Schmidt + Clemens Group

Centralloy® HT E

MATERIAL DATA SHEET

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Contents:

Product Forms

Centralloy® HT E 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 may be supplied upon request. Additional information regarding these topics and maximum and minimum sizes may be obtained from the sales department.

Chemical Composition(*)

	mass percentage
Carbon	0.45
Chromium	30.00
Nickel	45.00
Niobium	0.50
Aluminium	4.00
Iron	Balance

(*) This is a typical composition which may be slightly modified according to the application.

Applications

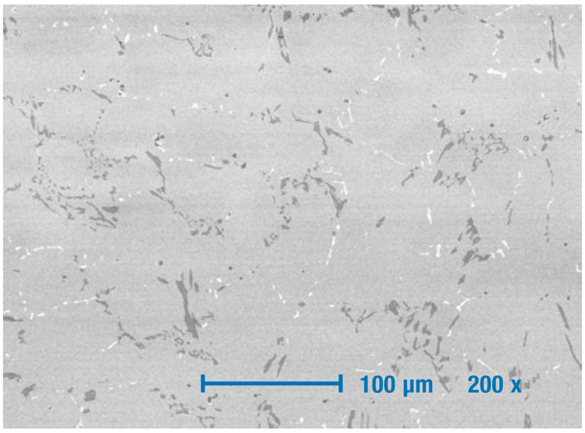
Tubular components requiring very high creep rupture strength combined with outstanding oxidation and excellent carburisation resistance. Centralloy® HT E is designed to withstand operating temperatures up to 1150°C. The combined strengths of Centralloy® HT E are initially targeting customers in the applications cited below:

- Radiant coils for steam cracker furnaces
- Furnace rollers
- General engineering for high temperature and hot corrosion environments, such as glass industry, waste incineration, and others

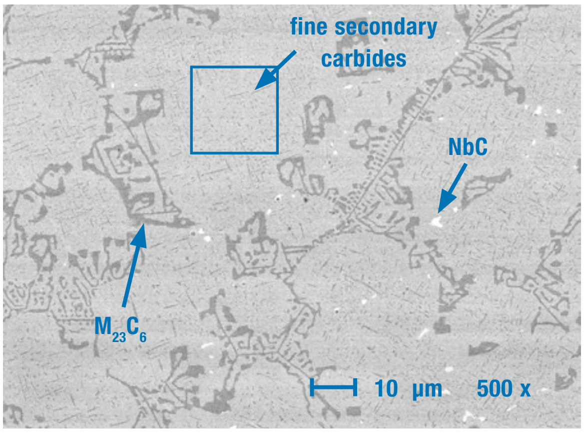
Features

Centralloy® HT E is a cast nickel-base alloy containing chromium, aluminium, niobium, titanium and other minor alloying elements. The alloy has excellent structural stability, very good high temperature stress rupture strength and excellent carburisation/oxidation resistance.

The presence of carbon leads to the formation of a series of carbides: chromium-rich carbides of the M_7C_3 and $M_{23}C_6$ types and niobium-rich carbides of the MC type. These have a profound influence on properties due to decomposition and re-precipitation reactions in service which produce secondary carbides in a rather uniform dispersion. Through this mechanism, dislocation movement is impeded with the result of significant strengthening at elevated temperatures.



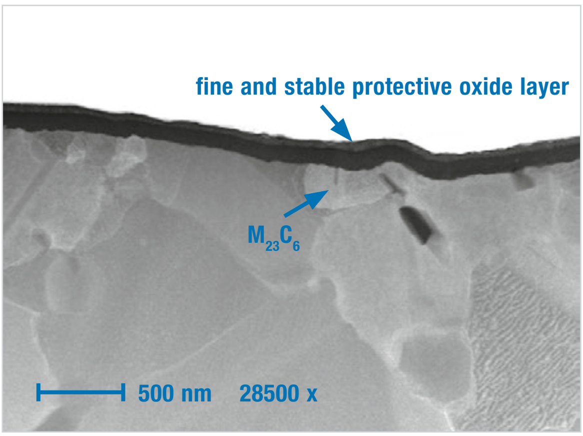
SEM image of a typical "as cast" microstructure, where gray carbides correspond to M_7C_3 and $M_{23}C_6$ (M mainly Cr), and white carbides correspond to MC (M mainly Nb).



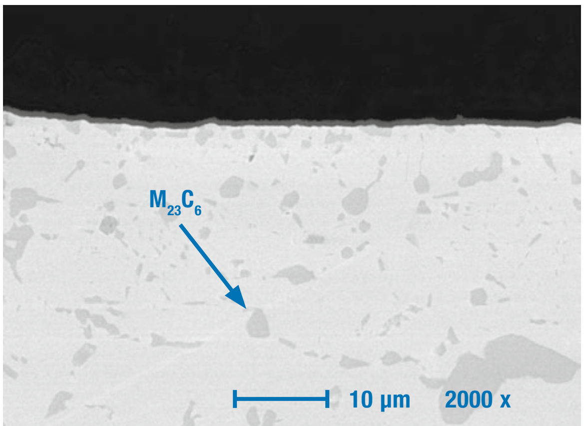
SEM image of a typical "aged" microstructure with fine secondary $M_{23}C_6$-carbides precipitated in the γ-matrix.

Centralloy® HT E with its increased aluminium content performs excellently in oxidising as well as reducing/carburising atmospheres. The Centralloy® HT family is a development of S+C and is patented worldwide.

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. For the use of these materials in the petrochemical industry, this new protective mechanism has the advantage of increased service life. Under typical steam cracker conditions coking rates in carbon rich atmospheres are significantly reduced.



TEM image of alloy microstructure and the initial oxide layer after steam cracker start-up.



SEM image of alloy microstructure and oxide layer after 10 coking-decoking cycles in a bench-scale unit, mainly Al_2O_3 containing oxide layer.

Physical Properties

Density at 20°C: 7.6 g/cm³

δ: Temperature
α: Mean coefficient of linear thermal expansion
E: Modulus of elasticity
c_p: Mean specific heat
λ: Thermal conductivity

Typical physical properties

δ, °C	α, 10^{-6}/K	E, GPa	c_p, J/kg K	λ, W/m K
20	–	178	492	10.4
100	13.3	172	508	11.5
200	14.2	167	518	12.8
300	14.5	162	529	14.4
400	14.6	156	545	16.1
500	14.8	150	568	18.1
600	15.3	144	594	20.0
700	16.1	138	620	21.7
800	17.1	130	644	23.2
900	17.9	122	663	24.4
1000	18.4	112	680	25.6
1100	18.7	102	700	27.2

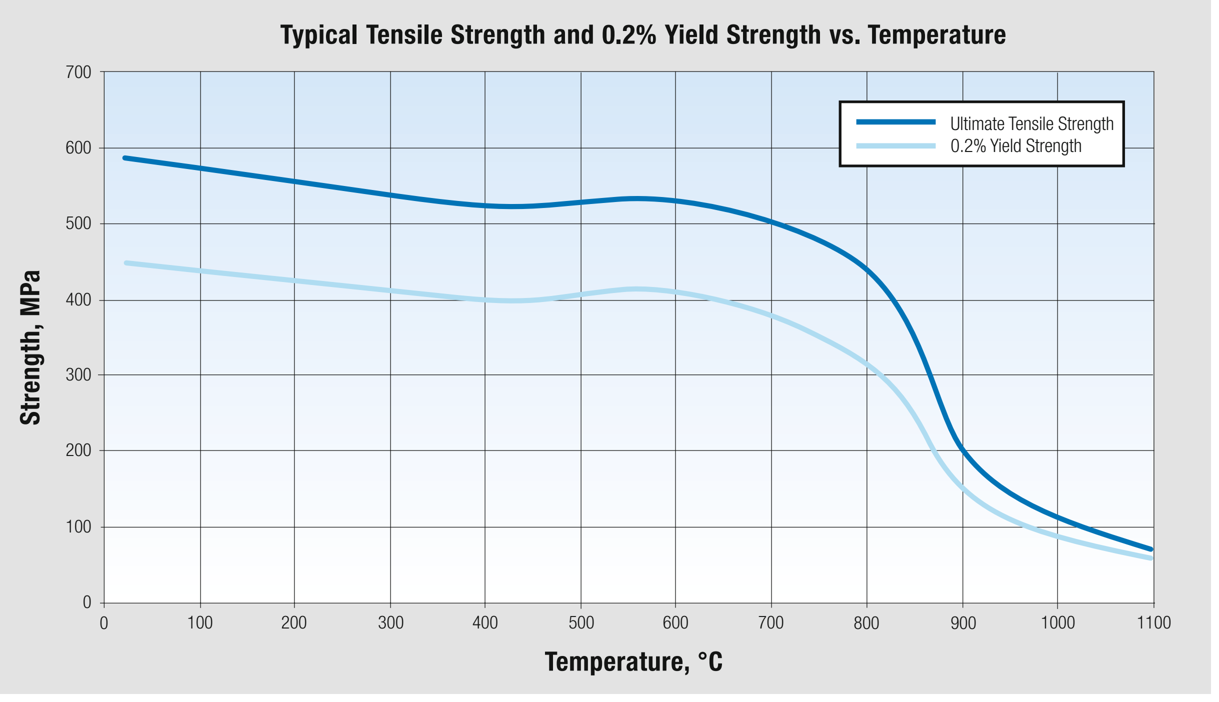
Mechanical Properties

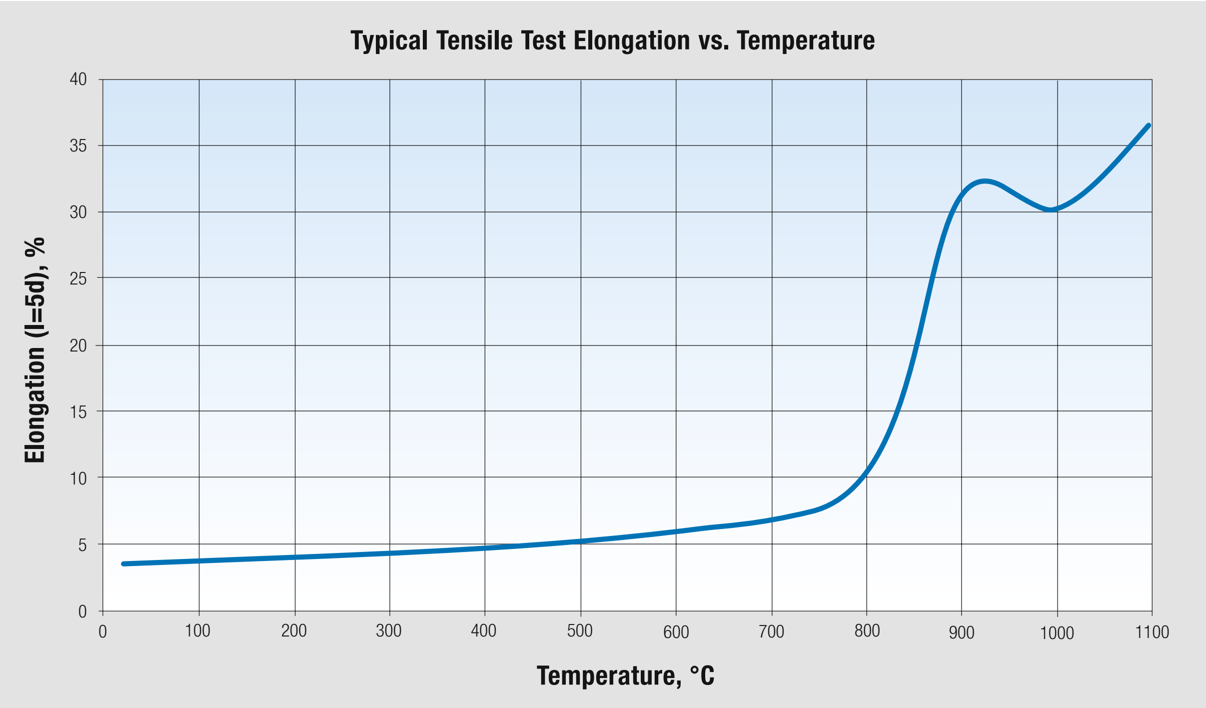
(only for wall thickness less than 25 mm, in the as cast conditions)

Tensile properties

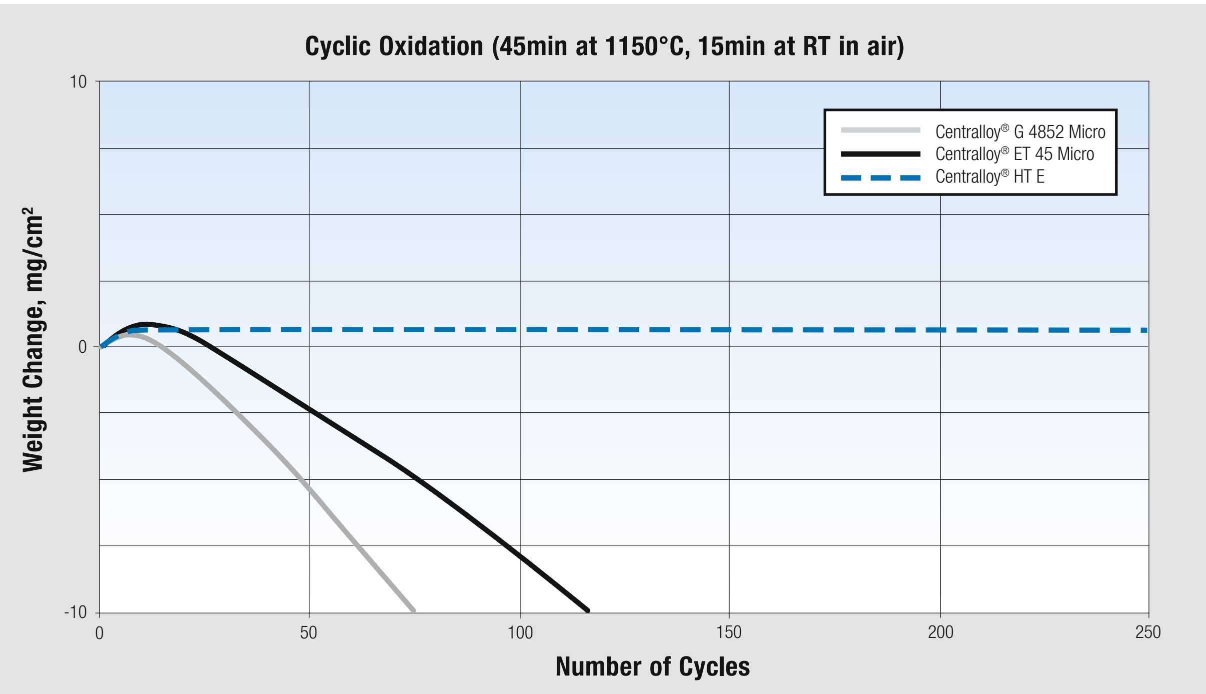
Minimum tensile properties at 20°C:

0.2% Yield strength:	400 MPa
Ultimate tensile strength:	550 MPa
Elongation, (l = 5d):	3.0%

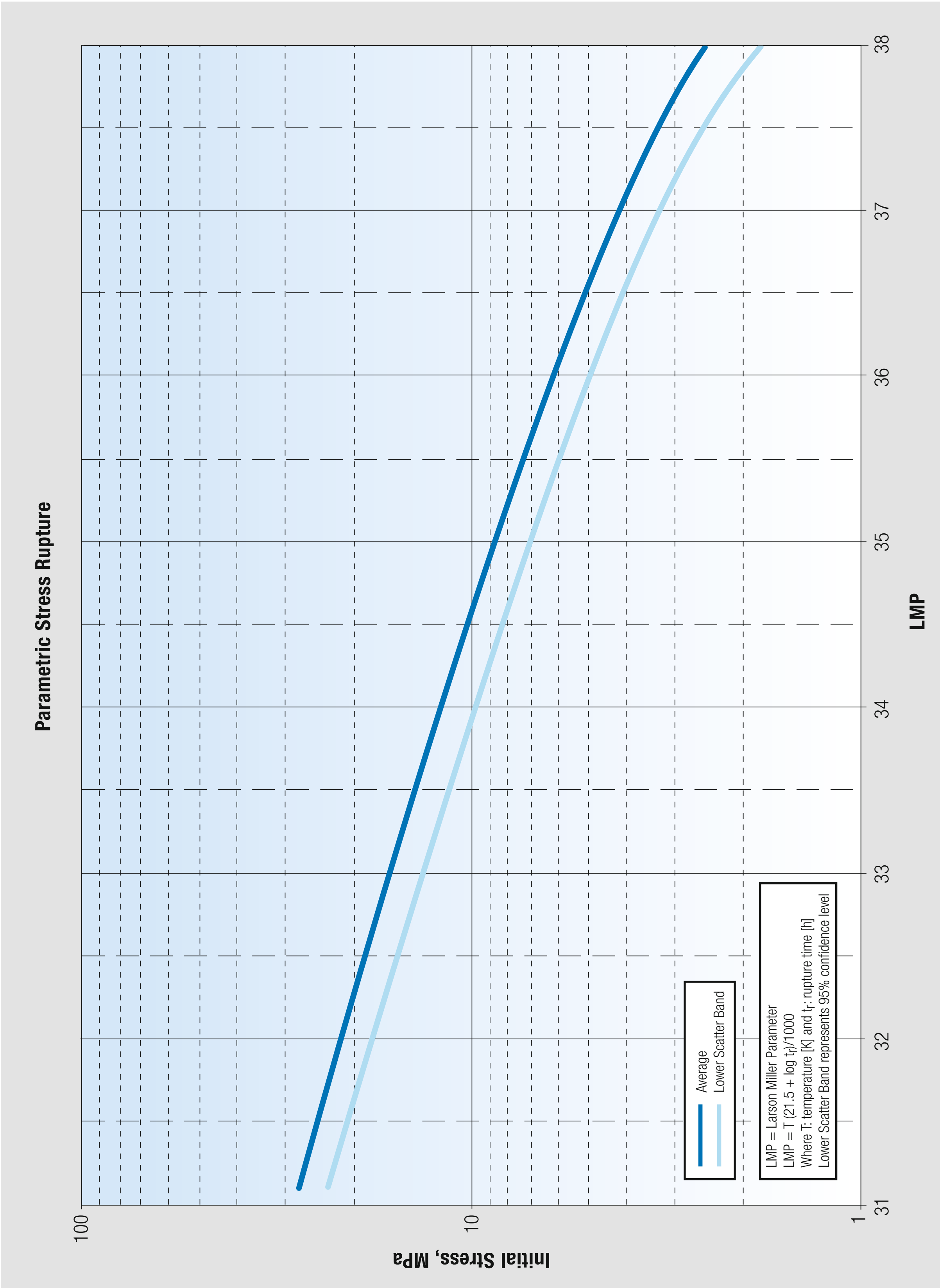




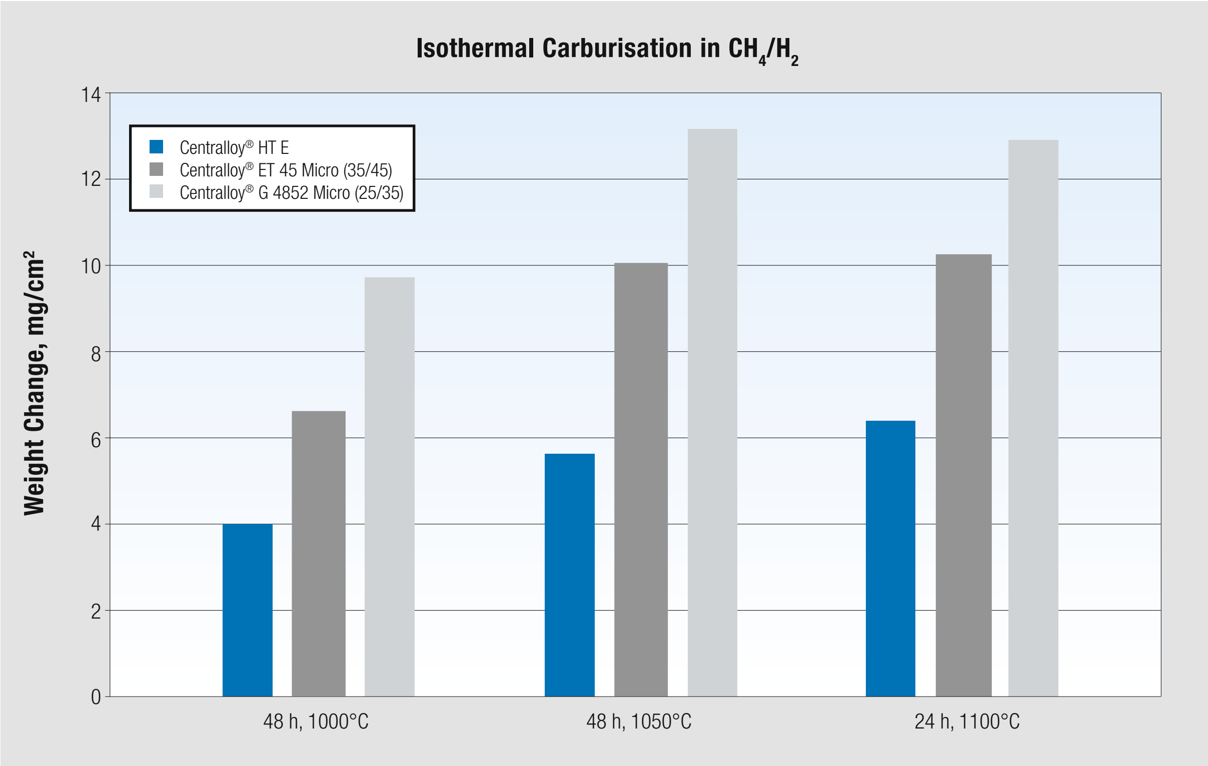
Oxidation Resistance



Parametric Stress Rupture Strength



Carburisation Resistance



Carburisation in the absence of any protective oxide scale

Manufacturing Characteristics

Welding

Matching filler materials are commercially available. These welding consumables have high strength properties at elevated temperatures with good retained ductility. Besides fillerless 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 are 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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- Metallurgical defect analysis
- Process and material consulting
- Design of tubes and tube systems
- Material welding services
- Mechanical machining
- Heat treatment
- Convection zones
- Site services and logistics

Production sites
Germany, Spain, Czech Republic, Malaysia, Saudi Arabia

Brinkmann GmbH · Marke · Menschen · Kommunikation, Krefeld 01/2019