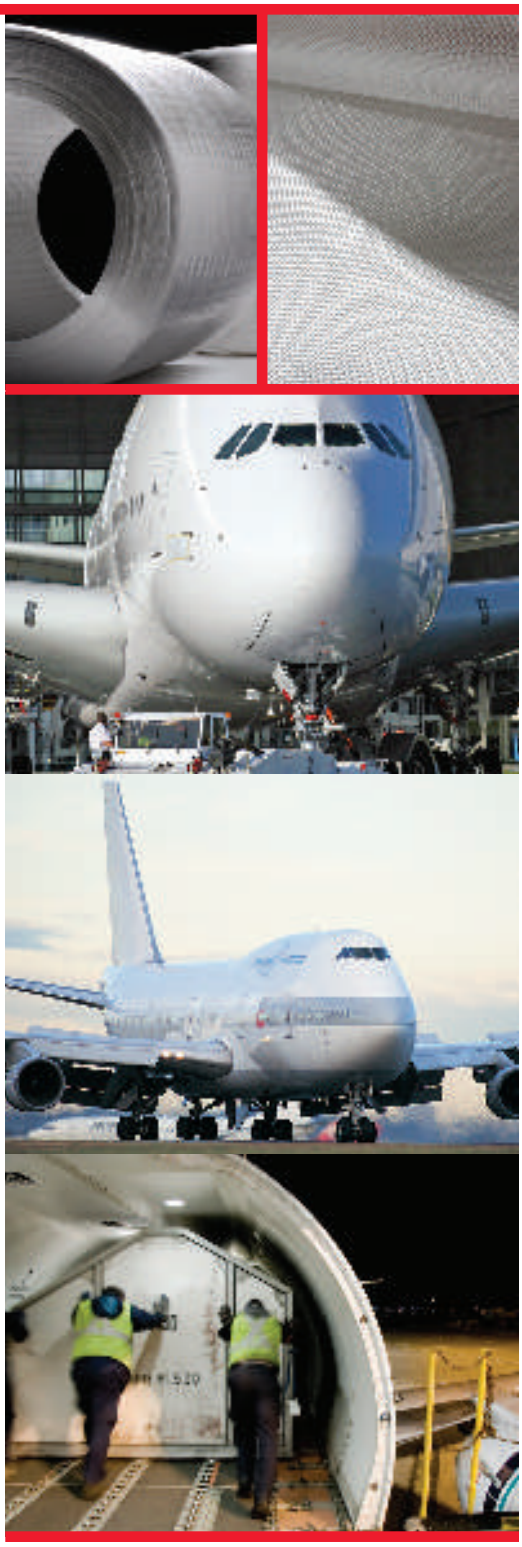
OCV™ Reinforcements

PRODUCT INFORMATION

# FliteStrand® S

*High-Performance Reinforcements*



## Delivering Performance.
## Enabling Possibilities.
## Increasing Choice.

Through innovative and breakthrough large scale glass fiber production technology, Owens Corning has revolutionized the high-performance glass reinforcements industry with the introduction of the FliteStrand® S rovings family of products. These products have been specifically designed to meet the rigorous demands of aerospace composite applications requiring a balance of high modulus, strength, and impact resistance, as well as durability.

*FliteStrand S* rovings are an integral part of a new generation of high-performance reinforcements. These products enable significantly stronger, stiffer, and lighter weight composites than are possible with conventional E-glass reinforcements, at an attractive price point compared to carbon, aramid, and competing S-glass fibers. This materials innovation changes the price-performance position for existing S glass composites and enables new, lighter weight solutions to replace current composite and metal designs.

- *FliteStrand S* rovings have shown outstanding Long Beam Bending performance in honeycomb sandwich panel structures with cross-plied unidirectional (UD) laminate facings.
- UD tapes have been successfully produced at areal weights of 150 gsm.
- *FliteStrand S* woven roving laminates have the potential to significantly outperform traditional E glass fabric laminates in impact and flexural strength, allowing the designer the option to reduce weight, increase performance, or both.
- *FliteStrand S* rovings are available in package forms, filament diameters and linear densities that enable seamless 'drop-in' fiber substitution in existing prepreg systems and applications.
- *FliteStrand S* rovings offer supply security from a comprehensive Composites Solutions partner to the aerospace industry.

*FliteStrand S* glass is a boron-free glass formulation that meets all internationally accepted S-glass standards: ASTM C-162, DIN 1259, ISO 2078, ASTM D578, and JIS R3410. This glass formulation is designed to optimize tensile strength and modulus while offering significantly better thermal and acidic corrosion resistance properties than conventional E-Glass.

This document specifies properties for the most commonly-used reinforcement product forms. However, should you have any special or unique requirements, please contact our technical sales staff, who will be glad to work with you!

FliteStrand® S

*High-Performance Reinforcements*

## USAGE AND PERFORMANCE

*FliteStrand S* rovings are compatible with phenolic, epoxy, and bismaleimide resins, making them ideal for unidirectional pre-impregnation, weaving, filament winding, and hand lay-up. *FliteStrand S* rovings are available in standard inside-pull packages and in outside-pull assembled roving packages. *FliteStrand S* rovings have excellent processing and handling characteristics such as low levels of catenary, strand twist, fuzz, and static as well as excellent run-out and spreadability. These properties combine to help reduce the occurrence of resin-rich areas in unidirectional prepregs and enable efficient weaving, knitting and fast wet-out in down-stream processes such as the resin infusion and vacuum bag processes, commonly used in aerospace manufacturing.

**Benefits**

- Seamless fiber replacement for current S-glass applications
- Weight savings of up to 35% versus current E-glass applications
- Excellent impact performance versus metals and Carbon Fiber Reinforced Plastics

**Provides**

- Lighter components
- Longer component service life versus metals or carbon fiber
- Lower total cost of ownership versus carbon fiber and aluminum parts

## COMPARATIVE FIBER PROPERTIES

| PRISTINE FIBER PROPERTIES | TEST METHOD | UNIT | OCV™ FLITESTRAND® S | COMPETITIVE S-GLASS |
|---|---|---|---|---|
| Density | ASTM C693 | g/cm$^3$ (lb/in$^3$) | 2.45 (.0885) | 2.48 (.0896) |
| Tensile Strength | ASTM D2101 | MPa (ksi) | 4826-5081 (700-737) | 4830-5205 (700-754) |
| Young's Modulus | ASTM D2101 | GPa (Msi) | 88 (12.7) | 86-90 (12.4-13.0) |
| Elongation at Break | ASTM D2101 | % | 5.5 | 5.4 |

## FLITESTRAND® S ROVINGS PROPERTIES

| IMPREGNATED STRAND AND SHEAR PROPERTIES[1] | TEST METHOD | UNIT | EPF 11[2] | MCF 14[3] |
|---|---|---|---|---|
| Tensile Strength | ASTM D2343 | MPa (ksi) | 3261-4226 (473-613) | 3392-4220 (492-612) |
| Shear Strength | ASTM D2344 | MPa (ksi) | 57.2-63.4 (8.3-9.2) | 46.2-51.0 (6.7-7.4) |

| UNIDIRECTIONAL COMPOSITE PROPERTIES[1] | TEST METHOD | UNIT | EPF 11[2] | MCF 14[3] |
|---|---|---|---|---|
| Tensile Strength | ASTM D3039 | MPa (ksi) | 1303-1365 (189-198) | 1089-1158 (158-168) |
| Tensile Modulus | ASTM D3039 | GPa (Msi) | 45.5-46.2 (6.6-6.7) | 41.4-43.4 (6.0-6.3) |
| Flexural Strength | ASTM D790 | MPa (ksi) | 1007-1069 (146-155) | 1234-1407 (179-204) |
| Resin Content by Weight | ASTM D2584 | % | 26-28 | 33-34 |
| Fiber Volume Fraction | ASTM D2734 | % | 56-58 | 47-48 |

| BIAXIAL COMPOSITE PROPERTIES[1] | TEST METHOD | UNIT | EPF 11[2] | MCF 14[3] |
|---|---|---|---|---|
| Instrumented Impact - Total Energy | ASTM D3763 | J (ft-lbs) | 111-115 (82.1-85.1) | 118-121 (86.7-89.2) |
| Maximum Load | ASTM D3763 | N (lbf) | 9092-9728 (2044-2187) | 9426-9862 (2119-2217) |
| Energy to Maximum Load | ASTM D3763 | J (ft-lbs) | 35.3-40.7 (26.0-30.0) | 31.3-34.3 (23.1-25.3) |
| Resin Content by Weight | ASTM D2584 | % | 25-27 | 30-32 |
| Fiber Volume Fraction | ASTM D2734 | % | 57-59 | 51-53 |

[1] Laminate and impregnated strand properties measured in either Hexion Epikote MGS 135 or Epon 826 Epoxy Resin using Epikure MGS LH 137 or Albemarle Ethacure 100 hardener. UD laminates produced utilizing a resin infusion process. Owens Corning has conducted all tests in a controlled laboratory environment and believes all data to be fair and accurate representations of relative product performance at its facilities, but makes no warranty, claim or guarantee as to specific performance in customer's resin system.

[2] EPF 11 Sizing recommended for use with Epoxy resins

[3] MCF 14 Sizing recommend for use with Phenolic, Epoxy and BMI resins

## PRODUCT OFFERINGS

| FLITESTRAND® S ROVINGS | RESIN COMPATIBILITY | NOMINAL FIBER DIAMETER (µ) | TEX (g/km) |
|---|---|---|---|
| EPF 11 | Epoxy | 9µ (G fiber) | 337 TEX (1472 yd/lb) |
| EPF 11 | Epoxy | 9µ (G fiber) | 675 TEX (735 yd/lb) |
| MCF 14 | Phenolic, Epoxy, BMI | 9µ (G fiber) | 337 TEX (1472 yd/lb) |
| MCF 14 | Phenolic, Epoxy, BMI | 9µ (G fiber) | 675 TEX (735 yd/lb) |

## PRODUCT CHARACTERISTICS AND QUALITY CONTROL LIMITS

| PRODUCT CHARACTERISTIC | PRODUCT NOMINAL BARE GLASS | TARGET (TEX WITH SIZING) | MINIMUM TEX | MAXIMUM TEX | METHOD |
|---|---|---|---|---|---|
| TEX (g/km) | 335 TEX (1480 yd/lb) | 337 (1472 yd/lb) | 310 (1600 yd/lb) | 364 (1363 yd/lb) | ISO 1889 |
| | 670 TEX (740 yd/lb) | 675 (735 yd/lb) | 621 (799 yd/lb) | 729 (680 yd/lb) | ISO 1889 |
| Strand Solids (LOI%) | EPF-S 11 | 0.67% | 0.54% | 0.80% | ISO 1887 |
| | MCF-S 14 | 0.32% | 0.22% | 0.42% | ISO 1887 |
| Moisture (%) | All | N/A | 0 | 0.15% | ISO 3344 |

## PRODUCT LABELING, PACKAGING AND PALLETIZING

*FliteStrand S* roving products are supplied on tubeless packages for inside pull (single-end roving) and 3 inch diameter cardboard tubes for outside pull assembled rovings.

**Package- Inside Pull:**

- Single-end roving - cylindrical bobbin without tube, nominal Outside Diameter (OD) 270 mm, height 260 - 300mm.
- Maximum bobbin weight must not exceed 19 kg.
- Single-end roving packages are covered by Tack-Pack™ film.

**Package- Outside Pull:**

- Assembled roving – 15 lbs (6.8 kg) wound on a 3 inch ID, 10.9 inch long Rhino tube.
- Typical package weight is 15 lbs. 8 lb packages are available via special order.

**Pallet- Inside Pull roving:**

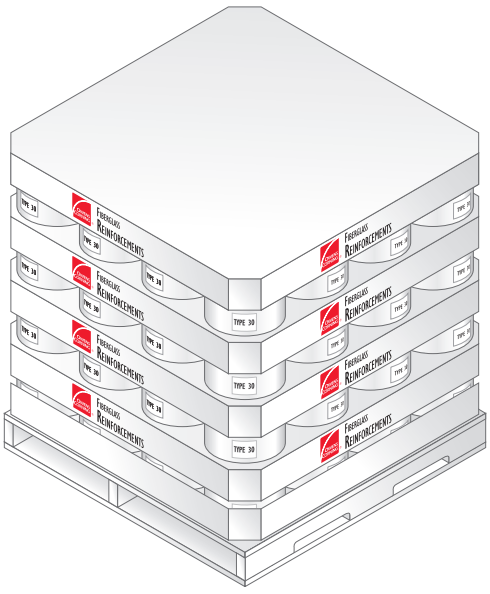
- Size: 1150 x 1150mm (45" x 45"), 4 ways entry.
- 16 bobbins (max OD) per layer. Pallets are 4 tiers high.
- Pallet is stretch-wrapped.

**Pallet- Outside Pull roving:**

- 20 packages per layer, 3 tiers high, 60 packages per pallet.
- Size: 1150 x 1150mm (45" x 45"), 4 ways entry.

**Identification:**

- Bobbin label (each bobbin).
- Five pallet labels, one on each side of the pallet and one inserted in the first layer.



## VISUAL INSPECTION REQUIREMENTS AND DOCUMENTATION

- A certificate of conformity or analysis will be issued upon request.
- The bobbin shall be firmly and evenly wound with a uniform lay and equal traverse length. The roving shall be wound with even tension and exhibit no catenary. The flanges of the package may present a yellowish aspect which is inherent in the product and is not a cause for rejection.
- A package that has (inside the build or on its surface) visible grease, oil, dirt or other foreign matter, 3 mm or less in diameter, is rejectable if the total number of defects exceeds two (2). A package is also rejectable if it contains one (1) or more of such defects greater than 3 mm in diameter.
- Any package build deformity which interferes with the smooth and uniform runoff of the strand is a cause of rejection of the package.

## STORAGE AND USAGE CONDITIONS

- Glass fiber products must remain in the packaging material until just prior to use. It is recommended to bring material in the workshop place at least 24 hours prior to use. Optimal atmospheric processing conditions are: temperature between 20-22°C and relative humidity between 60-65%.
- The packaging system is designed to allow stacking of two pallets. When stacking two high, care should be taken to place the top pallet correctly and smoothly. Owens Corning is not responsible for any damage resulting from stacking pallets higher than two high.

## CONTACT INFORMATION

- Please contact your sales representative.

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**OWENS CORNING**
**COMPOSITE MATERIALS, LLC**
ONE OWENS CORNING PARKWAY
TOLEDO, OHIO 43659
1.800.GET.PINK®
**www.owenscorning.com**
**www.ocvreinforcements.com**
Contact:
SingleEndRovings.ocvamericas@owenscorning.com

**OWENS CORNING**
**FIBERGLAS, SPRL.**
166, CHAUSSÉE DE LA HULPE
B-1170 BRUSSELS
BELGIUM
+32.2.674.82.11

Contact:
SingleEndRovings.ocvmea@owenscorning.com

**OWENS CORNING - OCV ASIA PACIFIC**
**SHANGHAI REGIONAL HEADQUARTERS**
2F OLIVE LVO MANSION
620 HUA SHAN ROAD
SHANGHAI 200040
CHINA
+86.21.62489922
Contact:
SingleEndRovings.ocvap@owenscorning.com



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