

**3B solutions for wind energy**

## the winds of change

About 1.5 billion people still do not have access to electricity and at the same time energy consumption by the industrial nations is permanently increasing. Together with the threat of climate change, this has prompted a major drive towards the installation of new wind turbines around the world. Wind is already an important player in the world's energy markets and the drivers for wind power still hold as there is a need for power generation that is clean, reliable and quick to install.



At 3B-the fibreglass company, we believe wind will play a key role in addressing the climate change challenge while meeting the world's long-term energy needs.

To contribute to the development of this fast growing market, we are committed to design efficient and innovative wind energy solutions available globally.

3B eco-solutions are built upon environmental responsibility, technological innovation and a global presence to most effectively service our customers.



## 3B and the wind industry



Supporting our customers in this regenerative source of energy, our vision is to be the wind energy solution provider, the thermoplastic global leader and the specialty business developer.

As a leading European developer and supplier of fibreglass products, 3B's unrivalled competence in fibreglass development and technology is helping to create a more sustainable future throughout the complete wind solutions value chain.

The following 3B brands and products offer leading edge performance to help design and implement wind energy solutions:

- Advantex® glass
- HiPer-tex®
- Continuous Filament Mat

## 3B Solutions for Wind Energy: HiPer-tex® , Advantex® glass, CFM

# 3B Continuous Filament Mat

The solution for a fast infusion process with excellent flow, 3B Continuous Filament Mat is a non-woven mat made out of Advantex® glass filaments. Consisting of continuous fibres randomly oriented in multiple layers, the glass fibre is bonded with a silane coupling agent and the layers held together with a suitable binder.

*3B Continuous Filament Mat made of Advantex® glass for Wind. A benchmark product for composites applications in the wind energy industry.*

The products contain an insoluble binder compatible with both unfilled or filled unsaturated polyester, vinylester, epoxy and polyurethane resin systems.

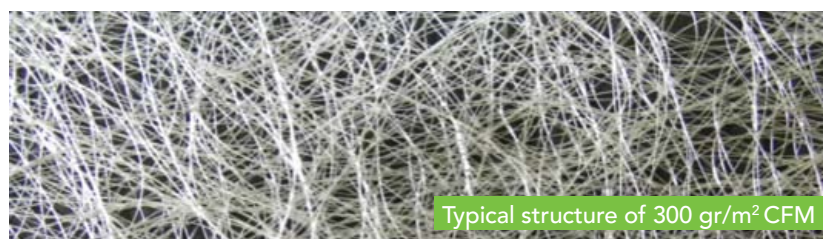
**Major benefits include:**

- Excellent flow-media for infusion process
- Reduced infusion time thanks to its high permeability
- Excellent wet-out and wet-through
- Excellent processing
- Multi-compatible sizing for polyester/vinylester/epoxy/polyurethane resin systems
- Excellent mechanical properties
- Excellent handling properties, easy to cut and good conformability
- Excellent weight uniformity and uniform strand integrity
- Availability in different widths, min. 55cm up to 260cm.

3B Continuous Filament Mat can be used either as a traditional flow media on the surface (which is removed after moulding) or as an in-situ interlaminar flow media, giving high permeability glass reinforced layer in a thick structural laminate.

**3B continuous filament mat for wind: M8615**

| Product name | Weight g/m <sup>2</sup> | Width cm | Bundle density tex | Solid content % |
|--------------|-------------------------|----------|--------------------|-----------------|
| M8615        | 225                     | 130-260  | 30                 | 3.5             |
|              | 300                     | 130-260  | 30                 | 3.5             |
|              | 450                     | 130-260  | 30                 | 3.5             |
|              | 600                     | 130-260  | 30                 | 3.5             |



Typical structure of 300 gr/m<sup>2</sup> CFM



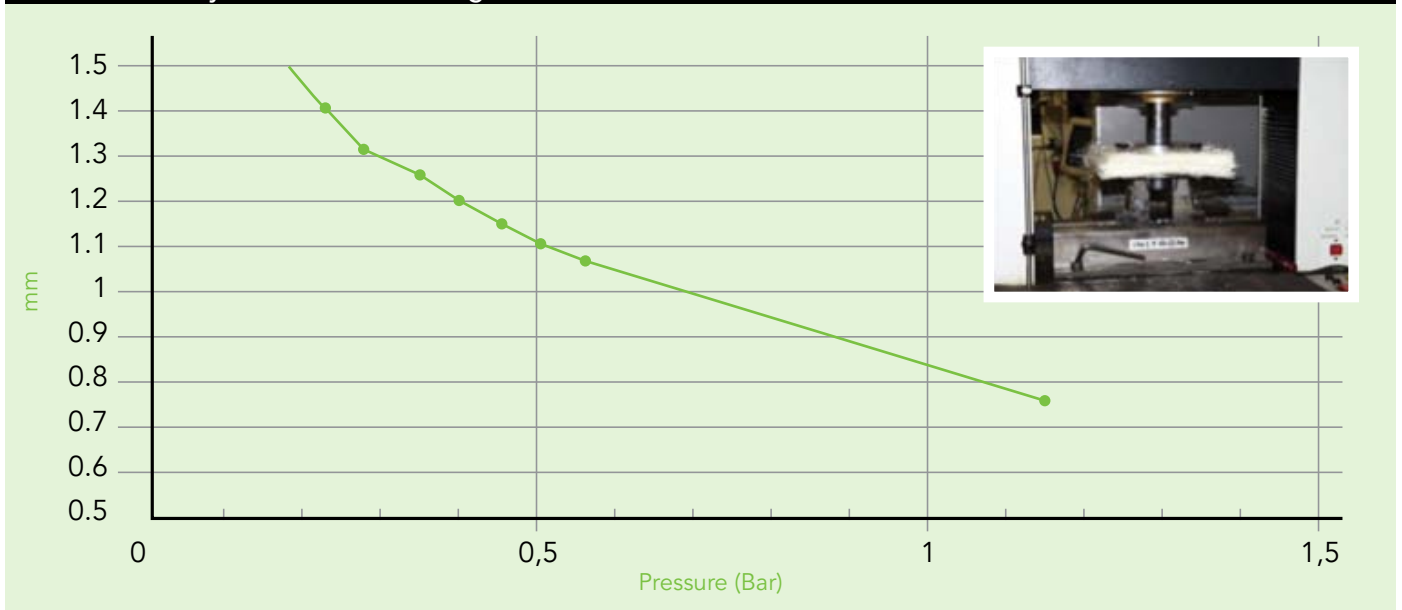
# discover your fibreglass world

| FEATURES   | BENEFITS   |
|--|--|
| <ul style="list-style-type: none"> <li>• Insoluble binder</li> <li>• Continuous fibre</li> <li>• Improved integrity of the layers of the mat</li> <li>• Softness of the mat</li> </ul> | <ul style="list-style-type: none"> <li>• Can be unrolled, cut and conveyed to the mould without losing mat integrity even large parts for the M8615 series</li> <li>• Conform to complex and difficult shapes without causing wrinkles or leaving ratio-rich radii, which may cause cracking</li> <li>• Resist to relocation in the mould under pressure and resin flow (wash resistance)</li> </ul> |
| <ul style="list-style-type: none"> <li>• High bundle linear density (tex) for a large porosity</li> </ul>  | <ul style="list-style-type: none"> <li>• Little resistance to resin flow for an easy and fast wet-through, even with filled resin resulting in a high productivity</li> </ul>  |



Courtesy of Euro GmbH

Thickness of 1 layer of CFM 8615 450 gr/m<sup>2</sup>



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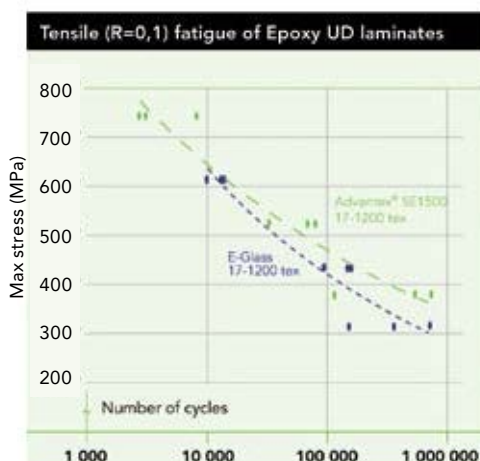
## the recognised benchmark in the fibreglass industry for the wind energy market

### Advantex<sup>®</sup> glass technology

If you are looking for high product performance with the lowest environmental impact, then look no further than the breakthrough Advantex<sup>®</sup> glass technology. With its High Mechanical Properties, Corrosion Resistance and Clean Manufacturing Technology, Advantex<sup>®</sup> glass is the ideal reinforcement for the composites parts in the wind energy industry, like blades, nacelles covers, drive shafts, etc.

### 3B Advantex<sup>®</sup> glass rovings for Wind

- SE2020 for epoxy resin systems and higher transverse tensile strength
- SE3030 for polyester/vinylester/epoxy/ (multi-compatible) resin systems
- SE1500 for epoxy resin systems



### High Mechanical Properties

The solution for durable blades, Advantex<sup>®</sup> glass offers:

- Up to 9% higher tensile strength and up to 5% higher E-modulus vs. traditional E-Glass
- Optimised sizings for excellent processing, enhanced fatigue performance and interfibre strength
- Superior corrosion resistance

### Advantex<sup>®</sup> Glass properties

| Property                         | Test method | Unit                             | Advantex <sup>®</sup> Glass | E-Glass   |
|----------------------------------|-------------|----------------------------------|-----------------------------|-----------|
| Density                          | ASTM D1505  | gr/cm <sup>3</sup>               | 2.62                        | 2.55-2.62 |
| Thermal linear expansion 0°-300° | ASTM D696   | 10 <sup>-6</sup> K <sup>-1</sup> | 6                           | 5.4       |
| Softening point                  | ASTM C338   | °C                               | 916                         | 830-860   |

### Roving & laminate properties

| Property                           | Test method  | Unit | Avantex <sup>®</sup> Glass |
|------------------------------------|--------------|------|----------------------------|
| Fibre tensile strength*            | ASTM 2343-08 | MPa  | 2200-2600                  |
| Fibre tensile modulus*             | ASTM 2343-08 | GPa  | 81-83                      |
| UD Laminate tensile strength**     | ISO 527-5    | MPa  | 1250-1500                  |
| UD Laminate tensile modulus**      | ISO 527-5    | GPa  | 48-52                      |
| UD Laminate compressive strength** | ISO 14126    | MPa  | 1247                       |
| UD Laminate compressive modulus**  | ISO 14126    | GPa  | 53                         |
| UD interlaminar shear strength**   | ISO 14130    | MPa  | 60-70                      |
| Laminate tensile strength***       | ISO 527-5    | MPa  | 900-1000                   |
| Laminate tensile modulus***        | ISO 527-5    | GPa  | 39-40                      |
| Interlaminar shear strength**      | ISO 14130    | MPa  | 42-46                      |

\* These values are representative of 17 micron-2400tex fibre, impregnated with epoxy resin

\*\* These values are representative of epoxy unidirectional laminates weight fraction of 78-79%

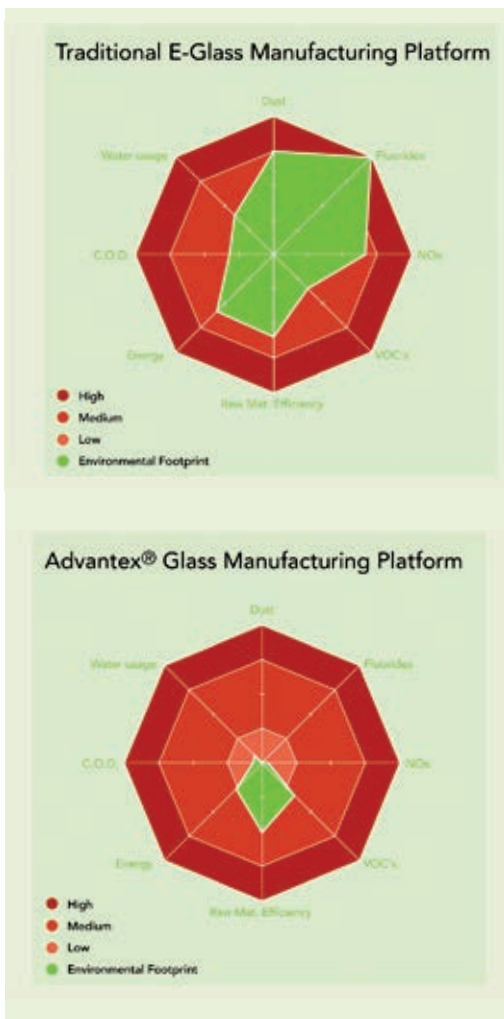
\*\*\* These values are representative of epoxy laminates based on UD1150g/m<sup>2</sup> fabrics with a glass weight fraction of 73-74%

# discover your fibreglass world

## Corrosion resistance

### The solution for offshore blades

Designed to withstand a wide range of aggressive environments, Advantex® glass is a boron-free E-CR glass in accordance with ASTM D578 and ISO 2078.



## Clean Manufacturing Technology

### The solution for a greener, cleaner environment

If you compare the environmental footprint of Advantex® glass with E-Glass, you can clearly see the substantial benefits achieved by implementing Advantex® glass composition and technology in our manufacturing processes. **The benefits to you?** Switching from traditional E-Glass to Advantex® boron-free glass means more value for you, the customer, and less impact on the environment.

- Removing boron from the glass composition stops dust particulates being created. These are associated with the partial volatilization when exposed to high temperatures
- The removal of added fluorides from the composition also reduces dust particulates
- The implementation of modern melting technology means a substantial reduction in greenhouse gas emissions reductions such as NO<sub>x</sub>
- Increased energy efficiency reduces CO<sub>2</sub> emissions

The table above summarises the stress corrosion test of pultruded rods made with the same isophthalic polyester resin: one set reinforced with E-Glass and the other with Advantex® glass.

### Tensile stress corrosion of Advantex® glass vs. E-Glass pultruded rods (Isophthalic UP resin). Load extrapolation to reach 50 years lifetime

| Environment   | Glass Reinforcement | % of initial static strength for 50 years lifetime | Max Stress (MPa) to reach 50 years lifetime | Delta Advantex® glass vs E-Glass |
|---------------|---------------------|--|---|----------------------------------|
| Air           | Advantex® glass     | 45.8%  | 490   | 0%                               |
|               | E-Glass             | 44.6%  | 501   |                                  |
| D.I. Water    | Advantex® glass     | 39.9%  | 427   | 129%                             |
|               | E-Glass             | 16.6%  | 187   |                                  |
| 5% Salt Water | Advantex® glass     | 42.4%  | 454   | 33%                              |
|               | E-Glass             | 30.3%  | 341   |                                  |

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# the glass fibre benchmark just moved to higher level

## HiPer-tex<sup>®</sup> glass technology

What distinguishes HiPer-tex<sup>®</sup> fibre is the benefits resulting from recent groundbreaking manufacturing technology developments. Our customers gain significantly from its high strength, high modulus, and high elongation at break.



HiPer-tex<sup>®</sup> fibre is based on a new patented glass formulation, which respects the environment, with new and optimised melt fiberizing and sizing technologies. A formulation that utilises a high capacity production platform, which delivers economies of scale while providing a step change in composite performance.

### Outstanding mechanical properties

#### The solution for longer blades for both onshore and offshore

Compared to E-Glass, the benefits of HiPer-tex<sup>™</sup> fibre are clear:

- Up to 25% higher tensile strength
- Up to 15 % higher tensile modulus
- Up to 40 % increase in fatigue strength

#### Longer blades, same weight

Weight savings of up to 10%, compared with conventional E-Glass blades of the same design, are now possible. This allows turbine manufacturers to increase blade lengths, while keeping the same blade weight. **The result?** Higher turbine efficiency, leading to lower cost of energy.

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## HiPer-tex<sup>®</sup> rovings for wind

- W2020 for epoxy resin systems
- W3030 for polyester, vinylester, epoxy, (multi-compatible) resin systems.

| Key benefits vs E-Glass                 | Results in   |
|---|--|
| 15% higher stiffness                    | Larger load for same deformation                             |
| 25% higher strength                     | Larger load (higher wind speed)                              |
| >10x improved fatigue life at same load | Improved durability, reliability and lower maintenance costs |
| 10% higher strain to failure            | Higher deformation allowable                                 |
| >30% higher strain energy density       | Better impact and damage tolerance                           |
| 8-10% weight savings for similar design |  |

## HiPer-tex<sup>™</sup> glass properties

| Property                                       | Test method     | Unit               | E-Glass   | HiPer-tex <sup>™</sup> |
|--|-----------------|--------------------|-----------|------------------------|
| Density of 17µm fibres                         | Pycnometer      | gr/cm <sup>3</sup> | 2.55-2.62 | 2,58                   |
| Softening Point                                | DIN ISO 7884-1  | °C                 | 886-904   | 925                    |
| Weight loss after 2 hours in 10% H2SO4 at 98°C | Adapted ISO 179 | %                  | 5-8%      | 0.1-0.3%               |

## HiPer-tex<sup>™</sup> glass properties

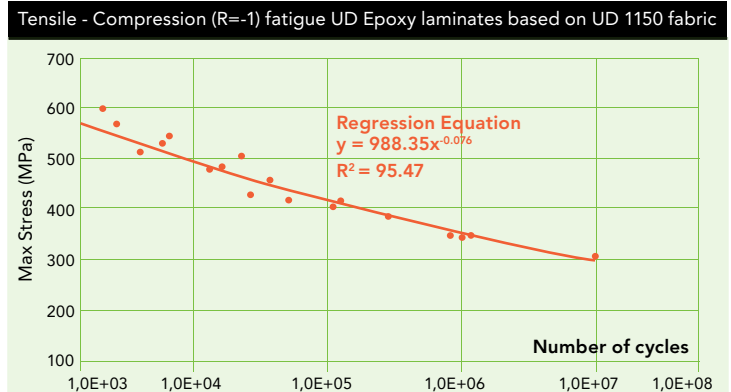
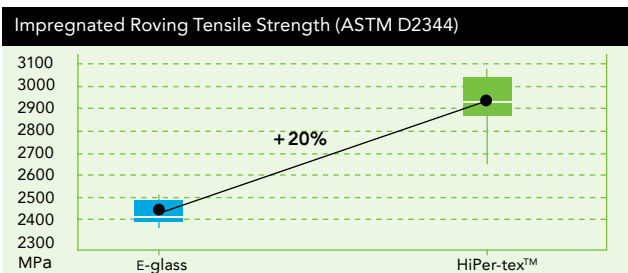
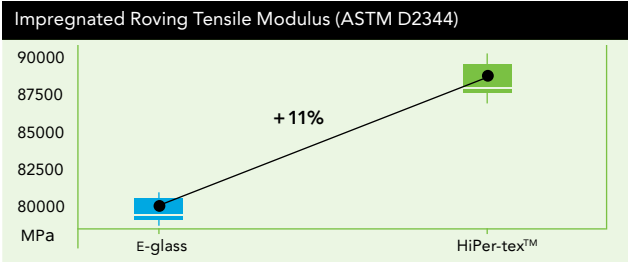
| Property                         | Test method  | Unit | E-Glass   | HiPer-tex <sup>™</sup> |
|----------------------------------|--------------|------|-----------|------------------------|
| Fibre Tensile Strength*          | ASTM 2343-08 | MPa  | 2000-2500 | 2700-3200              |
| Fibre Tensile Modulus*           | ASTM 2343-08 | GPa  | 74-80     | 86-89                  |
| UD Laminate tensile strength**   | ISO 527-5    | MPa  | 1100-1400 | 1300-1600              |
| UD Laminate tensile modulus**    | ISO 527-5    | GPa  | 46-49     | 52-54                  |
| UD interlaminar shear strength** | ISO 14130    | MPa  | 60-70     | 65-74                  |

\* These values are representative of 17 micron-2400tex fibre, impregnated with epoxy resin

\*\* These values are representative of epoxy wound roving unidirectional laminates with a glass volume fraction of 60 %



# discover your fibreglass world



**Properties summary of Epoxy UD laminates based on UD1150 fabric (36gsm of Weft) with HiPer-tex™ W2020 rovings**

| Test             | Properties                          | W2020 HiPer-tex™ |
|------------------|-------------------------------------|------------------|
| Tensile 0° *     | Tensile strength (MPa) / Strain (%) | 1234/2.56        |
|                  | Tensile Modulus (GPa)               | 48,20            |
| Compression 0° * | Compression strength (MPa)          | 944              |
|                  | Compression Modulus (GPa)           | 49,29            |
| Tensile 90°      | Fibre volume fraction (%)           | 53,44            |
|                  | Tensile strength (MPa) / Strain (%) | 56,9/0.59        |
|                  | Tensile Modulus (GPa)               | 11,5             |
| Compression 90°  | Compression strength (MPa)          | 160              |
|                  | Compression Modulus (GPa)           | 13,58            |

\* Values corrected to correspond to Vf=56%

## Corrosion resistance

### The solution for offshore blades

HiPer-tex<sup>®</sup> reinforcement is a non-added boron glass which can be classified as high strength R-glass, as defined by the ASTM C-162, DIN 1259 and ISO 20278 standards. This glass formulation is designed for excellent mechanical properties and also for better corrosion resistance than E-Glass in water and acidic environments.

## Environmental footprint

### The solution for a greener, cleaner environment

HiPer-tex<sup>T</sup> reinforcement is a non-added boron glass:

- Removing boron from glass composition stops dust particulates being created. These are associated with the partial volatilization when exposed to high temperatures
- The removal of added fluorides from the composition also reduces dust particulates
- The implementation of modern melting technology means a substantial reduction in greenhouse gas emissions such as NO<sub>x</sub>
- Increased energy efficiency reduces CO<sub>2</sub> emissions



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Knitting  
Epoxies compatible

## Advantex® glass

Advantex® glass is a boron-free glass and presents significantly improved corrosion resistance across a wide range of aggressive environments. Advantex® glass is an E-CR glass in accordance with ASTM D578 and ISO 2078. This translates into important benefits for end-users over traditional E glass: longer service life, larger safety coefficients for the same design, and material savings. Traditional E-glass includes boron and often contains added fluorides. By using new manufacturing technology to eliminate these components from the glass composition, Advantex® glass has become a benchmark for integrated pollution prevention and the highest energy efficiency – all in an optimized process. 3B measures its efforts and works continually to minimize its impact on the environment and to set new standards within the global fibreglass industry. This is our commitment.

## SE 1500 Direct Rovings



### Product Description

3B Direct Rovings consist of continuous filaments bonded into a single strand and wound onto a bobbin shape. A proprietary sizing applied on the fibres assures an excellent resin-to-glass bonding. SE1500 Direct Rovings made of Advantex® glass are specifically designed for knitting process. The sizing of SE1500 Direct Rovings is specifically designed for excellent adhesion with epoxy systems.

(It is not recommended to use these Direct Rovings with non-epoxy resin systems). SE1500 Direct Rovings made of Advantex® glass present high level of fatigue performances. They are approved by Germanischer Lloyd for manufacturing of windmill blades. SE1500 Direct Rovings made of Advantex® glass are also in use in filament winding process under specific conditions; contact us for further assistance.

| FEATURES                | BENEFITS   |
|-------------------------|--|
| Boron-free E-CR glass   | High corrosion resistance  |
| Epoxies compatible      | High fatigue performances of epoxy composites<br>Approved by Germanischer Lloyd for windmill blades manufacturing. |
| Medium strand integrity | High productivity and quality in knitting operations   |
| Globally available      | Get flexibility in manufacturing the highest quality wherever you are.   |

# SE 1500 Direct Rovings

**PRODUCT PORTFOLIO & GENERAL PROPERTIES (PLEASE CONTACT US FOR ADDITIONAL INFO ON PROPERTIES)**

| Product name               | Filament diameter<br>µm                           | Linear density<br>tex (gr/km) | Bobbin type   | Packaging |
|----------------------------|---|-------------------------------|---|-----------|
| SE1500                     | 16  | 300                           | R   | see below |
| SE1500                     | 17  | 600                           | C   | see below |
| SE1500                     | 17  | 1200                          | C   | see below |
| SE1500                     | 17  | 2400                          | C & G   | see below |
| SE1500                     | 17  | 2400                          | C & G   | see below |
| SE1500                     | 24  | 4800                          | C   | see below |
| Fibre's density            | 2.62 gr/cm <sup>3</sup>                           |                               |   |           |
| Fibre's CLTE               | 6.10 <sup>-6</sup> K <sup>-1</sup>                | (ASTM D696)                   |   |           |
| Tensile Strength           | 2400-2500 MPa                                     | (ASTM D2343-08)               |   |           |
| Tensile Modulus            | 81-83 GPa   | (ASTM D2343-08)               |   |           |
| Fatigue                    | Uni-directional                                   | (ISO 13003)                   | For 10 <sup>3</sup> < N < 2.10 <sup>5</sup>                   |           |
| Tension-Tension<br>(R=0.1) | 17 µm - 1200 tex<br>MGS L135i infused<br>(Wf=79%) |                               | S = 2369 N <sup>-0.1398</sup><br>S : Max Stress<br>N : cycles |           |

**PACKAGING**

Bobbins are individually wrapped with stretched plastic film for protection, improved handling and to allow optimum transfer from bobbin to bobbin. Nominal weights for R, C, and G bobbins are respectively 21, 25 and 40 kg. Two pallet configurations are available:

- Bulk-Pack: standard packaging, consists of individual bobbins
- Tack-Pack: bobbins are connected together for continuous unwinding and no bobbins handling for operators.

For detailed informations on bobbins, on pallet's weight, dimensions and layout, please contact us.

**STORAGE**

Storage in a cool and dry warehouse into the original packaging is formally recommended. More precisely ideal storage conditions are a temperature between 15°C and 35°C and a relative humidity comprised between 35% and 75%. If these conditions are maintained, the glass fibre product should not undergo significant changes when stored for extended periods of time. It is also strongly recommended to condition it in the workshop for at least 24 hours before use to prevent condensation. For an optimal processing it is recommended to use the product in ambient conditions (20°C-23°C and a relative humidity of 60%-65%)



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Weaving, NCF, Prepregs, Filament Winding, Pultrusion, ...

## Advantex® glass

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Advantex® glass is an E-CR glass in accordance with ASTM D578 and ISO 2078.

This translates into important benefits for end-users over traditional E-glass: longer service life, larger safety coefficients for the same design, and material savings. Traditional E-glass includes boron and often contains added fluorides. By using new manufacturing technology to eliminate these components from the glass composition, Advantex® glass has become a benchmark for integrated pollution prevention and the highest energy efficiency – all in an optimized process.

3B measures its efforts and works continually to minimize its impact on the environment and to set new standards within the global glassfibre industry. This is our commitment.

Advantex® glass is available from 3B European facilities in Battice - Belgium and Birkeland - Norway.

## SE 2020

Direct Roving for Epoxy Resins



### Product Description

3B Direct Rovings consist of continuous filaments bonded into a single strand and wound onto a bobbin shape. A proprietary sizing applied on the fibres assures an excellent resin-to-glass bonding.

SE 2020 Direct Rovings made of Advantex® glass are specifically designed for the production of Non Crimped Fabrics.

The sizing of SE 2020 Direct Rovings is specifically designed for excellent adhesion with epoxy resin systems.

SE 2020 Direct Rovings present high level of fatigue performances, superior interfibre and interlaminar shear strengths.

The SE 2020 Roving is approved by Germanischer Lloyd for the use in wind turbine rotor blades.

SE 2020 Direct Rovings made of Advantex® glass can also be used in prepreg, filament winding processes.

Please contact us for further assistance.

| FEATURES                | BENEFITS   |
|-------------------------|--|
| Boron-free ECR glass    | High corrosion resistance  |
| Epoxy compatible        | High fatigue performances of composites parts<br>Improved inter fibre (transverse tensile) and interlaminar shear strengths<br>Enhanced laminate quality<br>Approved by Germanischer Lloyd for windmill blades manufacturing |
| Medium strand integrity | High productivity and quality in Non Crimped Fabrics operations  |

# SE 2020

Direct Roving for Epoxy Resins

## PRODUCT PORTFOLIO

| Product Name | Filament diameter<br>µm | Linear Density<br>tex (gr/km) | Bobbin type |
|--------------|-------------------------|-------------------------------|-------------|
| SE 2020      | 16                      | 300                           | R           |
| SE 2020      | 17                      | 600                           | C           |
| SE 2020      | 17                      | 1200                          | C           |
| SE 2020      | 17                      | 2400                          | C           |
| SE 2020      | 24                      | 4800                          | C           |

## FIBRE PROPERTIES

| Density                 | CLTE<br>(ASTM D696)                | Tensile Strength<br>(ASTM D2343-08) | Tensile Modulus<br>(ASTM D2343-08) |
|-------------------------|------------------------------------|-------------------------------------|------------------------------------|
| 2.62 gr/cm <sup>3</sup> | 6.10 <sup>-6</sup> K <sup>-1</sup> | 2200-2500 MPa                       | 81 GPa                             |

## TYPICAL UNI-DIRECTIONAL LAMINATES PROPERTIES (Glass Vf 55%)

|                | Tensile Strength 0°<br>(ISO 527-5) | Tensile Modulus<br>(ISO 527-5) | Tensile Strength 90°<br>(ISO 527-5) | ILSS<br>(ISO 14130) | Fatigue<br>1 000 000 cycles |
|----------------|------------------------------------|--------------------------------|-------------------------------------|---------------------|-----------------------------|
| UD 1150 Fabric | 980 MPa                            | 44 GPa                         | 61 MPa                              | 59 MPa              | 255 MPa / R= -1             |

## PACKAGING

Bobbins are individually wrapped with stretched plastic film for protection, improved handling and to allow optimum transfer from bobbin to bobbin. Nominal weights for R and C bobbins are respectively 21 and 25 kg.

Two pallet configurations are available:

- Bulk Pack: standard packaging, consists of individual bobbins.
- Creel Pack: bobbins are connected together for continuous unwinding and no bobbins handling for operators.

For detailed information about bobbins, pallet weight, dimensions and layout please contact us.

## STORAGE

Storage in a cool and dry warehouse into the original packaging is formally recommended. More precisely ideal storage conditions are a temperature between 15°C and 35°C and a relative humidity comprised between 35% and 75%. If these conditions are maintained, the glass fibre product should not undergo significant changes when stored for extended periods of time. It is also strongly recommended to condition it in the workshop for at least 24 hours before use to prevent condensation.

For an optimal processing it is recommended to use the product in ambient conditions (20°C-23°C and a relative humidity of 60%-65%).



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Weaving, NCF, Prepregs,  
Filament Winding, Pultrusion, ...

## Advantex® glass

Advantex® glass is a boron-free glass and presents significantly improved corrosion resistance across a wide range of aggressive environments.

Advantex® glass is an E-CR glass in accordance with ASTM D578 and ISO 2078.

This translates into important benefits for end-users over traditional E-glass: longer service life, larger safety coefficients for the same design, and material savings. Traditional E-glass includes boron and often contains added fluorides. By using new manufacturing technology to eliminate these components from the glass composition, Advantex® glass has become a benchmark for integrated pollution prevention and the highest energy efficiency – all in an optimized process.

3B measures its efforts and works continually to minimize its impact on the environment and to set new standards within the global glassfibre industry. This is our commitment.

Advantex® glass is available from 3B European facilities in Battice - Belgium and Birkeland - Norway.

## SE 3030

Direct Roving for Polyester, Vinylester & Epoxy Resins



### Product Description

3B Direct Rovings consist of continuous filaments bonded into a single strand and wound onto a bobbin shape. A proprietary sizing applied on the fibres assures an excellent resin-to-glass bonding.

SE 3030 Direct Rovings made of Advantex® glass are specifically designed for multipurpose applications/processes such as the production of Non Crimped Fabrics, prepreg, fila-

ment winding, pultrusion, etc.

The sizing of SE 3030 Direct Rovings is compatible with multiple resins: i.e. polyester, vinylester and epoxies.

SE 3030 Direct Rovings present high level of fatigue performances, superior interfibre and interlaminar shear strengths.

Please contact us for further assistance.

| FEATURES                                | BENEFITS  |
|---|---|
| Boron-free ECR glass                    | High corrosion resistance   |
| Polyester, Vinylester, Epoxy compatible | High fatigue performances of composites parts, especially with polyester and vinylester resins<br>Improved inter fibre (transverse tensile) and interlaminar shear strengths<br>Enhanced laminate quality |
| Medium strand integrity                 | High productivity and quality in Non Crimped Fabrics operations   |

# SE 3030

Direct Roving for Polyester, Vinylester & Epoxy Resins

## PRODUCT PORTFOLIO

| Product Name | Filament diameter<br>µm | Linear Density<br>tex (gr/km) | Bobbin type |
|--------------|-------------------------|-------------------------------|-------------|
| SE 3030      | 16                      | 300                           | R           |
| SE 3030      | 17                      | 600                           | C           |
| SE 3030      | 17                      | 1200                          | C           |
| SE 3030      | 17                      | 2400                          | C           |
| SE 3030      | 24                      | 4800                          | C           |
| SE 3030      | 33                      | 9600                          | C           |

## FIBRE PROPERTIES

| Density                 | CLTE<br>(ASTM D696)                | Tensile Strength<br>(ASTM D2343-08) | Tensile Modulus<br>(ASTM D2343-08) |
|-------------------------|------------------------------------|-------------------------------------|------------------------------------|
| 2.62 gr/cm <sup>3</sup> | 6.10 <sup>-6</sup> K <sup>-1</sup> | 2200-2500 MPa                       | 81 GPa                             |

## TYPICAL UNI-DIRECTIONAL LAMINATES PROPERTIES (Glass Vf 60%)

|           | Tensile Strength 0°<br>(ISO 527-5) | Tensile Modulus<br>(ISO 527-5) | Tensile Strength 90°<br>(ISO 527-5) | ILSS<br>(ISO 14130) | Fatigue<br>(R=0.1) - 1 000 000 cycles |
|-----------|------------------------------------|--------------------------------|-------------------------------------|---------------------|---------------------------------------|
| Polyester | 1200 MPa                           | 49 GPa                         | 30 MPa                              | 57 MPa              | 310 MPa / 0.64 %                      |
| Epoxy     | 1200 MPa                           | 49 GPa                         | 55 MPa                              | 70 MPa              |                                       |

## PACKAGING

Bobbins are individually wrapped with stretched plastic film for protection, improved handling and to allow optimum transfer from bobbin to bobbin. Nominal weights for R and C bobbins are respectively 21 and 25 kg.

Two pallet configurations are available:

- Bulk Pack: standard packaging, consists of individual bobbins.
- Creel Pack: bobbins are connected together for continuous unwinding and no bobbins handling for operators.

For detailed information about bobbins, pallet weight, dimensions and layout please contact us.

## STORAGE

Storage in a cool and dry warehouse into the original packaging is formally recommended. More precisely ideal storage conditions are a temperature between 15°C and 35°C and a relative humidity comprised between 35% and 75%. If these conditions are maintained, the glass fibre product should not undergo significant changes when stored for extended periods of time. It is also strongly recommended to condition it in the workshop for at least 24 hours before use to prevent condensation.

For an optimal processing it is recommended to use the product in ambient conditions (20°C-23°C and a relative humidity of 60%-65%).



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Filament Winding, Pultrusion, ...

## HiPer-tex®

HiPer-tex® reinforcement is a non added boron glass which can be classified as high strength R-glass, as defined by the ASTM C-162, DIN 1259 and ISO 2078 standards.

This glass formulation is designed for high modulus, excellent mechanical properties and to offer significantly better thermal and corrosion resistance properties than E-glass.

Main benefits of HiPer-tex® fibre versus E-glass are:

- up to 30% higher strength
- up to 17% higher modulus
- up to 45% higher strain energy
- up to 10 times improved life time in fatigue.

Product line includes reinforcements developed for end applications such as wind turbine blades, composite ballistic panels, sport goods, as well as high pressure vessels.

Our dedicated Technical and Sales Team is looking forward to working on your applications.

[www.3B-fibreglass.com](http://www.3B-fibreglass.com)

## HiPer-tex® W 2020 Rovings

High Performance glass Direct Roving for Epoxy Resin



### Product Description

HiPer-tex® W 2020 Rovings are specifically designed to provide significantly higher modulus, strength and enhanced fatigue performances versus traditional E-glass for wind turbine blades made out of epoxy resin. HiPer-tex® W 2020 Rovings are perfectly suited for the production of high modulus Non Crimped Glass Fabrics and prepregs. The sizing W 2020 is purposely formulated for excellent adhesion with epoxy resin systems and leads to superior interfibre and interlaminar shear strengths as well as dynamic performances.

The specific boron free glass formulation provides superior hydrolysis and corrosion resistance.

These properties improvements versus typical E-glass will help blade designers to push further the limits of glass fibre blade designs, especially for the long blades required for the multi MW turbines for on shore and off shore.

The W 2020 roving is approved by Germanischer Lloyd for the use in wind turbine rotor blades.

| FIBRE PROPERTIES                   | VALUES  |
|------------------------------------|---|
| Tensile strength                   | 2700 - 2900 MPa (ASTM D2343-09)   |
| Tensile modulus                    | 86 - 89 GPa (ASTM D2343-09)   |
| Tensile strain                     | 3.1 - 3.3 % (ASTM D2343-09)   |
| Density                            | 2.58 gr/cm <sup>3</sup>   |
| Resin compatibility                | Epoxy   |
| Sizing amount                      | 0.4 - 0.6 %   |
| Filament diameter - linear density | 17 µm - 600 tex<br>17 µm - 1200 tex<br>17 µm - 2400 tex<br>24 µm - 4800 tex |



# HiPer-tex® W 2020 Rovings

High Performance glass Direct Roving for Epoxy Resins

## COMPOSITE CHARACTERISTICS (PLEASE CONTACT US FOR ADDITIONAL INFO ON PROPERTIES)

| Laminates type   | Characteristics             | Standard  | HiPer-tex® W 2020 |
|--|-----------------------------|-----------|-------------------|
| Uni-directional fabric 17 µm - 2400 tex roving<br>Infused with Epoxy resin | Tensile strength at Vf=56%  | ISO 527-5 | 1280 MPa          |
|  | Tensile modulus at Vf=56%   | ISO 527-5 | 48 GPa            |
|  | Transverse Tensile Strength | ISO 527-5 | 57 MPa            |
|  | Inter Lamina Shear Strength | ISO 14130 | 64 MPa            |
|  | Compression Strength        | ISO 14126 | 900 MPa           |

### PACKAGING

Bobbins are individually wrapped with stretched plastic film for protection, improved handling and to allow optimum transfer from bobbin to bobbin.

Nominal weight for bobbins is 25 kgs for tex >600 tex and 21 kgs for 600 tex rovings.

Two pallet configurations are available:

- Bulk Pack: standard packaging, consists of individual bobbins.
- Creel Pack: bobbins are connected together for continuous unwinding and no bobbins handling for operators.

For detailed information about bobbins, pallet weight, dimensions and layout please contact us.

### STORAGE

Storage in a cool and dry warehouse into the original packaging is formally recommended. More precisely ideal storage conditions are a temperature between 15°C and 35°C and a relative humidity comprised between 35% and 75%.

Two-height stacking is possible under customer's responsibility.

Place HiPer-tex® W2020 Rovings in the workshop at least 24 hours prior usage.

For an optimal processing we recommend to use the product in ambient conditions (20-23 °C, 60-65% RH).



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## HiPer-tex®

HiPer-tex® reinforcement is a non added boron glass which can be classified as high strength R-glass, as defined by the ASTM C-162, DIN 1259 and ISO 2078 standards.

This glass formulation is designed for high modulus, excellent mechanical properties and to offer significantly better thermal and corrosion resistance properties than E-glass.

Main benefits of HiPer-tex® fibre versus E-glass are:

- up to 30% higher strength
- up to 17% higher modulus
- up to 45% higher strain energy
- up to 10 times improved life time in fatigue.

Product line includes reinforcements developed for end applications such as wind turbine blades, composite ballistic panels, sport goods, as well as high pressure vessels.

Our dedicated Technical and Sales Team is looking forward to working on your applications.

[www.3B-fibreglass.com](http://www.3B-fibreglass.com)

## HiPer-tex® W 3030 Rovings

High Performance glass Direct Roving for Polyester, Vinylester & Epoxy Resins



### Product Description

HiPer-tex® W 3030 Rovings are specifically designed to provide significantly higher modulus, strength and enhanced fatigue performances versus traditional E-glass for wind turbine blades made out of unsaturated polyester, vinylester or Epoxy resin.

HiPer-tex® W 3030 Rovings are perfectly suited for the production of high modulus Non Crimped Glass Fabrics. The sizing W 3030 is purposely formulated for excellent adhesion with polyester, vinylester and Epoxy resin

systems and leads to superior interfibre and interlaminar shear strengths as well as dynamic performances.

The specific boron free glass formulation provides superior hydrolysis and corrosion resistance.

These properties improvements versus typical E-glass will help blade designers to push further the limits of glass fiber blade designs, especially for the long blades required for the multi MW turbines for on shore and off shore.

| FIBRE PROPERTIES                   | VALUES   |
|------------------------------------|--|
| Tensile strength                   | 2600 - 2900 MPa (ASTM D2343-09)                          |
| Tensile modulus                    | 86 - 89 GPa (ASTM D2343-09)                              |
| Tensile strain                     | 3.1 - 3.3 % (ASTM D2343-09)                              |
| Density (17µm fibre)               | 2.58 gr/cm <sup>3</sup>                                  |
| Resin compatibility                | Polyester, Vinylester, Epoxy                             |
| Sizing amount                      | 0.3 - 0.7 % (depending on tex)                           |
| Filament diameter - linear density | 17 µm - 1200 tex<br>17 µm - 2400 tex<br>24 µm - 4800 tex |

# HiPer-tex<sup>®</sup> W 3030 Rovings

High Performance glass Direct Roving for Polyester, Vinylester & Epoxy Resins

## COMPOSITE CHARACTERISTICS (PLEASE CONTACT US FOR ADDITIONAL INFO ON PROPERTIES)

| Laminates type                                 | Characteristics              | Standard  | HiPer-tex <sup>®</sup> W 3030<br>UP Resin |
|--|------------------------------|-----------|---|
| Uni-directional fabric 17 µm - 2400 tex roving | Tensile strength at Vf=56%   | ISO 527-5 | 1220 MPa                                  |
|  | Tensile modulus at Vf=56%    | ISO 527-5 | 48 GPa                                    |
|  | Transverse Tensile Strength  | ISO 14125 | 28 MPa                                    |
|  | Inter Laminar Shear Strength | ISO 14130 | 50 MPa                                    |

### PACKAGING

Bobbins are individually wrapped with stretched plastic film for protection, improved handling and to allow optimum transfer from bobbin to bobbin.

Nominal weight for bobbins is 25 kgs.

Two pallet configurations are available:

- Bulk Pack: standard packaging, consists of individual bobbins.
- Creel Pack: bobbins are connected together for continuous unwinding and no bobbins handling for operators.

For detailed information about bobbins, pallet weight, dimensions and layout please contact us.

### STORAGE

Storage in a cool and dry warehouse into the original packaging is formally recommended. More precisely ideal storage conditions are a temperature between 15°C and 35°C and a relative humidity comprised between 35% and 75%.

Two-height stacking is possible under customer's responsibility.

Place HiPer-tex<sup>®</sup> W3030 Rovings in the workshop at least 24 hours prior usage.

For an optimal processing we recommend to use the product in ambient conditions (20-23 °C, 60-65% RH).



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