



Advanced General Aviation Transport Experiments

Laminate Design Allowables for Epoxy – Based Prepreg

FiberCote Graphite Fabric T300 3KPW / E765

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1. INTRODUCTION

1.1. Scope

The test methods and results described in this document are intended to provide basic composite properties essential to most methods of analysis. These properties are considered to provide the initial base of the “building block” approach. Additional coupon level tests and subelement tests may be required to fully substantiate the full-scale design.

The test methods and results contained in this document are consistent with MIL-HDBK-17-1E,2D,3E - Military Handbook for Polymer Matrix Composites. All material, specimens, fixtures and test results contained within this document were traceable and conformed by the Federal Aviation Administration (FAA). It should be noted that before application of the basis values presented in this document to design, demonstration of the ability to consistently produce equivalent material properties as that evaluated during this program should be substantiated through an acceptable test program.

1.2. Symbols Used

E^{br}	cord modulus
E^c	compressive modulus, longitudinal
E^t	tensile modulus, longitudinal
F^{bu}	bearing strength
F^{cu}	compressive strength, longitudinal
F^{tu}	tensile strength, longitudinal
$F^{2\%}$	bearing 2% offset strength
ϵ^{by}	ultimate bypass strain
$\mu\epsilon$	micro-strain

Superscripts

br	bearing (for cord modulus)
bu	bearing ultimate
by	bearing-bypass ultimate
c	compression
cu	compression ultimate
t	tension
tu	tension ultimate
2%	2% offset

1.3. Acronyms and Definitions

AGATE	Advanced General Aviation Transport Experiments
ASTM	American Society for Testing and Materials
C. V.	coefficient of variation
CTD	cold temperature dry
CPT	cured ply thickness
DMA	dynamic mechanical analysis
dry	specimen tested with an “as fabricated” moisture content
ETD	elevated temperature dry
ETW	elevated temperature wet
FAR	Federal Aviation Regulations
FAW	fiber areal weight
Gr/Ep	graphite/epoxy
NASA	National Aeronautics and Space Administration
RTD	room temperature dry
SACMA	Suppliers of Advanced Composite Materials Association
SRM	SACMA Recommended Method
T_g	glass transition temperature
t_{ply}	cured ply thickness
wet	specimen tested with an equilibrium moisture content per section 1.5.2

1.4. References

ASTM Standards

D792-91	Density and Specific Gravity (Relative Density) of Plastics by Displacement
D2734-94	Void Content of Reinforced Plastics
D3171-90	Fiber Content of Resin – Matrix Composites by Matrix Digestion
D4065	Determining and Reporting Dynamic Mechanical Properties of Plastics
D5766-95	Open Hole Tensile Properties of Polymer Matrix Composite Laminates
D5961-01	Bearing Response of Polymer Matrix Composites Laminates
D6484-99	Open-Hole Compressive Strength of Polymer Matrix Composite Laminates

SACMA Standards

SRM 3R-94	Open-Hole Compression Properties of Oriented Fiber-Resin Composites
SRM 18-94	Glass Transition Temperature (T_g) Determination by DMA of Oriented Fiber-Resin Composites

Other Documents

FiberCote Document Number E765 MS100, Material Specification: Carbon Fiber Reinforced Epoxy Resin, Rev. N/A

FiberCote Document Number E765 PS1000, Process Specification: Layup and Cure of Epoxy Prepreg Materials, 270-280°F Curing, Rev. N/A

MIL-HDBK-17 1E, 2D, 3E – Military Handbook for Polymer Matrix Composites

1.5. Methodology

1.5.1. Test Matrix

Testing was performed according to the test methods delineated in the test matrix, with modifications as referenced in MIL-HDBK-17 Section 7 “Structural Element Characterization”. The test matrix for properties included in this document is listed on the next page.

The allowables used for design of composite laminate structures were developed from the testing summarized in Table 1. The data generated are physical properties and laminate mean strength and/or strain design allowables that include the effects of the critical environmental conditions. The specific design properties that were obtained from these laminate tests are the infinite plate gross strain design allowables for in-plane tension and compression as well as bearing strength/bypass strain allowables for bolted joints.

Table 1. Summary of Laminate Tests

Material Form	Test Description	Ref. Table Number
Plain Weave Fabric	Physical Properties	2
	Mechanical Properties	3, 4, 5, and 6

Physical property testing is presented in Table 2. As the mechanical properties of fiber reinforced epoxy matrix laminates are dependent upon both the volume percentages of the resin/fiber as well as the extent of the resin reaction achieved during processing, physical testing was performed to verify these characteristics for representative test laminates.

Table 2. Cured Laminate Physical Properties Test Matrix

Test Description	Test Method	Test Sampling Scheme
Cured Laminate Specific Gravity	ASTM D792	3 per laminate configuration
Cured Resin Content	299-947-299 (Method 506.1)	3 per laminate configuration
Percent Total Cure (DSC)	ASTM D3417	3 per material batch
Glass Transition Temperature	Dry Wet	ASTM D4065 ASTM D4065
		3 per material batch 3 per material batch

The test matrix for laminate in-plane tension properties of 193 g/m² plain weave carbon/epoxy is presented in Table 3. This testing was based upon the minimum recommended matrix for initial empirical assessment and determination of notched strength data for a range of laminates as

defined in section 7.2.6 of MIL-HDBK-17, with additional tests to account for variables that have been demonstrated to be critical in previous laminate design allowable test programs. The minimum recommended matrix has been modified in accordance with Table 3 as follows:

- No Hole Tension @ 75°F/Dry to verify classical laminate theory predictions of laminate stiffness, to determine stress-strain behavior up to ultimate load and to develop factors for notched vs. un-notched laminate tensile strength.
- Filled hole tension testing for all laminate configurations to define the pure bypass end-point of the tension bearing-bypass interaction curve for bolted joint allowables.
- Open hole tension testing for relatively “soft” laminates, since previous testing has demonstrated that for certain material systems, the open hole tension condition can be critical for soft laminate configurations.
- 180°F/Wet environment tension testing at the critical hole condition for relatively “soft” laminates, since previous testing has demonstrated that for certain material systems, the 180°F/Wet environment can be critical in tension for soft laminate configurations.
- All notched laminate testing for this program was performed with a 0.25-inch diameter hole at a W/D ratio of 6.

Table 3. Laminate Tension Tests for 193 g/m² Plain Weave Fabric

Layup	Specimen Type	Material Batch	Environment			Total
			-65°F/Dry	75°F/Dry	180°F/Wet	
40/20/40	No Hole	1		3		3
	Filled Hole	1	5	5		10
25/50/25	No Hole	1		3		3
	Filled Hole	1	5	5		10
	Open Hole	1	5	5		10
	Critical Hole Condition	1			5	5
10/80/10	No Hole	1		3		3
	Filled Hole	1	5	5		10
	Open Hole	1	5	5		10
	Critical Hole Condition	1			5	5
					Total =	69

[1] No-hole specimens instrumented with back-to-back strain gages.

[2] Test methods are described in Table 7.

[3] Fasteners: Pin = NAS 6604 - (); Collar = MS 35650-3252 or equivalent.

The test matrix for laminate in-plane compression properties of 193 g/m² plain weave fabric is presented in Table 4. This testing was based upon the minimum recommended matrix for initial empirical assessment and determination of notched strength data for a range of laminates as defined in section 7.2.6 of MIL-HDBK-17, with additional tests to account for variables that

have been demonstrated to be critical in previous laminate design allowable test programs. The minimum recommended matrix has been modified in accordance with Table 4 as follows:

- No Hole Compression @ 75°F/Dry to verify classical laminate theory predictions of laminate stiffness, to determine stress-strain behavior up to ultimate load and to develop factors for notched vs. un-notched laminate compression strength.
- 180°F/Wet Filled hole in addition to open hole compression testing, since previous testing has demonstrated that the 180°F/Wet condition is critical for compression loading and filled hole compression data at the critical condition is required to define the pure bypass end-point of the compression bearing-bypass interaction curve for mechanical joint allowables.

Table 4. Laminate Compression Tests for 193 g/m² Plain Weave Fabric

Layup	Specimen Type	Material Batch	Environment		Total Specimens
			75°F/Dry	180°F/Wet	
40/20/40	No Hole	1	3		3
	Open Hole	1	5	5	10
	Filled Hole	1		5	5
25/50/25	No Hole	1	3		3
	Open Hole	1	5	5	10
	Filled Hole	1		5	5
10/80/10	No Hole	1	3		3
	Open Hole	1	5	5	10
	Filled Hole	1		5	5
				Total =	54

[1] No-hole specimens instrumented with back-to-back strain gages.

[2] Test methods are described in Table 7.

[3] Fasteners: Pin = NAS 6604 - (); Collar = MS 35650-3252 or equivalent

The test matrix for laminate bearing strength properties of 193 g/m² plain weave fabric is presented in Table 5. This testing was based upon the minimum recommended matrix for initial empirical assessment and determination of bearing strength data for a range of laminates as defined in section 7.2.5 of MIL-HDBK-17, with modifications to account for variables that have been demonstrated to be critical in previous laminate design allowable test programs. The minimum recommended matrix has been modified in accordance with Table 5 as follows:

- Single shear and double shear joint configuration tests were performed to develop bearing strength allowables that account for mechanical joint stability. The acceptability of bearing design allowables based upon single bolt double shear and single shear stabilized joint configuration tests performed at the coupon level on previous programs have been substantiated through element, full scale and flight test. These earlier programs demonstrated

that the single shear stabilized and double shear specimen types best represent the bearing behavior observed for typical composite airframe bolted joints on full scale test articles.

- Bearing tests were performed under tension loading only, as previous testing has demonstrated that pure bearing strength is insensitive to whether the load is applied in tension or compression.
- Bearing tests were performed for one fastener diameter-to-thickness (D/t) ratio for this program.

Table 5. Laminate Bearing Tests for 193 g/m² Plain Weave Fabric

Layup	Specimen Type	Material Batch	Environment		Total Specimens
			75°F/Dry	180°F/Wet	
40/20/40	Double Shear	1	5	5	10
	Single Shear Stabilized	1	5	5	10
25/50/25	Double Shear	1	5	5	10
	Single Shear Stabilized	1	5	5	10
				Total =	40

Notes:

[1] Fasteners to be installed at 35 in-lb torque maximum (Low Clamp-up).

[2] Test methods are described in Table 7.

[3] Fasteners: Pin = NAS 6604 - (); Collar = MS 35650-3252 or equivalent; Washer = NAS1149V0432M or equivalent.

The test matrix for laminate bearing-bypass interaction properties of 193 g/m² plain weave fabric is presented in Table 6. This testing was based upon the minimum recommended matrix for initial empirical assessment and determination of bearing-bypass properties for a range of laminates as defined in section 7.2.7 of MIL-HDBK-17 given the following assumptions:

- The double shear vs. single shear stabilized joint configuration relationship developed from the pure bearing tests can be applied as necessary to account for joint stabilization effects on bearing-bypass specimens that exhibit bearing dominated failure modes.
- The pure bypass (no bolt load) end point of the bearing-bypass interaction curve, represented by the critical environment filled hole test data, can be used to establish the environmental factor to be applied to the bypass dominated failure mode portion of the interaction curve.
- The pure bearing (100% load transfer) end point of the bearing-bypass interaction curve, represented by the critical environment bearing strength test data, can be used to establish the environmental factor to be applied to the bearing dominated failure mode portion of the interaction curve.

Table 6. Laminate Bearing Bypass tests for 193 g/m² Plain Weave Fabric

Layup	Bearing/Bypass Ratio	Specimen Type	Loading	Environment	No. of Specimens
40/20/40	0.50 (50% Load Transfer)	Single Shear	Tension [2]	RTD	5
			Compression [1]	RTD	5
	0.25 (25% Load Transfer)	Double Shear	Tension [2]	RTD	5
			Compression [1]	RTD	5
25/50/25	0.50 (50% Load Transfer)	Single Shear	Tension [2]	RTD	5
			Compression [1]	RTD	5
	0.25 (25% Load Transfer)	Double Shear	Tension [2]	RTD	5
			Compression [1]	RTD	5
10/80/10	0.50 (50% Load Transfer)	Single Shear	Tension [2]	RTD	5
			Compression [1]	RTD	5
	0.25 (25% Load Transfer)	Double Shear	Tension [2]	RTD	5
			Compression [1]	RTD	5
				Total =	60

Notes:

[1] Fasteners to be installed at 70 ± 10 in-lb torque (High Clamp-up)

[2] Fasteners to be installed at 35 ± 5 in-lb torque (Low Clamp-up).

[3] Test methods are described in Table 7.

[4] Fasteners: Pin = NAS 6604 - (); Collar = MS 35650-3252 or equivalent; Washer = NAS1149V0432M or equivalent.

1.5.2. Environmental Conditioning

All 'wet' conditioned samples were exposed to elevated temperature and humidity conditions to establish moisture saturation of the material. Specimens were exposed to 85 ± 5 % relative humidity and 145 ± 5 °F until an equilibrium moisture weight gain of traveler, or witness coupons (1" x 1" x specimen thickness) was achieved. ASTM D5229 and SACMA SRM 11 were used as guidelines for environmental conditioning and moisture absorption.

Effective moisture equilibrium was achieved when the average moisture content of the traveler specimen changed by less than 0.05% for two consecutive readings within a span of 7 ± 0.5 days and was expressed by:

$$\frac{W_i - W_{i-1}}{W_b} < 0.0005$$

where W_i = weight at current time
 W_{i-1} = weight at previous time
 W_b = baseline weight prior to conditioning

It is common to see small fluctuations in an unfitted plot of the weight gain vs. time curve. There were no fluctuations that made significant errors in results or caused rejection in the moisture equilibrium criteria. Once the traveler coupons passed the criteria for two consecutive readings, the samples were removed from the environmental chamber and placed in a sealed bag with a moist paper or cotton towel for a maximum of 14 days until mechanical testing. Strain gauged specimens were removed from the controlled environment for a maximum of 2 hours for application of gages in ambient laboratory conditions.

1.5.3. Static Testing

Table 7. Static Test Specimen Configurations and Test Methods

Test Description	Test Method	Test Fixture Required
Tension, No Hole	SACMA SRM 5 (Modified) ASTM D5766 (Modified)	No
Tension, Open Hole	SACMA SRM 5 ASTM D5766	No
Tension, Filled Hole	SACMA SRM 5 (Modified) ASTM D5766 (Modified)	No
Compression, No Hole	SACMA SRM 3 (Modified) ASTM D6484 (Modified)	Yes
Compression, Open Hole	SACMA SRM 3 ASTM D6484	Yes
Compression, Filled Hole	SACMA SRM 3 (Modified) ASTM D6484 (Modified)	Yes
Bearing, Double Shear, Tension	ASTM D5961	No
Bearing, Single Shear Stabilized, Tension	ASTM D5961 (Modified)	No
50% Bearing-Bypass, Double-Shear, Tension	ASTM D5961 (Modified)	No
50% Bearing-Bypass, Double-Shear, Compression	ASTM D5961 (Modified)	Yes
25% Bearing-Bypass, Double-Shear, Tension	ASTM D5961 (Modified)	No
25% Bearing-Bypass, Double-Shear, Compression	ASTM D5961 (Modified)	Yes

Measurement of strain to failure is required for the unnotched tension and compression coupons tested at room temperature using strain gages mounted back-to-back to provide baseline modulus and stress-strain behavior verification of computed values up to ultimate load.

The Criteria for stopping static tests are: (1) Separation of the specimen into two pieces (major fracture across the specimen width or (2) Loss of load carrying capability. Load-displacement data shall be recorded during all testing. Load-strain data shall be recorded as required for instrumented specimens.

Test temperatures and corresponding soak times for mechanical testing is as follows;

- 1 CTD: One prepreg batch of material tested (test temperature = $-65 \pm 5^{\circ}$ F, moisture content = as fabricated, soak time at -65 was 3 min.)
- 2 RTD: One prepreg batches of material tested (test temperature = $70 \pm 10^{\circ}$ F, moisture content = as fabricated)
- 3 ETW: One prepreg batches of material tested (test temperature = $180 \pm 5^{\circ}$ F, moisture content = equilibrium per section 1.5.2, soak time at 180 was 2 min.)

2. FIBERCOTE T300 3KPW/E765 PREPREG PROPERTIES

2.1. Prepreg Documentation by Prepreg Batch

Prepreg Documentation	Prepreg Manufacturer: FiberCote Industries Product ID: MS1000, Rev. 3, Type 2, Grade B Material Identification (weave, form, class, etc.): 50" 3K 70 PW T-300/E-765 Impregnation Method: Solution coat		
Prepreg Batch #	912066-04	009102-01	009102-02
Batch ID as labeled on samples	1	2	3
Date of Manufacture	12/23/1999	10/2/2000	10/2/2000
Expiration Date	6/23/2000	4/2/2001	4/2/2001
Resin Content [%]	38.8	38.2	39.1
Reinforcement Areal Weight & Test Method	193.8	195.3	196.0
Resin Flow & Test Conditions	15.1 % (50 psi @ 275°F)	16.0 % (50 psi @ 275°F)	15.3 % (50 psi @ 275°F)
Gel Time & Test Conditions	256 (@ 275°F)	339 (@ 275°F)	341 (@ 275°F)
Volatile Content	0.3 (8 min @ 275°F)	0.5 (8 min @ 275°F)	0.4 (8 min @ 275°F)
Reinforcement Documentation	Fiber/Fabric Manufacturer & Product ID: Toray/BGF Industries and BP Amoco/BGF Industries (T300 Fiber) Precursor Type: PAN Nominal Filament Count: 3K Finish/Sizing Type and %: Nominal tow or yarn count/inch: Twist: untwisted		
Fabric Batch or Lot#	25	00929994/00020	00929994/00020
Date of Manufacture	9/27/1999	5/25/2000	5/25/2000
Average Fiber Density per Lot & Test Method	1.77 g/cm ³	1.74 g/cm ³	1.74 g/cm ³
Matrix Documentation	Resin Manufacturer & Product ID:		
Matrix Batch or Lot #	9M1248	0M0970	0M0970
Date of Manufacture	12/22/1999	9/29/2000	9/29/2000
Average Neat Resin Density by Lot & Test Method			

Notes: (1) Test methods to determine resin content, reinforcement areal weight, resin flow, gel time, and volatile content are defined in FiberCote Material Specification E765 MS1001. (2) These information and test results were submitted to NIAR by FiberCote Industries Inc.

2.2. Process Specification

2.2.1. Storage

When not in use, all prepreg materials were stored at or below 0°F.

2.2.2. Out Times

Maximum cumulative out time units did not exceed 180 as defined by the following equations:

N	=	Cumulative Units
N1	=	Days at 0°F (180 max., N2 and N3 equal to zero)
N2	=	Days between 1°F and 59°F (90 max., N1 and N3 equal to zero)
N3	=	Days between 60°F and 85°F (28 max., N1 and N2 equal to zero)
N	=	$N1 + 2 \times N2 + 6 \times N3$

This time included shipping time, storage on-the-roll, out time for cutting, and any storage time as a kit of pre-cut plies.

2.2.3. Working Environment

All handling and lay-up of prepreg materials was conducted in a reasonably clean environment. No tool preparation, drilling, grinding, trimming, sanding, or other process creating particles was conducted in the same room as the lay-up of prepregs. There were no solvents, lubricants, mold release agents, or other potential contaminants used or stored in the same room with prepreg materials.

Unless otherwise validated for the material system in use, the area was temperature and humidity controlled such that the minimum temperature was 65°F with a corresponding relative humidity not greater than 63 percent. The maximum temperature was 75°F with a corresponding relative humidity not greater than 46 percent. The temperature and relative humidity values between the minimum and maximum acceptable values listed above formed a straight-line relationship. Procedures for Quality Control to verify and record temperature and humidity conditions were established to ensure environmental stability.

A continuous recording device was used.

Sensors and recording devices maintained calibrations traceable to NIST. Re-calibration frequency was in accordance with manufacturers' recommendations.

Quality Assurance will maintain a file of all continuous records for a minimum of three (3) years.

2.2.4. Mold Preparation

Each mold or lay-up surface was cleaned prior to lay-up, using non-contaminating cleaners, such as Acetone or alcohol. Mold preparation was performed outside the lay-up room.

After cleaning, each mold was treated with non-contaminating release agents in accordance with the supplier's instructions.

Thermocouple quantity and location have been specified on the shop traveler.

Witness panels, when required, were fabricated to specific instructions on the shop traveler and represented at least one zone of the part.

2.2.5. Cutting and Lay-up

The cutting and lay-up area was kept free of contaminants.

Prepreg laminations were pre-cut and grouped into kits for lay-up and cure, therefore, the poly-film backing provided by FiberCote was not be removed until each ply was ready to be placed in the lay-up mold. Kits were stored in sealed, moisture-proof containers until lay-up.

Before lay-up, the prepreg material was near ambient temperature. Upon removal from storage, the prepreg materials were allowed to warm to room temperature inside the sealed moisture-proof bag for 3 1/2 hours.

Any peel ply requirements are specified on the drawing and/or shop traveler.

Because of no other specifications on the drawing, splices were allowed. They overlapped by at least one inch and no two splices in a single ply were placed closer than 24 inches. Minimum distance between splices in adjacent plies was six inches. Butt splices were generally avoided. If butt splices were used, the maximum gap at any point was 0.030 inches. Butt splices had one additional ply of material, the same as the base laminate, which extended for at least one inch on either side of the splice joint. There were at least three plies of unspliced material between any two butt splices.

Splicing was not allowed on material qualification specimens.

White, lint-free cotton gloves were required for hand / personal protection. Talc-free latex or nitrile gloves were acceptable alternates.

No cutting of prepreg materials was permitted on the tool.

Debulking was performed in order to achieve appropriate compaction.

Debulking according to the following procedure was required no less frequently than every eight (8) plies of woven fabric.

- a. One layer of porous release fabric was applied over the prepreg lay-up.
- b. One layer of breather was applied on top of the porous release film. If the breather was not contaminated with resin or other foreign material, the breather was re-used.
- c. Nylon bagging film was installed over the laminate or a silicone rubber bag and was form-fit and edge sealed to the tool with vacuum bag sealant; the vacuum connector was installed through the bag. Multiple vacuum connectors were used so that no point on the part was more than 60 inches from a vacuum source.

Note: The vacuum connectors were installed on the tool surface outside the perimeter of the laminate wherever possible. Placing the connector in a bag pleat was an acceptable alternate.

- d. Vacuum of at least 18 inches Hg was applied for at least 15 minutes at a rate that did not cause the prepreg to shift. When specified by the applicable shop traveler, the laminate was heated to 100°F maximum and held for 10-15 minutes during vacuum application but there were no more than six (6) debulks at 100°F on any lay-up.

Before lay-up, the prepreg material was equilibrated near ambient temperature. Upon removal from storage, the prepreg materials were allowed to warm to room temperature inside the sealed moisture-proof bag for 3 1/2 hours.

2.2.6. Bagging

The procedure was as follows:

- a. One layer of porous release fabric was applied over the prepreg lay-up.
- b. When specified on the shop traveler, bleeder cloth the same size as the laminate was applied over the release film. All wrinkles were smoothed out.

For laminates of six (6) plies or greater, such as qualification panels, two (2) or four (4) bleeder plies were added to aid in volatiles removal from the relatively tight weaves of E-765 6K 5HS and E-765 7781 materials.

Note: Porous release film and bleeder cloth were not used on Test Panels

- c. Breather strings were applied from each corner of the part to contact the breather fabric.
- d. One layer on non-porous release film was applied over the lay-up; extending at least 1/2 inch past each edge of the part.
- e. One layer of breather fabric was applied over the lay-up ensuring that it formed a path to the breather.
- f. Vacuum sources were not on the surface of the part. There were at least two (2) sources for any part larger than four (4) square ft. For larger parts, at least one vacuum connection was provided for every 18 square ft. of laminate surface. Where possible, the maximum distance to any point on the laminate surface did not exceed 60 inches. Applying extra breather under the vacuum port protected against resin clogging.
- g. Nylon bagging film was applied and edge sealed to the tool with vacuum bag sealant.
- h. The bag was evacuated to at least 18 inches Hg and was adjusted to eliminate wrinkles and bridging.
- i. A vacuum gauge was installed at the vacuum probe connector. The bagged assembly was allowed to stand for at least 15 minutes with an applied vacuum of at least 18 inches Hg. The vacuum source was removed and the bag vacuum monitored. Leakage did not exceed three (3) inches Hg in the first five (5) minutes after the vacuum source was removed.

2.2.7. Cure Cycle

All prepreg materials were cured according to tightly controlled time, temperature and vacuum requirements as shown in Table 8. Further details are clarified in FiberCote Process Specification E765 PS1001.

Table 8. Cure Cycles

Temperature Ramp rate	Cure Temperature	Pressure	Cooling Rate	Dwell Time At Cure
°F/Min.	°F (as defined by slowest heating part)	psi	°F/Min.	Minutes
1 - 6	250 - 280	40 - 50	3 - 10	110 - 130

3. FIBERCOTE T300 3KPW/E765 LAMINA PROPERTIES

3.1. Test Results

3.1.1. Summary

MATERIAL: E765/T300 3KPW Graphite Fabric	Fibercote E765/T300 3KPW Graphite Fabric
PREPREG: Fibercote E765/T300 3KPW Graphite Fabric	
FIBER: T300	RESIN: E 765
T_g (dry): 293 °F	T_g (wet): 225 °F
	T_g METHOD: DMA (SRM 18-94)
PROCESSING: Autoclave cure (45- psi) - 265 ±15°F for 120 ±10 min.	

LAMINATE MECHANICAL PROPERTY SUMMARY
 Data Reported as: Measured

Layup 0°/±45°/90°	Test Method	Loading Condition	2% Offset Strength (ksi)		Ultimate Strength (ksi)			Modulus (Msi)	Ultimate Strain (Microstrain)	Chord Modulus (Msi)		2% Offset Bypass Strain (Microstrain)	Ultimate Bypass Strain (Microstrain)
			RTD	ETW	RTD	ETW	CTD			RTD	ETW		
40/20/40	No Hole	Tension			67.670			7.333					
		Compression			70.820			6.737					
	Open Hole	Tension			41.711	26.117							
		Compression			46.793		45.469						
	Filled Hole	Tension					36.904						
		Compression											
	50% bypass	Tension	57.952		75.735					1.462			859.198
		Compression	74.263		86.532					2.002			1466.494
	25% bypass	Tension			128.005								1053.370
		Compression			200.933					10.763			4226.601
Single Shear Bearing	Tension	78.286	58.700	87.933	69.732				0.565	0.580			
Double Shear Bearing	Tension	65.489		67.745	40.866				0.587	1.548			
25/50/25	No Hole	Tension			71.633			5.961					
		Compression			68.100			5.617					
	Open Hole	Tension			38.676	40.982	37.034						
		Compression			39.687	23.706							
	Filled Hole	Tension			42.242		39.852						
		Compression					36.691						
	50% bypass	Tension	79.328		100.358								2052.709
		Compression	81.132		102.729					2.217			2077.160
	25% bypass	Tension			118.823								1394.530
		Compression			186.941					9.191			3613.956
Single Shear Bearing	Tension	80.485	69.460	106.372	81.355				0.704	0.724			
Double Shear Bearing	Tension	76.888		77.424	44.910				0.753	1.929			
10/80/10	No Hole	Tension			50.785			3.891					
		Compression			48.762			3.746					
	Open Hole	Tension			37.183	28.352	39.193						
		Compression			36.571	22.472							
	Filled Hole	Tension			40.614		42.206						
		Compression					27.093						
	50% bypass	Tension	63.794		79.850					1.314			2828.677
		Compression	72.353		94.126					1.900			2340.752
	25% bypass	Tension			116.300								54968.096
		Compression			138.719					6.145			4055.301
Single Shear Bearing	Tension												
Double Shear Bearing	Tension												

Layup Schedule:

40/20/40 ---- [0/90/0/90/45/-45/90/0/90/0]s

25/50/25 ---- [(45/0/-45/90)2]s

10/80/10 ---- [45/-45/90/45/-45/45/0/45/-45]s

NOTE: Shaded areas indicate data is not applicable for that test method. Open areas indicate data that was notobtained, but could be in future test programs.

3.1.2. Individual Test Summaries

3.1.2.1. Laminate Tension

Material:		Bell - Fibercote E765/T300 3KPW Graphite Fabric					
Resin content:		37.12 - 41.30 wt%	Comp. density:		1.4939 - 1.5119 g/cc		
Fiber volume:		49.83 - 54.02 vol%	Void content:		0 to 0.739 %		
Test method:		Sacma SRM 5, ASTM D5766 (Modified for no hole and filled hole)					
Type of bearing test:							
Fastener Type:		Pin = NAS 6604-2 or 3 w/ washer; Collar = MS 35650-3252					
Torque:		70±5 in-lbs					
Normalized by:		Not normalized					
		CTD		RTD		ETW	
Test Temperature [°F]		-65		75		180	
Moisture Conditioning		dry		dry		equilibrium	
Equilibrium at T, RH		as fabricated		as fabricated		145F,85%	
Source code		U(GHI)(HI)XXXXB		U(GHI)(JHI)XXXXA		U(GHI)HXXXXF	
		Open Hole	Filled Hole	No Hole	Open Hole	Filled Hole	Open Hole
F^{tu} (ksi)	Mean		45.47	67.67		46.79	
	Minimum		43.29	63.80		45.24	
	Maximum		47.20	72.23		48.35	
	C.V.(%)		3.10	6.29		3.10	
E^t (Msi)	Mean			7.33			
	Minimum			7.12			
	Maximum			7.56			
	C.V.(%)			2.12			
%0°/45°/90° - 40/20/40 [0/90/0/90/45/-45/90/0/90/0] _s t _{ply} : 0.00832 - 0.00868 in.		No. Specimens	5	3		5	
		No. Prepreg Lots	1	1		1	
F^{tu} (ksi)	Mean	37.03	39.85	71.63	38.68	42.24	40.98
	Minimum	35.56	38.41	70.37	37.47	41.06	40.33
	Maximum	37.92	41.93	73.43	40.15	43.57	42.03
	C.V.(%)	2.87	3.42	2.23	3.06	2.85	1.66
E^t (Msi)	Mean			5.96			
	Minimum			5.77			
	Maximum			6.10			
	C.V.(%)			2.01			
%0°/45°/90° - 25/50/25 [(45/0/-45/90) ₂] _s t _{ply} : 0.00838 - 0.00878 in.		No. Specimens	5	3	5	5	5
		No. Prepreg Lots	1	1	1	1	1
F^{tu} (ksi)	Mean	39.19	42.21	50.79	37.18	40.61	28.35
	Minimum	38.48	40.91	49.78	36.83	40.32	28.23
	Maximum	39.98	43.77	51.47	38.02	40.90	28.57
	C.V.(%)	1.50	2.83	1.75	1.38	0.58	0.50
E^t (Msi)	Mean			3.89			
	Minimum			3.75			
	Maximum			3.99			
	C.V.(%)			2.23			
%0°/45°/90° - 10/80/10 [45/-45/90/45/-45/45/-45/0/45/-45] _s t _{ply} : 0.00835 - 0.00864 in.		No. Specimens	5	3	5	5	5
		No. Prepreg Lots	1	1	1	1	1

3.1.2.2. Laminate Compression

Material:		Bell - Fibercote E765/T300 3KPW Graphite Fabric				Laminate Compression Gr/Ep Bell - Fibercote E765/T300 3KPW Graphite Fabric		
Resin content:		37.12 - 41.30 wt%	Comp. density:		1.4939 - 1.5119 g/cc			
Fiber volume:		49.83 - 54.02 vol%	Void content:		0 to 0.739 %			
Test method:		Sacma SRM 3, ASTM D6484 (Modified for no hole and filled hole)						
Type of bearing test:		Pin = NAS 6604-2 or 3 w/ washer; Collar = MS 35650-3252						
Fastener Type:		Pin = NAS 6604-2 or 3 w/ washer; Collar = MS 35650-3252						
Torque:		35±5 in-lbs						
Normalized by:		Not normalized						
		CTD		RTD		ETW		
Test Temperature [°F]				75		180		
Moisture Conditioning				dry		equilibrium		
Equilibrium at T, RH				as fabricated		145F,85%		
Source code				U(GHI)(KL)XXXXA		U(GHI)(LM)XXXXF		
				No Hole	Open Hole	Open Hole	Filled Hole	
F^{cu} (ksi)	Mean			70.82	41.71	26.12	36.90	
	Minimum			70.18	40.81	25.28	32.64	
	Maximum			71.41	42.43	26.95	39.45	
	C.V.(%)			0.87	1.77	2.67	6.98	
E^c (Msi)	Mean			6.74				
	Minimum			6.66				
	Maximum			6.86				
	C.V.(%)			1.22				
% 0°/45°/90° - 40/20/40 [0/90/0/90/45/-45/90/0/90/0] _s t _{ply} : 0.00841 - 0.00845 in.		No. Specimens		3	5	5	6	
		No. Prepreg Lots		1	1	1	1	
F^{cu} (ksi)	Mean			68.10	39.69	23.71	36.69	
	Minimum			66.85	36.93	23.26	35.21	
	Maximum			69.70	41.81	24.40	37.57	
	C.V.(%)			1.74	4.50	1.87	2.52	
E^c (Msi)	Mean			5.62				
	Minimum			5.40				
	Maximum			5.96				
	C.V.(%)			3.66				
% 0°/45°/90° - 25/50/25 [(45/0/-45/90) ₂] _s t _{ply} : 0.00835 - 0.00869 in.		No. Specimens		4	5	5	5	
		No. Prepreg Lots		1	1	1	1	
F^{cu} (ksi)	Mean			48.76	36.57	22.47	27.09	
	Minimum			48.68	35.46	20.73	25.67	
	Maximum			48.88	38.06	23.28	27.88	
	C.V.(%)			0.21	2.95	4.61	3.16	
E^c (Msi)	Mean			3.75				
	Minimum			3.68				
	Maximum			3.81				
	C.V.(%)			1.45				
% 0°/45°/90° - 10/80/10 [45/-45/90/45/-45/45/-45/0/45/-45] _s t _{ply} : 0.00849 - 0.00874 in.		No. Specimens		3	5	5	5	
		No. Prepreg Lots		1	1	1	1	

3.1.2.3. Laminate Bearing

Material:		Bell - Fibercote E765/T300 3KPW Graphite Fabric				Laminate Bearing Gr/Ep Bell - Fibercote E765/T300 3KPW Graphite Fabric	
Resin content:		37.94 - 40.50 wt%	Comp. density:		1.4871 - 1.5080 g/cc		
Fiber volume:		50.53 - 53.18 vol%	Void content:		0.069 to 1.155 %		
Test method:		ASTM D5961 (Modified for Single Shear Bearing)					
Type of bearing test:							
Fastener Type:		Pin = NAS 6604-8; Collar = MS 35650-3252					
Torque:		35±5 in-lbs					
Normalized by:		Not normalized					
		CTD		RTD		ETW	
Test Temperature [°F]		-65		75		180	
Moisture Conditioning		dry		dry		equilibrium	
Equilibrium at T, RH		as fabricated		as fabricated		145F,85%	
Source code		U(GHI)(12)XXXXB		U(GHI)(12)XXXXA		U(GHI)(12)XXXXF	
		Double Shear	Single Shear	Double Shear	Single Shear	Double Shear	Single Shear
F^{bu} (ksi)	Mean			67.74	87.93	40.87	69.73
	Minimum			67.06	87.01	40.02	67.07
	Maximum			68.83	89.40	41.52	73.56
	C.V.(%)			1.01	1.03	1.80	3.17
F^{2%} (ksi)	Mean			65.49	78.29		58.70
	Minimum			61.67	70.39		55.44
	Maximum			67.94	88.23		62.37
	C.V.(%)			3.62	9.35		4.01
E^{br} (Msi)	Mean			0.59	0.57	1.55	0.58
	Minimum			0.50	0.41	1.40	0.52
	Maximum			0.63	0.71	1.62	0.62
	C.V.(%)			8.35	19.85	5.68	5.51
% 0°/45°/90° - 40/20/40 [0/90/0/90/45/-45/90/0/90/0] _s t _{ply} : 0.00845 - 0.00868 in.		No. Specimens		5	5	5	6
		No. Prepreg Lots		1	1	1	1
F^{bu} (ksi)	Mean			77.42	106.37	44.91	81.35
	Minimum			76.50	95.28	43.60	76.39
	Maximum			78.41	117.11	47.07	87.88
	C.V.(%)			1.09	7.85	2.66	5.91
F^{2%} (ksi)	Mean			76.89	80.49		69.46
	Minimum			75.37	62.85		65.71
	Maximum			78.56	94.18		77.45
	C.V.(%)			1.62	15.17		6.69
E^{br} (Msi)	Mean			0.75	0.70	1.93	0.72
	Minimum			0.70	0.60	1.73	0.65
	Maximum			0.79	0.82	2.26	0.77
	C.V.(%)			5.25	14.81	11.15	7.27
% 0°/45°/90° - 25/50/25 [(45/0/-45/90) _s] t _{ply} : 0.00823 - 0.00858 in.		No. Specimens		5	5	6	5
		No. Prepreg Lots		1	1	1	1
F^{bu} (ksi)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
F^{2%} (ksi)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
E^{br} (Msi)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
% 0°/45°/90° - 10/80/10 [45/-45/90/45/-45/45/-45/0/45/-45] _s t _{ply} : x.xxxx - x.xxxx in.		No. Specimens					
		No. Prepreg Lots					

3.1.2.4. Laminate Bearing-Bypass Tension

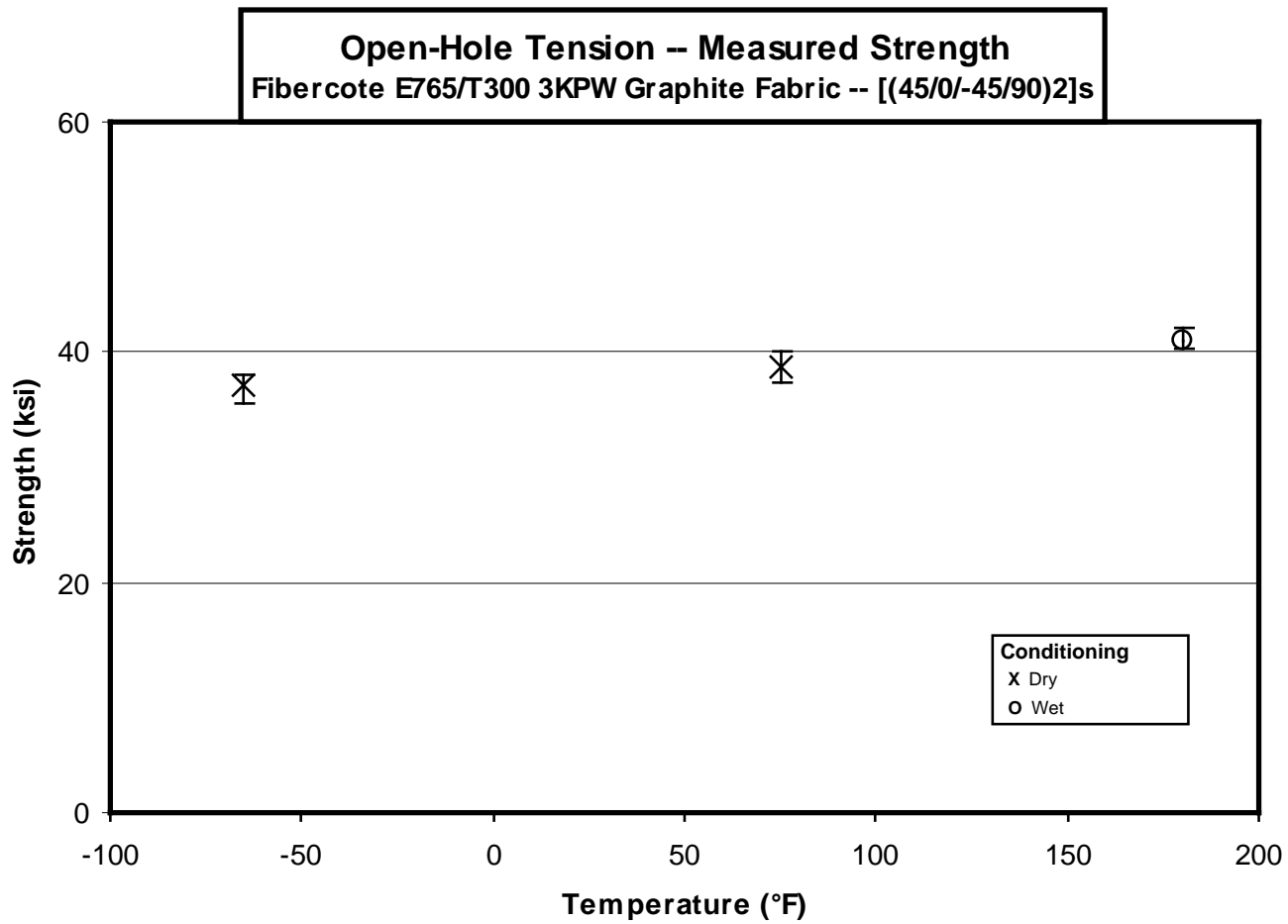
Material: Bell - Fibercote E765/T300 3KPW Graphite Fabric		Laminate Bypass-Tension					
		Gr/Ep					
Resin content: 38.19 - 41.07 wt%		Comp. density: 1.4906 - 1.5125 g/cc					
Fiber volume: 50.08 - 52.83 vol%		Void content: 0 to 0.922 %					
Test method: ASTM D5961 (Modified)							
Type of bearing test: Pin = NAS 6604-3, 4 or 5 w/ washer; Collar = MS 35650-3252							
Fastener Type: 35±5 in-lbs							
Torque: Not normalized							
Normalized by:							
		CTD		RTD		ETW	
Test Temperature [°F]		-65		75		180	
Moisture Conditioning		dry		dry		equilibrium	
Equilibrium at T, RH		as fabricated		as fabricated		145F,85%	
Source code		U(GHI)(35)XXXXB		U(GHI)(35)XXXXA		U(GHI)(35)XXXXF	
		50% Bypass	25% Bypass	50% Bypass	25% Bypass	50% Bypass	25% Bypass
F^{bu} (ksi)	Mean			75.74	128.01		
	Minimum			73.07	124.18		
	Maximum			78.45	133.23		
	C.V.(%)			2.67	2.87		
$F^{2\%}$ (ksi)	Mean			57.95			
	Minimum			56.60			
	Maximum			58.89			
	C.V.(%)			2.07			
E^{br} (Msi)	Mean			1.46			
	Minimum			1.28			
	Maximum			1.60			
	C.V.(%)			11.21			
ϵ^{by} (microstrain)	Mean			859.20	1053.37		
	Minimum			626.39	1025.95		
	Maximum			1092.01	1080.79		
	C.V.(%)			38.32	3.68		
% 0°/45°/90° - 40/20/40 [0/90/0/90/45/-45/90/0/90/0] _s t_{ply} 0.00838 - 0.00864 in.		No. Specimens		5	5		
		No. Prepreg Lots		1	1		
F^{bu} (ksi)	Mean			100.36	118.82		
	Minimum			95.57	112.95		
	Maximum			102.58	125.68		
	C.V.(%)			3.07	4.20		
$F^{2\%}$ (ksi)	Mean			79.33			
	Minimum			69.24			
	Maximum			84.05			
	C.V.(%)			7.73			
E^{br} (Msi)	Mean						
	Minimum						
	Maximum						
	C.V.(%)						
ϵ^{by} (microstrain)	Mean			2052.71	1394.53		
	Minimum			2050.43	1346.84		
	Maximum			2054.99	1442.22		
	C.V.(%)			0.16	4.84		
% 0°/45°/90° - 25/50/25 [(45/0/-45/90)] _s t_{ply} 0.00813 - 0.00855 in.		No. Specimens		5	5		
		No. Prepreg Lots		1	1		
F^{bu} (ksi)	Mean			79.85	116.30		
	Minimum			75.83	115.27		
	Maximum			85.18	117.61		
	C.V.(%)			4.44	0.76		
$F^{2\%}$ (ksi)	Mean			63.79			
	Minimum			58.22			
	Maximum			67.64			
	C.V.(%)			7.75			
E^{br} (Msi)	Mean			1.31			
	Minimum			1.23			
	Maximum			1.40			
	C.V.(%)			6.76			
ϵ^{by} (microstrain)	Mean			2828.68	54968.10		
	Minimum			2752.15	54962.56		
	Maximum			2905.20	54973.63		
	C.V.(%)			3.83	0.01		
% 0°/45°/90° - 10/80/10 [45/-45/90/45/-45/45/-45/0/45/-45] _s t_{ply} 0.00827 - 0.00846 in.		No. Specimens		5	5		
		No. Prepreg Lots		1	1		

3.1.2.5. Laminate Bearing-Bypass Compression

Material: Bell - Fibercote E765/T300 3KPW Graphite Fabric		Laminate Bypass- Compression Gr/Ep Bell - Fibercote E765/T300 3KPW Graphite Fabric					
		Resin content: 38.19 - 41.07 wt%	Comp. density: 1.4906 - 1.5125 g/cc	Fiber volume: 50.08 - 52.83 vol%	Void content: 0 to 0.922 %		
Test method: ASTM D5961 (Modified)		CTD		RTD		ETW	
Type of bearing test:		-65		75		180	
Fastener Type: Pin = NAS 6604-3, 4 or 5 w/ washer; Collar = MS 35650-3252		dry		dry		equilibrium	
Torque: 70±10 in-lbs		as fabricated		as fabricated		145F,85%	
Normalized by: Not normalized		U(GH)(46)XXXXB		U(GH)(46)XXXXA		U(GH)(46)XXXXF	
Equilibrium at T, RH		50% Bypass		50% Bypass		50% Bypass	
Source code		25% Bypass		25% Bypass		25% Bypass	
F^{bu} (ksi)	Mean			86.53	200.93		
	Minimum			84.16	193.92		
	Maximum			88.19	213.10		
	C.V.(%)			2.28	4.37		
$F^{2\%}$ (ksi)	Mean			74.26			
	Minimum			67.42			
	Maximum			79.83			
	C.V.(%)			6.90			
E^{br} (Msi)	Mean			2.00	10.76		
	Minimum			1.87	10.26		
	Maximum			2.05	10.95		
	C.V.(%)			4.29	2.67		
ϵ^{by} (microstrain)	Mean			1466.49	4226.60		
	Minimum			1440.79	3951.00		
	Maximum			1492.20	4502.20		
	C.V.(%)			2.48	9.22		
% 0°/45°/90° - 40/20/40 [0/90/0/90/45/-45/90/0/90/0] _s t_{ply} : 0.00852 - 0.00868 in.		No. Specimens		4	5		
		No. Prepreg Lots		1	1		
F^{bu} (ksi)	Mean			102.73	186.94		
	Minimum			101.42	179.02		
	Maximum			103.96	195.04		
	C.V.(%)			1.17	3.20		
$F^{2\%}$ (ksi)	Mean			81.13			
	Minimum			78.58			
	Maximum			82.93			
	C.V.(%)			2.30			
E^{br} (Msi)	Mean			2.22	9.19		
	Minimum			2.02	8.86		
	Maximum			2.33	9.70		
	C.V.(%)			5.57	3.42		
ϵ^{by} (microstrain)	Mean			2077.16	3613.96		
	Minimum			1994.51	2492.09		
	Maximum			2159.81	4735.82		
	C.V.(%)			5.63	43.90		
% 0°/45°/90° - 25/50/25 [(45/0/-45/90)] _s t_{ply} : 0.00827 - 0.00862 in.		No. Specimens		5	5		
		No. Prepreg Lots		1	1		
F^{bu} (ksi)	Mean			94.13	138.72		
	Minimum			91.00	134.34		
	Maximum			98.21	141.63		
	C.V.(%)			3.21	1.80		
$F^{2\%}$ (ksi)	Mean			72.35			
	Minimum			69.44			
	Maximum			75.29			
	C.V.(%)			3.64			
E^{br} (Msi)	Mean			1.90	6.15		
	Minimum			1.82	5.23		
	Maximum			1.98	6.54		
	C.V.(%)			3.52	7.90		
ϵ^{by} (microstrain)	Mean			2340.75	4055.30		
	Minimum			2241.76	4032.22		
	Maximum			2439.75	4078.39		
	C.V.(%)			5.98	0.81		
% 0°/45°/90° - 10/80/10 [45/-45/90/45/-45/45/0/45/-45] _s t_{ply} : 0.00827 - 0.00856 in.		No. Specimens		5	6		
		No. Prepreg Lots		1	1		

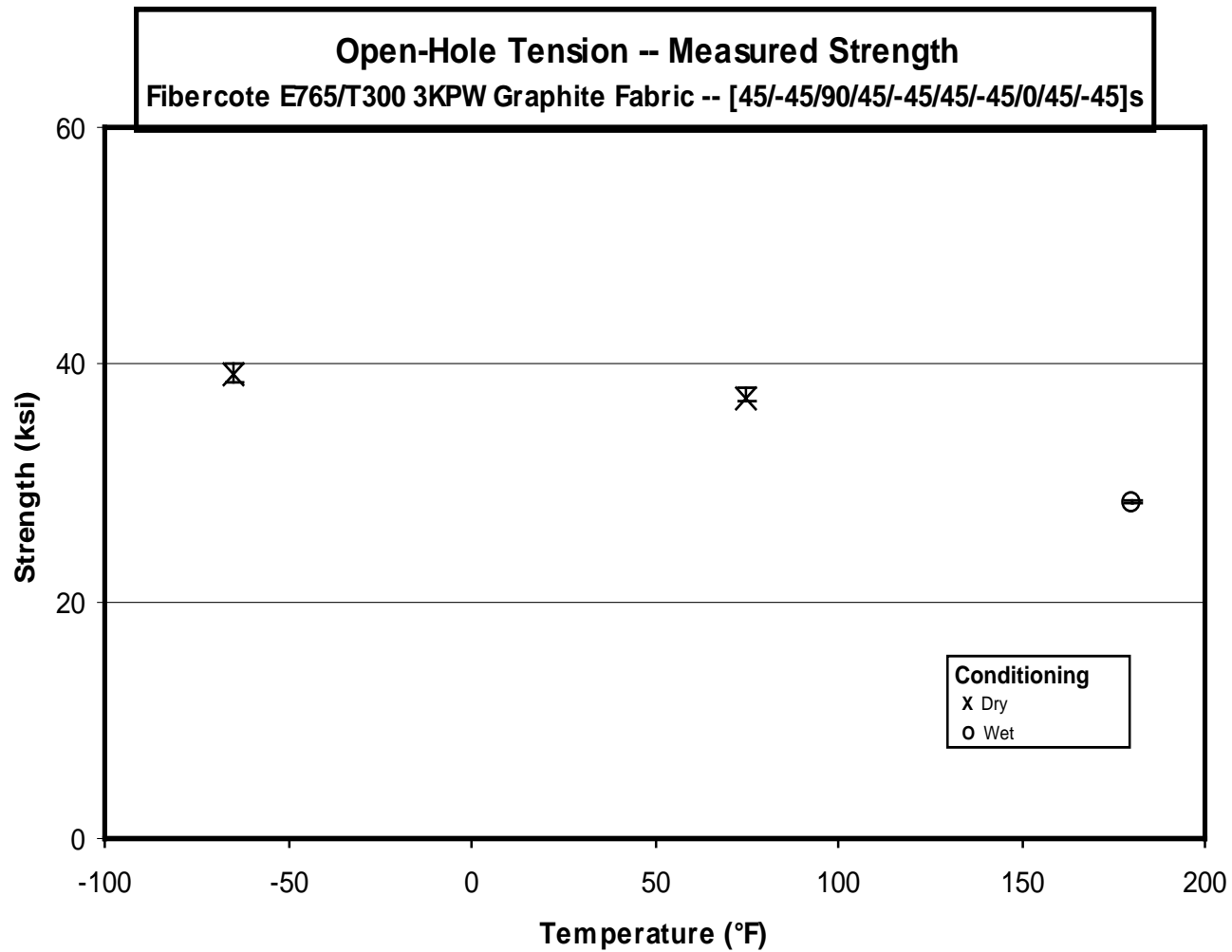
3.1.3. Individual Test Charts

3.1.3.1. Open-Hole Tension [25/50/25]



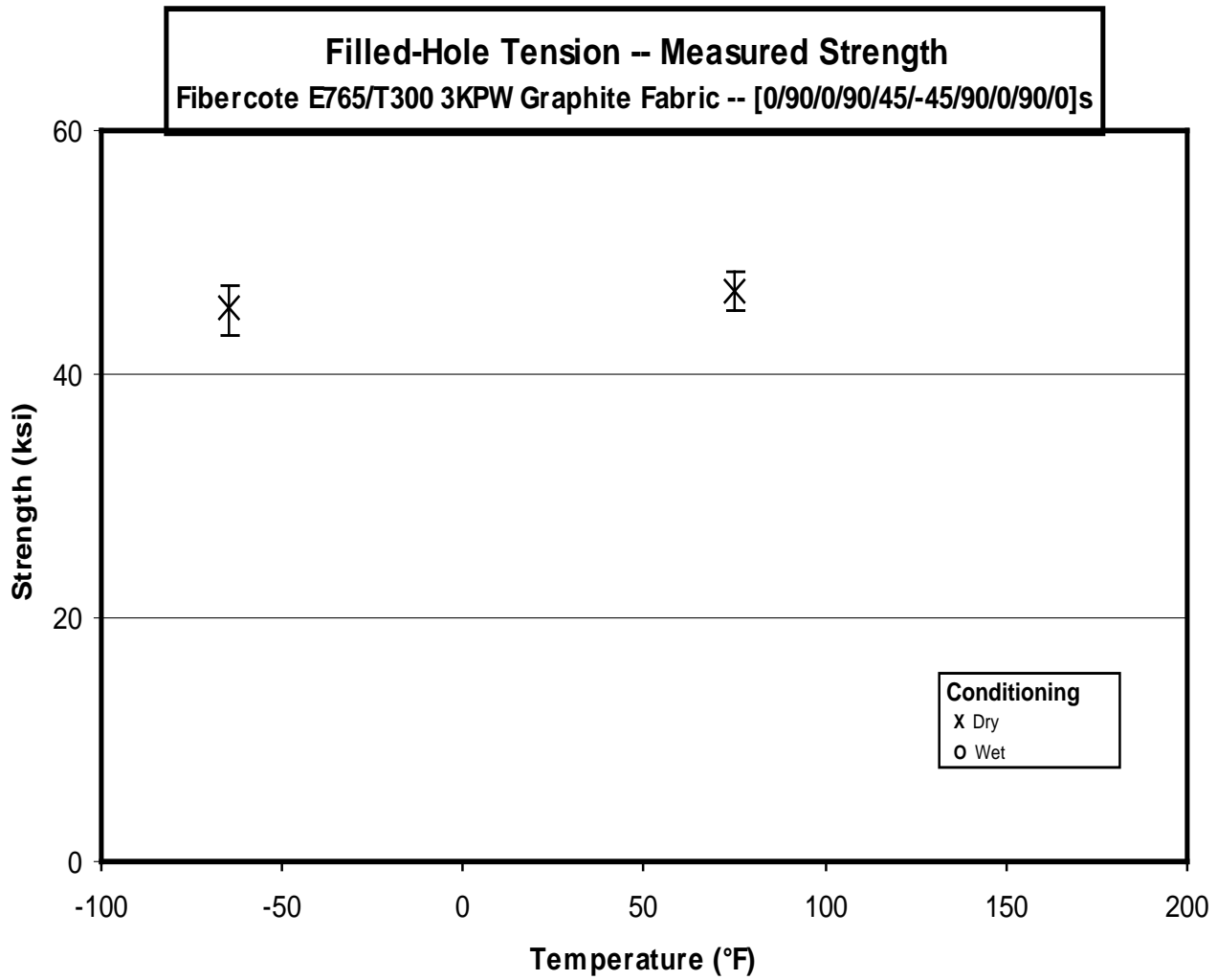
NOTE: The symbols represent the 'pooled' average of all tests, and the bars represent the upper and lower limit of the data.

3.1.3.2. Open-Hole Tension [10/80/10]

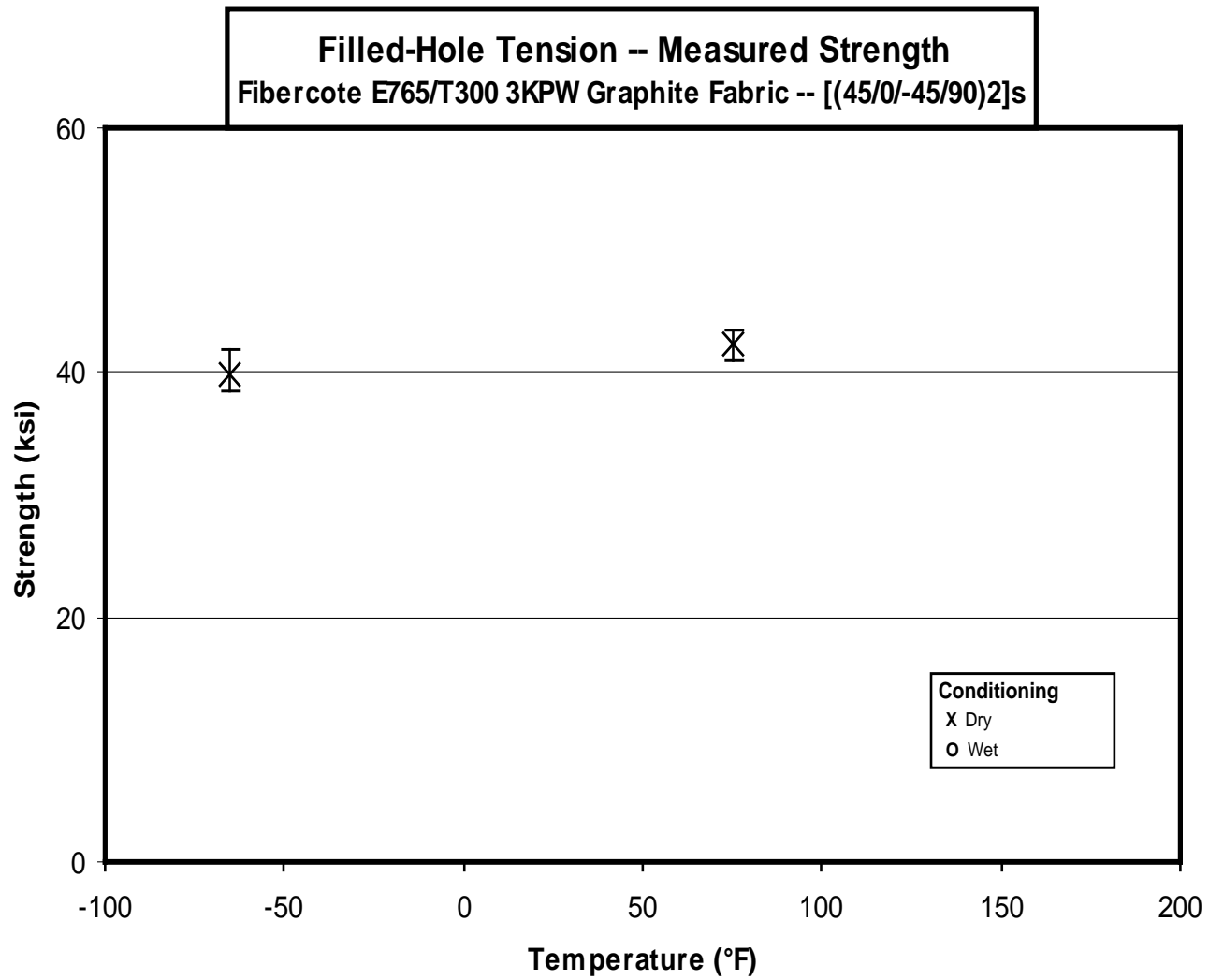


NOTE: The symbols represent the 'pooled' average of all tests, and the bars represent the upper and lower limit of the data.

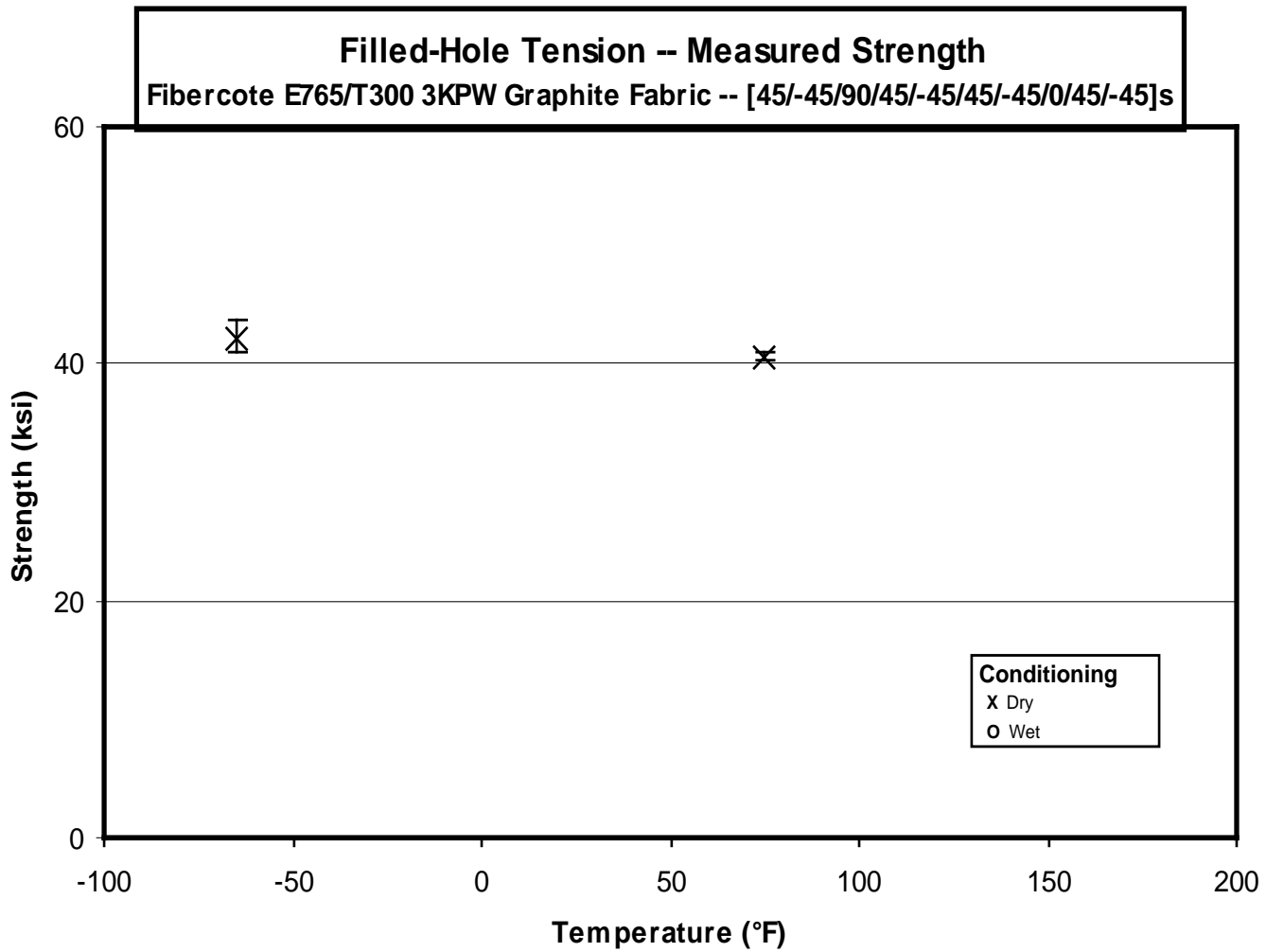
3.1.3.3. Filled-Hole Tension [40/20/40]



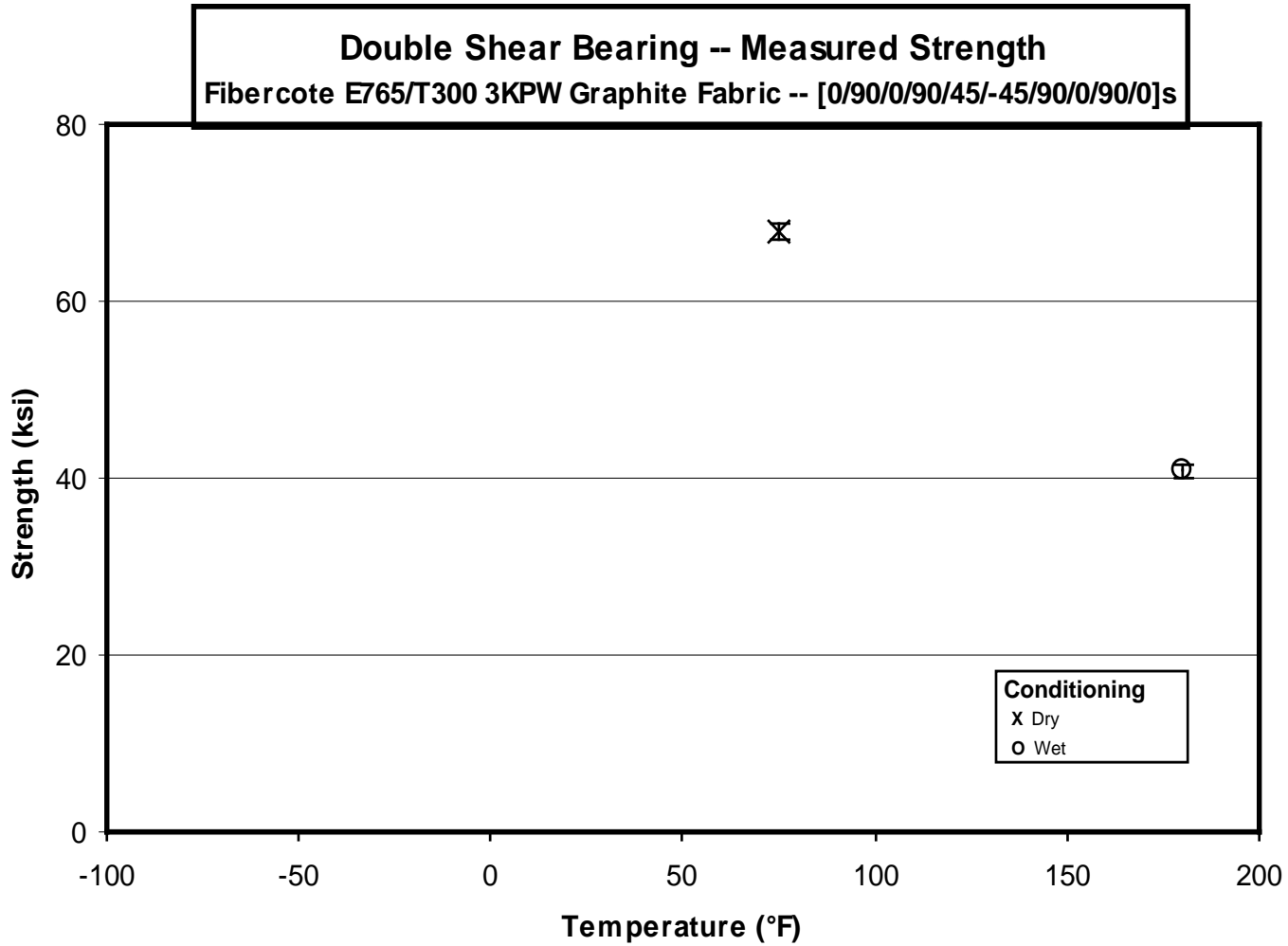
3.1.3.4. Filled-Hole Tension [25/50/25]



3.1.3.5. Filled-Hole Tension [10/80/10]

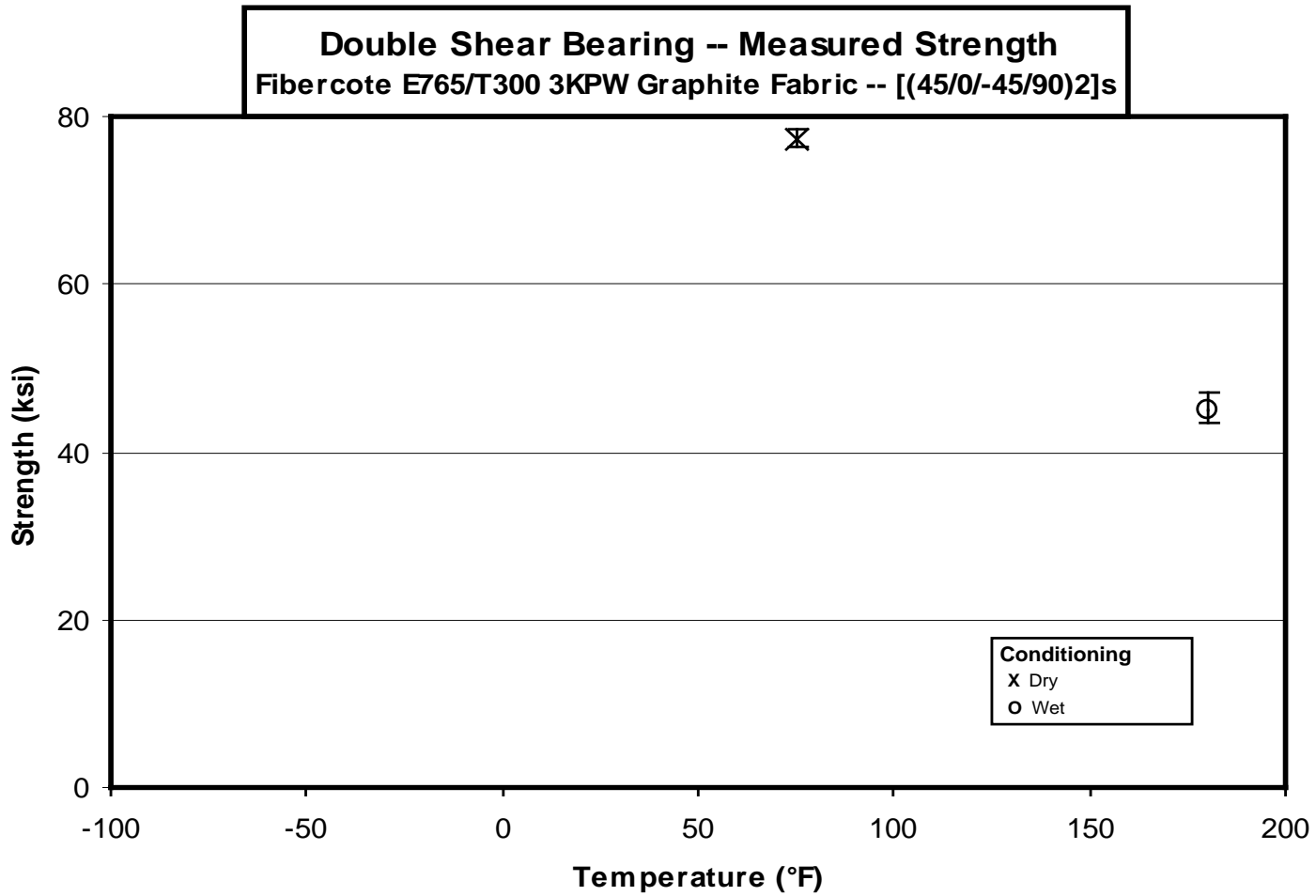


3.1.3.6. Double Shear Bearing [40/20/40]



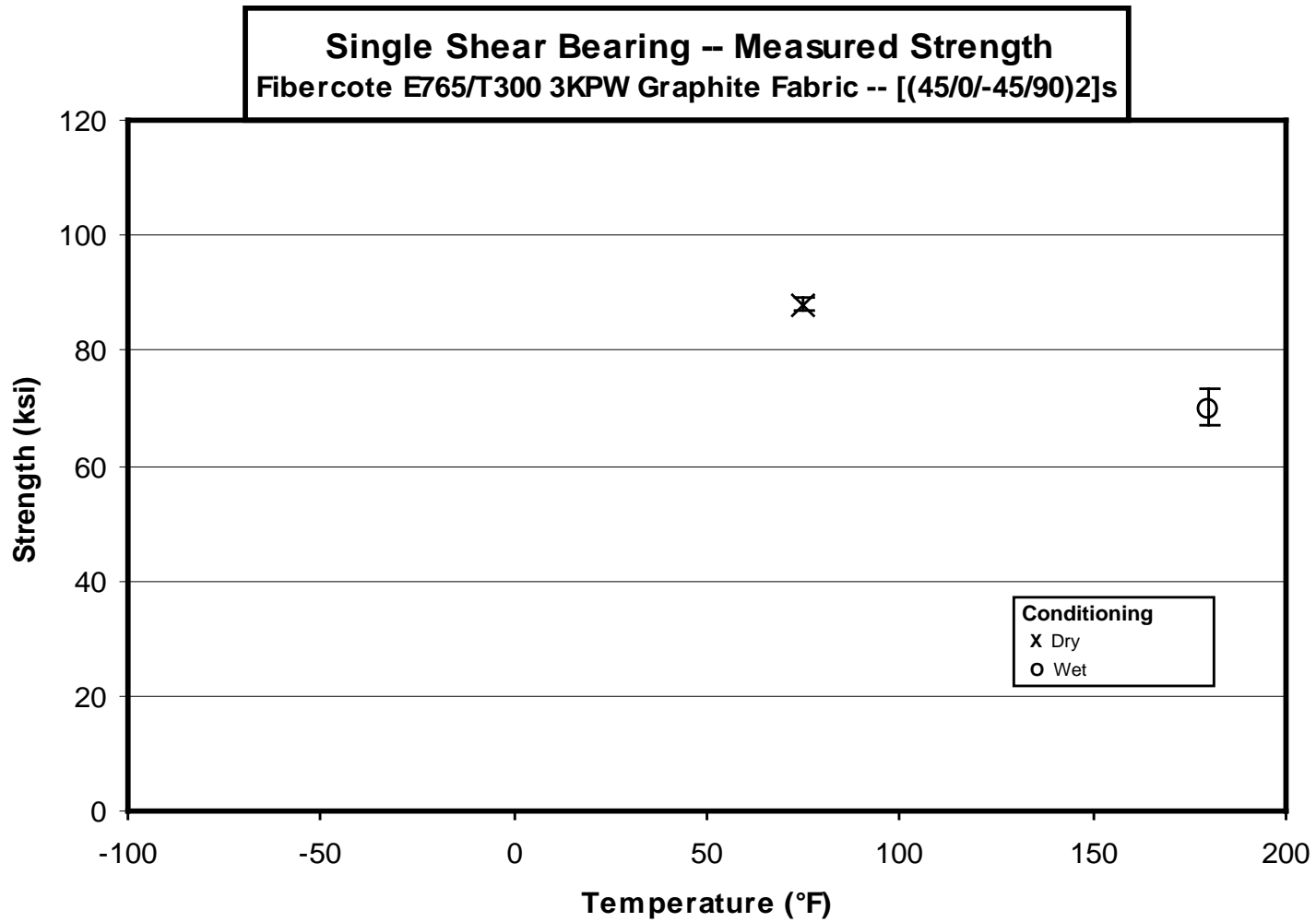
NOTE: The symbols represent the ‘pooled’ average of all tests, and the bars represent the upper and lower limit of the data.

3.1.3.7. Double Shear Bearing [25/50/25]



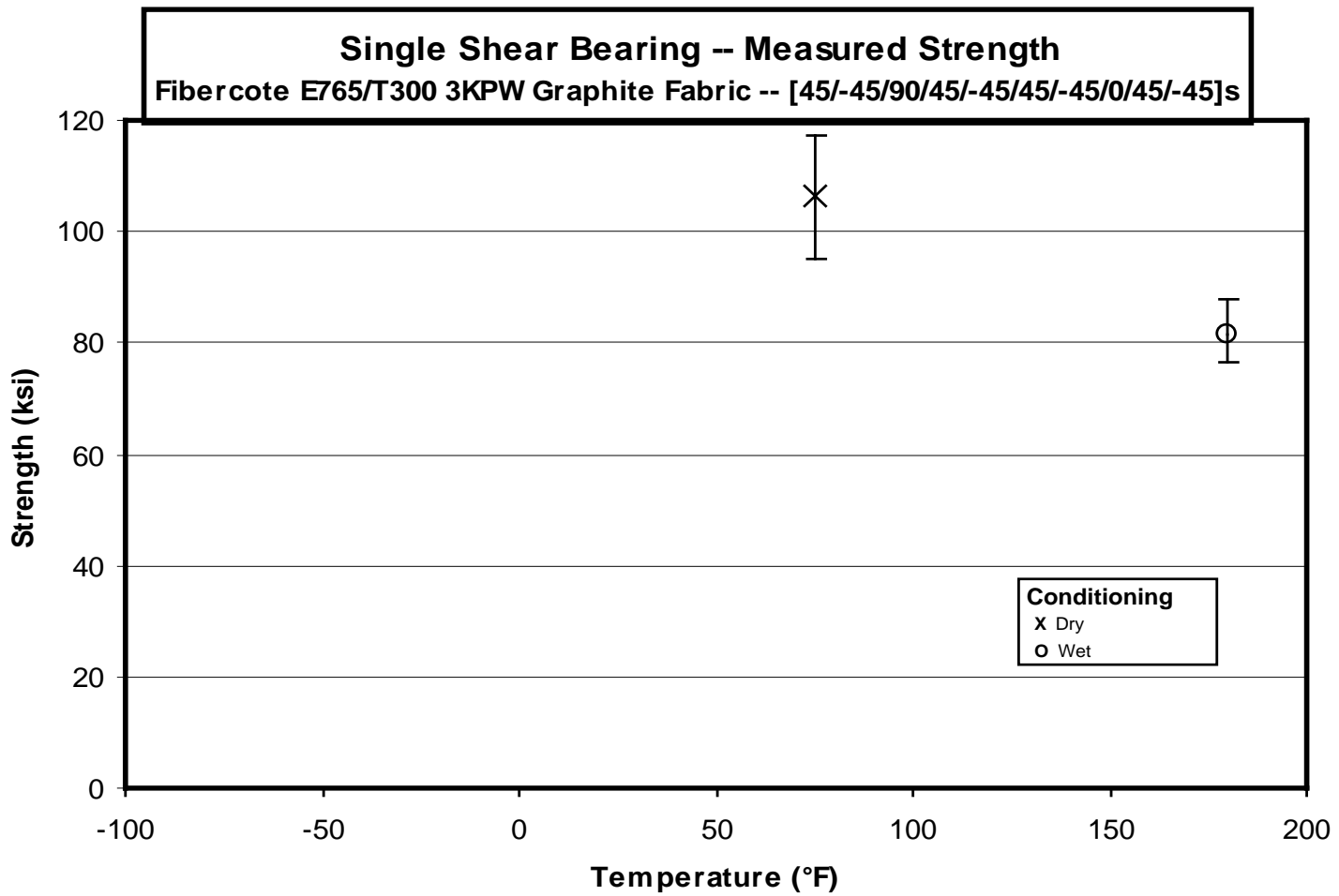
NOTE: The symbols represent the ‘pooled’ average of all tests, and the bars represent the upper and lower limit of the data.

3.1.3.8. Single Shear Bearing [25/50/25]



NOTE: The symbols represent the 'pooled' average of all tests, and the bars represent the upper and lower limit of the data.

3.1.3.9. Single Shear Bearing [10/80/10]



NOTE: The symbols represent the 'pooled' average of all tests, and the bars represent the upper and lower limit of the data.

3.2. Raw Data

Specimen Naming Convention

Test coupons were identified using an eight-digit specimen code, with the significance of each digit delineated below. A representative sample ID is shown for reference purposes.

U E K 1 2 3 1 A

1st Character: Fabricator

'U' designates BELL Helicopter

2nd Character: Material System & Layup Configuration

'G' designates T300 3KPW / E765 [40/20/40]

'H' designates T300 3KPW / E765 [25/50/25]

'I' designates T300 3KPW / E765 [10/80/10]

3rd Character: Test Type

'J' designates 0° Tension
Strength and Modulus, other
test types will be clearly labeled
at the top of each sheet

4th Character: Prepreg Batch ID

See section 2.1 for FiberCote Batch ID /
Sample Batch ID correlation.

5th Character: Panel Number

The panel(s) fabricated for a specific test method.

6th Character: Subpanel Number

The sub-panel(s) cut from each panel, with subpanel
numbers labeled increasing from reference edge.

7th Character: Sample Number

The sample(s) cut from each subpanel, with sample
numbers labeled increasing from reference edge.

8th Character: Test Condition

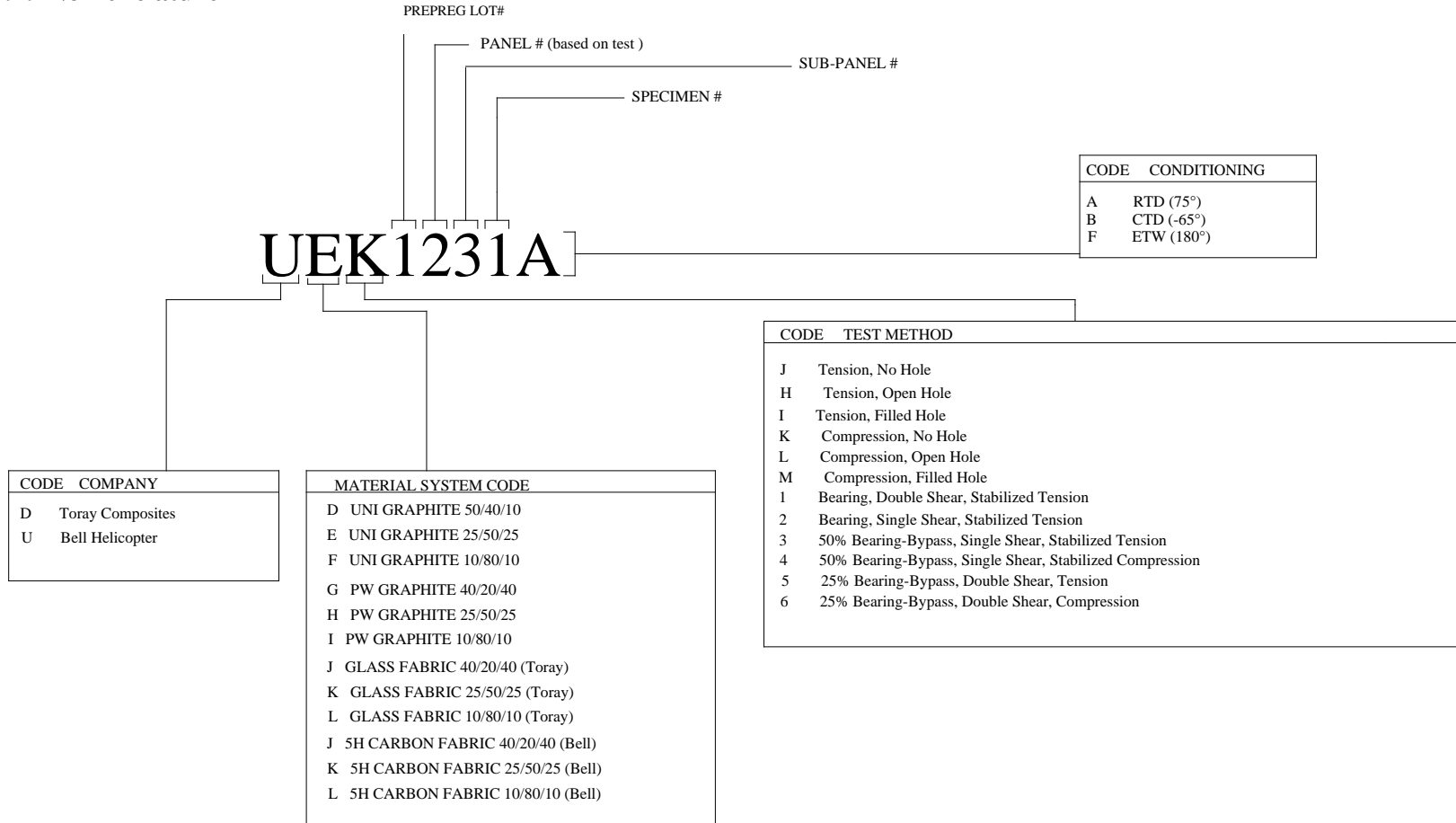
'A' --- RTD

'B' --- CTD

'F' --- ETW

See section 1.5.2 for condition parameters.

3.2.1. Nomenclature



3.3. Raw Data Spreadsheets and Scatter Charts

**40/20/40 Laminate Tension -- (RTD)
 Strength & Modulus**
 Bell - FiberCote E765/T300 3K PW Graphite Fabric [0/90/0/90/45/-45/90/0/90/0]_s

Specimen Number	Panel #	Cure Cycle	Prepreg Lot #	No Hole		No Hole Modulus [Msi]		Filled Hole Strength [ksi]	Avg. Specimen Thickn. [in]	# Plies in Laminate	Avg. t _{ply} [in]
				Strength [ksi]		Front	Back				
UGJ1111A	B1-4	A	1	66.981		7.560	7.341		0.166	20	0.00832
UGJ1112A	B1-4	A	1	63.799		7.448	7.290		0.168	20	0.00840
UGJ1113A	B1-4	A	1	72.230		7.241	7.119		0.171	20	0.00854
UGI1111A	B1-1	A	1					47.157	0.170	20	0.00849
UGI1112A	B1-1	A	1					45.236	0.172	20	0.00859
UGI1113A	B1-1	A	1					47.910	0.173	20	0.00866
UGI1114A	B1-1	A	1					45.312	0.174	20	0.00868
UGI1115A	B1-1	A	1					48.349	0.173	20	0.00863

Average	67.670	7.333	46.793	Average	0.0085
Standard Dev.	4.258	0.156	1.451		
Coeff. of Var. [%]	6.292	2.123	3.101		
Min.	63.799	7.119	45.236	Min.	0.0083
Max.	72.230	7.560	48.349	Max.	0.0087
Number of Spec.	3	3	5		

**40/20/40 Laminate Tension -- (CTD)
 Strength & Modulus**
 Bell - FiberCote E765/T300 3K PW Graphite Fabric [0/90/0/90/45/-45/90/0/90/0]_s

Specimen Number	Panel #	Cure Cycle	Prepreg Lot #	Filled Hole Strength [ksi]	Avg. Specimen Thickn. [in]	# Plies in Laminate	Avg. t _{ply} [in]
UGI1116B	B1-1	A	1	45.344	0.171	20	0.00857
UGI1117B	B1-1	A	1	45.558	0.173	20	0.00865
UGI1118B	B1-1	A	1	47.197	0.170	20	0.00852
UGI1119B	B1-1	A	1	45.955	0.169	20	0.00847
UGI1219B	B1-2	A	1	43.295	0.169	20	0.00847

Average	45.469	Average	0.0085
Standard Dev.	1.412		
Coeff. of Var. [%]	3.105		
Min.	43.295	Min.	0.0085
Max.	47.197	Max.	0.0087
Number of Spec.	5		

**40/20/40 Laminate Compression -- (RTD)
 Strength & Modulus**
 Bell - FiberCote E765/T300 3K PW Graphite Fabric [0/90/0/90/45/-45/90/0/90/0]_s

Specimen Number	Panel #	Cure Cycle	Prepreg Lot #	No Hole Strength [ksi]	No Hole Modulus [Msi]		Open Hole Strength [ksi]	Avg. Specimen Thickn. [in]	# Plies in Laminate	Avg. t _{ply} [in]
					Front	Back				
UGK1115A	B1-4	A	1	70.182	6.676	6.656		0.172	20	0.00861
UGK1116A	B1-4	A	1	71.407	6.811	6.697		0.171	20	0.00856
UGK1118A	B1-4	A	1	70.871	6.717	6.864		0.172	20	0.00862
UGL1212A	B1-5	A	1				40.808	0.172	20	0.00859
UGL1213A	B1-5	A	1				42.016	0.174	20	0.00868
UGL1214A	B1-5	A	1				42.259	0.175	20	0.00875
UGL1215A	B1-5	A	1				41.039	0.173	20	0.00863
UGL1216A	B1-5	A	1				42.435	0.169	20	0.00845

Average	70.820	6.737	41.711	Average	0.0086
Standard Dev.	0.614	0.082	0.739		
Coeff. of Var. [%]	0.867	1.220	1.771		
Min.	70.182	6.656	40.808	Min.	0.0084
Max.	71.407	6.864	42.435	Max.	0.0088
Number of Spec.	3	3	5		

40/20/40 Laminate Compression -- (ETW)
Strength & Modulus
 Bell - FiberCote E765/T300 3K PW Graphite Fabric [0/90/0/90/45/-45/90/0/90/0]_s

Specimen Number	Panel #	Cure Cycle	Prepreg Lot #	Open Hole Strength [ksi]	Filled Hole Strength [ksi]	Avg. Specimen Thickn. [in]	# Plies in Laminate	Avg. t _{ply} [in]
UGL1111F	B1-3	A	1	26.614		0.169	20	0.00843
UGL1112F	B1-3	A	1	26.160		0.170	20	0.00852
UGL1113F	B1-3	A	1	25.570		0.172	20	0.00861
UGL1114F	B1-3	A	1	26.953		0.172	20	0.00859
UGL1115F	B1-3	A	1	25.285		0.173	20	0.00864
UGM1211F	B1-2	A	1		38.286	0.168	20	0.00841
UGM1213F	B1-2	A	1		38.741	0.171	20	0.00855
UGM1214F	B1-2	A	1		32.641	0.173	20	0.00867
UGM1215F	B1-2	A	1		39.453	0.172	20	0.00860
UGM1216F	B1-2	A	1		37.173	0.172	20	0.00858
UGM1217F	B1-2	A	1		35.131	0.171	20	0.00857

Average	26.117	36.904	Average	0.0086
Standard Dev.	0.696	2.576		
Coeff. of Var. [%]	2.667	6.979		
Min.	25.285	32.641	Min.	0.0084
Max.	26.953	39.453	Max.	0.0087
Number of Spec.	5	6		

40/20/40 Double Shear Bearing -- (RTD)
Bearing Strength & Chord Modulus
 Bell - FiberCote E765/T300 3K PW Graphite Fabric [0/90/0/90/45/-45/90/0/90/0]_s

Specimen Number	Panel #	Cure Cycle	Prepreg Lot #	Ultimate Bearing Strength [ksi]	2% Offset Bearing Strength [ksi]	Chord Modulus [Msi]	Avg. Specimen Thicken. [in]	# Plies in Laminate	Avg. t _{ply} [in]
UG11121A	B1-13	F	1	68.825	67.935	0.595	0.172	20	0.00862
UG11122A	B1-13	F	1	67.561	65.465	0.590	0.172	20	0.00862
UG11123A	B1-13	F	1	67.323	61.666	0.504	0.173	20	0.00863
UG11124A	B1-13	F	1	67.952	66.848	0.629	0.171	20	0.00857
UG11125A	B1-13	F	1	67.063	65.532	0.616	0.171	20	0.00855

Average	67.745	65.489	0.587	Average	0.0086
Standard Dev.	0.687	2.369	0.049		
Coeff. of Var. [%]	1.014	3.618	8.352		
Min.	67.063	61.666	0.504	Min.	0.0086
Max.	68.825	67.935	0.629	Max.	0.0086
Number of Spec.	5	5	5		

40/20/40 Double Shear Bearing -- (ETW)
Bearing Strength & Chord Modulus
 Bell - FiberCote E765/T300 3K PW Graphite Fabric [0/90/0/90/45/-45/90/0/90/0]_s

Specimen Number	Panel #	Cure Cycle	Prepreg Lot #	Ultimate Bearing Strength [ksi]	2% Offset Bearing Strength [ksi]	Chord Modulus [Msi]	Avg. Specimen Thicken. [in]	# Plies in Laminate	Avg. t _{ply} [in]
UG11111F	B1-13	F	1	40.016	N/A	1.616	0.174	20	0.00868
UG11112F	B1-13	F	1	41.445	N/A	1.597	0.174	20	0.00868
UG11113F	B1-13	F	1	40.120	N/A	1.396	0.172	20	0.00862
UG11114F	B1-13	F	1	41.521	N/A	1.559	0.169	20	0.00846
UG11115F	B1-13	F	1	41.229	N/A	1.572	0.169	20	0.00845

Average	40.866	1.548	Average	0.0086
Standard Dev.	0.737	0.088		
Coeff. of Var. [%]	1.804	5.685		
Min.	40.016	1.396	Min.	0.0084
Max.	41.521	1.616	Max.	0.0087
Number of Spec.	5	5		

40/20/40 Single Shear Bearing -- (RTD)
Bearing Strength & Chord Modulus
 Bell - FiberCote E765/T300 3K PW Graphite Fabric [0/90/0/90/45/-45/90/0/90/0]_s

Specimen Number	Panel #	Cure Cycle	Prepreg Lot #	Ultimate Bearing Strength [ksi]	2% Offset Bearing Strength [ksi]	Chord Modulus [Msi]	Avg. Specimen Thicken. [in]	# Plies in Laminate	Avg. t _{ply} [in]
UG21111A & UG21112A	B1-11	E	1	89.404	88.231	0.412	0.170	20	0.00851
UG21113A & UG21114A	B1-11	E	1	88.045	74.273	0.707	0.173	20	0.00865
UG21115A & UG21116A	B1-11	E	1	87.009	75.077	0.512	0.173	20	0.00866
UG21121A & UG21122A	B1-11	E	1	87.687	70.394	0.569	0.171	20	0.00857
UG21123A & UG21124A	B1-11	E	1	87.520	83.456	0.627	0.173	20	0.00866

Average	87.933	78.286	0.565	Average	0.0086
Standard Dev.	0.903	7.320	0.112		
Coeff. of Var. [%]	1.027	9.350	19.850		
Min.	87.009	70.394	0.412	Min.	0.0085
Max.	89.404	88.231	0.707	Max.	0.0087
Number of Spec.	5	5	5		

40/20/40 Single Shear Bearing -- (ETW)
Bearing Strength & Chord Modulus
 Bell - FiberCote E765/T300 3K PW Graphite Fabric [0/90/0/90/45/-45/90/0/90/0]s

Specimen Number	Panel #	Cure Cycle	Prepreg Lot #	Ultimate Bearing Strength [ksi]	2% Offset Bearing Strength [ksi]	Chord Modulus [Msi]	Avg. Specimen Thicken. [in]	# Plies in Laminate	Avg. t _{ply} [in]
UG21211F & UG21212F	B1-12	E	1	73.562	62.366	0.588	0.173	20	0.00865
UG21213F & UG21214F	B1-12	E	1	69.499	60.107	0.620	0.173	20	0.00866
UG21215F & UG21216F	B1-12	E	1	70.034	58.501	0.572	0.173	20	0.00865
UG21221F & UG21222F	B1-12	E	1	70.050	57.452	0.581	0.171	20	0.00854
UG21223F & UG21224F	B1-12	E	1	67.067	55.441	0.598	0.170	20	0.00852
UG21225F & UG21226F	B1-12	E	1	68.181	58.333	0.524	0.171	20	0.00856

Average	69.732	58.700	0.580	Average	0.0086
Standard Dev.	2.210	2.357	0.032		
Coeff. of Var. [%]	3.169	4.015	5.514		
Min.	67.067	55.441	0.524	Min.	0.0085
Max.	73.562	62.366	0.620	Max.	0.0087
Number of Spec.	6	6	6		

40/20/40 Bearing-Bypass 50%-Tension -- (RTD)
Bearing Strength & Bypass Strain
 Bell - FiberCote E765/T300 3K PW Graphite Fabric [0/90/0/90/45/-45/90/0/90/0]_s

Specimen Number	Panel #	Cure Cycle	Prepreg Lot #	Ultimate Bearing Strength [ksi]	2% Offset Bearing Strength [ksi]	Chord Modulus [Msi]	Ultimate Bypass Strain (microstrain)	Avg. Specimen Thickn. [in]	# Plies in Laminate	Avg. t _{ply} [in]
UG31111A & UG31112A	B1-6	A	1	73.072			1092	0.171	20	0.00856
UG31113A & UG31115A	B1-6	A	1	78.455			626	0.171	20	0.00853
UG31115A & UG31116A	B1-6	A	1	76.848	58.891	1.598		0.168	20	0.00838
UG31211A & UG31212A	B1-7	E	1	75.118	58.367	1.280		0.170	20	0.00848
UG31213A & UG31214A	B1-7	E	1	75.184	56.599	1.508		0.173	20	0.00864

Average	75.735	57.952	1.462	859	Average	0.0085
Standard Dev.	2.026	1.201	0.164	329.238		
Coeff. of Var. [%]	2.675	2.073	11.209	38.319		
Min.	73.072	56.599	1.280	626.392	Min.	0.0084
Max.	78.455	58.891	1.598	1092.005	Max.	0.0086
Number of Spec.	5	3	3	2		

**40/20/40 Bearing-Bypass 50%-Compression -- (RTD)
 Bearing Strength & Bypass Strain**

Bell - FiberCote E765/T300 3K PW Graphite Fabric [0/90/0/90/45/-45/90/0/90/0]_s

Specimen Number	Panel #	Cure Cycle	Prepreg Lot #	Ultimate Bearing Strength [ksi]	2% Offset Bearing Strength [ksi]	Chord Modulus [Msi]	Ultimate Bypass Strain (microstrain)	Avg. Specimen Thickn. [in]	# Plies in Laminate	Avg. t _{ply} [in]
UG41311A & UG41312A	B1-8	E	1	88.186	79.834	2.041	1441	0.170	20	0.00852
UG41313A & UG41314A	B1-8	E	1	88.135	75.118	2.040	1492	0.174	20	0.00868
UG41315A & UG41316A	B1-8	E	1	84.161	67.424	1.874		0.173	20	0.00863
UG41317A & UG41318A	B1-8	E	1	85.645	74.675	2.054		0.173	20	0.00865

Average	86.532	74.263	2.002	1466	Average	0.0086
Standard Dev.	1.976	5.122	0.086	36.353		
Coeff. of Var. [%]	2.283	6.897	4.288	2.479		
Min.	84.161	67.424	1.874	1440.789	Min.	0.0085
Max.	88.186	79.834	2.054	1492.199	Max.	0.0087
Number of Spec.	4	4	4	2		

40/20/40 Bearing-Bypass 25%-Tension -- (RTD)
Bearing Strength & Bypass Strain
 Bell - FiberCote E765/T300 3K PW Graphite Fabric [0/90/0/90/45/-45/90/0/90/0]_s

Specimen Number	Panel #	Cure Cycle	Prepreg Lot #	Ultimate Bearing Strength [ksi]	2% Offset Bearing Strength [ksi]	Chord Modulus [Msi]	Ultimate Bypass Strain (microstrain)	Avg. Specimen Thicken. [in]	# Plies in Laminate	Avg. t _{ply} [in]
UG51111A	B1-9	E	1	125.864	N/A		1026	0.172	20	0.00861
UG51112A	B1-9	E	1	124.176	N/A		1081	0.171	20	0.00853
UG51113A	B1-9	E	1	126.502	N/A			0.172	20	0.00858
UG51114A	B1-9	E	1	133.233	N/A			0.168	20	0.00842
UG51115A	B1-9	E	1	130.251	N/A			0.169	20	0.00845

Average	128.005	1053	Average	0.0085
Standard Dev.	3.670	38.774		
Coeff. of Var. [%]	2.867	3.681		
Min.	124.176	1025.953	Min.	0.0084
Max.	133.233	1080.787	Max.	0.0086
Number of Spec.	5	2		

**40/20/40 Bearing-Bypass 25%-Compression -- (RTD)
 Bearing Strength & Bypass Strain**

Bell - FiberCote E765/T300 3K PW Graphite Fabric [0/90/0/90/45/-45/90/0/90/0]_s

Specimen Number	Panel #	Cure Cycle	Prepreg Lot #	Ultimate Bearing Strength [ksi]	2% Offset Bearing Strength [ksi]	Chord Modulus [Msi]	Ultimate Bypass Strain (microstrain)	Avg. Specimen Thickn. [in]	# Plies in Laminate	Avg. t _{ply} [in]
UG61211A	B1-10	E	1	193.924	N/A	10.784	3951	0.171	20	0.00853
UG61212A	B1-10	E	1	194.589	N/A	10.262		0.173	20	0.00865
UG61213A	B1-10	E	1	213.099	N/A	10.948	4502	0.171	20	0.00855
UG61214A	B1-10	E	1	207.433	N/A	10.900		0.171	20	0.00853
UG61215A	B1-10	E	1	195.620	N/A	10.921		0.172	20	0.00862

Average	200.933			10.763		4227		Average	0.0086
Standard Dev.	8.773			0.287		389.759			
Coeff. of Var. [%]	4.366			2.666		9.222			
Min.	193.924			10.262		3951.000		Min.	0.0085
Max.	213.099			10.948		4502.202		Max.	0.0086
Number of Spec.	5			5		2			

**25/50/25 Laminate Tension -- (RTD)
 Strength & Modulus**

Bell - FiberCote E765/T300 3K PW Graphite Fabric [(45/0/-45/90)₂]_s

Specimen Number	Panel #	Cure Cycle	Prepreg Lot #	No Hole Strength [ksi]	No Hole Modulus [Msi]		Open Hole Strength [ksi]	Filled Hole Strength [ksi]	Avg. Specimen Thickn. [in]	# Plies in Laminate	Avg. t _{ply} [in]
					Front	Back					
UHJ1111A	B2-3	B	1	70.374	6.058	5.925			0.134	16	0.00840
UHJ1112A	B2-3	B	1	73.432	6.012	5.898			0.136	16	0.00850
UHJ1113A	B2-3	B	1	71.094	6.100	5.774			0.136	16	0.00847
UHH1111A	B2-4	C	1				39.635		0.134	16	0.00839
UHH1112A	B2-4	C	1				40.151		0.134	16	0.00838
UHH1113A	B2-4	C	1				38.456		0.135	16	0.00842
UHH1114A	B2-4	C	1				37.466		0.135	16	0.00843
UHH1115A	B2-4	C	1				37.672		0.136	16	0.00850
UHI1111A	B2-1	B	1					41.056	0.138	16	0.00861
UHI1112A	B2-1	B	1					43.513	0.137	16	0.00853
UHI1113A	B2-1	B	1					41.439	0.137	16	0.00856
UHI1114A	B2-1	B	1					41.637	0.138	16	0.00860
UHI1115A	B2-1	B	1					43.565	0.137	16	0.00855

Average	71.633	5.961	38.676	42.242	Average	0.0085
Standard Dev.	1.599	0.120	1.185	1.202		
Coeff. of Var. [%]	2.232	2.008	3.064	2.846		
Min.	70.374	5.774	37.466	41.056	Min.	0.0084
Max.	73.432	6.100	40.151	43.565	Max.	0.0086
Number of Spec.	3	3	5	5		

**25/50/25 Laminate Tension -- (CTD)
 Strength**
 Bell - FiberCote E765/T300 3K PW Graphite Fabric [(45/0/-45/90)₂]_s

Specimen Number	Panel #	Cure Cycle	Prepreg Lot #	Open Hole Strength [ksi]	Filled Hole Strength [ksi]	Avg. Specimen Thickn. [in]	# Plies in Laminate	Avg. t _{ply} [in]
UHH1211B	B2-5	C	1	35.559		0.136	16	0.00852
UHH1212B	B2-5	C	1	37.839		0.141	16	0.00878
UHH1213B	B2-5	C	1	37.587		0.137	16	0.00856
UHH1214B	B2-5	C	1	37.925		0.138	16	0.00860
UHH1215B	B2-5	C	1	36.258		0.137	16	0.00856
UHI1116B	B2-1	A	1		40.386	0.138	16	0.00862
UHI1117B	B2-1	A	1		38.414	0.138	16	0.00859
UHI1118B	B2-1	A	1		41.933	0.134	16	0.00839
UHI1119B	B2-1	A	1		39.094	0.137	16	0.00858
UHI1218B	B2-2	A	1		39.435	0.137	16	0.00859

Average	37.034	39.852	Average	0.0086
Standard Dev.	1.064	1.363		
Coeff. of Var. [%]	2.872	3.421		
Min.	35.559	38.414	Min.	0.0084
Max.	37.925	41.933	Max.	0.0088
Number of Spec.	5	5		

25/50/25 Laminate Tension -- (ETW) Strength & Modulus Bell - FiberCote E765/T300 3K PW Graphite Fabric [(45/0/-45/90) ₂] _s							
Specimen Number	Panel #	Cure Cycle	Prepreg Lot #	Open Hole Strength [ksi]	Avg. Specimen Thicken. [in]	# Plies in Laminate	Avg. t _{ply} [in]
UHH1111F	B2-7	C	1	42.035	0.136	16	0.00847
UHH1112F	B2-7	C	1	40.489	0.137	16	0.00857
UHH1113F	B2-7	C	1	41.216	0.138	16	0.00863
UHH1114F	B2-7	C	1	40.843	0.138	16	0.00863
UHH1115F	B2-7	C	1	40.327	0.139	16	0.00867

Average	40.982	Average	0.0086
Standard Dev.	0.681		
Coeff. of Var. [%]	1.661		
Min.	40.327	Min.	0.0085
Max.	42.035	Max.	0.0087
Number of Spec.	5		

**25/50/25 Laminate Compression -- (RTD)
 Strength & Modulus**

Bell - FiberCote E765/T300 3K PW Graphite Fabric [(45/0/-45/90)₂]_s

Specimen Number	Panel #	Cure Cycle	Prepreg Lot #	No Hole		No Hole Modulus [Msi]		Open Hole Strength [ksi]	Avg. Specimen Thickn. [in]	# Plies in Laminate	Avg. t _{ply} [in]
				Strength [ksi]		Front	Back				
UHK1115A	B2-3	B	1	66.849		5.404	5.616		0.136	16	0.00852
UHK1116A	B2-3	B	1	68.010		5.789	5.473		0.137	16	0.00854
UHK1117A	B2-3	B	1	67.841		5.781	5.486		0.136	16	0.00847
UHK1118A	B2-3	B	1	69.699		5.964	5.426		0.134	16	0.00835
UHL1311A	B2-6	C	1					40.009	0.134	16	0.00838
UHL1312A	B2-6	C	1					36.933	0.137	16	0.00854
UHL1313A	B2-6	C	1					40.366	0.137	16	0.00853
UHL1314A	B2-6	C	1					39.316	0.138	16	0.00860
UHL1315A	B2-6	C	1					41.809	0.138	16	0.00860

Average	68.100	5.617	39.687	Average	0.0085
Standard Dev.	1.183	0.206	1.788		
Coeff. of Var. [%]	1.737	3.664	4.505		
Min.	66.849	5.404	36.933	Min.	0.0083
Max.	69.699	5.964	41.809	Max.	0.0086
Number of Spec.	4	4	5		

**25/50/25 Laminate Compression -- (ETW)
 Strength & Modulus**
 Bell - FiberCote E765/T300 3K PW Graphite Fabric [(45/0/-45/90)₂]_s

Specimen Number	Panel #	Cure Cycle	Prepreg Lot #	Open Hole Strength [ksi]	Filled Hole Strength [ksi]	Avg. Specimen Thicken. [in]	# Plies in Laminate	Avg. t _{ply} [in]
UHL1316F	B2-6	C	1	23.867		0.139	16	0.00869
UHL1317F	B2-6	C	1	23.484		0.139	16	0.00866
UHL1318F	B2-6	C	1	23.520		0.137	16	0.00859
UHL1319F	B2-6	C	1	23.264		0.135	16	0.00843
UHL1218F	B2-5	C	1	24.397		0.135	16	0.00844
UHM1211F	B2-2	A	1		35.207	0.135	16	0.00844
UHM1212F	B2-2	A	1		37.068	0.136	16	0.00848
UHM1213F	B2-2	A	1		37.179	0.138	16	0.00864
UHM1214F	B2-2	A	1		37.572	0.138	16	0.00862
UHM1215F	B2-2	A	1		36.429	0.138	16	0.00864

Average	23.706	36.691	Average	0.0086
Standard Dev.	0.442	0.926		
Coeff. of Var. [%]	1.866	2.523		
Min.	23.264	35.207	Min.	0.0084
Max.	24.397	37.572	Max.	0.0087
Number of Spec.	5	5		

25/50/25 Double Shear Bearing -- (RTD)
Bearing Strength & Chord Modulus
 Bell - FiberCote E765/T300 3K PW Graphite Fabric [(45/0/-45/90)₂]_s

Specimen Number	Panel #	Cure Cycle	Prepreg Lot #	Ultimate Bearing Strength [ksi]	2% Offset Bearing Strength [ksi]	Chord Modulus [Msi]	Avg. Specimen Thickn. [in]	# Plies in Laminate	Avg. t _{ply} [in]
UH11111A	B2-15	I	1	76.504	75.371	0.721	0.132	16	0.00825
UH11112A	B2-15	I	1	78.406	78.564	0.782	0.133	16	0.00828
UH11113A	B2-15	I	1	78.140	77.611	0.793	0.132	16	0.00823
UH11114A	B2-15	I	1	76.686	76.758	0.702	0.134	16	0.00837
UH11115A	B2-15	I	1	77.385	76.136	0.767	0.135	16	0.00842

Average	77.424	76.888	0.753	Average	0.0083
Standard Dev.	0.847	1.246	0.039		
Coeff. of Var. [%]	1.094	1.621	5.245		
Min.	76.504	75.371	0.702	Min.	0.0082
Max.	78.406	78.564	0.793	Max.	0.0084
Number of Spec.	5	5	5		

25/50/25 Double Shear Bearing -- (ETW)
Bearing Strength & Chord Modulus
 Bell - FiberCote E765/T300 3K PW Graphite Fabric [(45/0/-45/90)₂]_s

Specimen Number	Panel #	Cure Cycle	Prepreg Lot #	Ultimate Bearing Strength [ksi]	2% Offset Bearing Strength [ksi]	Chord Modulus [Msi]	Avg. Specimen Thickn. [in]	# Plies in Laminate	Avg. t _{ply} [in]
UH11121F	B2-15	I	1	45.104	N/A	1.882	0.133	16	0.00829
UH11122F	B2-15	I	1	44.436	N/A	1.728	0.136	16	0.00848
UH11123F	B2-15	I	1	47.068	N/A	1.839	0.136	16	0.00852
UH11124F	B2-15	I	1	45.043	N/A	1.744	0.136	16	0.00848
UH11125F	B2-15	I	1	44.204	N/A	2.126	0.135	16	0.00842
UH11126F	B2-15	I	1	43.603	N/A	2.257	0.136	16	0.00847

Average	44.910	1.929	Average	0.0084
Standard Dev.	1.195	0.215		
Coeff. of Var. [%]	2.661	11.153		
Min.	43.603	1.728	Min.	0.0083
Max.	47.068	2.257	Max.	0.0085
Number of Spec.	6	6		

25/50/25 Single Shear Bearing -- (RTD)
Bearing Strength & Chord Modulus
 Bell - FiberCote E765/T300 3K PW Graphite Fabric [(45/0/-45/90)₂]_S

Specimen Number	Panel #	Cure Cycle	Prepreg Lot #	Ultimate Bearing Strength [ksi]	2% Offset Bearing Strength [ksi]	Chord Modulus [Msi]	Avg. Specimen Thickn. [in]	# Plies in Laminate	Avg. t _{ply} [in]
UH21111A & UH21112A	B2-13	I	1	103.742	85.216	0.599	0.137	16	0.00858
UH21113A & UH21114A	B2-13	I	1	117.109	94.182	0.620	0.135	16	0.00843
UH21115A & UH21116A	B2-13	I	1	111.694	73.980	0.671	0.135	16	0.00842
UH21121A & UH21122A	B2-13	I	1	95.283	62.848	0.819	0.136	16	0.00850
UH21123A & UH21124A	B2-13	I	1	104.031	86.200	0.810	0.137	16	0.00856

Average	106.372	80.485	0.704	Average	0.0085
Standard Dev.	8.351	12.207	0.104		
Coeff. of Var. [%]	7.851	15.167	14.811		
Min.	95.283	62.848	0.599	Min.	0.0084
Max.	117.109	94.182	0.819	Max.	0.0086
Number of Spec.	5	5	5		

25/50/25 Single Shear Bearing -- (ETW)
Bearing Strength & Chord Modulus
 Bell - FiberCote E765/T300 3K PW Graphite Fabric [(45/0/-45/90)₂]_s

Specimen Number	Panel #	Cure Cycle	Prepreg Lot #	Ultimate Bearing Strength [ksi]	2% Offset Bearing Strength [ksi]	Chord Modulus [Msi]	Avg. Specimen Thickn. [in]	# Plies in Laminate	Avg. t _{ply} [in]
UH21213F & UH21214F	B2-14	I	1	87.881	65.711	0.651	0.134	16	0.00835
UH21215F & UH21216F	B2-14	I	1	80.673	68.799	0.765	0.133	16	0.00830
UH21217F & UH21218F	B2-14	I	1	84.412	77.446	0.687	0.134	16	0.00839
UH21221F & UH21222F	B2-14	I	1	76.386	66.721	0.769	0.134	16	0.00837
UH21223F & UH21224F	B2-14	I	1	77.423	68.621	0.750	0.134	16	0.00838

Average	81.355	69.460	0.724	Average	0.0084
Standard Dev.	4.810	4.649	0.053		
Coeff. of Var. [%]	5.913	6.694	7.270		
Min.	76.386	65.711	0.651	Min.	0.0083
Max.	87.881	77.446	0.769	Max.	0.0084
Number of Spec.	5	5	5		

25/50/25 Bearing-Bypass 50%-Tension -- (RTD)
Bearing Strength & Bypass Strain
 Bell - FiberCote E765/T300 3K PW Graphite Fabric [(45/0/-45/90)₂]_s

Specimen Number	Panel #	Cure Cycle	Prepreg Lot #	Ultimate Bearing Strength [ksi]	2% Offset Bearing Strength [ksi]	Chord Modulus [Msi]	Ultimate Bypass Strain (microstrain)	Avg. Specimen Thickn. [in]	# Plies in Laminate	Avg. t _{ply} [in]
UH31111A & UH31112A	B2-8	G	1	98.923	84.045		2050	0.135	16	0.00841
UH31113A & UH31114A	B2-8	G	1	95.574	83.681		2055	0.135	16	0.00845
UH31115A & UH31116A	B2-8	G	1	102.584	81.670			0.135	16	0.00846
UH31211A & UH31212A	B2-9	G	1	102.263	78.005			0.130	16	0.00813
UH31213A & UH31214A	B2-9	G	1	102.446	69.240			0.131	16	0.00822

Average	100.358	79.328	2053	Average	0.0083
Standard Dev.	3.078	6.128	3.229		
Coeff. of Var. [%]	3.067	7.725	0.157		
Min.	95.574	69.240	2050.426	Min.	0.0081
Max.	102.584	84.045	2054.992	Max.	0.0085
Number of Spec.	5	5	2		

NOTE: 2% offset is based on the actuator displacement

25/50/25 Bearing-Bypass 50%-Compression -- (RTD)
Bearing Strength & Bypass Strain
 Bell - FiberCote E765/T300 3K PW Graphite Fabric [(45/0/-45/90)₂]_s

Specimen Number	Panel #	Cure Cycle	Prepreg Lot #	Ultimate Bearing Strength [ksi]	2% Offset Bearing Strength [ksi]	Chord Modulus [Msi]	Ultimate Bypass Strain (microstrain)	Avg. Specimen Thickn. [in]	# Plies in Laminate	Avg. t _{ply} [in]
UH41311A & UH41312A	B2-10	H	1	101.447	82.125	2.333	2160	0.132	16	0.00827
UH41313A & UH41314A	B2-10	H	1	103.345	82.932	2.313	1995	0.133	16	0.00831
UH41315A & UH41316A	B2-10	H	1	101.423	82.269	2.022		0.133	16	0.00833
UH41317A & UH41318A	B2-10	H	1	103.957	78.580	2.222		0.133	16	0.00831
UH31117A & UH31118A	B2-8	G	1	103.473	79.752	2.197		0.134	16	0.00835

Average	102.729	81.132	2.217	2077	Average	0.0083
Standard Dev.	1.203	1.867	0.124	116.883		
Coeff. of Var. [%]	1.171	2.301	5.572	5.627		
Min.	101.423	78.580	2.022	1994.511	Min.	0.0083
Max.	103.957	82.932	2.333	2159.808	Max.	0.0083
Number of Spec.	5	5	5	2		

25/50/25 Bearing-Bypass 25%-Tension -- (RTD)
Bearing Strength & Bypass Strain
 Bell - FiberCote E765/T300 3K PW Graphite Fabric [(45/0/-45/90)₂]_s

Specimen Number	Panel #	Cure Cycle	Prepreg Lot #	Ultimate Bearing Strength [ksi]	2% Offset Bearing Strength [ksi]	Chord Modulus [Msi]	Ultimate Bypass Strain (microstrain)	Avg. Specimen Thickn. [in]	# Plies in Laminate	Avg. t _{ply} [in]
UH51111A	B2-11	H	1	125.683	N/A			0.134	16	0.00838
UH51112A	B2-11	H	1	117.103	N/A			0.136	16	0.00852
UH51113A	B2-11	H	1	116.463	N/A		1347	0.137	16	0.00855
UH51114A	B2-11	H	1	121.915	N/A		1442	0.136	16	0.00852
UH51115A	B2-11	H	1	112.951	N/A			0.136	16	0.00850

Average	118.823	1395	Average	0.0085
Standard Dev.	4.991	67.450		
Coeff. of Var. [%]	4.200	4.837		
Min.	112.951	1346.835	Min.	0.0084
Max.	125.683	1442.224	Max.	0.0085
Number of Spec.	5	2		

25/50/25 Bearing-Bypass 25%-Compression -- (RTD)
Bearing Strength & Bypass Strain
 Bell - FiberCote E765/T300 3K PW Graphite Fabric [(45/0/-45/90)₂]_s

Specimen Number	Panel #	Cure Cycle	Prepreg Lot #	Ultimate Bearing Strength [ksi]	2% Offset Bearing Strength [ksi]	Chord Modulus [Msi]	Ultimate Bypass Strain (microstrain)	Avg. Specimen Thickn. [in]	# Plies in Laminate	Avg. t _{ply} [in]
UH61211A	B2-12	H	1	190.019	N/A	9.036	4736	0.134	16	0.00839
UH61212A	B2-12	H	1	184.972	N/A	9.700	2492	0.135	16	0.00845
UH61213A	B2-12	H	1	195.043	N/A	9.227		0.137	16	0.00858
UH61214A	B2-12	H	1	179.024	N/A	9.126		0.138	16	0.00862
UH61215A	B2-12	H	1	185.646	N/A	8.865		0.136	16	0.00852

Average	186.941	9.191	3614	Average	0.0085
Standard Dev.	5.986	0.314	1586.556		
Coeff. of Var. [%]	3.202	3.420	43.901		
Min.	179.024	8.865	2492.092	Min.	0.0084
Max.	195.043	9.700	4735.820	Max.	0.0086
Number of Spec.	5	5	2		

**10/80/10 Laminate Tension -- (RTD)
 Strength & Modulus**
 Bell - FiberCote E765/T300 3K PW Graphite Fabric [45/-45/90/45/-45/45/-45/0/45/-45]_s

Specimen Number	Panel #	Cure Cycle	Prepreg Lot #	No Hole Strength [ksi]		No Hole Modulus [Msi]		Open Hole Strength [ksi]	Filled Hole Strength [ksi]	Avg. Specimen Thicken. [in]	# Plies in Laminate	Avg. t _{ply} [in]
				Front	Back	Front	Back					
UIJ1111A	B3-3	D	1	51.104	3.959	3.909				0.169	20	0.00844
UIJ1112A	B3-3	D	1	51.468	3.986	3.909				0.169	20	0.00845
UIJ1113A	B3-3	D	1	49.783	3.831	3.751				0.173	20	0.00863
UIH1111A	B3-4	D	1					36.831		0.170	20	0.00851
UIH1112A	B3-4	D	1					36.826		0.172	20	0.00859
UIH1113A	B3-4	D	1					36.901		0.172	20	0.00862
UIH1114A	B3-4	D	1					37.339		0.172	20	0.00861
UIH1115A	B3-4	D	1					38.016		0.171	20	0.00857
UII1111A	B3-1	D	1						40.895	0.170	20	0.00852
UII1112A	B3-1	D	1						40.493	0.170	20	0.00851
UII1113A	B3-1	D	1						40.808	0.170	20	0.00848
UII1114A	B3-1	D	1						40.553	0.170	20	0.00852
UII1115A	B3-1	D	1						40.322	0.170	20	0.00851

Average	50.785	3.891	37.183	40.614	Average	0.0085
Standard Dev.	0.887	0.087	0.512	0.235		
Coeff. of Var. [%]	1.746	2.226	1.376	0.578		
Min.	49.783	3.751	36.826	40.322	Min.	0.0084
Max.	51.468	3.986	38.016	40.895	Max.	0.0086
Number of Spec.	3	3	5	5		

**10/80/10 Laminate Tension -- (CTD)
 Strength**
 Bell - FiberCote E765/T300 3K PW Graphite Fabric [45/-45/90/45/-45/45/-45/0/45/-45]_s

Specimen Number	Panel #	Cure Cycle	Prepreg Lot #	Open Hole Strength [ksi]	Filled Hole Strength [ksi]	Avg. Specimen Thickn. [in]	# Plies in Laminate	Avg. t _{ply} [in]
UIH1211B	B3-5	D	1	39.272		0.167	20	0.00837
UIH1212B	B3-5	D	1	39.976		0.169	20	0.00845
UIH1213B	B3-5	D	1	38.758		0.170	20	0.00852
UIH1214B	B3-5	D	1	39.473		0.171	20	0.00853
UIH1215B	B3-5	D	1	38.484		0.170	20	0.00848
UII1116B	B3-1	D	1		41.652	0.173	20	0.00864
UII1117B	B3-1	D	1		41.557	0.171	20	0.00853
UII1118B	B3-1	D	1		40.911	0.170	20	0.00852
UII1119B	B3-1	D	1		43.768	0.169	20	0.00845
UII1211B	B3-2	D	1		43.140	0.168	20	0.00838

Average	39.193	42.206	Average	0.0085
Standard Dev.	0.590	1.196		
Coeff. of Var. [%]	1.504	2.833		
Min.	38.484	40.911	Min.	0.0084
Max.	39.976	43.768	Max.	0.0086
Number of Spec.	5	5		

10/80/10 Laminate Tension -- (ETW)
Strength & Modulus
 Bell - FiberCote E765/T300 3K PW Graphite Fabric [45/-45/90/45/-45/45/-45/0/45/-45]_s

Specimen Number	Panel #	Cure Cycle	Prepreg Lot #	Open Hole Strength [ksi]	Avg. Specimen Thckn. [in]	# Plies in Laminate	Avg. t _{ply} [in]
UIH1111F	B3-7	J	1	28.407	0.167	20	0.00835
UIH1112F	B3-7	J	1	28.229	0.170	20	0.00850
UIH1113F	B3-7	J	1	28.233	0.169	20	0.00845
UIH1114F	B3-7	J	1	28.570	0.167	20	0.00837
UIH1115F	B3-7	J	1	28.322	0.169	20	0.00844

Average	28.352	Average	0.0084
Standard Dev.	0.142		
Coeff. of Var. [%]	0.501		
Min.	28.229	Min.	0.0084
Max.	28.570	Max.	0.0085
Number of Spec.	5		

**10/80/10 Laminate Compression -- (RTD)
 Strength & Modulus**
 Bell - FiberCote E765/T300 3K PW Graphite Fabric [45/-45/90/45/-45/45/-45/0/45/-45]_s

Specimen Number	Panel #	Cure Cycle	Prepreg Lot #	No Hole Strength [ksi]	No Hole Modulus [Msi]		Open Hole Strength [ksi]	Avg. Specimen Thicken. [in]	# Plies in Laminate	Avg. t _{ply} [in]
					Front	Back				
UIK1115A	B3-3	D	1	48.684	3.768	3.682		0.171	20	0.00853
UIK1116A	B3-3	D	1	48.875	3.796	3.740		0.170	20	0.00850
UIK1117A	B3-3	D	1	48.728	3.809	3.685		0.170	20	0.00850
UIL1217A	B3-5	D	1				37.026	0.171	20	0.00854
UIL1218A	B3-5	D	1				38.058	0.170	20	0.00849
UIL1317A	B3-6	D	1				36.734	0.172	20	0.00858
UIL1318A	B3-6	D	1				35.458	0.170	20	0.00851
UIL1319A	B3-6	D	1				35.577	0.171	20	0.00857

Average	48.762	3.746	36.571	Average	0.0085
Standard Dev.	0.100	0.054	1.081		
Coeff. of Var. [%]	0.206	1.455	2.955		
Min.	48.684	3.682	35.458	Min.	0.0085
Max.	48.875	3.809	38.058	Max.	0.0086
Number of Spec.	3	3	5		

10/80/10 Laminate Compression -- (ETW)
Strength & Modulus
 Bell - FiberCote E765/T300 3K PW Graphite Fabric [45/-45/90/45/-45/45/-45/0/45/-45]_s

Specimen Number	Panel #	Cure Cycle	Prepreg Lot #	Open Hole Strength [ksi]	Filled Hole Strength [ksi]	Avg. Specimen Thickn. [in]	# Plies in Laminate	Avg. t _{ply} [in]
UIL1311F	B3-6	D	1	22.461		0.172	20	0.00859
UIL1312F	B3-6	D	1	23.277		0.172	20	0.00859
UIL1313F	B3-6	D	1	23.221		0.171	20	0.00853
UIL1314F	B3-6	D	1	22.674		0.171	20	0.00855
UIL1315F	B3-6	D	1	20.728		0.171	20	0.00857
UIM1212F	B3-2	D	1		27.879	0.170	20	0.00852
UIM1213F	B3-2	D	1		27.409	0.173	20	0.00866
UIM1214F	B3-2	D	1		25.675	0.175	20	0.00874
UIM1215F	B3-2	D	1		26.968	0.171	20	0.00856
UIM1216F	B3-2	D	1		27.532	0.173	20	0.00866

Average	22.472	27.093	Average	0.0086
Standard Dev.	1.036	0.857		
Coeff. of Var. [%]	4.610	3.164		
Min.	20.728	25.675	Min.	0.0085
Max.	23.277	27.879	Max.	0.0087
Number of Spec.	5	5		

10/80/10 Bearing-Bypass 50%-Tension -- (RTD)

Bearing Strength & Bypass Strain

Bell - FiberCote E765/T300 3K PW Graphite Fabric [45/-45/90/45/-45/45/-45/0/45/-45]_s

Specimen Number	Panel #	Cure Cycle	Prepreg Lot #	Ultimate Bearing Strength [ksi]	2% Offset Bearing Strength [ksi]	Chord Modulus [Msi]	Ultimate Bypass Strain (microstrain)	Avg. Specimen Thickn. [in]	# Plies in Laminate	Avg. t _{ply} [in]
UI31111A & UI31112A	B3-8	J	1	85.180			2905	0.168	20	0.00839
UI31113A & UI31114A	B3-8	J	1	77.578	58.219	1.227		0.166	20	0.00829
UI31115A & UI31116A	B3-8	J	1	80.168	67.642	1.405		0.166	20	0.00830
UI31211A & UI31212A	B3-9	J	1	80.497			2752	0.166	20	0.00831
UI31213A & UI31214A	B3-9	J	1	75.829	65.521	1.309		0.167	20	0.00836

Average	79.850	63.794	1.314	2829	Average 0.0083
Standard Dev.	3.545	4.943	0.089	108.222	
Coeff. of Var. [%]	4.439	7.749	6.755	3.826	
Min.	75.829	58.219	1.227	2752.152	Min. 0.0083
Max.	85.180	67.642	1.405	2905.201	Max. 0.0084
Number of Spec.	5	3	3	2	

**10/80/10 Bearing-Bypass 50%-Compression -- (RTD)
 Bearing Strength & Bypass Strain**
 Bell - FiberCote E765/T300 3K PW Graphite Fabric [45/-45/90/45/-45/45/-45/0/45/-45]s

Specimen Number	Panel #	Cure Cycle	Prepreg Lot #	Ultimate Bearing Strength [ksi]	2% Offset Bearing Strength [ksi]	Chord Modulus [Msi]	Ultimate Bypass Strain (microstrain)	Avg. Specimen Thickn. [in]	# Plies in Laminate	Avg. t _{ply} [in]
UI41311A & UI41312A	B3-10	J	1	91.785	71.645	1.952	2242	0.166	20	0.00832
UI41313A & UI41314A	B3-10	J	1	98.211	75.286	1.983	2440	0.166	20	0.00830
UI41315A & UI41316A	B3-10	J	1	96.179	69.441	1.817		0.166	20	0.00831
UI41317A & UI41318A	B3-10	J	1	90.997	70.477	1.882		0.167	20	0.00835
UI31117A & UI31118A	B3-8	J	1	93.456	74.919	1.867		0.168	20	0.00838

Average	94.126	72.353	1.900	2341	Average	0.0083
Standard Dev.	3.026	2.631	0.067	140.001		
Coeff. of Var. [%]	3.215	3.636	3.516	5.981		
Min.	90.997	69.441	1.817	2241.756	Min.	0.0083
Max.	98.211	75.286	1.983	2439.748	Max.	0.0084
Number of Spec.	5	5	5	2		

10/80/10 Bearing-Bypass 25%-Tension -- (RTD)

Bearing Strength & Bypass Strain

Bell - FiberCote E765/T300 3K PW Graphite Fabric [45/-45/90/45/-45/45/-45/0/45/-45]_s

Specimen Number	Panel #	Cure Cycle	Prepreg Lot #	Ultimate Bearing Strength [ksi]	2% Offset Bearing Strength [ksi]	Chord Modulus [Msi]	Ultimate Bypass Strain (microstrain)	Avg. Specimen Thickn. [in]	# Plies in Laminate	Avg. t_{ply} [in]
UI51111A	B3-11	J	1	117.607	N/A		54974	0.165	20	0.00827
UI51112A	B3-11	J	1	115.272	N/A		54963	0.166	20	0.00830
UI51113A	B3-11	J	1	116.577	N/A			0.168	20	0.00841
UI51114A	B3-11	J	1	115.795	N/A			0.168	20	0.00842
UI51115A	B3-11	J	1	116.251	N/A			0.169	20	0.00846

Average	116.300	54968	Average 0.0084
Standard Dev.	0.880	7.824	
Coeff. of Var. [%]	0.757	0.014	
Min.	115.272	54962.563	Min. 0.0083
Max.	117.607	54973.628	Max. 0.0085
Number of Spec.	5	2	

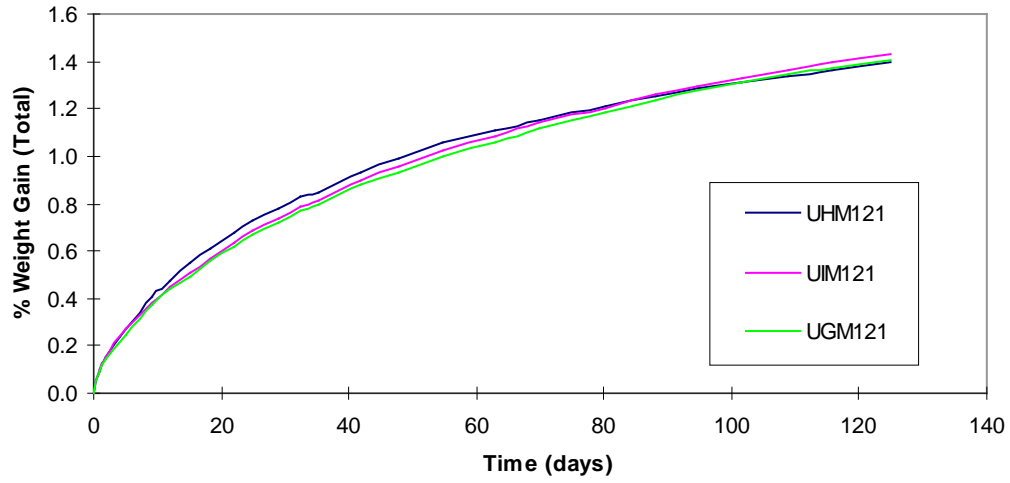
10/80/10 Bearing-Bypass 25%-Compression -- (RTD)
Bearing Strength & Bypass Strain
 Bell - FiberCote E765/T300 3K PW Graphite Fabric [45/-45/90/45/-45/45/-45/0/45/-45]_s

Specimen Number	Panel #	Cure Cycle	Prepreg Lot #	Ultimate Bearing Strength [ksi]	2% Offset Bearing Strength [ksi]	Chord Modulus [Msi]	Ultimate Bypass Strain (microstrain)	Avg. Specimen Thicken. [in]	# Plies in Laminate	Avg. t _{ply} [in]
UI61211A	B3-12	J	1	137.771	N/A	6.494	4078	0.165	20	0.00827
UI61212A	B3-12	J	1	140.015	N/A	6.209	4032	0.167	20	0.00833
UI61213A	B3-12	J	1	141.628	N/A	6.537		0.168	20	0.00838
UI61214A	B3-12	J	1	139.530	N/A	6.022		0.169	20	0.00845
UI61215A	B3-12	J	1	134.336	N/A	5.234		0.171	20	0.00856
UI61216A	B3-12	J	1	139.034	N/A	6.377		0.168	20	0.00841

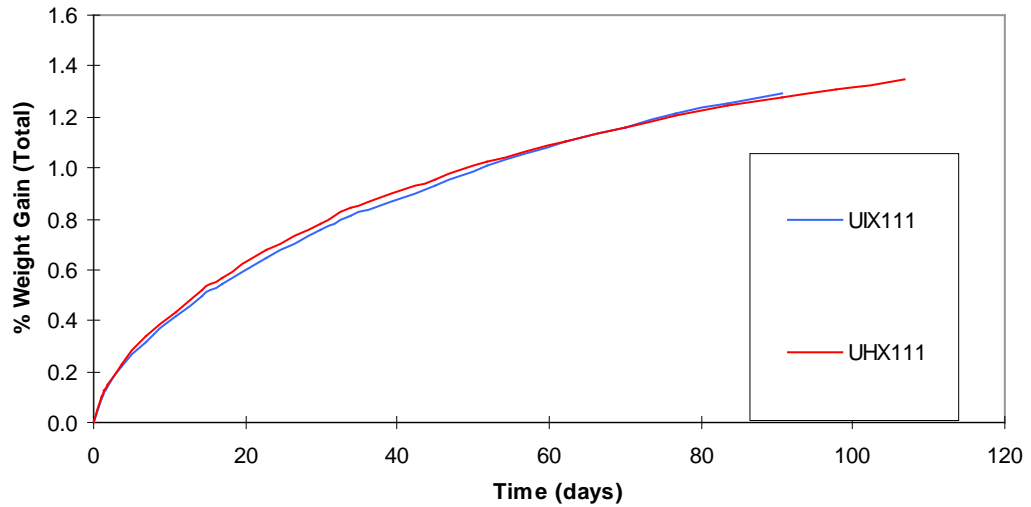
Average	138.719	6.145	4055	Average	0.0084
Standard Dev.	2.490	0.485	32.646		
Coeff. of Var. [%]	1.795	7.897	0.805		
Min.	134.336	5.234	4032.217	Min.	0.0083
Max.	141.628	6.537	4078.386	Max.	0.0086
Number of Spec.	6	6	2		

3.4. Moisture Conditioning History Charts

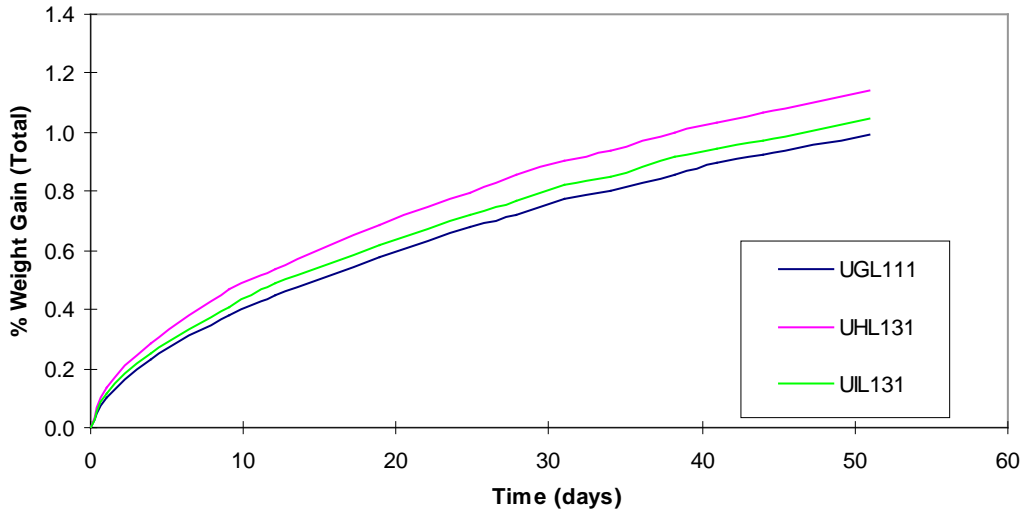
Conditioning History - BELL HELICOPTER



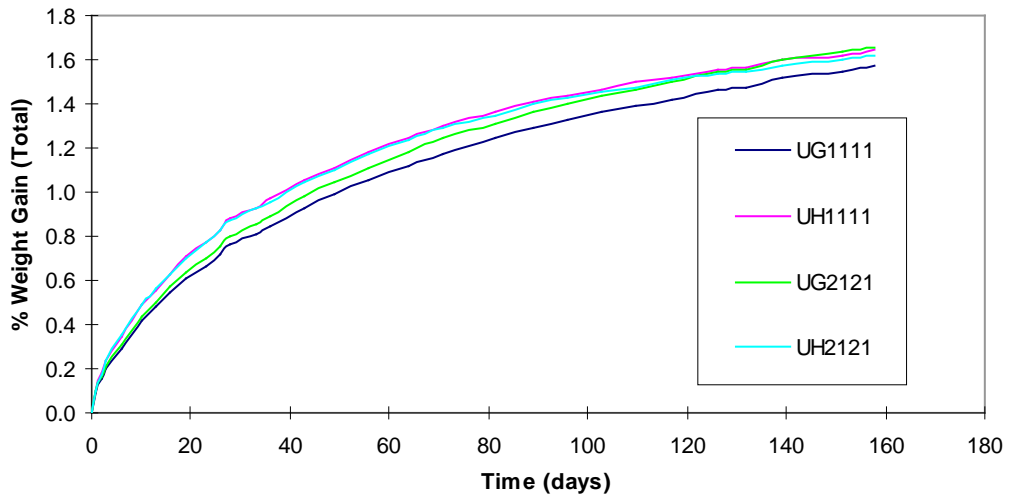
Conditioning History - BELL HELICOPTER



Conditioning History - BELL HELICOPTER



Conditioning History - BELL HELICOPTER



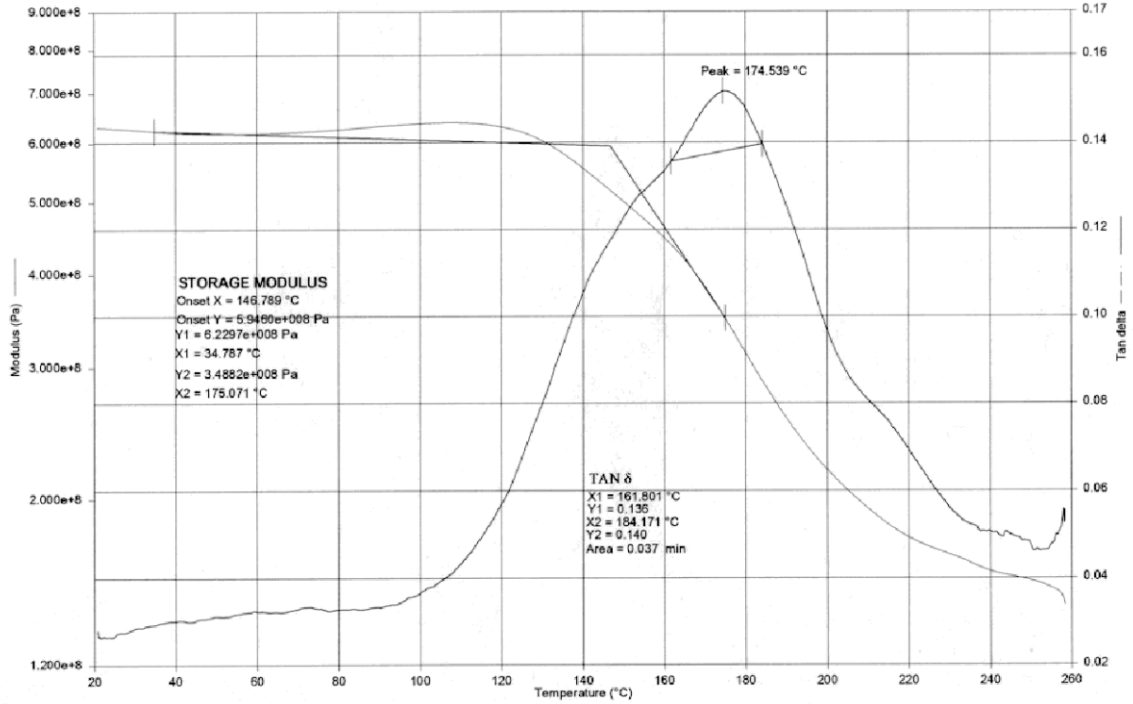
3.5. Physical Test Results

3.5.1. DMA Results and Graphs

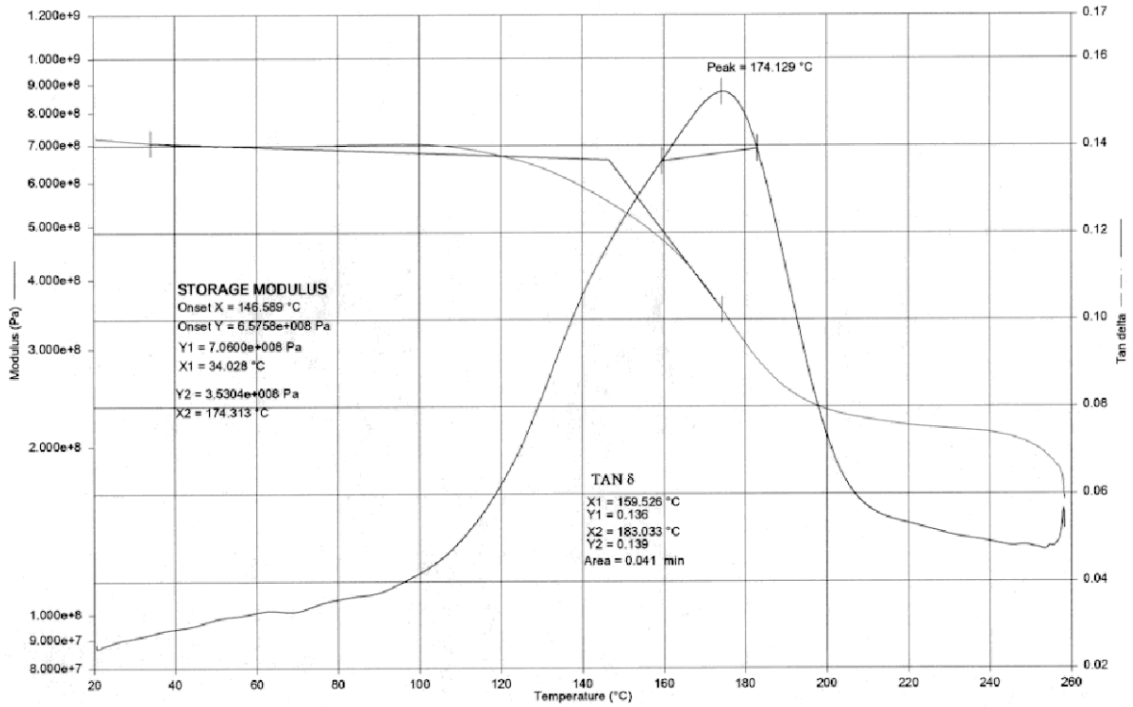
COMPANY : **Bell Helicopter**
 MATERIAL SYSTEM : **FiberCoteE765/3K PW Graphite Fabric**
 PROJECT : **000714c1**

DMA Results -- Onset Storage Modulus					
DRY			WET		
As Fabricated			Moisture Equilibrium at 85% RH		
Sample #	Tg [°C]	Tg [°F]	Sample #	Tg [°C]	Tg [°F]
UID1311A	146.79	296.22	UHD1112F	105.78	222.41
UID1312A	146.59	295.86	UHD1113F	110.17	230.30
UID1313A	140.21	284.39	UHD1114F	110.12	230.22
UID1314A	145.88	294.58	UHD1115F	105.65	222.17
			UHD1116F	104.05	219.29
			UHD1117F	107.30	225.14
Average [°F]		292.76	Average [°F]		224.92
Standard Dev. [°F]		5.63	Standard Dev. [°F]		4.53
Coeff. Of Var. [%]		1.92	Coeff. Of Var. [%]		2.02

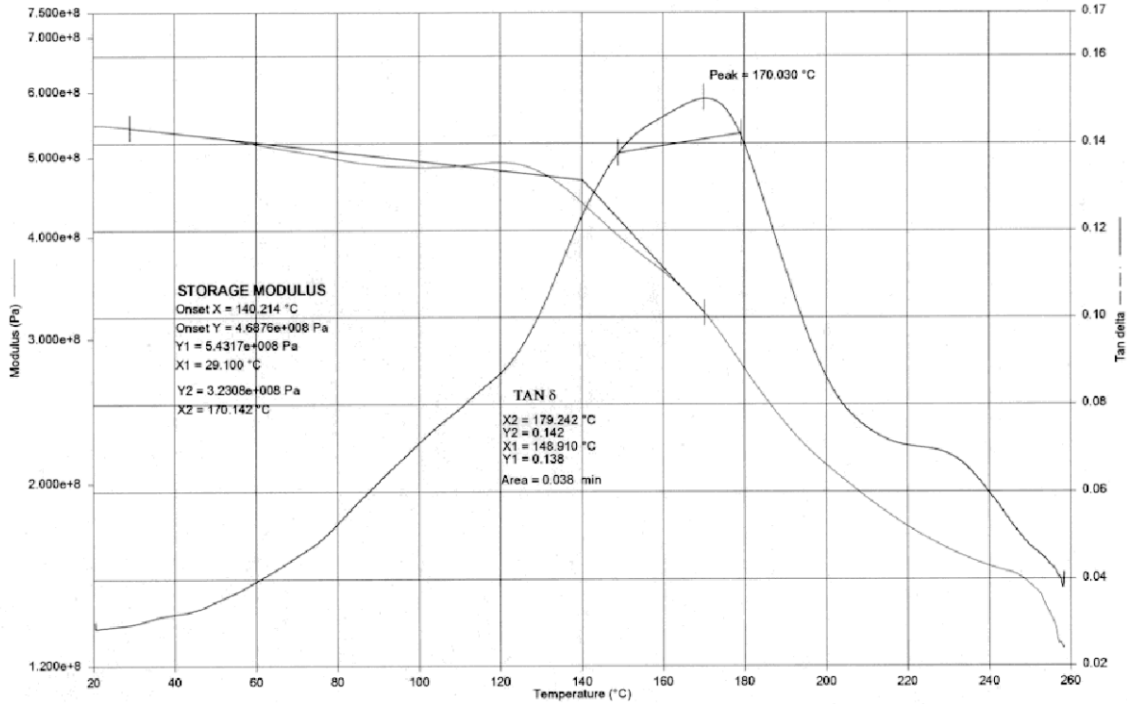
DMA Results - Peak Tan Delta					
DRY			WET		
As Fabricated			Moisture Equilibrium at 85% RH		
Sample #	Tg [°C]	Tg [°F]	Sample #	Tg [°C]	Tg [°F]
UID1311A	174.54	346.17	UHD1112F	128.24	262.83
UID1312A	174.13	345.43	UHD1113F	130.35	266.62
UID1313A	170.03	338.05	UHD1114F	127.43	261.37
UID1314A	173.14	343.66	UHD1115F	128.49	263.28
			UHD1116F	128.38	263.08
			UHD1117F	128.51	263.32
Average [°F]		343.33	Average [°F]		263.42
Standard Dev. [°F]		3.67	Standard Dev. [°F]		1.73
Coeff. Of Var. [%]		1.07	Coeff. Of Var. [%]		0.66



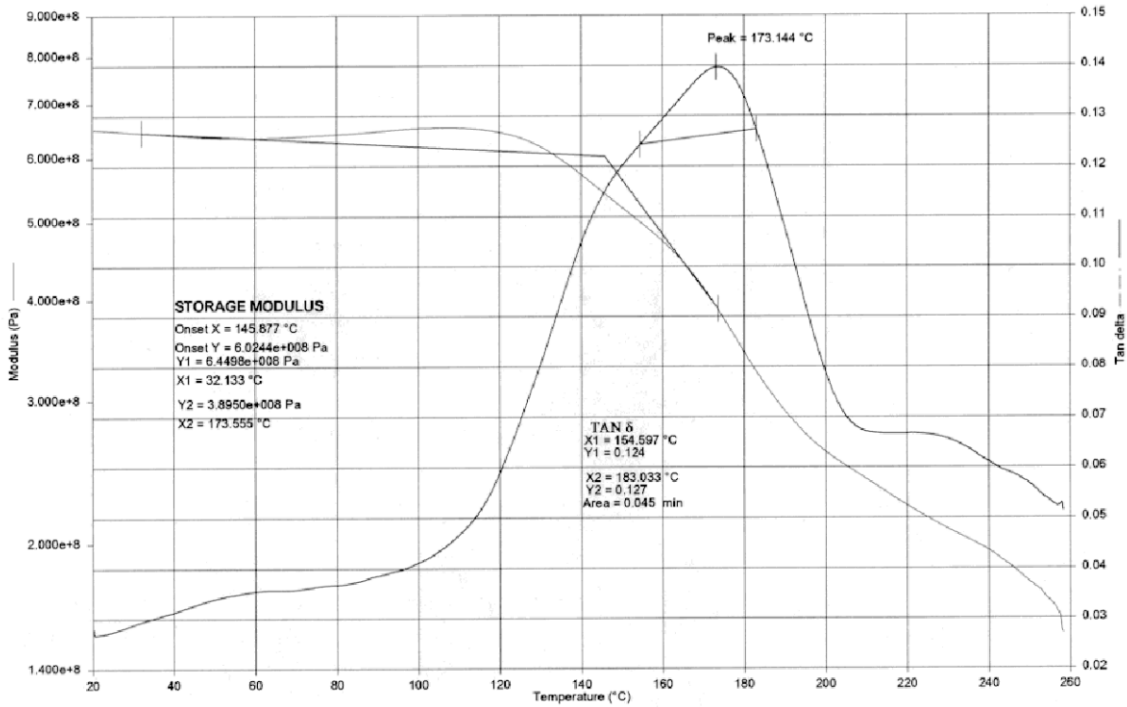
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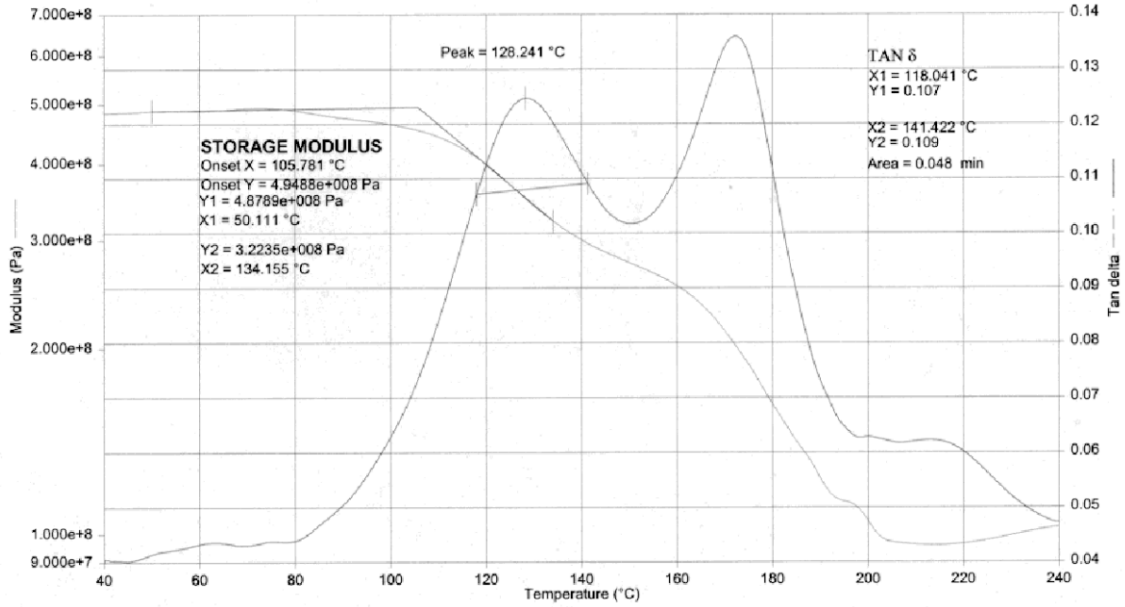
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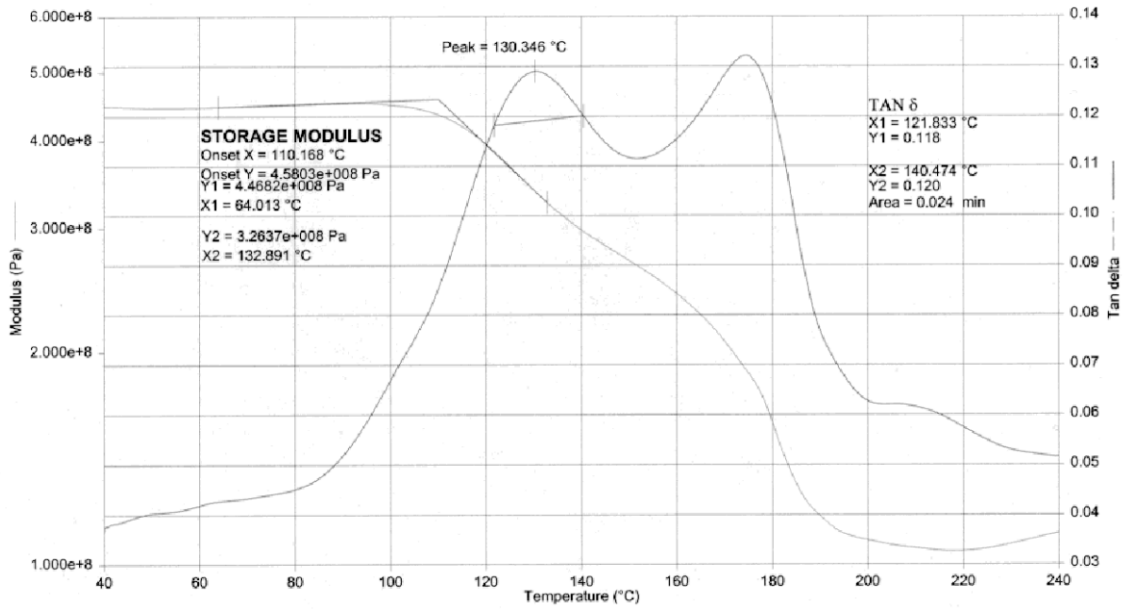
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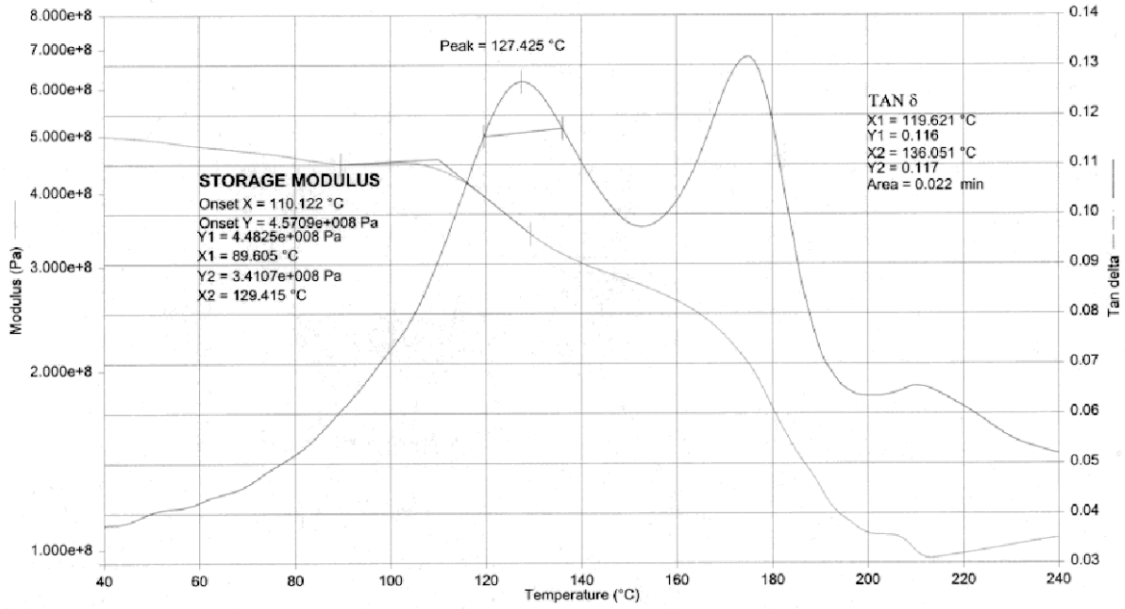
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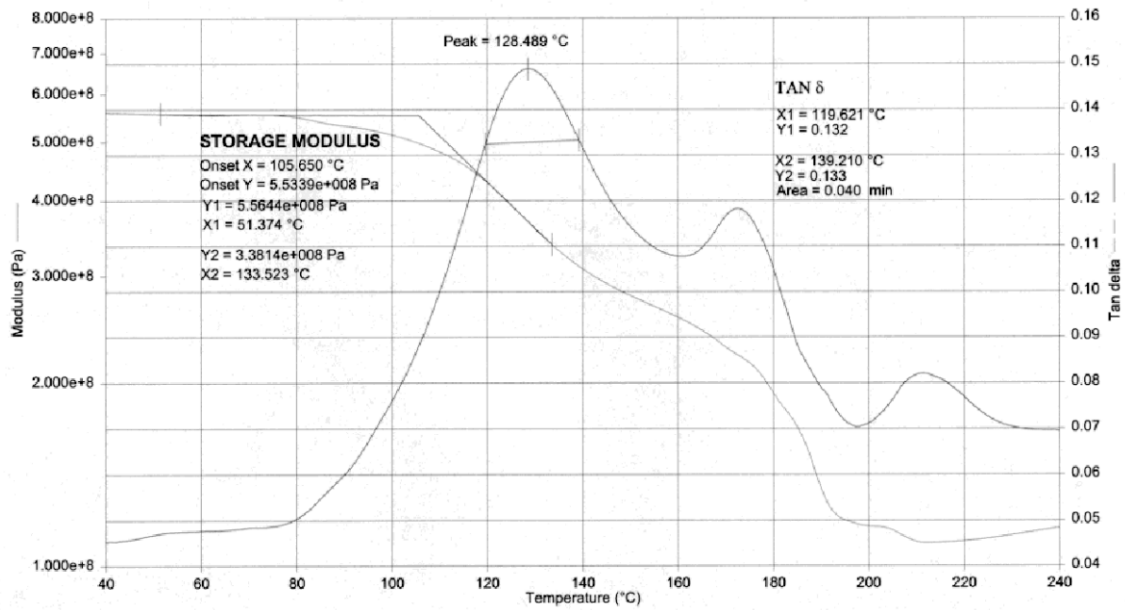
UHD 1112F



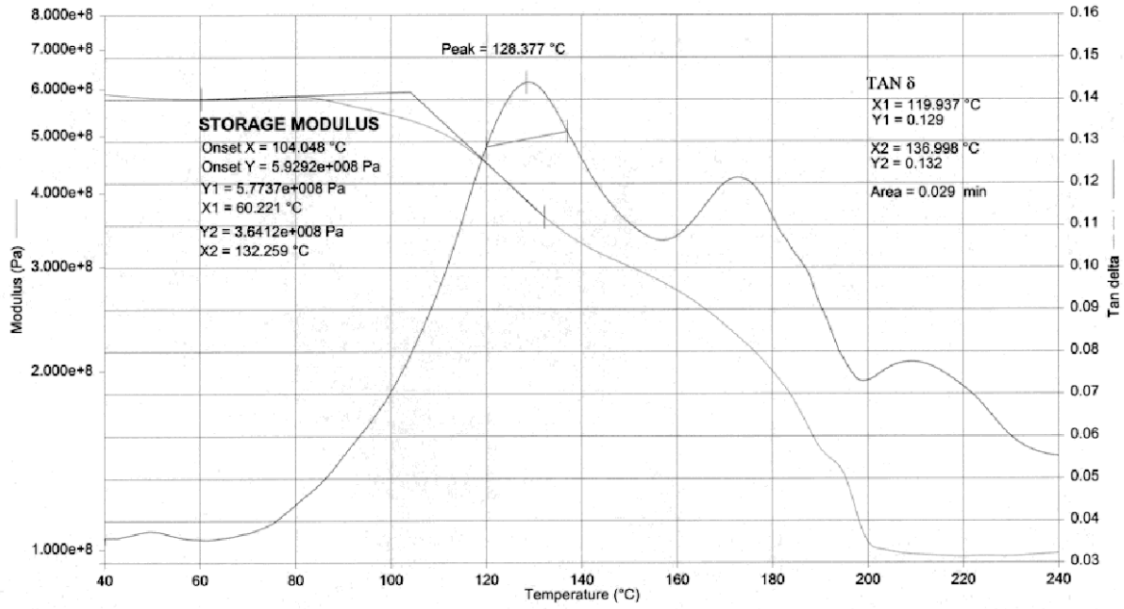
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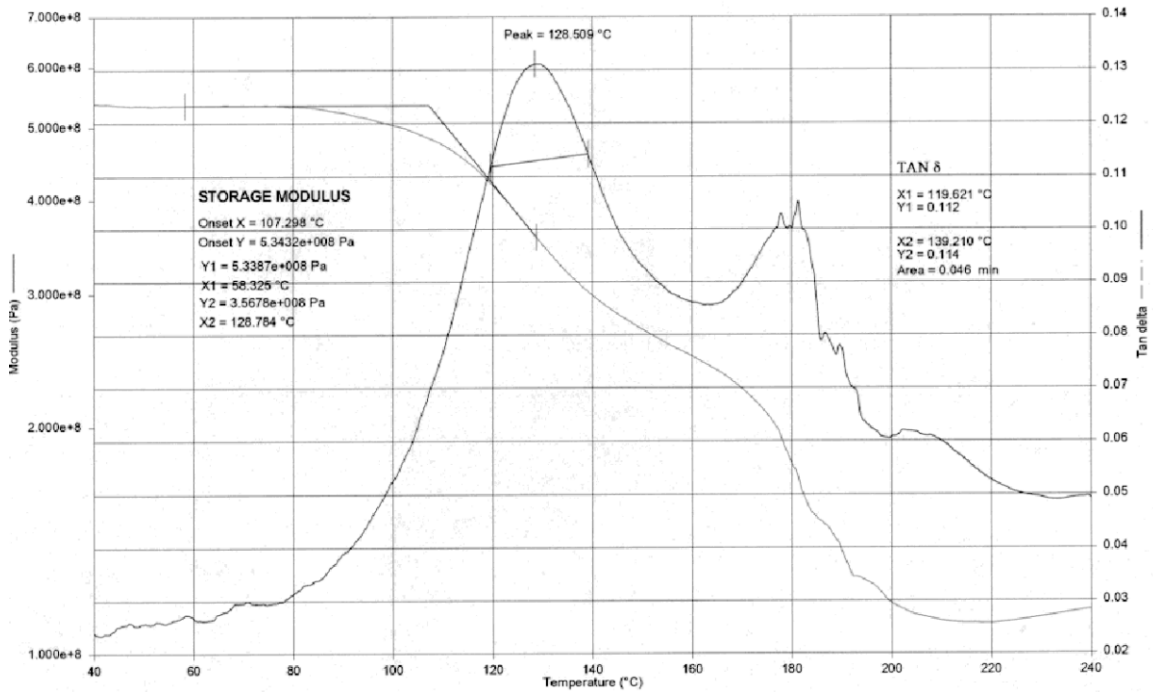
UHD 1114F



UHD 1115F



UHD 1116F



UHD 1117F

3.5.2. Physical Test Results

Physical Test Summary FiberCote - E765/T300 3K Plain Weave Graphite Fabric

	Composite Density [g/cc]	Resin Content [wt%]	Fiber Volume [vol%]	Void Content [vol%]
40/20/40 Laminate Tension				
No. of Specimens	13	13	13	13
Mean	1.501	39.119	51.911	0.369
Standard Deviation	0.005	1.240	1.209	0.275
40/20/40 Laminate Compression				
No. of Specimens				
Mean	Same as tension			
Standard Deviation	Same as tension			
25/50/25 Laminate Tension				
No. of Specimens	15	15	15	15
Mean	1.498	39.497	51.485	0.440
Standard Deviation	0.006	0.859	0.868	0.331
25/50/25 Laminate Compression				
No. of Specimens				
Mean	Same as tension			
Standard Deviation	Same as tension			
10/80/10 Laminate Tension				
No. of Specimens	12	12	12	12
Mean	1.499	39.409	51.621	0.373
Standard Deviation	0.006	0.608	0.659	0.225
10/80/10 Laminate Compression				
No. of Specimens				
Mean	Same as tension			
Standard Deviation	Same as tension			
Overall Summary				
Overall No. of Specimens	40	40	40	40
Overall Mean	1.499	39.348	51.664	0.397
Overall Std. Deviation	0.006	0.932	0.936	0.279

4. TESTING AND REPORTING COMMENTS

4.1. E765 Resin Components

The components used in the certification resin batches were:

Component A Shell
Component B Ciba
Component C Phenoxy Associates
Component D Air Products
Component E SKW

The identification of Components A, B, etc is proprietary to FiberCote. Details of the actual identifications are given in a letter from FiberCote to the FAA- Seattle, dated June 30, 1999 (ref. Project #TC1616SE-A).

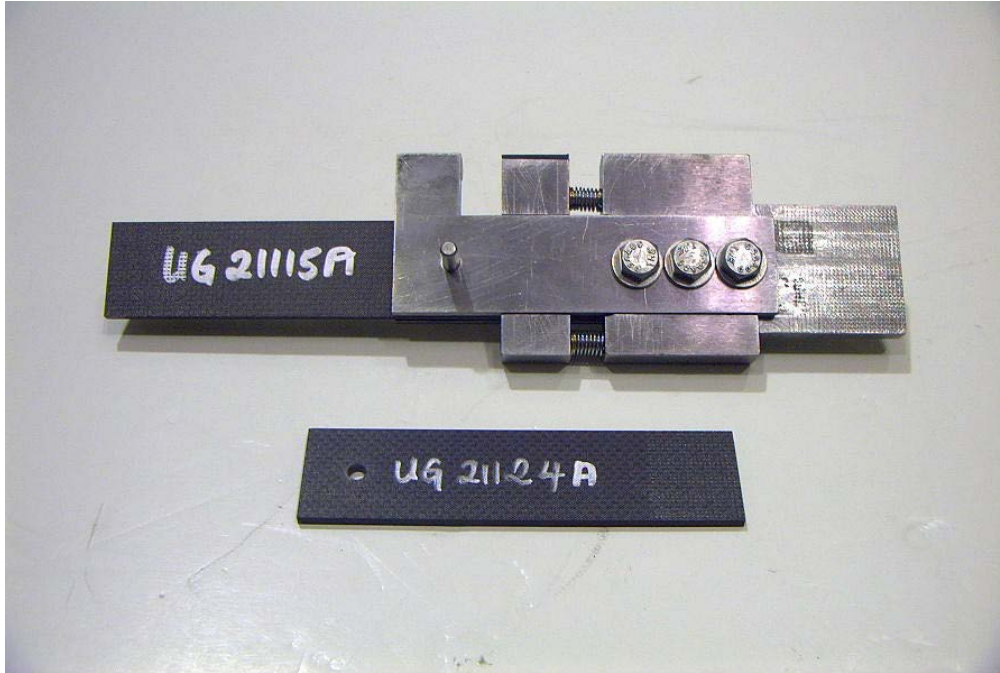
The identification will be made available to users of the material after the execution of a confidentiality agreement.

4.2. Pictures of Test Setup

50% bearing-bypass (single Shear)



Double Shear Bearing



Single Shear Bearing



25% Bearing-Bypass (Double Shear with Side Plates)



50% Bearing-Bypass (Single Shear with Two-Fasteners)



4.3. Pictures of Failure Modes

Please refer to the specimen names displayed in the figures for information regarding test method.

