Hexcel M91/IM8-GP 6K ZB Fabric PW 145gsm with 40% RC Material Allowables Statistical Analysis Report

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1. Introduction

This report contains statistical analysis of the Hexcel M91/IM8-GP 6K ZB fabric PW 145gsm 40% prepreg material property data published in NCAMP Test Report CAM-RP-2025-001 Rev -. The lamina and laminate material property data have been generated with NCAMP oversight through NCAMP Project Number NPN 062202 and also meet the requirements outlined in NCAMP Standard Operating Procedure NSP 100. The test panels and test specimens have been inspected by NCAMP Authorized Inspection Representatives (AIR) and the testing has been witnessed by NCAMP Authorized Engineering Representatives (AER).

B-Basis values, A-Basis values, and estimates were calculated using a variety of techniques that are detailed in section 2. The qualification material was procured to NCAMP Material Specification NMS 191/2 Rev A dated January 12th, 2026. The qualification test panels were cured in accordance with NCAMP Process Specification NPS 81910 Rev B dated October 13th, 2025 using baseline cure cycle "C" with a cure pressure of 35psi. The NCAMP Test Plan NTP M911Q1 Rev B was used for this qualification program.

Basis numbers are labeled as 'values' when the data meets all the requirements of CMH-17 Vol 1. When those requirements are not met, they will be labeled as 'estimates.' When the data does not meet all requirements, the failure to meet these requirements is reported and the specific requirement(s) the data fails to meet is identified. The method used to compute the Basis value is noted for each Basis value provided. When appropriate, in addition to the traditional computational methods, values computed using the modified coefficient of variation method is also provided.

The material property data acquisition process is designed to generate basic material property data with sufficient pedigree for submission to Complete Documentation sections of the Composite Materials Handbook (CMH-17 Vol 1).

The NCAMP shared material property database contains material property data of common usefulness to a wide range of aerospace projects. However, the data may not fulfill all the needs of a project. Specific properties, environments, laminate architecture, and loading situations that individual projects need 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 and accuracy 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.
Part fabricators that wish to utilize the material property data, allowables, and specifications may be able to do so by demonstrating the capability to reproduce the original material properties; a process known as equivalency. More information about this equivalency process including the test

statistics and its limitations can be found in Section 6 of DOT/FAA/AR-03/19 and Section 8.4.1 of CMH-17 Vol 1. The applicability of equivalency process must be evaluated on program-by-

program Basis by the applicant and certifying agency. The applicant and certifying agency must agree that the equivalency test plan along with the equivalency process described in Section 6 of DOT/FAA/AR-03/19 and Section 8.4.1 of CMH-17 Vol 1 are adequate for the given program.

Aircraft companies should not use the data published in this report without specifying NCAMP Material Specification NMS M91/2. NMS M91/2 has 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 NCAMP Material Specification NMS M91/2.* NMS M91/2 is a free, publicly available, non-proprietary aerospace industry material specification.

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

1.1 Symbols and Abbreviations

Test Property	Abbreviation
Warp Compression	WC
Warp Tension	WT
Fill Compression	FC
Fill Tension	FT
In-Plane Shear Tension	IPST
In-Plane Shear V-Notch	IPSV
Short Beam Strength	SBS
Unnotched Tension	UNT
Unnotched Compression	UNC
Filled Hole Tension	FHT
Filled Hole Compression	FHC
Open Hole Tension	OHT
Open Hole Compression	OHC
Single Shear Bearing	SSB
Interlaminar Tension	ILT
Compression After Impact	CAI

Table 1-1: Test Property Abbreviations

Test Property	Symbol
Warp Compression Strength	F_1^{cu}
Warp Compression Modulus	E_1^c
Warp Compression Poisson's Ratio	ν_{12}^c
Warp Tension Strength	F_1^{tu}
Warp Tension Modulus	E_1^t
Warp Tension Poisson's Ratio	ν_{12}^t
Fill Compression Strength	F_2^{cu}
Fill Compression Modulus	E_2^c
Fill Compression Poisson's Ratio	ν_{21}^c
Fill Tension Strength	F_2^{tu}
Fill Tension Modulus	E_2^t
In Plane Shear Strength at 5% strain	$F_{12}^{s5strain\%}$
In Plane Shear 0.2% Offset Strength	$F_{12}^{s0.2\%}$
In-Plane Shear Ultimate Strength	F_{12}^{su}
In Plane Shear Modulus	G_{12}^s

Table 1-2: Test Property Symbols

Environmental Condition	Abbreviation	Temperature
Cold Temperature Ambient	CTA	−65 ± 5˚F
Room Temperature Ambient	RTA	70 ± 10˚F
Elevated Temperature Wet	ETW	180 ± 5˚F

Table 1-3: Environmental Conditions Abbreviations

Tests with a number immediately after the abbreviation indicate the lay-up:

1 refers to a 25/50/25 layup. This is also referred to as "Quasi-Isotropic"
2 refers to a 10/80/10 layup. This is also referred to as "Soft"
3 refers to a 40/20/40 layup. This is also referred to as "Hard"

EX: OHT1 is an open hole tension test with a 25/50/25 layup

Detailed information about the test methods and conditions used is given in NCAMP Test Report CAM-RP-2025-001 Rev -.

1.2 Pooling Across Environments

When pooling across environments was allowable, the pooled coefficient of variation was used. CMH17 STATS (CMH17 Approved Statistical Analysis Program) was used to determine if pooling was allowable and to compute the pooled coefficient of variation for those tests. In these cases, the modified coefficient of variation based on the pooled data was used to compute the Basis values.

When pooling across environments was not advisable because the data was not eligible for pooling and engineering judgment indicated there was no justification for overriding the result, then B-Basis values were computed for each environmental condition separately, which are also provided by CMH17 STATS.

1.3 Basis Value Computational Process

The general form to compute engineering Basis values is: basis value = $\overline{X} - kS$ where k is a factor based on the sample size and the distribution of the sample data. There are many different methods to determine the value of k in this equation, depending on the sample size and the distribution of the data. In addition, the computational formula used for the standard deviation, S, may vary depending on the distribution of the data. The details of those different computations and when each should be used are in section 2.

1.4 Modified Coefficient of Variation (CV) Method

A common problem with new material qualifications is that the initial specimens produced and tested do not contain all of the variability that will be encountered when the material is being produced in larger amounts over a lengthy period of time. This can result in setting Basis values that are unrealistically high. The variability as measured in the qualification program is often lower than the actual material variability because of several reasons. The materials used in the qualification programs are usually manufactured within a short period of time, typically 2-3 weeks only, which is not representative of the production material. Some raw ingredients that are used to manufacture the multi-batch qualification materials may actually be from the same production batches or manufactured within a short period of time so the qualification materials, although regarded as multiple batches, may not truly be multiple batches so they are not representative of the actual production material variability.

The modified Coefficient of Variation (CV) used in this report is in accordance with section 8.4.4 of CMH-17 Vol 1. It is a method of adjusting the original Basis values downward in anticipation of the expected additional variation. Composite materials are expected to have a CV of at least 6%. The modified coefficient of variation (CV) method increases the measured coefficient of variation when it is below 8% prior to computing Basis values. A higher CV will result in lower or more conservative Basis values and lower specification limits. The use of the modified CV method is intended for a temporary period of time when there is minimal data available. When a sufficient number of production batches (approximately 8 to 15) have been produced and tested, the as-measured CV may be used so that the Basis values and specification limits may be adjusted higher.

The material allowables in this report are calculated using both the as-measured CV and modified CV, so users have the choice of using either one. When the measured CV is greater than 8%, the modified CV method does not change the Basis value. NCAMP recommended values make use of the modified CV method when it is appropriate for the data.

When the data fails the Anderson-Darling K-sample test for batch to batch variability or when the data fails the normality test, the modified CV method is not appropriate and no modified CV Basis value will be provided. When the ANOVA method is used, it may produce excessively conservative Basis values. When appropriate, a single batch or two batch estimate may be provided in addition to the ANOVA estimate.

In some cases a transformation of the data to fit the assumption of the modified CV resulted in the transformed data passing the ADK test and thus the data can be pooled only for the modified CV method.

NCAMP recommends that if a user decides to use the Basis values that are calculated from as-measured CV, the specification limits and control limits be calculated with as-measured CV also. Similarly, if a user decides to use the Basis values that are calculated from modified CV, the specification limits and control limits be calculated with modified CV also. This will ensure that the link between material allowables, specification limits, and control limits is maintained.

2. Background

Statistical computations are performed with CMH17 STATS. Pooling across environments will be used whenever it is permissible according to CMH-17 Vol 1 guidelines. If pooling is not permissible, the results of a single point analysis provided by CMH17 STATS is included instead. If the data does not meet CMH-17 Vol 1 requirements for a single point analysis, estimates are created by a variety of methods depending on which is most appropriate for the dataset available. Specific procedures used are presented in the individual sections where the data is presented.

2.1 CMH17 STATS Statistical Formulas and Computations

This section contains the details of the specific formulas CMH17 STATS uses in its computations.

2.1.1 Basic Descriptive Statistics

The basic descriptive statistics shown are computed according to the usual formulas, which are shown below:

Mean: $$\bar{X} = \sum_{i=1}^{n} \frac{X_i}{n}$$ **Equation 1**

Std. Dev.: $$S = \sqrt{\frac{1}{n-1} \sum_{i=1}^{n} \left(X_i - \bar{X} \right)^2}$$ **Equation 2**

% Co. Variation: $$\frac{S}{\bar{X}} \times 100$$ **Equation 3**

Where n refers to the number of specimens in the sample and X_i refers to the individual specimen measurements.

2.1.2 Statistics for Pooled Data

Prior to computing statistics for the pooled dataset, the data is normalized to a mean of one by dividing each value by the mean of all the data for that condition. This transformation does not affect the coefficients of variation for the individual conditions.

2.1.2.1 Pooled Standard Deviation

The formula to compute a pooled standard deviation is given below:

Pooled Std. Dev.: $$S_p = \sqrt{\frac{\sum_{i=1}^{k} (n_i - 1) S_i^2}{\sum_{i=1}^{k} (n_i - 1)}}$$ **Equation 4**

Where k refers to the number of batches, S_i indicates the standard deviation of i^{th} sample, and n_i refers to the number of specimens in the i^{th} sample.

2.1.2.2 Pooled Coefficient of Variation

Since the mean for the normalized data is 1.0 for each condition, the pooled normalized data also has a mean of one. The coefficient of variation for the pooled normalized data is the pooled standard deviation divided by the pooled mean, as in equation 3. Since the mean for the pooled normalized data is one, the pooled coefficient of variation is equal to the pooled standard deviation of the normalized data.

$$\textbf{Pooled Coefficient of Variation} = \frac{S_p}{1} = S_p \qquad \textbf{Equation 5}$$

2.1.3 Basis Value Computations

Basis values are computed using the mean and standard deviation for that environment, as follows: The mean is always the mean for the environment, but if the data meets all requirements for pooling, S_p can be used in place of the standard deviation for the environment, S.

Basis Values:

$$\begin{aligned} A-basis &= \overline{X} - K_a S \\ B-basis &= \overline{X} - K_b S \end{aligned} \qquad \textbf{Equation 6}$$

2.1.3.1 K-factor computations

K_a and K_b are computed according to the methodology documented in section 8.3.5 of CMH-17 Vol 1. The approximation formulas are given below:

$$K_a = \frac{2.3263}{\sqrt{q(f)}} + \sqrt{\frac{1}{c_A(f)\cdot n_j} + \left(\frac{b_A(f)}{2c_A(f)}\right)^2} - \frac{b_A(f)}{2c_A(f)} \qquad \textbf{Equation 7}$$

$$K_b = \frac{1.2816}{\sqrt{q(f)}} + \sqrt{\frac{1}{c_B(f)\cdot n_j} + \left(\frac{b_B(f)}{2c_B(f)}\right)^2} - \frac{b_B(f)}{2c_B(f)} \qquad \textbf{Equation 8}$$

Where

r = the number of environments being pooled together

n_j = number of data values for environment j

$$N = \sum_{j=1}^{r} n_j$$

$$f = N - r$$

$$q(f) = 1 - \frac{2.323}{\sqrt{f}} + \frac{1.064}{f} + \frac{0.9157}{f\sqrt{f}} - \frac{0.6530}{f^2} \qquad \textbf{Equation 9}$$

$$b_B(f) = \frac{1.1372}{\sqrt{f}} - \frac{0.49162}{f} + \frac{0.18612}{f\sqrt{f}} \qquad \textbf{Equation 10}$$

$$c_B(f) = 0.36961 + \frac{0.0040342}{\sqrt{f}} - \frac{0.71750}{f} + \frac{0.19693}{f\sqrt{f}} \qquad \textbf{Equation 11}$$

$$b_A(f) = \frac{2.0643}{\sqrt{f}} - \frac{0.95145}{f} + \frac{0.51251}{f\sqrt{f}}$$ **Equation 12**

$$c_A(f) = 0.36961 + \frac{0.0026958}{\sqrt{f}} - \frac{0.65201}{f} + \frac{0.011320}{f\sqrt{f}}$$ **Equation 13**

2.1.4 Modified Coefficient of Variation

The coefficient of variation is modified according to the following rules:

Modified CV = $$CV^* = \begin{cases} .06 & \text{if } CV < .04 \\ \frac{CV}{2} + .04 & \text{if } .04 \le CV < .08 \\ CV & \text{if } CV \ge .08 \end{cases}$$ **Equation 14**

This is converted to percent by multiplying by 100%.

CV^* is used to compute a modified standard deviation S^*.

$$S^* = CV^* \cdot \overline{X}$$ **Equation 15**

To compute the pooled standard deviation based on the modified CV:

$$S_p^* = \sqrt{\frac{\sum_{i=1}^{k}\left((n_i - 1)\left(CV_i^* \cdot \overline{X}_i\right)^2\right)}{\sum_{i=1}^{k}(n_i - 1)}}$$ **Equation 16**

The A-Basis and B-Basis values under the assumption of the modified CV method are computed by replacing S with S^*

2.1.4.1 Transformation of data based on Modified CV

In order to determine if the data would pass the diagnostic tests under the assumption of the modified CV, the data must be transformed such that the batch means remain the same while the standard deviation of transformed data (all batches) matches the modified standard deviation.

To accomplish this requires a transformation in two steps:

Step 1: Apply the modified CV rules to each batch and compute the modified standard deviation $S_i^* = CV^* \cdot \overline{X}_i$ for each batch. Transform the individual data values (X_{ij}) in each batch as follows:

$$X'_{ij} = C_i\left(X_{ij} - \overline{X}_i\right) + \overline{X}_i$$ **Equation 17**

$$C_i = \frac{S_i^*}{S_i}$$ **Equation 18**

Run the Anderson-Darling k-sample test for batch equivalence (see section 2.1.6) on the transformed data. If it passes, proceed to step 2. If not, stop. The data cannot be pooled.

Step 2: Another transformation is needed as applying the modified CV to each batch leads to a larger CV for the combined data than when applying the modified CV rules to the combined data (due to the addition of between batch variation when combining data from multiple batches). In order to alter the data to match S^*, the transformed data is transformed again, this time setting using the same value of C′ for all batches.

$$X''_{ij} = C'\left(X'_{ij} - \bar{X}_i\right) + \bar{X}_i \qquad \textbf{Equation 19}$$

$$C' = \sqrt{\frac{SSE^*}{SSE'}} \qquad \textbf{Equation 20}$$

$$SSE^* = (n-1)\left(CV^* \cdot \bar{X}\right)^2 - \sum_{i=1}^{k} n_i\left(\bar{X}_i - \bar{X}\right)^2 \qquad \textbf{Equation 21}$$

$$SSE' = \sum_{i=1}^{k}\sum_{j=1}^{n_i}\left(X'_{ij} - \bar{X}_i\right)^2 \qquad \textbf{Equation 22}$$

Once this second transformation has been completed, the k-sample Anderson Darling test for batch equivalence can be run on the transformed data to determine if the modified co-efficient of variation will permit pooling of the data.

2.1.5 Determination of Outliers

All outliers are identified in text and graphics. If an outlier is removed from the dataset, it will be specified and the reason why will be documented in the text. Outliers are identified using the Maximum Normed Residual Test for Outliers as specified in section 8.3.3 of CMH-17 Vol 1.

$$MNR = \frac{\max\limits_{all\ i}\left|X_i - \bar{X}\right|}{S}, \quad i = 1 \ldots n \qquad \textbf{Equation 23}$$

$$C = \frac{n-1}{\sqrt{n}}\sqrt{\frac{t^2}{n-2+t^2}} \qquad \textbf{Equation 24}$$

where t is the $1-\frac{.05}{2n}$ quartile of a t distribution with n−2 degrees of freedom, n being the total number of data values.

If MNR > C, then the X_i associated with the MNR is considered to be an outlier. If an outlier exists, then the X_i associated with the MNR is dropped from the dataset and the MNR procedure is applied again. This process is repeated until no outliers are detected. Additional information on this procedure can be found in references 1 and 2.

2.1.6 The k-Sample Anderson Darling Test for Batch Equivalency

The k-sample Anderson-Darling test is a nonparametric statistical procedure that tests the hypothesis that the populations from which two or more groups of data were drawn are identical.

The distinct values in the combined data set are ordered from smallest to largest, denoted $z_{(1)}, z_{(2)}, \ldots z_{(L)}$, where L will be less than n if there are tied observations. These rankings are used to compute the test statistic.

The k-sample Anderson-Darling test statistic is:

$$ADK = \frac{n-1}{n^2(k-1)} \sum_{i=1}^{k} \left[\frac{1}{n_i} \sum_{j=1}^{L} h_j \frac{\left(nF_{ij} - n_i H_j\right)^2}{H_j\left(n - H_j\right) - \frac{nh_j}{4}} \right] \qquad \textbf{Equation 25}$$

Where

n_i = the number of test specimens in each batch

$n = n_1+n_2+\ldots+n_k$

h_j = the number of values in the combined samples equal to $z_{(j)}$

H_j = the number of values in the combined samples less than $z_{(j)}$ plus ½ the number of values in the combined samples equal to $z_{(j)}$

F_{ij} = the number of values in the i^{th} group which are less than $z_{(j)}$ plus ½ the number of values in this group which are equal to $z_{(j)}$.

The critical value for the test statistic at 1−α level is computed:

$$ADC = 1 + \sigma_n \left[z_\alpha + \frac{0.678}{\sqrt{k-1}} - \frac{0.362}{k-1} \right] \qquad \textbf{Equation 26}$$

This formula is based on the formula in reference 3 at the end of section 5, using a Taylor's expansion to estimate the critical value via the normal distribution rather than using the t distribution with k-1 degrees of freedom.

$$\sigma_n^2 = VAR(ADK) = \frac{an^3 + bn^2 + cn + d}{(n-1)(n-2)(n-3)(k-1)^2} \qquad \textbf{Equation 27}$$

With

$$a = (4g-6)(k-1) + (10-6g)S$$

$$b = (2g-4)k^2 + 8Tk + (2g-14T-4)S - 8T + 4g - 6$$

$$c = (6T+2g-2)k^2 + (4T-4g+6)k + (2T-6)S + 4T$$

$$d = (2T+6)k^2 - 4Tk$$

$$S = \sum_{i=1}^{k} \frac{1}{n_i}$$

$$T = \sum_{i=1}^{n-1} \frac{1}{i}$$

$$g = \sum_{i=1}^{n-2} \sum_{j=i+1}^{n-1} \frac{1}{(n-i)j}$$

The data is considered to have failed this test (i.e. the batches are not from the same population) when the test statistic is greater than the critical value. For more information on this procedure, see reference 3.

2.1.7 The Anderson Darling Test for Normality

Normal Distribution: A two parameter (μ, σ) family of probability distributions for which the probability that an observation will fall between *a* and *b* is given by the area under the curve between a and b:

$$F(x) = \int_a^b \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(x-\mu)^2}{2\sigma^2}} dx \qquad \textbf{Equation 28}$$

A normal distribution with parameters (μ, σ) has population mean μ and variance σ^2.

The normal distribution is considered by comparing the cumulative normal distribution function that best fits the data with the cumulative distribution function of the data. Let

$$z_{(i)} = \frac{x_{(i)} - \overline{x}}{s}, \quad \text{for i = 1,…,n} \qquad \textbf{Equation 29}$$

where $x_{(i)}$ is the smallest sample observation, $\overline{x}$ is the sample average, and s is the sample standard deviation.

The Anderson Darling test statistic (AD) is:

$$AD = \sum_{i=1}^{n} \frac{1-2i}{n} \left\{ \ln\left[F_0(z_{(i)})\right] + \ln\left[1 - F_0\left(z_{(n+1-i)}\right)\right] \right\} - n \qquad \textbf{Equation 30}$$

Where F_0 is the standard normal distribution function. The observed significance level (OSL) is

$$OSL = \frac{1}{1+e^{-0.48+0.78\ln(AD^*)+4.58AD^*}}, \quad AD^* = \left(1 + \frac{4}{n} - \frac{25}{n^2}\right) AD \qquad \textbf{Equation 31}$$

This OSL measures the probability of observing an Anderson-Darling statistic at least as extreme as the value calculated if, in fact, the data are a sample from a normal population. If OSL > 0.05, the data is considered sufficiently close to a normal distribution.

2.1.8 Levene's Test for Equality of Coefficient of Variation

Levene's test performs an Analysis of Variance on the absolute deviations from their sample medians. The absolute value of the deviation from the median is computed for each data value. $w_{ij} = \left| y_{ij} - \tilde{y}_i \right|$ An F-test is then performed on the transformed data values as follows:

$$F = \frac{\sum_{i=1}^{k} n_i \left(\overline{w}_i - \overline{w}\right)^2 / (k-1)}{\sum_{i=1}^{k} \sum_{j=1}^{n_i} {}_i\left(w_{ij} - \overline{w}_i\right)^2 / (n-k)} \qquad \textbf{Equation 32}$$

If this computed F statistic is less than the critical value for the F-distribution having k-1 numerator and n-k denominator degrees of freedom at the 1-α level of confidence, then the data is not rejected as being too different in terms of the co-efficient of variation. CMH-17 STATS provides the appropriate critical values for F at α levels of 0.10, 0.05, 0.025, and 0.01. For more information on this procedure, see references 4, and 5.

2.1.9 Distribution Tests

In addition to testing for normality using the Anderson-Darling test (see 2.1.7), CMH17 STATS also tests to see if the Weibull or Lognormal distribution is a good fit for the data.

Each distribution is considered using the Anderson-Darling test statistic which is sensitive to discrepancies in the tail regions. The Anderson-Darling test compares the cumulative distribution function for the distribution of interest with the cumulative distribution function of the data.

An observed significance level (OSL) based on the Anderson-Darling test statistic is computed for each test. The OSL measures the probability of observing an Anderson-Darling test statistic at least as extreme as the value calculated if the distribution under consideration is in fact the underlying distribution of the data. In other words, the OSL is the probability of obtaining a value of the test statistic at least as large as that obtained if the hypothesis that the data are actually from the distribution being tested is true. If the OSL is less than or equal to 0.05, then the assumption that the data are from the distribution being tested is rejected with at most a five percent risk of being in error.

If the normal distribution has an OSL greater than 0.05, then the data is assumed to be from a population with a normal distribution. If not, then if either the Weibull or lognormal distributions has an OSL greater than 0.05, then one of those can be used. If neither of these distributions has an OSL greater than 0.05, a non-parametric approach is used.

In what follows, unless otherwise noted, the sample size is denoted by n, the sample observations by $x_1, ..., x_n$, and the sample observations ordered from least to greatest by $x_{(1)}, ..., x_{(n)}$.

2.1.9.1 One-sided B-Basis tolerance factors, k_B, for the normal distribution when sample size is greater than 15.

The exact computation of k_B values is $1/\sqrt{n}$ times the 0.95th quantile of the noncentral t-distribution with non-centrality parameter $1.282\sqrt{n}$ and n − 1 degrees of freedom. Since this is not a calculation that Excel can handle, the following approximation to the k_B values is used:

$$k_B \approx 1.282 + \exp\{0.958 - 0.520\ln(n) + 3.19/n\}$$ **Equation 33**

This approximation is accurate to within 0.2% of the tabulated values for sample sizes greater than or equal to 16.

2.1.9.2 One-sided A-Basis tolerance factors, k_A, for the normal distribution

The exact computation of k_A values is $1/\sqrt{n}$ times the 0.95th quantile of the noncentral t-distribution with non-centrality parameter $2.326\sqrt{n}$ and n − 1 degrees of freedom (Reference 11). Since this is not a calculation that Excel can handle easily, the following approximation to the k_A values is used:

$$k_A \approx 2.326 + \exp\{1.34 - 0.522\ln(n) + 3.87/n\} \qquad \textbf{Equation 34}$$

This approximation is accurate to within 0.2% of the tabulated values for sample sizes greater than or equal to 16.

2.1.9.3 Two-parameter Weibull Distribution

A probability distribution for which the probability that a randomly selected observation from this population lies between *a* and *b* $(0 < a < b < \infty)$ is given by

$$e^{-\left(a/\alpha\right)^{\beta}} - e^{-\left(b/\alpha\right)^{\beta}} \qquad \textbf{Equation 35}$$

where α is called the scale parameter and β is called the shape parameter.

In order to compute a check of the fit of a data set to the Weibull distribution and compute Basis values assuming Weibull, it is first necessary to obtain estimates of the population shape and scale parameters (Section 2.1.9.3.1). Calculations specific to the goodness-of-fit test for the Weibull distribution are provided in section 2.1.9.3.2.

2.1.9.3.1 Estimating Weibull Parameters

This section describes the *maximum likelihood* method for estimating the parameters of the two-parameter Weibull distribution. The maximum-likelihood estimates of the shape and scale parameters are denoted $\hat{\beta}$ and $\hat{\alpha}$. The estimates are the solution to the pair of equations:

$$\hat{\alpha}\hat{\beta}\mathrm{n} - \frac{\hat{\beta}}{\hat{\alpha}^{\hat{\beta}-1}}\sum_{\mathrm{i}=1}^{\mathrm{n}} \mathrm{x}_{\mathrm{i}}^{\hat{\beta}} = 0 \qquad \textbf{Equation 36}$$

$$\frac{n}{\hat{\beta}} - n\ln\hat{\alpha} + \sum_{i=1}^{n}\ln x_i - \sum_{i=1}^{n}\left[\frac{x_i}{\hat{\alpha}}\right]^{\hat{\beta}}\left(\ln x_i - \ln\hat{\alpha}\right) = 0 \qquad \textbf{Equation 37}$$

CMH17 STATS solves these equations numerically for $\hat{\beta}$ and $\hat{\alpha}$ in order to compute Basis values.

2.1.9.3.2 Goodness-of-fit test for the Weibull distribution

The two-parameter Weibull distribution is considered by comparing the cumulative Weibull distribution function that best fits the data with the cumulative distribution function of the data. Using the shape and scale parameter estimates from section 2.1.9.3.1, let

$$z_{(i)} = \left[x_{(i)}/\hat{\alpha}\right]^{\hat{\beta}}, \quad \text{for } i = 1,\ldots,n \qquad \textbf{Equation 38}$$

The Anderson-Darling test statistic is

$$\mathrm{AD} = \sum_{\mathrm{i}=1}^{\mathrm{n}} \frac{1-2\mathrm{i}}{\mathrm{n}}\left[\ln\left[1-\exp(-\mathrm{z}_{(\mathrm{i})})\right] - \mathrm{z}_{(\mathrm{n}+1-\mathrm{i})}\right] - \mathrm{n} \qquad \textbf{Equation 39}$$

and the observed significance level is

$$\mathrm{OSL} = 1/\left\{1+\exp[-0.10+1.24\ln(\mathrm{AD}^*)+4.48\mathrm{AD}^*]\right\} \qquad \textbf{Equation 40}$$

where

$$AD^* = \left(1+\frac{0.2}{\sqrt{n}}\right)AD \qquad \textbf{Equation 41}$$

This OSL measures the probability of observing an Anderson-Darling statistic at least as extreme as the value calculated if in fact the data is a sample from a two-parameter Weibull distribution. If OSL ≤ 0.05, one may conclude (at a five percent risk of being in error) that the population does not have a two-parameter Weibull distribution. Otherwise, the hypothesis that the population has a two-parameter Weibull distribution is not rejected. For further information on these procedures, see reference 6.

2.1.9.3.3 Basis value calculations for the Weibull distribution

For the two-parameter Weibull distribution, the B-Basis value is

$$B = \hat{q}e^{\left(-V/\hat{\beta}\sqrt{n}\right)}$$ **Equation 42**

where

$$\hat{q} = \hat{\alpha}\left(0.10536\right)^{1/\hat{\beta}}$$ **Equation 43**

To calculate the A-Basis value, substitute the equation below for the equation above.

$$\hat{q} = \hat{\alpha}(0.01005)^{1/\beta}$$ **Equation 44**

V is the value in Table 2-1 when the sample size is less than 16. For sample sizes of 16 or larger, a numerical approximation to the V values is given in the two equations immediately below.

$$V_B \approx 3.803 + \exp\left[1.79 - 0.516\ln(n) + \frac{5.1}{n-1}\right]$$ **Equation 45**

$$V_A \approx 6.649 + \exp\left[2.55 - 0.526\ln(n) + \frac{4.76}{n}\right]$$ **Equation 46**

This approximation is accurate within 0.5% of the tabulated values for n greater than or equal to 16.

Weibull Dist. K Factors for N<16		
N	B-basis	A-basis
2	690.804	1284.895
3	47.318	88.011
4	19.836	36.895
5	13.145	24.45
6	10.392	19.329
7	8.937	16.623
8	8.047	14.967
9	7.449	13.855
10	6.711	12.573
11	6.477	12.093
12	6.286	11.701
13	6.127	11.375
14	5.992	11.098
15	5.875	10.861

Table 2-1: Weibull Distribution Basis Value Factors

2.1.9.4 Lognormal Distribution

A probability distribution for which the probability that an observation selected at random from this population falls between a and b $\left(0 < a < b < \infty\right)$ is given by the area under the normal distribution between ln(a) and ln(b).

The lognormal distribution is a positively skewed distribution that is simply related to the normal distribution. If something is lognormally distributed, then its logarithm is normally distributed. The natural (base e) logarithm is used.

2.1.9.4.1 Goodness-of-fit test for the Lognormal distribution

In order to test the goodness-of-fit of the lognormal distribution, take the logarithm of the data and perform the Anderson-Darling test for normality from Section 2.1.7. Using the natural logarithm, replace Equation 29 above with Equation 47 below:

$$z_{(i)} = \frac{\ln\left(x_{(i)}\right) - \overline{x}_L}{s_L}, \quad \text{for } i = 1, \ldots, n \qquad \textbf{Equation 47}$$

where $x_{(i)}$ is the i^{th} smallest sample observation, $\overline{x}_L$ and s_L are the mean and standard deviation of the $\ln(x_i)$ values.

The Anderson-Darling statistic is then computed using Equation 30 above and the observed significance level (OSL) is computed using Equation 31 above. This OSL measures the probability of observing an Anderson-Darling statistic at least as extreme as the value calculated if in fact the data are a sample from a lognormal distribution. If OSL ≤ 0.05, one may conclude (at a five percent risk of being in error) that the population is not lognormally distributed. Otherwise, the hypothesis that the population is lognormally distributed is not rejected. For further information on these procedures, see reference 6.

2.1.9.4.2 Basis value calculations for the Lognormal distribution

If the data set is assumed to be from a population with a lognormal distribution, Basis values are calculated using the equation above in section 2.1.3. However, the calculations are performed using the logarithms of the data rather than the original observations. The computed Basis values are then transformed back to the original units by applying the inverse of the log transformation.

2.1.10 Non-parametric Basis Values

Non-parametric techniques do not assume any particularly underlying distribution for the population the sample comes from. It does require that the batches be similar enough to be grouped together, so the ADK test must have a positive result. While it can be used instead of assuming the normal, lognormal or Weibull distribution, it typically results in lower Basis values. One of following two methods should be used, depending on the sample size.

2.1.10.1 Non-parametric Basis Values for large samples

The required sample sizes for this ranking method differ for A and B Basis values. A sample size of at least 29 is needed for the B-Basis value while a sample size of 299 is required for the A-Basis.

To calculate a B-Basis value for n > 28, the value of r is determined with the following formulas:

For B-Basis values:

$$r_B = \frac{n}{10} - 1.645\sqrt{\frac{9n}{100}} + 0.23 \qquad \textbf{Equation 48}$$

For A-Basis values:

$$r_A = \frac{n}{100} - 1.645\sqrt{\frac{99n}{10,000}} + 0.29 + \frac{19.1}{n}$$ **Equation 49**

The formula for the A-Basis values should be rounded to the nearest integer. This approximation is exact for most values and for a small percentage of values (less than 0.2%), the approximation errs by one rank on the conservative side.

The B-Basis value is the r_B^{th} lowest observation in the data set, while the A-Basis value is the r_A^{th} lowest observation in the data set. For example, in a sample of size n = 30, the lowest (r = 1) observation is the B-Basis value. Further information on this procedure may be found in reference 7.

2.1.10.2 Non-parametric Basis Values for small samples

The Hanson-Koopmans method (references 8 and 9) is used for obtaining a B-Basis value for sample sizes not exceeding 28 and A-Basis values for sample sizes less than 299. This procedure requires the assumption that the observations are a random sample from a population for which the logarithm of the cumulative distribution function is concave, an assumption satisfied by a large class of probability distributions. There is substantial empirical evidence that suggests that composite strength data satisfies this assumption.

The Hanson-Koopmans B-Basis value is:

$$B = x_{(r)}\left[\frac{x_{(1)}}{x_{(r)}}\right]^k$$ **Equation 50**

The A-Basis value is:

$$A = x_{(n)}\left[\frac{x_{(1)}}{x_{(n)}}\right]^k$$ **Equation 51**

where $x_{(n)}$ is the largest data value, $x_{(1)}$ is the smallest, and $x_{(r)}$ is the r^{th} largest data value. The values of r and k depend on n and are listed in Table 2-2. This method is not used for the B-Basis value when $x_{(r)} = x_{(1)}$.

The Hanson-Koopmans method can be used to calculate A-Basis values for n less than 299. Find the value k_A corresponding to the sample size n in Table 2-3. For an A-Basis value that meets all the requirements of CMH-17 Vol 1, there must be at least five batches represented in the data and at least 55 data points. For a B-Basis value, there must be at least three batches represented in the data and at least 18 data points.

B-Basis Hanson-Koopmans Table		
n	r	k
2	2	35.177
3	3	7.859
4	4	4.505
5	4	4.101
6	5	3.064
7	5	2.858
8	6	2.382
9	6	2.253
10	6	2.137
11	7	1.897
12	7	1.814
13	7	1.738
14	8	1.599
15	8	1.540
16	8	1.485
17	8	1.434
18	9	1.354
19	9	1.311
20	10	1.253
21	10	1.218
22	10	1.184
23	11	1.143
24	11	1.114
25	11	1.087
26	11	1.060
27	11	1.035
28	12	1.010

Table 2-2: B-Basis Hanson-Koopmans Table

A-Basis Hanson-Koopmans Table					
n	k	n	k	n	k
2	80.00380	38	1.79301	96	1.32324
3	16.91220	39	1.77546	98	1.31553
4	9.49579	40	1.75868	100	1.30806
5	6.89049	41	1.74260	105	1.29036
6	5.57681	42	1.72718	110	1.27392
7	4.78352	43	1.71239	115	1.25859
8	4.25011	44	1.69817	120	1.24425
9	3.86502	45	1.68449	125	1.23080
10	3.57267	46	1.67132	130	1.21814
11	3.34227	47	1.65862	135	1.20620
12	3.15540	48	1.64638	140	1.19491
13	3.00033	49	1.63456	145	1.18421
14	2.86924	50	1.62313	150	1.17406
15	2.75672	52	1.60139	155	1.16440
16	2.65889	54	1.58101	160	1.15519
17	2.57290	56	1.56184	165	1.14640
18	2.49660	58	1.54377	170	1.13801
19	2.42833	60	1.52670	175	1.12997
20	2.36683	62	1.51053	180	1.12226
21	2.31106	64	1.49520	185	1.11486
22	2.26020	66	1.48063	190	1.10776
23	2.21359	68	1.46675	195	1.10092
24	2.17067	70	1.45352	200	1.09434
25	2.13100	72	1.44089	205	1.08799
26	2.09419	74	1.42881	210	1.08187
27	2.05991	76	1.41724	215	1.07595
28	2.02790	78	1.40614	220	1.07024
29	1.99791	80	1.39549	225	1.06471
30	1.96975	82	1.38525	230	1.05935
31	1.94324	84	1.37541	235	1.05417
32	1.91822	86	1.36592	240	1.04914
33	1.89457	88	1.35678	245	1.04426
34	1.87215	90	1.34796	250	1.03952
35	1.85088	92	1.33944	275	1.01773
36	1.83065	94	1.33120	299	1.00000
37	1.81139				

Table 2-3: A-Basis Hanson-Koopmans Table

2.1.11 Analysis of Variance (ANOVA) Basis Values

ANOVA is used to compute Basis values when the batch to batch variability of the data does not pass the ADK test. Since ANOVA makes the assumption that the different batches have equal variances, the data is checked to make sure the assumption is valid. Levene's test for equality of variance is used (see section 2.1.8). If the dataset fails Levene's test, the Basis values computed are likely to be conservative. Thus this method can still be used but the values produced will be listed as estimates.

2.1.11.1 Calculation of Basis values using ANOVA

The following calculations address batch-to-batch variability. In other words, the only grouping is due to batches and the k-sample Anderson-Darling test (Section 2.1.6) indicates that the batch to batch variability is too large to pool the data. The method is based on the one-way analysis of variance random-effects model, and the procedure is documented in reference 10.

ANOVA separates the total variation (called the sum of squares) of the data into two sources: between batch variation and within batch variation.

First, statistics are computed for each batch, which are indicated with a subscript $\left(n_i, \overline{x}_i, s_i^2\right)$ while statistics that were computed with the entire dataset do not have a subscript. Individual data values are represented with a double subscript, the first number indicated the batch and the second distinguishing between the individual data values within the batch. *k* stands for the number of batches in the analysis. With these statistics, the Sum of Squares Between batches (SSB) and the Total Sum of Squares (SST) are computed:

$$SSB = \sum_{i=1}^{k} n_i \overline{x}_I^2 - n\overline{x}^2 \qquad \textbf{Equation 52}$$

$$SST = \sum_{i=1}^{k} \sum_{j=1}^{n_i} x_{ij}^2 - n\overline{x}^2 \qquad \textbf{Equation 53}$$

The within-batch, or error, sum of squares (SSE) is computed by subtraction

$$SSE = SST - SSB \qquad \textbf{Equation 54}$$

Next, the mean sums of squares are computed:

$$MSB = \frac{SSB}{k-1} \qquad \textbf{Equation 55}$$

$$MSE = \frac{SSE}{n-k} \qquad \textbf{Equation 56}$$

Since the batches need not have equal numbers of specimens, an 'effective batch size,' is defined as

$$n' = \frac{n - \frac{1}{n}\sum_{i=1}^{k} n_i^2}{k-1} \qquad \textbf{Equation 57}$$

Using the two mean squares and the effective batch size, an estimate of the population standard deviation is computed:

$$S = \sqrt{\frac{MSB}{n'} + \left(\frac{n'-1}{n'}\right) MSE} \qquad \textbf{Equation 58}$$

Two k-factors are computed using the methodology of section 8.3.5 of CMH-17 Vol 1 using a sample size of n (denoted k_0) and a sample size of k (denoted k_1). Whether this value is an A- or B-Basis value depends only on whether k_0 and k_1 are computed for A or B-Basis values.

Denote the ratio of mean squares by

$$u = \frac{MSB}{MSE} \qquad \textbf{Equation 59}$$

If u is less than one, it is set equal to one. The tolerance limit factor is

$$T = \frac{k_0 - \frac{k_1}{\sqrt{n'}} + (k_1 - k_0)\sqrt{\frac{u}{u + n' - 1}}}{1 - \frac{1}{\sqrt{n'}}} \qquad \textbf{Equation 60}$$

The Basis value is $\bar{x} - TS$.

The ANOVA method can produce extremely conservative Basis values when a small number of batches are available. Therefore, when less than five (5) batches are available and the ANOVA method is used, the Basis values produced will be listed as estimates.

2.2 Single Batch and Two Batch Estimates using Modified CV

This method has not been approved for use by the CMH-17 organization. Values computed in this manner are estimates only. It is used only when fewer than three batches are available and no valid B-Basis value could be computed using any other method. The estimate is made using the mean of the data and setting the coefficient of variation to 8 percent if it was less than that. A modified standard deviation (S_{adj}) was computed by multiplying the mean by 0.08 and computing the A and B-Basis values using this inflated value for the standard deviation.

$$\textbf{Estimated B-Basis} = \bar{X} - k_b S_{adj} = \bar{X} - k_b \cdot 0.08 \cdot \bar{X} \qquad \textbf{Equation 61}$$

2.3 Lamina Variability Method (LVM)

This method has not been approved for use by the CMH-17 organization. Values computed in this manner are estimates only. It is used only when the sample size is less than 16 and no valid B-Basis value could be computed using any other method. The prime assumption for applying the LVM is that the intrinsic strength variability of the laminate (small) dataset is no greater than the strength variability of the lamina (large) dataset. This assumption was tested and found to be reasonable for composite materials as documented by Tomblin and Seneviratne [12].

To compute the estimate, the coefficients of variation (CVs) of laminate data are paired with lamina CV's for the same loading condition and environmental condition. For example, the 0º compression lamina CV CTA condition is used with open hole compression CTA condition. Bearing and in-plane shear laminate CV's are paired with 0º compression lamina CV's. However, if the laminate CV is larger than the corresponding lamina CV, the larger laminate CV value is used.

The LVM B-Basis value is then computed as:

LVM Estimated B-Basis = $\overline{X}_1 - K_{(N_1,N_2)} \cdot \overline{X}_1 \cdot \max\left(CV_1, CV_2\right)$ **Equation 62**

When used in conjunction with the modified CV approach, a minimum value of 8% is used for the CV.

Mod CV LVM Estimated B-Basis = $\overline{X}_1 - K_{(N_1,N_2)} \cdot \overline{X}_1 \cdot Max\left(8\%, CV_1, CV_2\right)$ **Equation 63**

With:

$\overline{X}_1$ the mean of the laminate (small dataset)

N_1 the sample size of the laminate (small dataset)

N_2 the sample size of the lamina (large dataset)

CV_1 is the coefficient of variation of the laminate (small dataset)

CV_2 is the coefficient of variation of the lamina (large dataset)

$K_{(N_1,N_2)}$ is given in Table 2-4

	N1													
N1+N2-2	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	4.508	0	0	0	0	0	0	0	0	0	0	0	0	0
4	3.827	3.607	0	0	0	0	0	0	0	0	0	0	0	0
5	3.481	3.263	3.141	0	0	0	0	0	0	0	0	0	0	0
6	3.273	3.056	2.934	2.854	0	0	0	0	0	0	0	0	0	0
7	3.134	2.918	2.796	2.715	2.658	0	0	0	0	0	0	0	0	0
8	3.035	2.820	2.697	2.616	2.558	2.515	0	0	0	0	0	0	0	0
9	2.960	2.746	2.623	2.541	2.483	2.440	2.405	0	0	0	0	0	0	0
10	2.903	2.688	2.565	2.484	2.425	2.381	2.346	2.318	0	0	0	0	0	0
11	2.856	2.643	2.519	2.437	2.378	2.334	2.299	2.270	2.247	0	0	0	0	0
12	2.819	2.605	2.481	2.399	2.340	2.295	2.260	2.231	2.207	2.187	0	0	0	0
13	2.787	2.574	2.450	2.367	2.308	2.263	2.227	2.198	2.174	2.154	2.137	0	0	0
14	2.761	2.547	2.423	2.341	2.281	2.236	2.200	2.171	2.147	2.126	2.109	2.093	0	0
15	2.738	2.525	2.401	2.318	2.258	2.212	2.176	2.147	2.123	2.102	2.084	2.069	2.056	0
16	2.719	2.505	2.381	2.298	2.238	2.192	2.156	2.126	2.102	2.081	2.063	2.048	2.034	2.022
17	2.701	2.488	2.364	2.280	2.220	2.174	2.138	2.108	2.083	2.062	2.045	2.029	2.015	2.003
18	2.686	2.473	2.348	2.265	2.204	2.158	2.122	2.092	2.067	2.046	2.028	2.012	1.999	1.986
19	2.673	2.459	2.335	2.251	2.191	2.144	2.108	2.078	2.053	2.032	2.013	1.998	1.984	1.971
20	2.661	2.447	2.323	2.239	2.178	2.132	2.095	2.065	2.040	2.019	2.000	1.984	1.970	1.958
21	2.650	2.437	2.312	2.228	2.167	2.121	2.084	2.053	2.028	2.007	1.988	1.972	1.958	1.946
22	2.640	2.427	2.302	2.218	2.157	2.110	2.073	2.043	2.018	1.996	1.978	1.962	1.947	1.935
23	2.631	2.418	2.293	2.209	2.148	2.101	2.064	2.033	2.008	1.987	1.968	1.952	1.938	1.925
24	2.623	2.410	2.285	2.201	2.139	2.092	2.055	2.025	1.999	1.978	1.959	1.943	1.928	1.916
25	2.616	2.402	2.277	2.193	2.132	2.085	2.047	2.017	1.991	1.969	1.951	1.934	1.920	1.907
26	2.609	2.396	2.270	2.186	2.125	2.078	2.040	2.009	1.984	1.962	1.943	1.927	1.912	1.900
27	2.602	2.389	2.264	2.180	2.118	2.071	2.033	2.003	1.977	1.955	1.936	1.920	1.905	1.892
28	2.597	2.383	2.258	2.174	2.112	2.065	2.027	1.996	1.971	1.949	1.930	1.913	1.899	1.886
29	2.591	2.378	2.252	2.168	2.106	2.059	2.021	1.990	1.965	1.943	1.924	1.907	1.893	1.880
30	2.586	2.373	2.247	2.163	2.101	2.054	2.016	1.985	1.959	1.937	1.918	1.901	1.887	1.874
40	2.550	2.337	2.211	2.126	2.063	2.015	1.977	1.946	1.919	1.897	1.877	1.860	1.845	1.832
50	2.528	2.315	2.189	2.104	2.041	1.993	1.954	1.922	1.896	1.873	1.853	1.836	1.820	1.807
60	2.514	2.301	2.175	2.089	2.026	1.978	1.939	1.907	1.880	1.857	1.837	1.819	1.804	1.790
70	2.504	2.291	2.164	2.079	2.016	1.967	1.928	1.896	1.869	1.846	1.825	1.808	1.792	1.778
80	2.496	2.283	2.157	2.071	2.008	1.959	1.920	1.887	1.860	1.837	1.817	1.799	1.783	1.769
90	2.491	2.277	2.151	2.065	2.002	1.953	1.913	1.881	1.854	1.830	1.810	1.792	1.776	1.762
100	2.486	2.273	2.146	2.060	1.997	1.948	1.908	1.876	1.849	1.825	1.805	1.787	1.771	1.757
125	2.478	2.264	2.138	2.051	1.988	1.939	1.899	1.867	1.839	1.816	1.795	1.777	1.761	1.747
150	2.472	2.259	2.132	2.046	1.982	1.933	1.893	1.861	1.833	1.809	1.789	1.770	1.754	1.740
175	2.468	2.255	2.128	2.042	1.978	1.929	1.889	1.856	1.828	1.805	1.784	1.766	1.750	1.735
200	2.465	2.252	2.125	2.039	1.975	1.925	1.886	1.853	1.825	1.801	1.781	1.762	1.746	1.732

Table 2-4: B-Basis Factors for Small Datasets Using Variability of Corresponding Large Dataset

2.4 Specification Limits

Specification limits are calculated based in the qualification dataset only. In order to compute specification limits we make the following assumptions: a) The qualification dataset represents the population[1] b) In the future we might draw a new sample of size n=5 c) In the future we might run an acceptance test for the new sample statistics (this is a hypothesis testing approach; testing the hypothesis that the sample statistics equal the population parameters with α = 1%). Then, the specification limits are computed as the limits required by the statistics of the future sample to pass the acceptance test. The statistics to be tested are be the modulus mean, the strength mean or the strength minimum individual of the qualification dataset. In the case of modulus mean, a two-tail interval is used. In case of strength mean and strength minimum individual, a one-tail left interval is used.

Therefore, in order to compute the specification limits we need to compute the intervals around the mean and minimum individual values from the qualification dataset for some specific material property, according to the following formulas. First, assume the following:

$x = \text{Some Material Strength Property}$
$\overline{x} = \text{Mean of x}$
$S = \text{Standard Deviation of x}$

Then we define:

$\mathrm{W_{mean}} = $ Specification limit for the mean
$\mathrm{W_{min\,indiv}} = $ Specification limit for the minimum individual

We compute these as the following:

$$\mathrm{W_{mean}} = \overline{x} - \mathrm{k_n^{mean}}.\mathrm{S} \quad \textbf{Equation 64}$$

$$\mathrm{W_{min\,indiv}} = \overline{x} - \mathrm{k_n^{min\,indiv}}.\mathrm{S} \quad \textbf{Equation 65}$$

Where the tolerance factor k^{mean} is found in table 8.5.17 in CMH-17 Vol 1 for n=5 and α =0.01 and tolerance factor $k^{min\ indiv}$ is found in table 8.5.18 in CMH-17 Vol 1 for n=5 and α =0.01

For modulus properties we define:

$\mathrm{W_{lower}} = $ Lower specification limit for the mean of modulus property
$\mathrm{W_{upper}} = $ Upper specification limit for the mean of modulus property

We compute these as the following:

$$\mathrm{W_{lower}} = \overline{x} - \mathrm{k.S} \quad \textbf{Equation 66}$$

$$\mathrm{W_{upper}} = \overline{x} + \mathrm{k.S} \quad \textbf{Equation 67}$$

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[1] This is a different assumption than the one required for computing allowables. While computing allowables, we assume that all the future material properties values are the population and the qualification dataset is the sample.

Where the tolerance factor k is determined by the following equations:

$$k = t_c \cdot \sqrt{\left(\frac{1}{N} + \frac{1}{n}\right)}$$

Equation 68

and

$$t_c = t.INV(\alpha, N)$$

Equation 69

Where t.INV is the inverse of the cumulative Student's t-distribution, N=sample size of the qualification dataset, n=5 and α =0.01.

2.4.1.1 Specification Limits for Program

Specification limits for this program are detailed in Table 2-5 for strength properties and in Table 2-6 for modulus properties.

Test Property	Test Condition	Mean [ksi]	CV (%)	Mod CV (%)	k_mean	k_min indiv	As-is		Mod CV		Notes
							W_mean [ksi]	W_min indiv [ksi]	W_mean [ksi]	W_min indiv [ksi]	
0° Tension Strength Normalized	RTA (70 °F)	178.3	3.655	6.000	1.143	3.072	170.9	158.3	166.1	145.5	Qualification Data Only
90° Compression Strength Normalized	RTA (70 °F)	112.0	5.738	6.869	1.143	3.072	104.7	92.26	103.2	88.37	Qualification Data Only
0° Short Beam Strength As-Measured	RTA (70 °F)	13.46	3.327	6.000	1.143	3.072	12.95	12.09	12.54	10.98	Qualification Data Only

Table 2-5: Specification Limits for Strength Properties

Test Property	Test Condition	Mean [Msi]	CV (%)	Mod CV (%)	t_statistic	As-is		Mod CV		Notes
						Lower Limit [Msi]	Upper Limit [Msi]	Lower Limit [Msi]	Upper Limit [Msi]	
0° Tension Modulus Normalized	RTA (70 °F)	11.72	2.447	6.000	2.670	11.37	12.08	10.85	12.60	Qualification Data Only
90° Compression Modulus Normalized	RTA (70 °F)	10.78	1.495	6.000	2.695	10.57	10.99	9.961	11.60	Qualification Data Only

Table 2-6: Specification Limits for Modulus Properties

3. Summary of Results

The Basis values for all tests are summarized in the following tables. The NCAMP recommended B-Basis values and A-Basis values meet all requirements of CMH-17 Vol 1. However, not all test data meets those requirements. The summary tables provide a complete listing of all computed Basis values and estimates of Basis values. Data that does not meet the requirements of CMH-17 Vol 1 are shown in shaded boxes and labeled as estimates. Basis values computed with the modified coefficient of variation (CV) are presented whenever possible. Basis values and estimates computed without that modification are presented for all tests.

3.1 NCAMP Recommended Basis Values

The following rules are used in determining what B-Basis and A-Basis values are included in Table 3-1 through Table 3-4 of recommended values.

1. Recommended values are NEVER estimates. Only Basis values that meet all requirements of CMH-17 Vol 1 are recommended.
2. Modified CV Basis values are preferred. Recommended values will be the modified CV Basis value when available. The CV provided with the recommended Basis value will be the one used in the computation of the Basis value.
3. Only normalized Basis values are given for properties that are normalized.
4. ANOVA values computed using five batches of data are recommended, while those with less are labeled as estimates, based on CMH-17 Vol 1 recommendations.
5. Basis values of 90% or more of the mean value imply that the CV is unusually low and may not be conservative. Caution is recommended with B-Basis values calculated from CMH-17 STATS when the B-Basis value is 90% or more of the average value. Such values will be indicated.
6. If the data appear questionable (e.g. when the CTA-RTA-ETW trend of the Basis values is not consistent with the CTA-RTA-ETW trend of the average values), then Basis values will not be recommended.

NCAMP Recommended A-Basis Values for
Hexcel M91/IM8-GP 6K Fabric 145 gsm with 40% RC
All A-Basis Values in this Table Meet the Standards for Publication in the CMH-17 Vol 1 Handbook
Values Are for Normalized Data Unless Noted

Lamina Strength Tests

Environment	Statistic	WT	WC	IPSV*			SBS*
				0.2% Offset Strength	Strength at 5% Strain	Ultimate Shear Strength	
CTA (-65°F)	A-Basis	125.3	93.94	7.805	16.90	19.40	14.55
	Mean	162.6	127.1	11.63	20.36	29.48	17.05
	CV	5.974	5.489	7.042	6.000	5.854	6.000
RTA (70 °F)	A-Basis	149.3	94.98	6.731	11.56	19.94	10.97
	Mean	178.3	114.5	8.361	14.88	24.02	13.46
	CV	6.000	6.000	3.787	3.943	6.000	6.000
ETW1 (180°F)	A-Basis	150.6	59.57	1.876	6.173	12.77	NA: I
	Mean	179.5	83.68	5.328	9.073	15.45	7.772
	CV	6.000	6.418	11.00	5.799	6.142	6.000

Notes: The modified CV A-Basis value is recommended when available.
The CV provided corresponds with the A-Basis value given.
NA implies that tests were run but data did not meet NCAMP's recommended requirements.
* Data is as measured rather than normalized

Table 3-1: NCAMP Recommended A-Basis Values for Lamina Test Data

NCAMP Recommended B-Basis Values for
Hexcel M91/IM8-GP 6K Fabric 145 gsm with 40% RC
All B-Basis Values in this Table Meet the Standards for Publication in the CMH-17 Vol 1 Handbook
Values Are for Normalized Data Unless Noted

Lamina Strength Tests

Environment	Statistic	WT	WC	FT	FC	IPSV*			IPST*		SBS*
						0.2% Offset Strength	Strength at 5% Strain	Ultimate Shear Strength	0.2% Offset Strength	Strength at 5% Strain	
CTA (-65°F)	B-basis	140.9	107.6	147.7**	NA: A	9.380	18.37	23.51	9.154	16.09	15.60
	Mean	162.6	127.1	156.8	128.4	11.63	20.36	29.48	10.12	18.25	17.05
	CV	5.974	5.489	4.037	4.850	7.042	6.000	5.854	6.000	6.000	6.000
RTA (70°F)	B-basis	161.5	103.3	153.5**	99.06**	7.399	12.92	21.68	6.420	11.86	12.02
	Mean	178.3	114.5	171.7	112.0	8.361	14.88	24.02	7.388	13.03	13.46
	CV	6.000	6.000	6.323	6.869	3.787	3.943	6.000	6.000	6.000	6.000
ETW1 (180°F)	B-basis	162.8	69.52	158.5**	74.17**	3.283	7.358	13.91	4.205	6.606	7.010
	Mean	179.5	83.68	176.1	84.03	5.328	9.073	15.45	4.770	7.779	7.772
	CV	6.000	6.418	6.000	7.010	11.00	5.799	6.142	6.000	6.000	6.000

Notes: The modified CV B-basis value is recommended when available.
The CV provided corresponds with the B-basis value given.
NA implies that tests were run but data did not meet NCAMP's recommended requirements.
"NA: A" indicates ANOVA with less than 5 batches. "NA: I" indicates there were insufficient data points to compute recommended values.
** The data for FC and FT from batch 4 was omitted on the computation. Both the properties came from panels with an incorrect reference edge, which resulted the test specimen to be misaligned, thereby greatly misrepresenting the strength and modulus the material posses.
* Data is as measured rather than normalized.

Table 3-2: NCAMP Recommended B-Basis Values for Lamina Test Data

NCAMP Recommended A-Basis Values for Hexcel M91/IM8-GP 6K Fabric 145 gsm with 40% RC All A-Basis Values in this Table Meet the Standards for Publication in the CMH-17-1H Handbook Laminate Strength Tests				
Layup	Environment	Statistic	ILT	
			Interlaminar Tension	Curved Beam Strength
100/0/0	CTA (-65°F)	A-Basis	9.043	277.7
		Mean	15.14	417.0
		CV	9.082	8.102
	RTA (70°F)	A-Basis	7.344	142.1
		Mean	12.71	347.9
		CV	7.756	10.02
	ETW1 (180°F)	A-Basis	3.334	57.95
		Mean	7.088	195.0
		CV	10.98	13.03
Notes: A-Basis values given use the original CV. Data is as measured rather than normalized.				

Table 3-3: NCAMP Recommended A-Basis Values for Laminate Test Data

NCAMP Recommended B-Basis Values for
Hexcel M91/IM8-GP 6K Fabric 145 gsm with 40% RC
All B-Basis Values in this Table Meet the Standards for Publication in the CMH-17 Vol 1 Handbook
Values Are for Normalized Data Unless Noted

Laminate Strength Tests

Layup	Environment	Statistic	UNT	UNC	OHT	FHT	OHC	FHC	SSB Proc. C		SSB Countersink Proc. C	
									Ultimate Strength	2% Offset Strength	Ultimate Strength	2% Offset Strength
25/50/25	CTA (-65°F)	B-basis	109.9		49.91	NA: A						
		Mean	125.3		56.35	69.91						
		CV	6.225		6.000	3.077						
	RTA (70°F)	B-basis	116.5	85.70	54.71	64.16	41.07	NA: I	134.9	107.6	90.46	79.74
		Mean	132.2	90.75	61.15	72.78	45.53	89.11	150.2	122.4	100.5	90.45
		CV	6.000	2.818	6.000	6.000	6.000	2.724	6.000	6.136	6.000	6.000
	ETW1 (180°F)	B-basis	120.9	59.15	57.62	65.27	31.04	NA: I	113.5	Note (2)	73.17	Note (3)
		Mean	128.0	67.10	64.02	74.04	35.50	67.24	128.8	107.4	83.15	80.39
		CV	3.367	6.000	6.000	6.000	6.000	2.134	6.000	11.72	6.000	3.048
10/80/10	CTA (-65°F)	B-basis	69.46		53.92	61.37						
		Mean	78.80		61.16	67.84						
		CV	6.000		6.000	6.000						
	RTA (70°F)	B-basis	67.55	57.42	50.17	56.09	39.19	NA: I				
		Mean	75.28	63.48	55.62	62.56	43.35	65.97				
		CV	6.000	6.000	6.000	6.000	6.000	2.863				
	ETW1 (180°F)	B-basis	58.05	40.80	37.96	44.56	27.68	NA: I				
		Mean	65.77	46.83	43.41	51.03	31.84	49.37				
		CV	6.000	6.000	6.000	6.000	6.000	3.068				
40/20/40	CTA (-65°F)	B-basis	128.7		56.82	70.74						
		Mean	145.4		65.03	79.51						
		CV	6.070		7.029	6.243						
	RTA (70°F)	B-basis	140.0	NA: I	63.85	73.08	41.11	84.11	101.6	93.09	82.08	NA: I
		Mean	156.6	102.9	72.06	81.85	45.69	93.33	113.5	105.6	91.19	84.64
		CV	6.086	6.101	6.423	6.029	6.000	6.168	6.002	6.000	6.000	4.484
	ETW1 (180°F)	B-basis	141.2	68.99	70.26	73.81	33.14	61.56	91.82	NA: I	64.66	Note (3)
		Mean	157.8	79.19	78.47	82.57	37.72	70.78	103.7	95.44	73.67	70.52
		CV	6.202	6.521	6.000	6.000	6.000	6.000	6.000	7.024	6.219	4.069
0/100/0	RTA (70°F)	B-basis							94.79	59.15		
		Mean							107.6	65.61		
		CV							6.045	6.371		
	ETW1 (180°F)	B-basis							NA: A	39.30		
		Mean							73.03	45.77		
		CV							6.601	6.066		

Layup	Environment	Statistic	SSB D1 Proc. C		SSB E1 Proc. C		SSB T1 Proc. C		ILT(1)	
			Ultimate Strength	2% Offset Strength	Ultimate Strength	2% Offset Strength	Ultimate Strength	2% Offset Strength	Interlaminar Tension	Curved Beam Strength
25/50/25	RTA (70°F)	B-basis	132.5	108.4	149.3	108.2	126.1	NA: A		
		Mean	147.1	121.5	156.5	124.1	143.1	104.4		
		CV	6.000	6.000	2.321	6.479	7.455	16.98		
	ETW1 (180°F)	B-basis	104.3	89.12	128.6	NA: A	114.4	NA: A		
		Mean	118.9	102.2	132.5	109.2	131.5	114.3		
		CV	6.017	6.961	1.375	8.189	6.000	13.31		
100/0/0	CTA (-65°F)	B-basis							11.56	335.4
		Mean							15.14	417.0
		CV							9.082	8.102
	RTA (70°F)	B-basis							9.539	225.9
		Mean							12.71	347.9
		CV							7.756	10.02
	ETW1 (180°F)	B-basis							4.878	114.0
		Mean							7.088	195.0
		CV							10.98	13.03

Notes: The modified CV B-Basis value is recommended when available.
The CV provided corresponds with the B-Basis value given.
NA implies that tests were run but data did not meet NCAMP's recommended requirements.
"NA: A" indicates ANOVA with 3 batches. "NA: I" indicates there were insufficient data points to compute recommended values.
Shaded empty boxes indicate that test data is not available for that property and condition.
(1) Data is as measured rather than normalized.
(2) 2% Offset ETW was lower for batch C as a compounded failure mode of bearing and shear was observed, compared to batches A and B, in which only bearing failure was observed.
(3) Insufficient data points as some specimens failed before achieving 2%.

Table 3-4: NCAMP Recommended B-Basis Values for Laminate Test Data

3.2 Lamina and Laminate Summary Tables

Prepreg Material:	Hexcel M91/IM8-GP 6K ZB Fabric 145gsm with 40% RC			**Hexcel M91/IM8-GP 6K ZB Fabric PW 145gsm with 40% RC Lamina Properties Summary**
Material Specification:	NMS 191/2			
Process Specification:	NPS 81910			
Fabric:	IM8-GP 6K ZB	**Resin:**	M91 Hexply	
Tg(dry): 383.3 °F		**Tg(wet):** 296.3 °F		**Tg METHOD:** DMA (ASTM D7028)

	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5
Date of fiber manufacture	1/22/2021	5/5/2022	10/23/2022	10/23/2022	2/24/2023
Date of resin manufacture	6/10/2022	9/14/2022	4/19/2023	5/1/2023	5/25/2023
Date of prepreg manufacture	7/18/2022	9/20/2022	4/27/2023	5/4/2023	6/6/2023
Date of composite manufactu			12/15/2022-10/10/2023		
Date of testing			May 2024 - August 2024		
Date of data submittal			9/9/2024		
Date of analysis			Sep 2024 - Feb 2025		

LAMINA MECHANICAL PROPERTY A-BASIS SUMMARY
Data reported: As-Measured Followed by Normalized Values in Parentheses. Normalizing CPT: 0.006100 in
Values Shown in Shaded Boxes do not Meet CMH-17 Vol 1 Requirements and are Estimates Only
These Values may not be Used for Certification Unless Specifically Allowed by the Certifying Agency

Test Condition		CTA (-65 °F)			RTA (70 °F)			ETW (180 °F)		
Property		A-Basis	Modified CV A-basis	Mean	A-Basis	Modified CV A-basis	Mean	A-Basis	Modified CV A-basis	Mean
F_1^{tu} (ksi)		112.9 (125.3)	NA	161.6 (162.6)	150.1 (153.1)	148.0 (149.3)	176.8 (178.3)	144.9 (150.4)	149.5 (150.6)	178.3 (179.5)
F_2^{tu} (ksi)		120.3 (137.2)	NA NA	155.8 (156.8)	136.2 (130.9)	139.9 (140.1)	170.5 (171.7)	160.0 (159.6)	144.4 (145.5)	174.8 (176.1)
F_1^{cu} (ksi)		95.60 (93.94)	NA	125.9 (127.1)	100.6 (98.40)	94.05 (94.98)	113.3 (114.5)	52.39 (59.57)	NA	83.05 (83.68)
F_2^{cu} (ksi)		108.8 (107.0)	NA NA	127.1 (128.4)	86.22 (89.90)	88.18 (89.54)	110.6 (112.0)	68.27 (69.34)	66.03 (66.92)	83.11 (84.03)
IPSV	$F_{12}^{s0.2\%}$ (ksi)	7.805	NA	11.63	6.731	NA	8.361	1.876	NA	5.328
	$F_{12}^{s5\%strain}$ (ksi)	17.19	16.90	20.36	11.56	NA	14.88	6.173	NA	9.073
	F_{12}^{su} (ksi)	19.40	NA	29.48	21.69	19.94	24.02	12.41	12.77	15.45
IPST	$F_{12}^{s0.2\%}$ (ksi)	7.781	8.495	10.12	5.335	5.761	7.388	3.182	3.804	4.770
	$F_{12}^{s5\%}$ (ksi)	14.05	14.56	18.25	9.990	11.06	13.03	4.815	5.808	7.779
SBS (ksi)		13.86	14.55	17.05	11.08	10.97	13.46	6.618	6.446	7.772
Notes:		NA means basis values could not be computed. ** The data for FC and FT from batch 4 was omitted on the computation. Both the properties came from panels with an incorrect reference edge, which resulted the test specimen to be misaligned, thereby greatly misrepresenting the strength and modulus the material posses.								

Table 3-5: Summary of Test Results for Lamina Data A-Basis

Prepreg Material:	Hexcel M91/IM8-GP 6K ZB Fabric 145gsm with 40% RC			**Hexcel M91/IM8-GP 6K ZB Fabric PW 145gsm with 40% RC Lamina Properties Summary**
Material Specification:	NMS 191/2			
Process Specification:	NPS 81910			
Fabric:	IM8-GP 6K ZB	**Resin:**	M91 Hexply	
Tg(dry): 383.3 °F	**Tg(wet):** 296.3 °F	**Tg METHOD:**	DMA (ASTM D7028)	

	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5
Date of fiber manufacture	1/22/2021	5/5/2022	10/23/2022	10/23/2022	2/24/2023
Date of resin manufacture	6/10/2022	9/14/2022	4/19/2023	5/1/2023	5/25/2023
Date of prepreg manufacture	7/18/2022	9/20/2022	4/27/2023	5/4/2023	6/6/2023
Date of composite manufacture			12/15/2022-10/10/2023		
Date of testing			May 2024 - August 2024		
Date of data submittal			9/9/2024		
Date of analysis			Sep 2024 - Feb 2025		

LAMINA MECHANICAL PROPERTY B-BASIS SUMMARY

Data reported: As-Measured Followed by Normalized Values in Parentheses. Normalizing CPT: 0.006100 in

Values Shown in Shaded Boxes do not Meet CMH-17 Vol 1 Requirements and are Estimates Only

These Values may not be Used for Certification Unless Specifically Allowed by the Certifying Agency

Test Condition	CTA (-65 °F)			RTA (70 °F)			ETW (180 °F)		
Property	**B-Basis**	**Modified CV B-basis**	**Mean**	**B-Basis**	**Modified CV B-basis**	**Mean**	**B-Basis**	**Modified CV B-basis**	**Mean**
F_1^{tu}	133.0	NA	161.6	161.2	160.1	176.8	158.7	161.6	178.3
(ksi)	(140.9)		(162.6)	(163.6)	(161.5)	(178.3)	(162.5)	(162.8)	(179.5)
E_1^t			11.77			11.63			11.78
(Msi)			(11.85)			(11.72)			(11.88)
ν_{12}^t			0.04836			0.04125			0.03875
F_2^{tu}	135.0	NA	155.8	150.4	152.9	170.5	166.3	157.3	174.8
(ksi)	(147.7)		(156.8)	(147.8)	(153.5)	(171.7)	(166.6)	(158.8)	(176.1)
E_2^t			11.79			11.86			11.54
(Msi)			(11.86)			(11.93)			(11.62)
F_1^{cu}	108.1	NA	125.9	106.0	102.3	113.3	64.96	NA	83.05
(ksi)	(107.6)		(127.1)	(107.0)	(103.3)	(114.5)	(69.52)		(83.68)
E_1^c			10.62			10.65			10.94
(Msi)			(10.71)			(10.76)			(11.03)
F_2^{cu}	118.6	NA	127.1	98.79	97.68	110.6	74.56	73.27	83.11
(ksi)	(116.0)		(128.4)	(101.5)	(99.06)	(112.0)	(75.56)	(74.17)	(84.03)
E_2^c			10.61			10.64			11.02
(Msi)			(10.71)			(10.78)			(11.14)
IPSV $F_{12}^{s0.2\%}$ (ksi)	9.380	NA	11.63	7.399	NA	8.361	3.283	NA	5.328
IPSV $F_{12}^{s5\%strain}$ (ksi)	18.49	18.37	20.36	12.92	NA	14.88	7.358	NA	9.073
IPSV F_{12}^{su} (ksi)	23.51	NA	29.48	22.65	21.68	24.02	13.66	13.91	15.45
IPSV G_{12}^{s} (Msi)			0.8103			0.6993			0.5470
IPST $F_{12}^{s0.2\%}$ (ksi)	8.756	9.154	10.12	6.190	6.420	7.388	3.843	4.205	4.770
IPST $F_{12}^{s5\%}$ (ksi)	15.80	16.09	18.25	11.26	11.86	13.03	6.049	6.606	7.779
IPST G_{12}^{s} (Msi)			0.8065			0.6602			0.4687
SBS (ksi)	15.17	15.60	17.05	12.06	12.02	13.46	7.092	7.010	7.772

Notes:

NA means basis values could not be computed.

**** The data for FC and FT from batch 4 was omitted on the computation. Both the properties came from panels with an incorrect reference edge, which resulted the test specimen to be misaligned, thereby greatly misrepresenting the strength and modulus the material posses.**

Table 3-6: Summary of Test Results for Lamina Data B-Basis

Prepreg Material:	Hexcel M91/IM8-GP 6K ZB Fabric PW 145gsm with 40% RC	**Hexcel M91/IM8-GP 6K ZB Fabric PW 145gsm with 40% RC Laminate Properties Summary**
Material Specification:	NMS 191/2	
Process Specification:	NPS 81910	
Fabric:	IM8-GP 6K ZB	**Resin:** M91 Hexply
Tg(dry): 383.3 °F	**Tg(wet):** 296.3 °F	**Tg METHOD:** DMA (ASTM D7028)

	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5
Date of fiber manufacture	1/22/2021	5/5/2022	10/23/2022	10/23/2022	2/24/2023
Date of resin manufacture	6/10/2022	9/14/2022	4/19/2023	5/1/2023	5/25/2023
Date of prepreg manufacture	7/18/2022	9/20/2022	4/27/2023	5/4/2023	6/6/2023
Date of composite manufacture	12/15/2022-10/10/2023				
Date of testing	May 2024 - August 2024				
Date of data submittal	9/9/2024				
Date of analysis	Sep 2024 - Feb 2025				

LAMINATE MECHANICAL PROPERTY A-BASIS SUMMARY
Data Reported Normalized, Unless Noted, Normalizing CPT: 0.006100 in
Values Shown in Shaded Boxes do not Meet CMH-17 Vol 1 Requirements and are Estimates Only
These Values may not be Used for Certification Unless Specifically Allowed by the Certifying Agency

Test	Property		Layup:	Quasi Isotropic 25/50/25			"Soft" 10/80/10			"Hard" 40/20/40		
		Unit	Test Condition	A-value	Mod. CV A-value	Mean	A-value	Mod. CV A-value	Mean	A-value	Mod. CV A-value	Mean
UNT	Strength	[ksi]	CTA (-65 °F)	73.88	99.00	125.3	75.90	62.85	78.80	80.88	117.6	145.4
			RTA (70 °F)	120.2	105.4	132.2	71.45	62.30	75.28	98.26	128.9	156.6
			ETW (180 °F)	116.0	NA	128.0	61.94	52.79	65.77	134.4	130.1	157.8
UNC	Strength	[ksi]	RTA (70 °F)	82.12	NA	90.75	59.71	53.31	63.48	88.16	81.48	102.9
			ETW (180 °F)	61.43	53.52	67.10	41.01	36.68	46.83	51.54	61.77	79.19
OHT	Strength	[ksi]	CTA (-65 °F)	51.05	45.62	56.35	57.42	48.78	61.16	53.64	51.34	65.03
			RTA (70 °F)	55.85	50.42	61.15	51.88	46.46	55.62	60.67	58.37	72.06
			ETW (180 °F)	58.73	53.32	64.02	41.64	34.25	43.41	64.18	64.78	78.47
FHT	Strength	[ksi]	CTA (-65 °F)	56.67	NA	69.91	64.30	57.06	67.84	68.96	64.89	79.51
			RTA (70 °F)	65.77	58.05	72.78	53.90	51.78	62.56	71.30	67.23	81.85
			ETW (180 °F)	67.02	59.05	74.04	41.51	40.25	51.03	58.17	67.96	82.57
OHC	Strength	[ksi]	RTA (70 °F)	41.94	38.03	45.53	35.09	36.36	43.35	42.68	37.99	45.69
			ETW (180 °F)	22.79	28.01	35.50	25.93	24.85	31.84	34.71	30.03	37.72
FHC	Strength	[ksi]	RTA (70 °F)	80.19	69.46	89.11	59.30	52.00	65.97	82.68	77.85	93.33
			ETW (180 °F)	61.67	51.59	67.24	40.43	26.06	49.37	60.13	55.30	70.78

Table 3-7: Summary of Test Results for Laminate Data A-Basis (Part A)

Test	Property	Unit	Test Condition	Quasi Isotropic 25/50/25 A-value	Quasi Isotropic 25/50/25 Mod. CV A-value	Quasi Isotropic 25/50/25 Mean	"Hard" 40/20/40 A-value	"Hard" 40/20/40 Mod. CV A-value	"Hard" 40/20/40 Mean	0/100/0 A-value	0/100/0 Mod. CV A-value	0/100/0 Mean
SSB Proc. C	Ultimate Strength	[ksi]	RTA (70 °F)	117.9	124.5	150.2	101.2	93.52	113.5	59.24	85.68	107.6
			ETW (180 °F)	117.3	103.1	128.8	91.41	83.74	103.7	18.79	NA	73.03
	2% Offset Strength	[ksi]	RTA (70 °F)	101.1	97.09	122.4	95.08	84.24	105.6	32.53	54.75	65.61
			ETW (180 °F) (1)	0.000	NA	107.4	72.18	70.60	95.44	39.39	34.91	45.77
	Initial Peak Strength	[ksi]	RTA (70 °F)				74.67	45.05	106.3			
			ETW (180 °F)	93.08	63.07	119.5	67.95	66.54	97.96			
SSB Countersink Proc. C	Ultimate Strength	[ksi]	RTA (70 °F)	91.50	83.65	100.5	81.82	75.91	91.19			
			ETW (180 °F)	74.17	66.34	83.15	64.35	58.46	73.67			
	2% Offset Strength	[ksi]	RTA (70 °F)	78.48	72.15	90.45	71.66	66.58	84.64			
			ETW (180 °F) (2)	67.69	47.06	80.39	49.86	29.90	70.52			
	Initial Peak Strength	[ksi]	RTA (70 °F)				71.93	59.25	85.99			
			ETW (180 °F)									
SSB D Proc. C	Ultimate Strength	[ksi]	RTA (70 °F)	107.0	122.5	147.1						
			ETW (180 °F)	102.7	94.31	118.9						
	2% Offset Strength	[ksi]	RTA (70 °F)	106.8	99.49	121.5						
			ETW (180 °F)	53.49	80.19	102.2						
	Initial Peak Strength	[ksi]	RTA (70 °F)									
			ETW (180 °F)			101.7						
SSB E Proc. C	Ultimate Strength	[ksi]	RTA (70 °F)	144.2	NA	156.5						
			ETW (180 °F)	124.1		132.5						
	2% Offset Strength	[ksi]	RTA (70 °F)	79.38	96.95	124.1						
			ETW (180 °F)	23.43	NA	109.2						
	Initial Peak Strength	[ksi]	RTA (70 °F)									
			ETW (180 °F)			119.0						
SSB T Proc. C	Ultimate Strength	[ksi]	RTA (70 °F)	63.55	114.4	143.1						
			ETW (180 °F)	93.85	102.7	131.5						
	2% Offset Strength	[ksi]	RTA (70 °F)	0.000	NA	104.4						
			ETW (180 °F)	0.000		114.3						
	Initial Peak Strength	[ksi]	RTA (70 °F)	3.563	3.563	82.93						
			ETW (180 °F)									
CAI	Strength	[ksi]	RTA (70 °F)	39.57	24.74	42.27						
			Layup:	100/0/0								
ILT*	Strength	[ksi]	CTA (-65 °F)	9.043	NA	15.14						
			RTA (70 °F)	7.344		12.71						
			ETW (180 °F)	3.334		7.088						
CBS*	Strength	[lb]	CTA (-65 °F)	277.7	NA	417.0						
			RTA (70 °F)	142.1		347.9						
			ETW (180 °F)	57.95		195.0						

Notes: NA means basis value could not be computed.
* Property reported as measured.
(1) 2% Offset was lower for batch C as a compounded failure mode of bearing and shear was observed, compared to batches A and B, in which only bearing failure was observed
(2) Insufficient data points as some specimens failed before achieving 2%.

Table 3-8: Summary of Test Results for Laminate Data A-Basis (Part B)

Prepreg Material:	Hexcel M91/IM8-GP 6K ZB Fabric PW 145gsm with 40% RC		**Hexcel M91/IM8-GP 6K ZB Fabric PW 145gsm with 40% RC Laminate Properties Summary**
Material Specification:	NMS 191/2		
Process Specification:	NPS 81910		
Fabric:	IM8-GP 6K ZB	**Resin:** M91 Hexply	
Tg(dry): 383.3 °F	**Tg(wet):** 296.3 °F	**Tg METHOD:** DMA (ASTM D7028)	

	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5
Date of fiber manufacture	1/22/2021	5/5/2022	10/23/2022	10/23/2022	2/24/2023
Date of resin manufacture	6/10/2022	9/14/2022	4/19/2023	5/1/2023	5/25/2023
Date of prepreg manufacture	7/18/2022	9/20/2022	4/27/2023	5/4/2023	6/6/2023
Date of composite manufacture	12/15/2022-10/10/2023				
Date of testing	May 2024 - August 2024				
Date of data submittal	9/9/2024				
Date of analysis	Sep 2024 - Feb 2025				

LAMINATE MECHANICAL PROPERTY B-BASIS SUMMARY
Data Reported Normalized, Unless Noted, Normalizing CPT: 0.006100 in
Values Shown in Shaded Boxes do not Meet CMH-17 Vol 1 Requirements and are Estimates Only
These Values may not be Used for Certification Unless Specifically Allowed by the Certifying Agency

Test	Property	Unit	Test Condition (Layup:)	Quasi Isotropic 25/50/25 B-value	Quasi Isotropic 25/50/25 Mod. CV B-value	Quasi Isotropic 25/50/25 Mean	"Soft" 10/80/10 B-value	"Soft" 10/80/10 Mod. CV B-value	"Soft" 10/80/10 Mean	"Hard" 40/20/40 B-value	"Hard" 40/20/40 Mod. CV B-value	"Hard" 40/20/40 Mean
UNT	Strength	[ksi]	CTA (-65 °F)	95.30	109.9	125.3	77.10	69.46	78.80	107.7	128.7	145.4
	Modulus	[Msi]				8.363			5.434			10.56
	Strength	[ksi]	RTA (70 °F)	125.1	116.5	132.2	73.00	67.55	75.28	122.6	140.0	156.6
	Modulus	[Msi]				8.208			5.224			10.51
	Strength	[ksi]	ETW (180 °F)	120.9	NA	128.0	63.49	58.05	65.77	144.1	141.2	157.8
	Modulus	[Msi]				8.076			4.811			10.41
UNC	Strength	[ksi]	RTA (70 °F)	85.70	NA	90.75	61.27	57.42	63.48	94.29	90.37	102.9
	Modulus	[Msi]				7.597			4.956			9.542
	Strength	[ksi]	ETW (180 °F)	63.78	59.15	67.10	44.05	40.80	46.83	63.04	68.99	79.19
	Modulus	[Msi]				7.643			4.673			9.791
OHT	Strength	[ksi]	CTA (-65 °F)	53.17	49.91	56.35	58.94	53.92	61.16	58.25	56.82	65.03
			RTA (70 °F)	57.97	54.71	61.15	53.39	50.17	55.62	65.28	63.85	72.06
			ETW (180 °F)	60.85	57.62	64.02	42.38	37.96	43.41	70.12	70.26	78.47
FHT	Strength	[ksi]	CTA (-65 °F)	62.18	NA	69.91	65.77	61.37	67.84	73.23	70.74	79.51
			RTA (70 °F)	68.61	64.16	72.78	57.50	56.09	62.56	75.57	73.08	81.85
			ETW (180 °F)	69.86	65.27	74.04	46.97	44.56	51.03	68.33	73.81	82.57
OHC	Strength	[ksi]	RTA (70 °F)	43.43	41.07	45.53	38.53	39.19	43.35	43.90	41.11	45.69
			ETW (180 °F)	28.09	31.04	35.50	28.39	27.68	31.84	35.93	33.14	37.72
FHC	Strength	[ksi]	RTA (70 °F)	83.86	77.56	89.11	62.06	57.77	65.97	86.99	84.11	93.33
			ETW (180 °F)	63.96	58.03	67.24	44.19	35.87	49.37	64.44	61.56	70.78

Table 3-9: Summary of Test Results for Laminate Data B-Basis (Part A)

Test	Property	Unit	Test Condition	Quasi Isotropic 25/50/25 B-value	Quasi Isotropic 25/50/25 Mod. CV B-value	Quasi Isotropic 25/50/25 Mean	"Hard" 40/20/40 B-value	"Hard" 40/20/40 Mod. CV B-value	"Hard" 40/20/40 Mean	0/100/0 B-value	0/100/0 Mod. CV B-value	0/100/0 Mean
SSB Proc. C	Ultimate Strength	[ksi]	RTA (70 °F)	131.4	134.9	150.2	106.2	101.6	113.5	79.40	94.79	107.6
			ETW (180 °F)	122.1	113.5	128.8	96.39	91.82	103.7	41.38	NA	73.03
	2% Offset Strength	[ksi]	RTA (70 °F)	112.0	107.6	122.4	99.44	93.09	105.6	46.31	59.15	65.61
			ETW (180 °F)	23.36	NA	107.4	81.80	80.86	95.44	42.03	39.30	45.77
	Initial Peak Strength	[ksi]	RTA (70 °F)				88.28	71.43	106.3			
			ETW (180 °F)	104.2	86.79	119.5	80.29	79.46	97.96			
SSB Countersink Proc. C	Ultimate Strength	[ksi]	RTA (70 °F)	95.13	90.46	100.5	85.60	82.08	91.19			
			ETW (180 °F)	77.82	73.17	83.15	68.14	64.66	73.67			
	2% Offset Strength	[ksi]	RTA (70 °F)	83.44	79.74	90.45	77.04	74.06	84.64			
			ETW (180 °F)	72.96	60.91	80.39	58.78	47.41	70.52			
	Initial Peak Strength	[ksi]	RTA (70 °F)				77.77	70.37	85.99			
			ETW (180 °F)									
SSB D Proc. C	Ultimate Strength	[ksi]	RTA (70 °F)	123.7	132.5	147.1						
			ETW (180 °F)	109.4	104.3	118.9						
	2% Offset Strength	[ksi]	RTA (70 °F)	112.9	108.4	121.5						
			ETW (180 °F)	73.78	89.12	102.2						
	Initial Peak Strength	[ksi]	RTA (70 °F)									
			ETW (180 °F)			101.7						
SSB E Proc. C	Ultimate Strength	[ksi]	RTA (70 °F)	149.3	NA	156.5						
			ETW (180 °F)	128.6		132.5						
	2% Offset Strength	[ksi]	RTA (70 °F)	97.97	108.2	124.1						
			ETW (180 °F)	59.15	NA	109.2						
	Initial Peak Strength	[ksi]	RTA (70 °F)									
			ETW (180 °F)			119.0						
SSB T Proc. C	Ultimate Strength	[ksi]	RTA (70 °F)	96.67	126.1	143.1						
			ETW (180 °F)	109.5	114.4	131.5						
	2% Offset Strength	[ksi]	RTA (70 °F)	32.00	NA	104.4						
			ETW (180 °F)	25.48		114.3						
	Initial Peak Strength	[ksi]	RTA (70 °F)	37.78	37.78	82.93						
			ETW (180 °F)									
CAI	Strength	[ksi]	RTA (70 °F)	40.69	32.03	42.27						
			Layup:	100/0/0								
ILT*	Strength	[ksi]	CTA (-65 °F)	11.56	NA	15.14						
			RTA (70 °F)	9.539		12.71						
			ETW (180 °F)	4.878		7.088						
CBS*	Strength	[lb]	CTA (-65 °F)	335.4	NA	417.0						
			RTA (70 °F)	225.9		347.9						
			ETW (180 °F)	114.0		195.0						

Notes: NA means basis value could not be computed.
* Property reported as measured.
(1) 2% Offset was lower for batch C as a compounded failure mode of bearing and shear was observed, compared to batches A and B, in which only bearing failure was observed
(2) Insufficient data points as some specimens failed before achieving 2%.

Table 3-10: Summary of Test Results for Laminate Data B-Basis (Part B)

4. Individual Test Summaries, Statistics, Basis Values and Graphs

Test data for fiber dominated properties was normalized according to nominal cured ply thickness. Both normalized and as-measured statistics were included in the tables, but only the normalized data values were graphed. Test failures, outliers and explanations regarding computational choices were noted in the accompanying text for each test.

All individual specimen results are graphed for each test by batch and environmental condition with a line indicating the recommended Basis values for each environmental condition. The data is jittered (moved slightly to the left or right) in order for all specimen values to be clearly visible. The strength values are always graphed on the vertical axis with the scale adjusted to include all data values and their corresponding Basis values. The vertical axis may not include zero. The horizontal axis values will vary depending on the data and how much overlapping there was of the data within and between batches. When there was little variation, the batches were graphed from left to right. The environmental conditions were identified by the shape and color of the symbol used to plot the data. Otherwise, the environmental conditions were graphed from left to right and the batches were identified by the shape and color of the symbol.

When a dataset fails the Anderson-Darling k-sample (ADK) test for batch-to-batch variation, an ANOVA analysis is required. In order for B-Basis values to be computed using the ANOVA method, data from five batches are required. Since this qualification dataset has only three batches, the Basis values computed using ANOVA are considered estimates only. However, the Basis values resulting from the ANOVA method using only three batches may be overly conservative. The ADK test is performed again after a transformation of the data according to the assumptions of the modified CV method (see section 2.1.4 for details). If the dataset still passes the ADK test at this point, modified CV Basis values are provided. If the dataset does not pass the ADK test after the transformation, estimates may be computed using the modified CV method per the guidelines of CMH-17 Vol 1 section 8.3.10.

4.1 Warp Tension (WT)

Warp Tension data is normalized by cured ply thickness. Both normalized and as-measured statistics are provided. Tests were conducted in the following environmental conditions: CTA, RTA and ETW.

The dataset consists of five batches of data with fifty-five specimens per environment, therefore A-Basis and B-Basis values where computed.

For both the normalized and as-measured datasets, the three conditions failed the ADK test for batch equivalency. ANOVA was used to compute A-Basis and B-Basis values for all the conditions. Applying the modified CV, the CTA condition failed the ADK test, therefore modified CV basis values were not computed for that condition. The RTA and ETW conditions met all the requirements for pooling.

There were two statistical outliers. The lowest normalized value in batch C of the CTA condition was an outlier for the batch and the condition. It was an outlier in the normalized and the as-measured datasets. The lowest normalized value in batch E of the CTA condition was an outlier for the batch but not for the condition. It was an outlier in the normalized and the as-measured datasets. They were retained for this analysis.

Statistics, estimates, and Basis values are given for the WT strength data in Table 4-1 and for the modulus data in Table 4-2. The normalized data and A-Basis values are in Figure 4-1 and the normalized data and B-Basis values in Figure 4-2.

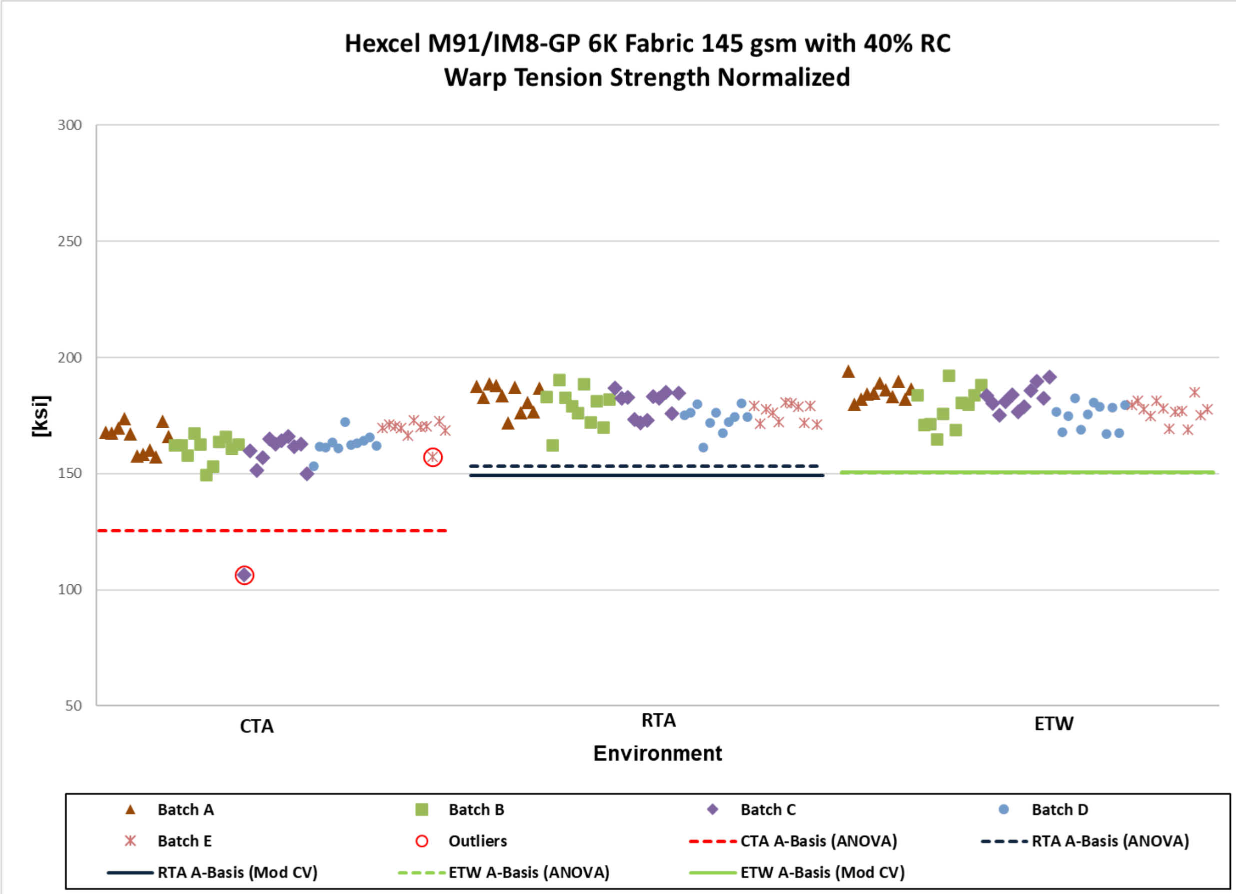

Figure 4-1: Batch Plot for WT Normalized Strength – A-Basis

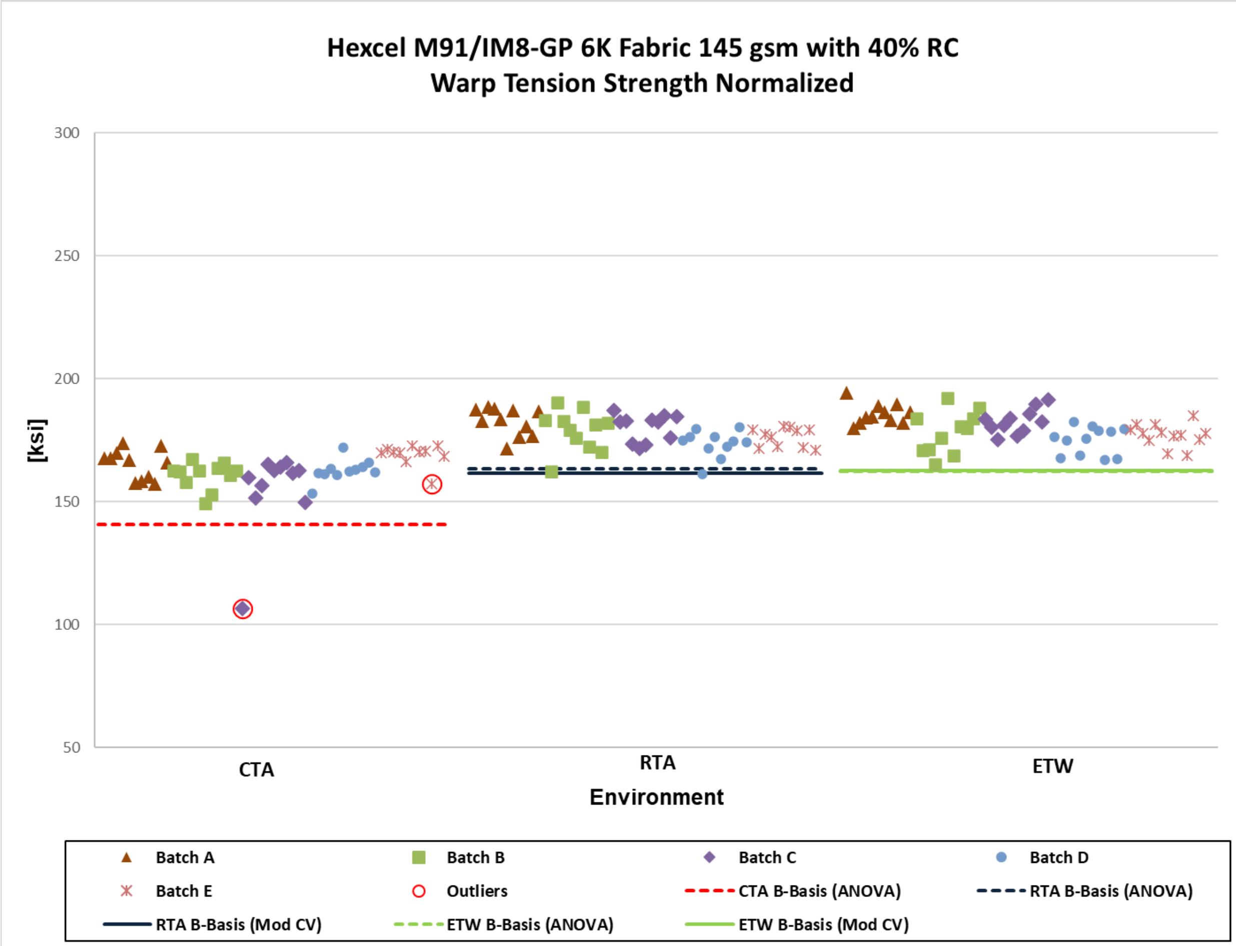

Figure 4-2: Batch Plot for WT Normalized Strength – B-Basis

Warp Tension (WT) Strength (ksi) Basis Values and Statistics						
	Normalized			As-Measured		
Environment	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)
Mean	162.6	178.3	179.5	161.6	176.8	178.3
Stdev	9.714	6.518	6.774	10.83	6.468	7.256
CV	5.974	3.655	3.773	6.704	3.658	4.070
Mod CV	6.987	6.000	6.000	7.352	6.000	6.035
Min	106.5	161.3	165.1	106.1	157.2	157.9
Max	173.8	190.4	194.3	178.4	187.2	193.0
No. Batches	5	5	5	5	5	5
No. Spec.	55	55	58	55	55	58
Basis Values and Estimates						
B-Basis Value	140.9	163.6	162.5	133.0	161.2	158.7
A-Basis Value	125.3	153.1	150.4	112.9	150.1	144.9
Method	ANOVA	ANOVA	ANOVA	ANOVA	ANOVA	ANOVA
Modified CV Basis Values and Estimates						
B-Basis Value	NA	161.5	162.8	NA	160.1	161.6
A-Basis Value		149.3	150.6		148.0	149.5
Method		Pooled	Pooled		Pooled	Pooled

Table 4-1: Statistics and Basis values for WT Strength Data

Warp Tension (WT) Modulus (Msi) Statistics						
	Normalized			As-Measured		
Environment	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)
Mean	11.85	11.72	11.88	11.77	11.63	11.78
Stdev	0.1879	0.2868	0.2267	0.2200	0.2934	0.4007
CV	1.585	2.447	1.909	1.868	2.524	3.401
Min	11.37	9.981	11.48	11.27	10.09	11.10
Max	12.31	12.03	12.64	12.20	12.03	12.85
No. Batches	5	5	5	5	5	5
No. Spec.	55	55	55	55	55	55

Table 4-2: Statistics from WT Modulus Data

4.2 Fill Tension (FT)

Fill Tension data is normalized by cured ply thickness. Both normalized and as-measured statistics are provided. Tests were conducted in the following environmental conditions: CTA, RTA, and ETW.

For the normalized dataset, the RTA condition failed the ADK test for batch equivalency. ANOVA was used to compute estimates for RTA. The CTA condition failed the normality test, but the Weibull distribution was a good fit, the normal method was used for ETW. Applying the modified CV, the CTA condition failed the normality test, therefore modified CV basis values were not computed for CTA. The normal method for modified CV was used for RTA and ETW.

For the as-measured dataset, the CTA and RTA conditions failed the ADK test for batch equivalency. ANOVA was used to compute estimates for CTA and RTA and the normal method was used for ETW. Appling the modified CV, the CTA condition failed the normality test, therefore modified CV basis values were not computed for CTA. The normal method for modified CV was used for RTA and ETW.

There were two statistical outliers. The lowest value in batch C of the CTA condition was an outlier for the batch and for the condition. It was an outlier in the normalized and in the as-measured datasets. The lowest value in batch A of the RTA condition was an outlier for the batch but not for the condition. It was an outlier in the normalized dataset and in the as-measured dataset. They were retained for this analysis.

Statistics are given for the FT strength data in Table 4-3 and for the modulus data in Table 4-4. The normalized data is shown graphically in Figure 4-3.

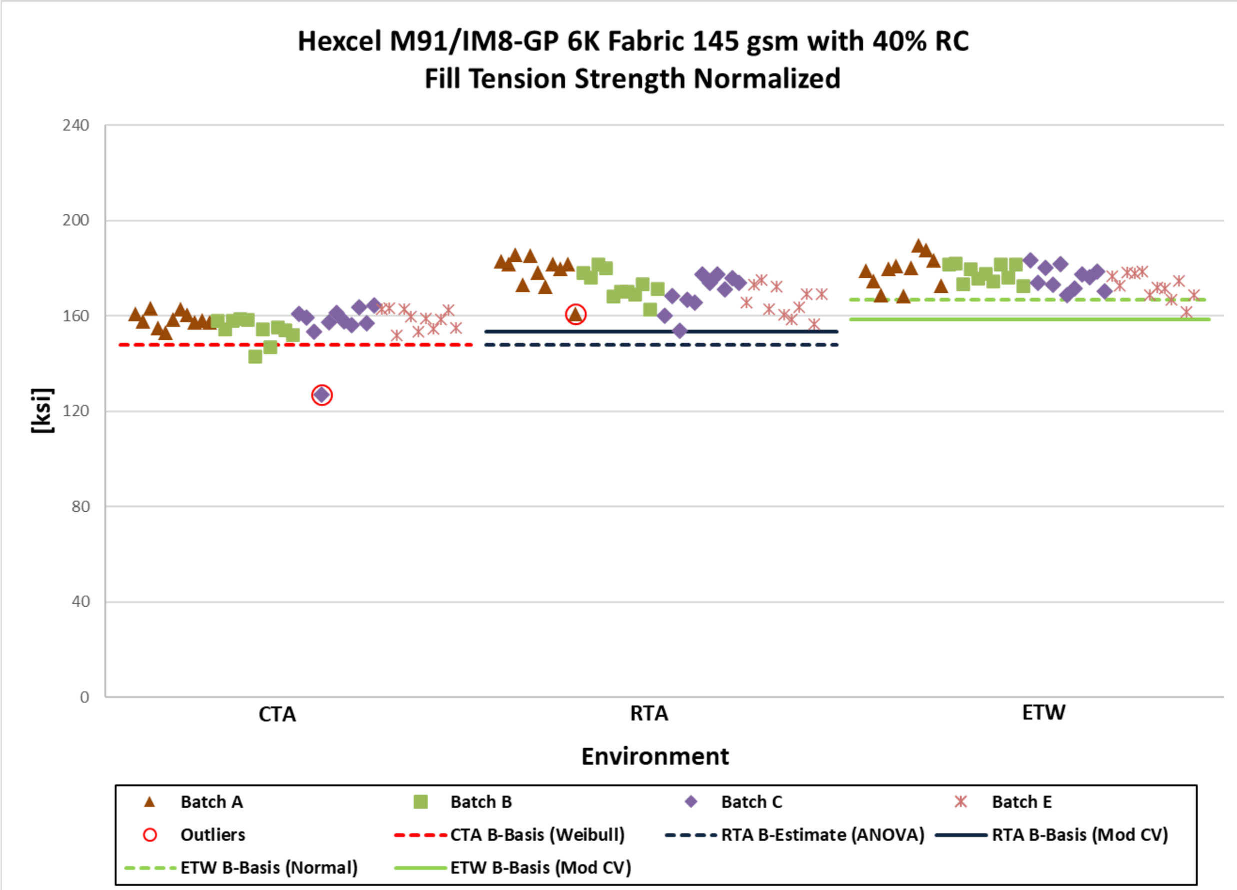

Figure 4-3: Batch Plot for FT Normalized Strength

Fill Tension (FT) Strength (ksi) Basis Values and Estimates						
	Normalized			As-Measured		
Environment	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)
Mean	156.8	171.7	176.1	155.8	170.5	174.8
Stdev	6.329	7.978	5.702	7.236	7.420	5.093
CV	4.037	4.647	3.238	4.645	4.351	2.914
Mod CV	6.018	6.323	6.000	6.322	6.176	6.000
Min	126.9	153.6	161.7	126.2	152.7	163.6
Max	164.4	185.7	189.6	167.1	184.4	187.5
No. Batches	4	4	4	4	4	4
No. Spec.	44	44	45	44	44	45
Basis Values and Estimates						
B-Basis Value	147.7		166.6			166.3
B-Estimate		147.8		135.0	150.4	
A-Estimate	137.2	130.9	159.6	120.3	136.2	160.0
Method	Weibull	ANOVA	Normal	ANOVA	ANOVA	Normal
Modified CV Basis Values and Estimates						
B-Basis Value	NA	153.5	158.5	NA	152.9	157.3
A-Estimate		140.1	145.5		139.9	144.4
Method		Normal	Normal		Normal	Normal

Table 4-3: Statistics and B-Basis Values for FT Strength Data

Fill Tension (FT) Modulus (Msi) Statistics						
	Normalized			As-Measured		
Environment	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)
Mean	11.86	11.93	11.62	11.79	11.86	11.54
Stdev	0.2235	0.5483	0.2191	0.3006	0.6103	0.3266
CV	1.885	4.595	1.885	2.551	5.147	2.830
Min	11.31	11.53	11.05	11.22	11.27	10.99
Max	12.18	15.37	12.69	12.38	15.56	12.84
No. Batches	4	4	4	4	4	4
No. Spec.	44	44	45	44	44	45

Table 4-4: Statistics from FT Modulus Data

4.3 Warp Compression (WC)

Warp Compression data is normalized by cured ply thickness. Both normalized and as-measured statistics are provided. Tests were conducted in the following environmental conditions: CTA, RTA, and ETW.

For CTA and ETW, the datasets consist of more than fifty-five specimens distributed in five batches, therefore, A-Basis and B-Basis values were computed for those conditions.

For the normalized dataset, the CTA and ETW conditions failed the ADK test for batch equivalency. ANOVA was used to compute Basis values for CTA and ETW, and the single point non-parametric method was used for RTA. Applying the modified CV, the CTA and RTA failed the ADK test, therefore Basis values were not computed for those conditions and the normal method for modified CV was used for RTA.

For the as-measured dataset, the CTA and ETW conditions failed the ADK test for batch equivalency. ANOVA was used to compute Basis value for CTA and ETW, and the single point normal method was used for RTA. Applying the modified CV, the CTA condition failed the ADK test and the ETW condition failed the ADK test and the normality test, therefore, Basis values were not computed for those conditions and the normal method for modified CV was used for RTA.

There were no statistical outliers.

Statistics, Basis values and estimates are given for the WC strength data in Table 4-5 and for the modulus data in Table 4-6. The normalized data, A-estimates and A-Basis values are shown graphically in Figure 4-4 and the normalized data and B-Basis values in Figure 4-5.

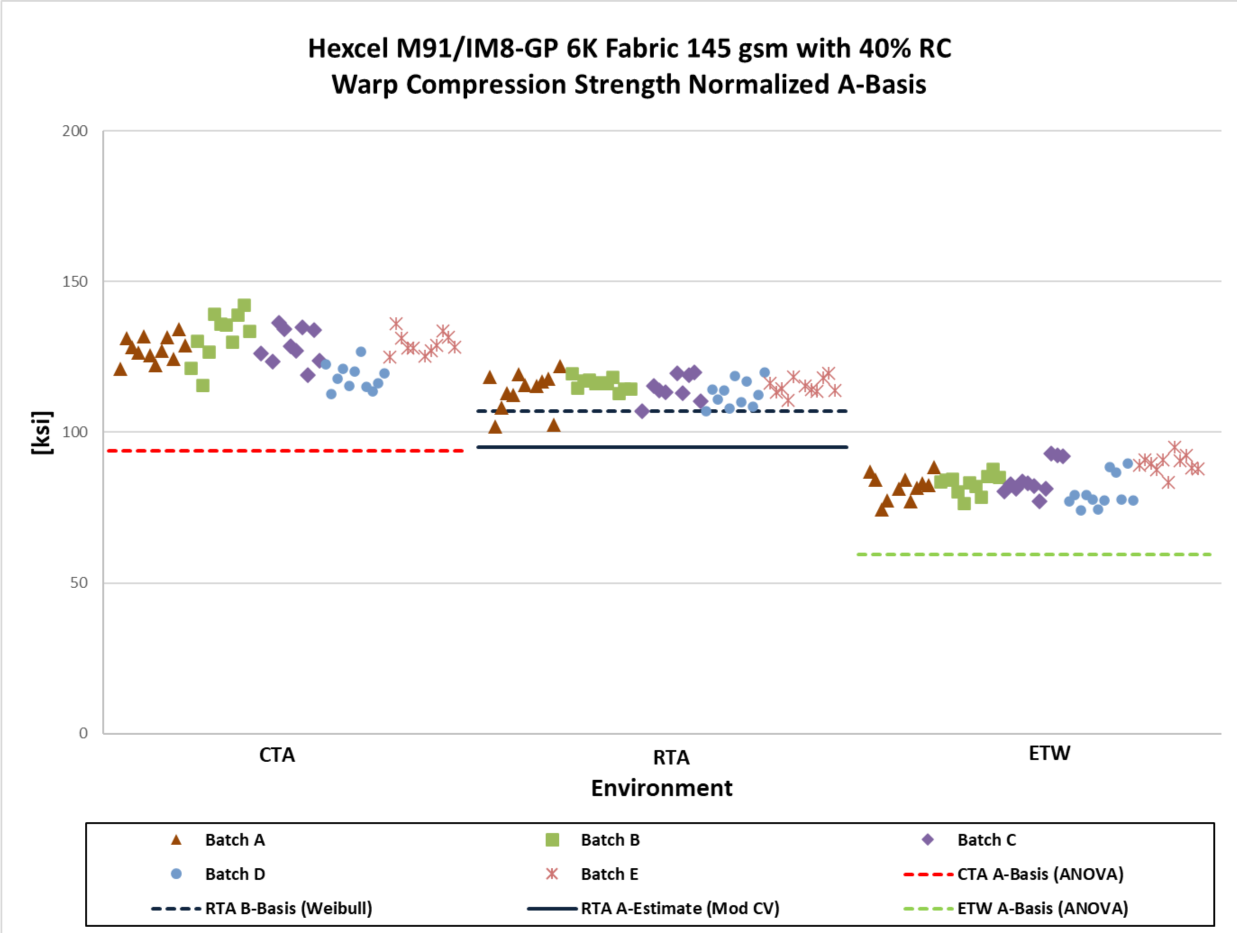

Figure 4-4: Batch Plot for WC Normalized Strength – A-Basis

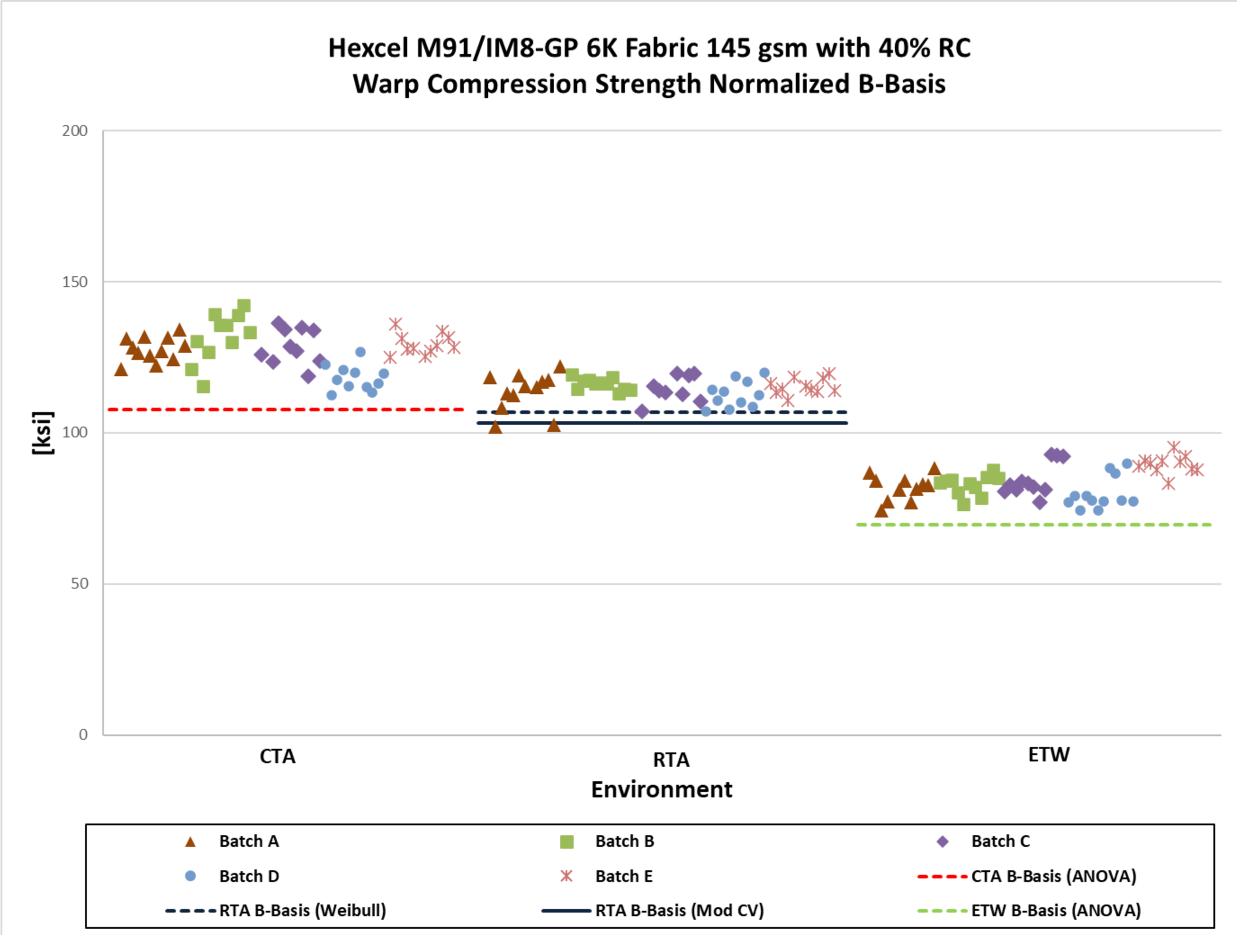

Figure 4-5: Batch Plot for WC Normalized Strength – B-Basis

Warp Compression (WC) Strength (ksi) Basis Values and Statistics						
	Normalized			As-Measured		
Environment	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)
Mean	127.1	114.5	83.68	125.9	113.3	83.05
Stdev	6.978	4.296	5.370	6.537	4.501	6.054
CV	5.489	3.753	6.418	5.192	3.971	7.290
Mod CV	6.745	6.000	7.209	6.596	6.000	7.645
Min	112.6	102.0	74.23	111.9	99.34	73.18
Max	142.4	122.0	95.15	138.0	121.2	96.67
No. Batches	5	5	5	5	5	5
No. Spec.	55	54	56	55	54	56
Basis Values and Estimates						
B-Basis Value	107.6	107.0	69.52	108.1	106.0	64.96
A-Basis Value	93.94		59.57	95.60		52.39
A-Estimate		98.40			100.6	
Method	ANOVA	Weibull	ANOVA	ANOVA	Normal	ANOVA
Modified CV Basis Values and Estimates						
B-Basis Value	NA	103.3	NA	NA	102.3	NA
A-Estimate		94.98			94.05	
Method		Normal			Normal	

Table 4-5: Statistics, Basis Values and Estimates for WC Strength Data

Warp Compression (WC) Modulus (Msi) Statistics						
	Normalized			As-Measured		
Environment	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)
Mean	10.71	10.76	11.03	10.62	10.65	10.94
Stdev	0.2483	0.1513	0.2679	0.3392	0.2465	0.3513
CV	2.318	1.407	2.429	3.195	2.314	3.212
Min	10.15	10.43	10.25	9.817	10.13	10.23
Max	11.32	11.06	11.62	11.24	11.17	11.77
No. Batches	5	5	5	5	5	5
No. Spec.	55	55	55	55	55	55

Table 4-6: Statistics from WC Modulus Data

4.4 Fill Compression (FC)

Fill Compression data is normalized by cured ply thickness. Both normalized and as-measured statistics are provided. Tests were conducted in the following environmental conditions: CTA, RTA, and ETW.

For the normalized dataset, the CTA condition failed the ADK test for batch equivalency. ANOVA was used to compute estimates for CTA. The RTA condition failed the normality test but the Weibull distribution was a good fit. The normal method was used for ETW. Applying the modified CV, the CTA condition failed the normality test, therefore modified CV basis values were not computed for CTA. The normal method for modified CV was used for RTA and ETW.

For the as-measured dataset, the CTA and RTA conditions failed the normality test but the Weibull distribution was a good fit for both conditions. The normal method was used for ETW. Applying the modified CV, the CTA condition failed the normality test, therefore modified CV basis values were not computed for CTA. The normal method for modified CV was used for RTA and ETW.

There were four statistical outliers. The lowest value in batch A of the CTA condition was an outlier for the batch and for the condition. It was an outlier in the normalized and the as-measured datasets. The lowest value in batch B of the CTA condition was an outlier for the batch but not for the condition. It was an outlier in the normalized and the as-measured datasets. The lowest value in batch A of the RTA condition was an outlier of the condition but not for the batch. It was an outlier in the normalized dataset and the as-measured. The lowest value in batch C of the ETW condition was an outlier for the batch but not for the condition. It was an outlier in the normalized and the as-measured datasets. They were retained for this analysis.

Statistics are given for the FC strength data in Table 4-7 and for the modulus data in Table 4-8. The normalized data is shown graphically in Figure 4-6.

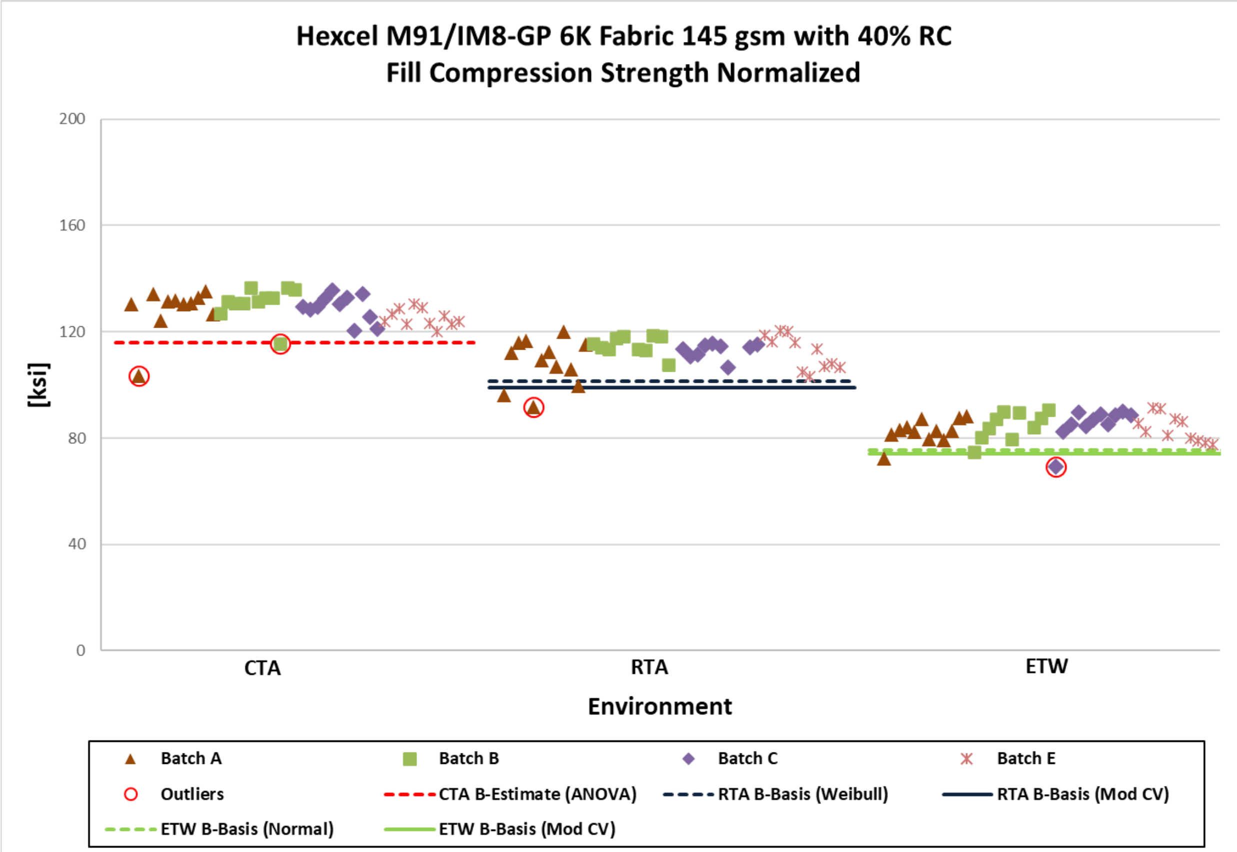

Figure 4-6: Batch Plot for FC Normalized Strength

Fill Compression (FC) Strength (ksi) Basis Values and Estimates						
	Normalized			As-Measured		
Environment	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)
Mean	128.4	112.0	84.03	127.1	110.6	83.11
Stdev	6.229	6.428	5.058	5.954	6.513	5.112
CV	4.850	5.738	6.019	4.683	5.888	6.151
Mod CV	6.425	6.869	7.010	6.341	6.944	7.075
Min	103.5	91.70	69.16	101.6	90.69	68.70
Max	136.8	120.3	91.22	134.0	121.4	92.61
No. Batches	4	4	4	4	4	4
No. Spec.	44	42	44	44	42	44
Basis Values and Estimates						
B-Basis Value		101.5	75.56	118.6	98.79	74.56
B-Estimate	116.0					
A-Estimate	107.0	89.90	69.34	108.8	86.22	68.27
Method	ANOVA	Weibull	Normal	Weibull	Weibull	Normal
Modified CV Basis Values and Estimates						
B-Basis Value	NA	99.06	74.17	NA	97.68	73.27
A-Estimate		89.54	66.92		88.18	66.03
Method		Normal	Normal		Normal	Normal

Table 4-7: Statistics, Basis Values and Estimates for FC Strength Data

Fill Compression (FC) Modulus (Msi) Statistics						
	Normalized			As-Measured		
Environment	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)
Mean	10.71	10.78	11.14	10.61	10.64	11.02
Stdev	0.2441	0.1612	0.3081	0.3007	0.2279	0.4138
CV	2.278	1.495	2.764	2.835	2.141	3.754
Min	10.11	10.41	10.31	9.979	10.23	10.29
Max	11.09	11.12	11.73	11.20	11.16	11.90
No. Batches	4	4	4	4	4	4
No. Spec.	44	44	44	44	44	44

Table 4-8: Statistics from FC Modulus Data

4.5 In-Plane Shear Tension (IPST)

In Plane Shear data is not normalized. Test results were available for 0.2% offset strength and strength at 5% strain in the following environmental conditions: CTA, RTA, and ETW.

For the three properties, all conditions failed the ADK test for batch equivalency. ANOVA was used to compute estimates for all conditions.

For the 0.2% offset strength dataset, applying the modified CV, the three conditions were not pooled because the pooled dataset failed the Levene's test for equality of standard deviations. CTA and RTA were acceptable for pooling and the normal method for modified CV was used for ETW.

For the strength at 5% strain dataset, applying the modified CV, the three conditions were not pooled because the pooled dataset failed the Levene's test for equality of standard deviations. RTA and ETW were pooled and the normal method for modified CV was used for CTA.

There were two statistical outliers. The highest value in batch C of the ETW condition for strength at 5% strain was an outlier for the batch and for the condition. It was also an outlier in the 0.2% offset strength dataset. The lowest value in batch B of the ETW condition was an outlier for the batch but not for the condition. They were retained for this analysis.

Statistics, Basis values and estimates are given for the IPST strength data in Table 4-9 and for the modulus data in Table 4-10. The as-measured data, B-Basis values and B-estimates are shown graphically for 0.2% offset strength in Figure 4-7 and strength at 5% strain in Figure 4-8.

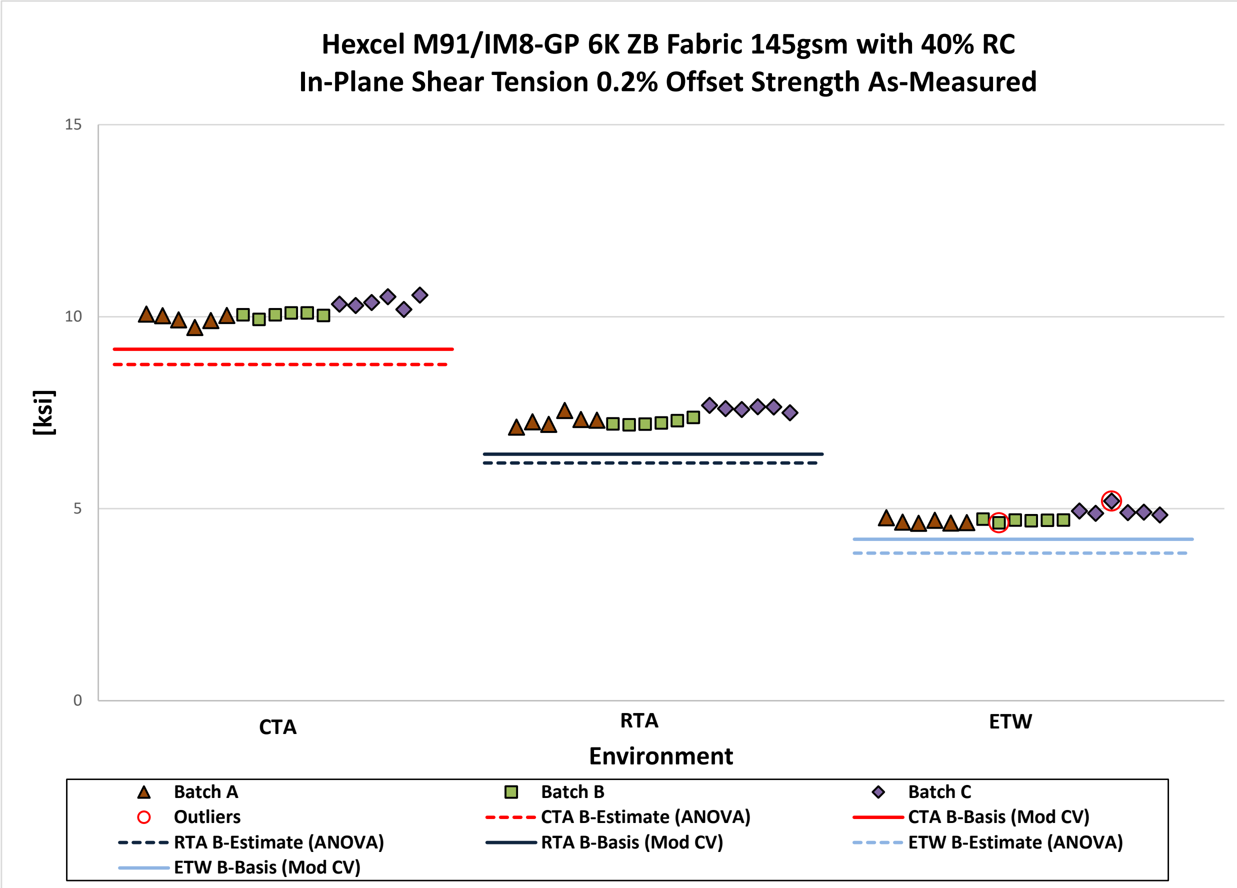

Figure 4-7: Batch Plot for IPST 0.2% Offset As-Measured Strength Data

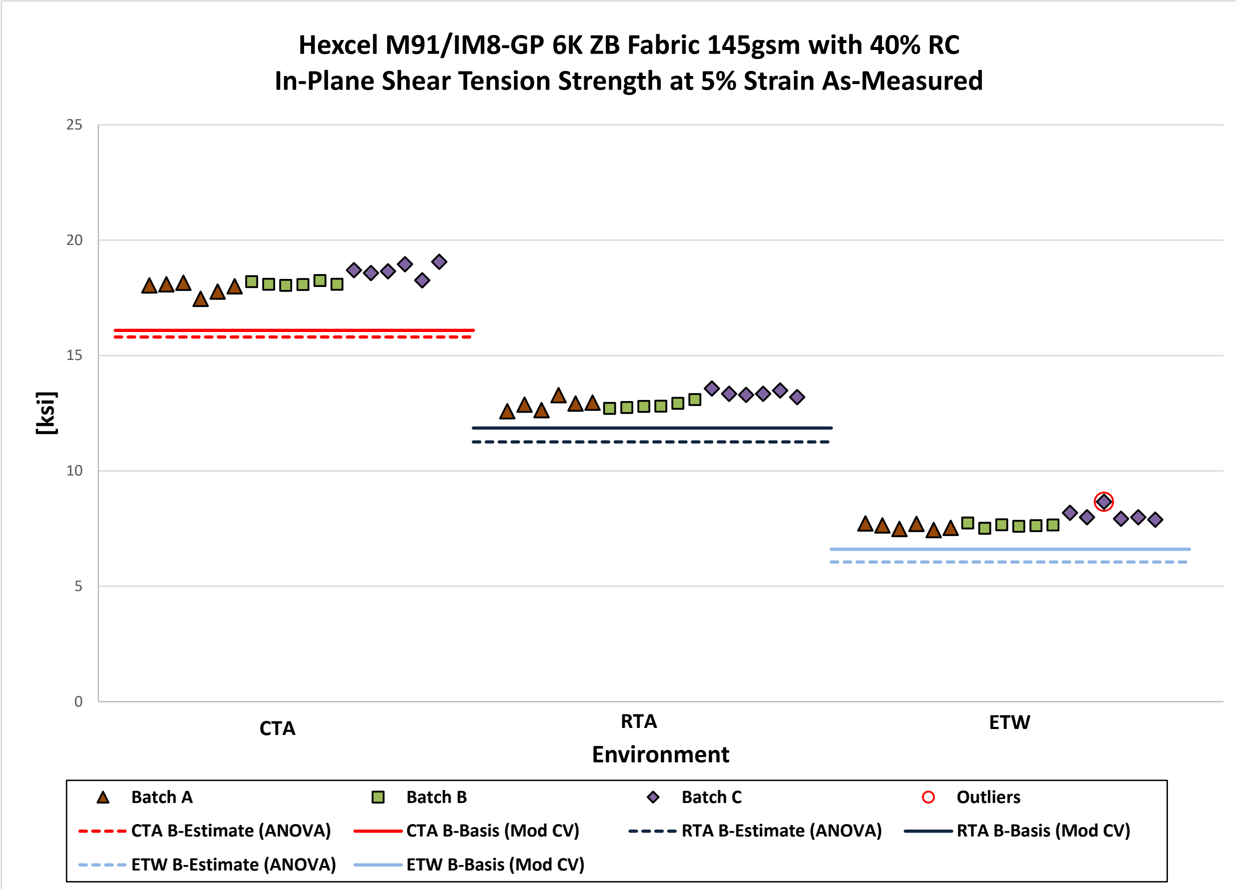

Figure 4-8: Batch Plot for IPST As-Measured Strength at 5% Strain Data

In Plane Shear Tension (IPST) Strength (ksi) Basis Values and Statistics						
	0.2% Offset Strength			Strength at 5% Strain		
Environment	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)
Mean	10.12	7.388	4.770	18.25	13.03	7.779
Stdev	0.2187	0.1921	0.1505	0.4035	0.3029	0.2983
CV	2.161	2.599	3.155	2.211	2.324	3.835
Mod CV	6.000	6.000	6.000	6.000	6.000	6.000
Min	9.718	7.128	4.624	17.46	12.58	7.436
Max	10.56	7.693	5.199	19.07	13.57	8.659
No. Batches	3	3	3	3	3	3
No. Spec.	18	18	18	18	18	18
Estimates						
B-Estimate	8.756	6.190	3.843	15.80	11.26	6.049
A-Estimate	7.781	5.335	3.182	14.05	9.990	4.815
Method	ANOVA	ANOVA	ANOVA	ANOVA	ANOVA	ANOVA
Modified CV Basis Values and Estimates						
B-Basis Value	9.154	6.420	4.205	16.09	11.86	6.606
A-Estimate	8.495	5.761	3.804	14.56	11.06	5.808
Method	Pooled	Pooled	Normal	Normal	Pooled	Pooled

Table 4-9: Statistics, Basis Values and Estimates for IPST Strength Data

In Plane Shear Tension (IPST) Modulus (Msi) Statistics			
Environment	**CTA (-65 °F)**	**RTA (70 °F)**	**ETW (180 °F)**
Mean	**0.8065**	**0.6602**	**0.4687**
Stdev	**0.009868**	**0.01029**	**0.01528**
CV	**1.224**	**1.559**	**3.261**
Min	**0.7890**	**0.6461**	**0.4514**
Max	**0.8258**	**0.6790**	**0.5092**
No. Batches	**3**	**3**	**3**
No. Spec.	**18**	**18**	**18**

Table 4-10: Statistics from IPS Modulus Data

4.6 In-Plane Shear V-Notch (IPSV)

In Plane Shear data is not normalized. Test results were available for 0.2% offset strength, strength at 5% strain and ultimate shear strength in the following environmental conditions: CTA, RTA, and ETW.

For the three properties, all the environmental conditions consists of more than fifty-five specimens distributed in five batches, therefore A-Basis and B-Basis values were computed.

For the three properties, all conditions failed the ADK test for batch equivalency. ANOVA was used to compute Basis values for all conditions.

For the 0.2% offset strength dataset, applying the modified CV, all conditions failed the ADK test, therefore Basis values were not computed.

For the strength at 5% strain dataset, applying the modified CV, the RTA and ETW conditions failed the ADK test, therefore modified CV basis values were not computed for those conditions. The normal method for modified CV was used for CTA.

For the ultimate shear strength dataset, applying the modified CV, the CTA condition failed the ADK test, therefore, Basis values were not computed for CTA. RTA and ETW were not pooled because the pooled dataset failed the Levene's test for equality of standard deviations. The normal method for modified CV was used for RTA and ETW.

There were six statistical outliers. For the 0.2% offset strength dataset, the highest value in batch B of the RTA condition was an outlier for the batch but not for the condition; the highest value in batch C of the RTA condition was an outlier for the batch but not for the condition. It was also an outlier in the ultimate shear strength dataset; and the highest value in batch C of the ETW condition was an outlier for the batch but not for the condition. For the ultimate shear strength dataset, the lowest value in batch D of the CTA condition was an outlier for the batch but not for the condition; and the two highest values in batch of the ETW condition were outlier for the condition but not for the batch. They were retained for this analysis.

Statistics and Basis values are given in Table 4-11 and for the modulus in Table 4-12. The as-measured data and Basis values are shown graphically for 0.2% offset strength in Figure 4-9 and Figure 4-10, for strength at 5% strain in Figure 4-11 and Figure 4-12, and for ultimate shear strength in Figure 4-13 and Figure 4-14.

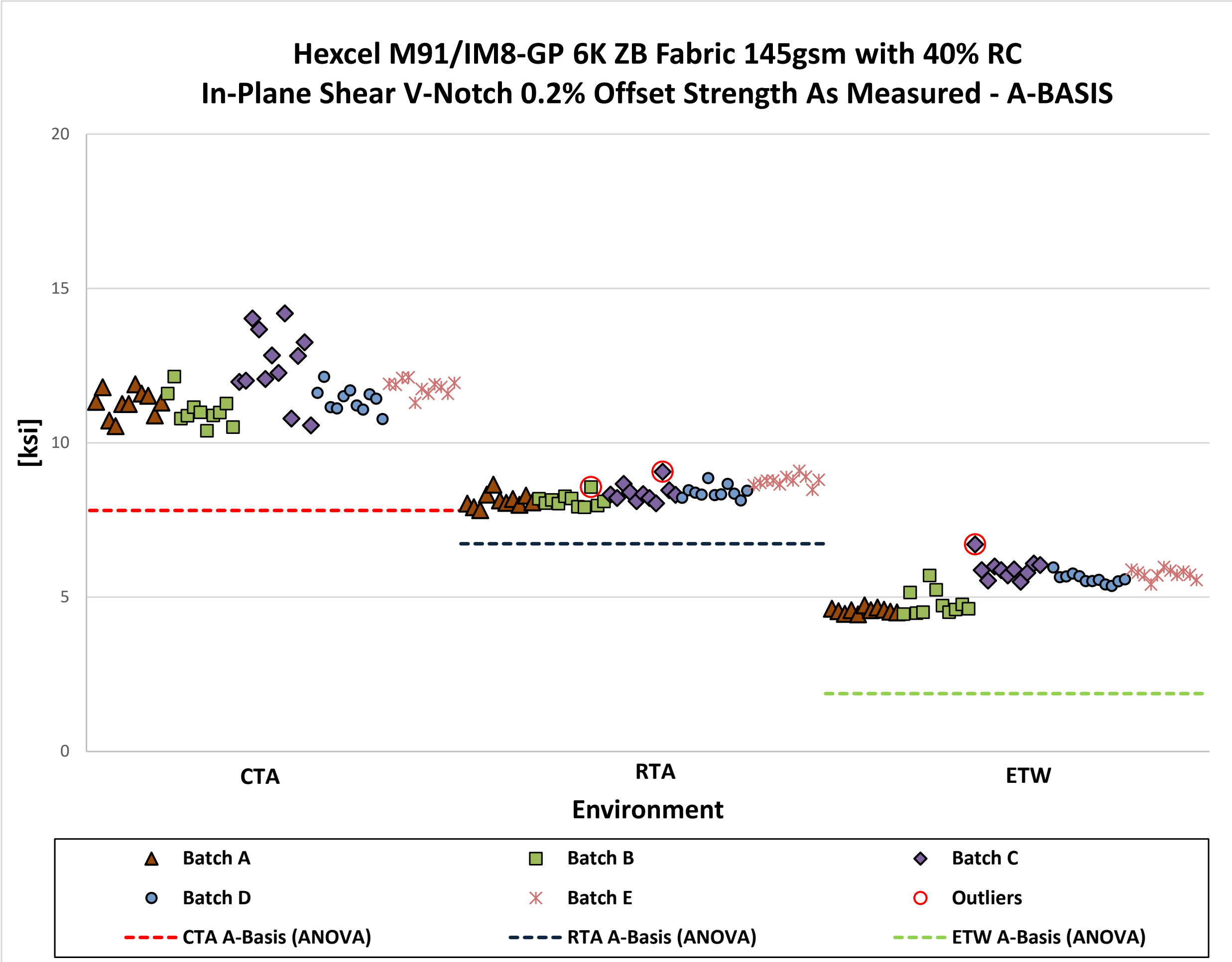

Figure 4-9: Batch Plot for IPSV 0.2% Offset As-Measured Strength Data - A-Basis

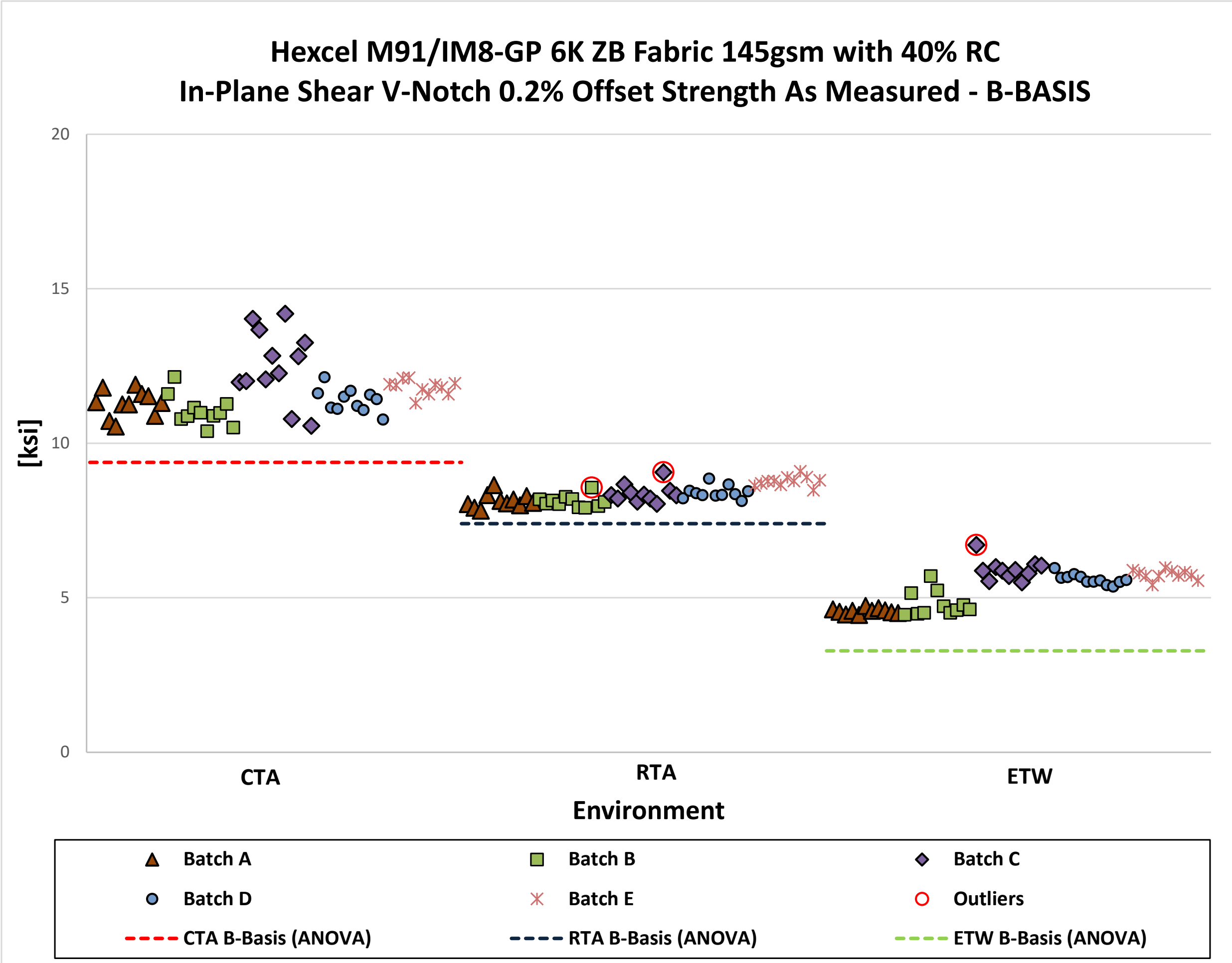

Figure 4-10: Batch Plot for IPSV 0.2% Offset As-Measured Strength Data - B-Basis

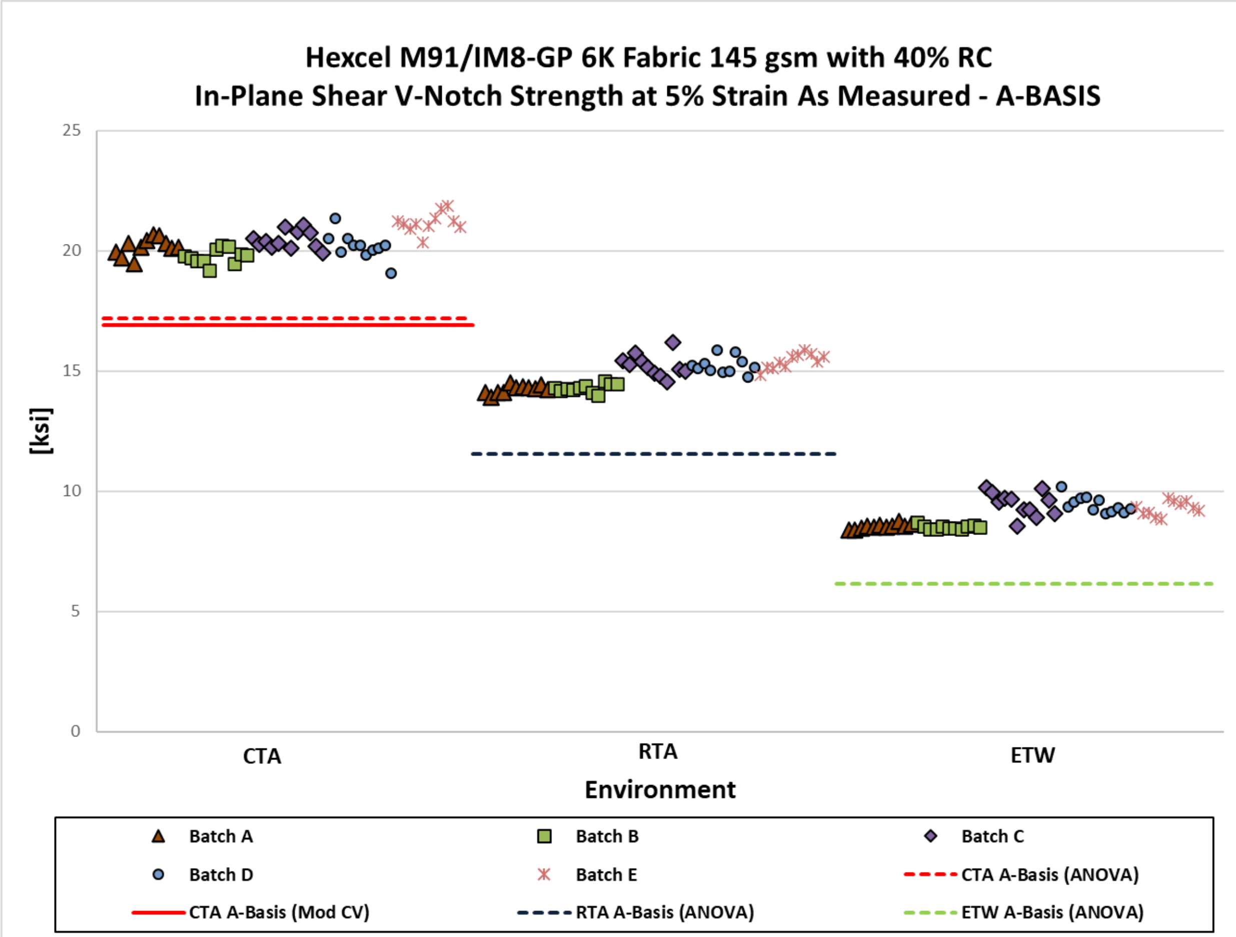

Figure 4-11: Batch Plot for IPSV Strength at 5% Strain Data - A-Basis

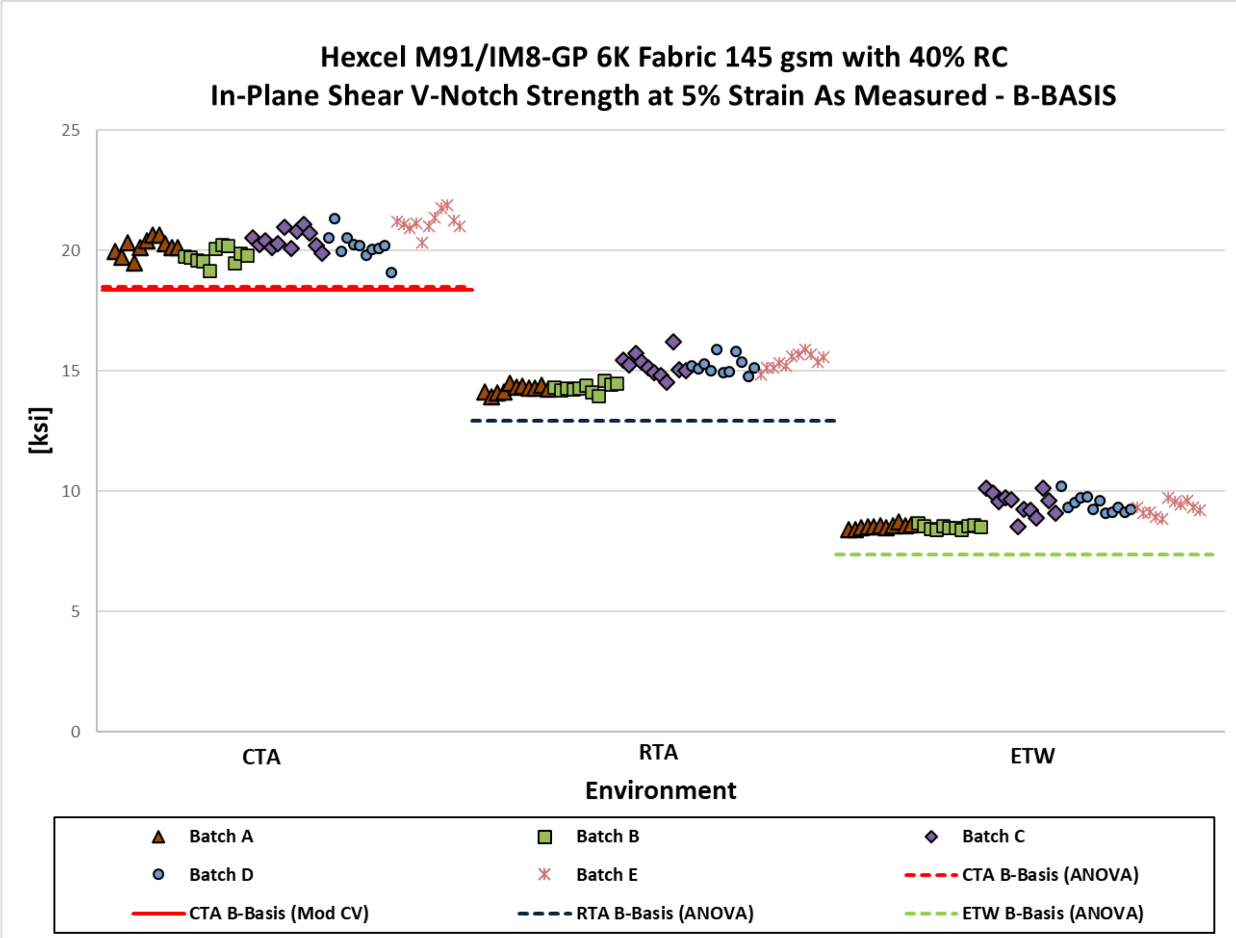

Figure 4-12: Batch Plot for IPSV Strength at 5% Strain Data - B-Basis

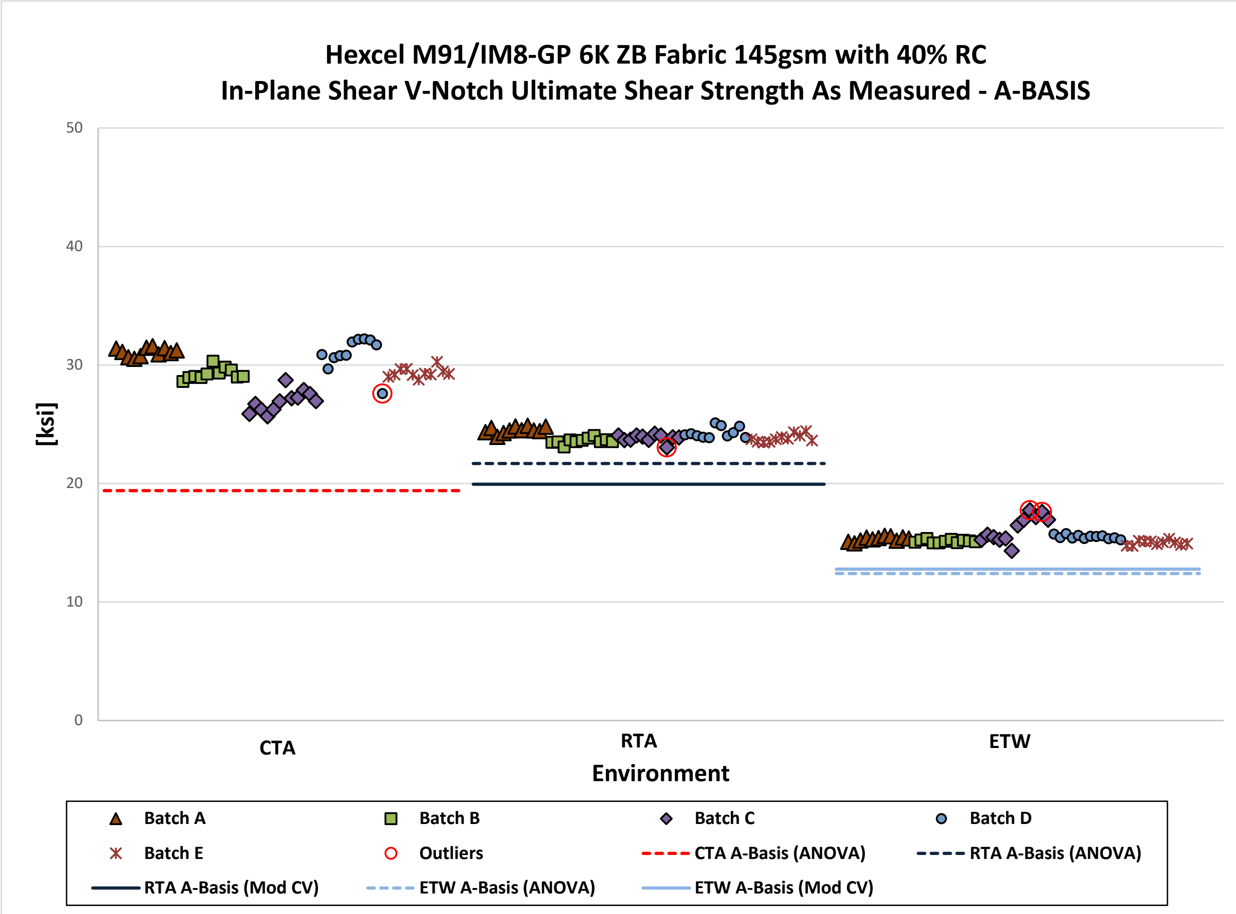

Figure 4-13: Batch Plot for IPSV Ultimate Shear As-Measured Strength Data - A-Basis

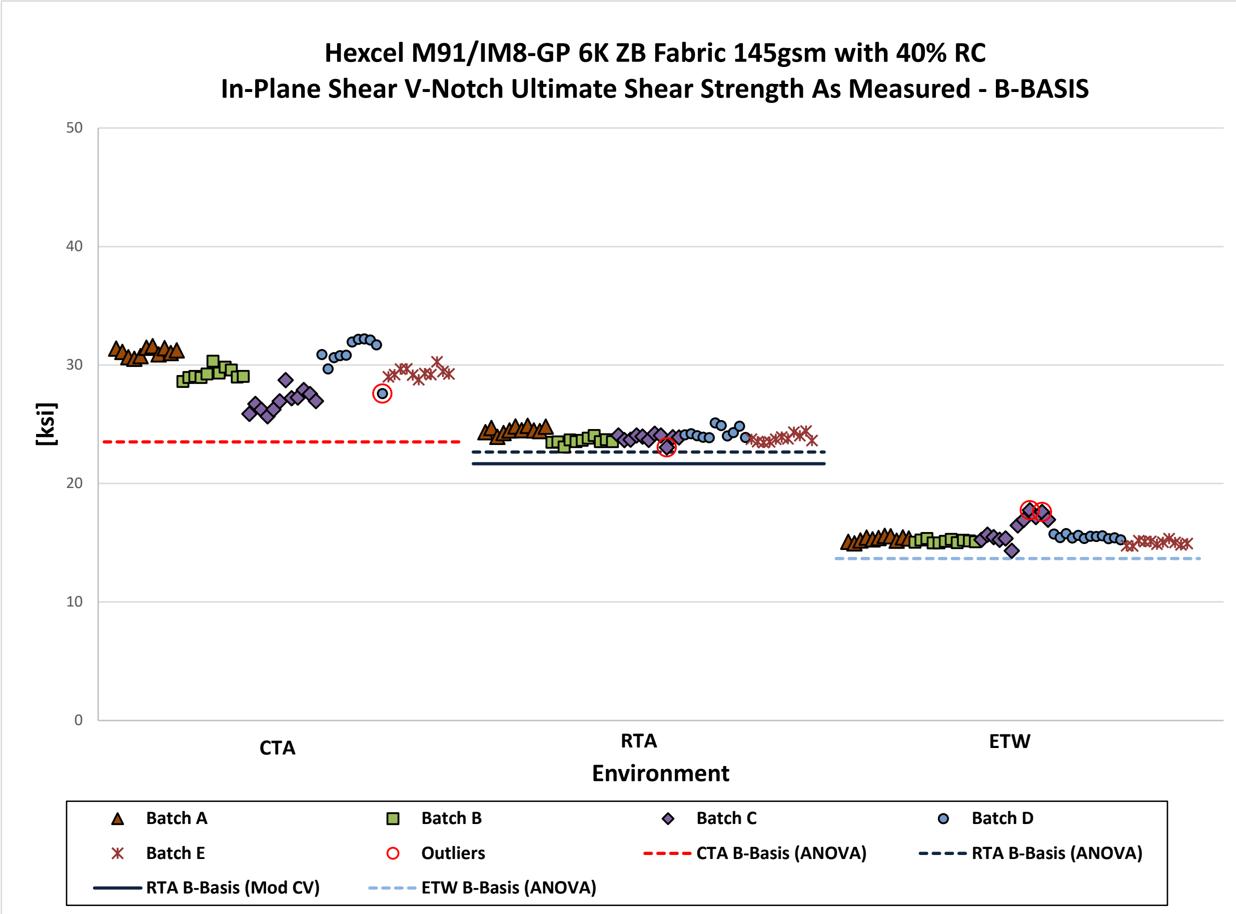

Figure 4-14: Batch Plot for IPSV Ultimate Shear As-Measured Strength Data - B-Basis

In Plane Shear V-Notch (IPSV) Strength (ksi) Basis Values and Statistics									
	0.2% Offset Strength			Ultimate Shear Strength			Strength at 5% Strain		
Environment	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)
Mean	11.63	8.361	5.328	29.48	24.02	15.45	20.36	14.88	9.073
Stdev	0.8190	0.3167	0.5862	1.726	0.4629	0.6618	0.6084	0.5868	0.5261
CV	7.042	3.787	11.00	5.854	1.927	4.284	2.989	3.943	5.799
Mod CV	7.521	6.000	11.00	6.927	6.000	6.142	6.000	6.000	6.899
Min	10.39	7.820	4.439	25.68	23.06	14.33	19.08	13.92	8.403
Max	14.19	9.095	6.710	32.21	25.13	17.76	21.87	16.20	10.21
No. Batches	5	5	5	5	5	5	5	5	5
No. Spec.	56	55	57	56	55	57	56	55	57
Basis Values									
B-Basis Value	9.380	7.399	3.283	23.51	22.65	13.66	18.49	12.92	7.358
A-Basis-Value	7.805	6.731	1.876	19.40	21.69	12.41	17.19	11.56	6.173
Method	ANOVA	ANOVA	ANOVA	ANOVA	ANOVA	ANOVA	ANOVA	ANOVA	ANOVA
Modified CV Basis Values									
B-Basis Value	NA	NA	NA	NA	21.68	13.91	18.37	NA	NA
A-Basis-Value					19.94	12.77	16.90		
Method					Normal	Normal	Normal		

Table 4-11: Statistics and Basis Values for IPSV 0.2% Offset Strength Data

In Plane Shear V-Notch (IPSV) Modulus (Msi) Statistics			
Environment	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)
Mean	0.8103	0.6993	0.5470
Stdev	0.06251	0.03766	0.03850
CV	7.715	5.385	7.038
Min	0.6662	0.6406	0.4520
Max	0.9391	0.8169	0.6364
No. Batches	5	5	5
No. Spec.	56	55	57

Table 4-12: Statistics for IPSV Modulus Data

4.7 Lamina Short-Beam Strength (SBS)

The Short Beam Strength data is not normalized. Tests were conducted in the following environmental conditions: CTA, RTA and ETW.

The datasets for the CTA and RTA conditions consist of fifty-five specimens distributed in five batches, therefore A-Basis and B-Basis values were computed for CTA and RTA.

The three conditions failed the ADK test for batch equivalency. ANOVA was used to compute Basis values for CTA and RTA, and estimates for ETW. Applying the modified CV, the CTA and RTA conditions were pooled and the normal method for modified CV was used for ETW.

There were no statistical outliers.

Statistics, Basis values and estimates are given for the SBS data in Table 4-13. The as-measured data, A-Basis values and A-estimates are shown graphically in Figure 4-15 and the as-measured data and B-Basis values in Figure 4-16.

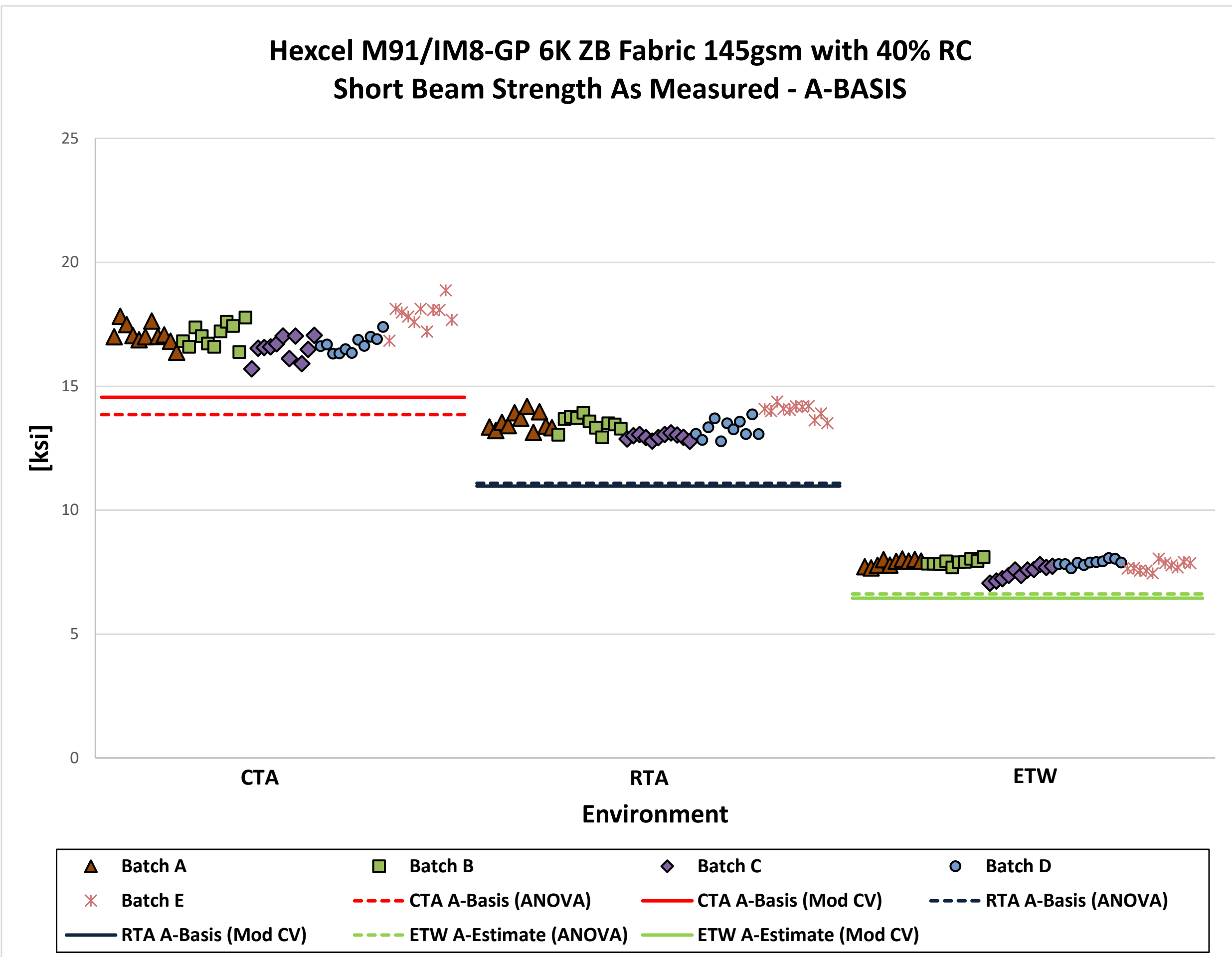

Figure 4-15: Batch Plot for SBS As-Measured Strength– A-Basis

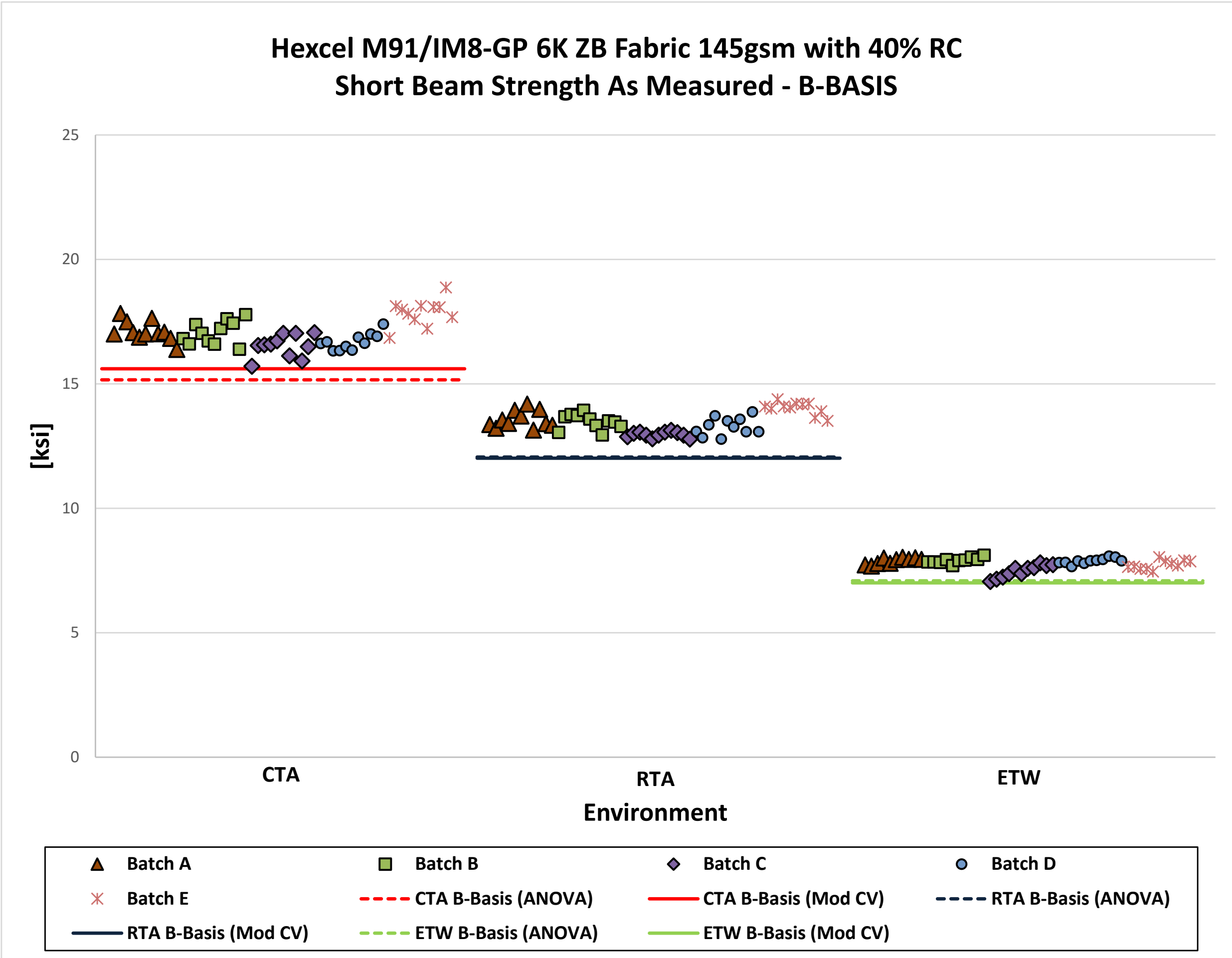

Figure 4-16: Batch Plot for SBS As-Measured Strength - B-Basis

Short Beam Strength (SBS) (ksi) As-Measured Basis Values and Statistics			
Environment	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)
Mean	17.05	13.46	7.772
Stdev	0.6291	0.4479	0.2320
CV	3.691	3.327	2.985
Mod CV	6.000	6.000	6.000
Min	15.71	12.78	7.055
Max	18.87	14.38	8.113
No. Batches	5	5	5
No. Spec.	55	55	53
Basis Values and Estimates			
B-Basis Value	15.17	12.06	7.092
A-Basis Value	13.86	11.08	
A-Estimate			6.618
Method	ANOVA	ANOVA	ANOVA
Modified CV Basis Values and Estimates			
B-Basis Value	15.60	12.02	7.010
A-Basis Value	14.55	10.97	
A-Estimate			6.446
Method	Pooled	Pooled	Normal

Table 4-13: Statistics, Basis Values and Estimates for SBS Data

4.8 "25/50/25" Unnotched Tension 1 (UNT1)

The UNT1 data is normalized by cured ply thickness. Both normalized and as-measured statistics are provided. Tests were conducted in the following environmental conditions: CTA, RTA, an ETW.

For the normalized dataset, the CTA condition failed the ADK test for batch equivalency. ANOVAS was used to compute estimates for CTA, and the remaining condition were pooled. Applying the modified CV, the ETW condition failed the normality test, therefore, Basis values were not computed for ETW. The normal method for modified CV was used for CTA and RTA.

For the as-measured dataset, the RTA failed the ADK test for batch equivalency, therefore, pooling was not possible. ANOVA was used to compute estimates for RTA and the single point normal method was used for the remaining conditions. Applying the modified CV, there were no diagnostic test failures and the three conditions were pooled.

For the normalized dataset, the ETW environment failed the ADK test for batch equivalency. ANOVA was used to compute its value, and with three batches of data available this is an estimate. The CTA and RTA environments were acceptable for pooling. Applying the modified CV, all pooling variations fail the Anderson Darling test for normality.

For the as-measured dataset, the CTA and ETW environments failed the ADK test for batch equivalency. ANOVA was used to compute their Basis values, and with three batches of data available, these are estimates. Applying the modified CV, there were no diagnostic test failures so pooling the three environments was acceptable.

There were three statistical outliers. The lowest normalized value in batch C of the RTA condition was an outlier for the batch but not for the condition. It was an outlier in the normalized dataset but not in the as-measured dataset. The lowest value in batch B of the ETW condition was an outlier for the batch and for the condition. It was an outlier in the normalized dataset and in the as-measured dataset. The lowest as-measured value in batch A of the RTA condition was an outlier for the batch but not for the condition. It was an outlier in the as-measured dataset but not in the normalized dataset. They were retained for this analysis.

Statistics, Basis values and estimates are given for the UNT1 strength data in Table 4-14 and for the modulus data in Table 4-15. The normalized data, B-Basis values and B-estimates are shown graphically in Figure 4-17.

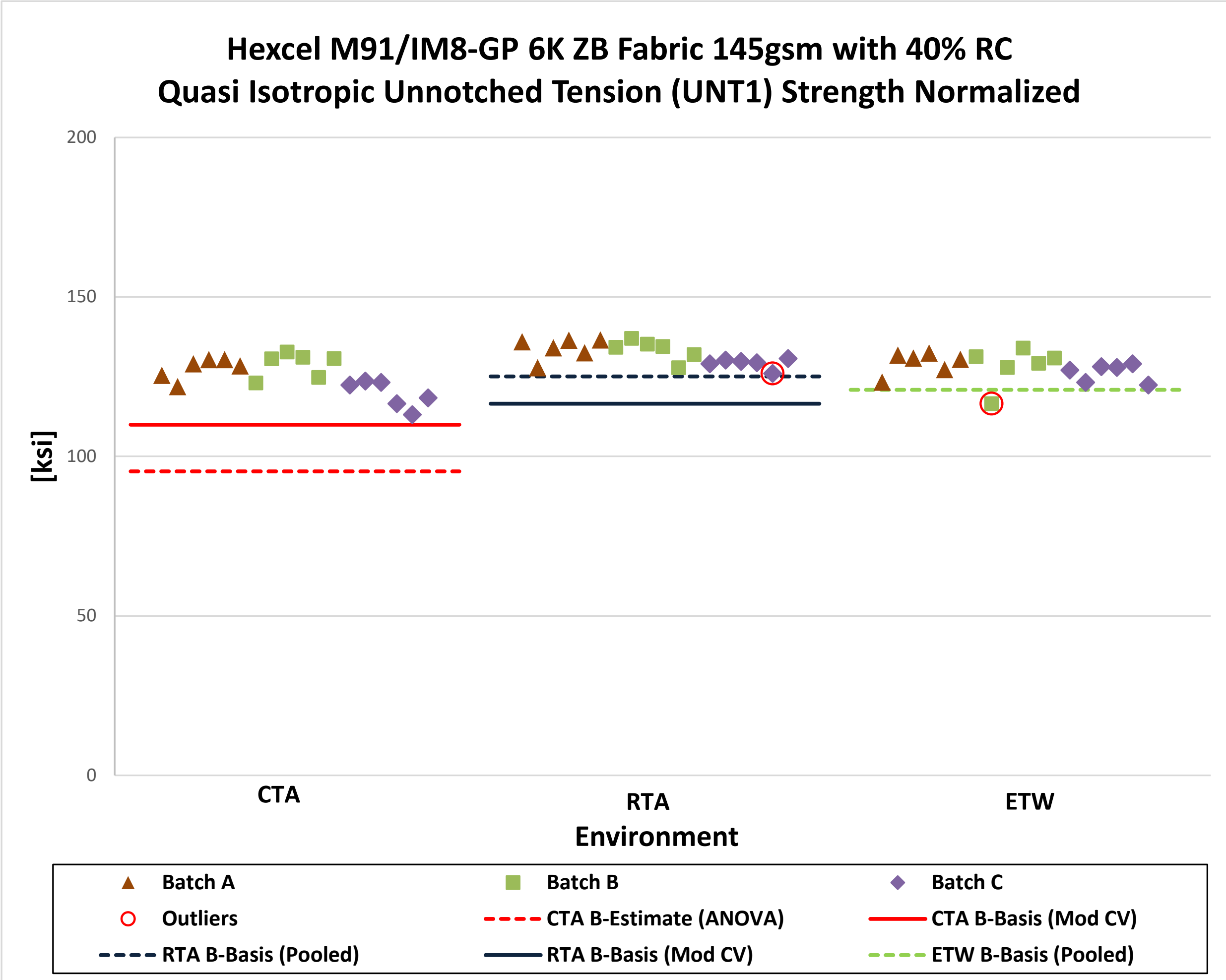

Figure 4-17: Batch Plot for UNT1 Normalized Strength

Unnotched Tension 1 (UNT1) Strength (ksi) Basis Values and Statistics						
	Normalized			As-Measured		
Environment	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)
Mean	125.3	132.2	128.0	123.3	129.9	125.7
Stdev	5.577	3.445	4.309	4.811	3.382	4.654
CV	4.450	2.606	3.367	3.904	2.604	3.703
Mod CV	6.225	6.000	6.000	6.000	6.000	6.000
Min	113.1	126.0	116.5	113.8	123.1	111.6
Max	132.8	137.0	134.0	132.0	135.6	132.3
No. Batches	3	3	3	3	3	3
No. Spec.	18	18	18	18	18	18
Basis Values and Estimates						
B-Basis Value		125.1	120.9	113.8		116.5
B-Estimate	95.30				116.1	
A-Estimate	73.88	120.2	116.0	107.0	106.3	110.0
Method	ANOVA	Pooled	Pooled	Normal	ANOVA	Normal
Modified CV Basis Values and Estimates						
B-Basis Value	109.9	116.5	NA	108.7	114.5	110.8
A-Estimate	99.00	105.4		98.3	103.6	100.3
Method	Normal	Normal		Normal	Normal	Normal

Table 4-14: Statistics, B-Basis Values and Estimates for UNT1 Strength Data

Unnotched Tension 1 (UNT1) Modulus Statistics						
	Normalized			As-Measured		
Environment	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)
Mean	8.363	8.208	8.076	8.228	8.067	7.931
Stdev	0.1620	0.07721	0.07754	0.1906	0.1434	0.1808
CV	1.937	0.9407	0.9601	2.317	1.777	2.280
Min	8.094	8.056	7.963	7.978	7.829	7.624
Max	8.582	8.359	8.197	8.675	8.247	8.189
No. Batches	3	3	3	3	3	3
No. Spec.	18	18	18	18	18	18

Table 4-15: Statistics from UNT1 Modulus Data

4.9 "10/80/10" Unnotched Tension 2 (UNT2)

The UNT2 data is normalized by cured ply thickness. Both normalized and as-measured statistics are provided. Tests were conducted in the following environmental conditions: CTA, RTA and ETW.

For the normalized dataset, the three conditions were not pooled because the pooled dataset failed the Levene's test for equality of standard deviations. The single point normal method was used for CTA, and RTA and ETW were pooled. Applying the modified CV, RTA and ETW were pooled and the normal method for modified CV was used for CTA.

For the as-measured dataset, the CTA and ETW conditions failed the ADK test for batch equivalency. ANOVA was used to compute estimates for CTA and ETW, and the single point normal method was used for RTA. Applying the modified CV, there were no diagnostic test failures, therefore all conditions were pooled.

There were no statistical outliers.

Statistics, Basis values and estimates are given for the UNT2 strength data in Table 4-16 and for the modulus data in Table 4-17. The normalized data, B-Basis values and B-estimates are shown graphically in Figure 4-18.

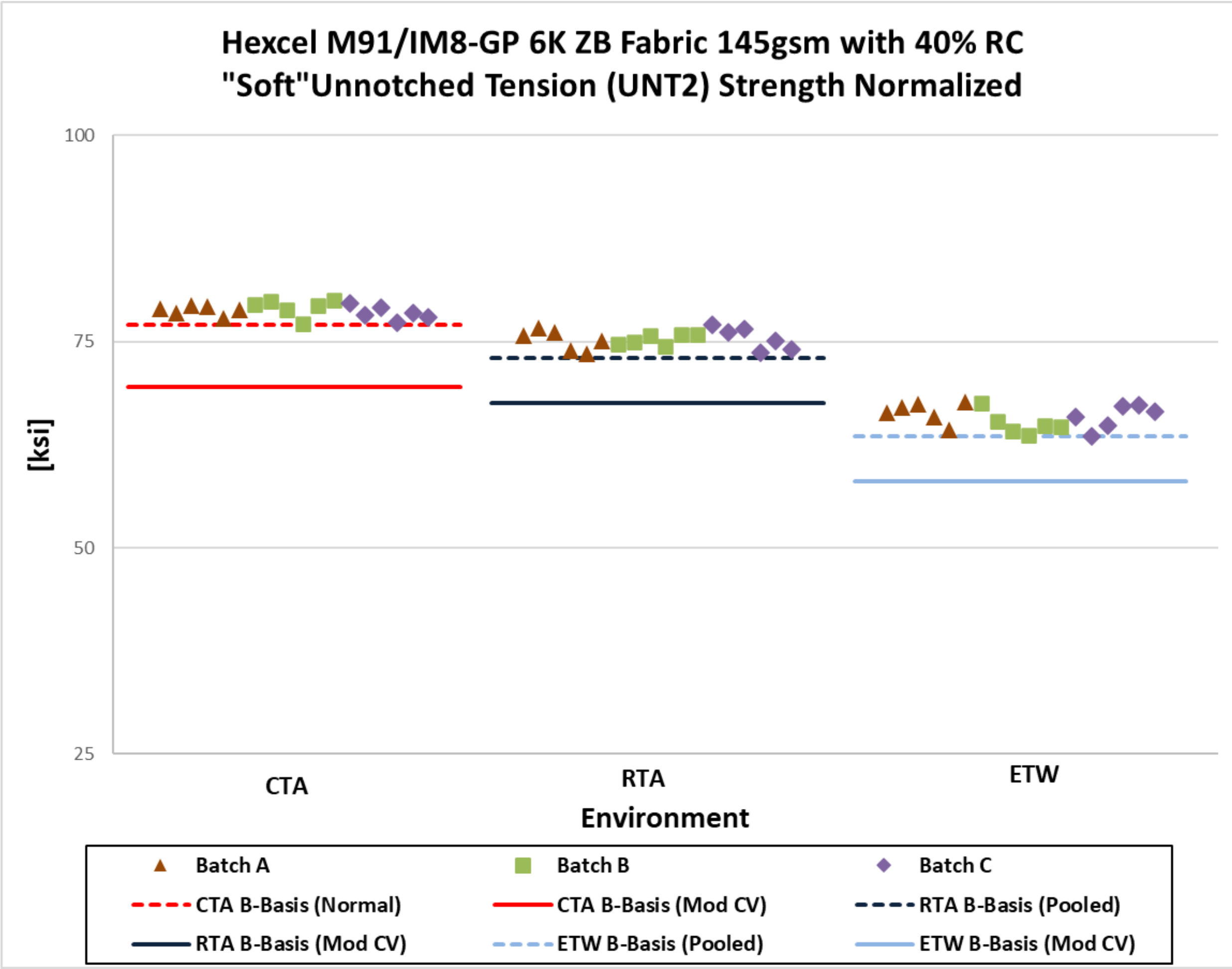

Figure 4-18: Batch Plot for UNT2 Normalized Strength

Unnotched Tension 2 (UNT2) Strength (ksi) Basis Values and Statistics						
	Normalized			As-Measured		
Environment	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)
Mean	78.80	75.28	65.77	77.17	73.83	64.47
Stdev	0.8585	1.075	1.404	1.273	1.642	1.957
CV	1.090	1.428	2.135	1.650	2.224	3.035
Mod CV	6.000	6.000	6.000	6.000	6.000	6.000
Min	77.12	73.48	63.49	73.89	71.34	61.09
Max	80.03	77.01	67.67	78.82	76.75	67.27
No. Batches	3	3	3	3	3	3
No. Spec.	18	18	18	18	18	18
Basis Values and Estimates						
B-Basis Value	77.10	73.00	63.49		70.59	
B-Estimate				70.64		53.66
A-Estimate	75.90	71.45	61.94	65.99	68.29	45.94
Method	Normal	Pooled	Pooled	ANOVA	Normal	ANOVA
Modified CV Basis Values and Estimates						
B-Basis Value	69.46	67.55	58.05	69.52	66.18	56.82
A-Estimate	62.85	62.30	52.79	64.41	61.07	51.71
Method	Normal	Pooled	Pooled	Pooled	Pooled	Pooled

Table 4-16: Statistics, B-Basis Values and Estimates for UNT2 Strength Data

Unnotched Tension 2 (UNT2) Modulus Statistics						
	Normalized			As-Measured		
Environment	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)
Mean	5.434	5.224	4.811	5.322	5.124	4.715
Stdev	0.06083	0.1006	0.07121	0.07619	0.1362	0.09221
CV	1.119	1.926	1.480	1.432	2.658	1.956
Min	5.325	5.113	4.703	5.177	4.960	4.567
Max	5.556	5.553	4.913	5.439	5.584	4.863
No. Batches	3	3	3	3	3	3
No. Spec.	18	18	18	18	18	18

Table 4-17: Statistics for UNT2 Modulus Data

4.10 "40/20/40" Unnotched Tension 3 (UNT3)

The UNT3 data is normalized by cured ply thickness. Both normalized and as-measured statistics are provided. Tests were conducted in the following environment conditions: CTA, RTA and ETW.

For the normalized dataset, the CTA and RTA conditions failed the ADK test for batch equivalency, therefore pooling was not possible. ANOVA was used to compute estimates for CTA and RTA, and the single point normal method was used for ETW. Applying the modified CV there were no diagnostic test failures and all conditions were pooled.

For the as-measured dataset, the three conditions failed the ADK test for batch equivalency. ANOVA was used to compute estimates for all conditions. Applying the modified CV, there were not diagnostic test failures and all conditions were pooled.

There were no outliers.

Statistics, Basis values and estimates are given for the UNT3 strength data in Table 4-18 and for the modulus data in Table 4-19. The normalized data, B-Basis values and B-estimates are shown graphically in Figure 4-19.

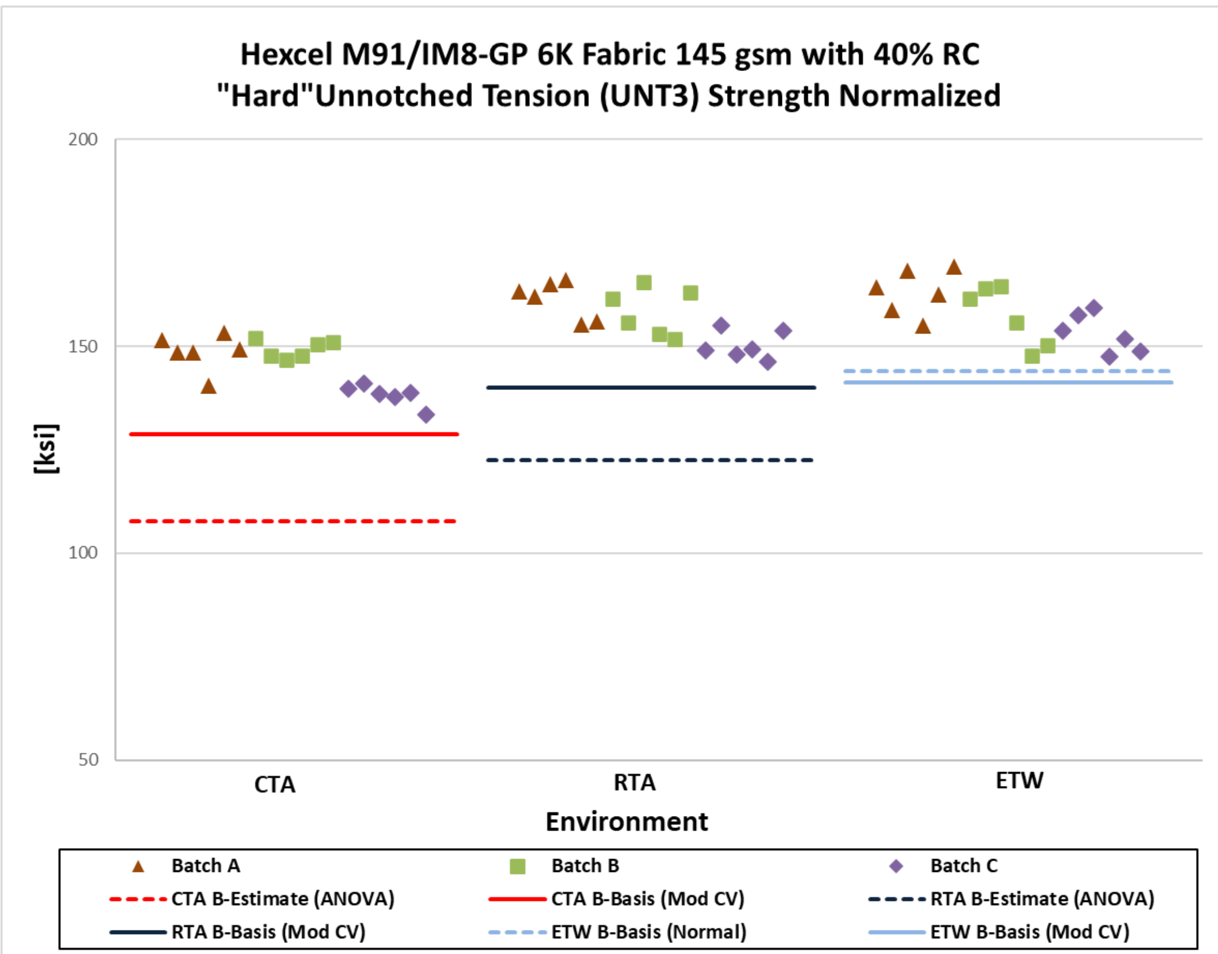

Figure 4-19: Batch Plot for UNT3 Normalized Strength

Unnotched Tension 3 (UNT3) Strength (ksi) Basis Values and Statistics						
	Normalized			As-Measured		
Environment	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)
Mean	145.4	156.6	157.8	142.5	153.6	154.6
Stdev	6.018	6.534	6.952	5.075	6.599	7.247
CV	4.140	4.172	4.404	3.560	4.297	4.689
Mod CV	6.070	6.086	6.202	6.000	6.148	6.344
Min	133.4	146.2	147.4	131.7	144.8	141.7
Max	153.3	166.1	169.4	151.9	165.5	167.0
No. Batches	3	3	3	3	3	3
No. Spec.	18	18	18	18	18	18
Basis Values and Estimates						
B-Basis Value			144.1	113.6	119.0	119.1
B-Estimate	107.7	122.6				
A-Estimate	80.88	98.26	134.4	92.91	94.29	93.87
Method	ANOVA	ANOVA	Normal	ANOVA	ANOVA	ANOVA
Modified CV Basis Values and Estimates						
B-Basis Value	128.7	140.0	141.2	126.1	137.1	138.1
A-Estimate	117.6	128.9	130.1	115.1	126.2	127.2
Method	Pooled	Pooled	Pooled	Pooled	Pooled	Pooled

Table 4-18: Normalized Statistics, B-Basis Values and Estimates for UNT3 Strength Data

Unnotched Tension 3 (UNT3) Modulus Statistics						
	Normalized			As-Measured		
Environment	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)
Mean	10.56	10.51	10.41	10.35	10.31	10.20
Stdev	0.1960	0.1451	0.09184	0.2292	0.2528	0.1685
CV	1.857	1.381	0.8821	2.214	2.453	1.653
Min	10.14	10.28	10.28	10.01	9.955	9.847
Max	10.87	10.79	10.57	10.79	10.70	10.57
No. Batches	3	3	3	3	3	3
No. Spec.	18	18	18	18	18	18

Table 4-19: Statistics from UNT3 Modulus Data

4.11 “25/50/25” Unnotched Compression 1 (UNC1)

The UNC1 data is normalized by cured ply thickness. Both normalized and as-measured statistics are provided. Tests were conducted in the following environmental conditions: RTA and ETW.

For the normalized dataset, pooling was not possible because the pooled dataset failed the Levene’s test for equality of standard deviations. The single point normal method was used for both conditions. Applying the modified CV, the RTA condition failed the normality test, therefore Basis values were not computed for RTA and the normal method for modified CV was used for ETW.

For as-measured dataset, there were no diagnostic test failures, therefore both conditions were pooled using the as-measured and modified CV.

There were two outliers. The lowest normalized value in batch A of the ETW condition was an outlier for the batch but not for the condition. It was an outlier in the normalized dataset but not in the as-measured dataset. The highest as-measured value in batch B of the ETW condition was an outlier for the batch but not for the condition. It was an outlier in the as-measured dataset but not in the normalized dataset. They were retained for this analysis.

Statistics, B-Basis values and estimates are given for the UNC1 strength data in Table 4-20 and for the modulus data in Table 4-21. The normalized data and B-Basis values are shown graphically in Figure 4-20.

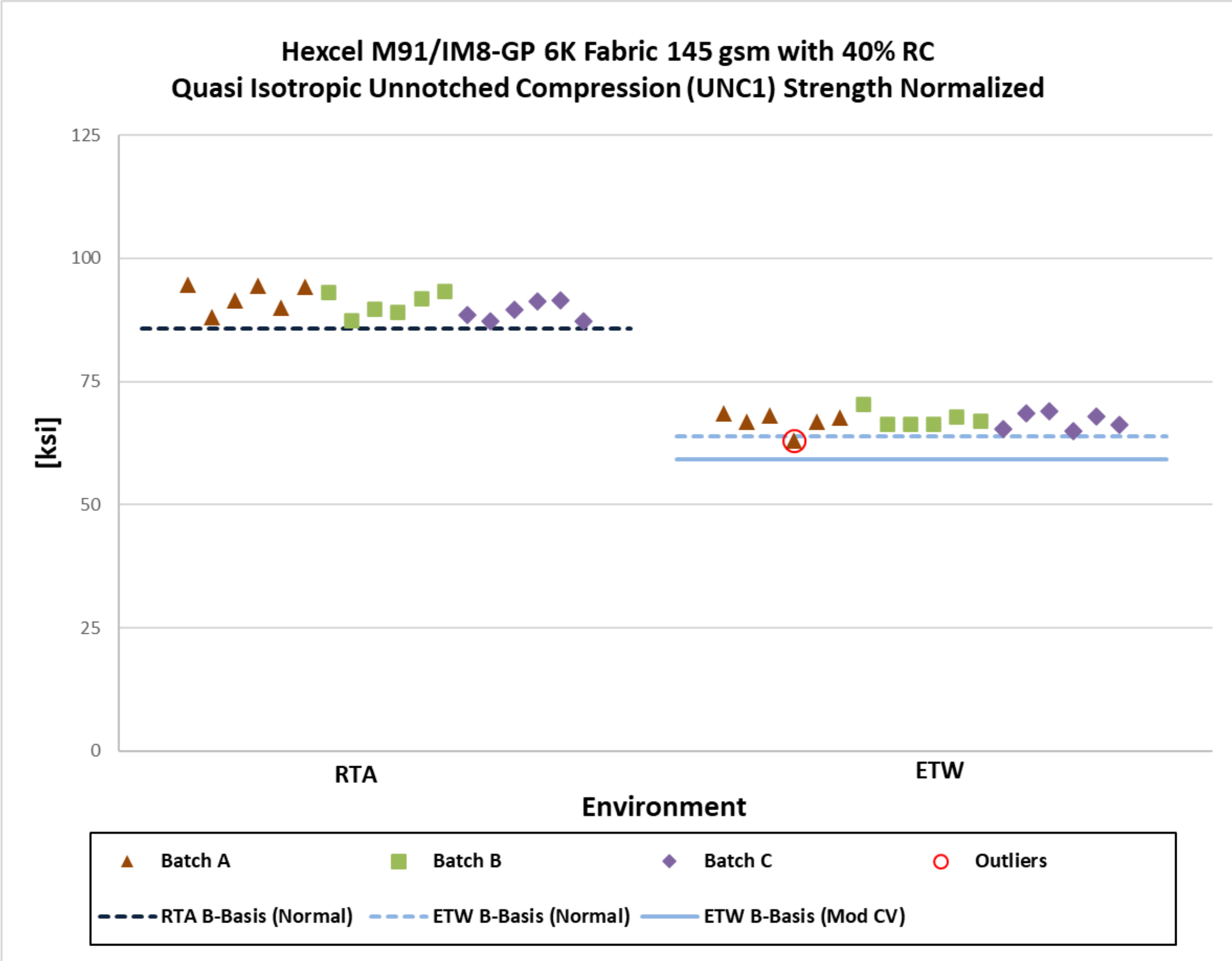

Figure 4-20: Batch Plot for UNC1 Normalized Strength

Unnotched Compression 1 (UNC1) Strength (ksi) Basis Values and Statistics				
	Normalized		As-Measured	
Environment	RTA (70 °F)	ETW (180 °F)	RTA (70 °F)	ETW (180 °F)
Mean	90.75	67.10	88.67	65.75
Stdev	2.557	1.682	2.760	1.802
CV	2.818	2.507	3.113	2.740
Mod CV	6.000	6.000	6.000	6.000
Min	87.29	63.07	82.97	62.77
Max	94.72	70.48	92.73	68.60
No. Batches	3	3	3	3
No. Spec.	18	18	18	18
Basis Values and Estimates				
B-Basis Value	85.70	63.78	84.42	61.50
A-Estimate	82.12	61.43	81.53	58.62
Method	Normal	Normal	Pooled	Pooled
Modified CV Basis Values and Estimates				
B-Basis Value	NA	59.15	80.14	57.22
A-Estimate		53.52	74.33	51.42
Method		Normal	Pooled	Pooled

Table 4-20: Statistics, B-Basis Values and Estimates for UNC1 Strength Data

Unnotched Compression 1 (UNC1) Modulus (Msi) Statistics				
	Normalized		As-Measured	
Environment	RTA (70 °F)	ETW (180 °F)	RTA (70 °F)	ETW (180 °F)
Mean	7.597	7.643	7.423	7.488
Stdev	0.1171	0.1639	0.1147	0.1624
CV	1.541	2.144	1.545	2.169
Min	7.291	7.094	7.217	7.071
Max	7.745	7.815	7.596	7.764
No. Batches	3	3	3	3
No. Spec.	18	18	18	18

Table 4-21: Statistics for UNC1 Modulus Data

4.12 “10/80/10” Unnotched Compression 2 (UNC2)

The UNC2 data is normalized by cured ply thickness. Both normalized and as-measured statistics are provided. Tests were conducted in the following environmental conditions: RTA and ETW.

For the normalized dataset, the conditions were not pooled because the pooled dataset failed the Anderson Darling test for normality. The single point normal method was used for RTA and the single point Weibull method was used for ETW. Applying the modified CV, both datasets were pooled.

For the as-measured dataset, both condition failed the ADK test for batch equivalency. ANOVA was used to compute estimates for both conditions. Applying the modified CV, there were no diagnostic test failures so both conditions were pooled.

There were two statistical outliers. The highest normalized value in batch C of the RTA condition was an outlier for the batch but not for the condition. It was an outlier in the normalized dataset but not in the as-measured dataset. The lowest normalized value in batch A of the ETW condition was an outlier for the batch but not for the condition. It was an outlier in the normalized dataset and in the as-measured dataset. They were retained for this analysis.

Statistics, B-Basis values and estimates are given for the UNC2 strength data in Table 4-22 and for the modulus data in Table 4-23. The normalized data and B-Basis values are shown graphically in Figure 4-21.

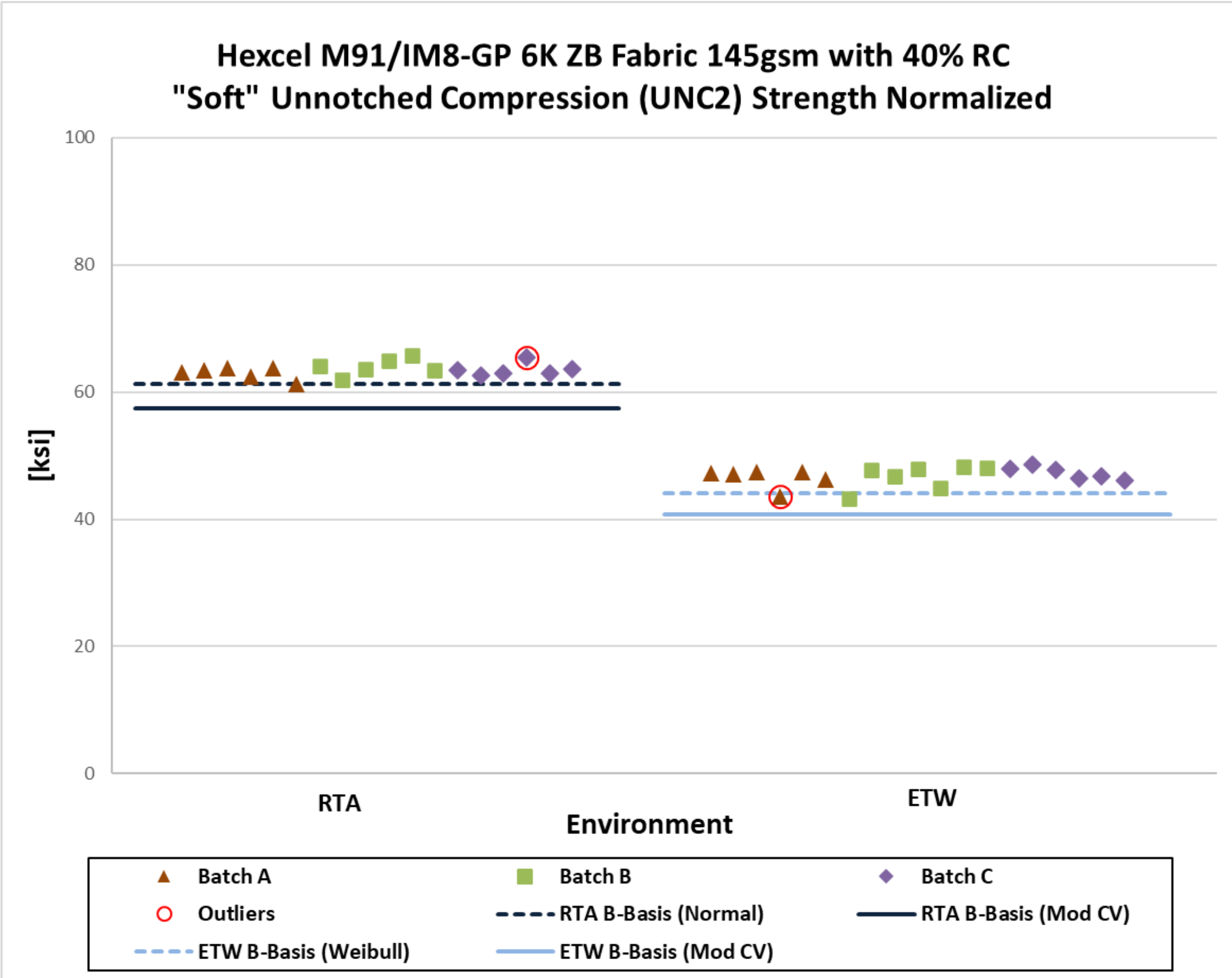

Figure 4-21: Batch Plot for UNC2 Normalized Strength

Unnotched Compression 2 (UNC2) Strength (ksi) Basis Values and Statistics				
	Normalized		As-Measured	
Environment	RTA (70 °F)	ETW (180 °F)	RTA (70 °F)	ETW (180 °F)
Mean	63.48	46.83	61.89	45.65
Stdev	1.117	1.497	1.444	1.587
CV	1.760	3.196	2.333	3.477
Mod CV	6.000	6.000	6.000	6.000
Min	61.29	43.24	58.84	41.66
Max	65.77	48.60	65.26	48.07
No. Batches	3	3	3	3
No. Spec.	18	19	18	19
Basis Values and Estimates				
B-Basis Value	61.27	44.05		
B-Estimate			54.64	39.51
A-Estimate	59.71	41.01	49.47	35.13
Method	Normal	Weibull	ANOVA	ANOVA
Modified CV Basis Values and Estimates				
B-Basis Value	57.42	40.80	55.99	39.77
A-Estimate	53.31	36.68	51.98	35.75
Method	Pooled	Pooled	Pooled	Pooled

Table 4-22: Statistics, B-Basis Values and Estimates for UNC2 Strength Data

Unnotched Compression 2 (UNC2) Modulus (Msi) Statistics				
	Normalized		As-Measured	
Environment	RTA (70 °F)	ETW (180 °F)	RTA (70 °F)	ETW (180 °F)
Mean	4.956	4.673	4.833	4.561
Stdev	0.05135	0.07410	0.1089	0.1207
CV	1.036	1.586	2.253	2.647
Min	4.859	4.549	4.682	4.413
Max	5.040	4.863	5.050	4.813
No. Batches	3	3	3	3
No. Spec.	18	18	18	18

Table 4-23: Statistics for UNC2 Modulus Data

4.13 “40/20/40” Unnotched Compression 3 (UNC3)

The UNC3 data is normalized by cured ply thickness. Both normalized and as-measured statistics are provided. Tests were conducted in the following environmental conditions: RTA and ETW.

The RTA conditions consists of seventeen specimens distributed in three batches, therefore, pooling was not possible and only estimates were computed for RTA.

For the normalized dataset, the ETW condition failed the ADK test for batch equivalency. ANOVA was used to compute estimates for ETW and the single point normal method was used for RTA. Applying the modified CV, the normal method for modified CV was used for both conditions.

For the as-measured dataset, the RTA condition failed the ADK test for batch equivalency. ANOVA was used to compute estimates for RTA and the single point non-parametric method was used for ETW. Applying the modified CV, the normal method for modified CV was used for both conditions.

There was one statistical outlier. The lowest normalized value in batch A of the ETW condition was an outlier for the batch and for the condition. It was an outlier in the normalized dataset and in the as-measured dataset. It was retained for this analysis.

Statistics, B-Basis values and estimates are given for the UNC3 strength data in Table 4-24 and for the modulus data in Table 4-25. The normalized data, B-Basis values and B-estimates are shown graphically in Figure 4-22.

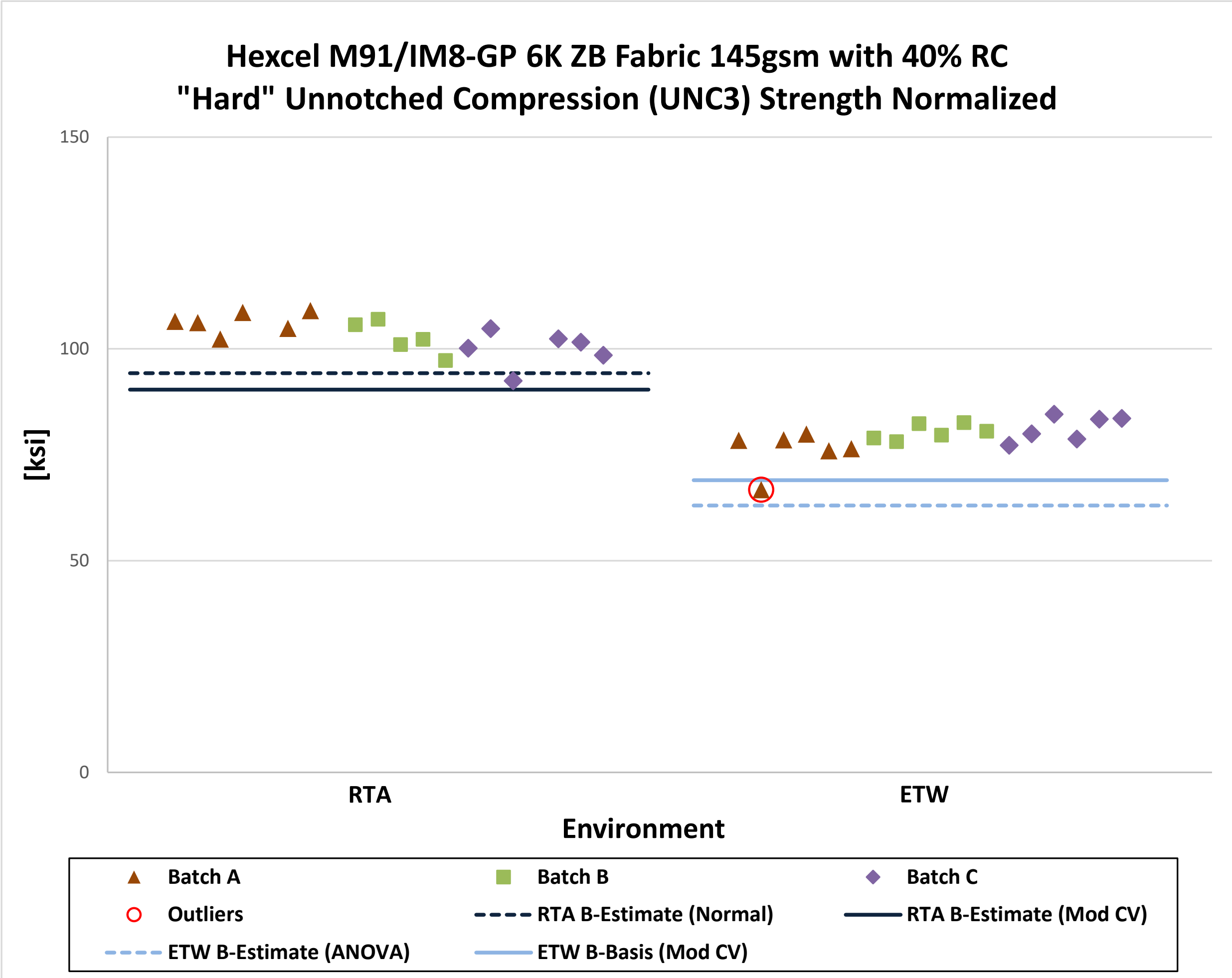

Figure 4-22: Batch Plot for UNC3 Normalized Strength

Unnotched Compression 3 (UNC3) Strength (ksi) Basis Values and Statistics				
	Normalized		As-Measured	
Environment	RTA (70 °F)	ETW (180 °F)	RTA (70 °F)	ETW (180 °F)
Mean	102.9	79.19	100.3	77.22
Stdev	4.326	3.992	4.607	4.003
CV	4.202	5.042	4.591	5.184
Mod CV	6.101	6.521	6.296	6.592
Min	92.46	66.72	91.58	65.58
Max	109.0	84.57	107.2	83.74
No. Batches	3	3	3	3
No. Spec.	17	18	17	18
Basis Values and Estimates				
B-Basis Value				61.94
B-Estimate	94.29	63.04	78.73	
A-Estimate	88.16	51.54	63.34	45.49
Method	Normal	ANOVA	ANOVA	Non-Parm.
Modified CV Basis Values and Estimates				
B-Basis Value		68.99		67.17
B-Estimate	90.37		87.69	
A-Estimate	81.48	61.77	78.74	60.05
Method	Normal	Normal	Normal	Normal

Table 4-24: Statistics and Basis Values for UNC3 Strength Data

Unnotched Compression 3 (UNC3) Modulus (Msi) Statistics				
	Normalized		As-Measured	
Environment	RTA (70 °F)	ETW (180 °F)	RTA (70 °F)	ETW (180 °F)
Mean	9.542	9.791	9.291	9.548
Stdev	0.1381	0.1386	0.1335	0.1319
CV	1.447	1.415	1.437	1.382
Min	9.262	9.549	9.059	9.257
Max	9.772	10.09	9.543	9.787
No. Batches	3	3	3	3
No. Spec.	18	18	18	18

Table 4-25: Statistics for UNC3 Modulus Data

4.14 “25/50/25” Open-Hole Tension 1 (OHT1)

The OHT1 data is normalized by cured ply thickness. Both normalized and as-measured statistics are provided. Tests were conducted in the following environmental conditions: CTA, RTA, and ETW.

For the normalized dataset, there were no diagnostic test failures so the three conditions were pooled using the as-measured CV and the modified CV.

For the as-measured dataset, using the as-measured and the modified CV, the three conditions were not pooled because the pooled datasets failed the Anderson Darling test for normality. The CTA and RTA conditions were pooled and the normal method was used for ETW.

There were no statistical outliers.

Statistics, B-Basis values and estimates are given for the OHT1 strength data in Table 4-26. The normalized data and B-Basis values are shown graphically in Figure 4-23.

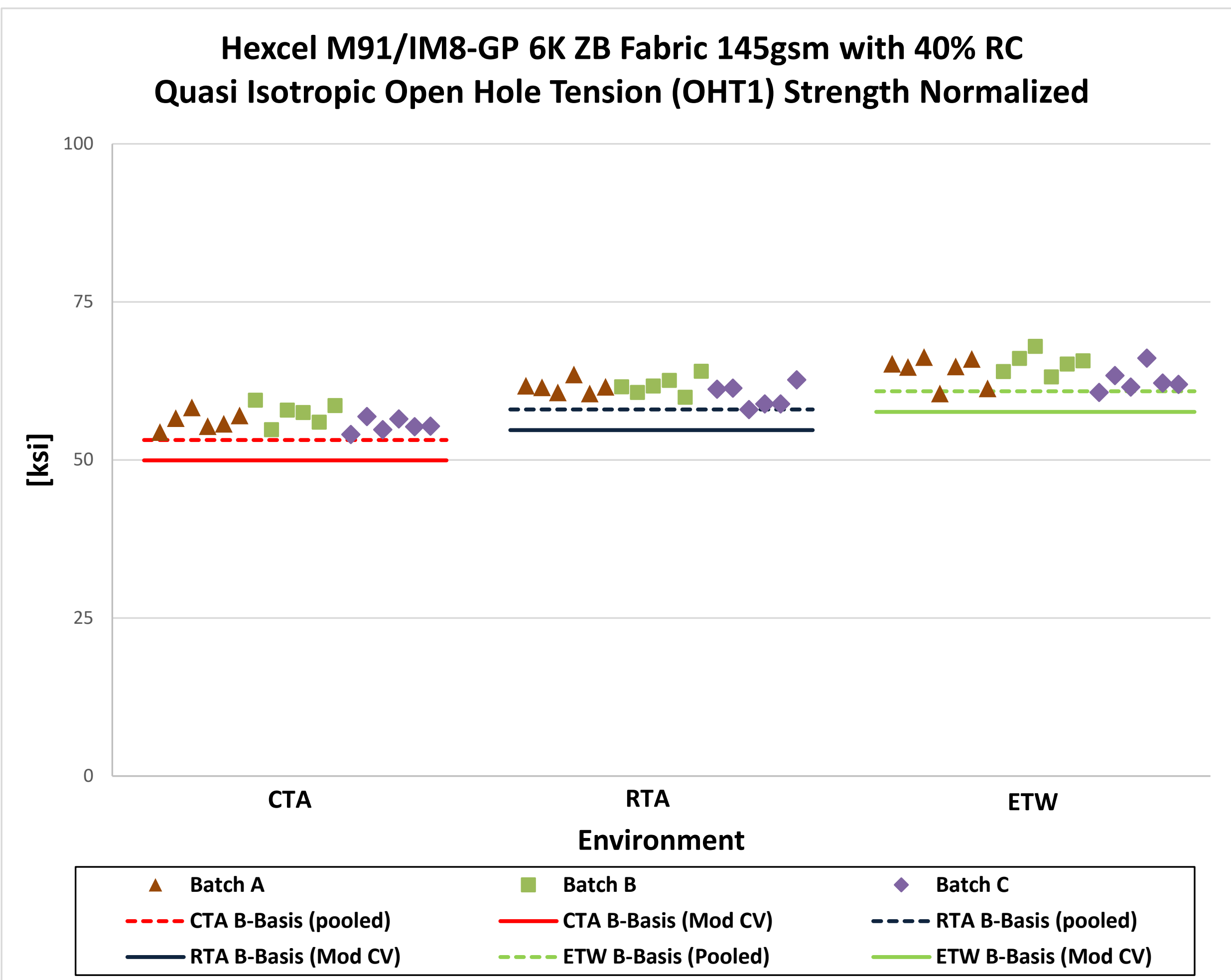

Figure 4-23: Batch Plot for OHT1 Normalized Strength

Open Hole Tension 1 (OHT1) Strength (ksi) Basis Values and Statistics						
	Normalized			As-Measured		
Environment	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)
Mean	56.35	61.15	64.02	55.20	59.85	62.74
Stdev	1.546	1.578	2.178	1.287	1.506	1.925
CV	2.743	2.581	3.402	2.332	2.516	3.068
Mod CV	6.000	6.000	6.000	6.000	6.000	6.000
Min	54.04	57.95	60.50	53.04	57.17	59.83
Max	59.44	64.00	67.96	57.31	62.14	65.85
No. Batches	3	3	3	3	3	3
No. Spec.	18	18	19	18	18	19
Basis Values and Estimates						
B-Basis Value	53.17	57.97	60.85	52.64	57.30	58.99
A-Estimate	51.05	55.85	58.73	50.91	55.56	56.33
Method	Pooled	Pooled	Pooled	Pooled	Pooled	Normal
Modified CV Basis Values and Estimates						
B-Basis Value	49.91	54.71	57.62	48.90	53.56	55.40
A-Estimate	45.62	50.42	53.32	44.62	49.28	50.19
Method	Pooled	Pooled	Pooled	Pooled	Pooled	Normal

Table 4-26: Statistics, Basis Values and Estimates for OHT1 Strength Data

4.15 "10/80/10" Open-Hole Tension 2 (OHT2)

The OHT2 data is normalized by cured ply thickness. Both normalized and as-measured statistics are provided. Tests were conducted in the following environmental conditions: CTA, RTA, and ETW.

For the normalized dataset, the three conditions were not pooled because the pooled dataset failed the Levene's test for equality of standard deviations. CTA and RTA were pooled and the single point normal method was used for ETW. Applying the modified CV, the normal method for modified CV was used for CTA, while RTA and ETW were pooled.

For the as-measured dataset, the ETW condition failed the ADK test for batch equivalency. ANOVA was used to compute estimates for ETW and the remaining condition were pooled. Applying the modified CV, there were no diagnostic test failures so the three conditions were pooled.

There were no statistical outliers.

Statistics, B-Basis values and estimates are given for the OHT2 strength data in Table 4-27. The normalized data, B-Basis values and estimates are shown graphically in Figure 4-24.

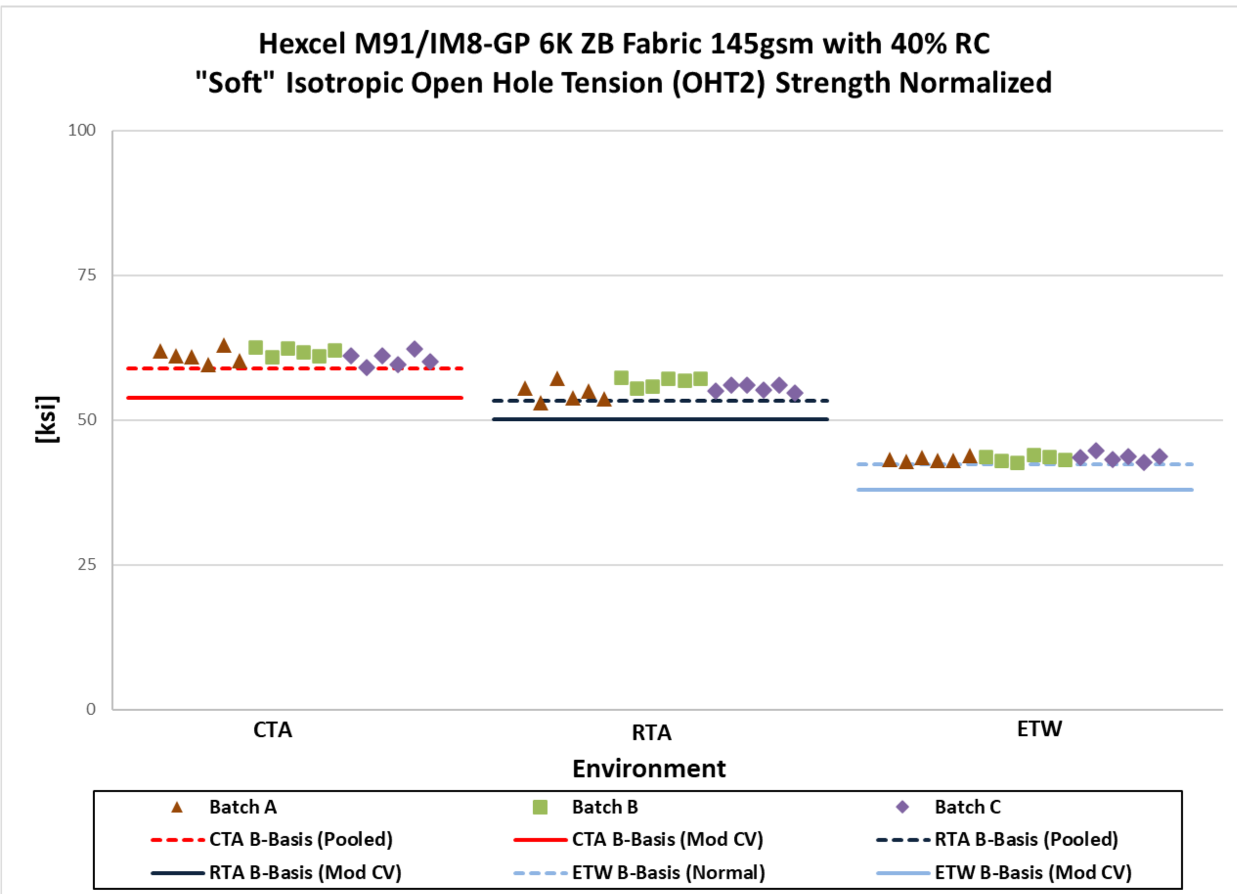

Figure 4-24: Batch Plot for OHT2 Normalized Strength

Open Hole Tension 2 (OHT2) Strength (ksi) Basis Values and Statistics						
	Normalized			As-Measured		
Environment	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)
Mean	61.16	55.62	43.41	59.88	54.33	42.51
Stdev	1.125	1.311	0.5246	1.100	1.027	0.8024
CV	1.839	2.357	1.208	1.837	1.891	1.888
Mod CV	6.000	6.000	6.000	6.000	6.000	6.000
Min	59.13	52.93	42.74	58.23	51.92	41.11
Max	62.96	57.37	44.75	62.61	56.12	44.00
No. Batches	3	3	3	3	3	3
No. Spec.	18	18	18	18	18	18
Basis Values and Estimates						
B-Basis Value	58.94	53.39	42.38	57.94	52.40	
B-Estimate						37.87
A-Estimate	57.42	51.88	41.64	56.62	51.08	34.57
Method	Pooled	Pooled	Normal	Pooled	Pooled	ANOVA
Modified CV Basis Values and Estimates						
B-Basis Value	53.92	50.17	37.96	54.27	48.73	36.90
A-Estimate	48.78	46.46	34.25	50.53	44.99	33.17
Method	Normal	Pooled	Pooled	Pooled	Pooled	Pooled

Table 4-27: Statistics, B-Basis Values and Estimates for OHT2 Strength Data

4.16 “40/20/40” Open-Hole Tension 3 (OHT3)

The OHT3 data is normalized by cured ply thickness. Both normalized and as-measured statistics are provided. Tests were conducted in the following environmental conditions: CTA, RTA, and ETW.

For the normalized dataset, the ETW condition failed the ADK test for batch equivalency. ANOVA was used to compute estimates for ETW and the remaining conditions were pooled. Applying the modified CV, there were no diagnostic test failures so the three conditions were pooled.

For the as-measured dataset, pooling the three conditions was not possible because the pooled dataset failed the Levene’s test for equality of standard deviations. The single point normal method was used for ETW and the remaining conditions were pooled. Applying the modified CV, there were no diagnostic test failures so the three conditions were pooled.

For both, the normalized and as-measured datasets, the three environments failed the ADK test for batch equivalency. ANOVA was used to compute their Basis values, and with three batches of data available these are estimates. Applying the modified CV, the RTA environment failed the ADK test for batch equivalency, therefore, Basis values were not computed for this environment and pooling was not acceptable.

There was one statistical outlier. The highest value in batch C of the CTA condition was an outlier for the batch but not for the condition. It was an outlier in the normalized dataset and in the as-measured dataset. It was retained for this analysis.

Statistics, B-Basis values and estimates are given for the OHT3 strength data in Table 4-28. The normalized data, B-Basis values and B-estimates are shown graphically in Figure 4-25.

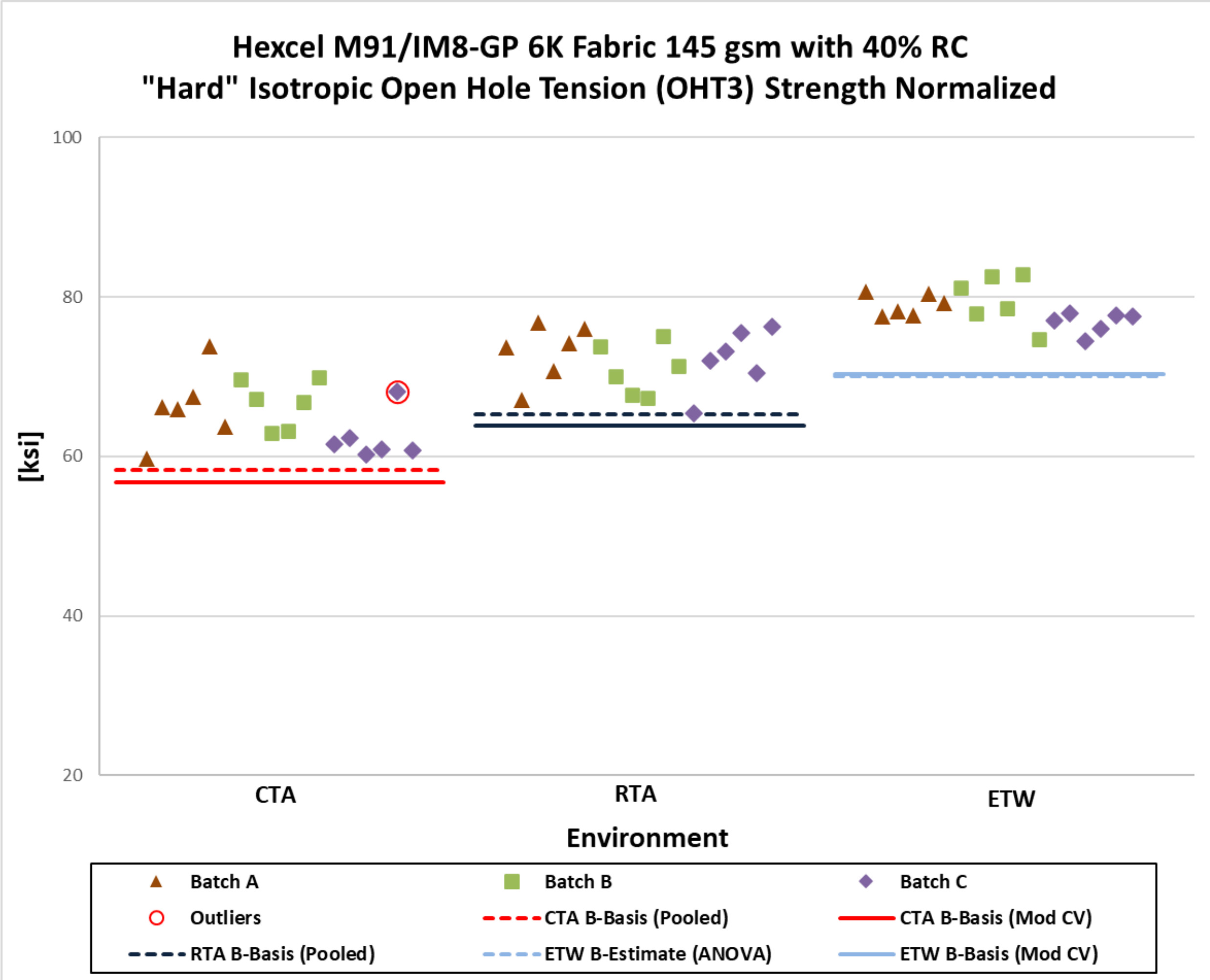

Figure 4-25: Batch Plot for OHT3 Normalized Strength

Open Hole Tension 3 (OHT3) Strength (ksi) Basis Values and Statistics						
	Normalized			As-Measured		
Environment	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)
Mean	65.03	72.06	78.47	63.72	70.56	76.86
Stdev	3.939	3.491	2.355	3.559	3.607	2.068
CV	6.058	4.845	3.001	5.586	5.111	2.691
Mod CV	7.029	6.423	6.000	6.793	6.556	6.000
Min	59.71	65.44	74.51	58.66	64.75	72.24
Max	73.85	76.82	82.84	72.34	75.23	80.08
No. Batches	3	3	3	3	3	3
No. Spec.	18	18	18	18	18	18
Basis Values and Estimates						
B-Basis Value	58.25	65.28		57.19	64.03	72.78
B-Estimate			70.12			
A-Estimate	53.64	60.67	64.18	52.75	59.59	69.89
Method	Pooled	Pooled	ANOVA	Pooled	Pooled	Normal
Modified CV Basis Values and Estimates						
B-Basis Value	56.82	63.85	70.26	55.71	62.55	68.85
A-Estimate	51.34	58.37	64.78	50.36	57.20	63.51
Method	Pooled	Pooled	Pooled	Pooled	Pooled	Pooled

Table 4-28: Statistics, B-Basis Values and Estimates for OHT3 Strength Data

4.17 "25/50/25" Filled-Hole Tension 1 (FHT1)

The FHT1 data is normalized by cured ply thickness. Both normalized and as-measured statistics are provided. Tests were conducted in the following environmental conditions: CTA, RTA, and ETW.

For the normalized dataset, the CTA condition failed the ADK test for batch equivalency. ANOVA was used to compute estimates for CTA and the remaining conditions were pooled. Applying the modified CV, the CTA condition failed the normality test, therefore Basis values were not computed for CTA. The RTA and ETW conditions were not pooled because the pooled dataset failed the Anderson Darling test for normality. The normal method for modified CV was used for RTA and ETW.

For the as-measured dataset, the three conditions were not pooled because the pooled dataset failed the Anderson Darling test for normality. The single point non-parametric method was used for CTA and the remaining conditions were pooled. Applying the modified CV, the CTA condition failed the normality test, therefore Basis values were not computed for CTA and the remaining conditions were pooled.

There were two statistical outliers. The highest normalized value in batch C of the CTA condition was an outlier for the batch but not for the condition for the normalized dataset, and a condition and batch outlier in the as-measured dataset. The highest normalized value in batch C of the ETW condition was an outlier for the batch but not for the condition. It was an outlier in the normalized dataset and in the as-measured dataset. They were retained for this analysis.

Statistics, B-Basis values and estimates are given for the FHT1 strength data in Table 4-29. The normalized data, B-Basis values and B-estimates are shown graphically in Figure 4-26.

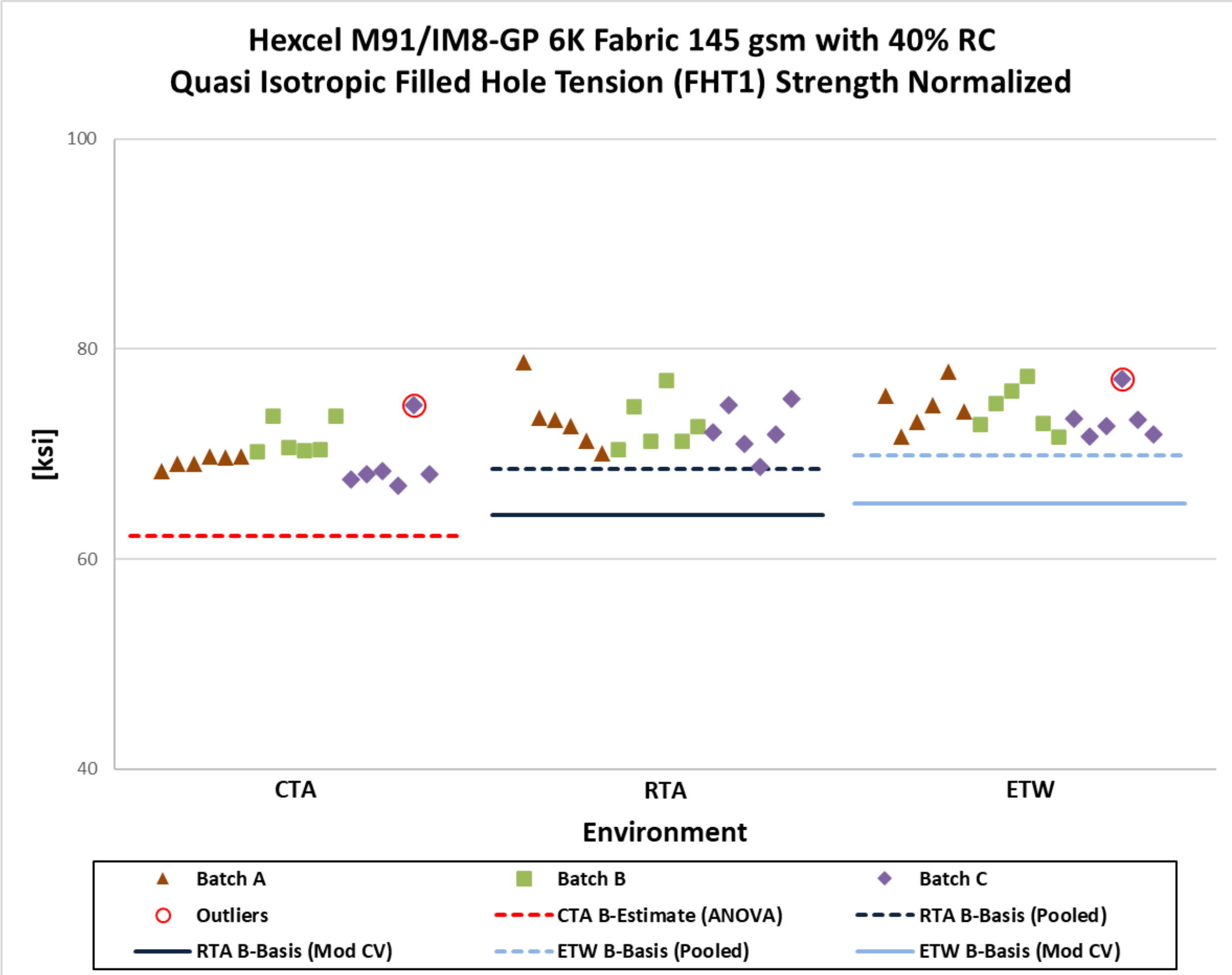

Figure 4-26: Batch Plot for FHT1 Normalized Strength

Filled-Hole Tension 1 (FHT1) Strength (ksi) Basis Values and Statistics						
	Normalized			As-Measured		
Environment	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)
Mean	69.91	72.78	74.04	68.57	71.43	72.51
Stdev	2.151	2.509	2.051	1.815	2.603	2.221
CV	3.077	3.448	2.771	2.646	3.643	3.063
Mod CV	6.000	6.000	6.000	6.000	6.000	6.000
Min	66.98	68.75	71.65	66.93	68.32	68.93
Max	74.67	78.69	77.88	73.93	78.17	77.19
No. Batches	3	3	3	3	3	3
No. Spec.	18	18	18	18	18	18
Basis Values and Estimates						
B-Basis Value		68.61	69.86	66.57	67.03	68.11
B-Estimate	62.18					
A-Estimate	56.67	65.77	67.02	57.66	64.03	65.11
Method	ANOVA	Pooled	Pooled	Non-Parm.	Pooled	Pooled
Modified CV Basis Values and Estimates						
B-Basis Value	NA	64.16	65.27	NA	63.57	64.65
A-Estimate		58.05	59.05		58.22	59.30
Method		Normal	Normal		Pooled	Pooled

Table 4-29: Statistics, B-Basis Values and Estimates for FHT1 Strength Data

4.18 “10/80/10” Filled-Hole Tension 2 (FHT2)

The FHT2 data is normalized by cured ply thickness. Both normalized and as-measured statistics are provided. Tests were conducted in the following environmental conditions: CTA, RTA, and ETW.

For the normalized dataset, the RTA condition failed the ADK test for batch equivalency, therefore pooling was not possible. ANOVA was used to compute estimates for RTA, the single point normal method was used for CTA and the single point non-parametric method was used for ETW. Applying the modified CV, there were no diagnostic test failures so the three conditions were pooled.

For the as-measured dataset, the RTA and ETW conditions failed the ADK test for batch equivalency, therefore pooling was not possible. ANOVA was used to compute estimates for RTA and ETW and the single point normal method was used for CTA. Applying the modified CV, there were no diagnostic test failures so the three conditions were pooled.

There were no statistical outliers.

Statistics, B-Basis values and estimates are given for the FHT2 strength data in Table 4-30. The normalized data, B-Basis values and B-estimates are shown graphically in Figure 4-27.

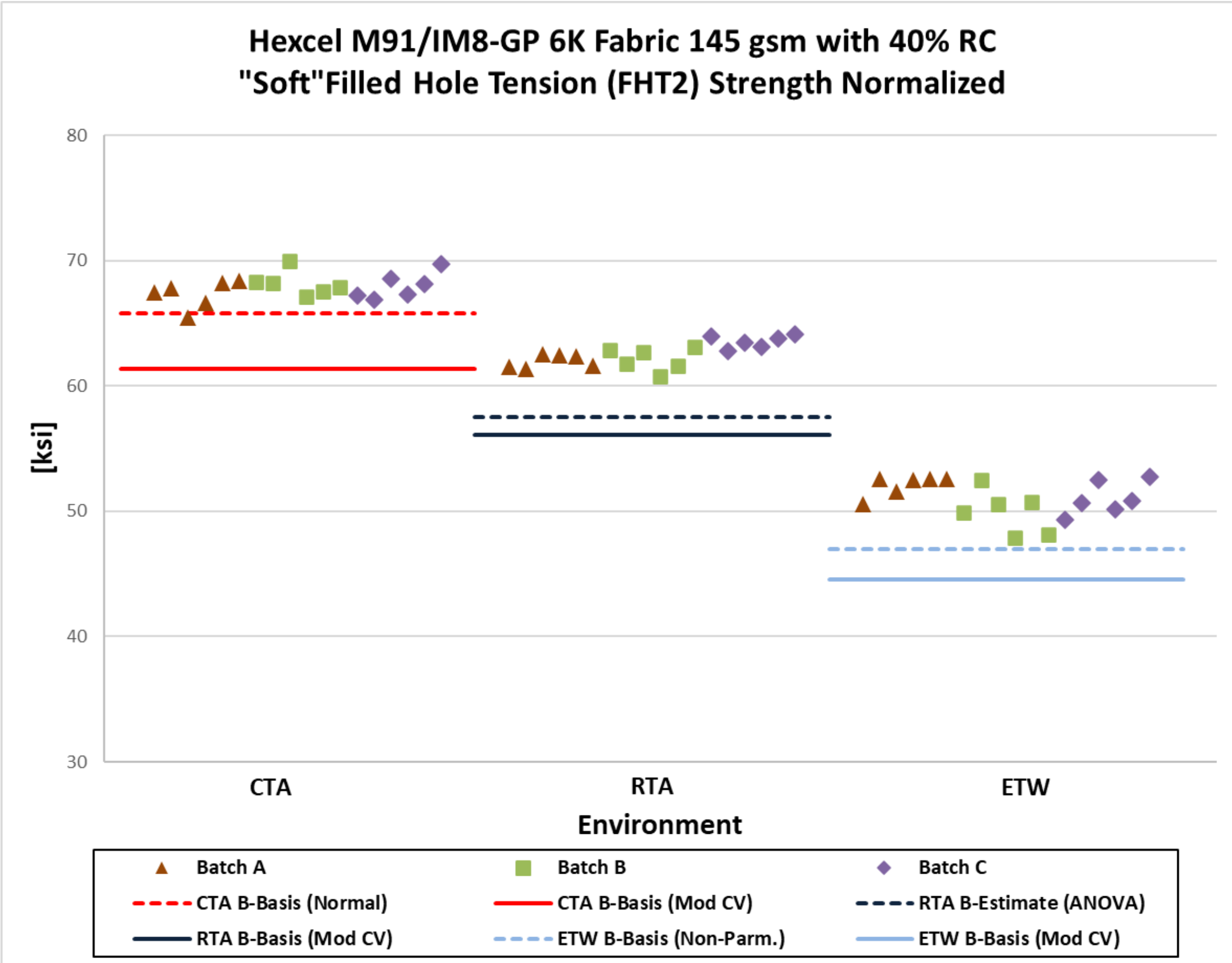

Figure 4-27: Batch plot for FHT2 Normalized Strength

Filled-Hole Tension 2 (FHT2) Strength (ksi) Basis Values and Statistics						
	Normalized			As-Measured		
Environment	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)
Mean	67.84	62.56	51.03	66.43	61.26	50.05
Stdev	1.049	0.9479	1.542	1.465	1.530	1.996
CV	1.546	1.515	3.021	2.206	2.497	3.988
Mod CV	6.000	6.000	6.000	6.000	6.000	6.000
Min	65.49	60.81	47.93	63.28	58.35	45.91
Max	70.01	64.10	52.77	69.17	63.29	52.42
No. Batches	3	3	3	3	3	3
No. Spec.	18	18	18	18	18	18
Basis Values and Estimates						
B-Basis Value	65.77		46.97	63.53		
B-Estimate		57.50			51.30	38.88
A-Estimate	64.30	53.90	41.51	61.48	44.20	30.92
Method	Normal	ANOVA	Non-Parm.	Normal	ANOVA	ANOVA
Modified CV Basis Values and Estimates						
B-Basis Value	61.37	56.09	44.56	60.09	54.92	43.72
A-Estimate	57.06	51.78	40.25	55.86	50.69	39.49
Method	Pooled	Pooled	Pooled	Pooled	Pooled	Pooled

Table 4-30: Statistics, B-Basis Values and Estimates for FHT2 Strength Data

"40/20/40" Filled-Hole Tension 3 (FHT3)

The FHT3 data is normalized by cured ply thickness. Both normalized and as-measured statistics are provided. Tests were conducted in the following environmental conditions: CTA, RTA, and ETW.

For both the normalized and as-measured datasets the ETW condition failed the ADK test for batch equivalency. ANOVA was used to compute estimates for ETW and the remaining conditions were pooled. Applying the modified CV, for both datasets, there were no diagnostic test failures so the three conditions were pooled.

There was one statistical outlier. The highest normalized value in batch A of the ETW condition was an outlier for the condition but not for the batch. It was an outlier in the normalized dataset but not in the as-measured dataset. It was retained for this analysis.

Statistics, B-Basis values and estimates are given for the FHT3 strength data in Table 4-31. The normalized data, B-Basis values and B-estimates are shown graphically in Figure 4-28.

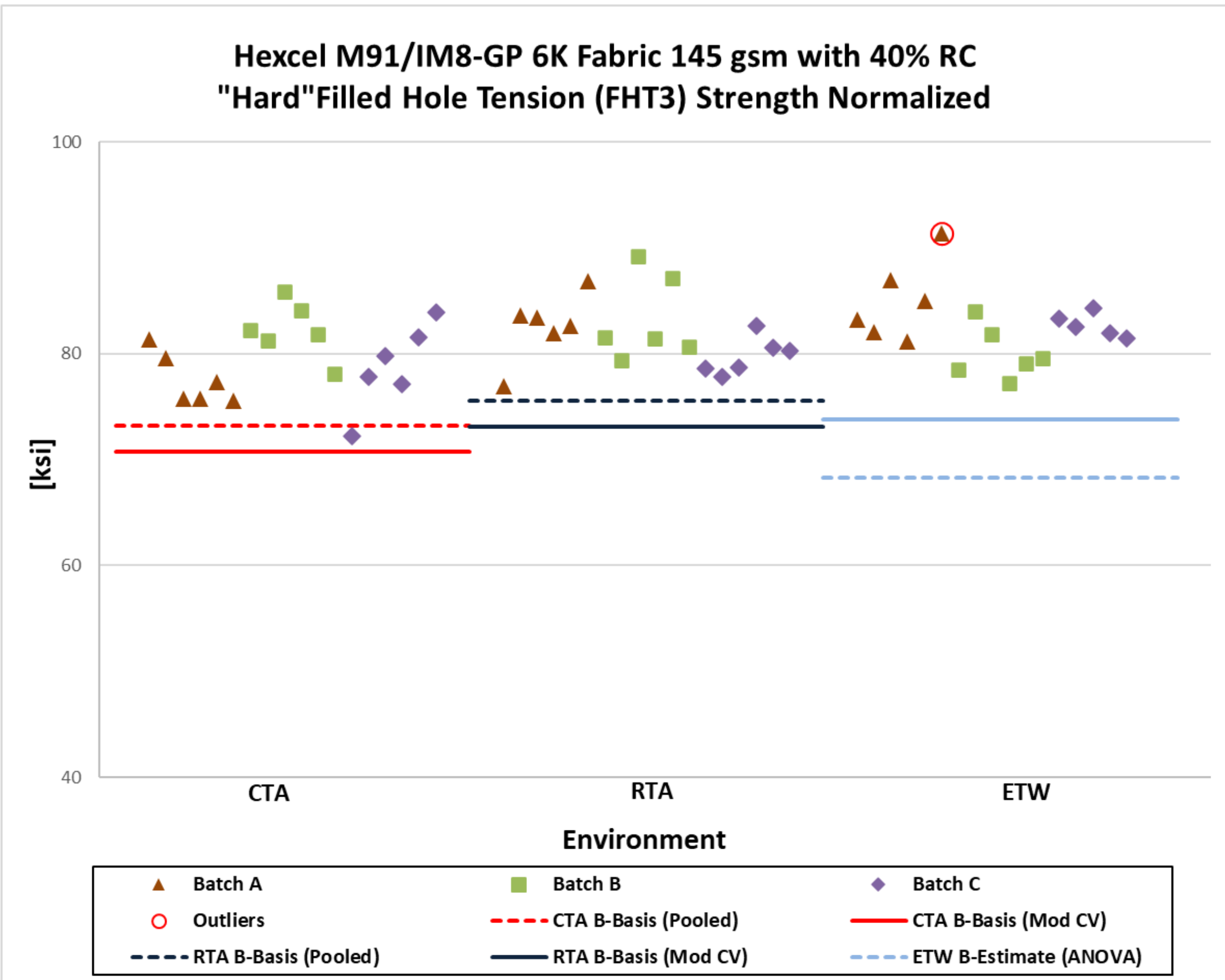

Figure 4-28: Batch plot for FHT3 Normalized Strength

Filled-Hole Tension 3 (FHT3) Strength (ksi) Basis Values and Statistics						
	Normalized			As-Measured		
Environment	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)
Mean	79.51	81.85	82.57	77.95	80.00	80.69
Stdev	3.567	3.321	3.249	3.019	3.027	3.630
CV	4.486	4.058	3.934	3.872	3.784	4.499
Mod CV	6.243	6.029	6.000	6.000	6.000	6.249
Min	72.21	76.91	77.24	72.35	74.64	74.39
Max	85.89	89.19	91.38	83.05	85.77	89.22
No. Batches	3	3	3	3	3	3
No. Spec.	18	18	18	18	18	18
Basis Values and Estimates						
B-Basis Value	73.23	75.57		72.44	74.49	
B-Estimate			68.33			62.30
A-Estimate	68.96	71.30	58.17	68.70	70.75	49.19
Method	Pooled	Pooled	ANOVA	Pooled	Pooled	ANOVA
Modified CV Basis Values and Estimates						
B-Basis Value	70.74	73.08	73.81	69.38	71.43	72.12
A-Estimate	64.89	67.23	67.96	63.66	65.71	66.40
Method	Pooled	Pooled	Pooled	Pooled	Pooled	Pooled

Table 4-31: Statistics, B-Basis Values and Estimates for FHT3 Strength Data

4.19 "25/50/25" Open-Hole Compression 1 (OHC1)

The OHC1 data is normalized by cured ply thickness. Both normalized and as-measured statistics are provided. Tests were conducted in the following environmental conditions: RTA and ETW.

For both the normalized and the as-measured datasets, the ETW condition ailed the ADK test for batch equivalency. ANOVA was used to compute estimates for ETW and the single point normal method was used for RTA. Applying the modified CV, for both datasets, there were no diagnostic test failures so the two conditions were pooled.

There were no statistical outliers.

Statistics, B-Basis values and estimates are given for the OHC1 strength data in Table 4-32. The normalized data, B-Basis values and B-estimates are shown graphically in Figure 4-29.

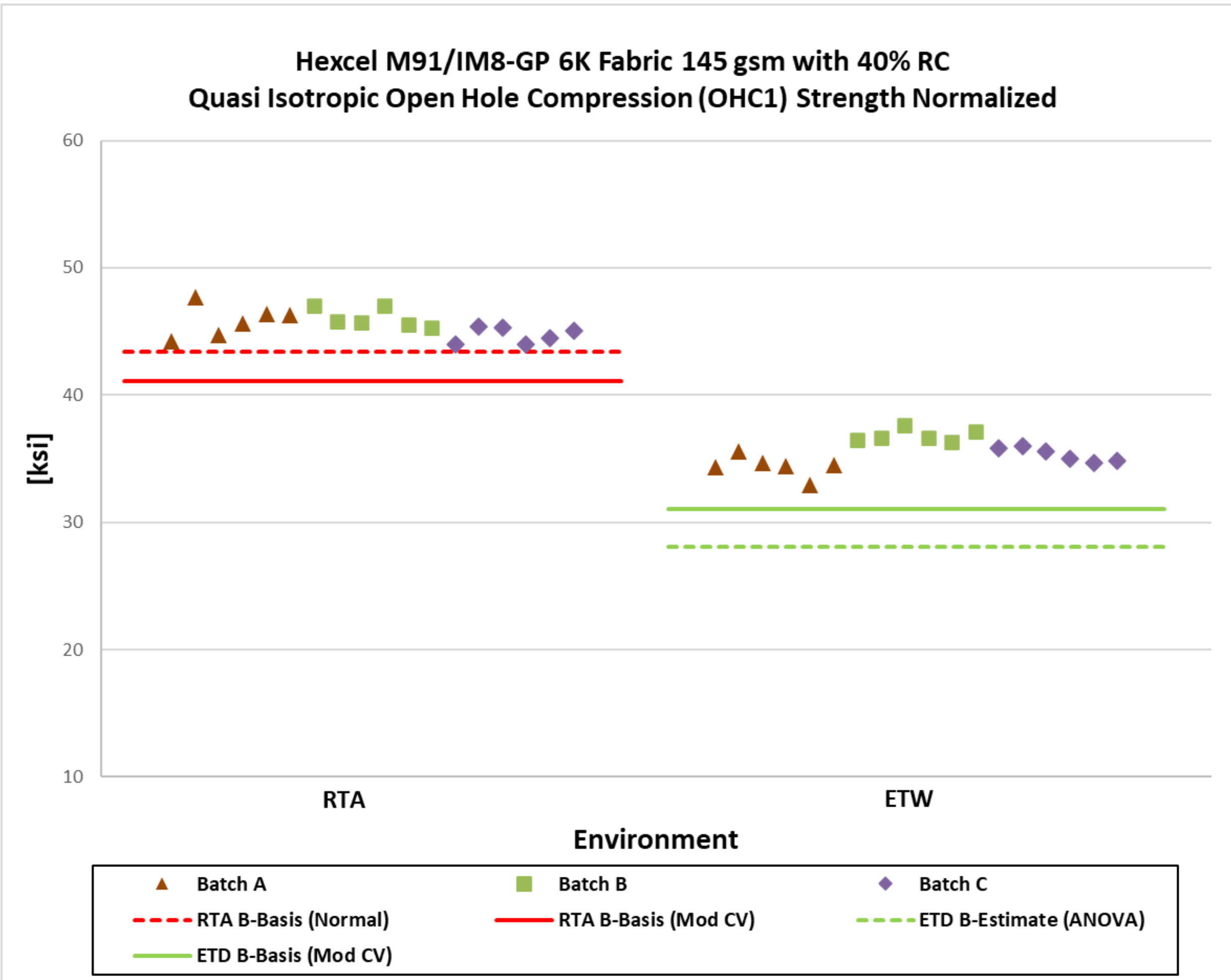

Figure 4-29: Batch Plot for OHC1 Normalized Strength

Open Hole Compression 1 (OHC1) Strength (ksi) Basis Values and Statistics				
	Normalized		As-Measured	
Environment	RTA (70 °F)	ETW (180 °F)	RTA (70 °F)	ETW (180 °F)
Mean	45.53	35.50	44.55	34.54
Stdev	1.063	1.198	0.8052	0.9726
CV	2.335	3.374	1.808	2.816
Mod CV	6.000	6.000	6.000	6.000
Min	43.96	32.91	43.55	32.09
Max	47.72	37.66	46.52	35.82
No. Batches	3	3	3	3
No. Spec.	18	18	18	18
Basis Values and Estimates				
B-Basis Value	43.43		42.96	
B-Estimate		28.09		28.93
A-Estimate	41.94	22.79	41.83	24.93
Method	Normal	ANOVA	Normal	ANOVA
Modified CV Basis Values and Estimates				
B-Basis Value	41.07	31.04	40.19	30.18
A-Estimate	38.03	28.01	37.23	27.22
Method	Pooled	Pooled	Pooled	Pooled

Table 4-32: Statistics and Basis Values for OHC1 Strength Data

4.20 “10/80/10” Open-Hole Compression 2 (OHC2)

The OHC2 data is normalized by cured ply thickness. Both normalized and as-measured statistics are provided. Tests were conducted in the following environmental conditions: RTA and ETW.

For the normalized dataset, both conditions failed the ADK test for batch equivalency, therefore pooling was not possible. ANOVA was used to compute estimates for RTA and ETW. Applying the modified CV, the RTA condition failed the normality test, therefore Basis values were not computed for RTA and the normal method for modified CV was used for ETW.

For the as-measured dataset, the ETW condition failed the ADK test for batch equivalency. ANOVA was used to compute estimates for ETW and the single point non-parametric method was used for RTA. Applying the modified CV, both conditions were not pooled because the pooled dataset failed the Anderson Darling test for normality. The normal method for modified CV was used for both conditions.

There was one statistical outlier. The highest as-measured value in batch A of the RTA condition was an outlier for the condition but not for the batch. It was an outlier in the as-measured dataset but not in the normalized dataset. It was retained for this analysis.

Statistics, B-Basis values and estimates are given for the OHC2 strength data in Table 4-33. The normalized data, B-Basis values and B-estimates are shown graphically in Figure 4-30.

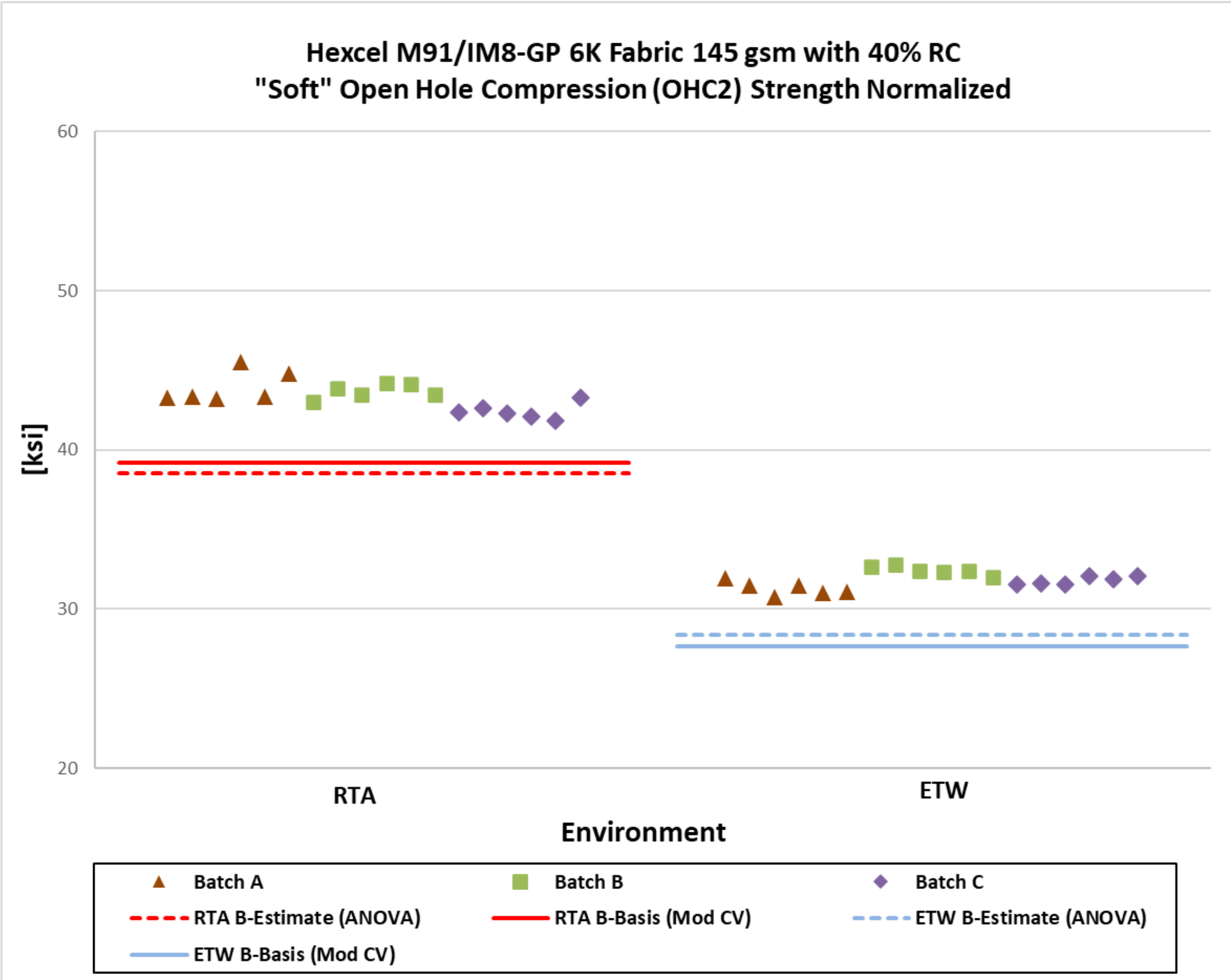

Figure 4-30: Batch Plot for OHC2 Normalized Strength

Open Hole Compression 2 (OHC2) Strength (ksi) Basis Values and Statistics				
	Normalized		As-Measured	
Environment	RTA (70 °F)	ETW (180 °F)	RTA (70 °F)	ETW (180 °F)
Mean	43.35	31.84	42.27	31.00
Stdev	0.9446	0.5693	0.7203	0.5254
CV	2.179	1.788	1.704	1.695
Mod CV	6.000	6.000	6.000	6.000
Min	41.84	30.75	41.33	29.93
Max	45.53	32.80	44.32	31.67
No. Batches	3	3	3	3
No. Spec.	18	18	18	18
Basis Values and Estimates				
B-Basis Value			41.07	
B-Estimate	38.53	28.39		28.00
A-Estimate	35.09	25.93	37.21	25.85
Method	ANOVA	ANOVA	Non-Parm.	ANOVA
Modified CV Basis Values and Estimates				
B-Basis Value	39.19	27.68	37.26	27.33
A-Estimate	36.36	24.85	33.72	24.73
Method	Pooled	Pooled	Normal	Normal

Table 4-33: Statistics, B-Basis Values and Estimates for OHC2 Strength Data

4.21 "40/20/40" Open-Hole Compression 3 (OHC3)

The OHC3 data is normalized by cured ply thickness. Both normalized and as-measured statistics are provided. Tests were conducted in the following environmental conditions: RTA and ETW.

For both the normalized and as-measured datasets, using the as-measured and modified CV, there were no diagnostic test failures. Therefore, both conditions were pooled in every scenario.

There were three statistical outliers. The highest normalized value in batch B of the RTA condition was an outlier for the batch but not for the condition. It was an outlier in the normalized dataset and in the as-measured dataset. The lowest normalized value in batch C of the RTA condition was an outlier for the condition but not for the batch. It was an outlier in the normalized dataset but not in the as-measured dataset. The lowest as-measured value in batch B of the ETW condition was an outlier for the condition but not for the batch. It was an outlier in the as-measured dataset but not in the normalized dataset. They were retained for this analysis.

Statistics, B-Basis values and estimates are given for the OHC3 strength data in Table 4-34. The normalized data, B-Basis values and B-estimates are shown graphically in Figure 4-31.

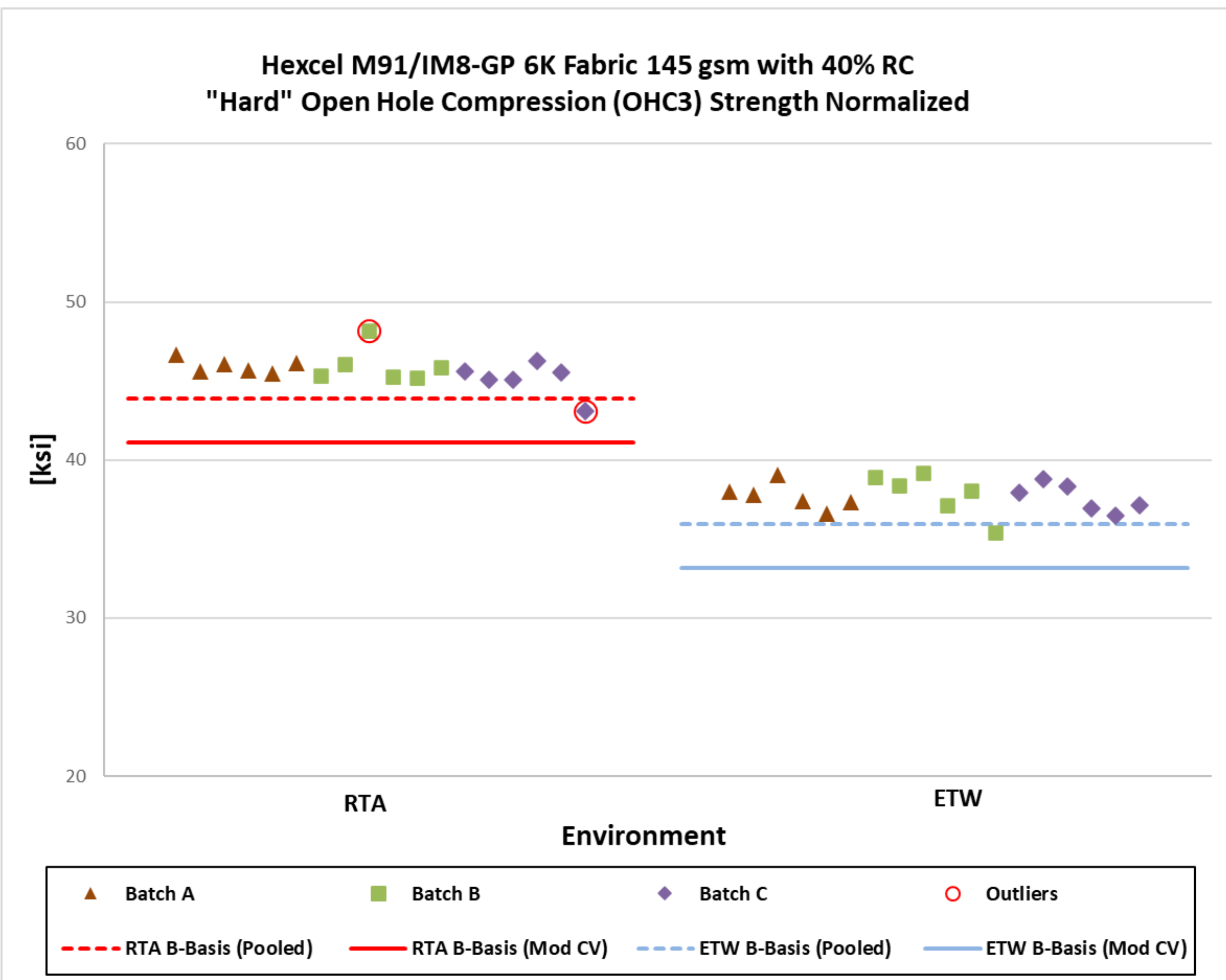

Figure 4-31: Batch Plot for OHC3 Normalized Strength

Open Hole Compression 3 (OHC3) Strength (ksi) Basis Values and Statistics				
	Normalized		As-Measured	
Environment	RTA (70 °F)	ETW (180 °F)	RTA (70 °F)	ETW (180 °F)
Mean	45.69	37.72	44.58	36.72
Stdev	0.9685	0.9993	0.9716	1.004
CV	2.120	2.649	2.179	2.734
Mod CV	6.000	6.000	6.000	6.000
Min	43.11	35.45	42.50	34.03
Max	48.20	39.16	46.28	38.23
No. Batches	3	3	3	3
No. Spec.	18	18	18	18
Basis Values and Estimates				
B-Basis Value	43.90	35.93	42.78	34.92
A-Estimate	42.68	34.71	41.56	33.69
Method	Pooled	Pooled	Pooled	Pooled
Modified CV Basis Values and Estimates				
B-Basis Value	41.11	33.14	40.12	32.25
A-Estimate	37.99	30.03	37.08	29.22
Method	Pooled	Pooled	Pooled	Pooled

Table 4-34: Statistics and Basis Values for OHC3 Strength Data

4.22 "25/50/25" Filled-Hole Compression 1 (FHC1)

The FHC1 data is normalized by cured ply thickness. Both normalized and as-measured statistics are provided. Tests were conducted in the following environmental conditions: RTA and ETW.

Both conditions consist of less than thirteen specimens, therefore only estimates were computed.

For both the normalized and as-measured datasets the normal method was used to compute estimates for both conditions.

There were no statistical outliers.

Statistics and estimates are given for the FHC1 strength data in Table 4-35. The normalized data and estimates are shown graphically in Figure 4-32.

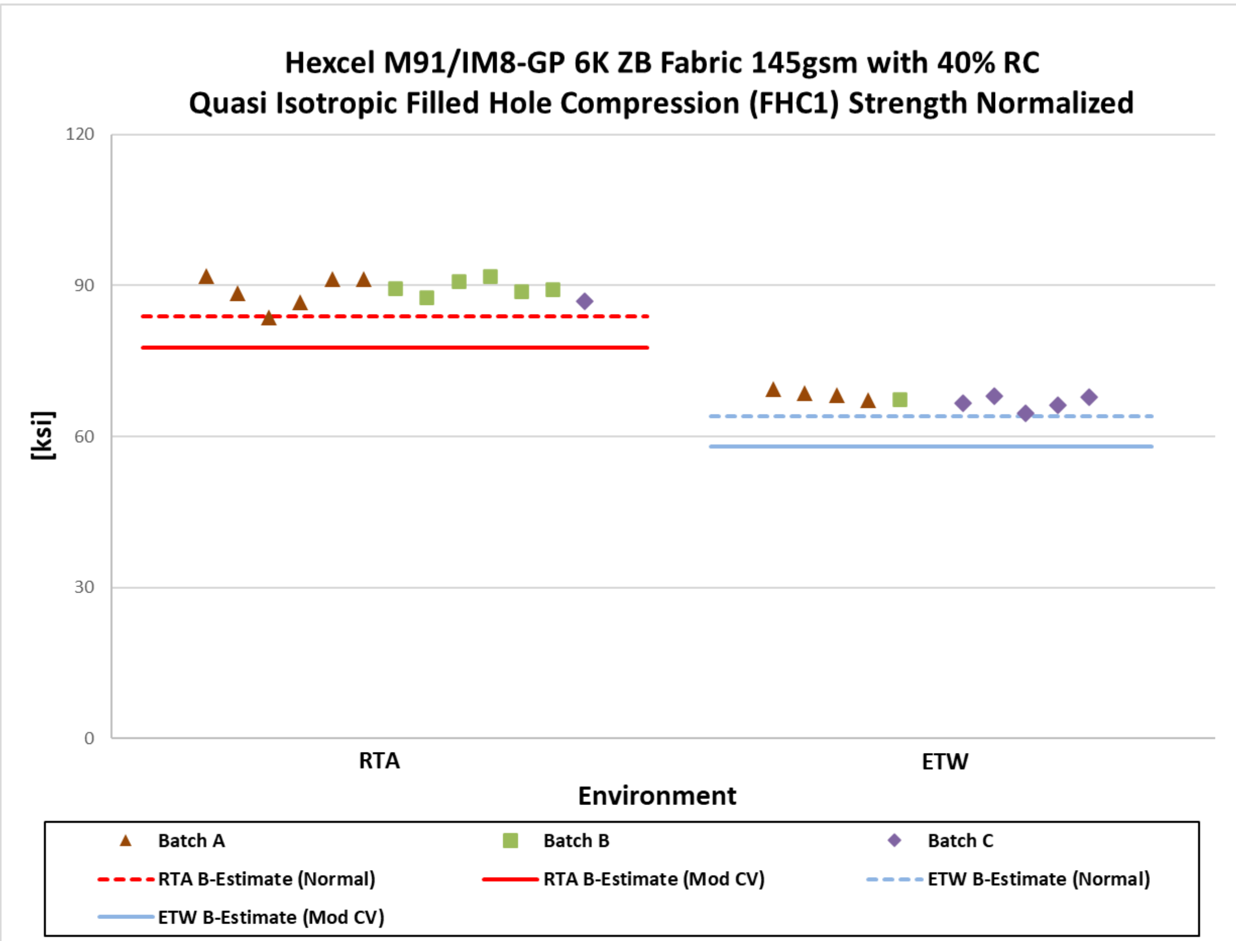

Figure 4-32: Batch plot for FHC1 Normalized Strength

Filled-Hole Compression 1 (FHC1) Strength (ksi) Basis Values and Statistics				
	Normalized		As-Measured	
Environment	RTA (70 °F)	ETW (180 °F)	RTA (70 °F)	ETW (180 °F)
Mean	89.11	67.24	86.76	66.17
Stdev	2.428	1.435	2.417	1.268
CV	2.724	2.134	2.786	1.916
Mod CV	6.000	6.000	6.000	6.000
Min	83.71	64.65	81.83	63.92
Max	91.90	69.49	90.30	68.08
No. Batches	3	3	3	3
No. Spec.	13	11	13	11
Estimates				
B-Estimate	83.86	63.96	81.53	63.28
A-Estimate	80.19	61.67	77.87	61.26
Method	Normal	Normal	Normal	Normal
Modified CV Estimates				
B-Estimate	77.56	58.03	75.51	57.11
A-Estimate	69.46	51.59	67.63	50.77
Method	Normal	Normal	Normal	Normal

Table 4-35: Statistics and Basis Values for FHC1 Strength Data

4.23 "10/80/10" Filled-Hole Compression 2 (FHC2)

The FHC2 data is normalized by cured ply thickness. Both normalized and as-measured statistics are provided. Tests were conducted in the following environmental conditions: RTA and ETW.

Both environments consist of fifteen specimens or less, therefore only estimates were computed.

For the normalized dataset, the normal method was used to compute estimates for both conditions using the as-measured CV and the modified CV.

For the as-measured dataset, the RTA condition failed the ADK test for batch equivalency. ANOVA was used for RTA and the single point normal method was used for ETW. Applying the modified CV, the normal method for modified CV was used for both conditions.

There was one statistical outlier. The highest normalized value in batch C of the RTA condition was an outlier for the batch but not for the condition It was an outlier in the normalized dataset but not in the as-measured dataset. It was retained for this analysis.

Statistics and estimates are given for the FHC2 strength data in Table 4-36. The normalized data and estimates are shown graphically in Figure 4-33.

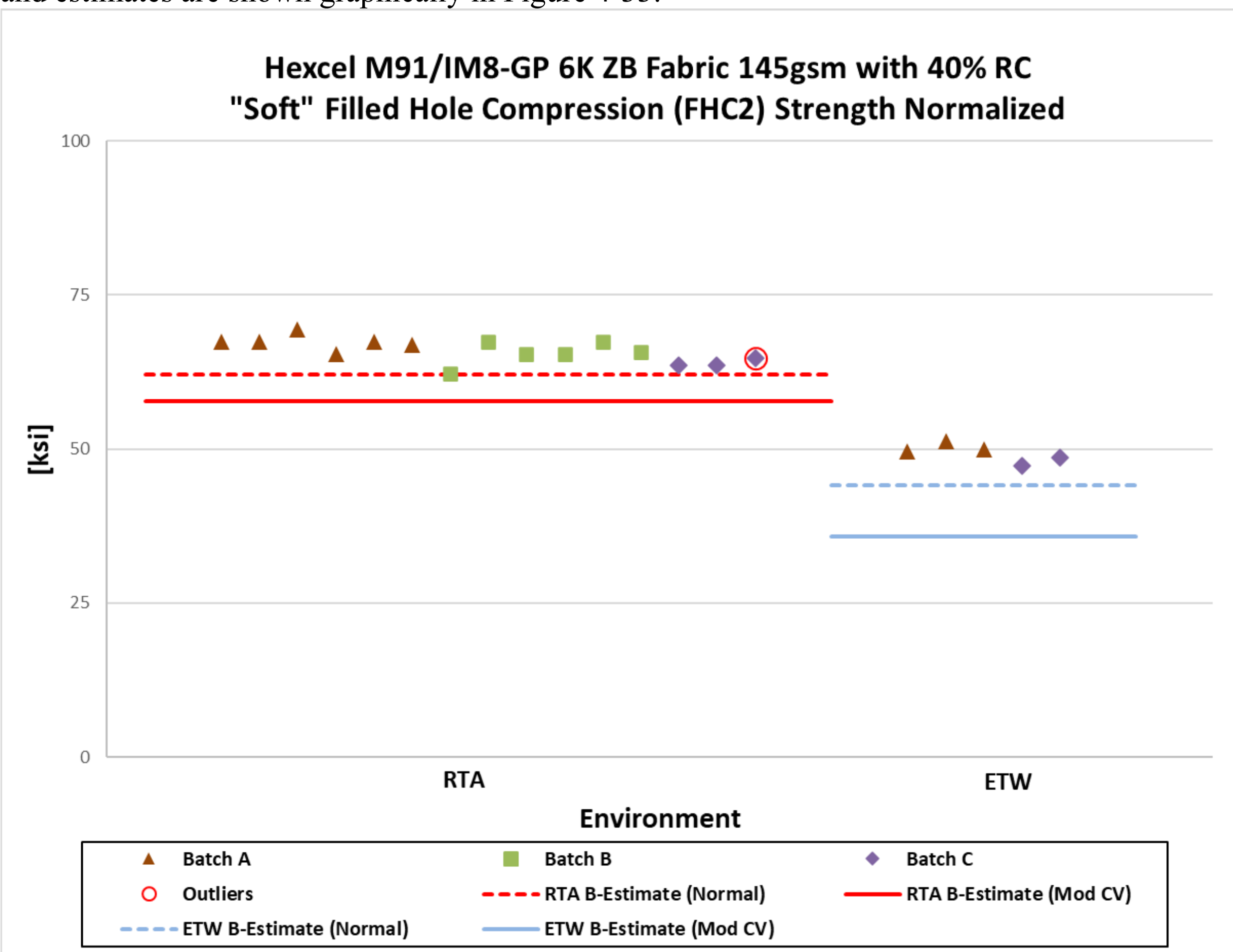

Figure 4-33: Batch Plot for FHC2 Normalized Strength

Filled-Hole Compression 2 (FHC2) Strength (ksi) Basis Values and Statistics				
	Normalized		As-Measured	
Environment	RTA (70 °F)	ETW (180 °F)	RTA (70 °F)	ETW (180 °F)
Mean	65.97	49.37	64.47	48.68
Stdev	1.888	1.515	1.861	1.443
CV	2.863	3.068	2.887	2.964
Mod CV	6.000	8.000	6.000	8.000
Min	62.30	47.23	60.48	46.67
Max	69.41	51.29	68.17	50.62
No. Batches	3	2	3	2
No. Spec.	15	5	15	5
Estimates				
B-Estimate	62.06	44.19	54.62	43.75
A-Estimate	59.30	40.43	47.61	40.17
Method	Normal	Normal	ANOVA	Normal
Modified CV Estimates				
B-Estimate	57.77	35.87	56.46	35.37
A-Estimate	52.00	26.06	50.82	25.70
Method	Normal	Normal	Normal	Normal

Table 4-36: Statistics and Basis Values for FHC2 Strength Data

4.24 "40/20/40" Filled-Hole Compression 3 (FHC3)

The FHC3 data is normalized by cured ply thickness. Both normalized and as-measured statistics are provided. Tests were conducted in the following environmental conditions: RTA and ETW.

For both the normalized and as-measured datasets, using the as-measured and modified CV, there were no diagnostic test failures, therefore the two conditions were pooled for all scenarios.

There was one statistical outlier. The highest normalized value in batch C of the ETW condition was an outlier for the batch but not for the condition. It was an outlier in the normalized dataset but not in the as-measured dataset. It was retained for this analysis.

Statistics, B-Basis values and estimates are given for the FHC3 strength data in Table 4-37. The normalized data and B-Basis values are shown graphically in Figure 4-34.

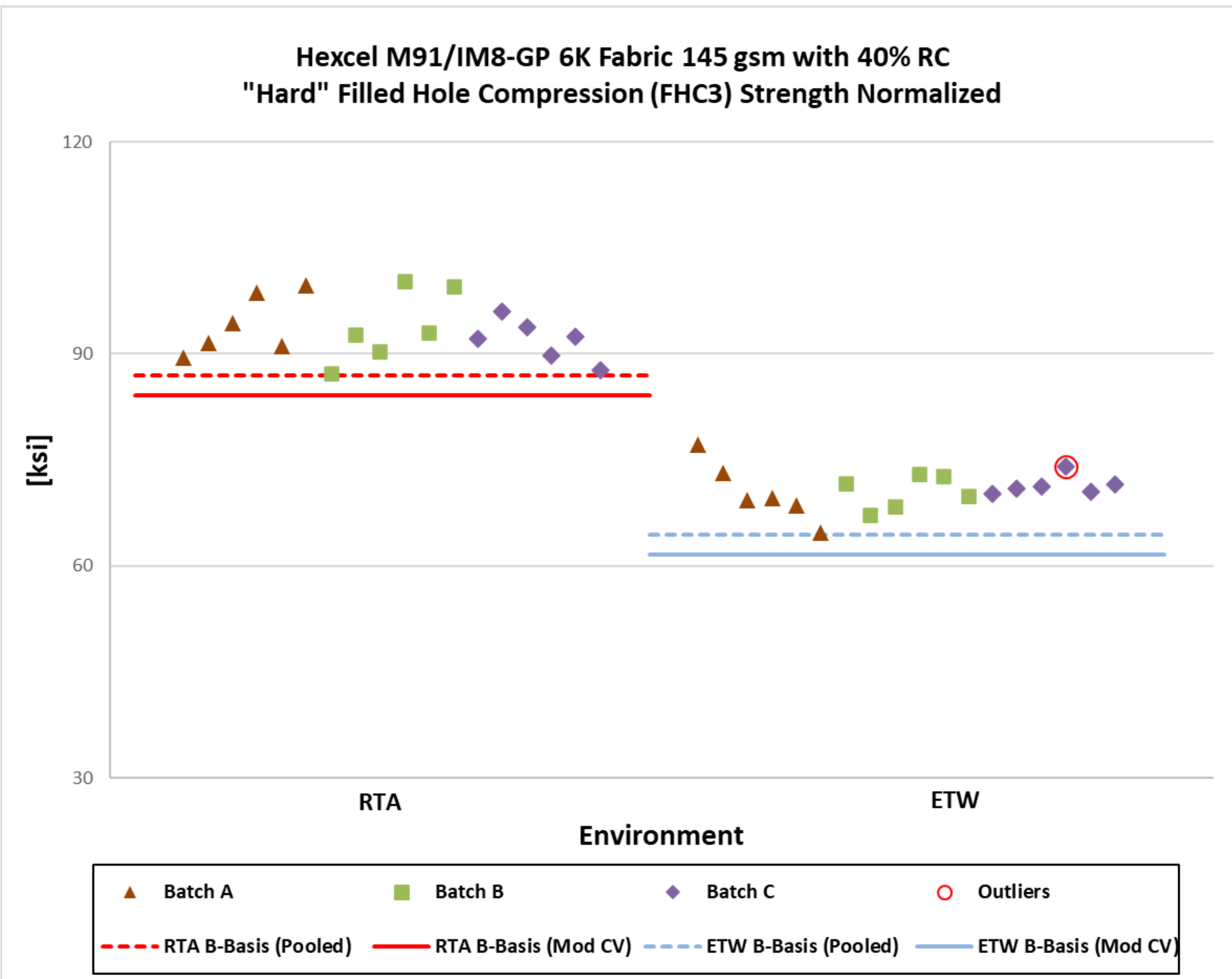

Figure 4-34: Batch Plot for FHC3 Normalized Strength

Filled-Hole Compression 3 (FHC3) Strength (ksi) Basis Values and Statistics				
	Normalized		As-Measured	
Environment	RTA (70 °F)	ETW (180 °F)	RTA (70 °F)	ETW (180 °F)
Mean	93.33	70.78	91.40	69.04
Stdev	4.047	2.801	3.945	2.840
CV	4.336	3.957	4.316	4.114
Mod CV	6.168	6.000	6.158	6.057
Min	87.29	64.67	84.45	63.65
Max	100.3	77.16	98.00	75.59
No. Batches	3	3	3	3
No. Spec.	18	18	18	18
Basis Values and Estimates				
B-Basis Value	86.99	64.44	85.14	62.77
A-Estimate	82.68	60.13	80.88	58.52
Method	Pooled	Pooled	Pooled	Pooled
Modified CV Basis Values and Estimates				
B-Basis Value	84.11	61.56	82.37	60.00
A-Estimate	77.85	55.30	76.23	53.86
Method	Pooled	Pooled	Pooled	Pooled

Table 4-37: Statistics, Basis Values and Estimates for FHC3 Strength Data

4.25 “25/50/25” Single-Shear Bearing 1 Proc. C (SSB1, D=0.19”, e=0.38)

The SSB1 data is normalized by cured ply thickness. Both normalized and as-measured statistics are provided. Tests were conducted in the following environmental conditions: RTA and ETW. Initial Peak strength tests were conducted in the ETW condition, but due to insufficient data only basis value estimates were computed for that test.

The 2% offset strength for ETW was lower for batch C as a compounded failure mode of bearing and shear was observed, compared to batches A and B, in which only bearing failure was observed.

For the normalized datasets, the ultimate strength RTA condition failed the ADK test for batch equivalency, therefore pooling was not possible. ANOVA was used to compute estimates for RTA and the single point normal method was used for ETW. Applying the modified CV, there were no diagnostic test failures so both conditions were pooled. The 2% offset strength ETW condition failed the ADK test for batch equivalency, therefore pooling was not possible. ANOVA was used to compute estimates for ETW and the single point normal method was used for RTA. The A-Estimate for ETW is zero because the software results gave a negative value. Applying the modified CV, the ETW condition failed the ADK test, so Basis values were not computed for ETW and the normal method for modified CV was used for RTA. The normal method was used for the initial peak strength ETW dataset, using the original CV and modified CV.

For the as-measured datasets, the ultimate strength conditions were not pooled because the pooled dataset failed the Anderson Darling test for normality. The single point normal method was used to compute values for RTA and ETW. Applying the modified CV, there were n diagnostic test failures so both conditions were pooled. The 2% offset strength ETW condition failed the ADK test for batch equivalency, therefore pooling was not possible. ANOVA was used to compute estimates for ETW and the single point normal method was used for RTA. The A-Estimate for ETW is zero because the software results gave a negative value. Applying the modified CV, the ETW condition failed the ADK test, so Basis values were not computed for ETW and the normal method for modified CV was used for RTA. The normal method was used for the initial peak strength ETW dataset, using the original CV and modified CV.

There was one statistical outlier. The lowest value in batch C of the RTA condition for the 2% offset strength dataset was an outlier for the condition but not for the batch. It was an outlier in the normalized dataset and in the as-measured dataset. It was retained for this analysis.

Statistics, B-Basis values and estimates are given for the SSB1 strength data in Table 4-38. The normalized data, B-Basis values and B-estimates are shown graphically in Figure 4-35.

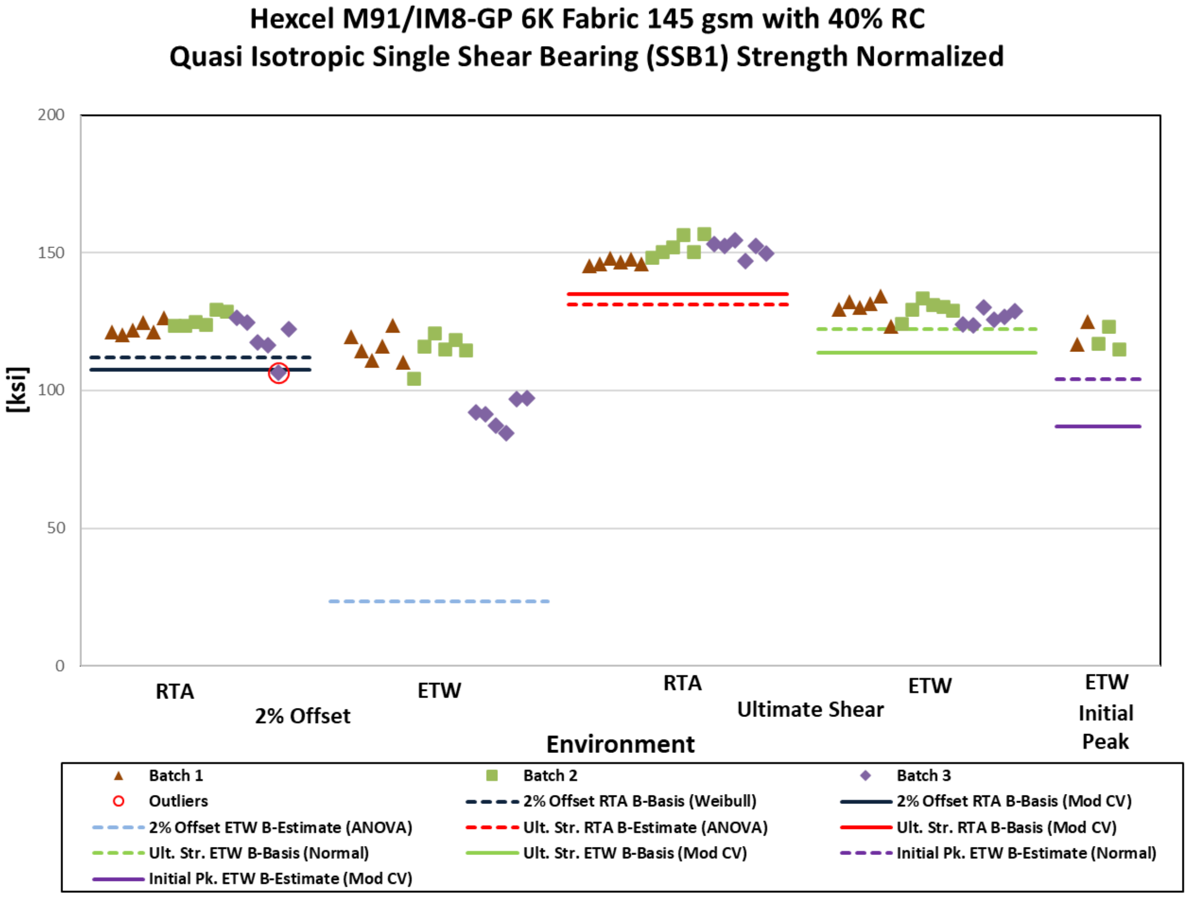

Figure 4-35: Batch Plot for SSB1 Proc. C Normalized Strength

Single-Shear Bearing 1 Proc. C (SSB1, D=0.19”, e=0.38) Strength (ksi) Basis Values and Statistics										
	Normalized					As-Measured				
Property	Ultimate Strength		2% Offset Strength		Initial Peak Strength	Ultimate Strength		2% Offset Strength		Initial Peak Strength
Environment	RTA (70 °F)	ETW (180 °F)	RTA (70 °F)	ETW (180 °F)	ETW (180 °F)	RTA (70 °F)	ETW (180 °F)	RTA (70 °F)	ETW (180 °F)	ETW (180 °F)
Mean	150.2	128.8	122.4	107.4	119.5	148.8	127.5	121.2	106.3	117.0
Stdev	3.625	3.405	5.230	12.59	4.470	3.292	2.935	4.783	11.80	5.023
CV	2.413	2.643	4.272	11.72	3.742	2.213	2.302	3.945	11.11	4.292
Mod CV	6.000	6.000	6.136	11.72	8.000	6.000	6.000	6.000	11.11	8.000
Min	145.2	123.3	106.4	84.53	115.0	144.4	123.5	105.9	84.28	111.7
Max	157.0	134.3	129.3	123.7	125.1	154.9	133.7	127.1	123.2	124.5
No. Batches	3	3	3	3	2	3	3	3	3	2
No. Spec.	18	18	18	18	5	18	18	18	18	5
Basis Values and Estimates										
B-Basis Value		122.1	112.0			142.3	121.7	112.3		
B-Estimate	131.4			23.36	104.2				27.27	99.86
A-Estimate	117.9	117.3	101.1	0.000	93.08	137.7	117.6	102.8	0.000	87.39
Method	ANOVA	Normal	Weibull	ANOVA	Normal	Normal	Normal	Weibull	ANOVA	Normal
Modified CV Basis Values and Estimates										
B-Basis Value	134.9	113.5	107.6	NA		133.6	112.4	106.9	NA	
B-Estimate					86.79					85.02
A-Estimate	124.5	103.1	97.09		63.07	123.3	102.1	96.71		61.78
Method	Pooled	Pooled	Normal		Normal	Pooled	Pooled	Normal		Normal
*2% Offset was lower for batch C as a compounded failure mode of bearing and shear was observed, compared to batches A and B, in which only bearing failure was observed										

Table 4-38: Statistics, B-Basis Values and Estimates for SSB1 Proc. C Strength Data

4.26 "40/20/40" Single-Shear Bearing 3 Proc. C (SSB3, D=0.19", e=0.38)

The SSB3 data is normalized by cured ply thickness. Both normalized and as-measured statistics are provided. Tests were conducted in the following environmental conditions: RTA and ETW. Initial Peak strength tests were conducted but due to insufficient data only basis value estimates were computed for that test.

The ETW condition for the 2% offset strength dataset consist of sixteen specimens, therefore only estimates were computed for that property and condition.

For the normalized ultimate shear strength dataset, there were no diagnostic test failures using the as-measured CV and the modified CV, therefore both conditions were pooled. For the normalized 2% offset strength dataset, the single point normal method was used for both conditions. Applying the modified CV, the normal method for modified CV was used for both conditions. For normalized initial peak strength, the normal method was used using the original CV and modified CV.

For the as-measured ultimate shear strength dataset, the RTA condition failed the ADK test for batch equivalency. ANOVA was used to compute estimates for RTA and the single point normal method was used for ETW. Applying the modified CV, there were no diagnostic test failures so both conditions were pooled. For the as-measured 2% offset strength dataset, the single point normal method was used for both conditions. Applying the modified CV, the normal method for modified CV was used for both conditions. For the as-measured initial peak strength dataset, the ETW condition failed the ADK test for batch equivalency. ANOVA was used for ETW and the normal method for RTA. Applying the modified CV, the ETW condition failed the ADK test, therefore basis value estimates are not available for that condition, and the normal method was used for ETW.

There were two statistical outliers. The highest value in batch B of the RTA condition of the ultimate shear strength dataset was an outlier for the batch but not for the condition. It was an outlier in the normalized dataset and in the as-measured dataset. The highest normalized value in batch C of the RTA condition of the 2% offset strength dataset was an outlier for the batch but not for the condition. It was an outlier in the normalized dataset but not in the as-measured dataset.

Statistics, B-Basis values and estimates are given for the SSB3 strength data in Table 4-39. The normalized data, B-Basis Values and B-estimates are shown graphically in Figure 4-36.

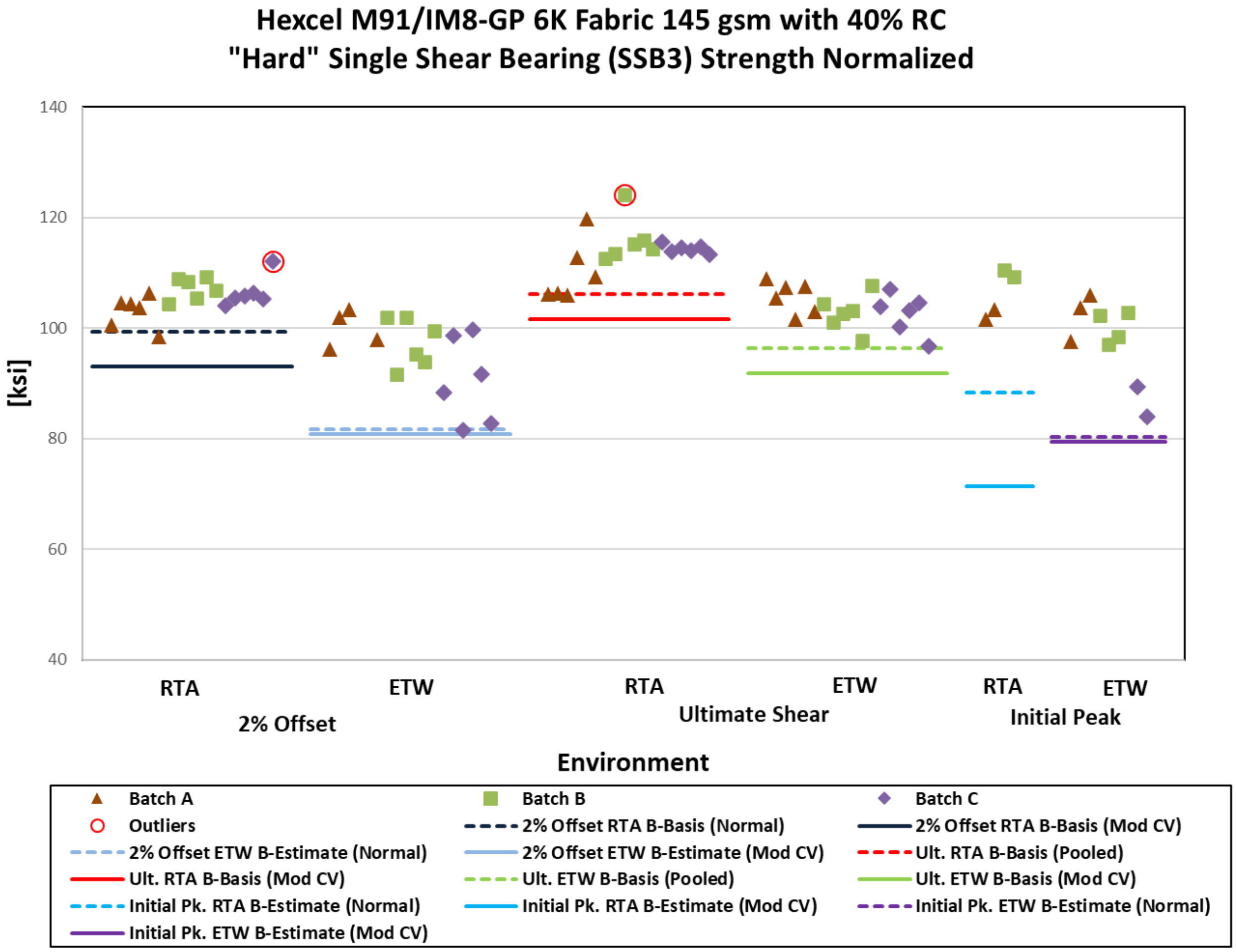

Figure 4-36: Batch Plot for SSB3 Proc. C Normalized Strength

Single-Shear Bearing 3 Proc. C (SSB3, D=0.19”, e=0.38) Strength (ksi) Basis Values and Statistics												
	Normalized						As-Measured					
Property	Ultimate Strength		2% Offset Strength		Initial Peak Strength		Ultimate Strength		2% Offset Strength		Initial Peak Strength	
Environment	RTA (70 °F)	ETW (180 °F)	RTA (70 °F)	ETW (180 °F)	RTA (70 °F)	ETW (180 °F)	RTA (70 °F)	ETW (180 °F)	RTA (70 °F)	ETW (180 °F)	RTA (70 °F)	ETW (180 °F)
Mean	113.5	103.7	105.6	95.44	106.3	97.96	112.3	102.7	104.5	94.44	104.0	96.93
Stdev	4.544	3.409	3.117	6.704	4.387	7.160	3.824	3.900	3.077	6.559	2.418	6.858
CV	4.004	3.287	2.952	7.024	4.129	7.309	3.407	3.798	2.945	6.945	2.325	7.076
Mod CV	6.002	6.000	6.000	7.512	6.064	7.655	6.000	6.000	6.000	7.472	6.000	7.538
Min	106.0	96.75	98.51	81.59	101.7	83.96	106.6	94.69	97.03	81.89	101.8	84.26
Max	124.1	108.9	112.1	103.3	110.6	106.0	121.2	109.1	112.1	103.3	106.7	106.0
No. Batches	3	3	3	3	2	3	3	3	3	3	2	3
No. Spec.	18	18	18	16	4	9	18	18	18	16	4	9
Basis Values and Estimates												
B-Basis Value	106.2	96.39	99.44					94.98	98.40			
B-Estimate				81.80	88.28	80.29	97.96			81.10	94.08	53.53
A-Estimate	101.2	91.41	95.08	72.18	74.67	67.95	87.79	89.52	94.10	71.68	86.58	22.63
Method	Pooled	Pooled	Normal	Normal	Normal	Normal	ANOVA	Normal	Normal	Normal	Normal	ANOVA
Modified CV Basis Values and Estimates												
B-Basis Value	101.6	91.82	93.09				100.5	90.92	92.10			NA
B-Estimate				80.86	71.43	79.46				80.09	78.43	
A-Estimate	93.52	83.74	84.24	70.60	45.05	66.54	92.50	82.92	83.33	69.95	59.07	
Method	Pooled	Pooled	Normal	Normal	Normal	Normal	Pooled	Pooled	Normal	Normal	Normal	

Table 4-39: Statistics, B-Basis Values and Estimates for SSB3 Proc. C Strength Data

4.27 “0/100/0” Single-Shear Bearing 4 Proc. C (SSB4, D=0.19”, e=0.38)

The SSB4 data is normalized by cured ply thickness. Both normalized and as-measured statistics are provided. Tests were conducted in the following environmental conditions: RTA and ETW.

For the normalized ultimate shear strength dataset, both conditions failed the ADK test for batch equivalency. ANOVA was used to compute estimates for both conditions. Applying the modified CV, the ETW condition failed the ADK test, therefore values were not computed for ETW and the normal method for modified CV was used for RTA.

For the normalized 2% offset strength dataset, the RTA condition failed the ADK test for batch equivalency. ANOVA was used to compute estimates for RTA and the single point normal method was used for ETW. Applying the modified CV, there were no diagnostic test failures so both conditions were pooled.

For the as-measured ultimate shear strength dataset, both conditions failed the ADK test for batch equivalency. ANOVA was used to compute estimates for both conditions. Applying the modified CV, the ETW condition failed the ADK test, therefore values were not computed for ETW and the normal method for modified CV was used for RTA.

For the as-measured 2% offset strength dataset, the RTA condition failed the ADK test for batch equivalency. ANOVA was used to compute estimates for RTA and the single point normal method was used for ETW. Applying the modified CV, the RTA condition failed the ADK test and the ETW condition failed the normality test, therefore Basis values were not computed for either condition.

There were no statistical outliers.

Statistics, B-Basis values and estimates are given for the SSB4 strength data in Table 4-40. The normalized data, B-Basis Values and B-estimates are shown graphically in Figure 4-37.

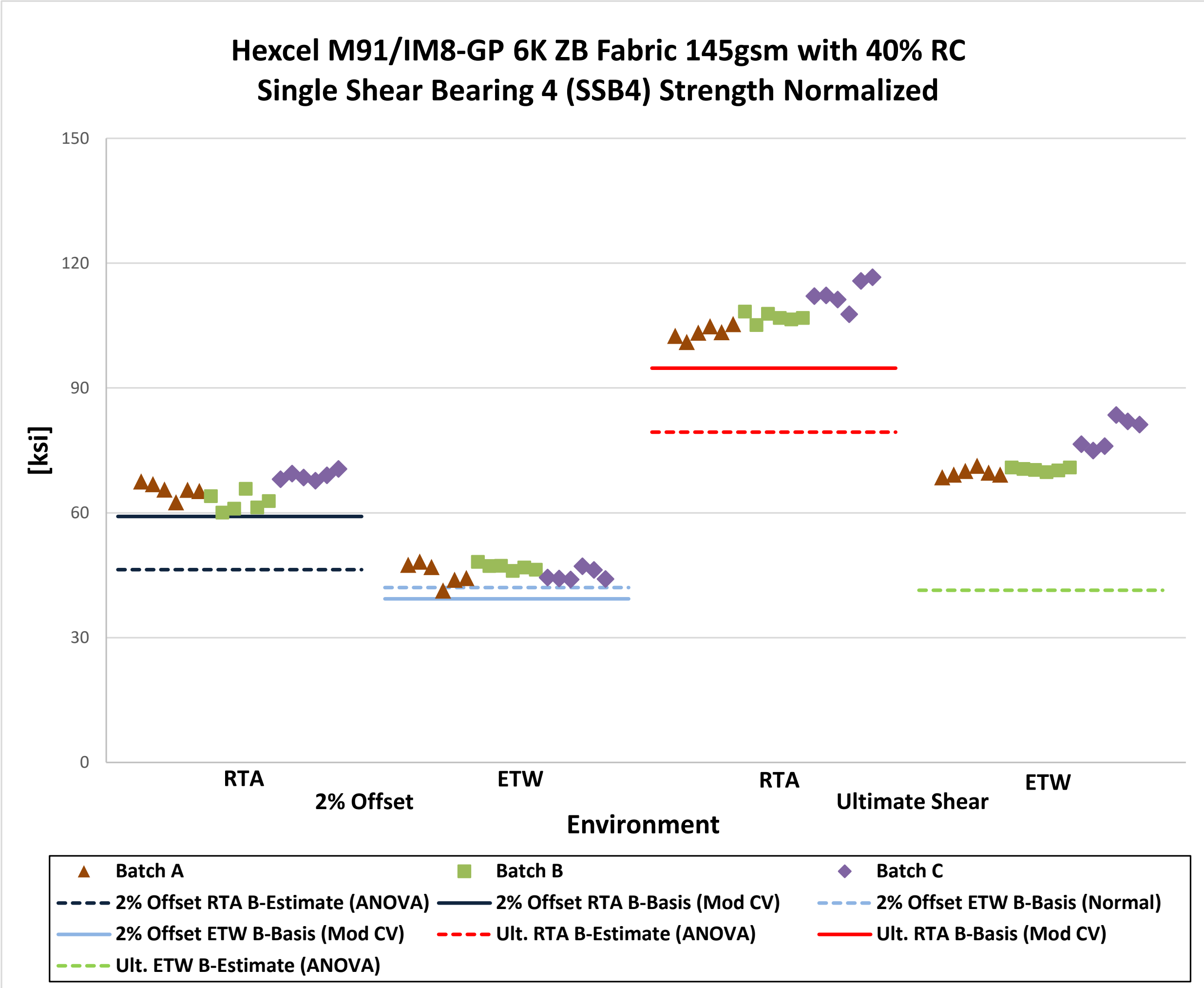

Figure 4-37: Batch Plot for SSB4 Proc. C Normalized Strength

Single Shear Bearing 4 Proc. C (SSB4, D=0.19", e=0.38) Strength (ksi) Basis Values and Statistics								
	Normalized				As-Measured			
Property	Ultimate Strength		2% Offset Strength		Ultimate Strength		2% Offset Strength	
Environment	RTA (70 °F)	ETW (180 °F)	RTA (70 °F)	ETW (180 °F)	RTA (70 °F)	ETW (180 °F)	RTA (70 °F)	ETW (180 °F)
Mean	107.6	73.03	65.61	45.77	106.5	72.45	64.96	45.40
Stdev	4.403	4.820	3.112	1.892	4.774	5.282	3.955	2.016
CV	4.091	6.601	4.743	4.133	4.482	7.289	6.088	4.441
Mod CV	6.045	7.300	6.371	6.066	6.241	7.645	7.044	6.220
Min	101.0	68.54	60.05	41.27	101.1	67.92	57.79	40.82
Max	116.6	83.51	70.51	48.24	116.8	83.74	70.62	48.96
No. Batches	3	3	3	3	3	3	3	3
No. Spec.	18	18	18	18	18	18	18	18
Basis Values and Estimates								
B-Basis Value				42.03				41.42
B-Estimate	79.40	41.38	46.31		75.51	37.52	40.32	
A-Estimate	59.24	18.79	32.53	39.39	53.39	12.58	22.74	38.60
Method	ANOVA	ANOVA	ANOVA	Normal	ANOVA	ANOVA	ANOVA	Normal
Modified CV Basis Values and Estimates								
B-Basis Value	94.79	NA	59.15	39.30	93.38	NA	NA	NA
A-Estimate	85.68		54.75	34.91	84.08			
Method	Normal		Pooled	Pooled	Normal			

Table 4-40: Statistics, B-Basis Values and Estimates for SSB4 Proc. C Strength Data

4.28 "25/50/25" Single-Shear Bearing 1 Countersink 1 Proc. C (SSB1C1, D=0.19", e=0.38)

The SSB1C1 data is normalized by cured ply thickness. Both normalized and as-measured statistics are provided. Tests were conducted in the following environmental conditions: RTA and ETW.

The 2% offset strength ETW condition dataset consists of one batch with six specimens, therefore, only estimates were computed for that property and condition. This dataset has a lower number of data points as some of the specimens failed before achieving 2%.

For the normalized ultimate shear strength dataset, using the as-measured CV and the modified CV, there were no diagnostic test failures, therefore both conditions were pooled.

For the normalized 2% offset strength dataset, using the as-measured CV and the modified CV, the normal method was used for both conditions.

For the as-measured ultimate shear strength dataset, using the as-measured CV and the modified CV, there were no diagnostic test failures, therefore both conditions were pooled.

For the as-measured 2% offset strength dataset, the RTA condition failed the ADK test for batch equivalency. ANOVA was used to compute estimates for RTA and the single point normal method was used for ETW. Applying the modified CV the normal method for modified CV was used for both conditions.

There was one statistical outlier. The lowest normalized value in batch A of the RTA condition for the ultimate strength dataset was an outlier for the batch but not for the condition. It was an outlier in normalized dataset but not in the as-measured dataset. It was retained for this analysis.

Statistics, B-Basis values and estimates are given for the SSB1C1 strength data in Table 4-41. The normalized data, B-Basis vales and B-estimates are shown graphically in Figure 4-38.

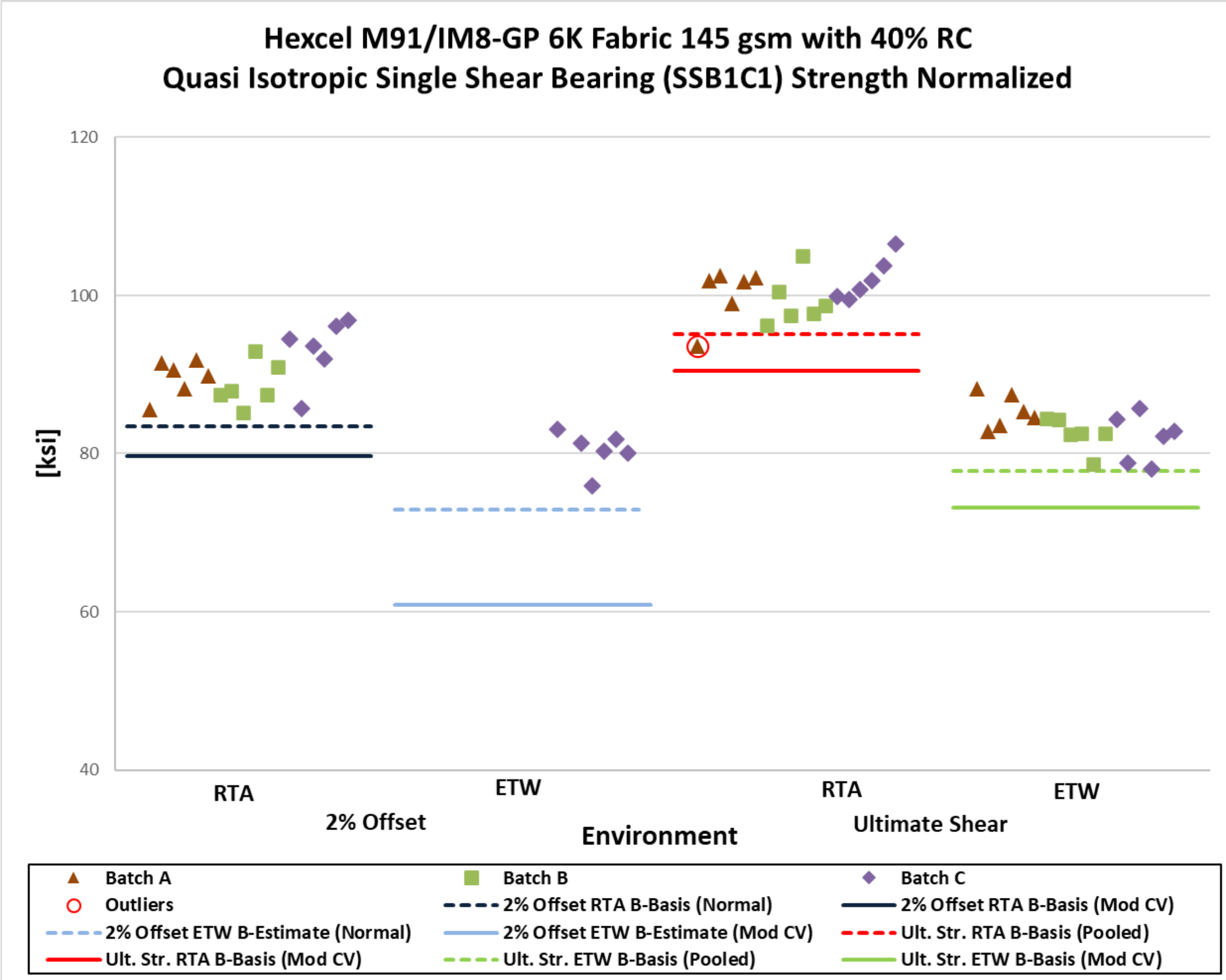

Figure 4-38: Batch Plot for SSB1C1 Proc. C Normalized Strength

Single Shear Bearing 1 Countersink 1 Proc. C (SSB1C1, D=0.19", e=0.38) Strength (ksi) Basis Values and Statistics								
	Normalized				As-Measured			
Property	Ultimate Strength		2% Offset Strength		Ultimate Strength		2% Offset Strength	
Environment	RTA (70 °F)	ETW (180 °F)	RTA (70 °F)	ETW (180 °F)	RTA (70 °F)	ETW (180 °F)	RTA (70 °F)	ETW (180 °F)
Mean	100.5	83.15	90.45	80.39	99.22	82.36	89.32	80.10
Stdev	3.157	2.735	3.551	2.451	3.862	2.914	4.193	2.328
CV	3.142	3.289	3.926	3.048	3.892	3.538	4.695	2.907
Mod CV	6.000	6.000	6.000	8.000	6.000	6.000	6.347	8.000
Min	93.55	78.07	85.14	75.93	92.27	76.57	82.88	75.88
Max	106.5	88.22	96.81	83.08	105.8	87.33	96.20	82.35
No. Batches	3	3	3	1	3	3	3	1
No. Spec.	18	19	18	6	18	19	18	6
Basis Values and Estimates								
B-Basis Value	95.13	77.82	83.44		93.03	76.20		
B-Estimate				72.97			70.44	73.04
A-Estimate	91.50	74.17	78.48	67.69	88.83	71.99	56.98	68.03
Method	Pooled	Pooled	Normal	Normal	Pooled	Pooled	ANOVA	Normal
Modified CV Basis Values and Estimates								
B-Basis Value	90.46	73.17	79.74		89.31	72.50	78.13	
B-Estimate				60.91				60.69
A-Estimate	83.65	66.34	72.15	47.06	82.57	65.75	70.19	46.89
Method	Pooled	Pooled	Normal	Normal	Pooled	Pooled	Normal	Normal
*2% Offset Strength is reported only when ultimate strength is achieved after 2% is observed								

Table 4-41: Statistics, B-Basis Values and Estimates for SSB1C1 Proc. C Strength Data

4.29 “40/20/40” Single-Shear Bearing 3 Countersink 1 Proc. C (SSB3C1, D=0.19”, e=0.38)

The SSB3C1 data is normalized by cured ply thickness. Both normalized and as-measured statistics are provided. Tests were conducted in the following environmental conditions: RTA and ETW. Initial Peak strength tests were conducted in the RTA condition but due to insufficient data only basis value estimates were computed for that test.

The RTA and ETW conditions for the 2% offset strength dataset consists of seventeen and four specimens, respectively, therefore only basis value estimates were computed for that property. The 2% offset strength ETW dataset has a lower number of data points because some of the specimens failed before achieving 2%.

For the normalized and as-measured ultimate shear strength datasets, there were no diagnostic test failures using the as-measured CV and the modified CV so both conditions were pooled in all scenarios. For the normalized 2% offset strength dataset, the normal method was used to compute estimates for both conditions using the as-measured CV and the modified CV. For the initial peak strength RTA dataset, the normal method was used for the original CV and the modified CV.

For the as-measured 2% offset strength dataset, the RTA condition failed the ADK test for batch equivalency. ANOVA was used for RTA and the single point normal method was used for ETW. Applying the modified CV, the normal method for modified CV was used for both conditions. For the initial peak strength RTA dataset, the normal method was used for the original CV and the modified CV.

There was one statistical outlier. In the as-measured dataset, the lowest value in batch B of the ETW condition in the 2% offset strength dataset was an outlier for the condition but not for the batch. It was an outlier in the as-measured dataset but not in the normalized dataset. The outlier is not graphed because the graph is for normalized values. It was retained for this analysis.

Statistics, B-Basis values and estimates are given for the SSB3C1 strength data in Table 4-42. The normalized data, B-Basis Values and B-estimates are shown graphically in Figure 4-39.

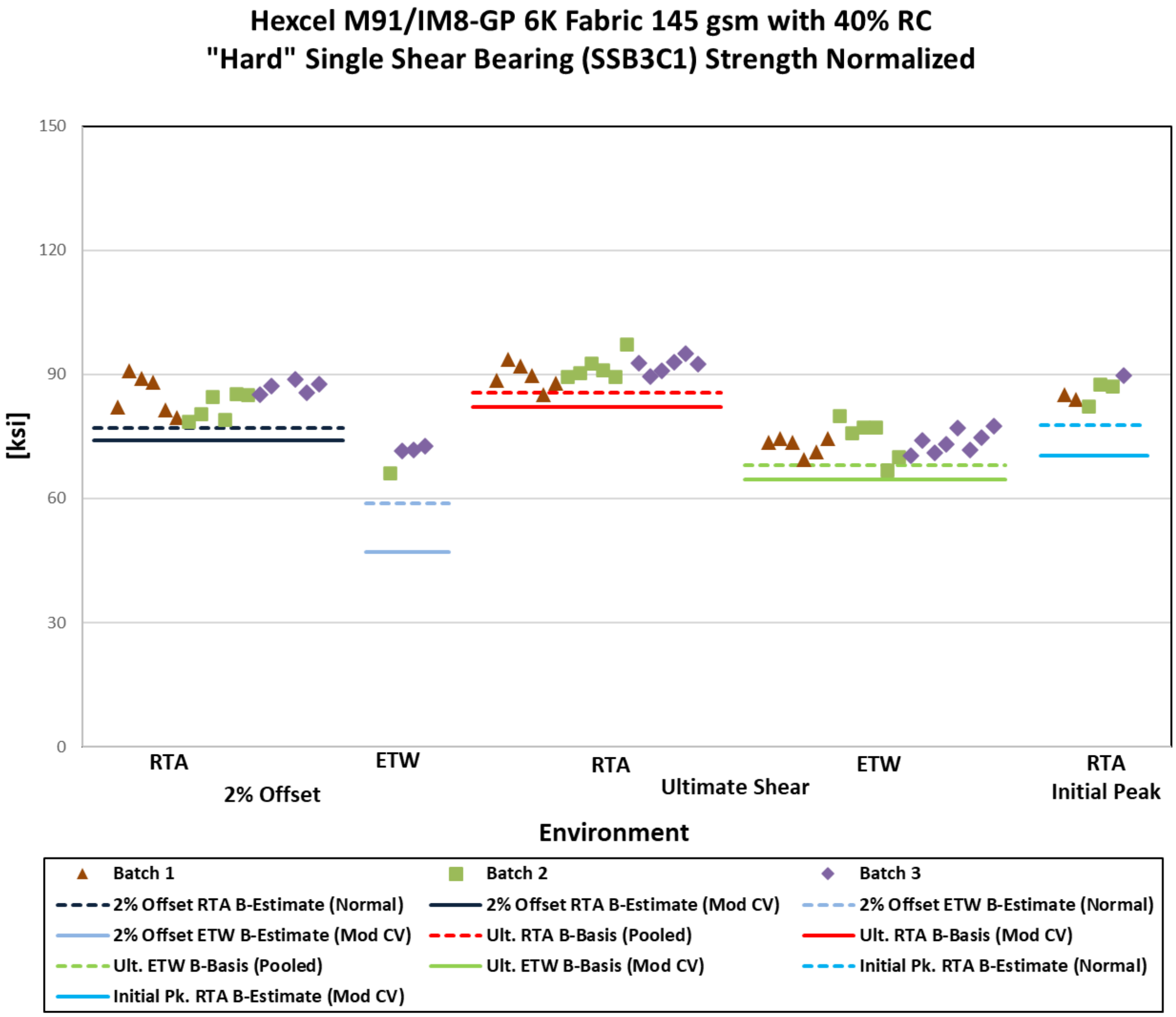

Figure 4-39: Batch Plot for SSB3C1 Proc. C Normalized Strength

Single Shear Bearing 3 Countersink 1 Proc. C (SSB3C1, D=0.19”, e=0.38) (SSB3C1) Strength (ksi) Basis Values and Statistics										
	Normalized					As-Measured				
Property	Ultimate Strength		2% Offset Strength		Initial Peak Strength	Ultimate Strength		2% Offset Strength		Initial Peak Strength
Environment	RTA (70 °F)	ETW (180 °F)	RTA (70 °F)	ETW (180 °F)	RTA (70 °F)	RTA (70 °F)	ETW (180 °F)	RTA (70 °F)	ETW (180 °F)	RTA (70 °F)
Mean	91.19	73.67	84.64	70.52	85.99	89.60	72.71	83.12	69.93	84.09
Stdev	2.850	3.270	3.795	2.870	2.714	2.987	3.125	4.366	3.447	3.432
CV	3.126	4.439	4.484	4.069	3.156	3.333	4.298	5.253	4.929	4.081
Mod CV	6.000	6.219	6.242	8.000	6.000	6.000	6.149	6.626	8.000	6.041
Min	85.08	66.88	78.61	66.29	82.28	83.74	65.39	75.94	64.81	79.49
Max	97.46	80.00	90.94	72.64	89.70	94.65	77.15	89.54	72.31	90.06
No. Batches	3	3	3	2	3	3	3	3	2	3
No. Spec.	18	20	17	4	6	18	20	17	4	6
Basis Values and Estimates										
B-Basis Value	85.60	68.14				84.06	67.21			
B-Estimate			77.04	58.77	77.77			62.15	55.81	73.69
A-Estimate	81.82	64.35	71.66	49.86	71.93	80.29	63.44	47.20	45.12	66.30
Method	Pooled	Pooled	Normal	Normal	Normal	Pooled	Pooled	ANOVA	Normal	Normal
Modified CV Basis Values and Estimates										
B-Basis Value	82.08	64.66				80.68	63.87			
B-Estimate			74.06	47.41	70.37			72.09	47.02	68.70
A-Estimate	75.91	58.46	66.58	29.90	59.25	74.64	57.80	64.29	29.65	57.76
Method	Pooled	Pooled	Normal	Normal	Normal	Pooled	Pooled	Normal	Normal	Normal
*2% Offset Strength is reported only when ultimate strength is achieved after 2% is observed										

Table 4-42: Statistics, B-Basis Values and Estimates for SSB3C1 Proc. C Strength Data

4.30 “25/50/25” Single-Shear Bearing 1 E1 Proc. C (SSB1E1, D=0.19”, e=0.57)

The SSB1E1 data is normalized by cured ply thickness. Both normalized and as-measured statistics are provided. Tests were conducted in the following environmental conditions: RTA and ETW. Initial Peak strength tests were conducted in the ETW condition but due to insufficient data points basis values were not computed for that test.

For the normalized ultimate shear strength dataset, both conditions were not pooled because the dataset failed the Anderson Darling test for normality. The single point normal method was used for RTA and the single point Weibull method was used for ETW. Applying the as-measured CV, both conditions failed the normality test, therefore Basis values were not computed.

For the normalized 2% offset strength dataset, both conditions failed the ADK test for batch equivalency. ANOVA was used to compute estimates for both conditions. Applying the modified CV, the ETW condition failed the ADK test so Basis values were not computed for ETW and the normal method for modified CV was used for RTA.

For the as-measured ultimate shear strength dataset, there were no diagnostic test failures so both conditions were pooled using the as-measured CV and the modified CV.

For the as-measured 2% offset strength dataset, both conditions failed the ADK test for batch equivalency. ANOVA was used to compute estimates for both conditions. Applying the modified CV, the ETW condition failed the ADK test so Basis values were not computed for ETW and the normal method for modified CV was used for RTA.

There were no statistical outliers.

Statistics, B-Basis values and estimates are given for the SSB1E1 strength data in Table 4-43. The normalized data, B-Basis values and B-estimates are shown graphically in Figure 4-40.

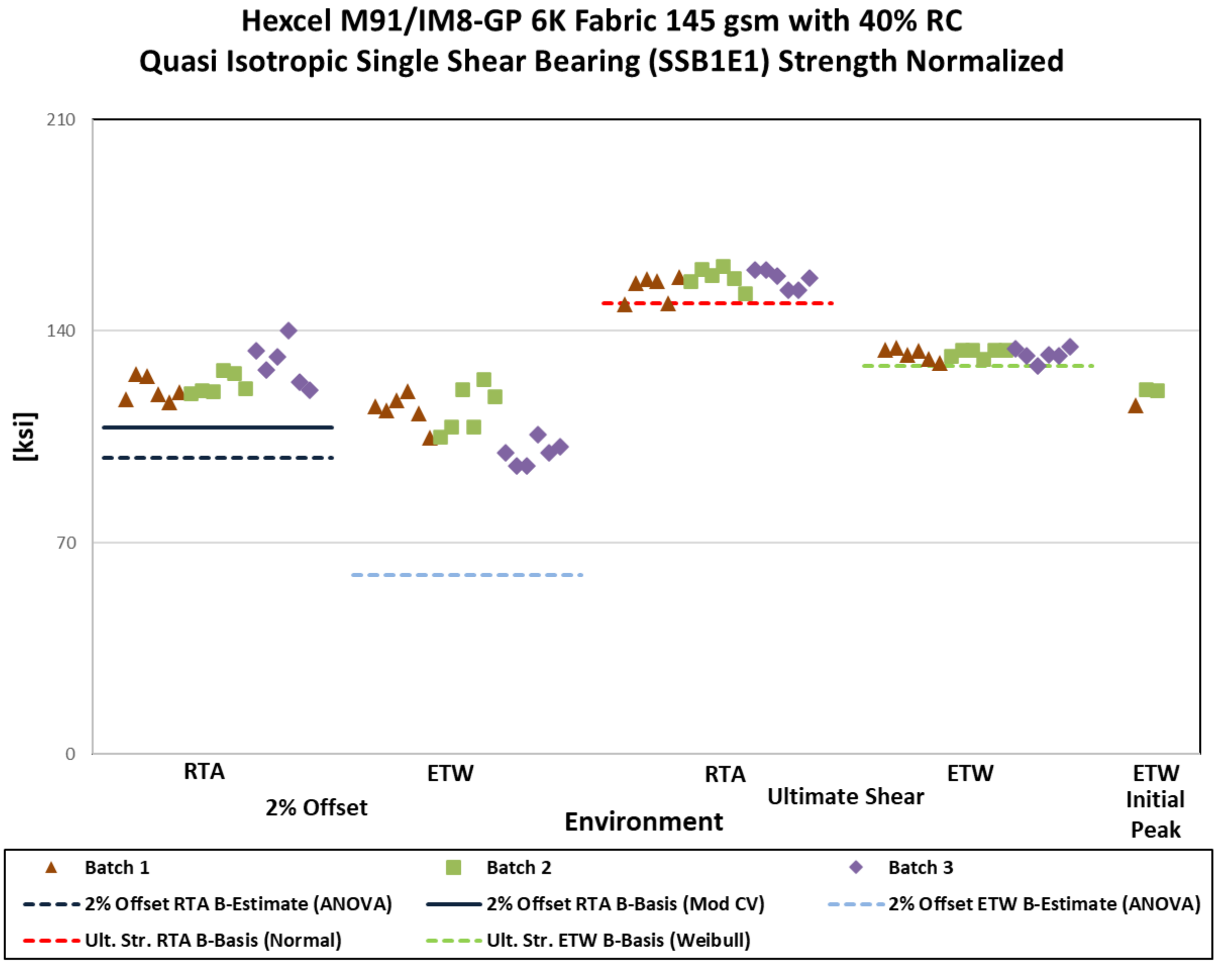

Figure 4-40: Batch Plot for SSB1E1 Proc. C Normalized Strength

Single Shear Bearing 1 E1 Proc. C (SSB1E1, D=0.19", e=0.57) Strength (ksi) Basis Values and Statistics										
	Normalized					As-Measured				
Property	Ultimate Strength		2% Offset Strength		Initial Peak Strength	Ultimate Strength		2% Offset Strength		Initial Peak Strength
Environment	RTA (70 °F)	ETW (180 °F)	RTA (70 °F)	ETW (180 °F)	ETW (180 °F)	RTA (70 °F)	ETW (180 °F)	RTA (70 °F)	ETW (180 °F)	ETW (180 °F)
Mean	156.5	132.5	124.1	109.2	119.0	154.7	131.0	122.7	107.9	116.7
Stdev	3.631	1.822	6.152	8.943	2.952	3.618	2.003	6.470	8.376	2.181
CV	2.321	1.375	4.959	8.189	2.481	2.338	1.529	5.273	7.762	1.868
Mod CV	6.000	6.000	6.479	8.189	6.000	6.000	6.000	6.636	7.881	6.000
Min	148.9	128.5	116.5	95.23	115.6	148.2	127.2	115.8	94.32	114.4
Max	161.5	134.9	140.0	124.0	120.9	160.5	134.4	139.0	121.5	118.7
No. Batches	3	3	3	3	2	3	3	3	3	2
No. Spec.	18	18	18	18	3	18	18	18	18	3
Basis Values and Estimates										
B-Basis Value	149.3	128.6			NA	149.4	125.6			NA
B-Estimate			97.97	59.15				93.07	62.87	
A-Estimate	144.2	124.1	79.38	23.43		145.8	122.0	71.95	30.74	
Method	Normal	Weibull	ANOVA	ANOVA		Pooled	Pooled	ANOVA	ANOVA	
Modified CV Basis Values and Estimates										
B-Basis Value	NA	NA	108.2	NA	NA	139.1	115.3	106.6	NA	NA
A-Estimate			96.95			128.4	104.6	95.23		
Method			Normal			Pooled	Pooled	Normal		

Table 4-43: Statistics, B-Basis Values and Estimates for SSB1E1 Proc. C Strength Data

4.31 "25/50/25" Single-Shear Bearing 1 D1 Proc. C (SSB1D1, D=0.25", e=0.5)

The SSB1D1 data is normalized by cured ply thickness. Both normalized and as-measured statistics are provided. Tests were conducted in the following environmental conditions: RTA and ETW. Initial Peak strength tests were conducted in the ETW condition but due to insufficient data points basis values were not computed for that test.

For the normalized ultimate shear strength dataset, the RTA condition failed the ADK test for batch equivalency. ANOVA was used to compute estimates for RTA and the single point normal method was used for ETW. Applying the modified CV, there were no diagnostic test failures so both conditions were pooled.

For the normalized 2% offset strength dataset, the ETW condition failed the ADK test for batch equivalency. ANOVA was used to compute estimates for ETW and the single point normal method was used for RTA. Applying the modified CV, there were no diagnostic test failures so both conditions were pooled.

For the as-measured ultimate shear strength dataset, the conditions were not pooled because the pooled dataset failed the Anderson Darling test for normality. The single point normal method was used for both conditions. Applying the modified CV, there were no diagnostic test failures so both conditions were pooled.

For the as-measured 2% offset strength dataset, the ETW condition failed the ADK test for batch equivalency. ANOVA was used to compute estimates for ETW and the single point normal method was used for RTA. Applying the modified CV, ETW failed the ADK test therefore Basis values were not computed for ETW and the normal method for modified CV was used for RTA.

There were no statistical outliers.

Statistics, B-Basis values and estimates are given for the SSB1D1 strength data in Table 4-44. The normalized data, B-Basis values and B-estimates are shown graphically in Figure 4-41.

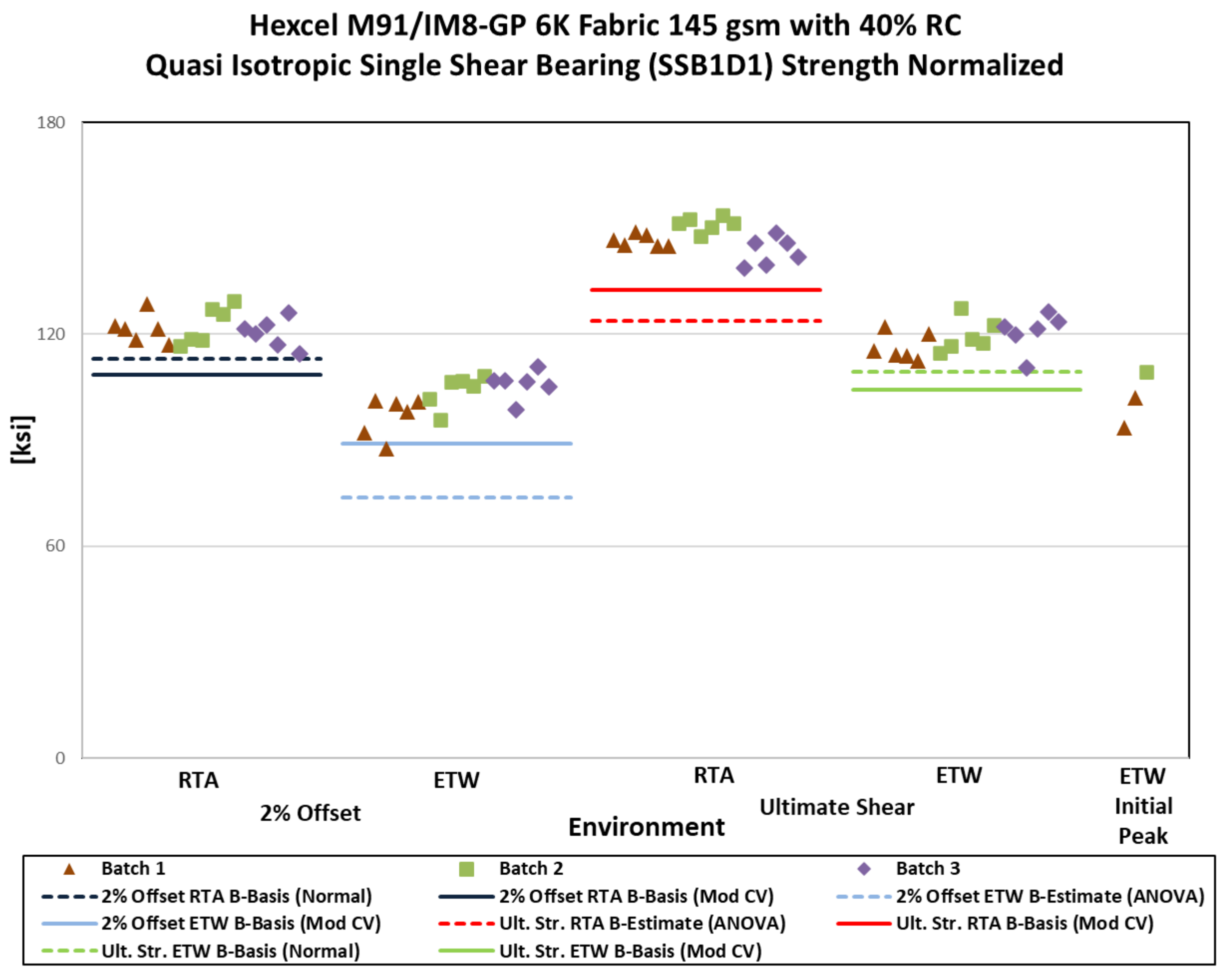

Figure 4-41: Batch Plot for SSB1D1 Proc. C Normalized Strength

Single Shear Bearing 1 D1 Proc. C (SSB1D1, D=0.25”, e=0.5) Strength (ksi) Basis Values and Statistics										
	Normalized					As-Measured				
Property	Ultimate Strength		2% Offset Strength		Initial Peak Strength	Ultimate Strength		2% Offset Strength		Initial Peak Strength
Environment	RTA (70 °F)	ETW (180 °F)	RTA (70 °F)	ETW (180 °F)	ETW (180 °F)	RTA (70 °F)	ETW (180 °F)	RTA (70 °F)	ETW (180 °F)	ETW (180 °F)
Mean	147.1	118.9	121.5	102.2	101.7	145.4	117.7	120.2	101.2	100.4
Stdev	4.184	4.798	4.362	6.054	7.837	3.267	4.756	4.490	6.050	7.393
CV	2.844	4.035	3.589	5.921	7.708	2.246	4.040	3.737	5.977	7.365
Mod CV	6.000	6.017	6.000	6.961	7.854	6.000	6.020	6.000	6.988	7.683
Min	138.7	110.5	114.6	87.70	93.63	139.3	111.1	113.6	86.85	92.72
Max	153.9	127.5	129.3	110.9	109.3	151.3	125.5	127.7	110.2	107.5
No. Batches	3	3	3	3	2	3	3	3	3	2
No. Spec.	18	18	18	18	3	18	18	18	18	3
Basis Values and Estimates										
B-Basis Value		109.4	112.9			139.0	108.3	111.3		
B-Estimate	123.7			73.78	NA				71.25	NA
A-Estimate	107.0	102.7	106.8	53.49		134.4	101.7	105.0	49.88	
Method	ANOVA	Normal	Normal	ANOVA		Normal	Normal	Normal	ANOVA	
Modified CV Basis Values and Estimates										
B-Basis Value	132.5	104.3	108.4	89.12		130.9	103.2	105.9		
A-Estimate	122.5	94.31	99.49	80.19	NA	121.1	93.39	95.85	NA	NA
Method	Pooled	Pooled	Pooled	Pooled		Pooled	Pooled	Normal		

Table 4-44: Statistics, B-Basis Values and Estimates for SSB1D1 Proc. C Strength Data

4.32 “25/50/25” Single-Shear Bearing 1 T1 Proc. C (SSB1T1, D=0.19”, e=0.38)

The SSB1T1 data is normalized by cured ply thickness. Both normalized and as-measured statistics are provided. Tests were conducted in the following environmental conditions: RTA and ETW. Initial Peak strength tests were conducted in the RTA condition but due to insufficient only basis value estimates were computed for this test.

For the normalized ultimate shear strength dataset, both conditions failed the ADK test for batch equivalency. ANOVA was used to compute estimates for both conditions. Applying the modified CV, there were no diagnostic test failures so both conditions were pooled. For the normalized 2% offset strength dataset, both conditions failed the ADK test for batch equivalency. ANOVA was used to compute estimates for both conditions. The A-estimates are zero because the software gave negative results. Applying the modified CV, both conditions failed the ADK test so Basis values were not computed. For the initial peak strength RTA dataset the normal method was used for the original CV, and since the original CV is larger than 8%, the modified CV was not applicable and the results are the same.

For the as-measured ultimate shear strength dataset, the RTA condition failed the ADK test for batch equivalency. ANOVA was used to compute estimates for RTA and the single point normal method was used for ETW. Applying the modified CV, the RTA condition failed the ADK test so Basis values were not computed for RTA and the normal method for modified CV was used for ETW. For the as-measured 2% offset strength dataset, both conditions failed the ADK test for batch equivalency. ANOVA was used to compute estimates for both conditions. Applying the modified CV, both conditions failed the ADK test so Basis values were not computed. For the initial peak strength RTA dataset the normal method was used for the original CV, and since the original CV is larger than 8%, the modified CV was not applicable and the results are the same.

There were no statistical outliers.

Statistics, B-Basis values and estimates are given for the SSb1T1 strength data in Table 4-45. The normalized data, B-Basis Values and B-estimates are shown graphically in Figure 4-42.

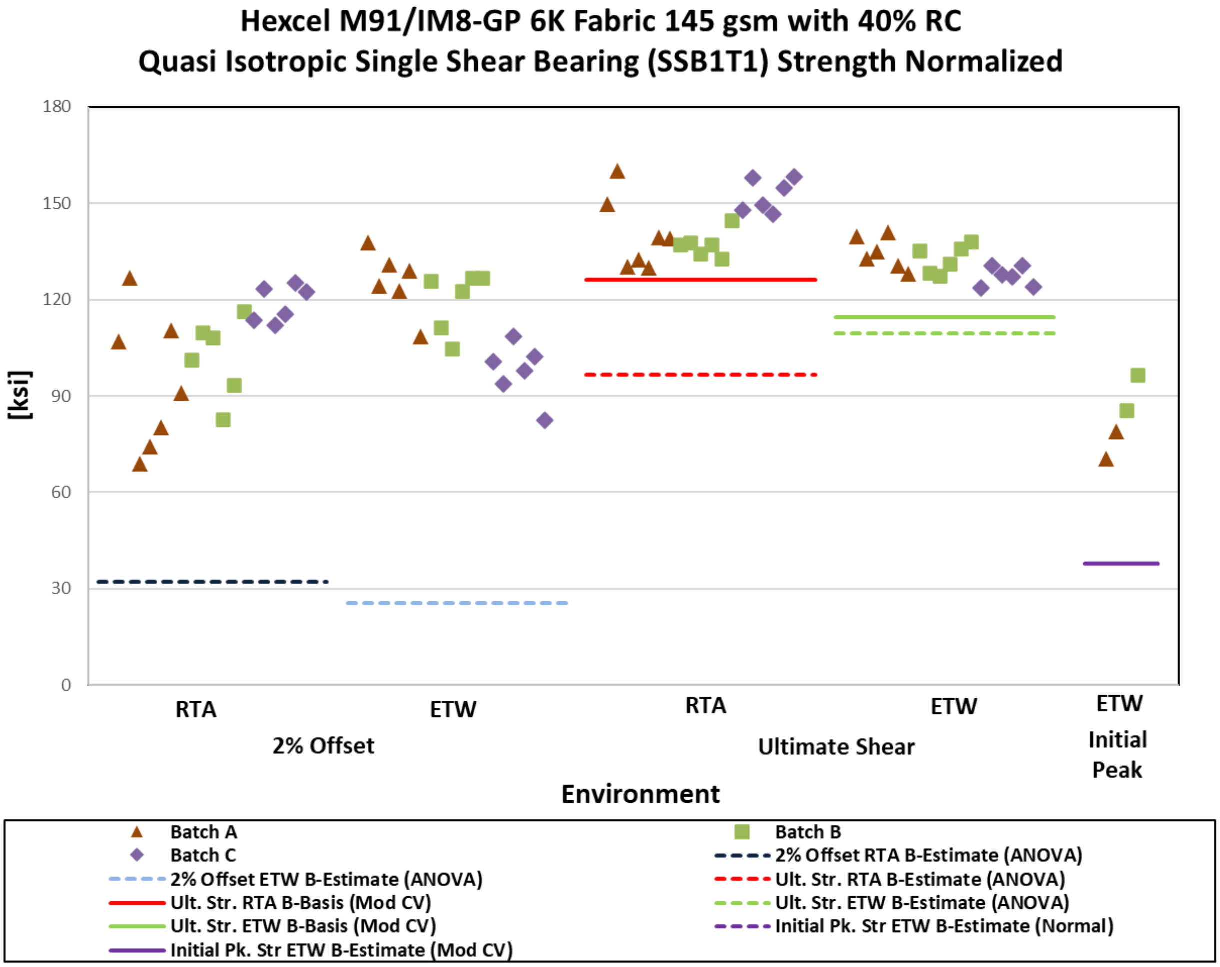

Figure 4-42: Batch Plot for SSB1T1 Proc. C Normalized Strength

Single Shear Bearing 1 T1 Proc. C (SSB1T1, D=0.19”, e=0.38) Strength (ksi) Basis Values and Statistics										
	Normalized					As-Measured				
Property	Ultimate Strength		2% Offset Strength		Initial Peak Strength	Ultimate Strength		2% Offset Strength		Initial Peak Strength
Environment	RTA (70 °F)	ETW (180 °F)	RTA (70 °F)	ETW (180 °F)	RTA (70 °F)	RTA (70 °F)	ETW (180 °F)	RTA (70 °F)	ETW (180 °F)	RTA (70 °F)
Mean	143.1	131.5	104.4	114.3	82.93	141.3	129.7	103.0	112.7	81.35
Stdev	9.889	5.097	17.73	15.21	11.02	10.35	4.922	17.64	14.73	10.24
CV	6.911	3.876	16.98	13.31	13.29	7.329	3.793	17.12	13.07	12.58
Mod CV	7.455	6.000	16.98	13.31	13.29	7.665	6.000	17.12	13.07	12.58
Min	130.0	123.6	69.03	82.38	70.49	128.3	123.1	68.03	81.79	69.47
Max	160.1	140.8	126.9	137.7	96.67	158.2	140.7	125.4	136.4	94.10
No. Batches	3	3	3	3	2	3	3	3	3	2
No. Spec.	19	18	19	18	4	19	18	19	18	4
Basis Values and Estimates										
B-Basis Value							120.0			
B-Estimate	96.67	109.5	32.00	25.48	37.78	87.31		28.78	27.72	39.42
A-Estimate	63.55	93.85	0.000	0.000	3.563	48.82	113.1	0.000	0.000	7.653
Method	ANOVA	ANOVA	ANOVA	ANOVA	Normal	ANOVA	Normal	ANOVA	ANOVA	Normal
Modified CV Basis Values and Estimates										
B-Basis Value	126.1	114.4			37.78		114.4			39.42
A-Estimate	114.4	102.7	NA	NA	3.563	NA	103.5	NA	NA	7.653
Method	Pooled	Pooled			Normal		Normal			Normal

Table 4-45: Statistics, B-Basis Values and Estimates for SSB1T1 Proc. C Strength Data

4.33 "25/50/25" Compression After Impact 1 (CAI1)

The CAI1 data is normalized by cured ply thickness. Testing is done only for the RTA condition. Only one batch of material was tested, therefore only statistics were provided for this property. Summary statistics and estimates are presented in Table 4-46 and the normalized data and b-estimates are displayed graphically in Figure 4-43.

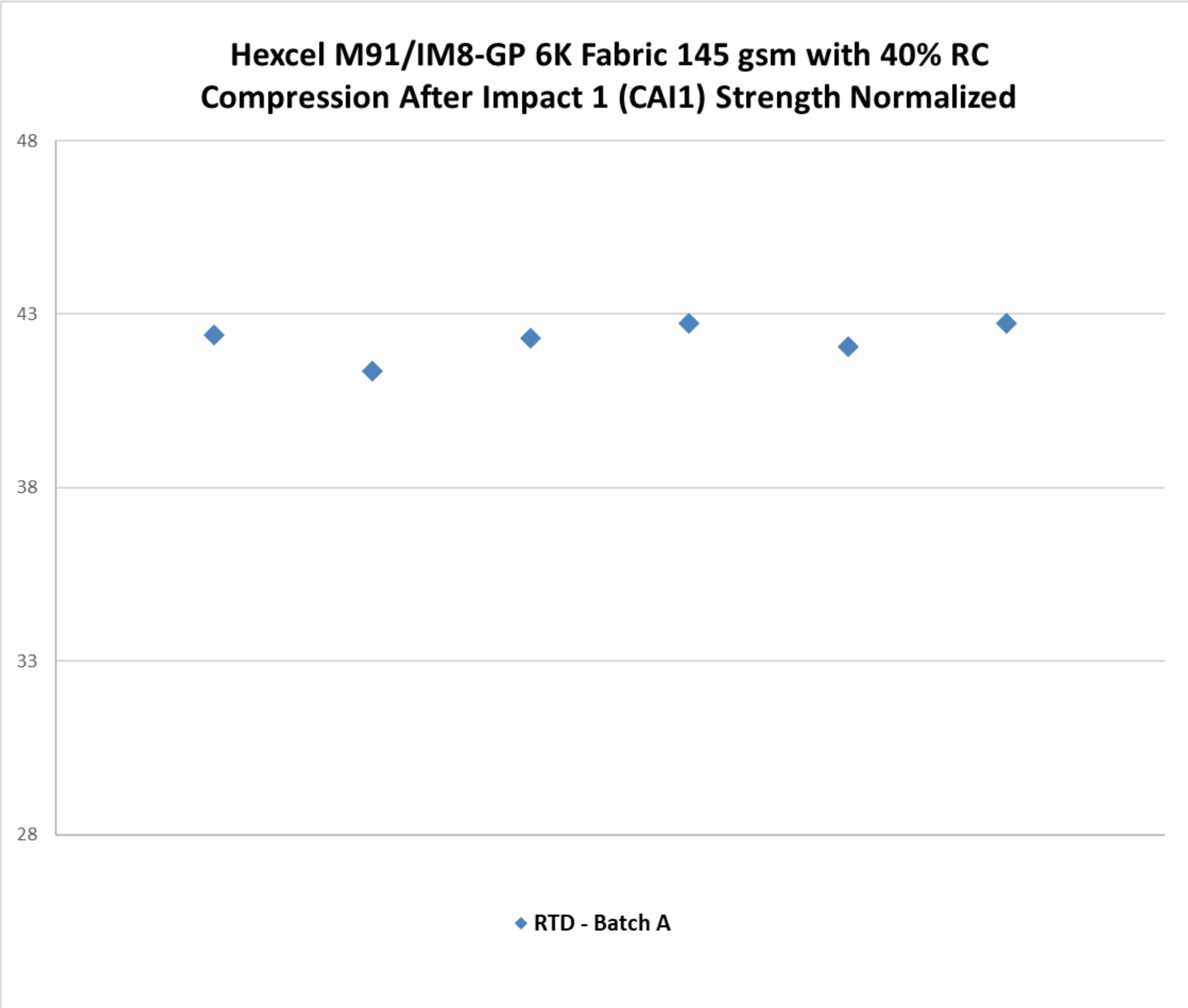

Figure 4-43: Batch Plot for Compression After Impact Normalized Strength

Compression After Impact (CAI1) Strength (ksi) Statistics		
	Normalized	As-Measured
Environment	RTA (70 °F)	RTA (70 °F)
Mean	42.27	41.54
Stdev	0.5207	0.4649
CV	1.232	1.119
Mod CV	8.000	8.000
Min	41.35	40.81
Max	42.75	41.88
No. Batches	1	1
No. Spec.	6	6

Table 4-46: Statistics for Compression After Impact Strength Data

4.34 Interlaminar Tension Strength (ILT) and Curved Beam Strength (CBS)

The ILT data is not normalized. Data is reported on two properties: Interlaminar Tension Strength and Curved Beam Strength. Testing was done in the following environmental conditions: CTA, RTA, and ETW.

For both properties tested, the three conditions consist of more than fifty-five specimens distributed in five batches, therefore A-Basis values and B-Basis values were computed.

For both properties, three conditions failed the ADK test for batch equivalency. ANOVA was used to compute Basis values for all scenarios. Applying the modified CV, for both properties, all conditions failed the ADK test, therefore Basis values were not computed.

There were five statistical outliers. The lowest value in batch B of the CTA condition in the ILT strength dataset was an outlier for the batch but not for the condition. It was also an outlier in the Curved Beam strength dataset. The lowest value in batch D of the CTA condition in the ILT strength dataset was an outlier for the batch but not for the condition. The lowest value in batch E of the CTA condition in the Curved Beam strength dataset was an outlier for the condition but not for the batch. The lowest value in batch E of the RTA condition in the ILT strength dataset was an outlier for the batch but not for the condition. It was also an outlier in the Curved Beam strength dataset. The lowest value in batch A of the ETW condition in the ILT strength dataset was an outlier for the batch and for the condition. It was only a batch outlier in the Curved Beam strength dataset. They were retained for analysis.

Statistics and Basis values are presented in for ILT in Table 4-47. The as-measured data and A-Basis values are displayed graphically in Figure 4-44 and Figure 4-45, and the as-measured data and B-Basis values are in Figure 4-46 and Figure 4-47.

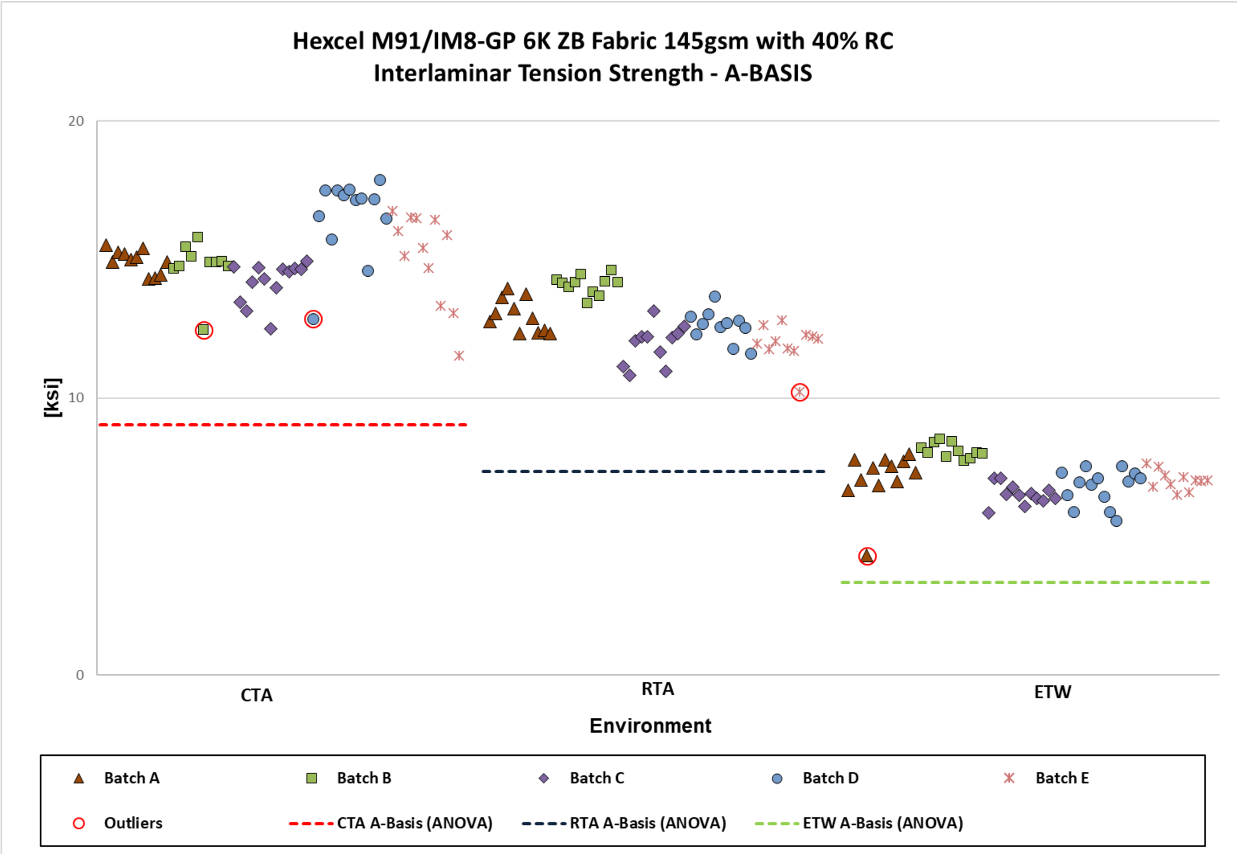

Figure 4-44: Batch Plot for Interlaminar Tension As-Measured Strength – A-Basis

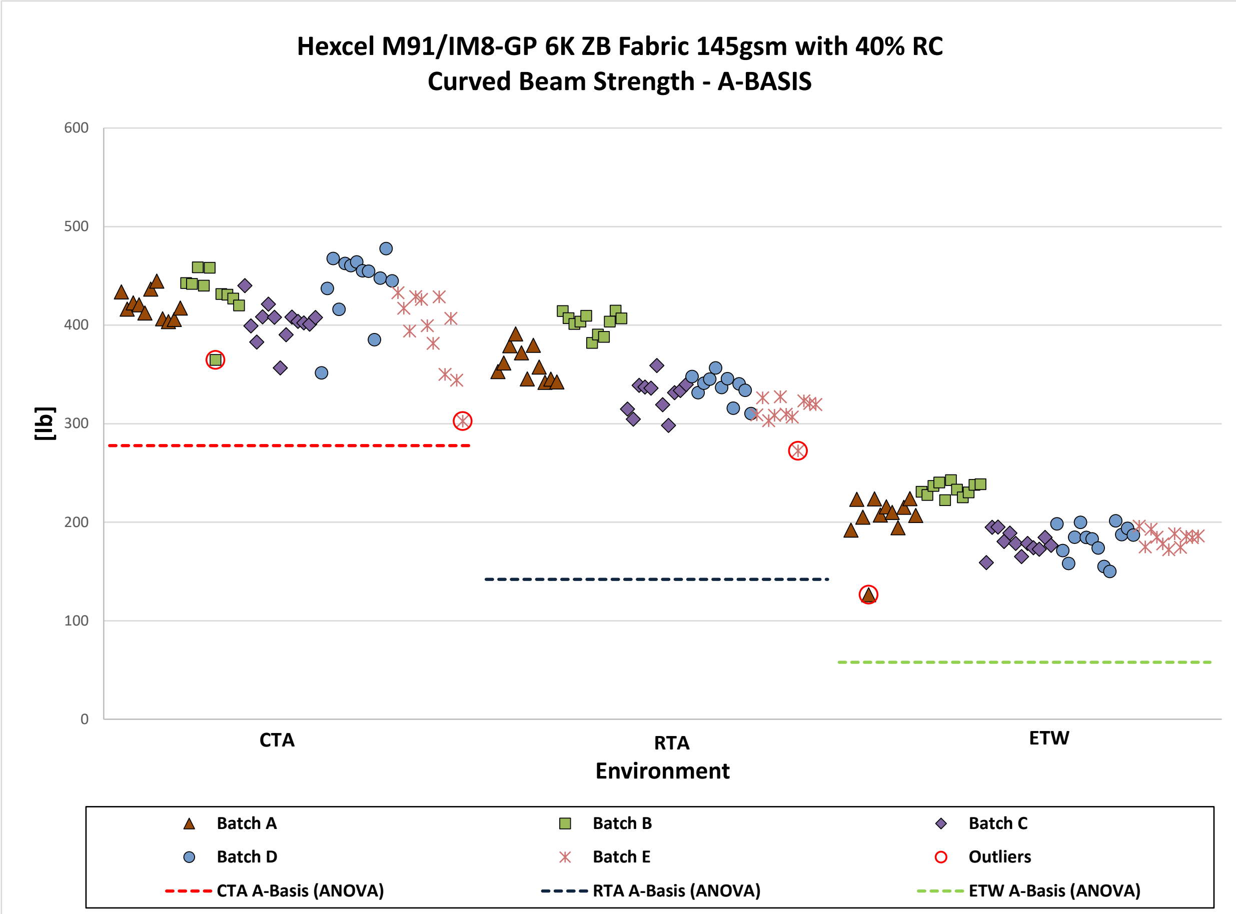

Figure 4-45: Batch Plot for Curved Beam As-Measured Strength - A-Basis

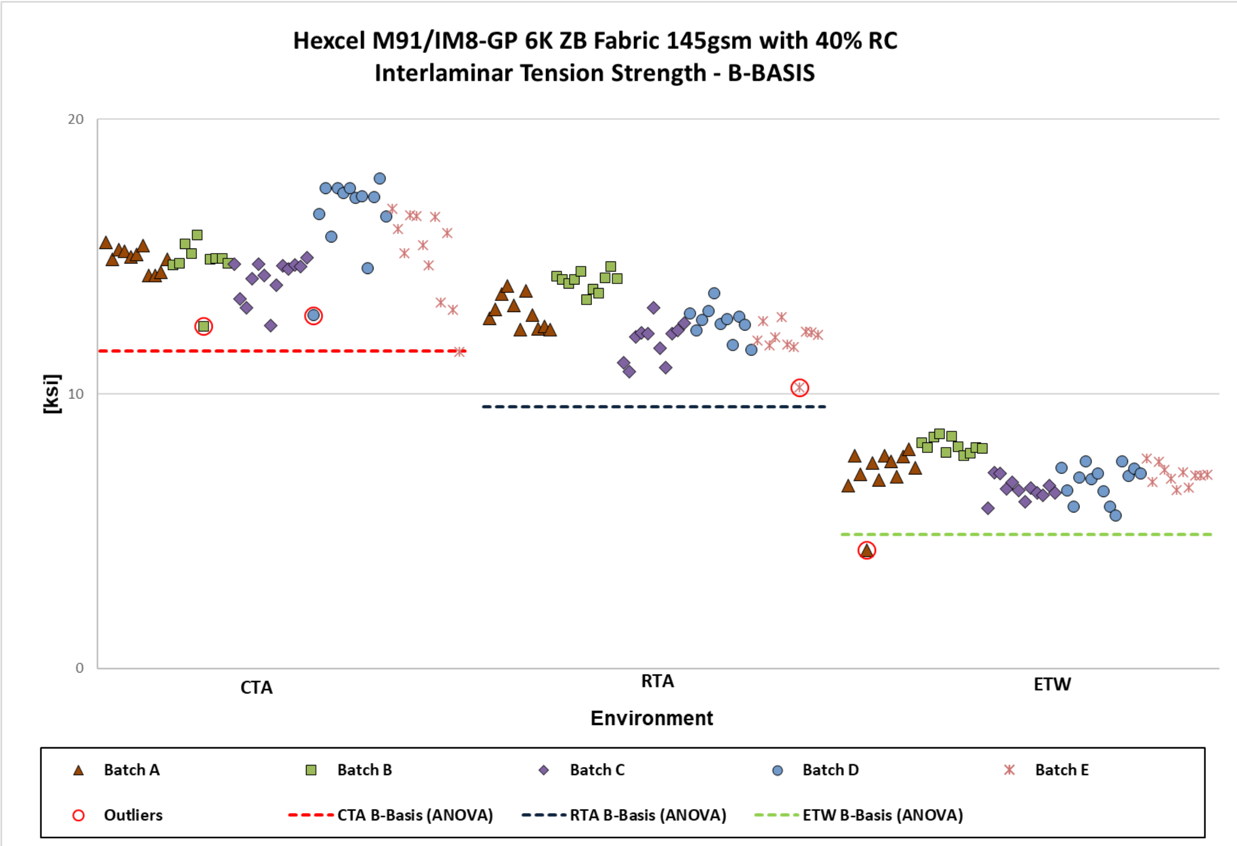

Figure 4-46: Batch Plot for Interlaminar Tension As-Measured Strength - B-Basis

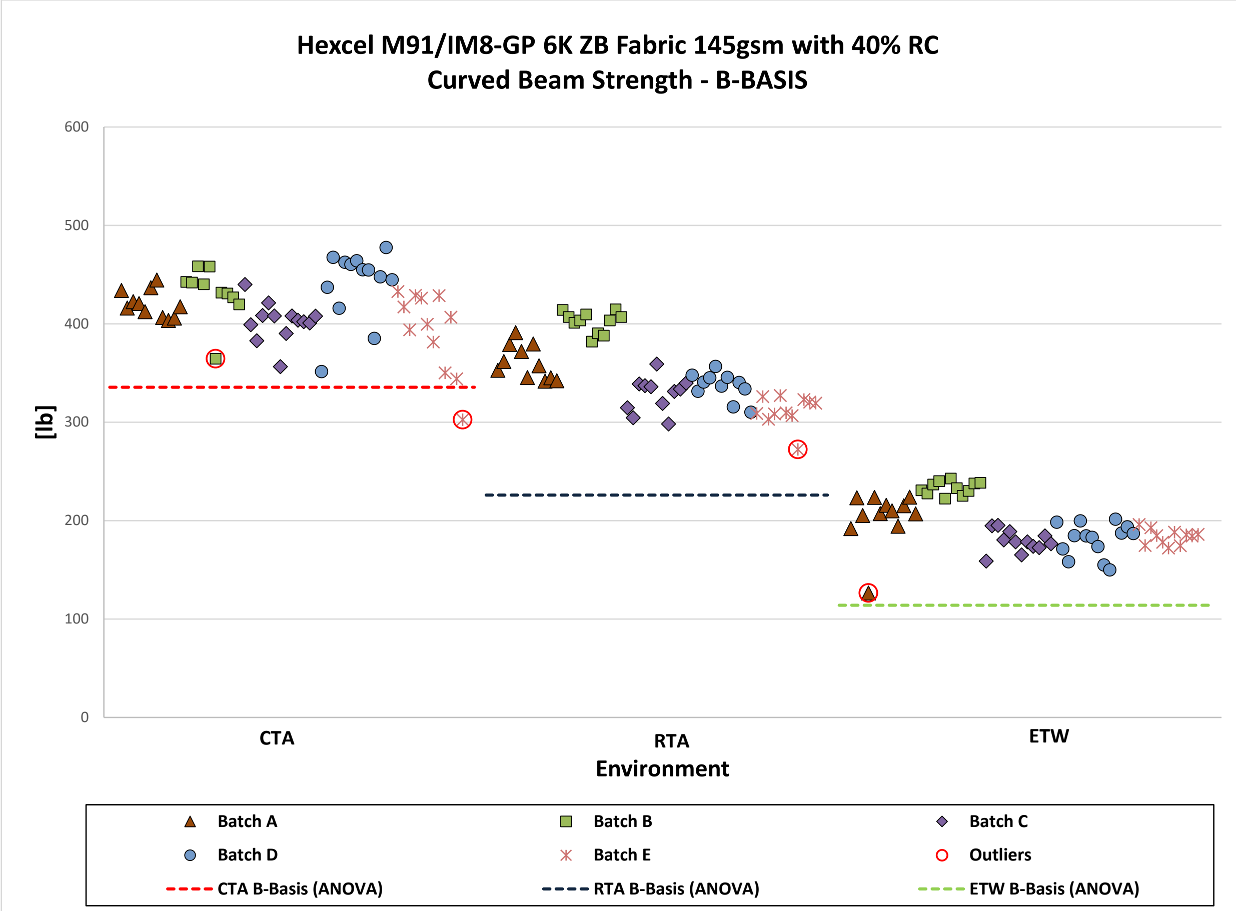

Figure 4-47: Batch Plot for Curved Beam As-Measured Strength - B-Basis

Interlaminar Tension (ILT) Basis Values and Statistics						
	Strength (ksi)			Curved Beam Strength (lb)		
Environment	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)	CTA (-65 °F)	RTA (70 °F)	ETW (180 °F)
Mean	15.14	12.71	7.088	417.0	347.9	195.0
Stdev	1.375	0.9861	0.7786	33.78	34.85	25.42
CV	9.082	7.756	10.98	8.102	10.02	13.03
Mod CV	9.082	7.878	10.98	8.102	10.02	13.03
Min	11.54	10.23	4.315	302.6	272.4	126.4
Max	17.85	14.62	8.529	477.7	414.7	242.7
No. Batches	5	5	5	5	5	5
No. Spec.	59	55	60	59	55	60
Basis Values						
B-Basis Value	11.56	9.539	4.878	335.4	225.9	114.0
A-Basis Value	9.043	7.344	3.334	277.7	142.1	57.95
Method	ANOVA	ANOVA	ANOVA	ANOVA	ANOVA	ANOVA
Cross head displacement exceeds 5 mm [0.2 in.] prior to failure						

Table 4-47: Statistics and Basis Values for ILT Data

5. Outliers

Outliers were identified according to the standards documented in section 2.1.5, which are in accordance with the guidelines developed in section 8.3.3 of CMH-17 Vol 1. An outlier may be an outlier in the normalized data, the as-measured data, or both. A specimen may be an outlier for the batch only (before pooling the three batches within a condition together) or for the condition (after pooling the three batches within a condition together) or both.

Approximately 5 out of 100 specimens will be identified as outliers due to the expected random variation of the data. This test is used only to identify specimens to be investigated for a cause of the extreme observation. Outliers that have an identifiable cause are removed from the dataset as they inject bias into the computation of statistics and Basis values. Specimens that are outliers for the condition and in both the normalized and as-measured data are typically more extreme and more likely to have a specific cause and be removed from the dataset than other outliers. Specimens that are outliers only for the batch, but not the condition and specimens that are identified as outliers only for the normalized data or the as-measured data but not both, are typical of normal random variation.

All outliers identified were investigated to determine if a cause could be found. Outliers with causes were removed from the dataset and the remaining specimens were analyzed for this report. Information about specimens that were removed from the dataset along with the cause for removal is documented in the material property data report, NCAMP Test Report CAM-RP-2025-001 Rev -. Outliers for which no causes could be identified are listed in Table 5-1. These outliers were included in the analysis for their respective test properties.

Test	Condition	Batch	Specimen No.	Property: Normalized Value	Property: As Measured Value	Outlier: High/Low	Outlier: Batch	Outlier: Condition
WT	CTA (-65 °F)	C	NTPM911Q1-HXL-H40-NIAR-WT-C-C1-1-CTA (-65 °F)-1	106.5	106.1	Low	Y	Y
WT	CTA (-65 °F)	E	NTPM911Q1-HXL-H40-SKS-WT-E-C2-1-CTA (-65 °F)-4	157.2	160.0	Low	Y	N
FT	CTA (-65 °F)	C	NTPM911Q1-HXL-H40-NIAR-FT-C-C1-1-CTA (-65 °F)-4	126.9	126.2	Low	Y	Y
FT	RTA (70 °F)	A	NTPM911Q1-HXL-H40-NIAR-FT-A-C2-1-RTA (70 °F)-6	160.6	160.6	Low	Y	N
FC	CTA (-65 °F)	A	NTPM911Q1-HXL-H40-NIAR-FC-A-C1-1-CTA (-65 °F)-2	103.5	101.6	Low	Y	Y
FC	CTA (-65 °F)	B	NTPM911Q1-HXL-H40-NIAR-FC-B-C2-1-CTA (-65 °F)-4	115.6	110.9	Low	Y	N
FC	RTA (70 °F)	A	NTPM911Q1-HXL-H40-NIAR-FC-A-C1-1-RTA (70 °F)-5	91.70	90.69	Low	N	Y
FC	ETW (180 °F)1	C	NTPM911Q1-HXL-H40-NIAR-FC-C-C1-1-ETW (180 °F)-1	69.16	68.70	Low	Y	N
IPST Strength at 5% Strain	ETW (180 °F)1	C	NTPM911Q1-HXL-H40-NIAR-IPST-C-C1-1-ETW (180 °F)-3	NA	8.659	High	Y	Y
IPST 0.2% Offset Strength	ETW (180 °F)1	B	NTPM911Q1-HXL-H40-NIAR-IPST-B-C1-1-ETW (180 °F)-2	NA	4.632	Low	Y	N
IPST 0.2% Offset Strength	ETW (180 °F)1	C	NTPM911Q1-HXL-H40-NIAR-IPST-C-C1-1-ETW (180 °F)-3	NA	5.199	High	Y	Y
IPSV Ultimate Shear Strength	CTA (-65 °F)	D	NTPM911Q1-HXL-H40-FACC-IPSV-D-C2-1-CTA (-65 °F)-7	NA	27.59	Low	Y	N
IPSV Ultimate Shear Strength	RTA (70 °F)	C	NTPM911Q1-HXL-H40-NIAR-IPSV-C-C2-1-RTA (70 °F)-4	NA	23.06	Low	Y	N
IPSV Ultimate Shear Strength	ETW (180 °F)1	C	NTPM911Q1-HXL-H40-NIAR-IPSV-C-C2-1-ETW (180 °F)-3	NA	17.76	High	N	Y
IPSV Ultimate Shear Strength	ETW (180 °F)1	C	NTPM911Q1-HXL-H40-NIAR-IPSV-C-C2-1-ETW (180 °F)-5	NA	17.60	High	N	Y
IPSV 0.2% Offset Strength	RTA (70 °F)	B	NTPM911Q1-HXL-H40-NIAR-IPSV-B-C2-1-RTA (70 °F)-4	NA	8.562	High	Y	N
IPSV 0.2% Offset Strength	RTA (70 °F)	C	NTPM911Q1-HXL-H40-NIAR-IPSV-C-C2-1-RTA (70 °F)-4	NA	9.058	High	Y	N
IPSV 0.2% Offset Strength	ETW (180 °F)1	C	NTPM911Q1-HXL-H40-NIAR-IPSV-C-C1-1-ETW (180 °F)-1	NA	6.710	High	Y	N
UNT1	RTA (70 °F)	C	NTPM911Q1-HXL-H40-NIAR-UNT1-C-C2-1-RTA (70 °F)-2	126.0	NoA	Low	Y	N
UNT1	ETW (180 °F)1	B	NTPM911Q1-HXL-H40-NIAR-UNT1-B-C1-1-ETW (180 °F)-2	116.5	111.6	Low	Y	Y
UNT1	RTA (70 °F)	A	NTPM911Q1-HXL-H40-NIAR-UNT1-A-C1-1-RTA (70 °F)-2	NoA	126.4	Low	Y	N
UNC1	ETW (180 °F)1	A	NTPM911Q1-HXL-H40-NIAR-UNC1-A-C2-1-ETW (180 °F)-1	50.5	NoA	Low	Y	N
UNC1	ETW (180 °F)1	B	NTPM911Q1-HXL-H40-NIAR-UNC1-B-C1-1-ETW (180 °F)-1	NoA	68.21	High	Y	N
UNC2	RTA (70 °F)	C	NTPM911Q1-HXL-H40-NIAR-UNC2-C-C2-1-RTA (70 °F)-1	65.41	NoA	High	Y	N
UNC2	ETW (180 °F)1	A	NTPM911Q1-HXL-H40-NIAR-UNC2-A-C2-1-ETW (180 °F)-1	43.53	42.78	Low	Y	N
UNC3	ETW (180 °F)1	A	NTPM911Q1-HXL-H40-NIAR-UNC3-A-C1-1-ETW (180 °F)-2	66.72	65.58	Low	Y	Y
OHT3	CTA (-65 °F)	C	NTPM911Q1-HXL-H40-NIAR-OHT3-C-C2-1-CTA (-65 °F)-2	68.16	67.18	High	Y	N
FHT1	CTA (-65 °F)	C	NTPM911Q1-HXL-H40-NIAR-FHT1-C-C2-1-CTA (-65 °F)-2	74.67		High	Y	N
FHT1	CTA (-65 °F)	C	NTPM911Q1-HXL-H40-NIAR-FHT1-C-C2-1-CTA (-65 °F)-2		73.93	High	Y	Y
FHT1	ETW (180 °F)1	C	NTPM911Q1-HXL-H40-NIAR-FHT1-C-C2-1-ETW (180 °F)-1	77.16	77.19	High	Y	N
FHT3	ETW (180 °F)1	A	NTPM911Q1-HXL-H40-NIAR-FHT3-A-C2-1-ETW (180 °F)-3	91.38	NoA	High	N	Y
OHC2	RTA (70 °F)	A	NTPM911Q1-HXL-H40-NIAR-OHC2-A-C2-1-RTA (70 °F)-1	NoA	44.32	High	N	Y
OHC3	RTA (70 °F)	B	NTPM911Q1-HXL-H40-NIAR-OHC3-B-C1-1-RTA (70 °F)-3	48.20	46.28	High	Y	N
OHC3	RTA (70 °F)	C	NTPM911Q1-HXL-H40-NIAR-OHC3-C-C2-1-RTA (70 °F)-3	43.11	NoA	Low	N	Y
OHC3	ETW (180 °F)1	B	NTPM911Q1-HXL-H40-NIAR-OHC3-B-C2-1-ETW (180 °F)-3	NoA	34.03	Low	N	Y
FHC2	RTA (70 °F)	C	NTPM911Q1-HXL-H40-NIAR-FHC2-C-C1-1-RTA (70 °F)-3	64.72	NoA	High	Y	N
FHC3	ETW (180 °F)1	C	NTPM911Q1-HXL-H40-NIAR-FHC3-C-C2-1-ETW (180 °F)-1	74.12	72.96	High	Y	N
SSB1 2% Offset Strength	RTA (70 °F)	C	NTPM911Q1-HXL-H40-NIAR-SSB1-C-C2-1-RTA (70 °F)-2	106.4	105.9	Low	N	Y
SSB3 Ultimate Strength	RTA (70 °F)	B	NTPM911Q1-HXL-H40-NIAR-SSB3-B-C1-1-RTA (70 °F)-3	124.1	121.2	High	Y	N
SSB3 2% Offset Strength	RTA (70 °F)	C	NTPM911Q1-HXL-H40-NIAR-SSB3-C-C2-1-RTA (70 °F)-3	112.1	NoA	High	Y	N
SSB1C1 Ultimate Strength	RTA (70 °F)	A	NTPM911Q1-HXL-H40-NIAR-SSB1C1-A-C1-1-RTA (70 °F)-1	93.55	NoA	Low	Y	N
SSB3C1 2% Offset Strength	ETW (180 °F)1	B	NTPM911Q1-HXL-H40-NIAR-SSB3C1-B-C2-1-ETW (180 °F)-2	NoA	64.81	Low	N	Y
ILT Strength	CTA (-65 °F)	B	NTPM911Q1-HXL-H40-NIAR-ILT-B-C2-1-CTA (-65 °F)-1	NA	12.46	Low	Y	N
ILT Strength	CTA (-65 °F)	D	NTPM911Q1-HXL-H40-FACC-ILT-D-C1-1-CTA (-65 °F)-1	NA	12.86	Low	Y	N
ILT Strength	RTA (70 °F)	E	NTPM911Q1-HXL-H40-SKS-ILT-E-C2-1-RTA (70 °F)-3	NA	10.23	Low	Y	N
ILT Strength	ETW (180 °F)1	A	NTPM911Q1-HXL-H40-NIAR-ILT-A-C1-1-ETW (180 °F)-5	NA	4.315	Low	Y	Y
ILT Curved Beam Strength	CTA (-65 °F)	B	NTPM911Q1-HXL-H40-NIAR-ILT-B-C2-1-CTA (-65 °F)-1	NA	364.6	Low	Y	N
ILT Curved Beam Strength	CTA (-65 °F)	E	NTPM911Q1-HXL-H40-SKS-ILT-E-C2-1-CTA (-65 °F)-7	NA	302.6	Low	N	Y
ILT Curved Beam Strength	RTA (70 °F)	E	NTPM911Q1-HXL-H40-SKS-ILT-E-C2-1-RTA (70 °F)-3	NA	272.4	Low	Y	N
ILT Curved Beam Strength	ETW (180 °F)1	A	NTPM911Q1-HXL-H40-NIAR-ILT-A-C1-1-ETW (180 °F)-5	NA	126.4	Low	Y	N

NA: Property not normalized
NoA: Not an Outlier
FHT1 grayed out cells are to make the distinction betweenn batch/condition outliers in the normalized and as-measured datasets.

Table 5-1: List of Outliers

6. References

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