



Aerospace Selector Guide

-  HexPly® Prepregs
-  HexFlow® & HiFlow® Resins
-  HexForce® Reinforcements
-  HexBond® Adhesives

Hexcel in Aerospace

Hexcel is a world leader in manufacturing advanced lightweight composite materials for the Commercial Aerospace and Space & Defense markets. From carbon fibers and reinforcement fabrics, to RTM resins, prepgs, tooling materials and structural parts, Hexcel is present at every stage. Our fiber-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 fiber 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, direct processes and reinforcements for aerospace prepgs

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 fiber reinforced phenol formaldehyde resin for a Bristol "Blenheim" bomber. Lightweighting was a major driver in the exploration and development of these new materials, alongside the need for higher mechanical properties and greater design flexibility.

The aerospace industry remains the greatest consumer of Hexcel prepgs, for civil aircraft, military jets, helicopters, aero-engines or space satellite and launchers. Hexcel's range of resin formulations for aerospace prepgs 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® prepgs are available with HexForce® woven and multiaxial reinforcements, or as unidirectional tapes in various forms.

HexFlow® & HiFlow® Liquid Resins

Hexcel is a global leader in providing composite solutions for aerospace and other high performance applications. Hexcel pioneered the development of resin formulations for composites and is the premier worldwide supplier of prepgs, RTM and RFI systems. Hexcel is also a major manufacturer of carbon fiber and a leader in reinforcement fabrics and non-wovens for composites. Our unrivaled integrated product range means that Hexcel is the composite specialist.

Direct processes, covering a wide variety of techniques to combine resin and reinforcement, including RTM VaRTM and RFI, are the focus of this brochure which complements Hexcel's prepg technology manual.

HexForce® Reinforcements

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

PrimeTex® Reinforcements

PrimeTex® is a range of carbon fabrics processed for a smooth, closed weave and uniform cosmetic appearance. The filaments in each tow are spread out, creating a thinner and more closely woven fabric, providing better mechanical properties and less porosity in a composite. PrimeTex® fabrics can also lower the mass in a structure when lighter weight is a key requirement.

PrimeTex® gives a clear visual benefit to the finished product, enhances the mechanical properties in a laminate and allows high K tow fibers to be used, for the lowest areal weight. The PrimeTex® range is available with HR, IM and HM fiber, from 3K up to 24K.

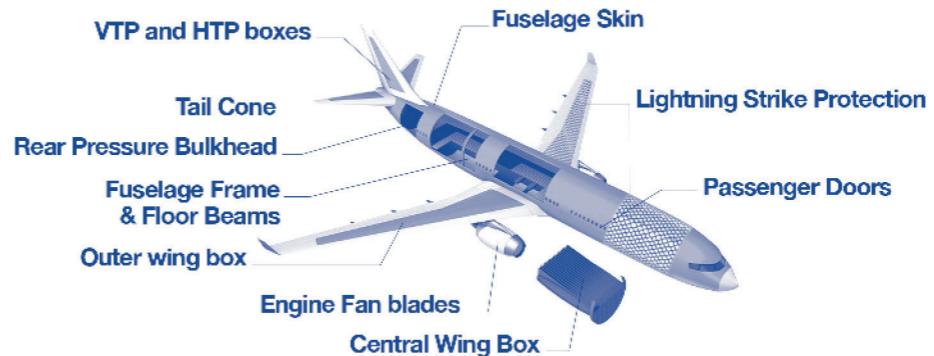
HexBond® Adhesives

Hexcel [HexBond® adhesives](#) have been used in the composites industry for more than 70 years. They have achieved worldwide acclaim for aerospace and industrial bonding. HexBond® adhesives are an efficient method for joining component pieces quickly and easily. Hexcel manufactures a wide range of film adhesives, foaming films, primers and liquid shims for metal-to-metal and composite bonding.

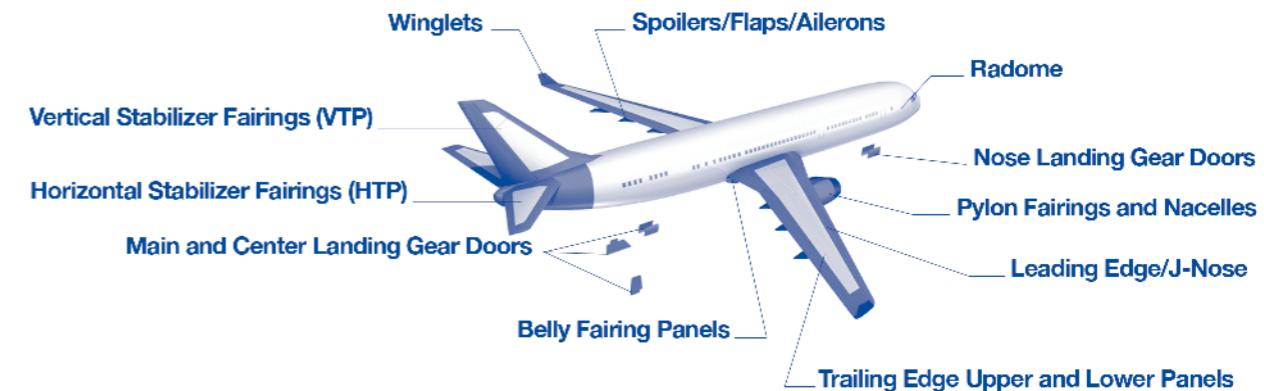
Civil Aircraft

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. Several commercial aircraft are more than 50% carbon fiber composite. Hexcel is a major supplier of materials to those programs.

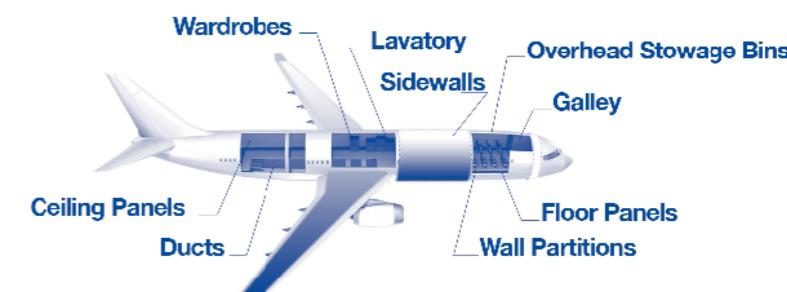
Primary Structures



Secondary Structures



Interiors



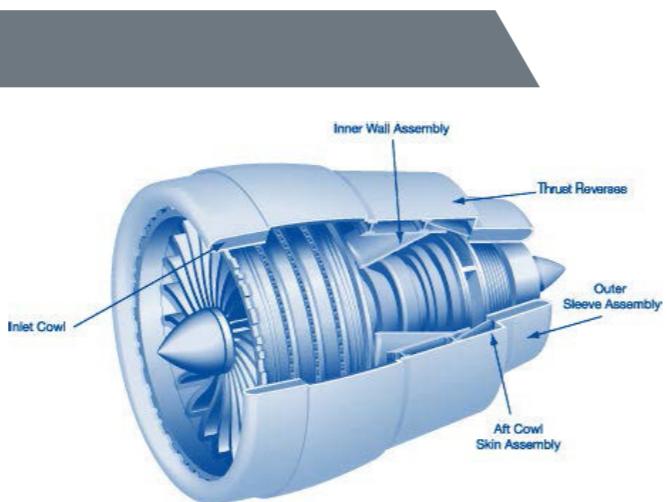
The drawings are generic, to allow the maximum number of potential applications to be identified.

The drawings are not intended to represent a specific aircraft.

These generic drawings illustrate typical applications for HexForce® fabrics, HexPly® prepgs and HexFlow® Liquid Resins. For information on the full range of Hexcel products for aerospace (carbon fibers, adhesives, honeycomb, etc.), please request a copy of our CD.

Aero-engines

By the 1970s, 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 fiber epoxy prepgs 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.



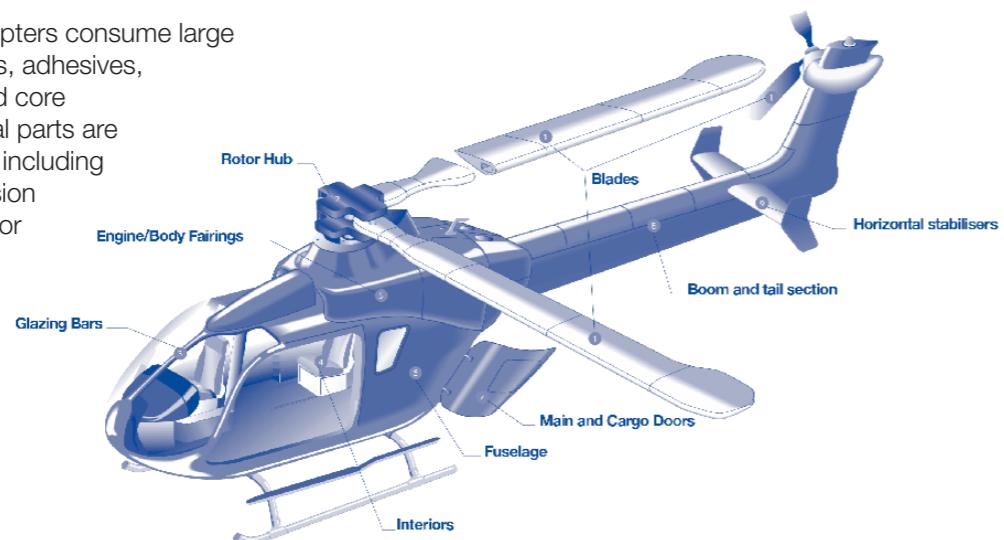
Defense Aircraft

The defense market has historically been an innovator in the use of, and source of significant demand for, adhesives and composites and Hexcel is currently qualified to supply materials to a broad range of more than 100 military aircraft and rotorcraft programs.

Helicopters

Both civil and defense helicopters consume large quantities of Hexcel prepgs, adhesives, honeycombs and engineered core components. Many structural parts are manufactured from prepg, including the rear beam, the transmission shaft, fuselage, and main rotor components.

Hexcel materials are also heavily used in UAV/AAM applications. Refer to the [Hexcel UAV brochure](#) for more information



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.

The drawings are generic, to allow the maximum number of potential applications to be identified.

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Index

HexPly® Prepgs

pg. 6-7

- Epoxies
- Phenolics
- BMI
- Cyanates

HexFlow® HiFlow® Liquid Resins

pg. 6-7

- Epoxies
- BMI

HexForce® Fabrics

pg. 8-9

- HS Carbon Fabrics
- IM HM UHM Carbon Fabrics
- Injectex Fabrics
- Carbon- Glass Hybrid Fabrics
- Aramid Fabrics
- Quartz Fabrics
- Peel Ply
- E and S-2 Glass Fabrics
- Finish For E and S-2 Glass Fabrics
- Powdering

pg. 10-11

pg. 12-13

HexPly® Resin System	Dry TG Onset (DMA) °C (°F)	Typical Cure Cycle		Cure Process		Flow		Outlife at Room Temperature	Storage at -18°C (0°F) months	Standard Prepreg Forms	HexPly® Resin System	Attributes	Typical Applications	Commercial Aircraft	Interiors	Helicopters	Military Jets	Nacelles Engines	Space	UAVs
		Temp °C (°F)	Time (mins)	Autoclave/Press	OoA	Controlled	High													
Epoxies																				
M26T	105 (220)	125 (255)	90	X		X		30	12	Fabric	M26T	self adhesive, self extinguishing	fairings / sandwich structures	X	X					
M59	125 (257)	120 (248)	90	X		X		30	12	Fabric/Towpreg, Metallic	M59	high toughness, self adhesive, flexible cure	structural components / fairings	X						X
913	150 (300)	125 (255)	60	X		X		30	12	UD Tape/Fabric/Towpreg, Metallic	913	versatile system with high environmental resistance	structural components / fairings / helicopter blades	X	X					X
M92	160 (320)	125 (255)	90	X		X		60	12	UD Tape/Fabric/Towpreg, Metallic	M92	self adhesive, self extinguishing versatile system with high environmental resistance	fairings / sandwich structures structural components	X	X	X				
M20	150 (300)	130 (265)	120	X	X	X		42	12	UD Tape/Fabric	M20	high temperature performance from low temperature cure	composite repair	X		X				
M91	185-190	180 (350)	120	X		X		42	12	UD Tape/Slit Tape	M91	latest product for aerospace structure and aero-engine, excellent toughness with very high residual compression strength after impact	Aircraft and aero-engine primary structure	X			X			
M21	190 (375)	180 (350)	120	X		X		30	12	UD Tape/Fabric/Slit Tape, Metallic	M21	preferred product for aerospace structures. high toughness and excellent translation of IM fiber	primary structures	X			X			
8552	195 (385)	180 (350)	120	X		X		30	12	UD Tape/Fabric/Towpreg/Slit Tape, Metallic	8552	preferred product for aerospace structures.	structural parts	X	X	X	X	X	X	
M51	170	180 (350)	40	X		X		21	12	UP Tape/Fabric	M51	Rapid curing system designed for press curing technologies with primary structure performances	primary structures	X	X	X	X	X	X	X
M56	198	180 (350)	120	X	X	X		35	12	UD Tape/Fabric/Slit Tape, Metallic	M56	M56 high temperature performance from Out of the autoclave cure, low density	primary and secondary structures out of autoclave	X			X	X	X	X
M18	200 (390)	180 (350)	120	X		X		30	12	UD Tape/Fabric/Towpreg	M18	low moisture uptake, low density	space applications							X
M42	193 (379)	180 (356)	120	X		X		18	12	Fabric/Towpreg	M42	high toughness, self extinguishing, self adhesive, very high temperature wet performance.	structural components / fairings	X	X	X				
Phenolics																				
HT93	80 (175) in Service	125 (255)	120	X		X		30	14	Fabric	HT93	low FST	aircraft interior panels / partitions		X					
200	200 (390)	150 (300)	30	X		X		30	12	Fabric	200	low FST, excellent ablative properties	fire proof panels & components		X					
BMI																				
M65	300 (572)	191 (375)	240 (1)	X		X		30	12	UD Tape/Fabric/Slit Tape	M65	high temperature, resistant BMI system	parts subjected to very high temperatures	X	X	X	X			
F655	290 (550)	191 (375)	240 (1)	X		X		30	12	UD Tape/Fabric	F655	high temperature	primary / secondary structures, engine components toughened	X			X			
Cyanates																				
996*	165 (330)	180 (350)	120	X		X		14	6	UD Tape/Fabric	996*	low water pick up	space and satellite applications							X
954-2A	205 (400)	180 (350)	120	X		X		14	12	UD Tape/Fabric	954-2A	low water pick up, controlled flow	space and satellite applications							X
954-3	205 (400)	180 (350)	120	X		X		14	12	UD Tape/Fabric	954-3	low water pick up	space and satellite applications							X
954-6*	150 (300)	121 (250)	180	X		X		14	12	UD Tape/Fabric	954-6*	low water pick up	space and satellite applications							X

HexFlow® & HiFlow® Resin System	DRY TG ONSET (DMA) °C (°F)	Typical Cure Cycle		Molding Process			HexPly® Resin System	Outlife at RT	Storage Conditions	Transport Restrictions	Product Form
		Temp °C (°F)	Time (mins)	RTM	Infusion	HP-RTM					
Epoxies											
RTM6	200°C	180°C	90	X	X		RTM6	15 days at 23°C	9 months -18°C	UN4.1	Mono-component
RTM6-2	200°C	180°C	45	X	X	X	RTM6-2	365 days at 23°C	365 days at 23°C	Standard Restrictions	Bi-component
RTM200	130°C	130°C	60	X	X	X	RTM200	365 days at 23°C	365 days at 23°C	Standard Restrictions	Bi-component
RTM 230ST	160°C	180°C	120	X			RTM 230ST	30 days at 23 ± 5 °C	12 months -18°C	Standard Restrictions	Mono-component
RTM 250ST	170°C	180°C	120	X			RTM 250ST	30 days at 23 ± 5 °C	12 months -18°C	Standard Restrictions	Mono-component
1078-1	200°C	180°C	120	X	X	X	1078-1	365 days at 23°C	365 days at 23°C	Standard Restrictions	Bi-component
HF610F-2	190°C	180°C	30	X		X	HF610F-2	365 days at 23°C	365 days at 23°C	Standard Restrictions	Bi-component
HF640F-2	190	180	15	X		X	HF640F-2	365 days at 23°C	365 days at 23°C	Standard Restrictions	Bi-component
BMI											
RTM 65	260°C	190°C +6H 230°C	6 hours	X			RTM 65		12 months -18°C	Standard Restrictions	Mono-component

*Available in US only

Weight		Style		Weave	PrimeTex® Option	Weight Rate		Fiber Count		Reinforcement Yarn		Thickness
gsm	oz/yd ²	EU	US			warp %	weft	warp (yarns/cm)	weft (picks/cm)	warp	weft	
Balanced Fabrics - High Strength Fibers												
84	2.48		84	PLAIN		50	50	6.3	6.3	HS 1K	HS 1K	0.09
98	2.89	G0801		PLAIN		50	50	7.4	7.4	HS 1K	HS 1K	0.10
98	2.89	43098		PLAIN	X	50	50	2.3	2.3	HS 3K	HS 3K	0.09
130	3.83	G0806	130	PLAIN		50	50	10	10	HS 1K	HS 1K	0.13
193	5.69	G0814/G0904/43193	282/AGP193	PLAIN	X	51	49	4.9	4.8	HS 3K	HS 3K	0.20
193	5.69		XAGP282P	BIAS PW		51	49	4.9	4.8	HS 3K	HS 3K	0.20
193	5.69	43195	284	TWILL 2X2	X	51	49	4.9	4.8	HS 3K	HS 3K	0.20
220	6.49	G0939/G0802		4 H SATIN		50	50	5.5	5.5	HS 3K	HS 3K	0.22
220	6.49	48221		PLAIN	X	50	50	1.35	1.35	HS12K	HS12K	0.22
280	8.26	G0833/G0933/43280	AGP 280	5H SATIN		50	50	7.0	7.0	HS 3K	HS 3K	0.29
285	8.41	G0803/G0963	433	5H SATIN		50	50	7.2	7.2	HS 3K	HS 3K	0.29
285	8.41	48286		TWILL 2X2	X	50	50	1.8	1.8	HS12K	HS12K	0.29
286	8.44	G0986	463	TWILL 2X2	X	50	50	3.5	3.5	HS 6K	HS 6K	0.29
300	8.85	48302		TWILL 2X2	X	50	50	1.8	1.8	HS 12K	HS 12K	0.30
370	10.91	43364/43370	584	8H SATIN		50	50	9.3	9.3	HS 3K	HS 3K	0.37
370	10.91	G0926/46364	613	5H SATIN		50	50	4.6	4.6	HS 6K	HS 6K	0.37

PrimeTex® is a range of carbon fabrics that have been processed for a smooth, closed weave and enhanced uniform appearance: fiber tows are flatly woven and spread in both warp and weft directions. Hexcel supplies PrimeTex® fabrics with the physical properties mentioned in the technical datasheet.

Unidirectional Fabrics - High Strength Fibers

Powdering												
160	4.72	G0827/G0947		UD PLAIN		97	3	7.9	4	HS 3K	EC5 5.5x2	0.16
170	5.01	42165		UD PLAIN		98	2	8.1	4	HS 3K	EC5 5.5x2	0.17
300 --> 326	8.85	48330		UD PLAIN		96	4	4	4	HS 12K	EC9 34	0.31

Intermediate Modulus Fibers

PrimeTex® Option												
98	2.89	46098		PLAIN	X	50	50	2.2	2.2	IM7 6K	IM7 6K	0.10
193	5.69	46195		TWILL 2X2	X	50	50	4.3	4.3	IM7 6K	IM7 6K	0.20
196	5.78		XSGP196 P	PLAIN		50	50	4.3	4.3	IM7 6K	IM7 6K	0.20
203	5.99		SGP203CS	CROW FOOT		50	50	4.5	4.5	IM7 6K	IM7 6K	0.23
203	5.99		XC1400	BIAS CROWFOOT		50	50	4.5	4.5	IM7 6K	IM7 6K	0.23
370	10.91	46370	SGP3708H	8H SATIN		50	50	8.1	8.1	IM7 6K	IM7 6K	0.37

High Modulus Fibers

150	4.42	48152Y		TWILL 2x2	X	50	50	1.7	1.7	HM63 12K	HM63 12K	0.15
200	5.99	48200		TWILL 2X2	X	50	50	2.35	2.35	HM63 12K	HM63 12K	0.20
285	8.41	48287		5H SATIN	X	50	50	3.35	3.35	HM63 12K	HM63 12K	0.28

Ultra High Modulus Fibers

90	2.68	43090		PLAIN	X	50	50	4.5	4.5	M60JB 3K	M60JB 3K	0.10
150	4.42	46150		PLAIN		50	50	4.5	4.5	M55JB 6K	M55JB 6K	0.15
195	5.75	G0969		UD PLAIN		89	11	8	3	M55JB 6K	HS 1K	0.21

Carbon AS Fibers

Powdering												
200	5.90	GB201/GB200		PLAIN	X	50	50	4.7	4.7	HS 3K	HS 3K	0.20
286	8.44	G0986	463	TWILL 2X2	X	50	50	3.5	3.5	HS 6K	HS 6K	0.29
290	8.55	G1157		UD PLAIN	X	96	4	6.7	3	HS 6K	EC9 34	0.31
370	10.91	G0926	613	5H SATIN	X	50	50	4.6	4.6	HS 6K	HS 6K	0.38
600	17.70	G1151		FORMABLE	X	50	50	7.4	7.4	HS 6K	HS 6K	0.60

Weight		Style	Weave	Weight Rate		Fiber Count		Reinforcement Yarn		Thickness
gsm	oz/yd ²			warp %	weft	warp (yarns/cm)	weft (picks/cm)	warp	weft	
Balanced Fabrics - High Strength Fibers										
135	3.98	G1088	TWILL 2X2	16-34	16-34	3.2/13.3	3.2/6.7	HS 1K/EC9 34	HS 1K/EC9 68	0.12
170	5.01	G0874	PLAIN	16-34	16-34	1.4/4.5	1.4/4.5	HS 3K/ET9 68x2	HS 3K/ET9 68x2	0.17
170	5.01	43596	PLAIN	16-34	16-34	1.4/8.4	1.4/8.4	HS 3K/EC9 68	HS 3K/EC9 68	0.15
178	5.25	G0973/G1081	TWILL 2X2	25/18/7	25/18/7	2x(2.2/4.7/2.2)		2x(HS 3K/PE/ET9 68)		0.18
158	5.45	G1177	TWILL 2X2	23-27	23-27	2.2/6.7	2.2/6.7	HS 3K/EC9 68	HS 3K/EC9 68	0.19
270	7.96	43743	TWILL 2X2	21-29	21-29	2.9/11.5	2.2/11.5	HS 3K/EC9 68	HS 3K/EC9 68	0.24

Weight		Style		Weave	Weight Rate		Fiber Count		Reinforcement Yarn		Thickness
gsm	oz/yd ²	EU	US		warp %	weft	warp (yarns/cm)	weft (picks/cm)	warp	weft	
Aramid Balanced Fabrics											
60	1.77	20796	350(AMS120)	PLAIN	50	50	13.5	13.5	HM 215	HM 215	0.07
120	3.54	21226		5H SATIN	50	50	14	14	HM 405	HM 405	0.15
166	4.90	21263	348	8H SATIN	50	50	19.2	19.2	HM 405	HM 405	0.20
175	5.16	20914	353(AMS 285)	4H SATIN	51	49	6.7	6.5	HM 1270	HM 1270	0.20

Weight		Style	Weave	Weight Rate		Fiber Count		Reinforcement Yarn		Thickness
gsm	oz/yd ²			warp %	weft	warp (yarns/cm)	weft (picks/cm)	warp	weft	
Balanced Fabrics										
145	4.28	610	LENO	52	48	11.2	10.5	SI C9 67	SI C9 67	0.11
265	7.82	593	5H SATIN	50	50	19.5	19.5	SI C9 67	SI C9 67	0.20
292	8.61	581	8H SATIN	50	50	21	21	SI C9 67	SI C9 67	0.22
300	8.85	595	TWILL 2X2	50	50	9.2	9.2	SI C14 80x2	SI C14 80x2	0.22

Weight		Style	Finish DP	Weave	Weight Rate		Fiber Count		Reinforcement Yarn		Thickness
gsm	oz/yd ²				warp %	weft	warp (yarns/cm)	weft (picks/cm)	warp	weft	
Polyamide Fabrics											
95	2.80	BI9760 White/Pink	X	PLAIN	50	50	19	19	PA66 235	PA66 235	0.07
105	3.10	T0089	X	PLAIN	52	48	22	20	PA66 235	PA66 235	0.08
105	3.10	T0098	Tracers	PLAIN	54	46	22	18.5	PA66 235	PA66 235	0.08
Polyester Fabrics											
90	2.65	BI9842	X	PLAIN	51	49	28	28	HT 144	HT 144	0.07

DP: Heat treated - Preformed (on request)

Weight		Style		Weave	Weight Rate			Fiber Count		Reinforcement Yarn		Thickness
gsm	oz/yd ²	EU	US		warp	%	weft	warp (yarns/cm)	weft (picks/cm)	warp	weft	mm
Balanced Fabrics												
48	1.42	1080	1080	PLAIN	56	44	24	19	EC5 11	EC5 11	0.04	
105	3.08	120	120	4H SATIN	51	49	24	23	EC5 11x2	EC5 11x2	0.08	
105	3.08	220	220	4H SATIN	51	49	24	23	EC7 22	EC7 22	0.08	
193	5.69	6580	6580	8H SATIN	50	50	28.3	28.3	S-2 34	S-2 34	0.15	
200	5.90	7628	7628	PLAIN	59	41	17	11.8	EC9 68	EC9 68	0.15	
200	5.90	1035	1035	TWILL 2X2	50	50	14	14	EC9 68	EC9 68	0.15	
202	5.96	66281HT	66281HT	4H Satin	51	49	14.9	14.5	S-2 68	S-2 68	0.17	
220	6.49	1034	X	4H SATIN	50	50	16	16	EC9 68	EC9 68	0.16	
290	8.55	791	X	TWILL 2X2	50	50	7	7	EC9 68x3	EC9 68x3	0.22	
300	8.85	1581	1581	8H SATIN	51	49	22	21	EC9 34x2	EC9 34x2	0.23	
300	8.85	7581	7581	8H SATIN	51	49	22	21	EC9 68	EC9 68	0.23	
300	8.85	7781	7781	8H SATIN	53	47	23.6	21	EC6 66	EC6 66	0.23	
302	8.91	6781HT	6781HT	8H SATIN	50	50	22.4	22.4	S-2 68	S-2 68	0.24	
305	9.00	6781	6781	8H SATIN	50	50	22.5	22.5	S-2 68	S-2 68	0.23	
Unidirectional Fabrics												
290	8.55	1543		UD 4H SATIN	90	10	19	11.8	EC9 68x2	EC7 22	0.22	
365	10.77	1055		UD 5H SATIN	83	13	45	9	EC9 68	EC9 68		

Other styles available on demand. Stated thickness is the theoretical thickness of a cured ply with 50% fiber volume content.

Fabric Treatment	Style			Description	Matrix Compatibility			
	Finish	EU	US		Epoxy	Polyester	Vinylester	Phenolic
Z 6040	X	X		Epoxy Silane				
TF 970	X			Aminosilane				
A 1100	X			Aminosilane				
F 69		X		Silane				
F 81		X		Silane				
HT		X		Direct Size E or S-2 Glass				

Ref	Compatibility	Storage at Room Temperature	Preforming	Applicable for	Injection Temperature	Curing Temperature of Resin System
HP03	PU & Epoxy	1 year	Starting at 80°C, Recommended 100°C	LRI	<45°C	>50°C
E01	Epoxy	Up to 1 year	Starting at 80°C, Recommended 100°C	RTM/LRI	No restriction	Any

Powdering: all fabrics can be epoxy powdered on 1 or 2 sides in order to facilitate preforming and dimensional stabilization

Notes

