Goodfellow

Serving The Needs of Science and Industry Worldwide
Au service de la Science et de l’Industrie dans le monde entier
Weltweiter Lieferant für Wissenschaft und Industrie

Metals and Alloys
Métaux et Alliages
Metalle und Legierungen

Ceramics
Céramiques
Keramiken

Polymers
Polymères
Polymere

Composites
Composites
Verbundwerkstoffe
Goodfellow Corporation
125 Hookstown Grade Road
Coraopolis, PA 15108-9302 PA 15108-9302
USA
Tel: 1-800-821-2870 (USA and Canada)
or +1 724 695 7060
Fax: 1-800-283-2020 (USA and Canada)
or +1 724 695 7063

Goodfellow Cambridge Limited
Ermine Business Park
HUNTINGDON
PE29 6WR
England
Tel: 011 44 1480 424 800
or 011 44 1480 424 800
Fax: 011 44 1480 424 900
or 011 44 1480 424 900

Goodfellow SARL
229, rue Solférino
F-59000 Lille
France
Tel : 0800 917 241 (numéro vert)
or +44 1480 424 813
Fax : 0800 917 313 (numéro vert)
or +44 1480 424 900

Goodfellow GmbH
Am Alstertwiete 3
D-20099 Hamburg
Germany
Tel: 0800 1000 579 (free call)
or +44 1480 424 810
Fax: 0800 1000 580 (free call)
or +44 1480 424 900

Goodfellow (Shanghai) Trading Co., Ltd
Room 803, Centro Build, No. 568 Hengfeng Road
SHANGHAI
200070
The People’s Republic of China
Tel: 00 86 21 6112 1560
Standard Price List for All Laminates

CONTENTS

Introduction 4
Product Descriptions 5
Hazards Information 9
General Information 10
Order information 11
Company Details 14
Conditions of Sale 15
Polymer 19
INDEX 25
Introduction

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.
<table>
<thead>
<tr>
<th>Product Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bar</strong></td>
</tr>
<tr>
<td>A straight length of rectangular, square or oval section material.</td>
</tr>
<tr>
<td><strong>Tolerances</strong></td>
</tr>
<tr>
<td>Section dimensions:</td>
</tr>
<tr>
<td>≤ 10mm: ± 10%</td>
</tr>
<tr>
<td>&gt; 10mm: ± 1mm</td>
</tr>
<tr>
<td>Length:</td>
</tr>
<tr>
<td>&lt; 100mm: ± 1mm</td>
</tr>
<tr>
<td>≥ 100mm: + 5% / -1%</td>
</tr>
<tr>
<td><strong>Bolt</strong></td>
</tr>
<tr>
<td>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.</td>
</tr>
<tr>
<td><strong>Fiber</strong></td>
</tr>
<tr>
<td>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 &quot;tex&quot;, the weight in grams of a 1km length of material.</td>
</tr>
<tr>
<td><strong>Tolerances</strong></td>
</tr>
<tr>
<td>Fiber diameter: ± 25%</td>
</tr>
<tr>
<td>Number of strands: ± 10%</td>
</tr>
<tr>
<td>Tex number: ± 10%</td>
</tr>
<tr>
<td>Length: + 5% / -1%</td>
</tr>
<tr>
<td><strong>Chopped Fiber</strong></td>
</tr>
<tr>
<td>Fibers cut into short lengths called cut, staple or chopped fiber.</td>
</tr>
<tr>
<td><strong>Tolerances</strong></td>
</tr>
<tr>
<td>Fiber diameter: ± 25%</td>
</tr>
<tr>
<td>Number of strands: ± 10%</td>
</tr>
<tr>
<td>Tex number: ± 10%</td>
</tr>
<tr>
<td>Length: + 5% / -1%</td>
</tr>
<tr>
<td><strong>Crucible</strong></td>
</tr>
<tr>
<td>A vessel in which other materials may be heated or melted, usually at high temperatures.</td>
</tr>
<tr>
<td><strong>Tolerances</strong></td>
</tr>
<tr>
<td>Height: ± 10%</td>
</tr>
<tr>
<td>Inside Dimensions: ± 10%</td>
</tr>
<tr>
<td>Outside Dimensions: ± 10%</td>
</tr>
<tr>
<td><strong>Fabric</strong></td>
</tr>
<tr>
<td>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).</td>
</tr>
<tr>
<td><strong>Tolerances</strong></td>
</tr>
<tr>
<td>Fabric thickness: ± 25%</td>
</tr>
<tr>
<td>Number of yarns: ± 10%</td>
</tr>
<tr>
<td>Tex number: ± 10%</td>
</tr>
<tr>
<td>Size (linear dimension):</td>
</tr>
<tr>
<td>&lt; 100mm: ± 5mm</td>
</tr>
<tr>
<td>≥ 100mm: ± 5%</td>
</tr>
<tr>
<td><strong>Film</strong></td>
</tr>
<tr>
<td>A non-metallic sheet material with a thickness &lt; 0.5mm.</td>
</tr>
<tr>
<td><strong>Tolerances</strong></td>
</tr>
<tr>
<td>Thickness: ± 20%</td>
</tr>
<tr>
<td>Size (linear dimension):</td>
</tr>
<tr>
<td>&lt; 100mm: ± 1mm</td>
</tr>
<tr>
<td>≥ 100mm: + 2% / -1%</td>
</tr>
<tr>
<td><strong>Flake</strong></td>
</tr>
<tr>
<td>Flat, irregularly shaped pieces of material. A maximum flake size is indicated but individual flakes may vary greatly in size.</td>
</tr>
<tr>
<td><strong>Dimensions shown are nominal</strong></td>
</tr>
</tbody>
</table>


**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.

**Tolerances**

<table>
<thead>
<tr>
<th>Thickness</th>
<th>±10%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size (linear dimension):</td>
<td></td>
</tr>
<tr>
<td>&lt;100mm</td>
<td>±1mm</td>
</tr>
<tr>
<td>&gt;100mm</td>
<td>±2% / -1%</td>
</tr>
</tbody>
</table>

**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.

**Tolerances**

Dimensions shown are nominal

**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.

**Tolerances**

| Thickness: | ±10%  |
| Size (linear dimension): |       |
| <100mm       | ±1mm  |
| >100mm       | ±2% / -1% |

**Lump**

A solid piece of material with no defined shape.

**Tolerances**

Dimensions shown are nominal

**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.

**Tolerances**

| Thickness: | ±10%  |
| Wire diameter: | ±20% |
| Size (linear dimension): |       |
| <100mm       | ±1mm  |
| >100mm       | ±2% / -1% |

**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.

**Tolerances**

| Thickness: | ±10%  |
| Size (linear dimension): |       |
| <100mm       | ±1mm  |
| ≥100mm       | ±2% / -1% |

---

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

© Goodfellow Corporation
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: ±30%
- Size: ±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: ±30%
- Size: ±20%

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

**Tolerances**
- Diameter: ±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): <100mm ±5mm
  ≥100mm ±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:
  - ≤10mm: ±10%
  - Polymer: +20%/-10%
  - Ceramic: +20%/-10%
  - >10mm: ±5%
  - Ceramic: +20%/-10%
  - Polymer: +20%/-10%
- Length:
  - <100mm: ±1mm
  - ≥100mm: ±5% / -1%
**Sheet**

Flat material with a thickness > 0.5mm.

**Tolerances**

<table>
<thead>
<tr>
<th>Material</th>
<th>Thickness</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):

- < 100mm: ± 1mm
- ≥ 100mm: + 2% / -1%

**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>Parameter</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**

| Diameter (standard) | ± 5% |
| Diameter (precision) | see item |

**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>Material</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polymer</td>
<td>± 0.5mm</td>
</tr>
<tr>
<td>Ceramic</td>
<td>± 0.5mm</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

**Tube**

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

**Tolerances**

| Diameter (standard) | ± 0.05mm |
| Diameter (precision) | see item |

**Wire**

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

**Tolerances**

<table>
<thead>
<tr>
<th>Material</th>
<th>Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polymer</td>
<td>± 5%</td>
</tr>
<tr>
<td>Ceramic</td>
<td>± 20%</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

Corrosive
Chemicals which may destroy living tissue when in contact with them.

Dangerous when wet
Chemicals which, in contact with water or damp air, evolve highly flammable or toxic gases and vapours in dangerous quantities.

Explosive
Chemicals which may react exothermically without atmospheric oxygen, quickly evolving gases, and which under defined test conditions detonate, quickly deflagrate or upon heating explode when partially confined.

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.

F oils 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.
If you intend to have the material transported or sent onwards please ensure that you are aware of the relevant transport restrictions.

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 
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.
<table>
<thead>
<tr>
<th>Order information</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
</tr>
<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>
<tr>
<td>Copies of our General Terms and Conditions are available upon request or can be downloaded from our websites at <a href="http://www.goodfellow.com">www.goodfellow.com</a> or <a href="http://www.goodfellowusa.com">www.goodfellowusa.com</a>.</td>
</tr>
</tbody>
</table>
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 Solféino
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

Please visit [www.goodfellowusa.com](http://www.goodfellowusa.com) or email info@goodfellowusa.com for latest prices.
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 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 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 make up the Goods 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 the 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 for the completion of the Contract; or
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 effected 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 or on no oral nor written order 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 acceptance (acknowledgement of order containing the entire obligations between the Seller and the Buyer. In the case of any inconsistency between any letter or quotation incorporated 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 written 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 generality 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 or 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 be revised or altered without prior notice to the Buyer for the benefit of the Seller or the Goods are delivered or the Services are provided by the Seller or the Goods are manufactured by or sold by the Seller as supplanted or varied by the Seller in its trade literature. The Seller is also entitled to incorporate 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
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 costs which the Seller may suffer or arising from the performance of the Contract by reason of any infringement of any such 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 the conditions of supply or the specifications given in Writing by the Buyer to the Seller or the Goods are delivered or the Services are provided by the Seller for the completion of the Contract; or
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 made by the Buyer set on 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 in their absolute discretion in connection with the default and/or cancellation or suspension
6.3 Unless otherwise stated, the price set out in the Seller’s quotation includes the cost of packaging, 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 any 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

9.5 All payments payable to the Seller under the Contract shall become due and payable at the time of completion by the Buyer of the Con- tract. Where goods are delivered or Services are by instalment each instalment shall be dealt with in accordance with the provisions of Condition 10.3.

8 QUANTITIES, INSTALMENTS AND STORAGE

8.1 Where Goods are delivered or Services are by instalment each instalment shall be dealt with in accordance with a separate Contract and the party in default in respect of any instalment shall be liable accordingly, but no default in respect of any one instalment shall effect due performance of the Contract as regards other instalments.

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, in the opinion of the Seller, it is impracticable to deliver the whole of the quantity ordered without delay, the Seller may deliver in instalments, and the Buyer shall be bound to accept such part of the delivery as is made, and, whether or not later instalments are made, the whole of the delivery shall be treated as delivered on the due date for the first delivery of the order.

8.3 If Goods or Services are to be delivered by the Seller, the Seller shall be entitled to invoice each instalment as and when delivery of all or any part of the instalment is made and payment for all delivered instalments shall be due and payable notwithstanding the non-delivery of other instalments or other default by the Buyer. Failure by the Buyer to make payment due 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 and without prejudice to any other right the Seller may have under any of the other provisions of this Conditions.

8.4 Notwithstanding that risk shall have passed to the Buyer pursuant to Condition 15 the Seller may in its absolute discretion arrange for storage of the Goods either at the request of the Buyer or as a result of the failure by the Buyer to take delivery of the Goods under Condition 7. The Seller may insures the goods whilst in storage and the Buyer shall indemnify and keep indemnified the Seller in full against all costs, losses, damages and expenses whatsoever arising in connection with the storage provided for the Buyer and any such costs, losses, damages and expenses will be added to and form part of the price of the Goods.

8.5 Unless otherwise agreed between the Buyer and the Seller, the Seller 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 TERMS OF PAYMENT

9.1 Unless otherwise agreed the price shall be due and payable by the Buyer in full against all costs, losses, damages and expenses whatsoever arising in connection with the storage provided for the Buyer and any such costs, losses, damages and expenses will be added to and form part of the price of the Goods.

9.2 If the Buyer does not pay the whole or any part of the price on the required day then the Buyer shall pay the Seller on request interest on the outstanding amount from the due day to the actual date of payment. In the case of partial loss, damage, non-conforming or defective Goods or Services, the Buyer will not in any circumstances be required to accept any portion thereof.

9.3 Condition 12 shall apply in the event of any alleged defect or failure to comply 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.

9.4 The Buyer shall not be entitled to withhold payment of any amount due to the Seller by reason of any alleged claim 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 and payable 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 and the Seller thereby expiring upon any goods or property of the Buyer or the Buyer makes any voluntary arrangement with its creditors or becomes subject to an administration order or (being an individual or firm) becomes bankrupt or (being an incorporated company) Telephone of Directors resolution for winding up (otherwise than for the purpose of amalgamation or reconstruction), or a Court makes an order to that effect, or the Buyer permits the Seller or its servants or agents full and free right of access to inspect the Goods and investigate the claim; and

10.2 If the Buyer requests the Seller to vary the terms of the Contract or to make any alteration to the Goods or Services or in any other way to the Contract which would be detrimental to the Seller in its sole discretion, the Seller shall have the right to cancel the Contract forthwith and in such event the Buyer shall pay to the Seller all amounts which have accrued or become due under the Contract and which will have become due had this Contract not been cancelled.

10.2 If the Buyer requires cancellation of the Contract this will only be accepted at the sole discretion of the Seller and unless otherwise agreed in writing only upon condition that all costs, charges or expenses (both direct and consequential) incurred by the Seller up to the date of cancellation and the value of all or any goods (both direct and consequen- tial) incurred by the Seller by reason of such cancellation will be reimbursed by the Buyer to the Seller. Acceptance by the Seller of any cancellation by the Buyer will only be binding upon the Seller if it is made in writing.

10.3 In the event of the Seller other than in any of the circumstances set out in Condition 10.1 being prevented or hindered from completing the Contract either wholly or in part in accordance with the terms thereof for any reason whatsoever beyond its reasonable control which, for the avoidance of doubt and without prejudice to the generality of the foregoing, shall include governmental action, war, riot, civil commotion, fire, flood, epidemic, labour disputes (including the work force or any part thereof of the Seller or Supplier), requisitions or delays affecting shipping or carriage, licensing, exporting or importing restrictions, currency restrictions and Acts of God then further performance of the Contract shall be suspended for the period during which the Seller is so prevented or provided that in the event of the Contract being suspended for a continuous period of more than 3 months then either party may give the other notice in writing to terminate the Contract forthwith and in such circumstances the Seller will pay to the Buyer an amount equal to 20% of the purchase price of the Goods at the date of termination or such other amount as shall be agreed between the parties in writing. The Seller shall be under no liability whatsoever to the Buyer for any direct or consequential loss or damage suffered by the Buyer as a result of the Seller’s inability to perform its obligations under the contract in these circumstances.

10.4 The Seller’s rights contained in Condition 17 (but not the Buyer’s rights) shall continue beyond the discharge of the parties’ primary obligations under the Contract consequent upon its termination.

10.5 The termination of the Contract for whatever reason will be without prejudice to the rights and duties of either party accrued prior to termination.

11 INSPECTION AND CLAIMS FOR DEFECTS

11.1 The Goods are of a highly specialised nature and must be treated with the utmost care. It is essential that the Buyer checks that they are suitably packed and to which it is the sole responsibility of the Buyer to notify the Seller of any discrepancies should be notified to the Seller immediately. The Buyer undertakes to ensure that all Goods are unpacked and inspected by persons qualified to deal with such specialised products, to safeguard against injury to the Goods or its ability to be used.

11.2 The Buyer shall inspect the Goods and carry out tests to ensure the Goods conform with the description of the Goods or Services in the Buyer’s orders within 7 days of Delivery and whether or not the Buyer carries out such inspection or test no claims for non-delivery, shortage, variation in quantity of units damaged or defective Goods, Non-conformity to description or partial loss or damage to Goods will be accepted by the Seller unless:-

11.2.1 they are notified in writing by the Buyer to the Seller within 10 days after the Date of Delivery (in the case of partial loss, damage, non-conforming or defective Goods or Services) or 14 days after the date of the invoice (in the case of non-delivery);

11.2.2 the Goods in respect of which a claim is made is made in writing by the Buyer to the Seller within 20 days of the Goods having been discovered at the Buyer’s premises or in transit by the Buyer or Buyer’s agents or servants to the Seller or Buyer’s orders and/or the Buyer permits the Seller or its servants or agents full and free right of access to inspect the Goods and investigate the claim; and

11.2.3 if the Buyer fails to give the appropriate notice as specified above in Condition 11.2.1 the Buyer’s claim is deemed to have been waived and will be absolutely barred

11.3 It is in all cases the responsibility of the Buyer to ensure by testing or otherwise that the Goods are fit for the purpose for which the Buyer requires them in the conditions in which they will be used. The Buyer acknowledges that the Seller shall be under no liability to the Buyer if the Goods prove to be unsuitable for whatever reason for application or use to which the Buyer apply or use the Goods to which the Seller, at the request of the Buyer, have given in good faith technical or other advice in relation to the purpose for application or use of the Goods and the Buyer shall indemnify the Seller in full against all costs, charges or expenses (both direct and consequen- tial) arising out of or connected with the application or use of the Goods.

11.4 Section 3 Sale and Supply of Goods Act 1984 shall not apply.

12 WARRANTY

12.1 In substitution for all and any other rights which the Buyer might or would have had but for these Conditions and subject to Condition 11,
14. The Seller will have the right to maintain an action against the Buyer in full the price paid by the Buyer to the Seller.

15. The Seller’s liability under this Condition shall automatically cease if:

15.1. The Buyer has not paid for all Goods or Services supplied under any Contract by the due date or is otherwise in breach of this or any other Contract made with the Seller; or

15.2. The Seller or its servants or agents are denied full and free right of access to the allegedly defective Goods; or

15.3. The Buyer has not properly maintained the Goods or has not complied with any Recommendations for Use; or

15.4. The defect or failure is caused by a breach by the Buyer of its undertakings and warranties contained in Condition 17; or

15.5. The Buyer has failed to notify the Seller in writing of any defect or suspected defect within 14 days of the same coming to the knowledge of the Buyer.

16. The warranty set out in Condition 12.1 shall be in lieu of any warranty, conditions or undertakings whether express or implied by statute, common law or otherwise howsoever which warranties, conditions and undertakings are hereby expressly excluded, except that such exclusions shall not apply to any implied condition that the Seller has or will have the right to sell the Goods when the property is to pass.

17. Nothing in these Conditions excludes or limits the liability of the Seller for death or personal injury caused by the Seller’s negligence or fraudulent misrepresentation.

18. SUBJECT TO CONDITIONS 12.4 AND 12.5

18.1. The Seller’s total liability in contract, tort (including negligence or breach of statutory duty), misrepresentation or otherwise arising in connection with the performance or contemplated performance of the contract shall be limited to the price paid for the Goods or services under the contract, and

18.2. The seller shall not be liable to the buyer for any indirect or consequential loss or damage (whether for loss of profit, loss of business, depletion of goodwill or otherwise), costs, expenses or other claims for consequential compensation whatever nature or description, which arise out of or in connection with the contract.

19. CONSUMER SALES

19.1. Where the Goods are sold under a consumer sale (as defined by the Sale of Goods Act 1979) the statutory rights of the Buyer are not affected by these conditions.

20. TITLE TO GOODS

20.1. Full legal and beneficial ownership of the Goods shall be retained by the Seller notwithstanding that the risk in the same shall pass to the Buyer at the time of delivery until the Seller has received payment in full in respect of:

20.1.1. The Goods; and

20.1.2. All other sums which become due and owing by the Buyer to the Seller on any account whatsoever

20.2. Until ownership of the Goods has passed to the Buyer the Buyer shall hold the Goods in a fiduciary capacity and as bailee of the Seller and shall take all proper care of the same and will not obliterate or obscure any identifying mark or their packaging and will keep the Goods separate from any other goods and in such manner that they may be clearly identified as belonging to the Seller and the Buyer hereby grants to the Seller the right to enter on the Buyer’s premises at any time during the continuation of the Contract to check that the Buyer is complying with the obligation contained in this Condition. The Buyer will return the Goods to the Seller if it receives a request whether verbally or in writing to do so prior to payment in full as aforesaid having been made and the Seller will then repay any part of the purchase price it has already received in respect of the Goods less a reasonable amount in respect of its costs and expenses in connection with the Contract.

20.3. For the purpose of Condition 14.1, the expression “the Buyer” includes any subsidiary or holding company or associate of the Buyer (as such terms are defined in the Companies Act 1985 (as amended))

20.4. 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

21. RISK AND INSURANCE

21.1. The risk in the Goods shall pass to the Buyer at the time of delivery as provided for in Condition 7

21.2. 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 to the insurance office of repays from the time of delivery of the Goods until the date title in the Goods passes to the Buyer pursuant to Condition 14.1

22. EXPORT TERMS

22.1. 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.

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

23.1. 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

23.2. The Buyer shall be responsible for complying with any regulation 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

23.3. 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

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

23.5. 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 knows or has reason to believe that person intends to resell the Goods in any such country

24. BUYER’S WARRANTIES

24.1. The Buyer warrants to the Seller that:

24.1.1. 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 statutory or other regulations governing the installation, operation, use or storage of the Goods and the Buyer is responsible for complying with any statute, regulation, bye law or other rule having the force of law and relating to the storage, transport or the Goods of the nature of the Goods; and

24.1.2. the Buyer has or will ensure that the Goods are stored in conditions appropriate to goods of that nature and will comply with any recommendations as to the storage of Goods notified to it by the Seller from time to time; and

24.2. The Buyer shall indemnify and keep indemnified the Seller in full against any claim, loss or damage (including, without limitation, damage to the reputation of the Seller) arising directly or indirectly from any breach of the warranty contained in Condition 17.1

25. SEVERANCE

25.1. 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 and the remainder of such provision shall not in any way be affected or impaired thereby.

26. JURISDICTION

26.1. 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.

27. NOTICES

27.1. Any notice required or permitted to be given by either party to the other under these Conditions shall be in writing addressed to that 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

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

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

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

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

27.3. 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

27.4. In this Condition 20, “Business Day” shall mean any day other than Saturday, Sunday or any other day which is a public holiday in the place at which the notice is sent to or to which such notice is despatched

28. WAIVER

28.1. No waiver by any party of any provision of these Conditions shall be deemed to be a further or continuing waiver of such or any other provision.

29. The Seller shall make good by replacement any failure in the Goods or Services which results from defects in the Seller’s materials or workmanship and which appear not later than 2 months after the Date of Delivery and shall replace any Goods or Services which do not conform with the description in the Buyer’s order

30. The Seller shall not be liable to the Buyer for any indirect or consequential loss or damage (whether for loss of profit, loss of business, depletion of goodwill or otherwise), costs, expenses or other claims for consequential compensation whatever nature or description, which arise out of or in connection with the contract.
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.
Polyethylene naphthalate

Common Brand Names: Kaladex, Kalidar

General Description: A polyester that is chemically quite similar to PET but which is more temperature resistant. So far available only as biaxially oriented and heat stabilized films, they are semi-crystalline and colorless, either crystal clear or slightly hazy (the latter are available from Goodfellow stock). Compared to their PET equivalents, they start to shrink significantly at 190°C rather than 150°C and are certified for long term electrical use at 155°C rather than 105/130°C. Their tensile strengths are similar, but the modulus of PEN films is higher - say 25% at ambient temperatures but several times higher in the 100-150°C region. They also have better UV resistance and barrier properties and are more resistant to hydrolysis in alkaline or very hot aqueous conditions. They are, however, more expensive and have a lower flex life.

Applications for the films are mainly in the electrical and electronic areas.

<table>
<thead>
<tr>
<th>Physical Properties</th>
<th>Mechanical Properties</th>
<th>Chemical Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.36 g cm⁻³</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flammability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VTM-2 - UL94, 0.075mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optical transmission</td>
<td></td>
<td></td>
</tr>
<tr>
<td>84 @ 0.075mm %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resistance to Ultra-violet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.4 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water absorption</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.2 @ 100kHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical Properties</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dielectric constant @ 1MHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>160 @ 0.075mm kV mm⁻¹</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dissipation factor @ 1kHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.0048 @ 10kHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dissipation factor @ 1kHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.005</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface resistivity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10⁻¹³ Ohm/sq</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volume resistivity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10⁻¹⁵ Ohm/cm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermal Properties</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coefficient of thermal expansion</td>
<td>20.21 - biax film x 10⁻⁶ K⁻¹</td>
<td></td>
</tr>
<tr>
<td>Thermal conductivity @ 23°C</td>
<td>0.15 W m⁻¹ K⁻¹</td>
<td></td>
</tr>
<tr>
<td>Upper working temperature</td>
<td>155°C</td>
<td></td>
</tr>
</tbody>
</table>

Applications for the films are mainly in the electrical and electronic areas.

### Laminate

**ES361620**

<table>
<thead>
<tr>
<th>Thickness</th>
<th>0.047mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Backing Material</td>
<td>0.018mm Copper</td>
</tr>
<tr>
<td>Polymer Thickness</td>
<td>0.012mm</td>
</tr>
<tr>
<td>Adhesive</td>
<td>Polyurethane</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Size</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Web Code</td>
<td>Size</td>
</tr>
<tr>
<td>173-351-904</td>
<td>250 x 250 mm</td>
</tr>
<tr>
<td>436-408-165</td>
<td>500 x 500 mm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Coil</th>
<th>Width 500mm</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Web Code</td>
<td>Length</td>
<td>1 Reel</td>
</tr>
<tr>
<td>794-045-438</td>
<td>1 m</td>
<td>USD 342.00</td>
</tr>
<tr>
<td>331-063-732</td>
<td>2 m</td>
<td>USD 449.00</td>
</tr>
<tr>
<td>563-630-470</td>
<td>5 m</td>
<td>USD 671.00</td>
</tr>
</tbody>
</table>

**ES361621**

<table>
<thead>
<tr>
<th>Thickness</th>
<th>0.050mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Backing Material</td>
<td>0.025mm Aluminum</td>
</tr>
<tr>
<td>Polymer Thickness</td>
<td>0.012mm</td>
</tr>
<tr>
<td>Adhesive</td>
<td>Epoxy</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Size</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Web Code</td>
<td>Size</td>
</tr>
<tr>
<td>002-728-215</td>
<td>250 x 250 mm</td>
</tr>
<tr>
<td>487-167-614</td>
<td>500 x 500 mm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Coil</th>
<th>Width 500mm</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Web Code</td>
<td>Length</td>
<td>1 Reel</td>
</tr>
<tr>
<td>042-529-351</td>
<td>1 m</td>
<td>USD 314.00</td>
</tr>
<tr>
<td>816-901-724</td>
<td>2 m</td>
<td>USD 408.00</td>
</tr>
<tr>
<td>477-445-569</td>
<td>5 m</td>
<td>USD 607.00</td>
</tr>
</tbody>
</table>
Polyethylene terephthalate
Polyester, PET, PETP

Common Brand Names: Arnite, Dacron, Hostaphan, Impet, Melinar, Melinex, Mylar, Rynite, Terylene, Trevira

General Description: The most common thermoplastic polyester, this polymer is often called just "polyester". This often causes confusion - not only is the chemically similar PBT also a (thermoplastic) polyester, the most common resin system used in GRP is also a polyester system - and also often called just "polyester". (In this latter case, however, the polyesters are chemically unsaturated and are "free-radical polymerized" into a thermoset).

PET is a hard, stiff, strong dimensionally stable material that absorbs very little water. It has good gas barrier properties and good chemical resistance except to alkalis (which hydrolyse it). Its crystallinity varies from amorphous to fairly high crystalline; it can be highly transparent and colorless but thicker sections are usually opaque and off-white.

Applications include bottles and electrical components but it is probably most widely known as the biaxially oriented and thermally stabilized films used for capacitors, graphics, film base and recording tapes etc.

Physical Properties
- **Density**: 1.3-1.4 g cm\(^{-3}\)
- **Flammability**: HB
- **Limiting oxygen index**: 21 %
- **Radiation resistance**: Good
- **Refractive index**: 1.58-1.64
- **Resistance to Ultra-violet**: Fair
- **Water absorption - equilibrium**: <0.7 %
- **Water absorption - over 24 hours**: 0.1 %

Electrical Properties
- **Dielectric constant @1MHz**: 3.0
- **Dielectric strength**: 17 kV mm\(^{-1}\)
- **Dissipation factor @ 1kHz**: 0.002
- **Surface resistivity**: 10\(^{10}\) Ohm/m²
- **Volume resistivity**: >10\(^{12}\) Ohm/cm

Thermal Properties
- **Coefficient of thermal expansion**: 20-80 x10\(^{-6}\) K\(^{-1}\)
- **Heat-deflection temperature - 0.45MPa**: 115 C
- **Heat-deflection temperature - 1.8MPa**: 80 C
- **Lower working temperature**: -40 to -60 C
- **Specific heat**: 1200 - 1350 J K\(^{-1}\) kg\(^{-1}\)
- **Thermal conductivity @23C**: 0.15-0.4 W m\(^{-1}\) K\(^{-1}\)
- **Upper working temperature**: 115-170 C

Chemical Resistance
- Acids - concentrated: Good-Poor
- Acids - dilute: Good
- Alcohols: Good
- Alkalis: Poor
- Aromatic hydrocarbons: Good-Fair
- Greases and Oils: Good
- Halogenated Hydrocarbons: Good-Poor
- Ketoners: Fair-Poor

Laminate

**ES301520**

| Thickness | 0.06mm |
| Backing Material | 0.018mm Copper |

**Mechanical Properties**
- **Coefficient of friction**: 0.2-0.4
- **Hardness - Rockwell**: M84-101
- **Izod impact strength**: 13-35 J m\(^{-1}\)
- **Tensile modulus**: 2-4 GPa
- **Tensile strength**: 80, for biax film 190-260 MPa

**Chemical Resistance**
- Acids - concentrated: Good-Poor
- Acids - dilute: Good
- Alcohols: Good
- Alkalis: Poor
- Aromatic hydrocarbons: Good-Fair
- Greases and Oils: Good
- Halogenated Hydrocarbons: Good-Poor
- Ketoners: Fair-Poor

**ES301532**

| Thickness | 0.1mm |
| Backing Material | 0.035mm Copper |

Polymer Thickness | 0.025mm

**Polymide – Polyethylene terephthalate**
## Polyethylene terephthalate
### Polyester, PET, PETP

**Laminate**

- **Thickness**: 0.16mm
- **Polymer Thickness**: 0.075mm
- **Backing Material**: 0.07mm Copper

<table>
<thead>
<tr>
<th>Size</th>
<th>1pc</th>
<th>2pcs</th>
<th>5pcs</th>
<th>10pcs</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 x 100 mm</td>
<td>USD 176.00</td>
<td>USD 197.00</td>
<td>USD 244.00</td>
<td>USD 305.00</td>
</tr>
<tr>
<td>150 x 150 mm</td>
<td>USD 196.00</td>
<td>USD 226.00</td>
<td>USD 291.00</td>
<td>USD 370.00</td>
</tr>
<tr>
<td>300 x 300 mm</td>
<td>USD 258.00</td>
<td>USD 314.00</td>
<td>USD 430.00</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Coil</th>
<th>1 Reel</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5 m</td>
<td>USD 368.00</td>
</tr>
<tr>
<td>1 m</td>
<td>USD 464.00</td>
</tr>
<tr>
<td>2 m</td>
<td>USD 652.00</td>
</tr>
<tr>
<td>3 m</td>
<td>USD 910.00</td>
</tr>
<tr>
<td>4 m</td>
<td>USD 1167.00</td>
</tr>
</tbody>
</table>

**Polymer – Polyethylene terephthalate**

**Goodfellow Corporation**
125 Hookstown Grade Road, Coraopolis, PA 15108-9302, USA
Tel: 1-800-821-2870, Fax 1-800-283-2020

Printed prices are correct as at March 27 2020. For current prices see www.goodfellowusa.com
Polyimide

Common Brand Names: Kapton, Kinel, Vespel

General Description: Normally insubflous, coloured (often amber) high performance polymers with predominantly aromatic molecules of high thermal stability. Semi-fabricated shapes and are usually supplied by the polymer manufacturer and made by powder sintering or working with more tractable pre-cursors and completing polymerisation in final form, though some melt-processable grades of resin are manufactured. They have excellent high temperature properties and radiation resistance, inherently low flammability and smoke emission, low creep and high wear resistance and are very expensive. They have moderately high water absorption and are prone to hydrolysis and attack by alkalis and concentrated acids.

A widely used form is DuPont™ Kapton® film, made in thicknesses from 0.008 to 0.125mm and which is a transparent amber colour. Thicker polyimide items are usually opaque. A range of DuPont™ Kapton® film variants are also available. In each of these, a large measure of DuPont™ Kapton® basic properties are combined with an extra attribute eg increased electrical or thermal conductivity, improved corona resistance, opacity and thermoplasticity.

Films are used for capacitors, insulation, printed circuit boards and in aerospace; other applications include engine components, bearings and mechanical parts exposed to radiation.

Explanation of DuPont™ Kapton® grade descriptions

- HN: Regular DuPont™ Kapton® - Transparent Amber - yellow film, increased thermal conductivity, opaque MT: Opaque black version of HN - Electrically (semi-)conductive - yellow XC: Electrically (semi-)conductive - translucent yellow CR: Improved corona resistance - translucent yellow

Superior dimensional stability and adhesion compared to HN HPP-ST: Similar to FPC a two-sided treated film with superior dimensional stability and superior adhesion compared to HN 200RS100: Two layer film with an electrically conductive layer on one side KJ: Thermoplastic - transparent yellow

PI: Improved electrical or thermal conductivity, improved corona resistance, opacity and thermoplasticity

KJP-11: Multi-layer heat-fusible film that enables higher operational temperature functionality and improved abrasion resistance

Availability of DuPont™ Kapton® Grades

Unfortunately due to export restrictions and rationalisation of the DuPont™ Kapton® product range, there are potential issues with the supply of some grades and thicknesses.

DuPont™ Kapton® HN 0.008 mm thick: This specific thickness of DuPont™ Kapton® HN is controlled under ECCN 9A515(x) requirements and is not offered outside of the US.

DuPont™ Kapton® XC & CB: These products are controlled under ECCN 9A515(x)requirements and are not offered outside of the US.

DuPont™ Kapton® KJ & MTB: Regrettably these grades are no longer produced by DuPont™ and we only have a limited range available from our stock.

Please contact your local sales office for an up to date statement on the availability of all grades of DuPont™ Kapton®.

DuPont™, Kapton® & Nomex® are registered trademarks of E.I. du Pont de Nemours and Company.
## Polyimide

### Laminate

**IM301510**

<table>
<thead>
<tr>
<th>Web Code</th>
<th>Size (mm)</th>
<th>Quantity</th>
<th>Price (USD) 1pc</th>
<th>Price (USD) 2pcs</th>
<th>Price (USD) 5pcs</th>
<th>Price (USD) 10pcs</th>
</tr>
</thead>
<tbody>
<tr>
<td>330-296-143</td>
<td>100 x 100 mm</td>
<td>1</td>
<td>203.00</td>
<td>231.00</td>
<td>270.00</td>
<td>315.00</td>
</tr>
<tr>
<td>287-014-910</td>
<td>150 x 150 mm</td>
<td>1</td>
<td>225.00</td>
<td>262.00</td>
<td>316.00</td>
<td>384.00</td>
</tr>
<tr>
<td>876-865-882</td>
<td>300 x 300 mm</td>
<td>1</td>
<td>291.00</td>
<td>354.00</td>
<td>503.00</td>
<td></td>
</tr>
</tbody>
</table>

**IM301522**

<table>
<thead>
<tr>
<th>Web Code</th>
<th>Size (mm)</th>
<th>Quantity</th>
<th>Price (USD) 1pc</th>
<th>Price (USD) 2pcs</th>
<th>Price (USD) 5pcs</th>
<th>Price (USD) 10pcs</th>
</tr>
</thead>
<tbody>
<tr>
<td>178-062-593</td>
<td>100 x 100 mm</td>
<td>1</td>
<td>192.00</td>
<td>215.00</td>
<td>244.00</td>
<td>278.00</td>
</tr>
<tr>
<td>257-817-118</td>
<td>150 x 150 mm</td>
<td>1</td>
<td>208.00</td>
<td>237.00</td>
<td>280.00</td>
<td>329.00</td>
</tr>
<tr>
<td>227-139-823</td>
<td>300 x 300 mm</td>
<td>1</td>
<td>256.00</td>
<td>305.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**IM301512**

<table>
<thead>
<tr>
<th>Web Code</th>
<th>Size (mm)</th>
<th>Quantity</th>
<th>Price (USD) 1pc</th>
<th>Price (USD) 2pcs</th>
<th>Price (USD) 5pcs</th>
<th>Price (USD) 10pcs</th>
</tr>
</thead>
<tbody>
<tr>
<td>591-826-120</td>
<td>100 x 100 mm</td>
<td>1</td>
<td>190.00</td>
<td>215.00</td>
<td>244.00</td>
<td>278.00</td>
</tr>
<tr>
<td>975-266-203</td>
<td>150 x 150 mm</td>
<td>1</td>
<td>219.00</td>
<td>244.00</td>
<td>280.00</td>
<td>329.00</td>
</tr>
<tr>
<td>283-280-259</td>
<td>300 x 300 mm</td>
<td>1</td>
<td>256.00</td>
<td>305.00</td>
<td>358.00</td>
<td>445.00</td>
</tr>
</tbody>
</table>

**IM301536**

<table>
<thead>
<tr>
<th>Web Code</th>
<th>Size (mm)</th>
<th>Quantity</th>
<th>Price (USD) 1pc</th>
<th>Price (USD) 2pcs</th>
<th>Price (USD) 5pcs</th>
<th>Price (USD) 10pcs</th>
</tr>
</thead>
<tbody>
<tr>
<td>873-219-113</td>
<td>100 x 100 mm</td>
<td>1</td>
<td>190.00</td>
<td>215.00</td>
<td>244.00</td>
<td>278.00</td>
</tr>
<tr>
<td>152-393-474</td>
<td>150 x 150 mm</td>
<td>1</td>
<td>219.00</td>
<td>244.00</td>
<td>280.00</td>
<td>329.00</td>
</tr>
<tr>
<td>049-180-244</td>
<td>300 x 300 mm</td>
<td>1</td>
<td>256.00</td>
<td>305.00</td>
<td>358.00</td>
<td>445.00</td>
</tr>
</tbody>
</table>

### Coils

**IM301510**

<table>
<thead>
<tr>
<th>Web Code</th>
<th>Width (mm)</th>
<th>Quantity</th>
<th>Price (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>603-234-814</td>
<td>610</td>
<td>1</td>
<td>436.00</td>
</tr>
<tr>
<td>029-351-221</td>
<td>610</td>
<td>1</td>
<td>650.00</td>
</tr>
</tbody>
</table>

**IM301522**

<table>
<thead>
<tr>
<th>Web Code</th>
<th>Width (mm)</th>
<th>Quantity</th>
<th>Price (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>392-475-447</td>
<td>610</td>
<td>1</td>
<td>372.00</td>
</tr>
<tr>
<td>059-429-873</td>
<td>610</td>
<td>1</td>
<td>461.00</td>
</tr>
</tbody>
</table>

**IM301512**

<table>
<thead>
<tr>
<th>Web Code</th>
<th>Width (mm)</th>
<th>Quantity</th>
<th>Price (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>378-771-818</td>
<td>610</td>
<td>1</td>
<td>558.00</td>
</tr>
<tr>
<td>346-481-954</td>
<td>610</td>
<td>1</td>
<td>937.00</td>
</tr>
</tbody>
</table>

## Printed prices are correct as at March 27 2020. For current prices see [www.goodfellowusa.com](http://www.goodfellowusa.com)
### Polyimide

**Laminate**

**IM301650**

<table>
<thead>
<tr>
<th>Size</th>
<th>Quantity</th>
<th>Web Code</th>
<th>Size</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>352-022-718</td>
<td>150 x 150 mm</td>
<td>1pc</td>
</tr>
<tr>
<td></td>
<td></td>
<td>002-840-607</td>
<td>300 x 300 mm</td>
<td>2pcs</td>
</tr>
</tbody>
</table>

**Polymer Thickness** 0.025mm

**Backing Material** Nomex®

**Polymer – Polyimide**

**PP301540**

<table>
<thead>
<tr>
<th>Size</th>
<th>Quantity</th>
<th>Web Code</th>
<th>Size</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>157-977-840</td>
<td>150 x 150 mm</td>
<td>1pc</td>
</tr>
<tr>
<td></td>
<td></td>
<td>506-586-918</td>
<td>300 x 300 mm</td>
<td>2pcs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>233-697-123</td>
<td>600 x 600 mm</td>
<td>5pcs</td>
</tr>
</tbody>
</table>

**Polymer Thickness** 0.050mm

### Polypropylene

**Common Brand Names:** Appryl, Hostalen PP, Lacqtene, Novolen, Propathene

**General Description:** A semi-crystalline, white, semi-opaque commodity thermoplastic made in a very wide variety of grades and modifications. It is a linear polyolefin which can be compared in many ways to high density polyethylene (HDPE) and that is manufactured in a very similar way. The catalysts used control the stereo-regularity quite well so that commercial polypropylenes are usually predominantly isotactic. Polypropylene homopolymer is harder and has a higher temperature resistance than HDPE but lower impact resistance and becomes brittle below 0°C. Hence copolymer grades are preferred for all applications exposed to cold/winter conditions. These copolymers have better impact strength, maintained down to lower temperatures, than homopolymer at the expense of quite small reductions in other properties. Like polyethylenes, polypropylene has good chemical but poor UV resistance (unless stabilized or protected).

Applications include (for homopolymers) appliance housings, housewares, packaging, cassette holders and fibers, monofilaments and slit-film tapes; for copolymers pipes, containers, boat hulls, seat shells and automotive parts e.g. battery cases and bumpers though the latter are often made from more heavily elastomer-modified polypropylenes.

### Physical Properties

**Density** 0.9 g cm⁻³

**Flammability** HB

**Limiting oxygen index** 18 %

**Radiation resistance** Fair

**Refractive index** 1.49

**Resistance to Ultra-violet** Poor

**Water absorption - equilibrium** 0.03 %

### Electrical Properties

**Dielectric constant @1MHz** 2.2-2.6

**Dielectric strength** 30-40 kV mm⁻¹

**Dissipation factor @1 MHz** 0.0003 - 0.0005

**Surface resistivity** 10⁵-10¹⁰ Ohm/sq

**Volume resistivity** 10¹³-10¹⁵ Ohmcm

### Thermal Properties

**Coefficient of thermal expansion** 100-180 x10⁻⁶ K⁻¹

**Heat-deflection temperature - 0.45MPa** 105-109 C

**Heat-deflection temperature - 1.8MPa** 60-65 C

**Lower working temperature** -10 to -40 C

**Specific heat** 1700 - 1900 J kg⁻¹ K⁻¹

**Upper working temperature** 90-120 C

**Mechanical Properties**

**Abrasive resistance - ASTM D1044** 13-16 mg/1000 cycles

**Elongation at break** 150-300, for biax film >50 %

**Hardness - Rockwell** R80-100

**Izod impact strength** 20-100 J m⁻¹

**Tensile modulus** 0.9-1.5, for biax film 2.2-4.2, GPa

**Tensile strength** 25-40, for biax film 130-300, MPa

### Chemical Resistance

**Acids - concentrated** Good-Fair

**Acids - dilute** Good-Fair

**Alcohols** Good

**Alkalis** Good-Poor

**Aromatic hydrocarbons** Fair

**Greases and Oils** Good-Fair

**Halogenated Hydrocarbons** Good-Poor

**Halogens** Poor

**Ketones** Good

**Physical Properties**

**Density** 0.9 g cm⁻³

**Flammability** HB

**Limiting oxygen index** 18 %

**Radiation resistance** Fair

**Refractive index** 1.49

**Resistance to Ultra-violet** Poor

**Water absorption - equilibrium** 0.03 %

### Mechanical Properties

**Abrasive resistance - ASTM D1044** 13-16 mg/1000 cycles

**Elongation at break** 150-300, for biax film >50 %

**Hardness - Rockwell** R80-100

**Izod impact strength** 20-100 J m⁻¹

**Tensile modulus** 0.9-1.5, for biax film 2.2-4.2, GPa

**Tensile strength** 25-40, for biax film 130-300, MPa

### Chemical Resistance

**Acids - concentrated** Good-Fair

**Acids - dilute** Good-Fair

**Alcohols** Good

**Alkalis** Good-Poor

**Aromatic hydrocarbons** Fair

**Greases and Oils** Good-Fair

**Halogenated Hydrocarbons** Good-Poor

**Halogens** Poor

**Ketones** Good
<table>
<thead>
<tr>
<th>INDEX — A-V</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A</strong></td>
</tr>
<tr>
<td>Appryl</td>
</tr>
<tr>
<td>Amite</td>
</tr>
<tr>
<td><strong>D</strong></td>
</tr>
<tr>
<td>Dacron</td>
</tr>
<tr>
<td><strong>H</strong></td>
</tr>
<tr>
<td>Hostalen PP</td>
</tr>
<tr>
<td>Hostaphan</td>
</tr>
<tr>
<td><strong>I</strong></td>
</tr>
<tr>
<td>Impet</td>
</tr>
<tr>
<td><strong>K</strong></td>
</tr>
<tr>
<td>Kaladex</td>
</tr>
<tr>
<td>Kalidar</td>
</tr>
<tr>
<td>Kapton</td>
</tr>
<tr>
<td>Kinel</td>
</tr>
<tr>
<td><strong>L</strong></td>
</tr>
<tr>
<td>Lacqylene</td>
</tr>
<tr>
<td>Laminate</td>
</tr>
<tr>
<td>... Polyethylene naphthalate</td>
</tr>
<tr>
<td>... Polyethylene terephthalate</td>
</tr>
<tr>
<td>... Polyimide</td>
</tr>
<tr>
<td>... Polypropylene</td>
</tr>
<tr>
<td><strong>M</strong></td>
</tr>
<tr>
<td>Melinar</td>
</tr>
<tr>
<td>Melinex</td>
</tr>
<tr>
<td>Mylar</td>
</tr>
<tr>
<td><strong>N</strong></td>
</tr>
<tr>
<td>Novolen</td>
</tr>
<tr>
<td><strong>P</strong></td>
</tr>
<tr>
<td>Polyethylene naphthalate (PEN)</td>
</tr>
<tr>
<td>Polyethylene terephthalate (Polyester, PET, PETP)</td>
</tr>
<tr>
<td>Polyimide (PI)</td>
</tr>
<tr>
<td>Polypropylene (PP)</td>
</tr>
<tr>
<td>Propathene</td>
</tr>
<tr>
<td><strong>R</strong></td>
</tr>
<tr>
<td>Rynite</td>
</tr>
<tr>
<td><strong>T</strong></td>
</tr>
<tr>
<td>Terylene</td>
</tr>
<tr>
<td>Trevira</td>
</tr>
<tr>
<td><strong>V</strong></td>
</tr>
<tr>
<td>Vespel</td>
</tr>
</tbody>
</table>