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Reinforcements

Sydney Ph: (+61 2) 9938 7222 Fax: (+61 2) 9938 5826
Melbourne Ph: (+61 3) 9550 5656 Fax: (+61 3) 9950 5651
Brisbane Ph: (+61 7) 3271 3944 Fax: (+61 7) 3271 3603
Gold Coast Ph: (+61 7) 5563 7771 Fax: (+61 7) 5563 7888

Adelaide Ph: (+61 8) 8234 9499 Fax: (+61 8) 9234 9490
Perth Ph: (+61 8) 9455 1972 Fax: (+61 8) 9455 1012
Cairns Ph: (+61 7) 4035 2126 Fax: (+61 7) 4035 2125

Auckland Ph: (+64 9) 838 7195 Fax: (+64 9) 837 1035
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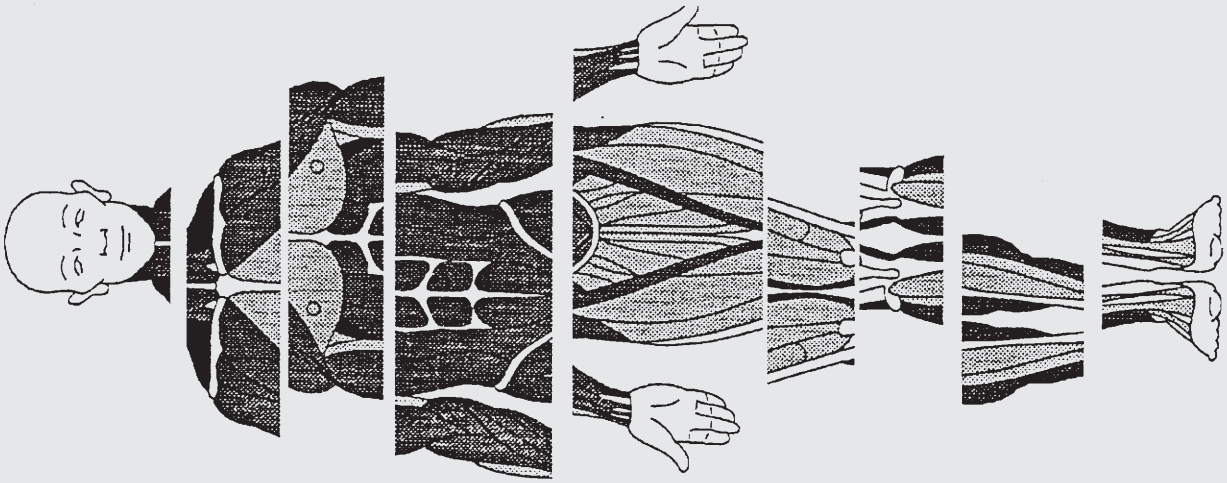
Don't Get Cut-Up About Cutting Reinforcements

FGI can now cut most rolls of glass to any width



- Economical
- Saves labour
- Reduces injuries
- Saves material – reduces wastage
- Accurate – width closely controlled
- Minimum quantity is only one original roll
- One roll can be cut to a number of different widths
- Fast turnaround
- Any size from 75mm up
- Cut without rerolling – no damage or contamination

Materials that can be cut include:

Chopped Strand Mat, Woven Roving, Cloth, Biaxial, Triaxial, Double Bias, Unidirectional, Continuous Filament Mat, Tissue.

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Reinforcement Selector

This Data Sheet summarises some characteristics of hand-laid laminates of a wide range of reinforcing fabrics.

Laminate results are approximate and the thickness, fibre content, weight and physical properties can vary substantially. Test laminates should be made to determine actual results.

Laminate bending properties are very sensitive to small changes in thickness. For example, a 10% change in thickness (all other properties equal) will result in approximate 30% change in bending stiffness (deflection in bending).

In general, efficient laminate design for maximum bending properties requires that the higher strength and stiffness layers are as far as possible from the centre of the laminate thickness. Other considerations such as chemicals resistance, interlaminar bond and fibre pattern print may affect the positioning of the individual layers through the thickness.

ABBREVIATIONS USED

CSM = Chopped Strand Mat
GUN = gun chopped strands
WR = Woven roving fabric
CLOTH = woven cloth fabric
TAPE = Woven tape
TISS = Tissue
UNI = Unidirectional stitched fabric
BI = Biaxial stitched fabric
DB = Double bias stitched fabric
TRI = Traixial stitched fabric
QUA = Quadaxial stitched fabric

EG = E Glass fibre
CG = C Glass fibre
CAR = Carbon Fibre
ARA = Aramid fibre
0 = along the roll
90 = across the roll
+45, -45 = at 45 degrees from 0 direction
/M = Chopped glass attached
/T = Tissue attached
/S = stitching or stabilising yarn

Note that the list of angles does NOT signify the stacking order within the fabric. The actual stacking order may significantly affect bending properties.

FGI Code	Fibre	Type Style	Dry Wt g/m² per layer	Construction		Approximate results with resin in laminate		
				Angles	Comments or Percentage of glass weight per angle	Wt% Reinf.	Thick/ layer mm	Wt/ layer kg/m²
Chopped Glass								
F02004	EG	CSM	225	Random	Emulsion binder	36	0.42	0.63
F02006	EG	CSM	300	Random	Emulsion binder	36	0.56	0.83
F02008	EG	CSM	450	Random	Emulsion binder	36	0.84	1.3
F02015	EG	CSM	600	Random	Emulsion binder	36	1.1	1.7
F02022	EG	CSM	900	Random	Emulsion binder	36	1.7	2.5
F02000	EG	CSM	300	Random	Powder binder	36	0.56	0.83
F02001	EG	CSM	450	Random	Powder binder	36	0.84	1.3
F02002	EG	CSM	600	Random	Powder binder	36	1.1	1.7
F02037	EG	GUN	1000	Random		36	1.9	2.8
Woven Roving								
F02030	EG	WR	265	0/90		50	0.32	0.53
F01092	EG	WR	630	0/90		53	0.70	1.2
F01093	EG	WR	830	0/90		53	0.93	1.6
Woven Cloth								
F02066	EG	CLOTH	84	0/90	Plain weave	50	0.10	0.17
F02333	EG	CLOTH	130	0/90	Super white Plain weave	50	0.16	0.26
F02034	EG	CLOTH	200	0/90	Super white Plain weave	50	0.24	0.40
F02077	EG	CLOTH	195	0/90	Plain weave	50	0.23	0.39
F02081	EG	CLOTH	288	0/90	Crowfoot weave	50	0.35	0.57
F02080	EG	CLOTH	323	0/90	Plain weave	50	0.39	0.64
E Glass Stitched Fabrics								
F02156	EG	BI MB4500	453	0/90/S	47/51/2	55	0.48	0.82
F02117	EG	BI MB6000	602	0/90/S	45/53/2	55	0.64	1.1
F02157	EG	BI MB8500	855	0/90/S	50/49/1	55	0.90	1.5
F02191	EG	BI/M MB6008	827	0/90/M/S	33/39/27/1	52	1.0	1.6

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Reinforcement Selector (cont.)

FGI Code	Fibre	Type Style	Dry Wt g/m² per layer	Construction		Approximate results with resin in laminate		
				Angles	Comments or Percentage of glass weight per angle	Wt% Reinf.	Thick/ layer mm	Wt/ layer kg/m²
E Glass Stitched Fabrics								
F02183	EG	BI/M MB8508	1079	0/90/M/S	39/39/21/1	53	1.2	2.0
F02112	EG	DB MX4200	435	+45/-45/S	48/48/4	55	0.46	0.79
F02159	EG	DB MX6000	616	+45/-45/S	48/48/4	55	0.65	1.1
F02182	EG	DB MX9000	905	+45/-45/S	49/49/2	55	1.0	1.6
F02111	EG	DB/M MX4208	660	+45/-45/M/S	32/32/34/4	51	0.77	1.3
F02189	EG	DB/M MX6008	841	+45/-45/M/S	36/36/27/2	52	1.0	1.6
F02200	EG	DB/M MX9008A	1128	+45/-45/M/S	39/39/20/2	53	1.3	2.1
F08183	EG	TRI MT7500	754	0/+45/-45/S	36/31/31/2	55	0.80	1.4
F08101	EG	TRI MT1160	1152	0/+45/-45/S	35/31/31/2	55	1.2	2.1
F08184	EG	TRI MT1150	1152	0/+45/-45/S	49/24/24/2	55	1.2	2.1
F02203	EG	TRI/M MT1158	1377	0/+45/-45/M/S	41/20/20/16/2	53	1.1	1.9
F02185	EG	TRI MZ7500	759	90/+45/-45/S	33/33/33/1	55	0.80	1.4
F02186	EG	QUA MQ6000	608	0/90/+45/-45/S	27/22/25/25/1	55	0.64	1.1
F02187	EG	QUA MQ8500	858	0/90/+45/-45/S	25/24/25/25/1	55	0.91	1.6
F02188	EG	QUA MQ1200	1204	0/90/+45/-45/S	23/25/25/25/1	55	1.3	2.2
F02205	EG EG	QUA/M MQ8508	1082	0/90/+45/-45/M/S	20/19/20/20/21/1	53	1.2	2.1
F02195	EG EG	QUA/M MQ1208	1430	0/90/+45/-45/M/S	20/16/18/18/27/1	54	1.6	2.7
F02116	EG	UNI MU4500	459	0/S	89/11	55	0.48	0.8
F02196	EG	UNI MU5601	628	0/T/S	90/5/5	50	0.72	1.2
F02190	EG	UNI MU8800	907	0/S	94/6	55	0.96	1.6
High Performance Fabrics								
F02338	CAR	CLOTH	198	0/90	Plain weave	41	0.36	0.48
F02336	CAR	CLOTH	200	0/90	Twill weave	41	0.36	0.48
F02173	CAR	UNI	153	0/S	96/4 300 & 600mm wide	44	0.26	0.35
F02174	CAR	UNI	305	0/S	98/2 – 300mm wide	45	0.51	0.68
F02388	CAR	UNI	227	0/S	97/3 – 600mm wide	50	0.33	0.45
F02390	CAR	UNI	825	0/S	99/1 – 250mm wide	59	1.0	1.4
F02220	CAR	DB	410	+45/-45/S	49/49/2	48	0.63	0.86
F02221	CAR	DB	589	+45/45/S	49/49/2	48	0.90	1.23
F02138	CAR ARA	CLOTH	200	0/90	Twill weave 38% aramid, 62% carbon by weight	41	0.38	0.49
F02145	ARA	CLOTH	75	0/90	Plain weave	38	0.16	0.20
F02148	ARA	CLOTH	170	0/90	Plain weave	38	0.37	0.45
F02150	ARA	CLOTH	300	0/90	Satin weave	38	0.65	0.80
F02166	ARA	UNI	200	0/S	97/3 – 600mm wide	40	0.41	0.50
Surface Tissue								
F02055	CG	TISS	22	Random	0.25mm thick	8	0.25	0.27
F02058	CG	TISS	26	Random	0.3mm thick	8	0.3	0.32
F02054	Nexus	TISS	40	0/90	Synthetic tissue	6	0.5	0.6

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Woven Fabric Selector Guide

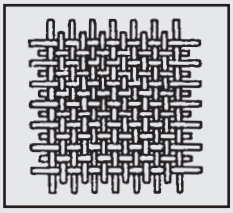
FABRIC SELECTION:
The combinations of the unique properties of Glass Fabric make them suitable for incorporation into a wide range of industrial products. The correct choice of fabric will be based on consideration of the following factors.

FABRIC THICKNESS:
The allowable thickness in relation to end use can be an important criterion. Glass fabrics are available in thicknesses ranging from 0.032 mm to 0.25 mm plus woven rovings.

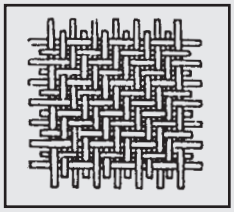
CONSTRUCTION:
This is the number of warp and weft ends per 25.4 mm.

WEIGHT:
Woven Glass Fabrics vary in weight from 25 gms to 660 gms.

BASIC WEAVE PATTERNS:
Following are some basic weave patterns that can be produced with glass fibre yarn.

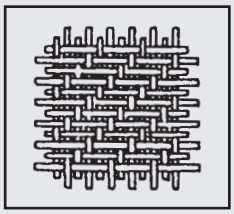


PLAIN WEAVE:
The basic and most commom textile weave. The warp and weft yarns are interlaced in an alternating fashion.



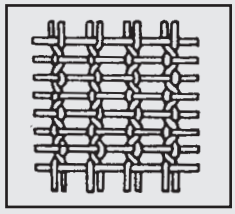
TWILL WEAVE:
A pattern characterised by a diagonal rib or twill line. Each end floats over at least two consecutive picks enabling a greater nujmber of yarns per unit area than a plain weave.

Characteristics: More pliable than the plain weave. Folds and hangs better than plain woven fabric and has better sewing characteristics than satin weaves.



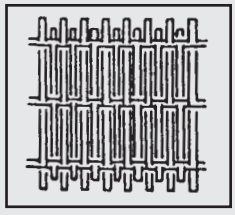
SATIN WEAVE:
The warp and weft threads are crossed in a programmed order and frequency in order to obtain a flat appearance, since the link points are not aranged continuously. As a result, one side of the fabric has more warp threads whilst the back appears to consist mainly of weft threads.

Characteristics: Satin weaves allow production of fabrics with high mass per unit of surface area and good drapability. This weave pliable to intricately contoured planes and mostly used in reinforced plastics sectors, especially in aeronautical industry.



LENO WEAVE:
It is a locking type weave in which two or more warp threads cross over each other and interlace with one or more weft ends.

Characteristics: Improves stability and prevents shifting of fibres in low count open weave fabrics.



UNIDIRECTIONAL WEAVE:
A greater number ofr relatively strong warp yarn are combined with fewer weft yarns.

Characteristics: Maximum strength in s specified direction, high impact strength as glass reinforced laminate.

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Emulsion Bonded M 705 Mat For Contact Moulding

1. PRODUCT DESCRIPTION

M 705 mat is made of chopped glass strands bonded in mat form with an emulsion binder. It is a thin, porous, well bonded mat which maintains its integrity during the impregnation process and provides an uniform wet-through rate.

M 705 is produced using Advantex® glass fiber. Advantex® glass fiber combines the electrical and mechanical properties of traditional E glasses with the acid corrosion resistance of E-CR glass. Advantex® meets the requirements stated of both E and E-CR glass in both ISO 2078 and ASTM D578-98.

M 705 mat is manufactured in conformity with ISO 2559, NF B38301 and DIN 61853 standards.

M 705 mat (300, 450 & 600 g/m²) is approved by the Lloyd's Register of Shipping and by Det Norske Veritas.

2. USE

M 705 mat is designed as a reinforcement medium for polyester resins used in contact moulding processes.
Typical applications are in laminates requiring good translucency and/or good ageing characteristics.

Major mat characteristics are: good drapability, rapid wet-through and wet-out, good laminate translucency, good mechanical properties.

3. AVAILABLE STANDARD PRODUCTS

a) Weight (g/m²) 300 – 375 – 450 – 600 & 900

b) Width (cm) – Standard widths: 104cm – 1 side trimmed. The width specified on the order for one side trimmed mat shall be the width as measured from the trimmed side up to the other side (untrimmed) at point where the mat becomes coherent.

1. Mat weight includes glass and binder.
2. Limits are valid for width of 32cm and over. When mat is supplied in width less than 32cm wide, the customer may request certification that the acceptance limits have been met before the product was slit.
3. The ignition loss includes essentially the binder, the sizing on the filaments and a small % of moisture which will not exceed 0.2%
4. Average of the 1000cm² specimens taken across the mat width. Valid for widths of 95cm and over.

5. VISUAL PROPERTIES

Colour The mat shall be white to off white.

Holes Holes over 50mm in diameter are not allowed.

4. PRODUCT ACCEPTANCE LIMITS AND TEST METHODS

Property	Mat Weight (g/m²)	Specification			Test Method
		Min ind	Nominal	Max ind	
Weight uniformity (g/1000cm²) (1) (2)	300 375 450 600 900	24.3 30.3 36.4 48.6 72.9	30.0 37.5 45.0 60.0 90.0	35.7 44.7 53.6 71.4 107.1	TM-MT-02-PP
Average weight uniformity (%) (4)	All	-10%	Nominal	+10%	
Ignition loss (%) (2) (3)	All	2.9%	–	6.0	TM-MT-04-PP
Tensile strength (N) (2)	300 375 450 600 900	70 80 90 100 110	– – – – –	– – – – –	TM-MT-06-PP
Width (cm) 1 side trimmed	All	-0.0	Nominal	+3.0	TM-MT-08-PP

Foreign matters (dirt spots, binder spots, unsplit fibers...)
Foreign matters above 25mm are not allowed.

Long fibers Long fibers above 30cm are not allowed.

6. PREPARATION FOR SHIPMENT

a) **Roll up** The mat is wound on a 7.5cm inside diameter carton tube.
Roll net weight: 32kg (±2).

b) **Wrap-ins rolls** On occasion it will be necessary to wrap-in two or three lengths of mat (none less than 10m) in order to reach a full roll diameter. Rolls containing wrap-ins are marked accordingly.

c) **Standard packaging method** The mat is packed in polyethylene prior to insertion in corrugated cartons of sufficient strength to protect the content during shipment and storage. The cartons are palletized 16 per pallet. Pallet sizes: 113 x 113cm. Cartons are fixed to the pallet by stretch wrapping.

d) **Storage conditions**
Unless otherwise specified, it is recommended to store glass fiber products in a cool dry area. Temperature should not exceed 35°C and the relative humidity should be kept below 75%. Glass fiber products must remain in packaging material until just prior to its use. If these conditions are respected, glass fiber products should not undergo significant changes when stored for extended periods of time.

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Emulsion Bonded M 705X12 Mat For Contact Moulding

1. **PRODUCT DESCRIPTION**

M 705X12 mat is made of chopped glass strands bonded in mat form with an emulsion binder. It is a thin, porous, well bonded mat which maintains its integrity during the impregnation process and provides an uniform wet-through rate.

M 705X12 is produced using Advantex® glass fiber. Advantex® glass fiber combines the electrical and mechanical properties of traditional E glasses with the acid corrosion resistance of E-CR glass. Advantex® meets the requirements stated of both E and E-CR glass in both ISO 2078 and ASTM D578-98.

M 705X12 mat is manufactured in conformity with ISO 2559, NF B38301 and DIN 61853 standards.

2. **USE**

M 705X12 mat is designed as a reinforcement medium for polyester resins used in contact moulding processes.

Typical applications are in laminates requiring good surface finish and/or good ageing characteristics.

Major mat characteristics are: good drapability, rapid wet-through and wet-out, good laminate translucency, good mechanical properties.

3. **AVAILABLE STANDARD PRODUCTS**

a) Weight (g/m^2)
225

b) Width (cm)
Standard widths: 102cm – 1 side trimmed.
The width specified on the order for one side trimmed mat shall be the width as measured from the trimmed side up to the other side (untrimmed) at point where the mat becomes coherent.

4. **PRODUCT ACCEPTANCE LIMITS AND TEST METHODS**

Property	Mat Weight (g/m^2)	Specification			Test Method
		Min ind	Nominal	Max ind	
Weight uniformity ($g/1000cm^2$) (1) (2)	225	18.2	22.5	26.8	TM-MT-02-PP
Average weight uniformity (%) (4)	All	-10%	Nominal	+10%	
Ignition loss (%) (2) (3)	All	2.9%	–	6.0	TM-MT-04-PP
Width (cm) 1 side trimmed	All	-0.0	Nominal	+3.0	TM-MT-08-PP

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Emulsion Bonded M 705X12 Mat For Contact Moulding (cont.)

1) Mat weight includes glass and binder.

2) Limits are valid for width of 32cm and over. When mat is supplied in width less than 32cm wide, the customer may request certification that the acceptance limits have been met before the product was slit.

3) The ignition loss includes essentially the binder, the sizing on the filaments and a very small percentage of moisture which will not exceed 0.2%.

4) Average of the 1000cm^2 specimens taken across the mat width. Valid for widths of 95cm and over.

5. VISUAL PROPERTIES

Colour

The mat shall be white to off white.

Holes

Holes over 50mm in diameter are not allowed.

Foreign matters

(dirt spots, binder spots, unsplit fibers...)
Foreign matters above 25mm are not allowed.

Long fibers

Long fibers above 30cm are not allowed.

6. PREPARATION FOR SHIPMENT

a) **Roll up**
The mat is wound on a 7.6cm inside diameter carton tube.
Roll net weight: 32kg (±2).

b) **Wrap-ins rolls**
On occasion it will be necessary to wrap-in two or three lengths of mat (none less than 10m) in order to reach a full roll diameter. Rolls containing wrap-ins are marked accordingly.

c) **Standard packaging method**
The mat is packed in polyethylene prior to insertion in corrugated cartons of sufficient strength to protect the content during shipment and storage.

The cartons are palletized 16 per pallet. Pallet sizes: 115 x 115cm.

Cartons are fixed to the pallet by stretch wrapping.

d) **Storage conditions**
Unless otherwise specified, it is recommended to store glass fiber products in a cool dry area. Temperature should not exceed 35°C and the relative humidity should be kept below 75%. Glass fiber products must remain in packaging material until just prior to its use. If these conditions are respected, glass fiber products should not undergo significant changes when stored for extended periods of time.

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Powder Bonded M 723 Mat For Contact Moulding

1. **PRODUCT DESCRIPTION**

M 723 mat is made of chopped glass strands bonded in mat form with a small amount of highly soluble powdered polyester binder and is designed to be randomly oriented and multi-resin compatible.

M 723 is produced using Advantex® glass fiber. Advantex glass fiber combines the electrical and mechanical properties of traditional E glasses with the acid corrosion resistance of E/CR glass. Advantex meets the requirements stated of both E and E-CR glass in both ISO 2078 and ASTM D578.

M 723 mat is manufactured in conformity with ISO 2559, NF B38301 and DIN 61853 standards.

M 723 mat (300, 450 & 600 g\m2) is approved by the Lloyd's Register of Shipping and by Det Norske Veritas.

2. **USE**

M 723 mat is recommended for skin coating and back up laminating in genral purposes, open mold processes.

3. **AVAILABLE STANDARD PRODUCTS**

a) Weight (g/m^2)
300 – 375 – 450 and 600.

b) Width (cm)
Standard widths: 104 & 125cm – 1 side trimmed. The width specified on the order for one side trimmed mat shall be the width as measured from the trimmed side up to the other side (untrimmed) at point where the mat becomes coherent.

4. **PRODUCT ACCEPTANCE LIMITS AND TEST METHODS**

Property	Mat Weight (g/m^2)	Specification			Test Method
		Min ind	Nominal	Max ind	
Weight uniformity ($g/1000cm^2$) (1) (2)	300	24.3	30.0	35.7	TM-MT-02-PP
	375	30.3	37.5	44.7	
	450	36.4	45.0	53.6	
	600	48.6	60.0	71.4	
Average weight uniformity (%) (4)	All	-10%	Nominal	+10%	
Ignition loss (%) (2)	300	3.1	3.9	4.7	TM-MT-04-PP
	375	3.1	3.9	4.7	
	450	2.7	3.5	4.3	
	600	2.7	3.5	4.3	
Tensile strength (N) (2)	300	130	–	–	TM-MT-06-PP
	375	160	–	–	
	450	195	–	–	
	600	260	–	–	
Width (mm) 1 side trimmed	All	-0.0	Nominal	+3.0	TM-MT-08-PP

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Powder Bonded M 723 Mat For Contact Moulding (cont.)

1) Mat weight includes glass and binder.
2) Limits are valid for width of 32cm and over. When mat is supplied in width less than 32cm wide, the customer may request certification that the acceptance limits have been met before the product was slit.
3) This ignition loss includes essentially the binder, the sizing on the filaments and a very small percentage of moisture which will not exceed 0.2%.
4) Average of the 1000m² specimens taken across the mat width. Valid for widths of 95c m and over.

5. VISUAL PROPERTIES

Colour

The mat shall be white to off white.

Holes

Holes over 50mm in diameter are not allowed.

Foreign matters

(dirt spots, binder spots, unsplit fibers...)
Foreign matters above 25mm are not allowed.

Long fibers

Long fibers above 15cm are not allowed.

6. PREPARATION FOR SHIPMENT

a) **Roll up**
The mat is wound on a 7.5 cm inside diameter carton tube to an overall outside diameter of approximately 30 cm (full roll) for 125 cm widths and 27 cm for 104 cm widths.

b) **Wrap-ins rolls**
On occasion it will be necessary to wrap in rolls. Wrapped in rolls will consist of 2 pieces only, the shortest of which will have a minimum length of 10 meters. The location of the wrap will be flagged by a strip of coloured paper.

c) **Rolls length and weight**

Nominal Mat Weight	Approx Nominal full roll length (125/104cm width)	Approx. full roll weight (125cm width)
300 g/m²	110/96 m	42/30 kg
450 g.m²	75/64 m	42/30 kg
600 g/m²	56/48 m	42/30 kg

d) **Standard packaging method**
The mat is packed in polyethylene prior to insertion in corrugated cartons of sufficient strength to protect the content during shipment and storage.
The cartons are stacked 12 per 127 x 97 cm pallets for 125 cm widths and 16 per 113 x 113 cm pallets for 104 cm widths. Cartons are fixed to the pallet with a stretch-wrap bag.

e) **Storage conditions**
Unless otherwise specified, it is recommended to store glass fibre products in a cool dry area. Temperature should not exceed 35°C and the relative humidity should be kept below 75%. Glass fibre products must remain in packaging material until just prior to its use.

If these conditions are respected, glass fibre products should not undergo significant changes when stored for extended periods of time.

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M 8610 Mat for Matched Die Moulding

1. **PRODUCT DESCRIPTION**

M 8610 is a continuous fiber, non woven mat which is treated with a suitable bonding resin and coupling agent. The mat has good handling properties, resists wash in the mold, has good porosity, fast wet through, good formability, weight uniformity and uniform strand integrity.

M 8610 is produced using Advantex® glass fiber. Advantex® glass fiber combines the electrical and mechanical properties of traditional E glasses with the acid corrosion resistance of E-CR glass. Advantex® meets the requirements stated of both E and E-CR glass in both ISO 2078 and ASTM D578.

M 8610 is approved by the Lloyd's Register of Shipping.

2. **USE**

M 8610 mat is specifically designed for the matched die moulding, resin transfer molding and S-RIM processes.

M 8610 provides random directional strength properties to molded parts. The mat performs well in applications where complex shapes, including plane changes and sharp angles, are involved. The M 8610 mat is designed for use in polyester and polyurethane resins, both filled and unfilled.

3. **AVAILABLE STANDARD PRODUCTS**

a) Weight
300 – 375 – 450 and 600 g/m^2.

b) Width
Standard width: 130cm – Two side trimmed.

c) Other weights & widths:
Information about availability on request.

4. **PRODUCT ACCEPTANCE LIMITS AND TEST METHODS**

Property	Mat Weight (g/m^2)	Specification			Test Method (1)
		Min ind	Nominal	Max ind	
Weight uniformity (2) (g/1000cm^2)	300	25.5	30.0	34.5	TM-MT-02-PP
	375	31.8	37.5	43.2	
	450	38.2	45.0	51.8	
	600	51.0	60.0	69.0	
Ignition loss (%)	All	1.25	2.50	3.75	TM-MT-04-PP (Method A)
Width (cm)	All	-0.3	Nominal	+0.3	TM-MT-04-PP (method A)

1) Copy available upon request.
2) Mat weight includes glass and binder.

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M 8610 Mat for Matched Die Moulding (cont.)

5. **VISUAL PROPERTIES**
The continuous strand mat shall meet requirements as set forth in the visual standards maintained by Owens Corning.

The visual standards manual allows a color paper flag to identify the location of imperfection. The maximum number of flagged imperfections allowed is six (6) per roll.

6. **MINIMUM RECOMMENDED LAMINATE THICKNESS**
Minimum recommend laminate thickness is 1.5mm for all mat weights.

7. **PREPARATION FOR SHIPMENT**

a) **Roll up**
The mat is wound on a 10.2 cm inside diameter carton tube which shall not protrude beyond either end of the roll, and shall have a length equal to the roll width (+0, -2.5 cm).

The mat shall be so wound that the maximum telescoping (*) of the roll shall not exceed 5 cm. See Owens Corning test method D-10B (copy available upon request).

(*) Telescoping is described as the condition where successive wraps of mat are not perfectly aligned one upon the other bringing about a concave effect on one end of the roll and a convex effect on the other.

b) **Roll diameter**
The rolls are manufactured to an outside diameter of 48 to 56 cm. Each pallet may contain maximum one roll with an outside diameter of 30 to 48 cm.

c) **Continuous length rolls**
All rolls will be continuous, one piece length with no wrap-ins permitted.

d) **Standard packaging method**

Mat widths up to 210 cm.

Six (6) vertical rolls by pallet. The rolls are individually wrapped in polyethylene, the ends are not sealed.

Pallet size: 168 x 112 cm. The load is fixed to the pallet with a stretch film.

Mat widths above 210 cm six (6) horizontal rolls by pallet. The rolls are individually wrapped in polyethelene, the ends are not sealed. Pallet size 205 x 115 cm. The load is fixed to the pallet with steel tube arches.

Labeling
Each roll is identified by a roll label including: product type and code, mass per unit area, width, net roll weight (defects excluded), approximate roll length (defects excluded), weight of the defects, Owens Corning internal identification for traceability (year, day, shift, roll number).

Each pallet is identified by minimum one pallet label including the date and the pallet weight.

8. **STORAGE CONDITIONS**
Unless otherwise specified, it is recommended to store glass fiber products in a cool dry area. Temperature should not exceed 35˚C and the relative humidity should be kept below 75%. Glass fiber products must remain in packaging material until just prior to its use. If these conditions are respected, glass fiber products should not undergo significant changes when stored for extended periods of time.

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359A-AA Roving Designed For Chopping Operations

1. PRODUCT DESCRIPTION

359A-AA roving is a chopper gun roving formed from a collection of continuous glass strands gathered, without mechanical twist, and wound into a cylindrical package. The strands are bonded together with a polyester-compatible silane (359A) size.

This product is produced using Advantex® glass fiber. Advantex® glass fiber combines the electrical and mechanical properties of traditional E glasses with the acid corrosion resistance of E-CR glass. Advantex® meets the requirements stated for both E and E-CR glass in both ISO 2078 and ASTM D578.

359A-AA roving is manufactured in conformity with the following standards: ISO 2797 and DIN 61855.

359A-AA roving is approved by the Lloyd's Register of Shipping and by Det Norske Veritas.

2. APPLICATION

359A-AA gun roving is a general purpose glass fibre reinforcement designed for use in chopper gun depositor systems using polyester laminating resins. It may be used with standard or filled grade resins in a variety of spray-up (chopper gun) equipment. The product is useful in a number of applications including, but not limited to, marine construction, consumer recreation and transportation. Applications versatility of 359A comes from its performance characteristics which include: excellent run-out with minimum static, minimum force requirement for cutting strands clearly (choppability), even & flat dispersion on the mould, rapid wet-out and conformity to commonly used radii without visible springback.

3. AVAILABLE STANDARD

Identification No.	359A-AA
Bare glass linear density (tex)	2400
Available package	N
Package Type	Tubeless
Approx. pkg weight (kg)	22.7

4. PACKAGING, IDENTIFICATION AND PALLETIZATION

For packaging, identification and palletization see packaging standards referenced below:
EPS 7 for Bulk Pack
EPS 8 for Creel-Pak®

® registered trademark of Owens Corning

5. SIGNIFICANT PROPERTIES AND TEST METHODS

Property	Specification			Test Method (1)
	Min	Nominal	Max	
Linear density (tex) (including solids)	2300	2420	2540	TR-RO-01-PP (2)
Loss on ignition (%) (3)	0.94	1.10	1.26	TM-RO-01-PP

1. Available upon request.
2. If one individual linear density result is found outside the specified limits, a recheck shall be made on the same roving ball after having unwound 100m. This recheck result is to be taken into consideration.
3. Moisture has been established at < 0.2%.

6. VISUAL REQUIREMENTS

The roving shall be firmly and evenly wound with uniform lay, equal traverse length and straight package build.

A package that has (inside the build or on its surface) visible grease, oil, dirt or other foreign matter, 3mm or less in diameter is rejectable if the total number of defects exceeds three. A package is also rejectable if it contains one of such defects greater than 3mm in diameter.

7. STORAGE CONDITIONS

Unless otherwise specified, it is recommended to store glass fibre products in a cool dry area. Temperature should not exceed 35˚C and the relative humidity should be kept below 75%. Glass fibre products must remain in packaging material until just prior to its use. If these conditions are respected, glass fibre products should not undergo significant changes when stored for extended periods of time.

The packaging system is designed to allow stacking of two pallets. When stacking two high, care should be taken to correctly and smoothly place the top pallet. Owens Corning is not responsible for any damage resulting from stacking pallets higher than two high.

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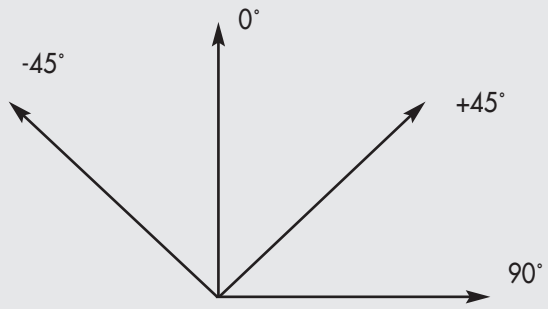
Multiaxial Fabrics

MQ: Quadraxial

DESCRIPTION:

Quadraxial Fabric: This fabric adds directional stability to structures in 0˚ as well as 90˚ axis with additional support in the ±45˚ axis both negative and positive. Often used as a body of structural laminate in hull bottoms. Available in 3 standard weights: 608gm; 856gm and 1202gm. Also available with 225gm chopped strand mat stitched to back of fabric for laminates requiring additional inter-laminate bonding.



KEY FEATURES:

- Offers structural support in four planes.
- Contours and drapes easily.
- Excellent for hull construction.
- Compatible with Epoxy, Vinyl Ester and Polyester resins.

Description	Weight Range
Light weight	608 gm
Heavy weight	856 gm
Super weight	1202 gm

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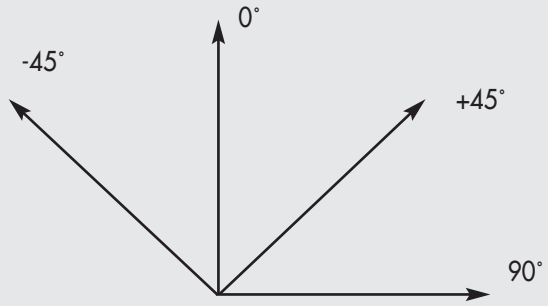
Multiaxial Fabrics

MT: Triaxial (Warp)

DESCRIPTION:

Triaxial Fabric: This fabric has its fibres split into 3 directions one at 0˚ and the other 2 at plus and minus 45˚. The 0˚ orientation is generally approximately 30% of the fibre make-up, but can be 50% of the total make-up. This gives the builder the ability to control the amount of fibre concentration in the area requiring it. This is typically seen in hull structures planked in cedar core where the cedar core has some longitudinal strength and the fibre adds strength across the hull with the 45% fibre adding additional cross bracing.

Available in 754gm and 1152mg. Also with 225gm chopped strand mat stitched to the back of the fabric.



KEY FEATURES:

- Excellent ability to conform too many shapes and cures.
- Commonly used as main component of hull and deck laminates.
- Gives good strength to panels and bulkheads.

Description	Weight Range
Light weight	754 gm
Heavy weight	1152 gm
Super weight	

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Multiaxial Fabrics

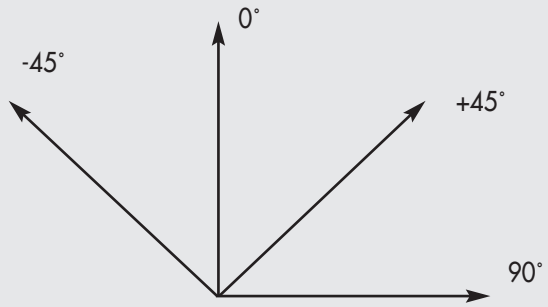
MZ: Triaxial (Weft)

DESCRIPTION:

Triweft Fabric: This fabric is the same as triaxial fabric, with the difference being that in the triaxial fabric, one section of the fibres runs at 90˚. In the Triweft fabric 30-50% of the fibres run at 90˚. This means they run across the roll instead of down the length of the roll in the case of triaxial.

This is handy where narrow hulls are formed such as catamarans or canoe type hulls and they can be sheathed with the Triweft fabric so as to elevate joins in the hull and keeping the 0˚ section of fibre travelling across the hull from side to side. Providing good hoop strength to the hull.

Available in 752gm-1154gm also with chopped strand mat stitched to the back of the fabric for additional bond requirements.



KEY FEATURES:

- Excellent for sheathing narrow hulls in one piece avoiding joins.
- Easily formed into concave and convex shapes.
- Provides good support to main laminates.

Description	Weight Range
Light weight	752 gm
Heavy weight	1152 gm
Super weight	

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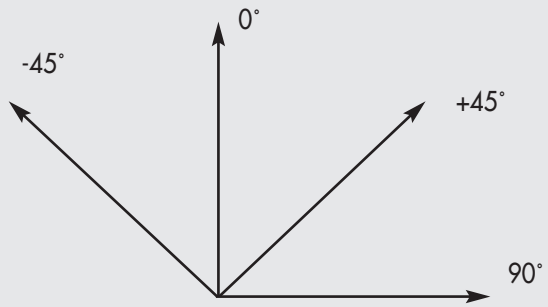
Multiaxial Fabrics

MB: Biaxial

DESCRIPTION:

Biaxial Fabric: This fabric is used in many general laminate applications. This is the modern day woven roving with many improved features such as the two fibre directions which are stitched to each other. Avoiding basket style weave of woven roving. Improving the directional strength of the fibres and improving the cosmetic finish of parts with this product in their laminate as the flat stitching method avoids corrugation print through associated with woven roving laminates.

Available in 450gm; 601gm and 887gm also with 225gm chopped strand mat stitched to the back of fabric.



KEY FEATURES:

- Improves rigidity in rectangle composite panels.
- Excellent contouring for decks cabin tops and flat structures.
- Adds directional strength to laminates with high CSM content.

Description	Weight Range
Light weight	450 gm
Heavy weight	601 gm
Super weight	887 gm

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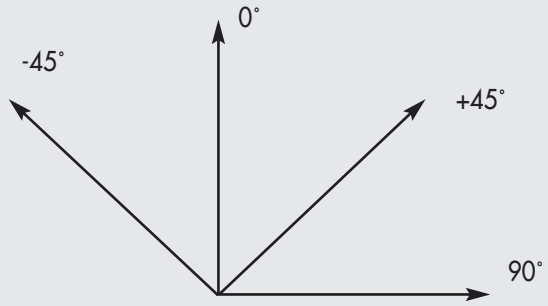
Multiaxial Fabrics

MX: Double Bias

DESCRIPTION:

Double Bias Fabric: Used where complex contours are concave make other fabrics hard to laminate. Also adds good structural support to square composite panels. Often cut into strips for join up of hull and deck and joining of bulkheads to hull and deck. Available with chopped strand mat stitched to back of fabric.

Available in 261gm; 420gm; 611gm and 902gm.



KEY FEATURES:

- Conforms to complex shapes easily.
- Excellent for strip planked structures.
- Excellent for joins and laminates such as bulkheads.
- Add good stability to square shaped composite panels.

Description	Weight Range
Light weight	261 gm
Heavy weight	611 gm
Super weight	902 gm

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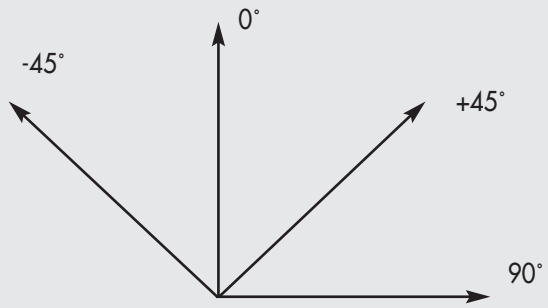
Multiaxial Fabrics

MU: Unidirectional (Warp)

DESCRIPTION:

Unidirectional Fabric: This fabric is used to add directional stability to structures in one specific direction. Fibre is at a 0˚ axis usually heeled together by lightweight stitching at 90˚ to uni fibres. This stitching is not structural. Often used to build up strength in beam type structure such as engine girders and frames such as ring frames or keel girders etc.

Available in 3 standard weights 461gm, 603gm and 882gm. Also available with 225gm chopped strand mat stitched to the back of fabric for additional bonding requirements.



KEY FEATURES:

- Maximise properties in one direction.
- Forms to convex and concave curves easily.
- Compatible with Epoxy, Vinyl Ester and Polyester resins.

Description	Weight Range
Light weight	461 gm
Heavy weight	882 gm

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Kevlar Aramid Fibers

Reinforcing Fibre for Composite Structures
Performance + Safety

• High Strength • High Stiffness • Light Weight • High Impact Resistance/Ductile Failure Behaviour

Kevlar 49 materials are now readily available in Australia through FGI who are the official distributors for Dupont of Kevlar materials to the marine industry.

FGI Offers:

- Wide product range of woven and unidirectional materials from 75 g/m to 460 g/m, plus S-Glass/Kevlar and Carbon/Kevlar hybrids.
- Lowest prices by weaving most styles in Australia.
- Large stocks to ensure maximum availability.
- Technical advice by Professional Engineers aided by the latest computer design techniques.
- Complete product range of all other composite materials (reinforcements, resins, gelcoats, core materials, etc).

Specifications of Kevlar Styles

Style	Weave	Dry Weight (g/m)	Construction (% by wt. of total fabric)	
			0° Direction	90° Direction
KW275	Plain	75	50% Kevlar	50% Kevlar
KW4170	Crowsfoot	170	50% Kevlar	50% Kevlar
KW2170	Plain	170	50% Kevlar	50% Kevlar
KW1300	5-H Satin	300	50% Kevlar	50% Kevlar
KR2460	Basket	460	53% Kevlar	47% Kevlar
KSU5214	Unidir. Hybrid	214	68% Kevlar 29% S-Glass	3% P.E. Thread
CKW3200	Plain Hybrid	200	31% Carbon 19% Kevlar	31% Carbon 19% Kevlar

Typical Properties of Woven Bi-Directional E-Glass & Kevlar* Hand-Laid Laminates

	Kevlar 49	E-Glass
Tensile Strength (MPa)	360	300
Tensile Modulus (GPa)	22	16
Flexural Strength (MPa)	260	300
Flexural Modulus (GPa)	19	15
Density (S.G.)	1.2	1.7
Relative Impact Failure Threshold (Drop ball test on 1.24mm laminates)	2.2	1.0
Relative Energy Required to Cause Total Flexural Failure	2.7	1.0
Relative Deflection of Equal Weight Panel in flex	0.32	1.0

Note: *Actual properties will vary between individual laminators, resins and weave styles. Test laminates should be made for any critical applications.*

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Guide to the Selection of High Performance Reinforcements

Kevlar* Aramid Carbon Fibre S-Glass

1. **INTRODUCTION**

This data sheet outlines the properties and gives some guidelines to the selection and use of these materials. Obtaining the full benefits of these materials requires detailed engineering analysis, and users should consult FGI technical and Professional Engineering staff for recommendations.

2. **DEFINITION OF PROPERTIES**

Throughout this data sheet the performance of laminates utilising these reinforcements are described in terms of their engineering properties. These engineering properties are described below.

2.1 **Tensile/Compressive Strength** – Load to failure of the laminate per unit cross-sectional area under tension/compression in the plane of the laminate.

2.2 **Tensile/Compression Modulus** – Stiffness in the plane of the laminate measured by the load that is theoretically would take to elongate/compress the laminate a unit amount, per unit cross-sectional area.

2.3 **Flexural Strength and Modulus** – A measure of the Composite behaviour in bending. They represent the bending properties of an equivalent homogeneous material of identical thickness.

2.4 **Strain to failure** – Percent elongation/compression of the material at the point of failure.

Note: Theoretically all of the above properties do not depend on the thickness or dimensions of the laminate, but are properties of the materials.

2.5 **Flexural Rigidity** – Apparent resistance of a laminate to deflection in bending under a given load. This is a very dependent on the laminate dimensions and material modulus. For equal modulus, the flexural rigidity is proportional to the thickness cubed (ie for the same material, doubling the thickness gives eight times the flexural rigidity or 1/8 the deflection). Doubling the modulus for the same thickness will give double the flexural rigidity.

2.6 **Neutral Axis** – Under bending, one surface of the laminate is in tension, and the other surface is in compression. Approximately through the centre of the laminate (depending on the stacking order of reinforcements) there is a plane that has no stress, called the neutral axis. The further than any reinforcement is away from the neutral axis, then the more effective it is in contributing to the flexural rigidity of the laminate. Thus the stacking order of reinforcements through the laminate thickness is critical to its behaviour in bending.

3. **PROPERTIES AND PERFORMANCE**

The engineering properties of laminates made of these reinforcements relative to E-Glass are summarised in table 1. Below are some descriptive notes on these properties.

3.1 **Kevlar Aramid** – Kevlar is characterised by high tensile strength and modulus and low density. Although its compressive properties look poor compared to E-glass, the mode of compressive failure needs to be clearly understood, as this gives the material high impact properties.

Kevlar has a ductile failure mode in compression, while all other reinforcements fail catastrophically in compression. In a bending situation (the normal situation for composite structures) Kevlar will show some ductile behaviour (not dissimilar to metals yielding and deforming) caused by the gradual buckling of the fibres on the compression face. Other reinforcements will fail at lower deformations. This ductile failure mode absorbs considerable energy and gives Kevlar very high impact properties. Thus it is a material with a high inbuilt safety factor. At deformations where other reinforcements will have failed totally, Kevlar (although deformed) will still be in one piece and in marine situations, still be able to keep the water out of a boat.

Kevlar is also the lightest material. Comparing the properties on an equal weight basis. Kevlar combines very high performance with build-in safety.

Other properties exhibited by Kevlar include excellent fatigue properties and vibration dampening, giving a quieter ride in marine situations.

FGI have a wide range of Kevlar styles available, to suit most applications. Kevlar can be used with most resin systems, although FGI SP epoxy and

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Guide to the Selection of High Performance Reinforcements (cont.)

SPV vinyl ester resin systems enable the full potential of the fibre to be realised.

3.2 Carbon Fibre

Carbon fibre laminates have high strength and very high modulus characteristics combined with light weight. However, the elongation to failure of the fibre is low (1.2%) giving carbon fibre laminates brittle failure characteristics.

Carbon fibre should be used where strength and modulus combined with light weight are critical, and impact situations are not likely to be encounted. As table 1 shows, the modulus compared to the other materials is very high. The flexural rigidity of a carbon fibre laminate is over four times greater than an E-glass laminate of equal weight.

3.3 S-Glass

S-Glass fibres have the greatest strain to failure (4.5%) and modulus slightly greater than E-Glass. This gives them the potential to have high tensile and flexural strength.

Because S-Glass has a high strain to failure, the full potential of the fibre is only achieved with the correct resin system. Most polyester resins have a strain to failure of 2% or less which would not enable the S-Glass to achieve anything like its strength potential before resin failure leads to early laminate failure. Higher elongation resins such as FGI's SPV vinyl-ester resins should always be used with S-Glass.

The behaviours of S-Glass laminates are characterised by an ability to deflect a long way before failure and to carry a high load, but failure when it occurs will be catastrophic. The high elongation gives high impact resistance. The density is slightly lower than E-Glass.

4. HYBRIDS AND SANDWICH CONSTRUCTION

Two techniques are commonly used to further improve the behaviour of laminates using these materials. These are hybrid and sandwich construction.

Hybrid construction refers to the mixing of two or more different materials in the one laminate. This can be done by using a fabric that consists of several fibre types in the one layer. Alternatively, different material types can be used in different layers.

Some common hybrid combinations and brief description of their applications are:

- Carbon/Kevlar – Used to improve the impact properties of the carbon and the stiffness properties of the Kevlar while maintaining light weight.
- E-Glass/Kevlar – Used to lower cost while maintaining some of the lightweight, strength, stiffness and impact properties of the Kevlar. E-Glass in chopped strand form is often used to aid in interlaminar bonding and to improve water resistance and surface finish on the outer layer of structures.

Sandwich Construction refers to increasing the laminate thickness by bonding high strength skins to a low density core material. This is effective because the thickness, and hence flexural rigidity is greatly increased with a small increase in weight. The high strength skins are moved further from the neutral axis where their contribution to the flexural rigidity is much greater.

There are a wide range of core materials that can be used. Products such as TERMANTO PVC foam are available in a range of configurations, densities and thicknesses and are suitable for most applications.

TABLE 1

RELATIVE PROPERTIES OF TYPICAL WOVEN CLOTH COMPOSITE LAMINATES

	E-Glass	S-Glass	Carbon	Kevlar* Aramid
Tensile Strength	1.0	1.3	1.4	1.3
Tensile Modulus	1.0	1.1	3.0	1.35
Compressive Strength	1.0	1.2	1.4	0.5
Compressive Modulus	1.0	1.1	2.0	0.8
Flexural Strength	1.0	1.3	1.0	0.8
Flexural Modulus	1.0	1.1	2.35	1.1
Density	1.0	0.95	0.8	0.70
Relative deflection of equal weight panel in flex	1.0	0.9	.23	0.32
Fibre Strain to failure	3.5%	4.5%	1.2%	2.5%

Note:

1. Except for fibre strain to failure, all E-Glass properties have been set to 1.0.
2. Comparisons are valid only across rows, not down columns.
3. Actual laminate results are dependent on the style of fabric and the individual laminator. Samples should be tested for all critical applications.