VDM Metals

A company of ACERINOX

VDM® Aluchrom W

Aluchrom W

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VDM® Aluchrom W is a ferritic chrome steel containing aluminum. By virtue of the high concentrations of aluminum and chromium, in combination with zircon, the alloy stands out for its good high-temperature resistance.

VDM® Aluchrom W is characterized by:
- good isothermal and cyclical oxidation resistance

Designations

Standard	Material designation
EN	1.4725 – X8CrAl14-4
UNS	K91670

Standards

Product form	ASTM	DIN
Strip	B603	17470
Wire	B603	17470

Table 1 – Designations and standards

Chemical composition

	C	Cr	Fe	S	Mn	Si	P	Al	Zr
Min.		13.0	Bal.					3.75	
Max.	0.10	15.0		0.030	1.00	0.50	0.045	4.75	0.30
Due to technical reasons the alloy may contain additional elements									

Table 2 – Typical chemical composition (%)

Physical properties

Density	Melting range	Relative magnetic permeability at 20 °C (68 °F)
7,3g/ cm³ at 20 °C 456 lb/ft³ at 68 °F	1,500 °C 2,730 °F	The alloy is magnetic

Temperature		Specific heat capacity		Thermal conductivity		Electrical resistivity	Coefficient of thermal expansion	
°C	°F	J / kg · K	Btu / lb · °F	W / m · K	Btu · in / sq. ft · h · °F	µΩ · cm	10^{-6} / K	10^{-6} / °F
20	68	480	0.115	15	104	125		
100	212					126		
200	392					127		
300	572					128		
400	752					130	12	6.67
500	932					132		
600	1,112					134		
700	1,292					136		
800	1,472					139	14	7.78
900	1,652					141		
1,000	1,832	650	0.155			142	15	8.33
1,100	2,012					144		

Table 3 – Typical physical properties at room and elevated temperatures

Microstructural properties

VDM® Aluchrom W has a cubic body-centered crystal structure.

Mechanical properties

The following mechanical properties apply to VDM® Aluchrom W in the soft-annealed condition.

Temperature		Yield strength[1] $R_{p\ 1,0}$		Tensile strength R_m	
°C	°F	MPa	ksi	MPa	ksi
20	68			600	87
600	1,112	16	2.32		
700	1,290	8	1.16		
800	1,472	4	0.58		
900	1,652	2	0.29		
1,000	1,832	0.8	0.116		

Table 4 – Typical mechanical properties in the annealed condition; 1) Creep limit according to DIN 17470

Temperatur		Nominal diameter resp- thickness		Elongation A
°C	°F	mm	in	%
20	68	0,02-0,063	0.000787-0.00248	8
20	68	0,063-0,125	0.00248-0.0049	10
20	68	0,125-0,5	0.0049-0.019	14
20	68	0,5-1	0.019-0.039	14
20	68	>1	> 0.039	18

Table 5 – Typical mechanical properties in the annealed condition (elongation at fracture (L0=100 mm) % with nominal diameter/thickness in mm

Corrosion resistance

VDM® Aluchrom W is a ferritic chrome steel with an additional 3.75-4.75% aluminum. The upper application temperature of VDM® Aluchrom W in air is 1,000 °C (1,832 °F).

Up to the upper application temperature, resistance to

- Air and other gases containing oxygen: high
- Low-oxygen gases containing nitrogen: low
- Sulfurous gases, oxidizing: high
- Sulfurous gases, reducing: high
- Carburization: high

Applications

VDM® Aluchrom W is used in:

- Components for high-temperature load resistors
- Components for braking and starting resistors
- Household devices

Fabrication and heat treatment

In the specified dimensions, VDM® Aluchrom W is ideally suited for processing with the common industrial processing techniques. After use in temperatures above 1,000°C (1,832 °F) and in the range between 400°C and 550°C (752 °F and 1,022) °F, cold embrittlement can occur.

Heating
Workpieces must be clean and free of any contaminants before and during heat treatment. Sulfur, phosphorus, lead and other low-melting-point metals can result in damage during the heat treatment of VDM® Aluchrom W. This type of contamination can be contained in marking and temperature display paints or pins, and also in lubricating grease, oils, fuels and similar materials. The sulfur content of fuels must be as low as possible. Natural gas should contain less than 0.1 wt.-% of sulfur. Heating oil with a sulfur content of maximum 0.5% in weight is also suitable. Heat treatment should preferably be carried out in electric furnaces under vacuum or shielding gas due to the precise temperature control and freedom of impurities. Heat treatment in air or in gas-heated furnaces are also acceptable, as long as impurities are at a low level so that a neutral and easily oxidizing furnace temperature can be set. A furnace temperature which alternates between oxidizing and reducing should be avoided. The workpieces should not come into direct contact with flames.

Cold forming
The workpieces should be in the annealed condition for cold forming. Intermediate annealing is necessary for major cold forming work. Oxidizing flat material can also be bent and cold formed. The internal bending diameter should be at least 3 x the sheet thickness.

Heat treatment
The annealing should be performed at temperatures above 800 °C (1,472 °F). Cooling down should be accelerated with water to achieve optimum properties. Thin strips can also be cooled rapidly in the air. The material must be placed in a furnace that has been heated up to the maximum annealing temperature before any heat treatment. For strip and wire products, the heat treatment can be performed in a continuous furnace at a speed and temperature that is adapted to the material thickness. The cleanliness requirements listed under "Heating" must be observed.

Descaling and pickling
High-temperature alloys develop a protective oxide layer in service. Pre-oxidation can improve the oxidation resistance in higher temperatures. The necessity for descaling must therefore be checked when placing the order. Oxides of VDM® Aluchrom W and heat tint in the area around welds adhere more strongly than in stainless steels. Should descaling be required, grinding using extremely fine abrasive belts or grinding discs is recommended. If pickling is required, which is usually done in saltpeter-hydrofluoric acid mixtures, the oxide layers must be destroyed by abrasive blasting or fine grinding or they must be pre-treated in salt baths. Particular attention must be paid to the pickling time and temperature of the pickle.

Machining
VDM® Aluchrom W should preferably be processed in the heat-treated condition. The processing parameters known for ferritic chrome steels must be used.

Welding information

When welding nickel alloys and special stainless steels, the following information should be taken into account:

Safety
The generally applicable safety recommendations, especially for avoiding dust and smoke exposure must be observed.

Although the welding VDM® Aluchrom W is not generally recommended as the joining method, the material can be welded for many applications, e.g. using the TIG or laser technique. In addition, soldering can be an alternative to welding. For welding, the material should be in the annealed condition and be free of scale, grease or markings. During welding, the greatest measure of cleanliness must be ensured and draft air has to be avoided. For welding VDM® Aluchrom W, the following general information should be taken into account for nickel alloys and special stainless steels.

Availability

VDM® Aluchrom W is available in the following semi-finished forms:

Strip

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

Thickness mm (in)	Width mm (in)	Coil-inside diameter mm (in)			
0,02-0,15 (0.000787-0.00591)	4-230 (0.157-9.06)	300 (11.8)	400 (15.7)	500 (19.7)	–
0,15-0.25 (0.00591-0.00984)	4-720 (0.157-28.3)	300 (11.8)	400 (15.7)	500 (19.7)	–
0,25-0,6 (0.00984-0.0236)	6-750 (0.236-29.5)	–	400 (15.7)	500 (19.7)	600 (23.6)
0,6-1 (0.0236 – 0.0393)	8-750 (0.315-29.5)	–	400 (15.7)	500 (19.7)	600 (23.6)
1-2 (0.00393-0.0787)	15-750 (0.590-29.5)				

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

Wire

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

Drawn (Outside diameter) mm (in)
0.16 – 4.5 (0.006-0.177)

Publications

The following technical literature has been published about the material VDM® Aluchrom W:

Coppolecchia V.D., Renner M., Rockel M.B.: "Corrosion Resistance of Stainless Steels and Nickel Alloys in Concentrated Sulfuric Acid" NACE CORROSION 1986, Paper No. 189, NACE Corrosion, Houston Texas, 1986.

Brill U., Heubner U.: "Werkstoffe für Metallträger von Automobil-Abgaskatalysatoren", Motortechnische Zeitschrift, Issue: 49, No. 9, 1988.

Hojda R., Fabio N.: "Improved Efficiency In Automotive Applications Through The Use Of Special Stainless Steels And Nickel Based Alloys ", IFHTES Italy, 2005.

Legal notice

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