VDM® Powder 738LC

VDM® Powder 738LC is the low carbon powder variant of a precipitation hardenable nickel-base alloy for use in additive manufacturing. The alloy is strengthened mainly through the precipitation of γ-phase with Ni3(Al, Ti).

VDM® Powder 738LC is characterized by:

- spherical particles with low level of satellites
- high purity and reproducibility level
- low oxygen content
- small amount of porosity
- good flowability
- high apparent and tap density

Designations and standards

<table>
<thead>
<tr>
<th>Standard</th>
<th>Material designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAE AMS</td>
<td>5410 C*</td>
</tr>
</tbody>
</table>

Table 1 – Designations and standards, *only chemical analysis except Zr.
Chemical composition

<table>
<thead>
<tr>
<th></th>
<th>Ni</th>
<th>C</th>
<th>Cr</th>
<th>Co</th>
<th>Mo</th>
<th>W</th>
<th>Ta</th>
<th>Nb</th>
<th>Al</th>
<th>Ti</th>
<th>B</th>
<th>Zr</th>
<th>Fe</th>
<th>Mn</th>
<th>Si</th>
<th>S</th>
<th>N</th>
<th>O</th>
</tr>
</thead>
<tbody>
<tr>
<td>min.</td>
<td>0.09</td>
<td>15.70</td>
<td>3.00</td>
<td>1.50</td>
<td>2.40</td>
<td>1.50</td>
<td>0.60</td>
<td>3.20</td>
<td>3.20</td>
<td>0.007</td>
<td>0.01</td>
<td>0.09</td>
<td>0.13</td>
<td>16.30</td>
<td>9.00</td>
<td>3.00</td>
<td>1.50</td>
<td>0.00</td>
</tr>
<tr>
<td>max.</td>
<td>0.13</td>
<td>16.30</td>
<td>9.00</td>
<td>2.00</td>
<td>2.80</td>
<td>2.00</td>
<td>1.10</td>
<td>3.70</td>
<td>3.70</td>
<td>0.012</td>
<td>0.08</td>
<td>0.10</td>
<td>0.02</td>
<td>0.30</td>
<td>0.015</td>
<td>0.02</td>
<td>0.03</td>
<td></td>
</tr>
</tbody>
</table>

Table 2 – Chemical composition (%)

Depending on the use conditions, stricter analysis limits apply to certain alloy elements.

Physical properties

<table>
<thead>
<tr>
<th>Particle size distribution [µm]</th>
<th>Flowability</th>
<th>Apparent density</th>
<th>Tap density</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-53</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3 – Selection of possible testing methods

Standard inspection certificate contains particle size distribution and chemical analysis. Additional tests can be performed on request.

<table>
<thead>
<tr>
<th>Density</th>
<th>Melting range</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.11 g/cm³ at 20 °C</td>
<td>1,230-1,315 °C</td>
</tr>
<tr>
<td>0.293 lb/in³ at 68 °F</td>
<td>2,250-2,400 °F</td>
</tr>
</tbody>
</table>

Table 4 – Density and melting range of VDM® Alloy 738
Microstructural properties

VDM® Powder 738LC microstructure consists primarily out of a $\gamma$-phase matrix and the $\gamma'$ intermetallic phase of the form Ni$_3$Al. The solid solution elements present are chromium, cobalt, tungsten and tantalum; these equally contribute to the structural stability of the alloy. Carbides and borides form the main grain boundary strengtheners.

Image 1: Exemplary morphology of VDM® Powder 738LC. Particle size: 15-53µm
Applications

VDM® Powder 738LC can be used for a wide range of processes:

- Laser based additive manufacturing
- Electron beam based additive manufacturing
- Coatings
- Direct energy deposition
- Overlay welding
- Cold and hot isostatic pressing (CIP / HIP)

VDM® Powder 738LC can be used for many demanding applications. Originally, it was developed and used for static and rotating components in aircraft turbines such as housings, mounting elements and turbine blades and vanes because of the excellent oxidation resistance.

Availability

According to the requirements of the powder based processes, VDM® Powder 738LC is available in a wide range of particle fractions from 15 to 250 µm. The typical powder atomization yield ranges from 0.1 to 300 µm. After atomization, the powder is sieved and air classified according to customers specifications. All production and handling operations are carried out under protective atmosphere (argon).

Standard particle fractions

<table>
<thead>
<tr>
<th>Particle size distribution</th>
<th>Fine particle</th>
<th>D10</th>
<th>D50</th>
</tr>
</thead>
<tbody>
<tr>
<td>[µm]</td>
<td></td>
<td>µm</td>
<td>µm</td>
</tr>
<tr>
<td>15-53</td>
<td>&lt;15 µm max. 3%</td>
<td>22</td>
<td>35</td>
</tr>
</tbody>
</table>

Table 6 – Standard particle size distribution

Other powder size range distributions are available on request. The determination of the PSD is done by laser diffraction according to ASTM B822. Sieve analysis according to ASTM B214 can also be offered on request.
Packaging

The whole production and packaging process at VDM Metals is under argon and the powder has no contact to atmosphere. The standard powder is packed in plastic bags (5 kg/10 kg/20 kg) under argon inside of sealed plastic drums (6l). Other packaging are available on request.

Handling

Please note that powder transportation may result in segregation of particle sizes. Do not open the container in humid environment. After contact with air the powder has limited storability. Humidity can influence the powder properties.
Legal notice

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