Critical applications require the highest quality products. Global Tungsten & Powders has been developing and manufacturing industry leading tungsten carbide based, molybdenum, and chrome based thermal spray powders for over 40 years. Many of our powders are approved for some of the world's most demanding applications. Whether you are responsible for jet engine components or deep hole drill bits, you can rely on GTP to provide the materials you need to stand up to the harshest environments. If corrosion issues are wearing on you, GTP can put your mind at ease.
Benefits of Working with GTP

PARTNERSHIP. When you succeed, we succeed; that is the approach we take at Global Tungsten & Powders. Your process, application and products are unique, we know that a cooperative technical effort is required to meet these needs. GTP will work with you through every step of the process to ensure our powders meet your specifications.

EXPERIENCE. Global Tungsten & Powders has been developing and manufacturing thermal spray powders for nearly forty years. We have developed numerous molybdenum, tungsten carbide and chrome carbide thermal spray powders to meet the specific needs of our customers applications.

SECURITY. Global Tungsten & Powders has exclusive supply agreements with tungsten mines throughout the world. We do not source from China or from conflict regions. From ore concentrate we produce our APT, tungsten oxide, tungsten powder, and tungsten carbide. Additionally, we have the capability to produce APT from secondary raw materials (or scrap). Our flexible front end allows us to ensure a consistent stream of product and helps you manage costs.

PRODUCTS. In addition to a strong technical relationship, a wide range of products is key to being a good partner. At GTP, we are constantly developing powders to meet the needs of the newest applications. If your process requires a special material, please contact us.

ENVIRONMENTAL RESPONSIBILITY. GTP has the highest regard for the environment. We have spent millions of dollars maintaining and upgrading our environmental protection equipment and are compliant with the standards set forth in ISO 14001. We recycle as many of our raw materials as possible including tungsten, hydrogen, ammonia, water and others. Preservation of our natural resources is an important component of how we do business.
Powder Perfect™ Thermal Spray Powders

SX178 - Tungsten Carbide Based

SX456 - Tungsten Carbide Based

SX195 - Chrome Carbide Based

Special Blends

Representation of where specific GTP Powders fall in relation to Wear Resistance, Corrosion Resistance, & Toughness

Wear Resistance

Toughness

Corrosion

SX 480
SX 427
SX 178
SX 195
SX 199
SX 112
SA 201
## Properties of typical Powder Perfect™ Thermal Spray Powders

Custom powders are routinely developed by GTP to meet specific customer requirements.

### Tungsten Carbide Based Thermal Spray Powders

<table>
<thead>
<tr>
<th>SEM Photo</th>
<th>GTP Type (µm)</th>
<th>Size Range</th>
<th>WC %</th>
<th>Co %</th>
<th>Cr %</th>
<th>Mo %</th>
<th>Ni %</th>
<th>C %</th>
<th>Apparent Density (g/cm³)</th>
<th>Morphology</th>
</tr>
</thead>
<tbody>
<tr>
<td>SX 427</td>
<td>-54 / +10</td>
<td>93.0</td>
<td>7.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>5.4 - 6.0</td>
<td>2.5 - 3.5</td>
<td></td>
</tr>
<tr>
<td>SA 201</td>
<td>-106 / +44, -54 / +10, -44 / +15, -44 / +10</td>
<td>88.0</td>
<td>12.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>5.15 min</td>
<td>4.6 - 5.4</td>
<td>Densified</td>
</tr>
<tr>
<td>SD 251</td>
<td>-44 / +10</td>
<td>89.0</td>
<td>11.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3.9 - 4.3</td>
<td>6.0 - 7.0</td>
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</tr>
<tr>
<td>SD 252</td>
<td>-106 / +44</td>
<td>89.0</td>
<td>11.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<td>3.6 - 4.3</td>
<td>6.0 - 6.4</td>
<td></td>
</tr>
<tr>
<td>SD 254</td>
<td>-25 / +5</td>
<td>89.0</td>
<td>11.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3.9 - 4.3</td>
<td>6.0 - 7.0</td>
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<tr>
<td>SX 408</td>
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<td>88.0</td>
<td>12.0</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>5.15 min</td>
<td>2.5 - 4.0</td>
<td></td>
</tr>
<tr>
<td>SX 112</td>
<td>-54 / +10, -44 / +10</td>
<td>83.0</td>
<td>17.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>4.8 - 5.6</td>
<td>3.0 - 3.8</td>
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</tr>
<tr>
<td>SX 158</td>
<td>-54 / +10, -44 / +10</td>
<td>83.0</td>
<td>17.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>4.6 - 5.6</td>
<td>4.7 - 5.5</td>
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</tr>
<tr>
<td>SX 178</td>
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<td>86.0</td>
<td>10.0</td>
<td>4.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>4.7 - 5.7</td>
<td>5.2 - 6.5</td>
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</tr>
<tr>
<td>SX 477</td>
<td>-44 / +10</td>
<td>90.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>10.0</td>
<td>5.15 min</td>
<td>3.0 - 3.8</td>
<td></td>
</tr>
<tr>
<td>SX 480</td>
<td>-54 / +10, -44 / +10</td>
<td>90.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>10.0</td>
<td>5.15 min</td>
<td>4.6 - 5.4</td>
<td></td>
</tr>
<tr>
<td>SX 454</td>
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<td>12.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>5.15 min</td>
<td>3.0 - 3.8</td>
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</tr>
<tr>
<td>SX 456</td>
<td>-44 / +10</td>
<td>86.0</td>
<td>10.0</td>
<td>4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>4.7 - 5.7</td>
<td>3.0 - 6.0</td>
<td></td>
</tr>
</tbody>
</table>
### Chrome Based Thermal Spray Powders

<table>
<thead>
<tr>
<th>SEM Photo</th>
<th>GTP Type (µm)</th>
<th>Size Range</th>
<th>WC %</th>
<th>Co %</th>
<th>Cr %</th>
<th>Mo %</th>
<th>Ni %</th>
<th>C %</th>
<th>Apparent Density (g/cm³)</th>
<th>Morphology</th>
</tr>
</thead>
<tbody>
<tr>
<td>SX 195</td>
<td>-54 / +10</td>
<td>-44 / +10</td>
<td>-32 / +5</td>
<td>&lt;2</td>
<td>&lt;0.5</td>
<td>Balance</td>
<td>20.0</td>
<td>9.0 - 10.1</td>
<td>2.6 - 3.8</td>
<td>Densified</td>
</tr>
<tr>
<td>SX 199</td>
<td>-54 / +10</td>
<td>Balance</td>
<td>&lt;0.5</td>
<td>21.0 - 25.0</td>
<td>-</td>
<td>7.0</td>
<td>5.5 - 6.5</td>
<td>4.7 - 5.6</td>
<td>Densified</td>
<td></td>
</tr>
<tr>
<td>SX 220</td>
<td>-54 / +15</td>
<td>&lt;2</td>
<td>&lt;0.5</td>
<td>Balance</td>
<td>-</td>
<td>20.0</td>
<td>9.0 - 10.1</td>
<td>2.6 - 3.8</td>
<td>Densified</td>
<td></td>
</tr>
<tr>
<td>SX 441</td>
<td>-54 / +15</td>
<td>&lt;2</td>
<td>&lt;0.5</td>
<td>Balance</td>
<td>Trace</td>
<td>40.0</td>
<td>6.0 - 7.0</td>
<td>3.5 - 4.5</td>
<td>Densified</td>
<td></td>
</tr>
</tbody>
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### Molybdenum Based Thermal Spray Powders

<table>
<thead>
<tr>
<th>SEM Photo</th>
<th>GTP Type (µm)</th>
<th>Size Range</th>
<th>WC %</th>
<th>Co %</th>
<th>Cr %</th>
<th>Mo %</th>
<th>Ni %</th>
<th>C %</th>
<th>Apparent Density (g/cm³)</th>
<th>Morphology</th>
</tr>
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<tbody>
<tr>
<td>SA 101</td>
<td>-90 / +44</td>
<td>-44 / +20</td>
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<td>-</td>
<td>-</td>
<td>&gt; 99.5</td>
<td>-</td>
<td>-</td>
<td>2.0 - 2.7</td>
<td>Agglomerated and Sintered</td>
</tr>
<tr>
<td>SD 151</td>
<td>-90 / +44</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>&gt; 99.5</td>
<td>-</td>
<td>-</td>
<td>5.0 min</td>
<td>Densified</td>
<td></td>
</tr>
<tr>
<td>SD 152</td>
<td>-44 / +10</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>&gt; 99.5</td>
<td>-</td>
<td>-</td>
<td>5.0 min</td>
<td>Densified</td>
<td></td>
</tr>
<tr>
<td>SX 276</td>
<td>-90 / +44</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>97.8</td>
<td>Trace</td>
<td>1.8 - 2.4</td>
<td>1.5 - 2.5</td>
<td>Agglomerated and Sintered</td>
<td></td>
</tr>
<tr>
<td>SX 391</td>
<td>-90 / +44</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>94</td>
<td>Trace</td>
<td>5.5 - 6.5</td>
<td>Report</td>
<td>Agglomerated and Sintered</td>
<td></td>
</tr>
<tr>
<td>SA 901C</td>
<td>-90 / +44</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2.0 - 5.0</td>
<td>Balance</td>
<td>12.5 - 16.5</td>
<td>0 - 1.5</td>
<td>2.0 - 4.3</td>
<td>Agglomerated and Sintered</td>
</tr>
</tbody>
</table>
Markets and Applications for Thermal Spray Powders

**Powder Perfect™ Tungsten Carbide Based Thermal Spray Powders**

- **Aerospace**
  - SX 158
  - Wear Resistance
  - Transverse Rupture Strength
  - Tribological Properties

- **Hydroelectric**
  - SX 178
  - Wear Resistance
  - Transverse Rupture Strength
  - Tribological Properties

**Powder Perfect™ Chrome Carbide Based Thermal Spray Powders**

- **Petrochemical**
  - SX 195
  - Wear Resistance
  - Transverse Rupture Strength
  - Tribological Properties

- **Paper**
  - SX 199
  - Wear Resistance
  - Transverse Rupture Strength
  - Tribological Properties

**Powder Perfect™ Molybdenum Based Thermal Spray Powders**

- **Plastics**
  - SX 276
  - Wear Resistance
  - Transverse Rupture Strength
  - Tribological Properties

- **Automotive**
  - SA 901C
  - Wear Resistance
  - Transverse Rupture Strength
  - Tribological Properties

**Critical Characteristics of Thermal Spray Powders:**

- **Wear resistance, hardness** - ability of one material to wear, abrade, deform or indent another material
- **Transverse rupture strength** - stress required to break a specimen; used to evaluate mechanical strength
- **Tribological properties** - dealing with interacting surfaces in relative motion, a process leading to wear
- **Specific weight, density** - a means of quality control, cemented WC approaches theoretical density when sintered
- **Thermal shock resistance** - measure of a material's ability to withstand major temperature changes without cracking
- **Corrosion resistance** - resistance to the interaction between oxygen molecules and the substances it interacts with
- **Tensile Adhesion** - stress required to break the bond between coating and substrate; evaluates coating adhesion strength
Global Tungsten & Powders analytical lab examines materials, breaking them down into their basic components using some of the most advanced testing methods, in one of the best equipped testing facilities in the US. GTP’s Materials Analysis Laboratories in Towanda are accredited for chemical and mechanical testing by the American Association for Laboratory Accreditation. Testing laboratories that comply with this International Standard also operate in accordance with ISO9001-2008. Additional information on this accreditation, including the scope, is available upon request. Analytical services are available to other groups in the corporation and to outside customers. For information about our analytical capabilities, please visit our web-site or contact GTP directly.

**Product and Shipping Information**

**Customization**
Thermal spray powders are some of the most unique powders produced today. We have shown our "standard" powders in this brochure, when it comes to thermal spray powders, there is no such thing as "standard." GTP has developed hundreds of thermal spray powder types over the years and will work closely with you to produce a powder that meets your specific needs.

**Packaging**
Typically each lot is packaged in a plastic bag inside a metal pail. Each pail contains 25 kilograms of thermal spray powder per pail. Alternative packaging can be discussed at time of order placement (for example, 5 kg orange plastic bottles).

**Certification**
Lot data for the above physical and chemical specifications is reported in a certificate of analysis that is provided for each batch. Additional Information is available upon request.
Global Tungsten & Powders
1 Hawes Street • Towanda, PA • 18848 • USA
Phone: +1 (570) 268-5000
e-mail: Info@globaltungsten.com
web: www.globaltungsten.com

History of Global Tungsten & Powders:
Global Tungsten & Powders is headquartered in Towanda PA. We have manufacturing facilities in Brúnctal in the Czech Republic and Jyväskylä in Finland. GTP began manufacturing tungsten products over 70 years ago. In addition to tungsten based powders and products, GTP produces molybdenum, cobalt, and tantalum powders. We began manufacturing WC/Co grade powders nearly 50 years ago followed shortly after that by thermal spray powders. Thermal spray powders manufactured by GTP are used in numerous industries including petrochemical, paper manufacturing, electronics, aerospace, automotive, plastics, power generation and anyplace else wear and corrosion resistance are important.

The information and recommendations contained in this publication are based upon data collected by Global Tungsten & Powders Corp. and believed to be correct. However, no guarantee or warranty of any kind, expressed or implied, is made with respect to the information contained herein, Global Tungsten & Powders Corp. assumes no responsibility for the results of the use of products and processes described herein. No statements or recommendations made herein are to be construed as inducements to infringe any relevant patent, now or hereafter in existence. © 2016