Serving The Needs of Science and Industry Worldwide
Au service de la Science et de l’Industrie dans le monde entier
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Tel: 00 86 21 6112 1560
# Standard Price List for All Powders

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Goodfellow is well known as a specialist supplier of small to medium size quantities of metals, alloys, ceramics, polymers and other materials to meet the research, development and specialist production requirements of science and industry worldwide. We realise that "small" means different things to different people, but we consider small to mean any quantity from a few grammes to a few kilos.

Goodfellow offers two distinct services to meet the requirements of our customers:

- The first meets the needs of our customers who need small quantities of products from our standard range of materials within 24-48 hours.
- The second service is for those who require larger quantities or further processing of our standard products or who need an item which falls within our general area of supply expertise.

The range of materials offered by Goodfellow is extensive, as are the forms in which the various products are available. This Catalog provides a detailed overview of our standard products which are available from stock. Full details of all of these items, including prices and technical information, can be found in our web Catalog at www.goodfellowusa.com.

Materials

Metals and Alloys

Goodfellow supplies virtually all of the pure metals from Aluminum to Zirconium as well as a comprehensive range of alloys. Most are available in a variety of forms, including rod, wire and foil. The Catalog details those materials which are available as standard products from stock. Custom-made items are also available, so please contact us if you are unable to identify the item you require.

Ceramics

The ceramic materials offered by Goodfellow have been carefully chosen and include both the established as well as more recently developed products. All are available as either standard or custom-made products in a variety of forms and sizes. The Catalog details those items which are available from stock. For ceramic components made to customer drawings, our Ceramic and Glass Division would be delighted to help. Please visit www.goodfellow-ceramics.com for further information.

Polymers

The range of polymers supplied by Goodfellow is broad and includes both the familiar as well as some of the more unusual or recently developed materials. The Catalog details those items which are available from stock; please contact us if you are unable to find the item you specifically require.

Compounds & Intermetallics

Goodfellow can supply aluminides, borides and silicides as well as other intermetallics and compounds. The majority of these items are made to order, and the Catalog details those which are available. Please contact us with details of your requirements.

Composites

Some examples of these materials are listed in the Catalog. As some of these are manufactured on a custom-made basis, please contact us with details of your requirements.

Glasses

Goodfellow offers two distinct types of glass products. The first are generally silica-based and transparent. Generally, these products are made to order for customers, so we do not list them in our Catalog, however, they are available through the Goodfellow Ceramic and Glass Division. Please contact us with your requirements.

The second type of glass product is commonly referred to as "metallic glasses" or "glassy metals". In contrast to crystalline metals and alloys with highly ordered atomic structures, these are non-crystalline (amorphous) metals or, more usually, alloys. Our Catalog details those glassy metals which are available from stock; please contact us if you are unable to find the item you specifically require.
Product Descriptions

**Bar**

A straight length of rectangular, square or oval section material.

**Tolerances**

<table>
<thead>
<tr>
<th>Section dimensions:</th>
<th>≤10mm</th>
<th>±10%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&gt;10mm</td>
<td>±1mm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Length:</th>
<th>&lt;100mm</th>
<th>±1mm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≥100mm</td>
<td>±5% / -1%</td>
</tr>
</tbody>
</table>

**Bolt**

A threaded pin that can be screwed into a nut or a tapped hole to fasten items together. Bolts are available with different head styles and also in metric and inch-threaded sizes.

**Tolerances**

See item

**Chopped Fiber**

Fibers cut into short lengths called cut, staple or chopped fiber.

**Tolerances**

<table>
<thead>
<tr>
<th>Fiber diameter:</th>
<th>±25%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of strands:</td>
<td>±10%</td>
</tr>
<tr>
<td>Tex number:</td>
<td>±10%</td>
</tr>
<tr>
<td>Length:</td>
<td>±5% / -1%</td>
</tr>
</tbody>
</table>

**Crucible**

A vessel in which other materials may be heated or melted, usually at high temperatures.

**Tolerances**

<table>
<thead>
<tr>
<th>Height:</th>
<th>±10%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inside Dimensions:</td>
<td>±10%</td>
</tr>
<tr>
<td>Outside Dimensions:</td>
<td>±10%</td>
</tr>
</tbody>
</table>

**Fabric**

Woven fabrics are made by the regular interlacing of two arrays of yarns at right angles to each other, these being referred to as the warp and weft (see also Non-woven fabric).

**Tolerances**

<table>
<thead>
<tr>
<th>Fabric thickness:</th>
<th>±25%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of yarns:</td>
<td>±10%</td>
</tr>
<tr>
<td>Tex number:</td>
<td>±10%</td>
</tr>
<tr>
<td>Size (linear dimension):</td>
<td>&lt;100mm</td>
</tr>
<tr>
<td></td>
<td>≥100mm</td>
</tr>
</tbody>
</table>

**Fiber**

Yarns or tows consisting of several approximately parallel individual filaments, each filament usually being smaller in diameter than a monofilament. Yarns contain a defined number of filaments, typically three to several hundred; tows contain thousands of filaments whose number is only defined approximately. Both are primarily specified by their linear density measured in "tex", the weight in grams of a 1km length of material.

**Tolerances**

<table>
<thead>
<tr>
<th>Fiber diameter:</th>
<th>±25%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of strands:</td>
<td>±10%</td>
</tr>
<tr>
<td>Tex number:</td>
<td>±10%</td>
</tr>
<tr>
<td>Length:</td>
<td>±5% / -1%</td>
</tr>
</tbody>
</table>

**Film**

A non-metallic sheet material with a thickness <0.5mm.

**Tolerances**

| Thickness: | ±20% |
| Size (linear dimension): | <100mm | ±1mm |
|                     | ≥100mm | ±2% / -1% |

**Flake**

Flat, irregularly shaped pieces of material. A maximum flake size is indicated but individual flakes may vary greatly in size.

**Tolerances**

Dimensions shown are nominal
Product Descriptions

**Foam**
A low density, permeable structure of cells and continuous ligaments offering a high surface area to volume ratio, and also a high strength to weight ratio. Owing to the nature of this material, dimensions are nominal.

**Foil**
Thin sheets of pure metal and metal alloys. Due to their fragile nature, some foils are coated on one side with an acrylic or polyester support. Where foils are supported they are indicated in the detailed item description.

**Granule**
Pellets of an approximately regular shape. Granules may vary in size and, therefore, the dimensions stated are nominal. In addition, the shape of a granule may vary from item to item.

**Honeycomb**
A cellular structure similar in appearance to natural honeycomb. Owing to the nature of this material, dimensions are nominal.

**Insulated Wire**
A single or multiple flexible strand of metal or alloy with an insulating sheath.

**Laminate**
Layers of material which have been bonded together by the use of heat, pressure and, possibly, adhesive.

**Lump**
A solid piece of material with no defined shape.

**Mesh**
Mesh is available as either a woven wire or electroformed product; in all cases, the quoted aperture sizes are nominal. Wire mesh: a material which is woven from metal wires to provide a thin grid with a regular series of holes. Electroformed mesh: a product made by electroplating the mesh geometry through a mask onto a substrate which is subsequently etched away.

**Metallized Film**
Film which is coated with a metal. The thickness of the metal is measured and described in terms of the material’s specific electrical resistance in ohms per square.

Please visit [www.goodfellowusa.com](http://www.goodfellowusa.com) or email [info@goodfellowusa.com](mailto:info@goodfellowusa.com) for latest prices.
## Product Descriptions

### Microfoil
An extremely thin sheet of metal or alloy mounted on a permanent support. This support cannot be removed without destroying the Microfoil.

**Tolerances**
- **Thickness:** $\pm 30\%$
- **Size:** $\pm 20\%$

### Microleaf
An extremely thin sheet of metal mounted on a removable support. Microleaf is not available for metals which are too brittle to be free standing.

**Tolerances**
- **Thickness:** $\pm 30\%$
- **Size:** $\pm 20\%$

### Monofilament
A single strand of a non-metallic material.

**Tolerances**
- **Diameter:** $\pm 20\%$
- **Length:** $+5\% / -1\%$

### Non-Woven Fabric
Non-woven fabrics are made by methods other than weaving or knitting, the yarns and fibers being held together, often quite loosely, by means other than geometric interlacing. Due to the open and porous nature of this material, all other dimensions are nominal.

**Tolerances**
- **Size (linear dimension):**
  - $< 100\text{mm}$: $\pm 5\text{mm}$
  - $\geq 100\text{mm}$: $\pm 5\%$

### Nut
Generally a flat piece of material with a threaded hole which can be screwed onto a bolt to fasten items together. Nuts typically have a hexagonal external shape. Nuts are available in metric and inch-threaded sizes.

**Tolerances**
- See item

### Powder
Small particles with an approximately defined size range. Those materials described as alloy precursors are not true alloys - they are made by sintering a blend of powders of the component metals to achieve alloying by diffusion. The resultant cake is ground and sieved to the required particle size range. Unless otherwise stated, the particle sizes shown are for guidance only. We do not guarantee either any particular size distribution between the quoted minimum and maximum sizes, or a specific particle shape.

**Tolerances**
- **Dimensions shown are nominal**

### Rod
A straight length of circular section material.

**Tolerances**
- **Diameter:**
  - $\leq 10\text{mm}$: $\pm 10\%$
  - Polymer: $+20\%/-10\%$
  - Ceramic: $+20\%/-10\%$
  - $> 10\text{mm}$: $\pm 5\%$
  - Ceramic: $+20\%/-10\%$
  - Polymer: $+20\%/-10\%$

- **Length:**
  - $< 100\text{mm}$: $\pm 1\text{mm}$
  - $\geq 100\text{mm}$: $+5\% / -1\%$

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Please visit [www.goodfellowusa.com](http://www.goodfellowusa.com) or email [info@goodfellowusa.com](mailto:info@goodfellowusa.com) for latest prices.
### Sheet

Flat material with a thickness > 0.5mm.

**Tolerances**

<table>
<thead>
<tr>
<th>Material</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceramic</td>
<td>±10%</td>
</tr>
<tr>
<td>Composite</td>
<td>±20%</td>
</tr>
<tr>
<td>Polymer</td>
<td>±20%</td>
</tr>
</tbody>
</table>

**Size (linear dimension):**

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;100mm</td>
<td>±1mm</td>
</tr>
<tr>
<td>≥100mm</td>
<td>+2% / -1%</td>
</tr>
</tbody>
</table>

### Single Crystal

A material grown as a monocrystal, generally to a specific orientation, dimension and surface finish. It may contain a dopant. Single crystals are usually made to order.

**Tolerances**

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orientation</td>
<td>±3°</td>
</tr>
<tr>
<td>Size</td>
<td>Sizes shown are nominal</td>
</tr>
</tbody>
</table>

### Sphere

A regular solid or hollow three-dimensional form in which every cross-section is a circle. Spheres are available with standard or precision tolerances, and can be supplied with different surface finishes depending on the material.

**Tolerances**

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter (standard)</td>
<td>±5%</td>
</tr>
<tr>
<td>Diameter (precision)</td>
<td>see item</td>
</tr>
</tbody>
</table>

### Sputtering Target

A high purity material used as a source for sputtering, a cold vaporization process in which atoms are physically removed from the target surface by ion bombardment.

**Tolerances**

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thickness</td>
<td>±0.5mm</td>
</tr>
<tr>
<td>Size</td>
<td>±0.5mm</td>
</tr>
</tbody>
</table>

### Tube

A hollow length of material normally circular in section. Most tubes are straight except those made of flexible polymer.

**Tolerances**

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside diameter (Polymer)</td>
<td>±0.05mm</td>
</tr>
<tr>
<td>≤2mm</td>
<td>±5%</td>
</tr>
<tr>
<td>Ceramic</td>
<td>±10%</td>
</tr>
<tr>
<td>≤5mm</td>
<td>±0.1mm</td>
</tr>
<tr>
<td>Ceramic</td>
<td>±10%</td>
</tr>
<tr>
<td>&gt;5mm</td>
<td>±5%</td>
</tr>
<tr>
<td>Polymer</td>
<td>±10%</td>
</tr>
<tr>
<td>Ceramic</td>
<td>±10%</td>
</tr>
</tbody>
</table>

**Wall thickness:**

<table>
<thead>
<tr>
<th>Material</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polymer</td>
<td>±10%</td>
</tr>
<tr>
<td>Ceramic</td>
<td>±20%</td>
</tr>
</tbody>
</table>

**Length:**

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;100mm</td>
<td>±1mm</td>
</tr>
<tr>
<td>≥100mm</td>
<td>+5% / -1%</td>
</tr>
</tbody>
</table>

### Washer

A thin, flat piece of material with a hole in the middle, used in conjunction with bolts and nuts to distribute the load of a threaded fastener.

**Tolerances**

See item

### Wire

A single or multiple flexible strand of pure metal or alloy.

**Tolerances**

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wire diameter</td>
<td>±10%</td>
</tr>
<tr>
<td>Length</td>
<td>±5% / -1%</td>
</tr>
</tbody>
</table>
HAZARDS
All materials listed in this catalog, whatever the quantity supplied, are sold for research or development purposes. We make no warranty that the materials are fit for a particular purpose. In purchasing materials from this catalog, customers should be aware that there may be hazards associated with their use and in the handling of them. Complete toxicological or hazard investigations are the responsibility of the customer. Ingestion or contact with the human body may be harmful. The responsibility for the safe use of our products rests with the customer. All materials should be handled by qualified personnel familiar with laboratory procedures and who are familiar with the nature of the material and any necessary precautions which should be taken in the handling, use and storage of the products. The customer shall be responsible for the control and use of the products offered in this catalog whether alone or in combination with other articles or substances or in any other manner whatsoever.

HAZARD SYMBOLS

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>Corrosive</td>
</tr>
<tr>
<td>D</td>
<td>Dangerous when wet</td>
</tr>
<tr>
<td>E</td>
<td>Explosive</td>
</tr>
<tr>
<td>F</td>
<td>Extremely Flammable</td>
</tr>
<tr>
<td>Xi</td>
<td>Irritant</td>
</tr>
<tr>
<td>Xn</td>
<td>Harmful</td>
</tr>
<tr>
<td>F+</td>
<td>Extremely Flammable</td>
</tr>
<tr>
<td>X</td>
<td>Highly flammable</td>
</tr>
<tr>
<td>R</td>
<td>Radioactive</td>
</tr>
<tr>
<td>T</td>
<td>Toxic</td>
</tr>
<tr>
<td>T+</td>
<td>Very Toxic</td>
</tr>
</tbody>
</table>

Extremely Flammable
Chemicals which when finely divided (small particle size) are liable to ignite spontaneously.

Harmful
Chemicals which may cause death or acute or chronic damage to health when inhaled, ingested or absorbed via the skin.

Highly flammable
Chemicals which will ignite after contact with flame, or which will evolve highly flammable gases in contact with water.

Irritant
Non-corrosive chemicals which, through immediate, prolonged or repeated contact with the skin or mucous membrane may cause inflammation.

Radioactive
Chemicals which will emit ionising radiation without being subject to irradiation. General precautions for Toxic chemicals apply to those of low activity. For chemicals of medium or high activity special regulations apply.

Toxic
Chemicals which may cause death or acute or chronic damage to health when inhaled, ingested or absorbed via the skin.

Very Toxic
Chemicals which in low quantities cause death or acute or chronic damage to health when inhaled, ingested or absorbed via the skin.
Analyses

**Typical Analysis:**
Where appropriate a typical analysis is given. All figures are parts per million (ppm) by weight unless otherwise stated. It must be emphasised that this data is "typical" and no guarantee is given that the material supplied will conform to these analyses. The compositions shown under alloy headings are generally weight percent. Exceptions are the glassy alloys and the rare earth magnets where the convention of using atomic ratio is followed.

**Purity**
Purities listed are quoted with respect to total metallic impurities. Typical analyses may give additional information about likely non-metallic impurities.

**High Purity**
For materials described in the catalog as High Purity, the actual analysis of metallic impurities will be supplied free of charge. For other items, an actual analysis can be supplied and a charge will be made for the analysis and for the sample used.

If you require an analysis please tell us whether you require analysis of metallic impurities only or metallic and gaseous. Where an analysis is required the shipment of your order may be delayed.

**Supports**
Some items from our range of foils need to be supported on one side of the foil to enable both you and us to handle these very delicate materials. Two types of support can be used, the choice being governed by the material. Wherever possible we use a temporary support, a permanent support only being used when the material is brittle (for example Chromium or Manganese).

The temporary support is Acrylic, approximately 0.2mm thick. This may be removed by dissolving in 2-Propanone (Acetone).

Our permanent support is Polyester, thickness 0.125mm, which is hot-press laminated to one face of the foil. It **cannot** be removed without destroying the foil.

Microfoil is mounted on a permanent 3.5μm polyester support. This support **cannot** be removed without destroying the Microfoil.

Microleaf is mounted on a specially treated support which allows separation of the metal film from the support. Full instructions on the method of removal are issued with each Microleaf supplied.

**Light Tight (LT) & Not Light Tested (NLT)**
Light tight (LT) foils are supplied without visible pinholes after examination without magnification. Foils 0.025mm or more in thickness are supplied LT unless otherwise stated.

Foils less than 0.025mm thick are normally supplied Not-Light Tested (NLT), and will normally contain pinholes but may occasionally be free from pinholes. Foils less than 0.025mm in thickness can often be supplied LT but may incur additional charges. Please specify if you require LT foils.

**Vacuum tight**
Vacuum tight foils show no detectable leakage when tested with a helium mass spectrometer with a sensitivity of $10^{-9}$ atm-cm$^3$.s$^{-1}$.

**Continuous Lengths**
If you require material in continuous lengths please tell us when you place your order. Unless otherwise specified, we reserve the right to supply in more than one length.

**Technical Data and Information**
All information and technical data are given as a guide only. Although every effort has been made to ensure that the information is correct, no warranty is given as to its completeness or accuracy.

**Tolerances**
For details of our standard tolerances, please refer to the Product Description section. In many cases, closer tolerances are available but may be subject to an extra charge. If you have any special requirements it is important that you tell us at the time of ordering. This includes special tolerances, dimensional uniformity or any other special requirement which you may have (for example edge finish, packaging, labelling etc.). Please indicate precisely what is required and we shall do our best to meet your specification.
General Information
There are over 70,000 stock packs listed and if you cannot find what you need amongst them, please ask for special sizes, thicknesses, tolerances, dimensions or larger quantities. We are also able to offer many other pure metals, alloys, polymers and ceramics to special order.

Prices
All the prices listed are total (lot) prices for the sizes and quantities listed.
Prices shown are in US$ and include free delivery by our standard 48 hour service except for those items marked as "special offer" or dangerous goods with transport restriction. Prices are subject to change without notice and orders will be invoiced at prices ruling on the date of despatch.

Transport Restriction
Some of the materials supplied by Goodfellow are subject to special transport restrictions. Additional shipment charges may apply which are dependent on destination. Please check the individual item on our website or contact us for details of the charges.

Delivery
Delivery by UPS or Federal Express is included in the prices, although alternative methods may be used depending on the materials ordered.

Split Shipment
All orders are accepted for one shipment on one date to one address. A charge will be made for split shipments made at the customer's request.

Special Analysis, Supports or Tolerances
An extra charge is made for non-standard supports, alternative tolerances and certificates of analysis. The analysis is free of charge for items marked "High Purity".

Cancellations
A charge for cancellation of orders may be made. The amount will depend on the circumstances.

Express Service
Please inform us if you need to have your goods shipped urgently. An administrative charge will be made for this service, details can be found on our website.

Shipment
We aim to have all items listed in this catalog in stock in the quantities and sizes listed. We can only undertake to ship an order on a particular date. The date of delivery at the customer's address is subject to the normal variations of the delivery service used.

Despatch
Orders will normally be shipped within 48 hours of receipt.

Non-delivery
If we have notified you of the shipment of goods and you have not received delivery within 5 days, please contact us.

Insurance
All consignments will be insured by us against the usual risks unless we are instructed in writing to the contrary.

Export Restrictions
A UK Government export licence may be required for some items to some destinations. If the item you require needs a special export licence or an end-use statement we will inform you at the time you order.

Materials Handling
Many of our materials are extremely delicate and it is essential every care is taken when handling them. Special attention is drawn to the extreme fragility of Microfoil, Microleaf and thinner and finer materials.

All materials are carefully packed to ensure safe transport of goods to your address. We do not accept responsibility for damage caused by mishandling once the outer transit packaging has been removed.

Terms of payment
Our normal terms of payment are net 30 days from date of invoice. Any alternative terms of payment are to be agreed with us in writing at the time of placing an order. Customers may be asked to pay cash with order or cash against pro-forma
invoice with their first order. In order to establish a credit account we will require details of your bankers, along with two trade references.

**Credit account**

We endeavour to keep our costs down and customers are requested to pay our invoices on time. We reserve the right to delay delivery if there are overdue invoices on the account. Accounts which remain unpaid beyond the due date may incur an interest charge at a rate of 2% per month.

**Credit card payments**

We also accept payment using the following credit and charge cards:

Mastercard, VISA and American Express.

**VAT**

VAT number for Goodfellow Cambridge: GB 212 8527 79

**UK**

VAT will be added to the invoice at the rate ruling at the date of invoice. Where a customer is exempt, VAT will be charged unless we receive a copy of the exemption form at the time the order is placed.

**EU**

Customers registered for VAT who provide their local registration number will not be charged UK VAT.

Customers who are exempt from VAT will not be charged UK VAT provided we are given a copy of their exemption form at the time the goods are ordered.

Customers not registered for VAT or who fail to give us their registration number will be charged UK VAT at the current rate.

**Export**

All exports to countries outside the EU are zero-rated for UK VAT unless the invoice is being paid from within the EU.

**Return of goods**

We will only accept return of goods provided we are contacted BEFORE the goods are returned. When we agree to the return we will issue a Goods Return Number and give instructions for the method of return of the goods. Goods will not be accepted for return without a valid Goods Return Number. Due to the nature of some of our materials, it is imperative that you check any possible transport restrictions with your proposed freight company.

**Claims**

Great care is taken during manufacture and packing and all items are carefully inspected before shipment. Any claim in respect of short delivery, incorrect material or defective quality must be notified to us in writing within three days of delivery. Please retain ALL packaging for our inspection. Our liability for any such claim shall not exceed the cost of replacement of the goods free of charge, or crediting the customer with the invoice value thereof.

**Goods ordered in error**

We do not accept responsibility for customers’ errors in ordering. The amount of credit for returned goods will be at our discretion. Where we accept returned goods a restocking charge will be made.

**Conditions of sale**

All orders, contracts and quotations are subject to our standard terms and conditions of sale.

Information and statements provided are indicative only and do not form part of any offer or contract.

**Exclusions**

We supply materials according to our specification. All conditions warranties and representations regarding the quality, fitness for purpose or state, size, shape, capacity or color of goods supplied whether expressed or implied by common law or statute or otherwise are hereby expressly excluded. We shall not be liable for any damage direct or consequential arising from the use of goods supplied by us however such damage is caused, nor for delay in delivery.

**Law**

Customers in the USA: Contracts between Goodfellow Corporation and the customer shall be deemed to be subject in all respects to the laws of the Commonwealth of Pennsylvania, or the United States of America.

Customers in France: Contracts between Goodfellow SARL and the customer shall be deemed to be subject in all respects to French law unless otherwise agreed in writing.

Please visit [www.goodfellowusa.com](http://www.goodfellowusa.com) or email [info@goodfellowusa.com](mailto:info@goodfellowusa.com) for latest prices.
## Order information

<table>
<thead>
<tr>
<th>Customers in Germany: Contracts between Goodfellow GmbH and the customer shall be deemed to be subject in all respects to German law unless otherwise agreed in writing.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customers in the UK and all other countries: Contracts between Goodfellow Cambridge Limited and the customer shall be deemed to be subject in all respects to English law unless otherwise agreed in writing.</td>
</tr>
</tbody>
</table>

Copies of our General Terms and Conditions are available upon request or can be downloaded from our websites at [www.goodfellow.com](http://www.goodfellow.com) or [www.goodfellowusa.com](http://www.goodfellowusa.com).
Company Structure
The Goodfellow Group consists of five companies:

**Goodfellow Cambridge Limited**
Goodfellow was established in the City of London in 1946. The Company now has subsidiary operations in France, Germany and North America with the Group’s research laboratories, workshop facilities & central administration located in Huntingdon, England.

**Goodfellow Corporation**
Established at the same time as our associate company in Germany, Goodfellow Corporation was set up to service the requirements of our customers in the USA.

**Goodfellow GmbH**
Since 1989, this member of the Goodfellow group of companies has been serving the needs of our German speaking customers within Europe.

**Goodfellow SARL**
Goodfellow established an operation in France in 1993 to meet the needs of our French-speaking customers in Europe.

**Goodfellow (Shanghai) Trading Co., Ltd**
Goodfellow established a representative office in Shanghai in 2006, and in 2012 followed this with the creation of a fully-fledged trading company, servicing the research and specialist manufacturing requirements of the Chinese market.

COMPANY DETAILS

**Goodfellow Cambridge Limited**
Ermine Business Park
HUNTINGDON
PE29 6WR
England
Registered in England and Wales no. 01188162
VAT registration GB 212 8527 79

**Goodfellow Corporation**
125 Hookstown Grade Road
Coraopolis, PA 15108-9302
USA
A Pennsylvania corporation
EIN 23-2557381

**Goodfellow SARL**
229, rue Solférino
F-59000 Lille
France
Registered in Lille : RCS : B 381 486 836
Siren : 381486836
Numéro de TVA Intracommunautaire :
FR 06 381 486 836

**Goodfellow GmbH**
Am Alstertwiete 3
D-20099 Hamburg
Germany
Registered in Hamburg No. HRB 152991
Import VAT number DE112610478

**Goodfellow (Shanghai) Trading Co., Ltd**
Room 803, Centro Build, No. 568 Hengfeng Road
SHANGHAI
200070
The People’s Republic of China
Conditions of Sale

1 GENERAL

1.1 In these Conditions:

1.1.1 the following expressions shall have the following meanings:-

"Buyer" the individual firm company or other party from whom an order to supply Goods and/or Services is received by the Seller;

"Conditions" the standard terms and conditions of sale of the Seller as set out herein and including any additional terms and conditions of sale agreed in writing by the Seller;

"Contract" a contract for the Supply of Goods and/or Services by the Seller to the Buyer;

"Date of Delivery" the date on which delivery of the Goods or Services takes place pursuant to Condition 7;

"Goods" the goods which the Seller is to supply (or, in respect of which the Seller is to provide Services) under the Contract and includes any of them or any part of them and where the context so admits includes raw materials, processed and/or manufactured products whether processed or not;

"Prepayment" a payment to be made by the Buyer pursuant to Condition 6.2 to be used at the Seller’s discretion for the purchase of materials and/or toward the cost of labour and other costs relating to the supply of Goods;

"Recommendations" the recommendations (if any) relating to the for Use* storage, handling, application and/or use of the Goods contained in the published literature of the Seller (or, if relevant, a Supplier) or any recommendations made in Writing by an authorised representative of the Seller (or, if relevant, a Supplier);

"Seller" Goodfellow Cambridge Limited and any subsidiary or holding company or associate (as such terms are defined in the Companies Act 1985 (as amended) of the said company);

"Services" the work or services or any of them to be provided by the Seller under the Contract;

"Supplier" any person, firm or company who or which supplies materials to the Seller which are to be supplied to the Buyer;

1.1.2 words importing the singular number shall include the plural and vice versa, words importing one gender shall include all genders, and words importing persons shall include bodies corporate, unincorporated associations and partnerships;

1.2 If satisfactory references and information on the Buyer are not provided within seven days of a request therefore by the Seller, or if, following the provision of such information, the Seller is unable to obtain satisfactory trade indemnity or similar cover in respect of its dealings with the Buyer, the Seller may terminate the Contract and all rights and liabilities of the parties shall be the same as if the Contract had been cancelled in accordance with the provisions of Condition 10.2.

1.3 The seller reserves the right to assign, sub-contract the Contract or any part thereof. The Buyer shall not be entitled to assign the benefit or burden of the Contract without the consent in writing of the Seller.

1.4 In relation to all obligations of the Buyer under these Conditions, the time of performance is of the essence.

1.5 The legal construction of these Conditions shall not be affected by their headings which are for convenience of reference only.

2 ORDERS

2.1 Notwithstanding that the Seller may have given a detailed quotation or estimate either verbally or in writing no order or contract shall be binding on the Seller unless and until it has been acknowledged in writing by the Seller or the Goods are delivered. The Services are provided by the Seller to the Buyer pursuant to the order.

2.2 In order to avoid duplication of orders the Buyer shall be responsible for ensuring that any confirmation of an order previously placed is prominently marked as being a confirmation and not a new order. The Buyer acknowledges that any order or confirmation of order which is not so marked may be treated and accepted by the Seller as a new order to create a contract in addition to any Contract arising out of the previously placed order.

2.3 These Conditions are incorporated in the Contract and together with any matter set out in the Seller’s quotation or acknowledgement of order contain the entire obligations between the Seller and the Buyer. In the case of any inconsistency between any letter or quotation incorporating or referring to these Conditions and any order, letter or form of contract sent by the Buyer to the Seller, whatever may be their respective dates, the provisions of these Conditions shall prevail. In the event of the Seller entering into the Contract without the Seller having submitted a written quotation or other document incorporating or referring to these Conditions but in circumstances where the Buyer has had prior notice of these Conditions then all Goods or Services supplied shall be subject to these Conditions.

2.4 No variation of the Contract by the Buyer shall be binding upon the Seller unless made in Writing and signed on behalf of the Seller. In the event of such variation the Buyer shall indemnify and keep indemnified the Seller in full against all loss, which term shall include (but without prejudice to the generally thereof) loss of profit, costs (including the cost of labour and materials), damages, charges and expenses incurred (directly or indirectly) by the Seller as a result of such variation.

2.5 Any representations (except fraudulent misrepresentations) or warranties made by or on behalf of the Seller prior to the Contract (whether verbally or in writing) are hereby expressly excluded and shall be of no effect.

3 DESCRIPTION

3.1 Any figures, statements, descriptions, illustrations, photographs, drawings, weights and any other matters contained in the Seller’s catalogues, pamphlets, price lists or advertising literature are not guaranteed to be accurate and are intended merely to represent a general picture of the Seller’s products and shall not form part of the Contract nor be regarded as a warranty or representation relating to the Goods or Services.

3.2 The Seller reserves the right to amend the specification of its products and services from time to time so that the descriptions thereof as set out in its catalogues, pamphlets, price lists or advertising literature may not be identical with the specification as set out in the Seller’s quotation and the Buyer is advised to check the specification set out in the Seller’s quotation before placing an order.

4 SPECIFICATIONS AND INTELLECTUAL PROPERTY

4.1 Where goods are supplied to the Buyer’s own specification, or where standard goods of the Seller are altered in accordance with the Buyer’s instructions the Buyer warrants and undertakes full responsibility for the suitability and fitness of the specification, pattern or design but also that such specification, pattern or design does not infringe any patent, trade mark, registered design, copyright or any other proprietary right of any third party and the Buyer shall indemnify and keep the Seller indemnified in full against any loss, damage or expense whatsoever (including (but without prejudice to the generality of the foregoing) any patent, trade mark, registered design, copyright or any other proprietary right.

4.2 The Seller reserves the right to change the Buyer’s specification as required to ensure that the Goods comply with any statutory requirement or provision and no such change by the Seller will constitute a breach of contract or impose upon the Seller any liability whatsoever.

4.3 Unless otherwise agreed in writing, the Seller will be the sole owner of all inventions, formulations, tools, patterns, designs or other similar items and the copyright in all documents and drawings made or produced by it in preparing a quotation for the Buyer or in the course of work on any Contract with the Buyer.

5 QUOTATIONS

5.1 The Seller’s quotations are provisional in so far as they are subject to alteration by reference to any changes in the price of raw materials, any item to be acquired by the Seller from a third party, rates of wages, other costs of production and any other circumstances beyond the Seller’s control taking place between the date of the quotation and the Buyer’s placing of an order in respect thereof.

6 PRICE

6.1 The Seller shall be entitled to adjust the Contract price of the Goods or Services whether before or after the making of the Contract in the event of any variation in the cost to the Seller of supplying the same or any part thereof caused by-

6.1.1 any increase in the cost of materials required by the Seller for the completion of the Contract; or

6.1.2 any increase in wages or production and manufacturing costs or other overheads; or

6.1.3 any other reason whatsoever beyond the control of the Seller including (but without prejudice to the generality of the foregoing) fluctuations in exchange rates between monetary currencies the action of any government or any other authority or any labour problems.

6.2 In the Seller’s absolute discretion, a Prepayment in respect of the Contract may be required to be paid by the Buyer set out in the terms set out in this Condition. The Prepayment shall be applied as follows:-

6.2.1 in the event that the Contract is performed in full by both parties the Prepayment shall be retained by the Seller in reduction of the total price payable by the Buyer under the Contract;

6.2.2 in the event that the Buyer is either in default of any of its obligations under the Contract or cancels or suspends the Contract in accordance with Condition 10 the Prepayment shall be set off by the Seller and the Buyer shall be liable for any costs arising in connection with the default and/or cancellation or suspension of the Contract;

6.3 Unless otherwise stated, the price set out in the Seller’s quotation includes the cost of packing, carriage, and (save as provided in Condition 6.4) insurance. In respect of supplies of Goods in the United States of America and Canada and Japan the price also includes import duties and sales taxes (if any). In respect of supplies of Goods in other countries the price does include any health, vat or other statutory requirement or provision and no such change by the Seller will constitute a breach of contract or impose upon the Seller any liability whatsoever.

6.4 Where the Buyer requests a particular means of delivery, the price set out in the Seller’s quotation does not include the insurance, which is to be arranged at the responsibility of the Buyer.

7 DELIVERY

7.1 Delivery of Goods shall be deemed to be effected by the Seller at the following times:

7.1.1 where Goods are collected by or on behalf of the Buyer by its servants or agents, or where Goods are collected
10.1 If the Buyer shall commit any breach of the Contract and fail to remedy it to the Seller’s satisfaction, or if any part of them has been delivered but not paid for, the price shall become immediately due and payable notwithstanding any previous agreement to the contrary but without prejudice to the Seller’s right to any unpaid price for Goods or Services delivered to the Buyer under the Contract and to damages for breach of contract (both direct and consequential) suffered in consequence of such determination.

8 QUANTITIES INSTAMTS AND STORAGE
8.1 Where Goods are delivered or Services are by instalment each instalment shall be deemed to be delivered under a separate Contract and in default in respect of any instalment shall be liable accordingly, but no default in respect of any one instalment shall affect due performance of the other instalments or other provisions of the Contract.

8.2 The Seller will endeavour to deliver the quantity of Goods ordered and every delivery shall be deemed to comply with the order. If there is a surplus or shortage of which the Buyer is not notified in writing within 15 days of the date on which the same was delivered, the Buyer shall be deemed to have accepted the Goods.

8.3 If Goods or Services are to be delivered by instalments, the Seller shall be entitled to invoice each instalment as and when delivery is made and all delivered instalments shall be due notwithstanding the non-delivery of other instalments or other default by the Buyer. Failure by the Buyer to make payment by the due date for any one instalment for whatever reason shall entitle the Seller to suspend delivery of Goods or provision of Services under the Contract but without prejudice to any other right the Seller may have under any of the other provisions of these Conditions.

8.4 Notwithstanding that risk shall have passed to the Buyer pursuant to Section 19 of the Sale of Goods Act 1979, the Goods shall remain at the risk of the Buyer until the title to such Goods shall pass to the Seller.

9 TERMS OF PAYMENT
9.1 Unless otherwise agreed by the Buyer and the Seller, the Buyer shall be entitled to its absolute discretion and without giving prior notice to the Buyer at the expiration of 3 months to sell or otherwise dispose of Goods kept in storage as provided in Condition 8.4.

9.2 The Buyer does not pay the whole or any part of the price on the required date then the Buyer shall pay to the Seller on request interest on the amount outstanding from the due date until the actual date of payment at the rate of 2% p.a. over the base rate of Barclays Bank plc from time to time in force which shall accrue on a daily basis.

9.3 Condition 12 shall apply in the event of any alleged defect or failure in or of the Goods or Services and the Buyer shall not delay or refuse to make payment in any such event.

9.4 The Buyer shall not be entitled to withhold payment of any amount due to the Seller by reason of any dispute claimed by the Buyer in connection with the Contract nor shall the Buyer be entitled to set off against any amount payable under the Contract to the Seller any amount which is not due and payable by the Seller or for which the Seller disputes liability.

9.5 All payments payable to the Seller under the Contract shall become due immediately upon termination of the Contract despite any other provision.

10 SUSPENSION AND CANCELLATION
10.1 If the Buyer shall commit any breach of the Contract and fail to remedy the same within 7 days of receiving the Seller’s request in writing so to do or the Seller expiring any period of time beyond such seven days as the Seller may in its absolute discretion determine, the Buyer shall cease to be bound by the Contract and the Seller may, at the Buyer’s expense and risk, take possession of any goods or property of the Buyer or the Buyer makes any voluntary arrangement with its creditors or becomes subject to an administrator or receiver or its creditors or becomes subject to an insolvency order under the Insolvency Act 1986. Failure by the Buyer to make payment thereof, or if the Buyer is wound up, or any decision to cease, to carry on business or is unable to pay its debts within the meaning of section 26 of the Insolvency Act 1986, the Seller reasonably apprehends that any of the events mentioned above is about to occur in relation to the Buyer and notifies the Buyer accordingly, the Seller may:

10.1.1 stop any Goods in transit and suspend any further deliveries;
14.4 The Seller will have the right to maintain an action against the Buyer for the price of the Goods notwithstanding that property in the Goods has not been passed.

15 RISK AND INSURANCE
15.1 The risk in the Goods shall pass to the Buyer at the time of delivery as provided for in Condition 7.
15.2 Notwithstanding the reservation of title contained in Condition 14, the Buyer shall insure the Goods and/or any products made wholly or partly therefrom for the full amount of the price payable under the Contract on the Sale's insurance office of repute from the time of delivery of the Goods until the date title in the Goods passes to the Buyer pursuant to Condition 14.1

16 EXPORT TERMS
16.1 In these Conditions "Incoterms" means the international rules for the interpretation of trade terms of the International Chamber of Commerce as in force at the date when the Contract is made. Unless the context otherwise requires, any term or expression which is defined in or given a particular meaning by the provisions of Incoterms has the same meaning in the Contract.

16.2 Where the Goods are supplied for export from the United Kingdom then unless otherwise agreed in writing between the Buyer and the Seller:

16.2.1 the provisions of Incoterms shall (subject to any special terms agreed in writing between the Buyer and the Seller) apply if there is any conflict between the provisions of Incoterms and these Conditions, the latter shall prevail;

16.2.2 the Buyer shall be responsible for complying with any legislation or regulations governing the importation of the Goods into the country of destination (and save in respect of the United States of America, Canada and Japan) for the payment of any duties and taxes thereon unless payment for these is included in the Contract;

16.2.3 the Buyer shall be deemed to have satisfied itself that such Goods comply with the safety regulations of any country or state in which the Goods are to be used outside the United Kingdom and the Seller shall indemnify and keep indemnified the Seller in full for any loss or damage whatsoever which the Seller may incur if such Goods do not comply with such safety regulations.

16.3 The Goods shall not be used in any country other than that for which they were aware they were originally ordered without the Seller's consent in writing.

16.4 The Buyer undertakes not to offer the Goods for resale in any country notified by the Seller or before the time the Buyer's order is placed, or to sell the Goods to any person if the Seller or any person has reason to believe that person intends to resell the Goods in any such country.

17 BUYER'S WARRANTIES
17.1 The Buyer warrants to the Seller that:

17.1.1 the Buyer will install, operate or otherwise use or store the Goods strictly in accordance with the Recommendations for Use and with all relevant or applicable safety, storage and transport regulations governing the installation, operation, use or storage of the Goods and the Goods and complies with any statute, regulation, by law or other rule having the force of law and relating to the storage of goods of the nature of the Goods; and

17.1.4 the Buyer will ensure that the Goods are stored in conditions appropriate to goods of that nature and will comply with any Recommendations for Use as to the storage of Goods notified to it by the Seller from time to time; and

17.2 The Buyer shall indemnify and keep indemnified the Seller in full against any claim, loss or damage (including, without limitation, damages for death or personal injury caused by the Seller's negligence or fraudulent misrepresentation) arising in connection with the performance or contemplated performance of the contract.

18 SEVERANCE
18.1 If at any time any one or more of the provisions or part thereof of these Conditions becomes or is invalid, illegal or unenforceable in any respect under any law or is held by a court to be invalid, illegal or unenforceable, the validity and enforceability of the remaining provisions hereof and the remainder of such provision shall not in any way be affected or impaired thereby.

19 JURISDICTION
19.1 These Conditions and each and every Contract made pursuant to them shall be governed by and construed in all respects in accordance with the laws of England and the Seller and the Buyer hereby agree to submit to the non-exclusive jurisdiction of the English Courts.

20 NOTICES
20.1 Any notice required or permitted to be given by either party to the other under these Conditions shall be in writing addressed to the other party at its registered office or principal place of business or such other address as may at the relevant time have been notified pursuant to this provision to the party giving notice.

20.2 Any notice given pursuant to clause 20.1 shall be deemed to have been served:

20.2.1 if delivered by hand, on the first Business Day following delivery;

20.2.2 if sent by post, on the third Business Day after posting if the address of the recipient is in the country of the Sellers; and otherwise on the seventh Business Day after posting;

20.2.3 if sent by facsimile transmission, on the first Business Day following successful transmission.

20.3 In proving service it shall be sufficient proof in the case of a notice sent by post, that the envelope containing the same was properly stamped, addressed and placed in the post and, in the case of facsimile transmission, that it was properly addressed and successfully transmitted.

20.4 In this Condition 20, "Business Day" means any day other than Saturday, Sunday or any other day which is a public holiday in the place at which the notice is to be received.
Conditions of Sale

21.1 No waiver by the Seller of any breach of any provision of the Contract by the Buyer shall be considered as a waiver of any subsequent breach of the same or any other provision and the Seller shall not be prejudiced by any forbearance or indulgence granted by it to the Buyer.
Aluminum was discovered by Hans Oersted in Copenhagen, Denmark in 1825.

Aluminum is a silvery white reactive metal which is usually covered by a tenacious oxide coating. This renders it inert to acids, but it is attacked by alkalis. It is the most common metallic element in the earth’s crust (8200 ppm) and is extracted from the hydrated oxide, Bauxite, by electrolysis of the oxide dissolved in molten sodium hexafluorosilicate (cryolite). The metal has good thermal properties and is malleable and ductile. Aluminum and its alloys are widely used for various applications including aircraft assemblies and engine parts.

**Atomic Properties**

- Atomic number: 13
- Atomic radius - Goldschmidt: 0.143 nm
- Atomic weight: 26.98154 amu
- Electronic structure: Ne 3s² 3p¹
- Photo-electric work function: 4.2 eV
- Valences shown: 3
- Natural isotope distribution: Mass No. %
  - 27: 100
- Ionization potential: No. eV
  - 1: 5.99
  - 2: 18.8
  - 3: 28.4
  - 4: 120
  - 5: 154
  - 6: 190

**Physical Properties**

- Boiling point: 2467 C
- Density @20°C: 2.70 g cm⁻³
- Melting point: 660.4 C

**Electrical Properties**

- Electrical resistivity @20°C: 2.67 µΩ cm
- Temperature coefficient @0-100°C: 0.0045 K⁻¹
- Superconductivity critical temperature: 1.175 K
- Thermal emf against Pt @cold 0°C - hot 100°C: +0.42 mV

**Thermal Properties**

- Thermal Properties:
  - Coefficient of thermal expansion @0-100°C: 23.5 x 10⁻⁶ K⁻¹
  - Latent heat of fusion: 388 J g⁻¹
  - Specific heat @29°C: 900 J K⁻¹
  - Thermal conductivity @0-100°C: 237 W m⁻¹ K⁻¹

**Mechanical Properties**

- Bulk modulus: 75.2 GPa
- Hardness - Vickers: 21 - 35-48
- Poisson’s ratio: 0.345
- Tensile modulus: 70.6 GPa
- Tensile strength: 50-90 - 130-195 MPa
- Yield strength: 10-35 - 110-170 MPa

**Powder**

**AL006038**

- Max. Particle size: 15 micron
- Purity: 99%

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<tr>
<th>Web Code</th>
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<th>Quantity</th>
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<tbody>
<tr>
<td>413-048-995</td>
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<td>820-616-704</td>
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<tr>
<td>013-920-503</td>
<td>500 g</td>
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<td>124-644-340</td>
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**Typical Analysis:** Additional shipment charges apply which are dependent on destination. Please check the individual item on our website or contact us for further details.

**AL006039**

- Max. Particle size: 25 micron
- Purity: 99%

<table>
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<tr>
<th>Web Code</th>
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<tr>
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<td>939-253-227</td>
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**Typical Analysis:** Additional shipment charges apply which are dependent on destination. Please check the individual item on our website or contact us for further details.

**AL006031**

- Max. Particle size: 60 micron
- Purity: 99.9%

<table>
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<tr>
<th>Web Code</th>
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<tr>
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<td>290-600-180</td>
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**Typical Analysis:** Ca 30, Cu 30, Fe 300, Ga 20, Li 30, Mg 4, Na 3, Pb 20, Si 400.

**AL006015**

- Max. Particle size: 125 micron
- Purity: 99.5%

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<td>766-116-187</td>
<td>5000 g</td>
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</table>

**Typical Analysis:** Cu <200, Fe <3500, Mn <200, Si <2500.

**Shipping Restriction:** Additional shipment charges apply which are dependent on destination. Please check the individual item on our website or contact us for further details.
## Aluminum

### Powder

<table>
<thead>
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<th>Web Code</th>
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<td>933-722-519</td>
<td>500 g</td>
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<td>704-286-977</td>
<td>1000 g</td>
<td>USD 253.00</td>
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<td>014-296-243</td>
<td>2000 g</td>
<td>USD 320.00</td>
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<td>014-296-243</td>
<td>5000 g</td>
<td>USD 555.00</td>
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Typical Analysis: Cu < 200, Fe < 3500, Mn < 200, Si < 2500.

Shipping Restriction. Additional shipment charges apply which are dependent on destination. Please check the individual item on our website or contact us for further details.
## INDEX

<table>
<thead>
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<th>A</th>
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<tbody>
<tr>
<td>Aluminum (Al)</td>
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