Schmidt + Clemens Group

Centralloy® 60 HT D

MATERIAL DATA SHEET

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Centralloy® 60 HT D

Contents

Features

Centralloy® 60 HT D is a cast nickel-base alloy with more than 50% nickel, chromium, aluminium, niobium plus additions of titanium and other minor alloying elements. The alloy has excellent structural stability, very good high temperature stress rupture strength and excellent carburisation and oxidation resistance.

Chromium and aluminium synergistically form a dense and strongly-adhering oxide layer which provides excellent protection against corrosion attack.

The presence of carbon leads to the formation of M(C,N)-, M_7C_3- and $M_{23}C_6$- carbides:

These chromium-rich carbides of the M_7C_3 and $M_{23}C_6$ types have a profound influence on the mechanical and creep properties due to their decomposition and re-precipitation reactions in service which provides secondary carbides in a rather uniform dispersion. Through this mechanism, dislocation movement is impeded which results in significant strengthening of the alloy at elevated temperatures.

Centralloy® 60 HT D is the preferred material selection for applications which require a maximum creep resistance together with good high temperature corrosion properties.

Product Forms

Centralloy® 60 HT D was designed as centrispun tube material to meet specific design criteria in terms of carburisation, coking, and oxidation resistance, creep rupture strength and weldability. Other forms e.g. statically cast and investment cast products can be supplied upon request. Additional information regarding these topics and maximum and minimum sizes available may be obtained from the sales department.

Chemical Composition*

	mess percentage
Carbon	0.3 – 0.6
Chromium	24 – 30
Niobium	0.4 – 1
Aluminium	2 – 3
Iron	< 10.00
Nickel	Balance

(*) The composition ranges can be slightly modified according to the application.

Applications

Tubular components requiring very high creep rupture strength combined with outstanding oxidation and excellent carburisation resistance.

Centralloy® 60 HT D is designed to withstand operating temperatures >1150°C.

The combined benefits of Centralloy® 60 HT D make this an ideal material selection for the products and applications below:

- Reformer tubes for DR plants e.g. Midrex®
- Furnace rollers
- General engineering for high temperature and hot corrosion environments, such as glass industry, waste incineration, and others

Physical Properties

Density at 20°C: 7.96 g/cm^3

Typical physical properties

δ, °C	α, 10^{-6}/K	E, GPa	λ, W/m K	c_p, J/kg K	ρ, µΩm
20	-	175*	13.4	462	1.25
100	12.6	172	14.7	476	1.26
200	13.0	167	16.2	491	1.28
300	13.4	162	17.8	505	1.30
400	13.8	156	19.3	519	1.32
500	14.1	150	20.8	536	1.33
600	14.6	143	22.4	590	1.34
700	15.3	136	24.0	635	1.33
800	16.1	128	25.8	660	1.32
900	16.7	121	27.3	690	1.32
1000	17.1	113	28.8	710	1.33
1100	17.6	85	29.3	740	1.30

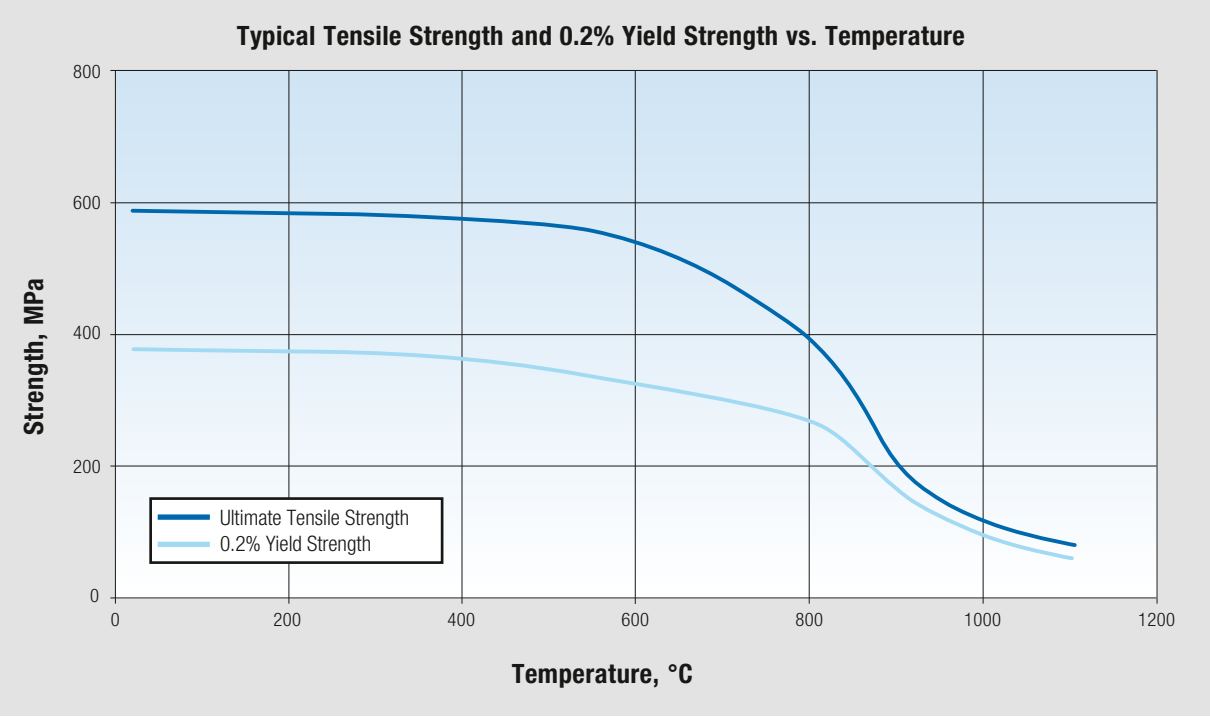
δ: Temperature
α: Mean coefficient of linear thermal expansion
E: Modulus of elasticity (* at 25°C)
λ: Thermal conductivity
c_p: Mean specific heat
ρ: Electrical resistivity

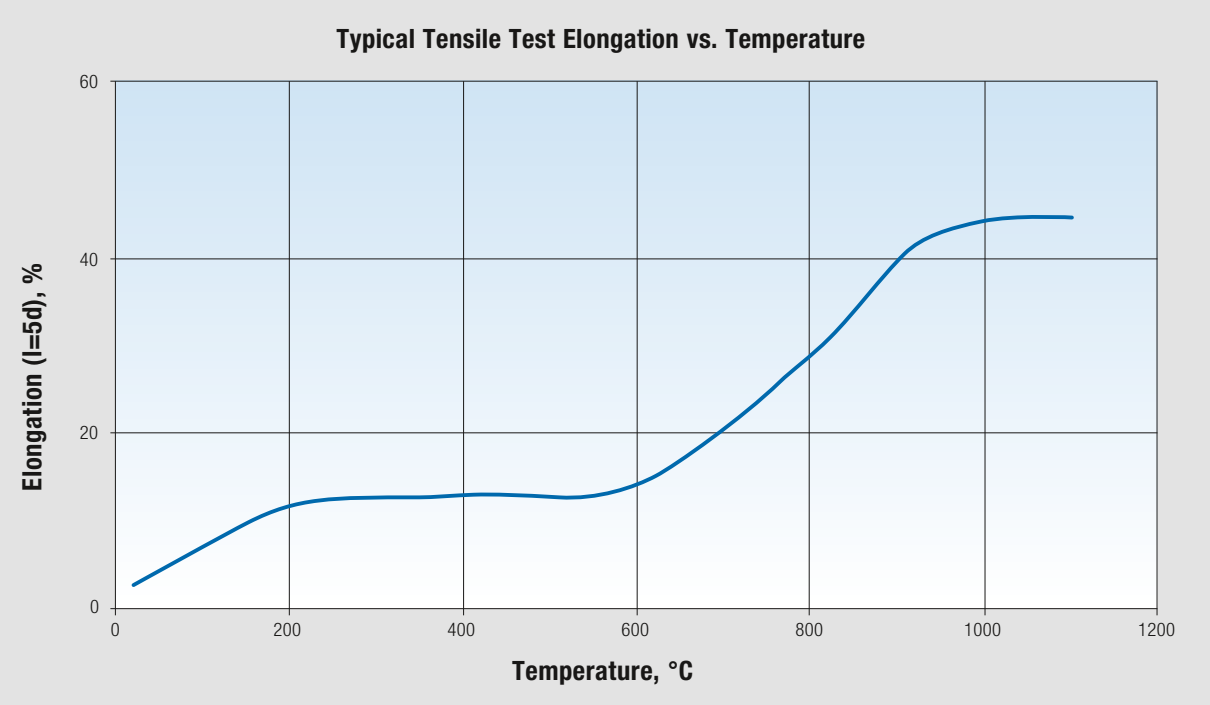
Mechanical Properties

(only for wall thickness less than 25 mm in the as cast condition)

Tensile properties

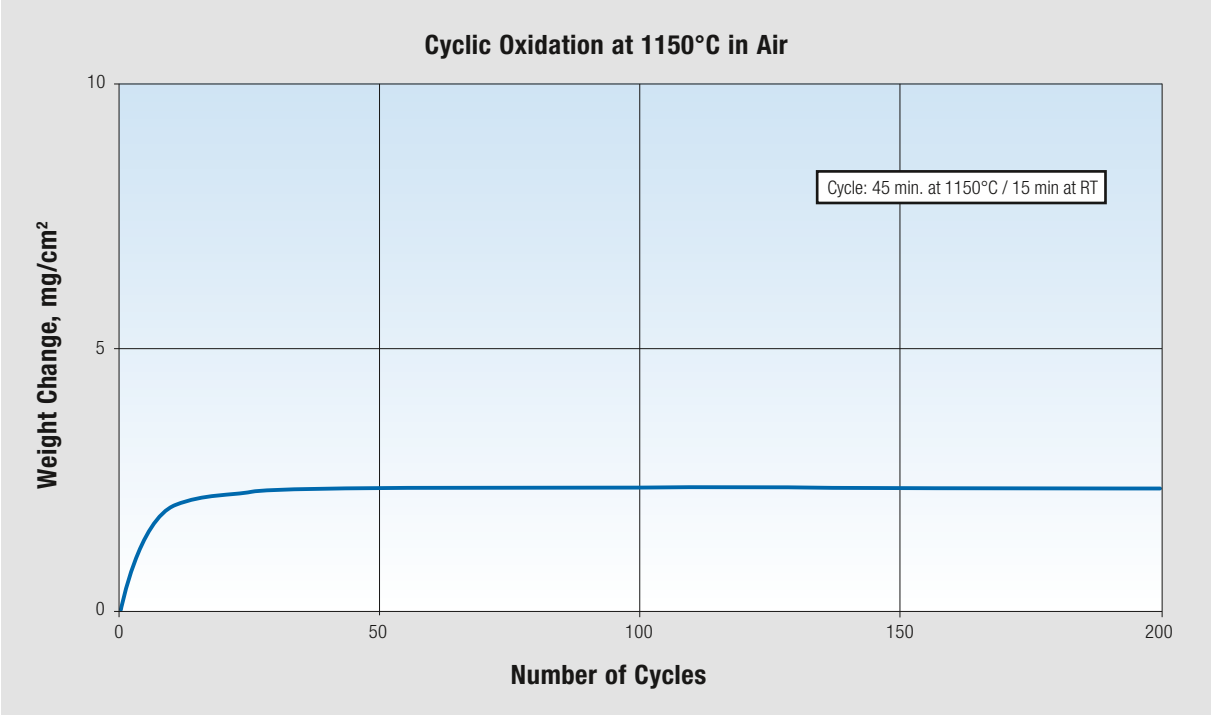
Minimum tensile properties at 20°C:	0.2% Yield strength:	290 MPa
	Ultimate tensile strength:	515 MPa
	Elongation, (l=5d):	4%



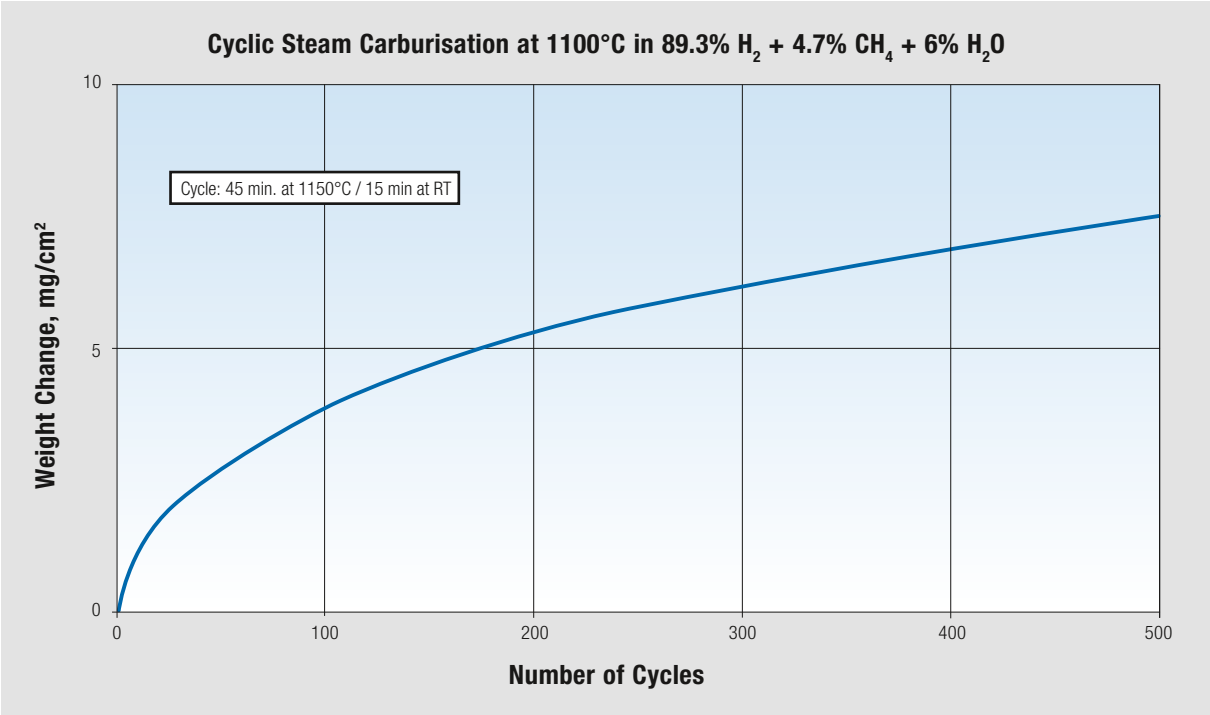


High Temperature Corrosion Resistance

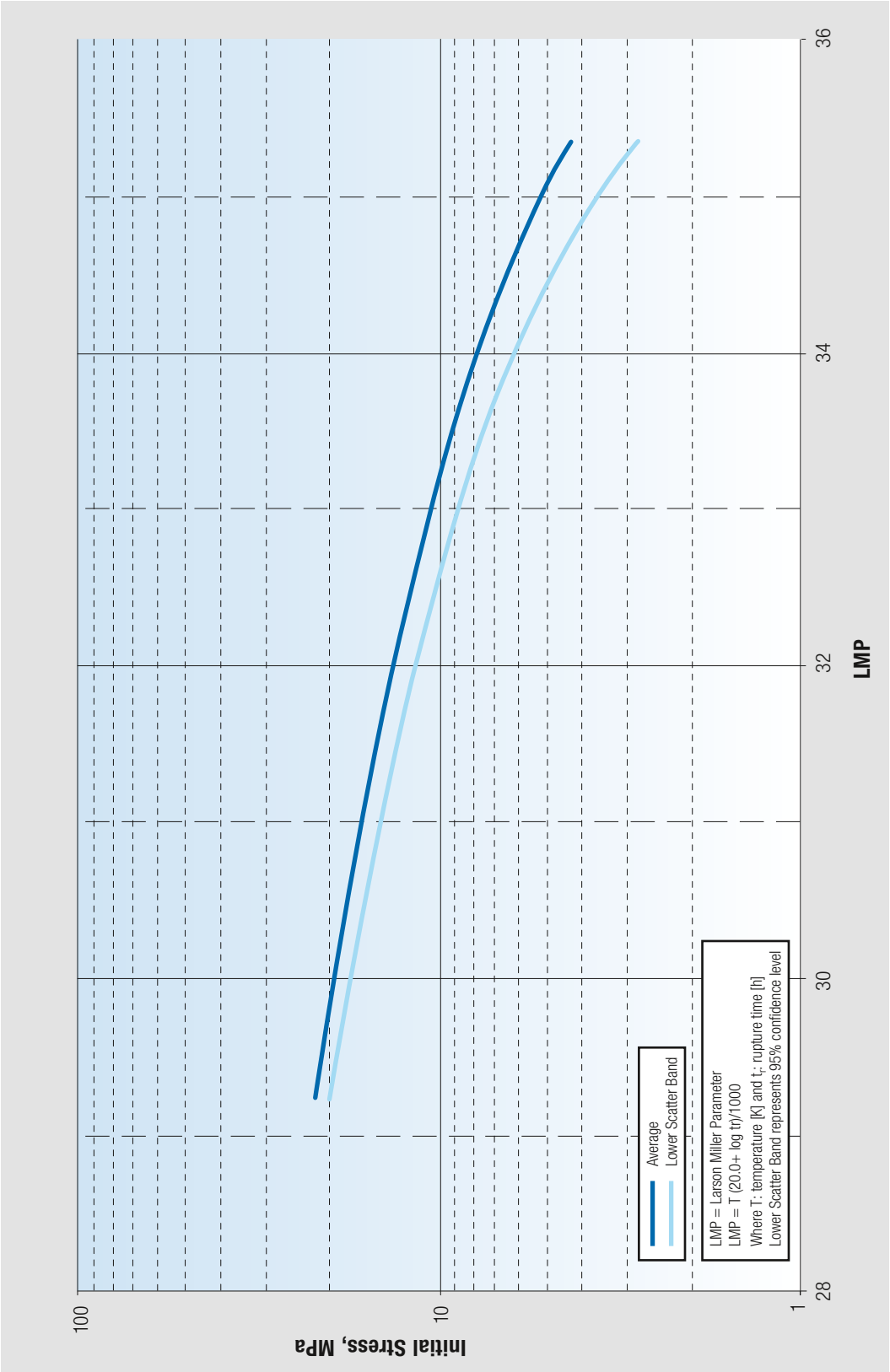
Oxidation resistance



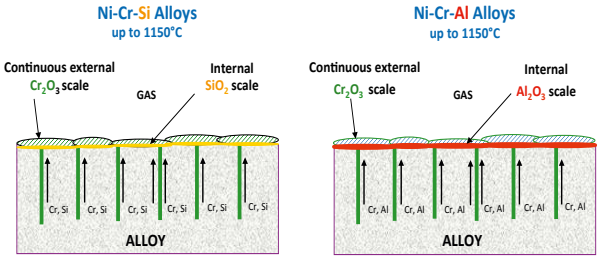
Carburisation resistance



Parametric Stress Rupture Strength



The Predominant Formation of Protective Oxide Scales



Ni-Cr-Si materials build protective oxide scales through the synergistic effect of the elements chromium and silicon. The dominating chromium oxide scale (Cr_2O_3) reliably protects the material up to temperatures of 1150°C against high temperature corrosion attack. Silicon supports the growth of the chromium oxide scale.

Ni-Cr-Al materials on the contrary initially build a mixed oxide of the elements chromium, nickel, and aluminium. The difference to the Ni-Cr-Si materials is that after a short time in operation, the initially formed oxides transform. The composition of the alloy ensures the formation of an aluminium oxide scale.

From a thermodynamic standpoint, aluminium oxide scales are known as the most stable protective scales of metallic materials. The slow growth rate of the scale ensures the materials survival in long-term service applications.

Manufacturing Characteristics

Machining

In general terms the machinability of Centralloy® 60 HT D is similar to that of other heat resistant alloys.

Welding

Matching filler materials are commercially available. These welding consumables have high strength properties at elevated temperatures with good retained ductility.

Beside PAW, GTAW and MAW have been satisfactorily used. Preheating and postweld heat treatment of the joint is not necessary. For dissimilar weld joints to austenitic materials suitable filler materials can be recommended.

Further information will be supplied upon request.

Health, Safety and Environmental Information

The operation and maintenance of welding equipment should conform to the provisions of relevant national standards for the protection of personnel and environment.

Mechanical ventilation is advisable and under certain conditions in confined spaces, it is necessary during welding operations to prevent possible exposure to hazardous fumes, gases or dust that may occur.

Nickel- and iron-base materials may contain, in varying concentrations, the elements chromium, iron, manganese, molybdenum, cobalt, nickel, tungsten and aluminium. Metal dust from welding, grinding, melting and dross handling of these alloy systems may cause adverse environmental and in case of inhalation health effects.

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Services

- Metallurgy and material engineering
- Material analysis and examinations
- Metallurgical defect analysis
- Process and material consulting
- Design of tubes and tube systems
- Material welding services
- Mechanical machining
- Heat treatment
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- Site services and logistics

Production sites

Germany, Spain, Czech Republic, Malaysia, Saudi Arabia

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