DuFLEX®

lightweight composite panels




DuFLEX® composite panels were specifically designed to reduce construction time and to optimise structural weight in high performance composite structures. Time-consuming laminating, coring and vacuum bagging steps normally required to fabricate high performance composites are avoided, and material waste, labour and tooling costs are greatly reduced.

- Strength
- Durability & Damage Tolerance
- Economy
- Expandability
- Kits
- Code approved manufacture available

Standard DuFLEX panels are 1200mm x 2400mm cored with rigid end-grain balsa or structural foam cores, and laminated with a high performance epoxy resin reinforced with multiaxial E-fibreglass or carbon fibre skins. Fibre orientation and ply schedules are based on design or engineering specifications to best meet weight targets, stress and impact loads, and other design parameters.

DuFLEX panels with carbon skins and foam or aramid honeycomb cores can be manufactured for high performance projects requiring superior stiffness or lightweight.


Schionning Designs

Manufacture

DuFLEX Panels are manufactured in a controlled environment and under-go strict Quality Inspections at all stages during the manufacturing process to ensure dimensional stability and consistent thickness.

The core and laminates are co-cured in a hot press, a method that consolidates the laminate under pressure increasing the fibre volume and therefore the strength of the finished panel. The E-glass fibre content of DuFLEX laminates is approximately 62% by weight.

The panels are finished with peel ply to protect the laminates from contamination and to reduce the amount of preparation required prior to secondary bonding or laminating.

Stock Panels

DuFLEX® WITH ProBalsa® 150 kg/m³ CORE			
Order Code*	**Core Thickness**	**Laminate**	**Nominal Weight kg/m²**
DP1010C6	10 mm	1 x 600gm biaxial E-glass on either side	3.8
DP1013C6	13 mm	1 x 600gm biaxial E-glass on either side	4.2
DP1016C6	16 mm	1 x 600gm biaxial E-glass on either side	4.7
DP1019C6	19 mm	1 x 600gm biaxial E-glass on either side	5.1
DP1025C6	25 mm	1 x 600gm biaxial E-glass on either side	6.0
DP2010C6	10 mm	2 x 600gm biaxial E-glass on either side	6.0
DP2013C6	13 mm	2 x 600gm biaxial E-glass on either side	6.5
DP2016C6	16 mm	2 x 600gm biaxial E-glass on either side	6.9
DP2019C6	19 mm	2 x 600gm biaxial E-glass on either side	7.2
DP2025C6	25 mm	2 x 600gm biaxial E-glass on either side	8.3

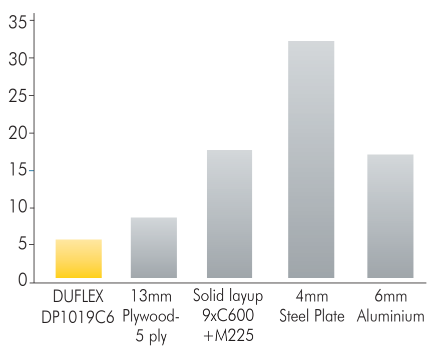
* **Example** - order code for a 13mm panel with 1 layer of 600 gm biaxial is DP1013C6 - Alternative skin laminates available on request
Sheet size - 1200mm x 2400mm. * Other panel sizes including 1200mm x 3600mm are available on request.

ATL Composites Pty Ltd reserve the right to alter specifications without prior notice. Weight may differ slightly (up or down) due to variations in core density.

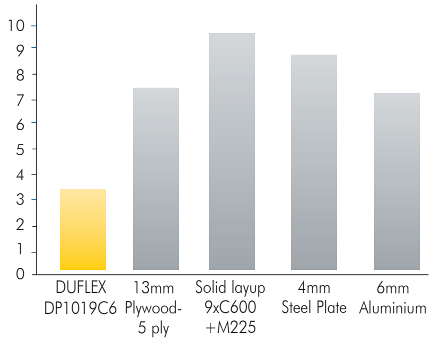
TYPICAL LAMINATE PROPERTIES Laminate thickness 0.53mm per 600gm		Fibre Fraction 62-64% weight fraction	
	Test Method	**Biaxial - Warp (0°)**	**Biaxial - Fill 90°**
Tensile Strength	ASTM D3039	371.9 MPa	327.6 MPa
Tensile Modulus	ASTM D3039	21.27 GPa	18.22 GPa
Compressive Strength	ASTM C-273	293.8 MPa	255.5 MPa
Compressive Modulus	ASTM C-273	21.27 GPa	18.22 GPa

MATERIAL COMPARISONS	Weight (kg/m²)	Deflection (mm)	Pressure to Failure(kPa)
DUFLEX Balsa - DP1019C6	5.1	3.4	35
13mm Plywood- 5ply	8.1	7.4	5
Solid Layup 9x C600+M225	16.9	9.5	30
4mm Steel Plate	31.4	8.6	19
6mm Aluminium	16.2	7.1	18

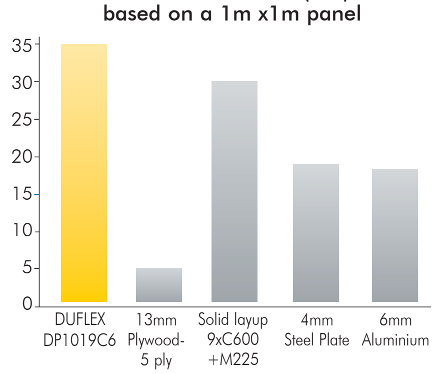
Weight (kg/m²)



Deflection (mm)
2.5kPa pressure on a 1m x1m panel



Pressure to Failure (kPa)
based on a 1m x1m panel



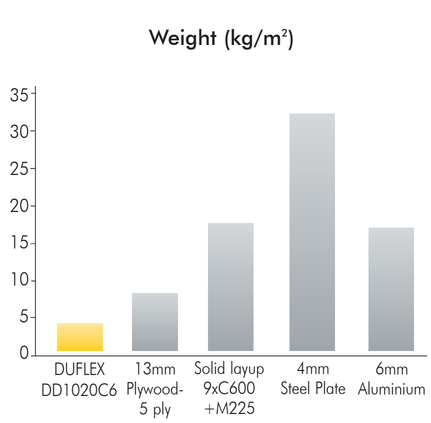
DuFLEX® WITH DIVINYCELL® STRUCTURAL 80 kg/m³ FOAM			
Order Code*	Core Thickness	Laminate	Nominal Weight kg/m²
DD1010C6	10 mm	1 x 600gm biaxial E-glass on either side	2.8
DD1012C6	12 mm	1 x 600gm biaxial E-glass on either side	3.1
DD1015C6	15 mm	1 x 600gm biaxial E-glass on either side	3.3
DD1020C6	20 mm	1 x 600gm biaxial E-glass on either side	3.6
DD1025C6	25 mm	1 x 600gm biaxial E-glass on either side	4.0
DD2010C6	10 mm	2 x 600gm biaxial E-glass on either side	4.9
DD2012C6	12 mm	2 x 600gm biaxial E-glass on either side	5.1
DD2015C6	15 mm	2 x 600gm biaxial E-glass on either side	5.4
DD2020C6	20 mm	2 x 600gm biaxial E-glass on either side	5.6
DD2025C6	25 mm	2 x 600gm biaxial E-glass on either side	6.1

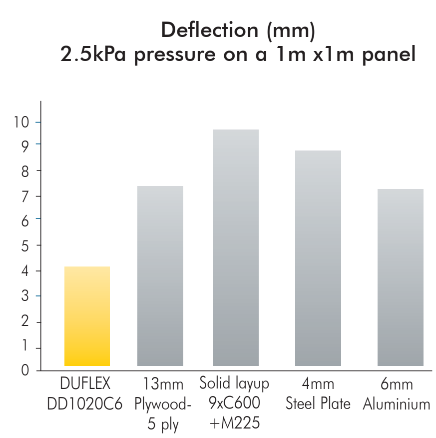
*** Example** - order code for a 12mm panel with 1 layer of 600 gm biaxial is DD1012C6 - Alternative skin laminates available on request
Sheet size - 1200mm x 2400mm. * Other panel sizes including 1200mm x 3600mm are available on request.

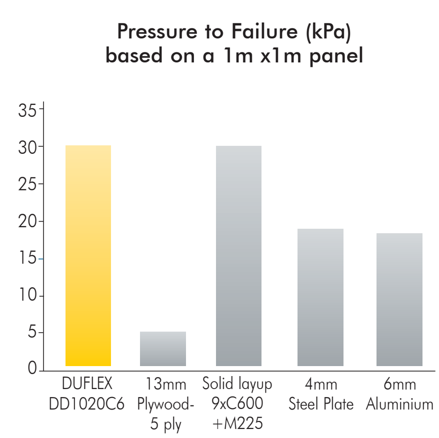
ATL Composites Pty Ltd reserve the right to alter specifications without prior notice. Weight may differ slightly (up or down) due to variations in core density.

TYPICAL LAMINATE PROPERTIES Laminate thickness 0.53mm per 600gm		Fibre Fraction 62-64% weight fraction	
	Test Method	Biaxial - Warp (0°)	Biaxial - Fill 90°
Tensile Strength	ASTM D3039	371.9 MPa	327.6 MPa
Tensile Modulus	ASTM D3039	21.27 GPa	18.22 GPa
Compressive Strength	ASTM C-273	293.8 MPa	255.5 MPa
Compressive Modulus	ASTM C-273	21.27 GPa	18.22 GPa

MATERIAL COMPARISONS	Weight (kg/m²)	Deflection (mm)	Pressure to Failure(kPa)
DUFLEX Foam - DD1020C6	3.6	4.2	30
13mm Plywood- 5ply	8.1	7.4	5
Solid Layup 9x C600+M225	16.9	9.5	30
4mm Steel Plate	31.4	8.6	19
6mm Aluminium	16.2	7.1	18







Technical Data

Epoxy Matrix

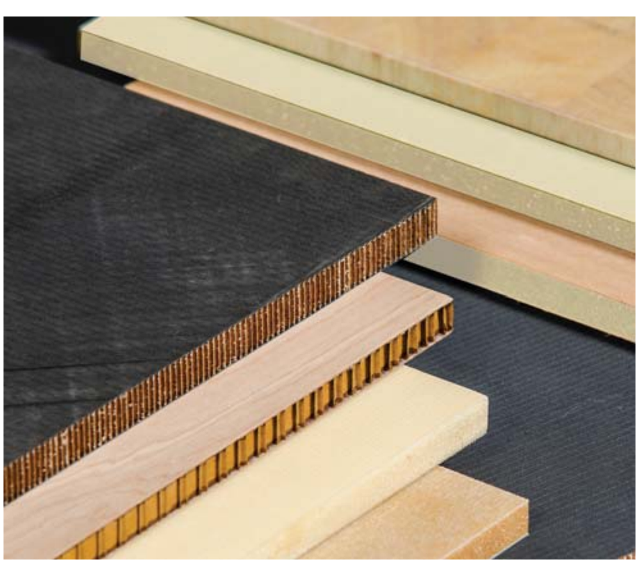
By using epoxy rather than polyester resin as the matrix in DuFLEX, a reduction of laminate thickness is achieved while improving damage tolerance. Epoxy exhibits better moisture and fatigue resistance, and has superior strain capabilities which provides DuFLEX laminates with greater impact resistance than polyester/E-glass laminates that are up to 3 times thicker.

Epoxy's excellent adhesion to balsa and foam cores, fibreglass, aramid and carbon fabrics allows the builder the advantage of selectively integrating these materials into the boat's structure to optimise strength, cost and weight.

Greater stiffness allows wider frame spacing, while further reducing weight and building costs. Total weight savings can reach 50%.

Compared to polyester resins, epoxies have greater strength, less shrinkage, better moisture and fatigue resistance, and there is no chance of osmotic blistering occurring in an epoxy matrix.

Tensile Modulus	3.650 MPa	(0.53E+6psi)
Tensile Strength	83.3 MPa	(12,800psi)
Tensile Elongation	9.8%	
Compressive Strength (yield)	98 MPa	(14,210psi)
Compressive Strength (ultimate)	130 MPa	(18,850psi)
Izod Impact	0.598 ft.lb/in notch	



Skin Mechanical Properties

Standard DuFLEX skin laminates are constructed using stitched biaxial E-glass, the material provides excellent properties in both warp and fill directions, surpassing American Bureau of Shipping (ABS) requirement for balanced laminates.

Compared to the ABS minimum tensile strength for basic laminate, DuFLEX skin laminates show far superior performance.

ABS Basic Laminate	Tensile Strength	Tensile Modulus
Warp (0°)	124.1 MPa (18,000 psi)	6,890 MPa (1.0E+6 psi)
Fill (90°)	99.28 (14,400 psi)	6,890 MPa (1.0E+6 psi)

DuFLEX Skin Laminate	Tensile Strength ASTM D3039	Tensile Modulus ASTM D3039
Biaxial-Warp(0°)	371.9 MPa (53,900 psi)	21.27 GPa (3.08E+6 psi)
Biaxial-Fill(0°)	327.6 MPa (47,500 psi)	18.22 GPa (2.64E+6 psi)
Laminate thickness	0.53mm per 600gsm (0.021" per 18oz)	
Fibre Fraction	62-64% weight fraction	
Poisson's ratio	0.10	

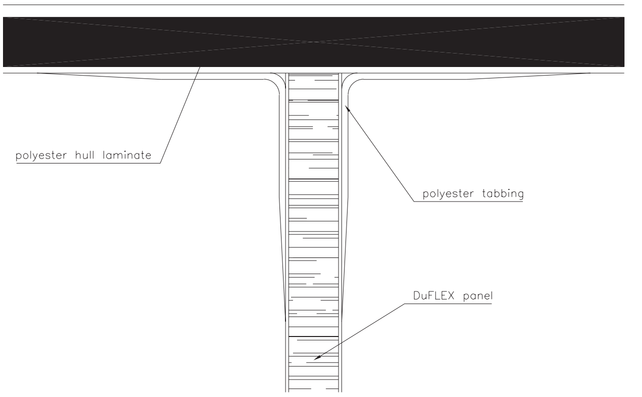
Compressive values have been extrapolated from sandwich flexural tests (ASTM C-273) conducted at the University of Southampton, UK in which skin bending was negligible.

DuFLEX Skin Laminate	Compressive Strength	Compressive Modulus
Biaxial-Warp (0°)	293.8 MPa (42,600 psi)	21.27 GPa (3.08E+6 psi)
Biaxial-Fill (90°)	255.5 MPa (37,000 psi)	18.22 MPa (2.64E+6 psi)

DuFLEX Skin Laminate	Increase Over ABS
Biaxial-Warp (0°) Tensile Strength	+300%
Biaxial-Fill (90°) Tensile Strength	+330%

Secondary Bonding

The issue of secondary bonding between polyester and epoxy substrates has been an area of concern for some time. Comparative in-house tests have abounded, but without quantative results they can only demonstrate modes of failure and give a 'feel' for the force required at break. ISO 527 was modified to accommodate a tensile double lap joint. Four types of specimen were tested to show that polyester tabbing has the same strength when bonding polyester or epoxy substrates.
(See table below for specifications).



Secondary Bonding Lap Joint Test Results

	Failure Load	Apparent Shear Strength	Failure Mode*
A	42.45 kN (9,540 lbf)	5.66 MPa (820 psi)	Interlaminar Shear**
B	48.47 kN (10,900 lbf)	6.46 Mpa (937 psi)	Interlaminar Shear
C	46.50 kN (10,450 lbf)	6.20 MPa (899 psi)	Interlaminar Shear
D	47.08 kN (10,580 lbf)	6.28 MPa (911 psi)	Interlaminar Shear

* Interlaminar failure occurred with the CSM layer of tabbing laminates ** One specimen showed adhesive failure between the tabbing and substrate.

A - Polyester peel plied substrate, polyester tabbing
B - Polyester sanded substrate (80 grit), polyester tabbing
C - Epoxy peel plied substrate, polyester tabbing
D - Epoxy sanded substrate (80 grit), polyester tabbing

This data is provided as an aid to materials selection only. No express or implied warranty is made regarding the accuracy of the information contained herein.

Core Mechanical Properties

ProBalsa®		
Nominal Density	**ASTM C-271**	150 kg/m^3
Tensile Strength perpendicular to the plane	**ASTM C-297**	13.0 MPa
Tensile Modulus perpendicular to the plane	**ASTM C-297**	3.52 GPa
Compressive Strength perpendicular to the plane	**ASTM C-365**	12.67 MPa
Compressive Modulus perpendicular to the plane	**ASTM C-365**	3.92 GPa
Shear Strength	**ASTM C-273**	2.94 MPa
Shear Modulus	**ASTM C-273**	159 MPa
Thermal Conductivity @ 24°C(75°F)	**ASTM C-177**	0.066 W/m.K

DIVINYCELL® H80 FOAM		
Nominal Density	**ISO 845**	80 kg/m^3
Tensile Strength perpendicular to the plane	**ASTM D-1623**	2.5 MPa
Tensile Modulus perpendicular to the plane	**ASTM D-1623**	95.0 MPa
Compressive Strength perpendicular to the plane	**ASTM D-1621**	1.4 MPa
Compressive Modulus perpendicular to the plane	**ASTM D-1621-B-73**	90.0 MPa
Shear Strength	**ASTM C-273**	1.15 MPa
Shear Modulus	**ASTM C-273**	27.0 MPa
Shear Strain	**ASTM C-273**	30%

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Technology vs Cost

Whether in computers, airplanes or boats, high tech is often associated with high cost. Time is valuable and there is no doubt that DuFLEX, especially in kit form, speeds up construction.

Kits

Computer aided design and manufacture (CAD/CAM) processes combined with computer numeric control (CNC) equipment allows the production of pre-fabricated DuFLEX Kits. The kit form process is practical even for one-off kit sets if the part files are available from a naval architect or designer. Parts to be formed into curved surfaces can be translated by design software into the correct flat panel shapes, and this electronic information is supplied to ATL's engineers, by your Naval Architect or designer. All parts required for the project are nested together within the panels to reduce wastage.

Once the panels are manufactured, the CAD information is used by a CNC router to machine the programmed shapes into the panels.

To offset their individual size, DuFLEX panels can be supplied with both long edges pre-machined to facilitate joining. This Z-Joint is structurally effective and achieves a smooth and fair surface profile.

The panels are sequentially numbered to indicate the correct joining sequence, and a nesting diagram, showing part numbers and descriptions is supplied for easy identification.

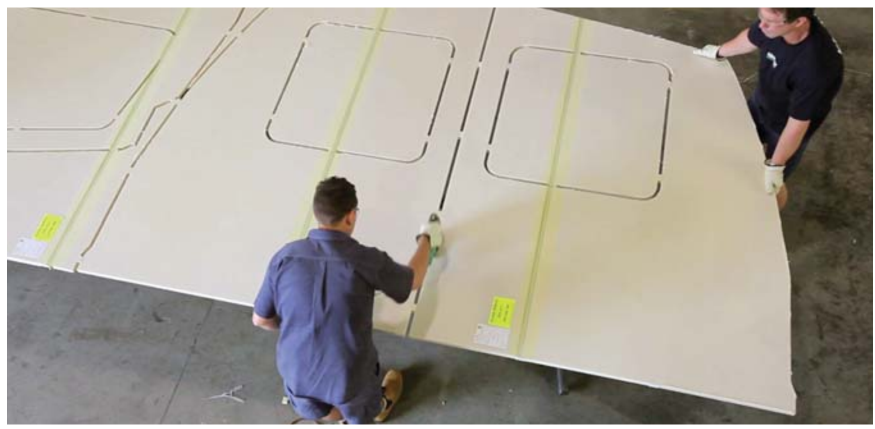
Each pre-cut part is left attached to the panel by small tabs to ensure the kit arrives with all components securely in place. The tabs are easily cut away, when the panels have been joined.

Custom kits can be engineered to meet the rules of all major regulatory authorities including Lloyd's Register of Shipping, American Bureau of Shipping, DNV-GL and Australian Standard AS4132.

With the DuFLEX system, boatbuilders can use widely spaced temporary female frames, or place hull panels over bulkheads which are aligned upside down over strongbacks. Large parts, for example a topside panel, may extend through two or more panels, so the panels are joined before the tabs are cut. Flat surfaces such as floors, walls and bulkheads are used as-cut, and curved surfaces are created by bending the flat panels into the required shape.

A strong, lightweight monocoque structure is achieved after adjacent parts and internal support structures are bonded together. On the hull interior, the joints are epoxy/fibreglass taped at points where differently angled panels meet; typically the keel, gunnels and chines.

The panels are designed to provide a fair surface on the hull exterior, and while the builder may choose to add laminate for aesthetic or other reasons, it's not required structurally.



Optimised Kit Technology

Minimises material waste, labour & tooling costs

Maximises mechanical properties

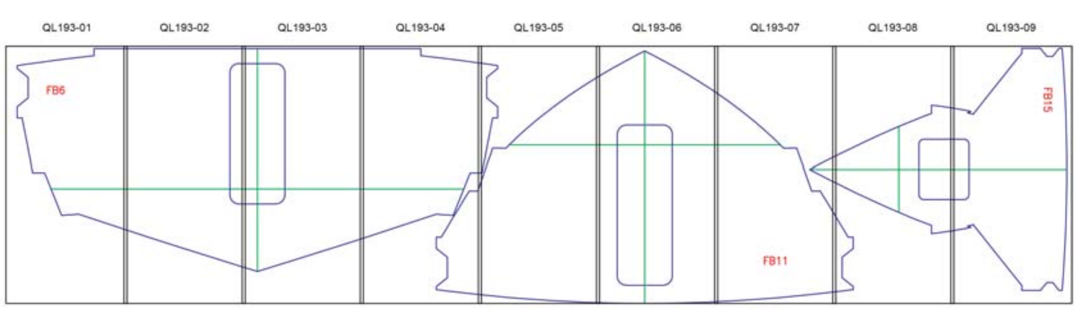
Tightens design allowables

Improves product quality

Simplifies quotations

Reduces VOC emissions

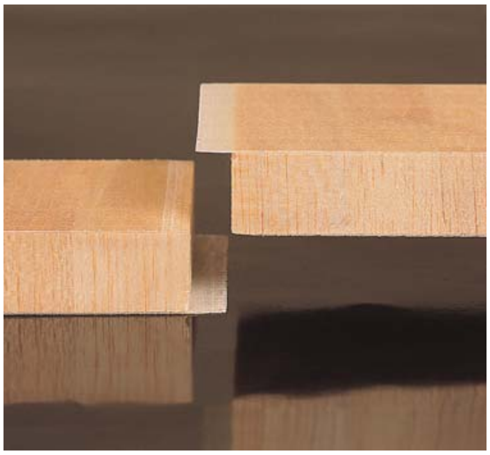
NESTING EXAMPLE - BULKHEADS



All kit parts are computer nested within the panels to reduce wastage.

Z- Joint

Particularly in strength critical applications the Z-Joint must be given adequate consideration. It can be considered analogous to a weld in aluminium, as a strength reduction exists. The Z-Joint must be bonded with a high density epoxy adhesive mixture.



Testing indicated no reduction in modulus, resulting in continuity of panel stiffness and fairness during formation. The majority of marine applications are stiffness critical and therefore a strength reduction in the laminate due to the joints presence is normally of little consequence. A weft unidirectional tape can be used in situations where strength continuity is desired.

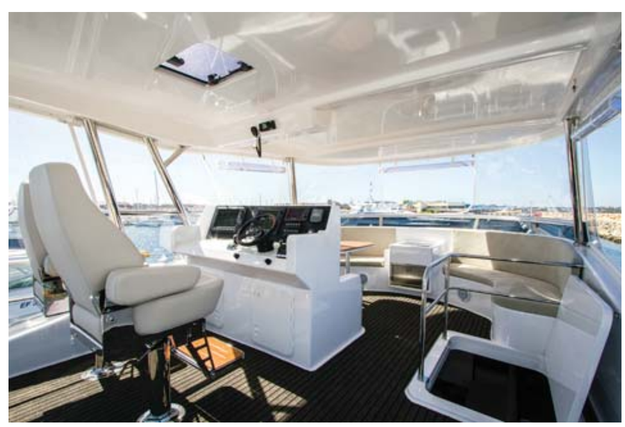
DuFLEX Skin Laminate	Tensile Strength ASTM D3039	Strength Reduction
Biaxial-Warp (0°)	298.6 MPa (43,310 psi)	19.8%
Biaxial-Fill (90°)	262.9 MPa (38,130 psi)	19.8%
Unidirectional-Warp (0°)	488.6 MPa (70,870 psi)	16.6%
Unidirectional-Fill (90°)	23.0 MPa (3,330 psi)	0.00%








The **DuFLEX**® Building System



To compliment the DuFLEX® System

Strips

Compound surfaces are also common in boats, for example sail boat hulls and the flared topsides in sport fishing boats. These surfaces can be made by bending and edge gluing DuFLEX Strips around temporary frames, as with traditional strip planking.

DuFLEX strips are pre-laminated with unidirectional reinforcements, in a 1200mm x 2400mm sheet with Z-Joints on both short ends.

The unidirectional fibre allows the planks to conform readily to highly convex or concave contours and can provide up to 50% of the total laminate. The stiffness of the DuFLEX Strips allows them to bend fairly over half the number of the frames required by other strip systems, and increases the stability when turning a boat hull.

Laminate Type	Tensile Strength ASTM D3039	Tensile Modulus ASTM D3039
Unidirectional@(0°)	585.6 MPa (84,900 psi)	34.73 GPa (5.04E+6 psi)
Unidirectional@(90°)	23.00 MPa (3,330 psi)	8.295 GPa (1.20E+6 psi)
Laminate thickness	0.88mm per 800gsm (0.035" per 23.5oz)	
Fibre Fraction	62-64% weight fraction	
Poisson's ratio	0.26	

The laminating required to complete the structure can be reduced by up to half and any additional layers of reinforcement can be applied after the part shape has been stripped. Tapered-edge triaxial E-glass, laminated to the planking, can often complete the structural requirement without disturbing the near-perfect fairness of the planked surface.

CNC-routed temporary frames

CNC-routed plywood or MDF (medium density fibreboard) temporary frames can also be supplied to provide the builder with accurate sections, cut exactly to drawing specifications.

Full Sized Component Packs

Tight build schedules are placing additional pressure on composite manufacturers worldwide. ATL Composites can now supply Production and Custom boat builders with Full Sized Component Packs to reduce build times and reduce wastage.

DuFLEX panels are manufactured and routed as per our standard processing, then ATL trained staff join the panels, release and trim the parts at our facility, to supply Full Sized Parts including Bulkheads, Floors, Soles, and Interior Fit-outs directly to our customers. The Full Sized Components are securely packed for freighting and arrive ready to install, simply tape into place.

FRP Bonding Angles

Composite 90° Bonding Angles have been designed to provide a quick and effective means for making right angle joints between DuFLEX panels. These pre-cured angles can be bonded in place with an epoxy paste adhesive, speeding up assembly and reducing wet lay-up.

Bonding Angles are supplied in 2400mm lengths

Bonding Angles consist of layers of multiaxial E-glass in a high performance epoxy matrix, peel plied on all surfaces, with the fibre direction tailored for optimum load carrying capability.

Bonding Angle Performance Data

Queensland University of Technology (QUT) Test report CET 4149/3 - Tensile tests to fibreglass connections - fins. Sample Data: Specimen 1 - polyester bonded : Specimen 2 - epoxy bonded Test Equipment : Grade A Tinius Olsen Universal Testing Machine, loading rate = 5mm/min

Test	Specimen Thickness 1	2	Nominal Area Resisting Shear (mm²)	Failure Load (kN)/ Failure Mode	Apparent Shear Strength (MPa)
1	21	21	48,400	77.6 part shear through polyester bond : part tearing	1.60
2	14	21	30,400	68.5kN shear through epoxy bond	2.25

In both circumstances, failure of the joins was through the adhesive rather than the Bonding Angle.

Basic Techniques

Joining the Panels

To streamline the joining process, the proprietary Z-Press applies heat and pressure to cure the epoxy adhesive on the Z-Joints. Joins are fully cured in 7 to 20 minutes, depending on the ambient temperature, type of hardener, core type and thickness of the panel. Checking the "squeeze-out" on the joint until it has become rubbery, will indicate when you can proceed with the next join.

Drums, or a purpose-built receiving stand, should be set up to support the full sized panel being joined. Once joined, the tabs can be cut to remove the full size parts of the DuFLEX kit. Large parts, for example a topside panel, may extend through two or more panels, so the panels should be joined before the tabs are cut.

Applying Adhesive to the Z-Joint

Prior to applying adhesive to the Z-Joint, carefully remove approximately 25mm of peelply from the outside edge of the male scarf, taking care not to damage the laminate. Scarfs should be brushed with a clean brush to remove dust and any contamination that would inhibit adhesion.

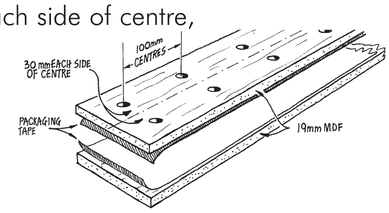
It is important to apply enough high-density adhesive to cover both Z-joints and exposed core, and to allow adequate squeeze out when the joints are pushed together.

The panels should be pushed together by sliding them back and forth to make a tight join of no more than 1mm, prior to applying pressure with the Z-Press or manual joining strips.

Manual Edge Joining Instructions

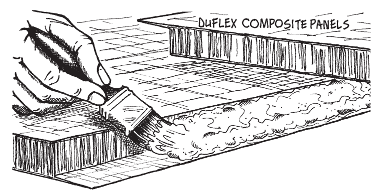
Step 1

Take two strips of 100mm wide, 19mm MDF (fibre-board) the length of the long side of the composite panel (2400mm). Cover one side of each strip with plastic tape as shown. Drill pairs of 3mm (approx.) screw holes, 30mm each side of centre, through one strip at 100mm centres.



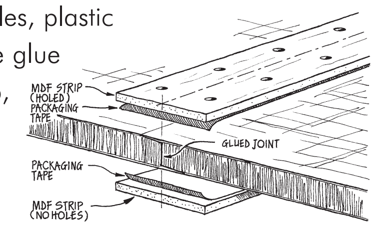
Step 2

Apply a high-density epoxy adhesive to both Z-Joints, making sure there is adequate adhesive to cover all core and scarf joint areas, and push joints together with a maximum gap of 1mm.



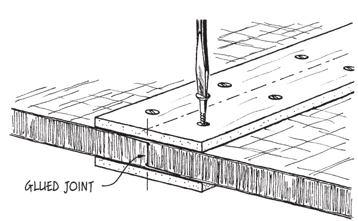
Step 3

Lay the strip with no holes, plastic side up, underneath the glue joint; lay the holed strip, plastic side down, on top of the glue joint.



Step 4

Screw through the holed top strip into the bottom strip, ensuring faces are squeezed together firmly. Leave to cure overnight.



Cutting the Panels

Diamond-coated fibreglass tooling is recommended for best tool life, for example, a jigsaw with a Makita No. 10S Type 150 blade to cut out parts. The best edge finish is achieved with circular saws running aluminium cutting blades, however blade life is greatly reduced.

Laminating with Epoxy

KINETIX® high performance laminating epoxies are specified for laminating fiberglass in DuFLEX kit construction.

Temperature and humidity considerations :

• At low temperatures, epoxy becomes more viscous. This makes the epoxy harder to apply and increases the possibility of air bubbles becoming trapped in the mixture, which can reduce reduce bond strength and moisture barrier effectiveness. Refer to manufacturer's technical data sheet for minimum temperature.

• Epoxy will usually cure without clouding or other moisture-related symptoms with the relative humidity as high as 80%. One problem with extremely high humidity is obtaining a good bond to the substrate.

Fibreglass Taping

Unless the design has been specified to have the core rebated at panel joints, epoxy/fibreglass tapes are applied on the inside and outside of where the DuFLEX panels meet.

Prior to taping, make sure the surfaces are free from contamination and have been sanded well to key the surface for good adhesion.

Use WEST SYSTEM® resin/hardener with 413 Microfibre Blend to create a neat cove in the join prior to applying your taping. Ideally the coving and taping should be done wet-on-wet to save work and time, and to give a nice, neat finish. A 20mm radius is generally sufficient.

Take into consideration the number of layers of tape that need to be applied and stagger the joins to reduce bulky overlaps, and keep the tapes neat and straight. To optimise the strength of these tapes, the fibreglass needs to be oriented in the correct direction over the join. If in doubt, ask your designer or materials supplier.

If tapes cannot be applied wet-on-wet, it is wise to apply a layer of peel-ply tape to the last layer to avoid having to prep and sand the surface prior to applying the next layer of tape the following day.

Application

1 Unroll the reinforcement and pre-fit it over the joint, cut it so that several excess inches extend beyond the taping surface. After pre-fitting, roll up each segment of reinforcement neatly and set it aside while you cove the joint. Roll a neat coat of resin/hardener onto the surface to be taped.

2 Unroll your tape and position it over the wet epoxy and cove. If the area is too vertical, you may want to wait until the epoxy becomes tacky. Work out any wrinkles by lifting the edge of the tape and smooth from the centre with your gloved hand or a squeegee.

3 Apply a second coat of epoxy with a foam roller to thoroughly wet-out the fabric.

4 Squeegee away any excess epoxy before the first batch begins to gel. Drag the squeegee over the fabric, using even-pressured, overlapping strokes to remove excess epoxy that could cause the fabric to float off the surface.

5 Run a brush down the centre of the cove ensure you have good adhesion.

Repeat steps 2 thru 5 until you have applied the correct number of tapes to the joint.








Fairing

A mixture of WEST SYSTEM resin/hardener and 410* Microlight fairing compound is best for minimum weight and ease of sanding. Because the panels are inherently smooth, fairing should be minimal.

**** If the boat is to be painted a dark colour, 417 Microballoons is the recommended fairing filler.***

There are several methods of fairing, but one that vdL recommends, is to take temporary battens of thin ply-wood or laminex, about 25mm wide, and tack them at even, comfortable spacings around the hull. The battens should be covered in plastic packaging tape to avoid inadvertent bonding.

Screed fairing compound in between the battens with a trowel, then take a 5mm * aluminium batten 50mm wide, the length of the space + the vertical batten width, with a fine edge on one side, press firmly on the battens and drag the horizontal batten down the side of the hull. This takes off the high spots and levels the panel to the height of the temporary battens.

** Curved areas will require a more flexible batten, similar to the ones taped on the hull.*

Remove the temporary battens and allow the compound to cure. Sand the batten space to a bevel edge and fill that space with compound to the same level as the main hull. Allow to cure, and then do your final fairing.

Alternatively the fibreglass tapes on the panel joints can be used as a guideline to apply the fairing compound, and screed horizontally the full length of the boat in two applications.

Allow to cure and do initial fairing. Follow with another full length run to cover the join. Allow to cure and then sand. Apply a final vertical screed to make sure all low spots are filled, prior to final fairing.

In all cases, the key is to screed carefully in the beginning to avoid extra work.

Once you have the hull faired, you will need to apply 2 coats of neat WEST SYSTEM resin/hardener above the waterline and 4 coats below the waterline, to seal the fairing compound prior to applying primer/undercoat.

Interior Bulkheads & Fit-Out

Bulkheads will need to be coved in with a high density mixture of WEST SYSTEM resin/hardener and 413 Microfibre Blend, and fibreglass taped to the designer's specification into position.

Non-structural interior furniture can be filleted into place with a low density 411 Microsphere Blend mix.

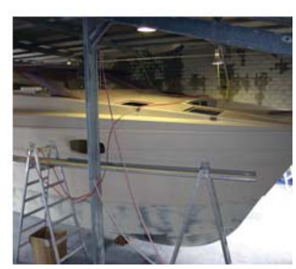










Edge detailing is the removal of the core on exposed edges of the parts and replacing it with a low density epoxy compound of WEST SYSTEM resin / hardener and 411 Microsphere Blend.

Use a T-router with a ball-trace to run along the laminate to remove core. Over-fill the routed edge with a low density filler compound and allow to cure. Sand the compound flush with the skins when it is fully cured.

Timber blocks can be used to replace the epoxy filler in areas where latches or hinges are to be placed.

Once the modular part is assembled, it should be dry-fitted to check the positioning and shape. Remove to the workbench to cove and tape the joins, and coat the surfaces. Once the joints have cured the part can then be permanently fitted in the boat.

For large curved pieces of furniture, such as cockpit or saloon seating, the DuFLEX panels can be kerffed to achieve the required shape. To make each of the radiused corners, run a portable circular saw against a plywood straightedge, through the core to the inside of the outside laminate. To determine the distance between the cuts - look for the flat spots in the curve on the floor and measure, and make a temporary jig of the curve if required.

A mixture of WEST SYSTEM resin / hardener and 413 Microfibre Blend should be spread into the open cuts: the panel is then bent over a temporary jig of its final shape and temporarily clamped until the epoxy cures. Fill the internal angle, with a 20mm radius of modified epoxy and allow to cure. Apply an additional layer of fibreglass cloth to the inside of the angle, overlapping the fillet by 25mm on each side.

Planning for Deck Hardware

With DuFLEX panels it is advisable to remove the balsa or foam core and replace with solid timber, or high density foam inserts, in preparation for deck hardware bonding, fitting rudder tubes and windows. This distributes high, single-point loads over a larger area. The core should be routed out without damaging the inside laminate and the insert should be bonded in place and laminated with the same thickness and weight as the original panel, and faired in.

When holes are drilled in the timber core for bolts or screws they should be over-drilled and filled with epoxy and re-drilled for the fastener after the resin has cured. This allows the epoxy to seal and protect the core exposed by the fastener hole. Fasteners should always be coated in resin before fitting.

Additional information on hardware bonding is available from ATL Composites.

Deck hatches

Make a pattern from the cut out information supplied by the hatch manufacturer, and cut the shape in the DuFLEX panel. Rout out the core and back fill the edges in the usual manner. Mark the location of the fasteners and then position the hatch. Silicone the edges to seal against water ingress.

For flat parts that need to be fitted to curved surfaces, such as hatches to the side of hulls, you will need to make a pattern, draw it onto the hull and cut the inside shape out. Make up a temporary jig and clamp over the hole on the outside.

Backfill with a mixture of WEST SYSTEM resin/hardener and 411 Microsphere Blend to make it fit flush. Fair and mold in prior to attaching the part.

Final exterior finish

Final finishing is important for cosmetic reasons and to protect the epoxy from ultraviolet light.

1. Allow the final sealing coat of epoxy on the fairing compound to cure thoroughly.

2. Wash the surface with a Scotchbrite pad and water to remove amine blush.

3. Sand to a smooth finish - the amount of sanding required will depend on how smoothly you applied the final epoxy coatings and which finishing system you choose.

4. Proceed with your final coating operation, following the specific instructions of your paint or coating system supplier.

The Tool Kit

General Hand Tools

- Screwdrivers - both straight and Phillips
- Hammers - standard carpenters claw hammer, soft rubber head and a dead blow mallet
- Pliers - standard 200mm slip-joint pliers.
- Wrenches - full sets of socket and combination wrenches
- Knives - standard shop utility knife with replaceable blades, a pocketknife and a single edge razor blade scraper
- Hand saws, planes, chisels and rasps & wood files, and tape measures

Power Tools

- Pistol drills • Sanders
- Router with tungsten bits
- Circular saw - with a diamond tipped blade for cutting through the DuFLEX laminate
- Power plane • Sander/polisher
- 4" grinder • Jigsaw • Power drill

Composite Tools

Diamond-coated fibreglass tooling is recommended for best tool life, for example, a jigsaw with a Makita No. 10S Type 150 blade to cut out parts.

Sharp, good quality scissors for cutting fibreglass. Battery operated fibreglass shears are also available.

Epoxy Application:

- WEST SYSTEM 800 Foam roller covers
- roller frames • plastic roller trays
- metal laminate rollers • rubber squeegees
- disposable brushes • plastic mixing containers
- mixing sticks • disposable gloves
- scotch-brite scouring pads

Other Useful Items

- Coving knives can be made up by machining 25mm paint scrapers to 20mm wide radiused ends.
- Step ladders and simple scaffolding for positioning of panel parts and fairing
- An industrial wet & dry vacuum cleaner
- Heavy duty gloves will prevent injury when handling fibreglassed parts

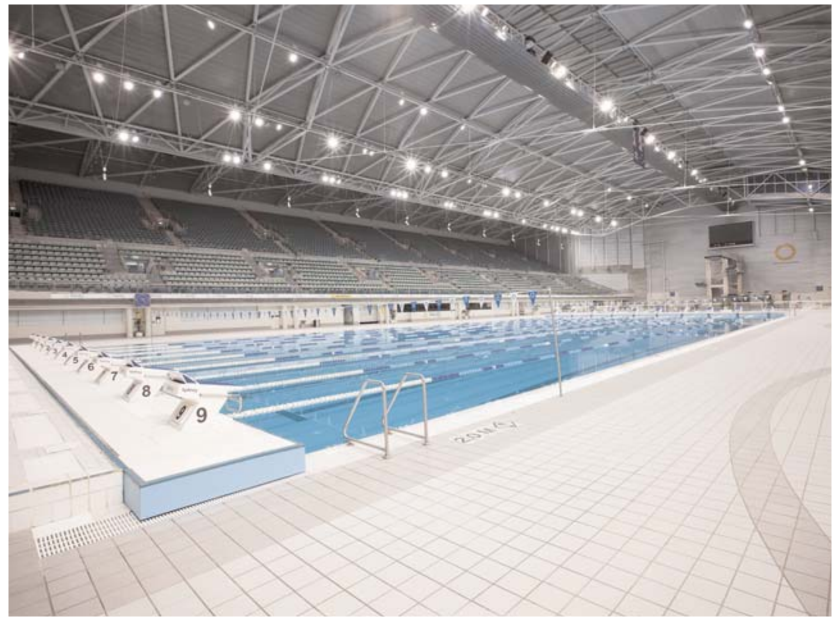
Grainger Designs

Storage

DuFLEX panels should be stored flat, out of direct sunlight, and kept dry and clean.

Safety

Avoid inhalation and eye contact with machining dust. Wear protective equipment such as hearing protection and safety glasses during cutting operations, and gloves to avoid cuts. Use guards as per machinery manufacturers instructions.



Sydney Olympic Park Aquatic Centre Pool

Marine

DuFLEX®panels are suitable for hull shells, decks, superstructures, bulkheads, frames, stringers, partitioning and furniture for one-off construction, prototypes and running plugs. DuFLEX can also be used to extend hulls or modify superstructures of existing boats.

Palm Beach Motor Yachts

Panels are available in plain sheets, strips or kit forms or full sized components for:

- recreational and pleasure craft
- cruising and racing yachts
- mega-yachts • high speed ferries
- water taxis • patrol craft

Grahame Parker Yacht Design

Other Applications

Road Transportation

- truck beds, bodies, side walls • bus floors

Industrial

- holding tanks and lids • staging, walkways, scaffolding
- form work • audio visual equipment containers

Rail Transportation

- flooring • roof/ceiling construction
- cabinetry and interiors • doors

Architectural

- building facades • structural cladding
- doors, gates and window frames
- acoustic insulation • pre-fabricated housing
- composite decks and bridges
- long span roofing

17.5m Cantilevered Roof - Deepdene Penthouse

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BESTPRACTICE CERTIFICATION ISO9001 QUALITY MANAGEMENT SYSTEM

DNV·GL
Shop Approval
 # KBZ 1095 HH
for the Production of
Composite Panels

ATL composites

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