



HexForce[®] and HexPly[®] Aerospace Selector Guide



European version



About HEXCEL

Hexcel is the largest US producer of carbon fibre; the world's largest weaver of structural fabrics; the number one producer of composite materials such as prepregs, film adhesives and honeycomb; and a leading manufacturer of composite parts and structures.

As the most vertically integrated supplier in the industry Hexcel manufactures the full spectrum of advanced material solutions. This means that we can offer enhanced design flexibility and support to our customers worldwide.

Hexcel's research and technology function supports our businesses worldwide with a highly developed expertise in materials science, textiles, process engineering and polymer chemistry.

Hexcel has pioneered the development of prepregs for over 60 years. The HexPly® trademark is renowned in high performance industries.

With in-house weaving capabilities for the manufacture of unidirectional and woven reinforcement fabrics in glass, carbon and aramid fibres and hybrids - all marketed under the HexForce® brand name - Hexcel provides customers with a total package of composite solutions.

Our global technical support team is on hand to assist with material selection, processing, and can provide training to those who are new to composites technology.

Hexcel in Aerospace

Hexcel is a world leader in the manufacture of advanced composite materials for the Commercial Aerospace, Helicopters, Space and Defense markets. From carbon fibres and reinforcement fabrics, through to RTM resins, prepregs, tooling materials and structural parts, Hexcel is present at every stage. Our fibre reinforced composite materials are complemented by our honeycomb technologies which extend from lightweight core materials to aircraft flooring panels, engineered core and Acousti-Cap™ noise dampening systems. Hexcel is the only composites supplier that supplies this wide range of fibre reinforced matrix technologies together with an extensive range of honeycomb, adhesives and engineered products.

The focus of this selector guide is Hexcel's resin matrices and reinforcements for aerospace prepregs.

HexForce® Reinforcements

The aerospace industry relies on Hexcel's woven glass, carbon, aramid and hybrid fibre fabrics for use in advanced composites. Due to the high strength, thermal and electrical insulating properties, and fire resistance of fibre glass and carbon fabrics, today's commercial aircraft industry uses HexForce™ in the design and manufacture of radomes, interior panelling systems, secondary structures (wing-to-body or belly fairing, leading edges, parts and flight control systems), engine and nacelles.

HexPly® Prepregs

Hexcel pioneered the development of composite materials to meet the requirements of early aircraft manufacturers. Ground-breaking projects included the construction of a full scale wing spar in flax fibre reinforced phenol formaldehyde resin for a Bristol "Blenheim" bomber. Weight-saving was a major driver in the exploration and development of these new materials, alongside the need for higher mechanical properties and greater design flexibility.

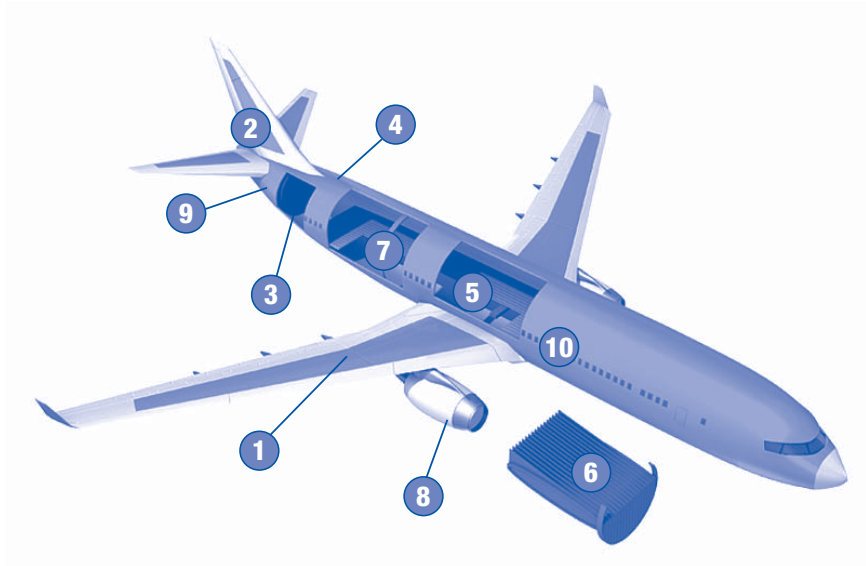
Sixty years on, the aerospace industry remains the greatest consumer of Hexcel prepregs, for civil aircraft, military jets, helicopters, aero-engines or space satellite and launchers. Hexcel's range of resin formulations for aerospace prepregs includes a wide range of epoxies for highly loaded parts and supreme toughness; BMI systems for high temperature performance; phenolics for fire, smoke and toxicity performance in aircraft interiors; and cyanate esters for space structures and satellite applications. HexPly® prepregs are available with HexForce® woven and multiaxial reinforcements, or as unidirectional tapes in various forms.



Civil Aircraft

Hexcel is the preferred supplier of composite materials to the civil aerospace industry, with materials present in virtually every commercial aircraft currently built in the western world.

PRIMARY STRUCTURES



1 Outer wing box

HexPly® UD carbon prepregs

2 VTP and HTP boxes

HexPly® UD prepregs

3 Rear Pressure Bulkhead

HexPly® carbon woven prepregs

HexForce® woven fabrics

4 Fuselage Skin

HexPly® UD carbon prepregs

5 Floor Beams

HexPly® UD carbon prepregs

6 Central Wing Box

HexPly® UD carbon prepregs

7 Fuselage Frame

HexPly® UD/woven carbon prepregs

HexForce® woven fabrics

8 Engine Fan blades

HexPly® woven glass/carbon prepreg

HexPly® UD/woven carbon prepreg

HexForce® woven fabrics

9 Tail Cone

HexPly® UD carbon prepregs slit tape

HexPly® woven prepregs

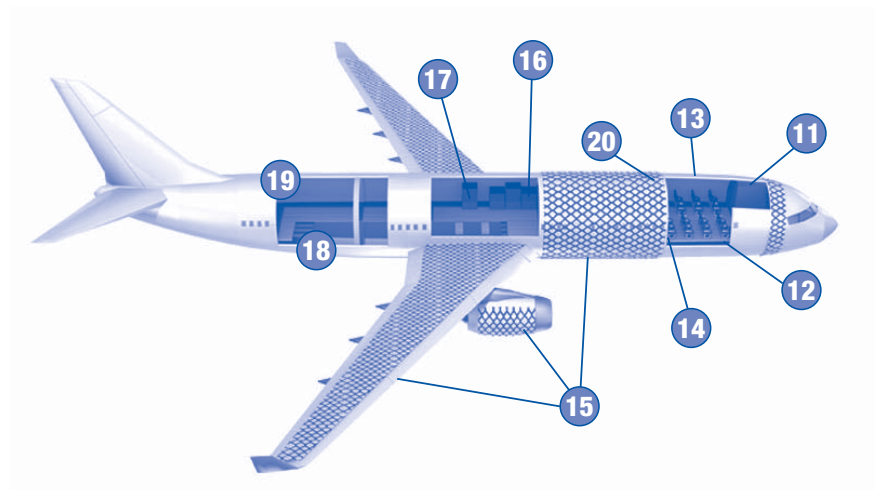
HexForce® woven fabrics

10 Passenger Doors

HexPly® UD/woven carbon/glass prepregs

HexForce® woven fabrics

INTERIORS



11 Galley

HexPly® glass/hybrid woven prepreg

HexForce® woven fabrics

12 Floor Panels

HexPly® UD/woven prepreg

HexForce® woven fabrics

13 Overhead Stowage Bins

HexPly® glass woven prepreg

HexPly® carbon/glass/aramid woven prepreg

HexForce® woven fabrics

14 Wall Partitions

HexPly® glass/hybrid woven prepreg

HexForce® woven fabrics

15 Lightning Strike Protection

HexPly® LS expanded foil or mesh prepreg

HexForce® woven fabrics

16 Lavatory

HexPly® glass woven prepreg

HexForce® woven fabrics

17 Wardrobes

HexPly® glass woven prepreg

HexForce® woven fabrics

18 Ducts

HexPly® glass/hybrid woven prepreg

HexForce® woven fabrics

19 Ceiling Panels

HexPly® glass woven prepreg

HexForce® woven fabrics

20 Sidewalls

HexPly® glass woven prepreg

HexForce® woven fabrics

The drawing is generic, to allow the maximum number of potential applications to be identified.

The drawing is not intended to represent a specific aircraft.

These generic drawings illustrate typical applications for HexForce® fabrics and HexPly® prepreps. For information on the full range of Hexcel products for aerospace (carbon fibres, adhesives, honeycombs, etc) please request a copy of our CD.

SECONDARY STRUCTURES



21 Nose Landing Gear Doors
HexPly® UD/woven carbon/glass
HexForce® woven fabrics

22 Leading Edge/J-Nose
HexPly® woven carbon/glass
HexForce® woven fabrics

23 Winglets
HexPly® woven carbon/glass
HexForce® woven fabrics

24 Trailing Edge Upper and Lower Panels
HexPly® woven carbon/glass
HexForce® woven fabrics

25 Main and Center Landing Gear Doors
HexPly® UD/woven carbon/glass
HexForce® woven fabrics

26 Pylon Fairings and Nacelles
HexPly® woven carbon/glass prepregs
HexForce® woven fabrics

27 Belly Fairing Panels
HexPly® woven carbon/glass or hybrid prepregs
HexForce® woven fabrics

28 Spoilers/Flaps/Ailerons
HexPly® UD carbon prepregs

29 Horizontal Stabilizer Fairings (HTP)
(Leading / Trailing Edges and Tip)
HexPly® woven carbon/glass prepregs
HexForce® woven fabrics

30 Vertical Stabilizer Fairings (VTP)
(Leading / Trailing Edges and Tip)
HexPly® woven carbon/glass prepregs
HexForce® woven fabrics

31 Radome
HexPly® woven glass, hybrid/quartz prepreg
HexForce® woven fabrics

Aero-engines

By the 1970's designers had turned to composites for the weight-savings necessary for the large nacelles required by the new generation of large high power turbofans. Today, engine nacelles and thrust reversers include so many major composite components that carbon fibre epoxy prepregs account for typically half the volume of the entire nacelle structure.

The next step for aero-engine designers has been to apply composites technology to more complex structures within the engine itself.

Defence Aircraft

In their quest for superior performance, defence aircraft designers were the first to experiment with new materials and to demonstrate the effectiveness of composites.

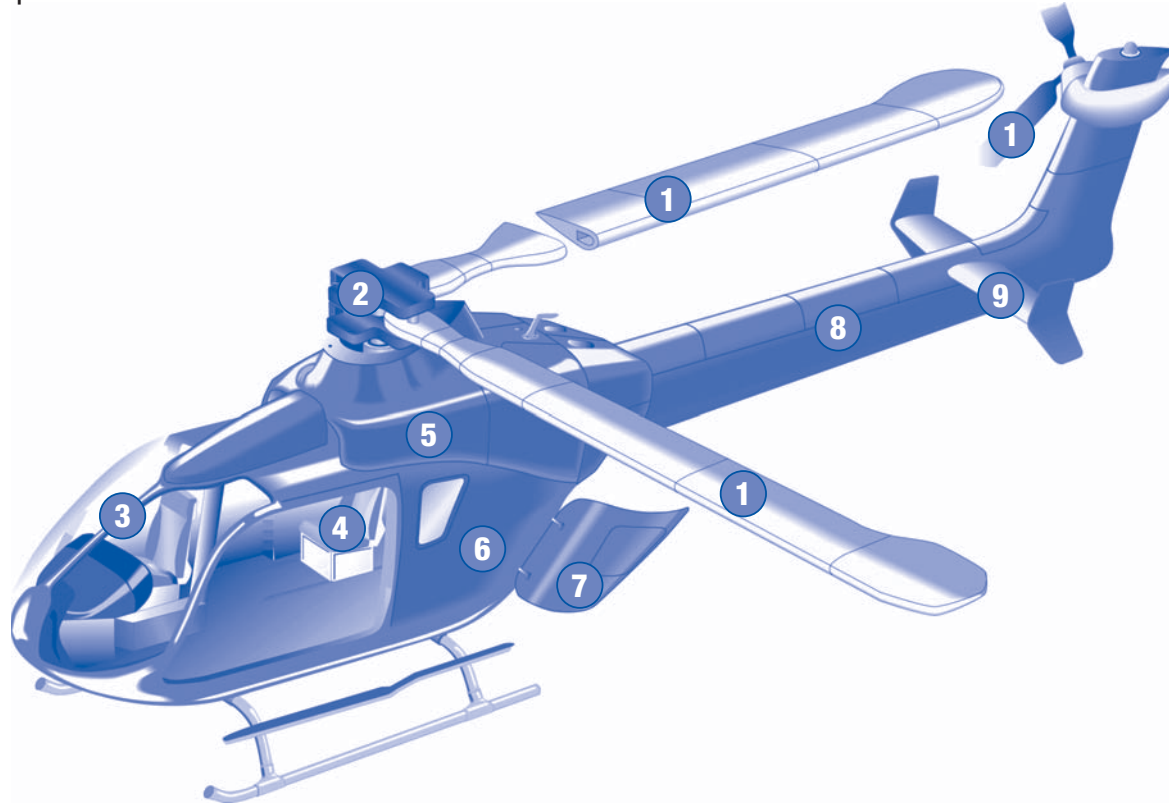
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Helicopters

Both civil and defence helicopters consume large quantities of Hexcel's prepregs, adhesives, honeycombs and engineered core components. Many structural parts are manufactured from prepreg, including the rear beam, fuselage, and main rotor components



1 Blades

HexPly® woven carbon glass prepregs
HexForce® woven fabrics

2 Rotor Hub

HexPly® woven carbon epoxy prepregs
HexForce® woven fabrics

3 Glazing Bars

HexPly® woven carbon epoxy and glass prepregs
HexForce® woven fabrics

4 Interiors

HexPly® woven glass prepregs
HexForce® woven fabrics

5 Engine/Body Fairings

HexPly® woven Epoxy/BMI prepregs
HexForce® woven fabrics

6 Fuselage

HexPly® woven carbon glass prepregs
HexForce® woven fabrics

7 Main and Cargo Doors

HexPly® woven carbon epoxy and glass prepregs
HexForce® woven fabrics

8 Boom and tail section

HexPly® woven carbon epoxy glass and hybrid carbon glass prepregs
HexForce® woven fabrics

9 Horizontal stabilisers

HexPly® woven carbon epoxy, aramid and glass prepregs
HexForce® woven fabrics

Space

Launching satellites into space creates the ultimate performance challenge for composite materials. In addition to the crucial weight savings, the materials also have to withstand extreme temperature fluctuations. The performance requirements can be accommodated by Hexcel's wide range of matrix systems.

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E GLASS FABRICS

HexForce® product data

Weight gsm	Style	Weave	Weight rate		Fibre count		Reinforcement yarn		Standard Width cm	Thickness mm
			Warp	Weft	Warp yarns/cm	Weft picks/cm	Warp	Weft		

BALANCED FABRICS

48	1080	PLAIN	56	44	24	19	EC5 11	EC5 11	110	0.04
105	120	4H SATIN	51	49	24	23	EC5 11X2	EC5 11X2	120	0.08
105	220	4H SATIN	51	49	24	23	EC7 22	EC7 22	120	0.07
200	7628	PLAIN	59	41	17	11.8	EC9 68	EC9 68	127	0.15
202	1035	TWILL 2X2	50	50	14	14	EC9 68	EC9 68	120	0.15
300	1581	8H SATIN	51	49	22	21	EC9 34X2	EC9 34X2	120	0.23
300	7581	8H SATIN	51	49	22	21	EC9 68	EC9 68	127	0.23
300	7781	8H SATIN	53	47	23.6	21	EC6 66	EC6 66	127	0.23

UNIDIRECTIONAL FABRICS

290	1543	UD 4H SATIN	90	10	19	11.8	EC9 68X2	EC7 22	100	0.22
365	1055	UD 5H SATIN	83	13	45	9	EC9 68	EC9 68	120	0.28

Other styles available on demand

Thickness : Theoretical thickness of a cured ply with 50% fiber volume content.



FINISH FOR E GLASS FABRICS

HexForce® product data

Matrix	Description	EPOXY	POLYESTER	VINYLESTER	PHENOLIC
Finish					
Z 6040	Epoxy Silanne				
TF 970	Amino silanne				
A 1100	Amino silanne				

Options	Advantages	Compability
EPOXY POWDERING POLYESTER POWDERING	PREFORMING/STABILIZATION PREFORMING/STABILIZATION	EPOXY POLYESTER



SPECIALITIES

HexForce® product data

Weight gsm	Style	Weave	Weight rate		Fibre count		Reinforcement yarn		Standard Width cm	Thickness mm
			Warp	Weft	Warp yarns/cm	Weft picks/cm	Warp	Weft		

GLASS FABRICS

193	6580	8H SATIN	50	50	28.3	28.3	S-2 34	S-2 34	127	0.15
305	6781	8H SATIN	50	50	22.5	22.5	S-2 68	S-2 68	127	0.23

QUARTZ FABRICS

178	21237	TWILL 2X2	55	45	19.2	15.8	SI C14 80 DIOLLEN 280	SI C14 80 DIOLLEN 280	96.5	0.09
265	593	5H SATIN	50	50	19.5	19.5	SI C9 67	SI C9 67	110	0.2
292	581	8H SATIN	50	50	21	21	SI C9 67	SI C9 67	96.5	0.22
300	595	TWILL 2X2	50	50	9.2	9.2	SI C14 80X2	SI C14 80X2	100	0.22



ARAMID FABRICS

HexForce® product data

Weight gsm	Style	Tracers		Weave	Weight rate		Fibre count		Reinforcement yarn		Standard Width cm	Thickness mm	Scoured
		Y	N		Warp	Weft	Warp yarns/cm	Weft picks/cm	Warp	Weft			

ARAMID BALANCED FABRICS

60	20796	X	X	PLAIN	50	50	13.5	13.5	HM 215	HM 215	120	0.07	X
120	21226		X	5H SATIN	50	50	14	14	HM 420	HM 420	120	0.15	X
166	21263	X		8H SATIN	50	50	19.2	19.2	HM 420	HM 420	120	0.2	X
175	20914	X	X	4H SATIN	51	49	6.7	6.5	HM 1270	HM 1270	120	0.2	X

Y : with tracers - N : no tracers



HS CARBON FABRICS

HexForce® product data

Weight gsm	Style	Weave	Weight rate		Fibre count		Reinforcement yarn		Standard Width cm	Thickness mm
			Warp	Weft	Warp yarns/cm	Weft picks/cm	Warp	Weft		

BALANCED FABRICS - HIGH STRENGTH FIBRES

98	G0801	PLAIN	50	50	7.4	7.4	1K HR	1K HR	102	0.1
130	G0806	PLAIN	50	50	10	10	1K HR	1K HR	100	0.13
193	G0814/G0904/43193	PLAIN	51	49	4.9	4.8	3K HR	3K HR	100/107/127	0.2
193	43195	TWILL 2X2	51	49	4.9	4.8	3K HR	3K HR	127	0.2
220	G0939/G0802	4H SATIN	50	50	5.5	5.5	3K HR	3K HR	100/120/126	0.23
280	G0833/G0933/43280	5H SATIN	50	50	6.8	6.8	3K HR	3K HR	100/150	0.29
285	G0803/G0963	5H SATIN	50	50	7.2	7.2	3K HR	3K HR	120	0.29
286	G0986	TWILL 2X2	50	50	3.5	3.5	6K HR	6K HR	120	0.29
300	48302	TWILL 2X2	50	50	1.8	1.8	12K HR	12K HR	120	0.3
365	43364	8H SATIN	51	49	9.3	9.2	3K HR	3K HR	107/127	0.37
370	43370	8H SATIN	50	50	9.5	9.2	3K HR	3K HR	107/127	0.37
370	G0926	5H SATIN	50	50	4.6	4.6	6K HR	6K HR	104/130	0.38
400	48400	PLAIN	50	50	2.5	2.5	12K HR	12K HR	120	0.41
600	48600	PLAIN	50	50	3.7	3.7	12K HR	12K HR	100	0.62

UNIDIRECTIONAL FABRICS - HIGH STRENGTH FIBRES

160	G0827/G0947	UD PLAIN	97	3	7.9	4	3K HR	EC5 5.5X2	104	0.16
170	42165	UD PLAIN	98	2	8.1	4	3K HR	EC5 5.5X2	90	0.17
290	G1157	UD PLAIN	96	4	6.7	3	6K HR	EC9 34	130	0.31
300	48330	UD PLAIN	96	4	4	4	12K HR	EC9 34	100	0.31



IM-HM CARBON FABRICS

HexForce® product data

Weight gsm	Style	Weave	Weight rate		Fibre count		Reinforcement yarn		Standard Width cm	Thickness mm
			Warp	Weft	Warp yarns/cm	Weft picks/cm	Warp	Weft		

HIGH MODULUS FIBRES

90	43090	UD PLAIN	50	50	4.5	4.5	M60JB 3K	M60JB 3K	46	0.1
195	G0969	UD PLAIN	89	11	8	3	M55J 6K	HR 1K	42	0.21



CARBON - GLASS HYBRID FABRICS

HexForce® product data

Weight gsm	Style	Weave	Weight rate		Fibre count		Reinforcement yarn		Standard Width cm	Thickness mm
			Warp	Weft	Warp yarns/cm	Weft picks/cm	Warp	Weft		
135	G1088	TWILL 2X2	16-34	16-34	3.2/13.3	3.2/6.7	1KHR/EC9 34	1KHR/EC9 68	120	0.12
170	43596	PLAIN			1.4/8.4	1.4/8.4	3KHR/EC9 68	3KHR/EC9 68	120	0.17
170	G0874	PLAIN	16-34	16-34	1.4/4.5	1.4/4.5	3KHR/ET9 68X2	3KHR/ET9 68X2	120	0.17
178	G0973/G1081	TWILL 2X2	25-18-7	25-18-7	2X(2.2/4.7/2.2)		2X(3KHR/PE/ET9 68)		120	0.18
185	G1177	TWILL 2X2	25-25	25-25	2.2/6.7	2.2/6.7	3KHR/EC9 68	3KHR/EC9 68	120	0.18
270	43743	TWILL 3X2	21-29	21-29	2.9/11.5	2.9/11.5	3KHR/EC9 68	3KHR/EC9 68	120	0.24



CARBON - ARAMID HYBRID FABRICS

HexForce® product data

Weight gsm	Style	Weave	Weight rate		Fibre count		Reinforcement yarn		Standard Width cm	Thickness mm
			Warp	Weft	Warp yarns/cm	Weft picks/cm	Warp	Weft		
210	73210	TWILL 2X2	22-28	22-28	2.2	2.2	3K HR	3K HR	122	0.24
					4.4	4.4	AR HM 1270	AR HM 1270		



PEEL PLY

HexForce® product data

Weight gsm	Style	Finish DP	Weave	Weight rate		Fibre count		Reinforcement yarn		Standard Width cm	Thickness mm
				Warp	Weft	Warp yarns/cm	Weft picks/cm	Warp	Weft		

POLYAMID FABRICS

95	BI9760 BLANC/WHITE	X	PLAIN	50	50	19	19	PA66 235	PA66 235	150	0.07
95	BI9760 ROSE/PINK	X	PLAIN	50	50	19	19	PA66 235	PA66 235	150	0.07
105	T0089		PLAIN	52	48	22	20	PA66 235	PA66 235	147	0.08
105	T0098		PLAIN	54	46	22	18.5	PA66 235	PA66 235	147	0.08

POLYESTER FABRICS

90	BI9842	X	PLAIN	51	49	28	28	HT 144	HT 144	160	0.07
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DP : heat treated - preformed (on request)



POWDERING

HexForce® product data

Ref	Compatibility	Storage at Room Temperature	Preforming	Applicable for	Temperature of injection	Curing Temperature of Resin System
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POWDERING

E01	EPOXY	1 YEAR	100°C - 20 MN UNDER VACUM	RTM/LRI	NO RESTRICTION	ANY
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HexPly® Prepreg Matrices for Aerospace

HexPly® Resin System	Dry Tg Onset (DMA) °C (°F)	Typical Cure Cycle		Cure Process		Flow		Outlife at room temperature days	Storage at -18°C (0°F) months	Standard Prepreg Forms
		Temp °C (°F)	Time (mins)	Autoclave/ Press	Vacuum Only	Controlled	High			
EPOXIES										
M26T	105 (220)	125 (255)	90	X	X	X		30	12	UD TAPE/FABRIC
M35-4	140 (285)	135 (275)	90	X		X		60	12	UD TAPE/FABRIC
M76	130 (265)	135 (275)	180	X		X		21	12	UD TAPE/FABRIC
913	150 (300)	125 (255)	60	X		X		30	12	UD TAPE/FABRIC
M20	150 (300)	130 (265)	120	X	X	X		30	12	UD TAPE/FABRIC
8551-7	155 (315)	180 (350)	120	X	X	X		30	12	UD TAPE /FABRIC/ TOWPREG/SLIT TAPE
F593	172 (342)	180 (350)	120	X	X	X		17	12	UD TAPE/FABRIC
M21	190 (375)	180 (350)	120	X		X		20	12	UD TAPE/FABRIC
8552	195 (385)	180 (350)	120	X	X	X		30	12	UD TAPE /FABRIC/ TOWPREG/SLIT TAPE
M18	200 (390)	180 (350)	120	X		X		30	12	UD TAPE/ FABRIC/TOWPREG
M18/1	200 (390)	180 (350)	120	X		X		30	12	FABRIC
922-1	210 (410)	180 (350)		X				10	12	UD TAPE/FABRIC
PHENOLICS										
HT93	[80 (175) IN SERVICE]	125 (255)	120	X		X		30	14	FABRIC
200	200 (390) IN SERVICE]	150 (300)	30	X		X		30	12	FABRIC
M25T	[80 (175) IN SERVICE]	140 (285)	60	X	X	X		21	12	FABRIC
BMI										
M65	300 (572)	191 (375)	240	X		X		12		UD TAPE/FABRIC
CYANATES										
996	165 (330)	180 (350)	120	X			X	14	6	UD TAPE/FABRIC
954-3	205 (400)	180 (350)	120	X			X	14	12	UD TAPE/FABRIC

HexPly® product data

Attributes	Typical Applications	Commercial Aircraft	Interiors	Helicopters	Military Jets	Nacelles Engines	Space	UAV's
self adhesive	floor panels / fairings / sandwich structures	X		X				
flexible curing matrix, tg of 200°C after post-cure, high toughness	UAV'S							X
high toughness, self adhesive, flexible cure	space applications						X	
versatile system with high environmental resistance	structural components / fairings / helicopter blades	X	X	X				
high temperature performance from low temperature cure	composite repair	X						
extreme damage resistance, very high toughness	structural components/engine parts/fan blades	X				X		
self adhesive, good sandwich panel and laminate properties	secondary structures	X						
preferred product for aerospace structures. high toughness and excellent translation of IM fibre	primary structures	X				X		
preferred product for aerospace structures. toughened system.	structural parts	X		X	X	X		
low moisture uptake	space applications						X	
self extinguishing. very high temperature wet performance.	helicopter structural parts			X				
high service temperature	engine / nacelle structures	X				X		

low FST	aircraft interior panels / partitions		X					
low FST, excellent ablative properties	fire proof panels & components		X					
low FST, excellent ablative properties	fire proof panels & components		X					

high temperature, resistant BMI system	parts subjected to very high temperatures	X		X	X	X		
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low water pick up	space and satellite applications						X	
low water pick up	space and satellite applications						X	

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