Leading the Way in the Production of Plasma Atomized Spherical Metal Powders

Specialists in Powders for Additive Manufacturing

10+ years servicing major customers
AP&C: Large Scale Production of Spherical Titanium Powders

Superior Features
- Low oxygen content
- High purity
- Crucible and ceramic free melting
- Excellent flowability
- High apparent and tap densities
- Highly spherical with very few satellites
- Low porosity content
- Virtually no gas entrapped porosities
- Batch to batch consistency
- High spherocity with few to no satellites
- Low internal particle hollows/pores
- Virtually no entrapped argon gas

Core Expertise In
- Plasma atomization technology
- Titanium and Ti alloys
- Nickel superalloys
- Reactive metals
- Powder handling

Superior Services
- Segregated reactors for main products
- Tailored size distributions
- Expert knowledge of Ti alloy powders
- Certified quality system (AS9100C and ISO 9001:2008)
- Complete powder certification
- Traceability from ingot to powder
- Flexible packaging solutions

End Markets
- Aerospace
- Biomedical
- Industrial
- Oil & gas
- Research

Spherical Powders Designed for
- Additive Manufacturing (3D printing)
- Metal Injection Moulding (MIM)
- Cold and Hot Isostatic Pressing (CIP and HIP)
- Coatings
AP&C has 10+ years of experience working with major biomedical and aerospace OEM. AP&C is the only company able to supply the highest quality AM powder at competitive price points.

AP&C’s mission is to enable the production of high quality parts made from Titanium and other high melting points alloys in Additive Manufacturing and Powder Metallurgy processes. AP&C continuously invest in R&D to optimize the proprietary Advanced Plasma Atomization process to provide superior quality products at competitive process.

In the fall of 2017 AP&C will open a new state-of-the-art facility for increased capacity and R&D. The new facility ensures site redundancy and a secured supply chain for customers.

“AP&C is the only company able to supply the highest quality AM powder at competitive price points.”
AP&C’s proprietary Plasma Atomization Process (APA) uses plasma torches to melt and atomize the metal wire feedstock which is sourced from 100% virgin/multiple melted material. The melting wire never comes into contact with any solid surface and thus the process prevents contamination, ensuring a high purity product. The reactor is purged to a low level vacuum prior to each production batch and the powder is atomized in a high purity argon atmosphere to ensure the lowest oxygen content.

Using a wire feedstock allows an accurate feeding rate and therefore provides excellent control over the powder size distribution and batch to batch consistency. The wire chemical composition is maintained allowing for better control of the powder chemistry.

AP&C’s plasma atomization process superheats the metal. The following cooling stage rapidly solidifies the melt into highly spherical powder. A low concentration of suspended particles is maintained in the reactor chamber in order to prevent the formation of satellites. Because of this low level of satellite particles, AP&C spherical powders exhibit an excellent flowability rating.

The as-produced powder size distribution ranges from 0 to 250 micron with the vast majority between 0 to 106 micron or 0 to 75 micron depending on configuration. Powder is sieved to the particular requirements of each customer. Before packaging and shipping, each lot is blended for homogeneity, tested and certified.
Standard Spherical Powder Products

- CP-Ti grade 1 and 2
- Ti-6Al-4V grade 5 and 23 (ELI)
- Nickel superalloy (IN 718)

Custom Spherical Powder Products

- Ti alloys
- Ti-6Al-2Sn-4Zr-2Mo
- Ti-5Al-5V-5Mo-3Cr
- Ti-5Al-2.5Sn (grade 6)
- Nickel-titanium
- etc.

- Nickel superalloys
- Molybdenum and alloys
- Niobium and alloys
- Tantalum and alloys
- Zirconium and alloys
- etc.

Characterization Available

- Size distribution by sieving (ASTM B214)
- Size distribution by laser diffraction (ASTM B822)
- Flowability (ASTM B213 and ASTM B964)
- Apparent density (ASTM B212)
- Tap density (ASTM B527)
- Chemical composition (ASTM E1409, E1447, E1941, E2371 etc.)*

*Powder chemical composition analysis is outsourced to a certified independent laboratory.
## Typical Physical Properties

<table>
<thead>
<tr>
<th>Size range</th>
<th>0-25 μm</th>
<th>0-45 μm</th>
<th>15-45 μm</th>
<th>45-106 μm</th>
<th>45-250 μm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morphology</td>
<td>spherical</td>
<td>spherical</td>
<td>spherical</td>
<td>spherical</td>
<td>spherical</td>
</tr>
<tr>
<td>Size distribution</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d10</td>
<td>8 μm</td>
<td>14 μm</td>
<td>20 μm</td>
<td>50 μm</td>
<td>60 μm</td>
</tr>
<tr>
<td>d50</td>
<td>15 μm</td>
<td>32 μm</td>
<td>34 μm</td>
<td>70 μm</td>
<td>144 μm</td>
</tr>
<tr>
<td>d90</td>
<td>24 μm</td>
<td>47 μm</td>
<td>46 μm</td>
<td>105 μm</td>
<td>225 μm</td>
</tr>
<tr>
<td>Flowability</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASTM B213&lt;sup&gt;(1)&lt;/sup&gt;</td>
<td>x</td>
<td>x</td>
<td>30 s</td>
<td>23 s</td>
<td>23 s</td>
</tr>
<tr>
<td>ASTM B964&lt;sup&gt;(2)&lt;/sup&gt;</td>
<td>x</td>
<td>x</td>
<td>10 s</td>
<td>4 s</td>
<td>4 s</td>
</tr>
<tr>
<td>Apparent density</td>
<td>NA</td>
<td>NA</td>
<td>2.50 g/cm³</td>
<td>2.55 g/cm³</td>
<td>2.70 g/cm³</td>
</tr>
<tr>
<td>Tap density</td>
<td>2.8 g/cm³</td>
<td>2.9 g/cm³</td>
<td>2.8 g/cm³</td>
<td>2.9 g/cm³</td>
<td>3.0 g/cm³</td>
</tr>
</tbody>
</table>

<sup>(1)</sup> Flowability tested using the Hall flowmeter.
<sup>(2)</sup> Flowability tested using the Carney flowmeter.

## Typical Chemical Composition

<table>
<thead>
<tr>
<th></th>
<th>CP-Ti grade 1</th>
<th>Ti-6Al-4V grade 5</th>
<th>Ti-6Al-4V grade 23</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum (Al)</td>
<td>-</td>
<td>5.50 - 6.75</td>
<td>5.50 - 6.50</td>
</tr>
<tr>
<td>Vanadium (V)</td>
<td>-</td>
<td>3.50 - 4.50</td>
<td>3.50 - 4.50</td>
</tr>
<tr>
<td>Oxygen (O)</td>
<td>0.07 - 0.18</td>
<td>0.11 - 0.20</td>
<td>0.07 - 0.13</td>
</tr>
<tr>
<td>Iron (Fe)</td>
<td>&lt; 0.20</td>
<td>&lt; 0.25</td>
<td>&lt; 0.25</td>
</tr>
<tr>
<td>Carbon (C)</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>Nitrogen (N)</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>Hydrogen (H)</td>
<td>0.010</td>
<td>0.010</td>
<td>0.010</td>
</tr>
<tr>
<td>Tin (Sn)</td>
<td>-</td>
<td>&lt; 0.10</td>
<td>&lt; 0.10</td>
</tr>
<tr>
<td>Molybdenum (Mo)</td>
<td>-</td>
<td>&lt; 0.10</td>
<td>&lt; 0.10</td>
</tr>
<tr>
<td>Copper (Cu)</td>
<td>-</td>
<td>&lt; 0.10</td>
<td>&lt; 0.10</td>
</tr>
<tr>
<td>Manganese (Mn)</td>
<td>-</td>
<td>&lt; 0.10</td>
<td>&lt; 0.10</td>
</tr>
<tr>
<td>Zirconium (Zr)</td>
<td>-</td>
<td>&lt; 0.10</td>
<td>&lt; 0.10</td>
</tr>
<tr>
<td>Yttrium (Y)</td>
<td>&lt; 0.005</td>
<td>&lt; 0.005</td>
<td>&lt; 0.005</td>
</tr>
<tr>
<td>Sn + Mo + Cu + Mn</td>
<td>-</td>
<td>&lt; 0.20</td>
<td>&lt; 0.20</td>
</tr>
<tr>
<td>Other elements, each</td>
<td>&lt; 0.10</td>
<td>&lt; 0.10</td>
<td>&lt; 0.10</td>
</tr>
<tr>
<td>Other elements, total</td>
<td>&lt; 0.40</td>
<td>&lt; 0.40</td>
<td>&lt; 0.40</td>
</tr>
<tr>
<td>Titanium (Ti)</td>
<td>balance</td>
<td>balance</td>
<td>balance</td>
</tr>
</tbody>
</table>

AP&C standard size distributions have a ±5% margin of error and are tested according to ASTM B214 standard. All AP&C titanium and titanium alloy powders conform to the chemistry of ASTM B348 and ASTM F1580 standards. Chemistry of AP&C CP-Ti grade 1 powders can also conform to ASTM F67 standard. Chemistry of AP&C Ti-6Al-4V grade 23 powders can also conform to ASTM F2924, ASTM F136 and AMS 4956 standards. Chemistry of AP&C Ti-6Al-4V grade 5 powders can also conform to ASTM F3001, AMS 4998 and AMS 4928 standards. Particle size distribution strongly influence the oxygen content.
Standard size distributions for CP-Ti and Ti-6Al-4V:

- 0-20, 0-25 and 0-45 micron (MIM and coatings)
- 15-45 and 25-45 micron (laser additive manufacturing or coatings)
- 45-106 micron (electron beam additive manufacturing)
- 45-150, 45-250 and 0-250 micron (CIP and HIP)

*Our fine spherical powders are of the highest quality to meet the demands of the biomedical and aerospace industries*
AP&C
A GE Additive Company

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ISO 9001 : 2008
AS 9100C