

C: max. 0,20
Cr: 19,0 - 21,0
Ni: 11,0 - 13,0
Si: 1,5 - 2,5

FERROTHERM®
4828
X15CrNiSi 20 12

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Stainless heat resistant austenitic Chromium Nickel Steel

Relevant current and obsolete standards:

- EN 10095 : 1.4828 X15CrNiSi 20 12
- AISI : similar 309
- BS : similar 309 S 24
- JIS : similar SUH 309
- AFNOR : Z 17 CNS 20-12
similar Z 9 CN 24-13
- DIN : 1.4828
- SEW 470 : 1.4828 X15CrNiSi 20 12
- UNS: similar S30900
- SAE J 405 : similar 30309
- ISO – H13 : X15CrNiSi 20 12

General properties

- corrosion resistance : low
- mechanical properties : medium
- forgeability : good
- weldability : good
- machinability : good

Special properties

- resistant to scaling in air up to 1000 °C

Physical properties

- density (kg/dm³) : 7,9
- electrical resistivity at 20°C (Ω mm²/m) : 0,85
- magnetisable : not possible
- thermal conductivity at 20°C (W/m K) : 15
- thermal conductivity at 500°C (W/m K) : 21
- specific heat capacity at 20°C (J/kg K) : 500
- thermal expansion (10⁻⁶K⁻¹) between
- 20 and 200°C : 16,5
- 20 and 400°C : 17,5
- 20 and 600°C : 18,0
- 20 and 800°C : 18,5
- 20 and 1000°C : 19,5

Typical applications

- construction of high temperature components
- automotive engineering
- chains, screens and mesh
- mechanical engineering
- furnace engineering

Processing properties

- automated machining : unusual
- machinable : yes
- hammer and die forging : yes
- cold forming : yes
- cold heading : yes

Product forms and conditions

- wire rod
- bars Ø 20 - 60
- bright wire h9, Ø 4 - 20
- solution annealed
- pickled
- drawn
- straightened
- peeled
- ground

Demand tendency

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Properties, applications and processing

Ferrotherm® 4828 is a standard steel grade used for the fabrication of furnace furniture and other high temperature components. Compared with **Ferrotherm® 4878** and **4713**, **Ferrotherm® 4828** exhibits superior resistance to scaling. Due to its high tensile strength at elevated temperatures, compared with other grades, **Ferrotherm® 4828** is ideally suited for applications where a greater emphasis is placed on mechanical property requirements.

High temperature resistance

Ferrotherm® 4828 has a low resistance to oxidising and reducing sulphur bearing gases. In these gasses, the use of **Ferrotherm® 4828** is generally limited to temperatures below 650°C. The resistance to carburising (up to 900°C) and to nitrogen bearing, oxygen depleted gases is average.

Heat treatment/mechanical properties

Optimal material properties are realised after solution annealing in the temperature range 1050 - 1150°C followed by rapid cooling in air or water. During operation and fabrication, the time spent in the temperature range 550 - 900°C must be minimised to avoid embrittlement, both chromium carbide precipitation and sigma phase formation. This embrittlement effect can be reversed by solution annealing the steel at a temperature in the range 1050 to 1100°C.

In the solution annealed condition the following mechanical properties may be attained when testing in the longitudinal direction at room temperature:

Property	Specification	Typical
- yield strength (N/mm ²)	R _{p0,2} : ≥ 230	400
- tensile strength (N/mm ²)	R _m : 550 – 750	675
- tensile elongation (%)	A ₅ : ≥ 30	45
- hardness	HB : ≤ 223	

Welding

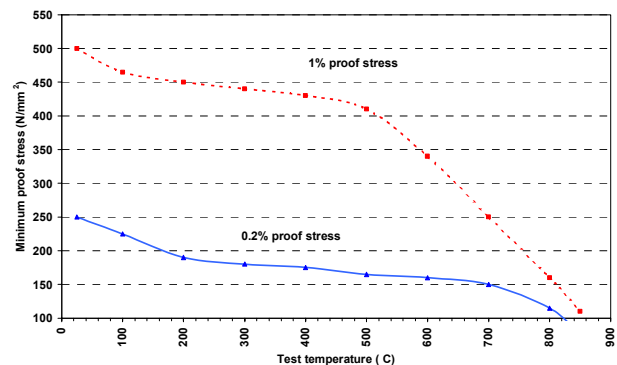
Ferrotherm® 4828 is weldable using all usual welding processes with no preheating being required. Low heat inputs should be used when welding, and post weld heat treatment is not necessary. **Novonit® 4829** and **4842** are suitable for use as filler materials when welding **Ferrotherm® 4828**.

Forging

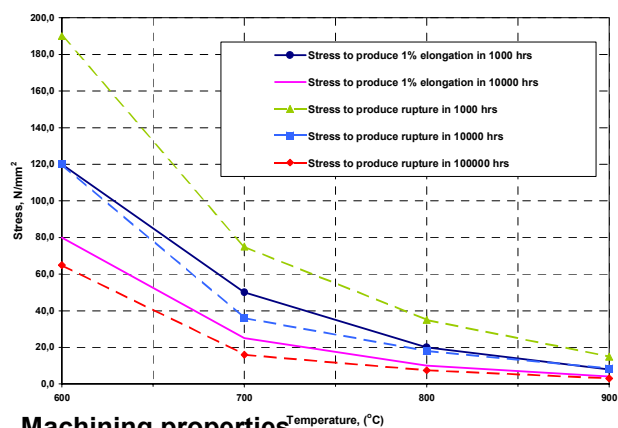
Forging is usually performed at 1150 - 800°C followed by rapid cooling in air or water.

Elevated temperature properties

The following minimum tensile properties at various temperatures are what can be typically expected of this grade of steel.



The temperature-stress-time relationships that are important for **Ferrotherm® 4828** from a creep point of view are presented in the graph below:



Machining properties

The formation of carbides in **Ferrotherm® 4828** will result in increased wear of cutting tools. In addition to this, rapid work hardening and poor thermal conductivity require the use of adequate cooling and good quality cutting/machining tools. It is thus recommended that machining is performed in the solution annealed condition using coated hard metal cutting/machining tools and the following machining parameters as a guideline:

tensile strengths	depth of cut (mm) feed (mm/rev)		
	6 mm 0,5 mm/r	3 mm 0,4 mm/r	1 mm 0,2 mm/r
R _m in N/mm ²			
solution annealed (520 - 600)	100 m/min	130 m/min	150 m/min