VDM Metals

A company of ACERINOX

VDM® Alloy 75
Nicrofer 7520

Material Data Sheet No. 4035 **Revision 01**
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Nicrofer 7520

The high-temperature VDM® Alloy 75 is a creep-resistant nickel-chromium-iron alloy with controlled carbon content and a small addition of titanium.

VDM® Alloy 75 is characterized by:

- Excellent resistance to oxidizing atmospheres at temperatures up to 1,100 °C (2,000 °F)
- High scaling resistance up to 1,000 °C (1,830 °F)
- Good mechanical properties at temperatures up to 1,000 °C (1830 °F)
- Good metallurgical stability

Designations and standards

Standard	Material designation
DIN EN	2.4951 - NiCr20Ti
UNS	N06075
ISO	NiCr20Ti

Product form	DIN EN	ISO
Sheet, plate	17750	6208
Strip	17750	6208
Rod, bar	17752	9723
Wire		9724

Table 1 – Designations and standards

Chemical composition

	Ni	Cr	Fe	C	Mn	Si	Cu	Al	Ti
Min.	bal.	19.0		0.08		0.3			0.2
Max.		21.0	5.0	0.13	1.0	0.7	0.5	0.3	0.6

Table 2 – Chemical composition (%) according to DIN EN 17742

Physical properties

Density	Melting range	Relative magnetic permeability at 20 °C (68 °F)
8.4 g/cm³	1,340 – 1,380 °C	≤ 1.001
0.303 lb/in³	2,440 – 2,520 °F	

Temperature		Specific heat		Thermal conductivity		Electrical resistivity	Modulus of elasticity		Coefficient of thermal expansion	
°C	°F	J / kg · K	Btu / lb · °F	W / m · K	Btu · in / sq. ft · h · °F	μΩ · cm	GPa	10³ ksi	10^{-6} / K	10^{-6} / °F
0	32									
20	68	445	0.106	12.1	84	109	221	32.0		
93	200		0.110		94			31.5		6.4
100	212	465		13.7		110	217		11.7	
200	392	490		15.6		112	211		12.6	
204	400		0.117		108			30.5		7.0
300	572	515		17.1		115	204		13.2	
316	600		0.124		120			29.4		7.4
400	752	540		18.8		117	197		13.8	
427	800		0.131		134			28.3		7.7
500	932	570		20.5		117	190		14.3	
538	1,000		0.138		147			27.1		8.1
600	1,112	600		22.6		115	182		14.8	
649	1,200		0.146		164			25.8		8.4
700	1,292	620		24.5		115	174		15.4	
760	1,400		0.152		178			24.4		8.7
800	1,472	650		26.4		115	165		16.0	
871	1,600		0.160		192			22.8		9.1
900	1,652	675		28.1		115	154		16.6	
982	1,800		0.166		205			20.7		9.6
1,000	1,832	700		29.9		116	140		17.5	

Table 3 – Typical physical properties at room and elevated temperatures

Microstructural properties

VDM® Alloy 75 has a face-centered cubic lattice. Chromium carbides, nitrides and carbonitrides can occur in the matrix.

Mechanical properties

The following properties are applicable to VDM® Alloy 75 in the solution-treated condition and indicated size ranges. Specified properties of material outside these size ranges are subject to special enquiry.

Form	Dimensions		Yield strength $R_{p\ 0.2}$		Yield strength $R_{p\ 1.0}$		Tensile strength R_m		Elongation A	Hardness Brinell
	mm	in	MPa	ksi	MPa	ksi	MPa	ksi	%	HB
Plate	≤ 20	≤ 0.8	240	34.8	270	39.2	650	94.3	25	≤ 230
Sheet, strip	≤ 2.5	≤ 0.1	240	34.8	270	39.2	650	94.3	25	≤ 230
Rod, bar	≤ 100	≤ 4	240	34.8	270	39.2	650	94.3	25	≤ 230
Forgings (cross section)	≤ 8,000 mm^2	≤ 124 in^2	240	34.8			650	94.3	25	≤ 230

Table 4 – Minimum mechanical properties at room temperature according to DIN 17750/51/52/54

Temperature		Plate, Sheet, Strip					Rod, bar, forgings				
		Yield strength $R_{p\ 0.2}$		Tensile strength R_m		Elongation A	Yield strength $R_{p\ 0.2}$		Tensile strength R_m		Elongation A
°C	°F	MPa	ksi	MPa	ksi	%	MPa	ksi	MPa	ksi	%
93	200		65		116	30		38		102	40
100	212	450		800		30	260		700		40
200	392	445		790		30	230		680		40
204	400		64		115	30		33		99	40
300	572	435		780		30	225		680		41
316	600		62		112	30		32		99	41
400	752	425		750		30	220		675		42
427	800		62		107	30		32		97	41
500	932	400		680		30	220		660		40
538	1,000		56		94	30		32		92	40
600	1,112	350		580		30	220		600		40
649	1,200		44		73	35		31		79	43
700	1,292	250		400		40	200		470		53
760	1,400		25		38	60		24		49	65
800	1,472	130		200		85	130		270		70
871	1,600		12		18	85		12		25	65
900	1,652	70		110		85	70		140		61
982	1,800		6		10	77		6		13	57
1,000	1,832	30		60		75	30		80		55

Table 5 – Typical short-time mechanical properties of VDM® Alloy 75 at elevated temperatures and in the solution-treated condition

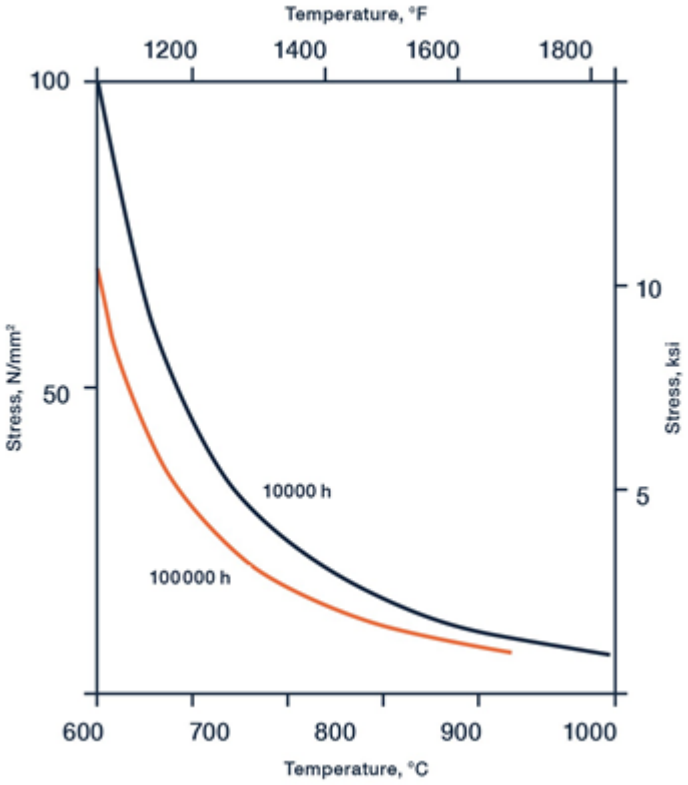

Figure 1 – Typical creep-rupture properties of VDM® Alloy 75, solution treated

Corrosion resistance

VDM® Alloy 75 shows excellent oxidation and scaling resistance up to 1,100 °C (2,000 °F). It forms an adherent oxide layer which protects the surface against progressive attack.

Applications

The high scaling resistance and good creep properties of VDM® Alloy 75 give it wide application in high-temperature service up to 1,100 °C (2,000 °F).

Typical fields of application for VDM® Alloy 75 are:

- components for industrial and aircraft gas turbines (casings, combustion chambers, ducting)
- industrial furnace components
- high temperature fasteners, springs, dies and cores
- thermocouple sheathing

Fabrication and heat treatment

VDM® Alloy 75 is readily fabricated by usual industrial procedures. Hot and cold working, however, require high-power machines, owing to the high strength of the material. The weldability of VDM® Alloy 75 is good. Joining can be performed by all conventional welding processes.

Heating

It is very important that the workpiece be clean and free from any contaminant before and during heating. VDM® Alloy 75 may become embrittled if heated in the presence of contaminants such as sulphur, phosphorus, lead and other low-melting-point metals. Sources of contamination include marking and temperature-indicating paints and crayons, lubricating grease and fluids, and fuels. Fuels must be low in sulphur; e.g. natural and liquefied petroleum gases should contain less than 0.1 % by mass and town gas 0.25 g/m³ maximum of sulphur. Fuel oils containing no more than 0.5% by mass of sulphur are satisfactory. Electric furnaces are desirable due to close control of temperature and freedom from contamination. Gas-fired furnaces are acceptable if impurities are at low levels. The furnace atmosphere should be neutral to slightly oxidizing and must not fluctuate between oxidizing and reducing. Flame impingement on the metal must be avoided. In all heating operations the material may be charged into the furnace at temperature.

Hot forming

VDM® Alloy 75 may be hot-worked in the range 1,220 to 900 °C (2,230 to 1,650 °F). Cooling should be by water quenching or as fast as possible. Heat treatment is required after hot working to ensure maximum creep resistance and optimum properties. The material may be charged into the furnace at maximum working temperature. After soaking for the required time the metal should be withdrawn immediately and worked within the specified range. If the metal temperature falls below the minimum working temperature, it must be reheated.

Cold forming
Cold working should be carried out on heat-treated material. VDM® Alloy 75 has a higher work-hardening rate than austenitic stainless steel, and the forming equipment must be designed accordingly. When heavy cold working is performed, interstage annealing may become necessary.

Heat treatment
Heat treatment should be carried out in the temperature range 1,000 to 1,050 °C (1,830 to 1,920 °F). Water quenching is desirable for maximum creep resistance. Interstage annealing may be performed at temperatures up to 1,050 °C (1,920 °F). During any heating operation the precautions outlined earlier regarding cleanliness must be observed.

Descaling and pickling
Oxides of VDM® Alloy 75 are more adherent than those of stainless steel. Both mechanical and chemical methods of descaling may be applied. Mechanical methods should be avoided which produce either contamination of the metal, or a highly-deformed surface layer. Before pickling in a nitric/hydroflouric acid mixture, oxides must be broken up by grit-blasting or by pretreatment in a fused salt bath.

Machining
VDM® Alloy 75 should be machined in the heat-treated condition. The alloy´s high work-hardening rate shoud be considered; i.e. only low surface cutting speeds are possible compared with low-alloy standard austenitic stainless steel. Tools should be engaged at all times. Heavy feeds are important in getting below the work-hardened 'skin'.

Welding information

VDM® Alloy 75 can be welded by all conventional processes, including gas tungsten-arc (GTAW/TIG), gas metal-arc (GMAW/MIG) and shielded metal-arc welding (SMAW/MMA). Pulsed arc welding is the preferred technique. Prior to welding, material should be in the heat-treated condition, clean and free from scale, grease, marking paints etc. A zone approximately 25 mm (1 in) wide on each side of the joint should be ground to bright metal. Low heat input is necessary. Interpass temperature should not exceed 120 °C (250 °F). Neither pre- nor post-weld heat treatment is required.

The following welding products are recommended:

GTAW/GMAW	VDM® FM 82 (2.4806) DIN EN ISO 18274: S Ni 6625 (SG-NiCr20Nb) AWS A 5.14 ERNiCr-3
SMAW	VDM® CW 182 (2.4648) EL-NiCr19Nb AWS A 5.14 ENiCr-3

Availability

VDM® Alloy 75 is available in all standard mill product forms.

Plate, sheet

Delivery condition: Hot or cold rolled, annealed, de-scaled resp. pickled

Condition	Thickness mm (in)	Width mm (in)	Length mm (in)	Piece weight kg
Cold rolled	1 – 7 (0.04 – 0.28)	1,000 – 2,500 (39.4 – 98.43)	≤ 12,500 (492.13)	
Hot rolled	3 – 100 (0.12 – 3.94)[1)]	1,000 – 2,500 (39.4 – 98.43)	≤ 12,500 (492.13)	≤ 2,700 (106.3)[2)]

[1)] 2 mm thickness on request
[2)] Piece weights up to 4,500 kg on request

Strip

Delivery condition: Cold-rolled, heat-treated, pickled or bright annealed

Thickness mm (in)	Width mm (in)	Coil – inside diameter mm			
0.02 – 0.15 (0.0008 – 0.006)	4 – 230 (0.16 – 9.06)	300	400	500	–
0.15 – 0.25 (0.006 – 0.01)	4 – 720 (0.16 – 28.34)	300	400	500	–
0.25 – 0.6 (0.01 – 0.024)	6 – 750 (0.24 – 29.5)	–	400	500	600
0.6 – 1 (0.024 – 0.04)	8 – 750 (0.32 – 29.5)	–	400	500	600
1 – 2 (0.04 – 0.08)	15 – 750 (0.6 – 29.5)	–	400	500	600
2 – 3 (0.08 – 0.12)	25 – 750 (0.98 – 29.5)	–	400	500	600

Rolled sheet – separated from the coil – are available in lengths from 250 to 4,000 mm (9.84 to 157.48 in).

Rod

Delivery condition: Forged, rolled, drawn, heat-treated, oxidized, de-scaled or pickled, machined, peeled, ground or polished

Condition	Outside diameter mm (in)	Length mm (in)
Rolled, drawn	6 – 125 (0.24 – 31.5)	≤ 12,000 (472.44)
Forged	125 – 600 (0.47 – 23.62)	≤ 7,500 (295.28)

Wire

Delivery condition: bright drawn, ¼ hard to hard, bright annealed in rings, containers, on spools and headstocks

Drawn mm (in)	Hot rolled mm (in)
0.16 – 10 (0.006 – 0.4)	5.5 – 19 (0.22 – 0.75)

Legal notice

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