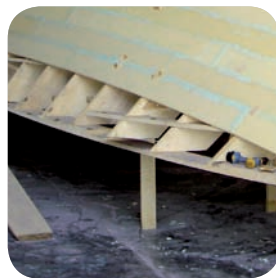
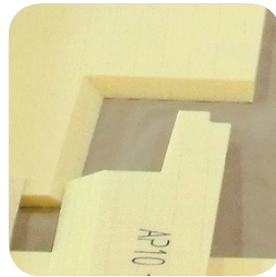
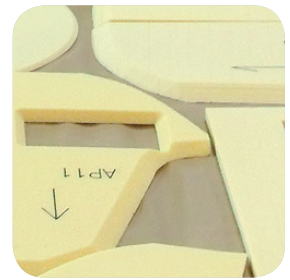
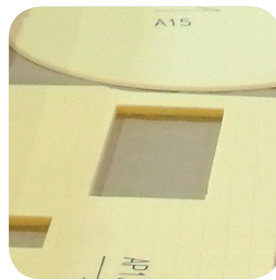


Core Materials for Marine



Introduction

SP-High Modulus, the marine business of Gurit, is a technical leader in the development and manufacture of structural core materials.

Cores in sandwich construction are specified by designers and architects to increase stiffness and reduce the weight of a composite structure. **Corecell™** is the leading structural foam core material, which has become widely accepted for the construction of large, high performance structures. It is the latest in foam core technology and although originally developed for the marine industry, it is now used in other applications such as wind turbines and sub sea vessels. Several grades of **Corecell™** exist to give specifiers the choice of foam that is optimised to their needs.

SP-High Modulus also offers G-PET, a recyclable structural core. Made with a high efficient “extrusion” process and low cost raw materials it offers a cost effective product for replacement of Balsa in composite structures.

Structural core materials are offered in sheet form and with a variety of cut patterns or finishes, tailored to customer needs or processing choice. Core is also available in kits offering efficient and speedy layup without unnecessary waste.

Full details of the Structural Foam product range can be downloaded at www.gurit.com/marine

SP-High Modulus' range of Core Materials

Product	Description	Attributes	Applications	Page no.
M-Foam	The Marine Foam	<ul style="list-style-type: none"> - High shear strength and low density - High temperature processing - High elongation for toughness - GL, DNV, RINA and ABS certified 	For all Marine structures	2
A-Foam	The Ultra Tough Foam	<ul style="list-style-type: none"> - Extremely resistant to impact, slamming and fatigue - Highly thermoformable - Ideal for resin infusion - GL, DNV, Lloyds Register of Shipping and ABS certified 	Suitable for dynamically-loaded structures	3
P-Foam	The Heat-stabilised, Ultra Tough Foam	<ul style="list-style-type: none"> - Extremely resistant to impact, slamming and fatigue - Highly thermoformable - Suitable for processing with prepreg up to 85C - GL, DNV, Lloyds Register of Shipping and ABS certified 	Suitable for dynamically-loaded structures	4
S-Foam	The Sub-sea Buoyancy Foam	<ul style="list-style-type: none"> - High hydrostatic crush strength and water resistance - Outstanding mechanical properties - Ultra-fine cell size - Lower density than resin-based syntactics 	Suitable for applications needing high hydrostatic crush strength	5
G-PET	The Recyclable Structural Foam	<ul style="list-style-type: none"> - Excellent mechanical properties - Cost effective - Recyclable - Withstands high process temperatures 	Cost-effective applications such as Balsa replacement	6

- Replacement for PVC cores
- High shear strength combined with low density
- High temperature processing (prepreg compatible)
- High elongation for toughness
- Suitable for all composite processes including prepreg
- Benefits from GL, DNV, RINA and ABS certification

Introduction

Corecell™ M-Foam is the newest addition to the Corecell™ range and shares the benefits of SAN chemistry common to all Corecell™ products.

Environmental stability

High tolerance for heat and chemical exposure

Built in toughness

High ductility and damage tolerance compared to cross-linked PVC and Balsa

Fine cell size

Resin absorption is very low, saving both weight and cost

Superior uniformity

Low density variation

Eliminating outgassing

Corecell™ eliminates the problems of foam outgassing

Compatibility

Suitable for use with all polyester, vinylester and epoxy resins

No inhibition

Corecell™ does not inhibit any epoxy resin curing mechanisms

Handling

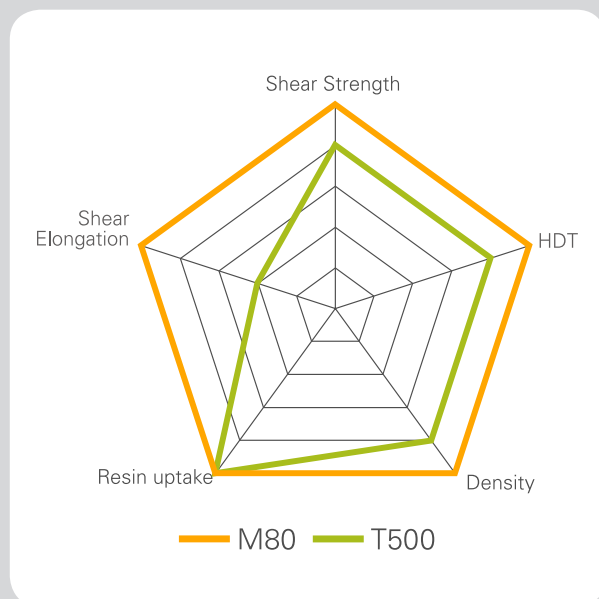
Tough and easy to machine

Typical Applications

Corecell™ M-Foam has been developed to deliver one product for all Marine applications. It provides a combination of high shear strength with low density, high elongation, high temperature resistance and low resin uptake. M-Foam is the perfect choice whether your application is slamming area or superstructure, hull or deck, using hand lamination, infusion or prepreg.

If looking for reliable processing, Corecell™ M-Foam delivers through the benefits recognised in all Corecell™ products of fine cell size and unique knife-cuts giving low resin uptake in infusion processes. For prepreg, Corecell™ M-Foam offers high temperature resistance to allow shorter cure cycles and the confidence to process without fear of inhibition of prepreg catalysis. Where static properties are important, Corecell™ M-Foam delivers high shear strength at a low density. Where dynamic performance is crucial, the high elongation delivers higher useful properties and the toughness to give impact resistance and superior fatigue performance.

Corecell™ M-Foam is available in resin infusion format and is compatible with polyester, vinylester and epoxy resin systems. The low resin absorption characteristics of Corecell™ and its unique knife cut formats allow for higher performing infusions, low resin cost and low weight. Gurit's global technical team have 10 years experience in resin infusion, hand lamination and prepreg processing and offer on-site support and structural engineering for Corecell™ customers. This combination makes Corecell™ a key part of a reliable package.



A-Foam

The Ultra Tough Foam

- Extremely resistant to impact, slamming and fatigue
- Highly thermoformable
- Suitable for dynamically-loaded structures
- Ideal for resin infusion
- Superior styrene and heat resistance to linear PVC foam

Introduction

Corecell™ A-Foam is the original Corecell™ material, developed because of frustrations with PVC core technology in marine sandwich structures. Corecell™ A-Foam is well known for its incredible toughness and resistance to cracking, which comes from its high ductility.

Tough

Far higher shear elongation than balsa or cross-linked PVC. This high shear elongation is directly related to toughness.

Shock, impact and slamming resistance

Corecell™ A-Foam is specifically designed for dynamic loading. No other core material is as safe in a marine environment.

High styrene and temperature resistance

Corecell™ A-Foam and Corecell™ P-Foam have excellent styrene and heat resistance. This sets Corecell™ apart from other ductile core materials.

Proven

Approved by American Bureau of Shipping (ABS), Lloyds Register of Shipping, Det Norske Veritas (DNV) and Germanischer Lloyd (GL) and tested in the world's toughest yacht races.

Typical Applications

Corecell™ A-Foam can elongate up to 65% in shear before failure, making core shear failure in a laminate almost impossible. Tests and experience show that Corecell™ A-Foam is the most reliable core material for dynamic loading situations where PVC and balsa may fail due to poor shear elongation properties. This reliability has made Corecell™ A-Foam the preferred choice amongst offshore yachtsmen for twenty years.

For the manufacturer, Corecell™ A-Foam offers the benefit of high resistance to styrene and other chemicals and better thermal stability than linear-PVC foam. Corecell™ A-Foam is also highly thermoformable, which is useful in many applications where cutting the core material is undesirable.

Corecell™ A-Foam is available in every resin infusion format and is compatible with polyester, vinylester and epoxy resin systems. The low resin absorption characteristics of Corecell™ and its unique knife cut formats deliver higher performing infusions, low resin cost and low weight. Gurit's global technical team have 10 years experience in resin infusion and offer on-site support for Corecell™ customers. This combination makes Corecell™ the most reliable resin infusion package available.

P-Foam

Heat Stabilised Ultra Tough Foam

- Excellent impact tolerance
- Suitable for processing with prepregs up to 85°C
- Superior styrene and heat resistance to linear PVC foam
- Suitable for dynamically-loaded structures
- Highly thermoformable

Introduction

Corecell™ P-Foam is a development of **Corecell™** A-Foam, intended for prepreg and SPRINT® manufacturing processes. **Corecell™** P-Foam has incredible toughness and resistance to cracking, which comes from its high ductility.

Built in toughness

Far higher shear elongation than balsa or cross-linked PVC. This high shear elongation is directly related to toughness.

Fine cell size

Resin absorption is very low, saving both weight and cost.

Superior uniformity

Low density variation.

Compatibility

Suitable for use with all polyester, vinylester and epoxy resins.

No outgassing inhibition

Safe for use with all prepregs since Corecell does not inhibit epoxy resin curing mechanisms.

Handling – Tough and easy to machine

Shock, impact and slamming resistance

Corecell™ P-Foam is specifically designed for dynamic loading. No other core material is as safe in a marine environment. High styrene and temperature resistance.

Corecell™ A-Foam and **Corecell™** P-Foam have excellent styrene and heat resistance. This sets **Corecell™** apart from other ductile core materials.

Proven

Approved by American Bureau of Shipping (ABS), Lloyds Register of Shipping, Det Norske Veritas (DNV) and Germanischer Lloyd (GL) and tested in the world's toughest yacht races.

Typical Applications

Corecell™ P-Foam can elongate up to 65% in shear before failure, making core shear failure in a laminate almost impossible.

For the manufacturer of prepreg or SPRINT® structures, especially yacht hulls, **Corecell™** P-Foam removes the problems of outgassing inhibition or thermal stability. **Corecell™** P-Foam is also highly thermoformable, which is invaluable in the construction of high performance prepreg or SPRINT® structures.

Corecell™ P-Foam is available in every resin infusion format and is compatible with polyester, vinylester and epoxy resin systems. The low resin absorption characteristics of **Corecell™** and its unique knife cut formats deliver higher performing infusions, low resin cost and low weight. Gurit's global technical team have 10 years experience in resin infusion and offer on-site support for **Corecell™** customers. This combination makes **Corecell™** the most reliable resin infusion package available.

S-Foam

The Sub-sea Buoyancy Foam

- High hydrostatic crush strength and water resistance
- Outstanding mechanical properties
- Ultra-fine cell size
- Lower density than resin-based syntactics

Introduction

Corecell™ S-Foam has been designed specifically for use in sub-sea buoyancy applications. Its resistance to crushing means that it can withstand depths of over 900m, and its closed-cell structure gives it a high water resistance that ensures buoyancy is maintained over time.

Designed for sub-sea applications

Corecell™ S-Foam can withstand the crushing forces at depths of over 900 metres and does not absorb water.

Manufacturing simplicity

Corecell™ S-Foams ultra fine cell size gives it excellent machining capabilities as well as minimising resin absorption. Complex shapes can be created using a variety of milling, routing, sawing and drilling techniques without risk of breakage.

Corecell™ S-Foam's unique properties allow it to replace other materials such as plywood when creating high strength inserts for through bolting in sandwich structures.

Low density

Available at lower densities than resin blended syntactic products. Standard products range from 150 kg/m³ to over 300 kg/m³.

Reliable

As with all **Corecell™** materials, consistent density is assured.

Typical Applications

With its very high compressive strength, **Corecell™** S-Foam can also replace other materials, such as plywood, when creating high strength inserts for through-bolting in composite laminates.

Having the smallest cell size of all the **Corecell™** products, **Corecell™** S-Foam absorbs very little resin in lamination processes, thus minimising weight gain. The small cell size and the product's inherent toughness also contribute to the excellent machineability of **Corecell™** S-Foam. Complex shapes can be created in **Corecell™** S-Foam using a variety of milling, routing, sawing and drilling techniques.

Corecell™ S-Foam is available at lower densities that can be achieved with a syntactic, with standard products ranging from 150 to just over 300kg/m³.

G-PET

Recyclable Structural Foam

- Withstands high process temperatures
- Excellent chemical resistance
- Good adhesion
- Excellent mechanical properties
- Recyclable
- Compatible with all types of composite manufacturing techniques

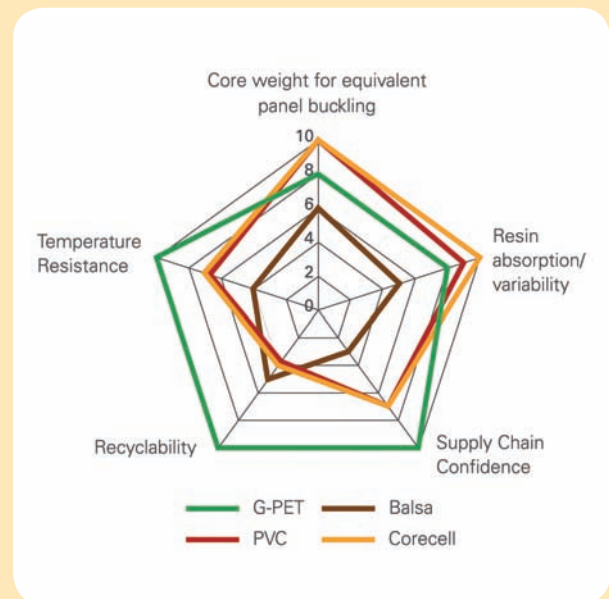
Introduction

G-PET is a structural foam based on the cost-effective polymer PET. It is particularly aimed at replacement of Balsa core. G-PET offers a highly effective balance of properties offering compelling advantages to engineers and purchasers alike:

- **Good economy of production through automated “extrusion” process and cost effective raw materials**
- **Recyclable, reducing the cost of waste**
- **Lower resin uptake than Balsa**
- **Available up to 160mm sheet thickness without bonding**
- **Mechanical properties meeting most customer specifications**
- **Temperature resistance for prepreg or high exotherm processes**

Typical Applications

G-PET is used extensively in wind turbine blade manufacture. G-PET is manufactured in Tianjin, PRC and is available in sheet, grooved/perforated forms or kit-cut to customer’s desired shapes.



Finishing

Forms of Supply

Corecell™ is supplied in a wide range of product forms, optimized for different applications and composite production processes. Our standard product forms are described below. SP-High Modulus can also tailor **Corecell™** sheets to your own specification - please call us to discuss your requirements.

PL - Plain Sheet – Optimum material properties. Limited bending in-mould.

PH - Plain with Bleeder Holes – Assists air release in vacuum bag processes. The standard format is 1.6mm (1/16”) holes drilled 50mm (2”) apart. Available on all sizes and foam types. Cuts for conformability – Available on M, A and P foam types.

SC - Single Cut - Provides flexibility in a single direction on one or both sides of a sheet. If done on both sides, the cuts intersect so no bleeder holes are necessary for vacuum bagging. Maximum sheet size is half of a full-size sheet.

DC - Double Cut – Provides flexibility in two directions on one or both sides of the sheet. If Double Cut on both sides, the intersecting cuts make DC a highly effective resin infusion medium. The cuts are not visible when the sheets lie flat and these narrow knife-cuts minimize unnecessary resin accumulations compared to sawn core materials. Standard DC is knife-cut in 30mm (1 3/16”) squares to a maximum depth of 75% depending on thickness. Double cut is available up to A800 and M130 densities and to a sheet thickness of 38mm (1 1/2”). Depth

of cut is limited to 16mm (5/8”) in the A800 and M130 densities but it should be noted that above 33mm (1 5/16”) thickness, cuts do not intersect. Maximum sheet size is half of a full-size sheet.

CS – Contour Scrim – provides optimum flexibility in two directions. Sheets are knife cut in 30mm (1 3/16”) squares and bonded to a glass scrim. Available on sheets up to 25mm (0.98”) thick and up to A800 and M100 densities. Maximum standard sheet size is half the full sheet.

Surface grooves for infusion – Available on all foam types

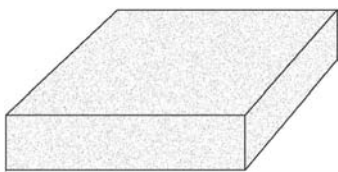
VIC - Vacuum Infusion Core – Tailor made **Corecell™** vacuum infusion materials are used by leading boatbuilders worldwide. There are several VIC options and we can customize grooving patterns and bleeder holes as required. For curved laminate sections, doubleside **DC Corecell™** is very effective system for resin infusion with low weight gain.

Heat forming VIC surface cut Corecell™ is also useful for obtaining curved panels with minimal resin uptake.

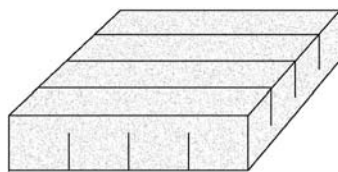
Other Product Formats

Bead and Cove - Bead and cove strip planking aids the building of large, curved structures, in a mouldless build method.

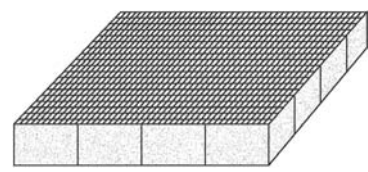
Fillet strips – Triangular edge strips to create tapered panel edge drop-offs, or stringer base fillets.



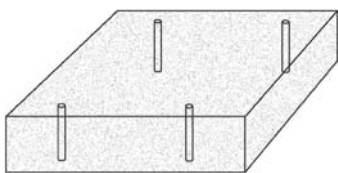
PL - Plain



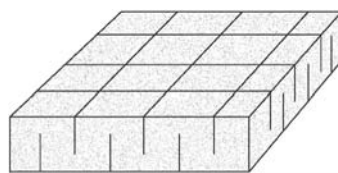
SC - Single Cut



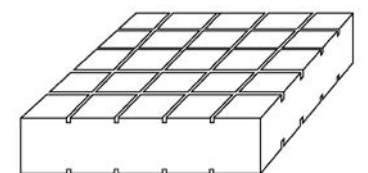
CS - Contour/Scrim



PH - Plain/Bleeder Holes



DC - Double Cut



VIC - Typical VIC

Kitting

Introduction

SP-High Modulus has an extensive kitting capability to provide all the Corecell™ formats in customized, numbered, ready to use, CNC machined kits. SP-High Modulus can make comprehensive kits using either full customer drawings or their SmartPac software solution for the Marine industry. All types of core can be supplied and machined including Corecell (SAN), PVC, PET and Balsawood.

SP-High Modulus use either 5 Axis, or 3 Axis CNC machines along with a range of Semi - automatic and manual machines to provide the optimum kitting solution depending upon kit complexity. We have developed specific knowledge and experience on the correct flute and clearance angles to provide optimum cutting conditions. This allows for quick cutting to minimise cost, accurate cutting for component dimensions and fine cutting to allow the best nesting routines so maximising yield rates and minimising waste.

Our machining strategy for core is to develop a range of cutting techniques that provide a cost effective and flexible solution to all of the kitting requirements of our customers. For complex shapes we will use either 5 or 3 axis CNC machining, for simpler plain sheets with only grooving and pin holes we will use semi - automatic machines with high throughput rates. Through the combination of these we can satisfy all customer requirements.



Technical Information and Pricing



For more detailed information on core materials for Marine, as well as the complete SP-High Modulus product portfolio, please visit: www.gurit.com/marine to view the following:

- Product Data Sheets
- News/Case Studies
- Events Schedules
- Product Brochures
- 'How to' Videos
- Composite Guides
- Representatives Contact Details
- Corporate videos

For pricing or other enquiries, please contact marine@gurit.com



www.gurit.com/marine



Product Datasheets



Case Studies



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