

CHAPTER 4 CARBON FIBER COMPOSITES

4.1 INTRODUCTION

4.2 CARBON - EPOXY COMPOSITES

4.2.1 T-500 12k/976 unidirectional tape

Material Description:

Material: T-500 12k/976

Form: Unidirectional tape, fiber areal weight of 142 g/m², typical cured resin content of 28-34%, typical cured ply thickness of 0.0053 inches.

Processing: Autoclave cure; 240°F, 85 psi, 1 hour; 350°F, 100 psi for 2 hours.

General Supplier Information:

Fiber: T-500 fibers are continuous carbon filaments made from PAN precursor, surface treated to improve handling characteristics and structural properties. Filament count is 12,000 filaments/tow. Typical tensile modulus is 35.5×10^6 psi. Typical tensile strength is 575,000 psi.

Matrix: 976 is a high flow, modified epoxy resin that meets the NASA outgassing requirements. 10 days out-time at 72°F.

Maximum Short Term Service Temperature: 350°F (dry), 250°F (wet)

Typical applications: General purpose commercial and military structural applications, good hot/wet properties.

4.2.1 T500 12k/976 unidirectional tape*

				C/Ep 145-UT T-500/976 Summary
MATERIAL:	T-500 12k/976 unidirectional tape			
FORM:	Fiberite Hy-E 3076P unidirectional tape prepreg			
FIBER:	Union Carbide Thornel T-500 12k	MATRIX:	Fiberite 976	
T _g (dry):	361°F	T _g (wet):	T _g METHOD:	
PROCESSING:	240°F, 1 hour, 85 psi; 350°F, 2 hours, 100 psi			

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

Date of fiber manufacture	Date of testing	
Date of resin manufacture	Date of data submittal	6/88
Date of form manufacture	Date of analysis	1/93
Date of composite manufacture		

LAMINA PROPERTY SUMMARY

	75°F/A		-65°F/A		250°F/A			
Tension, 1-axis	II - I		II - I		II - I			
Tension, 2-axis	II - I		II - I		II - I			
Tension, 3-axis								
Compression, 1-axis								
Compression, 2-axis								
Compression, 3-axis								
Shear, 12-plane								
Shear, 23-plane								
Shear, 31-plane								

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

		Nominal	As Submitted	Test Method
Fiber Density	(g/cm ³)	1.79	1.57 - 1.61 142 - 146 0.0050 - 0.0057	
Resin Density	(g/cm ³)	1.28		
Composite Density	(g/cm ³)	1.59		
Fiber Areal Weight	(g/m ²)	142		
Fiber Volume	(%)			
Ply Thickness	(in)	0.0053		

LAMINATE PROPERTY SUMMARY

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

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MATERIAL:		T-500 12k/976 unidirectional tape				Table 4.2.1(a) C/Ep 142-UT T-500/976 Tension, 1-axis [0]₈ 75/A, -65/A, 200/A Interim	
RESIN CONTENT:	28-34 wt%	COMP: DENSITY:	1.57-1.61 g/cm ³				
FIBER VOLUME:	59-64 %	VOID CONTENT:	0.3-1.7%				
PLY THICKNESS:	0.0050 - 0.0057 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3039-76		Chord, 20-40% of ultimate load					
NORMALIZED BY:		Specimen thickness and batch fiber volume to 60% fiber volume (0.0052 in. CPT)					
Temperature (°F)		75		-65		250	
Moisture Content (%)		ambient		ambient		ambient	
Equilibrium at T, RH							
Source Code		13		13		13	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{tu} (ksi)	Mean	295	298	213	213	273	276
	Minimum	257	270	163	196	236	258
	Maximum	329	328	243	235	302	310
	C.V.(%)	6.41	5.74	9.78	5.02	7.39	6.05
	B-value	(1)		(1)		(1)	
	Distribution	ANOVA		Weibull		Weibull	
	C ₁	20.5		221		282	
	C ₂	4.64		13.1		15.7	
No. Specimens		15		15		15	
No. Batches		3		3		3	
Data Class		Interim		Interim		Interim	
E ₁ ^t (Msi)	Mean	21.9	22.0	19.0	19.1	22.2	22.4
	Minimum	20.9	20.5	15.9	17.7	18.6	21.0
	Maximum	24.7	24.0	21.5	21.5	25.1	23.8
	C.V.(%)	4.42	4.15	8.11	5.76	6.91	4.17
	No. Specimens	15		15		15	
No. Batches		3		3		3	
Data Class		Interim		Interim		Interim	
ν ₁₂ ^t	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{tu} (με)	Mean	13000		10700		11800	
	Minimum	11700		9300		10800	
	Maximum	13900		12000		12900	
	C.V.(%)	4.98		5.98		5.32	
	B-value	(1)		(1)		(1)	
	Distribution	ANOVA		Weibull		Weibull	
	C ₁	706		11000		12100	
	C ₂	4.75		18.8		21.6	
	No. Specimens	15		15		15	
	No. Batches	3		3		3	
Data Class		Interim		Interim		Interim	

(1) Basis values are presented only for A and B data classes.

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MATERIAL: T-500 12k/976 unidirectional tape

RESIN CONTENT: 28-34 wt%

COMP. DENSITY: 1.57-1.61 lb/in³

FIBER VOLUME: 59-64 %

VOID CONTENT: 0.3-1.7%

PLY THICKNESS: 0.0050-0.0057 in.

TEST METHOD:

MODULUS CALCULATION:

ASTM D 3039-76

Chord, 20 - 40 % of ultimate load

NORMALIZED BY: Not normalized

Table 4.2.1(b)
C/Ep 142-UT
T-500/976
Tension, 2-axis
[90]₈
75/A, -65/A, 200/A
Interim

Temperature (°F)		75	-65	250			
Moisture Content (%)		ambient	ambient	ambient			
Equilibrium at T, RH							
Source Code		13	13	13			
F_2^{tu} (ksi)	Mean	10.2	10.3	7.90			
	Minimum	9.40	9.40	7.00			
	Maximum	11.3	12.1	8.80			
	C.V.(%)	5.59	6.61	5.35			
	B-value	(1)	(1)	(1)			
	Distribution	ANOVA	Lognormal	Weibull			
	C ₁	0.594	2.33	8.09			
	C ₂	3.48	0.0636	19.7			
	No. Specimens	15	15	15			
	No. Batches	3	3	3			
	Data Class	Interim	Interim	Interim			
E_2^t (Msi)	Mean	1.3	1.5	1.2			
	Minimum	1.3	1.4	1.1			
	Maximum	1.7	1.6	1.3			
	C.V.(%)	7.8	4.8	7.0			
	No. Specimens	15	15	15			
	No. Batches	3	3	3			
	Data Class	Interim	Interim	Interim			
ν_{21}^t	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ϵ_2^{tu} (µε)	Mean	7750	7110	6930			
	Minimum	5800	6200	5900			
	Maximum	8900	8600	8000			
	C.V.(%)	10.3	8.28	8.32			
	B-value	(1)	(1)	(1)			
	Distribution	Weibull	Weibull	Weibull			
	C ₁	8080	7390	7180			
	C ₂	12.4	11.5	13.7			
	No. Specimens	15	15	15			
	No. Batches	3	3	3			
	Data Class	Interim	Interim	Interim			

(1) Basis values are presented only for A and B data classes.

4.2.2 HITEX 33 6k/E7K8 unidirectional tape

Material Description:

Material:	HITEX 33-6k/E7K8
Form:	Unidirectional tape, fiber areal weight of 145 g/m ² , typical cured resin content of 34% typical cured ply thickness of 0.0057 inches.
Processing:	Autoclave cure; 300-310°F, 55 psi for 2 hours. Low exotherm profile for processing of thick parts.

General Supplier Information:

Fiber:	HITEX 33 fibers are continuous carbon filaments made from PAN precursor. Filament count is 6,000 filaments/tow. Typical tensile modulus is 33×10^6 psi. Typical tensile strength is 560,000 psi. Good drape.
Matrix:	E7K8 is a medium flow, low exotherm epoxy resin. Good tack; up to 20 days out-time at ambient temperature
Maximum Short Term Service Temperature:	300°F (dry), 190°F (wet)
Typical applications:	Primary and secondary structural applications on commercial and military aircraft, jet engine applications such as stationary airfoils and thrust reverser blocker doors.

4.2.2 HITEX 33 6k/E7K8 unidirectional tape*

MATERIAL:				HITEX 33 6k/E7K8 unidirectional tape	C/Ep 145-UT HITEX 33/E7K8 Summary	
FORM:						U.S. Polymeric HITEX 33 6k/E7K8 unidirectional tape, grade 145 prepreg
FIBER:		Hitco HITEX 33 6k, no twist	MATRIX:			U.S. Polymeric E7K8
T _g (dry):		T _g (wet):	T _g METHOD:			
PROCESSING:						Autoclave cure: 300 - 310°F, 120 - 130 min., 55 psi

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Date of fiber manufacture	Date of testing	
Date of resin manufacture	Date of data submittal	1/83
Date of form manufacture	Date of analysis	1/93
Date of composite manufacture		

LAMINA PROPERTY SUMMARY

	75°F/A		-65°F/A	180°F/A		75°F/W	180°F/W	
Tension, 1-axis	SSSS		SS-S			SSS-	SSS-	
Tension, 2-axis	SS--							
Tension, 3-axis								
Compression, 1-axis	SS-S		SS-S			SS--	SS--	
Compression, 2-axis								
Compression, 3-axis								
Shear, 12-plane	S---			S---		S---	S---	
Shear, 23-plane								
Shear, 31-plane								

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

	Nominal	As Submitted	Test Method
Fiber Density (g/cm ³)	1.80	1.56 - 1.61	
Resin Density (g/cm ³)	1.27		
Composite Density (g/cm ³)	1.59		
Fiber Areal Weight (g/m ²)	145		
Fiber Volume (%)	58.0	57 - 64	
Ply Thickness (in)	0.0057	0.0053 - 0.0058	

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MATERIAL:		HITEX 33 6k/E7K8 unidirectional tape				Table 4.2.2(a) C/Ep 145-UT HITEX 33/E7K8 Tension, 1-axis [0]₁₀ 75/A, -65/A, 75/1.5% Screening	
RESIN CONTENT:	34 wt%	COMP: DENSITY:	1.58 g/cm ³				
FIBER VOLUME:	58 %	VOID CONTENT:	0.0%				
PLY THICKNESS:	0.0057 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3039-76							
NORMALIZED BY:		Fiber volume to 60% (0.0057 in. CPT)					
Temperature (°F)	75		-65		75		
Moisture Content (%)	ambient		ambient		1.5		
Equilibrium at T, RH					(1)		
Source Code	20		20		20		
	Normalized	Measured	Normalized	Measured	Normalized	Measured	
F ₁ ^{tu} (ksi)	Mean	313	304	296	288	318	310
	Minimum	292	283	267	259	280	272
	Maximum	339	330	327	319	345	335
	C.V.(%)	4.80	4.84	9.19	9.20	7.63	7.65
	B-value	(2)	(2)	(2)	(2)	(2)	(2)
	Distribution	Weibull	Weibull	Normal	Normal	Normal	Normal
	C ₁	320	311	296	288	318	310
	C ₂	22.2	21.9	27.2	26.5	24.3	23.7
	No. Specimens	20		5		5	
	No. Batches	1		1		1	
Data Class	Screening		Screening		Screening		
E ₁ ^t (Msi)	Mean	18.2	17.7	18.5	18.0	18.5	18.0
	Minimum	17.5	17.0	18.1	17.7	18.3	17.8
	Maximum	19.0	18.5	18.6	18.1	18.7	18.2
	C.V.(%)	2.58	2.60	1.06	1.07	0.79	0.79
	No. Specimens	18		5		5	
No. Batches	1		1		1		
Data Class	Screening		Screening		Screening		
ν ₁₂ ^t	Mean	0.310				0.310	
	No. Specimens	5				5	
	No. Batches	1				1	
	Data Class	Screening				Screening	
ε ₁ ^{tu} (με)	Mean	15900		16100			
	Minimum	15200		15500			
	Maximum	17100		17000			
	C.V.(%)	4.81		3.61			
	B-value	(2)		(2)			
	Distribution	Normal		Normal			
	C ₁	15900		16200			
	C ₂	765		582			
	No. Specimens	5		5			
	No. Batches	1		1			
Data Class	Screening		Screening				

(1) Conditioned for 14 days at 160°F, 85% RH.

(2) Basis values are presented only for A and B data classes.

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MATERIAL:		HITEX 33 6k/E7K8 unidirectional tape				Table 4.2.2(b) C/Ep 145-UT HITEX 33/E7K8 Tension, 1-axis [0]₁₀ 180/1.5% Screening	
RESIN CONTENT:	34 wt%	COMP: DENSITY:	1.58 g/cm ³				
FIBER VOLUME:	58 %	VOID CONTENT:	0.0%				
PLY THICKNESS:	0.0057 in.						
TEST METHOD:	ASTM D 3039-76		MODULUS CALCULATION:				
NORMALIZED BY:		Fiber volume to 60% (0.0057 in. CPT)					
Temperature (°F)		180					
Moisture Content (%)		1.5					
Equilibrium at T, RH		(1)					
Source Code		20					
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{tu} (ksi)	Mean	308	300				
	Minimum	296	288				
	Maximum	318	309				
	C.V.(%)	2.65	2.65				
	B-value	(2)	(2)				
	Distribution	Normal	Normal				
	C ₁	308	300				
	C ₂	8.17	7.95				
	No. Specimens	5					
	No. Batches	1					
Data Class	Screening						
E ₁ ^t (Msi)	Mean	18.7	18.2				
	Minimum	17.8	17.3				
	Maximum	19.5	19.0				
	C.V.(%)	3.64	3.65				
	No. Specimens	5					
No. Batches	1						
Data Class	Screening						
ν ₁₂ ^t	Mean		0.300				
	No. Specimens	5					
	No. Batches	1					
	Data Class	Screening					
ε ₁ ^{tu} (με)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

(1) Conditioned for 14 days at 160°F, 85% RH.

(2) Basis values are presented only for A and B data classes.

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MATERIAL:		HITEX 33 6k/E7K8 unidirectional tape				Table 4.2.2(c) C/Ep 145-UT HITEX 33/E7K8 Tension, 2-axis [90]₂₀ 75/A Screening	
RESIN CONTENT:	34 wt%	COMP: DENSITY:	1.58 g/cm ³				
FIBER VOLUME:	58 %	VOID CONTENT:	0.39%				
PLY THICKNESS:	0.0058 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3039-76							
NORMALIZED BY:		Not normalized					
Temperature (°F)		75					
Moisture Content (%)		ambient					
Equilibrium at T, RH							
Source Code		20					
F ₂ ^{tu} (ksi)	Mean	6.90					
	Minimum	5.58					
	Maximum	8.07					
	C.V.(%)	11.2					
	B-value	(1)					
	Distribution	Weibull					
	C ₁	7.23					
	C ₂	10.9					
No. Specimens		20					
No. Batches		1					
Data Class		Screening					
E ₂ ^t (Msi)	Mean	1.25					
	Minimum	1.23					
	Maximum	1.27					
	C.V.(%)	0.977					
	No. Specimens	20					
No. Batches		1					
Data Class		Screening					
ν ₂₁ ^t	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₂ ^{tu} (με)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
No. Specimens							
No. Batches							
Data Class							

(1) Basis values are presented only for A and B data classes.

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MATERIAL:		HITEX 33 6k/E7K8 unidirectional tape				Table 4.2.2(d) C/Ep 145-UT HITEX 33/E7K8 Compression, 1-axis [0]₁₀ 75/A, -65/A, 75/1.5% Screening	
RESIN CONTENT:	34-35 wt%	COMP: DENSITY:	1.57-1.58 g/cm ³				
FIBER VOLUME:	57-58 %	VOID CONTENT:	0.0%				
PLY THICKNESS:	0.0057 in.						
TEST METHOD:		MODULUS CALCULATION:					
SACMA SRM 1-88							
NORMALIZED BY:		Fiber volume to 60% (0.0057 in. CPT)					
Temperature (°F)	75		-65		75		
Moisture Content (%)	ambient		ambient		1.5		
Equilibrium at T, RH					(1)		
Source Code	20		20		20		
	Normalized	Measured	Normalized	Measured	Normalized	Measured	
F ₁ ^{cu} (ksi)	Mean	209	204	230	224	198	193
	Minimum	168	164	209	204	178	174
	Maximum	234	228	254	248	217	211
	C.V.(%)	9.41	9.41	7.98	8.04	8.13	8.03
	B-value	(2)	(2)	(2)	(2)	(2)	(2)
	Distribution	Weibull	Weibull	Normal	Normal	Normal	Normal
	C ₁	218	212	230	224	198	193
	C ₂	13.7	13.7	18.3	17.9	16.1	15.7
	No. Specimens	20		5		5	
	No. Batches	1		1		1	
Data Class	Screening		Screening		Screening		
E ₁ ^c (Msi)	Mean	17.1	16.2	17.9	16.9	18.0	17.0
	Minimum	16.1	15.2	17.5	16.5	17.5	16.6
	Maximum	17.8	16.8	18.1	17.1	18.8	17.8
	C.V.(%)	2.89	2.94	1.23	1.35	3.04	5.59
	No. Specimens	20		5		5	
No. Batches	1		1		1		
Data Class	Screening		Screening		Screening		
ν ₁₂ ^c	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{cu} (με)	Mean	12600		13600			
	Minimum	12000		13600			
	Maximum	13400		13700			
	C.V.(%)	2.92		0.48			
	B-value	(2)		(2)			
	Distribution	Weibull		Normal			
	C ₁	12800		13600			
	C ₂	35.7		65.7			
	No. Specimens	20		5			
	No. Batches	1		1			
Data Class	Screening		Screening				

(1) Conditioned for 14 days at 160°F, 85% RH.

(2) Basis values are presented only for A and B data classes.

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MATERIAL:		HITEX 33 6k/E7K8 unidirectional tape				Table 4.2.2(e) C/Ep 145-UT HITEX 33/E7K8 Compression, 1-axis [0]₁₀ 180/1.5% Screening	
RESIN CONTENT:	34 -35 wt%	COMP: DENSITY:	1.57-1.58 g/cm ³				
FIBER VOLUME:	57-58 %	VOID CONTENT:	0.0%				
PLY THICKNESS:	0.0057 in.						
TEST METHOD:		MODULUS CALCULATION:					
SACMA SRM 1-88							
NORMALIZED BY:		Fiber volume to 60% (0.0057 in. CPT)					
Temperature (°F)		180					
Moisture Content (%)		1.5					
Equilibrium at T, RH		(1)					
Source Code		20					
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{cu} (ksi)	Mean	136	132				
	Minimum	111	108				
	Maximum	161	157				
	C.V.(%)	13.4	13.6				
	B-value	(2)	(2)				
	Distribution	Normal	Normal				
	C ₁	136	132				
	C ₂	18.3	17.8				
	No. Specimens	5					
	No. Batches	1					
Data Class	Screening						
E ₁ ^c (Msi)	Mean	17.6	16.6				
	Minimum	17.0	16.1				
	Maximum	18.0	17.0				
	C.V.(%)	2.47	2.47				
	No. Specimens	5					
No. Batches	1						
Data Class	Screening						
ν ₁₂ ^c	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{cu} (με)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

(1) Conditioned for 14 days at 160°F, 85% RH.

(2) Basis values are presented only for A and B data classes.

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		HITEX 33 6k/E7K8 unidirectional tape				Table 4.2.2(f) C/Ep 145-UT HITEX 33/E7K8 Shear, 12-plane [(±45)₂/45]_s 75/A, 180/A, 75/1.5%, 180/1.5% Screening	
RESIN CONTENT:	29-30 wt%	COMP: DENSITY:	1.59-1.61 g/cm ³				
FIBER VOLUME:	62-64 %	VOID CONTENT:	0.05-0.91%				
PLY THICKNESS:	0.0053 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3518-76							
NORMALIZED BY:		Not normalized					
Temperature (°F)	75	180	75	180			
Moisture Content (%)	ambient	ambient	1.5	1.5			
Equilibrium at T, RH			(1)	(1)			
Source Code	20	20	20	20			
Mean	15.0	13.2	16.3	11.7			
Minimum	13.5	13.1	15.8	11.5			
Maximum	15.8	13.3	16.7	11.9			
C.V.(%)	3.52	0.655	2.20	1.27			
F_{12}^{su}							
B-value	(2)	(2)	(2)	(2)			
Distribution	Weibull	Normal	Normal	Normal			
C ₁	15.2	13.2	16.3	11.7			
C ₂	34.8	0.0865	0.357	0.148			
No. Specimens	20	5	5	5			
No. Batches	1	1	1	1			
Data Class	Screening	Screening	Screening	Screening			
Mean							
Minimum							
Maximum							
C.V.(%)							
γ_{12}^{su}							
B-value							
Distribution							
C ₁							
C ₂							
No. Specimens							
No. Batches							
Data Class							
Mean							
Minimum							
Maximum							
C.V.(%)							
G_s^{12}							
(Msi)							
No. Specimens							
No. Batches							
Data Class							

(1) Conditioned for 14 days at 160°F, 85% RH.

(2) Basis values are presented only for A and B data classes.

4.2.3 AS4 12k/E7K8 unidirectional tape

Material Description:

Material: AS4-12k/E7K8

Form: Unidirectional tape, fiber areal weight of 145 g/m², typical cured resin content of 32-37%, typical cured ply thickness of 0.0054 inches.

Processing: Autoclave cure; 300-310° F, 85 psi for 2 hours. Low exotherm profile for processing of thick parts.

General Supplier Information:

Fiber: AS4 fibers are continuous carbon filaments made from PAN precursor, surface treated to improve handling characteristics and structural properties. Filament count is 12,000 filaments/tow. Typical tensile modulus is 34×10^6 psi. Typical tensile strength is 550,000 psi. Good drape.

Matrix: E7K8 is a medium flow, low exotherm epoxy resin. Good tack; up to 20 days out-time at ambient temperature.

Maximum Short Term Service Temperature: 300°F (dry), 190°F (wet)

Typical applications: Primary and secondary structural applications commercial and military aircraft, jet engine applications such as stationary airfoils and thrust reverser blocker doors.

4.2.3 AS4 12k/E7K8 unidirectional tape*

				C/Ep 145-UT AS4/E7K8 Summary
MATERIAL:	AS4 12k/E7K8 unidirectional tape			
FORM:	U.S. Polymeric AS4 12k/E7K8 unidirectional tape prepreg			
FIBER:	Hercules AS4 12k	MATRIX:	U.S. Polymeric E7K8	
T _g (dry):	T _g (wet):	T _g METHOD:		
PROCESSING:	Autoclave cure: 300 - 310°F, 120 - 130 min., 55 psi			

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

Date of fiber manufacture	Date of testing	
Date of resin manufacture	Date of data submittal	1/88
Date of form manufacture	Date of analysis	1/93
Date of composite manufacture		

LAMINA PROPERTY SUMMARY

	75°F/A		-65°F/A	180°F/A		75°F/W	180°F/W	
Tension, 1-axis	SSSS		SS-S			SSSS	SSSS	
Tension, 2-axis	SS--							
Tension, 3-axis								
Compression, 1-axis	SS-S		SS-S			SS--	SS--	
Compression, 2-axis								
Compression, 3-axis								
Shear, 12-plane	S---			S---		S---	S---	
Shear, 23-plane								
Shear, 31-plane								

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

	Nominal	As Submitted	Test Method
Fiber Density (g/cm ³)	1.80	1.52 - 1.59	
Resin Density (g/cm ³)	1.28		
Composite Density (g/cm ³)	1.59		
Fiber Areal Weight (g/m ²)	145		
Fiber Volume (%)	59.6	53 - 60	
Ply Thickness (in)	0.0054	0.0054 - 0.0057	

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		AS4 12k/E7K8 unidirectional tape				Table 4.2.3(a) C/Ep 145-UT AS4/E7K8 Tension, 1-axis [0]₁₀ 75/A, -65/A, 75/0.77% Screening	
RESIN CONTENT:	32-37 wt%	COMP: DENSITY:	1.53-1.59 g/cm ³				
FIBER VOLUME:	53-60 %	VOID CONTENT:	0.64-2.2%				
PLY THICKNESS:	0.0054 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3039-76		Slope of initial linear portion of load-displacement curve					
NORMALIZED BY:		Fiber volume to 60% (0.0054 in. CPT)					
Temperature (°F)		75		-65		75	
Moisture Content (%)		ambient		ambient		0.77	
Equilibrium at T, RH						(1)	
Source Code		20		20		20	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{tu} (ksi)	Mean	303	293	291	273	304	294
	Minimum	253	252	255	239	286	276
	Maximum	345	347	327	306	317	306
	C.V.(%)	8.26	8.94	8.93	8.90	4.16	4.22
	B-value	(2)	(2)	(2)	(2)	(2)	(2)
	Distribution	ANOVA	ANOVA	Normal	Normal	Normal	Normal
	C ₁	26.7	32.4	291	273	304	294
	C ₂	4.40	7.49	26.0	24.4	12.7	12.2
	No. Specimens	20		5		5	
	No. Batches	2		1		1	
Data Class		Screening		Screening		Screening	
E ₁ ^t (Msi)	Mean	19.3	18.7	20.1	18.8	19.6	18.9
	Minimum	18.5	17.4	19.7	18.4	19.0	18.4
	Maximum	21.3	21.4	20.6	19.3	20.1	19.4
	C.V.(%)	3.79	6.10	1.67	1.79	2.04	1.96
	No. Specimens	20		5		5	
No. Batches	2		1		1		
Data Class		Screening		Screening		Screening	
ν ₁₂ ^t	Mean	0.320				0.288	
	No. Specimens	5				5	
	No. Batches	1				1	
	Data Class	Screening				Screening	
ε ₁ ^{tu} (με)	Mean	13900		13500		14600	
	Minimum	12500		12000		13700	
	Maximum	16000		14800		15000	
	C.V.(%)	11.0		8.24		3.83	
	B-value	(2)		(2)		(2)	
	Distribution	Normal		Normal		Normal	
	C ₁	13900		13500		14600	
	C ₂	1530		1110		561	
	No. Specimens	5		5		5	
	No. Batches	1		1		1	
Data Class		Screening		Screening		Screening	

(1) Conditioned for 14 days at 160°F, 85% RH.

(2) Basis values are presented only for A and B data classes.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		AS4 12k/E7K8 unidirectional tape				Table 4.2.3(b) C/Ep 145-UT AS4/E7K8 Tension, 1-axis [0]₁₀ 180/0.77% Screening	
RESIN CONTENT:	32-37 wt%	COMP: DENSITY:	1.53-1.59 g/cm ³				
FIBER VOLUME:	53-60 %	VOID CONTENT:	0.64-2.2%				
PLY THICKNESS:	0.0054 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3039-76		Slope of initial linear portion of load-displacement curve					
NORMALIZED BY:		Fiber volume to 60% (0.0054 in. CPT)					
Temperature (°F)		180					
Moisture Content (%)		0.77					
Equilibrium at T, RH		(1)					
Source Code		20					
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{tu} (ksi)	Mean	310	296				
	Minimum	284	274				
	Maximum	326	306				
	C.V.(%)	5.87	4.76				
	B-value	(2)	(2)				
	Distribution	Normal	Normal				
	C ₁	310	296				
	C ₂	18.2	13.9				
	No. Specimens	5					
	No. Batches	1					
Data Class	Screening						
E ₁ ^t (Msi)	Mean	20.1	19.2				
	Minimum	19.1	18.5				
	Maximum	21.8	20.4				
	C.V.(%)	5.65	4.01				
	No. Specimens	5					
No. Batches	1						
Data Class	Screening						
ν ₁₂ ^t	Mean		0.288				
	No. Specimens	5					
	No. Batches	1					
	Data Class	Screening					
ε ₁ ^{tu} (με)	Mean		14600				
	Minimum		13900				
	Maximum		15400				
	C.V.(%)		4.21				
	B-value		(2)				
	Distribution		Normal				
	C ₁		14600				
	C ₂		616				
	No. Specimens	5					
	No. Batches	1					
Data Class	Screening						

(1) Conditioned for 14 days at 160°F, 85% RH.

(2) Basis values are presented only for A and B data classes.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		AS4 12k/E7K8 unidirectional tape				Table 4.2.3(c) C/Ep 145-UT AS4/E7K8 Tension, 2-axis [90]₂₀ 75/A Screening	
RESIN CONTENT:	32-38 wt%	COMP: DENSITY:	1.54-1.59 g/cm ³				
FIBER VOLUME:	53-60 %	VOID CONTENT:	0.64-0.75%				
PLY THICKNESS:	0.0057 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3039-76		Slope of initial linear portion of load-displacement curve					
NORMALIZED BY:		Not normalized					
Temperature (°F)		75					
Moisture Content (%)		ambient					
Equilibrium at T, RH							
Source Code		20					
F ₂ ^{tu} (ksi)	Mean	5.47					
	Minimum	4.10					
	Maximum	7.01					
	C.V.(%)	13.2					
	B-value	(1)					
	Distribution	Weibull					
	C ₁	5.79					
	C ₂	8.04					
No. Specimens		20					
No. Batches		1					
Data Class		Screening					
E ₂ ^t (Msi)	Mean	1.23					
	Minimum	1.16					
	Maximum	1.32					
	C.V.(%)	3.76					
	No. Specimens	20					
No. Batches		1					
Data Class		Screening					
ν ₂₁ ^t	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₂ ^{tu} (με)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

(1) Basis values are presented only for A and B data classes.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		AS4 12k/E7K8 unidirectional tape				Table 4.2.3(d) C/Ep 145-UT AS4/E7K8 Compression, 1-axis [0]₁₀ 75/A, -65/A, 75/0.77% Screening	
RESIN CONTENT:	35-40 wt%	COMP: DENSITY:	1.52-1.58 g/cm ³				
FIBER VOLUME:	51-57 %	VOID CONTENT:	1.4-2.3%				
PLY THICKNESS:	0.0054 in.						
TEST METHOD:		MODULUS CALCULATION:					
SACMA SRM 1-88		Slope of initial linear portion of load-displacement curve					
NORMALIZED BY:		Fiber volume to 60% (0.0054 in. CPT)					
Temperature (°F)		75		-65		75	
Moisture Content (%)		ambient		ambient		0.77	
Equilibrium at T, RH						(1)	
Source Code		20		20		20	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{cu} (ksi)	Mean	245	209	276	235	215	182
	Minimum	207	176	251	213	196	166
	Maximum	269	229	299	254	238	202
	C.V.(%)	8.00	7.80	6.57	6.60	7.78	7.75
	B-value	(2)	(2)	(2)	(2)	(2)	(2)
	Distribution	Weibull	Weibull	Normal	Normal	Normal	Normal
	C ₁	254	216	276	235	215	183
	C ₂	16.3	16.3	18.1	15.4	16.7	14.2
	No. Specimens	20		5		5	
	No. Batches	1		1		1	
Data Class		Screening		Screening		Screening	
E ₁ ^c (Msi)	Mean	19.0	17.9	17.6	16.5	18.5	17.4
	Minimum	17.3	16.3	16.6	15.7	17.7	16.7
	Maximum	20.4	19.2	18.0	17.0	19.0	17.9
	C.V.(%)	4.58	4.54	3.16	3.14	2.95	2.86
	No. Specimens	20		5		5	
No. Batches	1		1		1		
Data Class		Screening		Screening		Screening	
ν ₁₂ ^c	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{cu} (με)	Mean	11700		14400			
	Minimum	10800		13900			
	Maximum	13100		15100			
	C.V.(%)	4.81		3.89			
	B-value	(2)		(2)			
	Distribution	Normal		Normal			
	C ₁	11700		14400			
	C ₂	564		559			
	No. Specimens	20		5			
	No. Batches	1		1			
Data Class		Screening		Screening			

(1) Conditioned for 14 days at 160°F, 85% RH.

(2) Basis values are presented only for A and B data classes.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		AS4 12k/E7K8 unidirectional tape				Table 4.2.3(e) C/Ep 145-UT AS4/E7K8 Compression, 1-axis [0]₁₀ 180/0.77% Screening	
RESIN CONTENT:	35-40 wt%	COMP: DENSITY:	1.52-1.58 g/cm ³				
FIBER VOLUME:	51-57 %	VOID CONTENT:	1.4-2.3%				
PLY THICKNESS:	0.0054 in.						
TEST METHOD:		MODULUS CALCULATION:					
SACMA SRM 1-88		Slope of initial linear portion of load-displacement curve					
NORMALIZED BY:		Fiber volume to 60% (0.0054 in. CPT)					
Temperature (°F)		180					
Moisture Content (%)		0.77					
Equilibrium at T, RH		(1)					
Source Code		20					
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{cu} (ksi)	Mean	150	127				
	Minimum	125	106				
	Maximum	176	150				
	C.V.(%)	14.8	15.0				
	B-value	(2)	(2)				
	Distribution	Normal	Normal				
	C ₁	150	127				
	C ₂	22.2	18.9				
	No. Specimens	5					
	No. Batches	1					
Data Class	Screening						
E ₁ ^c (Msi)	Mean	18.0	17.0				
	Minimum	17.4	16.4				
	Maximum	18.4	17.3				
	C.V.(%)	2.46	2.41				
	No. Specimens	5					
	No. Batches	1					
Data Class	Screening						
ν ₁₂ ^c	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{cu} (με)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

(1) Conditioned for 14 days at 160°F, 85% RH.

(2) Basis values are presented only for A and B data classes.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL: AS4 12k/E7K8 unidirectional tape

RESIN CONTENT: 33-36 wt%

COMP: DENSITY: 1.54-1.55 g/cm³

FIBER VOLUME: 55-57 %

VOID CONTENT: 1.9-2.3%

PLY THICKNESS: 0.0055 in.

Table 4.2.3(f)
C/Ep 145-UT
AS4/E7K8
Shear, 12-plane
[(±45)₂/45]_s
75/A, 180/A, 75/0.77%,
180/0.77%
Screening

TEST METHOD:

MODULUS CALCULATION:

ASTM D 3518-76

NORMALIZED BY: Not normalized

Temperature (°F)	75	180	75	180		
Moisture Content (%)	ambient	ambient	0.77	0.77		
Equilibrium at T, RH			(1)	(1)		
Source Code	20	20	20	20		
Mean	16.5	14.6	15.1	13.4		
Minimum	13.8	14.2	13.5	13.0		
Maximum	17.0	14.9	15.8	13.8		
C.V.(%)	6.41	1.90	6.04	2.44		
F_{12}^{su}	(2)	(2)	(2)	(2)		
Distribution	ANOVA	Normal	Normal	Normal		
C ₁	2.46	14.6	15.1	13.4		
C ₂	7.58	0.277	0.905	0.328		
No. Specimens	20	5	5	5		
No. Batches	2	1	1	1		
Data Class	Screening	Screening	Screening	Screening		
Mean						
Minimum						
Maximum						
C.V.(%)						
G_{12}^s						
(Msi)						
No. Specimens						
No. Batches						
Data Class						
Mean						
Minimum						
Maximum						
C.V.(%)						
γ_{12}^{su}						
(µε)						
B-value						
Distribution						
C ₁						
C ₂						
No. Specimens						
No. Batches						
Data Class						

(1) Conditioned for 14 days at 160°F, 85% RH.

(2) Basis values are presented only for A and B data classes.

4.2.4 Celion 12k/E7K8 unidirectional tapeMaterial Description:

Material: Celion-12k/E7K8

Form: Unidirectional tape, fiber areal weight of 280 g/m², typical cured resin content of 29-33%, typical cured ply thickness of 0.011 inches.

Processing: Autoclave cure; 300-310°F, 55 psi for 2 hours. Low exotherm profile for processing of thick parts.

General Supplier Information:

Fiber: Celion fibers are continuous carbon filaments made from PAN precursor. Filament count is 12,000 filaments/tow. Typical tensile modulus is 34×10^6 psi. Typical tensile strength is 515,000 psi. Good drape.

Matrix: E7K8 is a medium flow, low exotherm epoxy resin. Good tack; up to 20 days out-time at ambient temperature.

Maximum Short Term Service Temperature: 300°F (dry), 190°F (wet)

Typical Applications: Primary and secondary structural applications on commercial and military aircraft.

4.2.4 Celion 12k/E7K8 unidirectional tape*

				C/Ep 280-UT Celion 12k/E7K8 Summary	
MATERIAL:	Celion 12k/E7K8 unidirectional tape				
FORM:	U.S. Polymeric Celion 12k/E7K8 unidirectional tape, grade 280 prepreg				
FIBER:	Celanese Celion 12k, no twist		MATRIX:	U.S. Polymeric E7K8	
T _g (dry):	T _g (wet):		T _g METHOD:		
PROCESSING:	Autoclave cure: 300 - 310°F, 120 - 130 min., 55 psi				

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

Date of fiber manufacture	Date of testing	
Date of resin manufacture	Date of data submittal	1/88
Date of form manufacture	Date of analysis	1/93
Date of composite manufacture		

LAMINA PROPERTY SUMMARY

	75°F/A		-65°F/A	180°F/A		75°F/W	180°F/W	
Tension, 1-axis	SSSS		SS-S			SSS-	SSSS	
Tension, 2-axis	SS--							
Tension, 3-axis								
Compression, 1-axis	SS-S		SS-S			SS--	SS--	
Compression, 2-axis								
Compression, 3-axis								
Shear, 12-plane	S---			S---		S---	S---	
Shear, 23-plane								
Shear, 31-plane								

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

	Nominal	As Submitted	Test Method
Fiber Density (g/cm ³)	1.8	1.59 - 1.61	
Resin Density (g/cm ³)	1.28		
Composite Density (g/cm ³)	1.59		
Fiber Areal Weight (g/m ²)	280		
Fiber Volume (%)	59.6	59 - 64	
Ply Thickness (in)	0.011	0.010 - 0.011	

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		Celion 12k/E7K8 unidirectional tape				Table 4.2.4(a) C/Ep 280-UT Celion E7K8 Tension, 1-axis [0]₅ 75/A, -65/A, 75/0.77% Screening	
RESIN CONTENT:	29 wt%	COMP: DENSITY:	1.61 g/cm ³				
FIBER VOLUME:	63-64 %	VOID CONTENT:	0.53-1.0%				
PLY THICKNESS:	0.011 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3039-76							
NORMALIZED BY:		Fiber volume to 60% (0.011 in. CPT)					
Temperature (°F)	75		-65		75		
Moisture Content (%)	ambient		ambient		0.77		
Equilibrium at T, RH					(1)		
Source Code	20		20		20		
	Normalized	Measured	Normalized	Measured	Normalized	Measured	
F ₁ ^{tu} (ksi)	Mean	293	309	281	302	300	314
	Minimum	265	285	268	287	292	306
	Maximum	317	332	307	330	315	330
	C.V.(%)	4.52	4.52	5.44	5.44	3.22	3.60
	B-value	(2)	(2)	(2)	(2)	(2)	(2)
	Distribution	Weibull	Weibull	Normal	Normal	Normal	Normal
	C ₁	299	316	281	302	300	314
	C ₂	25.6	25.9	15.3	16.4	9.67	10.1
No. Specimens	20		5		5		
No. Batches	1		1		1		
Data Class	Screening		Screening		Screening		
E ₁ ^t (Msi)	Mean	20.0	21.1	19.2	20.6	19.0	19.9
	Minimum	18.7	20.1	18.6	20.0	18.5	19.4
	Maximum	21.9	23.0	20.3	21.8	20.0	21.0
	C.V.(%)	4.48	4.25	3.40	3.80	3.22	3.60
	No. Specimens	20		5		5	
	No. Batches	1		1		1	
	Data Class	Screening		Screening		Screening	
ν ₁₂ ^t	Mean	0.286				0.292	
	No. Specimens	5				5	
	No. Batches	1				1	
	Data Class	Screening				Screening	
ε ₁ ^{tu} (μΕ)	Mean	14300		14800			
	Minimum	13500		14200			
	Maximum	14700		15800			
	C.V.(%)	3.34		3.87			
	B-value	(2)		(2)			
	Distribution	Normal		Normal			
	C ₁	14300		14800			
	C ₂	478		573			
	No. Specimens	5		5			
	No. Batches	1		1			
	Data Class	Screening		Screening			

(1) Conditioned for 14 days at 160°F, 85% RH.

(2) Basis values are presented only for A and B data classes.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		Celion 12k/E7K8 unidirectional tape				Table 4.2.4(b) C/Ep 280-UT Celion E7K8 Tension, 1-axis [0]₅ 180/0.77% Screening	
RESIN CONTENT:	29 wt%	COMP: DENSITY:	1.61 g/cm ³				
FIBER VOLUME:	63-64 %	VOID CONTENT:	0.53-1.0%				
PLY THICKNESS:	0.011 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3039-76							
NORMALIZED BY:		Fiber volume to 60% (0.011 in. CPT)					
Temperature (°F)		180					
Moisture Content (%)		0.77					
Equilibrium at T, RH		(1)					
Source Code		20					
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{tu} (ksi)	Mean	293	311				
	Minimum	269	286				
	Maximum	316	335				
	C.V.(%)	6.43	7.19				
	B-value	(2)	(2)				
	Distribution	Normal	Normal				
	C ₁	293	311				
	C ₂	18.9	20.0				
	No. Specimens	5					
No. Batches	1						
Data Class	Screening						
E ₁ ^t (Msi)	Mean	19.8	21.0				
	Minimum	19.4	20.6				
	Maximum	20.1	21.4				
	C.V.(%)	1.61	1.81				
	No. Specimens	5					
No. Batches	1						
Data Class	Screening						
ν ₁₂ ^t	Mean	0.322					
	No. Specimens	5					
	No. Batches	1					
	Data Class	Screening					
ε ₁ ^{tu} (με)	Mean	13800					
	Minimum	12300					
	Maximum	15400					
	C.V.(%)	10.4					
	B-value	(2)					
	Distribution	Normal					
	C ₁	13800					
	C ₂	1440					
	No. Specimens	5					
No. Batches	1						
Data Class	Screening						

(1) Conditioned for 14 days at 160°F, 85% RH.

(2) Basis values are presented only for A and B data classes.

Volume 2, Chapter 4 Carbon Fiber Composites

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		Celion 12k/E7K8 unidirectional tape				Table 4.2.4(c) C/Ep 280-UT Celion /E7K8 Tension, 2-axis [90]₁₂ 75/A Screening	
RESIN CONTENT:	31-33 wt%	COMP: DENSITY:	1.59-1.60 g/cm ³				
FIBER VOLUME:	59-61 %	VOID CONTENT:	0.68-0.74%				
PLY THICKNESS:	0.011 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3039-76							
NORMALIZED BY:		Not normalized					
Temperature (°F)		75					
Moisture Content (%)		ambient					
Equilibrium at T, RH							
Source Code		20					
F ₂ ^{tu} (ksi)	Mean	6.00					
	Minimum	5.21					
	Maximum	6.89					
	C.V.(%)	8.79					
	B-value	(1)					
	Distribution	Weibull					
	C ₁	6.24					
	C ₂	12.6					
No. Specimens		20					
No. Batches		1					
Data Class		Screening					
E ₂ ^t (Msi)	Mean	1.28					
	Minimum	1.19					
	Maximum	1.36					
	C.V.(%)	4.52					
	No. Specimens	20					
No. Batches		1					
Data Class		Screening					
ν ₂₁ ^t	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₂ ^{tu} (με)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
No. Specimens							
No. Batches							
Data Class							

(1) Basis values are presented only for A and B data classes.

Volume 2, Chapter 4 Carbon Fiber Composites

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		Celion 12k/E7K8 unidirectional tape				Table 4.2.4(d) C/Ep 280-UT Celion E7K8 Compression, 1-axis [0]₅ 75/A, -65/A, 75/0.77% Screening	
RESIN CONTENT:	29-30 wt%	COMP: DENSITY:	1.60-1.61 g/cm ³				
FIBER VOLUME:	62-64 %	VOID CONTENT:	0.78-0.79%				
PLY THICKNESS:	0.010 in.						
TEST METHOD:		MODULUS CALCULATION:					
SACMA SRM 1-88							
NORMALIZED BY:		Fiber volume to 60% (0.011 in. CPT)					
Temperature (°F)	75		-65		75		
Moisture Content (%)	ambient		ambient		0.77		
Equilibrium at T, RH					(1)		
Source Code	20		20		20		
	Normalized	Measured	Normalized	Measured	Normalized	Measured	
F ₁ ^{cu} (ksi)	Mean	206	213	221	229	207	214
	Minimum	171	177	198	205	198	205
	Maximum	247	255	267	276	219	227
	C.V.(%)	8.62	8.62	12.2	12.2	5.06	5.06
	B-value	(2)	(2)	(2)	(2)	(2)	(2)
	Distribution	Weibull	Weibull	Normal	Normal	Normal	Normal
	C ₁	214	221	221	228	207	214
	C ₂	12.1	12.1	27.0	28.0	10.5	10.8
	No. Specimens	20		5		5	
	No. Batches	1		1		1	
Data Class	Screening		Screening		Screening		
E ₁ ^c (Msi)	Mean	19.9	21.1	22.9	24.3	21.6	22.3
	Minimum	18.1	19.2	20.8	22.0	20.2	21.0
	Maximum	21.7	22.3	23.8	25.1	22.8	23.6
	C.V.(%)	4.95	5.08	5.28	5.90	5.25	5.86
	No. Specimens	20		5		5	
No. Batches	1		1		1		
Data Class	Screening		Screening		Screening		
ν ₁₂ ^c	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{cu} (μɛ)	Mean	11200		9870			
	Minimum	10800		9210			
	Maximum	11800		10600			
	C.V.(%)	3.59		5.32			
	B-value	(2)		(2)			
	Distribution	Normal		Normal			
	C ₁	11200		9870			
	C ₂	401		526			
	No. Specimens	5		5			
	No. Batches	1		1			
Data Class	Screening		Screening				

(1) Conditioned for 14 days at 160°F, 85% RH.

(2) Basis values are presented only for A and B data classes.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		Celion 12k/E7K8 unidirectional tape				Table 4.2.4(e) C/Ep 280-UT Celion E7K8 Compression, 1-axis [0]₅ 180/0.77% Screening	
RESIN CONTENT:	29-30 wt%	COMP: DENSITY:	1.60-1.61 g/cm ³				
FIBER VOLUME:	62-64 %	VOID CONTENT:	0.78-0.79%				
PLY THICKNESS:	0.010 in.						
TEST METHOD:	MODULUS CALCULATION:						
SACMA SRM 1-88							
NORMALIZED BY:		Fiber volume to 60% (0.011 in. CPT)					
Temperature (°F)		180					
Moisture Content (%)		0.77					
Equilibrium at T, RH		(1)					
Source Code		20					
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{cu} (ksi)	Mean	185	192				
	Minimum	158	164				
	Maximum	220	228				
	C.V.(%)	12.9	12.9				
	B-value	(2)	(2)				
	Distribution	Normal	Normal				
	C ₁	185	192				
	C ₂	24.0	24.8				
	No. Specimens	5					
	No. Batches	1					
Data Class	Screening						
E ₁ ^c (Msi)	Mean	21.1	22.3				
	Minimum	19.5	20.6				
	Maximum	23.1	24.5				
	C.V.(%)	6.80	7.63				
	No. Specimens	5					
No. Batches	1						
Data Class	Screening						
ν ₁₂ ^c	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{cu} (με)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

(1) Conditioned for 14 days at 160°F, 85% RH.

(2) Basis values are presented only for A and B data classes.

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		Celion 12k/E7K8 unidirectional tape				Table 4.2.4(f) C/Ep 280-UT Celion E7K8 Shear, 12-plane [±45/45]_s 75/A, 180/A, 75/0.77%, 180/077% Screening	
RESIN CONTENT:	30-31 wt%	COMP: DENSITY:	1.60 g/cm ³				
FIBER VOLUME:	61-62 %	VOID CONTENT:	0.41-0.61%				
PLY THICKNESS:	0.011 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3518-76							
NORMALIZED BY:		Not normalized					
Temperature (°F)		75	180	75	180		
Moisture Content (%)		ambient	ambient	0.77	0.77		
Equilibrium at T, RH				(1)	(1)		
Source Code		20	20	20	20		
F ₁₂ ^{su} (ksi)	Mean	9.9	10.0	12.0	10.0		
	Minimum	9.3	8.1	11.3	8.2		
	Maximum	11.1	11.1	12.3	11.4		
	C.V.(%)	4.16	11.7	3.41	11.7		
	B-value	(2)	(2)	(2)	(2)		
	Distribution	Nonpara.	Normal	Normal	Normal		
	C ₁	10	10.0	12.0	10.0		
	C ₂	1.25	1.17	0.407	1.17		
	No. Specimens	20	5	5	5		
	No. Batches	1	1	1	1		
Data Class		Screening	Screening	Screening	Screening		
G ₁₂ ^s (Msi)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	No. Specimens						
No. Batches							
Data Class							
γ ₁₂ ^{su} (μɛ)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

(1) Conditioned for 14 days at 160°F, 85% RH.

(2) Basis values are presented only for A and B data classes.

4.2.5 AS4 12k/938 unidirectional tapeMaterial Description:

Material: AS4-12k/938

Form: Unidirectional tape, fiber areal weight of 145 g/m², typical cured resin content of 35-49%, typical cured ply thickness of 0.0055 inches.

Processing: Autoclave cure; 350°F, 85 psi for 2 hours.

General Supplier Information:

Fiber: AS4 fibers are continuous carbon filaments made from PAN precursor, surface treated to improve handling characteristics and structural properties. Filament count is 12,000 filaments/tow. Typical tensile modulus is 34×10^6 psi. Typical tensile strength is 550,000 psi.

Matrix: 938 is an epoxy resin. 10 days out-time at 72°F.

Maximum Short Term Service Temperature: 350°F (dry), 200°F (wet)

Typical applications: Commercial and military structural applications

4.2.5 AS4 12k/938 unidirectional tape*

MATERIAL: AS4 12k/938 unidirectional tape

C/Ep 145-UT AS4/938 Summary
--

FORM: Fiberite Hy-E 1338H unidirectional tape, grade 145 prepreg

FIBER: Hercules AS4 12k, unsized, no twist MATRIX: Fiberite 938

T_g(dry): T_g(wet): 260°F T_g METHOD:

PROCESSING: Autoclave cure: 350 ± 10°F, 120 - 135 min., 100 ± 15 psi

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

Date of fiber manufacture	Date of testing	8/85
Date of resin manufacture	Date of data submittal	4/89
Date of form manufacture	Date of analysis	1/93
Date of composite manufacture		

LAMINA PROPERTY SUMMARY

	75°F/A		-65°F/A	200°F/A		200°F/W		
Tension, 1-axis	II - -		II - -	II - -				
Tension, 2-axis	II - -			II - -				
Tension, 3-axis								
Compression, 1-axis	II - -					II - -		
Compression, 2-axis	S - -							
Compression, 3-axis								
Shear, 12-plane	S - -			I - -				
Shear, 23-plane								
Shear, 31-plane								

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

		Nominal	As Submitted	Test Method
Fiber Density	(g/cm ³)	1.80	1.77 - 1.79	
Resin Density	(g/cm ³)	1.30	1.30	
Composite Density	(g/cm ³)	1.60	1.55 - 1.58	
Fiber Areal Weight	(g/m ²)	145	144 - 146	
Fiber Volume	(%)	60	52 - 60	
Ply Thickness	(in)	0.0055	0.0048 - 0.0065	

LAMINATE PROPERTY SUMMARY

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		AS4 12k/938 unidirectional tape				Table 4.2.5(a) C/Ep 145-UT AS4/938 Tension, 1-axis [0]₈ 75/A, -65/A, 200/A Interim	
RESIN CONTENT:	35-41 wt%	COMP: DENSITY:	1.55-1.57 g/cm ³				
FIBER VOLUME:	52-57 %	VOID CONTENT:	0.0-<1.0%				
PLY THICKNESS:	0.0042-0.0052 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3039-76 (1)							
NORMALIZED BY:		Specimen thickness and batch fiber volume to 60% (0.0053 in. CPT)					
Temperature (°F)		75		-65		200	
Moisture Content (%)		ambient		ambient		ambient	
Equilibrium at T, RH							
Source Code		12		12		12	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{tu} (ksi)	Mean	314	272	296	238	321	274
	Minimum	270	230	198	174	263	229
	Maximum	351	330	363	287	356	322
	C.V.(%)	7.45	8.79	14.4	11.0	7.79	8.10
	B-value	(2)	(2)	(2)	(2)	(2)	(2)
	Distribution	Weibull	ANOVA	ANOVA	ANOVA	ANOVA	Weibull
	C ₁	324	26.3	49.1	249	26.9	284
	C ₂	16.5	4.12	4.64	11.1	3.78	13.3
	No. Specimens	22		22		20	
	No. Batches	3		3		3	
Data Class		Interim		Interim		Interim	
E ₁ ^t (Msi)	Mean	22.4	19.4	19.5	19.0	20.4	20.8
	Minimum	18.8	17.1	18.5	16.9	18.4	18.4
	Maximum	26.9	21.0	21.5	22.0	24.0	22.4
	C.V.(%)	9.88	4.66	4.07	5.13	7.23	6.06
	No. Specimens	22		22		20	
No. Batches		3		3		3	
Data Class		Interim		Interim		Interim	
ν ₁₂ ^t	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{tu} (με)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

(1) Gage length 2.0 inches.

(2) Basis values are presented only for A and B data classes.

Volume 2, Chapter 4 Carbon Fiber Composites

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL: AS4 12k/938 unidirectional tape

RESIN CONTENT: 35-40 wt%

COMP:DENSITY: 1.56-1.58 g/cm³

FIBER VOLUME: 52-58 %

VOID CONTENT: 0.0-1.0%

PLY THICKNESS: 0.0053-0.0063 in.

Table 4.2.5(b)
C/Ep 145-UT
AS4/938
Tension, 2-axis
[90]₁₆
75/A, 200/A
Interim

TEST METHOD:

MODULUS CALCULATION:

ASTM D 3039-76 (1)

NORMALIZED BY: Not normalized

Temperature (°F)	75.0	200				
Moisture Content (%)	ambient	ambient				
Equilibrium at T, RH						
Source Code	12	12				
Mean	8.96	8.84				
Minimum	6.50	6.85				
Maximum	12.0	10.3				
C.V.(%)	15.2	12.2				
B-value	(2)	(2)				
Distribution	Weibull	ANOVA				
F_2^{tu}						
(ksi)						
C ₁	9.54	1.18				
C ₂	7.10	3.96				
No. Specimens	19	17				
No. Batches	3	3				
Data Class	Interim	Interim				
Mean	1.29	1.23				
Minimum	0.970	1.05				
Maximum	1.72	1.40				
C.V.(%)	7.89	7.81				
E_2^t						
(Msi)						
No. Specimens	19	17				
No. Batches	3	3				
Data Class	Interim	Interim				
Mean						
No. Specimens						
No. Batches						
Data Class						
ν_{21}^t						
Mean						
Minimum						
Maximum						
C.V.(%)						
B-value						
Distribution						
ϵ_2^{tu}						
(µε)						
C ₁						
C ₂						
No. Specimens						
No. Batches						
Data Class						

(1) Gage length 2.0 inches.

(2) Basis values are presented only for A and B data classes.

Volume 2, Chapter 4 Carbon Fiber Composites

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		AS4 12k/938 unidirectional tape				Table 4.2.5(c) C/Ep 145-UT AS4/938 Compression, 1-axis [0]₈ 75/A, 200/W Interim, Screening	
RESIN CONTENT:	33-38 wt%	COMP: DENSITY:	1.55-1.58 g/cm ³				
FIBER VOLUME:	54-60 %	VOID CONTENT:	0.0-<1.0%				
PLY THICKNESS:	0.0048-0.0060 in.						
TEST METHOD:		MODULUS CALCULATION:					
SACMA SRM 1-88							
NORMALIZED BY:		Specimen thickness and batch fiber volume to 60% (0.0053 in. CPT)					
Temperature (°F)	75		200				
Moisture Content (%)	ambient		(1)				
Equilibrium at T, RH			140°F, 95%				
Source Code	12		12				
	Normalized	Measured	Normalized	Measured	Normalized	Measured	
F ₁ ^{cu} (ksi)	Mean	228	211	190	168		
	Minimum	186	172	158	138		
	Maximum	265	251	223	194		
	C.V.(%)	9.31	10.2	8.96	9.29		
	B-value	(2)	(2)	(2)	(2)		
	Distribution	Weibull	ANOVA	ANOVA	ANOVA		
	C ₁	224	22.4	19.0	17.6		
	C ₂	12.5	3.31	4.40	4.57		
	No. Specimens	25		24			
	No. Batches	3		3			
Data Class	Interim		Interim				
E ₁ ^c (Msi)	Mean	18.2	18.4	19.1	18.4		
	Minimum	15.7	15.9	16.9	16.6		
	Maximum	21.0	22.5	24.0	21.0		
	C.V.(%)	9.13	12.4	12.8	9.10		
	No. Specimens	15		13			
No. Batches	2		2				
Data Class	Interim		Screening				
ν ₁₂ ^c	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{cu} (μɛ)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

(1) Specimens conditioned for one month.

(2) Basis values are presented only for A and B data classes.

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		AS4 12k/938 unidirectional tape				Table 4.2.5(d) C/Ep 145-UT AS4/938 Compression, 2-axis [90]₈ 75/A Screening	
RESIN CONTENT:	36 wt%	COMP: DENSITY:	1.56 g/cm ³				
FIBER VOLUME:	56 %	VOID CONTENT:	0.0%				
PLY THICKNESS:	0.0058 in.						
TEST METHOD:		MODULUS CALCULATION:					
SACMA SRM 1-88							
NORMALIZED BY:		Not normalized					
Temperature (°F)		75.0					
Moisture Content (%)		ambient					
Equilibrium at T, RH							
Source Code		12					
F ₂ ^{cu} (ksi)	Mean	30.4					
	Minimum	26.2					
	Maximum	39.7					
	C.V.(%)	16.4					
	B-value	(1)					
	Distribution	Nonpara.					
	C ₁	6					
	C ₂	2.14					
No. Specimens		10					
No. Batches		1					
Data Class		Screening					
E ₂ ^c (Msi)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	No. Specimens						
No. Batches							
Data Class							
ν ₂₁ ^c	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₂ ^{cu} (μɛ)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

(1) Basis values are presented only for A and B data classes.

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		AS4 12k/938 unidirectional tape		Table 4.2.5(e) C/Ep 145-UT AS4/938 Shear, 12-plane [±45]_{2s} 75/A, 200/A Interim, Screening		
RESIN CONTENT:	35-37 wt%	COMP: DENSITY:	1.56-1.58 g/cm ³			
FIBER VOLUME:	54-57 %	VOID CONTENT:	0.0-<1.0%			
PLY THICKNESS:	0.0051-0.0063 in.					
TEST METHOD:	MODULUS CALCULATION:					
ASTM D 3518-76						
NORMALIZED BY:		Not normalized				
Temperature (°F)	75.0	200				
Moisture Content (%)	ambient	ambient				
Equilibrium at T, RH						
Source Code	12	12				
F ₁₂ ^{su} (ksi)	Mean	13.0	13.9			
	Minimum	10.8	11.9			
	Maximum	13.9	16.0			
	C.V.(%)	6.36	7.63			
	B-value	(1)	(1)			
	Distribution	Weibull	ANOVA			
	C ₁	13.4	1.26			
	C ₂	25.4	4.96			
	No. Specimens	13	18			
No. Batches	3	3				
Data Class	Screening	Interim				
G ₁₂ ^s (Msi)	Mean					
	Minimum					
	Maximum					
	C.V.(%)					
	No. Specimens					
No. Batches						
Data Class						
γ ₁₂ ^{su} (μɛ)	Mean					
	Minimum					
	Maximum					
	C.V.(%)					
	B-value					
	Distribution					
	C ₁					
	C ₂					
	No. Specimens					
No. Batches						
Data Class						

(1) Basis values are presented only for A and B data classes.

4.2.6 T-300 3k/934 plain weave fabricMaterial Description:

Material: T-300 3k/934

Form: Plain weave fabric, fiber areal weight of 196 g/m², typical cured resin content of 34%, typical cured ply thickness of 0.0078 inches.

Processing: Autoclave cure; 355°F, 85-100 psi for 2 hours.

General Supplier Information:

Fiber: T-300 fibers are continuous, no twist carbon filaments made from PAN precursor, surface treated to improve handling characteristics and structural properties. Filament count is 3,000 filaments/tow. Typical tensile modulus is 33×10^6 . Typical tensile strength is 530,000 psi.

Matrix: 934 is a high flow, epoxy resin with good hot/wet properties and meets NASA outgassing requirements.

Maximum Short Term Service Temperature: 350°F (dry), 200°F (wet)

Typical applications: Aircraft primary and secondary structure, critical space structure.

4.2.6 T300 3k/934 plain weave fabric*

MATERIAL: T-300 3k/934 plain weave fabric

**C/Ep 194-PW
T-300/934
Summary**

FORM: Fiberite HMF-322/34 plain weave fabric

FIBER: Toray T-300 3k

MATRIX: Fiberite 934

T_g(dry): 410°FT_g(wet):T_g METHOD: DSC

PROCESSING: Autoclave cure: 355 ± 10°F, 120 - 130 min., 85-100 psig

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

Date of fiber manufacture	Date of testing	
Date of resin manufacture	Date of data submittal	6/88
Date of form manufacture 2/84	Date of analysis	1/93
Date of composite manufacture		

LAMINA PROPERTY SUMMARY

	75°F/A		-65°F/A	250°F/A		160°F/W	250°F/W	
Tension, 1-axis	IS - I		IS - I	SS - S		II - -	II - -	
Tension, 2-axis	II - I		II - I	SS - S		II - -	II - -	
Tension, 3-axis								
Compression, 1-axis	II - -		II - -	SI - -		I - - -	I - - -	
Compression, 2-axis	II - -		II - -	SI - -		I - - -	I - - -	
Compression, 3-axis								
Shear, 12-plane								
Shear, 23-plane								
SB Strength, 31-plane	S - - -		S - - -	S - - -				

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

		Nominal	As Submitted	Test Method
Fiber Density	(g/cm ³)		1.73 - 1.74	
Resin Density	(g/cm ³)	1.30		
Composite Density	(g/cm ³)	1.55	1.54 - 1.57	
Fiber Areal Weight	(g/m ²)	194	1.92 - 2.00	
Fiber Volume	(%)		58 - 60	
Ply Thickness	(in)		0.0073 - 0.0084	

LAMINATE PROPERTY SUMMARY

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		T-300 3k/934 plain weave fabric				Table 4.2.6(a) C/Ep 194-PW T-300/934 Tension, 1-axis [0_t]₁₂ 75/A, -65/A, 250/A Interim, Screening	
RESIN CONTENT:	33-35 wt%	COMP: DENSITY:	1.54-1.57 g/cm ³				
FIBER VOLUME:	58-60 %	VOID CONTENT:	<0.5-1.2%				
PLY THICKNESS:	0.0074-0.0082 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3039-76 (2)		Chord between 20 and 40% of typical ultimate load					
NORMALIZED BY:		Specimen thickness and batch fiber volume to 57% (0.0077 in. CPT)					
Temperature (°F)	75 ambient		-65 ambient		250 ambient		
Moisture Content (%)							
Equilibrium at T, RH							
Source Code	12		12		12		
	Normalized	Measured	Normalized	Measured	Normalized	Measured	
F ₁ ^{tu} (ksi)	Mean	91	94	83	85	109	113
	Minimum	82	85	78	79	104	109
	Maximum	99	100	87	90	114	118
	C.V.(%)	4.1	4.0	3.2	3.3	3.54	3.42
	B-value	(1)	(1)	(1)	(1)	(1)	(1)
	Distribution	Weibull	Weibull	Weibull	Weibull	Normal	Normal
	C ₁	93.0	96	83.7	86	86.0	113
	C ₂	28.2	31	35.8	36	2.86	3.87
	No. Specimens	20		20		5	
	No. Batches	4		4		1	
Data Class	Interim		Interim		Screening		
E ₁ ^t (Msi)	Mean	9.1	9.4	10.	10.	9.3	9.7
	Minimum	8.4	8.7	8.6	9.0	9.1	9.4
	Maximum	9.5	9.9	12	12	10.0	10.7
	C.V.(%)	3.3	3.6	11	10.	4.6	5.6
	No. Specimens	20		20		5	
	No. Batches	4		4		1	
	Data Class	Interim		Interim		Screening	
	Mean						
	No. Specimens						
	No. Batches						
Data Class							
ε ₁ ^{tu} (με)	Mean	9780		8990		11300	
	Minimum	8880		7990		10900	
	Maximum	11200		9800		11800	
	C.V.(%)	5.61		6.07		3.11	
	B-value	(1)		(1)		(1)	
	Distribution	ANOVA		ANOVA		Normal	
	C ₁	577		592		11300	
	C ₂	3.12		3.61		351	
	No. Specimens	20		20		5	
	No. Batches	4		4		1	
Data Class	Interim		Interim		Screening		

(1) Basis values are presented only for A and B data classes.

(2) Width 0.5 inch, speed of testing 0.05 in./in./min, gage length below recommendation

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		T-300 3k/934 plain weave fabric				Table 4.2.6(b) C/Ep 194-PW T-300/934 Tension, 1-axis [0_t]₁₂ 160/W, 250/W Interim	
RESIN CONTENT:	33-35 wt%	COMP: DENSITY:	1.54-1.57 g/cm ³				
FIBER VOLUME:	58-60 %	VOID CONTENT:	<0.5-1.2%				
PLY THICKNESS:	0.0074-0.0082 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3039-76 (2)		Chord between 20 and 40% of typical ultimate load					
NORMALIZED BY:		Specimen thickness and batch fiber volume to 57%					
Temperature (°F)	160		250				
Moisture Content (%)	(1)		(1)				
Equilibrium at T, RH							
Source Code	12		12				
	Normalized	Measured	Normalized	Measured	Normalized	Measured	
F ₁ ^{tu} (ksi)	Mean	96	98	79	82		
	Minimum	84	88	61	66		
	Maximum	104	106	95	97		
	C.V.(%)	5.7	5.11	14	11		
	B-value	(2)	(2)	(2)	(2)		
	Distribution	ANOVA	Weibull	ANOVA	Weibull		
	C ₁	6.0	101	12	86		
	C ₂	4.8	24	5.3	11		
	No. Specimens	15		15			
	No. Batches	3		3			
Data Class	Interim		Interim				
E ₁ ^t (Msi)	Mean	9.8	10.0	9.4	9.7		
	Minimum	8.1	8.6	6.8	7.1		
	Maximum	11.0	11.7	12.0	13.0		
	C.V.(%)	8.7	8.7	17.	18		
	No. Specimens	15		15			
	No. Batches	3		3			
Data Class	Interim		Interim				
ν ₁₂ ^t	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{tu} (με)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

(1) Immersed in water at 160°F for 14 days.

(2) Basis values are presented only for A and B data classes.

(3) Width 0.5 inch, speed of testing 0.05 in./in./min, gage length below recommendation.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		T-300 3k/934 plain weave fabric				Table 4.2.6(c) C/Ep 194-PW T-300/934 Tension, 2-axis [90_r]₁₂ 75/A, -65/A, 250/A Interim, Screening	
RESIN CONTENT:	33-35 wt%	COMP: DENSITY:	1.54-1.57 g/cm ³				
FIBER VOLUME:	58-60 %	VOID CONTENT:	<0.5-1.2%				
PLY THICKNESS:	0.0074-0.0082 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3039-76		Chord between 20 and 40% of typical ultimate load					
NORMALIZED BY:		Specimen thickness and batch fiber volume to 57% (0.0077 in. CPT)					
Temperature (°F)		75		-65		250	
Moisture Content (%)		ambient		ambient		ambient	
Equilibrium at T, RH							
Source Code		12		12		12	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₂ ^{tu} (ksi)	Mean	88	91	80.	82	94	98
	Minimum	80.	82	70.	72	90.	94
	Maximum	97	99	91	95	97	101
	C.V.(%)	5.7	5.5	6.2	6.5	2.6	2.7
	B-value	(1)	(1)	(1)	(1)	(1)	(1)
	Distribution	ANOVA	ANOVA	ANOVA	ANOVA	Normal	Normal
	C ₁	5.4	5.4	5.2	5.7	93.7	97.8
C ₂	3.5	3.4	3.3	3.4	2.47	2.59	
No. Specimens		20		20		5	
No. Batches		4		4		1	
Data Class		Interim		Interim		Screening	
E ₂ ^t (Msi)	Mean	9.0	9.3	9.1	9.5	8.1	8.5
	Minimum	8.3	8.7	8.1	8.3	8.0	8.3
	Maximum	9.9	10.3	10.8	11.1	8.2	8.6
	C.V.(%)	5.0	4.8	9.3	9.2	1.1	1.5
	No. Specimens	20		20		5	
No. Batches	4		4		1		
Data Class	Interim		Interim		Screening		
ν ₂₁ ^t Data Class	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₂ ^{tu} (με)	Mean	9630		9100		11400	
	Minimum	8680		7750		10400	
	Maximum	11100		10700		12400	
	C.V.(%)	6.18		7.44		8.59	
	B-value	(1)		(1)		(1)	
	Distribution	ANOVA		ANOVA		Normal	
	C ₁	616		710		11400	
	C ₂	2.82		3.08		981	
	No. Specimens	20		20		5	
	No. Batches	4		4		1	
Data Class	Interim		Interim		Screening		

(1) Basis values are presented only for A and B data classes.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		T-300 3k/934 plain weave fabric				Table 4.2.6(d) C/Ep 194-PW T-300/934 Tension, 2-axis [90_r]₁₂ 160/W, 250/W Interim	
RESIN CONTENT:	33-35 wt%	COMP: DENSITY:	1.54-1.57 g/cm ³				
FIBER VOLUME:	58-60 %	VOID CONTENT:	<0.5-1.2%				
PLY THICKNESS:	0.0074-0.0082 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3039-76		Chord between 20 and 40% of typical ultimate load					
NORMALIZED BY:		Specimen thickness and batch fiber volume to 57% (0.0077 in. CPT)					
Temperature (°F)	160		250				
Moisture Content (%)	(1)		(1)				
Equilibrium at T, RH							
Source Code	12		12				
	Normalized	Measured	Normalized	Measured	Normalized	Measured	
F ₂ ^{tu} (ksi)	Mean	97	100	81	83		
	Minimum	90.	92	73	75		
	Maximum	111	113	89	91		
	C.V.(%)	6.8	6.3	5.1	4.8		
	B-value	(2)	(2)	(2)	(2)		
	Distribution	ANOVA	ANOVA	ANOVA	ANOVA		
	C ₁	7.3	6.8	4.4	4.2		
	C ₂	4.8	4.5	4.5	4.2		
	No. Specimens	15		15			
	No. Batches	3		3			
Data Class	Interim		Interim				
E ₂ ^t (Msi)	Mean	10.	10.	9.9	10.		
	Minimum	8.0	8.2	8.2	8.5		
	Maximum	11.8	12.1	11.9	12.1		
	C.V.(%)	11	11	11	11		
	No. Specimens	15		15			
No. Batches	3		3				
Data Class	Interim		Interim				
ν ₂₁ ^t	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₂ ^{tu} (με)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

(1) Immersed in water at 160°F for 14 days.

(2) Basis values are presented only for A and B data classes.

Volume 2, Chapter 4 Carbon Fiber Composites

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		T-300 3k/934 plain weave fabric				Table 4.2.6(e) C/Ep 194-PW T-300/934 Compression, 1-axis [0]₁₂ 75/A, -65/A, 250/A Interim, Screening	
RESIN CONTENT:	33-35 wt%	COMP: DENSITY:	1.54-1.57 g/cm ³				
FIBER VOLUME:	58-60 %	VOID CONTENT:	<0.5-1.2%				
PLY THICKNESS:	0.0074-0.0082 in.						
TEST METHOD:		MODULUS CALCULATION:					
SACMA SRM 1-88		Chord between 20 and 40% of typical ultimate load					
NORMALIZED BY:		Specimen thickness and batch fiber volume to 57% (0.0077 in. CPT)					
Temperature (°F)		75		-65		250	
Moisture Content (%)		ambient		ambient		ambient	
Equilibrium at T, RH							
Source Code		12		12		12	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{cu} (ksi)	Mean	95	98	104	108	100.	105
	Minimum	83	87	87	90.	94	98
	Maximum	120	125	133	139	107	111
	C.V.(%)	10.	10.	13	14	5.6	5.1
	B-value	(1)	(1)	(1)	(1)	(1)	(1)
	Distribution	ANOVA	ANOVA	ANOVA	ANOVA	Normal	Normal
	C ₁	10.	11	15	16	100.	105
	C ₂	3.9	3.9	3.7	3.8	5.64	5.4
	No. Specimens	20		20		5	
	No. Batches	4		4		1	
Data Class		Interim		Interim		Screening	
E ₁ ^c (Msi)	Mean	8.4	8.8	8.2	8.6	8.4	8.9
	Minimum	7.7	8.0	7.4	7.8	7.9	8.1
	Maximum	9.0	9.4	8.9	9.7	10.0	10.1
	C.V.(%)	5.1	5.3	5.1	5.7	6.3	6.4
	No. Specimens	20		20		19	
	No. Batches	4		4		4	
	Data Class	Interim		Interim		Interim	
	Mean						
	No. Specimens						
	No. Batches						
Data Class							
v ₁₂ ^c	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
ε ₁ ^{cu} (με)	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
	Data Class						

(1) Basis values are presented only for A and B data classes.

(2) Tab thickness of 0.112 - 0.120 inch is larger than 0.070 inch nominal thickness per method.

(3) Specimen thickness of 0.09 - 0.10 inch is less than nominal 0.12 inch thickness per method.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		T-300 3k/934 plain weave fabric				Table 4.2.6(f) C/Ep 194-PW T-300/934 Compression, 1-axis [0_t]₁₂ 160/W, 250/W Interim	
RESIN CONTENT:	33-35 wt%	COMP: DENSITY:	1.54-1.57 g/cm ³				
FIBER VOLUME:	58-60 %	VOID CONTENT:	<0.5-1.2%				
PLY THICKNESS:	0.0074-0.0082 in.						
TEST METHOD:		MODULUS CALCULATION:					
SACMA SRM 1-88		Chord between 20 and 40% of typical ultimate load					
NORMALIZED BY:		Specimen thickness and batch fiber volume to 57% (0.0077 in. CPT)					
Temperature (°F)		160		250			
Moisture Content (%)		(1)		(1)			
Equilibrium at T, RH							
Source Code		12		12			
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{cu} (3) (ksi)	Mean	74	76	44	46		
	Minimum	67	68	40	41		
	Maximum	81	84	49	51		
	C.V.(%)	6.9	5.6	6.2	6.2		
	B-value	(2)	(2)	(2)	(2)		
	Distribution	ANOVA	ANOVA	Weibull	Weibull		
	C ₁	5.6	6.2	45.4	46.8		
	C ₂	4.9	5.0	17.4	16.9		
	No. Specimens	15		15			
	No. Batches	3		3			
Data Class		Interim		Interim			
E ₁ ^c (Msi)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
v ₁₂ ^c	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{cu} (με)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

(1) Immersed in water at 160°F for 14 days.

(2) Basis values are presented only for A and B data classes.

(3) Tab thickness of 0.112 - 0.120 inch is larger than 0.070 inch nominal thickness per method.

Volume 2, Chapter 4 Carbon Fiber Composites

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		T-300 3k/934 plain weave fabric				Table 4.2.6(g) C/Ep 194-PW T-300/934 Compression, 2-axis [90_i]₁₂ 75/A, -65/A, 250/A Interim, Screening	
RESIN CONTENT:	33-35 wt%	COMP: DENSITY:	1.54-1.57 g/cm ³				
FIBER VOLUME:	58-60 %	VOID CONTENT:	<0.5-1.2%				
PLY THICKNESS:	0.0074-0.0082 in.						
TEST METHOD:		MODULUS CALCULATION:					
SACMA SRM 1-88		Chord between 20 and 40% of typical ultimate load					
NORMALIZED BY:		Specimen thickness and batch fiber volume to 57% (0.0077 in. CPT)					
Temperature (°F)	75 ambient		-65 ambient		250 ambient		
Moisture Content (%)							
Equilibrium at T, RH							
Source Code	12		12		12		
	Normalized	Measured	Normalized	Measured	Normalized	Measured	
F ₂ ^{cu} (2) (ksi)	Mean	90.	93	103	106	82	85
	Minimum	81	85	94	98	77	81
	Maximum	100.	104	116	121	84	88
	C.V.(%)	5.9	6.0	6.2	6.1	3.4	3.4
	B-value	(4)	(4)	(1)	(1)	(1)	(1)
	Distribution	ANOVA	ANOVA	Normal	Normal	Normal	Normal
	C ₁	5.6	5.9	103	106	81.7	85.3
	C ₂	3.2	3.2	6.18	6.4	2.74	2.86
	No. Specimens	20		20		5	
	No. Batches	4		4		1	
Data Class	Interim		Interim		Screening		
E ₂ ^c (3) (Msi)	Mean	8.3	8.6	8.4	8.8	8.8	9.0
	Minimum	7.4	7.7	7.5	7.7	7.9	8.1
	Maximum	9.3	9.5	9.0	9.4	10.2	10.6
	C.V.(%)	7.0	6.6	5.1	5.5	8.4	8.9
	No. Specimens	20		20		20	
No. Batches	4		4		4		
Data Class	Interim		Interim		Interim		
ν ₂₁ ^c	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₂ ^{cu} (με)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

(1) Basis values are presented only for A and B data classes.

(2) Tab thickness of 0.112-0.120 inch is larger than 0.070 inch nominal thickness per method.

(3) Specimen thickness of 0.09-0.10 inch is less than nominal 0.120 inch thickness per method.

(4) B-basis values calculated from less than five batches of data using the ANOVA method are not presented.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		T-300 3k/934 plain weave fabric				Table 4.2.6(h) C/Ep 194-PW T-300/934 Compression, 2-axis [90_f]₁₂ 160/W, 250/W Interim	
RESIN CONTENT:	33-35 wt%	COMP: DENSITY:	1.54-1.57 g/cm ³				
FIBER VOLUME:	58-60 %	VOID CONTENT:	<0.5-1.2%				
PLY THICKNESS:	0.0074-0.0082 in.						
TEST METHOD:		MODULUS CALCULATION:					
SACMA SRM 1-88		Chord between 20 and 40% of typical ultimate load					
NORMALIZED BY:		Specimen thickness and batch fiber volume to 57% (0.0077 in. CPT)					
Temperature (°F)	160		250				
Moisture Content (%)	wet		wet				
Equilibrium at T, RH	(1)		(1)				
Source Code	12		12				
	Normalized	Measured	Normalized	Measured	Normalized	Measured	
F ₂ ^{cu} (3) (ksi)	Mean	75	77	46	47		
	Minimum	63	66	38	39		
	Maximum	81	83	59	60		
	C.V.(%)	7.2	6.5	11	11		
	B-value	(2)	(2)	(2)	(2)		
	Distribution	ANOVA	ANOVA	ANOVA	ANOVA		
	C ₁	6.0	5.4	5.9	5.8		
	C ₂	5.0	4.7	5.1	5.0		
	No. Specimens	15		15			
	No. Batches	3		3			
Data Class	Interim		Interim				
E ₂ ^c (Msi)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
ν ₂₁ ^c	No. Specimens						
	No. Batches						
	Data Class						
ε ₂ ^{cu} (με)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

(1) Immersed in water at 160°F for 14 days.

(2) Basis values are presented only for A and B data classes.

(3) Tab thickness of 0.112-0.120 inch is larger than 0.070 nominal thickness per method.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		T-300 3k/934 plain weave fabric			Table 4.2.6(i) C/Ep 194-PW T-300/934 SBS, 31-plane [0]_{i12} 75/A, -65/A, 250/A Screening	
RESIN CONTENT:	33-35 wt%	COMP: DENSITY:	1.54-1.57 g/cm ³			
FIBER VOLUME:	58-60 %	VOID CONTENT:	<0.5-1.2%			
PLY THICKNESS:	0.0074-0.0082 in.					
TEST METHOD:		MODULUS CALCULATION:				
ASTM D-2344-68 (1)		Chord between 20 and 40% of typical ultimate load				
NORMALIZED BY:		Not normalized				
Temperature (°F)		75	-65	250		
Moisture Content (%)		ambient	ambient	ambient		
Equilibrium at T, RH						
Source Code		12	12	12		
F ₃₁ ^{sbs} (ksi)	Mean	12.0	11.9	9.2		
	Minimum	10.5	10.0	9.1		
	Maximum	13.4	13.9	9.5		
	C.V.(%)	6.89	8.38	2.1		
	B-value	(2)	(2)	(2)		
	Distribution	ANOVA	ANOVA	Normal		
	C ₁	1.07	0.901	9.2		
	C ₂	3.41	3.71	0.20		
	No. Specimens	20	20	5		
	No. Batches	4	4	1		
Data Class		Screening	Screening	Screening		

- (1) Length-to-thickness ratio is approximately 11.
- (2) Short beam strength test data are approved for Screening Data Class only.

4.2.7 Celion 12k/938 unidirectional tapeMaterial Description:

Material: Celion-12k/938

Form: Unidirectional tape, fiber areal weight of 145 g/m², typical cured resin content of 28-40%, typical cured ply thickness of 0.0040-0.0073 inches.

Processing: Autoclave cure; 355°F, 85-100 psi for 2 hours.

General Supplier Information:

Fiber: Celion fibers are continuous carbon filaments made from PAN precursor. Filament count is 12,000 filaments/tow. Typical tensile modulus is 34×10^6 psi. Typical tensile strength is 515,000 psi.

Matrix: 938 is an epoxy resin. 10 days out-time at 72°F.

Maximum Short Term Service Temperature: 350°F (dry), 200°F (wet)

Typical applications: Commercial and military structural applications.

4.2.7 Celion 12k/938 unidirectional tape*

MATERIAL: Celion 12k/938 unidirectional tape

**C/Ep 145-UT
Celion 938
Summary**

FORM: Fiberite Hy-E 1638N unidirectional tape prepreg

FIBER: Celanese Celion 12k, EP06, no twist MATRIX: Fiberite 938

T_g(dry): T_g(wet): T_g METHOD:

PROCESSING: Autoclave cure: 355 ± 10°F, 120 - 130 min., 85 - 100 psig

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

Date of fiber manufacture	5/85	Date of testing	7/85
Date of resin manufacture		Date of data submittal	6/88
Date of form manufacture		Date of analysis	1/93
Date of composite manufacture			

LAMINA PROPERTY SUMMARY

	75°F/A		-67°F/A	250°F/A		180°F/W		
Tension, 1-axis	IIII		SSSS	IISI		IISI		
Tension, 2-axis	II-I		II-I	SS-S		II-I		
Tension, 3-axis								
Compression, 1-axis	II--		II--	II--		II--		
Compression, 2-axis	II--		II--	SI--		I---		
Compression, 3-axis								
Shear, 12-plane	I---		S---	S---		I---		
Shear, 23-plane								
Shear, 31-plane								
SB Strength, 31-plane	I---							

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

		Nominal	As Submitted	Test Method
Fiber Density	(g/cm ³)	1.78		
Resin Density	(g/cm ³)	1.30		
Composite Density	(g/cm ³)		1.54 - 1.61	
Fiber Areal Weight	(g/m ²)	145	144 - 147	
Fiber Volume	(%)		52 - 65	
Ply Thickness	(in)		0.0040 - 0.0073	

LAMINATE PROPERTY SUMMARY

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		Celion 12k/938 unidirectional tape				Table 4.2.7(a) C/Ep 145-UT Celion 12k/938 Tension, 1-axis [0]₇ 75/A, -67/A, 250/A Interim, Screening	
RESIN CONTENT:	28-36 wt%	COMP: DENSITY:	1.55-1.61 g/cm ³				
FIBER VOLUME:	56-65 %	VOID CONTENT:	<1.1%				
PLY THICKNESS:	0.0040-0.0063 in.						
TEST METHOD:	MODULUS CALCULATION:						
ASTM D 3039-76		Secant at 25% of typical ultimate load					
NORMALIZED BY:		Fiber volume to 60% (0.0053 in. CPT)					
Temperature (°F)		75		-67		250	
Moisture Content (%)		ambient		ambient		ambient	
Equilibrium at T, RH							
Source Code		12		12		12	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{tu} (ksi)	Mean	273	271	262	278	309	319
	Minimum	223	207	235	254	295	306
	Maximum	324	319	290	303	328	337
	C.V.(%)	7.56	9.76	7.67	6.25	3.00	2.82
	B-value	(1)	(1)	(1)	(1)	(1)	(1)
	Distribution	ANOVA	ANOVA	ANOVA	ANOVA	Weibull	Weibull
	C ₁	21.0	29.3	25.1	20.9	314	323
	C ₂	2.42	4.36	18.0	16.2	34.5	36.1
No. Specimens		102		10		15	
No. Batches		3		2		3	
Data Class		Interim		Screening		Interim	
E ₁ ^t (Msi)	Mean	19.7	19.5	19.0	20.2	20.1	20.7
	Minimum	16.9	16.5	17.3	18.1	16.9	17.9
	Maximum	23.1	21.8	20.3	22.0	23.4	23.4
	C.V.(%)	5.22	5.59	4.94	5.94	9.12	7.49
	No. Specimens	102		10		15	
	No. Batches	3		2		3	
	Data Class	Interim		Screening		Interim	
ν ₁₂ ^t (2)	Mean	0.317		0.279		0.280	
	No. Specimens	102		10		10	
	No. Batches	3		2		2	
	Data Class	Interim		Screening		Interim	
ε ₁ ^{tu} (με)	Mean	13100		12800		14800	
	Minimum	10600		11500		12900	
	Maximum	14800		14000		16100	
	C.V.(%)	6.95		6.72		5.81	
	B-value	(1)		(1)		(1)	
	Distribution	ANOVA		ANOVA		Weibull	
	C ₁	946		1060		15100	
	C ₂	3.14		17.2		21.4	
No. Specimens		102		10		15	
No. Batches		3		2		3	
Data Class		Interim		Screening		Interim	

(1) Basis values are presented only for A and B data classes.

(2) Poisson's ratio measured at 25% of typical ultimate load.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		Celion 12k/938 unidirectional tape				Table 4.2.7(b) C/Ep 145-UT Celion 938 Tension, 1-axis [0]₇ 180/W Interim, Screening	
RESIN CONTENT:	28-36 wt%	COMP: DENSITY:	1.55-1.59 g/cm ³				
FIBER VOLUME:	56-64 %	VOID CONTENT:	<1.4%				
PLY THICKNESS:	0.0044-0.0063 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3039-76		Secant at 25% of typical ultimate load					
NORMALIZED BY:		Fiber volume to 60% (0.0053 in. CPT)					
Temperature (°F)	180						
Moisture Content (%)	1.1						
Equilibrium at T, RH	(1)						
Source Code	12						
	Normalized	Measured	Normalized	Measured	Normalized	Measured	
F ₁ ^{tu} (ksi)	Mean	277	282				
	Minimum	236	219				
	Maximum	307	328				
	C.V.(%)	8.89	14.3				
	B-value	(3)	(3)				
	Distribution	ANOVA	ANOVA				
	C ₁	27.7	46.7				
	C ₂	5.36	5.89				
	No. Specimens	15					
	No. Batches	3					
Data Class	Interim						
E ₁ ^t (Msi)	Mean	18.9	19.2				
	Minimum	17.7	16.4				
	Maximum	20.5	21.9				
	C.V.(%)	4.81	9.74				
	No. Specimens	15					
	No. Batches	3					
Data Class	Interim						
ν ₁₂ ^t (2)	Mean		0.345				
	No. Specimens	14					
	No. Batches	3					
	Data Class	Screening					
ε ₁ ^{tu} (με)	Mean		14000				
	Minimum		11800				
	Maximum		15700				
	C.V.(%)		8.13				
	B-value		(3)				
	Distribution		ANOVA				
	C ₁		1180				
	C ₂		3.36				
	No. Specimens	15					
	No. Batches	3					
Data Class	Interim						

(1) Conditioned at 160°F, 88% RH until weight gain was between 1.0 and 1.2%.

(2) Poisson's ratio measured at 25% of typical ultimate load.

(3) Basis values are presented only for A and B data classes.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		Celion 12k/938 unidirectional tape				Table 4.2.7(c) C/Ep 145-UT Celion 938 Tension, 2-axis [90]₂₀ 75/A, -67/A, 250/A, 180/W Interim, Screening	
RESIN CONTENT:	32-37 wt%	COMP: DENSITY:	1.55-1.58 g/cm ³				
FIBER VOLUME:	55-60 %	VOID CONTENT:	<1.3%				
PLY THICKNESS:	0.0053-0.0064 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3039-76		Secant at 25% of typical ultimate load					
NORMALIZED BY:		Not normalized					
Temperature (°F)	75	-67	250	180			
Moisture Content (%)	ambient	ambient	ambient	1.1			
Equilibrium at T, RH				(1)			
Source Code	12	12	12	12			
Mean	9.6	9.5	8.8	5.8			
Minimum	7.5	8.5	7.1	5.0			
Maximum	13.9	10.4	10.7	6.6			
C.V.(%)	13	6.6	11	8.4			
F_2^{tu}	(2)	(2)	(2)	(2)			
Distribution	ANOVA	Weibull	Weibull	ANOVA			
C ₁	1.3	9.8	9.2	0.54			
C ₂	2.7	18	10	5.1			
No. Specimens	101	15	10	15			
No. Batches	3	3	2	3			
Data Class	Interim	Interim	Screening	Interim			
Mean	1.35	1.35	1.22	1.19			
Minimum	1.14	1.25	0.94	1.03			
Maximum	1.82	1.51	1.52	1.36			
C.V.(%)	9.29	4.96	12.5	8.65			
E_2^t							
(Msi)							
No. Specimens	101	15	10	15			
No. Batches	3	3	2	3			
Data Class	Interim	Interim	Screening	Interim			
Mean							
ν_{21}^t							
No. Specimens							
No. Batches							
Data Class							
Mean	7200	6700	7600	4900			
Minimum	1300	5500	6900	4200			
Maximum	9500	7900	9300	5800			
C.V.(%)	15	9.2	9.5	8.6			
ϵ_2^{tu}	(2)	(2)	(2)	(2)			
Distribution	Nonpara.	Weibull	Normal	Weibull			
C ₁	5	7000	7600	5100			
C ₂		12	720	12			
No. Specimens	97	15	10	15			
No. Batches	3	3	2	3			
Data Class	Interim	Interim	Screening	Interim			

(1) Conditioned at 160°F, 88% RH until weight gain was between 1.0 and 1.2%.

(2) Basis values are presented only for A and B data classes.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		Celion 12k/938 unidirectional tape				Table 4.2.7(d) C/Ep 145-UT Celion 938 Compression, 1-axis [0]₇ 75/A, -67/A, 250/A Interim	
RESIN CONTENT:	26-35 wt%	COMP: DENSITY:	1.56-1.61 g/cm ³				
FIBER VOLUME:	57-67 %	VOID CONTENT:	<1.5%				
PLY THICKNESS:	0.0046-0.0073 in.						
TEST METHOD:		MODULUS CALCULATION:					
SACMA SRM 1-88		Chord modulus between 20% and 40% of typical ultimate load					
NORMALIZED BY:		Fiber volume to 60% (0.0053 in. CPT)					
Temperature (°F)		75		-67		250	
Moisture Content (%)		ambient		ambient		ambient	
Equilibrium at T, RH							
Source Code		12		12		12	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F_1^{cu} (ksi)	Mean	201	198	240	240	195	201
	Minimum	166	172	204	216	180	179
	Maximum	255	246	286	276	214	229
	C.V.(%)	9.88	8.99	11.3	8.25	5.48	7.26
	B-value	(1)	(1)	(1)	(1)	(1)	(1)
	Distribution	ANOVA	ANOVA	ANOVA	ANOVA	ANOVA	ANOVA
	C ₁	21.4	18.7	31.1	21.9	11.9	16.7
	C ₂	3.93	3.35	5.59	4.97	5.07	5.59
No. Specimens		102		15		15	
No. Batches		3		3		3	
Data Class		Interim		Interim		Interim	
E_1^c (Msi)	Mean	17.2	18.2	18.8	19.1	18.1	18.1
	Minimum	14.7	15.0	16.6	16.6	17.1	16.3
	Maximum	21.0	21.5	21.7	22.5	19.1	20.3
	C.V.(%)	6.87	7.64	7.14	9.74	3.73	7.07
	No. Specimens	97		15		15	
No. Batches		3		3		3	
Data Class		Interim		Interim		Interim	
ν_{12}^c	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ϵ_1^{cu} (µε)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
No. Specimens							
No. Batches							
Data Class							

(1) Basis values are presented only for A and B data classes.

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MATERIAL:		Celion 12k/938 unidirectional tape				Table 4.2.7(e) C/Ep 145-UT Celion 938 Compression, 1-axis [0]₇ 180/W Interim	
RESIN CONTENT:	28-34 wt%	COMP: DENSITY:	1.58-1.60 g/cm ³				
FIBER VOLUME:	58-65 %	VOID CONTENT:	<1.0%				
PLY THICKNESS:	0.0044-0.0073 in.						
TEST METHOD:		MODULUS CALCULATION:					
SACMA SRM 1-88		Chord modulus between 20% and 40% of typical ultimate load					
NORMALIZED BY:		Fiber volume to 60% (0.0053 in. CPT)					
Temperature (°F)		180					
Moisture Content (%)		1.1					
Equilibrium at T, RH		(1)					
Source Code		12					
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F_1^{cu} (ksi) Mean Minimum Maximum C.V.(%) B-value Distribution C₁ C₂ No. Specimens No. Batches Data Class	185	188					
	157	160					
	206	217					
	7.40	7.55					
	(2)	(2)					
	Weibull	Weibull					
	191	194					
	16.3	14.4					
	15						
3							
Interim							
E_1^{c} (Msi) Mean Minimum Maximum C.V.(%) No. Specimens No. Batches Data Class	18.2	19.2					
	15.7	15.8					
	22.3	23.7					
	8.88	10.5					
	15						
3							
Interim							
ν_{12}^{c} Mean No. Specimens No. Batches Data Class							
ϵ_1^{cu} (μϵ) Mean Minimum Maximum C.V.(%) B-value Distribution C₁ C₂ No. Specimens No. Batches Data Class							

(1) Conditioned at 160°F, 88% RH until weight gain was between 1.0 and 1.2%.

(2) Basis values are presented only for A and B data classes.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL: Celion 12k/938 unidirectional tape RESIN CONTENT: 28-34 wt% COMP: DENSITY: 1.57-1.61 g/cm ³ FIBER VOLUME: 58-65 % VOID CONTENT: <1.4% PLY THICKNESS: 0.0044-0.0064 in. TEST METHOD: MODULUS CALCULATION: ASTM D 3518-76 NORMALIZED BY: Not normalized					
Table 4.2.7(f) C/Ep 145-UT Celion 938 Shear, 12-plane [±45]_{2S} 75/A, -65/A, 250/A, 180/W Interim, Screening					
Temperature (°F)	75	-67	250	180	
Moisture Content (%)	ambient	ambient	ambient	1.1	
Equilibrium at T, RH				(1)	
Source Code	12	12	12	12	
F_{12}^{SU} (ksi)	Mean	14	16	14	14
	Minimum	11	14	13	13
	Maximum	16	18	15	14
	C.V.(%)	7.3	10.	6.1	3.6
	B-value	(2)	(2)	(2)	(2)
	Distribution	ANOVA	ANOVA	Weibull	ANOVA
	C ₁	1.1	1.8	14	0.53
	C ₂	4.4	5.8	19	4.6
	No. Specimens	102	14	14	15
	No. Batches	3	3	3	3
G_{12}^S (Msi)	Mean				
	Minimum				
	Maximum				
	C.V.(%)				
γ_{12}^{SU} (µε)	Mean				
	Minimum				
	Maximum				
	C.V.(%)				
γ_{12}^{SU} (µε)	B-value				
	Distribution				
	C ₁				
	C ₂				
γ_{12}^{SU} (µε)	No. Specimens				
	No. Batches				
	Data Class				

(1) Conditioned at 160°F, 88% RH until weight gain was between 1.0 and 1.2%.

(2) Basis values are presented only for A and B data classes.

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		Celion 12k/938 unidirectional tape		Table 4.2.7(g) C/Ep 145-UT Celion 938 SBS, 31-plane [0]₁₄ 75/A Screening	
RESIN CONTENT:	31-40 wt%	COMP: DENSITY:	1.54-1.59 g/cm ³		
FIBER VOLUME:	52-62 %	VOID CONTENT:	<1.0%		
PLY THICKNESS:	0.0051-0.0064 in.				
TEST METHOD:	MODULUS CALCULATION:				
ASTM D 2344-67					
NORMALIZED BY:		Not normalized			
Temperature (°F)	75				
Moisture Content (%)	ambient				
Equilibrium at T, RH					
Source Code	12				
F ₃₁ ^{sbs} (ksi)	Mean	18.3			
	Minimum	16.6			
	Maximum	19.7			
	C.V.(%)	3.29			
	B-value	(1)			
	Distribution	ANOVA			
	C ₁	0.619			
	C ₂	2.76			
	No. Specimens	102			
No. Batches	3				
Data Class	Screening				

(1) Short beam strength test data are approved for Screening Data Class only.

4.2.8 AS4 12k/3502 unidirectional tape

Material Description:

Material:	AS4-12k/3502
Form:	Unidirectional tape, fiber areal weight of 150 g/m ² , typical cured resin content of 32-45%, typical cured ply thickness of 0.0052 inches.
Processing:	Autoclave cure; 275° F, 85 psi for 45 minutes; 350°F, 85 psi, hold for 2 hours. Post cure at 400°F to develop optimum 350°F properties.

General Supplier Information:

Fiber:	AS4 fibers are continuous high strength, high strain, standard, modulus carbon filaments made from PAN precursor. The fibers are surface treated to improve handling characteristics and structural properties, offering good drape. Filament count is 12,000 filaments/tow. Typical tensile modulus is 34 x 10 ⁶ psi. Typical tensile strength is 550,000 psi.
Matrix:	3502 is an epoxy resin. Good tack; up to 10 days out-time at ambient temperature.
Maximum Short Term Service Temperature:	350°F (dry), 180°F (wet)
Typical applications:	Primary and secondary structural applications on commercial and military aircraft.

Data Analysis Summary

1. Where noted, only normalized data were made available for analysis.

4.2.8 AS4 12k/3502 unidirectional tape*

				C/Ep 147-UT AS4/3502 Summary	
MATERIAL:	AS4 12k/3502 unidirectional tape				
FORM:	Hercules AS4/3502 unidirectional tape prepreg				
FIBER:	Hercules AS4 12k, surface-treated, no twist		MATRIX:	Hercules 3502	
T _g (dry):	407°F	T _g (wet):	T _g METHOD:	TMA	
PROCESSING:	Autoclave cure: 280 ± 5°F, 90 min, 85+15-0 psi; 350°F, 120 min.				

* Additional data set found on p. 73.

Date of fiber manufacture	4/83 - 6/83	Date of testing	11/83 - 7/84
Date of resin manufacture	6/83	Date of data submittal	12/93, 5/94
Date of form manufacture	6/83 - 7/83	Date of analysis	8/94
Date of composite manufacture	8/83 - 5/84		

LAMINA PROPERTY SUMMARY

	75°F/A		-65°F/A		180°F/W	250°F/W		
Tension, 1-axis	BM - -		BM - -		BM - -	BM - -		
Tension, 2-axis	BM - -		BM - -		BM - -	BM - -		
Tension, 3-axis								
Compression, 1-axis	BM - -		II - -		BM - -	BM - -		
Compression, 2-axis	BM - -		II - -		BM - -	BM - -		
Compression, 3-axis								
Shear, 12-plane	BM - -		bM - -		BM - -	II - -		
Shear, 23-plane								
Shear, 31-plane								

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

		Nominal	As Submitted	Test Method
Fiber Density	(g/cm ³)	1.79	1.77 - 1.80	
Resin Density	(g/cm ³)	1.26	1.24 - 1.29	
Composite Density	(g/cm ³)	1.57	1.56 - 1.59	
Fiber Areal Weight	(g/m ²)	147	146 - 150	
Fiber Volume	(%)	58	55 - 60	
Ply Thickness	(in)	0.0055	0.0049 - 0.0061	

LAMINATE PROPERTY SUMMARY

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

MATERIAL:		AS4 12k/3502 unidirectional tape				Table 4.2.8(a) C/Ep 147-UT AS4/3502 Tension, 1-axis [0]₈ 75/A, -65/A, 180/W B30, Mean	
RESIN CONTENT:	30-33 wt%	COMP: DENSITY:	1.56-1.59 g/cm ³				
FIBER VOLUME:	59-61 %	VOID CONTENT:	0.0-1.0%				
PLY THICKNESS:	0.0049-0.0061 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3039-76		Linear portion of curve					
NORMALIZED BY:		Specimen thickness and batch fiber volume to 60% (0.0055 in. CPT)					
Temperature (°F)		75		-65		180	
Moisture Content (%)		ambient		ambient		1.1 - 1.3	
Equilibrium at T, RH						(1)	
Source Code		49		49		49	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{tu} (ksi)	Mean	258		231		261	
	Minimum	191		162		140	
	Maximum	317		285		317	
	C.V.(%)	9.83		13.4		14.8	
	B-value	205		173		200	
	Distribution	Weibull	(2)	Weibull	(2)	Weibull	(2)
	C ₁	269		244		276	
	C ₂	11.2		8.82		9.39	
No. Specimens		36		38		40	
No. Batches		5		5		5	
Data Class		B30		B30		B30	
E ₁ ^t (Msi)	Mean	19.3		19.2		19.7	
	Minimum	15.6		16.8		15.1	
	Maximum	21.0		23.2		23.3	
	C.V.(%)	5.74		6.31		6.87	
		(2)		(2)		(2)	
No. Specimens		36		38		40	
No. Batches		5		5		5	
Data Class		Mean		Mean		Mean	
ν ₁₂ ^t	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{tu} (με)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

(1) Conditioned at 160°F, 95-100% relative humidity until the moisture content was between 1.1 and 1.3%.

(2) Only normalized data were made available for analysis.

MATERIAL:		AS4 12k/3502 unidirectional tape				Table 4.2.8(b) C/Ep 147-UT AS4/3502 Tension, 1-axis [0]₈ 250/W B30, Mean	
RESIN CONTENT:	30-33 wt%	COMP: DENSITY:	1.56-1.59 g/cm ³				
FIBER VOLUME:	59-61 %	VOID CONTENT:	0.0-1.0%				
PLY THICKNESS:	0.0055-0.0059 in.						
TEST METHOD:	ASTM D 3039-76			MODULUS CALCULATION:			
				Linear portion of curve			
NORMALIZED BY:		Specimen thickness and batch fiber volume to 60% (0.0055 in. CPT)					
Temperature (°F)		250					
Moisture Content (%)		1.1 - 1.3					
Equilibrium at T, RH		(1)					
Source Code		49					
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{tu} (ksi)	Mean	256	(2)				
	Minimum	200					
	Maximum	301					
	C.V.(%)	9.39					
	B-value	191					
	Distribution	ANOVA					
	C ₁	25.0					
	C ₂	2.61					
No. Specimens	30						
No. Batches	5						
Data Class	B30						
E ₁ ^t (Msi)	Mean	20.1	(2)				
	Minimum	17.8					
	Maximum	23.9					
	C.V.(%)	7.32					
	No. Specimens	30					
No. Batches	5						
Data Class	Mean						
ν ₁₂ ^t	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{tu} (με)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
No. Specimens							
No. Batches							
Data Class							

(1) Conditioned at 160°F, 95-100% relative humidity until the moisture content was between 1.1 and 1.3%.

(2) Only normalized data were made available for analysis.

MATERIAL:		AS4 12k/3502 unidirectional tape				Table 4.2.8(c) C/Ep 147-UT AS4/3502 Tension, 2-axis [90]₂₄ 75/A, -65/A, 180/W, 250/W B30, Mean
RESIN CONTENT:	31-33 wt%	COMP: DENSITY:	1.56-1.59 g/cm ³			
FIBER VOLUME:	59-60 %	VOID CONTENT:	0.0-1.0%			
PLY THICKNESS:	0.0052-0.0059 in.					
TEST METHOD:		MODULUS CALCULATION:				
ASTM D 3039-76		Linear portion of curve				
NORMALIZED BY:		Not normalized				
Temperature (°F)		75	-65	180	250	
Moisture Content (%)		ambient	ambient	1.1 - 1.3	1.1 - 1.3	
Equilibrium at T, RH				(1)	(1)	
Source Code		49	49	49	49	
F ₂ ^t (ksi)	Mean	7.76	6.65	4.39	2.68	
	Minimum	6.26	2.48	3.52	2.13	
	Maximum	10.2	8.93	5.20	3.40	
	C.V.(%)	10.7	18.0	8.44	12.3	
	B-value	6.28	4.57	3.46	1.65	
	Distribution	Normal	Weibull	ANOVA	ANOVA	
	C ₁	7.76	7.09	0.380	0.348	
	C ₂	0.832	7.20	2.43	2.94	
	No. Specimens	30	30	30	30	
	No. Batches	5	5	5	5	
	Data Class	B30	B30	B30	B30	
E ₂ ^t (Msi)	Mean	1.35	1.44	1.21	0.958	
	Minimum	1.28	1.32	1.14	0.912	
	Maximum	1.49	1.58	1.35	1.06	
	C.V.(%)	4.26	4.16	4.02	3.61	
	No. Specimens	30	30	30	30	
	No. Batches	5	5	5	5	
	Data Class	Mean	Mean	Mean	Mean	
ν ₂₁ ^t	Mean					
	No. Specimens					
	No. Batches					
	Data Class					
ε ₂ ^t (με)	Mean					
	Minimum					
	Maximum					
	C.V.(%)					
	B-value					
	Distribution					
	C ₁					
	C ₂					
	No. Specimens					
	No. Batches					
	Data Class					

(1) Conditioned at 160°F, 95-100% relative humidity until the moisture content was between 1.1 and 1.3%.

MATERIAL:		AS4 12k/3502 unidirectional tape				Table 4.2.8(d) C/Ep 147-UT AS4/3502 Compression, 1-axis [0]₁₉ 75/A, -65/A, 180/W B30, Mean, Interim	
RESIN CONTENT:	33-37 wt%	COMP: DENSITY:	1.56-1.57 g/cm ³				
FIBER VOLUME:	55-59 %	VOID CONTENT:	0.0%				
PLY THICKNESS:	0.0054-0.0060 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3410A-75		Linear portion of curve					
NORMALIZED BY:		Specimen thickness and batch fiber volume to 60% (0.0055 in. CPT)					
Temperature (°F)		75		-65		180	
Moisture Content (%)		ambient		ambient		1.1 - 1.3	
Equilibrium at T, RH						(1)	
Source Code		49		49		49	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{cu} (ksi)	Mean	204		233		176	
	Minimum	168		207		146	
	Maximum	226		252		200	
	C.V.(%)	6.45		5.63		6.31	
	B-value	171		(2)		145	
	Distribution	ANOVA		Weibull		ANOVA	
	C ₁					(3)	
	C ₂	13.5		238		11.5	
		2.44		23.0		2.65	
	No. Specimens	30		15		30	
	No. Batches	5		5		5	
	Data Class	B30		Interim		B30	
E ₁ ^c (Msi)	Mean	18.0		18.8		18.6	
	Minimum	16.9		17.1		17.5	
	Maximum	19.4		20.5		20.0	
	C.V.(%)	3.19		5.43		3.36	
			(3)		(3)		(3)
	No. Specimens	30		16		30	
	No. Batches	5		5		5	
	Data Class	Mean		Interim		Mean	
ν ₁₂ ^c	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{cu} (με)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

(1) Conditioned at 160°F, 95-100% relative humidity until the moisture content was between 1.1 and 1.3%.

(2) Basis values are presented only for A and B data classes.

(3) Only normalized data were made available for analysis.

MATERIAL:		AS4 12k/3502 unidirectional tape				Table 4.2.8(e) C/Ep 147-UT AS4/3502 Compression, 1-axis [0]₁₉ 250/W B30, Mean	
RESIN CONTENT:	33-37 wt%	COMP: DENSITY:	1.56-1.57 g/cm ³				
FIBER VOLUME:	55-59 %	VOID CONTENT:	0.0%				
PLY THICKNESS:	0.0054-0.0060 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3410A-75		Linear portion of curve					
NORMALIZED BY:		Specimen thickness and batch fiber volume to 60% (0.0055 in. CPT)					
Temperature (°F)		250					
Moisture Content (%)		1.1 - 1.3					
Equilibrium at T, RH		(1)					
Source Code		49					
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{cu} (ksi)	Mean	147	(2)				
	Minimum	118					
	Maximum	170					
	C.V.(%)	9.42					
	B-value Distribution	119 Weibull					
	C ₁	153					
	C ₂	12.5					
	No. Specimens	30					
No. Batches	5						
Data Class	B30						
E ₁ ^c (Msi)	Mean	18.7	(2)				
	Minimum	17.3					
	Maximum	20.6					
	C.V.(%)	3.99					
	No. Specimens	30					
	No. Batches	5					
	Data Class	Mean					
ν ₁₂ ^c	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{cu} (με)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
	Data Class						

(1) Conditioned at 160°F, 95-100% relative humidity until the moisture content was between 1.1 and 1.3%.

(2) Only normalized data were made available for analysis.

MATERIAL: AS4 12k/3502 unidirectional tape RESIN CONTENT: 31-33 wt% COMP: DENSITY: 1.56-1.59 g/cm ³ FIBER VOLUME: 59-60 % VOID CONTENT: 0.0-1.0% PLY THICKNESS: 0.0054-0.0058 in. TEST METHOD: ASTM D 695M (1) (4) MODULUS CALCULATION: Linear portion of curve NORMALIZED BY: Not normalized					
Table 4.2.8(f) C/Ep 147-UT AS4/3502 Compression, 2-axis [90]₂₄ 75/A, -65/A, 180/W, 250/W B30, Mean, Interim					
Temperature (°F)	75	-65	180	250	
Moisture Content (%)	ambient	ambient	1.1 - 1.3	1.1 - 1.3	
Equilibrium at T, RH			(2)	(2)	
Source Code	49	49	49	49	
F_2^{cu} (ksi)	Mean	34.6	49.8	24.7	18.4
	Minimum	27.5	42.5	23.0	17.0
	Maximum	40.4	57.2	26.7	19.9
	C.V.(%)	9.53	10.4	3.23	4.99
	B-value	26.6	(3)	22.3	15.3
	Distribution	ANOVA	Weibull	ANOVA	ANOVA
	C ₁	3.37	52.1	0.836	0.990
	C ₂	2.38	11.3	2.80	3.18
	No. Specimens	30	15	30	30
	No. Batches	5	5	5	5
	Data Class	B30	Interim	B30	B30
E_2^{c} (Msi)	Mean	1.41	1.68	1.24	1.09
	Minimum	1.29	1.57	1.14	0.973
	Maximum	1.60	1.95	1.41	1.41
	C.V.(%)	4.86	6.07	4.90	9.44
	No. Specimens	30	15	30	30
	No. Batches	5	5	5	5
	Data Class	Mean	Interim	Mean	Mean
ν_{21}^{c}	Mean				
	No. Specimens				
	No. Batches				
	Data Class				
ϵ_2^{cu} (µε)	Mean				
	Minimum				
	Maximum				
	C.V.(%)				
	B-value				
	Distribution				
	C ₁				
	C ₂				
	No. Specimens				
	No. Batches				
	Data Class				

(1) Tabbed specimen - length 3.12 inch, width 0.50 inch, gage length 0.50 inch.

(2) Conditioned at 160°F, 95-100% relative humidity until the moisture content was between 1.1 and 1.3%.

(3) Basis values are presented only for A and B data classes.

(4) The test method, ASTM D 695M-96, was withdrawn on July 10, 1996.

MATERIAL:		AS4 12k/3502 unidirectional tape				Table 4.2.8(g) C/Ep 147-UT AS4/3502 Shear, 12-plane [±45]_{4S} 75/A, -65/A, 180/W, 250/W B30, B18, Mean
RESIN CONTENT:	31-33 wt%	COMP: DENSITY:	1.56-1.59 g/cm ³			
FIBER VOLUME:	59-60 %	VOID CONTENT:	0.0-1.0%			
PLY THICKNESS:	0.0053-0.0059 in.					
TEST METHOD:		MODULUS CALCULATION:				
ASTM D 3518-76		Linear portion of curve				
NORMALIZED BY:		Not normalized				
Temperature (°F)		75	-65	180	250	
Moisture Content (%)		ambient	ambient	1.1 - 1.3	1.1 - 1.3	
Equilibrium at T, RH				(1)	(1)	
Source Code		49	49	49	49	
F ₁₂ ^{su} (ksi)	Mean	14.8	15.3	13.5	11.5	
	Minimum	13.7	13.3	12.5	10.5	
	Maximum	15.8	16.2	14.1	12.4	
	C.V.(%)	3.18	4.58	3.39	4.27	
	B-value	13.4	13.9	11.8	10.3	
	Distribution	ANOVA	ANOVA	ANOVA	ANOVA	
	C ₁	0.503	0.706	0.502	0.503	
	C ₂	2.91	2.04	3.24	2.32	
	No. Specimens	36	23	37	42	
	No. Batches	5	5	5	5	
Data Class		B30	B18	B30	B30	
G ₁₂ ^s (Msi)	Mean	0.543	0.769	0.217	0.141	
	Minimum	0.496	0.738	0.169	0.103	
	Maximum	0.593	0.863	0.260	0.205	
	C.V.(%)	5.16	3.69	9.25	17.9	
	No. Specimens	33	23	33	41	
	No. Batches	5	5	5	5	
	Data Class	Mean	Mean	Mean	Mean	
	Mean					
	Minimum					
	Maximum					
γ ₁₂ ^{su} (μɛ)	Mean					
	Minimum					
	Maximum					
	C.V.(%)					
	B-value					
	Distribution					
	C ₁					
	C ₂					
	No. Specimens					
	No. Batches					
Data Class						

(1) Conditioned at 160°F, 95-100% relative humidity until the moisture content was between 1.1 and 1.3%.

C/Ep 147-UT AS4/3502 Summary

MATERIAL:	AS4 12k/3502 unidirectional tape*		
FORM:	Hercules AS4/3502 unidirectional tape prepreg		
FIBER:	Hercules AS4 12k, surface-treated	MATRIX:	Hercules 3502
T _g (dry):	460°F	T _g (wet):	T _g METHOD: TMA
PROCESSING:	Autoclave cure: 275°F, 45 min.; 350°F, 2 hours, 85 psig; Postcure: 400°F, 4 hours		

* ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL. REFER TO PAGE 4-64 TO VIEW ADDITIONAL DATA SETS ON THIS MATERIAL SYSTEM.

Date of fiber manufacture	12/80 - 2/82	Date of testing	
Date of resin manufacture		Date of data submittal	6/90
Date of form manufacture	12/80 - 2/82	Date of analysis	1/93
Date of composite manufacture			

LAMINA PROPERTY SUMMARY

	75°F/A		-65°F/A	265°F/A		75°F/W	265°F/W	
Tension, 1-axis	IIII			IIII			IIII	
Tension, 2-axis	II - I					II - I	II - I	
Tension, 3-axis								
Compression, 1-axis			II - I	II - I			II - I	
Compression, 2-axis								
Compression, 3-axis								
Shear, 12-plane								
Shear, 23-plane								
Shear, 31-plane								

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

* ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

		Nominal	As Submitted	Test Method
Fiber Density	(g/cm ³)	1.79	1.78 - 1.81	
Resin Density	(g/cm ³)	1.26		
Composite Density	(g/cm ³)	1.58		
Fiber Areal Weight	(g/m ²)			
Fiber Volume	(%)	60	63 - 68	
Ply Thickness	(in)		0.0047 - 0.0062	

LAMINATE PROPERTY SUMMARY

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

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* ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		AS4 12k/3502 unidirectional tape				Table 4.2.8(h) C/Ep 147-UT AS4/3502 Tension, 1-axis [0]₆ 75/A, 265/A, 265/W Interim	
RESIN CONTENT:	25-29 wt%	COMP: DENSITY:	1.59-1.62 g/cm ³				
FIBER VOLUME:	63-68 %	VOID CONTENT:					
PLY THICKNESS:	0.0055-0.0058 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3039-76							
NORMALIZED BY:		Specimen thickness and batch fiber volume to 60% (0.0056 in. CPT)					
Temperature (°F)		75		265		265	
Moisture Content (%)		ambient		ambient		wet	
Equilibrium at T, RH		(1)		(1)		(2)	
Source Code		26		26		26	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{tu} (ksi)	Mean	253	275	269	292	251	273
	Minimum	212	226	148	165	183	196
	Maximum	294	323	314	358	287	315
	C.V.(%)	8.35	9.49	15.2	16.5	9.09	10.4
	B-value	(3)	(3)	(3)	(3)	(3)	(3)
	Distribution	ANOVA	ANOVA	ANOVA	ANOVA	ANOVA	ANOVA
	C ₁	21.5	27.2	24.0	30.2	24.0	30.2
	C ₂	2.20	2.60	2.83	3.01	2.83	3.01
	No. Specimens	30		20		25	
	No. Batches	5		4		5	
Data Class		Interim		Interim		Interim	
E ₁ ^t (Msi)	Mean	18.7	20.4	18.4	20.0	19.0	20.6
	Minimum	17.3	18.9	17.4	19.1	18.0	19.2
	Maximum	20.2	22.2	19.7	20.8	19.7	22.1
	C.V.(%)	3.88	3.37	3.52	2.59	3.53	3.22
	No. Specimens	29		20		25	
No. Batches		5		4		5	
Data Class		Interim		Interim		Interim	
ν ₁₂ ^t	Mean	0.340		0.356		0.280	
	No. Specimens	30		20		25	
	No. Batches	5		4		5	
	Data Class	Interim		Interim		Interim	
ε ₁ ^{tu} (με)	Mean	12400		13900		12400	
	Minimum	10200		10400		9220	
	Maximum	14400		15700		13900	
	C.V.(%)	8.65		12.0		8.95	
	B-value	(3)		(3)		(3)	
	Distribution	ANOVA		ANOVA		ANOVA	
	C ₁	1120		1850		1170	
	C ₂	2.62		3.92		2.87	
	No. Specimens	30		20		25	
	No. Batches	5		4		5	
Data Class		Interim		Interim		Interim	

(1) Conditioned at 180°F, ambient relative humidity for 2 days.

(2) Conditioned at 180°F, 75% relative humidity for 10 days.

(3) Basis values are presented only for A and B data classes.

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* ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		AS4 12k/3502 unidirectional tape			Table 4.2.8(i) C/Ep 147-UT AS4/3502 Tension, 2-axis [90]¹⁵ 75/A, 75/W, 265/W Interim	
RESIN CONTENT:	25-29 wt%	COMP: DENSITY:	1.59-1.62 g/cm ³			
FIBER VOLUME:	63-68 %	VOID CONTENT:				
PLY THICKNESS:	0.055-0.0059 in.					
TEST METHOD:	MODULUS CALCULATION:					
ASTM D 3039-76						
NORMALIZED BY:		Not normalized				
Temperature (°F)	75	75	265			
Moisture Content (%)	ambient	wet	wet			
Equilibrium at T, RH	(1)	(2)	(2)			
Source Code	26	26	26			
F ₂ ^{tu} (ksi)	Mean	8.04	3.27	3.29		
	Minimum	5.93	2.54	2.62		
	Maximum	10.6	4.15	4.15		
	C.V.(%)	13.5	16.3	13.0		
	B-value	(3)	(3)	(3)		
	Distribution	ANOVA	ANOVA	ANOVA		
	C ₁	1.11	0.560	0.452		
	C ₂	2.36	3.79	3.16		
	No. Specimens	30	15	20		
	No. Batches	5	3	4		
Data Class	Interim	Interim	Interim			
E ₂ ^t (Msi)	Mean	1.50	1.04	1.04		
	Minimum	1.43	0.95	0.95		
	Maximum	1.58	1.10	1.10		
	C.V.(%)	2.76	5.1	4.3		
	No. Specimens	30	15	20		
	No. Batches	5	3	4		
	Data Class	Interim	Interim	Interim		
ν ₂₁ ^t	Mean					
	No. Specimens					
	No. Batches					
	Data Class					
ε ₂ ^{tu} (με)	Mean	5500	3320	3440		
	Minimum	4000	2750	2840		
	Maximum	7390	4200	4200		
	C.V.(%)	13.7	13.3	12.1		
	B-value	(3)	(3)	(3)		
	Distribution	Weibull	ANOVA	ANOVA		
	C ₁	5820	506	456		
	C ₂	7.67	5.66	3.79		
	No. Specimens	30	15	20		
	No. Batches	5	3	4		
Data Class	Interim	Interim	Interim			

- (1) Conditioned at 180°F, ambient relative humidity for 2 days.
(2) Conditioned at 180°F, 75% relative humidity for 63 days.
(3) Basis values are presented only for A and B data classes.

* ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		AS4 12k/3502 unidirectional tape				Table 4.2.8(j) C/Ep 147-UT AS4/3502 Compression, 1-axis [0]₆ -65/A, 265/A, 265/W Interim	
RESIN CONTENT:	25-29 wt%	COMP: DENSITY:	1.59-1.62 g/cm ³				
FIBER VOLUME:	63-68 %	VOID CONTENT:					
PLY THICKNESS:	0.0047-0.0062 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3410C							
NORMALIZED BY:		Specimen thickness and batch fiber volume to 60% (0.0055 in. CPT)					
Temperature (°F)		-65		265		265	
Moisture Content (%)		ambient		ambient		wet	
Equilibrium at T, RH		(1)		(1)		(2)	
Source Code		26		26		26	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{cu} (ksi)	Mean	226	253	228	249	176	192
	Minimum	173	206	142	150	139	146
	Maximum	307	325	275	292	208	228
	C.V.(%)	16.8	14.1	15.0	15.1	11.5	13.3
	B-value	(3)	(3)	(3)	(3)	(3)	(3)
	Distribution	Weibull	Weibull	Weibull	Weibull	Weibull	Weibull
	C ₁	242	269	241	264	184	203
	C ₂	6.23	7.45	8.66	9.19	10.6	9.32
	No. Specimens	15		15		15	
	No. Batches	3		3		3	
Data Class	Interim		Interim		Interim		
E ₁ ^c (Msi)	Mean	19.3	21.1	21.2	23.2	19.6	21.4
	Minimum	17.1	19.3	17.1	19.3	18.5	20.5
	Maximum	21.8	23.7	23.1	26.3	20.6	22.5
	C.V.(%)	6.63	7.30	9.53	9.70	3.85	3.70
	No. Specimens	15		15		15	
No. Batches	3		3		3		
Data Class	Interim		Interim		Interim		
ν ₁₂ ^c	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{cu} (με)	Mean		16200		13400		10500
	Minimum		11100		7370		7770
	Maximum		21200		16000		12800
	C.V.(%)		17.4		16.2		14.1
	B-value		(3)		(3)		(3)
	Distribution		Weibull		Weibull		Weibull
	C ₁		17400		14200		11100
	C ₂		6.39		8.53		8.71
	No. Specimens	15		15		15	
	No. Batches	3		3		3	
Data Class	Interim		Interim		Interim		

(1) Conditioned at 180°F, ambient relative humidity for 2 days.

(2) Conditioned at 150°F, 98% relative humidity for 14 days.

(3) Basis values are presented only for A and B data classes.

4.2.9 Celion 3000/E7K8 plain weave fabricMaterial Description:

Material:	Celion 3000/E7K8
Form:	Plain weave fabric, areal weight of 195 g/m ² , typical cured resin content of 37-44%, typical cured ply thickness of 0.0075-0.0084 inches.
Processing:	Autoclave cure; 310°F, 85 psi for 2 hours. Low exotherm profile for processing of thick parts.

General Supplier Information:

Fiber:	Celion 3000 fibers are continuous carbon filaments made from PAN precursor. Filament count is 3000 filaments/tow. Typical tensile modulus is 34×10^6 psi. Typical tensile strength is 515,000 psi. Good drape.
Matrix:	E7K8 is a medium flow, low exotherm epoxy resin. Good tack; up to 20 days out-time at ambient temperature.
Maximum Short Term Service Temperature:	300°F (dry), 190°F (wet)
Typical applications:	Primary and secondary structural applications on commercial and military aircraft, jet engine applications such as stationary airfoils and thrust reverser blocker doors.

4.2.9 Celion 3000/E7K8 plain weave fabric*

MATERIAL: Celion 3000/E7K8 plain weave fabric

C/Ep 195-PW Celion 3000/E7K8 Summary

FORM: U.S. Polymeric Celion 3000/E7K8 plain weave fabric, Grade 195 prepreg

FIBER: Celanese Celion 3000

MATRIX: U.S. Polymeric E7K8

T_g(dry):T_g(wet):T_g METHOD:

PROCESSING: Autoclave: 310°F, 2 hours, 85 psig

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

Date of fiber manufacture	Date of testing	
Date of resin manufacture	Date of data submittal	1/88
Date of form manufacture 2/86 - 3/86	Date of analysis	1/93
Date of composite manufacture		

LAMINA PROPERTY SUMMARY

	75°F/A		-65°F/A	180°F/A		75°F/W	180°F/W	
Tension, 1-axis	SS - S		SS - -			SSSS	SSS -	
Tension, 2-axis	SS - S		SS - S			SS - S	SS - S	
Tension, 3-axis								
Compression, 1-axis	SS - S		SS - S	SS - S		SS - S	SS - S	
Compression, 2-axis	SS - S		SS - -	SS - -		SS - S	SS - -	
Compression, 3-axis								
Shear, 12-plane								
Shear, 23-plane								
Shear, 31-plane								
SB Strength, 31-plane	S - - -		S - - -	S - - -		S - - -	S - - -	

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

	Nominal	As Submitted	Test Method
Fiber Density (g/cm ³)	1.8	1.37 - 1.55	
Resin Density (g/cm ³)	1.28		
Composite Density (g/cm ³)	1.54		
Fiber Areal Weight (g/m ²)	195		
Fiber Volume (%)	50	51 - 56	
Ply Thickness (in)	0.0075	0.0078 - 0.011	

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		Celion 3000/E7K8 plain weave fabric				Table 4.2.9(a) C/Ep 195-PW Celion 3000/E7K8 Tension, 1-axis [0_t]₁₀ 75/A, -65/A Screening				
RESIN CONTENT:	37-38 wt%	COMP: DENSITY:	1.55 g/cm ³							
FIBER VOLUME:	55-56 %	VOID CONTENT:	0.0%							
PLY THICKNESS:	0.0078-0.0085 in.									
TEST METHOD:		MODULUS CALCULATION:								
ASTM D 3039-76										
NORMALIZED BY:		Specimen thickness and batch fiber volume to 57% (0.0075 in. CPT)								
Temperature (°F)		75		-65						
Moisture Content (%)		ambient		ambient						
Equilibrium at T, RH										
Source Code		20		20						
		Normalized	Measured	Normalized	Measured	Normalized	Measured			
F ₁ ^{tu} (ksi)	Mean	132	128	110	106					
	Minimum	120	115	101	98.4					
	Maximum	143	140	118	113					
	C.V.(%)	4.7	5.8	6.2	5.4					
	B-value	(1)	(1)	(1)	(1)					
	Distribution	Weibull	Weibull	Normal	Normal					
	C ₁	135	132	110	106					
	C ₂	25.7	21.4	6.88	5.74					
	No. Specimens	20		5						
	No. Batches	1		1						
Data Class		Screening		Screening						
E ₁ ^t (Msi)	Mean	9.67	9.38	9.98	9.66					
	Minimum	9.49	8.85	9.82	9.46					
	Maximum	9.98	9.74	10.0	9.90					
	C.V.(%)	1.2	2.5	1.0	1.8					
	No. Specimens	20		5						
	No. Batches	1		1						
	Data Class		Screening		Screening					
	ν ₁₂ ^t	Mean	0.0580							
		No. Specimens	5							
		No. Batches	1							
Data Class		Screening								
ε ₁ ^{tu} (με)	Mean	13700		11000						
	Minimum	12300		10200						
	Maximum	14800		11600						
	C.V.(%)	4.5		5.4						
	B-value	(1)		(1)						
	Distribution	Weibull		Normal						
	C ₁	14000		11000						
	C ₂	26.8		592						
	No. Specimens	20		5						
	No. Batches	1		1						
Data Class		Screening		Screening						

(1) Basis values are presented only for A and B data classes.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		Celion 3000/E7K8 plain weave fabric				Table 4.2.9(b) C/Ep 195-PW Celion 3000/E7K8 Tension, 1-axis [0_t]₁₀ 75/W, 180/W Screening	
RESIN CONTENT:	37 wt%	COMP: DENSITY:	1.55 g/cm ³				
FIBER VOLUME:	55 %	VOID CONTENT:	0.0%				
PLY THICKNESS:	0.0078-0.0081 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3039-76							
NORMALIZED BY:		Specimen thickness and batch fiber volume to 57% (0.0075 in. CPT)					
Temperature (°F)		75		180			
Moisture Content (%)		wet		wet			
Equilibrium at T, RH		(1)		(1)			
Source Code		20		20			
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{tu} (ksi)	Mean	125	122	123	120		
	Minimum	111	105	114	112		
	Maximum	130	129	131	127		
	C.V.(%)	6.3	8.1	6.5	6.3		
	B-value	(2)	(2)	(2)	(2)		
	Distribution	Normal	Normal	Normal	Normal		
	C ₁	125	122	123	120		
	C ₂	7.93	9.93	7.99	7.52		
	No. Specimens	5		5			
	No. Batches	1		1			
Data Class		Screening		Screening			
E ₁ ^t (Msi)	Mean	9.23	9.01	9.55	9.33		
	Minimum	8.93	8.81	9.37	9.15		
	Maximum	9.53	9.20	9.84	9.63		
	C.V.(%)	2.5	1.7	1.9	2.0		
	No. Specimens	5		5			
	No. Batches	1		1			
Data Class		Screening		Screening			
ν ₁₂ ^t	Mean	0.0620		0.0560			
	No. Specimens	5		5			
	No. Batches	1		1			
	Data Class		Screening		Screening		
ε ₁ ^{tu} (με)	Mean	13700		12800			
	Minimum	12100		11200			
	Maximum	14300		14100			
	C.V.(%)	6.9		9.6			
	B-value	(2)		(2)			
	Distribution	Normal		Normal			
	C ₁	13700		12800			
	C ₂	939		1230			
	No. Specimens	5		5			
	No. Batches	1		1			
Data Class		Screening		Screening			

(1) Conditioned at 160°F, 85% relative humidity for 7 days.

(2) Basis values are presented only for A and B data classes.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		Celion 3000/E7K8 plain weave fabric				Table 4.2.9(c) C/Ep 195-PW Celion 3000/E7K8 Tension, 1-axis [0_t]₁₂ 75/A, -65/A Screening	
RESIN CONTENT:	39-44 wt%	COMP: DENSITY:	1.55 g/cm ³				
FIBER VOLUME:	51-54 %	VOID CONTENT:	0.04-0.5%				
PLY THICKNESS:	0.0079-0.0084 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3039-76							
NORMALIZED BY:		Specimen thickness and batch fiber volume to 57% (0.0075 in. CPT)					
Temperature (°F)		75		-65			
Moisture Content (%)		ambient		ambient			
Equilibrium at T, RH							
Source Code		20		20			
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{tu} (ksi)	Mean	132	122	122	115		
	Minimum	106	100	117	111		
	Maximum	147	136	126	123		
	C.V.(%)	7.5	7.5	2.8	4.3		
	B-value	(1)	(1)	(1)	(1)		
	Distribution	Weibull	Weibull	Normal	Normal		
	C ₁	136	126	122	116		
	C ₂	16.4	17.3	3.44	4.97		
	No. Specimens	20		5			
	No. Batches	1		1			
Data Class		Screening		Screening			
E ₁ ^t (Msi)	Mean	9.96	9.21	9.29	8.82		
	Minimum	9.30	8.74	8.95	8.51		
	Maximum	9.98	9.78	9.66	9.41		
	C.V.(%)	1.2	2.5	2.8	4.0		
	No. Specimens	20		5			
No. Batches		1		1			
Data Class		Screening		Screening			
ν ₁₂ ^t	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{tu} (μɛ)	Mean	14100					
	Minimum	13600					
	Maximum	14600					
	C.V.(%)	2.6					
	B-value	(1)					
	Distribution	Normal					
	C ₁	14100					
	C ₂	371					
	No. Specimens	5					
	No. Batches	1					
Data Class		Screening					

(1) Basis values are presented only for A and B data classes.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL: Celion 3000/E7K8 plain weave fabric

RESIN CONTENT: 42 wt% COMP: DENSITY: 1.55 g/cm³
 FIBER VOLUME: 51 % VOID CONTENT: 0.48%
 PLY THICKNESS: 0.0081-0.0083 in.

TEST METHOD: MODULUS CALCULATION:
 ASTM D 3039-76

NORMALIZED BY: Specimen thickness and batch fiber volume to 57% (0.0075 in. CPT)

Table 4.2.9(d)
C/Ep 195-PW
Celion 3000/E7K8
Tension, 1-axis
[0_t]₁₂
75/W, 180/W
Screening

Temperature (°F)		75		180			
Moisture Content (%)		wet		wet			
Equilibrium at T, RH		(1)		(1)			
Source Code		20		20			
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{tu} (ksi)	Mean	145	129	148	133		
	Minimum	143	125	139	124		
	Maximum	148	131	154	142		
	C.V.(%)	1.6	1.8	4.0	5.6		
	B-value	(2)	(2)	(2)	(2)		
	Distribution	Normal	Normal	Normal	Normal		
	C ₁	145	129	148	133		
	C ₂	2.23	2.37	5.94	7.50		
	No. Specimens	5		5			
	No. Batches	1		1			
Data Class		Screening		Screening			
E ₁ ^t (Msi)	Mean	10.6	9.42	10.3	9.21		
	Minimum	10.1	8.79	10.1	8.91		
	Maximum	11.4	10.0	10.5	9.53		
	C.V.(%)	4.9	5.0	1.3	2.7		
	No. Specimens	5		5			
	No. Batches	1		1			
	Data Class	Screening		Screening			
	Mean	0.0560		0.0560			
	No. Specimens	5		5			
	No. Batches	1		1			
Data Class		Screening		Screening			
ε ₁ ^{tu} (μɛ)	Mean	13400					
	Minimum	12300					
	Maximum	14300					
	C.V.(%)	5.30					
	B-value	(2)					
	Distribution	Normal					
	C ₁	13400					
	C ₂	713					
	No. Specimens	5					
	No. Batches	1					
Data Class		Screening					

(1) Conditioned at 160°F, 85% relative humidity for 7 days.

(2) Basis values are presented only for A and B data classes.

Volume 2, Chapter 4 Carbon Fiber Composites

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		Celion 3000/E7K8 plain weave fabric				Table 4.2.9(e) C/Ep 195-PW Celion 3000/E7K8 Tension, 2-axis [0_t]₁₀ 75/A, -65/A Screening	
RESIN CONTENT:	36 wt%	COMP: DENSITY:	1.55 g/cm ³				
FIBER VOLUME:	56 %	VOID CONTENT:	0.0%				
PLY THICKNESS:	0.0078-0.0084 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3039-76							
NORMALIZED BY:		Specimen thickness and batch fiber volume to 57% (0.0075 in. CPT)					
Temperature (°F)		75		-65			
Moisture Content (%)		ambient		ambient			
Equilibrium at T, RH							
Source Code		20		20			
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₂ ^{tu} (ksi)	Mean	128	127	113	111		
	Minimum	120	115	101	100		
	Maximum	137	134	125	122		
	C.V.(%)	3.6	3.7	9.1	8.9		
	B-value	(1)	(1)	(1)	(1)		
	Distribution	Normal	Normal	Normal	Normal		
	C ₁	128	127	113	111		
	C ₂	4.64	4.69	10.3	9.89		
	No. Specimens	20		5			
	No. Batches	1		1			
Data Class	Screening		Screening				
E ₂ ^t (Msi)	Mean	9.50	9.37	9.51	9.34		
	Minimum	9.36	9.04	9.29	9.20		
	Maximum	9.69	9.71	9.65	9.68		
	C.V.(%)	0.98	1.8	1.6	2.1		
	No. Specimens	20		5			
No. Batches	1		1				
Data Class	Screening		Screening				
ν ₂₁ ^t	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₂ ^{tu} (μɛ)	Mean	13400		11700			
	Minimum	12600		10700			
	Maximum	14200		12700			
	C.V.(%)	3.5		7.7			
	B-value	(1)		(1)			
	Distribution	Weibull		Normal			
	C ₁	13600		11700			
	C ₂	32.5		902			
	No. Specimens	20		5			
	No. Batches	1		1			
Data Class	Screening		Screening				

(1) Basis values are presented only for A and B data classes.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		Celion 3000/E7K8 plain weave fabric				Table 4.2.9(f) C/Ep 195-PW Celion 3000/E7K8 Tension, 2-axis [90_f]₁₀ 75/W, 180/W Screening	
RESIN CONTENT:	36 wt%	COMP: DENSITY:	1.55 g/cm ³				
FIBER VOLUME:	56 %	VOID CONTENT:	0.0%				
PLY THICKNESS:	0.0078-0.0084 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3039-76							
NORMALIZED BY:		Specimen thickness and batch fiber volume to 57% (0.0075 in. CPT)					
Temperature (°F)		75		180			
Moisture Content (%)		wet		wet			
Equilibrium at T, RH		(1)		(1)			
Source Code		20		20			
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₂ ^{tu} (ksi)	Mean	119	117	130	128		
	Minimum	105	104	129	125		
	Maximum	130	126	132	131		
	C.V.(%)	7.8	7.3	0.89	1.8		
	B-value	(2)	(2)	(2)	(2)		
	Distribution	Normal	Normal	Normal	Normal		
	C ₁	119	117	130	128		
	C ₂	9.35	8.51	1.16	2.35		
	No. Specimens	5		5			
	No. Batches	1		1			
Data Class		Screening		Screening			
E ₂ ^t (Msi)	Mean	9.08	8.92	9.35	9.18		
	Minimum	8.98	8.73	9.26	8.96		
	Maximum	9.21	9.14	9.48	9.38		
	C.V.(%)	1.2	1.6	1.2	1.8		
	No. Specimens	5		5			
No. Batches	1		1				
Data Class		Screening		Screening			
ν ₂₁ ^t	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₂ ^{tu} (με)	Mean	13100		14200			
	Minimum	11400		13700			
	Maximum	14400		14800			
	C.V.(%)	8.7		3.5			
	B-value	(2)		(2)			
	Distribution	Normal		Normal			
	C ₁	13100		14200			
	C ₂	1135		490			
	No. Specimens	5		5			
	No. Batches	1		1			
Data Class		Screening		Screening			

(1) Conditioned at 160°F, 85% relative humidity for 7 days.

(2) Basis values are presented only for A and B data classes.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		Celion 3000/E7K8 plain weave fabric				Table 4.2.9(g) C/Ep 195-PW Celion 3000/E7K8 Compression, 1-axis [0_t]₁₀ 75/A, -65/A, 180/A Screening	
RESIN CONTENT:	36-40 wt%	COMP: DENSITY:	1.55 g/cm ³				
FIBER VOLUME:	53-55 %	VOID CONTENT:	0.0-0.75%				
PLY THICKNESS:	0.0079-0.0084 in.						
TEST METHOD:		MODULUS CALCULATION:					
SACMA SRM 1-88							
NORMALIZED BY:		Specimen thickness and batch fiber volume to 57% (0.0075 in. CPT)					
Temperature (°F)		75		-65		180	
Moisture Content (%)		ambient		ambient		ambient	
Equilibrium at T, RH							
Source Code		20		20		20	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{cu} (ksi)	Mean	104	101	121	118	97.4	94.5
	Minimum	90.5	87.7	113	111	87.5	85.1
	Maximum	122	120	132	126	105	100
	C.V.(%)	8.3	8.7	5.9	4.7	7.2	7.1
	B-value	(1)	(1)	(1)	(1)	(1)	(1)
	Distribution	Weibull	Weibull	Normal	Normal	Normal	Normal
	C ₁	108	105	121	118	97.4	94.5
	C ₂	13.0	12.1	7.19	5.58	7.00	6.72
	No. Specimens	20		5		5	
	No. Batches	1		1		1	
Data Class		Screening		Screening		Screening	
E ₁ ^c (Msi)	Mean	9.88	9.02	9.83	9.33	9.45	9.16
	Minimum	9.56	8.65	9.75	9.20	9.14	8.89
	Maximum	10.3	9.29	9.95	9.48	9.66	9.37
	C.V.(%)	2.3	2.0	1.0	1.1	2.3	2.0
No. Specimens	20		5		5		
No. Batches	1		1		1		
Data Class		Screening		Screening		Screening	
ν ₁₂ ^c 	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{cu} (με)	Mean	10900		12200		10400	
	Minimum	10500		12000		10200	
	Maximum	11200		12300		10800	
	C.V.(%)	2.2		1.0		2.3	
	B-value	(1)		(1)		(1)	
	Distribution	Weibull		Normal		Normal	
	C ₁	11000		12200		10400	
	C ₂	54.2		122		239	
	No. Specimens	20		5		5	
	No. Batches	1		1		1	
Data Class		Screening		Screening		Screening	

(1) Basis values are presented only for A and B data classes.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		Celion 3000/E7K8 plain weave fabric				Table 4.2.9(h) C/Ep 195-PW Celion 3000/E7K8 Compression, 1-axis [0_r]₁₀ 75/W, 180/W Screening	
RESIN CONTENT:	36-37 wt%	COMP: DENSITY:	1.55 g/cm ³				
FIBER VOLUME:	54-56 %	VOID CONTENT:	0.0-0.70%				
PLY THICKNESS:	0.0073-0.0086 in.						
TEST METHOD:		MODULUS CALCULATION:					
SACMA SRM 1-88							
NORMALIZED BY:		Specimen thickness and batch fiber volume to 57% (0.0075 in. CPT)					
Temperature (°F)		75		180			
Moisture Content (%)		wet		wet			
Equilibrium at T, RH		(1)		(1)			
Source Code		20		20			
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{cu} (ksi)	Mean	94.9	92.6	78.9	77.6		
	Minimum	89.7	88.2	72.7	70.5		
	Maximum	102	98.8	83.2	82.3		
	C.V.(%)	5.5	4.9	5.7	6.0		
	B-value	(2)	(2)	(2)	(2)		
	Distribution	Normal	Normal	Normal	Normal		
	C ₁	94.9	92.6	78.9	77.6		
	C ₂	5.47	4.57	4.53	4.65		
	No. Specimens	5		5			
	No. Batches	1		1			
Data Class		Screening		Screening			
E ₁ ^c (Msi)	Mean	9.39	8.92	8.97	8.52		
	Minimum	8.80	8.12	8.45	8.18		
	Maximum	10.2	9.79	9.54	8.80		
	C.V.(%)	6.3	6.8	4.4	3.5		
	No. Specimens	5		5			
No. Batches		1		1			
Data Class		Screening		Screening			
ν ₁₂ ^c	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{cu} (με)	Mean	9800		8130			
	Minimum	8970		7620			
	Maximum	10400		8600			
	C.V.(%)	6.0		4.4			
	B-value	(2)		(2)			
	Distribution	Normal		Normal			
	C ₁	9800		8130			
	C ₂	590		356			
	No. Specimens	5		5			
	No. Batches	1		1			
Data Class		Screening		Screening			

(1) Conditioned at 160°F, 85% relative humidity for 7 days.

(2) Basis values are presented only for A and B data classes.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		Celion 3000/E7K8 plain weave fabric				Table 4.2.9(i) C/Ep 195-PW Celion 3000/E7K8 Compression, 1-axis [0]₁₂ 75/A, -65/A, 180/A Screening	
RESIN CONTENT:	38-40 wt%	COMP: DENSITY:	1.55 g/cm ³				
FIBER VOLUME:	52-54 %	VOID CONTENT:	0.0%				
PLY THICKNESS:	0.0078-0.0084 in.						
TEST METHOD:		MODULUS CALCULATION:					
SACMA SRM 1-88							
NORMALIZED BY:		Specimen thickness and batch fiber volume to 57% (0.0075 in. CPT)					
Temperature (°F)	75 ambient		-65 ambient		180 ambient		
Moisture Content (%)							
Equilibrium at T, RH							
Source Code	20		20		20		
	Normalized	Measured	Normalized	Measured	Normalized	Measured	
F ₁ ^{cu} (ksi)	Mean	114	107	133	122	103	97.6
	Minimum	86.4	84.4	127	116	96.0	89.2
	Maximum	128	121	139	129	114	107
	C.V.(%)	9.5	9.1	3.9	4.6	6.8	7.2
	B-value	(1)	(1)	(1)	(1)	(1)	(1)
	Distribution	Weibull	Weibull	Normal	Normal	Normal	Normal
	C ₁	118	111	133	122	103	97.6
	C ₂	13.8	14.0	5.22	5.60	6.99	7.04
	No. Specimens	20		5		5	
	No. Batches	1		1		1	
Data Class	Screening		Screening		Screening		
E ₁ ^c (Msi)	Mean	8.22	7.80	8.45	7.71	8.40	7.67
	Minimum	8.07	7.51	8.27	7.43	8.20	7.58
	Maximum	8.50	8.05	8.73	8.09	8.54	7.84
	C.V.(%)	1.6	2.2	2.3	3.4	1.5	1.4
	No. Specimens	20		5		5	
	No. Batches	1		1		1	
	Data Class	Screening		Screening		Screening	
	Mean						
	No. Specimens						
	No. Batches						
Data Class							
ε ₁ ^{cu} (με)	Mean		13500				
	Minimum		13000				
	Maximum		13700				
	C.V.(%)		1.6				
	B-value		(1)				
	Distribution		Nonpara.				
	C ₁		10				
	C ₂		1.25				
	No. Specimens	20					
	No. Batches	1					
Data Class	Screening						

(1) Basis values are presented only for A and B data classes.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		Celion 3000/E7K8 plain weave fabric				Table 4.2.9(j) C/Ep 195-PW Celion 3000/E7K8 Compression, 1-axis [0_t]₁₂ 75/W, 180/W Screening	
RESIN CONTENT:	38-40 wt%	COMP: DENSITY:	1.55 g/cm ³				
FIBER VOLUME:	52-54 %	VOID CONTENT:	0.0-0.04%				
PLY THICKNESS:	0.0080-0.0084 in.						
TEST METHOD:		MODULUS CALCULATION:					
SACMA SRM 1-88							
NORMALIZED BY:		Specimen thickness and batch fiber volume to 57% (0.0075 in. CPT)					
Temperature (°F)		75		180			
Moisture Content (%)		wet		wet			
Equilibrium at T, RH		(1)		(1)			
Source Code		20		20			
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{cu} (ksi)	Mean	96.1	90.7	80.2	75.7		
	Minimum	83.9	78.4	74.4	72.2		
	Maximum	107	101	83.3	79.9		
	C.V.(%)	9.3	9.4	4.7	4.4		
	B-value	(2)	(2)	(2)	(2)		
	Distribution	Normal	Normal	Normal	Normal		
	C ₁	96.1	90.7	80.2	75.7		
	C ₂	8.91	8.55	3.73	3.31		
	No. Specimens	5		5			
	No. Batches	1		1			
Data Class		Screening		Screening			
E ₁ ^c (Msi)	Mean	9.08	8.30	9.36	8.54		
	Minimum	8.84	7.91	9.14	8.20		
	Maximum	9.17	8.62	9.57	8.84		
	C.V.(%)	1.5	3.2	2.0	2.9		
	No. Specimens	5		5			
No. Batches		1		1			
Data Class		Screening		Screening			
ν ₁₂ ^c	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{cu} (μɛ)	Mean	10700					
	Minimum	10600					
	Maximum	11000					
	C.V.(%)	1.5					
	B-value	(2)					
	Distribution	Normal					
	C ₁	10700					
	C ₂	164					
	No. Specimens	5					
	No. Batches	1					
Data Class		Screening					

(1) Conditioned at 160°F, 85% relative humidity for 7 days.

(2) Basis values are presented only for A and B data classes.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL: Celion 3000/E7K8 plain weave fabric

RESIN CONTENT: 36-39 wt%

COMP: DENSITY: 1.55 g/cm³

FIBER VOLUME: 54-56 %

VOID CONTENT: 0.0-0.75%

PLY THICKNESS: 0.0079-0.0081 in.

Table 4.2.9(k)
C/Ep 195-PW
Celion 3000/E7K8
SBS, 31-plane
[0_t]₁₄
75/A, -65/A, 180/A,
75/W, 180/W
Screening

TEST METHOD:

MODULUS CALCULATION:

ASTM D 2344-68

NORMALIZED BY: Not normalized

Temperature (°F)	75	-65	180	75	180
Moisture Content (%)	ambient	ambient	ambient	wet	wet
Equilibrium at T, RH				(1)	(1)
Source Code	20	20	20	20	20
Mean	10.3	11.6	9.70	9.81	6.92
Minimum	9.43	10.7	9.34	9.24	6.60
Maximum	11.4	13.6	9.94	10.4	7.22
C.V.(%)	5.7	10.8	3.0	7.0	3.4
B-value	(2)	(2)	(2)	(2)	(2)
Distribution	Normal	Normal	Normal	Normal	Normal
F_{31}^{sbs}					
(ksi)					
C ₁	10.3	11.6	9.70	9.81	6.92
C ₂	0.446	1.25	0.293	0.505	0.237
No. Specimens	20	5	5	5	5
No. Batches	1	1	1	1	1
Data Class	Screening	Screening	Screening	Screening	Screening

(1) Conditioned at 160°F, 85% relative humidity for 7 days.

(2) Short beam strength test data are approved for Screening Data Class only.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL: Celion 3000/E7K8 plain weave fabric				Table 4.2.9(I) C/Ep 195-PW Celion 3000/E7K8 SBS, 31-plane [0]_t¹² 75/A, -65/A, 180/A, 75/W, 180/W Screening	
RESIN CONTENT:	39 wt%	COMP: DENSITY:	1.55 g/cm ³		
FIBER VOLUME:	54 %	VOID CONTENT:	0.29%		
PLY THICKNESS:	0.0080 in.				
TEST METHOD: ASTM D 2344-68		MODULUS CALCULATION:			
NORMALIZED BY: Not normalized					
Temperature (°F)	75	-65	180	75	180
Moisture Content (%)	ambient	ambient	ambient	wet	wet
Equilibrium at T, RH				(1)	(1)
Source Code	20	20	20	20	20
F ₃₁ ^{sbs} (ksi)	Mean	9.76	10.2	9.72	8.72
	Minimum	9.00	9.54	8.76	8.35
	Maximum	10.7	10.5	10.3	9.00
	C.V.(%)	4.8	3.9	6.1	2.8
	B-value	(2)	(2)	(2)	(2)
	Distribution	Normal	Normal	Normal	Normal
	C ₁	9.76	10.2	9.72	8.72
	C ₂	0.470	0.395	0.591	0.247
	No. Specimens	20	5	5	5
No. Batches	1	1	1	1	
Data Class	Screening	Screening	Screening	Screening	Screening

(1) Conditioned at 160°F, 85% relative humidity for 7 days.

(2) Short beam strength test data are approved for Screening Data Class only.

4.2.10 HITEX 33 6k/E7K8 plain weave fabricMaterial Description:

Material:	HITEX 33-6k/E7K8
Form:	Plain weave fabric, areal weight of 195 g/m ² , typical cured resin content of 37-41%, typical cured ply thickness of 0.0085 inches.
Processing:	Autoclave cure; 310°F, 85 psi for 2 hours. Low exotherm profile for processing of thick parts.

General Supplier Information:

Fiber:	HITEX 33 fibers are continuous carbon filaments made from PAN precursor. Filament count is 6000 filaments/tow. Typical tensile modulus is 33×10^6 psi. Typical tensile strength is 560,000 psi. Good drape.
Matrix:	E7K8 is a medium flow, low exotherm epoxy resin. Good tack; up to 20 days out-time at ambient temperature.
Maximum Short Term Service Temperature:	300°F (dry), 190°F (wet)
Typical applications:	Primary and secondary structural applications on commercial and military aircraft, jet engine applications such as stationary airfoils and thrust reverser blocker doors.

4.2.10 HITEX 33 6k/E7K8 plain weave fabric*

MATERIAL:				HITEX 33 6k/E7K8 plain weave fabric	C/Ep 195-PW HITEX 33/E7K8 Summary	
FORM:				U.S. Polymeric Hitex 33 6k/E7K8 plain weave fabric prepreg		
FIBER:		Hitco HITEX 33 6k G'	MATRIX:			U.S. Polymeric E7K8
T _g (dry):		T _g (wet):		T _g METHOD:		
PROCESSING:				Autoclave: 310°F, 2 hours, 85 psig		

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

Date of fiber manufacture	Date of testing	
Date of resin manufacture	Date of data submittal	1/88
Date of form manufacture	Date of analysis	1/93
Date of composite manufacture		

LAMINA PROPERTY SUMMARY

	75°F/A		-65°F/A	180°F/A		75°F/W	180°F/W	
Tension, 1-axis								
Tension, 2-axis	SSSS		SS - S			SSSS	SSSS	
Tension, 3-axis								
Compression, 1-axis	SS - S		SS - -	SS - -		SS - S	SS - -	
Compression, 2-axis	SS - S		SS - -	SS - -		SS - S	SS - -	
Compression, 3-axis								
Shear, 12-plane								
Shear, 23-plane								
Shear, 31-plane								
SB Strength, 31-plane	S - - -		S - - -			S - - -	S - - -	

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

	Nominal	As Submitted	Test Method
Fiber Density (g/cm ³)	1.77		
Resin Density (g/cm ³)	1.27		
Composite Density (g/cm ³)	1.56		
Fiber Areal Weight (g/m ²)	195		
Fiber Volume (%)	58	47 - 55	
Ply Thickness (in)	0.0085	0.0077 - 0.0099	

LAMINATE PROPERTY SUMMARY

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		HITEX 33 6k/E7K8 plain weave fabric				Table 4.2.10(a) C/Ep 195-PW HITEX 33/E7K8 Tension, 2-axis [90]₁₂ 75/A, -65/A, 75/W Screening	
RESIN CONTENT:	37-41 wt%	COMP: DENSITY:	1.53-1.55 g/cm ³				
FIBER VOLUME:	51-55 %	VOID CONTENT:	0.0%				
PLY THICKNESS:	0.0087-0.0098 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3039-76							
NORMALIZED BY:		Specimen thickness and batch fiber volume to 57% (0.0076 in. CPT)					
Temperature (°F)		75		-65		75	
Moisture Content (%)		ambient		ambient		wet	
Equilibrium at T, RH						(1)	
Source Code		20		20		20	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₂ ^{tu} (ksi)	Mean	131	124	126	122	134	119
	Minimum	120	103	122	111	130	114
	Maximum	139	136	131	131	137	125
	C.V.(%)	4.3	6.8	3.1	6.7	2.8	3.8
	B-value	(2)	(2)	(2)	(2)	(2)	(2)
	Distribution	Weibull	Weibull	Normal	Normal	Normal	Normal
	C ₁	134	128	126	122	134	120
	C ₂	28.2	17.8	3.88	8.16	3.69	4.55
	No. Specimens	20		5		5	
	No. Batches	1		1		1	
Data Class		Screening		Screening		Screening	
E ₂ ^t (Msi)	Mean	8.65	8.14	8.10	7.82	9.61	8.55
	Minimum	8.01	7.52	7.73	7.54	9.26	8.20
	Maximum	9.65	8.62	8.29	8.26	9.94	9.13
	C.V.(%)	6.2	3.1	2.7	3.4	2.8	4.1
	No. Specimens	20		5		5	
No. Batches	1		1		1		
Data Class		Screening		Screening		Screening	
ν ₂₁ ^t	Mean	0.0460				0.0540	
	No. Specimens	5				5	
	No. Batches	1				1	
	Data Class	Screening				Screening	
ε ₂ ^{tu} (με)	Mean	14300		15600		10500	
	Minimum	13700		14600		9930	
	Maximum	14900		16500		10800	
	C.V.(%)	3.8		4.4		3.2	
	B-value	(2)		(2)		(2)	
	Distribution	Normal		Normal		Normal	
	C ₁	14300		15600		10500	
	C ₂	541		687		335	
	No. Specimens	5		5		5	
	No. Batches	1		1		1	
Data Class		Screening		Screening		Screening	

(1) Conditioned at 160°F, 85% relative humidity for 14 days.

(2) Basis values are presented only for A and B data classes.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		HITEX 33 6k/E7K8 plain weave fabric				Table 4.2.10(b) C/Ep 195-PW HITEX 33/E7K8 Tension, 2-axis [90_r]₁₂ 180/W Screening	
RESIN CONTENT:	41 wt%	COMP: DENSITY:	1.53 g/cm ³				
FIBER VOLUME:	51 %	VOID CONTENT:	0.0%				
PLY THICKNESS:	0.0089-0.0094 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3039-76							
NORMALIZED BY:		Specimen thickness and batch fiber volume to 57% (0.0076 in. CPT)					
Temperature (°F)	180						
Moisture Content (%)	wet						
Equilibrium at T, RH	(1)						
Source Code	20						
	Normalized	Measured	Normalized	Measured	Normalized	Measured	
F ₂ ^{tu} (ksi)	Mean	138	122				
	Minimum	120	107				
	Maximum	155	135				
	C.V.(%)	10.2	9.1				
	B-value	(2)	(2)				
	Distribution	Normal	Normal				
	C ₁	138	123				
	C ₂	14.1	11.1				
	No. Specimens	5					
No. Batches	1						
Data Class	Screening						
E ₂ ^t (Msi)	Mean	9.91	8.80				
	Minimum	9.11	8.23				
	Maximum	10.7	9.23				
	C.V.(%)	7.2	5.3				
	No. Specimens	5					
No. Batches	1						
Data Class	Screening						
ν ₂₁ ^t	Mean		0.0700				
	No. Specimens	5					
	No. Batches	1					
	Data Class	Screening					
ε ₂ ^{tu} (με)	Mean		10400				
	Minimum		9840				
	Maximum		10800				
	C.V.(%)		3.6				
	B-value		(2)				
	Distribution		Normal				
	C ₁		10400				
	C ₂		372				
	No. Specimens	5					
No. Batches	1						
Data Class	Screening						

(1) Conditioned at 160°F, 85% relative humidity for 14 days.

(2) Basis values are presented only for A and B data classes.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		HITEX 33 6k/E7K8 plain weave fabric				Table 4.2.10(c) C/Ep 195-PW HITEX 33/E7K8 Compression, 1-axis [0_t]₁₂ 75/A, -65/A, 180/A Screening	
RESIN CONTENT:	45 wt%	COMP: DENSITY:	1.51 g/cm ³				
FIBER VOLUME:	47 %	VOID CONTENT:	0.0%				
PLY THICKNESS:	0.0079-0.0099 in.						
TEST METHOD:		MODULUS CALCULATION:					
SACMA SRM 1-88							
NORMALIZED BY:		Specimen thickness and batch fiber volume to 57% (0.0076 in. CPT)					
Temperature (°F)	75 ambient		-65 ambient		180 ambient		
Moisture Content (%)							
Equilibrium at T, RH							
Source Code	20		20		20		
	Normalized	Measured	Normalized	Measured	Normalized	Measured	
F ₁ ^{cu} (ksi)	Mean	136	112	155	128	130	107
	Minimum	111	98.4	147	118	118	94.9
	Maximum	158	128	164	139	139	117
	C.V.(%)	8.4	7.5	5.5	7.5	6.3	7.8
	B-value	(1)	(1)	(1)	(1)	(1)	(1)
	Distribution	Weibull	Weibull	Normal	Normal	Normal	Normal
	C ₁	141	116	155	128	130	107
	C ₂	13.3	14.5	8.51	9.57	8.21	8.22
	No. Specimens	20		5		5	
	No. Batches	1		1		1	
Data Class	Screening		Screening		Screening		
E ₁ ^c (Msi)	Mean	9.11	7.53	10.1	8.30	9.37	7.75
	Minimum	8.64	6.83	9.72	7.74	9.15	7.38
	Maximum	9.63	8.17	10.8	8.76	9.66	8.66
	C.V.(%)	3.0	5.2	4.0	5.1	2.4	7.1
	No. Specimens	20		5		5	
No. Batches	1		1		1		
Data Class	Screening		Screening		Screening		
ν ₁₂ ^c Data Class	Mean						
	No. Specimens						
	No. Batches						
ε ₁ ^{cu} (μɛ)	Mean	14400					
	Minimum	13700					
	Maximum	15200					
	C.V.(%)	3.1					
	B-value	(1)					
	Distribution	Weibull					
	C ₁	14600					
	C ₂	34.7					
	No. Specimens	20					
	No. Batches	1					
Data Class	Screening						

(1) Basis values are presented only for A and B data classes.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		HITEX 33 6k/E7K8 plain weave fabric				Table 4.2.10(d) C/Ep 195-PW HITEX 33/E7K8 Compression, 1-axis [0_t]₁₂ 75/W, 180/W Screening	
RESIN CONTENT:	45 wt%	COMP: DENSITY:	1.51 g/cm ³				
FIBER VOLUME:	47 %	VOID CONTENT:	0.0%				
PLY THICKNESS:	0.0081-0.0098 in.						
TEST METHOD:		MODULUS CALCULATION:					
SACMA SRM 1-88							
NORMALIZED BY:		Specimen thickness and batch fiber volume to 57% (0.0076 in. CPT)					
Temperature (°F)	75	180					
Moisture Content (%)	wet	wet					
Equilibrium at T, RH	(1)	(1)					
Source Code	20	20					
	Normalized	Measured	Normalized	Measured	Normalized	Measured	
Mean	133	110	68.5	56.4			
Minimum	130	100	54.2	46.7			
Maximum	139	116	75.8	62.2			
C.V.(%)	2.8	5.8	13.6	12.0			
B-value	(2)	(2)	(2)	(2)			
Distribution	Normal	Normal	Normal	Normal			
F ₁ ^{cu}							
(ksi)							
C ₁	133	110	68.5	56.4			
C ₂	3.71	6.36	9.31	6.79			
No. Specimens	5		5				
No. Batches	1		1				
Data Class	Screening		Screening				
Mean	8.78	7.24	9.43	7.78			
Minimum	8.41	7.04	9.32	7.69			
Maximum	9.07	7.51	9.64	7.89			
C.V.(%)	3.2	2.5	1.4	9.5			
E ₁ ^c							
(Msi)							
No. Specimens	5		5				
No. Batches	1		1				
Data Class	Screening		Screening				
Mean							
No. Specimens							
No. Batches							
Data Class							
Mean		14600					
Minimum		14000					
Maximum		15400					
C.V.(%)		3.6					
B-value		(2)					
Distribution		Normal					
ε ₁ ^{cu}							
(με)							
C ₁		14600					
C ₂		525					
No. Specimens	5						
No. Batches	1						
Data Class	Screening						

(1) Conditioned at 160°F, 85% relative humidity for 14 days.

(2) Basis values are presented only for A and B data classes.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		HITEX 33 6k/E7K8 plain weave fabric				Table 4.2.10(e) C/Ep 195-PW HITEX 33/E7K8 Compression, 2-axis [90]s 75/A, -65/A, 180/A Screening	
RESIN CONTENT:	39-41 wt%	COMP: DENSITY:	1.53 g/cm ³				
FIBER VOLUME:	51-52 %	VOID CONTENT:	0.0%				
PLY THICKNESS:	0.0083-0.0087 in.						
TEST METHOD:		MODULUS CALCULATION:					
SACMA SRM 1-88							
NORMALIZED BY:		Specimen thickness and batch fiber volume to 57% (0.0076 in. CPT)					
Temperature (°F)	75 ambient		-65 ambient		180 ambient		
Moisture Content (%)							
Equilibrium at T, RH							
Source Code	20		20		20		
	Normalized	Measured	Normalized	Measured	Normalized	Measured	
F ₂ ^{cu} (ksi)	Mean	104	92.4	128	114	99.4	88.6
	Minimum	77.9	70.4	111	98.8	86.4	77.0
	Maximum	125	109	138	123	113	101
	C.V.(%)	13.1	12.6	8.0	8.1	12.0	12.0
	B-value	(1)	(1)	(1)	(1)	(1)	(1)
	Distribution	Weibull	Weibull	Normal	Normal	Normal	Normal
	C ₁	110	97.4	128	114	99.4	88.6
	C ₂	9.70	10.5	10.3	9.18	11.9	10.6
	No. Specimens	20		5		5	
	No. Batches	1		1		1	
Data Class	Screening		Screening		Screening		
E ₂ ^c (Msi)	Mean	8.92	8.21	9.49	8.74	9.07	8.35
	Minimum	8.50	7.78	9.36	8.65	8.95	8.20
	Maximum	9.40	8.77	9.58	8.93	9.18	8.52
	C.V.(%)	2.5	3.4	0.9	1.3	1.3	1.7
	No. Specimens	20		5		5	
No. Batches	1		1		1		
Data Class	Screening		Screening		Screening		
ν ₂₁ ^c	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₂ ^{cu} (μɛ)	Mean	10900					
	Minimum	10400					
	Maximum	11400					
	C.V.(%)	2.4					
	B-value	(1)					
	Distribution	Weibull					
	C ₁	11100					
	C ₂	46.5					
	No. Specimens	20					
	No. Batches	1					
Data Class	Screening						

(1) Basis values are presented only for A and B data classes.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		HITEX 33 6k/E7K8 plain weave fabric				Table 4.2.10(f) C/Ep 195-PW HITEX 33/E7K8 Compression, 2-axis [90_r]₆ 75/W, 180/W Screening	
RESIN CONTENT:	39-41 wt%	COMP: DENSITY:	1.53 g/cm ³				
FIBER VOLUME:	51-52 %	VOID CONTENT:	0.0%				
PLY THICKNESS:	0.0080-0.0083 in.						
TEST METHOD:		MODULUS CALCULATION:					
SACMA SRM 1-88							
NORMALIZED BY:		Specimen thickness and batch fiber volume to 57% (0.0076 in. CPT)					
Temperature (°F)	75	180					
Moisture Content (%)	wet	wet					
Equilibrium at T, RH	(1)	(1)					
Source Code	20	20					
	Normalized	Measured	Normalized	Measured	Normalized	Measured	
F ₂ ^{cu} (ksi)	Mean	99.2	88.5	84.0	74.9		
	Minimum	80.9	72.2	74.2	66.1		
	Maximum	112	100	88.8	79.2		
	C.V.(%)	12.1	12.1	7.0	6.9		
	B-value	(2)	(2)	(2)	(2)		
	Distribution	Normal	Normal	Normal	Normal		
	C ₁	99.2	88.5	84.0	74.9		
	C ₂	12.0	10.7	5.8	5.20		
	No. Specimens	5		5			
	No. Batches	1		1			
Data Class	Screening		Screening				
E ₂ ^c (Msi)	Mean	9.30	8.56	8.96	8.25		
	Minimum	8.74	7.98	8.69	8.03		
	Maximum	9.56	8.78	9.31	8.43		
	C.V.(%)	3.5	3.9	2.9	2.0		
	No. Specimens	5		5			
No. Batches	1		1				
Data Class	Screening		Screening				
ν ₂₁ ^c	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₂ ^{cu} (με)	Mean	10200					
	Minimum	9910					
	Maximum	10900					
	C.V.(%)	3.7					
	B-value	(2)					
	Distribution	Normal					
	C ₁	10200					
	C ₂	381					
	No. Specimens	5					
	No. Batches	1					
Data Class	Screening						

(1) Conditioned at 160°F, 85% relative humidity for 14 days.

(2) Basis values are presented only for A and B data classes.

Volume 2, Chapter 4 Carbon Fiber Composites

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		HITEX 33 6k/E7K8 plain weave fabric				Table 4.2.10(g) C/Ep 195-PW HITEX 33/E7K8 Compression, 2-axis [90°]₁₂ 75/A, -65/A, 180/A Screening	
RESIN CONTENT:	45 wt%	COMP: DENSITY:	1.51 g/cm ³				
FIBER VOLUME:	47 %	VOID CONTENT:	0.0%				
PLY THICKNESS:	0.0080-0.0097 in.						
TEST METHOD:		MODULUS CALCULATION:					
SACMA SRM 1-88							
NORMALIZED BY:		Specimen thickness and batch fiber volume to 57% (0.0076 in. CPT)					
Temperature (°F)	75 ambient		-65 ambient		180 ambient		
Moisture Content (%)							
Equilibrium at T, RH	20		20		20		
Source Code							
	Normalized	Measured	Normalized	Measured	Normalized	Measured	
F ₂ ^{cu} (ksi)	Mean	132	110	147	122	132	110
	Minimum	114	97.9	138	115	128	106
	Maximum	145	118	161	127	146	117
	C.V.(%)	5.7	5.3	6.0	4.1	5.9	4.7
	B-value	(1)	(1)	(1)	(1)	(1)	(1)
	Distribution	Weibull	Weibull	Normal	Normal	Normal	Normal
	C ₁	136	113	147	122	132	110
	C ₂	21.6	23.4	8.78	5.02	7.73	5.12
	No. Specimens	20		5		5	
	No. Batches	1		1		1	
Data Class	Screening		Screening		Screening		
E ₂ ^c (Msi)	Mean	8.74	7.27	9.09	7.54	9.11	7.57
	Minimum	8.41	6.70	8.12	7.07	8.61	7.41
	Maximum	9.20	8.06	10.1	7.90	9.49	7.71
	C.V.(%)	2.6	4.7	9.1	5.6	3.8	1.5
	No. Specimens	20		5		5	
No. Batches	1		1		1		
Data Class	Screening		Screening		Screening		
ν ₂₁ ^c	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₂ ^{cu} (μϵ)	Mean	14100					
	Minimum	13400					
	Maximum	14700					
	C.V.(%)	2.6					
	B-value	(1)					
	Distribution	Weibull					
	C ₁	14300					
	C ₂	46.4					
	No. Specimens	20					
	No. Batches	1					
Data Class	Screening						

(1) Basis values are presented only for A and B data classes.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		HITEX 33 6k/E7K8 plain weave fabric				Table 4.2.10(h) C/Ep 195-PW HITEX 33/E7K8 Compression, 2-axis [90_f]₁₂ 75/W, 180/W Screening	
RESIN CONTENT:	45 wt%	COMP: DENSITY:	1.51 g/cm ³				
FIBER VOLUME:	47 %	VOID CONTENT:	0.0%				
PLY THICKNESS:	0.0080-0.0097 in.						
TEST METHOD:		MODULUS CALCULATION:					
SACMA SRM 1-88							
NORMALIZED BY:		Specimen thickness and batch fiber volume to 57% (0.0076 in. CPT)					
Temperature (°F)		75		180			
Moisture Content (%)		wet		wet			
Equilibrium at T, RH		(1)		(1)			
Source Code		20		20			
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₂ ^{cu} (ksi)	Mean	117	97.4	61.1	50.8		
	Minimum	107	88.4	52.2	44.1		
	Maximum	132	105	66.4	57.2		
	C.V.(%)	9.1	6.9	9.9	9.9		
	B-value	(2)	(2)	(2)	(2)		
	Distribution	Normal	Normal	Normal	Normal		
	C ₁	117	97.4	61.1	50.8		
	C ₂	10.6	6.74	6.04	5.01		
	No. Specimens	5		5			
	No. Batches	1		1			
Data Class		Screening		Screening			
E ₂ ^c (Msi)	Mean	8.99	7.48	9.26	7.71		
	Minimum	8.48	7.08	8.76	7.32		
	Maximum	9.54	7.8	9.69	8.39		
	C.V.(%)	4.5	4.0	4.0	6.2		
	No. Specimens	5		5			
No. Batches	1		1				
Data Class		Screening		Screening			
ν ₂₁ ^c	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₂ ^{cu} (με)	Mean	13500					
	Minimum	12700					
	Maximum	14200					
	C.V.(%)	4.2					
	B-value	(2)					
	Distribution	Normal					
	C ₁	13500					
	C ₂	564					
	No. Specimens	5					
	No. Batches	1					
Data Class		Screening					

(1) Conditioned at 160°F, 85% relative humidity for 14 days.

(2) Basis values are presented only for A and B data classes.

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL: HITEX 33 6k/E7K8 plain weave fabric RESIN CONTENT: 44 wt% COMP: DENSITY: 1.51 g/cm ³ FIBER VOLUME: 48 % VOID CONTENT: 0.18% PLY THICKNESS: 0.0077-0.0093 in. TEST METHOD: MODULUS CALCULATION: ASTM D 2344-76 NORMALIZED BY: Not normalized					
Table 4.2.10(i) C/Ep 195-PW HITEX 33/E7K8 SBS, 31-plane [90°]₆ 75/A, -65/A, 180/A Screening					
Temperature (°F)	75.0	-65.0	75.0	180.0	
Moisture Content (%)	ambient	ambient	wet	wet	
Equilibrium at T, RH			(1)	(1)	
Source Code	20	20	20	20	
Mean	8.67	8.83	9.40	8.35	
Minimum	7.77	8.14	9.20	7.83	
Maximum	9.40	9.37	9.73	8.80	
C.V.(%)	5.0	6.3	2.1	4.5	
B-value	(2)	(2)	(2)	(2)	
F_{31}^{sbs} Distribution	Weibull	Normal	Normal	Normal	
(ksi) C ₁	8.86	8.83	9.40	8.35	
C ₂	23.6	0.554	0.202	0.379	
No. Specimens	20	5	5	5	
No. Batches	1	1	1	1	
Data Class	Screening	Screening	Screening	Screening	

(1) Conditioned at 160°F, 85% relative humidity for 14 days.

(2) Short beam strength test data are approved for Screening Data Class only.

4.2.11 AS4 3k/E7K8 plain weave fabricMaterial Description:

Material:	AS4-3k/E7K8
Form:	Plain weave fabric, areal weight of 195 g/m ² , typical cured resin content of 37-48%, typical cured ply thickness of 0.0087 inches.
Processing:	Autoclave cure; 290°F, 85 psi for 2 hours. Low exotherm profile for processing of thick parts.

General Supplier Information:

Fiber:	AS4 fibers are continuous carbon filaments made from PAN precursor, surface treated to improve handling characteristics and structural properties. Filament count is 3000 filaments/tow. Typical tensile modulus is 34×10^6 psi. Typical tensile strength is 550,000 psi. Good drape.
Matrix:	E7K8 is a medium flow, low exotherm epoxy resin. Good tack; up to 20 days out-time at ambient temperature.
Maximum Short Term Service Temperature:	>300°F (dry), >190°F (wet)
Typical applications:	Primary and secondary structural applications on commercial and military aircraft, jet engine applications such as stationary airfoils and thrust reverser blocker doors.

4.2.11 AS4 3k/E7K8 plain weave fabric*

MATERIAL:				AS4 3k/E7K8 plain weave fabric	C/Ep 195-PW AS4/E7K8 Summary	
FORM:						U.S. Polymeric AS4/E7K8 plain weave fabric prepreg
FIBER:		Hercules AS4 3k	MATRIX:			U.S. Polymeric E7K8
T _g (dry):		T _g (wet):		T _g METHOD:		
PROCESSING:						Autoclave: 290°F, 2 hours, 85 psig

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

Date of fiber manufacture	Date of testing	
Date of resin manufacture	Date of data submittal	1/88, 6/90
Date of form manufacture	Date of analysis	1/93
Date of composite manufacture		

LAMINA PROPERTY SUMMARY

	75°F/A							
Tension, 1-axis	II - I							
Tension, 2-axis								
Tension, 3-axis								
Compression, 1-axis								
Compression, 2-axis								
Compression, 3-axis								
Shear, 12-plane	S - - -							
Shear, 23-plane								
Shear, 31-plane								
SB Strength, 31-plane								

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

	Nominal	As Submitted	Test Method
Fiber Density (g/cm ³)	1.77	48 - 55 0.0074 - 0.0088	
Resin Density (g/cm ³)	1.28		
Composite Density (g/cm ³)	1.56		
Fiber Areal Weight (g/m ²)	195		
Fiber Volume (%)	58		
Ply Thickness (in)	0.0087		

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		AS4 3k/E7K8 plain weave fabric				Table 4.2.11(a) C/Ep 195-PW AS4/E7K8 Compression, 1-axis [0_f]₁₂ 75/A Interim	
RESIN CONTENT:	37-48 wt%	COMP: DENSITY:	1.52-1.54 g/cm ³				
FIBER VOLUME:	48-55 %	VOID CONTENT:	0.0-1.9%				
PLY THICKNESS:	0.0074-0.0085 in.						
TEST METHOD:		MODULUS CALCULATION:					
SACMA SRM 1-88							
NORMALIZED BY:		Specimen thickness and batch fiber volume to 57% (0.0076 in. CPT)					
Temperature (°F)		75					
Moisture Content (%)		ambient					
Equilibrium at T, RH							
Source Code		20,27					
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{cu} (ksi)	Mean	111	988				
	Minimum	64.4	58.0				
	Maximum	138	122				
	C.V.(%)	11.7	11.3				
	B-value	(1)	(1)				
	Distribution	ANOVA	ANOVA				
	C ₁	13.3	11.3				
	C ₂	1.81	1.80				
No. Specimens		206					
No. Batches		18					
Data Class		Interim					
E ₁ ^c (Msi)	Mean	9.02	8.07				
	Minimum	7.87	7.07				
	Maximum	10.5	9.04				
	C.V.(%)	5.24	4.28				
No. Specimens		210					
No. Batches		18					
Data Class		Interim					
ν ₁₂ ^c	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{cu} (με)	Mean	11600					
	Minimum	8820					
	Maximum	15000					
	C.V.(%)	14.5					
	B-value	(1)					
	Distribution	ANOVA					
	C ₁	1730					
	C ₂	1.97					
No. Specimens		190					
No. Batches		17					
Data Class		Interim					

(1) Basis values are presented only for A and B data classes.

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		AS4/E7K8 plain weave fabric				Table 4.2.11(b) C/Ep 195-PW AS4/E7K8 SBS, 31-plane [0]₁₂ 75/A Screening	
RESIN CONTENT:	38-48 wt%	COMP: DENSITY:	1.52-1.54 g/cm ³				
FIBER VOLUME:	48-55 %	VOID CONTENT:	0.0-1.9%				
PLY THICKNESS:	0.0074-0.0085 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 2344-84							
NORMALIZED BY:		Not normalized					
Temperature (°F)		75					
Moisture Content (%)		ambient					
Equilibrium at T, RH							
Source Code		20,27					
F ₃₁ ^{sbs} (ksi)	Mean	9.68					
	Minimum	7.53					
	Maximum	14.2					
	C.V.(%)	12.0					
	B-value	(1)					
	Distribution	ANOVA					
	C ₁	1.20					
	C ₂	1.95					
No. Specimens		170					
No. Batches		16					
Data Class		Screening					

(1) Short beam strength test data are approved for Screening Data Class only.

4.2.12 AS4/3501-6 (bleed) unidirectional tapeMaterial Description:

Material: AS4/3501-6

Form: Unidirectional tape, fiber areal weight of 145 g/m², typical cured resin content of 28%-34%, typical cured ply thickness of 0.0041-0.0062 inches.

Processing: Autoclave cure; 240°F, 85 psi for 1 hour; 350°F, 100 psi for 2 hours; bleed system.

General Supplier Information:

Fiber: AS4 fibers are continuous carbon filaments made from PAN precursor, surface treated to improve handling characteristics and structural properties. Typical tensile modulus is 34×10^6 psi. Typical tensile strength is 550,000 psi.

Matrix: 3501-6 is an amine-cured epoxy resin. It will retain light tack for a minimum of 10 days at room temperature.

Maximum Short Term Service Temperature: 300°F (dry), 180°F (wet)

Typical applications: General purpose structural applications.

4.2.12 AS4/3501-6 (bleed) unidirectional tape*

MATERIAL:				AS4/3501-6 unidirectional tape		C/Ep 145-UT AS4/3501-6 Summary	
FORM:							
FIBER:		Hercules AS4		MATRIX:		Hercules 3501-6	
T _g (dry):		390°F		T _g (wet):		T _g METHOD: TMA	
PROCESSING:		Autoclave cure: 240 ± 10°F, 60 minutes, 85 psig; 350 ± 10°F, 120 ± 10 minutes, 100 ± 10 psig, bleed					

* ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

Date of fiber manufacture	Date of testing	
Date of resin manufacture	Date of data submittal	6/90
Date of prepreg manufacture	Date of analysis	1/93
Date of composite manufacture		

LAMINA PROPERTY SUMMARY

	75°F/A		200°F/A		75°F/W	200°F/W		
Tension, 1-axis	II - -							
Tension, 2-axis	SS - -							
Tension, 3-axis								
Compression, 1-axis	IS - -		II - -		SS - -	SS - -		
Compression, 2-axis								
Compression, 3-axis								
Shear, 12-plane								
Shear, 23-plane								
Shear, 31-plane								
SB Strength, 31-plane	S - - -		S - - -		S - - -	S - - -		

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

* ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

		Nominal	As Submitted	Test Method
Fiber Density	(g/cm ³)	1.8	58 - 65 0.0041 - 0.0059	
Resin Density	(g/cm ³)	1.27		
Composite Density	(g/cm ³)	1.59		
Fiber Areal Weight	(g/m ²)	145		
Fiber Volume	(%)	60		
Ply Thickness	(in)			

LAMINATE PROPERTY SUMMARY

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

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* ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL: AS4/3501-6 (bleed) unidirectional tape

RESIN CONTENT: 34-38 wt%

COMP: DENSITY: 1.56 g/cm³

FIBER VOLUME: 58-65 %

VOID CONTENT:

PLY THICKNESS: 0.0048-0.0057 in.

TEST METHOD:

MODULUS CALCULATION:

ASTM D 3039-76

Table 4.2.12(a)
C/Ep 145-UT
AS4/3501-6
Tension, 1-axis
[0]₈
75/A
Interim

NORMALIZED BY: Specimen thickness and batch fiber volume to 60% (0.0053 in. CPT)

Temperature (°F)		75					
Moisture Content (%)		ambient					
Equilibrium at T, RH							
Source Code		26					
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F_1^{tu} (ksi)	Mean	291	295				
	Minimum	263	271				
	Maximum	326	326				
	C.V.(%)	6.09	5.05				
	B-value	(1)	(1)				
	Distribution	Weibull	Weibull				
	C ₁	300	302				
	C ₂	18.4	20.3				
	No. Specimens	21					
	No. Batches	7					
		Interim					
E_1^t (Msi)	Mean	19.6	19.9				
	Minimum	18.0	18.3				
	Maximum	21.1	22.6				
	C.V.(%)	3.73	6.48				
	No. Specimens	21					
	No. Batches	7					
		Interim					
ν_{12}^t	Mean						
	No. Specimens						
	No. Batches						
ϵ_1^{tu} ($\mu\epsilon$)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						

(1) Basis values are presented only for A and B data classes.

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* ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL: AS4/3501-6 (bleed) unidirectional tape

RESIN CONTENT: 28-29 wt% COMP: DENSITY: 1.60-1.61 g/cm³

FIBER VOLUME: 63-64 % VOID CONTENT:

PLY THICKNESS: 0.0048-0.0057 in.

TEST METHOD: MODULUS CALCULATION:

ASTM D 3039-76

NORMALIZED BY: Not normalized

Table 4.2.12(b)
C/Ep 145-UT
AS4/3501-6
Tension, 2-axis
[90]₈
75/A
Screening

Temperature (°F)	75					
Moisture Content (%)	ambient					
Equilibrium at T, RH						
Source Code	26					
Mean	7.78					
Minimum	7.00					
Maximum	9.50					
C.V.(%)	12.1					
B-value	(1)					
Distribution	Normal					
F_2^u						
(ksi)						
C ₁	7.78					
C ₂	0.941					
No. Specimens	6					
No. Batches	2					
Data Class	Screening					
Mean	1.48					
Minimum	1.40					
Maximum	1.50					
C.V.(%)	2.75					
E_2^t						
(Msi)						
No. Specimens	6					
No. Batches	2					
Data Class	Screening					
Mean						
No. Specimens						
No. Batches						
Data Class						
v_{12}^t						
Mean						
Minimum						
Maximum						
C.V.(%)						
B-value						
Distribution						
ϵ_2^u						
(µε)						
C ₁						
C ₂						
No. Specimens						
No. Batches						
Data Class						

(1) Basis values are presented only for A and B data classes.

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* ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL: AS4/3501-6 (bleed) unidirectional tape

RESIN CONTENT: 28-34 wt%

COMP: DENSITY: 1.58-1.61 g/cm³

FIBER VOLUME: 58-65 %

VOID CONTENT:

PLY THICKNESS: 0.0041-0.0055 in.

TEST METHOD:

MODULUS CALCULATION:

SACMA SRM 1-88

Table 4.2.12(c)
C/Ep 145-UT
AS4/3501-6
Compression, 1-axis
[0]₈
75/A, 200/A, 75/W
Interim, Screening

NORMALIZED BY: Specimen thickness and batch fiber volume to 60% (0.0053 in. CPT)

Temperature (°F)		75 ambient		200 ambient		75 wet (1)	
Moisture Content (%)		26		26		26	
Equilibrium at T, RH							
Source Code							
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F_1^c (ksi)	Mean	210	214	196	201	202	213
	Minimum	144	161	148	165	165	179
	Maximum	269	260	242	237	274	266
	C.V.(%)	16.0	13.5	13.6	10.7	18.0	14.1
	B-value	(2)	(2)	(2)	(2)	(2)	(2)
	Distribution	ANOVA	ANOVA	ANOVA	ANOVA	Weibull	Weibull
	C ₁	34.7	27.7	27.7	22.3	217	226
	C ₂	2.39	2.52	2.52	2.35	5.89	7.82
	No. Specimens	26		27		10	
	No. Batches	7		7		2	
Data Class		Interim		Interim		Screening	
E_1^c (Msi)	Mean	17.8	18.8	16.3	17.4	17.4	18.5
	Minimum	15.1	16.4	13.0	14.3	15.6	17.1
	Maximum	20.3	20.0	18.7	19.6	20.3	20.6
	C.V.(%)	7.50	7.18	10.7	10.1	9.14	5.84
	No. Specimens	14		15		10	
Data Class		Screening		Interim		Screening	
ν_{12}^c	Mean						
	No. Specimens						
	No. Batches						
Data Class							
ϵ_1^c ($\mu\epsilon$)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
Data Class							

(1) Conditioned at 140°F, 95% relative humidity for 30 days.

(2) Basis values are presented only for A and B data classes.

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* ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL: AS4/3501-6 (bleed) unidirectional tape

RESIN CONTENT: 28-34 wt% COMP: DENSITY: 1.58-1.61 g/cm³

FIBER VOLUME: 58-65 % VOID CONTENT:

PLY THICKNESS: 0.0041-0.0055 in.

TEST METHOD: MODULUS CALCULATION:

SACMA SRM 1-88

NORMALIZED BY: Specimen thickness and batch fiber volume to 60% (0.0053 in. CPT)

Table 4.2.12(d)
C/Ep 145-UT
AS4/3501-6
Compression, 1-axis
[0]₈
200/W
Screening

Temperature (°F)		200					
Moisture Content (%)		wet					
Equilibrium at T, RH							
Source Code		26					
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{cu} (ksi)	Mean	169	179				
	Minimum	100	107				
	Maximum	212	226				
	C.V.(%)	22.2	22.9				
	B-value	(1)	(1)				
	Distribution	ANOVA	ANOVA				
	C ₁	41.7	46.6				
	C ₂	5.28	5.72				
	No. Specimens	10					
	No. Batches	3					
Data Class		Screening					
E ₁ ^c (Msi)	Mean	17.7	18.7				
	Minimum	12.1	13.4				
	Maximum	27.2	25.5				
	C.V.(%)	21.6	15.8				
	No. Specimens	10					
	No. Batches	3					
Data Class		Screening					
ν ₁₂ ^c	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{cu} (με)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

(1) Basis values are presented only for A and B data classes.

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* ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL: AS4/3501-6 (bleed) unidirectional tape

RESIN CONTENT: 30-34 wt% COMP: DENSITY: 1.58-1.60 g/cm³

FIBER VOLUME: 58-62 % VOID CONTENT:

PLY THICKNESS: 0.0047-0.0055 in.

TEST METHOD: MODULUS CALCULATION:

ASTM D 2344

NORMALIZED BY: Not normalized

Table 4.2.12(e)
C/Ep 145-UT
AS4/3501-6
SBS, 31-plane
[0]₈
75/A, 200/A, 75/W,
200/W
Screening

Temperature (°F)	75 ambient	200 ambient	75 wet (1)	200 wet (1)	
Moisture Content (%)					
Equilibrium at T, RH					
Source Code	26	26	26	26	
Mean	17.3	13.0	13.9	9.0	
Minimum	14.1	11.1	13.1	8.3	
Maximum	19.4	14.9	15.5	10.1	
C.V.(%)	7.63	11.6	6.13	6.4	
B-value	(2)	(2)	(2)	(2)	
Distribution	ANOVA	ANOVA	Normal	Normal	
F ₃₁ ^{sbs}					
(ksi)					
C ₁	1.38	1.59	13.9	9.0	
C ₂	2.62	2.77	0.852	0.58	
No. Specimens	21	21	6	9	
No. Batches	7	7	2	3	
Data Class	Screening	Screening	Screening	Screening	

- (1) Conditioned at 140°F, 95% relative humidity for 30 days.
(2) Basis values are presented only for A and B data classes.

MATERIAL:		AS4/3501-6 (bleed) unidirectional tape				Table 4.2.12(f) C/Ep 145-UT AS4/3501-6 Tension, x-axis [0/45/90/-45]_s 75/A Screening	
RESIN CONTENT:	29-32 wt%	COMP: DENSITY:	1.59-1.60 g/cm ³				
FIBER VOLUME:	60-63 %	VOID CONTENT:					
PLY THICKNESS:	0.0055-0.0062 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3039-76		Linear portion of curve					
NORMALIZED BY:		Normalized by specimen thickness and batch fiber area weight to 60% (0.0059 in. CPT)					
Temperature (°F)		75					
Moisture Content (%)		ambient					
Equilibrium at T, RH							
Source Code		26					
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F _x ^{tu} (ksi)	Mean	107	95.8				
	Minimum	101	90.6				
	Maximum	118	106				
	C.V.(%)	6.03	5.95				
	B-value	(1)	(1)				
	Distribution	ANOVA	ANOVA				
	C ₁	7.51	29.9				
	C ₂	15.5	14.5				
	No. Specimens	6					
	No. Batches	2					
Data Class		Screening					
E _x ^t (Msi)	Mean	8.08	7.22				
	Minimum	7.39	6.60				
	Maximum	9.41	8.40				
	C.V.(%)	9.75	9.74				
	No. Specimens	6					
No. Batches		2					
Data Class		Screening					
ν _{xy} ^t	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε _x ^{tu} (με)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

(1) Basis values are presented only for A and B data classes.

MATERIAL:		AS4/3501-6 (bleed) unidirectional tape				Table 4.2.12(g) C/Ep 145-UT AS4/3501-6 Open Hole Tension, x-axis [0/45/90/-45]_s 75/A Screening	
RESIN CONTENT:	29-32 wt%	COMP: DENSITY:	1.59-1.60 g/cm ³				
FIBER VOLUME:	60-63 %	VOID CONTENT:					
PLY THICKNESS:	0.0055-0.0057 in.						
TEST METHOD:	MODULUS CALCULATION:						
SACMA SRM 5-88 (1)							
NORMALIZED BY:		Normalized by specimen thickness and batch fiber areal weight to 60% (0.0056 in. CPT)					
Temperature (°F)		75					
Moisture Content (%)		ambient					
Equilibrium at T, RH							
Source Code		26					
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F_x^{oht} (ksi)	Mean	65.6	62.0				
	Minimum	62.2	59.2				
	Maximum	69.0	65.1				
	C.V.(%)	3.42	3.13				
	B-value	(2)	(2)				
	Distribution	ANOVA	Normal				
	C ₁	2.50	62.0				
	C ₂	12.8	1.94				
	No. Specimens	6					
No. Batches	2						
Data Class	Screening						
E_x^{oht} (Msi)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	No. Specimens						
No. Batches							
Data Class							
ϵ_x^{oht} (µε)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
No. Batches							
Data Class							

- (1) Note SACMA SRM 5-88 uses a [+45/0/-45/90]_{2s} lay-up.
 (2) Basis values are presented only for A and B data classes.

4.2.13 AS4/3501-6 (no bleed) unidirectional tapeMaterial Description:

Material: AS4/3501-6

Form: Unidirectional tape, fiber areal weight of 145 g/m², typical cured resin content of 36%-39%, typical cured ply thickness of 0.0055-0.0063 inches.

Processing: Autoclave cure; 240°F, 85 psi for 1 hour; 350°F, 100 psi for 2 hours, no bleed.

General Supplier Information:

Fiber: AS4 fibers are continuous carbon filaments made from PAN precursor, surface treated to improve handling characteristics and structural properties. Typical tensile modulus is 34 x 10⁶ psi. Typical tensile strength is 550,000 psi.

Matrix: 3501-6 is an amine-cured epoxy resin. It will retain light tack for a minimum of 10 days at room temperature.

Maximum Short Term Service Temperature: 300°F (dry), 180°F (wet)

Typical applications: General purpose structural applications.

4.2.13 AS4/3501-6 (no bleed) unidirectional tape*

MATERIAL:	AS4/3501-6 unidirectional tape			
FORM:	Hercules AS4/3501-6 unidirectional tape prepreg			
FIBER:	Hercules AS4, unsized		MATRIX:	Hercules 3501-6
T _g (dry):	390°F	T _g (wet):	T _g METHOD:	TMA
PROCESSING:	Autoclave cure: 240 ± 10°F, 60 minutes; 85 psig; 350 ± 10°F, 120 ± 10 minutes, 100 ± 10 psig; no bleed			

C/Ep 145-UT
AS4/3501-6
Summary

* ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

Date of fiber manufacture	~12/82-8/89	Date of testing	~6/83 - ~4/91
Date of resin manufacture		Date of data submittal	6/90
Date of prepreg manufacture	1/83 - 11/89	Date of analysis	1/93
Date of composite manufacture			

LAMINA PROPERTY SUMMARY

	75°F/A		-65°F/A	200°F/A		200°F/W		
Tension, 1-axis	II - -		SS - -	SS - -				
Tension, 2-axis	SS - -							
Tension, 3-axis								
Compression, 1-axis	II - -			I - - -		II - -		
Compression, 2-axis								
Compression, 3-axis								
Shear, 12-plane								
Shear, 23-plane								
Shear, 31-plane								
SB Strength, 31-plane	S - - -			S - - -				

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

* ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

	Nominal	As Submitted	Test Method
Fiber Density (g/cm ³)	1.8		
Resin Density (g/cm ³)	1.27		
Composite Density (g/cm ³)	1.59		
Fiber Areal Weight (g/m ²)	145	142 - 149	
Fiber Volume (%)	60	52 - 60	
Ply Thickness (in)		0.0055 - 0.0063	

LAMINATE PROPERTY SUMMARY

	75°F/A							
[0/45/90/-45] family								
Tension, x-axis	S---							
OHT, x-axis	S---							

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

* ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		AS4/3501-6 (no bleed) unidirectional tape				Table 4.2.13(a) C/Ep 145-UT AS4/3501-6 Tension, 1-axis [0]₈ 75/A, -65/A, 200/A Interim, Screening	
RESIN CONTENT:	36-39 wt%	COMP: DENSITY:	1.55-1.57 g/cm ³				
FIBER VOLUME:	52-56 %	VOID CONTENT:					
PLY THICKNESS:	0.0055-0.0060 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3039-76		Initial tangent					
NORMALIZED BY:		Specimen thickness and batch fiber volume to 60% (0.0053 in. CPT)					
Temperature (°F)		75		-65		200	
Moisture Content (%)		ambient		ambient		ambient	
Equilibrium at T, RH							
Source Code		26		26		26	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{tu} (ksi)	Mean	290	262	261	237	315	286
	Minimum	262	235	207	187	278	247
	Maximum	322	286	300	274	330	297
	C.V.(%)	5.62	5.38	12.4	12.8	4.89	5.59
	B-value	(1)	(1)	(1)	(1)	(1)	(1)
	Distribution	ANOVA	ANOVA	ANOVA	ANOVA	Nonpara.	Nonpara.
	C ₁	16.5	14.3	34.9	33.1	6	6
	C ₂	2.05	2.01	4.69	5.05	2.25	2.25
No. Specimens		30		9		9	
No. Batches		10		3		3	
Data Class		Interim		Screening		Screening	
E ₁ ^t (Msi)	Mean	18.9	17.1	21.1	19.2	20.8	18.9
	Minimum	17.0	15.5	19.7	17.7	19.4	17.4
	Maximum	20.3	17.9	22.3	21.4	22.0	20.2
	C.V.(%)	4.0	3.20	4.60	5.78	4.72	4.70
	No. Specimens	30		9		9	
	No. Batches	10		3		3	
	Data Class	Interim		Screening		Screening	
ν ₁₂ ^t	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{tu} (με)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
No. Specimens							
No. Batches							
Data Class							

(1) Basis values are presented only for A and B data classes.

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* ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		AS4/3501-6 (no bleed) unidirectional tape				Table 4.2.13(b) C/Ep 145-UT AS4/3501-6 Tension, 2-axis [90]₈ 75/A Screening	
RESIN CONTENT:	37 wt%	COMP: DENSITY:	1.56 g/cm ³				
FIBER VOLUME:	54-55 %	VOID CONTENT:					
PLY THICKNESS:	0.0060-0.0062 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3039-76		Initial tangent					
NORMALIZED BY:		Not normalized					
Temperature (°F)		75					
Moisture Content (%)		ambient					
Equilibrium at T, RH							
Source Code		26					
F ₂ ^{tu} (ksi)	Mean	8.0					
	Minimum	6.8					
	Maximum	9.3					
	C.V.(%)	10					
	B-value	(1)					
	Distribution	Normal					
	C ₁	8.0					
	C ₂	0.81					
E ₂ ^t (Msi)	No. Specimens	9					
	No. Batches	3					
	Data Class	Screening					
ν ₂₁ ^t	Mean	1.2					
	Minimum	1.1					
	Maximum	1.4					
	C.V.(%)	8.9					
ε ₂ ^{tu} (με)	No. Specimens	9					
	No. Batches	3					
	Data Class	Screening					
ε ₂ ^{tu} (με)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
ε ₂ ^{tu} (με)	No. Specimens						
	No. Batches						
	Data Class						

(1) Basis values are presented only for A and B data classes.

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* ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		AS4/3501-6 (no bleed) unidirectional tape				Table 4.2.13(c) C/Ep 145-UT AS4/3501-6 Compression, 1-axis [0]₈ 75/A, 200/A, 20/W Interim	
RESIN CONTENT:	36-39 wt%	COMP: DENSITY:	1.55-1.57 g/cm ³				
FIBER VOLUME:	52-56 %	VOID CONTENT:					
PLY THICKNESS:	0.0056-0.0060 in.						
TEST METHOD:		MODULUS CALCULATION:					
SACMA SRM 1-88		Initial tangent					
NORMALIZED BY:		Specimen thickness and batch fiber volume to 60% (0.0053 in. CPT)					
Temperature (°F)		75		200		200	
Moisture Content (%)		ambient		ambient		wet	
Equilibrium at T, RH						(1)	
Source Code		26		26		26	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{cu} (ksi)	Mean	233	211	213	193	191	173
	Minimum	200	186	174	157	142	128
	Maximum	260	234	267	243	220	201
	C.V.(%)	6.39	6.16	9.74	10.0	11.0	11.4
	B-value	(2)	(2)	(2)	(2)	(2)	(2)
	Distribution	ANOVA	ANOVA	ANOVA	ANOVA	ANOVA	ANOVA
	C ₁	15.2	13.4	21.0	19.6	22.4	21.1
	C ₂	2.21	2.23	2.00	2.03	4.17	4.25
	No. Specimens	30		30		15	
	No. Batches	8		10		3	
Data Class		Interim		Interim		Interim	
E ₁ ^c (Msi)	Mean	18.8	17.0			18.3	16.6
	Minimum	17.9	16.2			17.5	15.7
	Maximum	19.7	17.8			19.1	17.3
	C.V.(%)	3.21	3.53			2.62	3.16
	No. Specimens	15				15	
No. Batches		3				3	
Data Class		Interim				Interim	
ν ₁₂ ^c	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{cu} (με)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

(1) Conditioned at 140°F, 95% relative humidity for 30 days.

(2) Basis values are presented only for A and B data classes.

* ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL: AS4/3501-6 (no bleed) unidirectional tape RESIN CONTENT: 36-39 wt% COMP: DENSITY: 1.55-1.57 g/cm ³ FIBER VOLUME: 52-56 % VOID CONTENT: PLY THICKNESS: 0.0057-0.0063 in. TEST METHOD: MODULUS CALCULATION: ASTM D 2344-76 Initial tangent NORMALIZED BY: Not normalized					
Table 4.2.13(d) C/Ep 145-UT AS4/3501-6 SBS, 31-plane [0]₈ 75/A, 200/A Screening					
Temperature (°F)	75	200			
Moisture Content (%)	ambient	ambient			
Equilibrium at T, RH					
Source Code	26	26			
Mean	17.9	14.0			
Minimum	16.5	12.9			
Maximum	19.0	15.4			
C.V.(%)	4.46	4.73			
B-value	(1)	(1)			
Distribution	ANOVA	ANOVA			
F_{31}^{sbs}					
(ksi) C ₁	0.824	0.683			
C ₂	2.36	2.34			
No. Specimens	30	30			
No. Batches	8	10			
Data Class	Screening	Screening			

(1) Short beam strength test data are approved for Screening Data Class only.

MATERIAL:		AS4/3501-6 (no bleed) unidirectional tape				Table 4.2.13(e) C/Ep 145-UT AS4/3501-6 Tension, x-axis [0/45/90/-45]_s 75/A Screening	
RESIN CONTENT:	36-37 wt%	COMP: DENSITY:	1.56-1.57 g/cm ³				
FIBER VOLUME:	54-56 %	VOID CONTENT:					
PLY THICKNESS:	0.0057-0.0062 in.						
TEST METHOD:	ASTM D 3039-76			MODULUS CALCULATION:			
NORMALIZED BY:		NA					
Temperature (°F)		75					
Moisture Content (%)		ambient					
Equilibrium at T, RH							
Source Code		26					
F_x^{tu} (ksi)	Mean	87.4					
	Minimum	83.2					
	Maximum	92.8					
	C.V.(%)	3.43					
	B-value	(1)					
	Distribution	Normal					
	C ₁	87.4					
	C ₂	3.00					
	No. Specimens	9					
	No. Batches	3					
	Data Class	Screening					
E_x^t (Msi)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	No. Specimens						
	No. Batches						
	Data Class						
ν_{xy}^t	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ϵ_x^{tu} (µε)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
	Data Class						

(1) Basis values are presented only for A and B data classes.

MATERIAL:		AS4/3501-6 (no bleed) unidirectional tape		Table 4.2.13(f) C/Ep 145-UT AS4/3501-6 Open Hole Tension, x-axis [0/45/90/-45]_s 75/A Screening		
RESIN CONTENT:	36-37 wt%	COMP: DENSITY:	1.56-1.57 g/cm ³			
FIBER VOLUME:	54-56 %	VOID CONTENT:				
PLY THICKNESS:	0.0060-0.0064 in					
TEST METHOD:	MODULUS CALCULATION:					
SACMA SRM 5-88 (1)						
NORMALIZED BY:		NA				
Temperature (°F)		75				
Moisture Content (%)		ambient				
Equilibrium at T, RH						
Source Code		26				
F _x ^{oh} (ksi)	Mean	56.8				
	Minimum	54.4				
	Maximum	60.8				
	C.V.(%)	3.75				
	B-value	(2)				
	Distribution	Normal				
	C ₁	56.8				
	C ₂	2.13				
	No. Specimens	9				
	No. Batches	3				
Data Class		Screening				
E _x ^{oh} (Msi)	Mean					
	Minimum					
	Maximum					
	C.V.(%)					
	No. Specimens					
	No. Batches					
	Data Class					
ν _{xy} ^t	Mean					
	No. Specimens					
	No. Batches					
	Data Class					
ε _x ^{oh} (με)	Mean					
	Minimum					
	Maximum					
	C.V.(%)					
	B-value					
	Distribution					
	C ₁					
	C ₂					
	No. Specimens					
	No. Batches					
Data Class						

(1) Note SACMA SRM 5-88 uses a [45/0/-45/90]_{2S} lay-up.

(2) Basis values are presented only for A and B data classes.

4.2.14 AS4 3k/3501-6 plain weave fabricMaterial Description:

Material: AS4-3k/3501-6

Form: Plain weave fabric, areal weight of 193 g/m², typical cured resin content of 37-41%, typical cured ply thickness of 0.0074-0.0086 inches.

Processing: Autoclave cure; 240°F, 85 psi for 1 hour; 350°F, 100 psi for 2 hours, no bleed.

General Supplier Information:

Fiber: AS4 fibers are continuous carbon filaments made from PAN precursor, surface treated to improve handling characteristics and structural properties. Filament count is 3000 filaments/tow. Typical tensile modulus is 34×10^6 psi. Typical tensile strength is 550,000 psi.

Matrix: 3501-6 is an amine-cured epoxy resin. It will retain light tack for a minimum of 10 days at room temperature.

Maximum Short Term Service Temperature: 300°F (dry), 180°F (wet)

Typical applications: General purpose structural applications.

4.2.14 AS4 3k/3501-6 plain weave*

C/Ep 193-PW AS4/3501-6 Summary			
MATERIAL:	AS4 3k/3501-6 plain weave fabric		
FORM:	Hercules AW193P plain weave fabric prepreg		
FIBER:	Hercules AS4 3k W	MATRIX:	Hercules 3501-6
T _g (dry):	T _g (wet):	T _g METHOD:	
PROCESSING:	Autoclave cure: 240 ± 10°F, 60 minutes, 85 psig; 350 ± 10°F, 120 ± 10 minutes, 100 ± 10 psig, no bleed		

* ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

Date of fiber manufacture	Date of testing	
Date of resin manufacture	Date of data submittal	6/88
Date of prepreg manufacture	Date of analysis	1/93
Date of composite manufacture		

LAMINA PROPERTY SUMMARY

	75°F/A		-65°A/F	200°F/A		75°F/W	200°F/W	
Tension, 1-axis	SS - -		SS - -	SS - -				
Tension, 2-axis								
Tension, 3-axis								
Compression, 1-axis	II - -			II - -		II - -	II - -	
Compression, 2-axis								
Compression, 3-axis								
Shear, 12-plane								
Shear, 23-plane								
Shear, 31-plane								
SB Strength, 31-plane	S - - -			S - - -		S - - -	S - - -	

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

		Nominal	As Submitted	Test Method
Fiber Density	(g/cm ³)	1.80	1.54 - 1.56	
Resin Density	(g/cm ³)	1.28		
Composite Density	(g/cm ³)	1.58		
Fiber Areal Weight	(g/m ²)	193	193	
Fiber Volume	(%)	58	51 - 54	
Ply Thickness	(in)	0.0070	0.0074 - 0.0086	

	75°F/A							
[0 _t /90 _t /±45 _t] Family Tension, x-axis	SS - -							
[±45 _t /0 _t /90 _t] Family OHT, x-axis	S - - -							

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* ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		AS4 3k/3501-6 plain weave fabric				Table 4.2.14(a) C/Ep 193-PW AS4/3501-6 Tension, 1-axis [0]8 75/A, -65/A, 200/A Screening		
RESIN CONTENT:	38 wt%	COMP: DENSITY:	1.56 g/cm ³					
FIBER VOLUME:	53-54 %	VOID CONTENT:						
PLY THICKNESS:	0.0074-0.0080 in.							
TEST METHOD:		MODULUS CALCULATION:						
ASTM D 3039-76								
NORMALIZED BY:		Specimen thickness and batch fiber volume to 57% (0.0074 in. CPT)						
Temperature (°F)		75		-65		200		
Moisture Content (%)		ambient		ambient		ambient		
Equilibrium at T, RH								
Source Code		26		26		26		
		Normalized	Measured	Normalized	Measured	Normalized	Measured	
F ₁ ^{tu} (ksi)	Mean	124	117	112	105	126	119	
	Minimum	117	111	103	98.1	116	108	
	Maximum	133	124	120	112	133	126	
	C.V.(%)	4.18	3.56	4.63	4.00	4.79	5.88	
	B-value	(2)	(2)	(2)	(2)	(2)	(2)	
	Distribution	Normal	Normal	Normal	Normal	Normal	Normal	
	C ₁	124	117	112	105	126	119	
	C ₂	5.17	4.15	5.17	4.21	6.05	7.00	
	No. Specimens	9		9		9		
	No. Batches	3		3		3		
Data Class		Screening		Screening		Screening		
E ₁ ^t (Msi)	Mean	9.8	9.2	10.5	9.9	10.1	9.5	
	Minimum	9.4	8.8	9.7	9.1	7.1	6.7	
	Maximum	10.2	9.5	11.1	10.4	10.7	10.1	
	C.V.(%)	3,0	2.5	4.6	4.2	11	11	
	No. Specimens	9		9		9		
	No. Batches	3		3		3		
	Data Class		Screening		Screening		Screening	
ν ₁₂ ^t	Mean							
	No. Specimens							
	No. Batches							
	Data Class							
ε ₁ ^{tu} (με)	Mean							
	Minimum							
	Maximum							
	C.V.(%)							
	B-value							
	Distribution							
	C ₁							
	C ₂							
	No. Specimens							
	No. Batches							
Data Class								

Table 4.2.14(a)
C/Ep 193-PW
AS4/3501-6
Tension, 1-axis
[0]_i
75/A, -65/A, 200/A
Screening

(1) Basis values are presented only for A and B data classes.

* ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		AS4 3k/3501-6 plain weave fabric				Table 4.2.14(b) C/Ep 193-PW AS4/3501-6 Compression, 1-axis [0]_t¹⁴ 75/A, 200/A, 75/W Interim	
RESIN CONTENT:	39-41 wt%	COMP: DENSITY:	1.54-1.55 g/cm ³				
FIBER VOLUME:	51-52 %	VOID CONTENT:					
PLY THICKNESS:	0.0081-0.0086 in.						
TEST METHOD:		MODULUS CALCULATION:					
SACMA SRM 1-88							
NORMALIZED BY:		Specimen thickness and batch fiber volume to 57% (0.0074 in. CPT)					
Temperature (°F)		75		200		75	
Moisture Content (%)						(1)	
Equilibrium at T, RH		ambient		ambient		wet	
Source Code		26		26		26	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{cu} (ksi)	Mean	130	117	108	97.3	112	101
	Minimum	115	104	92.8	83.0	99.6	88.0
	Maximum	140	127	121	109	122	109
	C.V.(%)	6.45	6.49	7.44	7.71	5.56	5.65
	B-value	(2)	(2)	(2)	(2)	(2)	(2)
	Distribution	Nonpara.	Nonpara.	Weibull	Normal	ANOVA	ANOVA
	C ₁	8	8	112	97.3	6.83	6.32
	C ₂	1.54	1.54	15.1	7.51	4.85	5.09
	No. Specimens	15		15		15	
	No. Batches	3		3		3	
Data Class		Interim		Interim		Interim	
E ₁ ^c (Msi)	Mean	9.2	8.3	9.8	8.8	9.4	8.4
	Minimum	8.5	7.7	9.2	8.4	8.8	8.1
	Maximum	9.8	8.8	10.2	9.1	9.9	8.8
	C.V.(%)	3.4	4.3	3.5	2.5	3.0	2.4
	No. Specimens	15		15		15	
No. Batches		3		3		3	
Data Class		Interim		Interim		Interim	
ν ₁₂ ^c	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{cu} (μɛ)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

(1) Conditioned at 140°F, 95% relative humidity for 30 days.

(2) Basis values are presented only for A and B data classes.

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* ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		AS4 3k/3501-6 plain weave fabric		Table 4.2.14(c) C/Ep 193-PW AS4/3501-6 Compression, 1-axis [0]₁₄ 200/W Interim			
RESIN CONTENT:	39-41 wt%	COMP: DENSITY:	1.54-1.55 g/cm ³				
FIBER VOLUME:	51-52 %	VOID CONTENT:					
PLY THICKNESS:	0.0081-0.0086 in.						
TEST METHOD:	MODULUS CALCULATION:						
SACMA SRM 1-88							
NORMALIZED BY:		Specimen thickness and batch fiber volume to 57% (0.0074 in. CPT)					
Temperature (°F)		200					
Moisture Content (%)		(1)					
Equilibrium at T, RH		wet					
Source Code		26					
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{cu} (ksi)	Mean	58.7	52.7				
	Minimum	51.7	46.2				
	Maximum	65.4	59.7				
	C.V.(%)	7.27	7.58				
	B-value	(2)	(2)				
	Distribution	Weibull	Weibull				
	C ₁	60.6	54.5				
	C ₂	15.6	15.2				
	No. Specimens	15					
	No. Batches	3					
Data Class	Interim						
E ₁ ^c (Msi)	Mean	9.1	8.1				
	Minimum	8.7	7.8				
	Maximum	9.4	8.5				
	C.V.(%)	2.4	2.9				
	No. Specimens	15					
	No. Batches	3					
	Data Class	Interim					
ν ₁₂ ^c	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{cu} (με)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

- (1) Conditioned at 140°F, 95% relative humidity for 30 days.
(2) Basis values are presented only for A and B data classes.

* ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL: AS4 3k/3501-6 plain weave fabric RESIN CONTENT: 39-41 wt% FIBER VOLUME: 51-52 % PLY THICKNESS: 0.0077-0.0082 in. COMP: DENSITY: 1.54-1.55 g/cm³ VOID CONTENT: TEST METHOD: ASTM D 2344 MODULUS CALCULATION: NORMALIZED BY: Not normalized					
Table 4.2.14(d) C/Ep 193-PW AS4/3501-6 SBS, 31-plane [0_t]₁₄ 75/A, 200/A, 75/W, 200/W Screening					
Temperature (°F)	75	200	75	200	
Moisture Content (%)	ambient	ambient	wet	wet	
Equilibrium at T, RH			(1)	(1)	
Source Code	26	26	26	26	
Mean	10.9	8.4	10.9	5.3	
Minimum	9.7	8.1	10.0	5.2	
Maximum	11.9	8.8	11.4	5.5	
C.V.(%)	6.09	2.5	3.47	2.3	
B-value	(2)	(2)	(2)	(2)	
Distribution	Weibull	Normal	Weibull	Nonpara.	
C ₁	11.2	8.4	11.0	7	
C ₂	20.1	0.21	35.4	1.81	
No. Specimens	15	9	15	12	
No. Batches	3	3	3	3	
Data Class	Screening	Screening	Screening	Screening	

(1) Conditioned at 140°F, 95% relative humidity for 30 days.
(2) Basis values are presented only for A and B data classes.

MATERIAL:		AS4 3k/3501-6 plain weave fabric				Table 4.2.14(e) C/Ep 193-PW AS4/3501-6 Tension, x-axis [0_f/90_f/±45_f]_{2s} 75/A Screening	
RESIN CONTENT:	37-38 wt%	COMP: DENSITY:	0.056 lb/in ³				
FIBER VOLUME:	53-54 %	VOID CONTENT:					
PLY THICKNESS:	0.0080-0.0085 in.						
TEST METHOD:	MODULUS CALCULATION:						
ASTM D 3039-76							
NORMALIZED BY:		Normalized by specimen thickness and batch fiber areal weight to 60% (0.0083 in. CPT)					
Temperature (°F)		75					
Moisture Content (%)		ambient					
Equilibrium at T, RH							
Source Code		26					
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F _x ^{tu} (ksi)	Mean	76.0	68.5				
	Minimum	68.8	62.0				
	Maximum	83.4	75.1				
	C.V.(%)	7.6	7.60				
	B-value	(1)	(1)				
	Distribution	Normal	Normal				
	C ₁	76.0	68.5				
	C ₂	5.78	5.21				
	No. Specimens	9					
	No. Batches	3					
Data Class		Screening					
E _x ^t (Msi)	Mean	6.7	6.0				
	Minimum	6.2	5.6				
	Maximum	6.9	6.3				
	C.V.(%)	3.5	3.6				
	No. Specimens	9					
No. Batches		3					
Data Class		Screening					
ν _{xy} ^t	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε _x ^{tu} (με)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

(1) Basis values are presented only for A and B data classes.

MATERIAL:		AS4 3k/3501-6 plain weave fabric				Table 4.2.14(f) C/Ep 193-PW AS4/3501-6 Open Hole Tension, x-axis [±45_f/0_f/90_f]_{2s} 75/A Screening	
RESIN CONTENT:	37-38 wt%	COMP: DENSITY:	0.056 lb/in ³				
FIBER VOLUME:	53-54 %	VOID CONTENT:					
PLY THICKNESS:	0.0080-0.0085 in.						
TEST METHOD:	SACMA SRM 5-88 (1)						
NORMALIZED BY:		Normalized by specimen thickness and batch fiber areal weight to 60% (0.0083 in. CPT)					
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F_x^{oht} (ksi)	Mean	57.0	51.4				
	Minimum	54.0	48.6				
	Maximum	59.7	53.8				
	C.V.(%)	3.4	3.40				
	B-value	(2)	(2)				
	Distribution	ANOVA	ANOVA				
	C ₁	2.12	2.46				
	C ₂	5.15	1.20				
	No. Specimens	9					
No. Batches	3						
Data Class	Screening						
E_x^t (Msi)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	No. Specimens						
No. Batches							
Data Class							
ϵ_x^{tu} (μϵ)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

- (1) Note SACMA SRM 5-88 uses a [45/0/-45/90]_s lay-up.
(2) Basis values are presented only for A and B data classes.

4.2.15 AS4 3k/3501-6S 5-harness satin weave fabricMaterial Description:

Material: AS4-3k/3501-6S

Form: 5-harness satin weave fabric, areal weight of 280 g/m², typical cured resin content of 33-35%, typical cured ply thickness of 0.0106 -0.0107 inches.

Processing: Autoclave cure; 240°F, 85 psi for 1 hour, 350°F, 100 psi for 2 hours, no bleed.

General Supplier Information:

Fiber: AS4 fibers are continuous carbon filaments made from PAN precursor, surface treated to improve handling characteristics and structural properties. Filament count is 3000 filaments/tow. Typical tensile modulus is 34×10^6 psi. Typical tensile strength is 550,000 psi.

Matrix: 3501-6S is an amine-cured epoxy resin. This resin is a solvated material. It results in a more drapeable prepreg for use on highly complex parts. This resin is also amenable to cocuring. The hot/wet strengths are slightly lower than the non-solvated resin. It will retain light tack for a minimum of 10 days at room temperature.

Maximum Short Term Service Temperature: 300°F (dry), 180°F (wet)

Typical Applications: General purpose structural applications.

4.2.15 AS4 3k/3501-6S 5-harness satin weave fabric*

MATERIAL:		AS4 3k/3501-6S 5-harness satin weave fabric		C/Ep 280-5HS AS4/3501-6S Summary	
FORM:		Hercules AW280 5-harness satin weave fabric prepreg			
FIBER:		Hercules AS4 3k W	MATRIX:		Hercules 3501-6S
T _g (dry):		T _g (wet):			T _g METHOD:
PROCESSING:		Autoclave cure: 240 ± 10°F, 60 minutes, 85 psig; 350 ± 10°F, 120 ± 10 minutes, 100 ± 10 psig, no bleed			

* ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

Date of fiber manufacture	Date of testing	
Date of resin manufacture	Date of data submittal	6/88
Date of prepreg manufacture	Date of analysis	1/93
Date of composite manufacture		

LAMINA PROPERTY SUMMARY

	75°F/A		200°F/A					
Tension, 1-axis	II - -							
Tension, 2-axis								
Tension, 3-axis								
Compression, 1-axis	I - - -		I - - -					
Compression, 2-axis								
Compression, 3-axis								
Shear, 12-plane								
Shear, 23-plane								
Shear, 31-plane								
SB Strength, 31-plane	S - - -		S - - -					

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

* ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

		Nominal	As Submitted	Test Method
Fiber Density	(g/cm ³)	1.80		
Resin Density	(g/cm ³)	1.28		
Composite Density	(g/cm ³)	1.58	1.58 - 1.59	
Fiber Areal Weight	(g/m ²)	280	279 - 284	
Fiber Volume	(%)	58	57 - 60	
Ply Thickness	(in)		0.0106 - 0.0107	

LAMINATE PROPERTY SUMMARY

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

* ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL: AS4 3k/3501-6S 5-harness satin weave fabric		RESIN CONTENT: 33-35 wt%		COMP: DENSITY: 1.58-1.59 g/cm ³	
FIBER VOLUME: 57-60 %		VOID CONTENT:			
PLY THICKNESS: 0.0106-0.0107 in.					
TEST METHOD: ASTM D 3039-76		MODULUS CALCULATION:			
NORMALIZED BY: Specimen thickness and batch fiber volume to 57% (0.0107 in. CPT)					
Temperature (°F)		75			
Moisture Content (%)		ambient			
Equilibrium at T, RH					
Source Code		26			
		Normalized	Measured	Normalized	Measured
F ₁ ^{tu} (ksi)	Mean	112	115		
	Minimum	97.6	100		
	Maximum	123	126		
	C.V.(%)	5.78	5.55		
	B-value	(1)	(1)		
	Distribution	ANOVA	ANOVA		
	C ₁	6.63	6.55		
	C ₂	2.26	2.25		
	No. Specimens	30			
	No. Batches	10			
Data Class		Interim			
E ₁ ^t (Msi)	Mean	9.73	10.0		
	Minimum	8.93	9.20		
	Maximum	10.1	10.3		
	C.V.(%)	2.48	2.31		
	No. Specimens	30			
No. Batches		10			
Data Class		Interim			
ν ₁₂ ^t	Mean				
	No. Specimens				
	No. Batches				
	Data Class				
ε ₁ ^{tu} (με)	Mean				
	Minimum				
	Maximum				
	C.V.(%)				
	B-value				
	Distribution				
	C ₁				
	C ₂				
	No. Specimens				
	No. Batches				
Data Class					

Table 4.2.15(a)
C/Ep 280-5HS
AS4/3501-6S
Tension, 1-axis
[0_t]₆
75/A
Interim

(1) Basis values are presented only for A and B data classes.

* ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		AS4 3k/3501-6S 5-harness satin weave fabric				Table 4.2.15(b) C/Ep 280-5HS AS4/3501-6S Compression, 1-axis [0]₆ 75/A, 200/A Interim	
RESIN CONTENT:	33-35 wt%	COMP: DENSITY:	1.58-1.59 g/cm ³				
FIBER VOLUME:	57-60 %	VOID CONTENT:					
PLY THICKNESS:	0.0106-0.0107 in.						
TEST METHOD:	MODULUS CALCULATION:						
SACMA SRM 1-88							
NORMALIZED BY: Specimen thickness and batch fiber volume to 57% (0.0107 in. CPT)							
Temperature (°F)		75		200			
Moisture Content (%)		ambient		ambient			
Equilibrium at T, RH							
Source Code		26		26			
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{cu} (ksi)	Mean	124	128	110	113		
	Minimum	108	111	96.1	99.0		
	Maximum	144	148	122	125		
	C.V.(%)	6.73	6.74	6.31	6.24		
	B-value	(1)	(1)	(1)	(1)		
	Distribution	Weibull	Weibull	ANOVA	ANOVA		
	C ₁	128	132	7.04	7.15		
	C ₂	15.4	15.3	2.10	2.09		
	No. Specimens	30		30			
	No. Batches	10		10			
Data Class		Interim		Interim			
E ₁ ^c (Msi)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
v ₁₂ ^c	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{cu} (με)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

(1) Basis values are presented only for A and B data classes.

* ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		AS4 3k/3501-6S 5-harness satin weave fabric		Table 4.2.15(c) C/Ep 280-5HS AS4/3501-6S SBS, 31-plane [0_i]₆ 75/A, 200/A Screening	
RESIN CONTENT:	33-35 wt%	COMP: DENSITY:	1.58-1.59 g/cm ³		
FIBER VOLUME:	57-60 %	VOID CONTENT:			
PLY THICKNESS:	0.0106-0.0107 in.				
TEST METHOD:	MODULUS CALCULATION:				
ASTM D 2344					
NORMALIZED BY:		Not normalized			
Temperature (°F)	75	200			
Moisture Content (%)	ambient	ambient			
Equilibrium at T, RH					
Source Code	26	26			
F ₃₁ ^{sbs} (ksi)	Mean	11.0	9.53		
	Minimum	9.00	8.40		
	Maximum	13.2	10.8		
	C.V.(%)	10.8	6.70		
	B-value	(1)	(1)		
	Distribution	ANOVA	ANOVA		
	C ₁	1.22	0.66		
	C ₂	2.18	2.32		
	No. Specimens	30	30		
No. Batches	10	10			
Data Class	Screening	Screening			

(1) Short beam strength test data are approved for Screening Data Class only.

4.2.16 AS4 6k/3502-6S 5-harness satin weave fabricMaterial Description:

Material: AS4-6k/3502-6S

Form: 5 harness satin weave fabric, fiber areal weight of 365 g/m², typical cured resin content of 56-57%, typical cured ply thickness of 0.0142-0.0157 inches.

Processing: Autoclave cure; 275°F, 85 psi for 45 minutes; 350°F, 85 psi, hold for two hours. Post cure at 400°F to develop optimum 350°F properties.

General Supplier Information:

Fiber: AS4 fibers are continuous high strength, high strain, standard modulus carbon filaments made from PAN precursor. The fibers are surface treated to improve handling characteristics and structural properties. Filament count is 6,000 filaments/tow. Typical tensile modulus is 34×10^6 psi. Typical tensile strength is 550,000 psi.

Matrix: 3502 is an epoxy resin. This is a solvated resin formulated to improve drapeability over complex shapes. The hot/wet strengths will be slightly lower than the non-solvated resin. Good tack up to 10 days out-time at ambient temperature.

Maximum Short Term Service Temperature: 350°F (dry), 180°F (wet)

Typical applications: Primary and secondary structural applications on commercial and military aircraft.

Data Analysis Summary:

1. Only normalized data were made available for analysis.

4.2.16 AS4 6k/3502-6S 5-harness satin weave fabric*

				C/Ep 365-5HS AS4/3502 Summary	
MATERIAL:	AS4 6k/3502 5-harness satin weave fabric				
FORM:	Hercules A370-5H/3502, 5-harness satin weave fabric, 11 x 11 tow/in. prepreg				
FIBER:	Hercules AS4 6k, surface-treated "W"*, no twist		MATRIX:	Hercules 3502	
T _g (dry):	404°F	T _g (wet):	313°F	T _g METHOD:	TMA
PROCESSING:	Autoclave cure: 280 ± 5°F, 90 minutes, 85+15-0 psi; 350°F, 120 minutes.				

* now "G"

Date of fiber manufacture	10/82-3/83	Date of testing	9/83-1/84
Date of resin manufacture	5/83	Date of data submittal	12/93, 5/94
Date of prepreg manufacture	5/83	Date of analysis	8/94
Date of composite manufacture	8/83-9/83		

LAMINA PROPERTY SUMMARY

	75°F/A		-65°F/A		180°F/W	250°F/W		
Tension, 1-axis	BM - -		BM - -		BM - -	BM - -		
Tension, 2-axis								
Tension, 3-axis								
Compression, 1-axis	BM - -		IS - -		BM - -	BM - -		
Compression, 2-axis								
Compression, 3-axis								
Shear, 12-plane	BM - -		BM - -		BS - -	BS - -		
Shear, 23-plane								
Shear, 31-plane								

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

		Nominal	As Submitted	Test Method
Fiber Density	(g/cm ³)	1.79		
Resin Density	(g/cm ³)	1.26		
Composite Density	(g/cm ³)	1.57	1.55 - 1.60	
Fiber Areal Weight	(g/m ²)	365	361 - 372	
Fiber Volume	(%)	58	56 - 57	
Ply Thickness	(in)	0.0145	0.0142 - 0.0158	

LAMINATE PROPERTY SUMMARY

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

MATERIAL:		AS4 6k/3502 5-harness satin weave fabric				Table 4.2.16(a) C/Ep 365 - 5HS AS4/3502 Tension, 1-axis [0_f/90_f/0_f/90_f/90_f/0_f] 75/A, -65/A, 180/W B30, Mean	
RESIN CONTENT:	36-37 wt%	COMP: DENSITY:	1.55-1.56 g/cm ³				
FIBER VOLUME:	56-57 %	VOID CONTENT:	0.0-0.2%				
PLY THICKNESS:	0.0146-0.0157 in.						
TEST METHOD:	BMS 8-168D						
		MODULUS CALCULATION:					
		Linear portion of curve					
NORMALIZED BY:		Fiber volume to 57% (0.0145 in. CPT)					
Temperature (°F)		75		-65		180	
Moisture Content (%)		ambient		ambient		1.1 - 1.3	
Equilibrium at T, RH						(1)	
Source Code		49		49		49	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{tu} (ksi)	Mean	114		105		117	
	Minimum	97.1		87.9		102	
	Maximum	126		116		128	
	C.V.(%)	6.87		5.33		5.29	
	B-value	91.9	(2)	95.0	(2)	102	(2)
	Distribution	ANOVA		Normal		ANOVA	
	C ₁	8.15		104.9		6.31	
	C ₂	2.70		5.59		2.33	
	No. Specimens	30		30		30	
	No. Batches	5		5		5	
	Data Class	B30		B30		B30	
E ₁ ^t (Msi)	Mean	9.61		9.67		10.5	
	Minimum	9.29		9.09		9.74	
	Maximum	10.4	(2)	10.1	(2)	10.9	(2)
	C.V.(%)	3.08		2.35		2.75	
	No. Specimens	30		30		30	
	No. Batches	5		5		5	
	Data Class	Mean		Mean		Mean	
ν ₁₂ ^t	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{tu} (μɛ)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

(1) Conditioned at 160°F, 95-100% relative humidity until the moisture content was between 1.1 and 1.3%.

(2) Only normalized data were made available for analysis.

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MATERIAL:		AS4 6k/3502 5-harness satin weave fabric				Table 4.2.16(b) C/EP 365 - 5HS AS4/3502 Tension, 1-axis [0_f/90_f/0_f/90_f/90_f/0_f] 250/W B30, Mean	
RESIN CONTENT:	36-37 wt%	COMP: DENSITY:	1.55-1.56 g/cm ³				
FIBER VOLUME:	56-57 %	VOID CONTENT:	0.0-0.2%				
PLY THICKNESS:	0.0150-0.0157 in.						
TEST METHOD:	BMS 8-168D						
		MODULUS CALCULATION:					
		Linear portion of curve					
NORMALIZED BY:		Fiber volume to 57% (0.0145 in. CPT)					
Temperature (°F)		250					
Moisture Content (%)		1.1 - 1.3					
Equilibrium at T, RH		(1)					
Source Code		49					
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{tu} (ksi)	Mean	108	(2)				
	Minimum	96.8					
	Maximum	119					
	C.V.(%)	4.62					
	B-value	96.6					
	Distribution	Weibull					
	C ₁	111					
	C ₂	23.1					
No. Specimens		30					
No. Batches		5					
Data Class		B30					
E ₁ ^t (Msi)	Mean	10.1	(2)				
	Minimum	9.29					
	Maximum	10.7					
	C.V.(%)	3.65					
	No. Specimens	30					
No. Batches		5					
Data Class		Mean					
ν ₁₂ ^t	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{tu} (με)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
No. Specimens							
No. Batches							
Data Class							

(1) Conditioned at 160°F, 95-100% relative humidity until the moisture content was between 1.1 and 1.3%.

(2) Only normalized data were made available for analysis.

MATERIAL:		AS4 6k/3502 5-harness satin weave fabric				Table 4.2.16(c) C/EP 365 - 5HS AS4/3502 Compression, 1-axis [0_i/90_i/0_i/90_i/90_i/0_i] 75/A, -65/A, 180/W B30, Mean, Interim	
RESIN CONTENT:	36-37 wt%	COMP: DENSITY:	1.55-1.56 g/cm ³				
FIBER VOLUME:	56-57 %	VOID CONTENT:	0.0-0.2%				
PLY THICKNESS:	0.0142-0.0157 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 695M (1) (4)		Linear portion of curve					
NORMALIZED BY:		Fiber volume to 57% (0.0145 in. CPT)					
Temperature (°F)		75		-65		180	
Moisture Content (%)		ambient		ambient		1.1 - 1.3	
Equilibrium at T, RH						(2)	
Source Code		49		49		49	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{cu} (ksi)	Mean	104		108		65.9	
	Minimum	79.7		85.0		52.1	
	Maximum	122		118		76.7	
	C.V.(%)	10.1		8.62		9.81	
	B-value	83.7	(5)	(3)	(5)	52.4	(5)
	Distribution	Weibull		Weibull		Weibull	
	C ₁	109		111		68.7	
	C ₂	12.1		16.4		11.7	
No. Specimens	30		15		30		
No. Batches	5		5		5		
Data Class	B30		Interim		B30		
E ₁ ^c (Msi)	Mean	8.49		8.90		9.21	
	Minimum	8.15		7.70		6.25	
	Maximum	8.86		11.0		12.5	
	C.V.(%)	2.13		10.3		18.2	
	No. Specimens	30		14		30	
No. Batches	5		5		5		
Data Class	Mean		Interim		Mean		
ν ₁₂ ^c	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{cu} (με)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
No. Specimens							
No. Batches							
Data Class							

(1) Tabbed specimen, length 3.12 inch, width 0.050 inch, gage length 0.50 inch.

(2) Conditioned at 160°F, 95-100% relative humidity until the moisture content was between 1.1 and 1.3%.

(3) Basis values are presented only for A and B data classes.

(4) The test method, ASTM D 695M-96, was withdrawn on July 10, 1996.

(5) Only normalized data were made available for analysis.

MATERIAL:		AS4 6k/3502 5-harness satin weave fabric				Table 4.2.16(d) C/EP 365 - 5HS AS4/3502 Compression, 1-axis [0_f/90_f/0_f/90_f/90_f/0_f] 250/W B30, Mean	
RESIN CONTENT:	36-37 wt%	COMP: DENSITY:	1.55-1.56 g/cm ³				
FIBER VOLUME:	56-57 %	VOID CONTENT:	0.0-0.2%				
PLY THICKNESS:	0.0142-0.0157 in.						
TEST METHOD:	MODULUS CALCULATION:						
ASTM D 695M (1) (3)		Linear portion of curve					
NORMALIZED BY:		Fiber volume to 57% (0.0145 in. CPT)					
Temperature (°F)		250					
Moisture Content (%)		1.1 - 1.3					
Equilibrium at T, RH		(2)					
Source Code		49					
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{cu} (ksi)	Mean	56.3	(4)				
	Minimum	45.5					
	Maximum	75.2					
	C.V.(%)	16.0					
	B-value	30.5					
	Distribution	ANOVA					
	C ₁	9.41					
	C ₂	2.75					
No. Specimens		30					
No. Batches		5					
Data Class		B30					
E ₁ ^c (Msi)	Mean	10.3	(4)				
	Minimum	8.88					
	Maximum	12.4					
	C.V.(%)	6.60					
	No. Specimens	30					
No. Batches		5					
Data Class		Mean					
ν ₁₂ ^c	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{cu} (με)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
No. Specimens							
No. Batches							
Data Class							

- (1) Tabbed specimen, length 3.12 inch, width 0.050 inch, gage length 0.50 inch.
- (2) Conditioned at 160°F, 95-100% relative humidity until the moisture content was between 1.1 and 1.3%.
- (3) The test method, ASTM D 695M-96, was withdrawn on July 10, 1996.
- (4) Only normalized data were made available for analysis.

MATERIAL:		AS4 6k/3502 5-harness satin weave fabric			Table 4.2.16(e) C/EP 365 - 5HS AS4/3502 Shear, 12-plane [±45_i/±45_i/±45_i] 75/A, -65/A, 180/W, 250/W B30, Mean, Screening	
RESIN CONTENT:	36-37 wt%	COMP: DENSITY:	1.55-1.56 g/cm ³			
FIBER VOLUME:	56-57 %	VOID CONTENT:	0.0-0.2%			
PLY THICKNESS:	0.0145-0.0158 in.					
TEST METHOD:	ASTM D 3518-76					
		MODULUS CALCULATION:				
		Linear portion of curve				
NORMALIZED BY:		Not normalized				
Temperature (°F)		75	-65	180	250	
Moisture Content (%)		ambient	ambient	1.1 - 1.3	1.1 - 1.3	
Equilibrium at T, RH				(1)	(1)	
Source Code		49	49	49	49	
F ₁₂ ^{su} (ksi)	Mean	12.6	14.0	11.7	9.30	
	Minimum	11.4	12.1	10.7	8.27	
	Maximum	13.7	15.4	12.9	10.5	
	C.V.(%)	5.61	7.47	5.24	6.76	
	B-value	10.1	10.1	9.53	6.95	
	Distribution	ANOVA	ANOVA	ANOVA	ANOVA	
	C ₁	0.775	1.16	0.669	0.698	
	C ₂	3.21	3.36	3.20	3.37	
	No. Specimens	36	36	36	36	
	No. Batches	5	5	5	5	
	Data Class	B30	B30	B30	B30	
G ₁₂ ^s (Msi)	Mean	0.514	0.682	0.204	0.174	
	Minimum	0.485	0.638	0.196	0.147	
	Maximum	0.553	0.731	0.212	0.203	
	C.V.(%)	3.68	3.40	2.82	11.8	
	No. Specimens	36	36	6	5	
	No. Batches	5	5	1	1	
	Data Class	Mean	Mean	Screening	Screening	
	Mean					
	Minimum					
	Maximum					
γ ₁₂ ^{su} (μϵ)	C.V.(%)					
	B-value					
	Distribution					
	C ₁					
	C ₂					
	No. Specimens					
	No. Batches					
	Data Class					
	Mean					
	Minimum					

(1) Conditioned at 160°F, 95-100% relative humidity until the moisture content was between 1.1 and 1.3%.

4.2.17 T-300 15k/976 unidirectional tapeMaterial Description:

Material: T-300 15k/976

Form: Unidirectional tape, fiber areal weight of 152 g/m², typical cured resin content of 25-35%, typical cured ply thickness of 0.0051 inches.

Processing: Autoclave cure; 250°F, 100 psi for 45 mins.; 350°F, 2 hours.

General Supplier Information:

Fiber: T-300 fibers are continuous carbon filaments made from PAN precursor, surface treated to improve handling characteristics and structural properties. Filament count is 15,000 filaments/tow. Typical tensile modulus is 33×10^6 psi. Typical tensile strength is 530,000 psi.

Matrix: 976 is a high flow, modified epoxy resin that meets the NASA outgassing requirements. 10 days out-time at 72°F.

Maximum Short Term Service Temperature: 350°F (dry), 250°F (wet)

Typical applications: General purpose commercial and military structural applications, good hot/wet properties.

4.2.17 T-300 15k/976 unidirectional tape*

MATERIAL: T300 15k/976 unidirectional tape

C/Ep - UT T300 15k/976 Summary

FORM: Fiberite T300/976 unidirectional tape prepreg

FIBER: Union Carbide T300 15k

MATRIX: Fiberite 976

T_g(dry): 518°F T_g(wet): 493°F T_g METHOD: DMA

PROCESSING: Autoclave cure: 250°F, 100 psi, 45 minutes; 350°F, 2 hours

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

Date of fiber manufacture	Date of testing	
Date of resin manufacture	Date of data submittal	2/82
Date of prepreg manufacture	Date of analysis	9/94
Date of composite manufacture		

LAMINA PROPERTY SUMMARY

	72°F/A		-67°F/A	260°F/A	350°F/A			
Tension, 1-axis	SSSS		SSSS	SSSS	SSSS			
Tension, 2-axis	SS-S		SS-S	SS-S	SS-S			
Tension, 3-axis								
Compression, 1-axis	SS-S		SS-S	SS-S	SS-S			
Compression, 2-axis	SS-S		SS-S	SS-S	SS-S			
Compression, 3-axis								
Shear, 12-plane	SS--		SS--	SS--	SS--			
Shear, 23-plane								
Shear, 31-plane								
SB Strength, 31-plane	S---		S---	S---	S---			

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

		Nominal	As Submitted	Test Method	
Fiber Density	(g/cm ³)	1.78	1.58 - 1.65		
Resin Density	(g/cm ³)	1.28			
Composite Density	(g/cm ³)	1.62			
Fiber Areal Weight	(g/m ²)	152	60 - 70		
Fiber Volume	(%)	68			
Ply Thickness	(in)				
			0.0049 - 0.0053		

LAMINATE PROPERTY SUMMARY

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		T300 15k/976 unidirectional tape				Table 4.2.17(a) C/Ep - UT T300 15k/976 Tension, 1-axis [0]₆ 72/A, -67/A, 260/A Screening		
RESIN CONTENT:	35 wt%	COMP: DENSITY:	1.60 g/cm ³					
FIBER VOLUME:	59 %	VOID CONTENT:	approx. 0.0%					
PLY THICKNESS:	0.0053 in.							
TEST METHOD:	MODULUS CALCULATION:							
ASTM D 3039-76		Linear portion of curve						
NORMALIZED BY:		Fiber volume to 60% (0.0053 in. CPT)						
Temperature (°F)		72		-67		260		
Moisture Content (%)		ambient		ambient		ambient		
Equilibrium at T, RH								
Source Code		48		48		48		
		Normalized	Measured	Normalized	Measured	Normalized	Measured	
F ₁ ^{tu} (ksi)	Mean	211	207	199	197	236	232	
	Minimum	185	191	187	173	205	212	
	Maximum	235	219	220	214	256	255	
	C.V.(%)	11.2	6.47	6.83	7.67	9.88	6.84	
	B-value	(1)	(1)	(1)	(1)	(1)	(1)	
	Distribution	Normal	Normal	Normal	Normal	Normal	Normal	
	C ₁	211	207	199	197	236	232	
	C ₂	23.6	13.4	13.6	15.1	23.3	15.9	
	No. Specimens	5		5		5		
	No. Batches	1		1		1		
Data Class		Screening		Screening		Screening		
E ₁ ^t (Msi)	Mean	19.6	19.3	20.8	20.4	22.6	22.4	
	Minimum	17.8	18.2	19.5	19.6	20.5	21.2	
	Maximum	21.2	20.4	22.6	21.0	24.9	22.9	
	C.V.(%)	6.09	5.18	5.88	2.74	8.97	2.19	
	No. Specimens	5		5		5		
	No. Batches	1		1		1		
	Data Class		Screening		Screening		Screening	
	Mean		0.318		0.318		0.312	
	No. Specimens	5		5		5		
	No. Batches	1		1		1		
Data Class		Screening		Screening		Screening		
ε ₁ ^{tu} (με)	Mean		10400		8600		9900	
	Minimum		10000		8000		9500	
	Maximum		10800		9000		10500	
	C.V.(%)		3.42		5.29		4.46	
	B-value		(1)		(1)		(1)	
	Distribution		Normal		Normal		Normal	
	C ₁		10400		8600		9900	
	C ₂		356		454		442	
	No. Specimens	5		4		5		
	No. Batches	1		1		1		
Data Class		Screening		Screening		Screening		

(1) Basis values are presented only for A and B data classes.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		T300 15k/976 unidirectional tape				Table 4.2.17(b) C/Ep - UT T300 15k/976 Tension, 1-axis [0]₆ 350/A Screening	
RESIN CONTENT:	35 wt%	COMP: DENSITY:	1.60 g/cm ³				
FIBER VOLUME:	59 %	VOID CONTENT:	approx. 0.0%				
PLY THICKNESS:	0.0053 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3039-76		Linear portion of curve					
NORMALIZED BY:		Fiber volume to 60% (0.0053 in. CPT)					
Temperature (°F)		350					
Moisture Content (%)		ambient					
Equilibrium at T, RH							
Source Code		48					
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{tu} (ksi)	Mean	232	228				
	Minimum	212	219				
	Maximum	248	242				
	C.V.(%)	7.11	3.77				
	B-value	(1)	(1)				
	Distribution	Normal	Normal				
	C ₁	232	228				
	C ₂	16.5	8.63				
	No. Specimens	5					
	No. Batches	1					
Data Class	Screening						
E ₁ ^t (Msi)	Mean	22.4	22.1				
	Minimum	21.0	20.2				
	Maximum	24.2	23.9				
	C.V.(%)	5.59	6.19				
	No. Specimens	5					
	No. Batches	1					
Data Class	Screening						
ν ₁₂ ^t	Mean		0.348				
	No. Specimens	5					
	No. Batches	1					
	Data Class	Screening					
ε ₁ ^{tu} (με)	Mean		9930				
	Minimum		9600				
	Maximum		10700				
	C.V.(%)		5.29				
	B-value		(2)				
	Distribution		Normal				
	C ₁		9930				
	C ₂		525				
	No. Specimens	4					
	No. Batches	1					
Data Class	Screening						

(1) Basis values are presented only for A and B data classes.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		T300 15k/976 unidirectional tape				Table 4.2.17(c) C/Ep - UT T300 15k/976 Tension, 2-axis [90]₁₅ 72/A, -67/A, 260/A, 350/A Screening	
RESIN CONTENT:	25 wt%	COMP: DENSITY:	1.64 g/cm ³				
FIBER VOLUME:	69 %	VOID CONTENT:	approx. 0.0%				
PLY THICKNESS:	0.0049 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3039-76		Linear portion of curve					
NORMALIZED BY:		Not normalized					
Temperature (°F)	72	-67	260	350			
Moisture Content (%)	ambient	ambient	ambient	ambient			
Equilibrium at T, RH							
Source Code	48	48	48	48			
F ₂ ^{tu} (ksi)	Mean	5.66	4.73	3.81	3.47		
	Minimum	4.53	3.23	2.87	2.67		
	Maximum	6.52	6.29	4.68	3.83		
	C.V.(%)	15.4	25.1	17.4	13.2		
	B-value	(1)	(1)	(1)	(1)		
	Distribution	Normal	Normal	Normal	Normal		
	C ₁	5.66	4.73	3.812	3.47		
	C ₂	0.870	1.19	0.664	0.458		
	No. Specimens	5	5	5	5		
	No. Batches	1	1	1	1		
Data Class	Screening	Screening	Screening	Screening			
E ₂ ^t (Msi)	Mean	1.34	1.69	1.37	1.30		
	Minimum	1.28	1.49	1.16	1.25		
	Maximum	1.39	1.88	1.55	1.43		
	C.V.(%)	3.13	9.01	10.1	5.83		
	No. Specimens	5	5	5	5		
	No. Batches	1	1	1	1		
	Data Class	Screening	Screening	Screening	Screening		
ν ₂₁ ^t	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₂ ^{tu} (μϵ)	Mean	3900	2760	2640	2620		
	Minimum	3200	1900	2100	2200		
	Maximum	4600	3300	3400	3000		
	C.V.(%)	14.6	20.4	19.1	13.3		
	B-value	(1)	(1)	(1)	(1)		
	Distribution	Normal	Normal	Normal	Normal		
	C ₁	3900	2760	2640	2620		
	C ₂	570	564	503	349		
	No. Specimens	5	5	5	5		
	No. Batches	1	1	1	1		
	Data Class	Screening	Screening	Screening	Screening		

(1) Basis values are presented only for A and B data classes.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		T300 15k/976 unidirectional tape				Table 4.2.17(d) C/Ep - UT T300 15k/976 Compression, 1-axis [0]₂₀ 72/A, -67/A, 260/A Screening	
RESIN CONTENT:	24 wt%	COMP: DENSITY:	1.63 g/cm ³				
FIBER VOLUME:	70 %	VOID CONTENT:	approx. 0.0%				
PLY THICKNESS:	0.0050 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3410A-75		Linear portion of curve					
NORMALIZED BY:		Fiber volume to 60% (0.0053 in. CPT)					
Temperature (°F)		72		-67		260	
Moisture Content (%)		ambient		ambient		ambient	
Equilibrium at T, RH							
Source Code		48		48		48	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{cu} (ksi)	Mean	188	218	192	223	147	171
	Minimum	139	162	169	196	95.6	111
	Maximum	214	248	218	254	177	205
	C.V.(%)	15.9	15.9	9.76	9.76	21.7	21.7
	B-value	(1)	(1)	(1)	(1)	(1)	(1)
	Distribution	Normal	Normal	Normal	Normal	Normal	Normal
	C ₁	188	218	192	223	147	171
	C ₂	29.9	34.7	18.8	21.8	31.9	37.1
	No. Specimens	5		5		5	
	No. Batches	1		1		1	
Data Class		Screening		Screening		Screening	
E ₁ ^c (Msi)	Mean	18.7	21.8	18.8	21.9	18.4	21.4
	Minimum	14.9	17.3	16.2	18.8	10.8	12.6
	Maximum	21.9	25.5	25.5	29.6	22.6	26.2
	C.V.(%)	13.4	13.4	20.1	20.1	26.5	26.5
	No. Specimens	5		5		5	
No. Batches	1		1		1		
Data Class		Screening		Screening		Screening	
ν ₁₂ ^c	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{cu} (μɛ)	Mean	12500		14500		8860	
	Minimum	9500		9900		6300	
	Maximum	19600		20000		12600	
	C.V.(%)	32.2		31.5		30.2	
	B-value	(1)		(1)		(1)	
	Distribution	Normal		Normal		Normal	
	C ₁	12500		14500		8860	
	C ₂	404		4560		2670	
	No. Specimens	5		5		5	
	No. Batches	1		1		1	
Data Class		Screening		Screening		Screening	

(1) Basis values are presented only for A and B data classes.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		T300 15k/976 unidirectional tape				Table 4.2.17(e) C/Ep - UT T300 15k/976 Compression, 1-axis [0]₂₀ 350/A Screening	
RESIN CONTENT:	24 wt%	COMP: DENSITY:	1.63 g/cm ³				
FIBER VOLUME:	70 %	VOID CONTENT:	approx. 1.0%				
PLY THICKNESS:	0.0050 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3410A-75		Linear portion of curve					
NORMALIZED BY:		Fiber volume to 60% (0.0053 in. CPT)					
Temperature (°F)		350					
Moisture Content (%)		ambient					
Equilibrium at T, RH							
Source Code		48					
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{cu} (ksi)	Mean	136	159				
	Minimum	107	124				
	Maximum	160	186				
	C.V.(%)	18.5	18.5				
	B-value	(1)	(1)				
	Distribution	Normal	Normal				
	C ₁	136	159				
	C ₂	25.2	29.3				
	No. Specimens	5					
	No. Batches	1					
Data Class		Screening					
E ₁ ^c (Msi)	Mean	19.7	22.9				
	Minimum	16.5	19.1				
	Maximum	23.0	26.7				
	C.V.(%)	13.2	13.2				
	No. Specimens	5					
	No. Batches	1					
	Data Class	Screening					
ν ₁₂ ^c	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{cu} (με)	Mean	9400					
	Minimum	5000					
	Maximum	14000					
	C.V.(%)	39.7					
	B-value	(2)					
	Distribution	Normal					
	C ₁	9400					
	C ₂	3730					
	No. Specimens	5					
	No. Batches	1					
Data Class		Screening					

(1) Basis values are presented only for A and B data classes.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL: T300 15k/976 unidirectional tape					Table 4.2.17(f) C/Ep - UT T300 15k/976 Compression, 2-axis [90]₂₀ 72/A, -67/A, 260/A, 350/A Screening	
RESIN CONTENT:	24 wt%	COMP: DENSITY:	1.63 g/cm ³			
FIBER VOLUME:	70 %	VOID CONTENT:	approx 0.0%			
PLY THICKNESS:	0.0050 in.					
TEST METHOD: ASTM D 3410A-75		MODULUS CALCULATION: Linear portion of curve				
NORMALIZED BY: Not normalized						
Temperature (°F)	72	-67	260	350		
Moisture Content (%)	ambient	ambient	ambient	ambient		
Equilibrium at T, RH						
Source Code	48	48	48	48		
F ₂ ^{cu} (ksi)	Mean	30.0	35.1	22.6	19.1	
	Minimum	26.7	26.7	19.4	17.3	
	Maximum	31.9	44.9	25.7	22.8	
	C.V.(%)	7.10	18.9	10.7	11.7	
	B-value	(1)	(1)	(1)	(1)	
	Distribution	Normal	Normal	Normal	Normal	
	C ₁	30.0	35.1	22.6	19.1	
	C ₂	2.13	6.62	2.42	2.24	
	No. Specimens	5	5	5	5	
	No. Batches	1	1	1	1	
Data Class	Screening	Screening	Screening	Screening		
E ₂ ^c (Msi)	Mean	1.46	1.84	1.84	1.64	
	Minimum	1.32	1.46	1.37	1.25	
	Maximum	1.73	2.18	3.03	2.02	
	C.V.(%)	11.1	17.0	36.7	19.6	
	No. Specimens	5	5	5	5	
	No. Batches	1	1	1	1	
	Data Class	Screening	Screening	Screening	Screening	
ν ₂₁ ^c	Mean					
	No. Specimens					
	No. Batches					
	Data Class					
ε ₂ ^{cu} (μϵ)	Mean	32300	22100	14900	14200	
	Minimum	7900	13000	9600	6900	
	Maximum	46300	27700	21400	21300	
	C.V.(%)	44.7	31.1	40.1	47.2	
	B-value	(1)	(1)	(2)	(1)	
	Distribution	Normal	Normal		Normal	
	C ₁	32300	22100		14200	
	C ₂	14400	6880		6720	
	No. Specimens	5	5	3	5	
	No. Batches	1	1	1	1	
Data Class	Screening	Screening	Screening	Screening		

(1) Basis values are presented only for A and B data classes.

(2) The statistical analysis is not completed for less than four specimens.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL: T300 15k/976 unidirectional tape RESIN CONTENT: 25 wt% COMP: DENSITY: 1.63 g/cm ³ FIBER VOLUME: 69 % VOID CONTENT: approx. 0.1% PLY THICKNESS: 0.0052 in. TEST METHOD: ASTM D 3518-76 MODULUS CALCULATION: Linear portion of curve NORMALIZED BY: Not normalized					
Table 4.2.17(g) C/Ep - UT T300 15k/976 Shear, 12-plane [±45]_{2S} 72/A, -67/A, 260/A, 350/A Screening					
Temperature (°F)	72	-67	260	350	
Moisture Content (%)	ambient	ambient	ambient	ambient	
Equilibrium at T, RH					
Source Code	48	48	48	48	
F₁₂^{su} (ksi)	Mean	11.1	13.7	8.25	8.30
	Minimum	11.0	13.2	7.78	7.67
	Maximum	11.4	15.5	8.72	9.36
	C.V.(%)	1.23	6.99	4.78	7.80
	B-value	(1)	(1)	(1)	(1)
	Distribution	Normal	Nonpara.	Normal	Normal
	C ₁	11.1	4	8.25	8.30
	C ₂	0.137	4.10	0.394	0.647
	No. Specimens	5	5	5	5
	No. Batches	1	1	1	1
	Data Class	Screening	Screening	Screening	Screening
G₁₂^s (Msi)	Mean	0.91	1.0	0.89	0.77
	Minimum	0.84	0.89	0.82	0.70
	Maximum	0.96	1.08	0.94	0.82
	C.V.(%)	5.1	7.1	5.3	7.4
	No. Specimens	5	5	5	5
	No. Batches	1	1	1	1
	Data Class	Screening	Screening	Screening	Screening
γ₁₂^{su} (μ€)	Mean				
	Minimum				
	Maximum				
	C.V.(%)				
	B-value				
	Distribution				
	C ₁				
	C ₂				
	No. Specimens				
	No. Batches				
	Data Class				

(1) Basis values are presented only for A and B data classes.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL: T300 15k/976 unidirectional tape RESIN CONTENT: 25 wt% COMP: DENSITY: 1.63 g/cm ³ FIBER VOLUME: 69 % VOID CONTENT: approx. 0.1% PLY THICKNESS: 0.0052 in. TEST METHOD: ASTM D 2344-76 MODULUS CALCULATION: Linear portion of curve NORMALIZED BY: Not normalized					
Table 4.2.17(h) C/Ep - UT T300 15k/976 SBS, 31-plane [0]₁₅ 72/A, -67/A, 260/A, 350/A Screening					
Temperature (°F)	72	-67	260	350	
Moisture Content (%)	ambient	ambient	ambient	ambient	
Equilibrium at T, RH					
Source Code	48	48	48	48	
Mean	12.9	16.6	9.36	8.60	
Minimum	9.42	14.2	8.59	7.71	
Maximum	17.1	19.6	10.8	9.56	
C.V.(%)	18.4	12.8	10.1	8.06	
B-value	(1)	(1)	(1)	(1)	
Distribution	Weibull	Normal	Normal	Normal	
C ₁	13.8	16.6	9.36	8.60	
C ₂	6.17	2.12	0.949	0.693	
No. Specimens	10	5	5	5	
No. Batches	1	1	1	1	
Data Class	Screening	Screening	Screening	Screening	

(1) Basis values are presented only for A and B data classes.

4.2.18 IM7 12k/8551-7A unidirectional tape

These data are presented in the MIL-HDBK-17-2F Annex A.

4.2.19 AS4 3k/3501-6 5-harness satin weave fabricMaterial Description:

Material: AS4-3k/3501-6

Form: 5 harness satin weave fabric, areal weight of 280 g/m², typical cured resin content of 28-30%, typical cured ply thickness of 0.0099 -0.0109 inches.

Processing: Autoclave cure; 240°F, 85 psi for 1 hour; 350°F, 100 psi for 2 hours, bleed.

General Supplier Information:

Fiber: AS4 fibers are continuous carbon filaments made from PAN precursor, surface treated to improve handling characteristics and structural properties. Filament count is 3000 filaments/tow, no twist. Typical tensile modulus is 34×10^6 psi. Typical tensile strength is 550,000 psi.

Matrix: 3501-6 is an amine-cured epoxy resin. It will retain light tack for a minimum of 10 days at room temperature.

Maximum Short Term Service Temperature: 300°F (dry), 180°F (wet)

Typical applications: General purpose structural applications.

4.2.19 AS4 3k/3501-6 5-harness satin weave fabric (bleed)*

MATERIAL:		AS4 3k/3501-6 5-harness satin weave fabric (Bleed)		C/Ep 280-5HS AS4/3501-6 (Bleed) Summary
FORM:				
FIBER:		Hercules AS4 3k, no twist		
T _g (dry):		T _g (wet):		
PROCESSING:		Autoclave cure, 240 ± 10°F at 85 psig for 60 minutes; 350 ± 10°F for 120 ± 10 minutes at 100 ± 5 psig		

* ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

Date of fiber manufacture	Date of testing	
Date of resin manufacture	Date of data submittal	6/90
Date of prepreg manufacture	Date of analysis	2/95
Date of composite manufacture		

LAMINA PROPERTY SUMMARY

	75°F/A		200°F/A		75°F/W	200°F/W		
Tension, 1-axis	SS - -							
Tension, 2-axis								
Tension, 3-axis								
Compression, 1-axis	SS - -		SS - -		SS - -	II - -		
Compression, 2-axis								
Compression, 3-axis								
Shear, 12-plane								
Shear, 23-plane								
Shear, 31-plane								
SB Strength, 31-plane	S - - -		S - - -		S - - -			

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

* ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

	Nominal	As Submitted	Test Method
Fiber Density (g/cm ³)	1.80	1.59 - 1.60	
Resin Density (g/cm ³)	1.26		
Composite Density (g/cm ³)			
Fiber Areal Weight (g/m ²)	280		
Fiber Volume (%)			
Ply Thickness (in)			
		60 - 62	
		0.0099 - 0.0171	

LAMINATE PROPERTY SUMMARY

	75°F/A							
0/±45/90 Family								
Tension, x-axis	SS - -							
OHT, x-axis	S - - -							

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

* ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		AS4 3k/3501-6 (Bleed) 5-harness satin weave fabric				Table 4.2.19(a) C/Ep 280-5HS AS4/3501-6 (Bleed) Tension, 1-axis [0_t]₈ 75/A Screening		
RESIN CONTENT:	29 wt%	COMP: DENSITY:	1.61 g/cm ³					
FIBER VOLUME:	61 vol %	VOID CONTENT:						
PLY THICKNESS:	0.0100-0.0106 in.							
TEST METHOD:	ASTM D 3039-76		MODULUS CALCULATION:					
NORMALIZED BY:		Specimen thickness and batch fiber volume to 57% (0.019 in. CPT)						
Temperature (°F)		75						
Moisture Content (%)		ambient						
Equilibrium at T, RH								
Source Code		43						
		Normalized	Measured	Normalized	Measured	Normalized	Measured	
F ₁ ^{tu} (ksi)	Mean	108	115					
	Minimum	93.3	98.8					
	Maximum	128	137					
	C.V.(%)	12.2	12.2					
	B-value	(1)	(1)					
	Distribution	ANOVA	ANOVA					
	C ₁	14.9	15.8					
	C ₂	5.74	5.72					
	No. Specimens	9						
No. Batches	3							
Data Class	Screening							
E ₁ ^t (Msi)	Mean	9.83	10.4					
	Minimum	8.25	8.80					
	Maximum	12.0	13.1					
	C.V.(%)	9.88	10.8					
	No. Specimens	9						
	No. Batches	3						
Data Class	Screening							
ν ₁₂ ^t	Mean							
	No. Specimens							
	No. Batches							
	Data Class							
ε ₁ ^{tu} (με)	Mean							
	Minimum							
	Maximum							
	C.V.(%)							
	B-value							
	Distribution							
	C ₁							
	C ₂							
	No. Specimens							
No. Batches								
Data Class								

(1) Basis values are presented only for A and B data classes.

* ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		AS4 3k/3501-6 (Bleed) 5-harness satin weave fabric				Table 4.2.19(b) C/Ep 280-5HS AS4/3501-6 (Bleed) Compression, 1-axis [0]₈ 75/A, 200/A, 75/W Screening	
RESIN CONTENT:	29 wt%	COMP: DENSITY:	1.61 g/cm ³				
FIBER VOLUME:	61 vol %	VOID CONTENT:					
PLY THICKNESS:	0.0099-0.0104 in.						
TEST METHOD:		MODULUS CALCULATION:					
SACMA SRM 1-88							
NORMALIZED BY:		Specimen thickness and batch fiber volume to 57% (0.019 in. CPT)					
Temperature (°F)	75 ambient		200 ambient		75 wet		
Moisture Content (%)					(1)		
Equilibrium at T, RH					43		
Source Code	43		43		43		
	Normalized	Measured	Normalized	Measured	Normalized	Measured	
F ₁ ^{cu} (ksi)	Mean	106	113	80.8	86.1	95.8	102
	Minimum	91.0	97.7	67.6	73.7	79.3	84.7
	Maximum	115	123	93.1	99.9	106	113
	C.V.(%)	6.52	6.65	8.84	8.69	9.43	9.42
	B-value	(2)	(2)	(2)	(2)	(2)	(2)
	Distribution	ANOVA	Weibull	Weibull	Weibull	Normal	Normal
	C ₁	7.21	116	83.9	89.4	95.8	102
	C ₂	3.73	18.4	13.6	13.4	9.03	9.64
	No. Specimens	13		13		9	
	No. Batches	3		3		2	
Data Class	Screening		Screening		Screening		
E ₁ ^c (Msi)	Mean	8.7	9.3	8.48	9.04	9.23	9.87
	Minimum	7.6	8.2	6.42	7.00	9.07	9.70
	Maximum	9.4	9.9	9.43	10.0	9.44	10.2
	C.V.(%)	8.2	8.4	10.6	10.4	1.55	1.68
	No. Specimens	13		13		9	
	No. Batches	3		3		2	
	Data Class	Screening		Screening		Screening	
	Mean						
	No. Specimens						
	No. Batches						
Data Class							
ε ₁ ^{cu} (μɛ)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

(1) Conditioned at 140°F, 95% relative humidity for 30 days.

(2) Basis values are presented only for A and B data classes.

* ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		AS4 3k/3501-6 (Bleed) 5-harness satin weave fabric				Table 4.2.19(c) C/Ep 280-5HS AS4/3501-6 (Bleed) Compression, 1-axis [0_r]₈ 200/W Interim	
RESIN CONTENT:	29 wt%	COMP: DENSITY:	1.59 g/cm ³				
FIBER VOLUME:	61 vol %	VOID CONTENT:					
PLY THICKNESS:	0.0111-0.0171 in.						
TEST METHOD:		MODULUS CALCULATION:					
SACMA SRM 1-88							
NORMALIZED BY:		Specimen thickness and batch fiber volume to 57% (0.019 in. CPT)					
Temperature (°F)		200					
Moisture Content (%)		wet					
Equilibrium at T, RH		(1)					
Source Code		43					
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{cu} (ksi)	Mean	57.0	60.8				
	Minimum	49.8	53.8				
	Maximum	67.8	72.2				
	C.V.(%)	8.85	8.82				
	B-value	(2)	(2)				
	Distribution	ANOVA	ANOVA				
	C ₁	5.46	5.761				
	C ₂	4.57	4.38				
	No. Specimens	15					
	No. Batches	3					
Data Class	Interim						
E ₁ ^c (Msi)	Mean	8.1	8.6				
	Minimum	6.5	7.0				
	Maximum	9.0	9.4				
	C.V.(%)	10	10				
	No. Specimens	15					
No. Batches	3						
Data Class	Interim						
ν ₁₂ ^c	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{cu} (μɛ)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

(1) Conditioned at 140°F, 95% relative humidity for 30 days.

(2) Basis values are presented only for A and B data classes.

* ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL: AS4 3k/3501-6 (Bleed) 5-harness satin weave fabric RESIN CONTENT: 28-30 wt% COMP: DENSITY: 1.59-1.60 g/cm ³ FIBER VOLUME: 60-62 vol % VOID CONTENT: PLY THICKNESS: 0.0099-0.0104 in. TEST METHOD: ASTM D 2344-84 MODULUS CALCULATION: N/A NORMALIZED BY: Not normalized					
Table 4.2.19(d) C/Ep 280-5HS AS4/3501-6 (Bleed) SBS, 31-plane [0]_i₈ 75/A, 200/A, 75/W Screening					
Temperature (°F)	75	200	75		
Moisture Content (%)	ambient	ambient	wet		
Equilibrium at T, RH			(1)		
Source Code	43	43	43		
Mean	9.93	7.94	9.35		
Minimum	8.50	7.60	9.00		
Maximum	10.7	8.40	9.60		
C.V.(%)	7.38	3.89	2.22		
B-value	(2)	(2)	(2)		
Distribution	Normal	ANOVA	Normal		
F_{31}^{sbs}					
(ksi)					
C ₁	9.93	0.353	9.35		
C ₂	0.733	6.02	0.207		
No. Specimens	9	9	6		
No. Batches	3	3	2		
Data Class	Screening	Screening	Screening		

(1) Conditioned at 140°F, 95% relative humidity for 30 days.

(2) Basis values are presented only for A and B data classes.

* ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		AS4 3k/3501-6 (Bleed) 5-harness satin weave fabric				Table 4.2.19(e) C/Ep 280-5HS AS4/3501-6 (Bleed) Tension, x-axis [(0/±45/90)_r]_s 75/A Screening				
RESIN CONTENT:	29 wt%	COMP: DENSITY:	1.59 g/cm ³							
FIBER VOLUME:	61 vol %	VOID CONTENT:								
PLY THICKNESS:	0.0105-0.0106 in.									
TEST METHOD:	ASTM D 3039-76		MODULUS CALCULATION:							
NORMALIZED BY:		Specimen thickness and batch fiber volume to 57% (0.019 in. CPT)								
Temperature (°F)		75								
Moisture Content (%)		ambient								
Equilibrium at T, RH										
Source Code		43								
		Normalized	Measured	Normalized	Measured	Normalized	Measured			
F _x ^{tu} (ksi)	Mean	83.4	88.6							
	Minimum	75.7	81.3							
	Maximum	88.2	94.2							
	C.V.(%)	5.28	4.86							
	B-value	(1)	(1)							
	Distribution	Normal	Normal							
	C ₁	83.4	88.6							
	C ₂	4.41	4.30							
	No. Specimens	6								
	No. Batches	2								
Data Class		Screening								
E _x ^t (Msi)	Mean	6.9	7.3							
	Minimum	6.6	7.0							
	Maximum	7.0	7.5							
	C.V.(%)	2.8	2.9							
	No. Specimens	6								
	No. Batches	2								
	Data Class		Screening							
	ν _{xy} ^t	Mean								
No. Specimens										
No. Batches										
Data Class										
ε _x ^{tu} (με)	Mean									
	Minimum									
	Maximum									
	C.V.(%)									
	B-value									
	Distribution									
	C ₁									
	C ₂									
	No. Specimens									
	No. Batches									
Data Class										

(1) Basis values are presented only for A and B data classes.

* ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL: AS4 3k/3501-6 (Bleed) 5-harness satin weave fabric		RESIN CONTENT: 29-30 wt%		COMP: DENSITY: 1.59-1.60 g/cm ³	
FIBER VOLUME: 61-62 vol %		VOID CONTENT:			
PLY THICKNESS: 0.0105-0.0109 in.					
TEST METHOD: SACMA SRM 5-88		MODULUS CALCULATION:			
NORMALIZED BY: Specimen thickness and batch fiber volume to 57% (0.019 in. CPT)					
Temperature (°F)		75			
Moisture Content (%)		ambient			
Equilibrium at T, RH					
Source Code		43			
		Normalized	Measured	Normalized	Measured
F_x^{oht} (ksi)	Mean	58.4	63.0		
	Minimum	57.0	60.9		
	Maximum	61.0	64.5		
	C.V.(%)	2.57	2.43		
	B-value	(1)	(1)		
	Distribution	Normal	Normal		
	C ₁	58.4	63.0		
	C ₂	1.50	1.53		
	No. Specimens	6			
	No. Batches	2			
	Data Class	Screening			
E_x^{oht} (Msi)	Mean				
	Minimum				
	Maximum				
	C.V.(%)				
	No. Specimens				
ϵ_x^{oht} (µε)	Mean				
	Minimum				
	Maximum				
	C.V.(%)				
	No. Specimens				
ϵ_x^{oht} (µε)	B-value				
	Distribution				
	C ₁				
	C ₂				
	No. Specimens				
ϵ_x^{oht} (µε)	Mean				
	Minimum				
	Maximum				
	C.V.(%)				
	No. Specimens				
ϵ_x^{oht} (µε)	B-value				
	Distribution				
	C ₁				
	C ₂				
	No. Specimens				

Table 4.2.19(f)
C/Ep 280-5HS
AS4/3501-6 (Bleed)
OHT, x-axis
[(0/±45/90)_i]_s
75/A
Screening

(1) Basis values are presented only for A and B data classes.

4.2.20 AS4 3k/3501-6 5-harness satin weave fabricMaterial Description:

Material: AS4-3k/3501-6

Form: 5 harness satin weave fabric, areal weight of 280 g/m², typical cured resin content of 36-39%, typical cured ply thickness of 0.0110 -0.0121 inches.

Processing: Autoclave cure; 240°F, 85 psi for 1 hour; 350°F, 100 psi for 2 hours, no bleed.

General Supplier Information:

Fiber: AS4 fibers are continuous carbon filaments made from PAN precursor, surface treated to improve handling characteristics and structural properties. Filament count is 3000 filaments per tow, no twist. Typical tensile modulus is 34×10^6 psi. Typical tensile strength is 550,000 psi.

Matrix: 3501-6 is an amine-cured epoxy resin. It will retain light tack for a minimum of 10 days at room temperature.

Maximum Short Term Service Temperature: 300°F (dry), 180°F (wet)

Typical applications: General purpose structural applications.

4.2.20 AS4 3k/3501-6 (no bleed) 5-harness satin weave fabric*

MATERIAL:				AS4 3k/3501-6 (No Bleed) 5-harness satin weave fabric		C/EP 280-5HS AS4/3501-6 (No Bleed) Summary		
FORM:								Hercules AW280-5H/3501-6 5-harness satin weave fabric prepreg
FIBER:		Hercules AS4 3k, no twist		MATRIX:				Hercules 3501-6
T _g (dry):		T _g (wet):		T _g METHOD:				
PROCESSING:		Autoclave cure, 240 ± 10°F at 85 psig for 60 minutes; 350 ± 10°F at 100 ± 5 psig for 120 ± 10 minutes.						

* ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

Date of fiber manufacture	Date of testing
Date of resin manufacture	Date of data submittal 6/90
Date of prepreg manufacture	Date of analysis 2/95-3/95
Date of composite manufacture	

LAMINA PROPERTY SUMMARY

	75°F/A		-65°F/A	200°F/A				
Tension, 1-axis	SS - -		SS - -	SS - -				
Tension, 2-axis								
Tension, 3-axis								
Compression, 1-axis	SS - -							
Compression, 2-axis								
Compression, 3-axis								
Shear, 12-plane								
Shear, 23-plane								
Shear, 31-plane								
SB Strength, 31-plane	S - -							

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

	Nominal	As Submitted	Test Method
Fiber Density (g/cm ³)	1.80	1.55 - 1.56	
Resin Density (g/cm ³)	1.27		
Composite Density (g/cm ³)	1.55		
Fiber Areal Weight (g/m ²)	280		
Fiber Volume (%)	53	52 - 55	
Ply Thickness (in)	0.011	0.011 - 0.017	

	75°F/A							
0/±45/90 Family								
Tension, x-axis	SS - -							
OHT, x-axis	S - - -							

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* ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		AS4 3k/3501-6 (No Bleed) 5-harness satin weave fabric				Table 4.2.20(a) C/EP 280-5HS AS4/3501-6 (No Bleed) Tension, 1-axis [0_t]₈ 75/A, -65/A, 200/A Screening	
RESIN CONTENT:	36-39 wt%	COMP: DENSITY:	1.55-1.56 g/cm ³				
FIBER VOLUME:	52-55 vol %	VOID CONTENT:					
PLY THICKNESS:	0.0111-0.0171 in.						
TEST METHOD:	ASTM D 3039-76			MODULUS CALCULATION:			
NORMALIZED BY:		Specimen thickness and batch fiber volume to 57% (0.011 in. CPT)					
Temperature (°F)		75		-65		200	
Moisture Content (%)		ambient		ambient		ambient	
Equilibrium at T, RH							
Source Code		43		43		43	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{tu} (ksi)	Mean	134	125	125	117	130	121
	Minimum	129	117	120	109	124	116
	Maximum	146	136	136	127	141	136
	C.V.(%)	3.79	4.85	3.85	4.89	4.49	5.11
	B-value	(1)	(1)	(1)	(1)	(1)	(1)
	Distribution	Normal	ANOVA	Normal	ANOVA	Lognormal	Nonpara.
	C ₁	134	6.56	125	6.07	4.86	6
	C ₂	5.07	4.77	4.81	4.40	0.0440	2.25
	No. Specimens	9		9		9	
	No. Batches	3		3		3	
Data Class		Screening		Screening		Screening	
E ₁ ^t (Msi)	Mean	9.67	9.06	10.2	9.57	10.8	10.1
	Minimum	9.39	8.60	9.63	8.80	9.88	9.00
	Maximum	9.88	9.50	11.0	10.3	11.8	11.3
	C.V.(%)	1.65	3.63	4.26	5.68	6.74	8.23
	No. Specimens	9		9		9	
No. Batches	3		3		3		
Data Class		Screening		Screening		Screening	
ν ₁₂ ^t Data Class	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{tu} (μɛ)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

(1) Basis values are presented only for A and B data classes.

* ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		AS4 3k/3501-6 (No Bleed) 5-harness satin weave fabric				Table 4.2.20(b) C/EP 280-5HS AS4/3501-6 (No Bleed) Compression, 1-axis [0_r]₈ 75/A Interim	
RESIN CONTENT:	36-39 wt%	COMP: DENSITY:	1.55-1.56 g/cm ³				
FIBER VOLUME:	52-55 vol %	VOID CONTENT:					
PLY THICKNESS:	0.0114-0.0121 in.						
TEST METHOD:		MODULUS CALCULATION:					
SACMA SRM 1-88							
NORMALIZED BY:		Specimen thickness and batch fiber volume to 57% (0.011 in. CPT)					
Temperature (°F)		75					
Moisture Content (%)		ambient					
Equilibrium at T, RH							
Source Code		43					
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{cu} (ksi)	Mean	129	121				
	Minimum	121	111				
	Maximum	145	137				
	C.V.(%)	5.02	6.03				
	B-value	(1)	(1)				
	Distribution	Weibull	ANOVA				
	C ₁	133	7.84				
	C ₂	18.9	4.39				
No. Specimens	15						
No. Batches	3						
Data Class	Interim						
E ₁ ^c (Msi)	Mean	9.42	8.81				
	Minimum	8.71	8.30				
	Maximum	10.0	9.50				
	C.V.(%)	4.25	5.35				
No. Specimens	15						
No. Batches	3						
Data Class	Interim						
ν ₁₂ ^c	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{cu} (με)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
No. Specimens							
No. Batches							
Data Class							

* ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		AS4 3k/3501-6 (No Bleed) 5-harness satin weave fabric				Table 4.2.20(c) C/Ep 280-5HS AS4/3501-6 (No Bleed) SBS, 31-plane [0_f]₈ 75/A Screening
RESIN CONTENT:	36-39 wt%	COMP: DENSITY:	1.55-1.56 g/cm ³			
FIBER VOLUME:	52-55 vol %	VOID CONTENT:				
PLY THICKNESS:	0.0110-0.0114 in.					
TEST METHOD:	MODULUS CALCULATION:					
ASTM D 2344-84		N/A				
NORMALIZED BY:		Not normalized				
Temperature (°F)		75				
Moisture Content (%)		ambient				
Equilibrium at T, RH						
Source Code		43				
F ₃₁ ^{sbs} (ksi)	Mean	11.3				
	Minimum	10.1				
	Maximum	12.1				
	C.V.(%)	5.05				
	B-value	(1)				
	Distribution	ANOVA				
	C ₁	0.611				
	C ₂	4.35				
	No. Specimens	15				
	No. Batches	3				
	Data Class	Screening				

(1) Short beam strength test data are approved for Screening Data Class only.

* ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		AS4 3k/3501-6 (No Bleed) 5-harness satin weave fabric				Table 4.2.20(d) C/EP 280-5HS AS4/3501-6 (No Bleed) Tension, x-axis [(0/45/90/-45) _t]_s 75/A Screening	
RESIN CONTENT:	36-39 wt%	COMP: DENSITY:	1.55-1.56 g/cm ³				
FIBER VOLUME:	52-55 vol %	VOID CONTENT:					
PLY THICKNESS:	0.0113-0.0116 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3039-76							
NORMALIZED BY:		Specimen thickness and batch fiber volume to 57% (0.011 in. CPT)					
Temperature (°F)		75					
Moisture Content (%)		ambient					
Equilibrium at T, RH							
Source Code		43					
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F _x ^{tu} (ksi)	Mean	80.4	75.3				
	Minimum	77.1	68.8				
	Maximum	86.4	82.0				
	C.V.(%)	3.85	5.41				
	B-value	(1)	(1)				
	Distribution	Normal	ANOVA				
	C ₁	80.4	4.45				
	C ₂	3.09	5.07				
	No. Specimens	9					
	No. Batches	3					
Data Class		Screening					
E _x ^t (Msi)	Mean	6.94	6.50				
	Minimum	6.73	6.30				
	Maximum	7.13	6.60				
	C.V.(%)	1.87	2.04				
	No. Specimens	9					
No. Batches		3					
Data Class		Screening					
ν _{xy} ^t	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε _x ^{tu} (με)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

(1) Basis values are presented only for A and B data classes.

* ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		AS4 3k/3501-6 (No Bleed) 5-harness satin weave fabric				Table 4.2.20(e) C/EP 280-5HS AS4/3501-6 (No Bleed) OHT, x-axis [(0/±45/90)_i]_s 75/A Screening	
RESIN CONTENT:	36-39 wt%	COMP: DENSITY:	1.55-1.56 g/cm ³				
FIBER VOLUME:	52-55 vol %	VOID CONTENT:					
PLY THICKNESS:	0.0113-0.0116 in.						
TEST METHOD:		MODULUS CALCULATION:					
SACMA SRM 5-88							
NORMALIZED BY:		Specimen thickness and batch fiber volume to 57% (0.011 in. CPT)					
Temperature (°F)		75					
Moisture Content (%)		ambient					
Equilibrium at T, RH							
Source Code		43					
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F _x ^{oht} (ksi)	Mean	54.4	55.5				
	Minimum	51.4	52.9				
	Maximum	57.7	58.7				
	C.V.(%)	4.58	3.72				
	B-value	(1)	(1)				
	Distribution	ANOVA	Normal				
	C ₁	2.80	55.5				
	C ₂	5.64	2.06				
	No. Specimens	9					
	No. Batches	3					
Data Class		Screening					
E _x ^{oht} (Msi)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	No. Specimens						
No. Batches							
Data Class							
ε _x ^{oht} (µε)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

(1) Basis values are presented only for A and B data classes.

4.2.21 IM6 3501-6 unidirectional tape

These data are presented in the MIL-HDBK-17-2F Annex A.

4.2.22 IM7 12k/8552 unidirectional tape

These data are presented in the MIL-HDBK-17-2F Annex A.

4.2.23 T300 3k/977-2 plain weave fabric

These data are presented in the MIL-HDBK-17-2F Annex A.

4.2.24 T-300 3k/977-2 8-harness satin weave fabric

These data are presented in the MIL-HDBK-17-2F Annex A.

4.2.25 IM7 12k/977-2 unidirectional tape

These data are presented in the MIL-HDBK-17-2F Annex A.

4.2.26 AS4 6k/PR500 5-harness satin weave fabricMaterial Description:

Material: AS4 6k/PR500

Form: 5 harness satin weave fabric, with 4% PT500 tackifier resin, fiber areal weight of 370 g/m², injected with PR500 resin by Resin Transfer Molding (RTM); typical cured resin content of 28-34%, typical cured ply thickness of 0.013 - 0.0145 inches.

Processing: RTM injection at > 320°F, cure for 2 hours at 350°F

General Supplier Information:

Fiber: Hercules/Hexcel AS4 fibers are continuous carbon filaments made from a PAN precursor woven into 5HS fabric. Typical tensile modulus is 34×10^6 psi. Typical tensile strength is 550,000 psi.

Matrix: 3M PR 500 is a one part, 350°F curing epoxy resin system especially suited to RTM processing. Characteristics include: excellent toughness with 300°F wet mechanical performance, several weeks of room temperature stability and low viscosity at recommended injection temperature.

Maximum Short Term Service Temperature: 350°F (dry), 300°F (wet)

Typical applications: Primary and secondary aircraft structure (commercial and military) and other applications requiring unusual hot/wet properties and impact resistance where RTM advantages such as precise dimensional tolerances, part consolidation, complex lay-ups and replicated surface finishes are desired.

4.2.26 AS4 6k/PR500 5-harness satin weave fabric*

MATERIAL:	AS4 6k/PR 500 harness satin weave fabric				C/Ep 370-5HS AS4/PR 500 Summary	
FORM:	Fiberite 5-harness satin weave fabric 12 tows/in., 4% PT-500					
FIBER:	Hercules AS4 6K, GP sizing, no twist		MATRIX:	3M PR 500 RTM		
T _g (dry):	378°F	T _g (wet):	340°F	T _g METHOD:		SRM 18-94, RDA GN knee
PROCESSING:	Resin transfer molding: 360±10°F, 120 minutes, press pressure 175 psi, internal cure pressure 80 psi, mold temperature during injection 320°F, pump plate temperature 140-5, pump hose temperature 160-5					

Date of fiber manufacture	12/93-5/94	Date of testing	5/95-11/95
Date of resin manufacture	8/94-9/94	Date of data submittal	6/96
Date of prepreg manufacture	11/94-12/94	Date of analysis	8/96
Date of composite manufacture	1/95-10/95		

LAMINA PROPERTY SUMMARY

	72°F/A	-75°F/A	180°F/A	300°F/A	350°F/A	180°F/ W	240°F/W	300°F/W
Tension, 1-axis	II - I		II - I	SS - S	IS - S	II - S	II - S	II - I
Tension, 2-axis								
Tension, 3-axis								
Compression, 1-axis	II --	- I --	II --	I ---	S ---	I ---	S ---	S ---
Compression, 2-axis								
Compression, 3-axis								
Shear, 12-plane	II --	II --	SS --	II --	SS --	II --	SS --	SS --
Shear, 23-plane								
Shear, 31-plane	I ---		I ---	I ---		I ---		I ---
SB Strength, 31-plane	S ---		S ---	S ---		S ---		S ---

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

Data are also included for 12-plane shear for four fluids in addition to water.

		Nominal	As Submitted	Test Method
Fiber Density	(g/cm ³)	1.787		ASTM C693
Resin Density	(g/cm ³)	1.25		ASTM D 792
Composite Density	(g/cm ³)		1.55-1.60*	
Fiber Areal Weight	(g/m ²)	370	375	SRM 23-94
Fiber Volume	(% vol)		55.5-64.8	
Ply Thickness	(in)	0.014	0.0128-0.0149	

* Throughout this section, resin content and composite density have been calculated assuming zero void content.

LAMINATE PROPERTY SUMMARY

	72°F/A	-75°F/A	180°F/A	300°F/A	350°F/A	180°F/W	240°F/W	300°F/W
[0/45/90/-45]								
OHT, x-axis	IS-S	IS-S	IS-S	IS-S	IS-S	IS-S	IS-S	BI-b
OHC, x-axis	BS-S		IS-S	II-I		IS-S	II-I	bI-I
CAI, x-axis	I---							
G _{lc}	S---							
G _{llc}	b---							

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

Data are also included for 240/W and five impact energy levels for CAI.

MATERIAL:		AS4 6k/PR 500 RTM 5-harness satin weave fabric				Table 4.2.26(a) C/Ep 370-5HS AS4/PR 500 Tension, 1-axis [0_r]_{3s} 72/A, 180/A, 240/A Interim, Screening	
RESIN CONTENT:	30 - 34 wt%	COMP: DENSITY:	1.56 - 1.58 g/cm ³				
FIBER VOLUME:	57.6 - 62.0 vol %	VOID CONTENT:	NA				
PLY THICKNESS:	0.0133 - 0.0142 in.						
TEST METHOD:	MODULUS CALCULATION:						
SRM 4R-94		Chord between 1000 and 3000 µε					
NORMALIZED BY:		Specimen thickness and batch fiber areal weight to 57% fiber volume (0.0145 in. CPT)					
Temperature (°F)		72		180		240	
Moisture Content (%)		ambient		ambient		ambient	
Equilibrium at T, RH							
Source Code		61		61		61	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{tu} (ksi)	Mean	115	120	115	118	117	122
	Minimum	105	111	102	105	103	106
	Maximum	124	129	126	128	125	133
	C.V.(%)	4.50	4.74	5.48	4.94	4.79	5.15
	B-value	(1)	(1)	(1)	(1)	(1)	(1)
	Distribution	ANOVA	ANOVA	ANOVA	Weibull	ANOVA	ANOVA
	C ₁	5.71	6.44	7.01	121	6.03	6.67
	C ₂	4.43	4.83	4.65	23.5	4.42	4.06
No. Specimens		17		16		15	
No. Batches		3		3		3	
Data Class		Interim		Interim		Interim	
E ₁ ^t (Msi)	Mean	9.54	9.97	9.44	9.73	9.53	9.94
	Minimum	9.15	9.46	9.01	9.09	9.26	9.46
	Maximum	9.86	10.5	9.80	10.2	9.88	10.2
	C.V.(%)	1.78	3.64	2.62	3.35	2.13	2.43
	No. Specimens	15		16		15	
No. Batches		3		3		3	
Data Class		Interim		Interim		Interim	
ν ₁₂ ^t Data Class	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{tu} (µε)	Mean	11900		11800		11600	
	Minimum	10800		10200		10000	
	Maximum	13700		16400		13100	
	C.V.(%)	6.17		12.4		7.68	
	B-value	(1)		(1)		(1)	
	Distribution	Nonpara		ANOVA		Weibull	
	C ₁	8		1510		12000	
	C ₂	1.54		3.294		16.2	
	No. Specimens	15		15		13	
	No. Batches	3		3		3	
Data Class	Interim		Interim		Screening		

(1) Basis values are presented only for A and B data classes.

MATERIAL:		AS4 6k/PR 500 RTM 5-harness satin weave fabric				Table 4.2.26(b) C/Ep 370-5HS AS4/PR 500 Tension, 1-axis [0]8 300/A, 350/A, 180/W Interim, Screening	
RESIN CONTENT:	30 - 34 wt%	COMP: DENSITY:	1.56 - 1.58 g/cm ³				
FIBER VOLUME:	57.6 - 62.0 vol %	VOID CONTENT:	NA				
PLY THICKNESS:	0.0133 - 0.0142 in.						
TEST METHOD:	MODULUS CALCULATION:						
SRM 4R-94		Chord between 1000 and 3000 µε					
NORMALIZED BY:		Specimen thickness and batch fiber areal weight to 57% fiber volume (0.0145 in. CPT)					
Temperature (°F)		300		350		180	
Moisture Content (%)		ambient		ambient		(2)	
Equilibrium at T, RH						160°F water	
Source Code		61		61		61	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{tu} (ksi)	Mean	111	117	105	114	112	114
	Minimum	104	111	94.6	103	103	109
	Maximum	118	122	112	123	119	119
	C.V.(%)	3.97	2.82	4.39	4.75	4.66	2.57
	B-value	(1)	(1)	(1)	(1)	(1)	(1)
	Distribution	ANOVA	Weibull	ANOVA	Weibull	ANOVA	ANOVA
	C ₁	4.91	119	5.19	117	5.89	3.25
	C ₂	5.14	49.5	5.34	25.9	5.48	5.03
No. Specimens		14		15		15	
No. Batches		3		3		3	
Data Class		Screening		Interim		Interim	
E ₁ ^t (Msi)	Mean	9.51	10.0	9.07	9.88	9.70	9.92
	Minimum	9.14	9.79	8.46	9.28	9.40	9.47
	Maximum	9.79	10.5	9.76	10.5	10.2	10.4
	C.V.(%)	2.16	2.21	4.50	3.76	2.25	2.78
	No. Specimens	14		12		15	
No. Batches		3		3		3	
Data Class		Screening		Screening		Interim	
ν ₁₂ ^t Data Class	Mean						
	No. Specimens						
	No. Batches						
ε ₁ ^{tu} (µε)	Mean	11500		11800		11000	
	Minimum	10900		10900		9700	
	Maximum	12800		12400		11900	
	C.V.(%)	4.78		3.88		5.88	
	B-value	(1)		(1)		(1)	
	Distribution	Normal		Weibull		ANOVA	
	C ₁	11500		12000		691.	
	C ₂	550.		34.4		4.32	
	No. Specimens	13		12		14	
	No. Batches	3		3		3	
Data Class	Screening		Screening		Screening		

(1) Basis values are presented only for A and B data classes.

(2) Held in 160°F water bath until full saturation or 95% of equilibrium once full saturation was established.

MATERIAL:		AS4 6k/PR 500 RTM 5-harness satin weave fabric				Table 4.2.26(c) C/Ep 370-5HS AS4/PR 500 Tension, 1-axis [0_r]₈ 240/W, 300/W Interim, Screening	
RESIN CONTENT:	30 - 34 wt%	COMP: DENSITY:	1.56 - 1.58 g/cm ³				
FIBER VOLUME:	57.6 - 62.0 vol %	VOID CONTENT:	NA				
PLY THICKNESS:	0.0133 - 0.0142 in.						
TEST METHOD:	MODULUS CALCULATION:						
SRM 4R-94		Chord between 1000 and 3000 με					
NORMALIZED BY:		Specimen thickness and batch fiber areal weight to 57% fiber volume (0.0145 in. CPT)					
Temperature (°F)		240		300			
Moisture Content (%)		(2)		(2)			
Equilibrium at T, RH		160°F water		160°F water			
Source Code		61		61			
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{tu} (ksi)	Mean	109	114	102	110		
	Minimum	98.0	104	98.1	102		
	Maximum	118	120	110	116		
	C.V.(%)	5.65	4.13	2.81	3.46		
	B-value	(1)	(1)	(1)	(1)		
	Distribution	ANOVA	ANOVA	Nonpara.	Weibull		
	C ₁	6.82	5.05	8	112		
	C ₂	4.98	4.32	1.43	35.4		
No. Specimens		15		17			
No. Batches		3		3			
Data Class		Interim		Interim			
E ₁ ^t (Msi)	Mean	9.42	9.84	9.24	9.96		
	Minimum	9.04	9.45	8.69	9.20		
	Maximum	9.82	10.5	9.60	10.5		
	C.V.(%)	2.47	3.11	2.60	3.62		
	No. Specimens	15		15			
No. Batches		3		3			
Data Class		Interim		Interim			
ν ₁₂ ^t	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{tu} (με)	Mean	11200		11000			
	Minimum	10400		10100			
	Maximum	13500		12000			
	C.V.(%)	7.43		4.38			
	B-value	(1)		(1)			
	Distribution	Nonpara.		Weibull			
	C ₁	7		11300			
	C ₂	1.81		23.7			
	No. Specimens	12		15			
	No. Batches	3		3			
Data Class	Screening		Interim				

(1) Basis values are presented only for A and B data classes.

(2) Held in 160°F water bath until full saturation or 95% of equilibrium once full saturation was established.

MATERIAL:		AS4 6k/PR 500 RTM 5-harness satin weave fabric				Table 4.2.26(d) C/Ep 370-5HS AS4/PR 500 Compression, 1-axis [0_r]_{3s} 72/A, -75/A, 180/A Interim	
RESIN CONTENT:	30 - 35 wt%	COMP: DENSITY:	1.55 - 1.58 g/cm ³				
FIBER VOLUME:	56.5 - 61.8 vol %	VOID CONTENT:	NA				
PLY THICKNESS:	0.0134 - 0.0146 in.						
TEST METHOD:		MODULUS CALCULATION:					
SRM 1R-94		Chord between 1000 and 3000 με					
NORMALIZED BY:		Specimen thickness and batch fiber areal weight to 57% fiber volume (0.0145 in. CPT)					
Temperature (°F)		72		-75		180	
Moisture Content (%)		ambient		ambient		ambient	
Equilibrium at T, RH							
Source Code		61		61		61	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{cu} (ksi)	Mean	118	127			105	110
	Minimum	103	110			92.1	94.4
	Maximum	136	141			116	126
	C.V.(%)	7.91	7.41			5.86	7.02
	B-value	(1)	(1)			(1)	(1)
	Distribution	ANOVA	Weibull			Weibull	Weibull
	C ₁	9.99	131			108	114
	C ₂	3.81	16.1			19.8	15.8
	No. Specimens	17				15	
	No. Batches	3				3	
Data Class		Interim				Interim	
E ₁ ^c (Msi)	Mean	8.88	8.95	8.85	8.90	8.99	9.00
	Minimum	8.30	8.28	8.19	8.10	8.69	7.99
	Maximum	9.41	9.86	9.30	9.72	9.30	9.48
	C.V.(%)	3.16	5.41	3.09	4.71	2.16	5.08
	No. Specimens	17		15		15	
No. Batches	3		3		3		
Data Class		Interim		Interim		Interim	
ν ₁₂ ^c	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{cu} (με)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

(1) Basis values are presented only for A and B data classes.

MATERIAL:		AS4 6k/PR 500 RTM 5-harness satin weave fabric				Table 4.2.26(e) C/Ep 370-5HS AS4/PR 500 Compression, 1-axis [0_i]_{3s} 240/A, 300/A, 350/A Interim, Screening	
RESIN CONTENT:	30 - 35 wt%	COMP: DENSITY:	1.55 - 1.58 g/cm ³				
FIBER VOLUME:	56.5 - 61.8 vol %	VOID CONTENT:	NA				
PLY THICKNESS:	0.0134 - 0.0146 in.						
TEST METHOD:		MODULUS CALCULATION:					
SRM 1R-94		Chord between 1000 and 3000 με					
NORMALIZED BY:		Specimen thickness and batch fiber areal weight to 57% fiber volume (0.0145 in. CPT)					
Temperature (°F)		240		300		350	
Moisture Content (%)		ambient		ambient		ambient	
Equilibrium at T, RH							
Source Code		61		61		61	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{cu} (ksi)	Mean	103	106	80.1	84.2	51.0	53.5
	Minimum	98.2	99.5	69.5	71.2	42.2	44.4
	Maximum	110	114	87.5	93.0	61.6	64.8
	C.V.(%)	3.36	4.37	6.69	7.31	9.72	10.6
	B-value	(1)	(1)	(1)	(1)	(1)	(1)
	Distribution	Weibull	ANOVA	Weibull	ANOVA	Weibull	ANOVA
	C ₁	104	4.94	82.5	6.68	53.3	6.10
	C ₂	29.3	4.14	18.0	4.18	10.7	4.30
	No. Specimens	15		16		12	
	No. Batches	3		3		3	
Data Class		Interim		Interim		Screening	
E ₁ ^c (Msi)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
v ₁₂ ^c (με)	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{cu} (με)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

(1) Basis values are presented only for A and B data classes.

MATERIAL:		AS4 6k/PR 500 RTM 5-harness satin weave fabric				Table 4.2.26(f) C/Ep 370-5HS AS4/PR 500 Compression, 1-axis [0_r]_{3s} 180/W, 240/W, 300/W Interim, Screening	
RESIN CONTENT:	30 - 35 wt%	COMP: DENSITY:	1.55 - 1.58 g/cm ³				
FIBER VOLUME:	56.5 - 61.8 vol %	VOID CONTENT:	NA				
PLY THICKNESS:	0.0134 - 0.0146 in.						
TEST METHOD:		MODULUS CALCULATION:					
SRM 1R-94		Chord between 1000 and 3000 με					
NORMALIZED BY:		Specimen thickness and batch fiber areal weight to 57% fiber volume (0.0145 in. CPT)					
Temperature (°F)		180		240		300	
Moisture Content (%)		(2)		(2)		(2)	
Equilibrium at T, RH		160°F water		160°F water		160°F water	
Source Code		61		61		61	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{cu} (ksi)	Mean	100	106	77.5	79.3	67.0	71.7
	Minimum	87.9	87.7	67.4	66.1	62.2	65.5
	Maximum	114	126	87.1	93.4	71.6	78.2
	C.V.(%)	7.08	10.2	8.97	12.3	4.43	6.05
	B-value	(1)	(1)	(1)	(1)	(1)	(1)
	Distribution	ANOVA	ANOVA	Normal	ANOVA	ANOVA	ANOVA
	C ₁	7.53	12.3	77.5	11.9	3.33	5.33
	C ₂	3.67	4.89	6.95	16.8	11.7	16.2
	No. Specimens	17		9		11	
	No. Batches	3		2		2	
Data Class		Interim		Screening		Screening	
E ₁ ^c (Msi)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
No. Specimens	No. Specimens						
	No. Batches						
	Data Class						
ν ₁₂ ^c	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{cu} (με)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

(1) Basis values are presented only for A and B data classes.

(2) Held in 160°F water bath until full saturation or 95% of equilibrium once full saturation was established.

Table 4.2.26(g)
C/Ep 370-5HS
AS4/PR 500
Shear, 12-plane
[45°]_{2s}
72/A, -75/A, 180/A,
240/A, 300/A
Interim, Screening

(1) Basis values are presented only for A and B data classes.

MATERIAL:		AS4 6k/PR 500 RTM 5-harness satin weave fabric				Table 4.2.26(h) C/Ep 370-5HS AS4/PR 500 Shear, 12-plane [45i]_{2s} 350/A, 180/W, 240/W, 300/W Interim, Screening	
RESIN CONTENT:	29 - 35 wt%	COMP: DENSITY:	1.55 - 1.59 g/cm ³				
FIBER VOLUME:	56.0 - 63.6 vol %	VOID CONTENT:	NA				
PLY THICKNESS:	0.0130 - 0.0148 in.						
TEST METHOD:		MODULUS CALCULATION:					
SRM 7R-94		Chord axial modulus between 1000 and 4000 με					
NORMALIZED BY:		Not normalized					
Temperature (°F)		350		180	240	300	
Moisture Content (%)		ambient		(2)	(2)	(2)	
Equilibrium at T, RH				160°F water	160°F water	160°F water	
Source Code		61		61	61	61	
F ₁₂ ^s (ksi)	Mean	7.75		12.2	10.2	7.82	
	Minimum	7.37		11.3	9.61	7.03	
	Maximum	8.15		13.0	11.4	8.45	
	C.V.(%)	4.36		4.76	4.78	6.35	
	B-value	(1)		(1)	(1)	(1)	
	Distribution	Normal		ANOVA	ANOVA	Weibull	
	C ₁	7.75		0.656	0.529	8.04	
	C ₂	0.338		5.36	4.62	19.6	
	No. Specimens	8		15	14	11	
	No. Batches	2		3	3	3	
Data Class		Screening		Interim	Screening	Screening	
G ₁₂ ^s (Msi)	Mean	0.252		0.506	0.400	0.235	
	Minimum	0.216		0.450	0.352	0.190	
	Maximum	0.264		0.577	0.450	0.274	
	C.V.(%)	6.02		5.80	6.95	12.0	
	No. Specimens	8		15	14	11	
	No. Batches	2		3	3	3	
	Data Class	Screening		Interim	Screening	Screening	

- (1) Basis values are presented only for A and B data classes.
- (2) Held in 160°F water bath until full saturation or 95% of equilibrium once full saturation was established.

MATERIAL:		AS4 6k/PR 500 RTM 5-harness satin weave fabric				Table 4.2.26(i) C/Ep 370-5HS AS4/PR 500 Shear, 12-plane [45i]_{2s} 72/Fluids Screening	
RESIN CONTENT:	29 - 35 wt%	COMP: DENSITY:	1.55 - 1.59 g/cm ³				
FIBER VOLUME:	56.0 - 63.6 vol %	VOID CONTENT:	NA				
PLY THICKNESS:	0.0130 - 0.0148 in.						
TEST METHOD:		MODULUS CALCULATION:					
SRM 7R-94		Chord axial modulus between 1000 and 3000 με					
NORMALIZED BY:		Not normalized					
Temperature (°F)		72	72	72	72		
Moisture Content (%)		(2)	(3)	(4)	(5)		
Equilibrium at T, RH							
Source Code		61	61	61	61		
F ₁₂ ^s (ksi)	Mean	13.5	14.6	15.0	14.8		
	Minimum	12.4	13.4	13.5	13.7		
	Maximum	14.9	16.7	16.7	15.8		
	C.V.(%)	6.46	8.44	8.41	6.88		
	B-value	(1)	(1)	(1)	(1)		
	Distribution	Normal	Normal	Normal	Normal		
	C ₁	13.5	14.6	15.0	14.8		
	C ₂	0.872	1.23	1.26	1.02		
	No. Specimens	7	7	6	6		
	No. Batches	1	1	1	1		
Data Class		Screening	Screening	Screening	Screening		
G ₁₂ ^s (Msi)	Mean	0.601	0.678	0.651	0.666		
	Minimum	0.560	0.639	0.633	0.650		
	Maximum	0.638	0.716	0.677	0.701		
	C.V.(%)	5.65	4.45	2.64	2.77		
	No. Specimens	7	7	6	6		
	No. Batches	1	1	1	1		
	Data Class		Screening	Screening	Screening	Screening	

- (1) Basis values are presented only for A and B data classes.
- (2) Held for 6 days at room temperature in MEK cleaning solvent.
- (3) Held for 6 days at 160°F in Skydrol hydraulic fluid.
- (4) Held for 6 days at room temperature in JP-4 jet fuel.
- (5) Held for 6 days at room temperature in deicing fluid.

MATERIAL:		AS4 6k/PR 500 RTM 5-harness satin weave fabric				Table 4.2.26(j) C/Ep 370-5HS AS4/PR 500 SBS, 31-plane [0r]_{3s} 72/A, 180/A, 300/A, 180/W, 300/W Screening
RESIN CONTENT:	30 - 34 wt%	COMP: DENSITY:	1.56 - 1.58 g/cm ³			
FIBER VOLUME:	57.6 - 62.0 vol %	VOID CONTENT:	NA			
PLY THICKNESS:	0.0133 - 0.0142 in.					
TEST METHOD:		MODULUS CALCULATION:				
SRM 8R-94		Chord axial modulus between 1000 and 3000 µε				
NORMALIZED BY:		Not normalized				
Temperature (°F)		72	180	300	180	300
Moisture Content (%)		ambient	ambient	ambient	(2)	(2)
Equilibrium at T, RH					160°F water	160°F water
Source Code		61	61	61	61	61
F ₃₁ ^{sbs} (ksi)	Mean	11.6	9.6	6.8	8.0	5.47
	Minimum	10.4	9.0	6.5	7.2	5.2
	Maximum	12.7	10.2	7.3	8.4	5.7
	C.V.(%)	5.36	3.4	3.2	4.6	3.3
	B-value	(1)	(1)	(1)	(1)	(1)
	Distribution	Weibull	ANOVA	Normal	Weibull	Normal
	C ₁	11.9	0.35	6.8	8.1	5.5
	C ₂	22.2	3.5	0.22	30.	0.18
	No. Specimens	19	19	19	12	7
	No. Batches	3	3	3	2	1
Data Class		Screening	Screening	Screening	Screening	Screening

(1) Short beam strength test data are approved for Screening Data Class only.

(2) Held in 160°F water bath until full saturation or 95% of equilibrium once full saturation was established.

MATERIAL:		AS4 6k/PR 500 RTM 5-harness satin weave fabric				Table 4.2.26(k) C/Ep 370-5HS AS4/PR 500 OHT, x-axis [0/-45/-90/-45]s 72/A, -75/A, 180/A Interim, Screening	
RESIN CONTENT:	28 - 36 wt%	COMP: DENSITY:	1.55 - 1.60 g/cm ³				
FIBER VOLUME:	55.5 - 64.8 vol %	VOID CONTENT:	NA				
PLY THICKNESS:	0.0128 - 0.0149 in.						
TEST METHOD:	MODULUS CALCULATION:						
SRM 5R-94		Chord between 1000 and 3000 με					
NORMALIZED BY:		Specimen thickness and batch fiber areal weight to 57% fiber volume (0.0145 in. CPT)					
Temperature (°F)		72		-75		180	
Moisture Content (%)		ambient		ambient		ambient	
Equilibrium at T, RH							
Source Code		61		61		61	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F _x ^{ohtu} (ksi)	Mean	47.5	49.4	47.7	49.9	46.9	48.3
	Minimum	42.5	41.7	41.7	40.6	43.8	44.9
	Maximum	51.5	54.0	51.6	54.8	48.8	51.5
	C.V.(%)	5.49	7.03	5.73	7.82	3.46	4.66
	B-value	(1)	(1)	(1)	(1)	(1)	(1)
	Distribution	Weibull	Weibull	Weibull	Weibull	ANOVA	ANOVA
	C ₁	48.7	51.0	48.8	51.5	1.69	2.20
	C ₂	21.8	17.6	22.6	17.6	3.61	3.81
	No. Specimens	15		15		15	
	No. Batches	3		3		3	
Data Class		Interim		Interim		Interim	
E _x ^{oht} (Msi)	Mean	6.86	7.24	7.25	7.77	6.75	7.04
	Minimum	6.72	7.09	7.08	7.63	6.55	6.71
	Maximum	7.07	7.41	7.34	7.94	7.14	7.45
	C.V.(%)	1.94	1.59	1.42	1.90	3.26	3.48
	No. Specimens	5		5		6	
	No. Batches	1		1		1	
	Data Class	Screening		Screening		Screening	
	Mean	7100		6700		7100	
	Minimum	6500		6600		6800	
	Maximum	7500		7000		7400	
ε _x ^{ohtu} (με)	C.V.(%)	5.7		2.5		3.8	
	B-value	(1)		(1)		(1)	
	Distribution	Normal		Normal		Normal	
	C ₁	7100		6700		7100	
	C ₂	400		170		270	
	No. Specimens	5		5		5	
	No. Batches	1		1		1	
	Data Class	Screening		Screening		Screening	

(1) Basis values are presented only for A and B data classes.

MATERIAL:		AS4 6k/PR 500 RTM 5-harness satin weave fabric				Table 4.2.26(I) C/Ep 370-5HS AS4/PR 500 OHT, x-axis [0/45/90/-45]_s 240/A, 300/A, 350/A Interim, Screening		
RESIN CONTENT:	28 - 36 wt%	COMP: DENSITY:	1.55 - 1.60 g/cm ³					
FIBER VOLUME:	55.5 - 64.8 vol %	VOID CONTENT:	NA					
PLY THICKNESS:	0.0128 - 0.0149 in.							
TEST METHOD:		MODULUS CALCULATION:						
SRM 5R-94		Chord between 1000 and 3000 με						
NORMALIZED BY:		Specimen thickness and batch fiber areal weight to 57% fiber volume (0.0145 in. CPT)						
Temperature (°F)		240		300		350		
Moisture Content (%)		ambient		ambient		ambient		
Equilibrium at T, RH								
Source Code		61		61		61		
		Normalized	Measured	Normalized	Measured	Normalized	Measured	
F _x ^{ohtu} (ksi)	Mean	48.6	51.2	47.5	49.7	44.1	45.4	
	Minimum	45.4	47.8	45.9	46.6	41.6	41.4	
	Maximum	52.8	56.1	51.2	53.3	46.7	48.4	
	C.V.(%)	3.89	4.96	3.20	4.11	3.61	3.86	
	B-value	(1)	(1)	(1)	(1)	(1)	(1)	
	Distribution	Weibull	Normal	Nonpara.	Weibull	ANOVA	Weibull	
	C ₁	49.5	51.2	8	50.7	1.70	46.3	
	C ₂	25.6	2.54	1.49	26.1	3.84	29.3	
	No. Specimens	16		16		16		
	No. Batches	3		3		3		
Data Class		Interim		Interim		Interim		
E _x ^{oht} (Msi)	Mean	6.58	6.96	6.64	7.02	6.01	6.28	
	Minimum	6.42	6.70	6.52	6.74	5.85	6.08	
	Maximum	6.78	7.20	6.87	7.12	6.33	6.52	
	C.V.(%)	2.10	2.82	1.84	2.03	3.14	2.56	
	No. Specimens	6		6		6		
	No. Batches	1		1		1		
	Data Class		Screening		Screening		Screening	
	Mean	7500		7200		7300		
	Minimum	7000		7000		7000		
	Maximum	7800		7300		7700		
ε _x ^{ohtu} (με)	C.V.(%)	3.7		1.8		3.6		
	B-value	(1)		(1)		(1)		
	Distribution	Normal		Normal		Normal		
	C ₁	7500		7200		7300		
	C ₂	270		130		260		
	No. Specimens	6		6		6		
	No. Batches	1		1		1		
	Data Class		Screening		Screening		Screening	
	Mean	7500		7200		7300		
	Minimum	7000		7000		7000		
Maximum	7800		7300		7700			
C.V.(%)	3.7		1.8		3.6			
B-value	(1)		(1)		(1)			
Distribution	Normal		Normal		Normal			
C ₁	7500		7200		7300			
C ₂	270		130		260			
No. Specimens	6		6		6			
No. Batches	1		1		1			
Data Class		Screening		Screening		Screening		

(1) Basis values are presented only for A and B data classes.

MATERIAL:		AS4 6k/PR 500 RTM 5-harness satin weave fabric				Table 4.2.26(m) C/Ep 370-5HS AS4/PR 500 OHT, x-axis [0/-45/90/-45]_s 180/W, 240/W, 300/W B18, Interim, Screening	
RESIN CONTENT:	28 - 36 wt%	COMP: DENSITY:	1.55 - 1.60 g/cm ³				
FIBER VOLUME:	55.5 - 64.8 vol %	VOID CONTENT:	NA				
PLY THICKNESS:	0.0128 - 0.0149 in.						
TEST METHOD:	MODULUS CALCULATION:						
SRM 5R-94		Chord between 1000 and 3000 με					
NORMALIZED BY:		Specimen thickness and batch fiber areal weight to 57% fiber volume (0.0145 in. CPT)					
Temperature (°F)		180		240		300	
Moisture Content (%)		(2)		(2)		(2)	
Equilibrium at T, RH		160°F water		160°F water		160°F water	
Source Code		61		61		61	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F _x ^{ohtu} (ksi)	Mean	47.1	49.3	46.4	48.6	46.5	48.6
	Minimum	43.1	44.2	43.7	46.0	44.4	45.7
	Maximum	50.0	53.6	49.4	53.4	50.1	52.3
	C.V.(%)	3.81	5.13	3.57	4.44	3.57	6.05
	B-value	(1)	(1)	(1)	(1)	41.9	43.6
	Distribution	Weibull	Weibull	Weibull	Nonpara.	Weibull	Weibull
	C ₁	47.9	50.4	47.2	8	28.1	26.8
	C ₂	29.6	22.0	31.0	1.49	47.3	49.6
	No. Specimens	16		16		21	
	No. Batches	3		3		3	
Data Class		Interim		Interim		B18	
E _x ^{oht} (Msi)	Mean	6.69	7.08	7.00	7.46	6.64	6.96
	Minimum	6.58	6.77	6.78	7.07	5.95	6.15
	Maximum	6.80	7.43	7.24	7.70	7.01	7.54
	C.V.(%)	1.63	3.44	2.96	3.74	4.92	5.93
	No. Specimens	6		6		16	
No. Batches	1		1		3		
Data Class		Screening		Screening		Interim	
ε _x ^{ohtu} (με)	Mean	7100		6600		6900	
	Minimum	6800		6100		6000	
	Maximum	7200		7100		7800	
	C.V.(%)	2.2		6.5		6.1	
	B-value	(1)		(1)		5800	
	Distribution	Normal		Normal		Weibull	
	C ₁	7100		6600		7100	
	C ₂	150		430		17	
	No. Specimens	6		6		18	
	No. Batches	1		1		3	
Data Class		Screening		Screening		B18	

(1) Basis values are presented only for A and B data classes.

(2) Held in 160°F water bath until full saturation or 95% of equilibrium once full saturation was established.

MATERIAL:		AS4 6k/PR 500 RTM 5-harness satin weave fabric				Table 4.2.26(n) C/Ep 370-5HS AS4/PR 500 OHC, x-axis [0_i/45_i/90_i/-45_i]_s 72/A,180/A,240/A B18, Interim, Screening	
RESIN CONTENT:	28 - 36 wt%	COMP: DENSITY:	1.55 - 1.60 g/cm ³				
FIBER VOLUME:	55.5 - 64.8 vol %	VOID CONTENT:	NA				
PLY THICKNESS:	0.0128 - 0.0149 in.						
TEST METHOD:	SRM 5R-94			MODULUS CALCULATION:			
				Chord between 1000 and 3000 με			
NORMALIZED BY:	Specimen thickness and batch fiber areal weight to 57% fiber volume (0.0145 in. CPT)						
Temperature (°F)	72		180		240		
Moisture Content (%)	ambient		ambient		ambient		
Equilibrium at T, RH							
Source Code	61		61		61		
	Normalized	Measured	Normalized	Measured	Normalized	Measured	
F _x ^{ohcu} (ksi)	Mean	45.3	47.2	38.2	40.4	35.6	37.9
	Minimum	42.7	44.7	34.8	37.0	32.2	33.9
	Maximum	48.2	51.4	44.1	47.3	37.9	41.0
	C.V.(%)	3.57	4.17	6.32	6.93	4.22	4.38
	B-value	41.0	41.5	(1)	(1)	(1)	(1)
	Distribution	Weibull	Weibull	Weibull	Normal	Weibull	Weibull
	C ₁	46.1	48.1	39.4	40.4	36.2	38.6
	C ₂	30.7	24.0	15.1	2.80	29.6	26.7
	No. Specimens	18		16		16	
	No. Batches	3		3		3	
Data Class	B18		Interim		Interim		
E _x ^{ohc} (Msi)	Mean	6.67	7.10	6.48	6.94	6.43	6.85
	Minimum	6.28	6.67	6.44	6.78	6.24	6.34
	Maximum	7.08	7.59	6.52	7.05	6.70	7.32
	C.V.(%)	4.47	5.02	0.549	1.44	1.87	4.35
	No. Specimens	8		5		15	
	No. Batches	1		1		3	
	Data Class	Screening		Screening		Screening	
	Mean	6900		6100		5500	
	Minimum	6500		5400		5100	
	Maximum	7500		6800		6000	
ε _x ^{ohcu} (με)	C.V.(%)	5.7		9.7		4.6	
	B-value	(1)		(1)		(1)	
	Distribution	Normal		Normal		Weibull	
	C ₁	6900		6100		5700	
	C ₂	390		590		24	
	No. Specimens	5		5		15	
	No. Batches	1		1		3	
	Data Class	Screening		Screening		Screening	

(1) Basis values are presented only for A and B data classes.

MATERIAL:		AS4 6k/PR 500 RTM 5-harness satin weave fabric				Table 4.2.26(o) C/Ep 370-5HS AS4/PR 500 OHC, x-axis [0/45/90/-45]_s 300/A Interim						
RESIN CONTENT:	28 - 36 wt%	COMP: DENSITY:	1.55 - 1.60 g/cm ³									
FIBER VOLUME:	55.5 - 64.8 vol %	VOID CONTENT:	NA									
PLY THICKNESS:	0.0128 - 0.0149 in.											
TEST METHOD:		MODULUS CALCULATION:										
SRM 5R-94		Chord between 1000 and 3000 με										
NORMALIZED BY:		Specimen thickness and batch FAW to 57% fiber volume (0.0145 in. CPT)										
Temperature (°F)		300										
Moisture Content (%)		ambient										
Equilibrium at T, RH												
Source Code		61										
		Normalized	Measured	Normalized	Measured	Normalized	Measured					
F _x ^{ohcu} (ksi)	Mean	32.1	34.0									
	Minimum	26.2	28.9									
	Maximum	36.6	38.6									
	C.V.(%)	7.92	7.41									
	B-value	(1)	(1)									
	Distribution	Weibull	Weibull									
	C ₁	33.2	35.1									
	C ₂	15.7	14.9									
	No. Specimens	17										
	No. Batches	3										
Data Class		Interim										
E _x ^{ohc} (Msi)	Mean	6.24	6.60									
	Minimum	6.02	6.19									
	Maximum	6.38	7.24									
	C.V.(%)	1.73	4.13									
	No. Specimens	17										
	No. Batches	3										
	Data Class		Interim									
	ε _x ^{ohcu} (με)	Mean						5100				
		Minimum						4300				
		Maximum						5700				
C.V.(%)			7.6									
B-value			(1)									
Distribution			Weibull									
C ₁			5300									
C ₂			17									
No. Specimens		17										
No. Batches		3										
Data Class		Interim										

(1) Basis values are presented only for A and B data classes.

MATERIAL:		AS4 6k/PR 500 RTM 5-harness satin weave fabric				Table 4.2.26(p) C/Ep 370-5HS AS4/PR 500 OHC, x-axis [0_t/45_t/90_t/-45_t]_s 180/W, 240/W, 300/W B18, Interim, Screening	
RESIN CONTENT:	28 - 36 wt%	COMP: DENSITY:	1.55 - 1.60 g/cm ³				
FIBER VOLUME:	55.5 - 64.8 vol %	VOID CONTENT:	NA				
PLY THICKNESS:	0.0128 - 0.0149 in.						
TEST METHOD:		MODULUS CALCULATION:					
SRM 5R-94		Chord between 1000 and 3000 με					
NORMALIZED BY:		Specimen thickness and batch fiber areal weight to 57% fiber volume (0.0145 in. CPT)					
Temperature (°F)		180		240		300	
Moisture Content (%)		(2)		(2)		(2)	
Equilibrium at T, RH		160°F water		160°F water		160°F water	
Source Code		61		61		61	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F _x ^{ohcu} (ksi)	Mean	36.3	38.5	32.8	34.6	27.1	28.4
	Minimum	32.2	34.5	30.3	31.8	25.0	26.1
	Maximum	40.9	44.2	36.5	38.4	30.2	32.1
	C.V.(%)	7.01	7.02	5.76	6.39	6.35	6.52
	B-value	(1)	(1)	(1)	(1)	25.4	23.5
	Distribution	Weibull	ANOVA	Weibull	Weibull	Nonpara.	Weibull
	C ₁	37.5	2.90	33.7	35.7	9	29.3
	C ₂	16.1	3.97	18.2	17.2	1.35	16.4
	No. Specimens	16		17		18	
	No. Batches	3		3		3	
Data Class		Interim		Interim		B18	
E _x ^{ohc} (Msi)	Mean	6.39	6.90	6.45	6.83	6.10	6.40
	Minimum	6.29	6.56	6.22	6.49	5.84	5.78
	Maximum	6.53	7.13	7.05	7.46	6.45	6.87
	C.V.(%)	1.69	2.89	3.54	4.03	2.64	4.57
	No. Specimens	6		15		15	
No. Batches	1		3		3		
Data Class		Screening		Interim		Interim	
ε _x ^{ohcu} (με)	Mean	5800		5100		4500	
	Minimum	5400		4500		4100	
	Maximum	6500		5800		4900	
	C.V.(%)	7.0		7.2		5.4	
	B-value	(1)		(1)		(1)	
	Distribution	Normal		Weibull		Weibull	
	C ₁	5800		5300		4600	
	C ₂	410		15		20	
	No. Specimens	6		15		15	
	No. Batches	1		3		3	
Data Class		Screening		Interim		Interim	

(1) Basis values are presented only for A and B data classes.

(2) Held in 160°F water bath until full saturation or 95% of equilibrium once full saturation was established.

MATERIAL:		AS4 6k/PR 500 RTM 5-harness satin weave fabric				Table 4.2.26(q) C/Ep 370-5HS AS4/PR 500 CAI, x-axis [0_f/45_f/90_f/-45_f]_{2s} 72/A, Impact Interim	
RESIN CONTENT:	30 - 33 wt%	COMP: DENSITY:	1.56 - 1.59 g/cm ³				
FIBER VOLUME:	58.5 - 62.4 vol %	VOID CONTENT:	NA				
PLY THICKNESS:	0.0133 - 0.0141 in.						
TEST METHOD:		MODULUS CALCULATION:					
SRM 2-94, Impact energy (see footnotes)							
NORMALIZED BY:		Specimen thickness and batch FAW to 57% fiber volume (0.0145 in. CPT)					
Temperature (°F)		72		72		72	
Moisture Content (%)		ambient		ambient		ambient	
Equilibrium at T, RH		(2)		(3)		(4)	
Source Code		61		61		61	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F _x ^{cai} (ksi)	Mean	60.5	64.3	43.1	45.8	39.5	41.9
	Minimum	55.6	59.1	40.6	42.4	35.5	39.0
	Maximum	67.2	71.7	45.3	48.6	45.7	47.6
	C.V.(%)	5.33	5.42	3.31	4.23	6.32	5.47
	B-value	(1)	(1)	(1)	(1)	(1)	(1)
	Distribution	Weibull	Weibull	ANOVA	ANOVA	ANOVA	ANOVA
	C ₁	62.0	66.0	1.58	2.17	2.64	2.45
	C ₂	19.6	18.9	4.98	5.26	3.99	4.18
	No. Specimens	15		15		15	
	No. Batches	3		3		3	
Data Class		Interim		Interim		Interim	

- (1) Basis values are presented only for A and B data classes.
(2) Impact energy: 135 in-lbs.
(3) Impact energy: 270 in-lbs.
(4) Impact energy: 360 in-lbs.

MATERIAL:		AS4 6k/PR 500 RTM 5-harness satin weave fabric				Table 4.2.26(r) C/Ep 370-5HS AS4/PR 500 CAI, x-axis [0_r/45_r/90_r/-45_r]_{2s} 72/A, Impact Interim	
RESIN CONTENT:	30 - 33 wt%	COMP: DENSITY:	1.56 - 1.59 g/cm ³				
FIBER VOLUME:	58.5 - 62.4 vol %	VOID CONTENT:	NA				
PLY THICKNESS:	0.0133 - 0.0141 in.						
TEST METHOD:		MODULUS CALCULATION:					
SRM 2R-94, Impact energy (see footnotes)							
NORMALIZED BY:		Specimen thickness and batch FAW to 57% fiber volume (0.0145 in. CPT)					
Temperature (°F)		72		72			
Moisture Content (%)		ambient		ambient			
Equilibrium at T, RH		(2)		(3)			
Source Code		61		61			
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F _x ^{cai} (ksi)	Mean	37.2	39.4	35.1	37.4		
	Minimum	34.8	36.1	33.0	34.5		
	Maximum	40.9	43.7	37.5	39.8		
	C.V.(%)	4.61	4.91	4.15	4.26		
	B-value	(1)	(1)	(1)	(1)		
	Distribution	ANOVA	ANOVA	ANOVA	ANOVA		
	C ₁	1.91	2.11	1.59	1.74		
	C ₂	5.12	4.73	4.65	4.75		
No. Specimens	15		15				
No. Batches	3		3				
Data Class	Interim		Interim				

(1) Basis values are presented only for A and B data classes.
(2) Impact energy: 450 in-lbs.
(3) Impact energy: 545 in-lbs.

MATERIAL:		AS4 6k/PR 500 RTM 5-harness satin weave fabric				Table 4.2.26(s) C/Ep 370-5HS AS4/PR 500 G_{Ic}, x-axis [0_i]_{6s} 72/A Screening
RESIN CONTENT:	33 - 34 wt%	COMP: DENSITY:	1.56 g/cm ³			
FIBER VOLUME:	57.3 - 58.3 vol %	VOID CONTENT:	NA			
PLY THICKNESS:	0.0142 - 0.0144 in.					
TEST METHOD:		MODULUS CALCULATION:				
BMS 8-276, Section 8.5.7 Double Cantilever beam (2)						
NORMALIZED BY:		Not normalized				
Temperature (°F)		72				
Moisture Content (%)		ambient				
Equilibrium at T, RH						
Source Code		61				
G _{Ic} (in-lbs/in ²)	Mean	2.63				
	Minimum	1.64				
	Maximum	3.88				
	C.V.(%)	20.1				
	B-value	(1)				
	Distribution	ANOVA				
	C ₁	0.642				
	C ₂	8.30				
	No. Specimens	56				
No. Batches	2					
Data Class		Screening				

(1) Basis values are presented only for A and B data classes.
(2) Equivalent to ASTM D 5528-94 with 0.5 inch specimen width.

MATERIAL:		AS4 6k/PR 500 RTM 5-harness satin weave fabric				Table 4.2.26(t) C/Ep 370-5HS AS4/PR 500 G_{IIc}, x-axis [0_r]_{6s} 72/A B18
RESIN CONTENT:	33 - 34 wt%	COMP: DENSITY:	1.56 g/cm ³			
FIBER VOLUME:	57.3 - 58.3 vol %	VOID CONTENT:	NA			
PLY THICKNESS:	0.0142 - 0.0144 in.					
TEST METHOD:	MODULUS CALCULATION:					
BMS 8-276, Section 8.5.9 End Notched Flexure						
NORMALIZED BY:		Not normalized				
Temperature (°F)		72				
Moisture Content (%)		ambient				
Equilibrium at T, RH						
Source Code		61				
G _{IIc} (in-lbs/in ²)	Mean	7.88				
	Minimum	6.21				
	Maximum	10.8				
	C.V.(%)	13.1				
	B-value	(1)				
	Distribution	ANOVA				
	C ₁	1.20				
	C ₂	5.02				
	No. Specimens	47				
	No. Batches	3				
Data Class		B18				

(1) B-basis values calculated from less than five batches of data using the ANOVA method are not presented.

4.2.27 T300 3k/EA9396 8-harness satin weave fabricMaterial Description:

Material: T300 3k/EA9396

Form: 8-harness satin fabric of Hexcel weave W133 using 3k tows at 24x23 tows per inch, fiber areal weight of 366 g/m², wet lay-up, typical cured resin content ranged from 31.9 to 37.1%, typical cured ply thickness of 0.015 inches.

Processing: Vacuum Bag cure; 195°F, 126 mm Hg, 45 minutes

General Supplier Information:

Fiber: T300 3k fibers are continuous carbon filaments made from PAN precursor, surface treated to improve handling characteristics and structural properties. Filament count is 3,000 filaments per tow. Typical tensile modulus is 33×10^6 psi. Typical tensile strength is 530,000 psi.

Matrix: EA9396 is a 200°F curing toughened epoxy resin with improved hot/wet properties. 75 minute pot life for 1 lb. batch. This resin is a two part, unfilled version of EA 9394.

Maximum Short Term Service Temperature: 300°F (dry), 180°F (wet)

Typical applications: aircraft repair

Data Analysis Summary:

1. This material was tested at fiber volumes that exceed what are typically used for repair. Data should be substantiated if used at lower fiber volumes.
2. Elevated temperature, wet properties for compression and shear are low and have increased variability because the material was tested near the glass transition temperature.
3. Reported fiber volumes and resin contents are not consistent with the measured ply thicknesses.
4. Data are from publicly available report, Reference 4.2.27.

4.2.27 T300 3k/EA 9396 8-harness satin weave fabric*

C/Ep 366-8HS T300/EA 9396 Summary					
MATERIAL:	T300 3k/EA 9396 8-harness satin weave fabric				
FORM:	Dry carbon fabric impregnated with epoxy resin in a wet lay-up impregnation process.				
FIBER:	Toray T300 , 3k, UC 309 Sizing		MATRIX:	Dexter-Hysol EA 9396	
T _g (dry):	349°F	T _g (wet):	225°F	T _g METHOD:	DMA
PROCESSING:	Vacuum Bag Cure: 195-200°F, 45 min., 25 in. Hg.				

* ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

Date of fiber manufacture		Date of testing	11/88-5/91
Date of resin manufacture	8/88-10/88	Date of data submittal	3/98
Date of prepreg manufacture	NA	Date of analysis	8/98
Date of composite manufacture	11/88-5/91		

LAMINA PROPERTY SUMMARY

	72°F/A		-65°F/A	200°F/A		-65°F/W	72°F/W	200°F/W
Tension, 1-axis	IISI						IISI	
Tension, 2-axis	SSSS		IISI	IISI		IISI	IISI	IISI
Tension, 3-axis								
Compression, 1-axis	SS-S						II-I	
Compression, 2-axis	SS-S		IS-S	II-I		II-I	II-I	SS-S
Compression, 3-axis								
Shear, 12-plane	II--		II--	II--		II--	IS--	II--
Shear, 23-plane								
Shear, 31-plane								

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

		Nominal	As Submitted	Test Method
Fiber Density	(g/cm ³)	1.78	1.78	D 792
Resin Density	(g/cm ³)	1.14		
Composite Density	(g/cm ³)	1.45	1.46-1.48	D 792
Fiber Areal Weight	(g/m ²)	366	366	
Fiber Volume	(%)	54	53.7-57.3	D 3171A
Ply Thickness	(in)	0.0142	0.014-0.016	

Nominal composite densities assume void content of 0%.

LAMINATE PROPERTY SUMMARY

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

MATERIAL:		T300 3k/EA 9396 8-harness satin weave fabric				Table 4.2.27(a) C/Ep 366-8HS T300 3k/EA 9396 Tension, 1-axis [0]_r₈ 72/A,72/W Interim, Screening	
RESIN CONTENT:	32.7-34.2 wt%	COMP. DENSITY:	1.48 g/cm ³				
FIBER VOLUME:	56.3-57.3 %	VOID CONTENT:	4.0-4.8 %				
PLY THICKNESS:	0.0148-0.0153 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3039		Chord between 1000 and 3000µε					
NORMALIZED BY:		Specimen thickness and areal weight to 57% (0.0142 in. CPT)					
Temperature (°F)		72		72			
Moisture Content (%)		Ambient		(1)			
Equilibrium at T, RH				140, 95-100			
Source Code		31		31			
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{tu} (ksi)	Mean	88.3	80.6	92.8	84.9		
	Minimum	80.2	73.1	84.1	74.3		
	Maximum	94.4	86.0	102	91.4		
	C.V.(%)	5.79	6.39	5.49	6.00		
	B-value	(2)	(2)	(2)	(2)		
	Distribution	Weibull	Nonpara.	Weibull	Weibull		
	C ₁	90.6	8	95.1	87.2		
	C ₂	22.5	1.54	20.7	21.1		
	No. Specimens	15		15			
	No. Batches	3		3			
Data Class	Interim		Interim				
E ₁ ^t (Msi)	Mean	9.17	8.38	9.68	8.85		
	Minimum	8.68	7.69	9.38	8.44		
	Maximum	10.1	9.22	10.3	9.34		
	C.V.(%)	3.96	4.60	2.43	2.71		
	No. Specimens	15		15			
No. Batches	3		3				
Data Class	Interim		Interim				
v ₁₂ ^t	Mean	0.0587		0.0372			
	No. Specimens	7		6			
	No. Batches	3		3			
	Data Class	Screening		Screening			
ε ₁ ^{tu} (µε)	Mean	7830		9570			
	Minimum	5500		8800			
	Maximum	9480		10400			
	C.V.(%)	14.3		5.34			
	B-value	(2)		(2)			
	Distribution	ANOVA		Weibull			
	C ₁	4.64		9800			
	C ₂	1220		22.7			
	No. Specimens	15		15			
	No. Batches	3		3			
Data Class	Interim		Interim				

(1) Unknown weight gain.

(2) Basis values are presented only for A and B data classes.

MATERIAL:		T300 3k/EA 9396 8-harness satin weave fabric				Table 4.2.27(b) C/Ep 366-8HS T300 3k/EA 9396 Tension, 2-axis [0]s 72/A, -65/A, 200/A Interim, Screening		
RESIN CONTENT:	32.7-34.2 wt%	COMP. DENSITY:	1.48 g/cm ³					
FIBER VOLUME:	56.3-57.3 %	VOID CONTENT:	4.0-4.8 %					
PLY THICKNESS:	0.0148-0.0153 in.							
TEST METHOD:	MODULUS CALCULATION:							
ASTM D 3039		Chord between 1000 and 3000µε						
NORMALIZED BY:		Specimen thickness and areal weight to 57% (0.0142 in. CPT)						
Temperature (°F)		72		-65		200		
Moisture Content (%)		Ambient		Ambient		Ambient		
Equilibrium at T, RH								
Source Code		31		31		31		
		Normalized	Measured	Normalized	Measured	Normalized	Measured	
F ₂ ^{tu} (ksi)	Mean	100	93.0	93.6	90.6	78.9	75.5	
	Minimum	80.4	75.1	87.0	82.9	59.7	57.3	
	Maximum	110	101	103	107	94.6	91.7	
	C.V.(%)	9.39	9.11	5.19	6.89	12.4	13.1	
	B-value	(1)	(1)	(1)	(1)	(1)	(1)	
	Distribution	Weibull	Weibull	Weibull	Lognormal	ANOVA	ANOVA	
	C ₁	104	96.4	95.9	4.50	4.61	4.61	
	C ₂	15.2	16.0	19.7	0.0663	10.6	10.7	
	No. Specimens	14		15		15		
	No. Batches	3		3		3		
Data Class		Screening		Interim		Interim		
E ₂ ^t (Msi)	Mean	9.10	8.51	9.60	9.29	9.05	8.64	
	Minimum	8.11	7.31	8.97	8.33	8.37	7.75	
	Maximum	9.68	9.44	10.1	10.2	9.67	9.23	
	C.V.(%)	5.12	6.58	3.27	4.66	4.92	5.14	
	No. Specimens	14		15		15		
	No. Batches	3		3		3		
	Data Class		Screening		Interim		Interim	
	v ₂₁ ^t	Mean	0.0509		0.0543		0.0575	
		No. Specimens	9		7		6	
		No. Batches	3		3		3	
Data Class		Screening		Screening		Screening		
ε ₂ ^{tu} (µε)	Mean	10500		9580		8590		
	Minimum	8520		8850		6460		
	Maximum	11700		10600		10000		
	C.V.(%)	10.3		6.71		10.7		
	B-value	(1)		(1)		(1)		
	Distribution	Weibull		ANOVA		Weibull		
	C ₁	10900		4.81		8980		
	C ₂	13.0		704		11.3		
	No. Specimens	14		15		15		
	No. Batches	3		3		3		
Data Class		Screening		Interim		Interim		

(1) Basis values are presented only for A and B data classes.

MATERIAL:		T300 3k/EA 9396 8-harness satin weave fabric				Table 4.2.27(c) C/Ep 366-8HS T300 3k/EA 9396 Tension, 2-axis [0]_s -65/W, 72/W, 200/W Interim, Screening		
RESIN CONTENT:	32.7-34.2 wt%	COMP. DENSITY:	1.48 g/cm ³					
FIBER VOLUME:	56.3-57.3 %	VOID CONTENT:	4.0-4.8 %					
PLY THICKNESS:	0.0148-0.0153 in.							
TEST METHOD:		MODULUS CALCULATION:						
ASTM D 3039		Chord between 1000 and 3000µε						
NORMALIZED BY:		Specimen thickness and areal weight to 57% (0.0142 in. CPT)						
Temperature (°F)		-65		72		200		
Moisture Content (%)		(1)		(1)		(1)		
Equilibrium at T, RH		140, 95-100		140, 95-100		140, 95-100		
Source Code		31		31		31		
		Normalized	Measured	Normalized	Measured	Normalized	Measured	
F ₂ ^{tu} (ksi)	Mean	100	96.7	93.3	87.5	66.7	64.3	
	Minimum	79.4	80.6	80.4	72.0	60.2	56.7	
	Maximum	110	105	101	101	71.9	72.1	
	C.V.(%)	7.40	6.88	5.94	9.29	5.51	6.51	
	B-value	(2)	(2)	(2)	(2)	(2)	(2)	
	Distribution	Weibull	Weibull	Weibull	Weibull	Weibull	Normal	
	C ₁	103	99.4	95.7	91.2	68.4	64.3	
	C ₂	19.1	20.2	21.2	12.1	22.0	4.18	
	No. Specimens	15		15		16		
	No. Batches	3		3		3		
Data Class		Interim		Interim		Interim		
E ₂ ^t (Msi)	Mean	9.84	9.52	9.32	8.73	8.29	7.98	
	Minimum	9.51	8.91	8.89	8.22	7.29	7.01	
	Maximum	10.1	10.4	9.81	9.63	9.28	9.20	
	C.V.(%)	1.95	3.69	2.83	4.21	7.49	7.73	
	No. Specimens	15		15		16		
	No. Batches	3		3		3		
	Data Class		Interim		Interim		Interim	
	v ₂₁ ^t	Mean	0.0535		0.0460		0.0497	
		No. Specimens	6		6		10	
		No. Batches	3		3		3	
Data Class		Screening		Screening		Screening		
ε ₂ ^{tu} (µε)	Mean	9830		10000		7370		
	Minimum	7210		8390		3070		
	Maximum	11000		11700		9520		
	C.V.(%)	10.5		8.61		23.5		
	B-value	(2)		(2)		(2)		
	Distribution	Weibull		Weibull		Weibull		
	C ₁	10200		10400		8000		
	C ₂	14.4		12.5		5.72		
	No. Specimens	15		15		16		
	No. Batches	3		3		3		
Data Class		Interim		Interim		Interim		

(1) Unknown weight gain.

(2) Basis values are presented only for A and B data classes.

MATERIAL:		T300 3k/EA 9396 8-harness satin weave fabric				Table 4.2.27(d) C/Ep 366-8HS T300 3k/EA 9396 Compression, 1-axis [0]₁₂ 72/A,72/W Interim, Screening	
RESIN CONTENT:	34.7-37.1 wt%	COMP. DENSITY:	1.48 g/cm ³				
FIBER VOLUME:	53.7-55.5 %	VOID CONTENT:	2.8-4.8 %				
PLY THICKNESS:	0.0147-0.0152 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3410B		Chord between 1000 and 3000µε					
NORMALIZED BY:		Specimen thickness and batch areal weight to 57% (0.0142 in. CPT)					
Temperature (°F)		72		72			
Moisture Content (%)		Ambient		2.18-2.43			
Equilibrium at T, RH				(1)			
Source Code		31		31			
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F _I ^{cu} (ksi)	Mean	75.0	69.9	58.0	53.9		
	Minimum	60.1	56.4	47.4	42.3		
	Maximum	84.1	78.5	72.9	65.4		
	C.V.(%)	8.48	8.22	11.9	11.1		
	B-value	(2)	(2)	(2)	(2)		
	Distribution	Weibull	Weibull	Weibull	ANOVA		
	C ₁	77.6	72.3	61.1	3.06		
	C ₂	15.1	15.7	8.65	6.12		
	No. Specimens	12		15			
	No. Batches	3		3			
Data Class		Screening		Interim			
E ₁ ^c (Msi)	Mean	8.92	8.37	8.29	7.70		
	Minimum	6.56	6.15	6.49	6.05		
	Maximum	11.1	10.3	9.88	9.21		
	C.V.(%)	15.0	15.8	13.0	13.5		
	No. Specimens	12		15			
	No. Batches	3		3			
	Data Class		Screening		Interim		
ν ₁₂ ^c	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{cu} (µε)	Mean	8940		7840			
	Minimum	6670		5410			
	Maximum	14300		12300			
	C.V.(%)	27.3		26.4			
	B-value	(2)		(2)			
	Distribution	Lognormal		Weibull			
	C ₁	9.07		8630			
	C ₂	0.248		4.10			
	No. Specimens	12		15			
	No. Batches	3		3			
Data Class		Screening		Interim			

(1) Specimens conditioned at 140°F, 95-100% RH for 99 days.

(2) Basis values are presented only for A and B data classes.

MATERIAL:		T300 3k/EA 9396 8-harness satin weave fabric				Table 4.2.27(e) C/Ep 366-8HS T300 3k/EA 9396 Compression, 2-axis [0]₁₂ -65/A, 72/A, 200/A Interim, Screening	
RESIN CONTENT:	34.7-37.1 wt%	COMP. DENSITY:	1.48 g/cm ³				
FIBER VOLUME:	53.7-55.5 %	VOID CONTENT:	2.8-4.8 %				
PLY THICKNESS:	0.0147-0.0153 in.						
TEST METHOD:	ASTM D 3410B		MODULUS CALCULATION:		Chord between 1000 and 3000µε		
NORMALIZED BY:	Specimen thickness and areal weight to 57% (0.0142 in. CPT)						
Temperature (°F)	72		-65		200		
Moisture Content (%)	Ambient		Ambient		Ambient		
Equilibrium at T, RH							
Source Code	31		31		31		
	Normalized	Measured	Normalized	Measured	Normalized	Measured	
F ₂ ^{cu} (ksi)	Mean	63.7	60.9	86.4	83.2	42.1	40.4
	Minimum	52.5	52.3	72.3	70.6	35.0	35.2
	Maximum	69.1	65.6	96.8	91.2	49.4	45.8
	C.V.(%)	7.50	7.03	10.2	8.38	9.61	7.86
	B-value	(1)	(1)	(1)	(1)	(1)	(1)
	Distribution	Weibull	Weibull	Weibull	Weibull	ANOVA	ANOVA
	C ₁	65.7	62.7	90.2	86.1	4.48	5.27
	C ₂	18.7	19.1	12.7	15.8	5.05	3.56
	No. Specimens	14		15		15	
	No. Batches	3		3		3	
Data Class	Screening		Interim		Interim		
E ₂ ^c (Msi)	Mean	8.21	7.86	8.79	8.46	8.26	7.95
	Minimum	6.41	5.94	7.77	7.38	6.75	6.46
	Maximum	9.48	9.21	12.0	11.2	9.93	9.56
	C.V.(%)	9.69	10.6	12.5	11.6	11.1	11.0
	No. Specimens	14		13		15	
No. Batches	3		3		3		
Data Class	Screening		Screening		Interim		
v ₂₁ ^c	Mean						
	No. Specimens						
	No. Batches						
Data Class							
ε ₂ ^{cu} (µε)	Mean		8260		11700		5360
	Minimum		5580		8230		3590
	Maximum		13900		14000		7610
	C.V.(%)		26.1		17.1		21.4
	B-value		(1)		(1)		(1)
	Distribution		Normal		Weibull		ANOVA
	C ₁		8260		12400		3.97
	C ₂		2150		8.15		1210
	No. Specimens		14		13		15
	No. Batches		3		3		3
Data Class		Screening		Screening		Interim	

(1) Basis values are presented only for A and B data classes.

MATERIAL:		T300 3k/EA 9396 8-harness satin weave fabric				Table 4.2.27(f) C/Ep 366-8HS T300 3k/EA 9396 Compression, 2-axis [0]₁₂ -65/W, 72/W, 200/W Interim, Screening		
RESIN CONTENT:	34.7-37.1 wt%	COMP. DENSITY:	1.48 g/cm ³					
FIBER VOLUME:	53.7-55.5 %	VOID CONTENT:	2.8-4.8 %					
PLY THICKNESS:	0.0147-0.0152 in.							
TEST METHOD:		MODULUS CALCULATION:						
ASTM D 3410B		Chord between 1000 and 3000µε						
NORMALIZED BY:		Specimen thickness and areal weight to 57% (0.0142 in. CPT)						
Temperature (°F)		72		-65		200		
Moisture Content (%)		1.91-2.30		1.91-2.30		1.91-2.30		
Equilibrium at T, RH		(1)		(1)		(1)		
Source Code		31		31		31		
		Normalized	Measured	Normalized	Measured	Normalized	Measured	
F ₂ ^{cu} (ksi)	Mean	52.8	50.7	79.5	76.4	29.3	28.0	
	Minimum	45.8	44.4	69.0	67.6	20.6	19.8	
	Maximum	65.3	59.9	92.8	86.0	39.3	37.1	
	C.V.(%)	9.49	8.02	8.94	7.54	17.8	17.4	
	B-value	(2)	(2)	(2)	(2)	(2)	(2)	
	Distribution	Weibull	Weibull	Weibull	Weibull	Weibull	Weibull	
	C ₁	55.1	52.6	82.7	79.1	31.4	30.0	
	C ₂	10.2	12.7	12.2	14.7	6.42	6.58	
	No. Specimens	15		15		13		
	No. Batches	3		3		3		
Data Class		Interim		Interim		Screening		
E ₂ ^c (Msi)	Mean	8.57	8.24	9.14	8.80	9.12	8.73	
	Minimum	6.91	6.56	8.48	8.19	7.51	7.36	
	Maximum	9.60	9.34	10.5	10.2	11.2	10.7	
	C.V.(%)	10.1	10.3	6.29	6.01	11.9	11.5	
	No. Specimens	15		15		13		
	No. Batches	3		3		3		
	Data Class		Interim		Interim		Screening	
v ₂₁ ^c	Mean							
	No. Specimens							
	No. Batches							
	Data Class							
ε ₂ ^{cu} (µε)	Mean	6490		9850		3440		
	Minimum	3690		7460		1930		
	Maximum	12900		14100		5130		
	C.V.(%)	32.6		19.6		28.9		
	B-value	(2)		(2)		(2)		
	Distribution	Lognormal		Weibull		Weibull		
	C ₁	8.74		10600		38000		
	C ₂	0.283		5.42		4.07		
	No. Specimens	15		15		13		
	No. Batches	3		3		3		
Data Class		Interim		Interim		Screening		

(1) Specimens conditioned at 140°F, 95-100% RH for 62-99 days.

(2) Basis values are presented only for A and B data classes.

MATERIAL:		T300 3k/EA 9396 8-harness satin weave fabric					Table 4.2.27(g) C/Ep 366-8HS T300 3k/EA 9396 Shear, 12-plane [+/-45°]₈ 72/A, -65/A, 200/A, 72/W, -65/W, 200/W Interim, Screening
RESIN CONTENT:	31.9-35.4 wt%	COMP. DENSITY:	1.49 g/cm ³				
FIBER VOLUME:	53.9-57.0 %	VOID CONTENT:	4.6-5.6 %				
PLY THICKNESS:	0.0150-0.0160 in.						
TEST METHOD:	MODULUS CALCULATION:						
ASTM D 3518							
NORMALIZED BY:		Not normalized					
Temperature (°F)	72	-65	200	72	-65	200	
Moisture Content (%)	Ambient	Ambient	Ambient	2.08-2.34	2.08-2.34	2.08-2.34	
Equilibrium at T, RH				(1)	(1)	(1)	
Source Code	31	31	31	31	31	31	
Mean Minimum Maximum C.V.(%) E_{12}^{su} (ksi)	12.8	18.4	7.82	10.5	16.8	4.49	
	11.4	15.7	6.94	8.79	13.7	3.82	
	15.4	21.8	9.30	12.6	20.8	5.46	
	9.95	9.53	9.51	12.2	11.9	11.2	
	(2)	(2)	(2)	(2)	(2)	(2)	
	Normal	Weibull	Weibull	Normal	Weibull	Normal	
	12.8	19.2	8.16	10.5	17.7	4.49	
	1.28	11.7	11.1	1.27	8.95	0.502	
	No. Specimens	15	15	15	15	15	
	No. Batches	3	3	3	3	3	
	Data Class	Interim	Interim	Interim	Interim	Interim	
Mean Minimum Maximum C.V.(%) G_{12}^s (Msi)	0.634	0.829	0.413	0.542	0.824	0.249	
	0.510	0.719	0.347	0.452	0.623	0.153	
	0.851	0.967	0.561	0.757	1.08	0.468	
	13.9	9.07	16.5	17.5	15.3	32.5	
	No. Specimens	15	15	15	15	14	
	No. Batches	3	3	3	3	3	
	Data Class	Interim	Interim	Interim	Interim	Screening	
	Screening	Screening	Screening	Screening	Screening	Screening	
	Mean No. Specimens No. Batches Data Class γ_{12}^s						

(1) Specimens conditioned at 140°F, 95-100% RH for 91 days.

(2) Basis values are presented only for A and B data classes.

4.2.28 AS4 12k/997 unidirectional tapeMaterial Description:

Material: AS4 /997

Form: Unidirectional tape, filament count of 12,000 filaments per tow, fiber areal weight of 145 g/m², typical cured resin content of 35%, typical cured ply thickness of 0.0056 inches.

Processing: Autoclave cure; 350° F, 85 psi for two hours.

General Supplier Information:

Fiber: AS4 fibers are continuous carbon filaments made from PAN precursor, surface treated to improve handling characteristics and structural properties. Filament count is 12,000 filaments per tow. Typical tensile modulus is 34×10^6 psi. Typical tensile strength is 550,000 psi.

Matrix: 997 is a 350°F curing epoxy resin.

Maximum Short Term Service Temperature: 350°F (dry), 250°F (wet)

Typical applications: Primary and secondary aircraft structure. Elevated temperature service.

4.2.28 AS4 12k/997 unidirectional tape

MATERIAL: AS4 12k/997 unidirectional tape

**C/Ep 145-UT
AS4/997
Summary**

FORM: Fiberite HyE 997/AS4 Unsized 12k prepreg

FIBER: Hexcel AS4 12k, no twist

MATRIX: Fiberite 997

T_g(dry): 410°F T_g(wet): 320°F T_g METHOD: DMA E'

PROCESSING: Autoclave: 2 hours, 350°F, 85 psi

Date of fiber manufacture	7/96-3/97	Date of testing	5/97-10/97
Date of resin manufacture	4/97	Date of data submittal	7/97
Date of prepreg manufacture	4/97	Date of analysis	2/99
Date of composite manufacture	4/97		

LAMINA PROPERTY SUMMARY

	73°F/A		-65°F/A		180°F/W			
Tension, 1-axis	BM - B		BM - B		BM - B			
Tension, 2-axis	BM - B		BM - B		BM - B			
Tension, 3-axis								
Compression, 1-axis	BM - B		BM - B		BM - B			
Compression, 2-axis	BM - B		BM - B		BM - B			
Compression, 3-axis								
Shear, 12-plane								
Shear, 23-plane								
Shear, 13-plane								
SBS, 31-plane	S - - -		S - - -		S - - -			

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

	Nominal	As Submitted	Test Method
Fiber Density (g/cm ³)	1.79	1.77-1.80	SACMA SRM-15
Resin Density (g/cm ³)	1.30		ASTM D 792
Composite Density (g/cm ³)	1.60	1.58-1.60	
Fiber Areal Weight (g/m ²)	145		ASTM 3529-90, modified
Fiber Volume (%)	57	54.4-62.6	
Ply Thickness (in)	0.0056	0.0053-0.0059	

LAMINATE PROPERTY SUMMARY

	73/A		-65/A		180/W		
[0,±45, 90] _{3S} Family							
Bearing	SS--		SS--		SS--		
OHT	S---		S---		S---		
OHC	S---		S---		S---		

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

MATERIAL:		AS4 12k/997 unidirectional tape				Table 4.2.28(a) C/Ep 145-UT AS4 12k/997 Tension, 1-axis [0]₈ 73/A, -65/A, 180/W B30, Mean	
RESIN CONTENT:	27.4-31.1 wt%	COMP. DENSITY:	1.58-1.59 g/cm ³				
FIBER VOLUME:	55.5-64.8 %	VOID CONTENT:	0-0.32 %				
PLY THICKNESS:	0.0055-0.0058 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3039-76		Chord modulus in linear range					
NORMALIZED BY:		Specimen thickness and fiber areal weight to 60% fiber volume (0.0056 in. CPT)					
Temperature (°F)		73		-65		180	
Moisture Content (%)		ambient		ambient		1.10	
Equilibrium at T, RH						(1)	
Source Code		85		85		85	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{tu} (ksi)	Mean	327	325	306	303	327	322
	Minimum	285	271	178	172	301	298
	Maximum	359	362	344	334	351	344
	C.V.(%)	4.52	5.93	9.59	9.80	3.79	3.98
	B-value	292	291	263	262	298	298
	Distribution	Weibull	Normal	Weibull	Weibull	Weibull	Nonpara.
	C ₁	334	325	317	313	332	
	C ₂	24.1	19.3	17.0	17.6	29.4	
	No. Specimens	30		30		30	
	No. Batches	5		5		5	
Data Class		B30		B30		B30	
E ₁ ^t (Msi)	Mean	19.9	19.8	20.0	19.8	20.1	19.8
	Minimum	18.4	19.0	19.3	18.6	18.4	18.7
	Maximum	21.1	20.5	20.8	20.8	21.8	22.2
	C.V.(%)	3.30	2.19	2.23	2.44	3.78	3.55
	No. Specimens	30		30		30	
No. Batches		5		5		5	
Data Class		Mean		Mean		Mean	
ν ₁₂ ^t	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{tu} (με)	Mean	15300		14300		15000	
	Minimum	13500		8330		13700	
	Maximum	16500		15500		16100	
	C.V.(%)	4.23		9.09		3.78	
	B-value	13700		12600		13800	
	Distribution	ANOVA		Weibull		Weibull	
	C ₁	666		14700		15290	
	C ₂	2.45		20.5		29.9	
	No. Specimens	30		30		30	
	No. Batches	5		5		5	
Data Class		B30		B30		B30	

(1) Conditioned at 160°F, 85% RH.

MATERIAL:		AS4 12k/997 unidirectional tape		Table 4.2.28(b) C/Ep 145-UT AS4 12k/997 Tension, 2-axis [90]₂₄ 73/A, -65/A, 180/W B30, Mean
RESIN CONTENT:	29.4-32.7 wt%	COMP. DENSITY:	1.58-1.59 g/cm ³	
FIBER VOLUME:	55.5-64.8 %	VOID CONTENT:	0 -1.24 %	
PLY THICKNESS:	0.0056-0.0059 in.			
TEST METHOD:	MODULUS CALCULATION:			
ASTM D 3039-76		Chord modulus in linear range		
NORMALIZED BY:		Not normalized.		
Temperature (°F)		73	-65	180
Moisture Content (%)		ambient	ambient	1.10
Equilibrium at T, RH				(1)
Source Code		85	85	85
F ₂ ^{tu} (ksi)	Mean	11.3	12.7	5.64
	Minimum	9.70	11.2	4.30
	Maximum	13.3	14.4	6.60
	C.V.(%)	6.06	6.58	8.64
	B-value	10.1	10.8	4.15
	Distribution	Normal	Weibull	ANOVA
	C ₁	11.3	13.1	0.515
	C ₂	0.683	16.3	2.90
	No. Specimens	30	30	30
	No. Batches	5	5	5
Data Class		B30	B30	B30
E ₂ ^t (Msi)	Mean	1.36	1.53	1.21
	Minimum	1.27	1.43	1.16
	Maximum	1.50	1.61	1.32
	C.V.(%)	3.19	2.63	3.38
	No. Specimens	30	30	30
No. Batches	5	5	5	
Data Class		Mean	Mean	Mean
ν ₂₁ ^t	Mean			
	No. Specimens			
	No. Batches			
	Data Class			
ε ₂ ^{tu} (με)	Mean	8820	8700	4940
	Minimum	7390	7470	3710
	Maximum	11200	10100	5980
	C.V.(%)	8.07	7.25	9.17
	B-value	7640	7390	3650
	Distribution	Lognormal	ANOVA	ANOVA
	C ₁	9.08	637	472
	C ₂	0.079	2.06	2.72
	No. Specimens	30	30	30
	No. Batches	5	5	5
Data Class		B30	B30	B30

(1) Conditioned at 160°F, 85% RH.

MATERIAL:		AS4 12k/997 unidirectional tape				Table 4.2.28(c) C/Ep 145-UT AS4 12k/997 Compression, 1-axis [0]₁₉ 73/A, -65/A, 180/W B30, Mean	
RESIN CONTENT:	30.6-32.5 wt%	COMP. DENSITY:	1.58-1.59 g/cm ³				
FIBER VOLUME:	54.4-62.6 %	VOID CONTENT:	0.34-0.74				
PLY THICKNESS:	0.0055-0.0057 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3410A-94							
NORMALIZED BY:		Specimen thickness and batch fiber areal weight to 60% fiber volume (0.0056 in. CPT)					
Temperature (°F)		73		-65		180	
Moisture Content (%)		ambient		ambient		1.10	
Equilibrium at T, RH						(1)	
Source Code		85		85		85	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{cu} (ksi)	Mean	229	221	233	227	159	152
	Minimum	169	174	182	182	132	130
	Maximum	263	251	273	261	179	178
	C.V.(%)	7.88	7.14	8.76	8.89	6.43	6.71
	B-value	195	186	191	186	135	125
	Distribution	Weibull	ANOVA	Weibull	Weibull	ANOVA	ANOVA
	C ₁	236	16.0	242	236	10.4	10.6
	C ₂	16.5	2.19	13.3	13.2	2.29	2.58
	No. Specimens	30		30		30	
	No. Batches	5		5		5	
Data Class		B30		B30		B30	
E ₁ ^c (Msi)	Mean	17.8	17.2	18.1	17.6	18.6	17.8
	Minimum	16.6	16.5	17.1	16.8	17.2	17.1
	Maximum	18.7	18.0	20.1	19.5	20.5	19.2
	C.V.(%)	2.86	1.96	4.11	3.26	4.23	2.50
	No. Specimens	30		30		30	
No. Batches		5		5		5	
Data Class		Mean		Mean		Mean	
ν ₁₂ ^c Data Class	Mean						
	No. Specimens						
	No. Batches						
ε ₁ ^{cu} (με)	Mean	15400		15600		9550	
	Minimum	10700		11300		7830	
	Maximum	17900		19200		11500	
	C.V.(%)	9.82		12.9		10.1	
	B-value	11900		11500		6900	
	Distribution	ANOVA		Weibull		ANOVA	
	C ₁	1544		16500		998	
	C ₂	2.26		8.72		2.66	
	No. Specimens	30		30		30	
	No. Batches	5		5		5	
Data Class		B30		B30		B30	

(1) Conditioned at 160°F, 85% RH.

MATERIAL:		AS4 12k/997 unidirectional tape		Table 4.2.28(d) C/Ep 145-UT AS4 12k/997 Compression, 2-axis [90]₂₄ 73/A, -65/A, 180/W B30, Mean
RESIN CONTENT:	29.4-32.7 wt%	COMP. DENSITY:	1.58-1.59 g/cm ³	
FIBER VOLUME:	54.4-62.6 %	VOID CONTENT:	0 -1.24 %	
PLY THICKNESS:	0.0056-0.0059 in.			
TEST METHOD:		MODULUS CALCULATION:		
SRM 1-94		Chord modulus between 1000 and 3000 με		
NORMALIZED BY:		Not normalized.		
Temperature (°F)		73	-65	180
Moisture Content (%)		ambient	ambient	1.10
Equilibrium at T, RH				(1)
Source Code		85	85	85
F₂^{cu} (ksi)	Mean	37.0	39.0	25.4
	Minimum	29.5	20.7	24.0
	Maximum	40.8	53.9	27.9
	C.V.(%)	8.43	24.3	3.26
	B-value	28.9	6.79	23.4
	Distribution	ANOVA	ANOVA	ANOVA
	C ₁	3.22	10.2	0.848
	C ₂	2.52	3.16	2.37
	No. Specimens	30	30	30
	No. Batches	5	5	5
	Data Class	B30	B30	B30
E₂^c (Msi)	Mean	1.45	1.55	1.34
	Minimum	1.12	1.33	1.20
	Maximum	1.70	1.92	1.50
	C.V.(%)	9.93	7.63	5.93
	No. Specimens	30	30	30
	No. Batches	5	5	5
	Data Class	Mean	Mean	Mean
ν₂₁^c	Mean			
	No. Specimens			
	No. Batches			
	Data Class			
ε₂^{cu} (με)	Mean	30600	24700	34800
	Minimum	24200	12200	28900
	Maximum	37900	41400	39500
	C.V.(%)	11.9	26.7	6.97
	B-value	22700	2670	29100
	Distribution	Weibull	ANOVA	ANOVA
	C ₁	32200	7371	2473
	C ₂	9.05	3.13	2.30
	No. Specimens	30	30	30
	No. Batches	5	5	5
	Data Class	B30	B30	B30

(1) Conditioned at 160°F, 85% RH.

MATERIAL:		AS4 12k/997 unidirectional tape			Table 4.2.28(e) C/Ep 145-UT AS4 12k/997 Shear, 12-plane [+45/-45]_{4s} 73/A, -65/A, 180/W B18	
RESIN CONTENT:	28.2-32 wt%	COMP. DENSITY:	1.58-1.60 g/cm ³			
FIBER VOLUME:	54.4-62.6 %	VOID CONTENT:	0.0-0.95			
PLY THICKNESS:	0.0053-0.0058 in.					
TEST METHOD:			MODULUS CALCULATION:			
ASTM D 3518-94						
NORMALIZED BY:		N/A				
Temperature (°F)		73	-65	180		
Moisture Content (%)		Ambient	Ambient	Wet		
Equilibrium at T, RH				(1)		
Source Code		85	85	85		
F ₁₂ ^{su} (ksi)	Mean	Table 4.2.28(e) will be added when necessary documentation is submitted				
	Minimum					
	Maximum					
	C.V.(%)					
	B-value					
	Distribution					
	C ₁					
	C ₂					
	No. Specimens					
	No. Batches					
	Data Class					
G ₁₂ ^s (Msi)	Mean					
	Minimum					
	Maximum					
	C.V.(%)					
	No. Specimens					
	No. Batches					
	Data Class					
γ ₁₂ ^{su} (μɛ)	Mean					
	Minimum					
	Maximum					
	C.V.(%)					
	B-value					
	Distribution					
	C ₁					
	C ₂					
	No. Specimens					
	No. Batches					
	Data Class					

(1) Conditioned at 160°F, 85% RH.

MATERIAL:		AS4 12k/997 unidirectional tape			Table 4.2.28(f) C/Ep 145-UT AS4 12k/997 SBS, 31-plane [0]₁₆ 73/A, -65/A, 180/W Screening
RESIN CONTENT:	28.9-33.8 wt%	COMP. DENSITY:	1.58-1.60 g/cm ³		
FIBER VOLUME:	54.4-62.6 %	VOID CONTENT:	0.0-0.95		
PLY THICKNESS:	0.0053-0.0058 in.				
TEST METHOD:	ASTM D 2344-84				
NORMALIZED BY:		N/A			
Temperature (°F)		73	-65	180	
Moisture Content (%)		Ambient	Ambient	1.10	
Equilibrium at T, RH				(1)	
Source Code		85	85	85	
F ₃₁ ^{sbs} (ksi)	Mean	18.3	23.1	11.4	
	Minimum	17.6	21.1	9.33	
	Maximum	19.6	25.3	12.0	
	C.V.(%)	2.35	4.91	7.44	
	B-value	(2)	(2)	(2)	
	Distribution	ANOVA	ANOVA	ANOVA	
	C ₁	0.438	1.18	0.914	
	C ₂	2.25	2.62	3.37	
	No. Specimens	30	28	30	
No. Batches	5	5	5		
Data Class	Screening	Screening	Screening		

(1) Conditioned at 160°F, 85% RH.
(2) Short beam strength test data are approved for Screening Data Class only.

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MATERIAL:		AS4 12k/997 unidirectional tape		Table 4.2.28(g) C/Ep 145-UT AS4 12k/997 Bearing, x-axis [0/±45/90]_{3s} 73/A, -65/A, 180/W Screening	
RESIN CONTENT:	34.6 wt%	COMP. DENSITY:	1.57 g/cm ³		
FIBER VOLUME:	57.7 %	VOID CONTENT:	0.54 %		
PLY THICKNESS:	0.0058 in.				
TEST METHOD:		ASTM D 953-93			
TYPE OF BEARING TEST:		double lap shear			
JOINT CONFIGURATION					
Member 1 (t,w,d,e):		0.25 in., 0.92 in., 0.25 in., 0.75 in. (e/d = 3.0)			
Member 2 (t,w,d,e):					
FASTENER TYPE:	0.25" hardened steel	HOLE CLEARANCE:	0.001 in.		
TORQUE:	Not applicable	COUNTER SINK ANGLE & DEPTH	Not applicable		
NORMALIZED BY:	Not normalized				
Temperature (°F)		73	-65	180	
Moisture Content (%)		Ambient	Ambient	1.10	
Equilibrium at T, RH (°F, %)				(1)	
Source Code		85	85	85	
F ^{bu} (ksi)	Mean	92.7	92.0	70.3	
	Minimum	87.9	82.9	67.2	
	Maximum	101	106	75.7	
	C.V. (%)	4.78	8.44	5.18	
	B-value	(3)	(3)	(3)	
	Distribution	Normal	Normal	Normal	
	C ₁	92.7	92.0	70.3	
	C ₂	4.43	7.77	3.65	
	No. Specimens	6	6	6	
	No. Batches	1	1	1	
	Data Class	Screening	Screening	Screening	
F ^{bry} (2) (ksi)	Mean	34.4	34.1	31.0	
	Minimum	23.0	29.7	28.7	
	Maximum	39.2	39.4	33.7	
	C.V. (%)	17.9	11.2	7.20	
	B-value	(3)	(3)	(3)	
	Distribution	Normal	Normal	Normal	
	C ₁	34.4	34.1	31.0	
	C ₂	6.17	3.81	2.23	
	No. Specimens	6	6	6	
	No. Batches	1	1	1	
	Data Class	Screening	Screening	Screening	

(1) Conditioned at 160°F, 85% RH.

(2) Offset measured at 4% hole diameter.

(3) Basis values are presented only for A and B data classes.

MATERIAL:		AS4 12k/997 unidirectional tape				Table 4.2.28(h) C/Ep 145-UT AS4 12k/997 OHT, x-axis [0/±45/90]_{3s} 73/A, -65/A, 180/W Screening	
RESIN CONTENT:	28.8-29.0 wt%	COMP. DENSITY:	1.59-1.60 lb/in ³				
FIBER VOLUME:	56.6-59.5 %	VOID CONTENT:	0.75-1.11 %				
PLY THICKNESS:	0.0057-0.0058 in.						
TEST METHOD:		SRM 5-94					
SPECIMEN GEOMETRY:		t = 0.10 in., w = 1.50 in., d = 0.25 in.					
FASTENER TYPE:		Not applicable		HOLE CLEARANCE:			
TORQUE:		COUNTER SINK ANGLE & DEPTH:					
NORMALIZED BY:		Specimen thickness and FAW to 60% (0.0056 in. CPT)					
Temperature (°F)		73		-65		180	
Moisture Content (%)		Ambient		Ambient		1.10	
Equilibrium at T, RH (°F, %)						(1)	
Source Code		85		85		85	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F _x ^{oht} (ksi)	Mean	54.1	51.4	49.2	46.8	54.9	52.6
	Minimum	51.3	48.9	45.9	44.3	53.5	51.5
	Maximum	58.4	55.1	52.4	50.0	56.0	54.1
	C.V. (%)	4.76	4.48	5.51	4.74	1.67	1.77
	B-value	(2)	(2)	(2)	(2)	(2)	(2)
	Distribution	Normal	Normal	Normal	Normal	Normal	Normal
	C ₁	54.1	46.8	49.2	46.8	54.9	52.6
	C ₂	2.58	2.22	2.71	2.22	0.916	0.929
	No. Specimens	6		6		6	
	No. Batches	1		1		1	
Data Class		Screening		Screening		Screening	

- (1) Conditioned at 160°F, 85% RH.
(2) Basis values are presented only for A and B data classes.

MATERIAL:		AS4 12k/997 unidirectional tape				Table 4.2.28(i) C/Ep 145-UT AS4 12k/997 OHC, x-axis [0,±45,90]_{3s} 73/A, -65/A, 180/W Screening	
RESIN CONTENT:	28.8-29.0 wt%	COMP. DENSITY:	1.59-1.60 lb/in ³				
FIBER VOLUME:	56.3-56.9 %	VOID CONTENT:	0.75-1.11 %				
PLY THICKNESS:	0.0057-0.0058 in.						
TEST METHOD:	SRM 3-94						
SPECIMEN GEOMETRY:	t = 0.10 in., w = 1.50 in., d = 0.25 in.						
FASTENER TYPE:	Not applicable		HOLE CLEARANCE:				
TORQUE:	COUNTER SINK ANGLE & DEPTH:						
NORMALIZED BY:	Specimen thickness and FAW to 60% (0.0056 in. CPT)						
Temperature (°F)	73		-65		180		
Moisture Content (%)	Ambient		Ambient		1.10		
Equilibrium at T, RH (°F, %)					(1)		
Source Code	85		85		85		
	Normalized	Measured	Normalized	Measured	Normalized	Measured	
F _x ^{ohc} (ksi)	Mean	53.0	50.5	59.8	57.0	45.3	42.9
	Minimum	52.3	50.0	58.4	55.7	43.2	41.0
	Maximum	54.2	51.5	61.0	58.3	46.5	44.1
	C.V. (%)	1.33	1.15	1.77	1.96	2.76	2.60
	B-value	(2)	(2)	(2)	(2)	(2)	(2)
	Distribution	Normal	Normal	Normal	Normal	Normal	Normal
	C ₁	53.0	50.5	59.8	57.0	45.4	42.9
	C ₂	0.704	0.582	1.06	1.12	1.25	1.12
	No. Specimens	6		6		6	
	No. Batches	1		1		1	
Data Class	Screening		Screening		Screening		

(1) Conditioned at 160°F, 85% RH.

(2) Basis values are presented only for A and B data classes.

4.2.29 T650-35 12k/976 unidirectional tapeMaterial Description:

Material: T650-35 12k/976

Form: Unidirectional tape prepreg, fiber areal weight of 145 g/m², typical cured resin content of 39-45%, typical cured ply thickness of 0.0049 - 0.0058 inches.

Processing: Autoclave cure, 350°F, 95 psi, 90 minutes

General Supplier Information:

Fiber: T650-35 fibers are continuous, no twist carbon filaments made from PAN precursor, surface treated to improve handling characteristics and structural properties. Filament count is 12,000 filaments/tow. Typical tensile modulus is 35×10^6 psi. Typical tensile strength is 650,000 psi.

Matrix: 976 is a high flow, modified epoxy resin that meets the NASA outgassing requirements. 10 days out-time at 72°F.

Maximum Short Term Service Temperature: 350°F (dry), 250°F (wet)

Typical applications: General purpose commercial and military structural applications.

Data Analysis Summary:

1. Glass transition temperature results were high for an epoxy.
2. Low longitudinal tension strengths were not reported due to low data and unresolved issues about the testing.
3. A high end outlier for compression modulus at 72°F ambient was not discarded because no inconsistencies were found.
4. For transverse tension strength at -67°F ambient and 250°F wet, scatter is too high to report basis values.

4.2.29 T650-35 12k/976 unidirectional tape

MATERIAL: T650-35 12k/976 unidirectional tape

145-UT T650-35/976 Summary

FORM: ICI Fiberite T650-35 12k/976 unidirectional tape prepreg

FIBER: Amoco T650-35 12k, UC 309 sizing, no twist MATRIX: ICI Fiberite 976

T_g(dry): 486°F T_g(wet): 410°F T_g METHOD: DMA E'

PROCESSING: Autoclave cure: 90 ±10 min., 350±10°F, 95 ± 5 psi.

Date of fiber manufacture	3/93-1/94	Date of testing	7/93-1/96
Date of resin manufacture	7/93-10/94	Date of data submittal	12/97
Date of prepreg manufacture	8/93-11/94	Date of analysis	5/00
Date of composite manufacture	10/94-6/95		

LAMINA PROPERTY SUMMARY

	72°F/A		-67°F/A	250°F/W				
Tension, 1-axis	BM - -		BM - -	BM - -				
Tension, 2-axis	bS - -		IS - -	IS - -				
Tension, 3-axis								
Compression, 1-axis	IM - -		bM - -	bM - -				
Compression, 2-axis	bS - -		IS - -	bS - -				
Compression, 3-axis								
Shear, 12-plane	BM - -		BM - -	BM - -				
Shear, 23-plane								
Shear, 31-plane								

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

PHYSICAL PROPERTY SUMMARY

		Nominal	As Submitted	Test Method
Fiber Density	(g/cm ³)	1.77	1.77-1.78	SRM 15
Resin Density	(g/cm ³)	1.28	1.28	ASTM D 792
Composite Density	(g/cm ³)		1.55-1.61	
Fiber Areal Weight	(g/m ²)	145	144-147	Solvent Extraction
Fiber Volume	(%)	61	55.3-65.3	
Ply Thickness	(in)	0.0052	0.0049-0.0058	

LAMINATE PROPERTY SUMMARY

	72°F/A		-67°F/A	250°F/W				
[90/0] Family Compression, x-axis	bM - -		bM - -	bM - -				

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

MATERIAL:		T650-35 12k/976 unidirectional tape				Table 4.4.29(a) C/Ep 145-UT T650-35/976 Tension, 1-axis [0]₉ 72/A, -67/A, 250/W B30, Mean	
RESIN CONTENT:	39-45 wt%	COMP. DENSITY:	1.57-1.61 g/cm ³				
FIBER VOLUME:	56.9-64.5 %	VOID CONTENT:	0-1.0 %				
PLY THICKNESS:	0.0050-0.0057 in.						
TEST METHOD:	ASTM D 3039-89						
		MODULUS CALCULATION:					
		Chord, 1000 - 6000 µε					
NORMALIZED BY:		Specimen thickness and batch fiber areal weight to 60% fiber volume (0.0052 in. CPT)					
Temperature (°F)		72		-67		250	
Moisture Content (%)		ambient		ambient		1.11-1.21	
Equilibrium at T, RH						160, 85	
Source Code		80		80		80	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{tu} (ksi)	Mean	231	236	170	174	258	260
	Minimum	175	173	120	123	223	220
	Maximum	256	264	210	208	286	295
	C.V.(%)	7.37	8.27	14.5	13.7	5.89	7.58
	B-value	202	200	124	132	212	197
	Distribution	Weibull	Weibull	Weibull	Weibull	ANOVA	ANOVA
	C ₁	238	244	180	184	16.0	21.0
	C ₂	19.1	15.8	8.55	9.56	2.87	3.01
	No. Specimens	32		30		30	
	No. Batches	5		5		5	
Data Class	B30		B30		B30		
E ₁ ^t (Msi)	Mean	22.0	22.5	20.7	21.2	20.9	21.0
	Minimum	20.9	20.2	19.4	19.9	19.6	19.3
	Maximum	23.5	24.8	22.4	22.4	22.2	22.5
	C.V.(%)	3.00	4.64	2.89	3.60	2.72	3.66
	No. Specimens	32		30		3	
No. Batches	5		5		5		
Data Class	Mean		Mean		Mean		
ν ₁₂ ^t	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{tu} (µε)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

MATERIAL:		T650-35 12k/976 unidirectional tape		Table 4.2.29(b) C/Ep 145-UT T650-35/976 Tension, 2-axis [90]₂₄ 72/A, -67/A, 250/A B18, Screening
RESIN CONTENT:	39-45 wt%	COMP. DENSITY:	1.57-1.61 g/cm ³	
FIBER VOLUME:	55.3-62.4 %	VOID CONTENT:	0-1.0 %	
PLY THICKNESS:	0.0052-0.0058 in.			
TEST METHOD:	ASTM D 3039-89	MODULUS CALCULATION:	Chord, 1000 - 6000 µε	
NORMALIZED BY:		Not normalized.		
Temperature (°F)	72	-67	250	
Moisture Content (%)	ambient	ambient	0.97-1.03	
Equilibrium at T, RH			160, 85	
Source Code	80	80	80	
F ₂ ^{tu} (ksi)	Mean	5.71	4.76	2.40
	Minimum	4.66	2.61	1.32
	Maximum	6.74	7.07	3.46
	C.V.(%)	9.23	22.6	26.7
	B-value	4.42	(1)	(1)
	Distribution	Weibull	ANOVA	ANOVA
	C ₁	5.95	1.14	0.720
	C ₂	12.0	3.57	4.80
	No. Specimens	18	18	18
	No. Batches	3	3	3
Data Class	B18	B18	B18	
E ₂ ^t (Msi)	Mean	1.30	1.37	0.934
	Minimum	1.18	1.24	0.820
	Maximum	1.42	1.61	1.07
	C.V.(%)	4.97	8.38	10.2
	No. Specimens	9	9	9
	No. Batches	3	3	3
	Data Class	Screening	Screening	Screening
	Mean			
	No. Specimens			
	No. Batches			
Data Class				
ε ₂ ^{tu} (µε)	Mean			
	Minimum			
	Maximum			
	C.V.(%)			
	B-value			
	Distribution			
	C ₁			
	C ₂			
	No. Specimens			
	No. Batches			
Data Class				

(1) B-basis values calculated from less than five batches of data using the ANOVA method are not presented.

MATERIAL: T650-35 12k/976 unidirectional tape		Table 4.2.29(c) C/Ep 145-UT T650-35/976 Compression, 2-axis [90]₂₂ 72/A, -67/A, 250/W B18, Interim, Screening	
RESIN CONTENT:	39-45 wt%	COMP. DENSITY:	1.57-1.60 g/cm ³
FIBER VOLUME:	60.0-62.2 %	VOID CONTENT:	0-1.0 %
PLY THICKNESS:	0.0050-0.0054 in.		
TEST METHOD:	ASTM D 3410-87	MODULUS CALCULATION:	Chord, 1000 - 3000 µε
NORMALIZED BY: Not normalized.			
Temperature (°F)	72	-67	250
Moisture Content (%)	ambient	ambient	(1)
Equilibrium at T, RH			160, 85
Source Code	80	80	80
Mean	33.6	39.5	18.6
Minimum	30.7	33.9	15.3
Maximum	37.4	44.6	20.0
C.V.(%)	6.40	6.84	5.68
B-value	28.1	(2)	16.4
Distribution	Weibull	Weibull	Weibull
F ₂ ^{cu}			
(ksi)			
C ₁	34.6	40.7	19.0
C ₂	17.1	16.4	24.6
No. Specimens	18	17	18
No. Batches	3	3	3
Data Class	B18	Interim	B18
Mean	1.38	1.55	1.08
Minimum	1.23	1.45	0.940
Maximum	1.44	1.66	1.21
C.V.(%)	5.48	4.11	8.38
E ₂ ^c			
(Msi)			
No. Specimens	9	8	10
No. Batches	3	3	3
Data Class	Screening	Screening	Screening
Mean			
No. Specimens			
No. Batches			
Data Class			
v ₂₁ ^c			
Mean			
Minimum			
Maximum			
C.V.(%)			
B-value			
Distribution			
ε ₂ ^{cu}			
(µε)			
C ₁			
C ₂			
No. Specimens			
No. Batches			
Data Class			

(1) Unknown moisture content.

(2) Basis values are presented only for A and B data classes.

MATERIAL:		T650-35 12k/976 unidirectional tape			Table 4.2.29(d) C/Ep 145-UT T650-35/976 Shear, 12-plane [+45/-45]_{4s} 72/A, -67/A, 250/W B30, Mean	
RESIN CONTENT:	39-45 wt%	COMP. DENSITY:	1.58-1.59 g/cm ³			
FIBER VOLUME:	58.6-62.2 %	VOID CONTENT:	0-1.0 %			
PLY THICKNESS:	0.0052-0.0055 in.					
TEST METHOD:		MODULUS CALCULATION:				
ASTM D 3518-82		Chord, 1000 - 3000 µε				
NORMALIZED BY:		Not normalized				
Temperature (°F)		72	-67	250		
Moisture Content (%)		ambient	ambient	1.16-1.22		
Equilibrium at T, RH				160, 85		
Source Code		80	80	80		
F ₁₂ ^{su} (ksi)	Mean	14.9	17.4	11.8		
	Minimum	13.1	16.1	10.9		
	Maximum	18.1	19.2	12.4		
	C.V.(%)	11.4	4.85	3.54		
	B-value	8.57	14.7	10.4		
	Distribution	ANOVA	ANOVA	ANOVA		
	C ₁	1.86	0.893	0.455		
	C ₂	3.39	2.98	3.25		
	No. Specimens	30	30	30		
	No. Batches	5	5	5		
Data Class		B30	B30	B30		
G ₁₂ ^s (Msi)	Mean	0.745	0.919	0.542		
	Minimum	0.680	0.700	0.510		
	Maximum	0.830	1.05	0.580		
	C.V.(%)	4.82	10.4	3.91		
	No. Specimens	30	30	30		
No. Batches		5	5	5		
Data Class		Mean	Mean	Mean		
γ ₁₂ ^{su} (µε)	Mean					
	Minimum					
	Maximum					
	C.V.(%)					
	B-value					
	Distribution					
	C ₁					
	C ₂					
	No. Specimens					
	No. Batches					
Data Class						

MATERIAL:		T650-35 12k/976 unidirectional tape				Table 4.2.29(e) C/Ep 145-UT T650-35/976 Compression, x-axis [90/0]₈ 72/A, -67/A, 250/W B18, Mean	
RESIN CONTENT:	39-45 wt%	COMP. DENSITY:	1.57-1.60 g/cm ³				
FIBER VOLUME:	57.3-65.3 %	VOID CONTENT:	0-1.0 %				
PLY THICKNESS:	0.0049-0.0056 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3410-87		Chord, 1000 - 3000 µε					
NORMALIZED BY:		Specimen thickness and batch fiber areal weight to 60% fiber volume (0.0052 in. CPT)					
Temperature (°F)		72		-67		250	
Moisture Content (%)		ambient		ambient		1.21-1.33	
Equilibrium at T, RH						160, 85	
Source Code		80		80		80	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F _x ^{cu} (ksi)	Mean	131	131	146	145	95.9	98.2
	Minimum	117	115	131	129	83.8	87.9
	Maximum	144	148	161	163	110	111
	C.V.(%)	6.34	6.54	5.50	6.22	6.76	5.74
	B-value	(1)	(1)	127	(1)	77.2	83.4
	Distribution	ANOVA	ANOVA	Weibull	ANOVA	ANOVA	ANOVA
	C ₁	8.64	9.11	150	9.53	6.79	5.82
	C ₂	2.93	3.25	19.6	3.12	2.77	2.53
	No. Specimens	23		24		29	
	No. Batches	4		4		5	
Data Class		B18		B18		B18	
E _x ^c (Msi)	Mean	9.72	9.76	10.2	10.1	10.0	10.3
	Minimum	8.65	8.86	9.48	9.37	9.57	9.15
	Maximum	10.8	10.8	11.0	10.7	10.9	11.2
	C.V.(%)	4.41	4.58	3.99	4.28	3.71	5.08
	No. Specimens	23		24		29	
No. Batches		4		4		5	
Data Class		Mean		Mean		Mean	
ν _{xy} ^c	Mean						
	No. Specimens						
	No. Batches						
Data Class							
ε _x ^{cu} (µε)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

(1) B-basis values calculated from less than five batches of data using the ANOVA method are not presented.

4.2.30 IM7 12k/PR381 unidirectional tape

These data are presented in the MIL-HDBK-17-2F Annex A.

4.2.31 IM7 6k/PR500 4-harness satin weave fabric

These data are presented in the MIL-HDBK-17-2F Annex A.

4.2.32 T650-35 3k/976 8-harness satin weave fabricMaterial Description:

Material: T650-35 3k/976

Form: Eight harness satin fabric prepreg, fiber areal weight of 374 g/m², typical cured resin content of 40%, typical cured ply thickness of 0.011 - 0.014 inches.

Processing: Autoclave cure, 350°F, 95 psi, 90 minutes

General Supplier Information:

Fiber: T650-35 fibers are continuous, no-twist carbon filaments made from PAN precursor, surface treated to improve handling characteristics and structural properties. Filament count is 3000 filaments/tow. Typical tensile modulus is 35×10^6 psi. Typical tensile strength is 650,000 psi.

Matrix: 976 is a high flow, modified epoxy resin that meets the NASA outgassing requirements. 10 days out-time at 72°F.

Maximum Short Term Service Temperature: 350°F (dry), 250°F (wet)

Typical applications: General purpose commercial and military structural applications.

Data Analysis Summary:

1. For transverse tension, a bowtie specimen is not in concert with the test method used.
2. Two low end outliers for transverse compression modulus at -67°F ambient were not discarded because no inconsistencies were found.

4.2.32 T650-35 3k/976 8 harness satin weave fabric

C/Ep 374 – 8HS T650-35 976 Summary					
MATERIAL:	T650-35 3k/976 8-harness satin weave fabric				
FORM:	Cytec Fiberite 8-harness satin weave fabric prepreg				
FIBER:	Amoco T650-35 3k, UC 309, no twist		MATRIX:	Cytec Fiberite 976	
T _g (dry):	443°F	T _g (wet):	380°F	T _g METHOD:	DMA E'
PROCESSING:	Autoclave cure, 350°F, 90 min, 95 psi				

Date of fiber manufacture	9/90 – 9/95	Date of testing	6/93 – 1/96
Date of resin manufacture	6/92 – 6/94	Date of data submittal	12/97
Date of prepreg manufacture	6/92 – 10/94	Date of analysis	1/01
Date of composite manufacture	1/93 – 4/95		

LAMINA PROPERTY SUMMARY

	72°F/A		-67°F/A		250°F/W			
Tension, 1-axis	BM - -		BM - -		bSS -			
Tension, 2-axis	bS - -		BI - -		bSS -			
Tension, 3-axis								
Compression, 1-axis	bS - -		BM - -		bM - -			
Compression, 2-axis	bS - -		BM - -		bS - -			
Compression, 3-axis								
Shear, 12-plane	BM - -		bM - -		BM - -			
Shear, 23-plane								
Shear, 13-plane								

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

PHYSICAL PROPERTY SUMMARY

		Nominal	As Submitted	Test Method
Fiber Density	(g/cm ³)	1.77	1.76 – 1.78	SRM 15 ASTM D 792
Resin Density	(g/cm ³)	1.28	-	
Composite Density	(g/cm ³)	1.57	1.56-1.59	
Fiber Areal Weight	(g/m ²)	374	-	
Fiber Volume	(%)	59	58-61	
Ply Thickness	(in)	0.0130	0.0113 - 0.0146	

LAMINATE PROPERTY SUMMARY

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

MATERIAL:		T650-35 3k 976/8-harness satin weave fabric				Table 4.2.32(a) C/Ep 374-8HS T650-35 976 Tension, 1-axis [0]7 72/A, -67/A, 250/W B30, B18, Mean, Screening	
RESIN CONTENT:	28 – 34 % wt	COMP: DENSITY:	1.56-1.59 g/cm ³				
FIBER VOLUME:	59 - 64 vol %	VOID CONTENT:	0 %				
PLY THICKNESS:	0.013-0.014 in.						
TEST METHOD:		MODULUS CALCULATION:					
Bowtie Specimen- ASTM D 3039 76		Chord, 1000 - 6000 µε					
NORMALIZED BY: Normalized by specimen thickness and batch fiber areal weight to 57% fiber volume (0.0146 in. CPT)							
Temperature (°F)		72 ambient		-67 ambient		250	
Moisture Content (%)						1.12-1.21	
Equilibrium at T, RH						160, 85	
Source Code		80		80		80	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{tu} (ksi)	Mean	99.2	107	82.0	86.8	104	115
	Minimum	79.2	85.4	68.4	70.8	90.2	99.3
	Maximum	111	124	92.5	99.5	118	130
	C.V.(%)	7.03	7.16	8.24	8.65	7.85	7.62
	B-value	82.5	89.2	64.9	67.5	88.8	95.2
	Distribution	ANOVA	ANOVA	ANOVA	ANOVA	Weibull	Weibull
	C ₁	7.91	7.91	6.98	7.78	108	119
	C ₂	2.33	2.29	2.44	2.48	16.0	16.2
	No. Specimens	36		36		18	
	No. Batches	6		6		3	
Data Class	B30		B30		B18		
E ₁ ^t (Msi)	Mean	10.3	11.1	10.3	11.4	11.0	12.1
	Minimum	9.23	10.4	10.1	10.6	10.3	11.4
	Maximum	10.8	11.5	10.7	13.0	11.9	13.1
	C.V.(%)	3.62	2.81	2.28	4.71	5.38	5.45
	No. Specimens	27		18		9	
No. Batches	6		6		3		
Data Class	Mean		Mean		Screening		
ν ₁₂ ^t	Mean					0.033	
	No. Specimens					9	
	No. Batches					3	
	Data Class					Screening	
ε ₁ ^{tu} (µε)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
No. Specimens							
No. Batches							
Data Class							

(1) Basis values are presented only for A and B data classes.

MATERIAL:		T650-35 3k 976/8-harness satin weave fabric				Table 4.2.32(b) C/Ep 374-8HS T650-35 976 Tension, 2-axis [90 i]7 72/A, -67/A, 250/W B30, B18, Screening, Interim	
RESIN CONTENT:	28 – 34 % wt	COMP: DENSITY:	1.56-1.59 g/cm ³				
FIBER VOLUME:	59 - 64 vol %	VOID CONTENT:	0 %				
PLY THICKNESS:	0.013-0.014 in.						
TEST METHOD:		MODULUS CALCULATION:					
Bowtie Specimen- ASTM D 3039 76 (2)		Chord, 1000-6000 µε					
NORMALIZED BY:		Specimen thickness and batch fiber areal weight to 57% fiber volume (0.0146 in. CPT)					
Temperature (°F)	72 ambient		-67 ambient		250		
Moisture Content (%)					1.12-1.21		
Equilibrium at T, RH					160, 85		
Source Code	80		80		80		
	Normalized	Measured	Normalized	Measured	Normalized	Measured	
F ₂ ^{tu} (ksi)	Mean	106	116	82.2	89.2	111	122
	Minimum	95.2	105	61.7	63.8	93.3	103
	Maximum	115	126	97.4	108	125	137
	C.V.(%)	4.62	4.59	10.6	11.4	6.15	6.22
	B-value	94.0	102	62.0	62.8	97.8	104
	Distribution	Weibull	Weibull	ANOVA	ANOVA	Normal	Weibull
	C ₁	108	118	8.91	10.5	111	126
	C ₂	26.0	23.9	2.26	2.52	6.85	18.4
	No. Specimens	18		30		18	
	No. Batches	3		5		3	
Data Class	B18		B30		B18		
E ₂ ^t (Msi)	Mean	10.7	11.7	10.4	11.1	10.8	11.80
	Minimum	9.83	10.9	9.74	10.2	9.67	10.9
	Maximum	11.6	12.6	11.1	12.0	11.2	12.3
	C.V.(%)	5.81	4.55	3.01	4.07	5.29	4.15
	No. Specimens	9		15		9	
No. Batches	3		5		3		
Data Class	Screening		Interim		Screening		
ν ₂₁ ^t	Mean				0.030		
	No. Specimens				3		
	No. Batches				1		
Data Class					Screening		
ε ₂ ^{tu} (µε)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
No. Specimens							
No. Batches							
Data Class							

(1) Basis values are presented only for A and B data classes.

(2) Bowtie specimen is not the standard specimen geometry using this method.

MATERIAL:		T650-35 3k 976/8-harness satin weave fabric				Table 4.2.32(c) C/Ep 374-8HS T650-35 976 Compression, 1-axis [0]7 72/A, -67/A, 250/W B30, B18, Screening	
RESIN CONTENT:	28 – 34 % wt	COMP: DENSITY:	1.56-1.59 g/cm ³				
FIBER VOLUME:	59 - 64 vol %	VOID CONTENT:	0 %				
PLY THICKNESS:	0.013-0.014 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3410-87 Procedure B		Chord, 1000-3000 µε					
NORMALIZED BY: Specimen thickness and batch fiber areal weight to 57% fiber volume (0.0146 in. CPT)							
Temperature (°F)		72 ambient		-67 ambient		250	
Moisture Content (%)						1.00-1.30	
Equilibrium at T, RH						160, 85	
Source Code		80		80		80	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{cu} (ksi)	Mean	86.2	95.5	92.6	102	55.1	57.1
	Minimum	62.9	71.6	72.9	78.7	42.4	46.0
	Maximum	100	108	115	131	68.6	68.4
	C.V.(%)	10.3	9.82	12.7	13.7	15.1	11.9
	B-value	70.3	77.0	55.0	56.8	25.6	34.2
	Distribution	Weibull	Weibull	ANOVA	ANOVA	ANOVA	ANOVA
	C ₁	89.8	99.4	12.5	15.4	9.05	7.32
	C ₂	13.2	14.0	3.00	3.12	3.25	3.12
	No. Specimens	18		30		21	
	No. Batches	3		5		5	
Data Class	B18		B30		B18		
E ₁ ^c (Msi)	Mean	8.81	9.81	9.38	10.0	9.35	9.76
	Minimum	8.45	9.26	8.82	9.51	8.53	9.28
	Maximum	9.12	10.3	9.99	10.4	9.98	10.4
	C.V.(%)	2.19	4.03	4.21	2.40	5.22	4.03
	No. Specimens	9		20		21	
	No. Batches	3		5		5	
	Data Class	Screening		B18		B18	
ν ₁₂ ^t	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₂ ^{cu} (µε)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

MATERIAL:		T650-35 3k 976/8-harness satin weave fabric				Table 4.2.32(d) C/Ep 374-8HS T650-35 976 Compression, 2-axis [90]7 72/A, -67/A, 250/W B30, B18, Mean, Screening	
RESIN CONTENT:	28 – 34 % wt	COMP: DENSITY:	1.56-1.59 g/cm ³				
FIBER VOLUME:	59 - 64 vol %	VOID CONTENT:	0				
PLY THICKNESS:	0.013-0.014 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3410-87 Procedure B		Chord, 1000-3000 µε					
NORMALIZED BY: Normalized by specimen thickness and batch fiber areal weight to 57% fiber volume (0.0146 in. CPT)							
Temperature (°F)		72 ambient		-67 ambient		250	
Moisture Content (%)						1.00-1.30	
Equilibrium at T, RH						160, 85	
Source Code		80		80		80	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₂ ^{cu} (ksi)	Mean	90.1	97.5	97.4	106	54.7	59.9
	Minimum	82.1	88.5	74.5	81	50.3	53.6
	Maximum	99.6	112	113	127	63.0	70.9
	C.V.(%)	6.75	6.62	9.90	9.95	6.74	8.21
	B-value	(1)	(1)	72.3	71.5	47.4	(1)
	Distribution	ANOVA	ANOVA	ANOVA	ANOVA	Normal	ANOVA
	C ₁	6.41	6.70	10.1	11.2	54.7	5.22
	C ₂	3.54	3.20	2.49	3.05	3.69	3.72
	No. Specimens	18		30		18	
	No. Batches	3		6		3	
Data Class		B18		B30		B18	
E ₂ ^c (Msi)	Mean	8.98	9.73	9.21	9.82	9.43	10.3
	Minimum	8.04	8.58	8.20	9.03	8.98	9.99
	Maximum	9.51	10.6	10.0	10.7	9.75	10.6
	C.V.(%)	6.01	6.54	4.05	4.22	3.32	2.46
	No. Specimens	9		26		9	
No. Batches		3		6		3	
Data Class		Screening		Mean		Screening	
ν ₂₁ ^t	Mean						
	No. Specimens						
	No. Batches						
Data Class							
ε ₂ ^{cu} (µε)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

(1) B-basis values calculated from less than five batches of data using the ANOVA method are not presented.

MATERIAL:		T650-35 3k 976/8-harness satin weave fabric		Table 4.2.32(e) C/Ep 374-8HS T650-35 976 Shear, 12-plane [+45/-45 i]s 72/A, -67/A, 250/W B30, B18, Mean
RESIN CONTENT:	28 – 34 % wt	COMP. DENSITY:	1.56-1.59 g/cm ³	
FIBER VOLUME:	59 - 64 vol %	VOID CONTENT:	0	
PLY THICKNESS:	0.013-0.014 in.			
TEST METHOD:		MODULUS CALCULATION:		
ASTM D 3518-82 (1)		Chord, 0 - 3000 µε		
NORMALIZED BY:		Not normalized		
Temperature (°F)	72	-67	250	
Moisture Content (%)	Ambient	Ambient	1.22	
Equilibrium at T, RH			160,85	
Source Code	80	80	80	
Mean	12.8	14.5	8.99	
Minimum	12.0	13.6	8.41	
Maximum	13.9	15.2	10.4	
C.V.(%)	3.81	2.58	5.60	
F ₁₂ ^{su} (ksi)	B-value	11.0	13.3	8.41
	Distribution	ANOVA	ANOVA	Nonpara.
	C ₁	0.53	0.39	1.00
	C ₂	3.49	2.57	1.22
No. Specimens	30	29	30	
No. Batches	5	5	5	
Data Class	B30	B18	B30	
Mean	0.85	1.05	.47	
Minimum	0.73	0.93	.37	
Maximum	0.98	1.13	.52	
C.V.(%)	7.10	5.07	9.63	
G ₁₂ ^s (Msi)	No. Specimens	26	30	21
	No. Batches	5	5	5
	Data Class	Mean	Mean	Mean
Mean				
Minimum				
Maximum				
C.V.(%)				
γ ₁₂ ^{su} (µε)	B-value			
	Distribution			
	C ₁			
	C ₂			
No. Specimens				
No. Batches				
Data Class				

(1) Test method used ultimate strength to failure.

4.2.33 T700S 12k/3900-2 plain weave fabricMaterial Description:

Material: T700S 12k/3900-2

Form: Plain weave fabric prepreg, 3 tows per inch, fiber areal weight of 193 g/m², typical cured resin content of 35%-36%, typical cured ply thickness of 0.0073-0.0079 inches.

Processing: Autoclave cure, 350°F, 85 psi, 3°F/minute ramp rate, 2 hours

General Supplier Information:

Fiber: T700 fibers are continuous, standard modulus, no twist carbon filaments made from a PAN precursor, surface treated to improve handling characteristics and structural properties. Filament count is 12,000 filaments/tow. Typical tensile modulus is 34×10^6 psi. Typical tensile strength is 700,000 psi.

Matrix: 3900-2 is an toughened epoxy resin.

Maximum Short Term Service Temperature: 300°F (dry), 180°F (wet)

Typical applications: General purpose commercial and military aerospace structural applications.

Data Analysis Summary:

None

4.2.33 T700S 12k/3900-2 plain weave fabric

MATERIAL:				T700S 12k/3900-2 plain weave fabric		C/Ep T700S/3900-2 Summary			
FORM:				Toray F6273C-30H plain weave fabric prepreg					
FIBER:				Toray	T700SC-12000-50C,	3	MATRIX:	Toray 3900-2	
				tows/inch, UD309 Sizing, no twist					
T _g (dry):		330°F		T _g (wet):		230°F		T _g METHOD:	ASTM E 1545 (TMA)
PROCESSING:				Autoclave Cure: 350°F, 85 psi, 3°F/minute ramp rate, 2 hours					

Date of fiber manufacture	1/98	Date of testing	1/99-3/99
Date of resin manufacture	1/98	Date of data submittal	12/99
Date of prepreg manufacture	1/98	Date of analysis	1/00
Date of composite manufacture	3/99		

LAMINA PROPERTY SUMMARY

	75/A		-67/A	180/W				
Tension, 1-axis								
Tension, 2-axis								
Tension, 3-axis								
Compression, 1-axis								
Compression, 2-axis								
Compression, 3-axis								
Shear, 12-plane								
Shear, 23-plane	SS - -		SS - -	SS - -				
Shear, 31-plane	SS - -		SS - -	SS - -				
SB Strength, 31-plane	S - - -		S - - -	S - - -				

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

PHYSICAL PROPERTY SUMMARY

		Nominal	As Submitted	Test Method
Fiber Density	(g/cm ³)	1.80	1.80	ASTM D 3800
Resin Density	(g/cm ³)	1.22		ASTM D 791
Composite Density	(g/cm ³)	1.53	1.54	
Fiber Areal Weight	(g/m ²)	193	192.1	ASTM D 5300
Fiber Volume	(%)	54	54.6-55.4	ASTM D 3171
Ply Thickness	(in)	0.0079	0.0078-0.0079	

LAMINATE PROPERTY SUMMARY

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

MATERIAL:		T700S 12k/3900-2 plain weave fabric				Table 4.2.33(a) C/Ep 193-PW T700S/3900-2 SBS, 31-plane [0_r]₃₄ 75/A, -67/A, 180/W Screening	
RESIN CONTENT:	35.3 wt. %	COMP. DENSITY:	1.54 g/cm ³				
FIBER VOLUME:	55 %	VOID CONTENT:	0 %				
PLY THICKNESS:	0.0073-0.0074 in.						
TEST METHOD:	ASTM D 2344-84						
		MODULUS CALCULATION:					
		N/A					
NORMALIZED BY:		Not normalized					
Temperature (°F)		75	-67	180			
Moisture Content (%)		Ambient	Ambient	1.0			
Equilibrium at T, RH				(1)			
Source Code		90	90	90			
F ₃₁ ^{sbs} (ksi)	Mean	10.3	12.4	7.67			
	Minimum	10.2	11.7	7.45			
	Maximum	10.7	12.9	7.91			
	C.V.(%)	1.94	4.41	2.13			
	B-value	(2)	(2)	(2)			
	Distribution	Nonpara.	Normal	Normal			
	C ₁		12.4	7.67			
	C ₂		0.546	0.164			
	No. Specimens	6	6	6			
No. Batches	1	1	1				
Data Class		Screening	Screening	Screening			

- (1) Conditioned at 160°F and 95 ± 2% RH until 1.0% moisture content attained.
(2) Short beam strength test data are approved for Screening Data Class only.

MATERIAL:		T700S 12k/3900-2 plain weave fabric				Table 4.2.33(b) C/Ep 193-PW T700S/3900-2 Shear, 13-plane [0_i]₉₅ 75/A, -67/A, 180/W Screening	
RESIN CONTENT:	36.1 wt. %	COMP. DENSITY:	1.54 g/cm ³				
FIBER VOLUME:	54.6 %	VOID CONTENT:	0 %				
PLY THICKNESS:	0.0078-0.0079 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 5379-93		Chord, 1000 - 3000 µε					
NORMALIZED BY:		Not normalized					
Temperature (°F)		75	-67	180			
Moisture Content (%)		Ambient	Ambient	1.0			
Equilibrium at T, RH				(1)			
Source Code		90	90	90			
F ₁₃ ^{su} (ksi)	Mean	10.4	13.3	6.97			
	Minimum	10.2	12.6	6.80			
	Maximum	10.6	13.6	7.10			
	C.V.(%)	1.28	3.08	1.48			
	B-value	(2)	(2)	(2)			
	Distribution	Normal	Normal	Normal			
	C ₁	10.4	13.3	6.97			
	C ₂	0.133	0.410	0.103			
	No. Specimens	6	6	6			
	No. Batches	1	1	1			
	Data Class	Screening	Screening	Screening			
G ₁₃ ^s (Msi)	Mean	0.418	0.498	0.374			
	Minimum	0.394	0.467	0.366			
	Maximum	0.436	0.520	0.381			
	C.V.(%)	3.58	3.72	1.58			
	No. Specimens	6	6	6			
	No. Batches	1	1	1			
	Data Class	Screening	Screening	Screening			
γ ₁₃ ^{su} (µε)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
	Data Class						

(1) Conditioned at 160°F and 95 ± 2% RH until 1.0% moisture content attained.

(2) Basis values are presented only for A and B data classes.

MATERIAL:		T700S 12k/3900-2 plain weave fabric			Table 4.2.33(c) C/Ep 193-PW T700S/3900-2 Shear, 23-plane [0]95 75/A, -67/A, 180/W Screening	
RESIN CONTENT:	36.1 wt. %	COMP. DENSITY:	1.54 g/cm ³			
FIBER VOLUME:	54.6 %	VOID CONTENT:	0 %			
PLY THICKNESS:	0.0078-0.0079 in.					
TEST METHOD:		MODULUS CALCULATION:				
ASTM D 5379-93		Chord, 1000 - 3000 µε				
NORMALIZED BY:		Not normalized				
Temperature (°F)		75	-67	180		
Moisture Content (%)		Ambient	Ambient	1.0		
Equilibrium at T, RH				(1)		
Source Code		90	90	90		
F ₂₃ ^{su} (ksi)	Mean	10.3	13.2	7.08		
	Minimum	10.0	12..7	6.99		
	Maximum	10.9	13.7	7.14		
	C.V.(%)	3.29	2.56	0.870		
	B-value	(2)	(2)	(2)		
	Distribution	Normal	Normal	Normal		
	C ₁	10.3	13.2	7.08		
	C ₂	0.339	0.337	0.062		
	No. Specimens	5	6	6		
	No. Batches	1	1	1		
	Data Class	Screening	Screening	Screening		
G ₂₃ ^s (Msi)	Mean	0.401	0.500	0.349		
	Minimum	0.375	0.478	0.333		
	Maximum	0.445	0.525	0.376		
	C.V.(%)	6.60	3.76	4.15		
	No. Specimens	6	6	6		
	No. Batches	1	1	1		
	Data Class	Screening	Screening	Screening		
γ ₂₃ ^{su} (µε)	Mean					
	Minimum					
	Maximum					
	C.V.(%)					
	B-value					
	Distribution					
	C ₁					
	C ₂					
	No. Specimens					
	No. Batches					
	Data Class					

- (1) Conditioned at 160°F and 95 ± 2% RH until 1.0% moisture content attained.
(2) Basis values are presented only for A and B data classes.

4.2.34 800HB 12k/3900-2 unidirectional tapeMaterial Description:

Material: 800HB 12k/3900-2

Form: Unidirectional tape prepreg, fiber areal weight of 190 g/m², typical cured resin content of 36%-37%, typical cured ply thickness of 0.0075-0.0082 inches.

Processing: Autoclave cure, 350°F, 85 psi, 3°F/minute ramp rate, 2 hours

General Supplier Information:

Fiber: 800HB fibers are continuous, standard modulus, no twist carbon filaments made from a PAN precursor, surface treated to improve handling characteristics and structural properties. Filament count is 12,000 filaments/tow. Typical tensile modulus is 34×10^6 psi. Typical tensile strength is 700,000 psi.

Matrix: 3900-2 is an toughened epoxy resin.

Maximum Short Term Service Temperature: 300°F (dry), 180°F (wet)

Typical applications: General purpose commercial and military aerospace structural applications.

Data Analysis Summary:

None

4.2.34 800HB 12k/3900-2 unidirectional tape

MATERIAL:				800H 12k/3900-2 unidirectional tape		C/Ep 800HB/3900-2 Summary	
FORM:				Toray P2302-19 unidirectional tape prepreg			
FIBER:		Toray T800HB 12k, 3 tows/inch, sizing H, no twist		MATRIX:		Toray 3900-2	
T _g (dry):		330°F		T _g (wet):		230°F	
				T _g METHOD:		ASTM E 1545 (TMA)	
PROCESSING:				Autoclave cure: 350°F, 85 psi, 3°F/minute ramp rate, 2 hours			

Date of fiber manufacture	7/97	Date of testing	1/99-7/99
Date of resin manufacture	7/97	Date of data submittal	12/99
Date of prepreg manufacture	12/97	Date of analysis	1/00
Date of composite manufacture	12/97		

LAMINA PROPERTY SUMMARY

	75/A		-67/A	180/W				
Tension, 1-axis								
Tension, 2-axis								
Tension, 3-axis								
Compression, 1-axis								
Compression, 2-axis								
Compression, 3-axis								
Shear, 12-plane								
Shear, 23-plane	SS - -		SS - -	SS - -				
Shear, 13-plane	SS - -		SS - -	SS - -				
SB Strength, 31-plane	S - - -		S - - -	S - - -				

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

PHYSICAL PROPERTY SUMMARY

		Nominal	As Submitted	Test Method
Fiber Density	(g/cm ³)	1.81	1.80	ASTM D 3800
Resin Density	(g/cm ³)	1.22		ASTM D 891
Composite Density	(g/cm ³)	1.55	1.56	
Fiber Areal Weight	(g/m ²)	190	191.1	ASTM D 5300
Fiber Volume	(%)	55.5	54.0-55.5	ASTM D 3171
Ply Thickness	(in)	0.0075	0.0075-0.0082	

LAMINATE PROPERTY SUMMARY

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

MATERIAL: 800H 12k/3900-2 unidirectional tape				Table 4.2.34(a) C/Ep 190-UT 800HB/3900-2 SBS, 31-plane [0]₃₄ 75/A, -67/A, 180/W Screening		
RESIN CONTENT:	36.3 wt. %	COMP. DENSITY:	1.56 g/cm ³			
FIBER VOLUME:	55.5 %	VOID CONTENT:	0-1.10 %			
PLY THICKNESS:	0.0073-0.0074 in.					
TEST METHOD:		MODULUS CALCULATION:				
ASTM D 2344-84		N/A				
NORMALIZED BY:		Not normalized				
Temperature (°F)	75	-67	180			
Moisture Content (%)	Ambient	Ambient	1.0			
Equilibrium at T, RH			(1)			
Source Code	90	90	90			
Mean	12.7	16.7	7.63			
Minimum	12.6	16.3	7.55			
Maximum	13.1	17.0	7.71			
C.V.(%)	1.47	1.34	0.772			
B-value	(2)	(2)	(2)			
F ₃₁ ^{sbs} Distribution	Normal	Normal	Normal			
(ksi) C ₁	12.8	16.7	7.63			
C ₂	0.187	0.223	0.059			
No. Specimens	6	6	6			
No. Batches	1	1	1			
Data Class	Screening	Screening	Screening			

(1) Conditioned at 160°F and 95 ± 2% RH until 1.0% moisture content attained.
(2) Short beam strength test data are approved for Screening Data Class only.

MATERIAL:		800H 12k/3900-2 unidirectional tape			Table 4.2.34(b) C/Ep 190-UT 800HB/3900-2 Shear, 13-plane [0]₁₀₀ 75/A, -67/A, 180/W Screening	
RESIN CONTENT:	37.3 wt. %	COMP. DENSITY:	1.56 g/cm ³			
FIBER VOLUME:	54.0 %	VOID CONTENT:	0-1.10 %			
PLY THICKNESS:	0.0075-0.0079					
TEST METHOD:		MODULUS CALCULATION:				
ASTM D 5379-93		Chord, 1000 - 3000 µε				
NORMALIZED BY:		Not normalized				
Temperature (°F)		75	-67	180		
Moisture Content (%)		Ambient	Ambient	1.0		
Equilibrium at T, RH				(1)		
Source Code		90	90	90		
F ₁₃ ^{su} (ksi)	Mean	12.8	18.6	7.20		
	Minimum	12.5	18.2	6.90		
	Maximum	12.9	19.3	7.50		
	C.V.(%)	1.21	2.24	3.11		
	B-value	(2)	(2)	(2)		
	Distribution	Normal	Normal	Normal		
	C ₁	12.8	18.6	7.20		
	C ₂	0.155	0.417	0.224		
	No. Specimens	6	6	5		
	No. Batches	1	1	1		
	Data Class	Screening	Screening	Screening		
G ₁₃ ^s (Msi)	Mean	0.478	0.598	0.401		
	Minimum	0.464	0.560	0.396		
	Maximum	0.489	0.630	0.405		
	C.V.(%)	2.34	3.87	0.872		
	No. Specimens	6	6	5		
	No. Batches	1	1	1		
	Data Class	Screening	Screening	Screening		
γ ₁₃ ^{su} (µε)	Mean					
	Minimum					
	Maximum					
	C.V.(%)					
	B-value					
	Distribution					
	C ₁					
	C ₂					
	No. Specimens					
	No. Batches					
	Data Class					

- (1) Conditioned at 160°F and 95 ± 2% RH until 1.0% moisture content attained.
(2) Basis values are presented only for A and B data classes.

MATERIAL: 800H 12k/3900-2 unidirectional tape				Table 4.2.34(c) C/Ep 190-UT 800HB/3900-2 Shear, 23-plane [0]₁₀₀ 75/A, -67/A, 180/W Screening		
RESIN CONTENT:	37.3 wt.%	COMP. DENSITY:	1.56 g/cm ³			
FIBER VOLUME:	54.0 %	VOID CONTENT:	0-1.10 %			
PLY THICKNESS:	0.0078-0.0082					
TEST METHOD: ASTM D 5379-93		MODULUS CALCULATION: Chord, 1000 - 3000 µε				
NORMALIZED BY: Not normalized						
Temperature (°F)	75	-67	180			
Moisture Content (%)	Ambient	Ambient	1.0			
Equilibrium at T, RH			(1)			
Source Code	90	90	90			
F ₂₃ ^{su} (ksi)	Mean	6.10	6.45	4.22		
	Minimum	4.79	4.68	3.91		
	Maximum	6.72	7.27	4.35		
	C.V.(%)	13.1	13.7	4.24		
	B-value	(2)	(2)	(2)		
	Distribution	Normal	Normal	Normal		
	C ₁	6.10	6.45	4.22		
	C ₂	0.801	0.886	0.179		
	No. Specimens	6	7	6		
	No. Batches	1	1	1		
	Data Class	Screening	Screening	Screening		
G ₂₃ ^s (Msi)	Mean	0.317	0.377	0.281		
	Minimum	0.306	0.360	0.258		
	Maximum	0.330	0.399	0.293		
	C.V.(%)	2.94	3.36	4.45		
	No. Specimens	6	7	6		
	No. Batches	1	1	1		
	Data Class	Screening	Screening	Screening		
γ ₂₃ ^{su} (µε)	Mean					
	Minimum					
	Maximum					
	C.V.(%)					
	B-value					
	Distribution					
	C ₁					
	C ₂					
	No. Specimens					
	No. Batches					
	Data Class					

(1) Conditioned at 160°F and 95 ± 2% RH until 1.0% moisture content attained.

(2) Basis values are presented only for A and B data classes.

4.2.35 T650-35 3k/976 plain weave fabricMaterial Description:

Material: T650-35 3k / 976

Form: Plain weave fabric prepreg, fiber areal weight of 194 g/m², typical cured resin content of 40%, typical cured ply thickness of 0.0067 - 0.0069 inches.

Processing: Autoclave cure, 350°F, 95 psi, 90 minutes

General Supplier Information:

Fiber: T650-35 fibers are continuous, no twist carbon filaments made from PAN precursor, surface treated to improve handling characteristics and structural properties. Filament count is 3000 filaments/tow. Typical tensile modulus is 35×10^6 psi. Typical tensile strength is 650,000 psi.

Matrix: 976 is a high flow, modified epoxy resin that meets the NASA outgassing requirements. 10 days out-time at 72°F.

Maximum Short Term Service Temperature: 350°F (dry), 250°F (wet)

Typical applications: General purpose commercial and military structural applications.

Data Analysis Summary:

1. For transverse tension, a bowtie specimen is an exception to this test method.

4.2.35 T650-35 3k/976 plain weave

MATERIAL: T650-35 3k/976 plain weave fabric

C/Ep 194-PW T650-35 976 Summary
--

FORM: Cytec Fiberite 976/T650-35 plain weave fabric prepreg

FIBER: Amoco T650-35 3k, UC 309, no twist MATRIX: ICI Fiberite 976

T_g(dry): 461°F T_g(wet): 393°F T_g METHOD: DMA E'

PROCESSING: Autoclave cure 350°F +10/-10°F, 90 min +10/-10 min, 95 psi +5/-5 psi

Date of fiber manufacture	9/90 – 5/95	Date of testing	7/93 – 10/96
Date of resin manufacture	9/90 – 7/94	Date of data submittal	12/97
Date of prepreg manufacture	6/92 – 8/94	Date of analysis	1/01
Date of composite manufacture	7/93 – 10/96		

LAMINA PROPERTY SUMMARY

	72°F/A		-67°F/A		250°F/W			
Tension, 1-axis	bS - -		bS - -		BM - -			
Tension, 2-axis	BM - -		BM - -		BM - -			
Tension, 3-axis								
Compression, 1-axis	BM - -		BM - -		BM - -			
Compression, 2-axis								
Compression, 3-axis	bS - -		bS - -		BM - -			
Shear, 12-plane	BM - -		bM - -		BM - -			
Shear, 23-plane								
Shear, 31-plane								

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

PHYSICAL PROPERTY SUMMARY

		Nominal	As Submitted	Test Method
Fiber Density	(g/cm ³)	1.77	1.76 – 1.78	SRM 15
Resin Density	(g/cm ³)	1.28	1.28	ASTM D 792
Composite Density	(g/cm ³)	1.57	1.55-1.58	
Fiber Areal Weight	(g/m ²)	194	-	
Fiber Volume	(%)	59	58-61	
Ply Thickness	(in)	0.0069	0.0066 - 0.0079	

LAMINATE PROPERTY SUMMARY

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

MATERIAL:		T650-35 3k 976 plain weave fabric				Table 4.2.35(a) C/Ep 194-PW T650-35 976 Tension, 1-axis [0_i]₁₂ 72/A, -67/A, 250/W B30, B18, Mean, Screening	
RESIN CONTENT:	28 – 34 % wt	COMP: DENSITY:	1.56-1.58 g/cm ³				
FIBER VOLUME:	59 - 64 vol %	VOID CONTENT:	0 – 1%				
PLY THICKNESS:	0.0062-0.0079 in.						
TEST METHOD:		MODULUS CALCULATION:					
Bowtie Specimen - ASTM D 3039 76		Chord, 1000 - 6000 µε					
NORMALIZED BY: Normalized by specimen thickness and batch fiber areal weight to 57%(0.0076 in. CPT)							
Temperature (°F)		72		-67		250	
Moisture Content (%)		ambient		ambient		1.09-1.20	
Equilibrium at T, RH						160, 85	
Source Code		80		80		80	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{tu} (ksi)	Mean	94.4	103	75.4	82.6	106	113
	Minimum	83.3	89.7	65.9	73.3	93.6	102
	Maximum	103	116	80.9	88.7	116	125
	C.V.(%)	7.05	7.10	6.03	5.70	6.38	5.75
	B-value	79.9	(1)	(1)	72.9	88.9	98.1
	Distribution	Weibull	ANOVA	ANOVA	Weibull	ANOVA	Weibull
	C ₁	97.35	7.87	4.74	84.2	6.99	116
	C ₂	18.09	4.08	3.27	6.35	2.50	18.9
	No. Specimens	18		18		30	
	No. Batches	3		3		5	
Data Class	B18		B18		B30		
E ₁ ^t (Msi)	Mean	10.4	11.2	10.5	11.5	10.7	11.2
	Minimum	9.91	10.5	10.0	10.7	9.81	10.0
	Maximum	11.4	11.8	10.7	11.9	11.3	12.4
	C.V.(%)	4.54	4.32	2.43	3.40	2.82	5.48
	No. Specimens	9		9		21	
No. Batches	3		3		5		
Data Class	Screening		Screening		Mean		
ν ₁₂ ^t	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{tu} (µε)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

(1) B-basis values calculated from less than five batches of data using the ANOVA method are not presented.

MATERIAL:		T650-35 3k 976 plain weave fabric				Table 4.2.35(b) C/Ep 194-PW T650-35 976 Tension, 2-axis [90 i]₁₂ 72/A, -67/A, 250/W B30, Mean	
RESIN CONTENT:	28 – 34 % wt	COMP: DENSITY:	1.56-1.58 g/cm ³				
FIBER VOLUME:	59 - 64 vol %	VOID CONTENT:	0 – 1%				
PLY THICKNESS:	0.0062-0.0079 in.						
TEST METHOD:		MODULUS CALCULATION:					
Bowtie Specimen- ASTM D 3039 76		Chord, 1000-6000 µε					
NORMALIZED BY:		Normalized by specimen thickness and batch fiber areal weight to 57%(0.0076 in. CPT)					
Temperature (°F)		72 ambient		-67 ambient		250	
Moisture Content (%)						1.14-1.22	
Equilibrium at T, RH						160, 85	
Source Code		80		80		80	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₂ ^{tu} (ksi)	Mean	93.7	101	74.0	80.8	98.3	105
	Minimum	78.5	83.4	62.1	64.1	88.5	94.3
	Maximum	106	118	87.4	108	111	122
	C.V.(%)	7.07	8.48	8.22	11.7	6.02	6.98
	B-value	76.4	74.9	57.4	51.4	81.6	82.5
	Distribution	ANOVA	ANOVA	ANOVA	ANOVA	ANOVA	ANOVA
	C ₁	6.91	8.98	6.31	10.0	6.17	7.75
	C ₂	2.51	2.87	2.64	2.93	2.70	2.90
	No. Specimens	30		30		30	
	No. Batches	5		5		5	
Data Class		B30		B30		B30	
E ₂ ^t (Msi)	Mean	10.0	10.6	9.91	10.6	9.93	10.5
	Minimum	9.59	9.61	9.46	9.93	9.16	9.57
	Maximum	10.9	11.9	10.5	11.5	11.0	12.2
	C.V.(%)	3.40	5.17	3.28	5.32	4.87	7.31
	No. Specimens	21		21		21	
No. Batches		5		5		5	
Data Class		Mean		Mean		Mean	
ν ₂₁ ^t	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₂ ^{tu} (µε)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

Table 4.2.35(c)
C/Ep 194 - PW
T650-35 976
Compression, 1-axis
[0°]₁₂
72/A, -67/A, 250/W
B30, Mean

MATERIAL:		T650-35 3k 976 plain weave fabric				Table 4.2.35(d) C/Ep 194-PW T650-35 976 Compression, 2-axis [90 r]₁₂ 72/A, -67/A, 250/W B30, B18, Mean, Screening	
RESIN CONTENT:	28 – 34 % wt	COMP: DENSITY:	1.56-1.58 g/cm ³				
FIBER VOLUME:	59 - 64 vol %	VOID CONTENT:	0 – 1%				
PLY THICKNESS:	0.0062-0.0079 in.						
TEST METHOD:	MODULUS CALCULATION:						
ASTM D 3410-87, Procedure B		Chord, 1000-3000 µε					
NORMALIZED BY:		Normalized by specimen thickness and batch fiber areal weight to 57%(0.0076 in. CPT)					
Temperature (°F)		72		-67		250	
Moisture Content (%)		ambient		ambient		1.03 – 1.33	
Equilibrium at T, RH						160, 85	
Source Code		80		80		80	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₂ ^{cu} (ksi)	Mean	92.6	99.1	88.0	94.2	52.5	56.1
	Minimum	79.7	88.6	70.5	78.4	38.1	40.3
	Maximum	105	11130	98.9	108	61.0	64.3
	C.V.(%)	9.23	8.28	10.3	9.77	10.9	10.5
	B-value	(1)	79.7	69.2	73.6	37.5	41.8
	Distribution	ANOVA	Weibull	Weibull	Weibull	ANOVA	ANOVA
	C ₁	8.93	103	91.89	98.2	5.92	6.05
	C ₂	12.5	14.0	12.61	12.3	2.53	2.37
	No. Specimens	18		18		30	
	No. Batches	3		3		5	
Data Class		B18		B18		B30	
E ₂ ^c (Msi)	Mean	8.82	9.39	8.95	9.62	8.89	9.52
	Minimum	8.26	8.83	8.13	8.93	8.44	8.81
	Maximum	9.19	9.84	9.34	9.96	9.40	9.96
	C.V.(%)	3.25	3.87	4.11	3.40	2.68	2.78
	No. Specimens	9		9		21	
	No. Batches	3		3		5	
	Data Class		Screening		Screening		Mean
ν ₂₁ ^t	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₂ ^{cu} (µε)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

(1) B-basis values calculated from less than five batches of data using the ANOVA method are not presented.

MATERIAL:		T650-35 3k 976 plain weave fabric			Table 4.2.35(e) C/Ep 194 - PW T650-35 976 Shear, 12-plane [+45/-45]_{3s} 72/A, -67/A, 250/W B30, B18, Mean		
RESIN CONTENT:	28 – 34 % wt	COMP. DENSITY:	1.56-1.58 g/cm ³				
FIBER VOLUME:	59 - 64 vol %	VOID CONTENT:	0 – 1%				
PLY THICKNESS:	0.0062-0.0079 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3518-82 (1)		Chord, 0 - 3000 µε					
NORMALIZED BY:		Not normalized					
Temperature (°F)		72	-67	250			
Moisture Content (%)		Ambient	Ambient	1.15 – 1.25			
Equilibrium at T, RH				160,85			
Source Code		80	80	80			
F ₁₂ ^{su} (ksi)	Mean	15.0	17.2	10.8			
	Minimum	13.6	15.3	9.95			
	Maximum	16.3	17.7	11.4			
	C.V.(%)	4.93	3.04	3.56			
	B-value	13.0	16.3	9.72			
	Distribution	ANOVA	Weibull	ANOVA			
	C ₁	0.77	17.3	0.40			
	C ₂	2.58	58.2	2.69			
	No. Specimens	34	18	30			
	No. Batches	5	3	5			
Data Class		B30	B18	B30			
G ₁₂ ^s (Msi)	Mean	0.80	1.01	0.51			
	Minimum	0.73	.95	0.47			
	Maximum	0.88	1.08	0.54			
	C.V.(%)	4.90	3.82	3.73			
	No. Specimens	24	18	22			
No. Batches		5	3	5			
Data Class		Mean	Mean	Mean			
γ ₁₂ ^{su} (µε)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

(1) Test method used ultimate strength at failure.

4.3 CARBON - POLYESTER COMPOSITES

4.4 CARBON - BISMALEIMIDE COMPOSITES

4.4.1 T-300 3k/F650 unidirectional tapeMaterial Description:

Material: T300 3k/F650 unidirectional tape

Form: Unidirectional tape, fiber areal weight of 189 g/m^2 , typical cured resin content of 32%, typical cured ply thickness of 0.0070 inches.

Processing: Autoclave cure; 375°F, 85 psi for 4 hours; postcure at 475°F for 4 hours

General Supplier Information:

Fiber: T-300 fibers are continuous, no twist carbon filaments made from PAN precursor, surface treated to improve handling characteristics and structural properties. Filament count is 3,000 filaments/tow. Typical tensile modulus is 33×10^6 psi. Typical tensile strength is 530,000 psi.

Matrix: F650 is a 350°F curing bismaleimide resin. It will retain light tack for several weeks at 70°F.

Maximum Short Term Service Temperature: 500°F (dry), 350°F (wet)

Typical applications: Primary and secondary structural applications.

4.4.1 T-300 3k/F650 unidirectional tape*

MATERIAL: T-300 3k/F650 unidirectional tape

C/BMI 189-UT T-300/F650 Summary
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FORM: Hexcel T3T190/F652 unidirectional tape prepreg

FIBER: Toray T-300 3k

MATRIX: Hexcel F650

T_g(dry): 600°FT_g(wet):T_g METHOD:

PROCESSING: Autoclave cure: 375°F, 4 hours, 85 psig; Postcure: 475°F, 4 hours, free-standing oven

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

Date of fiber manufacture

Date of testing

Date of resin manufacture

Date of data submittal

4/89

Date of prepreg manufacture

Date of analysis

1/93

Date of composite manufacture

LAMINA PROPERTY SUMMARY

	75°F/A		-67°F/A	400°F/A				
Tension, 1-axis	SS - -		S - - -	SS - -				
Tension, 2-axis								
Tension, 3-axis								
Compression, 1-axis								
Compression, 2-axis								
Compression, 3-axis								
Shear, 12-plane								
Shear, 23-plane								
Shear, 31-plane								
SB Strength, 31-plane	S - - -			S - - -				

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

		Nominal	As Submitted	Test Method
Fiber Density	(g/cm ³)	1.76	1.57	
Resin Density	(g/cm ³)	1.27		
Composite Density	(g/cm ³)	1.56		
Fiber Areal Weight	(g/m ²)	189	61	
Fiber Volume	(%)	59		
Ply Thickness	(in)	0.0070		

LAMINATE PROPERTY SUMMARY

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		T-300 3k/F650 unidirectional tape				Table 4.4.1(a) C/BMI 189-UT T-300/F650 Tension, 1-axis [0]₆ 75/A, -67/A, 400/A Screening	
RESIN CONTENT:	32 wt%	COMP: DENSITY:	1.57 g/cm ³				
FIBER VOLUME:	61 %	VOID CONTENT:					
PLY THICKNESS:	0.0070 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3039-76							
NORMALIZED BY:		Fiber volume to 60% (0.0070 in. CPT)					
Temperature (°F)		75		-67		400	
Moisture Content (%)		ambient		ambient		ambient	
Equilibrium at T, RH							
Source Code		21		21		21	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{tu} (ksi)	Mean	248	252	194	197	229	233
	Minimum	216	220	167	170	216	220
	Maximum	293	298	212	216	243	247
	C.V.(%)	7.14	7.15	8.68	8.68	3.97	3.97
	B-value	(1)	(1)	(1)	(1)	(1)	(1)
	Distribution	Normal	Normal	Normal	Normal	Normal	Normal
	C ₁	248	252	194	197	229	233
	C ₂	17.7	18.0	16.8	17.1	11.1	9.24
	No. Specimens	15		15		7	
	No. Batches	1		1		1	
Data Class		Screening		Screening		Screening	
E ₁ ^t (Msi)	Mean	18.9	19.2			19.1	19.4
	Minimum	16.5	16.8			16.8	17.1
	Maximum	20.3	20.6			21.0	21.4
	C.V.(%)	5.58	5.49			7.26	7.23
	No. Specimens	15				9	
No. Batches		1				1	
Data Class		Screening				Screening	
ν ₁₂ ^t	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{tu} (με)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

(1) Basis values are presented only for A and B data classes.

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		T-300 3k/F650 unidirectional tape		Table 4.4.1(b) C/BMI 189-UT T-300/F650 SBS, 31-plane [0]₃₄ 75/A, 400/A Screening	
RESIN CONTENT:	32 wt%	COMP: DENSITY:	1.57 g/cm ³		
FIBER VOLUME:	61 %	VOID CONTENT:			
PLY THICKNESS:	0.0070 in.				
TEST METHOD:		MODULUS CALCULATION:			
ASTM D 2344					
NORMALIZED BY:		Not normalized			
Temperature (°F)		75	400		
Moisture Content (%)		ambient	ambient		
Equilibrium at T, RH					
Source Code		21	21		
F ₃₁ ^{sbs} (ksi)	Mean	14.1	9.39		
	Minimum	13.5	8.77		
	Maximum	15.0	10.1		
	C.V.(%)	3.04	4.25		
	B-value	(1)	(1)		
	Distribution	Weibull	Weibull		
	C ₁	14.3	9.59		
	C ₂	32.3	24.6		
	No. Specimens	15	15		
	No. Batches	1	1		
Data Class		Screening	Screening		

(1) Basis values are presented only for A and B data classes.

4.4.2 T-300 3k/F650 8-harness satin weave fabricMaterial Description:

Material: T300 3k/F650

Form: 8 harness satin weave fabric, fiber areal weight of 370 g/m^2 , typical cured resin content of 40%, typical cured ply thickness of 0.015 inches.

Processing: Autoclave cure; 375°F, 85 psi for 4 hours; postcure at 475°F for 4 hours

General Supplier Information:

Fiber: T-300 fibers are continuous, no twist carbon filaments made from PAN precursor, surface treated to improve handling characteristics and structural properties. Filament count is 3,000 filaments/tow. Typical tensile modulus is 33×10^6 psi. Typical tensile strength is 530,000 psi.

Matrix: F650 is a 350°F curing bismaleimide resin. It will retain light tack for several weeks at 70°F.

Maximum Short Term Service Temperature: 500°F (dry), 350°F (wet)

Typical applications: Primary and secondary structural applications.

4.4.2 T-300 3k/F650 8-harness satin weave fabric*

				C/BMI 370-8HS T-300/F650 Summary	
MATERIAL:	T-300 3k/F650 8-harness satin weave fabric				
FORM:	Hexcel F3T584/F650 8-harness satin weave fabric prepreg				
FIBER:	Toray T-300 3k		MATRIX:	Hexcel F650	
T _g (dry):	600°F	T _g (wet):	T _g METHOD:		
PROCESSING:	Autoclave cure: 375°F, 4 hours, 85 psig; Postcure: 475°F, 4 hours, free-standing oven				

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

Date of fiber manufacture	Date of testing	
Date of resin manufacture	Date of data submittal	4/89
Date of prepreg manufacture	Date of analysis	1/93
Date of composite manufacture		

LAMINA PROPERTY SUMMARY

	75°F/A		350°F/A	450°F/A				
Tension, 1-axis								
Tension, 2-axis								
Tension, 3-axis								
Compression, 1-axis								
Compression, 2-axis								
Compression, 3-axis								
Shear, 12-plane	SS - -							
Shear, 23-plane								
Shear, 31-plane								
SB Strength, 31-plane	S - - -		S - - -	S - - -				

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

		Nominal	As Submitted	Test Method
Fiber Density	(g/cm ³)	1.75	52	
Resin Density	(g/cm ³)	1.27		
Composite Density	(g/cm ³)	1.54		
Fiber Areal Weight	(g/m ²)	370		
Fiber Volume	(%)	56		
Ply Thickness	(in)	0.015		

LAMINATE PROPERTY SUMMARY

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		T-300 3k/F650 8-harness satin weave fabric				Table 4.4.2(a) C/BMI 370-8HS T-300/F650 Shear, 12-plane [±45_f]_{4s} 75/A Screening
RESIN CONTENT:	40 wt%	COMP: DENSITY:	1.51 g/cm ³			
FIBER VOLUME:	52 %	VOID CONTENT:				
PLY THICKNESS:	0.015 in.					
TEST METHOD:	MODULUS CALCULATION:					
ASTM D 3518-76						
NORMALIZED BY:		Not normalized				
Temperature (°F)		75				
Moisture Content (%)		ambient				
Equilibrium at T, RH						
Source Code		21				
F ₁₂ ^{su} (ksi)	Mean	9.77				
	Minimum	8.57				
	Maximum	11.1				
	C.V.(%)	8.78				
	B-value	(1)				
	Distribution	Weibull				
	C ₁	10.2				
	C ₂	12.9				
	No. Specimens	15				
	No. Batches	1				
Data Class		Screening				
G ₁₂ ^s (Msi)	Mean	0.69				
	Minimum	0.59				
	Maximum	0.81				
	C.V.(%)	10				
	No. Specimens	14				
	No. Batches	1				
	Data Class		Screening			
γ ₁₂ ^{su} (μɛ)	Mean					
	Minimum					
	Maximum					
	C.V.(%)					
	B-value					
	Distribution					
	C ₁					
	C ₂					
	No. Specimens					
	No. Batches					
Data Class						

(1) Basis values are presented only for A and B data classes.

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		T-300 3k/F650 8-harness satin weave fabric			Table 4.4.2(b) C/BMI 370-8HS T-300/F650 SBS, 31-plane [0_r]₈ 75/A, 350/A, 450/A Screening	
RESIN CONTENT:	40 wt%	COMP: DENSITY:	1.51 g/cm ³			
FIBER VOLUME:	52 %	VOID CONTENT:				
PLY THICKNESS:	0.015 in.					
TEST METHOD:	ASTM D 2344		MODULUS CALCULATION:			
NORMALIZED BY:		Not normalized				
Temperature (°F)	75	350	450			
Moisture Content (%)	ambient	ambient	ambient			
Equilibrium at T, RH						
Source Code	21	21	21			
F ₃₁ ^{sbs} (ksi)	Mean	5.83	5.59	5.80		
	Minimum	4.75	4.93	5.23		
	Maximum	8.06	6.44	6.57		
	C.V.(%)	15.0	10.9	6.81		
	B-value	(1)	(1)	(1)		
	Distribution	Nonpara.	Weibull	Weibull		
	C ₁	8	5.86	5.98		
	C ₂	1.54	11.0	15.5		
	No. Specimens	15	10	10		
No. Batches	1	1	1			
Data Class	Screening	Screening	Screening			

(1) Short beam strength test data are approved for Screening Data Class only.

4.4.3 T-300 3k/F652 8-harness satin weave fabric

Material Description:

Material: T300 3k/F652

Form: 8 harness satin weave fabric, fiber areal weight of 367 g/m^2 , typical cured resin content of 27%, typical cured ply thickness of 0.0124 inches.

Processing: Press cure, 400°F, 2.5 hours, 125 psi; postcure at 550°F, 4 hours

General Supplier Information:

Fiber: T-300 3K fibers are continuous, no twist carbon filaments made from PAN precursor, surface treated to improve handling characteristics and structural properties. Filament count is 3,000 filaments/tow. Typical tensile modulus is 33×10^6 psi. Typical tensile strength is 530,000 psi.

Matrix: F652 is a bismaleimide resin that has been modified from F650 to reduce the flow of the resin. The lower flow allows the resin to be used in press forming operations and also for high temperature honeycomb. The properties are equivalent to F650.

Maximum Short Term Service Temperature: 500°F (dry), 350°F (wet)

Typical applications: Primary and secondary structural applications.

4.4.3 T-300 3k/F652 8-harness satin weave fabric*

MATERIAL:	T-300 3k/F652 8-harness satin weave fabric		
FORM:	Hexcel F3G584/F652 8-harness satin weave fabric prepreg		
FIBER:	Amoco Thornel T-300	MATRIX:	Hexcel F652
T _g (dry):	600°F	T _g (wet):	T _g METHOD:
PROCESSING:	Press cured: 400°F, 2.5 hours, 125 psig; Postcure: 550°F, 4 hours		

C/BMI 367-8HS
T-300/F652
Summary

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

Date of fiber manufacture	Date of testing	
Date of resin manufacture	Date of data submittal	4/89
Date of prepreg manufacture	Date of analysis	1/93
Date of composite manufacture		

LAMINA PROPERTY SUMMARY

	70°F/A		600°F/A					
Tension, 1-axis	SS - -							
Tension, 2-axis								
Tension, 3-axis								
Compression, 1-axis								
Compression, 2-axis								
Compression, 3-axis								
Shear, 12-plane								
Shear, 23-plane								
Shear, 31-plane								
SB Strength, 31-plane	S - - -		S - - -					

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

		Nominal	As Submitted	Test Method
Fiber Density	(g/cm ³)	1.76	1.57	
Resin Density	(g/cm ³)	1.26		
Composite Density	(g/cm ³)	1.55		
Fiber Areal Weight	(g/m ²)	367	64.8	
Fiber Volume	(%)	58		
Ply Thickness	(in)	.00124		

LAMINATE PROPERTY SUMMARY

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		T-300 3k/F652 8-harness satin weave fabric				Table 4.4.3(a) C/BMI 367-8HS T-300/F652 Tension, 1-axis [0_f]₁₀ 70/A Screening	
RESIN CONTENT:	27.2 wt%	COMP: DENSITY:	1.57 g/cm ³				
FIBER VOLUME:	64.8 %	VOID CONTENT:					
PLY THICKNESS:	0.012 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3039-76							
NORMALIZED BY:		Batch fiber volume to 57% (0.012 in. CPT)					
Temperature (°F)		70					
Moisture Content (%)		ambient					
Equilibrium at T, RH							
Source Code		21					
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{tu} (ksi)	Mean	73.6	84.0				
	Minimum	58.8	67.1				
	Maximum	84.3	96.1				
	C.V.(%)	10.1	10.0				
	B-value	(1)	(1)				
	Distribution	Weibull	Weibull				
	C ₁	76.8	87.6				
	C ₂	12.3	12.4				
	No. Specimens	15					
	No. Batches	1					
Data Class		Screening					
E ₁ ^t (Msi)	Mean	9.71	11.1				
	Minimum	8.94	10.2				
	Maximum	10.2	11.6				
	C.V.(%)	4.36	4.28				
	No. Specimens	15					
No. Batches	1						
Data Class		Screening					
ν ₁₂ ^t	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{tu} (με)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

(1) Basis values are presented only for A and B data classes.

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		T-300 3k/F652 8-harness satin weave fabric				Table 4.4.3(b) C/BMI 367-8HS T-300/F652 SBS, 31-plane [0_f]₁₀ 70/A, 600/A Screening
RESIN CONTENT:	27.2 wt%	COMP: DENSITY:	1.57 g/cm ³			
FIBER VOLUME:	64.8 %	VOID CONTENT:				
PLY THICKNESS:	0.0012 in.					
TEST METHOD:	ASTM D 2344		MODULUS CALCULATION:			
NORMALIZED BY:		Not normalized				
Temperature (°F)	70	600				
Moisture Content (%)	ambient	ambient				
Equilibrium at T, RH						
Source Code	21	21				
F ₃₁ ^{sbs} (ksi)	Mean	5.97	4.59			
	Minimum	5.13	4.29			
	Maximum	6.64	4.82			
	C.V.(%)	8.17	3.60			
	B-value	(1)	(1)			
	Distribution	Weibull	Weibull			
	C ₁	6.18	4.66			
	C ₂	14.8	36.8			
	No. Specimens	15	15			
No. Batches	1	1				
Data Class	Screening	Screening				

(1) Basis values are presented only for A and B data classes.

4.4.4 AS4/5250-3 unidirectional tape

Material Description:

Material: AS4/5250-3

Form: Unidirectional tape, fiber areal weight of 147 g/m², typical cured resin content of 26-38%, typical cured ply thickness of 0.0055 inches.

Processing: Autoclave cure; 250°F, 85 psi, 1 hour; 350°F, 85 psi, 6 hours; postcure; 475°F, 6 hours.

General Supplier Information:

Fiber: AS4 fibers are continuous carbon filaments made from PAN precursor, surface treated to improve handling characteristics and structural properties. Typical tensile modulus is 34 x 10⁶ psi. Typical tensile strength is 550,000 psi.

Matrix: 5250-3 is a modified bismaleimide resin possessing good hot/wet strength and improved toughness over standard bismaleimides. Good high temperature resistance.

Maximum Short Term Service Temperature: 450°F (dry), 350°F (wet)

Typical applications: Primary and secondary structural applications on commercial and military aircraft.

Data Analysis Summary:

1. Data are from publicly available report, Reference 4.4.4.

4.4.4 AS4/5250-3 unidirectional tape*

MATERIAL: AS4/5250-3 unidirectional tape

C/BMI 147-UT AS4/5250-3 Summary
--

FORM: Narmco AS4/5250-3 unidirectional tape, grade 147 prepreg

FIBER: Hercules AS4

MATRIX: Narmco 5250-3

T_g(dry): 642°F T_g(wet): 561°F T_g METHOD: DMA

PROCESSING: Autoclave cure: 250°F, 60 minutes; 350°F, 360 minutes, 85 psi; Postcure: 475°F, 6 hours

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

Date of fiber manufacture	Date of testing
Date of resin manufacture	Date of data submittal 12/88
Date of prepreg manufacture	Date of analysis 1/93
Date of composite manufacture	

LAMINA PROPERTY SUMMARY

	72°F/A		-67°F/A	350°F/A	450°F/A		74°F/W	350°F/W
Tension, 1-axis	SSSS		SSSS	SSSS	SSSS		SSSS	SSSS
Tension, 2-axis	SS-S		SS-S	SS-S	SS-S			
Tension, 3-axis								
Compression, 1-axis	SS-S		SS-S	SS-S	SS-S		SS-S	SS-S
Compression, 2-axis								
Compression, 3-axis								
Shear, 12-plane	SS--		SS--	SS--	SS--		SS--	SS--
Shear, 23-plane								
Shear, 31-plane								

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

		Nominal	As Submitted	Test Method
Fiber Density	(g/cm ³)	1.80		ASTM D 3529
Resin Density	(g/cm ³)	1.25		
Composite Density	(g/cm ³)	1.58	1.52 - 1.63	
Fiber Areal Weight	(g/m ²)	147	132 - 165	
Fiber Volume	(%)	60	51 - 66	
Ply Thickness	(in)	0.0051 - 0.0059	0.0050 - 0.0062	

LAMINATE PROPERTY SUMMARY

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		AS4/5250-3 unidirectional tape				Table 4.4.4(a) C/BMI 147-UT AS4/5250-3 Tension, 1-axis [0]₈ 72/A, -67/A, 350/A Screening		
RESIN CONTENT:	26-28 wt%	COMP: DENSITY:	1.58-1.61 g/cm ³					
FIBER VOLUME:	63-66 %	VOID CONTENT:	0.1-0.9%					
PLY THICKNESS:	0.0050-0.0053 in.							
TEST METHOD:		MODULUS CALCULATION:						
ASTM D 3039-76								
NORMALIZED BY:		Specimen thickness and batch fiber volume to 60% (0.0055 in. CPT)						
Temperature (°F)		72		-67		350		
Moisture Content (%)		ambient		ambient		ambient		
Equilibrium at T, RH								
Source Code		(1)		(1)		(1)		
		Normalized	Measured	Normalized	Measured	Normalized	Measured	
F ₁ ^{tu} (ksi)	Mean	252	291	270	311	266	308	
	Minimum	223	255	249	285	241	276	
	Maximum	275	322	288	332	283	325	
	C.V.(%)	7.63	8.48	6.12	6.48	6.87	7.54	
	B-value	(2)	(2)	(2)	(2)	(2)	(2)	
	Distribution	Normal	Normal	Normal	Normal	Normal	Nonpara.	
	C ₁	252	291	270	312	266	5	
	C ₂	19.2	24.7	16.5	20.2	18.3	3.06	
	No. Specimens	6		6		6		
	No. Batches	1		1		1		
Data Class		Screening		Screening		Screening		
E ₁ ^t (Msi)	Mean	15.9	18.3	16.4	18.9	16.4	19.0	
	Minimum	15.3	17.7	15.9	18.5	15.8	18.2	
	Maximum	16.4	18.9	16.8	19.4	16.7	19.5	
	C.V.(%)	3.04	2.51	2.23	1.91	2.07	2.85	
	No. Specimens	6		6		6		
	No. Batches	1		1		1		
	Data Class		Screening		Screening		Screening	
	Mean		0.300		0.295		0.302	
	No. Specimens	6		6		6		
	No. Batches	1		1		1		
Data Class		Screening		Screening		Screening		
ε ₁ ^{tu} (με)	Mean		17100		15800		15900	
	Minimum		14900		14100		14800	
	Maximum		20000		18000		17100	
	C.V.(%)		13.3		9.6		4.98	
	B-value		(2)		(2)		(2)	
	Distribution		Normal		Normal		Normal	
	C ₁		17100		15800		15900	
	C ₂		2270		1520		789	
	No. Specimens	6		6		6		
	No. Batches	1		1		1		
Data Class		Screening		Screening		Screening		

(1) Reference 4.4.4.

(2) Basis values are presented only for A and B data classes.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		AS4/5250-3 unidirectional tape				Table 4.4.4(b) C/BMI 147-UT AS4/5250-3 Tension, 1-axis [0]₈ 450/A, 74/W, 350/W Screening	
RESIN CONTENT:	26-28 wt%	COMP: DENSITY:	1.61-1.63 g/cm ³				
FIBER VOLUME:	63-67 %	VOID CONTENT:	0.0-0.9%				
PLY THICKNESS:	0.0050-0.0053 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3039-76							
NORMALIZED BY:		Specimen thickness and batch fiber volume to 60% (0.0055 in. CPT)					
Temperature (°F)		450		74		350	
Moisture Content (%)		ambient		0.70		0.73	
Equilibrium at T, RH				160°F, 95%		(1)	
Source Code		(2)		(2)		(2)	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{tu} (ksi)	Mean	253	292	268	312	249	287
	Minimum	208	237	235	268	232	264
	Maximum	269	314	293	347	261	305
	C.V.(%)	8.87	9.64	7.74	8.99	4.50	5.42
	B-value	(3)	(3)	(3)	(3)	(3)	(3)
	Distribution	Nonpara.	Normal	Normal	Normal	Normal	Normal
	C ₁	5	292	268	312	249	288
	C ₂	3.06	28.1	20.7	28.1	11.2	15.6
	No. Specimens	6		6		5	
	No. Batches	1		1		1	
Data Class		Screening		Screening		Screening	
E ₁ ^t (Msi)	Mean	16.5	19.0	16.6	19.3	15.9	18.4
	Minimum	15.7	18.1	16.2	18.9	15.4	17.8
	Maximum	16.9	19.7	17.3	19.9	16.4	19.1
	C.V.(%)	3.43	3.56	2.36	1.82	2.41	2.71
	No. Specimens	6		6		5	
No. Batches	1		1		1		
Data Class		Screening		Screening		Screening	
ν ₁₂ ^t	Mean	0.295		0.335		0.368	
	No. Specimens	6		6		5	
	No. Batches	1		1		1	
	Data Class	Screening		Screening		Screening	
ε ₁ ^{tu} (με)	Mean	13900		15200		14900	
	Minimum	11700		13500		13200	
	Maximum	15000		16600		15500	
	C.V.(%)	8.14		7.14		6.46	
	B-value	(3)		(3)		(3)	
	Distribution	Normal		Normal		Normal	
	C ₁	13900		15200		14900	
	C ₂	1130		1080		961	
	No. Specimens	6		6		6	
	No. Batches	1		1		1	
Data Class		Screening		Screening		Screening	

(1) Conditioned at 160°F, 95% relative humidity for 29 days (75% saturation).

(2) Reference 4.4.4.

(3) Basis values are presented only for A and B data classes.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		AS4/5250-3 unidirectional tape				Table 4.4.4(c) C/BMI 147-UT AS4/5250-3 Tension, 1-axis [0]₈ 350/W Screening	
RESIN CONTENT:	26-28 wt%	COMP: DENSITY:	1.61 g/cm ³				
FIBER VOLUME:	63-66 %	VOID CONTENT:	0.1-0.9%				
PLY THICKNESS:	0.0050-0.0053 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3039-76							
NORMALIZED BY:		Specimen thickness and batch fiber volume to 60% (0.0055 in. CPT)					
Temperature (°F)		350					
Moisture Content (%)		1.0					
Equilibrium at T, RH		160°F, 95%					
Source Code		(1)					
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{tu} (ksi)	Mean	235	270				
	Minimum	176	202				
	Maximum	259	296				
	C.V.(%)	12.8	13.0				
	B-value	(2)	(2)				
	Distribution	Normal	Normal				
	C ₁	235	270				
	C ₂	29.9	35.1				
	No. Specimens	6					
	No. Batches	1					
Data Class		Screening					
E ₁ ^t (Msi)	Mean	16.7	19.2				
	Minimum	15.5	17.7				
	Maximum	18.4	21.2				
	C.V.(%)	6.43	6.26				
	No. Specimens	6					
	No. Batches	1					
Data Class		Screening					
ν ₁₂ ^t	Mean	0.363					
	No. Specimens	4					
	No. Batches	1					
	Data Class	Screening					
ε ₁ ^{tu} (με)	Mean	14400					
	Minimum	9950					
	Maximum	16200					
	C.V.(%)	16.0					
	B-value	(2)					
	Distribution	Normal					
	C ₁	14400					
	C ₂	2300					
	No. Specimens	6					
	No. Batches	1					
Data Class		Screening					

(1) Reference 4.4.4.

(2) Basis values are presented only for A and B data classes.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		AS4/5250-3 unidirectional tape				Table 4.4.4(d) C/BMI 147-UT AS4/5250-3 Tension, 2-axis [90]₈ 72/A, -67/A, 350/A, 450/A Screening	
RESIN CONTENT:	27-40 wt%	COMP: DENSITY:	1.52-1.61 g/cm ³				
FIBER VOLUME:	51-65 %	VOID CONTENT:	0.1-0.8%				
PLY THICKNESS:	0.0051-0.0059 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3039-76							
NORMALIZED BY:		Not normalized					
Temperature (°F)	72	-67	350	450			
Moisture Content (%)	ambient	ambient	ambient	ambient			
Equilibrium at T, RH							
Source Code	(2)	(2)	(2)	(2)			
F ₂ ^{tu} (ksi)	Mean	4.61	4.98	4.63	4.54		
	Minimum	3.52	4.68	3.43	4.13		
	Maximum	5.65	5.94	5.33	5.19		
	C.V.(%)	18.4	9.69	13.7	9.20		
	B-value	(1)	(1)	(1)	(1)		
	Distribution	Normal	Nonpara.	Normal	Normal		
	C ₁	4.61	5	4.63	4.54		
	C ₂	0.847	3.06	0.637	0.417		
	No. Specimens	6	6	6	6		
	No. Batches	1	1	1	1		
Data Class	Screening	Screening	Screening	Screening			
E ₂ ^t (Msi)	Mean	1.24	1.40	1.04	1.08		
	Minimum	1.17	1.26	0.940	0.930		
	Maximum	1.35	1.47	1.16	1.26		
	C.V.(%)	5.90	5.50	8.50	10.3		
	No. Specimens	6	6	5	6		
	No. Batches	1	1	1	1		
	Data Class	Screening	Screening	Screening	Screening		
ν ₂₁ ^t	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₂ ^{tu} (μϵ)	Mean	3540	3580	4680	4330		
	Minimum	2000	3180	3300	3600		
	Maximum	4900	4740	6000	5600		
	C.V.(%)	26.9	16.5	19.0	18.0		
	B-value	(1)	(1)	(1)	(1)		
	Distribution	Normal	Lognormal	Normal	Normal		
	C ₁	3540	8.17	4680	4330		
	C ₂	955	0.149	889	782		
	No. Specimens	6	6	6	6		
	No. Batches	1	1	1	1		
Data Class	Screening	Screening	Screening	Screening			

(1) Basis values are presented only for A and B data classes.

(2) Reference 4.4.4.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		AS4/5250-3 unidirectional tape				Table 4.4.4(e) C/BMI 147-UT AS4/5250-3 Compression, 1-axis [0]₈ 72/A, -67/A, 350/A Screening	
RESIN CONTENT:	36-38 wt%	COMP: DENSITY:	1.55 g/cm ³				
FIBER VOLUME:	53-56 %	VOID CONTENT:	0.1-0.9%				
PLY THICKNESS:	0.0057-0.0062 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3410A-87							
NORMALIZED BY:		Specimen thickness and batch fiber volume to 60% (0.0055 in. CPT)					
Temperature (°F)		72		-67		350	
Moisture Content (%)		ambient		ambient		ambient	
Equilibrium at T, RH							
Source Code		(1)		(1)		(1)	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{cu} (ksi)	Mean	175	158	198	179	174	148
	Minimum	122	110	176	160	141	127
	Maximum	203	184	222	201	235	185
	C.V.(%)	15.9	15.9	8.0	8.0	23.6	15.9
	B-value	(2)	(2)	(2)	(2)	(2)	(2)
	Distribution	Normal	Normal	Normal	Normal	Normal	Normal
	C ₁	175	158	198	179	174	149
	C ₂	27.7	25.1	15.8	14.3	41.1	23.6
	No. Specimens	6		6		6	
	No. Batches	1		1		1	
Data Class		Screening		Screening		Screening	
E ₁ ^c (Msi)	Mean	17.0	15.4	15.5	14.0	17.4	14.9
	Minimum	14.1	12.8	13.9	12.6	15.2	13.8
	Maximum	22.7	20.5	18.5	16.7	21.9	17.2
	C.V.(%)	20.1	20.0	10.7	10.6	14.7	8.55
	No. Specimens	6		6		6	
No. Batches	1		1		1		
Data Class		Screening		Screening		Screening	
ν ₁₂ ^c	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{cu} (μϵ)	Mean	12100		19800		15300	
	Minimum	8000		8360		10200	
	Maximum	22700		26700		18400	
	C.V.(%)	46.2		43.9		18.1	
	B-value	(2)		(2)		(2)	
	Distribution	Normal		Normal		Normal	
	C ₁	12100		19800		15300	
	C ₂	5570		8710		2770	
	No. Specimens	6		6		6	
	No. Batches	1		1		1	
Data Class		Screening		Screening		Screening	

(1) Reference 4.4.4.

(2) Basis values are presented only for A and B data classes.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		AS4/5250-3 unidirectional tape				Table 4.4.4(f) C/BMI 147-UT AS4/5250-3 Compression, 1-axis [0]₈ 450/A, 74/W, 350/W Screening	
RESIN CONTENT:	36-38 wt%	COMP: DENSITY:	1.55 g/cm ³				
FIBER VOLUME:	53-56 %	VOID CONTENT:	0.1-0.9%				
PLY THICKNESS:	0.0057-0.0062 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3410A-87							
NORMALIZED BY:		Specimen thickness and batch fiber volume to 60% (0.0055 in. CPT)					
Temperature (°F)		450		74		350	
Moisture Content (%)		ambient		0.82		0.79	
Equilibrium at T, RH				160°F, 95%		(1)	
Source Code		(2)		(2)		(2)	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{cu} (ksi)	Mean	153	131	194	176	153	139
	Minimum	119	108	175	159	113	102
	Maximum	207	163	216	195	173	157
	C.V.(%)	21.2	15.1	8.6	8.63	15.5	15.5
	B-value	(3)	(3)	(3)	(3)	(3)	(3)
	Distribution	Normal	Normal	Normal	Normal	Normal	Normal
	C ₁	153	131	194	176	153	139
	C ₂	32.4	19.7	16.7	15.2	23.8	21.5
	No. Specimens	6		6		5	
	No. Batches	1		1		1	
Data Class		Screening		Screening		Screening	
E ₁ ^c (Msi)	Mean	18.2	15.6	18.5	16.8	16.1	14.6
	Minimum	14.0	12.6	16.4	14.9	14.3	12.9
	Maximum	21.7	17.1	21.5	19.5	18.2	16.5
	C.V.(%)	16.0	10.4	9.42	9.39	9.78	9.75
	No. Specimens	6		6		5	
No. Batches		1		1		1	
Data Class		Screening		Screening		Screening	
ν ₁₂ ^c	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{cu} (με)	Mean	8480		15900		12600	
	Minimum	2900		10600		6400	
	Maximum	14600		22900		16000	
	C.V.(%)	44.7		32.5		30.2	
	B-value	(3)		(3)		(3)	
	Distribution	Normal		Normal		Normal	
	C ₁	8480		15900		12600	
	C ₂	3790		5170		3810	
	No. Specimens	6		6		5	
	No. Batches	1		1		1	
Data Class		Screening		Screening		Screening	

(1) Conditioned at 160°F, 95% relative humidity for 7 days (75% saturation).

(2) Reference 4.4.4.

(3) Basis values are presented only for A and B data classes.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		AS4/5250-3 unidirectional tape				Table 4.4.4(g) C/BMI 147-UT AS4/5250-3 Compression, 1-axis [0]₈ 350/W Screening	
RESIN CONTENT:	36 wt%	COMP: DENSITY:	1.55 g/cm ³				
FIBER VOLUME:	56 %	VOID CONTENT:	0.0%				
PLY THICKNESS:	0.0050-0.0053 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3410A-87							
NORMALIZED BY:		Specimen thickness and batch fiber volume to 60% (0.0055 in. CPT)					
Temperature (°F)		350					
Moisture Content (%)		1.0					
Equilibrium at T, RH		160°F, 95%					
Source Code		(1)					
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{cu} (ksi)	Mean	127	115				
	Minimum	108	97.9				
	Maximum	152	138				
	C.V.(%)	11.4	11.4				
	B-value	(2)	(2)				
	Distribution	Normal	Normal				
	C ₁	127	115				
	C ₂	14.4	13.0				
	No. Specimens	6					
	No. Batches	1					
Data Class		Screening					
E ₁ ^c (Msi)	Mean	18.1	16.4				
	Minimum	16.6	15.0				
	Maximum	20.7	18.7				
	C.V.(%)	7.93	7.89				
	No. Specimens	6					
No. Batches		1					
Data Class		Screening					
ν ₁₂ ^c	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{cu} (με)	Mean	8120					
	Minimum	6600					
	Maximum	9180					
	C.V.(%)	11.5					
	B-value	(2)					
	Distribution	Normal					
	C ₁	8120					
	C ₂	934					
	No. Specimens	6					
	No. Batches	1					
Data Class		Screening					

Table 4.4.4(g)
C/BMI 147-UT
AS4/5250-3
Compression, 1-axis
[0]₈
350/W
Screening

(1) Reference 4.4.4.

(2) Basis values are presented only for A and B data classes.

Volume 2, Chapter 4 Carbon Fiber Composites

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL: AS4/5250-3 unidirectional tape RESIN CONTENT: 28-32 wt% COMP: DENSITY: 1.58-1.61 g/cm ³ FIBER VOLUME: 59-63 % VOID CONTENT: 0.0-1.2% PLY THICKNESS: 0.0055-0.0058 in. TEST METHOD: ASTM D 3518-76 MODULUS CALCULATION: NORMALIZED BY: Not normalized					
Table 4.4.4(h) C/BMI 147-UT AS4/5250-3 Shear, 12-plane [±45]_{4s} 72/A, -67/A, 350/A, 450/A Screening					
Temperature (°F)	72	-67	350	450	
Moisture Content (%)	ambient	ambient	ambient	ambient	
Equilibrium at T, RH					
Source Code	(1)	(1)	(1)	(1)	
F₁₂^{su} (ksi)	Mean	9.61	10.1	10.4	9.01
	Minimum	8.49	9.67	9.55	8.44
	Maximum	10.4	10.5	11.0	9.47
	C.V.(%)	6.95	3.50	5.31	4.87
	B-value	(2)	(2)	(2)	(2)
	Distribution	Normal	Normal	Normal	Normal
	C ₁	9.61	10.1	10.4	9.01
	C ₂	0.668	0.352	0.553	0.439
	No. Specimens	6	6	6	6
	No. Batches	1	1	1	1
	Data Class	Screening	Screening	Screening	Screening
G₁₂^s (Msi)	Mean	0.77	0.84	0.66	0.62
	Minimum	0.71	0.78	0.62	0.50
	Maximum	0.83	0.86	0.72	0.69
	C.V.(%)	5.6	3.6	5.3	12
	No. Specimens	6	6	6	6
	No. Batches	1	1	1	1
	Data Class	Screening	Screening	Screening	Screening
γ₁₂^{su} (μ€)	Mean				
	Minimum				
	Maximum				
	C.V.(%)				
	B-value				
	Distribution				
	C ₁				
	C ₂				
	No. Specimens				
	No. Batches				
	Data Class				

(1) Reference 4.4.4.

(2) Basis values are presented only for A and B data classes.

Volume 2, Chapter 4 Carbon Fiber Composites

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		AS4/5250-3 unidirectional tape			Table 4.4.4(i) C/BMI 147-UT AS4/5250-3 Shear, 12-plane [±45]_{4s} 74/W, 350/W, 350/W Screening	
RESIN CONTENT:	28-32 wt%	COMP: DENSITY:	1.58-1.61 g/cm ³			
FIBER VOLUME:	59-63 %	VOID CONTENT:	0.0-1.2%			
PLY THICKNESS:	0.0055-0.0058 in.					
TEST METHOD:	ASTM D 3518-76					
NORMALIZED BY:		Not normalized				
Temperature (°F)		74	350	350		
Moisture Content (%)		0.55	0.55	1.1		
Equilibrium at T, RH		160°F, 95%	(1)	160°F, 95%		
Source Code		(2)	(2)	(2)		
F ₁₂ ^{su} (ksi)	Mean	12.5	8.70	9.81		
	Minimum	11.3	8.24	8.13		
	Maximum	13.2	8.95	10.6		
	C.V.(%)	5.26	3.42	9.27		
	B-value	(3)	(3)	(3)		
	Distribution	Normal	Normal	Normal		
	C ₁	12.5	8.70	9.81		
	C ₂	0.656	0.298	0.909		
	No. Specimens	6	5	6		
	No. Batches	1	1	1		
Data Class		Screening	Screening	Screening		
G ₁₂ ^s (Msi)	Mean	0.79	0.46	0.49		
	Minimum	0.77	0.43	0.40		
	Maximum	0.81	0.48	0.56		
	C.V.(%)	1.9	4.0	14		
	No. Specimens	6	6	4		
	No. Batches	1	1	1		
	Data Class	Screening	Screening	Screening		
γ ₁₂ ^{su} (μɛ)	Mean					
	Minimum					
	Maximum					
	C.V.(%)					
	B-value					
	Distribution					
	C ₁					
	C ₂					
	No. Specimens					
	No. Batches					
Data Class						

(1) Conditioned at 160°F, 95% relative humidity for 3 days (75% saturation).

(2) Reference 4.4.4.

(3) Basis values are presented only for A and B data classes.

4.4.5 IM7 6k/5250-4 RTM 4-harness satin weave fabric

These data are presented in the MIL-HDBK-17-2F Annex A.

4.4.6 T650-35 3k/5250-4 8-harness satin weave fabric

These data are presented in the MIL-HDBK-17-2F Annex A.

4.4.7 T650-35 3k/5250-4 plain weave fabric

These data are presented in the MIL-HDBK-17-2F Annex A.

4.5 CARBON - POLYIMIDE COMPOSITES

4.5.1 Celion 3000/F670 8-harness satin weave fabricMaterial Description:

Material: Celion 3000/F670

Form: 8 harness satin fabric, areal weight of 384 g/m², typical cured resin content of 30-34%, typical cured ply thickness of 0.0132-0.0144 inches.

Processing: Autoclave cure; 440°F for 2 hours; 600°F for 3 hours, 200 psi; postcure to achieve high temperature service.

General Supplier Information:

Fiber: Celion 3000 fibers are continuous carbon filaments made from PAN precursor. Filament count is 3000 filaments/tow. Typical tensile modulus is 34 x 10⁶ psi. Typical tensile strength is 515,000 psi.

Matrix: F670 is a polyimide resin (PMR 15) with good high temperature performance.

Maximum Short Term Service Temperature: 575°F (dry)

Typical applications: Commercial and military aircraft applications where high temperature resistance is a requirement.

4.5.1 Celion 3000/F670 8-harness satin weave fabric*

				C/PI 384-8HS Celion 3000/F670 Summary	
MATERIAL:	Celion 3000/F670 8-harness satin weave fabric				
FORM:	Hexcel F3L584/F670 8-harness satin weave fabric prepreg				
FIBER:	Celanese Celion 3000		MATRIX:	Hexcel F670 (PMR-15)	
T _g (dry):	635°F	T _g (wet):	T _g METHOD:		
PROCESSING:	Autoclave cure: 440°F, 2 hours; 600°F, 3 Hours, 200 psig; Postcure				

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

Date of fiber manufacture	Date of testing	8/87
Date of resin manufacture	Date of data submittal	4/89
Date of prepreg manufacture	Date of analysis	1/93
Date of composite manufacture		

LAMINA PROPERTY SUMMARY

	75°F/A		550°F/A					
Tension, 1-axis	SS - -		SS - -					
Tension, 2-axis	SS - -		SS - -					
Tension, 3-axis								
Compression, 1-axis	SS - -		SS - -					
Compression, 2-axis	SS - -		SS - -					
Compression, 3-axis								
Shear, 12-plane								
Shear, 23-plane								
Shear, 31-plane								
SB Strength, 23-plane	S - - -							
SB Strength, 31-plane	S - - -							

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

		Nominal	As Submitted	Test Method	
Fiber Density	(g/cm ³)	1.8	1.59 - 1.63		
Resin Density	(g/cm ³)	1.32			
Composite Density	(g/cm ³)	1.59			
Fiber Areal Weight	(g/m ²)	384	57 - 64		
Fiber Volume	(%)	56			
Ply Thickness	(in)				
			0.0132 - 0.0144		

LAMINATE PROPERTY SUMMARY

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		Celion 3000/F670 8-harness satin weave fabric				Table 4.5.1(a) C/PI 384-8HS Celion 3000/F670 Tension, 1-axis [0]₈ 75/A, 550/A Screening	
RESIN CONTENT:	30-34 wt%	COMP: DENSITY:	1.59-1.63 g/cm ³				
FIBER VOLUME:	57-64 %	VOID CONTENT:	0.0-0.62%				
PLY THICKNESS:	0.0132-0.0144 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3039-76							
NORMALIZED BY:		Fiber volume to 57% (0.0147 in. CPT)					
Temperature (°F)		75		550			
Moisture Content (%)		ambient		ambient			
Equilibrium at T, RH							
Source Code		22		22			
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{tu} (ksi)	Mean	132	136	116	120		
	Minimum	127	131	95.4	98.7		
	Maximum	140	144	129	134		
	C.V.(%)	2.75	2.76	7.94	7.95		
	B-value	(1)	(1)	(1)	(1)		
	Distribution	Normal	Normal	Normal	Normal		
	C ₁	132	136	116	120		
	C ₂	3.63	3.76	9.18	9.52		
	No. Specimens	9		9			
	No. Batches	3		3			
Data Class		Screening		Screening			
E ₁ ^t (Msi)	Mean	9.03	9.35	8.67	8.98		
	Minimum	8.66	8.96	8.50	8.80		
	Maximum	9.35	9.68	9.07	9.39		
	C.V.(%)	3.22	3.23	2.54	2.55		
	No. Specimens	9		9			
	No. Batches	3		3			
	Data Class		Screening		Screening		
ν ₁₂ ^t	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{tu} (με)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

(1) Basis values are presented only for A and B data classes.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		Celion 3000/F670 8-harness satin weave fabric				Table 4.5.1(b) C/PI 384-8HS Celion 3000/F670 Tension, 2-axis [90°]₈ 75/A, 550/A Screening	
RESIN CONTENT:	30-34 wt%	COMP: DENSITY:	1.59-1.63 g/cm ³				
FIBER VOLUME:	57-64 %	VOID CONTENT:	0.0-0.62%				
PLY THICKNESS:	0.0132-0.0144 in.						
TEST METHOD:	ASTM D 3039-76						
		MODULUS CALCULATION:					
NORMALIZED BY:		Fiber volume to 57% (0.0147 in. CPT)					
Temperature (°F)		75		550			
Moisture Content (%)		ambient		ambient			
Equilibrium at T, RH							
Source Code		22		22			
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₂ ^{tu} (ksi)	Mean	107	111	90.4	93.5		
	Minimum	85.6	88.6	61.9	64.1		
	Maximum	129	133	123	127		
	C.V.(%)	15.7	15.7	23.8	23.8		
	B-value	(1)	(1)	(1)	(1)		
	Distribution	ANOVA	ANOVA	ANOVA	ANOVA		
	C ₁	19.3	20.0	24.7	25.5		
	C ₂	6.09	6.09	6.02	6.02		
	No. Specimens	9		9			
	No. Batches	3		3			
Data Class	Screening		Screening				
E ₂ ^t (Msi)	Mean	8.43	8.73	8.23	8.52		
	Minimum	7.43	7.69	7.58	7.85		
	Maximum	9.33	9.66	8.84	9.15		
	C.V.(%)	7.45	7.46	5.49	5.48		
	No. Specimens	9		9			
No. Batches	3		3				
Data Class	Screening		Screening				
ν ₂₁ ^t	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₂ ^{tu} (με)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

(1) Basis values are presented only for A and B data classes.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		Celion 3000/F670 8-harness satin weave fabric				Table 4.5.1(c) C/PI 384-8HS Celion 3000/F670 Compression, 1-axis [0]_t₈ 75/A, 550/A Screening	
RESIN CONTENT:	30-34 wt%	COMP: DENSITY:	1.59-1.63 g/cm ³				
FIBER VOLUME:	57-64 %	VOID CONTENT:	0.0-0.62%				
PLY THICKNESS:	0.0132-0.0144 in.						
TEST METHOD:		MODULUS CALCULATION:					
SACMA SRM 1-88							
NORMALIZED BY:		Fiber volume to 57% (0.0147 in. CPT)					
Temperature (°F)		75		550			
Moisture Content (%)		ambient		ambient			
Equilibrium at T, RH							
Source Code		22		22			
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{cu} (ksi)	Mean	99.4	103	66.0	68.3		
	Minimum	87.9	91.3	59.0	61.1		
	Maximum	118	122	71.7	74.2		
	C.V.(%)	9.33	9.33	6.60	6.59		
	B-value	(1)	(1)	(1)	(1)		
	Distribution	ANOVA	ANOVA	Normal	Normal		
	C ₁	10.2	10.6	66.0	68.3		
	C ₂	5.28	5.28	4.36	4.51		
	No. Specimens	9		9			
	No. Batches	3		3			
Data Class		Screening		Screening			
E ₁ ^c (Msi)	Mean	8.61	8.92	8.09	8.38		
	Minimum	8.40	8.69	7.26	7.51		
	Maximum	9.09	9.41	8.78	9.09		
	C.V.(%)	2.54	2.54	5.19	5.21		
	No. Specimens	9		9			
No. Batches	3		3				
Data Class		Screening		Screening			
ν ₁₂ ^c	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{cu} (μɛ)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

(1) Basis values are presented only for A and B data classes.

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		Celion 3000/F670 8-harness satin weave fabric				Table 4.5.1(d) C/PI 384-8HS Celion 3000/F670 Compression, 2-axis [90_r]₈ 75/A, 550/A Screening	
RESIN CONTENT:	30-34 wt%	COMP: DENSITY:	1.59-1.63 g/cm ³				
FIBER VOLUME:	57-64 %	VOID CONTENT:	0.0-0.62%				
PLY THICKNESS:	0.0132-0.0144 in.						
TEST METHOD:	MODULUS CALCULATION:						
SACMA SRM 1-88							
NORMALIZED BY:		Fiber volume to 57% (0.0147 in. CPT)					
Temperature (°F)		75		550			
Moisture Content (%)		ambient		ambient			
Equilibrium at T, RH							
Source Code		22		22			
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₂ ^{cu} (ksi)	Mean	78.9	81.7	54.2	56.1		
	Minimum	76.1	78.8	52.4	54.2		
	Maximum	80.7	83.5	56.6	58.6		
	C.V.(%)	3.10	3.10	4.02	4.03		
	B-value	(1)					
	Distribution						
	C ₁						
	C ₂						
	No. Specimens	3		3			
	No. Batches	1		1			
Data Class	Screening		Screening				
E ₂ ^c (Msi)	Mean	8.08	8.37	7.67	7.94		
	Minimum	8.03	8.31	7.59	7.86		
	Maximum	8.14	8.43	7.77	8.04		
	C.V.(%)	0.681	0.720	1.19	1.15		
	No. Specimens	3		3			
	No. Batches	1		1			
	Data Class	Screening		Screening			
ν ₁₂ ^c	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₂ ^{cu} (με)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

(1) Insufficient observations to complete the statistical evaluations.

Table 4.5.1(e)
C/PI 384-8HS
Celion 3000/F670
SBS, 23-plane
[0_f]₈
75/A
Screening

MATERIAL:		Celion 3000/F670 8-harness satin weave fabric			
RESIN CONTENT:	30-34 wt%	COMP: DENSITY:	1.59-1.63 g/cm ³		
FIBER VOLUME:	57-64 %	VOID CONTENT:	0.0-0.62%		
PLY THICKNESS:	0.0132-0.0144 in.				
TEST METHOD:		MODULUS CALCULATION:			
ASTM D 2344-84					
NORMALIZED BY:		Not normalized			
Temperature (°F)		75			
Moisture Content (%)		ambient			
Equilibrium at T, RH					
Source Code		22			
F ₂₃ ^{sbs} (ksi)	Mean	11.1			
	Minimum	10.4			
	Maximum	11.7			
	C.V.(%)	5.88			
	B-value	(1)			
	Distribution				
	C ₁				
	C ₂				
	No. Specimens	3			
No. Batches	1				
Data Class	Screening				

4-300

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		Celion 3000/F670 8-harness satin weave fabric		Table 4.5.1(f) C/PI 384-8HS Celion 3000/F670 SBS, 31-plane [0_f]₈ 75/A Screening	
RESIN CONTENT:	30-34 wt%	COMP: DENSITY:	1.59-1.63 g/cm ³		
FIBER VOLUME:	57-64 %	VOID CONTENT:	0.0-0.62%		
PLY THICKNESS:	0.0132-0.0144 in.				
TEST METHOD:	MODULUS CALCULATION:				
ASTM D 2344-84					
NORMALIZED BY:		Not normalized			
Temperature (°F)	75				
Moisture Content (%)	ambient				
Equilibrium at T, RH					
Source Code	22				
F ^{sbs} ₃₁ (ksi)	Mean	10.9			
	Minimum	9.70			
	Maximum	12.0			
	C.V.(%)	6.15			
	B-value	(1)			
	Distribution	ANOVA			
	C ₁	0.722			
	C ₂	4.78			
	No. Specimens	9			
No. Batches	3				
Data Class	Screening				

(1) Short beam strength test data are approved for Screening Data Class only.

4.6 CARBON - PHENOLIC COMPOSITES

4.7 CARBON - SILICONE COMPOSITES

4.8 CARBON - POLYBENZIMIDAZOLE COMPOSITES

4.9 CARBON - PEEK COMPOSITES

4.9.1 IM6 12k/APC-2 unidirectional tape

Material Description:

Material: IM6 12k/APC-2

Form: Unidirectional tape, fiber areal weight of 150 g/m², typical cured resin content of 32%, typical cured ply thickness of 0.0053 inches.

Processing: Autoclave cure; 720°F, 30-45 mins., 60 psi.

General Supplier Information:

Fiber: IM6 fibers are continuous, intermediate modulus carbon filaments made from PAN precursor, surface treated to improve handling characteristics and structural properties. Filament count is 12,000 filaments per tow. Typical tensile modulus is 40×10^6 psi. Typical tensile strength is 635,000 psi.

Matrix: APC-2 is a semi-crystalline thermoplastic (polyetheretherketone, PEEK) resin that has high toughness and damage tolerance. It can be stored indefinitely at ambient conditions.

Maximum Short Term Service Temperature: 250°F (dry), 250°F (wet)

Typical applications: Primary and secondary structural applications on commercial and military aircraft, space components.

Data Analysis Summary:

1. Data are from publicly available report, Reference 4.9.1.

4.9.1 IM6 12k/APC-2 unidirectional tape*

					C/PEEK - UT IM6/APC-2 Summary
MATERIAL:	IM6 12k/APC-2 unidirectional tape				
FORM:	Fiberite IM6/APC-2 unidirectional tape prepreg				
FIBER:	Hercules IM6 12k		MATRIX:	Fiberite APC-2	
T _g (dry):	291°F	T _g (wet):	309°F	T _g METHOD:	DMA
PROCESSING:	Autoclave cure: 720°F, 30 - 45 minutes, 60 psig				

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

Date of fiber manufacture	Date of testing
Date of resin manufacture	Date of data submittal 12/88
Date of prepreg manufacture	Date of analysis 1/93
Date of composite manufacture	

LAMINA PROPERTY SUMMARY

	74°F/A		-67°F/A	180°F/A	250°F/A	180°F/O	74°F/W	180°F/W
Tension, 1-axis	SSSS		SSSS	SSSS	SSSS	SSSS	SSSS	SSSS
Tension, 2-axis	SS-S		SS-S	SS-S	SS-S			
Tension, 3-axis								
Compression, 1-axis	SS-S		SS-S	SS-S	SS-S	SS-S	SS-S	SS-S
Compression, 2-axis								
Compression, 3-axis								
Shear, 12-plane	SS--		SS--	SS--	SS--	SS--	SS--	SS--
Shear, 23-plane								
Shear, 31-plane								

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WERE NOT SUPPLIED FOR THIS MATERIAL.

		Nominal	As Submitted	Test Method	
Fiber Density	(g/cm ³)	1.73	1.54 - 1.58	ASTM D 792	
Resin Density	(g/cm ³)	1.28			
Composite Density	(g/cm ³)	1.55			
Fiber Areal Weight	(g/m ²)		60 - 62		
Fiber Volume	(%)	60			
Ply Thickness	(in)	0.0054			

LAMINATE PROPERTY SUMMARY

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		IM6 12k/APC-2 unidirectional tape				Table 4.9.1(a) C/PEEK - UT IM6/APC-2 Tension, 1-axis [0]₈ 74/A, -67/A, 180/A Screening	
RESIN CONTENT:	32 wt%	COMP: DENSITY:	1.55 g/cm ³				
FIBER VOLUME:	61-62 %	VOID CONTENT:	0.0-0.2%				
PLY THICKNESS:	0.0053-0.0054 in.						
TEST METHOD:	MODULUS CALCULATION:						
ASTM D 3039-76							
NORMALIZED BY:		Specimen thickness and batch fiber volume to 60% (0.0055 in. CPT)					
Temperature (°F)		74		-67		180	
Moisture Content (%)		ambient		ambient		ambient	
Equilibrium at T, RH							
Source Code		(1)		(1)		(1)	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{tu} (ksi)	Mean	350	370	376	398	327	344
	Minimum	266	282	326	345	234	248
	Maximum	426	455	412	439	402	421
	C.V.(%)	15.9	16.0	8.69	8.93	17.3	16.8
	B-value	(2)	(2)	(2)	(2)	(2)	(2)
	Distribution	Normal	Normal	Normal	Normal	Normal	Normal
	C ₁	350	370	376	398	327	344
	C ₂	55.5	59.3	32.7	35.6	56.4	58.0
No. Specimens		6		6		6	
No. Batches		1		1		1	
Data Class		Screening		Screening		Screening	
E ₁ ^t (Msi)	Mean	21.6	22.9	22.0	23.3	23.2	24.4
	Minimum	21.3	22.4	20.9	22.2	22.3	23.6
	Maximum	22.0	23.3	23.2	24.5	23.7	25.0
	C.V.(%)	1.41	1.58	3.35	3.26	2.24	2.17
	No. Specimens	6		6		6	
	No. Batches	1		1		1	
	Data Class	Screening		Screening		Screening	
	Mean	0.342		0.357		0.355	
ν ₁₂ ^t	No. Specimens	6		6		6	
	No. Batches	1		1		1	
	Data Class	Screening		Screening		Screening	
ε ₁ ^{tu} (με)	Mean	13600		15900		14100	
	Minimum	8100		13500		10400	
	Maximum	17500		17200		16800	
	C.V.(%)	24.6		9.23		14.9	
	B-value	(2)		(2)		(2)	
	Distribution	Normal		Normal		Normal	
	C ₁	13600		15900		14100	
	C ₂	3350		1470		2100	
	No. Specimens	6		6		6	
	No. Batches	1		1		1	
Data Class		Screening		Screening		Screening	

(1) Reference 4.9.1.

(2) Basis values are presented only for A and B data classes.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		IM6 12k/APC-2 unidirectional tape				Table 4.9.1(b) C/PEEK - UT IM6/APC-2 Tension, 1-axis [0]₈ 250/A, 74/0.13%, 180/0.11% Screening	
RESIN CONTENT:	32 wt%	COMP: DENSITY:	1.55 g/cm ³				
FIBER VOLUME:	61-62 %	VOID CONTENT:	0.0-0.2%				
PLY THICKNESS:	0.0053-0.0054 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3039-76							
NORMALIZED BY:		Specimen thickness and batch fiber volume to 60% (0.0055 in. CPT)					
Temperature (°F)		250		180		74	
Moisture Content (%)		ambient		0.11		0.13	
Equilibrium at T, RH				(1)		160°F, 95%	
Source Code		(2)		(2)		(2)	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F_1^{tu} (ksi)	Mean	304	322	369	390	352	371
	Minimum	253	269	303	320	271	286
	Maximum	341	363	403	425	415	434
	C.V.(%)	11.4	11.4	12.3	12.2	14.6	14.2
	B-value	(3)	(3)	(3)	(3)	(3)	(3)
	Distribution	Normal	Normal	Normal	Normal	Normal	Normal
	C ₁	304	322	369	390	352	371
	C ₂	34.7	36.6	45.3	47.6	51.4	52.6
	No. Specimens	6		5		6	
	No. Batches	1		1		1	
Data Class		Screening		Screening		Screening	
E_1^t (Msi)	Mean	21.4	22.7	21.8	23.0	21.2	22.3
	Minimum	20.5	21.9	20.9	22.1	20.4	21.6
	Maximum	22.1	23.4	22.2	23.5	22.0	23.0
	C.V.(%)	2.70	2.42	2.42	2.42	3.15	3.04
	No. Specimens	6		5		6	
No. Batches	1		1		1		
Data Class		Screening		Screening		Screening	
ν_{12}^t	Mean	0.338		0.366		0.372	
	No. Specimens	6		5		6	
	No. Batches	1		1		1	
	Data Class	Screening		Screening		Screening	
ϵ_1^{tu} (µε)	Mean	14800		16300		18100	
	Minimum	12500		14400		15700	
	Maximum	16400		17200		20800	
	C.V.(%)	11.8		6.70		10.8	
	B-value	(3)		(3)		(3)	
	Distribution	Normal		Normal		Normal	
	C ₁	14800		16300		18100	
	C ₂	1760		1090		1960	
	No. Specimens	6		5		6	
	No. Batches	1		1		1	
Data Class		Screening		Screening		Screening	

(1) Conditioned at 160°F, 96% relative humidity for 3 days (75% saturation).

(2) Reference 4.9.1.

(3) Basis values are presented only for A and B data classes.

* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		IM6 12k/APC-2 unidirectional tape				Table 4.9.1(c) C/PEEK - UT IM6/APC-2 Tension, 1-axis [0]₈ 180/0.14% Screening						
RESIN CONTENT:	32 wt%	COMP: DENSITY:	1.55 g/cm ³									
FIBER VOLUME:	61-62 %	VOID CONTENT:	0.0-0.2%									
PLY THICKNESS:	0.0053-0.0054 in.											
TEST METHOD:	MODULUS CALCULATION:											
ASTM D 3039-76												
NORMALIZED BY:		Specimen thickness and batch fiber volume to 60% (0.0055 in. CPT)										
Temperature (°F)		180										
Moisture Content (%)		0.14										
Equilibrium at T, RH		160°F, 95%										
Source Code		(1)										
		Normalized	Measured	Normalized	Measured	Normalized	Measured					
F ₁ ^{tu} (ksi)	Mean	364	385									
	Minimum	325	344									
	Maximum	411	436									
	C.V.(%)	10.2	10.1									
	B-value	(2)	(2)									
	Distribution	Normal	Normal									
	C ₁	364	385									
	C ₂	37.2	38.8									
	No. Specimens	6										
	No. Batches	1										
Data Class		Screening										
E ₁ ^t (Msi)	Mean	21.2	22.4									
	Minimum	20.5	21.8									
	Maximum	22.2	23.2									
	C.V.(%)	3.14	2.77									
	No. Specimens	6										
	No. Batches	1										
	Data Class		Screening									
	ν ₁₂ ^t	Mean						0.332				
		No. Specimens	6									
		No. Batches	1									
Data Class		Screening										
ε ₁ ^{tu} (με)	Mean		15400									
	Minimum		13600									
	Maximum		17200									
	C.V.(%)		9.24									
	B-value		(2)									
	Distribution		Normal									
	C ₁		15400									
	C ₂		1420									
	No. Specimens	6										
	No. Batches	1										
Data Class		Screening										

(1) Reference 4.9.1.

(2) Basis values are presented only for A and B data classes.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		IM6 12k/APC-2 unidirectional tape				Table 4.9.1(d) C/PEEK-UT IM6/APC-2 Tension, 2-axis [90]₁₆ 74/A, -67/A, 180/A, 250/A Screening	
RESIN CONTENT:	31-34 wt%	COMP: DENSITY:	1.55 g/cm ³				
FIBER VOLUME:	60-62 %	VOID CONTENT:	0.0%				
PLY THICKNESS:	0.0054-0.0058 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3039-76							
NORMALIZED BY:		Not normalized					
Temperature (°F)		74	-67	180	250		
Moisture Content (%)		ambient	ambient	ambient	ambient		
Equilibrium at T, RH							
Source Code		(1)	(1)	(1)	(1)		
F ₂ ^{tu} (ksi)	Mean	9.41	9.67	11.1	9.07		
	Minimum	8.53	8.72	10.0	7.30		
	Maximum	10.6	10.7	12.2	9.72		
	C.V.(%)	9.35	6.52	8.87	10.1		
	B-value	(2)	(2)	(2)	(2)		
	Distribution	Normal	Normal	Normal	Normal		
	C ₁	9.41	9.67	11.1	9.07		
	C ₂	0.880	0.631	0.985	0.916		
	No. Specimens	6	6	6	6		
	No. Batches	1	1	1	1		
Data Class		Screening	Screening	Screening	Screening		
E ₂ ^t (Msi)	Mean	1.28	1.41	1.22	1.32		
	Minimum	1.24	1.35	1.17	1.27		
	Maximum	1.36	1.46	1.25	1.38		
	C.V.(%)	3.33	3.32	2.13	3.44		
	No. Specimens	6	6	6	6		
	No. Batches	1	1	1	1		
	Data Class	Screening	Screening	Screening	Screening		
ν ₂₁ ^t	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₂ ^{tu} (μɛ)	Mean	7610	7120	10900	12300		
	Minimum	6650	6450	8850	8510		
	Maximum	8830	8180	14900	23600		
	C.V.(%)	11.2	8.15	20.0	45.5		
	B-value	(2)	(2)	(2)	(2)		
	Distribution	Normal	Normal	Normal	Nonpara.		
	C ₁	7610	7120	10900	5		
	C ₂	850	581	2180	3.06		
	No. Specimens	6	6	6	6		
	No. Batches	1	1	1	1		
	Data Class	Screening	Screening	Screening	Screening		

(1) Reference 4.9.1.

(2) Basis values are presented only for A and B data classes.

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* DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		IM6 12k/APC-2 unidirectional tape				Table 4.9.1(e) C/PEEK - UT IM6/APC-2 Compression, 1-axis [0]₁₆ 74/A, -67/A, 180/A Screening	
RESIN CONTENT:	32 wt%	COMP: DENSITY:	1.55 g/cm ³				
FIBER VOLUME:	60-62 %	VOID CONTENT:	0.0%				
PLY THICKNESS:	0.0054-0.0058 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3410A-87							
NORMALIZED BY:		Specimen thickness and batch fiber volume to 60% (0.0055 in. CPT)					
Temperature (°F)		74		-67		180	
Moisture Content (%)		ambient		ambient		ambient	
Equilibrium at T, RH							
Source Code		(1)		(1)		(1)	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{cu} (ksi)	Mean	167	169	156	160	156	155
	Minimum	139	144	115	118	103	96.7
	Maximum	197	200	179	181	195	190
	C.V.(%)	13.3	13.3	16.0	15.6	20.2	20.4
	B-value	(2)	(2)	(2)	(2)	(2)	(2)
	Distribution	Normal	Normal	Normal	Normal	Normal	Normal
	C ₁	167	169	156	160	156	155
	C ₂	22.1	22.4	25.0	24.9	31.5	31.6
	No. Specimens	6		6		6	
	No. Batches	1		1		1	
Data Class		Screening		Screening		Screening	
E ₁ ^c (Msi)	Mean	19.4	19.7	20.4	20.9	21.4	21.2
	Minimum	17.6	18.1	16.9	17.3	17.0	16.0
	Maximum	20.9	21.2	24.0	24.8	27.5	26.7
	C.V.(%)	6.54	7.17	12.2	12.6	16.1	16.1
	No. Specimens	6		6		6	
No. Batches		1		1		1	
Data Class		Screening		Screening		Screening	
ν ₁₂ ^c	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{cu} (με)	Mean	8790		7910		8010	
	Minimum	7780		4510		5950	
	Maximum	10500		9630		9350	
	C.V.(%)	11.8		24.7		14.9	
	B-value	(2)		(2)		(2)	
	Distribution	Normal		Normal		Normal	
	C ₁	8790		7910		8010	
	C ₂	1040		1950		1200	
	No. Specimens	6		6		6	
	No. Batches	1		1		1	
Data Class		Screening		Screening		Screening	

(1) Reference 4.9.1.

(2) Basis values are presented only for A and B data classes.

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MATERIAL:		IM6 12k/APC-2 unidirectional tape				Table 4.9.1(f) C/PEEK - UT IM6/APC-2 Compression, 1-axis [0]₁₆ 250/A, 74/0.12%, 180/0.097% Screening	
RESIN CONTENT:	32 wt%	COMP: DENSITY:	1.55 g/cm ³				
FIBER VOLUME:	60-62 %	VOID CONTENT:	0.0%				
PLY THICKNESS:	0.0054-0.0058 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3410A-87							
NORMALIZED BY:		Specimen thickness and batch fiber volume to 60% (0.0055 in. CPT)					
Temperature (°F)		250		180		74	
Moisture Content (%)		ambient		0.097		0.12	
Equilibrium at T, RH				(1)		160°F, 95%	
Source Code		(2)		(2)		(2)	
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{cu} (ksi)	Mean	129	126	162	160	174	176
	Minimum	70.0	71.5	156	146	141	144
	Maximum	154	145	168	169	186	192
	C.V.(%)	23.6	21.8	3.25	5.36	9.6	9.7
	B-value	(3)	(3)	(3)	(3)	(3)	(3)
	Distribution	Normal	Nonpara.	Normal	Normal	Normal	Normal
	C ₁	129	5	162	160	174	176
	C ₂	30.5	3.06	5.26	8.59	16.7	17.1
	No. Specimens	6		5		6	
	No. Batches	1		1		1	
Data Class		Screening		Screening		Screening	
E ₁ ^c (Msi)	Mean	21.2	20.7	19.5	19.3	21.4	21.6
	Minimum	19.6	19.0	18.7	18.6	18.8	19.3
	Maximum	24.7	23.2	20.0	20.7	23.9	23.9
	C.V.(%)	8.47	7.37	2.91	4.42	8.60	7.38
	No. Specimens	6		5		6	
No. Batches		1		1		1	
Data Class		Screening		Screening		Screening	
ν ₁₂ ^c	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{cu} (με)	Mean	6860		8310		8690	
	Minimum	3380		7500		6950	
	Maximum	8990		9390		12100	
	C.V.(%)	28.7		8.94		23.5	
	B-value	(3)		(3)		(3)	
	Distribution	Normal		Normal		Normal	
	C ₁	6860		8310		8690	
	C ₂	1970		743		2050	
	No. Specimens	6		5		6	
	No. Batches	1		1		1	
Data Class		Screening		Screening		Screening	

(1) Conditioned at 160°F, 95% relative humidity for 10 days (75% saturation).

(2) Reference 4.9.1.

(3) Basis values are presented only for A and B data classes.

- DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		IM6 12k/APC-2 unidirectional tape				Table 4.9.1(g) C/PEEK - UT IM6/APC-2 Compression, 1-axis [0]₁₆ 180/W Screening	
RESIN CONTENT:	32 wt%	COMP: DENSITY:	1.55 g/cm ³				
FIBER VOLUME:	60-62 %	VOID CONTENT:	0.0%				
PLY THICKNESS:	0.0054-0.0058 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3410A-87							
NORMALIZED BY:		Specimen thickness and batch fiber volume to 60% (0.0055 in. CPT)					
Temperature (°F)		180					
Moisture Content (%)		0.11					
Equilibrium at T, RH		160°F, 95%					
Source Code		(1)					
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{cu} (ksi)	Mean	154	151				
	Minimum	105	98.5				
	Maximum	189	183				
	C.V.(%)	18.2	19.3				
	B-value	(2)	(2)				
	Distribution	Normal	Normal				
	C ₁	154	151				
	C ₂	28.0	29.3				
	No. Specimens	6					
	No. Batches	1					
Data Class		Screening					
E ₁ ^c (Msi)	Mean	20.3	19.8				
	Minimum	15.6	15.7				
	Maximum	25.3	24.6				
	C.V.(%)	18.4	17.6				
	No. Specimens	6					
	No. Batches	1					
	Data Class	Screening					
ν ₁₂ ^c	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{cu} (με)	Mean	8180					
	Minimum	6580					
	Maximum	9500					
	C.V.(%)	13.0					
	B-value	(2)					
	Distribution	Normal					
	C ₁	8180					
	C ₂	1070					
	No. Specimens	6					
	No. Batches	1					
Data Class		Screening					

(1) Reference 4.9.1.

(2) Basis values are presented only for A and B data classes.

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MATERIAL: IM6 12k/APC-2 unidirectional tape RESIN CONTENT: 31-32 wt% COMP: DENSITY: 1.55 g/cm ³ FIBER VOLUME: 61 % VOID CONTENT: 0.0-0.2% PLY THICKNESS: 0.0052-0.0056 in. TEST METHOD: ASTM D 3518-76 MODULUS CALCULATION: NORMALIZED BY: Not normalized					
Table 4.9.1(h) C/PEEK - UT IM6/APC-2 Shear, 12-plane [±45]_{4S} 74/A, -67/A, 180/A, 250/A Screening					
Temperature (°F)	74	-67	180	250	
Moisture Content (%)	ambient	ambient	ambient	ambient	
Equilibrium at T, RH					
Source Code	(1)	(1)	(1)	(1)	
F_{12}^{su} (ksi)	Mean	23.9	25.4	22.4	19.8
	Minimum	18.9	18.1	17.2	14.2
	Maximum	27.8	29.0	25.3	23.1
	C.V.(%)	14.8	14.8	15.6	15.1
	B-value	(2)	(2)	(2)	(2)
	Distribution	Normal	Normal	Normal	Normal
	C ₁	23.9	25.4	22.4	19.8
	C ₂	3.53	3.77	3.49	2.98
	No. Specimens	6	6	6	6
	No. Batches	1	1	1	1
	Data Class	Screening	Screening	Screening	Screening
G_{12}^s (Msi)	Mean	0.78	0.91	0.78	0.71
	Minimum	0.73	0.83	0.72	0.63
	Maximum	0.83	0.96	0.86	0.79
	C.V.(%)	5.5	5.5	6.2	9.3
	No. Specimens	6	6	6	6
	No. Batches	1	1	1	1
	Data Class	Screening	Screening	Screening	Screening
γ_{12}^{su} (µε)	Mean				
	Minimum				
	Maximum				
	C.V.(%)				
	B-value				
	Distribution				
	C ₁				
	C ₂				
	No. Specimens				
	No. Batches				
	Data Class				

(1) Reference 4.9.1.

(2) Basis values are presented only for A and B data classes.

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- DATA WERE SUBMITTED BEFORE THE ESTABLISHMENT OF DATA DOCUMENTATION REQUIREMENTS (JUNE 1989). ALL DOCUMENTATION PRESENTLY REQUIRED WAS NOT SUPPLIED FOR THIS MATERIAL.

MATERIAL:		IM6 12k/APC-2 unidirectional tape			Table 4.9.1(i) C/PEEK - UT IM6/APC-2 Shear, 12-plane [±45]_{4s} 74/0.21%, 180/0.17%, 180/0.20% Screening	
RESIN CONTENT:	31-32 wt%	COMP: DENSITY:	1.55 g/cm ³			
FIBER VOLUME:	61 %	VOID CONTENT:	0.0-0.2%			
PLY THICKNESS:	0.0052-0.0056 in.					
TEST METHOD:		MODULUS CALCULATION:				
ASTM D 3518-76						
NORMALIZED BY:		Not normalized				
Temperature (°F)		180	74	180		
Moisture Content (%)		0.17	0.21	0.20		
Equilibrium at T, RH		(1)	160°F, 95%	160°F, 95%		
Source Code		(2)	(2)	(2)		
F ₁₂ ^{su} (ksi)	Mean	23.3	23.0	20.0		
	Minimum	21.8	16.2	14.5		
	Maximum	24.0	26.7	26.1		
	C.V.(%)	3.85	15.4	22.4		
	B-value	(3)	(3)	(3)		
	Distribution	Normal	Normal	Normal		
	C ₁	23.3	23.0	20.0		
	C ₂	0.897	3.55	4.48		
	No. Specimens	5	6	6		
	No. Batches	1	1	1		
Data Class		Screening	Screening	Screening		
G ₁₂ ^s (Msi)	Mean	0.76	0.79	0.71		
	Minimum	0.74	0.65	0.64		
	Maximum	0.78	0.89	0.78		
	C.V.(%)	2.7	10	9.0		
	No. Specimens	4	6	6		
	No. Batches	1	1	1		
	Data Class	Screening	Screening	Screening		
γ ₁₂ ^{su} (μɛ)	Mean					
	Minimum					
	Maximum					
	C.V.(%)					
	B-value					
	Distribution					
	C ₁					
	C ₂					
	No. Specimens					
	No. Batches					
Data Class						

(1) Conditioned at 160°F, 95% relative humidity for 27 days (75% saturation).

(2) Reference 4.9.1.

(3) Basis values are presented only for A and B data classes.

4.10 CARBON – CYANATE ESTER COMPOSITES

4.10.1 M55J 6k/954-3 unidirectional tape

Material Description:

Material: M55J 6k/954

Form: Unidirectional tape, nominal fiber areal weight of 72.9 g/m^2 , nominal cured resin content of 27%, typical cured ply thickness of 0.0024 inches.

Processing: Autoclave cure; 350°F, 100 psi for two hours

General Supplier Information:

Fiber: M55J 6k fibers are continuous untwisted carbon filaments made from PAN precursor. Filament count is 6,000 filaments per tow. Typical tensile modulus is 78×10^6 psi. Typical tensile strength is 583,000 psi.

Matrix: 954 is a 350°F curing cyanate ester resin.

Maximum Short Term Service Temperature: 350°F (dry), 250°F (wet)

Typical applications: Dimensionally stable structure for optical instruments

4.10.1 M55J 6k/954-3 unidirectional tape

				C/CE 73-UT M55J/954-3 Summary	
MATERIAL:	M55J 6k/954-3 unidirectional tape				
FORM:	M55J 6k/954-3 unidirectional tape prepreg				
FIBER:	Toray M55J 6k, surface treated Type 5, no twist		MATRIX:	Hexcel 954-3	
T _g (dry):	390°F	T _g (wet):	340°F	T _g METHOD:	TMA flexure @ ramp rate 70°F/min
PROCESSING:	Autoclave cure: 350°F, 2 hrs., 100 psi				

Date of fiber manufacture	1/96 - 2/97	Date of testing	1/96 - 7/97
Date of resin manufacture	1/96 - 7/97	Date of data submittal	10/1/97
Date of prepreg manufacture	1/96 - 7/97	Date of analysis	9/98
Date of composite manufacture	1/96 - 7/97		

LAMINA PROPERTY SUMMARY

	72°F/A							
Tension, 1-axis	aM - -							
Tension, 2-axis								
Tension, 3-axis								
Compression, 1-axis	aM - -							
Compression, 2-axis								
Compression, 3-axis								
SBS, 31-plane	S - - -							

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

		Nominal	As Submitted	Test Method
Fiber Density	(g/cm ³)	1.91	1.91	ASTM D 792-86 ASTM D 792-86 ASTM D 3529-90
Resin Density	(g/cm ³)	1.19	1.19	
Composite Density	(g/cm ³)	1.65	1.62 - 1.66	
Fiber Areal Weight	(g/m ²)	72.9	71.2 - 75.1	
Fiber Volume	(%)	64	53 - 67	
Ply Thickness	(in)	0.0024	0.0023-0.0026	

LAMINATE PROPERTY SUMMARY

Classes of data in Strength/Modulus/Poisson's Ratio/Strain-to-Failure order: A = A75, a = A55, B = B30, b = B18, M = Mean, I = Interim, S = Screening, - = no data (See Table 1.4.2(c))

MATERIAL:		M55J 6k/954-3 unidirectional tape		Table 4.10.1(a) C/CE 73-UT M55J/954-3 Tension, 1-axis [0]₁₆ 72/A A55, Mean			
RESIN CONTENT:	22.3 - 24.1 wt%	COMP: DENSITY:	1.66 - 1.67 g/cm ³				
FIBER VOLUME:	53.1 - 65.4 %	VOID CONTENT:	0.30 - 0.49%				
PLY THICKNESS:	0.0024 - 0.0025 in.						
TEST METHOD:		MODULUS CALCULATION:					
ASTM D 3039-95		Chord between 1000 and 3000 με					
NORMALIZED BY:		Specimen thickness and batch fiber areal weight to 60% (0.0024 in. CPT)					
Temperature (°F)		72					
Moisture Content (%)		Ambient					
Equilibrium at T, RH							
Source Code		72					
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{tu} (ksi)	Mean	324	320				
	Minimum	274	277				
	Maximum	367	387				
	C.V.(%)	5.37	7.52				
	A-value/B-value	250/286	216/260				
	Distribution	ANOVA	ANOVA				
	C ₁	17.8	25.0				
	C ₂	2.15	2.41				
	No. Specimens	109					
	No. Batches	6					
Data Class	A55						
E ₁ ^t (Msi)	Mean	47.7	47.0				
	Minimum	43.6	43.1				
	Maximum	52.0	52.1				
	C.V.(%)	3.66	4.21				
	No. Specimens	109					
	No. Batches	6					
	Data Class	Mean					
ν ₁₂ ^t	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{tu} (με)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

MATERIAL:		M55J 6k/954-3 unidirectional tape		Table 4.10.1(b) C/CE 73-UT M55J/954-3 Compression, 1-axis [0]₃₂ 72/A A55, Mean			
RESIN CONTENT:	23.5 - 27.4 wt%	COMP: DENSITY:	1.63 - 1.67 g/cm ³				
FIBER VOLUME:	54.9 - 66.1 %	VOID CONTENT:	0.17 - 0.27%				
PLY THICKNESS:	0.0023 - 0.0024 in.						
TEST METHOD:		MODULUS CALCULATION:					
SACMA SRM1-94 (1)		Chord between 1000 and 3000 µε					
NORMALIZED BY:		Specimen thickness and batch fiber areal weight to 60% (0.0024 in. CPT)					
Temperature (°F)		72					
Moisture Content (%)		Ambient					
Equilibrium at T, RH		72					
Source Code							
		Normalized	Measured	Normalized	Measured	Normalized	Measured
F ₁ ^{cu} (ksi)	Mean	136	138				
	Minimum	109	111				
	Maximum	163	163				
	C.V.(%)	7.22	6.73				
	A-value/B-value	96/109	103/118				
	Distribution	ANOVA	ANOVA				
	C ₁	10.4	9.50				
	C ₂	2.62	2.14				
	No. Specimens	102					
	No. Batches	6					
Data Class		A55					
E ₁ ^c (Msi)	Mean	44.8	45.6				
	Minimum	39.8	42.3				
	Maximum	49.3	50.0				
	C.V.(%)	4.70	3.78				
	No. Specimens	102					
	No. Batches	6					
	Data Class	Mean					
ν ₁₂ ^c	Mean						
	No. Specimens						
	No. Batches						
	Data Class						
ε ₁ ^{cu} (µε)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
	B-value						
	Distribution						
	C ₁						
	C ₂						
	No. Specimens						
	No. Batches						
Data Class							

(1) Torque on fixture bolts was “finger tight”, not specifically torqued to 5-10 in-lbs.

MATERIAL:		M55J 6k/954-3 unidirectional tape				Table 4.10.1(c) C/CE 73-UT M55J/954-3 SBS, 31 plane [0]₃₂ 72/A Screening
RESIN CONTENT:	23.5 - 27.4 wt%	COMP: DENSITY:	1.63 - 1.67 g/cm ³			
FIBER VOLUME:	57.3 - 66.7 %	VOID CONTENT:	0.17 - 0.27%			
PLY THICKNESS:	0.0023 - 0.0024 in.					
TEST METHOD:	MODULUS CALCULATION:					
ASTM D 2344-95						
NORMALIZED BY:		Not normalized				
Temperature (°F)		72				
Moisture Content (%)		Ambient				
Equilibrium at T, RH						
Source Code		72				
F ₁₃ ^{sbs} (ksi)	Mean	11.1				
	Minimum	9.90				
	Maximum	12.2				
	C.V.(%)	5.31				
	A-value/B-value	(1)				
	Distribution	ANOVA				
	C ₁	0.623				
	C ₂	2.68				
	No. Specimens	113				
	No. Batches	6				
	Data Class	Screening				

(1) Short beam strength test data are approved for Screening Data Class only.

REFERENCES

- 4.2.27 Askins, Robert, "Characterization of EA9396 Epoxy Resin for Composite Repair Applications," University of Dayton Research Center, UDR-TR-91-77, WL-TR-92-4060, October 1991.
- 4.4.4 Rondeau, R.A., Askins, D. R., and Sjoblom, P., "Development of Engineering Data on New Aerospace Materials," University of Dayton Research Institute, UDR-TR-88-88, AFWAL-TR-88-4217, December 1988, Distribution authorized to DoD and DoD contractors only; critical technology; September 1988. Other requests for this document should be referred to AFWAL/MLSE, OH 45433-6533.
- 4.9.1 Rondeau, R.A., Askins, D. R., and Sjoblom, P., "Development of Engineering Data on New Aerospace Materials," University of Dayton Research Institute, UDR-TR-88-88, AFWAL-TR-88-4217, December 1988, Distribution authorized to DoD and DoD contractors only; critical technology; September 1988. Other requests for this document should be referred to AFWAL/MLSE, OH 45433-6533.