Advanced General Aviation Transport Experiments

B-Basis Design Allowables for Wet Layup / Field Repair Fiber Reinforced Composite Material Systems

3K Plain Weave Carbon Cloth / MGS 418

AGATE-WP3.3-033051-115

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TABLE OF CONTENTS

1.0 INTRODUCTION 4
1.1 Scope 4
1.2 Symbols Used 5
1.3 Acronyms and Definitions 6
1.4 References 7
1.5 Methodology 8
1.5.1 Test Matrix 8
1.5.2 Environmental Conditioning 10
1.5.3 Fluid Sensitivity Screening 10
1.5.4 Normalization Procedures 12
1.5.5 Statistical Analysis 13
1.5.6 Material Performance Envelope and Interpolation 13
1.5.6.1 Interpolation Example 15

2.0 LANCAIR 3K PW CARBON/ MGS 418 WET LAY-UP PROPERTIES 17
2.1 Material Documentation by Material Batch 18
2.2 Process Specification 19

3.0 LANCAIR 3K PW CARBON / MGS 418 LAMINA PROPERTIES 22
3.1 Test Results 23
3.1.1 Summary 24
3.1.2 Individual Test Summaries 25
3.1.2.1 Tension, 2-axis 26
3.1.2.2 Compression, 2-axis 27
3.1.2.3 Shear, 12 axis 28
3.1.2.4 Shear, 13 axis 28
3.1.2.4 Shear, 13 axis 29
3.1.2.5 Bearing Strength 30
3.1.3 Individual Test Charts 31
3.1.3.1 Tension, 2-axis 32
3.1.3.2 Compression, 2-axis 33
3.1.3.3 Shear, 12 axis 34
3.1.3.4 Shear, 13 axis 35
3.2 Raw Data 36
3.2.1 Raw Data Spreadsheets and Scatter Charts 37
3.2.2 Fluid Sensitivity Raw Data Spreadsheets and Scatter Charts 72

3.2.3 Representative Shear Stress-Strain Curve 77
3.3 Statistical Results 79
3.3.1 Plot by Condition 80
3.3.2 Plot of Pooled Data 87
3.4 Moisture Conditioning History Charts 94
3.5 DMA Results 98

4.0 TESTING AND REPORTING COMMENTS 112

APPENDIX A. DATES OF PANEL MANUFACTURE AND COPY OF FAA FORM 8130-3 114

1.0 INTRODUCTION

1.1 Scope

The Advanced General Aviation Transport Experiments (AGATE) consortium is an industry-university-government partnership initiated by NASA to create the technological basis for revitalization of the United States general aviation industry. It was founded in 1994 to develop affordable new technology as well as the industrial standards and certification methods for composite airframe, cockpit, flight systems and airspace infrastructure for Federal Aviation Regulations (FAR) Part 23 aircraft. The composite material properties contained within the document were generated under Work Package 3: Integrated Design and Manufacturing Methods.

Although AGATE was focused towards the small general aviation aircraft (Part 23), 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) as part of the AGATE effort. 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.

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.

1.2 Symbols Used

ν_{21}^{t}	Poisson's ratio, tension – relating contraction in the 1 direction as a result of extension in the 2 direction
$\mu\varepsilon$	micro-strain
E_2^{c}	compressive modulus, transverse
E_2^{t}	tensile modulus, transverse
F_{12}^{su}	in – plane shear strength
F_{13}^{su}	apparent interlaminar shear strength
F_2^{cu}	compressive strength, transverse
F_2^{tu}	tensile strength, transverse
G_{12}^{s}	in – plane shear modulus

Superscripts

bu	bearing ultimate
c	compression
cu	compression ultimate
s	shear
su	shear ultimate
t	tension
tu	tension ultimate

Subscripts

1	1 – axis; longitudinal
2	2 – axis; transverse (parallel to fill direction of reinforcement)
12	in – plane shear
13	interlaminar shear (apparent)

1.3 Acronyms and Definitions

A – Basis	95% lower confidence limit on the first population percentile
AGATE	Advanced General Aviation Transport Experiments
ASTM	American Society for Testing and Materials
B – Basis	95% lower confidence limit on the tenth population percentile
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
C/Ep	Carbon/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

D3039-95	Tensile Properties of Polymer Matrix Composite Materials
D5379-93	Shear Properties of Composite Materials by the V-Notched Beam Method
D2344-89	Apparent Interlaminar Shear Strength of Parallel Fiber Composites by Short – Beam Method
D792-91	Density and Specific Gravity (Relative Density) of Plastics by Displacement
D2584-94	Ignition Loss of Cured Reinforced Plastics
D2734-94	Void Content of Reinforced Plastics
D695-91	Compressive Properties of Rigid Plastics
D953-95	Standard Test Method for Bearing Strength of Plastics

SACMA Standards

SRM 1-94	Compressive Properties of Oriented Fiber-Resin Composites
SRM 8-94	Short Beam Shear Strength of Oriented Fiber-Resin Composites
SRM 18-94	Glass Transition Temperature (T_g) Determination by DMA of Oriented Fiber-Resin Composites

Other Documents

FAA Document DOT/FAA/AR-00/47: Material Qualification and Equivalency for Polymer Matrix Composite Material Systems, J.S. Tomblin, Y.C. Ng and K.S. Raju, 2001.

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

PACUSA Lancair Document No: AX513001 Rev. B1, Initial Material Qualification of MGS 418 Resin System with 7781 Glass Fabric and Plain Weave Carbon Cloth for Structural Wet Layup Epoxy Laminates, February 1997.

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 the AGATE report, *Material Qualification and Equivalency for Polymer Matrix Composite Material Systems*. The test matrix for properties included in this document is listed on the next page, with the following notation cited in each column:

X#

where the X represents the required material batch letter defined as: material containing 3K Plain Weave Carbon from one mill roll, impregnated with one batch of resin in one continuous manufacturing operation with traceability to all components. and the # represents the required number of replicates for that batch. For example, “A6, B6, C6” refers to three material batches A, B, and C; with six specimens per batch for a total requirement of 18 test specimens. The minimum sample requirements are shown, but more samples may have been tested.

Table 1.5.1: Test Matrix and Standards Used

TEST	METHOD	NO. OF REPLICATES PER TEST CONDITION			
		CTD[2,6]	RTD[1,3,6]	ETW[1,4]	ETD[5,6]
90° (fill) Tension Strength	ASTM D3039-95	B4	A4, B4, C4	A4, B4, C4, D4	A4, B4, C4
90° (fill) Tension Modulus and Strength	ASTM D3039-95	B2	A2, B2, C2	A2, B2, C2, D2	A2, B2, C2
90° (fill) Compression Strength	SACMA SRM 1-94	B6	A6, B6, C6	A6, B6, C6, D6	A6, B6, C6
90° (fill) Compression Modulus	SACMA SRM 1-94	B2	A2, B2, C2	A2, B2, C2, D2	A2, B2, C2
In-Plane Shear Strength	ASTM D5379-93	B4	A4, B4, C4	A4, B4, C4, D4	A4, B4, C4
In-Plane Shear Modulus and Strength	ASTM D5379-93	B2	A2, B2, C2	A2, B2, C2, D2	A2, B2, C2
Short Beam Shear	ASTM D2344-89	--	A6, B6, C6, D6	--	--
Fiber Volume	ASTM D3171-90	One sample per panel			
Resin Volume	ASTM D3171-90	One sample per panel			
Void Content[7]	ASTM D2734-94	One sample per panel			
Cured Neat Resin Density	---	Supplied by manufacturer for material			
Glass Transition Temperature	SACMA SRM 18-94	3 dry, 3 wet per material batch			

Notes :

1 Per the current test plan, panels 72-74 are Batch D. Per previous revisions, these panels are Batch E. All tested specimens and data sets that are labeled Batch E are equivalent to Batch D.

2 CTD: One batch of material tested (test temperature = -65 ± 5° F, moisture content = as fabricated, soak time at –65 was 3 min.)

3 RTD: Three batches of material tested (test temperature = 70 ± 10° F, moisture content = as fabricated)

4 ETW: Four batches of material tested (test temperature = 180 ± 5° F, moisture content = equilibrium per section 1.5.2, soak time at 180 was 60 sec.)

5 ETD: Three batches of material tested (test temperature = 180 ± 5° F, moisture content = as fabricated, soak time at 180 was 3 min.)

6 Dry specimens are “as fabricated” specimens that have been maintained at ambient conditions in an environmentally controlled laboratory.

7 The generic 418 resin density value (1.2 g/cc) is used to calculate void content and does not take into account the effects of the resin/hardener mix ratio or the cure cycle.

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 Fluid Sensitivity Screening

Although epoxy-based materials historically have not been shown to be sensitive to fluids other than water or moisture, the influence of some fluids other than water or moisture on the mechanical properties were characterized. These fluids fell into two exposure classifications. The first class was considered to be in contact with the material for an extended period of time, and the second class was considered to be wiped on and off (or evaporate) with relatively short exposure times.

To assess the degree of sensitivity of fluids other than water or moisture, Table 1.5.2 shows the fluids which were used in this qualification plan.

Table 1.5.2: Fluid Types Used for Sensitivity Studies

Fluid Type	Specification	Exposure Classification
Jet Fuel (JP-4)	MIL-T-5624	Extended Period
Hydraulic Fluid (Tri-N-butyl phosphate ester)	MIL-H-5606G	Extended Period
Solvent (Methyl Ethyl Ketone)	Laboratory Grade	Wipe On and Off

To assess the influence of various fluids types, a test method sensitive to matrix degradation was used as an indicator of fluid sensitivity and compared to the unexposed results at both room temperature dry and elevated temperature dry conditions. Table 1.5.3 describes the fluid sensitivity-testing matrix with respect to the fluids defined in Table 1.5.2. Engineering judgment and statistical tests were used to assess the degree of material degradation. The results of this screening are included following the data sheets in section 3.2.2.

Table 1.5.3: Material Qualification Program for Fluid Resistance

Fluid Type	Test Method	Test Temp. (^{o} F)	Exposure[1]	Number of Replicates[2]
Jet Fuel JP-4	ASTM D5379[3]	180	See note 4	5
Hydraulic Fluid	ASTM D5379[3]	180	See note 5	5
Solvent (MEK)	ASTM D5379[3]	Ambient	See note 5	5

Notes :

1 Soaking in fluid at ambient temperature (immersion).
2 Only a single batch of material is required.
3 Shear strength only.
4 Immersion duration = 500 hours $\pm$ 50 hours
5 Immersion duration = 60 to 90 minutes

1.5.4 Normalization Procedures

The normalization procedure attempts to reduce variability in fiber-dominated material properties by adjusting raw test values to a specified fiber volume content. Only the following properties were normalized:

- 90° (fill) Tension Strength and Modulus
- 90° (fill) Compression Strength and Modulus

The normalization procedure was adopted from MIL-HDBK-17-1E, section 2.4.3.3. The procedure which was used to normalize the data is based on two primary assumptions:

- The relationship between fiber volume fraction and ultimate laminate strength is linear over the entire range of fiber/resin ratios. (It neglects the effects of resin starvation at high fiber contents.)

- Fiber volume is not commonly measured for each test sample, so this method accounts for the fiber volume variation between individual test specimens by utilizing a relationship between fiber volume fraction and laminate cured ply thickness. This relationship is virtually linear in the 0.45 to 0.65 fiber volume fraction range.

Additional information is detailed in *Material Qualification and Equivalency for Polymer Matrix Composite Material Systems.* For all normalized data contained in this document, the test values are normalized by cured ply thickness according to:

$$Normalized\ \ Value = Test\ Value \times \frac{CPT_{specimen}}{CPT_{normalizing}}$$

where:

$$CPT_{specimen} = \frac{Average\ \ Sample\ Thickness}{\#\ of\ \ plies}$$

1.5.5 Statistical Analysis

When compared to metallic materials, fiber reinforced composite materials exhibit a high degree of material property variability. This variability is due to many factors, including but not limited to: raw material and prepreg manufacture, material handling, part fabrication techniques, ply stacking sequence, environmental conditions, and testing techniques. This inherent variability drives up the cost of composite testing and tends to render smaller data sets than those produced for metallic materials. This necessitates the usage of statistical techniques for determining reasonable design allowables for composites.

The analyses and design allowable generation for both A and B basis values were performed using the procedure detailed in section 5.3 of FAA Document DOT/FAA/AR-00/47: *Material Qualification and Equivalency for Polymer Matrix Composite Material Systems*.

1.5.6 Material Performance Envelope and Interpolation

Using the B-basis numbers, a material performance envelope may be generated for the material system by plotting these values as a function of temperature. Figure 1.5.1 shows an example material performance envelope using B-basis values.

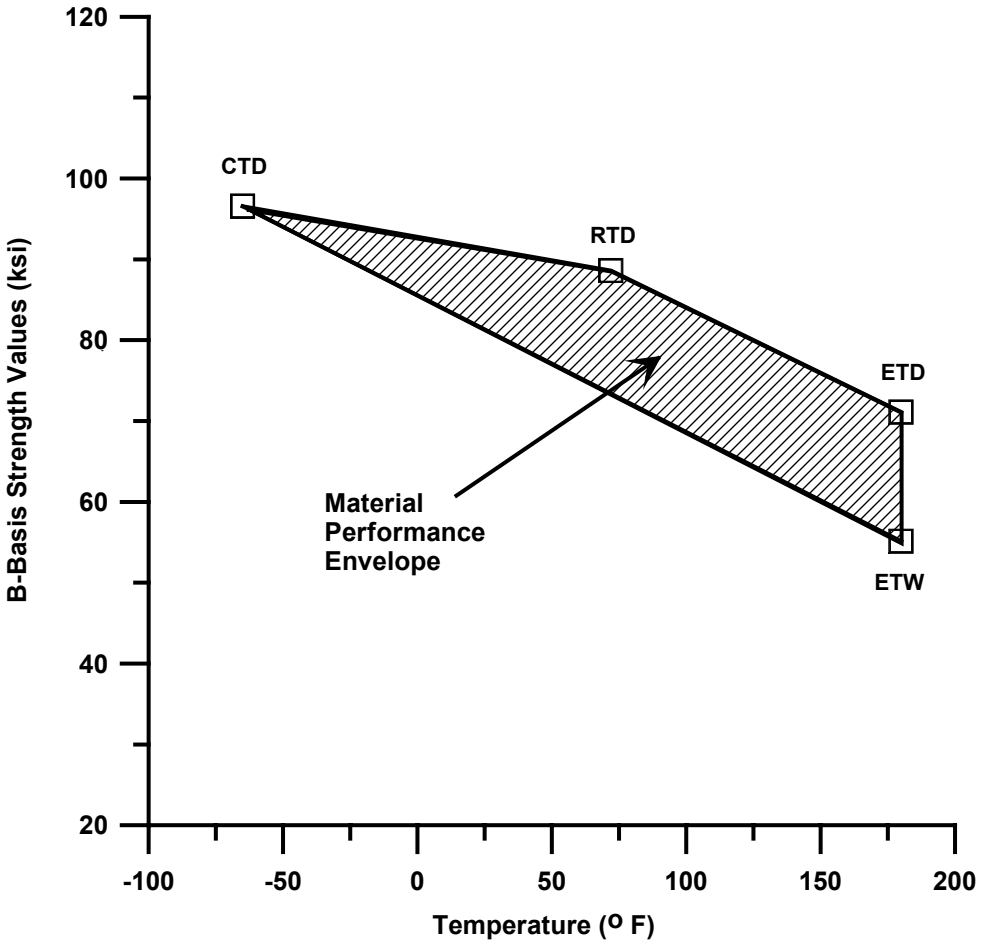


Figure 1.5.1 Material performance envelope.

Since each specific aircraft application of the qualified material may have different Maximum Operational Limits (MOL) than those tested in the material qualification (which is usually the upper limit), some applications may require a reduced MOL. In this case, simple linear interpolation may be used to obtain the corresponding basis values at the new application MOL.

This interpolation may be accomplished using the following simple relationships assuming $T_{RTD} < T_{MOL} < T_{ETD}$:

For the corresponding MOL "dry" basis value, the "interpolated" basis value using the qualification data is

$$B_{MOL} = B_{RTD} - \frac{(B_{RTD} - B_{ETD})(T_{RTD} - T_{MOL})}{(T_{RTD} - T_{ETD})}$$

where B_{MOL} = new application basis value interpolated to T_{MOL}
B_{RTD} = basis RTD strength value
B_{ETD} = basis ETD strength value
T_{RTD} = RTD test temperature
T_{ETD} = ETD test temperature
T_{MOL} = new application MOL temperature

For the corresponding MOL "wet" basis value, an estimated Room Temperature Wet (RTW) value must be calculated. This may be accomplished by the simple relation

$$B_{RTW} = B_{RTD} - (B_{ETD} - B_{ETW})$$

The "interpolated" wet basis value using the qualification data may then be obtained by

$$B_{MOL} = B_{RTW} - \frac{(B_{RTW} - B_{ETW})(T_{RTW} - T_{MOL})}{(T_{RTW} - T_{ETW})}$$

where B_{MOL} = new application basis value interpolated to T_{MOL}
B_{RTW} = estimated basis RTW strength value
B_{ETW} = basis ETW strength value
T_{RTW} = RTW (i.e., RTD) test temperature
T_{ETW} = ETW test temperature
T_{MOL} = new application MOL temperature

These equations may also be used for interpolated mean strengths as well as A-basis values with the appropriate substitutions. It should be noted that because unforeseen material property drop-offs with respect to temperature and environment can occur, *extrapolation* to a higher MOL should not be attempted without additional testing and verification. In addition, the interpolation equations shown above are practical for materials obeying *typical* mechanical behavior. In most cases, some minimal amount of testing may also be required to verify the interpolated values.

1.5.6.1 Interpolation Example

This section provides an example of linear interpolations to a specific application environment less than the tested upper material limit used in qualification. Assuming a specific application environment of 150° F, Figure 1.5.2 depicts the linear interpolation of the B-basis design allowable to this environment. Using the above equations along with the nominal testing temperatures (see Table 1.5.1), the interpolated basis values at 150° F become

ETD : B_{MOL} = 75.106 ksi

ETW : B_{MOL} = 59.746 ksi

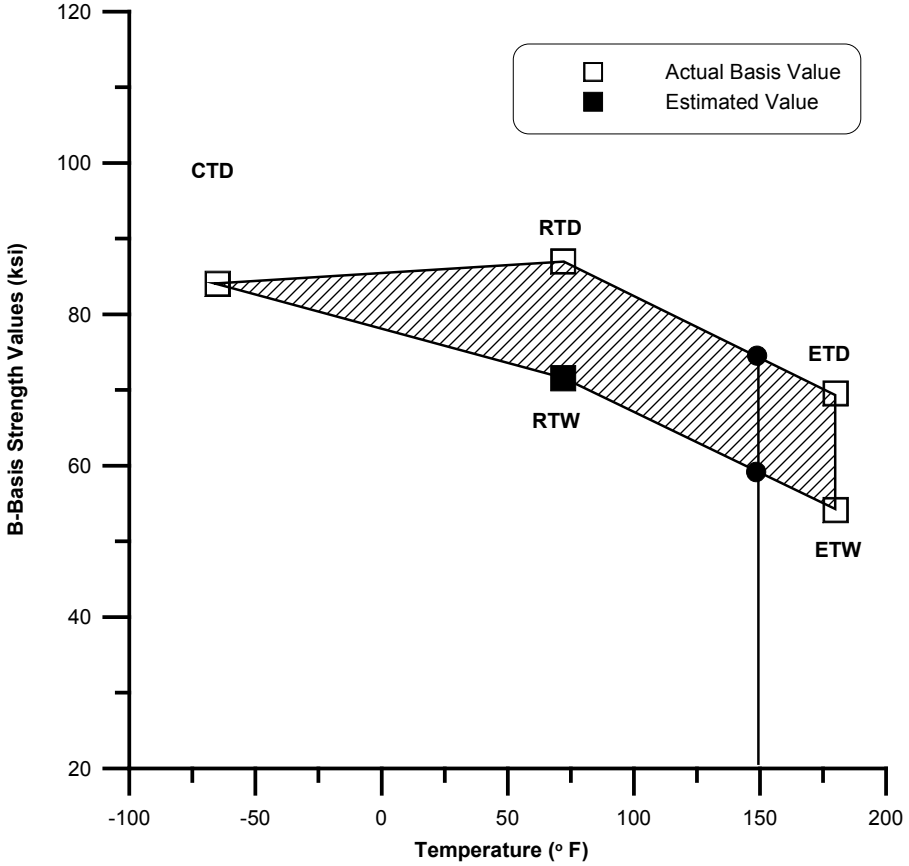


Figure 1.5.2 Example of 150° F interpolation for B-basis values.

2.0 LANCAIR 3K PW CARBON/ MGS 418 WET LAY-UP PROPERTIES

2.1 Material Documentation by Material Batch

Wet Lay-up Documentation	**Manufacturer & Product ID: PAC** **Material Identification (weave, form, class, etc.):** **Impregnation Method: Wet Layup**				
Resin : Hardener Ratio	100 : 37 by wt.	100 : 40 by wt.	100 : 43 by wt.	100 : 40 by wt.	
Batch (Lot) ID as labeled on samples	**A**	**B**	**C**	**D**[1]	**E**
Date of Manufacture (Post Cure)	6/98	6/98	6/98	6/98	
Expiration Date	N/A	N/A	N/A	N/A	
Resin Content [wt %]	38%	38%	38%	46%	
Reinforcement Areal Weight & Test Method	See Fabric Info.				
Resin Flow & Test Conditions	Not Tested				
Gel Time & Test Conditions	Not Tested				
Volatile Content					
Reinforcement Documentation	**Fiber/Fabric Manufacturer & Product ID: Plain-weave, 3K T-300 fibers** **Precursor Type: Unknown** **Nominal Filament Count: 3K Fabric with 12.2 ends & 12.4 picks** **Finish/Sizing Type and %: Unknown** **Nominal tow or yarn count/inch: Above** **Twist:**				
Fabric Batch or Lot #	Multiple[2]	Multiple	Multiple	Multiple	
Date of Manufacture	Multiple[2]	Multiple	Multiple	Multiple	
Average Fiber Density per Lot & Test Method	1.75-1.76[2] g/cc	1.75-1.76 g/cc	1.75-1.76 g/cc	1.75-1.76 g/cc	
Matrix Documentation	**Resin Manufacturer & Product ID: MGS 418**				
Matrix Batch or Lot # (Resin)	No Records	Unknown	640022 or 713014	649007	
Matrix Batch or Lot # (Hardener)	No Records	648016	719005 or 719008	648016	
Date of Manufacture	Unknown	Unknown	Unknown	Unknown	
Average Neat Resin Density by Lot & Test Method	No Records	No Certs.	No Certs.	No Certs.	

Note: Test Methods used to determine resin content, reinforced areal weight, resin flow, gel time, and volatile content are defined in PAC USA Lancair AX513001 Rev. B1 specification

[1]Per current test plan, panels 72-74 are Batch D. Per previous revisions, these are Batch E.

[2]Assumed, but no records.

2.2 Process Specification

This specification does not address issues relating to safety, quality control, bagging material selection, bagging procedure, tool preparation, or equipment selection. Although these may affect overall part quality, it is the responsibility of the end user to develop procedures related to these issues in a manner that produces parts with high quality and consistency.

The following processing procedures are excerpts from PACUSA Lancair Document No: AX513001 Rev. B1, "Initial Material Qualification of MGS 418 Resin System with 7781 Glass Fabric and Plain Weave Carbon Cloth for Structural Wet Layup Epoxy Laminates". All test specimens were cured per this specification by Pacific Aviation Composites.

Panel Processing Parameters

Table 2.2.1 defines how the four batches of panels were processed. Definitions for each of the process variables follow the table.

Table 2.2.1: Panel Processing

Panel Batch	Resin Content	Fiber Content (by weight %)		Curing Agent Content	Cure Cycle
		Glass	Carbon		
A	Nominal	62 ± 1	53 ± 1	Minimum	Minimum
B	Nominal	62 ± 1	53 ± 1	Nominal	Nominal
C	Nominal	62 ± 1	53 ± 1	Maximum	Over
D	Maximum	54 ± 1	45 ± 1	Nominal	Nominal
E	Nominal	62 ± 1	53 ± 1	Nominal	Nominal

Panel Batch A ..... Minimum curing agent content in combination with the minimum cure cycle and nominal resin content.

Panel Batch B ..... Nominal curing agent content in combination with the nominal cure cycle and nominal resin content.

Panel Batch C ..... Maximum curing agent content in combination with an over cure cycle and nominal resin content.

Panel Batch D ..... Nominal curing agent content in combination with the nominal cure cycle and maximum resin content.

Panel Batch E ..... Nominal curing agent content in combination with the nominal cure cycle and the nominal resin content, using glass fabric from full-scale fatigue test.

Nominal Resin Content..... Layup with 62 ± 1% glass fiber by weight and 53 ± 1% carbon fiber by weight.

Max Resin Content ..... Layup with 54 ± 1% glass fiber by weight and 45 ± 1% carbon fiber by weight.

Curing Agent Content ..... Nominal, Minimum and Maximum in Table 2.1.2.

Minimum Cure Cycle..... Nominal cure cycle temperature minus 30°F with nominal cure time minus 1 hour.

Over Cure Cycle ..... Nominal cure cycle temperature plus 30°F plus three extra nominal cure cycle times.

Table 2.1.2: Curing Agent Content

Minimum curing agent content	100:37 by weight
Nominal curing agent content	100:40 by weight
Maximum curing agent content	100:43 by weight

Oven Cure Procedure

Nominal Cure Cycle[1]:

a. Pre-cure undisturbed at room temperature until resin is "set", defined as does not stick to the finger when touched.

b. Install the assembly in a cool oven (temperatures less than 100° F). Verify the functioning of the thermocouple recording equipment before initiating the cure.

c. Perform post-cure to the following steps:
- Ramp from ambient to 150 ± 10°F over a period of 120 ± 10 minutes (2 hrs).
- Hold at 150 ± 10°F for 240 (+10, -0) minutes (4 hrs.).
- Ramp to 200 ± 10°F over a period of 120 ± 10 minutes (2 hrs.).
- Hold at 200 ± 10°F for 360 (+10, -0) minutes (6 hrs.).
- Ramp down below 170°F at a rate not to exceed 10°F per minute before removing the cured panel from the oven.

Minimum Cure Cycle[1]:

a. Pre-cure undisturbed at room temperature until resin is "set", defined as does not stick to the finger when touched.

b. Install the assembly in a cool oven (temperatures less than 100° F). Verify the functioning of the thermocouple recording equipment before initiating the cure.

[1] All temperatures are oven temperature.

c. Perform post-cure to the following steps:
   - Ramp from ambient to 120 ± 10°F over a period of 120 ± 10 minutes (2 hrs.).
   - Hold at 120 ± 10°F for 210 (+10, -0) minutes (3-1/2 hrs.).
   - Ramp to 170 ± 10°F over a period of 120 ± 10 minutes (2 hrs.).
   - Hold at 170 ± 10° F for 330 (+10, -0) minutes (5-1/2 hrs.).
   - Ramp down below 140°F at a rate not to exceed 10°F per minute before removing the cured panel from the oven.

Over Cure Cycle[1]:

a. Pre-cure undisturbed at room temperature until resin is "set", defined as does not stick to the finger when touched.

b. Install the assembly in a cool oven (temperatures less than 100° F). Verify the functioning of the thermocouple recording equipment before initiating the cure.

c. Perform post-cure to the following steps:
   - Ramp from ambient to 180 ± 10°F over a period of 120 ± 10 minutes (2 hrs.).
   - Hold at 180 ± 10°F for 960 ± 10 minutes (14 hrs.).
   - Ramp to 230 ± 10°F over a period of 120 ± 10 minutes (2 hrs.).
   - Hold at 230 ± 10° F for 1440 ± 10 minutes (24 hrs).
   - Ramp down below 170°F at a rate not to exceed 10°F per minute before removing the cured panel from the oven.

3.0 LANCAIR 3K PW CARBON / MGS 418 LAMINA PROPERTIES

3.1 Test Results

3.1.1 Summary

MATERIAL:	PAC 3K Plain Weave Carbon / MGS 418 Wet Layup	**3K PW Carbon/MGS 418 Summary**
FIBER:	3KT-300 PW Carbon Fibers	**RESIN:** MGS 418
T_g (dry): 216.2 °F	**T_g (wet):** 207.6 °F	**T_g METHOD:** DMA (SRM 18-94)
PROCESSING:	Vacuum bag cure (22+ in. Hg.): 170-230± 10°F for 5.5-24 hours	

Date of fiber manufacture	Multiple	**Date of testing**	4/12/99 – 10/4/99
Date of resin manufacture	Unknown	**Date of data submittal**	10/8/99
Date of composite manufacture	6/98	**Date of analysis**	4/13/99 – 10/5/99

LAMINA MECHANICAL PROPERTY

Data Reported as: Measured
(Normalized by CPT=0.0104 in)

	CTD		RTD		ETD		ETW	
	B-Basis	**Mean**	**B-Basis**	**Mean**	**B-Basis**	**Mean**	**B-Basis**	**Mean**
F_2^{tu} **(ksi)**	61.87 (60.49)	67.83 (65.86)	56.54 (56.99)	61.98 (62.06)	57.05 (58.66)	62.54 (63.87)	57.13 (57.89)	62.64 (63.03)
E_2^t **(Msi)**	---	7.24 (7.03)	---	6.85 (6.91)	---	6.77 (6.92)	---	6.84 (6.90)
ν_{21}^{tu} **(ksi)**	---	0.069	---	0.074	---	0.064	---	0.055
F_2^{cu} **(ksi)**	58.66 (61.52)	68.53 (71.55)	54.09 (53.44)	63.20 (62.15)	39.48 (39.07)	46.13 (45.43)	32.35 (32.62)	37.79 (37.93)
E_2^c **(Msi)**	---	7.03 (6.45)	---	6.36 (6.25)	---	6.21 (6.14)	---	5.90 (5.92)
F_{12}^{su} **(ksi)**	18.63	20.26	14.13	15.37	8.87	9.65	7.72	8.39
G_{12}^s **(Msi)**	---	0.43	---	0.34	---	0.23	---	0.26
F_{13}^{su**} **(ksi)**	---	---	8.15	8.79	---	---	---	---

** *Apparent* interlaminar shear strength

3.1.2 Individual Test Summaries

3.1.2.1 Tension, 2-axis

Tension, 2-axis
C/Ep
3K PW Carbon / MGS 418
$[0]_{12}$

Material:	Lancair 3K Plain Weave Carbon / MGS 418 Wet Layup		
Resin content:	46 - 50 wt%	**Comp. density:**	1.34 - 1.37 g/cc
Fiber volume:	37 - 41 vol%	**Void content:**	4.5 to 7.2 %
Ply thickness:	0.0095 - 0.0111 in.		
Ply range:	12 plies		
Test method:	D3039-95	**Modulus calculation:**	N/A
Normalized by:	0.0104 in. ply thickness		

		CTD (B)		RTD (A)		ETD (G)		ETW(F)			
Test Temperature [°F]		-65		75		180		180			
Moisture Conditioning		dry		dry		dry		equilibrium			
Equilibrium at T, RH		as fabricated		as fabricated		as fabricated		145 F, 85 %			
Source code		MWUXXXXB		MWUXXXXXA		MWUXXXXG		MWUXXXXF			
		Normalized	**Measured**	**Normalized**	**Measured**	**Normalized**	**Measured**	**Normalized**	**Measured**	**Normalized**	**Measured**
F_2^{tu} (ksi)	**Mean**	65.86	67.83	62.06	61.98	63.87	62.54	63.03	62.64		
	Minimum	61.73	63.44	56.69	55.78	59.57	55.90	56.69	57.08		
	Maximum	70.76	72.72	69.01	68.47	68.80	71.79	71.34	68.23		
	C.V.(%)	5.30	5.35	4.98	5.50	4.28	7.42	5.97	4.75		
	B-value	60.49	61.87	56.99	56.54	58.66	57.05	57.89	57.13		
	A-value	56.45	57.40	53.18	52.45	54.74	52.92	54.02	53.00		
	No. Specimens	6		18		19		34			
	No. Batches	1		3		3		4			
E_2^t (Msi)	**Mean**	7.03	7.24	6.91	6.85	6.92	6.77	6.90	6.84		
	Minimum	6.98	7.17	6.86	6.63	6.53	6.19	6.56	6.22		
	Maximum	7.08	7.31	7.03	7.00	7.69	8.02	7.16	7.26		
	C.V.(%)	1.01	1.40	0.97	2.10	7.19	10.23	2.81	5.32		
	No. Specimens	2		6		6		8			
	No. Batches	1		3		3		4			
ν_{21}^t	**Mean**		0.052		0.055		0.044		0.037		
	No. Specimens	2		6		6		8			
	No. Batches	1		3		3		4			

3.1.2.2 Compression, 2-axis

Compression, 2-axis
C/Ep
3K PW Carbon / MGS
[0]$_2$

Material:	Lancair 3K Plain Weave Carbon / MGS 418 Wet Layup			
Resin content:	46 - 52 wt%	**Comp. density:**	1.34 - 1.37 g/cc	
Fiber volume:	37 - 41 vol%	**Void content:**	4.5 to 6.6 %	
Ply thickness:	0.0090 - 0.0112 in.			
Ply range:	12 plies			
Test method:	D2344-89	**Modulus calculation:**	N/A	
Normalized by:	N/A			

		CTD (B)		RTD (A)		ETD (G)		ETW(F)			
Test Temperature [°F]		-65		75		180		180			
Moisture Conditioning		dry		dry		dry		equilibrium			
Equilibrium at T, RH		as fabricated		as fabricated		as fabricated		145 F, 85 %			
Source code		MWWXXXXB		MWWXXXXA		MWWXXXXG		MWWXXXXF			
		Normalized	**Measured**	**Normalized**	**Measured**	**Normalized**	**Measured**	**Normalized**	**Measured**	**Normalized**	**Measured**
F_2^{cu} (ksi)	**Mean**	71.55	68.53	62.15	63.20	45.43	46.13	37.93	37.79		
	Minimum	58.80	56.44	56.76	56.06	40.29	40.24	26.70	26.33		
	Maximum	81.20	77.69	69.04	70.47	49.21	50.07	45.81	43.62		
	C.V.(%)	10.98	10.87	6.32	6.99	5.66	6.31	11.47	11.56		
	B-value	61.52	58.66	53.44	54.09	39.07	39.48	32.62	32.35		
	A-value	54.00	51.24	46.91	47.25	34.29	34.49	28.63	28.26		
	No. Specimens	6		20		18		32			
	No. Batches	1		3		3		4			
E_2^c (Msi)	**Mean**	6.45	7.03	6.25	6.36	6.14	6.21	5.92	5.90		
	Minimum	6.44	6.81	5.93	6.02	5.50	5.67	4.65	4.66		
	Maximum	6.47	7.24	6.45	7.06	6.91	6.87	6.84	6.74		
	C.V.(%)	0.35	4.40	3.41	5.97	9.40	8.29	14.45	11.24		
	No. Specimens	2		6		6		8			
	No. Batches	1		3		3		4			

3.1.2.3 Shear, 12 axis

Shear, 12-axis
C/Ep
3K PW Carbon / MGS 418
$[0/90]_6$

Material:	Lancair 3K Plain Weave Carbon / MGS 418 Wet Layup			
Resin content:	41 - 53 wt%	**Comp. density:**	1.32 - 1.38 g/cc	
Fiber volume:	35 - 45 vol%	**Void content:**	5.2 to 6.6%	
Ply thickness:	0.0101 - 0.0117 in.			
Ply range:	12 plies			
Test method:	D5379-93	**Modulus calculation:**	N/A	
Normalized by:	N/A			

		CTD (B)		RTD (A)		ETD (G)		ETW(F)			
Test Temperature [°F]		-65		75		180		180			
Moisture Conditioning		dry		dry		dry		equilibrium			
Equilibrium at T, RH		as fabricated		as fabricated		as fabricated		145 F, 85 %			
Source code		MWNXXXXB		MWNXXXXA		MWNXXXXG		MWNXXXXF			
		Normalized	**Measured**	**Normalized**	**Measured**	**Normalized**	**Measured**	**Normalized**	**Measured**	**Normalized**	**Measured**
F_{12}^{su} (ksi)	**Mean**		20.26		15.37		9.65		8.39		
	Minimum		19.44		13.45		8.55		7.73		
	Maximum		20.73		16.88		10.47		9.29		
	C.V.(%)		2.10		7.37		4.48		4.64		
	B-value		18.63		14.13		8.87		7.72		
	A-value		17.40		13.20		8.28		7.20		
	No. Specimens			21		21		35			
	No. Batches	1		3		3		4			
G_{12}^{s} (Msi)	**Mean**		0.43		0.34		0.23		0.26		
	Minimum		0.37		0.31		0.22		0.21		
	Maximum		0.48		0.37		0.24		0.29		
	C.V.(%)		18.54		6.80		4.25		10.95		
	No. Specimens			6		6		8			
	No. Batches	1		3		3		4			

3.1.2.4 Shear, 13 axis

Shear, 13-axis
C/Ep
3K PW Carbon / MGS 418
$[0]_{12}$

Material:	Lancair 3K Plain Weave Carbon / MGS 418 Wet Layup		
Resin content:	46 - 50 wt%	**Comp. density:**	1.34 - 1.38 g/cc
Fiber volume:	38 - 41 vol%	**Void content:**	4.5 to 6.4 %
Ply thickness:	0.0099 - 0.0116 in.		
Ply range:	12 plies		
Test method:	D2344	**Modulus calculation:**	N/A
Normalized by:	0.0104 in. ply thickness		

		RTD (A)							
Test Temperature [°F]			75						
Moisture Conditioning			dry						
Equilibrium at T, RH			as fabricated						
Source code			MWQXXXX						
		Normalized	Measured	Normalized	Measured	Normalized	Measured	Normalized	Measured	Normalized	Measured
	Mean			8.79							
	Minimum			8.27							
	Maximum			9.43							
	C.V.(%)			4.09							
F_{13}^{su} (ksi)	**B-value**			8.15							
	A-value			7.69							
	No. Specimens			30							
	No. Batches			4							

NOTE: These values represent the apparent interlaminar shear properties and are to be used for quality control purposes only. Do not use these values for interlaminar shear strength design values.

3.1.2.5 Bearing Strength

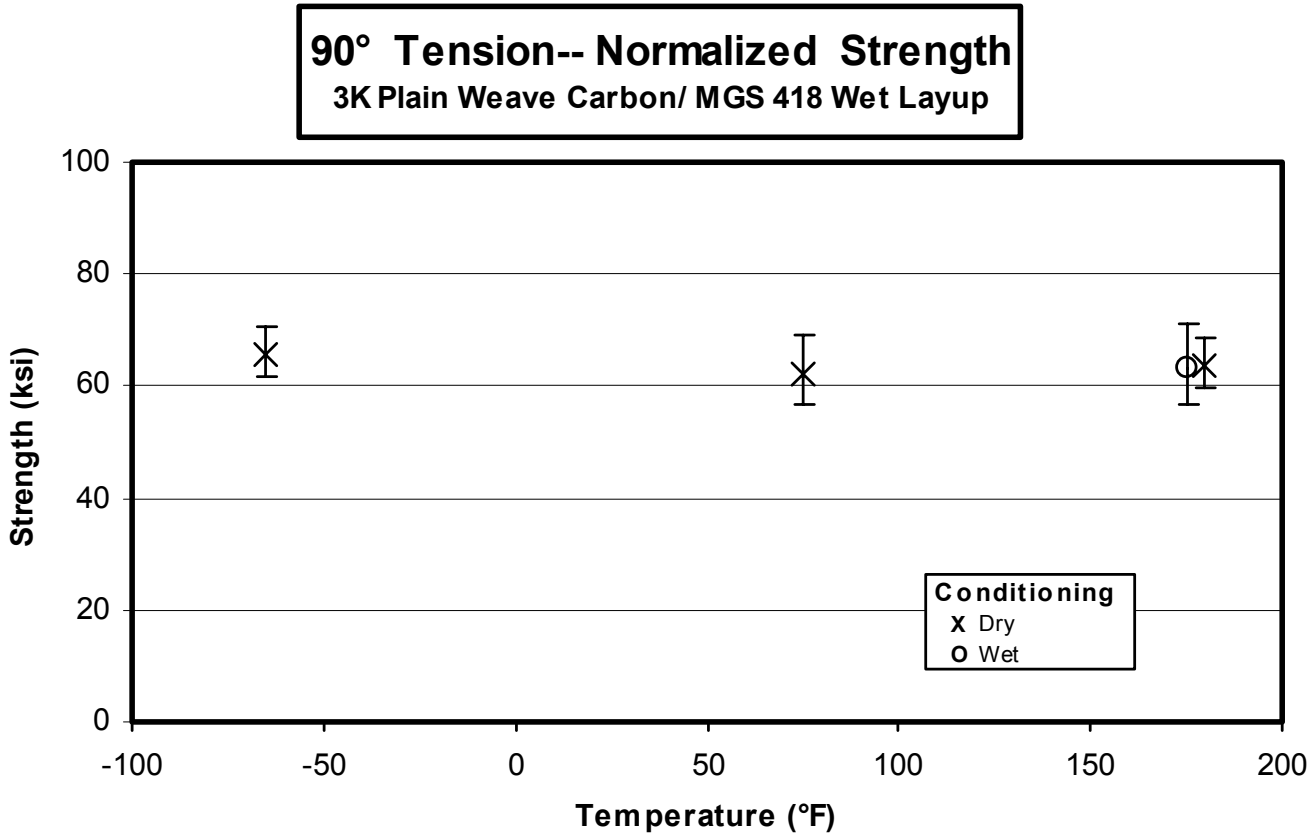
Bearing Strength
C/Ep
Lancair 3K Plain Weave Carbon/MGS 418 Wet Layup

Material:	Lancair 3K Plain Weave Carbon / MGS 418 Wet Layup		
Resin content:	33 - 52 wt%	**Comp. density:**	1.34 - 1.46 g/cc
Fiber volume:	36 - 56 %	**Void content:**	2.8 to 7.9 %
Test method:	ASTM D953-95		
Type of bearing test:	Double Shear Pin Bearing		
Fastener Type:	Hardened Steel Pin		
Torque:	N/A		
Normalized by:	Not normalized		

		CTD			RTD			ETD			ETW		
Test Temperature [°F]		-65			75			180			180		
Moisture Conditioning		dry			dry			dry			equilibrium		
Equilibrium at T, RH		as fabricated			as fabricated			as fabricated			145F, 85%		
Source code		MW#XXXXB			MW#XXXXA			MW#XXXXG			MW#XXXXF		
Diameter[in]		0.1875	0.250	0.375	0.1875	0.250	0.375	0.1875	0.250	0.375	0.1875	0.25	0.375
	Mean	62.74	45.18		47.27	35.40		32.43	23.91		20.08	19.17	
F^{bu}	**Minimum**	57.92	37.41		44.77	33.43		30.16	22.47		16.21	15.64	
(ksi)	**Maximum**	68.00	58.68		49.25	37.83		35.53	24.85		22.28	21.34	
$[0/45/0]_s$ **(6 plies)**	**C.V.(%)**	5.59	14.93		3.37	4.75		7.13	3.66		9.04	8.63	
t_{ply}: **0.0096 - 0.0154 in.**													
	Failure Mode	Bearing	Bearing		Bearing	Bearing		Bearing	Bearing		Bearing	Bearing	
	No. Specimens	6	7		6	6		6	6		8	8	
	No. Batches	1	1		1	1		1	1		1	1	
	Mean		78.38	66.72		51.78	43.98		38.14	34.03		35.52	28.51
F^{bu}	**Minimum**		75.70	63.84		48.89	39.45		36.62	30.08		32.57	25.08
(ksi)	**Maximum**		84.00	70.62		54.61	46.44		39.54	37.78		41.85	31.61
$[(0/45)_5]_s$ **(20 plies)**	**C.V.(%)**		3.92	3.59		3.80	5.84		3.66	9.92		7.70	7.98
t_{ply}: **0.0078 - 0.0098 in.**													
	Failure Mode		Bearing	Bearing		Bearing	Bearing		Bearing	Bearing		Bearing	Bearing
	No. Specimens		6	6		6	6		6	6		8	8
	No. Batches		1	1		1	1		1	1		1	1

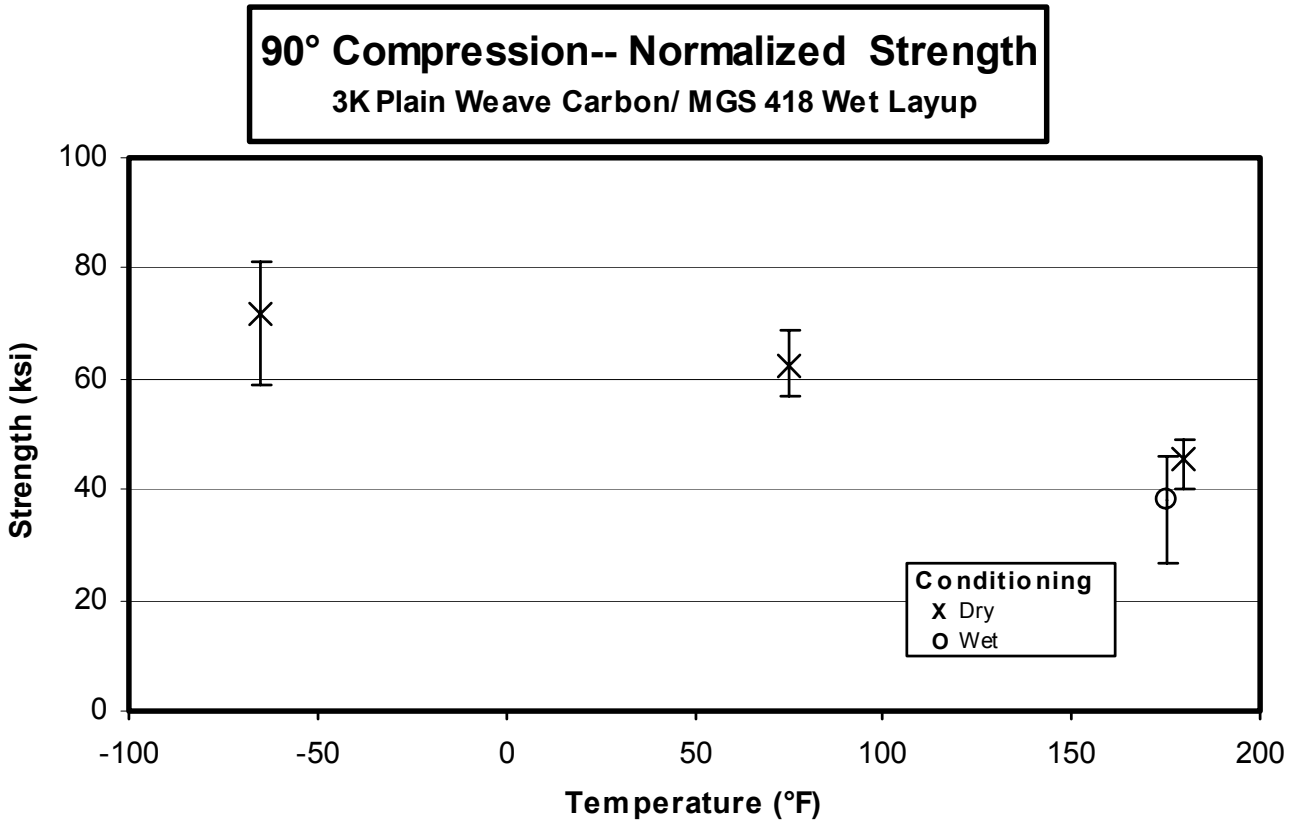
3.1.3 Individual Test Charts

3.1.3.1 Tension, 2-axis



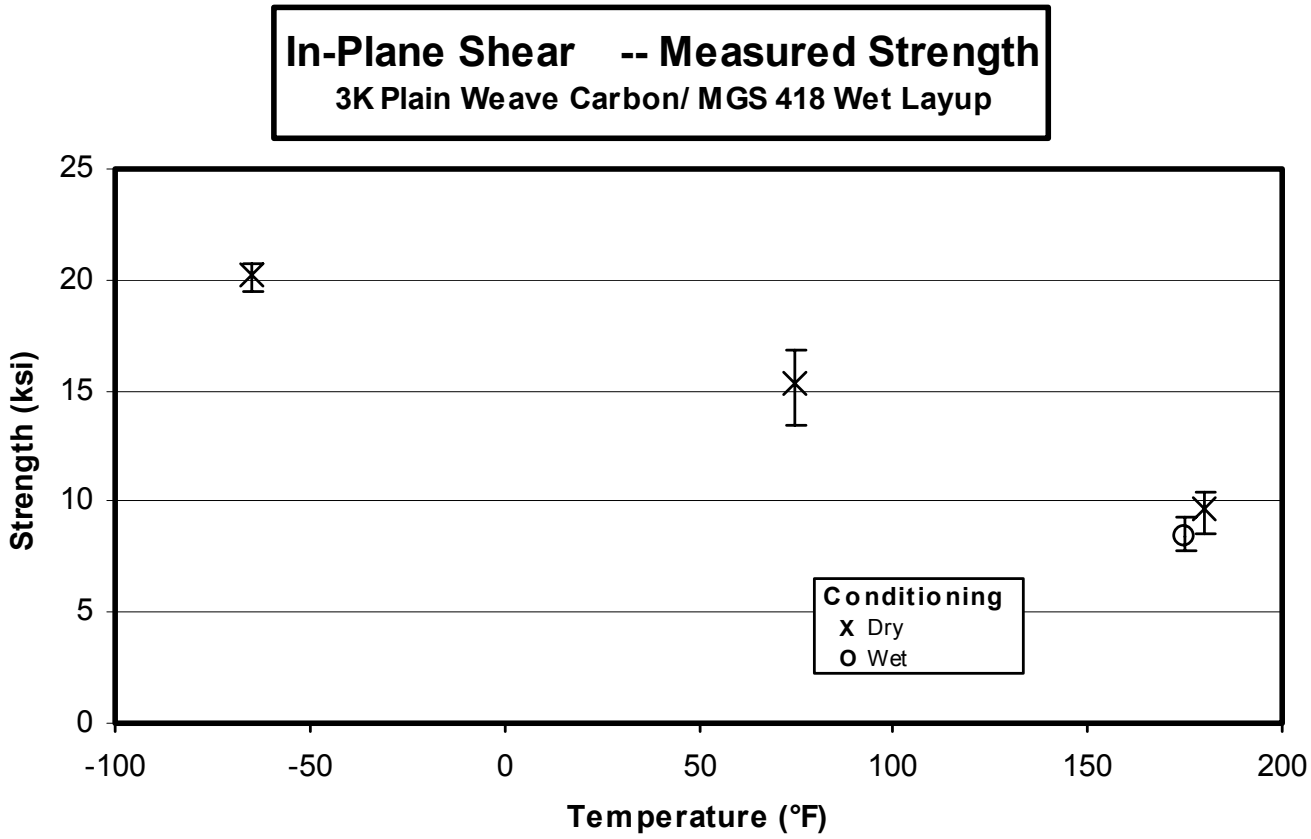
NOTE: The symbols represent the 'pooled' average of all tests, and the bars represent the upper and lower limit of the data. The 180° dry and wet data have been staggered for clarity.

3.1.3.2 Compression, 2-axis



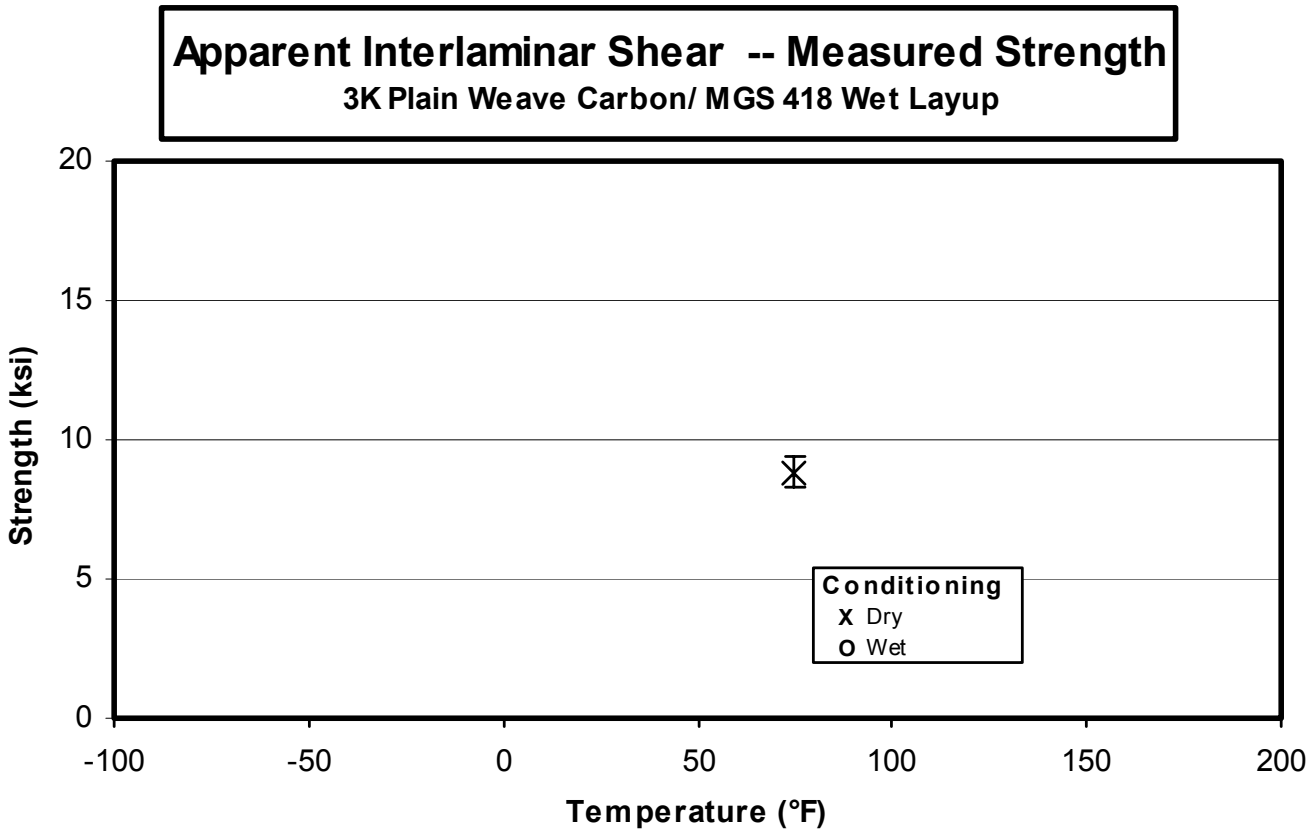
NOTE: The symbols represent the 'pooled' average of all tests, and the bars represent the upper and lower limit of the data. The 180° dry and wet data have been staggered for clarity.

3.1.3.3 Shear, 12 axis



NOTE: The symbols represent the 'pooled' average of all tests, and the bars represent the upper and lower limit of the data. The 180° dry and wet data have been staggered for clarity.

3.1.3.4 Shear, 13 axis



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.

M W U 2 1 2 5 F

1st Character: Fabricator
'M' designates Lancair

2nd Character: Material System
'W' designates 3K PW Carbon / MGS 418

3rd Character: Test Type
'U' designates 90° Tension Strength and Modulus, other test types will be clearly labeled at the top of each sheet

4th Character: Material Batch ID
See Table 2.1 for Lancair Batch ID Documentation.

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 samples numbered 1,2…9,A,B,….

8th Character: Test Condition
'A' --- RTD
'B' --- CTD
'F' --- ETW
'G' --- ETD
See Table 1.5.1 for condition parameters.

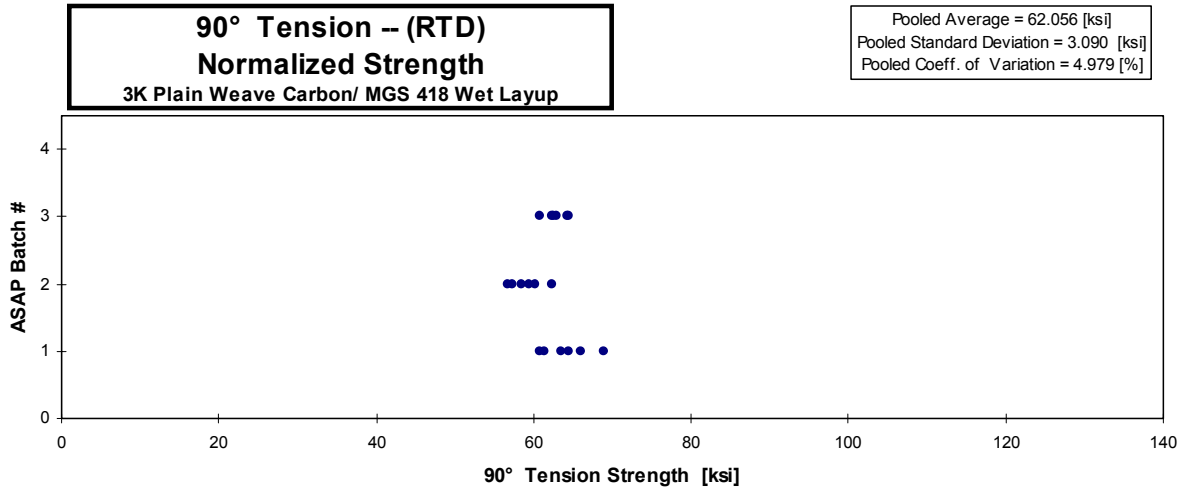
3.2.1 Raw Data Spreadsheets and Scatter Charts

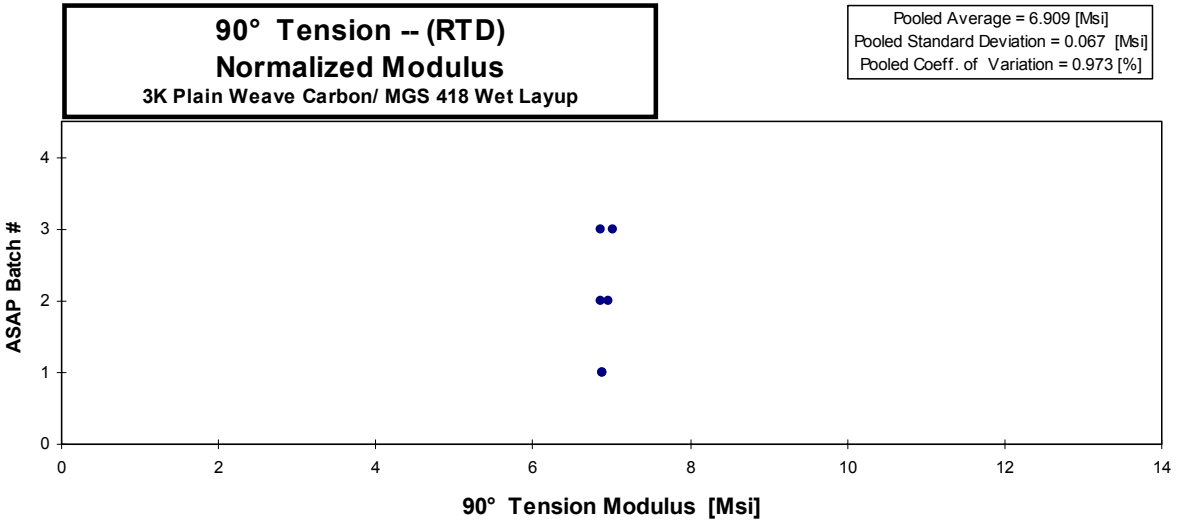
90° Tension-- (RTD)
Strength & Modulus
3K Plain Weave Carbon/ MGS 418 Wet Layup

normalizing t_{ply} [in]: 0.0104

Specimen Number	Panel Batch #	ASAP Batch #	Strength [ksi]	Modulus [Msi]	Poisson's Ratio	Avg. Specimen Thickn. [in]	# Plies in Laminate	Avg. t_{ply} [in]	$Strength_{norm}$ [ksi]	$Modulus_{norm}$ [Msi]
MWUA1X6A	A	1	65.681	7.000	0.046	0.123	12	0.01022	64.567	6.882
MWUA1X7A	A	1	64.493	6.982	0.046	0.123	12	0.01025	63.537	6.879
MWUA1X8A	A	1	61.965			0.122	12	0.01019	60.716	
MWUA3X5A	A	1	65.428			0.126	12	0.01050	66.066	
MWUA3X6A	A	1	68.468			0.126	12	0.01048	69.008	
MWUA3X7A	A	1	62.283			0.123	12	0.01025	61.401	
MWUB2X1A	B	2	58.228	6.627	0.061	0.129	12	0.01076	60.242	6.857
MWUB2X2A	B	2	55.779	6.768	0.076	0.128	12	0.01068	57.306	6.954
MWUB2X3A	B	2	57.349			0.127	12	0.01061	58.490	
MWUB2X4A	B	2	56.344			0.126	12	0.01046	56.690	
MWUB2X5A	B	2	63.123			0.123	12	0.01026	62.263	
MWUB2X6A	B	2	60.768			0.122	12	0.01018	59.462	
MWUC1X6A	C	3	61.376	6.911	0.039	0.127	12	0.01057	62.392	7.025
MWUC1X7A	C	3	63.604	6.789	0.062	0.126	12	0.01050	64.241	6.857
MWUC1X8A	C	3	60.206			0.126	12	0.01050	60.793	
MWUC4X5A	C	3	63.270			0.124	12	0.01035	62.966	
MWUC4X6A	C	3	62.688			0.124	12	0.01036	62.453	
MWUC4X7A	C	3	64.618			0.124	12	0.01037	64.411	

Average	**61.982**	**6.846**	**0.055**	**$Average_{norm}$**	**0.01042**	**62.056**	**6.909**
Standard Dev.	**3.412**	**0.144**	**0.014**	**$Standard\ Dev._{norm}$**		**3.090**	**0.067**
Coeff. of Var. [%]	**5.504**	**2.103**	**24.983**	**$Coeff.\ of\ Var.\ [\%]_{norm}$**		**4.979**	**0.973**
Min.	**55.779**	**6.627**	**0.039**	**Min.**	**0.0102**	**56.690**	**6.857**
Max.	**68.468**	**7.000**	**0.076**	**Max.**	**0.0108**	**69.008**	**7.025**
Number of Spec.	**18**	**6**	**6**	**Number of Spec.**		**18**	**6**



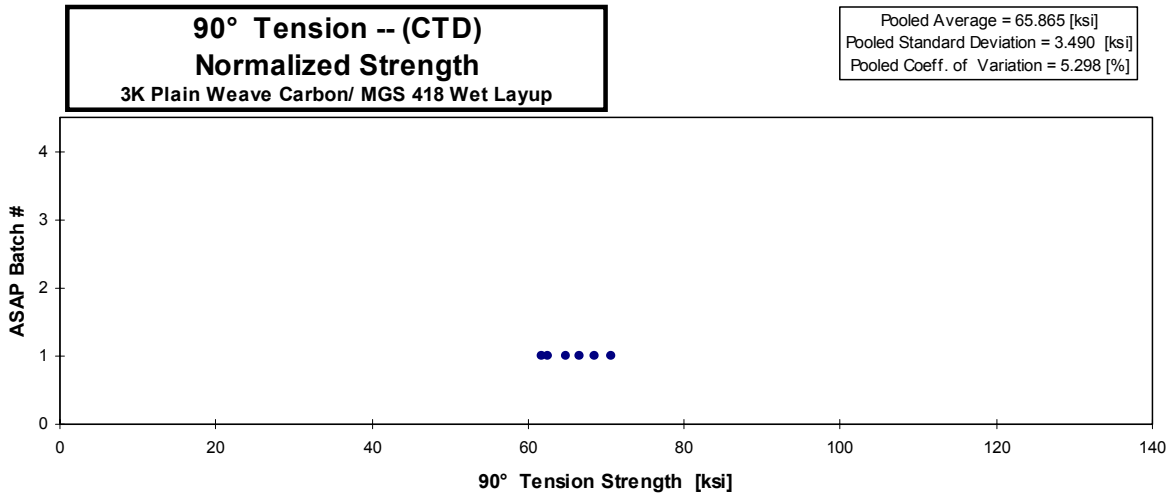


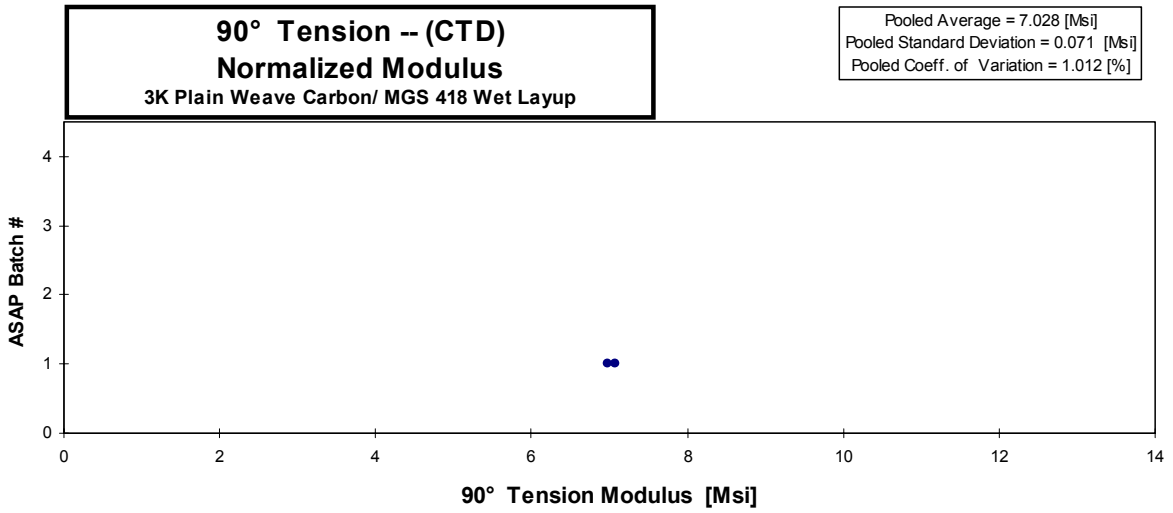
90° Tension-- (CTD)
Strength & Modulus
3K Plain Weave Carbon/ MGS 418 Wet Layup

normalizing t_{ply} [in]: 0.0104

Specimen Number	Panel Batch #	ASAP Batch #	Strength [ksi]	Modulus [Msi]	Poisson's Ratio	Avg. Specimen Thickn. [in]	# Plies in Laminate	Avg. t_{ply} [in]	$Strength_{norm}$ [ksi]	$Modulus_{norm}$ [Msi]
MWUB1X1B	B	1	72.717	7.171	0.045	0.121	12	0.01012	70.755	6.978
MWUB1X2B	B	1	70.905	7.315	0.058	0.121	12	0.01006	68.613	7.078
MWUB1X3B	B	1	64.283			0.121	12	0.01012	62.549	
MWUB1X4B	B	1	68.386			0.122	12	0.01013	66.578	
MWUB1X5B	B	1	63.442			0.121	12	0.01012	61.730	
MWUB1X6B	B	1	67.263			0.121	12	0.01004	64.963	

Average	**67.833**	**7.243**	**0.052**	**$Average_{norm}$**	**0.01010**	**65.865**	**7.028**
Standard Dev.	**3.628**	**0.101**	**0.009**	**$Standard\ Dev._{norm}$**		**3.490**	**0.071**
Coeff. of Var. [%]	**5.348**	**1.401**	**17.849**	**$Coeff.\ of\ Var.\ [\%]_{norm}$**		**5.298**	**1.012**
Min.	**63.442**	**7.171**	**0.045**	**Min.**	**0.0100**	**61.730**	**6.978**
Max.	**72.717**	**7.315**	**0.058**	**Max.**	**0.0101**	**70.755**	**7.078**
Number of Spec.	**6**	**2**	**2**	**Number of Spec.**		**6**	**2**



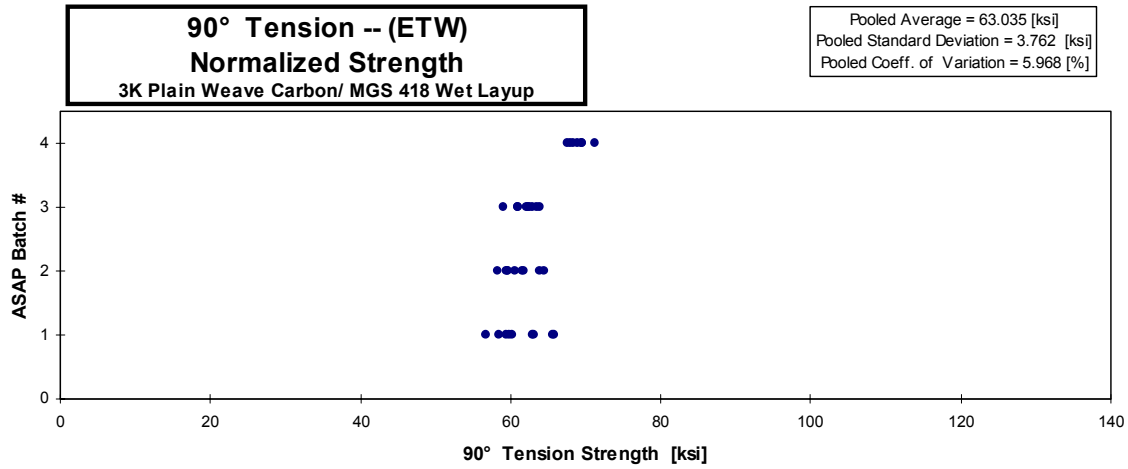


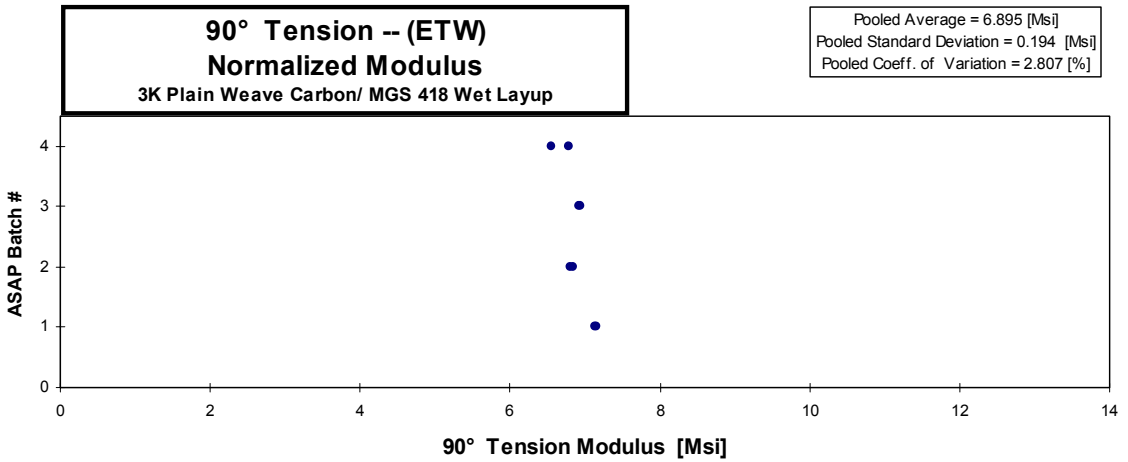
90° Tension-- (ETW)
Strength & Modulus
3K Plain Weave Carbon/ MGS 418 Wet Layup

normalizing t_{ply} [in]: 0.0104

Specimen Number	Panel Batch #	ASAP Batch #	Strength [ksi]	Modulus [Msi]	Poisson's Ratio	Avg. Specimen Thickn. [in]	# Plies in Laminate	Avg. t_{ply} [in]	$Strength_{norm}$ [ksi]	$Modulus_{norm}$ [Msi]
MWUA1X1F	A	1	66.532	7.258	0.024	0.123	12	0.01025	65.599	7.157
MWUA1X2F	A	1	63.904	7.243	0.022	0.123	12	0.01025	62.957	7.135
MWUA1X3F	A	1	61.225			0.123	12	0.01022	60.146	
MWUA1X4F	A	1	64.230			0.123	12	0.01023	63.158	
MWUA1X5F	A	1	66.921			0.123	12	0.01024	65.884	
MWUA3X1F	A	1	57.378			0.129	12	0.01077	59.424	
MWUA3X2F	A	1	57.076			0.128	12	0.01066	58.517	
MWUA3X3F	A	1	57.085			0.124	12	0.01033	56.689	
MWUA3X4F	A	1	59.542			0.125	12	0.01045	59.829	
MWUB3X1F	B	2	60.620	6.669	0.021	0.127	12	0.01061	61.843	6.804
MWUB3X2F	B	2	63.337	6.779	0.029	0.126	12	0.01050	63.920	6.841
MWUB3X3F	B	2	64.960			0.114	12	0.00953	59.503	
MWUB3X4F	B	2	58.867			0.126	12	0.01054	59.645	
MWUB3X5F	B	2	62.663			0.119	12	0.00990	59.642	
MWUB3X6F	B	2	59.946			0.126	12	0.01051	60.554	
MWUB3X7F	B	2	63.315			0.127	12	0.01059	64.465	
MWUB3X8F	B	2	60.039			0.121	12	0.01011	58.380	
MWUB3X9F	B	2	62.009			0.124	12	0.01033	61.570	
MWUC4X1F	C	3	64.106	7.009	0.040	0.124	12	0.01029	63.438	6.936
MWUC4X2F	C	3	61.587	7.006	0.063	0.123	12	0.01029	60.929	6.932
MWUC4X3F	C	3	64.500			0.124	12	0.01030	63.888	
MWUC4X4F	C	3	63.382			0.124	12	0.01032	62.874	
MWUC1X1F	C	3	62.214			0.125	12	0.01042	62.322	
MWUC1X2F	C	3	60.374			0.126	12	0.01051	60.995	
MWUC1X3F	C	3	61.996			0.125	12	0.01041	62.079	
MWUC1X4F	C	3	58.951			0.125	12	0.01040	58.967	
MWUC1X5F	C	3	61.511			0.127	12	0.01059	62.620	
MWUE1X2F	E	4	64.120	6.221	0.049	0.132	12	0.01097	67.622	6.560
MWUE1X3F	E	4	68.228	6.499	0.048	0.131	12	0.01088	71.345	6.796
MWUE1X4F	E	4	64.507			0.131	12	0.01095	67.927	
MWUE1X5F	E	4	66.411			0.131	12	0.01088	69.488	
MWUE1X6F	E	4	65.779			0.131	12	0.01091	69.011	
MWUE1X7F	E	4	66.686			0.130	12	0.01084	69.518	
MWUE1X8F	E	4	65.592			0.130	12	0.01085	68.430	

Average	**62.635**	**6.836**	**0.037**	**$Average_{norm}$**	**0.01046**	**63.035**	**6.895**
Standard Dev.	**2.973**	**0.364**	**0.015**	**$Standard\ Dev._{norm}$**		**3.762**	**0.194**
Coeff. of Var. [%]	**4.747**	**5.322**	**41.670**	**$Coeff.\ of\ Var.\ [\%]_{norm}$**		**5.968**	**2.807**
Min.	**57.076**	**6.221**	**0.021**	**Min.**	**0.0095**	**56.689**	**6.560**
Max.	**68.228**	**7.258**	**0.063**	**Max.**	**0.0110**	**71.345**	**7.157**
Number of Spec.	**34**	**8**	**8**	**Number of Spec.**		**34**	**8**



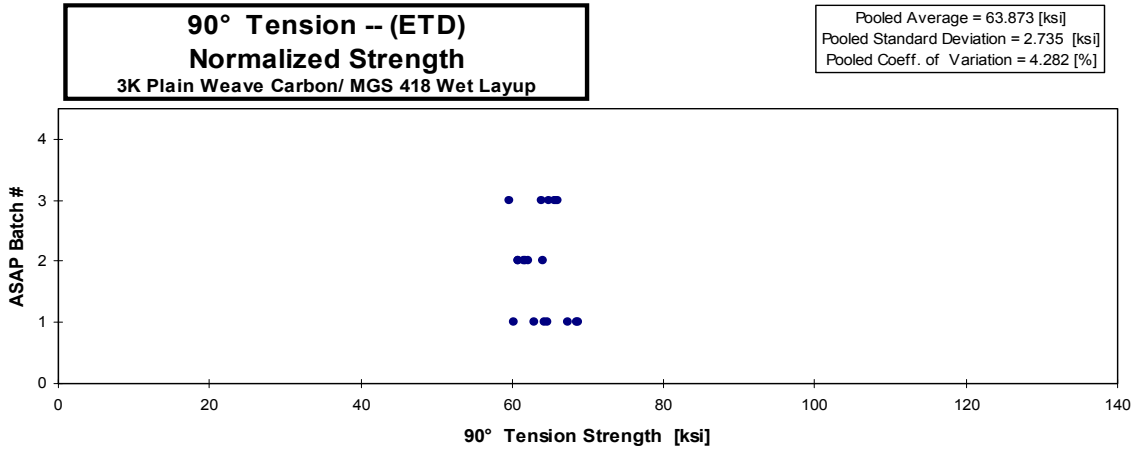


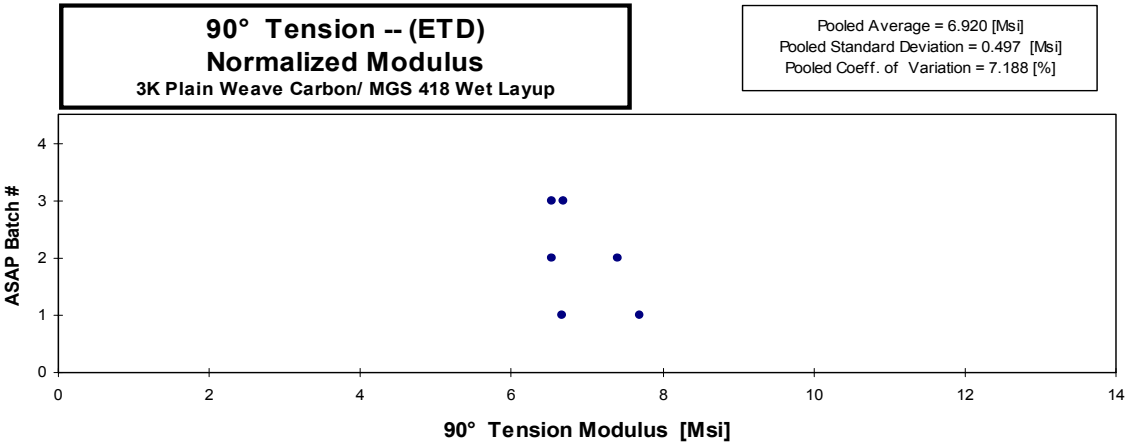
90° Tension-- (ETD)
Strength & Modulus
3K Plain Weave Carbon/ MGS 418 Wet Layup

normalizing t_{ply} [in]: 0.0104

Specimen Number	Panel Batch #	ASAP Batch #	Strength [ksi]	Modulus [Msi]	Poisson's Ratio	Avg. Specimen Thickn. [in]	# Plies in Laminate	Avg. t_{ply} [in]	$Strength_{norm}$ [ksi]	$Modulus_{norm}$ [Msi]
MWUA2X1G	A	1	62.564			0.126	12	0.01046	62.940	
MWUA2X2G	A	1	71.793	8.023	0.022	0.120	12	0.00997	68.802	7.689
MWUA2X3G	A	1	64.064			0.125	12	0.01043	64.252	
MWUA2X4G	A	1	70.523			0.121	12	0.01010	68.460	
MWUA2X5G	A	1	68.483			0.123	12	0.01022	67.321	
MWUA2X6G	A	1	68.830			0.117	12	0.00978	64.712	
MWUA2X7G	A	1	60.706	6.717	0.033	0.124	12	0.01033	60.317	6.674
MWUB4X1G	B	2	58.618	7.036	0.055	0.131	12	0.01094	61.687	7.405
MWUB4X2G	B	2	58.221	6.186	0.040	0.132	12	0.01100	61.588	6.544
MWUB4X3G	B	2	58.827			0.132	12	0.01099	62.143	
MWUB4X4G	B	2	57.425			0.132	12	0.01102	60.823	
MWUB4X5G	B	2	60.765			0.131	12	0.01096	64.011	
MWUB4X6G	B	2	57.493			0.132	12	0.01099	60.756	
MWUC2X1G	C	3	62.278	6.372	0.042	0.128	12	0.01066	63.825	6.531
MWUC2X2G	C	3	55.900	6.269	0.073	0.133	12	0.01108	59.573	6.681
MWUC2X3G	C	3	62.922			0.131	12	0.01088	65.846	
MWUC2X4G	C	3	65.489			0.124	12	0.01030	64.885	
MWUC2X5G	C	3	61.339			0.134	12	0.01114	65.689	
MWUC2X6G	C	3	62.031			0.133	12	0.01106	65.958	

Average	**62.541**	**6.767**	**0.044**	**$Average_{norm}$**	**0.01065**	**63.873**	**6.920**
Standard Dev.	**4.638**	**0.692**	**0.018**	**Standard $Dev._{norm}$**		**2.735**	**0.497**
Coeff. of Var. [%]	**7.416**	**10.225**	**40.335**	**Coeff. of Var. $[\%]_{norm}$**		**4.282**	**7.188**
Min.	**55.900**	**6.186**	**0.022**	**Min.**	**0.0098**	**59.573**	**6.531**
Max.	**71.793**	**8.023**	**0.073**	**Max.**	**0.0111**	**68.802**	**7.689**
Number of Spec.	**19**	**6**	**6**	**Number of Spec.**		**19**	**6**



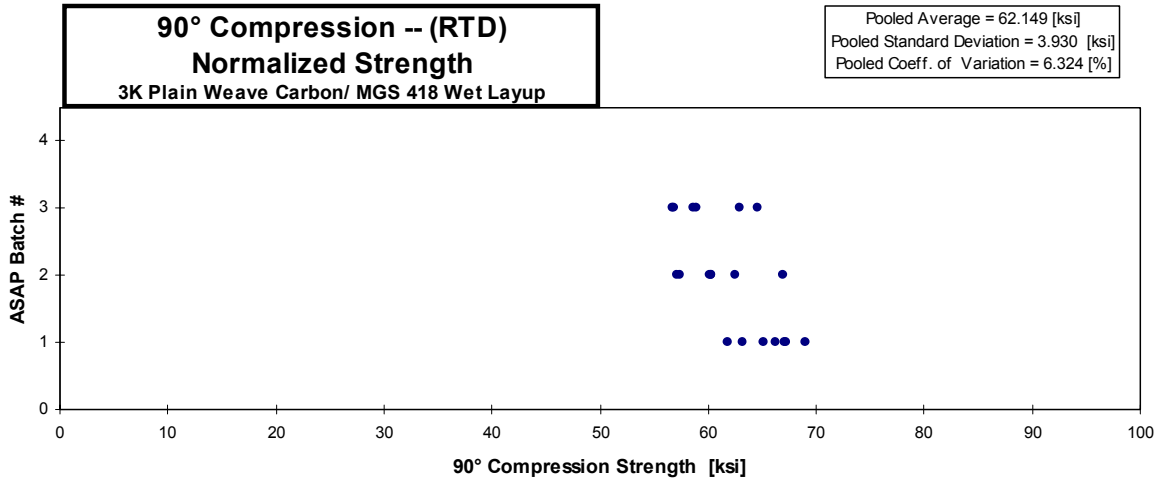


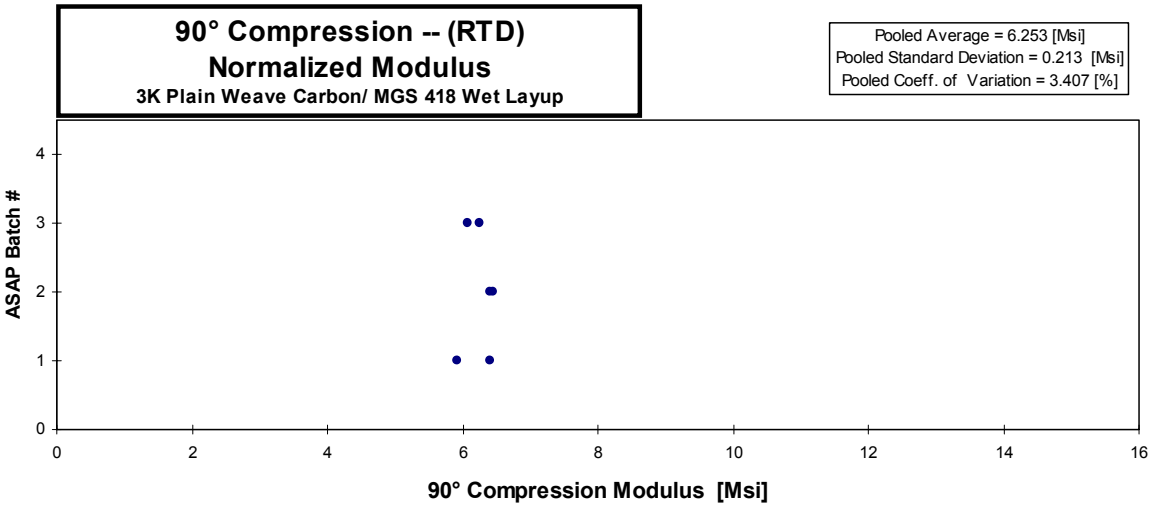
90° Compression-- (RTD)
Strength & Modulus
3K Plain Weave Carbon/ MGS 418 Wet Layup

normalizing t_{ply} [in]: 0.0104

Specimen Number	Panel Batch #	ASAP Batch #	Strength [ksi]	Modulus [Msi]	Avg. Specimen Thickn. [in]	# Plies in Laminate	Avg. t_{ply} [in]	$Strength_{norm}$ [ksi]	$Modulus_{norm}$ [Msi]
MWWA121A	A	1	70.468		0.122	12	0.01019	69.042	
MWWA122A	A	1	69.266		0.121	12	0.01010	67.240	
MWWA123A	A	1	67.618		0.122	12	0.01019	66.264	
MWWA124A	A	1	68.547		0.122	12	0.01017	67.036	
MWWA125A	A	1	64.521		0.122	12	0.01019	63.229	
MWWA126A	A	1	67.012		0.121	12	0.01010	65.105	
MWWA127A	A	1	63.411		0.122	12	0.01014	61.823	
MWZA3X6A	A	1		6.421	0.125	12	0.01039		6.417
MWZA3X7A	A	1		6.024	0.123	12	0.01024		5.932
MWWB121A	B	2	58.802		0.121	12	0.01010	57.106	
MWWB122A	B	2	62.534		0.120	12	0.01003	60.304	
MWWB123A	B	2	69.166		0.121	12	0.01006	66.880	
MWWB124A	B	2	62.427		0.120	12	0.01002	60.151	
MWWB125A	B	2	59.602		0.120	12	0.01001	57.381	
MWWB126A	B	2	62.041		0.121	12	0.01010	60.239	
MWWB127A	B	2	64.171		0.122	12	0.01013	62.474	
MWZB2X8A	B	2		7.062	0.114	12	0.00949		6.447
MWZB2X9A	B	2		6.387	0.125	12	0.01044		6.410
MWWC121A	C	3	61.640		0.128	12	0.01063	62.986	
MWWC122A	C	3	57.951		0.127	12	0.01057	58.914	
MWWC123A	C	3	56.065		0.126	12	0.01054	56.817	
MWWC124A	C	3	56.863		0.125	12	0.01038	56.760	
MWWC125A	C	3	58.273		0.125	12	0.01046	58.588	
MWWC126A	C	3	63.700		0.127	12	0.01055	64.644	
MWZC4X6A	C	3		6.201	0.126	12	0.01047		6.243
MWZC4X7A	C	3		6.066	0.125	12	0.01040		6.068

Average	**63.204**	**6.360**	**$Average_{norm}$**	**0.01023**	**62.149**	**6.253**
Standard Dev.	**4.418**	**0.380**	**$Standard\ Dev._{norm}$**		**3.930**	**0.213**
Coeff. of Var. [%]	**6.990**	**5.971**	**$Coeff.\ of\ Var.\ [\%]_{norm}$**		**6.324**	**3.407**
Min.	**56.065**	**6.024**	**Min.**	**0.0095**	**56.760**	**5.932**
Max.	**70.468**	**7.062**	**Max.**	**0.0106**	**69.042**	**6.447**
Number of Spec.	**20**	**6**	**Number of Spec.**		**20**	**6**



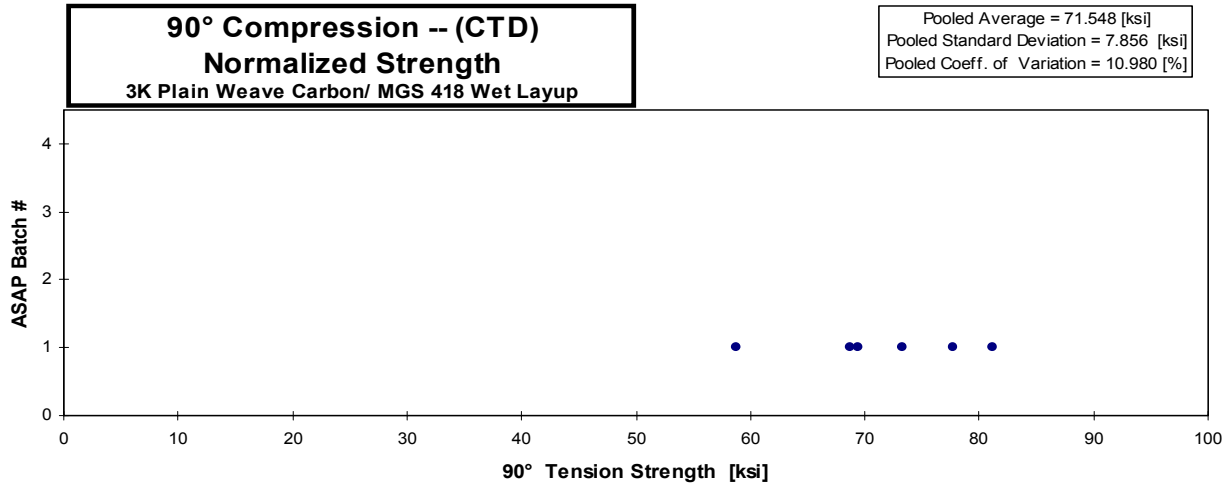


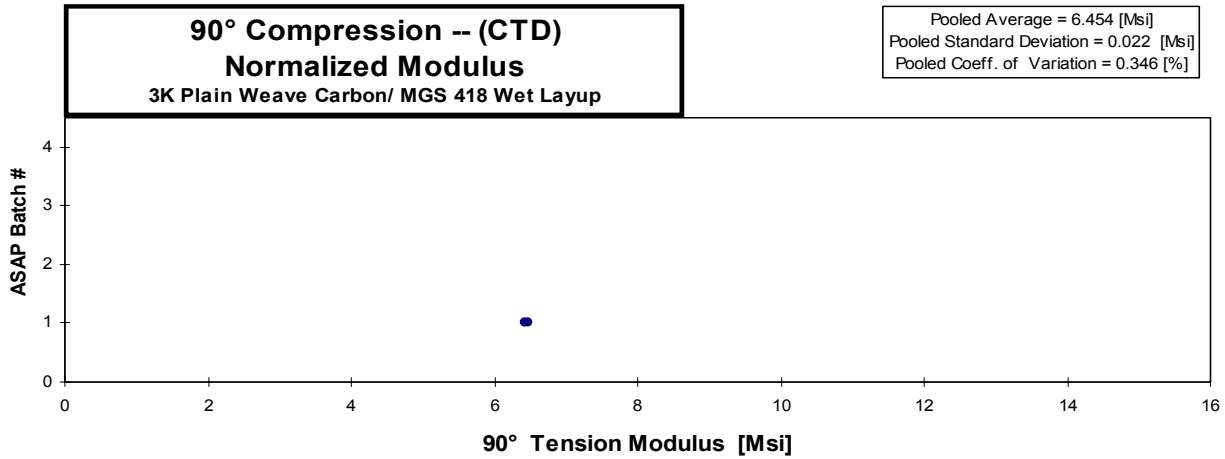
90° Compression-- (CTD)
Strength & Modulus
3K Plain Weave Carbon/ MGS 418 Wet Layup

normalizing t_{ply} [in]: 0.0104

Specimen Number	Panel Batch #	ASAP Batch #	Strength [ksi]	Modulus [Msi]	Avg. Specimen Thickn. [in]	# Plies in Laminate	Avg. t_{ply} [in]	$Strength_{norm}$ [ksi]	$Modulus_{norm}$ [Msi]
MWWB411B	B	1	66.614		0.130	12	0.01085	69.496	
MWWB412B	B	1	56.441		0.130	12	0.01084	58.804	
MWWB413B	B	1	65.864		0.130	12	0.01086	68.806	
MWWB414B	B	1	70.256		0.130	12	0.01084	73.239	
MWWB415B	B	1	74.342		0.131	12	0.01088	77.737	
MWWB416B	B	1	77.688		0.130	12	0.01087	81.205	
MWZB2X5B	B	1		7.243	0.111	12	0.00929		6.470
MWZB2X6B	B	1		6.807	0.118	12	0.00984		6.439

Average	**68.534**	**7.025**	**$Average_{norm}$**	**0.01053**	**71.548**	**6.454**
Standard Dev.	**7.450**	**0.309**	**$Standard\ Dev._{norm}$**		**7.856**	**0.022**
Coeff. of Var. [%]	**10.871**	**4.397**	**$Coeff.\ of\ Var.\ [\%]_{norm}$**		**10.980**	**0.346**
Min.	**56.441**	**6.807**	**Min.**	**0.0093**	**58.804**	**6.439**
Max.	**77.688**	**7.243**	**Max.**	**0.0109**	**81.205**	**6.470**
Number of Spec.	**6**	**2**	**Number of Spec.**		**6**	**2**



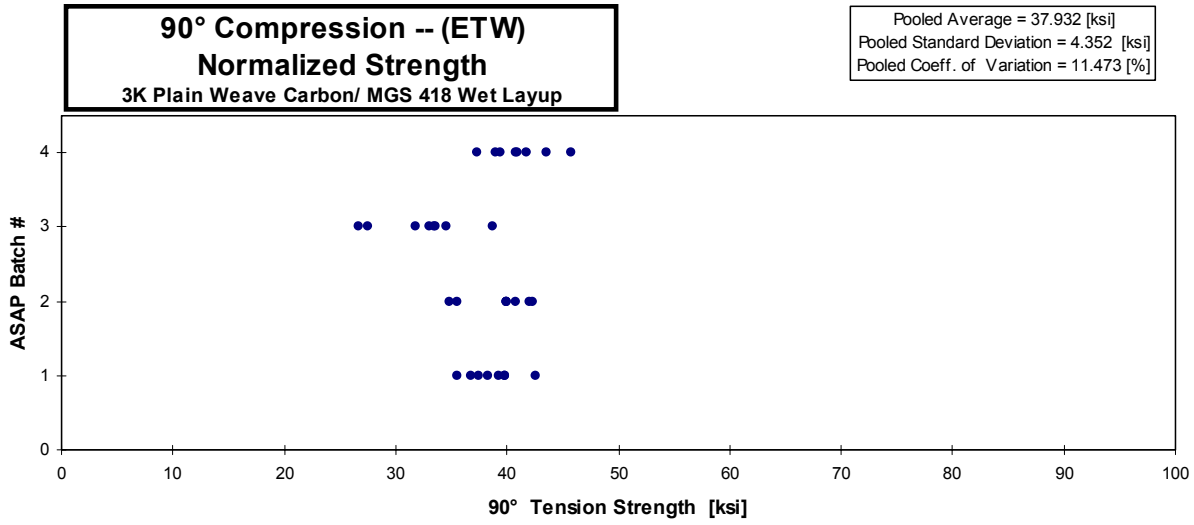


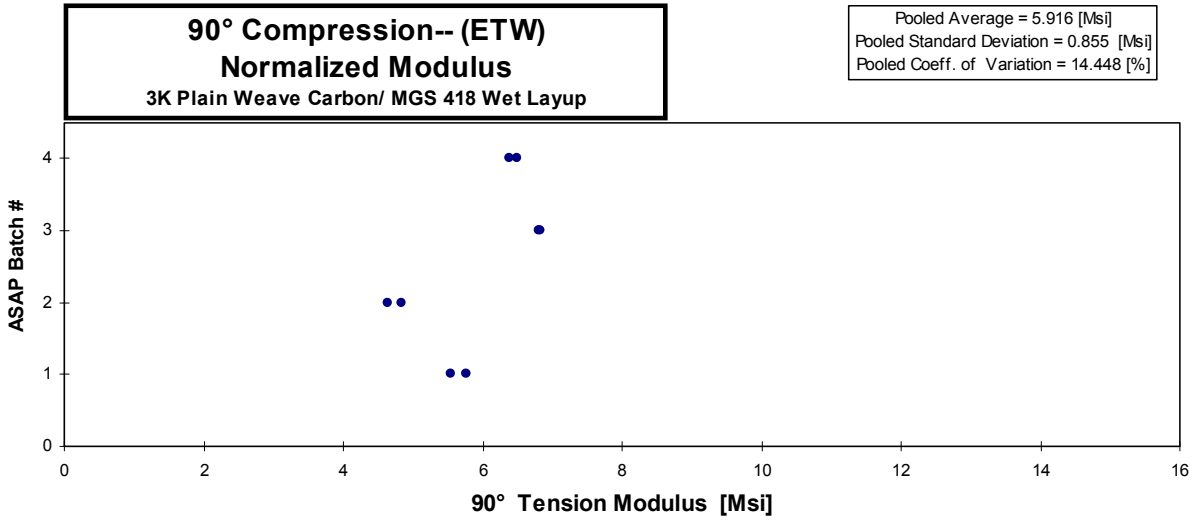
90° Compression-- (ETW)
Strength & Modulus
3K Plain Weave Carbon/ MGS 418 Wet Layup

normalizing t_{ply} [in]: 0.0104

Specimen Number	Panel Batch #	ASAP Batch #	Strength [ksi]	Modulus [Msi]	Avg. Specimen Thickn. [in]	# Plies in Laminate	Avg. t_{ply} [in]	$Strength_{norm}$ [ksi]	$Modulus_{norm}$ [Msi]
MWWA111F	A	1	40.918		0.122	12	0.01014	39.894	
MWWA112F	A	1	40.889		0.121	12	0.01012	39.775	
MWWA113F	A	1	43.452		0.122	12	0.01020	42.608	
MWWA114F	A	1	37.993		0.121	12	0.01008	36.821	
MWWA115F	A	1	36.514		0.122	12	0.01013	35.578	
MWWA116F	A	1	39.096		0.123	12	0.01021	38.375	
MWWA117F	A	1	40.160		0.122	12	0.01018	39.299	
MWWA118F	A	1	38.579		0.121	12	0.01011	37.497	
MWZA3X1F	A	1		5.628	0.123	12	0.01024		5.540
MWZA3X2F	A	1		5.858	0.123	12	0.01024		5.769
MWWB111F	B	2	41.688		0.120	12	0.00998	40.009	
MWWB112F	B	2	42.077		0.121	12	0.01010	40.863	
MWWB113F	B	2	43.615		0.121	12	0.01009	42.305	
MWWB114F	B	2	43.158		0.122	12	0.01014	42.068	
MWWB115F	B	2	41.139		0.121	12	0.01011	39.977	
MWWB116F	B	2	36.444		0.122	12	0.01013	35.502	
MWWB117F	B	2	35.941		0.121	12	0.01008	34.839	
MWWB118F	B	2	41.017		0.122	12	0.01015	40.031	
MWZB2X1F	B	2		4.661	0.124	12	0.01037		4.649
MWZB2X2F	B	2		5.609	0.108	12	0.00898		4.845
MWWC111F	C	3	27.024		0.127	12	0.01060	27.533	
MWWC112F	C	3	26.326		0.127	12	0.01055	26.701	
MWWC113F	C	3	38.552		0.125	12	0.01044	38.683	
MWWC114F	C	3	33.922		0.127	12	0.01060	34.575	
MWWC115F	C	3	33.683		0.123	12	0.01023	33.116	
MWWC116F	C	3	33.009		0.126	12	0.01053	33.405	
MWWC117F	C	3	31.582		0.126	12	0.01049	31.861	
MWWC118F	C	3	33.707		0.125	12	0.01039	33.673	
MWZC4X1F	C	3		6.708	0.127	12	0.01055		6.803
MWZC4X2F	C	3		6.742	0.127	12	0.01055		6.839
MWWE1X1F	E	4	35.138		0.132	12	0.01104	37.299	
MWWE1X2F	E	4	37.373		0.132	12	0.01098	39.440	
MWWE1X3F	E	4	38.130		0.134	12	0.01114	40.826	
MWWE1X4F	E	4	36.639		0.133	12	0.01109	39.061	
MWWE1X5F	E	4	40.614		0.134	12	0.01117	43.608	
MWWE1X6F	E	4	43.314		0.132	12	0.01100	45.813	
MWWE1X7F	E	4	39.194		0.133	12	0.01109	41.793	
MWWE1X8F	E	4	38.550		0.133	12	0.01106	41.006	
MWZE211F	E	4		6.023	0.135	12	0.01122		6.497
MWZE212F	E	4		5.964	0.134	12	0.01114		6.388

Average	**37.795**	**5.899**		**$Average_{norm}$**	**0.01022**	**37.932**	**5.916**
Standard Dev.	**4.369**	**0.663**		**Standard $Dev._{norm}$**		**4.352**	**0.855**
Coeff. of Var. [%]	**11.560**	**11.237**		**Coeff. of Var. $[\%]_{norm}$**		**11.473**	**14.448**
Min.	**26.326**	**4.661**		**Min.**	**0.0090**	**26.701**	**4.649**
Max.	**43.615**	**6.742**		**Max.**	**0.0112**	**45.813**	**6.839**
Number of Spec.	**32**	**8**		**Number of Spec.**		**32**	**8**



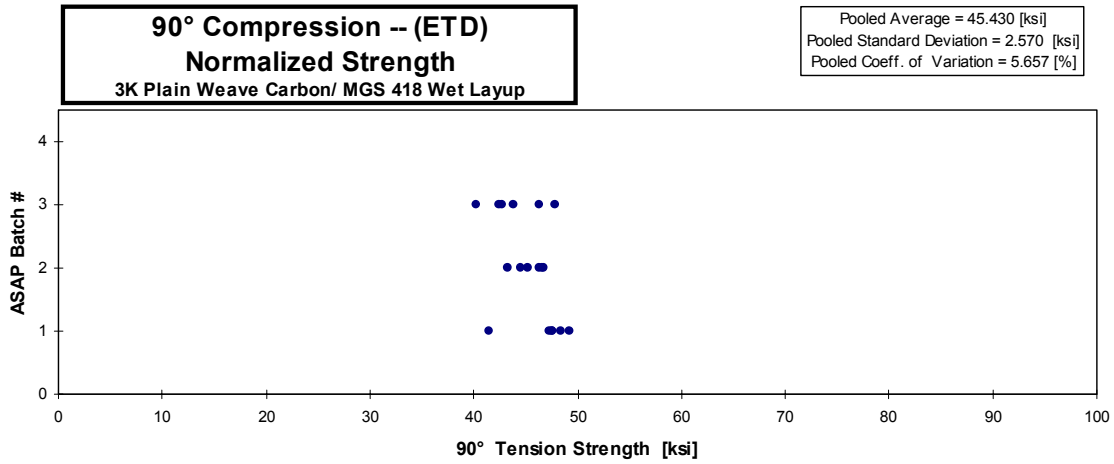


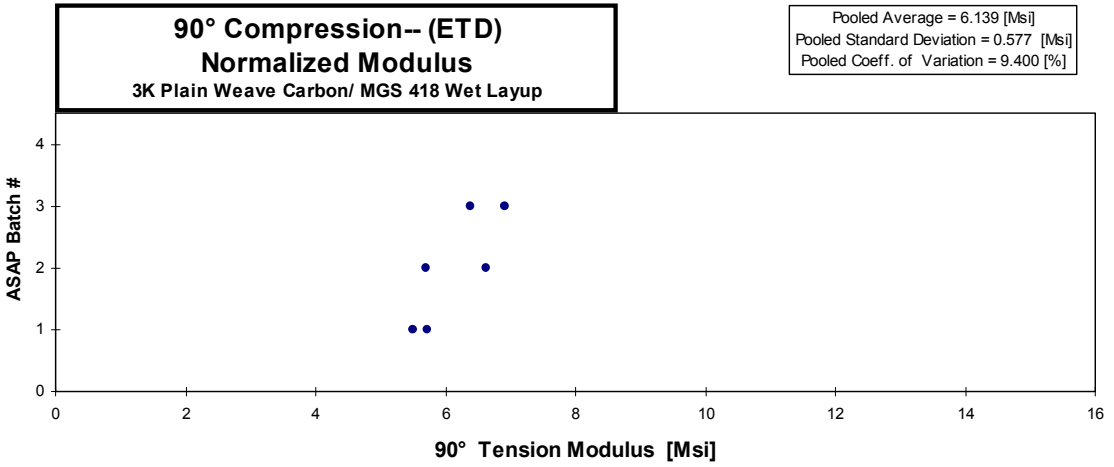
90° Compression-- (ETD)
Strength & Modulus
3K Plain Weave Carbon/ MGS 418 Wet Layup

normalizing t_{ply} [in]: 0.0104

Specimen Number	Panel Batch #	ASAP Batch #	Strength [ksi]	Modulus [Msi]	Avg. Specimen Thickn. [in]	# Plies in Laminate	Avg. t_{ply} [in]	$Strength_{norm}$ [ksi]	$Modulus_{norm}$ [Msi]
MWWA119G	A	1	50.066		0.123	12	0.01022	49.213	
MWWA11AG	A	1	42.664		0.121	12	0.01011	41.476	
MWWA128G	A	1	49.302		0.122	12	0.01020	48.354	
MWWA129G	A	1	48.422		0.123	12	0.01021	47.540	
MWWA12AG	A	1	48.574		0.122	12	0.01019	47.572	
MWWA12BG	A	1	48.309		0.122	12	0.01017	47.255	
MWZA3X9G	A	1		5.981	0.120	12	0.00996		5.728
MWZA3XAG	A	1		5.700	0.120	12	0.01003		5.499
MWWB128G	B	2	48.133		0.121	12	0.01008	46.657	
MWWB129G	B	2	47.975		0.121	12	0.01006	46.389	
MWWB12AG	B	2	45.921		0.121	12	0.01007	44.468	
MWWB119G	B	2	47.788		0.122	12	0.01017	46.735	
MWWB11AG	B	2	46.750		0.121	12	0.01006	45.205	
MWWB11BG	B	2	44.473		0.121	12	0.01011	43.243	
MWZB2XBG	B	2		6.743	0.123	12	0.01022		6.625
MWZB2XCG	B	2		5.674	0.125	12	0.01043		5.692
MWWC119G	C	3	46.281		0.125	12	0.01040	46.300	
MWWC11AG	C	3	42.152		0.127	12	0.01056	42.803	
MWWC11BG	C	3	47.825		0.125	12	0.01042	47.911	
MWWC11CG	C	3	43.501		0.126	12	0.01049	43.875	
MWWC128G	C	3	42.009		0.126	12	0.01051	42.446	
MWWC129G	C	3	40.242		0.125	12	0.01041	40.291	
MWZC4X9G	C	3		6.316	0.126	12	0.01051		6.384
MWZC4XAG	C	3		6.868	0.126	12	0.01046		6.908

Average	**46.133**	**6.214**	**$Average_{norm}$**	**0.01025**	**45.430**	**6.139**
Standard Dev.	**2.912**	**0.515**	**Standard $Dev._{norm}$**		**2.570**	**0.577**
Coeff. of Var. [%]	**6.312**	**8.293**	**Coeff. of $Var.[\%]_{norm}$**		**5.657**	**9.400**
Min.	**40.242**	**5.674**	**Min.**	**0.0100**	**40.291**	**5.499**
Max.	**50.066**	**6.868**	**Max.**	**0.0106**	**49.213**	**6.908**
Number of Spec.	**18**	**6**	**Number of Spec.**		**18**	**6**

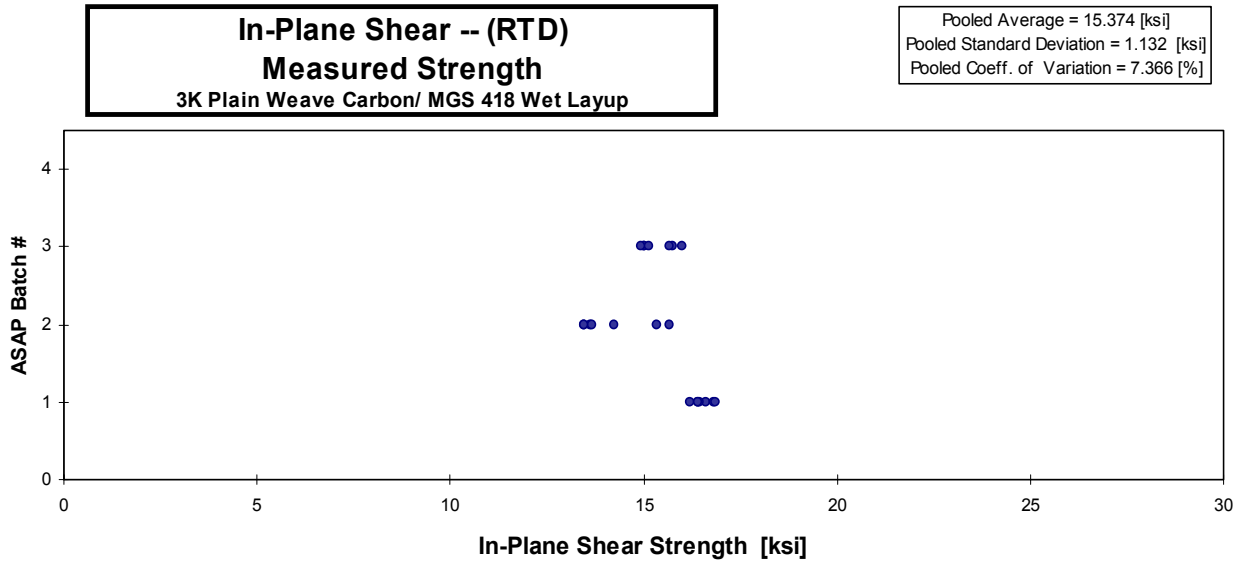


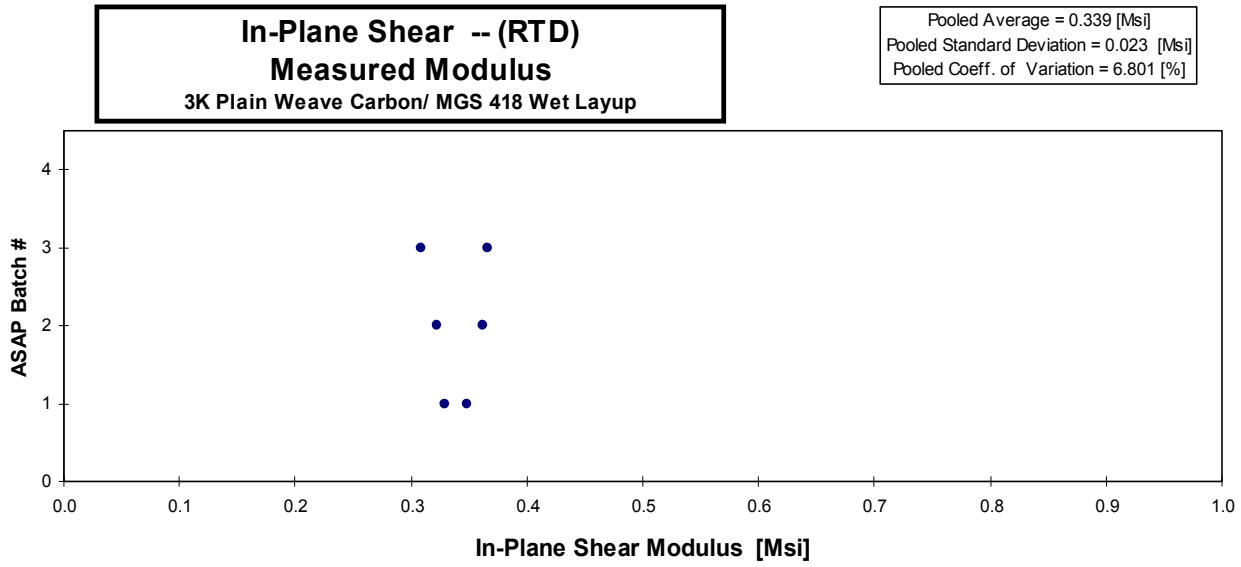


In-Plane Shear -- (RTD)
Strength & Modulus
3K Plain Weave Carbon/ MGS 418 Wet Layup

Specimen Number	Panel Batch #	ASAP Batch #	Strength [ksi]	Modulus [Msi]	Avg. Specimen Thickn. [in]	# Plies in Laminate	Avg. t_{ply} [in]
MWNA121A	A	1	16.207	0.348	0.122	12	0.01017
MWNA122A	A	1	16.608		0.126	12	0.01049
MWNA123A	A	1	16.829	0.329	0.124	12	0.01032
MWNA124A	A	1	16.421		0.128	12	0.01064
MWNA125A	A	1	16.466		0.126	12	0.01053
MWNA126A	A	1	16.396		0.128	12	0.01065
MWNA127A	A	1	16.881		0.125	12	0.01038
MWNB111A	B	2	13.635	0.362	0.134	12	0.01116
MWNB112A	B	2	14.241	0.322	0.135	12	0.01127
MWNB113A	B	2	13.681		0.136	12	0.01136
MWNB114A	B	2	13.451		0.135	12	0.01125
MWNB115A	B	2	13.461		0.135	12	0.01123
MWNB129A	B	2	15.679		0.139	12	0.01159
MWNB12AA	B	2	15.363		0.134	12	0.01114
MWNC131A	C	3	15.024	0.309	0.138	12	0.01148
MWNC132A	C	3	15.011	0.366	0.127	12	0.01060
MWNC133A	C	3	15.741		0.134	12	0.01113
MWNC134A	C	3	15.659		0.129	12	0.01072
MWNC135A	C	3	15.154		0.136	12	0.01134
MWNC136A	C	3	15.992		0.131	12	0.01094
MWNC137A	C	3	14.948		0.123	12	0.01024

Average	**15.374**	**0.339**		**0.0109**
Standard Dev.	**1.132**	**0.023**		
Coeff. of Var. [%]	**7.366**	**6.801**		
Min.	**13.451**	**0.309**	**Min.**	**0.0102**
Max.	**16.881**	**0.366**	**Max.**	**0.0116**
Number of Spec.	**21**	**6**		

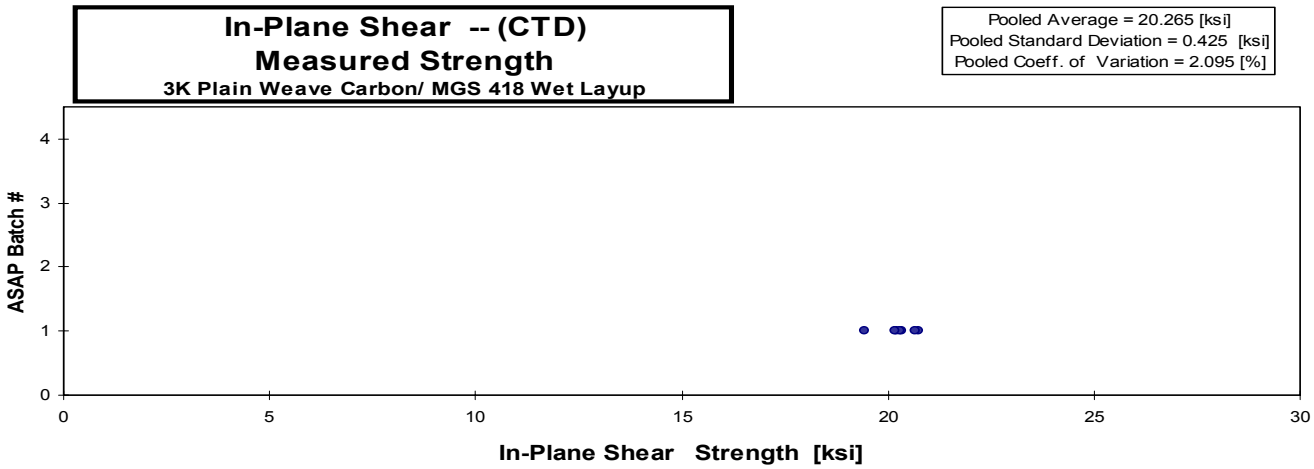


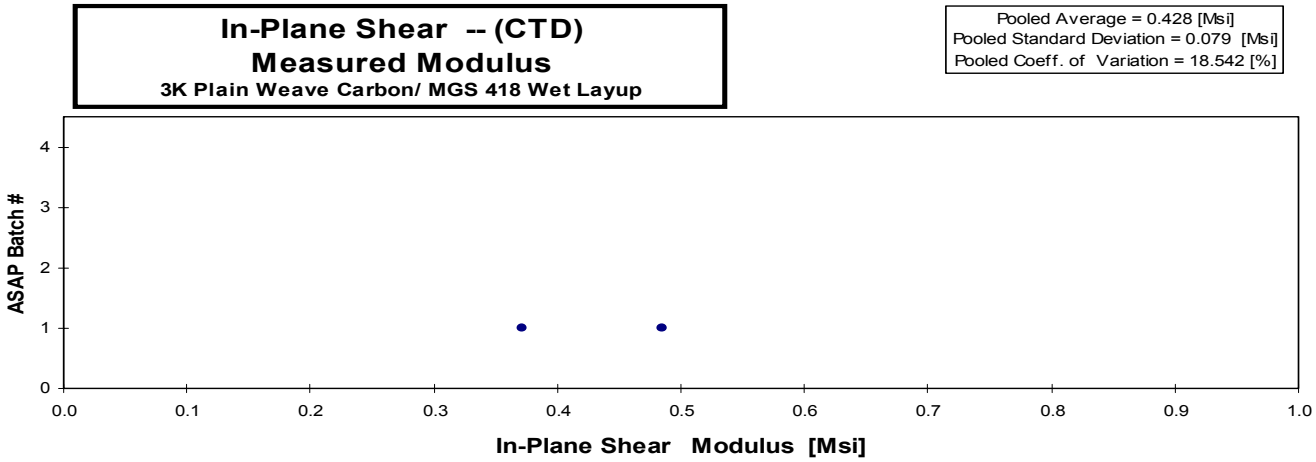


In-Plane Shear -- (CTD)
Strength & Modulus
3K Plain Weave Carbon/ MGS 418 Wet Layup

Specimen Number	Panel Batch#	ASAP Batch #	Strength [ksi]	Modulus [Msi]	Avg. Specimen Thickn. [in]	# Plies in Laminate	Avg. t_{ply} [in]
MWNB131B	B	1	20.359	0.372	0.140	12	0.01169
MWNB132B	B	1	20.732	0.484	0.137	12	0.01146
MWNB133B	B	1	20.217		0.139	12	0.01156
MWNB134B	B	1	20.659		0.139	12	0.01158
MWNB135B	B	1	20.285		0.140	12	0.01164
MWNB136B	B	1	19.436		0.137	12	0.01142
MWNB137B	B	1	20.166		0.138	12	0.01154

Average	**20.265**	**0.428**		**0.0116**
Standard Dev.	**0.425**	**0.079**		
Coeff. of Var. [%]	**2.095**	**18.542**		
Min.	**19.436**	**0.372**	**Min.**	**0.0114**
Max.	**20.732**	**0.484**	**Max.**	**0.0117**
Number of Spec.	**7**	**2**		

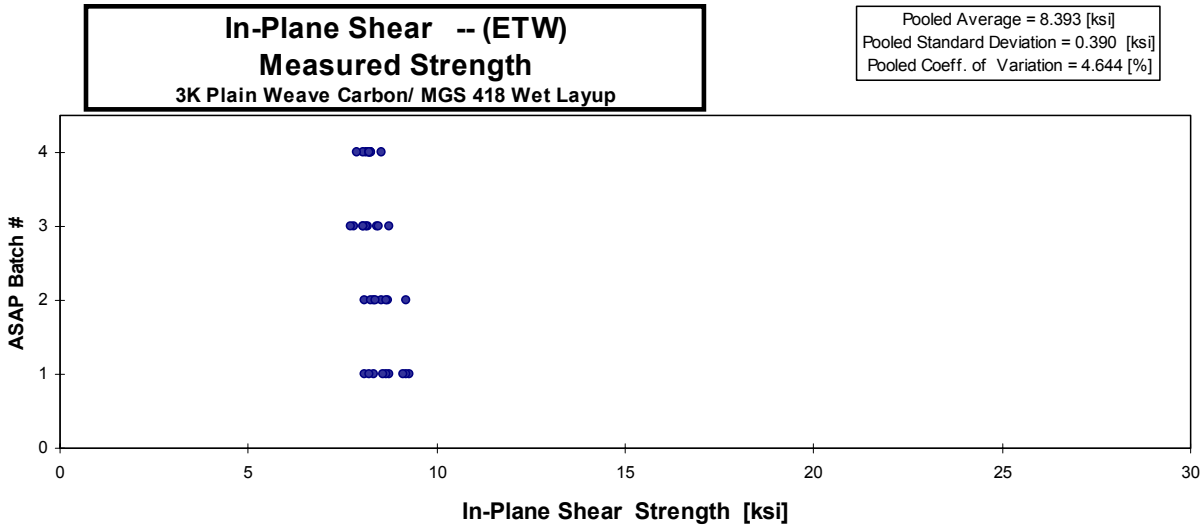


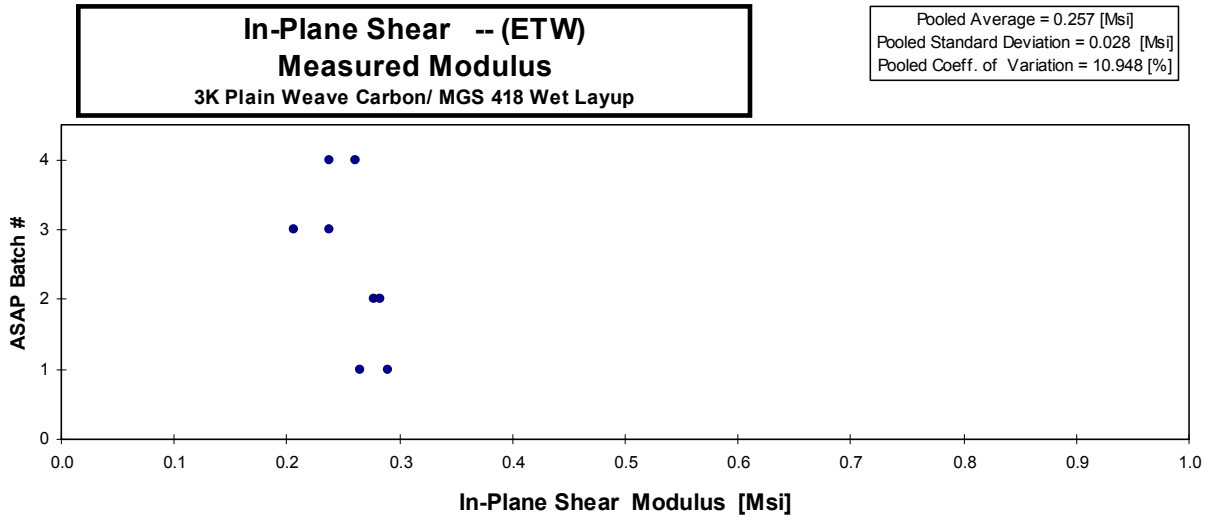


In-Plane Shear -- (ETW)
Strength & Modulus
3K Plain Weave Carbon/ MGS 418 Wet Layup

Specimen Number	Panel Batch #	ASAP Batch #	Strength [ksi]	Modulus [Msi]	Avg. Specimen Thickn. [in]	# Plies in Laminate	Avg. t_{ply} [in]
MWNA111F	A	1	8.743	0.264	0.127	12	0.01061
MWNA112F	A	1	8.074	0.290	0.127	12	0.01058
MWNA113F	A	1	9.287		0.127	12	0.01055
MWNA114F	A	1	9.185		0.123	12	0.01023
MWNA115F	A	1	8.651		0.123	12	0.01028
MWNA116F	A	1	9.135		0.127	12	0.01057
MWNA117F	A	1	8.596		0.126	12	0.01048
MWNA118F	A	1	8.340		0.128	12	0.01067
MWNA119F	A	1	8.197		0.129	12	0.01071
MWNB121F	B	2	8.561	0.278	0.138	12	0.01153
MWNB122F	B	2	8.345	0.283	0.137	12	0.01145
MWNB123F	B	2	9.203		0.135	12	0.01128
MWNB124F	B	2	8.705		0.133	12	0.01112
MWNB125F	B	2	8.094		0.139	12	0.01159
MWNB126F	B	2	8.648		0.138	12	0.01154
MWNB127F	B	2	8.241		0.134	12	0.01118
MWNB128F	B	2	8.361		0.137	12	0.01143
MWNC111F	C	3	8.741	0.206	0.124	12	0.01031
MWNC112F	C	3	8.157	0.238	0.129	12	0.01074
MWNC113F	C	3	8.434		0.134	12	0.01114
MWNC114F	C	3	8.465		0.126	12	0.01046
MWNC115F	C	3	8.150		0.122	12	0.01019
MWNC116F	C	3	8.068		0.135	12	0.01121
MWNC117F	C	3	8.036		0.133	12	0.01105
MWNC118F	C	3	7.793		0.131	12	0.01092
MWNC119F	C	3	7.735		0.133	12	0.01111
MWNE111F	E	4	8.260	0.260	0.141	12	0.01175
MWNE112F	E	4	8.137	0.238	0.138	12	0.01152
MWNE113F	E	4	8.533		0.140	12	0.01165
MWNE114F	E	4	8.072		0.141	12	0.01172
MWNE115F	E	4	8.209		0.139	12	0.01156
MWNE116F	E	4	8.225		0.141	12	0.01171
MWNE117F	E	4	7.869		0.141	12	0.01173
MWNE118F	E	4	8.272		0.140	12	0.01170
MWNE119F	E	4	8.230		0.141	12	0.01171

Average	**8.393**	**0.257**		**0.0109**
Standard Dev.	**0.390**	**0.028**		
Coeff. of Var. [%]	**4.644**	**10.948**		
Min.	**7.735**	**0.206**	**Min.**	**0.0102**
Max.	**9.287**	**0.290**	**Max.**	**0.0116**
Number of Spec.	**35**	**8**		

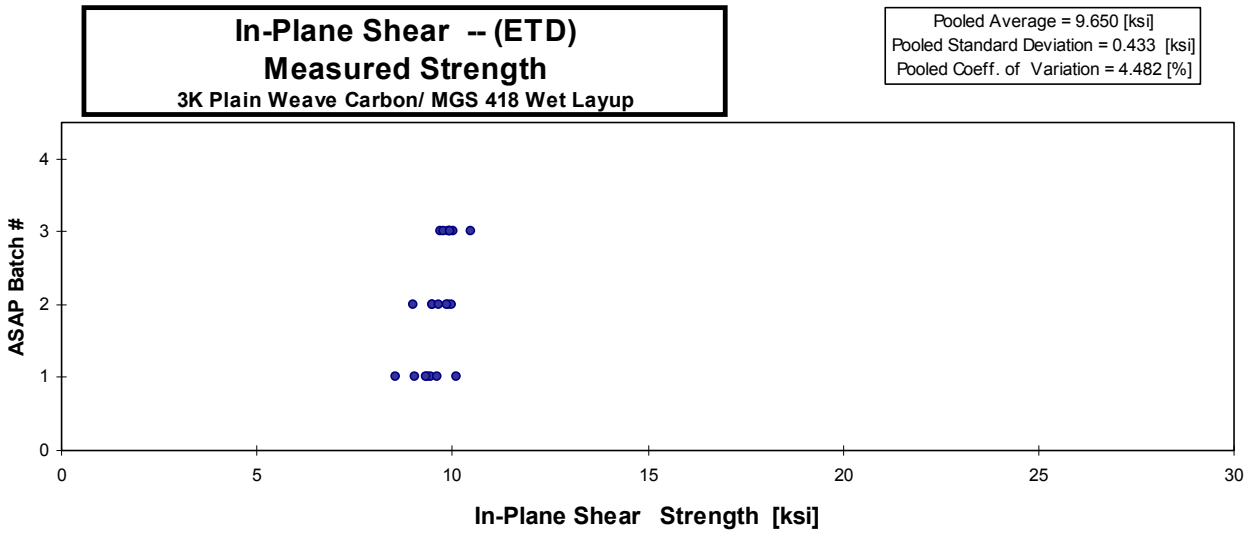


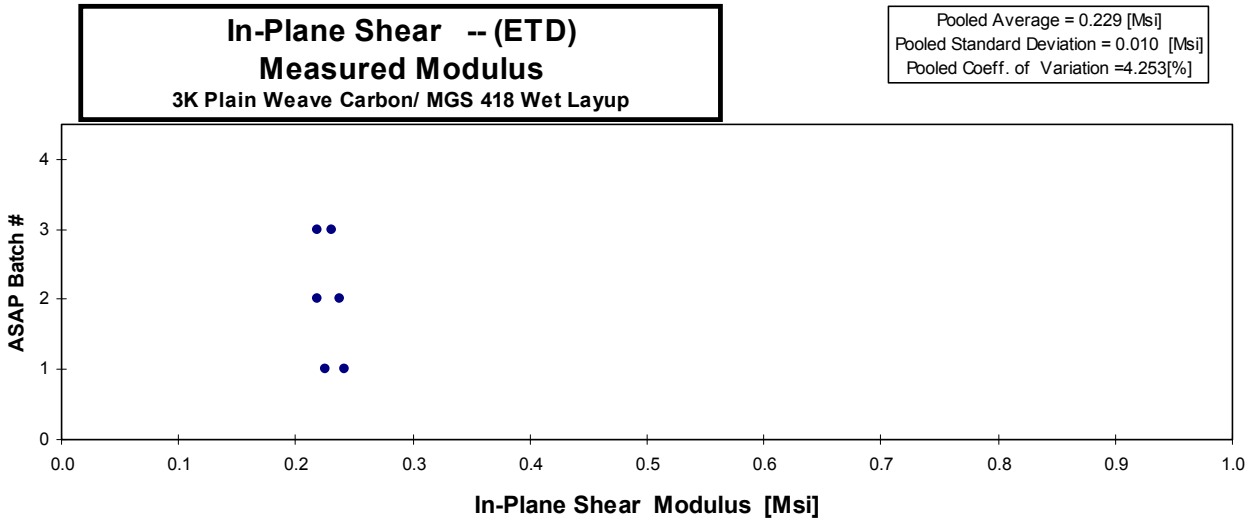


In-Plane Shear -- (ETD)
Strength & Modulus
3K Plain Weave Carbon/ MGS 418 Wet Layup

Specimen Number	Panel Batch #	ASAP Batch #	Strength [ksi]	Modulus [Msi]	Avg. Specimen Thickn. [in]	# Plies in Laminate	Avg. t_{ply} [in]
MWNA131G	A	1	9.356	0.242	0.125	12	0.01040
MWNA132G	A	1	9.063	0.225	0.129	12	0.01076
MWNA133G	A	1	10.096		0.128	12	0.01066
MWNA134G	A	1	9.445		0.128	12	0.01070
MWNA135G	A	1	9.348		0.125	12	0.01045
MWNA136G	A	1	9.604		0.129	12	0.01074
MWNA137G	A	1	8.546		0.129	12	0.01072
MWNB151G	B	2	9.508	0.238	0.132	12	0.01096
MWNB152G	B	2	9.886	0.219	0.137	12	0.01142
MWNB153G	B	2	9.481		0.137	12	0.01139
MWNB154G	B	2	9.986		0.132	12	0.01101
MWNB155G	B	2	9.854		0.135	12	0.01127
MWNB156G	B	2	9.014		0.135	12	0.01124
MWNB157G	B	2	9.648		0.131	12	0.01094
MWNC141G	C	3	10.035	0.231	0.131	12	0.01088
MWNC142G	C	3	9.715	0.218	0.125	12	0.01042
MWNC143G	C	3	10.468		0.131	12	0.01094
MWNC144G	C	3	9.891		0.131	12	0.01096
MWNC145G	C	3	9.956		0.123	12	0.01027
MWNC146G	C	3	9.793		0.121	12	0.01005
MWNC147G	C	3	9.964		0.128	12	0.01068

Average	**9.650**	**0.229**		**0.0108**
Standard Dev.	**0.433**	**0.010**		
Coeff. of Var. [%]	**4.482**	**4.253**		
Min.	**8.546**	**0.218**	**Min.**	**0.0101**
Max.	**10.468**	**0.242**	**Max.**	**0.0114**
Number of Spec.	**21**	**6**		

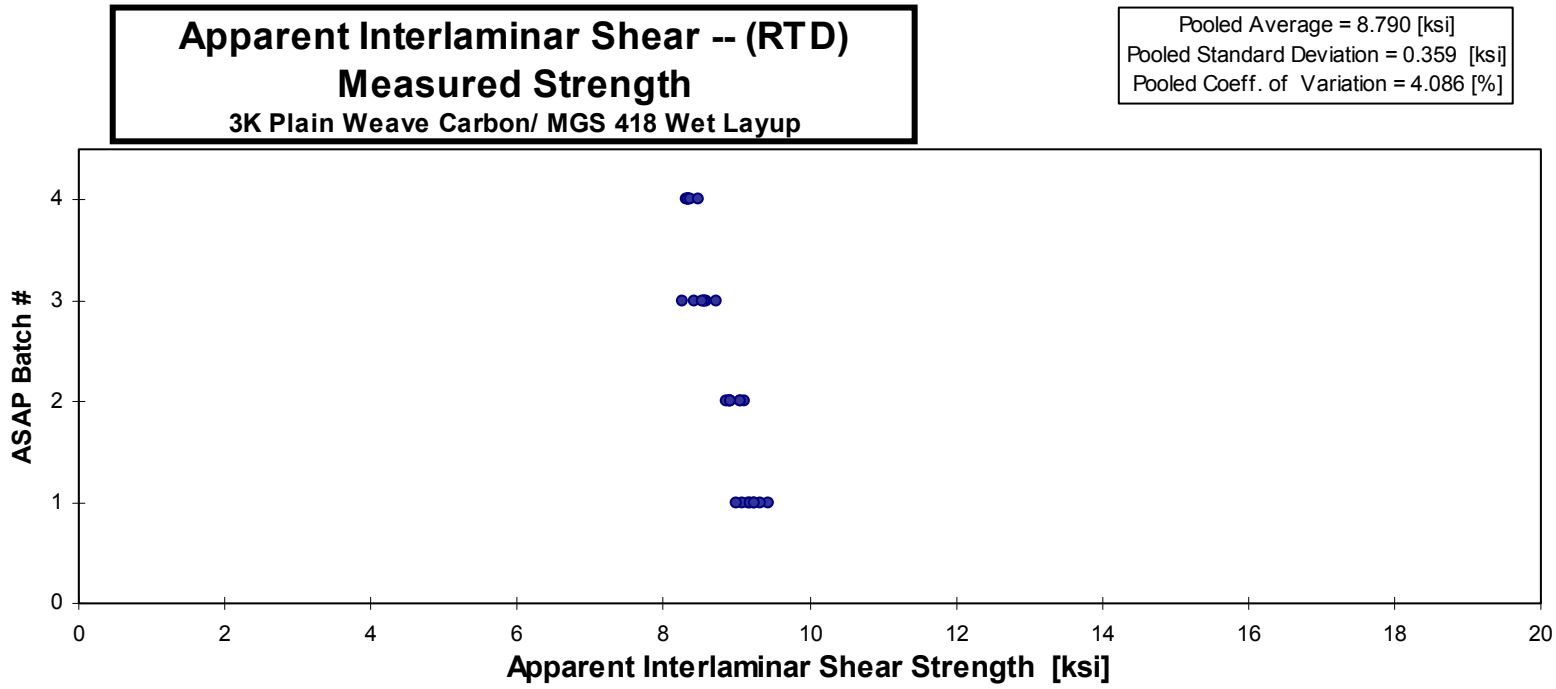




Apparent Interlaminar Shear -- (RTD)
Strength & Modulus
3K Plain Weave Carbon/ MGS 418 Wet Layup

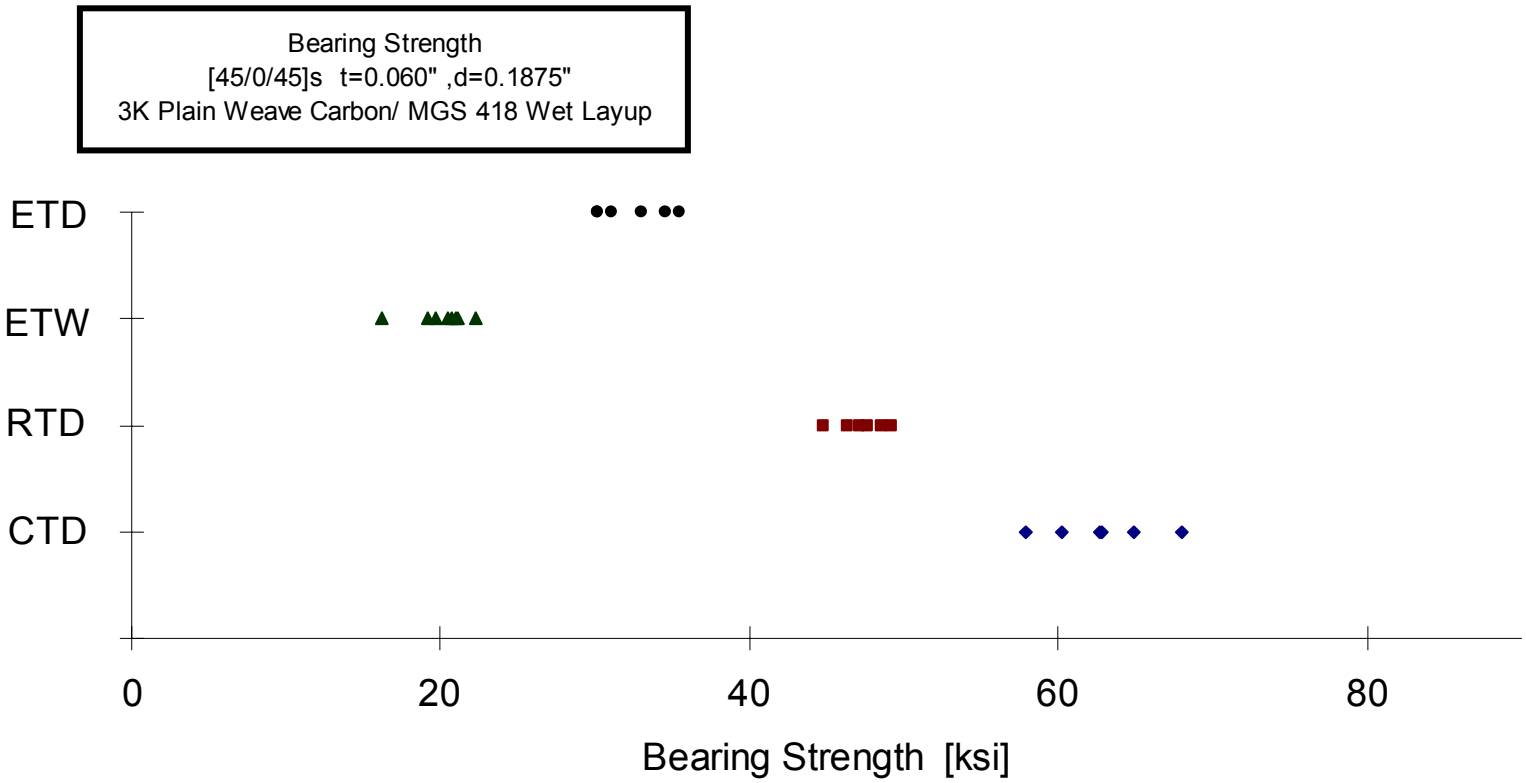
Specimen Number	Panel Batch #	ASAP Batch #	Strength [ksi]	Avg. Specimen Thickn. [in]	# Plies in Laminate	Avg. t_{ply} [in]
MWQA111A	A	1	9.254	0.122	12	0.01020
MWQA112A	A	1	9.434	0.121	12	0.01009
MWQA113A	A	1	9.164	0.122	12	0.01017
MWQA114A	A	1	9.086	0.122	12	0.01019
MWQA115A	A	1	9.319	0.122	12	0.01016
MWQA116A	A	1	9.002	0.123	12	0.01023
MWQA117A	A	1	9.203	0.123	12	0.01023
MWQA118A	A	1	9.240	0.122	12	0.01018
MWQB1X1A	B	2	9.112	0.120	12	0.00997
MWQB1X2A	B	2	8.901	0.120	12	0.01002
MWQB1X3A	B	2	9.053	0.120	12	0.00997
MWQB1X4A	B	2	8.916	0.120	12	0.00997
MWQB1X5A	B	2	9.053	0.119	12	0.00993
MWQB1X6A	B	2	8.930	0.120	12	0.01003
MWQB1X7A	B	2	8.871	0.120	12	0.01002
MWQB1X8A	B	2	8.914	0.120	12	0.01001
MWQC111A	C	3	8.741	0.129	12	0.01074
MWQC112A	C	3	8.417	0.129	12	0.01076
MWQC113A	C	3	8.593	0.129	12	0.01071
MWQC114A	C	3	8.553	0.129	12	0.01073
MWQC115A	C	3	8.552	0.129	12	0.01078
MWQC116A	C	3	8.530	0.129	12	0.01078
MWQC117A	C	3	8.271	0.130	12	0.01081
MWQE111A	E	4	8.328	0.139	12	0.01158
MWQE112A	E	4	8.337	0.124	12	0.01031
MWQE113A	E	4	8.350	0.131	12	0.01091
MWQE115A	E	4	8.355	0.138	12	0.01153
MWQE116A	E	4	8.356	0.128	12	0.01070
MWQE117A	E	4	8.380	0.126	12	0.01051
MWQE118A	E	4	8.494	0.138	12	0.01152

Average	**8.790**		**0.0105**
Standard Dev.	**0.359**		
Coeff. of Var. [%]	**4.086**		
Min.	**8.271**	**Min.**	**0.0099**
Max.	**9.434**	**Max.**	**0.0116**
Number of Spec.	**30**		



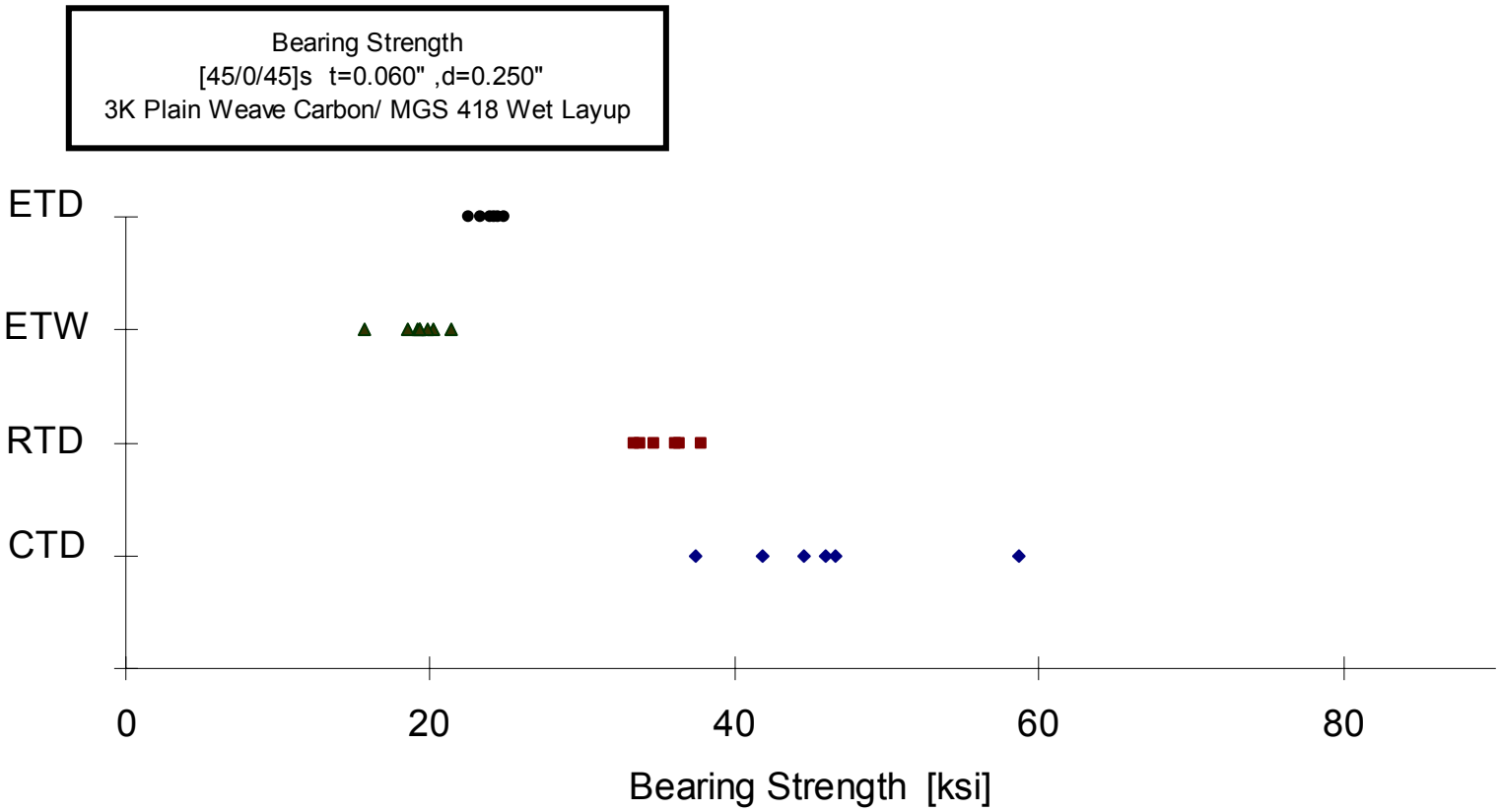
Bearing Strength
$[45/0/45]_s$ t=0.060" ,d=0.1875"
3K Plain Weave Carbon/ MGS 418 Wet Layup

Condition	Specimen Number	Panel Batch #	Strength [ksi]	Avg. Specimen Thickn. [in]	# Plies in laminate	Avg. tply [in]		
	MW1B211B	B	57.918	0.092	6	0.01527	62.745	Average
	MW1B212B	B	68.004	0.091	6	0.01518	3.504	Standard Dev.
CTD	MW1B213B	B	60.273	0.092	6	0.01527	5.585	Coeff. of Var. [%]
	MW1B214B	B	62.619	0.092	6	0.01527	57.918	Min.
	MW1B215B	B	64.820	0.091	6	0.01519	68.004	Max.
	MW1B216B	B	62.833	0.091	6	0.01520	6	Number of Spec.
	MW1B231A	B	47.590	0.092	6	0.01528	47.271	Average
	MW1B232A	B	48.522	0.091	6	0.01522	1.592	Standard Dev.
RTD	MW1B233A	B	44.770	0.092	6	0.01530	3.367	Coeff. of Var. [%]
	MW1B234A	B	49.247	0.092	6	0.01535	44.770	Min.
	MW1B235A	B	46.364	0.091	6	0.01515	49.247	Max.
	MW1B236A	B	47.136	0.091	6	0.01523	6	Number of Spec.
	MW1B221F	B	20.482	0.076	6	0.01262		
	MW1B223F	B	22.282	0.072	6	0.01199		
	MW1B224F	B	16.208	0.070	6	0.01160	20.075	Average
ETW	MW1B225F	B	21.075	0.077	6	0.01280	1.815	Standard Dev.
	MW1B226F	B	19.176	0.072	6	0.01199	9.040	Coeff. of Var. [%]
	MW1B227F	B	19.734	0.071	6	0.01186	16.208	Min.
	MW1B228F	B	20.717	0.070	6	0.01173	22.282	Max.
	MW1B229F	B	20.929	0.077	6	0.01279	8	Number of Spec.
	MW1B111G	B	31.049	0.091	6	0.01522	32.432	Average
	MW1B112G	B	34.595	0.089	6	0.01491	2.313	Standard Dev.
ETD	MW1B113G	B	35.527	0.090	6	0.01500	7.132	Coeff. of Var. [%]
	MW1B114G	B	30.188	0.091	6	0.01516	30.164	Min.
	MW1B115G	B	30.164	0.091	6	0.01521	35.527	Max.
	MW1B117G	B	33.069	0.091	6	0.01512	6	Number of Spec.



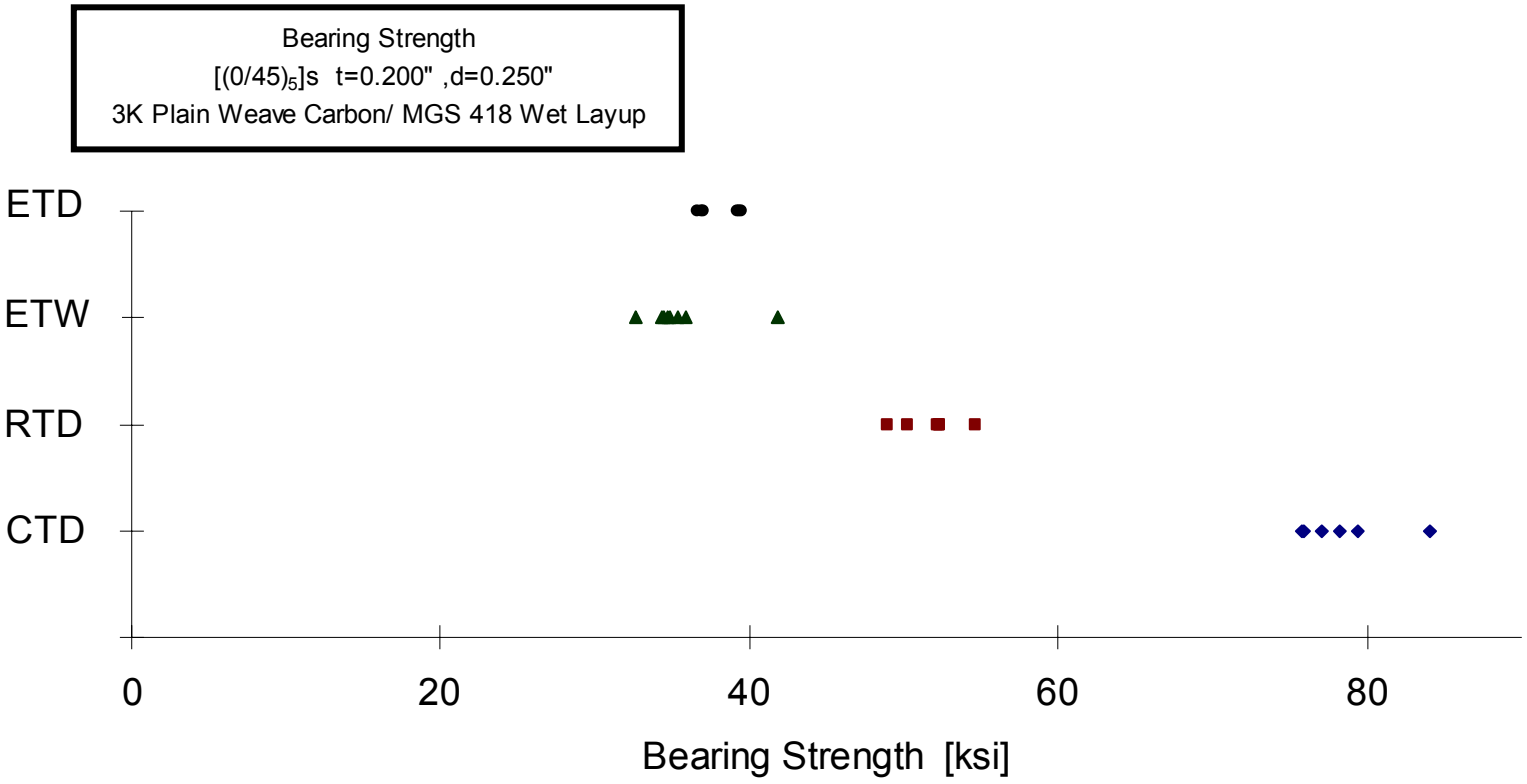
Bearing Strength
$[45/0/45]_s$ t=0.060" ,d=0.250"
3K Plain Weave Carbon/ MGS 418 Wet Layup

Condition	Specimen Number	Panel Batch #	Strength [ksi]	Avg. Specimen Thickn. [in]	# Plies in laminate	Avg. t_{ply} [in]		
CTD	MW2B221B	B	58.684	0.058	6	0.00974		
	MW2B222B	B	46.594	0.059	6	0.00979	45.176	Average
	MW2B223B	B	45.977	0.059	6	0.00977	6.745	Standard Dev.
	MW2B224B	B	44.556	0.059	6	0.00977	14.931	Coeff. of Var. [%]
	MW2B225B	B	41.841	0.058	6	0.00968	37.410	Min.
	MW2B226B	B	37.410	0.058	6	0.00961	58.684	Max.
	MW2B227B	B	41.167	0.058	6	0.00963	7	Number of Spec.
RTD	MW2B111A	B	37.833	0.058	6	0.00972	35.396	Average
	MW2B112A	B	36.179	0.058	6	0.00966	1.681	Standard Dev.
	MW2B113A	B	33.428	0.059	6	0.00979	4.750	Coeff. of Var. [%]
	MW2B115A	B	34.724	0.058	6	0.00974	33.428	Min.
	MW2B116A	B	36.347	0.059	6	0.00980	37.833	Max.
	MW2B117A	B	33.862	0.059	6	0.00979	6	Number of Spec.
ETW	MW2B211F	B	19.339	0.060	6	0.00992		
	MW2B212F	B	20.211	0.059	6	0.00976		
	MW2B213F	B	19.824	0.059	6	0.00975	19.172	Average
	MW2B214F	B	21.338	0.059	6	0.00983	1.655	Standard Dev.
	MW2B215F	B	19.190	0.058	6	0.00970	8.633	Coeff. of Var. [%]
	MW2B216F	B	18.489	0.058	6	0.00967	15.643	Min.
	MW2B217F	B	19.343	0.059	6	0.00978	21.338	Max.
	MW2B218F	B	15.643	0.059	6	0.00984	8	Number of Spec.
ETD	MW2B232G	B	24.278	0.059	6	0.00979	23.909	Average
	MW2B233G	B	22.470	0.058	6	0.00972	0.874	Standard Dev.
	MW2B234G	B	24.523	0.058	6	0.00975	3.657	Coeff. of Var. [%]
	MW2B235G	B	23.319	0.058	6	0.00970	22.470	Min.
	MW2B236G	B	24.019	0.059	6	0.00980	24.846	Max.
	MW2B237G	B	24.846	0.058	6	0.00968	6	Number of Spec.



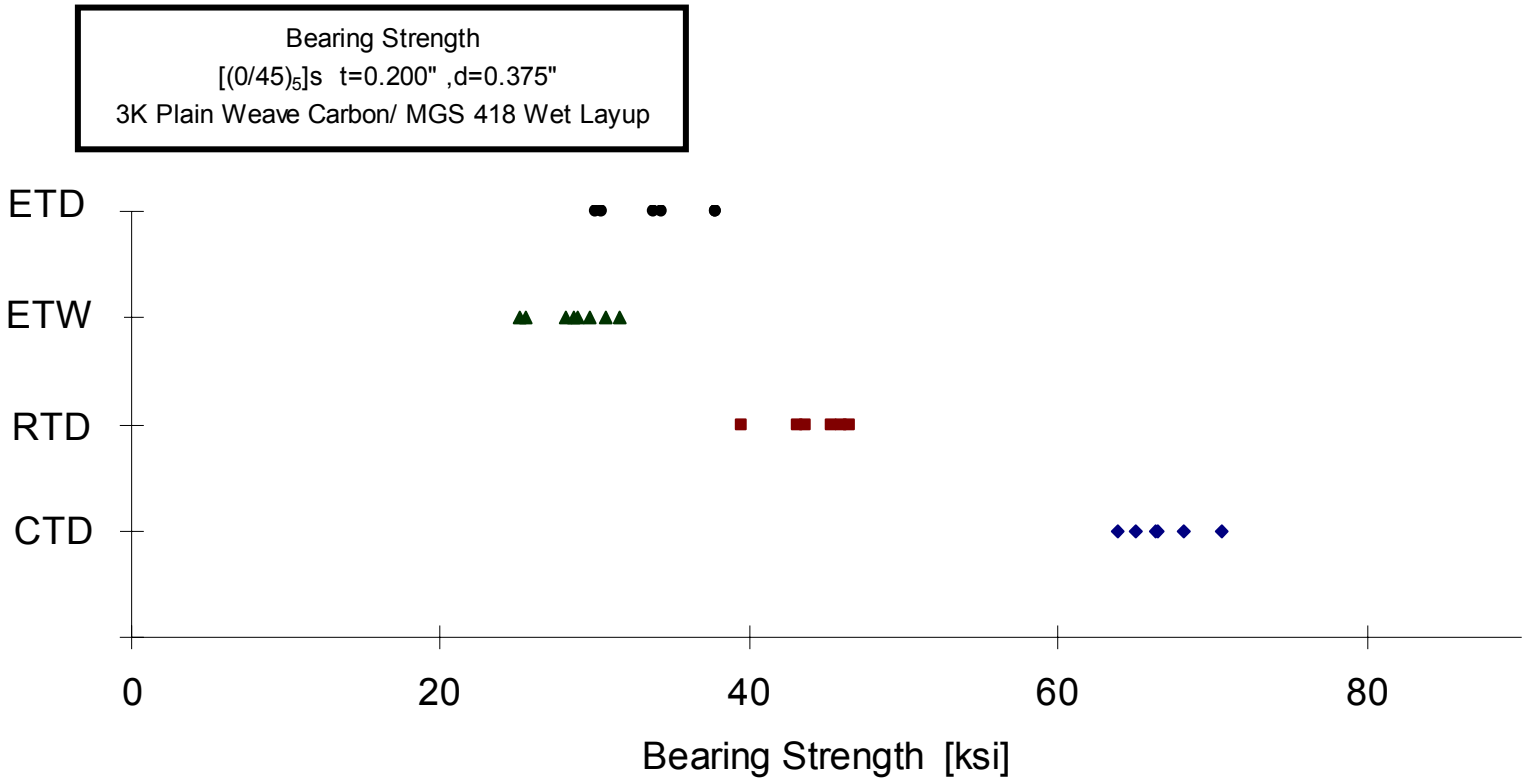
Bearing Strength
$[(0/45)_5]_s$ t=0.200" ,d=0.250"
3K Plain Weave Carbon/ MGS 418 Wet Layup

Condition	Specimen Number	Panel Batch #	Strength [ksi]	Avg. Specimen Thickn. [in]	# Plies in laminate	Avg. t_{ply} [in]		
CTD	MW3B311B	B	84.000	0.169	20	0.00845	78.382	Average
	MW3B312B	B	75.696	0.167	20	0.00836	3.076	Standard Dev.
	MW3B313B	B	77.114	0.170	20	0.00850	3.925	Coeff. of Var. [%]
	MW3B314B	B	79.364	0.168	20	0.00838	75.696	Min.
	MW3B315B	B	78.169	0.167	20	0.00836	84.000	Max.
	MW3B316B	B	75.949	0.169	20	0.00843	6	Number of Spec.
RTD	MW3B331A	B	54.613	0.174	20	0.00872	51.776	Average
	MW3B332A	B	48.893	0.184	20	0.00920	1.965	Standard Dev.
	MW3B333A	B	52.161	0.173	20	0.00866	3.796	Coeff. of Var. [%]
	MW3B334A	B	52.345	0.172	20	0.00861	48.893	Min.
	MW3B335A	B	50.304	0.173	20	0.00863	54.613	Max.
	MW3B336A	B	52.338	0.172	20	0.00861	6	Number of Spec.
ETW	MW3B111F	B	41.850	0.157	20	0.00786		
	MW3B112F	B	34.706	0.164	20	0.00819		
	MW3B113F	B	35.345	0.159	20	0.00796	35.516	Average
	MW3B114F	B	34.367	0.163	20	0.00814	2.736	Standard Dev.
	MW3B115F	B	34.478	0.157	20	0.00785	7.705	Coeff. of Var. [%]
	MW3B116F	B	32.573	0.162	20	0.00810	32.573	Min.
	MW3B117F	B	35.917	0.165	20	0.00824	41.850	Max.
	MW3B118F	B	34.893	0.155	20	0.00775	8	Number of Spec.
ETD	MW3B321G	B	39.537	0.170	20	0.00852	38.135	Average
	MW3B322G	B	39.249	0.169	20	0.00847	1.397	Standard Dev.
	MW3B323G	B	36.919	0.171	20	0.00853	3.665	Coeff. of Var. [%]
	MW3B324G	B	37.066	0.185	20	0.00924	36.622	Min.
	MW3B325G	B	36.622	0.184	20	0.00919	39.537	Max.
	MW3B326G	B	39.418	0.185	20	0.00924	6	Number of Spec.



Bearing Strength
$[(0/45)_5]_S$ t=0.200" ,d=0.375"
3K Plain Weave Carbon/ MGS 418 Wet Layup

Condition	Specimen Number	Panel Batch #	Strength [ksi]	Avg. Specimen Thickn. [in]	# Plies in laminate	Avg. tply [in]		
CTD	MW4B211B	B	66.392	0.157	20	0.00785	66.719	Average
	MW4B212B	B	66.313	0.161	20	0.00803	2.397	Standard Dev.
	MW4B213B	B	65.000	0.157	20	0.00784	3.593	Coeff. of Var. [%]
	MW4B214B	B	68.144	0.157	20	0.00785	63.843	Min.
	MW4B215B	B	70.619	0.158	20	0.00789	70.619	Max.
	MW4B216B	B	63.843	0.160	20	0.00799	6	Number of Spec.
RTD	MW4B131A	B	46.440	0.193	20	0.00965	43.983	Average
	MW4B132A	B	45.963	0.192	20	0.00961	2.570	Standard Dev.
	MW4B133A	B	43.132	0.192	20	0.00960	5.842	Coeff. of Var. [%]
	MW4B134A	B	45.285	0.192	20	0.00962	39.454	Min.
	MW4B135A	B	43.626	0.192	20	0.00961	46.440	Max.
	MW4B136A	B	39.454	0.190	20	0.00948	6	Number of Spec.
ETW	MW4B111F	B	31.611	0.195	20	0.00977		
	MW4B112F	B	28.905	0.195	20	0.00973		
	MW4B113F	B	29.598	0.193	20	0.00963	28.509	Average
	MW4B114F	B	28.127	0.196	20	0.00979	2.275	Standard Dev.
	MW4B115F	B	25.077	0.194	20	0.00971	7.981	Coeff. of Var. [%]
	MW4B116F	B	25.545	0.195	20	0.00976	25.077	Min.
	MW4B122F	B	28.562	0.194	20	0.00972	31.611	Max.
	MW4B123F	B	30.646	0.192	20	0.00961	8	Number of Spec.
ETD	MW4B124G	B	33.821	0.194	20	0.00970	34.026	Average
	MW4B125G	B	34.310	0.194	20	0.00969	3.374	Standard Dev.
	MW4B126G	B	30.399	0.195	20	0.00974	9.916	Coeff. of Var. [%]
	MW4B217G	B	37.765	0.160	20	0.00801	30.080	Min.
	MW4B218G	B	30.080	0.161	20	0.00805	37.779	Max.
	MW4B219G	B	37.779	0.160	20	0.00801	6	Number of Spec.



3.2.2 Fluid Sensitivity Raw Data Spreadsheets and Scatter Charts

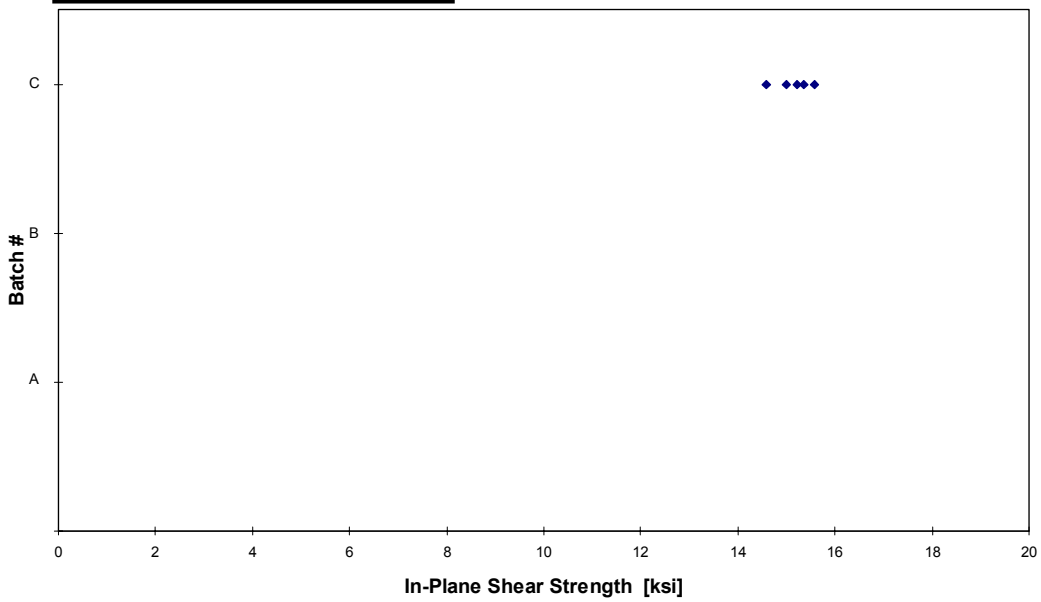
In-Plane Shear -- (MEK - RTD)
Strength & Modulus
3K Plain Weave Carbon/ MGS 418 Wet Layup

Specimen Number	Batch Number	Strength [ksi]	Avg. Specimen Thickn. [in]	# Plies in Laminate	Avg. t_{ply} [in]
MWNC11AT	C	15.011	0.134	12	0.01115
MWNC138T	C	14.587	0.138	12	0.01151
MWNC148T	C	15.211	0.131	12	0.01094
MWNC149T	C	15.364	0.130	12	0.01081
MWNC14AT	C	15.592	0.127	12	0.01056

Average	**15.153**		**0.0110**
Standard Dev.	**0.381**		
Coeff. of Var. [%]	**2.514**		
Min.	**14.587**	**Min.**	**0.0106**
Max.	**15.592**	**Max.**	**0.0115**
Number of Spec.	**5**		

In-Plane Shear -- (MEK - RTD)
Measured Strength
3K Plain Weave Carbon/ MGS 418 Wet Layup

Pooled Average = 15.153 [ksi]
Pooled Standard Deviation = 0.381 [ksi]
Pooled Coeff. of Variation = 2.514 [%]



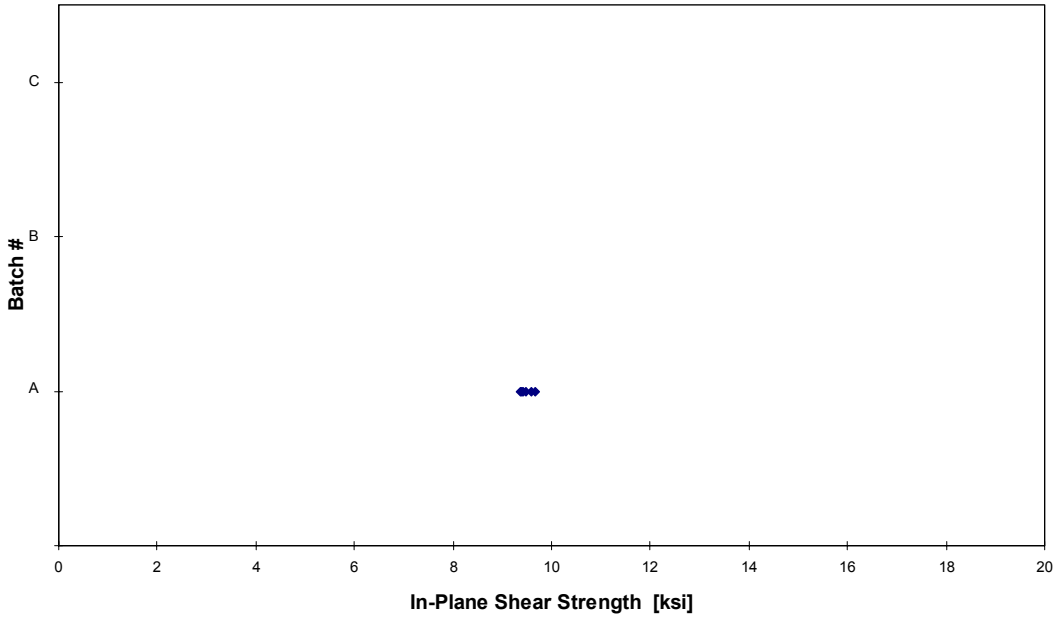
In-Plane Shear -- (JP-4 JET FUEL - ETD)
Strength & Modulus
3K Plain Weave Carbon/ MGS 418 Wet Layup

Specimen Number	Batch Number	Strength [ksi]	Avg. Specimen Thickn. [in]	# Plies in Laminate	Avg. t_{ply} [in]
MWNA128R	A	9.413	0.128	12	0.01065
MWNA129R	A	9.673	0.125	12	0.01041
MWNA12AR	A	9.469	0.127	12	0.01060
MWNA138R	A	9.366	0.128	12	0.01071
MWNA139R	A	9.578	0.127	12	0.01057
MWNA13AR	A	9.384	0.125	12	0.01040

Average	**9.481**		**0.0106**
Standard Dev.	**0.121**		
Coeff. of Var. [%]	**1.281**		
Min.	**9.366**	**Min.**	**0.0104**
Max.	**9.673**	**Max.**	**0.0107**
Number of Spec.	**6**		

In-Plane Shear -- (JP-4 JET FUEL - ETD)
Measured Strength
3K Plain Weave Carbon/ MGS 418 Wet Layup

Pooled Average = 9.481 [ksi]
Pooled Standard Deviation = 0.121 [ksi]
Pooled Coeff. of Variation = 1.281 [%]



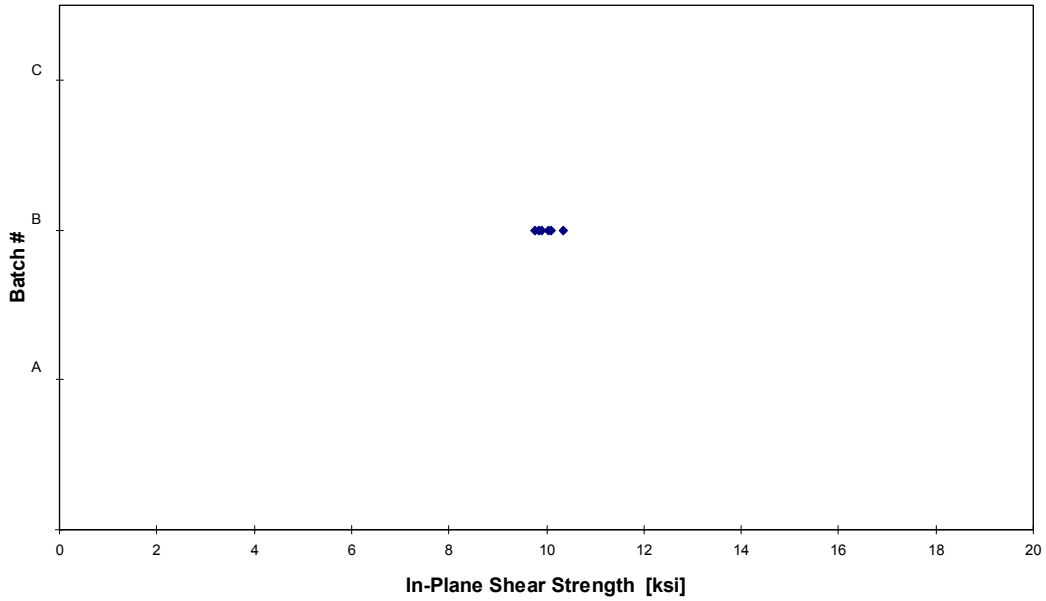
In-Plane Shear -- (Hydraulic Fluid - ETD)
Strength & Modulus
3K Plain Weave Carbon/ MGS 418 Wet Layup

Specimen Number	Batch Number	Strength [ksi]	Avg. Specimen Thickn. [in]	# Plies in Laminate	Avg. t_{ply} [in]
MWNB138V	B	9.904	0.137	12	0.01145
MWNB139V	B	9.766	0.139	12	0.01157
MWNB13AV	B	9.851	0.135	12	0.01126
MWNB158V	B	10.356	0.134	12	0.01114
MWNB159V	B	10.107	0.132	12	0.01099
MWNB15AV	B	10.053	0.131	12	0.01089

Average	**10.006**			**0.0112**
Standard Dev.	**0.213**			
Coeff. of Var. [%]	**2.128**			
Min.	**9.766**		**Min.**	**0.0109**
Max.	**10.356**		**Max.**	**0.0116**
Number of Spec.	**6**			

In-Plane Shear -- (Hydraulic Fluid - ETD)
Measured Strength
3K Plain Weave Carbon/ MGS 418 Wet Layup

Pooled Average = 10.006 [ksi]
Pooled Standard Deviation = 0.213 [ksi]
Pooled Coeff. of Variation = 2.128 [%]



Fluid Sensitivity Comparison:

Average In-Plane Shear Strength with Fluid (ksi)	**Same Environment In-Plane Shear Strength without Fluid (ksi)**	**Worst Case Environment In-Plane Shear Strength (ksi)**
MEK (RTD)	(RTD)	(ETW)
15.15	15.37	8.39

The RTD average in-plane shear strength was reduced by 1% after exposure to MEK. However it remained 81% higher than water exposure in ETW conditions.

Average In-Plane Shear Strength with Fluid (ksi)	**Same Environment In-Plane Shear Strength without Fluid (ksi)**	**Worst Case Environment In-Plane Shear Strength (ksi)**
JP-4 JET FUEL (ETD)	(ETD)	(ETW)
9.48	9.65	8.39

The ETD average in-plane shear strength was reduced by 2% after exposure to JP-4 Jet Fuel. However it remained 13% higher than water exposure in ETW conditions.

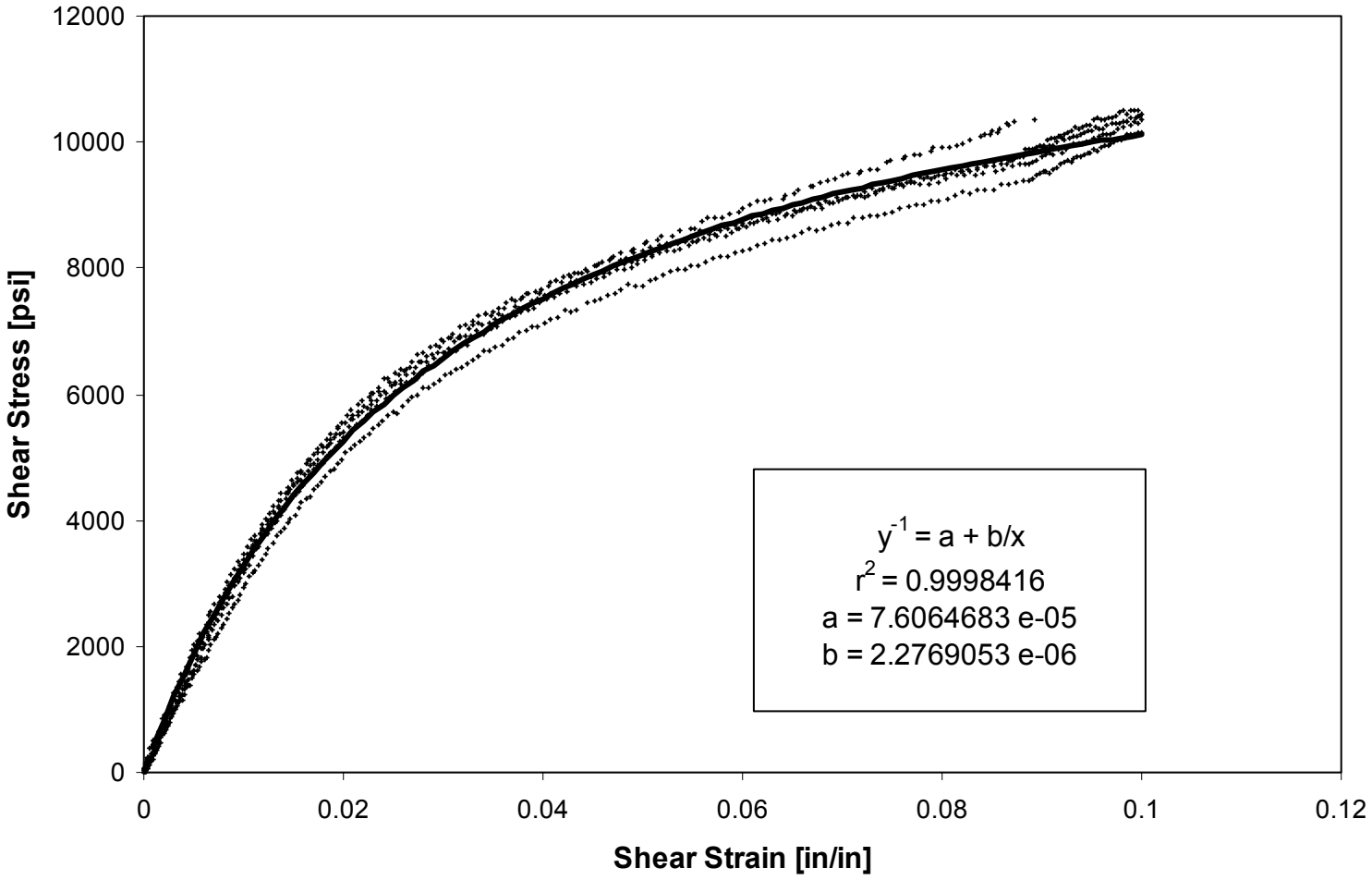
Average In-Plane Shear Strength with Fluid (ksi)	**Same Environment In-Plane Shear Strength without Fluid (ksi)**	**Worst Case Environment In-Plane Shear Strength (ksi)**
HYDRAULIC FLUID (ETD)	(ETD)	(ETW)
10.01	9.65	8.39

The ETD average in-plane shear strength was not reduced after exposure to Hydraulic Fluid.

3.2.3 Representative Shear Stress-Strain Curve

The following shear stress-strain curve is representative of the 3K PW Carbon / MGS 418 Wet Lay-up system. The tension and compression stress-strain curves are not presented in graphical form. If strain design allowables from these tests are required, simple one-dimensional linear stress-strain relationships may be used to obtain corresponding strain design values. This process should approximate tensile and compressive strain behavior relatively well but may produce extremely conservative strain values in shear due to the nonlinear behavior. A more realistic approach for shear strain design allowables is to use a maximum strain value of 5% (reference MIL-HDBK-17-1E, section 5.7.6). If a nonlinear analysis of the material's shear behavior is required, the curve-fit of the shear stress-strain curve may be used. The representative shear stress-strain curve was obtained by taking the average of all the sample shear curves and determining the best-fit line through the data. The actual data points also presented on the chart to demonstrate material variability.

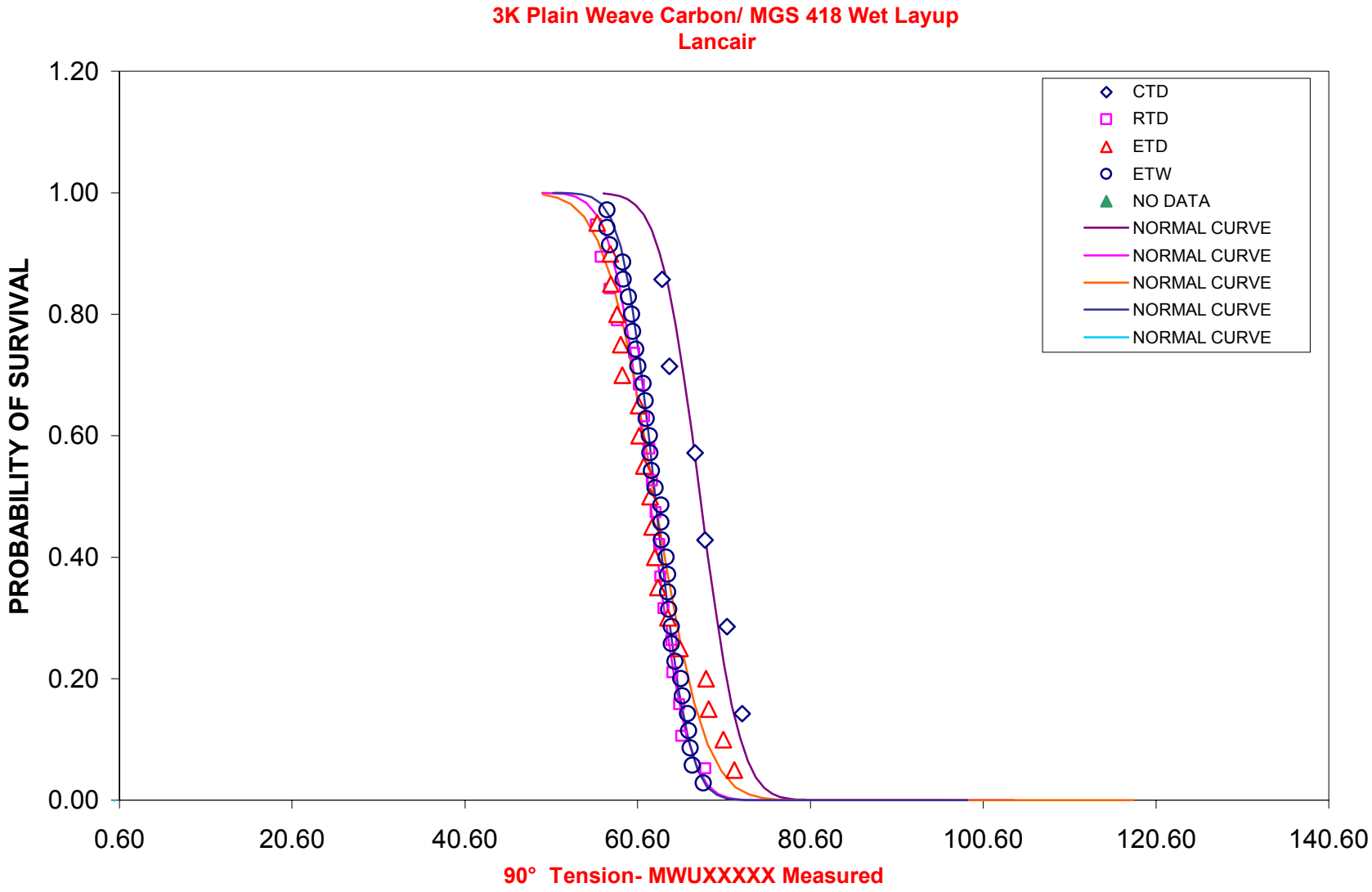
Shear Stress vs. Shear Strain, RTD



3.3 Statistical Results

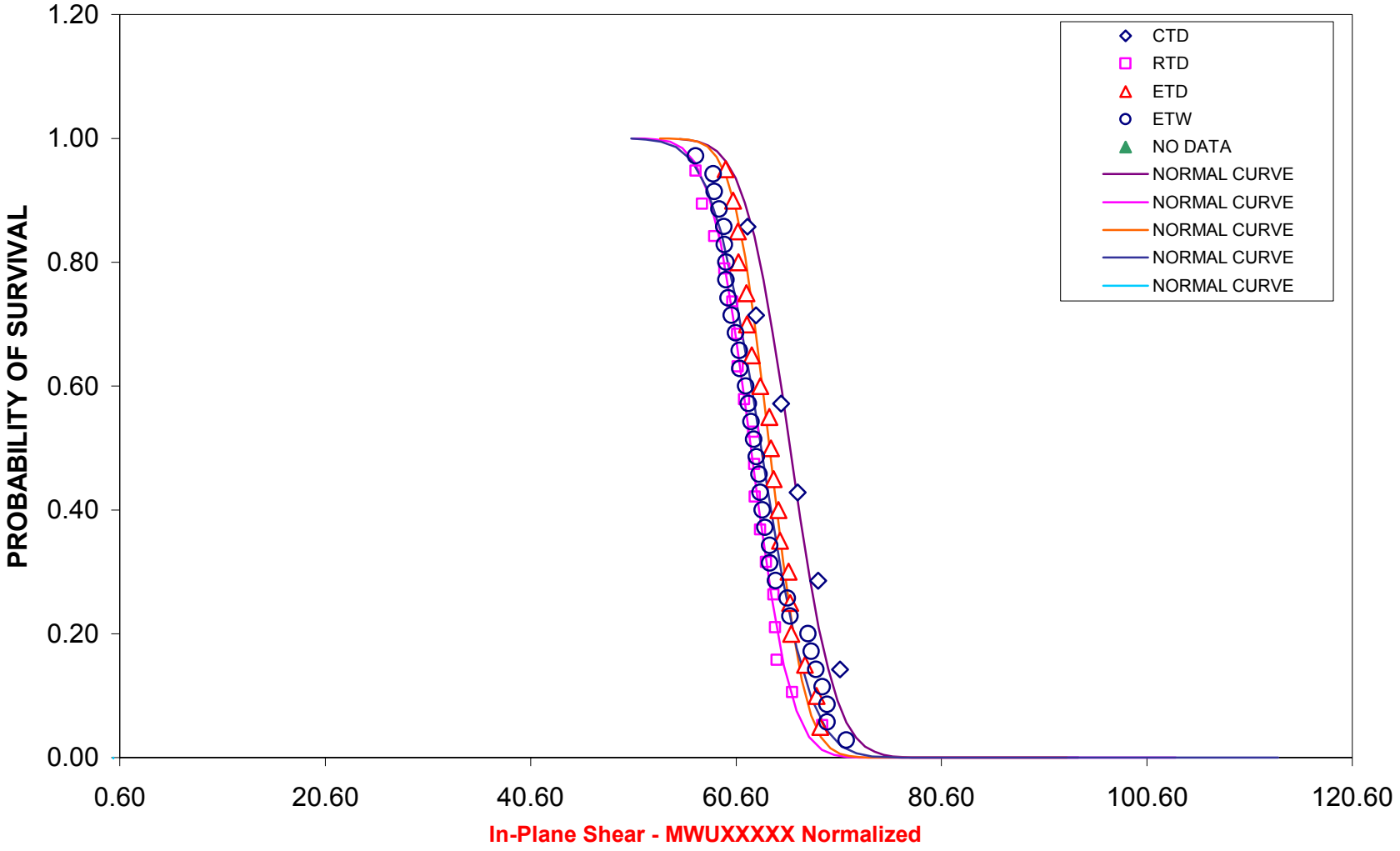
3.3.1 Plot by Condition

DISTRIBUTION OF GROUPED DATA FOR DIFFERENT TEST CONDITIONS



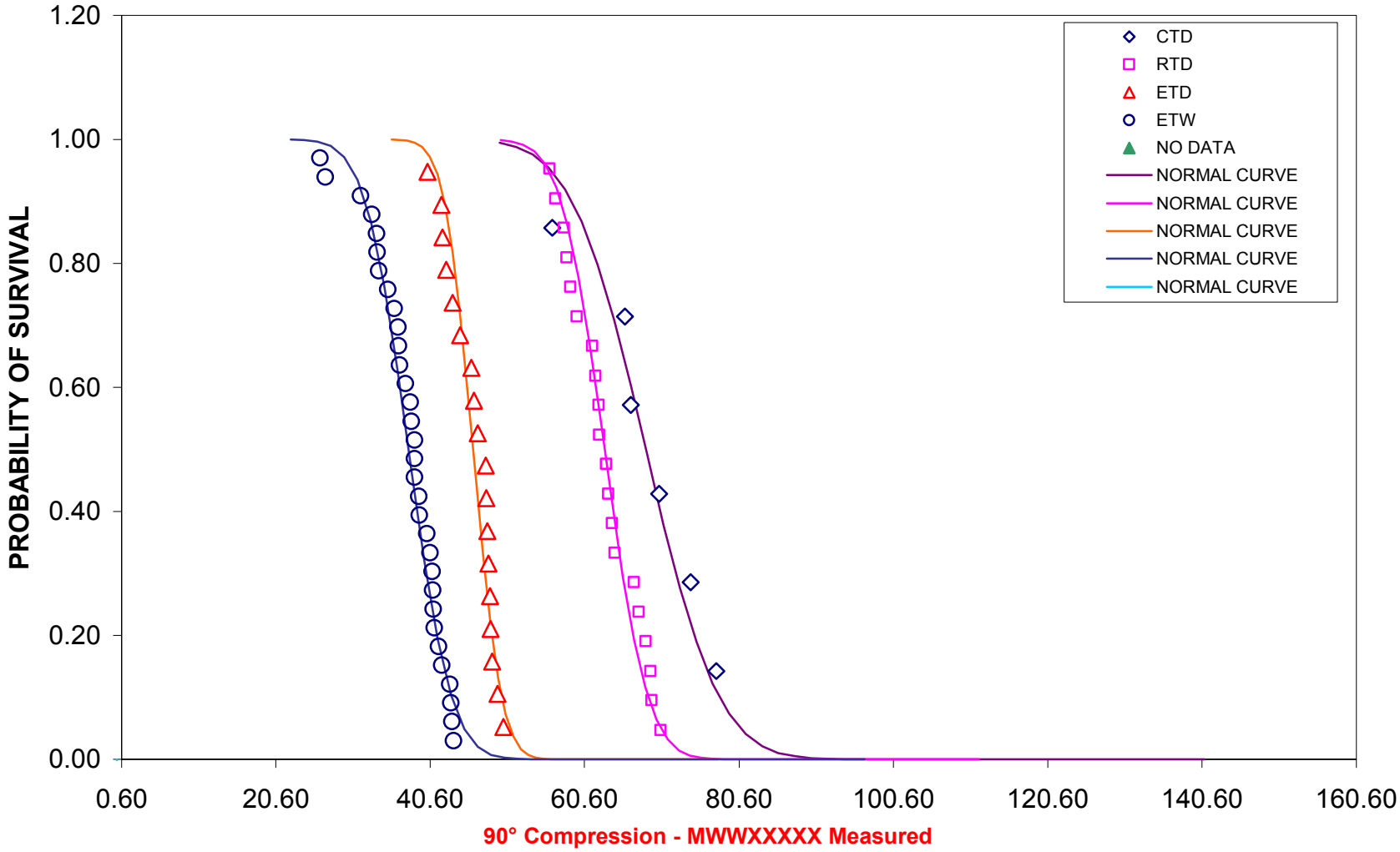
DISTRIBUTION OF GROUPED DATA FOR DIFFERENT TEST CONDITIONS

3K Plain Weave Carbon/ MGS 418 Wet Layup
Lancair

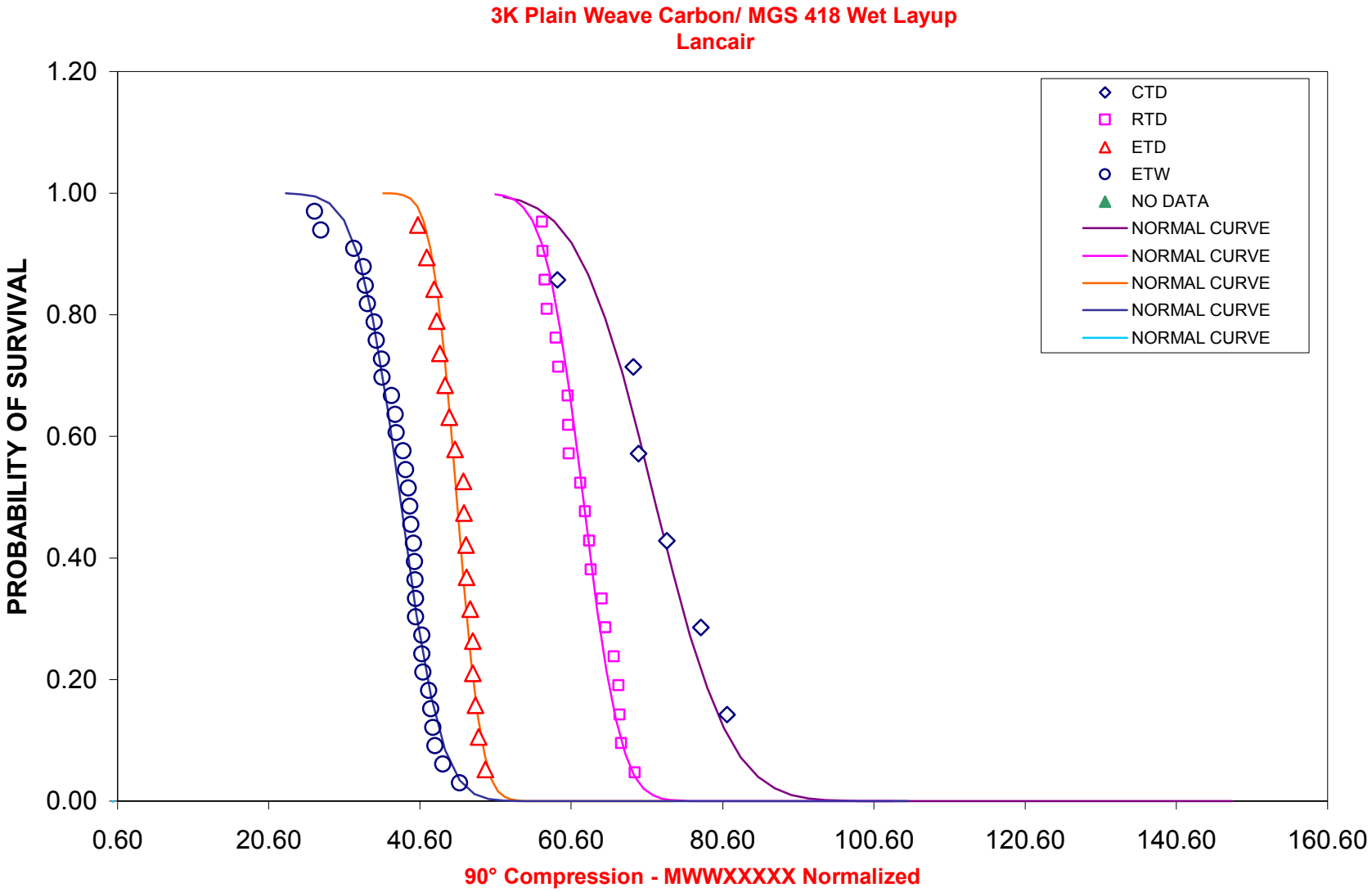


DISTRIBUTION OF GROUPED DATA FOR DIFFERENT TEST CONDITIONS

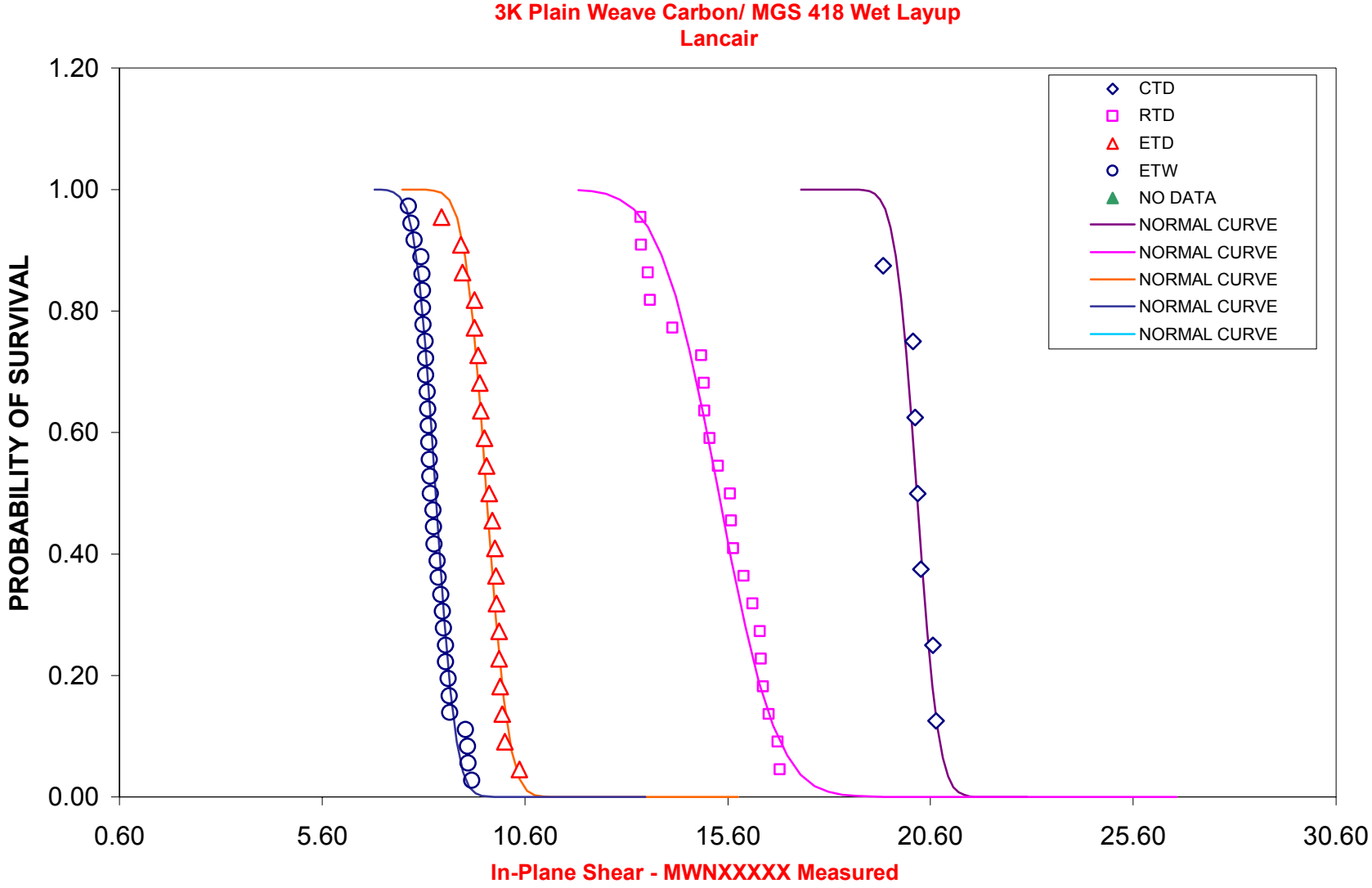
3K Plain Weave Carbon/ MGS 418 Wet Layup
Lancair



DISTRIBUTION OF GROUPED DATA FOR DIFFERENT TEST CONDITIONS

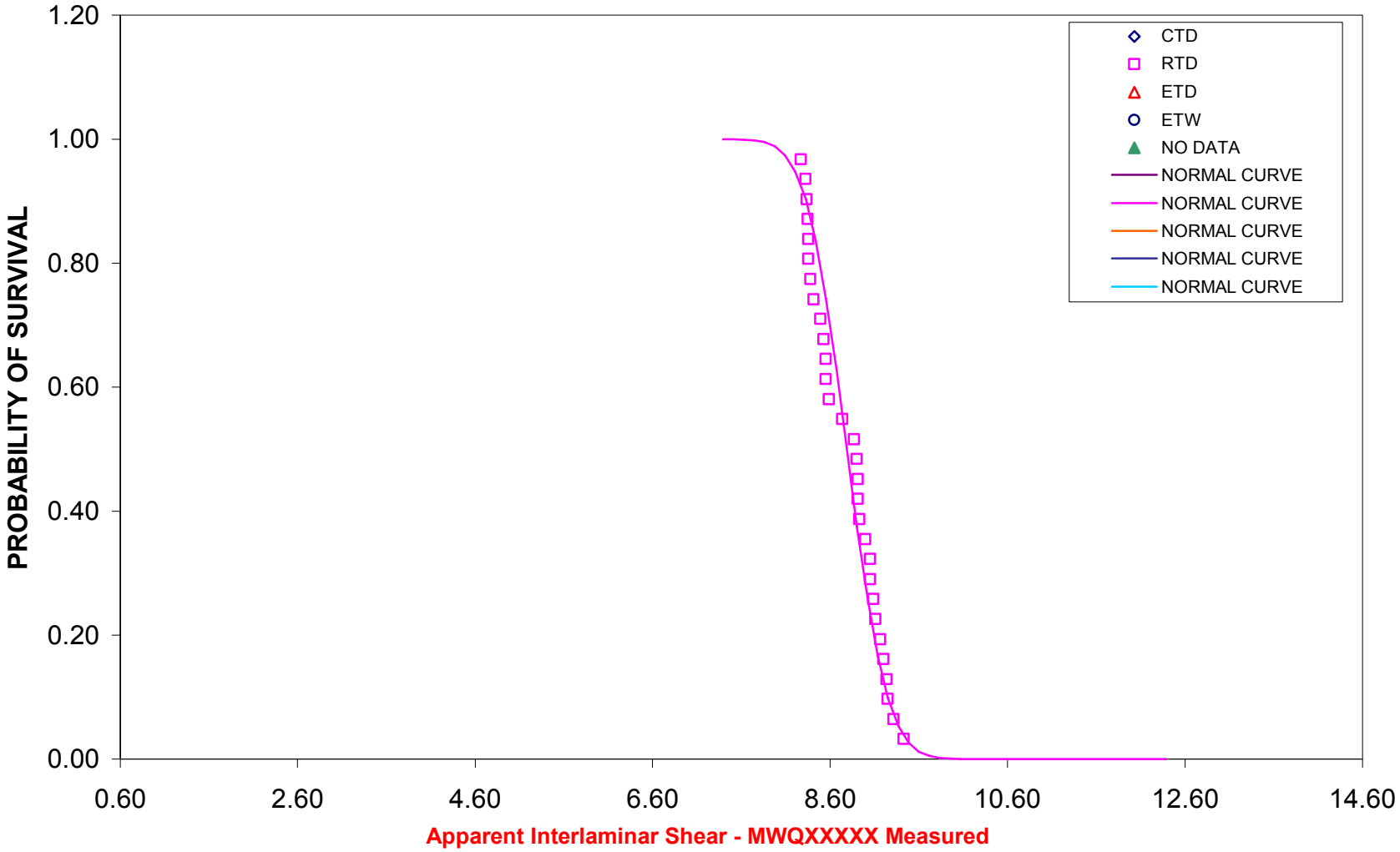


DISTRIBUTION OF GROUPED DATA FOR DIFFERENT TEST CONDITIONS



DISTRIBUTION OF GROUPED DATA FOR DIFFERENT TEST CONDITIONS

3K Plain Weave Carbon/ MGS 418 Wet Layup
Lancair



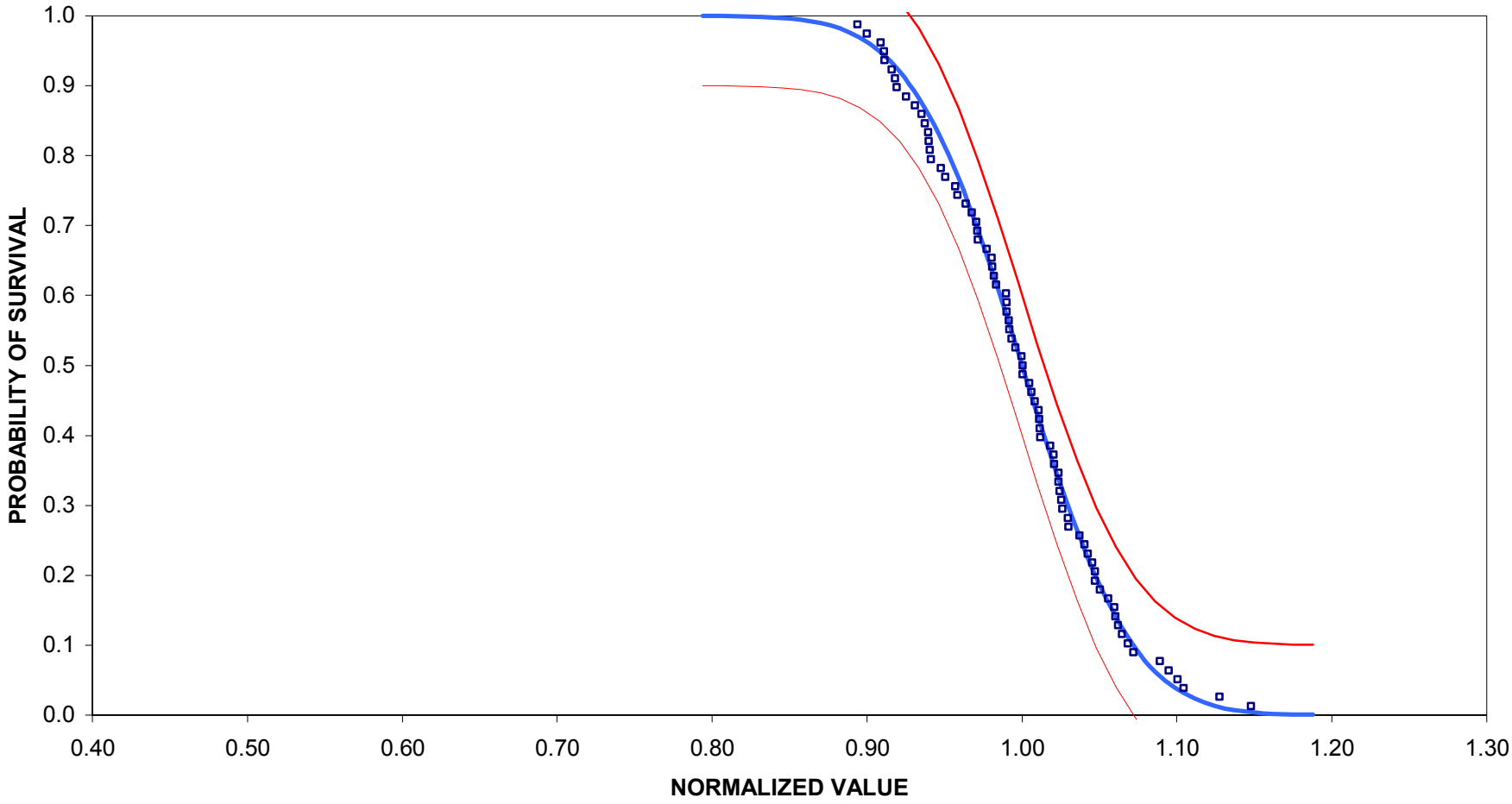
3.3.2 Plot of Pooled Data

DISTRIBUTION OF POOLED DATA

3K Plain Weave Carbon/ MGS 418 Wet Layup

Lancair

90° Tension- MWUXXXXX Measured

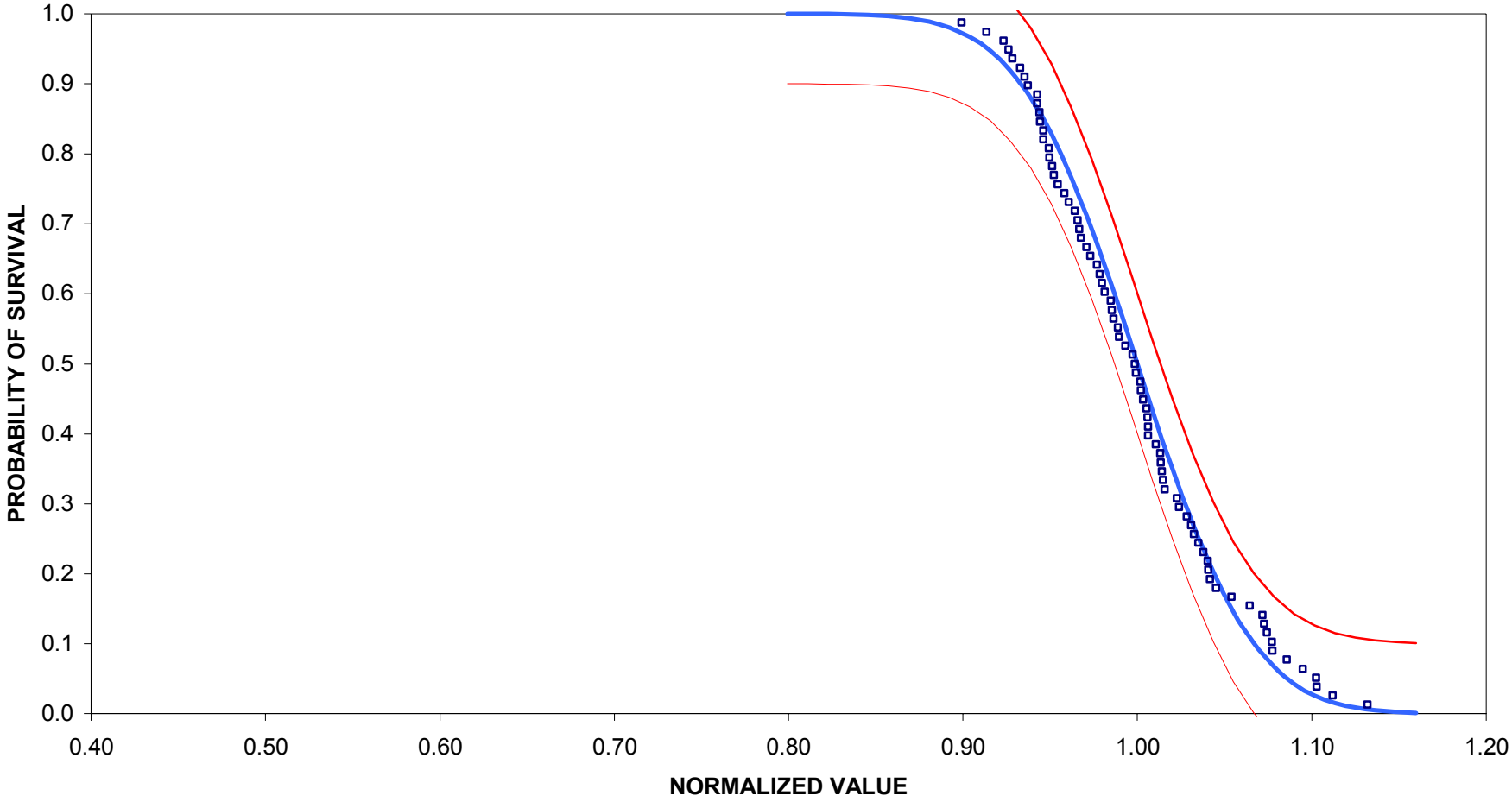


DISTRIBUTION OF POOLED DATA

3K Plain Weave Carbon/ MGS 418 Wet Layup

Lancair

In-Plane Shear - MWUXXXXX Normalized

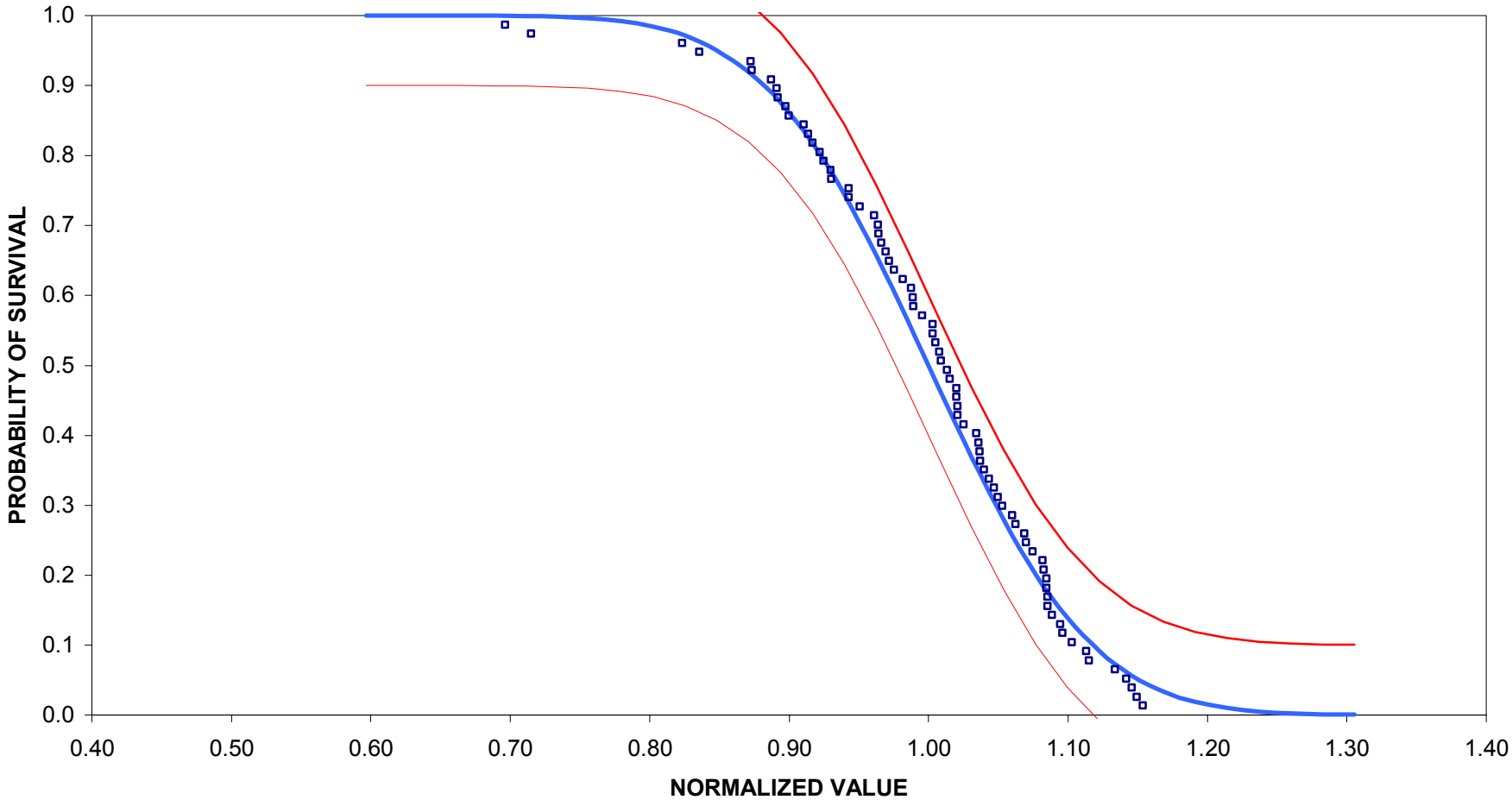


DISTRIBUTION OF POOLED DATA

3K Plain Weave Carbon/ MGS 418 Wet Layup

Lancair

90° Compression - MWWXXXXX Measured

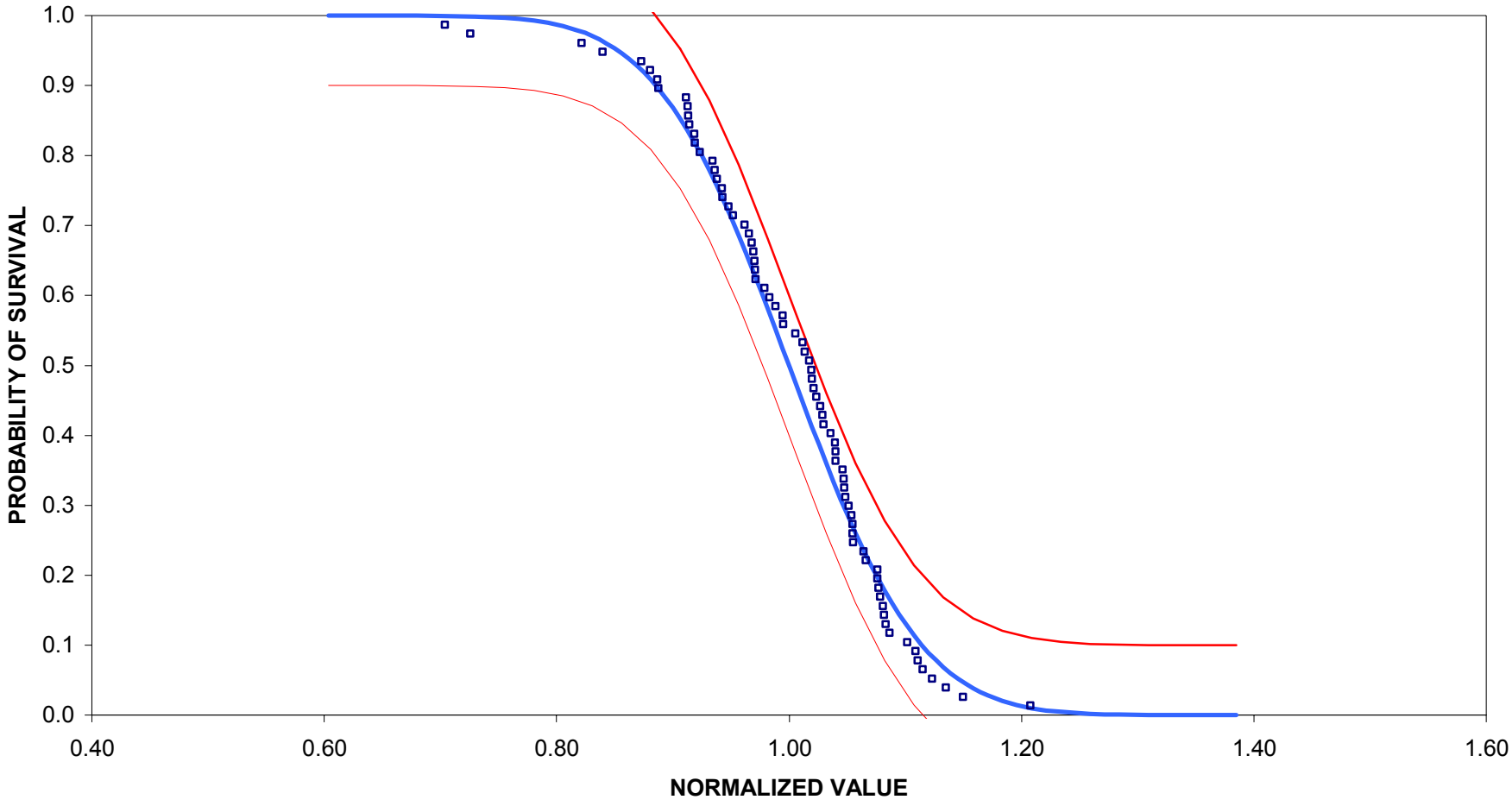


DISTRIBUTION OF POOLED DATA

3K Plain Weave Carbon/ MGS 418 Wet Layup

Lancair

90° Compression - MWWXXXXX Normalized

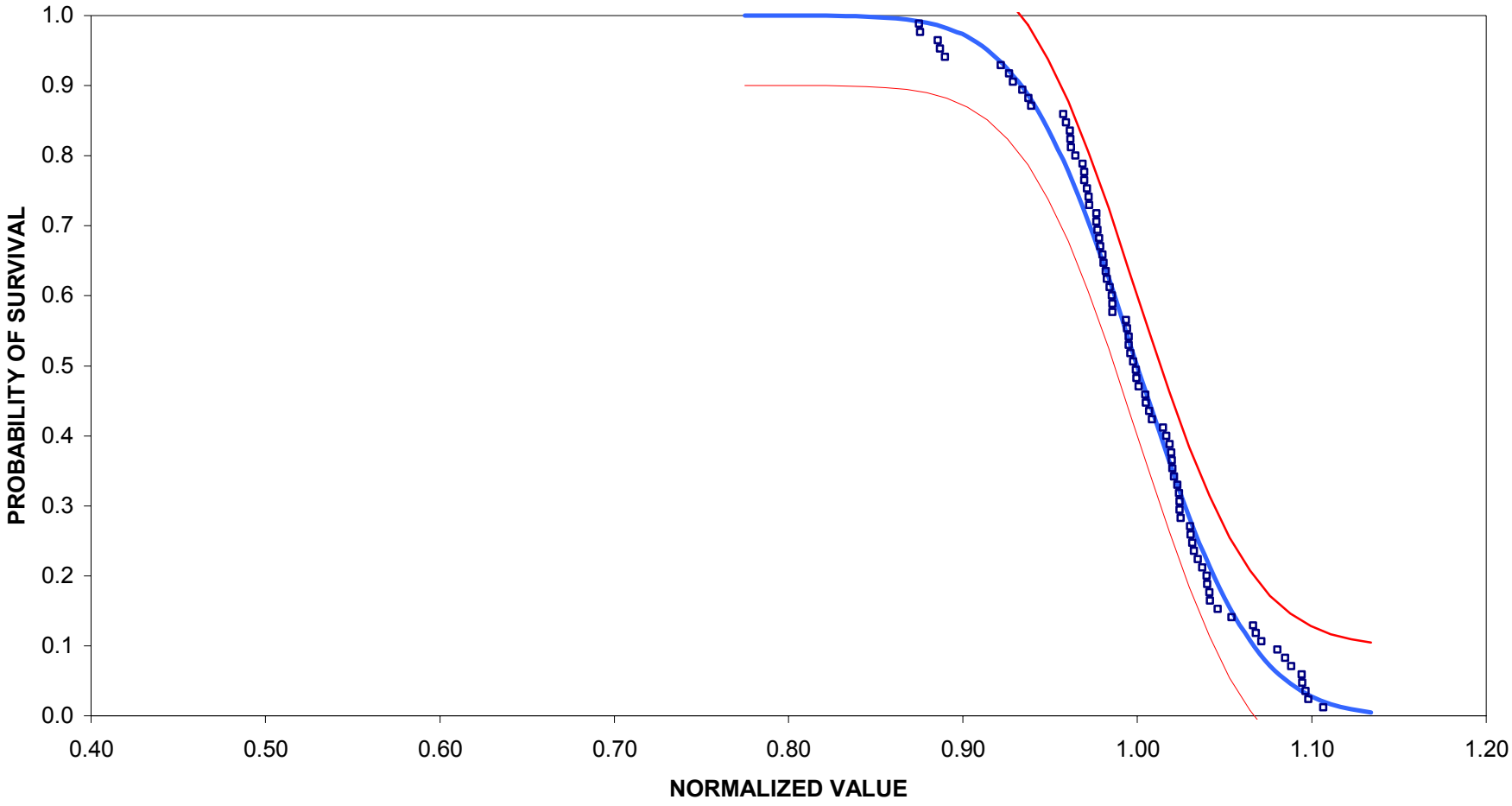


DISTRIBUTION OF POOLED DATA

3K Plain Weave Carbon/ MGS 418 Wet Layup

Lancair

In-Plane Shear - MWNXXXXX Measured

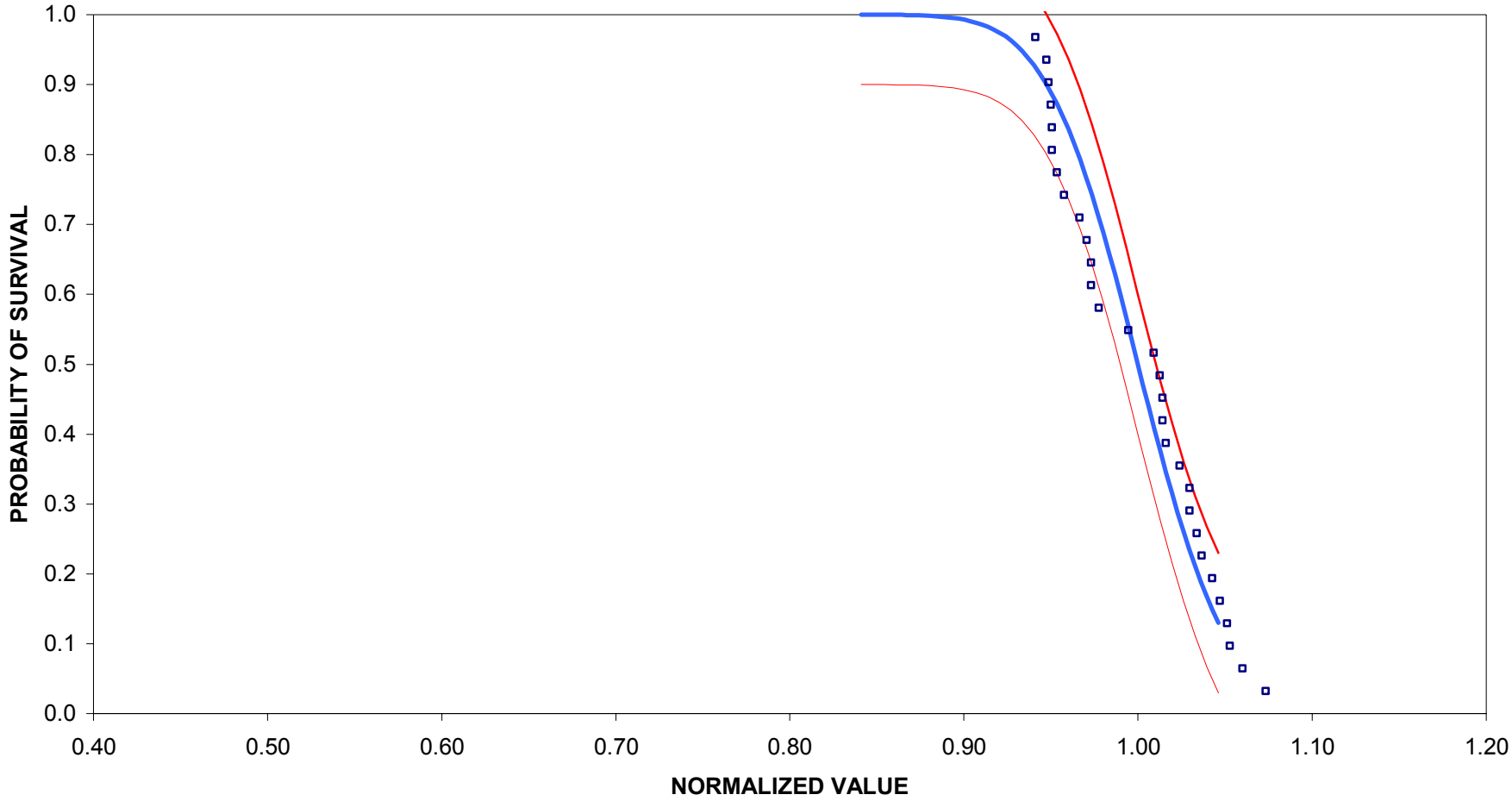


DISTRIBUTION OF POOLED DATA

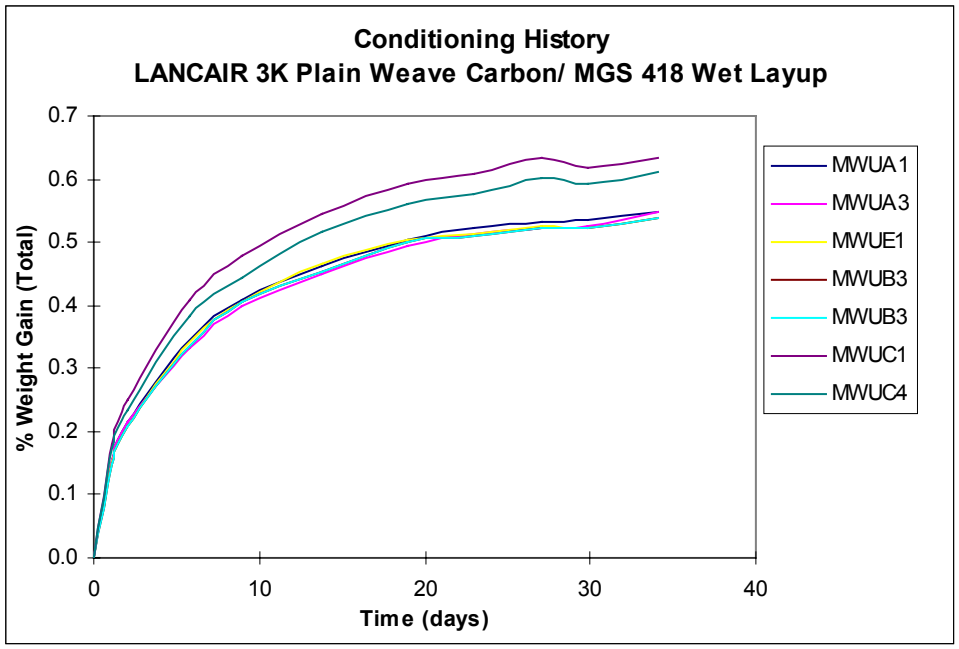
3K Plain Weave Carbon/ MGS 418 Wet Layup

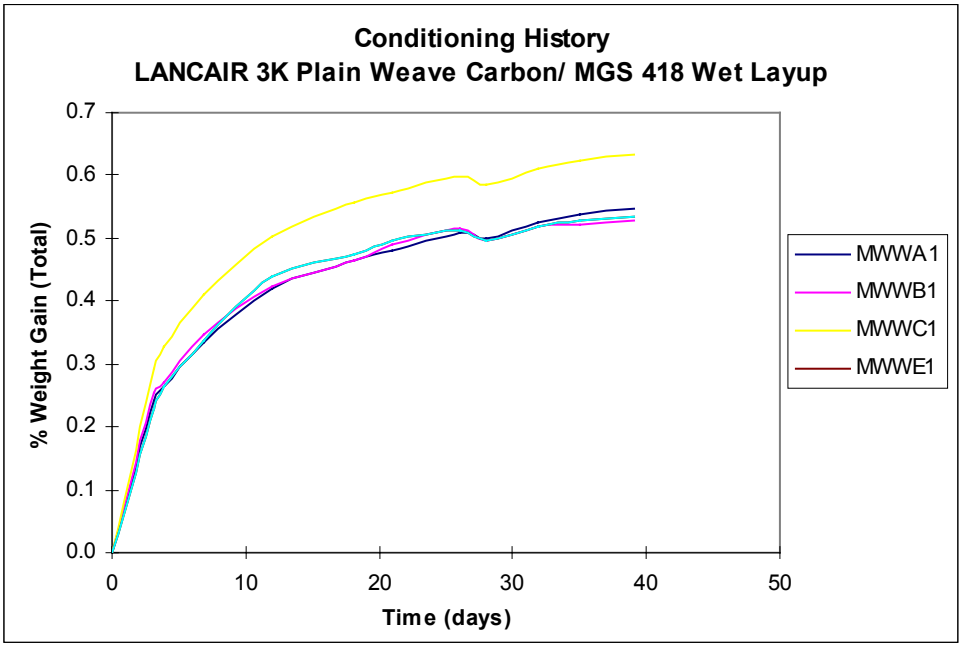
Lancair

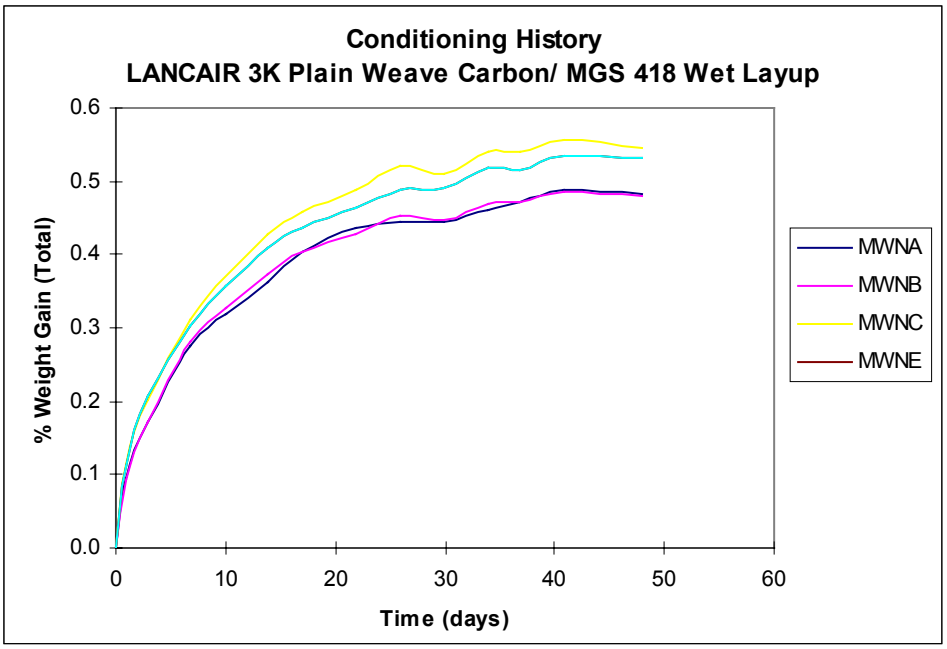
Apparent Interlaminar Shear - MWQXXXXX Measured

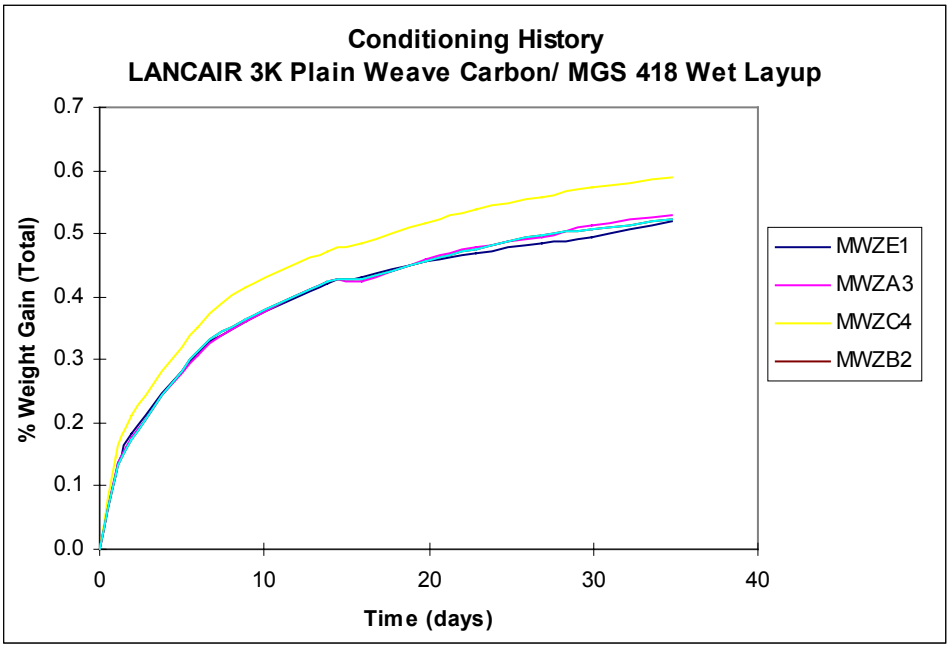


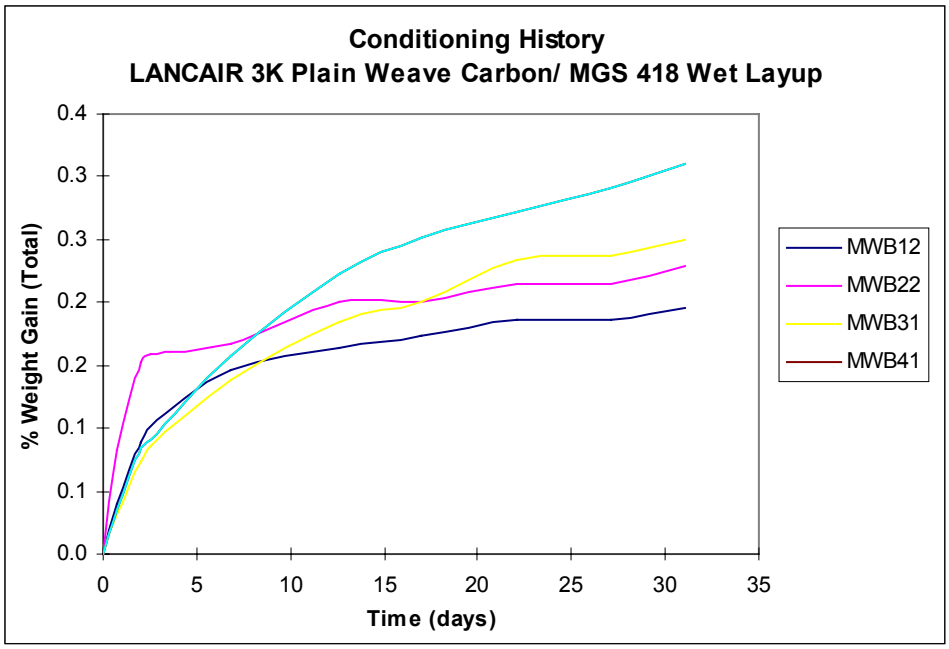
3.4 Moisture Conditioning History Charts

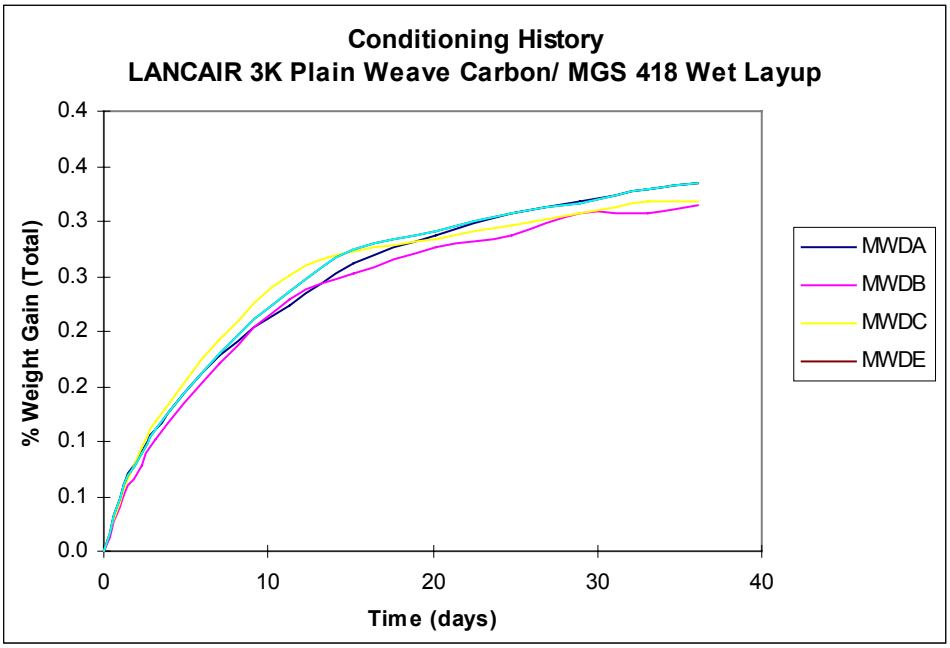












3.5 DMA Results

COMPANY: Lancair
MATERIAL SYSTEM: 3K PW Carbon / MGS 418 Wet Layup
PROJECT: 981111C1

DMA Results -- Onset Storage Modulus

DRY

As Fabricated		
Sample #	**Tg [°C]**	**Tg [°F]**
MWDA1D7A	95.08	203.14
MWDA1D8A	94.49	202.07
MWDA1D9A	94.80	202.63
MWDB2D7A	102.92	217.25
MWDB2D8A	103.64	218.56
MWDB2DAA	102.97	217.35
MWDC3D7A	106.50	223.71
MWDC3D8A	108.90	228.02
MWDC3D9A	104.55	220.18
MWDE2D7A	104.99	220.99
MWDE2D8A	104.87	220.76
MWDE2D9A	104.48	220.07
Average [°F]		**216.23**
Standard Dev. [°F]		**8.70**
Coeff. Of Var. [%]		**4.02**

WET

Moisture Equilibrium at 85% RH		
Sample #	**Tg [°C]**	**Tg [°F]**
MWDA1D1F	97.08	206.75
MWDA1D2F	97.38	207.29
MWDA1D3F	95.18	203.32
MWDB2D1F	99.52	211.14
MWDB2D2F	100.96	213.72
MWDB2D3F	99.76	211.57
MWDC3D1F	97.54	207.57
MWDC3D2F	97.10	206.78
MWDC3D3F	92.08	197.74
MWDE2D1F	96.51	205.72
MWDE2D2F	95.14	203.24
MWDE2D3F	102.45	216.41
Average [°F]		**207.60**
Standard Dev. [°F]		**5.07**
Coeff. Of Var. [%]		**2.44**

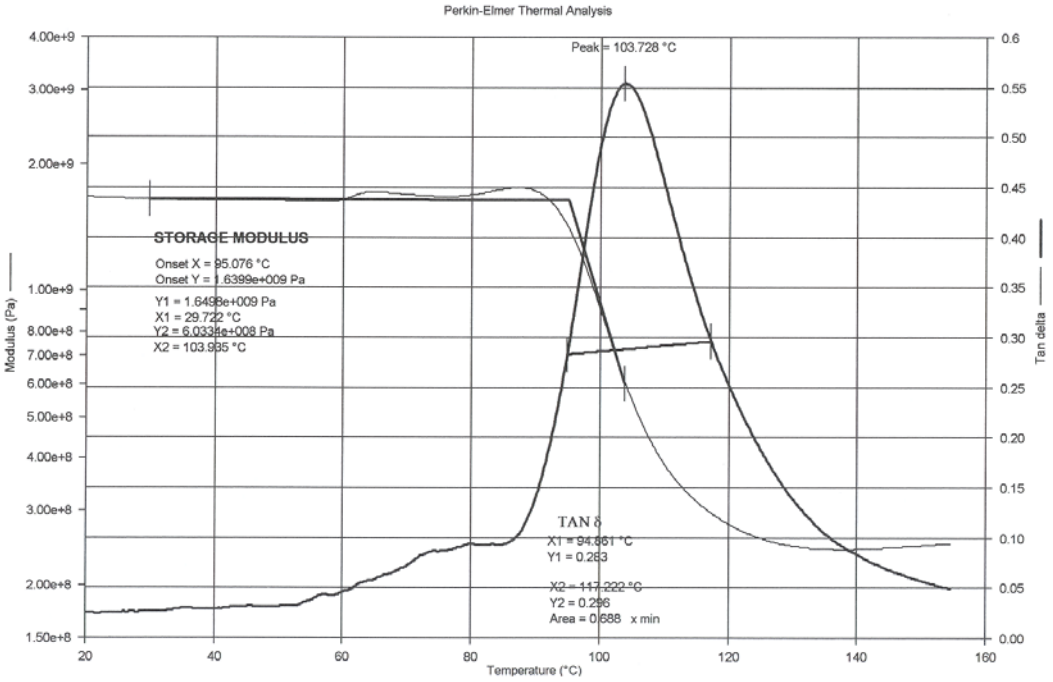
DMA Results - Peak Tan Delta

DRY

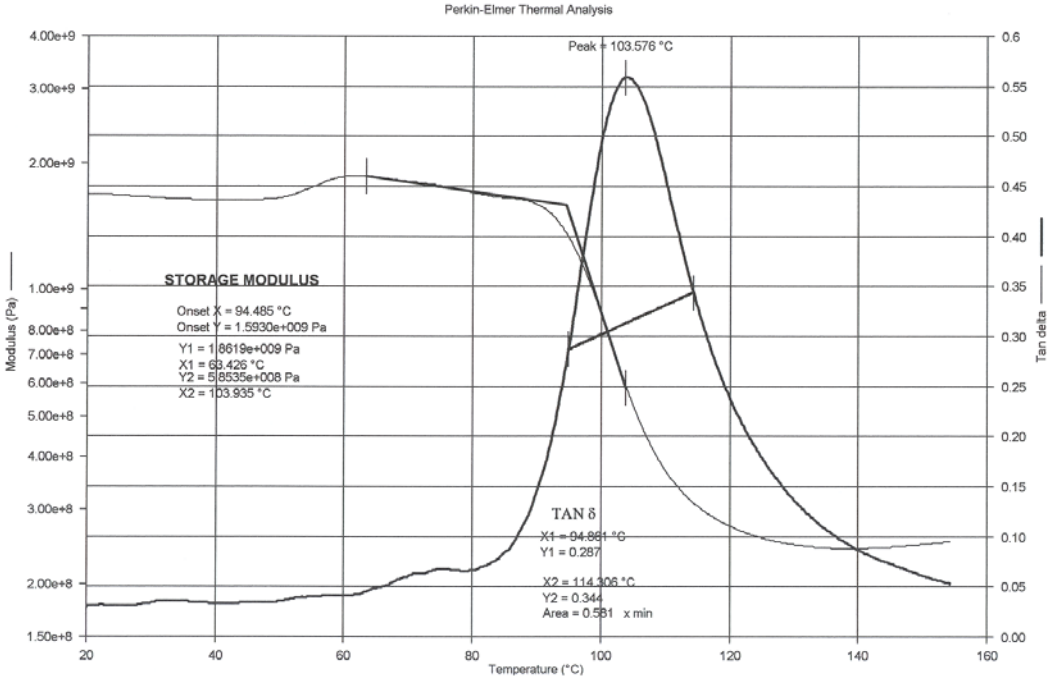
As Fabricated		
Sample #	**Tg [°C]**	**Tg [°F]**
MWDA1D7A	103.73	218.71
MWDA1D8A	103.58	218.44
MWDA1D9A	104.00	219.20
MWDB2D7A	112.63	234.73
MWDB2D8A	113.40	236.11
MWDB2DAA	113.15	235.67
MWDC3D7A	114.71	238.48
MWDC3D8A	114.79	238.63
MWDC3D9A	114.48	238.06
MWDE2D7A	112.74	234.93
MWDE2D8A	112.74	234.94
MWDE2D9A	113.04	235.46
Average [°F]		**231.95**
Standard Dev. [°F]		**8.06**
Coeff. Of Var. [%]		**3.47**

WET

Moisture Equilibrium at 85% RH		
Sample #	**Tg [°C]**	**Tg [°F]**
MWDA1D1F	108.02	226.44
MWDA1D2F	107.53	225.55
MWDA1D3F	106.88	224.38
MWDB2D1F	109.37	228.86
MWDB2D2F	109.89	229.80
MWDB2D3F	108.67	227.61
MWDC3D1F	106.30	223.35
MWDC3D2F	106.12	223.01
MWDC3D3F	105.68	222.23
MWDE2D1F	108.45	227.20
MWDE2D2F	109.15	228.46
MWDE2D3F	108.35	227.04
Average [°F]		**226.16**
Standard Dev. [°F]		**2.46**
Coeff. Of Var. [%]		**1.09**



MWDA1D7A



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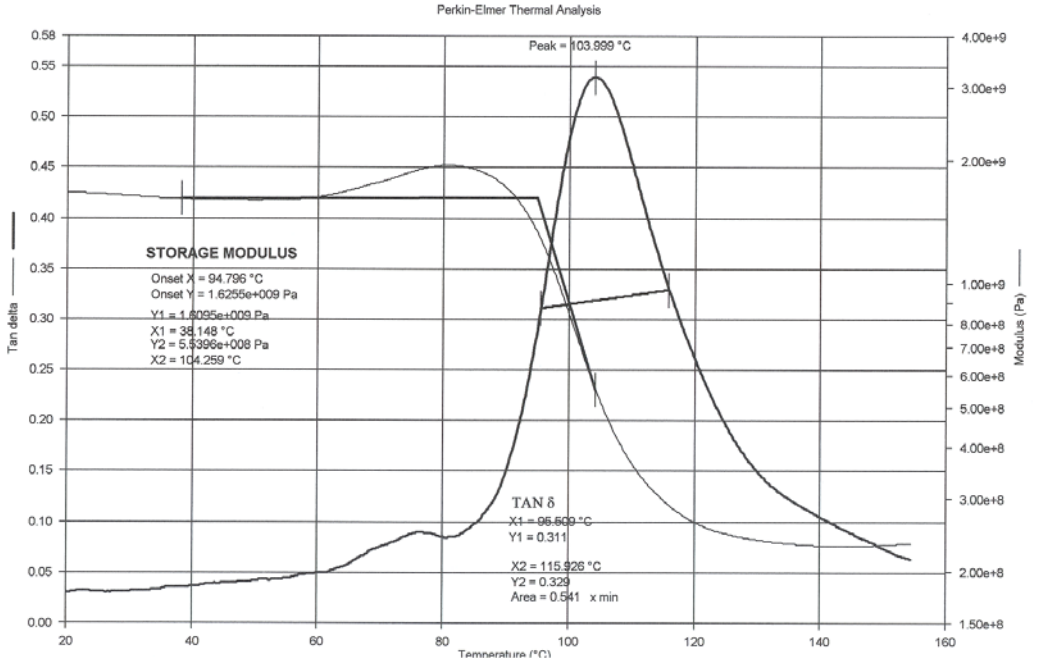

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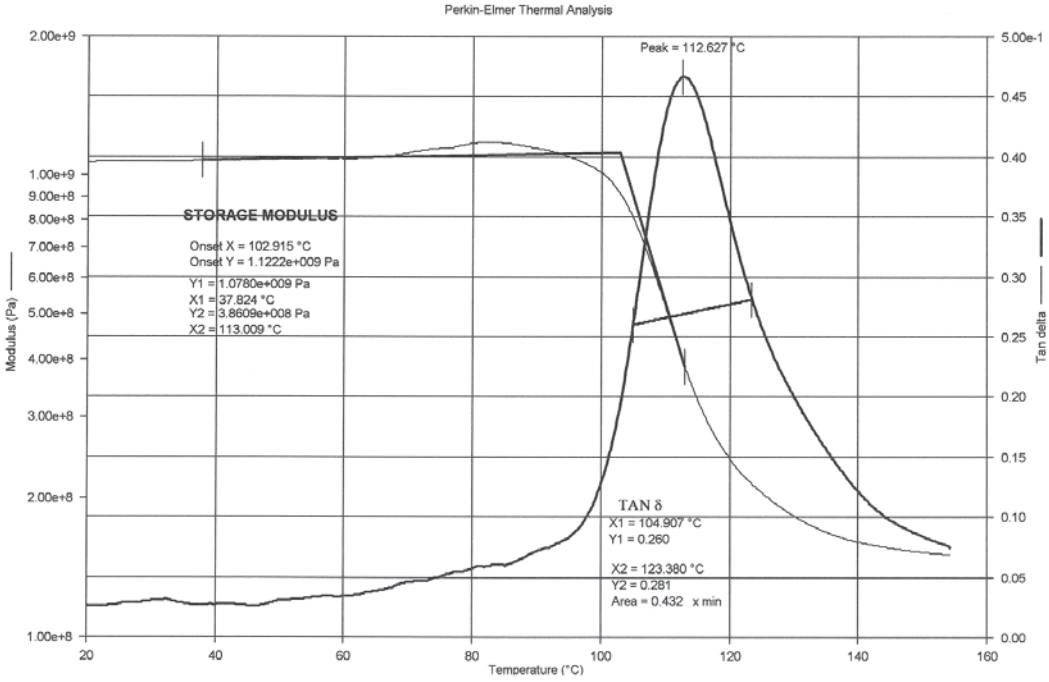

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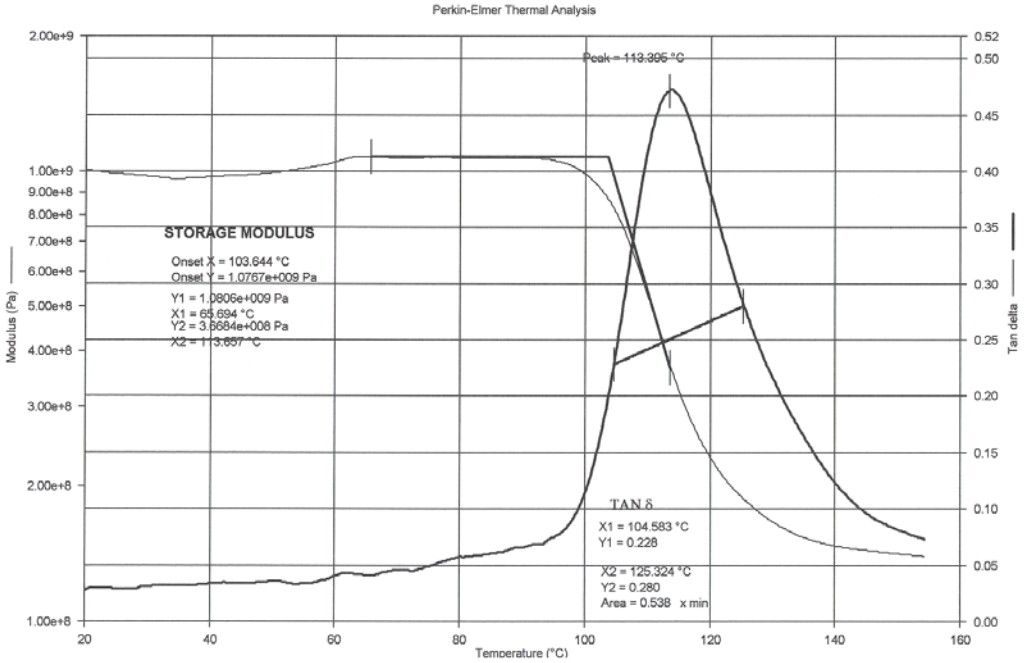

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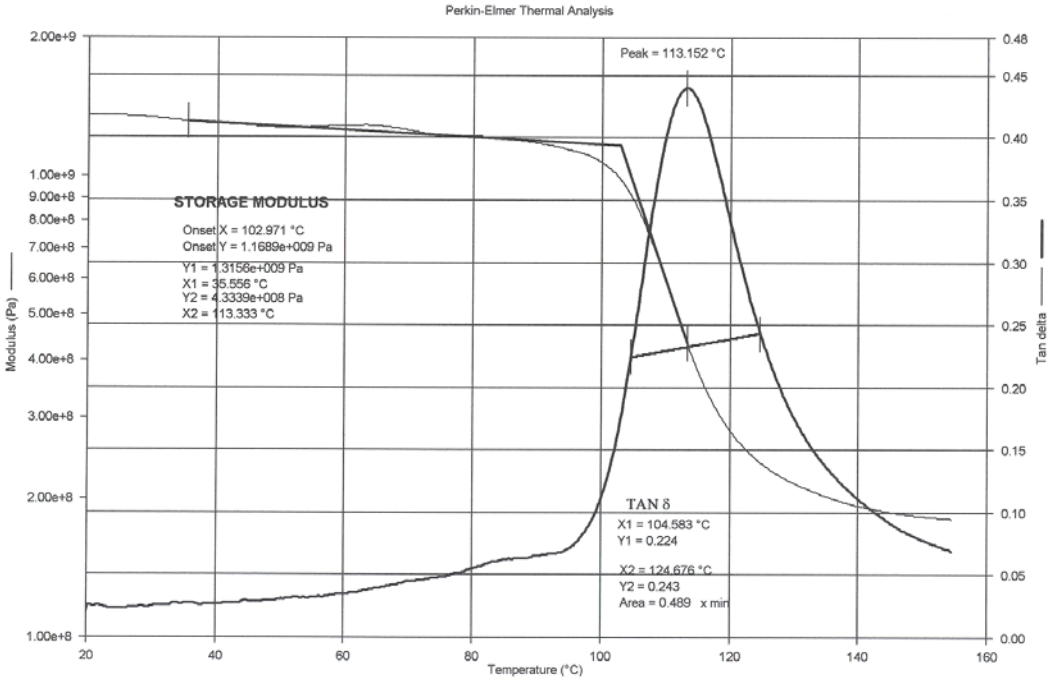

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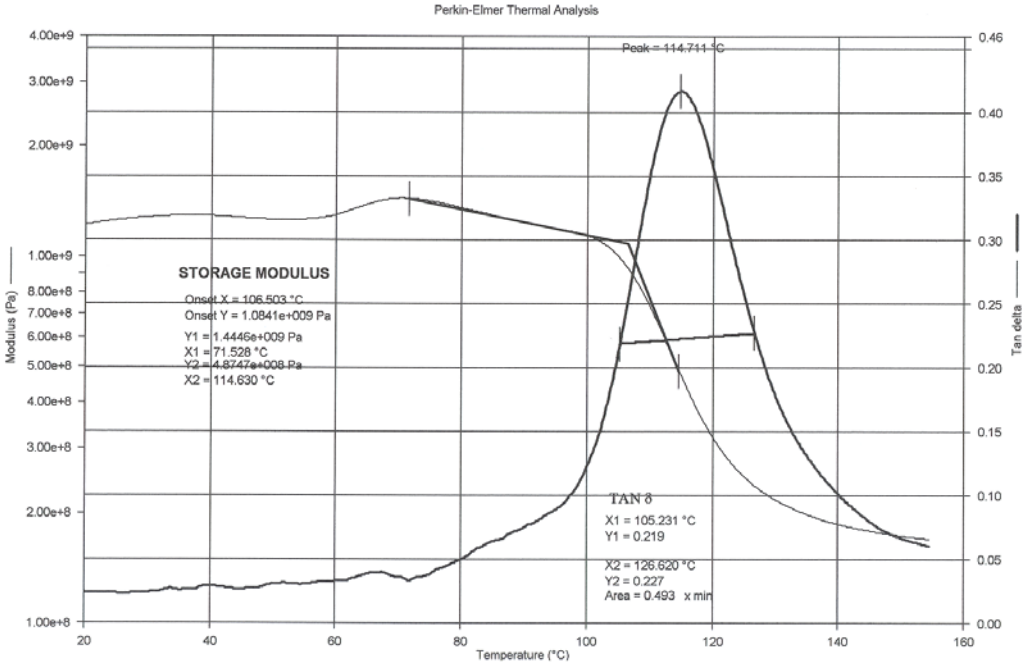

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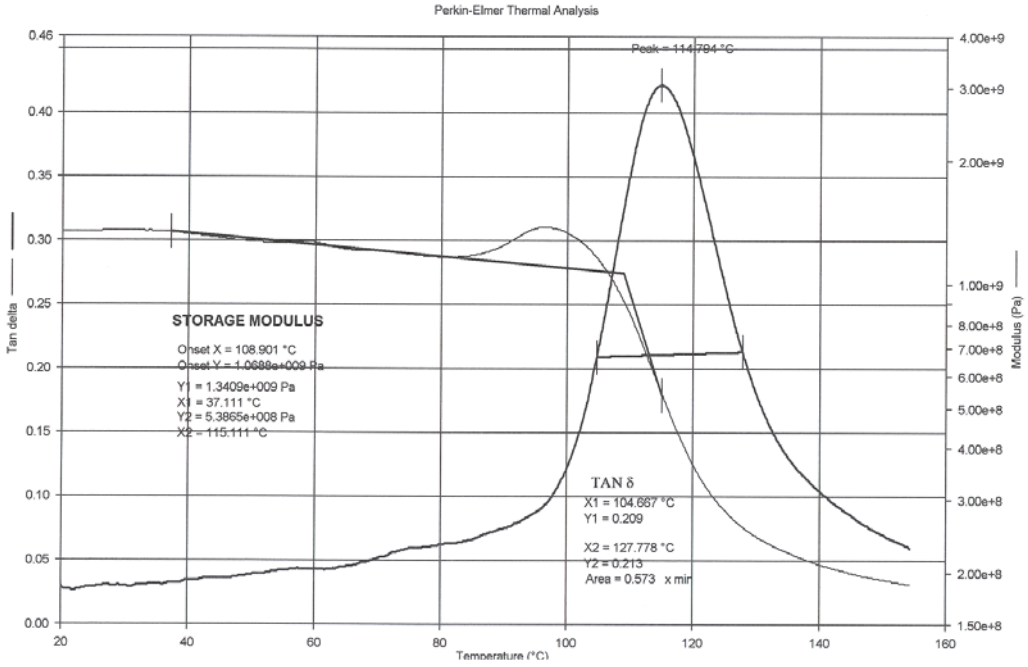

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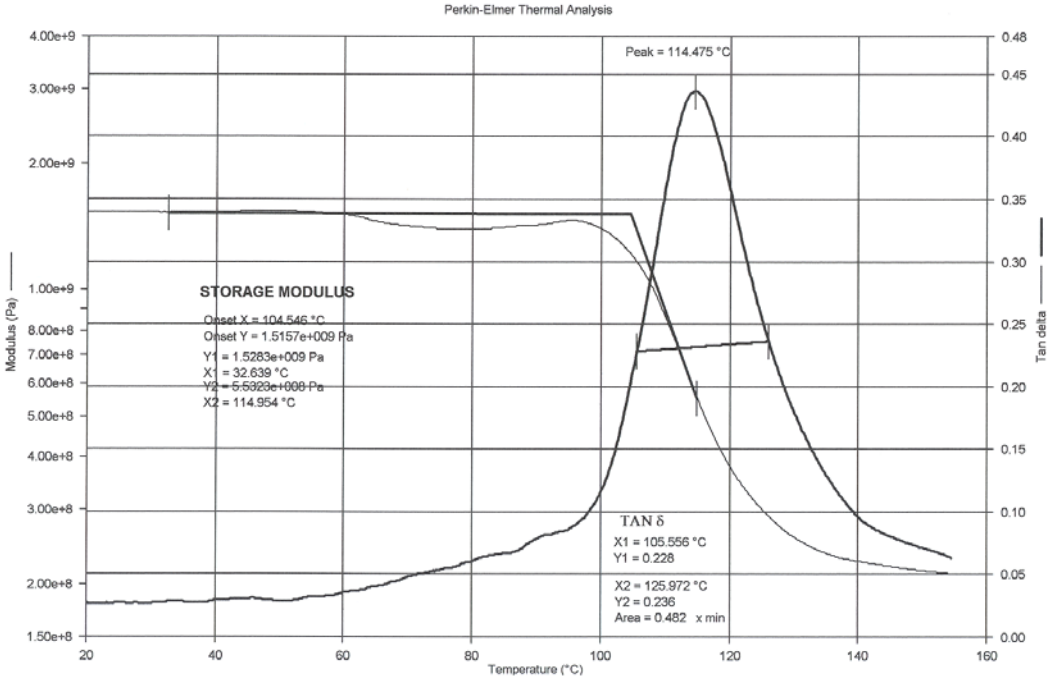

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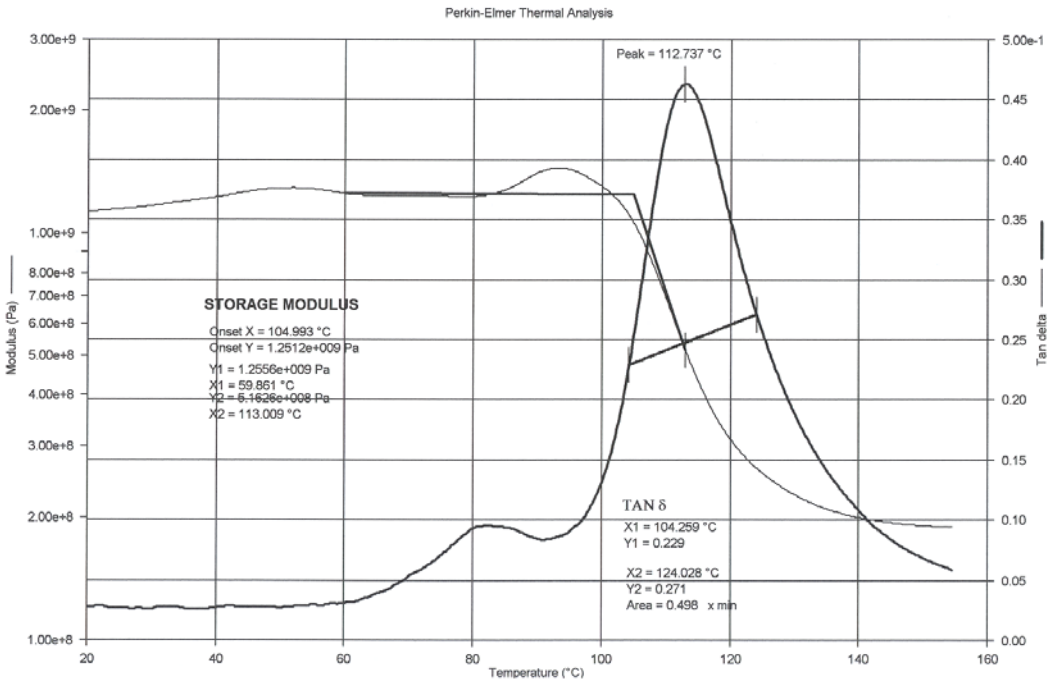

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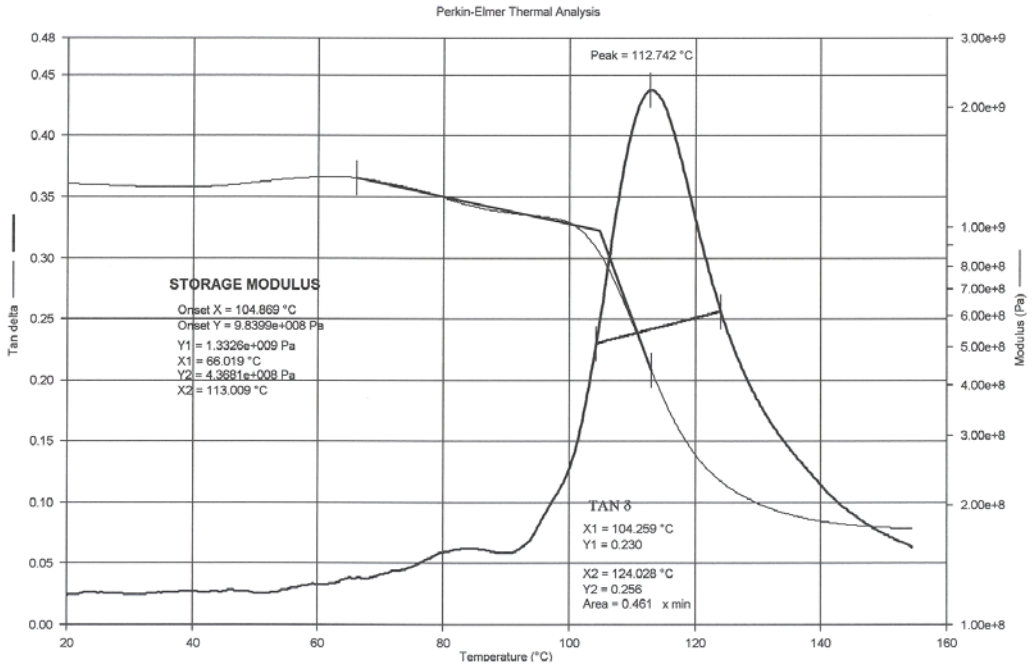

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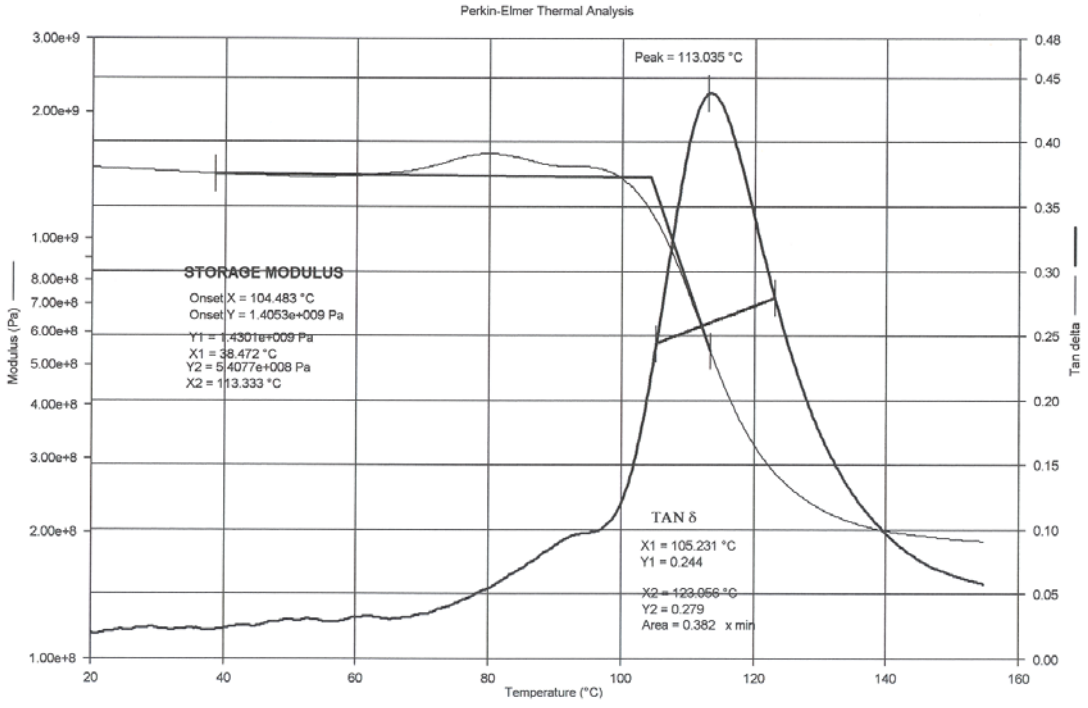

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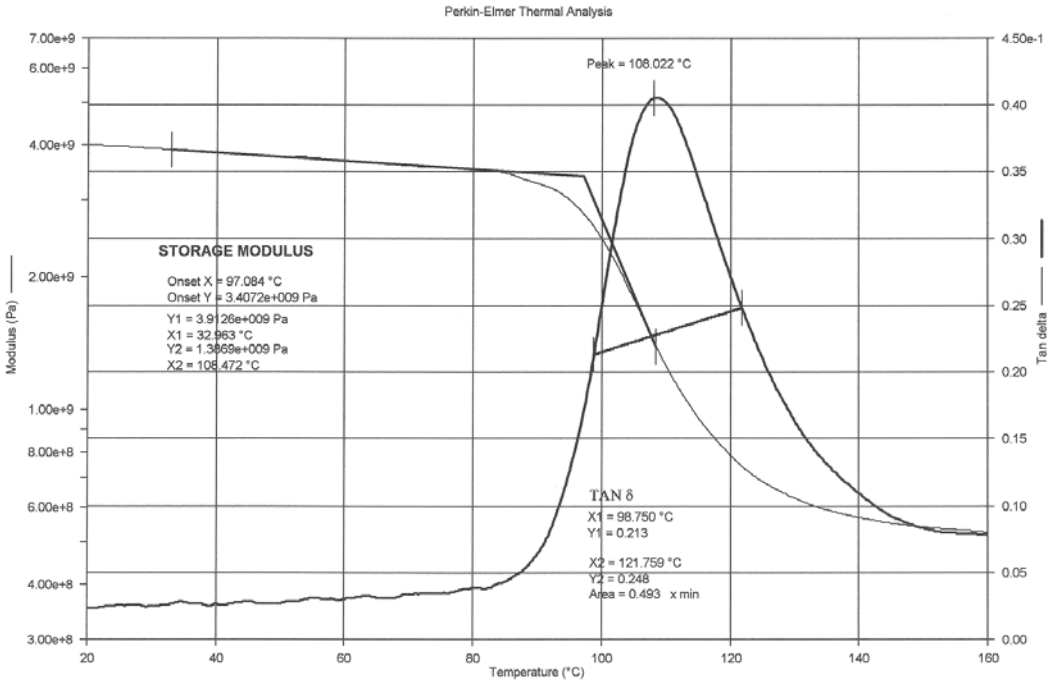
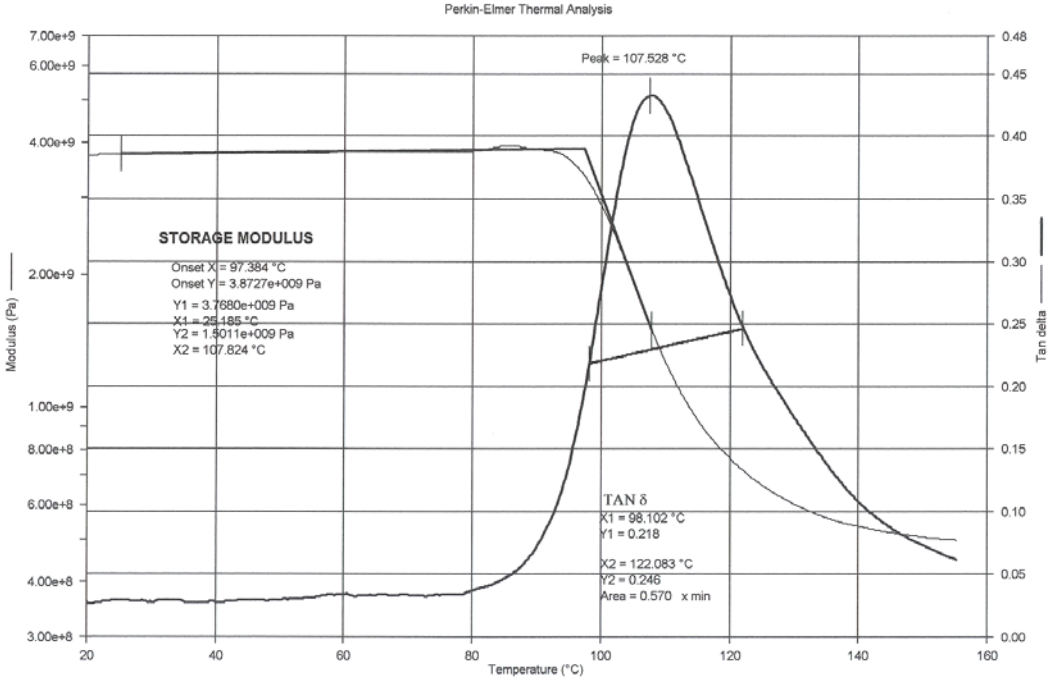


MWDA1D1F



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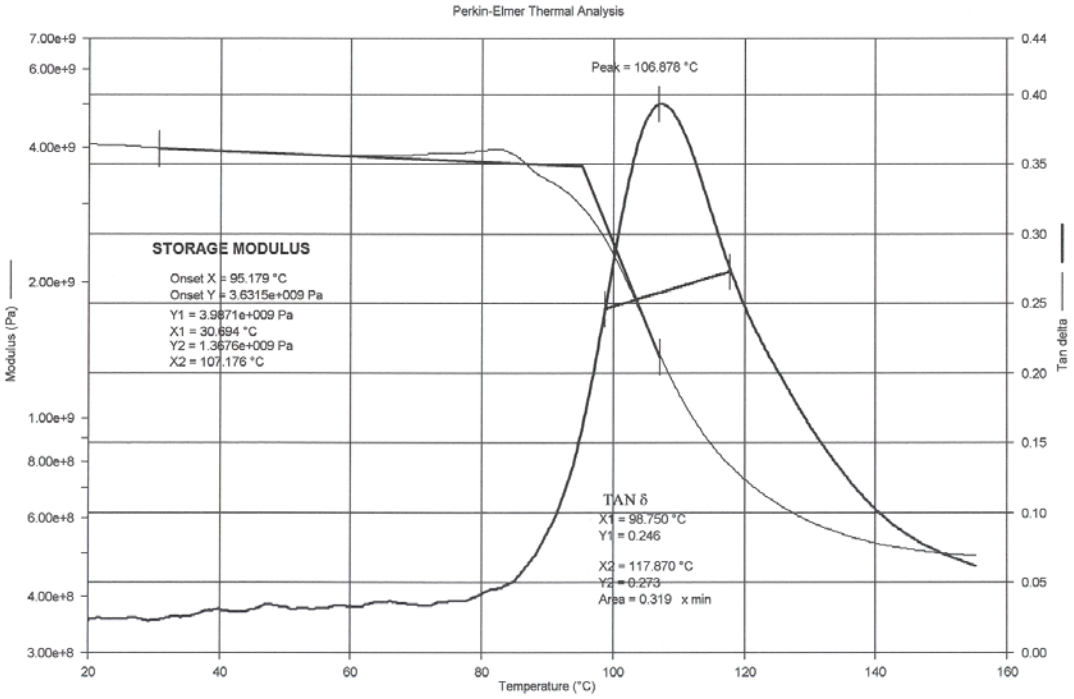

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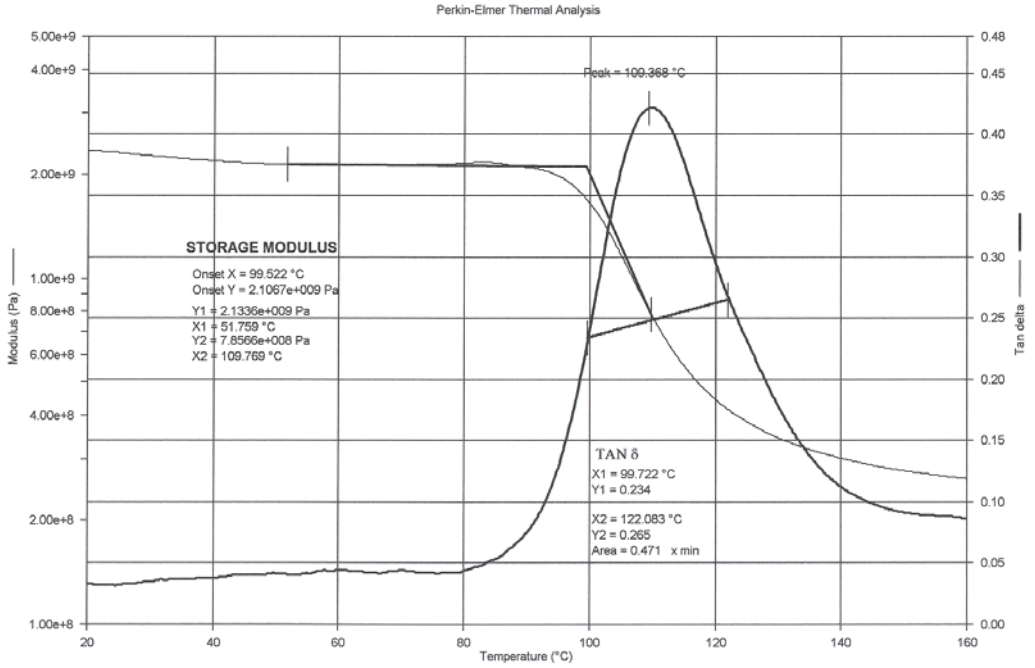

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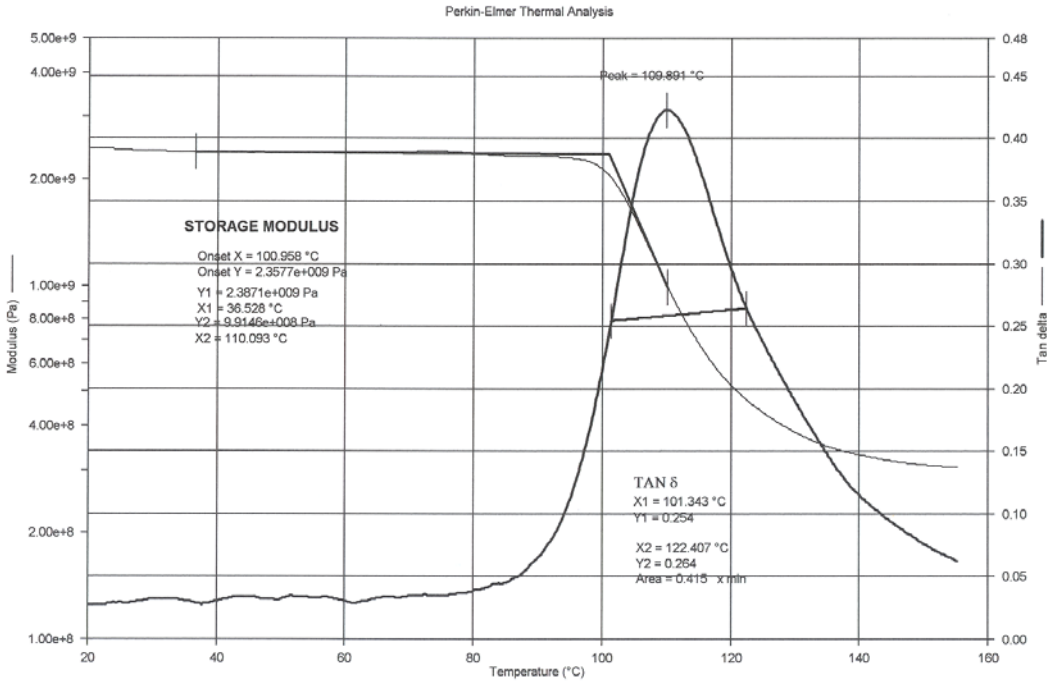

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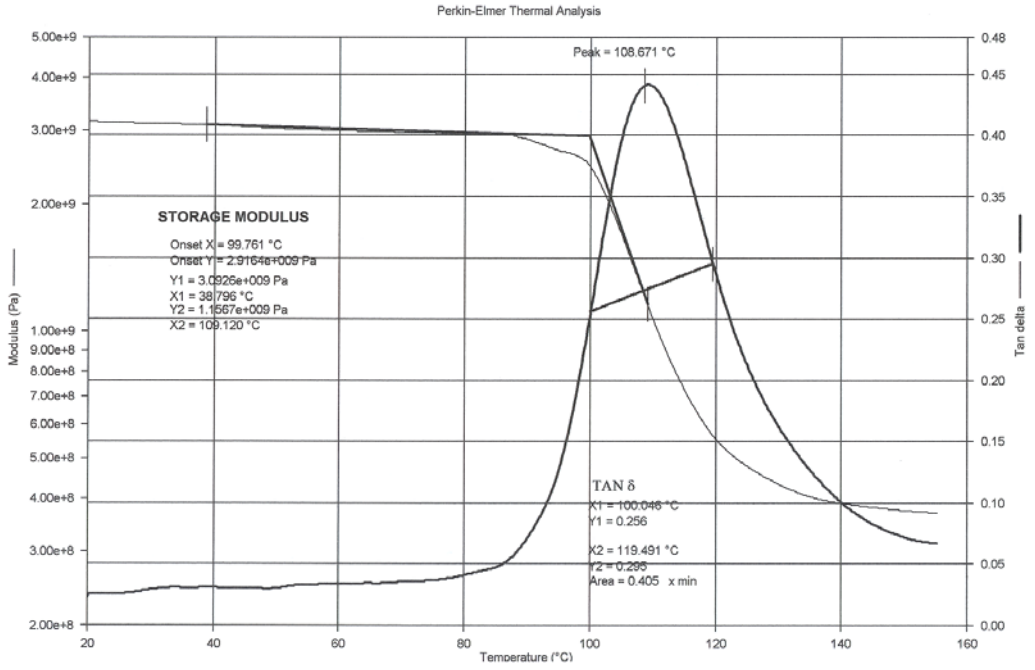

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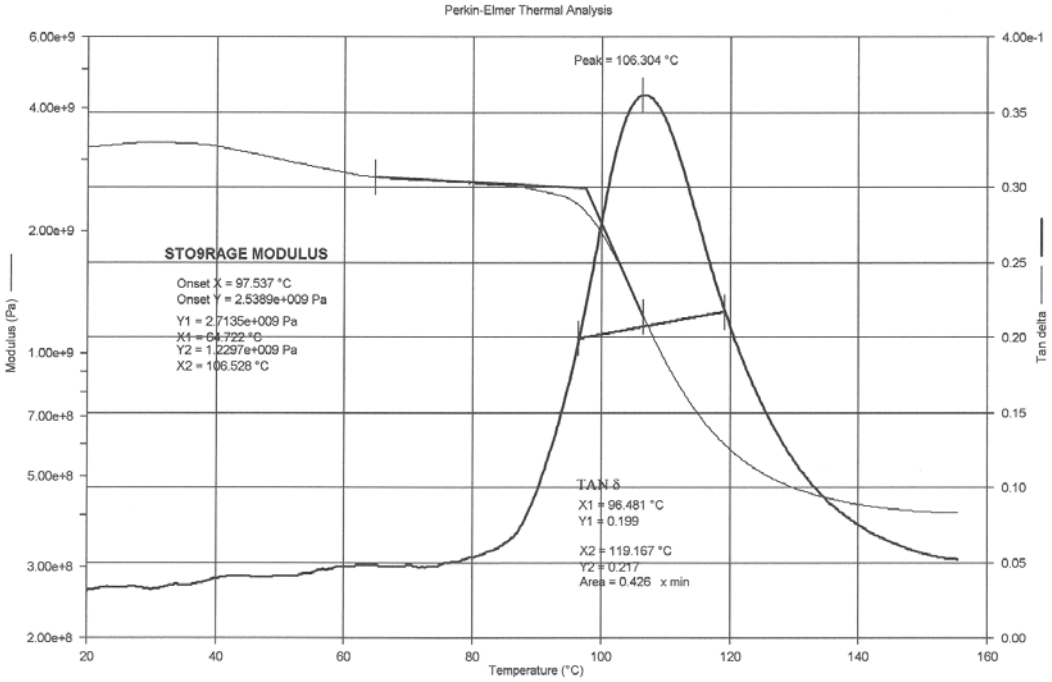
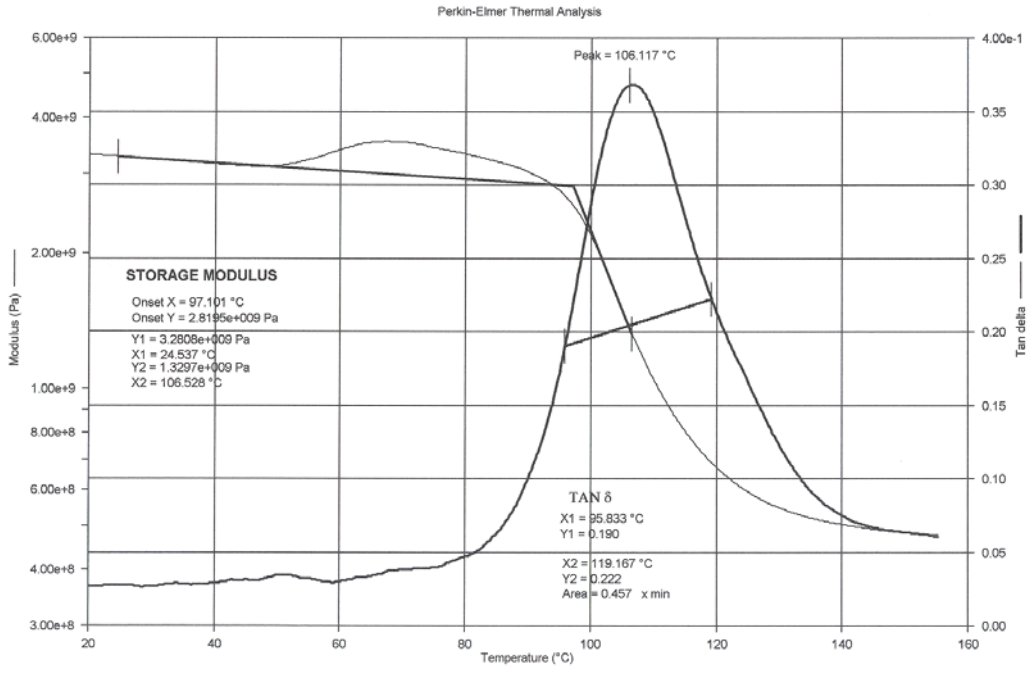


MWDC3D1F



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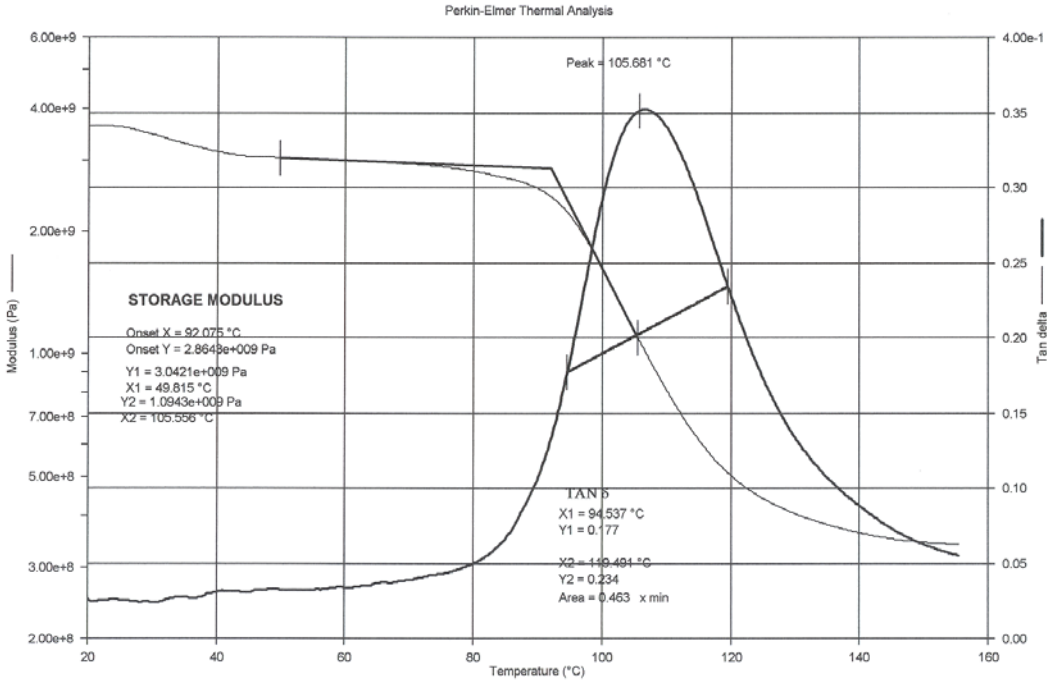

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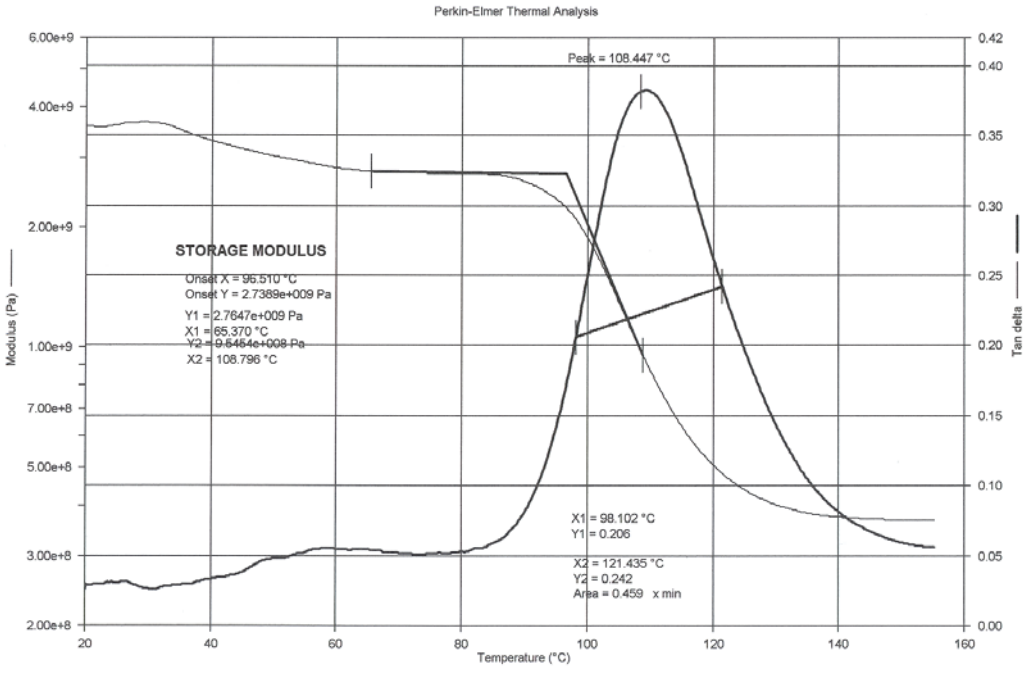

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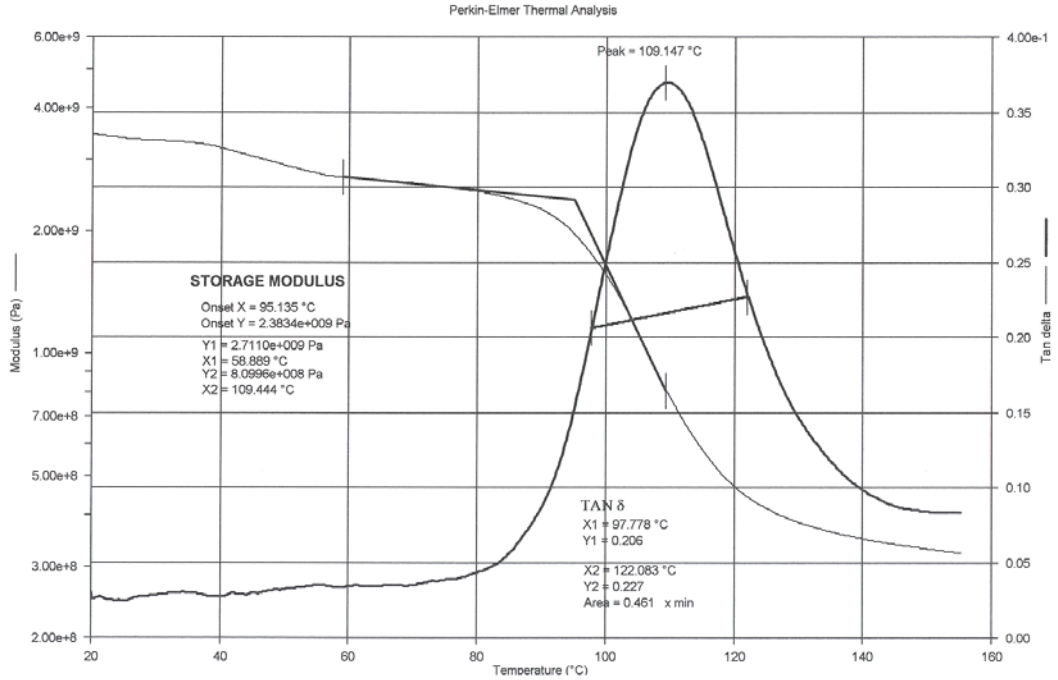
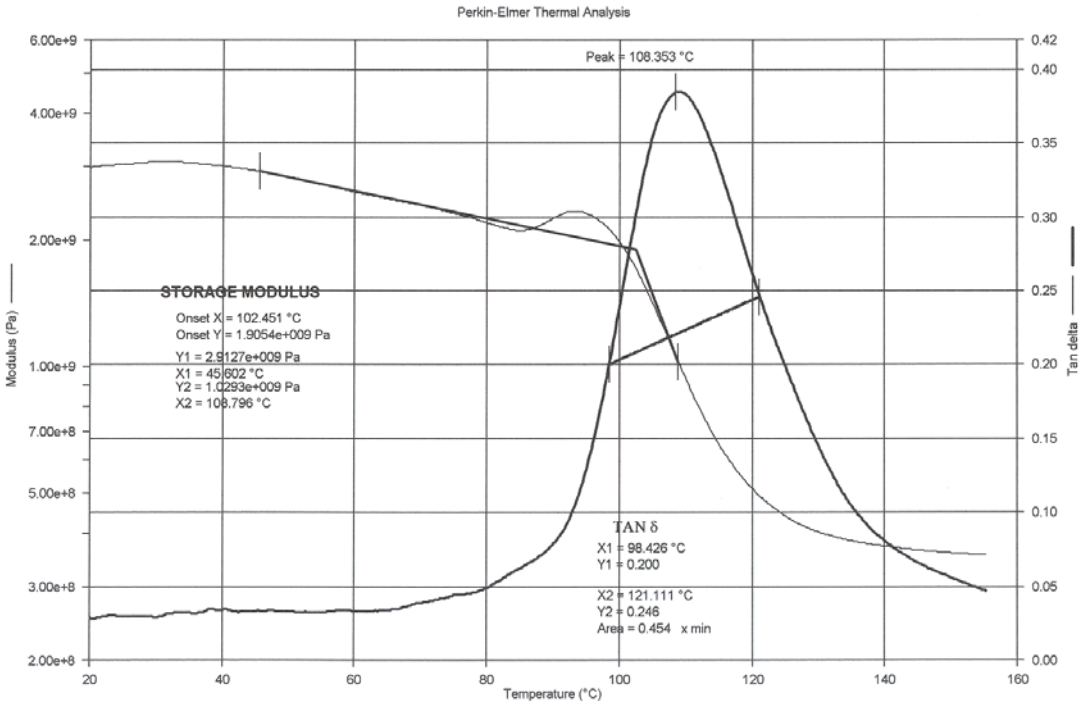


MWDE2D2F



MWDE2D3F

4.0 TESTING AND REPORTING COMMENTS

Conformity data is documented and archived as part of the Lancair certification program. FAA project No. TC 1616SE-A.

APPENDIX A. DATES OF PANEL MANUFACTURE AND COPY OF FAA FORM 8130-3

1. UNITED STATES

2. **FAA FORM 8130-3**
AIRWORTHINESS APPROVAL TAG
U.S. Department of Transportation
Federal Aviation Administration

3. System Tracking Ref. No.: PAC-98-010

4. Organization: Pacific Aviation Composites USA, LLC. 22550 Nelson Road. Bend, Or. 97701

5. Work Order, ~~Contract, or Invoice~~ Number: 98-00241

6. Item	7. Description	8. Part Number	9. Eligibility *	10. Quantity	11. Serial/Batch Number	12. Status/~~Work~~
1	Test Panels	N/A	N/A	34	N/A	Test Specimens

13. Remarks

"CONFORMITY INSPECTION ONLY". Test Panels for testing I/A/W Document No. AX513001A, Rev'A', dated 12/3/97,"Initial Material Qualification of MSG 418 Resin System with 7781 Glass Fabric and Plain Weave Carbon Cloth with AS4 3K Fibers for Wet Layup Epoxy Laminates". Conformed Test Panels I/A/W Appendix B.2 Carbon Cloth Requirements. Panels 38 thru 74, except panels 69, 70 & 71 are exempt. Ref. FAA Form 8120-10, Request for Conformity, FAA Project No. TC1616SE-A, dated 7/28/98. Also Ref. FAA Form 8130-9, Statement of Conformity, dated 8/13/98, for deviations.

Limited life parts must be accompanied by maintenance history including total time/total cycles/time since new.

14. New [X]
Newly Overhauled [ ]

Certifies that the new or newly overhauled part(s) identified above, except as otherwise specified in block 13 was (were) manufactured in accordance with FAA approved design data and airworthiness.

NOTE: In case of parts to be exported, the special reqirements of the importing country have been met.

19. **Return to Service in Accordance with FAR 43.9**

Certifies that the work specified in block 13 (or attached) above was carried out in accordance with FAA airworthiness regulations and in respect to the work performed the part(s) is (are) approved for return to service.

15. Signature: George B. Pittelkau

16. FAA Authorization No.: DARF351006NM

20. Authorized Signature:

21. Certificate Number:

17. Name *(Typed or Printed)*: George B. Pittelkau

18. Date: 8/14/98

22. Name *(Typed or Printed)*

23. Date:

FAA Form 8130-3 (11-93)

* (Optional) Installer must cross check eligibility with applicable technical data.

1. UNITED STATES

2. **FAA FORM 8130-3**
AIRWORTHINESS APPROVAL TAG
U.S. Department of Transportation
Federal Aviation Administration

3. System Tracking Ref. No.: 102297 JWD-7

4. Organization: PAC-USA PEDMOND, OR

5. Work Order, Contract, or Invoice Number:

6. Item	7. Description	8. Part Number	9. Eligibility *	10. Quantity	11. Serial/Batch Number	12. Status/Work
1	ASTM D953 (20 PLY) TEST PNL	N/A	LL40	6	N/A	TEST

13. Remarks

DWG MX 513605 REV NC 9/9/97
WO 97-00591

Limited life parts must be accompanied by maintenance history including total time/total cycles/time since new.

14. New ☒
Newly Overhauled ☐

Certifies that the new or newly overhauled part(s) identified above, except as otherwise specified in block 13 was (were) manufactured in accordance with FAA approved design data and airworthiness.

NOTE: In case of parts to be exported, the special reqirements of the importing country have been met.

19. **Return to Service in Accordance with FAR 43.9**

Certifies that the work specified in block 13 (or attached) above was carried out in accordance with FAA airworthiness regulations and in respect to the work performed the part(s) is (are) approved for return to service.

15. Signature	16. FAA Authorization No.:	20. Authorized Signature:	21. Certificate Number:
James W. Doyle	SEATTLE MIDO		
17. Name *(Typed or Printed)*: JAMES W. DOYLE	**18. Date:** 10/22/97	**22. Name** *(Typed or Printed)*	**23. Date:**

FAA Form 8130-3 (11-93)

* (Optional) Installer must cross check eligibility with applicable technical data.

1. UNITED STATES

2. **FAA FORM 8130-3**
AIRWORTHINESS APPROVAL TAG
U.S. Department of Transportation
Federal Aviation Administration

3. System Tracking Ref. No.: 102297 JWD - 6

4. Organization: PAC-USA REDMOND, OR

5. Work Order, Contract, or Invoice Number:

6. Item	7. Description	8. Part Number	9. Eligibility *	10. Quantity	11. Serial/Batch Number	12. Status/Work
1	ASTM D953 (6 PLY) TEST PNL	N/A	LC40	6	N/A	TEST

13. Remarks

DWG MX 513605 REV N/C 9/9/97
WO 97-00591

Limited life parts must be accompanied by maintenance history including total time/total cycles/time since new.

14. New ☒
Newly Overhauled ☐

Certifies that the new or newly overhauled part(s) identified above, except as otherwise specified in block 13 was (were) manufactured in accordance with FAA approved design data and airworthiness.

NOTE: In case of parts to be exported, the special reqirements of the importing country have been met.

19. **Return to Service in Accordance with FAR 43.9**

Certifies that the work specified in block 13 (or attached) above was carried out in accordance with FAA airworthiness regulations and in respect to the work performed the part(s) is (are) approved for return to service.

15. Signature	16. FAA Authorization No.:	20. Authorized Signature:	21. Certificate Number:
James W. Doyle	SEATTLE MIDO		
17. Name *(Typed or Printed):* JAMES W. DOYLE	**18. Date:** 10/22/97	**22. Name** *(Typed or Printed)*	**23. Date:**

FAA Form 8130-3 (11-93)

* (Optional) Installer must cross check eligibility with applicable technical data.

1. UNITED STATES

2.

FAA FORM 8130-3

AIRWORTHINESS APPROVAL TAG

U.S. Department of Transportation
Federal Aviation Administration

3. System Tracking Ref. No.: 102297 JWD-5

4. Organization: BAC - USA REDMOND, OR

5. Work Order, Contract, or Invoice Number:

6. Item	7. Description	8. Part Number	9. Eligibility *	10. Quantity	11. Serial/Batch Number	12. Status/Work
1	ASTM D2344 TEST PNL	N/A	LC40	1	N/A	TEST

13. Remarks

DWG MX 513605 REV NK 9/9/97
WO 97-00591

Limited life parts must be accompanied by maintenance history including total time/total cycles/time since new.

14.
New ☒
Newly Overhauled ☐

Certifies that the new or newly overhauled part(s) identified above, except as otherwise specified in block 13 was (were) manufactured in accordance with FAA approved design data and airworthiness.

NOTE: In case of parts to be exported, the special reqirements of the importing country have been met.

19.
Return to Service in Accordance with FAR 43.9

Certifies that the work specified in block 13 (or attached) above was carried out in accordance with FAA airworthiness regulations and in respect to the work performed the part(s) is (are) approved for return to service.

15. Signature	16. FAA Authorization No.:	20. Authorized Signature:	21. Certificate Number:
	SEATTLE MIDO		
17. Name *(Typed or Printed)*:	**18. Date:**	**22. Name *(Typed or Printed)***	**23. Date:**
JAMES W. DOYLE	10/22/97		

FAA Form 8130-3 (11-93)

* (Optional) Installer must cross check eligibility with applicable technical data.

1. UNITED STATES

2. **FAA FORM 8130-3**
AIRWORTHINESS APPROVAL TAG
U.S. Department of Transportation
Federal Aviation Administration

3. System Tracking Ref. No. 102297 JWD - 4

4. Organization: PAC-USA REDMOND, OR

5. Work Order, Contract, or Invoice Number:

6. Item	7. Description	8. Part Number	9. Eligibility *	10. Quantity	11. Serial/Batch Number	12. Status/Work
1	ASTM D5379 TEST PNL	N/A	LC 40	1	N/A	TEST

13. Remarks

DWG MX 513605 REV N/C 9/9/97
WO 97-00591

Limited life parts must be accompanied by maintenance history including total time/total cycles/time since new.

14.
New [X]
Newly Overhauled [ ]

Certifies that the new or newly overhauled part(s) identified above, except as otherwise specified in block 13 was (were) manufactured in accordance with FAA approved design data and airworthiness.

NOTE: In case of parts to be exported, the special reqirements of the importing country have been met.

19.
Return to Service in Accordance with FAR 43.9

Certifies that the work specified in block 13 (or attached) above was carried out in accordance with FAA airworthiness regulations and in respect to the work performed the part(s) is (are) approved for return to service.

15. Signature	16. FAA Authorization No.:	20. Authorized Signature:	21. Certificate Number:
	SEATTLE MIDO		
17. Name *(Typed or Printed)*:	**18. Date:**	**22. Name *(Typed or Printed)***	**23. Date:**
JAMES W. DOYLE	10/22/97		

FAA Form 8130-3 (11-93)

* (Optional) Installer must cross check eligibility with applicable technical data.

1. UNITED STATES

2. **FAA FORM 8130-3**
AIRWORTHINESS APPROVAL TAG
U.S. Department of Transportation
Federal Aviation Administration

3. System Tracking Ref. No.: 102297 JWD . 3

4. Organization: PAC-USA REDMOND, OR

5. Work Order, Contract, or Invoice Number:

6. Item	7. Description	8. Part Number	9. Eligibility *	10. Quantity	11. Serial/Batch Number	12. Status/Work
1	ASTM D695 TEST PNL	N/A	LC 40	1	N/A	TEST

13. Remarks

DWG MX 513605 REV N/C 9/9/97
WO 97-00591

Limited life parts must be accompanied by maintenance history including total time/total cycles/time since new.

14. New ☒
Newly Overhauled ☐

Certifies that the new or newly overhauled part(s) identified above, except as otherwise specified in block 13 was (were) manufactured in accordance with FAA approved design data and airworthiness.

NOTE: In case of parts to be exported, the special reqirements of the importing country have been met.

19. **Return to Service in Accordance with FAR 43.9**

Certifies that the work specified in block 13 (or attached) above was carried out in accordance with FAA airworthiness regulations and in respect to the work performed the part(s) is (are) approved for return to service.

15. Signature	16. FAA Authorization No.:	20. Authorized Signature:	21. Certificate Number:
	SEATTLE MIDO		
17. Name *(Typed or Printed)*: JAMES W. DOYLE	**18. Date:** 10/22/97	**22. Name *(Typed or Printed)***	**23. Date:**

FAA Form 8130-3 (11-93)

* (Optional) Installer must cross check eligibility with applicable technical data.

1. UNITED STATES

2. **FAA FORM 8130-3**
AIRWORTHINESS APPROVAL TAG
U.S. Department of Transportation
Federal Aviation Administration

3. System Tracking Ref. No. 102297JWD-2

4. Organization: PAC-USA REDMOND, OR

5. Work Order, Contract, or Invoice Number:

6. Item	7. Description	8. Part Number	9. Eligibility *	10. Quantity	11. Serial/Batch Number	12. Status/Work
1	ASTM D3039 TEST PNL	N/A	LC 40	1	N/A	TEST

13. Remarks

DWG MX 513605 REV N/C 9/9/97
WO 97-00591

Limited life parts must be accompanied by maintenance history including total time/total cycles/time since new.

14. New ☒ Newly Overhauled ☐

Certifies that the new or newly overhauled part(s) identified above, except as otherwise specified in block 13 was (were) manufactured in accordance with FAA approved design data and airworthiness.

NOTE: In case of parts to be exported, the special reqirements of the importing country have been met.

19. **Return to Service in Accordance with FAR 43.9**

Certifies that the work specified in block 13 (or attached) above was carried out in accordance with FAA airworthiness regulations and in respect to the work performed the part(s) is (are) approved for return to service.

15. Signature	16. FAA Authorization No.:	20. Authorized Signature:	21. Certificate Number:
James W. Doyle	SEATTLE MIDO		
17. Name *(Typed or Printed)*:	**18. Date:**	**22. Name *(Typed or Printed)***	**23. Date:**
JAMES W. DOYLE	10/22/97		

FAA Form 8130-3 (11-93)

* (Optional) Installer must cross check eligibility with applicable technical data.

1. UNITED STATES

2. **FAA FORM 8130-3**
AIRWORTHINESS APPROVAL TAG
U.S. Department of Transportation
Federal Aviation Administration

3. System Tracking Ref. No.: 102297 JWD - 1

4. Organization: DAC-USA REDMOND, OR

5. Work Order, Contract, or Invoice Number:

6. Item	7. Description	8. Part Number	9. Eligibility *	10. Quantity	11. Serial/Batch Number	12. Status/Work
1	ASTM D5418 TEST PNL	N/A	LC40	1	N/A	TEST

13. Remarks

DWG MX 513605 REV N/C 9/9/97
WO 97-00591

Limited life parts must be accompanied by maintenance history including total time/total cycles/time since new.

14. New [X]
Newly Overhauled [ ]

Certifies that the new or newly overhauled part(s) identified above, except as otherwise specified in block 13 was (were) manufactured in accordance with FAA approved design data and airworthiness.

NOTE: In case of parts to be exported, the special reqirements of the importing country have been met.

19. **Return to Service in Accordance with FAR 43.9**

Certifies that the work specified in block 13 (or attached) above was carried out in accordance with FAA airworthiness regulations and in respect to the work performed the part(s) is (are) approved for return to service.

15. Signature	16. FAA Authorization No.:	20. Authorized Signature:	21. Certificate Number:
James W. Doyle	SEATTLE MIDO		
17. Name *(Typed or Printed)*: JAMES W. DOYLE	**18. Date:** 10/22/97	**22. Name** *(Typed or Printed)*	**23. Date:**

FAA Form 8130-3 (11-93)

* (Optional) Installer must cross check eligibility with applicable technical data.

1. UNITED STATES

2. **FAA FORM 8130-3**
AIRWORTHINESS APPROVAL TAG
U.S. Department of Transportation
Federal Aviation Administration

3. System Tracking Ref. No.: PAC-98-011

4. Organization: Pacific Aviation Composites USA LLC. 22550 Nelson Road. Bend, Or. 97701

5. Work Order, Contract, or Invoice Number: 98-00241

6. Item	7. Description	8. Part Number	9. Eligibility *	10. Quantity	11. Serial/Batch Number	12. Status/Work
1	Test Panels	N/A	N/A	22	N/A	Test Specimens

13. Remarks

"CONFORMITY INSPECTION ONLY". Test panel for testing I/A/W Document No. AX513001A, Rev 'A', dated 12/3/97, "Initial Material Qualification of MSG 418 Resin System with 7781 Glass Fabric and Plain Weave Carbon Cloth with AS4 3K Fibers for Wet Layup Epoxy Laminates". Conformed Test Panels I/A/W Appendix B. Panel Requirements, Table B.1 Glass Cloth Panel Requirements. Panels 7 thru 18 not comformed at this time. To be done at a later date. Panels 1 thru 37 to be tested, except panels 32,33 &34 are exempt from testing and are not included in this batch. Ref. FAA Form 8130-9, Statement of Conformity, dated 9/2/98 and FAA Form 8120-10, Request for Conformity, FAA Project No. TC1616SE-A, Dated 7/28/98.

Limited life parts must be accompanied by maintenance history including total time/total cycles/time since new.

14. New [x]
Newly Overhauled [ ]

Certifies that the new or newly overhauled part(s) identified above, except as otherwise specified in block 13 was (were) manufactured in accordance with FAA approved design data and airworthiness.

NOTE: In case of parts to be exported, the special reqirements of the importing country have been met.

19. **Return to Service in Accordance with FAR 43.9**

Certifies that the work specified in block 13 (or attached) above was carried out in accordance with FAA airworthiness regulations and in respect to the work performed the part(s) is (are) approved for return to service.

15. Signature	16. FAA Authorization No.:	20. Authorized Signature:	21. Certificate Number:
George B. Pittelkau	DARF351006NM		
17. Name *(Typed or Printed)*:	**18. Date:**	**22. Name *(Typed or Printed)***	**23. Date:**
George B. Pittelkau	9/8/98		

FAA Form 8130-3 (11-93)

* (Optional) Installer must cross check eligibility with applicable technical data.