VDM Metals

VDM® Alloys 600/600 H
Nicrofer 7216/7216 H

Material Data Sheet No. 4007
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Nicrofer® 7216/7216 H – alloys 600/600 H

Nicrofer 7216/7216 H are nickel-chromium-iron alloys, characterized by:

- good resistance to oxidation, carburization and nitridation
- good resistance to stress corrosion cracking, at both room and elevated temperatures
- good resistance to dry chlorine and hydrogen chloride
- good mechanical properties at sub-zero, room and elevated temperatures

Nicrofer 7216 H is recommended for service above 700 °C (1290 °F) because of its higher creep-rupture properties, obtained via controlled carbon content and, except for strip products, coarse grain size.

Designations and standards

Country National standards	Material designation	Specification							
		Chemical composition	Tube and pipe		Sheet and plate	Rod and bar	Strip	Wire	Forgings
			seamless	welded					
D EN DIN DIN VdTÜV	**W.-Nr. 2.4816** NiCr15Fe	 10095 17742 305	 17751 305		 10095 17750 305	 10095 17752 305	 10095 17750	 10095 17753	 17754 305
F AFNOR	NC15Fe								
UK BS	NA 14		3074		3072	3076	3073	3075	
USA ASTM ASME AMS	UNS N06600		B 167 SB 167 5580	B 163 B 516/517 SB 163 SB 516/517	B 168 SB 168 5540	B 166 SB 166 5665	B 168 SB 168 5540	B 166 SB 166 5687	B 564 SB 564 5665
ISO	NiCr15Fe8								

Table 1 – Designations and standards.

Chemical composition

	Ni	Cr	Fe	C	Mn	Si	Cu	Al	Ti	B	P	S
min.	72.0	14.0	6.0									
max.		17.0	10.0	0.15	1.0	0.5	0.5	0.3	0.3	0.006	0.015	0.015

Table 2 – Chemical composition (wt.-%) of Nicrofer 7216/7216 H according to ASTM.
Note: Compositional limits of other specifications may vary slightly.

Physical properties

Density	8.4 g/cm³	0.30 lb/in.³
Melting range	1370 – 1425 °C	2500 – 2600 °F
Permeability at 20 °C/68 °F (RT)	1.05	

Temperature (T)		Specific heat		Thermal conductivity		Electrical resistivity		Modulus of elasticity		Coefficient of thermal expansion between room temperature and T	
°C	°F	J / kg K	Btu / lb °F	W / m K	Btu in. / ft² h °F	µ Ω cm	Ω circ mil / ft	kN / mm²	10³ ksi	10⁻⁶ / K	10⁻⁶ / °F
0	32										
20	**68**	455	0.108	14.8	103	103	620	214	31.0		
93	**200**		0.112		109		626		30.5		7.5
100	212	475		15.8		104		209		13.7	
200	392	495		17.0		106		205		14.1	
204	**400**		0.118		118		638		29.7		7.8
300	572	508		18.4		107		200		14.4	
316	**600**		0.122		130		647		28.9		8.0
400	752	525		20.0		108		194		14.8	
427	**800**		0.126		143		655		27.8		8.3
500	932	550		22.0		111		187		15.1	
538	**1000**		0.132		160		674		26.7		8.4
600	1112	572		24.0		112		180		15.4	
649	**1200**		0.140		172		674		25.5		8.6
700	1292	602		25.7		112		172		15.8	
760	**1400**		0.146		186		674		24.2		8.7
800	1472	620		27.5		112		163		16.1	
871	**1600**		0.150		201		678		22.8		9.0
900	1652	630		29.4		113		153		16.4	
982	**1800**		0.151		215		683		21.0		9.3
1000	1832	635		31.2		114		143		16.9	

Table 3 – Typical physical properties at room and elevated temperatures.

Nicrofer® 7216/7216 H – alloys 600/600 H

Mechanical properties

The following properties are applicable to soft annealed Nicrofer 7216 and solution annealed Nicrofer 7216 H in the indicated product and size ranges. Specified properties of material outside these size ranges are subject to special enquiry.

Strip	up to 3 mm	up to 0.12 in.
Sheet & plate	up to 50 mm	up to 2 in.
Rod & bar	up to 300 mm	up to 12 in.
Tube	up to 125 mm	up to 5 in.
Wire	0.08 – 10 mm	0.003 – 0.4 in.

Alloy and condition	Tensile strength R_m N/mm²	ksi	Yield strength $R_{p\,0.2}$ N/mm²	ksi	Elongation A_5* %	Brinell hardness HB
Nicrofer 7216 soft annealed	550	80	240	35	30	≤ 195
Nicrofer 7216 H solution annealed	500	73	180	26	35	≤ 185

*Elongation values for strip products are normally determined based on an initial gauge length of 50 mm (2 in.).
These values are lower, dependent on the alloy, than the corresponding A_5 values by an order of approx. 10 %.

Table 4 – Minimum mechanical properties at room temperature.

ISO V-notch impact toughness

Nicrofer 7216 average at RT: ≥ 150 J/cm² transverse
≥ 200 J/cm² longitudinal

Nicrofer 7216 average at RT: ≥ 120 J/cm² transverse (forgings)

Alloy and condition	Tensile strength, R_m[1] N/mm²					Yield strength, $R_{p0.2}$[2] N/mm²				
Temperature, °C	100	200	300	400	450	100	200	300	400	450
Nicrofer 7216 soft annealed	520	500	485	480	475	180	165	155	150	145
Nicrofer 7216 H solution annealed	480	460	445	440	435	170	160	150	150	145

	ksi					ksi				
Temperature, °F	200	400	600	800	900	200	400	600	800	900
Nicrofer 7216 soft annealed	75.4	72.5	69.6	68.9	68.2	26.1	23.9	22.0	21.0	20.3
Nicrofer 7216 H solution annealed	69.6	66.7	63.8	63.1	62.4	24.7	23.2	21.5	21.0	20.3

[1] mean values
[2] minimum values according to VdTÜV data sheet 305

Table 5 – Mechanical properties at elevated temperatures.

Product and condition	Dimensions mm	Dimensions in.	Tensile strength R_m N/mm²	Tensile strength R_m ksi	Yield strength $R_{p\,0.2}$ N/mm²	Yield strength $R_{p\,0.2}$ ksi	Elongation A_5* %	Grain size µm	Grain size ASTM	Brinell hardness HB
Sheet	≤ 1.3	≤ 0.05	550	80	240	35	30	76	4.5	
cr + annealed	> 1.3 – 6.35	> 0.05 – 0.25						107	3.5	
Plate hr + annealed	≤ 50	≤ 2.0								
hr + stress relieved			585	85	240	35	30			
1/4 hard			–	–	–	–	–			175 – 205
1/2 hard			–	–	–	–	–			195 – 230
hard			860	125	620	90	2			
Strip* cr + annealed	≤ 3.2	≤ 0.125	550	80	240	35	30			
Rod	< 12.7	< 0.50	825	120	620	90	7			
cold finished	≥ 12.7 – 25.4	≥ 0.50 – 1.0	760	110	585	85	10			230 – 310
	> 25.4 – 63.5	> 1.0 – 2.5	725	105	550	80	12			205 – 285
hot finished	≥ 6.35 – 12.7	≥ 0.25 – 0.50	655	95	310	45	20			135 – 240
	> 12.7 – 76.2	> 0.50 – 3.0	620	90	275	40	25			135 – 215
	> 63.5 – 114.3	> 2.5 – 4.5	585	85	240	35	30			
cf/hf + annealed	all sizes		550	80	240	35	30			
Forgings hot f. + annealed	≥ 63.5	≥ 2.5	550	80	205	30	35			≤ 185
Wire	0.05 – 0.38	0.002 – 0.015	895	130						
cold drawn	> 0.38 – 1.02	> 0.015 – 0.04	795	115						
	> 1.02	> 0.04	760	110						
cold dr. + annealed			550	80						
cold drawn										
regular temper			< 1825	< 120						
spring temper			≤ 1140	≤ 165						

*Elongation values for strip products are normally determined based on an initial gauge length of 50 mm (2 in.).
These values are lower, dependent on the alloy, than the corresponding A_5 values by an order of approx. 10 %.

*Table 6 – Minimum mechanical properties of **Nicrofer 7216** at room temperature for various conditions and size ranges.*

Nicrofer® 7216/7216 H – alloys 600/600 H

Temperature T		Creep-rupture strength, R_m				Creep strength, $R_{p1.0}$			
		10^4 h		10^5 h		10^4 h		10^5 h	
°C	°F	N/mm²	ksi	N/mm²	ksi	N/mm²	ksi	N/mm²	ksi
500	932	297		215		153		126	
538	**1000**		32.1		24.1		18.4		14.8
600	1112	138		97		91		66	
649	**1200**		13.8		9.6		9.4		6.5
700	1292	63		42		43		28	
760	**1400**		5.8		3.5		3.6		2.5
800	1472	29		17.1		18		12	
850	1562	17		9.2		11		6.7	
871	**1600**		2.2		1.2		1.3		0.9
900	1652	13		7		8		4	

*Table 7 – Long-term properties of **Nicrofer 7216 H**, solution annealed at 1120 °C (2050 °F).*

Up to approximately 700 °C (1290 °F) there is virtually no difference between the creep strengths of material in the annealed and solution-treated conditions. For applications at temperatures above 750 °C (1380 °F), the use of material in the solution-treated condition with a minimum average grain size of 65 µm/ASTM 5 is recommended.

Metallurgical structure

Nicrofer 7216/7216 H have face-centered cubic structures.

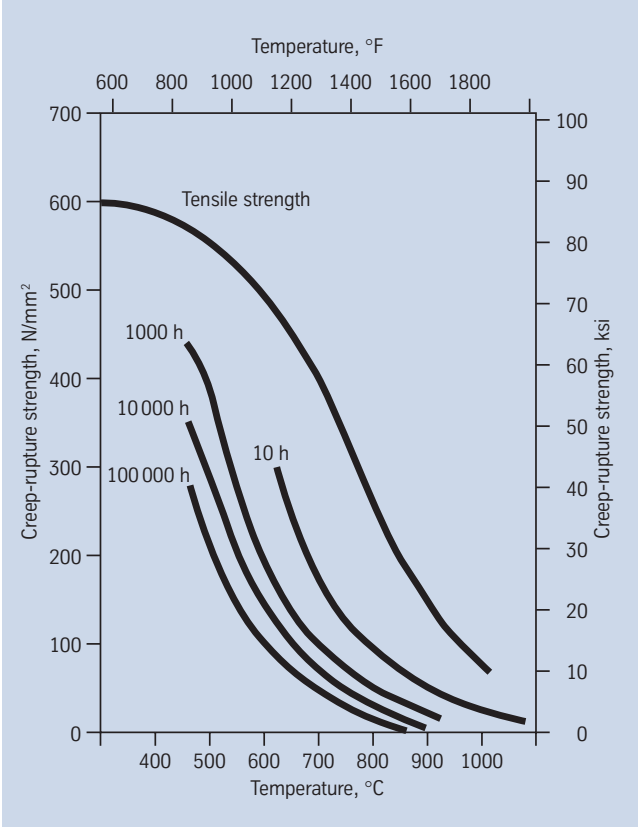

*Fig. 1 – Typical creep-rupture properties of **Nicrofer 7216 H**, solution annealed at 1120 °C (2050 °F).*

Corrosion resistance
Nicrofer 7216/7216 H are resistant to a wide range of corrosive media. Due to the chromium content the alloys possess better corrosion resistance than Nickel 99.2 (alloy 200) and LC-Nickel 99.2 (alloy 201) under oxidizing conditions. At the same time, the high nickel content results in good corrosion resistance under reducing conditions and in alkaline solutions and leads to virtual immunity to chloride-ion stress-corrosion cracking.

Nicrofer 7216/7216 H show moderate resistance to mineral acids and good resistance to acetic, formic, stearic and other organic acids.

Excellent resistance is shown in high purity water, as used in the primary and secondary circuits of some nuclear reactors.

Nicrofer 7216/7216 H are particularly resistant to attack by dry chlorine or hydrogen chloride, even at temperatures up to 650 °C (1200 °F).

At high temperatures in air the soft-annealed and solution-annealed alloys show good resistance to oxide scaling and have high strength.

The alloys also resist ammonia bearing atmospheres, as well as nitrogen and carburizing gases. Under alternating oxidizing and reducing conditions the alloys may suffer from selective oxidation (green rot).

Applications
Typical applications are:

- thermocouple sheathing in aggresive atmospheres
- vinylchloride monomer production: resistance to chlorine, hydrogen chloride, oxidation and carburization
- conversion of uranium oxide to hexafluoride: resistance to attack by hydrogen fluoride
- production and use of caustic alkalis, particularly in the presence of sulphur compounds
- production of titanium dioxide by the chlorine route
- production of organic and inorganic chlorinated and fluorinated compounds: resistance to attack by chlorine and fluorine
- nuclear reactor components
- heat treatment furnace retorts, furnace belts and components, particularly with carburizing or nitriding atmospheres
- catalyst regenerators in petrochemical production

Fabrication and heat treatment
Nicrofer 7216/7216 H can readily be hot- and cold-worked and machined.

Heating
Workpieces must be clean and free from all kinds of contaminants before and during any heat treatment.

Nicrofer 7216/7216 H may become impaired if heated in the presence of contaminants such as sulphur, phosphorus, lead and other low-melting-point metals. Sources of such contaminants include marking and temperature-indicating paints and crayons, lubricating grease and fluids, and fuels.

Fuels must be as low in sulphur as possible. Natural gas should contain less than 0.1 wt.-% sulphur. Fuel oils with a sulphur content not exceeding 0.5 wt.-% are suitable.

Due to their close control of temperature and freedom from contamination, thermal treatments in electric furnaces under vacuum or an inert gas atmosphere are to be preferred. Treatments in an air atmosphere and alternatively in gas-fired furnaces are acceptable though, if contaminants are at low levels so that a neutral or slightly oxidizing furnace atmosphere is attained. A furnace atmosphere fluctuating between oxidizing and reducing must be avoided as well as direct flame impingement on the metal.

Hot working
Nicrofer 7216/7216 H may be hot-worked in the temperature range 1200 to 900 °C (2200 to 1650 °F), followed by water quenching or rapid air cooling.

Heat treatment after hot working is recommended in order to achieve optimum properties.

For heating-up, workpieces should be charged into the furnace at maximum working temperature.

Cold working
For cold working the material should be in the soft- or solution-annealed condition. Nicrofer 7216/7216 H have work-hardening rates similar to that of austenitic stainless steels. This should be taken into account when selecting forming equipment.

Interstage annealing may be necessary with high degrees of cold forming.

After cold working with more than 15 % deformation, soft- or solution annealing is required.

Heat treatment
Soft annealing of Nicrofer 7216 should be carried out in the temperature range 920 to 1000 °C (1700 to 1830 °F) followed by water quenching or rapid air cooling.

Solution annealing of Nicrofer 7216 H, is carried out in the temperature range 1080 to 1150 °C (1970 to 2100 °F) followed by water quenching or rapid air cooling.

For any thermal treatment the material should be charged into the furnace at temperature. Also for any thermal treatment operation the precautions concerning cleanliness mentioned earlier under **'Heating'** must be observed.

Descaling and pickling

High-temperature alloys develop a protective oxide layer in service. Pre-oxidation in air can produce increased corrosion resistance. Therefore on the basis of the end use the necessity of descaling should be checked.

Oxides of Nicrofer 7216/7216 H and discoloration adjacent to welds are more adherent than on stainless steels. Grinding with very fine abrasing belts or discs is recommended. Care should be taken to prevent tarnishing.

Before pickling which may be performed, in a nitric/hydrofluoric acid mixture with proper control of pickling time and temperature, the surface oxide layer must be broken up by abrasive blasting, by carefully performed grinding or by pretreatment in a fused salt bath.

Machining

Nicrofer 7216/7216 H should preferably be machined in the heat-treated condition. As the alloys are prone to work-hardening, only low cutting speeds should be used and the tool should be engaged at all time.

An adequate depth of cut is important in order to cut below the previously formed work-hardened zone.

Welding

When welding nickel-base alloys, the following instructions should be adhered to:

Workplace

The workplace should be in a separate location, well away from areas where carbon steel fabrication takes place. Maximum cleanliness and avoidance of draughts are paramount.

Auxiliaries, clothing

Clean fine leather gloves and clean working clothes should be used.

Tools and machines

Tools used for nickel-base alloys and stainless steels must not be used for other materials. Brushes should be made of stainless materials.

Fabricating and working machinery such as shears, presses or rollers should be fitted with means (felt, cardboard, plastic sheeting) of avoiding contamination of the metal with ferrous particles, which can be pressed into the surface and thus lead to corrosion.

Cleaning

Cleaning of the base metal in the weld area (both sides) and of the filler metal (e.g. welding rod) should be carried out with ACETONE.

Trichlorethylene (TRI), perchlorethylene (PER) and carbon tetrachloride (TETRA) must not be used.

Edge preparation

This should preferably be done by mechanical means by turning, milling or planing; plasma cutting is also possible. However, in the latter case the cut edge (the face to be welded) must be finished off cleanly. Careful grinding without overheating is permitted. Also a zone approximately 25 mm (1 in.) wide on each side of the joint should be ground to bright metal.

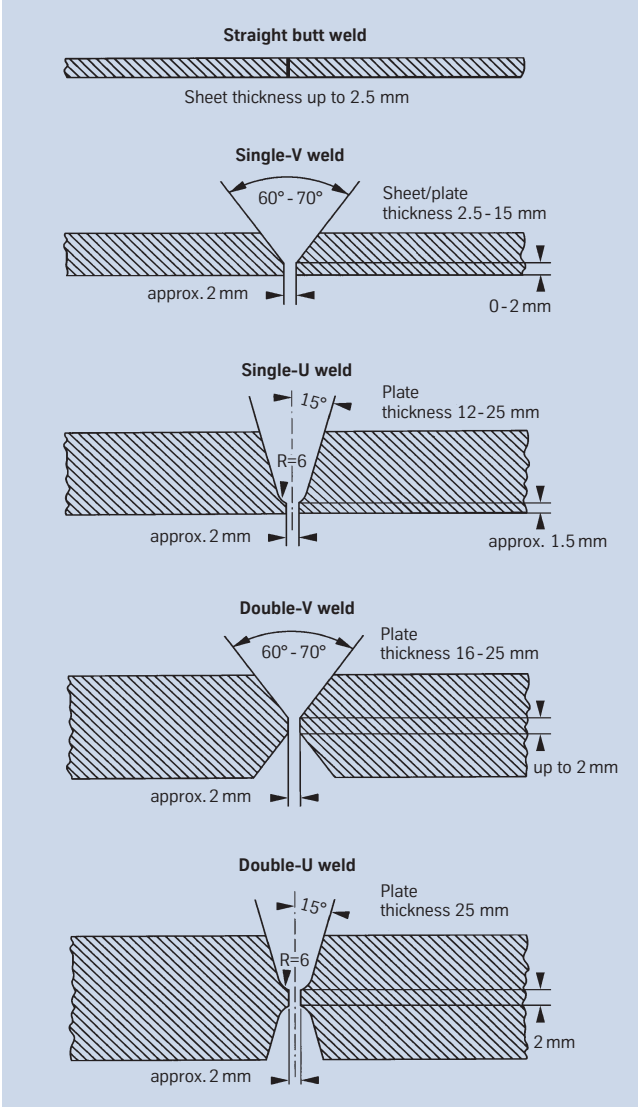

Fig. 2 – Edge preparation for welding of nickel-base alloys and special stainless steels.

Included angle

The different physical characteristics of nickel-base alloys and special stainless steels compared with carbon steel generally manifest themselves in lower thermal conductivity and a higher rate of thermal expansion.

This should be allowed for by means of, among other things, wider root gaps or openings (1 – 3 mm), while larger included angles (60 – 70 °), as shown in Fig. 1, should be used for individual butt joints owing to the viscous nature of the molten weld metal and to counteract the pronounced shrinkage tendency.

Striking of the arc
The arc should only be struck in the weld area, e.g. on the faces to be welded or on a run-out piece. Striking marks lead to corrosion.

Welding processes
Nicrofer 7216/7216 H can be joined to itself and to many other metals by conventional welding processes. These include GTAW (TIG), plasma arc, GMAW (MIG/MAG) and SMAW (MMA). Pulsed arc welding is the preferred technique. For the MAG process the use of a multi-component shielding gas ($Ar+He+H_2+CO_2$) is recommended.

For welding, Nicrofer 7216/7216 H should be in the annealed condition and be free from scale, grease and markings. When welding the root, care should be taken to achieve best-quality root backing (argon 99.99), so that the weld is free from oxides after welding the root. Any heat tint should be removed preferably by brushing with a stainless steel wire brush while the weld metal is still hot.

Filler metal
For the gas-shielded welding processes, the following filler metals are recommended:

Bare electrodes:	Nicrofer S 7020 – FM 82 Werkstoff-Nr. 2.4806 SG-NiCr 20Nb AWS A 5.14: ERNiCr-3
Covered electrodes:	Werkstoff-Nr. 2.4648 EL-NiCr19Nb AWS A 5.11: ENiCrFe-3

Welding parameters and influences
(heat input/energy input per unit length of weld)

Care should be taken that the work is performed with a deliberately chosen, low heat input as indicated in Table 9 by way of example. Use of the stringer bead technique should be aimed at. Interpass temperature should be kept below 150 °C (300 °F).

The welding parameters should be monitored as a matter of principle.

The heat input Q may be calculated as follows:

$$Q = \frac{U \times I \times 60}{v \times 1000} \text{ (kJ/cm)}$$

U = arc voltage, volts
I = welding current, amps
v = welding speed, cm/min.

Consultation with ThyssenKrupp VDM's Welding Laboratory is recommended.

Postweld treatment
(brushing, pickling and thermal treatments)

Brushing with a stainless steel wire brush immediately after welding, i.e. while the metal is still hot generally results in removal of heat tint and produces the desired surface condition without additional pickling.

Pickling, if required or prescribed, however, would generally be the last operation performed on the weldment. Also refer to the information on **'Descaling and pickling'**.

Neither pre- nor postweld thermal treatments are required.

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Sheet/ plate thick-ness mm	Welding process	Filler metal Diameter mm	Speed m / min.	Welding parameters Root pass A	Root pass V	Intermediate and final passes A	Intermediate and final passes V	Welding speed cm / min.	Flux/ shielding gas rate l / min.	Plasma-gas rate l / min.	Plasma-nozzle diameter mm
3.0	Manual GTAW	2.0		90	10	110 – 120	11	10 – 15	Ar W3[1] 8 – 10		
6.0	Manual GTAW	2.0 – 2.4		100 – 110	10	120 – 130	12	10 – 15	Ar W3[1] 8 – 10		
8.0	Manual GTAW	2.4		110 – 120	11	130 – 140	12	10 – 15	Ar W3[1] 8 – 10		
10.0	Manual GTAW	2.4		110 – 120	11	130 – 140	12	10 – 15	Ar W3[1] 8 – 10		
3.0	Autom. GTAW	1.2	0.5	manual		150	10	25	Ar W3[1] 15 – 20		
5.0	Autom. GTAW	1.2	0.5	manual		150	10	25	Ar W3[1] 15 – 20		
2.0	Hot wire GTAW	1.0	0.3			180	10	80	Ar W3[1] 15 – 20		
10.0	Hot wire GTAW	1.2	0.45	manual		250	12	40	Ar W3[1] 15 – 20		
4.0	Plasma arc	1.2	0.5	165	25			25	Ar W3[1] 30	Ar W3[1] 3.0	3.2
6.0	Plasma arc	1.2	0.5	190 – 200	25			25	Ar W3[1] 30	Ar W3[1] 3.5	3.2
8.0	MIG/MAG GMAW	1.0	approx. 8	GTAW		130 – 140	23 – 27	24 – 30	MAG[2] MIG: argon 18 – 20		
10.0	MIG/MAG GMAW	1.2	approx. 5	GTAW		130 – 150	23 – 27	20 – 26	MAG[2] MIG: argon 18 – 20		
6.0	SMAW	2.5		40 – 70	approx. 21	40 – 70	approx. 21				
8.0	SMAW	2.5 – 3.25		40 – 70	approx. 21	70 – 100	approx. 22				
16.0	SMAW	4.0				90 – 130	approx. 22				

[1] Argon or argon + max. 3 % hydrogen
[2] For MAG welding the use of the shielding gas Cronigon He30S or Argomag-Ni, for example, is recommended.
In all gas-shielded welding operations, ensure adequate back shielding.
These figures are only a guide and are intended to facilitate setting of the welding machines.

Table 8 – Welding parameters (guide values).

Welding process	Heat input per unit length kJ / cm	Welding process	Heat input per unit length kJ / cm
GTAW, manual, fully mechanised	max. 10	GMAW, MIG/MAG, manual, fully mechanised	max. 11
Hot wire GTAW	max. 6	SMAW, manual metal arc (MMA)	max. 7
Plasma arc	max. 10		

Table 9 – Heat input per unit length (guide values).

Availability

Nicrofer 7216/7216 H are available in the following standard product forms:

Sheet & plate

(for cut-to-length availability, refer to strip)

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

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

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

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

Discs and rings

Conditions:
hot rolled or forged,
thermally treated,
oxidized, descaled or pickled or machined

Product	Weight kg	Thickness mm	O. D.[1] mm	I. D.[1] mm
Disc	≤ 10000	≤ 300	≤ 3000	
Ring	≤ 3000	≤ 200	≤ 2500	on request

	lbs	inches	inches	inches
Disc	≤ 22000	≤ 12	≤ 120	
Ring	≤ 6600	≤ 8	≤ 100	on request

[1] other sizes subject to special enquiry

Rod & bar

Conditions:
forged, rolled, drawn,
thermally treated,
oxidized, descaled or pickled, machined, peeled or ground

Product	Forged[1] mm	Rolled[1] mm	Drawn[1] mm
Rod (o. d.)	≤ 600	8 – 100	12 – 65
Bar, square (a)	40 – 600	15 – 280	not standard
Bar, flat (a x b)	(40 – 80) x (200 – 600)	(5 – 20) x (120 – 600)	(10 – 20) x (30 – 80)
Bar, hexagonal (s)	40 – 80	13 – 41	≤ 50

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

[1] other sizes and conditions subject to special enquiry

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

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

Thickness mm	Width[3)] mm	Coil I. D. mm			
0.04 – ≤ 0.10	4 – 200	300	400		
> 0.10 – ≤ 0.20	4 – 350	300	400	500	
> 0.20 – ≤ 0.25	4 – 750		400	500	600
> 0.25 – ≤ 0.60	6 – 750		400	500	600
> 0.60 – ≤ 1.0	8 – 750		400	500	600
> 1.0 – ≤ 2.0	15 – 750		400	500	600
> 2.0 – ≤ 3.0	25 – 750		400	500	600

inches	inches	inches			
0.0016 – ≤ 0.004	0.16 – 8	12	16		
> 0.004 – ≤ 0.008	0.16 – 14	12	16	20	
> 0.008 – ≤ 0.010	0.16 – 30		16	20	24
> 0.010 – ≤ 0.024	0.20 – 30		16	20	24
> 0.024 – ≤ 0.040	0.32 – 30		16	20	24
> 0.040 – ≤ 0.080	0.60 – 30		16	20	24
> 0.080 – ≤ 0.120	1.0 – 30		16	20	24

[1)] Cut-to-length available in lengths from 250 to 4000 mm (10 to 158 in.)
[2)] Maximum thickness 3 mm (0.125 in.)
[3)] Wider widths subject to special enquiry

Wire
Conditions:
bright drawn, $^1/_4$ hard to hard,
bright annealed or oxidized

Dimensions:
0.01 – 12.0 mm (0.0004 – 0.47 in.) diameter,
in coils, pay-off packs, on spools and spiders

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

Seamless tube and pipe
Using ThyssenKrupp VDM cast materials seamless tubes and pipes are produced and available from DMV STAINLESS Int. Sales, Tour Neptune, F-92086 Paris, La Defence Cedex (Fax: +33-1-4796 8126; Tel.: +33-1-4796 8128).

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

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