

Centralloy® G 4852 Micro R

MATERIAL DATA SHEET

Designation: GX45NiCrNbSiTi35-25

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Chemical Composition^(*)

	mass percentage
Carbon	0.45
Silicon	0.80
Manganese	1.00
Chromium	25.00
Nickel	35.00
Niobium	1.00
Titanium	Additions
Iron	Balance

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

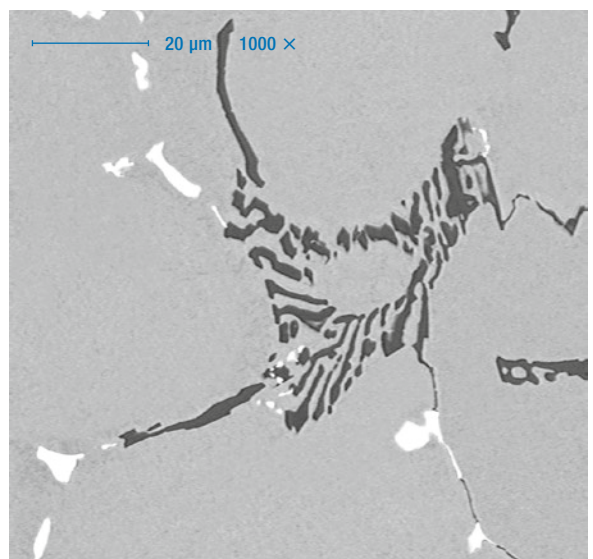
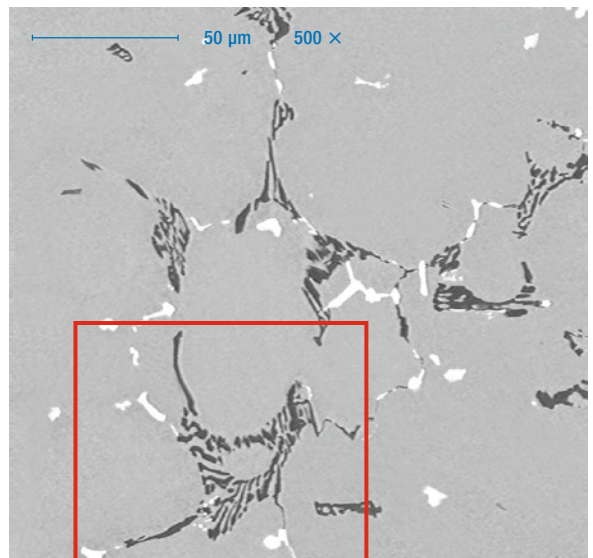
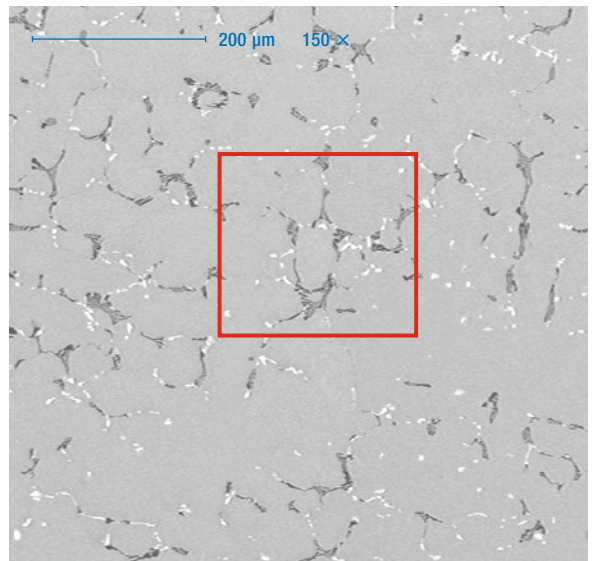
Features

Centralloy® G 4852 Micro R is a cast austenitic steel with 35% nickel, 25% chromium plus niobium, titanium and others. The alloy possesses excellent structural stability, very good high temperature stress rupture strength and good oxidation resistance.

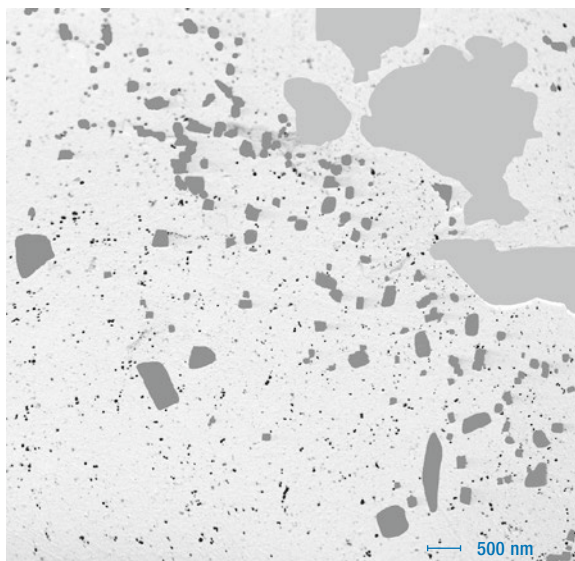
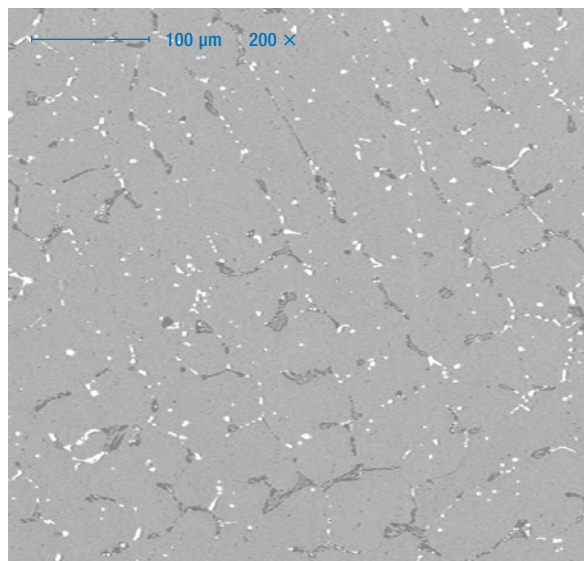
The presence of carbon leads to the formation of a series of carbides:

a) During solidification ("as cast" condition)

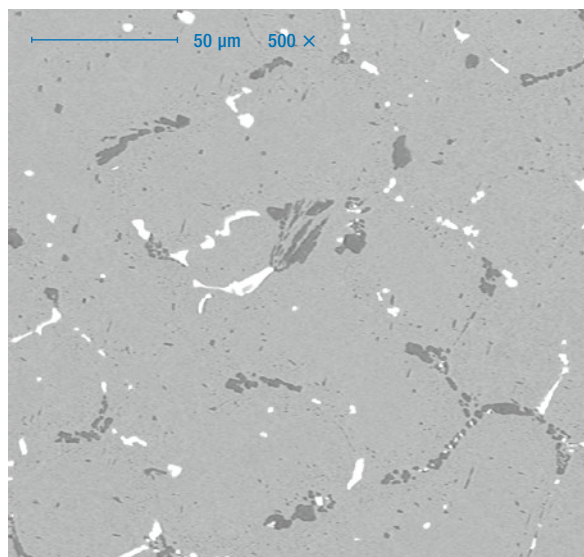
Intergranular carbides of the M_7C_3 type (where M is mainly Cr) and carbides/carbonitrides of the $M(C,N)$ type where M is mainly Nb. These primary precipitates are visible in unetched micro specimens – see SEM images – its colouring varying from light grey (MC-carbides) to dark grey (M_7C_3 -carbides) and some smaller orange/yellow cubic MC-carbonitrides (M being mainly Ti).



a) SEM images of Centralloy® G 4852 Micro R as cast condition



TEM image of Centralloy® G 4852 Micro R



b) After exposure to operational conditions (“aged” condition)

The primary M_7C_3 -carbides are transformed to $M_{23}C_6$ -carbides and small intragranular secondary $M_{23}C_6$ -carbides are precipitated. Due to the balance of niobium and micro alloying elements secondary nano particles are precipitated intragranularly. The uniform dispersion and size of such particles leads to a hindered mechanism of dislocation movement with the result of significant strengthening of the material (see SEM images). The secondary precipitates are visible in unetched micro specimens (see SEM images) of dark grey colour, and the size of the nano particles can be detected in very high magnification by TEM examination (see TEM image, black colour).

Product Forms

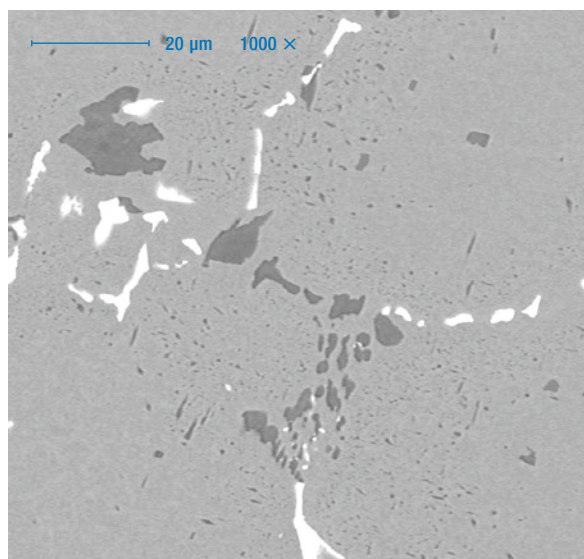
Centralloy® G 4852 Micro R was designed as centrif spun tube material to meet specific design criteria in terms of creep rupture strength, oxidation resistance, and weldability. It is available as centrif spun tubes, statically cast and investment cast product forms.

Other forms may be supplied upon request. Further information regarding these topics, and maximum and minimum sizes, may be obtained from the sales department.

Applications

Tubular systems requiring excellent stress rupture strength combined with good oxidation resistance. The main applications for the material are:

Process:	max. operating temperature, °C
Steam reforming	1050
Direct reduction of iron ore	1050

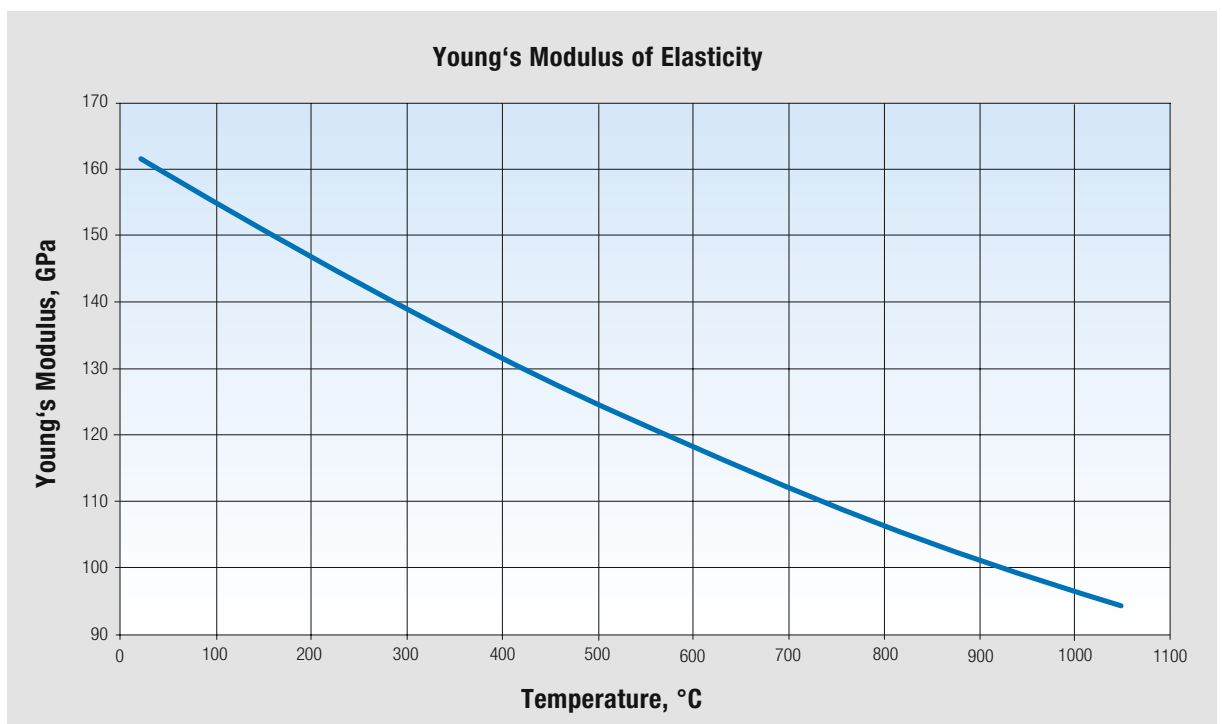
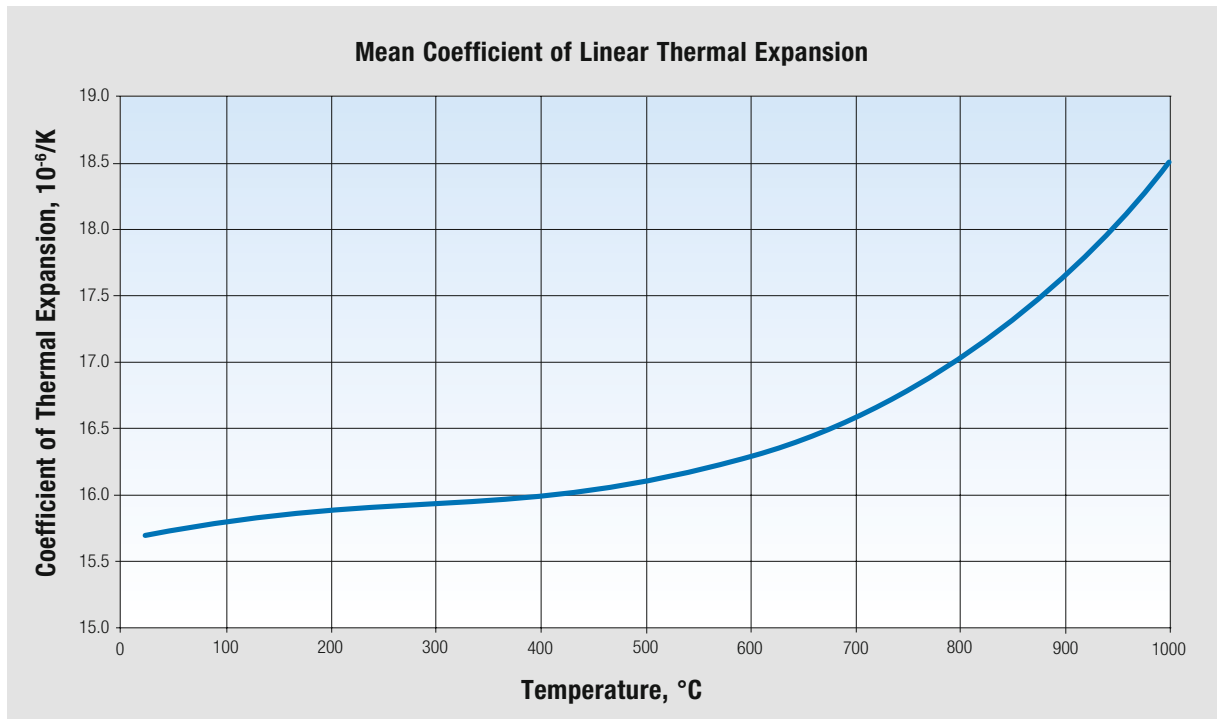


b) SEM images of Centralloy® G 4852 Micro R aged condition

Physical Properties

Density: 7.9 g/cm³

Thermal conductivity at 20°C: 14.6 W/mK



Mechanical Properties

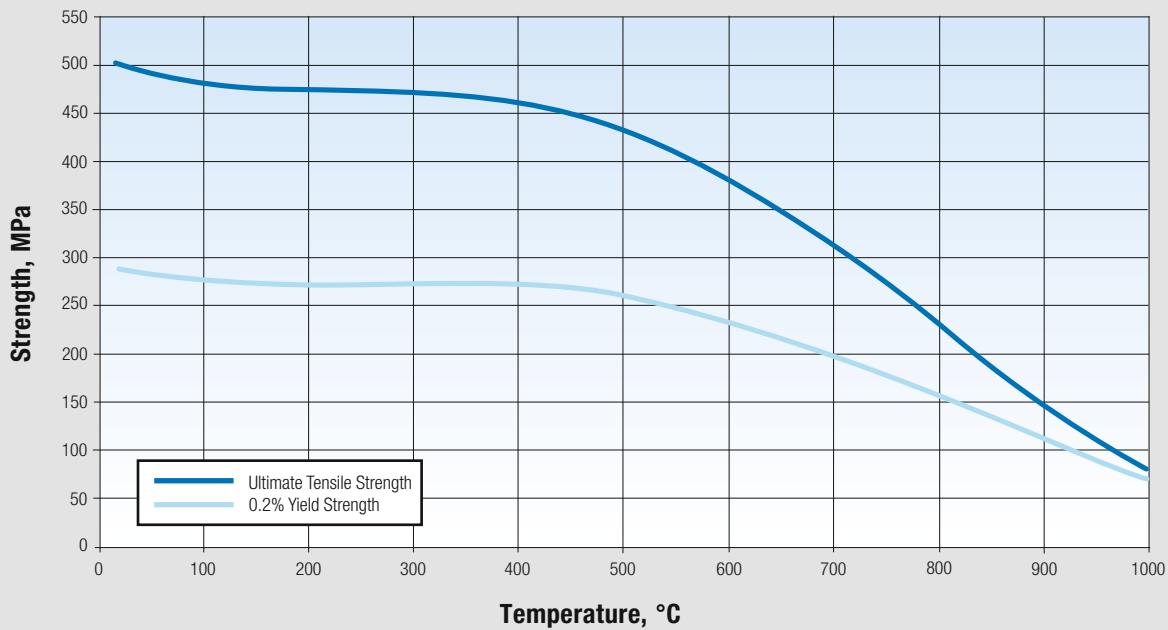
(only for wall thickness less than 25 mm, in the as cast conditions)

Tensile properties

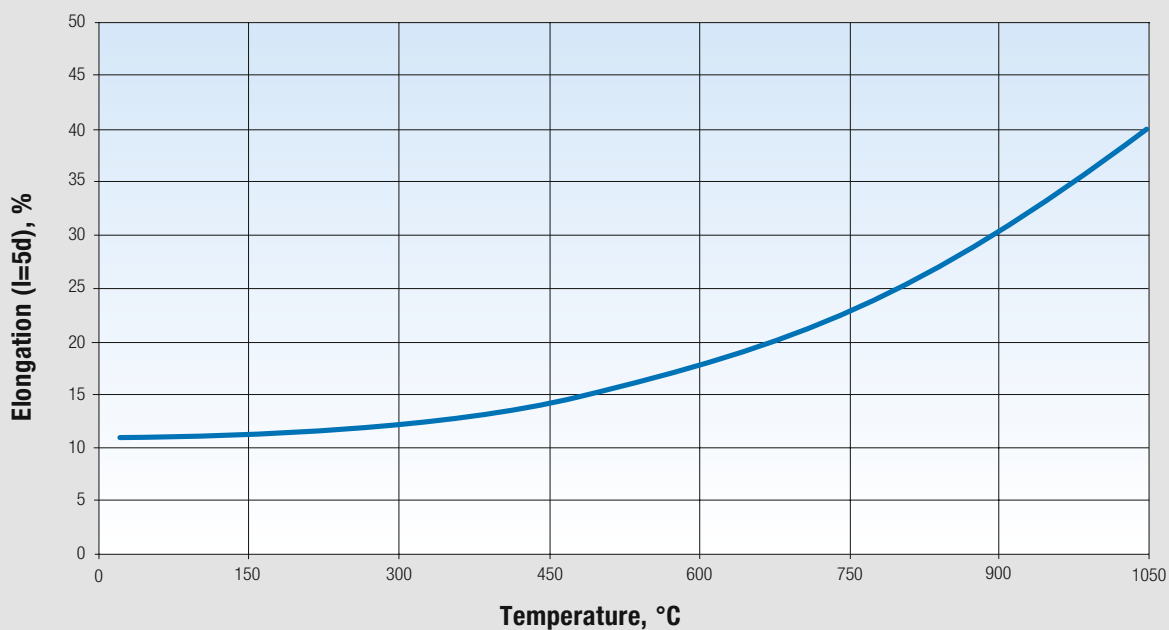
Minimum tensile properties at 20°C:

0.2% Yield strength:	230 MPa
Ultimate tensile strength:	450 MPa
Elongation, (l = 5d):	8% for centricast tubes 6% for static castings

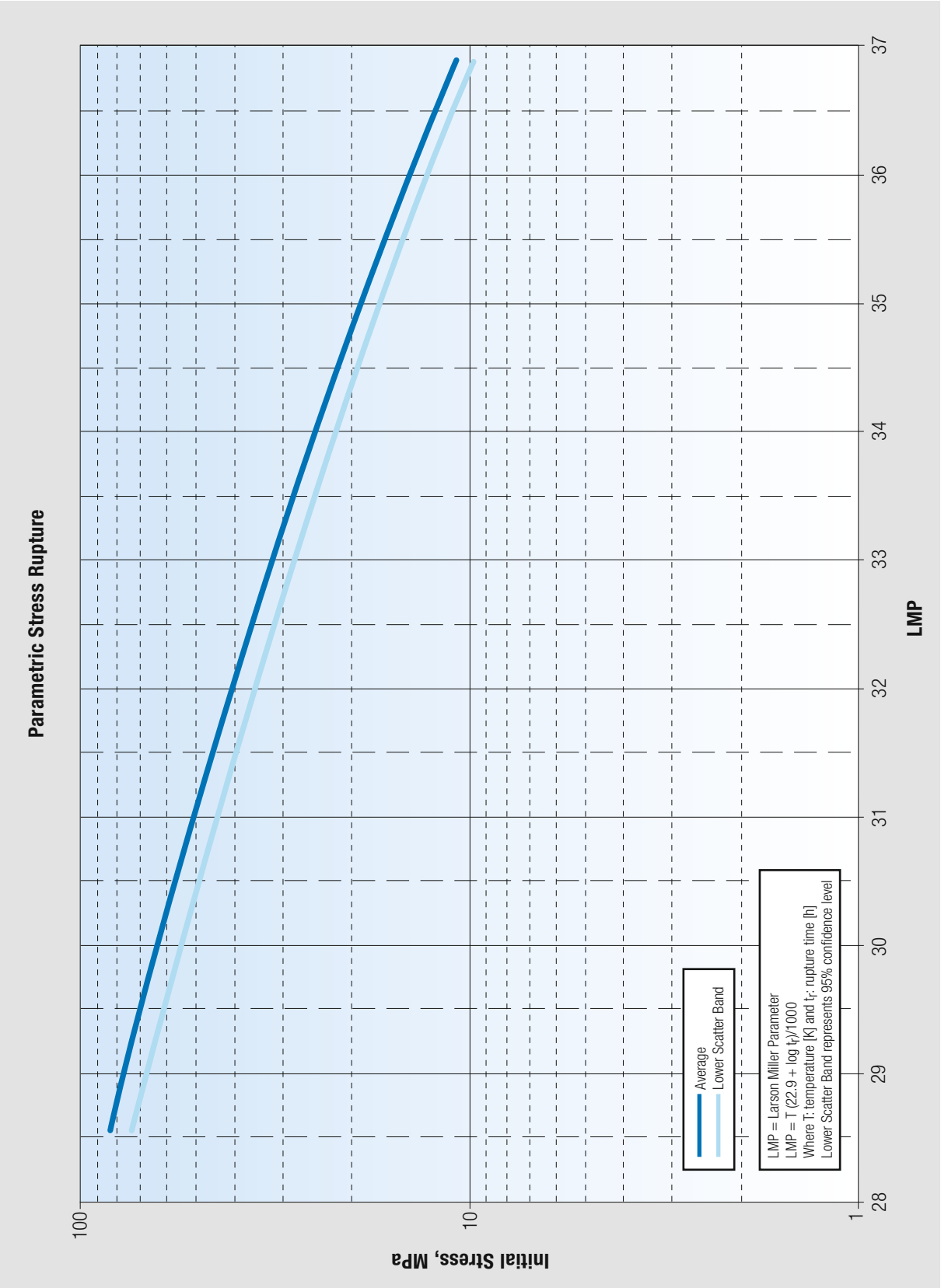
Typical Tensile Strength and 0.2% Yield Strength vs. Temperature



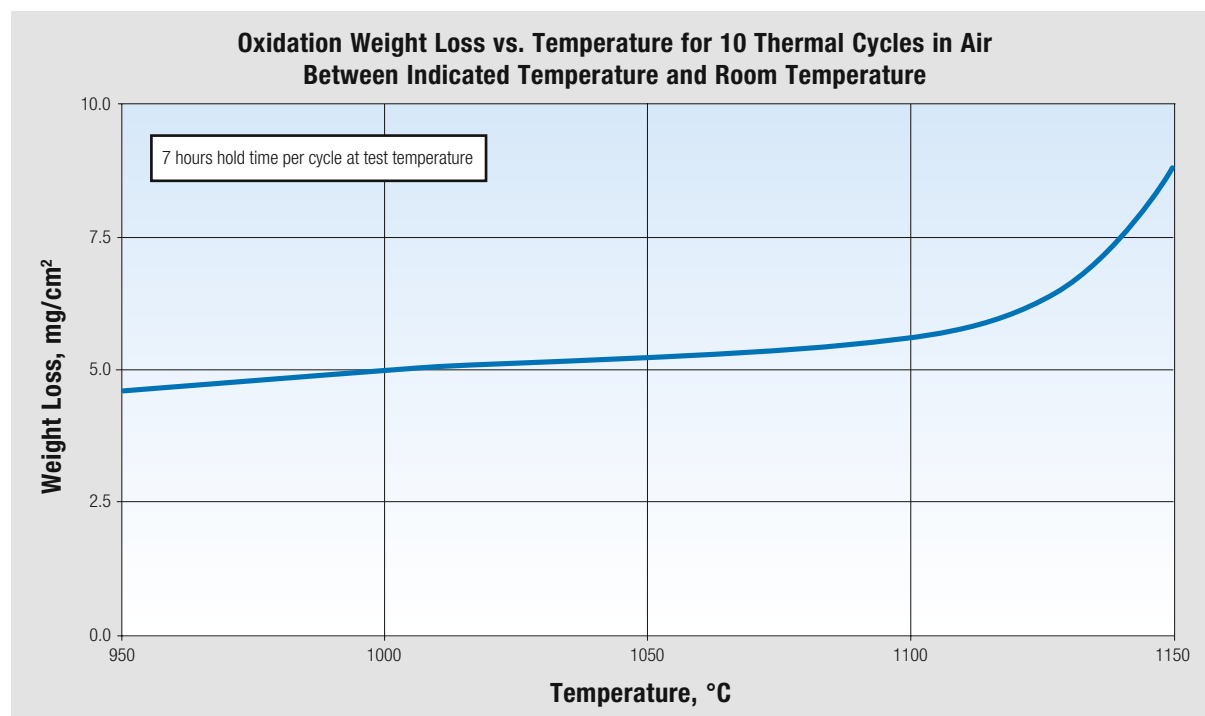
Typical Tensile Test Elongation vs. Temperature



Parametric Stress Rupture Strength



Oxidation Resistance



Manufacturing Characteristics

Machining

In general terms the machinability of Centralloy® G 4852 Micro R is similar to that of other heat resistant alloys.

Welding

For critical, highly stressed and corrosion resistant joints coated electrodes, flux cored wire and non-coated filler material are commercially available. These welding consumables have high strength properties at elevated temperatures with good retained ductilities.

Besides fillerless PAW, SMAW, TIG and GMAW have been used satisfactorily for component fabrication or repair welding. Preheating and postweld heat treatment of the joint is not necessary.

For dissimilar weld joints to austenitic materials the same filler materials are recommended. Further information will be supplied upon request.

Health and Safety Information

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

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

Nickel-iron-base materials may contain, in varying concentrations, elemental constitutions of chromium, iron, manganese, molybdenum, cobalt, nickel, tungsten and aluminium. Inhalation of metal dust from welding, grinding, melting and dross handling of these alloy systems may cause adverse health effects.

The information in this publication is as complete and accurate as possible at the time of publication. Variations in properties can occur to production and process routes. However, no warranty or any legal liability for its accuracy, completeness and results to be obtained for any particular use of the information herein contained is given. Where possible the test conditions are fully described. Where reference, is made to the balance of the alloy's composition it is not guaranteed that this balance is composed exclusively of the element mentioned, but that it predominates and others are present only in minimal quantities. The creep rupture data are frequently insufficient to be directly translatable to specific design or performance applications without examination and verification of their applicability and suitability by professionally qualified personnel. The primary units for property data are based on those of the SI-system.



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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

Production sites

Germany, Spain, Czech Republic, Malaysia, Saudi Arabia

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