–
Nicrofer 5716 hMoW	– alloy C-276	0.322	0.097	73	752	30.2	6.5	6.7	7.1	7.3	7.6	7.9	8.4	8.8	9.1
Nicrofer 5219 Nb	– alloy 718	0.296	0.103	77	738	29.7	7.0	7.5	7.7	7.9	8.1	8.4	8.8	9.2	–
Nicrofer 4823 hMo	– alloy G-3	0.300	0.105	77	692	30.6	7.9	8.2	8.4	8.6	8.8	9.0	–	–	–
NiCrFe – FeNiCrMo – standard alloys															
Nicrofer 7216 LC	– alloy 600 L	0.303	0.108	103	620	31.0	7.5	7.8	8.0	8.3	8.4	8.6	8.7	9.0	9.3
Nicrofer 6030	– alloy 690	0.296	0.108	83	692	31.2	7.8	8.0	8.1	8.3	8.6	8.9	9.1	9.4	9.6
Nicrofer 4221	– alloy 825	0.293	0.105	75	678	28.3	7.8	8.3	8.5	8.7	8.8	9.1	9.5	9.7	9.9
Nicrofer 3620 Nb	– alloy 20	0.293	0.109	80	644	29.3	8.3	8.7	8.9	9.2	9.4	9.6	9.5	9.8	–
Nicrofer 3220	– alloy 800	0.289	0.113	80	608	28.2	8.3	8.7	9.0	9.3	9.5	9.8	10.0	10.1	10.3
Nicrofer 3127 hMo	– alloy 31	0.293	0.108	81	620	28.7	7.9	8.2	8.5	8.6	8.8	–	–	–	–
Nicrofer 3127 LC	– alloy 28	0.289	0.108	81	623	27.7	8.3	8.8	8.9	9.0	9.3	–	–	–	–
FeNiCr – special stainless steels															
Nicrofer 3033	– alloy 33	0.285	~ 0.12	94	~ 623	28.3	8.1	8.5	8.5	8.8	9.0	–	–	–	–
Cronifer 2525 LCN		0.289	0.113	83	577	28.4	9.2	9.6	9.9	10.1	10.3	–	–	–	–
Cronifer 1925 hMo	– alloy 926	0.293	0.098	83	577	28.0	8.3	8.7	9.0	9.2	9.4	–	–	–	–
CuNi															
Cunifer 30	– alloy CuNi70/30	0.322	0.088	150	235	21.8	8.6	8.8	9.1	9.4	9.6	9.9	9.9	10.1	10.4
Cunifer 10	– alloy CuNi90/10	0.322	0.090	312	114	18.9	9.0	9.2	9.5	9.8	10.1	10.0	10.3	10.6	11.0

High-performance materials: sheet and plate
Mechanical properties (Imperial Values)

Mechanical properties at room temperature (RT)										Krupp VDM alloy designation	
Heat treatment and temperature, °F		annealed/solution treated				age hardened					
		Rp 0.2 ksi	Rp 1.0 ksi	Rm ksi	A5 %	Rp 0.2 ksi	Rp 1.0 ksi	Rm ksi	A5 %		
Corrosion-resistant alloys											
Ni – NiCu											
annealed	1290 – 1560	≥ 14.5	≥ 18.1	≥ 55	≥ 40	–	–	–	–	VDM Nickel 99.2	– alloy 200
annealed	1290 – 1560	≥ 11.6	≥ 15	≥ 49.3	≥ 40	–	–	–	–	VDM LC-Nickel 99.2	– alloy 201
annealed	1290 – 1470	≥ 11.6	≥ 15	≥ 49.3	≥ 40	–	–	–	–	VDM LC-Nickel 99.6	– alloy 205
annealed	1300 – 1650	≥ 25.4	≥ 29.7	≥ 65	≥ 35	–	–	–	–	Nicorros	– alloy 400
NiMo – NiCrMo – NiCrFeMo – superalloys											
solution treated	1940 – 1980	≥ 49	≥ 55	≥ 109	≥ 40	–	–	–	–	Nimofer 6928	– alloy B-2
solution treated	1940 – 2050	≥ 49	≥ 55	≥ 109	≥ 40	–	–	–	–	Nimofer 6629	– alloy B-4
solution treated	2100 – 2190	≥ 46.5	≥ 52	≥ 104	≥ 40	–	–	–	–	Nimofer 6224	– alloy B-10
solution treated	1920 – 2010	≥ 44	≥ 49	≥ 100	≥ 40	–	–	–	–	Nicrofer 6616 hMo	– alloy C-4
annealed	1740 – 1920	≥ 60	≥ 44.5	≥ 120	≥ 30	–	–	–	–	Nicrofer 6020 hMo	– alloy 625
solution treated	2010 – 2160	≥ 49	≥ 55	≥ 100	≥ 40	–	–	–	–	Nicrofer 5923 hMo	– alloy 59
solution treated	2010 – 2120	≥ 45	≥ 48	≥ 108	≥ 30	–	–	–	–	Nicrofer 5716 hMoW	– alloy C-276
sol. treated 1760	age h.1325 + 1150	≥ 80	–	≥ 139	≥ 30	≥ 150	–	≥ 180	≥ 12	Nicrofer 5219 Nb	– alloy 718
solution treated	2010 – 2100	≥ 35	≥ 38	≥ 90	≥ 45	–	–	–	–	Nicrofer 4823 hMo	– alloy G-3
NiCrFe – FeNiCrMo – standard alloys											
annealed	1700 – 1800	≥ 26.1	≥ 30.5	≥ 80	≥ 30	–	–	–	–	Nicrofer 7216 LC	– alloy 600 L
annealed	1870 – 1960	≥ 35	≥ 38.5	≥ 85	≥ 30	–	–	–	–	Nicrofer 6030	– alloy 690
annealed	1690 – 1800	≥ 35	≥ 38	≥ 85	≥ 30	–	–	–	–	Nicrofer 4221	– alloy 825
annealed	1690 – 1760	≥ 35	≥ 40.6	≥ 80	≥ 30	–	–	–	–	Nicrofer 3620 Nb	– alloy 20
annealed	1690 – 1800	≥ 30.5	≥ 34.8	≥ 72.5	≥ 35	–	–	–	–	Nicrofer 3220	– alloy 800
solution treated	2100 – 2160	≥ 40.6	≥ 45	≥ 94.3	≥ 40	–	–	–	–	Nicrofer 3127 hMo	– alloy 31
solution treated	1980 – 2100	≥ 31.9	≥ 36.3	≥ 72.5	≥ 35	–	–	–	–	Nicrofer 3127 LC	– alloy 28
FeNiCr – special stainless steels											
solution treated	1980 – 2100	≥ 55	≥ 61	≥ 104	≥ 40	–	–	–	–	Nicrofer 3033	– alloy 33
solution treated	1940 – 2100	≥ 38.0	≥ 42.8	≥ 78.3	≥ 35	–	–	–	–	Cronifer 2525 LCN	
solution treated	2100 – 2160	≥ 43.5	≥ 49.3	≥ 94.3	≥ 40	–	–	–	–	Cronifer 1925 hMo	– alloy 926
CuNi											
annealed	1290 – 1470	≥ 17.4	≥ 20.3	≥ 50.8	≥ 35	–	–	–	–	Cunifer 30	– CuNi70/30
annealed	1380 – 1470	≥ 14.5	≥ 18.1	≥ 43.5	≥ 30	–	–	–	–	Cunifer 10	– CuNi90/10

High-performance materials: sheet and plate
Mechanical properties (Imperial Values)

Krupp VDM alloy designation	Heat treatment	Mechanical properties at elevated temperatures, °F											
		Yield strength Rp 0.2, ksi						Yield strength Rp 1.0, ksi					
		200	400	600	800	1000	1200	200	400	600	800	1000	1200
Corrosion-resistant alloys													
Ni – NiCu													
VDM Nickel 99.2 – alloy 200	annealed	22.2	18.9	20.3	18.1	13.3	10.9	26.7	23.2	24.7	22.5	17.4	11.2
VDM LC-Nickel 99.2 – alloy 201	annealed	≥ 10.2	≥ 9.4	≥ 8.6	≥ 7.9	≥ 6.8	–	≥ 13.8	≥ 13.1	≥ 12.2	≥ 10.5	≥ 10.3	–
VDM LC-Nickel 99.6 – alloy 205	annealed	10.2	9.4	8.6	7.9	–	–	13.8	13.1	12.2	10.5	–	–
Nicorros – alloy 400	annealed	≥ 21.9	≥ 19.6	≥ 18.9	≥ 18.9	–	–	32	30.5	27.6	26	–	–
NiMo – NiCrMo – NiCrFeMo – superalloys													
Nimofer 6928 – alloy B-2	solution treated	≥ 46	≥ 41	≥ 39	36	≥ 32.5	–	≥ 52	≥ 47	≥ 45	42	–	–
Nimofer 6629 – alloy B-4	solution treated	≥ 46	≥ 41	≥ 39	36	–	–	≥ 52	≥ 47	≥ 45	42	–	–
Nimofer 6224 – alloy B-10	solution treated	≥ 42.8	≥ 37.5	≥ 33	≥ 29	–	–	49.4	42.8	39	35.5	–	–
Nicrofer 6616 hMo – alloy C-4	solution treated	≥ 41.6	≥ 36.9	≥ 35.1	31.9	–	–	≥ 46.1	≥ 41.3	≥ 39	37.4	–	–
Nicrofer 6020 hMo – alloy 625	annealed	≥ 51.5	≥ 46.4	≥ 42.8	≥ 39.9	–	–	–	–	–	–	–	–
Nicrofer 5923 hMo – alloy 59	solution treated	≥ 43	≥ 36	≥ 31	≥ 26	–	–	≥ 48	≥ 42	≥ 37	≥ 32	–	–
Nicrofer 5716 hMoW – alloy C-276	solution treated	≥ 41	≥ 34	≥ 31	≥ 27.6	–	–	≥ 44	≥ 40	≥ 35	≥ 33	–	–
Nicrofer 5219 Nb – alloy 718	sol. tr. + age h.	154	150	148	145	142	138	–	–	–	–	–	–
Nicrofer 4823 hMo – alloy G-3	solution treated	≥ 39	≥ 33	≥ 30	≥ 27	≥ 25	–	≥ 42	≥ 38	≥ 34	≥ 31	≥ 30	–
NiCrFe – FeNiCrMo – standard alloys													
Nicrofer 7216 LC – alloy 600 L	annealed	≥ 22.0	≥ 20.3	≥ 18.7	≥ 18.0	≥ 17.2	≥ 16.4	≥ 26.4	≥ 24.6	≥ 22.9	≥ 21.5	≥ 21.5	18.7
Nicrofer 6030 – alloy 690	annealed	38	32	28	25	24	–	42	38	33	30	29	–
Nicrofer 4221 – alloy 825	annealed	≥ 30.5	≥ 26.1	≥ 24.4	≥ 22.6	≥ 21.2	–	≥ 34.8	≥ 29.7	≥ 28	≥ 26.3	≥ 25.3	–
Nicrofer 3620 Nb – alloy 20	annealed	≥ 30.5	≥ 26.1	≥ 22.6	–	–	–	≥ 36	≥ 31	≥ 28	–	–	–
Nicrofer 3220 – alloy 800	annealed	≥ 27.1	≥ 23.2	≥ 20.5	≥ 18.9	≥ 17.5	–	≥ 30.2	≥ 26.1	≥ 23.6	≥ 22	≥ 20.6	–
Nicrofer 3127 hMo – alloy 31	solution treated	≥ 30.6	≥ 27.5	≥ 23.3	≥ 21.3	≥ 18.5	–	≥ 35.5	≥ 30.5	≥ 27.6	≥ 25.5	≥ 23	–
Nicrofer 3127 LC – alloy 28	solution treated	≥ 28.1	≥ 23.9	≥ 21.2	≥ 18.9	≥ 16.7	–	≥ 29.6	≥ 28.2	≥ 25.8	≥ 23.2	≥ 21.2	–
FeNiCr – special stainless steels													
Nicrofer 3033 – alloy 33	solution treated	≥ 46.4	≥ 39	≥ 33	≥ 32	≥ 30.5	–	≥ 51.5	≥ 42.8	≥ 39	≥ 36	≥ 33	–
Cronifer 2525 LCN	solution treated	≥ 29	≥ 22.5	≥ 19.3	≥ 17.8	16	–	≥ 33.4	≥ 26.8	≥ 23	≥ 21.3	19.7	–
Cronifer 1925 hMo – alloy 926	solution treated	≥ 33.5	≥ 27.4	≥ 24.5	≥ 23	≥ 16.7	–	≥ 39.3	≥ 33.3	≥ 28.9	≥ 27.3	≥ 21	–
CuNi													
Cunifer 30 – alloy CuNi70/30	annealed	–	–	–	–	–	–	≥ 18.9	≥ 17.8	≥ 16.8	–	–	–
Cunifer 10 – alloy CuNi90/10	annealed	–	–	–	–	–	–	≥ 17.1	≥ 15.8	≥ 14.3	–	–	–

High-performance materials: sheet and plate
Mechanical properties (Imperial Values)

Mechanical properties at elevated temperatures, °F												Heat treatment	Krupp VDM alloy designation
Tensile strength Rm, ksi						Elongation A5, %							
200	400	600	800	1000	1200	200	400	600	800	1000	1200		
Corrosion-resistant alloys													
Ni – NiCu													
57	52	53	45	33	27	40	40	45	40	33	28	annealed	VDM Nickel 99.2 – alloy 200
42.2	39.9	37.1	33.6	27.1	–	–	–	–	–	–	–	annealed	VDM LC-Nickel 99.2 – alloy 201
–	–	–	–	–	–	–	–	–	–	–	–	annealed	VDM LC-Nickel 99.6 – alloy 205
68.9	56.6	54.8	53.2	–	–	30	30	30	30	–	–	annealed	Nicorros – alloy 400
NiMo – NiCrMo – NiCrFeMo – superalloys													
122	120	118	116	110	104	64	60	56	52	47	50	solution treated	Nimofer 6928 – alloy B-2
122	120	118	116	110	104	64	60	56	52	47	50	solution treated	Nimofer 6629 – alloy B-4
–	–	–	–	–	–	–	–	–	–	–	–	solution treated	Nimofer 6224 – alloy B-10
107	98	96	95	93	85	65	58	60	62	–	–	solution treated	Nicrofer 6616 hMo – alloy C-4
107	101	98	96	–	–	–	–	–	–	–	–	annealed	Nicrofer 6020 hMo – alloy 625
95	89	84	77	–	–	50	50	50	50	–	–	solution treated	Nicrofer 5923 hMo – alloy 59
99	98	94	90	–	–	50	60	65	60	–	–	solution treated	Nicrofer 5716 hMoW – alloy C-276
193	187	183	178	174	160	26	25	23	23	23	21	sol. tr. + age h.	Nicrofer 5219 Nb – alloy 718
94	86	81	79	75	70	60	60	65	65	–	–	solution treated	Nicrofer 4823 hMo – alloy G-3
NiCrFe – FeNiCrMo – standard alloys													
77.1	72.4	69.9	69.3	–	–	≥ 45	≥ 45	≥ 45	≥ 45	–	–	annealed	Nicrofer 7216 LC – alloy 600 L
84	80	74	72	70	–	45	45	45	45	45	–	annealed	Nicrofer 6030 – alloy 690
77	74.7	72.2	70.8	69	–	40	40	40	–	–	–	annealed	Nicrofer 4221 – alloy 825
75.4	72.5	69.6	–	–	–	40	40	40	–	–	–	annealed	Nicrofer 3620 Nb – alloy 20
61.6	58.0	56.6	54.4	50	–	–	–	–	–	–	–	annealed	Nicrofer 3220 – alloy 800
90.6	83.4	76.0	71.3	66.7	–	50	50	50	50	50	–	solution treated	Nicrofer 3127 hMo – alloy 31
72.5	71	69	66	–	–	40	40	40	40	–	–	solution treated	Nicrofer 3127 LC – alloy 28
FeNiCr – special stainless steels													
–	–	–	–	–	–	–	–	–	–	–	–	solution treated	Nicrofer 3033 – alloy 33
77.1	72.5	69.2	67	–	–	–	–	–	–	–	–	solution treated	Cronifer 2525 LCN
88.5	79.8	73.5	72	–	–	–	–	–	–	–	–	solution treated	Cronifer 1925 hMo – alloy 926
CuNi													
–	–	–	–	–	–	–	–	–	–	–	–		Cunifer 30 – alloy CuNi70/30
46	42	39	–	–	–	–	–	–	–	–	–		Cunifer 10 – alloy CuNi90/10

High-performance materials: sheet and plate
Mechanical properties (Imperial Values)

Krupp VDM alloy designation	Heat treatment	Creep properties, ksi at elevated temperatures, °F											
		Creep strength Rp 1.0/10⁴ hrs						Creep-rupture strength Rm/10⁴ hrs					
		600	700	800	900	1000	1100	600	700	800	900	1000	1100
Corrosion-resistant alloys													
Ni – NiCu													
VDM Nickel 99.2 – alloy 200	–	–	–	–	–	–	–	–	–	–	–	–	–
VDM LC-Nickel 99.2 – alloy 201	annealed	15.2	12.2	9.1	5.9	3.6	1.7	35.4	41.3	19.7	13.9	9.1	6.8
VDM LC-Nickel 99.6 – alloy 205	–	–	–	–	–	–	–	–	–	–	–	–	–
Nicorros – alloy 400	annealed	–	26.7	18.6	11.2	7.3	2.8	–	49.4	33.1	21.0	13.1	7.1
NiMo – NiCrMo – NiCrFeMo – superalloys													
Nimofer 6928 – alloy B-2	–	–	–	–	–	–	–	–	–	–	–	–	–
Nimofer 6629 – alloy B-4	–	–	–	–	–	–	–	–	–	–	–	–	–
Nimofer 6224 – alloy B-10	–	–	–	–	–	–	–	–	–	–	–	–	–
Nicrofer 6616 hMo – alloy C-4	–	–	–	–	–	–	–	–	–	–	–	–	–
Nicrofer 6020 hMo – alloy 625	–	–	–	–	–	–	–	–	–	–	–	–	–
Nicrofer 5923 hMo – alloy 59	–	–	–	–	–	–	–	–	–	–	–	–	–
Nicrofer 5716 hMoW – alloy C-276	–	–	–	–	–	–	–	–	–	–	–	–	–
Nicrofer 5219 Nb – alloy 718	–	–	–	–	–	–	–	–	–	–	–	–	–
Nicrofer 4823 hMo – alloy G-3	–	–	–	–	–	–	–	–	–	–	–	–	–
NiCrFe – FeNiCrMo – standard alloys													
Nicrofer 7216 LC – alloy 600 L	–	–	–	–	–	–	–	–	–	–	–	–	–
Nicrofer 6030 – alloy 690	–	–	–	–	–	–	–	–	–	–	–	–	–
Nicrofer 4221 – alloy 825	–	–	–	–	–	–	–	–	–	–	–	–	–
Nicrofer 3620 Nb – alloy 20	–	–	–	–	–	–	–	–	–	–	–	–	–
Nicrofer 3220 – alloy 800	–	–	–	–	–	–	–	–	–	–	–	–	–
Nicrofer 3127 hMo – alloy 31	–	–	–	–	–	–	–	–	–	–	–	–	–
Nicrofer 3127 LC – alloy 28	–	–	–	–	–	–	–	–	–	–	–	–	–
FeNiCr – special stainless steels													
Nicrofer 3033 – alloy 33	–	–	–	–	–	–	–	–	–	–	–	–	–
Cronifer 2525 LCN	–	–	–	–	–	–	–	–	–	–	–	–	–
Cronifer 1925 hMo – alloy 926	–	–	–	–	–	–	–	–	–	–	–	–	–
CuNi													
Cunifer 30 – alloy CuNi70/30	annealed	13.5	12.4	6.6	–	–	–	–	–	–	–	–	–
Cunifer 10 – alloy CuNi90/10	annealed	10.9	9.6	–	–	–	–	–	–	–	–	–	–

High-performance materials: sheet and plate
Mechanical properties (Imperial Values)

Creep properties, ksi at elevated temperatures, °F												Heat treatment	Krupp VDM alloy designation
Creep strength Rp 1.0/10^5 hrs						Creep-rupture strength Rm/10^5 hrs							
600	700	800	900	1000	1100	600	700	800	900	1000	1100		
Corrosion-resistant alloys													
Ni – NiCu													
–	–	–	–	–	–	–	–	–	–	–	–	–	VDM Nickel 99.2 – alloy 200
13.1	10.2	7.0	4.1	2.0	0.7	32.2	24.7	17.4	10.1	5.7	3.9	annealed	VDM LC-Nickel 99.2 – alloy 201
–	–	–	–	–	–	–	–	–	–	–	–	–	VDM LC-Nickel 99.6 – alloy 205
–	22.5	15.5	10.4	5.8	1.6	–	43.9	26.7	13.8	7.0	3.3	annealed	Nicorros – alloy 400
NiMo – NiCrMo – NiCrFeMo – superalloys													
–	–	–	–	–	–	–	–	–	–	–	–	–	Nimofer 6928 – alloy B-2
–	–	–	–	–	–	–	–	–	–	–	–	–	Nimofer 6629 – alloy B-4
–	–	–	–	–	–	–	–	–	–	–	–	–	Nimofer 6224 – alloy B-10
–	–	–	–	–	–	–	–	–	–	–	–	–	Nicrofer 6616 hMo – alloy C-4
–	–	–	–	–	–	–	–	–	–	–	–	–	Nicrofer 6020 hMo – alloy 625
–	–	–	–	–	–	–	–	–	–	–	–	–	Nicrofer 5923 hMo – alloy 59
–	–	–	–	–	–	–	–	–	–	–	–	–	Nicrofer 5716 hMoW – alloy C-276
–	–	–	–	–	–	–	–	–	–	–	–	–	Nicrofer 5219 Nb – alloy 718
–	–	–	–	–	–	–	–	–	–	–	–	–	Nicrofer 4823 hMo – alloy G-3
NiCrFe – FeNiCrMo – standard alloys													
–	–	–	–	–	–	–	–	–	–	–	–	–	Nicrofer 7216 LC – alloy 600 L
–	–	–	–	–	–	–	–	–	–	–	–	–	Nicrofer 6030 – alloy 690
–	–	–	–	–	–	–	–	–	–	–	–	–	Nicrofer 4221 – alloy 825
–	–	–	–	–	–	–	–	–	–	–	–	–	Nicrofer 3620 Nb – alloy 20
–	–	–	–	–	–	–	–	–	–	–	–	–	Nicrofer 3220 – alloy 800
–	–	–	–	–	–	–	–	–	–	–	–	–	Nicrofer 3127 hMo – alloy 31
–	–	–	–	–	–	–	–	–	–	–	–	–	Nicrofer 3127 LC – alloy 28
FeNiCr – special stainless steels													
–	–	–	–	–	–	–	–	–	–	–	–	–	Nicrofer 3033 – alloy 33
–	–	–	–	–	–	–	–	–	–	–	–	–	Cronifer 2525 LCN
–	–	–	–	–	–	–	–	–	–	–	–	–	Cronifer 1925 hMo – alloy 926
CuNi													
12.6	11.5	–	–	–	–	–	–	–	–	–	–	–	Cunifer 30 – alloy CuNi70/30
9.1	–	–	–	–	–	–	–	–	–	–	–	–	Cunifer 10 – alloy CuNi90/10

High-performance materials: sheet and plate
Fabrication characteristics (Imperial Values)

Krupp VDM alloy designation		Fabrication characteristics		Welding processes and weldability					Inter-pass temperature max °F	Filler Metal for GTAW TIG/TIG Hot Wire and GMAW MIG/MAG
		Melting temperature °F	Hot-working temperature °F	GTAW TIG/TIG Hot Wire	GMAW MIG/MAG[1]	SMAW	Plasma	SAW		
Corrosion-resistant alloys										
Ni – NiCu										
VDM Nickel 99.2	– alloy 200	2630	2190 – 1470	+	•	•	+	–	300	VDM Nickel S 9604 – FM 61
VDM LC-Nickel 99.2	– alloy 201	2630	2190 – 1470	+	•	•	+	–	300	VDM Nickel S 9604 – FM 61
VDM LC-Nickel 99.6	– alloy 205	2630	2190 – 1470	+	•	•	+	–	300	VDM Nickel S 9604 – FM 61
Nicorros	– alloy 400	2460	2190 – 1470	+	+	+	+	•	300	Nicorros S 6530 – FM 60
NiMo – NiCrMo – NiCrFeMo – superalloys										
Nimofer 6928	– alloy B-2	2520	2120 – 1650	+	+[2]	•	+	–	250	Nimofer S 6928 – FM B-2
Nimofer 6629	– alloy B-4	2520	2120 – 1650	+	+[2]	•	+	–	250	Nimofer S 6629 – FM B-4
Nimofer 6224	– alloy B-10	2520	2120 – 1650	+	+[2]	•	+	–	250	Nimofer S 6224 – FM B-10
Nicrofer 6616 hMo	– alloy C-4	2520	1980 – 1650	+	•	•	+	•	300	Nicrofer S 6616 – FM C-4
Nicrofer 6020 hMo	– alloy 625	2460	2120 – 1740	+	+	+	+	+	300	Nicrofer S 6020 – FM 625
Nicrofer 5923 hMo	– alloy 59	2480	2160 – 1740	+	+	•	+	–	300	Nicrofer S 5923 – FM 59
Nicrofer 5716 hMoW	– alloy C-276	2500	2190 – 1740	+	+	•	+	–	250	Nicrofer S 5923 – FM 59 or
				+	•	•	+	–	250	Nicrofer S 5716 – FM C-276
Nicrofer 5219 Nb	– alloy 718[3]	2440	2050 – 1650	+	–	–	–	–	250	Nicrofer S 5219 – FM 718
Nicrofer 4823 hMo	– alloy G-3	2440	2100 – 1650	+	+	+	+	•	300	Nicrofer S 6020 – FM 625
NiCrFe – FeNiCrMo – standard alloys										
Nicrofer 7216 LC	– alloy 600 L	2600	2190 – 1600	+	•	+	+	•	300	Nicrofer S 7020 – FM 82
Nicrofer 6030	– alloy 690	2510	2250 – 1650	+	•	•	•	–	250	Nicrofer S 7020 – FM 82 or
				+	–	–	–	–	250	Nicrofer S 6030 – FM 690
Nicrofer 4221	– alloy 825	2550	2100 – 1650	+	•	+	+	•	250	Nicrofer S 6020 – FM 625
Nicrofer 3620 Nb	– alloy 20	2590	2100 – 1830	+	•	+	+	•	250	Nicrofer S 5923 – FM 59 or
				+	+	+	+	–	250	Nicrofer S 6020 – FM 625
Nicrofer 3220	– alloy 800	2550	2190 – 1650	+	•	+	•	•	250	Nicrofer S 7020 – FM 82
Nicrofer 3127 hMo	– alloy 31	2500	2190 – 1920	+	+	•	+	–	250	Nicrofer S 5923 – FM 59 or
				+	•	•	•	–	250	Nicrofer S 3127 – FM 31
Nicrofer 3127 LC	– alloy 28	2500	2190 – 1920	+	+	+	+	•	300	Nicrofer S 6020 – FM 625 or
				+	+	+	+	•	300	Nicrofer S 3028 – FM 28
FeNiCr – special stainless steels										
Nicrofer 3033	– alloy 33	2500	2190 – 1830	+	–	–	–	–	250	Nicrofer S 3033
Cronifer 2525 LCN		2570	2190 – 1740	+	•	+	+	–	300	matching
Cronifer 1925 hMo	– alloy 926	2530	2190 – 1650	+	+	+	+	•	250	Nicrofer S 5923 – FM 59
CuNi										
Cunifer 30	– alloy CuNi70/30	2260	1890 – 1650	+	•	•	+	•	300	Cunifer S 7030 – FM 67
Cunifer 10	– alloy CuNi90/10	2080	1740 – 1380	+	•	•	+	•	250	Cunifer S 7030 – FM 67

[1] MAG welding is to be carried out using the shielding gas CRONIGON He30S.
We recommend to consult our Welding Laboratory.

[2] MAG welding is to be carried out using the gas shielding CRONIGON He50S.

[3] annealed

\+ readily and easily weldable

• please contact our Welding Laboratory

– not recommended

GTAW = Gas Tungsten Arc Welding
GMAW = Gas Metal Arc Welding
SMAW = Shielded Metal Arc Welding
SAW = Submerged Arc Welding

High-performance materials: sheet and plate
Fabrication characteristics

				Covered electrodes for SMAW/MMA				Krupp VDM alloy designation	
Werkst.-Nr.	Designation	AWS	Classification	Werkst.-Nr.	Designation	AWS	Classification		
Corrosion-resistant alloys									
Ni – NiCu									
2.4155	SG-NiTi 4	A5.14	ERNi-1	2.4156	EL-NiTi3	A5.11	ENi-1	VDM Nickel 99.2	– alloy 200
2.4155	SG-NiTi 4	A5.14	ERNi-1	2.4156	EL-NiTi3	A5.11	ENi-1	VDM LC-Nickel 99.2	– alloy 201
2.4155	SG-NiTi 4	A5.14	ERNi-1	2.4156	EL-NiTi3	A5.11	ENi-1	VDM LC-Nickel 99.6	– alloy 205
2.4377	SG-NiCu30MnTi	A5.14	ERNiCu-7	2.4366	EL-NiCu30Mn	A5.11	ENiCu-7	Nicorros	– alloy 400
NiMo – NiCrMo – NiCrFeMo – superalloys									
2.4615	SG-NiMo27	A5.14	ERNiMo-7	2.4616	EL-NiMo29	A5.11	ENiMo-7	Nimofer 6928	– alloy B-2
2.4701	SG-NiMo28Cr	A5.14	ERNiMo-7	2.4616	EL-NiMo29	A5.11	ENiMo-7	Nimofer 6629	– alloy B-4
2.4702	SG-NiMo24Cr8Fe	–	–	–	–	–	–	Nimofer 6224	– alloy B-10
2.4611	SG-NiMo16Cr16Ti	A5.14	ERNiCrMo-7	2.4612	EL-NiMo15Cr15Ti	A5.11	ENiCrMo-7	Nicrofer 6616 hMo	– alloy C-4
2.4831	SG-NiCr21Mo9Nb	A5.14	ERNiCrMo-3	2.4621	EL-NiCr20Mo9Nb	A5.11	ENiCrMo-3	Nicrofer 6020 hMo	– alloy 625
2.4607	SG-NiCr23Mo16	A5.14	ERNiCrMo-13	2.4609	EL-NiCr22Mo16	A5.11	ENiCrMo-13	Nicrofer 5923 hMo	– alloy 59
2.4607	SG-NiCr23Mo16	A5.14	ERNiCrMo-13	2.4609	EL-NiCr22Mo16	A5.11	ENiCrMo-13	Nicrofer 5716 hMoW	– alloy C-276
2.4886	SG-NiMo16Cr16W	A5.14	ERNiCrMo-4	2.4887	EL-NiMo15Cr15W	A5.11	ENiCrMo-4		
2.4667	SG-NiCr19NbMoTi	A5.14	ERNiFeCr-2	–	–	–	–	Nicrofer 5219 Nb	– alloy 718[1]
2.4831	SG-NiCr21Mo9Nb	A5.14	ERNiCrMo-3	2.4621	EL-NiCr20Mo9Nb	A5.11	ENiCrMo-3	Nicrofer 4823 hMo	– alloy G-3
NiCrFe – FeNiCrMo – standard alloys									
2.4806	SG-NiCr20Nb	A5.14	ERNiCr-3	2.4648	EL-NiCr19Nb	(A5.11)	(ENiCrFe-3)	Nicrofer 7216 LC	– alloy 600 L
2.4806	SG-NiCr20Nb	A5.14	ERNiCr-3	2.4648	EL-NiCr19Nb	(A5.11)	(ENiCrFe-3)	Nicrofer 6030	– alloy 690
2.4642	NiCr29Fe	A5.14	ERNiCr-3	2.4648	EL-NiCr19Nb	(A5.11)	(ENiCrFe-3)		
2.4831	SG-NiCr21Mo9Nb	A5.14	ERNiCrMo-3	2.4621	EL-NiCr20Mo9Nb	A5.11	ENiCrMo-3	Nicrofer 4221	– alloy 825
2.4607	SG-NiCr23Mo16	A5.14	ERNiCrMo-13	2.4609	EL-NiCr22Mo16	A5.11	ENiCrMo13	Nicrofer 3620 Nb	– alloy 20
2.4831	SG-NiCr21Mo9Nb	A5.14	ERNiCrMo-3	2.4621	EL-NiCr20Mo9Nb	A5.11	ENiCrMo-3		
2.4806	SG-NiCr20Nb	A5.14	ERNiCr-3	2.4648	EL-NiCr19Nb	(A5.11)	(ENiCrFe-3)	Nicrofer 3220	– alloy 800
2.4607	SG-NiCr23Mo16	A5.14	ERNiCrMo-13	2.4609	EL-NiCr22Mo16	(A5.11)	ENiCrMo-13	Nicrofer 3127 hMo	– alloy 31
1.4562	X1NiCrMoCu32-28-7	A5.14	ERNiCrMo	1.4562	X1NiCrMoCu32-28-7	A5.11	ENiCrMo		
2.4831	SG-NiCr21Mo9Nb	A5.14	ERNiCrMo-3	2.4621	EL-NiCr20Mo9Nb	A5.11	ENiCrMo-3	Nicrofer 3127 LC	– alloy 28
1.4563	X1NiCrMoCuN31-27-4	–	–	1.4563	X1NiCrMoCuN31-27-4	–	–		
FeNiCr – special stainless steels									
1.4591	X1CrNiMoCuN33-32-1	–	–	1.4591	X1CrNiMoCuN33-32-1	–	–	Nicrofer 3033	– alloy 33
1.4466	X2CrNiMoN25-25	–	–	1.4466	EL-25-20-2	A5.11	E310Mo	Cronifer 2525 LCN	
2.4607	SG-NiCr23Mo16	A5.14	ERNiCrMo-13	2.4609	EL-NiCr22Mo16	A5.11	ENiCrMo-13	Cronifer 1925 hMo	– alloy 926
CuNi									
2.0837	SG-CuNi30Fe	A5.7	ERCuNi	2.0838	EL-CuNi30Mn	A5.7	ECuNi	Cunifer 30	– alloy CuNi70/30
2.0837	SG-CuNi30Fe	A5.7	ERCuNi	2.0838	EL-CuNi30Mn	A5.7	ECuNi	Cunifer 10	– alloy CuNi90/10

High-performance materials: sheet and plate
Material characteristics

Krupp VDM alloy designation	Material characteristics

Corrosion-resistant alloys		
Ni – NiCu		
VDM Nickel 99.2	– alloy 200	Good mechanical properties, thermal and electrical conductivity, corrosion resistance.
VDM LC-Nickel 99.2	– alloy 201	As VDM Nickel 99.2 – alloy 200 but with reduced C-content to avoid graphite precipitation above 315 °C (600 °F).
VDM LC-Nickel 99.6	– alloy 205	As VDM LC-Nickel 99.2 – alloy 201, with even lower levels of residuals.
Nicorros	– alloy 400	Good resistance to seawater, hydrofluoric acid, dilute reducing acids, alkalis and salt solutions.

NiMo – NiCrMo – NiCrFeMo – superalloys		
Nimofer 6928	– alloy B-2	Excellent resistance to stress-corrosion cracking and pitting. Very high resistance to reducing media such as hydrochloric acid.
Nimofer 6629	– alloy B-4	As Nimofer 6928 – alloy B-2 but with better workability.
Nimofer 6224	– alloy B-10	Excellent resistance to condensing sulfuric acid, good resistance in reducing media. Resistance to general and intergranular corrosion.
Nicrofer 6616 hMo	– alloy C-4	Excellent resistance to crevice corrosion, pitting and stress-corrosion cracking, high resistance in contaminated reducing mineral acids and reducing gaseous chloride media.
Nicrofer 6020 hMo	– alloy 625	Excellent resistance to pitting and crevice corrosion and to stress-corrosion cracking. High resistance to mineral acids and to alkalis.
Nicrofer 5923 hMo	– alloy 59	Best overall resistance to corrosive media under both oxidizing and reducing conditions.
Nicrofer 5716 hMoW	– alloy C-276	Outstanding resistance to a wide range of media, particularly reducing, as well as to pitting and stress-corrosion cracking.
Nicrofer 5219 Nb	– alloy 718	High strength age-hardenable alloy with good corrosion resistance at high and low temperatures.
Nicrofer 4823 hMo	– alloy G-3	Very good resistance to both oxidizing and reducing media, as well as to pitting and stress-corrosion cracking and to chloride- and fluoride-contaminated mineral acids.

NiCrFe – FeNiCrMo – standard alloys		
Nicrofer 7216 LC	– alloy 600 L	Excellent resistance to intercrystalline and to stress-corrosion cracking, as well as to high-temperature halogen corrosion.
Nicrofer 6030	– alloy 690	High corrosion resistance to oxidizing media, including hot contaminated nitric acid.
Nicrofer 4221	– alloy 825	Good resistance to pitting, crevice and stress corrosion, and to oxidizing and reducing acids, alkalis and seawater.
Nicrofer 3620 Nb	–alloy 20	Good resistance to sulfuric acid, even at high temperatures.
Nicrofer 3220	– alloy 800	Excellent resistance to oxidation, to nitriding and to hydrogen embrittelment up to 600 °C (1110 °F).
Nicrofer 3127 hMo	– alloy 31	Excellent resistance to pitting, crevice and stress corrosion in mineral and organic acids particularly under oxidizing conditions. Outstanding resistance to phosphoric acid and to medium-concentration sulfuric acid.
Nicrofer 3127 LC	– alloy 28	High resistance to pitting, crevice and stress corrosion, especially in oxidizing media. Excellent resistance to phosphoric acid. Good resistance to nitric acid.

FeNiCr – special stainless steels		
Nicrofer 3033	– alloy 33	Excellent resistance to oxidizing media, HNO_3/HF-mixtures, halides and caustic soda. Outstanding resistance to hot, concentraded sulfuric acid. Very high strength and ductility.
Cronifer 2525 LCN		Excellent resistance in oxidizing media such as nitric acid and in urea.
Cronifer 1925 hMo	– alloy 926	Excellent resistance to pitting, crevice and stress corrosion in halide media.High mechanical properties.

CuNi		
Cunifer 30	– alloy CuNi70/30	Excellent resistance to flowing contaminated seawater at flow rates from 1 to 4 m/s. Good resistance to erosion-corrosion and to cavitation.
Cunifer 10	– alloy CuNi90/10	Very good resistance to seawater at moderate flow rates from 1 to 3 m/s.

High-performance materials: sheet and plate
Major applications

Krupp VDM alloy designation	Major applications

Corrosion-resistant alloys		
Ni – NiCu		
VDM Nickel 99.2	– alloy 200	Caustic soda production, VCM production, food processing, production of soap and detergents, organic chlorinations.
VDM LC-Nickel 99.2	– alloy 201	Caustic soda production, VCM production, food processing, production of soap and detergents, organic chlorinations preferably above 300 °C (570 °F).
VDM LC-Nickel 99.6	– alloy 205	Caustic soda production, VCM production, food processing, production of soap and detergents, organic chlorinations preferably above 300 °C (570 °F).
Nicorros	– alloy 400	Chemical and offshore industry, feedwater heaters, salt production, nuclear fuel processing.

NiMo – NiCrMo – NiCrFeMo – superalloys		
Nimofer 6928	– alloy B-2	Chemical process industry: acetic acid production, styrene production, methyl methacrylate production.
Nimofer 6629	– alloy B-4	Chemical process industry: acetic acid production, styrene production, methyl methacrylate production.
Nimofer 6224	– alloy B-10	Chemical processes, energy production and pollution control, flue gas desulfurization, waste sulfuric acid.
Nicrofer 6616 hMo	– alloy C-4	Inorganic chemicals, fertilizer and pesticide production.
Nicrofer 6020 hMo	– alloy 625	FGD units, waste incineration, super phosphoric acid production, offshore oil and gas platforms, high-temperature bellows and fans.
Nicrofer 5923 hMo	– alloy 59	FGD systems, waste incineration systems, fine chemicals production, ore processing.
Nicrofer 5716 hMoW	– alloy C-276	Chemical and petrochemical processes, FGD systems, fine chemicals production.
Nicrofer 5219 Nb	– alloy 718	Offshore and marine engineering, drilling equipment, pumps and valves.
Nicrofer 4823 hMo	– alloy G-3	Fertilizer production, sour-gas field equipment, petrochemical processing.

NiCrFe – FeNiCrMo – standard alloys		
Nicrofer 7216 LC	– alloy 600 L	Steam generators, feedwater heaters and moderator coolers in nuclear power stations. Production of caustic soda and VCM. Flightrecorder foils. Pulp and paper industry.
Nicrofer 6030	– alloy 690	Nuclear fuel processing. Steam generators in pressurized water reactors.
Nicrofer 4221	– alloy 825	Sulfuric acid plant, nuclear waste reprocessing. Heat exchangers in offshore oil and gas production. Caustic soda concentrators, pickling plant.
Nicrofer 3620 Nb	– alloy 20	Processing of sulfuric acid. Hydrofluoric acid production. Refinery equipment.
Nicrofer 3220	– alloy 800	Heat exchangers and piping systems in chemical and petrochemical plants. Steam superheater tubes. Sheathed heating elements.
Nicrofer 3127 hMo	– alloy 31	Production and processing of phosphoric and sulfuric acids; FGD systems; pulp and paper industry, marine and offshore engineering; pickling plant; petrochemical plant, waste acid systems.
Nicrofer 3127 LC	– alloy 28	Production and processing of nitric, sulfuric and phosphoric acids, offshore oil and gas production, refinery heat exchangers.

FeNiCr – special stainless steels		
Nicrofer 3033	– alloy 33	Sulfuric acid production, HNO_3/HF pickling installations, caustic soda processing, heat exchangers using seawater and brackish water, waste acid systems.
Cronifer 2525 LCN		Production and processing of urea (strippers, condensers) and sulfuric acid.
Cronifer 1925 hMo	– alloy 926	Pulp and paper industry; offshore platforms, FGD systems, salt concentration plants, chemicals processing.

CuNi		
Cunifer 30	– alloy CuNi70/30	Seawater piping systems on ships, offshore platforms, desalination plants. Heat exchangers using seawater and brackish water. Salt plants.
Cunifer 10	– alloy CuNi90/10	Seawater piping systems on ships, offshore platforms, desalination plants. Heat exchangers using seawater and brackish water. Salt plants. Sheathing of platform legs and risers.

Heat-resistant alloys
High-temperature, high-strength alloys
Heating-element and resistance alloys
Expansion and glass-sealing alloys
Sheet and plate

High-performance materials: sheet and plate
Designations and specifications

Krupp VDM alloy designation		Designations and specifications					
		Werkst.-Nr.	DIN, VdEh	UNS	ISO 9722 6208	BS	AFNOR
Heat-resistant alloys							
NiCrFe – FeNiCr							
Nicrofer 7520	– alloy 75	2.4951	NiCr20Ti	N06075	NW6621	HR 203	NC20T
Nicrofer 7216	– alloy 600	2.4816	NiCr15Fe	N06600	NW6600	NA 14	NC15Fe
Nicrofer 6030	– alloy 690	2.4642	NiCr29Fe	N06690	NW6690	–	NC30Fe
Nicrofer 3718 So	– alloy DS	1.4862	X8NiCrSi38-18	–	–	NA 17	Z 12 NCS 37.18
Nicrofer 3718	– (alloy 330)	1.4864	X12NiCrSi36-16	(N08330)	–	–	Z 12 NCS 35.16
High-temperature, high-strength alloys							
NiCr – NiCrFe – NiCrMo – NiCrCoMo – superalloys							
Nicrofer 7016 TiNb	– alloy X-750	2.4669	NiCr15Fe7TiAl	N07750	NW7750	–	NC15TNbA
Nicrofer 6025 HT	– alloy 602 CA	2.4633	NiCr25FeAlY	N06025	–	–	–
Nicrofer 5520 Co	– alloy 617	2.4663	NiCr23Co12Mo	N06617	NW6617	–	–
Nicrofer 5219 Nb	– alloy 718	2.4668	NiCr19NbMo	N07718	NW7718	–	NC19FeNb
Nicrofer 5120 CoTi	– alloy C-263	2.4650	NiCo20Cr20MoTi	N07263	NW7263	HR 206	NCK20D
Nicrofer 4722 Co	– alloy X	2.4665	NiCr22Fe18Mo	N06002	NW6002	HR 204	NC22FeD
Nicrofer 4626 MoW	– alloy 333	2.4608	NiCr26MoW	N06333	NW6333	–	NC26DW
NiCrFe – FeNiCr – standard alloys							
Nicrofer 7216 H	– alloy 600 H	2.4816	NiCr15Fe	N06600	–	NA 14 (H)	NC15Fe
Nicrofer 6023 H	– alloy 601 H	2.4851	NiCr23Fe	N06601	–	–	NC23FeA
Nicrofer 45 TM	– alloy 45 TM	2.4889	NiCr28FeSiCe	N06045	–	–	–
Nicrofer 3220 HT	– alloy 800 HP	1.4959	X8NiCrAlTi32-21	N08811	NW8811	–	–
Nicrofer 3220 H	– alloy 800 H	1.4876 1.4958	X10NiCrAlTi32-20 X5NiCrAlTi31-20	N08810	NW8810	NA 15 (H)	–
CoCrNiW							
Conicro 5010 W	– alloy 25	2.4964	CoCr20W15Ni	R30605	–	HR 240	KC20WN
Conicro 4023 W	– alloy 188	2.4683	CoCr22NiW	R30188	–	–	KCN22W
Heating-element and resistance alloys							
NiCr – FeCrAl							
Cronix 80	– alloy NiCr80/20	2.4869	NiCr80-20	N06003	–	–	–
Cronix 70	– alloy NiCr70/30	2.4658	NiCr70-30	N06008	–	–	–
Controlled expansion and glass-sealing alloys							
FeNi – FeNiCo							
Pernifer 36	– alloy 36	1.3912	Ni36	K93601	–	–	Fe-Ni36
Pernifer 2918		1.3981	NiCo29-18	K94610	–	–	Fe-Ni29Co17

High-performance materials: sheet and plate
Designations and specifications

Designations and specifications							Krupp VDM alloy designation	
EN	DIN, SEW, WL Chemical composition	DIN, SEW, WL Technical delivery conditions	VdTÜV data sheet	ASTM	ASME	AMS		
Heat-resistant alloys								
NiCrFe – FeNiCr								
10095	17742	17750	–	–	–	–	Nicrofer 7520	– alloy 75
10095	17742	17750	305	B168	SB168	5540	Nicrofer 7216	– alloy 600
–	–	–	–	B168	SB168	–	Nicrofer 6030	– alloy 690
–	–	SEW 310	–	–	–	–	Nicrofer 3718 So	– alloy DS
10095	SEW 470	SEW 310/470	–	(B536)	–	(5592)	Nicrofer 3718	– (alloy 330)
High-temperature, high-strength alloys								
NiCr – NiCrFe – NiCrMo – NiCrCoMo – superalloys								
–	–	–	–	–	–	5542, 5598	Nicrofer 7016 TiNb	– alloy X-750
–	–	–	–	B168	–	–	Nicrofer 6025 HT	– alloy 602 CA
–	–	–	485	–	–	–	Nicrofer 5520 Co	– alloy 617
–	WL 2.4668	WL, part 1	–	B670	–	5596, 5597	Nicrofer 5219 Nb	– alloy 718
–	WL 2.4650	WL, part 1	–	–	–	5872	Nicrofer 5120 CoTi	– alloy C-263
–	WL 2.4665	WL, part 1	–	B435	SB435	5536	Nicrofer 4722 Co	– alloy X
–	–	–	–	B718	–	5593	Nicrofer 4626 MoW	– alloy 333
NiCrFe – FeNiCr – standard alloys								
–	17742	17750	305	–	–	–	Nicrofer 7216 H	– alloy 600 H
–	17742	17750	–	–	–	–	Nicrofer 6023 H	– alloy 601 H
–	–	–	519	B168	SB168	–	Nicrofer 45 TM	– alloy 45 TM
–	17460	17460/SEW310	–	B409	–	–	Nicrofer 3220 HT	– alloy 800 HP
–	17460	17460/SEW310	412, 434	B409	SB409	–	Nicrofer 3220 H	– alloy 800 H
CoCrNiW								
–	WL 2.4964	WL, part 1 + 100	–	–	–	5537	Conicro 5010 W	– alloy 25
–	–	–	–	–	–	5608	Conicro 4023 W	– alloy 188
Heating-element and resistance alloys								
NiCr – FeCrAl								
–	17742	(17470)	–	(B344)	–	–	Cronix 80	– alloy NiCr80/20
–	17742	(17470)	–	–	–	–	Cronix 70	– alloy NiCr70/30
Controlled expansion and glass-sealing alloys								
FeNi – FeNiCo								
–	–	SEW 385	–	A658/B399	–	–	Pernifer 36	– alloy 36
–	17745	SEW 385	–	F15	–	7728	Pernifer 2918	

High-performance materials: sheet and plate
Chemical composition

Krupp VDM alloy designation		Chemical composition, %						
		Ni	Cr	Fe	C	Mn	Si	Cu
Heat-resistant alloys								
NiCrFe – FeNiCr								
Nicrofer 7520	– alloy 75	balance	19.0 – 21.0	≤ 5.0	0.08 – 0.13	≤ 1.0	0.3 – 0.7	≤ 0.5
Nicrofer 7216	– alloy 600	≥ 72.0	14.0 – 17.0	6.0 – 10.0	0.05 – 0.08	≤ 1.0	≤ 0.5	≤ 0.5
Nicrofer 6030	– alloy 690	≥ 60.0	27.0 – 30.0	8.0 – 10.0	≤ 0.02	≤ 0.3	≤ 0.3	≤ 0.5
Nicrofer 3718 So	– alloy DS	35.0 – 39.0	17.0 – 19.0	balance	≤ 0.10	0.8 – 1.5	1.9 – 2.5	≤ 0.5
Nicrofer 3718	– (alloy 330)	34.0 – 37.0	15.0 – 17.0	balance	≤ 0.15	≤ 2.0	1.0 – 2.0	–
High-temperature, high-strength alloys								
NiCr – NiCrFe – NiCrMo – NiCrCoMo – superalloys								
Nicrofer 7016 TiNb	– alloy X-750	≥ 70.0	14.0 – 17.0	5.0 – 9.0	≤ 0.08	≤ 1.0	≤ 0.50	≤ 0.50
Nicrofer 6025 HT	– alloy 602 CA	balance	24.0 – 26.0	8.0 – 11.0	0.15 – 0.25	≤ 0.1	≤ 0.5	≤ 0.1
Nicrofer 5520 Co	– alloy 617	balance	20.0 – 23.0	≤ 2.0	0.05 – 0.10	≤ 0.70	≤ 0.70	–
Nicrofer 5219 Nb	– alloy 718	50.0 – 55.0	17.0 – 21.0	balance	0.02 – 0.08	≤ 0.35	≤ 0.35	≤ 0.20
Nicrofer 5120 CoTi	– alloy C-263	balance	19.0 – 21.0	≤ 0.7	0.04 – 0.08	≤ 0.6	≤ 0.4	≤ 0.2
Nicrofer 4722 Co	– alloy X	balance	20.5 – 23.5	17.0 – 20.0	0.05 – 0.15	≤ 1.0	≤ 1.0	–
Nicrofer 4626 MoW	– alloy 333	44.0 – 47.0	24.0 – 26.0	balance	0.03 – 0.06	1.2 – 2.0	0.8 – 1.2	≤ 0.5
NiCrFe – FeNiCr – standard alloys								
Nicrofer 7216 H	– alloy 600 H	≥ 72.0	14.0 – 17.0	6.0 – 10.0	0.05 – 0.08	≤ 1.0	≤ 0.5	≤ 0.5
Nicrofer 6023 H	– alloy 601 H	58.0 – 63.0	22.0 – 24.0	balance	≤ 0.10	≤ 0.6	≤ 0.5	≤ 0.5
Nicrofer 45 TM	– alloy 45 TM	≥ 45.0	26.0 – 29.0	21.0 – 25.0	0.05 – 0.12	≤ 1.0	2.5 – 3.0	≤ 0.3
Nicrofer 3220 HT	– alloy 800 HP	30.0 – 32.0	19.0 – 22.0	balance	0.06 – 0.10	0.5 – 1.0	0.2 – 0.6	≤ 0.5
Nicrofer 3220 H	– alloy 800 H	30.0 – 32.0	19.0 – 21.0	balance	0.06 – 0.08	0.5 – 1.0	0.2 – 0.6	≤ 0.5
CoCrNiW								
Conicro 5010 W	– alloy 25	9.0 – 11.0	19.0 – 21.0	≤ 3.0	0.05 – 0.15	1.0 – 2.0	≤ 0.3	–
Conicro 4023 W	– alloy 188	20.0 – 24.0	20.0 – 24.0	≤ 3.0	0.05 – 0.15	≤ 1.25	0.2 – 0.4	–
Heating-element and resistance alloys								
NiCr – FeCrAl								
Cronix 80	– alloy NiCr80/20	balance	19.0 – 21.0	≤ 1.0	≤ 0.08	≤ 1.0	1.0 – 1.5	≤ 0.5
Cronix 70	– alloy NiCr70/30	balance	29.0 – 31.0	≤ 1.0	≤ 0.07	≤ 1.0	1.0 – 1.5	≤ 0.5
Expansion and glass-sealing alloys								
FeNi – FeNiCo								
Pernifer 36	– alloy 36	35.0 – 37.0	≤ 0.2	balance	≤ 0.03	≤ 0.35	≤ 0.2	–
Pernifer 2918		28.0 – 29.5	–	balance	≤ 0.03	≤ 0.3	≤ 0.2	≤ 0.2

High-performance materials: sheet and plate
Chemical composition

Chemical composition, %						Krupp VDM alloy designation
Mo	Co	Al	Ti	Nb	others	
Heat-resistant alloys						
NiCrFe – FeNiCr						
–	–	≤ 0.3	0.2 – 0.6	–	–	Nicrofer 7520 – alloy 75
–	–	≤ 0.3	≤ 0.3	–	B ≤ 0.006	Nicrofer 7216 – alloy 600
–	–	≤ 0.3	≤ 0.3	–	–	Nicrofer 6030 – alloy 690
–	–	–	≤ 0.20	–	–	Nicrofer 3718 So – alloy DS
–	–	–	≤ 0.20	–	(N ≤ 0.11)	Nicrofer 3718 – (alloy 330)
High-temperature, high-strength alloys						
NiCr – NiCrFe – NiCrMo – NiCrCoMo – superalloys						
–	(≤ 1.0)	0.40 – 1.00	2.25 – 2.75	0.70 – 1.20	–	Nicrofer 7016 TiNb – alloy X-750
–	–	1.8 – 2.4	0.1 – 0.2	–	Y = 0.05 – 0.12, Zr = 0.01 – 0.10	Nicrofer 6025 HT – alloy 602 CA
8.0 – 10.0	10.0 – 13.0	0.60 – 1.50	0.20 – 0.60	–	–	Nicrofer 5520 Co – alloy 617
2.8 – 3.3	≤ 1.0	0.30 – 0.70	0.70 – 1.15	4.8 – 5.5	B = 0.002 – 0.006	Nicrofer 5219 Nb – alloy 718
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 5120 CoTi – alloy C-263
8.0 – 10.0	0.5 – 2.5	≤ 0.10	–	–	W = 0.2 – 1.0, B ≤ 0.005	Nicrofer 4722 Co – alloy X
2.5 – 3.5	2.5 – 3.5	–	0.1 – 0.2	–	W = 2.5 – 3.5	Nicrofer 4626 MoW – alloy 333
NiCrFe – FeNiCr – standard alloys						
–	–	≤ 0.3	≤ 0.3	–	B ≤ 0.006	Nicrofer 7216 H – alloy 600 H
–	–	1.1 – 1.6	0.3 – 0.6	–	Zr ≤ 0.03	Nicrofer 6023 H – alloy 601 H
–	–	–	–	–	RE = 0.05 – 0.15 (Ce = 0.03 – 0.09)	Nicrofer 45 TM – alloy 45 TM
–	–	0.30 – 0.60	0.30 – 0.60	–	(Al+Ti) = 0.85 – 1.20	Nicrofer 3220 HT – alloy 800 HP
–	–	0.20 – 0.40	0.20 – 0.50	–	(Al+Ti) ≤ 0.7	Nicrofer 3220 H – alloy 800 H
CoCrNiW						
–	balance	–	–	–	W = 14.0 – 16.0	Conicro 5010 W – alloy 25
–	balance	≤ 0.20	–	–	W = 13.0 – 16.0, La = 0.02 – 0.12, B ≤ 0.01	Conicro 4023 W – alloy 188
Heating-element and resistance alloys						
NiCr – FeCrAl						
–	–	≤ 0.20	–	–	RE = 0.01 – 0.04	Cronix 80 – alloy NiCr80/20
–	–	≤ 0.20	–	–	RE = 0.01 – 0.04	Cronix 70 – alloy NiCr70/30
Expansion and glass-sealing alloys						
FeNi – FeNiCo						
–	≤ 0.5	–	–	–	–	Pernifer 36 – alloy 36
–	16.5 – 18.0	≤ 0.05	≤ 0.1	–	(Al+Mg+Zr+Ti) ≤ 0.20	Pernifer 2918

High-performance materials: sheet and plate
Physical properties

Krupp VDM alloy designation		Physical properties at room temperature					Thermal expansion between 20 °C and T, 10^{-6}/K							
		Density g/cm³	Specific heat J/kg K	Thermal conductivity W/m K	Electrical resistivity µΩ cm	Modulus of elasticity kN/mm²	100	200	300	400	500	600	700	800
Heat-resistant alloys														
NiCrFe – FeNiCr														
Nicrofer 7520	– alloy 75	8.4	445	12.1	109	221	11.7	12.6	13.2	13.8	14.3	14.8	15.4	16.0
Nicrofer 7216	– alloy 600	8.4	455	14.8	103	214	13.7	14.1	14.4	14.8	15.1	15.4	15.8	16.1
Nicrofer 6030	– alloy 690	8.2	450	12.0	115	215	14.1	14.3	14.5	14.8	15.2	15.7	16.2	16.6
Nicrofer 3718 So	– alloy DS	8.0	472	11.4	104	194	15.1	15.7	16.2	16.6	17.0	17.4	17.7	18.0
Nicrofer 3718	– (alloy 330)	8.0	472	11.4	104	194	15.1	15.7	16.2	16.6	17.0	17.4	17.7	18.0
High-temperature, high-strength alloys														
NiCr – NiCrFe – NiCrMo – NiCrCoMo – superalloys														
Nicrofer 7016 TiNb	– alloy X-750	8.3	430	12.0	121	214	12.9	13.4	14.0	14.5	14.8	15.4	16.3	17.1
Nicrofer 6025 HT	– alloy 602 CA	7.9	450	11.3	118	215	11.9	13.5	14.0	14.5	14.7	14.9	15.7	16.6
Nicrofer 5520 Co	– alloy 617	8.4	420	13.4	122	212	11.6	12.6	13.1	13.6	13.9	14.0	14.8	15.4
Nicrofer 5219 Nb	– alloy 718	8.2	432	11.1	123	205	12.6	13.4	13.8	14.1	14.4	14.8	15.4	16.1
Nicrofer 5120 CoTi	– alloy C-263	8.4	426	11.7	115	222	10.7	12.0	12.5	13.0	13.5	14.1	14.9	15.9
Nicrofer 4722 Co	– alloy X	8.3	435	11.3	115	205	13.6	13.9	14.3	14.6	14.9	15.2	15.6	15.9
Nicrofer 4626 MoW	– alloy 333	8.2	441	11.1	114	201	12.7	13.9	14.7	15.0	15.4	16.0	16.7	16.8
NiCrFe – FeNiCr – standard alloys														
Nicrofer 7216 H	– alloy 600 H	8.4	455	14.8	103	214	13.7	14.1	14.4	14.8	15.1	15.4	15.8	16.1
Nicrofer 6023 H	– alloy 601 H	8.1	450	11.3	119	207	13.8	14.4	14.6	14.8	15.3	15.7	16.3	16.7
Nicrofer 45 TM	– alloy 45 TM	8.0	500	13	118	193	13.0	14.5	14.9	15.4	15.7	16.2	16.6	17.0
Nicrofer 3220 HT	– alloy 800 HP	8.0	472	11.5	101	194	15.1	15.7	16.2	16.6	17.0	17.4	17.7	18.0
Nicrofer 3220 H	– alloy 800 H	8.0	472	11.5	101	194	15.1	15.7	16.2	16.6	17.0	17.4	17.7	18.0
CoCrNiW														
Conicro 5010 W	– alloy 25	9.1	385	9.7	89	226	12.3	12.9	13.3	13.8	14.2	14.6	15.1	15.7
Conicro 4023 W	– alloy 188	9.1	405	10.2	95	222	11.9	12.6	13.2	13.8	14.5	15.2	15.8	16.5
Heating-element and resistance alloys														
NiCr – FeCrAl														
Cronix 80	– alloy NiCr80/20	8.3	420	15	112	200	13.5	14.0	14.5	15.0	15.4	15.5	15.7	16.0
Cronix 70	– alloy NiCr70/30	8.1	420	13.8	119	200	13.0	13.5	14.0	14.5	14.8	15.0	15.4	16.0
Expansion and glass-sealing alloys														
FeNi – FeNiCo														
Pernifer 36	– alloy 36	8.1	515	12.8	76	143	1.2	2.2	4.9	7.9	9.2	10.5	–	–
Pernifer 2918		8.3	500	17.5	49	160	6.3	5.8	5.4	5.1	6.4	8.0	–	–

Imperial values see page 66

High-performance materials: sheet and plate
Mechanical properties

Mechanical properties at room temperature									Krupp VDM alloy designation
Heat-treatment condition and temperature	annealed / solution treated				age hardened				
	Rp 0.2 N/mm²	Rp 1.0 N/mm²	Rm N/mm²	A5 %	Rp 0.2 N/mm²	Rp 1.0 N/mm²	Rm N/mm²	A5 %	
Heat-resistant alloys									
NiCrFe – FeNiCr									
annealed 1000 – 1050 °C	≥ 240	≥ 270	≥ 650	≥ 25	–	–	–	–	Nicrofer 7520 – alloy 75
annealed 920 – 1100 °C	≥ 240	265	≥ 550	≥ 30	–	–	–	–	Nicrofer 7216 – alloy 600
annealed 1020 – 1070 °C / solution treated 1080 – 1150 °C	≥ 240	≥ 270	≥ 586	≥ 30	–	–	–	–	Nicrofer 6030 – alloy 690
annealed 1020 – 1120 °C	≥ 285	≥ 310	≥ 650	30	–	–	–	–	Nicrofer 3718 So – alloy DS
annealed 1020 – 1120 °C	≥ 285	≥ 310	≥ 650	30	–	–	–	–	Nicrofer 3718 – (alloy 330)
High-temperature, high-strength alloys									
NiCr – NiCrFe – NiCrMo – NiCrCoMo – superalloys									
solution treated 980 °C / age hardened 730/620 °C	≥ 515	–	≥ 930	≥ 30	≥ 795	–	≥ 1170	≥ 18	Nicrofer 7016 TiNb – alloy X-750
solution treated 1180 – 1220 °C	≥ 270	≥ 330	≥ 680	≥ 30	–	–	–	–	Nicrofer 6025 HT – alloy 602 CA
solution treated 1150 – 1200 °C	≥ 300	≥ 330	≥ 700	≥ 35	–	–	–	–	Nicrofer 5520 Co – alloy 617
solution treated 960 °C / age hardened 720/620 °C	≥ 550	–	≥ 965	≥ 30	≥ 1035	–	≥ 1240	≥ 12	Nicrofer 5219 Nb – alloy 718
solution treated 1140 – 1160 °C / age hardened 800 °C	400	–	540	–	≥ 570	–	≥ 970	≥ 30	Nicrofer 5120 CoTi – alloy C-263
solution treated 1160 – 1190 °C	≥ 310	–	≥ 725	≥ 30	–	–	–	–	Nicrofer 4722 Co – alloy X
solution treated 1150 – 1180 °C	≥ 240	–	≥ 550	≥ 30	–	–	–	–	Nicrofer 4626 MoW – alloy 333
NiCrFe – FeNiCr – standard alloys									
solution treated 1080 – 1150 °C	≥ 180	210	≥ 500	≥ 35	–	–	–	–	Nicrofer 7216 H – alloy 600 H
solution treated 1100 – 1180 °C	≥ 240	≥ 270	≥ 600	≥ 30	–	–	–	–	Nicrofer 6023 H – alloy 601 H
solution treated 1160 – 1200 °C	≥ 240	≥ 280	≥ 620	≥ 35	–	–	–	–	Nicrofer 45 TM – alloy 45 TM
solution treated 1150 – 1200 °C	≥ 170	≥ 200	≥ 450	≥ 30	–	–	–	–	Nicrofer 3220 HT – alloy 800 HP
solution treated 1150 °C	≥ 170	≥ 200	≥ 450	≥ 30	–	–	–	–	Nicrofer 3220 H – alloy 800 H
CoCrNiW									
solution treated 1180 – 1220 °C	≥ 380	–	≥ 900	≥ 30	–	–	–	–	Conicro 5010 W – alloy 25
solution treated 1180 – 1220 °C	≥ 380	–	≥ 860	≥ 40	–	–	–	–	Conicro 4023 W – alloy 188
Heating-element and resistance alloys									
NiCr – FeCrAl									
annealed 870 – 1100 °C	≥ 280	–	≥ 650	≥ 30	–	–	–	–	Cronix 80 – alloy NiCr80/20
annealed 850 – 900 °C	≥ 300	–	≥ 700	≥ 25	–	–	–	–	Cronix 70 – alloy NiCr70/30
Expansion and glass-sealing alloys									
FeNi – FeNiCo									
annealed 800 – 850 °C	≥ 270	–	≥ 490	≥ 40	–	–	–	–	Pernifer 36 – alloy 36
annealed 800 – 900 °C	370	–	530	30	–	–	–	–	Pernifer 2918

Imperial values see page 67

High-performance materials: sheet and plate
Mechanical properties

Krupp VDM alloy designation		Heat treatment	Mechanical properties at elevated temperatures, °C											
			Yield strength Rp 0.2, N/mm²						Yield strength Rp 1.0, N/mm²					
			100	200	300	400	500	600	100	200	300	400	500	600
Heat-resistant alloys														
NiCrFe – FeNiCr														
Nicrofer 7520	– alloy 75	onnealed	450	445	435	425	400	350	–	–	–	–	–	–
Nicrofer 7216	– alloy 600	annealed	≥ 180	≥ 165	≥ 155	≥ 150	140	–	–	–	–	–	–	–
Nicrofer 6030	– alloy 690	solution treated	260	220	200	180	170	160	290	260	240	220	200	190
Nicrofer 3718 So	– alloy DS	annealed	265	240	220	210	200	195	290	265	250	235	225	215
Nicrofer 3718	– (alloy 330)	annealed	265	240	220	210	200	195	290	265	250	235	225	215
High-temperature, high-strength alloys														
NiCr – NiCrFe – NiCrMo – NiCrCoMo – superalloys														
Nicrofer 7016 TiNb	– alloy X-750	age hardened	790	780	770	750	740	720	–	–	–	–	–	–
Nicrofer 6025 HT	– alloy 602 CA	solution treated	≥ 240	≥ 220	≥ 200	≥ 190	≥ 180	≥ 175	≥ 290	≥ 260	≥ 240	≥ 220	≥ 215	≥ 210
Nicrofer 5520 Co	– alloy 617	solution treated	≥ 270	≥ 230	≥ 220	≥ 210	≥ 200	≥ 190	≥ 300	≥ 260	≥ 250	≥ 240	≥ 225	≥ 210
Nicrofer 5219 Nb	– alloy 718	age hardened	1060	1040	1020	1000	980	950	–	–	–	–	–	–
Nicrofer 5120 CoTi	– alloy C-263	age hardened	520	490	480	480	480	470	–	–	–	–	–	–
Nicrofer 4722 Co	– alloy X	solution treated	310	290	270	250	230	220	–	–	–	–	–	–
Nicrofer 4626 MoW	– alloy 333	solution treated	280	240	210	190	190	180	–	–	–	–	–	–
NiCrFe – FeNiCr – standard alloys														
Nicrofer 7216 H	– alloy 600 H	solution treated	≥ 170	≥ 160	≥ 150	≥ 150	140	132	–	–	–	–	–	–
Nicrofer 6023 H	– alloy 601 H	solution treated	260	220	200	180	170	170	–	–	–	–	–	–
Nicrofer 45 TM	– alloy 45 TM	solution treated	≥ 220	≥ 200	≥ 185	≥ 170	≥ 150	≥ 135	≥ 260	≥ 240	≥ 225	≥ 210	≥ 190	≥ 170
Nicrofer 3220 HT	– alloy 800 HP	solution treated	–	–	–	–	–	–	–	–	–	–	–	–
Nicrofer 3220 H	– alloy 800 H	solution treated	≥ 140	≥ 115	≥ 95	≥ 85	≥ 80	≥ 75	≥ 160	≥ 135	≥ 115	≥ 105	≥ 100	≥ 95
CoCrNiW														
Conicro 5010 W	– alloy 25	solution treated	400	350	310	280	260	250	–	–	–	–	–	–
Conicro 4023 W	– alloy 188	solution treated	420	370	330	310	300	300	–	–	–	–	–	–
Heating-element and resistance alloys														
NiCr – FeCrAl														
Cronix 80	– alloy NiCr80/20	annealed	–	–	–	–	–	–	–	–	–	–	–	–
Cronix 70	– alloy NiCr70/30	annealed	–	–	–	–	–	–	–	–	–	–	–	–
Expansion and glass-sealing alloys														
FeNi – FeNiCo														
Pernifer 36	– alloy 36	annealed	180	115	95	90	90	75	–	–	–	–	–	–
Pernifer 2918		annealed	260	200	140	110	100	90	–	–	–	–	–	–

Imperial values see page 68

High-performance materials: sheet and plate
Mechanical properties

Mechanical properties at elevated temperatures, °C												Heat treatment	Krupp VDM alloy designation	
Tensile strength Rm, N/mm²						Elongation A5, %								
100	200	300	400	500	600	100	200	300	400	500	600			
Heat-resistant alloys														
NiCrFe – FeNiCr														
800	790	780	750	680	580	30	30	30	30	30	30	annealed	Nicrofer 7520	– alloy 75
520	500	485	480	470	–	35	35	35	35	–	–	annealed	Nicrofer 7216	– alloy 600
580	550	520	500	490	470	45	45	45	45	45	35	solution treated	Nicrofer 6030	– alloy 690
630	615	605	590	555	480	30	30	30	30	30	30	annealed	Nicrofer 3718 So	– alloy DS
630	615	605	590	555	480	30	30	30	30	30	30	annealed	Nicrofer 3718	– (alloy 330)
High-temperature, high-strength alloys														
NiCr – NiCrFe – NiCrMo – NiCrCoMo – superalloys														
1170	1150	1120	1080	1020	880	30	35	40	40	40	30	age hardened	Nicrofer 7016 TiNb	– alloy X-750
725	700	675	660	645	630	45	45	45	40	40	35	solution treated	Nicrofer 6025 HT	– alloy 602 CA
≥ 650	≥ 625	≥ 600	≥ 580	≥ 560	≥ 520	≥ 30	≥ 30	≥ 30	≥ 30	≥ 30	≥ 30	solution treated	Nicrofer 5520 Co	– alloy 617
1340	1290	1270	1240	1210	1150	26	25	24	23	23	24	age hardened	Nicrofer 5219 Nb	– alloy 718
890	850	825	815	805	785	40	41	42	43	42	41	age hardened	Nicrofer 5120 CoTi	– alloy C-263
720	710	700	680	640	600	40	40	45	45	45	40	solution treated	Nicrofer 4722 Co	– alloy X
650	620	580	550	530	500	40	40	45	50	45	40	solution treated	Nicrofer 4626 MoW	– alloy 333
NiCrFe – FeNiCr – standard alloys														
480	460	445	440	430	–	–	–	–	–	–	–	solution treated	Nicrofer 7216 H	– alloy 600 H
670	630	600	580	540	500	50	50	50	45	45	45	solution treated	Nicrofer 6023 H	– alloy 601 H
595	570	545	520	500	460	–	35	–	35	–	35	solution treated	Nicrofer 45 TM	– alloy 45 TM
–	–	–	–	–	–	–	–	–	–	–	–	solution treated	Nicrofer 3220 HT	– alloy 800 HP
425	400	390	380	360	300	–	–	–	–	–	–	solution treated	Nicrofer 3220 H	– alloy 800 H
CoCrNiTu														
960	930	880	840	810	760	70	71	72	70	65	55	solution treated	Conicro 5010 W	– alloy 25
900	860	820	790	760	730	55	60	63	64	62	60	solution treated	Conicro 4023 W	– alloy 188
Heating-element and resistance alloys														
NiCr – FeCrAl														
840	810	780	740	700	650	30	27	25	22	21	20	annealed	Cronix 80	– alloy NiCr80/20
–	–	–	–	–	–	–	–	–	–	–	–	annealed	Cronix 70	– alloy NiCr70/30
Expansion and glass-sealing alloys														
FeNi – FeNiCo														
435	430	410	350	290	210	45	45	50	55	60	70	annealed	Pernifer 36	– alloy 36
430	405	395	350	280	200	40	40	45	50	55	60	annealed	Pernifer 2918	

Imperial values see page 69

High-performance materials: sheet and plate
Mechanical properties

Krupp VDM alloy designation		Heat treatment	Creep properties, N/mm² at elevated temperatures, °C													
			Creep strength Rp 1.0/10⁴hrs							Creep-rupture strength Rm/10⁴hrs						
			500	600	700	800	900	1000	1100	500	600	700	800	900	1000	1100
Heat-resistant alloys																
NiCrFe – FeNiCr																
Nicrofer 7520	– alloy 75	annealed	–	–	–	–	–	–	–	–	100	36	16	9.5	6	–
Nicrofer 7216	– alloy 600	annealed	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Nicrofer 6030	– alloy 690	solution treated	–	–	42	20	8.2	3.4	–	–	105	56	31	15.4	7.7	–
Nicrofer 3718 So	– alloy DS	solution treated	–	80	35	15	5	(3)	–	–	125	45	20	8	(4)	–
Nicrofer 3718	– (alloy 330)	solution treated	–	80	35	15	5	(3)	–	–	125	45	20	8	(4)	–
High-temperature, high-strength alloys																
NiCr – NiCrFe – NiCrMo – NiCrCoMo – superalloys																
Nicrofer 7016 TiNb	– alloy X-750	age hardened	–	425	245	15	–	–	–	–	440	255	60	–	–	–
Nicrofer 6025 HT	– alloy 602 CA	solution treated	–	–	42	20	9.4	4.3	2.2	–	–	56	31	17.4	10.0	5.1
Nicrofer 5520 Co	– alloy 617	solution treated	–	220	99	45	19	5.5	–	–	260	123	65	30	10	–
Nicrofer 5219 Nb	– alloy 718	age hardened	–	580	200	19	–	–	–	–	620	248	36	–	–	–
Nicrofer 5120 CoTi	– alloy C-263	age hardened	–	500	310	90	10	–	–	–	600	345	125	32	–	–
Nicrofer 4722 Co	– alloy X	solution treated	–	123	74	42	18.5	4.9	–	–	231	122	59	31	7.4	–
Nicrofer 4626 MoW	– alloy 333	solution treated	–	72	38	19	9	4.2	–	–	150	80	42	17.5	6.9	–
NiCrFe – FeNiCr – standard alloys																
Nicrofer 7216 H	– alloy 600 H	solution treated	153	91	43	18	8	–	–	297	138	63	29	13	–	–
Nicrofer 6023 H	– alloy 601 H	solution treated	–	151	69	22	6.9	–	–	–	205	101	31	10.1	–	–
Nicrofer 45 TM	– alloy 45 TM	solution treated	120	52	22	10.5	4.7	2.5	–	160	80	32	15	7.5	4.5	–
Nicrofer 3220 HT	– alloy 800 HP	solution treated	–	–	59	28.2	12.1	3.5	–	–	–	74	32.6	15.6	6.4	–
Nicrofer 3220 H	– alloy 800 H	solution treated[1]	–	–	–	–	–	–	–	–	152	75	37	17	–	–
CoCrNiW																
Conicro 5010 W	– alloy 25	solution treated	–	–	–	–	–	–	–	–	–	160	75	35	12	–
Conicro 4023 W	– alloy 188	solution treated	–	–	–	–	–	–	–	–	(280)	160	80	30	12	–
Heating-element and resistance alloys																
NiCr – FeCrAl																
Cronix 80	– alloy NiCr80/20	annealed	10³h:	80	40	15	9	4	1.5	–	–	–	–	–	–	–
Cronix 70	– alloy NiCr70/30	annealed	10³h:	80	40	15	9	4	1.5	–	–	–	–	–	–	–
Expansion and glass-sealing alloys																
FeNi – FeNiCo																
Pernifer 36	– alloy 36	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Pernifer 2918		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

[1] according to VdTÜV 412
other values of Nicrofer 3220 H and HT according to DIN 17460

Imperial values see page 70

High-performance materials: sheet and plate
Mechanical properties

Creep properties, N/mm² at elevated temperatures, °C														Heat treatment	Krupp VDM alloy designation	
Creep strength Rp 1.0/10⁵hrs							Creep-rupture strength Rm/10⁵hrs									
500	600	700	800	900	1000	1100	500	600	700	800	900	1000	1100			
Heat-resistant alloys																
NiCrFe – FeNiCr																
–	–	–	–	–	–	–	160	68	23	11.5	7	5	–	annealed	Nicrofer 7520	– alloy 75
–	–	–	–	–	–	–	–	–	–	–	–	–	–	annealed	Nicrofer 7216	– alloy 600
–	–	30	12	4.8	1.9	–	–	70	40	21	10	4.8	–	solution treated	Nicrofer 6030	– alloy 690
–	40	14	4	1.5	–	–	–	75	25	7	3	1.5	–	solution treated	Nicrofer 3718 So	– alloy DS
–	40	14	4	1.5	–	–	–	75	25	7	3	1.5	–	solution treated	Nicrofer 3718	– (alloy 330)
High-temperature, high-strength alloys																
NiCr – NiCrFe – NiCrMo – NiCrCoMo – superalloys																
–	345	75	4	–	–	–	–	360	135	28	–	–	–	age hardened	Nicrofer 7016 TiNb	– alloy X-750
–	–	28	12	5.6	2.7	1.2	–	–	41	22	11.9	6.4	3.0	solution treated	Nicrofer 6025 HT	– alloy 602 CA
–	140	66	28	10	1	–	–	190	95	43	16	4.5	–	solution treated	Nicrofer 5520 Co	– alloy 617
–	430	88	6.1	–	–	–	–	505	132	12	–	–	–	age hardened	Nicrofer 5219 Nb	– alloy 718
–	440	230	35	3.5	–	–	–	490	250	68	17	–	–	age hardened	Nicrofer 5120 CoTi	– alloy C-263
–	100	60	29	9.6	2.3	–	–	186	97	38	14	3.2	–	solution treated	Nicrofer 4722 Co	– alloy X
–	60	25	13	6.1	2.5	–	–	110	60	32	12	4	–	solution treated	Nicrofer 4626 MoW	– alloy 333
NiCrFe – FeNiCr – standard alloys																
126	66	28	12	4	–	–	215	97	42	17.1	7	–	–	solution treated	Nicrofer 7216 H	– alloy 600 H
–	116	39	11.8	2.2	–	–	–	156	55	16.7	3.7	–	–	solution treated	Nicrofer 6023 H	– alloy 601 H
84	36	15	6.5	2.8	1.5	–	140	60	23	10.8	4.7	2.4	–	solution treated	Nicrofer 45 TM	– alloy 45 TM
–	–	42	16	5.7	1.4	–	–	–	50	21.4	9.4	3.7	–	solution treated	Nicrofer 3220 HT	– alloy 800 HP
–	–	–	–	–	–	–	–	114	53	24	10.5	–	–	solution treated	Nicrofer 3220 H	– alloy 800 H
CoCrNiW																
–	–	–	–	–	–	–	–	–	–	–	–	–	–	solution treated	Conicro 5010 W	– alloy 25
–	–	–	–	–	–	–	–	–	–	–	–	–	–	solution treated	Conicro 4023 W	– alloy 188
Heating-element and resistance alloys																
NiCr – FeCrAl																
–	–	–	–	–	–	–	–	–	–	–	–	–	–	annealed	Cronix 80	– alloy NiCr80/20
–	–	–	–	–	–	–	–	–	–	–	–	–	–	annealed	Cronix 70	– alloy NiCr70/30
Expansion and glass-sealing alloys																
FeNi – FeNiCo																
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Pernifer 36	– alloy 36
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	Pernifer 2918	

Imperial values see page 71

High-performance materials: sheet and plate
Fabrication characteristics

Krupp VDM alloy designation		Fabrication characteristics		Welding processes and weldability					Interpass temperature max °C	Filler Metal for GTAW TIG/TIG Hot Wire and GMAW MIG/MAG
		Melting temperature °C	Hot-working temperature °C	GTAW TIG/TIG Hot Wire	GMAW MIG/MAG[1]	SMAW	Plasma	SAW		
Heat-resistant alloys										
NiCrFe – FeNiCr										
Nicrofer 7520	– alloy 75	1380	1220 – 900	+	•	•	+	–	120	Nicrofer S 7020 – FM 82
Nicrofer 7216	– alloy 600	1425	1200 – 900	+	+	+	+	•	150	Nicrofer S 7020 – FM 82
Nicrofer 6030	– alloy 690	1380	1230 – 900	+	•	•	•	–	120	Nicrofer S 7020 – FM 82 or Nicrofer S 6030 – FM 690
Nicrofer 3718 So	– alloy DS	1400	1150 – 950	+	•	+	+	•	150	Nicrofer S 7020 – FM 82
Nicrofer 3718	– (alloy 330)	1400	1150 – 950	+	•	+	+	•	150	Nicrofer S 7020 – FM 82
High-temperature, high-strength alloys										
NiCr – NiCrFe – NiCrMo – NiCrCoMo – superalloys										
Nicrofer 7016 TiNb	– alloy X-750	1430	1280 – 980	+	–	•	–	–	120	Nicrofer S 7020 – FM 82
Nicrofer 6025 HT	– alloy 602 CA	1370	1200 – 900	+	•	+	+	–	120	Nicrofer S 6025 – FM 602
Nicrofer 5520 Co	– alloy 617	1380	1200 – 950	+	+	+	+	+	150	Nicrofer S 5520 – FM 617
Nicrofer 5219 Nb	– alloy 718[2]	1340	1120 – 900	+	–	–	–	–	120	Nicrofer S 5219 – FM 718
Nicrofer 5120 CoTi	– alloy C-263	1360	1170 – 950	+	•	–	+	–	100	Nicrofer S 5120 – FM 263
Nicrofer 4722 Co	– alloy X	1355	1200 – 950	+	•	–	+	–	100	Nicrofer S 4722 – FM X
Nicrofer 4626 MoW	– alloy 333	1345	1180 – 950	+	•	–	•	–	120	Nicrofer S 4626 – FM 333
NiCrFe – FeNiCr – standard alloys										
Nicrofer 7216 H	– alloy 600 H	1425	1200 – 900	+ +	• •	+ +	+ +	• •	150	Nicrofer S 6020 – FM 625 or Nicrofer S 7020 – FM 82
Nicrofer 6023 H	– alloy 601 H	1370	1200 – 900	+	•	+	+	–	120	Nicrofer S 6025 – FM 602
Nicrofer 45 TM	– alloy 45 TM	1390	1180 – 900	+	•	+	•	–	120	Nicrofer S 3028 – FM 28
Nicrofer 3220 HT	– alloy 800 HP	1400	1200 – 900	+	•	+	+	•	120	Nicrofer S 7020 – FM 82 or matching (S 2133)
Nicrofer 3220 H	– alloy 800 H	1400	1200 – 900	+	•	+	+	•	120	Nicrofer S 7020 – FM 82 or matching (S 2133)
CoCrNiW										
Conicro 5010 W	– alloy 25	1410	1230 – 1000	+	–	–	+	–	120	Conicro S 5010 – FM 25
Conicro 4023 W	– alloy 188	1330	1200 – 1000	+	–	–	+	–	120	Conicro S 4023 – FM 188
Heating-element and resistance alloys										
NiCr – FeCrAl										
Cronix 80	– alloy NiCr80/20	1400	1200 – 1000	•	–	–	–	–	120	matching
Cronix 70	– alloy NiCr70/30	1380	1200 – 1000	•	–	–	–	–	120	matching and Nicrofer S 7020 – FM 82
Expansion and glass-sealing alloys										
FeNi – FeNiCo										
Pernifer 36	– alloy 36	1430	1160 – 850	+	–	–	–	–	120	S 7020 – FM 82 or matching
Pernifer 2918		1450	1050 – 750	+	–	–	–	–	120	matching

[1] MAG welding is to be carried out using the shielding gas Cronigon He30S.
We recommend that you consult our Welding Laboratory.

[2] annealed

\+ readily and easily weldable
• please contact our Welding Laboratory
– not recommended

GTAW = Gas Tungsten Arc Welding
GMAW = Gas Metal Arc Welding
SMAW = Shielded Metal Arc Welding
SAW = Submerged Arc Welding

High-performance materials: sheet and plate
Fabrication characteristics

				Covered electrodes for SMAW/MMA				Krupp VDM alloy designation	
Werkst.-Nr.	Designation	AWS	Classification	Werkst.-Nr.	Designation	AWS	Classification		
Heat-resistant alloys									
NiCrFe – FeNiCr									
2.4806	SG-NiCr20Nb	A5.14	ERNiCr-3	2.4648	EL-NiCr19Nb	(A5.11)	(ENiCrFe-3)	Nicrofer 7520	– alloy 75
2.4806	SG-NiCr20Nb	A5.14	ERNiCr-3	2.4648	EL-NiCr19Nb	(A .11)	(ENiCrFe-3)	Nicrofer 7216	– alloy 600
2.4806 2.4642	SG-NiCr20Nb NiCr29Fe	A5.14	ERNiCr-3	2.4648	EL-NiCr19Nb	(A5.11)	(ENiCrFe-3)	Nicrofer 6030	– alloy 690
2.4806	SG-NiCr20Nb	A5.14	ERNiCr-3	2.4648	EL-NiCr19Nb	(A5.11)	(ENiCrFe-3)	Nicrofer 3718 So	– alloy DS
2.4806	SG-NiCr20Nb	A5.14	ERNiCr-3	2.4648	EL-NiCr19Nb	(A5.11)	(ENiCrFe-3)	Nicrofer 3718	– (alloy 330)
High-temperature, high-strength alloys									
NiCr – NiCrFe – NiCrMo – NiCrCoMo – superalloys									
2.4806	SG-NiCr20Nb	A5.14	ERNiCrFe-7	2.4648	EL-NiCr19Nb	(A5.11)	(ENiCrFe-3)	Nicrofer 7016 TiNb	– alloy X-750
2.4649	SG-NiCr25FeAlY	–	–	–	–	–	–	Nicrofer 6025 HT	– alloy 602 CA
2.4627	SG-NiCr22Co12Mo	A5.14	ERNiCrCoMo-1	2.4628	EL-NiCr21Co12Mo	A5.11	ENiCrCoMo-1	Nicrofer 5520 Co	– alloy 617
2.4667	SG-NiCr19NbMoTi	A5.14	ERNiFeCr-2	–	–	–	–	Nicrofer 5219 Nb	– alloy 718*
2.4650	NiCo20Cr20MoTi	–	–	–	–	–	–	Nicrofer 5120 CoTi	– alloy C-263
2.4613	SG-NiCr21Fe18Mo	A5.14	ERNiCrMo-2	–	–	A5.11	ENiCrMo-2	Nicrofer 4722 Co	– alloy X
2.4608	NiCr26MoW	–	–	–	–	–	–	Nicrofer 4626 MoW	– alloy 333
NiCrFe – FeNiCr – standard alloys									
2.4831	SG-NiCr21Mo9Nb	A5.14	ERNiCrMo-3	2.4621	EL-NiCr20Mo9Nb	A5.11	ENiCrMo-3	Nicrofer 7216 H	– alloy 600 H
2.4806	SG-NiCr20Nb	A5.14	ERNiCr-3	2.4648	EL-NiCr19Nb	(A5.11)	(ENiCrFe-3)		
2.4649	SG-NiCr25FeAlY	–	–	–	–	–	–	Nicrofer 6023 H	– alloy 601 H
1.4563	X1CrNiMoCuN31-27-4	–	–	1.4563	–	–	–	Nicrofer 45 TM	– alloy 45 TM
2.4806	SG-NiCr20Nb	A5.14	ERNiCr-3	2.4648	EL-NiCr19Nb	(A5.11)	(ENiCrFe-3)	Nicrofer 3220 HT	– alloy 800 HP
2.4806	SG-NiCr20Nb	A5.14	ERNiCr-3	2.4648	EL-NiCr19Nb	(A5.11)	(ENiCrFe-3)	Nicrofer 3220 H	– alloy 800 H
CoCrNiTu									
2.4964	CoCr20W15Ni	–	–	–	–	–	–	Conicro 5010 W	– alloy 25
2.4683	CoCr22NiW	–	–	–	–	–	–	Conicro 4023 W	– alloy 188
Heating-element and resistance alloys									
NiCr – FeCrAl									
2.4869	SG-NiCr20Nb	–	–	–	–	–	–	Cronix 80	– alloy NiCr80/20
2.4806	SG-NiCr20Nb	A5.14	ERNiCr-3	2.4648	EL-NiCr19Nb	(A5.11)	(ENiCrFe-3)	Cronix 70	– alloy NiCr70/30
Expansion and glass-sealing alloys									
FeNi – FeNiCo									
2.4806	SG-NiCr20Nb	A5.14	ERNiCr-3	2.4648	EL-NiCr19Nb	(A5.11)	(ENiCrFe-3)	Pernifer 36	– alloy 36
–	–	–	–	–	–	–	–	Pernifer 2918	

Imperial values see page 72

High-performance materials: sheet and plate
Physical properties (Imperial Values)

Krupp VDM alloy designation	Physical properties at room temperature (RT)					Thermal expansion coefficient between RT and T, 10^{-6}/°F								
	Density $\frac{lb}{in^3}$	Specific heat $\frac{Btu}{lb\ °F}$	Thermal conductivity $\frac{Btu\ in}{ft^2\ h\ °F}$	Electrical resistivity $\frac{\Omega\ circ\ mil}{ft}$	Modulus of elasticity 10^3 ksi	200	400	600	800	1000	1200	1400	1600	1800
Heat-resistant alloys														
NiCrFe – FeNiCr														
Nicrofer 7520 – alloy 75	0.303	0.106	84	655	32.0	6.4	7.0	7.4	7.7	8.1	8.4	8.7	9.1	9.6
Nicrofer 7216 – alloy 600	0.303	0.108	103	620	31.0	7.5	7.8	8.0	8.3	8.4	8.6	8.7	9.0	9.3
Nicrofer 6030 – alloy 690	0.296	0.108	83	692	31.2	7.8	8.0	8.1	8.3	8.6	8.9	9.1	9.4	9.6
Nicrofer 3718 So – alloy DS	0.289	0.113	79	623	28.2	8.3	8.7	9.0	9.3	9.5	9.8	10.0	10.1	10.3
Nicrofer 3718 – alloy (330)	0.289	0.113	79	623	28.2	8.3	8.7	9.0	9.3	9.5	9.8	10.0	10.1	10.3
High-temperature, high-strength alloys														
NiCr – NiCrFe – NiCrMo – NiCrCoMo – superalloys														
Nicrofer 7016 TiNb – alloy X-750	0.300	0.103	83	731	31.0	7.1	7.5	7.9	8.1	8.3	8.8	9.3	9.8	10.2
Nicrofer 6025 HT – alloy 602 CA	0.285	0.107	78	710	31.2	6.6	7.5	7.8	8.1	8.2	8.5	9.0	9.5	9.7
Nicrofer 5520 Co – alloy 617	0.303	0.100	94	734	30.7	6.4	7.0	7.4	7.6	7.7	8.0	8.4	8.7	9.0
Nicrofer 5219 Nb – alloy 718	0.296	0.103	77	738	29.7	7.0	7.5	7.7	7.9	8.1	8.4	8.8	9.2	–
Nicrofer 5120 CoTi – alloy C-263	0.303	0.102	81	692	32.3	6.0	6.7	7.0	7.3	7.6	8.0	8.5	9.2	9.9
Nicrofer 4722 Co – alloy X	0.300	0.104	78	692	29.7	7.5	7.7	8.0	8.2	8.4	8.6	8.8	9.0	9.2
Nicrofer 4626 MoW – alloy 333	0.295	0.105	77	688	29.1	7.0	7.8	8.2	8.4	8.7	9.1	9.3	9.5	9.8
NiCrFe – FeNiCr – standard alloys														
Nicrofer 7216 H – alloy 600 H	0.303	0.108	103	620	31.0	7.5	7.8	8.0	8.3	8.4	8.6	8.7	9.0	9.3
Nicrofer 6023 H – alloy 601 H	0.293	0.107	78	716	30.0	7.6	8.0	8.1	8.3	8.6	8.9	9.1	9.5	9.8
Nicrofer 45 TM – alloy 45 TM	0.289	0.12	90	710	28.0	7.1	8.1	8.3	8.6	8.8	9.1	9.4	9.6	9.8
Nicrofer 3220 HT – alloy 800 HP	0.289	0.113	80	608	28.2	8.3	8.7	9.0	9.3	9.5	9.8	10.0	10.1	10.3
Nicrofer 3220 H – alloy 800 H	0.289	0.113	80	608	28.2	8.3	8.7	9.0	9.3	9.5	9.8	10.0	10.1	10.3
CoCrNiW														
Conicro 5010 W – alloy 25	0.329	0.092	67	535	32.8	6.8	7.2	7.5	7.7	8.0	8.2	8.6	9.0	9.5
Conicro 4023 W – alloy 188	0.329	0.097	71	570	32.2	6.6	7.0	7.4	7.8	8.2	8.6	9.0	9.4	9.9
Heating-element and resistance alloys														
NiCr – FeCrAl														
Cronix 80 – alloy NiCr80/20	0.300	0.100	104	674	29.0	7.5	7.8	8.1	8.4	8.6	8.7	8.9	9.1	9.4
Cronix 70 – alloy NiCr70/30	0.293	0.100	96	716	29.0	7.2	7.5	7.8	8.1	8.3	8.4	8.8	9.3	–
Expansion and glass-sealing alloys														
FeNi – FeNiCo														
Pernifer 36 – alloy 36	0.293	0.123	89	457	20.7	0.6	1.1	3.1	4.7	5.4	–	–	–	–
Pernifer 2918	0.300	0.120	121	295	23.2	(3.3)	3.1	2.8	2.7	3.8	4.8	–	–	–

High-performance materials: sheet and plate
Mechanical properties (Imperial Values)

Mechanical properties at room temperature (RT)									Krupp VDM alloy designation	
Heat treatment and temperature, °F		annealed/solution treated				age hardened				
		Rp 0.2 ksi	Rp 1.0 ksi	Rm ksi	A5 %	Rp 0.2 ksi	Rp 1.0 ksi	Rm ksi	A5 %	
Heat-resistant alloys										
NiCrFe – FeNiCr										
annealed	1830 – 1920	≥ 34.8	≥ 39.2	≥ 94.3	≥ 25	–	–	–	–	Nicrofer 7520 – alloy 75
annealed	1700 – 1830	≥ 35	38.4	≥ 80	≥ 30	–	–	–	–	Nicrofer 7216 – alloy 600
ann. 1870 – 1960, sol. tr.	1980 – 2100	≥ 35	≥ 38.5	≥ 85	≥ 30	–	–	–	–	Nicrofer 6030 – alloy 690
annealed	1870 – 2060	≥ 42	≥ 45	≥ 94	≥ 30	–	–	–	–	Nicrofer 3718 So – alloy DS
annealed	1870 – 2060	≥ 42	≥ 45	≥ 94	≥ 30	–	–	–	–	Nicrofer 3718 – alloy (330)
High-temperature, high-strength alloys										
NiCr – NiCrFe – NiCrMo – NiCrCoMo – superalloys										
sol. tr. 1800	age h. 1350 – 1150	≥ 75	–	≥ 135	≥ 30	≥ 115	–	≥ 170	≥ 18	Nicrofer 7016 TiNb – alloy X-750
solution treated	2180 – 2230	≥ 38.5	≥ 47.9	≥ 103	≥ 30	–	–	–	–	Nicrofer 6025 HT – alloy 602 CA
solution treated	2100 – 2190	≥ 51	≥ 55	≥ 109	≥ 35	–	–	–	–	Nicrofer 5520 Co – alloy 617
sol. tr. 1760	age h. 1330 + 1150	≥ 80	–	≥ 140	≥ 30	≥ 150	–	≥ 180	≥ 12	Nicrofer 5219 Nb – alloy 718
sol. tr. 2110	age h. 1470	58	–	≥ 78	–	≥ 82.7	–	≥ 141	≥ 30	Nicrofer 5120 CoTi – alloy C-263
solution treated	2120 – 2170	≥ 45	–	≥ 105	≥ 30	–	–	–	–	Nicrofer 4722 Co – alloy X
solution treated	2100 – 2160	≥ 35	–	≥ 80	≥ 30	–	–	–	–	Nicrofer 4626 MoW – alloy 333
NiCrFe – FeNiCr – standard alloys										
solution treated	1980 – 2100	≥ 26	30.5	≥ 73	≥ 35	–	–	–	–	Nicrofer 7216 H – alloy 600 H
solution treated	2010 – 2160	≥ 34.8	≥ 39.2	≥ 87	≥ 30	–	–	–	–	Nicrofer 6023 H – alloy 601 H
solution treated	2120 – 2190	≥ 34.8	≥ 40.6	≥ 89.9	≥ 35	–	–	–	–	Nicrofer 45 TM – alloy 45 TM
solution treated	2100 – 2190	≥ 24.7	≥ 29	≥ 65.3	≥ 30	–	–	–	–	Nicrofer 3220 HT – alloy 800 HP
solution treated	2100	≥ 24.7	≥ 29	≥ 65.3	≥ 30	–	–	–	–	Nicrofer 3220 H – alloy 800 H
CoCrNiW										
solution treated	2160 – 2230	≥ 55	–	≥ 130	≥ 30	–	–	–	–	Conicro 5010 W – alloy 25
solution treated	2160 – 2230	≥ 55	–	≥ 125	≥ 40	–	–	–	–	Conicro 4023 W – alloy 188
Heating-element and resistance alloys										
NiCr – FeCrAl										
annealed	1600 – 2010	≥ 40.6	–	≥ 94.3	≥ 30	–	–	–	–	Cronix 80 – alloy NiCr80/20
annealed	1560 – 1650	≥ 43.5	–	≥ 101.5	≥ 25	–	–	–	–	Cronix 70 – alloy NiCr70/30
Expansion and glass-sealing alloys										
FeNi – FeNiCo										
annealed	1470 – 1560	≥ 34	–	≥ 71	≥ 40	–	–	–	–	Pernifer 36 – alloy 36
annealed	1470 – 1650	54	–	77	30	–	–	–	–	Pernifer 2918

High-performance materials: sheet and plate
Mechanical properties (Imperial Values)

Krupp VDM alloy designation		Heat treatment	Mechanical properties at elevated temperatures, °F												
			Yield strength Rp 0.2, ksi						Yield strength Rp 1.0, ksi						
			200	400	600	800	1000	1200	200	400	600	800	1000	1200	1400
Heat-resistant alloys															
NiCrFe – FeNiCr															
Nicrofer 7520	– alloy 75	annealed	65	64	62	62	56	44	–	–	–	–	–	–	–
Nicrofer 7216	– alloy 600	annealed	≥ 26.1	≥ 23.9	≥ 22	≥ 21	–	–	–	–	–	–	–	–	–
Nicrofer 6030	– alloy 690	solution treated	38	32	28	25	24	–	42	38	33	30	29	–	–
Nicrofer 3718 So	– alloy DS	annealed	37.3	34	32	29.9	28.3	28	42	37.3	35.1	33.4	32.7	31.1	–
Nicrofer 3718	– alloy (330)	annealed	37.3	34	32	29.9	28.3	28	42	37.3	35.1	33.4	32.7	31.1	–
High-temperature, high-strength alloys															
NiCr – NiCrFe – NiCrMo – NiCrCoMo – superalloys															
Nicrofer 7016 TiNb	– alloy X-750	age hardened	115	113	112	109	107	101	–	–	–	–	–	–	–
Nicrofer 6025 HT	– alloy 602 CA	solution treated	≥ 34.5	≥ 32	≥ 28.3	≥ 27.6	≥ 26.1	≥ 25.4	≥ 42	≥ 38.4	≥ 34.5	≥ 32	≥ 31.1	≥ 30	–
Nicrofer 5520 Co	– alloy 617	solution treated	≥ 40.6	≥ 33.4	≥ 32	≥ 30.2	≥ 28.3	≥ 27.6	≥ 44.2	≥ 37.7	≥ 36.3	≥ 34.5	≥ 32	≥ 30.5	≥ 29
Nicrofer 5219 Nb	– alloy 718	age hardened	154	151	148	145	141	135	–	–	–	–	–	–	–
Nicrofer 5120 CoTi	– alloy C-263	age hardened	75.7	71	70	70	69.2	66	–	–	–	–	–	–	–
Nicrofer 4722 Co	– alloy X	solution treated	45.2	42.1	38.4	35.1	32.8	31.9	–	–	–	–	–	–	–
Nicrofer 4626 MoW	– alloy 333	solution treated	41.3	34.8	29.9	27.6	26.8	24.9	–	–	–	–	–	–	–
NiCrFe – FeNiCr – standard alloys															
Nicrofer 7216 H	– alloy 600 H	solution treated	≥ 24.7	≥ 23.2	≥ 21.5	≥ 21	≥ 20.5	≥ 20	–	–	–	–	–	–	–
Nicrofer 6023 H	– alloy 601 H	solution treated	38.4	31.9	27.6	26.1	24.7	24.5	–	–	–	–	–	–	–
Nicrofer 45 TM	– alloy 45 TM	solution treated	≥ 32	≥ 28.3	≥ 26	≥ 24.7	≥ 21	≥ 20.2	≥ 38.4	≥ 34	≥ 32.7	≥ 30.2	≥ 27	≥ 24.7	–
Nicrofer 3220 HT	– alloy 800 HP	solution treated	–	–	–	–	–	–	–	–	–	–	–	–	–
Nicrofer 3220 H	– alloy 800 H	solution treated	≥ 20.5	≥ 16.7	≥ 13.6	≥ 12.0	≥ 11.2	≥ 10.7	≥ 23.5	≥ 19.6	≥ 16.5	≥ 14.9	≥ 14.1	≥ 13.5	–
CoCrNiW															
Conicro 5010 W	– alloy 25	solution treated	56.8	49.3	45.2	41.3	38	35.1	–	–	–	–	–	–	–
Conicro 4023 W	– alloy 188	solution treated	60.9	52.2	47.9	44.2	43.5	43.5	–	–	–	–	–	–	–
Heating-element and resistance alloys															
NiCr – FeCrAl															
Cronix 80	– alloy NiCr80/20	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Cronix 70	– alloy NiCr70/30	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Expansion and glass-sealing alloys															
FeNi – FeNiCo															
Pernifer 2918		annealed	38	29	20	16	14	–	–	–	–	–	–	–	–
Pernifer 36	– alloy 36	annealed	26	17	14	14	12	–	–	–	–	–	–	–	–

High-performance materials: sheet and plate
Mechanical properties (Imperial Values)

Mechanical properties at elevated temperatures, °F												Heat treatment	Krupp VDM alloy designation	
Tensile strength Rm, ksi						Elongation A5, %								
200	400	600	800	1000	1200	200	400	600	800	1000	1200			
Heat-resistant alloys														
NiCrFe – FeNiCr														
116	115	112	107	94	73	30	30	30	30	30	30	annealed	Nicrofer 7520	– alloy 75
75.4	72.5	69.6	68.9	–	–	–	–	–	–	–	–	annealed	Nicrofer 7216	– alloy 600
84	80	74	72	70	–	45	45	45	45	45	–	solution treated	Nicrofer 6030	– alloy 690
91.6	89	86.9	85.1	77	69	30	30	30	30	30	30	annealed	Nicrofer 3718 So	– alloy DS
91.6	89	86.9	85.1	77	69	30	30	30	30	30	30	annealed	Nicrofer 3718	– alloy (330)
High-temperature, high-strength alloys														
NiCr – NiCrFe – NiCrMo – NiCrCoMo– superalloys														
169	167	162	155	141	114	30	35	40	40	40	30	age hardened	Nicrofer 7016 TiNb	– alloy X-750
104	102	97	95	93	90	45	45	45	40	40	35	solution treated	Nicrofer 6025 HT	– alloy 602 CA
≥ 96	≥ 90	≥ 86	≥ 82	≥ 77	≥ 67	–	–	–	–	–	–	solution treated	Nicrofer 5520 Co	– alloy 617
193	187	182	178	172	160	26	25	23	23	23	21	age hardened	Nicrofer 5219 Nb	– alloy 718
131	123	120	118	116	114	40	41	42	43	42	40	age hardened	Nicrofer 5120 CoTi	– alloy C-263
105	103	101	97.2	90.1	82.7	40	40	45	45	43	40	solution treated	Nicrofer 4722 Co	– alloy X
95	89.6	83.8	79.3	75.1	69.6	40	40	46	49	43	37	solution treated	Nicrofer 4626 MoW	– alloy 333
NiCrFe – FeNiCr – standard alloys														
69.6	66.7	63.8	63.1	–	–	–	–	–	–	–	–	solution treated	Nicrofer 7216 H	– alloy 600 H
98	91	86	82	75	71	50	50	50	45	45	45	solution treated	Nicrofer 6023 H	– alloy 601 H
≥ 85.5	≥ 82	≥ 75.8	≥ 72	≥ 69.6	≥ 67	–	≥ 35	–	≥ 35	–	≥ 35	solution treated	Nicrofer 45 TM	– alloy 45 TM
–	–	–	–	–	–	–	–	–	–	–	–	solution treated	Nicrofer 3220 HT	– alloy 800 HP
62	58	56	55	50	36	–	–	–	–	–	–	solution treated	Nicrofer 3220 H	– alloy 800 H
CoCrNiW														
141	136	128	122	111	108	70	71	72	69	62	55	solution treated	Conicro 5010 W	– alloy 25
131	125	119	113	108	104	55	60	63	64	62	60	solution treated	Conicro 4023 W	– alloy 188
Heating-element and resistance alloys														
NiCr – FeCrAl														
122	117	112	106	98	90	30	27	24	21	20	19	annealed	Cronix 80	– alloy NiCr80/20
–	–	–	–	–	–	–	–	–	–	–	–	–	Cronix 70	– alloy NiCr70/30
Expansion and glass-sealing alloys														
FeNi – FeNiCo														
63	62	59	49	38	–	45	45	50	55	60	70	annealed	Pernifer 36	– alloy 36
63	59	57	47	35	–	40	40	45	50	55	60	annealed	Pernifer 2918	

High-performance materials: sheet and plate
Mechanical properties (Imperial Values)

Krupp VDM alloy designation		Heat treatment	Creep properties, ksi at elevated temperatures, °F											
			Creep strength Rp 1.0/10^4 hrs						Creep-rupture strength Rm/10^4 hrs					
			1000	1200	1400	1600	1800	2000	1000	1200	1400	1600	1800	2000
Heat-resistant alloys														
NiCrFe ~ FeNiCr														
Nicrofer 7520	~ alloy 75	annealed	–	–	–	–	–	–	–	8.8	3.1	1.5	0.87	–
Nicrofer 7216	~ alloy 600	~	–	–	–	–	–	–	–	–	–	–	–	–
Nicrofer 6030	~ alloy 690	solution treated	–	8	4	1.6	0.59	0.23	–	9.1	6	2.7	1.3	0.58
Nicrofer 3718 So	~ alloy DS	solution treated	–	7.7	3.1	1.1	0.26	–	–	10.3	4.1	1.6	0.65	–
Nicrofer 3718	~ alloy (330)	solution treated	–	7.7	3.1	1.1	0.26	–	–	10.3	4.1	1.6	0.65	–
High-temperature, high-strength alloys														
NiCr ~ NiCrFe ~ NiCrMo ~ NiCrCoMo ~ superalloys														
Nicrofer 7016 TiNb	~ alloy X-750	age hardened	–	47.9	9.4	0.4	–	–	–	50.5	16	4.8	–	–
Nicrofer 6025 HT	~ alloy 602 CA	solution treated	–	7.8	3.9	1.7	0.73	0.33	–	10.6	5.7	3	1.6	0.88
Nicrofer 5520 Co	~ alloy 617	solution treated	–	21.0	9	3.6	1.2	–	–	24.7	12.2	5.8	1.9	(0.4)
Nicrofer 5219 Nb	~ alloy 718	age hardened	–	53	10.2	–	–	–	–	62	14.5	–	–	–
Nicrofer 5120 CoTi	~ alloy C-263	age hardened	–	59.5	22.5	3.6	–	–	–	68.2	30.5	6.1	–	–
Nicrofer 4722 Co	~ alloy X	solution treated	23.9	14.1	7.7	3.5	1.0	–	–	26.1	11.3	5.5	1.7	–
Nicrofer 4626 MoW	~ alloy 333	solution treated	15.2	7.5	3.6	1.6	0.65	–	–	15.7	8	3.3	1.16	–
NiCrFe ~ FeNiCr~ standard alloys														
Nicrofer 7216 H	~ alloy 600 H	solution treated	18.4	9.4	3.6	1.3	–	–	32.1	13.8	5.8	2.2	–	–
Nicrofer 6023 H	~ alloy 601 H	solution treated	28.3	15.4	5.1	1.45	–	–	–	21.8	7.3	1.9	–	–
Nicrofer 45 TM	~ alloy 45 TM	solution treated	14	6	2.2	1.0	0.47	0.25	16	7.7	3.1	1.2	0.7	0.45
Nicrofer 3220 HT	~ alloy 800 HP	solution treated	–	–	–	–	–	–	–	–	8.1	3.0	1.3	–
Nicrofer 3220 H	~ alloy 800 H	solution treated	–	–	–	–	–	–	–	15.7	7.3	2.4	0.9	–
CoCrNiW														
Conicro 5010 W	~ alloy 25	solution treated	–	–	–	–	–	–	–	31.9	16	6.1	2	–
Conicro 4023 W	~ alloy 188	solution treated	–	–	–	–	–	–	–	31.2	15.2	6.4	2.2	–
Heating-element and resistance alloys														
NiCr ~ FeCrAl														
Cronix 80	~ alloy NiCr80/20	annealed	10^3 hrs:	8.3	3.2	1.5	0.7	0.2	–	–	–	–	–	–
Cronix 70	~ alloy NiCr70/30	annealed	10^3 hrs:	8.3	3.2	1.5	0.7	0.2	–	–	–	–	–	–
Expansion and glass-sealing alloys														
FeNi ~ FeNiCo														
Pernifer 36	~ alloy 36	–	–	–	–	–	–	–	–	–	–	–	–	–
Pernifer 2918		–	–	–	–	–	–	–	–	–	–	–	–	–

High-performance materials: sheet and plate
Mechanical properties (Imperial Values)

Creep properties, ksi at elevated temperature, °F												Heat treatment	Krupp VDM alloy designation	
Creep strength Rp 1.0/10⁵ hrs						Creep-rupture strength Rm/10⁵ hrs								
1000	1200	1400	1600	1800	2000	1000	1200	1400	1600	1800	2000			
Heat-resistant alloys														
NiCrFe – FeNiCr														
–	–	–	–	–	–	17.4	5.9	2.2	1.2	0.79	–	annealed	Nicrofer 7520	– alloy 75
–	–	–	–	–	–	–	–	–	–	–	–	–	Nicrofer 7216	– alloy 600
–	6.5	2.5	0.93	0.33	–	–	7.4	4	1.8	0.78	0.41	solution treated	Nicrofer 6030	– alloy 690
–	3.6	1	0.22	–	–	–	6.2	2	0.52	0.23	–	solution treated	Nicrofer 3718 So	– alloy DS
–	3.6	1	0.22	–	–	–	6.2	2	0.52	0.23	–	solution treated	Nicrofer 3718	– alloy (330)
High-temperature, high-strength alloys														
NiCr – NiCrFe – NiCrMo – NiCrCoMo – superalloys														
–	34.1	1.9	–	–	–	–	39.2	7.3	2.2	–	–	age hardened	Nicrofer 7016 TiNb	– alloy X-750
–	6.1	2.5	1.7	0.75	0.19	–	9.1	4.1	2.0	1	0.55	solution treated	Nicrofer 6025 HT	– alloy 602 CA
–	13.8	5.8	2	0.4	–	–	19.7	8	3.2	0.9	–	solution treated	Nicrofer 5520 Co	– alloy 617
–	36.3	2.9	–	–	–	–	46	5.1	–	–	–	age hardened	Nicrofer 5219 Nb	– alloy 718
–	49.3	11.6	1.5	–	–	–	53	17.4	3.6	–	–	age hardened	Nicrofer 5120 CoTi	– alloy C-263
19.7	11.3	5.8	2.1	0.5	–	–	20.6	8.4	2.8	0.6	–	solution treated	Nicrofer 4722 Co	– alloy X
–	5.5	2.5	1.1	0.44	–	–	11.9	6.1	2.4	0.87	–	solution treated	Nicrofer 4626 MoW	– alloy 333
NiCrFe – FeNiCr– standard alloys														
14.8	6.5	2.5	0.9	–	–	24.1	9.6	3.5	1.2	–	–	solution treated	Nicrofer 7216 H	– alloy 600 H
23.9	9.9	2.9	0.44	–	–	31.2	14.5	3.9	0.87	–	–	solution treated	Nicrofer 6023 H	– alloy 601 H
9.1	3.9	1.3	0.26	0.26	0.13	13.8	5.9	2.1	0.9	0.4	0.2	solution treated	Nicrofer 45 TM	– alloy 45 TM
–	(7.7)	–	–	–	–	–	9.8	5	2	0.68	–	solution treated	Nicrofer 3220 HT	– alloy 800 HP
–	–	–	–	–	–	–	9.8	4.5	1.6	0.26	–	solution treated	Nicrofer 3220 H	– alloy 800 H
CoCrNiW														
–	–	–	–	–	–	–	–	–	–	–	–	–	Conicro 5010 W	– alloy 25
–	–	–	–	–	–	–	–	–	–	–	–	–	Conicro 4023 W	– alloy 188
Heating-element and resistance alloys														
NiCr – FeCrAl														
–	–	–	–	–	–	–	–	–	–	–	–	–	Cronix 80	– alloy NiCr80/20
–	–	–	–	–	–	–	–	–	–	–	–	–	Cronix 70	– alloy NiCr70/30
Expansion and glass-sealing alloys														
FeNi – FeNiCo														
–	–	–	–	–	–	–	–	–	–	–	–	–	Pernifer 36	– alloy 36
–	–	–	–	–	–	–	–	–	–	–	–	–	Pernifer 2918	

High-performance materials: sheet and plate
Fabrication characteristics (Imperial Values)

Krupp VDM alloy designation		Fabrication characteristics		Welding processes and weldability					Interpass temperature max °F	Filler Metal for GTAW TIG/TIG Hot Wire and GMAW MIG/MAG
		Melting temperature °F	Hot-working temperature °F	GTAW TIG/TIG Hot Wire	GMAW MIG/MAG[3]	SMAW	Plasma	SAW		
Heat-resistant alloys										
NiCrFe – FeNiCr										
Nicrofer 7520	– alloy 75	2520	2230 – 1650	+	•	•	+	–	250	Nicrofer S 7020 – FM 82
Nicrofer 7216	– alloy 600	2600	2190 – 1650	+	+	+	+	•	300	Nicrofer S 7020 – FM 82
Nicrofer 6030	– alloy 690	2510	2250 – 1650	+	•	•	•	–	250	Nicrofer S 7020 – FM 82 or Nicrofer S 6030 – FM 690
Nicrofer 3718 So	– alloy DS	2550	2100 – 1470	+	•	+	+	•	300	Nicrofer S 7020 – FM 82
Nicrofer 3718	– (alloy 330)	2550	2100 – 1740	+	•	+	+	•	300	Nicrofer S 7020 – FM 82
High-temperature, high strength alloys										
NiCr – NiCrFe – NiCrMo – NiCrCoMo – superalloys										
Nicrofer 7016 TiNb	– alloy X-750	2610	2340 – 1800	+	–	•	–	–	250	Nicrofer S 7020 – FM 82
Nicrofer 6025 HT	– alloy 602 CA	2500	2190 – 1650	+	–	•	–	–	250	Nicrofer S 6025 – FM 602
Nicrofer 5520 Co	– alloy 617	2510	2190 – 1740	+	+	+	+	+	300	Nicrofer S 5520 – FM 617
Nicrofer S 5219 Nb	– alloy 718	2440	2050 – 1650	+	–	–	–	–	250	Nicrofer S 5219 – FM 718
Nicrofer 5120 CoTi	– alloy C-263	2480	2140 – 1740	+	•	–	+	–	210	Nicrofer S 5120 – FM 263
Nicrofer 4722 Co	– alloy X	2470	2190 – 1740	+	•	–	+	–	210	Nicrofer S 4722 – FM X
Nicrofer 4626 MoW	– alloy 333	2450	2160 – 1740	+	•	–	•	–	250	Nicrofer S 4626 – FM 333
NiCrFe – FeNiCr – standard alloys										
Nicrofer 7216 H	– alloy 600 H	2600	2190 – 1650	+ +	• •	+ +	+ +	• •	300	Nicrofer S 6020 – FM 625 or Nicrofer S 7020 – FM 82
Nicrofer 6023 H	– alloy 601 H	2500	2190 – 1650	+	•	+	+	–	250	Nicrofer S 6025 – FM 602
Nicrofer 45 TM	– alloy 45 TM	2530	2160 – 1650	+	•	+	•	–	250	Nicrofer S 3028 – FM 28
Nicrofer 3220 HT	– alloy 800 HP	2550	2190 – 1650	+	•	+	+	•	250	Nicrofer S 7020 – FM 82 or matching (S 2133)
Nicrofer 3220 H	– alloy 800 H	2550	2190 – 1650	+	•	+	+	•	250	Nicrofer S 7020 – FM 82 or matching (S 2133)
CoCrNiW										
Conicro 5010 W	– alloy 25	2570	2250 – 1830	+	–	–	+	–	250	Conicro S 5010 – FM 25
Conicro 4023 W	– alloy 188	2430	2190 – 1830	+	–	–	+	–	250	Conicro S 4023 – FM 188
Heating-element and resistance alloys										
NiCr – FeCrAl										
Cronix 80	– alloy NiCr80/20	2550	2190 – 1830	•	–	–	–	–	250	matching
Cronix 70	– alloy NiCr70/30	2520	2190 – 1830	•	–	–	–	–	250	matching and Nicrofer S 7020 – FM 82
Expansion and glass-sealing alloys										
FeNi – FeNiCo										
Pernifer 2918		2640	1920 – 1380	+	–	–	–	–	250	matching
Pernifer 36	– alloy 36	2610	2120 – 1560	+	–	–	–	–	250	S 7020 – FM 82 or matching

[3] MAG welding is to be carried out using the shielding gas Cronigon He30S.
We recommend that you consult our Welding Laboratory.

[2] annealed

\+ readily and easily weldable
• please contact our Welding Laboratory
– not recommended

GTAW = Gas Tungsten Arc Welding
GMAW = Gas Metal Arc Welding
SMAW = Shielded Metal Arc Welding
SAW = Submerged Arc Welding

High-performance materials: sheet and plate
Fabrication characteristics

				Covered electrodes for SMAW/MMA				Krupp VDM alloy designation	
Werkst.-Nr.	Designation	AWS	Classification	Werkst.-Nr.	Designation	AWS	Classification		
Heat-resistant alloys									
NiCrFe – FeNiCr									
2.4806	SG-NiCr20Nb	A5.14	ERNiCr-3	2.4648	EL-NiCr19Nb	(A5.11)	(ENiCrFe-3)	Nicrofer 7520	– alloy 75
2.4806	SG-NiCr20Nb	A5.14	ERNiCr-3	2.4648	EL-NiCr19Nb	(A 11)	(ENiCrFe-3)	Nicrofer 7216	– alloy 600
2.4806	SG-NiCr20Nb	A5.14	ERNiCr-3	2.4648	EL-NiCr19Nb	(A5.11)	(ENiCrFe-3)	Nicrofer 6030	– alloy 690
2.4642	NiCr29Fe								
2.4806	SG-NiCr20Nb	A5.14	ERNiCr-3	2.4648	EL-NiCr19Nb	(A5.11)	(ENiCrFe-3)	Nicrofer 3718 So	– alloy DS
2.4806	SG-NiCr20Nb	A5.14	ERNiCr-3	2.4648	EL-NiCr19Nb	(A5.11)	(ENiCrFe-3)	Nicrofer 3718	– (alloy 330)
High-temperature, high-strength alloys									
NiCr – NiCrFe – NiCrMo – NiCrCoMo – superalloys									
2.4806	SG-NiCr20Nb	A5.14	ERNiCrFe-7	2.4648	EL-NiCr19Nb	(A5.11)	(ENiCrFe-3)	Nicrofer 7016 TiNb	– alloy X-750
2.4649	SG-NiCr25FeAlY	–	–	–	–	–	–	Nicrofer 6025 HT	– alloy 602 CA
2.4627	SG-NiCr22Co12Mo	A5.14	ERNiCrCoMo-1	2.4628	EL-NiCr21Co12Mo	A5.11	ENiCrCoMo-1	Nicrofer 5520 Co	– alloy 617
2.4667	SG-NiCr19NbMoTi	A5.14	ERNiFeCr-2	–	–	–	–	Nicrofer 5219 Nb	– alloy 718[2]
2.4650	NiCo20Cr20MoTi	–	–	–	–	–	–	Nicrofer 5120 CoTi	– alloy C-263
2.4613	SG-NiCr21Fe18Mo	A5.14	ERNiCrMo-2	–	–	A5.11	ENiCrMo-2	Nicrofer 4722 Co	– alloy X
2.4608	NiCr26MoW	–	–	–	–	–	–	Nicrofer 4626 MoW	– alloy 333
NiCrFe – FeNiCr – standard alloys									
2.4831	SG-NiCr21Mo9Nb	A5.14	ERNiCrMo-3	2.4621	EL-NiCr20Mo9Nb	A5.11	ENiCrMo-3	Nicrofer 7216 H	– alloy 600 H
2.4806	SG-NiCr20Nb	A5.14	ERNiCr-3	2.4648	EL-NiCr19Nb	(A5.11)	(ENiCrFe-3)		
2.4649	SG-NiCr25FeAlY	–	–	–	–	–	–	Nicrofer 6023 H	– alloy 601 H
1.4563	X1CrNiMoCuN31-27-4	–	–	1.4563	–	–	–	Nicrofer 45 TM	– alloy 45 TM
2.4806	SG-NiCr20Nb	A5.14	ERNiCr-3	2.4648	EL-NiCr19Nb	(A5.11)	(ENiCrFe-3)	Nicrofer 3220 HT	– alloy 800 HP
2.4806	SG-NiCr20Nb	A5.14	ERNiCr-3	2.4648	EL-NiCr19Nb	(A5.11)	(ENiCrFe-3)	Nicrofer 3220 H	– alloy 800 H
CoCrNiTu									
2.4964	CoCr20W15Ni	–	–	–	–	–	–	Conicro 5010 W	– alloy 25
2.4683	CoCr22NiW	–	–	–	–	–	–	Conicro 4023 W	– alloy 188
Heating-element and resistance alloys									
NiCr – FeCrAl									
2.4869	SG-NiCr20Nb	–	–	–	–	–	–	Cronix 80	– alloy NiCr80/20
2.4806	SG-NiCr20Nb	A5.14	ERNiCr-3	2.4648	EL-NiCr19Nb	(A5.11)	(ENiCrFe-3)	Cronix 70	– alloy NiCr70/30
Expansion and glass-sealing alloys									
FeNi – FeNiCo									
2.4806	SG-NiCr20Nb	A5.14	ERNiCr-3	2.4648	EL-NiCr19Nb	(A5.11)	(ENiCrFe-3)	Pernifer 36	– alloy 36
–	–	–	–	–	–	–	–	Pernifer 2918	

High-performance materials: sheet and plate
Material characteristics

Krupp VDM alloy designation	Material characteristics

Heat-resistant alloys		
NiCrFe – FeNiCr		
Nicrofer 7520	– alloy 75	Excellent scaling resistance up to 1100 °C (2010 °F).
Nicrofer 7216	– alloy 600	Good resistance to oxidizing, carburizing and nitriding atmospheres.
Nicrofer 6030	– alloy 690	Good resistance to oxidizing and sulfidizing media.
Nicrofer 3718 So	– alloy DS	Good resistance to oxidizing and carburizing media up to 1000 °C (1830 °F) even under alternating conditions.
Nicrofer 3718	– (alloy 330)	Good resistance to oxidizing and carburizing media up to 1000 °C (1830 °F) even under alternating conditions.

High-temperature, high-strength alloys		
NiCr – NiCrFe – NiCrMo – NiCrCoMo – superalloys		
Nicrofer 7016 TiNb	– alloy X-750	Age-hardenable alloy with high corrosion resistance and creep strength up to 800 °C (1470 °F).
Nicrofer 6025 HT	– alloy 602 CA	Outstanding resistance to oxidation and carburization up to 1200 °C (2190 °F).
Nicrofer 5520 Co	– alloy 617	High creep strength and excellent resistance to oxidizing and carburizing atmospheres.
Nicrofer 5219 Nb	– alloy 718	Age-hardenable alloy with particularly high creep strength up to 700 °C (1290 °F) and good corrosion resistance.
Nicrofer 5120 CoTi	– alloy C-263	Age-hardenable alloy with very good creep strength up to 850 °C (1500 °F) and oxidation resistance up to 1000 °C (1830 °F). Good weldability.
Nicrofer 4722 Co	– alloy X	Excellent resistance to oxidation and high mechanical strength up to 1200 °C (2190 °F).
Nicrofer 4626 MoW	– alloy 333	Excellent resistance to oxidation, carburization and sulfidation. Excellent high temperature strength, even above 1000 °C (1830 °F).

NiCrFe – FeNiCr – standard alloys		
Nicrofer 7216 H	– alloy 600 H	Solution-annealed version of Nicrofer 7216 – alloy 600 with higher creep strength for service temperatures above 700 °C (1290 °F).
Nicrofer 6023 H	– alloy 601 H	A grade of Nicrofer 6023 – alloy 601 with improved creep strength for service temperature up to 1100 °C (2000 °F).
Nicrofer 45 TM	– alloy 45 TM	Alloy designed for service in severely corrosive media at high temperatures: fuel ash, incineration off-gases, sulfur compounds, alkali metal oxides.
Nicrofer 3220 HT	– alloy 800 HP	Variation of Nicrofer 3220 H – alloy 800 H with particularly high creep strength in the temperature range 700 – 1000 °C (1290 – 1830 °F).
Nicrofer 3220 H	– alloy 800 H	Variation of Nicrofer 3220 – alloy 800 with elevated creep values in the temperature range 600 – 950 °C (1110 – 1830 °F).
CoCrNiW		
Conicro 5010 W	– alloy 25	Excellent creep strength and resistance to scaling and oxidation up to 1050 °C (1920 °F).
Conicro 4023 W	– alloy 188	Excellent high-temperature properties and resistance to scaling and oxidation up to 1150 °C (2100 °F).

Heating-element and resistance alloys		
NiCr – FeCrAl		
Cronix 80	– alloy NiCr80/20	Good resistance to oxide scaling and to thermal fatigue up to 1200 °C (2190 °F).
Cronix 70	– alloy NiCr70/30	Good resistance to oxide scaling and to alternating oxidizing-carburizing atmospheres, for service up to 1250 °C (2280 °F).

Expansion and glass-sealing alloys		
FeNi – FeNiCo		
Pernifer 2918		Expansion alloy with extremely low coefficient of thermal expansion between –100 and 450 °C (–150 to 840 °F).
Pernifer 36	– alloy 36	Alloy with lowest coefficient of thermal expansion from cryogenic temperature to about 200 °C (390 °F).

High-performance materials: sheet and plate
Major applications

Krupp VDM alloy designation		Major applications
Heat-resistant alloys		
NiCrFe – FeNiCr		
Nicrofer 7520	– alloy 75	Gas turbine casings and flame tubes, components in heat-treatment furnaces.
Nicrofer 7216	– alloy 600	VCM and perchlorethylene synthesis, production of titanium dioxide, aluminium fluoride and chloride. Nitriding furnace muffles and retorts. MDI and TDI production.
Nicrofer 6030	– alloy 690	PWR steam-generator tubing, components in heavy-oil fired furnaces.
Nicrofer 3718 So	– alloy DS	Muffles and equipment for carburizing, carbonitriding and enamelling furnaces; flare stacks; mesh belts.
Nicrofer 3718	– (alloy 330)	Muffles and equipment for carburizing, carbonitriding and enamelling furnaces; flare stacks; mesh belts.
High-temperature, high-strength alloys		
NiCr – NiCrFe – NiCrMo – NiCrCoMo – superalloys		
Nicrofer 7016 TiNb	– alloy X-750	Gas turbine components, fasteners, springs and bolts including for nuclear reactors.
Nicrofer 6025 HT	– alloy 602 CA	Furnace components: radiant tubes, rollers and muffles, pigtails. Automobile catalyst systems. Enamelling equipment. Heat exchanger tubes in fluidised bed systems.
Nicrofer 5520 Co	– alloy 617	Stationary gas turbines; nitric acid catalyst grids; gas-cooled nuclear reactor components.
Nicrofer 5219 Nb	– alloy 718	Gas turbine and rocket components. Wellhead and downhole equipment in sour gas and oil fields.
Nicrofer 5120 CoTi	– alloy C-263	Parts for gas turbines: rings, casings, combustion chambers.
Nicrofer 4722 Co	– alloy X	Parts for gas turbines and heat treatment furnaces; catalyst supports in nitric acid production.
Nicrofer 4626 MoW	– alloy 333	Parts for gas turbines and heat treatment furnaces; petrochemical process industry.
NiCrFe – FeNiCr – standard alloys		
Nicrofer 7216 H	– alloy 600 H	Bright annealing muffles, radiant tubes, furnace baskets and containers. VCM synthesis, melamine and fumed silica production.
Nicrofer 6023 H	– alloy 601 H	Heat treatment furnace components. Oxygen preheaters in titanium dioxide production. Waste incineration systems.
Nicrofer 45 TM	– alloy 45 TM	Waste incineration, coal gasification, refinery furnaces, hydrocarbon processsing.
Nicrofer 3220 HT	– alloy 800 HP	Petrochemical plant: styrene steam piping, hydrogen reformer plant, acetic anhydride crackers, furnace tubing.
Nicrofer 3220 H	– alloy 800 H	Petrochemical plant: styrene steam piping, hydrogen reformer plant, acetic anhydride crackers, furnace tubing.
CoCrNiW		
Conicro 5010 W	– alloy 25	Turbine components; furnace rollers and muffles.
Conicro 4023 W	– alloy 188	Gas turbines, furnace rollers and muffles, high temperature heat exchangers.
Heating-element and resistance alloys		
NiCr – FeCrAl		
Cronix 80	– alloy NiCr80/20	Electric furnaces; enamelling furnaces; night storage heaters; domestic appliances; mesh belts.
Cronix 70	– alloy NiCr70/30	Electric furnaces; enamelling furnaces; night storage heaters; domestic appliances; mesh belts.
Expansion and glass-sealing alloys		
FeNi – FeNiCo		
Pernifer 36	– alloy 36	Tanks for liquefied natural gas, measuring and thermostatic instruments, precision parts, laser welding equipment.
Pernifer 2918		Glass/ceramic sealing, lead frames

Welding products

High-performance welding products
Designations and specifications

Krupp VDM alloy designation	Designations and specifications					
	Werkst.-Nr.	Designation	DIN	UNS	AWS	Classification
Welding material						
Welding rod and wire, wire electrodes (FM = Filler Metal)						
Nickel S 9604 – FM 61	2.4155	SG-NiTi4	1736	N02061	A 5.14	ERNi-1
Nicorros S 6530 – FM 60	2.4377	SG-NiCu30MnTi	1736	N04060	A 5.14	ERNiCu-7
Cunifer S 7030 – FM 67	2.0837	SG-CuNi30Fe	1733	C71581	A 5.7	ERCuNi
Cunifer S 9010	2.0873	SG-CuNi10Fe	1733	–	–	–
Nimofer S 6928 – FM B-2	2.4615	SG-NiMo 27	1736	N10665	A 5.14	ERNiMo-7
Nimofer S 6629 – FM B-4	2.4701	SG-NiMo28Cr	–	–	–	–
Nimofer S 6224 – FM B-10	2.4702	SG-NiMo24Cr9Fe	–	–	–	–
Nicrofer S 7020 – FM 82	2.4806	SG-NiCr20Nb	1736	N06082	A 5.14	ERNiCr-3
Nicrofer S 6616 – FM C-4	2.4611	SG-NiMo16Cr16Ti	1736	N06455	A 5.14	ERNiCrMo-7
Nicrofer S 6219 – FM 626	2.4832	SG-NiCr19MoSi	–	–	–	–
Nicrofer S 6030 – FM 690	2.4642	NiCr29Fe	–	N06690	–	–
Nicrofer S 6025 – FM 602	2.4649	SG-NiCr25FeAlY	–	N06025	–	–
Nicrofer S 6020 – FM 625	2.4831	SG-NiCr21Mo9Nb	1736	N06625	A 5.14	ERNiCrMo-3
Nicrofer S 5923 – FM 59	2.4607	SG-NiCr23Mo16	1736	N06059	A 5.14	ERNiCrMo-13
Nicrofer S 5716 – FM C-276	2.4886	SG-NiMo16Cr16W	1736	N10276	A 5.14	ERNiCrMo-4
Nicrofer S 5520 – FM 617	2.4627	SG-NiCr22Co12Mo	1736	N06617	A 5.14	ERNiCrCoMo-1
Nicrofer S 5219 – FM 718	2.4667	SG-NiCr19NbMoTi	1736	N07718	A 5.14	ERNiFeCr-2
Nicrofer S 5120 – FM 263	2.4650	NiCo20Cr20MoTi	–	N07263	–	–
Nicrofer S 4722 – FM X	2.4613	SG-NiCr21Fe18Mo	–	N06002	A 5.14	ERNiCrMo-2
Nicrofer S 4626 – FM 333	2.4608	NiCr26MoW	–	N06333	–	–
Nicrofer S 3127 – FM 31	1.4562	X1NiCrMoCu32-28-7	–	N 08031	–	–
Nicrofer S 3033 – FM 33	1.4591	X1CrNiMoCuN33-32-1	–	R20033	–	–
Nicrofer S 3028 – FM 28	1.4563	X1NiCrMoCuN31-27-4	–	N08028	–	–
Conicro S 5010 – FM 25	2.4964	CoCr20W15Ni	–	R 30605	–	–
Conicro S 4023 – FM 188	2.4683	CoCr22NiW	–	R 30188	–	–
Strip electrodes (WS = Weld Strip)						
Nicorros B 6530 – WS 60	2.4377	UP-NiCu30MnTi	1736	(N04060)	–	(ERNiCu-7)
Cunifer B 7030 – WS 67	2.0837	UP-CuNi30Fe	1733	(C71581)	–	(ERCuNi)
Nimofer B 6928 – WS B-2	2.4615	UP-NiMo27	1736	(N10665)	–	(ERNiMo-7)
Nicrofer B 7020 – WS 82	2.4806	UP-NiCr20Nb	1736	(N06082)	–	(ERNiCr-3)
Nicrofer B 6616 – WS C-4	2.4611	UP-NiMo16Cr16Ti	1736	(N06455)	–	(ERNiCrMo-7)
Nicrofer B 6020 – WS 625	2.4831	UP-NiCr21Mo9Nb	1736	N06625)	–	(ERNiCrMo-3)
Nicrofer B 5923 – WS 59	2.4607	UP-NiCr23Mo16	1736	(N06059)	–	(ERNiCrMo-13)
Nicrofer B 5716 – WS C-276	2.4886	UP-NiMo16Cr16W	1736	(N10276)	–	(ERNiCrMo-4)

High-performance welding products
Designations and specifications

BS 2901 Type	AFNOR	Approval	Krupp VDM alloy designation		
Welding material					
Welding rod and wire, wire electrodes (FM = Filler Metal)					
NA 32	–	TÜV, ABS	Nickel S 9604	– FM 61	
NA 33	–	TÜV, ABS	Nicorros S 6530	– FM 60	
C 18	–	TÜV, ABS	Cunifer S 7030	– FM 67	
C 16	–	–	Cunifer S 9010		
NA 44	–	–	Nimofer S 6928	– FM B-2	
–	–	–	Nimofer S 6629	– FM B-4	
–	–	–	Nimofer S 6224	– FM B-10	
NA 35	–	TÜV, ABS	Nicrofer S 7020	– FM 82	
NA 45	–	TÜV	Nicrofer S 6616	– FM C-4	
–	–	–	Nicrofer S 6219	– FM 626	
–	NC30 Fe	–	Nicrofer S 6030	– FM 690	
–	–	–	Nicrofer S 6025	– FM 602	
NA 43	–	TÜV, ABS	Nicrofer S 6020	– FM 625	
–	–	TÜV, ABS	Nicrofer S 5923	– FM 59	
NA 48	–	TÜV	Nicrofer S 5716	– FM C-276	
NA 50	–	TÜV	Nicrofer S 5520	– FM 617	
NA 51	–	–	Nicrofer S 5219	– FM 718	
NA 38	NCK20D	–	Nicrofer S 5120	– FM 263	
NA 40	–	–	Nicrofer S 4722	– FM X	
–	NC26DW	–	Nicrofer S 4626	– FM 333	
–	–	–	Nicrofer S 3127	– FM 31	
–	–	–	Nicrofer S 3033	– FM 33	
–	–	–	Nicrofer S 3028	– FM 28	
–	KC20WN	–	Conicro S 5010	– FM 25	
–	KCN22W	–	Conicro S 4023	– FM 188	
Strip electrodes (WS = Weld Strip)					
(NA 33)	–	–	Nicorros B 6530	– WS 60	
(C 18)	–	–	Cunifer B 7030	– WS 67	
(NA 44)	–	–	Nimofer B 6928	– WS B-2	
(NA 35)	–	–	Nicrofer B 7020	– WS 82	
(NA 45)	–	–	Nicrofer B 6616	– WS C-4	
(NA 43)	–	–	Nicrofer B 6020	– WS 625	
–	–	–	Nicrofer B 5923	– WS 59	
(NA 48)	–	–	Nicrofer B 5716	– WS C-276	

High-performance welding products
Chemical composition

Krupp VDM alloy designation	Chemical composition, %						
	Ni	Cr	Fe	C	Mn	Si	Cu
Welding material							
Welding rods and wire, wire electrodes (FM = Filler Metal)							
VDM Nickel S 9604 – FM 61	≥ 93.0	–	≤ 0.7	≤ 0.05	≤ 0.8	≤ 0.75	≤ 0.2
Nicorros S 6530 – FM 60	≥ 62.0	–	0.5 – 2.5	≤ 0.10	3.0 – 4.0	≤ 1.0	28.0 – 34.0
Cunifer S 7030 – FM 67	30.0 – 32.0	–	0.4 – 0.7	≤ 0.05	0.5 – 1.0	≤ 0.10	balance
Cunifer S 9010	10.0 – 11.0	–	1.3 – 1.8	≤ 0.05	0.5 – 1.0	≤ 0.10	balance
Nimofer S 6928 – FM B-2	balance	0.4 – 1.0	1.5 – 2.0	≤ 0.010	≤ 1.0	≤ 0.08	≤ 0.5
Nimofer S 6629 – FM B-4	≥ 65.0	0.5 – 1.5	2.0 – 6.0	≤ 0.01	≤ 1.5	≤ 0.05	≤ 0.5
Nimofer S 6224 – FM B-10	≥ 58.0	6.0 – 10.0	5.0 – 8.0	≤ 0.01	≤ 1.0	≤ 0.1	≤ 0.5
Nicrofer S 7020 – FM 82	≥ 67.0	18.0 – 22.0	≤ 3.0	≤ 0.05	2.5 – 3.5	≤ 0.5	≤ 0.5
Nicrofer S 6616 – FM C-4	balance	14.0 – 18.0	≤ 3.0	≤ 0.010	≤ 0.5	≤ 0.08	–
Nicrofer S 6219 – FM 626	balance	18.0 – 22.0	2.0 – 4.0	≤ 0.05	≤ 0.5	0.7 – 1.1	–
Nicrofer S 6030 – FM 690	≥ 60.0	27.0 – 30.0	8.0 – 10.0	≤ 0.02	≤ 0.3	≤ 0.3	≤ 0.5
Nicrofer S 6025 – FM 602	balance	24.0 – 26.0	8.0 – 11.0	0.15 – 0.25	≤ 0.1	≤ 0.5	≤ 0.1
Nicrofer S 6020 – FM 625	≥ 60.0	20.0 – 23.0	≤ 2.0	≤ 0.025	≤ 0.5	≤ 0.5	≤ 0.5
Nicrofer S 5923 – FM 59	balance	22.0 – 24.0	≤ 1.5	≤ 0.010	≤ 0.5	≤ 0.10	–
Nicrofer S 5716 – FM C-276	balance	15.0 – 16.5	4.0 – 7.0	≤ 0.010	≤ 1.0	≤ 0.08	–
Nicrofer S 5520 – FM 617	≥ 50.0	20.0 – 24.0	≤ 1.0	0.05 – 0.10	≤ 1.0	≤ 0.5	≤ 0.5
Nicrofer S 5219 – FM 718	≥ 50.0	17.0 – 21.0	balance	0.02 – 0.08	≤ 0.35	≤ 0.35	≤ 0.3
Nicrofer S 5120 – FM 263	balance	19.0 – 21.0	≤ 0.7	0.04 – 0.08	≤ 0.6	≤ 0.4	≤ 0.2
Nicrofer S 4722 – FM X	balance	20.0 – 22.5	17.0 – 20.0	0.05 – 0.9	≤ 1.0	0.2 – 0.8	≤ 0.5
Nicrofer S 4626 – FM 333	44.0 – 47.0	24.0 – 26.0	balance	0.03 – 0.06	1.2 – 2.0	0.8 – 1.2	≤ 0.5
Nicrofer S 3127 – FM 31	30.0 – 32.0	26.0 – 28.0	balance	≤ 0.015	–	–	1.0 – 1.4
Nicrofer S 3033 – FM 33	30.0 – 33.0	31.0 – 35.0	balance	≤ 0.015	≤ 2.0	≤ 0.5	0.3 – 1.2
Nicrofer S 3028 – FM 28	30.0 – 32.0	26.0 – 28.0	balance	≤ 0.015	–	–	1.0 – 1.4
Conicro S 5010 – FM 25	9.0 – 11.0	19.0 – 21.0	≤ 3.0	0.05 – 0.15	1.0 – 2.0	≤ 0.3	–
Conicro S 4023 – FM 188	20.0 – 24.0	20.0 – 24.0	≤ 3.0	0.05 – 0.15	≤ 1.25	0.2 – 0.4	–
Strip electrodes (WS = Weld Strip)							
Nicorros B 6530 – WS 60	≥ 62.0	–	≤ 0.5	≤ 0.10	3.0 – 4.0	≤ 1.0	28.0 – 34.0
Cunifer B 7030 – WS 67	30.0 – 32.0	–	0.4 – 0.7	≤ 0.05	0.5 – 1.0	≤ 0.10	balance
Nimofer B 6928 – WS B-2	balance	0.4 – 1.0	1.5 – 2.0	≤ 0.010	≤ 1.0	≤ 0.08	–
Nicrofer B 7020 – WS 82	≥ 67.0	18.0 – 22.0	≤ 3.0	≤ 0.05	2.5 – 3.5	≤ 0.5	≤ 0.5
Nicrofer B 6616 – WS C-4	balance	14.0 – 18.0	≤ 3.0	≤ 0.010	≤ 0.5	≤ 0.08	–
Nicrofer B 6020 – WS 625	≥ 60.0	20.0 – 23.0	≤ 2.0	≤ 0.025	≤ 0.5	≤ 0.5	≤ 0.5
Nicrofer B 5923 – WS 59	balance	22.0 – 24.0	≤ 1.5	≤ 0.010	≤ 0.5	≤ 0.10	–
Nicrofer B 5716 – WS C-276	balance	15.0 – 16.5	4.0 – 7.0	≤ 0.010	≤ 1.0	≤ 0.08	–

High-performance welding products
Chemical composition

Chemical composition						Krupp VDM alloy designation
Mo	Co	Al	Ti	Nb	others	
Welding material						
Welding rods and wire, wire electrodes (FM = Filler Metal)						
–	–	≤ 1.0	2.0 – 3.5	–	≤ 0.5	VDM Nickel S 9604 – FM 61
–	–	≤ 1.0	1.5 – 3.0	–	≤ 0.5	Nicorros S 6530 – FM 60
–	–	–	0.2 – 0.5	–	Pb ≤ 0.02, Zn ≤ 0.2	Cunifer S 7030 – FM 67
–	–	–	0.2 – 0.5	–	≤ 0.4	Cunifer S 9010
26.0 – 30.0	≤ 1.0	–	–	–	W ≤ 1.0	Nimofer S 6928 – FM B-2
26.0 – 30.0	≤ 2.5	0.1 – 0.5	–	–	–	Nimofer S 6629 – FM B-4
21.0 – 25.0	–	≤ 0.5	–	–	–	Nimofer S 6224 – FM B-10
–	≤ 0.1	–	≤ 0.75	2.0 – 3.0	≤ 0.5	Nicrofer S 7020 – FM 82
14.0 – 17.0	≤ 2.0	–	≤ 0.7	–	≤ 0.5	Nicrofer S 6616 – FM C-4
7.0 – 9.0	≤ 1.0	≤ 0.5	≤ 0.5	–	–	Nicrofer S 6219 – FM 626
–	–	–	≤ 0.3	–	–	Nicrofer S 6030 – FM 690
–	–	1.8 – 2.4	0.1 – 0.2	–	Y = 0.05 – 0.12, Zr = 0.01 – 0.10	Nicrofer S 6025 – FM 602
8.0 – 10.0	≤ 1.0	≤ 0.3	≤ 0.4	3.2 – 4.1	–	Nicrofer S 6020 – FM 625
15.0 – 16.5	≤ 0.3	0.1 – 0.4	–	–	–	Nicrofer S 5923 – FM 59
15.0 – 17.0	≤ 2.5	–	–	–	W = 3.0 – 4.5, V = 0.1 – 0.3	Nicrofer S 5716 – FM C-276
8.0 – 10.0	10.0 – 14.0	0.8 – 1.5	≤ 0.6	–	–	Nicrofer S 5520 – FM 617
2.8 – 3.3	–	0.2 – 0.8	0.65 – 1.10	4.8 – 5.5	B ≤ 0.006	Nicrofer S 5219 – FM 718
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 S 5120 – FM 263
8.5 – 9.5	0.5 – 1.5	–	–	–	W = 0.2 – 1.0	Nicrofer S 4722 – FM X
2.5 – 3.5	2.5 – 3.5	–	0.1 – 0.2	–	W = 2.5 – 3.5	Nicrofer S 4626 – FM 333
6.0 – 7.0	–	–	–	–	N = 0.15 – 0.25	Nicrofer S 3127 – FM 31
0.5 – 2.0	–	–	–	–	N = 0.35 – 0.60	Nicrofer S 3033 – FM 33
3.0 – 4.0	–	–	–	–	N = 0.04 – 0.07	Nicrofer S 3028 – FM 28
–	balance	–	–	–	W = 14.0 – 16.0	Conicro S 5010 – FM 25
–	balance	≤ 0.20	–	–	W = 13.0 – 16.0, La = 0.02 – 0.12	Conicro S 4023 – FM 188
Strip electrodes (WS = Weld Strip)						
–	–	≤ 1.0	1.5 – 3.0	–	≤ 0.5	Nicorros B 6530 – WS 60
–	–	–	0.2 – 0.5	–	Pb ≤ 0.02, Zn ≤ 0.2	Cunifer B 7030 – WS 67
26.0 – 30.0	≤ 1.0	–	–	–	W ≤ 1.0	Nimofer B 6928 – WS B-2
–	≤ 0.1	–	≤ 0.75	2.3 – 3.0	≤ 0.5	Nicrofer B 7020 – WS 82
14.0 – 17.0	≤ 2.0	–	≤ 0.7	–	≤ 0.5	Nicrofer B 6616 – WS C-4
8.0 – 10.0	–	≤ 0.3	≤ 0.4	3.2 – 4.1	≤ 0.5	Nicrofer B 6020 – WS 625
15.0 – 16.5	≤ 0.3	0.1 – 0.4	–	–	–	Nicrofer B 5923 – WS 59
15.0 – 17.0	≤ 2.5	–	–	–	W = 3.0 – 4.5, V = 0.1 – 0.3	Nicrofer B 5716 – WS C-276

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