

# 1.4724

X10CrAlSi 13

## Stainless heat resistant ferritic chromium steel with aluminium addition

C max. 0.12 Si 0.70 – 1.40 Cr 12.0 – 14.0 Al 0.70 – 1.20

**General comments** FERROTHERM® 4724 is a heat resistant, ferritic stainless steel which is characterised by its resistance sulphur bearing gasses. Due to its lower chromium content, FERROTHERM® 4724 is not as resistant to high temperature oxidation as FERROTHERM® 4742.

<b>Relevant current and obsolete standards</b>	EN 10088-3	1.4724	X10CrAlSi13
	EN 10095	1.4724	
	AFNOR	Z10C13	
	SEW 470	1.4724	

<b>General properties</b>	corrosion resistance	average
	mechanical properties	average
	forgeability	good
	weldability	limited
	machinability	average

**Special properties** resistant to scaling in air up to 850 °C

<b>Physical properties</b>	density (kg/dm <sup>3</sup> )	7.70
	electrical resistivity at 20 °C (Ω mm <sup>2</sup> /m)	0.75
	magnetizability	yes
	thermal conductivity at 20 °C (W/m K)	21
	at 500 °C (W/m K)	23
	specific heat capacity at 20 °C (J/kg K)	500
	melting point (°C)	approx. 1420
	thermal expansion (K <sup>-1</sup> )	20 – 200 °C: 10.5 x 10 <sup>-6</sup> 20 – 400 °C: 11.5 x 10 <sup>-6</sup> 20 – 600 °C: 12.0 x 10 <sup>-6</sup> 20 – 800 °C: 12.5 x 10 <sup>-6</sup>

**Typical applications** high temperature nozzles and jets  
high temperature conveyor systems  
mechanical engineering  
furnace engineering, grills  
chains

<b>Processing properties</b>	automated machining	seldom
	machinable	seldom
	hammer and die forging	yes
	cold forming	yes
	cold heading	not common

**Conditions** solution annealed

**Demand tendency** rising

**High temperature corrosion resistance** FERROTHERM® 4724 is resistant to oxidising sulphur bearing gases and displays somewhat less, but still good, resistance to sulphur bearing gasses in reducing environments. FERROTHERM® 4724 displays poor resistance to carburising gasses, and is also not resistant to high temperature nitriding, oxygen denuded gasses. This grade of steel is resistant to scaling in air up to temperatures of 850 °C.

**Heat treatment and mechanical properties** Optimal material properties are realised after annealing by holding in the temperature range 800 °C – 860 °C\*, followed by rapid cooling in air or water. In this condition the following mechanical properties can be expected when testing in the longitudinal direction at room temperature:

\* When heat treatment is performed in a continuous furnace, the upper temperature must be aimed for and in some cases can even be exceeded.

Property		Specification	Typical
yield strength (N/mm <sup>2</sup> )	R <sub>p0.2</sub>	≥ 250	360
tensile strength (N/mm <sup>2</sup> )	R <sub>m</sub>	450 – 650	660
tensile elongation (%)	A <sub>5</sub>	≥ 15	510
hardness	HB	≤ 192	



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A slight tendency for grain growth and embrittlement exists at above temperatures of 950 °C. It must be noted that any properties that are adversely affected by grain coarsening occurs cannot be recovered by simple thermal treatments.

The moderate chromium content and fully ferritic microstructure of this steel makes it susceptible to 475 embrittlement when held at temperatures within the range 400 °C to 550 °C. Slow heating or cooling through this temperature range should thus be avoided. The effects of 475 embrittlement can be reversed by briefly heating to within the temperature range 700 °C to 800 °C. This steel is also susceptible to embrittlement by sigma phase formation within the temperature range 600 °C to 800 °C over long periods of time. The effects of sigma phase formation may be reversed by heating to above 1050 °C to take all of the sigma phase into solution again.

The mechanical properties (d ≥ 160 mm) have to be agreed on for thicker dimensions, or the delivered product is based on the values given.

## Elevated temperature properties

Due to the much poorer high temperature mechanical properties of FERROTHERM® 4724, compared to the heat resistant austenitic grades, this steel can only be used in applications where the high temperature mechanical requirements are not too great.

## Welding

FERROTHERM® 4724 is weldable using all usual welding processes with preheating to a temperature between 200 °C and 300 °C, being recommended. Low heat inputs should be used when welding to reduce any possible grain coarsening effects. Although post weld heat treatment is not necessary, a stress relief treatment is sometimes performed in the temperature range 750 °C to 800 °C, followed by air cooling, when large differences in cross-section exist and/or when the components have been extensively cold worked.

Novonit® 4723, 4820 and 4829 are all suitable for use as filler material when welding FERROTHERM® 4724.

## Forging

Forging is usually performed at 1150 °C – 800 °C followed by rapid cooling in air or water. Generally, forging is followed by the heat treatment described previously.

## Machining

Ferritic stainless steels such as FERROTHERM® 4724 tend to smear during machining which results in the formation of longer swarf thereby making machining difficult. When machining this grade of steel with coated hard metal cutting/machining tools, the following machining parameters can be used as a guideline:

	Depth of cut (mm)	6	3	1
	Feed rate (mm/r)	0.5	0.4	0.2
<b>Solution annealed R<sub>m</sub> 450 – 550 N/mm<sup>2</sup></b>	Cutting speed (m/min)	140	170	240