Centralloy® G 4879 Micro
MATERIAL DATA SHEET

Designation: G-NiCrTi28W
Centralloy® G 4879 Micro is a cast austenitic alloy containing nickel, chromium, tungsten and titanium. The alloy has good high temperature stress rupture strength and good carburisation and oxidation resistance. The presence of carbon leads to the formation of a series of carbides:

a) Intergranularly occurring primary carbides, nitrides or carbonitrides of the general form $M_6(C,N)$, where $M$ is tungsten. These greatly affect the generation of good high temperature properties. The phase is visible in unetched micro specimen, its colour varying from the orange/yellow of the nitride to the grey/mauve of the carbide.

b) Chromium-rich intergranular carbides of the $M_7C_3$ and $M_{23}C_6$ types. These carbides have a profound influence on properties due to decomposition and re-precipitation reactions in service producing secondary carbides in a rather uniform dispersion. By this mechanism dislocation movement is impeded with the result of significant strengthening at elevated temperatures.

Product Forms

Centralloy® G 4879 Micro was designed as centrispun tube material to match specific design criteria in terms of carburisation 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.

Features

Chemical Composition (*)

<table>
<thead>
<tr>
<th>Element</th>
<th>Mass Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon</td>
<td>0.50</td>
</tr>
<tr>
<td>Silicon</td>
<td>1.00</td>
</tr>
<tr>
<td>Manganese</td>
<td>0.75</td>
</tr>
<tr>
<td>Chromium</td>
<td>28.00</td>
</tr>
<tr>
<td>Iron</td>
<td>15.00</td>
</tr>
<tr>
<td>Tungsten</td>
<td>5.00</td>
</tr>
<tr>
<td>Titanium</td>
<td>Additions</td>
</tr>
<tr>
<td>Nickel</td>
<td>Balance</td>
</tr>
</tbody>
</table>

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

Applications

Tubular components requiring carburisation and oxidation resistance combined with high creep rupture strength and creep resistance. No heat treatment is required for most applications of this grade. Main high temperature application for the material is:

<table>
<thead>
<tr>
<th>Process:</th>
<th>Max. Operating Temperature, °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct reduction of iron ore</td>
<td>1175</td>
</tr>
</tbody>
</table>
Physical Properties

Density at 20°C: 8.2 g/cm³

Typical physical properties

<table>
<thead>
<tr>
<th>δ, °C</th>
<th>α, 10⁻⁶/K</th>
<th>λ, W/m K</th>
<th>c_p, J/kg K</th>
<th>a, 10⁻⁶ m²/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>--</td>
<td>13.8</td>
<td>445.9</td>
<td>2.8</td>
</tr>
<tr>
<td>100</td>
<td>14.0</td>
<td>15.1</td>
<td>464.1</td>
<td>3.1</td>
</tr>
<tr>
<td>200</td>
<td>14.5</td>
<td>16.8</td>
<td>483.9</td>
<td>3.4</td>
</tr>
<tr>
<td>300</td>
<td>15.0</td>
<td>18.4</td>
<td>501.0</td>
<td>3.7</td>
</tr>
<tr>
<td>400</td>
<td>15.5</td>
<td>20.0</td>
<td>515.8</td>
<td>4.0</td>
</tr>
<tr>
<td>500</td>
<td>15.9</td>
<td>21.6</td>
<td>528.9</td>
<td>4.3</td>
</tr>
<tr>
<td>600</td>
<td>16.3</td>
<td>23.2</td>
<td>540.6</td>
<td>4.6</td>
</tr>
<tr>
<td>700</td>
<td>16.7</td>
<td>24.9</td>
<td>551.5</td>
<td>4.8</td>
</tr>
<tr>
<td>800</td>
<td>17.0</td>
<td>26.5</td>
<td>561.9</td>
<td>5.0</td>
</tr>
<tr>
<td>900</td>
<td>17.3</td>
<td>28.1</td>
<td>572.3</td>
<td>5.2</td>
</tr>
<tr>
<td>1000</td>
<td>17.5</td>
<td>29.7</td>
<td>583.3</td>
<td>5.4</td>
</tr>
<tr>
<td>1100</td>
<td>17.7</td>
<td>31.2</td>
<td>595.2</td>
<td>5.5</td>
</tr>
</tbody>
</table>

δ: Temperature
α: Mean coefficient of linear thermal expansion
λ: Thermal conductivity
c_p: Mean specific heat
a: Thermal diffusivity
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: 290 MPa
- Ultimate tensile strength: 490 MPa
- Elongation, (l = 5d): 4.0% for centricast tubes
  3.0% for static castings

![Typical Tensile Strength and 0.2% Yield Strength vs. Temperature](image)

![Typical Tensile Test Elongation vs. Temperature](image)
Oxidation Resistance

Oxidation Weight Loss vs. Temperature for 10 Thermal Cycles in Air Between Indicated Temperature and Room Temperature

Weight Loss, mg/cm²

Temperature, °C

7 hours hold time per cycle at test temperature

Parametric Minimum Creep Rate

P = (1.279) (20-lg[min. creep rate in % per hour])/1000

Initial Stress, MPa
Parametric Stress Rupture Strength

LMP = Larson Miller Parameter
LMP = T (21.5 + log tr)/1000
Where: Temperature [K] and rupture time [h]
Lower Scatter Band represents 95% confidence level
Manufacturing Characteristics

Machining
In general terms the machinability of Centralloy® G 4879 Micro 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. 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 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, 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. 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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- Petrochemicals
- Iron-ore direct reduction

Services
- Business consulting
- Analysis of operational data
- Training of customer personnel
- Welding supervision

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