GENERAL INFORMATION

Fechroma®15 – it is the ferritic chrome-plated steel on the basis of iron, alloyed with rare-earth metals and which containes aluminum.
Alloy has high thermal stability due to high content of aluminum and chrome in combination with rare-earth metals.
Main characteristics of Fechroma®15:
- good isometric and cyclic resistance to oxidizing processes;
- good heat resistance.

Classification

DIN	1.4767 (CrAl20 5)
UNS	K 92400*

* closest specification

Chemical composition, %

Cr	Fe	Al	C
14.0-16.0	rest	4.5-5.5	≤0.05
Mn	**Si**	**Ni**	**S**
≤0.50	≤0.50	0.30	≤0.015

Mechanical properties at 20°C

Diameter, mm	Elongation,% not less	Tensile strength, MPa
0,12 – 0,5	10	
0,5 – 1,00	10	637-784
1,0 – 12,0	12	

PHYSICAL PROPERTIES

Temperature, °C	Resistance μΩm	Exten. 10^{-6}/K
20	1,35	-
200	1,36	11,0
400	1,37	12,0
500	1,39	-
600	1,40	13,0
800	1,42	14,0
1000	1,44	15,0
1200	1,44	-

Short-term mechanical properties of strip Fechroma®15 with thickness up to 2 mm after soft annealing

Temperature (T)		Yield strength, $\sigma_{0,2}$		Yield strength, $\sigma_{0,1}$		Tensile strength, $\sigma_в$		Elongation, δ_{50}
°C	°F	N/mm²	Ksi	N/mm²	Ksi	N/mm²	Ksi	%
20	68	490	71	510	74	660	74	min 20

PROCESSING AND THERMAL PROCESSING

Fechroma®15 can be easily processed by usual industrial technologies. The processed products have to be both cleaned and not contain any impurity before and during heat treatment.
Sulfur, phosphorus, lead and others, metals with a low temperature of melting at heat treatment of Fechroma®15 can cause damages. Marking and thermometric paints and pencils, lubricants, liquids and combustible materials can be a source of similar impurity. Fuel has to contain as little sulfur as possible. Natural gas has to contain no more than 0,1% of sulfur mass, and content of sulfur in liquid fuel has to be not higher than 0,5% on weight.
Carrying out heat treatment in electric furnaces is recommended (in a vacuum or inert gas) since in this case it is possible to provide exact control of parameters of temperature and to guarantee lack of impurity.
Gas furnaces are also acceptable, on condition of the low content of impurity and establishment of neutral atmosphere of furnace or slightly oxidizing. It is necessary to avoid fluctuation of the atmosphere of the furnace between oxidizing and recovery, and also to avoid direct impact of flame on metal.

HOT DEFORMATION

Fechroma®15 has to be hot deformed in the range of temperatures 1050-850°C (1920-1560°F) with the subsequent cooling in water or on air, and passing of a temperature interval 560-400°C (1040-750°F) has to be carried out fast.
The thermal bend is carried out preferably at a temperature of 200-300°C. It is necessary to avoid the top temperature of 400°C-750°C (390-570°F).

COLD DEFORMATION

At essential deformations intermediate annealings are necessary.
After cold deformation by reduction at the level of 30% of product it is demanded to repeat softening annealing.

HEAT TREATMENT

Heat treatment is carried out at temperature 760-900°C (1400-1680°F), preferable temperature is 800°C (1470°F). Quenching in water is necessary for obtaining optimum properties. At the small sizes of a product it is possible to carry out forced air cooling.
When carrying out any heat treatment it is necessary to observe the requirements about product purity specified earlier.

SCALE REMOVAL

Heat resisting materials create in use protective oxide layers. Therefore need of removal of scale has to be coordinated.

Fechroma®15 scale keeps stronger, than at stainless steel. If SCALE REMOVAL is obligatory, then grinding is recommended by a fine-grained tape, a grinding wheel.

MACHINING

Fechroma®15 has to be machined in non-oxide condition.
For ferriferous chrome steel uses the standard parameters of machining.

PROCESSING PROPERTIES

Melting point	1500°C
Density	7,1 g/cm^3
Heat conductivity	46,1 W/m·K
Elastic modulus	210 KN/mm^2
Maximal work temperature	1270°C
Operating time	3500 hours

DELIVERY CONDITION

Fechroma®15 is delivered in shape of wire and strip
Strip*

Delivery condition:
Cold-rolled oxidized with bright annealing or oxidizing

Thickness, mm	Width, mm	Coils inner Ø, 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

WELDING

Fechroma® 15 it can be welded by SMAW technology.
For material could be welded, it has to be in the annealed condition and cleaned from scale, fat and marking. The zone in radius of 25 mm on both sides of a seam is grinded to metal gloss. In many cases annealing colors can be removed with brushes so far material is in a warm condition. During welding an indispensable condition is high degree of purity.

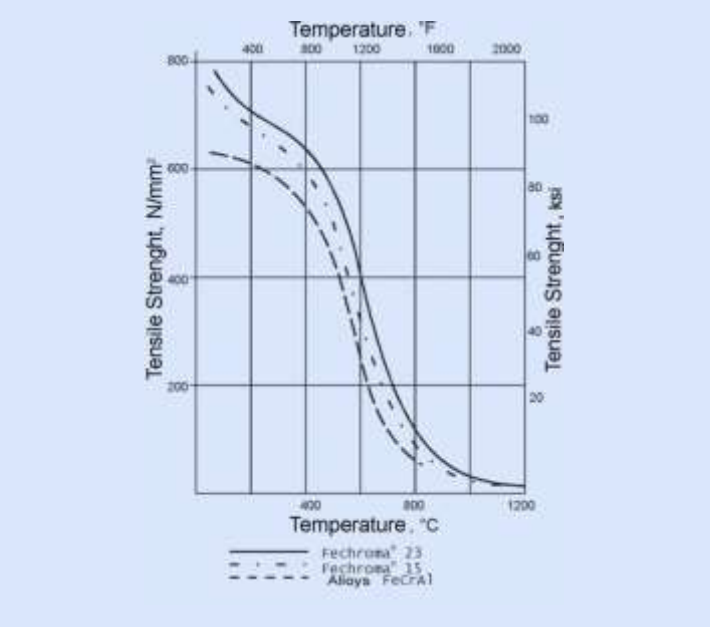
Both the low supply of heat, and the forced heat removal is necessary. Intermediate temperature shouldn't exceed 150°C.

Preliminary and subsequent heat treatments aren't carried out.

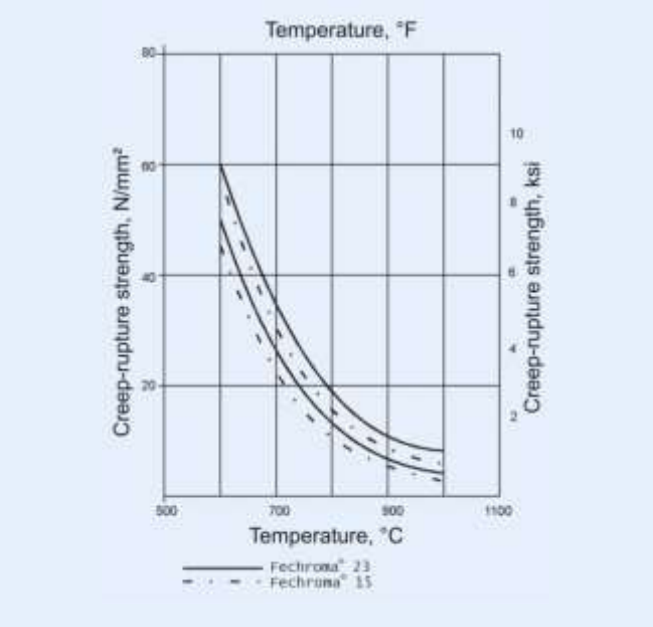
It is desirable to use auxiliary materials, which corresponds to welding.

CREEP CHARACTERISTICS

Temperature, °C	Creep resistance, 10^{-6}/K
600	40
800	15
1000	6
1200	1



Pic.1 – Comparison of typical tensile strengths depending on temperature



Pic.2 – Comparison of typical creep-rupture strength (10^3 and 10^4 hour)

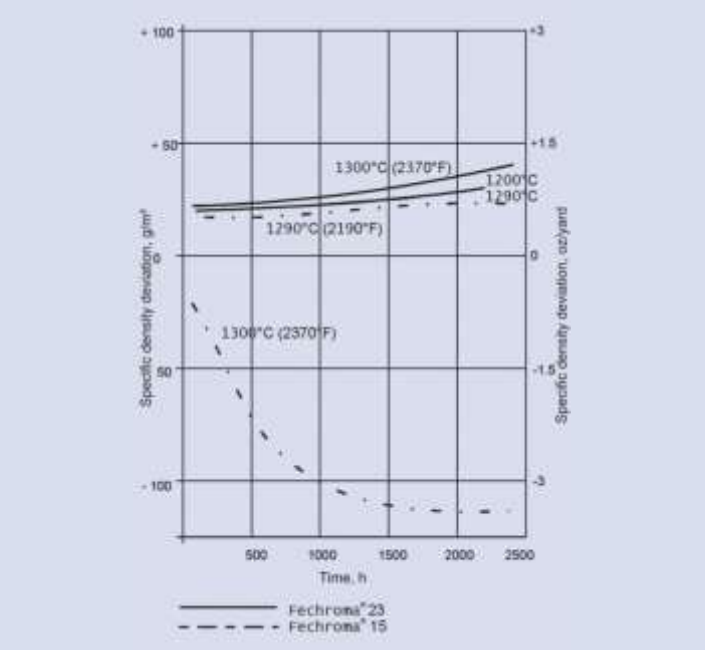
Metallurgical structure

Fechroma®15 has body-centered cubic lattice.

Corrosion resistance

Fechroma®15 – it is ferrito-chromic alloy on an iron basis with addition about 5% on the mass of aluminum and about 0,05% on the mass of rare-earth metals.

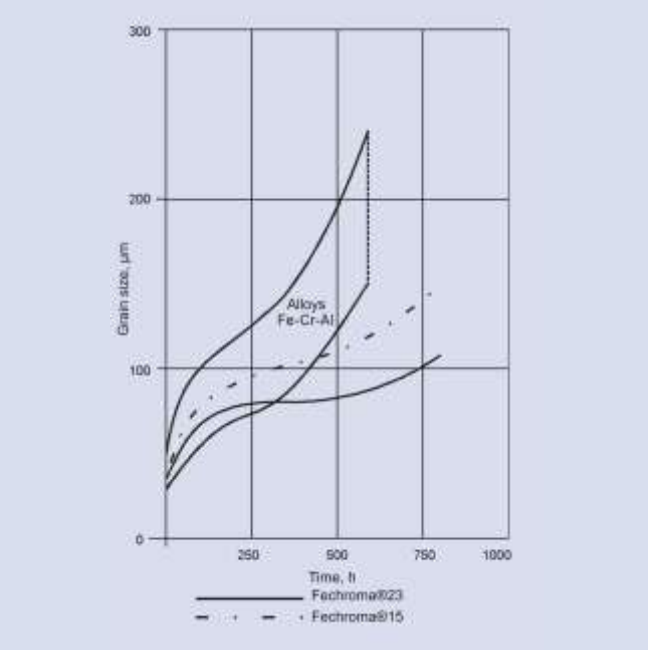
Resistance to oxidation allows to apply products from Fechroma®15 at temperatures up to 1200°C. Even under extreme conditions as cyclic heating and cooling, qualities of Fechroma®15 remain due to oxide layer of aluminum.



Pic. 3 – Change of specific weight depending on temperature at cyclic testing on air.

Typical application

Change of specific weight depending on temperature at cyclic testing on air.



Pic. 4 – Increase of grain Fechroma®23 and Fechroma®15 in comparison with traditional FeCrAl alloys at 1050°C

Temperature		Specific heat		Heat conductivity		Electrical resistance		Expansion coefficient from 20°C to T		Surface load	
°C	°F	J/kg K	Btu/lb °F	W/m·K	$\frac{\text{Btu In.}}{\text{Ft h °F}}$	μΩcm	$\frac{\Omega\text{circ mil}}{\text{ft}}$	10^{-6}/K	10^{-4}/°F	W/in^2	W/in^2
0	32										
20	68	460	0,110	13	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		7,8		
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	1653					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