Solvay (Formerly Cytec) 5320-1 T650 3k-PW fabric with 36% RC Equivalency Material Property Data Report for Laminate Repair Prepreg Batch

NCAMP Project Number: NPN 031801

NCAMP Test Report Number: CAM-RP-2019-045 Rev N/C

Report Date: December 19, 2019

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Rev	By	Date	Pages Revised or Added
N/C	Evelyn Lian	12/19/2019	Document Initial Release

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1. Introduction

1.1 Scope

The test methods and results described in this document are intended to provide basic composite properties essential to most methods of analysis and are consistent with CMH-17-1G—Composite Materials Handbook for Polymer Matrix Composites. This report contains material property data of common usefulness to wide range of projects. The lamina and laminate material property data have been generated with NCAMP oversight in accordance with NSP 100 NCAMP Standard Operating Procedures; the test panels and test specimens have been inspected by NCAMP Authorized Inspection Representatives (AIR) and the testing has been witnessed by NCAMP Authorized Engineering Representatives (AER). However, the data may not fulfill all the needs of any specific company's program; specific properties, environments, laminate architecture, and loading situations may require additional testing.

The use of NCAMP material and process specifications does not guarantee material or structural performance. Material users should be actively involved in evaluating material performance and quality including, but not limited to, performing regular purchaser quality control tests, performing periodic equivalency/additional testing, participating in material change management activities, conducting statistical process control, and conducting regular supplier audits.

The applicability of NCAMP material property data, material allowables, and specifications must be evaluated on a case-by-case basis by aircraft companies and certifying agencies. NCAMP assumes no liability whatsoever, expressed or implied, related to the use of the material property data, material allowables and specifications.

This report contains material property data only. Equivalency statistical analysis data is given in NCP-RP-2018-017 Rev N/C and engineering basis values generated from material qualification testing can be obtained from NCP-RP-2012-023 Rev N/C or later revisions. The equivalency material was procured to NCAMP Material Specification NMS 532/6 Rev A Release dated September 19, 2016. The equivalency test panels were cured in accordance with NCAMP Process Specification NPS 85321 Revision C dated May 31, 2018 Baseline “C” Cure Cycle. The NCAMP Test Plan NTP 5325QR1 was used for this equivalency program.

Part fabricators that wish to utilize the material property data, allowables and specifications may be able to do so by demonstrating the capability to reproduce the original material properties; a process known as equivalency. More information about this equivalency process including the test statistics and its limitations can be found in Section 6 of DOT/FAA/AR-03/19 and Section 8.4.1 of CMH-17-1G. The applicability of equivalency process must be evaluated on program-by-program basis by the applicant and certifying agency. The applicant and certifying agency must agree that the equivalency test plan, along with the equivalency process described in Section 6 of DOT/FAA/AR-03/19 and Section 8.4.1 of CMH-17-1G, are adequate for the given program.

Aircraft companies should not use the data published in this report without specifying NCAMP Material Specification NMS 532/6. NMS 532/6 have additional requirements that are listed in its prepreg process control document (PCD), fiber specification, fiber PCD and other raw material specifications and PCDs which impose essential quality controls on the raw materials and raw material manufacturing equipment and processes. *Aircraft companies and certifying agencies should assume that the material property data published in this report is not applicable when the material is not procured to NMS 532/6.* NMS 532/6 is a free, publicly available, non-proprietary aerospace industry material specification.

The data in this report is intended for general distribution to the public, either freely or at a price that does not exceed the cost of reproduction (e.g. printing) and distribution (e.g. postage).

1.2 Symbols

ν_{12}^{t}	major Poisson's ratio, tension
$\mu\varepsilon$	micro-strain
E_1^{c}	compressive modulus, longitudinal / warp direction
E_1^{t}	tensile modulus, longitudinal / warp direction
E_2^{c}	compressive modulus, transverse / fill direction
E_2^{t}	tensile modulus, transverse / fill direction
F_1^{cu}	ultimate compressive strength, longitudinal / warp direction
F_1^{tu}	ultimate tensile strength, longitudinal / warp direction
F_2^{cu}	ultimate compressive strength, transverse / fill direction
F_2^{tu}	ultimate tensile strength, transverse / fill direction
SBS	short beam strength
ν_{12}^{c}	major Poisson's Ratio, compression
ν_{21}^{c}	minor Poisson's Ratio, compression
$F_{12}^{s5\% \text{ strain}}$	in-plane shear strength at 5% strain
$F_{12}^{s0.2\%}$	in-plane shear strength at 0.2% offset
G_{12}^{s}	in-plane shear modulus

Superscripts

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

Subscripts

1	axis; longitudinal / warp direction (parallel to warp direction of reinforcement)
2	axis; transverse / fill direction (parallel to fill direction of reinforcement)
12	in-plane

Acronyms and Definitions

ASTM	American Society for Testing and Materials
B – Basis	95% lower confidence limit on the tenth population percentile
CV	Coefficient of variation
CTD	cold temperature dry
CPT	cured ply thickness
ETD	elevated temperature dry
ETW	elevated temperature wet
Gr/Ep	graphite/epoxy
norm	normalized
RTD	room temperature dry
SACMA	Suppliers of Advanced Composite Materials Association
SRM	SACMA Recommended Method
Tply	thickness divided by the number of plies provides the thickness average per specimen
wet	specimen with an “equilibrium” moisture content
T, RH	temperature, relative humidity

1.3 NIAR–Specimen Naming Format

NAMING FORMAT — Lamina & Laminate Tests (Equivalency)

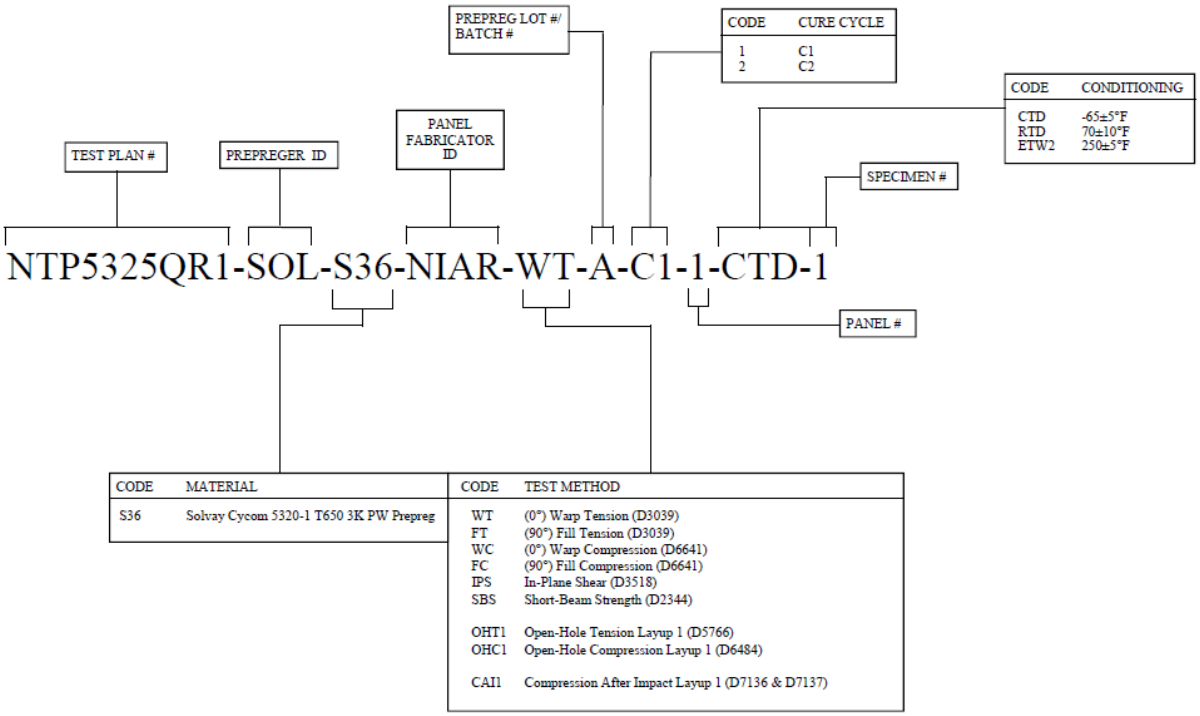


Figure 1-1: Material Naming Format

1.4 References

ASTM Standards

All testing was in accordance with nationally recognized standards, methods and procedures. Specific mechanical property test methods applicable to the test program in this document include:

- ASTM D2344/D2344M-16 – Standard Test Method for Short-Beam Strength of Polymer Matrix Composite Materials and Their Laminates
- ASTM D3039/D3039M-17 – Standard Test Method for Tensile Properties of Polymer Matrix Composite Materials
- ASTM D3518/D3518M-18 – Standard Test Method for In-Plane Shear Response of Polymer Matrix Composite Materials by Tensile Test of a ± 45º Laminate
- ASTM D5766/D5766M-11(2018) – Standard Test Method for Open Hole Tensile Strength of Polymer Matrix Composite Laminates
- ASTM D6484/D6484M-14 – Standard Test Method for Open-Hole Compressive Strength of Polymer Matrix Composite Laminates
- ASTM D6641/D6641M-16e1 – Standard Test Method for Compressive Properties of Polymer Matrix Composite Materials Using a Combined Loading Compression (CLC) Test Fixture
- ASTM D7028-07(2015) – Standard Test Method for Glass Transition Temperature (DMA Tg) of Polymer Matrix Composites by Dynamic Mechanical Analysis (DMA)
- ASTM D7136/D7136M-15 – Standard Test Method for Measuring the Damage Resistance of a Fiber-Reinforced Polymer Matrix Composite to a Drop-Weight Impact Event
- ASTM D7137/D7137M-17 – Standard Test Method for Compressive Residual Strength Properties of Damaged Polymer Matrix Composite Plates
- ASTM D8131/D8131M-17e1 – Standard Test Method for Tensile Properties of Tapered and Stepped Joints of Polymer Matrix Composite Laminates

1.5 Methodology

1.5.1 Process Definition

A single batch of prepreg was used to demonstrate equivalency. These single batch tests are designed to demonstrate equivalency with the original three batches qualification data for purposes described in CMH-17-1G Section 8.4.1 and DOT/FAA/AR-03/19 Section 6.

For each combination of test, batch and condition, the specimens were selected from a minimum of two separate panels cured separately as shown in Figure 1-2 unless otherwise specified.

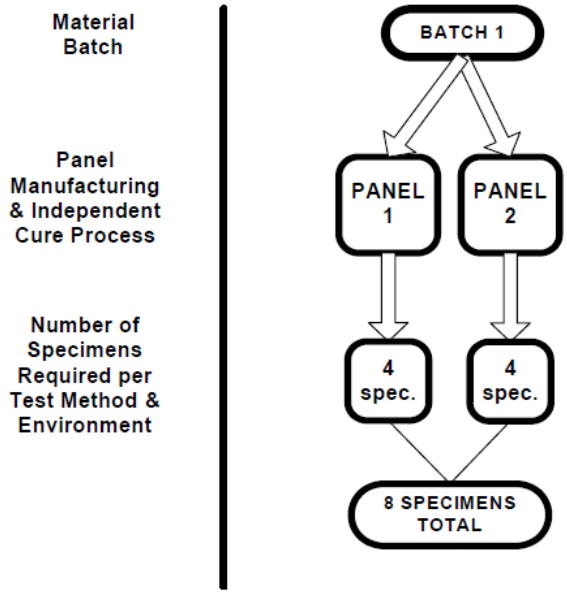


Figure 1-2: Specimen Selection Methodology - Equivalency

All panels were fabricated in accordance with NCAMP Process Specification NPS 85321 using Baseline “C” Cure Cycle.

In order to facilitate individual specimen traceability, individual specimen numbering and/or skewed lines were written or drawn across each sub-panel as shown in Figure 1-3.

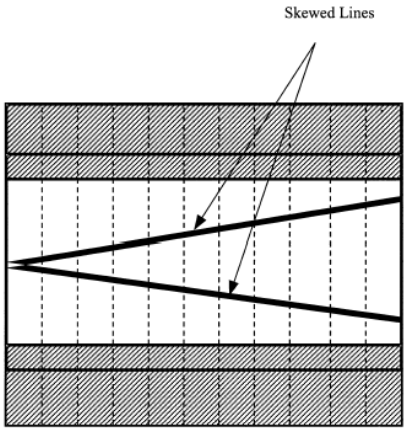


Figure 1-3: Specimen Traceability Line

1.5.2 Specimen & Testing Details

1.5.2.1 Tabbing

Tabs were not used for this program.

1.5.2.2Specimen Strain Device Used

Corresponding Gage ID can be obtained from Appendix 1 of NTP 5325QR1.

Uniaxial gages were used on:

All CTD Fill Tension specimens

Two of RTD Fill Tension specimens from each cure cycle for obtaining full stress strain curves

All conditions of combined loading compression specimens

Two of RTD OHC specimens from each cure cycle for detecting buckling

One CAI un-impacted specimen for balancing

Biaxial gages were used on:

All CTD Warp Tension specimens

Two of RTD Warp Tension specimens from each cure cycle for obtaining full stress strain curves

Four of ETW2 Warp Tension specimens from each cure cycle

All conditions of IPS specimens

Uniaxial Extensometers were used on:

Remaining of RTD and all ETW2 Fill Tension specimens

Biaxial Extensometers were used on:

Remaining of RTD and ETW2 Warp Tension specimens

1.5.3 Test Matrix

The table below shows lay-ups and test matrices used for lamina and laminate level testing on the single batch equivalency of the Solvay 5320-1 T650 3k PW prepreg material.

Layup	Test Type and Direction	Property	Number of Batches x Number of Panels x Number of Specimens		
			Test Temperature/ Moisture Condition		
			CTD	RTD	ETW2
$[0]_{15}$	ASTM D3039 Warp Tension	Strength, Modulus and Poisson's Ratio	1x2x4	1x2x4 (4)	1x2x4
$[0]_{15}$	ASTM D6641 Warp Compression	Strength, Modulus and Poisson's Ratio	1x2x4	1x2x4 (1)(4)	1x2x4 (3)
$[90]_{15}$	ASTM D3039 Fill Tension	Strength and Modulus	1x2x4	1x2x4 (4)	1x2x4
$[90]_{15}$	ASTM D6641 Fill Compression	Strength and Modulus	1x2x4	1x2x4 (1)(4)	1x2x4 (3)
$[45/-45]_{3S}$	ASTM D3518 In-Plane Shear (2)	Strength and Modulus	1x2x4	1x2x4 (4)	1x2x4
$[0]_{32}$	ASTM D2344 Short Beam	Strength	1x2x4	1x2x4	1x2x4
(25/50/25 - QI) [45/0/-45/90]2S	ASTM D5766 Open-Hole Tension	Strength		1x2x4	1x2x4
(25/50/25 - QI) [45/0/-45/90/45/0/-45/90/-45/90]S	ASTM D6484 Open-Hole Compression (5)	Strength		1x2x4 (1)	1x2x4
(25/50/25 - QI) [45/0/-45/90]3S	ASTM D7136 & D7137 Compression After Impact (1500 in/lb/in)	Strength		1x2x4	

Table 1-1: Equivalency Test Matrix

Note 1: Back-to-back strain gages are needed on the first two specimens. If no buckling is observed, the remaining modulus specimens will require a strain gage on one side of the specimens only. An appropriate extensometer may be used in place of the strain gage.

Note 2: Gripped (tab) length is 1.5±0.5" on each end of the 10" long specimen. Once the samples have reached the 5% strain level, the actuator/crosshead displacement rate can be increased by four times the initial rate. Continue testing at the higher strain rate until ultimate failure is observed.

Note 3: If strain gage is used for modulus measurement, a separate un-gaged specimen must be used for strength measurement; because the strain gage and its protective coating may prevent moisture absorption in the gage area.

Note 4: At least two specimens must be gaged to obtain full stress-strain curve to failure. An appropriate extensometer may be used in place of the strain gage for the remaining specimens.

Note 5: Open-hole configuration: 0.25" hole diameter, 1.5" width.

Table 1-1 shows the single batch of the Solvay 5320-1 T650 3k PW prepreg test matrix. The layup angles 0º, 45º, -45º and 90º refer to the orientation of the warp direction. The laminate stacking sequences in this program are not specific to any design. Therefore, careful consideration should be given to the validity of properties derived from this program based on the design specific laminates in a structure to be certified.

1.5.4 Cured Laminate Physical Testing

The properties in Table 1-2 were determined for each panel used for test coupons with the exception of Tg by DMA which were conducted on one laminate per batch from each oven cure conducted where that batch is present. The tests were performed by the National Institute for Aviation Research (NIAR) Composites Laboratory under the supervision of NCAMP.

Property	**Condition/Method** (Note 1)	**Min Replicates per panel**
Cured Ply Thickness	ASTM D3171-11	All data from mechanical test specimens
Laminate Density	ASTM D792-08	3
Fiber Volume, % by Volume	ASTM D3171-11 (Note 2)	3
Resin Content, % by Weight	ASTM D3171-11 (Note 2)	3
Ultrasonic Through Transmission, C-Scan	MIL-HDBK-787A (Note 3)	1
Glass Transition Temperature, Tg	Dry and Wet – ASTM D7028	1 Dry, 1 Wet (Note 4)

Table 1-2: Physical Testing Matrix

Note 1: Where the applicable standard allows variations in specimen form or test method, the specific parameters to be used will be specified in the test work instructions and reported in the final test report.
Note 2: Method II
Note 3: Five MHz is preferred for solid laminates. Panels with anomaly should be segregated. Microscopy images may be taken from questionable areas. NCAMP must be involved in the review of all C-scans.
Note 4: Minimum a total of 8 dry and 8 wet.

1.5.5 Environmental Conditioning

The following tests were performed by the NIAR Composites Laboratory under the supervision of NCAMP.

Test environments are defined as:

CTD = -65±5°F, dry
RTD = 70±10°F, dry
ETW2 = 250±5°F, wet

Within each test method and test environment, the failure mode was evaluated immediately after each test by an NCAMP staff engineer or NCAMP AER. All tested specimens were digitally photographed after each test in order to pictorially document failure modes.

For dry testing, specimens were dried at 250°F±5°F for at least 24 hours. After drying, specimens were kept in a desiccator until mechanical testing. Alternatively, the specimens may have been left ambient laboratory condition for a maximum of 14 days until mechanical testing (no drying was required if specimens were tested within 14 days from the date they were cured). Ambient laboratory condition is defined as 70°F±10°F. Since moisture absorption and desorption rate for epoxy is very slow at ambient temperature, there was no requirement to maintain relative humidity levels.

For wet conditioning, specimens were dried at 250°F±5°F for a minimum of 24 hours before being conditioned to equilibrium at 160°F±5°F and 85% ± 5%. Effective moisture equilibrium was achieved when the average moisture content of the traveler specimen changed by less than 0.02% for two consecutive readings which are 7 ±0.5 days apart and may be expressed by:

$$\frac{W_i - W_{i-1}}{W_b} < 0.0002$$

Where:

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

When representative specimens could not be measured to determine the moisture content (due to size, fastener and tab effects), traveler coupons of at least 1” by 1” by specimen thickness and weighing at least 15 grams were used to establish weight gain measurements. If the specimens or traveler coupons passed the criteria for two consecutive readings which are 7±0.5 days apart, the specimens were kept in the environmental chamber for up to an additional 60 days. Alternatively, the specimens may have been removed from the environmental chamber and placed in a sealed plastic bag along with a moist 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 gauges in ambient laboratory conditions.

1.5.6 Non-ambient Testing

The chamber was of adequate size so that all test fixtures and load frame grips were contained within the chamber.

For elevated temperature testing, the temperature chamber, test fixture, and grips were preheated to the specified temperature. Each specimen was heated to the required test temperature as verified by a thermocouple in direct contact with and taped to the specimen gage section. The heat-up time of the specimen did not exceed 5 minutes, unless otherwise specified in individual test summary sheets. The test was started 5^{+1}_{-0} minutes after the specimen reached the test temperature. During the test, the temperature, as measured on the specimen, was within ±5°F of the required test temperature.

For subzero temperature testing, each specimen was cooled to the required test temperature as verified by a thermocouple in direct contact with and taped to the specimen gage section. The test started 5^{+1}_{-0} minutes after the specimen reached the test temperature. During the test, the temperature, as measured on the specimen, was within ±5°F of the required test temperature.

For wet specimens, the moisture loss was determined by subjecting representative specimens to the same amount of time required to heat-up and fail the specimens. For filled-hole or bearing specimens, fasteners were removed prior to conducting moisture loss measurements. For tabbed specimens, representative coupons without tabs and having the same number of plies were used to conduct the moisture loss measurements. A minimum of one specimen or representative coupon was used to measure the moisture loss for every combination of test temperature and stacking sequence.

1.5.7 Normalization Procedures

Most lamina level tension and compression strength and modulus properties, and all laminate level properties were normalized according to nominal cured ply thickness. Lamina level properties that were not normalized include 90º tensile strength and modulus (unidirectional only), 90º compressive strength and modulus (unidirectional only), in-plane shear strength and modulus, Poisson's ratio, SBS, and ILT. After normalizing, data scatter reduced or remained the same. If data scatter increased significantly after normalizing, the reason was investigated. Wherever properties are normalized, both measured and normalized data were reported.

The average cured ply thickness of 0.0077 inches has been used as the nominal cured ply thickness (CPT) for normalization purpose. This value was used in the normalization of data in the qualification program. The following normalization formula was used:

Normalized Value = Measured Value x Measured CPT / Nominal CPT.

1.5.8 Inspection Verification

The 1-batch equivalency panels have been fabricated according to the requirements of the test plan and conformed by an NCAMP AIR. The test specimens and test setup have also been conformed by an NCAMP AIR.

Testing was witnessed by NCAMP. Test setup and witnessing was delegated to an NCAMP AER. Mechanical testing was carried out at the National Institute for Aviation Research, Wichita State University.

1.5.9 Material Pedigree Information

The PMC Data Collection Template includes the material pedigree information required, such as material and batch information, as well as panel fabrication record, environmental conditioning, test equipment, and test procedures.

2. Test Results

2.1 Lamina Level Test Summary

Prepreg Material: Solvay 5320-1 T650 3k-PW fabric with 36% RC
Material Specification: NMS 532/6
Process Specification: NPS 85321 Baseline Cure Cycle
Fabric: T650 3k PW **Resin:** Cycom 5320-1
Tg(dry): 393.03°F **Tg(wet):** 314.21°F **Tg METHOD:** DMA (ASTM D7028)

Solvay 5320-1 T650 3k-PW fabric with 36% RC Lamina Properties Summary

LAMINA MECHANICAL PROPERTY SUMMARY
Data reported as: Normalized & Measured
(Normalized by CPT= 0.0077 inch)

Property	CTD Mean		RTD Mean		ETW2 Mean	
	Normalized	Measured	Normalized	Measured	Normalized	Measured
F_1^{tu} [ksi]	108.021	109.315	121.316	122.606	135.410	136.203
E_1^t [Msi]	9.806	9.923	9.755	9.858	9.751	9.809
ν_{12}^t		0.054		0.049		0.046
F_2^{tu} [ksi]	104.228	104.780	115.574	116.068	129.582	130.519
E_2^t [Msi]	9.805	9.857	9.627	9.669	9.700	9.770
F_1^{cu} [ksi]	131.625	133.299	122.163	123.121	77.107	76.933
E_1^c [Msi]	8.999	9.114	8.981	9.054	8.922	8.925
F_2^{cu} [ksi]	128.457	128.709	115.460	115.643	77.026	77.008
E_2^c [Msi]	8.889	8.907	8.773	8.786	8.792	8.794
$F_{12}^{s0.2\%}$ [ksi]		11.536		8.322		3.523
$F_{12}^{s5\%strain}$ [ksi]		18.308		14.455		6.712
G_{12}^s [Msi]		0.847		0.726		0.365
SBS [ksi]		14.356		12.983		6.945

Table 2-1: Lamina Summary Data

2.2 Laminate Level Test Summary

Prepreg Material: Solvay 5320-1 T650 3k-PW fabric with 36% RC
Material Specification: NMS 532/6
Process Specification: NPS 85321 Baseline Cure Cycle
Fabric: T650 3k PW **Resin:** Cycom 5320-1

Solvay 5320-1 T650 3k-PW fabric with 36% RC Laminate Properties Summary

Tg(dry): 393.03°F **Tg(wet):** 314.21°F **Tg METHOD:** DMA (ASTM D7028)

LAMINATE MECHANICAL PROPERTY SUMMARY
Data reported as: Normalized & Measured
(Normalized by CPT=0.0077 inch)

	Layup	25/50/25 (Quasi)		10/80/10 (Soft)		40/20/40 (Hard)	
Property	**Test Condition**	**Normalized**	**Measured**	**Normalized**	**Measured**	**Normalized**	**Measured**
OHT Strength [ksi]	**RTD**	43.951	43.910				
	ETW2	48.089	48.046				
OHC Strength [ksi]	**RTD**	48.841	48.733				
	ETW2	34.424	34.331				
CAI Strength [ksi]	**RTD**	32.943	32.873				

Table 2-2: Laminate Summary Data

2.3 Individual Test Summaries

2.3.1 Warp Tension Properties (WT)

Material:	Solvay 5320-1 T650 3k-PW fabric with 36% RC							**Tension, 1-axis** Solvay 5320-1 T650 3k-PW fabric with 36% RC [0]15	
Resin content:	37.53 %wt	**Comp. density:** 1.553 g/cc							
Fiber volume:	54.83 %vol								
Ply count:	15								
Test method:	ASTM D3039-17	**Modulus calculation:** 1000-3000 microstrain							
Normalized by:	0.0077 in. CPT								
		CTD		**RTD**		**ETW2**			
Test Temperature [°F]		-65		70		250			
Moisture Conditioning		Dry		Dry		Equilibrium			
Equilibrium at T, RH						160 F,85%			
Source code prefixed by: NTP-5325QRI-SOL-S36-NIAR-		WT-X-CX-1-CTD-X		WT-X-CX-1-RTD-X		WT-X-CX-1-ETW2-X			
		Normalized	**Measured**	**Normalized**	**Measured**	**Normalized**	**Measured**		
	Mean	108.021	109.315	121.316	122.606	135.410	136.203		
	Minimum	105.173	106.713	118.808	119.498	129.038	130.257		
	Maximum	111.779	113.515	124.669	126.754	140.538	142.805		
F_1^{tu} [ksi]	**C.V.(%)**	2.222	2.238	1.662	1.929	2.473	2.774		
	No. Specimens	8		9		16			
	No. Prepreg Lots	1		1		1			
	Mean	9.806	9.923	9.755	9.858	9.751	9.809		
	Minimum	9.728	9.838	9.663	9.775	9.487	9.456		
	Maximum	9.908	10.062	9.902	10.068	9.971	10.140		
E_1^t [Msi]	**C.V.(%)**	0.637	0.717	0.688	0.948	1.483	2.253		
	No. Specimens	8		9		16			
	No. Prepreg Lots	1		1		1			
	Mean		0.054		0.049		0.046		
	Minimum		0.049		0.042		0.034		
	Maximum		0.060		0.055		0.051		
ν_{12}^t	**C.V.(%)**		7.419		7.228		11.600		
	No. Specimens	8		9		8			
	No. Prepreg Lots	1		1		1			

2.3.2 Fill Tension Properties (FT)

Material: Solvay 5320-1 T650 3k-PW fabric with 36% RC

Resin content: 36.41 %wt **Comp. density:** 1.554 g/cc
Fiber volume: 55.81 %vol
Ply count: 15

Test method: ASTM D3039-17 **Modulus calculation:** 1000-3000 microstrain

Normalized by: 0.0077 in. CPT

Tension, 2-axis
Solvay 5320-1 T650 3k-PW fabric with 36% RC
[90]15

		CTD		RTD		ETW2	
Test Temperature [°F]		-65		70		250	
Moisture Conditioning		Dry		Dry		Equilibrium	
Equilibrium at T, RH						160 F,85%	
Source code prefixed by: NTP-5325QRI-SOL-S36-NIAR-		FT-X-CX-1R-CTD-X		FT-X-CX-1R-RTD-X		FT-X-CX-1R-ETW2-X	
		Normalized	**Measured**	**Normalized**	**Measured**	**Normalized**	**Measured**
	Mean	104.228	104.780	115.574	116.068	129.582	130.519
	Minimum	100.111	99.708	110.066	111.189	125.112	125.662
	Maximum	108.229	107.948	121.855	121.680	136.500	137.843
F_2^{tu} [ksi]	**C.V.(%)**	2.744	2.926	3.276	2.790	3.498	3.412
	No. Specimens	8		8		8	
	No. Prepreg Lots	1		1		1	
	Mean	9.805	9.857	9.627	9.669	9.700	9.770
	Minimum	9.656	9.671	9.562	9.556	9.527	9.610
	Maximum	9.875	9.986	9.721	9.820	10.037	10.033
E_2^t [Msi]	**C.V.(%)**	0.690	1.227	0.593	1.080	1.687	1.362
	No. Specimens	8		8		8	
	No. Prepreg Lots	1		1		1	

2.3.3 Warp Compression Properties (WC)

Material: Solvay 5320-1 T650 3k-PW fabric with 36% RC

Resin content: 37.60 %wt **Comp. density:** 1.549 g/cc
Fiber volume: 54.61 %vol
Ply count: 15

Test method: ASTM D6641-16e1 **Modulus calculation:** 1000-3000 microstrain

Normalized by: 0.0077 in. CPT

Compression, 1-axis
Solvay 5320-1 T650 3k-PW fabric with 36% RC
[0]15

		CTD		RTD		ETW2	
Test Temperature [°F]		-65		70		250	
Moisture Conditioning		Dry		Dry		Equilibrium	
Equilibrium at T, RH						160 F,85%	
Source code prefixed by: NTP-5325QRI-SOL-S36-NIAR-		WC-X-CX-1-CTD-X		WC-X-CX-1-RTD-X		WC-X-CX-1-ETW2-X	
		Normalized	**Measured**	**Normalized**	**Measured**	**Normalized**	**Measured**
	Mean	131.625	133.299	122.163	123.121	77.107	76.933
	Minimum	120.146	122.677	113.701	114.577	58.374	57.774
	Maximum	136.498	138.578	125.890	126.786	85.809	86.057
F_1^{cu} [ksi]	**C.V.(%)**	3.820	3.610	3.156	3.168	8.258	8.623
	No. Specimens	8		8		16	
	No. Prepreg Lots	1		1		1	
	Mean	8.999	9.114	8.981	9.054	8.922	8.925
	Minimum	8.667	8.806	8.856	8.919	8.830	8.779
	Maximum	9.627	9.733	9.239	9.339	9.043	9.099
E_1^c [Msi]	**C.V.(%)**	3.125	3.114	1.761	1.909	0.959	1.073
	No. Specimens	8		8		8	
	No. Prepreg Lots	1		1		1	

2.3.4 Fill Compression Properties (FC)

Material: Solvay 5320-1 T650 3k-PW fabric with 36% RC

Resin content: 36.47 %wt **Comp. density:** 1.553 g/cc
Fiber volume: 55.76 %vol
Ply count: 15

Test method: ASTM D6641-16e1 **Modulus calculation:** 1000-3000 microstrain

Normalized by: 0.0077 in. CPT

Compression, 2-axis
Solvay 5320-1 T650 3k-PW fabric with 36% RC
[90]15

		CTD		RTD		ETW2	
Test Temperature [°F]		-65		70		250	
Moisture Conditioning		Dry		Dry		Equilibrium	
Equilibrium at T, RH						160 F,85%	
Source code prefixed by: NTP5325QRI-SOL-S36-NIAR-		FC-X-CX-1R-CTD-X		FC-X-CX-1R-RTD-X		FC-X-CX-1R-ETW2-X	
		Normalized	**Measured**	**Normalized**	**Measured**	**Normalized**	**Measured**
	Mean	128.457	128.709	115.460	115.643	77.026	77.008
	Minimum	120.568	121.550	103.014	103.193	69.438	69.574
	Maximum	131.594	131.514	121.397	121.274	85.356	84.890
F_2^{cu} [ksi]	**C.V.(%)**	2.838	2.619	5.859	5.872	6.223	6.121
	No. Specimens	8		8		14	
	No. Prepreg Lots	1		1		1	
	Mean	8.889	8.907	8.773	8.786	8.792	8.794
	Minimum	8.740	8.703	8.665	8.680	8.659	8.634
	Maximum	9.115	9.189	9.057	9.064	8.909	8.918
E_2^c [Msi]	**C.V.(%)**	1.579	1.780	1.474	1.425	1.071	1.279
	No. Specimens	8		8		8	
	No. Prepreg Lots	1		1		1	

2.3.5 In-Plane Shear Properties (IPS)

In-Plane Shear
Solvay 5320-1 T650 3k-PW fabric with 36% RC
[45/-45]3S

Material:	Solvay 5320-1 T650 3k-PW fabric with 36% RC								
Resin content:	37.09 %wt	**Comp. density:**	1.551 g/cc						
Fiber volume:	55.12 %vol								
Ply count:	12								
Test method:	ASTM D3518-18	**Modulus calculation:**	2000-6000 microstrain						
Normalized by:	NA								
		CTD		**RTD**		**ETW2**			
Test Temperature [°F]		-65		70		250			
Moisture Conditioning		Dry		Dry		Equilibrium			
Equilibrium at T, RH						160 F,85%			
Source code prefixed by:	NTP-5325QRI-SOL-S36-NIAR-	IPS-X-CX-1-CTD-X		IPS-X-CX-1-RTD-X		IPS-X-CX-1-ETW2-X			
		Normalized	**Measured**	**Normalized**	**Measured**	**Normalized**	**Measured**		
$F_{12}^{s0.2\%}$ [ksi]	**Mean**		11.536		8.322		3.523		
	Minimum		11.169		8.230		3.434		
	Maximum		11.788		8.415		3.633		
	C.V.(%)		1.703		0.630		1.870		
	No. Specimens		10		8		8		
	No. Prepreg Lots		1		1		1		
$F_{12}^{s5\%strain}$ [ksi]	**Mean**		18.308		14.455		6.712		
	Minimum		17.843		14.289		6.549		
	Maximum		18.761		14.700		6.968		
	C.V.(%)		2.137		0.835		2.182		
	No. Specimens		5		8		8		
	No. Prepreg Lots		1		1		1		
G_{12}^{s} [Msi]	**Mean**		0.847		0.726		0.365		
	Minimum		0.827		0.717		0.357		
	Maximum		0.868		0.755		0.374		
	C.V.(%)		1.829		1.651		1.626		
	No. Specimens		10		8		8		
	No. Prepreg Lots		1		1		1		

2.3.6 Lamina Short-Beam Strength Properties (SBS)

Material:	Solvay 5320-1 T650 3k-PW fabric with 36% RC							**Short-Beam Strength** Solvay 5320-1 T650 3k-PW fabric with 36% RC [0]32	
Resin content:	37.05 %wt	**Comp. density:** 1.551 g/cc							
Fiber volume:	55.17 %vol								
Ply count:	32								
Test method:	ASTM D2344-16								
Normalized by:	NA								
		CTD		**RTD**		**ETW2**			
Test Temperature [°F]		-65		70		250			
Moisture Conditioning		Dry		Dry		Equilibrium			
Equilibrium at T, RH						160 F,85%			
Source code prefixed by: NTP-5325QRI-SOL-S36-NIAR-		SBS-X-CX-1-CTD-X		SBS-X-CX-1-RTD-X		SBS-X-CX-1-ETW2-X			
		Normalized	**Measured**	**Normalized**	**Measured**	**Normalized**	**Measured**		
	Mean		14.356		12.983		6.945		
	Minimum		13.810		12.760		6.739		
	Maximum		15.070		13.433		7.391		
SBS [ksi]	**C.V.(%)**		3.022		1.715		3.026		
	No. Specimens		8		8		8		
	No. Prepreg Lots		1		1		1		

2.3.7 "25/50/25" Open-Hole Tension 1 Properties (OHT1)

Material: Solvay 5320-1 T650 3k-PW fabric with 36% RC

Resin content: 37.65 % wt **Comp. density:** 1.544 g/cc
Fiber volume: 54.40 % vol
Ply count: 16

Test method: ASTM D5766-11

Normalized by: 0.0077 in. CPT

Open-Hole Tension 1
Solvay 5320-1 T650 3k-PW fabric with 36% RC
[45/0/-45/90]2S

		RTD		ETW2					
Test Temperature [°F]		70		250					
Moisture Conditioning		Dry		Equilibrium					
Equilibrium at T, RH				160 F,85%					
Source code prefixed by: NTP-5325QRI-SOL-S36-NIAR-		OHT1-X-CX-1-RTD-X		OHT1-X-CX-1-ETW2-X					
		Normalized	**Measured**	**Normalized**	**Measured**				
	Mean	43.951	43.910	48.089	48.046				
	Minimum	40.550	40.534	46.157	46.151				
	Maximum	46.590	46.634	49.744	49.663				
OHT1 Strength [ksi]	**C.V.(%)**	4.420	4.457	2.929	2.874				
	No. Specimens	8		8					
	No. Prepreg Lots	1		1					

2.3.8 “25/50/25” Open-Hole Compression 1 Properties (OHC1)

Material:	Solvay 5320-1 T650 3k-PW fabric with 36% RC					**Open-Hole Compression 1** Solvay 5320-1 T650 3k-PW fabric with 36% RC [45/0/-45/90/45/0/-45/90/-45/90]S		
Resin content:	37.47 %wt	**Comp. density:** 1.545 g/cc						
Fiber volume:	54.59 %vol							
Ply count:	20							
Test method:	ASTM D6484-14							
Normalized by:	0.0077 in. CPT							
		RTD		**ETW2**				
Test Temperature [°F]		70		250				
Moisture Conditioning		Dry		Equilibrium				
Equilibrium at T, RH				160 F,85%				
Source code prefixed by:	NTP-5325QRI-SOL-S36-NIAR-	OHC1-X-CX-1-RTD-X		OHC1-X-CX-1-ETW2-X				
		Normalized	**Measured**	**Normalized**	**Measured**			
	Mean	48.841	48.733	34.424	34.331			
	Minimum	47.549	47.462	32.504	32.316			
	Maximum	50.365	50.099	36.655	36.568			
OHC1 Strength [ksi]	**C.V.(%)**	1.718	1.623	3.808	3.830			
	No. Specimens	8		8				
	No. Prepreg Lots	1		1				

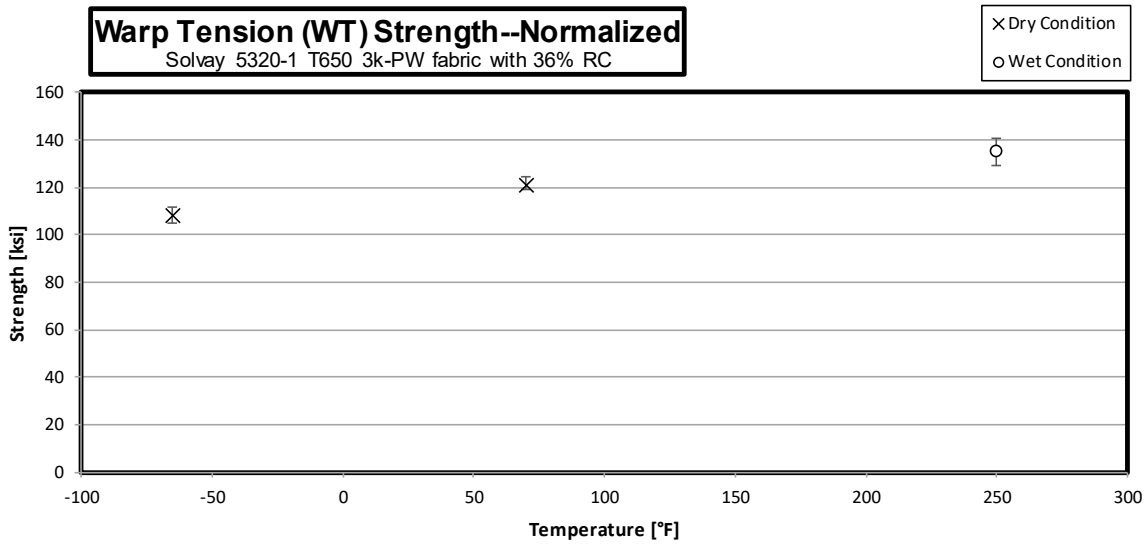
2.3.9 “25/50/25” Compression after Impact 1 Properties (CAI1)

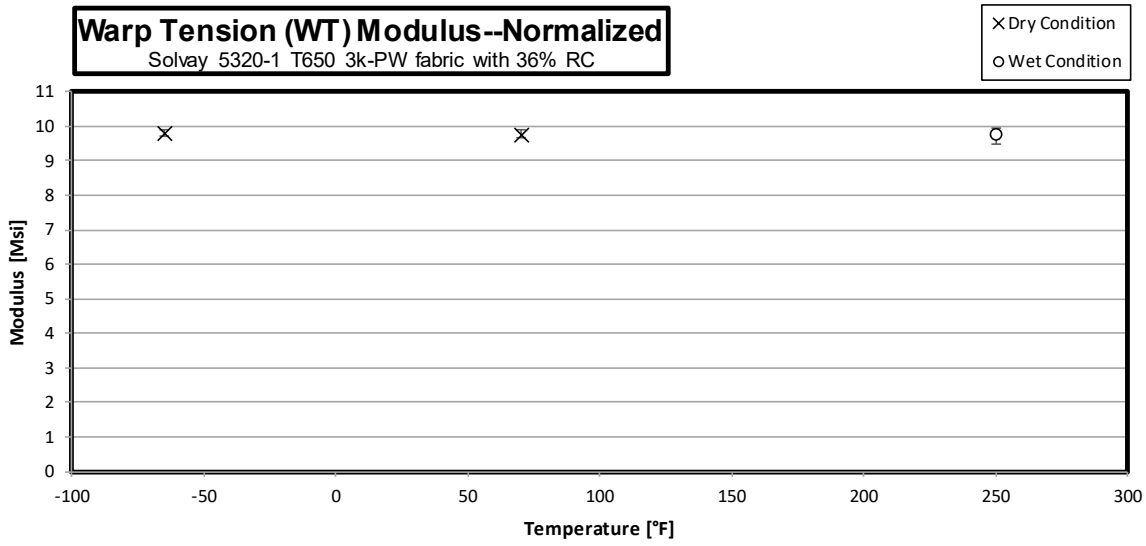
Material:	Solvay 5320-1 T650 3k-PW fabric with 36% RC						**Compression After Impact 1** Solvay 5320-1 T650 3k-PW fabric with 36% RC [45/0/-45/90]3S	
Resin content:	37.93 %wt	**Comp. density:** 1.547 g/cc						
Fiber volume:	54.25 %vol							
Ply count:	24							
Test method:	ASTM D7136-15/D7137-17							
Normalized by:	0.0077 in. CPT							
		RTD						
Test Temperature [°F]		70						
Moisture Conditioning		Dry						
Equilibrium at T, RH								
Source code prefixed by: NTP-5325QRI-SOL-S36-NIAR-		CAI1-A-CX-1-RTD-X						
		Normalized	**Measured**					
	Mean	32.943	32.873					
	Minimum	31.583	31.537					
	Maximum	34.104	34.241					
CAI1 Strength [ksi]	**C.V.(%)**	2.188	2.355					
	No. Specimens	8						
	No. Prepreg Lots	1						

3. Individual Test Charts

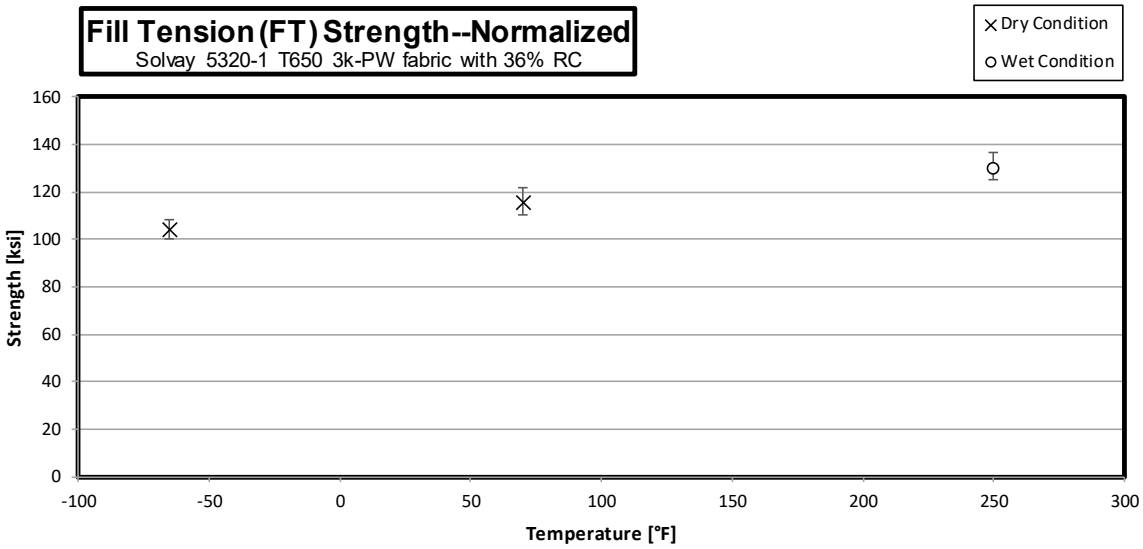
These charts combine all data and plot the minimum and maximum modulus and strength range based on the test temperature.

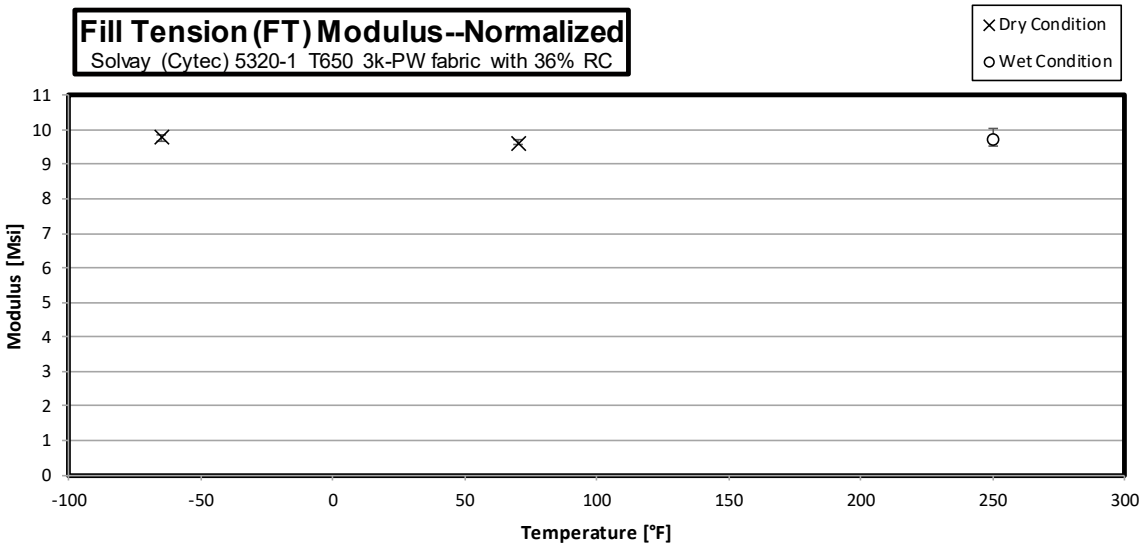
3.1 Warp Tension Properties (WT)



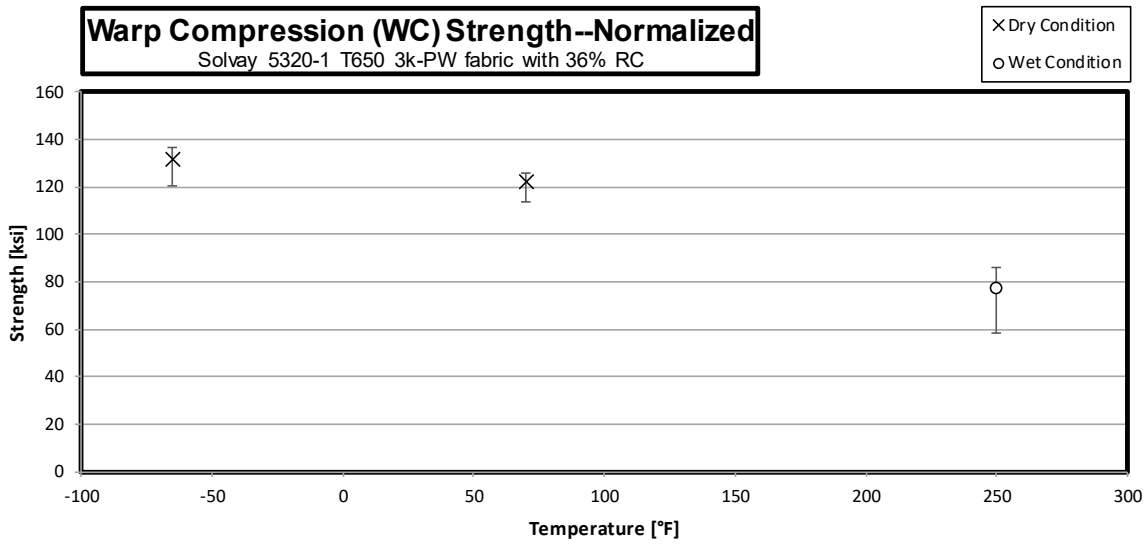


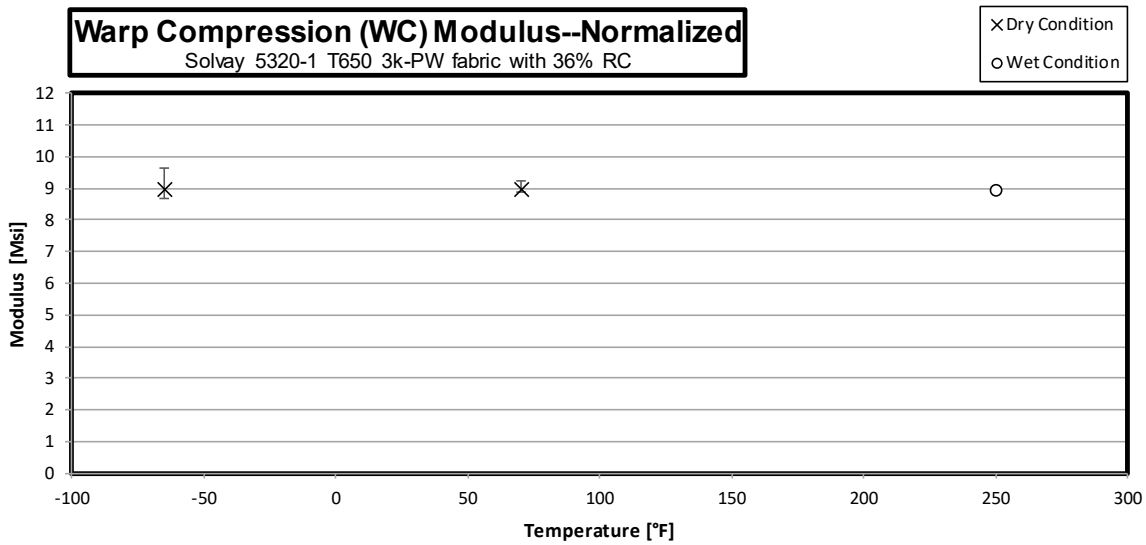
3.2 Fill Tension Properties (FT)



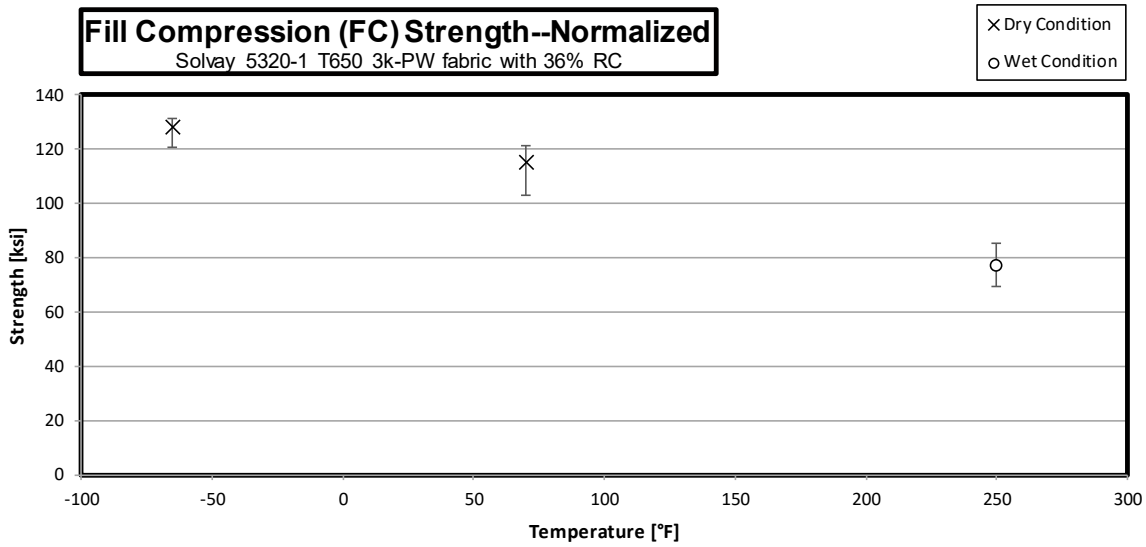


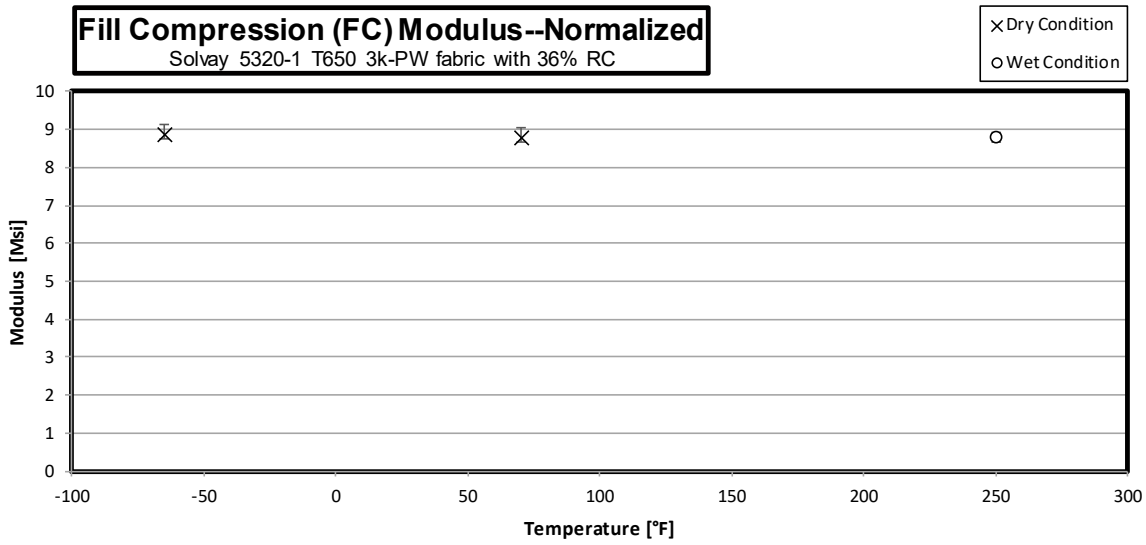
3.3 Warp Compression Properties (WC)



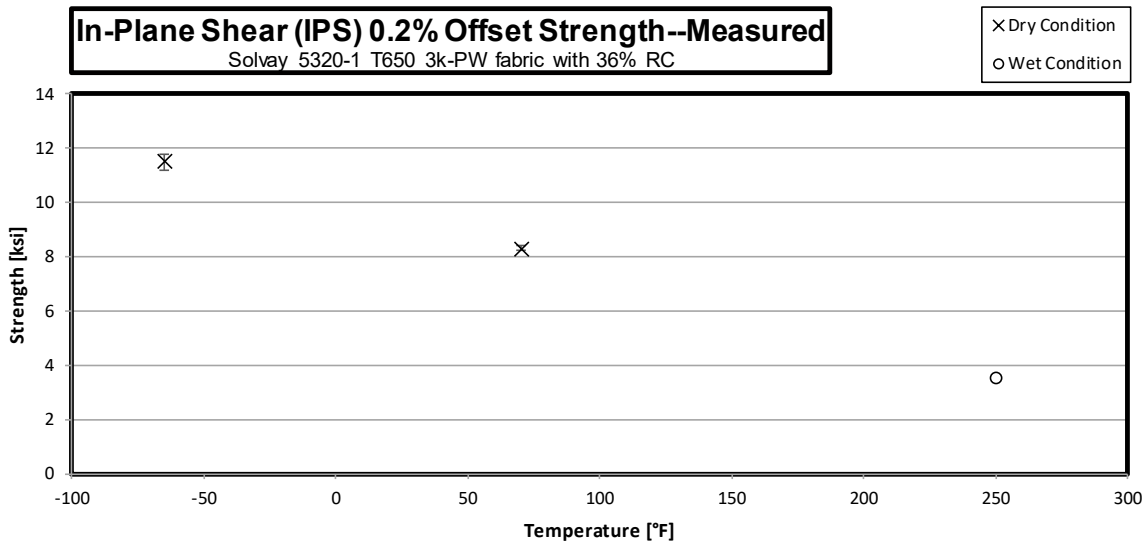


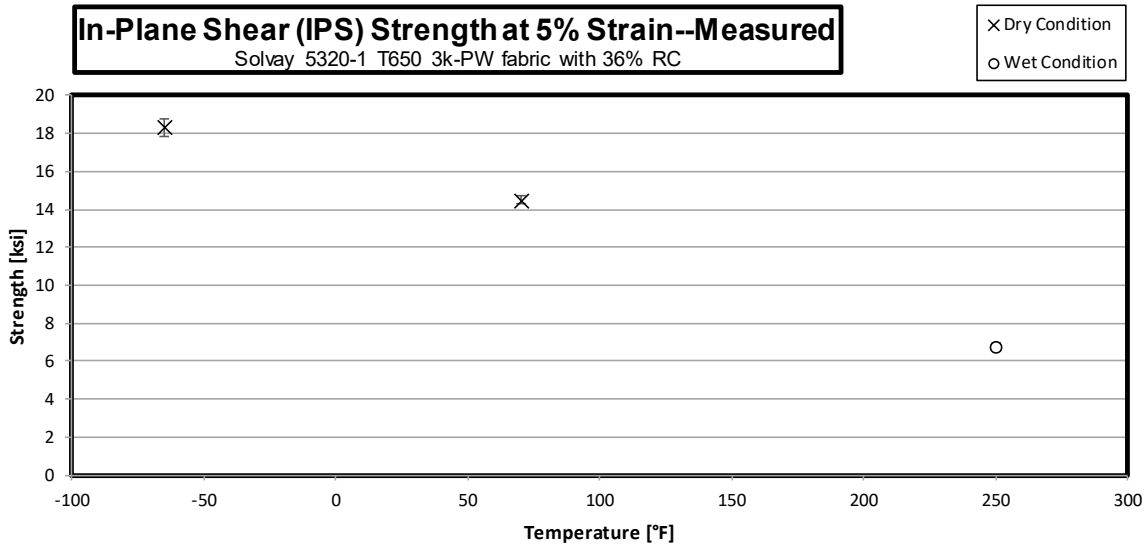
3.4 Fill Compression Properties (FC)

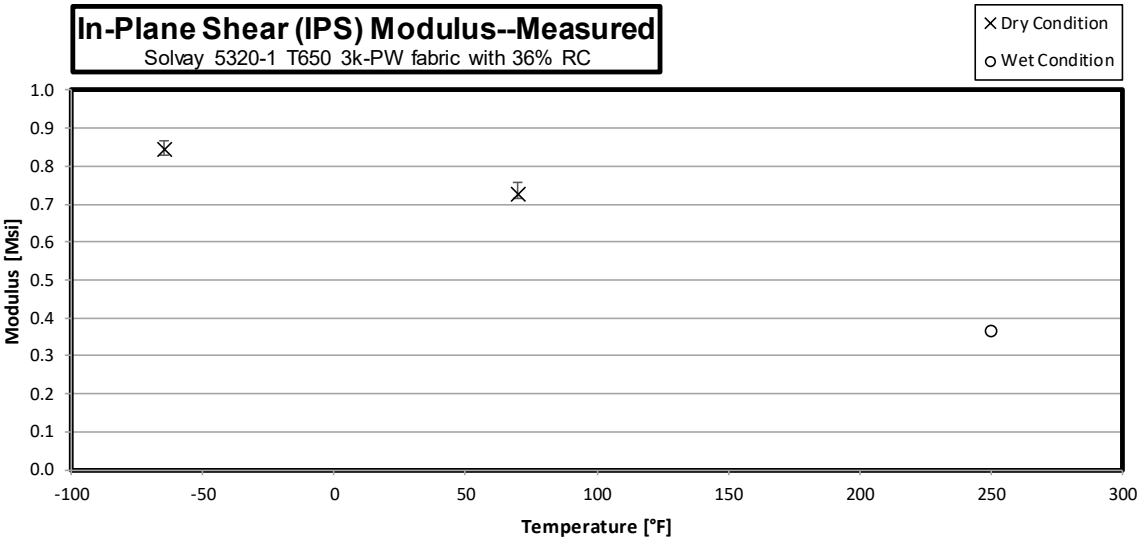




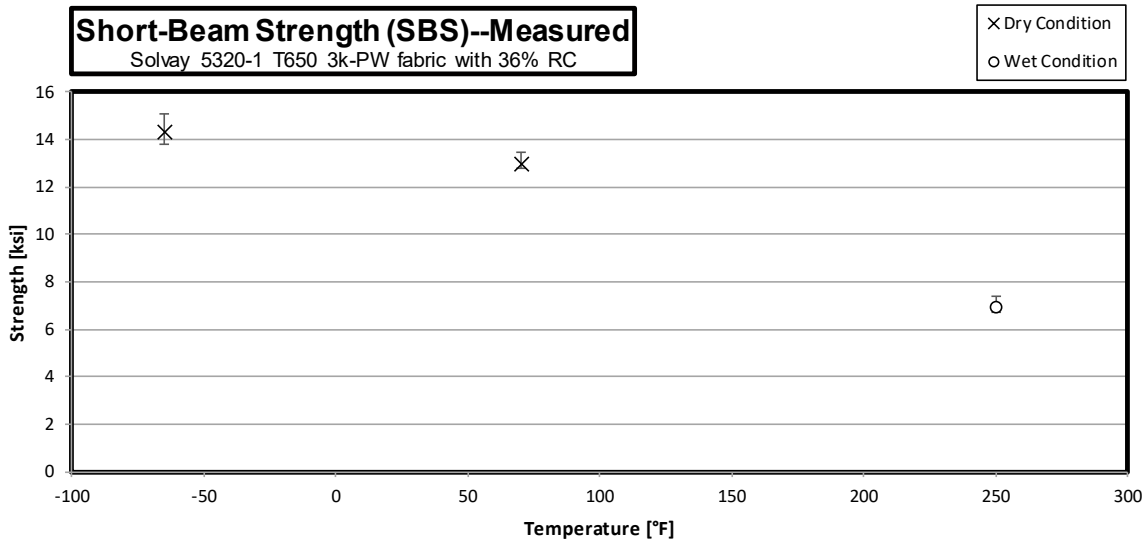
3.5 In-Plane Shear Properties (IPS)



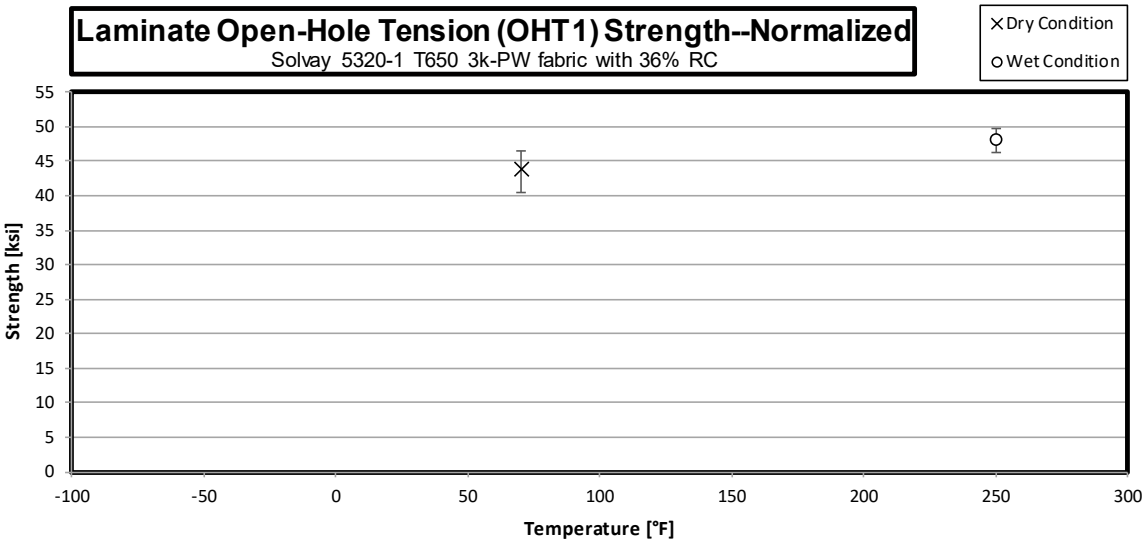



In-Plane Shear (IPS) Modulus--Measured
Solvay 5320-1 T650 3k-PW fabric with 36% RC
Dry Condition
Wet Condition
Modulus [Msi]
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-100
-50
0
50
100
150
200
250
300
Temperature [°F]

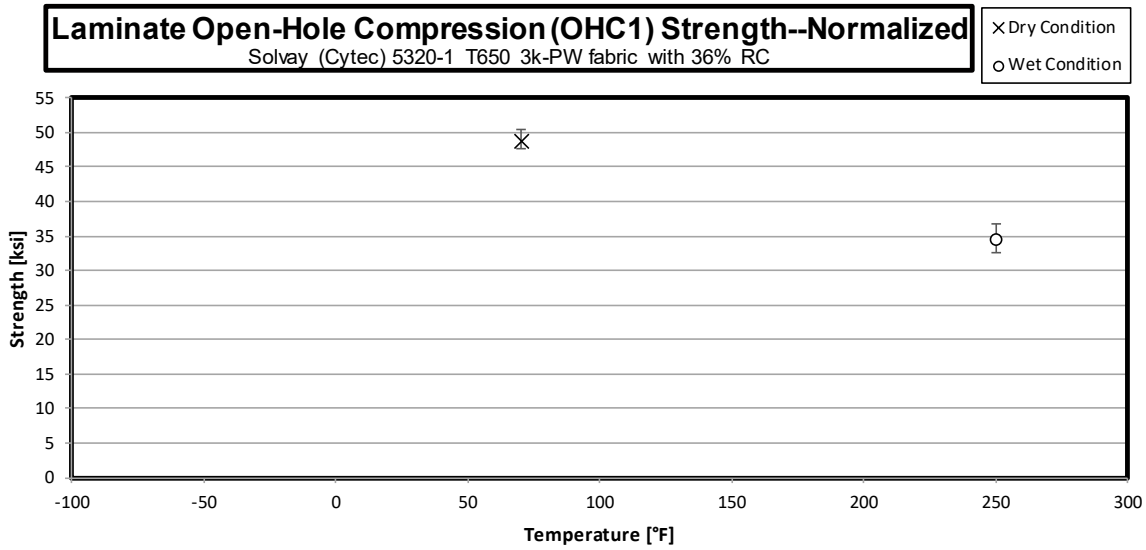
3.6 Lamina Short-Beam Strength Properties (SBS)



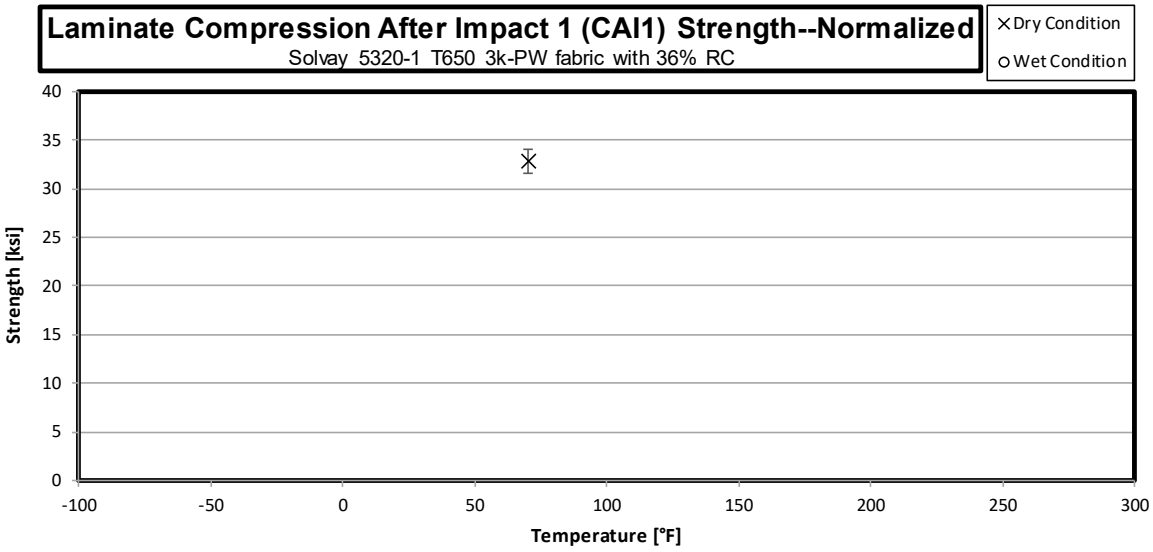
3.7 "25/50/25" Open-Hole Tension 1 Properties (OHT1)



3.8 "25/50/25" Open-Hole Compression 1 Properties (OHC1)



3.9 "25/50/25" Compression Strength After Impact 1 Properties (CAI1)



4. Raw Data

4.1 Warp Tension Properties (WT)

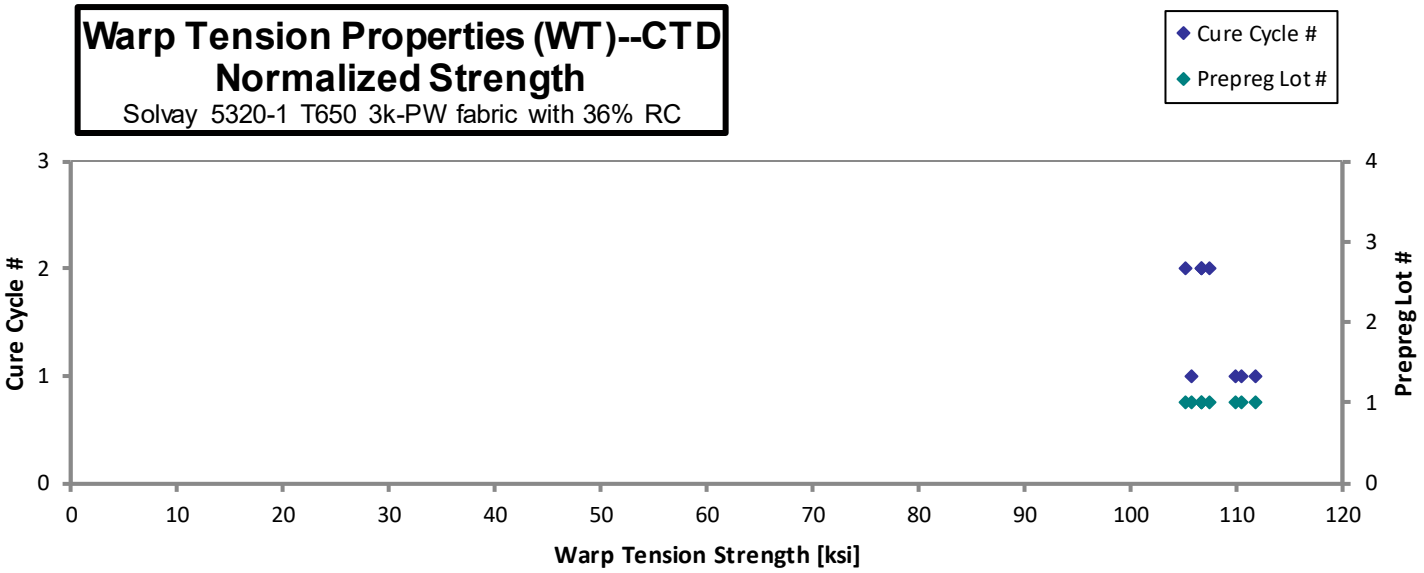
Warp Tension Properties (WT)--CTD
Strength & Modulus
Solvay 5320-1 T650 3k-PW fabric with 36% RC

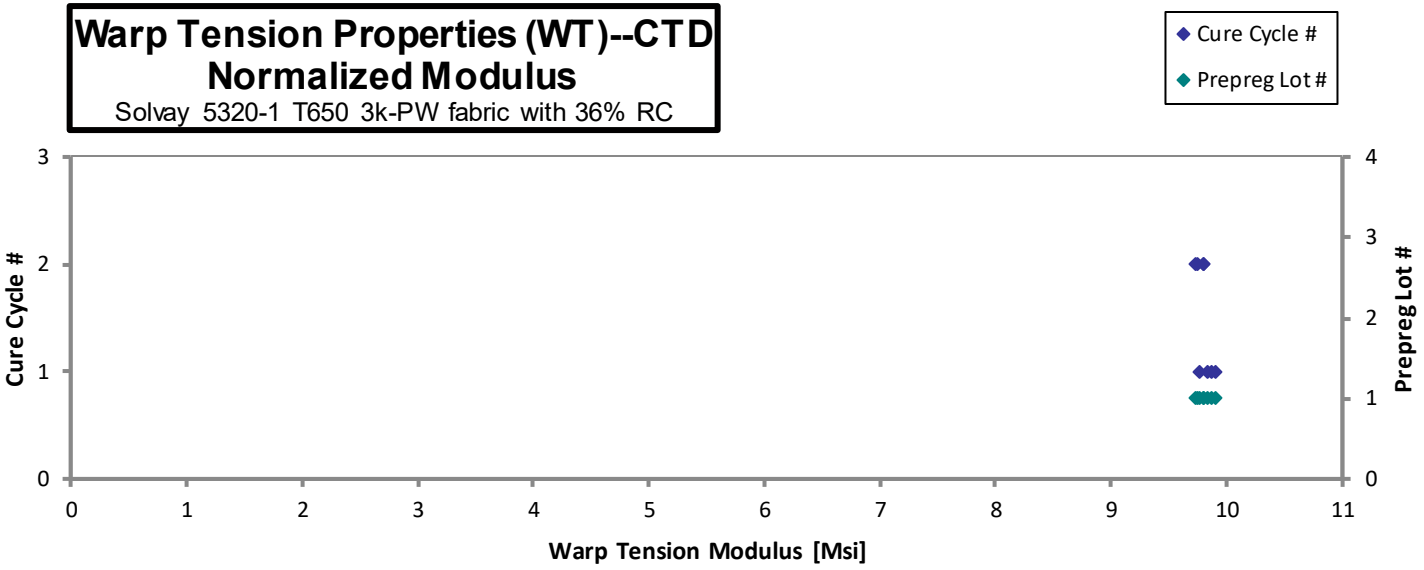
normalizing t_{ply} [in]
0.0077

Specimen Number	NIAR Batch #	NIAR Cure Cycle	Prepreg Lot #	Cure Cycle #	Strength [ksi]	Modulus [Msi]	Poisson's Ratio	Avg. Specimen Thickness [in]	# Plies in Laminate	Failure Mode	Avg. t_{ply} [in]	$Strength_{norm}$ [ksi]	$Modulus_{norm}$ [Msi]
NTP-5325QRI-SOL-S36-NIAR-WT-A-C1-1-CTD-1	A	C1	1	1	111.645	9.866	0.060	0.114	15	LGB	0.0076	110.517	9.767
NTP-5325QRI-SOL-S36-NIAR-WT-A-C1-1-CTD-2	A	C1	1	1	111.009	9.937	0.051	0.114	15	LGB	0.0076	109.888	9.837
NTP-5325QRI-SOL-S36-NIAR-WT-A-C1-1-CTD-3	A	C1	1	1	107.031	9.982	0.053	0.114	15	LAB	0.0076	105.810	9.868
NTP-5325QRI-SOL-S36-NIAR-WT-A-C1-1-CTD-4	A	C1	1	1	113.515	10.062	0.054	0.114	15	LGM	0.0076	111.779	9.908
NTP-5325QRI-SOL-S36-NIAR-WT-A-C2-1-CTD-1	A	C2	1	2	106.713	9.883	0.050	0.114	15	LGM	0.0076	105.173	9.740
NTP-5325QRI-SOL-S36-NIAR-WT-A-C2-1-CTD-2	A	C2	1	2	108.613	9.909	0.049	0.114	15	LGM	0.0076	107.500	9.808
NTP-5325QRI-SOL-S36-NIAR-WT-A-C2-1-CTD-3	A	C2	1	2	108.054	9.910	0.059	0.114	15	LGT	0.0076	106.760	9.792
NTP-5325QRI-SOL-S36-NIAR-WT-A-C2-1-CTD-4	A	C2	1	2	107.940	9.838	0.056	0.114	15	LGT	0.0076	106.741	9.728

Average	**109.315**	**9.923**	**0.054**
Standard Dev.	**2.447**	**0.071**	**0.004**
Coeff. of Var. [%]	**2.238**	**0.717**	**7.419**
Min.	**106.713**	**9.838**	**0.049**
Max.	**113.515**	**10.062**	**0.060**
Number of Spec.	**8**	**8**	**8**

$Average_{norm}$	**0.0076**	**108.021**	**9.806**
$Standard\ Dev._{norm}$		**2.400**	**0.062**
Coeff. of Var. $[\%]_{norm}$		**2.222**	**0.637**
Min.	**0.0076**	**105.173**	**9.728**
Max.	**0.0076**	**111.779**	**9.908**
Number of Spec.	**8**	**8**	**8**


Warp Tension Properties (WT)--CTD
Normalized Strength
Solvay 5320-1 T650 3k-PW fabric with 36% RC
Cure Cycle #
Prepreg Lot #
Cure Cycle #
Prepreg Lot #
Warp Tension Strength [ksi]
0
10
20
30
40
50
60
70
80
90
100
110
120
0
1
2
3
4


Warp Tension Properties (WT)--CTD
Normalized Modulus
Solvay 5320-1 T650 3k-PW fabric with 36% RC
Cure Cycle #
Prepreg Lot #
Cure Cycle #
Prepreg Lot #
Warp Tension Modulus [Msi]
0
1
2
3
4
5
6
7
8
9
10
11
0
1
2
3
4

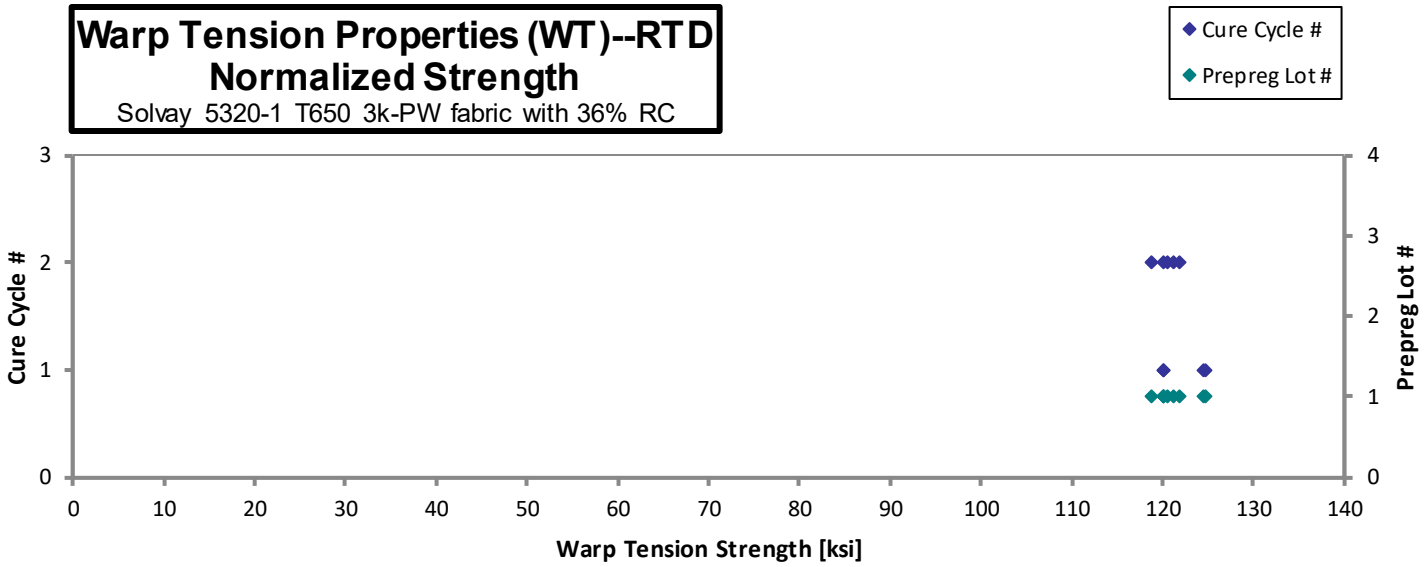
Warp Tension Properties (WT)--RTD
Strength & Modulus
Solvay 5320-1 T650 3k-PW fabric with 36% RC

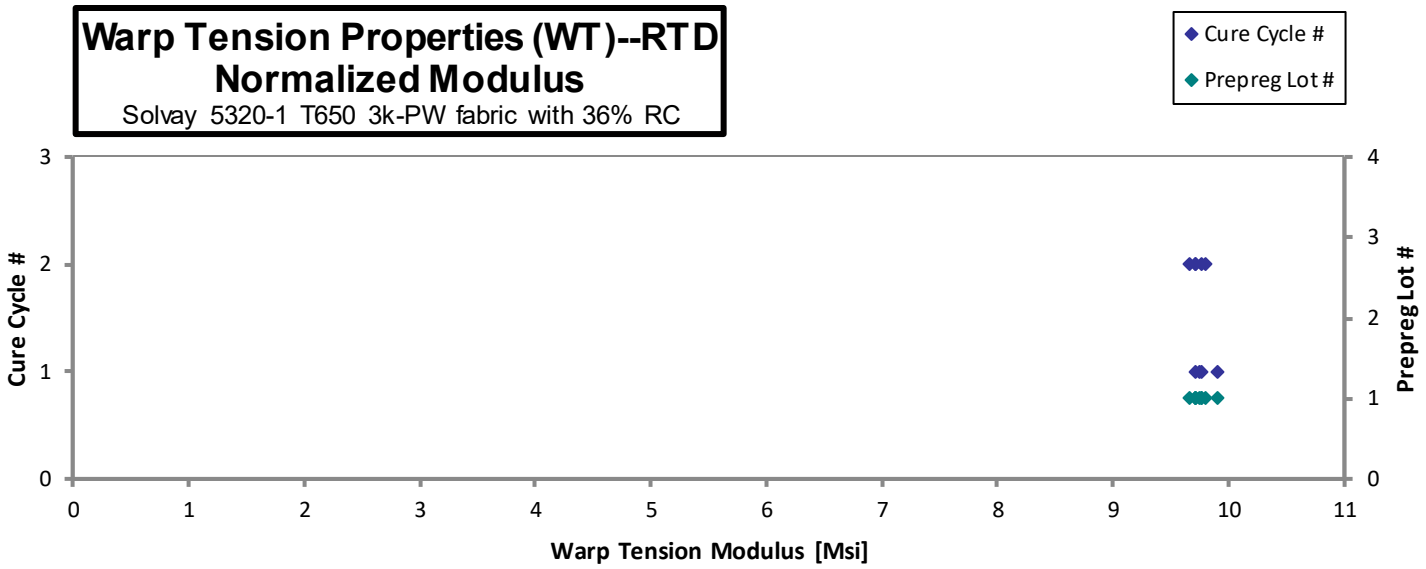
normalizing t_{ply} [in]: 0.0077

Specimen Number	NIAR Batch #	NIAR Cure Cycle	Prepreg Lot #	Cure Cycle #	Strength [ksi]	Modulus [Msi]	Poisson's Ratio	Avg. Specimen Thickness [in]	# Plies in Laminate	Failure Mode	Avg. t_{ply} [in]	$Strength_{norm}$ [ksi]	$Modulus_{norm}$ [Msi]
NTP-5325QRI-SOL-S36-NIAR-WT-A-C1-1-RTD-1*	A	C1	1	1	126.754	10.068	0.049	0.114	15	LGB	0.0076	124.669	9.902
NTP-5325QRI-SOL-S36-NIAR-WT-A-C1-1-RTD-2*	A	C1	1	1	121.376	9.819	0.049	0.114	15	LGT	0.0076	120.132	9.719
NTP-5325QRI-SOL-S36-NIAR-WT-A-C1-1-RTD-3	A	C1	1	1	121.155	9.847	0.050	0.114	15	LGT	0.0076	120.071	9.759
NTP-5325QRI-SOL-S36-NIAR-WT-A-C1-1-RTD-4	A	C1	1	1	125.621	9.851	0.053	0.114	15	LGT	0.0076	124.406	9.756
NTP-5325QRI-SOL-S36-NIAR-WT-A-C2-1-RTD-1*	A	C2	1	2	123.789	9.946	0.042	0.114	15	LGB	0.0076	121.949	9.799
NTP-5325QRI-SOL-S36-NIAR-WT-A-C2-1-RTD-2*	A	C2	1	2	122.550	9.827	0.055	0.114	15	LAT	0.0076	121.153	9.714
NTP-5325QRI-SOL-S36-NIAR-WT-A-C2-1-RTD-3	A	C2	1	2	119.498	9.778	0.050	0.115	15	LGM	0.0077	118.808	9.722
NTP-5325QRI-SOL-S36-NIAR-WT-A-C2-1-RTD-4	A	C2	1	2	121.934	9.812	0.049	0.114	15	LWT	0.0076	120.087	9.663
NTP-5325QRI-SOL-S36-NIAR-WT-A-C2-1-RTD-5	A	C2	1	2	120.782	9.775	0.047	0.115	15	LAB	0.0077	120.573	9.758

*Strain measurement was measured with strain gauge. Extensometer used on other coupons.

	Strength [ksi]	Modulus [Msi]	Poisson's Ratio		$Strength_{norm}$ [ksi]	$Modulus_{norm}$ [Msi]
Average	122.606	9.858	0.049	Average	121.316	9.755
Standard Dev.	2.365	0.093	0.004	Standard Dev.	2.016	0.067
Coeff. of Var. [%]	1.929	0.948	7.228	Coeff. of Var. [%]	1.662	0.688
Min.	119.498	9.775	0.042	Min.	118.808	9.663
Max.	126.754	10.068	0.055	Max.	124.669	9.902
Number of Spec.	9	9	9	Number of Spec.	9	9


Warp Tension Properties (WT)--RTD
Normalized Strength
Solvay 5320-1 T650 3k-PW fabric with 36% RC
Cure Cycle #
Prepreg Lot #
Cure Cycle #
Prepreg Lot #
Warp Tension Strength [ksi]
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
0
1
2
3
4


Warp Tension Properties (WT)--RTD
Normalized Modulus
Solvay 5320-1 T650 3k-PW fabric with 36% RC
Cure Cycle #
Prepreg Lot #
Cure Cycle #
Prepreg Lot #
Warp Tension Modulus [Msi]
0
1
2
3
4
5
6
7
8
9
10
11
0
1
2
3
4

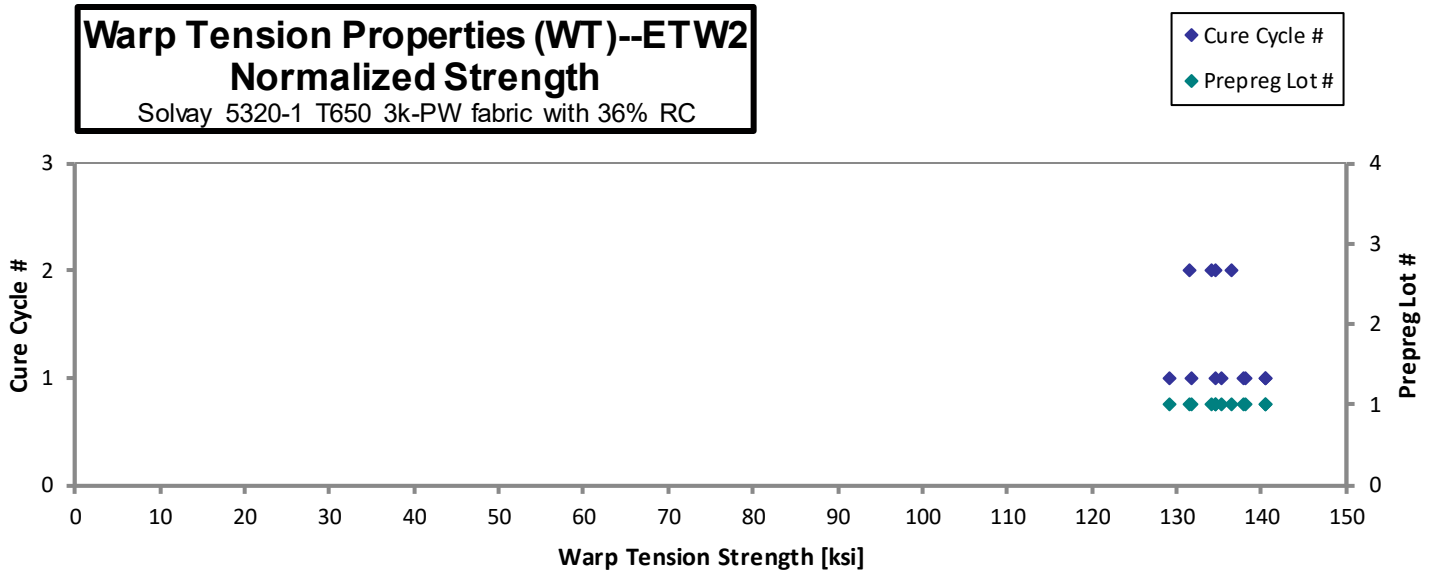
Warp Tension Properties (WT)--ETW2
Strength & Modulus
Solvay 5320-1 T650 3k-PW fabric with 36% RC

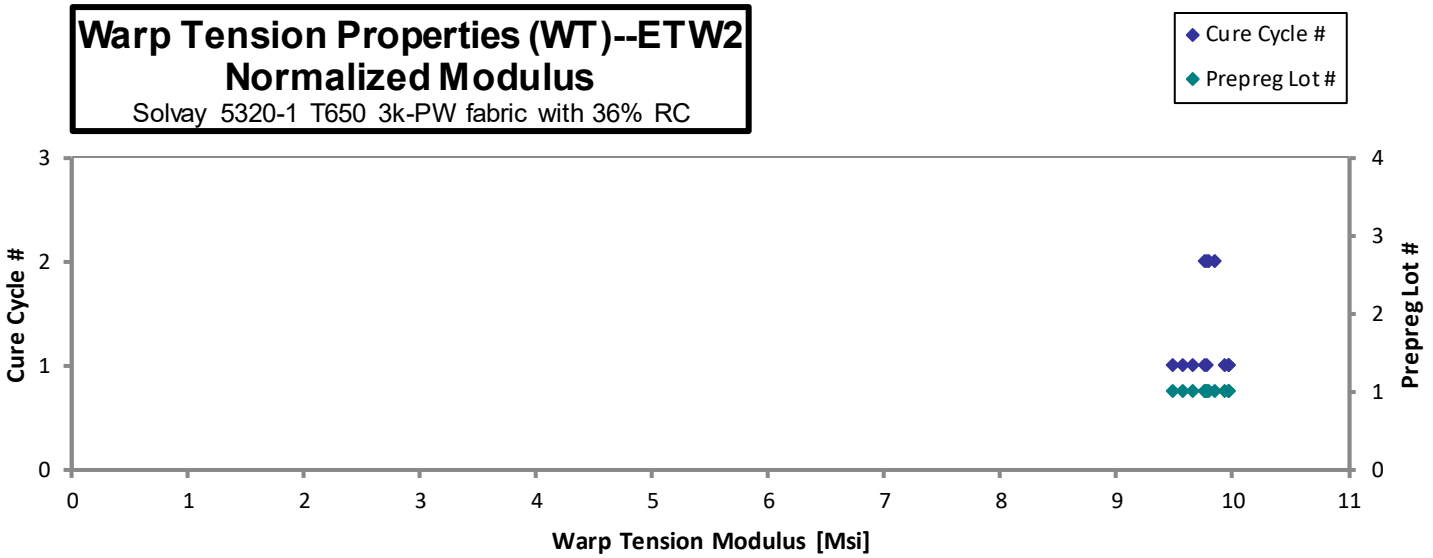
normalizing t_{ply} [in]: 0.0077

Specimen Number	NIAR Batch #	NIAR Cure Cycle	Prepreg Lot #	Cure Cycle #	Strength [ksi]	Modulus [Msi]	Poisson's Ratio	Avg. Specimen Thickness [in]	# Plies in Laminate	Failure Mode	Avg. t_{ply} [in]	$Strength_{norm}$ [ksi]	$Modulus_{norm}$ [Msi]
NTP-5325QRI-SOL-S36-NIAR-WT-A-C1-1-ETW2-1*	A	C1	1	1	130.488	10.083		0.114	15	LGB	0.0076	129.038	9.971
NTP-5325QRI-SOL-S36-NIAR-WT-A-C1-1-ETW2-2*	A	C1	1	1	142.794	9.946		0.114	15	LGB	0.0076	140.404	9.780
NTP-5325QRI-SOL-S36-NIAR-WT-A-C1-1-ETW2-3*	A	C1	1	1	142.805	10.095		0.114	15	LWT, LWB	0.0076	140.538	9.935
NTP-5325QRI-SOL-S36-NIAR-WT-A-C1-1-ETW2-4*	A	C1	1	1	140.481	10.140		0.113	15	LGB	0.0076	137.967	9.959
NTP-5325QRI-SOL-S36-NIAR-WT-A-C1-1-ETW2-6**	A	C1	1	1	137.563	9.456	0.051	0.116	15	LGT, LWB	0.0077	138.020	9.487
NTP-5325QRI-SOL-S36-NIAR-WT-A-C1-1-ETW2-7**	A	C1	1	1	133.695	9.722	0.049	0.114	15	LGM	0.0076	131.669	9.575
NTP-5325QRI-SOL-S36-NIAR-WT-A-C1-1-ETW2-8**	A	C1	1	1	135.342	9.661	0.048	0.115	15	LGM	0.0077	135.303	9.658
NTP-5325QRI-SOL-S36-NIAR-WT-A-C1-1-ETW2-9**	A	C1	1	1	136.925	9.923	0.045	0.114	15	LWT, LWB	0.0076	134.554	9.751
NTP-5325QRI-SOL-S36-NIAR-WT-A-C2-1-ETW2-1*	A	C2	1	2	135.406	9.835		0.115	15	LGT, LWB	0.0076	134.488	9.768
NTP-5325QRI-SOL-S36-NIAR-WT-A-C2-1-ETW2-2*	A	C2	1	2	133.480	9.998		0.114	15	LGB	0.0076	131.476	9.847
NTP-5325QRI-SOL-S36-NIAR-WT-A-C2-1-ETW2-3*	A	C2	1	2	137.575	9.849		0.115	15	LGB	0.0076	136.403	9.765
NTP-5325QRI-SOL-S36-NIAR-WT-A-C2-1-ETW2-4*	A	C2	1	2	135.489	9.882		0.114	15	LWT, LGB	0.0076	134.180	9.786
NTP-5325QRI-SOL-S36-NIAR-WT-A-C2-1-ETW2-6**	A	C2	1	2	134.538	9.474	0.045	0.117	15	LWT	0.0078	136.771	9.631
NTP-5325QRI-SOL-S36-NIAR-WT-A-C2-1-ETW2-7**	A	C2	1	2	139.223	9.572	0.049	0.115	15	LGT, LWB	0.0077	139.122	9.565
NTP-5325QRI-SOL-S36-NIAR-WT-A-C2-1-ETW2-8**	A	C2	1	2	130.257	9.754	0.034	0.117	15	LWB	0.0078	131.723	9.863
NTP-5325QRI-SOL-S36-NIAR-WT-A-C2-1-ETW2-9**	A	C2	1	2	133.190	9.553	0.045	0.117	15	LGT	0.0078	134.900	9.675

*Poisson's ratio not reported due to non-linearity.
**Strain measurement was measured with strain gauge. Extensometer used on other coupons.

Average	**136.203**	**9.809**	**0.046**	**$Average_{norm}$**	**0.0077**	**135.410**	**9.751**
Standard Dev.	**3.779**	**0.221**	**0.005**	**$Standard\ Dev._{norm}$**		**3.349**	**0.145**
Coeff. of Var. [%]	**2.774**	**2.253**	**11.600**	**Coeff. of Var. $[\%]_{norm}$**		**2.473**	**1.483**
Min.	**130.257**	**9.456**	**0.034**	**Min.**	**0.0076**	**129.038**	**9.487**
Max.	**142.805**	**10.140**	**0.051**	**Max.**	**0.0078**	**140.538**	**9.971**
Number of Spec.	**16**	**16**	**8**	**Number of Spec.**	**16**	**16**	**16**


Warp Tension Properties (WT)--ETW2
Normalized Strength
Solvay 5320-1 T650 3k-PW fabric with 36% RC
Cure Cycle #
Prepreg Lot #
Cure Cycle #
Prepreg Lot #
Warp Tension Strength [ksi]
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150
0 1 2 3
0 1 2 3 4


Warp Tension Properties (WT)--ETW2
Normalized Modulus
Solvay 5320-1 T650 3k-PW fabric with 36% RC
Cure Cycle #
Prepreg Lot #
Cure Cycle #
Prepreg Lot #
Warp Tension Modulus [Msi]
0 1 2 3 4 5 6 7 8 9 10 11
0 1 2 3
0 1 2 3 4

4.2 Fill Tension Properties (FT)

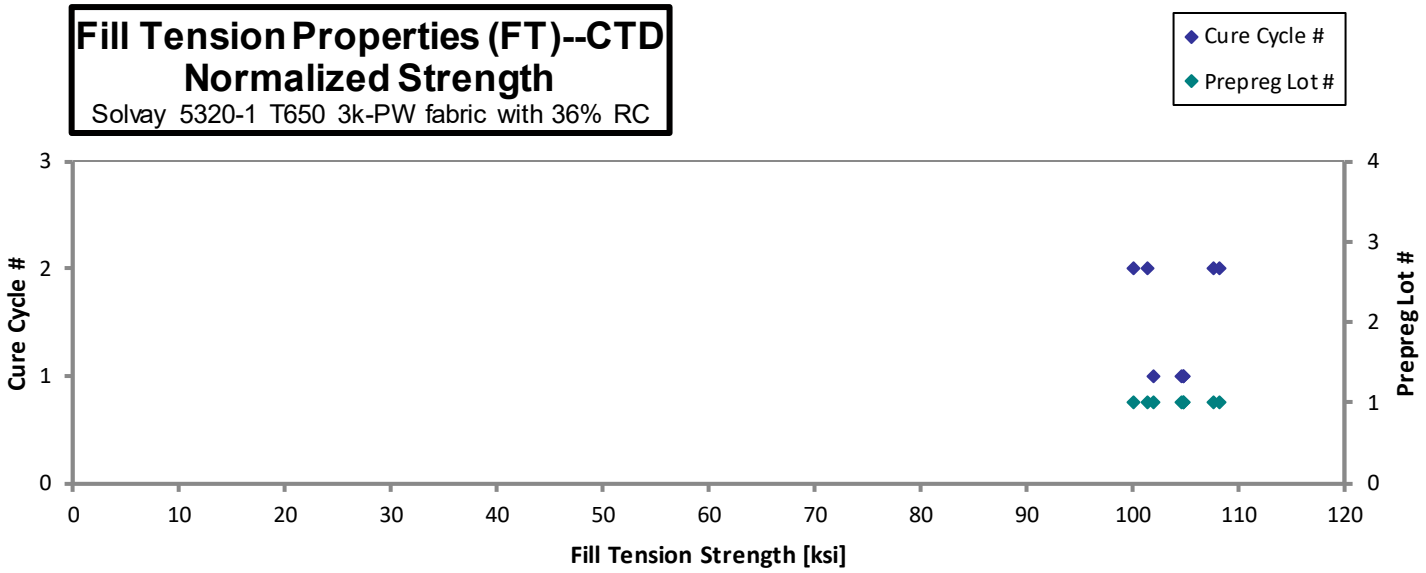
Fill Tension Properties (FT)--CTD
Strength & Modulus
Solvay 5320-1 T650 3k-PW fabric with 36% RC

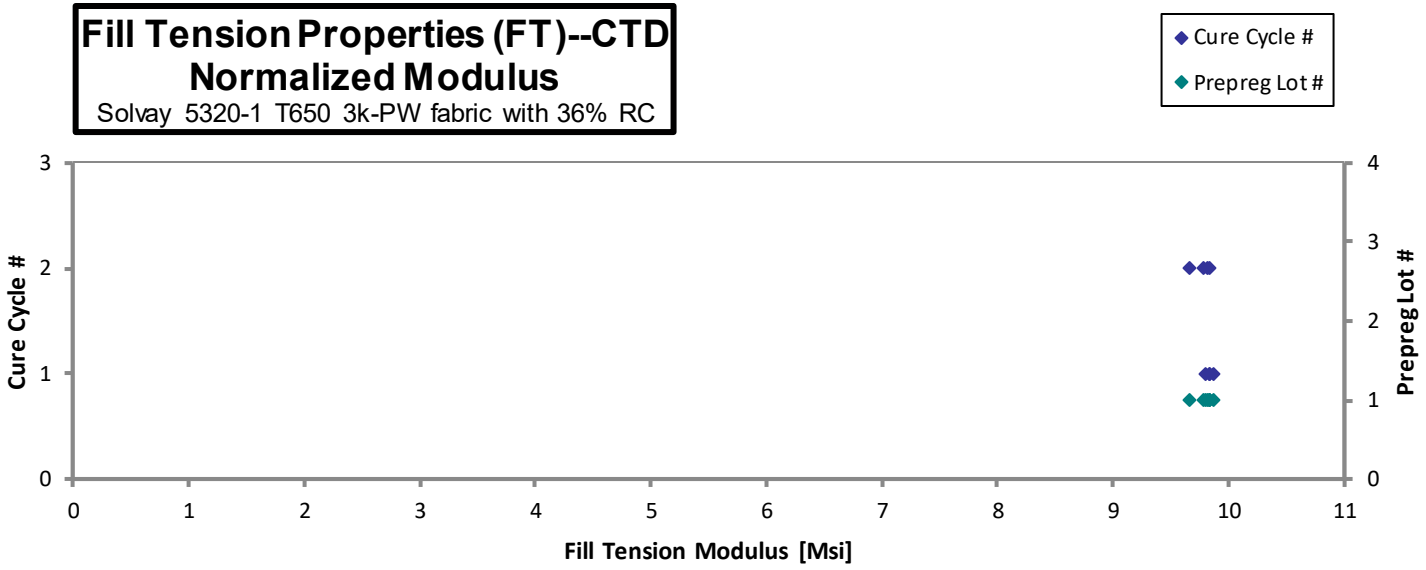
normalizing t_{ply} [in]: 0.0077

Specimen Number	NIAR Batch #	NIAR Cure Cycle	Prepreg Lot #	Cure Cycle #	Strength [ksi]	Modulus [Msi]	Avg. Specimen Thickness [in]	# Plies in Laminate	Failure Mode	Avg. t_{ply} [in]	$Strength_{norm}$ [ksi]	$Modulus_{norm}$ [Msi]
NTP5325QR1-SOL-S36-NIAR-FT-A-C1-1R-CTD-1	A	C1	1	1	103.236	9.953	0.114	15	LGT	0.0076	102.089	9.842
NTP5325QR1-SOL-S36-NIAR-FT-A-C1-1R-CTD-2	A	C1	1	1	105.968	9.986	0.114	15	LGM	0.0076	104.790	9.875
NTP5325QR1-SOL-S36-NIAR-FT-A-C1-1R-CTD-3	A	C1	1	1	106.253	9.974	0.114	15	LGB	0.0076	104.827	9.840
NTP5325QR1-SOL-S36-NIAR-FT-A-C1-1R-CTD-4	A	C1	1	1	106.223	9.938	0.114	15	LGM	0.0076	104.721	9.797
NTP5325QR1-SOL-S36-NIAR-FT-A-C2-1R-CTD-1	A	C2	1	2	101.153	9.780	0.116	15	LAB	0.0077	101.474	9.811
NTP5325QR1-SOL-S36-NIAR-FT-A-C2-1R-CTD-2	A	C2	1	2	107.948	9.816	0.116	15	LGM	0.0077	108.229	9.842
NTP5325QR1-SOL-S36-NIAR-FT-A-C2-1R-CTD-3	A	C2	1	2	107.751	9.671	0.115	15	LGB	0.0077	107.580	9.656
NTP5325QR1-SOL-S36-NIAR-FT-A-C2-1R-CTD-4	A	C2	1	2	99.708	9.738	0.116	15	LGB	0.0077	100.111	9.778

	Strength [ksi]	Modulus [Msi]
Average	104.780	9.857
Standard Dev.	3.066	0.121
Coeff. of Var. [%]	2.926	1.227
Min.	99.708	9.671
Max.	107.948	9.986
Number of Spec.	8	8

	Avg. t_{ply} [in]	$Strength_{norm}$ [ksi]	$Modulus_{norm}$ [Msi]
$Average_{norm}$	0.0077	104.228	9.805
$Standard\ Dev._{norm}$		2.860	0.068
$Coeff.\ of\ Var.\ [\%]_{norm}$		2.744	0.690
Min.	0.0076	100.111	9.656
Max.	0.0077	108.229	9.875
Number of Spec.	8	8	8


Fill Tension Properties (FT)--CTD
Normalized Strength
Solvay 5320-1 T650 3k-PW fabric with 36% RC
Cure Cycle #
Prepreg Lot #
Cure Cycle #
Prepreg Lot #
Fill Tension Strength [ksi]
0
10
20
30
40
50
60
70
80
90
100
110
120
0
1
2
3
4


Fill Tension Properties (FT)--CTD
Normalized Modulus
Solvay 5320-1 T650 3k-PW fabric with 36% RC
Cure Cycle #
Prepreg Lot #
Cure Cycle #
Prepreg Lot #
Fill Tension Modulus [Msi]
0
1
2
3
4
5
6
7
8
9
10
11
0
1
2
3
4

Fill Tension Properties (FT)--RTD
Strength & Modulus
Solvay 5320-1 T650 3k-PW fabric with 36% RC

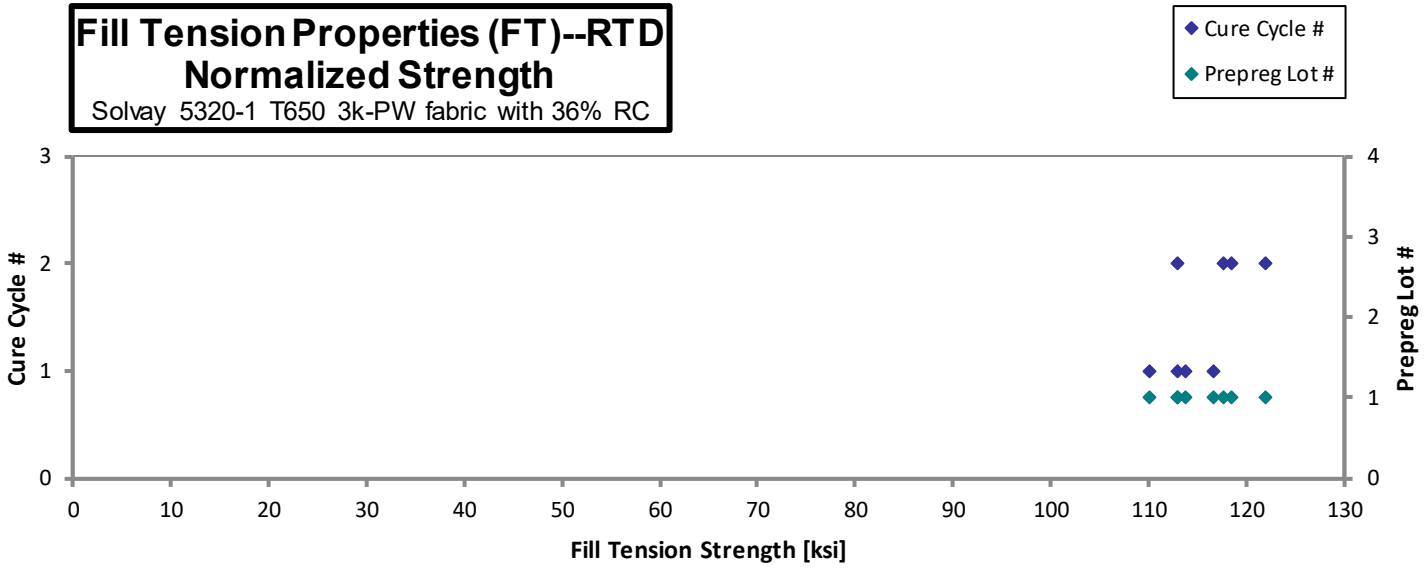
normalizing t_{ply} [in]
0.0077

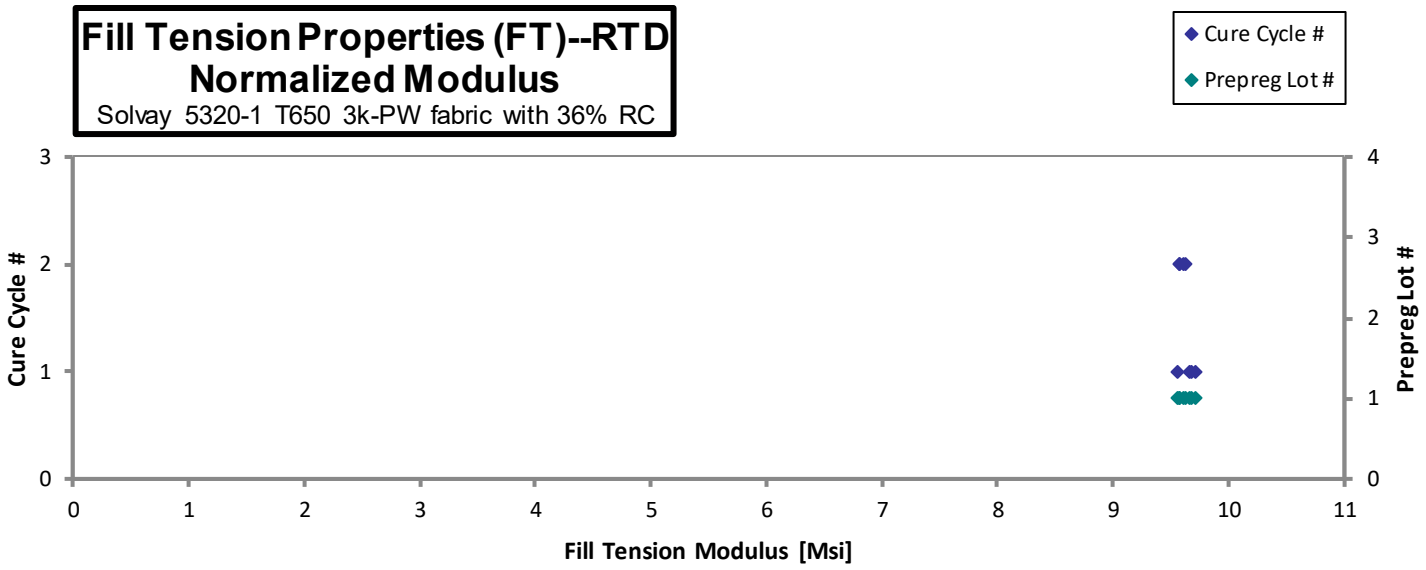
Specimen Number	NIAR Batch #	NIAR Cure Cycle	Prepreg Lot #	Cure Cycle #	Strength [ksi]	Modulus [Msi]	Avg. Specimen Thickness [in]	# Plies in Laminate	Failure Mode	Avg. t_{ply} [in]	$Strength_{norm}$ [ksi]	$Modulus_{norm}$ [Msi]
NTP5325QR1-SOL-S36-NIAR-FT-A-C1-1R-RTD-1*	A	C1	1	1	115.271	9.798	0.114	15	LAB	0.0076	113.873	9.680
NTP5325QR1-SOL-S36-NIAR-FT-A-C1-1R-RTD-2*	A	C1	1	1	111.189	9.820	0.114	15	LAT	0.0076	110.066	9.721
NTP5325QR1-SOL-S36-NIAR-FT-A-C1-1R-RTD-3	A	C1	1	1	113.426	9.605	0.115	15	LGM	0.0077	112.919	9.562
NTP5325QR1-SOL-S36-NIAR-FT-A-C1-1R-RTD-4	A	C1	1	1	117.297	9.707	0.115	15	LGM	0.0077	116.722	9.660
NTP5325QR1-SOL-S36-NIAR-FT-A-C2-1R-RTD-1*	A	C2	1	2	117.504	9.556	0.116	15	LGT	0.0077	117.741	9.576
NTP5325QR1-SOL-S36-NIAR-FT-A-C2-1R-RTD-2*	A	C2	1	2	121.680	9.561	0.116	15	LWT	0.0077	121.855	9.574
NTP5325QR1-SOL-S36-NIAR-FT-A-C2-1R-RTD-3	A	C2	1	2	117.947	9.597	0.116	15	LAB	0.0077	118.406	9.635
NTP5325QR1-SOL-S36-NIAR-FT-A-C2-1R-RTD-4	A	C2	1	2	114.227	9.709	0.114	15	LAT	0.0076	113.007	9.605

*Strain measurement was measured with strain gauge. Extensometer used on other coupons.

	Strength [ksi]	Modulus [Msi]
Average	116.068	9.669
Standard Dev.	3.238	0.104
Coeff. of Var. [%]	2.790	1.080
Min.	111.189	9.556
Max.	121.680	9.820
Number of Spec.	8	8

	t_{ply} [in]	$Strength_{norm}$ [ksi]	$Modulus_{norm}$ [Msi]
$Average_{norm}$	0.0077	115.574	9.627
$Standard\ Dev._{norm}$		3.786	0.057
$Coeff.\ of\ Var.\ [\%]_{norm}$		3.276	0.593
Min.	0.0076	110.066	9.562
Max.	0.0077	121.855	9.721
Number of Spec.	8	8	8


Fill Tension Properties (FT)--RTD
Normalized Strength
Solvay 5320-1 T650 3k-PW fabric with 36% RC
Cure Cycle #
Prepreg Lot #
Cure Cycle #
Prepreg Lot #
Fill Tension Strength [ksi]
0
10
20
30
40
50
60
70
80
90
100
110
120
130
0
1
2
3
4


Fill Tension Properties (FT)--RTD
Normalized Modulus
Solvay 5320-1 T650 3k-PW fabric with 36% RC
Cure Cycle #
Prepreg Lot #
Cure Cycle #
Prepreg Lot #
Fill Tension Modulus [Msi]
0
1
2
3
4
5
6
7
8
9
10
11
0
1
2
3
4

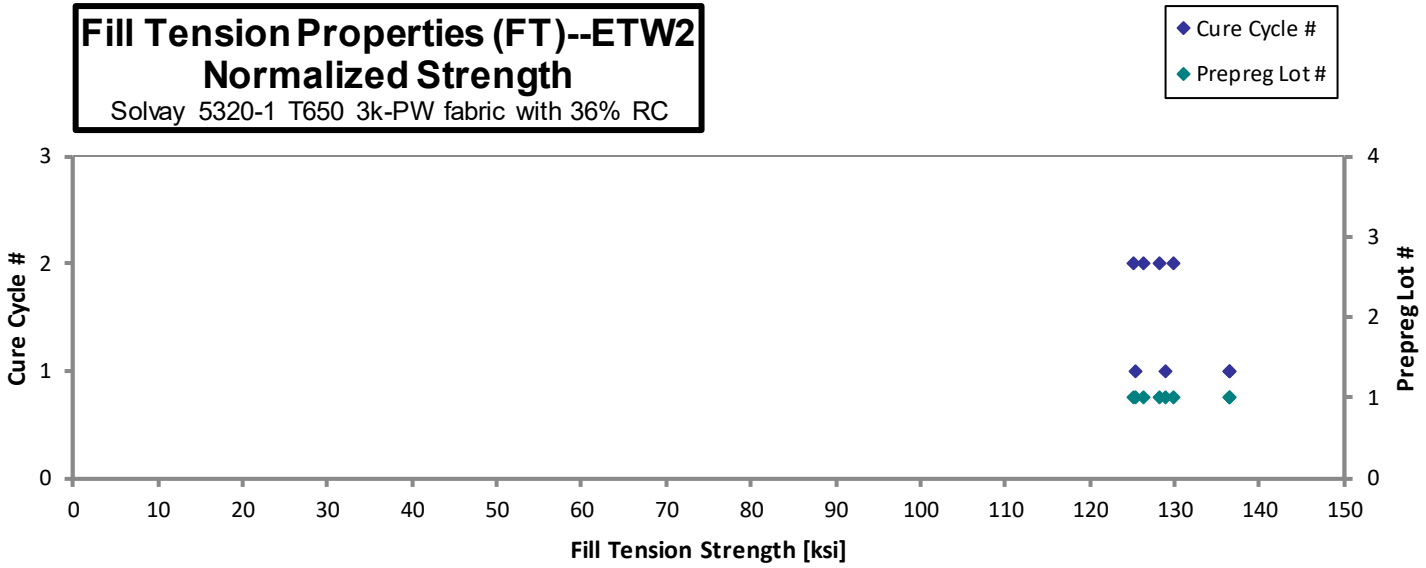
Fill Tension Properties (FT)--ETW2
Strength & Modulus
Solvay 5320-1 T650 3k-PW fabric with 36% RC

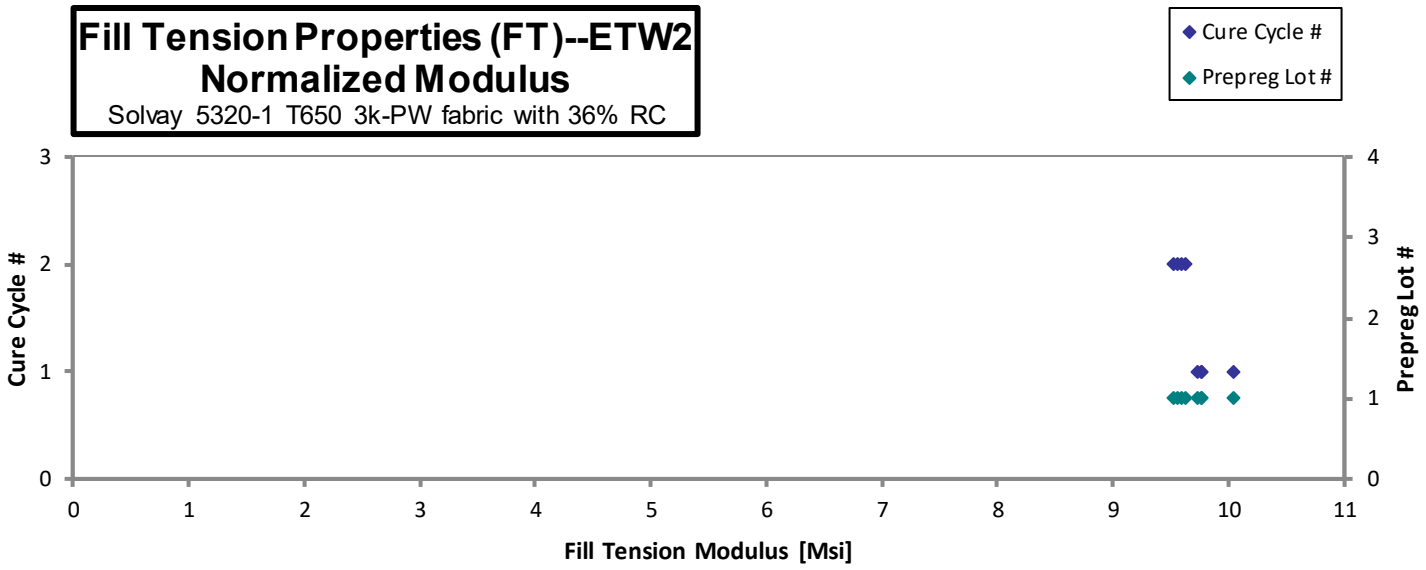
normalizing t_{ply} [in]: 0.0077

Specimen Number	NIAR Batch #	NIAR Cure Cycle	Prepreg Lot #	Cure Cycle #	Strength [ksi]	Modulus [Msi]	Avg. Specimen Thickness [in]	# Plies in Laminate	Failure Mode	Avg. t_{ply} [in]	$Strength_{norm}$ [ksi]	$Modulus_{norm}$ [Msi]
NTP5325QR1-SOL-S36-NIAR-FT-A-C1-1R-ETW2-1	A	C1	1	1	125.662	9.742	0.115	15	LAT	0.0077	125.463	9.727
NTP5325QR1-SOL-S36-NIAR-FT-A-C1-1R-ETW2-2	A	C1	1	1	137.843	9.863	0.114	15	LGB	0.0076	136.371	9.757
NTP5325QR1-SOL-S36-NIAR-FT-A-C1-1R-ETW2-3	A	C1	1	1	129.457	9.812	0.115	15	LGM	0.0077	128.878	9.769
NTP5325QR1-SOL-S36-NIAR-FT-A-C1-1R-ETW2-4	A	C1	1	1	136.441	10.033	0.116	15	LGB	0.0077	136.500	10.037
NTP5325QR1-SOL-S36-NIAR-FT-A-C2-1R-ETW2-1	A	C2	1	2	127.888	9.748	0.114	15	LAT	0.0076	126.338	9.630
NTP5325QR1-SOL-S36-NIAR-FT-A-C2-1R-ETW2-2	A	C2	1	2	126.425	9.664	0.114	15	LWB	0.0076	125.112	9.564
NTP5325QR1-SOL-S36-NIAR-FT-A-C2-1R-ETW2-3	A	C2	1	2	131.098	9.688	0.114	15	LWB	0.0076	129.774	9.591
NTP5325QR1-SOL-S36-NIAR-FT-A-C2-1R-ETW2-4	A	C2	1	2	129.342	9.610	0.115	15	LAB	0.0076	128.222	9.527

	Strength [ksi]	Modulus [Msi]
Average	130.519	9.770
Standard Dev.	4.453	0.133
Coeff. of Var. [%]	3.412	1.362
Min.	125.662	9.610
Max.	137.843	10.033
Number of Spec.	8	8

	Avg. t_{ply} [in]	$Strength_{norm}$ [ksi]	$Modulus_{norm}$ [Msi]
$Average_{norm}$	0.0076	129.582	9.700
$Standard\ Dev._{norm}$		4.533	0.164
$Coeff.\ of\ Var.\ [\%]_{norm}$		3.498	1.687
Min.	0.0076	125.112	9.527
Max.	0.0077	136.500	10.037
Number of Spec.	8	8	8


Fill Tension Properties (FT)--ETW2
Normalized Strength
Solvay 5320-1 T650 3k-PW fabric with 36% RC
Cure Cycle #
Prepreg Lot #
Cure Cycle #
Prepreg Lot #
Fill Tension Strength [ksi]
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150
0 1 2 3
0 1 2 3 4


Fill Tension Properties (FT)--ETW2
Normalized Modulus
Solvay 5320-1 T650 3k-PW fabric with 36% RC
Cure Cycle #
Prepreg Lot #
Cure Cycle #
Prepreg Lot #
Fill Tension Modulus [Msi]
0 1 2 3 4 5 6 7 8 9 10 11
0 1 2 3
0 1 2 3 4

4.3 Warp Compression Properties (WC)

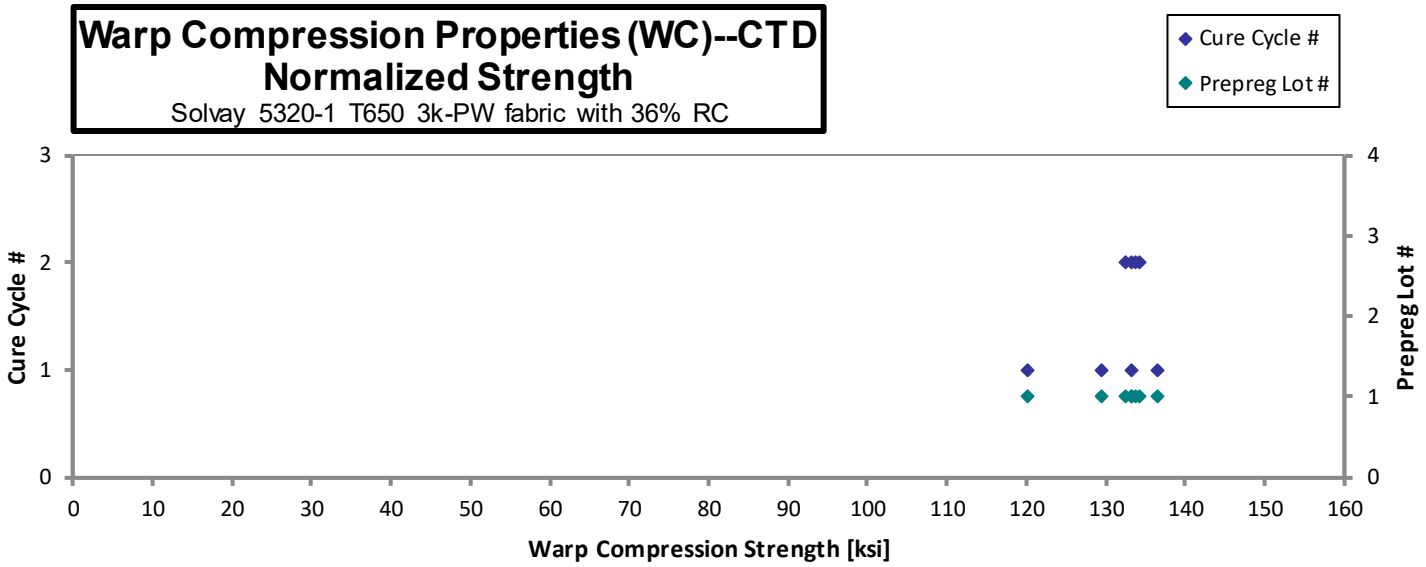
Warp Compression Properties (WC)--CTD
Strength & Modulus
Solvay 5320-1 T650 3k-PW fabric with 36% RC

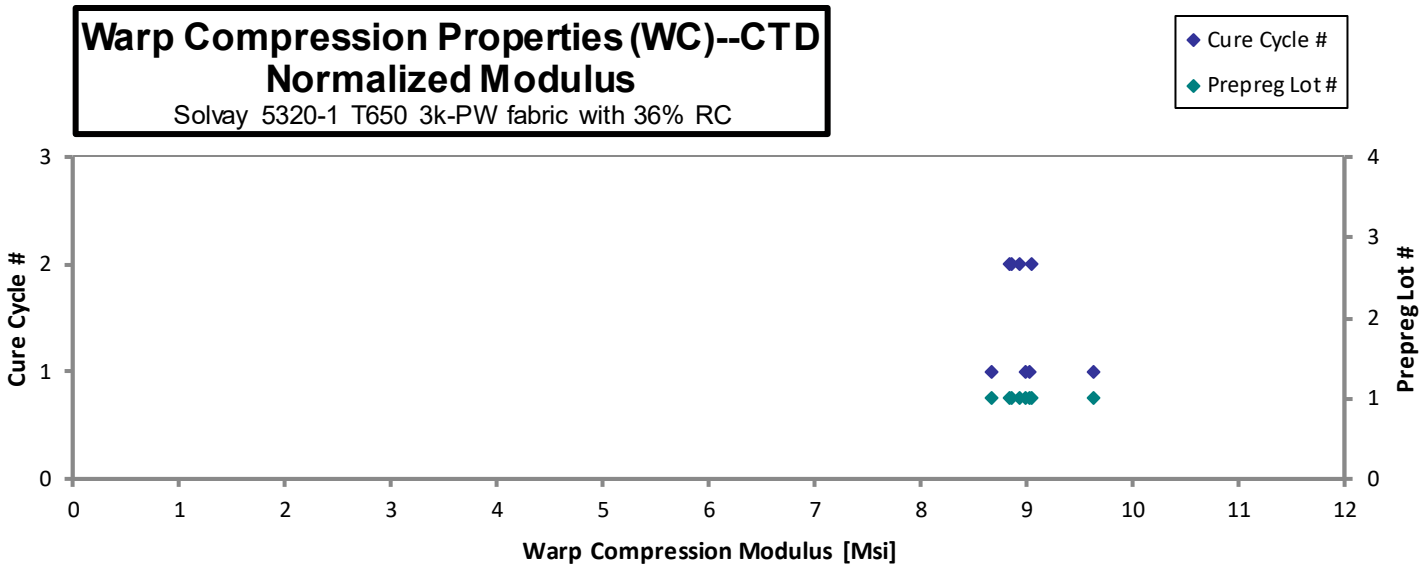
normalizing t_{ply} [in]: 0.0077

Specimen Number	NIAR Batch #	NIAR Cure Cycle	Prepreg Lot #	Cure Cycle #	Strength [ksi]	Modulus [Msi]	Avg. Specimen Thickness [in]	# Plies in Laminate	Failure Mode	Avg. t_{ply} [in]	$Strength_{norm}$ [ksi]	$Modulus_{norm}$ [Msi]
NTP-5325QRI-SOL-S36-NIAR-WC-A-C1-1-CTD-1	A	C1	1	1	122.677	9.211	0.113	15	BGM	0.0075	120.146	9.021
NTP-5325QRI-SOL-S36-NIAR-WC-A-C1-1-CTD-2	A	C1	1	1	138.578	9.126	0.114	15	BGM	0.0076	136.498	8.989
NTP-5325QRI-SOL-S36-NIAR-WC-A-C1-1-CTD-3	A	C1	1	1	135.480	8.806	0.114	15	BGM	0.0076	133.349	8.667
NTP-5325QRI-SOL-S36-NIAR-WC-A-C1-1-CTD-4	A	C1	1	1	130.935	9.733	0.114	15	BGM	0.0076	129.518	9.627
NTP-5325QRI-SOL-S36-NIAR-WC-A-C2-1-CTD-1	A	C2	1	2	135.978	9.157	0.114	15	BGM	0.0076	134.251	9.041
NTP-5325QRI-SOL-S36-NIAR-WC-A-C2-1-CTD-2	A	C2	1	2	135.109	8.964	0.114	15	BGM	0.0076	133.666	8.868
NTP-5325QRI-SOL-S36-NIAR-WC-A-C2-1-CTD-3	A	C2	1	2	133.628	8.919	0.114	15	BGM	0.0076	132.432	8.839
NTP-5325QRI-SOL-S36-NIAR-WC-A-C2-1-CTD-4	A	C2	1	2	134.008	8.994	0.115	15	BGM	0.0077	133.138	8.936

	Strength [ksi]	Modulus [Msi]
Average	133.299	9.114
Standard Dev.	4.812	0.284
Coeff. of Var. [%]	3.610	3.114
Min.	122.677	8.806
Max.	138.578	9.733
Number of Spec.	8	8

	t_{ply} [in]	$Strength_{norm}$ [ksi]	$Modulus_{norm}$ [Msi]
$Average_{norm}$	0.0076	131.625	8.999
$Standard\ Dev._{norm}$		5.028	0.281
$Coeff.\ of\ Var.\ [\%]_{norm}$		3.820	3.125
Min.	0.0075	120.146	8.667
Max.	0.0077	136.498	9.627
Number of Spec.	8	8	8


Warp Compression Properties (WC)--CTD
Normalized Strength
Solvay 5320-1 T650 3k-PW fabric with 36% RC
Cure Cycle #
Prepreg Lot #
Cure Cycle #
Prepreg Lot #
Warp Compression Strength [ksi]
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160
0 1 2 3
0 1 2 3 4


Warp Compression Properties (WC)--CTD
Normalized Modulus
Solvay 5320-1 T650 3k-PW fabric with 36% RC
Cure Cycle #
Prepreg Lot #
Cure Cycle #
Prepreg Lot #
Warp Compression Modulus [Msi]
0 1 2 3 4 5 6 7 8 9 10 11 12
0 1 2 3
0 1 2 3 4

Warp Compression Properties (WC)--RTD
Strength & Modulus
Solvay 5320-1 T650 3k-PW fabric with 36% RC

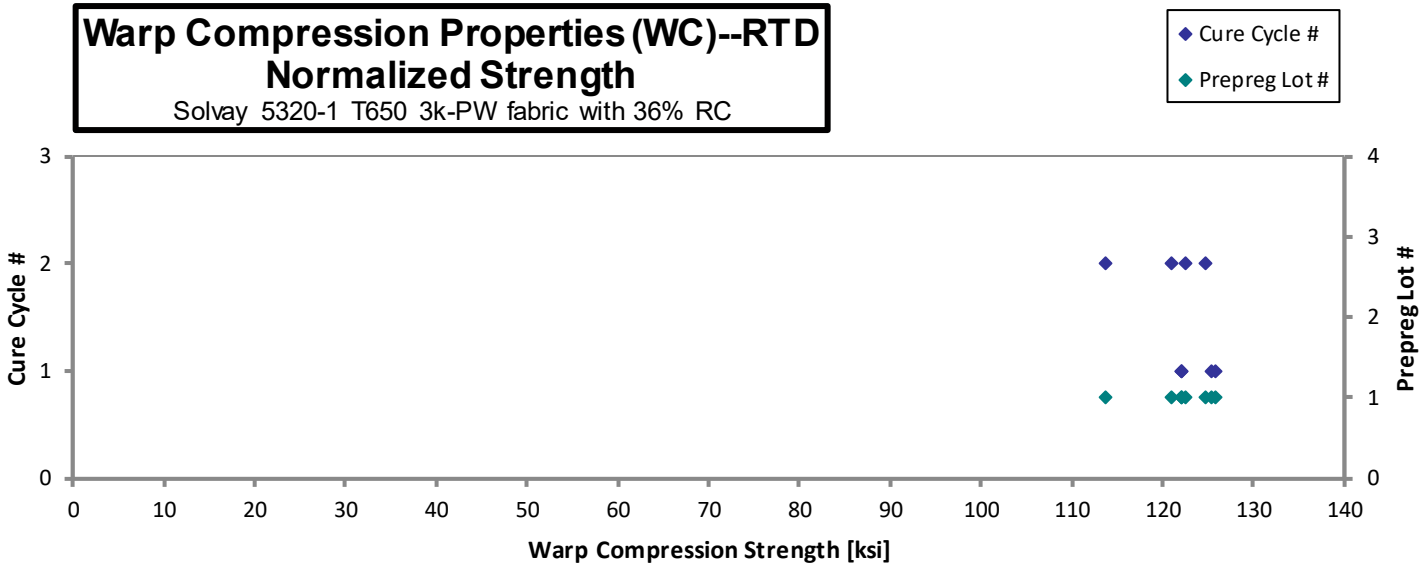
normalizing t_{ply} [in]: 0.0077

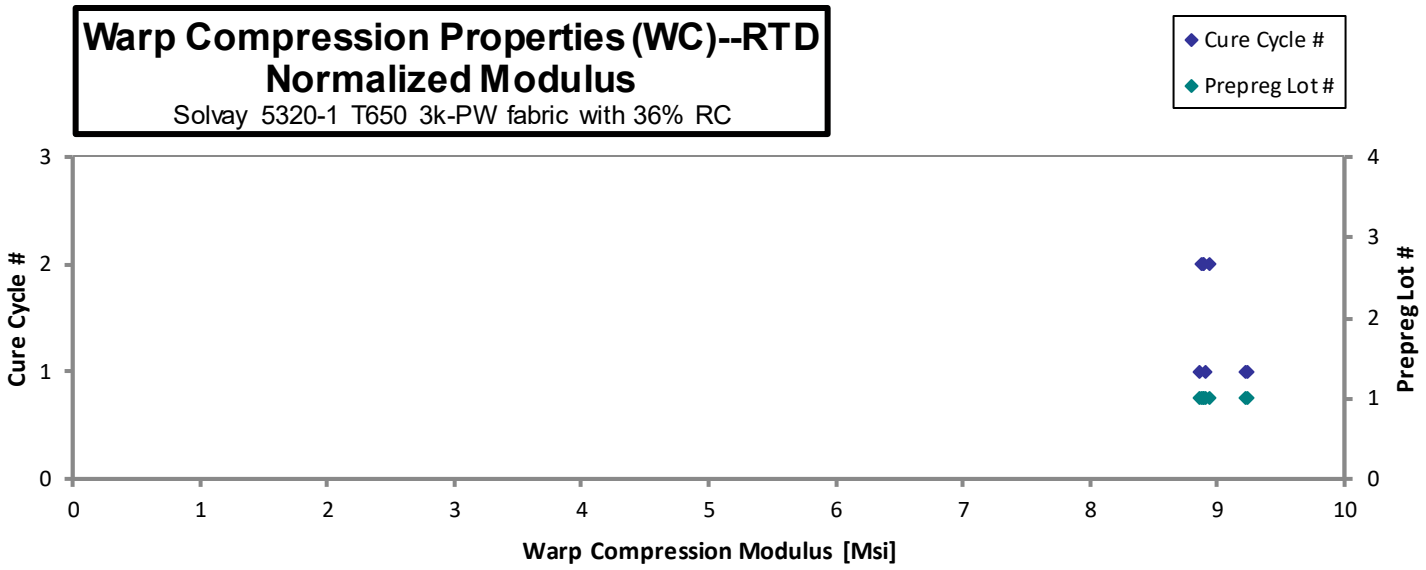
Specimen Number	NIAR Batch #	NIAR Cure Cycle	Prepreg Lot #	Cure Cycle #	Strength [ksi]	Modulus [Msi]	Avg. Specimen Thickness [in]	# Plies in Laminate	Failure Mode	Avg. t_{ply} [in]	$Strength_{norm}$ [ksi]	$Modulus_{norm}$ [Msi]
NTP-5325QRI-SOL-S36-NIAR-WC-A-C1-1-RTD-1*	A	C1	1	1	126.786	8.919	0.115	15	BGM	0.0076	125.890	8.856
NTP-5325QRI-SOL-S36-NIAR-WC-A-C1-1-RTD-2*	A	C1	1	1	122.642	8.946	0.115	15	BGM	0.0077	122.164	8.911
NTP-5325QRI-SOL-S36-NIAR-WC-A-C1-1-RTD-3	A	C1	1	1	126.631	9.322	0.114	15	BGM	0.0076	125.370	9.229
NTP-5325QRI-SOL-S36-NIAR-WC-A-C1-1-RTD-4	A	C1	1	1	123.297	9.339	0.114	15	BGM	0.0076	121.980	9.239
NTP-5325QRI-SOL-S36-NIAR-WC-A-C2-1-RTD-1*	A	C2	1	2	125.575	8.942	0.115	15	HAT, BAT	0.0076	124.723	8.881
NTP-5325QRI-SOL-S36-NIAR-WC-A-C2-1-RTD-2*/**	A	C2	1	2		8.988	0.114	15	HIT	0.0076		8.898
NTP-5325QRI-SOL-S36-NIAR-WC-A-C2-1-RTD-3	A	C2	1	2	114.577	9.007	0.115	15	BGM, HAT	0.0076	113.701	8.938
NTP-5325QRI-SOL-S36-NIAR-WC-A-C2-1-RTD-4	A	C2	1	2	121.965	8.969	0.115	15	BGM, HAT	0.0076	120.926	8.893
NTP-5325QRI-SOL-S36-NIAR-WC-A-C2-1-RTD-5***	A	C2	1	2	123.497		0.115	15	HAT, BGM	0.0076	122.553	

*Modulus are averaged values of 2 strain gages.
**Strength not reported due to unacceptable failure mode.
***Specimen was not gaged, only strength is tested.

	Strength [ksi]	Modulus [Msi]
Average	123.121	9.054
Standard Dev.	3.901	0.173
Coeff. of Var. [%]	3.168	1.909
Min.	114.577	8.919
Max.	126.786	9.339
Number of Spec.	8	8

	t_{ply} [in]	$Strength_{norm}$ [ksi]	$Modulus_{norm}$ [Msi]
$Average_{norm}$	0.0076	122.163	8.981
$Standard\ Dev._{norm}$		3.855	0.158
$Coeff.\ of\ Var.\ [\%]_{norm}$		3.156	1.761
Min.	0.0076	113.701	8.856
Max.	0.0077	125.890	9.239
Number of Spec.	9	8	8


Warp Compression Properties (WC)--RTD
Normalized Strength
Solvay 5320-1 T650 3k-PW fabric with 36% RC
Cure Cycle #
Prepreg Lot #
Cure Cycle #
Prepreg Lot #
Warp Compression Strength [ksi]
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
0
1
2
3
4


Warp Compression Properties (WC)--RTD
Normalized Modulus
Solvay 5320-1 T650 3k-PW fabric with 36% RC
Cure Cycle #
Prepreg Lot #
Cure Cycle #
Prepreg Lot #
Warp Compression Modulus [Msi]
0
1
2
3
4
5
6
7
8
9
10
0
1
2
3
4

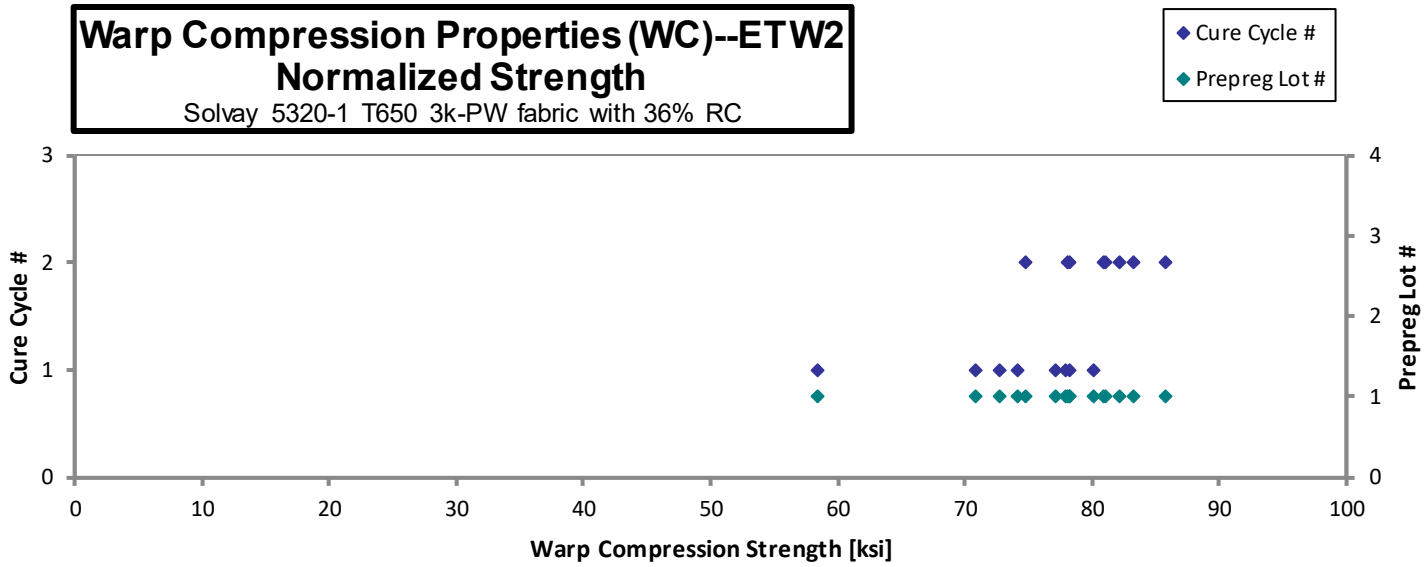
Warp Compression Properties (WC)--ETW2
Strength & Modulus
Solvay 5320-1 T650 3k-PW fabric with 36% RC

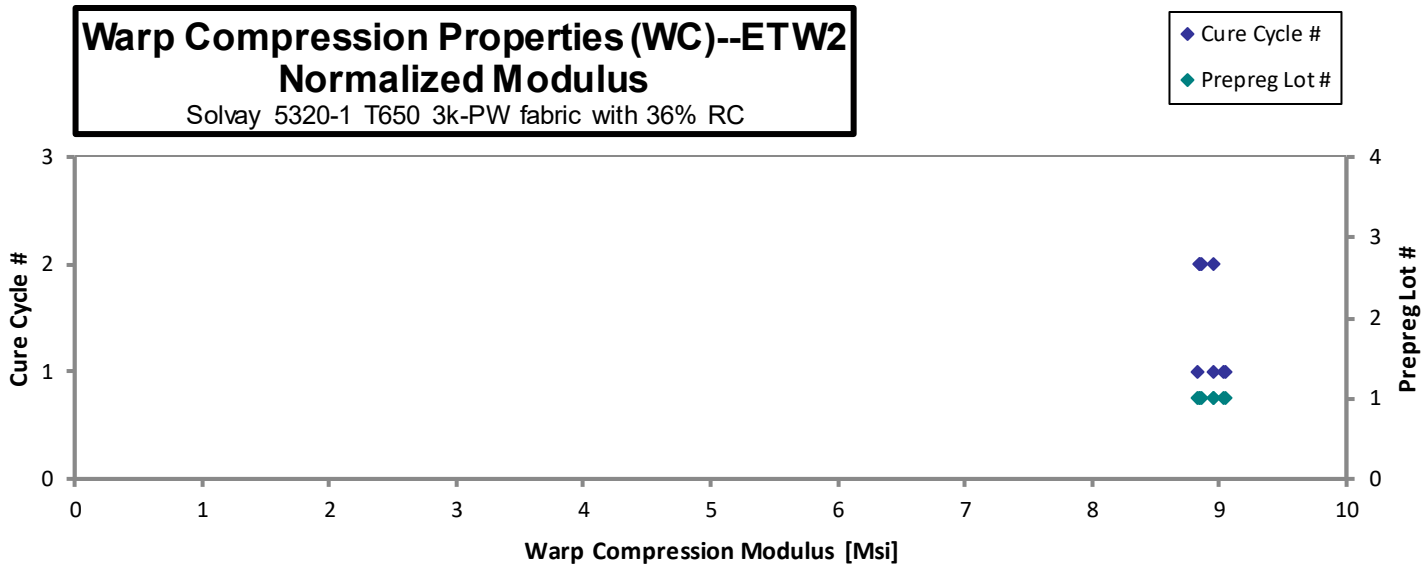
normalizing t_{ply} [in]: 0.0077

Specimen Number	NIAR Batch #	NIAR Cure Cycle	Prepreg Lot #	Cure Cycle #	Strength [ksi]	Modulus [Msi]	Avg. Specimen Thickness [in]	# Plies in Laminate	Failure Mode	Avg. t_{ply} [in]	$Strength_{norm}$ [ksi]	$Modulus_{norm}$ [Msi]
NTP-5325QRI-SOL-S36-NIAR-WC-A-C1-1-ETW2-1*	A	C1	1	1		9.099	0.115	15	CIT, CIB	0.0077		9.043
NTP-5325QRI-SOL-S36-NIAR-WC-A-C1-1-ETW2-2	A	C1	1	1	77.588	8.924	0.116	15	HAB	0.0077	77.891	8.958
NTP-5325QRI-SOL-S36-NIAR-WC-A-C1-1-ETW2-3	A	C1	1	1	79.659	8.779	0.116	15	BGM	0.0077	80.118	8.830
NTP-5325QRI-SOL-S36-NIAR-WC-A-C1-1-ETW2-4	A	C1	1	1	70.028	8.931	0.117	15	HAB	0.0078	70.796	9.029
NTP-5325QRI-SOL-S36-NIAR-WC-A-C1-1-ETW2-5**	A	C1	1	1	76.065		0.117	15	BAT	0.0078	77.075	
NTP-5325QRI-SOL-S36-NIAR-WC-A-C1-1-ETW2-6**	A	C1	1	1	73.489		0.116	15	BGM	0.0078	74.104	
NTP-5325QRI-SOL-S36-NIAR-WC-A-C1-1-ETW2-7**	A	C1	1	1	72.167		0.116	15	HAB	0.0078	72.708	
NTP-5325QRI-SOL-S36-NIAR-WC-A-C1-1-ETW2-8**	A	C1	1	1	57.774		0.117	15	HAT	0.0078	58.374	
NTP-5325QRI-SOL-S36-NIAR-WC-A-C1-1-ETW2-9**	A	C1	1	1	77.665		0.116	15	BGM	0.0078	78.236	
NTP-5325QRI-SOL-S36-NIAR-WC-A-C2-1-ETW2-1	A	C2	1	2	75.290	9.014	0.115	15	BGM	0.0076	74.780	8.952
NTP-5325QRI-SOL-S36-NIAR-WC-A-C2-1-ETW2-2	A	C2	1	2	83.649	8.879	0.115	15	BGM	0.0077	83.335	8.845
NTP-5325QRI-SOL-S36-NIAR-WC-A-C2-1-ETW2-3	A	C2	1	2	81.279	8.887	0.115	15	BGM	0.0077	80.916	8.847
NTP-5325QRI-SOL-S36-NIAR-WC-A-C2-1-ETW2-4	A	C2	1	2	78.431	8.888	0.115	15	BAT	0.0077	78.261	8.869
NTP-5325QRI-SOL-S36-NIAR-WC-A-C2-1-ETW2-5**	A	C2	1	2	78.236		0.115	15	BGM	0.0077	78.066	
NTP-5325QRI-SOL-S36-NIAR-WC-A-C2-1-ETW2-6**	A	C2	1	2	81.097		0.115	15	BGM	0.0077	81.038	
NTP-5325QRI-SOL-S36-NIAR-WC-A-C2-1-ETW2-7**	A	C2	1	2	86.057		0.115	15	BAT	0.0077	85.809	
NTP-5325QRI-SOL-S36-NIAR-WC-A-C2-1-ETW2-8**	A	C2	1	2	82.448		0.115	15	HAB	0.0077	82.210	

*Strength not reported due to unacceptable failure mode.
**Specimen was not gaged, only strength is tested.

	Strength [ksi]	Modulus [Msi]		t_{ply} [in]	$Strength_{norm}$ [ksi]	$Modulus_{norm}$ [Msi]
Average	76.933	8.925	$Average_{norm}$	0.0077	77.107	8.922
Standard Dev.	6.634	0.096	$Standard\ Dev._{norm}$		6.368	0.086
Coeff. of Var. [%]	8.623	1.073	Coeff. of Var. $[\%]_{norm}$		8.258	0.959
Min.	57.774	8.779	Min.	0.0076	58.374	8.830
Max.	86.057	9.099	Max.	0.0078	85.809	9.043
Number of Spec.	16	8	Number of Spec.	17	16	8


Warp Compression Properties (WC)--ETW2
Normalized Strength
Solvay 5320-1 T650 3k-PW fabric with 36% RC
Cure Cycle #
Prepreg Lot #
Cure Cycle #
Prepreg Lot #
Warp Compression Strength [ksi]
0
10
20
30
40
50
60
70
80
90
100
0
1
2
3
4


Warp Compression Properties (WC)--ETW2
Normalized Modulus
Solvay 5320-1 T650 3k-PW fabric with 36% RC
Cure Cycle #
Prepreg Lot #
Cure Cycle #
Prepreg Lot #
Warp Compression Modulus [Msi]
0
1
2
3
4
5
6
7
8
9
10
0
1
2
3
4

4.4 Fill Compression Properties (FC)

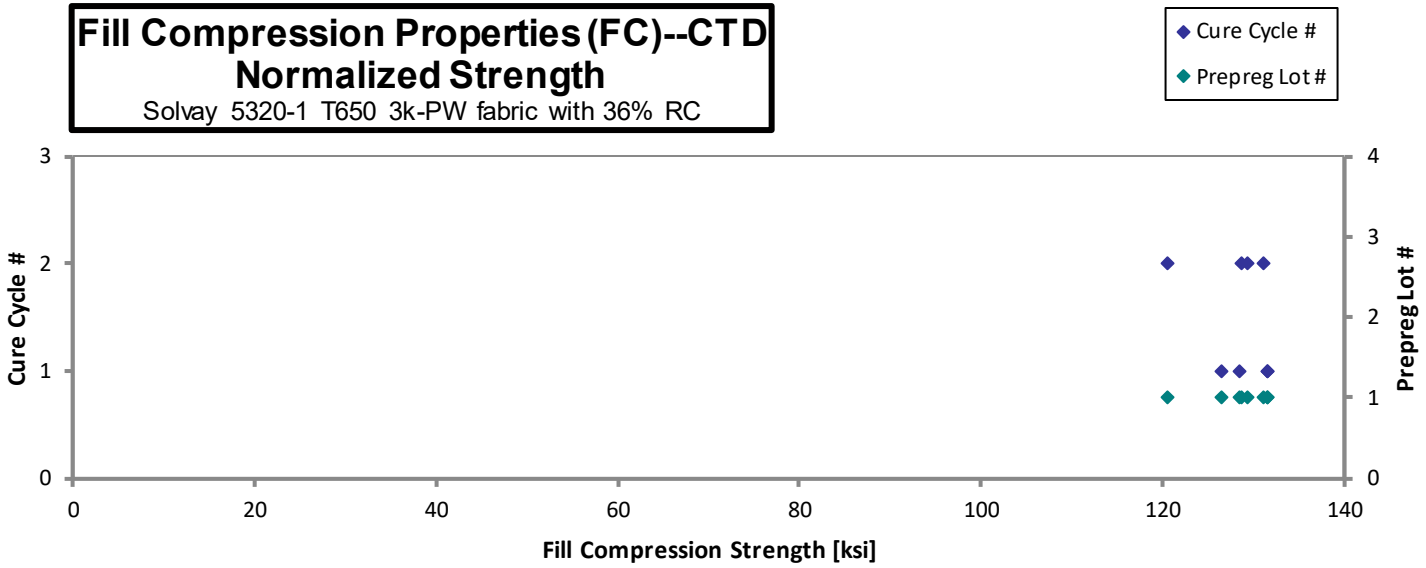
Fill Compression Properties (FC)--CTD
Strength & Modulus
Solvay 5320-1 T650 3k-PW fabric with 36% RC

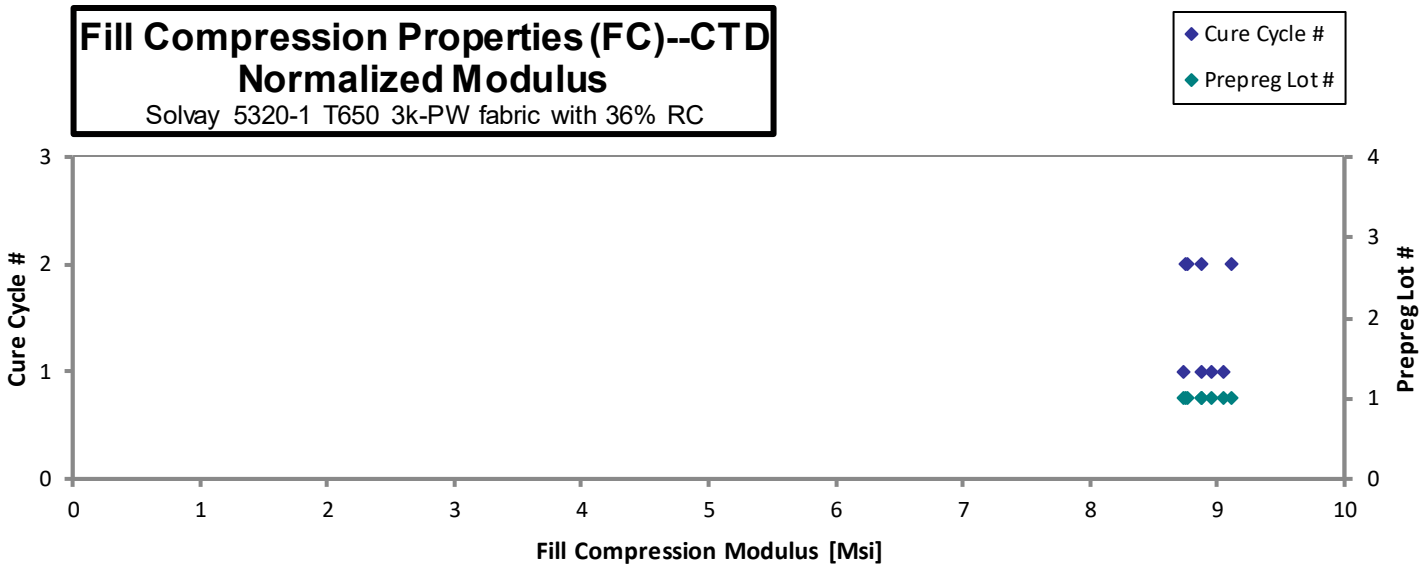
normalizing t_{ply} [in]
0.0077

Specimen Number	NIAR Batch #	NIAR Cure Cycle	Prepreg Lot #	Cure Cycle #	Strength [ksi]	Modulus [Msi]	Avg. Specimen Thickness [in]	# Plies in Laminate	Failure Mode	Avg. t_{ply} [in]	$Strength_{norm}$ [ksi]	$Modulus_{norm}$ [Msi]
NTP5325QR1-SOL-S36-NIAR-FC-A-C1-1R-CTD-1	A	C1	1	1	128.989	8.991	0.115	15	BAT	0.0077	128.394	8.949
NTP5325QR1-SOL-S36-NIAR-FC-A-C1-1R-CTD-2	A	C1	1	1	131.121	9.016	0.116	15	BGM	0.0077	131.594	9.048
NTP5325QR1-SOL-S36-NIAR-FC-A-C1-1R-CTD-3	A	C1	1	1	131.004	8.703	0.116	15	BGM	0.0077	131.552	8.740
NTP5325QR1-SOL-S36-NIAR-FC-A-C1-1R-CTD-4	A	C1	1	1	126.142	8.851	0.116	15	BAT	0.0077	126.469	8.874
NTP5325QR1-SOL-S36-NIAR-FC-A-C2-1R-CTD-1	A	C2	1	2	129.044	8.767	0.115	15	BGM	0.0077	128.765	8.748
NTP5325QR1-SOL-S36-NIAR-FC-A-C2-1R-CTD-2	A	C2	1	2	130.306	8.942	0.115	15	BGM	0.0076	129.272	8.871
NTP5325QR1-SOL-S36-NIAR-FC-A-C2-1R-CTD-3	A	C2	1	2	121.550	9.189	0.115	15	BGM	0.0076	120.568	9.115
NTP5325QR1-SOL-S36-NIAR-FC-A-C2-1R-CTD-4	A	C2	1	2	131.514	8.798	0.115	15	BAB	0.0077	131.040	8.766

	Strength [ksi]	Modulus [Msi]
Average	128.709	8.907
Standard Dev.	3.371	0.159
Coeff. of Var. [%]	2.619	1.780
Min.	121.550	8.703
Max.	131.514	9.189
Number of Spec.	8	8

	Avg. t_{ply} [in]	$Strength_{norm}$ [ksi]	$Modulus_{norm}$ [Msi]
$Average_{norm}$	0.0077	128.457	8.889
$Standard\ Dev._{norm}$		3.646	0.140
$Coeff.\ of\ Var.\ [\%]_{norm}$		2.838	1.579
Min.	0.0076	120.568	8.740
Max.	0.0077	131.594	9.115
Number of Spec.	8	8	8


Fill Compression Properties (FC)--CTD
Normalized Strength
Solvay 5320-1 T650 3k-PW fabric with 36% RC
Cure Cycle #
Prepreg Lot #
Cure Cycle #
Prepreg Lot #
Fill Compression Strength [ksi]
0
20
40
60
80
100
120
140
0
1
2
3
4


Fill Compression Properties (FC)--CTD
Normalized Modulus
Solvay 5320-1 T650 3k-PW fabric with 36% RC
Cure Cycle #
Prepreg Lot #
Cure Cycle #
Prepreg Lot #
Fill Compression Modulus [Msi]
0
1
2
3
4
5
6
7
8
9
10
0
1
2
3
4

Fill Compression Properties (FC)--RTD
Strength & Modulus
Solvay 5320-1 T650 3k-PW fabric with 36% RC

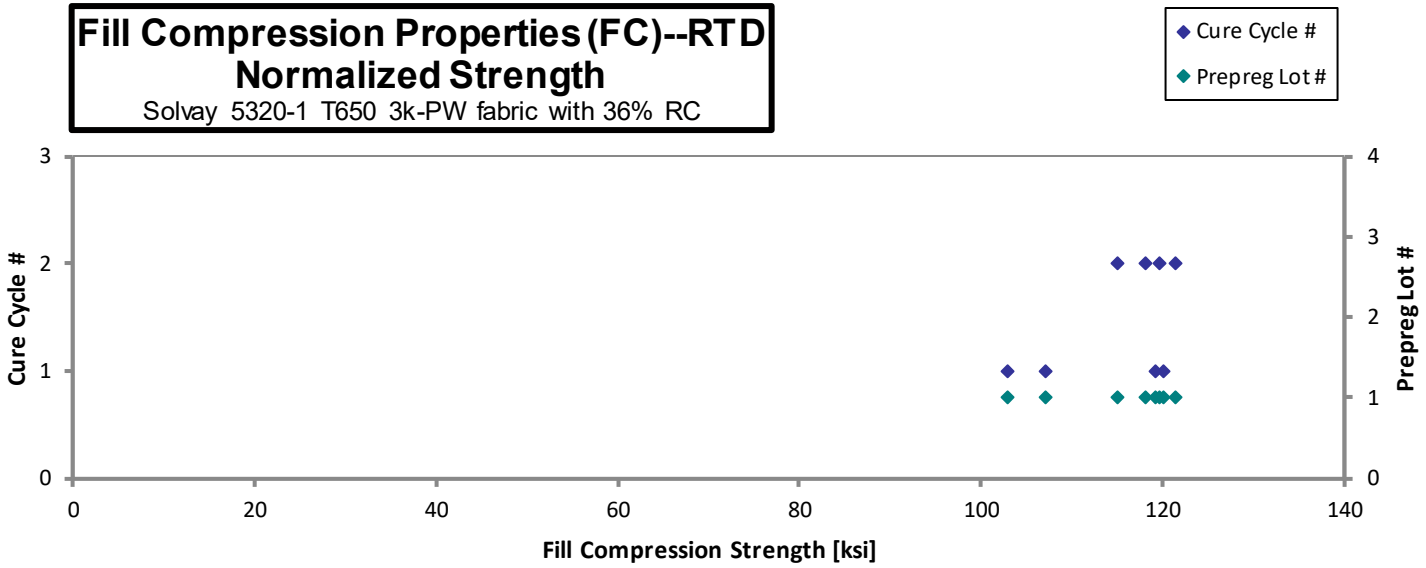
normalizing t_{ply} [in]
0.0077

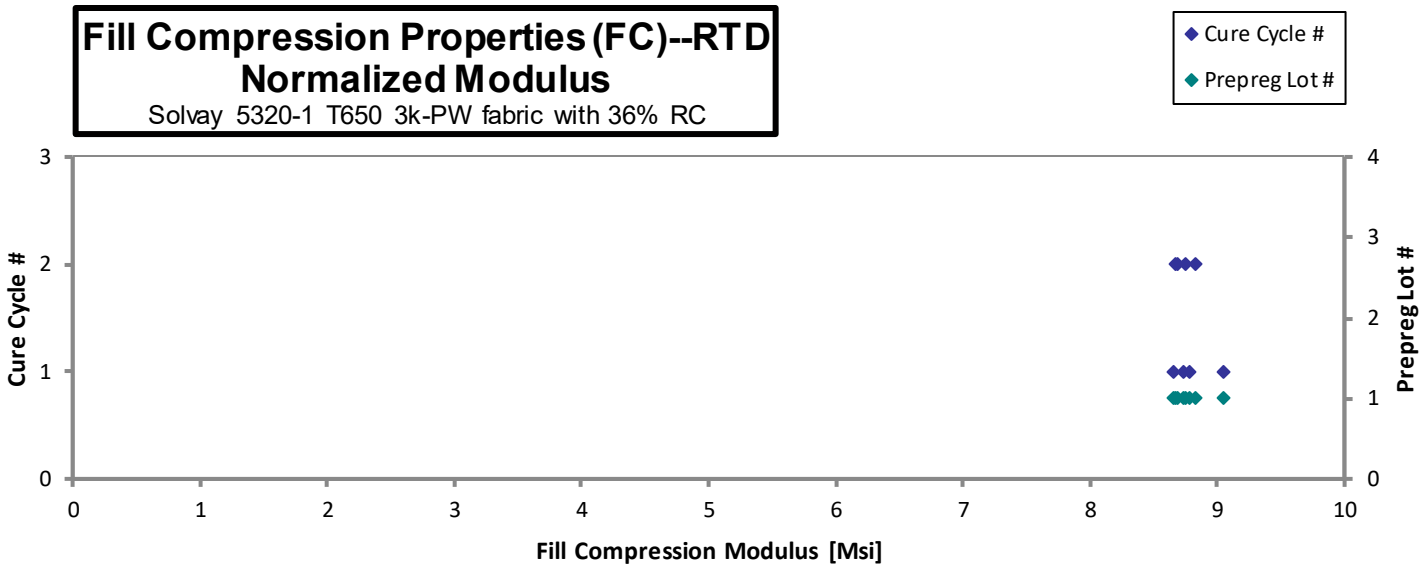
Specimen Number	NIAR Batch #	NIAR Cure Cycle	Prepreg Lot #	Cure Cycle #	Strength [ksi]	Modulus [Msi]	Avg. Specimen Thickness [in]	# Plies in Laminate	Failure Mode	Avg. t_{ply} [in]	$Strength_{norm}$ [ksi]	$Modulus_{norm}$ [Msi]
NTP5325QR1-SOL-S36-NIAR-FC-A-C1-1R-RTD-1*	A	C1	1	1	119.134	8.729	0.116	15	BAT	0.0077	119.237	8.736
NTP5325QR1-SOL-S36-NIAR-FC-A-C1-1R-RTD-2*	A	C1	1	1	103.193	8.680	0.115	15	BGM	0.0077	103.014	8.665
NTP5325QR1-SOL-S36-NIAR-FC-A-C1-1R-RTD-3	A	C1	1	1	107.209	8.799	0.115	15	BGM	0.0077	107.101	8.790
NTP5325QR1-SOL-S36-NIAR-FC-A-C1-1R-RTD-4	A	C1	1	1	120.126	9.064	0.115	15	BGM	0.0077	120.039	9.057
NTP5325QR1-SOL-S36-NIAR-FC-A-C2-1R-RTD-1*	A	C2	1	2	118.625	8.708	0.115	15	BGM	0.0077	118.077	8.668
NTP5325QR1-SOL-S36-NIAR-FC-A-C2-1R-RTD-2*	A	C2	1	2	115.101	8.684	0.116	15	BGM	0.0077	115.101	8.684
NTP5325QR1-SOL-S36-NIAR-FC-A-C2-1R-RTD-3	A	C2	1	2	120.481	8.803	0.115	15	BGM	0.0077	119.716	8.747
NTP5325QR1-SOL-S36-NIAR-FC-A-C2-1R-RTD-4	A	C2	1	2	121.274	8.824	0.116	15	BGM, HAB	0.0077	121.397	8.833

*Modulus are averaged values of 2 strain gages.

	Strength [ksi]	Modulus [Msi]
Average	115.643	8.786
Standard Dev.	6.790	0.125
Coeff. of Var. [%]	5.872	1.425
Min.	103.193	8.680
Max.	121.274	9.064
Number of Spec.	8	8

	t_{ply} [in]	$Strength_{norm}$ [ksi]	$Modulus_{norm}$ [Msi]
$Average_{norm}$	0.0077	115.460	8.773
$Standard\ Dev._{norm}$		6.765	0.129
$Coeff.\ of\ Var.\ [\%]_{norm}$		5.859	1.474
Min.	0.0077	103.014	8.665
Max.	0.0077	121.397	9.057
Number of Spec.	8	8	8


Fill Compression Properties (FC)--RTD
Normalized Strength
Solvay 5320-1 T650 3k-PW fabric with 36% RC
Cure Cycle #
Prepreg Lot #
Cure Cycle #
Prepreg Lot #
Fill Compression Strength [ksi]
0
20
40
60
80
100
120
140
0
1
2
3
4


Fill Compression Properties (FC)--RTD
Normalized Modulus
Solvay 5320-1 T650 3k-PW fabric with 36% RC
Cure Cycle #
Prepreg Lot #
Cure Cycle #
Prepreg Lot #
Fill Compression Modulus [Msi]
0
1
2
3
4
5
6
7
8
9
10
0
1
2
3
4

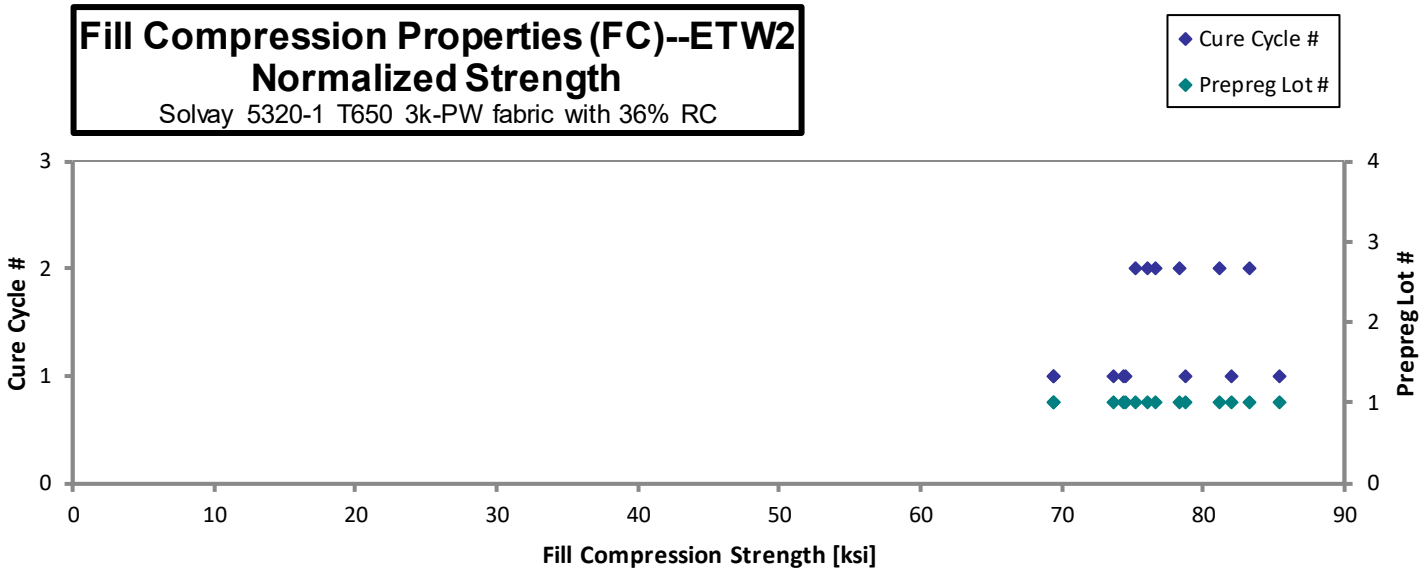
Fill Compression Properties (FC)--ETW2
Strength & Modulus
Solvay 5320-1 T650 3k-PW fabric with 36% RC

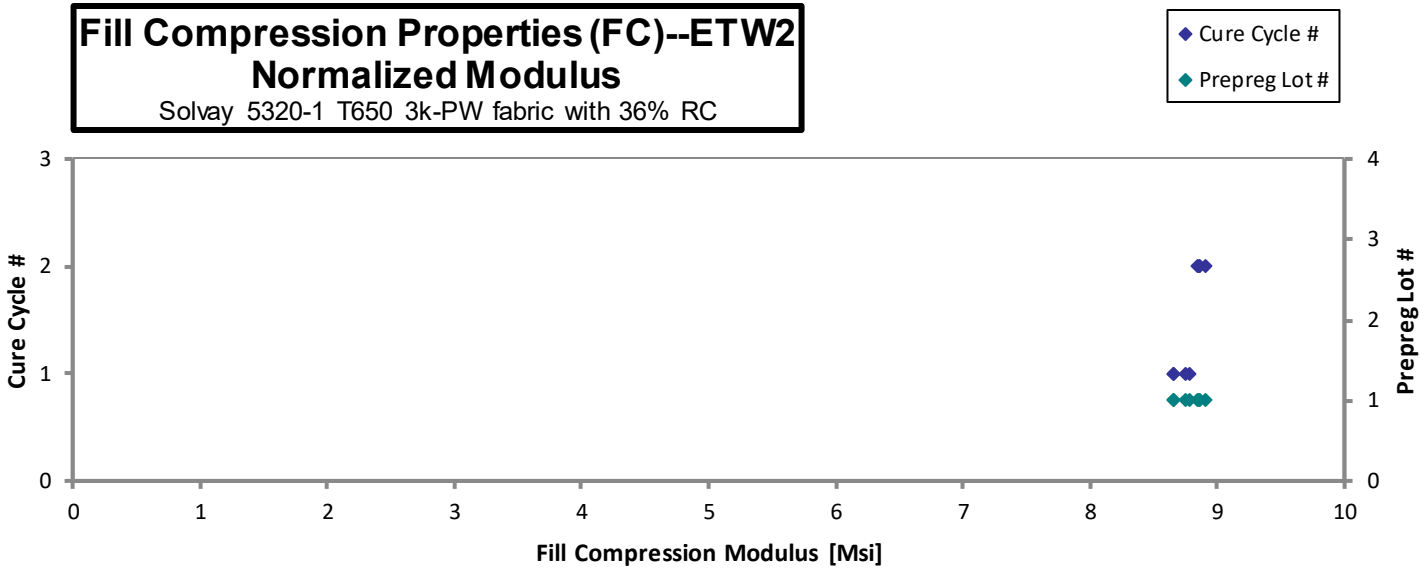
normalizing t_{ply} [in]: 0.0077

Specimen Number	NIAR Batch #	NIAR Cure Cycle	Prepreg Lot #	Cure Cycle #	Strength [ksi]	Modulus [Msi]	Avg. Specimen Thickness [in]	# Plies in Laminate	Failure Mode	Avg. t_{ply} [in]	$Strength_{norm}$ [ksi]	$Modulus_{norm}$ [Msi]
NTP5325QR1-SOL-S36-NIAR-FC-A-C1-1R-ETW2-1	A	C1	1	1	78.833	8.661	0.115	15	BGM	0.0077	78.821	8.659
NTP5325QR1-SOL-S36-NIAR-FC-A-C1-1R-ETW2-2	A	C1	1	1	84.890	8.707	0.116	15	BGM	0.0077	85.356	8.755
NTP5325QR1-SOL-S36-NIAR-FC-A-C1-1R-ETW2-3	A	C1	1	1	73.472	8.634	0.116	15	BGM	0.0077	73.716	8.663
NTP5325QR1-SOL-S36-NIAR-FC-A-C1-1R-ETW2-4	A	C1	1	1	74.580	8.799	0.115	15	BGM	0.0077	74.386	8.777
NTP5325QR1-SOL-S36-NIAR-FC-A-C1-1R-ETW2-5**	A	C1	1	1	74.693		0.115	15	HGM	0.0077	74.542	
NTP5325QR1-SOL-S36-NIAR-FC-A-C1-1R-ETW2-6**	A	C1	1	1	69.588		0.115	15	BGM	0.0077	69.438	
NTP5325QR1-SOL-S36-NIAR-FC-A-C1-1R-ETW2-7**	A	C1	1	1	81.995		0.116	15	BGM	0.0077	82.031	
NTP5325QR1-SOL-S36-NIAR-FC-A-C1-1R-ETW2-8**	A	C1	1	1	69.574		0.115	15	BGM	0.0077	69.443	
NTP5325QR1-SOL-S36-NIAR-FC-A-C2-1R-ETW2-1	A	C2	1	2	78.597	8.884	0.115	15	BGM	0.0077	78.291	8.850
NTP5325QR1-SOL-S36-NIAR-FC-A-C2-1R-ETW2-2*	A	C2	1	2		8.903	0.115	15	CIT, CIB	0.0077		8.864
NTP5325QR1-SOL-S36-NIAR-FC-A-C2-1R-ETW2-3	A	C2	1	2	83.333	8.918	0.115	15	BGM	0.0077	83.249	8.909
NTP5325QR1-SOL-S36-NIAR-FC-A-C2-1R-ETW2-4	A	C2	1	2	81.056	8.843	0.116	15	BAB, HAB, HIB	0.0077	81.173	8.856
NTP5325QR1-SOL-S36-NIAR-FC-A-C2-1R-ETW2-6**	A	C2	1	2	76.323		0.116	15	BGM	0.0077	76.643	
NTP5325QR1-SOL-S36-NIAR-FC-A-C2-1R-ETW2-7**	A	C2	1	2	76.323		0.115	15	BGM	0.0077	76.048	
NTP5325QR1-SOL-S36-NIAR-FC-A-C2-1R-ETW2-8**	A	C2	1	2	74.860		0.116	15	BGM	0.0077	75.227	

*Strength not reported due to unacceptable failure mode.
**Specimen was not gaged, only strength is tested.

Average	77.008	8.794	$Average_{norm}$	0.0077	77.026	8.792
Standard Dev.	4.714	0.112	$Standard\ Dev._{norm}$		4.793	0.094
Coeff. of Var. [%]	6.121	1.279	Coeff. of Var. $[\%]_{norm}$		6.223	1.071
Min.	69.574	8.634	Min.	0.0077	69.438	8.659
Max.	84.890	8.918	Max.	0.0077	85.356	8.909
Number of Spec.	14	8	Number of Spec.	15	14	8


Fill Compression Properties (FC)--ETW2
Normalized Strength
Solvay 5320-1 T650 3k-PW fabric with 36% RC
Cure Cycle #
Prepreg Lot #
Cure Cycle #
Prepreg Lot #
Fill Compression Strength [ksi]
0
10
20
30
40
50
60
70
80
90
0
1
2
3
4

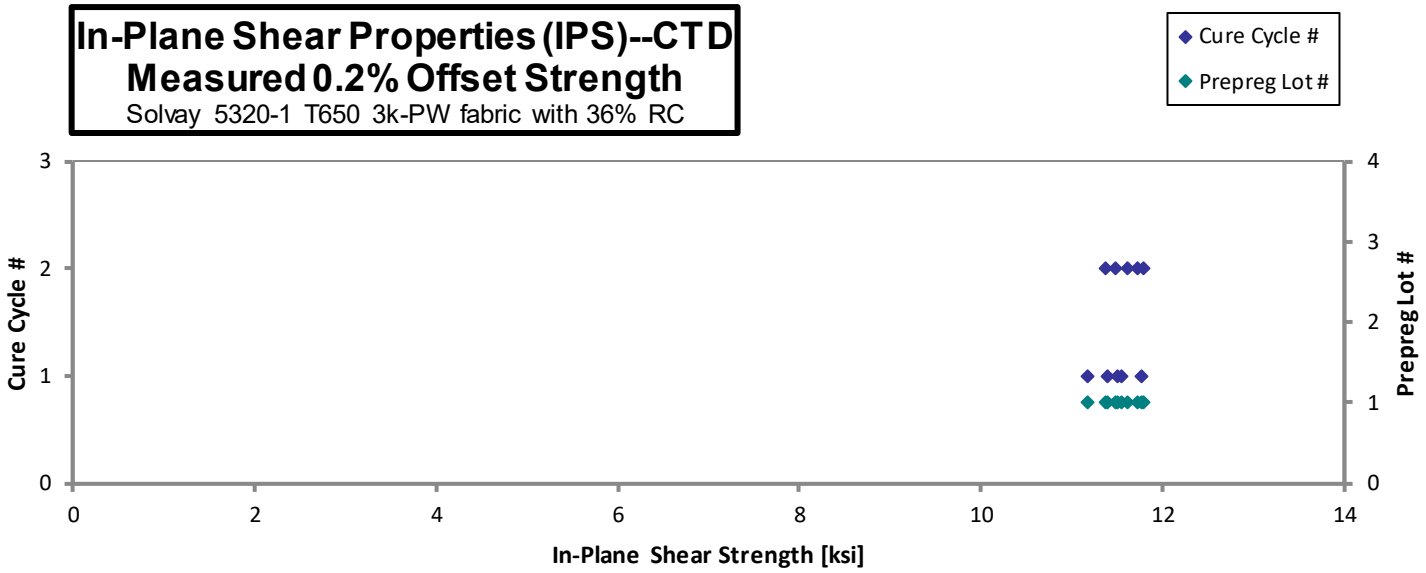

Fill Compression Properties (FC)--ETW2
Normalized Modulus
Solvay 5320-1 T650 3k-PW fabric with 36% RC
Cure Cycle #
Prepreg Lot #
Cure Cycle #
Prepreg Lot #
Fill Compression Modulus [Msi]
0
1
2
3
4
5
6
7
8
9
10
0
1
2
3
4

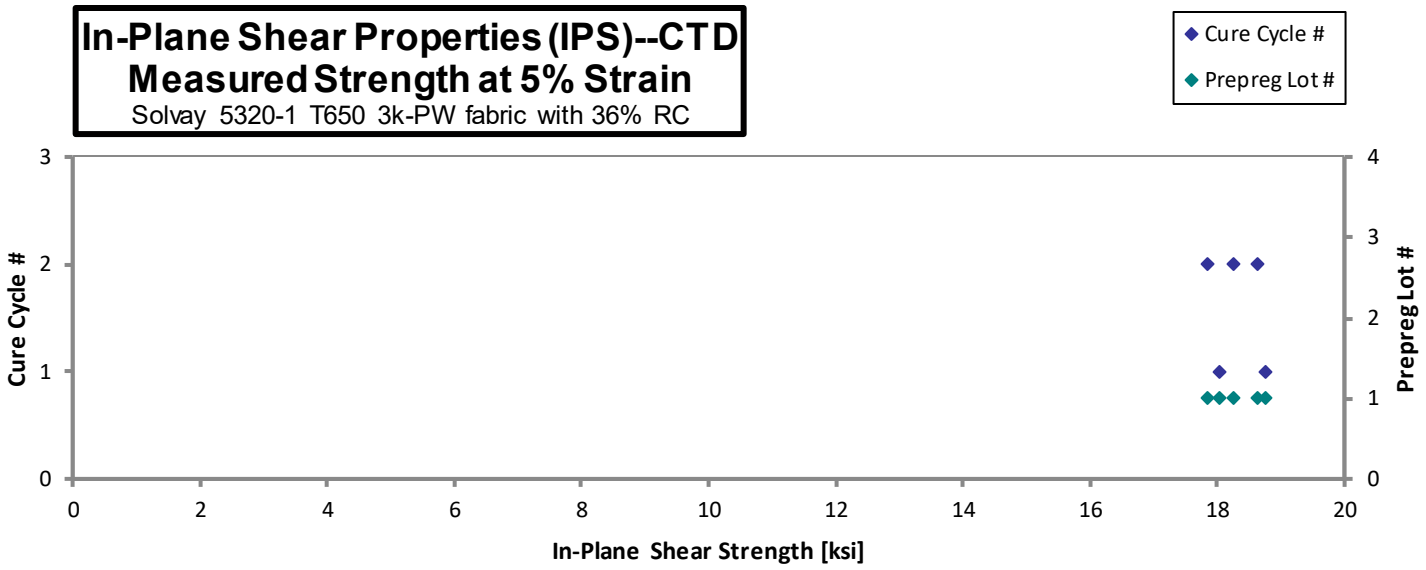
4.5 In-Plane Shear Properties (IPS)

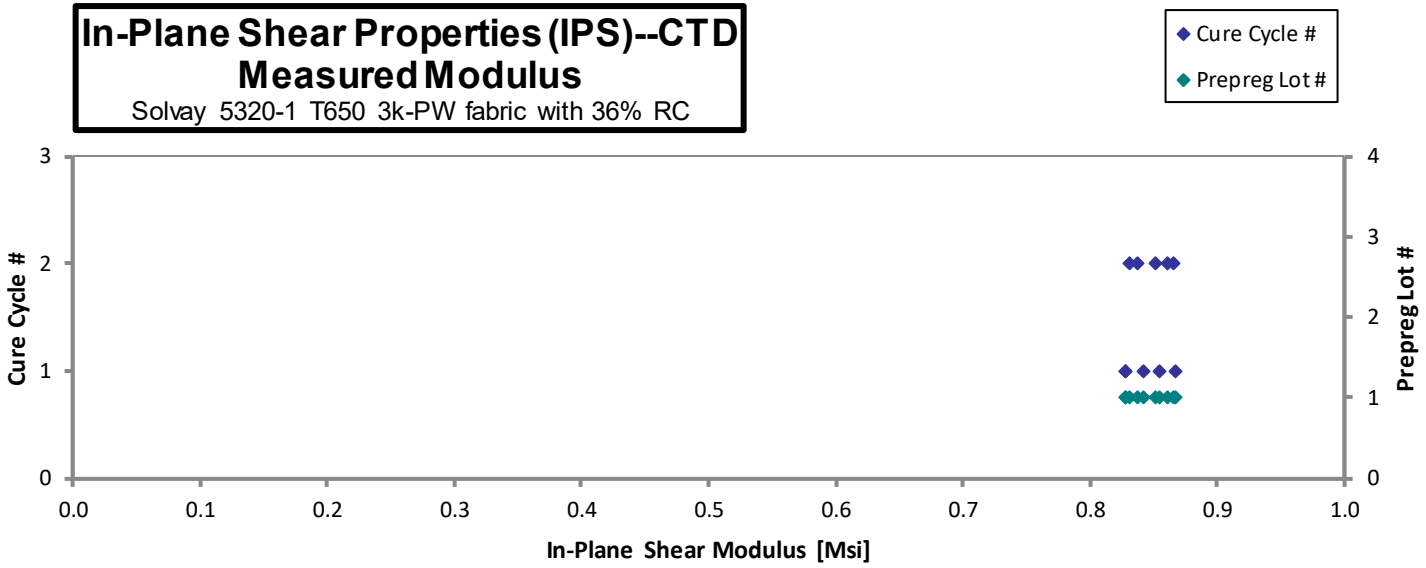
In-Plane Shear Properties (IPS)--CTD
Strength & Modulus
Solvay 5320-1 T650 3k-PW fabric with 36% RC

Specimen Number	NIAR Batch #	NIAR Cure Cycle	Prepreg Lot #	Cure Cycle #	0.2% Offset Strength [ksi]	Strength at 5% Strain [ksi]	Modulus [Msi]	Avg. Specimen Thickness [in]	# Plies in Laminate	Avg. t_{ply} [in]
NTP-5325QRI-SOL-S36-NIAR-IPS-A-C1-1-CTD-1	A	C1	1	1	11.551	18.761	0.855	0.093	12	0.0077
NTP-5325QRI-SOL-S36-NIAR-IPS-A-C1-1-CTD-2*	A	C1	1	1	11.773		0.868	0.092	12	0.0077
NTP-5325QRI-SOL-S36-NIAR-IPS-A-C1-1-CTD-3*	A	C1	1	1	11.397		0.843	0.093	12	0.0078
NTP-5325QRI-SOL-S36-NIAR-IPS-A-C1-1-CTD-4	A	C1	1	1	11.169	18.030	0.829	0.093	12	0.0078
NTP-5325QRI-SOL-S36-NIAR-IPS-A-C1-1-CTD-5*	A	C1	1	1	11.494		0.827	0.093	12	0.0078
NTP-5325QRI-SOL-S36-NIAR-IPS-A-C2-1-CTD-1*	A	C2	1	2	11.788		0.865	0.092	12	0.0077
NTP-5325QRI-SOL-S36-NIAR-IPS-A-C2-1-CTD-2*	A	C2	1	2	11.607		0.860	0.093	12	0.0077
NTP-5325QRI-SOL-S36-NIAR-IPS-A-C2-1-CTD-3	A	C2	1	2	11.726	18.643	0.852	0.093	12	0.0077
NTP-5325QRI-SOL-S36-NIAR-IPS-A-C2-1-CTD-4	A	C2	1	2	11.487	18.263	0.837	0.093	12	0.0077
NTP-5325QRI-SOL-S36-NIAR-IPS-A-C2-1-CTD-5	A	C2	1	2	11.371	17.843	0.830	0.093	12	0.0077
Average					**11.536**	**18.308**	**0.847**			**0.0077**
Standard Dev.					**0.196**	**0.391**	**0.015**			
Coeff. of Var. [%]					**1.703**	**2.137**	**1.829**			
Min.					**11.169**	**17.843**	**0.827**			**0.0077**
Max.					**11.788**	**18.761**	**0.868**			**0.0078**
Number of Spec.					**10**	**5**	**10**			**10**

*Strength at 5% strain is not available because strain gage failed prior to reaching 5% strain.

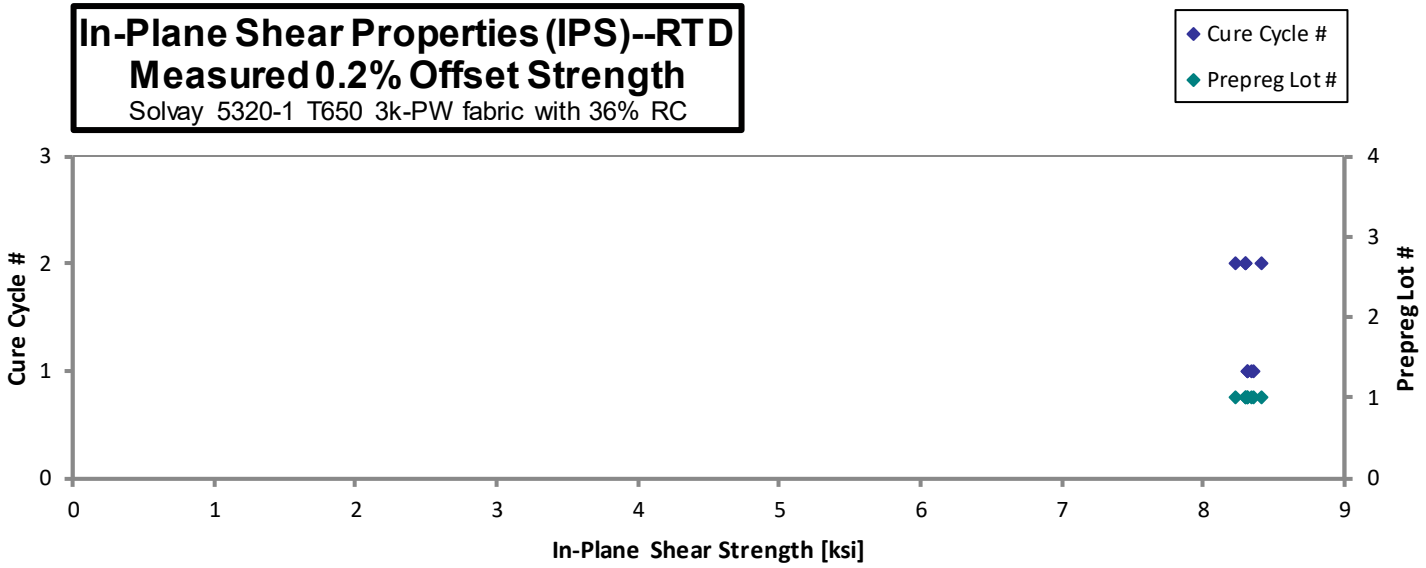

In-Plane Shear Properties (IPS)--CTD
Measured 0.2% Offset Strength
Solvay 5320-1 T650 3k-PW fabric with 36% RC
Cure Cycle #
Prepreg Lot #
Cure Cycle #
Prepreg Lot #
In-Plane Shear Strength [ksi]
0
1
2
3
4
0
2
4
6
8
10
12
14

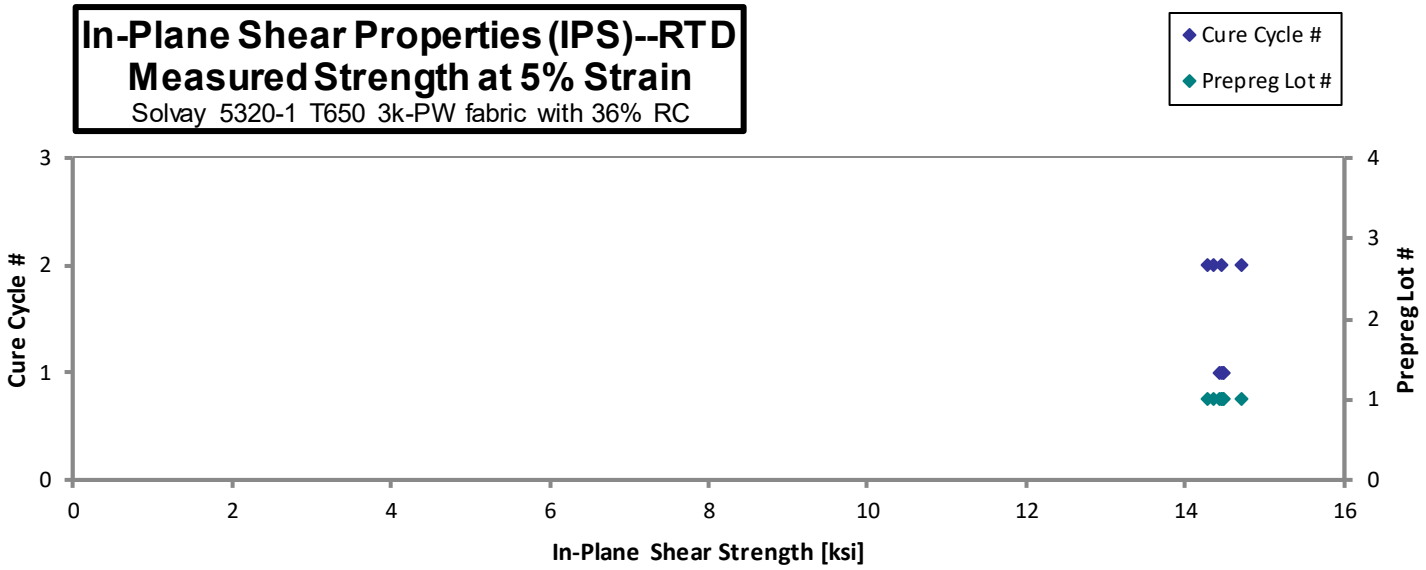

In-Plane Shear Properties (IPS)--CTD
Measured Strength at 5% Strain
Solvay 5320-1 T650 3k-PW fabric with 36% RC
Cure Cycle #
Prepreg Lot #
Cure Cycle #
Prepreg Lot #
In-Plane Shear Strength [ksi]
0
1
2
3
4
0
2
4
6
8
10
12
14
16
18
20

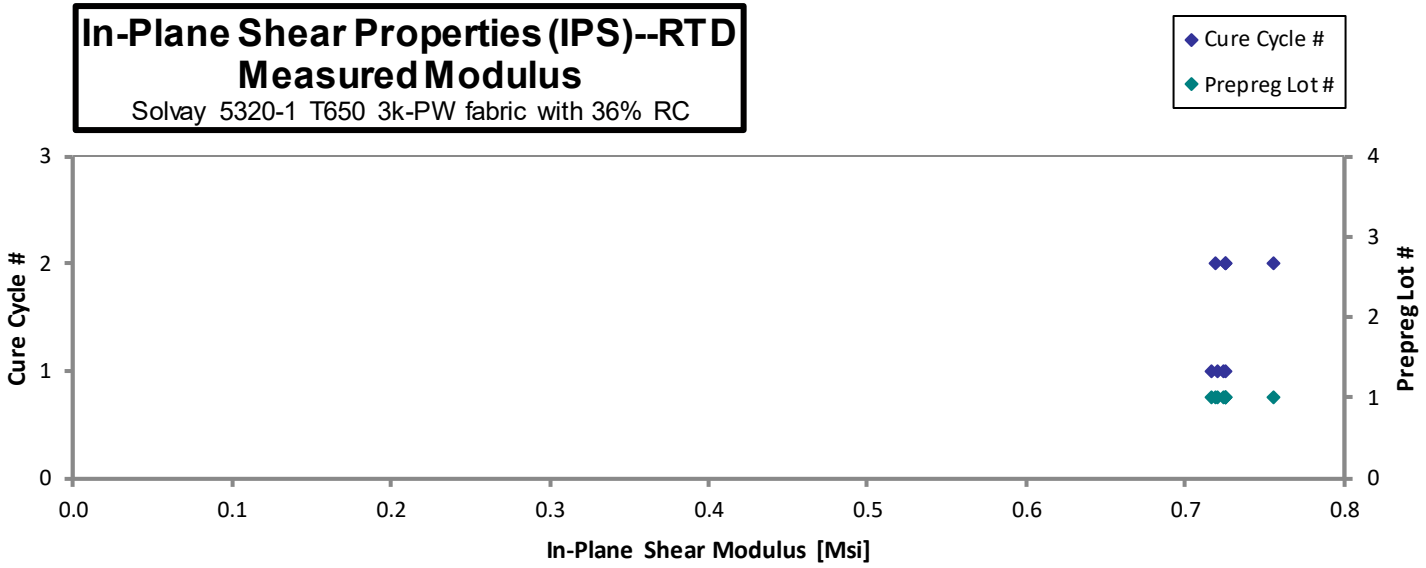

In-Plane Shear Properties (IPS)--CTD
Measured Modulus
Solvay 5320-1 T650 3k-PW fabric with 36% RC
Cure Cycle #
Prepreg Lot #
Cure Cycle #
Prepreg Lot #
In-Plane Shear Modulus [Msi]
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
0
1
2
3
4

In-Plane Shear Properties (IPS)--RTD
Strength & Modulus
Solvay 5320-1 T650 3k-PW fabric with 36% RC

Specimen Number	NIAR Batch #	NIAR Cure Cycle	Prepreg Lot #	Cure Cycle #	0.2% Offset Strength [ksi]	Strength at 5% Strain [ksi]	Modulus [Msi]	Avg. Specimen Thickness [in]	# Plies in Laminate	Avg. t_{ply} [in]
NTP-5325QRI-SOL-S36-NIAR-IPS-A-C1-1-RTD-1	A	C1	1	1	8.309	14.483	0.720	0.093	12	0.0078
NTP-5325QRI-SOL-S36-NIAR-IPS-A-C1-1-RTD-2	A	C1	1	1	8.342	14.474	0.726	0.093	12	0.0077
NTP-5325QRI-SOL-S36-NIAR-IPS-A-C1-1-RTD-3	A	C1	1	1	8.318	14.431	0.725	0.092	12	0.0077
NTP-5325QRI-SOL-S36-NIAR-IPS-A-C1-1-RTD-4	A	C1	1	1	8.352	14.456	0.717	0.093	12	0.0078
NTP-5325QRI-SOL-S36-NIAR-IPS-A-C2-1-RTD-1	A	C2	1	2	8.230	14.289	0.719	0.093	12	0.0077
NTP-5325QRI-SOL-S36-NIAR-IPS-A-C2-1-RTD-2	A	C2	1	2	8.303	14.343	0.725	0.093	12	0.0077
NTP-5325QRI-SOL-S36-NIAR-IPS-A-C2-1-RTD-3	A	C2	1	2	8.308	14.465	0.725	0.093	12	0.0077
NTP-5325QRI-SOL-S36-NIAR-IPS-A-C2-1-RTD-4	A	C2	1	2	8.415	14.700	0.755	0.092	12	0.0077
				Average	**8.322**	**14.455**	**0.726**			**0.0077**
				Standard Dev.	**0.052**	**0.121**	**0.012**			
				Coeff. of Var. [%]	**0.630**	**0.835**	**1.651**			
				Min.	**8.230**	**14.289**	**0.717**			**0.0077**
				Max.	**8.415**	**14.700**	**0.755**			**0.0078**
				Number of Spec.	**8**	**8**	**8**			**8**

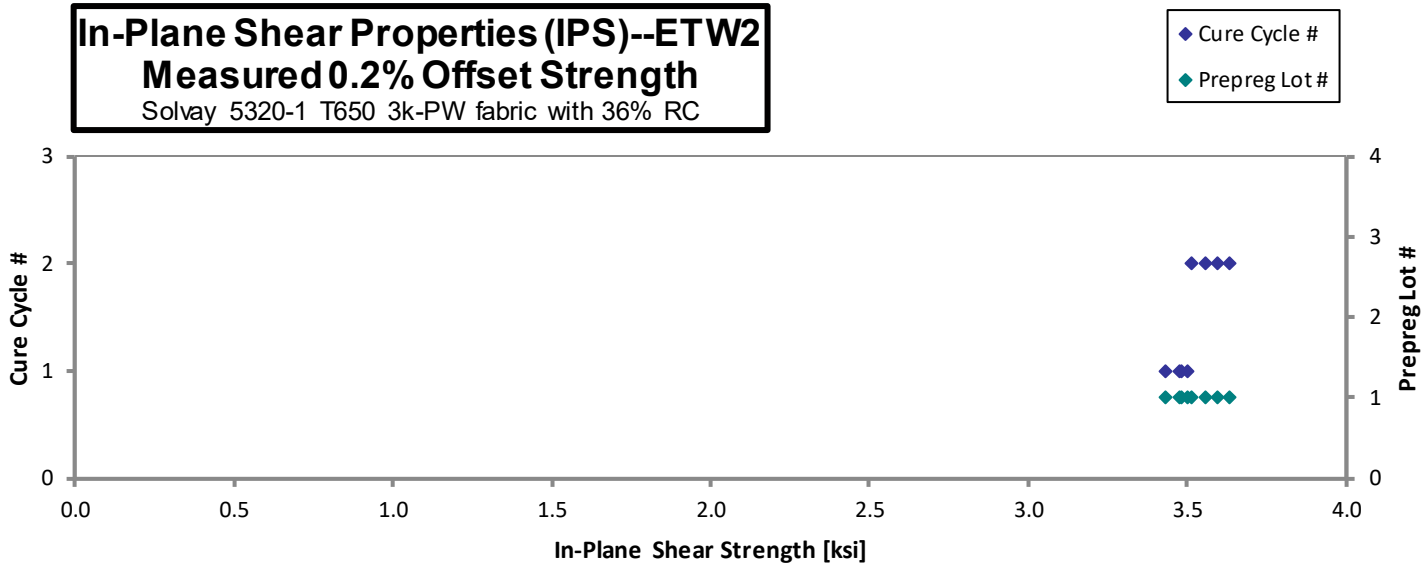

In-Plane Shear Properties (IPS)--RTD
Measured 0.2% Offset Strength
Solvay 5320-1 T650 3k-PW fabric with 36% RC
Cure Cycle #
Prepreg Lot #
Cure Cycle #
Prepreg Lot #
In-Plane Shear Strength [ksi]
0
1
2
3
4
5
6
7
8
9

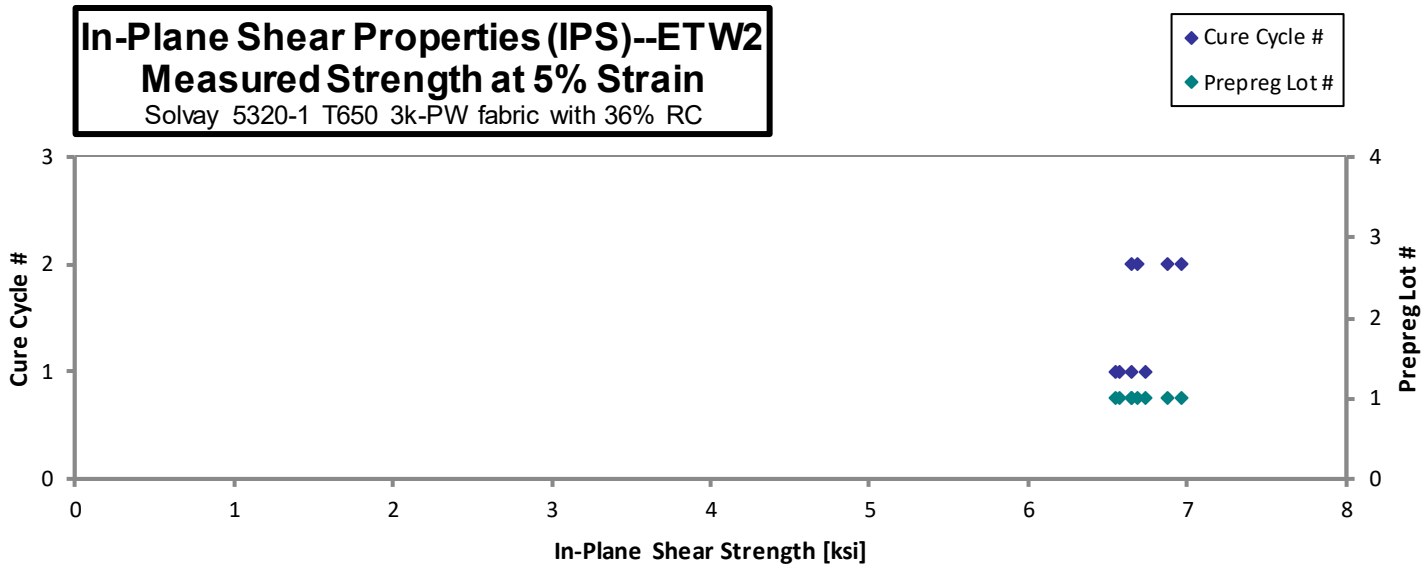

In-Plane Shear Properties (IPS)--RTD
Measured Strength at 5% Strain
Solvay 5320-1 T650 3k-PW fabric with 36% RC
Cure Cycle #
Prepreg Lot #
Cure Cycle #
Prepreg Lot #
In-Plane Shear Strength [ksi]
0
2
4
6
8
10
12
14
16

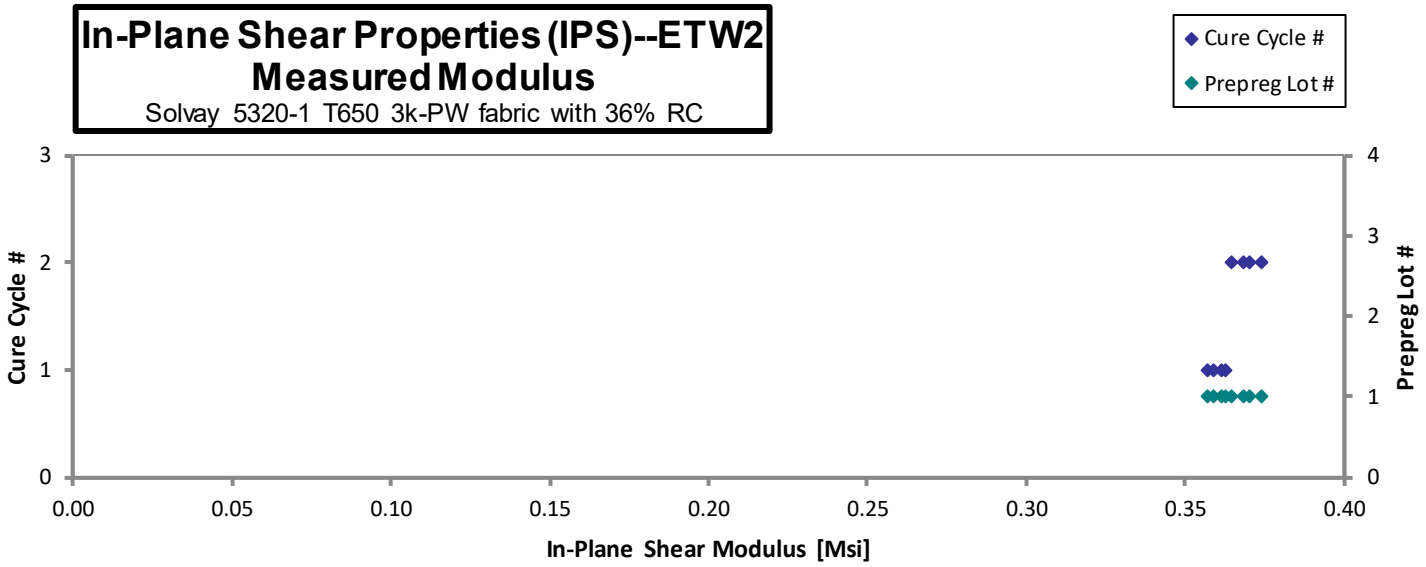

In-Plane Shear Properties (IPS)--RTD
Measured Modulus
Solvay 5320-1 T650 3k-PW fabric with 36% RC
Cure Cycle #
Prepreg Lot #
Cure Cycle #
Prepreg Lot #
In-Plane Shear Modulus [Msi]
0
1
2
3
4
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8

In-Plane Shear Properties (IPS)--ETW2
Strength & Modulus
Solvay 5320-1 T650 3k-PW fabric with 36% RC

Specimen Number	NIAR Batch #	NIAR Cure Cycle	Prepreg Lot #	Cure Cycle #	0.2% Offset Strength [ksi]	Strength at 5% Strain [ksi]	Modulus [Msi]	Avg. Specimen Thickness [in]	# Plies in Laminate	Avg. t_{ply} [in]
NTP-5325QRI-SOL-S36-NIAR-IPS-A-C1-1-ETW2-1	A	C1	1	1	3.499	6.549	0.362	0.093	12	0.0077
NTP-5325QRI-SOL-S36-NIAR-IPS-A-C1-1-ETW2-2	A	C1	1	1	3.483	6.567	0.362	0.094	12	0.0078
NTP-5325QRI-SOL-S36-NIAR-IPS-A-C1-1-ETW2-3	A	C1	1	1	3.434	6.647	0.357	0.094	12	0.0078
NTP-5325QRI-SOL-S36-NIAR-IPS-A-C1-1-ETW2-4	A	C1	1	1	3.476	6.742	0.359	0.094	12	0.0078
NTP-5325QRI-SOL-S36-NIAR-IPS-A-C2-1-ETW2-1	A	C2	1	2	3.513	6.654	0.365	0.093	12	0.0077
NTP-5325QRI-SOL-S36-NIAR-IPS-A-C2-1-ETW2-2	A	C2	1	2	3.554	6.688	0.368	0.093	12	0.0077
NTP-5325QRI-SOL-S36-NIAR-IPS-A-C2-1-ETW2-3	A	C2	1	2	3.633	6.968	0.374	0.093	12	0.0077
NTP-5325QRI-SOL-S36-NIAR-IPS-A-C2-1-ETW2-4	A	C2	1	2	3.594	6.879	0.370	0.093	12	0.0078
				Average	**3.523**	**6.712**	**0.365**			**0.0078**
				Standard Dev.	**0.066**	**0.146**	**0.006**			
				Coeff. of Var. [%]	**1.870**	**2.182**	**1.626**			
				Min.	**3.434**	**6.549**	**0.357**			**0.0077**
				Max.	**3.633**	**6.968**	**0.374**			**0.0078**
				Number of Spec.	**8**	**8**	**8**			**8**


In-Plane Shear Properties (IPS)--ETW2
Measured 0.2% Offset Strength
Solvay 5320-1 T650 3k-PW fabric with 36% RC
Cure Cycle #
Prepreg Lot #
Cure Cycle #
Prepreg Lot #
In-Plane Shear Strength [ksi]
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
0
1
2
3
4

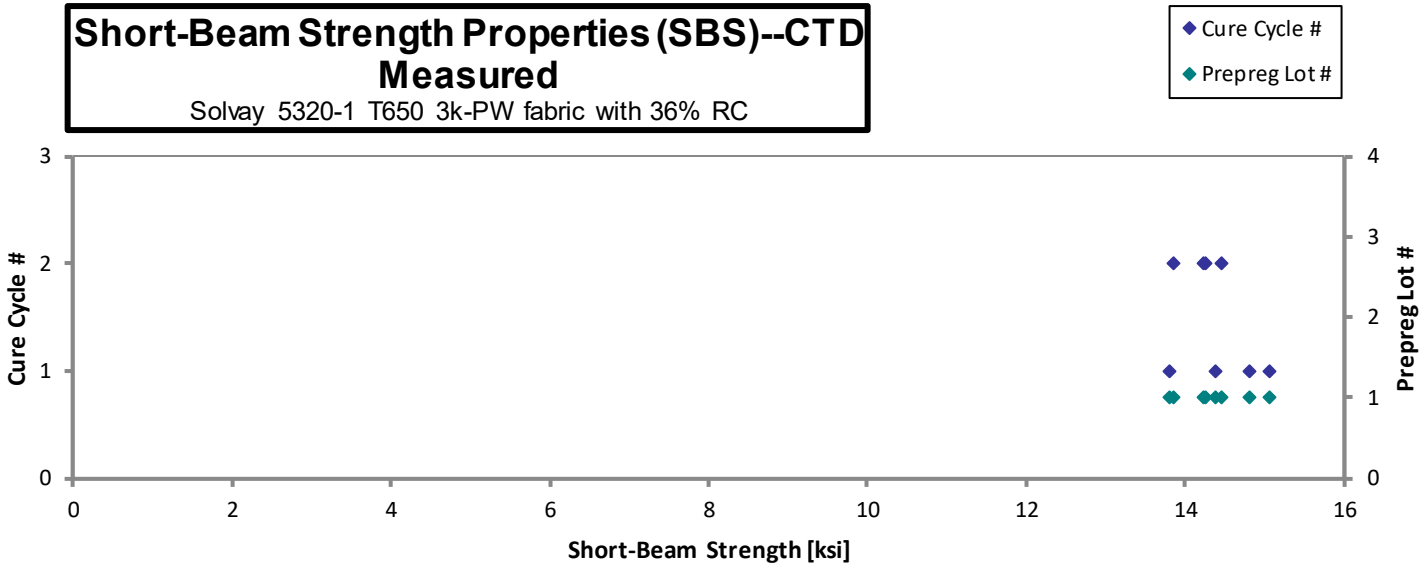

In-Plane Shear Properties (IPS)--ETW2
Measured Strength at 5% Strain
Solvay 5320-1 T650 3k-PW fabric with 36% RC
Cure Cycle #
Prepreg Lot #
Cure Cycle #
Prepreg Lot #
In-Plane Shear Strength [ksi]
0
1
2
3
4
5
6
7
8
0
1
2
3
4


In-Plane Shear Properties (IPS)--ETW2
Measured Modulus
Solvay 5320-1 T650 3k-PW fabric with 36% RC
Cure Cycle #
Prepreg Lot #
Cure Cycle #
Prepreg Lot #
In-Plane Shear Modulus [Msi]
0
1
2
3
4
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40

4.6 Lamina Short-Beam Strength Properties (SBS)

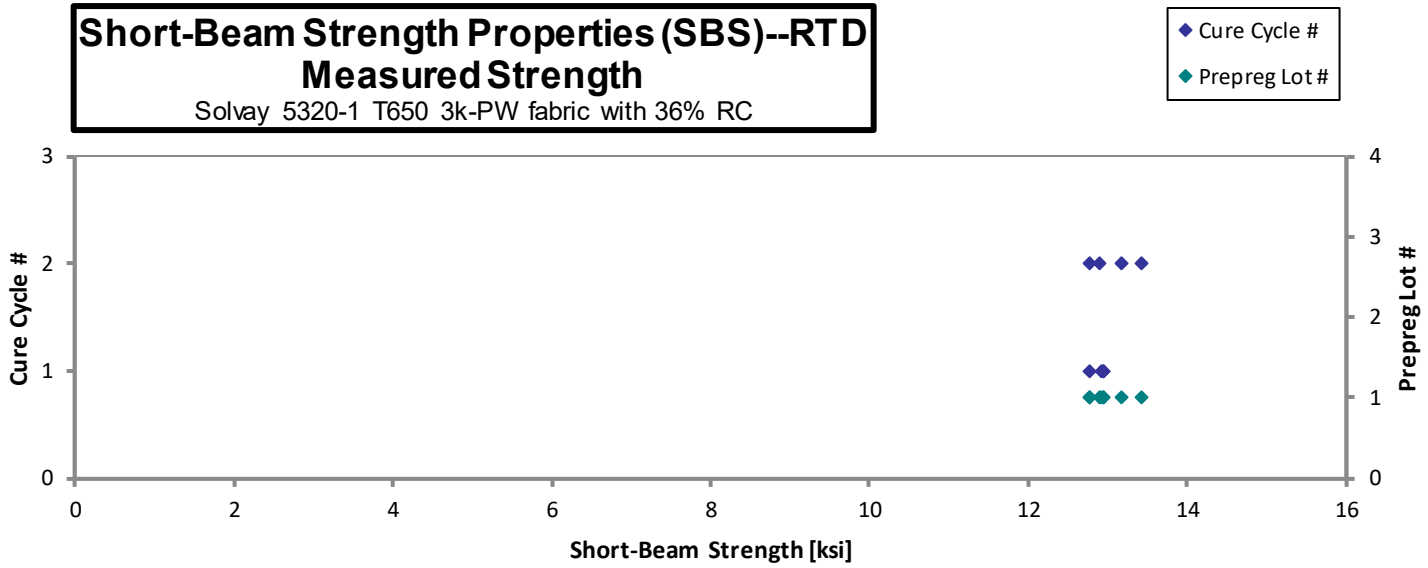
Short-Beam Strength Properties (SBS)--CTD
Solvay 5320-1 T650 3k-PW fabric with 36% RC

Specimen Number	NIAR Batch #	NIAR Cure Cycle	Prepreg Lot #	Cure Cycle #	Strength [ksi]	Avg. Specimen Thickness [in]	# Plies in Laminate	Avg. t_{ply} [in]	Failure Mode
NTP-5325QRI-SOL-S36-NIAR-SBS-A-C1-1-CTD-1	A	C1	1	1	14.385	0.244	32	0.0076	INTERLAMINAR SHEAR, TENSION
NTP-5325QRI-SOL-S36-NIAR-SBS-A-C1-1-CTD-2	A	C1	1	1	15.070	0.243	32	0.0076	INTERLAMINAR SHEAR, TENSION
NTP-5325QRI-SOL-S36-NIAR-SBS-A-C1-1-CTD-3	A	C1	1	1	13.810	0.243	32	0.0076	INTERLAMINAR SHEAR, TENSION
NTP-5325QRI-SOL-S36-NIAR-SBS-A-C1-1-CTD-4	A	C1	1	1	14.816	0.243	32	0.0076	INTERLAMINAR SHEAR
NTP-5325QRI-SOL-S36-NIAR-SBS-A-C2-1-CTD-1	A	C2	1	2	13.845	0.246	32	0.0077	INTERLAMINAR SHEAR, TENSION
NTP-5325QRI-SOL-S36-NIAR-SBS-A-C2-1-CTD-2	A	C2	1	2	14.250	0.245	32	0.0077	INTERLAMINAR SHEAR, TENSION
NTP-5325QRI-SOL-S36-NIAR-SBS-A-C2-1-CTD-3	A	C2	1	2	14.227	0.245	32	0.0077	INTERLAMINAR SHEAR, TENSION
NTP-5325QRI-SOL-S36-NIAR-SBS-A-C2-1-CTD-4	A	C2	1	2	14.444	0.246	32	0.0077	INTERLAMINAR SHEAR, TENSION
				Average	**14.356**			**0.0076**	
				Standard Dev.	**0.434**				
				Coeff. of Var. [%]	**3.022**				
				Min.	**13.810**			**0.0076**	
				Max.	**15.070**			**0.0077**	
				Number of Spec.	**8**			**8**	


Short-Beam Strength Properties (SBS)--CTD Measured
Solvay 5320-1 T650 3k-PW fabric with 36% RC
Cure Cycle #
Prepreg Lot #
Cure Cycle #
Prepreg Lot #
Short-Beam Strength [ksi]
0
1
2
3
4
0
2
4
6
8
10
12
14
16

Short-Beam Strength Properties (SBS)--RTD
Solvay 5320-1 T650 3k-PW fabric with 36% RC

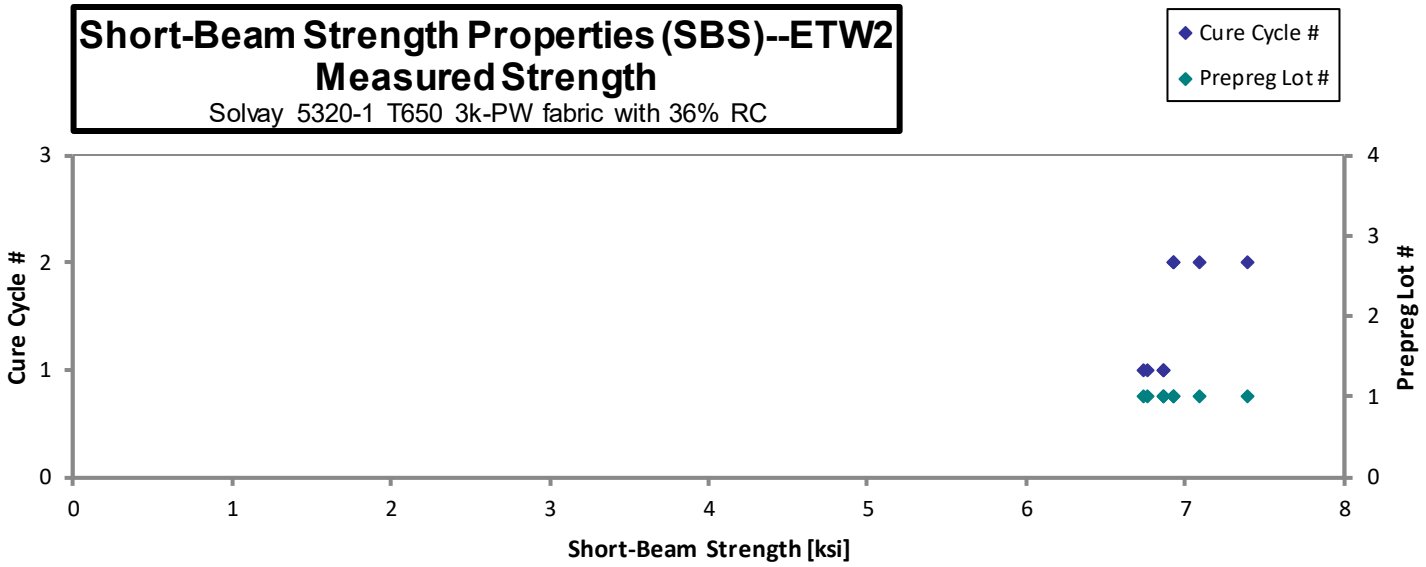
Specimen Number	NIAR Batch #	NIAR Cure Cycle	Prepreg Lot #	Cure Cycle #	Strength [ksi]	Avg. Specimen Thickness [in]	# Plies in Laminate	Avg. t_{ply} [in]	Failure Mode
NTP-5325QRI-SOL-S36-NIAR-SBS-A-C1-1-RTD-1	A	C1	1	1	12.760	0.243	32	0.0076	INTERLAMINAR SHEAR
NTP-5325QRI-SOL-S36-NIAR-SBS-A-C1-1-RTD-2	A	C1	1	1	12.932	0.243	32	0.0076	INTERLAMINAR SHEAR, TENSION
NTP-5325QRI-SOL-S36-NIAR-SBS-A-C1-1-RTD-3	A	C1	1	1	12.948	0.244	32	0.0076	INTERLAMINAR SHEAR
NTP-5325QRI-SOL-S36-NIAR-SBS-A-C1-1-RTD-4	A	C1	1	1	12.945	0.243	32	0.0076	INTERLAMINAR SHEAR
NTP-5325QRI-SOL-S36-NIAR-SBS-A-C2-1-RTD-1	A	C2	1	2	13.180	0.244	32	0.0076	INTERLAMINAR SHEAR
NTP-5325QRI-SOL-S36-NIAR-SBS-A-C2-1-RTD-2	A	C2	1	2	12.887	0.244	32	0.0076	INTERLAMINAR SHEAR
NTP-5325QRI-SOL-S36-NIAR-SBS-A-C2-1-RTD-3	A	C2	1	2	12.779	0.244	32	0.0076	INTERLAMINAR SHEAR
NTP-5325QRI-SOL-S36-NIAR-SBS-A-C2-1-RTD-4	A	C2	1	2	13.433	0.244	32	0.0076	INTERLAMINAR SHEAR
				Average	**12.983**			**0.0076**	
				Standard Dev.	**0.223**				
				Coeff. of Var. [%]	**1.715**				
				Min.	**12.760**			**0.0076**	
				Max.	**13.433**			**0.0076**	
				Number of Spec.	**8**			**8**	


Short-Beam Strength Properties (SBS)--RTD
Measured Strength
Solvay 5320-1 T650 3k-PW fabric with 36% RC
Cure Cycle #
Prepreg Lot #
Cure Cycle #
Prepreg Lot #
Short-Beam Strength [ksi]
0
1
2
3
4
0
2
4
6
8
10
12
14
16

Short-Beam Strength Properties (SBS)--ETW2

Solvay 5320-1 T650 3k-PW fabric with 36% RC

Specimen Number	NIAR Batch #	NIAR Cure Cycle	Prepreg Lot #	Cure Cycle #	Strength [ksi]	Avg. Specimen Thickness [in]	# Plies in Laminate	Avg. t_{ply} [in]	Failure Mode
NTP-5325QRI-SOL-S36-NIAR-SBS-A-C1-1-ETW2-1	A	C1	1	1	6.739	0.245	32	0.0076	INTERLAMINAR SHEAR
NTP-5325QRI-SOL-S36-NIAR-SBS-A-C1-1-ETW2-2	A	C1	1	1	6.762	0.244	32	0.0076	INTERLAMINAR SHEAR
NTP-5325QRI-SOL-S36-NIAR-SBS-A-C1-1-ETW2-3	A	C1	1	1	6.859	0.244	32	0.0076	INTERLAMINAR SHEAR
NTP-5325QRI-SOL-S36-NIAR-SBS-A-C1-1-ETW2-4	A	C1	1	1	6.866	0.244	32	0.0076	INTERLAMINAR SHEAR
NTP-5325QRI-SOL-S36-NIAR-SBS-A-C2-1-ETW2-1	A	C2	1	2	7.391	0.245	32	0.0077	INTERLAMINAR SHEAR
NTP-5325QRI-SOL-S36-NIAR-SBS-A-C2-1-ETW2-2	A	C2	1	2	7.087	0.245	32	0.0076	INTERLAMINAR SHEAR
NTP-5325QRI-SOL-S36-NIAR-SBS-A-C2-1-ETW2-3	A	C2	1	2	6.929	0.244	32	0.0076	INTERLAMINAR SHEAR
NTP-5325QRI-SOL-S36-NIAR-SBS-A-C2-1-ETW2-4	A	C2	1	2	6.923	0.244	32	0.0076	INTERLAMINAR SHEAR
				Average	**6.945**			**0.0076**	
				Standard Dev.	**0.210**				
				Coeff. of Var. [%]	**3.026**				
				Min.	**6.739**			**0.0076**	
				Max.	**7.391**			**0.0077**	
				Number of Spec.	**8**			**8**	


Short-Beam Strength Properties (SBS)--ETW2
Measured Strength
Solvay 5320-1 T650 3k-PW fabric with 36% RC
Cure Cycle #
Prepreg Lot #
Cure Cycle #
Prepreg Lot #
Short-Beam Strength [ksi]
0
1
2
3
4
5
6
7
8

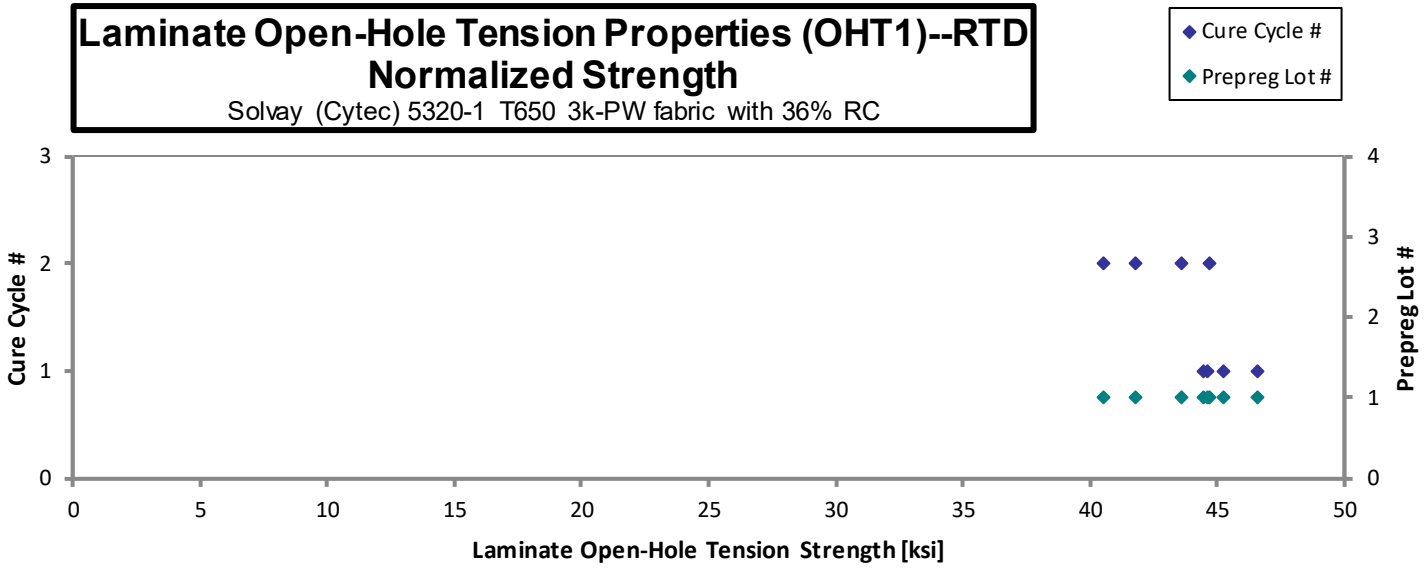
4.7 "25/50/25" Open-Hole Tension 1 Properties (OHT1)

Laminate Open-Hole Tension Properties (OHT1)--RTD
Strength
Solvay 5320-1 T650 3k-PW fabric with 36% RC

normalizing t_{ply} [in]
0.0077

Specimen Number	NIAR Batch #	NIAR Cure Cycle	Prepreg Lot #	Cure Cycle #	Strength [ksi]	Avg. Specimen Thickness [in]	# Plies in Laminate	Failure Mode	Avg. t_{ply} [in]	$Strength_{norm}$ [ksi]
NTP-5325QRI-SOL-S36-NIAR-OHT1-A-C1-1-RTD-1	A	C1	1	1	46.634	0.123	16	LGM	0.0077	46.590
NTP-5325QRI-SOL-S36-NIAR-OHT1-A-C1-1-RTD-2	A	C1	1	1	45.283	0.123	16	LGM	0.0077	45.289
NTP-5325QRI-SOL-S36-NIAR-OHT1-A-C1-1-RTD-3	A	C1	1	1	44.242	0.124	16	LGM	0.0077	44.451
NTP-5325QRI-SOL-S36-NIAR-OHT1-A-C1-1-RTD-4	A	C1	1	1	44.615	0.123	16	LGM	0.0077	44.633
NTP-5325QRI-SOL-S36-NIAR-OHT1-A-C2-1-RTD-1	A	C2	1	2	41.763	0.123	16	LGM	0.0077	41.791
NTP-5325QRI-SOL-S36-NIAR-OHT1-A-C2-1-RTD-2	A	C2	1	2	43.467	0.124	16	LGM	0.0077	43.585
NTP-5325QRI-SOL-S36-NIAR-OHT1-A-C2-1-RTD-3	A	C2	1	2	44.739	0.123	16	LGM	0.0077	44.715
NTP-5325QRI-SOL-S36-NIAR-OHT1-A-C2-1-RTD-4	A	C2	1	2	40.534	0.123	16	LGM	0.0077	40.550

Average	**43.910**		**$Average_{norm}$**	**0.0077**	**43.951**
Standard Dev.	**1.957**		**Standard $Dev._{norm}$**		**1.943**
Coeff. of Var. [%]	**4.457**		**Coeff. of Var. $[\%]_{norm}$**		**4.420**
Min.	**40.534**		**Min.**	**0.0077**	**40.550**
Max.	**46.634**		**Max.**	**0.0077**	**46.590**
Number of Spec.	**8**		**Number of Spec.**	**8**	**8**


Laminate Open-Hole Tension Properties (OHT1)--RTD
Normalized Strength
Solvay (Cytec) 5320-1 T650 3k-PW fabric with 36% RC
Cure Cycle #
Prepreg Lot #
Cure Cycle #
Prepreg Lot #
Laminate Open-Hole Tension Strength [ksi]
0
1
2
3
4
0
5
10
15
20
25
30
35
40
45
50

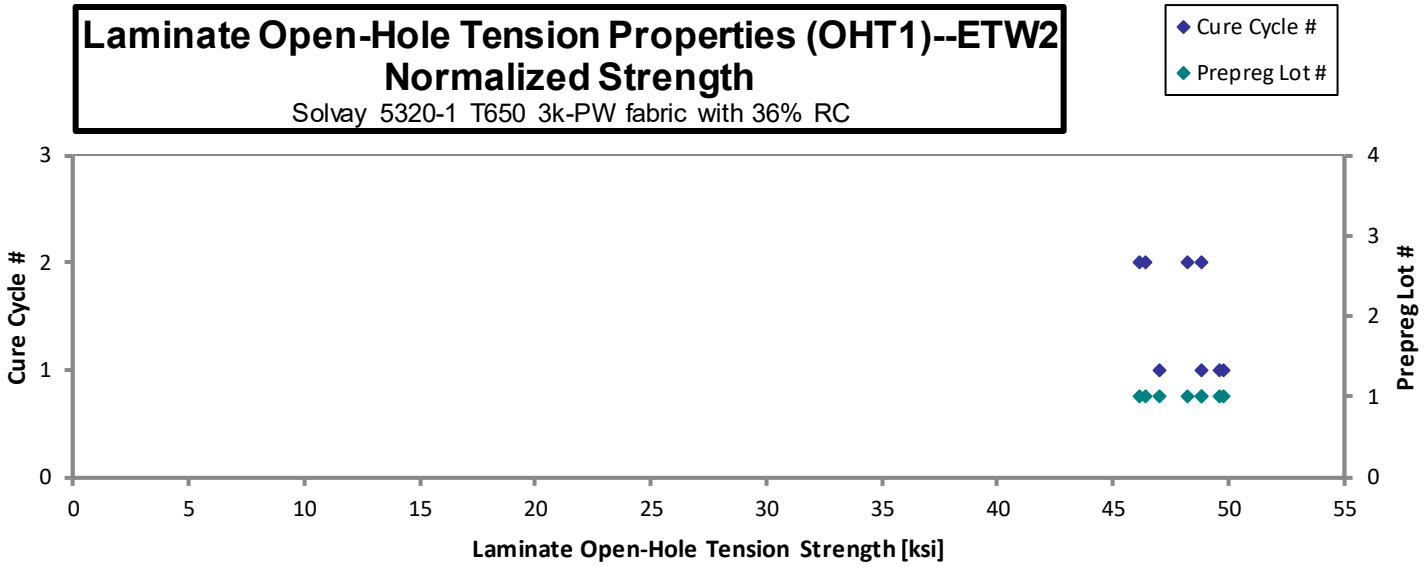
Laminate Open-Hole Tension Properties (OHT1)--ETW2
Strength
Solvay 5320-1 T650 3k-PW fabric with 36% RC

normalizing t_{ply} [in]
0.0077

Specimen Number	NIAR Batch #	NIAR Cure Cycle	Prepreg Lot #	Cure Cycle #	Strength [ksi]	Avg. Specimen Thickness [in]	# Plies in Laminate	Failure Mode	Avg. t_{ply} [in]	$Strength_{norm}$ [ksi]
NTP-5325QRI-SOL-S36-NIAR-OHT1-A-C1-1-ETW2-1	A	C1	1	1	49.543	0.123	16	LGM	0.0077	49.604
NTP-5325QRI-SOL-S36-NIAR-OHT1-A-C1-1-ETW2-2	A	C1	1	1	46.755	0.124	16	LGM	0.0077	46.976
NTP-5325QRI-SOL-S36-NIAR-OHT1-A-C1-1-ETW2-3	A	C1	1	1	48.566	0.124	16	LGM	0.0077	48.789
NTP-5325QRI-SOL-S36-NIAR-OHT1-A-C1-1-ETW2-4	A	C1	1	1	49.663	0.123	16	LGM	0.0077	49.744
NTP-5325QRI-SOL-S36-NIAR-OHT1-A-C2-1-ETW2-1	A	C2	1	2	46.526	0.123	16	LGM	0.0077	46.406
NTP-5325QRI-SOL-S36-NIAR-OHT1-A-C2-1-ETW2-2	A	C2	1	2	48.769	0.123	16	LGM	0.0077	48.829
NTP-5325QRI-SOL-S36-NIAR-OHT1-A-C2-1-ETW2-3	A	C2	1	2	46.151	0.123	16	LGM	0.0077	46.157
NTP-5325QRI-SOL-S36-NIAR-OHT1-A-C2-1-ETW2-4	A	C2	1	2	48.396	0.123	16	LGM	0.0077	48.206

Average	**48.046**	
Standard Dev.	**1.381**	
Coeff. of Var. [%]	**2.874**	
Min.	**46.151**	
Max.	**49.663**	
Number of Spec.	**8**	

$Average_{norm}$	**0.0077**	**48.089**
Standard $Dev._{norm}$		**1.408**
Coeff. of Var. $[\%]_{norm}$		**2.929**
Min.	**0.0077**	**46.157**
Max.	**0.0077**	**49.744**
Number of Spec.	**8**	**8**


Laminate Open-Hole Tension Properties (OHT1)--ETW2
Normalized Strength
Solvay 5320-1 T650 3k-PW fabric with 36% RC
Cure Cycle #
Prepreg Lot #
Cure Cycle #
Prepreg Lot #
Laminate Open-Hole Tension Strength [ksi]
0
1
2
3
4
0
5
10
15
20
25
30
35
40
45
50
55

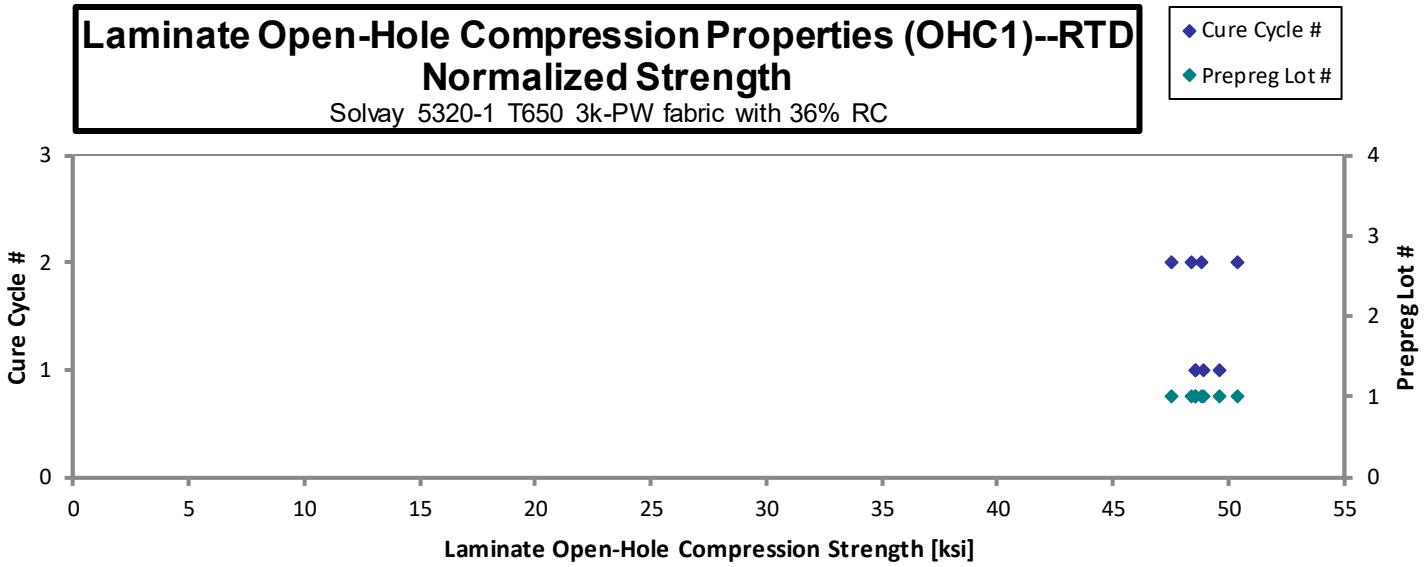
4.8 "25/50/25" Open-Hole Compression 1 Properties (OHC1)

Laminate Open-Hole Compression Properties (OHC1)--RTD
Strength
Solvay 5320-1 T650 3k-PW fabric with 36% RC

normalizing t_{ply} [in]
0.0077

Specimen Number	NIAR Batch #	NIAR Cure Cycle	Prepreg Lot #	Cure Cycle #	Strength [ksi]	Avg. Specimen Thickness [in]	# Plies in Laminate	Failure Mode	Avg. t_{ply} [in]	$Strength_{norm}$ [ksi]
NTP-5325QRI-SOL-S36-NIAR-OHC1-A-C1-1-RTD-1	A	C1	1	1	49.490	0.154	20	M(A,L)GM	0.0077	49.581
NTP-5325QRI-SOL-S36-NIAR-OHC1-A-C1-1-RTD-2	A	C1	1	1	48.572	0.154	20	M(A,L)GM	0.0077	48.530
NTP-5325QRI-SOL-S36-NIAR-OHC1-A-C1-1-RTD-3	A	C1	1	1	48.524	0.154	20	M(A,L)GM	0.0077	48.593
NTP-5325QRI-SOL-S36-NIAR-OHC1-A-C1-1-RTD-4	A	C1	1	1	48.819	0.154	20	M(A,L)GM	0.0077	48.924
NTP-5325QRI-SOL-S36-NIAR-OHC1-A-C2-1-RTD-1	A	C2	1	2	48.242	0.154	20	M(A,L)GM	0.0077	48.367
NTP-5325QRI-SOL-S36-NIAR-OHC1-A-C2-1-RTD-2	A	C2	1	2	50.099	0.155	20	M(A,L)GM	0.0077	50.365
NTP-5325QRI-SOL-S36-NIAR-OHC1-A-C2-1-RTD-3	A	C2	1	2	47.462	0.154	20	M(A,L)GM	0.0077	47.549
NTP-5325QRI-SOL-S36-NIAR-OHC1-A-C2-1-RTD-4	A	C2	1	2	48.653	0.155	20	M(A,L)GM	0.0077	48.816

	Strength		$Strength_{norm}$
Average	48.733	$Average_{norm}$	48.841
Standard Dev.	0.791	$Standard\ Dev._{norm}$	0.839
Coeff. of Var. [%]	1.623	$Coeff.\ of\ Var.\ [\%]_{norm}$	1.718
Min.	47.462	Min.	47.549
Max.	50.099	Max.	50.365
Number of Spec.	8	Number of Spec.	8

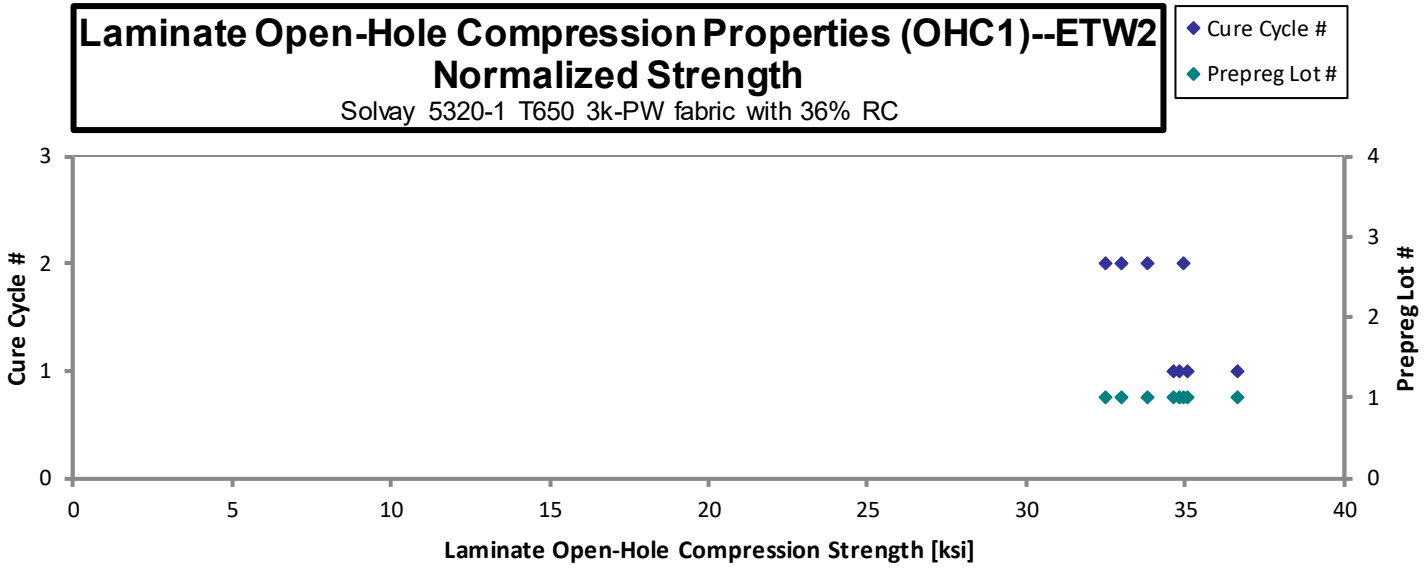

Laminate Open-Hole Compression Properties (OHC1)--RTD
Normalized Strength
Solvay 5320-1 T650 3k-PW fabric with 36% RC
Cure Cycle #
Prepreg Lot #
Cure Cycle #
Prepreg Lot #
0
1
2
3
4
0
5
10
15
20
25
30
35
40
45
50
55
Laminate Open-Hole Compression Strength [ksi]

Laminate Open-Hole Compression Properties (OHC1)--ETW2
Strength
Solvay (Cytec) 5320-1 T650 3k-PW fabric with 36% RC

normalizing t_{ply} [in]
0.0077

Specimen Number	NIAR Batch #	NIAR Cure Cycle	Prepreg Lot #	Cure Cycle #	Strength [ksi]	Avg. Specimen Thickness [in]	# Plies in Laminate	Failure Mode	Avg. t_{ply} [in]	$Strength_{norm}$ [ksi]
NTP-5325QRI-SOL-S36-NIAR-OHC1-A-C1-1-ETW2-1	A	C1	1	1	34.488	0.155	20	M(A,L)GM	0.0077	34.603
NTP-5325QRI-SOL-S36-NIAR-OHC1-A-C1-1-ETW2-2	A	C1	1	1	36.568	0.154	20	M(A,L)GM	0.0077	36.655
NTP-5325QRI-SOL-S36-NIAR-OHC1-A-C1-1-ETW2-3	A	C1	1	1	34.768	0.154	20	M(A,L)GM	0.0077	34.843
NTP-5325QRI-SOL-S36-NIAR-OHC1-A-C1-1-ETW2-4	A	C1	1	1	35.007	0.154	20	M(A,L)GM	0.0077	35.049
NTP-5325QRI-SOL-S36-NIAR-OHC1-A-C2-1-ETW2-1	A	C2	1	2	34.782	0.155	20	M(A,L)GM	0.0077	34.970
NTP-5325QRI-SOL-S36-NIAR-OHC1-A-C2-1-ETW2-2	A	C2	1	2	32.990	0.154	20	M(A,L)GM	0.0077	32.990
NTP-5325QRI-SOL-S36-NIAR-OHC1-A-C2-1-ETW2-3	A	C2	1	2	33.729	0.154	20	M(A,L)GM	0.0077	33.780
NTP-5325QRI-SOL-S36-NIAR-OHC1-A-C2-1-ETW2-4	A	C2	1	2	32.316	0.155	20	M(A,L)GM	0.0077	32.504

Average	**34.331**		**$Average_{norm}$**	**0.0077**	**34.424**
Standard Dev.	**1.315**		**Standard $Dev._{norm}$**		**1.311**
Coeff. of Var. [%]	**3.830**		**Coeff. of Var. $[\%]_{norm}$**		**3.808**
Min.	**32.316**		**Min.**	**0.0077**	**32.504**
Max.	**36.568**		**Max.**	**0.0077**	**36.655**
Number of Spec.	**8**		**Number of Spec.**	**8**	**8**


Laminate Open-Hole Compression Properties (OHC1)--ETW2
Normalized Strength
Solvay 5320-1 T650 3k-PW fabric with 36% RC
Cure Cycle #
Prepreg Lot #
Cure Cycle #
Prepreg Lot #
0
1
2
3
4
0
5
10
15
20
25
30
35
40
Laminate Open-Hole Compression Strength [ksi]

4.9 "25/50/25" Compression Strength After Impact 1 Properties (CAI1)

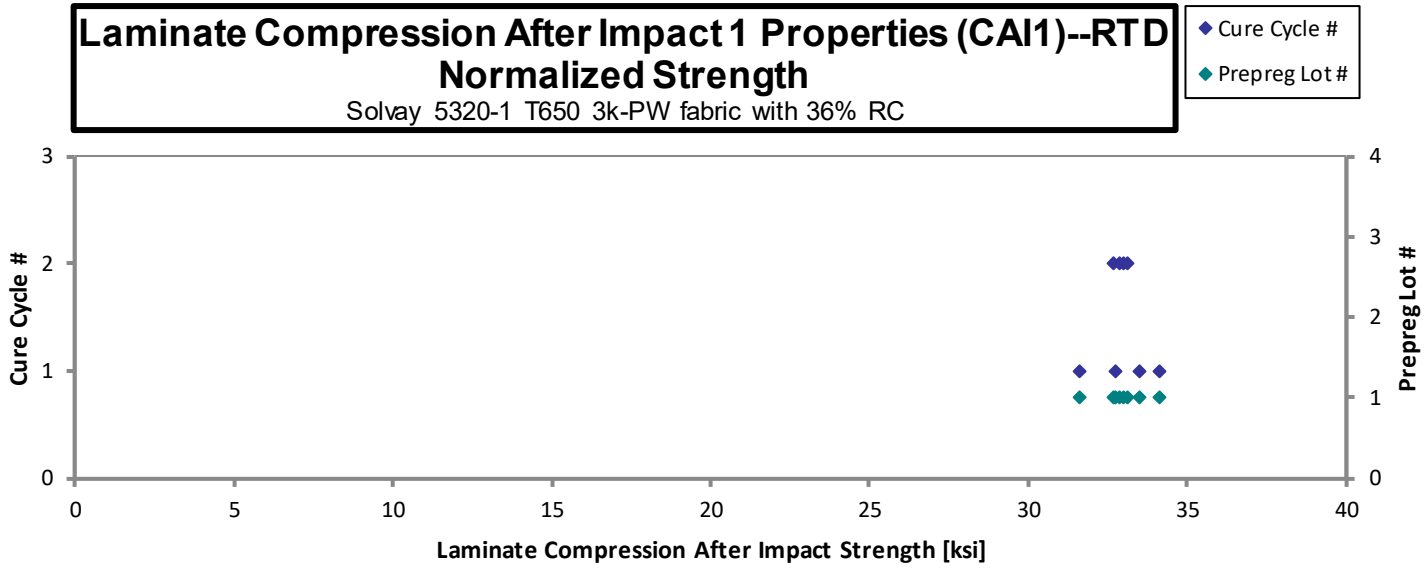
Laminate Compression After Impact 1 Properties (CAI1)--RTD
Strength
Solvay 5320-1 T650 3k-PW fabric with 36% RC

normalizing t_{ply} [in]
0.0077

Specimen Number	NIAR Batch #	NIAR Cure Cycle	Prepreg Lot #	Cure Cycle #	Strength [ksi]	Measured Impact Energy [in-lbf]	Avg. Specimen Thickness [in]	# Plies in Laminate	Failure Mode	Avg. t_{ply} [in]	$Strength_{norm}$ [ksi]
NTP-5325QRI-SOL-S36-NIAR-CAI1-A-C1-1-RTD-1	A	C1	1	1	34.241	273.46	0.184	24	LDM	0.0077	34.104
NTP-5325QRI-SOL-S36-NIAR-CAI1-A-C1-1-RTD-2	A	C1	1	1	32.716	280.41	0.185	24	LDM	0.0077	32.716
NTP-5325QRI-SOL-S36-NIAR-CAI1-A-C1-1-RTD-3	A	C1	1	1	31.537	277.66	0.185	24	LDM	0.0077	31.583
NTP-5325QRI-SOL-S36-NIAR-CAI1-A-C1-1-RTD-4	A	C1	1	1	33.465	280.03	0.185	24	LDM	0.0077	33.478
NTP-5325QRI-SOL-S36-NIAR-CAI1-A-C2-1-RTD-1	A	C2	1	2	32.504	280.79	0.186	24	LDM	0.0077	32.700
NTP-5325QRI-SOL-S36-NIAR-CAI1-A-C2-1-RTD-2	A	C2	1	2	32.908	280.37	0.186	24	LDM	0.0077	33.115
NTP-5325QRI-SOL-S36-NIAR-CAI1-A-C2-1-RTD-3	A	C2	1	2	32.905	280.17	0.185	24	LDM	0.0077	33.008
NTP-5325QRI-SOL-S36-NIAR-CAI1-A-C2-1-RTD-4	A	C2	1	2	32.713	280.07	0.186	24	LDM	0.0077	32.841

	Strength [ksi]
Average	32.873
Standard Dev.	0.774
Coeff. of Var. [%]	2.355
Min.	31.537
Max.	34.241
Number of Spec.	8

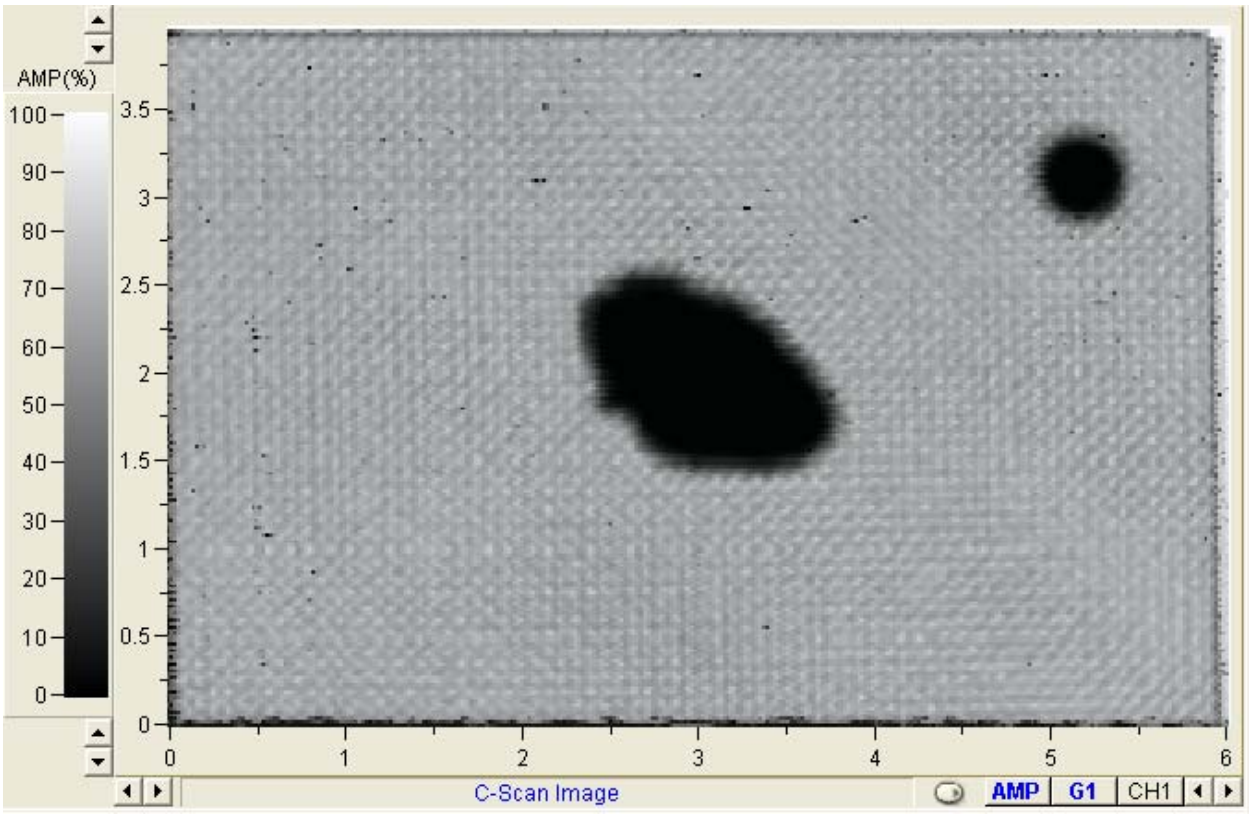
	t_{ply} [in]	$Strength_{norm}$ [ksi]
$Average_{norm}$	0.0077	32.943
$Standard\ Dev._{norm}$		0.721
$Coeff.\ of\ Var.\ [\%]_{norm}$		2.188
Min.	0.0077	31.583
Max.	0.0077	34.104
Number of Spec.	8	8


Laminate Compression After Impact 1 Properties (CAI1)--RTD
Normalized Strength
Solvay 5320-1 T650 3k-PW fabric with 36% RC
Cure Cycle #
Prepreg Lot #
Cure Cycle #
Prepreg Lot #
Laminate Compression After Impact Strength [ksi]
0
1
2
3
4
0
5
10
15
20
25
30
35
40

5. Additional Compression After Impact Data

Impactor Diameter: 0.625”

Representative of Damage Area:

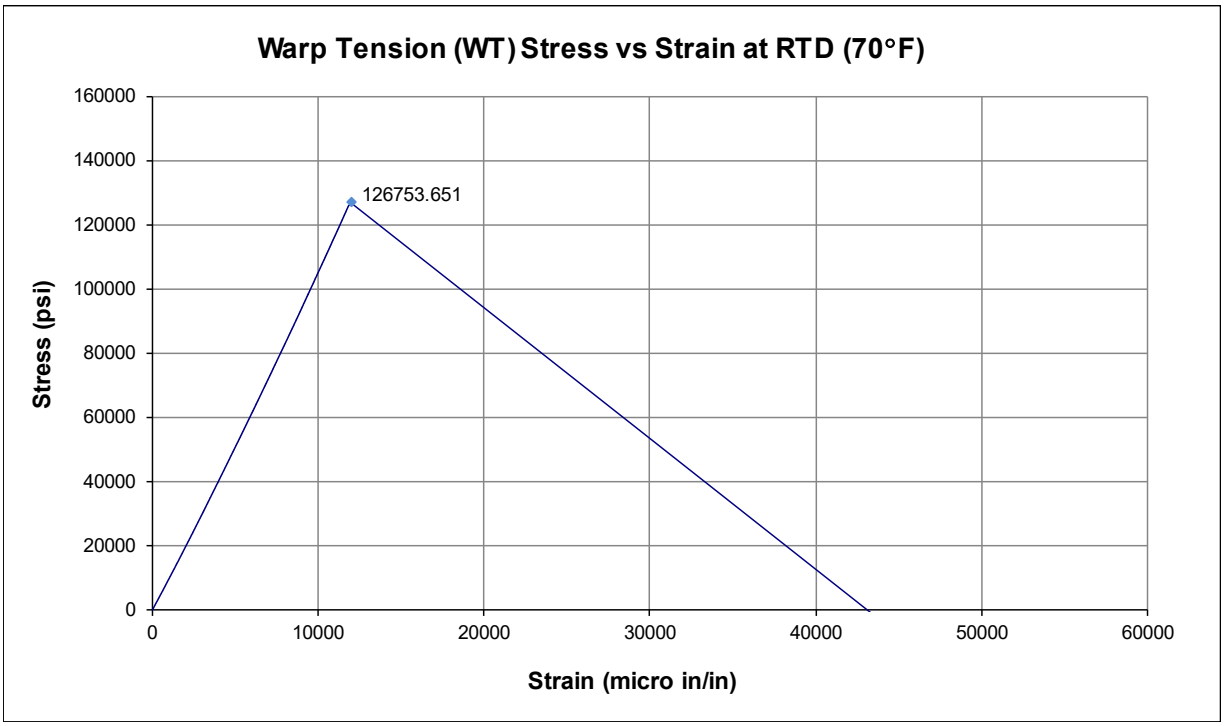


Damage Area and Dent Depth Summary:

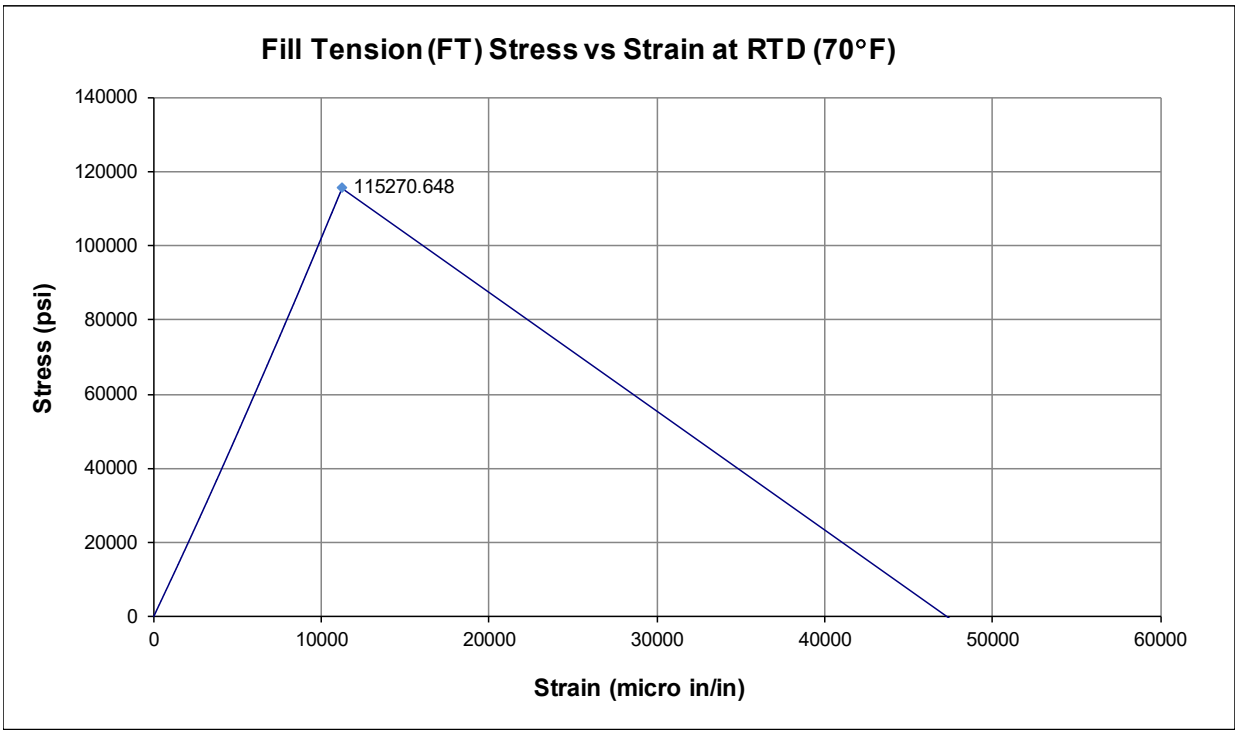
Specimen ID	Damage Area (inch^2)	Dent Depth (inch)
NTP-5325QR1-SOL-S36-NIAR-CAI1-A-C1-1-RTD-1	0.0335	1.179
NTP-5325QR1-SOL-S36-NIAR-CAI1-A-C1-1-RTD-2	0.0375	1.403
NTP-5325QR1-SOL-S36-NIAR-CAI1-A-C1-1-RTD-3	0.0335	1.316
NTP-5325QR1-SOL-S36-NIAR-CAI1-A-C1-1-RTD-4	0.0325	1.040
NTP-5325QR1-SOL-S36-NIAR-CAI1-A-C2-1-RTD-1	0.0425	1.107
NTP-5325QR1-SOL-S36-NIAR-CAI1-A-C2-1-RTD-2	0.0405	1.287
NTP-5325QR1-SOL-S36-NIAR-CAI1-A-C2-1-RTD-3	0.0405	1.103
NTP-5325QR1-SOL-S36-NIAR-CAI1-A-C2-1-RTD-4	0.0395	1.176

6. Full Shear Stress vs. Shear Strain Curve

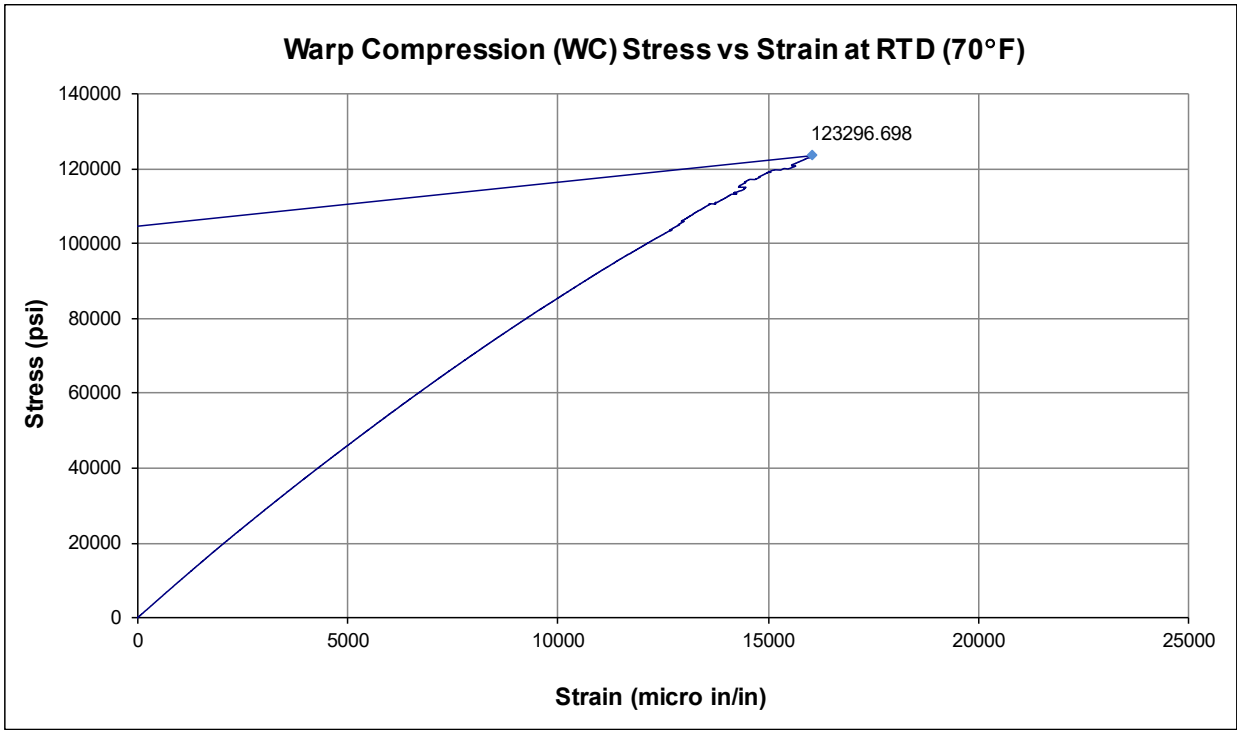
6.1 Warp Tension – RTD



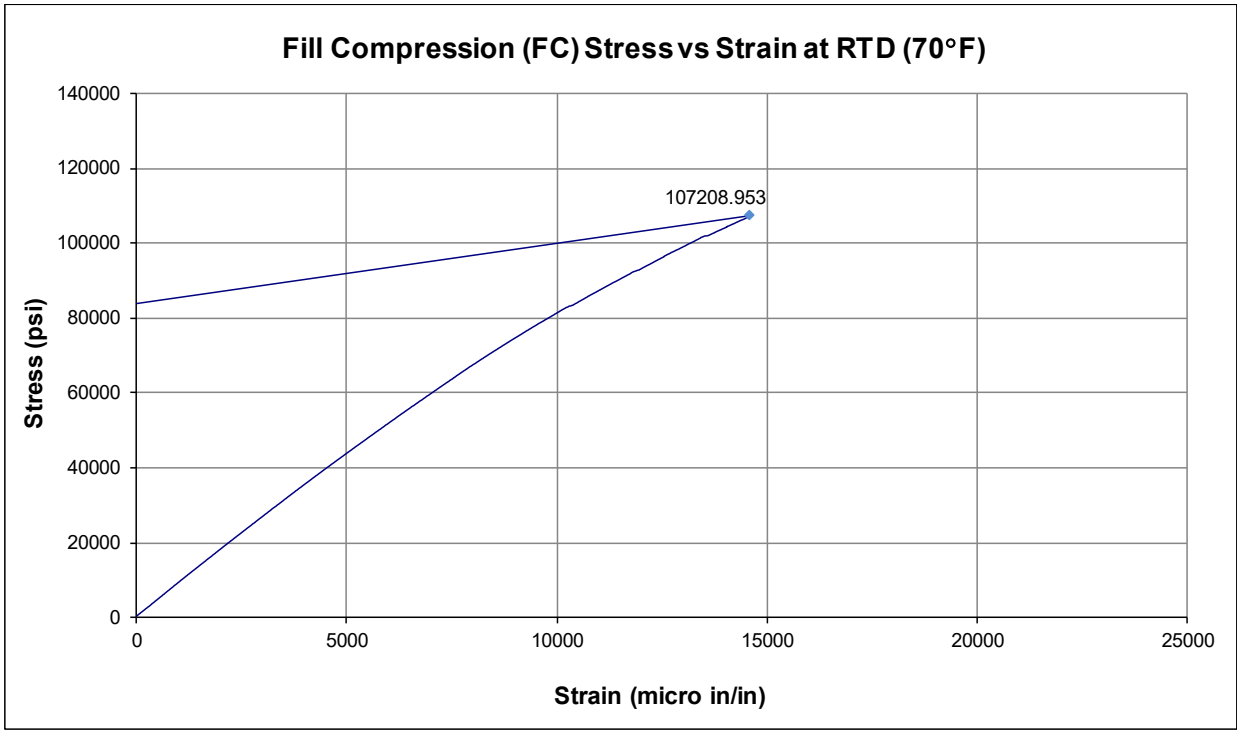
6.2 Fill Tension – RTD



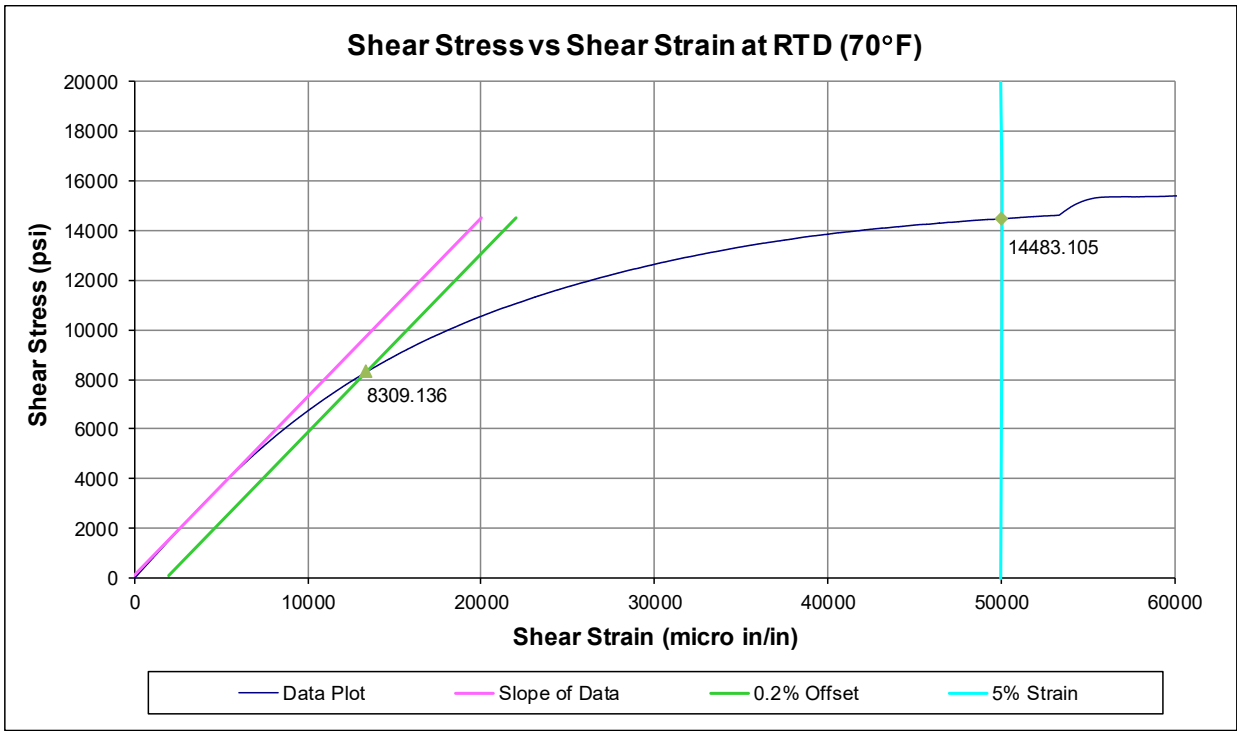
6.3 Warp Compression – RTD



6.4 Fill Compression – RTD

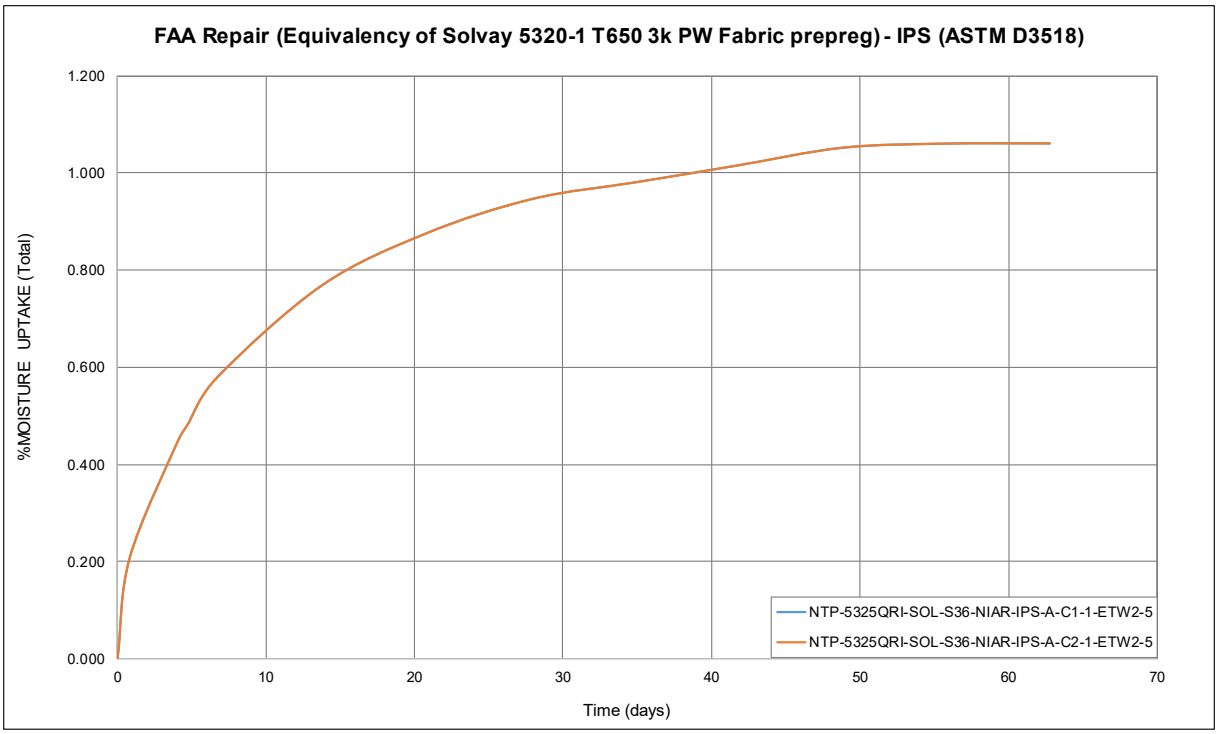


6.5 In-Plane Shear – RTD

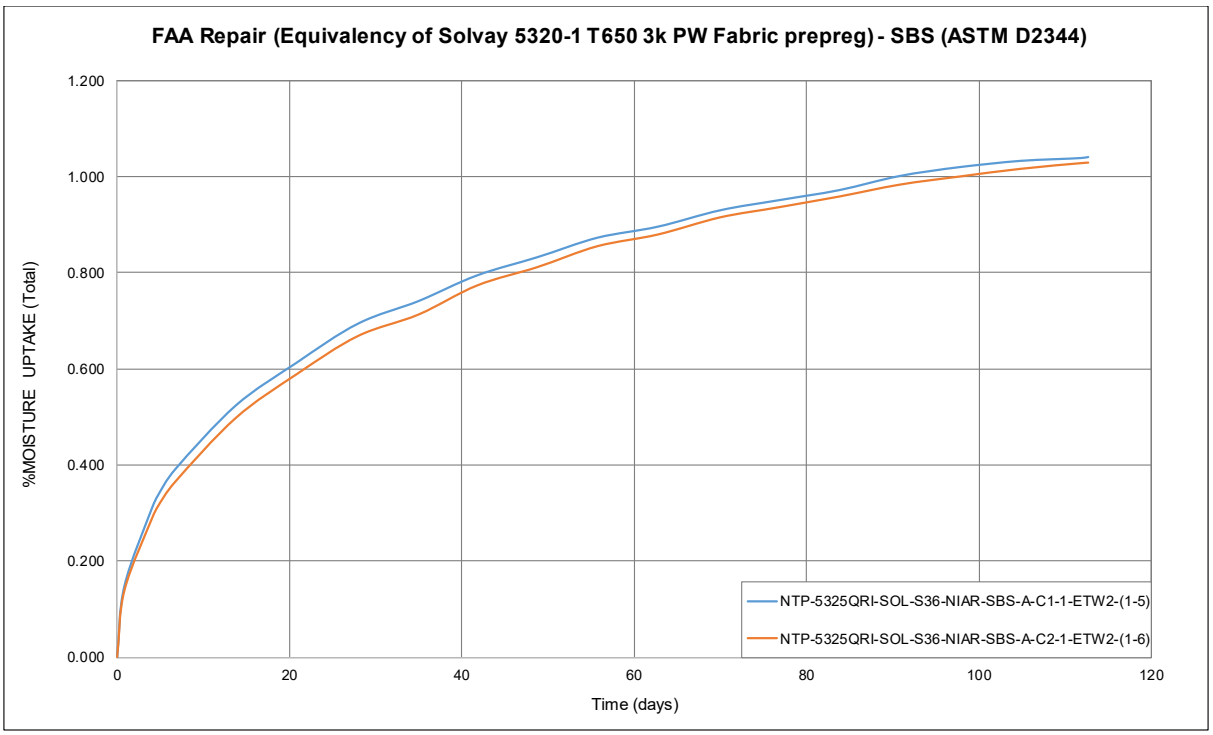


7. Moisture Conditioning Charts

7.1 In-Plane Shear – Thinnest Panel



7.2 Short Beam Strength – Thickest Panel



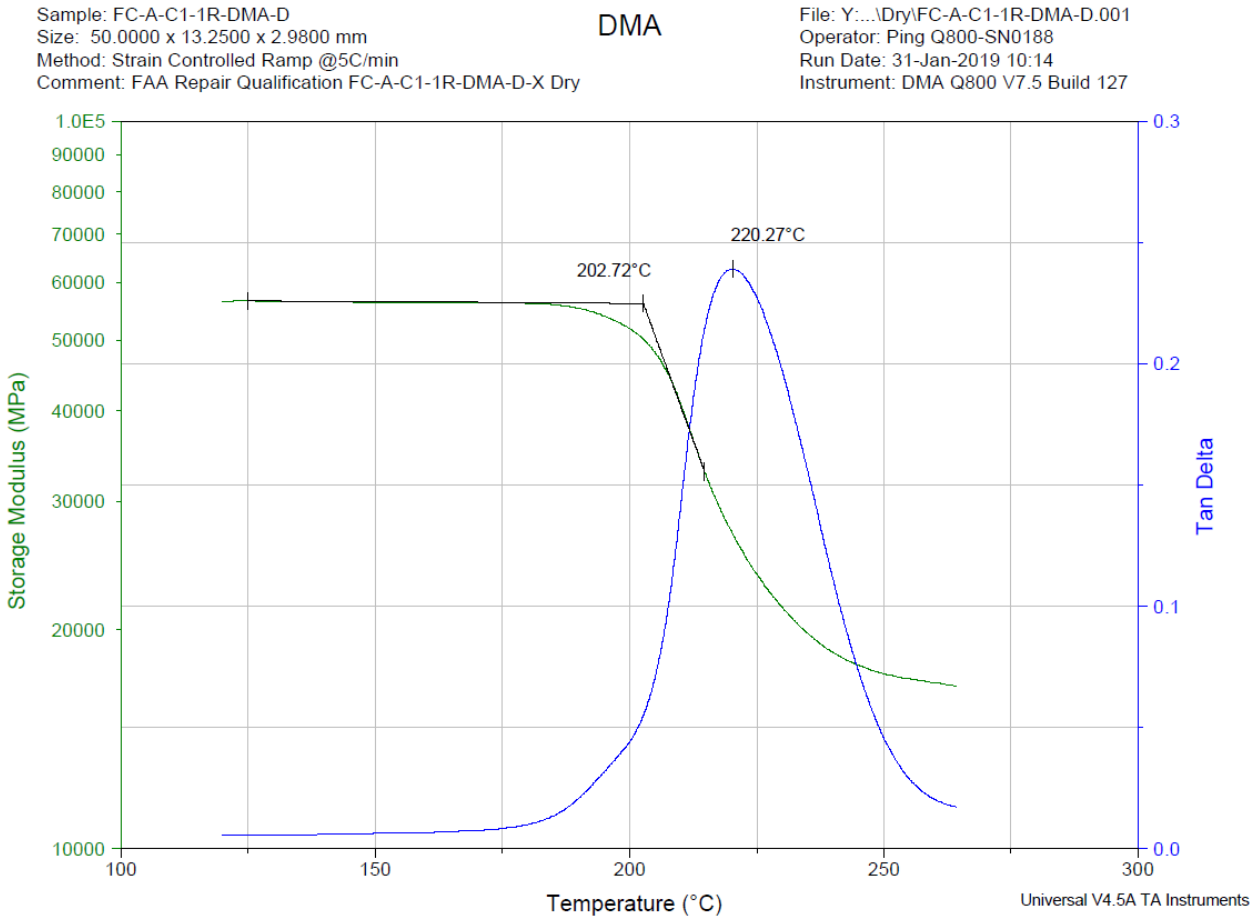
8. DMA Results

DMA Results Summary - FAA Repair Qualification NTP-5325QRI-SOL-S36-NIAR DMA Dry (Equivalency)				
Sample #	Onset Storage Modulus		Peak of Tangent Delta	
	T_g [°C]	T_g [°F]	T_g [°C]	T_g [°F]
CAI1-A-C1-1-DMA-D	200.52	392.94	214.27	417.69
CAI1-A-C2-1-DMA-D	201.11	394.00	214.75	418.55
FC-A-C1-1R-DMA-D	202.72	396.90	220.27	428.49
FC-A-C2-1R-DMA-D	203.52	398.34	221.87	431.37
FT-A-C1-1R-DMA-D	203.11	397.60	220.73	429.31
FT-A-C2-1R-DMA-D	203.50	398.30	220.38	428.68
IPS-A-C1-1-DMA-D	195.17	383.31	211.41	412.54
IPS-A-C2-1-DMA-D	195.76	384.37	212.33	414.19
OHC1-A-C1-1-DMA-D	201.98	395.56	218.12	424.62
OHC1-A-C2-1-DMA-D	199.54	391.17	214.49	418.08
OHT1-A-C1-1-DMA-D	198.05	388.49	215.18	419.32
OHT1-A-C2-1-DMA-D	198.29	388.92	215.73	420.31
SBS-A-C1-1-DMA-D	204.73	400.51	215.03	419.05
SBS-A-C2-1-DMA-D	203.12	397.62	215.32	419.58
WC-A-C1-1-DMA-D	198.89	390.00	214.72	418.50
WC-A-C2-1-DMA-D	201.47	394.65	218.48	425.26
WT-A-C1-1-DMA-D	198.79	389.82	214.59	418.26
WT-A-C2-1-DMA-D	199.99	391.98	216.46	421.63
Average	200.57	393.03	216.34	421.41
Standard Deviation	2.73	4.91	2.97	5.35

DMA Results Summary - FAA Repair Qualification NTP-5325QRI-SOL-S36-NIAR DMA Wet (Equivalency)				
Sample #	Onset Storage Modulus		Peak of Tangent Delta	
	T_g [°C]	T_g [°F]	T_g [°C]	T_g [°F]
CAI1-A-C1-1-DMA-W	159.01	318.22	173.93	345.07
CAI1-A-C2-1-DMA-W	158.37	317.07	173.89	345.00
FC-A-C1-1R-DMA-W	156.99	314.58	171.16	340.09
FC-A-C2-1R-DMA-W	156.41	313.54	170.95	339.71
FT-A-C1-1R-DMA-W	157.59	315.66	171.43	340.57
FT-A-C2-1R-DMA-W	158.82	317.88	171.78	341.20
IPS-A-C1-1-DMA-W	145.98	294.76	167.39	333.30
IPS-A-C2-1-DMA-W	145.64	294.15	167.56	333.61
OHC1-A-C1-1-DMA-W	157.96	316.33	173.93	345.07
OHC1-A-C2-1-DMA-W	156.79	314.22	172.69	342.84
OHT1-A-C1-1-DMA-W	156.63	313.93	171.93	341.47
OHT1-A-C2-1-DMA-W	157.01	314.62	173.29	343.92
SBS-A-C1-1-DMA-W	161.88	323.38	174.23	345.61
SBS-A-C2-1-DMA-W	161.14	322.05	174.30	345.74
WC-A-C1-1-DMA-W	158.02	316.44	171.82	341.28
WC-A-C2-1-DMA-W	158.83	317.89	172.98	343.36
WT-A-C1-1-DMA-W	157.61	315.70	170.59	339.06
WT-A-C2-1-DMA-W	157.38	315.28	171.15	340.07
Average	156.78	314.21	171.94	341.50
Standard Deviation	4.25	7.64	2.03	3.66

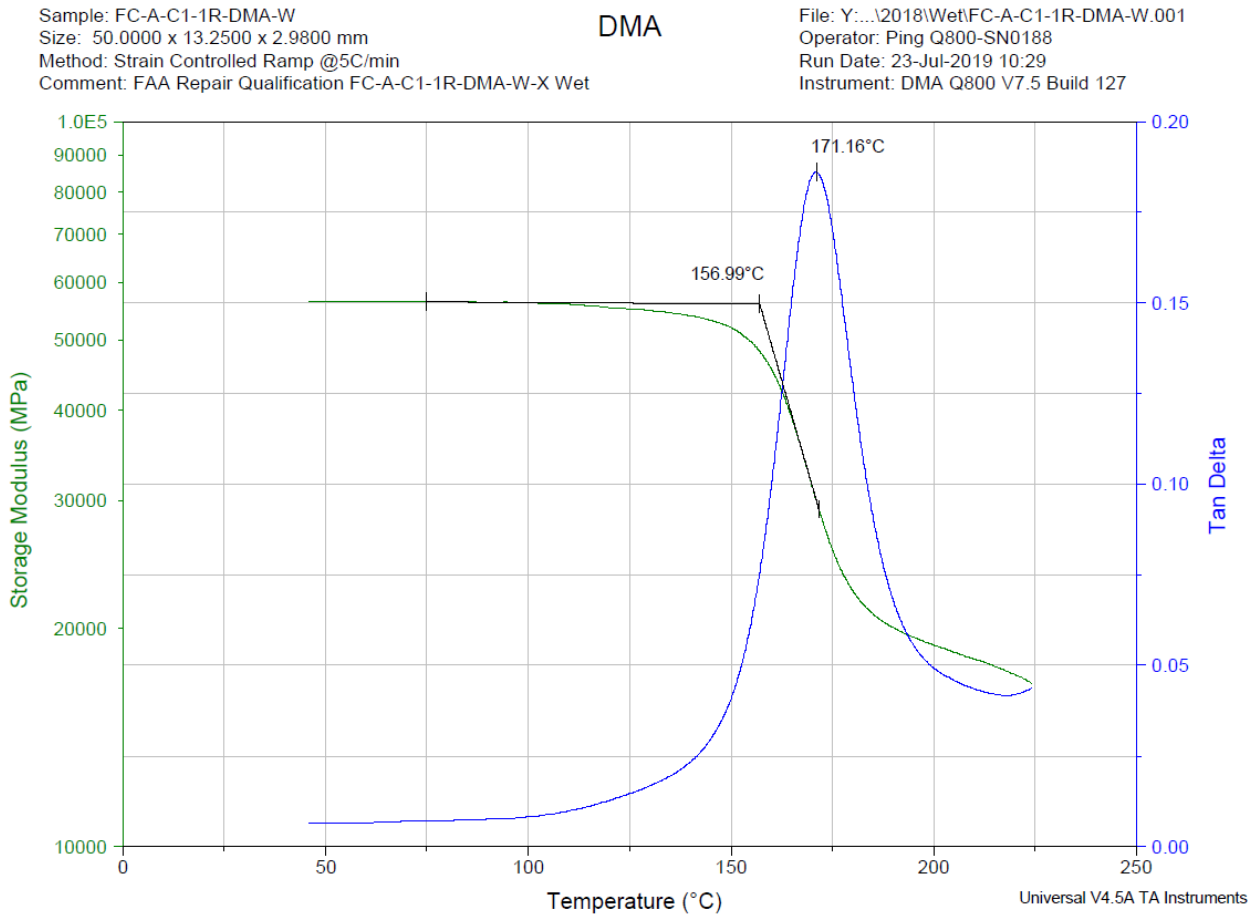
8.1 DMA Dry Batch A

A representative of DMA Dry profile from Batch A is provided below.



8.2 DMA Wet Batch A

A representative of DMA Wet profile from Batch A is provided below.



9. Deviations

N/A