Aluchrom I SE

Material Data Sheet No. 8002
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Aluchrom I SE is a ferritic chromium steel alloyed with rare earths and containing aluminium. The high aluminium and chromium contents in conjunction with rare earths give this alloy good high-temperature strength.

Aluchrom I SE is characterised by
- good isothermal and cyclic resistance to oxidation
- good heat resistance

Designation and standards

Country	Material designation	Specification			
		Chemical composisition	Strip		
Germany	**(W.-Nr. ~ 1.4767)** CrAl 22 5 (SE)	see Table 2	up to 2.0 mm		

Chemical composition (%)

		Ni	Cr	Fe	C	Mn	Si	Al	Ti	RE*	N
Aluchrom I SE	min	–	19.0	bal	–	–	–	4.5	–	0.01	–
CrAl 20 5 (SE)	max	0.30	21.0		0.10	0.50	0.50	5.5	0.10	0.10	0.02

* Rare earths

Aluchrom I SE

Physical properties
Typical physical properties at room and elevated temperatures.

Density	7.15 g/cm³	0.258 lb/in³
Melting temperature	approx. 1500 °C	2730 °F

Temperature T		Specific heat		Thermal conductivity		Electrical resistivity		Coefficient of thermal expansion between room temperature and T		Surface loading	
°C	°F	J/kg K	Btu / lb °F	W/mK	Btu in / ft² h °F	µ Ω cm	Ω circ mil / ft	10^{-6}/K	10^{-6} / °F	W/dm²	W / in²
20	**68**	460	0.110	13.0	90	138	830				
93	**200**						830		6.4		
100	212					138		11.5			
200	392					138		11.9			
204	**400**						830		6.6		
300	572					138		12.1			
316	**600**						830		6.7		
400	752					139		12.3			
427	**800**						839		6.8		
500	932					140		12.6			
538	**1000**						845		7.1		
600	1112					141		13.0			
649	**1200**						851		7.4		
700	1292					142		13.5			
760	**1400**						857		7.6		
800	1472					143		13.8		250–300	
871	**1600**						865		7.8		12.2–14.5
900	1652					144		14.2		170–200	
982	**1800**						866		8.2		9.0–10.6
1000	1832					144		14.8		130–160	
1093	**2000**								8.6		6.5– 9.0
1100	2012	630	0.151					15.5		100–140	
1148	**2100**										5.8– 8.2
1200	2192									80–120	
1204	**2200**										5.1– 7.7
1260	**2300**										4.5– 6.0
1300	2372									60– 80	
1316	**2400**										3.7– 4.8

Aluchrom I SE

Mechanical properties

for strip up to 2 mm thickness.

Temperature T		0.2 % Yield strength		1.0 % Yield strength		Tensile strength Rm		Elongation A5
°C	°F	N/mm²	ksi	N/mm²	ksi	N/mm²	ksi	%
20	**68**	490	71	510	74	660	96	min 20

Table 4 – Typical short-time properties of Aluchrom I SE strip of soft-annealed condition.

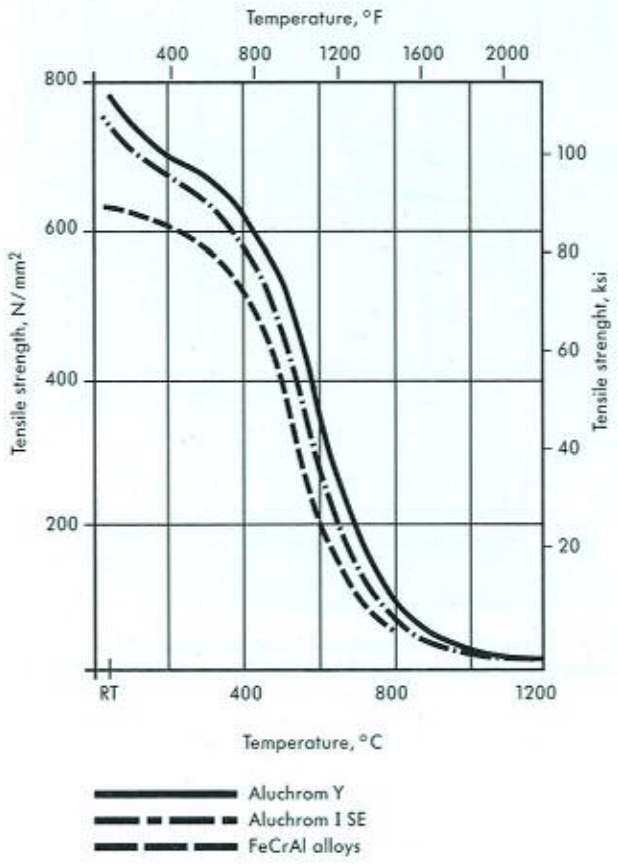

Fig. 1 – Comparison of typical tensile strengths in relation to temperature.

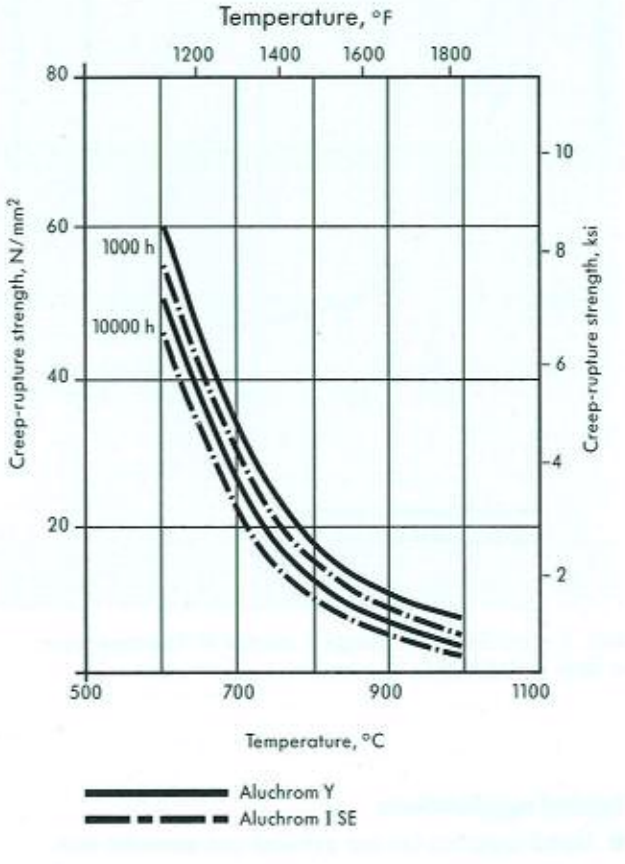

Fig. 2 – Comparison of typical creep-rupture strengths (10^3 and 10^4 hr) in relation to temperature.

Metallurgical structure

Aluchrom I SE has a body-centred cubic structure.

Corrosion resistance

Aluchrom I SE is a ferritic chromium steel with additions of approx. 5 % aluminium and approx. 0.05 % rare earths.

The good resistance of Aluchrom I SE to oxidation enables it to be used at temperatures of up to 1200 °C (2190 °F). Aluchrom I SE maintains this behaviour even under extreme conditions such as cyclic heating and cooling on account of its strongly adherent surface layer of aluminium oxide.

Aluchrom I SE

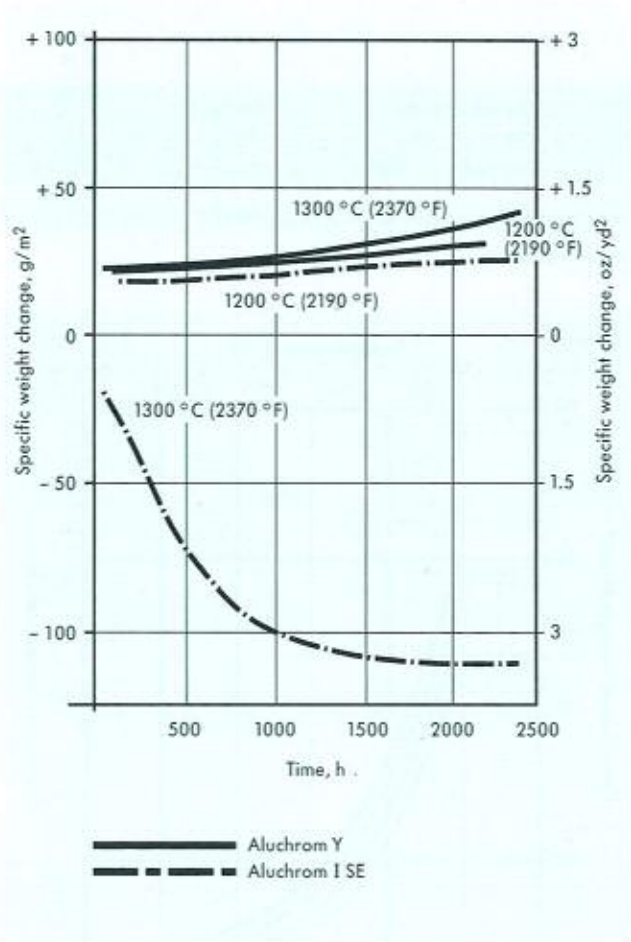

Abb. 3 – Specific weight change in relation to the temperature in cyclic testing in air.

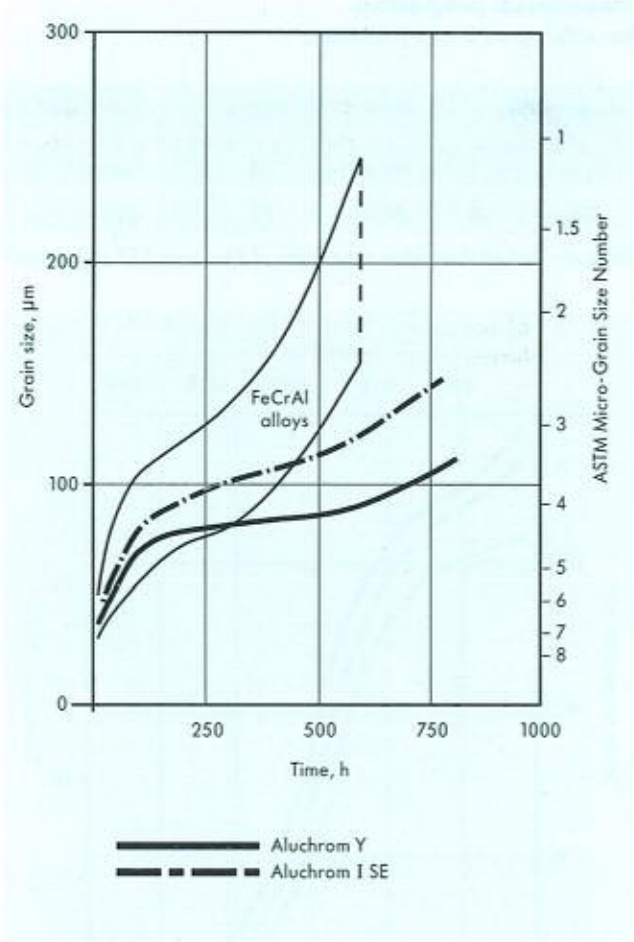

Fig. 4 – Grain growth of Aluchrom Y and Aluchrom I SE in comparison with conventional FeCrAl alloys at 1050 °C (1920 °F).

Typical applications

- Metal supports for car exhaust gas catalytic converters

Aluchrom I SE

Fabrication and heat treatment
Aluchrom I SE is readily fabricated by conventional industrial techniques.

It is important that the workpiece be clean and free from any contaminant before and during heat treatment.

The presence of sulphur, phosphorus, lead and other low-melting-point metals may lead to damage during heat treatment of Aluchrom I SE.

Sources of such contamination include marking and temperature-indicating paints and crayons as well as lubricating grease, oils, fuels and the like.

Fuels should be as low in sulphur as possible. Natural gas should have a sulphur content of less than 0.1 wt%. Fuel oil with a content of max 0.5 wt% is also suitable.

The use of electric furnaces is desirable due to their close control of temperature and freedom from contamination.

Gas-fired furnaces are acceptable if impurities are kept at low levels.

The furnace atmosphere should be neutral to slightly oxidising and must not fluctuate between oxidising and reducing. Flame impingement on the workpiece must be avoided.

Hot working
Aluchrom I SE should be hot-worked in the range 1050 to 850 °C (1920 – 1560 °F), followed by rapid water quenching or air cooling; in particular, rapid passage through the temperature range 560 – 400 °C (1040 – 750 °F) should be ensured.

The preferred temperature range for hot bending is 200 – 300 °C (390 – 570 °F). Temperatures in excess of 400 °C (750 °F) should be avoided.

Cold working
With cold working operations involving severe deformation, interstage annealing is necessary.

Renewed soft annealing is necessary after cold working operations involving 30% or more deformation.

Heat treatment
Heat treatment should be carried out in the temperature range 760 – 900 °C (1400 – 1650 °F), preferably at 800 °C (1470 °F).

Rapid water quenching is desirable for optimum properties. With small dimensions, rapid cooling is also suitable.

During any heat treatment operation, the precautions outlined earlier regarding cleanliness should be observed.

Descaling
High-temperature materials develop protective oxide layers under service conditions. The necessity of descaling should therefore be examined.

Oxides of Aluchrom I SE are more adherent than those on stainless steels. If descaling is necessary, grinding with very fine abrasive belts or discs is recommended.

Machining
Aluchrom I SE should preferably be machined in oxide-free condition.

The well-known machining parameters for ferritic chromium steels may be used.

Joining
Aluchrom I SE can be welded by the GTAW (TIG) process.

Prior to welding, the material should be in the soft-annealed condition and free from scale, grease or markings. A zone approximately 25 mm (1 in) wide on each side of the joint should be ground to bright metal. Any tarnishing can often be removed by brushing the joint while still warm. Painstaking attention to cleanliness is required during welding.

Low heat input and rapid heat dissipation are necessary. Interpass temperatures should not exceed 150 °C (300 °F).

Neither pre- nor post-weld heat treatment are necessary.

The use of a matching filler metal is recommended.

Aluchrom I SE

Availability
Aluchrom I SE is available in strip form.

Strip*
Condition:
cold rolled and bright annealed or oxidised

Thickness mm		Width mm		Coil I D mm			
0.04	≤ 0.10	30 – 120	100	300			
> 0.10	≤ 0.20	4 – 200		300	400		
> 0.20	≤ 0.25	4 – 400		300	400		
> 0.25	≤ 0.60	5 – 635		300	400		
> 0.60	≤ 1.0	8 – 635			400	500	
> 1.0	– 2.0	15 – 635			400	500	600

inches		inches		inches			
0.0016	≤ 0.004	1.20 – 5	4	12			
> 0.004	≤ 0.008	0.16 – 8		12	16		
> 0.008	≤ 0.010	0.16 – 16		12	16		
> 0.010	≤ 0.024	0.20 – 25		12	16		
> 0.024	≤ 0.04	0.32 – 25			16	20	
> 0.04	– 0.08	0.60 – 25			16	20	24

* cut-to length available in lengths from 500 to 3000 mm (20 to 120 in)

Technical publications
The following technical publications by Krupp VDM GmbH have appeared in connection with Aluchrom I SE:

U. Brill
Metallic Materials for Automotive Exhaust Gas Catalyst Supports, International Conf. on Stainless Steels 1991, Chiba, Japan

U. Brill, G. Cloppenburg
Catalytic converter strip from Krupp VDM, an innovative product for invironment-friendly motor vehicles, Technische Mitteilungen Krupp (English edition) 1/1995, pp. 35–38

U. Brill, U. Heubner
Werkstoffe für Metallträger von Automobil-Abgas-katalysatoren, MTZ Motorentechnische Zeitschrift 49, Heft 9 (1988). pp. 365–368

U. Brill, U. Heubner
Werkstoffe für Metallträger von Automobil-Abgas-katalysatoren, Stahl im Automobilbau, international trade conference, Würzburg, 24-26 September 1990

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