



# **Hexcel 8552 IM7 Unidirectional Prepreg 190 gsm & 35%RC Qualification Material Property Data Report**

**FAA Special Project Number SP4614WI-Q**

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| N/C | Kristin Marlett | 11/17/2010 | Yeow Ng    | Minor lamina chart template changed and IPS conditioning chart modified                                                                                |

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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 MIL-HDBK-17-1F—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 FAA oversight through FAA Special Project Number SP4652WI-Q and also meet the requirements of NCAMP Standard Operating Procedure NSP 100; the test panels, test specimens, and test setups have been conformed by the FAA and the testing has been witnessed by the FAA. However, the data may not fulfill all the needs of any specific company's programs; specific properties, environments, laminate architecture, and loading situations may require additional testing.

The use of NCAMP material and process specifications do 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 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. Statistical analysis of the data including the calculations of b-basis values is given in a separate report, Hexcel IM7 Unidirectional Prepreg 190 gsm 35% RC Qualification Statistical Analysis Report NCP-RP-2009-028 N/C. The qualification material was procured to NCAMP Material Specification NMS 128/2 Rev - Initial Release dated February 6, 2007. The panels were fabricated by Cessna Aircraft Company, 5800 E Pawnee, Wichita, KS 67218. The qualification test panels were cured in accordance with Baseline Cure Cycle (M) of NCAMP Process Specification NPS 81228 Rev A Initial Release June 7, 2007. The NCAMP Test Plan NTP 1828Q1 Rev B was used for this qualification 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 MIL-HDBK-17-1F. 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 MIL-HDBK-17-1F are adequate for the given program.

Aircraft companies should not use the data published in this report without specifying NCAMP Material Specification NMS 128/2. NMS 128/2 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 128/2.* NMS 128/2 is a free, publicly available, non-proprietary aerospace industry material specification.

The data contained 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). Data that is subject to export control regulations, if any, will be made available on a case by case basis through written request to NCAMP.

## 1.2 Symbols Used

|                                |                                                              |
|--------------------------------|--------------------------------------------------------------|
| $\nu_{12}^t$                   | major Poisson's ratio, tension                               |
| $\mu\epsilon$                  | 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                                          |
| $\nu_{12}^c$                   | major Poisson's Ratio, compression                           |
| $\nu_{21}^c$                   | 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)

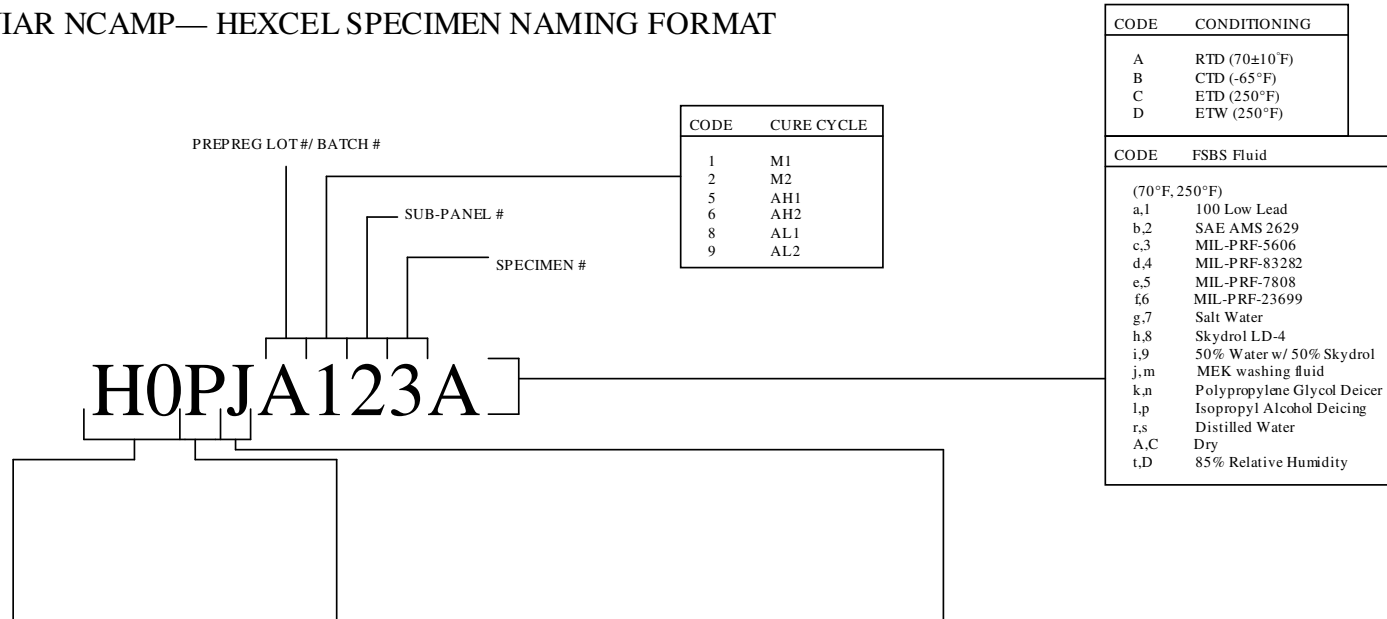
2 – axis; transverse / fill direction  
(parallel to fill direction of reinforcement)  
12; in-plane

## **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                                                             |
| CPT       | cured ply thickness                                                                  |
| 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– Hexcel Specimen Naming Format

#### NIAR NCAMP— HEXCEL SPECIMEN NAMING FORMAT



| CODE | COMPANY                     | CODE | MATERIAL SYSTEM                       | CODE | TEST METHOD                                                   | CODE | TEST METHOD                                     |
|------|-----------------------------|------|---------------------------------------|------|---------------------------------------------------------------|------|-------------------------------------------------|
| HO   | Hexcel                      | P    | (H1 1) AS4 PW Fab Prepreg 38% RC-1628 | J    | (WT) Warp Tension/ (LT) Longitudinal Tension (D3039)          | Q    | (SBS) Short Beam Shear (D2344)                  |
| HT   | ATK Space Systems           | I    | (H1 2) IM7 Uni Prepreg 38% RC-1828    | U    | (FT) Fill Tension/ (TT) Transverse Tension (D3039)            | q    | (SBS1) Laminate Short Beam Shear                |
| HB   | Bell Helicopter             | U    | (H1 3) AS4 Uni Prepreg 35% RC-1128Q1  | L    | (WC) Warp Compression/ (LC) Longitudinal Compression (D6641)  |      |                                                 |
| HE   | Boeing Helicopters          |      |                                       | Z    | (FC) Fill Compression/ (TC) Transverse Compression (D6641)    |      |                                                 |
| HF   | Cessna Aircraft Company     |      |                                       | N    | (IPS) In Plane Shear (D3518)                                  |      |                                                 |
| HG   | General Atomics             |      |                                       |      |                                                               |      |                                                 |
| HW   | Goodrich                    |      |                                       | A    | (UNT1) Un-notched Tension Layup 1 (D3039)                     | 1    | (SSB1) Single Shear Pin Bearing Layup 1 (D5961) |
| HU   | Gulfstream Aerospace        |      |                                       | B    | (UNT2) Un-notched Tension Layup 2 (D3039)                     | 2    | (SSB2) Single Shear Pin Bearing Layup 2 (D5961) |
| HY   | Hawker Beechcraft           |      |                                       | C    | (UNT3) Un-notched Tension Layup 3 (D3039)                     | 3    | (SSB3) Single Shear Pin Bearing Layup 3 (D5961) |
| HJ   | Israel Aircraft Industries  |      |                                       | W    | (UNC1) Un-notched Compression Layup 1 (D6641)                 | P    | (UNT0) Un-notched Tension 0/90 (D3039)          |
| HL   | Lockheed Martin Aeronautics |      |                                       | X    | (UNC2) Un-notched Compression Layup 2 (D6641)                 | R    | (UNC0) Un-notched Compression 0/90 (D6641)      |
| HN   | Northrop Grumman            |      |                                       | Y    | (UNC3) Un-notched Compression Layup 3 (D6641)                 |      |                                                 |
| HP   | Spirit AeroSystems          |      |                                       | D    | (OHT1) Open Hole Tension Layup 1 (D5766)                      | 4    | (FHT1) Filled Hole Tension Layup 1 (D6742)      |
|      |                             |      |                                       | E    | (OHT2) Open Hole Tension Layup 2 (D5766)                      | 5    | (FHT2) Filled Hole Tension Layup 2 (D6742)      |
|      |                             |      |                                       | F    | (OHT3) Open Hole Tension Layup 3 (D5766)                      | 6    | (FHT3) Filled Hole Tension Layup 3 (D6742)      |
|      |                             |      |                                       | G    | (OHC1) Open Hole Compression 1 (D6484)                        | 7    | (FHC1) Filled Hole Compression Layup 1 (D6484)  |
|      |                             |      |                                       | H    | (OHC2) Open Hole Compression 2 (D6484)                        | 8    | (FHC2) Filled Hole Compression Layup 2 (D6484)  |
|      |                             |      |                                       | I    | (OHC3) Open Hole Compression 3 (D6484)                        | 9    | (FHC3) Filled Hole Compression Layup 3 (D6484)  |
|      |                             |      |                                       | K    | (CAI1) Compression After Impact Layup 1 (SRM-2R)              |      |                                                 |
|      |                             |      |                                       | M    | (ILT1) Interlaminar Tension Layup 1 (D6415)                   |      |                                                 |
|      |                             |      |                                       | T    | (MOL) Material Operating Limit Short Beam Shear (D2344)       |      |                                                 |
|      |                             |      |                                       | V    | (MOLC) Material Operating Limit Open Hole Compression (D2344) |      |                                                 |

## 1.4 References

### ASTM Standards

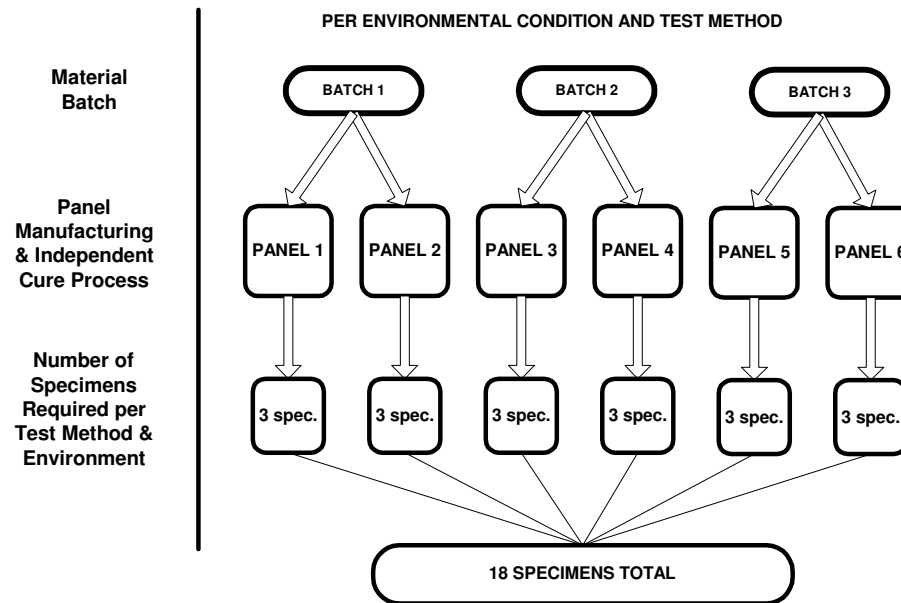
All testing was in accordance with nationally recognized standards, methods and procedures. Specific mechanical property test methods applicable to the test program in this document include:

- ASTM D2344/D2344M-00e1 – Standard Test Method for Short-Beam Strength of Polymer Matrix Composite Materials and Their Laminates
- ASTM D3039/D3039M-08 – Standard Test Method for Tensile Properties of Polymer Matrix Composite Materials
- ASTM D3518/D3518M-94(2007) – Standard Test Method for In-Plane Shear Response of Polymer Matrix Composite Materials by Tensile Test of a  $\pm 45^\circ$  Laminate In-Plane Shear Strength and Modulus
- ASTM D5766/D5766M-02a – Standard Test Method for Open Hole Tensile Strength of Polymer Matrix Composite Laminates
- ASTM D5961/D5961M-08 – Standard Test Method for Bearing Response of Polymer Matrix Composite Laminates
- ASTM D6415-06ae1 – Standard Test Method for Measuring the Curved Beam Strength of a Fiber-Reinforced Polymer-Matrix Composite
- ASTM D6484/D6484M-04 – Standard Test Method for Open-Hole Compressive Strength of Polymer Matrix Composite Laminates
- ASTM D6641/D6641M-01e1 – Standard Test Method for Determining the Compressive Properties of Polymer Matrix Composite Laminates Using a Combined Loading Compression (CLC) Test Fixture
- ASTM D6742/D6742M-02 – Standard Practice for Filled-Hole Tension and Compression Testing of Polymer Matrix Composite Laminates
- ASTM D7136/D7136M-07 – Standard Test Method for Measuring the Damage Resistance of a Fiber-Reinforced Polymer Matrix Composite to a Drop-Weight Impact Event
- ASTM D7137/D7137M-05e1 – Standard Test Method for Compressive Residual Strength Properties of Damaged Polymer Matrix Composite Plates

## 1.5 Methodology

### 1.5.1 Process Definition

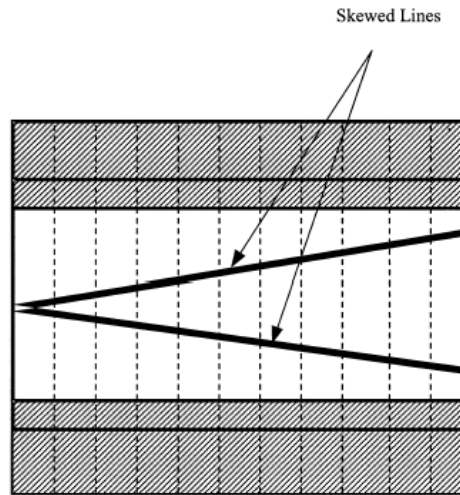
For each combination of test, batch and condition, the specimens were selected from minimum two separate panels cured separately as shown in Figure 1-1 unless otherwise specified.



**Figure 1-1: Specimen Selection Methodology**

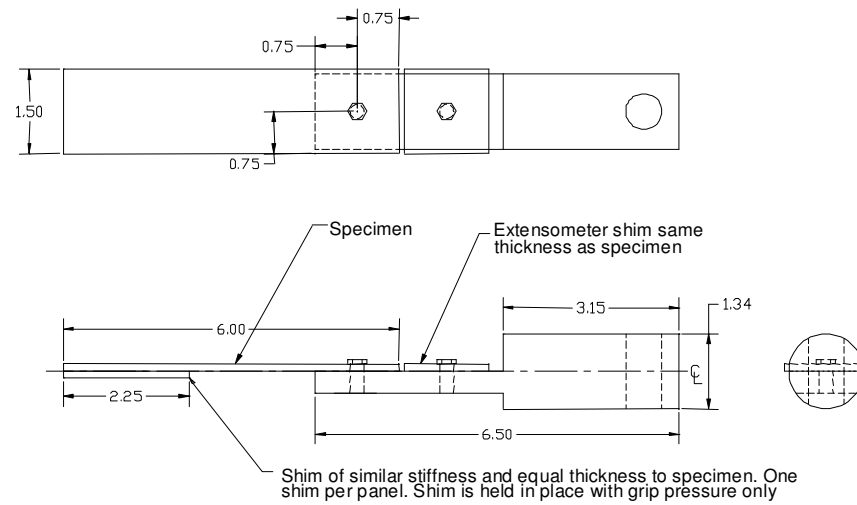
All panels were fabricated in accordance with NCAMP Process Specification NPS 81228 “M” Cure Cycle.

In order to facilitate individual specimen trace ability, individual specimen numbering and/or skewed lines were written or drawn across each sub-panel as shown in Figure 1-2.



**Figure 1-2: Specimen Traceability Line**

For the single shear bearing tests, the ASTM D5961 was used with one of the pairs of specimens replaced by a steel fixture. The configuration is shown in Figure 1-3 below.



**Figure 1-3: Modified ASTM D5961 (Single Shear Bearing) Specimen and Loading Arrangement**



## **1.5.2 Specimen & Testing Details**

### **1.5.2.1 Tabbings**

Tabs were used on all Longitudinal Tension specimens.

### **1.5.2.2 Specimen Dimensions & Test Configuration**

For filled-hole and bearing tests, the hole diameter was 0.25 in -0.000 +0.003 in. For filled-hole tension tests, the fasteners were installed to 85±5 in-lb. For filled-hole compression and bearing tests, the fasteners were installed to 30±5 in-lb. Fasteners were installed after moisture conditioning.

Unless otherwise specified, a tolerance of ±5 °F applied to all temperature conditions specified in this document.

For filled-hole and bearing tests, the hole diameter was 0.25 in -0.000 +0.003 in. The following fasteners were used:

- 1) NASM 21297-04003 bolts with MS 21084 nuts and MS21206 washers for FHT and FHC
- 2) NASM 21297-04013 bolts with MS 21084 nuts and MS21206 washers for SSB

### 1.5.3 Test Matrix

The tables below show the lay-ups and test matrices used for lamina and laminate level testing.

| Layup                  | Test Type and Direction                    | Property                              | Number of Batches x No. of Panels x No. of Specimens |       |       |       |
|------------------------|--------------------------------------------|---------------------------------------|------------------------------------------------------|-------|-------|-------|
|                        |                                            |                                       | Test Temperature/Moisture Condition                  |       |       |       |
|                        |                                            |                                       | CTD                                                  | RTD   | ETD   | ETW   |
| [0] <sub>6</sub>       | ASTM D3039 0° Tension                      | Strength, Modulus and Poisson's Ratio | 3x2x3                                                | 3x2x3 |       | 3x2x3 |
| [0] <sub>14</sub>      | ASTM D6641 0° Compression (Note 1)         | Modulus                               | 3x2x3                                                | 3x2x3 | 3x2x3 | 3x2x3 |
| [90] <sub>11</sub>     | ASTM D3039 90° Tension                     | Strength and Modulus                  | 3x2x3                                                | 3x2x3 |       | 3x2x3 |
| [90] <sub>14</sub>     | ASTM D6641 90° Compression (Note 1)        | Strength and Modulus                  | 3x2x3                                                | 3x2x3 |       | 3x2x3 |
| [0/90] <sub>2s</sub>   | ASTM D3039 0° Tension (see Note 2)         | Strength and Modulus                  | 3x2x3                                                | 3x2x3 |       | 3x2x3 |
| [90/0/90] <sub>5</sub> | ASTM D6641 0° Compression (see Note 1 & 2) | Strength and Modulus                  | 3x2x3                                                | 3x2x3 | 3x2x3 | 3x2x3 |
| [45/-45] <sub>3s</sub> | ASTM D3518 In-Plane Shear                  | Strength and Modulus                  | 3x2x3                                                | 3x2x3 |       | 3x2x3 |
| [0] <sub>34</sub>      | ASTM D2344 Short Beam                      | Strength                              | 3x2x3                                                | 3x2x3 | 3x2x3 | 3x2x3 |

Note 1: Back-to-back strain gages are needed on the first two specimens of each environment. 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 strain gage.

Note 2: Derive the 0° lamina tensile or compressive strength  $F_{0^\circ \text{ plies}}^u$  as follows

$$F_{0^\circ \text{ plies}}'' = BF \frac{P^f}{wh}$$

$$BF = \frac{E_1 [V_0 E_2 + (1 - V_0) E_1] - (\nu_{12} E_2)^2}{[V_0 E_1 + (1 - V_0) E_2] [V_0 E_2 + (1 - V_0) E_1] - (\nu_{12} E_2)^2}$$

Where  $BF$  = Back-out factor obtained using linear classical lamination theory

$P^f$  = Peak load carried by the test specimen (usually at failure)

$w$  = specimen gage width, mm [in.]

$h$  = specimen gage thickness, mm [in.]

$V_0$  = fraction of  $0^\circ$  plies in the cross-ply laminate (1/2 for  $[0/90]_n$ s and 1/3 for  $[90/0/90]_n$ )

$E_1$  = axial tensile or compressive stiffness of  $0^\circ$  plies, from an average of all batches

$E_2$  = transverse tensile or compressive stiffness of  $0^\circ$  plies, from an average of all batches

$\nu_{12}$  = major Poisson's ratio of  $0^\circ$  plies, from an average of all batches

**Table 1-1: Lamina Level Test Matrix**

Table 1-2 below summarizes the laminate level tests carried out. The layup angles  $0^\circ$ ,  $45^\circ$ ,  $-45^\circ$ , and  $90^\circ$  refer to the orientation of the warp/longitudinal fiber 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.

Table 1-2 also emphasizes those properties and test condition combinations believed to constitute the worst case, which in general is cold dry for tension and hot wet for compression and other matrix dominated properties.

| (%0°/±45°/90°)<br>Actual Test Type | Test Type and Layup (5)                                                                            | Property              | Number of Batches x Number of<br>Panels x Number of Test<br>Specimens |       |       |
|------------------------------------|----------------------------------------------------------------------------------------------------|-----------------------|-----------------------------------------------------------------------|-------|-------|
|                                    |                                                                                                    |                       | Test Temperature/Moisture<br>Condition                                |       |       |
|                                    |                                                                                                    |                       | CTD                                                                   | RTD   | ETW   |
| (25/50/25 - QI)<br>UNT1            | ASTM D3039 Un-notched Tension<br>[45/0/-45/90]2S                                                   | Strength &<br>modulus | 3x2x3                                                                 | 3x2x3 | 3x2x3 |
| (10/80/10)<br>UNT2                 | ASTM D3039 Un-notched Tension<br>[45/-45/0/45/-45/90/45/-45/45/-45]S                               | Strength &<br>modulus | 3x2x3                                                                 | 3x2x3 | 3x2x3 |
| (50/40/10)<br>UNT3                 | ASTM D3039 Un-notched Tension<br>[0/45/0/90/0/-45/0/45/0/-45]S                                     | Strength &<br>modulus | 3x2x3                                                                 | 3x2x3 | 3x2x3 |
| (25/50/25 - QI)<br>UNC1            | ASTM D6641 Un-notched Compression (4)<br>[45/0/-45/90]2S                                           | Strength &<br>modulus |                                                                       | 3x2x3 | 3x2x3 |
| (10/80/10)<br>UNC2                 | ASTM D6641 Un-notched Compression (4)<br>[45/-45/0/45/-45/90/45/-45/45/-45]S                       | Strength &<br>modulus |                                                                       | 3x2x3 | 3x2x3 |
| (50/40/10)<br>UNC3                 | ASTM D6641 Un-notched Compression (4)<br>[45/0/90/0/-45/0/45/0/-45/0]S                             | Strength &<br>modulus |                                                                       | 3x2x3 | 3x2x3 |
| (25/50/25 - QI)<br>SBS1            | ASTM D2344 Short Beam<br>(specimens may be taken from panels<br>designed for (25/50/25 - QI) CAI1) | Strength              |                                                                       | 3x2x3 | 3x2x3 |
| (25/50/25 - QI)<br>OHT1            | ASTM D5766 Open Hole Tension (1)<br>[45/0/-45/90]2S                                                | Strength              | 3x2x3                                                                 | 3x2x3 | 3x2x3 |
| (10/80/10)<br>OHT2                 | ASTM D5766 Open Hole Tension (1)<br>[45/-45/0/45/-45/90/45/-45/45/-45]S                            | Strength              | 3x2x3                                                                 | 3x2x3 | 3x2x3 |
| (50/40/10)<br>OHT3                 | ASTM D5766 Open Hole Tension (1)<br>[0/45/0/90/0/-45/0/45/0/-45]S                                  | Strength              | 3x2x3                                                                 | 3x2x3 | 3x2x3 |
| (25/50/25 - QI)<br>FHT1            | ASTM D6742 Filled Hole Tension (2)<br>[45/0/-45/90]2S                                              | Strength              | 3x2x3                                                                 | 3x2x3 | 3x2x3 |
| (10/80/10)<br>FHT2                 | ASTM D6742 Filled Hole Tension (2)<br>[45/-45/0/45/-45/90/45/-45/45/-45]S                          | Strength              | 3x2x3                                                                 | 3x2x3 | 3x2x3 |
| (50/40/10)<br>FHT3                 | ASTM D6742 Filled Hole Tension (2)<br>[0/45/0/90/0/-45/0/45/0/-45]S                                | Strength              | 3x2x3                                                                 | 3x2x3 | 3x2x3 |
| (25/50/25 - QI)<br>OHC1            | ASTM D6484 Open Hole Compression (1)(4)<br>[45/0/-45/90]3S                                         | Strength              |                                                                       | 3x2x3 | 3x2x3 |
| (10/80/10)<br>OHC2                 | ASTM D6484 Open Hole Compression (1)(4)<br>[45/-45/0/45/-45/90/45/-45/45/-45]S                     | Strength              |                                                                       | 3x2x3 | 3x2x3 |
| (50/40/10)<br>OHC3                 | ASTM D6484 Open Hole Compression (1)(4)<br>[0/45/0/90/0/-45/0/45/0/-45]S                           | Strength              |                                                                       | 3x2x3 | 3x2x3 |
| (25/50/25 - QI)<br>FHC1            | ASTM D6484 Filled Hole Compression (2)<br>[45/0/-45/90]3S                                          | Strength              |                                                                       | 3x2x3 | 3x2x3 |

|                         |                                                                                       |                           |       |       |       |
|-------------------------|---------------------------------------------------------------------------------------|---------------------------|-------|-------|-------|
| (10/80/10)<br>FHC2      | ASTM D6484 Filled Hole Compression (2)<br>[45/-45/0/45/-45/90/45/-45/45/-45]S         | Strength                  |       | 3x2x3 | 3x2x3 |
| (50/40/10)<br>FHC3      | ASTM D6484 Filled Hole Compression (2)<br>[0/45/0/90/0/-45/0/45/0/-45]S               | Strength                  |       | 3x2x3 | 3x2x3 |
| (25/50/25 - QI)<br>SSB1 | ASTM D5961 Single Shear Bearing (3) (6)<br>[45/0/-45/90]2S                            | Strength &<br>Deformation |       | 3x2x3 | 3x2x3 |
| (10/80/10)<br>SSB2      | ASTM D5961 Single Shear Bearing (3) (6)<br>[45/-45/0/45/-45/90/45/-45/45/-45]S        | Strength &<br>Deformation |       | 3x2x3 | 3x2x3 |
| (50/40/10)<br>SSB3      | ASTM D5961 Single Shear Bearing (3) (6)<br>[0/45/0/90/0/-45/0/45/0/-45]S              | Strength &<br>Deformation |       | 3x2x3 | 3x2x3 |
| (100/0/0)<br>ILT        | ASTM D6415 Interlaminar Tension<br>[0]22                                              | Strength                  | 1x1x6 | 1x1x6 | 1x1x6 |
| (25/50/25 - QI)<br>CAI1 | ASTM D7136 & D7137 Compression After<br>Impact (1500 in.lb/in) (4)<br>[45/0/-45/90]3S | Strength                  |       | 1x1x6 |       |

(1) Open-hole configuration: 0.25" hole diameter, 1.5 inch width.

(2) Filled-hole test configuration: 0.25" diameter, see section 2 for fastener callout, 1.5" width.

(3) Single shear bearing test configuration: 0.25: hole diameter, 1.5" width, see section 2 for fastener callout, e/D=3

(4) Back-to-back strain gages needed on the first two specimens of each environment. If no buckling is observed, the remaining modulus specimens will require strain gage on one side of the specimens only. Appropriate extensometer may be used in place of the strain gage.

(5) Loading direction is generally along the 0-degree direction

(6) Use modified ASTM D5961 per Figure 3

(Note that the layup numbers 1, 2 and 3 correspond to those designated as "quasi isotropic," "soft" and "hard" respectively. In addition, the 0°/90° cross-ply laminates used for the unidirectional materials only are designated "Layup 0").

**Table 1-2: Laminate Level Test Matrix**

### 1.5.4 Physical Testing

The properties in Table 1-3 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.

| <b>Property</b>                         | <b>Condition/Method (Note 1)</b>            | <b>Min Replicates per panel</b>         |
|-----------------------------------------|---------------------------------------------|-----------------------------------------|
| Cured Ply Thickness                     | ASTM D3171-06                               | All data from mechanical test specimens |
| Laminate Density                        | ASTM D792-00                                | 3                                       |
| Fiber Volume, % by Volume               | ASTM D3171-06(Note 2)                       | 3                                       |
| Resin Content, % by Weight              | ASTM D3171-06(Note 2)                       | 3                                       |
| Ultrasonic Through Transmission, C-Scan | MIL-HDBK-787A (Note 3)                      | 1                                       |
| Glass Transition Temperature, Tg by DMA | Dry and Wet – SACMA SRM 18R-94              | 1 Dry, 1 Wet (Note 4)                   |
| Glass Transition Temperature, Tg by TMA | Dry and Wet - HSP-T2 Rev 1 (by TMA)(Note 5) | 1 Dry, 1 Wet (Note 4)                   |

- Notes
- 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.
  - 2: Method II, except for laminates of materials where actual fiber weight is not accurately known prior to impregnation, as in the case for unidirectional materials. For these materials, in order to verify Method II is accurate, a minimum of 12 samples per batch shall be tested by Method I, Procedure B.
  - 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.
  - 4: Minimum total of 24 dry and 24 wet for each material system.
  - 5: HSP-T2 Revision 1 is a Hexcel non-proprietary test method standard which may be obtained from NCAMP. HSP-T2 is similar but not equivalent to ASTM E2092.

**Table 1-3: Physical Testing Matrix**

### **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 =  $-65 \pm 5$  °F, dry

RTD =  $70 \pm 10$  °F, room temperature dry

ETD =  $250 \pm 5$  °F, dry

ETW =  $250 \pm 5$  °F, wet (equilibrium moisture content)

Within each test method and test environment, the failure mode was evaluated immediately after each test by an FAA DER. All tested specimens were digitally photographed after each test in order to pictorially document failure modes. Representative photos are included in the CD accompanying this report.

For dry testing, specimens were dried at  $160 \text{ °F} \pm 5 \text{ °F}$  for 120 to 130 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 160°F±5°F for 120 to 130 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 0.05% for three consecutive readings which are 7 ±0.5 days apart and may be expressed by:

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

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

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 5 grams were used to establish weight gain measurements. If the specimens or traveler coupons pass the criteria for three 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 gages 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  $2^{+1}_{-0}$  minutes after the specimen reached the test temperature. During the test, the temperature, as measured on the specimen, was within  $\pm 5^{\circ}\text{F}$  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  $\pm 5^{\circ}\text{F}$  of the required test temperature.

### 1.5.7 Fluid Sensitivity Screening

Table 1-4 lists the requirements for fluid sensitivity screening, which requires ASTM D2344 Short Beam Strength testing on  $[0^\circ]_{34}$  lamina level specimens dried at  $160^\circ\text{F} \pm 5^\circ\text{F}$  for 120 to 130 hours before being subjected to the conditions indicated, five replicates per fluid and one cure cycle. Specimens were cleaned with a dry towel prior to the tests. In addition to short beam strength, load versus displacement curves were plotted to aid in the identification of matrix/resin softening. Since load versus displacement curves are influenced by test machine and fixture compliance, all the tests were performed with the identical machine and fixture, through a single setup. Experience suggests that for the vast majority of epoxy resins, water is the fluid with the most deleterious effect on properties. Should screening tests for fluid sensitivity indicate this to be the case, further testing of this type might be unnecessary since exposure to water moisture to equilibrium level is an inherent part of the multi batch allowables test program. However, users must evaluate the applicability of the exposure conditions and time on case-by-case basis. For example, the exposure condition for jet fuel may not fully represent the condition of integral fuel tanks.

| <u>Extended Contact:</u>                                          | Exposure                    | Test Condition | Code   |
|-------------------------------------------------------------------|-----------------------------|----------------|--------|
| 100 Low Lead Aviation Fuel                                        | 90 days min. @ 70°F±10°F    | 70°F           | FS11RT |
|                                                                   | 90 days min. @ 70°F±10°F    | 250°F          | FS11ET |
| SAE AMS 2629 Jet Reference Fluid                                  | 90 days min. @ 70°F±10°F    | 70°F           | FS12RT |
|                                                                   | 90 days min. @ 70°F±10°F    | 250°F          | FS12ET |
| MIL-PRF-5606 Hydraulic Oil                                        | 90 days min. @ 70°F±10°F    | 70°F           | FS13RT |
|                                                                   | 90 days min. @ 70°F±10°F    | 250°F          | FS13ET |
| MIL-PRF-83282 Hydraulic Oil                                       | 90 days min. @ 70°F±10°F    | 70°F           | FS14RT |
|                                                                   | 90 days min. @ 70°F±10°F    | 250°F          | FS14ET |
| MIL-PRF-7808 Engine Oil                                           | 90 days min. @ 70°F±10°F    | 70°F           | FS15RT |
|                                                                   | 90 days min. @ 70°F±10°F    | 250°F          | FS15ET |
| MIL-PRF-23699, Class STD Engine Oil                               | 90 days min. @ 70°F±10°F    | 70°F           | FS16RT |
|                                                                   | 90 days min. @ 70°F±10°F    | 250°F          | FS16ET |
| Salt Water                                                        | 90 days min. @ 70°F±10°F    | 70°F           | FS17RT |
|                                                                   | 90 days min. @ 70°F±10°F    | 250°F          | FS17ET |
| Skydrol LD-4<br>(SAE AS1241, Type IV, Class 1)                    | 90 days min. @ 70°F±10°F    | 70°F           | FS18RT |
|                                                                   | 90 days min. @ 70°F±10°F    | 250°F          | FS18ET |
| 50% Water with 50% Skydrol LD-4<br>(SAE AS1241, Type IV, Class 1) | 90 days min. @ 70°F±10°F    | 70°F           | FS19RT |
|                                                                   | 90 days min. @ 70°F±10°F    | 250°F          | FS19ET |
| <u>Short Duration Contact:</u>                                    |                             |                |        |
| MEK washing fluid. ASTM D740                                      | 90 minutes min. @ 70°F±10°F | 70°F           | FS21RT |
|                                                                   | 90 minutes min. @ 70°F±10°F | 250°F          | FS21ET |
| Polypropylene Glycol Deicer<br>(Type I) Mil-A-824 3               | 90 minutes min. @ 70°F±10°F | 70°F           | FS22RT |
|                                                                   | 90 minutes min. @ 70°F±10°F | 250°F          | FS22ET |
| Isopropyl Alcohol Deicing Agent<br>(TT-I-735)                     | 48±4 hours @70°F±10°F       | 70°F           | FS23RT |
|                                                                   | 48±4 hours @70°F±10°F       | 250°F          | FS23ET |
| <u>Control Tests:</u>                                             |                             |                |        |
| Distilled Water                                                   | 90 days min. at 70°F±10°F   | 70°F           | FS31RT |
|                                                                   | 90 days min. at 70°F±10°F   | 250°F          | FS31ET |

|                       |                     |       |        |
|-----------------------|---------------------|-------|--------|
| Dry                   | Dry per section 6.1 | 70°F  | FS32RT |
|                       | Dry per section 6.1 | 250°F | FS32ET |
| 85% Relative Humidity | Per section 6.1     | 70°F  | FS33RT |
|                       | Per section 6.1     | 250°F | FS33ET |

**Table 1-4: Fluid Sensitivity Matrix**

### 1.5.8 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 90° tensile strength and modulus (unidirectional only), 90° 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.

For unidirectional materials the fiber areal weight cannot be measured in advance of impregnation, hence Method I of ASTM D3171, utilizing acid digestion, will be used to verify the CPT method in accordance with note (2) of Table 1-3.

Method I Fiber Volume (%vol) is 58.535 and Method 2 Fiber Volume (%vol) is 59.405. By comparing Fiber Volume values obtained from Method I and Method II, the values are deemed close enough therefore the FAW is close to the nominal of ~190 gsm. Based on the FAW data from Hexcel (Avg ~190 gsm) and our Method I Phys test data (Avg. void content ~ 0% except for a panel where it is close to 4%) it is appropriate to use the CPT Method for normalization.

The average cured ply thickness of 0.0072 inch has been used as the nominal cured ply thickness (CPT) for normalization purpose. The following normalization formula was used:

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

Prior to beginning the qualification program, we predicted the cured ply thickness value to be 0.0074 inch. However, the as-measured cured ply thickness of the qualification and the equivalency panels are 0.007174 inch and 0.007293 inch, respectively (please review the attached file for cured ply thickness calculation). The grand average of all qualification and equivalency panel thickness is 0.007229 inch. A vote was taken among the material users, and 3 out of the four participating companies agreed that 0.0072 was an acceptable CPT. Not all companies cast a vote.

### **1.5.9 Conformity**

The 3-batch qualification panels have been fabricated according to the requirements of the test plan and conformed by the FAA. The test specimens and test setups have also been conformed by the FAA.

Testing was witnessed by the FAA. Witnessing was delegated to a DER. Mechanical testing was carried out at the National Institute for Aviation Research, Wichita State University. The test setup and procedures were reviewed by NCAMP IAB and NCAMP staff during a facility audit. FAA conformity inspection records and approvals are included in the CD accompanying this report.

### **1.5.10 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. This template in Microsoft Excel file format is included on the CD provided with this report.





## 2. Test Results

### 2.1 Lamina Level Test Summary

|                                                                                                        |                    |                          |             |                                                               |                    |          |            |          |
|--------------------------------------------------------------------------------------------------------|--------------------|--------------------------|-------------|---------------------------------------------------------------|--------------------|----------|------------|----------|
| Prepreg Material: Hexcel Corporation - Hexcel 8552 IM7 Unidirectional NMS 128/2 Material Specification |                    |                          |             | Hexcel 8552 IM7 Unidirectional Tape Lamina Properties Summary |                    |          |            |          |
| Fiber                                                                                                  | IM7 unidirectional | Resin                    | Hexcel 8552 |                                                               |                    |          |            |          |
| Tg(dry)                                                                                                | 406.43 °F          | Tg(wet)                  | 321.41 °F   |                                                               |                    |          |            |          |
| PROCESSING:                                                                                            |                    | NPS 81228 "M" Cure Cycle |             | Tg METHOD DMA (SRM 18-94)                                     |                    |          |            |          |
|                                                                                                        | Lot 1              | Lot 2                    | Lot 3       |                                                               |                    |          |            |          |
| Date of fiber manufacture                                                                              | 01/26/2007         | 12/25/2006               | 02/05/2007  | Date of testing                                               | 1/22/2008 - 3/4/10 |          |            |          |
| Date of resin manufacture                                                                              | 02/28/2007         | 01/24/2007               | 03/01/2007  | Date of data submittal                                        | 4/5/2010           |          |            |          |
| Date of prepreg manufacture                                                                            | 02/28/2007         | 01/24/2007               | 03/01/2007  |                                                               |                    |          |            |          |
| Date of composite manufacture                                                                          | 9/2007 to 10/2007  |                          |             |                                                               |                    |          |            |          |
| LAMINA MECHANICAL PROPERTY SUMMARY                                                                     |                    |                          |             |                                                               |                    |          |            |          |
| Data reported as: Normalized & Measured                                                                |                    |                          |             |                                                               |                    |          |            |          |
| (Normalized by CPT= 0.0072 inch)                                                                       |                    |                          |             |                                                               |                    |          |            |          |
|                                                                                                        |                    |                          |             |                                                               |                    |          |            |          |
| CTD Mean RTD Mean ETD Mean ETW Mean                                                                    |                    |                          |             |                                                               |                    |          |            |          |
|                                                                                                        | Normalized         | Measured                 | Normalized  | Measured                                                      | Normalized         | Measured | Normalized | Measured |
| F <sub>1</sub> <sup>tu</sup> (ksi)<br>from LT<br>from UNT0                                             | 357.39             | 353.70                   | 362.69      | 371.08                                                        | ---                | ---      | 333.50     | 327.96   |
|                                                                                                        | 286.78             | 281.57                   | 324.62      | 320.79                                                        | ---                | ---      | 346.85     | 340.46   |
| E <sub>1</sub> <sup>t</sup> (Msi)<br>of LT                                                             | 22.57              | 22.33                    | 22.99       | 23.51                                                         | ---                | ---      | 24.00      | 23.77    |
| E (Msi)<br>of UNT0                                                                                     | 11.92              | 11.71                    | 11.99       | 11.85                                                         | ---                | ---      | 11.94      | 11.74    |
| ν <sub>12</sub> <sup>t</sup>                                                                           |                    | 0.270                    |             | 0.316                                                         |                    |          |            | 0.393    |
| F <sub>2</sub> <sup>tu</sup> (ksi)                                                                     | ---                | 9.60                     | ---         | 9.29                                                          | ---                | ---      | ---        | 3.49     |
| E <sub>2</sub> <sup>t</sup> (Msi)<br>of TT                                                             | ---                | 1.46                     | ---         | 1.30                                                          | ---                | ---      | ---        | 0.81     |
| F <sub>1</sub> <sup>cu</sup> (ksi)<br>from UNC0                                                        | 296.49             | 291.99                   | 248.94      | 251.13                                                        | 201.93             | 199.50   | 173.00     | 172.58   |
| E <sub>1</sub> <sup>c</sup> (Msi)<br>of LC                                                             | 20.68              | 20.53                    | 20.04       | 20.44                                                         | 20.25              | 20.00    | 20.37      | 20.65    |
| E (Msi)<br>of UNC0                                                                                     | 7.75               | 7.64                     | 7.47        | 7.52                                                          | 7.57               | 7.53     | 7.74       | 7.82     |
| ν <sub>12</sub> <sup>c</sup>                                                                           | ---                | 0.362                    |             | 0.356                                                         |                    | 0.374    |            | 0.383    |
| F <sub>2</sub> <sup>cu</sup> (ksi)<br>of TC                                                            | ---                | 55.31                    | ---         | 41.44                                                         | ---                | ---      | ---        | 19.02    |
| E <sub>2</sub> <sup>c</sup> (Msi)<br>of TC                                                             | ---                | 1.53                     | ---         | 1.41                                                          | ---                | ---      | ---        | 1.18     |
| ν <sub>21</sub> <sup>c</sup><br>of TC                                                                  | ---                | 0.028                    | ---         | 0.024                                                         | ---                | ---      | ---        | 0.018    |
| ν<br>of UNC0                                                                                           | ---                | 0.041                    |             | 0.035                                                         |                    | 0.030    |            | 0.017    |
| F <sub>12</sub> <sup>s5%strain</sup> (ksi)                                                             | ---                | ---                      | ---         | 13.22                                                         | ---                | ---      | ---        | 5.54     |
| F <sub>12</sub> <sup>s0.2%</sup> (ksi)                                                                 | ---                | 11.29                    | ---         | 7.76                                                          | ---                | ---      | ---        | 3.31     |
| G <sub>12</sub> <sup>s</sup> (Msi)                                                                     | ---                | 0.86                     | ---         | 0.68                                                          | ---                | ---      | ---        | 0.31     |
| SBS (ksi)                                                                                              | ---                | 21.04                    | ---         | 17.13                                                         | ---                | 11.23    | ---        | 8.25     |

\* Derived from cross-ply using back-out factor

**Table 2-1: Lamina Summary Data**

## 2.2 Laminate Level Test Summary

|                                                                                                                     |                    |                          |                     |                                                   |                                       |            |          |
|---------------------------------------------------------------------------------------------------------------------|--------------------|--------------------------|---------------------|---------------------------------------------------|---------------------------------------|------------|----------|
| Prepreg Material: Hexcel Corporation - Hexcel 8552 IM7 Unidirectional<br>NMS 128/2 Material Specification           |                    |                          |                     | Hexcel 8552 IM7<br>Laminate Properties<br>Summary |                                       |            |          |
| Fiber                                                                                                               | IM7 unidirectional | Resin                    | Hexcel 8552         |                                                   |                                       |            |          |
| Tg(dry)                                                                                                             | 406.43 °F          | Tg(wet)                  | 321.41 °F           | Tg METHOD                                         | DMA (SRM 18-94)                       |            |          |
| PROCESSING:                                                                                                         |                    | NPS 81228 "M" Cure Cycle |                     |                                                   |                                       |            |          |
| Date of fiber manufacture                                                                                           |                    | Lot 1<br>01/26/2007      | Lot 2<br>12/25/2006 | Lot 3<br>02/05/2007                               | Date of testing<br>1/22/2008 - 3/4/10 |            |          |
| Date of resin manufacture                                                                                           |                    | 02/28/2007               | 01/24/2007          | 03/01/2007                                        | Date of data submittal<br>4/5/2010    |            |          |
| Date of prepreg manufacture                                                                                         |                    | 02/28/2007               | 01/24/2007          | 03/01/2007                                        |                                       |            |          |
| Date of composite manufacture                                                                                       |                    | 9/2007 to 10/2007        |                     |                                                   |                                       |            |          |
| LAMINATE MECHANICAL PROPERTY SUMMARY<br>Data reported as: Normalized & Measured<br>(Normalized by CPT= 0.0072 inch) |                    |                          |                     |                                                   |                                       |            |          |
|                                                                                                                     | Layup:             | 25/50/25                 |                     | 10/80/10                                          |                                       | 50/40/10   |          |
|                                                                                                                     | Test Condition     | Normalized               | Measured            | Normalized                                        | Measured                              | Normalized | Measured |
| OHT<br>Strength (ksi)                                                                                               | CTD                | 57.75                    | 57.28               | 45.95                                             | 45.63                                 | 78.75      | 77.97    |
|                                                                                                                     | RTD                | 59.00                    | 58.70               | 43.65                                             | 43.65                                 | 86.59      | 86.63    |
|                                                                                                                     | ETW                | 66.97                    | 66.48               | 38.39                                             | 38.34                                 | 114.86     | 113.87   |
| OHC<br>Strength (ksi)                                                                                               | RTD                | 49.08                    | 48.89               | 38.80                                             | 38.40                                 | 63.24      | 63.36    |
|                                                                                                                     | ETW                | 35.52                    | 35.29               | 25.76                                             | 25.57                                 | 46.42      | 46.22    |
| UNT<br>Strength (ksi)                                                                                               | CTD                | 99.35                    | 98.79               | 70.22                                             | 68.97                                 | 174.18     | 173.12   |
|                                                                                                                     | RTD                | 104.69                   | 104.01              | 67.01                                             | 67.08                                 | 175.63     | 176.22   |
|                                                                                                                     | ETW                | 112.46                   | 111.50              | 54.17                                             | 53.44                                 | 187.43     | 187.30   |
| Modulus (msi)                                                                                                       | CTD                | 8.35                     | 8.30                | 5.52                                              | 5.42                                  | 13.11      | 13.02    |
|                                                                                                                     | RTD                | 8.39                     | 8.34                | 5.22                                              | 5.23                                  | 13.15      | 13.20    |
|                                                                                                                     | ETW                | 7.99                     | 7.92                | 4.47                                              | 4.41                                  | 13.14      | 13.15    |
| UNC<br>Strength (ksi)                                                                                               | RTD                | 87.05                    | 86.95               | 66.44                                             | 67.49                                 | 120.84     | 121.06   |
|                                                                                                                     | ETW                | 57.68                    | 57.09               | 40.61                                             | 40.43                                 | 79.42      | 78.79    |
| Modulus (msi)                                                                                                       | RTD                | 7.86                     | 7.86                | 4.90                                              | 4.98                                  | 11.90      | 11.93    |
|                                                                                                                     | ETW                | 7.13                     | 7.06                | 4.10                                              | 4.06                                  | 11.77      | 11.66    |
| vUNC                                                                                                                | RTD                | ---                      | 0.334               | ---                                               | 0.587                                 | ---        | 0.423    |
|                                                                                                                     | ETW                | ---                      | 0.356               | ---                                               | 0.665                                 | ---        | 0.416    |
| FHT<br>Strength (ksi)                                                                                               | CTD                | 64.02                    | 63.52               | 52.25                                             | 52.05                                 | 80.70      | 80.53    |
|                                                                                                                     | RTD                | 65.87                    | 65.95               | 48.15                                             | 48.08                                 | 91.95      | 91.93    |
|                                                                                                                     | ETW                | 70.29                    | 69.52               | 42.63                                             | 42.30                                 | 101.26     | 100.77   |
| FHC<br>Strength (ksi)                                                                                               | RTD                | 69.19                    | 69.30               | 54.57                                             | 54.25                                 | 98.57      | 98.16    |
|                                                                                                                     | ETW                | 51.68                    | 51.61               | 41.17                                             | 40.86                                 | 72.79      | 72.20    |
| LSBS<br>Strength (ksi)                                                                                              | RTD                | ---                      | 12.13               | ---                                               | ---                                   | ---        | ---      |
|                                                                                                                     | ETW                | ---                      | 6.99                | ---                                               | ---                                   | ---        | ---      |
|                                                                                                                     |                    | ---                      |                     | ---                                               | ---                                   | ---        | ---      |
| SSB<br>2% offset Strength<br>Strength (ksi)                                                                         | RTD                | 109.89                   | 112.98              | 114.02                                            | 114.20                                | 113.90     | 113.93   |
|                                                                                                                     | ETW                | 88.14                    | 89.88               | 86.22                                             | 86.87                                 | 91.67      | 91.80    |
| ILT<br>Strength (ksi)                                                                                               | CTD                | ---                      | 11.96               | ---                                               | ---                                   | ---        | ---      |
|                                                                                                                     | RTD                | ---                      | 11.04               | ---                                               | ---                                   | ---        | ---      |
|                                                                                                                     | ETW                | ---                      | 6.46                | ---                                               | ---                                   | ---        | ---      |
| CAI<br>Strength (ksi)                                                                                               | RTD                | 31.45                    | 30.96               | ---                                               | ---                                   | ---        | ---      |

Table 2-2: Laminate Summary Data

## 2.3 Individual Test Summaries

### 2.3.1 Longitudinal Tension Properties

|                                                   |                         |                                                                                       |                 |                   |                 |                   |                 |
|---------------------------------------------------|-------------------------|---------------------------------------------------------------------------------------|-----------------|-------------------|-----------------|-------------------|-----------------|
| <b>Material:</b> HEXCEL 8552 - IM7 UNI PREPREG    |                         | <b>Tension, 1-axis</b><br>Gr/ Ep<br>HEXCEL 8552 - IM7 UNI PREPREG<br>[0] <sub>6</sub> |                 |                   |                 |                   |                 |
| <b>Resin content:</b>                             | 42.70 % vol             |                                                                                       |                 |                   |                 |                   |                 |
| <b>Fiber volume:</b>                              | 57.30 % vol             |                                                                                       |                 |                   |                 |                   |                 |
| <b>Ply count:</b>                                 | 6                       |                                                                                       |                 |                   |                 |                   |                 |
| <b>Test method:</b> ASTM D3039-00E <sup>1</sup>   |                         | <b>Modulus calculation:</b> linear fit from 1000 to 3000 micro in/in                  |                 |                   |                 |                   |                 |
| <b>Normalized by:</b> 0.0072 in CPT               |                         |                                                                                       |                 |                   |                 |                   |                 |
|                                                   |                         | <b>CTD (B)</b>                                                                        |                 | <b>RTD (A)</b>    |                 | <b>ETW (D)</b>    |                 |
| <b>Test Temperature [°F]</b>                      |                         | -65F                                                                                  |                 | 70F               |                 | 250F              |                 |
| <b>Moisture Conditioning</b>                      |                         | dry                                                                                   |                 | dry               |                 | equilibrium       |                 |
| <b>Equilibrium at T, RH</b>                       |                         |                                                                                       |                 |                   |                 | 160 F, 85%        |                 |
| <b>Source code</b>                                |                         | HFJXXXXB                                                                              |                 | HFJXXXXA          |                 | HFJXXXXD          |                 |
|                                                   |                         | <b>Normalized</b>                                                                     | <b>Measured</b> | <b>Normalized</b> | <b>Measured</b> | <b>Normalized</b> | <b>Measured</b> |
| <b>F<sub>1</sub><sup>tu</sup></b><br><b>(ksi)</b> | <b>Mean</b>             | 357.39                                                                                | 353.70          | 362.69            | 371.08          | 333.50            | 327.96          |
|                                                   | <b>Minimum</b>          | 325.69                                                                                | 322.58          | 325.68            | 340.31          | 244.53            | 241.83          |
|                                                   | <b>Maximum</b>          | 379.97                                                                                | 378.95          | 392.32            | 401.22          | 373.23            | 366.86          |
|                                                   | <b>C.V.(%)</b>          | 3.53                                                                                  | 3.70            | 4.43              | 4.10            | 11.64             | 10.73           |
|                                                   | <b>No. Specimens</b>    | 22                                                                                    |                 | 18                |                 | 18                |                 |
|                                                   | <b>No. Prepreg Lots</b> | 3                                                                                     |                 | 3                 |                 | 3                 |                 |
| <b>E<sub>1</sub><sup>t</sup></b><br><b>(Msi)</b>  | <b>Mean</b>             | 22.57                                                                                 | 22.33           | 22.99             | 23.51           | 24.00             | 23.77           |
|                                                   | <b>Minimum</b>          | 21.85                                                                                 | 21.74           | 20.71             | 22.78           | 23.22             | 22.69           |
|                                                   | <b>Maximum</b>          | 23.22                                                                                 | 22.97           | 23.94             | 24.38           | 25.58             | 26.17           |
|                                                   | <b>C.V.(%)</b>          | 1.72                                                                                  | 1.65            | 3.53              | 2.27            | 2.32              | 2.92            |
|                                                   | <b>No. Specimens</b>    | 22                                                                                    |                 | 18                |                 | 29                |                 |
|                                                   | <b>No. Prepreg Lots</b> | 3                                                                                     |                 | 3                 |                 | 3                 |                 |
| <b>v<sub>12</sub><sup>t</sup></b>                 | <b>Mean</b>             | 0.270                                                                                 |                 | 0.316             |                 | 0.393             |                 |
|                                                   | <b>No. Specimens</b>    | 22                                                                                    |                 | 18                |                 | 25                |                 |
|                                                   | <b>No. Prepreg Lots</b> | 3                                                                                     |                 | 3                 |                 | 3                 |                 |

## 2.3.2 Transverse Tension Properties

|                                                  |                         |                                                                      |                 |                                                                                                      |                 |                   |                 |                   |                 |
|--------------------------------------------------|-------------------------|----------------------------------------------------------------------|-----------------|------------------------------------------------------------------------------------------------------|-----------------|-------------------|-----------------|-------------------|-----------------|
| <b>Material:</b> HEXCEL 8552 - IM7 UNI PREPREG   |                         |                                                                      |                 | <div><b>Tension, 2-axis</b><br/>Gr/ Ep<br/>HEXCEL 8552 - IM7 UNI PREPREG<br/>[90]<sub>11</sub></div> |                 |                   |                 |                   |                 |
| <b>Resin content:</b>                            | 40.08 % vol             | <b>Comp. density:</b>                                                |                 |                                                                                                      |                 | 1.58 [g/cc]       |                 |                   |                 |
| <b>Fiber volume:</b>                             | 59.92 % vol             |                                                                      |                 |                                                                                                      |                 |                   |                 |                   |                 |
| <b>Ply count:</b>                                | 11                      |                                                                      |                 |                                                                                                      |                 |                   |                 |                   |                 |
| <b>Test method:</b> ASTM D3039-00                |                         | <b>Modulus calculation:</b> linear fit from 1000 to 3000 micro in/in |                 |                                                                                                      |                 |                   |                 |                   |                 |
| <b>Normalized by:</b> NA                         |                         |                                                                      |                 |                                                                                                      |                 |                   |                 |                   |                 |
|                                                  |                         | <b>CTD (B)</b>                                                       | <b>RTD (A)</b>  | <b>ETW(D)</b>                                                                                        |                 |                   |                 |                   |                 |
| <b>Test Temperature [°F]</b>                     |                         | -65F                                                                 | 70F             | 250F                                                                                                 |                 |                   |                 |                   |                 |
| <b>Moisture Conditioning</b>                     |                         | dry                                                                  | dry             | equilibrium                                                                                          |                 |                   |                 |                   |                 |
| <b>Equilibrium at T, RH</b>                      |                         |                                                                      |                 | 160 F,85%                                                                                            |                 |                   |                 |                   |                 |
| <b>Source code</b>                               |                         | HFUXXXXB                                                             | HFUXXXXA        | HFUXXXXD                                                                                             |                 |                   |                 |                   |                 |
|                                                  |                         | <b>Normalized</b>                                                    | <b>Measured</b> | <b>Normalized</b>                                                                                    | <b>Measured</b> | <b>Normalized</b> | <b>Measured</b> | <b>Normalized</b> | <b>Measured</b> |
| <b>F<sub>2</sub><sup>u</sup></b><br><b>(ksi)</b> | <b>Mean</b>             |                                                                      | 9.60            |                                                                                                      | 9.29            |                   | 3.49            |                   |                 |
|                                                  | <b>Minimum</b>          |                                                                      | 7.88            |                                                                                                      | 7.40            |                   | 3.22            |                   |                 |
|                                                  | <b>Maximum</b>          |                                                                      | 11.19           |                                                                                                      | 10.80           |                   | 3.91            |                   |                 |
|                                                  | <b>C.V.(%)</b>          |                                                                      | 8.30            |                                                                                                      | 9.47            |                   | 6.28            |                   |                 |
|                                                  | <b>No. Specimens</b>    |                                                                      | 21              |                                                                                                      | 20              |                   | 19              |                   |                 |
|                                                  | <b>No. Prepreg Lots</b> |                                                                      | 3               |                                                                                                      | 3               |                   | 3               |                   |                 |
| <b>E<sub>2</sub><sup>t</sup></b><br><b>(Msi)</b> | <b>Mean</b>             |                                                                      | 1.46            |                                                                                                      | 1.30            |                   | 0.81            |                   |                 |
|                                                  | <b>Minimum</b>          |                                                                      | 1.42            |                                                                                                      | 1.21            |                   | 0.76            |                   |                 |
|                                                  | <b>Maximum</b>          |                                                                      | 1.53            |                                                                                                      | 1.40            |                   | 0.89            |                   |                 |
|                                                  | <b>C.V.(%)</b>          |                                                                      | 2.04            |                                                                                                      | 3.37            |                   | 5.15            |                   |                 |
|                                                  | <b>No. Specimens</b>    |                                                                      | 21              |                                                                                                      | 20              |                   | 19              |                   |                 |
|                                                  | <b>No. Prepreg Lots</b> |                                                                      | 3               |                                                                                                      | 3               |                   | 3               |                   |                 |

## 2.3.3 Longitudinal Compression Properties

|                                                  |                         |                                                                                                                          |                 |                   |                 |
|--------------------------------------------------|-------------------------|--------------------------------------------------------------------------------------------------------------------------|-----------------|-------------------|-----------------|
| <b>Material:</b> HEXCEL 8552 - IM7 UNI PREPREG   |                         | <b>Compression, 1-axis</b><br><b>Gr/ Ep</b><br><b>HEXCEL 8552 - IM7 UNI</b><br><b>PREPREG</b><br><b>[0]<sub>14</sub></b> |                 |                   |                 |
| <b>Resin content:</b>                            | 38.92 % vol             |                                                                                                                          |                 |                   |                 |
| <b>Fiber volume:</b>                             | 61.08 % vol             |                                                                                                                          |                 |                   |                 |
| <b>Ply count:</b>                                | 14                      |                                                                                                                          |                 |                   |                 |
| <b>Test method:</b> ASTM D6641M-01E <sup>1</sup> |                         | <b>Modulus calculation:</b> linear fit from 1000 to 3000 micro in/in                                                     |                 |                   |                 |
| <b>Normalized by:</b> 0.0072 in CPT              |                         |                                                                                                                          |                 |                   |                 |
|                                                  |                         | <b>CTD (B)</b>                                                                                                           | <b>RTD (A)</b>  | <b>ETD</b>        | <b>ETW (D)</b>  |
| <b>Test Temperature [°F]</b>                     |                         | -65F                                                                                                                     | 70F             | 250F              | 250F            |
| <b>Moisture Conditioning</b>                     |                         | dry                                                                                                                      | dry             | dry               | equilibrium     |
| <b>Equilibrium at T, RH</b>                      |                         |                                                                                                                          |                 |                   | 160 F, 85%      |
| <b>Source code</b>                               |                         | HFILXXXXB                                                                                                                | HFILXXXXA       | HFILXXXXC         | HFILXXXXD       |
|                                                  |                         | <b>Normalized</b>                                                                                                        | <b>Measured</b> | <b>Normalized</b> | <b>Measured</b> |
| <b>E<sub>1</sub><sup>c</sup></b><br><b>(Msi)</b> | <b>Mean</b>             | 20.68                                                                                                                    | 20.53           | 20.25             | 20.00           |
|                                                  | <b>Minimum</b>          | 17.80                                                                                                                    | 19.05           | 18.37             | 19.37           |
|                                                  | <b>Maximum</b>          | 22.39                                                                                                                    | 21.29           | 22.12             | 20.92           |
|                                                  | <b>C.V.(%)</b>          | 6.40                                                                                                                     | 2.94            | 5.76              | 2.31            |
|                                                  | <b>No. Specimens</b>    | 20                                                                                                                       | 15              | 17                | 35              |
|                                                  | <b>No. Prepreg Lots</b> | 3                                                                                                                        | 3               | 3                 | 3               |
| <b>v<sub>12</sub><sup>c</sup></b>                | <b>Mean</b>             | 0.362                                                                                                                    | 0.356           | 0.374             | 0.383           |
|                                                  | <b>No. Specimens</b>    | 20                                                                                                                       | 15              | 17                | 35              |
|                                                  | <b>No. Prepreg Lots</b> | 3                                                                                                                        | 3               | 3                 | 3               |

## 2.3.4 Transverse Compression Properties

|                                                   |                         |                                                                      |                 |                   |                 |                                                                                                          |                 |                   |                 |
|---------------------------------------------------|-------------------------|----------------------------------------------------------------------|-----------------|-------------------|-----------------|----------------------------------------------------------------------------------------------------------|-----------------|-------------------|-----------------|
| <b>Material:</b> HEXCEL 8552 - IM7 UNI PREPREG    |                         |                                                                      |                 |                   |                 | <b>Compression, 2-axis</b><br>Gr/ Ep<br><b>HEXCEL 8552 - IM7 UNI PREPREG</b><br><b>[90]<sub>14</sub></b> |                 |                   |                 |
| <b>Resin content:</b>                             | 39.62 % vol             | <b>Comp. density:</b>                                                |                 | 1.58 [g/cc]       |                 |                                                                                                          |                 |                   |                 |
| <b>Fiber volume:</b>                              | 60.38 % vol             |                                                                      |                 |                   |                 |                                                                                                          |                 |                   |                 |
| <b>Ply count:</b>                                 | 14                      |                                                                      |                 |                   |                 |                                                                                                          |                 |                   |                 |
| <b>Test method:</b> ASTM D6641-01e1               |                         | <b>Modulus calculation:</b> linear fit from 1000 to 3000 micro in/in |                 |                   |                 |                                                                                                          |                 |                   |                 |
| <b>Normalized by:</b> NA                          |                         |                                                                      |                 |                   |                 |                                                                                                          |                 |                   |                 |
|                                                   |                         | <b>CTD (B)</b>                                                       |                 | <b>RTD (A)</b>    |                 | <b>ETW (D)</b>                                                                                           |                 |                   |                 |
| <b>Test Temperature [°F]</b>                      |                         | -65F                                                                 |                 | 70F               |                 | 250F                                                                                                     |                 |                   |                 |
| <b>Moisture Conditioning</b>                      |                         | dry                                                                  |                 | dry               |                 | equilibrium                                                                                              |                 |                   |                 |
| <b>Equilibrium at T, RH</b>                       |                         |                                                                      |                 |                   |                 | 160 F,85%                                                                                                |                 |                   |                 |
| <b>Source code</b>                                |                         | HFIZXXXB                                                             |                 | HFIZXXXA          |                 | HFIZXXXD                                                                                                 |                 |                   |                 |
|                                                   |                         | <b>Normalized</b>                                                    | <b>Measured</b> | <b>Normalized</b> | <b>Measured</b> | <b>Normalized</b>                                                                                        | <b>Measured</b> | <b>Normalized</b> | <b>Measured</b> |
| <b>F<sub>2</sub><sup>cu</sup></b><br><b>(ksi)</b> | <b>Mean</b>             | 55.31                                                                |                 | 41.44             |                 | 19.02                                                                                                    |                 |                   |                 |
|                                                   | <b>Minimum</b>          | 50.41                                                                |                 | 38.79             |                 | 16.78                                                                                                    |                 |                   |                 |
|                                                   | <b>Maximum</b>          | 61.39                                                                |                 | 46.40             |                 | 20.70                                                                                                    |                 |                   |                 |
|                                                   | <b>C.V.(%)</b>          | 5.19                                                                 |                 | 4.50              |                 | 5.47                                                                                                     |                 |                   |                 |
|                                                   | <b>No. Specimens</b>    | 20                                                                   |                 | 20                |                 | 25                                                                                                       |                 |                   |                 |
|                                                   | <b>No. Prepreg Lots</b> | 3                                                                    |                 | 3                 |                 | 3                                                                                                        |                 |                   |                 |
| <b>E<sub>2</sub><sup>c</sup></b><br><b>(Msi)</b>  | <b>Mean</b>             | 1.53                                                                 |                 | 1.41              |                 | 1.18                                                                                                     |                 |                   |                 |
|                                                   | <b>Minimum</b>          | 1.26                                                                 |                 | 1.25              |                 | 1.03                                                                                                     |                 |                   |                 |
|                                                   | <b>Maximum</b>          | 1.70                                                                 |                 | 1.66              |                 | 1.35                                                                                                     |                 |                   |                 |
|                                                   | <b>C.V.(%)</b>          | 7.64                                                                 |                 | 6.63              |                 | 7.99                                                                                                     |                 |                   |                 |
|                                                   | <b>No. Specimens</b>    | 20                                                                   |                 | 20                |                 | 9                                                                                                        |                 |                   |                 |
|                                                   | <b>No. Prepreg Lots</b> | 3                                                                    |                 | 3                 |                 | 3                                                                                                        |                 |                   |                 |
| <b>v21</b>                                        | <b>Mean</b>             | 0.028                                                                |                 | 0.024             |                 | 0.018                                                                                                    |                 |                   |                 |
|                                                   | <b>No. Specimens</b>    | 20                                                                   |                 | 20                |                 | 9                                                                                                        |                 |                   |                 |
|                                                   | <b>No. Prepreg Lots</b> | 3                                                                    |                 | 3                 |                 | 3                                                                                                        |                 |                   |                 |

## 2.3.5 In-Plane Shear Properties

|                                                               |                  |                               |                            |            |          |                                                                                                                        |          |            |          |  |  |
|---------------------------------------------------------------|------------------|-------------------------------|----------------------------|------------|----------|------------------------------------------------------------------------------------------------------------------------|----------|------------|----------|--|--|
| Material:                                                     |                  | HEXCEL 8552 - IM7 UNI PREPREG |                            |            |          | <div>In-Plane Shear</div> <div>Gr/ Ep</div> <div>HEXCEL 8552 - IM7 UNI</div> <div>PREPREG</div> <div>[+45/-45]3s</div> |          |            |          |  |  |
| Resin content:                                                | 41.07 % vol      |                               | Comp. density: 1.57 [g/cc] |            |          |                                                                                                                        |          |            |          |  |  |
| Fiber volume:                                                 | 58.93 % vol      |                               |                            |            |          |                                                                                                                        |          |            |          |  |  |
| Ply count:                                                    | 12               |                               |                            |            |          |                                                                                                                        |          |            |          |  |  |
| Test method:                                                  | ASTM D3518-94    |                               |                            |            |          |                                                                                                                        |          |            |          |  |  |
| Modulus calculation: linear fit from 2000 to 6000 micro in/in |                  |                               |                            |            |          |                                                                                                                        |          |            |          |  |  |
| Normalized by:                                                |                  | NA                            |                            |            |          |                                                                                                                        |          |            |          |  |  |
|                                                               |                  | CTD (B)                       |                            | RTD (A)    |          | ETW (D)                                                                                                                |          |            |          |  |  |
| Test Temperature [°F]                                         |                  | -65F                          |                            | 70F        |          | 250F                                                                                                                   |          |            |          |  |  |
| Moisture Conditioning                                         |                  | dry                           |                            | dry        |          | equilibrium                                                                                                            |          |            |          |  |  |
| Equilibrium at T, RH                                          |                  |                               |                            |            |          | 160 F,85%                                                                                                              |          |            |          |  |  |
| Source code                                                   |                  | HFINXXXB                      |                            | HFINXXXA   |          | HFINXXXD                                                                                                               |          |            |          |  |  |
|                                                               |                  | Normalized                    | Measured                   | Normalized | Measured | Normalized                                                                                                             | Measured | Normalized | Measured |  |  |
| F <sub>12</sub> <sup>s5% strain</sup><br>(ksi)                | Mean             |                               |                            |            | 13.22    |                                                                                                                        | 5.54     |            |          |  |  |
|                                                               | Minimum          |                               |                            |            | 12.85    |                                                                                                                        | 5.18     |            |          |  |  |
|                                                               | Maximum          |                               |                            |            | 13.61    |                                                                                                                        | 5.95     |            |          |  |  |
|                                                               | C.V.(%)          |                               |                            |            | 1.60     |                                                                                                                        | 3.38     |            |          |  |  |
|                                                               | No. Specimens    |                               |                            | 12         |          | 19                                                                                                                     |          |            |          |  |  |
|                                                               | No. Prepreg Lots |                               |                            | 3          |          | 3                                                                                                                      |          |            |          |  |  |
| F <sub>12</sub> <sup>s0.2%</sup><br>(ksi)                     | Mean             |                               | 11.29                      |            | 7.76     |                                                                                                                        | 3.31     |            |          |  |  |
|                                                               | Minimum          |                               | 10.78                      |            | 7.48     |                                                                                                                        | 3.05     |            |          |  |  |
|                                                               | Maximum          |                               | 11.66                      |            | 8.28     |                                                                                                                        | 3.63     |            |          |  |  |
|                                                               | C.V.(%)          |                               | 2.10                       |            | 2.81     |                                                                                                                        | 4.63     |            |          |  |  |
|                                                               | No. Specimens    | 21                            |                            | 16         |          | 20                                                                                                                     |          |            |          |  |  |
|                                                               | No. Prepreg Lots | 3                             |                            | 3          |          | 3                                                                                                                      |          |            |          |  |  |
| G <sub>12</sub> <sup>s</sup><br>(Msi)                         | Mean             |                               | 0.86                       |            | 0.68     |                                                                                                                        | 0.31     |            |          |  |  |
|                                                               | Minimum          |                               | 0.81                       |            | 0.65     |                                                                                                                        | 0.28     |            |          |  |  |
|                                                               | Maximum          |                               | 0.89                       |            | 0.73     |                                                                                                                        | 0.34     |            |          |  |  |
|                                                               | C.V.(%)          |                               | 2.90                       |            | 3.27     |                                                                                                                        | 4.51     |            |          |  |  |
|                                                               | No. Specimens    | 21                            |                            | 16         |          | 20                                                                                                                     |          |            |          |  |  |
|                                                               | No. Prepreg Lots | 3                             |                            | 3          |          | 3                                                                                                                      |          |            |          |  |  |

Note: All CTD specimens failed to reach 50,000 microstrain

## 2.3.6 Unnotched Compression 0 Properties

|                       |                  |                               |        |                                                               |       |                                                                                                                     |       |                    |       |
|-----------------------|------------------|-------------------------------|--------|---------------------------------------------------------------|-------|---------------------------------------------------------------------------------------------------------------------|-------|--------------------|-------|
| Material:             |                  | HEXCEL 8552 - IM7 UNI PREPREG |        |                                                               |       | <div>Unnotched Compression 0</div> <div>Gr/ Ep</div> <div>HEXCEL 8552 - IM7 UNI PREPREG</div> <div>[90,0,90]5</div> |       |                    |       |
| Resin content:        |                  | 39.67 % vol                   |        | Comp. density: 1.58 [g/cc]                                    |       |                                                                                                                     |       |                    |       |
| Fiber volume:         |                  | 60.30 % vol                   |        |                                                               |       |                                                                                                                     |       |                    |       |
| Ply count:            |                  | 15                            |        |                                                               |       |                                                                                                                     |       |                    |       |
| Test method:          |                  | ASTM D6641-01E1               |        | Modulus calculation: linear fit from 1000 to 3000 micro in/in |       |                                                                                                                     |       |                    |       |
| Normalized by:        |                  | 0.0072 in CPT                 |        |                                                               |       |                                                                                                                     |       |                    |       |
|                       |                  | CTD (B)                       |        | RTD (A)                                                       |       | ETD (C)                                                                                                             |       | ETW (D)            |       |
| Test Temperature [°F] |                  | -65F                          |        | 70F                                                           |       | 250F                                                                                                                |       | 250 F              |       |
| Moisture Conditioning |                  | dry                           |        | dry                                                           |       | dry                                                                                                                 |       | equilibrium        |       |
| Equilibrium at T, RH  |                  |                               |        |                                                               |       |                                                                                                                     |       | 160 F,85%          |       |
| Source code           |                  | HFIRXXXXB                     |        | HFIRXXXXA                                                     |       | HFIRXXXXC                                                                                                           |       | HFIRXXXXD          |       |
|                       |                  | NormalizedMeasured            |        | NormalizedMeasured                                            |       | NormalizedMeasured                                                                                                  |       | NormalizedMeasured |       |
| UNC0                  | Mean             | 113.26                        | 111.64 | 94.51                                                         | 95.11 | 75.53                                                                                                               | 75.13 | 64.28              | 64.03 |
|                       | Minimum          | 105.46                        | 104.58 | 84.82                                                         | 89.79 | 66.78                                                                                                               | 66.57 | 53.94              | 52.06 |
|                       | Maximum          | 121.75                        | 118.90 | 99.74                                                         | 98.54 | 81.34                                                                                                               | 81.64 | 70.95              | 74.96 |
|                       | C.V.(%)          | 4.19                          | 4.02   | 5.91                                                          | 3.22  | 6.61                                                                                                                | 6.81  | 8.23               | 9.70  |
|                       | No. Specimens    | 9                             |        | 9                                                             |       | 9                                                                                                                   |       | 17                 |       |
|                       | No. Prepreg Lots | 2                             |        | 2                                                             |       | 2                                                                                                                   |       | 2                  |       |
| UNC0                  | Mean             | 7.75                          | 7.64   | 7.47                                                          | 7.52  | 7.57                                                                                                                | 7.53  | 7.74               | 7.82  |
|                       | Minimum          | 7.47                          | 7.43   | 7.04                                                          | 7.32  | 7.11                                                                                                                | 7.11  | 7.41               | 7.30  |
|                       | Maximum          | 8.03                          | 7.85   | 7.60                                                          | 7.73  | 7.88                                                                                                                | 7.84  | 8.12               | 8.22  |
|                       | C.V.(%)          | 3.08                          | 2.36   | 2.62                                                          | 1.53  | 3.41                                                                                                                | 3.12  | 3.04               | 3.88  |
|                       | No. Specimens    | 9                             |        | 9                                                             |       | 9                                                                                                                   |       | 8                  |       |
|                       | No. Prepreg Lots | 2                             |        | 2                                                             |       | 2                                                                                                                   |       | 2                  |       |
| vUNC0                 | Mean             | 0.041                         |        | 0.035                                                         |       | 0.030                                                                                                               |       | 0.017              |       |
|                       | No. Specimens    | 9                             |        | 9                                                             |       | 9                                                                                                                   |       | 8                  |       |
|                       | No. Prepreg Lots | 2                             |        | 2                                                             |       | 2                                                                                                                   |       | 2                  |       |

Batch A Cure Cycle 1 and 2 and Batch C Cure Cycle 2 has improper layup so data was removed



## 2.3.7 Unnotched Tension 0 Properties

|                                                  |                         |                                                                      |                   |                                                                                                        |                   |                 |        |
|--------------------------------------------------|-------------------------|----------------------------------------------------------------------|-------------------|--------------------------------------------------------------------------------------------------------|-------------------|-----------------|--------|
| <b>Material:</b> HEXCEL 8552 - IM7 UNI PREPREG   |                         |                                                                      |                   | <b>Unnotched Tension 0</b><br><b>Gr/ Ep</b><br><b>HEXCEL 8552 - IM7 UNI PREPREG</b><br><b>[0,90]2S</b> |                   |                 |        |
| <b>Resin content:</b>                            | 40.79 % vol             | <b>Comp. density:</b> 1.58 [g/cc]                                    |                   |                                                                                                        |                   |                 |        |
| <b>Fiber volume:</b>                             | 59.21 % vol             |                                                                      |                   |                                                                                                        |                   |                 |        |
| <b>Ply count:</b>                                | 8                       |                                                                      |                   |                                                                                                        |                   |                 |        |
| <b>Test method:</b> ASTM D3039M-00 <sup>E1</sup> |                         | <b>Modulus calculation:</b> linear fit from 1000 to 3000 micro in/in |                   |                                                                                                        |                   |                 |        |
| <b>Normalized by:</b>                            | 0.0072 in CPT           |                                                                      |                   |                                                                                                        |                   |                 |        |
|                                                  |                         | <b>CTD (B)</b>                                                       | <b>RTD (A)</b>    |                                                                                                        | <b>ETW (D)</b>    |                 |        |
| <b>Test Temperature [°F]</b>                     | -65F                    | 70F                                                                  |                   | 250F                                                                                                   |                   |                 |        |
| <b>Moisture Conditioning</b>                     | dry                     | dry                                                                  |                   | equilibrium                                                                                            |                   |                 |        |
| <b>Equilibrium at T, RH</b>                      |                         |                                                                      |                   | 160 F,85%                                                                                              |                   |                 |        |
| <b>Source code</b>                               | HFIPXXXXB               | HFIPXXXXA                                                            |                   | HFIPXXXXD                                                                                              |                   |                 |        |
|                                                  | <b>Normalized</b>       | <b>Measured</b>                                                      | <b>Normalized</b> | <b>Measured</b>                                                                                        | <b>Normalized</b> | <b>Measured</b> |        |
| <b>UNT0</b><br><b>Strength (ksi)</b>             | <b>Mean</b>             | 152.58                                                               | 149.90            | 171.38                                                                                                 | 169.16            | 179.23          | 175.98 |
|                                                  | <b>Minimum</b>          | 142.06                                                               | 138.38            | 143.99                                                                                                 | 150.39            | 165.98          | 164.55 |
|                                                  | <b>Maximum</b>          | 159.85                                                               | 156.68            | 182.90                                                                                                 | 182.06            | 189.18          | 189.34 |
|                                                  | <b>C.V.(%)</b>          | 3.39                                                                 | 3.61              | 5.43                                                                                                   | 4.18              | 3.75            | 3.67   |
|                                                  | <b>No. Specimens</b>    | 19                                                                   |                   | 18                                                                                                     |                   | 18              |        |
|                                                  | <b>No. Prepreg Lots</b> | 3                                                                    |                   | 3                                                                                                      |                   | 3               |        |
| <b>UNT0</b><br><b>Modulus (Msi)</b>              | <b>Mean</b>             | 11.92                                                                | 11.71             | 11.99                                                                                                  | 11.85             | 11.94           | 11.74  |
|                                                  | <b>Minimum</b>          | 11.55                                                                | 11.25             | 11.50                                                                                                  | 11.33             | 11.60           | 11.29  |
|                                                  | <b>Maximum</b>          | 12.15                                                                | 11.91             | 12.34                                                                                                  | 12.46             | 12.35           | 12.26  |
|                                                  | <b>C.V.(%)</b>          | 1.24                                                                 | 1.61              | 1.76                                                                                                   | 2.50              | 1.76            | 2.09   |
|                                                  | <b>No. Specimens</b>    | 19                                                                   |                   | 18                                                                                                     |                   | 19              |        |
|                                                  | <b>No. Prepreg Lots</b> | 3                                                                    |                   | 3                                                                                                      |                   | 3               |        |

## 2.3.8 Short Beam Strength Properties

|                                                 |                   |                                                                                            |                   |                 |                   |
|-------------------------------------------------|-------------------|--------------------------------------------------------------------------------------------|-------------------|-----------------|-------------------|
| <b>Material:</b> HEXCEL 8552 - IM7 UNI PREPREG  |                   | <b>Short Beam Strength</b><br>Gr/ Ep<br>HEXCEL 8552 - IM7 UNI PREPREG<br>[0] <sub>34</sub> |                   |                 |                   |
| <b>Resin content:</b>                           | 38.85 % vol       |                                                                                            |                   |                 |                   |
| <b>Fiber volume:</b>                            | 61.15 % vol       |                                                                                            |                   |                 |                   |
| <b>Ply count:</b>                               | 34                |                                                                                            |                   |                 |                   |
| <b>Test method:</b> ASTM D2344-00 <sup>E1</sup> |                   |                                                                                            |                   |                 |                   |
| <b>Normalized by:</b> N/A                       |                   |                                                                                            |                   |                 |                   |
|                                                 | <b>CTD (B)</b>    | <b>RTD (A)</b>                                                                             | <b>ETD (C)</b>    | <b>ETW (D)</b>  |                   |
| <b>Test Temperature [°F]</b>                    | -65F              | 70F                                                                                        | 250F              | 250F            |                   |
| <b>Moisture Conditioning</b>                    | dry               | dry                                                                                        | dry               | equilibrium     |                   |
| <b>Equilibrium at T, RH</b>                     |                   |                                                                                            |                   | 160 F, 85%      |                   |
| <b>Source code</b>                              | HFQXXXXB          | HFQXXXXA                                                                                   | HFQXXXXC          | HFQXXXXD        |                   |
|                                                 | <b>Normalized</b> | <b>Measured</b>                                                                            | <b>Normalized</b> | <b>Measured</b> | <b>Normalized</b> |
| <b>Mean</b>                                     |                   | 21.04                                                                                      |                   | 17.13           |                   |
| <b>Minimum</b>                                  |                   | 19.68                                                                                      |                   | 16.20           |                   |
| <b>Maximum</b>                                  |                   | 22.58                                                                                      |                   | 17.78           |                   |
| <b>SBS C.V.(%)</b>                              |                   | 3.05                                                                                       |                   | 2.51            |                   |
| <b>Strength (ksi)</b>                           |                   |                                                                                            |                   |                 |                   |
| <b>No. Specimens</b>                            |                   | 19                                                                                         |                   | 18              |                   |
| <b>No. Prepreg Lots</b>                         |                   | 3                                                                                          |                   | 3               |                   |

## 2.3.9 Unnotched Tension 1 Properties

|                                         |                              |                                                               |            |                                                                                                        |            |          |
|-----------------------------------------|------------------------------|---------------------------------------------------------------|------------|--------------------------------------------------------------------------------------------------------|------------|----------|
| Material: HEXCEL 8552 - IM7 UNI PREPREG |                              |                                                               |            | <b>Unnotched Tension 1</b><br>Gr/ Ep<br><b>HEXCEL 8552 - IM7 UNI PREPREG</b><br><b>[45,0,-45,90]2s</b> |            |          |
| Resin content:                          | 42.20 % vol                  | Comp. density: 1.58 g[cc]                                     |            |                                                                                                        |            |          |
| Fiber volume:                           | 57.80 % vol                  |                                                               |            |                                                                                                        |            |          |
| Ply count:                              | 16                           |                                                               |            |                                                                                                        |            |          |
| Test method:                            | ASTM D3039M-00 <sup>e1</sup> | Modulus calculation: linear fit from 1000 to 3000 micro in/in |            |                                                                                                        |            |          |
| Normalized by:                          | 0.0072 in CPT                |                                                               |            |                                                                                                        |            |          |
|                                         | CTD (B)                      | RTD (A)                                                       |            | ETW (D)                                                                                                |            |          |
| Test Temperature [°F]                   | -65F                         | 70F                                                           |            | 250F                                                                                                   |            |          |
| Moisture Conditioning                   | dry                          | dry                                                           |            | equilibrium                                                                                            |            |          |
| Equilibrium at T, RH                    |                              |                                                               |            | 160 F,85%                                                                                              |            |          |
| Source code                             | HFIAXXXB                     | HFIAXXXA                                                      |            | HFIAXXXD                                                                                               |            |          |
|                                         | Normalized                   | Measured                                                      | Normalized | Measured                                                                                               | Normalized | Measured |
| Mean                                    | 99.35                        | 98.79                                                         | 104.69     | 104.01                                                                                                 | 112.46     | 111.50   |
| Minimum                                 | 91.60                        | 93.70                                                         | 89.56      | 96.38                                                                                                  | 101.64     | 104.09   |
| Maximum                                 | 105.84                       | 104.20                                                        | 113.71     | 111.12                                                                                                 | 119.29     | 119.12   |
| UNT1 C.V.(%)                            | 3.46                         | 2.78                                                          | 6.95       | 3.90                                                                                                   | 4.99       | 3.50     |
| Strength (ksi)                          |                              |                                                               |            |                                                                                                        |            |          |
| No. Specimens                           | 16                           |                                                               | 16         |                                                                                                        | 17         |          |
| No. Prepreg Lots                        | 3                            |                                                               | 3          |                                                                                                        | 3          |          |
| Mean                                    | 8.35                         | 8.30                                                          | 8.39       | 8.34                                                                                                   | 7.99       | 7.92     |
| Minimum                                 | 7.29                         | 7.91                                                          | 7.28       | 7.90                                                                                                   | 7.07       | 7.15     |
| Maximum                                 | 8.75                         | 8.52                                                          | 8.98       | 8.69                                                                                                   | 8.51       | 8.29     |
| UNT1 C.V.(%)                            | 3.70                         | 1.74                                                          | 5.73       | 2.68                                                                                                   | 5.16       | 3.86     |
| Modulus (Msi)                           |                              |                                                               |            |                                                                                                        |            |          |
| No. Specimens                           | 16                           |                                                               | 16         |                                                                                                        | 17         |          |
| No. Prepreg Lots                        | 3                            |                                                               | 3          |                                                                                                        | 3          |          |

## 2.3.10 Unnotched Tension 2 Properties

|                                                  |                         |                                                                      |                 |                                                                                                                                   |                 |
|--------------------------------------------------|-------------------------|----------------------------------------------------------------------|-----------------|-----------------------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Material:</b> HEXCEL 8552 - IM7 UNI PREPREG   |                         |                                                                      |                 | <b>Unnotched Tension 2</b><br><b>Gr/ Ep</b><br><b>HEXCEL 8552 - IM7 UNI PREPREG</b><br><b>[45,-45,0,45,-45,90,45,-45,45,-45]S</b> |                 |
| <b>Resin content:</b> 40.91 % vol                |                         | <b>Comp. density:</b> 1.58 [g/cc]                                    |                 |                                                                                                                                   |                 |
| <b>Fiber volume:</b> 59.09 % vol                 |                         |                                                                      |                 |                                                                                                                                   |                 |
| <b>Ply count:</b> 20                             |                         |                                                                      |                 |                                                                                                                                   |                 |
| <b>Test method:</b> ASTM D3039M-00 <sup>E1</sup> |                         | <b>Modulus calculation:</b> linear fit from 1000 to 3000 micro in/in |                 |                                                                                                                                   |                 |
| <b>Normalized by:</b> 0.0072 in CPT              |                         |                                                                      |                 |                                                                                                                                   |                 |
|                                                  |                         | <b>CTD (B)</b>                                                       | <b>RTD (A)</b>  | <b>ETW (D)</b>                                                                                                                    |                 |
| <b>Test Temperature [°F]</b>                     |                         | -65F                                                                 | 70F             | 250F                                                                                                                              |                 |
| <b>Moisture Conditioning</b>                     |                         | dry                                                                  | dry             | equilibrium                                                                                                                       |                 |
| <b>Equilibrium at T, RH</b>                      |                         |                                                                      |                 | 160 F,85%                                                                                                                         |                 |
| <b>Source code</b>                               |                         | HFIBXXXXB                                                            | HFIBXXXXA       | HFIBXXXXD                                                                                                                         |                 |
|                                                  |                         | <b>Normalized</b>                                                    | <b>Measured</b> | <b>Normalized</b>                                                                                                                 | <b>Measured</b> |
| <b>UNT2</b><br><b>Strength (ksi)</b>             | <b>Mean</b>             | 70.22                                                                | 68.97           | 67.01                                                                                                                             | 67.08           |
|                                                  | <b>Minimum</b>          | 66.60                                                                | 65.98           | 57.64                                                                                                                             | 62.42           |
|                                                  | <b>Maximum</b>          | 75.29                                                                | 72.93           | 71.95                                                                                                                             | 69.98           |
|                                                  | <b>C.V.(%)</b>          | 2.54                                                                 | 2.33            | 5.69                                                                                                                              | 3.17            |
|                                                  | <b>No. Specimens</b>    | 17                                                                   |                 | 18                                                                                                                                |                 |
|                                                  | <b>No. Prepreg Lots</b> | 3                                                                    |                 | 3                                                                                                                                 |                 |
|                                                  |                         |                                                                      |                 |                                                                                                                                   |                 |
| <b>UNT2</b><br><b>Modulus (Msi)</b>              | <b>Mean</b>             | 5.52                                                                 | 5.42            | 5.22                                                                                                                              | 5.23            |
|                                                  | <b>Minimum</b>          | 5.31                                                                 | 5.14            | 4.70                                                                                                                              | 4.95            |
|                                                  | <b>Maximum</b>          | 5.77                                                                 | 5.62            | 5.72                                                                                                                              | 5.54            |
|                                                  | <b>C.V.(%)</b>          | 2.03                                                                 | 2.26            | 5.27                                                                                                                              | 3.31            |
|                                                  | <b>No. Specimens</b>    | 17                                                                   |                 | 18                                                                                                                                |                 |
|                                                  | <b>No. Prepreg Lots</b> | 3                                                                    |                 | 3                                                                                                                                 |                 |
|                                                  |                         |                                                                      |                 |                                                                                                                                   |                 |

## 2.3.11 Unnotched Tension 3 Properties

|                                         |                              |                                                               |            |                                                                                                  |            |          |
|-----------------------------------------|------------------------------|---------------------------------------------------------------|------------|--------------------------------------------------------------------------------------------------|------------|----------|
| Material: HEXCEL 8552 - IM7 UNI PREPREG |                              |                                                               |            | <b>Unnotched Tension 3</b><br>Gr/ Ep<br>HEXCEL 8552 - IM7 UNI PREPREG<br>[0,45,0,90,0,45,0,-45]s |            |          |
| Resin content:                          | 41.31 % vol                  | Comp. density: 1.58 [g/cc]                                    |            |                                                                                                  |            |          |
| Fiber volume:                           | 58.69 % vol                  |                                                               |            |                                                                                                  |            |          |
| Ply count:                              | 20                           |                                                               |            |                                                                                                  |            |          |
| Test method:                            | ASTM D3039M-00 <sup>E1</sup> | Modulus calculation: linear fit from 1000 to 3000 micro in/in |            |                                                                                                  |            |          |
| Normalized by:                          | 0.0072 in CPT                |                                                               |            |                                                                                                  |            |          |
|                                         | CTD (B)                      | RTD (A)                                                       |            | ETW (D)                                                                                          |            |          |
| Test Temperature [°F]                   | -65F                         | 70F                                                           |            | 250F                                                                                             |            |          |
| Moisture Conditioning                   | dry                          | dry                                                           |            | equilibrium                                                                                      |            |          |
| Equilibrium at T, RH                    |                              |                                                               |            | 160 F,85%                                                                                        |            |          |
| Source code                             | HFICXXXXB                    | HFICXXXXA                                                     |            | HFICXXXXD                                                                                        |            |          |
|                                         | Normalized                   | Measured                                                      | Normalized | Measured                                                                                         | Normalized | Measured |
| Mean                                    | 174.18                       | 173.12                                                        | 175.63     | 176.22                                                                                           | 187.43     | 187.30   |
| Minimum                                 | 159.91                       | 160.82                                                        | 159.04     | 158.49                                                                                           | 161.56     | 172.30   |
| Maximum                                 | 188.80                       | 187.85                                                        | 188.00     | 190.86                                                                                           | 203.39     | 199.33   |
| UNT3 C.V.(%)                            | 4.47                         | 4.74                                                          | 4.78       | 4.21                                                                                             | 5.84       | 4.33     |
| Strength (ksi)                          |                              |                                                               |            |                                                                                                  |            |          |
| No. Specimens                           | 19                           |                                                               | 22         |                                                                                                  | 19         |          |
| No. Prepreg Lots                        | 3                            |                                                               | 3          |                                                                                                  | 3          |          |
| Mean                                    | 13.11                        | 13.02                                                         | 13.15      | 13.20                                                                                            | 13.14      | 13.15    |
| Minimum                                 | 12.57                        | 12.36                                                         | 11.50      | 11.40                                                                                            | 11.69      | 12.48    |
| Maximum                                 | 13.60                        | 13.41                                                         | 15.13      | 14.84                                                                                            | 14.41      | 13.90    |
| UNT3 C.V.(%)                            | 1.98                         | 2.17                                                          | 6.04       | 5.63                                                                                             | 4.65       | 2.68     |
| Modulus (Msi)                           |                              |                                                               |            |                                                                                                  |            |          |
| No. Specimens                           | 19                           |                                                               | 22         |                                                                                                  | 22         |          |
| No. Prepreg Lots                        | 3                            |                                                               | 3          |                                                                                                  | 3          |          |

## 2.3.12 Unnotched Compression 1 Properties

|                                                 |                         |                                                                                                            |                   |                 |                   |                                   |  |
|-------------------------------------------------|-------------------------|------------------------------------------------------------------------------------------------------------|-------------------|-----------------|-------------------|-----------------------------------|--|
| <b>Material:</b> HEXCEL 8552 - IM7 UNI PREPREG  |                         | <div><b>Unnotched Compression 1</b><br/>Gr/ Ep<br/>HEXCEL 8552 - IM7 UNI PREPREG<br/>[45,0,-45,90]2S</div> |                   |                 |                   |                                   |  |
| <b>Resin content:</b>                           | 40.04 % vol             |                                                                                                            |                   |                 |                   | <b>Comp. density:</b> 1.58 [g/cc] |  |
| <b>Fiber volume:</b>                            | 59.96 % vol             |                                                                                                            |                   |                 |                   |                                   |  |
| <b>Ply count:</b>                               | 16                      |                                                                                                            |                   |                 |                   |                                   |  |
| <b>Test method:</b> ASTM D6641-01 <sup>E1</sup> |                         | <b>Modulus calculation:</b> linear fit from 1000 to 3000 micro in/in                                       |                   |                 |                   |                                   |  |
| <b>Normalized by:</b> 0.0072 in CPT             |                         |                                                                                                            |                   |                 |                   |                                   |  |
|                                                 |                         | <b>RTD (A)</b>                                                                                             |                   | <b>ETW (D)</b>  |                   |                                   |  |
| <b>Test Temperature [°F]</b>                    | 70F                     | 250 F                                                                                                      |                   |                 |                   |                                   |  |
| <b>Moisture Conditioning</b>                    | dry                     | equilibrium                                                                                                |                   |                 |                   |                                   |  |
| <b>Equilibrium at T, RH</b>                     |                         | 160 F,85%                                                                                                  |                   |                 |                   |                                   |  |
| <b>Source code</b>                              | HFIWXXXXA               | HFIWXXXXD                                                                                                  |                   |                 |                   |                                   |  |
|                                                 | <b>Normalized</b>       | <b>Measured</b>                                                                                            | <b>Normalized</b> | <b>Measured</b> | <b>Normalized</b> | <b>Measured</b>                   |  |
| <b>UNC1</b><br><b>Strength (ksi)</b>            | <b>Mean</b>             | 87.05                                                                                                      | 86.95             | 57.68           | 57.09             |                                   |  |
|                                                 | <b>Minimum</b>          | 68.07                                                                                                      | 73.46             | 48.72           | 48.54             |                                   |  |
|                                                 | <b>Maximum</b>          | 97.04                                                                                                      | 96.78             | 72.23           | 70.98             |                                   |  |
|                                                 | <b>C.V.(%)</b>          | 9.32                                                                                                       | 7.51              | 11.02           | 10.87             |                                   |  |
|                                                 | <b>No. Specimens</b>    | 16                                                                                                         |                   | 30              |                   |                                   |  |
|                                                 | <b>No. Prepreg Lots</b> | 3                                                                                                          |                   | 3               |                   |                                   |  |
| <b>UNC1</b><br><b>Modulus (Msi)</b>             | <b>Mean</b>             | 7.86                                                                                                       | 7.86              | 7.13            | 7.06              |                                   |  |
|                                                 | <b>Minimum</b>          | 6.89                                                                                                       | 7.20              | 6.85            | 6.79              |                                   |  |
|                                                 | <b>Maximum</b>          | 8.41                                                                                                       | 8.61              | 7.34            | 7.38              |                                   |  |
|                                                 | <b>C.V.(%)</b>          | 4.75                                                                                                       | 4.86              | 1.80            | 2.28              |                                   |  |
|                                                 | <b>No. Specimens</b>    | 16                                                                                                         |                   | 16              |                   |                                   |  |
|                                                 | <b>No. Prepreg Lots</b> | 3                                                                                                          |                   | 3               |                   |                                   |  |
| <b>vUNC1</b>                                    | <b>Mean</b>             | 0.334                                                                                                      |                   | 0.356           |                   |                                   |  |
|                                                 | <b>No. Specimens</b>    | 16                                                                                                         |                   | 16              |                   |                                   |  |
|                                                 | <b>No. Prepreg Lots</b> | 3                                                                                                          |                   | 3               |                   |                                   |  |

### 2.3.13 Unnotched Compression 2 Properties

|                                                 |                   |                                                                                                                                       |                   |
|-------------------------------------------------|-------------------|---------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| <b>Material:</b> HEXCEL 8552 - IM7 UNI PREPREG  |                   | <b>Unnotched Compression 2</b><br><b>Gr/ Ep</b><br><b>HEXCEL 8552 - IM7 UNI PREPREG</b><br><b>[45,-45,0,45,-45,90,45,-45,45,-45]S</b> |                   |
| <b>Resin content:</b>                           | 38.98 % vol       | <b>Comp. density:</b>                                                                                                                 | 1.58 [g/cc]       |
| <b>Fiber volume:</b>                            | 61.02 % vol       |                                                                                                                                       |                   |
| <b>Ply count:</b>                               | 20                |                                                                                                                                       |                   |
| <b>Test method:</b> ASTM D6641-01 <sup>E1</sup> |                   | <b>Modulus calculation:</b> linear fit from 1000 to 3000 micro in/in                                                                  |                   |
| <b>Normalized by:</b> 0.0072 in CPT             |                   |                                                                                                                                       |                   |
|                                                 | <b>RTD (A)</b>    | <b>ETW</b>                                                                                                                            |                   |
| <b>Test Temperature [°F]</b>                    | 70F               | 250F                                                                                                                                  |                   |
| <b>Moisture Conditioning</b>                    | DRY               | equilibrium                                                                                                                           |                   |
| <b>Equilibrium at T, RH</b>                     |                   | 160 F,85%                                                                                                                             |                   |
| <b>Source code</b>                              | HFIXXXXXA         | HFIXXXXXD                                                                                                                             |                   |
|                                                 | <b>Normalized</b> | <b>Measured</b>                                                                                                                       | <b>Normalized</b> |
| <b>Mean</b>                                     | 66.44             | 67.49                                                                                                                                 | 40.61             |
| <b>Minimum</b>                                  | 57.29             | 60.87                                                                                                                                 | 31.19             |
| <b>Maximum</b>                                  | 72.61             | 73.01                                                                                                                                 | 50.34             |
| <b>UNC2 C.V.(%)</b>                             | 7.36              | 5.53                                                                                                                                  | 10.91             |
| <b>Strength (ksi)</b>                           |                   |                                                                                                                                       |                   |
| <b>No. Specimens</b>                            | 16                |                                                                                                                                       | 31                |
| <b>No. Prepreg Lots</b>                         | 3                 |                                                                                                                                       | 3                 |
| <b>Mean</b>                                     | 4.90              | 4.98                                                                                                                                  | 4.10              |
| <b>Minimum</b>                                  | 4.35              | 4.58                                                                                                                                  | 3.96              |
| <b>Maximum</b>                                  | 5.35              | 5.33                                                                                                                                  | 4.25              |
| <b>UNC2 C.V.(%)</b>                             | 6.10              | 4.84                                                                                                                                  | 2.21              |
| <b>Modulus (Msi)</b>                            |                   |                                                                                                                                       |                   |
| <b>No. Specimens</b>                            | 16                |                                                                                                                                       | 16                |
| <b>No. Prepreg Lots</b>                         | 3                 |                                                                                                                                       | 3                 |
| <b>Mean</b>                                     | 0.587             |                                                                                                                                       | 0.665             |
| <b>vUNC2 No. Specimens</b>                      | 16                |                                                                                                                                       | 16                |
| <b>No. Prepreg Lots</b>                         | 3                 |                                                                                                                                       | 3                 |

## 2.3.14 Unnotched Compression 3 Properties

|                        |                             |                               |                |                                                                                                                                                              |          |             |
|------------------------|-----------------------------|-------------------------------|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|-------------|
| Material:              |                             | HEXCEL 8552 - IM7 UNI PREPREG |                | <div>Unnotched Compression</div> <div>3</div> <div>Gr/ Ep</div> <div>HEXCEL 8552 - IM7 UNI</div> <div>PREPREG</div> <div>[45,0,90,0,-45,0,45,0,-45,0]S</div> |          |             |
| Resin content:         | 40.22 % vol                 |                               | Comp. density: |                                                                                                                                                              |          | 1.58 [g/cc] |
| Fiber volume:          | 59.78 % vol                 |                               |                |                                                                                                                                                              |          |             |
| Ply count              | 20                          |                               |                |                                                                                                                                                              |          |             |
| Test method:           | ASTM D6641-01 <sup>E1</sup> |                               |                |                                                                                                                                                              |          |             |
| Normalized by:         |                             | 0.0072 in CPT                 |                | Modulus calculation: linear fit from 1000 to 3000 micro in/in                                                                                                |          |             |
|                        |                             | RTD (A)                       |                | ETW                                                                                                                                                          |          |             |
| Test Temperature [°F]  |                             | 70F                           |                | 250F                                                                                                                                                         |          |             |
| Moisture Conditioning  |                             | dry                           |                | equilibrium                                                                                                                                                  |          |             |
| Equilibrium at T, RH   |                             |                               |                | 160 F,85%                                                                                                                                                    |          |             |
| Source code            |                             | HFYXXXXA                      |                | HFYXXXXD                                                                                                                                                     |          |             |
|                        |                             | Normalized                    | Measured       | Normalized                                                                                                                                                   | Measured |             |
| UNC3<br>Strength (ksi) | Mean                        | 120.84                        | 121.06         | 79.42                                                                                                                                                        | 78.79    |             |
|                        | Minimum                     | 108.20                        | 111.74         | 68.05                                                                                                                                                        | 67.56    |             |
|                        | Maximum                     | 136.09                        | 137.70         | 96.63                                                                                                                                                        | 94.50    |             |
|                        | C.V.(%)                     | 5.86                          | 5.53           | 10.31                                                                                                                                                        | 9.99     |             |
|                        | No. Specimens               | 16                            |                | 27                                                                                                                                                           |          |             |
|                        | No. Prepreg Lots            | 3                             |                | 3                                                                                                                                                            |          |             |
| UNC3<br>Modulus (Msi)  | Mean                        | 11.90                         | 11.93          | 11.77                                                                                                                                                        | 11.66    |             |
|                        | Minimum                     | 10.32                         | 11.20          | 11.24                                                                                                                                                        | 11.22    |             |
|                        | Maximum                     | 12.58                         | 12.74          | 12.22                                                                                                                                                        | 11.96    |             |
|                        | C.V.(%)                     | 4.35                          | 3.38           | 2.35                                                                                                                                                         | 2.09     |             |
|                        | No. Specimens               | 17                            |                | 15                                                                                                                                                           |          |             |
|                        | No. Prepreg Lots            | 3                             |                | 3                                                                                                                                                            |          |             |
| √UNC3                  | Mean                        | 0.423                         |                | 0.416                                                                                                                                                        |          |             |
|                        | No. Specimens               | 17                            |                | 15                                                                                                                                                           |          |             |
|                        | No. Prepreg Lots            | 3                             |                | 3                                                                                                                                                            |          |             |



### 2.3.15 Laminate Short Beam Strength Properties

|                                                 |                   |                                                                                                   |                   |
|-------------------------------------------------|-------------------|---------------------------------------------------------------------------------------------------|-------------------|
| <b>Material:</b> HEXCEL 8552 - IM7 UNI PREPREG  |                   | <b>Laminate Short Beam Strength</b><br>Gr/ Ep<br>HEXCEL 8552 - IM7 UNI PREPREG<br>[45,0,-45,90]3s |                   |
| <b>Resin content:</b>                           | 34.55 % vol       |                                                                                                   |                   |
| <b>Fiber volume:</b>                            | 65.45 % vol       |                                                                                                   |                   |
| <b>Ply count:</b>                               | 24                |                                                                                                   |                   |
| <b>Test method:</b> ASTM D2344-00 <sup>E1</sup> |                   |                                                                                                   |                   |
| <b>Normalized by:</b> NA                        |                   |                                                                                                   |                   |
|                                                 | <b>RTD (A)</b>    | <b>ETW (D)</b>                                                                                    |                   |
| <b>Test Temperature [°F]</b>                    | 70F               | 250F                                                                                              |                   |
| <b>Moisture Conditioning</b>                    | dry               | equilibrium                                                                                       |                   |
| <b>Equilibrium at T, RH</b>                     |                   | 160 F,85%                                                                                         |                   |
| <b>Source code</b>                              | HFqXXXA           | HFqXXXD                                                                                           |                   |
|                                                 | <b>Normalized</b> | <b>Measured</b>                                                                                   | <b>Normalized</b> |
|                                                 |                   |                                                                                                   | <b>Measured</b>   |
| <b>Mean</b>                                     | 12.13             | 6.99                                                                                              |                   |
| <b>Minimum</b>                                  | 9.55              | 6.63                                                                                              |                   |
| <b>Maximum</b>                                  | 12.98             | 7.70                                                                                              |                   |
| <b>LSBS</b>                                     | 6.85              | 3.65                                                                                              |                   |
| <b>C.V.(%)</b>                                  |                   |                                                                                                   |                   |
| <b>(ksi)</b>                                    |                   |                                                                                                   |                   |
| <b>No. Specimens</b>                            | 21                | 19                                                                                                |                   |
| <b>No. Prepreg Lots</b>                         | 3                 | 3                                                                                                 |                   |

physical testing only available from batch A cure 1

## 2.3.16 Open Hole Tension 1 Properties

|                                         |                  |                 |          |                                                                                   |          |             |          |
|-----------------------------------------|------------------|-----------------|----------|-----------------------------------------------------------------------------------|----------|-------------|----------|
| Material: HEXCEL 8552 - IM7 UNI PREPREG |                  |                 |          | Open Hole Tension 1<br>Gr/ Ep<br>HEXCEL 8552 - IM7 UNI PREPREG<br>[45,0,-45,90]2S |          |             |          |
| Resin content:                          |                  | 42.20 % vol     |          | Comp. density: 1.57 [g/cc]                                                        |          |             |          |
| Fiber volume:                           |                  | 57.80 % vol     |          |                                                                                   |          |             |          |
| Ply count:                              |                  | 16              |          |                                                                                   |          |             |          |
| Test method:                            |                  | ASTM D5766M-02a |          |                                                                                   |          |             |          |
| Normalized by:                          |                  | 0.0072 in CPT   |          |                                                                                   |          |             |          |
|                                         |                  | CTD (B)         |          | RTD (A)                                                                           |          | ETW (D)     |          |
| Test Temperature [°F]                   |                  | -65F            |          | 70F                                                                               |          | 250F        |          |
| Moisture Conditioning                   |                  | dry             |          | dry                                                                               |          | equilibrium |          |
| Equilibrium at T, RH                    |                  |                 |          |                                                                                   |          | 160 F,85%   |          |
| Source code                             |                  | HFIDXXXB        |          | HFIDXXXA                                                                          |          | HFIDXXXD    |          |
|                                         |                  | Normalized      | Measured | Normalized                                                                        | Measured | Normalized  | Measured |
| OHT1<br>Strength (ksi)                  | Mean             | 57.75           | 57.28    | 59.00                                                                             | 58.70    | 66.97       | 66.48    |
|                                         | Minimum          | 53.64           | 53.27    | 54.12                                                                             | 53.32    | 62.15       | 62.21    |
|                                         | Maximum          | 62.52           | 61.67    | 64.61                                                                             | 64.44    | 72.59       | 72.59    |
|                                         | C.V.(%)          | 4.21            | 3.95     | 3.98                                                                              | 4.07     | 4.26        | 4.29     |
|                                         |                  |                 |          |                                                                                   |          |             |          |
|                                         | No. Specimens    | 19              |          | 19                                                                                |          | 20          |          |
|                                         | No. Prepreg Lots | 3               |          | 3                                                                                 |          | 3           |          |

## 2.3.17 Open Hole Tension 2 Properties

|                                                |                   |                                                                                                                                          |                   |                 |                   |                                 |  |
|------------------------------------------------|-------------------|------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-----------------|-------------------|---------------------------------|--|
| <b>Material:</b> HEXCEL 8552 - IM7 UNI PREPREG |                   | <div>Open Hole Tension 2</div> <div>Gr/ Ep</div> <div>HEXCEL 8552 - IM7 UNI PREPREG</div> <div>[45,-45,0,45,-45,90,45,-45,45,-45]s</div> |                   |                 |                   |                                 |  |
| <b>Resin content:</b>                          | 40.64 % vol       |                                                                                                                                          |                   |                 |                   | <b>Comp. densit</b> 1.58 [g/cc] |  |
| <b>Fiber volume:</b>                           | 59.36 % vol       |                                                                                                                                          |                   |                 |                   |                                 |  |
| <b>Ply count</b>                               | 20                |                                                                                                                                          |                   |                 |                   |                                 |  |
| <b>Test method:</b>                            | ASTM D5766-02a    |                                                                                                                                          |                   |                 |                   |                                 |  |
| <b>Normalized by:</b>                          | 0.0072 in CPT     |                                                                                                                                          |                   |                 |                   |                                 |  |
|                                                |                   | <b>CTD (B)</b>                                                                                                                           |                   | <b>RTD (A)</b>  |                   | <b>ETW (D)</b>                  |  |
| <b>Test Temperature [°F]</b>                   | -65F              |                                                                                                                                          | 70F               |                 | 250F              |                                 |  |
| <b>Moisture Conditioning</b>                   | dry               |                                                                                                                                          | dry               |                 | equilibrium       |                                 |  |
| <b>Equilibrium at T, RH</b>                    |                   |                                                                                                                                          |                   |                 | 160 F,85%         |                                 |  |
| <b>Source code</b>                             | HFIEXXXB          |                                                                                                                                          | HFIEXXXA          |                 | HFIEXXXD          |                                 |  |
|                                                | <b>Normalized</b> | <b>Measured</b>                                                                                                                          | <b>Normalized</b> | <b>Measured</b> | <b>Normalized</b> | <b>Measured</b>                 |  |
| <b>Mean</b>                                    | 45.95             | 45.63                                                                                                                                    | 43.65             | 43.65           | 38.39             | 38.34                           |  |
| <b>Minimum</b>                                 | 44.04             | 43.88                                                                                                                                    | 39.91             | 41.05           | 36.27             | 36.18                           |  |
| <b>Maximum</b>                                 | 47.20             | 47.02                                                                                                                                    | 45.96             | 45.86           | 40.71             | 40.04                           |  |
| <b>OHT2 C.V.(%)</b>                            | 1.92              | 2.16                                                                                                                                     | 3.28              | 2.77            | 3.10              | 3.11                            |  |
| <b>Strength (ksi)</b>                          |                   |                                                                                                                                          |                   |                 |                   |                                 |  |
| <b>No. Specimens</b>                           | 19                |                                                                                                                                          | 19                |                 | 18                |                                 |  |
| <b>No. Prepreg Lots</b>                        | 3                 |                                                                                                                                          | 3                 |                 | 3                 |                                 |  |

### 2.3.18 Open Hole Tension 3 Properties

|                                                |                       |                                                                                                                             |                 |                   |                 |                   |                 |
|------------------------------------------------|-----------------------|-----------------------------------------------------------------------------------------------------------------------------|-----------------|-------------------|-----------------|-------------------|-----------------|
| <b>Material:</b> HEXCEL 8552 - IM7 UNI PREPREG |                       | <b>Open Hole Tension 3</b><br><b>Gr/ Ep</b><br><b>HEXCEL 8552 - IM7 UNI PREPREG</b><br><b>[0.45,0.90,0,-45.0,45.0,-45]S</b> |                 |                   |                 |                   |                 |
| <b>Resin content:</b>                          | 40.45                 | <b>Comp. density</b> 1.58 [g/cc]                                                                                            |                 |                   |                 |                   |                 |
| <b>Fiber volume:</b>                           | 59.55                 |                                                                                                                             |                 |                   |                 |                   |                 |
| <b>Ply count:</b>                              | 20                    |                                                                                                                             |                 |                   |                 |                   |                 |
| <b>Test method:</b> ASTM D5766-02a             |                       |                                                                                                                             |                 |                   |                 |                   |                 |
| <b>Normalized by:</b> 0.0072 in CPT            |                       |                                                                                                                             |                 |                   |                 |                   |                 |
|                                                |                       | <b>CTD (B)</b>                                                                                                              |                 | <b>RTD (A)</b>    |                 | <b>ETW (D)</b>    |                 |
| <b>Test Temperature [°F]</b>                   | -65F                  | 70F                                                                                                                         |                 | 250F              |                 |                   |                 |
| <b>Moisture Conditioning</b>                   | dry                   | dry                                                                                                                         |                 | equilibrium       |                 |                   |                 |
| <b>Equilibrium at T, RH</b>                    |                       | 160 F,85%                                                                                                                   |                 |                   |                 |                   |                 |
| <b>Source code</b>                             | HFIFXXXB              | HFIFXXXA                                                                                                                    |                 | HFIFXXXD          |                 |                   |                 |
|                                                |                       | <b>Normalized</b>                                                                                                           | <b>Measured</b> | <b>Normalized</b> | <b>Measured</b> | <b>Normalized</b> | <b>Measured</b> |
| <b>OHT3</b>                                    | <b>Mean</b>           | 78.75                                                                                                                       | 77.97           | 86.59             | 86.627          | 114.86            | 113.87          |
|                                                | <b>Minimum</b>        | 72.41                                                                                                                       | 70.75           | 78.90             | 79.07           | 105.04            | 102.24          |
|                                                | <b>Maximum</b>        | 84.29                                                                                                                       | 84.38           | 95.17             | 94.49           | 129.75            | 128.78          |
|                                                | <b>C.V.(%)</b>        | 5.03                                                                                                                        | 6.01            | 5.46              | 5.72            | 5.95              | 6.37            |
|                                                | <b>Strength (ksi)</b> |                                                                                                                             |                 |                   |                 |                   |                 |
| <b>No. Specimens</b>                           |                       | 19                                                                                                                          |                 | 19                |                 | 20                |                 |
| <b>No. Prepreg Lots</b>                        |                       | 3                                                                                                                           |                 | 3                 |                 | 3                 |                 |

## 2.3.19 Filled-Hole Tension 1 Properties

|                                         |                |                            |            |                                                                                            |             |          |
|-----------------------------------------|----------------|----------------------------|------------|--------------------------------------------------------------------------------------------|-------------|----------|
| Material: HEXCEL 8552 - IM7 UNI PREPREG |                |                            |            | <b>Filled-Hole Tension 1</b><br>Gr/ Ep<br>HEXCEL 8552 - IM7 UNI PREPREG<br>[45,0,-45,90]2S |             |          |
| Resin content:                          | 40.79 % vol    | Comp. density: 1.58 [g/cc] |            |                                                                                            |             |          |
| Fiber volume:                           | 59.21 % vol    |                            |            |                                                                                            |             |          |
| Ply count:                              | 16             |                            |            |                                                                                            |             |          |
| Test method:                            | ASTM D6742M-02 |                            |            |                                                                                            |             |          |
| Normalized by:                          | 0.0072 in CPT  |                            |            |                                                                                            |             |          |
|                                         | CTD (B)        |                            | RTD (A)    |                                                                                            | ETW(D)      |          |
| Test Temperature [°F]                   | -65F           |                            | 70F        |                                                                                            | 250F        |          |
| Moisture Conditioning                   | dry            |                            | dry        |                                                                                            | equilibrium |          |
| Equilibrium at T, RH                    |                |                            |            |                                                                                            | 160 F,85%   |          |
| Source code                             | HFXXXXB        |                            | HF4XXXXA   |                                                                                            | HF4XXXXD    |          |
|                                         | Normalized     | Measured                   | Normalized | Measured                                                                                   | Normalized  | Measured |
| Mean                                    | 64.02          | 63.52                      | 65.87      | 65.95                                                                                      | 70.29       | 69.52    |
| Minimum                                 | 58.00          | 57.30                      | 59.20      | 59.60                                                                                      | 65.17       | 64.29    |
| Maximum                                 | 69.40          | 68.01                      | 72.34      | 72.19                                                                                      | 74.40       | 74.58    |
| FHT1 C.V.(%)                            | 4.39           | 4.86                       | 4.95       | 5.41                                                                                       | 3.24        | 3.90     |
| Strength (ksi)                          |                |                            |            |                                                                                            |             |          |
| No. Specimens                           | 19             |                            | 19         |                                                                                            | 22          |          |
| No. Prepreg Lots                        | 3              |                            | 3          |                                                                                            | 3           |          |

## 2.3.20 Filled-Hole Tension 2 Properties

|                                                |                |                   |                 |                                                                                                                                          |                 |                   |                 |
|------------------------------------------------|----------------|-------------------|-----------------|------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-------------------|-----------------|
| <b>Material:</b> HEXCEL 8552 - IM7 UNI PREPREG |                |                   |                 | <b>Filled-Hole Tension 2</b><br><b>Gr/ Ep</b><br><b>HEXCEL- IM7 UNI PREPREG</b><br><b>[45,-45,0,45,-45,90,45,-45,45,-45]<sub>s</sub></b> |                 |                   |                 |
| <b>Resin content:</b> 39.04 % vol              |                |                   |                 |                                                                                                                                          |                 |                   |                 |
| <b>Fiber volume:</b> 60.96 % vol               |                |                   |                 |                                                                                                                                          |                 |                   |                 |
| <b>Ply count:</b> 20                           |                |                   |                 |                                                                                                                                          |                 |                   |                 |
| <b>Comp. density:</b> 1.59 [g/cc]              |                |                   |                 |                                                                                                                                          |                 |                   |                 |
| <b>Test method:</b> ASTM D6742M-02             |                |                   |                 |                                                                                                                                          |                 |                   |                 |
| <b>Normalized by:</b> 0.0072 in CPT            |                |                   |                 |                                                                                                                                          |                 |                   |                 |
|                                                |                | <b>CTD (B)</b>    |                 | <b>RTD (A)</b>                                                                                                                           |                 | <b>ETW (D)</b>    |                 |
| <b>Test Temperature [°F]</b>                   |                | -65F              |                 | 70F                                                                                                                                      |                 | 250F              |                 |
| <b>Moisture Conditioning</b>                   |                | dry               |                 | dry                                                                                                                                      |                 | equilibrium       |                 |
| <b>Equilibrium at T, RH</b>                    |                |                   |                 |                                                                                                                                          |                 | 160 F,85%         |                 |
| <b>Source code</b>                             |                | HF5XXXXB          |                 | HF5XXXXA                                                                                                                                 |                 | HF5XXXXD          |                 |
|                                                |                | <b>Normalized</b> | <b>Measured</b> | <b>Normalized</b>                                                                                                                        | <b>Measured</b> | <b>Normalized</b> | <b>Measured</b> |
| <b>Mean</b>                                    |                | 52.25             | 52.05           | 48.15                                                                                                                                    | 48.08           | 42.63             | 42.30           |
| <b>Minimum</b>                                 |                | 48.54             | 50.23           | 44.59                                                                                                                                    | 44.67           | 41.22             | 40.75           |
| <b>Maximum</b>                                 |                | 54.64             | 54.73           | 50.79                                                                                                                                    | 50.24           | 43.75             | 43.54           |
| <b>FHT2</b>                                    | <b>C.V.(%)</b> | 3.00              | 2.53            | 4.03                                                                                                                                     | 3.34            | 1.73              | 1.97            |
| <b>Strength (ksi)</b>                          |                |                   |                 |                                                                                                                                          |                 |                   |                 |
| <b>No. Specimens</b>                           |                | 19                |                 | 19                                                                                                                                       |                 | 19                |                 |
| <b>No. Prepreg Lots</b>                        |                | 3                 |                 | 3                                                                                                                                        |                 | 3                 |                 |

Note: The physical testing data is missing averages from Batch B cure cycle 1.

## 2.3.21 Filled-Hole Tension 3 Properties

|                                                |                |                                   |                 |                                                                                                                           |                 |                   |                 |                |  |
|------------------------------------------------|----------------|-----------------------------------|-----------------|---------------------------------------------------------------------------------------------------------------------------|-----------------|-------------------|-----------------|----------------|--|
| <b>Material:</b> HEXCEL 8552 - IM7 UNI PREPREG |                |                                   |                 | <div><b>Filled-Hole Tension 3</b><br/>Gr/ Ep<br/>HEXCEL 8552 - IM7 UNI<br/>PREPREG<br/>[0,45,0,90,0,-45,0,45,0-45]s</div> |                 |                   |                 |                |  |
| <b>Resin content:</b> 40.33 % vol              |                | <b>Comp. density:</b> 1.58 [g/cc] |                 |                                                                                                                           |                 |                   |                 |                |  |
| <b>Fiber volume:</b> 59.67 % vol               |                |                                   |                 |                                                                                                                           |                 |                   |                 |                |  |
| <b>Ply count:</b> 20                           |                |                                   |                 |                                                                                                                           |                 |                   |                 |                |  |
| <b>Test method:</b> ASTM D6742M-02             |                |                                   |                 |                                                                                                                           |                 |                   |                 |                |  |
| <b>Normalized by:</b> 0.0072 in CPT            |                |                                   |                 |                                                                                                                           |                 |                   |                 |                |  |
|                                                |                |                                   |                 | <b>CTD (B)</b>                                                                                                            |                 | <b>RTD (A)</b>    |                 | <b>ETW (D)</b> |  |
| <b>Test Temperature [°F]</b>                   |                | -65F                              |                 | 70F                                                                                                                       |                 | 250F              |                 |                |  |
| <b>Moisture Conditioning</b>                   |                | dry                               |                 | dry                                                                                                                       |                 | equilibrium       |                 |                |  |
| <b>Equilibrium at T, RH</b>                    |                |                                   |                 |                                                                                                                           |                 | 160 F,85%         |                 |                |  |
| <b>Source code</b>                             |                | HF16XXXXB                         |                 | HF16XXXXA                                                                                                                 |                 | HF16XXXXD         |                 |                |  |
|                                                |                | <b>Normalized</b>                 | <b>Measured</b> | <b>Normalized</b>                                                                                                         | <b>Measured</b> | <b>Normalized</b> | <b>Measured</b> |                |  |
| <b>Mean</b>                                    |                | 80.70                             | 80.53           | 91.95                                                                                                                     | 91.93           | 101.26            | 100.77          |                |  |
| <b>Minimum</b>                                 |                | 70.25                             | 71.22           | 79.15                                                                                                                     | 77.08           | 93.92             | 92.01           |                |  |
| <b>Maximum</b>                                 |                | 88.15                             | 88.23           | 102.16                                                                                                                    | 102.61          | 108.11            | 107.29          |                |  |
| <b>FHT3</b>                                    | <b>C.V.(%)</b> | 5.69                              | 6.13            | 7.20                                                                                                                      | 7.91            | 3.90              | 3.82            |                |  |
| <b>Strength (ksi)</b>                          |                |                                   |                 |                                                                                                                           |                 |                   |                 |                |  |
| <b>No. Specimens</b>                           |                | 19                                |                 | 19                                                                                                                        |                 | 19                |                 |                |  |
| <b>No. Prepreg Lots</b>                        |                | 3                                 |                 | 3                                                                                                                         |                 | 3                 |                 |                |  |

## 2.3.22 Open Hole Compression 1 Properties

|                                                |                         |                                   |                 |                                                                                                                                 |                 |  |  |
|------------------------------------------------|-------------------------|-----------------------------------|-----------------|---------------------------------------------------------------------------------------------------------------------------------|-----------------|--|--|
| <b>Material:</b> HEXCEL 8552 - IM7 UNI PREPREG |                         |                                   |                 | <div><b>Open Hole Compression 1</b><br/><b>Gr/ Ep</b><br/><b>HEXCEL 8552 - IM7 UNI PREPREG</b><br/><b>[45,0,-45,90]3S</b></div> |                 |  |  |
| <b>Resin content:</b> 41.74 % vol              |                         | <b>Comp. density:</b> 1.58 [g/cc] |                 |                                                                                                                                 |                 |  |  |
| <b>Fiber volume:</b> 58.26% vol                |                         |                                   |                 |                                                                                                                                 |                 |  |  |
| <b>Ply count:</b> 24                           |                         |                                   |                 |                                                                                                                                 |                 |  |  |
| <b>Test method:</b> ASTM D6484M-04             |                         |                                   |                 |                                                                                                                                 |                 |  |  |
| <b>Normalized by:</b> 0.0072 in CPT            |                         |                                   |                 |                                                                                                                                 |                 |  |  |
|                                                |                         | <b>RTD (A)</b>                    |                 | <b>ETW (D)</b>                                                                                                                  |                 |  |  |
| <b>Test Temperature [°F]</b>                   |                         | 70F                               |                 | 250F                                                                                                                            |                 |  |  |
| <b>Moisture Conditioning</b>                   |                         | dry                               |                 | equilibrium                                                                                                                     |                 |  |  |
| <b>Equilibrium at T, RH</b>                    |                         |                                   |                 | 160 F,85%                                                                                                                       |                 |  |  |
| <b>Source code</b>                             |                         | HFIGXXXXA                         |                 | HFIGXXXXD                                                                                                                       |                 |  |  |
|                                                |                         | <b>Normalized</b>                 | <b>Measured</b> | <b>Normalized</b>                                                                                                               | <b>Measured</b> |  |  |
| <b>OHC1</b><br><b>Strength (ksi)</b>           | <b>Mean</b>             | 49.08                             | 48.89           | 35.52                                                                                                                           | 35.29           |  |  |
|                                                | <b>Minimum</b>          | 43.91                             | 45.15           | 33.08                                                                                                                           | 33.59           |  |  |
|                                                | <b>Maximum</b>          | 50.99                             | 51.28           | 38.96                                                                                                                           | 37.50           |  |  |
|                                                | <b>C.V.(%)</b>          | 3.65                              | 2.96            | 4.07                                                                                                                            | 3.25            |  |  |
|                                                |                         |                                   |                 |                                                                                                                                 |                 |  |  |
|                                                | <b>No. Specimens</b>    | 19                                |                 | 19                                                                                                                              |                 |  |  |
|                                                | <b>No. Prepreg Lots</b> | 3                                 |                 | 3                                                                                                                               |                 |  |  |



### 2.3.23 Open Hole Compression 2 Properties

|                                                |                         |                                   |                 |                                                                                                                  |                 |                   |                 |
|------------------------------------------------|-------------------------|-----------------------------------|-----------------|------------------------------------------------------------------------------------------------------------------|-----------------|-------------------|-----------------|
| <b>Material:</b> HEXCEL 8552 - IM7 UNI PREPREG |                         |                                   |                 | <b>Open Hole Compression 2</b><br>Gr/ Ep<br>HEXCEL 8552 - IM7 UNI PREPREG<br>[45,-45,0,45,-45,90,45,-45,45,-45]S |                 |                   |                 |
| <b>Resin content:</b> 41.14 % vol              |                         | <b>Comp. density:</b> 1.58 [g/cc] |                 |                                                                                                                  |                 |                   |                 |
| <b>Fiber volume:</b> 58.86 % vol               |                         |                                   |                 |                                                                                                                  |                 |                   |                 |
| <b>Ply count:</b> 20                           |                         |                                   |                 |                                                                                                                  |                 |                   |                 |
| <b>Test method:</b> ASTM D6484M-04             |                         |                                   |                 |                                                                                                                  |                 |                   |                 |
| <b>Normalized by:</b> 0.0072 in CPT            |                         |                                   |                 |                                                                                                                  |                 |                   |                 |
|                                                |                         | <b>RTD (A)</b>                    |                 | <b>ETW (D)</b>                                                                                                   |                 |                   |                 |
| <b>Test Temperature [°F]</b>                   |                         | 70F                               |                 | 250F                                                                                                             |                 |                   |                 |
| <b>Moisture Conditioning</b>                   |                         | dry                               |                 | equilibrium                                                                                                      |                 |                   |                 |
| <b>Equilibrium at T, RH</b>                    |                         |                                   |                 | 160 F,85%                                                                                                        |                 |                   |                 |
| <b>Source code</b>                             |                         | HFIHXXXXA                         |                 | HFIHXXXXD                                                                                                        |                 |                   |                 |
|                                                |                         | <b>Normalized</b>                 | <b>Measured</b> | <b>Normalized</b>                                                                                                | <b>Measured</b> | <b>Normalized</b> | <b>Measured</b> |
| <b>OHC2</b><br><br><b>Strength (ksi)</b>       | <b>Mean</b>             | 38.80                             | 38.40           | 25.76                                                                                                            | 25.57           |                   |                 |
|                                                | <b>Minimum</b>          | 36.25                             | 35.93           | 22.36                                                                                                            | 22.24           |                   |                 |
|                                                | <b>Maximum</b>          | 41.33                             | 40.85           | 27.57                                                                                                            | 27.56           |                   |                 |
|                                                | <b>C.V.(%)</b>          | 3.29                              | 3.41            | 5.02                                                                                                             | 4.40            |                   |                 |
|                                                | <b>No. Specimens</b>    | 18                                |                 | 20                                                                                                               |                 |                   |                 |
|                                                | <b>No. Prepreg Lots</b> | 3                                 |                 | 3                                                                                                                |                 |                   |                 |

### 2.3.24 Open Hole Compression 3 Properties

|                                                |                   |                                                                                                                                 |                   |
|------------------------------------------------|-------------------|---------------------------------------------------------------------------------------------------------------------------------|-------------------|
| <b>Material:</b> HEXCEL 8552 - IM7 UNI PREPREG |                   | <b>Open Hole Compression 3</b><br><b>Gr/ Ep</b><br><b>HEXCEL 8552 - IM7 UNI PREPREG</b><br><b>[0,45,0,90,0,-45,0,45,0,-45]S</b> |                   |
| <b>Resin content:</b>                          | 39.62 % vol       |                                                                                                                                 |                   |
| <b>Fiber volume:</b>                           | 60.38 % vol       |                                                                                                                                 |                   |
| <b>Ply count:</b>                              | 20                |                                                                                                                                 |                   |
| <b>Test method:</b>                            | ASTM D6484M-04    | <b>Comp. density:</b> 1.58 [g/cc]                                                                                               |                   |
| <b>Normalized by:</b>                          | 0.0072 in CPT     |                                                                                                                                 |                   |
|                                                | <b>RTD (A)</b>    | <b>ETW (D)</b>                                                                                                                  |                   |
| <b>Test Temperature [°F]</b>                   | 70F               | 250F                                                                                                                            |                   |
| <b>Moisture Conditioning</b>                   | dry               | equilibrium                                                                                                                     |                   |
| <b>Equilibrium at T, RH</b>                    |                   | 160 F,85%                                                                                                                       |                   |
| <b>Source code</b>                             | HFIIXXXA          | HFIIXXXD                                                                                                                        |                   |
|                                                | <b>Normalized</b> | <b>Measured</b>                                                                                                                 | <b>Normalized</b> |
| <b>Mean</b>                                    | 63.24             | 63.36                                                                                                                           | 46.42             |
| <b>Minimum</b>                                 | 56.63             | 59.06                                                                                                                           | 42.01             |
| <b>Maximum</b>                                 | 69.28             | 69.24                                                                                                                           | 50.50             |
| <b>OHC3 C.V.(%)</b>                            | 4.54              | 4.28                                                                                                                            | 4.55              |
| <b>Strength (ksi)</b>                          |                   |                                                                                                                                 |                   |
| <b>No. Specimens</b>                           | 19                |                                                                                                                                 | 20                |
| <b>No. Prepreg Lots</b>                        | 3                 |                                                                                                                                 | 3                 |

## 2.3.25 Filled-Hole Compression 1 Properties

|                                                |                         |                                   |                 |                                                                                                                 |                 |                   |                 |
|------------------------------------------------|-------------------------|-----------------------------------|-----------------|-----------------------------------------------------------------------------------------------------------------|-----------------|-------------------|-----------------|
| <b>Material:</b> HEXCEL 8552 - IM7 UNI PREPREG |                         |                                   |                 | <b>Filled-Hole Compression 1</b><br>Gr/ Ep<br><b>HEXCEL 8552 - IM7 UNI</b><br><b>PREPREG</b><br>[45,0,-45,90]3S |                 |                   |                 |
| <b>Resin content:</b> 41.85 % vol              |                         | <b>Comp. density:</b> 1.58 [g/cc] |                 |                                                                                                                 |                 |                   |                 |
| <b>Fiber volume:</b> 58.15 % vol               |                         |                                   |                 |                                                                                                                 |                 |                   |                 |
| <b>Ply count:</b> 24                           |                         |                                   |                 |                                                                                                                 |                 |                   |                 |
| <b>Test method:</b> ASTM D6742M-02             |                         |                                   |                 |                                                                                                                 |                 |                   |                 |
| <b>Normalized by:</b> 0.0072 in CPT            |                         |                                   |                 |                                                                                                                 |                 |                   |                 |
|                                                |                         |                                   |                 | <b>RTD (A)</b>                                                                                                  |                 | <b>ETW (D)</b>    |                 |
| <b>Test Temperature [°F]</b>                   |                         | 70F                               |                 | 250F                                                                                                            |                 |                   |                 |
| <b>Moisture Conditioning</b>                   |                         | dry                               |                 | equilibrium                                                                                                     |                 |                   |                 |
| <b>Equilibrium at T, RH</b>                    |                         |                                   |                 | 160 F,85%                                                                                                       |                 |                   |                 |
| <b>Source code</b>                             |                         | HF17XXXXA                         |                 | HF17XXXXD                                                                                                       |                 |                   |                 |
|                                                |                         | <b>Normalized</b>                 | <b>Measured</b> | <b>Normalized</b>                                                                                               | <b>Measured</b> | <b>Normalized</b> | <b>Measured</b> |
| <b>FHC1</b><br><b>Strength (ksi)</b>           | <b>Mean</b>             | 69.19                             | 69.30           | 51.68                                                                                                           | 51.61           |                   |                 |
|                                                | <b>Minimum</b>          | 62.34                             | 62.44           | 47.70                                                                                                           | 47.93           |                   |                 |
|                                                | <b>Maximum</b>          | 76.17                             | 76.20           | 55.60                                                                                                           | 54.57           |                   |                 |
|                                                | <b>C.V.(%)</b>          | 5.34                              | 5.56            | 4.41                                                                                                            | 3.85            |                   |                 |
|                                                | <b>No. Specimens</b>    | 20                                |                 | 19                                                                                                              |                 |                   |                 |
|                                                | <b>No. Prepreg Lots</b> | 3                                 |                 | 3                                                                                                               |                 |                   |                 |

## 2.3.26 Filled-Hole Compression 2 Properties

|                                         |                |                            |            |                                                                                                                                |            |          |
|-----------------------------------------|----------------|----------------------------|------------|--------------------------------------------------------------------------------------------------------------------------------|------------|----------|
| Material: HEXCEL 8552 - IM7 UNI PREPREG |                |                            |            | <b>Filled-Hole Compression 2</b><br>Gr/ Ep<br>HEXCEL 8552 - IM7 UNI PREPREG<br>[45,-45,0,45,-45,90,45,-45,45,-45] <sub>s</sub> |            |          |
| Resin content:                          | 41.09 % vol    | Comp. density: 1.58 [g/cc] |            |                                                                                                                                |            |          |
| Fiber volume:                           | 58.91 % vol    |                            |            |                                                                                                                                |            |          |
| Ply count:                              | 20             |                            |            |                                                                                                                                |            |          |
| Test method:                            | ASTM D6742M-02 |                            |            |                                                                                                                                |            |          |
| Normalized by:                          | 0.0072 in CPT  |                            |            |                                                                                                                                |            |          |
|                                         | RTD (A)        | ETW (D)                    |            |                                                                                                                                |            |          |
| Test Temperature [°F]                   | 70F            | 250F                       |            |                                                                                                                                |            |          |
| Moisture Conditioning                   | dry            | equilibrium                |            |                                                                                                                                |            |          |
| Equilibrium at T, RH                    |                | 160 F,85%                  |            |                                                                                                                                |            |          |
| Source code                             | HF18XXXXA      | HF1XXXXD                   |            |                                                                                                                                |            |          |
|                                         | Normalized     | Measured                   | Normalized | Measured                                                                                                                       | Normalized | Measured |
| Mean                                    | 54.57          | 54.25                      | 41.17      | 40.86                                                                                                                          |            |          |
| Minimum                                 | 50.41          | 50.57                      | 37.36      | 37.86                                                                                                                          |            |          |
| Maximum                                 | 57.71          | 57.54                      | 43.99      | 43.20                                                                                                                          |            |          |
| FHC2 C.V.(%)                            | 4.13           | 3.17                       | 4.39       | 3.66                                                                                                                           |            |          |
| Strength (ksi)                          |                |                            |            |                                                                                                                                |            |          |
| No. Specimens                           | 19             |                            | 19         |                                                                                                                                |            |          |
| No. Prepreg Lots                        | 3              |                            | 3          |                                                                                                                                |            |          |

## 2.3.27 Filled-Hole Compression 3 Properties

|                                         |  |                |          |                                                                                                       |          |             |          |
|-----------------------------------------|--|----------------|----------|-------------------------------------------------------------------------------------------------------|----------|-------------|----------|
| Material: HEXCEL 8552 - IM7 UNI PREPREG |  |                |          | Filled-Hole Compression 3<br>Gr/ Ep<br>HEXCEL 8552 - IM7 UNI PREPREG<br>[0,45,0,90,0,-45,0,45,0,-45]s |          |             |          |
| Resin content:                          |  | 41.63 % vol    |          | Comp. density:                                                                                        |          | 1.58 [g/cc] |          |
| Fiber volume:                           |  | 58.37 % vol    |          |                                                                                                       |          |             |          |
| Ply count                               |  | 20             |          |                                                                                                       |          |             |          |
| Test method:                            |  | ASTM D6742M-02 |          |                                                                                                       |          |             |          |
| Normalized by:                          |  | 0.0072 in CPT  |          |                                                                                                       |          |             |          |
|                                         |  | RTD (A)        |          | ETW (D)                                                                                               |          |             |          |
| Test Temperature [°F]                   |  | 70F            |          | 250F                                                                                                  |          |             |          |
| Moisture Conditioning                   |  | dry            |          | equilibrium                                                                                           |          |             |          |
| Equilibrium at T, RH                    |  |                |          | 160 F,85%                                                                                             |          |             |          |
| Source code                             |  | HF9XXXXA       |          | HF9XXXXD                                                                                              |          |             |          |
|                                         |  | Normalized     | Measured | Normalized                                                                                            | Measured | Normalized  | Measured |
| Mean                                    |  | 98.57          | 98.16    | 72.79                                                                                                 | 72.20    |             |          |
| Minimum                                 |  | 89.45          | 87.81    | 69.47                                                                                                 | 68.99    |             |          |
| Maximum                                 |  | 106.54         | 104.25   | 78.09                                                                                                 | 77.22    |             |          |
| FHC3 C.V.(%)                            |  | 4.61           | 4.25     | 3.03                                                                                                  | 3.14     |             |          |
| Strength (ksi)                          |  |                |          |                                                                                                       |          |             |          |
| No. Specimens                           |  | 18             |          | 19                                                                                                    |          |             |          |
| No. Prepreg Lots                        |  | 3              |          | 3                                                                                                     |          |             |          |

## 2.3.28 Single Shear Bearing 1 Properties

|                                                |                                 |                                                                                                |                 |                   |                 |
|------------------------------------------------|---------------------------------|------------------------------------------------------------------------------------------------|-----------------|-------------------|-----------------|
| <b>Material:</b> HEXCEL 8552 - IM7 UNI PREPREG |                                 | <div>Laminate Bearing 1<br/>Gr/ Ep<br/>HEXCEL 8552 - IM7 UNI PREPREG<br/>[45,0,-45,90]2S</div> |                 |                   |                 |
| <b>Resin content:</b>                          | 40.38 % vol                     | <b>Comp. density:</b>                                                                          |                 | 1.58 [g/cc]       |                 |
| <b>Fiber volume:</b>                           | 59.62 % vol                     |                                                                                                |                 |                   |                 |
| <b>Ply count:</b>                              | 16                              |                                                                                                |                 |                   |                 |
| <b>Test method:</b>                            | ASTM D5961M-05 <sup>a1</sup>    |                                                                                                |                 |                   |                 |
| <b>Normalized by:</b>                          | 0.0072 in CPT                   |                                                                                                |                 |                   |                 |
|                                                |                                 | <b>RTD (A)</b>                                                                                 |                 | <b>ETW (D)</b>    |                 |
| <b>Test Temperature [°F]</b>                   | 70F                             |                                                                                                | 250F            |                   |                 |
| <b>Moisture Conditioning</b>                   | dry                             |                                                                                                | equilibrium     |                   |                 |
| <b>Equilibrium at T, RH</b>                    |                                 |                                                                                                | 160 F,85%       |                   |                 |
| <b>Source code</b>                             | HF1XXXXA                        |                                                                                                | HF1XXXXD        |                   |                 |
|                                                |                                 | <b>Normalized</b>                                                                              | <b>Measured</b> | <b>Normalized</b> | <b>Measured</b> |
| <b>SSB1</b>                                    | <b>Mean</b>                     | 109.89                                                                                         | 112.98          | 88.14             | 89.88           |
|                                                | <b>Minimum</b>                  | 99.31                                                                                          | 106.30          | 69.19             | 68.62           |
|                                                | <b>Maximum</b>                  | 119.86                                                                                         | 118.98          | 101.13            | 99.81           |
|                                                | <b>C.V.(%)</b>                  | 5.51                                                                                           | 3.56            | 10.10             | 9.49            |
|                                                | <b>2% offset Strength (ksi)</b> |                                                                                                |                 |                   |                 |
|                                                | <b>No. Specimens</b>            | 19                                                                                             |                 | 21                |                 |
|                                                | <b>No. Prepreg Lots</b>         | 3                                                                                              |                 | 3                 |                 |

Ultimate Strength not obtained

## 2.3.29 Single Shear Bearing 2 Properties

|                                         |                              |                |                                                                                                                                         |          |  |             |
|-----------------------------------------|------------------------------|----------------|-----------------------------------------------------------------------------------------------------------------------------------------|----------|--|-------------|
| Material: HEXCEL 8552 - IM7 UNI PREPREG |                              |                | <div>Laminate Bearing 2</div> <div>Gr/ Ep</div> <div>HEXCEL 8552 - IM7 UNI PREPREG</div> <div>[45,-45,0,45,-45,90,45,-45,45,-45]S</div> |          |  |             |
| Resin content:                          | 40.40 % vol                  | Comp. density: |                                                                                                                                         |          |  | 1.58 [g/cc] |
| Fiber volume:                           | 59.60 % vol                  |                |                                                                                                                                         |          |  |             |
| Ply count:                              | 20                           |                |                                                                                                                                         |          |  |             |
| Test method:                            | ASTM D5961M-05 <sup>e1</sup> |                |                                                                                                                                         |          |  |             |
| Normalized by:                          | 0.0072 in CPT                |                |                                                                                                                                         |          |  |             |
|                                         |                              |                | RTD (A)                                                                                                                                 | ETW (D)  |  |             |
| Test Temperature [ °F]                  | 70F                          |                | 250F                                                                                                                                    |          |  |             |
| Moisture Conditioning                   | dry                          |                | equilibrium                                                                                                                             |          |  |             |
| Equilibrium at T, RH                    |                              |                | 160 F,85%                                                                                                                               |          |  |             |
| Source code                             | HF12XXXXA                    |                | HF12XXXXD                                                                                                                               |          |  |             |
|                                         | Normalized                   | Measured       | Normalized                                                                                                                              | Measured |  |             |
| Mean                                    | 114.02                       | 114.20         | 86.22                                                                                                                                   | 86.87    |  |             |
| Minimum                                 | 100.30                       | 104.42         | 78.40                                                                                                                                   | 77.48    |  |             |
| Maximum                                 | 121.80                       | 122.56         | 94.73                                                                                                                                   | 97.23    |  |             |
| SSB2 C.V.(%)                            | 4.88                         | 3.86           | 6.52                                                                                                                                    | 6.21     |  |             |
| 2% offset Strength                      |                              |                |                                                                                                                                         |          |  |             |
| (ksi)                                   | No. Specimens                | 19             |                                                                                                                                         | 19       |  |             |
|                                         | No. Prepreg Lots             | 3              |                                                                                                                                         | 3        |  |             |

Physical testing not available for Batch A Cure Cycle 1

Ultimate Strength not obtained

## 2.3.30 Single Shear Bearing 3 Properties

|                                         |                              |                |             |                                                                                                                  |        |
|-----------------------------------------|------------------------------|----------------|-------------|------------------------------------------------------------------------------------------------------------------|--------|
| Material: HEXCEL 8552 - IM7 UNI PREPREG |                              |                |             | <div>Laminate Bearing 3<br/>Gr/ Ep<br/>HEXCEL 8552 - IM7 UNI<br/>PREPREG<br/>[0,45,0,90,0,-45,0,45,0,-45]S</div> |        |
| Resin content:                          | 40.65 % vol                  | Comp. density: |             | 1.58 [g/cc]                                                                                                      |        |
| Fiber volume:                           | 59.35 % vol                  |                |             |                                                                                                                  |        |
| Ply thickness:                          | 0.0067 - 0.0075              |                |             |                                                                                                                  |        |
| Ply count:                              | 20                           |                |             |                                                                                                                  |        |
| Test method:                            | ASTM D5961M-05 <sup>e1</sup> |                |             |                                                                                                                  |        |
| Normalized by:                          | 0.0072                       |                |             |                                                                                                                  |        |
|                                         |                              | RTD (A)        |             | ETW (D)                                                                                                          |        |
| Test Temperature [°F]                   | 70F                          |                | 250F        |                                                                                                                  |        |
| Moisture Conditioning                   | dry                          |                | equilibrium |                                                                                                                  |        |
| Equilibrium at T, RH                    |                              |                | 160 F,85%   |                                                                                                                  |        |
| Source code                             | HF13XXXXA                    |                | HF13XXXXD   |                                                                                                                  |        |
|                                         | Normalized                   | Measured       | Normalized  | Measured                                                                                                         |        |
| SSB3                                    | Mean                         | 113.90         | 113.93      | 91.67                                                                                                            | 91.80  |
|                                         | Minimum                      | 104.32         | 104.57      | 79.33                                                                                                            | 81.00  |
|                                         | Maximum                      | 121.80         | 122.04      | 102.78                                                                                                           | 101.30 |
|                                         | C.V.(%)                      | 5.01           | 3.79        | 7.15                                                                                                             | 6.83   |
|                                         | 2% offset Strength           |                |             |                                                                                                                  |        |
| (ksi)                                   | No. Specimens                | 19             |             | 19                                                                                                               |        |
|                                         | No. Prepreg Lots             | 3              |             | 3                                                                                                                |        |

Ultimate Strength not obtained



### 2.3.31 Compression after Impact Properties

|                                                |                         |                                                                                                                           |                 |                   |                 |                       |                 |
|------------------------------------------------|-------------------------|---------------------------------------------------------------------------------------------------------------------------|-----------------|-------------------|-----------------|-----------------------|-----------------|
| <b>Material:</b> HEXCEL 8552 - IM7 UNI PREPREG |                         | <div>Compression After Impact</div> <div>Gr/ Ep</div> <div>HEXCEL 8552 - IM7 UNI PREPREG</div> <div>[45.0,-45.90]3s</div> |                 |                   |                 |                       |                 |
| <b>Resin content:</b>                          | 41.6 % vol              |                                                                                                                           |                 |                   |                 | <b>Comp. density:</b> | 1.58 [g/cc]     |
| <b>Fiber volume:</b>                           | 58.40 % vol             |                                                                                                                           |                 |                   |                 |                       |                 |
| <b>Ply count:</b>                              | 24                      |                                                                                                                           |                 |                   |                 |                       |                 |
| <b>Test method:</b> SACMA SRM 2R-94            |                         |                                                                                                                           |                 |                   |                 |                       |                 |
| <b>Normalized by:</b> 0.0072 in CPT            |                         |                                                                                                                           |                 |                   |                 |                       |                 |
| RTD (A)                                        |                         |                                                                                                                           |                 |                   |                 |                       |                 |
| <b>Test Temperature [ °F]</b>                  |                         | 70F                                                                                                                       |                 |                   |                 |                       |                 |
| <b>Moisture Conditioning</b>                   |                         | dry                                                                                                                       |                 |                   |                 |                       |                 |
| <b>Equilibrium at T, RH</b>                    |                         |                                                                                                                           |                 |                   |                 |                       |                 |
| <b>Source code</b>                             |                         | HF1KXXXXA                                                                                                                 |                 |                   |                 |                       |                 |
|                                                |                         | <b>Normalized</b>                                                                                                         | <b>Measured</b> | <b>Normalized</b> | <b>Measured</b> | <b>Normalized</b>     | <b>Measured</b> |
| <b>CAI</b>                                     | <b>Mean</b>             | 31.45                                                                                                                     | 30.96           |                   |                 |                       |                 |
|                                                | <b>Minimum</b>          | 30.17                                                                                                                     | 29.53           |                   |                 |                       |                 |
|                                                | <b>Maximum</b>          | 33.80                                                                                                                     | 33.43           |                   |                 |                       |                 |
|                                                | <b>C.V.(%)</b>          | 4.16                                                                                                                      | 4.65            |                   |                 |                       |                 |
|                                                | <b>Strength (ksi)</b>   |                                                                                                                           |                 |                   |                 |                       |                 |
|                                                | <b>No. Specimens</b>    | 7                                                                                                                         |                 |                   |                 |                       |                 |
|                                                | <b>No. Prepreg Lots</b> | 1                                                                                                                         |                 |                   |                 |                       |                 |

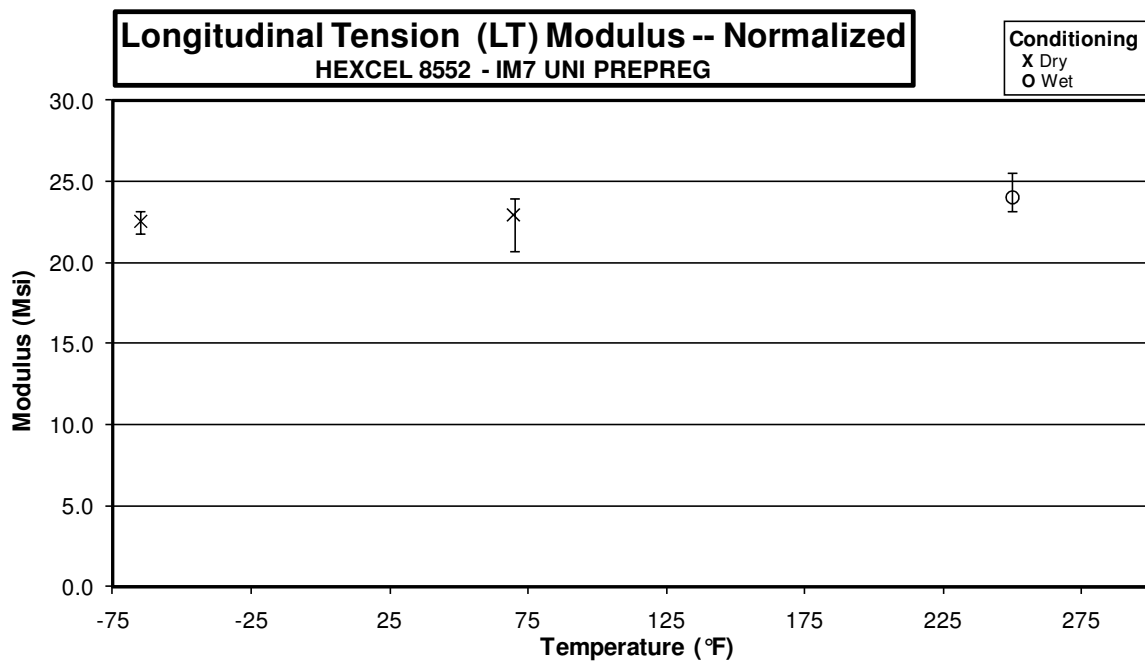
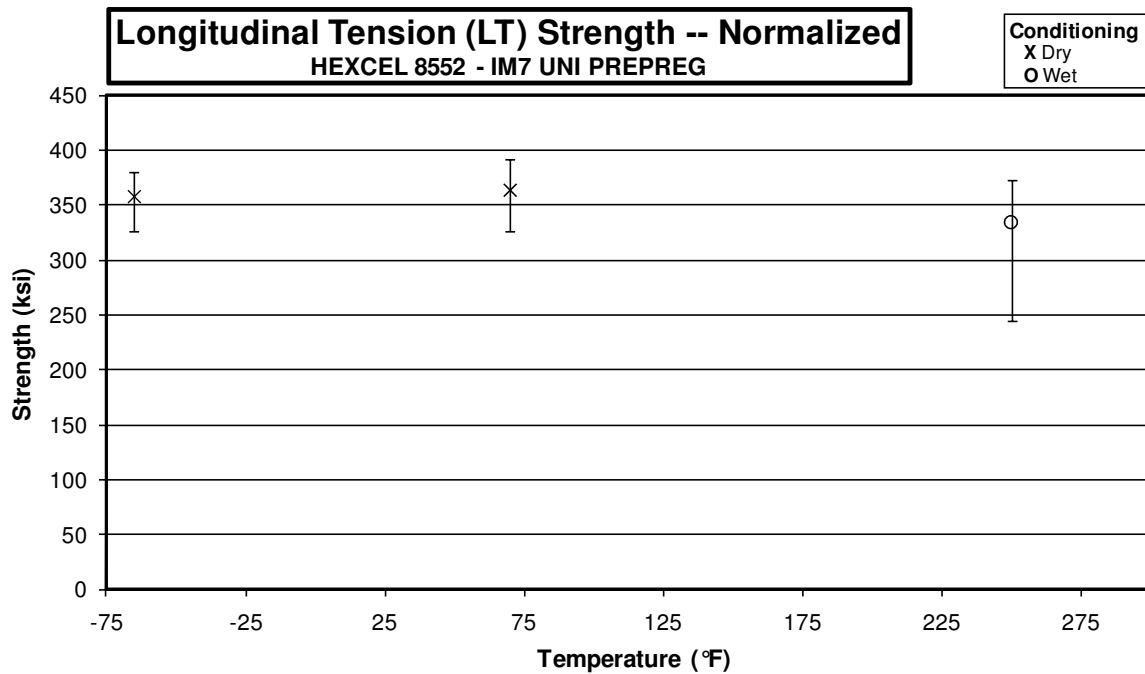
## 2.3.32 Interlaminar Tension Properties

|                                                |                             |                                                                                                                     |                   |                                   |                   |                 |
|------------------------------------------------|-----------------------------|---------------------------------------------------------------------------------------------------------------------|-------------------|-----------------------------------|-------------------|-----------------|
| <b>Material:</b> HEXCEL 8552 - IM7 UNI PREPREG |                             | <div><div>Interlaminar Tension</div><div>Gr/ Ep</div><div>HEXCEL 8552 - IM7 UNI PREPREG</div><div>[0]22</div></div> |                   |                                   |                   |                 |
| <b>Resin content:</b>                          | 42.83 % wt                  |                                                                                                                     |                   | <b>Comp. density:</b> 1.57 [g/cc] |                   |                 |
| <b>Fiber volume:</b>                           | 57.17 % vol                 |                                                                                                                     |                   |                                   |                   |                 |
| <b>Ply count:</b>                              | 22                          |                                                                                                                     |                   |                                   |                   |                 |
| <b>Test method:</b>                            | ASTM D6415-99E <sup>1</sup> |                                                                                                                     |                   |                                   |                   |                 |
| <b>Normalized by:</b>                          | NA                          |                                                                                                                     |                   |                                   |                   |                 |
|                                                | <b>CTD (B)</b>              |                                                                                                                     | <b>RTD (A)</b>    |                                   | <b>ETW (D)</b>    |                 |
| <b>Test Temperature [ °F]</b>                  | -65F                        |                                                                                                                     | 70F               |                                   | 250F              |                 |
| <b>Moisture Conditioning</b>                   | dry                         |                                                                                                                     | dry               |                                   | equilibrium       |                 |
| <b>Equilibrium at T, RH</b>                    |                             |                                                                                                                     |                   |                                   | 160 F,85%         |                 |
| <b>Source code</b>                             | HFIMXXXB                    |                                                                                                                     | HFIMXXXA          |                                   | HFIMXXXD          |                 |
|                                                | <b>Normalized</b>           | <b>Measured</b>                                                                                                     | <b>Normalized</b> | <b>Measured</b>                   | <b>Normalized</b> | <b>Measured</b> |
| <b>Mean</b>                                    |                             | 11.96                                                                                                               |                   | 11.04                             |                   | 6.46            |
| <b>Minimum</b>                                 |                             | 7.64                                                                                                                |                   | 9.99                              |                   | 6.19            |
| <b>Maximum</b>                                 |                             | 14.71                                                                                                               |                   | 13.25                             |                   | 6.71            |
| <b>ILT C.V.(%)</b>                             |                             | 20.68                                                                                                               |                   | 10.41                             |                   | 3.08            |
| <b>Strength (ksi)</b>                          |                             |                                                                                                                     |                   |                                   |                   |                 |
| <b>No. Specimens</b>                           | 8                           |                                                                                                                     | 7                 |                                   | 7                 |                 |
| <b>No. Prepreg Lots</b>                        | 1                           |                                                                                                                     | 1                 |                                   | 1                 |                 |

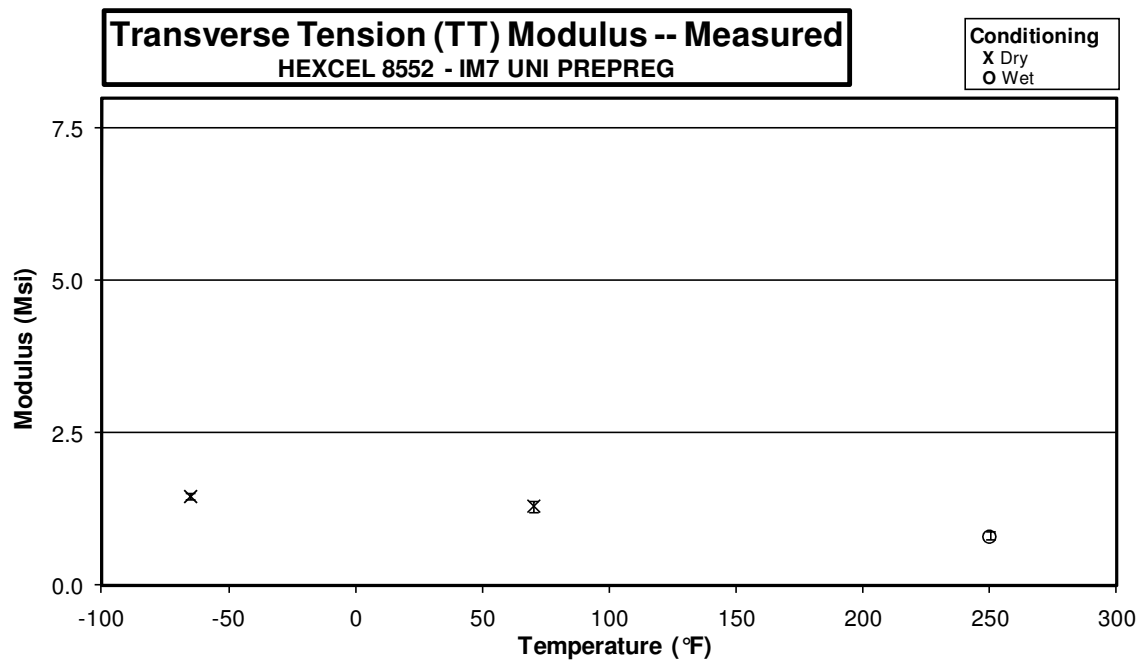
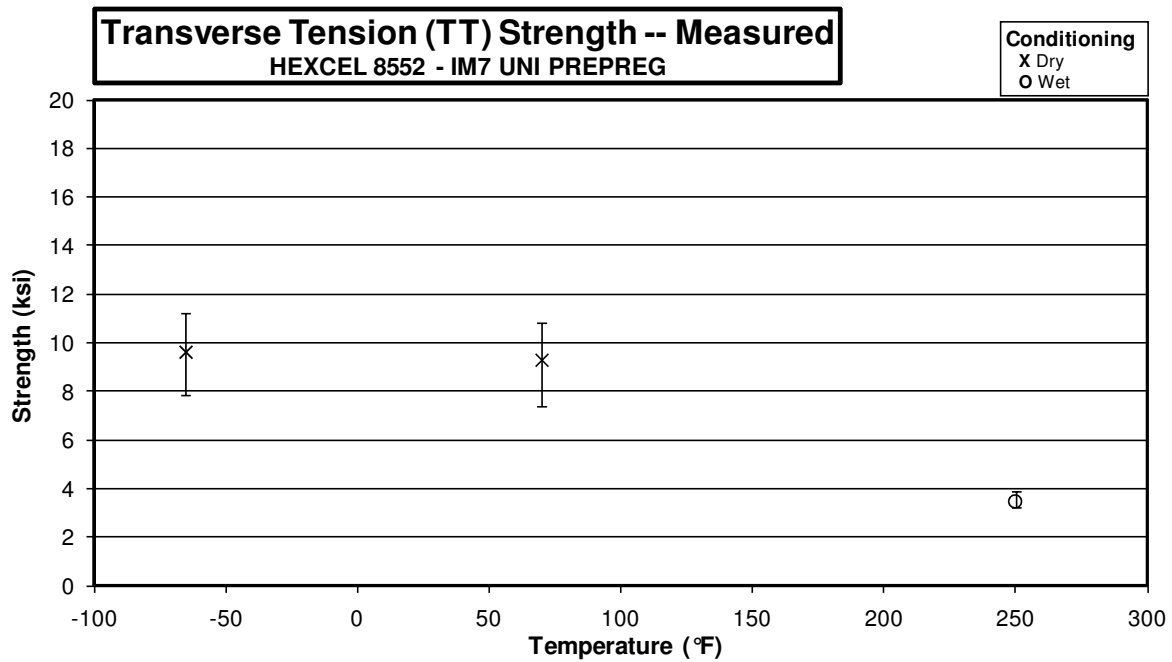
### **3. Individual Test Charts**

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

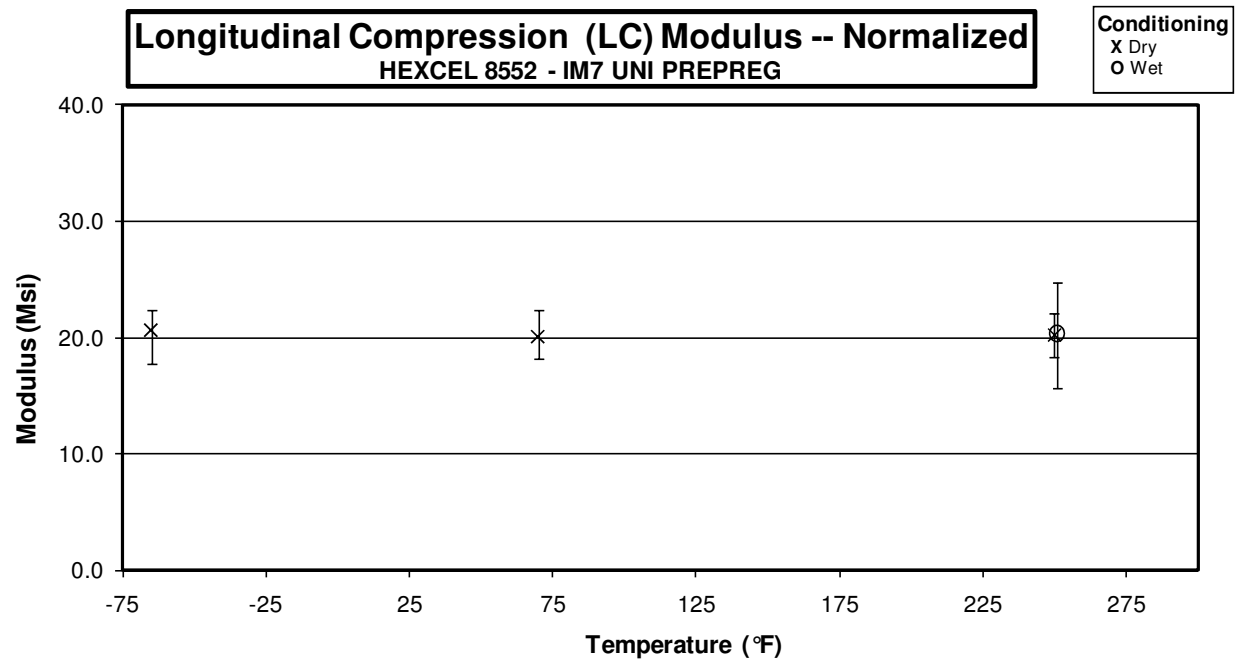
### 3.1 Longitudinal Tension Properties



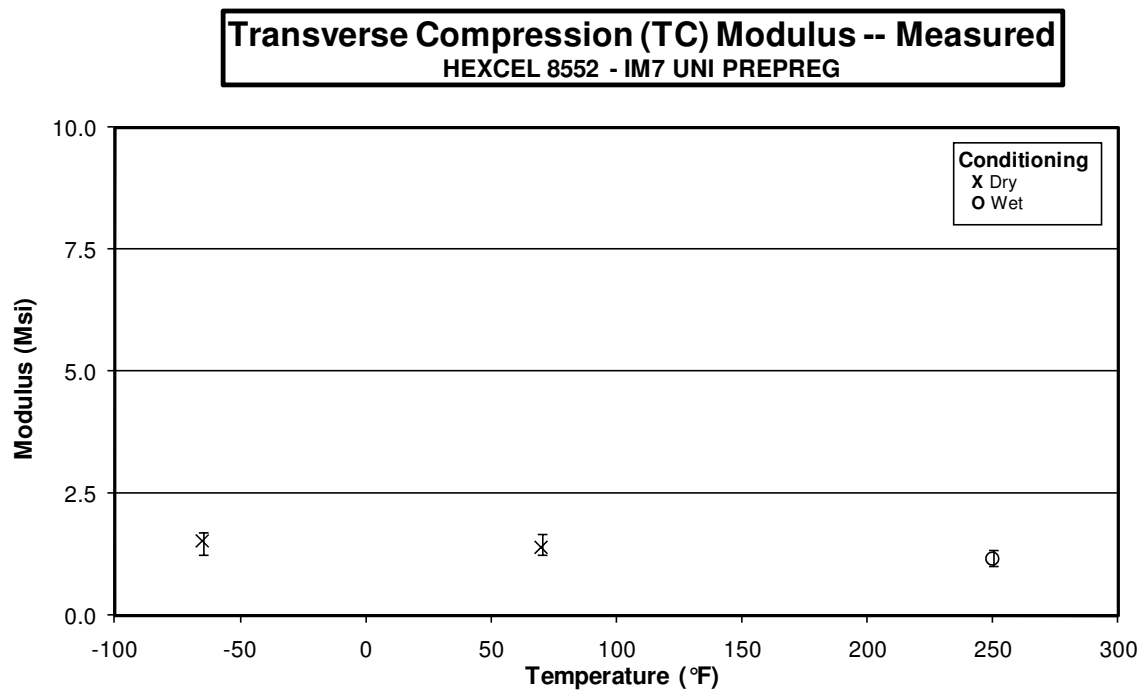
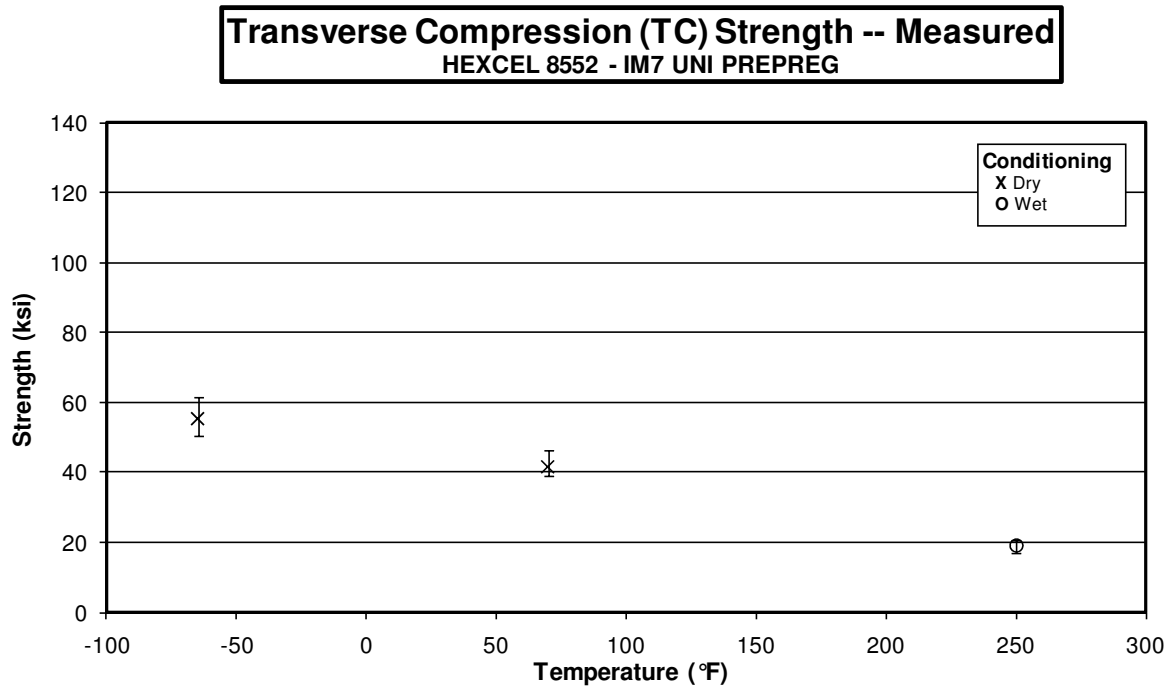
### 3.2 Transverse Tension Properties



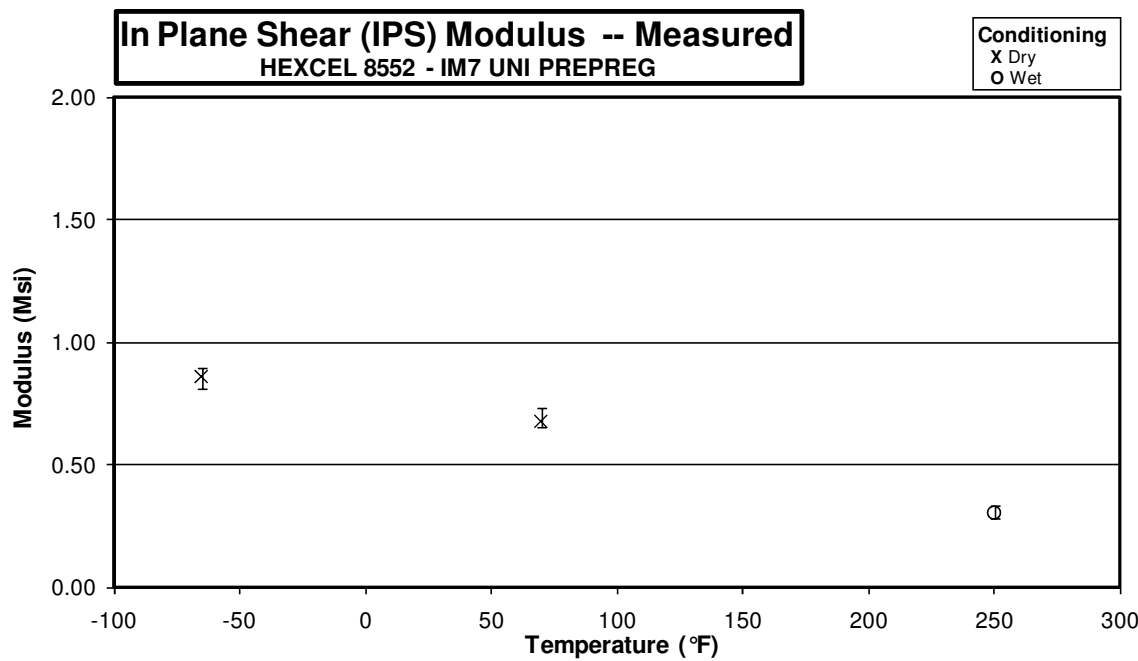
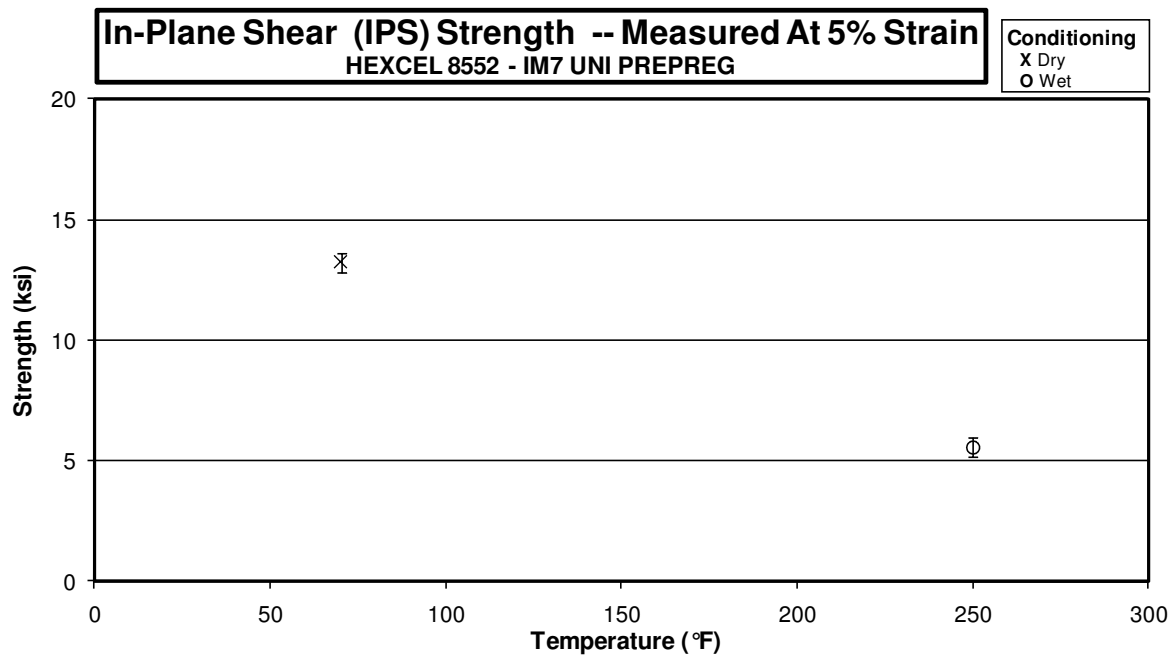
### 3.3 Longitudinal Compression Properties



### 3.4 Transverse Compression Properties

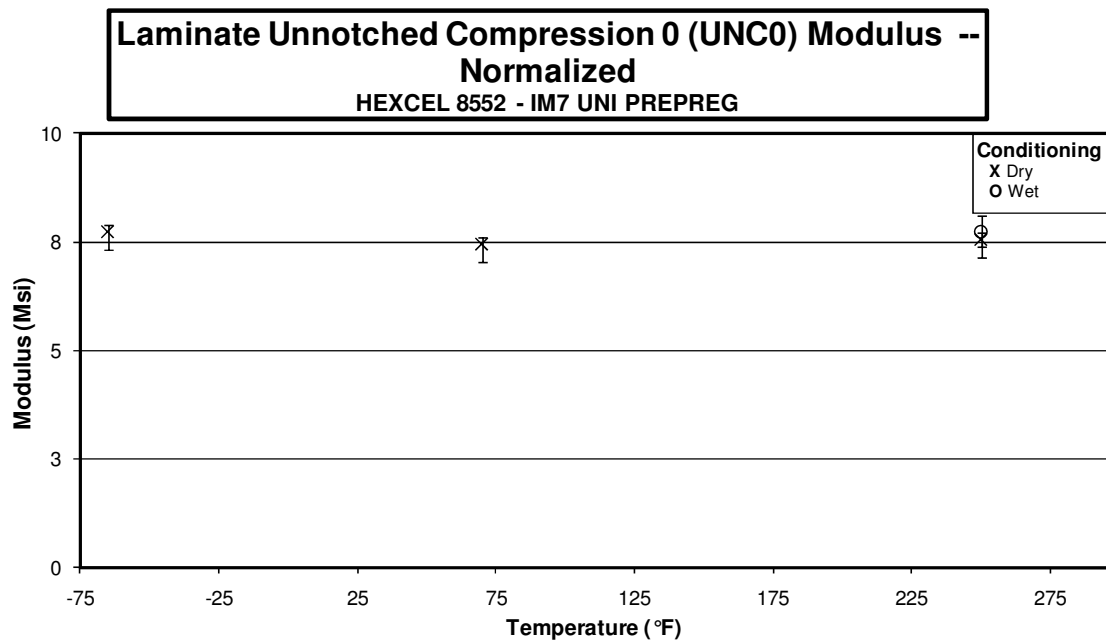
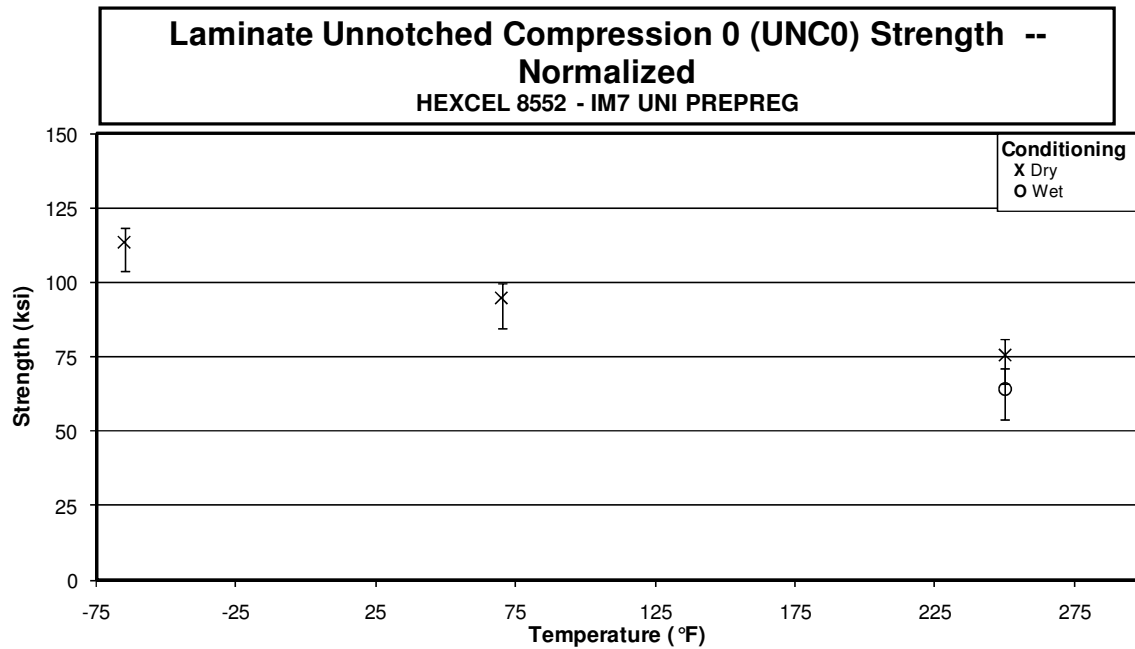


3.5 In-Plane Shear Properties

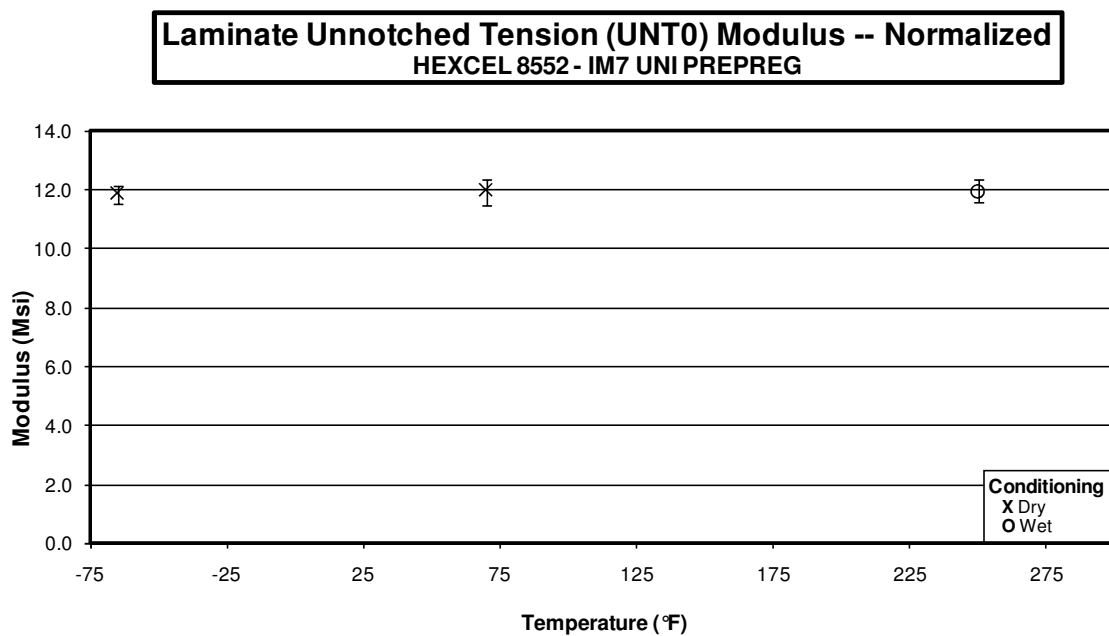
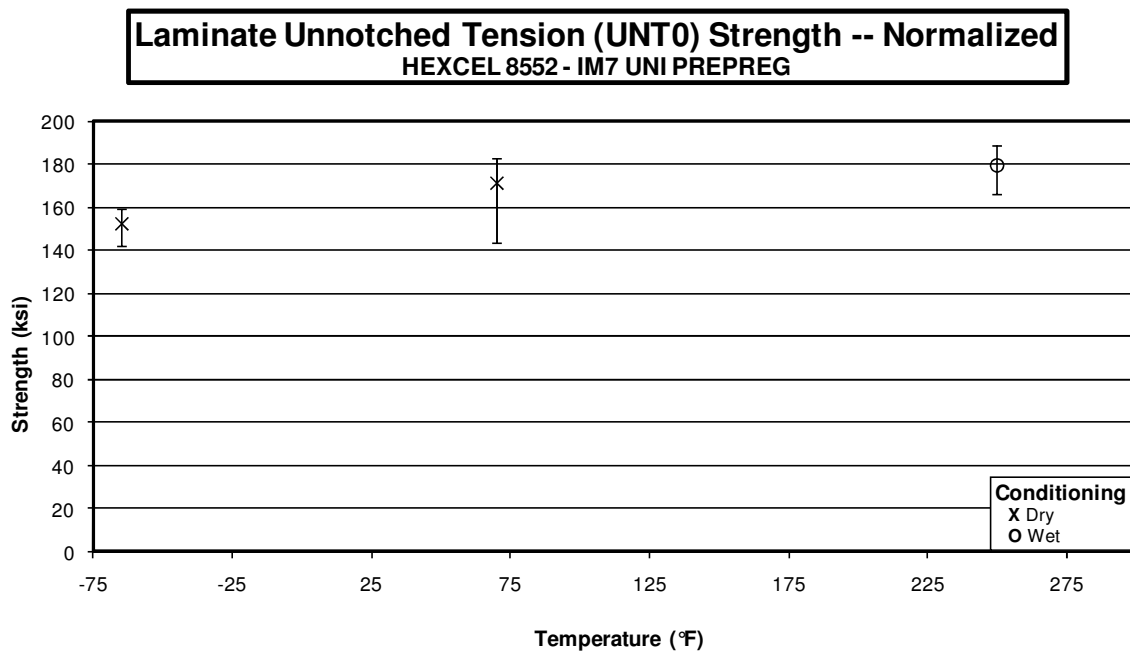




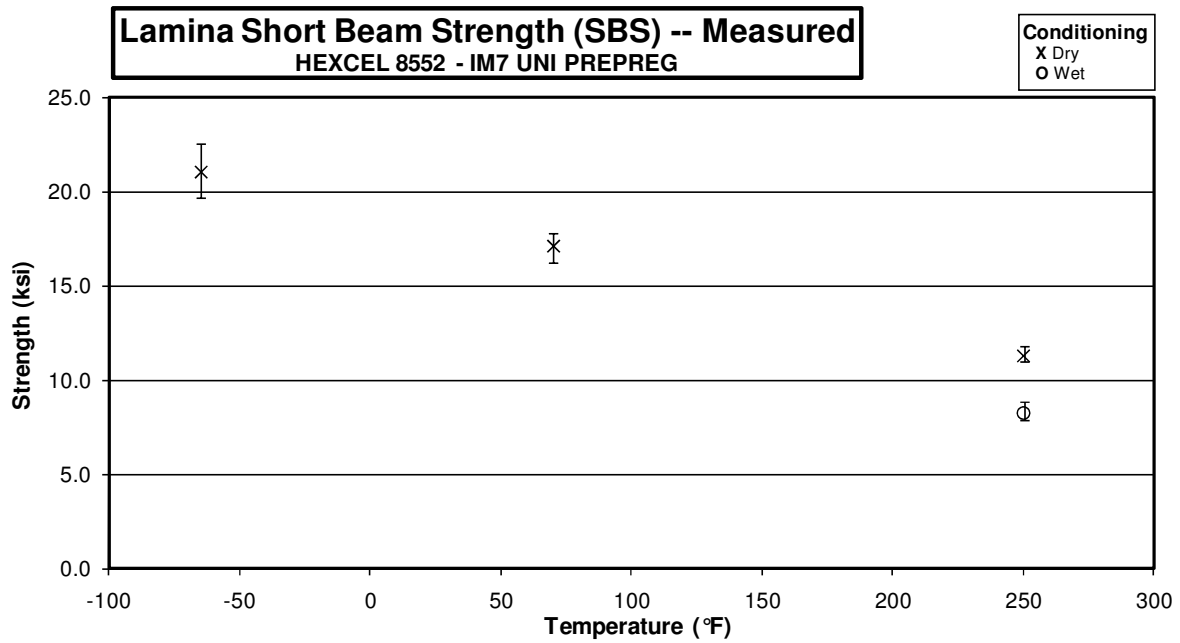
### 3.6 Unnotched Compression 0 Properties



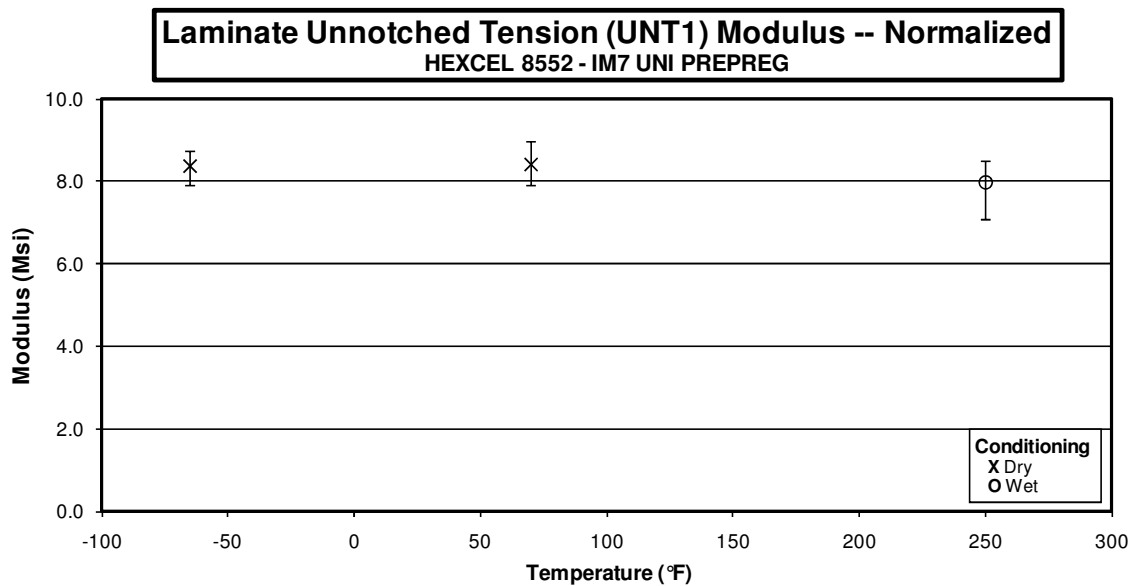
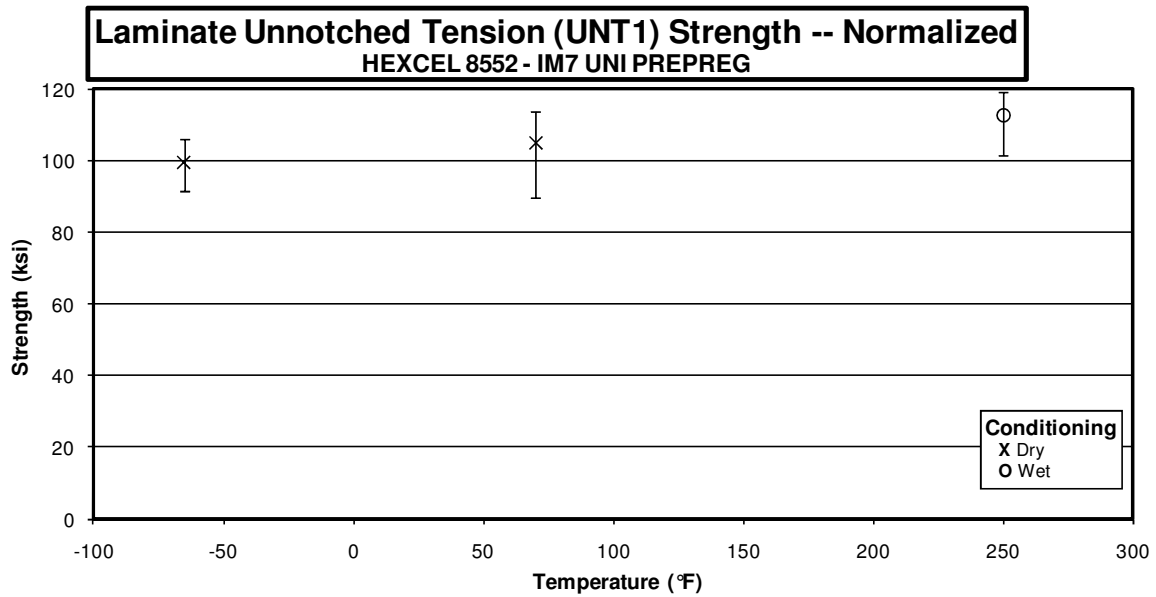
### 3.7 Unnotched Tension 0 Properties



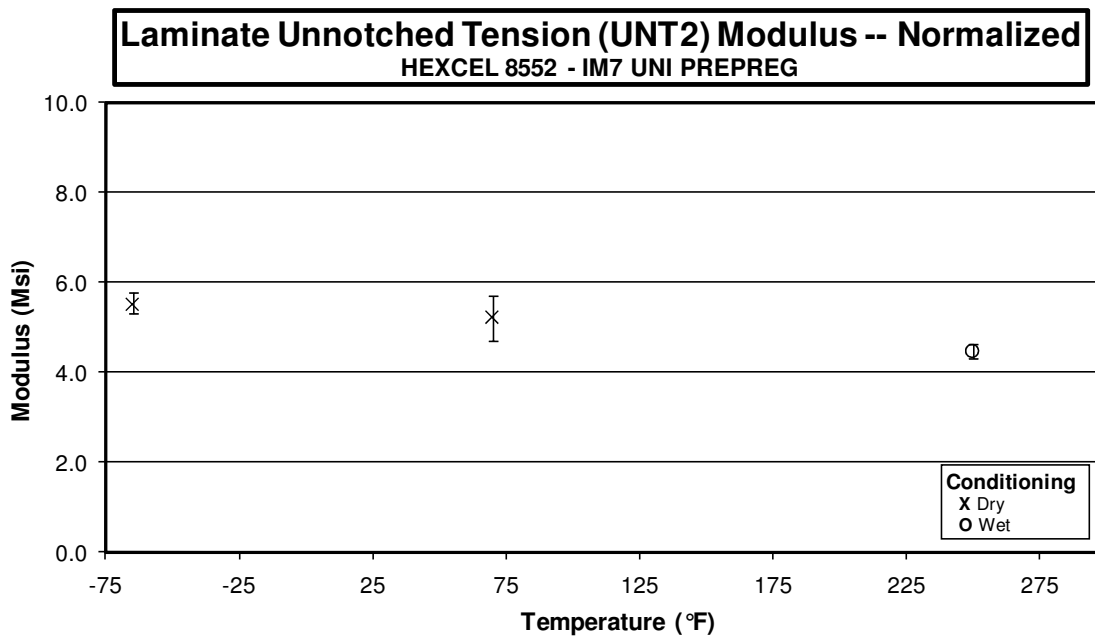
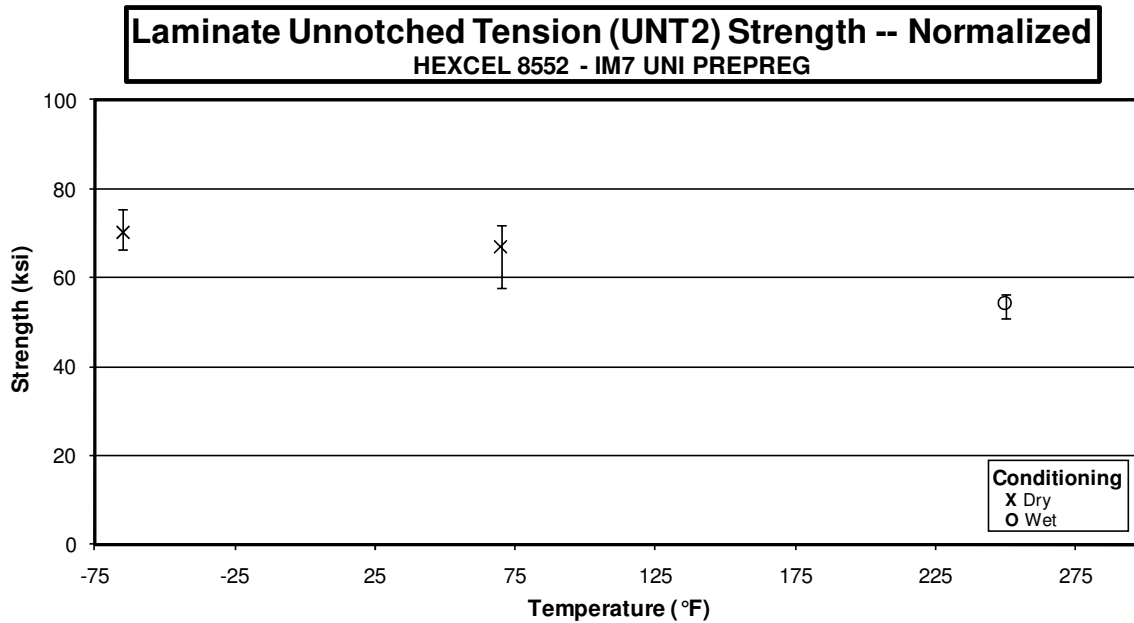
### 3.8 Lamina Short Beam Strength



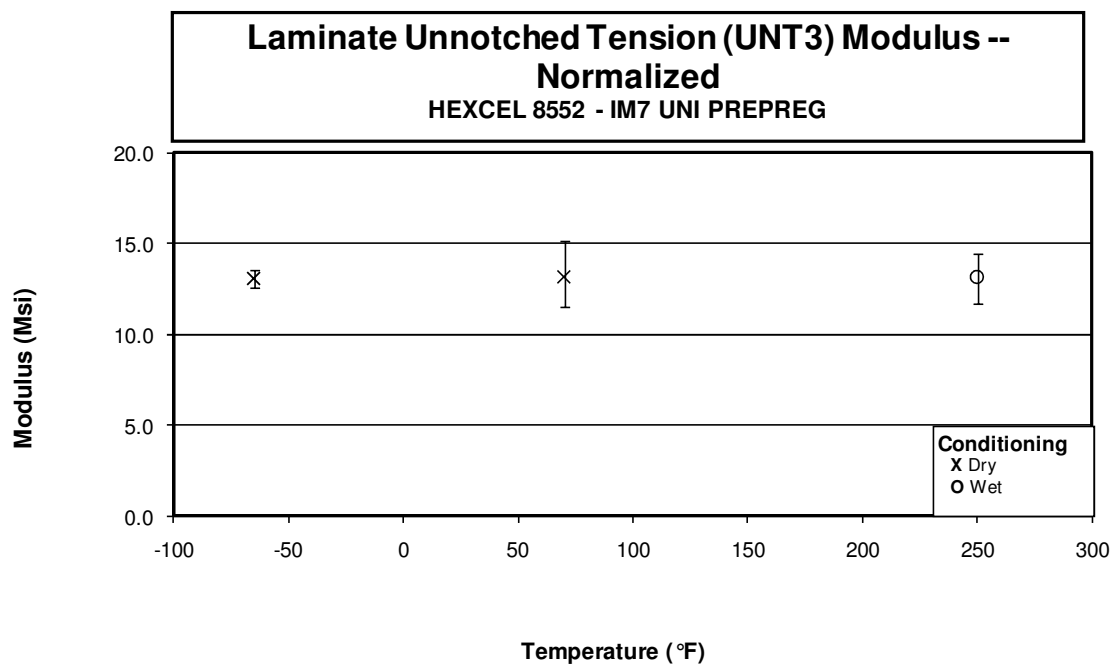
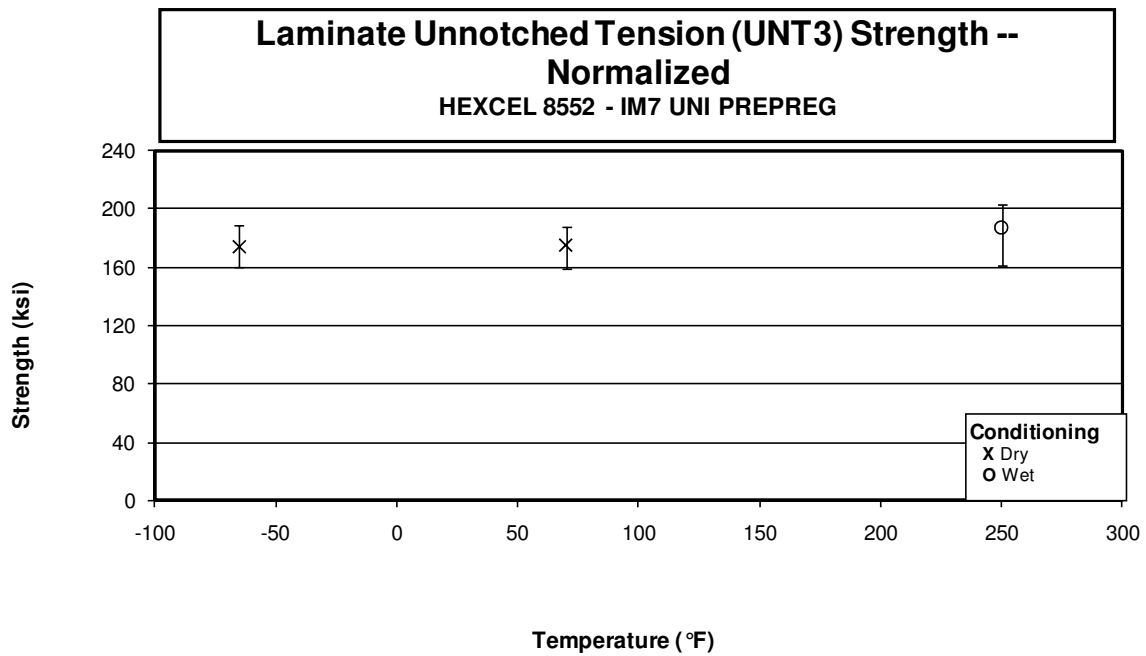
### 3.9 Unnotched Tension 1 Properties



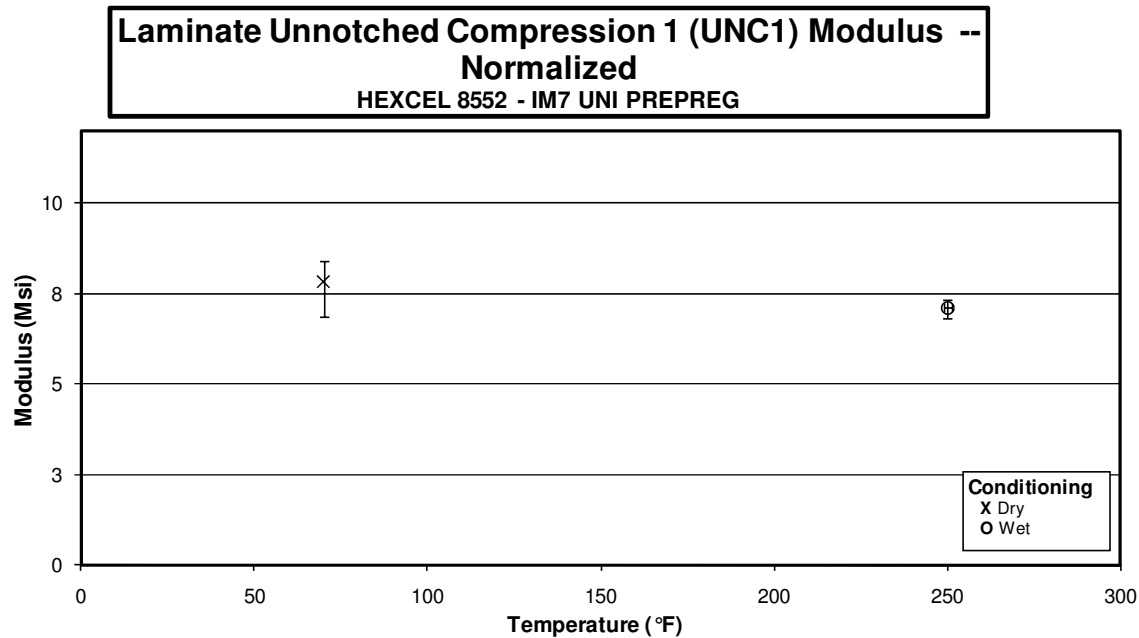
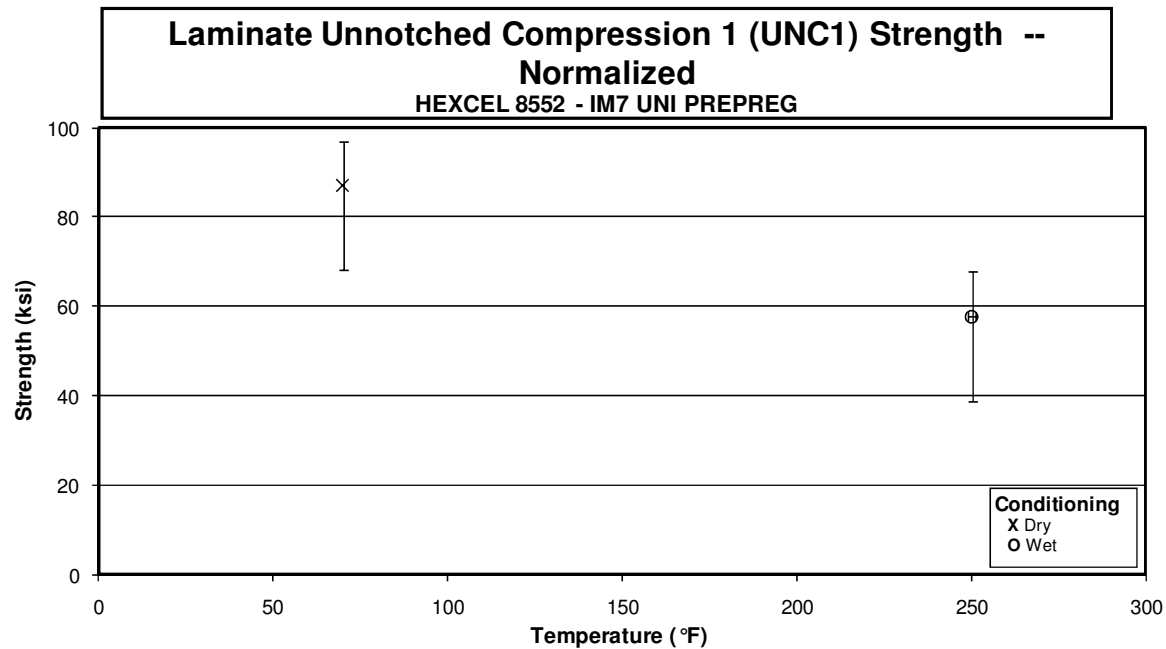
### 3.10 Unnotched Tension 2 Properties



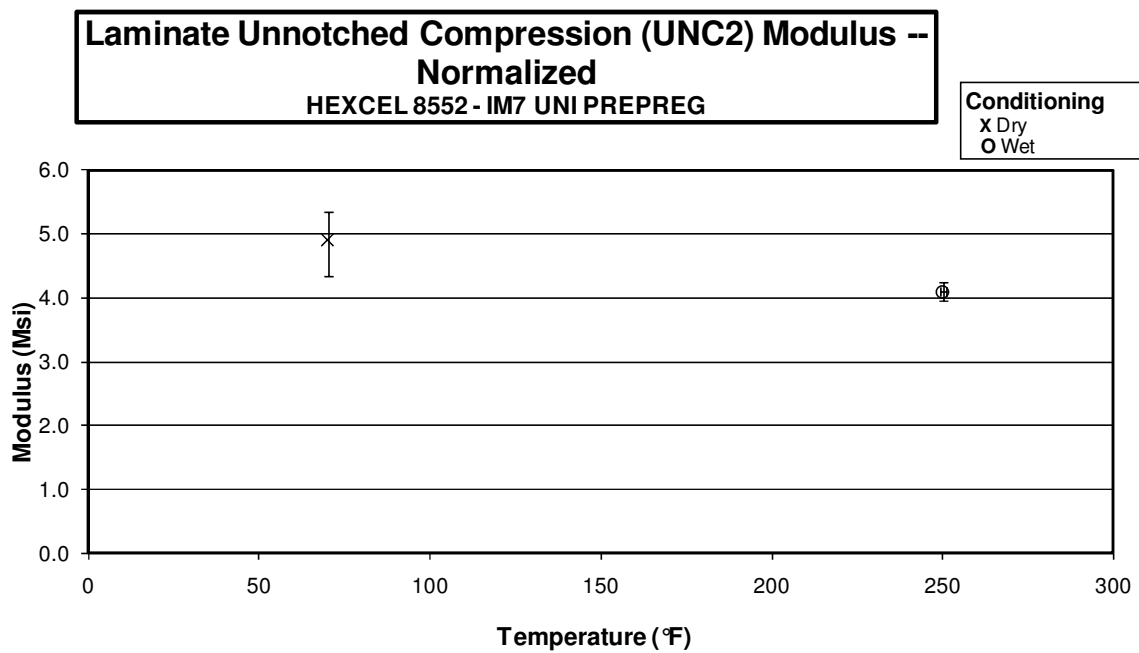
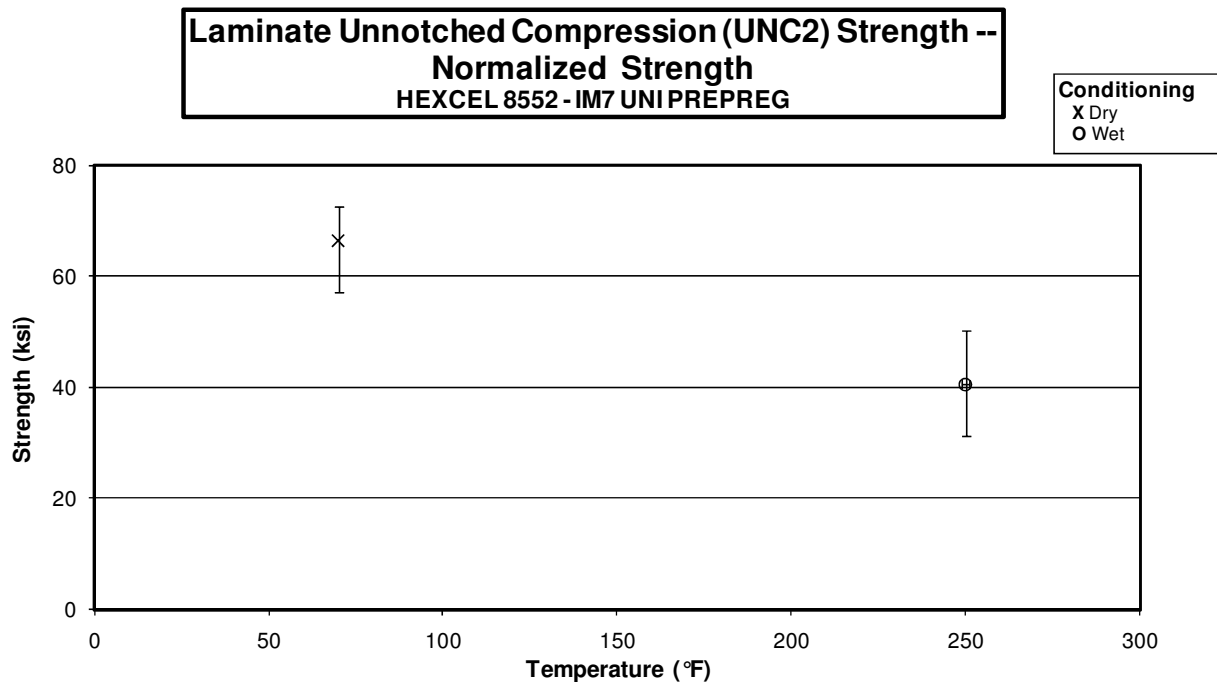
### 3.11 Unnotched Tension 3 Properties



3.12 Unnotched Compression 1 Properties

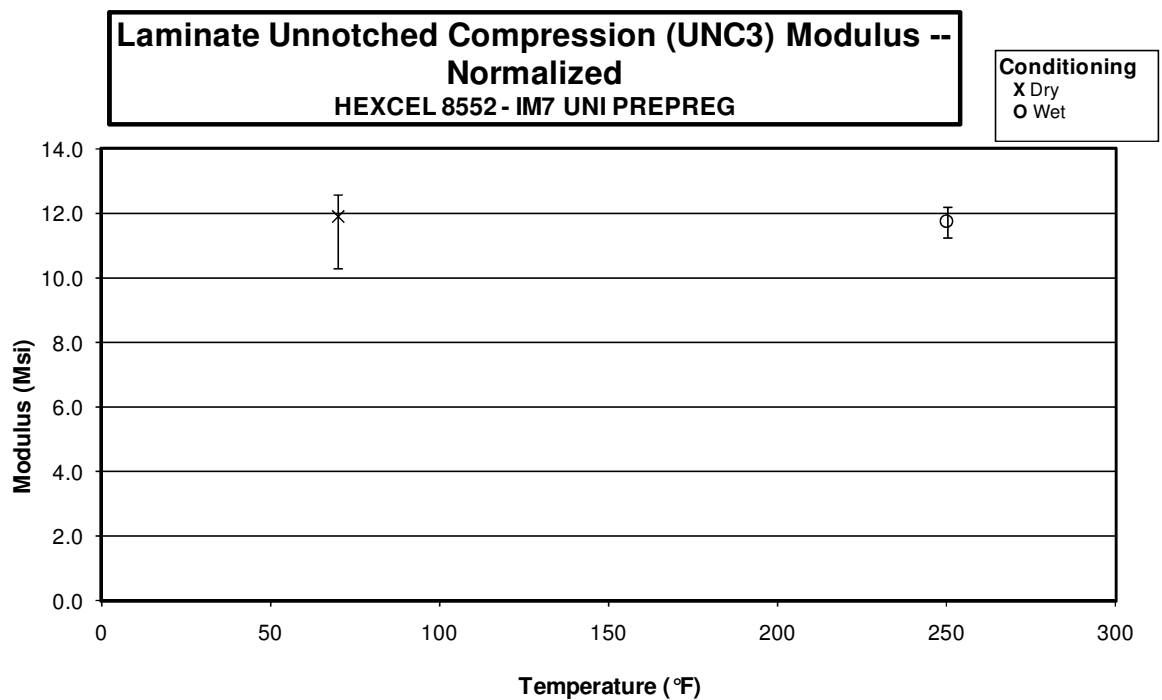
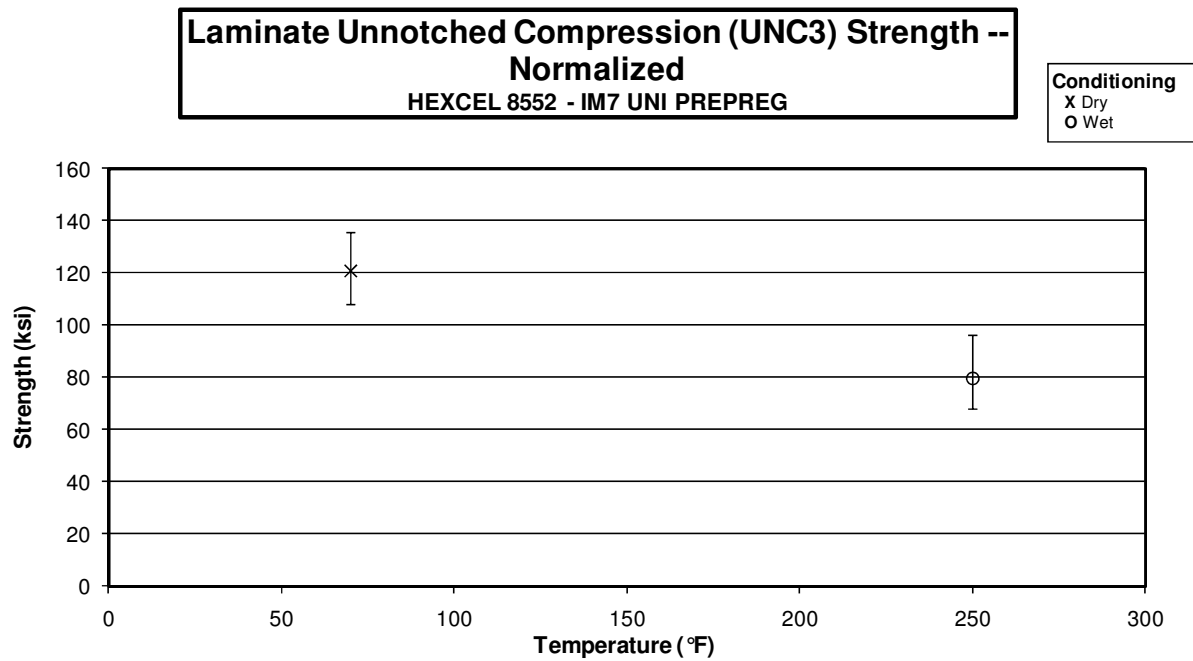


### 3.13 Unnotched Compression 2 Properties

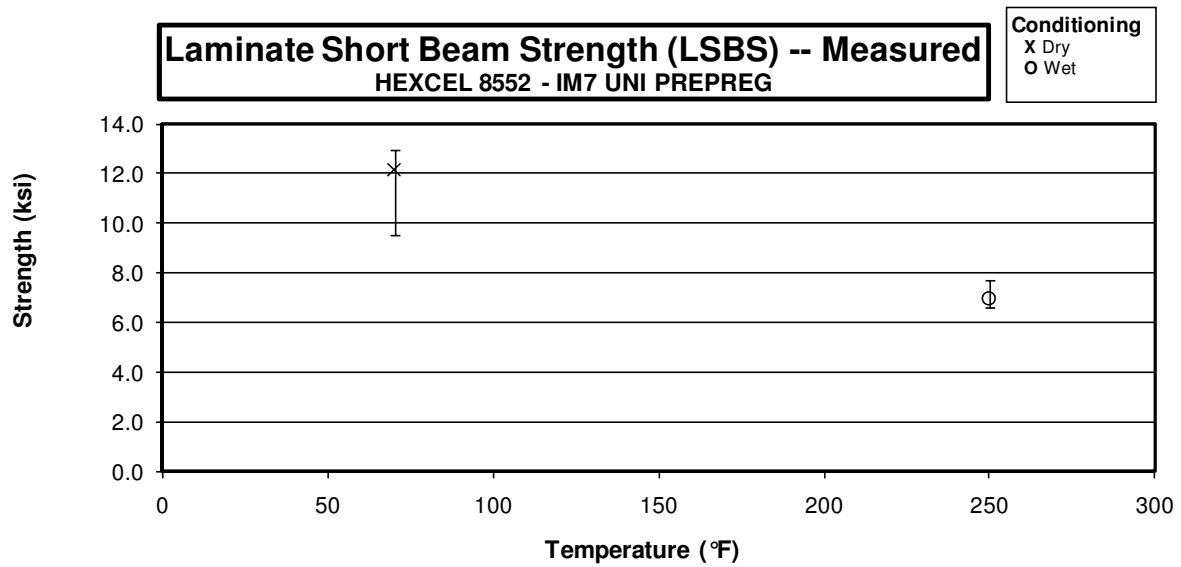




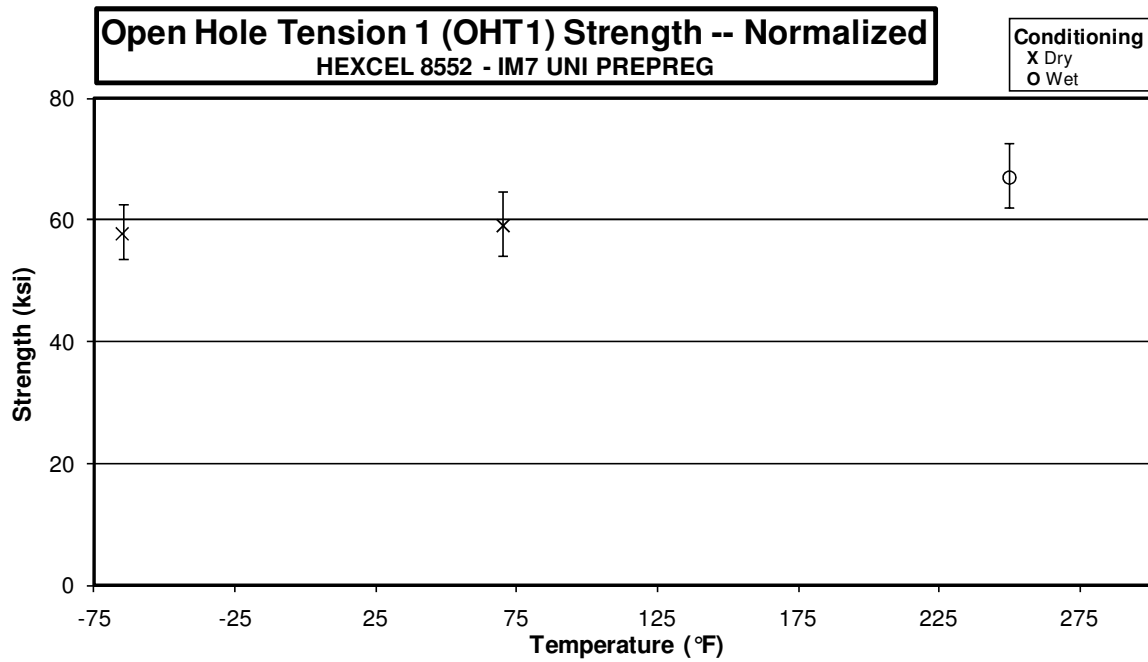
### 3.14 Unnotched Compression 3 Properties



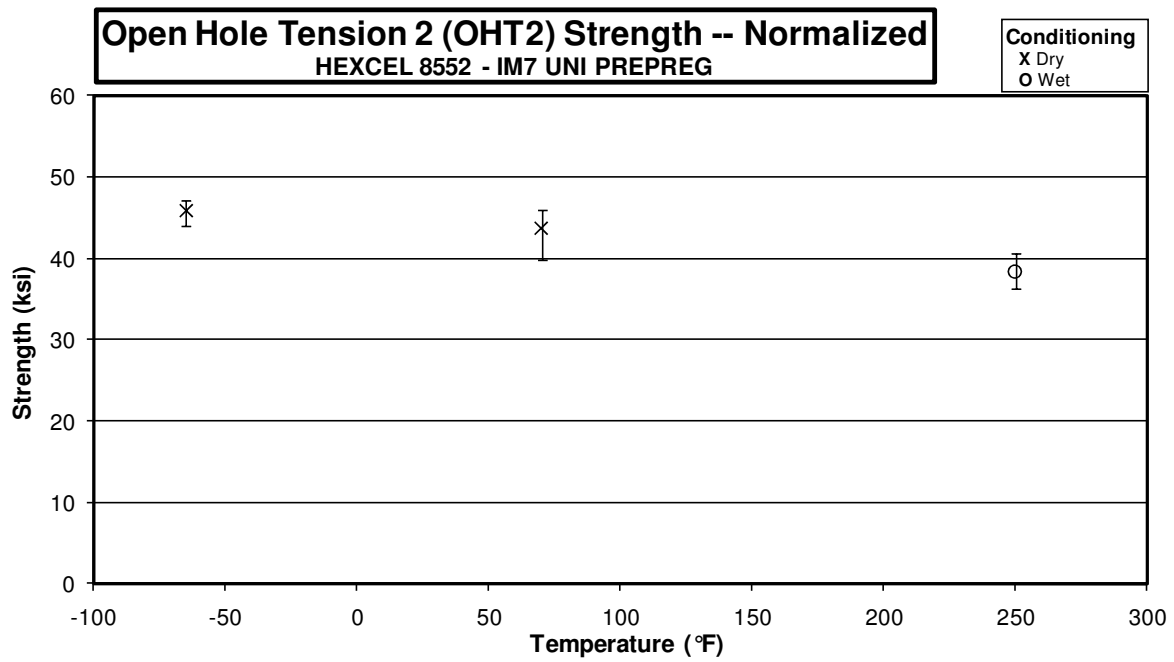
### 3.15 Laminate Short Beam Shear Properties



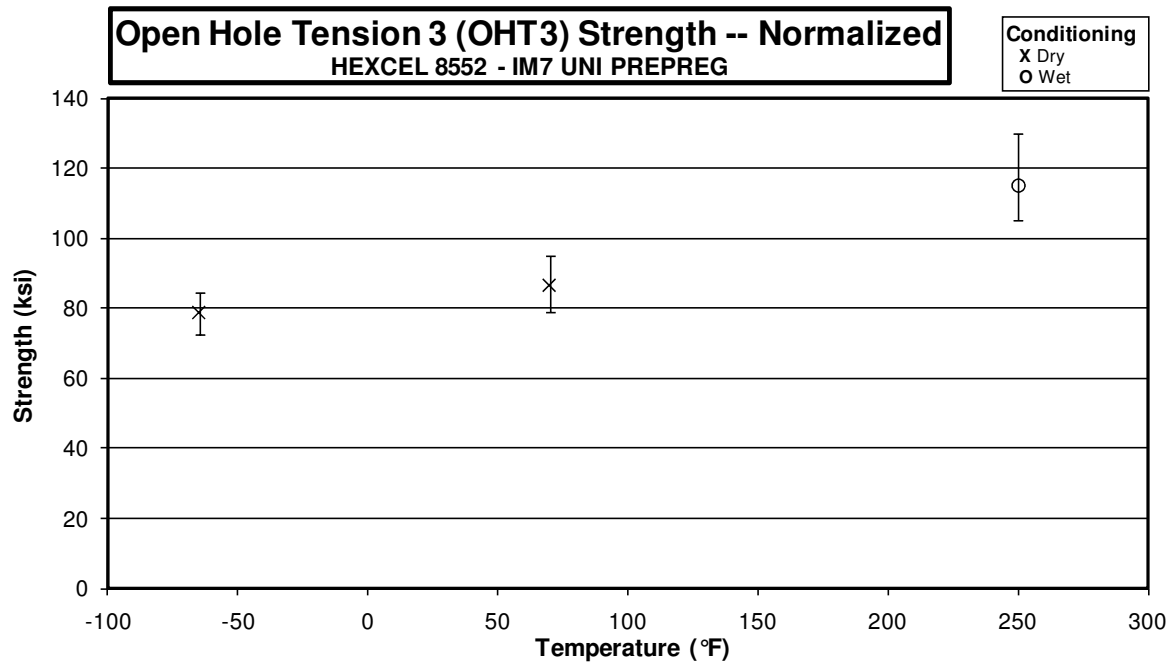
### 3.16 Open Hole Tension 1 Properties



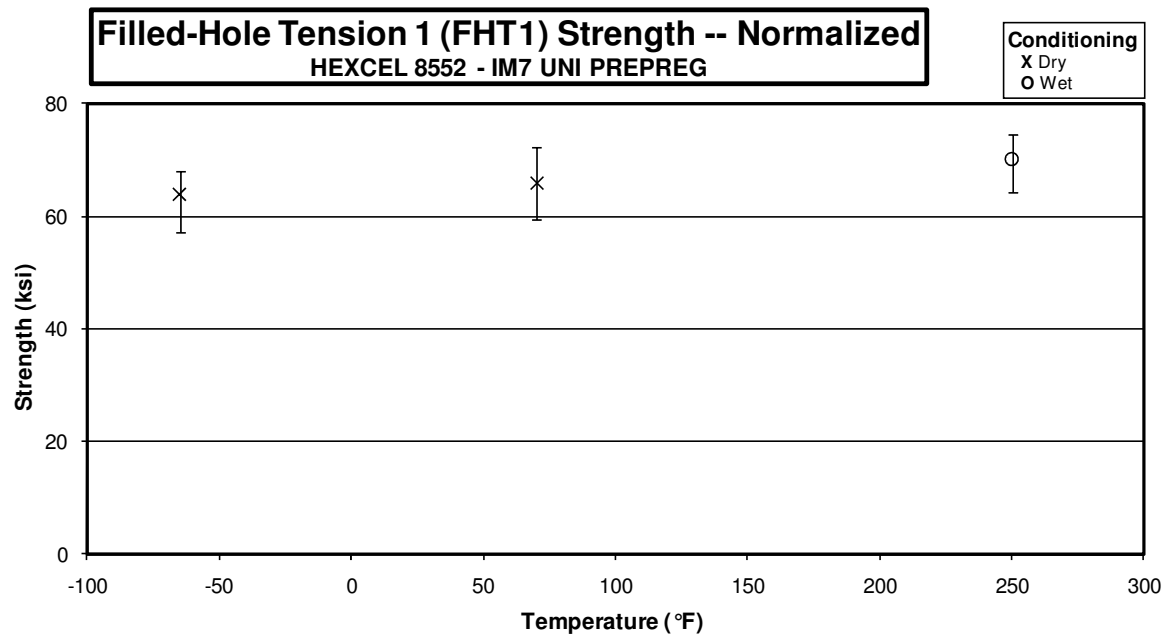
### 3.17 Open Hole Tension 2 Properties



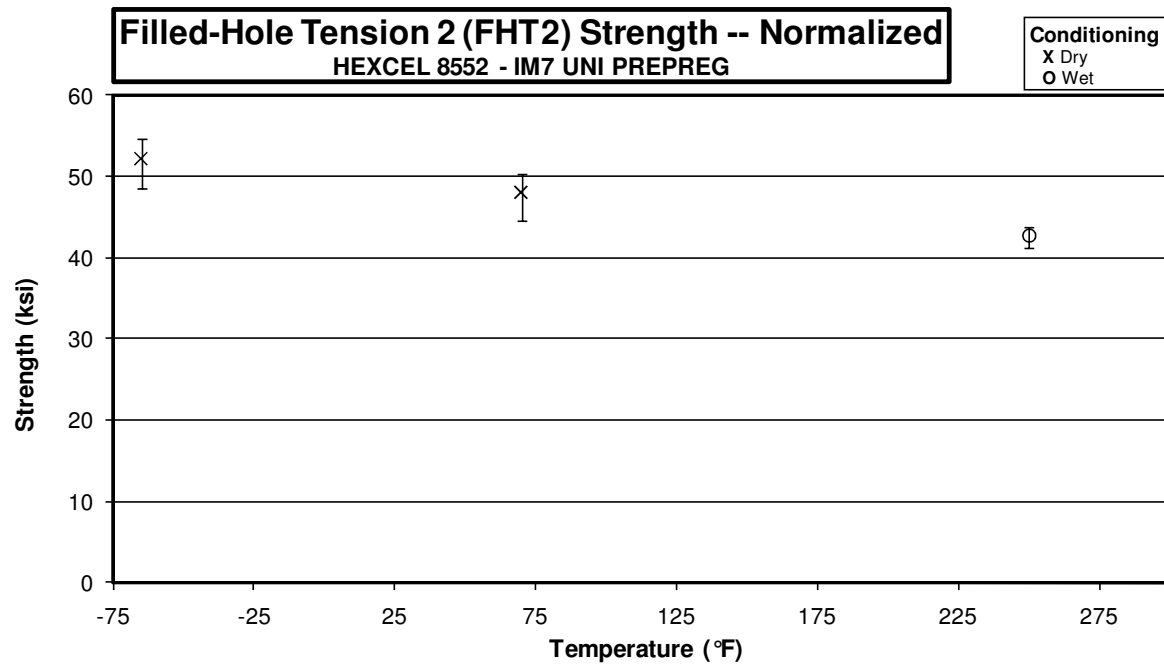
### 3.18 Open Hole Tension 3 Properties



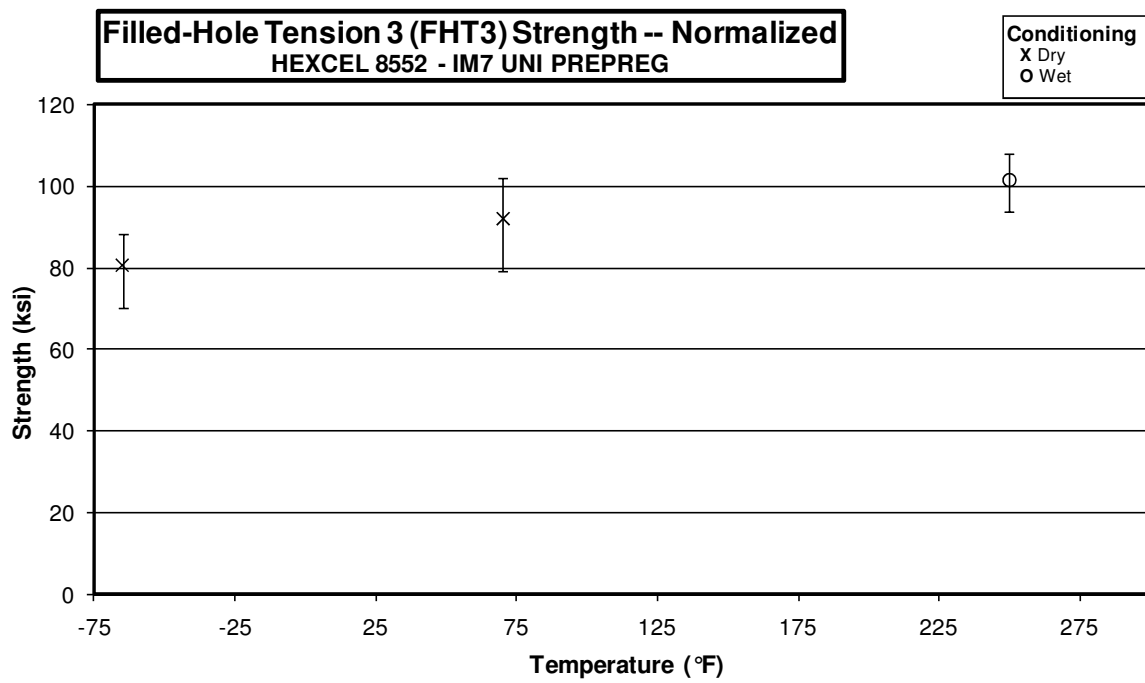
### 3.19 Filled-Hole Tension 1 Properties



### 3.20 Filled-Hole Tension 2 Properties

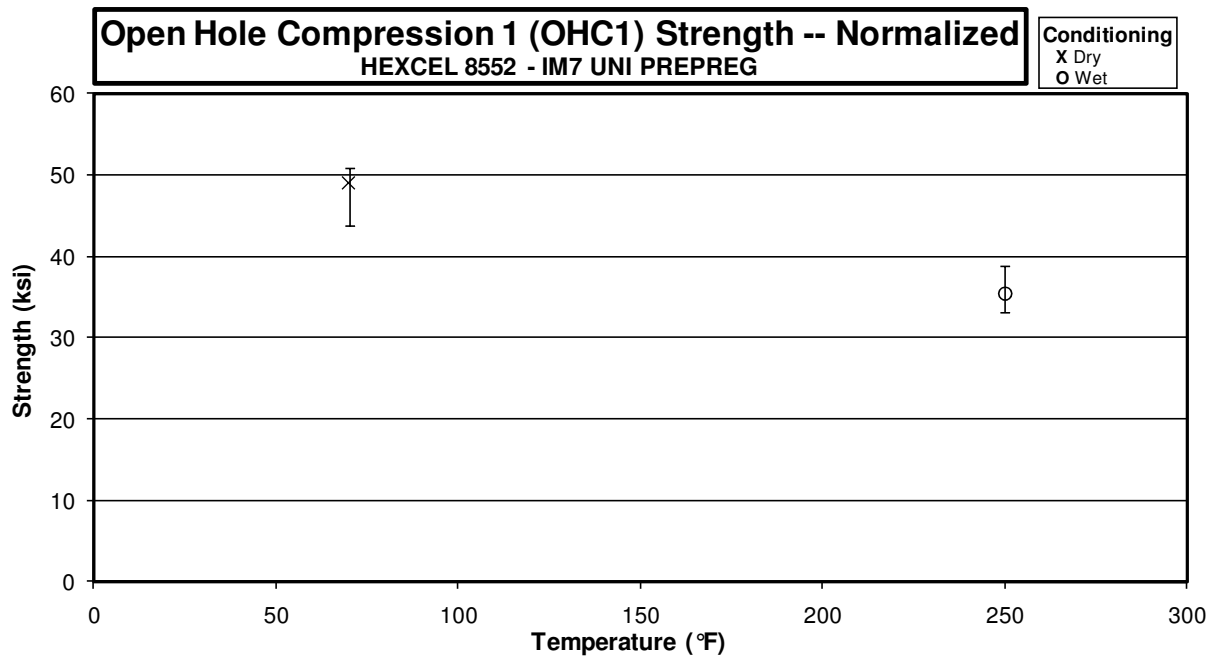


### 3.21 Filled-Hole Tension 3 Properties

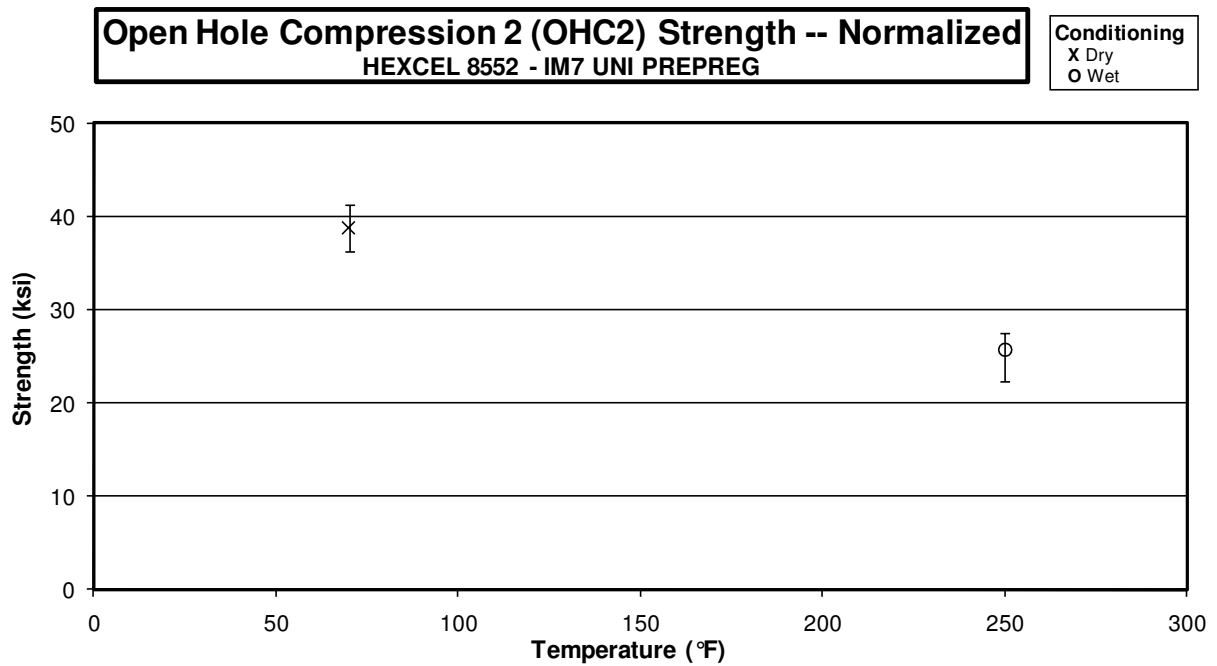




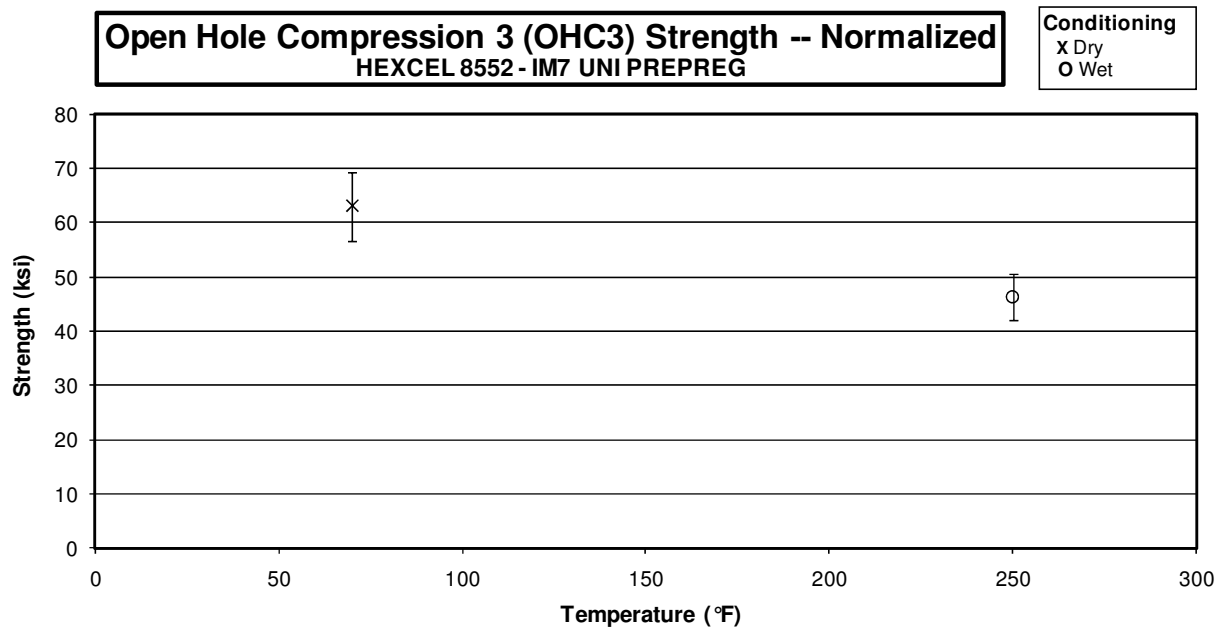
### 3.22 Open Hole Compression 1 Properties



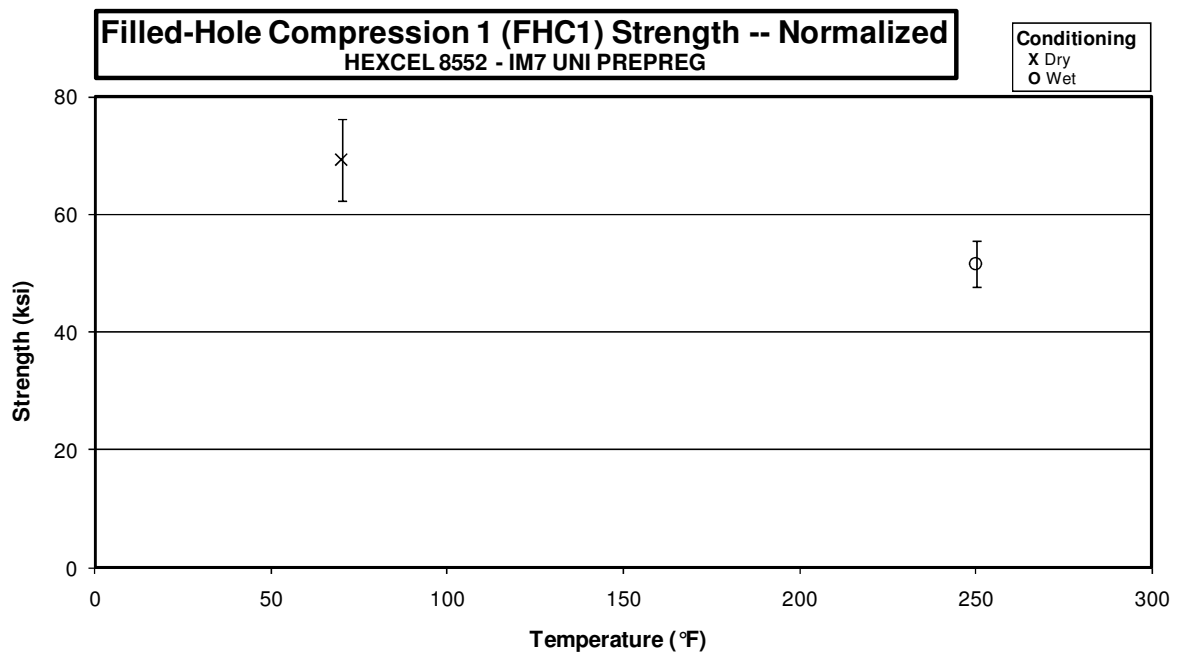
### 3.23 Open Hole Compression 2 Properties



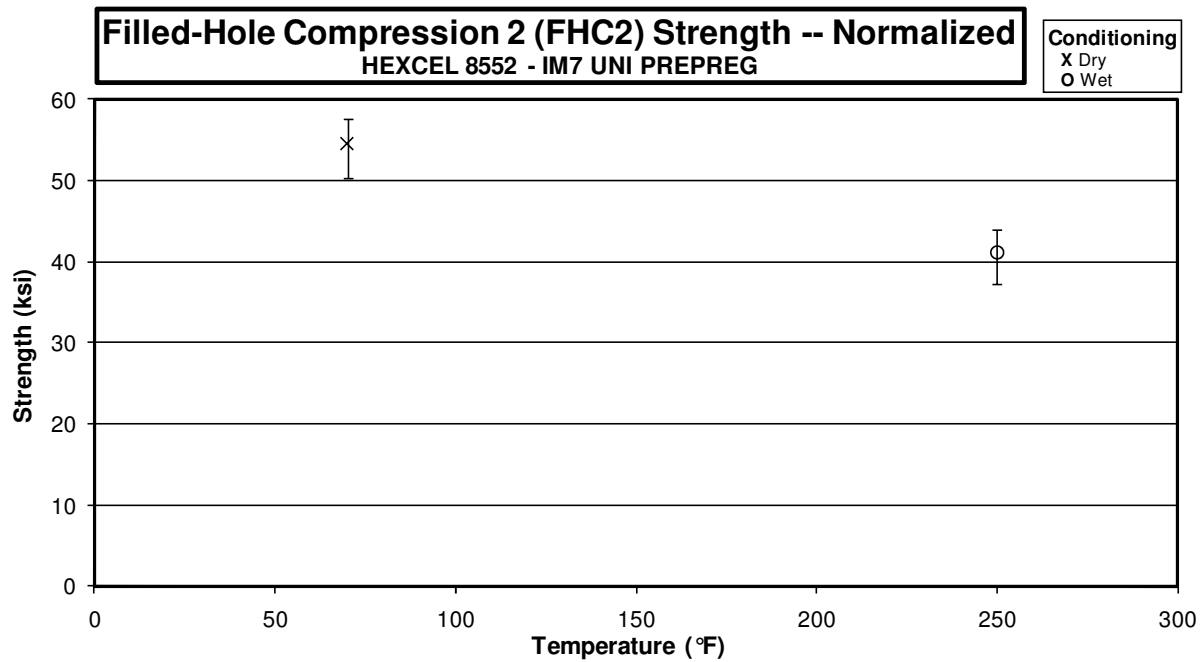
### 3.24 Open Hole Compression 3 Properties



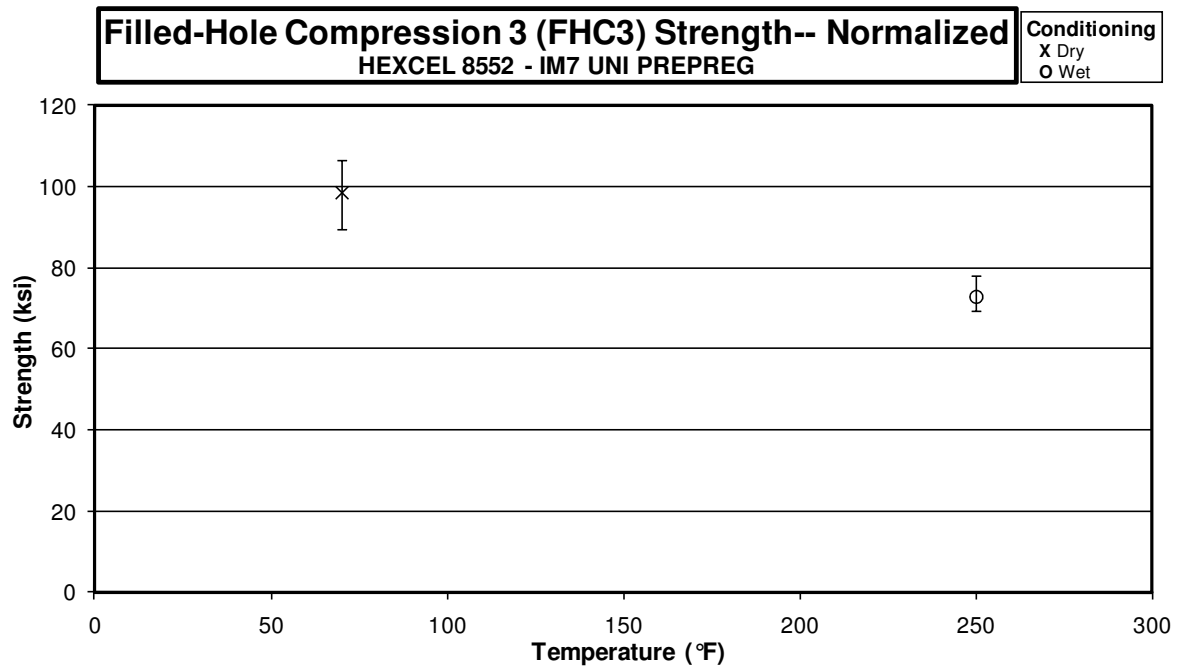
### 3.25 Filled-Hole Compression 1 Properties



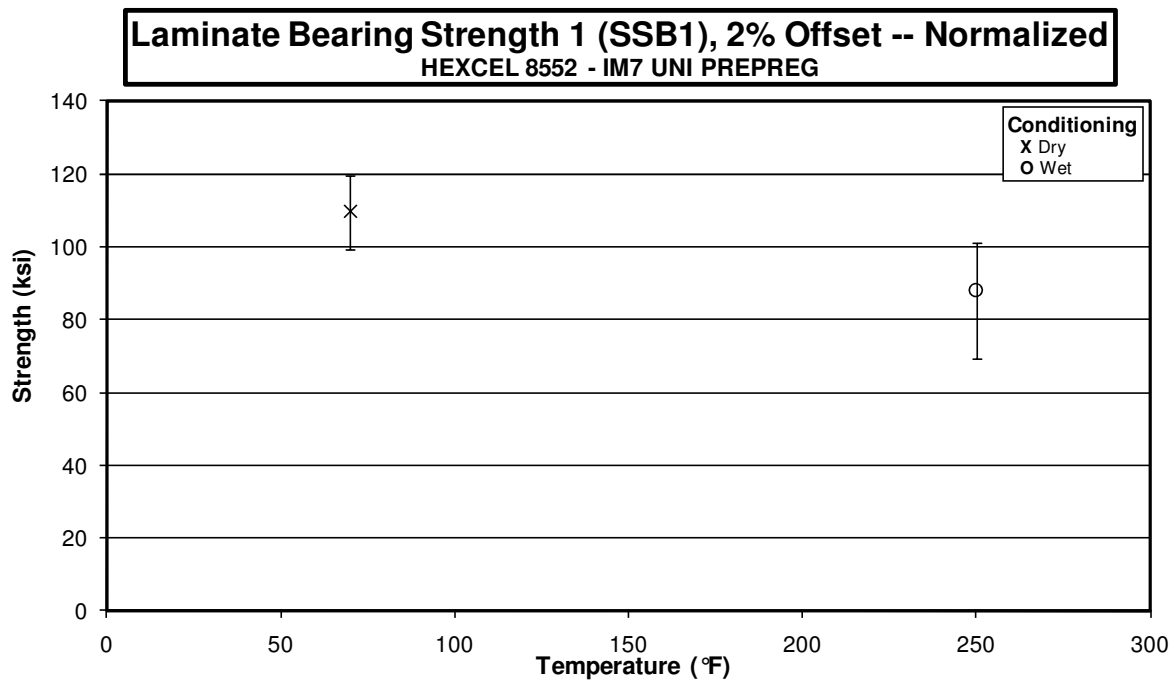
### 3.26 Filled-Hole Compression 2 Properties



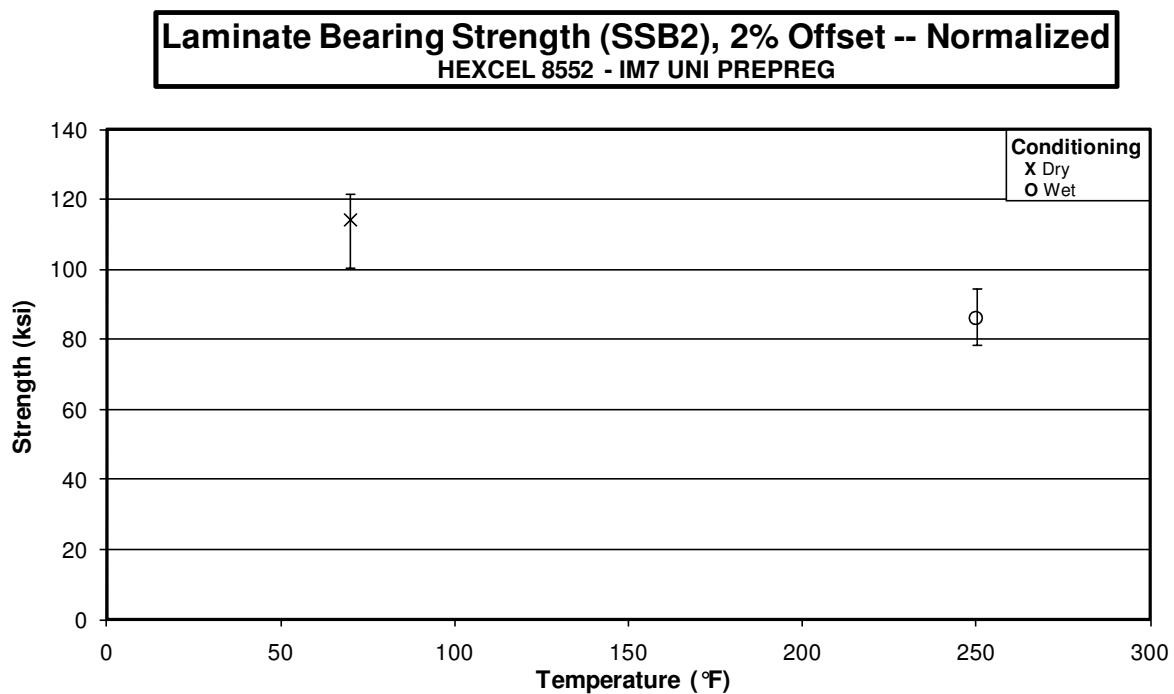
### 3.27 Filled-Hole Compression 3 Properties



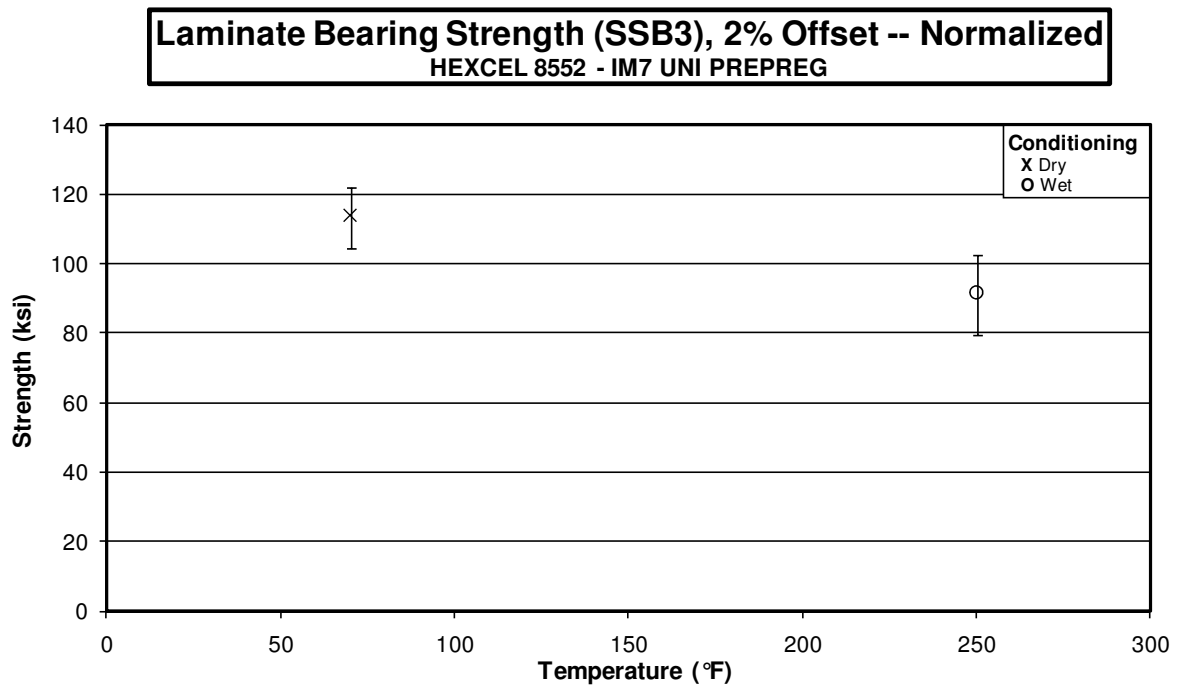
### 3.28 Single Shear Bearing Strength1 Properties



### 3.29 Single Shear Bearing Strength 2 Properties

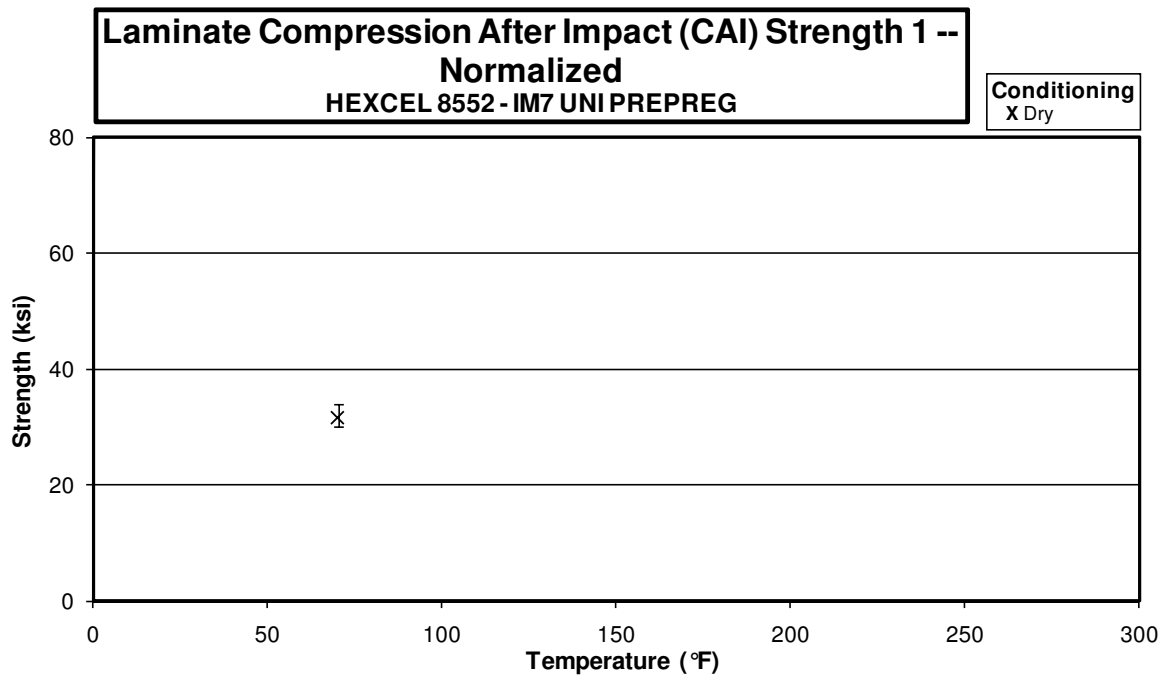


### 3.30 Single Shear Bearing 3 Properties

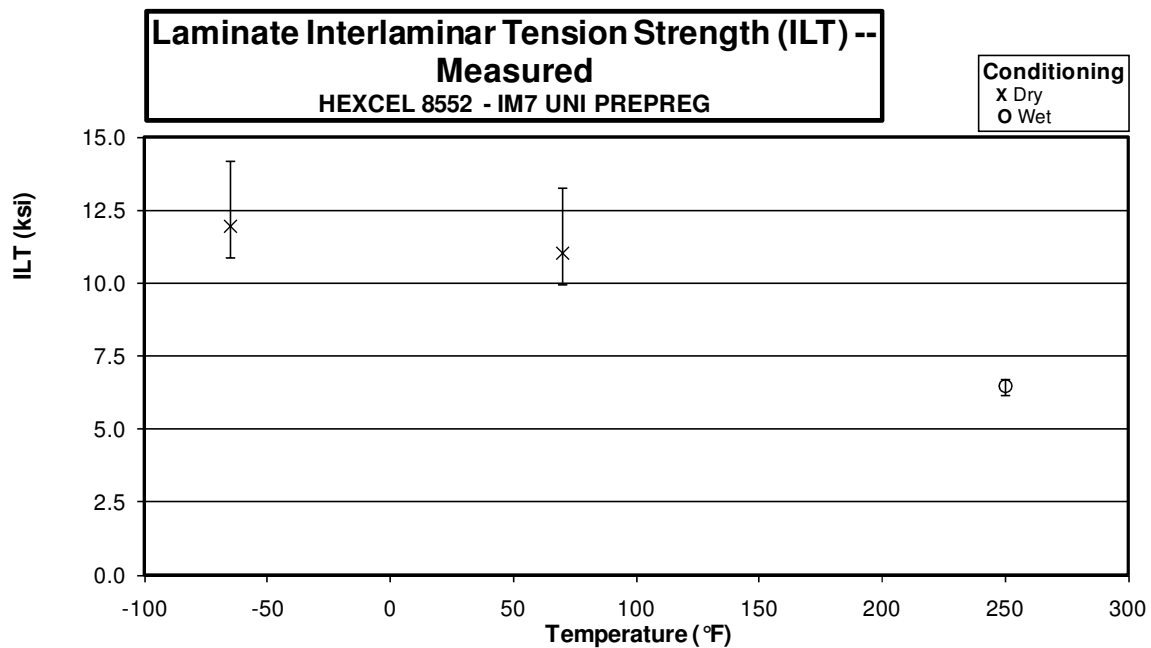
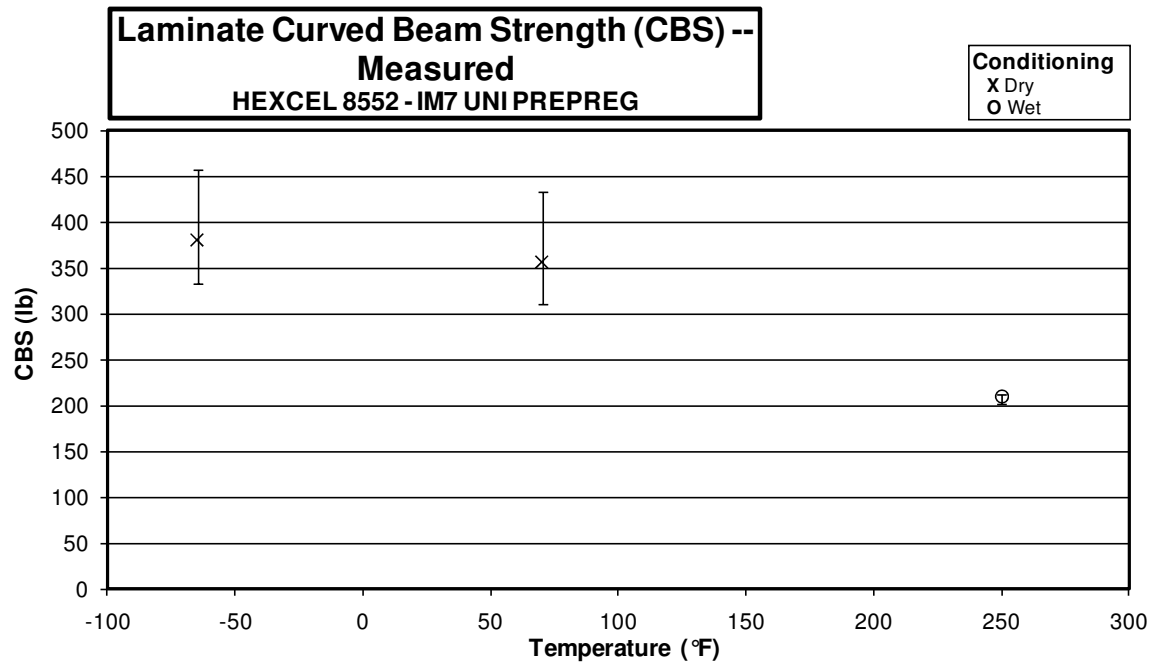




### 3.31 Compression Strength After Impact 1 Properties



### 3.32 Interlaminar Tension Properties



## **4. Raw Data**

## 4.1 Longitudinal Tension Properties

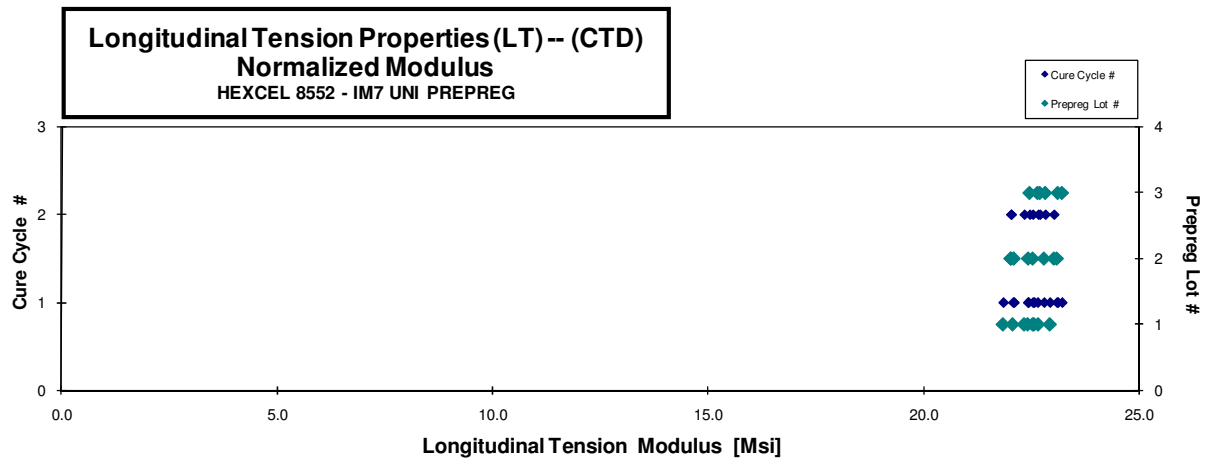
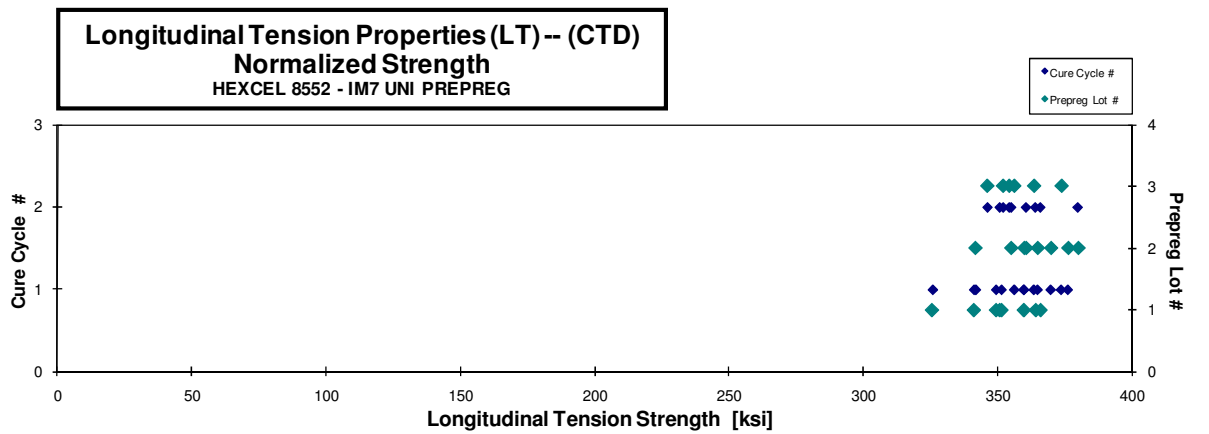
### Longitudinal Tension Properties (LT) -- (CTD) Strength & Modulus HEXCEL 8552 - IM7 UNI PREPREG

normalizing  $t_{ply}$   
[in]  
0.0072

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Modulus [Msi] | Poisson's Ratio | Avg. Specimen Thicken. [in] | # Plies in Laminate | Failure Mode | Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] | Modulus <sub>norm</sub> [Msi] |
|-----------------|----------------|-------------------|---------------|--------------|----------------|---------------|-----------------|-----------------------------|---------------------|--------------|---------------------|--------------------------------|-------------------------------|
| HFUA116B        | A              | M1                | 1             | 1            | 322.580        | 22.211        | 0.213           | 0.044                       | 6                   | LGM/SGM      | 0.0073              | 325.692                        | 22.425                        |
| HFUA117B        | A              | M1                | 1             | 1            | 344.115        | 21.742        | 0.260           | 0.044                       | 6                   | LGM/SGM      | 0.0073              | 349.426                        | 22.078                        |
| HFUA118B        | A              | M1                | 1             | 1            | 347.430        | 22.315        | 0.223           | 0.044                       | 6                   | XGM          | 0.0073              | 351.451                        | 22.573                        |
| HFUA119B        | A              | M1                | 1             | 1            | 357.922        | 22.822        | 0.241           | 0.043                       | 6                   | XGM          | 0.0072              | 359.717                        | 22.937                        |
| HFUA11AB        | A              | M1                | 1             | 1            | 340.005        | 21.777        | 0.271           | 0.043                       | 6                   | LGM/SGM      | 0.0072              | 341.186                        | 21.852                        |
| HFUA216B        | A              | M2                | 1             | 2            | 345.794        | 22.348        | 0.292           | 0.044                       | 6                   | LGM/SGM      | 0.0073              | 350.730                        | 22.667                        |
| HFUA217B        | A              | M2                | 1             | 2            | 357.079        | 21.911        | 0.270           | 0.044                       | 6                   | LGM/SGM      | 0.0073              | 364.105                        | 22.342                        |
| HFUA218B        | A              | M2                | 1             | 2            | 362.177        | 22.309        | 0.260           | 0.044                       | 6                   | LGM/SGM      | 0.0073              | 365.950                        | 22.541                        |
| HFUB116B        | B              | M1                | 2             | 1            | 372.292        | 22.689        | 0.249           | 0.043                       | 6                   | XGM          | 0.0072              | 369.851                        | 22.540                        |
| HFUB117B        | B              | M1                | 2             | 1            | 363.978        | 22.690        | 0.270           | 0.043                       | 6                   | XGM          | 0.0071              | 359.906                        | 22.436                        |
| HFUB118B        | B              | M1                | 2             | 1            | 372.635        | 22.583        | 0.273           | 0.044                       | 6                   | XGM          | 0.0073              | 376.229                        | 22.801                        |
| HFUB119B        | B              | M1                | 2             | 1            | 361.972        | 22.914        | 0.287           | 0.044                       | 6                   | XGM          | 0.0073              | 364.904                        | 23.099                        |
| HFUB11AB        | B              | M1                | 2             | 1            | 336.611        | 21.767        | 0.263           | 0.044                       | 6                   | LGM/SGM      | 0.0073              | 341.805                        | 22.103                        |
| HFUB216B        | B              | M2                | 2             | 2            | 356.433        | 22.119        | 0.282           | 0.043                       | 6                   | XGM          | 0.0072              | 355.058                        | 22.034                        |
| HFUB217B        | B              | M2                | 2             | 2            | 378.947        | 22.968        | 0.260           | 0.043                       | 6                   | LGM/SGM      | 0.0072              | 379.970                        | 23.030                        |
| HFUB218B        | B              | M2                | 2             | 2            | 357.856        | 21.870        | 0.259           | 0.044                       | 6                   | XGM          | 0.0073              | 360.617                        | 22.039                        |
| HFUC116B        | C              | M1                | 3             | 1            | 351.051        | 22.324        | 0.265           | 0.044                       | 6                   | XGM          | 0.0073              | 356.197                        | 22.651                        |
| HFUC117B        | C              | M1                | 3             | 1            | 350.530        | 22.293        | 0.299           | 0.045                       | 6                   | XGM          | 0.0075              | 363.513                        | 23.119                        |
| HFUC118B        | C              | M1                | 3             | 1            | 363.478        | 22.583        | 0.297           | 0.044                       | 6                   | XGM          | 0.0074              | 373.715                        | 23.219                        |
| HFUC216B        | C              | M2                | 3             | 2            | 342.104        | 22.203        | 0.316           | 0.044                       | 6                   | SGM/LGM      | 0.0073              | 346.196                        | 22.468                        |
| HFUC217B        | C              | M2                | 3             | 2            | 346.534        | 22.476        | 0.299           | 0.044                       | 6                   | XGM          | 0.0073              | 352.015                        | 22.832                        |
| HFUC218B        | C              | M2                | 3             | 2            | 349.867        | 22.421        | 0.295           | 0.044                       | 6                   | XGM          | 0.0073              | 354.321                        | 22.706                        |

Average 353.700 22.333 0.270  
Standard Dev. 13.087 0.368 0.025  
Coeff. of Var. [%] 3.700 1.646 9.317  
Min. 322.580 21.742 0.213  
Max. 378.947 22.968 0.316  
Number of Spec. 22 22 22

Average<sub>norm</sub> 0.0073 357.389 22.568  
Standard Dev.<sub>norm</sub> 12.620 0.387  
Coeff. of Var. [%]<sub>norm</sub> 3.531 1.717  
Min. 0.0071 325.692 21.852  
Max. 0.0075 379.970 23.219  
Number of Spec. 22 22



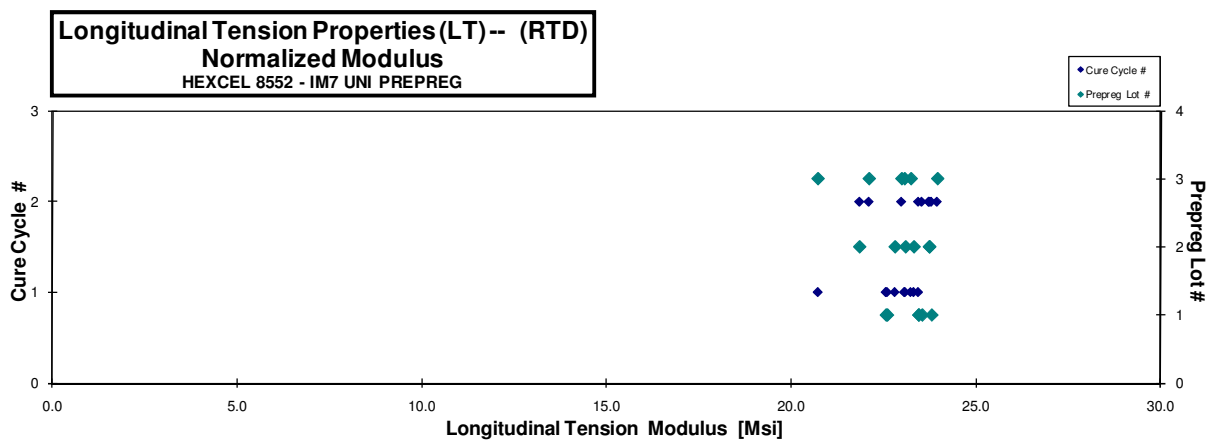
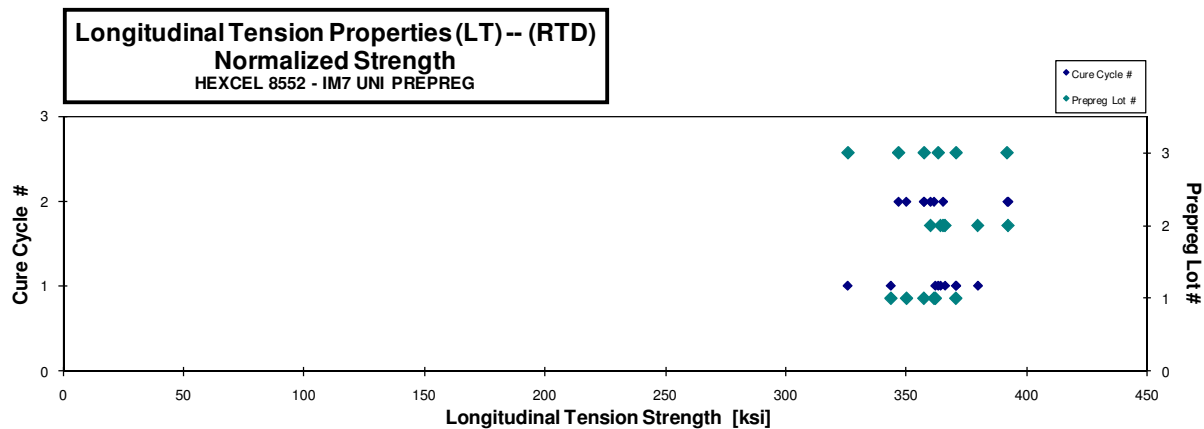
**Longitudinal Tension Properties (LT) -- (RTD)**  
**Strength & Modulus**  
 HEXCEL 8552 - IM7 UNI PREPREG

normalizing  $t_{ply}$   
 [in]  
 0.0072

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Modulus [Msi] | Poisson's Ratio | Avg. Specimen Thicken. [in] | # Plies in Laminate | Failure Mode | Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] | Modulus <sub>norm</sub> [Msi] |
|-----------------|----------------|-------------------|---------------|--------------|----------------|---------------|-----------------|-----------------------------|---------------------|--------------|---------------------|--------------------------------|-------------------------------|
| HFUA111A        | A              | M1                | 1             | 1            | 363.189        | 23.841        | 0.300           | 0.041                       | 6                   | XGM          | 0.0068              | 343.573                        | 22.553                        |
| HFUA112A        | A              | M1                | 1             | 1            | 374.161        | 23.658        | 0.283           | 0.043                       | 6                   | XGM          | 0.0071              | 370.552                        | 23.430                        |
| HFUA113A        | A              | M1                | 1             | 1            | 368.425        | 22.987        | 0.312           | 0.042                       | 6                   | XGM          | 0.0071              | 362.029                        | 22.588                        |
| HFUA211A        | A              | M2                | 1             | 2            | 370.513        | 24.377        | 0.356           | 0.042                       | 6                   | XGM          | 0.0070              | 361.507                        | 23.785                        |
| HFUA212A        | A              | M2                | 1             | 2            | 340.311        | 22.783        | 0.306           | 0.044                       | 6                   | XGM          | 0.0074              | 350.027                        | 23.433                        |
| HFUA213A        | A              | M2                | 1             | 2            | 348.015        | 22.918        | 0.325           | 0.044                       | 6                   | XGM          | 0.0074              | 357.280                        | 23.528                        |
| HFUB111A        | B              | M1                | 2             | 1            | 389.234        | 24.235        | 0.316           | 0.041                       | 6                   | XGM          | 0.0068              | 366.109                        | 22.795                        |
| HFUB112A        | B              | M1                | 2             | 1            | 381.337        | 23.404        | 0.308           | 0.043                       | 6                   | XGM          | 0.0072              | 379.719                        | 23.305                        |
| HFUB113A        | B              | M1                | 2             | 1            | 361.174        | 22.881        | 0.308           | 0.044                       | 6                   | XGM          | 0.0073              | 364.239                        | 23.076                        |
| HFUB211A        | B              | M2                | 2             | 2            | 401.224        | 24.332        | 0.315           | 0.039                       | 6                   | XGM          | 0.0065              | 360.049                        | 21.835                        |
| HFUB212A        | B              | M2                | 2             | 2            | 391.416        | 23.661        | 0.326           | 0.043                       | 6                   | XGM          | 0.0072              | 392.322                        | 23.716                        |
| HFUB213A        | B              | M2                | 2             | 2            | 359.564        | 23.361        | 0.319           | 0.044                       | 6                   | XGM          | 0.0073              | 365.251                        | 23.731                        |
| HFUC111A        | C              | M1                | 3             | 1            | 368.314        | 23.417        | 0.315           | 0.038                       | 6                   | XGM          | 0.0064              | 325.685                        | 20.707                        |
| HFUC112A        | C              | M1                | 3             | 1            | 378.487        | 24.196        | 0.354           | 0.041                       | 6                   | XGM          | 0.0069              | 363.301                        | 23.225                        |
| HFUC112A        | C              | M1                | 3             | 1            | 367.440        | 22.850        | 0.314           | 0.044                       | 6                   | XGM          | 0.0073              | 370.700                        | 23.053                        |
| HFUC211A        | C              | M2                | 3             | 2            | 372.821        | 23.749        | 0.306           | 0.040                       | 6                   | XGM          | 0.0067              | 346.787                        | 22.090                        |
| HFUC212A        | C              | M2                | 3             | 2            | 359.372        | 23.098        | 0.306           | 0.043                       | 6                   | XGM          | 0.0072              | 357.431                        | 22.973                        |
| HFUC213A        | C              | M2                | 3             | 2            | 384.495        | 23.488        | 0.312           | 0.044                       | 6                   | XGM          | 0.0073              | 391.912                        | 23.941                        |

Average 371.083 23.513 0.316  
 Standard Dev. 15.227 0.533 0.017  
 Coeff. of Var. [%] 4.103 2.267 5.450  
 Min. 340.311 22.783 0.283  
 Max. 401.224 24.377 0.356  
 Number of Spec. 18 18 18

Average<sub>norm</sub> 0.0070 362.693 22.987  
 Standard Dev.<sub>norm</sub> 16.057 0.812  
 Coeff. of Var. [%]<sub>norm</sub> 4.427 3.532  
 Min. 0.0064 325.685 20.707  
 Max. 0.0074 392.322 23.941  
 Number of Spec. 18 18



**Longitudinal Tension Properties (LT) -- (ETW)**  
**Strength & Modulus**  
 HEXCEL 8552 - IM7 UNI PREPREG

normalizing  $t_{ply}$ 

[in]

0.0072

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Modulus [Msi] | Poisson's Ratio | Avg. Specimen Thickn. [in] | # Plies in Laminate | Failure Mode | Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] | Modulus <sub>norm</sub> [Msi] |
|-----------------|----------------|-------------------|---------------|--------------|----------------|---------------|-----------------|----------------------------|---------------------|--------------|---------------------|--------------------------------|-------------------------------|
| HFUA11BD        | A              | M1                | 1             | 1            | 331.955        | 23.036        | 0.431           | 0.044                      | 6                   | SGM          | 0.0073              | 335.541                        | 23.285                        |
| HFUA11CD        | A              | M1                | 1             | 1            | 301.489        | 23.846        | 0.435           | 0.043                      | 6                   | XGM          | 0.0072              | 303.117                        | 23.975                        |
| HFUA11DD*       | A              | M1                | 1             | 1            |                | 23.922        | 0.400           | 0.043                      | 6                   | SGM / SIT    | 0.0072              |                                | 23.793                        |
| HFUA11FD*       | A              | M1                | 1             | 1            |                | 23.564        | 0.396           | 0.043                      | 6                   | SGM / SIT    | 0.0071              |                                | 23.382                        |
| HFUA11GD        | A              | M1                | 1             | 1            | 256.064        | 26.174        | 0.470           | 0.042                      | 6                   | XGM          | 0.0070              | 250.235                        | 25.578                        |
| HFUA21BD        | A              | M2                | 1             | 2            | 351.042        | 23.311        | 0.428           | 0.044                      | 6                   | XGM          | 0.0073              | 357.814                        | 23.761                        |
| HFUA21CD        | A              | M2                | 1             | 2            | 330.067        | 24.009        | 0.217           | 0.044                      | 6                   | XGM          | 0.0073              | 335.288                        | 24.389                        |
| HFUA21DD        | A              | M2                | 1             | 2            | 241.828        | 23.023        | 0.189           | 0.044                      | 6                   | SGM          | 0.0073              | 244.533                        | 23.281                        |
| HFUA21ED        | A              | M2                | 1             | 2            | 337.005        | 23.286        | 0.359           | 0.044                      | 6                   | XGM          | 0.0074              | 347.016                        | 23.977                        |
| HFUA21FD        | A              | M2                | 1             | 2            | 352.193        | 22.694        | 0.334           | 0.045                      | 6                   | SGM          | 0.0075              | 366.596                        | 23.622                        |
| HFUB11BD**      | B              | M1                | 2             | 1            | 292.200        |               |                 | 0.044                      | 6                   | XGM          | 0.0073              | 296.033                        |                               |
| HFUB11CD*       | B              | M1                | 2             | 1            |                | 24.475        | 0.443           | 0.044                      | 6                   | XGM / SIT    | 0.0073              |                                | 24.702                        |
| HFUB11DD**(*)   | B              | M1                | 2             | 1            |                | 23.469        |                 | 0.043                      | 6                   | SGM/SIT      | 0.0072              |                                | 23.496                        |
| HFUB11ED        | B              | M1                | 2             | 1            | 343.230        | 23.122        | 0.353           | 0.044                      | 6                   | XGM          | 0.0074              | 352.102                        | 23.719                        |
| HFUB11FD        | B              | M1                | 2             | 1            | 345.534        | 23.158        | 0.365           | 0.044                      | 6                   | XGM          | 0.0074              | 355.532                        | 23.828                        |
| HFUB21BD*       | B              | M2                | 2             | 2            |                | 23.704        | 0.477           | 0.043                      | 6                   | SIT          | 0.0072              |                                | 23.558                        |
| HFUB21CD*       | B              | M2                | 2             | 2            |                | 24.072        | 0.491           | 0.043                      | 6                   | XGM / SIT    | 0.0071              |                                | 23.738                        |
| HFUB21DD**(*)   | B              | M2                | 2             | 2            |                | 24.203        |                 | 0.043                      | 6                   | SGM / SIT    | 0.0072              |                                | 24.063                        |
| HFUB21ED*       | B              | M2                | 2             | 2            |                | 24.319        | 0.426           | 0.043                      | 6                   | SGM / SIT    | 0.0072              |                                | 24.356                        |
| HFUB21FD        | B              | M2                | 2             | 2            | 360.612        | 22.912        | 0.364           | 0.044                      | 6                   | XGM          | 0.0073              | 365.481                        | 23.222                        |
| HFUC11BD        | C              | M1                | 3             | 1            | 341.059        | 24.199        | 0.430           | 0.043                      | 6                   | DGM          | 0.0072              | 342.901                        | 24.329                        |
| HFUC11CD        | C              | M1                | 3             | 1            | 331.939        | 24.406        | 0.432           | 0.043                      | 6                   | XGM          | 0.0072              | 331.555                        | 24.378                        |
| HFUC11DD**      | C              | M1                | 3             | 1            | 308.746        | 23.422        |                 | 0.043                      | 6                   | XGM          | 0.0072              | 309.103                        | 23.449                        |
| HFUC11ED        | C              | M1                | 3             | 1            |                | 24.622        | 0.412           | 0.044                      | 6                   | SGM / SIT    | 0.0073              |                                | 24.831                        |
| HFUC11FD        | C              | M1                | 3             | 1            | 366.864        | 23.363        | 0.363           | 0.044                      | 6                   | XGM          | 0.0073              | 373.234                        | 23.769                        |
| HFUC21BD        | C              | M2                | 3             | 2            |                | 23.810        | 0.409           | 0.043                      | 6                   | SGM / SIT    | 0.0072              |                                | 23.930                        |
| HFUC21CD        | C              | M2                | 3             | 2            |                | 23.857        | 0.440           | 0.044                      | 6                   | SGM / SIT    | 0.0073              |                                | 24.023                        |
| HFUC21DD**      | C              | M2                | 3             | 2            |                | 24.376        |                 | 0.044                      | 6                   | SGM / SIT    | 0.0073              |                                | 24.790                        |
| HFUC21ED        | C              | M2                | 3             | 2            | 359.071        | 23.347        | 0.380           | 0.044                      | 6                   | XGM          | 0.0074              | 369.461                        | 24.023                        |
| HFUC21FD        | C              | M2                | 3             | 2            | 352.438        | 23.761        | 0.382           | 0.045                      | 6                   | XGM          | 0.0075              | 367.531                        | 24.778                        |

HIGH FREQUENCY OF UNACCEPTABLE FAILURES. ADHESIVE USED TO BOND TABS APPEARS TO BE INADEQUATE

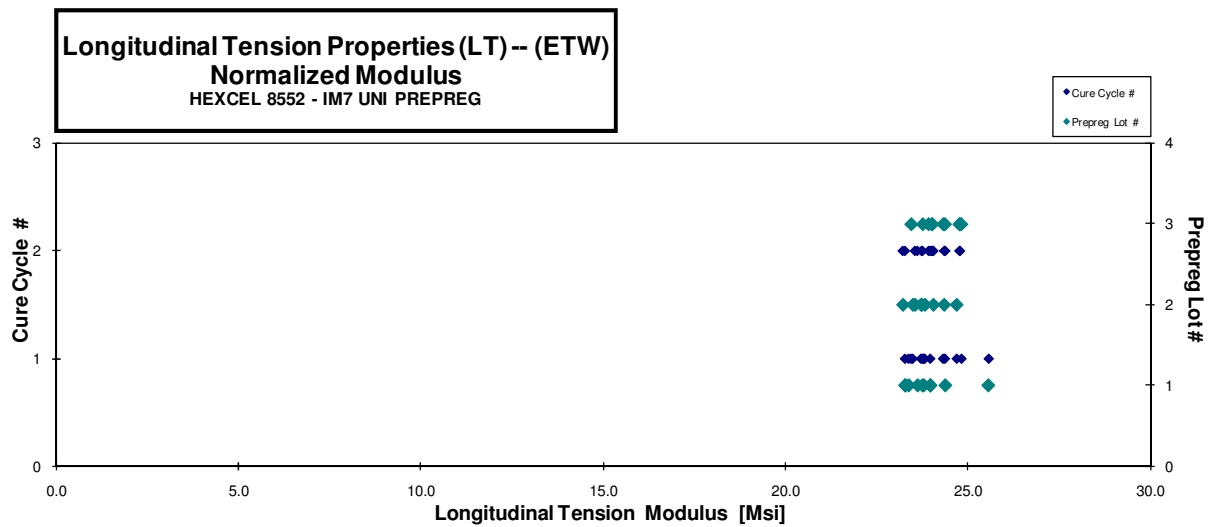
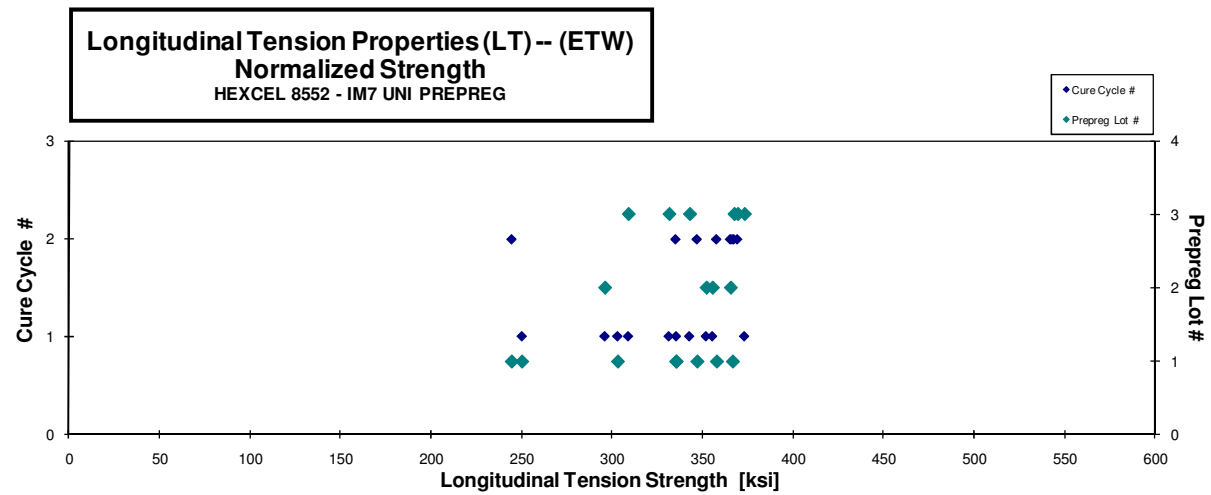
\*COUPONS EXPERIENCED AN UN ACCEPTABLE FAILURE AND THE STRENGTH WAS REMOVED

\*\*MODULUS AND/OR POISSONS RATIO WAS REMOVED DUE TO NON-LINEARITY

|                    |         |        |        |
|--------------------|---------|--------|--------|
| Average            | 327.963 | 23.775 | 0.393  |
| Standard Dev.      | 35.176  | 0.693  | 0.070  |
| Coeff. of Var. [%] | 10.726  | 2.917  | 17.820 |
| Min.               | 241.828 | 22.694 | 0.189  |
| Max.               | 366.864 | 26.174 | 0.491  |
| Number of Spec.    | 18      | 29     | 25     |

|                                    |        |         |        |
|------------------------------------|--------|---------|--------|
| Average <sub>norm</sub>            | 0.0073 | 333.504 | 24.001 |
| Standard Dev. <sub>norm</sub>      |        | 38.823  | 0.557  |
| Coeff. of Var. [%] <sub>norm</sub> |        | 11.641  | 2.321  |
| Min.                               | 0.0070 | 244.533 | 23.222 |
| Max.                               | 0.0075 | 373.234 | 25.578 |
| Number of Spec.                    |        | 18      | 29     |



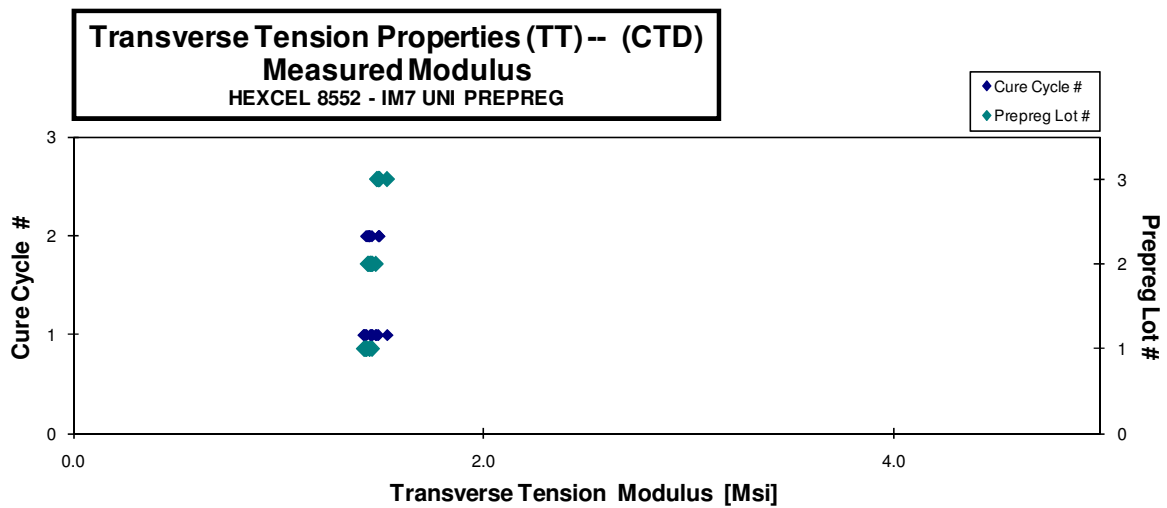
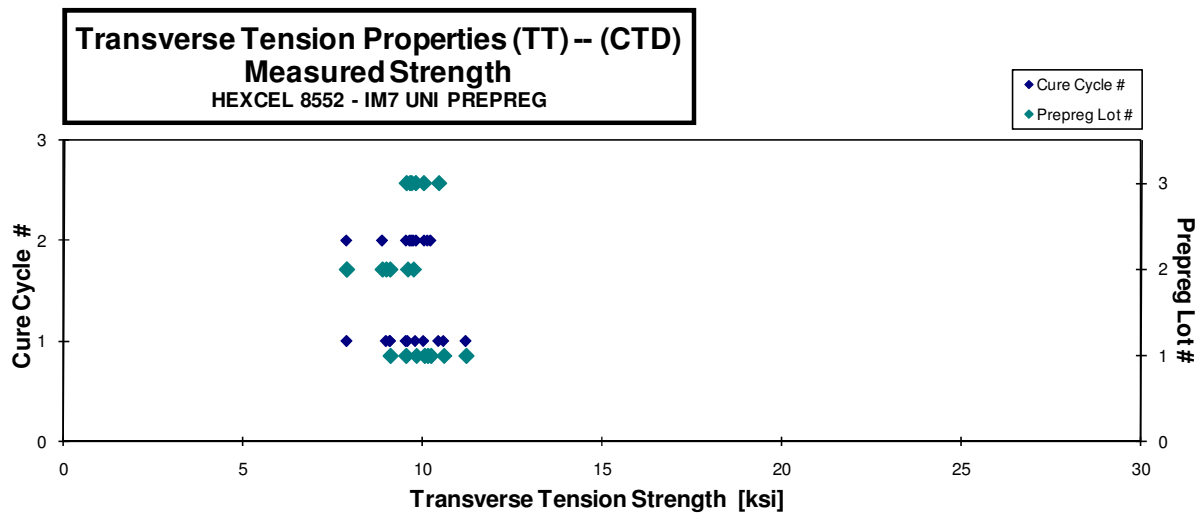


## 4.2 Transverse Tension Properties

|                                                                                                                      |
|----------------------------------------------------------------------------------------------------------------------|
| <b>Transverse Tension Properties (TT) -- (CTD)</b><br><b>Strength &amp; Modulus</b><br>HEXCEL 8552 - IM7 UNI PREPREG |
|----------------------------------------------------------------------------------------------------------------------|

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Modulus [Msi] | Avg. Specimen Thickn. [in] | # Plies in Laminate | Avg. $t_{ply}$ [in] | Failure Mode |
|-----------------|----------------|-------------------|---------------|--------------|----------------|---------------|----------------------------|---------------------|---------------------|--------------|
| HFIUA116B       | A              | M1                | 1             | 1            | 9.090          | 1.431         | 0.081                      | 11                  | 0.0074              | LGM          |
| HFIUA117B       | A              | M1                | 1             | 1            | 9.524          | 1.421         | 0.081                      | 11                  | 0.0074              | LAT          |
| HFIUA118B       | A              | M1                | 1             | 1            | 11.192         | 1.425         | 0.082                      | 11                  | 0.0075              | LAB          |
| HFIUA119B       | A              | M1                | 1             | 1            | 10.574         | 1.417         | 0.082                      | 11                  | 0.0075              | LAT/LWB      |
| HFIUA215B       | A              | M2                | 1             | 2            | 9.812          | 1.446         | 0.081                      | 11                  | 0.0073              | LGM          |
| HFIUA216B       | A              | M2                | 1             | 2            | 10.127         | 1.445         | 0.081                      | 11                  | 0.0074              | LGM/LAT      |
| HFIUA217B       | A              | M2                | 1             | 2            | 10.039         | 1.458         | 0.081                      | 11                  | 0.0073              | LGM          |
| HFIUA218B       | A              | M2                | 1             | 2            | 10.215         | 1.430         | 0.082                      | 11                  | 0.0075              | LGM          |
| HFIUB115B       | B              | M1                | 2             | 1            | 9.082          | 1.460         | 0.078                      | 11                  | 0.0071              | LAB          |
| HFIUB116B       | B              | M1                | 2             | 1            | 8.976          | 1.476         | 0.078                      | 11                  | 0.0071              | LAB          |
| HFIUB117B       | B              | M1                | 2             | 1            | 7.881          | 1.450         | 0.078                      | 11                  | 0.0071              | LAB          |
| HFIUB118B       | B              | M1                | 2             | 1            | 9.574          | 1.455         | 0.080                      | 11                  | 0.0072              | LGM          |
| HFIUB215B       | B              | M2                | 2             | 2            | 7.876          | 1.441         | 0.079                      | 11                  | 0.0072              | LWT          |
| HFIUB216B       | B              | M2                | 2             | 2            | 9.734          | 1.448         | 0.079                      | 11                  | 0.0072              | LWT          |
| HFIUB217B       | B              | M2                | 2             | 2            | 8.869          | 1.436         | 0.078                      | 11                  | 0.0071              | LAT          |
| HFIUC115B       | C              | M1                | 3             | 1            | 9.790          | 1.488         | 0.081                      | 11                  | 0.0074              | LWB          |
| HFIUC116B       | C              | M1                | 3             | 1            | 10.432         | 1.532         | 0.076                      | 11                  | 0.0069              | LAT          |
| HFIUC117B       | C              | M1                | 3             | 1            | 10.014         | 1.481         | 0.080                      | 11                  | 0.0072              | LAB          |
| HFIUC215B       | C              | M2                | 3             | 2            | 9.632          | 1.491         | 0.080                      | 11                  | 0.0073              | LWT          |
| HFIUC216B       | C              | M2                | 3             | 2            | 9.535          | 1.491         | 0.080                      | 11                  | 0.0073              | LWT          |
| HFIUC217B       | C              | M2                | 3             | 2            | 9.681          | 1.494         | 0.079                      | 11                  | 0.0072              | LGM          |

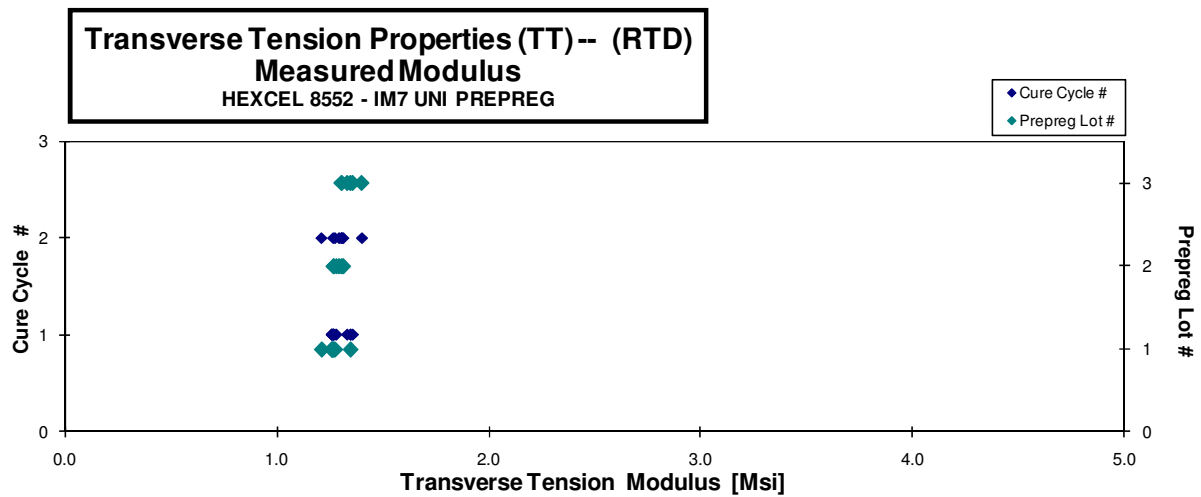
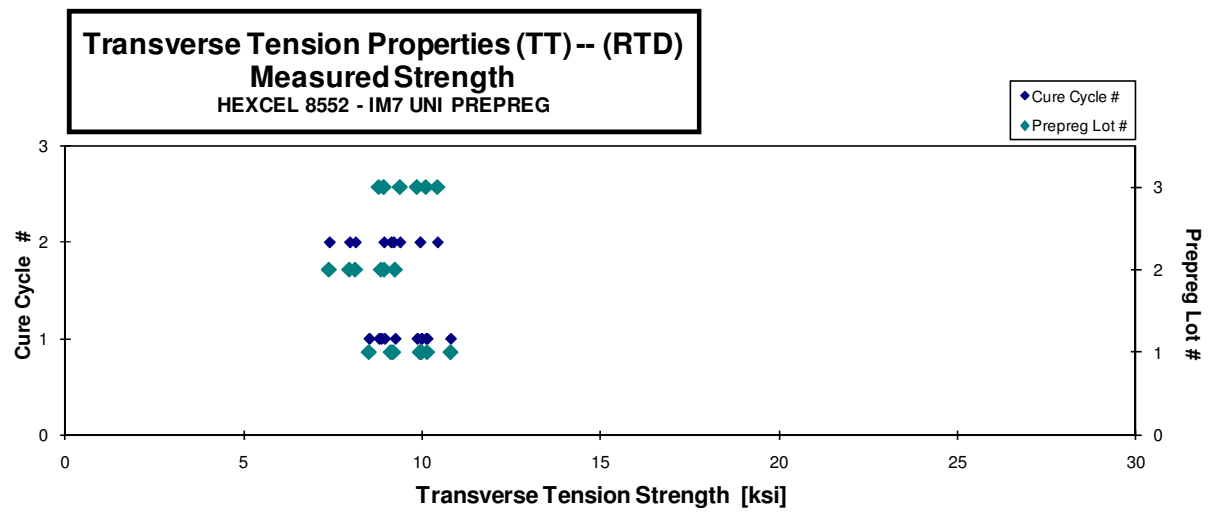
|                    |        |       |        |
|--------------------|--------|-------|--------|
| Average            | 9.602  | 1.458 | 0.0073 |
| Standard Dev.      | 0.797  | 0.030 |        |
| Coeff. of Var. [%] | 8.297  | 2.037 |        |
| Min.               | 7.876  | 1.417 | 0.0069 |
| Max.               | 11.192 | 1.532 | 0.0075 |
| Number of Spec.    | 21     | 21    |        |



**Transverse Tension Properties (TT) -- (RTD)**  
**Strength & Modulus**  
 HEXCEL 8552 - IM7 UNI PREPREG

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Modulus [Msi] | Avg. Specimen Thickn. [in] | # Plies in Laminate | Avg. $t_{ply}$ [in] | Failure Mode |
|-----------------|----------------|-------------------|---------------|--------------|----------------|---------------|----------------------------|---------------------|---------------------|--------------|
| HFIUA111A       | A              | M1                | 1             | 1            | 9.972          | 1.350         | 0.075                      | 11                  | 0.0068              | LAT          |
| HFIUA112A       | A              | M1                | 1             | 1            | 10.801         | 1.263         | 0.083                      | 11                  | 0.0076              | LWT          |
| HFIUA113A       | A              | M1                | 1             | 1            | 8.514          | 1.271         | 0.083                      | 11                  | 0.0075              | LGM          |
| HFIUA114A       | A              | M1                | 1             | 1            | 9.987          | 1.262         | 0.081                      | 11                  | 0.0074              | LAB          |
| HFIUA115A       | A              | M1                | 1             | 1            | 10.145         | 1.262         | 0.082                      | 11                  | 0.0074              | LAT          |
| HFIUA212A       | A              | M2                | 1             | 2            | 9.127          | 1.276         | 0.082                      | 11                  | 0.0075              | LGM          |
| HFIUA213A       | A              | M2                | 1             | 2            | 9.942          | 1.214         | 0.082                      | 11                  | 0.0075              | LGM          |
| HFIUA214A       | A              | M2                | 1             | 2            | 9.195          | 1.268         | 0.081                      | 11                  | 0.0073              | LGM          |
| HFIUB112A       | B              | M1                | 2             | 1            | 8.853          | 1.269         | 0.079                      | 11                  | 0.0072              | LGM          |
| HFIUB113A       | B              | M1                | 2             | 1            | 8.946          | 1.270         | 0.080                      | 11                  | 0.0072              | LWB          |
| HFIUB114A       | B              | M1                | 2             | 1            | 9.246          | 1.282         | 0.078                      | 11                  | 0.0071              | LWB          |
| HFIUB212A       | B              | M2                | 2             | 2            | 7.397          | 1.295         | 0.080                      | 11                  | 0.0073              | LGM          |
| HFIUB213A       | B              | M2                | 2             | 2            | 7.967          | 1.307         | 0.079                      | 11                  | 0.0072              | LAB          |
| HFIUB214A       | B              | M2                | 2             | 2            | 8.132          | 1.315         | 0.078                      | 11                  | 0.0071              | LAT          |
| HFIUC111A       | C              | M1                | 3             | 1            | 9.860          | 1.359         | 0.078                      | 11                  | 0.0071              | LGM          |
| HFIUC112A       | C              | M1                | 3             | 1            | 8.791          | 1.333         | 0.080                      | 11                  | 0.0073              | LAT          |
| HFIUC113A       | C              | M1                | 3             | 1            | 10.109         | 1.348         | 0.080                      | 11                  | 0.0072              | LAT          |
| HFIUC211A       | C              | M2                | 3             | 2            | 8.929          | 1.401         | 0.075                      | 11                  | 0.0068              | LGM          |
| HFIUC212A       | C              | M2                | 3             | 2            | 10.430         | 1.307         | 0.081                      | 11                  | 0.0074              | LGM          |
| HFIUC213A       | C              | M2                | 3             | 2            | 9.381          | 1.307         | 0.080                      | 11                  | 0.0073              | LAT          |

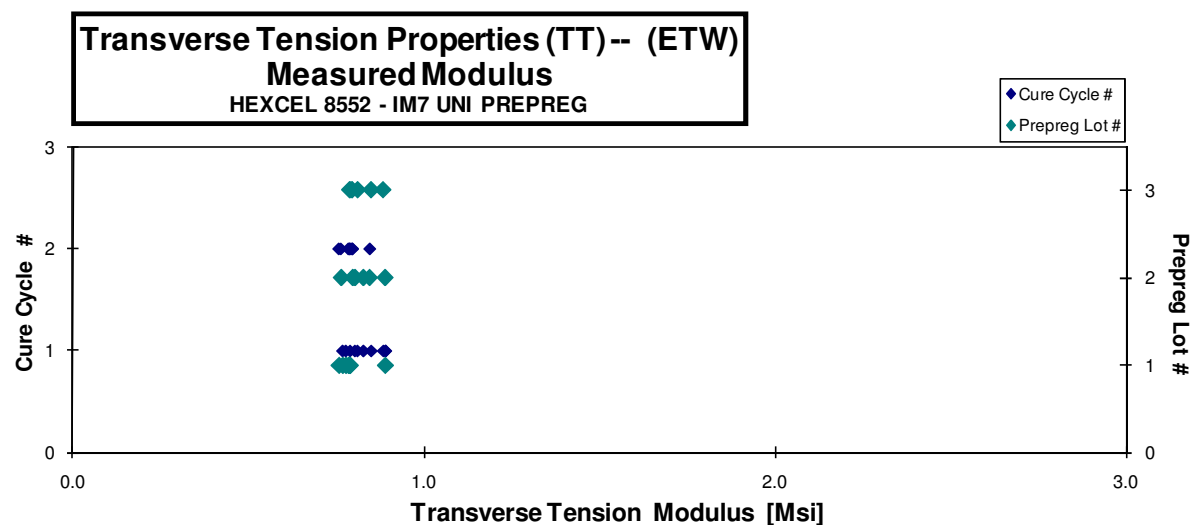
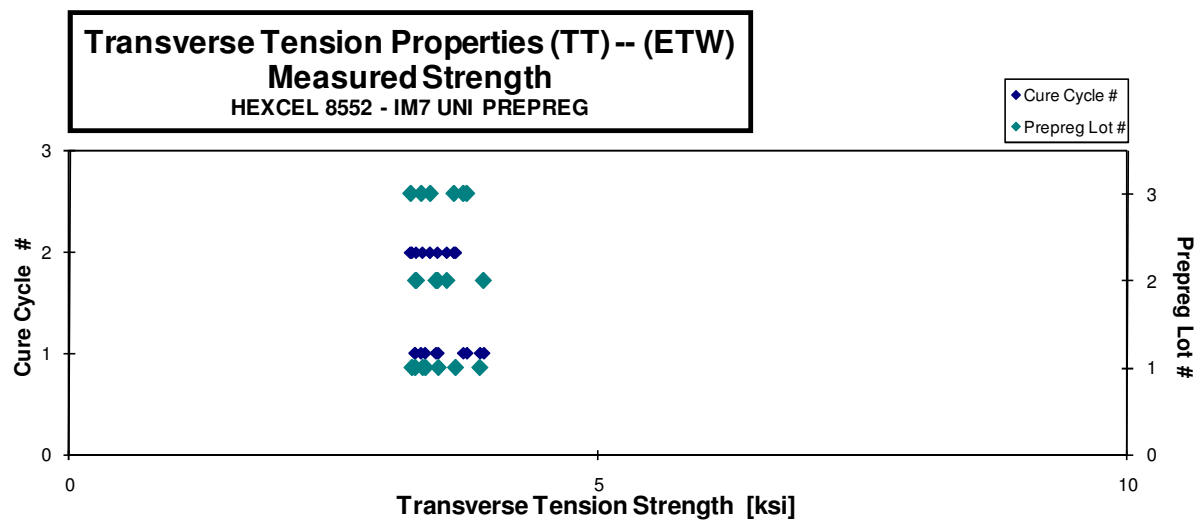
|                           |               |              |               |
|---------------------------|---------------|--------------|---------------|
| <b>Average</b>            | <b>9.286</b>  | <b>1.298</b> | <b>0.0073</b> |
| <b>Standard Dev.</b>      | <b>0.879</b>  | <b>0.044</b> |               |
| <b>Coeff. of Var. [%]</b> | <b>9.470</b>  | <b>3.365</b> |               |
| <b>Min.</b>               | <b>7.397</b>  | <b>1.214</b> | <b>0.0068</b> |
| <b>Max.</b>               | <b>10.801</b> | <b>1.401</b> | <b>0.0076</b> |
| <b>Number of Spec.</b>    | <b>20</b>     | <b>20</b>    |               |



|                                                                                                                      |
|----------------------------------------------------------------------------------------------------------------------|
| <b>Transverse Tension Properties (TT) -- (ETW)</b><br><b>Strength &amp; Modulus</b><br>HEXCEL 8552 - IM7 UNI PREPREG |
|----------------------------------------------------------------------------------------------------------------------|

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Modulus [Msi] | Avg. Specimen Thickn. [in] | # Plies in Laminate | Avg. $t_{ply}$ [in] | Failure Mode |
|-----------------|----------------|-------------------|---------------|--------------|----------------|---------------|----------------------------|---------------------|---------------------|--------------|
| HFIUA11AD       | A              | M1                | 1             | 1            | 3.879          | 0.891         | 0.076                      | 11                  | 0.0069              | LGM          |
| HFIUA11BD       | A              | M1                | 1             | 1            | 3.265          | 0.791         | 0.082                      | 11                  | 0.0074              | LGM          |
| HFIUA11CD       | A              | M1                | 1             | 1            | 3.362          | 0.769         | 0.081                      | 11                  | 0.0074              | LGM          |
| HFIUA11DD       | A              | M1                | 1             | 1            | 3.486          | 0.778         | 0.080                      | 11                  | 0.0073              | LGM          |
| HFIUA219D       | A              | M2                | 1             | 2            | 3.337          | 0.786         | 0.081                      | 11                  | 0.0074              | LGM          |
| HFIUA21BD       | A              | M2                | 1             | 2            | 3.236          | 0.759         | 0.083                      | 11                  | 0.0075              | LGM          |
| HFIUA21CD       | A              | M2                | 1             | 2            | 3.649          | 0.789         | 0.082                      | 11                  | 0.0075              | LGM          |
| HFIUB119D       | B              | M1                | 2             | 1            | 3.464          | 0.804         | 0.080                      | 11                  | 0.0073              | LGM          |
| HFIUB11AD       | B              | M1                | 2             | 1            | 3.269          | 0.828         | 0.076                      | 11                  | 0.0069              | LGM          |
| HFIUB11BD       | B              | M1                | 2             | 1            | 3.915          | 0.890         | 0.072                      | 11                  | 0.0065              | LGM          |
| HFIUB218D       | B              | M2                | 2             | 2            | 3.566          | 0.798         | 0.079                      | 11                  | 0.0072              | LGM          |
| HFIUB219D       | B              | M2                | 2             | 2            | 3.277          | 0.765         | 0.080                      | 11                  | 0.0073              | LGM          |
| HFIUB21BD       | B              | M2                | 2             | 2            | 3.478          | 0.846         | 0.073                      | 11                  | 0.0067              | LGM          |
| HFIUC118D       | C              | M1                | 3             | 1            | 3.756          | 0.850         | 0.080                      | 11                  | 0.0073              | LGM          |
| HFIUC119D       | C              | M1                | 3             | 1            | 3.323          | 0.811         | 0.081                      | 11                  | 0.0074              | LGM          |
| HFIUC11AD       | C              | M1                | 3             | 1            | 3.721          | 0.884         | 0.075                      | 11                  | 0.0068              | LGM          |
| HFIUC218D       | C              | M2                | 3             | 2            | 3.633          | 0.793         | 0.080                      | 11                  | 0.0073              | LGM          |
| HFIUC219D       | C              | M2                | 3             | 2            | 3.223          | 0.796         | 0.081                      | 11                  | 0.0074              | LGM          |
| HFIUC21BD       | C              | M2                | 3             | 2            | 3.408          | 0.789         | 0.081                      | 11                  | 0.0074              | LGM          |

|                           |              |              |               |
|---------------------------|--------------|--------------|---------------|
| <b>Average</b>            | <b>3.487</b> | <b>0.811</b> | <b>0.0072</b> |
| <b>Standard Dev.</b>      | <b>0.219</b> | <b>0.042</b> |               |
| <b>Coeff. of Var. [%]</b> | <b>6.281</b> | <b>5.149</b> |               |
| <b>Min.</b>               | <b>3.223</b> | <b>0.759</b> | <b>0.0065</b> |
| <b>Max.</b>               | <b>3.915</b> | <b>0.891</b> | <b>0.0075</b> |
| <b>Number of Spec.</b>    | <b>19</b>    | <b>19</b>    |               |

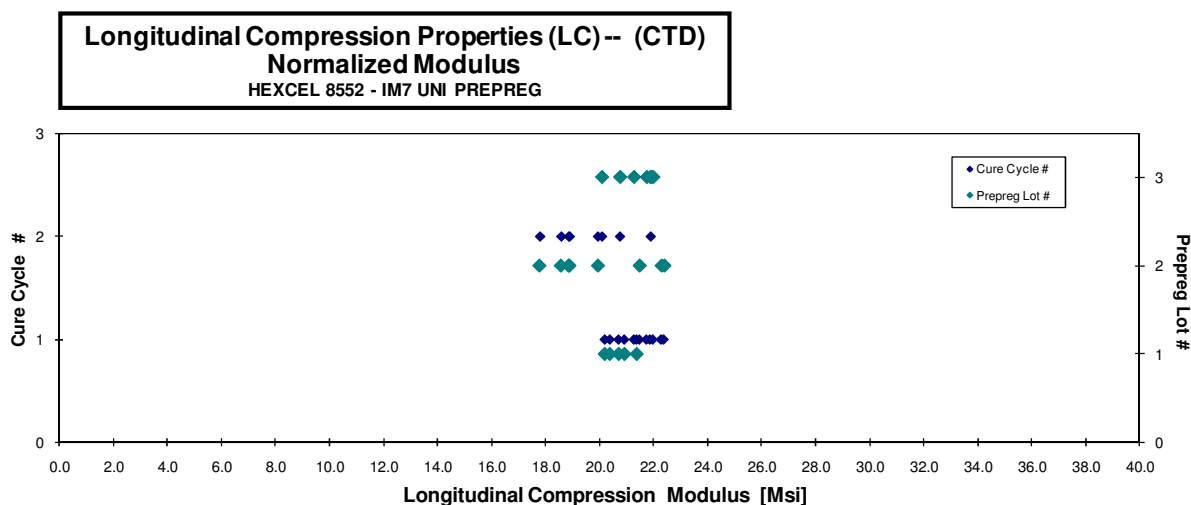


### 4.3 Longitudinal Compression Properties

| Longitudinal Compression Properties (LC)-- (CTD)<br>Strength & Modulus<br>HEXCEL 8552 - IM7 UNI PREPREG |                |                   |               |              |               |                 |                            |                     | normalizing $t_{ply}$<br>[in]<br>0.0072 |                               |
|---------------------------------------------------------------------------------------------------------|----------------|-------------------|---------------|--------------|---------------|-----------------|----------------------------|---------------------|-----------------------------------------|-------------------------------|
| Specimen Number                                                                                         | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Modulus [Msi] | Poisson's Ratio | Avg. Specimen Thickn. [in] | # Plies in Laminate | Avg. $t_{ply}$ [in]                     | Modulus <sub>norm</sub> [Msi] |
| HFILA115B                                                                                               | A              | M1                | 1             | 1            | 20.088        | 0.451           | 0.104                      | 14                  | 0.0074                                  | 20.709                        |
| HFILA116B                                                                                               | A              | M1                | 1             | 1            | 20.307        | 0.404           | 0.104                      | 14                  | 0.0074                                  | 20.925                        |
| HFILA117B                                                                                               | A              | M1                | 1             | 1            | 21.024        | 0.287           | 0.102                      | 14                  | 0.0073                                  | 21.375                        |
| HFILA118B                                                                                               | A              | M1                | 1             | 1            | 20.317        | 0.335           | 0.101                      | 14                  | 0.0072                                  | 20.384                        |
| HFILA119B                                                                                               | A              | M1                | 1             | 1            | 20.148        | 0.364           | 0.101                      | 14                  | 0.0072                                  | 20.201                        |
| HFILA215B*                                                                                              | A              | M2                | 1             | 2            |               |                 |                            | 14                  |                                         |                               |
| HFILA216B*                                                                                              | A              | M2                | 1             | 2            |               |                 |                            | 14                  |                                         |                               |
| HFILA217B*                                                                                              | A              | M2                | 1             | 2            |               |                 |                            | 14                  |                                         |                               |
| HFILB115B                                                                                               | B              | M1                | 2             | 1            | 20.258        | 0.362           | 0.107                      | 14                  | 0.0076                                  | 21.484                        |
| HFILB116B                                                                                               | B              | M1                | 2             | 1            | 20.915        | 0.335           | 0.108                      | 14                  | 0.0077                                  | 22.392                        |
| HFILB117B                                                                                               | B              | M1                | 2             | 1            | 20.967        | 0.289           | 0.107                      | 14                  | 0.0077                                  | 22.291                        |
| HFILB215B                                                                                               | B              | M2                | 2             | 2            | 21.136        | 0.331           | 0.095                      | 14                  | 0.0068                                  | 19.952                        |
| HFILB216B                                                                                               | B              | M2                | 2             | 2            | 19.971        | 0.466           | 0.094                      | 14                  | 0.0067                                  | 18.584                        |
| HFILB217B                                                                                               | B              | M2                | 2             | 2            | 19.049        | 0.305           | 0.094                      | 14                  | 0.0067                                  | 17.796                        |
| HFILB218B                                                                                               | B              | M2                | 2             | 2            | 20.368        | 0.447           | 0.093                      | 14                  | 0.0067                                  | 18.866                        |
| HFILB219B                                                                                               | B              | M2                | 2             | 2            | 20.413        | 0.354           | 0.093                      | 14                  | 0.0067                                  | 18.901                        |
| HFILC115B                                                                                               | C              | M1                | 3             | 1            | 20.998        | 0.411           | 0.105                      | 14                  | 0.0075                                  | 21.873                        |
| HFILC116B                                                                                               | C              | M1                | 3             | 1            | 21.288        | 0.351           | 0.104                      | 14                  | 0.0074                                  | 21.989                        |
| HFILC117B                                                                                               | C              | M1                | 3             | 1            | 21.291        | 0.355           | 0.103                      | 14                  | 0.0074                                  | 21.745                        |
| HFILC118B                                                                                               | C              | M1                | 3             | 1            | 20.974        | 0.378           | 0.102                      | 14                  | 0.0073                                  | 21.280                        |
| HFILC215B                                                                                               | C              | M2                | 3             | 2            | 21.130        | 0.372           | 0.105                      | 14                  | 0.0075                                  | 21.916                        |
| HFILC216B                                                                                               | C              | M2                | 3             | 2            | 19.562        | 0.301           | 0.104                      | 14                  | 0.0074                                  | 20.099                        |
| HFILC217B                                                                                               | C              | M2                | 3             | 2            | 20.370        | 0.332           | 0.103                      | 14                  | 0.0073                                  | 20.767                        |

Specimens have uneven grip marks so values are removed

|                    |        |        |                                    |        |        |
|--------------------|--------|--------|------------------------------------|--------|--------|
| Average            | 20.529 | 0.362  | Average <sub>norm</sub>            | 0.0072 | 20.676 |
| Standard Dev.      | 0.603  | 0.052  | Standard Dev. <sub>norm</sub>      |        | 1.323  |
| Coeff. of Var. [%] | 2.935  | 14.482 | Coeff. of Var. [%] <sub>norm</sub> |        | 6.396  |
| Min.               | 19.049 | 0.287  |                                    | 0.0067 | 17.796 |
| Max.               | 21.291 | 0.466  |                                    | 0.0077 | 22.392 |
| Number of Spec.    | 20     | 20     |                                    |        | 20     |





**Longitudinal Compression Properties (LC) -- (RTD)**  
**Strength & Modulus**  
 HEXCEL 8552 - IM7 UNI PREPREG

normalizing  $t_{ply}$   
 [in]  
 0.0072

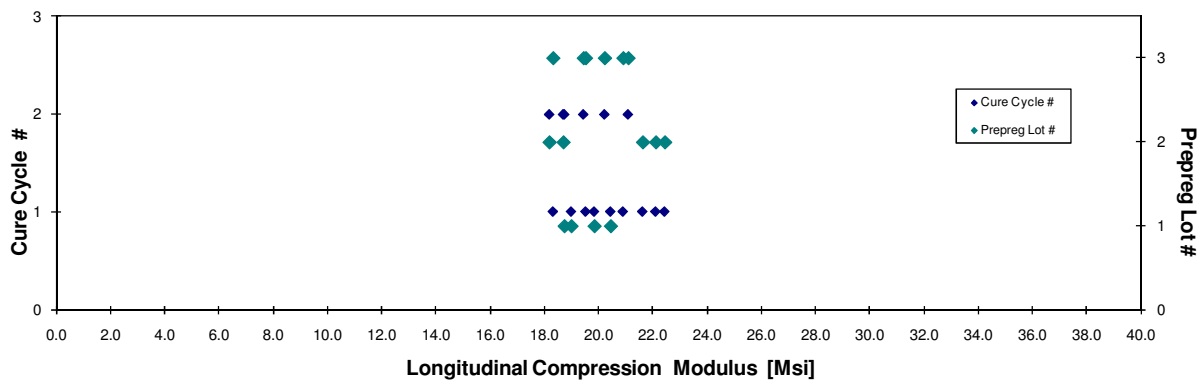
| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Modulus [Msi] | Poisson's Ratio | Avg. Specimen Thickn. [in] | # Plies in Laminate | Avg. $t_{ply}$ [in] | Modulus <sub>norm</sub> [Msi] |
|-----------------|----------------|-------------------|---------------|--------------|---------------|-----------------|----------------------------|---------------------|---------------------|-------------------------------|
| HFILA111A*      | A              | M1                | 1             | 1            |               |                 |                            | 14                  |                     |                               |
| HFILA112A       | A              | M1                | 1             | 1            | 20.248        | 0.352           | 0.095                      | 14                  | 0.0068              | 18.993                        |
| HFILA113A       | A              | M1                | 1             | 1            | 19.799        | 0.366           | 0.101                      | 14                  | 0.0072              | 19.839                        |
| HFILA114A       | A              | M1                | 1             | 1            | 19.957        | 0.372           | 0.103                      | 14                  | 0.0074              | 20.439                        |
| HFILA211A*      | A              | M2                | 1             | 2            |               |                 |                            | 14                  |                     |                               |
| HFILA212A*      | A              | M2                | 1             | 2            |               |                 |                            | 14                  |                     |                               |
| HFILA213A       | A              | M2                | 1             | 2            | 20.235        | 0.360           | 0.093                      | 14                  | 0.0067              | 18.742                        |
| HFILB111A       | B              | M1                | 2             | 1            | 20.667        | 0.423           | 0.108                      | 14                  | 0.0077              | 22.099                        |
| HFILB112A       | B              | M1                | 2             | 1            | 20.777        | 0.335           | 0.109                      | 14                  | 0.0078              | 22.429                        |
| HFILB113A       | B              | M1                | 2             | 1            | 20.230        | 0.310           | 0.108                      | 14                  | 0.0077              | 21.618                        |
| HFILB211A*      | B              | M2                | 2             | 2            |               |                 |                            | 14                  |                     |                               |
| HFILB212A       | B              | M2                | 2             | 2            | 20.534        | 0.335           | 0.089                      | 14                  | 0.0064              | 18.188                        |
| HFILB213A       | B              | M2                | 2             | 2            | 20.256        | 0.310           | 0.093                      | 14                  | 0.0066              | 18.702                        |
| HFILC111A       | C              | M1                | 3             | 1            | 20.888        | 0.332           | 0.088                      | 14                  | 0.0063              | 18.325                        |
| HFILC112A       | C              | M1                | 3             | 1            | 20.446        | 0.369           | 0.096                      | 14                  | 0.0069              | 19.526                        |
| HFILC113A       | C              | M1                | 3             | 1            | 20.737        | 0.393           | 0.102                      | 14                  | 0.0073              | 20.898                        |
| HFILC211A       | C              | M2                | 3             | 2            | 20.745        | 0.358           | 0.094                      | 14                  | 0.0067              | 19.445                        |
| HFILC212A       | C              | M2                | 3             | 2            | 20.430        | 0.365           | 0.100                      | 14                  | 0.0071              | 20.221                        |
| HFILC213A       | C              | M2                | 3             | 2            | 20.658        | 0.365           | 0.103                      | 14                  | 0.0074              | 21.088                        |

Specimens have thickness taper on edge of coupon, so values were removed.

near edge thickness taper

|                    |        |       |                                    |        |        |
|--------------------|--------|-------|------------------------------------|--------|--------|
| Average            | 20.440 | 0.356 | Average <sub>norm</sub>            | 0.0071 | 20.037 |
| Standard Dev.      | 0.317  | 0.029 | Standard Dev. <sub>norm</sub>      |        | 1.365  |
| Coeff. of Var. [%] | 1.549  | 8.278 | Coeff. of Var. [%] <sub>norm</sub> |        | 6.810  |
| Min.               | 19.799 | 0.310 |                                    | 0.0063 | 18.188 |
| Max.               | 20.888 | 0.423 |                                    | 0.0078 | 22.429 |
| Number of Spec.    | 15     | 15    |                                    |        | 15     |

**Longitudinal Compression Properties (LC) -- (RTD)**  
**Normalized Modulus**  
 HEXCEL 8552 - IM7 UNI PREPREG



**Longitudinal Compression Properties (LC)-- (ETD)**  
**Strength & Modulus**  
 HEXCEL 8552 - IM7 UNI PREPREG

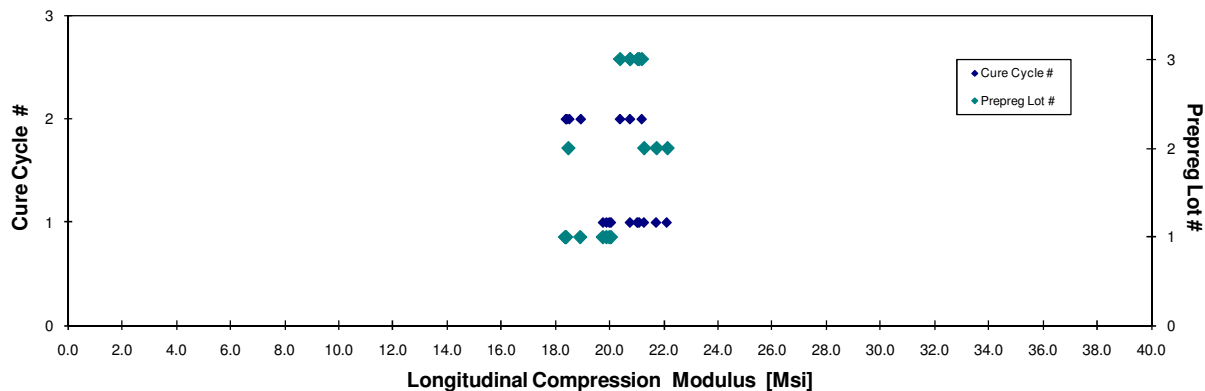
normalizing  $t_{ply}$   
 [in]  
 0.0072

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Modulus [Msi] | Poisson's Ratio | Avg. Specimen Thickn. [in] | # Plies in Laminate | Avg. $t_{ply}$ [in] | Modulus <sub>norm</sub> [Msi] |
|-----------------|----------------|-------------------|---------------|--------------|---------------|-----------------|----------------------------|---------------------|---------------------|-------------------------------|
| HFILA1ROC       | A              | M1                | 1             | 1            | 19.773        | 0.385           | 0.101                      | 14                  | 0.0072              | 19.883                        |
| HFILA1RPC       | A              | M1                | 1             | 1            | 19.556        | 0.372           | 0.102                      | 14                  | 0.0073              | 19.753                        |
| HFILA1RQC       | A              | M1                | 1             | 1            | 19.564        | 0.369           | 0.103                      | 14                  | 0.0074              | 19.990                        |
| HFILA1RRC       | A              | M1                | 1             | 1            | 19.375        | 0.394           | 0.104                      | 14                  | 0.0075              | 20.048                        |
| HFILA218C       | A              | M2                | 1             | 2            | 19.534        | 0.396           | 0.095                      | 14                  | 0.0068              | 18.404                        |
| HFILA219C       | A              | M2                | 1             | 2            | 19.663        | 0.373           | 0.094                      | 14                  | 0.0067              | 18.369                        |
| HFILA21DC       | A              | M2                | 1             | 2            | 19.759        | 0.354           | 0.097                      | 14                  | 0.0069              | 18.923                        |
| HFILB118C       | B              | M1                | 2             | 1            | 20.919        | 0.401           | 0.107                      | 14                  | 0.0076              | 22.123                        |
| HFILB119C       | B              | M1                | 2             | 1            | 20.483        | 0.391           | 0.107                      | 14                  | 0.0076              | 21.722                        |
| HFILB11DC       | B              | M1                | 2             | 1            | 19.776        | 0.338           | 0.108                      | 14                  | 0.0077              | 21.271                        |
| HFILB21DC       | B              | M2                | 2             | 2            | 19.877        | 0.357           | 0.094                      | 14                  | 0.0067              | 18.493                        |
| HFILB2RMC*      | B              | M2                | 2             | 2            |               |                 | 0.084                      | 14                  |                     |                               |
| HFILB2RNC*      | B              | M2                | 2             | 2            |               |                 | 0.090                      | 14                  |                     |                               |
| HFILC11DC       | C              | M1                | 3             | 1            | 20.062        | 0.381           | 0.104                      | 14                  | 0.0074              | 20.756                        |
| HFILC114C       | C              | M1                | 3             | 1            | 20.358        | 0.360           | 0.104                      | 14                  | 0.0074              | 21.031                        |
| HFILC1RPC       | C              | M1                | 3             | 1            | 20.297        | 0.376           | 0.105                      | 14                  | 0.0075              | 21.092                        |
| HFILC21DC       | C              | M2                | 3             | 2            | 19.978        | 0.357           | 0.105                      | 14                  | 0.0075              | 20.754                        |
| HFILC218C       | C              | M2                | 3             | 2            | 20.084        | 0.366           | 0.102                      | 14                  | 0.0073              | 20.386                        |
| HFILC219C       | C              | M2                | 3             | 2            | 20.913        | 0.396           | 0.102                      | 14                  | 0.0073              | 21.190                        |

Specimens have thickness taper on edge of coupon, so values were removed.

|                           |               |              |                                          |               |               |
|---------------------------|---------------|--------------|------------------------------------------|---------------|---------------|
| <b>Average</b>            | <b>19.998</b> | <b>0.374</b> | <b>Average<sub>norm</sub></b>            | <b>0.0073</b> | <b>20.246</b> |
| <b>Standard Dev.</b>      | <b>0.463</b>  | <b>0.018</b> | <b>Standard Dev<sub>norm</sub></b>       |               | <b>1.165</b>  |
| <b>Coeff. of Var. [%]</b> | <b>2.313</b>  | <b>4.781</b> | <b>Coeff. of Var. [%]<sub>norm</sub></b> |               | <b>5.757</b>  |
| <b>Min.</b>               | <b>19.375</b> | <b>0.338</b> |                                          | <b>0.0067</b> | <b>18.369</b> |
| <b>Max.</b>               | <b>20.919</b> | <b>0.401</b> |                                          | <b>0.0077</b> | <b>22.123</b> |
| <b>Number of Spec.</b>    | <b>17</b>     | <b>17</b>    |                                          |               | <b>17</b>     |

**Longitudinal Compression Properties (LC)-- (ETD)**  
**Normalized Modulus**  
 HEXCEL 8552 - IM7 UNI PREPREG



**Longitudinal Compression Properties (LC) -- (ETW)**  
**Strength & Modulus**  
 HEXCEL 8552 - IM7 UNI PREPREG

normalizing  $t_{ply}$ 

[in]

0.0072

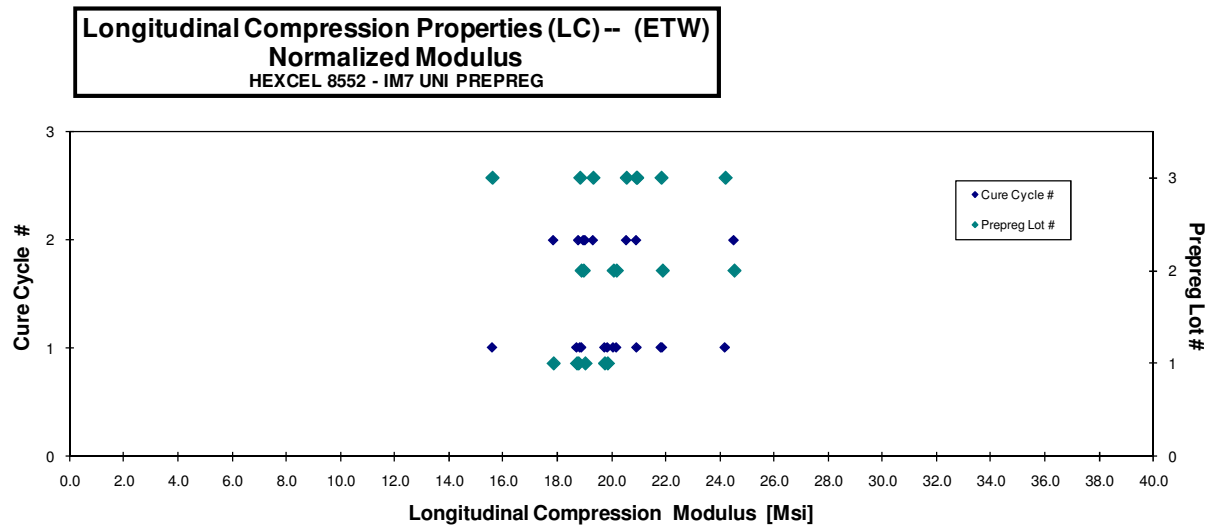
| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Modulus | Poisson's | Avg. Specimen | # Plies in Laminate | Avg. $t_{ply}$ [in] | Modulus <sub>norm</sub> [Msi] |
|-----------------|----------------|-------------------|---------------|--------------|---------|-----------|---------------|---------------------|---------------------|-------------------------------|
| HFILA11GD       | A              | M1                | 1             | 1            | 19.933  | 0.379     | 0.100         | 14                  | 0.0071              | 19.758                        |
| HFILA11HD       | A              | M1                | 1             | 1            | 20.124  | 0.409     | 0.094         | 14                  | 0.0067              | 18.723                        |
| HFILA11ID       | A              | M1                | 1             | 1            | 19.455  | 0.335     | 0.103         | 14                  | 0.0074              | 19.863                        |
| HFILA21ED       | A              | M2                | 1             | 2            | 19.539  | 0.351     | 0.097         | 14                  | 0.0069              | 18.793                        |
| HFILA21FD       | A              | M2                | 1             | 2            | 19.888  | 0.342     | 0.097         | 14                  | 0.0069              | 19.040                        |
| HFILA21GD       | A              | M2                | 1             | 2            | 19.229  | 0.344     | 0.094         | 14                  | 0.0067              | 17.865                        |
| HFILB11ED*      | B              | M1                | 2             | 1            | 20.777  | 0.346     | 0.106         | 14                  | 0.0076              | 21.880                        |
| HFILB11FD*      | B              | M1                | 2             | 1            | 20.158  | 0.336     | 0.101         | 14                  | 0.0072              | 20.188                        |
| HFILB11GD*      | B              | M1                | 2             | 1            | 21.348  | 0.359     | 0.095         | 14                  | 0.0068              | 20.077                        |
| HFILB21ED       | B              | M2                | 2             | 1            | 20.248  | 0.341     | 0.094         | 14                  | 0.0067              | 18.899                        |
| HFILB21FD       | B              | M2                | 2             | 2            | 20.131  | 0.341     | 0.095         | 14                  | 0.0068              | 18.973                        |
| HFILB21GD       | B              | M2                | 2             | 2            | 26.641  | 0.412     | 0.093         | 14                  | 0.0066              | 24.518                        |
| HFILC11ED       | C              | M1                | 3             | 1            | 20.987  | 0.322     | 0.105         | 14                  | 0.0075              | 21.833                        |
| HFILC11FD       | C              | M1                | 3             | 1            | 20.445  | 0.329     | 0.103         | 14                  | 0.0074              | 20.939                        |
| HFILC11GD       | C              | M1                | 3             | 1            | 24.827  | 0.466     | 0.098         | 14                  | 0.0070              | 24.195                        |
| HFILC11HD       | C              | M1                | 3             | 1            | 20.498  | 0.362     | 0.093         | 14                  | 0.0066              | 18.847                        |
| HFILC11ID       | C              | M1                | 3             | 1            | 17.674  | 0.355     | 0.089         | 14                  | 0.0064              | 15.614                        |
| HFILC21ED       | C              | M2                | 3             | 2            | 20.085  | 0.310     | 0.105         | 14                  | 0.0075              | 20.925                        |
| HFILC21FD       | C              | M2                | 3             | 2            | 20.112  | 0.352     | 0.103         | 14                  | 0.0074              | 20.558                        |
| HFILC21GD       | C              | M2                | 3             | 2            | 19.741  | 0.324     | 0.099         | 14                  | 0.0071              | 19.330                        |
| HFILA11JD       | A              | M1                | 1             | 1            | 19.858  | 0.392     | 0.105         | 14                  | 0.0075              | 20.744                        |
| HFILA11KD       | A              | M1                | 1             | 1            | 19.580  | 0.416     | 0.106         | 14                  | 0.0075              | 20.499                        |
| HFILA1RMD       | A              | M1                | 1             | 1            | 19.955  | 0.529     | 0.101         | 14                  | 0.0072              | 20.070                        |
| HFILA1RND       | A              | M1                | 1             | 2            | 20.050  | 0.412     | 0.101         | 14                  | 0.0072              | 20.120                        |
| HFILA21HD*      | A              | M2                | 1             | 2            |         |           |               | 14                  |                     |                               |
| HFILA214D       | A              | M2                | 1             | 2            | 26.053  | 0.509     | 0.096         | 14                  | 0.0068              | 24.761                        |
| HFILB11HD       | B              | M1                | 2             | 1            | 20.996  | 0.379     | 0.107         | 14                  | 0.0076              | 22.187                        |
| HFILB11ID       | B              | M1                | 2             | 1            | 20.077  | 0.399     | 0.109         | 14                  | 0.0078              | 21.687                        |
| HFILB114D       | B              | M1                | 2             | 1            | 19.972  | 0.390     | 0.108         | 14                  | 0.0077              | 21.349                        |
| HFILB21ID*      | B              | M2                | 2             | 1            |         |           |               | 14                  |                     |                               |
| HFILB214D       | B              | M2                | 2             | 2            | 20.822  | 0.376     | 0.095         | 14                  | 0.0068              | 19.586                        |
| HFILC1RMD       | C              | M1                | 3             | 1            | 21.213  | 0.451     | 0.096         | 14                  | 0.0069              | 20.261                        |
| HFILC1RND       | C              | M1                | 3             | 1            | 20.134  | 0.403     | 0.101         | 14                  | 0.0072              | 20.220                        |
| HFILC1ROD       | C              | M1                | 3             | 1            | 20.821  | 0.446     | 0.105         | 14                  | 0.0075              | 21.692                        |
| HFILC21HD       | C              | M2                | 3             | 1            | 20.601  | 0.370     | 0.092         | 14                  | 0.0066              | 18.778                        |
| HFILC21ID       | C              | M2                | 3             | 1            | 20.282  | 0.402     | 0.094         | 14                  | 0.0067              | 18.897                        |
| HFILC214D       | C              | M2                | 3             | 2            | 20.436  | 0.413     | 0.104         | 14                  | 0.0075              | 21.159                        |

\*Specimens have thickness taper on edge of coupon, so values were removed.

**DATA WAS NOT REPORTED FOR HFILA11FD DUE TO BAD FAILURE****HFILB21HD STRAIN GAGE WENT BAD HENCE THE MODULUS AND POISSONS RATIO WAS REMOVED**

Shaded portion was originally tested with improper strain gage adhesive

|                    |        |        |       |                                    |        |        |
|--------------------|--------|--------|-------|------------------------------------|--------|--------|
| Average            | 20.648 | 0.383  | 0.099 | Average <sub>norm</sub>            | 0.0071 | 20.367 |
| Standard Dev.      | 1.754  | 0.051  | 0.005 | Standard Dev. <sub>norm</sub>      |        | 1.834  |
| Coeff. of Var. [%] | 8.494  | 13.446 | 5.383 | Coeff. of Var. [%] <sub>norm</sub> |        | 9.005  |
| Min.               | 17.674 | 0.310  | 0.089 |                                    | 0.0064 | 15.614 |
| Max.               | 26.641 | 0.529  | 0.109 |                                    | 0.0078 | 24.761 |
| Number of Spec.    | 35     | 35     | 35    |                                    | 35     | 35     |



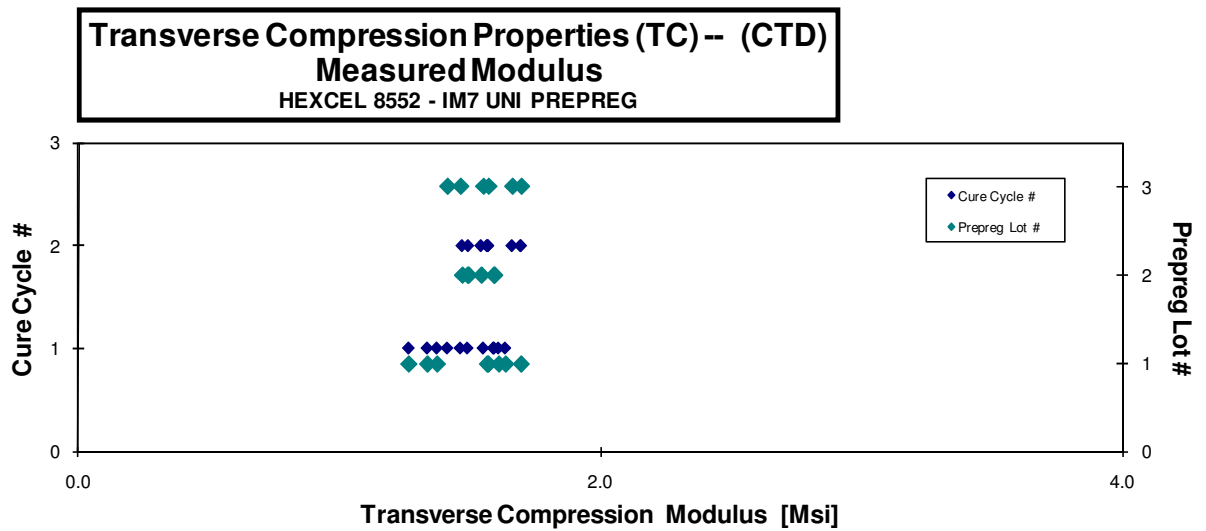
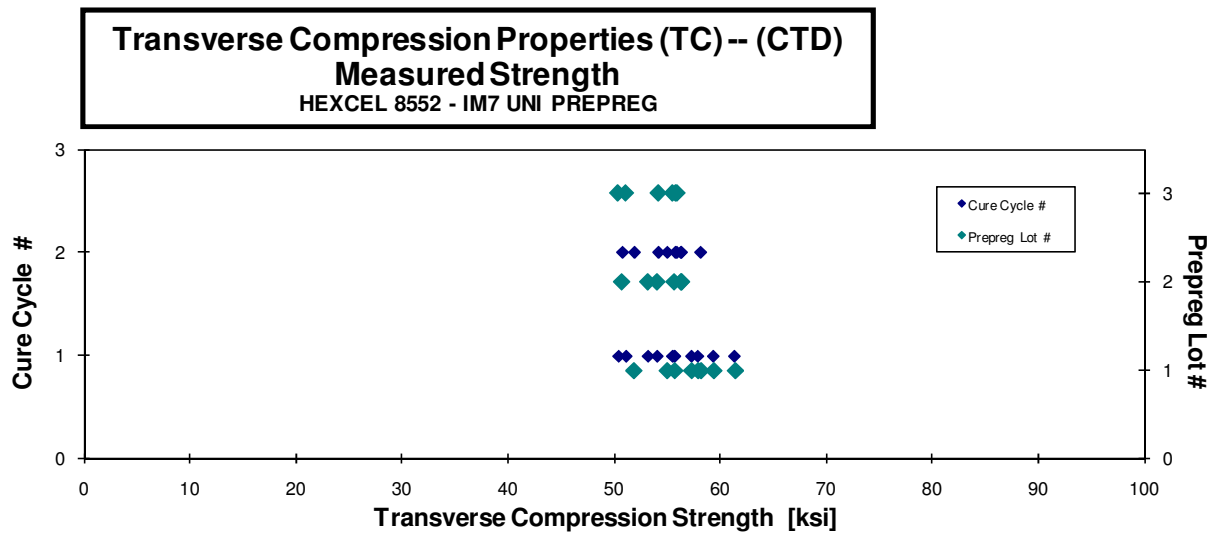
## 4.4 Transverse Compression Properties

### Transverse Compression Properties (TC) -- (CTD) Strength & Modulus HEXCEL 8552 - IM7 UNI PREPREG

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Modulus [Msi] | Poisson's Ratio | Avg. Specimen Thickn. [in] | # Plies in Laminate | Avg. $t_{ply}$ [in] | Failure Mode |
|-----------------|----------------|-------------------|---------------|--------------|----------------|---------------|-----------------|----------------------------|---------------------|---------------------|--------------|
| HFIZA116B       | A              | M1                | 1             | 1            | 59.383         | 1.609         | 0.027           | 0.099                      | 14                  | 0.0071              | HAT/HIT      |
| HFIZA117B       | A              | M1                | 1             | 1            | 61.395         | 1.373         | 0.021           | 0.099                      | 14                  | 0.0071              | HGM          |
| HFIZA118B       | A              | M1                | 1             | 1            | 55.734         | 1.264         | 0.028           | 0.100                      | 14                  | 0.0071              | HGM/HIB      |
| HFIZA119B       | A              | M1                | 1             | 1            | 57.917         | 1.336         | 0.027           | 0.100                      | 14                  | 0.0072              | HGM/HIB/HIT  |
| HFIZA11AB       | A              | M1                | 1             | 1            | 57.316         | 1.635         | 0.031           | 0.100                      | 14                  | 0.0072              | HAT          |
| HFIZA217B       | A              | M2                | 1             | 2            | 55.031         | 1.565         | 0.025           | 0.100                      | 14                  | 0.0071              | HGM          |
| HFIZA218B       | A              | M2                | 1             | 2            | 51.915         | 1.569         | 0.032           | 0.100                      | 14                  | 0.0072              | HGM          |
| HFIZA219B       | A              | M2                | 1             | 2            | 58.191         | 1.694         | 0.030           | 0.101                      | 14                  | 0.0072              | HGM          |
| HFIZB115B       | B              | M1                | 2             | 1            | 53.205         | 1.592         | 0.027           | 0.102                      | 14                  | 0.0073              | HGM          |
| HFIZB116B*      | B              | M1                | 2             | 1            | 55.667         | 1.590         | 0.031           | 0.101                      | 14                  | 0.0072              | HGM/HAB/HIB  |
| HFIZB117B*      | B              | M1                | 2             | 1            | 54.068         | 1.490         | 0.028           | 0.101                      | 14                  | 0.0072              | HGM/HIT/HIB  |
| HFIZB216B       | B              | M2                | 2             | 2            | 56.320         | 1.494         | 0.026           | 0.099                      | 14                  | 0.0071              | HGM          |
| HFIZB217B       | B              | M2                | 2             | 2            | 56.367         | 1.543         | 0.029           | 0.099                      | 14                  | 0.0071              | HGM          |
| HFIZB218B       | B              | M2                | 2             | 2            | 50.774         | 1.470         | 0.029           | 0.100                      | 14                  | 0.0071              | HGM          |
| HFIZC117B       | C              | M1                | 3             | 1            | 55.515         | 1.551         | 0.028           | 0.102                      | 14                  | 0.0073              | HGM          |
| HFIZC118B       | C              | M1                | 3             | 1            | 51.129         | 1.463         | 0.018           | 0.102                      | 14                  | 0.0073              | HGM          |
| HFIZC119B       | C              | M1                | 3             | 1            | 50.408         | 1.413         | 0.031           | 0.103                      | 14                  | 0.0073              | HGM          |
| HFIZC216B       | C              | M2                | 3             | 2            | 54.186         | 1.662         | 0.027           | 0.101                      | 14                  | 0.0072              | HAT          |
| HFIZC217B       | C              | M2                | 3             | 2            | 55.937         | 1.696         | 0.032           | 0.100                      | 14                  | 0.0072              | HAT          |
| HFIZC218B       | C              | M2                | 3             | 2            | 55.812         | 1.570         | 0.029           | 0.102                      | 14                  | 0.0073              | HAT          |

\* Bad failures occurred secondary to the first failure

|                    |        |       |        |        |
|--------------------|--------|-------|--------|--------|
| Average            | 55.313 | 1.529 | 0.028  | 0.0072 |
| Standard Dev.      | 2.873  | 0.117 | 0.004  |        |
| Coeff. of Var. [%] | 5.194  | 7.641 | 12.744 |        |
| Min.               | 50.408 | 1.264 | 0.018  | 0.0071 |
| Max.               | 61.395 | 1.696 | 0.032  | 0.0073 |
| Number of Spec.    | 20     | 20    | 20     |        |

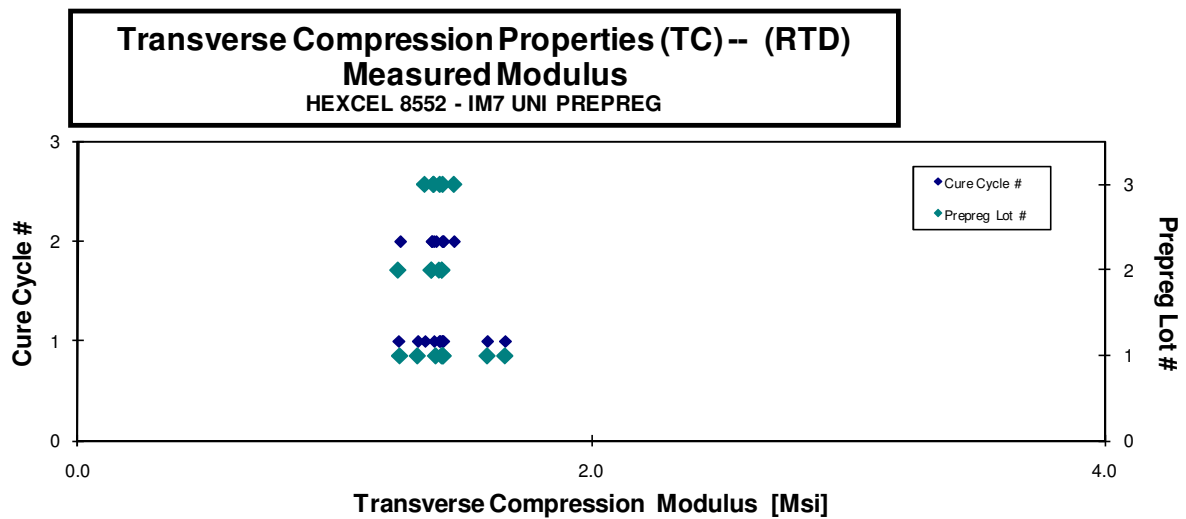
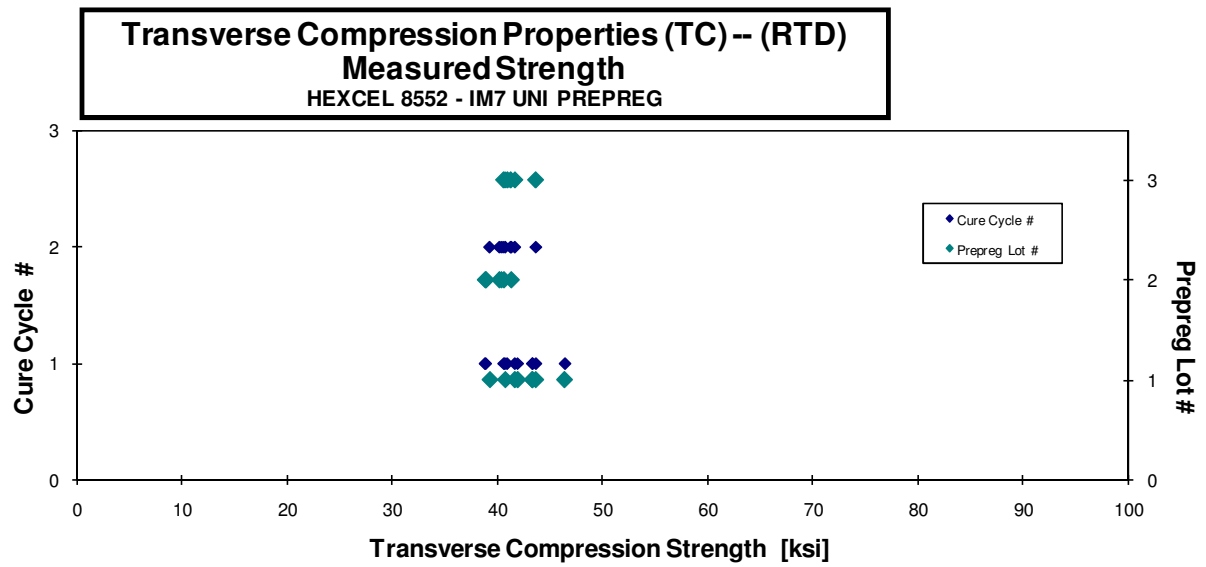


**Transverse Compression Properties (TC)-- (RTD)**  
**Strength & Modulus**  
 HEXCEL 8552 - IM7 UNI PREPREG

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Modulus [Msi] | Poisson's Ratio | Avg. Specimen Thickn. [in] | # Plies in Laminate | Avg. $t_{ply}$ [in] | Failure Mode |
|-----------------|----------------|-------------------|---------------|--------------|----------------|---------------|-----------------|----------------------------|---------------------|---------------------|--------------|
| HFIZA111A       | A              | M1                | 1             | 1            | 46.403         | 1.664         | 0.022           | 0.089                      | 14                  | 0.0063              | BAB          |
| HFIZA112A       | A              | M1                | 1             | 1            | 43.300         | 1.594         | 0.025           | 0.094                      | 14                  | 0.0067              | BAB          |
| HFIZA113A       | A              | M1                | 1             | 1            | 43.323         | 1.324         | 0.023           | 0.099                      | 14                  | 0.0071              | BAB          |
| HFIZA114A       | A              | M1                | 1             | 1            | 43.633         | 1.423         | 0.024           | 0.101                      | 14                  | 0.0072              | BAB          |
| HFIZA115A       | A              | M1                | 1             | 1            | 41.892         | 1.419         | 0.022           | 0.101                      | 14                  | 0.0072              | BAB          |
| HFIZA212A       | A              | M2                | 1             | 2            | 39.235         | 1.424         | 0.025           | 0.097                      | 14                  | 0.0069              | HGM          |
| HFIZA213A       | A              | M2                | 1             | 2            | 40.716         | 1.395         | 0.024           | 0.101                      | 14                  | 0.0072              | BGM          |
| HFIZA214A       | A              | M2                | 1             | 2            | 41.630         | 1.255         | 0.022           | 0.103                      | 14                  | 0.0074              | HGM          |
| HFIZB112A       | B              | M1                | 2             | 1            | 38.789         | 1.419         | 0.022           | 0.098                      | 14                  | 0.0070              | BGM          |
| HFIZB113A       | B              | M1                | 2             | 1            | 40.581         | 1.408         | 0.025           | 0.102                      | 14                  | 0.0073              | BGM          |
| HFIZB114A       | B              | M1                | 2             | 1            | 38.857         | 1.249         | 0.020           | 0.103                      | 14                  | 0.0073              | BGM          |
| HFIZB213A*      | B              | M2                | 2             | 2            | 40.340         | 1.378         | 0.023           | 0.102                      | 14                  | 0.0073              | HGM / HIT    |
| HFIZB214A*      | B              | M2                | 2             | 2            | 41.291         | 1.419         | 0.026           | 0.101                      | 14                  | 0.0072              | HGM / HIT    |
| HFIZB215A       | B              | M2                | 2             | 2            | 40.150         | 1.379         | 0.022           | 0.100                      | 14                  | 0.0072              | HGM          |
| HFIZC112A       | C              | M1                | 3             | 1            | 40.681         | 1.352         | 0.022           | 0.099                      | 14                  | 0.0071              | HGM          |
| HFIZC113A       | C              | M1                | 3             | 1            | 40.902         | 1.411         | 0.023           | 0.103                      | 14                  | 0.0074              | HGM          |
| HFIZC114A       | C              | M1                | 3             | 1            | 41.630         | 1.387         | 0.025           | 0.104                      | 14                  | 0.0074              | HAT          |
| HFIZC213A       | C              | M2                | 3             | 2            | 41.218         | 1.465         | 0.025           | 0.103                      | 14                  | 0.0073              | HAB          |
| HFIZC214A       | C              | M2                | 3             | 2            | 43.627         | 1.386         | 0.027           | 0.103                      | 14                  | 0.0074              | BGM          |
| HFIZC215A       | C              | M2                | 3             | 2            | 40.524         | 1.422         | 0.023           | 0.102                      | 14                  | 0.0073              | BAT          |

\* Bad failures occurred secondary to the first failure

|                           |               |              |              |               |
|---------------------------|---------------|--------------|--------------|---------------|
| <b>Average</b>            | <b>41.436</b> | <b>1.409</b> | <b>0.024</b> | <b>0.0072</b> |
| <b>Standard Dev.</b>      | <b>1.864</b>  | <b>0.093</b> | <b>0.002</b> |               |
| <b>Coeff. of Var. [%]</b> | <b>4.497</b>  | <b>6.634</b> | <b>7.615</b> |               |
| <b>Min.</b>               | <b>38.789</b> | <b>1.249</b> | <b>0.020</b> | <b>0.0063</b> |
| <b>Max.</b>               | <b>46.403</b> | <b>1.664</b> | <b>0.027</b> | <b>0.0074</b> |
| <b>Number of Spec.</b>    | <b>20</b>     | <b>20</b>    | <b>20</b>    |               |



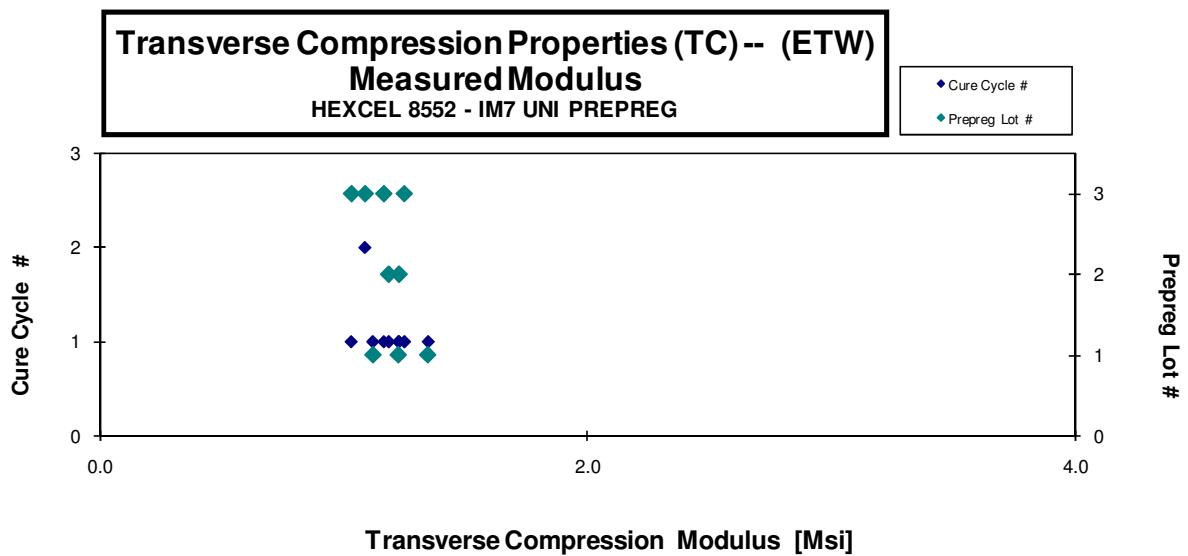
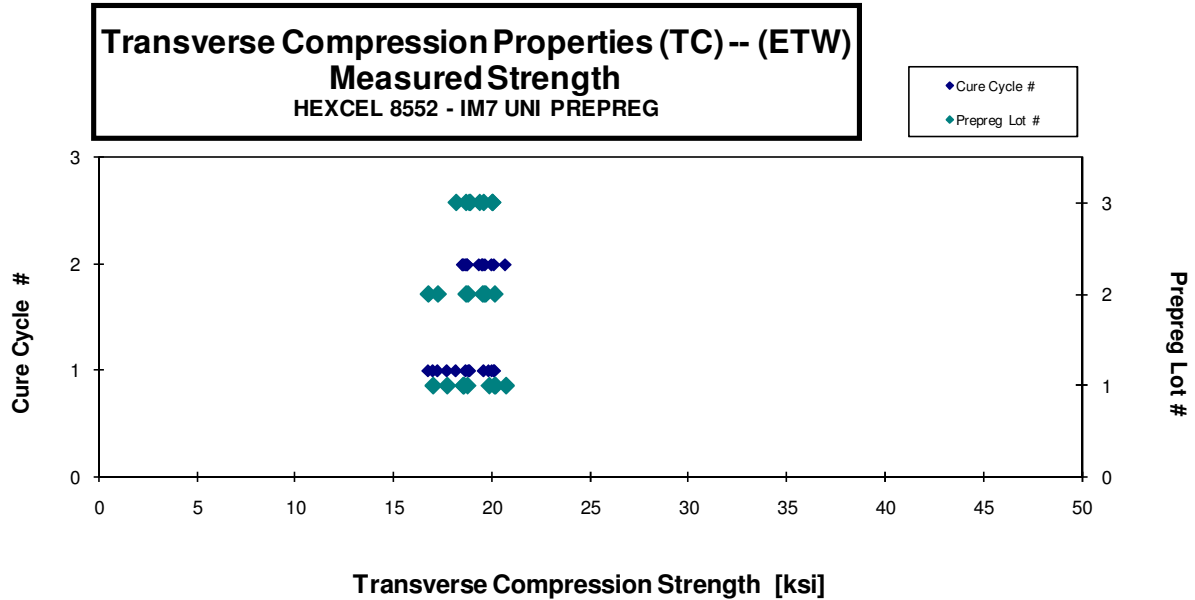


**Transverse Compression Properties (TC)-- (ETW)**  
**Strength & Modulus**  
 HEXCEL 8552 - IM7 UNI PREPREG

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Modulus* [Msi] | Poisson's Ratio | Avg. Specimen Thickn. [in] | # Plies in Laminate | Avg. $t_{ply}$ [in] | Failure Mode |
|-----------------|----------------|-------------------|---------------|--------------|----------------|----------------|-----------------|----------------------------|---------------------|---------------------|--------------|
| HFIZA11BD       | A              | M1                | 1             | 1            | 20.168         |                |                 | 0.099                      | 14                  | 0.0071              | HGM          |
| HFIZA11CD       | A              | M1                | 1             | 1            | 20.118         |                |                 | 0.100                      | 14                  | 0.0071              | HGM          |
| HFIZA11DD       | A              | M1                | 1             | 1            | 17.022         |                |                 | 0.100                      | 14                  | 0.0072              | HGM          |
| HFIZA11ED       | A              | M1                | 1             | 1            | 19.857         |                |                 | 0.102                      | 14                  | 0.0073              | HGM          |
| HFIZA11FD       | A              | M1                | 1             | 1            | 17.733         |                |                 | 0.102                      | 14                  | 0.0073              | HGM          |
| HFIZA21AD       | A              | M2                | 1             | 2            | 18.535         |                |                 | 0.101                      | 14                  | 0.0072              | HGM          |
| HFIZA21BD       | A              | M2                | 1             | 2            | 18.757         |                |                 | 0.101                      | 14                  | 0.0072              | HGM          |
| HFIZA21CD       | A              | M2                | 1             | 2            | 18.574         |                |                 | 0.100                      | 14                  | 0.0072              | HGM          |
| HFIZA21ED       | A              | M2                | 1             | 2            | 20.702         |                |                 | 0.102                      | 14                  | 0.0073              | HGM          |
| HFIZB119D       | B              | M1                | 2             | 1            | 17.259         |                |                 | 0.101                      | 14                  | 0.0072              | HGM          |
| HFIZB11AD       | B              | M1                | 2             | 1            | 16.779         |                |                 | 0.101                      | 14                  | 0.0072              | HGM          |
| HFIZB11BD       | B              | M1                | 2             | 1            | 18.688         |                |                 | 0.100                      | 14                  | 0.0072              | HGM          |
| HFIZB11CD       | B              | M1                | 2             | 1            | 19.599         |                |                 | 0.101                      | 14                  | 0.0072              | HGM          |
| HFIZB219D       | B              | M2                | 2             | 2            | 19.524         |                |                 | 0.100                      | 14                  | 0.0071              | HGM          |
| HFIZB21AD       | B              | M2                | 2             | 2            | 19.676         |                |                 | 0.100                      | 14                  | 0.0071              | HGM          |
| HFIZB21BD       | B              | M2                | 2             | 2            | 18.781         |                |                 | 0.100                      | 14                  | 0.0071              | HGM          |
| HFIZB21CD       | B              | M2                | 2             | 2            | 20.132         |                |                 | 0.100                      | 14                  | 0.0072              | HGM          |
| HFIZC11AD       | C              | M1                | 3             | 1            | 18.895         |                |                 | 0.103                      | 14                  | 0.0073              | HGM          |
| HFIZC11BD       | C              | M1                | 3             | 1            | 18.186         |                |                 | 0.102                      | 14                  | 0.0073              | HGM          |
| HFIZC11CD       | C              | M1                | 3             | 1            | 18.838         |                |                 | 0.102                      | 14                  | 0.0073              | HGM          |
| HFIZC11FD       | C              | M1                | 3             | 1            | 20.021         |                |                 | 0.104                      | 14                  | 0.0074              | HGM          |
| HFIZC21AD       | C              | M2                | 3             | 2            | 18.681         |                |                 | 0.102                      | 14                  | 0.0073              | HGM          |
| HFIZC21BD       | C              | M2                | 3             | 2            | 19.567         |                |                 | 0.102                      | 14                  | 0.0073              | HGM          |
| HFIZC21CD       | C              | M2                | 3             | 2            | 19.370         |                |                 | 0.100                      | 14                  | 0.0072              | HGM          |
| HFIZC21DD       | C              | M2                | 3             | 2            | 20.011         |                |                 | 0.101                      | 14                  | 0.0072              | HGM          |
| HFIZA215D*      | A              | M1                | 1             | 1            |                | 1.224          | 0.018           | 0.103                      | 14                  | 0.0074              | HGM          |
| HFIZA211D*      | A              | M1                | 1             | 1            |                | 1.346          | 0.018           | 0.087                      | 14                  | 0.0062              | HGM          |
| HFIZA216D*      | A              | M1                | 1             | 1            |                | 1.119          | 0.017           | 0.101                      | 14                  | 0.0072              | HGM          |
| HFIZB111D*      | B              | M1                | 2             | 1            |                | 1.184          | 0.017           | 0.091                      | 14                  | 0.0065              | HGM          |
| HFIZB118D*      | B              | M1                | 2             | 1            |                | 1.227          | 0.016           | 0.100                      | 14                  | 0.0072              | HGM          |
| HFIZC111D*      | C              | M1                | 3             | 1            |                | 1.249          | 0.018           | 0.092                      | 14                  | 0.0066              | HGM          |
| HFIZC115D*      | C              | M1                | 3             | 1            |                | 1.164          | 0.018           | 0.104                      | 14                  | 0.0074              | HGM          |
| HFIZC116D*      | C              | M1                | 3             | 1            |                | 1.031          | 0.017           | 0.103                      | 14                  | 0.0073              | HGM          |
| HFIZC219D*      | C              | M2                | 3             | 2            |                | 1.087          | 0.020           | 0.102                      | 14                  | 0.0073              | HGM          |

\* Modulus only coupons

|                    |        |       |       |       |
|--------------------|--------|-------|-------|-------|
| Average            | 19.019 | 1.181 | 0.018 | 0.007 |
| Standard Dev.      | 1.041  | 0.094 | 0.001 |       |
| Coeff. of Var. [%] | 5.474  | 7.994 | 7.577 |       |
| Min.               | 16.779 | 1.031 | 0.016 | 0.006 |
| Max.               | 20.702 | 1.346 | 0.020 | 0.007 |
| Number of Spec.    | 25     | 9     | 9     | 34    |



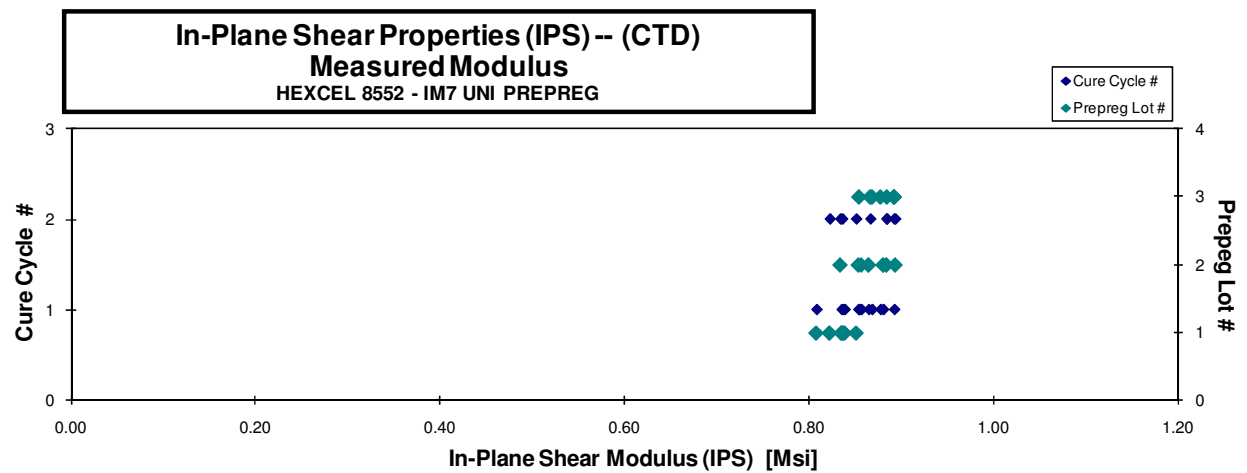
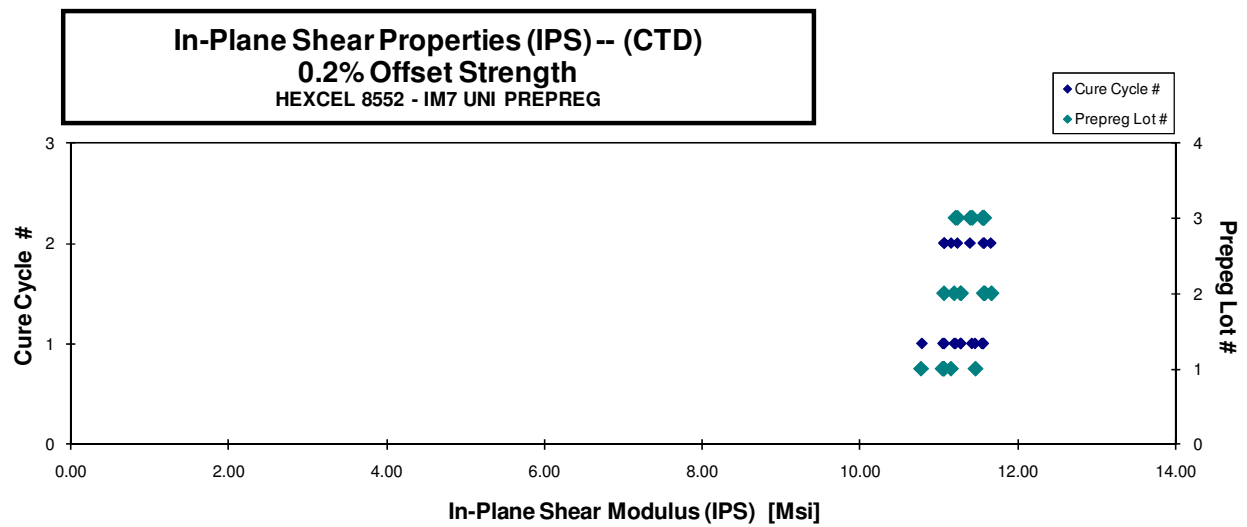
## 4.5 In-Plane Shear Properties

### In-Plane Shear Properties (IPS)-- (CTD) Strength & Modulus HEXCEL 8552 - IM7 UNI PREPREG

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | 0.2% Offset Strength [ksi] | Modulus [Msi] | Avg. Specimen Thickn. [in] | # Plies in Laminate | Avg. tply [in] |
|-----------------|----------------|-------------------|---------------|--------------|----------------------------|---------------|----------------------------|---------------------|----------------|
| HFINA11FB       | A              | M1                | 1             | 1            | 11.066                     | 0.835         | 0.088                      | 12                  | 0.0073         |
| HFINA11GB       | A              | M1                | 1             | 1            | 11.048                     | 0.837         | 0.088                      | 12                  | 0.0073         |
| HFINA11AB       | A              | M1                | 1             | 1            | 11.460                     | 0.839         | 0.082                      | 12                  | 0.0068         |
| HFINA1RMB       | A              | M1                | 1             | 1            | 10.779                     | 0.808         | 0.088                      | 12                  | 0.0074         |
| HFINA21EB       | A              | M2                | 1             | 2            | 11.063                     | 0.836         | 0.088                      | 12                  | 0.0074         |
| HFINA21FB       | A              | M2                | 1             | 2            | 11.154                     | 0.851         | 0.088                      | 12                  | 0.0073         |
| HFINA21AB       | A              | M2                | 1             | 2            | 11.065                     | 0.822         | 0.089                      | 12                  | 0.0074         |
| HFINB11FB       | B              | M1                | 2             | 1            | 11.277                     | 0.854         | 0.087                      | 12                  | 0.0072         |
| HFINB11AB       | B              | M1                | 2             | 1            | 11.275                     | 0.865         | 0.083                      | 12                  | 0.0069         |
| HFINB114B       | B              | M1                | 2             | 1            | 11.194                     | 0.857         | 0.087                      | 12                  | 0.0072         |
| HFINB21EB       | B              | M2                | 2             | 1            | 11.564                     | 0.881         | 0.086                      | 12                  | 0.0072         |
| HFINB21FB       | B              | M2                | 2             | 2            | 11.661                     | 0.884         | 0.087                      | 12                  | 0.0072         |
| HFINB219B       | B              | M2                | 2             | 2            | 11.067                     | 0.834         | 0.088                      | 12                  | 0.0073         |
| HFINB21AB       | B              | M2                | 2             | 2            | 11.578                     | 0.894         | 0.081                      | 12                  | 0.0068         |
| HFINC11EB       | C              | M1                | 3             | 1            | 11.549                     | 0.893         | 0.085                      | 12                  | 0.0071         |
| HFINC11FB       | C              | M1                | 3             | 1            | 11.420                     | 0.878         | 0.086                      | 12                  | 0.0072         |
| HFINC11AB       | C              | M1                | 3             | 1            | 11.565                     | 0.869         | 0.080                      | 12                  | 0.0067         |
| HFINC114B       | C              | M1                | 3             | 1            | 11.211                     | 0.855         | 0.086                      | 12                  | 0.0071         |
| HFINC21EB       | C              | M2                | 3             | 2            | 11.233                     | 0.867         | 0.087                      | 12                  | 0.0073         |
| HFINC21FB       | C              | M2                | 3             | 2            | 11.564                     | 0.893         | 0.082                      | 12                  | 0.0068         |
| HFINC219B       | C              | M2                | 3             | 2            | 11.395                     | 0.885         | 0.081                      | 12                  | 0.0067         |

All specimens failed to reach 50,000 micro strain.

|                    |       |       |                    |        |
|--------------------|-------|-------|--------------------|--------|
| Average            | 11.29 | 0.86  | Average            | 0.0071 |
| Standard Dev.      | 0.24  | 0.02  | Standard Dev.      |        |
| Coeff. of Var. [%] | 2.10  | 2.90  | Coeff. of Var. [%] |        |
| Min.               | 10.78 | 0.81  | Min.               | 0.0067 |
| Max.               | 11.66 | 0.89  | Max.               | 0.0074 |
| Number of Spec.    | 21.00 | 21.00 | Number of Spec.    | 21     |



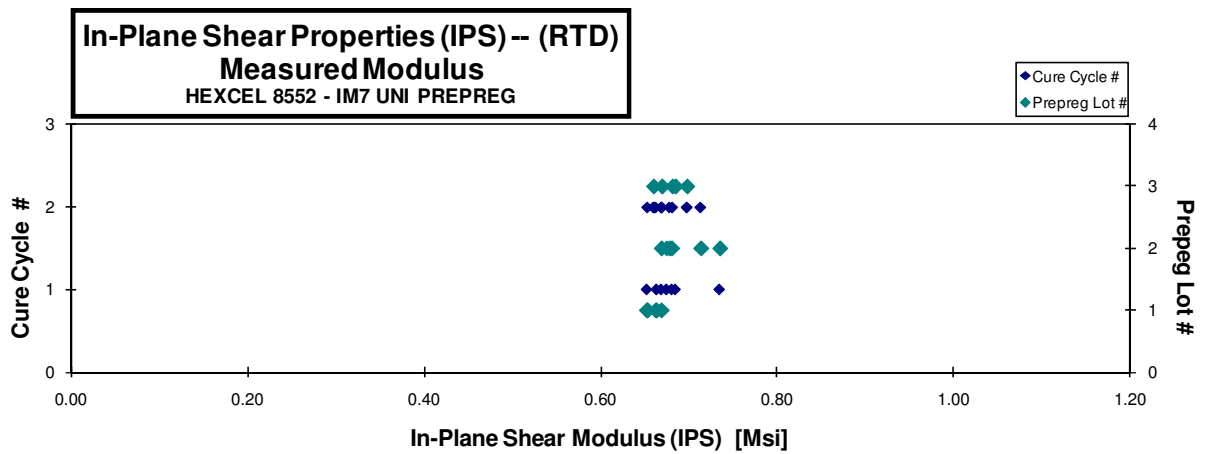
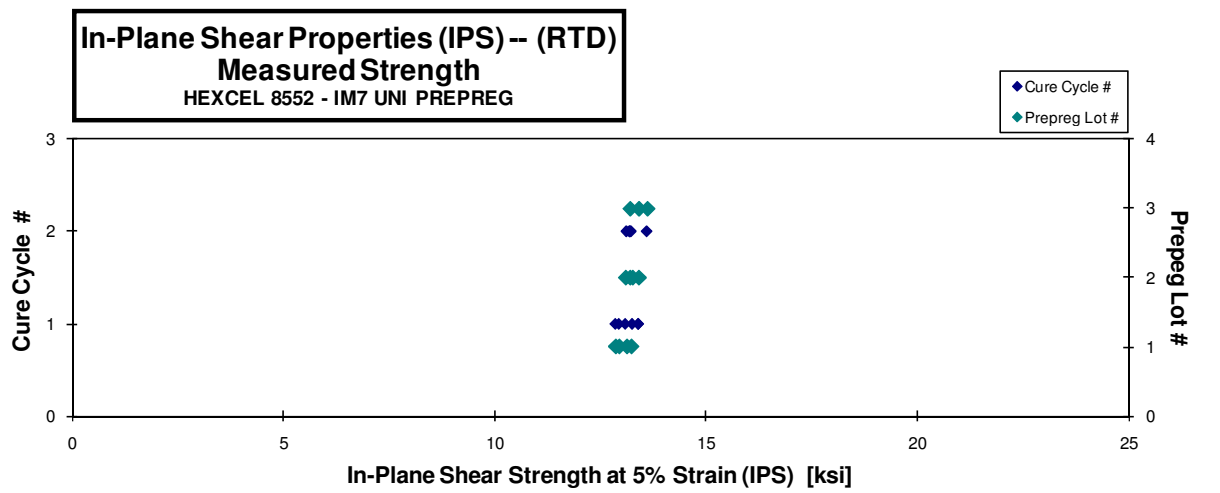
**In-Plane Shear Properties (IPS) -- (RTD)**  
**Strength & Modulus**  
 HEXCEL 8552 - IM7 UNI PREPREG

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength at 5% Strain [ksi] | 0.2% Offset Strength [ksi] | Modulus [Msi] | Avg. Specimen Thickn. [in] | # Plies in Laminate | Avg. tply [in] |
|-----------------|----------------|-------------------|---------------|--------------|-----------------------------|----------------------------|---------------|----------------------------|---------------------|----------------|
| HFINA111A**     | A              | M1                | 1             | 1            |                             |                            |               |                            |                     |                |
| HFINA112A*      | A              | M1                | 1             | 1            |                             | 7.698                      | 0.668         | 0.090                      | 12                  | 0.0075         |
| HFINA113A       | A              | M1                | 1             | 1            | 12.855                      | 7.481                      | 0.652         | 0.089                      | 12                  | 0.0074         |
| HFINA114A       | A              | M1                | 1             | 1            | 12.939                      | 7.603                      | 0.663         | 0.088                      | 12                  | 0.0073         |
| HFINA115A**     | A              | M1                | 1             | 1            |                             |                            |               |                            |                     |                |
| HFINA211A**     | A              | M2                | 1             | 2            |                             |                            |               |                            |                     |                |
| HFINA212A       | A              | M2                | 1             | 2            | 13.228                      | 7.585                      | 0.653         | 0.089                      | 12                  | 0.0074         |
| HFINA213A       | A              | M2                | 1             | 2            | 13.121                      | 7.589                      | 0.662         | 0.088                      | 12                  | 0.0073         |
| HFINB111A       | B              | M1                | 2             | 1            | 13.259                      | 8.117                      | 0.735         | 0.082                      | 12                  | 0.0068         |
| HFINB112A       | B              | M1                | 2             | 1            | 13.092                      | 7.672                      | 0.674         | 0.088                      | 12                  | 0.0073         |
| HFINB113A       | B              | M1                | 2             | 1            | 13.405                      | 7.776                      | 0.680         | 0.088                      | 12                  | 0.0073         |
| HFINB211A*      | B              | M2                | 2             | 2            |                             | 7.600                      | 0.669         | 0.088                      | 12                  | 0.0074         |
| HFINB212A*      | B              | M2                | 2             | 2            |                             | 7.943                      | 0.713         | 0.084                      | 12                  | 0.0070         |
| HFINB213A       | B              | M2                | 2             | 2            | 13.197                      | 7.686                      | 0.678         | 0.088                      | 12                  | 0.0073         |
| HFINC111A**     | C              | M1                | 3             | 1            |                             |                            |               |                            |                     |                |
| HFINC112A       | C              | M1                | 3             | 1            | 13.407                      | 7.977                      | 0.684         | 0.088                      | 12                  | 0.0073         |
| HFINC113A**     | C              | M1                | 3             | 1            |                             |                            |               |                            |                     |                |
| HFINC211A       | C              | M2                | 3             | 2            | 13.609                      | 7.755                      | 0.669         | 0.089                      | 12                  | 0.0074         |
| HFINC212A       | C              | M2                | 3             | 2            | 13.200                      | 7.741                      | 0.681         | 0.088                      | 12                  | 0.0073         |
| HFINC213A*      | C              | M2                | 3             | 2            |                             | 8.279                      | 0.698         | 0.087                      | 12                  | 0.0072         |
| HFINC214A       | C              | M2                | 3             | 2            | 13.387                      | 7.591                      | 0.660         | 0.087                      | 12                  | 0.0073         |

\*specimens failed to reach 50,000 micro strain

\*\* data was omitted due to Biaxial Extensometer slippage

|                           |               |              |              |                           |               |
|---------------------------|---------------|--------------|--------------|---------------------------|---------------|
| <b>Average</b>            | <b>13.225</b> | <b>7.756</b> | <b>0.677</b> | <b>Average</b>            | <b>0.0073</b> |
| <b>Standard Dev.</b>      | <b>0.211</b>  | <b>0.218</b> | <b>0.022</b> | <b>Standard Dev.</b>      |               |
| <b>Coeff. of Var. [%]</b> | <b>1.595</b>  | <b>2.808</b> | <b>3.272</b> | <b>Coeff. of Var. [%]</b> |               |
| <b>Min.</b>               | <b>12.855</b> | <b>7.481</b> | <b>0.652</b> | <b>Min.</b>               | <b>0.0068</b> |
| <b>Max.</b>               | <b>13.609</b> | <b>8.279</b> | <b>0.735</b> | <b>Max.</b>               | <b>0.0075</b> |
| <b>Number of Spec.</b>    | <b>12</b>     | <b>16</b>    | <b>16</b>    | <b>Number of Spec.</b>    | <b>16</b>     |



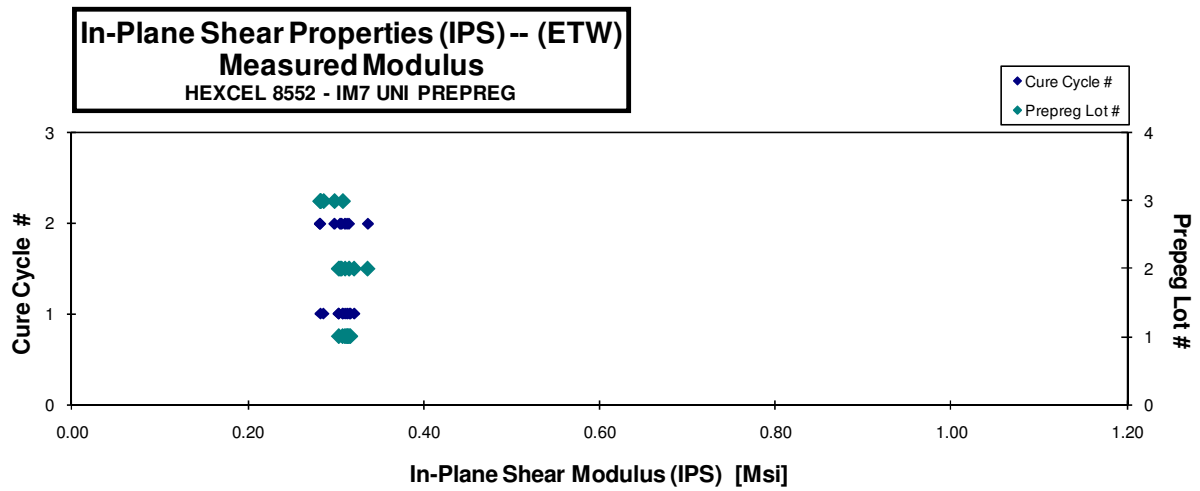
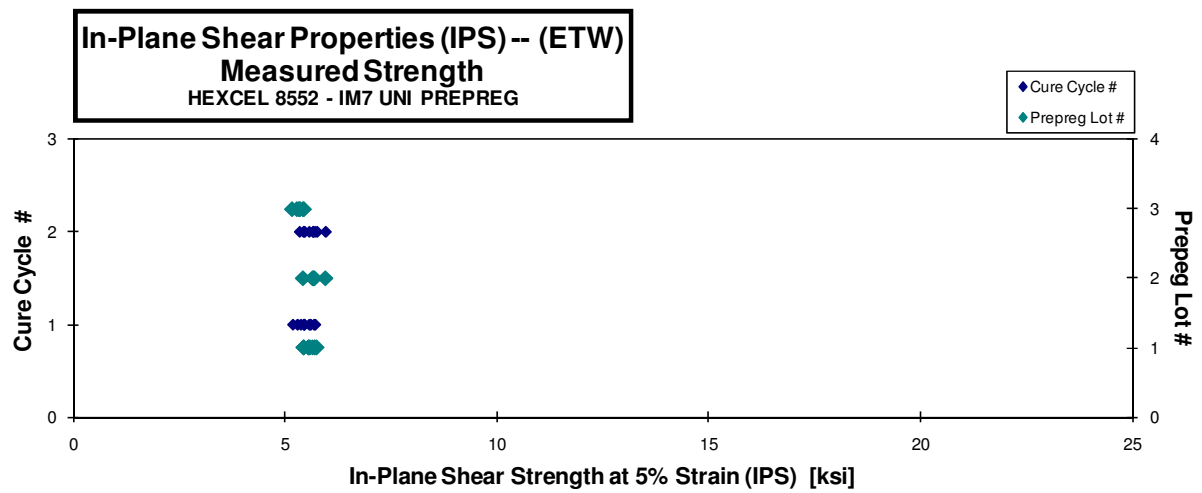
|                                                                                                                   |
|-------------------------------------------------------------------------------------------------------------------|
| <b>In-Plane Shear Properties (IPS) -- (ETW)</b><br><b>Strength &amp; Modulus</b><br>HEXCEL 8552 - IM7 UNI PREPREG |
|-------------------------------------------------------------------------------------------------------------------|

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength at 5% Strain [ksi] | 0.2% Offset Strength [ksi] | Modulus [Msi] | Avg. Specimen Thickn. [in] | # Plies in Laminate | Avg. tply [in] |
|-----------------|----------------|-------------------|---------------|--------------|-----------------------------|----------------------------|---------------|----------------------------|---------------------|----------------|
| HFINA11BD       | A              | M1                | 1             | 1            | 5.451                       | 3.4082                     | 0.308         | 0.081                      | 12                  | 0.0067         |
| HFINA11CD       | A              | M1                | 1             | 1            | 5.563                       | 3.3495                     | 0.317         | 0.089                      | 12                  | 0.0075         |
| HFINA11DD       | A              | M1                | 1             | 1            | 5.597                       | 3.2809                     | 0.304         | 0.089                      | 12                  | 0.0075         |
| HFINA11ED       | A              | M1                | 1             | 1            | 5.447                       | 3.3080                     | 0.313         | 0.088                      | 12                  | 0.0073         |
| HFINA21BD       | A              | M2                | 1             | 2            | 5.706                       | 3.262                      | 0.311         | 0.089                      | 12                  | 0.0074         |
| HFINA21CD       | A              | M2                | 1             | 2            | 5.657                       | 3.373                      | 0.315         | 0.088                      | 12                  | 0.0073         |
| HFINA21DD       | A              | M2                | 1             | 2            | 5.563                       | 3.292                      | 0.313         | 0.088                      | 12                  | 0.0073         |
| HFINB11BD       | B              | M1                | 2             | 1            | 5.751                       | 3.627                      | 0.321         | 0.082                      | 12                  | 0.0068         |
| HFINB11CD       | B              | M1                | 2             | 1            | 5.678                       | 3.462                      | 0.311         | 0.087                      | 12                  | 0.0073         |
| HFINB11DD*      | B              | M1                | 2             | 1            |                             | 3.432                      | 0.315         | 0.087                      | 12                  | 0.0072         |
| HFINB11ED       | B              | M1                | 2             | 1            | 5.434                       | 3.090                      | 0.303         | 0.086                      | 12                  | 0.0072         |
| HFINB21BD       | B              | M2                | 2             | 2            | 5.954                       | 3.539                      | 0.336         | 0.083                      | 12                  | 0.0069         |
| HFINB21CD       | B              | M2                | 2             | 2            | 5.657                       | 3.350                      | 0.305         | 0.088                      | 12                  | 0.0073         |
| HFINB21DD       | B              | M2                | 2             | 2            | 5.700                       | 3.349                      | 0.307         | 0.087                      | 12                  | 0.0073         |
| HFINC11BD       | C              | M1                | 3             | 1            | 5.289                       | 3.304                      | 0.308         | 0.082                      | 12                  | 0.0069         |
| HFINC11CD       | C              | M1                | 3             | 1            | 5.366                       | 3.088                      | 0.283         | 0.087                      | 12                  | 0.0073         |
| HFINC11DD       | C              | M1                | 3             | 1            | 5.178                       | 3.050                      | 0.286         | 0.086                      | 12                  | 0.0072         |
| HFINC21BD       | C              | M2                | 3             | 2            | 5.431                       | 3.248                      | 0.282         | 0.089                      | 12                  | 0.0074         |
| HFINC21CD       | C              | M2                | 3             | 2            | 5.456                       | 3.265                      | 0.283         | 0.088                      | 12                  | 0.0073         |
| HFINC21DD       | C              | M2                | 3             | 2            | 5.338                       | 3.060                      | 0.299         | 0.087                      | 12                  | 0.0072         |

ALL SPECIMENS: SHEAR MODULUS STRAIN RANGE CUTS INTO NON-LINEAR REGION

\* Unable to reach 50,000 microstrain

|                           |              |              |              |                           |               |
|---------------------------|--------------|--------------|--------------|---------------------------|---------------|
| <b>Average</b>            | <b>5.54</b>  | <b>3.31</b>  | <b>0.31</b>  | <b>Average</b>            | <b>0.0072</b> |
| <b>Standard Dev.</b>      | <b>0.19</b>  | <b>0.15</b>  | <b>0.01</b>  | <b>Standard Dev.</b>      |               |
| <b>Coeff. of Var. [%]</b> | <b>3.38</b>  | <b>4.63</b>  | <b>4.51</b>  | <b>Coeff. of Var. [%]</b> |               |
| <b>Min.</b>               | <b>5.18</b>  | <b>3.05</b>  | <b>0.28</b>  | <b>Min.</b>               | <b>0.0067</b> |
| <b>Max.</b>               | <b>5.95</b>  | <b>3.63</b>  | <b>0.34</b>  | <b>Max.</b>               | <b>0.0075</b> |
| <b>Number of Spec.</b>    | <b>19.00</b> | <b>20.00</b> | <b>20.00</b> | <b>Number of Spec.</b>    | <b>20</b>     |



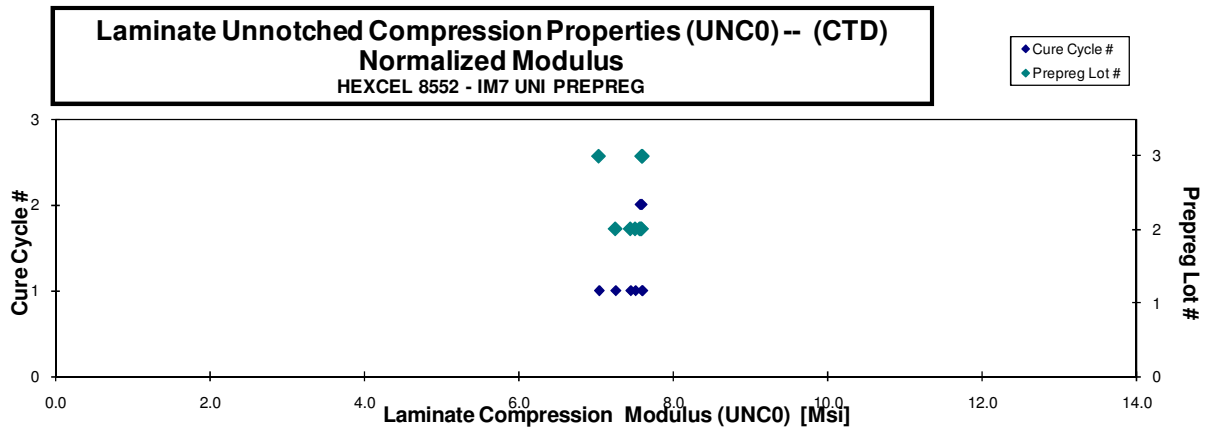
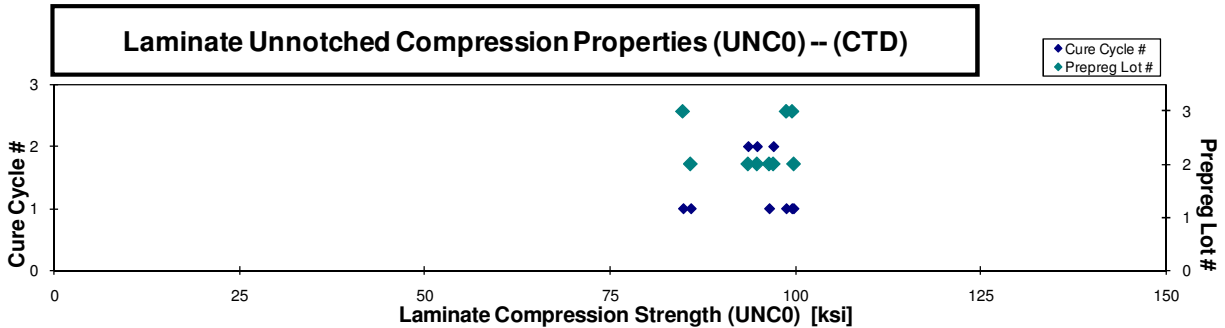


## 4.6 Unnotched Compression 0 Properties

| Laminate Unnotched Compression Properties (UNC0) -- (CTD)<br>Strength & Modulus<br>HEXCEL 8552 - IM7 UNI PREPREG |                |                   |               |                    |                |               |                 |                           |                     |              | normalizing $t_{ply}$<br>[in]<br>0.0072 |                                |                               |
|------------------------------------------------------------------------------------------------------------------|----------------|-------------------|---------------|--------------------|----------------|---------------|-----------------|---------------------------|---------------------|--------------|-----------------------------------------|--------------------------------|-------------------------------|
| Specimen Number                                                                                                  | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle Batch # | Strength [ksi] | Modulus [Msi] | Poisson's Ratio | Avg. Specimen Thckn. [in] | # Plies in Laminate | Failure Mode | Avg. $t_{ply}$ [in]                     | Strength <sub>norm</sub> [ksi] | Modulus <sub>norm</sub> [Msi] |
| HFIRB115B                                                                                                        | B              | M1                | 2             | 1                  | 110.782        | 7.426         | 0.060           | 0.109                     | 15                  | BGM          | 0.0073                                  | 111.944                        | 7.504                         |
| HFIRB116B                                                                                                        | B              | M1                | 2             | 1                  | 104.576        | 7.503         | 0.038           | 0.109                     | 15                  | BGM          | 0.0073                                  | 105.464                        | 7.567                         |
| HFIRB117B                                                                                                        | B              | M1                | 2             | 1                  | 114.578        | 7.466         | 0.030           | 0.108                     | 15                  | BGM          | 0.0072                                  | 114.578                        | 7.466                         |
| HFIRB215B                                                                                                        | B              | M2                | 2             | 2                  | 111.952        | 7.849         | 0.045           | 0.109                     | 15                  | BGM          | 0.0073                                  | 112.799                        | 7.908                         |
| HFIRB216B                                                                                                        | B              | M2                | 2             | 2                  | 108.713        | 7.436         | 0.033           | 0.109                     | 15                  | BGM          | 0.0073                                  | 109.954                        | 7.521                         |
| HFIRB217B                                                                                                        | B              | M2                | 2             | 2                  | 115.841        | 7.723         | 0.041           | 0.109                     | 15                  | BGM/BAB      | 0.0072                                  | 116.431                        | 7.762                         |
| HFIRC115B                                                                                                        | C              | M1                | 3             | 1                  | 112.448        | 7.704         | 0.047           | 0.112                     | 15                  | BGM          | 0.0075                                  | 116.578                        | 7.987                         |
| HFIRC116B                                                                                                        | C              | M1                | 3             | 1                  | 118.903        | 7.839         | 0.033           | 0.111                     | 15                  | HAT          | 0.0074                                  | 121.747                        | 8.027                         |
| HFIRC117B                                                                                                        | C              | M1                | 3             | 1                  | 106.963        | 7.809         | 0.044           | 0.111                     | 15                  | BAT          | 0.0074                                  | 109.819                        | 8.017                         |

Batch A Cure Cycle 1 and 2 and Batch C Cure Cycle 2 has improper layup so data was removed

|                    |         |       |        |                                    |        |         |       |
|--------------------|---------|-------|--------|------------------------------------|--------|---------|-------|
| Average            | 111.640 | 7.639 | 0.041  | Average <sub>norm</sub>            | 0.0073 | 113.257 | 7.751 |
| Standard Dev.      | 4.484   | 0.180 | 0.009  | Standard Dev. <sub>norm</sub>      |        | 4.748   | 0.239 |
| Coeff. of Var. [%] | 4.017   | 2.357 | 22.360 | Coeff. of Var. [%] <sub>norm</sub> |        | 4.192   | 3.083 |
| Min.               | 104.576 | 7.426 | 0.030  | Min.                               | 0.0072 | 105.464 | 7.466 |
| Max.               | 118.903 | 7.849 | 0.060  | Max.                               | 0.0075 | 121.747 | 8.027 |
| Number of Spec.    | 9       | 9     | 9      | Number of Spec.                    |        | 9       | 9     |



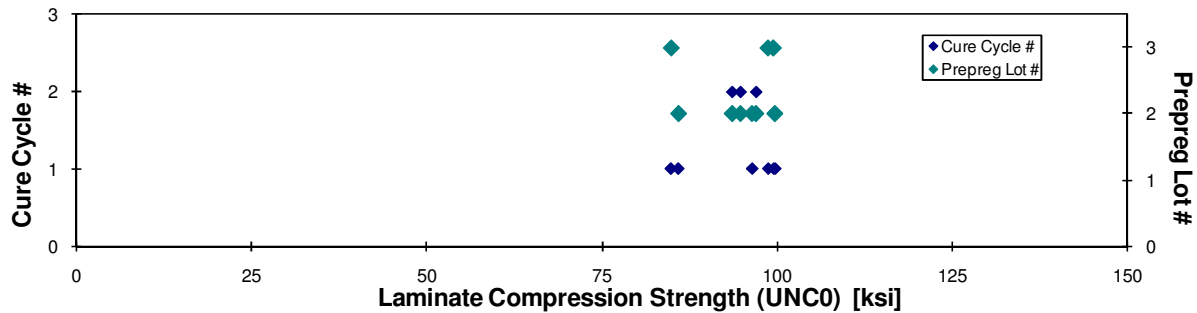
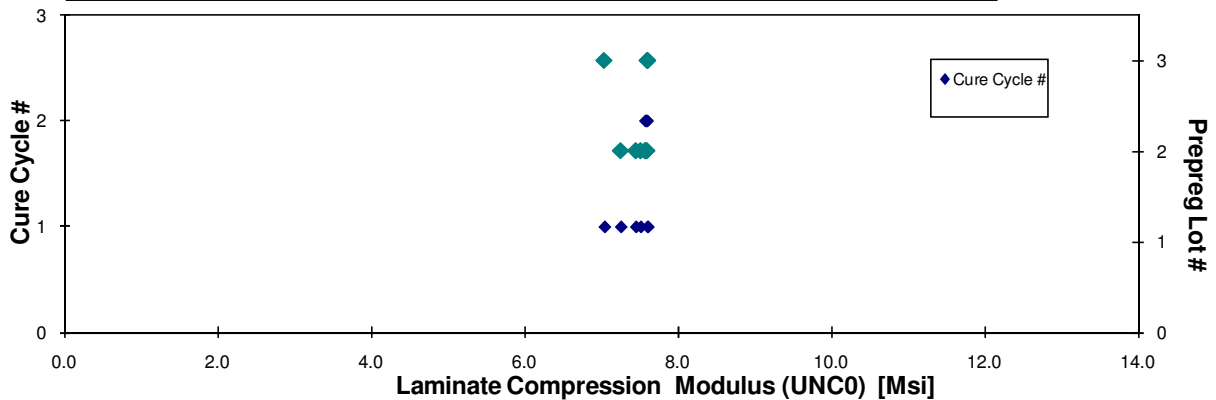
**Laminate Unnotched Compression Properties (UNC0) -- (RTD)**  
**Strength & Modulus**  
 HEXCEL 8552 - IM7 UNI PREPREG

 normalizing  $t_{ply}$   
 [in]  
 0.0072

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle Batch # | Strength [ksi] | Modulus [Msi] | Poisson's Ratio | Avg. Specimen Thickn. [in] | # Plies in Laminate | Failure Mode | Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] | Modulus <sub>norm</sub> [Msi] |
|-----------------|----------------|-------------------|---------------|--------------------|----------------|---------------|-----------------|----------------------------|---------------------|--------------|---------------------|--------------------------------|-------------------------------|
| HFIRB111A       | B              | M1                | 2             | 1                  | 91.558         | 7.732         | 0.035           | 0.101                      | 15                  | BGM          | 0.0068              | 85.878                         | 7.253                         |
| HFIRB112A       | B              | M1                | 2             | 1                  | 97.669         | 7.541         | 0.037           | 0.107                      | 15                  | BGM          | 0.0071              | 96.449                         | 7.447                         |
| HFIRB113A       | B              | M1                | 2             | 1                  | 98.542         | 7.419         | 0.035           | 0.109                      | 15                  | BGM          | 0.0073              | 99.743                         | 7.509                         |
| HFIRB211A       | B              | M2                | 2             | 2                  | 96.791         | 7.564         | 0.036           | 0.108                      | 15                  | BAT          | 0.0072              | 97.015                         | 7.582                         |
| HFIRB212A       | B              | M2                | 2             | 2                  | 93.387         | 7.550         | 0.037           | 0.108                      | 15                  | BGM          | 0.0072              | 93.603                         | 7.567                         |
| HFIRB213A       | B              | M2                | 2             | 2                  | 94.371         | 7.559         | 0.034           | 0.108                      | 15                  | BGM          | 0.0072              | 94.794                         | 7.592                         |
| HFIRC111A       | C              | M1                | 3             | 1                  | 89.785         | 7.451         | 0.032           | 0.102                      | 15                  | BGM          | 0.0068              | 84.825                         | 7.039                         |
| HFIRC112A       | C              | M1                | 3             | 1                  | 98.082         | 7.544         | 0.033           | 0.109                      | 15                  | BAT          | 0.0072              | 98.747                         | 7.595                         |
| HFIRC113A       | C              | M1                | 3             | 1                  | 95.814         | 7.319         | 0.039           | 0.112                      | 15                  | BGM          | 0.0075              | 99.525                         | 7.602                         |

Batch A Cure Cycle 1 and 2 and Batch C Cure Cycle 2 has improper layup so data was removed

|                    |        |       |       |                                    |        |        |       |
|--------------------|--------|-------|-------|------------------------------------|--------|--------|-------|
| Average            | 95.111 | 7.520 | 0.035 | Average <sub>norm</sub>            | 0.0071 | 94.509 | 7.465 |
| Standard Dev.      | 3.061  | 0.115 | 0.002 | Standard Dev. <sub>norm</sub>      |        | 5.587  | 0.195 |
| Coeff. of Var. [%] | 3.218  | 1.530 | 6.397 | Coeff. of Var. [%] <sub>norm</sub> |        | 5.912  | 2.615 |
| Min.               | 89.785 | 7.319 | 0.032 | Min.                               | 0.0068 | 84.825 | 7.039 |
| Max.               | 98.542 | 7.732 | 0.039 | Max.                               | 0.0075 | 99.743 | 7.602 |
| Number of Spec.    | 9      | 9     | 9     | Number of Spec.                    |        | 9      | 9     |

**Laminate Unnotched Compression Properties (UNC0) -- (RTD)**  
**Normalized Strength**

**Laminate Unnotched Compression Properties (UNC0) -- (RTD)**  
**Normalized Modulus**


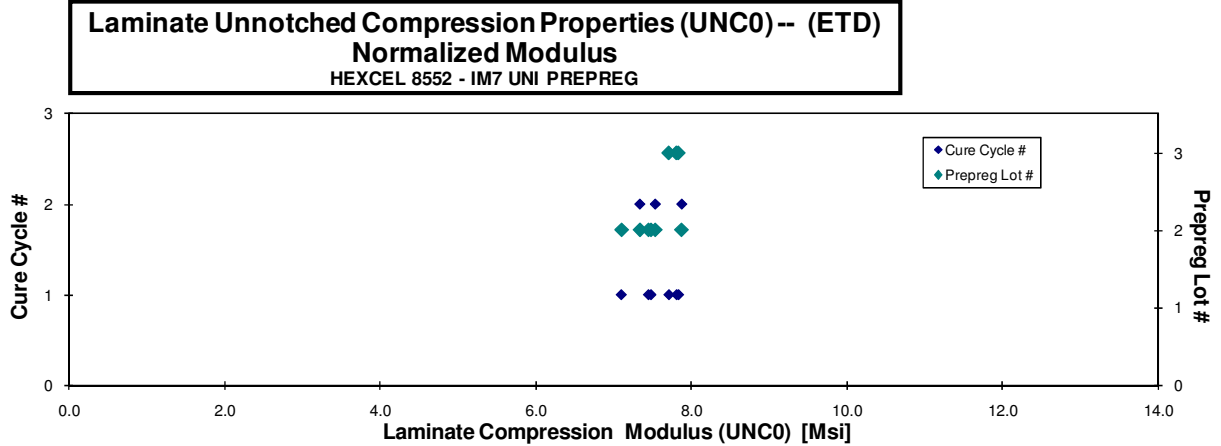
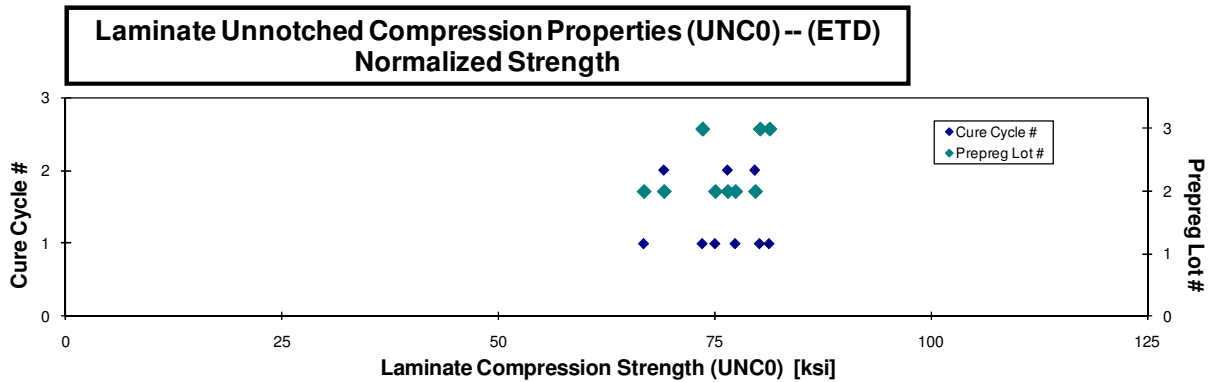
**Laminate Unnotched Compression Properties (UNC0) -- (ETD)**  
**Strength & Modulus**  
 HEXCEL 8552 - IM7 UNI PREPREG

normalizing  $t_{ply}$   
 [in]  
 0.0072

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle Batch # | Strength [ksi] | Modulus [Msi] | Poisson's Ratio | Avg. Specimen Thickn. [in] | # Plies in Laminate | Failure Mode | Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] | Modulus <sub>norm</sub> [Msi] |
|-----------------|----------------|-------------------|---------------|--------------------|----------------|---------------|-----------------|----------------------------|---------------------|--------------|---------------------|--------------------------------|-------------------------------|
| HFIRB11CC       | B              | M1                | 2             | 1                  | 75.164         | 7.462         | 0.032           | 0.108                      | 15                  | BAB          | 0.0072              | 75.059                         | 7.452                         |
| HFIRB11DC       | B              | M1                | 2             | 1                  | 66.566         | 7.458         | 0.031           | 0.108                      | 15                  | HGM          | 0.0072              | 66.781                         | 7.483                         |
| HFIRB118C       | B              | M1                | 2             | 1                  | 77.437         | 7.109         | 0.032           | 0.108                      | 15                  | HAB          | 0.0072              | 77.401                         | 7.105                         |
| HFIRB219C       | B              | M2                | 2             | 2                  | 78.236         | 7.400         | 0.025           | 0.110                      | 15                  | BAB          | 0.0073              | 79.697                         | 7.538                         |
| HFIRB21DC       | B              | M2                | 2             | 2                  | 81.637         | 7.834         | 0.025           | 0.101                      | 15                  | BAT          | 0.0067              | 76.509                         | 7.342                         |
| HFIRB218C       | B              | M2                | 2             | 2                  | 68.787         | 7.838         | 0.031           | 0.109                      | 15                  | BGM          | 0.0072              | 69.127                         | 7.876                         |
| HFIRC11DC       | C              | M1                | 3             | 1                  | 71.555         | 7.594         | 0.034           | 0.111                      | 15                  | BGM          | 0.0074              | 73.587                         | 7.810                         |
| HFIRC1RMC       | C              | M1                | 3             | 1                  | 79.904         | 7.697         | 0.033           | 0.110                      | 15                  | BGM          | 0.0073              | 81.341                         | 7.835                         |
| HFIRC1RNC       | C              | M1                | 3             | 1                  | 76.899         | 7.390         | 0.022           | 0.113                      | 15                  | BGM          | 0.0075              | 80.246                         | 7.712                         |

Batch A Cure Cycle 1 and 2 and Batch C Cure Cycle 2 has improper layup so data was removed

|                    |        |       |        |                                    |        |        |       |
|--------------------|--------|-------|--------|------------------------------------|--------|--------|-------|
| Average            | 75.132 | 7.531 | 0.030  | Average <sub>norm</sub>            | 0.0072 | 75.528 | 7.573 |
| Standard Dev.      | 5.118  | 0.235 | 0.004  | Standard Dev. <sub>norm</sub>      |        | 4.992  | 0.258 |
| Coeff. of Var. [%] | 6.813  | 3.123 | 14.554 | Coeff. of Var. [%] <sub>norm</sub> |        | 6.610  | 3.407 |
| Min.               | 66.566 | 7.109 | 0.022  | Min.                               | 0.0067 | 66.781 | 7.105 |
| Max.               | 81.637 | 7.838 | 0.034  | Max.                               | 0.0075 | 81.341 | 7.876 |
| Number of Spec.    | 9      | 9     | 9      | Number of Spec.                    | 9      | 9      | 9     |



**Laminate Unnotched Compression Properties (UNC0) -- (ETW)**  
**Strength & Modulus**  
 HEXCEL 8552 - IM7 UNI PREPREG

normalizing  $t_{ply}$   
 [in]  
 0.0072

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Modulus* [Msi] | Poisson's Ratio | Avg. Specimen Thickn. [in] | # Plies in Laminate | Failure Mode | Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] | Modulus <sub>norm</sub> [Msi] |
|-----------------|----------------|-------------------|---------------|--------------|----------------|----------------|-----------------|----------------------------|---------------------|--------------|---------------------|--------------------------------|-------------------------------|
| HFIRB11ED       | B              | M1                | 2             | 1            | 64.567         |                |                 | 0.110                      | 15                  | BGM          | 0.0073              | 65.543                         |                               |
| HFIRB11FD       | B              | M1                | 2             | 1            | 61.927         |                |                 | 0.110                      | 15                  | BGM          | 0.0073              | 62.978                         |                               |
| HFIRB11GD       | B              | M1                | 2             | 1            | 64.966         |                |                 | 0.107                      | 15                  | BGM          | 0.0072              | 64.645                         |                               |
| HFIRB11HD       | B              | M1                | 2             | 1            | 74.964         |                |                 | 0.102                      | 15                  | BGM          | 0.0068              | 70.950                         |                               |
| HFIRB21ED       | B              | M2                | 2             | 2            | 52.845         |                |                 | 0.110                      | 15                  | HAT          | 0.0073              | 53.938                         |                               |
| HFIRB21FD       | B              | M2                | 2             | 2            | 57.458         |                |                 | 0.109                      | 15                  | BGM          | 0.0073              | 58.229                         |                               |
| HFIRB21GD       | B              | M2                | 2             | 2            | 62.622         |                |                 | 0.108                      | 15                  | BGM          | 0.0072              | 62.786                         |                               |
| HFIRC11ED       | C              | M1                | 3             | 1            | 52.059         |                |                 | 0.113                      | 15                  | BAT          | 0.0075              | 54.357                         |                               |
| HFIRC11FD       | C              | M1                | 3             | 1            | 60.193         |                |                 | 0.113                      | 15                  | BGM          | 0.0075              | 63.045                         |                               |
| HFIRC11GD       | C              | M1                | 3             | 1            | 59.456         |                |                 | 0.110                      | 15                  | BGM          | 0.0073              | 60.649                         |                               |
| HFIRB11ID*      | B              | M1                | 2             | 1            |                |                |                 | 0.099                      | 15                  | BAT          |                     |                                |                               |
| HFIRB114D       | B              | M1                | 2             | 1            | 69.360         | 7.748          | 0.019           | 0.110                      | 15                  | BAB          | 0.0073              | 70.795                         | 7.908                         |
| HFIRB11RMD      | B              | M1                | 2             | 1            | 69.098         | 7.898          | 0.020           | 0.107                      | 15                  | BAT          | 0.0071              | 68.245                         | 7.801                         |
| HFIRB21HD       | B              | M2                | 2             | 2            |                | 7.963          | 0.015           | 0.103                      | 15                  | HIT          | 0.0069              |                                | 7.614                         |
| HFIRB21ID       | B              | M2                | 2             | 2            | 70.790         | 8.216          | 0.019           | 0.103                      | 15                  | HAB          | 0.0068              | 67.185                         | 7.797                         |
| HFIRB214D       | B              | M2                | 2             | 2            | 67.719         | 8.128          | 0.013           | 0.108                      | 15                  | BGM          | 0.0072              | 67.635                         | 8.118                         |
| HFIRC11HD       | C              | M1                | 3             | 1            | 65.131         | 7.745          | 0.011           | 0.103                      | 15                  | BAB          | 0.0069              | 62.327                         | 7.412                         |
| HFIRC114D       | C              | M1                | 3             | 1            | 67.033         | 7.531          | 0.021           | 0.112                      | 15                  | BAT          | 0.0075              | 69.588                         | 7.818                         |
| HFIRC118D       | C              | M1                | 3             | 1            | 68.351         | 7.298          | 0.021           | 0.110                      | 15                  | BAB          | 0.0074              | 69.827                         | 7.456                         |

Compressive strength for HFIRA21ID and HFIRB21HD is not reported as unacceptable failure mode was

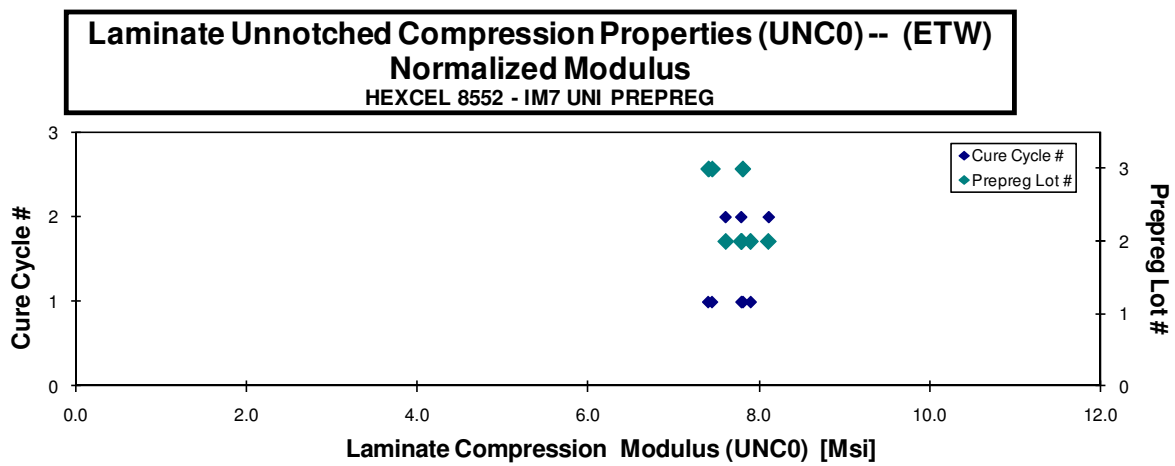
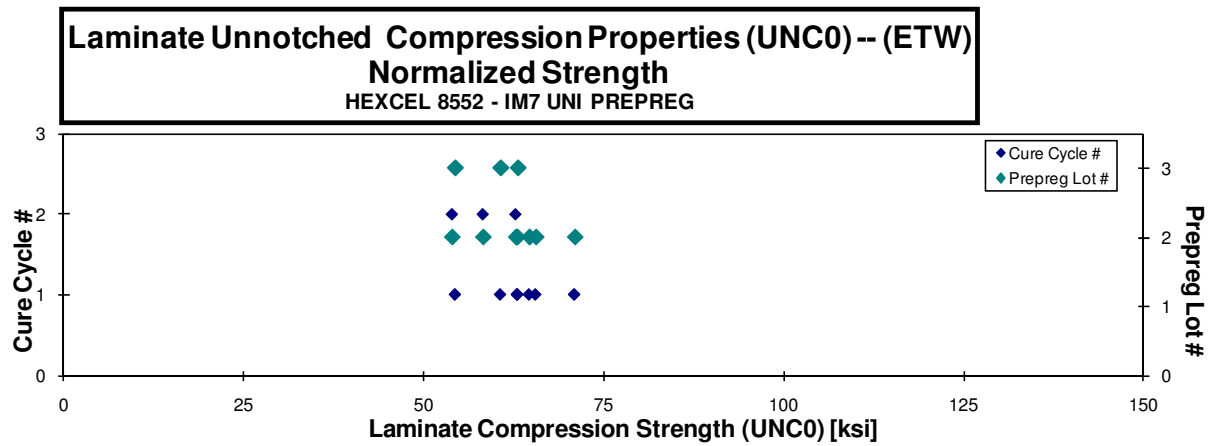
Modulus not reported due to improper strain gage adhesive used

Batch A Cure Cycle 1 and 2 and Batch C Cure Cycle 2 has improper layup so data was removed

COMPRESSIVE STRENGTH WAS NOT REPORTED FOR SPECIMEN # HFIRC21FD DUE TO UNACCEPTABLE FAILURE MODE.

\* Specimens have uneven grip marks so data is not reported

|                    |        |       |        |                                    |        |        |       |
|--------------------|--------|-------|--------|------------------------------------|--------|--------|-------|
| Average            | 64.032 | 7.816 | 0.017  | Average <sub>norm</sub>            | 0.0072 | 64.278 | 7.740 |
| Standard Dev.      | 6.208  | 0.303 | 0.004  | Standard Dev. <sub>norm</sub>      |        | 5.289  | 0.236 |
| Coeff. of Var. [%] | 9.696  | 3.882 | 22.032 | Coeff. of Var. [%] <sub>norm</sub> |        | 8.228  | 3.043 |
| Min.               | 52.059 | 7.298 | 0.011  | Min.                               | 0.0068 | 53.938 | 7.412 |
| Max.               | 74.964 | 8.216 | 0.021  | Max.                               | 0.0075 | 70.950 | 8.118 |
| Number of Spec.    | 17     | 8     | 8      | Number of Spec.                    |        | 17     | 8     |



## 4.7 Unnotched Tension 0 Properties

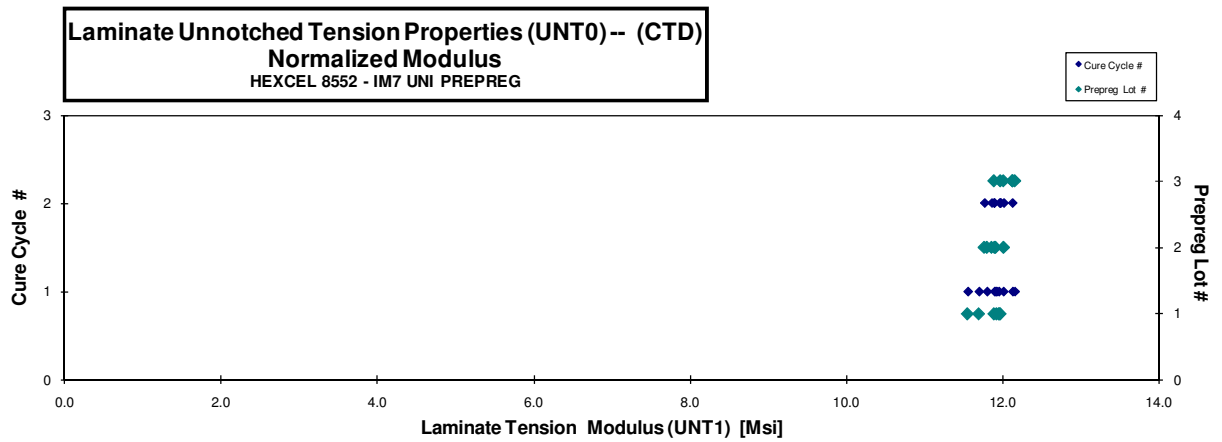
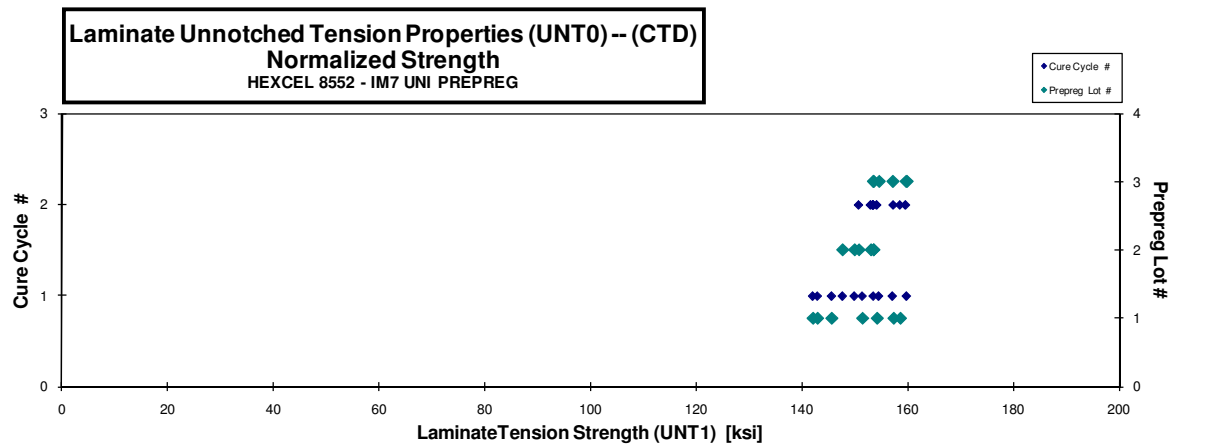
**Laminate Unnotched Tension Properties (UNT0)-- (CTD)**  
**Strength & Modulus**  
 HEXCEL 8552 - IM7 UNI PREPREG

normalizing  $t_{ply}$   
 [in]  
 0.0072

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Modulus [Msi] | Avg. Specimen Thickn. [in] | # Plies in Laminate | Failure Mode | Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] | Modulus <sub>norm</sub> [Msi] |
|-----------------|----------------|-------------------|---------------|--------------|----------------|---------------|----------------------------|---------------------|--------------|---------------------|--------------------------------|-------------------------------|
| HFIPA116B       | A              | M1                | 1             | 1            | 140.452        | 11.491        | 0.059                      | 8                   | LGM          | 0.0073              | 142.931                        | 11.694                        |
| HFIPA117B       | A              | M1                | 1             | 1            | 138.380        | 11.251        | 0.059                      | 8                   | LGM          | 0.0074              | 142.064                        | 11.551                        |
| HFIPA118B       | A              | M1                | 1             | 1            | 149.109        | 11.735        | 0.059                      | 8                   | LGM          | 0.0073              | 151.439                        | 11.919                        |
| HFIPA119B       | A              | M1                | 1             | 1            | 138.826        | 11.390        | 0.060                      | 8                   | LGM          | 0.0076              | 145.615                        | 11.947                        |
| HFIPA216B       | A              | M2                | 1             | 2            | 153.285        | 11.488        | 0.060                      | 8                   | LGM          | 0.0075              | 158.607                        | 11.887                        |
| HFIPA217B       | A              | M2                | 1             | 2            | 148.863        | 11.543        | 0.060                      | 8                   | LGM          | 0.0075              | 154.204                        | 11.958                        |
| HFIPA218B       | A              | M2                | 1             | 2            | 153.556        | 11.680        | 0.059                      | 8                   | LGM          | 0.0074              | 157.333                        | 11.968                        |
| HFIPB116B       | B              | M1                | 2             | 1            | 149.540        | 11.876        | 0.058                      | 8                   | LGM          | 0.0072              | 149.929                        | 11.907                        |
| HFIPB117B       | B              | M1                | 2             | 1            | 154.720        | 11.886        | 0.057                      | 8                   | LGM          | 0.0071              | 153.556                        | 11.797                        |
| HFIPB118B       | B              | M1                | 2             | 1            | 146.994        | 11.837        | 0.058                      | 8                   | LWB          | 0.0072              | 147.675                        | 11.892                        |
| HFIPB216B       | B              | M2                | 2             | 2            | 150.463        | 11.832        | 0.058                      | 8                   | LWB          | 0.0072              | 150.767                        | 11.856                        |
| HFIPB217B       | B              | M2                | 2             | 2            | 152.509        | 11.686        | 0.058                      | 8                   | LGM          | 0.0072              | 153.523                        | 11.763                        |
| HFIPB218B       | B              | M2                | 2             | 2            | 150.815        | 11.835        | 0.058                      | 8                   | LAB          | 0.0073              | 153.040                        | 12.010                        |
| HFIPC116B       | C              | M1                | 3             | 1            | 154.979        | 11.838        | 0.058                      | 8                   | LGM          | 0.0073              | 157.176                        | 12.006                        |
| HFIPC117B       | C              | M1                | 3             | 1            | 156.681        | 11.909        | 0.059                      | 8                   | LGM          | 0.0073              | 159.854                        | 12.151                        |
| HFIPC118B       | C              | M1                | 3             | 1            | 148.810        | 11.670        | 0.060                      | 8                   | LGM          | 0.0075              | 154.579                        | 12.122                        |
| HFIPC216B       | C              | M2                | 3             | 2            | 151.797        | 11.830        | 0.058                      | 8                   | LGM          | 0.0073              | 153.554                        | 11.967                        |
| HFIPC217B       | C              | M2                | 3             | 2            | 152.579        | 11.818        | 0.058                      | 8                   | LGM          | 0.0072              | 153.462                        | 11.886                        |
| HFIPC218B       | C              | M2                | 3             | 2            | 155.700        | 11.820        | 0.059                      | 8                   | LGM          | 0.0074              | 159.664                        | 12.121                        |

Average 149.898 11.706  
 Standard Dev. 5.417 0.189  
 Coeff. of Var. [%] 3.614 1.612  
 Min. 138.380 11.251  
 Max. 156.681 11.909  
 Number of Spec. 19 19

Average<sub>norm</sub> 0.0073 152.578 11.916  
 Standard Dev.<sub>norm</sub> 5.172 0.147  
 Coeff. of Var. [%]<sub>norm</sub> 3.389 1.236  
 Min. 0.0071 142.064 11.551  
 Max. 0.0076 159.854 12.151  
 Number of Spec. 19 19



**Laminate Unnotched Tension Properties (UNT0) -- (RTD)**  
**Strength & Modulus**  
 HEXCEL 8552 - IM7 UNI PREPREG

normalizing  $t_{ply}$   
 [in]  
 0.0072

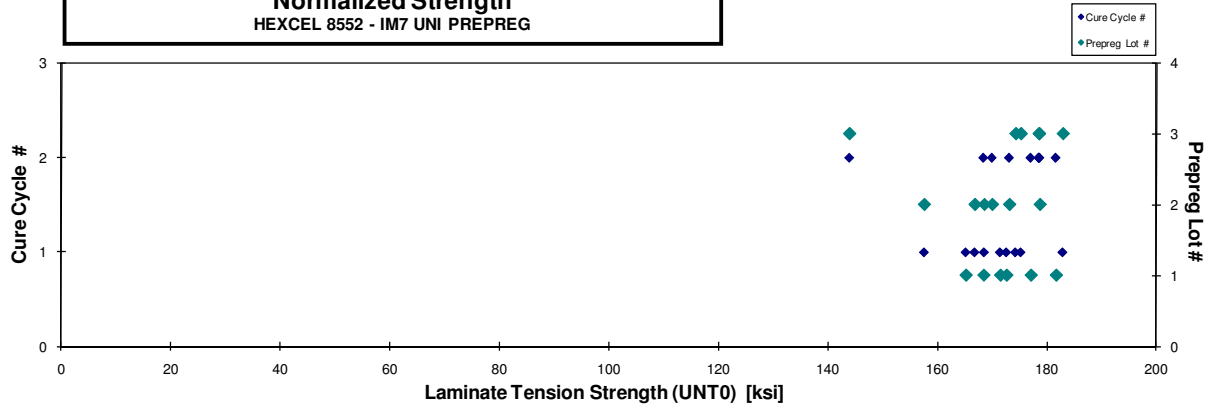
| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Modulus [Msi] | Avg. Specimen Thckn. [in] | # Plies in Laminate | Failure Mode | Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] | Modulus <sub>norm</sub> [Msi] |
|-----------------|----------------|-------------------|---------------|--------------|----------------|---------------|---------------------------|---------------------|--------------|---------------------|--------------------------------|-------------------------------|
| HFIPA111A*      | A              | M1                | 1             | 1            |                |               |                           |                     |              |                     |                                |                               |
| HFIPA112A       | A              | M1                | 1             | 1            | 160.028        | 11.338        | 0.059                     | 8                   | LWT/LWB      | 0.0074              | 165.214                        | 11.706                        |
| HFIPA113A       | A              | M1                | 1             | 1            | 165.993        | 11.753        | 0.060                     | 8                   | LGM          | 0.0075              | 172.621                        | 12.222                        |
| HFIPA114A       | A              | M1                | 1             | 1            | 170.162        | 12.003        | 0.058                     | 8                   | LWT/LAB      | 0.0073              | 171.491                        | 12.097                        |
| HFIPA211A       | A              | M2                | 1             | 2            | 170.274        | 11.629        | 0.057                     | 8                   | LAT/LAB      | 0.0071              | 168.451                        | 11.504                        |
| HFIPA212A       | A              | M2                | 1             | 2            | 166.740        | 11.334        | 0.061                     | 8                   | LGM          | 0.0076              | 177.065                        | 12.036                        |
| HFIPA213A       | A              | M2                | 1             | 2            | 177.388        | 11.745        | 0.059                     | 8                   | LWB/LWT      | 0.0074              | 181.648                        | 12.027                        |
| HFIPB111A       | B              | M1                | 2             | 1            | 167.506        | 12.347        | 0.054                     | 8                   | LGM          | 0.0068              | 157.619                        | 11.618                        |
| HFIPB112A       | B              | M1                | 2             | 1            | 164.698        | 11.723        | 0.058                     | 8                   | LWT/LAB      | 0.0073              | 166.842                        | 11.875                        |
| HFIPB113A       | B              | M1                | 2             | 1            | 169.650        | 12.020        | 0.057                     | 8                   | LWT/LWB      | 0.0072              | 168.570                        | 11.943                        |
| HFIPB211A       | B              | M2                | 2             | 2            | 165.886        | 11.892        | 0.059                     | 8                   | LGM          | 0.0074              | 170.014                        | 12.188                        |
| HFIPB212A       | B              | M2                | 2             | 2            | 169.856        | 11.745        | 0.059                     | 8                   | LGM          | 0.0073              | 173.149                        | 11.973                        |
| HFIPB213A       | B              | M2                | 2             | 2            | 177.983        | 12.004        | 0.058                     | 8                   | LWB          | 0.0072              | 178.704                        | 12.052                        |
| HFIPC111A       | C              | M1                | 3             | 1            | 168.776        | 11.646        | 0.059                     | 8                   | LWT          | 0.0074              | 174.295                        | 12.027                        |
| HFIPC112A       | C              | M1                | 3             | 1            | 169.224        | 11.688        | 0.060                     | 8                   | LWT          | 0.0075              | 175.247                        | 12.104                        |
| HFIPC113A       | C              | M1                | 3             | 1            | 182.062        | 12.029        | 0.058                     | 8                   | LGM          | 0.0072              | 182.904                        | 12.084                        |
| HFIPC211A       | C              | M2                | 3             | 2            | 150.387        | 12.455        | 0.055                     | 8                   | LGM          | 0.0069              | 143.990                        | 11.926                        |
| HFIPC212A       | C              | M2                | 3             | 2            | 173.159        | 11.766        | 0.059                     | 8                   | LGM          | 0.0074              | 178.570                        | 12.134                        |
| HFIPC213A       | C              | M2                | 3             | 2            | 175.088        | 12.104        | 0.059                     | 8                   | LGM          | 0.0073              | 178.533                        | 12.342                        |

\*Data from was removed due to thickness taper due to pinching on edge of panel during bagging.

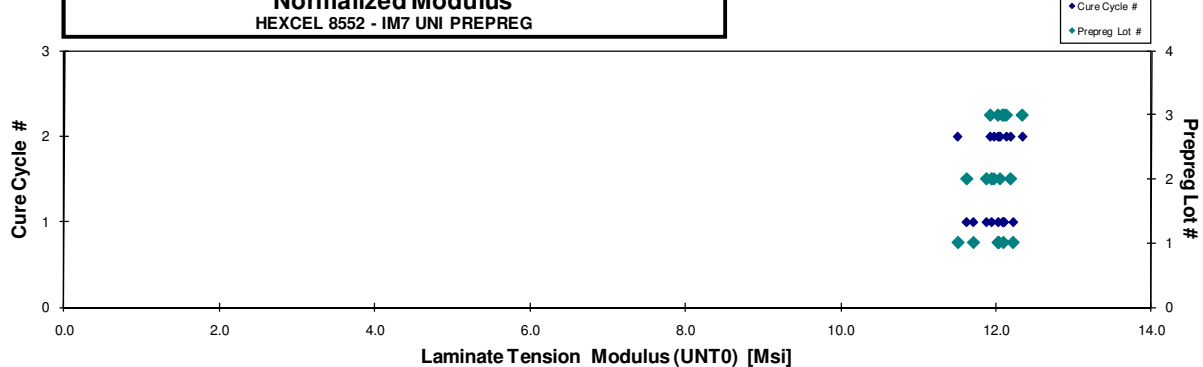
Average 169.159 11.846  
 Standard Dev. 7.077 0.296  
 Coeff. of Var. [%] 4.183 2.496  
 Min. 150.387 11.334  
 Max. 182.062 12.455  
 Number of Spec. 18 18

Average<sub>norm</sub> 0.0073 171.385 11.992  
 Standard Dev.<sub>norm</sub> 9.304 0.211  
 Coeff. of Var. [%]<sub>norm</sub> 5.429 1.757  
 Min. 0.0068 143.990 11.504  
 Max. 0.0076 182.904 12.342  
 Number of Spec. 18 18

**Laminate Unnotched Tension Properties (UNT0) -- (RTD)**  
**Normalized Strength**  
 HEXCEL 8552 - IM7 UNI PREPREG



**Laminate Unnotched Tension Properties (UNT0) -- (RTD)**  
**Normalized Modulus**  
 HEXCEL 8552 - IM7 UNI PREPREG





**Laminate Unnotched Tension Properties (UNT0) -- (ETW)**  
**Strength & Modulus**  
 HEXCEL 8552 - IM7 UNI PREPREG

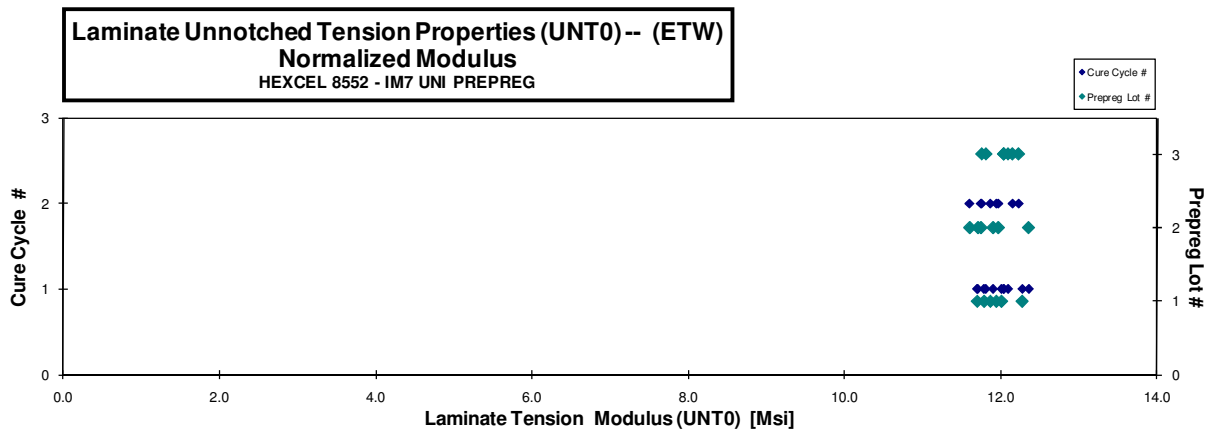
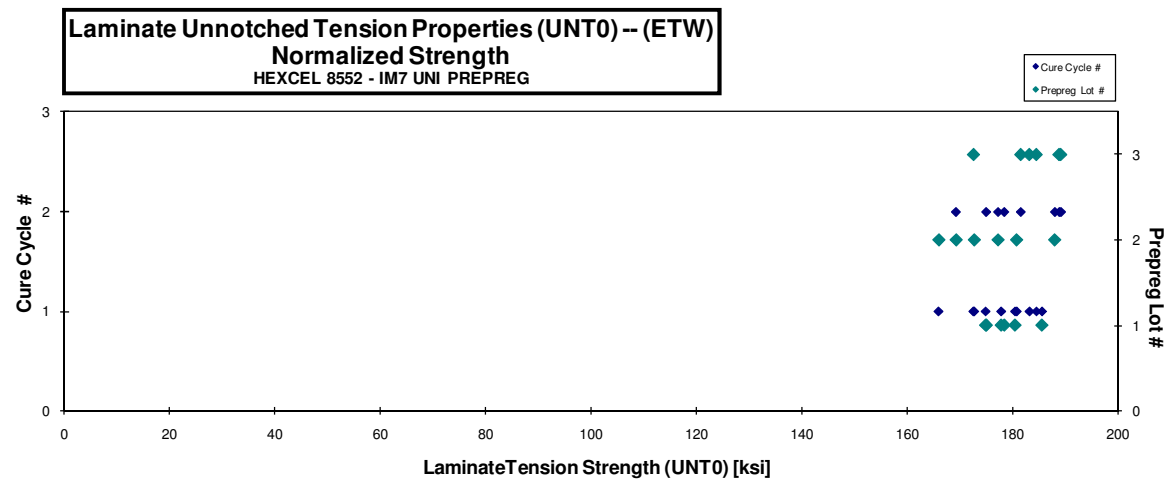
normalizing  $t_{ply}$   
 [in]  
 0.0072

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Modulus [Msi] | Avg. Specimen Thickn. [in] | # Plies in Laminate | Failure Mode    | Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] | Modulus <sub>norm</sub> [Msi] |
|-----------------|----------------|-------------------|---------------|--------------|----------------|---------------|----------------------------|---------------------|-----------------|---------------------|--------------------------------|-------------------------------|
| HFIPA11BD       | A              | M1                | 1             | 1            | 176.795        | 11.690        | 0.060                      | 8                   | LAT / LGM / LAB | 0.0076              | 185.594                        | 12.272                        |
| HFIPA11CD       | A              | M1                | 1             | 1            | 174.123        | 11.286        | 0.060                      | 8                   | LAT / LAB       | 0.0075              | 180.471                        | 11.697                        |
| HFIPA11DD       | A              | M1                | 1             | 1            | 175.012        | 11.816        | 0.059                      | 8                   | LWT / LGM       | 0.0073              | 177.848                        | 12.008                        |
| HFIPA11ED       | A              | M1                | 1             | 1            | 170.114        | 11.463        | 0.059                      | 8                   | LAT / LAB       | 0.0074              | 174.889                        | 11.785                        |
| HFIPA21BD*      | A              | M2                | 1             | 2            |                |               |                            |                     |                 |                     |                                |                               |
| HFIPA21CD       | A              | M2                | 1             | 2            | 169.361        | 11.335        | 0.061                      | 8                   | LAT / LWB       | 0.0076              | 178.427                        | 11.942                        |
| HFIPA21DD       | A              | M2                | 1             | 2            | 170.950        | 11.590        | 0.059                      | 8                   | LAT / LAB       | 0.0074              | 175.007                        | 11.865                        |
| HFIPB11BD       | B              | M1                | 2             | 1            | 178.511        | 12.198        | 0.058                      | 8                   | LAT / LWB       | 0.0073              | 180.784                        | 12.353                        |
| HFIPB11CD       | B              | M1                | 2             | 1            | 164.549        | 11.798        | 0.058                      | 8                   | LAT / LGM       | 0.0073              | 165.977                        | 11.900                        |
| HFIPB11ED       | B              | M1                | 2             | 1            | 172.023        | 11.659        | 0.058                      | 8                   | LAT / LGM       | 0.0072              | 172.720                        | 11.706                        |
| HFIPB21BD       | B              | M2                | 2             | 2            | 186.089        | 11.843        | 0.058                      | 8                   | LAT / LGM / LAB | 0.0073              | 188.028                        | 11.966                        |
| HFIPB21CD       | B              | M2                | 2             | 2            | 169.321        | 11.605        | 0.058                      | 8                   | LGM             | 0.0072              | 169.272                        | 11.601                        |
| HFIPB21DD       | B              | M2                | 2             | 2            | 175.679        | 11.641        | 0.058                      | 8                   | LAT / LGM       | 0.0073              | 177.254                        | 11.745                        |
| HFIPC11BD       | C              | M1                | 3             | 1            | 172.929        | 11.832        | 0.057                      | 8                   | LGM / LWB       | 0.0072              | 172.579                        | 11.808                        |
| HFIPC11CD       | C              | M1                | 3             | 1            | 177.552        | 11.718        | 0.059                      | 8                   | LAT / LWB       | 0.0074              | 183.203                        | 12.091                        |
| HFIPC11DD*      | C              | M1                | 3             | 1            | 11.947         |               | 0.058                      | 8                   | LIT / LWB       | 0.0073              |                                | 12.034                        |
| HFIPC11ED       | C              | M1                | 3             | 1            | 179.743        | 11.724        | 0.059                      | 8                   | LAT / LAB       | 0.0074              | 184.528                        | 12.036                        |
| HFIPC21BD       | C              | M2                | 3             | 2            | 189.339        | 12.258        | 0.055                      | 8                   | LAT / LAB       | 0.0069              | 181.560                        | 11.755                        |
| HFIPC21CD       | C              | M2                | 3             | 2            | 181.866        | 11.677        | 0.060                      | 8                   | LWT / LGM / LAB | 0.0075              | 189.181                        | 12.147                        |
| HFIPC21DD       | C              | M2                | 3             | 2            | 183.749        | 11.894        | 0.059                      | 8                   | LAT / LAB       | 0.0074              | 188.853                        | 12.224                        |

\*Data from was removed due to thickness variation due to pinching on edge of panel during bagging.

Average 175.984 11.735  
 Standard Dev. 6.450 0.245  
 Coeff. of Var. [%] 3.665 2.091  
 Min. 164.549 11.286  
 Max. 189.339 12.258  
 Number of Spec. 18 19

Average<sub>norm</sub> 0.0073 179.232 11.944  
 Standard Dev.<sub>norm</sub> 6.718 0.211  
 Coeff. of Var. [%]<sub>norm</sub> 3.748 1.764  
 Min. 0.0069 165.977 11.601  
 Max. 0.0076 189.181 12.353  
 Number of Spec. 18 19



## 4.8 Unnotched Tension 1 Properties

**Laminate Unnotched Tension Properties (UNT1) -- (CTD)**  
**Strength & Modulus**  
 HEXCEL 8552 - IM7 UNI PREPREG

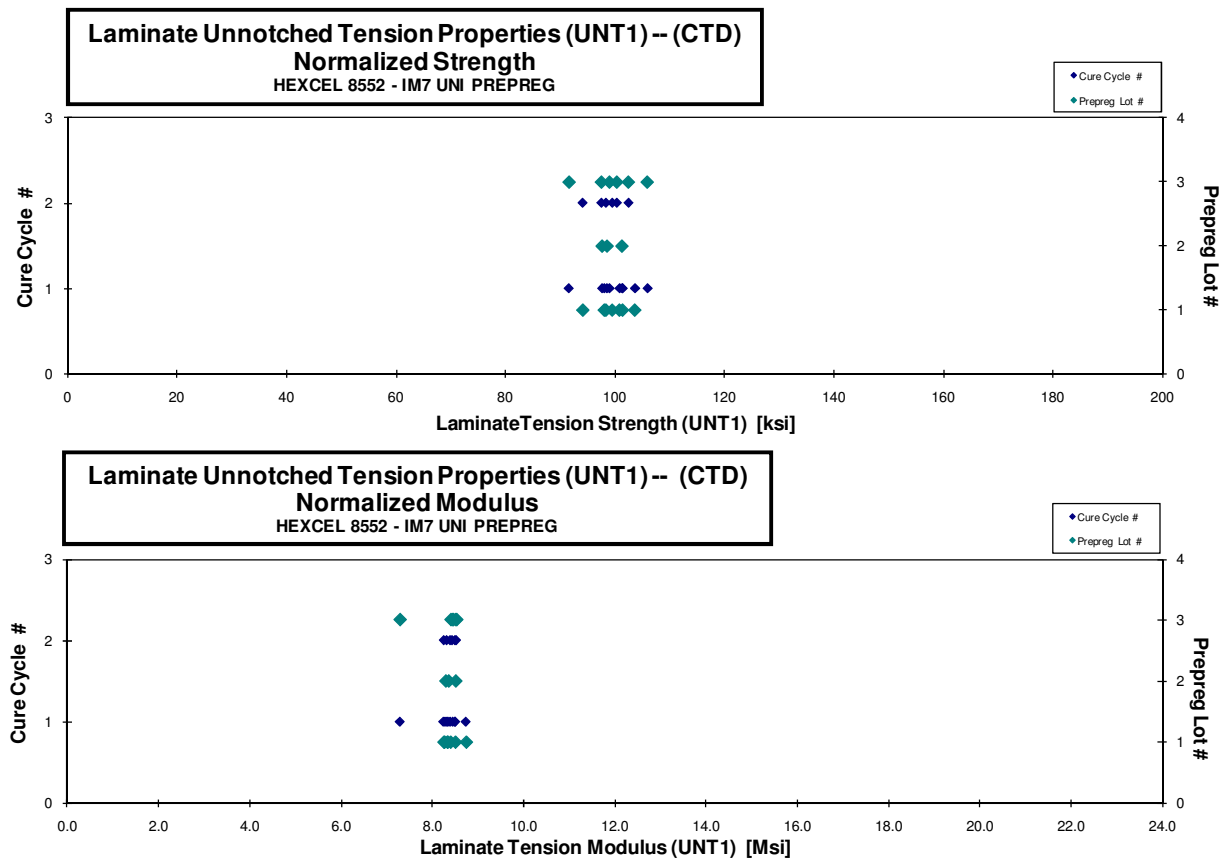
normalizing  $t_{ply}$   
 [in]  
 0.0072

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Modulus [Msi] | Avg. Specimen Thickn. [in] | # Plies in Laminate | Failure Mode | Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] | Modulus <sub>norm</sub> [Msi] |
|-----------------|----------------|-------------------|---------------|--------------|----------------|---------------|----------------------------|---------------------|--------------|---------------------|--------------------------------|-------------------------------|
| HFIAA116B       | A              | M1                | 1             | 1            | 98.622         | 8.511         | 0.118                      | 16                  | LGM / AGM    | 0.0074              | 101.333                        | 8.745                         |
| HFIAA117B       | A              | M1                | 1             | 1            | 99.922         | 8.181         | 0.116                      | 16                  | AGM          | 0.0073              | 100.789                        | 8.252                         |
| HFIAA118B       | A              | M1                | 1             | 1            | 102.825        | 8.274         | 0.116                      | 16                  | AWT          | 0.0073              | 103.584                        | 8.335                         |
| HFIAA119B       | A              | M1                | 1             | 1            | 95.738         | 8.311         | 0.118                      | 16                  | AGM          | 0.0074              | 98.009                         | 8.508                         |
| HFIAA215B       | A              | M2                | 1             | 2            | 98.424         | 8.242         | 0.116                      | 16                  | LGM          | 0.0073              | 99.449                         | 8.328                         |
| HFIAA216B       | A              | M2                | 1             | 2            | 97.607         | 8.342         | 0.116                      | 16                  | LGM          | 0.0073              | 98.313                         | 8.402                         |
| HFIAA217B       | A              | M2                | 1             | 2            | 93.700         | 8.231         | 0.116                      | 16                  | LWB          | 0.0072              | 94.093                         | 8.265                         |
| HFIAB115B       | B              | M1                | 2             | 1            | 97.175         | 8.253         | 0.116                      | 16                  | AGM          | 0.007               | 97.639                         | 8.293                         |
| HFIAB116B       | B              | M1                | 2             | 1            | 97.723         | 8.290         | 0.116                      | 16                  | AWT          | 0.0073              | 98.514                         | 8.357                         |
| HFIAB117B       | B              | M1                | 2             | 1            | 101.304        | 8.519         | 0.115                      | 16                  | AGM          | 0.0072              | 101.245                        | 8.514                         |
| HFAC115B        | C              | M1                | 3             | 1            | 96.981         | 8.237         | 0.118                      | 16                  | AGM / DGM    | 0.0073              | 98.974                         | 8.406                         |
| HFAC116B        | C              | M1                | 3             | 1            | 104.197        | 8.331         | 0.117                      | 16                  | AGM          | 0.0073              | 105.840                        | 8.462                         |
| HFAC111B        | C              | M1                | 3             | 1            | 99.363         | 7.913         | 0.106                      | 16                  | AGM          | 0.0066              | 91.601                         | 7.295                         |
| HFAC215B        | C              | M2                | 3             | 2            | 95.780         | 8.362         | 0.117                      | 16                  | AGM          | 0.0073              | 97.485                         | 8.511                         |
| HFAC216B        | C              | M2                | 3             | 2            | 100.348        | 8.450         | 0.115                      | 16                  | AWT          | 0.0072              | 100.290                        | 8.446                         |
| HFAC217B        | C              | M2                | 3             | 2            | 100.956        | 8.414         | 0.117                      | 16                  | AWB          | 0.0073              | 102.402                        | 8.535                         |

Data for HFIAB 21XB was removed due to unbalanced lay up.

Average 98.792 8.304  
 Standard Dev. 2.750 0.145  
 Coeff. of Var. [%] 2.784 1.742  
 Min. 93.700 7.913  
 Max. 104.197 8.519  
 Number of Spec. 16 16

Average<sub>norm</sub> 0.0072 99.348 8.353  
 Standard Dev.<sub>norm</sub> 3.442 0.309  
 Coeff. of Var. [%]<sub>norm</sub> 3.464 3.696  
 Min. 0.0066 91.601 7.295  
 Max. 0.0074 105.840 8.745  
 Number of Spec. 16 16 16



**Laminate Unnotched Tension Properties (UNT1)-- (RTD)**  
**Strength & Modulus**  
 HEXCEL 8552 - IM7 UNI PREPREG

normalizing  $t_{ply}$ 

[in]

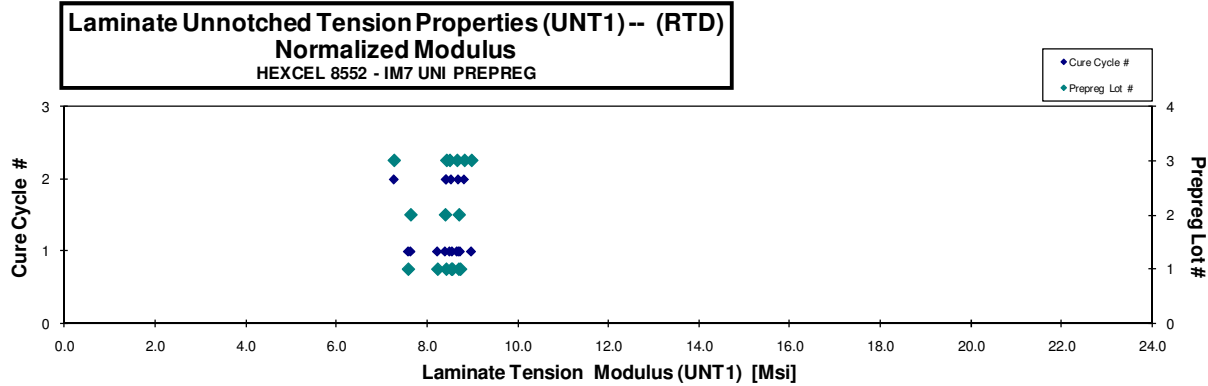
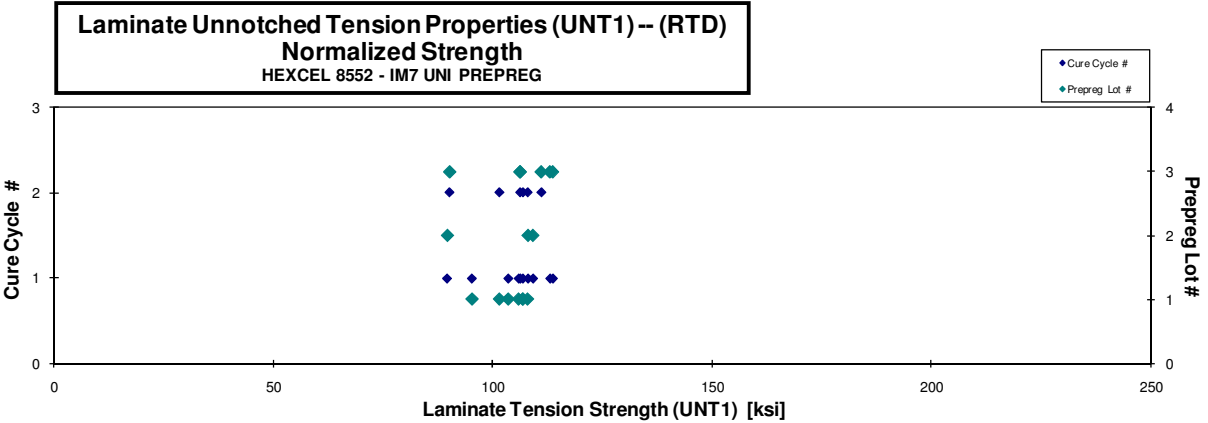
0.0072

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Modulus [Msi] | Avg. Specimen Thickn. [in] | # Plies in Laminate | Failure Mode | Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] | Modulus <sub>norm</sub> [Msi] |
|-----------------|----------------|-------------------|---------------|--------------|----------------|---------------|----------------------------|---------------------|--------------|---------------------|--------------------------------|-------------------------------|
| HFIAA111A       | A              | M1                | 1             | 1            | 102.024        | 8.116         | 0.117                      | 16                  | AWT          | 0.0073              | 103.515                        | 8.235                         |
| HFIAA112A       | A              | M1                | 1             | 1            | 101.477        | 8.093         | 0.108                      | 16                  | AGM          | 0.0068              | 95.194                         | 7.592                         |
| HFIAA113A       | A              | M1                | 1             | 1            | 103.733        | 8.310         | 0.119                      | 16                  | AGM          | 0.0074              | 106.855                        | 8.560                         |
| HFIAA114A       | A              | M1                | 1             | 1            | 103.511        | 8.543         | 0.118                      | 16                  | AWB          | 0.0074              | 105.892                        | 8.739                         |
| HFIAA212A       | A              | M2                | 1             | 2            | 105.753        | 8.366         | 0.118                      | 16                  | AWT          | 0.0074              | 107.956                        | 8.541                         |
| HFIAA213A       | A              | M2                | 1             | 2            | 104.779        | 8.528         | 0.118                      | 16                  | AGM          | 0.0073              | 106.871                        | 8.698                         |
| HFIAA214A       | A              | M2                | 1             | 2            | 101.098        | 8.393         | 0.116                      | 16                  | AGM          | 0.0072              | 101.493                        | 8.426                         |
| HFIB111A        | B              | M1                | 2             | 1            | 96.381         | 8.227         | 0.107                      | 16                  | AGM          | 0.0067              | 89.563                         | 7.645                         |
| HFIB112A        | B              | M1                | 2             | 1            | 107.280        | 8.554         | 0.117                      | 16                  | AGM          | 0.0073              | 109.174                        | 8.705                         |
| HFIB113A        | B              | M1                | 2             | 1            | 106.160        | 8.257         | 0.117                      | 16                  | AWT          | 0.0073              | 108.049                        | 8.404                         |
| HFAC112A        | C              | M1                | 3             | 1            | 110.004        | 8.691         | 0.119                      | 16                  | AWB          | 0.0074              | 113.712                        | 8.984                         |
| HFAC113A        | C              | M1                | 3             | 1            | 102.238        | 8.186         | 0.120                      | 16                  | AWT          | 0.0075              | 106.246                        | 8.507                         |
| HFAC114A        | C              | M1                | 3             | 1            | 111.125        | 8.519         | 0.117                      | 16                  | AWB          | 0.0073              | 113.070                        | 8.668                         |
| HFAC211A        | C              | M2                | 3             | 2            | 97.791         | 7.900         | 0.106                      | 16                  | AWB          | 0.0066              | 90.080                         | 7.277                         |
| HFAC212A        | C              | M2                | 3             | 2            | 108.416        | 8.618         | 0.118                      | 16                  | AGM          | 0.0074              | 111.066                        | 8.828                         |
| HFAC213A        | C              | M2                | 3             | 2            | 102.436        | 8.133         | 0.119                      | 16                  | AGM          | 0.0075              | 106.230                        | 8.435                         |

Data for HFIB 21XA was removed due to unbalanced lay up.

Average 104.013 8.340  
 Standard Dev. 4.054 0.224  
 Coeff. of Var. [%] 3.898 2.682  
 Min. 96.381 7.900  
 Max. 111.125 8.691  
 Number of Spec. 16 16

Average<sub>norm</sub> 0.0072 104.685 8.390  
 Standard Dev.<sub>norm</sub> 7.276 0.480  
 Coeff. of Var. [%]<sub>norm</sub> 6.950 5.727  
 Min. 0.0066 89.563 7.277  
 Max. 0.0075 113.712 8.984  
 Number of Spec. 16 16



**Laminate Unnotched Tension Properties (UNT1) -- (ETW)**  
**Strength & Modulus**  
 HEXCEL 8552 - IM7 UNI PREPREG

normalizing  $t_{ply}$ 

[in]

0.0072

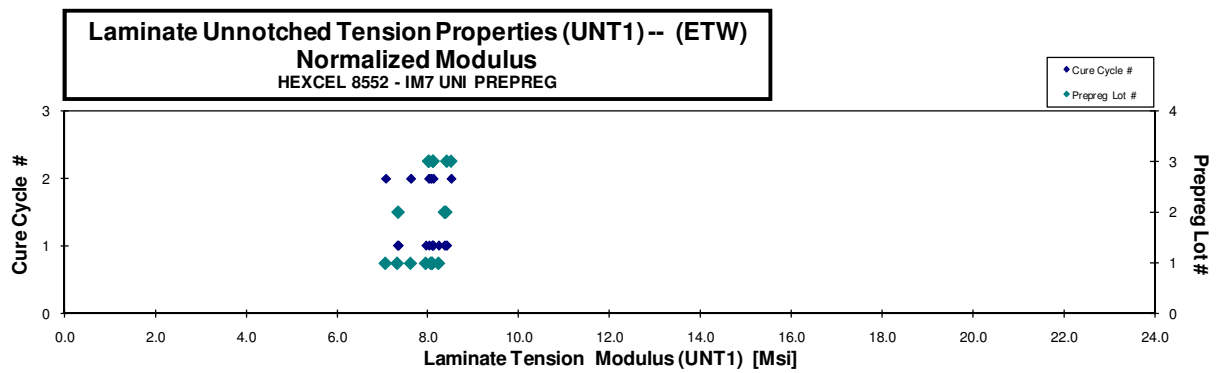
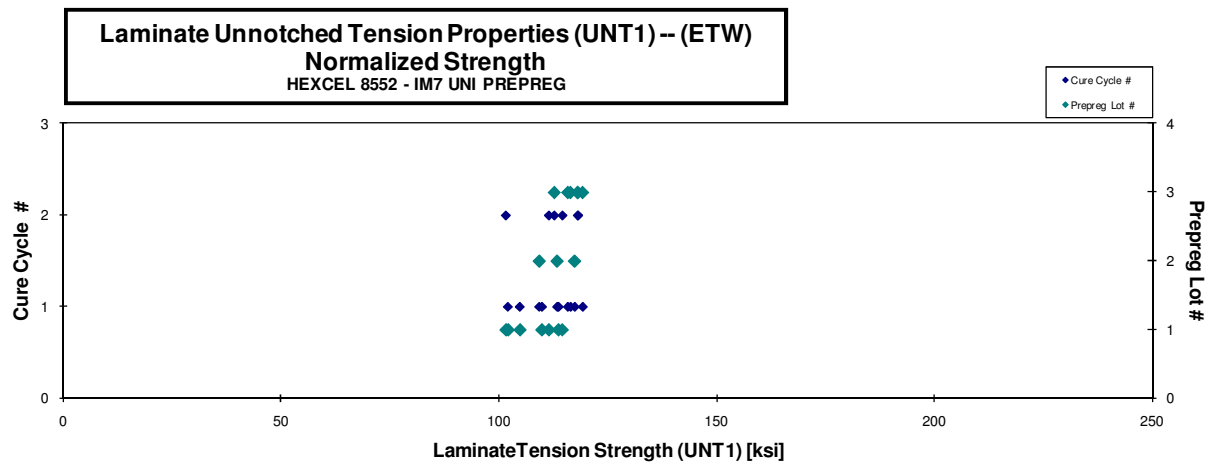
| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Modulus [Msi] | Avg. Specimen Thicken. [in] | # Plies in Laminate | Failure Mode | Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] | Modulus <sub>norm</sub> [Msi] |
|-----------------|----------------|-------------------|---------------|--------------|----------------|---------------|-----------------------------|---------------------|--------------|---------------------|--------------------------------|-------------------------------|
| HFIAA11AD**     | A              | M1                | 1             | 1            |                | 7.968         | 0.117                       | 16                  | *            | 0.0073              |                                | 8.098                         |
| HFIAA11BD       | A              | M1                | 1             | 1            | 109.007        | 7.825         | 0.108                       | 16                  | AGM/AWB      | 0.0067              | 102.115                        | 7.330                         |
| HFIAA11CD       | A              | M1                | 1             | 1            | 111.481        | 7.933         | 0.118                       | 16                  | AGM          | 0.0073              | 113.739                        | 8.094                         |
| HFIAA11DD       | A              | M1                | 1             | 1            | 107.732        | 8.074         | 0.118                       | 16                  | AGM          | 0.0073              | 109.929                        | 8.238                         |
| HFIAA11FD       | A              | M1                | 1             | 1            | 104.093        | 7.898         | 0.116                       | 16                  | AGM          | 0.0073              | 104.861                        | 7.956                         |
| HFIAA218D       | A              | M2                | 1             | 2            | 112.321        | 7.906         | 0.118                       | 16                  | DGM          | 0.0073              | 114.612                        | 8.067                         |
| HFIAA219D       | A              | M2                | 1             | 2            | 109.153        | 7.460         | 0.118                       | 16                  | DGM          | 0.0074              | 111.521                        | 7.622                         |
| HFIAA21AD       | A              | M2                | 1             | 2            | 108.151        | 7.522         | 0.108                       | 16                  | DGM/AWT/AWB  | 0.0068              | 101.642                        | 7.069                         |
| HFIAB118D       | B              | M1                | 2             | 1            | 111.994        | 8.292         | 0.117                       | 16                  | DGM/AGM      | 0.0073              | 113.420                        | 8.398                         |
| HFIAB119D       | B              | M1                | 2             | 1            | 115.193        | 8.207         | 0.117                       | 16                  | DGM          | 0.0073              | 117.443                        | 8.367                         |
| HFIAB11AD       | B              | M1                | 2             | 1            | 106.398        | 7.155         | 0.118                       | 16                  | DGM/AWB      | 0.0074              | 109.292                        | 7.350                         |
| HFIA118D        | C              | M1                | 3             | 1            | 111.908        | 8.128         | 0.119                       | 16                  | DGM          | 0.0075              | 115.875                        | 8.416                         |
| HFIA119D        | C              | M1                | 3             | 1            | 119.118        | 8.105         | 0.115                       | 16                  | DGM          | 0.0072              | 119.290                        | 8.117                         |
| HFIA11AD        | C              | M1                | 3             | 1            | 112.566        | 7.754         | 0.119                       | 16                  | DGM          | 0.0075              | 116.491                        | 8.024                         |
| HFIA218D        | C              | M2                | 3             | 2            | 115.435        | 7.926         | 0.118                       | 16                  | DGM          | 0.0074              | 118.224                        | 8.117                         |
| HFIA219D        | C              | M2                | 3             | 2            | 114.366        | 8.241         | 0.119                       | 16                  | DGM          | 0.0074              | 118.155                        | 8.514                         |
| HFIA21AD        | C              | M2                | 3             | 2            | 115.103        | 8.187         | 0.113                       | 16                  | LWT/DGM      | 0.0071              | 112.772                        | 8.021                         |

\*\*SPECIMEN SLIPPED DURING TESTING, STRENGTH NOT REPORTED

Data for HFIA21AD was removed due to unbalanced lay up.

Average 111.501 7.916  
 Standard Dev. 3.904 0.305  
 Coeff. of Var. [%] 3.501 3.857  
 Min. 104.093 7.155  
 Max. 119.118 8.292  
 Number of Spec. 16 17

Average<sub>norm</sub> 0.0073 112.461 7.988  
 Standard Dev.<sub>norm</sub> 5.606 0.412  
 Coeff. of Var. [%]<sub>norm</sub> 4.985 5.162  
 Min. 0.0067 101.642 7.069  
 Max. 0.0075 119.290 8.514  
 Number of Spec. 17 16 17





## 4.9 Unnotched Tension 2 Properties

**Laminate Unnotched Tension Properties (UNT2) -- (CTD)****Strength & Modulus**  
HEXCEL 8552 - IM7 UNI PREPREGnormalizing  $t_{ply}$ 

[in]

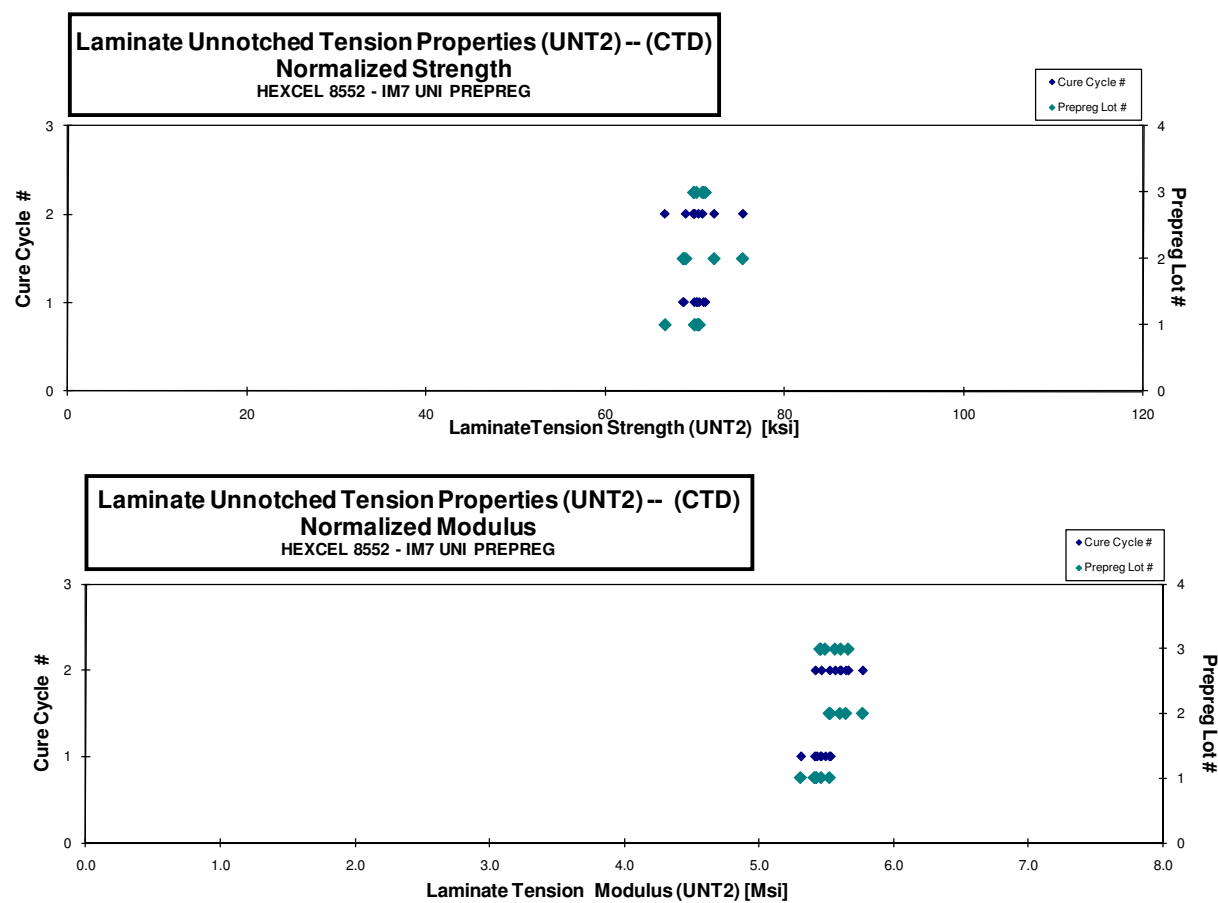
0.0072

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Modulus [Msi] | Avg. Specimen Thickn. [in] | # Plies in Laminate | Failure Mode | Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] | Modulus <sub>norm</sub> [Msi] |
|-----------------|----------------|-------------------|---------------|--------------|----------------|---------------|----------------------------|---------------------|--------------|---------------------|--------------------------------|-------------------------------|
| HFIBA117B       | A              | M1                | 1             | 1            | 68.999         | 5.320         | 0.147                      | 20                  | AGM          | 0.0073              | 70.196                         | 5.412                         |
| HFIBA118B       | A              | M1                | 1             | 1            | 67.700         | 5.143         | 0.149                      | 20                  | AGM          | 0.0074              | 69.902                         | 5.310                         |
| HFIBA119B       | A              | M1                | 1             | 1            | 68.762         | 5.300         | 0.148                      | 20                  | AGM          | 0.0074              | 70.433                         | 5.429                         |
| HFIBA11AB*      | A              | M1                | 1             | 1            |                |               |                            |                     |              |                     |                                |                               |
| HFIBA216B       | A              | M2                | 1             | 2            | 65.977         | 5.366         | 0.145                      | 20                  | AWB          | 0.0073              | 66.603                         | 5.417                         |
| HFIBA217B       | A              | M2                | 1             | 2            | 69.702         | 5.413         | 0.145                      | 20                  | AWB          | 0.0073              | 70.340                         | 5.463                         |
| HFIBA218B       | A              | M2                | 1             | 2            | 68.153         | 5.384         | 0.148                      | 20                  | AGM          | 0.0074              | 69.927                         | 5.524                         |
| HFIBB1X3B       | B              | M1                | 2             | 1            | 69.069         | 5.565         | 0.143                      | 20                  | AGM          | 0.0072              | 68.637                         | 5.530                         |
| HFIBB1X4B       | B              | M1                | 2             | 1            | 69.980         | 5.623         | 0.141                      | 20                  | AWB          | 0.0071              | 68.733                         | 5.523                         |
| HFIBB217B       | B              | M2                | 2             | 2            | 70.872         | 5.548         | 0.147                      | 20                  | AGM          | 0.0073              | 72.102                         | 5.645                         |
| HFIBB218B       | B              | M2                | 2             | 2            | 66.597         | 5.412         | 0.149                      | 20                  | AWT          | 0.0075              | 68.933                         | 5.602                         |
| HFIBB219B       | B              | M2                | 2             | 2            | 72.926         | 5.588         | 0.149                      | 20                  | AWT          | 0.0074              | 75.289                         | 5.769                         |
| HFIBC116B       | C              | M1                | 3             | 1            | 68.989         | 5.402         | 0.146                      | 20                  | AWB          | 0.0073              | 70.139                         | 5.492                         |
| HFIBC117B       | C              | M1                | 3             | 1            | 69.926         | 5.385         | 0.146                      | 20                  | AWB          | 0.0073              | 70.914                         | 5.461                         |
| HFIBC118B       | C              | M1                | 3             | 1            | 69.297         | 5.315         | 0.148                      | 20                  | AGM          | 0.0074              | 71.118                         | 5.454                         |
| HFIBC216B       | C              | M2                | 3             | 2            | 68.195         | 5.431         | 0.148                      | 20                  | AWB          | 0.0074              | 69.884                         | 5.565                         |
| HFIBC217B       | C              | M2                | 3             | 2            | 69.646         | 5.518         | 0.146                      | 20                  | AGM          | 0.0073              | 70.790                         | 5.608                         |
| HFIBC218B       | C              | M2                | 3             | 2            | 67.780         | 5.499         | 0.148                      | 20                  | AGM          | 0.0074              | 69.796                         | 5.662                         |

\*Data was removed due to thickness taper due to pinching on edge of panel during bagging.

**Average** 68.975 5.424  
**Standard Dev.** 1.605 0.123  
**Coeff. of Var. [%]** 2.328 2.263  
**Min.** 65.977 5.143  
**Max.** 72.926 5.623  
**Number of Spec.** 17 17

**Average<sub>norm</sub>** 0.0073 70.220 5.522  
**Standard Dev.<sub>norm</sub>** 1.783 0.112  
**Coeff. of Var. [%]<sub>norm</sub>** 2.539 2.030  
**Min.** 0.0071 66.603 5.310  
**Max.** 0.0075 75.289 5.769  
**Number of Spec.** 17 17



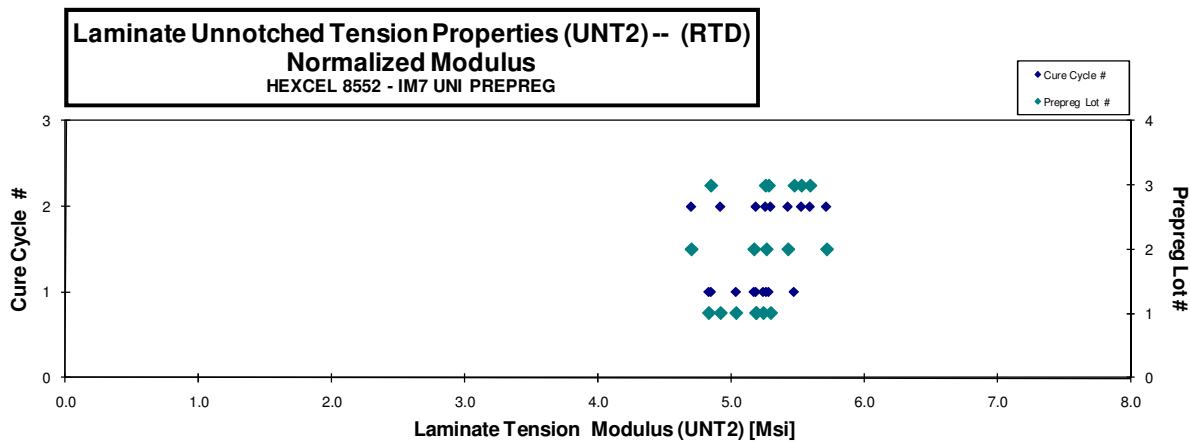
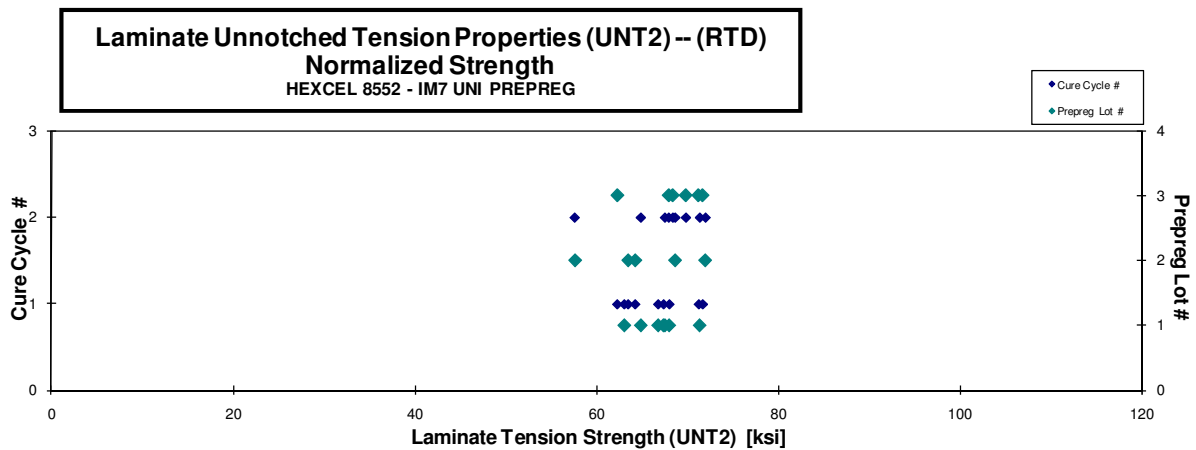
**Laminate Unnotched Tension Properties (UNT2) -- (RTD)**  
**Strength & Modulus**  
 HEXCEL 8552 - IM7 UNI PREPREG

normalizing  $t_{ply}$   
 [in]  
 0.0072

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Modulus [Msi] | Avg. Specimen Thickn. [in] | # Plies in Laminate | Failure Mode | Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] | Modulus <sub>norm</sub> [Msi] |
|-----------------|----------------|-------------------|---------------|--------------|----------------|---------------|----------------------------|---------------------|--------------|---------------------|--------------------------------|-------------------------------|
| HFIBA111A       | A              | M1                | 1             | 1            | 65.315         | 5.006         | 0.139                      | 20                  | DGM          | 0.0070              | 63.055                         | 4.832                         |
| HFIBA113A       | A              | M1                | 1             | 1            | 66.335         | 5.060         | 0.148                      | 20                  | DGM          | 0.0074              | 67.993                         | 5.186                         |
| HFIBA114A       | A              | M1                | 1             | 1            | 66.255         | 5.156         | 0.146                      | 20                  | DGM          | 0.0073              | 67.359                         | 5.242                         |
| HFIBA115A       | A              | M1                | 1             | 1            | 65.636         | 4.951         | 0.147                      | 20                  | DGM          | 0.0073              | 66.776                         | 5.037                         |
| HFIBA211A       | A              | M2                | 1             | 2            | 67.895         | 5.150         | 0.138                      | 20                  | DWT          | 0.0069              | 64.870                         | 4.920                         |
| HFIBA212A       | A              | M2                | 1             | 2            | 69.978         | 5.196         | 0.147                      | 20                  | DGM          | 0.0073              | 71.339                         | 5.297                         |
| HFIBA213A       | A              | M2                | 1             | 2            | 66.443         | 5.106         | 0.146                      | 20                  | DWB          | 0.0073              | 67.512                         | 5.188                         |
| HFIBB1X1A       | B              | M1                | 2             | 1            | 67.953         | 5.536         | 0.135                      | 20                  | DGM          | 0.0067              | 63.486                         | 5.172                         |
| HFIBB1X2A       | B              | M1                | 2             | 1            | 63.968         | 5.241         | 0.145                      | 20                  | DGM          | 0.0072              | 64.264                         | 5.265                         |
| HFIBB211A       | B              | M2                | 2             | 2            | 62.419         | 5.092         | 0.133                      | 20                  | DGM          | 0.0066              | 57.637                         | 4.701                         |
| HFIBB212A       | B              | M2                | 2             | 2            | 69.711         | 5.539         | 0.149                      | 20                  | DGM          | 0.0074              | 71.954                         | 5.718                         |
| HFIBB213A       | B              | M2                | 2             | 2            | 66.311         | 5.243         | 0.149                      | 20                  | DGM          | 0.0075              | 68.644                         | 5.427                         |
| HFIBC111A       | C              | M1                | 3             | 1            | 66.102         | 5.146         | 0.136                      | 20                  | DGM          | 0.0068              | 62.285                         | 4.849                         |
| HFIBC112A       | C              | M1                | 3             | 1            | 69.586         | 5.316         | 0.148                      | 20                  | DGM          | 0.0074              | 71.656                         | 5.474                         |
| HFIBC113A       | C              | M1                | 3             | 1            | 69.367         | 5.146         | 0.148                      | 20                  | DGM          | 0.0074              | 71.205                         | 5.282                         |
| HFIBC211A       | C              | M2                | 3             | 2            | 69.692         | 5.394         | 0.140                      | 20                  | DWB/DGM      | 0.0070              | 67.934                         | 5.258                         |
| HFIBC212A       | C              | M2                | 3             | 2            | 66.268         | 5.421         | 0.149                      | 20                  | DGM          | 0.0074              | 68.369                         | 5.593                         |
| HFIBC213A       | C              | M2                | 3             | 2            | 68.155         | 5.398         | 0.147                      | 20                  | DGM          | 0.0074              | 69.804                         | 5.529                         |

Average 67.077 5.228  
 Standard Dev. 2.124 0.173  
 Coeff. of Var. [%] 3.167 3.305  
 Min. 62.419 4.951  
 Max. 69.978 5.539  
 Number of Spec. 18 18

Average<sub>norm</sub> 0.0072 67.008 5.221  
 Standard Dev.<sub>norm</sub> 3.814 0.275  
 Coeff. of Var. [%]<sub>norm</sub> 5.692 5.271  
 Min. 0.0066 57.637 4.701  
 Max. 0.0075 71.954 5.718  
 Number of Spec. 18 18



**Laminate Unnotched Tension Properties (UNT2) -- (ETW)**  
**Strength & Modulus**  
 HEXCEL 8552 - IM7 UNI PREPREG

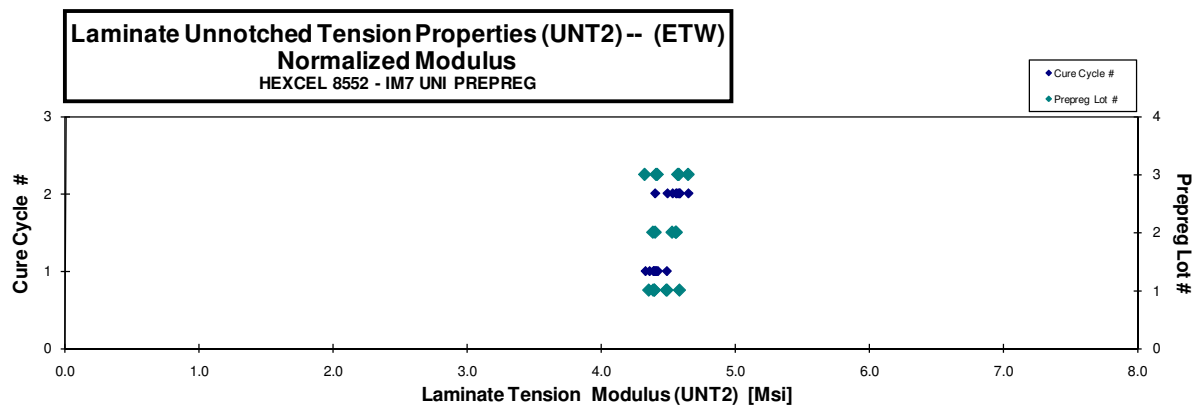
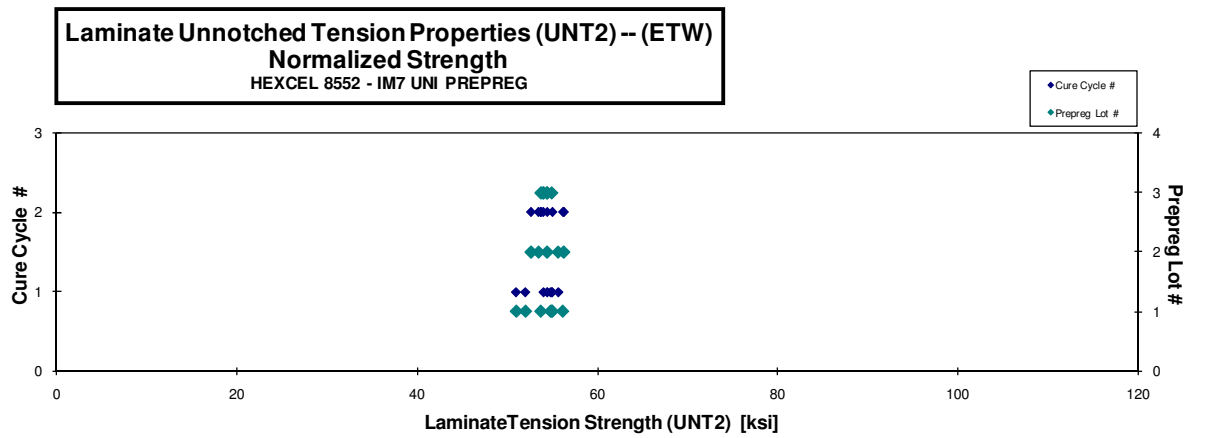
normalizing  $t_{ply}$   
 [in]  
 0.0072

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Modulus [Msi] | Avg. Specimen Thickn. [in] | # Plies in Laminate | Failure Mode | Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] | Modulus <sub>norm</sub> [Msi] |
|-----------------|----------------|-------------------|---------------|--------------|----------------|---------------|----------------------------|---------------------|--------------|---------------------|--------------------------------|-------------------------------|
| HFIBA11DD       | A              | M1                | 1             | 1            | 53.540         | 4.284         | 0.148                      | 20                  | DGM          | 0.0074              | 54.928                         | 4.395                         |
| HFIBA11ED       | A              | M1                | 1             | 1            | 54.012         | 4.422         | 0.146                      | 20                  | DGM          | 0.0073              | 54.775                         | 4.484                         |
| HFIBA11FD       | A              | M1                | 1             | 1            | 50.226         | 4.323         | 0.146                      | 20                  | DGM          | 0.0073              | 50.965                         | 4.387                         |
| HFIBA11GD       | A              | M1                | 1             | 1            | 51.145         | 4.285         | 0.146                      | 20                  | DGM          | 0.0073              | 51.985                         | 4.356                         |
| HFIBA21BD       | A              | M2                | 1             | 2            | 54.794         | 4.473         | 0.148                      | 20                  | DGM          | 0.0074              | 56.126                         | 4.582                         |
| HFIBA21CD       | A              | M2                | 1             | 2            | 52.714         | 4.318         | 0.147                      | 20                  | DGM          | 0.0073              | 53.685                         | 4.398                         |
| HFIBA21DD       | A              | M2                | 1             | 2            | 54.527         | 4.454         | 0.145                      | 20                  | DGM          | 0.0073              | 54.963                         | 4.489                         |
| HFIBB1X5D*      | B              | M1                | 2             | 1            | 56.418         | 4.466         | 0.142                      | 20                  | DGM          | 0.0071              | 55.615                         | 4.402                         |
| HFIBB1X6D*      | B              | M1                | 2             | 1            | 54.904         | 4.427         | 0.143                      | 20                  | DGM          | 0.0071              | 54.390                         | 4.385                         |
| HFIBB21ED       | B              | M2                | 2             | 2            | 52.034         | 4.479         | 0.146                      | 20                  | DGM          | 0.0073              | 52.606                         | 4.528                         |
| HFIBB21FD       | B              | M2                | 2             | 2            | 55.349         | 4.482         | 0.146                      | 20                  | DGM          | 0.0073              | 56.233                         | 4.553                         |
| HFIBB21GD       | B              | M2                | 2             | 2            | 52.600         | 4.487         | 0.146                      | 20                  | DGM          | 0.0073              | 53.440                         | 4.559                         |
| HFIBC11CD       | C              | M1                | 3             | 1            | 52.726         | 4.307         | 0.147                      | 20                  | DGM          | 0.0074              | 53.983                         | 4.409                         |
| HFIBC11DD       | C              | M1                | 3             | 1            | 54.608         | 4.394         | 0.145                      | 20                  | DGM          | 0.0072              | 54.905                         | 4.418                         |
| HFIBC11ED       | C              | M1                | 3             | 1            | 53.866         | 4.284         | 0.145                      | 20                  | DGM          | 0.0073              | 54.390                         | 4.325                         |
| HFIBC21BD       | C              | M2                | 3             | 2            | 52.347         | 4.509         | 0.148                      | 20                  | DGM          | 0.0074              | 53.940                         | 4.646                         |
| HFIBC21CD       | C              | M2                | 3             | 2            | 52.559         | 4.473         | 0.147                      | 20                  | DGM          | 0.0074              | 53.703                         | 4.570                         |
| HFIBC21DD       | C              | M2                | 3             | 2            | 53.588         | 4.510         | 0.146                      | 20                  | DGM          | 0.0073              | 54.394                         | 4.577                         |

\*PANEL WAS NOT REPLACED BECAUSE OF INSUFICIENT MATERIAL. SPECIMENS WERE TAKEN FROM UNC2 PANEL.

Average 53.442 4.410  
 Standard Dev. 1.550 0.085  
 Coeff. of Var. [%] 2.901 1.930  
 Min. 50.226 4.284  
 Max. 56.418 4.510  
 Number of Spec. 18 18

Average<sub>norm</sub> 0.0073 54.168 4.470  
 Standard Dev.<sub>norm</sub> 1.350 0.095  
 Coeff. of Var. [%]<sub>norm</sub> 2.492 2.127  
 Min. 0.0071 50.965 4.325  
 Max. 0.0074 56.233 4.646  
 Number of Spec. 18 18



## 4.10 Unnotched Tension 3 Properties

**Laminate Unnotched Tension Properties (UNT3) -- (CTD)**  
**Strength & Modulus**  
 HEXCEL 8552 - IM7 UNI PREPREG

normalizing  $t_{ply}$ 

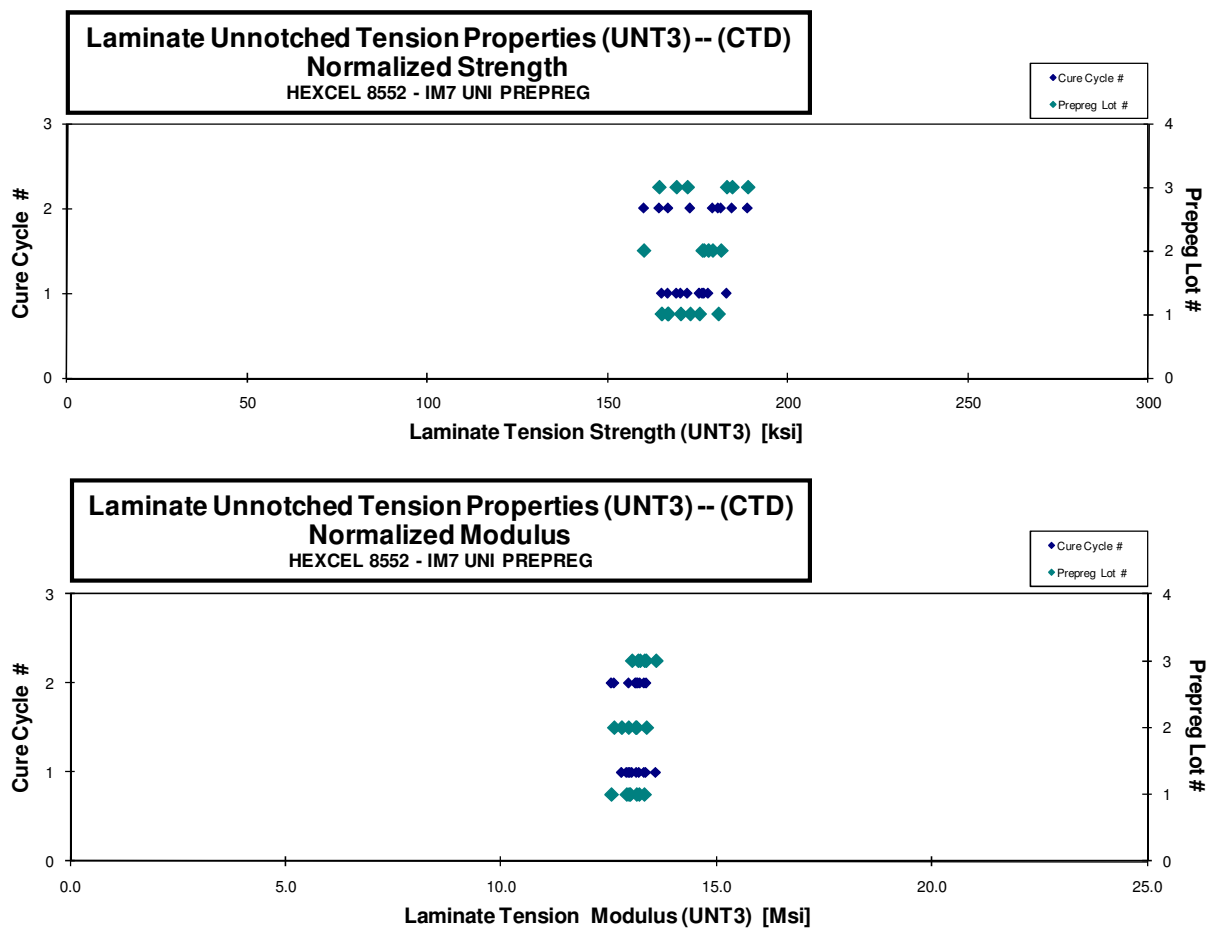
[in]

0.0072

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Modulus [Msi] | Avg. Specimen Thickn. [in] | # Plies in Laminate | Failure Mode    | Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] | Modulus <sub>norm</sub> [Msi] |
|-----------------|----------------|-------------------|---------------|--------------|----------------|---------------|----------------------------|---------------------|-----------------|---------------------|--------------------------------|-------------------------------|
| HFICA116B       | A              | M1                | 1             | 1            | 173.739        | 12.884        | 0.145                      | 20                  | AWT             | 0.0073              | 175.368                        | 13.005                        |
| HFICA117B       | A              | M1                | 1             | 1            | 165.963        | 13.282        | 0.145                      | 20                  | DWT / LWT / LAB | 0.0072              | 166.559                        | 13.329                        |
| HFICA118B       | A              | M1                | 1             | 1            | 166.866        | 12.669        | 0.147                      | 20                  | LAB / DAB       | 0.0073              | 170.188                        | 12.921                        |
| HFICA119B       | A              | M1                | 1             | 1            | 161.608        | 12.952        | 0.147                      | 20                  | LWB             | 0.0073              | 164.863                        | 13.213                        |
| HFICA215B       | A              | M2                | 1             | 2            | 163.835        | 12.356        | 0.146                      | 20                  | DGM / LAT / AWT | 0.0073              | 166.660                        | 12.569                        |
| HFICA216B       | A              | M2                | 1             | 2            | 170.370        | 12.971        | 0.146                      | 20                  | DGM / AWB / AAT | 0.0073              | 172.776                        | 13.154                        |
| HFICA217B       | A              | M2                | 1             | 2            | 178.529        | 12.824        | 0.146                      | 20                  | DGM / LAB / AWT | 0.0073              | 180.595                        | 12.972                        |
| HFICB115B       | B              | M1                | 2             | 1            | 177.874        | 13.058        | 0.143                      | 20                  | LWT / DGM       | 0.0072              | 176.638                        | 12.967                        |
| HFICB116B       | B              | M1                | 2             | 1            | 178.969        | 13.237        | 0.143                      | 20                  | LAT / LAB / DGM | 0.0072              | 177.829                        | 13.153                        |
| HFICB117B       | B              | M1                | 2             | 1            | 176.503        | 12.829        | 0.144                      | 20                  | LAT / LWB       | 0.0072              | 176.197                        | 12.807                        |
| HFICB214B       | B              | M2                | 2             | 2            | 178.802        | 13.116        | 0.144                      | 20                  | DGM / LWT / LWB | 0.0072              | 179.029                        | 13.132                        |
| HFICB216B       | B              | M2                | 2             | 2            | 160.819        | 12.705        | 0.143                      | 20                  | LAB / LWT       | 0.0072              | 159.907                        | 12.633                        |
| HFICB217B       | B              | M2                | 2             | 2            | 181.762        | 13.411        | 0.144                      | 20                  | LAB             | 0.0072              | 181.362                        | 13.381                        |
| HFICC115B       | C              | M1                | 3             | 1            | 169.266        | 12.837        | 0.146                      | 20                  | AGM / DGM       | 0.0073              | 172.028                        | 13.047                        |
| HFICC116B       | C              | M1                | 3             | 1            | 180.101        | 13.162        | 0.146                      | 20                  | LAT / LWB       | 0.0073              | 182.957                        | 13.370                        |
| HFICC117B       | C              | M1                | 3             | 1            | 166.222        | 13.379        | 0.146                      | 20                  | LWB             | 0.0073              | 168.973                        | 13.600                        |
| HFICC215B       | C              | M2                | 3             | 2            | 185.159        | 13.384        | 0.143                      | 20                  | LWT / LWB       | 0.0072              | 184.452                        | 13.333                        |
| HFICC216B       | C              | M2                | 3             | 2            | 164.960        | 13.250        | 0.143                      | 20                  | LWT             | 0.0072              | 164.177                        | 13.187                        |
| HFICC217B       | C              | M2                | 3             | 2            | 187.845        | 13.168        | 0.145                      | 20                  | LWT / LWB       | 0.0072              | 188.802                        | 13.235                        |

Average 173.115 13.025  
 Standard Dev. 8.207 0.282  
 Coeff. of Var. [%] 4.741 2.166  
 Min. 160.819 12.356  
 Max. 187.845 13.411  
 Number of Spec. 19 19

Average<sub>norm</sub> 0.0072 174.177 13.106  
 Standard Dev.<sub>norm</sub> 7.790 0.260  
 Coeff. of Var. [%]<sub>norm</sub> 4.472 1.985  
 Min. 0.0072 159.907 12.569  
 Max. 0.0073 188.802 13.600  
 Number of Spec. 19 19





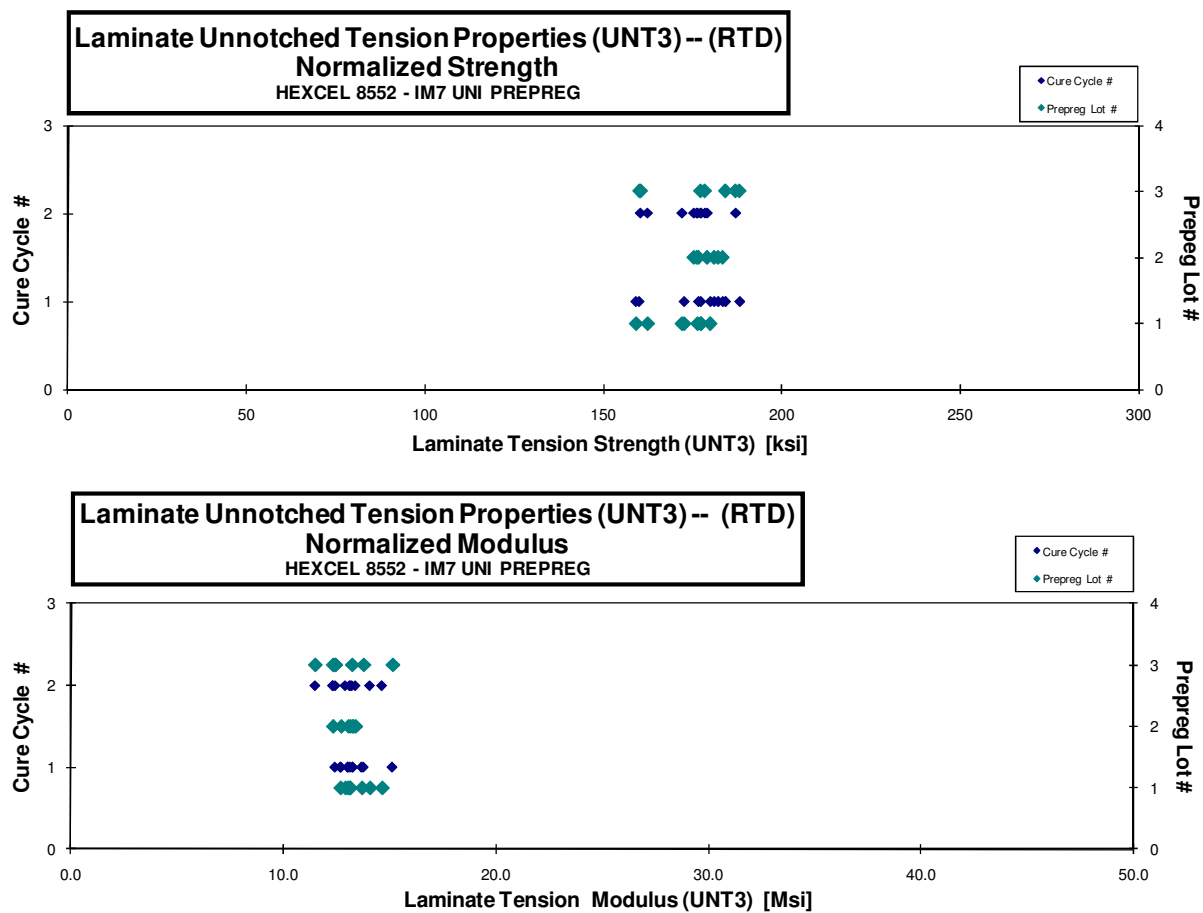
**Laminate Unnotched Tension Properties (UNT3) -- (RTD)**  
**Strength & Modulus**  
 HEXCEL 8552 - IM7 UNI PREPREG

normalizing  $t_{ply}$   
 [in]  
 0.0072

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Modulus [Msi] | Avg. Specimen Thickn. [in] | # Plies in Laminate | Failure Mode    | Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] | Modulus <sub>norm</sub> [Msi] |
|-----------------|----------------|-------------------|---------------|--------------|----------------|---------------|----------------------------|---------------------|-----------------|---------------------|--------------------------------|-------------------------------|
| HFICA112A       | A              | M1                | 1             | 1            | 170.864        | 13.556        | 0.145                      | 20                  | DGM / LGM       | 0.0073              | 172.525                        | 13.688                        |
| HFICA113A       | A              | M1                | 1             | 1            | 172.992        | 12.827        | 0.147                      | 20                  | DGM / LGM       | 0.0074              | 177.157                        | 13.136                        |
| HFICA114A       | A              | M1                | 1             | 1            | 178.974        | 12.978        | 0.145                      | 20                  | DGM / LWT       | 0.0072              | 179.844                        | 13.041                        |
| HFICA115A       | A              | M1                | 1             | 1            | 158.489        | 12.642        | 0.145                      | 20                  | LAB             | 0.0072              | 159.040                        | 12.686                        |
| HFICA211A       | A              | M2                | 1             | 2            | 170.462        | 14.775        | 0.137                      | 20                  | LAT / LWB       | 0.0069              | 162.294                        | 14.067                        |
| HFICA212A       | A              | M2                | 1             | 2            | 172.953        | 14.363        | 0.147                      | 20                  | DGM / LAT       | 0.0073              | 176.276                        | 14.639                        |
| HFICA213A       | A              | M2                | 1             | 2            | 167.997        | 12.824        | 0.147                      | 20                  | LGM             | 0.0074              | 171.905                        | 13.122                        |
| HFICA214A       | A              | M2                | 1             | 2            | 175.427        | 12.782        | 0.146                      | 20                  | DGM / LWT       | 0.0073              | 177.274                        | 12.916                        |
| HFICB111A       | B              | M1                | 2             | 1            | 190.858        | 13.423        | 0.137                      | 20                  | DGM / LAT       | 0.0068              | 180.917                        | 12.724                        |
| HFICB112A       | B              | M1                | 2             | 1            | 181.054        | 12.986        | 0.145                      | 20                  | DGM / LAT       | 0.0072              | 182.018                        | 13.055                        |
| HFICB113A       | B              | M1                | 2             | 1            | 175.890        | 13.232        | 0.145                      | 20                  | DGM / LAT/ LAB  | 0.0072              | 176.521                        | 13.279                        |
| HFICB114A       | B              | M1                | 2             | 1            | 183.397        | 13.273        | 0.144                      | 20                  | AGM / AWB       | 0.0072              | 183.269                        | 13.264                        |
| HFICB211A       | B              | M2                | 2             | 2            | 185.538        | 13.003        | 0.137                      | 20                  | DGM /LWT / LWB  | 0.0068              | 176.025                        | 12.336                        |
| HFICB212A       | B              | M2                | 2             | 2            | 174.416        | 13.331        | 0.145                      | 20                  | DGM / AGM       | 0.0072              | 175.183                        | 13.390                        |
| HFICB213A       | B              | M2                | 2             | 2            | 177.385        | 13.042        | 0.145                      | 20                  | DGM / AGM       | 0.0073              | 178.946                        | 13.157                        |
| HFICC111A       | C              | M1                | 3             | 1            | 166.230        | 12.920        | 0.139                      | 20                  | LWT / LAB / DGM | 0.0069              | 159.977                        | 12.434                        |
| HFICC112A       | C              | M1                | 3             | 1            | 182.653        | 13.380        | 0.148                      | 20                  | AGM / DGM       | 0.0074              | 188.001                        | 13.772                        |
| HFICC113A       | C              | M1                | 3             | 1            | 180.532        | 14.836        | 0.147                      | 20                  | AGM / DGM       | 0.0073              | 184.064                        | 15.127                        |
| HFICC211A       | C              | M2                | 3             | 2            | 170.513        | 13.121        | 0.135                      | 20                  | LWB/AWB/LAT     | 0.0068              | 160.330                        | 12.337                        |
| HFICC212A       | C              | M2                | 3             | 2            | 176.813        | 13.211        | 0.144                      | 20                  | DGM /LWT /LWB   | 0.0072              | 177.079                        | 13.231                        |
| HFICC213A       | C              | M2                | 3             | 2            | 176.746        | 11.400        | 0.145                      | 20                  | DGM / LGM       | 0.0073              | 178.280                        | 11.499                        |
| HFICC214A       | C              | M2                | 3             | 2            | 186.723        | 12.437        | 0.144                      | 20                  | DGM / LGM       | 0.0072              | 186.852                        | 12.446                        |

Average 176.223 13.197  
 Standard Dev. 7.423 0.743  
 Coeff. of Var. [%] 4.212 5.626  
 Min. 158.489 11.400  
 Max. 190.858 14.836  
 Number of Spec. 22 22

Average<sub>norm</sub> 0.0072 175.626 13.152  
 Standard Dev.<sub>norm</sub> 8.388 0.795  
 Coeff. of Var. [%]<sub>norm</sub> 4.776 6.043  
 Min. 0.0068 159.040 11.499  
 Max. 0.0074 188.001 15.127  
 Number of Spec. 22 22



**Laminate Unnotched Tension Properties (UNT3) -- (ETW)**  
**Strength & Modulus**  
 HEXCEL 8552 - IM7 UNI PREPREG

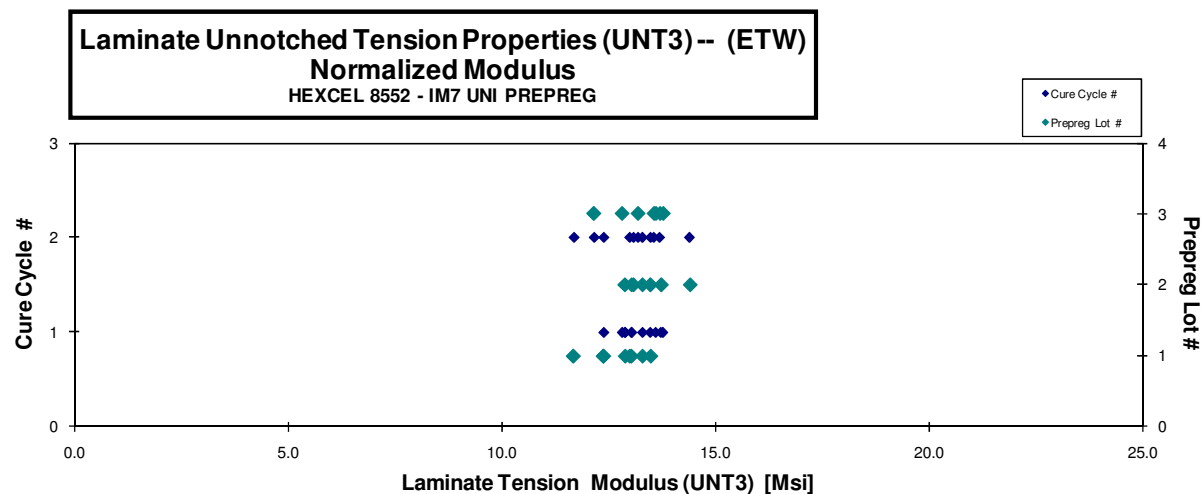
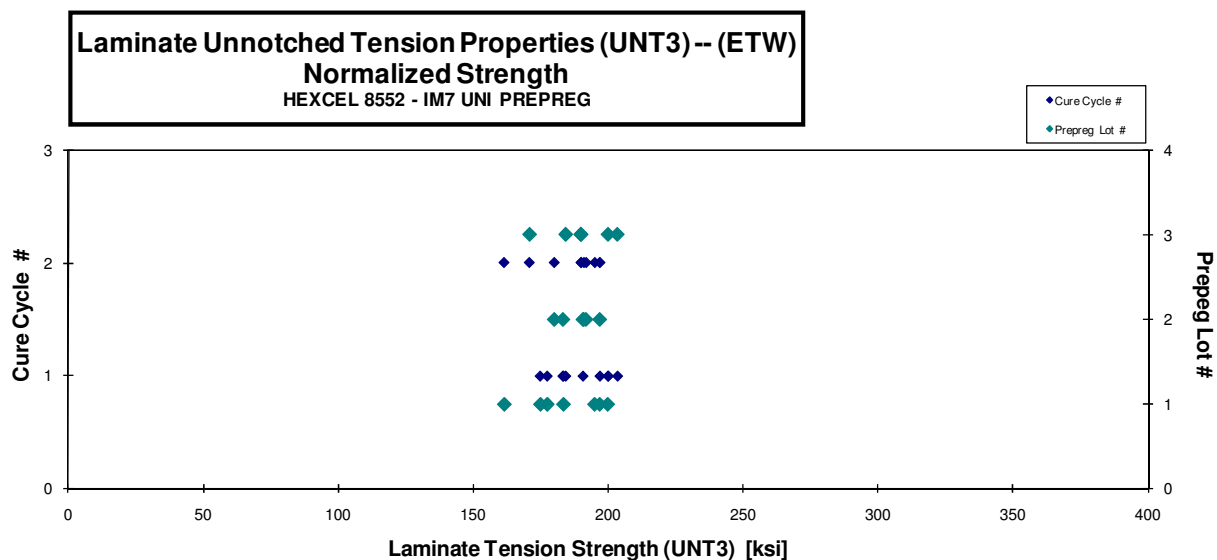
normalizing  $t_{ply}$   
 [in]  
 0.0072

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Modulus [Msi] | Avg. Specimen Thckn. [in] | # Plies in Laminate | Failure Mode  | Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] | Modulus <sub>norm</sub> [Msi] |
|-----------------|----------------|-------------------|---------------|--------------|----------------|---------------|---------------------------|---------------------|---------------|---------------------|--------------------------------|-------------------------------|
| HFICA11AD       | A              | M1                | 1             | 1            | 195.340        | 13.192        | 0.135                     | 20                  | LWB/LWT       | 0.0068              | 183.448                        | 12.389                        |
| HFICA11CD       | A              | M1                | 1             | 1            | 172.304        | 13.105        | 0.146                     | 20                  | LGM/AGM       | 0.0073              | 174.896                        | 13.302                        |
| HFICA11DD       | A              | M1                | 1             | 1            | 195.017        | 12.585        | 0.148                     | 20                  | DGM/AGM       | 0.0074              | 199.847                        | 12.897                        |
| HFICA11ED       | A              | M1                | 1             | 1            | 175.968        | 12.931        | 0.145                     | 20                  | DGM/LWB/LWT   | 0.0073              | 177.476                        | 13.042                        |
| HFICA21AD       | A              | M1                | 1             | 2            |                | 12.979        | 0.137                     | 20                  | LIT           | 0.0069              |                                | 12.388                        |
| HFICA219D       | A              | M2                | 1             | 2            | 189.435        | 13.106        | 0.148                     | 20                  | LGM           | 0.0074              | 194.982                        | 13.490                        |
| HFICA21BD       | A              | M2                | 1             | 2            | 172.460        | 12.478        | 0.135                     | 20                  | LWT / LWB     | 0.0067              | 161.561                        | 11.690                        |
| HFICA21CD       | A              | M2                | 1             | 2            | 193.503        | 12.780        | 0.146                     | 20                  | DGM/LWT / LWB | 0.0073              | 196.840                        | 13.000                        |
| HFICB118D*      | B              | M0                | 2             | 1            |                | 13.473        | 0.144                     | 20                  | *             | 0.0072              |                                | 13.482                        |
| HFICB119D       | B              | M1                | 2             | 1            | 182.419        | 13.673        | 0.145                     | 20                  | LAT/LAB/DGM   | 0.0072              | 183.242                        | 13.735                        |
| HFICB11AD       | B              | M1                | 2             | 1            | 190.108        | 13.006        | 0.144                     | 20                  | AGM           | 0.0072              | 190.680                        | 13.045                        |
| HFICB11BD       | B              | M1                | 2             | 1            | 196.122        | 12.837        | 0.145                     | 20                  | AGM           | 0.0072              | 196.893                        | 12.887                        |
| HFICB218D       | B              | M2                | 2             | 2            | 185.097        | 13.903        | 0.149                     | 20                  | DGM/AGM       | 0.0075              | 191.824                        | 14.409                        |
| HFICB219D       | B              | M2                | 2             | 2            | 189.991        | 13.228        | 0.145                     | 20                  | DGM/LAT       | 0.0072              | 191.002                        | 13.299                        |
| HFICB21AD       | B              | M2                | 2             | 2            | 180.302        | 13.108        | 0.144                     | 20                  | AGM/DGM       | 0.0072              | 180.051                        | 13.090                        |
| HFICC118D       | C              | M1                | 3             | 1            | 199.333        | 13.508        | 0.147                     | 20                  | LWB/LGM       | 0.0073              | 203.394                        | 13.783                        |
| HFICC119D       | C              | M1                | 3             | 1            | 191.362        | 13.319        | 0.139                     | 20                  | LWB/DGM       | 0.0069              | 184.252                        | 12.824                        |
| HFICC11AD       | C              | M1                | 3             | 1            | 195.315        | 13.294        | 0.147                     | 20                  | DGM/LWT       | 0.0074              | 199.995                        | 13.612                        |
| HFICC218D*      | C              | M1                | 3             | 2            |                | 13.544        | 0.144                     | 20                  | *             | 0.0072              |                                | 13.568                        |
| HFICC219D       | C              | M2                | 3             | 2            | 187.265        | 13.008        | 0.146                     | 20                  | DGM/AGM       | 0.0073              | 189.953                        | 13.195                        |
| HFICC21BD       | C              | M2                | 3             | 2            | 180.648        | 12.859        | 0.136                     | 20                  | LAT/LAB       | 0.0068              | 170.905                        | 12.165                        |
| HFICC21CD       | C              | M2                | 3             | 2            | 186.654        | 13.470        | 0.147                     | 20                  | DGM/LWB       | 0.0073              | 189.916                        | 13.706                        |

\* Specimen had a bad failure so strength was excluded

Average 187.297 13.154  
 Standard Dev. 8.102 0.352  
 Coeff. of Var. [%] 4.326 2.676  
 Min. 172.304 12.478  
 Max. 199.333 13.903  
 Number of Spec. 19 22

Average<sub>norm</sub> 0.0072 187.429 13.136  
 Standard Dev.<sub>norm</sub> 10.938 0.611  
 Coeff. of Var. [%]<sub>norm</sub> 5.836 4.652  
 Min. 0.0067 161.561 11.690  
 Max. 0.0075 203.394 14.409  
 Number of Spec. 19 22



## 4.11 Unnotched Compression 1 Properties

**Laminate Unnotched Compression Properties (UNC1)-- (RTD)**  
**Strength & Modulus**  
 HEXCEL 8552 - IM7 UNI PREPREG

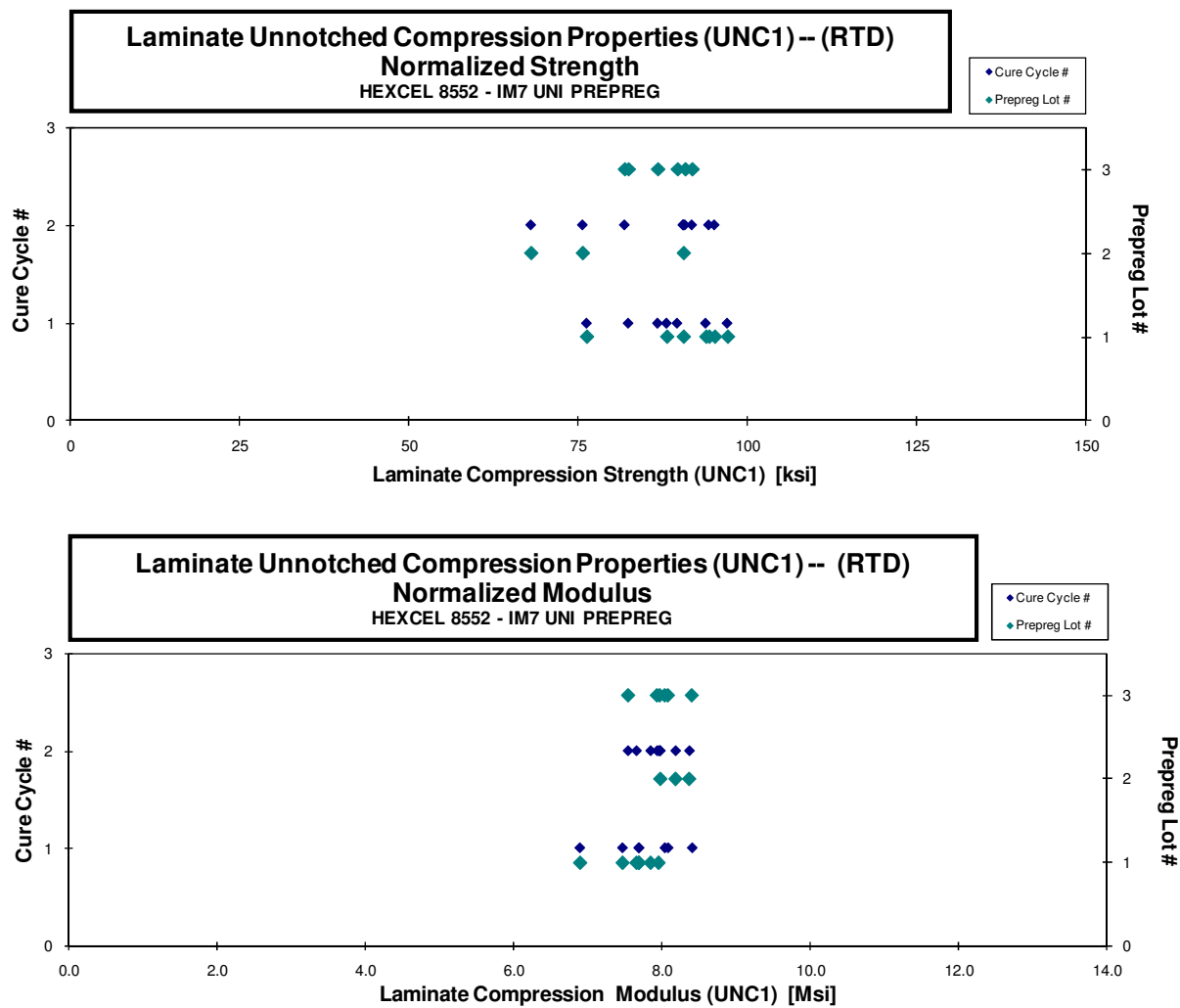
normalizing  $t_{ply}$   
 [in]  
 0.0072

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle Batch # | Strength [ksi] | Modulus [Msi] | Poisson's Ratio | Avg. Specimen Thckn. [in] | # Plies in Laminate | Failure Mode | Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] | Modulus <sub>norm</sub> [Msi] |
|-----------------|----------------|-------------------|---------------|--------------------|----------------|---------------|-----------------|---------------------------|---------------------|--------------|---------------------|--------------------------------|-------------------------------|
| HFIWA111A       | A              | M1                | 1             | 1                  | 82.117         | 7.418         | 0.290           | 0.107                     | 16                  | BGM          | 0.0067              | 76.272                         | 6.890                         |
| HFIWA112A       | A              | M1                | 1             | 1                  | 96.785         | 7.671         | 0.320           | 0.116                     | 16                  | BGM          | 0.0072              | 97.037                         | 7.690                         |
| HFIWA113A       | A              | M1                | 1             | 1                  | 90.832         | 7.440         | 0.310           | 0.119                     | 16                  | BGM          | 0.0074              | 93.855                         | 7.688                         |
| HFIWA114A       | A              | M1                | 1             | 1                  | 84.912         | 7.199         | 0.304           | 0.120                     | 16                  | BGM          | 0.0075              | 88.081                         | 7.467                         |
| HFIWA211A       | A              | M2                | 1             | 2                  | 91.192         | 7.711         | 0.338           | 0.114                     | 16                  | BGM          | 0.0071              | 90.532                         | 7.655                         |
| HFIWA212A       | A              | M2                | 1             | 2                  | 92.530         | 7.739         | 0.367           | 0.118                     | 16                  | BGM          | 0.0074              | 95.127                         | 7.957                         |
| HFIWA213A       | A              | M2                | 1             | 2                  | 91.329         | 7.602         | 0.354           | 0.119                     | 16                  | BGM          | 0.0074              | 94.289                         | 7.848                         |
| HFIWB111A       | B              | M1                | 2             | 1                  |                |               |                 |                           |                     |              |                     |                                |                               |
| HFIWB112A       | B              | M1                | 2             | 1                  |                |               |                 |                           |                     |              |                     |                                |                               |
| HFIWB113A       | B              | M1                | 2             | 1                  |                |               |                 |                           |                     |              |                     |                                |                               |
| HFIWB211A       | B              | M2                | 2             | 2                  | 73.465         | 8.612         | 0.314           | 0.107                     | 16                  | BGM          | 0.0067              | 68.065                         | 7.979                         |
| HFIWB212A       | B              | M2                | 2             | 2                  | 91.759         | 8.485         | 0.348           | 0.114                     | 16                  | BGM          | 0.0071              | 90.538                         | 8.372                         |
| HFIWB213A       | B              | M2                | 2             | 2                  | 74.784         | 8.092         | 0.336           | 0.117                     | 16                  | BGM          | 0.0073              | 75.660                         | 8.187                         |
| HFIWC111A       | C              | M1                | 3             | 1                  | 88.972         | 8.245         | 0.314           | 0.112                     | 16                  | BGM          | 0.0070              | 86.745                         | 8.039                         |
| HFIWC112A       | C              | M1                | 3             | 1                  | 86.634         | 8.125         | 0.341           | 0.119                     | 16                  | BGM          | 0.0075              | 89.642                         | 8.407                         |
| HFIWC113A       | C              | M1                | 3             | 1                  | 79.952         | 7.841         | 0.349           | 0.119                     | 16                  | BGM          | 0.0074              | 82.427                         | 8.084                         |
| HFIWC211A       | C              | M2                | 3             | 2                  | 85.577         | 7.884         | 0.339           | 0.110                     | 16                  | BGM          | 0.0069              | 81.875                         | 7.543                         |
| HFIWC212A       | C              | M2                | 3             | 2                  | 91.348         | 7.933         | 0.356           | 0.116                     | 16                  | BGM          | 0.0072              | 91.797                         | 7.972                         |
| HFIWC213A       | C              | M2                | 3             | 2                  | 89.030         | 7.781         | 0.360           | 0.117                     | 16                  | BGM          | 0.0073              | 90.782                         | 7.934                         |

Batch B Cure Cycle 1 has improper layup so results were removed

Average 86.951 7.861 0.334  
 Standard Dev. 6.529 0.382 0.022  
 Coeff. of Var. [%] 7.508 4.861 6.705  
 Min. 73.465 7.199 0.290  
 Max. 96.785 8.612 0.367  
 Number of Spec. 16 16 16

out check for extras  
 Average<sub>norm</sub> 0.0072 87.045 7.857  
 Standard Dev.<sub>norm</sub> 8.111 0.373  
 Coeff. of Var. [%]<sub>norm</sub> 9.318 4.749  
 Min. 0.0067 68.065 6.890  
 Max. 0.0075 97.037 8.407  
 Number of Spec. 16 16 16



**Laminate Unnotched Compression Properties (UNC1) -- (ETW)**  
**Strength & Modulus**  
 HEXCEL 8552 - IM7 UNI PREPREG

normalizing  $t_{ply}$ 

[in]

0.0072

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Modulus [Msi] | Poisson's Ratio | Avg. Specimen Thickn. [in] | # Plies in Laminate | Failure Mode | Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] | Modulus <sub>norm</sub> [Msi] |
|-----------------|----------------|-------------------|---------------|--------------|----------------|---------------|-----------------|----------------------------|---------------------|--------------|---------------------|--------------------------------|-------------------------------|
| HFIWA11DD       | A              | M1                | 1             | 1            | 54.607         | 7.001         | 0.369           | 0.118                      | 16                  | BGM          | 0.0074              | 55.744                         | 7.147                         |
| HFIWA11ED       | A              | M1                | 1             | 1            | 59.118         | 6.924         | 0.356           | 0.118                      | 16                  | BGM          | 0.0074              | 60.555                         | 7.093                         |
| HFIWA11FD       | A              | M1                | 1             | 1            | 51.227         | 7.240         | 0.356           | 0.116                      | 16                  | BGM          | 0.0073              | 51.605                         | 7.293                         |
| HFIWA115D       | A              | M1                | 1             | 1            | 51.738         | 6.987         | 0.362           | 0.118                      | 16                  | BGM          | 0.0074              | 52.958                         | 7.152                         |
| HFIWA214D       | A              | M2                | 1             | 2            | 64.777         | 6.971         | 0.334           | 0.118                      | 16                  | BGM          | 0.0073              | 66.071                         | 7.111                         |
| HFIWA215D       | A              | M2                | 1             | 2            | 58.623         | 6.817         | 0.367           | 0.117                      | 16                  | BAB          | 0.0073              | 59.284                         | 6.894                         |
| HFIWA216D       | A              | M2                | 1             | 2            | 51.583         | 6.791         | 0.375           | 0.116                      | 16                  | BGM / DGM    | 0.0073              | 52.046                         | 6.852                         |
| HFIWB21CD       | B              | M2                | 2             | 1            | 58.036         | 7.198         | 0.379           | 0.115                      | 16                  | DGM / BGM    | 0.0072              | 57.726                         | 7.159                         |
| HFIWB216D       | B              | M2                | 2             | 1            | 56.134         | 7.126         | 0.350           | 0.115                      | 16                  | HGM          | 0.0072              | 55.874                         | 7.093                         |
| HFIWB21RMD      | B              | M2                | 2             | 1            | 61.874         | 6.905         | 0.354           | 0.117                      | 16                  | DGM / BGM    | 0.0073              | 62.841                         | 7.013                         |
| HFIWC11AD       | C              | M1                | 3             | 1            | 52.051         | 7.024         | 0.359           | 0.117                      | 16                  | DGM          | 0.0073              | 52.804                         | 7.126                         |
| HFIWC11BD       | C              | M1                | 3             | 1            | 56.854         | 7.040         | 0.356           | 0.117                      | 16                  | BGM          | 0.0073              | 57.520                         | 7.122                         |
| HFIWC11CD       | C              | M1                | 3             | 1            | 50.531         | 7.184         | 0.317           | 0.116                      | 16                  | BGM          | 0.0073              | 51.065                         | 7.260                         |
| HFIWC21AD       | C              | M2                | 3             | 2            | 49.367         | 7.204         | 0.339           | 0.115                      | 16                  | DGM          | 0.0072              | 49.345                         | 7.201                         |
| HFIWC21BD       | C              | M2                | 3             | 2            | 50.270         | 7.375         | 0.361           | 0.115                      | 16                  | BAT          | 0.0072              | 50.059                         | 7.344                         |
| HFIWC21CD       | C              | M2                | 3             | 2            | 48.540         | 7.136         | 0.369           | 0.116                      | 16                  | BGM          | 0.0072              | 48.716                         | 7.161                         |
| HFIWA118D       | A              | M1                | 1             | 1            | 70.392         |               |                 | 0.117                      | 16                  | BGM          | 0.0073              | 71.543                         |                               |
| HFIWA119D       | A              | M1                | 1             | 1            | 70.983         |               |                 | 0.117                      | 16                  | BGM          | 0.0073              | 72.226                         |                               |
| HFIWA11AD*      | A              | M1                | 1             | 1            | 56.125         |               |                 | 0.117                      | 16                  | BGM          | 0.0073              | 57.075                         |                               |
| HFIWA11BD*      | A              | M1                | 1             | 1            | 58.329         |               |                 | 0.118                      | 16                  | BGM          | 0.0073              | 59.511                         |                               |
| HFIWA11CD*      | A              | M1                | 1             | 1            |                |               |                 | 0.117                      | 16                  | HIB          | 0.0073              |                                |                               |
| HFIWA217D*      | A              | M2                | 1             | 2            | 55.250         |               |                 | 0.117                      | 16                  | HAB          | 0.0073              | 56.130                         |                               |
| HFIWA218D*      | A              | M2                | 1             | 2            | 58.901         |               |                 | 0.117                      | 16                  | BGM          | 0.0073              | 60.009                         |                               |
| HFIWA219D*      | A              | M2                | 1             | 2            | 54.659         |               |                 | 0.117                      | 16                  | HGM          | 0.0073              | 55.735                         |                               |
| HFIWB217D       | B              | M2                | 2             | 2            | 54.624         |               |                 | 0.115                      | 16                  | BGM          | 0.0072              | 54.339                         |                               |
| HFIWB218D       | B              | M2                | 2             | 2            | 69.184         |               |                 | 0.115                      | 16                  | HGM          | 0.0072              | 69.194                         |                               |
| HFIWB219D       | B              | M2                | 2             | 2            | 64.638         |               |                 | 0.115                      | 16                  | BGM          | 0.0072              | 64.563                         |                               |
| HFIWB21AD       | B              | M2                | 2             | 2            | 62.823         |               |                 | 0.115                      | 16                  | HAT          | 0.0072              | 62.569                         |                               |
| HFIWB21BD       | B              | M2                | 2             | 2            |                |               |                 | 0.115                      | 16                  | HIT          |                     |                                |                               |
| HFIWC117D*      | C              | M1                | 3             | 1            |                |               |                 | 0.117                      | 16                  | BGM          |                     |                                |                               |
| HFIWC118D*      | C              | M1                | 3             | 1            | 55.329         |               |                 | 0.117                      | 16                  | BAB          | 0.0073              | 56.065                         |                               |
| HFIWC119D*      | C              | M1                | 3             | 1            | 55.844         |               |                 | 0.117                      | 16                  | HAB          | 0.0073              | 56.636                         |                               |
| HFIWC217D*      | C              | M2                | 3             | 2            | 50.176         |               |                 | 0.116                      | 16                  | HAT          | 0.0072              | 50.452                         |                               |
| HFIWC218D*      | C              | M2                | 3             | 2            |                |               |                 | 0.117                      | 16                  | HAB          |                     |                                |                               |
| HFIWC219D*      | C              | M2                | 3             | 2            |                |               |                 | 0.117                      | 16                  | HAT          |                     |                                |                               |

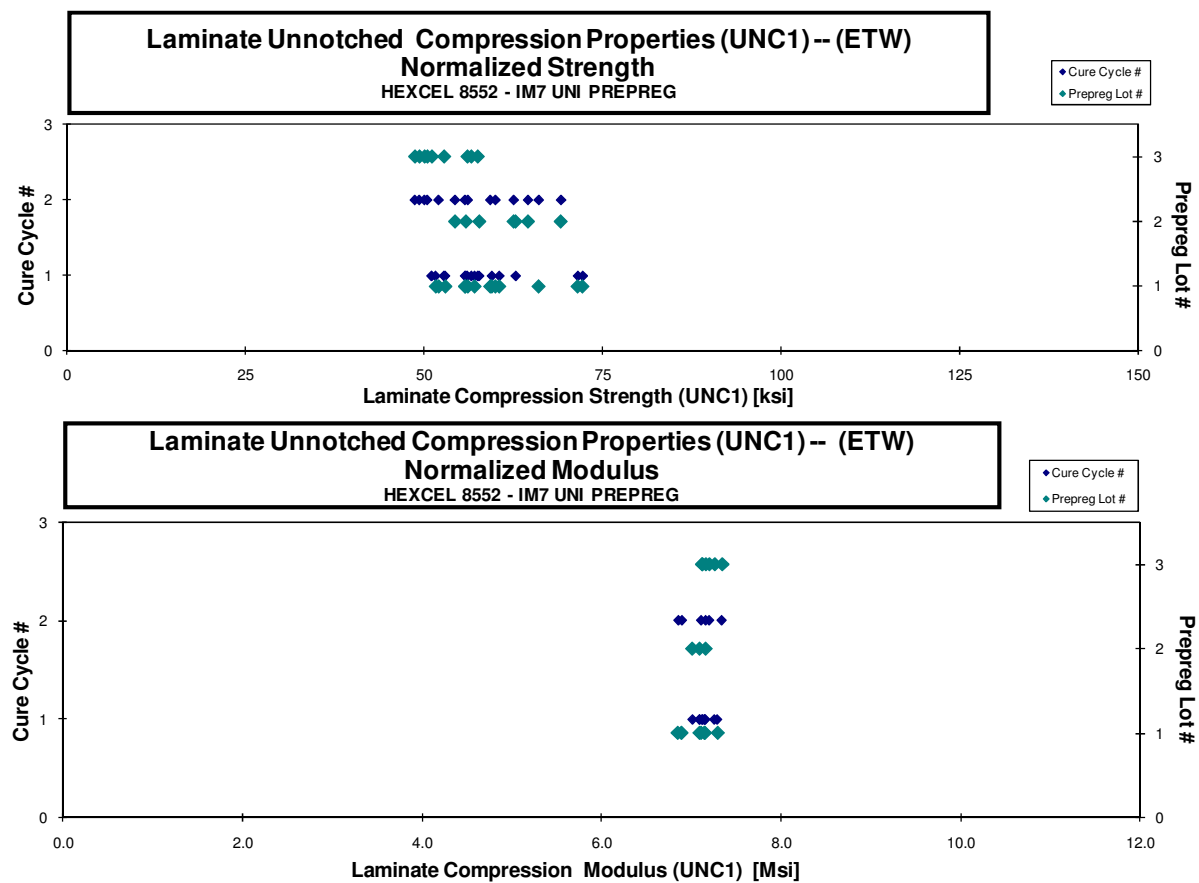
Compressive Strength is not reported for HFIWB 116D as unacceptable failure mode was observed  
 STRENGTH WAS NOT REPORTED FOR SPECIMENS HFIWA11CD and HFIWB21BD DUE TO AN UNACCEPTABLE FAILURE MODE.

Shaded specimens had modulus removed due to improper strain gage adhesive used

Batch B Cure Cycle 1 has improper layup so results were removed

\* Specimens have uneven grip marks due to thickness variation

|                    |        |       |       |                                    |        |        |       |
|--------------------|--------|-------|-------|------------------------------------|--------|--------|-------|
| Average            | 57.086 | 7.058 | 0.356 | Average <sub>norm</sub>            | 0.0073 | 57.675 | 7.126 |
| Standard Dev.      | 6.207  | 0.161 | 0.016 | Standard Dev. <sub>norm</sub>      |        | 6.355  | 0.128 |
| Coeff. of Var. [%] | 10.872 | 2.282 | 4.424 | Coeff. of Var. [%] <sub>norm</sub> |        | 11.019 | 1.801 |
| Min.               | 48.540 | 6.791 | 0.317 | Min.                               | 0.0072 | 48.716 | 6.852 |
| Max.               | 70.983 | 7.375 | 0.379 | Max.                               | 0.0074 | 72.226 | 7.344 |
| Number of Spec.    | 30     | 16    | 16    | Number of Spec.                    | 31     | 30     | 16    |





## 4.12 Unnotched Compression 2 Properties

**Laminate Unnotched Compression Properties (UNC2) -- (RTD)**  
**Strength & Modulus**  
 HEXCEL 8552 - IM7 UNI PREPREG

normalizing  $t_{ply}$ 

[in]

0.0072

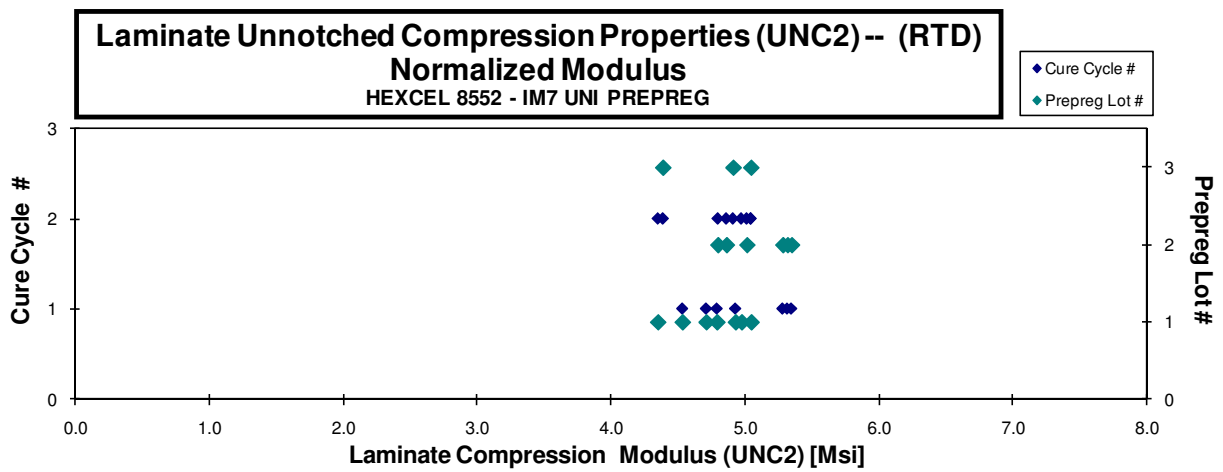
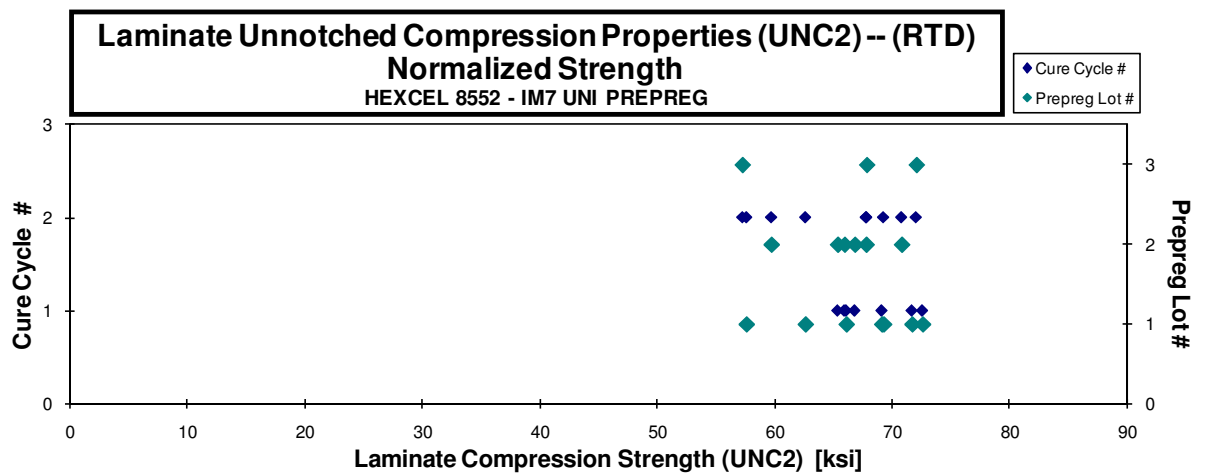
| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Modulus [Msi] | Poisson's Ratio | Avg. Specimen Thicken. [in] | # Plies in Laminate | Failure Mode | Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] | Modulus <sub>norm</sub> [Msi] |
|-----------------|----------------|-------------------|---------------|--------------|----------------|---------------|-----------------|-----------------------------|---------------------|--------------|---------------------|--------------------------------|-------------------------------|
| HFIXA111A       | A              | M1                | 1             | 1            | 73.013         | 4.789         | 0.535           | 0.136                       | 20                  | BGM          | 0.0068              | 69.151                         | 4.536                         |
| HFIXA112A       | A              | M1                | 1             | 1            | 71.811         | 4.938         | 0.566           | 0.144                       | 20                  | BGM          | 0.0072              | 71.720                         | 4.932                         |
| HFIXA113A       | A              | M1                | 1             | 1            | 64.461         | 4.672         | 0.562           | 0.148                       | 20                  | BGM          | 0.0074              | 66.125                         | 4.793                         |
| HFIXA114A       | A              | M1                | 1             | 1            | 70.533         | 4.578         | 0.581           | 0.148                       | 20                  | BGM          | 0.0074              | 72.615                         | 4.713                         |
| HFIXA211A       | A              | M2                | 1             | 2            | 60.868         | 4.598         | 0.563           | 0.136                       | 20                  | BGM          | 0.0068              | 57.627                         | 4.353                         |
| HFIXA212A       | A              | M2                | 1             | 2            | 63.297         | 5.027         | 0.608           | 0.143                       | 20                  | BGM          | 0.0071              | 62.652                         | 4.976                         |
| HFIXA213A       | A              | M2                | 1             | 2            | 68.035         | 4.955         | 0.612           | 0.147                       | 20                  | BGM          | 0.0073              | 69.302                         | 5.047                         |
| HFIXB111A       | B              | M1                | 2             | 1            | 67.082         | 5.303         | 0.664           | 0.144                       | 20                  | BGM          | 0.0072              | 66.849                         | 5.284                         |
| HFIXB112A       | B              | M1                | 2             | 1            | 65.716         | 5.328         | 0.675           | 0.145                       | 20                  | BGM          | 0.0072              | 65.975                         | 5.349                         |
| HFIXB113A       | B              | M1                | 2             | 1            | 64.557         | 5.251         | 0.662           | 0.146                       | 20                  | BGM          | 0.0073              | 65.394                         | 5.319                         |
| HFIXB211A*      | B              | M2                | 2             | 2            | 64.745         | 5.202         | 0.546           | 0.133                       | 20                  | BGM          | 0.0066              | 59.747                         | 4.800                         |
| HFIXB212A       | B              | M2                | 2             | 2            | 69.508         | 5.141         | 0.587           | 0.141                       | 20                  | BGM          | 0.0070              | 67.818                         | 5.016                         |
| HFIXB213A       | B              | M2                | 2             | 2            | 70.542         | 4.844         | 0.563           | 0.145                       | 20                  | BGM          | 0.0072              | 70.836                         | 4.864                         |
| HFIXC211A*      | C              | M2                | 3             | 2            | 63.253         | 4.847         | 0.514           | 0.130                       | 20                  | BGM          | 0.0065              | 57.294                         | 4.390                         |
| HFIXC212A       | C              | M2                | 3             | 2            | 70.328         | 5.092         | 0.574           | 0.139                       | 20                  | BGM          | 0.0069              | 67.862                         | 4.914                         |
| HFIXC213A       | C              | M2                | 3             | 2            | 72.077         | 5.046         | 0.572           | 0.144                       | 20                  | BGM          | 0.0072              | 72.085                         | 5.046                         |

For batch C, cure cycle 1 panel has wrong layup, has two -45 degree plies at beginning of layup.

\*Specimens have thickness taper at edge of coupon

|                           |               |              |              |
|---------------------------|---------------|--------------|--------------|
| <b>Average</b>            | <b>67.489</b> | <b>4.976</b> | <b>0.587</b> |
| <b>Standard Dev.</b>      | <b>3.735</b>  | <b>0.241</b> | <b>0.047</b> |
| <b>Coeff. of Var. [%]</b> | <b>5.534</b>  | <b>4.842</b> | <b>7.960</b> |
| <b>Min.</b>               | <b>60.868</b> | <b>4.578</b> | <b>0.514</b> |
| <b>Max.</b>               | <b>73.013</b> | <b>5.328</b> | <b>0.675</b> |
| <b>Number of Spec.</b>    | <b>16</b>     | <b>16</b>    | <b>16</b>    |

|                                          |               |               |              |
|------------------------------------------|---------------|---------------|--------------|
| <b>Average<sub>norm</sub></b>            | <b>0.0071</b> | <b>66.441</b> | <b>4.896</b> |
| <b>Standard Dev.<sub>norm</sub></b>      |               | <b>4.890</b>  | <b>0.299</b> |
| <b>Coeff. of Var. [%]<sub>norm</sub></b> |               | <b>7.360</b>  | <b>6.100</b> |
| <b>Min.</b>                              | <b>0.0065</b> | <b>57.294</b> | <b>4.353</b> |
| <b>Max.</b>                              | <b>0.0074</b> | <b>72.615</b> | <b>5.349</b> |
| <b>Number of Spec.</b>                   |               | <b>16</b>     | <b>16</b>    |



**Laminate Unnotched Compression Properties (UNC2) -- (ETW)**  
**Strength & Modulus**  
 HEXCEL 8552 - IM7 UNI PREPREG

normalizing  $t_{ply}$   
 [in]  
 0.0072

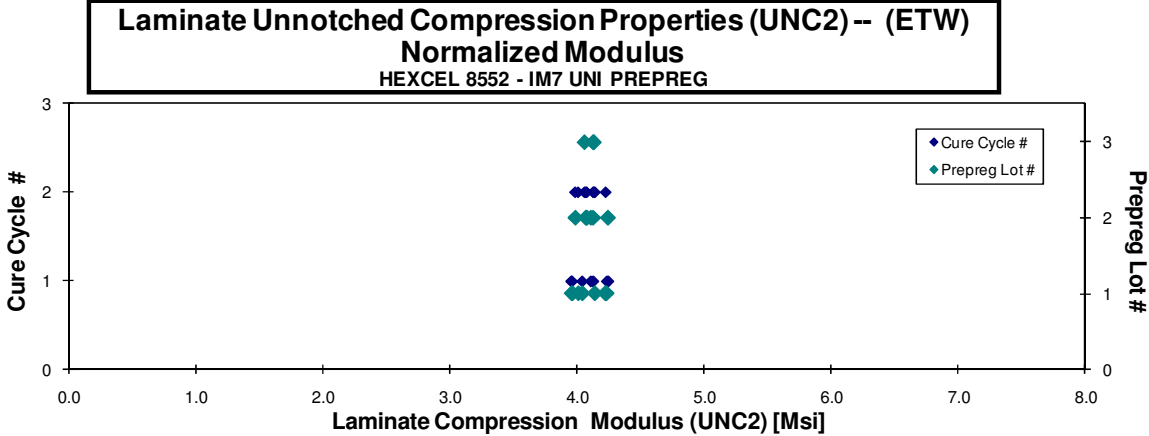
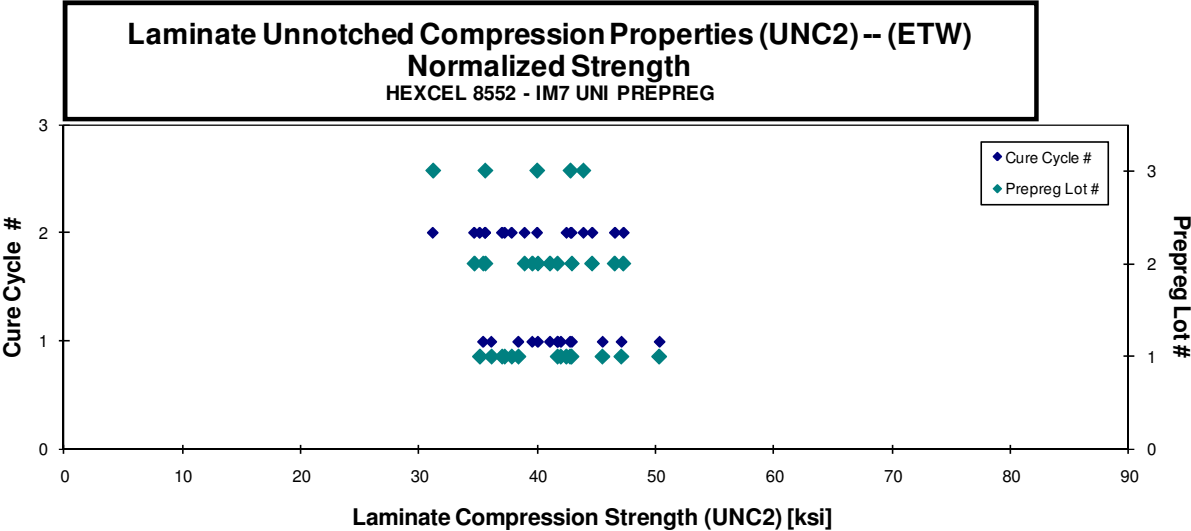
| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Modulus* [Msi] | Poisson's Ratio | Avg. Specimen Thicken. [in] | # Plies in Laminate | Failure Mode | Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] | Modulus <sub>norm</sub> [Msi] |
|-----------------|----------------|-------------------|---------------|--------------|----------------|----------------|-----------------|-----------------------------|---------------------|--------------|---------------------|--------------------------------|-------------------------------|
| HFIXA11DD       | A              | M1                | 1             | 1            | 37.314         | 3.847          | 0.641           | 0.148                       | 20                  | DGM          | 0.0074              | 38.415                         | 3.961                         |
| HFIXA11ED       | A              | M1                | 1             | 1            | 34.936         | 3.910          | 0.642           | 0.149                       | 20                  | DGM          | 0.0074              | 36.137                         | 4.045                         |
| HFIXA11FD       | A              | M1                | 1             | 1            | 41.150         | 4.149          | 0.673           | 0.147                       | 20                  | DGM          | 0.0074              | 42.008                         | 4.235                         |
| HFIXA11SD       | A              | M1                | 1             | 1            | 40.617         | 3.860          | 0.659           | 0.148                       | 20                  | DGM          | 0.0074              | 41.735                         | 3.967                         |
| HFIXA21AD       | A              | M2                | 1             | 2            | 36.826         | 3.967          | 0.670           | 0.146                       | 20                  | DGM          | 0.0073              | 37.256                         | 4.013                         |
| HFIXA21BD       | A              | M2                | 1             | 2            | 36.576         | 4.173          | 0.698           | 0.146                       | 20                  | BGM          | 0.0073              | 37.037                         | 4.225                         |
| HFIXA21CD       | A              | M2                | 1             | 2            | 34.595         | 4.077          | 0.685           | 0.146                       | 20                  | DGM          | 0.0073              | 35.156                         | 4.143                         |
| HFIXB119D       | B              | M1                | 2             | 1            | 41.295         | 4.131          | 0.690           | 0.143                       | 20                  | DGM          | 0.0072              | 41.094                         | 4.111                         |
| HFIXB11AD       | B              | M1                | 2             | 1            | 41.878         | 4.145          | 0.671           | 0.143                       | 20                  | DGM          | 0.0072              | 41.723                         | 4.130                         |
| HFIXB114D       | B              | M1                | 2             | 1            | 42.303         | 4.182          | 0.695           | 0.146                       | 20                  | DGM          | 0.0073              | 42.949                         | 4.246                         |
| HFIXB21BD       | B              | M2                | 2             | 2            | 35.933         | 4.115          | 0.654           | 0.143                       | 20                  | BGM/DGM      | 0.0071              | 35.622                         | 4.080                         |
| HFIXB21CD       | B              | M2                | 2             | 2            | 34.825         | 4.005          | 0.646           | 0.143                       | 20                  | DGM          | 0.0072              | 34.692                         | 3.990                         |
| HFIXB214D       | B              | M2                | 2             | 2            | 38.605         | 4.038          | 0.669           | 0.145                       | 20                  | DGM          | 0.0073              | 38.941                         | 4.073                         |
| HFIXC21AD       | C              | M2                | 3             | 2            | 31.309         | 4.077          | 0.655           | 0.143                       | 20                  | DGM          | 0.0072              | 31.189                         | 4.062                         |
| HFIXC21BD       | C              | M2                | 3             | 2            | 35.807         | 4.158          | 0.661           | 0.143                       | 20                  | DGM          | 0.0072              | 35.608                         | 4.135                         |
| HFIXC214D       | C              | M2                | 3             | 2            | 42.616         | 4.108          | 0.631           | 0.145                       | 20                  | DGM          | 0.0072              | 42.828                         | 4.129                         |
| HFIXA118D       | A              | M1                | 1             | 1            | 49.443         |                |                 | 0.147                       | 20                  | BGM          | 0.0073              | 50.336                         |                               |
| HFIXA119D       | A              | M1                | 1             | 1            | 44.763         |                |                 | 0.146                       | 20                  | BGM          | 0.0073              | 45.530                         |                               |
| HFIXA11AD       | A              | M1                | 1             | 1            | 46.375         |                |                 | 0.146                       | 20                  | BGM          | 0.0073              | 47.131                         |                               |
| HFIXA11BD       | A              | M1                | 1             | 1            | 42.111         |                |                 | 0.146                       | 20                  | BGM          | 0.0073              | 42.794                         |                               |
| HFIXA217D       | A              | M2                | 1             | 2            | 37.693         |                |                 | 0.145                       | 20                  | BGM          | 0.0072              | 37.855                         |                               |
| HFIXA218D       | A              | M2                | 1             | 2            | 42.187         |                |                 | 0.145                       | 20                  | BGM          | 0.0073              | 42.480                         |                               |
| HFIXA219D       | A              | M2                | 1             | 2            | 42.274         |                |                 | 0.146                       | 20                  | BGM          | 0.0073              | 42.910                         |                               |
| HFIXB116D       | B              | M1                | 2             | 1            | 37.228         |                |                 | 0.137                       | 20                  | BAB          | 0.0069              | 35.444                         |                               |
| HFIXB117D       | B              | M1                | 2             | 1            | 40.263         |                |                 | 0.142                       | 20                  | BGM          | 0.0071              | 39.597                         |                               |
| HFIXB118D       | B              | M1                | 2             | 1            | 40.542         |                |                 | 0.142                       | 20                  | BGM          | 0.0071              | 40.068                         |                               |
| HFIXB217D       | B              | M2                | 2             | 2            | 47.639         |                |                 | 0.143                       | 20                  | BGM          | 0.0071              | 47.303                         |                               |
| HFIXB218D       | B              | M2                | 2             | 2            | 45.032         |                |                 | 0.143                       | 20                  | BGM          | 0.0071              | 44.657                         |                               |
| HFIXB219D       | B              | M2                | 2             | 2            | 46.851         |                |                 | 0.143                       | 20                  | BGM          | 0.0072              | 46.575                         |                               |
| HFIXC217D       | C              | M2                | 3             | 2            | 40.333         |                |                 | 0.143                       | 20                  | BGM          | 0.0071              | 40.007                         |                               |
| HFIXC218D       | C              | M2                | 3             | 2            |                |                |                 | 0.142                       | 20                  | BGM / CIB    | 0.0071              |                                |                               |
| HFIXC219D       | C              | M2                | 3             | 2            | 43.987         |                |                 | 0.144                       | 20                  | BGM          | 0.0072              | 43.921                         |                               |

HFIXC218D: STRENGTH REMOVED DUE TO A BAD FAILURE MODE

For batch C, cure cycle 1 panel has wrong layup, has two -45 degree plies at beginning of layu

\* Modulus removed due to improper strain gage adhesvie used

|                    |        |       |       |                                    |        |        |       |
|--------------------|--------|-------|-------|------------------------------------|--------|--------|-------|
| Average            | 40.429 | 4.059 | 0.665 | Average <sub>norm</sub>            | 0.0072 | 40.613 | 4.096 |
| Standard Dev.      | 4.330  | 0.111 | 0.020 | Standard Dev <sub>norm</sub>       |        | 4.430  | 0.090 |
| Coeff. of Var. [%] | 10.710 | 2.723 | 3.029 | Coeff. of Var. [%] <sub>norm</sub> |        | 10.907 | 2.206 |
| Min.               | 31.309 | 3.847 | 0.631 | Min.                               | 0.0069 | 31.189 | 3.961 |
| Max.               | 49.443 | 4.182 | 0.698 | Max.                               | 0.0074 | 50.336 | 4.246 |
| Number of Spec.    | 31     | 16    | 16    | Number of Spec.                    | 32     | 31     | 16    |



## 4.13 Unnotched Compression 3 Properties

**Laminate Unnotched Compression Properties (UNC3) -- (RTD)**  
**Strength & Modulus**  
 HEXCEL 8552 - IM7 UNI PREPREG

normalizing  $t_{ply}$ 

[in]

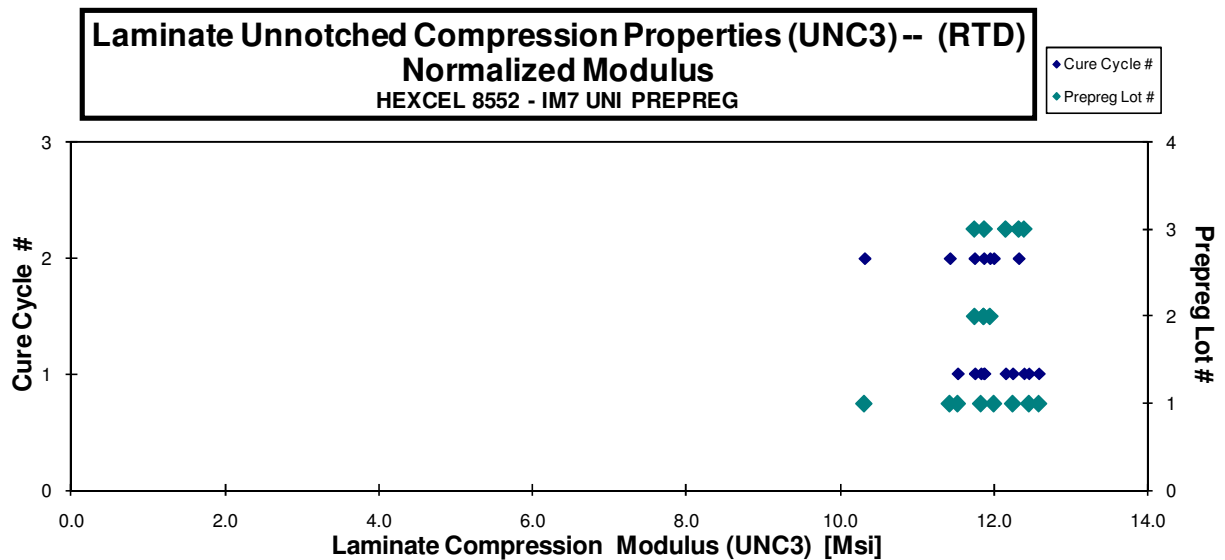
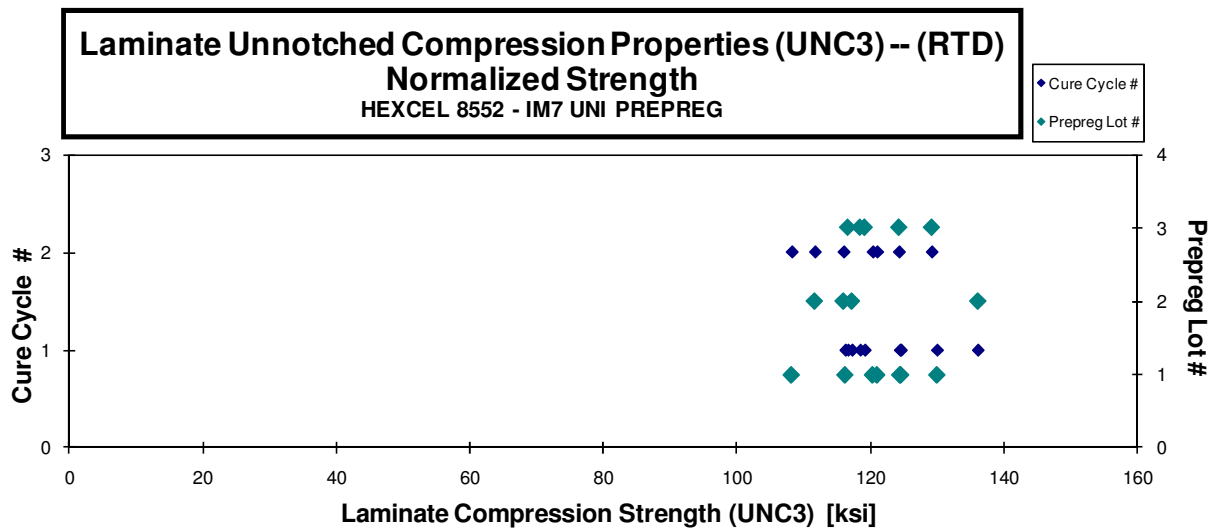
0.0072

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Modulus [ksi] | Poisson's Ratio | Avg. Specimen Thickn. [in] | # Plies in Laminate | Failure Mode | Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] | Modulus <sub>norm</sub> [ksi] |
|-----------------|----------------|-------------------|---------------|--------------|----------------|---------------|-----------------|----------------------------|---------------------|--------------|---------------------|--------------------------------|-------------------------------|
| HFIYA112A       | A              | M1                | 1             | 1            |                | 12.739        | 0.452           | 0.141                      | 20                  | END CRUSH    | 0.0070              |                                | 12.451                        |
| HFIYA113A       | A              | M1                | 1             | 1            | 128.027        | 11.653        | 0.394           | 0.146                      | 20                  | BGM          | 0.0073              | 129.969                        | 11.830                        |
| HFIYA114A       | A              | M1                | 1             | 1            | 121.763        | 11.980        | 0.382           | 0.147                      | 20                  | BGM          | 0.0074              | 124.426                        | 12.242                        |
| HFIYA115A       | A              | M1                | 1             | 1            | 122.888        | 11.373        | 0.404           | 0.146                      | 20                  | BGM          | 0.0073              | 124.566                        | 11.528                        |
| HFIYA116A       | A              | M1                | 1             | 1            | 115.332        | 12.483        | 0.433           | 0.145                      | 20                  | BGM          | 0.0073              | 116.227                        | 12.579                        |
| HFIYA211A       | A              | M2                | 1             | 2            | 117.385        | 11.196        | 0.384           | 0.133                      | 20                  | BGM          | 0.0066              | 108.201                        | 10.320                        |
| HFIYA212A       | A              | M2                | 1             | 2            | 123.466        | 11.659        | 0.443           | 0.141                      | 20                  | BGM          | 0.0071              | 120.994                        | 11.426                        |
| HFIYA213A       | A              | M2                | 1             | 2            | 118.442        | 11.807        | 0.453           | 0.146                      | 20                  | BGM          | 0.0073              | 120.348                        | 11.997                        |
| HFIYB111A*      | B              | M1                | 2             | 1            |                |               |                 |                            |                     |              |                     |                                |                               |
| HFIYB112A       | B              | M1                | 2             | 1            | 122.753        | 12.304        | 0.430           | 0.138                      | 20                  | BGM          | 0.0069              | 117.226                        | 11.750                        |
| HFIYB113A       | B              | M1                | 2             | 1            | 137.699        | 12.005        | 0.412           | 0.142                      | 20                  | BGM          | 0.0071              | 136.089                        | 11.865                        |
| HFIYB2C1A*      | B              | M2                | 2             | 2            |                |               |                 |                            |                     |              |                     |                                |                               |
| HFIYB2C2A       | B              | M2                | 2             | 2            | 116.554        | 11.926        | 0.439           | 0.143                      | 20                  | BGM          | 0.0072              | 115.974                        | 11.866                        |
| HFIYB2C3A       | B              | M2                | 2             | 2            | 112.003        | 11.984        | 0.450           | 0.144                      | 20                  | BGM          | 0.0072              | 111.666                        | 11.947                        |
| HFIYC111A       | C              | M1                | 3             | 1            | 118.911        | 12.436        | 0.438           | 0.143                      | 20                  | BGM          | 0.0072              | 118.456                        | 12.389                        |
| HFIYC112A       | C              | M1                | 3             | 1            | 111.743        | 11.642        | 0.412           | 0.150                      | 20                  | BGM          | 0.0075              | 116.631                        | 12.151                        |
| HFIYC113A       | C              | M1                | 3             | 1            | 116.408        | 11.601        | 0.422           | 0.147                      | 20                  | BGM          | 0.0074              | 119.143                        | 11.873                        |
| HFIYC211A*      | C              | M2                | 3             | 2            |                |               |                 |                            |                     |              |                     |                                |                               |
| HFIYC212A       | C              | M2                | 3             | 2            | 126.639        | 11.970        | 0.399           | 0.141                      | 20                  | BGM          | 0.0071              | 124.279                        | 11.747                        |
| HFIYC213A       | C              | M2                | 3             | 2            | 127.022        | 12.114        | 0.436           | 0.146                      | 20                  | BGM          | 0.0073              | 129.183                        | 12.320                        |

\*Specimens have thickness taper at end of specimen

Average 121.065 11.934 0.423  
 Standard Dev. 6.699 0.404 0.024  
 Coeff. of Var. [%] 5.533 3.383 5.596  
 Min. 111.743 11.196 0.382  
 Max. 137.699 12.739 0.453  
 Number of Spec. 16 17 17

Average<sub>norm</sub> 0.0072 120.836 11.899  
 Standard Dev.<sub>norm</sub> 7.083 0.518  
 Coeff. of Var. [%]<sub>norm</sub> 5.862 4.350  
 Min. 0.0066 108.201 10.320  
 Max. 0.0075 136.089 12.579  
 Number of Spec. 17 16 17



**Laminate Unnotched Compression Properties (UNC3) -- (ETW)**  
**Strength & Modulus**  
 HEXCEL 8552 - IM7 UNI PREPREG

normalizing  $t_{ply}$ 

[in]

0.0072

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Modulus [Msi] | Poisson's Ratio | Avg. Specimen Thicken. [in] | # Plies in Laminate | Failure Mode | Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] | Modulus <sub>norm</sub> [Msi] |
|-----------------|----------------|-------------------|---------------|--------------|----------------|---------------|-----------------|-----------------------------|---------------------|--------------|---------------------|--------------------------------|-------------------------------|
| HFIYA111D*      | A              | M1                | 1             | 1            |                |               |                 | 0.132                       | 20                  | BAT          |                     |                                |                               |
| HFIYA117D       | A              | M1                | 1             | 1            |                | 11.218        | 0.420           | 0.144                       | 20                  | BAT/HIT      | 0.0072              |                                | 11.243                        |
| HFIYA21BD       | A              | M2                | 1             | 2            |                | 11.351        | 0.414           | 0.146                       | 20                  | HAT / HIT    | 0.0073              |                                | 11.498                        |
| HFIYA21CD       | A              | M2                | 1             | 2            |                | 11.407        | 0.434           | 0.146                       | 20                  | ENDCRUSH     | 0.0073              |                                | 11.584                        |
| HFIYA214D       | A              | M2                | 1             | 2            |                | 11.597        | 0.450           | 0.148                       | 20                  | ENDCRUSH     | 0.0074              |                                | 11.905                        |
| HFIYB118D       | B              | M1                | 2             | 1            | 78.090         | 11.699        | 0.415           | 0.142                       | 20                  | DGM / BGM    | 0.0071              | 77.077                         | 11.547                        |
| HFIYB11CD       | B              | M1                | 2             | 1            | 88.909         | 11.821        | 0.399           | 0.144                       | 20                  | BGM          | 0.0072              | 88.899                         | 11.820                        |
| HFIYB114D       | B              | M1                | 2             | 1            |                | 11.946        | 0.427           | 0.144                       | 20                  | HAB / HIB    | 0.0072              |                                | 11.974                        |
| HFIYB2CBD       | B              | M2                | 2             | 2            | 75.171         | 11.835        | 0.403           | 0.140                       | 20                  | BAT          | 0.0070              | 73.266                         | 11.535                        |
| HFIYB2CCD*      | B              | M2                | 2             | 2            |                |               |                 | 0.130                       | 20                  | BAT          |                     |                                |                               |
| HFIYB2C4D       | B              | M2                | 2             | 2            |                | 11.555        | 0.426           | 0.144                       | 20                  | ENDCRUSH     | 0.0072              |                                | 11.537                        |
| HFIYC11BD       | C              | M1                | 3             | 1            | 90.400         | 11.493        | 0.423           | 0.148                       | 20                  | BAT          | 0.0074              | 92.744                         | 11.791                        |
| HFIYC11CD       | C              | M1                | 3             | 1            |                | 11.639        | 0.417           | 0.147                       | 20                  | HIT          | 0.0074              |                                | 11.899                        |
| HFIYC114D       | C              | M1                | 3             | 1            |                | 11.479        | 0.408           | 0.148                       | 20                  | HIT          | 0.0074              |                                | 11.797                        |
| HFIYC21CD       | C              | M2                | 3             | 2            | 88.788         | 11.949        | 0.402           | 0.146                       | 20                  | BAB          | 0.0073              | 89.877                         | 12.095                        |
| HFIYC214D       | C              | M2                | 3             | 2            | 94.499         | 11.953        | 0.416           | 0.147                       | 20                  | BAB          | 0.0074              | 96.632                         | 12.223                        |
| HFIYC215D       | C              | M2                | 3             | 2            | 93.549         | 11.958        | 0.389           | 0.146                       | 20                  | BAB          | 0.0073              | 94.978                         | 12.140                        |
| HFIYA119D       | A              | M1                | 1             | 1            | 70.041         |               |                 | 0.145                       | 20                  | HAB          | 0.0072              | 70.479                         |                               |
| HFIYA11AD       | A              | M1                | 1             | 1            | 67.563         |               |                 | 0.145                       | 20                  | HAT          | 0.0073              | 68.048                         |                               |
| HFIYA11BD       | A              | M1                | 1             | 1            | 76.395         |               |                 | 0.146                       | 20                  | HAT          | 0.0073              | 77.314                         |                               |
| HFIYA11CD       | A              | M1                | 1             | 1            | 74.707         |               |                 | 0.146                       | 20                  | HAB          | 0.0073              | 75.883                         |                               |
| HFIYA217D       | A              | M2                | 1             | 2            | 83.165         |               |                 | 0.146                       | 20                  | HGM          | 0.0073              | 84.272                         |                               |
| HFIYA218D       | A              | M2                | 1             | 2            |                |               |                 | 0.146                       | 20                  | HIB          | 0.0073              |                                |                               |
| HFIYA219D       | A              | M2                | 1             | 2            | 68.257         |               |                 | 0.145                       | 20                  | HAT          | 0.0073              | 68.881                         |                               |
| HFIYA21AD       | A              | M2                | 1             | 2            | 77.754         |               |                 | 0.146                       | 20                  | HAB          | 0.0073              | 78.663                         |                               |
| HFIYB117D       | B              | M1                | 2             | 1            | 78.394         |               |                 | 0.142                       | 20                  | BAB          | 0.0071              | 77.314                         |                               |
| HFIYB119D       | B              | M1                | 2             | 1            | 74.240         |               |                 | 0.143                       | 20                  | BAB          | 0.0071              | 73.647                         |                               |
| HFIYB11AD       | B              | M1                | 2             | 1            | 75.914         |               |                 | 0.143                       | 20                  | BAT          | 0.0072              | 75.510                         |                               |
| HFIYB11BD       | B              | M1                | 2             | 1            | 85.654         |               |                 | 0.144                       | 20                  | BAB          | 0.0072              | 85.515                         |                               |
| HFIYB2C7D       | B              | M2                | 2             | 2            | 83.154         |               |                 | 0.144                       | 20                  | BGM          | 0.0072              | 83.125                         |                               |
| HFIYB2C8D       | B              | M2                | 2             | 2            | 71.529         |               |                 | 0.145                       | 20                  | BGM          | 0.0072              | 71.968                         |                               |
| HFIYB2C9D*      | B              | M2                | 2             | 2            |                |               |                 | 0.146                       | 20                  | BAT          |                     |                                |                               |
| HFIYB2CAD       | B              | M2                | 2             | 2            | 87.745         |               |                 | 0.145                       | 20                  | BAT          | 0.0073              | 88.629                         |                               |
| HFIYC117D       | C              | M1                | 3             | 1            | 78.159         |               |                 | 0.150                       | 20                  | HAB          | 0.0075              | 81.162                         |                               |
| HFIYC118D       | C              | M1                | 3             | 1            | 68.776         |               |                 | 0.148                       | 20                  | HAT          | 0.0074              | 70.639                         |                               |
| HFIYC11AD       | C              | M1                | 3             | 1            | 72.324         |               |                 | 0.148                       | 20                  | HAB          | 0.0074              | 74.132                         |                               |
| HFIYC217D       | C              | M2                | 3             | 2            | 72.290         |               |                 | 0.145                       | 20                  | HAB          | 0.0072              | 72.650                         |                               |
| HFIYC218D       | C              | M2                | 3             | 2            | 78.362         |               |                 | 0.145                       | 20                  | HAB          | 0.0072              | 78.707                         |                               |
| HFIYC21BD       | C              | M2                | 3             | 2            | 73.619         |               |                 | 0.145                       | 20                  | HAT          | 0.0073              | 74.292                         |                               |

COMPRESSIVE MODULUS AND POISSON'S RATIO WAS NOT REPORTED FOR SPECIMEN HFIYA21AD.

Modulus of shaded specimens removed due to improper strain gage adhesive used

SPECIMEN HFIYA118D TO HFIYA11CD WERE NOT GAUGED

SPECIMEN HFIYB117C TO HFIYB11AD WERE NOT GAUGED

HFIYB2CAD HAD A BAD STRAIN GAGE

Compressive strengths for HFIYA21XD, HFIYA 117D not reported as unacceptable failure modes were observed

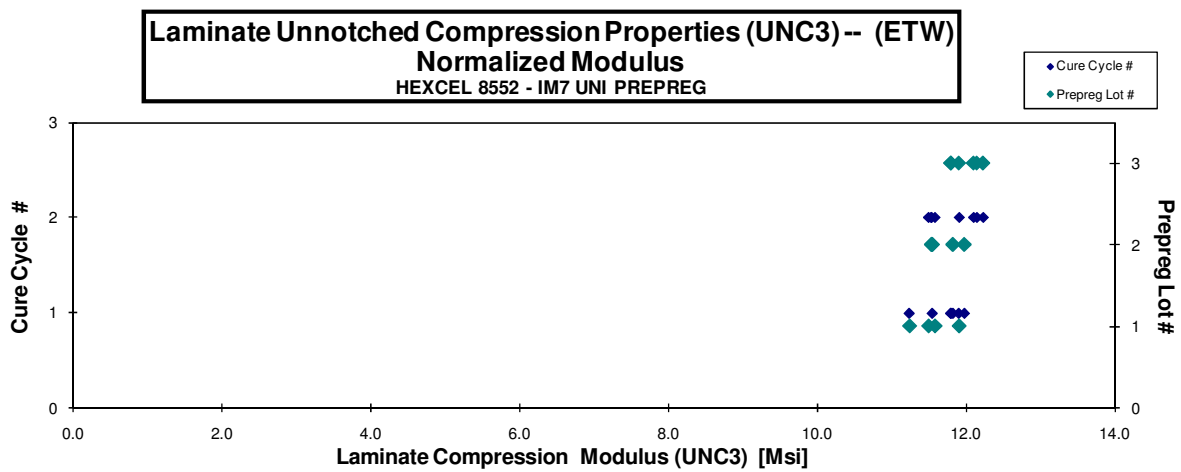
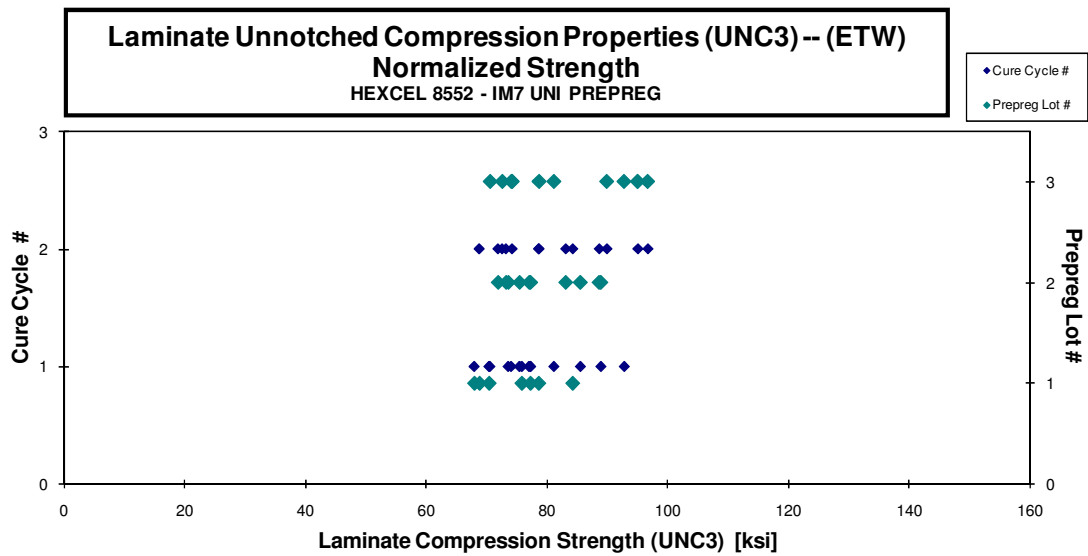
Compressive strengths not reported for HFIYB 114D, HFIYB 2C4D as unacceptable failure modes were observed.

Compressive strength for HFIYC 11CD, HFIYC 114D is not reported as unacceptable failure mode was observed.

\*Specimens have thickness taper on edge of specimen

|                    |        |        |       |
|--------------------|--------|--------|-------|
| Average            | 78.794 | 11.660 | 0.416 |
| Standard Dev.      | 7.872  | 0.243  | 0.015 |
| Coeff. of Var. [%] | 9.991  | 2.087  | 3.623 |
| Min.               | 67.563 | 11.218 | 0.389 |
| Max.               | 94.499 | 11.958 | 0.450 |
| Number of Spec.    | 27     | 15     | 15    |

|                                    |        |        |        |
|------------------------------------|--------|--------|--------|
| Average <sub>norm</sub>            | 0.0073 | 79.419 | 11.772 |
| Standard Dev. <sub>norm</sub>      |        | 8.192  | 0.277  |
| Coeff. of Var. [%] <sub>norm</sub> |        | 10.315 | 2.352  |
| Min.                               | 0.0070 | 68.048 | 11.243 |
| Max.                               | 0.0075 | 96.632 | 12.223 |
| Number of Spec.                    | 36     | 27     | 15     |



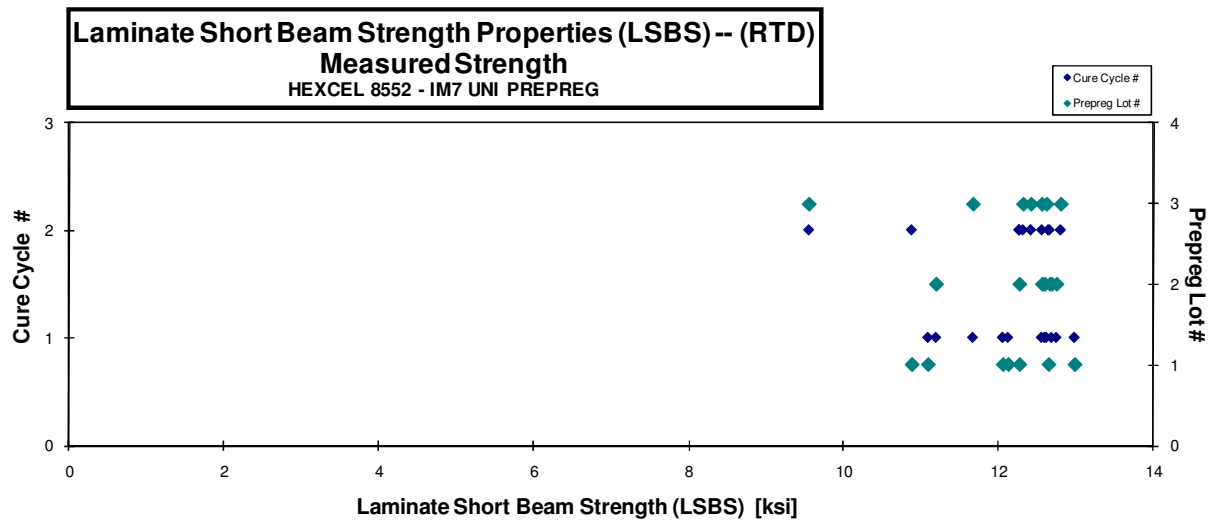


## 4.14 Laminate Short Beam Strength Properties

**Laminate Short Beam Strength Properties (LSBS)-- (RTD)  
Strength**  
HEXCEL 8552 - IM7 UNI PREPREG

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Avg. Specimen Thckn. [in] | # Plies in Laminate | Avg. tply [in] | Failure Mode       |
|-----------------|----------------|-------------------|---------------|--------------|----------------|---------------------------|---------------------|----------------|--------------------|
| HFlqA171A       | A              | M1                | 1             | 1            | 11.089         | 0.161                     | 24                  | 0.0067         | INTERLAMINAR SHEAR |
| HFlqA172A       | A              | M1                | 1             | 1            | 12.055         | 0.174                     | 24                  | 0.0073         | INTERLAMINAR SHEAR |
| HFlqA173A       | A              | M1                | 1             | 1            | 12.983         | 0.179                     | 24                  | 0.0075         | INTERLAMINAR SHEAR |
| HFlqA174A       | A              | M1                | 1             | 1            | 12.125         | 0.178                     | 24                  | 0.0074         | INTERLAMINAR SHEAR |
| HFlqA27X1A      | A              | M2                | 1             | 2            | 12.646         | 0.176                     | 24                  | 0.0073         | INTERLAMINAR SHEAR |
| HFlqA27X2A      | A              | M2                | 1             | 2            | 10.879         | 0.176                     | 24                  | 0.0073         | INTERLAMINAR SHEAR |
| HFlqA27X3A      | A              | M2                | 1             | 2            | 12.271         | 0.176                     | 24                  | 0.0073         | INTERLAMINAR SHEAR |
| HFlqB171A       | B              | M1                | 2             | 1            | 12.748         | 0.172                     | 24                  | 0.0072         | INTERLAMINAR SHEAR |
| HFlqB172A       | B              | M1                | 2             | 1            | 12.594         | 0.173                     | 24                  | 0.0072         | INTERLAMINAR SHEAR |
| HFlqB173A       | B              | M1                | 2             | 1            | 11.193         | 0.173                     | 24                  | 0.0072         | INTERLAMINAR SHEAR |
| HFlqB174A       | B              | M1                | 2             | 1            | 12.687         | 0.173                     | 24                  | 0.0072         | INTERLAMINAR SHEAR |
| HFlqB271A       | B              | M2                | 2             | 2            | 12.562         | 0.174                     | 24                  | 0.0072         | INTERLAMINAR SHEAR |
| HFlqB272A       | B              | M2                | 2             | 2            | 12.662         | 0.173                     | 24                  | 0.0072         | INTERLAMINAR SHEAR |
| HFlqB273A       | B              | M2                | 2             | 2            | 12.269         | 0.172                     | 24                  | 0.0072         | INTERLAMINAR SHEAR |
| HFlqC17X1A      | C              | M1                | 3             | 1            | 11.670         | 0.173                     | 24                  | 0.0072         | INTERLAMINAR SHEAR |
| HFlqC17X2A      | C              | M1                | 3             | 1            | 12.620         | 0.174                     | 24                  | 0.0073         | INTERLAMINAR SHEAR |
| HFlqC17X3A      | C              | M1                | 3             | 1            | 12.560         | 0.174                     | 24                  | 0.0073         | INTERLAMINAR SHEAR |
| HFlqC271A       | C              | M2                | 3             | 2            | 12.420         | 0.172                     | 24                  | 0.0072         | INTERLAMINAR SHEAR |
| HFlqC272A       | C              | M2                | 3             | 2            | 9.550          | 0.172                     | 24                  | 0.0072         | INTERLAMINAR SHEAR |
| HFlqC273A       | C              | M2                | 3             | 2            | 12.318         | 0.172                     | 24                  | 0.0072         | INTERLAMINAR SHEAR |
| HFlqC274A       | C              | M2                | 3             | 2            | 12.804         | 0.172                     | 24                  | 0.0072         | INTERLAMINAR SHEAR |

|                    |        |                    |        |
|--------------------|--------|--------------------|--------|
| Average            | 12.129 | Average            | 0.0072 |
| Standard Dev.      | 0.831  | Standard Dev.      |        |
| Coeff. of Var. [%] | 6.851  | Coeff. of Var. [%] |        |
| Min.               | 9.550  | Min.               | 0.0067 |
| Max.               | 12.983 | Max.               | 0.0075 |
| Number of Spec.    | 21     | Number of Spec.    | 21     |

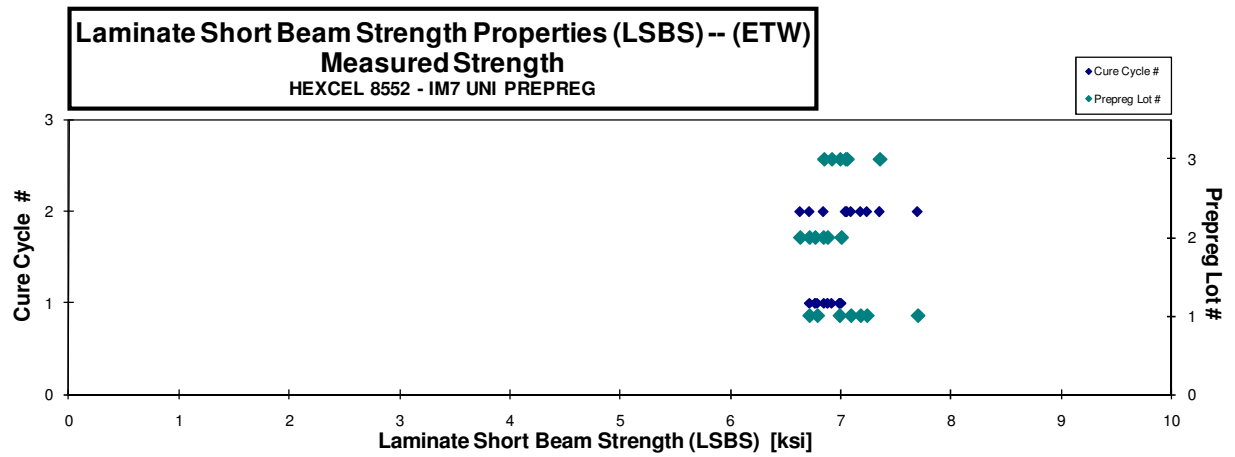


**Laminate Short Beam Strength Properties (LSBS) -- (ETW)**  
**Measured Strength**  
 HEXCEL 8552 - IM7 UNI PREPREG

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Avg. Specimen Thickn. [in] | # Plies in Laminate | Avg. tply [in] | Failure Mode       |
|-----------------|----------------|-------------------|---------------|--------------|----------------|----------------------------|---------------------|----------------|--------------------|
| HFlqA177D       | A              | M1                | 1             | 1            | 6.721          | 0.176                      | 24                  | 0.0073         | INTERLAMINAR SHEAR |
| HFlqA178D       | A              | M1                | 1             | 1            | 6.792          | 0.176                      | 24                  | 0.0073         | INTERLAMINAR SHEAR |
| HFlqA17AD       | A              | M1                | 1             | 1            | 6.993          | 0.175                      | 24                  | 0.0073         | INTERLAMINAR SHEAR |
| HFlqA27X6D      | A              | M2                | 1             | 2            | 7.699          | 0.174                      | 24                  | 0.0072         | INTERLAMINAR SHEAR |
| HFlqA27X7D      | A              | M2                | 1             | 2            | 7.182          | 0.174                      | 24                  | 0.0073         | INTERLAMINAR SHEAR |
| HFlqA27X8D      | A              | M2                | 1             | 2            | 7.240          | 0.175                      | 24                  | 0.0073         | INTERLAMINAR SHEAR |
| HFlqA27X9D      | A              | M2                | 1             | 2            | 7.095          | 0.176                      | 24                  | 0.0073         | INTERLAMINAR SHEAR |
| HFlqB178D       | B              | M1                | 2             | 1            | 7.008          | 0.173                      | 24                  | 0.0072         | INTERLAMINAR SHEAR |
| HFlqB179D       | B              | M1                | 2             | 1            | 6.885          | 0.174                      | 24                  | 0.0072         | INTERLAMINAR SHEAR |
| HFlqB17AD       | B              | M1                | 2             | 1            | 6.772          | 0.175                      | 24                  | 0.0073         | INTERLAMINAR SHEAR |
| HFlqB276D       | B              | M2                | 2             | 2            | 6.635          | 0.173                      | 24                  | 0.0072         | INTERLAMINAR SHEAR |
| HFlqB277D       | B              | M2                | 2             | 2            | 6.846          | 0.172                      | 24                  | 0.0072         | INTERLAMINAR SHEAR |
| HFlqB278D       | B              | M2                | 2             | 2            | 6.719          | 0.172                      | 24                  | 0.0072         | INTERLAMINAR SHEAR |
| HFlqC17X6D      | C              | M1                | 3             | 1            | 6.996          | 0.174                      | 24                  | 0.0072         | INTERLAMINAR SHEAR |
| HFlqC17X7D      | C              | M1                | 3             | 1            | 6.922          | 0.173                      | 24                  | 0.0072         | INTERLAMINAR SHEAR |
| HFlqC17X8D      | C              | M1                | 3             | 1            | 6.853          | 0.173                      | 24                  | 0.0072         | INTERLAMINAR SHEAR |
| HFlqC276D       | C              | M2                | 3             | 2            | 7.355          | 0.173                      | 24                  | 0.0072         | INTERLAMINAR SHEAR |
| HFlqC277D       | C              | M2                | 3             | 2            | 7.060          | 0.173                      | 24                  | 0.0072         | INTERLAMINAR SHEAR |
| HFlqC278D       | C              | M2                | 3             | 2            | 7.047          | 0.173                      | 24                  | 0.0072         | INTERLAMINAR SHEAR |

Average 6.991  
 Standard Dev. 0.255  
 Coeff. of Var. [%] 3.646  
 Min. 6.635  
 Max. 7.699  
 Number of Spec. 19

Average 0.0072  
 Standard Dev. 0.0002  
 Coeff. of Var. [%] 0.286  
 Min. 0.0072  
 Max. 0.0073  
 Number of Spec. 19



## 4.15 Lamina Short Beam Strength Properties

|                                                                                                          |
|----------------------------------------------------------------------------------------------------------|
| <b>Short Beam Strength Properties (SBS) -- (CTD)</b><br><b>Strength</b><br>HEXCEL 8552 - IM7 UNI PREPREG |
|----------------------------------------------------------------------------------------------------------|

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Avg. Specimen Thickn. [in] | # Plies in Laminate | Avg. tply [in] | Failure Mode       |
|-----------------|----------------|-------------------|---------------|--------------|----------------|----------------------------|---------------------|----------------|--------------------|
| HFIQA113B       | A              | M1                | 1             | 1            | 20.889         | 0.238                      | 34                  | 0.0070         | INTERLAMINAR SHEAR |
| HFIQA118B       | A              | M1                | 1             | 1            | 20.948         | 0.237                      | 34                  | 0.0070         | INTERLAMINAR SHEAR |
| HFIQA11CB       | A              | M1                | 1             | 1            | 20.000         | 0.239                      | 34                  | 0.0070         | INTERLAMINAR SHEAR |
| HFIQA11HB       | A              | M1                | 1             | 1            | 21.120         | 0.241                      | 34                  | 0.0071         | INTERLAMINAR SHEAR |
| HFIQA214B       | A              | M2                | 1             | 2            | 21.244         | 0.255                      | 34                  | 0.0075         | INTERLAMINAR SHEAR |
| HFIQA215B       | A              | M2                | 1             | 2            | 21.257         | 0.258                      | 34                  | 0.0076         | INTERLAMINAR SHEAR |
| HFIQA216B       | A              | M2                | 1             | 2            | 21.148         | 0.257                      | 34                  | 0.0075         | INTERLAMINAR SHEAR |
| HFIQB11DB       | B              | M1                | 2             | 1            | 19.680         | 0.253                      | 34                  | 0.0074         | INTERLAMINAR SHEAR |
| HFIQB11EB       | B              | M1                | 2             | 1            | 21.135         | 0.257                      | 34                  | 0.0075         | INTERLAMINAR SHEAR |
| HFIQB11FB       | B              | M1                | 2             | 1            | 21.188         | 0.255                      | 34                  | 0.0075         | INTERLAMINAR SHEAR |
| HFIQB217B       | B              | M2                | 2             | 2            | 20.735         | 0.247                      | 34                  | 0.0073         | INTERLAMINAR SHEAR |
| HFIQB21DB       | B              | M2                | 2             | 2            | 21.155         | 0.248                      | 34                  | 0.0073         | INTERLAMINAR SHEAR |
| HFIQB21GB       | B              | M2                | 2             | 2            | 22.130         | 0.244                      | 34                  | 0.0072         | INTERLAMINAR SHEAR |
| HFIQC114B       | C              | M1                | 3             | 1            | 20.907         | 0.253                      | 34                  | 0.0074         | INTERLAMINAR SHEAR |
| HFIQC115B       | C              | M1                | 3             | 1            | 20.787         | 0.259                      | 34                  | 0.0076         | INTERLAMINAR SHEAR |
| HFIQC116B       | C              | M1                | 3             | 1            | 20.868         | 0.259                      | 34                  | 0.0076         | INTERLAMINAR SHEAR |
| HFIQC215B       | C              | M2                | 3             | 2            | 20.492         | 0.251                      | 34                  | 0.0074         | INTERLAMINAR SHEAR |
| HFIQC216B       | C              | M2                | 3             | 2            | 21.548         | 0.250                      | 34                  | 0.0074         | INTERLAMINAR SHEAR |
| HFIQC21DB       | C              | M2                | 3             | 2            | 22.577         | 0.256                      | 34                  | 0.0075         | INTERLAMINAR SHEAR |

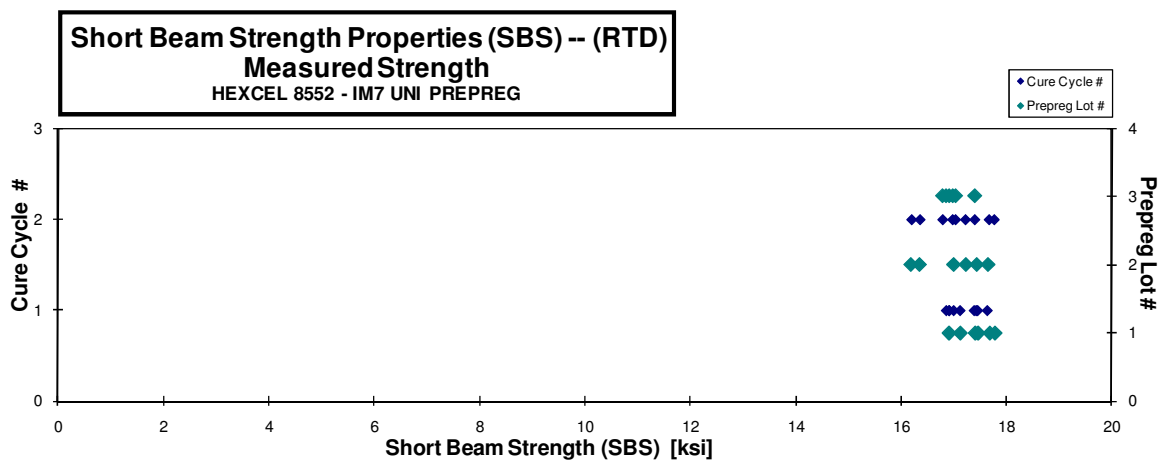
|                    |        |                    |        |
|--------------------|--------|--------------------|--------|
| Average            | 21.043 | Average            | 0.0074 |
| Standard Dev.      | 0.642  | Standard Dev.      |        |
| Coeff. of Var. [%] | 3.053  | Coeff. of Var. [%] |        |
| Min.               | 19.680 | Min.               | 0.0070 |
| Max.               | 22.577 | Max.               | 0.0076 |
| Number of Spec.    | 19     | Number of Spec.    | 19     |



**Short Beam Strength Properties (SBS) -- (RTD)**  
**Strength**  
 HEXCEL 8552 - IM7 UNI PREPREG

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Avg. Specimen Thickn. [in] | # Plies in Laminate | Avg. tply [in] | Failure Mode       |
|-----------------|----------------|-------------------|---------------|--------------|----------------|----------------------------|---------------------|----------------|--------------------|
| HFIQA112A       | A              | M1                | 1             | 1            | 17.128         | 0.224                      | 34                  | 0.0066         | INTERLAMINAR SHEAR |
| HFIQA119A       | A              | M1                | 1             | 1            | 17.463         | 0.228                      | 34                  | 0.0067         | INTERLAMINAR SHEAR |
| HFIQA11BA       | A              | M1                | 1             | 1            | 16.916         | 0.223                      | 34                  | 0.0066         | INTERLAMINAR SHEAR |
| HFIQA211A       | A              | M2                | 1             | 2            | 17.780         | 0.225                      | 34                  | 0.0066         | INTERLAMINAR SHEAR |
| HFIQA21BA       | A              | M2                | 1             | 2            | 17.682         | 0.227                      | 34                  | 0.0067         | INTERLAMINAR SHEAR |
| HFIQA21HA       | A              | M2                | 1             | 2            | 17.409         | 0.229                      | 34                  | 0.0067         | INTERLAMINAR SHEAR |
| HFIQB113A       | B              | M1                | 2             | 1            | 17.649         | 0.231                      | 34                  | 0.0068         | INTERLAMINAR SHEAR |
| HFIQB117A       | B              | M1                | 2             | 1            | 17.436         | 0.234                      | 34                  | 0.0069         | INTERLAMINAR SHEAR |
| HFIQB11BA       | B              | M1                | 2             | 1            | 17.002         | 0.230                      | 34                  | 0.0068         | INTERLAMINAR SHEAR |
| HFIQB213A       | B              | M2                | 2             | 2            | 17.233         | 0.243                      | 34                  | 0.0071         | INTERLAMINAR SHEAR |
| HFIQB218A       | B              | M2                | 2             | 2            | 16.360         | 0.237                      | 34                  | 0.0070         | INTERLAMINAR SHEAR |
| HFIQB21CA       | B              | M2                | 2             | 2            | 16.198         | 0.240                      | 34                  | 0.0071         | INTERLAMINAR SHEAR |
| HFIQC112A       | C              | M1                | 3             | 1            | 16.861         | 0.225                      | 34                  | 0.0066         | INTERLAMINAR SHEAR |
| HFIQC119A       | C              | M1                | 3             | 1            | 16.919         | 0.223                      | 34                  | 0.0066         | INTERLAMINAR SHEAR |
| HFIQC11HA       | C              | M1                | 3             | 1            | 17.398         | 0.227                      | 34                  | 0.0067         | INTERLAMINAR SHEAR |
| HFIQC21EA       | C              | M2                | 3             | 2            | 16.984         | 0.261                      | 34                  | 0.0077         | INTERLAMINAR SHEAR |
| HFIQC21FA       | C              | M2                | 3             | 2            | 17.039         | 0.262                      | 34                  | 0.0077         | INTERLAMINAR SHEAR |
| HFIQC21GA       | C              | M2                | 3             | 2            | 16.794         | 0.258                      | 34                  | 0.0076         | INTERLAMINAR SHEAR |

|                    |        |                    |        |
|--------------------|--------|--------------------|--------|
| Average            | 17.125 | Average            | 0.0069 |
| Standard Dev.      | 0.430  | Standard Dev.      |        |
| Coeff. of Var. [%] | 2.511  | Coeff. of Var. [%] |        |
| Min.               | 16.198 | Min.               | 0.0066 |
| Max.               | 17.780 | Max.               | 0.0077 |
| Number of Spec.    | 18     | Number of Spec.    | 18     |

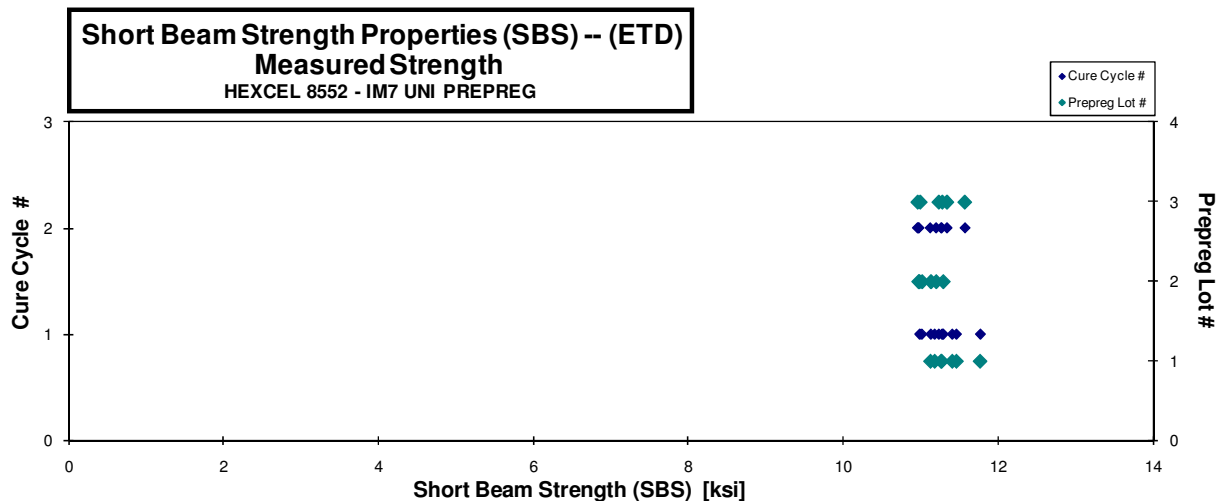


**Short Beam Strength Properties (SBS) -- (ETD)**  
**Strength**  
 HEXCEL 8552 - IM7 UNI PREPREG

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle Batch # | Strength [ksi] | Avg. Specimen Thickn. [in] | # Plies in Laminate | Avg. tply [in] | Failure Mode       |
|-----------------|----------------|-------------------|---------------|--------------------|----------------|----------------------------|---------------------|----------------|--------------------|
| HFIQA114C       | A              | M1                | 1             | 1                  | 11.181         | 0.247                      | 34                  | 0.0073         | INTERLAMINAR SHEAR |
| HFIQA117C       | A              | M1                | 1             | 1                  | 11.775         | 0.245                      | 34                  | 0.0072         | INTERLAMINAR SHEAR |
| HFIQA11DC       | A              | M1                | 1             | 1                  | 11.465         | 0.248                      | 34                  | 0.0073         | INTERLAMINAR SHEAR |
| HFIQA11GC       | A              | M1                | 1             | 1                  | 11.411         | 0.248                      | 34                  | 0.0073         | INTERLAMINAR SHEAR |
| HFIQA212C       | A              | M2                | 1             | 2                  | 11.125         | 0.237                      | 34                  | 0.0070         | INTERLAMINAR SHEAR |
| HFIQA21CC       | A              | M2                | 1             | 2                  | 11.264         | 0.237                      | 34                  | 0.0070         | INTERLAMINAR SHEAR |
| HFIQA21GC       | A              | M2                | 1             | 2                  | 11.273         | 0.238                      | 34                  | 0.0070         | INTERLAMINAR SHEAR |
| HFIQB112C       | B              | M1                | 2             | 1                  | 11.293         | 0.220                      | 34                  | 0.0065         | INTERLAMINAR SHEAR |
| HFIQB118C       | B              | M1                | 2             | 1                  | 11.015         | 0.224                      | 34                  | 0.0066         | INTERLAMINAR SHEAR |
| HFIQB111C       | B              | M1                | 2             | 1                  | 11.132         | 0.222                      | 34                  | 0.0065         | INTERLAMINAR SHEAR |
| HFIQB219C       | B              | M2                | 2             | 2                  | 11.201         | 0.224                      | 34                  | 0.0066         | INTERLAMINAR SHEAR |
| HFIQB21BC       | B              | M2                | 2             | 2                  | 10.980         | 0.228                      | 34                  | 0.0067         | INTERLAMINAR SHEAR |
| HFIQB211C       | B              | M2                | 2             | 2                  | 10.970         | 0.222                      | 34                  | 0.0065         | INTERLAMINAR SHEAR |
| HFIQC117C       | C              | M1                | 3             | 1                  | 10.989         | 0.252                      | 34                  | 0.0074         | INTERLAMINAR SHEAR |
| HFIQC11EC       | C              | M1                | 3             | 1                  | 11.235         | 0.248                      | 34                  | 0.0073         | INTERLAMINAR SHEAR |
| HFIQC11FC       | C              | M1                | 3             | 1                  | 11.279         | 0.247                      | 34                  | 0.0073         | INTERLAMINAR SHEAR |
| HFIQC214C       | C              | M2                | 3             | 2                  | 11.576         | 0.245                      | 34                  | 0.0072         | INTERLAMINAR SHEAR |
| HFIQC217C       | C              | M2                | 3             | 2                  | 11.341         | 0.245                      | 34                  | 0.0072         | INTERLAMINAR SHEAR |
| HFIQC21CC       | C              | M2                | 3             | 2                  | 10.958         | 0.247                      | 34                  | 0.0073         | INTERLAMINAR SHEAR |

Average 11.235  
 Standard Dev. 0.218  
 Coeff. of Var. [%] 1.944  
 Min. 10.958  
 Max. 11.775  
 Number of Spec. 19

Average 0.0070  
 Standard Dev. 0.0065  
 Coeff. of Var. [%] 0.0074  
 Min. 0.0065  
 Max. 0.0074  
 Number of Spec. 19

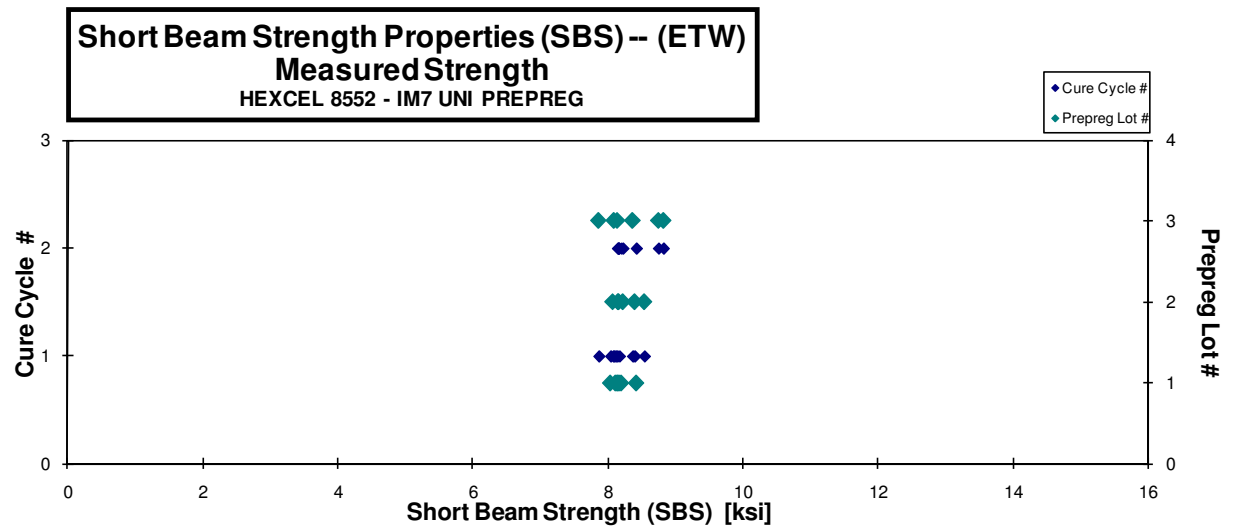




**Short Beam Shear Properties (SBS) -- (ETW)**  
**Measured Strength**  
 HEXCEL 8552 - IM7 UNI PREPREG

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Avg. Specimen Thckn. [in] | # Plies in Laminate | Avg. tply [in] | Failure Mode                     |
|-----------------|----------------|-------------------|---------------|--------------|----------------|---------------------------|---------------------|----------------|----------------------------------|
| HFIQA115D       | A              | M1                | 1             | 1            | 8.113          | 0.251                     | 34                  | 0.0074         | COMPRESSION / INTERLAMINAR SHEAR |
| HFIQA116D       | A              | M1                | 1             | 1            | 8.038          | 0.249                     | 34                  | 0.0073         | COMPRESSION / INTERLAMINAR SHEAR |
| HFIQA11ED       | A              | M1                | 1             | 1            | 8.169          | 0.253                     | 34                  | 0.0074         | COMPRESSION / INTERLAMINAR SHEAR |
| HFIQA11FD       | A              | M1                | 1             | 1            | 8.137          | 0.252                     | 34                  | 0.0074         | COMPRESSION / INTERLAMINAR SHEAR |
| HFIQA21DD       | A              | M2                | 1             | 2            | 8.419          | 0.244                     | 34                  | 0.0072         | COMPRESSION / INTERLAMINAR SHEAR |
| HFIQA21ED       | A              | M2                | 1             | 2            | 8.151          | 0.247                     | 34                  | 0.0073         | COMPRESSION / INTERLAMINAR SHEAR |
| HFIQA21FD       | A              | M2                | 1             | 2            | 8.198          | 0.246                     | 34                  | 0.0072         | COMPRESSION / INTERLAMINAR SHEAR |
| HFIQB115D       | B              | M1                | 2             | 1            | 8.538          | 0.244                     | 34                  | 0.0072         | COMPRESSION / INTERLAMINAR SHEAR |
| HFIQB116D       | B              | M1                | 2             | 1            | 8.395          | 0.241                     | 34                  | 0.0071         | COMPRESSION / INTERLAMINAR SHEAR |
| HFIQB11CD       | B              | M1                | 2             | 1            | 8.074          | 0.244                     | 34                  | 0.0072         | COMPRESSION / INTERLAMINAR SHEAR |
| HFIQB214D       | B              | M2                | 2             | 2            | 8.161          | 0.251                     | 34                  | 0.0074         | COMPRESSION / INTERLAMINAR SHEAR |
| HFIQB21ED       | B              | M2                | 2             | 2            | 8.151          | 0.251                     | 34                  | 0.0074         | COMPRESSION / INTERLAMINAR SHEAR |
| HFIQB21FD       | B              | M2                | 2             | 2            | 8.222          | 0.250                     | 34                  | 0.0074         | COMPRESSION / INTERLAMINAR SHEAR |
| HFIQC113D       | C              | M1                | 3             | 1            | 8.091          | 0.241                     | 34                  | 0.0071         | COMPRESSION / INTERLAMINAR SHEAR |
| HFIQC118D       | C              | M1                | 3             | 1            | 7.863          | 0.240                     | 34                  | 0.0071         | COMPRESSION / INTERLAMINAR SHEAR |
| HFIQC11DD       | C              | M1                | 3             | 1            | 8.364          | 0.242                     | 34                  | 0.0071         | COMPRESSION / INTERLAMINAR SHEAR |
| HFIQC213D       | C              | M2                | 3             | 2            | 8.820          | 0.236                     | 34                  | 0.0069         | COMPRESSION / INTERLAMINAR SHEAR |
| HFIQC218D       | C              | M2                | 3             | 2            | 8.748          | 0.237                     | 34                  | 0.0070         | COMPRESSION / INTERLAMINAR SHEAR |
| HFIQC21BD       | C              | M2                | 3             | 2            | 8.140          | 0.236                     | 34                  | 0.0069         | COMPRESSION / INTERLAMINAR SHEAR |

|                    |       |                    |        |
|--------------------|-------|--------------------|--------|
| Average            | 8.252 | Average            | 0.0072 |
| Standard Dev.      | 0.242 | Standard Dev.      |        |
| Coeff. of Var. [%] | 2.927 | Coeff. of Var. [%] |        |
| Min.               | 7.863 | Min.               | 0.0069 |
| Max.               | 8.820 | Max.               | 0.0074 |
| Number of Spec.    | 19    | Number of Spec.    | 19     |



## 4.16 Open Hole Tension 1 Properties

### Laminate Open Hole Tension Properties (OHT1) -- (CTD) Strength HEXCEL 8552 - IM7 UNI PREPREG

normalizing  $t_{ply}$   
[in]  
0.0072

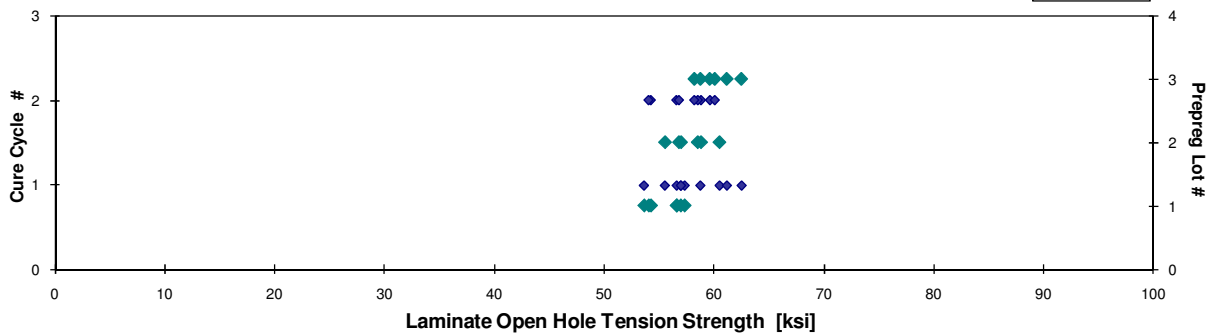
| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Avg. Specimen Thckn. [in] | # Plies in Laminate | Failure Modes |
|-----------------|----------------|-------------------|---------------|--------------|----------------|---------------------------|---------------------|---------------|
| HFIDA116B       | A              | M1                | 1             | 1            | 56.265         | 0.117                     | 16                  | MGM           |
| HFIDA117B       | A              | M1                | 1             | 1            | 55.416         | 0.118                     | 16                  | MGM           |
| HFIDA118B       | A              | M1                | 1             | 1            | 57.519         | 0.115                     | 16                  | MGM           |
| HFIDA119B       | A              | M1                | 1             | 1            | 54.997         | 0.112                     | 16                  | MGM           |
| HFIDA216B       | A              | M2                | 1             | 2            | 53.305         | 0.117                     | 16                  | MGM           |
| HFIDA217B       | A              | M2                | 1             | 2            | 55.545         | 0.117                     | 16                  | MGM           |
| HFIDA218B       | A              | M2                | 1             | 2            | 53.271         | 0.117                     | 16                  | MGM           |
| HFIDB115B       | B              | M1                | 2             | 1            | 56.508         | 0.116                     | 16                  | MGM           |
| HFIDB116B       | B              | M1                | 2             | 1            | 55.718         | 0.115                     | 16                  | MGM           |
| HFIDB117B       | B              | M1                | 2             | 1            | 58.780         | 0.119                     | 16                  | MGM           |
| HFIDB216B       | B              | M2                | 2             | 2            | 59.065         | 0.115                     | 16                  | MGM           |
| HFIDB217B       | B              | M2                | 2             | 2            | 58.040         | 0.116                     | 16                  | MGM           |
| HFIDB218B       | B              | M2                | 2             | 2            | 57.482         | 0.114                     | 16                  | MGM           |
| HFIDC116B       | C              | M1                | 3             | 1            | 60.750         | 0.116                     | 16                  | MGM           |
| HFIDC117B       | C              | M1                | 3             | 1            | 61.668         | 0.117                     | 16                  | MGM           |
| HFIDC118B       | C              | M1                | 3             | 1            | 58.242         | 0.116                     | 16                  | MGM           |
| HFIDC216B       | C              | M2                | 3             | 2            | 58.836         | 0.117                     | 16                  | MGM           |
| HFIDC217B       | C              | M2                | 3             | 2            | 59.173         | 0.117                     | 16                  | MGM           |
| HFIDC218B       | C              | M2                | 3             | 2            | 57.662         | 0.116                     | 16                  | MGM           |

| Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] |
|---------------------|--------------------------------|
| 0.0073              | 57.006                         |
| 0.0074              | 56.635                         |
| 0.0072              | 57.344                         |
| 0.0070              | 53.645                         |
| 0.0073              | 54.269                         |
| 0.0073              | 56.598                         |
| 0.0073              | 54.073                         |
| 0.0073              | 57.015                         |
| 0.0072              | 55.549                         |
| 0.0074              | 60.531                         |
| 0.0072              | 58.843                         |
| 0.0073              | 58.544                         |
| 0.0071              | 56.825                         |
| 0.0073              | 61.190                         |
| 0.0073              | 62.524                         |
| 0.0073              | 58.781                         |
| 0.0073              | 59.645                         |
| 0.0073              | 60.089                         |
| 0.0073              | 58.229                         |

Average 57.276  
Standard Dev. 2.262  
Coeff. of Var. [%] 3.950  
Min. 53.271  
Max. 61.668  
Number of Spec. 19

Average<sub>norm</sub> 0.0073 57.754  
Standard Dev<sub>norm</sub> 2.433  
Coeff. of Var. [%]<sub>norm</sub> 4.213  
Min. 0.0070 53.645  
Max. 0.0074 62.524  
Number of Spec. 19 19

### Laminate Open Hole Tension Properties (OHT1) -- (CTD) Normalized Strength HEXCEL 8552 - IM7 UNI PREPREG



**Laminate Open Hole Tension Properties (OHT1) -- (RTD)**  
**Strength**  
 HEXCEL 8552 - IM7 UNI PREPREG

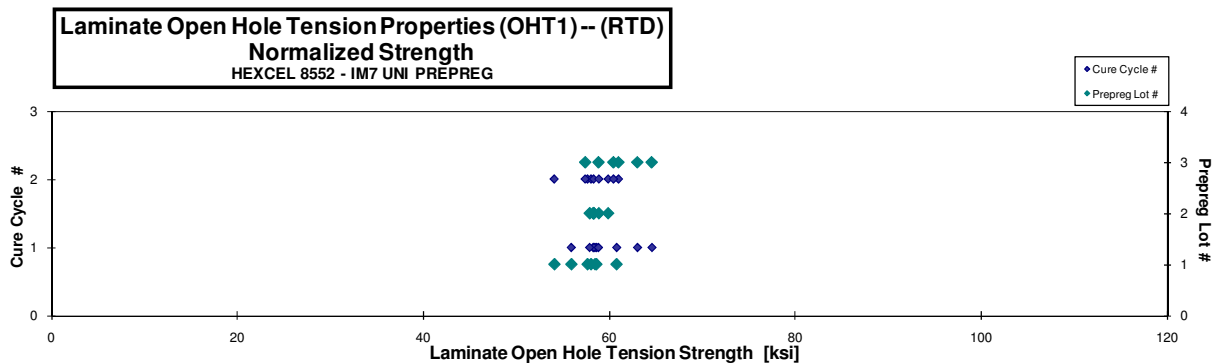
normalizing  $t_{ply}$   
 [in]  
 0.0072

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Avg. Specimen Thckn. [in] | # Plies in Laminate | Failure Modes |
|-----------------|----------------|-------------------|---------------|--------------|----------------|---------------------------|---------------------|---------------|
| HFIDA111A       | A              | M1                | 1             | 1            | 57.333         | 0.112                     | 16                  | MGM           |
| HFIDA112A       | A              | M1                | 1             | 1            | 57.225         | 0.118                     | 16                  | MGM           |
| HFIDA113A       | A              | M1                | 1             | 1            | 57.430         | 0.117                     | 16                  | MGM           |
| HFIDA114A       | A              | M1                | 1             | 1            | 59.787         | 0.117                     | 16                  | MGM           |
| HFIDA211A       | A              | M2                | 1             | 2            | 53.318         | 0.117                     | 16                  | MGM           |
| HFIDA212A       | A              | M2                | 1             | 2            | 56.126         | 0.118                     | 16                  | MGM           |
| HFIDA213A       | A              | M2                | 1             | 2            | 56.851         | 0.118                     | 16                  | MGM           |
| HFIDB111A       | B              | M1                | 2             | 1            | 58.569         | 0.115                     | 16                  | MGM           |
| HFIDB112A       | B              | M1                | 2             | 1            | 57.566         | 0.117                     | 16                  | MGM           |
| HFIDB113A       | B              | M1                | 2             | 1            | 57.722         | 0.116                     | 16                  | MGM           |
| HFIDB211A       | B              | M2                | 2             | 2            | 59.861         | 0.112                     | 16                  | MGM           |
| HFIDB212A       | B              | M2                | 2             | 2            | 58.439         | 0.116                     | 16                  | MGM           |
| HFIDB213A       | B              | M2                | 2             | 2            | 60.377         | 0.114                     | 16                  | MGM           |
| HFIDC111A       | C              | M1                | 3             | 1            | 59.887         | 0.113                     | 16                  | MGM           |
| HFIDC112A       | C              | M1                | 3             | 1            | 62.217         | 0.117                     | 16                  | MGM           |
| HFIDC113A       | C              | M1                | 3             | 1            | 64.442         | 0.116                     | 16                  | MGM           |
| HFIDC211A       | C              | M2                | 3             | 2            | 58.071         | 0.114                     | 16                  | MGM           |
| HFIDC212A       | C              | M2                | 3             | 2            | 59.987         | 0.117                     | 16                  | MGM           |
| HFIDC213A       | C              | M2                | 3             | 2            | 60.004         | 0.116                     | 16                  | MGM           |

| Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] |
|---------------------|--------------------------------|
| 0.0070              | 55.956                         |
| 0.0074              | 58.649                         |
| 0.0073              | 58.502                         |
| 0.0073              | 60.825                         |
| 0.0073              | 54.120                         |
| 0.0074              | 57.693                         |
| 0.0074              | 58.068                         |
| 0.0072              | 58.298                         |
| 0.0073              | 58.382                         |
| 0.0072              | 57.922                         |
| 0.0070              | 58.345                         |
| 0.0073              | 58.912                         |
| 0.0071              | 59.915                         |
| 0.0071              | 58.865                         |
| 0.0073              | 63.063                         |
| 0.0072              | 64.610                         |
| 0.0071              | 57.440                         |
| 0.0073              | 61.020                         |
| 0.0073              | 60.481                         |

Average 58.695  
 Standard Dev. 2.390  
 Coeff. of Var. [%] 4.072  
 Min. 53.318  
 Max. 64.442  
 Number of Spec. 19

Average<sub>norm</sub> 0.00724 59.003  
 Standard Dev.<sub>norm</sub> 2.350  
 Coeff. of Var. [%]<sub>norm</sub> 3.982  
 Min. 0.0070 54.120  
 Max. 0.0074 64.610  
 Number of Spec. 19 19



**Laminate Open Hole Tension Properties (OHT1)-- (ETW)**  
**Strength**  
 HEXCEL 8552 - IM7 UNI PREPREG

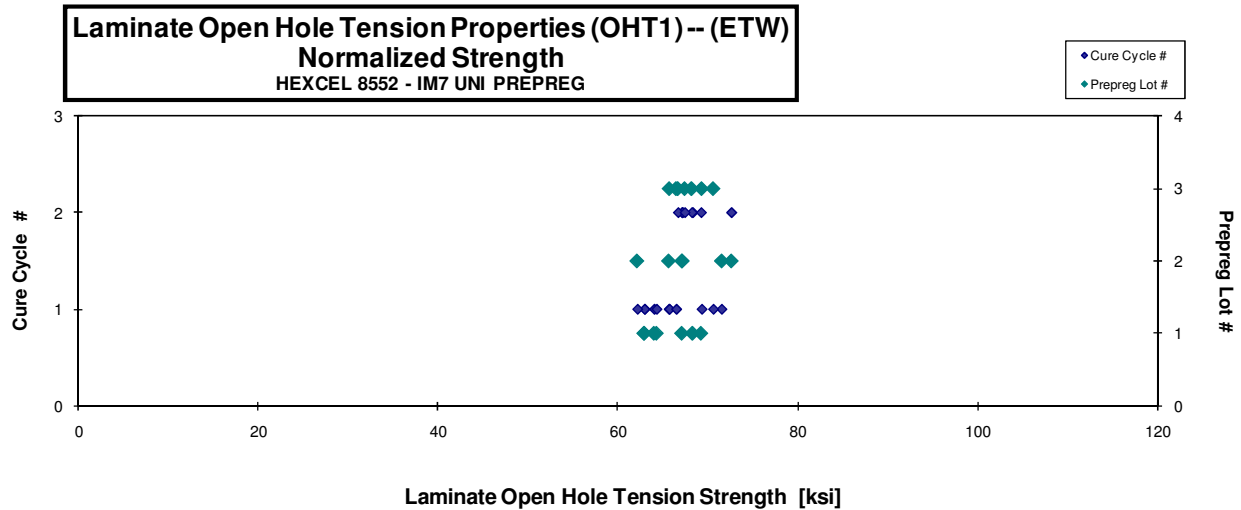
| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Avg. Specimen Thckn. [in] | # Plies in Laminate | Failure Modes |
|-----------------|----------------|-------------------|---------------|--------------|----------------|---------------------------|---------------------|---------------|
| HFIDA11BD       | A              | M1                | 1             | 1            | 63.475         | 0.116                     | 16                  | AGM           |
| HFIDA11CD       | A              | M1                | 1             | 1            | 62.272         | 0.116                     | 16                  | AGM           |
| HFIDA11DD       | A              | M1                | 1             | 1            | 62.206         | 0.117                     | 16                  | AGM           |
| HFIDA11ED       | A              | M1                | 1             | 1            | 63.863         | 0.116                     | 16                  | AGM           |
| HFIDA21BD       | A              | M2                | 1             | 2            | 66.003         | 0.117                     | 16                  | AGM           |
| HFIDA21CD       | A              | M2                | 1             | 2            | 67.056         | 0.117                     | 16                  | MGM           |
| HFIDA21DD       | A              | M2                | 1             | 2            | 67.795         | 0.118                     | 16                  | AGM           |
| HFIDB119D       | B              | M1                | 2             | 1            | 63.402         | 0.113                     | 16                  | AGM           |
| HFIDB11AD       | B              | M1                | 2             | 1            | 65.212         | 0.116                     | 16                  | AGM           |
| HFIDB11BD       | B              | M1                | 2             | 1            | 71.042         | 0.116                     | 16                  | MGM           |
| HFIDB21BD       | B              | M2                | 2             | 2            | 73.233         | 0.114                     | 16                  | AGM           |
| HFIDB21CD       | B              | M2                | 2             | 2            | 67.200         | 0.115                     | 16                  | AGM           |
| HFIDB21DD       | B              | M2                | 2             | 2            | 67.239         | 0.115                     | 16                  | AGM           |
| HFIDC11BD       | C              | M1                | 3             | 1            | 65.357         | 0.116                     | 16                  | AGM           |
| HFIDC11CD       | C              | M1                | 3             | 1            | 69.942         | 0.116                     | 16                  | AGM           |
| HFIDC11DD       | C              | M1                | 3             | 1            | 68.968         | 0.116                     | 16                  | AGM           |
| HFIDC11FD       | C              | M1                | 3             | 1            | 65.533         | 0.117                     | 16                  | MGM           |
| HFIDC21BD       | C              | M2                | 3             | 2            | 67.346         | 0.117                     | 16                  | AGM           |
| HFIDC21CD       | C              | M2                | 3             | 2            | 65.625         | 0.117                     | 16                  | AGM           |
| HFIDC21DD       | C              | M2                | 3             | 2            | 66.795         | 0.116                     | 16                  | AGM           |

normalizing  $t_{ply}$   
 [in]  
 0.0072

| Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] |
|---------------------|--------------------------------|
| 0.0073              | 64.017                         |
| 0.0073              | 62.966                         |
| 0.0073              | 62.926                         |
| 0.0072              | 64.297                         |
| 0.0073              | 67.092                         |
| 0.0073              | 68.288                         |
| 0.0074              | 69.218                         |
| 0.0071              | 62.154                         |
| 0.0072              | 65.656                         |
| 0.0072              | 71.515                         |
| 0.0071              | 72.587                         |
| 0.0072              | 67.152                         |
| 0.0072              | 67.141                         |
| 0.0072              | 65.716                         |
| 0.0073              | 70.579                         |
| 0.0072              | 69.297                         |
| 0.0073              | 66.472                         |
| 0.0073              | 68.184                         |
| 0.0073              | 66.660                         |
| 0.0073              | 67.413                         |

Average 66.478  
 Standard Dev. 2.853  
 Coeff. of Var. [%] 4.292  
 Min. 62.206  
 Max. 73.233  
 Number of Spec. 20

Average<sub>norm</sub> 0.0073 66.966  
 Standard Dev.<sub>norm</sub> 2.850  
 Coeff. of Var. [%]<sub>norm</sub> 4.255  
 Min. 0.0071 62.154  
 Max. 0.0074 72.587  
 Number of Spec. 20



## 4.17 Open Hole Tension 2 Properties

**Laminate Open Hole Tension Properties (OHT2) -- (CTD)**  
**Strength**  
 HEXCEL 8552 - IM7 UNI PREPREG

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Avg. Specimen Thckn. [in] | # Plies in Laminate | Failure |
|-----------------|----------------|-------------------|---------------|--------------|----------------|---------------------------|---------------------|---------|
| HFIEA115B       | A              | M1                | 1             | 1            | 44.404         | 0.145                     | 20                  | AGM     |
| HFIEA116B       | A              | M1                | 1             | 1            | 45.649         | 0.146                     | 20                  | AGM     |
| HFIEA117B       | A              | M1                | 1             | 1            | 44.586         | 0.146                     | 20                  | AGM     |
| HFIEA118B       | A              | M1                | 1             | 1            | 45.233         | 0.146                     | 20                  | AGM     |
| HFIEA215B       | A              | M2                | 1             | 2            | 43.883         | 0.147                     | 20                  | AGM     |
| HFIEA216B       | A              | M2                | 1             | 2            | 44.158         | 0.146                     | 20                  | AGM     |
| HFIEA217B       | A              | M2                | 1             | 2            | 44.366         | 0.149                     | 20                  | AGM     |
| HFIEB115B       | B              | M1                | 2             | 1            | 45.728         | 0.144                     | 20                  | AGM     |
| HFIEB116B       | B              | M1                | 2             | 1            | 46.353         | 0.144                     | 20                  | AGM     |
| HFIEB117B       | B              | M1                | 2             | 1            | 45.119         | 0.145                     | 20                  | AGM     |
| HFIEB215B       | B              | M2                | 2             | 2            | 46.586         | 0.144                     | 20                  | AGM     |
| HFIEB216B       | B              | M2                | 2             | 2            | 46.601         | 0.143                     | 20                  | AGM     |
| HFIEB217B       | B              | M2                | 2             | 2            | 46.631         | 0.144                     | 20                  | AGM     |
| HFIEC115B       | C              | M1                | 3             | 1            | 45.492         | 0.139                     | 20                  | AGM     |
| HFIEC116B       | C              | M1                | 3             | 1            | 46.661         | 0.146                     | 20                  | AGM     |
| HFIEC117B       | C              | M1                | 3             | 1            | 47.025         | 0.144                     | 20                  | AGM     |
| HFIEC215B       | C              | M2                | 3             | 2            | 46.563         | 0.145                     | 20                  | AGM     |
| HFIEC216B       | C              | M2                | 3             | 2            | 46.288         | 0.145                     | 20                  | AGM     |
| HFIEC217B       | C              | M2                | 3             | 2            | 45.652         | 0.147                     | 20                  | AGM     |

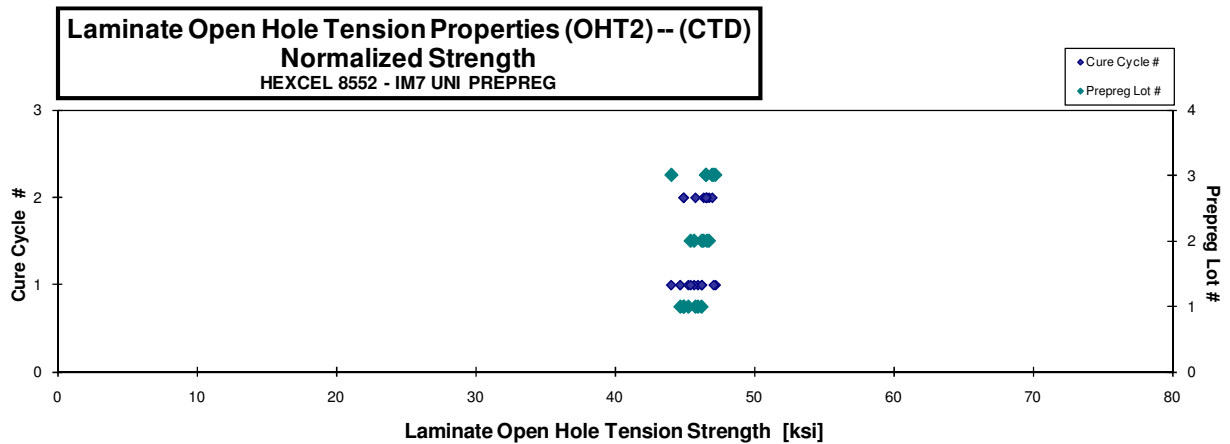
normalizing  $t_{ply}$   
 [in]

0.0072

| Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] |
|---------------------|--------------------------------|
| 0.0072              | 44.686                         |
| 0.0073              | 46.209                         |
| 0.0073              | 45.262                         |
| 0.0073              | 45.940                         |
| 0.0074              | 44.940                         |
| 0.0073              | 44.920                         |
| 0.0074              | 45.768                         |
| 0.0072              | 45.664                         |
| 0.0072              | 46.224                         |
| 0.0072              | 45.422                         |
| 0.0072              | 46.586                         |
| 0.0072              | 46.347                         |
| 0.0072              | 46.734                         |
| 0.0070              | 44.045                         |
| 0.0073              | 47.196                         |
| 0.0072              | 47.063                         |
| 0.0073              | 46.962                         |
| 0.0072              | 46.535                         |
| 0.0073              | 46.524                         |

Average 45.630  
 Standard Dev. 0.987  
 Coeff. of Var. [%] 2.164  
 Min. 43.883  
 Max. 47.025  
 Number of Spec. 19

Average<sub>norm</sub> 0.0073 45.949  
 Standard Dev.<sub>norm</sub> 0.881  
 Coeff. of Var. [%]<sub>norm</sub> 1.918  
 Min. 0.0070 44.045  
 Max. 0.0074 47.196  
 Number of Spec. 19 19



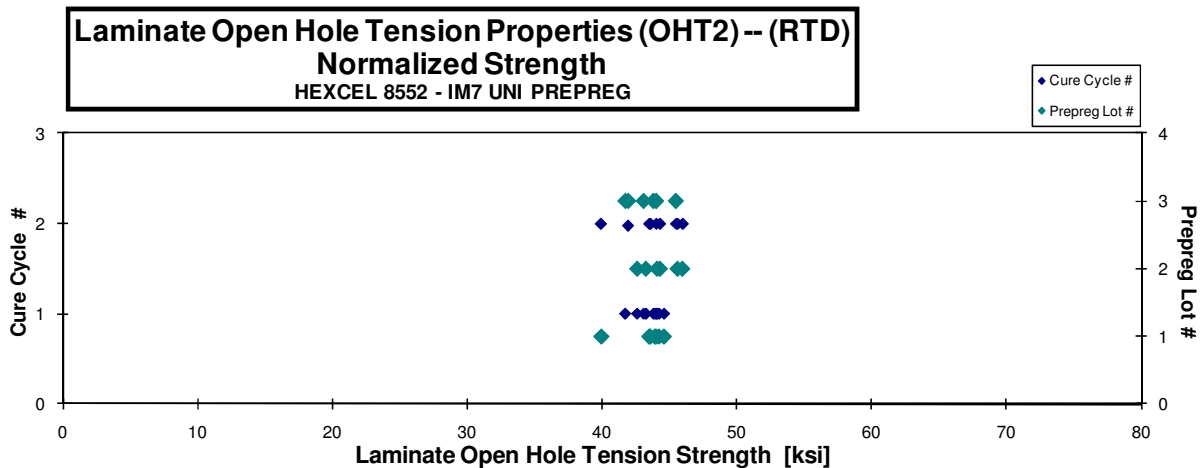
**Laminate Open Hole Tension Properties (OHT2) -- (RTD)**  
**Strength**  
 HEXCEL 8552 - IM7 UNI PREPREG

normalizing  $t_{ply}$   
 [in]  
 0.0072

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Avg. Specimen Thickn. [in] | # Plies in Laminate | Failure Modes | Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] |
|-----------------|----------------|-------------------|---------------|--------------|----------------|----------------------------|---------------------|---------------|---------------------|--------------------------------|
| HFIEA111A       | A              | M1                | 1             | 1            | 44.383         | 0.142                      | 20                  | AGM           | 0.0071              | 43.915                         |
| HFIEA112A       | A              | M1                | 1             | 1            | 43.792         | 0.147                      | 20                  | AGM           | 0.0073              | 44.583                         |
| HFIEA113A       | A              | M1                | 1             | 1            | 43.592         | 0.145                      | 20                  | AGM           | 0.0073              | 44.006                         |
| HFIEA114A       | A              | M1                | 1             | 1            | 43.843         | 0.145                      | 20                  | AGM           | 0.0073              | 44.218                         |
| HFIEA211A       | A              | M2                | 1             | 2            | 41.048         | 0.140                      | 20                  | AGM           | 0.0070              | 39.912                         |
| HFIEA212A       | A              | M2                | 1             | 2            | 42.213         | 0.149                      | 20                  | AGM           | 0.0074              | 43.571                         |
| HFIEA213A       | A              | M2                | 1             | 2            | 42.685         | 0.147                      | 20                  | AGM           | 0.0073              | 43.490                         |
| HFIEB111A       | B              | M1                | 2             | 1            | 42.668         | 0.144                      | 20                  | AGM           | 0.0072              | 42.589                         |
| HFIEB112A       | B              | M1                | 2             | 1            | 43.774         | 0.145                      | 20                  | AGM           | 0.0072              | 44.068                         |
| HFIEB113A       | B              | M1                | 2             | 1            | 43.345         | 0.144                      | 20                  | AGM           | 0.0072              | 43.240                         |
| HFIEB211A       | B              | M2                | 2             | 2            | 45.471         | 0.140                      | 20                  | AGM           | 0.0070              | 44.286                         |
| HFIEB212A       | B              | M2                | 2             | 2            | 45.720         | 0.145                      | 20                  | AGM           | 0.0072              | 45.958                         |
| HFIEB213A       | B              | M2                | 2             | 2            | 45.864         | 0.143                      | 20                  | AGM           | 0.0072              | 45.598                         |
| HFIEC111A       | C              | M1                | 3             | 1            | 42.805         | 0.140                      | 20                  | AGM           | 0.0070              | 41.705                         |
| HFIEC112A       | C              | M1                | 3             | 1            | 42.882         | 0.145                      | 20                  | AGM           | 0.0072              | 43.071                         |
| HFIEC113A       | C              | M1                | 3             | 1            | 43.976         | 0.143                      | 20                  | AGM           | 0.0072              | 43.798                         |
| HFIEC211A       | C              | M2                | 3             | 2            | 43.083         | 0.140                      | 20                  | AGM           | 0.0070              | 41.916                         |
| HFIEC212A       | C              | M2                | 3             | 2            | 44.403         | 0.147                      | 20                  | AGM           | 0.0074              | 45.472                         |
| HFIEC213A       | C              | M2                | 3             | 2            | 43.720         | 0.145                      | 20                  | AGM           | 0.0072              | 44.009                         |

Average 43.646  
 Standard Dev. 1.207  
 Coeff. of Var. [%] 2.766  
 Min. 41.048  
 Max. 45.864  
 Number of Spec. 19

Average<sub>norm</sub> 0.0072 43.653  
 Standard Dev.<sub>norm</sub> 1.433  
 Coeff. of Var. [%]<sub>norm</sub> 3.284  
 Min. 0.0070 39.912  
 Max. 0.0074 45.958  
 Number of Spec. 19



**Laminate Open Hole Tension Properties (OHT2) -- (ETW)**  
**Strength**  
 HEXCEL 8552 - IM7 UNI PREPREG

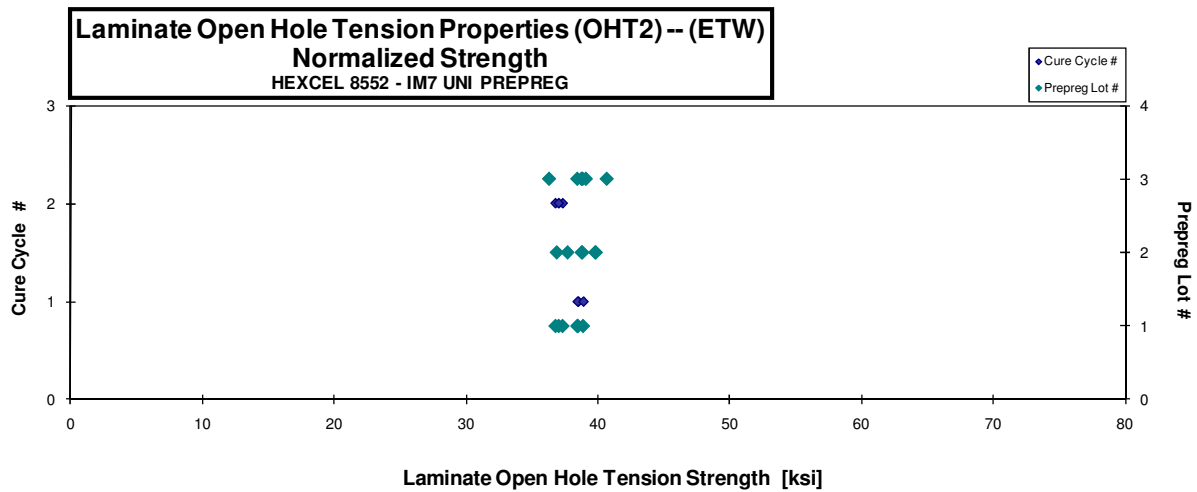
normalizing  $t_{ply}$   
 [in]  
 0.0072

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Avg. Specimen Thckn. [in] | # Plies in Laminate | Failure Modes |
|-----------------|----------------|-------------------|---------------|--------------|----------------|---------------------------|---------------------|---------------|
| HFIEA11AD       | A              | M1                | 1             | 1            | 38.273         | 0.145                     | 20                  | AGM           |
| HFIEA11BD       | A              | M1                | 1             | 1            | 37.898         | 0.146                     | 20                  | AGM           |
| HFIEA11CD       | A              | M1                | 1             | 1            | 38.398         | 0.146                     | 20                  | AGM           |
| HFIEA219DD      | A              | M2                | 1             | 2            | 36.182         | 0.146                     | 20                  | AGM           |
| HFIEA21AD       | A              | M2                | 1             | 2            | 36.377         | 0.148                     | 20                  | AGM           |
| HFIEA21BD       | A              | M2                | 1             | 2            | 36.605         | 0.146                     | 20                  | AGM           |
| HFIEB119D       | B              | M1                | 2             | 1            | 38.837         | 0.140                     | 20                  | AGM           |
| HFIEB11AD       | B              | M1                | 2             | 1            | 39.577         | 0.145                     | 20                  | LGM           |
| HFIEB11BD       | B              | M1                | 2             | 1            | 39.010         | 0.143                     | 20                  | LGM           |
| HFIEB218D       | B              | M2                | 2             | 2            | 37.223         | 0.143                     | 20                  | AGM           |
| HFIEB219D       | B              | M2                | 2             | 2            | 38.589         | 0.145                     | 20                  | AGM           |
| HFIEB21AD       | B              | M2                | 2             | 2            | 40.019         | 0.143                     | 20                  | AGM           |
| HFIEC118D       | C              | M1                | 3             | 1            | 39.249         | 0.143                     | 20                  | AGM           |
| HFIEC119D       | C              | M1                | 3             | 1            | 38.575         | 0.144                     | 20                  | AGM           |
| HFIEC11AD       | C              | M1                | 3             | 1            | 38.907         | 0.144                     | 20                  | AGM           |
| HFIEC218D       | C              | M2                | 3             | 2            | 39.152         | 0.143                     | 20                  | AGM           |
| HFIEC219D       | C              | M2                | 3             | 2            | 37.182         | 0.140                     | 20                  | AGM           |
| HFIEC21AD       | C              | M2                | 3             | 2            | 40.037         | 0.146                     | 20                  | AGM           |

| Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] |
|---------------------|--------------------------------|
| 0.0072              | 38.499                         |
| 0.0073              | 38.451                         |
| 0.0073              | 38.891                         |
| 0.0073              | 36.773                         |
| 0.0074              | 37.316                         |
| 0.0073              | 37.020                         |
| 0.0070              | 37.691                         |
| 0.0072              | 39.810                         |
| 0.0072              | 38.789                         |
| 0.0071              | 36.861                         |
| 0.0072              | 38.825                         |
| 0.0072              | 39.875                         |
| 0.0072              | 39.095                         |
| 0.0072              | 38.445                         |
| 0.0072              | 38.853                         |
| 0.0071              | 38.771                         |
| 0.0070              | 36.270                         |
| 0.0073              | 40.709                         |

Average 38.338  
 Standard Dev. 1.192  
 Coeff. of Var. [%] 3.110  
 Min. 36.182  
 Max. 40.037  
 Number of Spec. 18

Average<sub>norm</sub> 0.0072 38.386  
 Standard Dev.<sub>norm</sub> 1.189  
 Coeff. of Var. [%]<sub>norm</sub> 3.098  
 Min. 0.0070 36.270  
 Max. 0.0074 40.709  
 Number of Spec. 18





## 4.18 Open Hole Tension 3 Properties

**Laminate Open Hole Tension Properties (OHT3) -- (CTD)**  
**Strength**  
 HEXCEL 8552 - IM7 UNI PREPREG

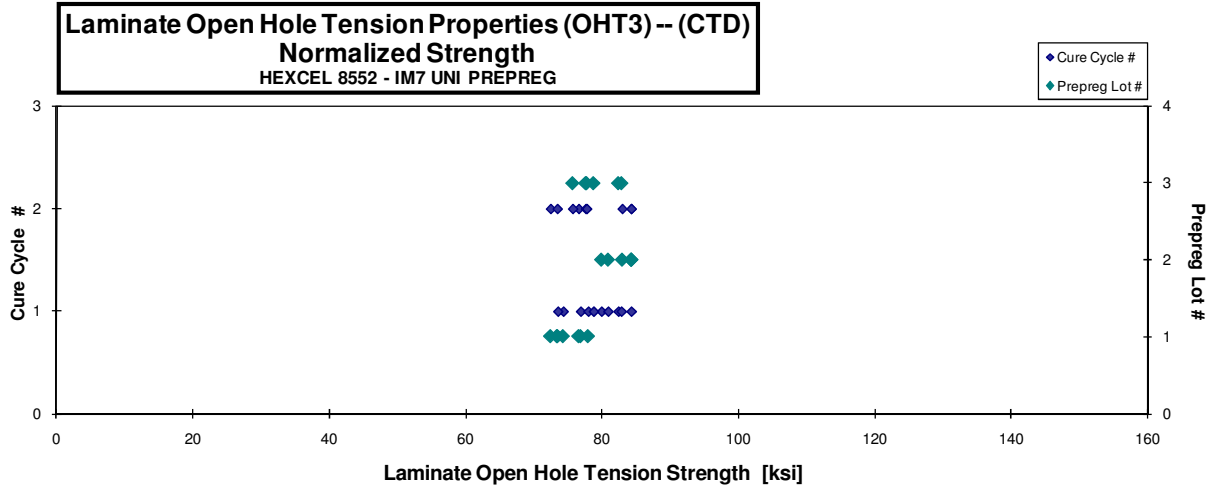
| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Avg. Specimen Thckn. [in] | # Plies in Laminate | Failure Mode |
|-----------------|----------------|-------------------|---------------|--------------|----------------|---------------------------|---------------------|--------------|
| HFIFA116B       | A              | M1                | 1             | 1            | 72.748         | 0.147                     | 20                  | AGM / LGM    |
| HFIFA117B       | A              | M1                | 1             | 1            | 71.330         | 0.148                     | 20                  | AGM / LGM    |
| HFIFA118B       | A              | M1                | 1             | 1            | 74.260         | 0.149                     | 20                  | AGM / LGM    |
| HFIFA119B       | A              | M1                | 1             | 1            | 75.999         | 0.148                     | 20                  | AGM / LGM    |
| HFIFA215B       | A              | M2                | 1             | 2            | 70.749         | 0.147                     | 20                  | AGM / LGM    |
| HFIFA216B       | A              | M2                | 1             | 2            | 74.477         | 0.148                     | 20                  | AGM / LGM    |
| HFIFA217B       | A              | M2                | 1             | 2            | 70.910         | 0.149                     | 20                  | AGM / LGM    |
| HFIFB115B       | B              | M1                | 2             | 1            | 84.181         | 0.144                     | 20                  | LGM / AGM    |
| HFIFB116B       | B              | M1                | 2             | 1            | 80.126         | 0.144                     | 20                  | AGM          |
| HFIFB117B       | B              | M1                | 2             | 1            | 80.709         | 0.144                     | 20                  | LGM / AGM    |
| HFIFB214B       | B              | M2                | 2             | 2            | 82.090         | 0.146                     | 20                  | LGM / AGM    |
| HFIFB215B       | B              | M2                | 2             | 2            | 83.543         | 0.145                     | 20                  | LGM / AGM    |
| HFIFB216B       | B              | M2                | 2             | 2            | 84.377         | 0.144                     | 20                  | AGM          |
| HFIFC115B       | C              | M1                | 3             | 1            | 82.716         | 0.143                     | 20                  | LGM/AGM      |
| HFIFC116B       | C              | M1                | 3             | 1            | 83.049         | 0.144                     | 20                  | LGM          |
| HFIFC117B       | C              | M1                | 3             | 1            | 78.341         | 0.145                     | 20                  | AGM          |
| HFIFC215B       | C              | M2                | 3             | 2            | 76.176         | 0.143                     | 20                  | AGM/LGM      |
| HFIFC216B       | C              | M2                | 3             | 2            | 77.746         | 0.144                     | 20                  | AGM          |
| HFIFC217B       | C              | M2                | 3             | 2            | 77.844         | 0.144                     | 20                  | LGM          |

normalizing  $t_{ply}$   
 [in]  
 0.0072

| Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] |
|---------------------|--------------------------------|
| 0.0074              | 74.264                         |
| 0.0074              | 73.476                         |
| 0.0075              | 76.839                         |
| 0.0074              | 77.935                         |
| 0.0074              | 72.412                         |
| 0.0074              | 76.537                         |
| 0.0075              | 73.389                         |
| 0.0072              | 84.288                         |
| 0.0072              | 79.894                         |
| 0.0072              | 80.868                         |
| 0.0073              | 82.945                         |
| 0.0073              | 84.269                         |
| 0.0072              | 84.279                         |
| 0.0072              | 82.362                         |
| 0.0072              | 82.828                         |
| 0.0072              | 78.731                         |
| 0.0072              | 75.664                         |
| 0.0072              | 77.566                         |
| 0.0072              | 77.727                         |

Average 77.967  
 Standard Dev. 4.683  
 Coeff. of Var. [%] 6.006  
 Min. 70.749  
 Max. 84.377  
 Number of Spec. 19

Average<sub>norm</sub> 0.0073 78.751  
 Standard Dev.<sub>norm</sub> 3.964  
 Coeff. of Var. [%]<sub>norm</sub> 5.033  
 Min. 0.0072 72.412  
 Max. 0.0075 84.288  
 Number of Spec. 19 19



**Laminate Open Hole Tension Properties (OHT3) -- (RTD)**  
**Strength**  
 HEXCEL 8552 - IM7 UNI PREPREG

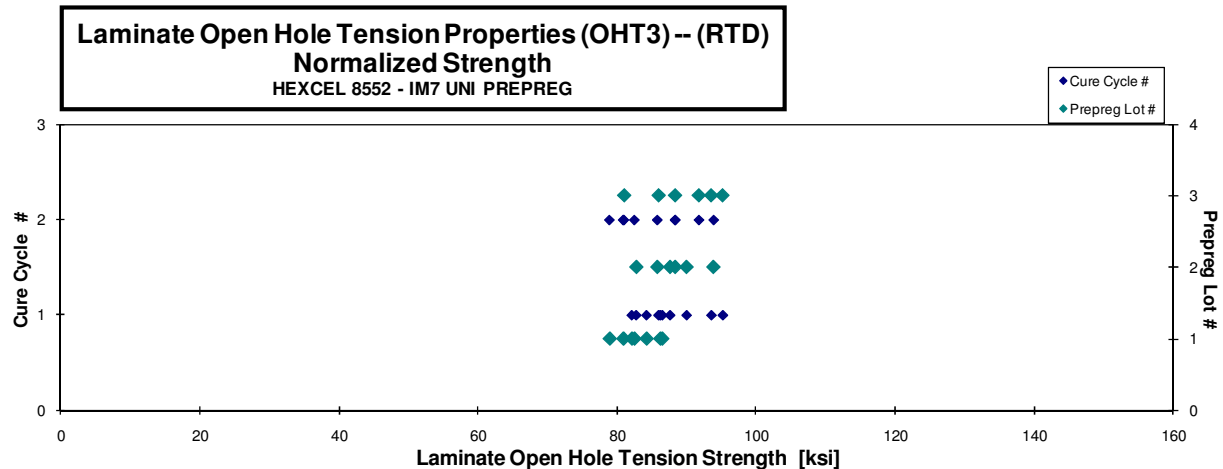
| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Avg. Specimen Thickn. [in] | # Plies in Laminate | Failure Mode |
|-----------------|----------------|-------------------|---------------|--------------|----------------|----------------------------|---------------------|--------------|
| HFIFA111A       | A              | M1                | 1             | 1            | 81.536         | 0.145                      | 20                  | LGM/AGM      |
| HFIFA112A       | A              | M1                | 1             | 1            | 81.570         | 0.149                      | 20                  | LGM          |
| HFIFA113A       | A              | M1                | 1             | 1            | 84.147         | 0.148                      | 20                  | LGM          |
| HFIFA114A       | A              | M1                | 1             | 1            | 83.870         | 0.148                      | 20                  | LGM/AGM      |
| HFIFA211A       | A              | M2                | 1             | 2            | 80.490         | 0.141                      | 20                  | LGM/AGM      |
| HFIFA212A       | A              | M2                | 1             | 2            | 79.778         | 0.149                      | 20                  | LGM          |
| HFIFA213A       | A              | M2                | 1             | 2            | 79.068         | 0.147                      | 20                  | LGM          |
| HFIFB111A       | B              | M1                | 2             | 1            | 89.781         | 0.133                      | 20                  | AGM          |
| HFIFB112A       | B              | M1                | 2             | 1            | 88.390         | 0.147                      | 20                  | AGM          |
| HFIFB113A       | B              | M1                | 2             | 1            | 88.177         | 0.143                      | 20                  | AGM / LGM    |
| HFIFB211A       | B              | M2                | 2             | 2            | 89.962         | 0.141                      | 20                  | AGM / LGM    |
| HFIFB212A       | B              | M2                | 2             | 2            | 93.126         | 0.145                      | 20                  | AGM / LGM    |
| HFIFB213A       | B              | M2                | 2             | 2            | 85.187         | 0.145                      | 20                  | AGM          |
| HFIFC111A       | C              | M1                | 3             | 1            | 89.951         | 0.138                      | 20                  | LGM / AGM    |
| HFIFC112A       | C              | M1                | 3             | 1            | 94.489         | 0.145                      | 20                  | LGM / AGM    |
| HFIFC113A       | C              | M1                | 3             | 1            | 94.135         | 0.143                      | 20                  | LGM / AGM    |
| HFIFC211A       | C              | M2                | 3             | 2            | 83.280         | 0.140                      | 20                  | LGM / AGM    |
| HFIFC212A       | C              | M2                | 3             | 2            | 87.504         | 0.145                      | 20                  | LGM / AGM    |
| HFIFC213A       | C              | M2                | 3             | 2            | 91.470         | 0.144                      | 20                  | LGM / AGM    |

normalizing  $t_{ply}$   
 [in]  
 0.0072

| Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] |
|---------------------|--------------------------------|
| 0.0073              | 82.103                         |
| 0.0074              | 84.213                         |
| 0.0074              | 86.484                         |
| 0.0074              | 86.200                         |
| 0.0071              | 78.897                         |
| 0.0074              | 82.475                         |
| 0.0074              | 80.880                         |
| 0.0066              | 82.735                         |
| 0.0073              | 89.976                         |
| 0.0072              | 87.595                         |
| 0.0071              | 88.328                         |
| 0.0073              | 93.859                         |
| 0.0072              | 85.768                         |
| 0.0069              | 85.953                         |
| 0.0073              | 95.167                         |
| 0.0072              | 93.536                         |
| 0.0070              | 80.977                         |
| 0.0073              | 88.324                         |
| 0.0072              | 91.746                         |

Average 86.627  
 Standard Dev. 4.958  
 Coeff. of Var. [%] 5.724  
 Min. 79.068  
 Max. 94.489  
 Number of Spec. 19

Average<sub>norm</sub> 0.0072 86.590  
 Standard Dev.<sub>norm</sub> 4.725  
 Coeff. of Var. [%]<sub>norm</sub> 5.457  
 Min. 0.0066 78.897  
 Max. 0.0074 95.167  
 Number of Spec. 19



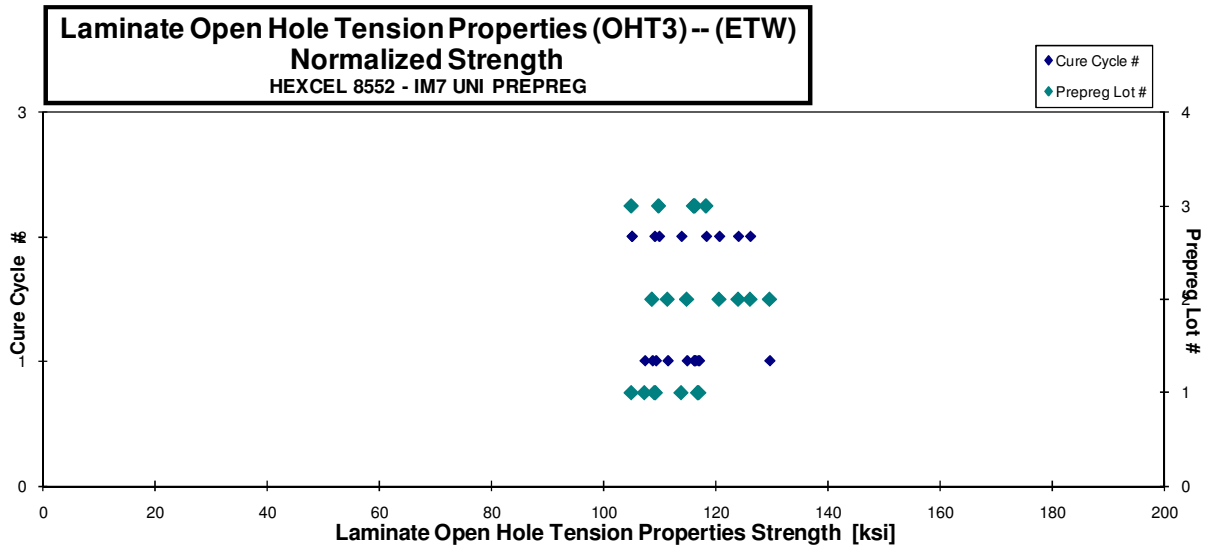
**Laminate Open Hole Tension Properties (OHT3)-- (ETW)**  
**Strength**  
 HEXCEL 8552 - IM7 UNI PREPREG

normalizing  $t_{ply}$   
 [in]  
 0.0072

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Avg. Specimen Thicken. [in] | # Plies in Laminate | Failure Mode | Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] |
|-----------------|----------------|-------------------|---------------|--------------|----------------|-----------------------------|---------------------|--------------|---------------------|--------------------------------|
| HFIFA11BD*      | A              | M1                | 1             | 1            | 114.518        | 0.147                       | 20                  | LGM          | 0.0074              | 116.903                        |
| HFIFA11CD*      | A              | M1                | 1             | 1            | 107.381        | 0.147                       | 20                  | LGM          | 0.0073              | 109.370                        |
| HFIFA11DD*      | A              | M1                | 1             | 1            | 114.736        | 0.147                       | 20                  | LGM          | 0.0074              | 117.126                        |
| HFIFA11ED*      | A              | M1                | 1             | 1            | 103.774        | 0.149                       | 20                  | LGM          | 0.0075              | 107.377                        |
| HFIFA219D       | A              | M2                | 1             | 2            | 102.238        | 0.148                       | 20                  | LGM          | 0.0074              | 105.042                        |
| HFIFA21AD       | A              | M2                | 1             | 2            | 110.569        | 0.148                       | 20                  | LGM          | 0.0074              | 113.948                        |
| HFIFA21BD       | A              | M2                | 1             | 2            | 106.810        | 0.147                       | 20                  | LGM          | 0.0074              | 109.146                        |
| HFIFB118D       | B              | M1                | 2             | 1            | 128.781        | 0.145                       | 20                  | AGM          | 0.0073              | 129.750                        |
| HFIFB119D*      | B              | M1                | 2             | 1            | 117.340        | 0.137                       | 20                  | LGM/AGM      | 0.0068              | 111.486                        |
| HFIFB11AD       | B              | M1                | 2             | 1            | 106.610        | 0.147                       | 20                  | LGM/AGM      | 0.0073              | 108.732                        |
| HFIFB11BD       | B              | M1                | 2             | 1            | 114.723        | 0.144                       | 20                  | LGM/AGM      | 0.0072              | 114.935                        |
| HFIFB218D       | B              | M2                | 2             | 2            | 125.681        | 0.145                       | 20                  | LGM/AGM      | 0.0072              | 126.278                        |
| HFIFB219D       | B              | M2                | 2             | 2            | 119.126        | 0.146                       | 20                  | LGM/AGM      | 0.0073              | 120.726                        |
| HFIFB21AD       | B              | M2                | 2             | 2            | 121.801        | 0.147                       | 20                  | LGM/AGM      | 0.0073              | 124.141                        |
| HFIFC119D       | C              | M1                | 3             | 1            | 116.543        | 0.144                       | 20                  | AGM          | 0.0072              | 116.435                        |
| HFIFC11AD       | C              | M1                | 3             | 1            | 115.517        | 0.145                       | 20                  | LGM          | 0.0072              | 116.266                        |
| HFIFC11BD       | C              | M1                | 3             | 1            | 117.042        | 0.143                       | 20                  | AGM/LGM      | 0.0071              | 116.188                        |
| HFIFC219D       | C              | M2                | 3             | 2            | 119.003        | 0.143                       | 20                  | AGM          | 0.0072              | 118.397                        |
| HFIFC21AD       | C              | M2                | 3             | 2            | 104.988        | 0.144                       | 20                  | AGM/LGM      | 0.0072              | 105.036                        |
| HFIFC21BD       | C              | M2                | 3             | 2            | 110.152        | 0.144                       | 20                  | AGM          | 0.0072              | 109.935                        |

Average 113.867  
 Standard Dev. 7.248  
 Coeff. of Var. [%] 6.365  
 Min. 102.238  
 Max. 128.781  
 Number of Spec. 20

Average<sub>norm</sub> 0.0073 114.861  
 Standard Dev.<sub>norm</sub> 6.830  
 Coeff. of Var. [%]<sub>norm</sub> 5.946  
 Min. 0.0068 105.036  
 Max. 0.0075 129.750  
 Number of Spec. 20 20

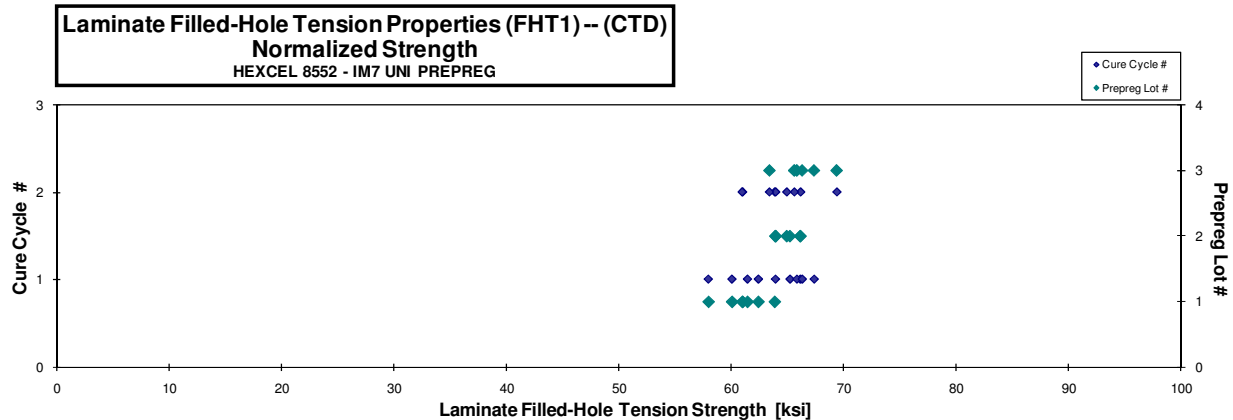


## 4.19 Filled-Hole Tension 1 Properties

| Laminate Filled-Hole Tension Properties (FHT1) -- (CTD)<br>Strength<br>HEXCEL 8552 - IM7 UNI PREPREG |                |                   |               |              |                |                            |                     |              | normalizing $t_{ply}$<br>[in]<br>0.0072 |                                |
|------------------------------------------------------------------------------------------------------|----------------|-------------------|---------------|--------------|----------------|----------------------------|---------------------|--------------|-----------------------------------------|--------------------------------|
| Specimen Number                                                                                      | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Avg. Specimen Thickn. [in] | # Plies in Laminate | Failure Mode | Avg. $t_{ply}$ [in]                     | Strength <sub>norm</sub> [ksi] |
| HF14A117B                                                                                            | A              | M1                | 1             | 1            | 59.027         | 0.117                      | 16                  | AGM          | 0.0073                                  | 60.095                         |
| HF14A118B                                                                                            | A              | M1                | 1             | 1            | 57.302         | 0.117                      | 16                  | AGM          | 0.0073                                  | 57.998                         |
| HF14A119B                                                                                            | A              | M1                | 1             | 1            | 60.172         | 0.118                      | 16                  | AGM          | 0.0074                                  | 61.469                         |
| HF14A11AB                                                                                            | A              | M1                | 1             | 1            | 61.327         | 0.117                      | 16                  | AGM          | 0.0073                                  | 62.436                         |
| HF14A215B                                                                                            | A              | M2                | 1             | 2            | 62.748         | 0.117                      | 16                  | AGM          | 0.0073                                  | 63.891                         |
| HF14A216B                                                                                            | A              | M2                | 1             | 2            | 60.030         | 0.117                      | 16                  | AGM          | 0.0073                                  | 61.046                         |
| HF14A217B                                                                                            | A              | M2                | 1             | 2            | 59.748         | 0.118                      | 16                  | AGM          | 0.0074                                  | 61.002                         |
| HF14B115B                                                                                            | B              | M1                | 2             | 1            | 65.873         | 0.114                      | 16                  | AGM          | 0.0071                                  | 65.244                         |
| HF14B116B                                                                                            | B              | M1                | 2             | 1            | 67.053         | 0.114                      | 16                  | AGM          | 0.0071                                  | 66.151                         |
| HF14B117B                                                                                            | B              | M1                | 2             | 1            | 64.288         | 0.115                      | 16                  | AGM          | 0.0072                                  | 63.953                         |
| HF14B215B                                                                                            | B              | M2                | 2             | 2            | 65.191         | 0.115                      | 16                  | AGM          | 0.0072                                  | 64.955                         |
| HF14B216B                                                                                            | B              | M2                | 2             | 2            | 64.500         | 0.114                      | 16                  | AGM          | 0.0071                                  | 63.968                         |
| HF14B217B                                                                                            | B              | M2                | 2             | 2            | 66.214         | 0.115                      | 16                  | AGM          | 0.0072                                  | 66.185                         |
| HF14C115B                                                                                            | C              | M1                | 3             | 1            | 65.035         | 0.117                      | 16                  | AGM          | 0.0073                                  | 65.853                         |
| HF14C116B                                                                                            | C              | M1                | 3             | 1            | 65.600         | 0.118                      | 16                  | AGM          | 0.0074                                  | 67.384                         |
| HF14C117B                                                                                            | C              | M1                | 3             | 1            | 66.666         | 0.115                      | 16                  | AGM          | 0.0072                                  | 66.328                         |
| HF14C215B                                                                                            | C              | M2                | 3             | 2            | 62.871         | 0.116                      | 16                  | AGM          | 0.0073                                  | 63.417                         |
| HF14C216B                                                                                            | C              | M2                | 3             | 2            | 65.150         | 0.116                      | 16                  | AGM          | 0.0073                                  | 65.630                         |
| HF14C217B                                                                                            | C              | M2                | 3             | 2            | 68.013         | 0.118                      | 16                  | AGM          | 0.0073                                  | 69.401                         |

|                    |        |                                    |        |        |
|--------------------|--------|------------------------------------|--------|--------|
| Average            | 63.516 | Average <sub>norm</sub>            | 0.0073 | 64.021 |
| Standard Dev.      | 3.085  | Standard Dev. <sub>norm</sub>      |        | 2.810  |
| Coeff. of Var. [%] | 4.856  | Coeff. of Var. [%] <sub>norm</sub> |        | 4.390  |
| Min.               | 57.302 | Min.                               | 0.0071 | 57.998 |
| Max.               | 68.013 | Max.                               | 0.0074 | 69.401 |
| Number of Spec.    | 19     | Number of Spec.                    | 19     | 19     |



**Laminate Filled-Hole Tension Properties (FHT1) -- (RTD)**  
**Strength**  
 HEXCEL 8552 - IM7 UNI PREPREG

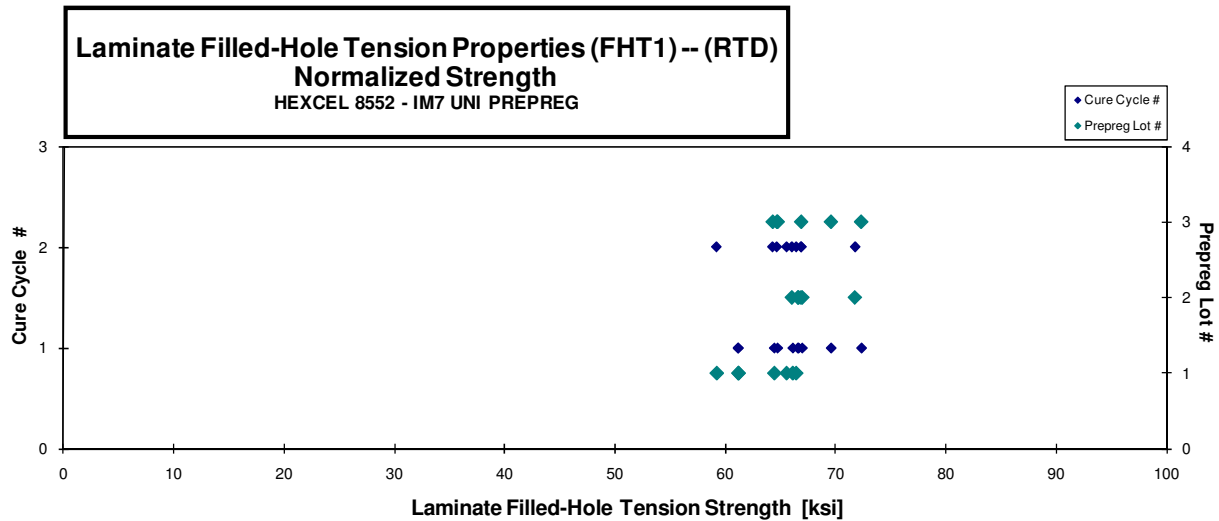
normalizing  $t_{ply}$   
 [in]  
 0.0072

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Avg. Specimen Thckn. [in] | # Plies in Laminate | Failure Mode |
|-----------------|----------------|-------------------|---------------|--------------|----------------|---------------------------|---------------------|--------------|
| HF4A112A        | A              | M1                | 1             | 1            | 64.899         | 0.117                     | 16                  | AGM          |
| HF4A113A        | A              | M1                | 1             | 1            | 60.163         | 0.117                     | 16                  | AGM          |
| HF4A114A        | A              | M1                | 1             | 1            | 59.596         | 0.118                     | 16                  | AGM          |
| HF4A115A        | A              | M1                | 1             | 1            | 63.146         | 0.118                     | 16                  | AGM          |
| HF4A211A        | A              | M2                | 1             | 2            | 60.980         | 0.112                     | 16                  | AGM          |
| HF4A212A        | A              | M2                | 1             | 2            | 64.939         | 0.118                     | 16                  | AGM          |
| HF4A214A        | A              | M2                | 1             | 2            | 64.451         | 0.117                     | 16                  | AGM          |
| HF4B111A        | B              | M1                | 2             | 1            | 70.013         | 0.110                     | 16                  | AGM          |
| HF4B112A        | B              | M1                | 2             | 1            | 66.645         | 0.116                     | 16                  | AGM          |
| HF4B113A        | B              | M1                | 2             | 1            | 67.424         | 0.114                     | 16                  | AGM          |
| HF4B211A        | B              | M2                | 2             | 2            | 69.067         | 0.110                     | 16                  | AGM          |
| HF4B212A        | B              | M2                | 2             | 2            | 66.498         | 0.116                     | 16                  | AGM          |
| HF4B214A        | B              | M2                | 2             | 2            | 72.193         | 0.115                     | 16                  | AGM          |
| HF4C111A        | C              | M1                | 3             | 1            | 67.382         | 0.111                     | 16                  | AGM          |
| HF4C113A*       | C              | M1                | 3             | 1            | 71.250         | 0.117                     | 16                  | AGM          |
| HF4C114A*       | C              | M1                | 3             | 1            | 68.599         | 0.117                     | 16                  | AGM          |
| HF4C211A        | C              | M2                | 3             | 2            | 67.144         | 0.111                     | 16                  | AGM          |
| HF4C212A        | C              | M2                | 3             | 2            | 62.523         | 0.118                     | 16                  | AGM          |
| HF4C213A        | C              | M2                | 3             | 2            | 66.195         | 0.116                     | 16                  | AGM          |

| Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] |
|---------------------|--------------------------------|
| 0.0073              | 66.120                         |
| 0.0073              | 61.190                         |
| 0.0074              | 61.165                         |
| 0.0073              | 64.444                         |
| 0.0070              | 59.198                         |
| 0.0074              | 66.433                         |
| 0.0073              | 65.561                         |
| 0.0068              | 66.579                         |
| 0.0072              | 66.982                         |
| 0.0071              | 66.644                         |
| 0.0069              | 66.030                         |
| 0.0072              | 66.863                         |
| 0.0072              | 71.764                         |
| 0.0069              | 64.740                         |
| 0.0073              | 72.343                         |
| 0.0073              | 69.591                         |
| 0.0069              | 64.667                         |
| 0.0074              | 64.287                         |
| 0.0073              | 66.885                         |

Average 65.953  
 Standard Dev. 3.569  
 Coeff. of Var. [%] 5.412  
 Min. 59.596  
 Max. 72.193  
 Number of Spec. 19

Average<sub>norm</sub> 0.0072 65.868  
 Standard Dev.<sub>norm</sub> 3.259  
 Coeff. of Var. [%]<sub>norm</sub> 4.948  
 Min. 0.0068 59.198  
 Max. 0.0074 72.343  
 Number of Spec. 19 19



**Laminate Filled-Hole Tension Properties (FHT1) -- (ETW)**  
**Strength**  
 HEXCEL 8552 - IM7 UNI PREPREG

normalizing  $t_{ply}$   
 [in]  
 0.0072

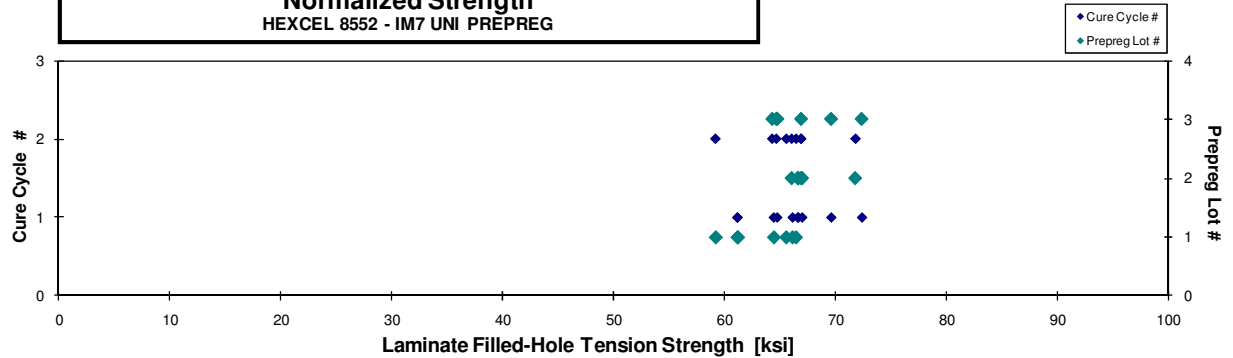
| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Avg. Specimen Thicken. [in] | # Plies in Laminate | Failure Mode |
|-----------------|----------------|-------------------|---------------|--------------|----------------|-----------------------------|---------------------|--------------|
| HF14A11BD       | A              | M1                | 1             | 1            | 67.367         | 0.118                       | 16                  | MGM          |
| HF14A11CD       | A              | M1                | 1             | 1            | 66.790         | 0.117                       | 16                  | MGM          |
| HF14A11DD       | A              | M1                | 1             | 1            | 67.424         | 0.117                       | 16                  | MGM          |
| HF14A11FD       | A              | M1                | 1             | 1            | 64.289         | 0.117                       | 16                  | MGM          |
| HF14A218D       | A              | M2                | 1             | 2            | 69.017         | 0.117                       | 16                  | MGM          |
| HF14A21AD       | A              | M2                | 1             | 2            | 67.726         | 0.117                       | 16                  | MGM          |
| HF14A21BD       | A              | M2                | 1             | 2            | 69.612         | 0.117                       | 16                  | MGM          |
| HF14A21CD       | A              | M2                | 1             | 2            | 67.440         | 0.116                       | 16                  | MGM          |
| HF14B118D       | B              | M1                | 2             | 1            | 69.282         | 0.115                       | 16                  | MGM          |
| HF14B11AD       | B              | M1                | 2             | 1            | 68.161         | 0.116                       | 16                  | MGM          |
| HF14B11BD       | B              | M1                | 2             | 1            | 73.843         | 0.114                       | 16                  | MGM          |
| HF14B218D       | B              | M2                | 2             | 2            | 74.583         | 0.115                       | 16                  | MGM          |
| HF14B21BD       | B              | M2                | 2             | 2            | 72.453         | 0.115                       | 16                  | MGM          |
| HF14B21CD       | B              | M2                | 2             | 2            | 72.070         | 0.115                       | 16                  | MGM          |
| HF14C118D       | C              | M1                | 3             | 1            | 71.303         | 0.117                       | 16                  | MGM          |
| HF14C11AD       | C              | M1                | 3             | 1            | 65.293         | 0.120                       | 16                  | MGM          |
| HF14C11BD       | C              | M1                | 3             | 1            | 72.470         | 0.117                       | 16                  | MGM          |
| HF14C11CD       | C              | M1                | 3             | 1            | 70.193         | 0.118                       | 16                  | MGM          |
| HF14C21AD       | C              | M2                | 3             | 2            | 67.537         | 0.118                       | 16                  | MGM          |
| HF14C21BD       | C              | M2                | 3             | 2            | 71.258         | 0.116                       | 16                  | MGM          |
| HF14C21CD       | C              | M2                | 3             | 2            | 71.493         | 0.117                       | 16                  | MGM          |
| HF14C21DD       | C              | M2                | 3             | 2            | 69.776         | 0.117                       | 16                  | MGM          |

| Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] |
|---------------------|--------------------------------|
| 0.0074              | 68.770                         |
| 0.0073              | 67.959                         |
| 0.0073              | 68.429                         |
| 0.0073              | 65.172                         |
| 0.0073              | 69.945                         |
| 0.0073              | 68.911                         |
| 0.0073              | 70.418                         |
| 0.0073              | 67.958                         |
| 0.0072              | 69.362                         |
| 0.0072              | 68.526                         |
| 0.0071              | 72.914                         |
| 0.0072              | 74.400                         |
| 0.0072              | 72.316                         |
| 0.0072              | 71.882                         |
| 0.0073              | 72.211                         |
| 0.0075              | 67.910                         |
| 0.0073              | 73.309                         |
| 0.0073              | 71.604                         |
| 0.0074              | 69.149                         |
| 0.0073              | 71.939                         |
| 0.0073              | 72.600                         |
| 0.0073              | 70.634                         |

Average 69.517  
 Standard Dev. 2.709  
 Coeff. of Var. [%] 3.897  
 Min. 64.289  
 Max. 74.583  
 Number of Spec. 22

Average<sub>norm</sub> 0.0073 70.287  
 Standard Dev.<sub>norm</sub> 2.278  
 Coeff. of Var. [%]<sub>norm</sub> 3.240  
 Min. 0.0071 65.172  
 Max. 0.0075 74.400  
 Number of Spec. 22 22

**Laminate Filled-Hole Tension Properties (FHT1) -- (ETW)**  
**Normalized Strength**  
 HEXCEL 8552 - IM7 UNI PREPREG



## 4.20 Filled-Hole Tension 2 Properties

**Laminate Filled-Hole Tension Properties (FHT2) -- (CTD)**  
**Strength**  
 HEXCEL 8552 - IM7 UNI PREPREG

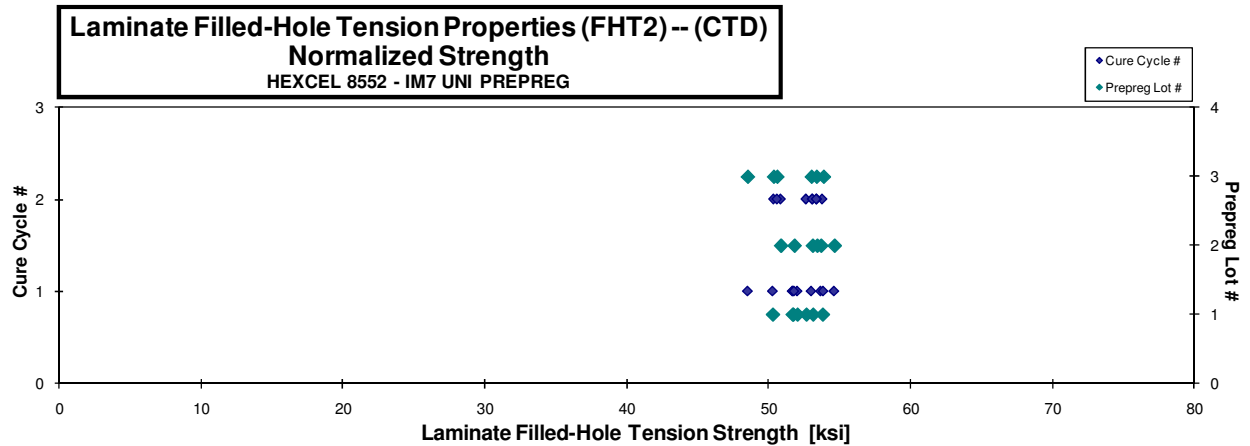
normalizing  $t_{ply}$   
 [in]  
 0.0072

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle Batch # | Strength [ksi] | Avg. Specimen Thckn. [in] | # Plies in Laminate | Failure Mode |
|-----------------|----------------|-------------------|---------------|--------------------|----------------|---------------------------|---------------------|--------------|
| HF15A115B       | A              | M1                | 1             | 1                  | 51.005         | 0.146                     | 20                  | AGM          |
| HF15A116B       | A              | M1                | 1             | 1                  | 51.396         | 0.146                     | 20                  | AGM          |
| HF15A117B       | A              | M1                | 1             | 1                  | 50.245         | 0.148                     | 20                  | AGM          |
| HF15A118B       | A              | M1                | 1             | 1                  | 51.243         | 0.141                     | 20                  | AGM          |
| HF15A215B       | A              | M2                | 1             | 2                  | 51.790         | 0.148                     | 20                  | AGM          |
| HF15A216B       | A              | M2                | 1             | 2                  | 51.627         | 0.147                     | 20                  | AGM          |
| HF15A217B       | A              | M2                | 1             | 2                  | 52.243         | 0.148                     | 20                  | AGM          |
| HF15B183B       | B              | M1                | 2             | 1                  | 54.728         | 0.144                     | 20                  | AGM          |
| HF15B184B       | B              | M1                | 2             | 1                  | 53.591         | 0.144                     | 20                  | AGM          |
| HF15B185B       | B              | M1                | 2             | 1                  | 51.798         | 0.144                     | 20                  | AGM          |
| HF15B215B       | B              | M2                | 2             | 2                  | 53.233         | 0.145                     | 20                  | AGM          |
| HF15B216B       | B              | M2                | 2             | 2                  | 53.008         | 0.144                     | 20                  | AGM          |
| HF15B219B       | B              | M2                | 2             | 2                  | 50.393         | 0.145                     | 20                  | AGM          |
| HF15C116B       | C              | M1                | 3             | 1                  | 53.211         | 0.144                     | 20                  | AGM          |
| HF15C117B       | C              | M1                | 3             | 1                  | 53.345         | 0.145                     | 20                  | AGM          |
| HF15C118B       | C              | M1                | 3             | 1                  | 50.679         | 0.138                     | 20                  | AGM          |
| HF15C216B       | C              | M2                | 3             | 2                  | 50.227         | 0.144                     | 20                  | AGM          |
| HF15C217B       | C              | M2                | 3             | 2                  | 53.565         | 0.144                     | 20                  | AGM          |
| HF15C218B       | C              | M2                | 3             | 2                  | 51.544         | 0.141                     | 20                  | AGM          |

| Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] |
|---------------------|--------------------------------|
| 0.0073              | 51.749                         |
| 0.0073              | 52.038                         |
| 0.0074              | 51.693                         |
| 0.0071              | 50.306                         |
| 0.0074              | 53.127                         |
| 0.0073              | 52.661                         |
| 0.0074              | 53.809                         |
| 0.0072              | 54.640                         |
| 0.0072              | 53.697                         |
| 0.0072              | 51.822                         |
| 0.0072              | 53.424                         |
| 0.0072              | 53.106                         |
| 0.0073              | 50.877                         |
| 0.0072              | 53.026                         |
| 0.0073              | 53.876                         |
| 0.0069              | 48.544                         |
| 0.0072              | 50.378                         |
| 0.0072              | 53.386                         |
| 0.0071              | 50.613                         |

Average 52.046  
 Standard Dev. 1.316  
 Coeff. of Var. [%] 2.528  
 Min. 50.227  
 Max. 54.728  
 Number of Spec. 19

Average<sub>norm</sub> 0.0072 52.251  
 Standard Dev.<sub>norm</sub> 1.567  
 Coeff. of Var. [%]<sub>norm</sub> 2.999  
 Min. 0.0069 48.544  
 Max. 0.0074 54.640  
 Number of Spec. 19 19



**Laminate Filled-Hole Tension Properties (FHT2) -- (RTD)**  
**Strength**  
 HEXCEL 8552 - IM7 UNI PREPREG

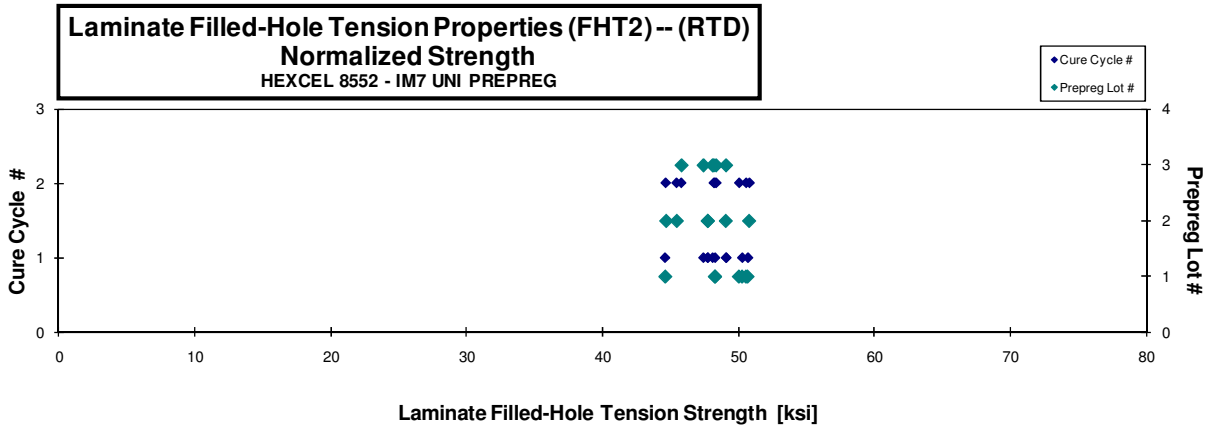
| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Avg. Specimen Thicken. [in] | # Plies in Laminate | Failure Mode |
|-----------------|----------------|-------------------|---------------|--------------|----------------|-----------------------------|---------------------|--------------|
| HF15A111A       | A              | M1                | 1             | 1            | 45.997         | 0.140                       | 20                  | AGM          |
| HF15A112A       | A              | M1                | 1             | 1            | 47.027         | 0.148                       | 20                  | AGM          |
| HF15A113A       | A              | M1                | 1             | 1            | 50.242         | 0.145                       | 20                  | AGM          |
| HF15A114A       | A              | M1                | 1             | 1            | 49.553         | 0.146                       | 20                  | AGM          |
| HF15A211A       | A              | M2                | 1             | 2            | 49.823         | 0.145                       | 20                  | AGM          |
| HF15A212A       | A              | M2                | 1             | 2            | 49.363         | 0.147                       | 20                  | AGM          |
| HF15A213A       | A              | M2                | 1             | 2            | 47.248         | 0.147                       | 20                  | AGM          |
| HF15B181A       | B              | M1                | 2             | 1            | 48.549         | 0.142                       | 20                  | AGM          |
| HF15B121A       | B              | M1                | 2             | 1            | 48.010         | 0.143                       | 20                  | AGM          |
| HF15B182A       | B              | M1                | 2             | 1            | 48.932         | 0.144                       | 20                  | AGM          |
| HF15B211A       | B              | M2                | 2             | 2            | 46.169         | 0.142                       | 20                  | AGM          |
| HF15B212A       | B              | M2                | 2             | 2            | 50.056         | 0.146                       | 20                  | AGM          |
| HF15B213A       | B              | M2                | 2             | 2            | 44.673         | 0.144                       | 20                  | AGM          |
| HF15C111A       | C              | M1                | 3             | 1            | 49.493         | 0.140                       | 20                  | AGM          |
| HF15C112A       | C              | M1                | 3             | 1            | 48.053         | 0.147                       | 20                  | AGM          |
| HF15C113A       | C              | M1                | 3             | 1            | 47.632         | 0.143                       | 20                  | AGM          |
| HF15C211A       | C              | M2                | 3             | 2            | 48.980         | 0.142                       | 20                  | AGM          |
| HF15C213A       | C              | M2                | 3             | 2            | 48.012         | 0.144                       | 20                  | AGM          |
| HF15C214A       | C              | M2                | 3             | 2            | 45.723         | 0.144                       | 20                  | AGM          |

normalizing  $t_{ply}$   
 [in]  
 0.0072

| Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] |
|---------------------|--------------------------------|
| 0.0070              | 44.587                         |
| 0.0074              | 48.268                         |
| 0.0073              | 50.679                         |
| 0.0073              | 50.264                         |
| 0.0072              | 50.036                         |
| 0.0074              | 50.546                         |
| 0.0074              | 48.244                         |
| 0.0071              | 47.723                         |
| 0.0072              | 47.726                         |
| 0.0072              | 49.068                         |
| 0.0071              | 45.437                         |
| 0.0073              | 50.786                         |
| 0.0072              | 44.637                         |
| 0.0070              | 48.084                         |
| 0.0074              | 49.087                         |
| 0.0072              | 47.411                         |
| 0.0071              | 48.350                         |
| 0.0072              | 48.173                         |
| 0.0072              | 45.781                         |

Average 48.081  
 Standard Dev. 1.605  
 Coeff. of Var. [%] 3.337  
 Min. 44.673  
 Max. 50.242  
 Number of Spec. 19

Average<sub>norm</sub> 0.0072 48.152  
 Standard Dev.<sub>norm</sub> 1.941  
 Coeff. of Var. [%]<sub>norm</sub> 4.031  
 Min. 0.0070 44.587  
 Max. 0.0074 50.786  
 Number of Spec. 19





**Laminate Filled-Hole Tension Properties (FHT2) -- (ETW)**  
**Strength**  
 HEXCEL 8552 - IM7 UNI PREPREG

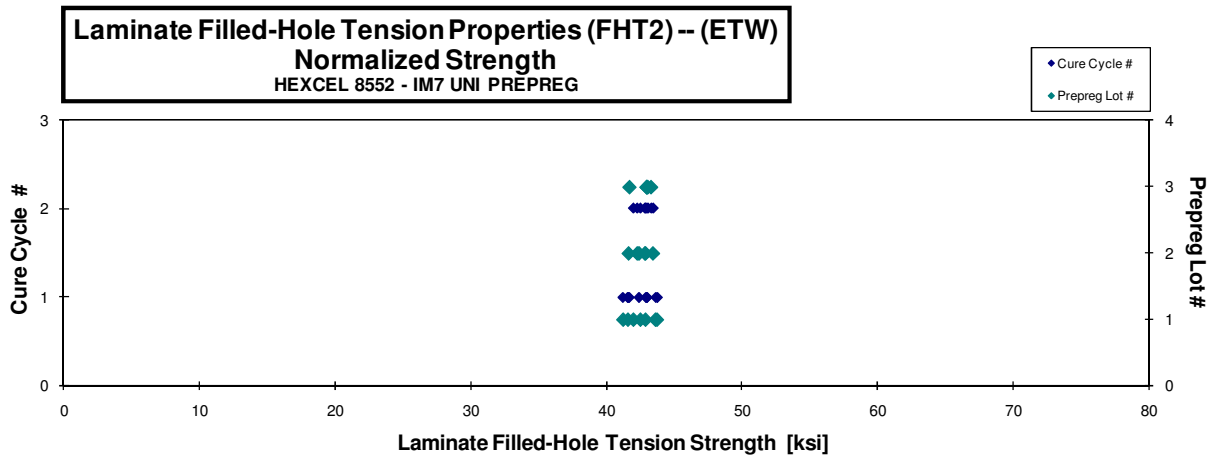
normalizing  $t_{ply}$   
 [in]  
 0.0072

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Avg. Specimen Thickn. [in] | # Plies in Laminate | Failure Mode |
|-----------------|----------------|-------------------|---------------|--------------|----------------|----------------------------|---------------------|--------------|
| HF15A11AD       | A              | M1                | 1             | 1            | 40.752         | 0.146                      | 20                  | MGM          |
| HF15A11BD       | A              | M1                | 1             | 1            | 41.247         | 0.145                      | 20                  | MGM          |
| HF15A11DD       | A              | M1                | 1             | 1            | 42.864         | 0.147                      | 20                  | MGM          |
| HF15A11ED       | A              | M1                | 1             | 1            | 42.513         | 0.148                      | 20                  | MGM          |
| HF15A21AD       | A              | M2                | 1             | 2            | 41.976         | 0.147                      | 20                  | MGM          |
| HF15A21CD       | A              | M2                | 1             | 2            | 40.962         | 0.148                      | 20                  | MGM          |
| HF15A21DD       | A              | M2                | 1             | 2            | 41.571         | 0.147                      | 20                  | MGM          |
| HF15B186D       | B              | M1                | 2             | 1            | 42.962         | 0.144                      | 20                  | MGM          |
| HF15B122D       | B              | M1                | 2             | 1            | 41.756         | 0.144                      | 20                  | MGM          |
| HF15B187D       | B              | M1                | 2             | 1            | 42.322         | 0.144                      | 20                  | MGM          |
| HF15B21CD       | B              | M2                | 2             | 2            | 42.137         | 0.144                      | 20                  | MGM          |
| HF15B21DD       | B              | M2                | 2             | 2            | 43.421         | 0.144                      | 20                  | MGM          |
| HF15B21ED       | B              | M2                | 2             | 2            | 42.356         | 0.146                      | 20                  | MGM          |
| HF15C11BD       | C              | M1                | 3             | 1            | 43.106         | 0.144                      | 20                  | MGM          |
| HF15C11CD       | C              | M1                | 3             | 1            | 41.453         | 0.145                      | 20                  | MGM          |
| HF15C11DD       | C              | M1                | 3             | 1            | 42.816         | 0.145                      | 20                  | MGM          |
| HF15C21BD       | C              | M2                | 3             | 2            | 42.810         | 0.145                      | 20                  | MGM          |
| HF15C21CD       | C              | M2                | 3             | 2            | 43.152         | 0.143                      | 20                  | MGM          |
| HF15C21ED       | C              | M2                | 3             | 2            | 43.538         | 0.143                      | 20                  | MGM          |

| Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] |
|---------------------|--------------------------------|
| 0.0073              | 41.219                         |
| 0.0073              | 41.572                         |
| 0.0073              | 43.643                         |
| 0.0074              | 43.753                         |
| 0.0074              | 42.885                         |
| 0.0074              | 41.986                         |
| 0.0074              | 42.509                         |
| 0.0072              | 42.898                         |
| 0.0072              | 41.621                         |
| 0.0072              | 42.400                         |
| 0.0072              | 42.264                         |
| 0.0072              | 43.451                         |
| 0.0073              | 42.842                         |
| 0.0072              | 43.002                         |
| 0.0072              | 41.683                         |
| 0.0072              | 42.974                         |
| 0.0072              | 43.067                         |
| 0.0072              | 42.982                         |
| 0.0072              | 43.307                         |

Average 42.301  
 Standard Dev. 0.832  
 Coeff. of Var. [%] 1.967  
 Min. 40.752  
 Max. 43.538  
 Number of Spec. 19

Average<sub>norm</sub> 0.0073 42.635  
 Standard Dev.<sub>norm</sub> 0.738  
 Coeff. of Var. [%]<sub>norm</sub> 1.732  
 Min. 0.0072 41.219  
 Max. 0.0074 43.753  
 Number of Spec. 19 19

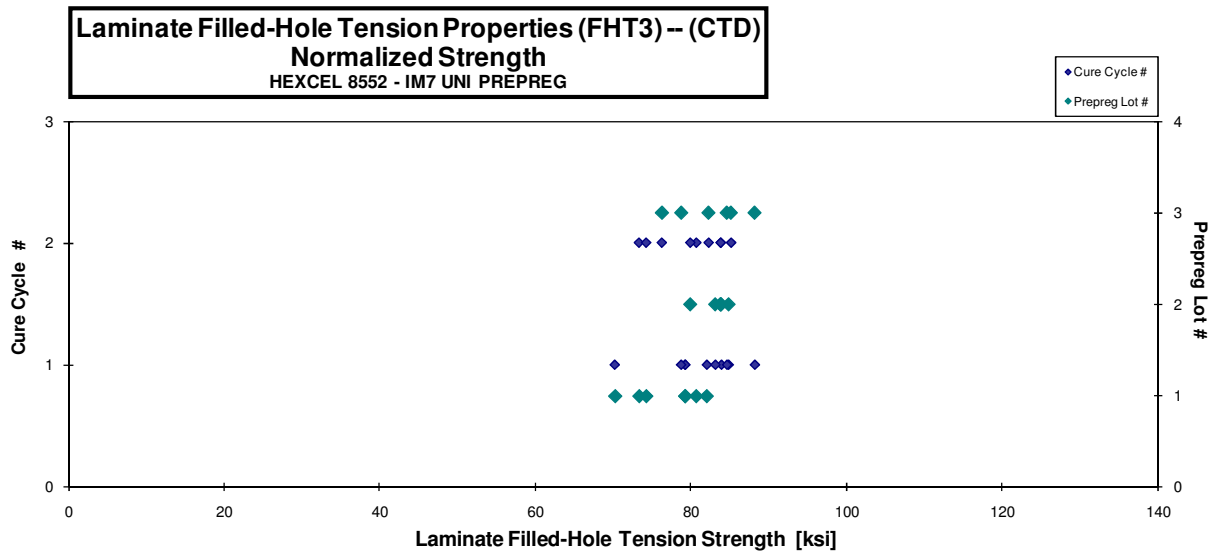


## 4.21 Filled-Hole Tension 3 Properties

| Laminate Filled-Hole Tension Properties (FHT3) -- (CTD)<br>Strength<br>HEXCEL 8552 - IM7 UNI PREPREG |                |                   |               |              |                |                            |                     |              | normalizing $t_{ply}$<br>[in]<br>0.0072 |                                |
|------------------------------------------------------------------------------------------------------|----------------|-------------------|---------------|--------------|----------------|----------------------------|---------------------|--------------|-----------------------------------------|--------------------------------|
| Specimen Number                                                                                      | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Avg. Specimen Thickn. [in] | # Plies in Laminate | Failure Mode | Avg. $t_{ply}$ [in]                     | Strength <sub>norm</sub> [ksi] |
| HF16A111B                                                                                            | A              | M1                | 1             | 1            | 76.916         | 0.148                      | 20                  | LGM          | 0.0074                                  | 79.230                         |
| HF16A112B*                                                                                           | A              | M1                | 1             | 1            | 77.654         | 0.147                      | 20                  | LGM          | 0.0074                                  | 79.271                         |
| HF16A113B                                                                                            | A              | M1                | 1             | 1            | 79.761         | 0.148                      | 20                  | LGM          | 0.0074                                  | 82.013                         |
| HF16A114B                                                                                            | A              | M1                | 1             | 1            | 71.758         | 0.141                      | 20                  | LGM          | 0.0070                                  | 70.247                         |
| HF16A212B                                                                                            | A              | M2                | 1             | 2            | 71.220         | 0.148                      | 20                  | LGM          | 0.0074                                  | 73.339                         |
| HF16A213B                                                                                            | A              | M2                | 1             | 2            | 72.885         | 0.147                      | 20                  | LGM          | 0.0073                                  | 74.260                         |
| HF16A214B                                                                                            | A              | M2                | 1             | 2            | 79.149         | 0.147                      | 20                  | LGM          | 0.0073                                  | 80.670                         |
| HF16B112B                                                                                            | B              | M1                | 2             | 1            | 83.462         | 0.145                      | 20                  | LGM          | 0.0072                                  | 83.877                         |
| HF16B113B                                                                                            | B              | M1                | 2             | 1            | 85.087         | 0.144                      | 20                  | LGM          | 0.0072                                  | 84.811                         |
| HF16B115B                                                                                            | B              | M1                | 2             | 1            | 83.583         | 0.143                      | 20                  | AGM          | 0.0072                                  | 83.109                         |
| HF16B216B                                                                                            | B              | M2                | 2             | 2            | 84.691         | 0.142                      | 20                  | AGM          | 0.0071                                  | 83.799                         |
| HF16B217B                                                                                            | B              | M2                | 2             | 2            | 79.312         | 0.145                      | 20                  | AGM          | 0.0073                                  | 79.899                         |
| HF16B219B*                                                                                           | B              | M2                | 2             | 2            | 86.562         | 0.139                      | 20                  | AGM          | 0.0070                                  | 83.777                         |
| HF16C116B*                                                                                           | C              | M1                | 3             | 1            | 88.226         | 0.144                      | 20                  | LGM          | 0.0072                                  | 88.154                         |
| HF16C117B                                                                                            | C              | M1                | 3             | 1            | 83.733         | 0.145                      | 20                  | LGM          | 0.0073                                  | 84.595                         |
| HF16C118B                                                                                            | C              | M1                | 3             | 1            | 80.774         | 0.140                      | 20                  | AGM          | 0.0070                                  | 78.726                         |
| HF16C216B                                                                                            | C              | M2                | 3             | 2            | 85.168         | 0.144                      | 20                  | AGM          | 0.0072                                  | 85.119                         |
| HF16C217B                                                                                            | C              | M2                | 3             | 2            | 82.027         | 0.144                      | 20                  | LGM          | 0.0072                                  | 82.245                         |
| HF16C218B                                                                                            | C              | M2                | 3             | 2            | 78.179         | 0.140                      | 20                  | LGM          | 0.0070                                  | 76.252                         |

|                    |        |                                    |        |        |
|--------------------|--------|------------------------------------|--------|--------|
| Average            | 80.534 | Average <sub>norm</sub>            | 0.0072 | 80.705 |
| Standard Dev.      | 4.936  | Standard Dev. <sub>norm</sub>      |        | 4.593  |
| Coeff. of Var. [%] | 6.129  | Coeff. of Var. [%] <sub>norm</sub> |        | 5.691  |
| Min.               | 71.220 | Min.                               | 0.0070 | 70.247 |
| Max.               | 88.226 | Max.                               | 0.0074 | 88.154 |
| Number of Spec.    | 19     | Number of Spec.                    | 19     | 19     |



**Laminate Filled-Hole Tension Properties (FHT3)-- (RTD)  
Strength**  
HEXCEL 8552 - IM7 UNI PREPREG

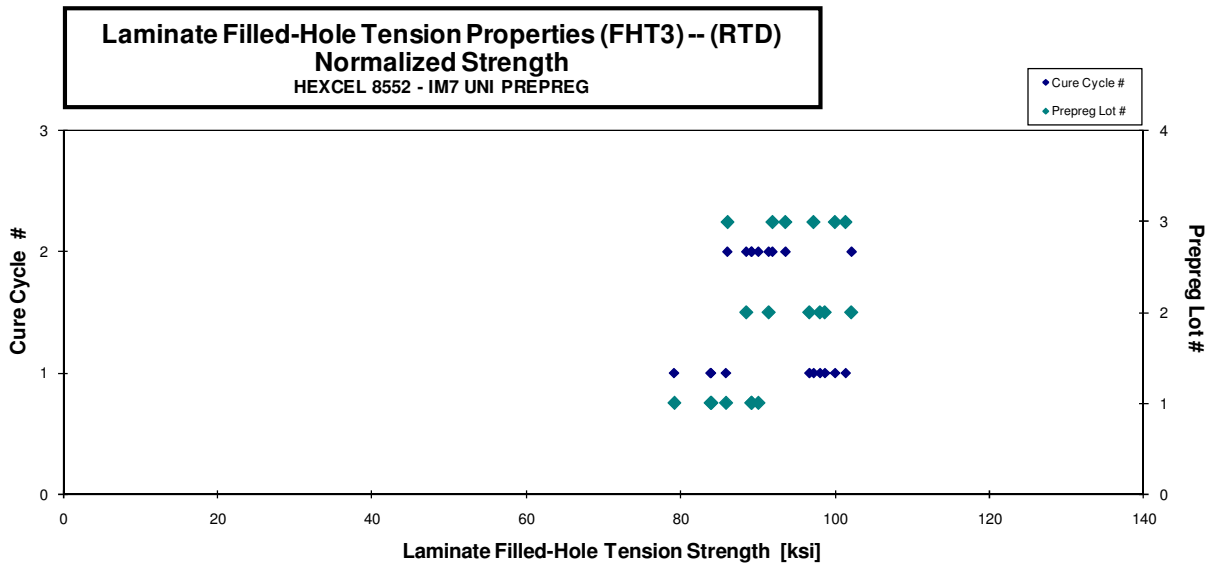
| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Avg. Specimen Thckn. [in] | # Plies in Laminate | Failure Mode |
|-----------------|----------------|-------------------|---------------|--------------|----------------|---------------------------|---------------------|--------------|
| HF16A115A       | A              | M1                | 1             | 1            | 84.133         | 0.147                     | 20                  | LGM          |
| HF16A116A       | A              | M1                | 1             | 1            | 82.476         | 0.147                     | 20                  | LGM          |
| HF16A117A       | A              | M1                | 1             | 1            | 77.075         | 0.148                     | 20                  | LGM          |
| HF16A118A       | A              | M1                | 1             | 1            | 84.415         | 0.143                     | 20                  | LGM          |
| HF16A215A       | A              | M2                | 1             | 2            | 87.203         | 0.147                     | 20                  | LGM          |
| HF16A216A       | A              | M2                | 1             | 2            | 87.870         | 0.148                     | 20                  | LGM          |
| HF16A218A       | A              | M2                | 1             | 2            | 89.304         | 0.144                     | 20                  | LGM          |
| HF16B116A       | B              | M1                | 2             | 1            | 99.567         | 0.143                     | 20                  | LGM          |
| HF16B117A       | B              | M1                | 2             | 1            | 96.382         | 0.144                     | 20                  | LGM          |
| HF16B118A       | B              | M1                | 2             | 1            | 101.085        | 0.140                     | 20                  | LGM          |
| HF16B212A       | B              | M2                | 2             | 2            | 91.092         | 0.145                     | 20                  | LGM          |
| HF16B213A       | B              | M2                | 2             | 2            | 89.175         | 0.143                     | 20                  | LGM          |
| HF16B215A       | B              | M2                | 2             | 2            | 102.608        | 0.143                     | 20                  | LGM          |
| HF16C112A       | C              | M1                | 3             | 1            | 96.557         | 0.145                     | 20                  | LGM          |
| HF16C113A1      | C              | M1                | 3             | 1            | 100.427        | 0.143                     | 20                  | LGM          |
| HF16C114A       | C              | M1                | 3             | 1            | 101.732        | 0.144                     | 20                  | LGM          |
| HF16C211A       | C              | M2                | 3             | 2            | 90.816         | 0.136                     | 20                  | LGM          |
| HF16C212A       | C              | M2                | 3             | 2            | 91.339         | 0.145                     | 20                  | LGM          |
| HF16C215A       | C              | M2                | 3             | 2            | 93.490         | 0.144                     | 20                  | LGM          |

normalizing  $t_{ply}$   
[in]  
0.0072

| Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] |
|---------------------|--------------------------------|
| 0.0073              | 85.876                         |
| 0.0073              | 83.956                         |
| 0.0074              | 79.154                         |
| 0.0072              | 83.887                         |
| 0.0074              | 89.212                         |
| 0.0074              | 90.077                         |
| 0.0072              | 89.169                         |
| 0.0071              | 98.714                         |
| 0.0072              | 96.694                         |
| 0.0070              | 98.066                         |
| 0.0072              | 91.419                         |
| 0.0071              | 88.514                         |
| 0.0072              | 102.156                        |
| 0.0073              | 97.238                         |
| 0.0072              | 100.020                        |
| 0.0072              | 101.391                        |
| 0.0068              | 86.065                         |
| 0.0072              | 91.900                         |
| 0.0072              | 93.588                         |

Average 91.934  
Standard Dev. 7.269  
Coeff. of Var. [%] 7.906  
Min. 77.075  
Max. 102.608  
Number of Spec. 19

Average<sub>norm</sub> 0.0072 91.952  
Standard Dev.<sub>norm</sub> 6.624  
Coeff. of Var. [%]<sub>norm</sub> 7.204  
Min. 0.0068 79.154  
Max. 0.0074 102.156  
Number of Spec. 19 19



**Laminate Filled-Hole Tension Properties (FHT3) -- (ETW)**  
**Strength**  
 HEXCEL 8552 - IM7 UNI PREPREG

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Avg. Specimen Thckn. [in] | # Plies in Laminate | Failure Mode |
|-----------------|----------------|-------------------|---------------|--------------|----------------|---------------------------|---------------------|--------------|
| HF16A21AD       | A              | M2                | 1             | 2            | 101.196        | 0.149                     | 20                  | MGM          |
| HF16A21BD       | A              | M2                | 1             | 2            | 102.134        | 0.147                     | 20                  | MGM          |
| HF16A21ED       | A              | M2                | 1             | 2            | 101.429        | 0.148                     | 20                  | MGM          |
| HF16A119D*      | A              | M1                | 1             | 1            | 96.211         | 0.141                     | 20                  | MGM          |
| HF16A11AD       | A              | M1                | 1             | 1            | 97.394         | 0.149                     | 20                  | MGM          |
| HF16A11BD       | A              | M1                | 1             | 1            | 92.014         | 0.147                     | 20                  | MGM          |
| HF16A11CD       | A              | M1                | 1             | 1            | 99.674         | 0.147                     | 20                  | MGM          |
| HF16B11BD       | B              | M1                | 2             | 1            | 102.156        | 0.143                     | 20                  | MGM          |
| HF16B11CD       | B              | M1                | 2             | 1            | 96.596         | 0.143                     | 20                  | MGM          |
| HF16B11ED       | B              | M1                | 2             | 1            | 106.183        | 0.142                     | 20                  | MGM          |
| HF16B21BD       | B              | M2                | 2             | 2            | 99.756         | 0.143                     | 20                  | MGM          |
| HF16B21CD       | B              | M2                | 2             | 2            | 97.666         | 0.143                     | 20                  | MGM          |
| HF16B21DD       | B              | M2                | 2             | 2            | 105.477        | 0.143                     | 20                  | MGM          |
| HF16C11AD**     | C              | M1                | 3             | 1            | 100.274        | 0.144                     | 20                  | MGM          |
| HF16C11CD       | C              | M1                | 3             | 1            | 105.904        | 0.144                     | 20                  | MGM          |
| HF16C11FD       | C              | M1                | 3             | 1            | 107.293        | 0.145                     | 20                  | MGM          |
| HF16C21BD       | C              | M2                | 3             | 2            | 100.091        | 0.144                     | 20                  | MGM          |
| HF16C21CD       | C              | M2                | 3             | 2            | 100.494        | 0.143                     | 20                  | MGM          |
| HF16C21DD       | C              | M2                | 3             | 2            | 102.630        | 0.144                     | 20                  | MGM          |

normalizing  $t_{ply}$   
 [in]

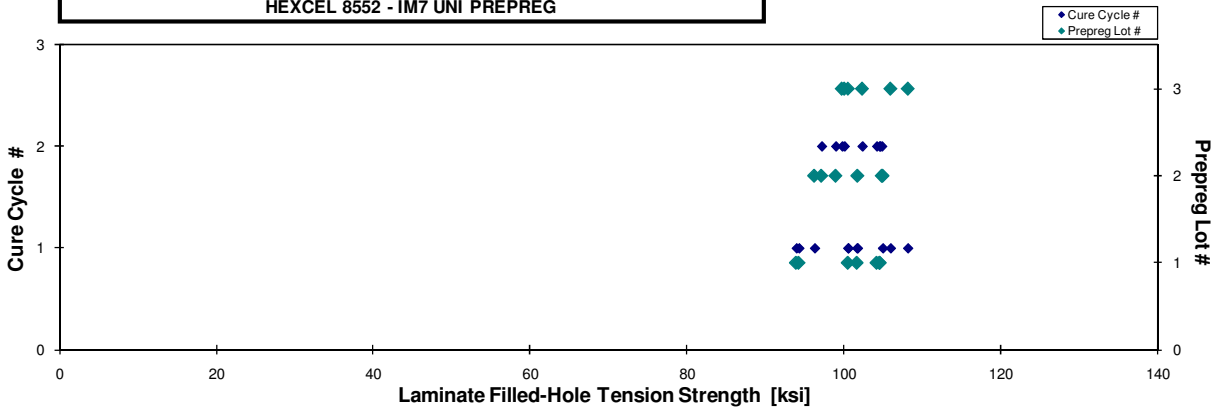
0.0072

| Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] |
|---------------------|--------------------------------|
| 0.0074              | 104.558                        |
| 0.0074              | 104.521                        |
| 0.0074              | 104.152                        |
| 0.0071              | 94.263                         |
| 0.0074              | 100.506                        |
| 0.0073              | 93.921                         |
| 0.0073              | 101.635                        |
| 0.0072              | 101.719                        |
| 0.0072              | 96.239                         |
| 0.0071              | 104.917                        |
| 0.0071              | 98.936                         |
| 0.0072              | 97.146                         |
| 0.0072              | 104.818                        |
| 0.0072              | 100.518                        |
| 0.0072              | 105.916                        |
| 0.0073              | 108.112                        |
| 0.0072              | 99.743                         |
| 0.0072              | 100.041                        |
| 0.0072              | 102.309                        |

Average 100.767  
 Standard Dev. 3.852  
 Coeff. of Var. [%] 3.823  
 Min. 92.014  
 Max. 107.293  
 Number of Spec. 19

Average<sub>norm</sub> 0.0072 101.262  
 Standard Dev<sub>norm</sub> 3.953  
 Coeff. of Var. [%]<sub>norm</sub> 3.904  
 Min. 0.0071 93.921  
 Max. 0.0074 108.112  
 Number of Spec. 19 19

**Laminate Filled-Hole Tension Properties (FHT3) -- (ETW)**  
**Normalized Strength**  
 HEXCEL 8552 - IM7 UNI PREPREG



## 4.22 Open Hole Compression 1 Properties

**Laminate Open Hole Compression Properties (OHC1) -- (RTD)**  
**Strength**  
 HEXCEL 8552 - IM7 UNI PREPREG

normalizing  $t_{ply}$   
 [in]  
 0.0072

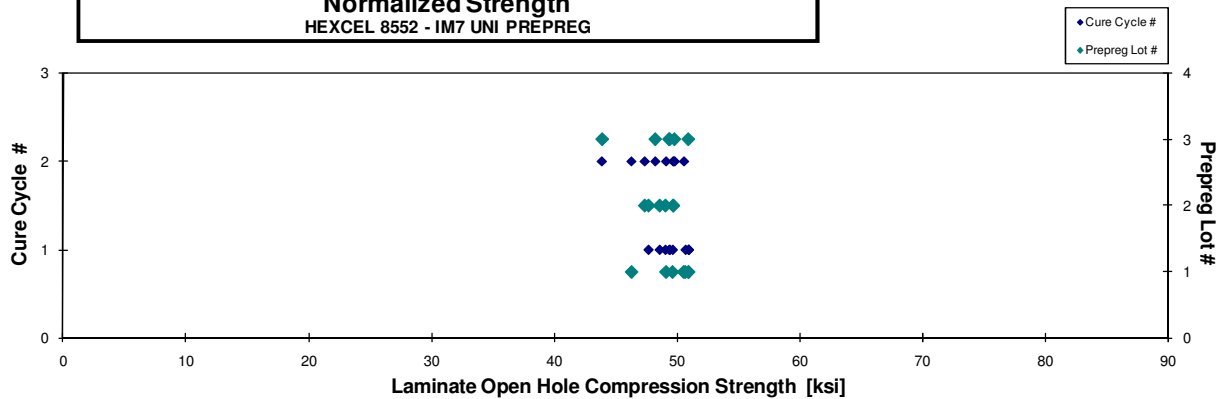
| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Avg. Specimen Thckn. [in] | # Plies in Laminate | Failure Modes |
|-----------------|----------------|-------------------|---------------|--------------|----------------|---------------------------|---------------------|---------------|
| HFIGA111A       | A              | M1                | 1             | 1            | 49.352         | 0.174                     | 24                  | LGM           |
| HFIGA112A       | A              | M1                | 1             | 1            | 48.708         | 0.181                     | 24                  | LGM           |
| HFIGA113A       | A              | M1                | 1             | 1            | 49.494         | 0.178                     | 24                  | LGM           |
| HFIGA114A       | A              | M1                | 1             | 1            | 49.152         | 0.178                     | 24                  | LGM           |
| HFIGA211A       | A              | M2                | 1             | 2            | 47.573         | 0.168                     | 24                  | LGM           |
| HFIGA212A       | A              | M2                | 1             | 2            | 46.871         | 0.181                     | 24                  | LGM           |
| HFIGA213A       | A              | M2                | 1             | 2            | 49.658         | 0.176                     | 24                  | LGM           |
| HFIGB111A       | B              | M1                | 2             | 1            | 51.283         | 0.165                     | 24                  | LGM           |
| HFIGB112A       | B              | M1                | 2             | 1            | 47.434         | 0.174                     | 24                  | LGM           |
| HFIGB113A       | B              | M1                | 2             | 1            | 48.741         | 0.172                     | 24                  | LGM           |
| HFIGB211A       | B              | M2                | 2             | 2            | 49.322         | 0.166                     | 24                  | LGM           |
| HFIGB212A       | B              | M2                | 2             | 2            | 49.005         | 0.175                     | 24                  | LGM           |
| HFIGB213A       | B              | M2                | 2             | 2            | 49.499         | 0.174                     | 24                  | LGM           |
| HFIGC111A       | C              | M1                | 3             | 1            | 50.305         | 0.170                     | 24                  | LGM           |
| HFIGC112A       | C              | M1                | 3             | 1            | 51.152         | 0.172                     | 24                  | LGM           |
| HFIGC113A       | C              | M1                | 3             | 1            | 49.517         | 0.173                     | 24                  | LGM           |
| HFIGC211A       | C              | M2                | 3             | 2            | 45.150         | 0.168                     | 24                  | LGM           |
| HFIGC212A       | C              | M2                | 3             | 2            | 48.727         | 0.177                     | 24                  | LGM           |
| HFIGC213A       | C              | M2                | 3             | 2            | 48.053         | 0.174                     | 24                  | LGM           |

| Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] |
|---------------------|--------------------------------|
| 0.0072              | 49.676                         |
| 0.0075              | 50.991                         |
| 0.0074              | 50.993                         |
| 0.0074              | 50.731                         |
| 0.0070              | 46.316                         |
| 0.0075              | 49.145                         |
| 0.0073              | 50.592                         |
| 0.0069              | 49.096                         |
| 0.0072              | 47.717                         |
| 0.0072              | 48.624                         |
| 0.0069              | 47.400                         |
| 0.0073              | 49.756                         |
| 0.0072              | 49.719                         |
| 0.0071              | 49.393                         |
| 0.0072              | 50.974                         |
| 0.0072              | 49.455                         |
| 0.0070              | 43.909                         |
| 0.0074              | 49.831                         |
| 0.0072              | 48.266                         |

Average 48.894  
 Standard Dev. 1.448  
 Coeff. of Var. [%] 2.962  
 Min. 45.150  
 Max. 51.283  
 Number of Spec. 19

Average<sub>norm</sub> 0.0072 49.083  
 Standard Dev.<sub>norm</sub> 1.793  
 Coeff. of Var. [%]<sub>norm</sub> 3.653  
 Min. 0.0069 43.909  
 Max. 0.0075 50.993  
 Number of Spec. 19

**Laminate Open Hole Compression Properties (OHC1) -- (RTD)**  
**Normalized Strength**  
 HEXCEL 8552 - IM7 UNI PREPREG



**Laminate Open Hole Compression Properties (OHC1) -- (ETW)**  
**Strength**  
 HEXCEL 8552 - IM7 UNI PREPREG

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Avg. Specimen Thickn. [in] | # Plies in Laminate | Failure Modes |
|-----------------|----------------|-------------------|---------------|--------------|----------------|----------------------------|---------------------|---------------|
| HFIGA117D       | A              | M1                | 1             | 1            | 37.501         | 0.180                      | 24                  | LGM           |
| HFIGA118D       | A              | M1                | 1             | 1            | 36.396         | 0.172                      | 24                  | LGM           |
| HFIGA119D       | A              | M1                | 1             | 1            | 36.163         | 0.179                      | 24                  | LGM           |
| HFIGA11AD       | A              | M1                | 1             | 1            | 35.770         | 0.176                      | 24                  | LGM           |
| HFIGA216D       | A              | M2                | 1             | 2            | 35.276         | 0.177                      | 24                  | LGM           |
| HFIGA217D       | A              | M2                | 1             | 2            | 35.697         | 0.179                      | 24                  | LGM           |
| HFIGA218D       | A              | M2                | 1             | 2            | 33.586         | 0.173                      | 24                  | LGM           |
| HFIGB116D       | B              | M1                | 2             | 1            | 34.888         | 0.172                      | 24                  | LGM           |
| HFIGB117D       | B              | M1                | 2             | 1            | 35.442         | 0.174                      | 24                  | LGM           |
| HFIGB118D       | B              | M1                | 2             | 1            | 34.874         | 0.169                      | 24                  | LGM           |
| HFIGB216D       | B              | M2                | 2             | 2            | 36.226         | 0.173                      | 24                  | LGM           |
| HFIGB217D       | B              | M2                | 2             | 2            | 33.749         | 0.176                      | 24                  | LGM           |
| HFIGB218D       | B              | M2                | 2             | 2            | 36.958         | 0.169                      | 24                  | LGM           |
| HFIGC116D       | C              | M                 | 3             | 1            | 34.153         | 0.173                      | 24                  | LGM           |
| HFIGC117D       | C              | M1                | 3             | 1            | 33.898         | 0.176                      | 24                  | LGM           |
| HFIGC118D       | C              | M1                | 3             | 1            | 34.086         | 0.168                      | 24                  | LGM           |
| HFIGC216D       | C              | M2                | 3             | 2            | 36.149         | 0.173                      | 24                  | LGM           |
| HFIGC217D       | C              | M2                | 3             | 2            | 34.019         | 0.177                      | 24                  | LGM           |
| HFIGC218D       | C              | M2                | 3             | 2            | 35.613         | 0.171                      | 24                  | LGM           |

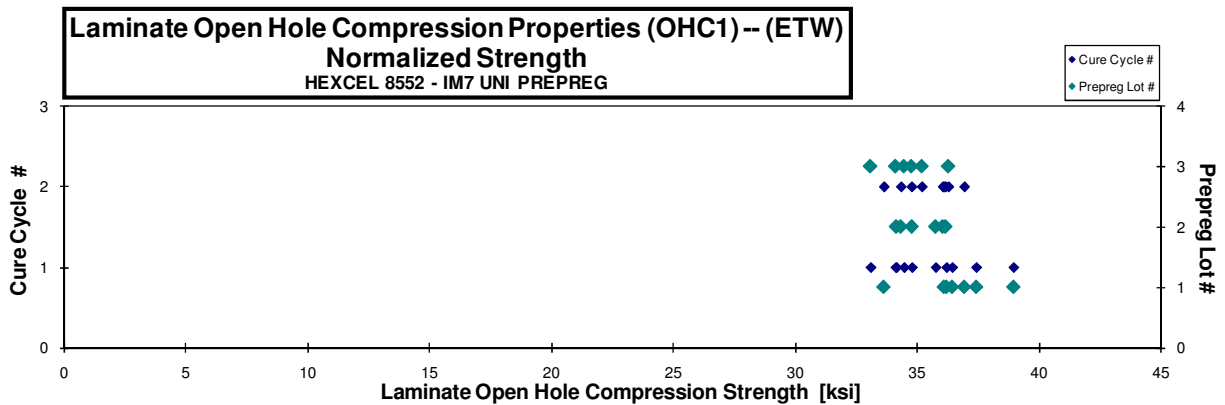
normalizing  $t_{ply}$   
 [in]

0.0072

| Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] |
|---------------------|--------------------------------|
| 0.0075              | 38.956                         |
| 0.0072              | 36.203                         |
| 0.0075              | 37.426                         |
| 0.0073              | 36.436                         |
| 0.0074              | 36.102                         |
| 0.0074              | 36.933                         |
| 0.0072              | 33.628                         |
| 0.0072              | 34.781                         |
| 0.0073              | 35.757                         |
| 0.0070              | 34.144                         |
| 0.0072              | 36.163                         |
| 0.0073              | 34.329                         |
| 0.0070              | 36.049                         |
| 0.0072              | 34.110                         |
| 0.0073              | 34.457                         |
| 0.0070              | 33.080                         |
| 0.0072              | 36.278                         |
| 0.0074              | 34.764                         |
| 0.0071              | 35.190                         |

Average 35.287  
 Standard Dev. 1.148  
 Coeff. of Var. [%] 3.252  
 Min. 33.586  
 Max. 37.501  
 Number of Spec. 19

Average<sub>norm</sub> 0.0072 35.515  
 Standard Dev.<sub>norm</sub> 1.445  
 Coeff. of Var. [%]<sub>norm</sub> 4.069  
 Min. 0.0070 33.080  
 Max. 0.0075 38.956  
 Number of Spec. 19



## 4.23 Open Hole Compression 2 Properties

**Laminate Open Hole Compression Properties (OHC2) -- (RTD)**  
**Strength**  
 HEXCEL 8552 - IM7 UNI PREPREG

normalizing  $t_{ply}$   
 [in]  
 0.0072

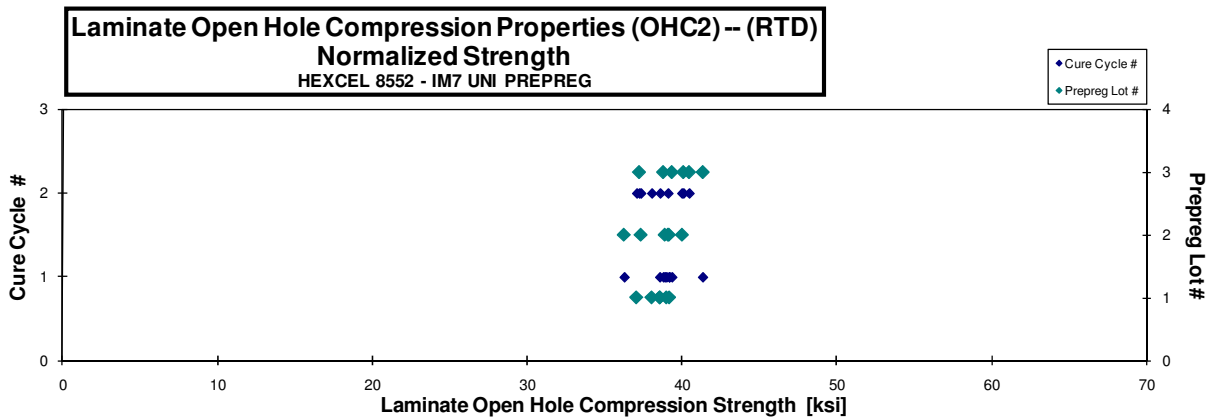
| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Avg. Specimen Thickn. [in] | # Plies in Laminate | Failure Modes |
|-----------------|----------------|-------------------|---------------|--------------|----------------|----------------------------|---------------------|---------------|
| HFIHA111A*      | A              | M1                | 1             | 1            |                |                            |                     |               |
| HFIHA112A       | A              | M1                | 1             | 1            | 37.632         | 0.149                      | 20                  | LGM           |
| HFIHA113A       | A              | M1                | 1             | 1            | 37.773         | 0.147                      | 20                  | AGM / LGM     |
| HFIHA114A       | A              | M1                | 1             | 1            | 38.392         | 0.147                      | 20                  | LGM           |
| HFIHA212A       | A              | M2                | 1             | 2            | 35.927         | 0.149                      | 20                  | LGM           |
| HFIHA213A       | A              | M2                | 1             | 2            | 37.419         | 0.146                      | 20                  | LGM           |
| HFIHA214A       | A              | M2                | 1             | 2            | 37.776         | 0.147                      | 20                  | LGM           |
| HFIHB111A       | B              | M1                | 2             | 1            | 36.276         | 0.144                      | 20                  | LGM           |
| HFIHB112A       | B              | M1                | 2             | 1            | 39.054         | 0.143                      | 20                  | LGM           |
| HFIHB113A       | B              | M1                | 2             | 1            | 39.284         | 0.144                      | 20                  | LGM / AGM     |
| HFIHB212A       | B              | M2                | 2             | 2            | 39.428         | 0.143                      | 20                  | LGM           |
| HFIHB213A       | B              | M2                | 2             | 2            | 40.133         | 0.144                      | 20                  | LGM           |
| HFIHB214A       | B              | M2                | 2             | 2            | 37.460         | 0.144                      | 20                  | LGM           |
| HFIHC111A       | C              | M1                | 3             | 1            | 39.165         | 0.143                      | 20                  | LGM           |
| HFIHC112A       | C              | M1                | 3             | 1            | 38.456         | 0.147                      | 20                  | LGM           |
| HFIHC113A       | C              | M1                | 3             | 1            | 40.851         | 0.146                      | 20                  | LGM           |
| HFIHC212A       | C              | M2                | 3             | 2            | 37.306         | 0.144                      | 20                  | LGM / AGM     |
| HFIHC213A       | C              | M2                | 3             | 2            | 39.456         | 0.148                      | 20                  | LGM           |
| HFIHC214A       | C              | M2                | 3             | 2            | 39.482         | 0.146                      | 20                  | LGM           |

| Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] |
|---------------------|--------------------------------|
| 0.0075              | 38.983                         |
| 0.0073              | 38.552                         |
| 0.0073              | 39.174                         |
| 0.0074              | 37.062                         |
| 0.0073              | 38.042                         |
| 0.0074              | 38.585                         |
| 0.0072              | 36.255                         |
| 0.0072              | 38.896                         |
| 0.0072              | 39.166                         |
| 0.0071              | 39.085                         |
| 0.0072              | 39.993                         |
| 0.0072              | 37.338                         |
| 0.0071              | 38.793                         |
| 0.0074              | 39.337                         |
| 0.0073              | 41.333                         |
| 0.0072              | 37.237                         |
| 0.0074              | 40.456                         |
| 0.0073              | 40.090                         |

\*Data from was removed due to thickness variation due to pinching on edge of panel during bagging.

Average 38.404  
 Standard Dev. 1.310  
 Coeff. of Var. [%] 3.412  
 Min. 35.927  
 Max. 40.851  
 Number of Spec. 18

Average<sub>norm</sub> 0.0073 38.799  
 Standard Dev.<sub>norm</sub> 1.276  
 Coeff. of Var. [%]<sub>norm</sub> 3.290  
 Min. 0.0071 36.255  
 Max. 0.0075 41.333  
 Number of Spec. 18 18



**Laminate Open Hole Compression Properties (OHC2) -- (ETW)**  
**Strength**  
 HEXCEL 8552 - IM7 UNI PREPREG

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Avg. Specimen Thicken. [in] | # Plies in Laminate | Failure Modes |
|-----------------|----------------|-------------------|---------------|--------------|----------------|-----------------------------|---------------------|---------------|
| HFIHA117D       | A              | M2                | 1             | 2            | 24.954         | 0.149                       | 20                  | LGM           |
| HFIHA118D       | A              | M2                | 1             | 2            | 25.246         | 0.143                       | 20                  | LGM           |
| HFIHA119D       | A              | M2                | 1             | 2            | 25.126         | 0.148                       | 20                  | LGM           |
| HFIHA11CD       | A              | M2                | 1             | 2            | 25.557         | 0.148                       | 20                  | LGM           |
| HFIHA217D       | A              | M2                | 1             | 2            | 25.927         | 0.148                       | 20                  | LGM           |
| HFIHA218D       | A              | M2                | 1             | 2            | 25.139         | 0.146                       | 20                  | LGM           |
| HFIHA21AD       | A              | M2                | 1             | 2            | 26.064         | 0.148                       | 20                  | LGM           |
| HFIHB117D       | B              | M1                | 2             | 1            | 25.576         | 0.144                       | 20                  | LGM           |
| HFIHB118D       | B              | M1                | 2             | 1            | 24.776         | 0.140                       | 20                  | LGM           |
| HFIHB119D       | B              | M1                | 2             | 1            | 25.648         | 0.144                       | 20                  | LGM           |
| HFIHB217D       | B              | M2                | 2             | 2            | 24.900         | 0.144                       | 20                  | LGM           |
| HFIHB218D       | B              | M2                | 2             | 2            | 24.411         | 0.139                       | 20                  | LGM           |
| HFIHB219D       | B              | M2                | 2             | 2            | 26.302         | 0.145                       | 20                  | LGM           |
| HFIHC117D       | C              | M1                | 3             | 1            | 26.780         | 0.148                       | 20                  | LGM           |
| HFIHC118D       | C              | M1                | 3             | 1            | 27.563         | 0.142                       | 20                  | LGM           |
| HFIHC11AD       | C              | M1                | 3             | 1            | 26.133         | 0.145                       | 20                  | LGM           |
| HFIHC217D       | C              | M2                | 3             | 2            | 27.200         | 0.145                       | 20                  | LGM           |
| HFIHC218D*      | C              | M2                | 3             | 2            | 22.243         | 0.145                       | 20                  | LGM           |
| HFIHC219D       | C              | M2                | 3             | 2            | 25.674         | 0.145                       | 20                  | LGM           |
| HFIHC21AD       | C              | M2                | 3             | 2            | 26.151         | 0.145                       | 20                  | LGM           |

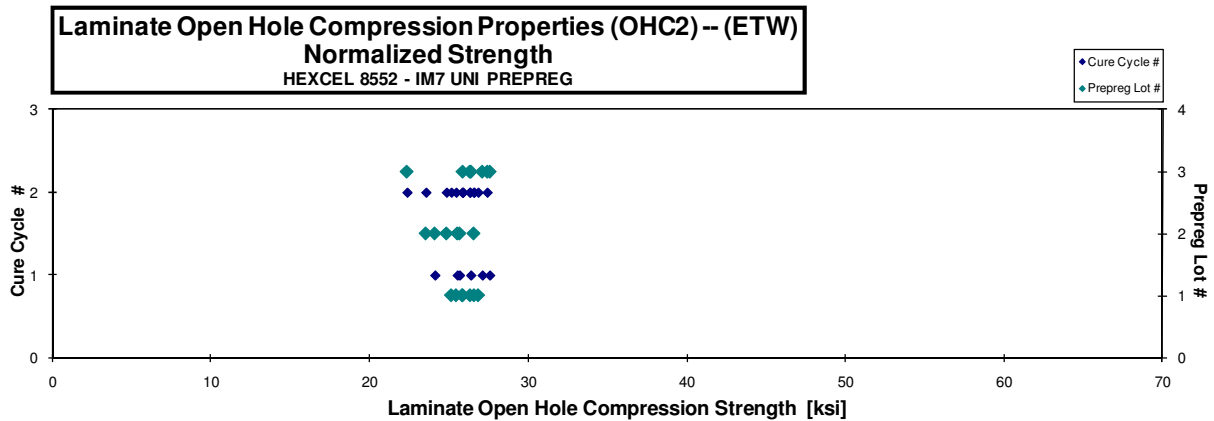
reviewed data and specimens; found no cause for removal

Average 25.568  
 Standard Dev. 1.125  
 Coeff. of Var. [%] 4.399  
 Min. 22.243  
 Max. 27.563  
 Number of Spec. 20

Average<sub>norm</sub> 0.0073 25.765  
 Standard Dev.<sub>norm</sub> 1.295  
 Coeff. of Var. [%]<sub>norm</sub> 5.025  
 Min. 0.0069 22.359  
 Max. 0.0075 27.568  
 Number of Spec. 20 20

normalizing  $t_{ply}$   
 [in]  
 0.0072

| Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] |
|---------------------|--------------------------------|
| 0.0075              | 25.870                         |
| 0.0072              | 25.143                         |
| 0.0074              | 25.835                         |
| 0.0074              | 26.326                         |
| 0.0074              | 26.581                         |
| 0.0073              | 25.453                         |
| 0.0074              | 26.839                         |
| 0.0072              | 25.526                         |
| 0.0070              | 24.114                         |
| 0.0072              | 25.665                         |
| 0.0072              | 24.842                         |
| 0.0069              | 23.549                         |
| 0.0073              | 26.552                         |
| 0.0074              | 27.568                         |
| 0.0071              | 27.098                         |
| 0.0073              | 26.384                         |
| 0.0073              | 27.411                         |
| 0.0072              | 22.359                         |
| 0.0073              | 25.864                         |
| 0.0072              | 26.317                         |



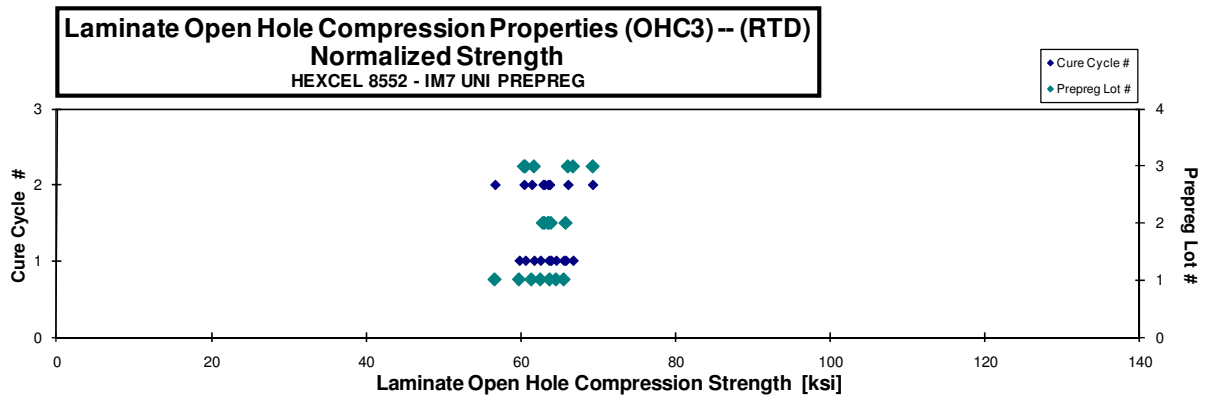


## 4.24 Open Hole Compression 3 Properties

| Laminate Open Hole Compression Properties (OHC3) -- (RTD)<br>Strength<br>HEXCEL 8552 - IM7 UNI PREPREG |                |                   |               |              |                |                            |                     |               | normalizing $t_{ply}$<br>[in]<br>0.0072 |                                |
|--------------------------------------------------------------------------------------------------------|----------------|-------------------|---------------|--------------|----------------|----------------------------|---------------------|---------------|-----------------------------------------|--------------------------------|
| Specimen Number                                                                                        | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Avg. Specimen Thickn. [in] | # Plies in Laminate | Failure Modes | Avg. $t_{ply}$ [in]                     | Strength <sub>norm</sub> [ksi] |
| HFIIA112A                                                                                              | A              | M1                | 1             | 1            | 60.942         | 0.141                      | 20                  | LGM           | 0.0071                                  | 59.772                         |
| HFIIA113A                                                                                              | A              | M1                | 1             | 1            | 60.721         | 0.148                      | 20                  | LGM           | 0.0074                                  | 62.513                         |
| HFIIA114A                                                                                              | A              | M1                | 1             | 1            | 64.256         | 0.147                      | 20                  | LGM           | 0.0073                                  | 65.520                         |
| HFIIA115A                                                                                              | A              | M1                | 1             | 1            | 63.061         | 0.147                      | 20                  | LGM / AGM     | 0.0074                                  | 64.535                         |
| HFIIA211A                                                                                              | A              | M2                | 1             | 2            | 59.243         | 0.138                      | 20                  | LGM           | 0.0069                                  | 56.631                         |
| HFIIA212A                                                                                              | A              | M2                | 1             | 2            | 59.063         | 0.150                      | 20                  | LGM           | 0.0075                                  | 61.381                         |
| HFIIA213A                                                                                              | A              | M2                | 1             | 2            | 62.584         | 0.147                      | 20                  | LGM           | 0.0073                                  | 63.700                         |
| HFIIB111A                                                                                              | B              | M1                | 2             | 1            | 67.551         | 0.140                      | 20                  | LGM           | 0.0070                                  | 65.799                         |
| HFIIB112A                                                                                              | B              | M1                | 2             | 1            | 63.679         | 0.144                      | 20                  | AGM           | 0.0072                                  | 63.613                         |
| HFIIB113A                                                                                              | B              | M1                | 2             | 1            | 63.819         | 0.144                      | 20                  | LGM           | 0.0072                                  | 63.863                         |
| HFIIB211A                                                                                              | B              | M2                | 2             | 2            | 65.022         | 0.139                      | 20                  | LGM           | 0.0070                                  | 62.862                         |
| HFIIB212A                                                                                              | B              | M2                | 2             | 2            | 62.890         | 0.145                      | 20                  | LGM           | 0.0073                                  | 63.523                         |
| HFIIB213A                                                                                              | B              | M2                | 2             | 2            | 63.372         | 0.143                      | 20                  | LGM           | 0.0072                                  | 63.050                         |
| HFIIIC111A                                                                                             | C              | M1                | 3             | 1            | 64.202         | 0.138                      | 20                  | LGM           | 0.0069                                  | 61.690                         |
| HFIIIC112A                                                                                             | C              | M1                | 3             | 1            | 60.008         | 0.145                      | 20                  | LGM           | 0.0073                                  | 60.570                         |
| HFIIIC113A                                                                                             | C              | M1                | 3             | 1            | 66.739         | 0.144                      | 20                  | LGM           | 0.0072                                  | 66.731                         |
| HFIIIC211A                                                                                             | C              | M2                | 3             | 2            | 62.358         | 0.139                      | 20                  | LGM           | 0.0070                                  | 60.402                         |
| HFIIIC212A                                                                                             | C              | M2                | 3             | 2            | 65.106         | 0.146                      | 20                  | LGM           | 0.0073                                  | 66.078                         |
| HFIIIC213A                                                                                             | C              | M2                | 3             | 2            | 69.243         | 0.144                      | 20                  | LGM           | 0.0072                                  | 69.283                         |

|                    |        |                                    |        |        |
|--------------------|--------|------------------------------------|--------|--------|
| Average            | 63.361 | Average <sub>norm</sub>            | 0.0072 | 63.238 |
| Standard Dev.      | 2.714  | Standard Dev. <sub>norm</sub>      |        | 2.872  |
| Coeff. of Var. [%] | 4.284  | Coeff. of Var. [%] <sub>norm</sub> |        | 4.542  |
| Min.               | 59.063 | Min.                               | 0.0069 | 56.631 |
| Max.               | 69.243 | Max.                               | 0.0075 | 69.283 |
| Number of Spec.    | 19     | Number of Spec.                    |        | 19     |



**Laminate Open Hole Compression Properties (OHC3) -- (ETW)**  
**Strength**  
 HEXCEL 8552 - IM7 UNI PREPREG

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Avg. Specimen Thckn. [in] | # Plies in Laminate | Failure Modes |
|-----------------|----------------|-------------------|---------------|--------------|----------------|---------------------------|---------------------|---------------|
| HFIIA117D       | A              | M1                | 1             | 1            | 43.892         | 0.147                     | 20                  | LGM           |
| HFIIA119D       | A              | M1                | 1             | 1            | 46.817         | 0.148                     | 20                  | LGM           |
| HFIIA11AD       | A              | M1                | 1             | 1            | 45.668         | 0.147                     | 20                  | LGM           |
| HFIIA11BD       | A              | M1                | 1             | 1            | 47.637         | 0.147                     | 20                  | LGM           |
| HFIIA217D       | A              | M2                | 1             | 2            | 43.825         | 0.149                     | 20                  | LGM           |
| HFIIA218D       | A              | M2                | 1             | 2            | 44.311         | 0.144                     | 20                  | LGM           |
| HFIIA219D       | A              | M2                | 1             | 2            | 46.269         | 0.148                     | 20                  | LGM           |
| HFII B117D      | B              | M1                | 2             | 1            | 50.124         | 0.145                     | 20                  | LGM           |
| HFII B118D      | B              | M1                | 2             | 1            | 45.102         | 0.143                     | 20                  | LGM           |
| HFII B119D      | B              | M1                | 2             | 1            | 48.963         | 0.147                     | 20                  | LGM           |
| HFII B217D      | B              | M2                | 2             | 2            | 44.869         | 0.145                     | 20                  | LGM           |
| HFII B218D      | B              | M2                | 2             | 2            | 45.558         | 0.142                     | 20                  | LGM           |
| HFII B21AD      | B              | M2                | 2             | 2            | 46.396         | 0.146                     | 20                  | LGM           |
| HFII C117D      | C              | M1                | 3             | 1            | 44.907         | 0.145                     | 20                  | LGM           |
| HFII C118D      | C              | M1                | 3             | 1            | 48.614         | 0.141                     | 20                  | LGM           |
| HFII C11AD      | C              | M1                | 3             | 1            | 45.907         | 0.146                     | 20                  | LGM           |
| HFII C216D      | C              | M2                | 3             | 2            | 42.659         | 0.142                     | 20                  | LGM           |
| HFII C217D      | C              | M2                | 3             | 2            | 46.524         | 0.143                     | 20                  | LGM           |
| HFII C218D      | C              | M2                | 3             | 2            | 51.350         | 0.137                     | 20                  | LGM           |
| HFII C21AD      | C              | M2                | 3             | 2            | 44.945         | 0.143                     | 20                  | LGM           |

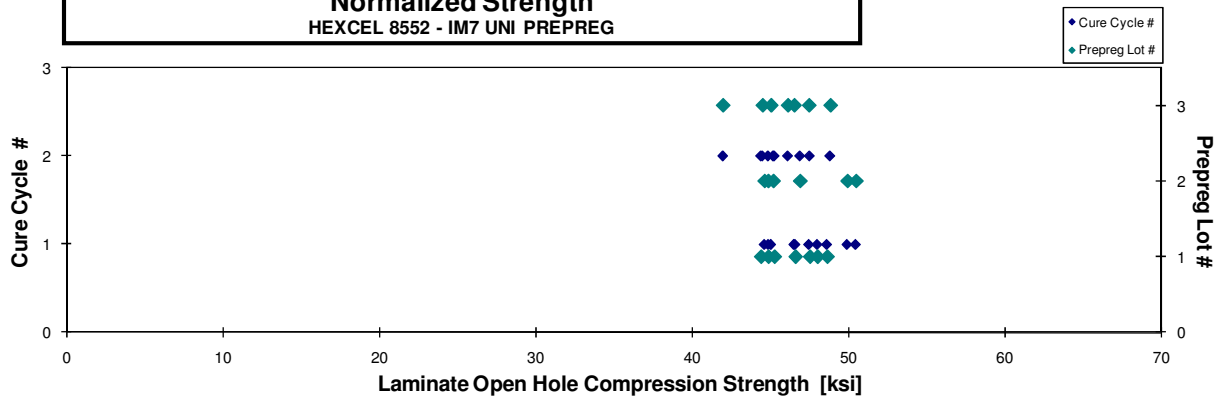
Average 46.217  
 Standard Dev. 2.201  
 Coeff. of Var. [%] 4.762  
 Min. 42.659  
 Max. 51.350  
 Number of Spec. 20

Average<sub>norm</sub> 0.0072 46.417  
 Standard Dev.<sub>norm</sub> 2.111  
 Coeff. of Var. [%]<sub>norm</sub> 4.548  
 Min. 0.0069 42.007  
 Max. 0.0074 50.495  
 Number of Spec. 20

normalizing  $t_{ply}$   
 [in]  
 0.0072

| Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] |
|---------------------|--------------------------------|
| 0.0074              | 44.908                         |
| 0.0074              | 48.036                         |
| 0.0074              | 46.630                         |
| 0.0074              | 48.657                         |
| 0.0074              | 45.296                         |
| 0.0072              | 44.434                         |
| 0.0074              | 47.549                         |
| 0.0073              | 50.495                         |
| 0.0071              | 44.653                         |
| 0.0073              | 49.949                         |
| 0.0073              | 45.222                         |
| 0.0071              | 44.893                         |
| 0.0073              | 46.928                         |
| 0.0072              | 45.078                         |
| 0.0070              | 47.499                         |
| 0.0073              | 46.550                         |
| 0.0071              | 42.007                         |
| 0.0071              | 46.152                         |
| 0.0069              | 48.860                         |
| 0.0071              | 44.534                         |

**Laminate Open Hole Compression Properties (OHC3) -- (ETW)**  
**Normalized Strength**  
 HEXCEL 8552 - IM7 UNI PREPREG



## 4.25 Filled-Hole Compression 1 Properties

**Laminate Filled-Hole Compression Properties (FHC1) -- (RTD)**  
**Strength**  
 HEXCEL 8552 - IM7 UNI PREPREG

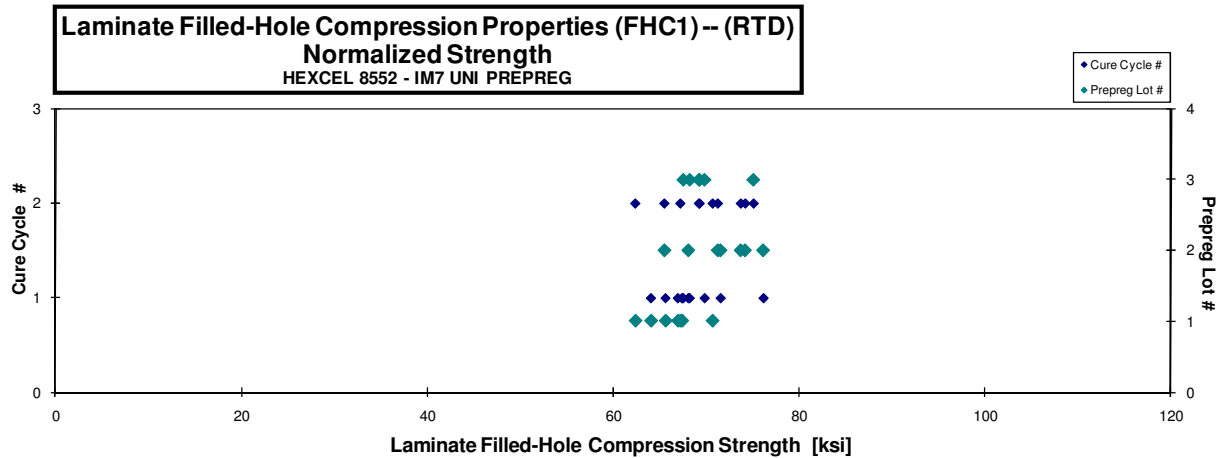
normalizing  $t_{ply}$   
 [in]  
 0.0072

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Avg. Specimen Thicken. [in] | # Plies in Laminate | Failure Mode |
|-----------------|----------------|-------------------|---------------|--------------|----------------|-----------------------------|---------------------|--------------|
| HF17A111A       | A              | M1                | 1             | 1            | 65.463         | 0.177                       | 24                  | LGF          |
| HF17A112A       | A              | M1                | 1             | 1            | 62.442         | 0.177                       | 24                  | MGM          |
| HF17A113A       | A              | M1                | 1             | 1            | 64.338         | 0.176                       | 24                  | MGF          |
| HF17A116A       | A              | M1                | 1             | 1            | 65.893         | 0.177                       | 24                  | MGF          |
| HF17A211A       | A              | M2                | 1             | 2            | 63.946         | 0.168                       | 24                  | MGF          |
| HF17A212A       | A              | M2                | 1             | 2            | 66.211         | 0.175                       | 24                  | MGF          |
| HF17A213A       | A              | M2                | 1             | 2            | 70.538         | 0.173                       | 24                  | MGF          |
| HF17B112A       | B              | M1                | 2             | 1            | 76.196         | 0.173                       | 24                  | MGF          |
| HF17B113A       | B              | M1                | 2             | 1            | 72.336         | 0.171                       | 24                  | MGF          |
| HF17B114A       | B              | M1                | 2             | 1            | 68.620         | 0.171                       | 24                  | MGF          |
| HF17B211A       | B              | M2                | 2             | 2            | 68.994         | 0.164                       | 24                  | MGF          |
| HF17B212A       | B              | M2                | 2             | 2            | 72.258         | 0.176                       | 24                  | MGF          |
| HF17B213A       | B              | M2                | 2             | 2            | 71.491         | 0.172                       | 24                  | MGF          |
| HF17B214A       | B              | M2                | 2             | 2            | 74.418         | 0.172                       | 24                  | MGF          |
| HF17C111A       | C              | M1                | 3             | 1            | 69.807         | 0.169                       | 24                  | LGF          |
| HF17C112A       | C              | M1                | 3             | 1            | 67.037         | 0.174                       | 24                  | MGF          |
| HF17C113A       | C              | M1                | 3             | 1            | 70.097         | 0.172                       | 24                  | MGM          |
| HF17C211A       | C              | M2                | 3             | 2            | 71.561         | 0.167                       | 24                  | MGF          |
| HF17C213A       | C              | M2                | 3             | 2            | 75.282         | 0.172                       | 24                  | MGF          |
| HF17C214A       | C              | M2                | 3             | 2            | 69.069         | 0.173                       | 24                  | LGF          |

| Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] |
|---------------------|--------------------------------|
| 0.0074              | 66.953                         |
| 0.0074              | 64.032                         |
| 0.0073              | 65.610                         |
| 0.0074              | 67.393                         |
| 0.0070              | 62.343                         |
| 0.0073              | 67.201                         |
| 0.0072              | 70.695                         |
| 0.0072              | 76.167                         |
| 0.0071              | 71.555                         |
| 0.0071              | 68.064                         |
| 0.0068              | 65.481                         |
| 0.0073              | 73.728                         |
| 0.0072              | 71.250                         |
| 0.0072              | 74.210                         |
| 0.0070              | 68.218                         |
| 0.0073              | 67.515                         |
| 0.0072              | 69.820                         |
| 0.0070              | 69.277                         |
| 0.0072              | 75.100                         |
| 0.0072              | 69.222                         |

Average 69.300  
 Standard Dev. 3.851  
 Coeff. of Var. [%] 5.557  
 Min. 62.442  
 Max. 76.196  
 Number of Spec. 20

Average<sub>norm</sub> 0.0072 69.192  
 Standard Dev.<sub>norm</sub> 3.693  
 Coeff. of Var. [%]<sub>norm</sub> 5.338  
 Min. 0.0068 62.343  
 Max. 0.0074 76.167  
 Number of Spec. 20 20



**Laminate Filled-Hole Compression Properties (FHC1) -- (ETW)  
Strength**  
HEXCEL 8552 - IM7 UNI PREPREG

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Avg. Specimen Thickn. [in] | # Plies in Laminate | Failure Mode |
|-----------------|----------------|-------------------|---------------|--------------|----------------|----------------------------|---------------------|--------------|
| HF17A117D       | A              | M1                | 1             | 1            | 52.767         | 0.179                      | 24                  | LGM          |
| HF17A118D       | A              | M1                | 1             | 1            | 51.092         | 0.167                      | 24                  | LGM          |
| HF17A119D       | A              | M1                | 1             | 1            | 50.055         | 0.178                      | 24                  | LGM          |
| HF17A11AD       | A              | M1                | 1             | 1            | 48.041         | 0.178                      | 24                  | LGM          |
| HF17A216D       | A              | M2                | 1             | 2            | 49.903         | 0.173                      | 24                  | LGM          |
| HF17A218D       | A              | M2                | 1             | 2            | 48.614         | 0.170                      | 24                  | LGM          |
| HF17A219D       | A              | M2                | 1             | 2            | 47.933         | 0.176                      | 24                  | LGM          |
| HF17B116D       | B              | M1                | 2             | 1            | 54.567         | 0.171                      | 24                  | LGM          |
| HF17B117D       | B              | M1                | 2             | 1            | 51.569         | 0.173                      | 24                  | LGM          |
| HF17B119D       | B              | M1                | 2             | 1            | 51.627         | 0.171                      | 24                  | LGM          |
| HF17B216D       | B              | M2                | 2             | 2            | 53.877         | 0.172                      | 24                  | LGM          |
| HF17B217D       | B              | M2                | 2             | 2            | 51.456         | 0.174                      | 24                  | LGM          |
| HF17B21AD       | B              | M2                | 2             | 2            | 51.286         | 0.163                      | 24                  | LGM          |
| HF17C116D       | C              | M1                | 3             | 1            | 51.701         | 0.172                      | 24                  | LGM, LGF     |
| HF17C119D       | C              | M1                | 3             | 1            | 52.987         | 0.175                      | 24                  | LGM, LGF     |
| HF17C11AD       | C              | M1                | 3             | 1            | 53.041         | 0.172                      | 24                  | LGM          |
| HF17C217D       | C              | M2                | 3             | 2            | 53.076         | 0.174                      | 24                  | LGM          |
| HF17C218D       | C              | M2                | 3             | 2            | 52.625         | 0.174                      | 24                  | LGM, LGO     |
| HF17C21AD       | C              | M2                | 3             | 2            | 54.428         | 0.177                      | 24                  | LGM          |

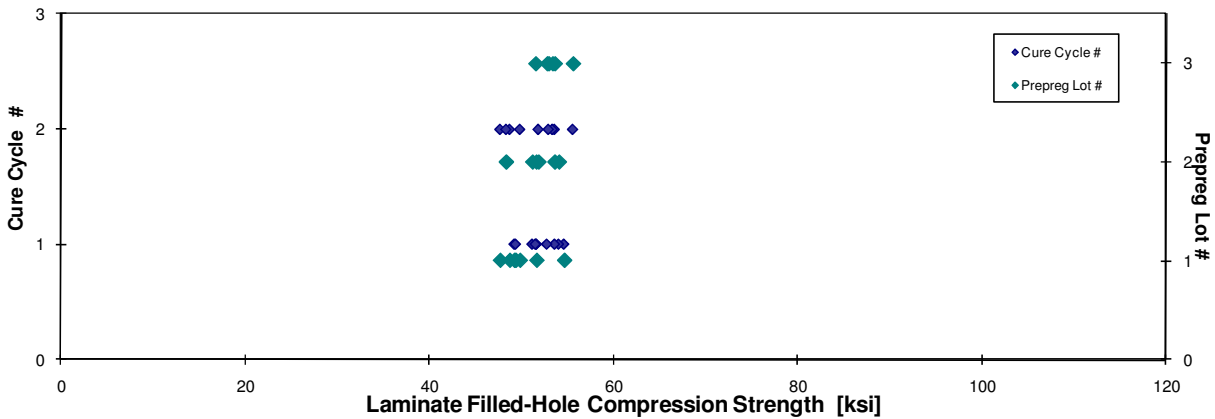
normalizing  $t_{ply}$   
[in]  
0.0072

| Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] |
|---------------------|--------------------------------|
| 0.007               | 54.645                         |
| 0.007               | 49.254                         |
| 0.007               | 51.653                         |
| 0.007               | 49.389                         |
| 0.007               | 49.855                         |
| 0.007               | 47.705                         |
| 0.007               | 48.742                         |
| 0.007               | 54.067                         |
| 0.007               | 51.623                         |
| 0.007               | 51.204                         |
| 0.007               | 53.612                         |
| 0.007               | 51.863                         |
| 0.007               | 48.352                         |
| 0.007               | 51.546                         |
| 0.007               | 53.631                         |
| 0.007               | 52.790                         |
| 0.007               | 53.393                         |
| 0.007               | 52.965                         |
| 0.007               | 55.604                         |

Average 51.613  
Standard Dev. 1.990  
Coeff. of Var. [%] 3.855  
Min. 47.933  
Max. 54.567  
Number of Spec. 19

Average<sub>norm</sub> 0.0072 51.679  
Standard Dev.<sub>norm</sub> 2.279  
Coeff. of Var. [%]<sub>norm</sub> 4.410  
Min. 0.0068 47.705  
Max. 0.0075 55.604  
Number of Spec. 19 19

**Laminate Filled-Hole Compression Properties (FHC1) -- (ETW)  
Normalized Strength**  
HEXCEL 8552 - IM7 UNI PREPREG



## 4.26 Filled-Hole Compression 2 Properties

### Laminate Filled-Hole Compression Properties (FHC2) -- (RTD) Strength HEXCEL 8552 - IM7 UNI PREPREG

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Avg. Specimen Thckn. [in] | # Plies in Laminate | Failure Mode |
|-----------------|----------------|-------------------|---------------|--------------|----------------|---------------------------|---------------------|--------------|
| HF18A111A       | A              | M1                | 1             | 1            | 52.194         | 0.141                     | 20                  | MGF          |
| HF18A112A       | A              | M1                | 1             | 1            | 56.130         | 0.148                     | 20                  | MGF          |
| HF18A113A       | A              | M1                | 1             | 1            | 56.315         | 0.146                     | 20                  | MGF          |
| HF18A114A       | A              | M1                | 1             | 1            | 54.064         | 0.147                     | 20                  | MGF          |
| HF18A212A       | A              | M2                | 1             | 2            | 55.486         | 0.147                     | 20                  | LGF          |
| HF18A213A       | A              | M2                | 1             | 2            | 53.907         | 0.146                     | 20                  | AGM          |
| HF18A214A       | A              | M2                | 1             | 2            | 54.713         | 0.147                     | 20                  | MGF          |
| HF18B111A       | B              | M1                | 2             | 1            | 51.968         | 0.140                     | 20                  | AGM          |
| HF18B112A       | B              | M1                | 2             | 1            | 53.821         | 0.146                     | 20                  | MGF          |
| HF18B113A       | B              | M1                | 2             | 1            | 56.128         | 0.144                     | 20                  | MGF          |
| HF18B211A       | B              | M2                | 2             | 2            | 54.346         | 0.142                     | 20                  | MGF          |
| HF18B212A       | B              | M2                | 2             | 2            | 50.572         | 0.144                     | 20                  | LGM          |
| HF18B213A       | B              | M2                | 2             | 2            | 53.535         | 0.144                     | 20                  | AGM          |
| HF18C111A       | C              | M1                | 3             | 1            | 54.090         | 0.144                     | 20                  | MGF          |
| HF18C112A       | C              | M1                | 3             | 1            | 53.683         | 0.144                     | 20                  | MGF          |
| HF18C113A       | C              | M1                | 3             | 1            | 57.536         | 0.144                     | 20                  | MGF          |
| HF18C211A       | C              | M2                | 3             | 2            | 52.267         | 0.144                     | 20                  | LGF          |
| HF18C215A       | C              | M2                | 3             | 2            | 55.097         | 0.146                     | 20                  | MGF          |
| HF18C216A       | C              | M2                | 3             | 2            | 54.892         | 0.146                     | 20                  | MGF          |

Note: HF18A211A was not included due to bad failure.

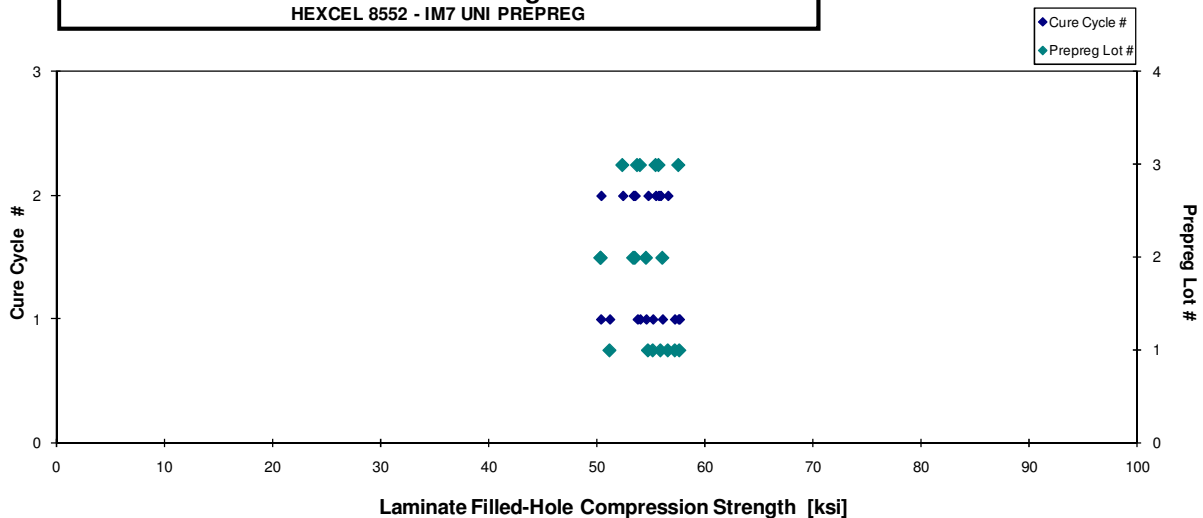
Average 54.250  
Standard Dev. 1.717  
Coeff. of Var. [%] 3.166  
Min. 50.572  
Max. 57.536  
Number of Spec. 19

Average<sub>norm</sub> 0.0072 54.566  
Standard Dev.<sub>norm</sub> 2.252  
Coeff. of Var. [%]<sub>norm</sub> 4.127  
Min. 0.0070 50.410  
Max. 0.0074 57.708  
Number of Spec. 19 19

normalizing  $t_{ply}$   
[in]  
0.0072

| Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] |
|---------------------|--------------------------------|
| 0.0071              | 51.240                         |
| 0.0074              | 57.708                         |
| 0.0073              | 57.279                         |
| 0.0074              | 55.241                         |
| 0.0074              | 56.649                         |
| 0.0073              | 54.812                         |
| 0.0074              | 55.967                         |
| 0.0070              | 50.410                         |
| 0.0073              | 54.612                         |
| 0.0072              | 56.147                         |
| 0.0071              | 53.591                         |
| 0.0072              | 50.426                         |
| 0.0072              | 53.448                         |
| 0.0072              | 54.059                         |
| 0.0072              | 53.807                         |
| 0.0072              | 57.623                         |
| 0.0072              | 52.442                         |
| 0.0073              | 55.792                         |
| 0.0073              | 55.502                         |

### Laminate Filled-Hole Compression Properties (FHC2) -- (RTD) Normalized Strength HEXCEL 8552 - IM7 UNI PREPREG



### Laminate Filled-Hole Compression Properties (FHC2) -- (ETW) Strength

HEXCEL 8552 - IM7 UNI PREPREG

normalizing  $t_{ply}$   
[in]

0.0072

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Avg. Specimen Thicken. [in] | # Plies in Laminate | Failure Mode |
|-----------------|----------------|-------------------|---------------|--------------|----------------|-----------------------------|---------------------|--------------|
| HF18A11AD       | A              | M1                | 1             | 1            | 42.022         | 0.148                       | 20                  | LGM          |
| HF18A11BD       | A              | M1                | 1             | 1            | 43.199         | 0.146                       | 20                  | LGM          |
| HF18A11CD       | A              | M1                | 1             | 1            | 43.160         | 0.147                       | 20                  | LGM,LGO      |
| HF18A11DD       | A              | M1                | 1             | 1            | 40.875         | 0.147                       | 20                  | LGM          |
| HF18A217D       | A              | M2                | 1             | 2            | 40.631         | 0.148                       | 20                  | LGM          |
| HF18A218D       | A              | M2                | 1             | 2            | 41.624         | 0.141                       | 20                  | LGM          |
| HF18A219D       | A              | M2                | 1             | 2            | 41.044         | 0.148                       | 20                  | LGM          |
| HF18B116D       | B              | M1                | 2             | 1            | 40.181         | 0.144                       | 20                  | LGM          |
| HF18B117D       | B              | M1                | 2             | 1            | 39.512         | 0.145                       | 20                  | LGM          |
| HF18B118D       | B              | M1                | 2             | 1            | 38.952         | 0.143                       | 20                  | LGM          |
| HF18B217D       | B              | M2                | 2             | 2            | 37.862         | 0.142                       | 20                  | LGM          |
| HF18B218D       | B              | M2                | 2             | 2            | 39.184         | 0.144                       | 20                  | LGM          |
| HF18B219D       | B              | M2                | 2             | 2            | 39.181         | 0.144                       | 20                  | LGM          |
| HF18C117D       | C              | M1                | 3             | 1            | 42.391         | 0.144                       | 20                  | AGM,LGM      |
| HF18C118D       | C              | M1                | 3             | 1            | 42.392         | 0.145                       | 20                  | AGM,LGM      |
| HF18C119D       | C              | M1                | 3             | 1            | 40.212         | 0.144                       | 20                  | LGM          |
| HF18C217D       | C              | M2                | 3             | 2            | 40.523         | 0.145                       | 20                  | LGM          |
| HF18C218D       | C              | M2                | 3             | 2            | 41.263         | 0.146                       | 20                  | LGM          |
| HF18C219D       | C              | M2                | 3             | 2            | 42.118         | 0.145                       | 20                  | LGM          |

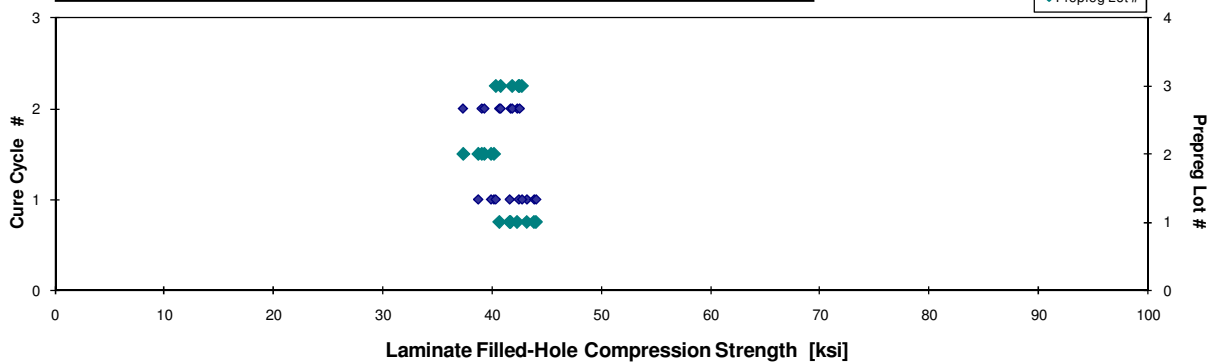
| Avg. $t_{ply}$ [in] | Strength <sub>norm</sub> [ksi] |
|---------------------|--------------------------------|
| 0.0074              | 43.160                         |
| 0.0073              | 43.809                         |
| 0.0073              | 43.994                         |
| 0.0073              | 41.594                         |
| 0.0074              | 41.670                         |
| 0.0070              | 40.646                         |
| 0.0074              | 42.279                         |
| 0.0072              | 40.167                         |
| 0.0073              | 39.906                         |
| 0.0072              | 38.736                         |
| 0.0071              | 37.358                         |
| 0.0072              | 39.052                         |
| 0.0072              | 39.290                         |
| 0.0072              | 42.411                         |
| 0.0073              | 42.711                         |
| 0.0072              | 40.324                         |
| 0.0072              | 40.763                         |
| 0.0073              | 41.826                         |
| 0.0073              | 42.493                         |

Average 40.859  
Standard Dev. 1.496  
Coeff. of Var. [%] 3.661  
Min. 37.862  
Max. 43.199  
Number of Spec. 19

Average<sub>norm</sub> 0.0073 41.168  
Standard Dev.<sub>norm</sub> 1.809  
Coeff. of Var. [%]<sub>norm</sub> 4.394  
Min. 0.0070 37.358  
Max. 0.0074 43.994  
Number of Spec. 19

### Laminate Filled-Hole Compression Properties (FHC2) -- (ETW) Normalized Strength

HEXCEL 8552 - IM7 UNI PREPREG

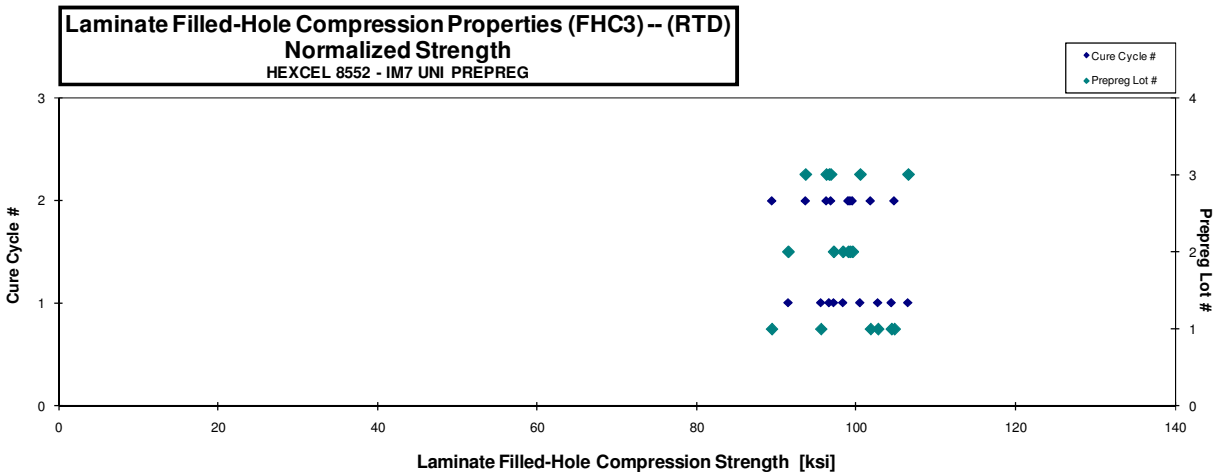


## 4.27 Filled-Hole Compression 3 Properties

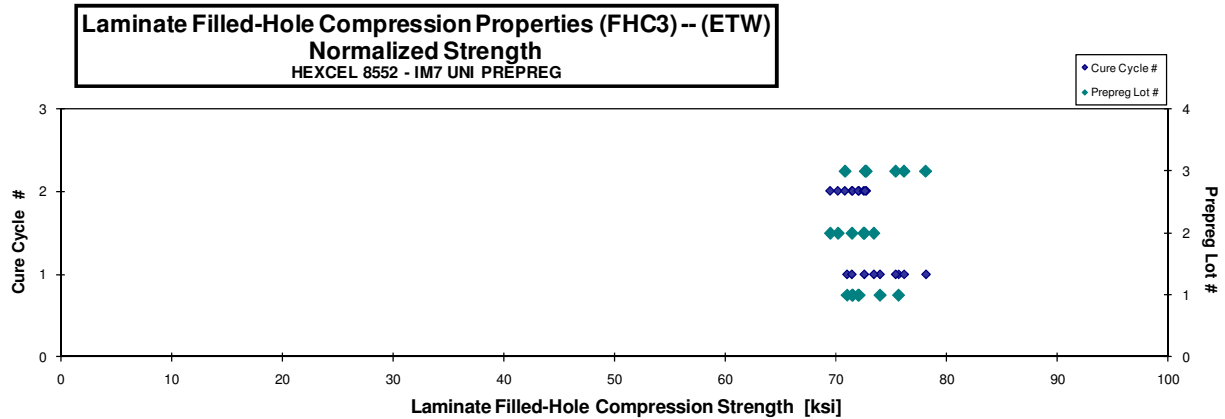
| Laminate Filled-Hole Compression Properties (FHC3) -- (RTD)<br>Strength<br>HEXCEL 8552 - IM7 UNI PREPREG |                |                   |               |              |                |                            |                     |              | normalizing $t_{ply}$<br>[in]<br>0.0072 |                                |
|----------------------------------------------------------------------------------------------------------|----------------|-------------------|---------------|--------------|----------------|----------------------------|---------------------|--------------|-----------------------------------------|--------------------------------|
| Specimen Number                                                                                          | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Avg. Specimen Thickn. [in] | # Plies in Laminate | Failure Mode | Avg. $t_{ply}$ [in]                     | Strength <sub>norm</sub> [ksi] |
| HF19A113A                                                                                                | A              | M1                | 1             | 1            | 100.899        | 0.147                      | 20                  | MGF          | 0.0073                                  | 102.756                        |
| HF19A114A                                                                                                | A              | M1                | 1             | 1            | 102.545        | 0.147                      | 20                  | MGF          | 0.0073                                  | 104.456                        |
| HF19A115A                                                                                                | A              | M1                | 1             | 1            | 93.040         | 0.148                      | 20                  | MGF          | 0.0074                                  | 95.603                         |
| HF19A212A                                                                                                | A              | M2                | 1             | 2            | 98.641         | 0.149                      | 20                  | MGF          | 0.0074                                  | 101.826                        |
| HF19A213A                                                                                                | A              | M2                | 1             | 2            | 102.738        | 0.147                      | 20                  | MGF          | 0.0073                                  | 104.807                        |
| HF19A215A                                                                                                | A              | M2                | 1             | 2            | 87.810         | 0.147                      | 20                  | MGF          | 0.0073                                  | 89.446                         |
| HF19B111A                                                                                                | B              | M1                | 2             | 1            | 94.763         | 0.139                      | 20                  | MGF          | 0.0070                                  | 91.494                         |
| HF19B112A                                                                                                | B              | M1                | 2             | 1            | 96.989         | 0.144                      | 20                  | MGF          | 0.0072                                  | 97.202                         |
| HF19B113A                                                                                                | B              | M1                | 2             | 1            | 99.323         | 0.143                      | 20                  | MGF          | 0.0071                                  | 98.369                         |
| HF19B211A                                                                                                | B              | M2                | 2             | 2            | 101.931        | 0.140                      | 20                  | MGF          | 0.0070                                  | 99.264                         |
| HF19B212A                                                                                                | B              | M2                | 2             | 2            | 99.865         | 0.143                      | 20                  | MGF          | 0.0071                                  | 99.033                         |
| HF19B215A                                                                                                | B              | M2                | 2             | 2            | 100.124        | 0.143                      | 20                  | MGF          | 0.0072                                  | 99.556                         |
| HF19C111A                                                                                                | C              | M1                | 3             | 1            | 99.109         | 0.140                      | 20                  | MGF          | 0.0070                                  | 96.631                         |
| HF19C112A                                                                                                | C              | M1                | 3             | 1            | 104.248        | 0.147                      | 20                  | MGF          | 0.0074                                  | 106.541                        |
| HF19C113A                                                                                                | C              | M1                | 3             | 1            | 100.123        | 0.145                      | 20                  | MGF          | 0.0072                                  | 100.517                        |
| HF19C213A                                                                                                | C              | M2                | 3             | 2            | 95.335         | 0.145                      | 20                  | MGF          | 0.0073                                  | 96.284                         |
| HF19C214A                                                                                                | C              | M2                | 3             | 2            | 92.969         | 0.145                      | 20                  | LGF          | 0.0073                                  | 93.668                         |
| HF19C215A                                                                                                | C              | M2                | 3             | 2            | 96.374         | 0.145                      | 20                  | MGF          | 0.0072                                  | 96.843                         |

|                    |         |                                    |        |         |
|--------------------|---------|------------------------------------|--------|---------|
| Average            | 98.157  | Average <sub>norm</sub>            | 0.0072 | 98.572  |
| Standard Dev.      | 4.176   | Standard Dev <sub>norm</sub>       |        | 4.542   |
| Coeff. of Var. [%] | 4.254   | Coeff. of Var. [%] <sub>norm</sub> |        | 4.608   |
| Min.               | 87.810  | Min.                               | 0.0070 | 89.446  |
| Max.               | 104.248 | Max.                               | 0.0074 | 106.541 |
| Number of Spec.    | 18      | Number of Spec.                    |        | 18      |



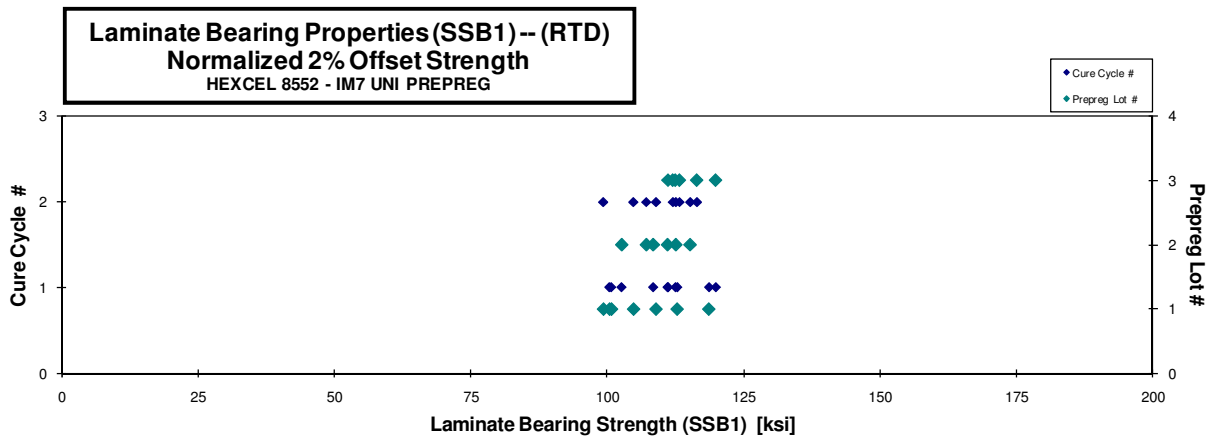
| Laminate Filled-Hole Compression Properties (FHC3) -- (ETW)<br>Strength<br>HEXCEL 8552 - IM7 UNI PREPREG |                |                   |               |              |                |                                    |                     |              | normalizing $t_{ply}$<br>[in]<br>0.0072 |                                |
|----------------------------------------------------------------------------------------------------------|----------------|-------------------|---------------|--------------|----------------|------------------------------------|---------------------|--------------|-----------------------------------------|--------------------------------|
| Specimen Number                                                                                          | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Strength [ksi] | Avg. Specimen Thicken. [in]        | # Plies in Laminate | Failure Mode | Avg. $t_{ply}$ [in]                     | Strength <sub>norm</sub> [ksi] |
| HF19A117D                                                                                                | A              | M1                | 1             | 1            | 69.224         | 0.148                              | 20                  | LGM          | 0.0074                                  | 70.995                         |
| HF19A118D                                                                                                | A              | M1                | 1             | 1            | 74.689         | 0.146                              | 20                  | LGM          | 0.0073                                  | 75.648                         |
| HF19A11AD                                                                                                | A              | M1                | 1             | 1            | 71.517         | 0.149                              | 20                  | LGM          | 0.0074                                  | 73.976                         |
| HF19A11CD                                                                                                | A              | M1                | 1             | 2            | 70.467         | 0.146                              | 20                  | LGM          | 0.0073                                  | 71.446                         |
| HF19A216D                                                                                                | A              | M2                | 1             | 2            | 70.881         | 0.146                              | 20                  | LGM          | 0.0073                                  | 72.070                         |
| HF19A217D                                                                                                | A              | M2                | 1             | 2            | 71.904         | 0.143                              | 20                  | LGM          | 0.0072                                  | 71.505                         |
| HF19A218D                                                                                                | A              | M2                | 1             | 2            | 70.754         | 0.147                              | 20                  | LGM          | 0.0073                                  | 72.006                         |
| HF19B116D                                                                                                | B              | M1                | 2             | 1            | 71.675         | 0.144                              | 20                  | LGM          | 0.0072                                  | 71.435                         |
| HF19B117D                                                                                                | B              | M1                | 2             | 1            | 72.240         | 0.145                              | 20                  | LGM          | 0.0072                                  | 72.558                         |
| HF19B11AD                                                                                                | B              | M1                | 2             | 1            | 73.884         | 0.143                              | 20                  | LGM          | 0.0072                                  | 73.413                         |
| HF19B217D                                                                                                | B              | M2                | 2             | 2            | 73.508         | 0.142                              | 20                  | LGM          | 0.0071                                  | 72.487                         |
| HF19B218D                                                                                                | B              | M2                | 2             | 2            | 69.873         | 0.145                              | 20                  | LGM          | 0.0072                                  | 70.181                         |
| HF19B219D                                                                                                | B              | M2                | 2             | 2            | 69.943         | 0.143                              | 20                  | LGM          | 0.0072                                  | 69.474                         |
| HF19C116D                                                                                                | C              | M1                | 3             | 1            | 77.225         | 0.146                              | 20                  | LGM          | 0.0073                                  | 78.092                         |
| HF19C117D                                                                                                | C              | M1                | 3             | 1            | 74.844         | 0.146                              | 20                  | LGM          | 0.0073                                  | 76.134                         |
| HF19C118D                                                                                                | C              | M1                | 3             | 1            | 75.632         | 0.144                              | 20                  | LGM          | 0.0072                                  | 75.378                         |
| HF19C217D                                                                                                | C              | M2                | 3             | 2            | 72.003         | 0.145                              | 20                  | LGM          | 0.0073                                  | 72.728                         |
| HF19C218D                                                                                                | C              | M2                | 3             | 2            | 72.482         | 0.144                              | 20                  | LGM          | 0.0072                                  | 72.624                         |
| HF19C219D                                                                                                | C              | M2                | 3             | 2            | 68.986         | 0.148                              | 20                  | LGM          | 0.0074                                  | 70.806                         |
| Average                                                                                                  |                |                   |               |              | 72.196         | Average <sub>norm</sub>            |                     |              | 0.0073                                  | 72.787                         |
| Standard Dev.                                                                                            |                |                   |               |              | 2.264          | Standard Dev <sub>norm</sub>       |                     |              |                                         | 2.205                          |
| Coeff. of Var. [%]                                                                                       |                |                   |               |              | 3.135          | Coeff. of Var. [%] <sub>norm</sub> |                     |              |                                         | 3.029                          |
| Min.                                                                                                     |                |                   |               |              | 68.986         | Min.                               |                     |              | 0.0071                                  | 69.474                         |
| Max.                                                                                                     |                |                   |               |              | 77.225         | Max.                               |                     |              | 0.0074                                  | 78.092                         |
| Number of Spec.                                                                                          |                |                   |               |              | 19             | Number of Spec.                    |                     |              | 19                                      | 19                             |





## 4.28 Single Shear Bearing 1 Properties

| Laminate Bearing Properties (SSB1) -- (RTD)<br>Strength & Modulus<br>HEXCEL 8552 - IM7 UNI PREPREG |                |                   |               |              |                          |                                          |                     | normalizing $t_{ply}$<br>[in]<br>0.0072 |                     |                                   |
|----------------------------------------------------------------------------------------------------|----------------|-------------------|---------------|--------------|--------------------------|------------------------------------------|---------------------|-----------------------------------------|---------------------|-----------------------------------|
| Specimen Number                                                                                    | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | 2% Offset Strength [ksi] | Avg. Specimen Thicken. [in]              | # Plies in Laminate | Comments                                | Avg. $t_{ply}$ [in] | 2% Strength <sub>norm</sub> [ksi] |
| HF11A112A                                                                                          | A              | M1                | 1             | 1            | 106.298                  | 0.109                                    | 16                  | B11 / 2% OFFSET FOR UBS*                | 0.0068              | 100.423                           |
| HF11A113A                                                                                          | A              | M1                | 1             | 1            | 107.274                  | 0.108                                    | 16                  | B11 / 2% OFFSET FOR UBS*                | 0.0068              | 100.771                           |
| HF11A114A                                                                                          | A              | M1                | 1             | 1            | 111.618                  | 0.116                                    | 16                  | B11 / 2% OFFSET FOR UBS*                | 0.0073              | 112.829                           |
| HF11A115A                                                                                          | A              | M1                | 1             | 1            | 116.831                  | 0.117                                    | 16                  | B11 / 2% OFFSET FOR UBS*                | 0.0073              | 118.623                           |
| HF11A211A                                                                                          | A              | M2                | 1             | 2            | 107.034                  | 0.107                                    | 16                  | B11 / 2% OFFSET FOR UBS*                | 0.0067              | 99.307                            |
| HF11A212A                                                                                          | A              | M2                | 1             | 2            | 112.704                  | 0.111                                    | 16                  | B11 / 2% OFFSET FOR UBS*                | 0.0070              | 108.953                           |
| HF11A213A                                                                                          | A              | M2                | 1             | 2            | 107.280                  | 0.113                                    | 16                  | B11 / 2% OFFSET FOR UBS*                | 0.007               | 104.812                           |
| HF11B111A                                                                                          | B              | M1                | 2             | 1            | 111.703                  | 0.106                                    | 16                  | B11 / 2% OFFSET FOR UBS*                | 0.007               | 102.653                           |
| HF11B112A                                                                                          | B              | M1                | 2             | 1            | 112.467                  | 0.111                                    | 16                  | B11 / 2% OFFSET FOR UBS*                | 0.0069              | 108.431                           |
| HF11B113A                                                                                          | B              | M1                | 2             | 1            | 115.988                  | 0.110                                    | 16                  | B11 / 2% OFFSET FOR UBS*                | 0.0069              | 111.055                           |
| HF11B211A                                                                                          | B              | M2                | 2             | 2            | 118.291                  | 0.112                                    | 16                  | B11 / 2% OFFSET FOR UBS*                | 0.0070              | 115.193                           |
| HF11B212A                                                                                          | B              | M2                | 2             | 2            | 114.477                  | 0.113                                    | 16                  | B11 / 2% OFFSET FOR UBS*                | 0.0071              | 112.572                           |
| HF11B213A                                                                                          | B              | M2                | 2             | 2            | 109.247                  | 0.113                                    | 16                  | B11 / 2% OFFSET FOR UBS*                | 0.0071              | 107.161                           |
| HF11C111A                                                                                          | C              | M1                | 3             | 1            | 117.118                  | 0.111                                    | 16                  | B11 / 2% OFFSET FOR UBS*                | 0.0069              | 112.475                           |
| HF11C112A                                                                                          | C              | M1                | 3             | 1            | 113.824                  | 0.112                                    | 16                  | B11 / 2% OFFSET FOR UBS*                | 0.0070              | 111.140                           |
| HF11C113A                                                                                          | C              | M1                | 3             | 1            | 118.980                  | 0.116                                    | 16                  | B11 / 2% OFFSET FOR UBS*                | 0.0073              | 119.858                           |
| HF11C211A                                                                                          | C              | M2                | 3             | 2            | 116.861                  | 0.110                                    | 16                  | B11 / 2% OFFSET FOR UBS*                | 0.0069              | 112.008                           |
| HF11C212A                                                                                          | C              | M2                | 3             | 2            | 113.651                  | 0.118                                    | 16                  | B11 / 2% OFFSET FOR UBS*                | 0.0074              | 116.413                           |
| HF11C213A                                                                                          | C              | M2                | 3             | 2            | 114.993                  | 0.113                                    | 16                  | B11 / 2% OFFSET FOR UBS*                | 0.0071              | 113.229                           |
| Ultimate Bearing Strength / B11 Bearing, 1st hole, 1: Inapplicable (not on bolt, nut or head side) |                |                   |               |              |                          |                                          |                     |                                         |                     |                                   |
| *Ultimate Strength not obtained                                                                    |                |                   |               |              |                          |                                          |                     |                                         |                     |                                   |
| Average                                                                                            |                |                   |               |              | 112.981                  | Average <sub>norm</sub> 0.0070           |                     |                                         |                     |                                   |
| Standard Dev.                                                                                      |                |                   |               |              | 4.018                    | Standard Dev. <sub>norm</sub> 6.059      |                     |                                         |                     |                                   |
| Coeff. of Var. [%]                                                                                 |                |                   |               |              | 3.556                    | Coeff. of Var. [%] <sub>norm</sub> 5.514 |                     |                                         |                     |                                   |
| Min.                                                                                               |                |                   |               |              | 106.298                  | Min. 0.0066                              |                     |                                         |                     |                                   |
| Max.                                                                                               |                |                   |               |              | 118.980                  | Max. 0.0074                              |                     |                                         |                     |                                   |
| Number of Spec.                                                                                    |                |                   |               |              | 19                       | Number of Spec. 19                       |                     |                                         |                     |                                   |



**Laminate Bearing Properties (SSB1)-- (ETW)**  
**Strength & Modulus**  
 HEXCEL 8552 - IM7 UNI PREPREG

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | 2% Offset Strength [ksi] | Avg. Specimen Thicken. [in] | # Plies in Laminate | Comments                |
|-----------------|----------------|-------------------|---------------|--------------|--------------------------|-----------------------------|---------------------|-------------------------|
| HF11A117D       | A              | M1                | 1             | 1            | 92.906                   | 0.114                       | 16                  | B11/ 2% OFFSET FOR UBS* |
| HF11A118D       | A              | M1                | 1             | 1            | 86.483                   | 0.115                       | 16                  | B11/ 2% OFFSET FOR UBS* |
| HF11A119D       | A              | M1                | 1             | 1            | 94.390                   | 0.116                       | 16                  | B11/ 2% OFFSET FOR UBS* |
| HF11A11AD       | A              | M1                | 1             | 1            | 94.925                   | 0.117                       | 16                  | B11/ 2% OFFSET FOR UBS* |
| HF11A217D       | A              | M2                | 1             | 2            | 95.782                   | 0.115                       | 16                  | B11/ 2% OFFSET FOR UBS* |
| HF11A218D       | A              | M2                | 1             | 2            | 99.813                   | 0.117                       | 16                  | B11/ 2% OFFSET FOR UBS* |
| HF11A219D       | A              | M2                | 1             | 2            | 92.654                   | 0.117                       | 16                  | B11/ 2% OFFSET FOR UBS* |
| HF11B116D       | B              | M1                | 2             | 1            | 96.354                   | 0.111                       | 16                  | B11/ 2% OFFSET FOR UBS* |
| HF11B117D       | B              | M1                | 2             | 1            | 98.015                   | 0.109                       | 16                  | B11/ 2% OFFSET FOR UBS* |
| HF11B118D       | B              | M1                | 2             | 1            | 96.256                   | 0.111                       | 16                  | B11/ 2% OFFSET FOR UBS* |
| HF11B119D       | B              | M1                | 2             | 1            | 75.485                   | 0.117                       | 16                  | B11/ 2% OFFSET FOR UBS* |
| HF11B216D       | B              | M2                | 2             | 2            | 95.780                   | 0.117                       | 16                  | B11/ 2% OFFSET FOR UBS* |
| HF11B217D       | B              | M2                | 2             | 2            | 79.089                   | 0.111                       | 16                  | B11/ 2% OFFSET FOR UBS* |
| HF11B219D       | B              | M2                | 2             | 2            | 77.542                   | 0.118                       | 16                  | B11/ 2% OFFSET FOR UBS* |
| HF11B21AD       | B              | M2                | 2             | 2            | 68.615                   | 0.116                       | 16                  | B11/ 2% OFFSET FOR UBS* |
| HF11C116D       | C              | M1                | 3             | 1            | 95.379                   | 0.112                       | 16                  | B11/ 2% OFFSET FOR UBS* |
| HF11C117D       | C              | M1                | 3             | 1            | 83.578                   | 0.103                       | 16                  | B11/ 2% OFFSET FOR UBS* |
| HF11C118D       | C              | M1                | 3             | 1            | 94.145                   | 0.106                       | 16                  | B11/ 2% OFFSET FOR UBS* |
| HF11C216D       | C              | M2                | 3             | 2            | 88.240                   | 0.118                       | 16                  | B11/ 2% OFFSET FOR UBS* |
| HF11C217D       | C              | M2                | 3             | 2            | 86.389                   | 0.103                       | 16                  | B11/ 2% OFFSET FOR UBS* |
| HF11C218D       | C              | M2                | 3             | 2            | 95.743                   | 0.111                       | 16                  | B11/ 2% OFFSET FOR UBS* |

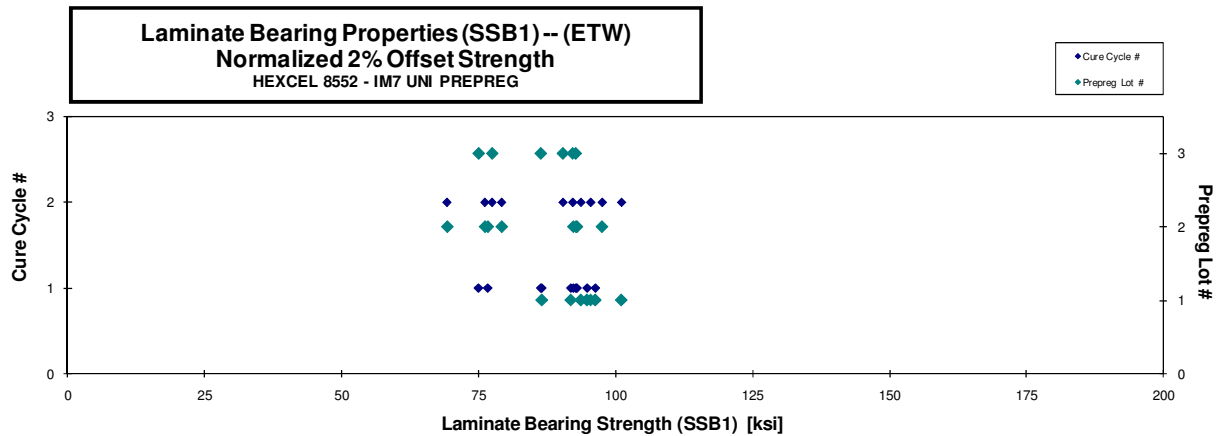
\*Ultimate Strength not obtained

Average 89.884  
 Standard Dev. 8.534  
 Coeff. of Var. [%] 9.495  
 Min. 68.615  
 Max. 99.813  
 Number of Spec. 21.000

normalizing  $t_{ply}$   
 [in]  
 0.0072

| Avg. $t_{ply}$ [in] | 2% Strength <sub>norm</sub> [ksi] |
|---------------------|-----------------------------------|
| 0.0071              | 91.858                            |
| 0.0072              | 86.520                            |
| 0.0072              | 94.827                            |
| 0.0073              | 96.339                            |
| 0.0072              | 95.491                            |
| 0.0073              | 101.128                           |
| 0.007               | 93.699                            |
| 0.0069              | 92.813                            |
| 0.0068              | 92.329                            |
| 0.0070              | 92.997                            |
| 0.0073              | 76.642                            |
| 0.0073              | 97.595                            |
| 0.0069              | 76.125                            |
| 0.0074              | 79.191                            |
| 0.0073              | 69.191                            |
| 0.0070              | 92.771                            |
| 0.0065              | 74.945                            |
| 0.0066              | 86.354                            |
| 0.0074              | 90.423                            |
| 0.0065              | 77.440                            |
| 0.0069              | 92.211                            |

Average<sub>norm</sub> 0.0071 88.138  
 Standard Dev<sub>norm</sub> 8.903  
 Coeff. of Var. [%]<sub>norm</sub> 10.101  
 Min. 0.0065 69.191  
 Max. 0.0074 101.128  
 Number of Spec. 21 21



## 4.29 Single Shear Bearing 2 Properties

**Laminate Bearing Properties (SSB2) -- (RTD)**  
**Strength & Modulus**  
 HEXCEL 8552 - IM7 UNI PREPREG

normalizing  $t_{ply}$   
 [in]  
 0.0072

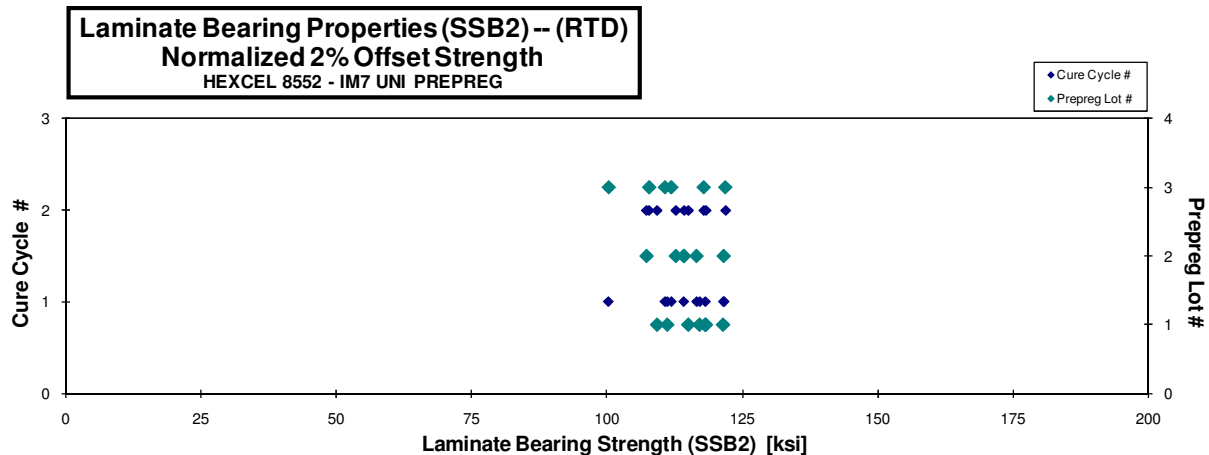
| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | 2% Offset Strength [ksi] | Avg. Specimen Thckn. [in] | # Plies in Laminate | Comments                 |
|-----------------|----------------|-------------------|---------------|--------------|--------------------------|---------------------------|---------------------|--------------------------|
| HF12A111A       | A              | M1                | 1             | 1            | 109.784                  | 0.146                     | 20                  | B11 / 2% OFFSET FOR UBS* |
| HF12A113A       | A              | M1                | 1             | 1            | 115.844                  | 0.146                     | 20                  | B11 / 2% OFFSET FOR UBS* |
| HF12A114A       | A              | M1                | 1             | 1            | 119.732                  | 0.146                     | 20                  | B11 / 2% OFFSET FOR UBS* |
| HF12A115A       | A              | M1                | 1             | 1            | 116.225                  | 0.146                     | 20                  | B11 / 2% OFFSET FOR UBS* |
| HF12A212A       | A              | M2                | 1             | 2            | 107.330                  | 0.147                     | 20                  | B11 / 2% OFFSET FOR UBS* |
| HF12A213A       | A              | M2                | 1             | 2            | 113.680                  | 0.146                     | 20                  | B11 / 2% OFFSET FOR UBS* |
| HF12A214A       | A              | M2                | 1             | 2            | 116.978                  | 0.146                     | 20                  | B11 / 2% OFFSET FOR UBS* |
| HF12B111A       | B              | M1                | 2             | 1            | 122.564                  | 0.143                     | 20                  | B11 / 2% OFFSET FOR UBS* |
| HF12B112A       | B              | M1                | 2             | 1            | 113.243                  | 0.145                     | 20                  | B11 / 2% OFFSET FOR UBS* |
| HF12B113A       | B              | M1                | 2             | 1            | 117.116                  | 0.143                     | 20                  | B11 / 2% OFFSET FOR UBS* |
| HF12B212A       | B              | M2                | 2             | 2            | 111.830                  | 0.145                     | 20                  | B11 / 2% OFFSET FOR UBS* |
| HF12B213A       | B              | M2                | 2             | 2            | 114.749                  | 0.143                     | 20                  | B11 / 2% OFFSET FOR UBS* |
| HF12B215A       | B              | M2                | 2             | 2            | 109.087                  | 0.142                     | 20                  | B11 / 2% OFFSET FOR UBS* |
| HF12C111A       | C              | M1                | 3             | 1            | 104.420                  | 0.138                     | 20                  | B11 / 2% OFFSET FOR UBS* |
| HF12C112A       | C              | M1                | 3             | 1            | 114.777                  | 0.139                     | 20                  | B11 / 2% OFFSET FOR UBS* |
| HF12C113A       | C              | M1                | 3             | 1            | 115.248                  | 0.140                     | 20                  | B11 / 2% OFFSET FOR UBS* |
| HF12C211A       | C              | M2                | 3             | 2            | 111.985                  | 0.139                     | 20                  | B11 / 2% OFFSET FOR UBS* |
| HF12C212A       | C              | M2                | 3             | 2            | 118.646                  | 0.148                     | 20                  | B11 / 2% OFFSET FOR UBS* |
| HF12C213A       | C              | M2                | 3             | 2            | 116.496                  | 0.146                     | 20                  | B11 / 2% OFFSET FOR UBS* |

| Avg. $t_{ply}$ [in] | 2% Strength <sub>norm</sub> [ksi] |
|---------------------|-----------------------------------|
| 0.0073              | 111.093                           |
| 0.0073              | 117.051                           |
| 0.0073              | 121.381                           |
| 0.0073              | 118.068                           |
| 0.0073              | 109.231                           |
| 0.0073              | 114.969                           |
| 0.0073              | 118.210                           |
| 0.0071              | 121.500                           |
| 0.0073              | 114.108                           |
| 0.0072              | 116.492                           |
| 0.0073              | 112.672                           |
| 0.0072              | 114.205                           |
| 0.0071              | 107.269                           |
| 0.0069              | 100.298                           |
| 0.0069              | 110.659                           |
| 0.0070              | 111.833                           |
| 0.0069              | 107.760                           |
| 0.0074              | 121.805                           |
| 0.0073              | 117.804                           |

Ultimate Bearing Strength / B11:  
 B: Bearing, 1: first hole, t: inapplicable  
 (not on bolt, nut or head side)

Average 114.197  
 Standard Dev. 4.413  
 Coeff. of Var. [%] 3.865  
 Min. 104.420  
 Max. 122.564  
 Number of Spec. 19

Average<sub>norm</sub> 0.0072 114.021  
 Standard Dev.<sub>norm</sub> 5.566  
 Coeff. of Var. [%]<sub>norm</sub> 4.882  
 Min. 0.0069 100.298  
 Max. 0.0074 121.805  
 Number of Spec. 19



**Laminate Bearing Properties (SSB2) -- (ETW)**  
**Strength & Modulus**  
 HEXCEL 8552 - IM7 UNI PREPREG

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | 2% Offset Strength [ksi] | Avg. Specimen Thicken. [in] | # Plies in Laminate | Comments                |
|-----------------|----------------|-------------------|---------------|--------------|--------------------------|-----------------------------|---------------------|-------------------------|
| HF12A118D       | A              | M1                | 1             | 1            | 92.682                   | 0.147                       | 20                  | B11/ 2% OFFSET FOR UBS* |
| HF12A119D       | A              | M1                | 1             | 1            | 81.650                   | 0.139                       | 20                  | B11/ 2% OFFSET FOR UBS* |
| HF12A11AD       | A              | M1                | 1             | 1            | 91.223                   | 0.140                       | 20                  | B11/ 2% OFFSET FOR UBS* |
| HF12A11BD       | A              | M1                | 1             | 1            | 97.233                   | 0.140                       | 20                  | B11/ 2% OFFSET FOR UBS* |
| HF12A216D       | A              | M2                | 1             | 2            | 88.887                   | 0.148                       | 20                  | B11/ 2% OFFSET FOR UBS* |
| HF12A218D       | A              | M2                | 1             | 2            | 77.484                   | 0.146                       | 20                  | B11/ 2% OFFSET FOR UBS* |
| HF12A219D       | A              | M2                | 1             | 2            | 92.381                   | 0.145                       | 20                  | B11/ 2% OFFSET FOR UBS* |
| HF12B115D       | B              | M1                | 2             | 1            | 89.332                   | 0.144                       | 20                  | B11/ 2% OFFSET FOR UBS* |
| HF12B116D       | B              | M1                | 2             | 1            | 86.144                   | 0.137                       | 20                  | B11/ 2% OFFSET FOR UBS* |
| HF12B117D       | B              | M1                | 2             | 1            | 91.640                   | 0.144                       | 20                  | B11/ 2% OFFSET FOR UBS* |
| HF12B216D       | B              | M2                | 2             | 2            | 82.833                   | 0.145                       | 20                  | B11/ 2% OFFSET FOR UBS* |
| HF12B217D       | B              | M2                | 2             | 2            | 86.520                   | 0.137                       | 20                  | B11/ 2% OFFSET FOR UBS* |
| HF12B21AD       | B              | M2                | 2             | 2            | 90.471                   | 0.144                       | 20                  | B11/ 2% OFFSET FOR UBS* |
| HF12C116D       | C              | M1                | 3             | 1            | 83.364                   | 0.148                       | 20                  | B11/ 2% OFFSET FOR UBS* |
| HF12C118D       | C              | M1                | 3             | 1            | 77.965                   | 0.146                       | 20                  | B11/ 2% OFFSET FOR UBS* |
| HF12C119D       | C              | M1                | 3             | 1            | 79.807                   | 0.146                       | 20                  | B11/ 2% OFFSET FOR UBS* |
| HF12C216D       | C              | M2                | 3             | 2            | 84.712                   | 0.142                       | 20                  | B11/ 2% OFFSET FOR UBS* |
| HF12C217D       | C              | M2                | 3             | 2            | 86.483                   | 0.135                       | 20                  | B11/ 2% OFFSET FOR UBS* |
| HF12C218D       | C              | M2                | 3             | 2            | 89.800                   | 0.146                       | 20                  | B11/ 2% OFFSET FOR UBS* |

Ultimate Bearing Strength / B11:  
 B: Bearing, 1: first hole, i: inapplicable  
 (not on bolt, nut or head side)

normalizing  $t_{ply}$   
 [in]

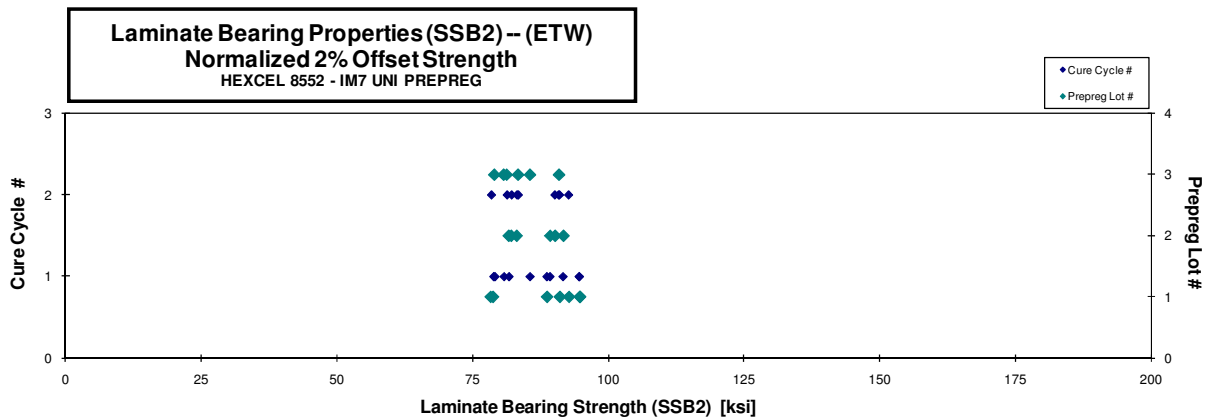
0.0072

| Avg. $t_{ply}$ [in] | 2% Strength <sub>norm</sub> [ksi] |
|---------------------|-----------------------------------|
| 0.0074              | 94.731                            |
| 0.0070              | 78.815                            |
| 0.0070              | 88.700                            |
| 0.0070              | 94.701                            |
| 0.0074              | 91.047                            |
| 0.0073              | 78.398                            |
| 0.0072              | 92.734                            |
| 0.0072              | 89.270                            |
| 0.0068              | 81.678                            |
| 0.0072              | 91.704                            |
| 0.0072              | 83.149                            |
| 0.0068              | 82.154                            |
| 0.0072              | 90.178                            |
| 0.0074              | 85.574                            |
| 0.0073              | 79.048                            |
| 0.0073              | 80.758                            |
| 0.0071              | 83.399                            |
| 0.0068              | 81.318                            |
| 0.0073              | 90.881                            |

Average 86.874  
 Standard Dev. 5.393  
 Coeff. of Var. [%] 6.208  
 Min. 77.484  
 Max. 97.233  
 Number of Spec. 19

Average  
 Standard Dev.  
 Coeff. of Var. [%]  
 Min.  
 Max.  
 Number of Spec.

Average<sub>norm</sub> 0.0071  
 Standard Dev.<sub>norm</sub>  
 Coeff. of Var. [%]<sub>norm</sub>  
 Min. 0.0068  
 Max. 0.0074  
 Number of Spec. 19



## 4.30 Single Shear Bearing 3 Properties

**Laminate Bearing Properties (SSB3) -- (RTD)**  
**Strength & Modulus**  
 HEXCEL 8552 - IM7 UNI PREPREG

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | 2% Offset Strength [ksi] | Avg. Specimen Thckn. [in] | # Plies in Laminate | Comments                 |
|-----------------|----------------|-------------------|---------------|--------------|--------------------------|---------------------------|---------------------|--------------------------|
| HF3A112A        | A              | M1                | 1             | 1            | 111.329                  | 0.147                     | 20                  | B11 / 2% OFFSET FOR UBS* |
| HF3A113A        | A              | M1                | 1             | 1            | 110.555                  | 0.140                     | 20                  | B11 / 2% OFFSET FOR UBS* |
| HF3A114A        | A              | M1                | 1             | 1            | 110.982                  | 0.139                     | 20                  | B11 / 2% OFFSET FOR UBS* |
| HF3A115A        | A              | M1                | 1             | 1            | 110.014                  | 0.137                     | 20                  | B11 / 2% OFFSET FOR UBS* |
| HF3A212A        | A              | M2                | 1             | 2            | 118.853                  | 0.147                     | 20                  | B11 / 2% OFFSET FOR UBS* |
| HF3A213A        | A              | M2                | 1             | 2            | 118.684                  | 0.146                     | 20                  | B11 / 2% OFFSET FOR UBS* |
| HF3A214A        | A              | M2                | 1             | 2            | 118.053                  | 0.147                     | 20                  | B11 / 2% OFFSET FOR UBS* |
| HF3B111A        | B              | M1                | 2             | 1            | 112.900                  | 0.137                     | 20                  | B11 / 2% OFFSET FOR UBS* |
| HF3B112A        | B              | M1                | 2             | 1            | 108.476                  | 0.147                     | 20                  | B11 / 2% OFFSET FOR UBS* |
| HF3B113A        | B              | M1                | 2             | 1            | 109.396                  | 0.144                     | 20                  | B11 / 2% OFFSET FOR UBS* |
| HF3B211A        | B              | M2                | 2             | 2            | 116.878                  | 0.139                     | 20                  | B11 / 2% OFFSET FOR UBS* |
| HF3B212A        | B              | M2                | 2             | 2            | 115.519                  | 0.146                     | 20                  | B11 / 2% OFFSET FOR UBS* |
| HF3B213A        | B              | M2                | 2             | 2            | 122.041                  | 0.144                     | 20                  | B11 / 2% OFFSET FOR UBS* |
| HF3C111A        | C              | M1                | 3             | 1            | 113.847                  | 0.147                     | 20                  | B11 / 2% OFFSET FOR UBS* |
| HF3C112A        | C              | M1                | 3             | 1            | 116.374                  | 0.144                     | 20                  | B11 / 2% OFFSET FOR UBS* |
| HF3C114A        | C              | M1                | 3             | 1            | 115.629                  | 0.145                     | 20                  | B11 / 2% OFFSET FOR UBS* |
| HF3C212A        | C              | M2                | 3             | 2            | 104.569                  | 0.146                     | 20                  | B11 / 2% OFFSET FOR UBS* |
| HF3C213A        | C              | M2                | 3             | 2            | 114.501                  | 0.149                     | 20                  | B11 / 2% OFFSET FOR UBS* |
| HF3C215A        | C              | M2                | 3             | 2            | 116.007                  | 0.146                     | 20                  | B11 / 2% OFFSET FOR UBS* |

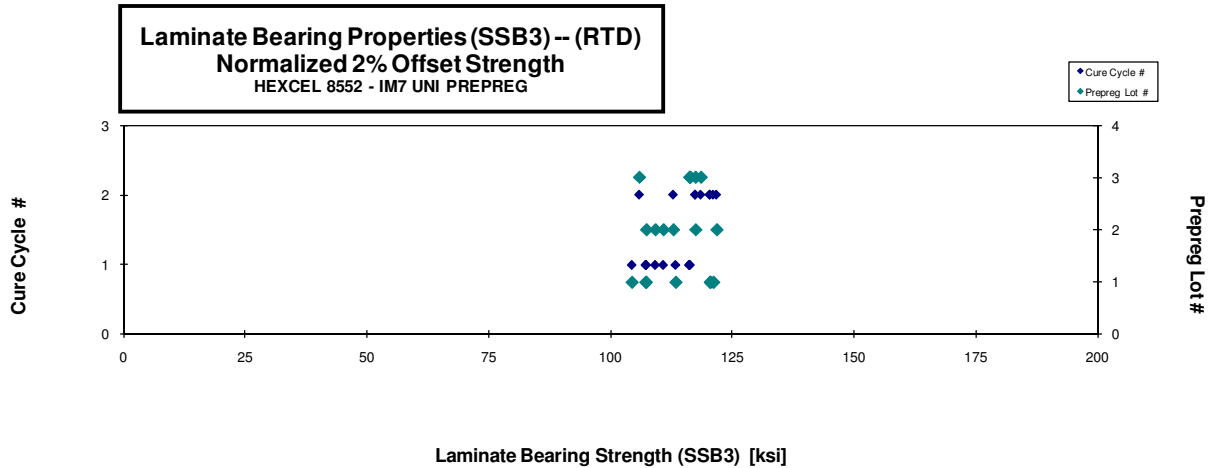
Ultimate Bearing Strength / B11:  
 B: Bearing, 1: first hole, t: Inapplicable  
 (not on bolt, nut or head side)

Average 113.927  
 Standard Dev. 4.317  
 Coeff. of Var. [%] 3.790  
 Min. 104.569  
 Max. 122.041  
 Number of Spec. 19

Average<sub>norm</sub> 0.0072 113.896  
 Standard Dev.<sub>norm</sub> 5.710  
 Coeff. of Var. [%]<sub>norm</sub> 5.014  
 Min. 0.0068 104.322  
 Max. 0.0075 121.801  
 Number of Spec. 19 19

normalizing  $t_{ply}$   
 [in]  
 0.0072

| Avg. $t_{ply}$ [in] | 2% Strength <sub>norm</sub> [ksi] |
|---------------------|-----------------------------------|
| 0.0073              | 113.352                           |
| 0.0070              | 107.151                           |
| 0.0070              | 107.244                           |
| 0.0068              | 104.322                           |
| 0.0073              | 121.123                           |
| 0.0073              | 120.428                           |
| 0.007               | 120.458                           |
| 0.007               | 107.307                           |
| 0.0074              | 110.812                           |
| 0.0072              | 109.142                           |
| 0.0070              | 112.861                           |
| 0.0073              | 117.445                           |
| 0.0072              | 121.801                           |
| 0.0074              | 116.219                           |
| 0.0072              | 116.361                           |
| 0.0072              | 116.191                           |
| 0.0073              | 105.840                           |
| 0.0075              | 118.543                           |
| 0.0073              | 117.417                           |



**Laminate Bearing Properties (SSB3) -- (ETW)**  
**Strength & Modulus**  
 HEXCEL 8552 - IM7 UNI PREPREG

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | 2% Offset Strength [ksi] | Avg. Specimen Thckn. [in] | # Plies in Laminate | Comments                |
|-----------------|----------------|-------------------|---------------|--------------|--------------------------|---------------------------|---------------------|-------------------------|
| HF3A117D        | A              | M1                | 1             | 1            | 99.478                   | 0.139                     | 20                  | B11/ 2% OFFSET FOR UBS* |
| HF3A119D        | A              | M1                | 1             | 1            | 87.757                   | 0.145                     | 20                  | B11/ 2% OFFSET FOR UBS* |
| HF3A11AD        | A              | M1                | 1             | 1            | 94.216                   | 0.145                     | 20                  | B11/ 2% OFFSET FOR UBS* |
| HF3A11BD        | A              | M1                | 1             | 1            | 91.661                   | 0.143                     | 20                  | B11/ 2% OFFSET FOR UBS* |
| HF3A216D        | A              | M2                | 1             | 2            | 99.866                   | 0.148                     | 20                  | B11/ 2% OFFSET FOR UBS* |
| HF3A218D        | A              | M2                | 1             | 2            | 99.109                   | 0.145                     | 20                  | B11/ 2% OFFSET FOR UBS* |
| HF3A219D        | A              | M2                | 1             | 2            | 95.924                   | 0.144                     | 20                  | B11/ 2% OFFSET FOR UBS* |
| HF3B116D        | B              | M1                | 2             | 1            | 101.302                  | 0.146                     | 20                  | B11/ 2% OFFSET FOR UBS* |
| HF3B117D        | B              | M1                | 2             | 1            | 92.665                   | 0.141                     | 20                  | B11/ 2% OFFSET FOR UBS* |
| HF3B118D        | B              | M1                | 2             | 1            | 98.556                   | 0.139                     | 20                  | B11/ 2% OFFSET FOR UBS* |
| HF3B216D        | B              | M2                | 2             | 2            | 94.921                   | 0.145                     | 20                  | B11/ 2% OFFSET FOR UBS* |
| HF3B217D        | B              | M2                | 2             | 2            | 85.275                   | 0.134                     | 20                  | B11/ 2% OFFSET FOR UBS* |
| HF3B218D        | B              | M2                | 2             | 2            | 86.622                   | 0.141                     | 20                  | B11/ 2% OFFSET FOR UBS* |
| HF3C116D        | C              | M1                | 3             | 1            | 86.888                   | 0.144                     | 20                  | B11/ 2% OFFSET FOR UBS* |
| HF3C117D        | C              | M1                | 3             | 1            | 87.638                   | 0.146                     | 20                  | B11/ 2% OFFSET FOR UBS* |
| HF3C118D        | C              | M1                | 3             | 1            | 81.004                   | 0.146                     | 20                  | B11/ 2% OFFSET FOR UBS* |
| HF3C216D        | C              | M2                | 3             | 2            | 85.372                   | 0.147                     | 20                  | B11/ 2% OFFSET FOR UBS* |
| HF3C217D        | C              | M2                | 3             | 2            | 83.126                   | 0.147                     | 20                  | B11/ 2% OFFSET FOR UBS* |
| HF3C218D        | C              | M2                | 3             | 2            | 92.797                   | 0.145                     | 20                  | B11/ 2% OFFSET FOR UBS* |

Ultimate Bearing Strength / B11  
 B Bearing, 1: first hole, 2:  
 Inapplicable (not on bolt, nut or  
 head side)

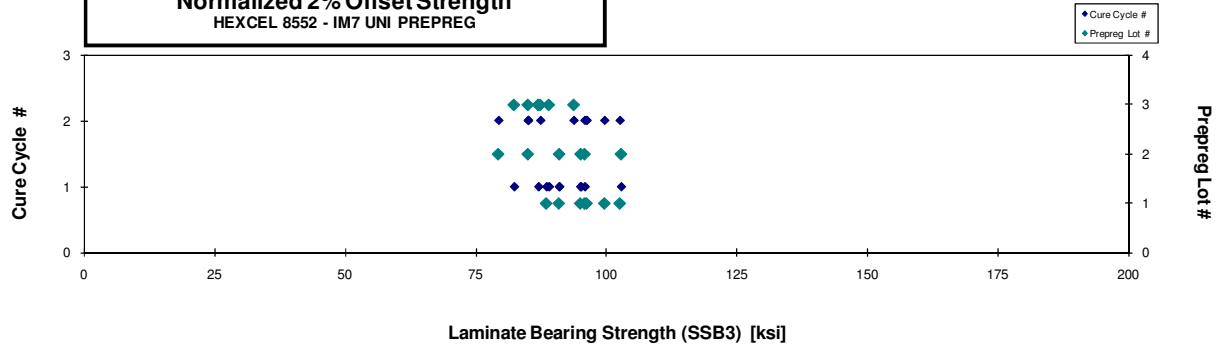
Average 91.799  
 Standard Dev. 6.272  
 Coeff. of Var. [%] 6.832  
 Min. 81.004  
 Max. 101.302  
 Number of Spec. 19

Average<sub>norm</sub> 0.0072 91.673  
 Standard Dev<sub>norm</sub> 6.556  
 Coeff. of Var. [%]<sub>norm</sub> 7.152  
 Min. 0.0067 79.333  
 Max. 0.0074 102.780  
 Number of Spec. 19

normalizing  $t_{ply}$   
 [in]  
 0.0072

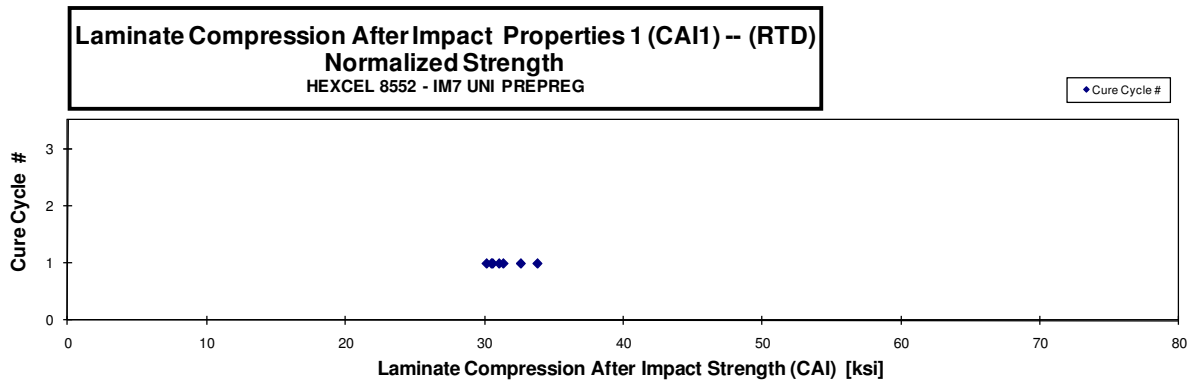
| Avg. $t_{ply}$ [in] | 2% Strength <sub>norm</sub> [ksi] |
|---------------------|-----------------------------------|
| 0.0069              | 95.828                            |
| 0.0073              | 88.489                            |
| 0.0073              | 94.979                            |
| 0.0071              | 90.898                            |
| 0.0074              | 102.525                           |
| 0.0072              | 99.591                            |
| 0.0072              | 96.191                            |
| 0.0073              | 102.780                           |
| 0.0071              | 90.970                            |
| 0.0069              | 95.088                            |
| 0.0073              | 95.800                            |
| 0.0067              | 79.333                            |
| 0.0071              | 84.988                            |
| 0.0072              | 86.958                            |
| 0.0073              | 88.987                            |
| 0.0073              | 82.316                            |
| 0.0074              | 87.358                            |
| 0.0074              | 84.993                            |
| 0.0073              | 93.720                            |

**Laminate Bearing Properties (SSB3) -- (ETW)**  
**Normalized 2% Offset Strength**  
 HEXCEL 8552 - IM7 UNI PREPREG



### 4.31 Compression Strength After Impact 1 Properties

| Laminate Compression After Impact Properties (CAI) -- (RTD)<br>Strength<br>HEXCEL 8552 - IM7 UNI PREPREG |                |                   |               |              |                                 |                |                            |                     |              | normalizing $t_{ply}$<br>[in]<br>0.0072 |                                |        |
|----------------------------------------------------------------------------------------------------------|----------------|-------------------|---------------|--------------|---------------------------------|----------------|----------------------------|---------------------|--------------|-----------------------------------------|--------------------------------|--------|
| Specimen Number                                                                                          | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Measured Impact Energy (in-lbf) | Strength [ksi] | Avg. Specimen Thickn. [in] | # Plies in Laminate | Failure Mode | Avg. $t_{ply}$ [in]                     | Strength <sub>norm</sub> [ksi] |        |
| HFIKA112A                                                                                                | A              | M1                | 1             | 1            | 261.23                          | 30.134         | 0.175                      | 24                  | LDM          | 0.0073                                  | 30.599                         |        |
| HFIKA113A                                                                                                | A              | M1                | 1             | 1            | 264.22                          | 30.591         | 0.176                      | 24                  | LDM          | 0.0073                                  | 31.072                         |        |
| HFIKA114A                                                                                                | A              | M1                | 1             | 1            | 265.46                          | 29.761         | 0.177                      | 24                  | LDM          | 0.0074                                  | 30.525                         |        |
| HFIKA115A                                                                                                | A              | M1                | 1             | 1            | 261.64                          | 32.374         | 0.174                      | 24                  | LDM          | 0.0073                                  | 32.618                         |        |
| HFIKA116A                                                                                                | A              | M1                | 1             | 1            | 266.12                          | 29.529         | 0.177                      | 24                  | LDM          | 0.0074                                  | 30.170                         |        |
| HFIKA117A                                                                                                | A              | M1                | 1             | 1            | 262.11                          | 30.898         | 0.175                      | 24                  | LDM          | 0.0073                                  | 31.372                         |        |
| HFIKA118A                                                                                                | A              | M1                | 1             | 1            | 262.37                          | 33.434         | 0.175                      | 24                  | LDM          | 0.0073                                  | 33.798                         |        |
| Average                                                                                                  |                |                   |               |              |                                 | 30.960         |                            |                     |              | Average <sub>norm</sub>                 | 0.00732                        | 31.451 |
| Standard Dev.                                                                                            |                |                   |               |              |                                 | 1.439          |                            |                     |              | Standard Dev. <sub>norm</sub>           |                                | 1.307  |
| Coeff. of Var. [%]                                                                                       |                |                   |               |              |                                 | 4.649          |                            |                     |              | Coeff. of Var. [%] <sub>norm</sub>      |                                | 4.155  |
| Min.                                                                                                     |                |                   |               |              |                                 | 29.529         |                            |                     |              | Min.                                    | 0.0073                         | 30.170 |
| Max.                                                                                                     |                |                   |               |              |                                 | 33.434         |                            |                     |              | Max.                                    | 0.0074                         | 33.798 |
| Number of Spec.                                                                                          |                |                   |               |              |                                 | 7              |                            |                     |              | Number of Spec.                         |                                | 7      |



## 4.32 Interlaminar Tension Properties

### Laminate Curved Beam Strength Properties (CBS) -- (CTD) Strength

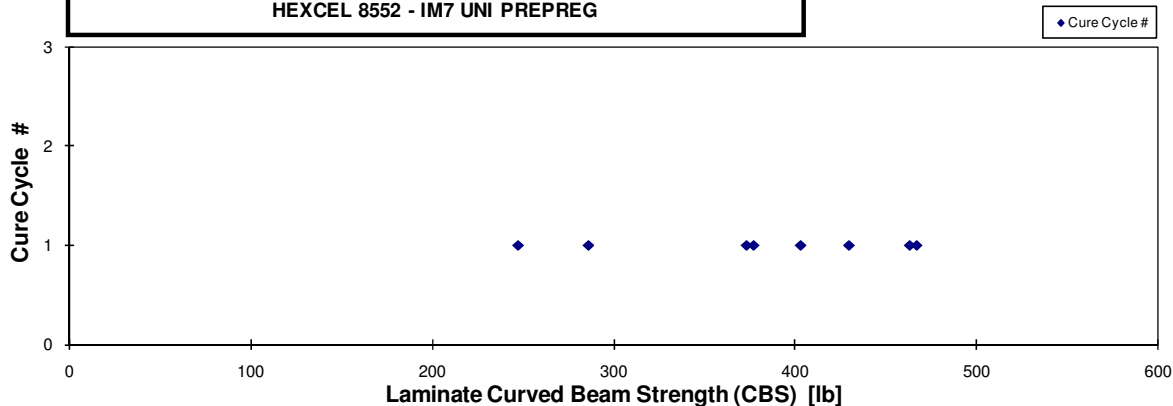
HEXCEL 8552 - IM7 UNI PREPREG

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Curved Beam Strength [lb] | Interlaminar Tension Strength [ksi] | Avg. Specimen Thickn. [in] | # Plies in Laminate | Avg. $t_{ply}$ [in] |
|-----------------|----------------|-------------------|---------------|--------------|---------------------------|-------------------------------------|----------------------------|---------------------|---------------------|
| HFIMA119B       | A              | M1                | 1             | 1            | 286.007                   | 8.970                               | 0.151                      | 22                  | 0.0069              |
| HFIMA11AB       | A              | M1                | 1             | 1            | 402.797                   | 13.144                              | 0.146                      | 22                  | 0.0066              |
| HFIMA11BB       | A              | M1                | 1             | 1            | 429.446                   | 13.340                              | 0.152                      | 22                  | 0.0069              |
| HFIMA11CB       | A              | M1                | 1             | 1            | 376.970                   | 12.066                              | 0.148                      | 22                  | 0.0067              |
| HFIMA11DB       | A              | M1                | 1             | 1            | 247.302                   | 7.635                               | 0.153                      | 22                  | 0.0070              |
| HFIMA11EB       | A              | M1                | 1             | 1            | 462.853                   | 14.709                              | 0.149                      | 22                  | 0.0068              |
| HFIMA11FB       | A              | M1                | 1             | 1            | 373.011                   | 11.782                              | 0.150                      | 22                  | 0.0068              |
| HFIMA11GB       | A              | M1                | 1             | 1            | 466.694                   | 14.018                              | 0.157                      | 22                  | 0.0071              |

|                    |         |        |         |        |
|--------------------|---------|--------|---------|--------|
| Average            | 380.635 | 11.958 | Average | 0.0069 |
| Standard Dev.      | 79.141  | 2.472  | Min.    | 0.0066 |
| Coeff. of Var. [%] | 20.792  | 20.675 | Max.    | 0.0071 |
| Min.               | 247.302 | 7.635  |         |        |
| Max.               | 466.694 | 14.709 |         |        |
| Number of Spec.    | 8       | 8      |         |        |

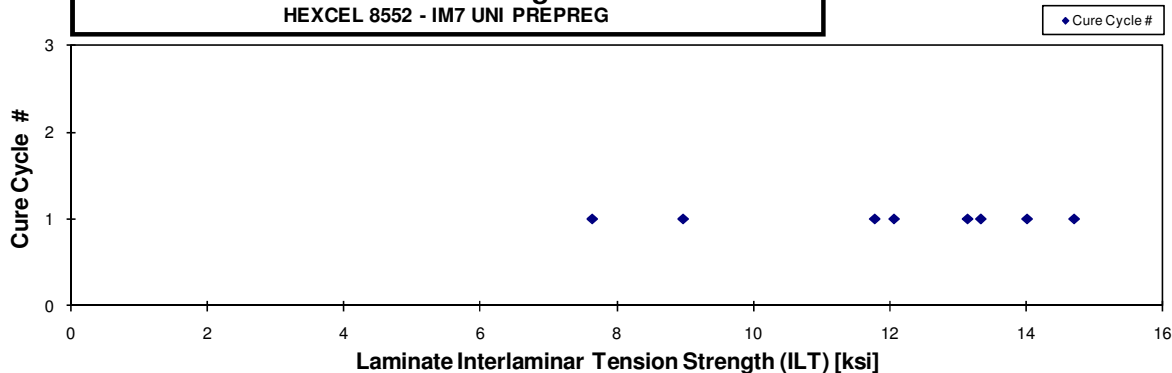
### Laminate Interlaminar Tension Strength (ILT) -- (CTD) Measured Strength

HEXCEL 8552 - IM7 UNI PREPREG



### Laminate Interlaminar Tension Strength (ILT) -- (CTD) Measured Strength

HEXCEL 8552 - IM7 UNI PREPREG





### Laminate Curved Beam Strength Properties (CBS) -- (RTD) Strength

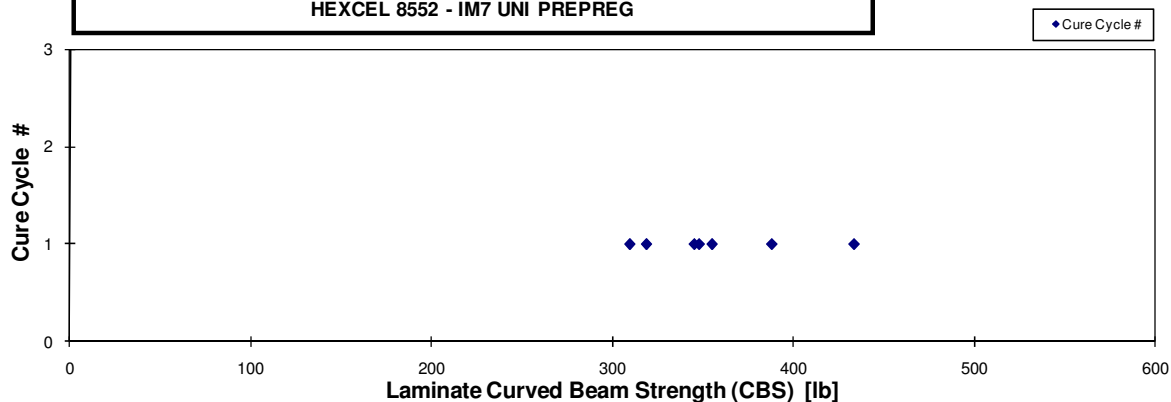
HEXCEL 8552 - IM7 UNI PREPREG

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Curved Beam Strength [lb] | Interlaminar Tension Strength [ksi] | Avg. Specimen Thckn. [in] | # Plies in Laminate | Avg. $t_{ply}$ [in] |
|-----------------|----------------|-------------------|---------------|--------------|---------------------------|-------------------------------------|---------------------------|---------------------|---------------------|
| HFIMA111A       | A              | M1                | 1             | 1            | 433.114                   | 13.246                              | 0.154                     | 22                  | 0.0070              |
| HFIMA112A       | A              | M1                | 1             | 1            | 355.037                   | 10.806                              | 0.155                     | 22                  | 0.0070              |
| HFIMA113A       | A              | M1                | 1             | 1            | 345.304                   | 10.490                              | 0.155                     | 22                  | 0.0071              |
| HFIMA114A       | A              | M1                | 1             | 1            | 387.874                   | 11.821                              | 0.155                     | 22                  | 0.0070              |
| HFIMA115A       | A              | M1                | 1             | 1            | 309.813                   | 9.990                               | 0.148                     | 22                  | 0.0067              |
| HFIMA116A       | A              | M1                | 1             | 1            | 347.870                   | 10.869                              | 0.152                     | 22                  | 0.0069              |
| HFIMA117A       | A              | M1                | 1             | 1            | 318.963                   | 10.061                              | 0.150                     | 22                  | 0.0068              |

|                    |         |        |         |        |
|--------------------|---------|--------|---------|--------|
| Average            | 356.853 | 11.041 | Average | 0.0069 |
| Standard Dev.      | 42.119  | 1.149  | Min.    | 0.0067 |
| Coeff. of Var. [%] | 11.803  | 10.410 | Max.    | 0.0071 |
| Min.               | 309.813 | 9.990  |         |        |
| Max.               | 433.114 | 13.246 |         |        |
| Number of Spec.    | 7       | 7      |         |        |

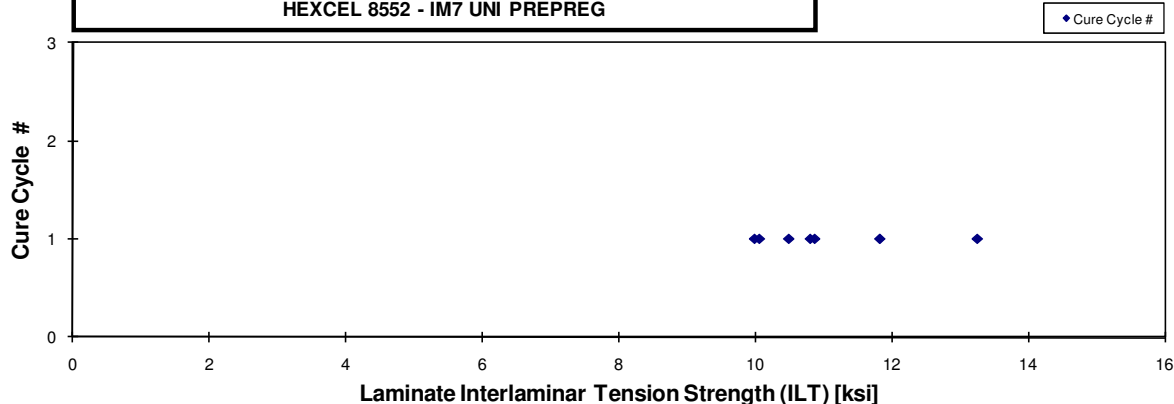
### Laminate Curved Beam Strength Properties (CBS)-- (RTD) Measured Strength

HEXCEL 8552 - IM7 UNI PREPREG



### Laminate Interlaminar Tension Strength (ILT)-- (RTD) Measured Strength

HEXCEL 8552 - IM7 UNI PREPREG



### Laminate Curved Beam Strength Properties (CBS) -- (ETW) Strength

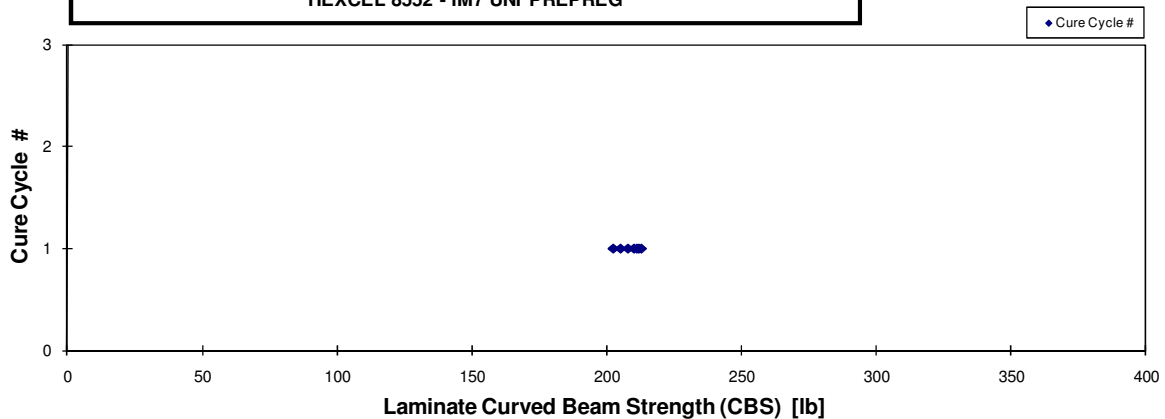
HEXCEL 8552 - IM7 UNI PREPREG

| Specimen Number | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Cure Cycle # | Curved Beam Strength [lb] | Interlaminar Tension Strength [ksi] | Avg. Specimen Thickn. [in] | # Plies in Laminate | Avg. $t_{ply}$ [in] |
|-----------------|----------------|-------------------|---------------|--------------|---------------------------|-------------------------------------|----------------------------|---------------------|---------------------|
| HFIMA11HD       | A              | M1                | 1             | 1            | 207.829                   | 6.391                               | 0.154                      | 22                  | 0.0070              |
| HFIMA11ID       | A              | M1                | 1             | 1            | 211.004                   | 6.608                               | 0.151                      | 22                  | 0.0069              |
| HFIMA11JD       | A              | M1                | 1             | 1            | 209.973                   | 6.601                               | 0.151                      | 22                  | 0.0069              |
| HFIMA11KD       | A              | M1                | 1             | 1            | 202.503                   | 6.192                               | 0.154                      | 22                  | 0.0070              |
| HFIMA11LD       | A              | M1                | 1             | 1            | 212.626                   | 6.715                               | 0.150                      | 22                  | 0.0068              |
| HFIMA11MD       | A              | M1                | 1             | 1            | 211.706                   | 6.490                               | 0.154                      | 22                  | 0.0070              |
| HFIMA11ND       | A              | M1                | 1             | 1            | 205.110                   | 6.230                               | 0.155                      | 22                  | 0.0071              |

|                    |         |       |         |        |
|--------------------|---------|-------|---------|--------|
| Average            | 208.679 | 6.461 | Average | 0.0069 |
| Standard Dev.      | 3.729   | 0.199 | Min.    | 0.0068 |
| Coeff. of Var. [%] | 1.787   | 3.077 | Max.    | 0.0071 |
| Min.               | 202.503 | 6.192 |         |        |
| Max.               | 212.626 | 6.715 |         |        |
| Number of Spec.    | 7       | 7     |         |        |

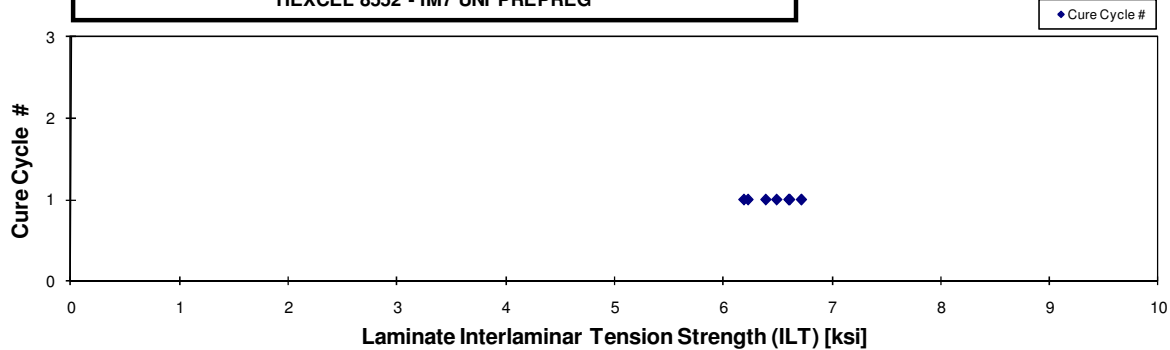
### Laminate Curved Beam Strength Properties (CBS) -- (ETW) Measured Strength

HEXCEL 8552 - IM7 UNI PREPREG

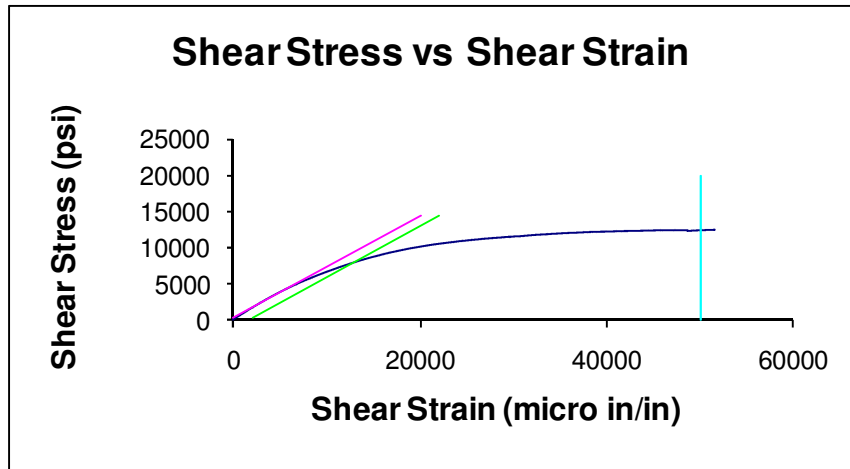


### Laminate Interlaminar Tension Strength (ILT) -- (ETW) Measured Strength

HEXCEL 8552 - IM7 UNI PREPREG



## 5. Shear Stress vs. Shear Strain, RTD



## 6. FLUID SENSITIVITY COMPARISON

| Fluid | Average Short Beam        | Same Environment Short Beam Strength |  | Worst Case Environment Short | % Strength Reduction With |
|-------|---------------------------|--------------------------------------|--|------------------------------|---------------------------|
|       | Strength With Fluid (ksi) | Without Fluid (ksi) (ETD)            |  | Beam Strength (ksi) (ETW)    | Respect to ETD (no fluid) |
| a     | 18.131                    | 16.96                                |  | 14.81                        | -6.895                    |
| b     | 16.821                    | 16.96                                |  | 14.81                        | 0.828                     |
| c     | 16.749                    | 16.96                                |  | 14.81                        | 1.252                     |
| d     | 16.561                    | 16.96                                |  | 14.81                        | 2.361                     |
| e     | 16.480                    | 16.96                                |  | 14.81                        | 2.843                     |
| f     | 16.221                    | 16.96                                |  | 14.81                        | 4.369                     |
| g     | 15.835                    | 16.96                                |  | 14.81                        | 6.643                     |
| h     | 16.586                    | 16.96                                |  | 14.81                        | 2.214                     |
| i     | 15.852                    | 16.96                                |  | 14.81                        | 6.545                     |
| j     | 16.804                    | 16.96                                |  | 14.81                        | 0.930                     |
| k     | 16.794                    | 16.96                                |  | 14.81                        | 0.989                     |
| l     | 16.297                    | 16.96                                |  | 14.81                        | 3.916                     |
| r     | 15.819                    | 16.96                                |  | 14.81                        | 6.735                     |
| A     | 16.962                    | 16.96                                |  | 14.81                        | 0.000                     |
| t     | 14.811                    | 16.96                                |  | 14.81                        | 12.681                    |

- a 100 Low lead Fuel
- b SAE AMS 2629 JRF
- c Mil-PRF-5606 Hydraulic Oil
- d Mil-PRF-83282 Hydraulic Oil
- e Engine Lube Oil Mil-L-7808
- f Engine Lube Oil Mil-L-23699
- g Salt Water
- h Skydrol LD-4
- i 50% Water + 50% Skydrol
- j MEK Washing Fluid
- k Polypropylene Glycol Deicer
- l Isopropyl Alcohol Deicing Agent
- r Distilled Water
- A Dry (Room Temp)
- t 160°F±5°F(85%±5%) until Equilibrium

**CAM-RP-2009-015 April 22, 2011 Revision A**

| Fluid | Average Short Beam        | Same Environment Short Beam        | Worst Case Environment Short | % Strength Reduction With |
|-------|---------------------------|------------------------------------|------------------------------|---------------------------|
|       | Strength With Fluid (ksi) | Strength Without Fluid (ksi) (ETD) | Beam Strength (ksi) (ETW)    | Respect to ETD (no fluid) |
| 1     | 10.630                    | 11.008                             | 8.193                        | 3.429                     |
| 2     | 11.298                    | 11.008                             | 8.193                        | -2.635                    |
| 3     | 11.053                    | 11.008                             | 8.193                        | -0.413                    |
| 4     | 10.934                    | 11.008                             | 8.193                        | 0.674                     |
| 5     | 10.442                    | 11.008                             | 8.193                        | 5.135                     |
| 6     | 10.451                    | 11.008                             | 8.193                        | 5.062                     |
| 7     | 9.847                     | 11.008                             | 8.193                        | 10.542                    |
| 8     | 10.463                    | 11.008                             | 8.193                        | 4.952                     |
| 9     | 9.527                     | 11.008                             | 8.193                        | 13.454                    |
| m     | 11.050                    | 11.008                             | 8.193                        | -0.381                    |
| n     | 11.133                    | 11.008                             | 8.193                        | -1.135                    |
| p     | 11.120                    | 11.008                             | 8.193                        | -1.018                    |
| s     | 9.642                     | 11.008                             | 8.193                        | 12.407                    |
| C     | 11.008                    | 11.008                             | 8.193                        | 0.000                     |
| D     | 8.193                     | 11.008                             | 8.193                        | 25.574                    |

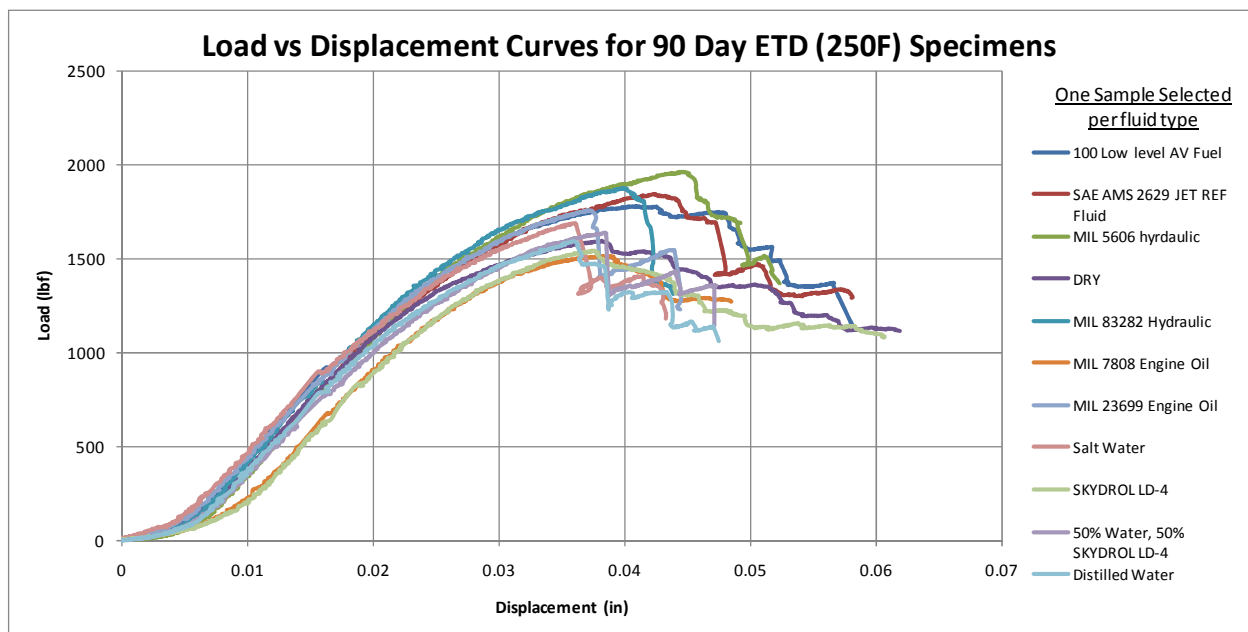
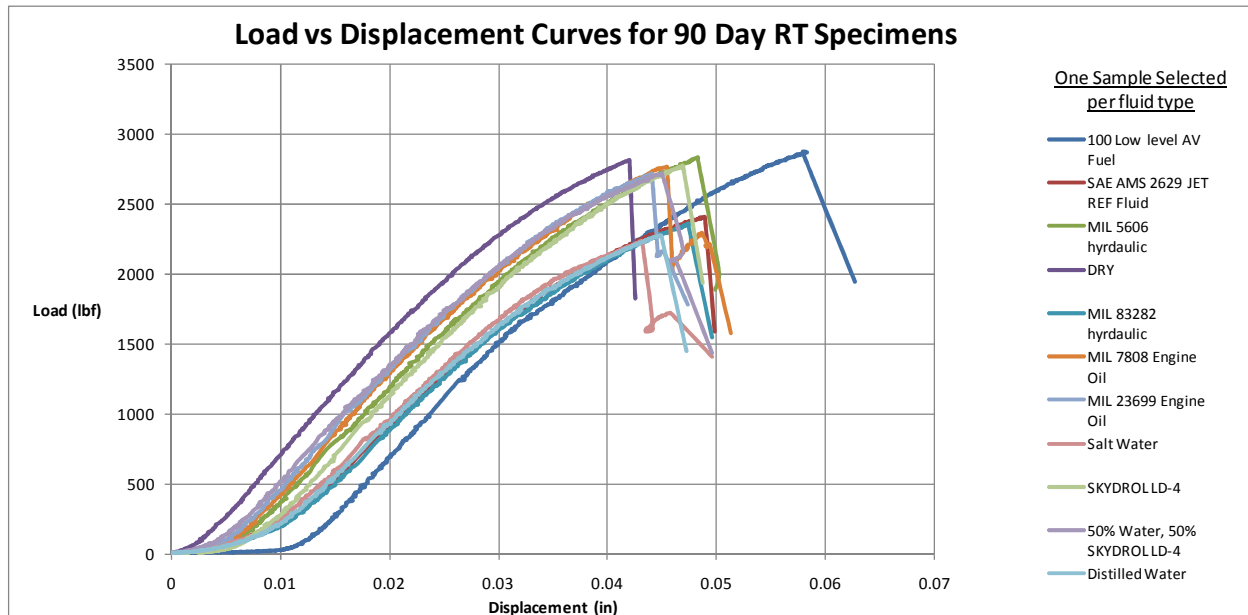
- 1 100 Low lead Fuel
- 2 SAE AMS 2629 JRF
- 3 Mil-PRF-5606 Hydraulic Oil
- 4 Mil-PRF-83282 Hydraulic Oil
- 5 Engine Lube Oil Mil-L-7808
- 6 Engine Lube Oil Mil-L-23699
- 7 Salt Water
- 8 Skydrol LD-4
- 9 50% Water + 50% Skydrol
- m MEK Washing Fluid
- n Polypropylene Glycol Deicer
- p Isopropyl Alcohol Deicing Agent
- s Distilled Water
- C Dry (Room Temp)
- D 160 °F±5 °F(85%±5%) until Equilibrium

| <b>Fluid Sensitivity Screening</b><br><b>Short Beam Strength Properties (FSBS)-- (RTD) Strength</b><br>HEXCEL 8552 - IM7 UNI PREPREG |                |                   |               |       |                |                             |                     |                |                    |
|--------------------------------------------------------------------------------------------------------------------------------------|----------------|-------------------|---------------|-------|----------------|-----------------------------|---------------------|----------------|--------------------|
| Specimen Number                                                                                                                      | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Fluid | Strength [ksi] | Avg. Specimen Thicken. [in] | # Plies in Laminate | Avg. tply [in] | Failure Mode       |
| HF1QA121a                                                                                                                            | A              | MH1               | 1             | 1     | 21.418         | 0.200                       | 34                  | 0.0059         | INTERLAMINAR SHEAR |
| HF1QA122a                                                                                                                            | A              | MH1               | 1             | 1     | 17.274         | 0.212                       | 34                  | 0.0062         | INTERLAMINAR SHEAR |
| HF1QA123a                                                                                                                            | A              | MH1               | 1             | 1     | 17.170         | 0.223                       | 34                  | 0.0066         | INTERLAMINAR SHEAR |
| HF1QA124a                                                                                                                            | A              | MH1               | 1             | 1     | 17.648         | 0.233                       | 34                  | 0.0068         | INTERLAMINAR SHEAR |
| HF1QA125a                                                                                                                            | A              | MH1               | 1             | 1     | 17.687         | 0.238                       | 34                  | 0.0070         | INTERLAMINAR SHEAR |
| HF1QA126a                                                                                                                            | A              | MH1               | 1             | 1     | 17.589         | 0.241                       | 34                  | 0.0071         | INTERLAMINAR SHEAR |
| HF1QA121b                                                                                                                            | A              | MH1               | 1             | 2     | 16.630         | 0.216                       | 34                  | 0.0063         | INTERLAMINAR SHEAR |
| HF1QA121b                                                                                                                            | A              | MH1               | 1             | 2     | 16.780         | 0.226                       | 34                  | 0.0066         | INTERLAMINAR SHEAR |
| HF1QA121b                                                                                                                            | A              | MH1               | 1             | 2     | 16.647         | 0.237                       | 34                  | 0.0070         | INTERLAMINAR SHEAR |
| HF1QA121b                                                                                                                            | A              | MH1               | 1             | 2     | 16.886         | 0.245                       | 34                  | 0.0072         | INTERLAMINAR SHEAR |
| HF1QA121b                                                                                                                            | A              | MH1               | 1             | 2     | 16.931         | 0.251                       | 34                  | 0.0074         | INTERLAMINAR SHEAR |
| HF1QA120b                                                                                                                            | A              | MH1               | 1             | 2     | 17.053         | 0.254                       | 34                  | 0.0075         | INTERLAMINAR SHEAR |
| HF1QA131c                                                                                                                            | A              | MH1               | 1             | 3     | 16.482         | 0.256                       | 34                  | 0.0075         | INTERLAMINAR SHEAR |
| HF1QA132c                                                                                                                            | A              | MH1               | 1             | 3     | 16.659         | 0.257                       | 34                  | 0.0076         | INTERLAMINAR SHEAR |
| HF1QA133c                                                                                                                            | A              | MH1               | 1             | 3     | 16.777         | 0.257                       | 34                  | 0.0076         | INTERLAMINAR SHEAR |
| HF1QA134c                                                                                                                            | A              | MH1               | 1             | 3     | 16.804         | 0.257                       | 34                  | 0.0076         | INTERLAMINAR SHEAR |
| HF1QA135c                                                                                                                            | A              | MH1               | 1             | 3     | 16.651         | 0.257                       | 34                  | 0.0075         | INTERLAMINAR SHEAR |
| HF1QA136c                                                                                                                            | A              | MH1               | 1             | 3     | 17.121         | 0.257                       | 34                  | 0.0076         | INTERLAMINAR SHEAR |
| HF1QA130d                                                                                                                            | A              | MH1               | 1             | 4     | 16.450         | 0.214                       | 34                  | 0.0063         | INTERLAMINAR SHEAR |
| HF1QA13Ed                                                                                                                            | A              | MH1               | 1             | 4     | 16.582         | 0.224                       | 34                  | 0.0066         | INTERLAMINAR SHEAR |
| HF1QA13Fd                                                                                                                            | A              | MH1               | 1             | 4     | 16.250         | 0.234                       | 34                  | 0.0069         | INTERLAMINAR SHEAR |
| HF1QA13Gd                                                                                                                            | A              | MH1               | 1             | 4     | 16.805         | 0.243                       | 34                  | 0.0071         | INTERLAMINAR SHEAR |
| HF1QA13Hd                                                                                                                            | A              | MH1               | 1             | 4     | 16.287         | 0.249                       | 34                  | 0.0073         | INTERLAMINAR SHEAR |
| HF1QA13Id                                                                                                                            | A              | MH1               | 1             | 4     | 16.993         | 0.251                       | 34                  | 0.0074         | INTERLAMINAR SHEAR |
| HF1QA141e                                                                                                                            | A              | MH1               | 1             | 5     | 16.326         | 0.253                       | 34                  | 0.0074         | INTERLAMINAR SHEAR |
| HF1QA142e                                                                                                                            | A              | MH1               | 1             | 5     | 16.538         | 0.251                       | 34                  | 0.0074         | INTERLAMINAR SHEAR |
| HF1QA143e                                                                                                                            | A              | MH1               | 1             | 5     | 16.367         | 0.247                       | 34                  | 0.0073         | INTERLAMINAR SHEAR |
| HF1QA144e                                                                                                                            | A              | MH1               | 1             | 5     | 16.283         | 0.242                       | 34                  | 0.0071         | INTERLAMINAR SHEAR |
| HF1QA145e                                                                                                                            | A              | MH1               | 1             | 5     | 16.436         | 0.235                       | 34                  | 0.0069         | INTERLAMINAR SHEAR |
| HF1QA146e                                                                                                                            | A              | MH1               | 1             | 5     | 16.928         | 0.226                       | 34                  | 0.0067         | INTERLAMINAR SHEAR |
| HF1QA14Df                                                                                                                            | A              | MH1               | 1             | 6     | 16.064         | 0.251                       | 34                  | 0.0074         | INTERLAMINAR SHEAR |
| HF1QA14Ef                                                                                                                            | A              | MH1               | 1             | 6     | 16.548         | 0.252                       | 34                  | 0.0074         | INTERLAMINAR SHEAR |
| HF1QA14Ff                                                                                                                            | A              | MH1               | 1             | 6     | 16.399         | 0.252                       | 34                  | 0.0074         | INTERLAMINAR SHEAR |
| HF1QA14Gf                                                                                                                            | A              | MH1               | 1             | 6     | 16.014         | 0.252                       | 34                  | 0.0074         | INTERLAMINAR SHEAR |
| HF1QA14Hf                                                                                                                            | A              | MH1               | 1             | 6     | 16.087         | 0.253                       | 34                  | 0.0074         | INTERLAMINAR SHEAR |
| HF1QA14If                                                                                                                            | A              | MH1               | 1             | 6     | 16.213         | 0.253                       | 34                  | 0.0074         | INTERLAMINAR SHEAR |
| HF1QA151g                                                                                                                            | A              | MH1               | 1             | 7     | 15.457         | 0.216                       | 34                  | 0.0064         | INTERLAMINAR SHEAR |
| HF1QA152g                                                                                                                            | A              | MH1               | 1             | 7     | 16.263         | 0.227                       | 34                  | 0.0067         | INTERLAMINAR SHEAR |
| HF1QA153g                                                                                                                            | A              | MH1               | 1             | 7     | 14.951         | 0.236                       | 34                  | 0.0069         | INTERLAMINAR SHEAR |
| HF1QA154g                                                                                                                            | A              | MH1               | 1             | 7     | 15.984         | 0.243                       | 34                  | 0.0072         | INTERLAMINAR SHEAR |
| HF1QA155g                                                                                                                            | A              | MH1               | 1             | 7     | 15.915         | 0.248                       | 34                  | 0.0073         | INTERLAMINAR SHEAR |
| HF1QA156g                                                                                                                            | A              | MH1               | 1             | 7     | 16.441         | 0.251                       | 34                  | 0.0074         | INTERLAMINAR SHEAR |
| HF1QA150h                                                                                                                            | A              | MH1               | 1             | 8     | 16.374         | 0.253                       | 34                  | 0.0074         | INTERLAMINAR SHEAR |
| HF1QA15Eh                                                                                                                            | A              | MH1               | 1             | 8     | 16.910         | 0.251                       | 34                  | 0.0074         | INTERLAMINAR SHEAR |
| HF1QA15Fh                                                                                                                            | A              | MH1               | 1             | 8     | 16.811         | 0.247                       | 34                  | 0.0073         | INTERLAMINAR SHEAR |
| HF1QA15Gh                                                                                                                            | A              | MH1               | 1             | 8     | 16.291         | 0.243                       | 34                  | 0.0071         | INTERLAMINAR SHEAR |
| HF1QA15Hh                                                                                                                            | A              | MH1               | 1             | 8     | 16.567         | 0.235                       | 34                  | 0.0069         | INTERLAMINAR SHEAR |
| HF1QA15Ih                                                                                                                            | A              | MH1               | 1             | 8     | 16.564         | 0.226                       | 34                  | 0.0066         | INTERLAMINAR SHEAR |
| HF1QA161i                                                                                                                            | A              | MH1               | 1             | 9     | 16.090         | 0.252                       | 34                  | 0.0074         | INTERLAMINAR SHEAR |
| HF1QA162i                                                                                                                            | A              | MH1               | 1             | 9     | 16.125         | 0.252                       | 34                  | 0.0074         | INTERLAMINAR SHEAR |
| HF1QA163i                                                                                                                            | A              | MH1               | 1             | 9     | 15.797         | 0.252                       | 34                  | 0.0074         | INTERLAMINAR SHEAR |
| HF1QA164i                                                                                                                            | A              | MH1               | 1             | 9     | 15.769         | 0.252                       | 34                  | 0.0074         | INTERLAMINAR SHEAR |
| HF1QA165i                                                                                                                            | A              | MH1               | 1             | 9     | 15.476         | 0.252                       | 34                  | 0.0074         | INTERLAMINAR SHEAR |
| HF1QA16Dj                                                                                                                            | A              | MH1               | 1             | 10    | 17.656         | 0.215                       | 34                  | 0.0063         | INTERLAMINAR SHEAR |
| HF1QA16Ej                                                                                                                            | A              | MH1               | 1             | 10    | 17.078         | 0.226                       | 34                  | 0.0066         | INTERLAMINAR SHEAR |
| HF1QA16Fj                                                                                                                            | A              | MH1               | 1             | 10    | 16.641         | 0.235                       | 34                  | 0.0069         | INTERLAMINAR SHEAR |
| HF1QA16Gj                                                                                                                            | A              | MH1               | 1             | 10    | 16.892         | 0.243                       | 34                  | 0.0071         | INTERLAMINAR SHEAR |
| HF1QA16Hj                                                                                                                            | A              | MH1               | 1             | 10    | 16.266         | 0.248                       | 34                  | 0.0073         | INTERLAMINAR SHEAR |
| HF1QA16Ij                                                                                                                            | A              | MH1               | 1             | 10    | 16.290         | 0.251                       | 34                  | 0.0074         | INTERLAMINAR SHEAR |
| HF1QA171k                                                                                                                            | A              | MH1               | 1             | 11    | 16.905         | 0.252                       | 34                  | 0.0074         | INTERLAMINAR SHEAR |
| HF1QA172k                                                                                                                            | A              | MH1               | 1             | 11    | 16.930         | 0.251                       | 34                  | 0.0074         | INTERLAMINAR SHEAR |
| HF1QA173k                                                                                                                            | A              | MH1               | 1             | 11    | 16.382         | 0.248                       | 34                  | 0.0073         | INTERLAMINAR SHEAR |
| HF1QA174k                                                                                                                            | A              | MH1               | 1             | 11    | 16.512         | 0.243                       | 34                  | 0.0071         | INTERLAMINAR SHEAR |
| HF1QA175k                                                                                                                            | A              | MH1               | 1             | 11    | 17.143         | 0.237                       | 34                  | 0.0070         | INTERLAMINAR SHEAR |
| HF1QA176k                                                                                                                            | A              | MH1               | 1             | 11    | 16.891         | 0.229                       | 34                  | 0.0067         | INTERLAMINAR SHEAR |
| HF1QA17DL                                                                                                                            | A              | MH1               | 1             | 12    | 16.419         | 0.253                       | 34                  | 0.0074         | INTERLAMINAR SHEAR |
| HF1QA17EL                                                                                                                            | A              | MH1               | 1             | 12    | 16.410         | 0.253                       | 34                  | 0.0074         | INTERLAMINAR SHEAR |
| HF1QA17FL                                                                                                                            | A              | MH1               | 1             | 12    | 16.230         | 0.252                       | 34                  | 0.0074         | INTERLAMINAR SHEAR |
| HF1QA17GL                                                                                                                            | A              | MH1               | 1             | 12    | 16.639         | 0.253                       | 34                  | 0.0075         | INTERLAMINAR SHEAR |
| HF1QA17HL                                                                                                                            | A              | MH1               | 1             | 12    | 15.845         | 0.253                       | 34                  | 0.0074         | INTERLAMINAR SHEAR |
| HF1QA17IL                                                                                                                            | A              | MH1               | 1             | 12    | 16.241         | 0.253                       | 34                  | 0.0074         | INTERLAMINAR SHEAR |
| HF1QA181r                                                                                                                            | A              | MH1               | 1             | 13    | 15.918         | 0.213                       | 34                  | 0.0063         | INTERLAMINAR SHEAR |
| HF1QA182r                                                                                                                            | A              | MH1               | 1             | 13    | 15.536         | 0.226                       | 34                  | 0.0066         | INTERLAMINAR SHEAR |
| HF1QA183r                                                                                                                            | A              | MH1               | 1             | 13    | 15.983         | 0.235                       | 34                  | 0.0069         | INTERLAMINAR SHEAR |
| HF1QA184r                                                                                                                            | A              | MH1               | 1             | 13    | 15.599         | 0.243                       | 34                  | 0.0071         | INTERLAMINAR SHEAR |
| HF1QA185r                                                                                                                            | A              | MH1               | 1             | 13    | 15.765         | 0.248                       | 34                  | 0.0073         | INTERLAMINAR SHEAR |
| HF1QA186r                                                                                                                            | A              | MH1               | 1             | 13    | 16.116         | 0.251                       | 34                  | 0.0074         | INTERLAMINAR SHEAR |
| HF1QA18DA                                                                                                                            | A              | MH1               | 1             | 14    | 16.659         | 0.253                       | 34                  | 0.0074         | INTERLAMINAR SHEAR |
| HF1QA18EA                                                                                                                            | A              | MH1               | 1             | 14    | 16.852         | 0.251                       | 34                  | 0.0074         | INTERLAMINAR SHEAR |
| HF1QA18FA                                                                                                                            | A              | MH1               | 1             | 14    | 16.800         | 0.248                       | 34                  | 0.0073         | INTERLAMINAR SHEAR |
| HF1QA18GA                                                                                                                            | A              | MH1               | 1             | 14    | 16.898         | 0.243                       | 34                  | 0.0071         | INTERLAMINAR SHEAR |
| HF1QA18HA                                                                                                                            | A              | MH1               | 1             | 14    | 17.201         | 0.236                       | 34                  | 0.0069         | INTERLAMINAR SHEAR |
| HF1QA18IA                                                                                                                            | A              | MH1               | 1             | 14    | 17.359         | 0.227                       | 34                  | 0.0067         | INTERLAMINAR SHEAR |
| HF1QA191t                                                                                                                            | A              | MH1               | 1             | 15    | 15.132         | 0.252                       | 34                  | 0.0074         | INTERLAMINAR SHEAR |
| HF1QA192t                                                                                                                            | A              | MH1               | 1             | 15    | 14.993         | 0.253                       | 34                  | 0.0074         | INTERLAMINAR SHEAR |
| HF1QA193t                                                                                                                            | A              | MH1               | 1             | 15    | 14.716         | 0.253                       | 34                  | 0.0074         | INTERLAMINAR SHEAR |
| HF1QA194t                                                                                                                            | A              | MH1               | 1             | 15    | 15.192         | 0.252                       | 34                  | 0.0074         | INTERLAMINAR SHEAR |
| HF1QA195t                                                                                                                            | A              | MH1               | 1             | 15    | 13.958         | 0.252                       | 34                  | 0.0074         | INTERLAMINAR SHEAR |
| HF1QA196t                                                                                                                            | A              | MH1               | 1             | 15    | 14.874         | 0.253                       | 34                  | 0.0074         | INTERLAMINAR SHEAR |

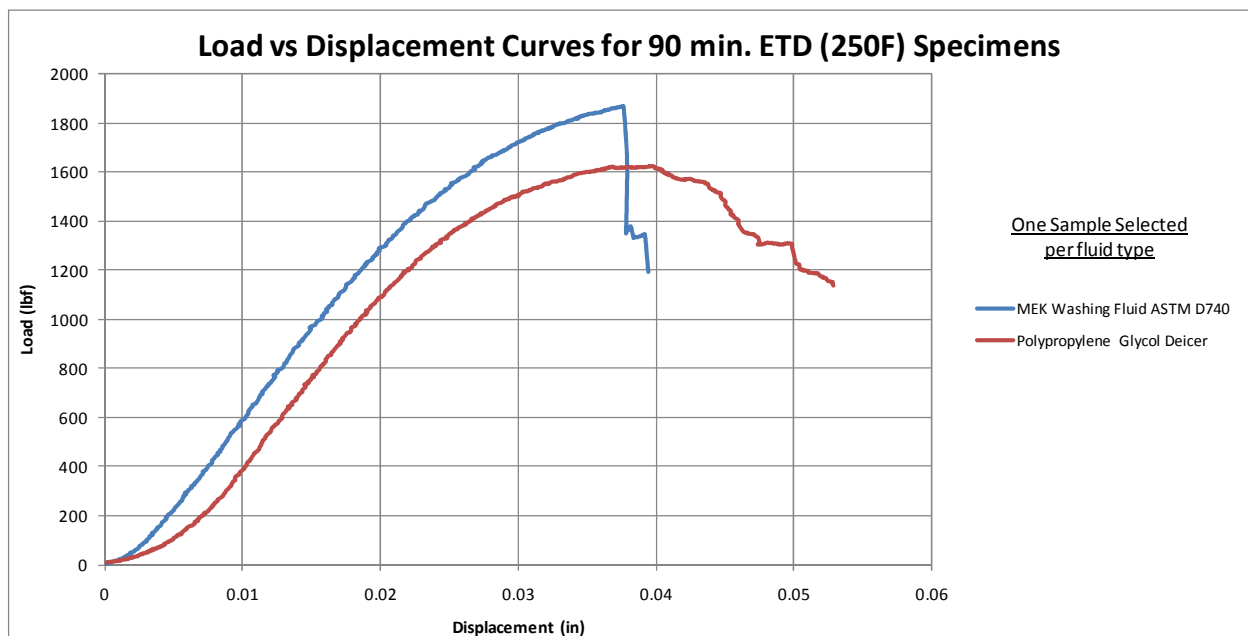
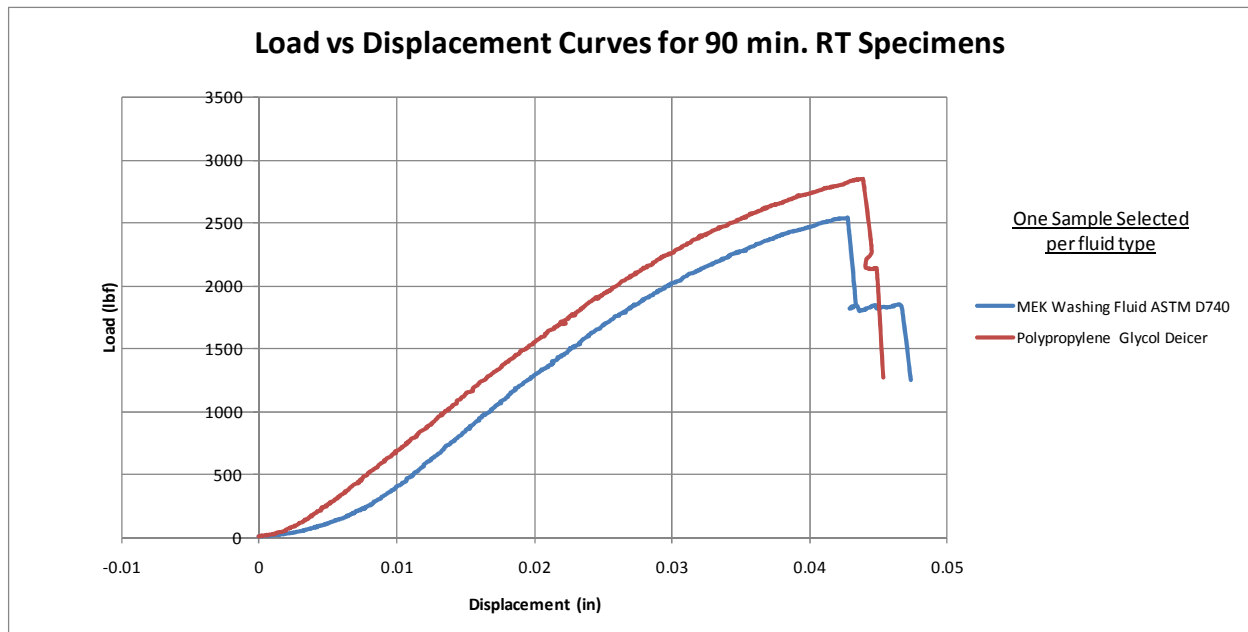
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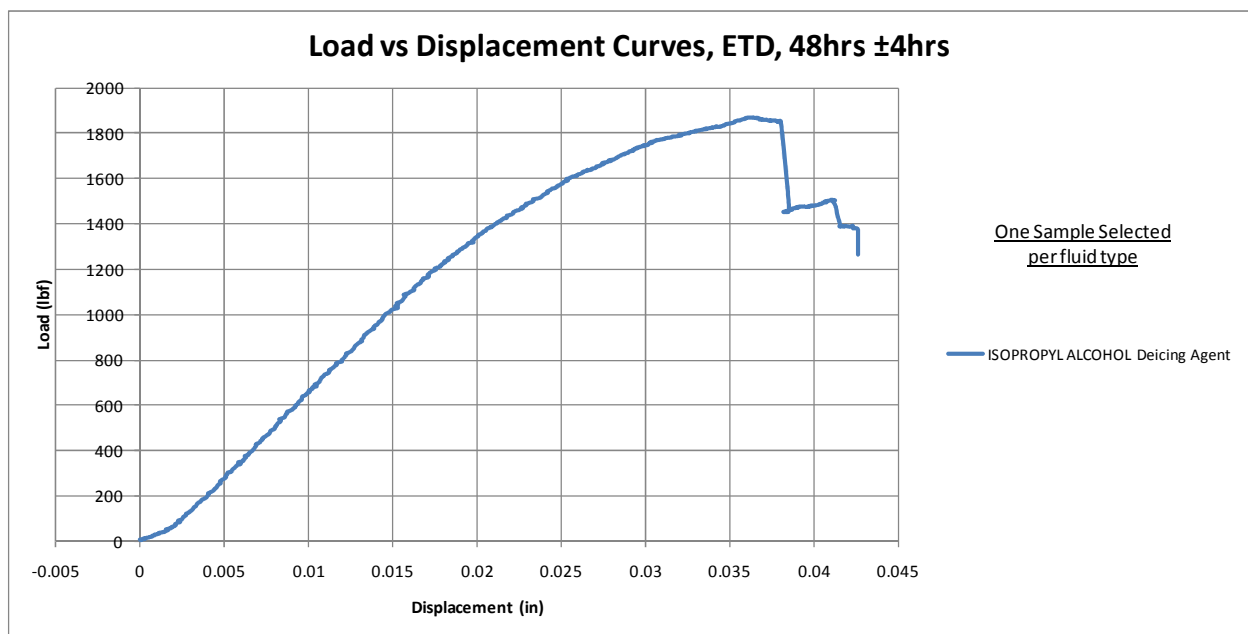
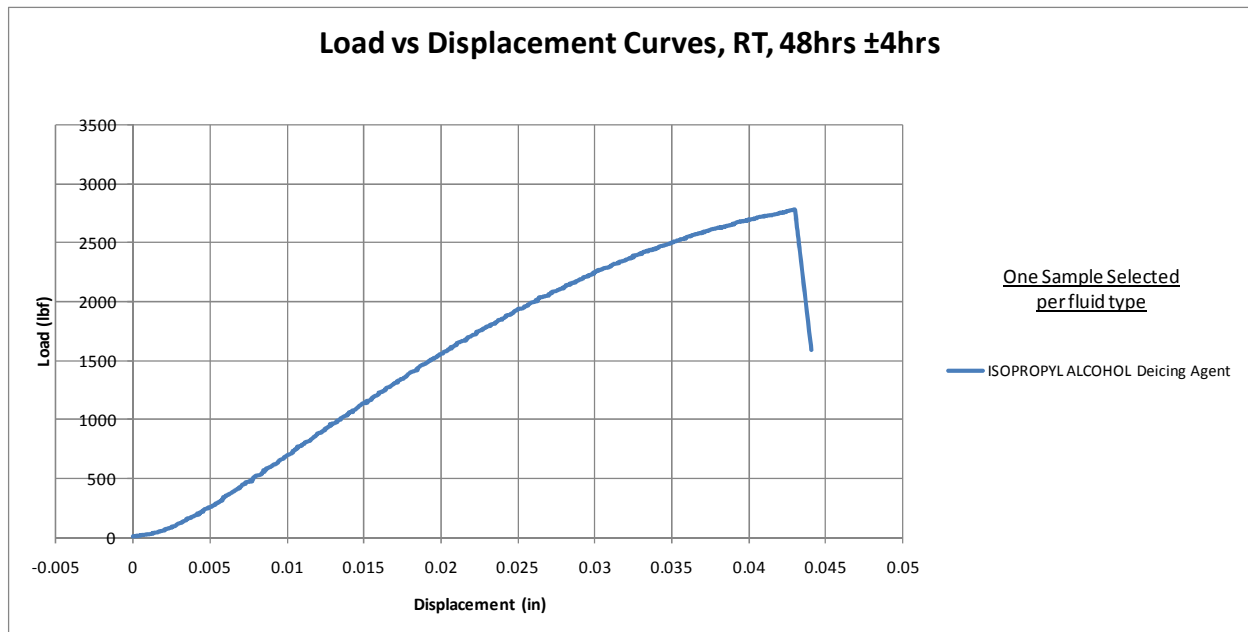
| <b>Fluid Sensitivity Screening</b><br><b>Short Beam Strength Properties (FSBS)-- (ETD) Strength</b><br><b>HEXCEL 8552 - IM7 UNI PREPREG</b> |                |                   |               |       |                |                            |                     |                |                                  |
|---------------------------------------------------------------------------------------------------------------------------------------------|----------------|-------------------|---------------|-------|----------------|----------------------------|---------------------|----------------|----------------------------------|
| Specimen Number                                                                                                                             | Hexcel Batch # | Hexcel Cure Cycle | Prepreg Lot # | Fluid | Strength [ksi] | Avg. Specimen Thichn. [in] | # Piles in Laminata | Avg. tply [in] | Failure Mode                     |
| HF1QA1271                                                                                                                                   | A              | MH1               | 1             | 1     | 10.925         | 0.243                      | 34                  | 0.0071         | INTERLAMINAR SHEAR               |
| HF1QA1281                                                                                                                                   | A              | MH1               | 1             | 1     | 11.029         | 0.242                      | 34                  | 0.0071         | INTERLAMINAR SHEAR               |
| HF1QA1291                                                                                                                                   | A              | MH1               | 1             | 1     | 10.866         | 0.243                      | 34                  | 0.0071         | INTERLAMINAR SHEAR               |
| HF1QA12A1                                                                                                                                   | A              | MH1               | 1             | 1     | 8.809          | 0.242                      | 34                  | 0.0071         | INTERLAMINAR SHEAR               |
| HF1QA12B1                                                                                                                                   | A              | MH1               | 1             | 1     | 11.063         | 0.242                      | 34                  | 0.0071         | INTERLAMINAR SHEAR               |
| HF1QA12C1                                                                                                                                   | A              | MH1               | 1             | 1     | 11.090         | 0.243                      | 34                  | 0.0071         | INTERLAMINAR SHEAR               |
| HF1QA12D2                                                                                                                                   | A              | MH1               | 1             | 2     | 11.334         | 0.243                      | 34                  | 0.0072         | INTERLAMINAR SHEAR               |
| HF1QA12E2                                                                                                                                   | A              | MH1               | 1             | 2     | 11.269         | 0.240                      | 34                  | 0.0071         | INTERLAMINAR SHEAR               |
| HF1QA12F2                                                                                                                                   | A              | MH1               | 1             | 2     | 11.302         | 0.236                      | 34                  | 0.0069         | INTERLAMINAR SHEAR               |
| HF1QA12G2                                                                                                                                   | A              | MH1               | 1             | 2     | 11.200         | 0.231                      | 34                  | 0.0068         | INTERLAMINAR SHEAR               |
| HF1QA12H2                                                                                                                                   | A              | MH1               | 1             | 2     | 11.603         | 0.224                      | 34                  | 0.0066         | INTERLAMINAR SHEAR               |
| HF1QA12I2                                                                                                                                   | A              | MH1               | 1             | 2     | 11.080         | 0.214                      | 34                  | 0.0063         | INTERLAMINAR SHEAR               |
| HF1QA1373                                                                                                                                   | A              | MH1               | 1             | 3     | 11.415         | 0.256                      | 34                  | 0.0075         | INTERLAMINAR SHEAR               |
| HF1QA1383                                                                                                                                   | A              | MH1               | 1             | 3     | 11.188         | 0.254                      | 34                  | 0.0075         | INTERLAMINAR SHEAR               |
| HF1QA1393                                                                                                                                   | A              | MH1               | 1             | 3     | 11.167         | 0.251                      | 34                  | 0.0074         | INTERLAMINAR SHEAR               |
| HF1QA13A3                                                                                                                                   | A              | MH1               | 1             | 3     | 10.870         | 0.245                      | 34                  | 0.0072         | INTERLAMINAR SHEAR               |
| HF1QA13B3                                                                                                                                   | A              | MH1               | 1             | 3     | 10.971         | 0.237                      | 34                  | 0.0070         | INTERLAMINAR SHEAR               |
| HF1QA13C3                                                                                                                                   | A              | MH1               | 1             | 3     | 10.708         | 0.228                      | 34                  | 0.0067         | INTERLAMINAR SHEAR               |
| HF1QA13J4                                                                                                                                   | A              | MH1               | 1             | 4     | 11.031         | 0.253                      | 34                  | 0.0074         | INTERLAMINAR SHEAR               |
| HF1QA13K4                                                                                                                                   | A              | MH1               | 1             | 4     | 10.999         | 0.253                      | 34                  | 0.0075         | INTERLAMINAR SHEAR               |
| HF1QA13L4                                                                                                                                   | A              | MH1               | 1             | 4     | 10.744         | 0.253                      | 34                  | 0.0075         | INTERLAMINAR SHEAR               |
| HF1QA13M4                                                                                                                                   | A              | MH1               | 1             | 4     | 10.975         | 0.254                      | 34                  | 0.0075         | INTERLAMINAR SHEAR               |
| HF1QA13N4                                                                                                                                   | A              | MH1               | 1             | 4     | 10.913         | 0.253                      | 34                  | 0.0075         | INTERLAMINAR SHEAR               |
| HF1QA13O4                                                                                                                                   | A              | MH1               | 1             | 4     | 10.939         | 0.253                      | 34                  | 0.0074         | INTERLAMINAR SHEAR               |
| HF1QA1475                                                                                                                                   | A              | MH1               | 1             | 5     | 10.534         | 0.214                      | 34                  | 0.0063         | INTERLAMINAR SHEAR / COMPRESSION |
| HF1QA1485                                                                                                                                   | A              | MH1               | 1             | 5     | 10.598         | 0.225                      | 34                  | 0.0066         | INTERLAMINAR SHEAR               |
| HF1QA1495                                                                                                                                   | A              | MH1               | 1             | 5     | 10.451         | 0.234                      | 34                  | 0.0069         | INTERLAMINAR SHEAR               |
| HF1QA14A5                                                                                                                                   | A              | MH1               | 1             | 5     | 10.467         | 0.241                      | 34                  | 0.0071         | INTERLAMINAR SHEAR               |
| HF1QA14B5                                                                                                                                   | A              | MH1               | 1             | 5     | 10.248         | 0.247                      | 34                  | 0.0073         | INTERLAMINAR SHEAR               |
| HF1QA14C5                                                                                                                                   | A              | MH1               | 1             | 5     | 10.357         | 0.251                      | 34                  | 0.0074         | INTERLAMINAR SHEAR               |
| HF1QA14J6                                                                                                                                   | A              | MH1               | 1             | 6     | 10.398         | 0.252                      | 34                  | 0.0074         | INTERLAMINAR SHEAR / COMPRESSION |
| HF1QA14K6                                                                                                                                   | A              | MH1               | 1             | 6     | 10.327         | 0.250                      | 34                  | 0.0074         | INTERLAMINAR SHEAR / COMPRESSION |
| HF1QA14L6                                                                                                                                   | A              | MH1               | 1             | 6     | 10.047         | 0.247                      | 34                  | 0.0073         | INTERLAMINAR SHEAR / COMPRESSION |
| HF1QA14M6                                                                                                                                   | A              | MH1               | 1             | 6     | 10.455         | 0.241                      | 34                  | 0.0071         | INTERLAMINAR SHEAR / COMPRESSION |
| HF1QA14N6                                                                                                                                   | A              | MH1               | 1             | 6     | 10.712         | 0.234                      | 34                  | 0.0069         | INTERLAMINAR SHEAR / COMPRESSION |
| HF1QA14O6                                                                                                                                   | A              | MH1               | 1             | 6     | 10.764         | 0.226                      | 34                  | 0.0066         | INTERLAMINAR SHEAR / COMPRESSION |
| HF1QA1577                                                                                                                                   | A              | MH1               | 1             | 7     | 9.993          | 0.252                      | 34                  | 0.0074         | INTERLAMINAR SHEAR               |
| HF1QA1587                                                                                                                                   | A              | MH1               | 1             | 7     | 9.909          | 0.253                      | 34                  | 0.0074         | INTERLAMINAR SHEAR               |
| HF1QA1597                                                                                                                                   | A              | MH1               | 1             | 7     | 9.651          | 0.253                      | 34                  | 0.0074         | INTERLAMINAR SHEAR               |
| HF1QA15A7                                                                                                                                   | A              | MH1               | 1             | 7     | 9.877          | 0.252                      | 34                  | 0.0074         | INTERLAMINAR SHEAR               |
| HF1QA15B7                                                                                                                                   | A              | MH1               | 1             | 7     | 9.774          | 0.253                      | 34                  | 0.0074         | INTERLAMINAR SHEAR               |
| HF1QA15C7                                                                                                                                   | A              | MH1               | 1             | 7     | 9.880          | 0.253                      | 34                  | 0.0074         | INTERLAMINAR SHEAR               |
| HF1QA15J8                                                                                                                                   | A              | MH1               | 1             | 8     | 10.641         | 0.216                      | 34                  | 0.0063         | INTERLAMINAR SHEAR / COMPRESSION |
| HF1QA15K8                                                                                                                                   | A              | MH1               | 1             | 8     | 10.674         | 0.226                      | 34                  | 0.0066         | INTERLAMINAR SHEAR / COMPRESSION |
| HF1QA15L8                                                                                                                                   | A              | MH1               | 1             | 8     | 10.532         | 0.234                      | 34                  | 0.0069         | INTERLAMINAR SHEAR / COMPRESSION |
| HF1QA15M8                                                                                                                                   | A              | MH1               | 1             | 8     | 10.321         | 0.243                      | 34                  | 0.0071         | INTERLAMINAR SHEAR / COMPRESSION |
| HF1QA15N8                                                                                                                                   | A              | MH1               | 1             | 8     | 10.386         | 0.248                      | 34                  | 0.0073         | INTERLAMINAR SHEAR / COMPRESSION |
| HF1QA15O8                                                                                                                                   | A              | MH1               | 1             | 8     | 10.221         | 0.251                      | 34                  | 0.0074         | INTERLAMINAR SHEAR / COMPRESSION |
| HF1QA1679                                                                                                                                   | A              | MH1               | 1             | 9     | 9.691          | 0.252                      | 34                  | 0.0074         | INTERLAMINAR SHEAR               |
| HF1QA1689                                                                                                                                   | A              | MH1               | 1             | 9     | 9.274          | 0.251                      | 34                  | 0.0074         | INTERLAMINAR SHEAR / COMPRESSION |
| HF1QA1699                                                                                                                                   | A              | MH1               | 1             | 9     | 9.467          | 0.248                      | 34                  | 0.0073         | INTERLAMINAR SHEAR               |
| HF1QA16A9                                                                                                                                   | A              | MH1               | 1             | 9     | 9.419          | 0.244                      | 34                  | 0.0072         | INTERLAMINAR SHEAR               |
| HF1QA16B9                                                                                                                                   | A              | MH1               | 1             | 9     | 9.633          | 0.236                      | 34                  | 0.0069         | INTERLAMINAR SHEAR               |
| HF1QA16C9                                                                                                                                   | A              | MH1               | 1             | 9     | 9.675          | 0.227                      | 34                  | 0.0067         | INTERLAMINAR SHEAR               |
| HF1QA16Jm                                                                                                                                   | A              | MH1               | 1             | 10    | 11.079         | 0.253                      | 34                  | 0.0074         | INTERLAMINAR SHEAR               |
| HF1QA16Km                                                                                                                                   | A              | MH1               | 1             | 10    | 11.226         | 0.253                      | 34                  | 0.0074         | INTERLAMINAR SHEAR               |
| HF1QA16Lm                                                                                                                                   | A              | MH1               | 1             | 10    | 10.934         | 0.253                      | 34                  | 0.0074         | INTERLAMINAR SHEAR               |
| HF1QA16Mm                                                                                                                                   | A              | MH1               | 1             | 10    | 11.036         | 0.252                      | 34                  | 0.0074         | INTERLAMINAR SHEAR               |
| HF1QA16Nm                                                                                                                                   | A              | MH1               | 1             | 10    | 10.943         | 0.252                      | 34                  | 0.0074         | INTERLAMINAR SHEAR               |
| HF1QA16Om                                                                                                                                   | A              | MH1               | 1             | 10    | 11.081         | 0.252                      | 34                  | 0.0074         | INTERLAMINAR SHEAR               |
| HF1QA177n                                                                                                                                   | A              | MH1               | 1             | 11    | 11.388         | 0.214                      | 34                  | 0.0063         | INTERLAMINAR SHEAR               |
| HF1QA178n                                                                                                                                   | A              | MH1               | 1             | 11    | 11.276         | 0.225                      | 34                  | 0.0066         | INTERLAMINAR SHEAR               |
| HF1QA179n                                                                                                                                   | A              | MH1               | 1             | 11    | 11.319         | 0.235                      | 34                  | 0.0069         | INTERLAMINAR SHEAR               |
| HF1QA17An                                                                                                                                   | A              | MH1               | 1             | 11    | 11.043         | 0.244                      | 34                  | 0.0072         | INTERLAMINAR SHEAR               |
| HF1QA17Bn                                                                                                                                   | A              | MH1               | 1             | 11    | 10.959         | 0.248                      | 34                  | 0.0073         | INTERLAMINAR SHEAR               |
| HF1QA17Cn                                                                                                                                   | A              | MH1               | 1             | 11    | 10.811         | 0.252                      | 34                  | 0.0074         | INTERLAMINAR SHEAR               |
| HF1QA17Jp                                                                                                                                   | A              | MH1               | 1             | 12    | 11.070         | 0.252                      | 34                  | 0.0074         | INTERLAMINAR SHEAR               |
| HF1QA17Kp                                                                                                                                   | A              | MH1               | 1             | 12    | 11.014         | 0.251                      | 34                  | 0.0074         | INTERLAMINAR SHEAR               |
| HF1QA17Lp                                                                                                                                   | A              | MH1               | 1             | 12    | 11.074         | 0.248                      | 34                  | 0.0073         | INTERLAMINAR SHEAR               |
| HF1QA17Mp                                                                                                                                   | A              | MH1               | 1             | 12    | 11.082         | 0.243                      | 34                  | 0.0071         | INTERLAMINAR SHEAR               |
| HF1QA17Np                                                                                                                                   | A              | MH1               | 1             | 12    | 11.290         | 0.237                      | 34                  | 0.0070         | INTERLAMINAR SHEAR               |
| HF1QA17Op                                                                                                                                   | A              | MH1               | 1             | 12    | 11.189         | 0.228                      | 34                  | 0.0067         | INTERLAMINAR SHEAR               |
| HF1QA187s                                                                                                                                   | A              | MH1               | 1             | 13    | 9.424          | 0.252                      | 34                  | 0.0074         | INTERLAMINAR SHEAR               |
| HF1QA188s                                                                                                                                   | A              | MH1               | 1             | 13    | 9.683          | 0.253                      | 34                  | 0.0075         | INTERLAMINAR SHEAR               |
| HF1QA189s                                                                                                                                   | A              | MH1               | 1             | 13    | 9.554          | 0.252                      | 34                  | 0.0074         | INTERLAMINAR SHEAR               |
| HF1QA18As                                                                                                                                   | A              | MH1               | 1             | 13    | 9.697          | 0.252                      | 34                  | 0.0074         | INTERLAMINAR SHEAR               |
| HF1QA18Bs                                                                                                                                   | A              | MH1               | 1             | 13    | 9.712          | 0.252                      | 34                  | 0.0074         | INTERLAMINAR SHEAR               |
| HF1QA18Cs                                                                                                                                   | A              | MH1               | 1             | 13    | 9.783          | 0.253                      | 34                  | 0.0074         | INTERLAMINAR SHEAR               |
| HF1QA18Jc                                                                                                                                   | A              | MH1               | 1             | 14    | 11.122         | 0.215                      | 34                  | 0.0063         | INTERLAMINAR SHEAR               |
| HF1QA18Kc                                                                                                                                   | A              | MH1               | 1             | 14    | 10.883         | 0.225                      | 34                  | 0.0066         | INTERLAMINAR SHEAR               |
| HF1QA18Lc                                                                                                                                   | A              | MH1               | 1             | 14    | 10.986         | 0.236                      | 34                  | 0.0069         | INTERLAMINAR SHEAR               |
| HF1QA18Mc                                                                                                                                   | A              | MH1               | 1             | 14    | 11.400         | 0.244                      | 34                  | 0.0072         | INTERLAMINAR SHEAR               |
| HF1QA18Nc                                                                                                                                   | A              | MH1               | 1             | 14    | 10.839         | 0.248                      | 34                  | 0.0073         | INTERLAMINAR SHEAR               |
| HF1QA18Oc                                                                                                                                   | A              | MH1               | 1             | 14    | 10.817         | 0.251                      | 34                  | 0.0074         | INTERLAMINAR SHEAR               |
| HF1QA197D                                                                                                                                   | A              | MH1               | 1             | 15    | 8.335          | 0.252                      | 34                  | 0.0074         | INTERLAMINAR SHEAR               |
| HF1QA198D                                                                                                                                   | A              | MH1               | 1             | 15    | 8.207          | 0.252                      | 34                  | 0.0074         | INTERLAMINAR SHEAR               |
| HF1QA199D                                                                                                                                   | A              | MH1               | 1             | 15    | 8.324          | 0.247                      | 34                  | 0.0073         | INTERLAMINAR SHEAR               |
| HF1QA19AD                                                                                                                                   | A              | MH1               | 1             | 15    | 7.842          | 0.243                      | 34                  | 0.0071         | INTERLAMINAR SHEAR               |
| HF1QA19BD                                                                                                                                   | A              | MH1               | 1             | 15    | 8.293          | 0.235                      | 34                  | 0.0069         | INTERLAMINAR SHEAR               |
| HF1QA19CD                                                                                                                                   | A              | MH1               | 1             | 15    | 8.154          | 0.225                      | 34                  | 0.0066         | INTERLAMINAR SHEAR               |

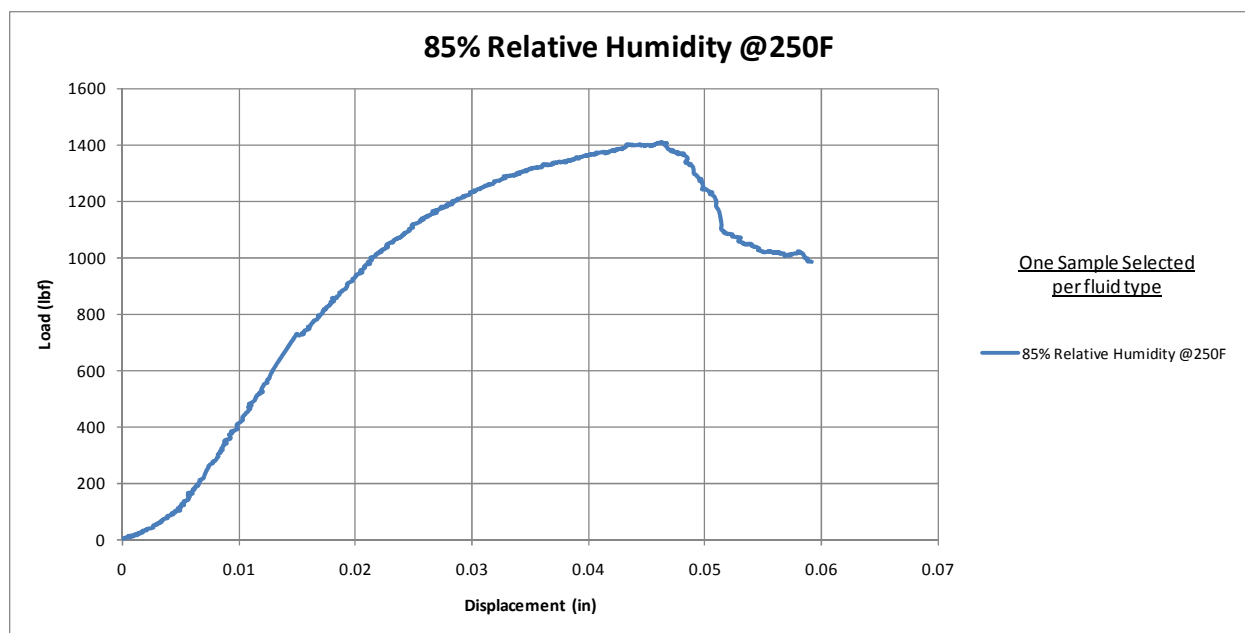
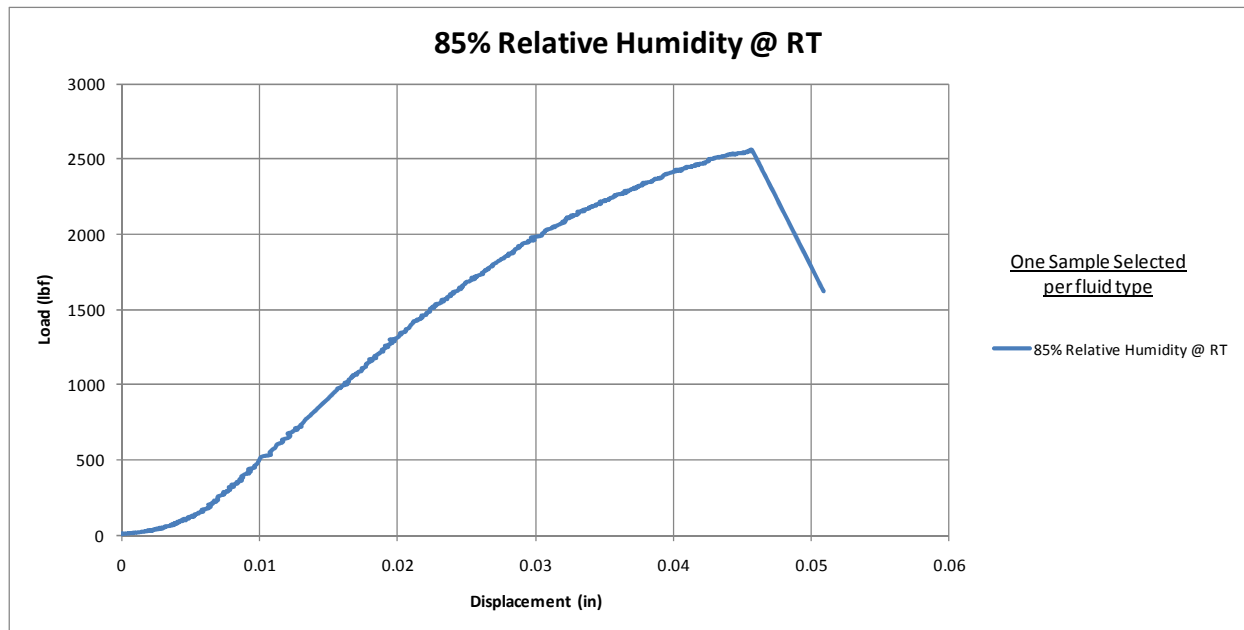
Average 0.0071  
Min 0.0063  
Max 0.0075





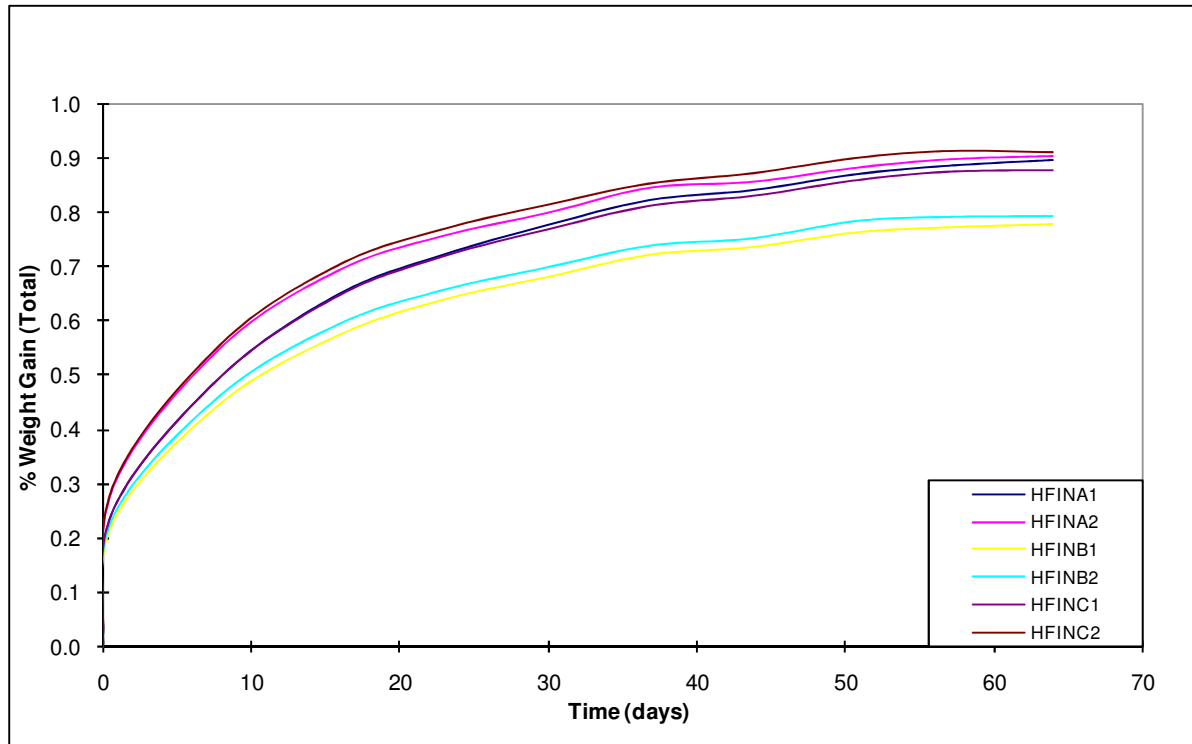




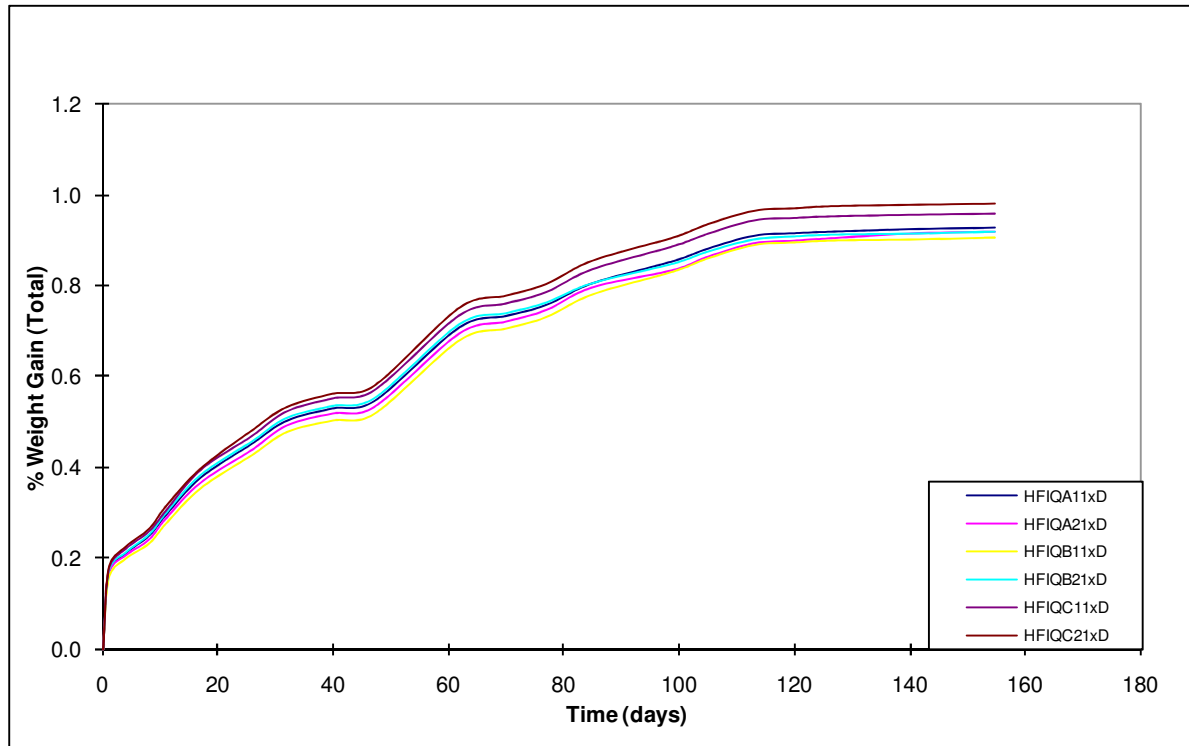


## 7. MOISTURE CONDITIONING CHARTS

### 7.1 In-Plane Shear– Thinnest Panel



## 7.2 Short Beam Strength- Thickest Panel



The rest of the curves can be found on the CD that accompanies this report.

## 8. DMA Results

The charts and graphs below are only examples. The remaining files can be obtained from the CD provided with this report.

| <b>DMA Results Summary</b>                  |                              |                |                              |                |
|---------------------------------------------|------------------------------|----------------|------------------------------|----------------|
| <b>Hexcel / Cessna HF 071105C1 (TT) Wet</b> |                              |                |                              |                |
| <b>Sample #</b>                             | <b>Onset Storage Modulus</b> |                | <b>Peak of Tangent Delta</b> |                |
|                                             | <b>Average</b>               |                | <b>Average</b>               |                |
|                                             | <b>Tg [°C]</b>               | <b>Tg [°F]</b> | <b>Tg [°C]</b>               | <b>Tg [°F]</b> |
| HFIDA 11                                    | 160.50                       | 320.90         | 174.65                       | 346.36         |
| HFIDA 21                                    | 159.82                       | 319.67         | 173.38                       | 344.08         |
| HFIDB 11                                    | 160.28                       | 320.50         | 172.74                       | 342.93         |
| HFIDB 21                                    | 158.75                       | 317.74         | 171.56                       | 340.80         |
| HFIDC 11                                    | 159.21                       | 318.57         | 172.69                       | 342.83         |
| HFIDC 21                                    | 158.27                       | 316.88         | 171.91                       | 341.43         |
|                                             | <b>AVERAGE</b>               | <b>319.04</b>  |                              |                |

| <b>DMA Results Summary</b>                    |                              |                |                              |                |
|-----------------------------------------------|------------------------------|----------------|------------------------------|----------------|
| <b>Hexcel / Cessna HF 071105C1 (UNT3) Wet</b> |                              |                |                              |                |
| <b>Sample #</b>                               | <b>Onset Storage Modulus</b> |                | <b>Peak of Tangent Delta</b> |                |
|                                               | <b>Average</b>               |                | <b>Average</b>               |                |
|                                               | <b>Tg [°C]</b>               | <b>Tg [°F]</b> | <b>Tg [°C]</b>               | <b>Tg [°F]</b> |
| HFIDA 11                                      | 162.39                       | 324.30         | 178.21                       | 352.77         |
| HFIDA 21                                      | 161.98                       | 323.56         | 176.77                       | 350.19         |
| HFIDB 11                                      | 162.03                       | 323.65         | 176.59                       | 349.85         |
| HFIDB 21                                      | 161.46                       | 322.63         | 177.09                       | 350.76         |
| HFIDC 11                                      | 161.68                       | 323.02         | 176.25                       | 349.24         |
| HFIDC 21                                      | 163.09                       | 325.55         | 177.15                       | 350.87         |
|                                               | <b>AVERAGE</b>               | <b>323.79</b>  |                              |                |

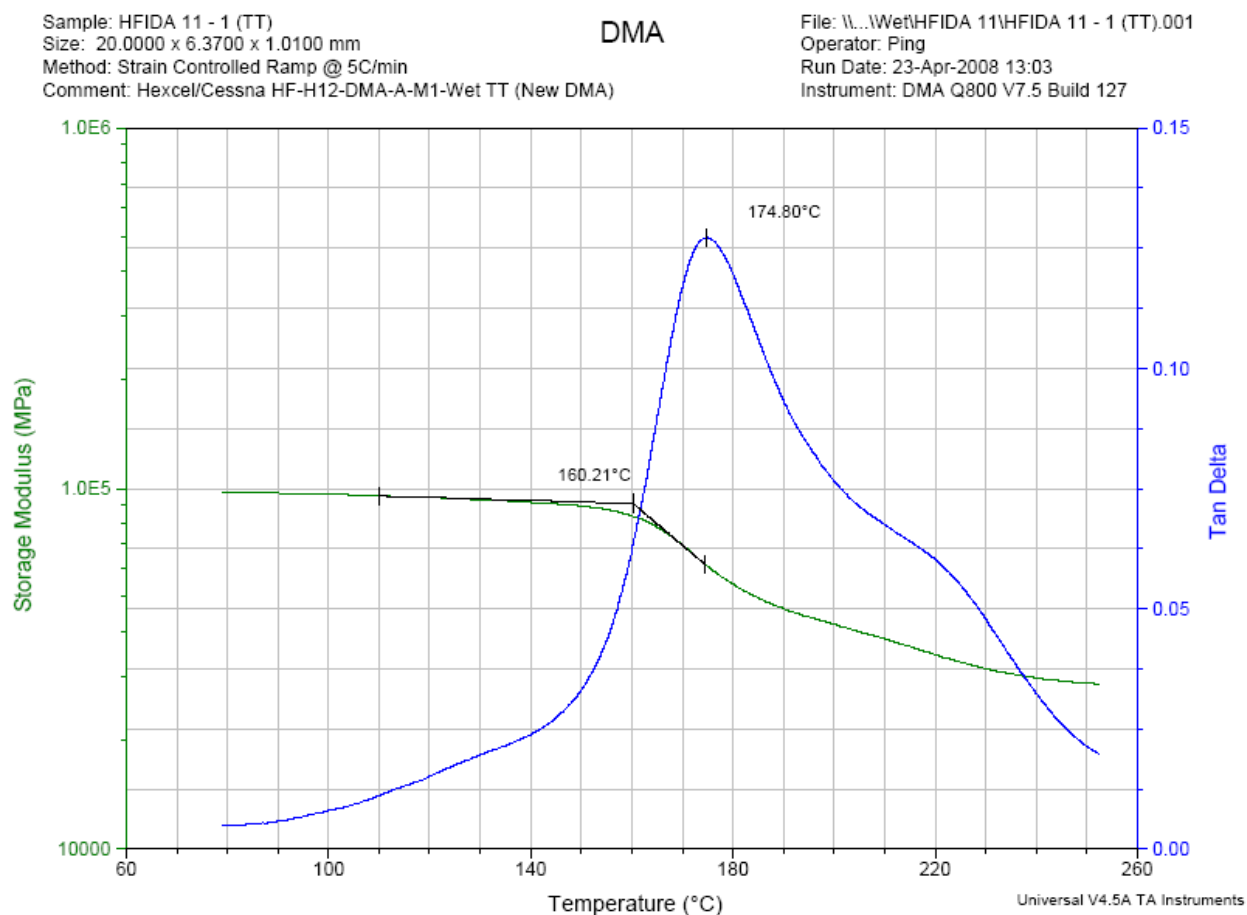
**Table 8-1: DMA Wet Results**

| <b>DMA Results Summary</b>                  |                              |                |                              |                |
|---------------------------------------------|------------------------------|----------------|------------------------------|----------------|
| <b>Hexcel / Cessna HF 071105C1 (TT) Dry</b> |                              |                |                              |                |
| <b>Sample #</b>                             | <b>Onset Storage Modulus</b> |                | <b>Peak of Tangent Delta</b> |                |
|                                             | <b>Average</b>               |                | <b>Average</b>               |                |
|                                             | <b>Tg [°C]</b>               | <b>Tg [°F]</b> | <b>Tg [°C]</b>               | <b>Tg [°F]</b> |
| HFIDA 11                                    | 207.27                       | 405.08         | 228.19                       | 442.73         |
| HFIDA 21                                    | 209.23                       | 408.61         | 231.93                       | 449.47         |
| HFIDB 11                                    | 209.35                       | 408.82         | 231.76                       | 449.16         |
| HFIDB 21                                    | 207.37                       | 405.26         | 231.58                       | 448.84         |
| HFIDC 11                                    | 204.70                       | 400.45         | 232.99                       | 451.37         |
| HFIDC 21                                    | 206.82                       | 404.28         | 233.50                       | 452.30         |
|                                             | <b>AVERAGE</b>               | <b>405.41</b>  |                              |                |

| <b>DMA Results Summary</b>                    |                              |                |                              |                |
|-----------------------------------------------|------------------------------|----------------|------------------------------|----------------|
| <b>Hexcel / Cessna HF 071105C1 (UNT3) Dry</b> |                              |                |                              |                |
| <b>Sample #</b>                               | <b>Onset Storage Modulus</b> |                | <b>Peak of Tangent Delta</b> |                |
|                                               | <b>Average</b>               |                | <b>Average</b>               |                |
|                                               | <b>Tg [°C]</b>               | <b>Tg [°F]</b> | <b>Tg [°C]</b>               | <b>Tg [°F]</b> |
| HFIDA 11                                      | 209.37                       | 408.87         | 234.62                       | 454.31         |
| HFIDA 21                                      | 208.99                       | 408.17         | 234.89                       | 454.79         |
| HFIDB 11                                      | 206.87                       | 404.37         | 235.17                       | 455.31         |
| HFIDB 21                                      | 210.96                       | 411.73         | 236.27                       | 457.29         |
| HFIDC 11                                      | 207.34                       | 405.21         | 235.41                       | 455.74         |
| HFIDC 21                                      | 207.94                       | 406.28         | 235.60                       | 456.08         |
|                                               | <b>AVERAGE</b>               | <b>407.44</b>  |                              |                |

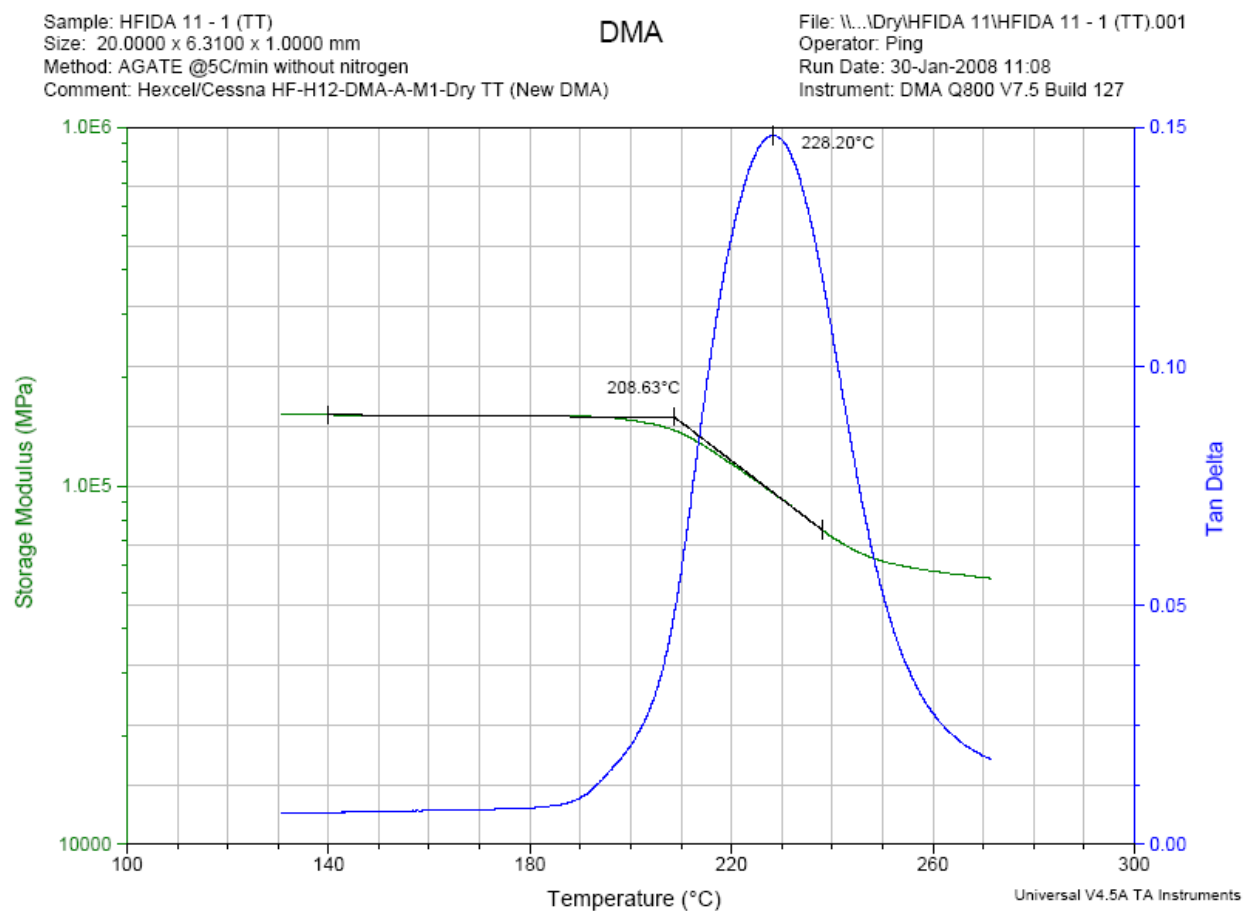
Table 8-2: DMA Dry Results

## 8.1 DMA Wet Batch A





## 8.2 DMA Dry Batch A



## 9. TMA Results

The TMA results were tested at Hexcel. Specimens were taken from the same panels as DMA and wet and dry testing was tested concurrently.

4/23/2008



**Wet Specimens tested for Tg by TMA to HSP-T2 (NMS 128)**

| Sample ID                  | Rep | Thickness (mm) | Tg (Deg C) |        | Avg           |
|----------------------------|-----|----------------|------------|--------|---------------|
| HF071105C1 IAU2 2 HFITA21  | 1   | 0.1036         | 222.25     | 432.05 | 428.13        |
| HF071105C1 IAU2 2 HFITA21  | 2   | 0.1346         | 217.89     | 424.20 |               |
| HF071105C1 IBU1 1 HFITB11  | 1   | 0.1863         | 218.91     | 426.04 | 422.81        |
| HF071105C1 IBU1 1 HFITB11  | 2   | 0.1715         | 215.32     | 419.58 |               |
| HF071105C1 IAU1 1 HFITA 11 | 1   | 0.1652         | 220.96     | 429.73 | 429.78        |
| HF071105C1 IAU1 1 HFITA 11 | 2   | 0.1482         | 221.02     | 429.84 |               |
| HF071105C1 IBU12 2         | 1   | 0.1910         | 216.55     | 421.79 | 419.79        |
| HF071105C1 IBU12 2         | 2   | 0.1783         | 214.33     | 417.79 |               |
| HF071105C1 ICU1 1 HFITC 11 | 1   | 0.1585         | 219.76     | 427.57 | 421.57        |
| HF071105C1 ICU1 1 HFITC 11 | 2   | 0.1477         | 213.09     | 415.56 |               |
| HF071105C1 ICU2 2 HFITC 21 | 1   | 0.1644         | 217.99     | 424.38 | 424.40        |
| HF071105C1 ICU2 2 HFITC 21 | 2   | 0.1614         | 218.01     | 424.42 |               |
| HF071105C1 IAC1 1 HFITA 11 | 1   | 0.1627         | 221.11     | 430.00 | 428.50        |
| HF071105C1 IAC1 1 HFITA 11 | 2   | 0.1707         | 219.45     | 427.01 |               |
| HF071105C1 ICC2 2 HFITC 21 | 1   | 0.1464         | 221.74     | 431.13 | 430.79        |
| HF071105C1 ICC2 2 HFITC 21 | 2   | 0.1825         | 221.36     | 430.45 |               |
| HF071105C1 IAC2 2 HFITA 21 | 1   | 0.1702         | 212.45     | 414.41 | 414.98        |
| HF071105C1 IAC2 2 HFITA 21 | 2   | 0.1658         | 213.08     | 415.54 |               |
| HF071105C1 IAC1 1 HFITC 11 | 1   | 0.1432         | 219.08     | 426.34 | 426.78        |
| HF071105C1 IAC1 1 HFITC 11 | 2   | 0.1321         | 219.56     | 427.21 |               |
| HF071105C1 IBC1 1 HFITB 11 | 1   | 0.1750         | 212.53     | 414.55 | 417.18        |
| HF071105C1 IBC1 1 HFITB 11 | 2   | 0.1785         | 215.45     | 419.81 |               |
| HF071105C1 IBC2 2 HFITB 21 | 1   | 0.1492         | 218.42     | 425.16 | 426.02        |
| HF071105C1 IBC2 2 HFITB 21 | 2   | 0.1427         | 219.38     | 426.88 |               |
|                            |     |                |            |        |               |
| <b>AVERAGE</b>             |     |                |            |        | <b>424.23</b> |

**Table 9-1: Wet TMA Results**

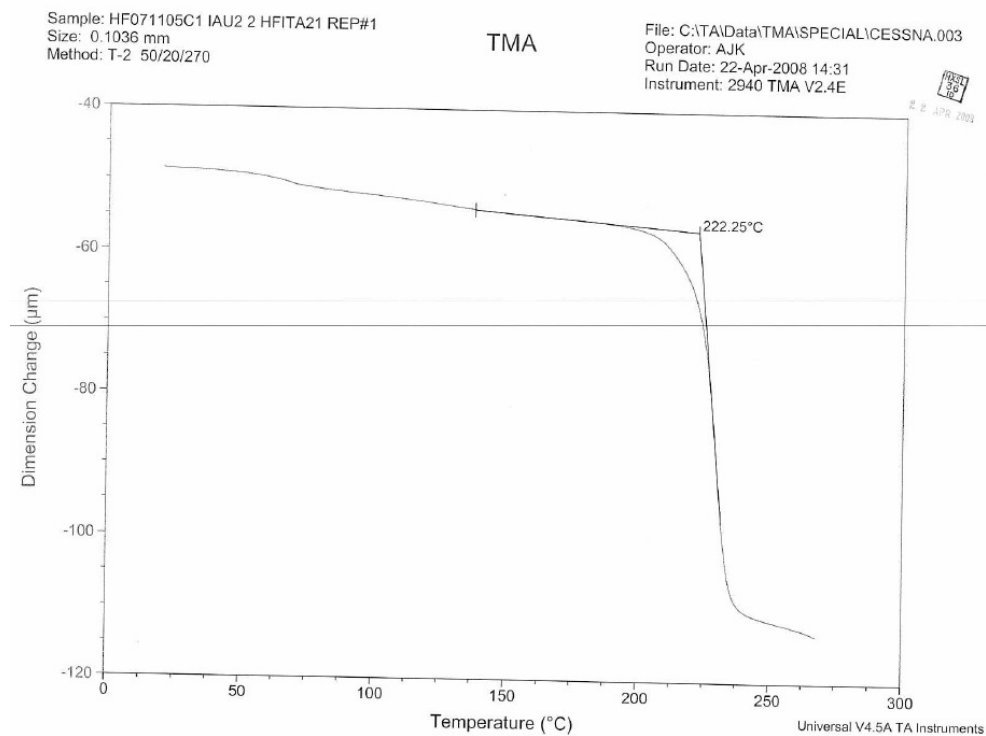
1/21/2008



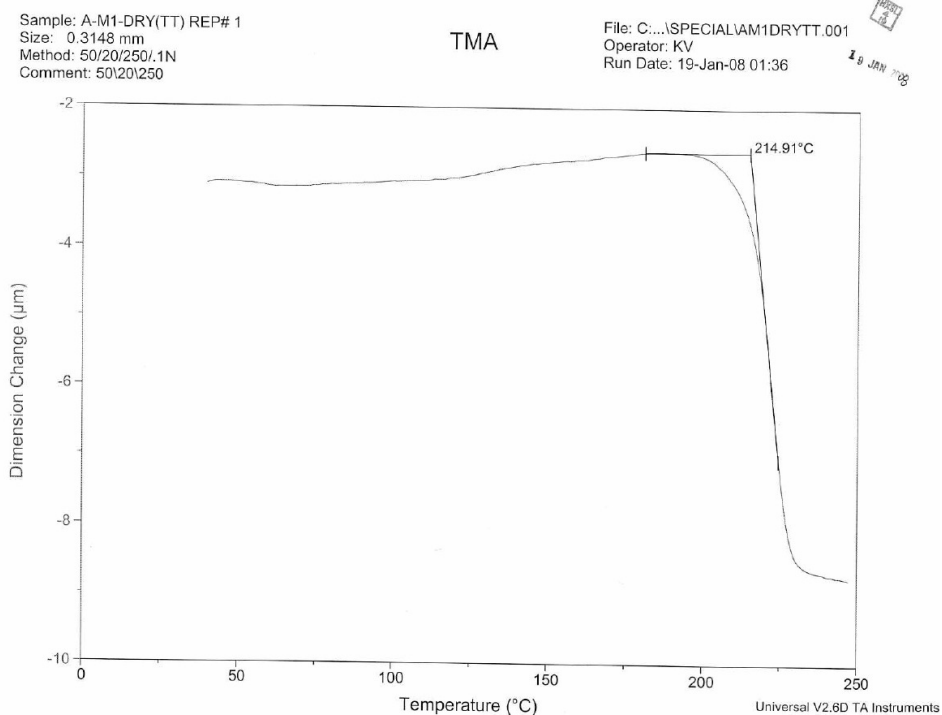
| Summary of Dry NCAMP Supplied Tg (TMA) Specimens |     |        |        |        |           |       |          |
|--------------------------------------------------|-----|--------|--------|--------|-----------|-------|----------|
| Specimen ID                                      | Rep | Tg     | Avg    |        | Test Date | Time  | Operator |
| HF-H12-TMA-A-M1-Dry (TT)                         | 1   | 214.91 | 216.36 | 421.44 | 1/19/2008 | 1:36  | KV       |
|                                                  | 2   | 217.80 |        |        | 1/19/2008 | 0:37  | KV       |
| HF-H12-TMA-A-M2-Dry (TT)                         | 1   | 216.52 | 218.24 | 424.83 | 1/19/2008 | 1:54  | KV       |
|                                                  | 2   | 219.96 |        |        | 1/19/2008 | 2:11  | KV       |
| HF-H12-TMA-B-M1-Dry (TT)                         | 1   | 217.71 | 216.22 | 421.20 | 1/19/2008 | 2:35  | KV       |
|                                                  | 2   | 214.73 |        |        | 1/19/2008 | 3:17  | KV       |
| HF-H12-TMA-B-M2-Dry (TT)                         | 1   | 215.29 | 214.83 | 418.69 | 1/19/2008 | 3:42  | KV       |
|                                                  | 2   | 214.37 |        |        | 1/19/2008 | 4:23  | KV       |
| HF-H12-TMA-C-M1-Dry (TT)                         | 1   | 212.16 | 210.86 | 411.55 | 1/19/2008 | 5:02  | KV       |
|                                                  | 2   | 209.56 |        |        | 1/19/2008 | 5:19  | KV       |
| HF-H12-TMA-C-M2-Dry (TT)                         | 1   | 215.03 | 217.35 | 423.22 | 1/19/2008 | 5:35  | KV       |
|                                                  | 2   | 219.66 |        |        | 1/19/2008 | 5:52  | KV       |
| HF-H12-TMA-A-M1-Dry (UNT3)                       | 1   | 221.79 | 222.64 | 432.74 | 1/21/2008 | 7:09  | KV       |
|                                                  | 2   | 223.48 |        |        | 1/21/2008 | 7:24  | KV       |
| HF-H12-TMA-A-M2-Dry (UNT3)                       | 1   | 221.24 | 219.60 | 427.27 | 1/21/2008 | 7:41  | KV       |
|                                                  | 2   | 217.95 |        |        | 1/21/2008 | 7:58  | KV       |
| HF-H12-TMA-B-M1-Dry (UNT3)                       | 1   | 212.86 | 212.99 | 415.37 | 1/21/2008 | 8:16  | KV       |
|                                                  | 2   | 213.11 |        |        | 1/21/2008 | 8:34  | KV       |
| HF-H12-TMA-B-M2-Dry (UNT3)                       | 1   | 220.95 | 220.23 | 428.41 | 1/21/2008 | 8:51  | KV       |
|                                                  | 2   | 219.50 |        |        | 1/21/2008 | 9:06  | KV       |
| HF-H12-TMA-C-M1-Dry (UNT3)                       | 1   | 216.67 | 217.65 | 423.76 | 1/21/2008 | 9:53  | KV       |
|                                                  | 2   | 218.62 |        |        | 1/21/2008 | 10:09 | KV       |
| HF-H12-TMA-C-M2-Dry (UNT3)                       | 1   | 217.71 | 217.31 | 423.15 | 1/21/2008 | 10:37 | KV       |
|                                                  | 2   | 216.90 |        |        | 1/21/2008 | 10:52 | KV       |
| AVERAGE                                          |     |        |        |        |           |       |          |
| AVERAGE                                          |     |        |        | 422.64 |           |       |          |

Table 9-2: Dry TMA Results

## 9.1 TMA Wet Batch A Results



## 9.2 TMA Wet Batch A Results



## 10. Physical Test Results

The following physical test results were obtained at Hexcel. Remaining results required per section 4 of the test plan can be found on the CD accompanying this report.

|                                                    |      |     |           |       |      |         |       |       |            |       |       |           |  |
|----------------------------------------------------|------|-----|-----------|-------|------|---------|-------|-------|------------|-------|-------|-----------|--|
| NMS 128/2 Rev.- IM7G/8552 Type35, Class1, Grade190 |      |     |           |       |      |         |       |       |            |       |       |           |  |
| IM7G                                               | 8552 |     |           |       |      |         |       |       |            |       |       |           |  |
| Lot                                                | spl  | rep | Date      | Ind   | Avg  | Test ID | Ind   | Avg   | Test ID    | Ind   | Avg   | Test ID   |  |
| P6942-4SQ                                          | 1    | 1   | 25-Jan-07 | 12    | 12   | GEL350  | 13.26 | 13.25 | X_FLOW350B | 0.688 | 0.711 | X_VOL350P |  |
| P6942-4SQ                                          |      | 2   | 25-Jan-07 | 12    |      | GEL350  | 12.98 |       | X_FLOW350B | 0.615 |       | X_VOL350P |  |
|                                                    |      | 3   |           |       |      |         | 13.5  |       | X_FLOW350B | 0.831 |       | X_VOL350P |  |
| P6942-4SQ                                          | 16   | 1   | 25-Jan-07 | 12    | 12   | GEL350  | 13.12 | 13.06 | X_FLOW350B | 0.966 | 0.981 | X_VOL350P |  |
| P6942-4SQ                                          |      | 2   | 25-Jan-07 | 12    |      | GEL350  | 12.95 |       | X_FLOW350B | 0.931 |       | X_VOL350P |  |
|                                                    |      | 3   |           |       |      |         | 13.1  |       | X_FLOW350B | 1.045 |       | X_VOL350P |  |
| P6944                                              | 1    | 1   | 2-Mar-07  | 13    | 13   | GEL350  | 13.69 | 12.36 | X_FLOW350B | 0.556 | 0.572 | X_VOL350P |  |
| P6944                                              |      | 2   | 2-Mar-07  | 13    |      | GEL350  | 11.38 |       | X_FLOW350B | 0.57  |       | X_VOL350P |  |
|                                                    |      | 3   |           |       |      |         | 12    |       | X_FLOW350B | 0.589 |       | X_VOL350P |  |
| P6944                                              | 14   | 1   | 2-Mar-07  | 12    | 12.2 | GEL350  | 13.17 | 11.7  | X_FLOW350B | 0.569 | 0.501 | X_VOL350P |  |
| P6944                                              |      | 2   | 2-Mar-07  | 12.5  |      | GEL350  | 11.34 |       | X_FLOW350B | 0.495 |       | X_VOL350P |  |
|                                                    |      | 3   |           |       |      |         | 10.6  |       | X_FLOW350B | 0.438 |       | X_VOL350P |  |
| P7059                                              | 1    | 1   | 1-Mar-07  | 12.75 | 12.6 | GEL350  | 14.42 | 14.75 | X_FLOW350B | 0.46  | 0.582 | X_VOL350P |  |
| P7059                                              |      | 2   | 1-Mar-07  | 12.5  |      | GEL350  | 14.95 |       | X_FLOW350B | 0.645 |       | X_VOL350P |  |
|                                                    |      | 3   |           |       |      |         | 14.87 |       | X_FLOW350B | 0.642 |       | X_VOL350P |  |
| P7059                                              | 16   | 1   | 1-Mar-07  | 13    | 13   | GEL350  | 15.72 | 16.38 | X_FLOW350B | 0.733 | 0.59  | X_VOL350P |  |
| P7059                                              |      | 2   | 1-Mar-07  | 13    |      | GEL350  | 16.27 |       | X_FLOW350B | 0.601 |       | X_VOL350P |  |

**Table 10-1: Hexcel Physical Testing Results**

## 11. Deviations

1. For fluid sensitivity testing, the Jet Reference fluid called out in the NCAMP test plan is a rare fuel and therefore extremely expensive. As a replacement, we used Jet Fuel A per ASTM D1655. AMS2629 is a jet reference fuel intended to simulate jet engine fuel only. This was approved by all participating panel fabricators.
2. For the ETW testing, it was discovered that the original adhesive used to bond the strain gauges was not rated for the 250 degree F testing. Therefore, specimens were refabricated and retested for modulus. This caused a delay in the program due the time required to recondition and retest the specimens. Below is a summary of what decisions were made affecting this Hexcel 8552 program.
  - CLC's – Gauge bonded with M Bond 600, cured for 1 hour 30 minutes at 300F
  - Gauges were be applied before drying and then moisture conditioned.
  - Previously Tested CLC specimens - Hot Dry 250F : NCAMP looked for scraps for modulus specimens – more specimens were found and retested
  - ALL CLC specimens with Hot Wet 250F testing required 6 specimens per panel; 3 for modulus (gauged) and 3 for strength (not gauged). The number of specimens were 'doubled' because the protective coating applied on the gage might prevent (or slow down) moisture absorption rate in the gauged section.