Renegade RM-2014-LDk-Tk 4581 8HS Quartz fabric 286 gsm 38% RC Material Allowables Statistical Analysis Report

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1. Introduction

This report contains statistical analysis of the Renegade RM-2014-LDk-Tk 4581 8HS Quartz satin fabric prepreg material property data published in NCAMP Test Report CAM-RP-2024-007 Rev N/C. The lamina and laminate material property data have been generated with NCAMP oversight through NCAMP Project Number NPN 032302 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-estimates, and B-estimates were calculated using a variety of techniques that are detailed in section 2. The qualification material was procured to NCAMP Material Specification NMS 201/1 Rev -, dated August 31st, 2023. The qualification test panels were cured in accordance with NCAMP Process Specification NPS 82014 Rev -, dated July 5th, 2023 using "A" Cure Cycle. The panels were fabricated at Resonant Sciences, 4085 Executive Dr., Dayton, OH 45430. The NCAMP Test Plan NTP 2014Q1 was used for this qualification program. The testing was performed at Renegade Materials Corporation in Miamisburg, Ohio and the National Institute for Aviation Research (NIAR) in Wichita, Kansas.

Basis numbers are labeled as 'values' when the data meets all the requirements of CMH-17-1H. 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-17-1H).

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

Aircraft companies should not use the data published in this report without specifying NCAMP Material Specification NMS 201/1. NMS 201/1 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 201/1*. NMS 201/1 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	IPS
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	$F_{12}^{s5\%}$
In Plane Shear Strength at 0.2% offset	$F_{12}^{s0.2\%}$
In Plane Shear Modulus	G_{12}^s

Table 1-2: Test Property Symbols

Environmental Condition	Abbreviation	Temperature
Cold Temperature Dry	CTD	−65 ± 5˚F
Room Temperature Dry	RTD	70 ± 10˚F
Elevated Temperature Dry	ETD	212 ± 5˚F
Elevated Temperature Wet	ETW	212 ± 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-2024-007 Rev N/C.

1.2 Pooling Across Environments

When pooling across environments was allowable, the pooled co-efficient 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: $\text{basis value} = \bar{X} - kS$ 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-17-1G. 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-17-1G 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-17-1G 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.

$$\textbf{Pooled Coefficient of Variation} = \frac{S_p}{1} = S_p$$ **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: $$A-basis = \overline{X} - K_a S$$ $$B-basis = \overline{X} - K_b S$$ **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-17-1G. The approximation formulas are given below:

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

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

Where

r = the number of environments being pooled together

n_j = number of data values for environment j

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

$$f = N - r$$

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

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

$$c_B(f) = 0.36961 + \frac{0.0040342}{\sqrt{f}} - \frac{0.71750}{f} + \frac{0.19693}{f\sqrt{f}}$$ **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^*.

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

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

$$S_p^* = \sqrt{\frac{\sum_{i=1}^{k}\left((n_i - 1)\left(CV_i^* \cdot \bar{X}_i\right)^2\right)}{\sum_{i=1}^{k}(n_i - 1)}}$$ **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 $S_i^* = CV^* \cdot \bar{X}_i$ for each batch. Transform the individual data values (X_{ij}) in each batch as follows:

$$X'_{ij} = C_i \left(X_{ij} - \bar{X}_i \right) + \bar{X}_i$$ **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.

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

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

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

$$SSE' = \sum_{i=1}^{k} \sum_{j=1}^{n_i} \left(X'_{ij} - \bar{X}_i \right)^2$$ **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-17-1G.

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

$$C = \frac{n-1}{\sqrt{n}} \sqrt{\frac{t^2}{n-2+t^2}}$$ **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:

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

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

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

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:

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

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 noncentrality parameter $1.282\sqrt{n}$ and n − 1 degrees of freedom. Since this in not a calculation that Excel can handle, the following approximation to the k_B values is used:

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

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 noncentrality 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:

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

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

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

The Anderson-Darling test statistic is

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

and the observed significance level is

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

where

$$AD^* = \left(1 + \frac{0.2}{\sqrt{n}}\right)AD$$ **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 $\le$ 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:

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

where $x_{(i)}$ is the i^{th} smallest sample observation, $\bar{x}_L$ 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-17-1G, 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 $\left(n_i, \bar{x}_i, s_i^2\right)$ 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:

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

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

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-17-1G 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

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

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.

Estimated B-Basis = $\bar{X} - k_b S_{adj} = \bar{X} - k_b \cdot 0.08 \cdot \bar{X}$ **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 CTD condition is used with open hole compression CTD 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 = $\bar{X}_1 - K_{(N_1,N_2)} \cdot \bar{X}_1 \cdot \max\left(CV_1, CV_2\right)$ **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 = $\bar{X}_1 - K_{(N_1,N_2)} \cdot \bar{X}_1 \cdot Max\left(8\%, CV_1, CV_2\right)$ **Equation 63**

With:

$\bar{X}_1$ 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

3. Summary of Results

The basis values for all tests are summarized in the following tables. The NCAMP recommended B-basis values meet all requirements of CMH-17-1G. 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-17-1G 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 B-basis Values

The following rules are used in determining what B-basis value, if any, is included in tables Table 3-1 and Table 3-2 of recommended values.

1. Recommended values are NEVER estimates. Only B-basis values that meet all requirements of CMH-17-1G 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 B-basis values are not recommended since only three batches of material are available and CMH-17-1G recommends that no less than five batches be used when computing basis values with the ANOVA method.
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 CTD-RTD-ETW trend of the basis values is not consistent with the CTD-RTD-ETW trend of the average values), then the B-basis values will not be recommended.

NCAMP Recommended B-basis Values for
Renegade RM-2014-LDk-Tk 45818 8HS Quartz Fabric 286 gs 38% RC
All B-basis values in this table meet the standards for publication in CMH-17-1G Handbook
Values are for normalized data unless noted

Lamina Strength Tests

Environment	Statistic	WT	WC	FT	FC	IPS*		SBS*
						0.2% Offset	5% Strain	
CTD (-65°F)	B-basis	111.1	72.21	NA: A	59.98	4.951	8.936	8.602
	Mean	122.2	79.16	102.4	66.02	5.616	9.901	9.467
	CV	6.000	6.728	7.550	6.000	6.000	6.000	6.000
RTD (70°F)	B-basis	97.07	61.72	82.41	52.28	3.822	6.657	7.773
	Mean	108.1	68.67	93.33	58.33	4.335	7.622	8.638
	CV	6.000	6.037	6.000	6.000	6.000	6.000	6.000
ETD (212°F)	B-basis	99.88	48.23	NA: A	38.32	2.468	NA: A	5.018
	Mean	110.9	55.18	90.63	44.36	2.791	4.923	5.883
	CV	6.000	6.982	8.318	6.597	6.000	6.939	6.000
ETW (212°F)	B-basis	63.70	34.83	NA: A	24.85	1.428	2.139	3.017
	Mean	74.75	41.57	63.12	30.73	1.653	2.527	3.447
	CV	6.000	6.486	12.73	11.22	7.139	7.781	6.321

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.
* Data is as measured rather than normalized

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

NCAMP Recommended B-basis Values for
Renegade RM-2014-LDk-Tk 45818 8HS Quartz Fabric 286 gs 38% RC
All B-basis values in this table meet the standards for publication in CMH-17-1G Handbook
Values are for normalized data unless noted

Laminate Strength Tests

Layup	Environment	Statistic	UNT	UNC	SBS*	OHT	FHT	OHC	FHC	SSB	
										2% Offset	Ult. Str.
25/50/25	CTD (-65°F)	B-basis	NA			44.96	46.64				
		Mean	82.81			49.37	51.30				
		CV	6.000			6.000	6.000				
	RTD (70°F)	B-basis	67.55	51.79	6.927	39.53	41.07	29.04	51.02	77.91	93.35
		Mean	76.62	58.75	7.857	43.95	45.72	32.05	57.77	87.73	103.6
		CV	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000
	ETD (212°F)	B-basis				37.98		21.90			
		Mean				42.39		24.91			
		CV				6.00		6.00			
	ETW (212°F)	B-basis	43.96	NA: A	2.977	25.84	27.47	18.69	NA: A	59.50	61.50
		Mean	49.31	31.93	3.423	30.26	32.13	21.69	29.83	69.32	71.77
		CV	6.035	8.878	7.031	6.120	6.016	7.586	6.911	7.960	6.962
10/80/10	CTD (-65°F)	B-basis	42.07			30.71	33.47				
		Mean	46.05			34.20	37.97				
		CV	6.000			6.000	6.000				
	RTD (70°F)	B-basis	35.44	32.15		25.94	27.46	21.68	33.42	66.61	86.54
		Mean	39.42	36.47		29.43	31.15	24.60	37.79	74.67	95.42
		CV	6.000	6.000		6.000	6.000	6.000	6.000	6.000	6.000
	ETD (212°F)	B-basis									
		Mean									
		CV									
	ETW (212°F)	B-basis	17.45	NA: A		15.57	16.44	12.39	16.01	48.61	56.56
		Mean	21.43	19.17		17.67	18.71	14.14	18.16	56.63	65.39
		CV	6.460	7.322		6.000	6.148	6.271	6.000	7.750	6.000
40/20/40	CTD (-65°F)	B-basis	90.89			62.91	56.77				
		Mean	101.4			71.37	63.23				
		CV	6.000			6.000	6.000				
	RTD (70°F)	B-basis	80.07	52.44		NA: A	48.15	28.91	52.79	70.71	79.56
		Mean	90.57	57.77		58.00	54.60	32.80	57.89	78.97	88.06
		CV	6.000	6.000		7.840	6.000	6.000	6.000	6.261	6.000
	ETD (212°F)	B-basis									
		Mean									
		CV									
	ETW (212°F)	B-basis	55.18	27.01		33.96	NA: A	NA: A	26.29	50.00	50.55
		Mean	61.81	32.24		38.52	38.41	21.08	31.48	58.26	59.04
		CV	6.000	7.622		6.000	6.703	7.470	6.000	7.026	6.685

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.
Shaded empty boxes indicate that no test data is available for that property and condition.
* Data is as measured rather than normalized.

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

3.2 Lamina and Laminate Summary Tables

Prepreg Material: Renegade RM-2014-LDk-Tk 4581 8HS Quartz Fabric 286 gsm with RC 38%
Material Specification: NMS 201/1
Process Specification: NPS 82014 Rev -
Fabric: 4581 8HS Quartz satin weave **Resin:** Renegade RM-2014-LDk-TK

Renegade RM-2014-LDk-Tk 4581 8HS Quartz Fabric 286 gsm with RC 38% Lamina Properties Summary

Tg (dry) 3-pt Bend: 294.5°F **Tg (wet) 3-pt Bend:** 245.5°F **Tg METHOD:** ASTM D7028
Tg (dry) Single Cantilever: 318.1°F

	Lot 1	Lot 2	Lot 3
Date of fiber manufacture	12/16/2021	1/4/2023	6/12/2023
Date of resin manufacture	3/7/2023	8/8/2023	9/6/2023
Date of prepreg manufacture	3/7/2023	8/10/2023	9/8/2023
Date of composite manufacture		7/8/2023 - 9/25/2023	
Date of testing		9/12/2023 - 3/15/2024	
Date of data submittal		4/8/2024	
Date of analysis		4/22/2024 - 5/22/2024	

LAMINA MECHANICAL PROPERTY B-BASIS SUMMARY
Data reported: As measured followed by normalized values in parentheses, normalizing CPT: 0.01120 in
Values shown in shaded boxes do not meet CMH-17G requirements and are estimates only
These values may not be used for certification unless specifically allowed by the certifying agency

Test Condition	**CTD**			**RTD**			**ETD**			**ETW**		
Property	**B-Basis**	**Modified CV B-basis**	**Mean**	**B-Basis**	**Modified CV B-basis**	**Mean**	**B-Basis**	**Modified CV B-basis**	**Mean**	**B-Basis**	**Modified CV B-basis**	**Mean**
F_1^{tu}	110.8	108.9	123.5	70.03	NA	108.3	98.93	98.01	111.2	54.66	65.13	75.09
(ksi)	(117.8)	(111.1)	(122.2)	(88.29)	(97.07)	(108.1)	(105.69)	(99.88)	(110.9)	(69.19)	(63.70)	(74.75)
E_1^{t}			3.534			3.281			3.131			3.033
(Msi)			(3.495)			(3.275)			(3.124)			(3.024)
ν_{12}^{t}			0.1284			0.1247			0.1001			0.07861
F_2^{tu}	77.20	91.95	103.35	89.16	81.87	93.33	59.73	79.00	90.46	27.42	NA	62.89
(ksi)	(64.64)	NA	(102.37)	(75.32)	(82.41)	(93.33)	(45.99)	NA	(90.63)	(16.13)	NA	(63.12)
E_2^{t}			3.428			3.279			2.976			2.979
(Msi)			(3.403)			(3.270)			(2.971)			(2.948)
F_1^{cu}	73.53	72.10	79.11	62.45	61.01	68.03	49.10	47.66	54.68	36.09	34.70	41.50
(ksi)	(60.89)	(72.21)	(79.16)	(63.15)	(61.72)	(68.67)	(41.09)	(48.23)	(55.18)	(32.57)	(34.83)	(41.57)
E_1^{c}			3.576			3.466			3.300			3.198
(Msi)			(3.579)			(3.499)			(3.328)			(3.208)
F_2^{cu}	61.84	60.70	66.84	46.83	52.43	58.56	40.21	38.41	44.54	24.35	25.07	31.03
(ksi)	(61.97)	(59.98)	(66.02)	(54.28)	(52.28)	(58.33)	(34.46)	(38.32)	(44.36)	(24.26)	(24.85)	(30.73)
E_2^{c}			3.451			3.360			3.194			2.937
(Msi)			(3.408)			(3.346)			(3.180)			(2.906)
$F_{12}^{s0.2\%}$ (ksi)	5.460	4.951	5.616	3.721	3.822	4.335	2.193	2.468	2.791	1.456	1.428	1.653
$F_{12}^{s5\%}$ (ksi)	9.325	8.936	9.901	7.046	6.657	7.622	3.301	NA	4.923	2.149	2.139	2.527
G_{12}^{s} (Msi)			0.7640			0.599			0.4137			0.2470
SBS (ksi)	9.201	8.602	9.467	7.587	7.773	8.638	5.350	5.018	5.883	3.131	3.017	3.447

Table 3-3: Summary of Test Results for Lamina Data

Renegade RM-2014-LDk-Tk 4581 8HS Quartz Fabric 286 gsm with RC 38% Laminate Properties Summary

Prepreg Material: Renegade RM-2014-LDk-Tk 4581 8HS Quartz Fabric 286 gsm with RC 38%
Material Specification: NMS 201/1
Process Specification: NPS 82014
Fabric: 4581 8HS Quartz satin weave **Resin:** Renegade RM-2014-LDk-TK

Tg (dry) 3-pt Bend: 294.5°F **Tg (wet) 3-pt Bend:** 245.5°F **Tg METHOD:** ASTM D7028
Tg (dry) Single Cantilever: 318.1°F

	Lot 1	Lot 2	Lot 3
Date of fiber manufacture	12/16/2021	1/4/2023	6/12/2023
Date of resin manufacture	3/7/2023	8/8/2023	9/6/2023
Date of prepreg manufacture	3/7/2023	8/10/2023	9/8/2023
Date of composite manufacture		7/8/2023 - 9/25/2023	
Date of testing		9/12/2023 - 3/15/2024	
Date of data submittal		4/8/2024	
Date of analysis		4/22/2024 - 5/22/2024	

LAMINATE MECHANICAL PROPERTY B-BASIS SUMMARY
Data reported as normalized, normalizing CPT: 0.01120 in

Values shown in shaded boxes do not meet CMH-17G requirements and are estimates only
These values may not be used for certification unless specifically allowed by the certifying agency

Test	Property	Test Condition	Unit	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
OHT (normalized)	Strength	CTD	ksi	47.59	44.96	49.37	32.92	30.71	34.20	64.13	62.91	71.37
		RTD	ksi	42.16	39.53	43.95	28.15	25.94	29.43	26.06	NA	58.00
		ETD	ksi	40.61	37.98	42.39	15.05	15.57	17.67	---	---	---
		ETW	ksi	21.97	25.84	30.26	---	---		28.66	33.96	38.52
OHC (normalized)	Strength	RTD	ksi	30.77	29.04	32.05	21.53	21.68	24.60	30.85	28.91	32.80
		ETD	ksi	20.59	21.90	24.91	---	---	---	---	---	---
		ETW	ksi	18.86	18.69	21.69	10.27	12.39	14.14	11.76	NA	21.08
UNT (normalized)	Strength	CTD	ksi	78.14	NA	82.81	44.53	42.07	46.05	89.19	90.89	101.4
	Modulus		msi	---	---	2.881	---	---	2.450	---	---	3.245
	Strength	RTD	ksi	71.96	67.55	76.62	32.81	35.44	39.42	74.26	80.07	90.57
	Modulus		msi	---	---	2.616	---	---	2.087	---	---	3.008
	Strength	ETW	ksi	40.36	43.96	49.31	15.06	17.45	21.43	47.66	55.18	61.81
	Modulus		msi	---	---	2.083	---	---	1.549	---	---	2.628
UNC (normalized)	Strength	RTD	ksi	56.21	51.79	58.75	34.17	32.15	36.47	54.67	52.44	57.77
	Modulus		msi	---	---	2.799	---	---	2.213	---	---	3.131
	Strength	ETW	ksi	14.57	NA	31.93	11.84	NA	19.17	27.84	27.01	32.24
	Modulus		msi	---	---	2.232	---	---	1.484	---	---	2.709
SBS1 (as measured)	Strength	RTD	ksi	6.930	6.927	7.857	---	---	---	---	---	---
		ETW	ksi	3.038	2.977	3.423	---	---	---	---	---	---
FHT (normalized)	Strength	CTD	ksi	42.19	46.64	51.30	36.59	33.47	37.97	51.36	56.77	63.23
		RTD	ksi	40.15	41.07	45.72	28.69	27.46	31.15	48.89	48.15	54.60
		ETW	ksi	23.73	27.47	32.13	17.12	16.44	18.71	24.16	NA	38.41
FHC (normalized)	Strength	RTD	ksi	56.19	51.02	57.77	33.45	33.42	37.79	50.69	52.79	57.89
		ETW	ksi	19.39	NA	29.83	17.14	16.01	18.16	29.44	26.29	31.48
Single Shear Bearing (normalized)	2% Offset Strength	RTD	ksi	79.38	77.91	87.73	70.30	66.61	74.67	58.47	70.71	78.97
		ETW	ksi	60.97	59.50	69.32	48.35	48.61	56.63	51.30	50.00	58.26
	Ultimate Strength	RTD	ksi	89.50	93.35	103.6	78.56	86.54	95.42	82.95	79.56	88.06
		ETW	ksi	63.38	61.50	71.77	60.36	56.56	65.39	53.93	50.55	59.04
CAI (normalized)	Strength	RTD	ksi	---	---	26.04	---	---	---	---	---	---
ILT (as measured)	Strength	CTD	ksi	---	---	10.39	---	---	---	---	---	---
		RTD	ksi	---	---	7.979	---	---	---	---	---	---
		ETW	ksi	---	---	2.949	---	---	---	---	---	---
CBS (as measured)	Strength	CTD	lb	---	---	527.3	---	---	---	---	---	---
		RTD	lb	---	---	401.4	---	---	---	---	---	---
		ETW	lb	---	---	150.1	---	---	---	---	---	---

Table 3-4: Summary of Test Results for Laminate Data

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-17-1G 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: CTD, RTD, ETD, and ETW.

For the normalized dataset, the RTD environment failed the ADK test for batch equivalency. ANOVA was used to compute its basis value, and with three batches of data available this is an estimate. Applying the modified CV, there were no diagnostic test failures so pooling was acceptable for the four conditions.

For the as-measured dataset, all the environments failed the ADK for batch equivalency. ANOVA was used to compute basis values, and with three batches of data available these are estimates. Applying the modified CV, the RTD environment failed the ADK test for batch equivalency, therefore basis values could not be computed for that environment, and pooling across environments was not acceptable.

There were two statistical outliers. The highest normalized value in batch two of the CTD environment was an outlier for the batch but not for the environment. It was an outlier in the normalized CTD dataset but not in the as-measured CTD dataset. The highest normalized value in batch three of the RTD environment was an outlier for the batch but not for the environment. It was an outlier in the normalized RTD dataset but not in the as-measured RTD dataset. 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, B-estimates, and B-basis values are shown graphically in Figure 4-1.

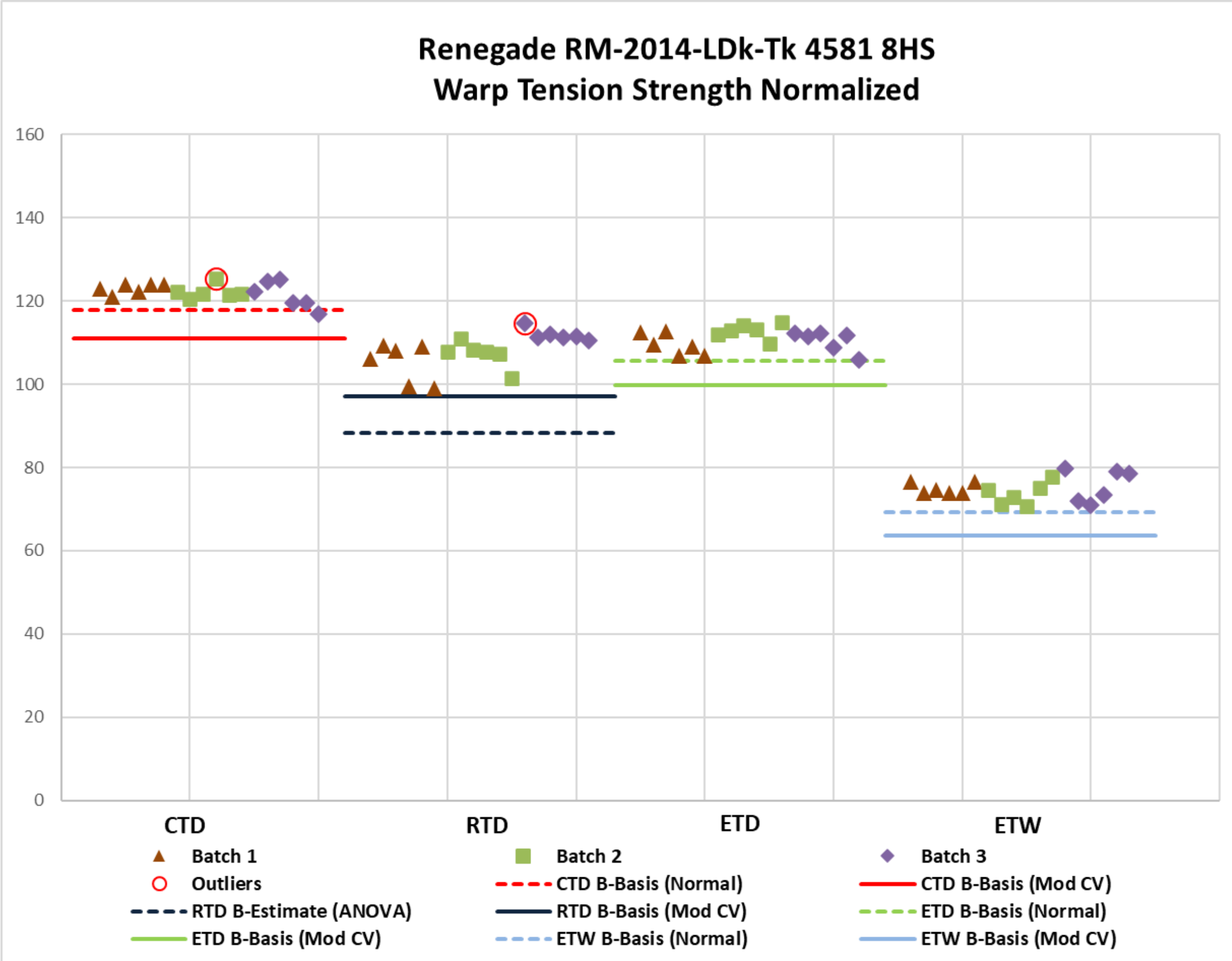

Figure 4-1: Batch Plot for WT Normalized Strength

Warp Tension (WT) Basis Values and Statistics								
	Normalized				As-Measured			
Env	CTD	RTD	ETD	ETW	CTD	RTD	ETD	ETW
Mean	122.2	108.1	110.9	74.75	123.5	108.3	111.2	75.09
Stdev	2.200	4.236	2.651	2.817	2.916	6.067	2.812	4.091
CV	1.801	3.918	2.390	3.769	2.362	5.600	2.529	5.448
Mod CV	6.000	6.000	6.000	6.000	6.000	6.800	6.000	6.724
Min	116.9	99.11	105.8	70.62	117.7	98.90	105.9	67.60
Max	125.3	114.5	114.9	79.80	130.6	117.7	115.8	82.80
No. Batches	3	3	3	3	3	3	3	3
No. Spec.	18	18	18	18	18	18	18	18
Basis Value Estimates								
B-Basis Value	117.8		105.7	69.19				
B-Estimate		88.29			110.8	70.03	98.93	54.66
A-Estimate	114.7	74.16	102.0	65.24	101.7	42.68	90.19	40.09
Method	Normal	ANOVA	Normal	Normal	ANOVA	ANOVA	ANOVA	ANOVA
Modified CV Basis Value Estimates								
B-Value	111.1	97.07	99.88	63.70	108.9	NA	98.01	65.13
A-Estimate	103.8	89.79	92.60	56.42	98.52		88.70	58.07
Method	Pooled	Pooled	Pooled	Pooled	Normal		Normal	Normal

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

Warp Tension (WT) Modulus Statistics								
	Normalized				As-Measured			
Env	CTD	RTD	ETD	ETW	CTD	RTD	ETD	ETW
Mean	3.495	3.275	3.124	3.024	3.534	3.281	3.131	3.033
Stdev	0.03362	0.06087	0.09843	0.1739	0.08252	0.1009	0.09731	0.1286
CV	0.9619	1.859	3.151	5.752	2.335	3.077	3.108	4.240
Mod CV	6.000	6.000	6.000	6.876	6.000	6.000	6.000	6.120
Min	3.415	3.062	2.988	2.837	3.394	3.090	2.970	2.860
Max	3.537	3.359	3.310	3.420	3.678	3.450	3.340	3.390
No. Batches	3	3	3	3	3	3	3	3
No. Spec.	18	18	18	18	18	18	18	18

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: CTD, RTD, ETD, and ETW.

For the normalized dataset, all the environments failed the ADK test for batch equivalency. ANOVA was used to compute basis values, and with three batches of data available these are estimates. Applying the modified CV, only the RTD environment passed the ADK test for batch equivalency, therefore pooling is not acceptable.

For the as-measured dataset, the CTD, ETD and ETW environments failed the ADK test for batch equivalency. ANOVA was used to compute basis values, and with three batches of data available these are estimates. Applying the modified CV, CTD and ETD passed the ADK test for batch equivalency, but ETW failed and basis values were not computed. CTD, RTD, and ETD were acceptable for pooling.

There were no statistical outliers.

Statistics, estimates and basis values are given for the FT strength data in Table 4-3 and for the modulus data in Table 4-4. The normalized data, B-estimates and the B-basis values are shown graphically in Figure 4-2.

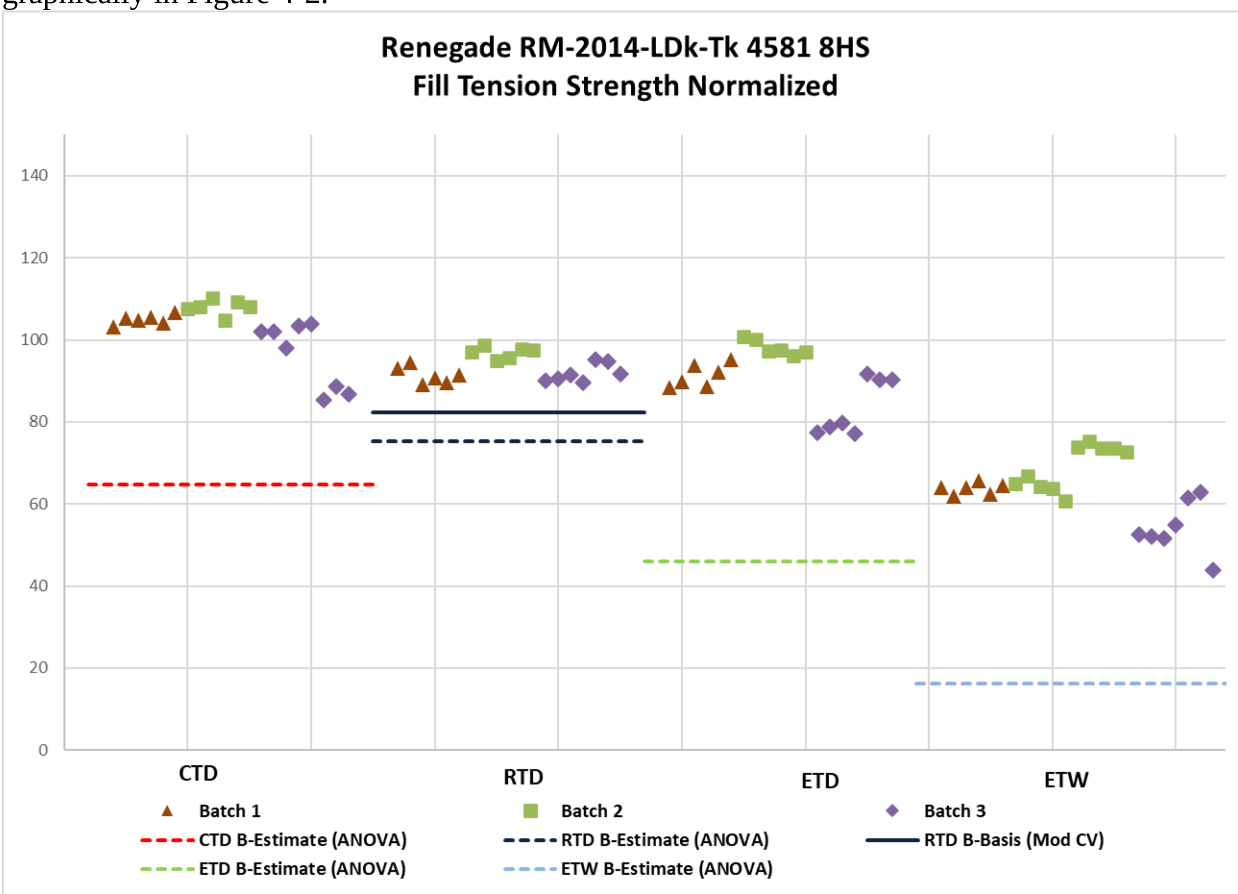

Figure 4-2: Batch Plot for FT Normalized Strength

Fill Tension (FT) Strength Basis Values and Statistics								
	Normalized				As-Measured			
Env	CTD	RTD	ETD	ETW	CTD	RTD	ETD	ETW
Mean	102.4	93.33	90.63	63.12	103.4	93.33	90.46	62.89
Stdev	7.267	3.109	7.539	8.036	6.153	2.139	6.043	6.324
CV	7.099	3.331	8.318	12.73	5.953	2.292	6.680	10.06
Mod CV	7.550	6.000	8.318	12.73	6.977	6.000	7.340	10.06
Min	85.32	89.00	77.10	43.82	86.82	89.00	78.50	46.30
Max	110.2	98.63	100.8	75.23	109.5	96.90	99.00	71.40
No. Batches	3	3	3	3	3	3	3	3
No. Spec.	20	19	19	23	20	19	19	23
Basis Value Estimates								
B-Basis Value						89.16		
B-Estimate	64.64	75.32	45.99	16.13	77.20		59.73	27.42
A-Estimate	37.72	62.47	14.13	NA	58.55	86.20	37.81	2.098
Method	ANOVA	ANOVA	ANOVA	ANOVA	ANOVA	Normal	ANOVA	ANOVA
Modified CV Basis Value Estimates								
B-Basis Value	NA	82.41	NA	NA	91.95	81.87	79.00	NA
A-Estimate		74.67			84.27	74.20	71.34	
Method		Normal			Pooled	Pooled	Pooled	

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

Fill Tension (FT) Modulus Statistics								
	Normalized				As-Measured			
Env	CTD	RTD	ETD	ETW	CTD	RTD	ETD	ETW
Mean	3.403	3.270	2.971	2.948	3.428	3.279	2.976	2.979
Stdev	0.03599	0.06790	0.09929	0.2638	0.08113	0.1122	0.09955	0.2664
CV	1.058	2.077	3.342	8.950	2.367	3.420	3.345	8.943
Mod CV	6.000	6.000	6.000	8.950	6.000	6.000	6.000	8.943
Min	3.313	3.082	2.775	2.688	3.213	3.110	2.800	2.700
Max	3.447	3.361	3.143	3.548	3.559	3.453	3.230	3.580
No. Batches	3	3	3	3	3	3	3	3
No. Spec.	18	20	20	17	18	20	20	17

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: CTD, RTD, ETD, and ETW.

For the normalized dataset, the CTD, ETD and ETW environments failed the ADK test for batch equivalency. ANOVA was used to compute 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 four environments was acceptable.

For the as-measured dataset, there were no diagnostic test failures so pooling the four environments was acceptable.

There were two statistical outliers. The highest as-measured value in batch two of the ETD environment was an outlier for the batch but not for the environment. It was an outlier in the as-measured dataset but not in normalized dataset. The lowest as-measured value in batch three of the ETD environment was an outlier for the environment 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, 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, B-estimates and B-basis values are shown graphically in Figure 4-3.

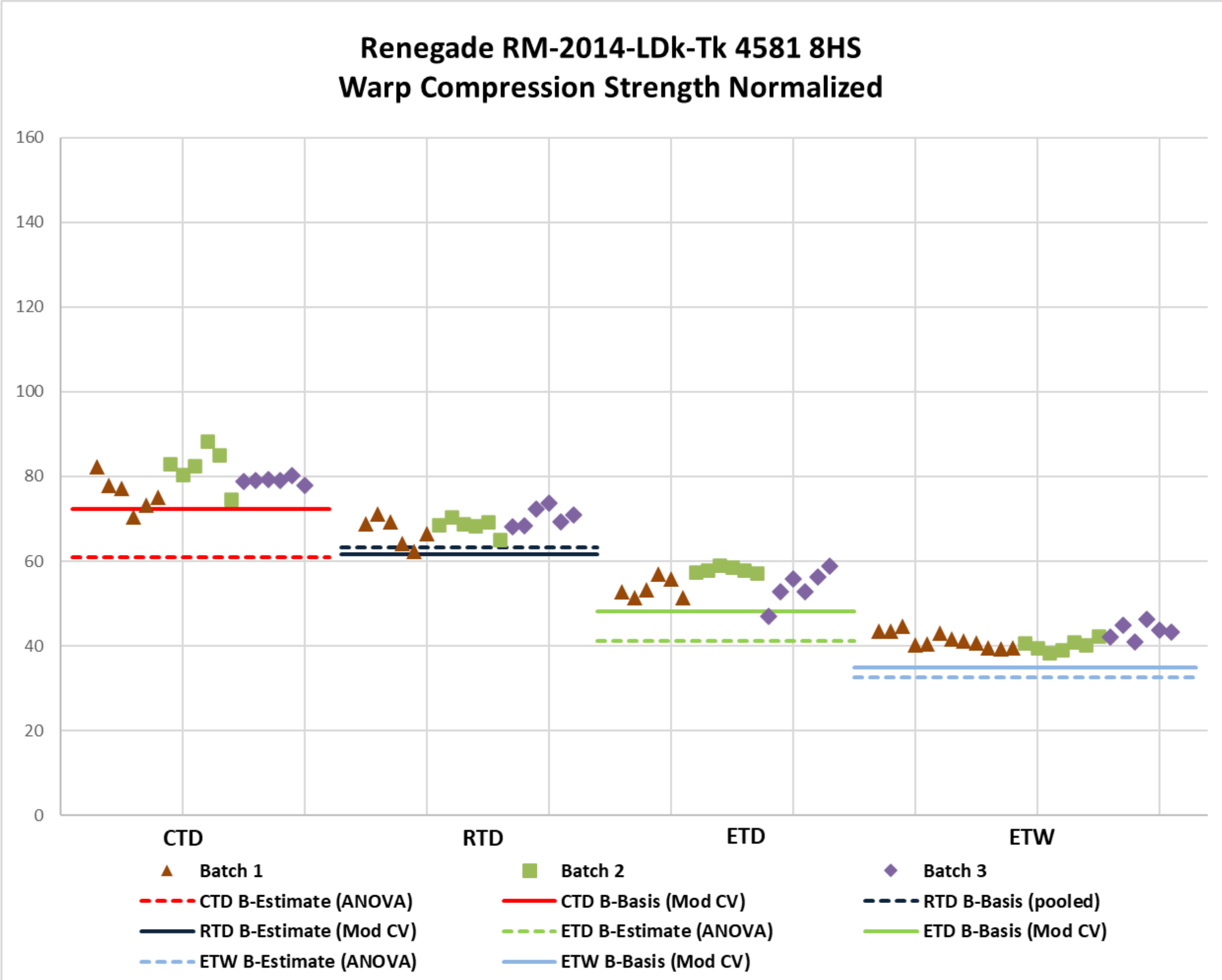

Figure 4-3: Batch Plot for WC Normalized Strength

Warp Compression (WC) Basis Values and Statistics								
	Normalized				As-Measured			
Env	CTD	RTD	ETD	ETW	CTD	RTD	ETD	ETW
Mean	79.16	68.67	55.18	41.57	79.11	68.03	54.68	41.50
Stdev	4.319	2.797	3.291	2.067	4.440	3.322	2.823	2.194
CV	5.456	4.073	5.964	4.972	5.612	4.883	5.163	5.286
Mod CV	6.728	6.037	6.982	6.486	6.806	6.442	6.581	6.643
Min	70.37	62.33	47.10	38.30	69.66	60.70	47.10	38.30
Max	88.38	73.80	59.04	46.21	87.51	73.80	58.90	45.80
No. Batches	3	3	3	3	3	3	3	3
No. Spec.	18	18	18	25	18	18	18	25
Basis Value Estimates								
B-Basis Value		63.15			73.53	62.45	49.10	36.09
B-Estimate	60.89		41.09	32.57				
A-Estimate	47.87	59.24	31.05	26.13	69.87	58.78	45.43	32.40
Method	ANOVA	Normal	ANOVA	ANOVA	Pooled	Pooled	Pooled	Pooled
Modified CV Basis Value Estimates								
B-Value	72.21	61.72	48.23	34.83	72.10	61.01	47.66	34.70
A-Estimate	67.64	57.15	43.66	30.22	67.49	56.40	43.05	30.06
Method	Pooled	Pooled	Pooled	Pooled	Pooled	Pooled	Pooled	Pooled

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

Warp Compression (WC) Modulus Statistics								
	Normalized				As-Measured			
Env	CTD	RTD	ETD	ETW	CTD	RTD	ETD	ETW
Mean	3.579	3.499	3.328	3.208	3.576	3.466	3.300	3.198
Stdev	0.03018	0.06806	0.1280	0.2087	0.03841	0.07717	0.1486	0.2250
CV	0.8432	1.945	3.846	6.503	1.074	2.227	4.504	7.033
Mod CV	6.000	6.000	6.000	7.252	6.000	6.000	6.252	7.517
Min	3.520	3.388	3.030	2.976	3.514	3.340	3.030	2.950
Max	3.617	3.610	3.550	3.938	3.651	3.610	3.550	4.010
No. Batches	3	3	3	3	3	3	3	3
No. Spec.	18	18	18	18	18	18	18	18

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: CTD, RTD, ETD, and ETW.

For the normalized dataset, the ETD environment failed the ADK test for batch equivalency. ANOVA was used to compute its basis value, and with three batches of data available this is an estimate. The ETW environment failed the normality test. Applying the modified CV, there were no diagnostic tests failures so pooling the four environments was acceptable.

For the as-measured data, the RTD environment failed the ADK test for batch equivalency, ANOVA was used to compute its basis value, and with three batches of data available this is an estimate. The ETW environment failed the normality test. Applying the modified CV, there were no diagnostic test failures so pooling the four environments was acceptable.

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

Statistics, basis values and estimates are given for the FC strength data in Table 4-7 and for the modulus data in Table 4-8. The normalized data, B-estimates and B-basis values are shown graphically in Figure 4-4.

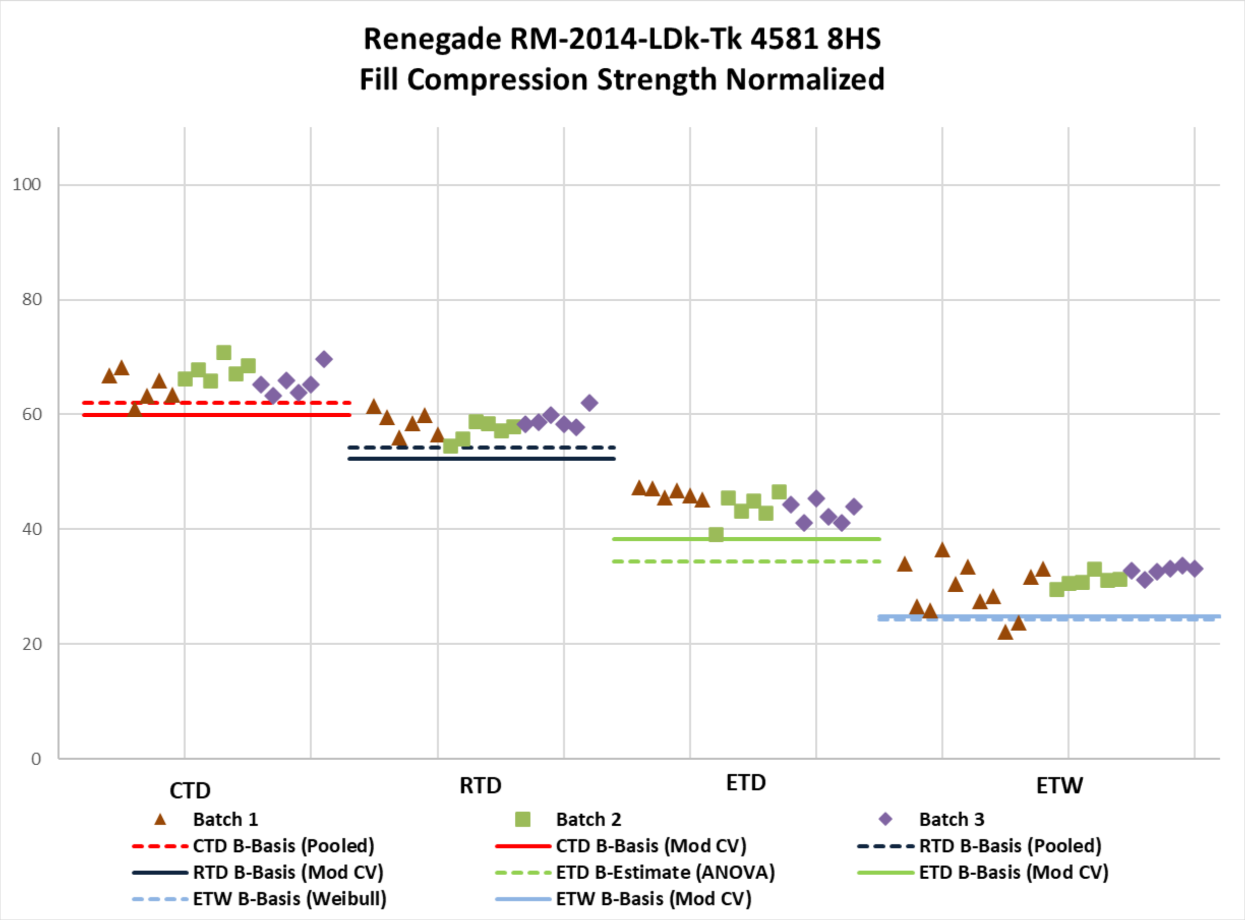

Figure 4-4: Batch Plot for FC Normalized Strength

Fill Compression (FC) Strength Basis Values and Statistics								
	Normalized				As-Measured			
Env	CTD	RTD	ETD	ETW	CTD	RTD	ETD	ETW
Mean	66.02	58.33	44.36	30.73	66.84	58.56	44.54	31.03
Stdev	2.513	1.890	2.304	3.449	2.530	2.408	2.194	3.568
CV	3.806	3.240	5.194	11.22	3.785	4.111	4.925	11.50
Mod CV	6.000	6.000	6.597	11.22	6.000	6.056	6.463	11.50
Min	60.95	54.58	39.25	22.20	61.75	54.10	38.90	22.20
Max	70.90	62.07	47.30	36.57	71.55	63.20	47.50	36.90
No. Batches	3	3	3	3	3	3	3	3
No. Spec.	18	18	18	24	18	18	18	24
Basis Value Estimates								
B-Basis Value	61.97	54.28		24.26	61.84		40.21	24.35
B-Estimate			34.46			46.83		
A-Estimate	59.22	51.52	27.39	18.45	58.30	38.47	37.14	18.39
Method	Pooled	Pooled	ANOVA	Weibull	Normal	ANOVA	Normal	Weibull
Modified CV Basis Value Estimates								
B-Basis Value	59.98	52.28	38.32	24.85	60.70	52.43	38.41	25.07
A-Estimate	56.00	48.31	34.35	20.85	56.67	48.40	34.38	21.01
Method	Pooled	Pooled	Pooled	Pooled	Pooled	Pooled	Pooled	Pooled

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

Fill Compression (FC) Modulus Statistics								
	Normalized				As-Measured			
Env	CTD	RTD	ETD	ETW	CTD	RTD	ETD	ETW
Mean	3.408	3.346	3.180	2.906	3.451	3.360	3.194	2.937
Stdev	0.05918	0.1230	0.1193	0.1500	0.09116	0.1723	0.1498	0.1664
CV	1.736	3.675	3.753	5.163	2.641	5.128	4.690	5.667
Mod CV	6.000	6.000	6.000	6.582	6.000	6.564	6.345	6.833
Min	3.283	3.148	2.966	2.650	3.283	3.120	2.940	2.650
Max	3.482	3.591	3.410	3.163	3.603	3.690	3.410	3.250
No. Batches	3	3	3	3	3	3	3	3
No. Spec.	18	18	18	18	18	18	18	18

Table 4-8: Statistics from FC Modulus Data

4.5 In-Plane Shear (IPS)

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: CTD, RTD, ETD, and ETW.

For the 0.2% Offset Strength dataset, the RTD and ETD 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 environments were not acceptable for pooling because the dataset failed the Levene's Test for equality of variances.

For the Strength at 5% strain dataset, the ETD environment failed the ADK test for batch equivalency. ANOVA was used to compute its basis value and with three batches of data available this is an estimate. The CTD and RTD environments were acceptable for pooling. Applying the modified CV, the ETD environment failed the ADK test for batch equivalency, therefore a basis value could not be computed.

There were two outliers. The highest value in batch three of the 0.2% offset strength ETW dataset was an outlier for the batch but not for the environment. The highest value in batch three of the strength at 5% strain ETD dataset was an outlier for the batch but not for the environment. They were retained for this analysis. Statistics, basis values and estimates are given for the IPS 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 Strength at 5% Strain in

Figure 4-5 and for 0.2% Offset Strength in Figure 4-6.

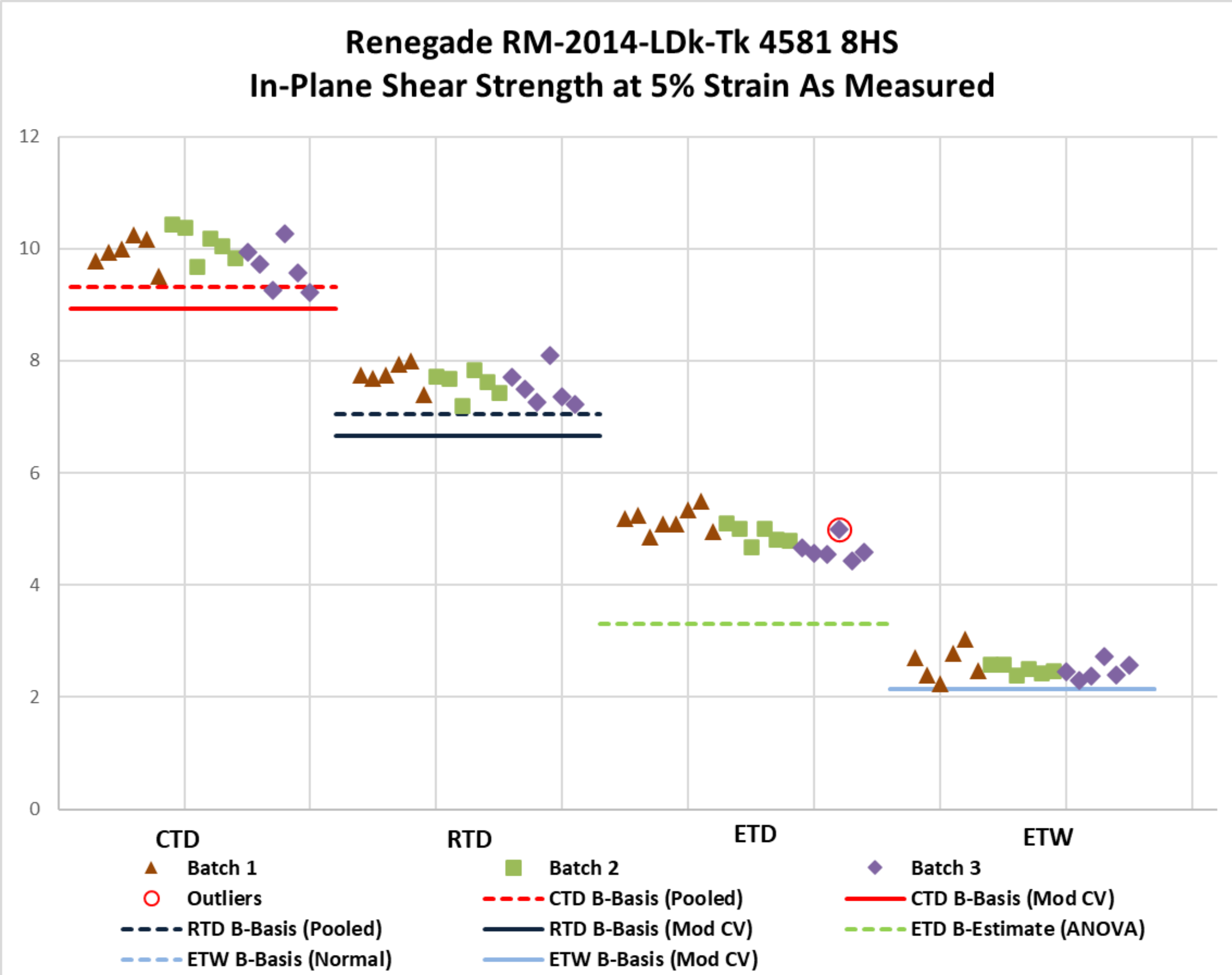

Figure 4-5: Batch Plot for IPS Maximum Strength and Strength at 5% Strain As-Measured

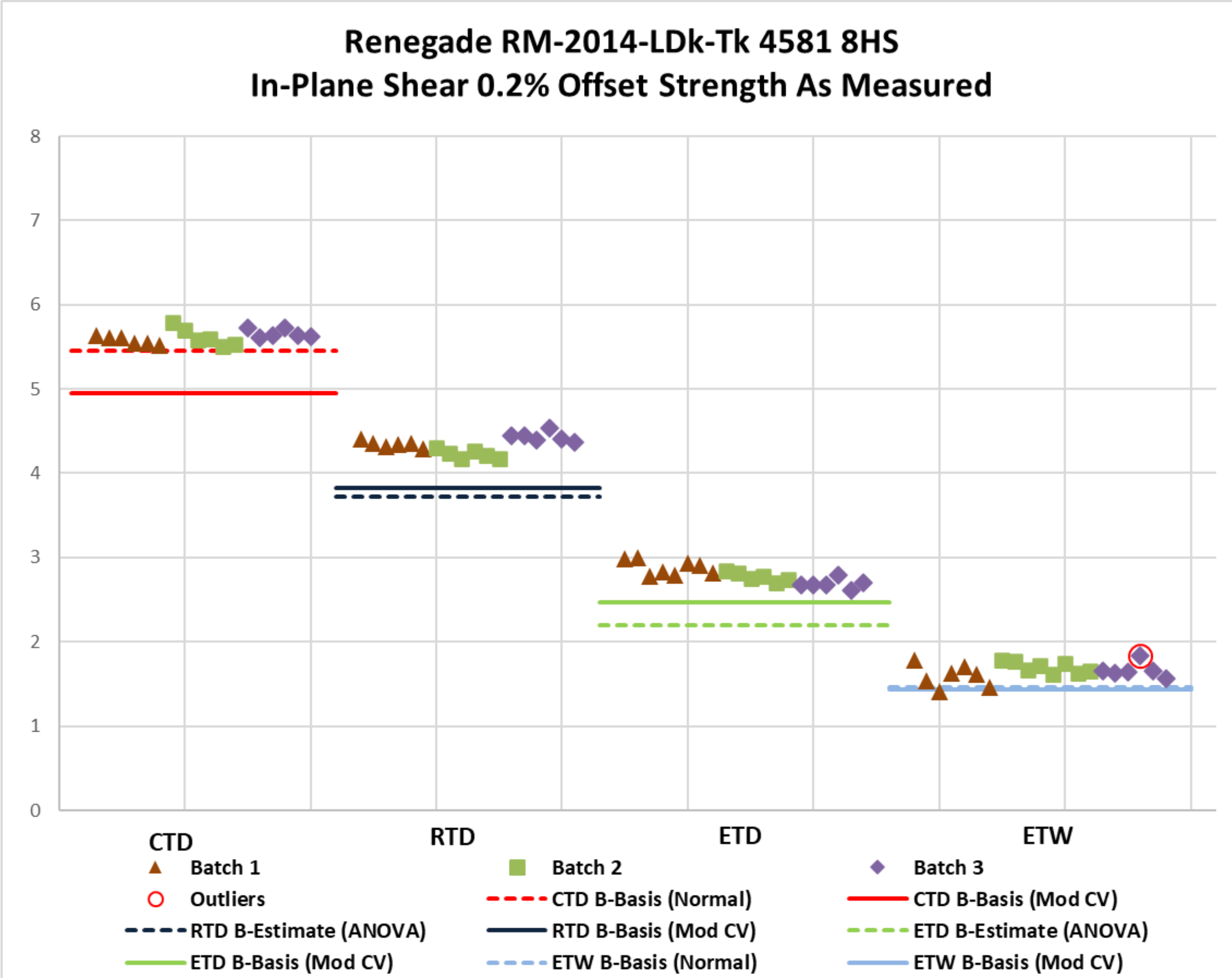

Figure 4-6: Batch Plot for IPS 0.2% Offset Strength As-Measured

In Plane Shear Strength Basis Values and Statistics								
	0.2% Offset Strength				Strength at 5% Strain			
Env	CTD	RTD	ETD	ETW	CTD	RTD	ETD	ETW
Mean	5.616	4.335	2.791	1.653	9.901	7.622	4.923	2.527
Stdev	0.07899	0.09660	0.1065	0.1038	0.3607	0.2649	0.2893	0.1911
CV	1.406	2.228	3.816	6.278	3.643	3.476	5.877	7.562
Mod CV	6.000	6.000	6.000	7.139	6.000	6.000	6.939	7.781
Min	5.503	4.180	2.610	1.410	9.217	7.210	4.440	2.250
Max	5.789	4.530	3.000	1.830	10.45	8.090	5.500	3.030
No. Batches	3	3	3	3	3	3	3	3
No. Spec.	18	18	20	21	18	18	20	18
Basis Value Estimates								
B-basis Value	5.460			1.456	9.325	7.046		2.149
B-Estimate		3.721	2.193				3.301	
A-Estimate	5.350	3.283	1.766	1.315	8.933	6.654	2.143	1.882
Method	Normal	ANOVA	ANOVA	Normal	Pooled	Pooled	ANOVA	Normal
Modified CV Basis Value Estimates								
B-basis Value	4.951	3.822	2.468	1.428	8.936	6.657	NA	2.139
A-Estimate	4.480	3.458	2.239	1.268	8.279	6.000		1.864
Method	Normal	Normal	Normal	Normal	Pooled	Pooled		Normal

Table 4-9: Statistics and Basis Values for IPS Strength Data

In Plane Shear As Measured Modulus Statistics				
Env	CTD	RTD	ETD	ETW
Mean	0.7640	0.5988	0.4137	0.2470
Stdev	0.01668	0.01971	0.01454	0.02201
CV	2.183	3.291	3.516	8.913
Mod CV	6.000	6.000	6.000	8.913
Min	0.7336	0.5700	0.3900	0.2170
Max	0.7878	0.6440	0.4370	0.3060
No. Batches	3	3	3	3
No. Spec.	18	18	20	21

Table 4-10: Statistics from IPS Modulus Data

4.6 "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: CTD, RTD, an ETW.

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 CTD and RTD 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 CTD 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 no statistical outliers.

Statistics, basis values and estimates are given for the UNT1 strength data in Table 4-11 and for the modulus data in Table 4-12. The normalized data, B-estimates and B-basis values are shown graphically in Figure 4-7.

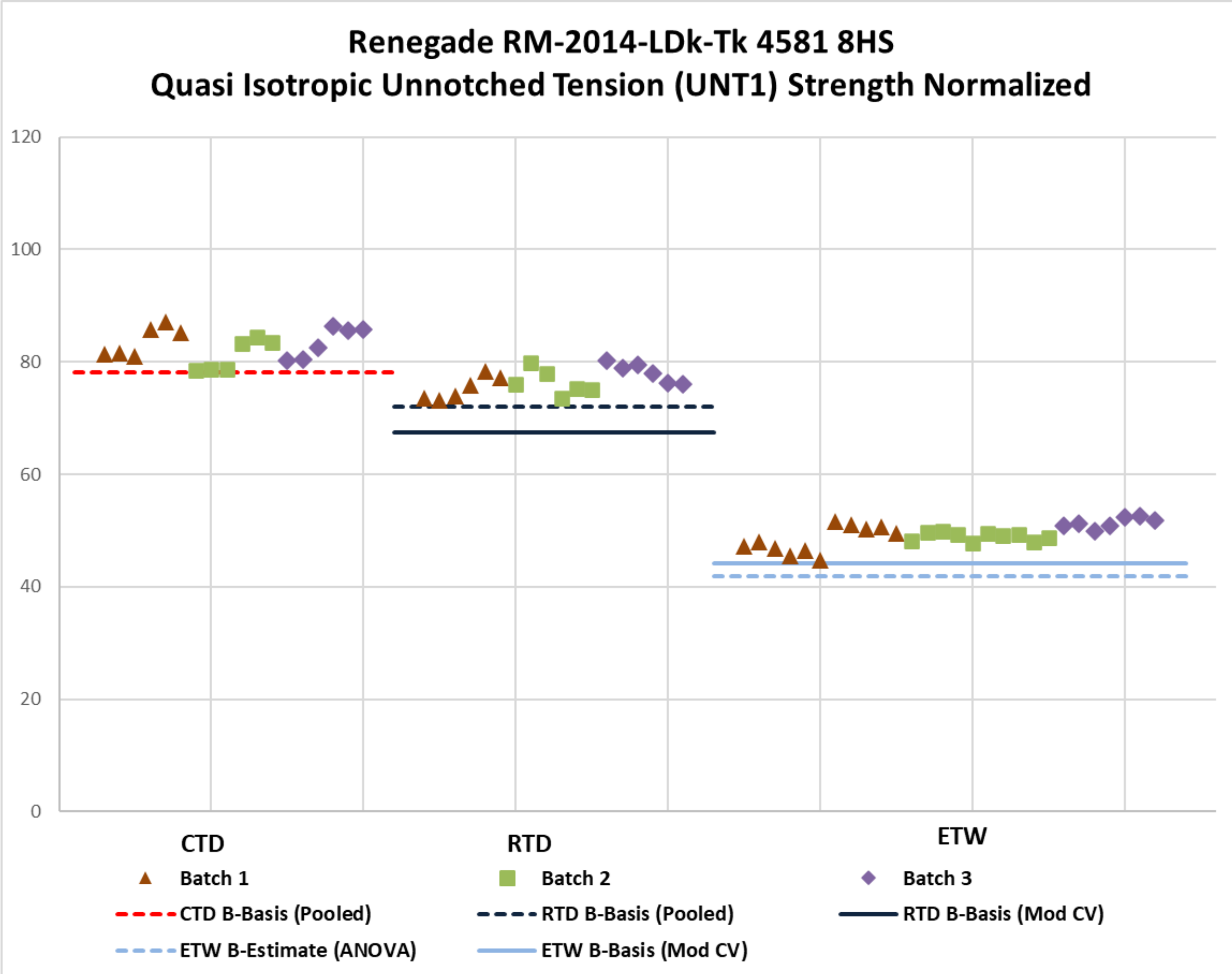

Figure 4-7: Batch Plot for UNT1 Normalized Strength

Unnotched Tension 1 (UNT1) Basis Values and Statistics						
	Normalized			As-Measured		
Env	CTD	RTD	ETW	CTD	RTD	ETW
Mean	82.81	76.62	49.31	81.77	75.52	48.94
Stdev	2.830	2.262	2.007	2.772	2.267	1.604
CV	3.417	2.952	4.071	3.390	3.003	3.277
Mod CV	6.000	6.000	6.035	6.000	6.000	6.000
Min	78.50	73.27	44.69	77.03	71.20	45.50
Max	87.09	80.24	52.50	85.73	79.30	51.50
No. Batches	3	3	3	3	3	3
No. Spec.	18	18	28	18	18	28
Basis Value Estimates						
B-Basis Value	78.14	71.96			71.04	
B-Estimate			40.36	68.21		40.60
A-Estimate	74.97	68.78	33.95	58.54	67.87	34.63
Method	Pooled	Pooled	ANOVA	ANOVA	Normal	ANOVA
Modified CV Basis Value Estimates						
B-Estimate	NA	67.55	43.96	NA	NA	43.66
A-Estimate		61.13	40.10			39.85
Method		Normal	Normal			Normal

Table 4-11: Statistics and Basis Values for UNT1 Strength Data

Unnotched Tension 1 (UNT1) Modulus Statistics						
	Normalized			As-Measured		
Env	CTD	RTD	ETW	CTD	RTD	ETW
Mean	2.881	2.616	2.083	2.846	2.577	2.327
Stdev	0.03367	0.1081	0.06325	0.05972	0.08171	0.3807
CV	1.169	4.132	3.04	2.099	3.170	16.36
Mod CV	6.000	6.066	6.000	6.000	6.000	16.36
Min	2.796	2.452	1.945	2.724	2.439	1.950
Max	2.937	2.730	2.151	2.971	2.718	3.110
No. Batches	3	3	3	3	3	3
No. Spec.	18	18	16	18	18	16

Table 4-12: Statistics from UNT1 Modulus Data

4.7 "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: CTD, RTD, and ETW.

For the normalized dataset, the RTD 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 thee environments was acceptable.

For the as-measured dataset, 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 RTD and ETW environments failed the ADK test for batch equivalency so basis values were not computed for those.

There was one outlier. The lowest normalized value in batch three of the RTD environment was an outlier for the batch but not for the environment. It was an outlier in the normalized and as-measured dataset,. It was retained for this analysis.

Statistics, basis values and estimates are given for the UNT2 strength data in Table 4-13 and for the modulus data in Table 4-14. The normalized data, B-estimates and B-basis values are shown graphically in Figure 4-8.

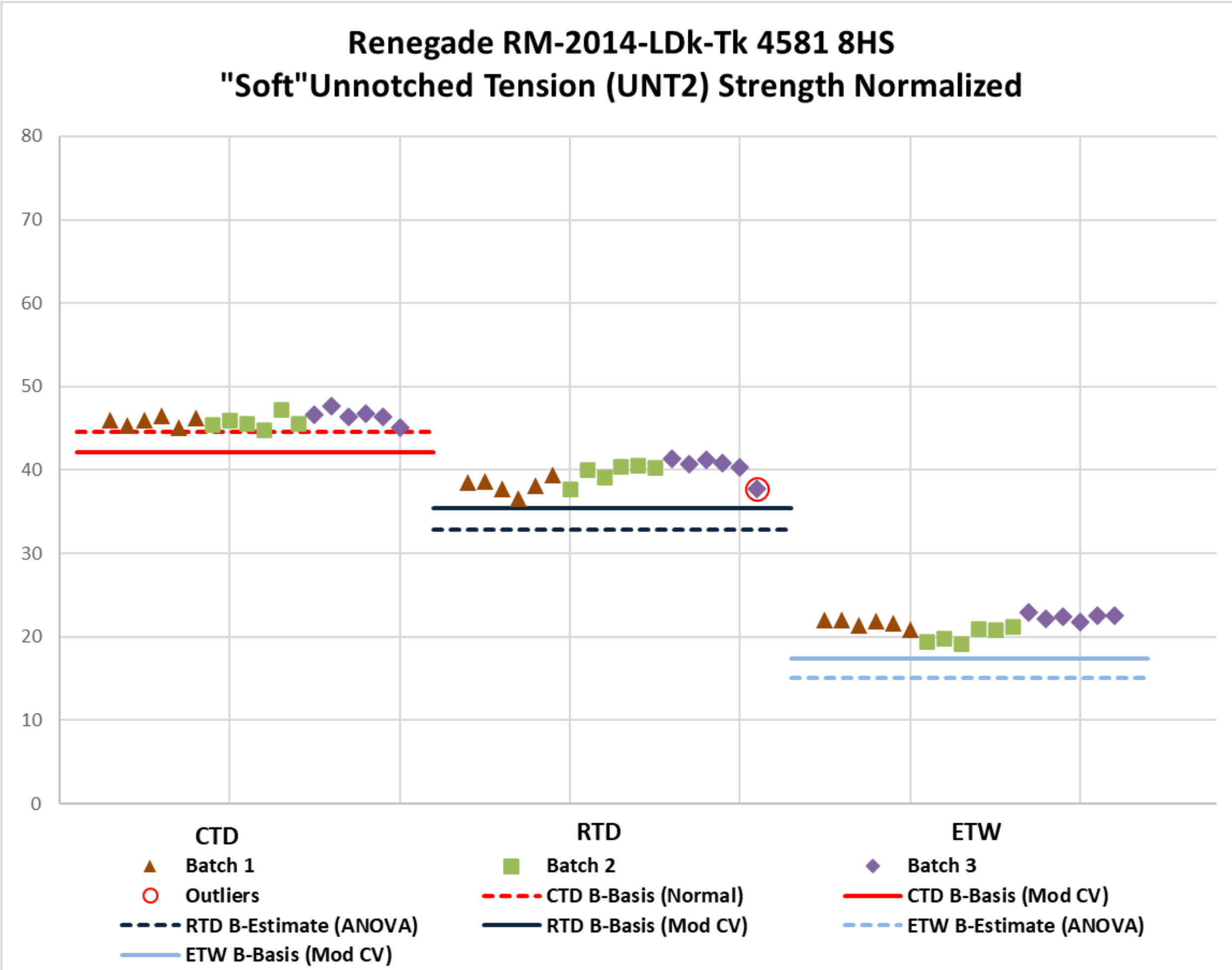

Figure 4-8: Batch Plot for UNT2 Normalized Strength

Unnotched Tension 2 (UNT2) Basis Values and Statistics						
	Normalized			As-Measured		
Env	CTD	RTD	ETW	CTD	RTD	ETW
Mean	46.05	39.42	21.43	46.11	39.40	21.54
Stdev	0.7691	1.424	1.054	1.075	1.702	1.124
CV	1.670	3.613	4.919	2.331	4.320	5.218
Mod CV	6.000	6.000	6.460	6.000	6.160	6.609
Min	44.82	36.62	19.25	44.01	36.30	19.40
Max	47.72	41.35	22.90	48.46	42.40	22.90
No. Batches	3	3	3	3	3	3
No. Spec.	18	18	18	18	18	18
Basis Value Estimates						
B-Basis Value	44.53					
B-Estimate		32.81	15.06	40.62	29.77	14.43
A-Estimate	43.46	28.10	10.51	36.70	22.90	9.356
Method	Normal	ANOVA	ANOVA	ANOVA	ANOVA	ANOVA
Modified CV Basis Value Estimates						
B-Value	42.07	35.44	17.45	40.65	NA	NA
A-Estimate	39.42	32.79	14.80	36.79		
Method	Pooled	Pooled	Pooled	Normal		

Table 4-13: Statistics and Basis Values for UNT2 Strength Data

Unnotched Tension 2 (UNT2) Modulus Statistics						
	Normalized			As-Measured		
Env	CTD	RTD	ETW	CTD	RTD	ETW
Mean	2.450	2.087	1.549	2.453	2.085	1.556
Stdev	0.02747	0.08428	0.1614	0.04164	0.1015	0.1558
CV	1.121	4.037	10.42	1.698	4.867	10.01
Mod CV	6.000	6.019	10.42	6.000	6.433	10.01
Min	2.369	1.939	1.326	2.349	1.922	1.350
Max	2.484	2.175	1.917	2.507	2.228	1.900
No. Batches	3	3	3	3	3	3
No. Spec.	18	18	18	18	18	18

Table 4-14: Statistics from UNT2 Modulus Data

4.8 "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 three environmental conditions.

For the normalized dataset, the three environments fail 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, pooling the three environments failed the Levene's test for equality of variances but the CTD and RTD environments were acceptable for pooling.

For the as-measured dataset, the RTD 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, the RTD and ETW environments failed the ADK test for batch equivalency so basis values were not computed for those.

There was one outlier. The lowest normalized value in batch three of the RTD environment was an outlier for the batch but not for the environment. It was an outlier in the normalized dataset but not in the as-measured dataset. It was retained for this analysis.

Statistics, basis values and estimates are given for the UNT3 strength data in Table 4-15 and for the modulus data in Table 4-16. The normalized data, B-estimates and B-basis values are shown graphically in Figure 4-9.

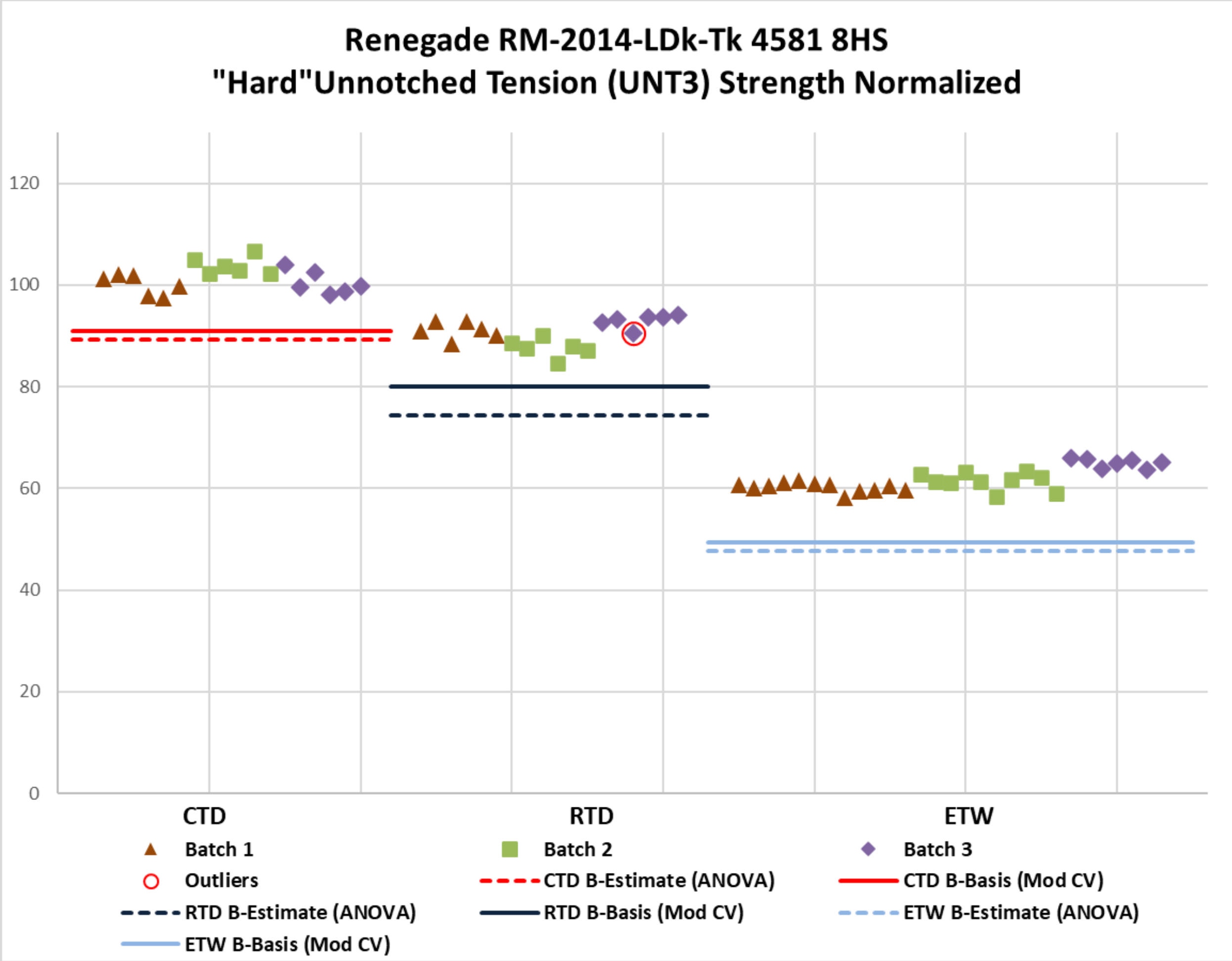

Figure 4-9: Batch Plot for UNT3 Normalized Strength

Unnotched Tension 3 (UNT3) Basis Values and Statistics						
	Normalized			As-Measured		
Env	CTD	RTD	ETW	CTD	RTD	ETW
Mean	101.4	90.57	61.81	102.1	91.42	62.63
Stdev	2.615	2.725	2.221	2.511	4.294	2.903
CV	2.579	3.008	3.593	2.459	4.697	4.635
Mod CV	6.000	6.000	6.000	6.000	6.349	6.318
Min	97.38	84.65	58.20	97.13	83.90	58.20
Max	106.7	94.01	65.90	106.7	98.40	67.90
No. Batches	3	3	3	3	3	3
No. Spec.	18	18	29	18	18	29
Basis Value Estimates						
B-Basis Value				97.15		
B-Estimate	89.19	74.26	47.66		62.82	42.90
A-Estimate	80.50	62.61	37.56	93.64	42.40	28.82
Method	ANOVA	ANOVA	ANOVA	Normal	ANOVA	ANOVA
Modified CV Basis Value Estimates						
B-Value	90.89	80.07	55.18	90.01	NA	NA
A-Estimate	83.74	72.92	50.39	81.46		
Method	Pooled	Pooled	Normal	Normal		

Table 4-15: Statistics and Basis Values for UNT3 Strength Data

Unnotched Tension 3 (UNT3) Modulus Statistics						
	Normalized			As-Measured		
Env	CTD	RTD	ETW	CTD	RTD	ETW
Mean	3.245	3.008	2.628	3.268	3.035	2.669
Stdev	0.02366	0.1237	0.05955	0.04205	0.1475	0.07075
CV	0.7291	4.111	2.266	1.287	4.861	2.650
Mod CV	6.000	6.055	6.00	6.000	6.430	6.000
Min	3.203	2.780	2.557	3.198	2.780	2.580
Max	3.284	3.125	2.754	3.329	3.234	2.800
No. Batches	3	3	3	3	3	3
No. Spec.	18	18	18	18	18	18

Table 4-16: Statistics from UNT3 Modulus Data

4.9 "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: RTD and ETW.

For the normalized dataset, the ETW environment failed the ADK test for batch equivalency. ANOVA was used to compute its basis value, and with three batches of data available, this is an estimate. Applying the modified CV, the ETW environment failed the ADK test for batch equivalency, therefore, a basis value was not computed.

For the as-measured dataset, both 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 ETW environment failed the ADK test for batch equivalency, therefore a basis value was not computed.

There was one outlier. The lowest normalized value in batch two of the ETW environment was an outlier for the environment 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, basis values and estimates are given for the UNC1 strength data in Table 4-17 and for the modulus data in Table 4-18. The normalized data and B-basis values are shown graphically in Figure 4-10.

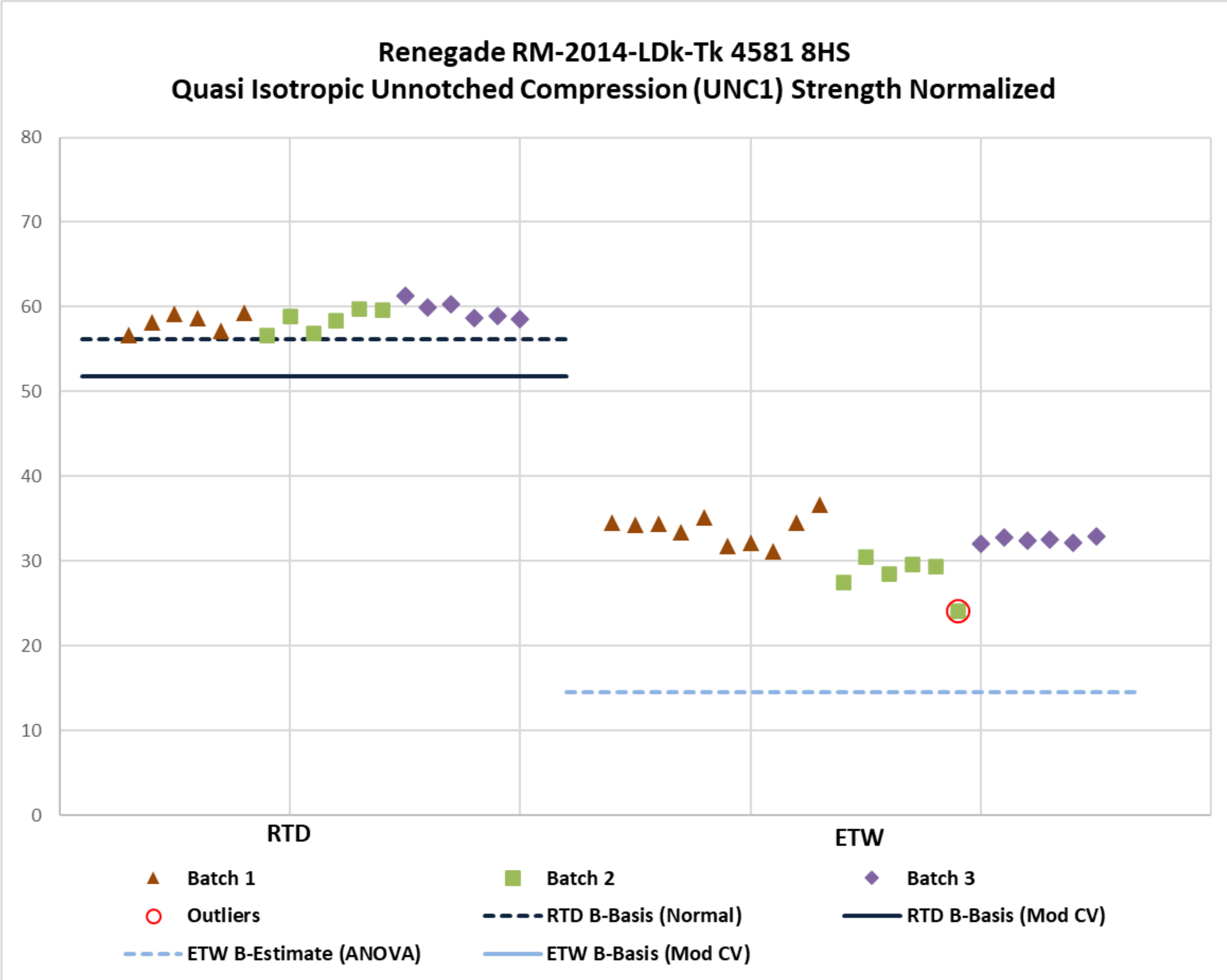

Figure 4-10: Batch Plot for UNC1 Normalized Strength

Unnotched Compression 1 (UNC1) Basis Values and Statistics				
	Normalized		As-Measured	
Env	RTD	ETW	RTD	ETW
Mean	58.75	31.93	58.55	32.05
Stdev	1.285	2.835	1.717	3.091
CV	2.188	8.878	2.933	9.643
Mod CV	6.000	8.878	6.000	9.643
Min	56.63	24.11	55.20	24.00
Max	61.26	36.63	61.90	37.30
No. Batches	3	3	3	3
No. Spec.	18	22	18	22
Basis Value Estimates				
B-Basis Value	56.21			
B-Estimate		14.57	50.65	12.08
A-Estimate	54.41	2.183	45.03	NA
Method	Normal	ANOVA	ANOVA	ANOVA
Modified CV Basis Value Estimates				
B-Value	51.79	NA	51.61	NA
A-Estimate	46.86		46.71	
Method	Normal		Normal	

Table 4-17: Statistics and Basis Values for UNC1 Strength Data

Unnotched Compression 1 (UNC1) Modulus Statistics				
	Normalized		As-Measured	
Env	RTD	ETW	RTD	ETW
Mean	2.799	2.232	2.789	2.232
Stdev	0.05678	0.06787	0.03848	0.05264
CV	2.029	3.041	1.380	2.358
Mod CV	6.000	6.000	6.000	6.000
Min	2.671	2.108	2.720	2.130
Max	2.854	2.344	2.850	2.300
No. Batches	3	3	3	3
No. Spec.	18	18	18	18

Table 4-18: Statistics from UNC1 Modulus Data

4.10 "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: RTD and ETW.

For the normalized dataset, the ETW environment failed the ADK test for batch equivalency. ANOVA was used to compute its basis value, and with three batches of data available, this is an estimate. Applying the modified CV, the ETW environment failed the ADK test for batch equivalency, therefore, a basis value was not computed.

For the as-measured dataset, the ETW environment failed the ADK test for batch equivalency. ANOVA was used to compute its basis value, and with three batches of data available this is an estimate. Applying the modified CV, the ETW environment failed the ADK test for batch equivalency, therefore, a basis value was not computed.

There were no statistical outlies.

Statistics, basis values and estimates are given for the UNC2 strength data in Table 4-19 and for the modulus data in Table 4-20. The normalized data and B-basis values are shown graphically in Figure 4-11.

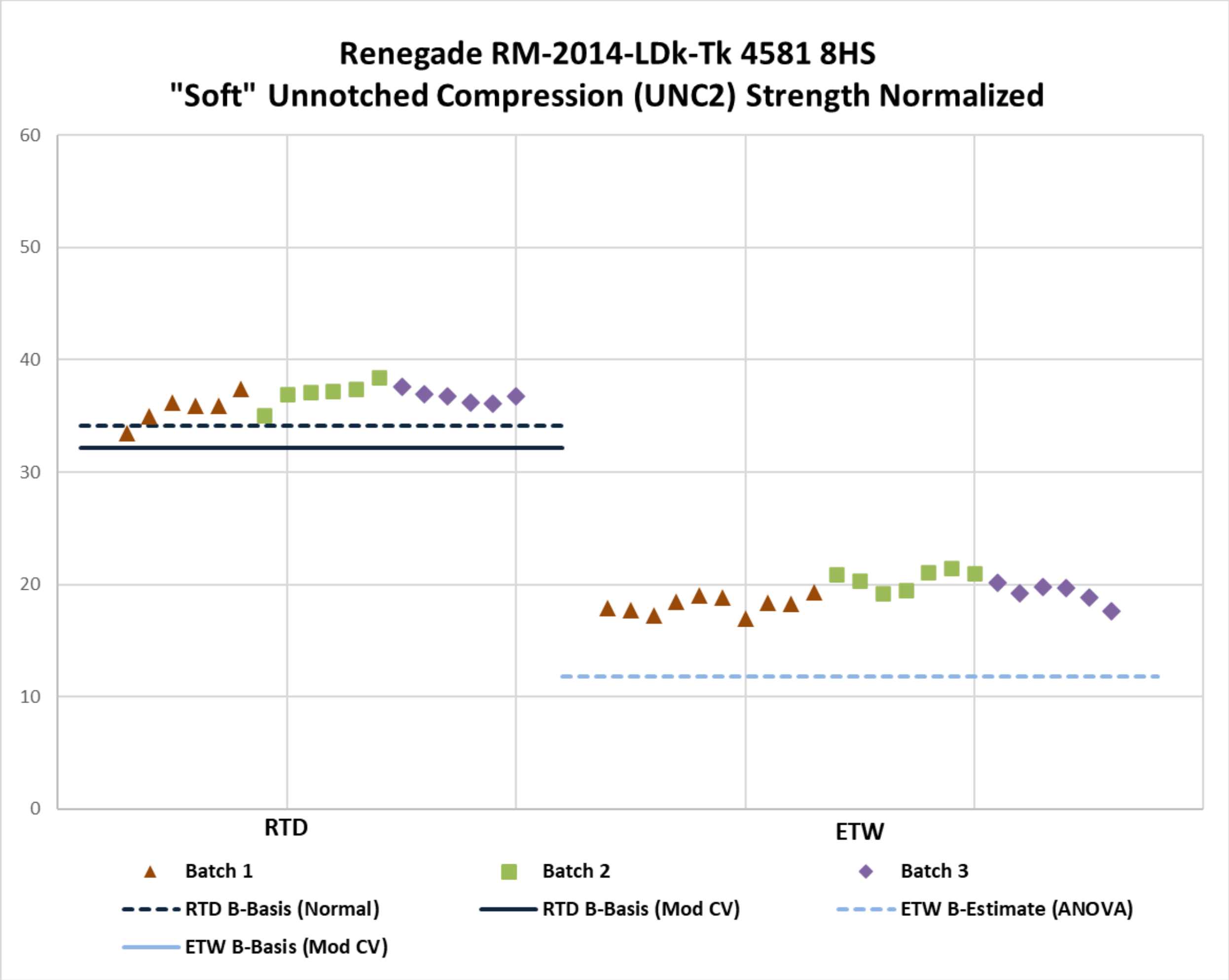

Figure 4-11: Batch Plot for UNC2 Normalized Strength

Unnotched Compression 2 (UNC2) Basis Values and Statistics				
	Normalized		As-Measured	
Env	RTD	ETW	RTD	ETW
Mean	36.47	19.17	37.13	19.53
Stdev	1.165	1.274	0.9653	1.144
CV	3.194	6.645	2.599	5.859
Mod CV	6.000	7.322	6.000	6.930
Min	33.46	16.99	34.70	17.30
Max	38.48	21.50	38.60	21.50
No. Batches	3	3	3	3
No. Spec.	18	23	18	23
Basis Value Estimates				
B-Basis Value	34.17		35.23	
B-Estimate		11.84		13.40
A-Estimate	32.54	6.597	33.88	9.029
Method	Normal	ANOVA	Normal	ANOVA
Modified CV Basis Value Estimates				
B-Value	32.15	NA	32.73	NA
A-Estimate	29.10		29.62	
Method	Normal		Normal	

Table 4-19: Statistics and Basis Values for UNC2 Strength Data

Unnotched Compression 2 (UNC2) Modulus Statistics				
	Normalized		As-Measured	
Env	RTD	ETW	RTD	ETW
Mean	2.213	1.484	2.254	1.506
Stdev	0.05096	0.08025	0.05054	0.06955
CV	2.302	5.407	2.242	4.618
Mod CV	6.000	6.704	6.000	6.309
Min	2.112	1.347	2.150	1.400
Max	2.309	1.610	2.330	1.610
No. Batches	3	3	3	3
No. Spec.	18	18	18	18

Table 4-20: Statistics from UNC2 Modulus Data

4.11 "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 two environmental conditions.

For the normalized dataset, there were no diagnostic test failures for the normalized datasets. Pooling the two conditions was acceptable.

For the as-measured dataset, the pooled dataset failed the Anderson Darling test for normality. Applying the modified CV, there were no diagnostic test failures.

There were no statistical outliers.

Statistics, basis values and estimates are given for the UNC3 strength data in Table 4-21 and for the modulus data in Table 4-22. The normalized data, B-estimates and B-basis values are shown graphically in Figure 4-12.

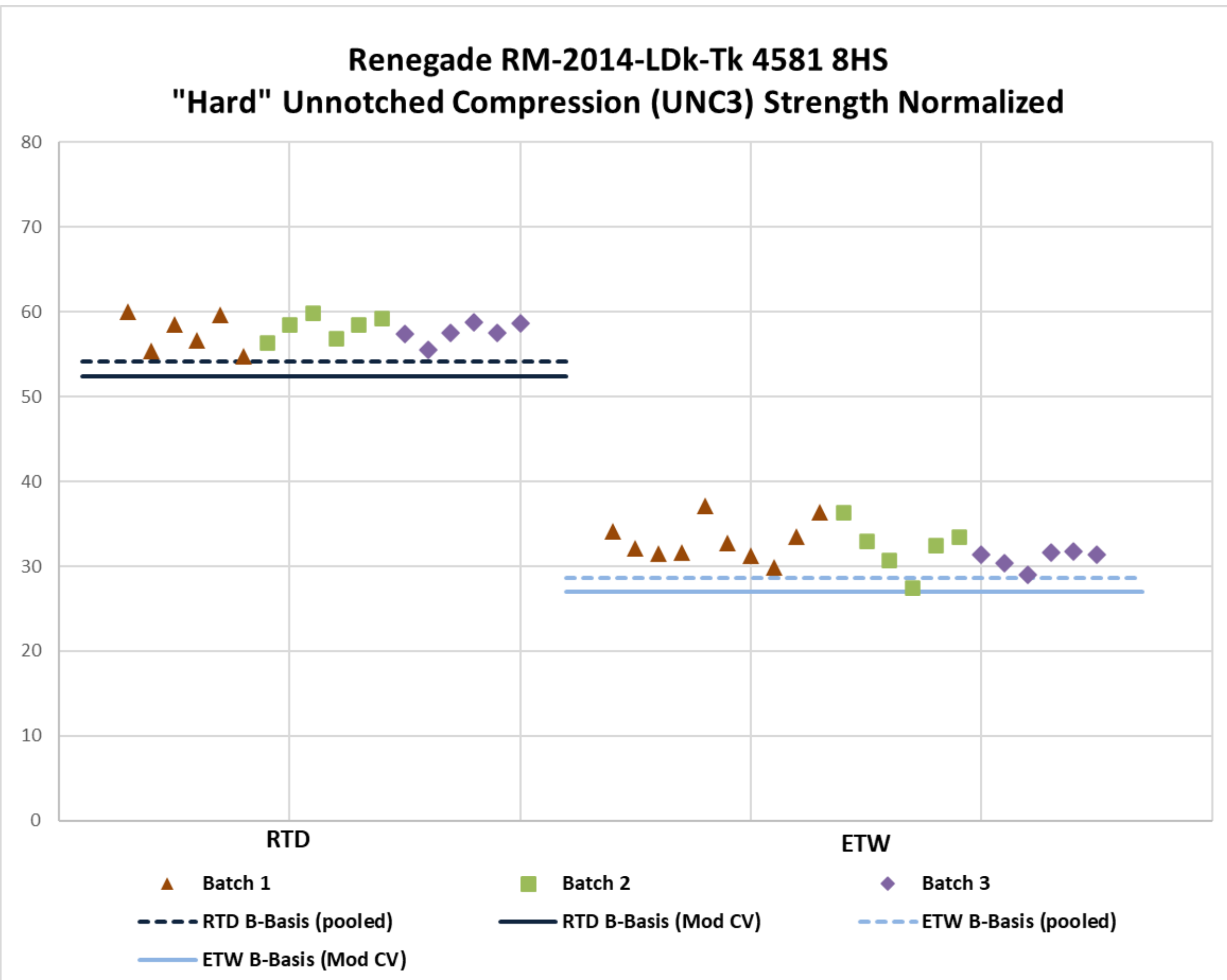

Figure 4-12: Batch Plot for UNC3 Normalized Strength

Unnotched Compression 3 (UNC3) Basis Values and Statistics				
	Normalized		As-Measured	
Env	RTD	ETW	RTD	ETW
Mean	57.77	32.24	58.13	32.58
Stdev	1.573	2.335	1.731	2.413
CV	2.723	7.244	2.978	7.408
Mod CV	6.000	7.622	6.000	7.704
Min	54.80	27.50	54.80	27.50
Max	59.96	37.13	60.90	37.80
No. Batches	3	3	3	3
No. Spec.	18	22	18	22
Basis Value Estimates				
B-Basis Value	54.67	27.84	54.72	28.03
A-Estimate	52.47	24.69	52.29	24.77
Method	Normal	Normal	Normal	Normal
Modified CV Basis Value Estimates				
B-Value	52.44	27.01	52.74	27.28
A-Estimate	48.84	23.38	49.09	23.61
Method	Pooled	Pooled	Pooled	Pooled

Table 4-21: Statistics and Basis Values for UNC3 Strength Data

Unnotched Compression 3 (UNC3) Modulus Statistics				
	Normalized		As-Measured	
Env	RTD	ETW	RTD	ETW
Mean	3.131	2.709	3.152	2.733
Stdev	0.1105	0.08700	0.1596	0.08568
CV	3.529	3.212	5.064	3.135
Mod CV	6.000	6.000	6.532	6.000
Min	2.931	2.495	2.880	2.540
Max	3.300	2.830	3.370	2.850
No. Batches	3	3	3	3
No. Spec.	18	18	18	18

Table 4-22: Statistics from UNC3 Modulus Data

4.12 Lamina Short-Beam Strength (SBS)

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

The datasets for the RTD and ETD 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, pooling the four environments was not acceptable because the pooled dataset failed the Levene's test for equality of variances. The CTD, RTD, and ETD environments were acceptable for pooling.

There were no statistical outliers.

Statistics, basis values and estimates are given for the SBS data in Table 4-23. The as-measured data, B-estimates and B-basis values are shown graphically in Figure 4-13.

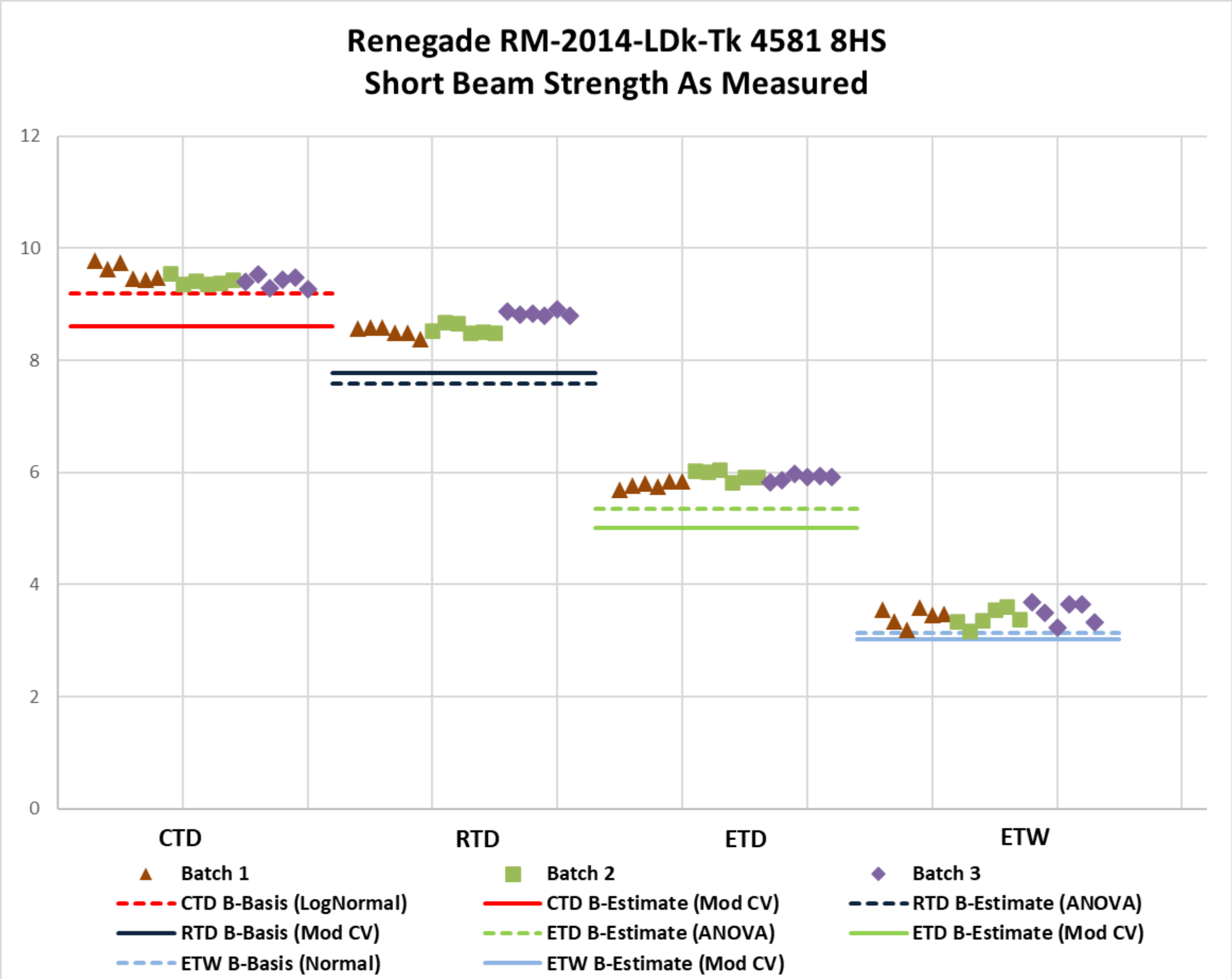

Figure 4-13: Batch Plot for SBS As-Measured

Short Beam Strength (SBS) As Measured Basis Values and Statistics				
Env	CTD	RTD	ETD	ETW
Mean	9.467	8.638	5.883	3.447
Stdev	0.1370	0.1602	0.09888	0.1600
CV	1.447	1.855	1.681	4.642
Mod CV	6.000	6.000	6.000	6.321
Min	9.275	8.380	5.690	3.180
Max	9.780	8.900	6.050	3.680
No. Batches	3	3	3	3
No. Spec.	18	18	18	18
Basis Value Estimates				
B-Basis Value	9.201			3.131
B-Estimate		7.587	5.350	
A-Estimate	9.017	6.837	4.970	2.907
Method	LogNormal	ANOVA	ANOVA	Normal
Modified CV Basis Value Estimates				
B-Value	8.602	7.773	5.018	3.017
A-Estimate	8.025	7.196	4.441	2.712
Method	Pooled	Pooled	Pooled	Normal

Table 4-23: Statistics and Basis Values for SBS Data

4.13 Laminate Short-Beam Strength (SBS1)

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

The RTD dataset failed the ADK test for batch equivalency. ANOVA was used to compute its basis value and with three batches of data available, this is an estimate. Applying the modified CV, pooling the two environments was not acceptable because the pooled dataset failed the Levene's test for equality of variances.

There were two statistical outliers. The lowest value in batch two for the RTD environment was an outlier for the batch but not for the environment. The highest value in batch three for the ETW environment was an outlier for the environment but not for the batch. They were retained for this analysis.

Statistics, basis values and estimates are given for the SBS1 data in Table 4-24. The as-measured data, B-estimates and B-basis values are shown graphically in Figure 4-14.

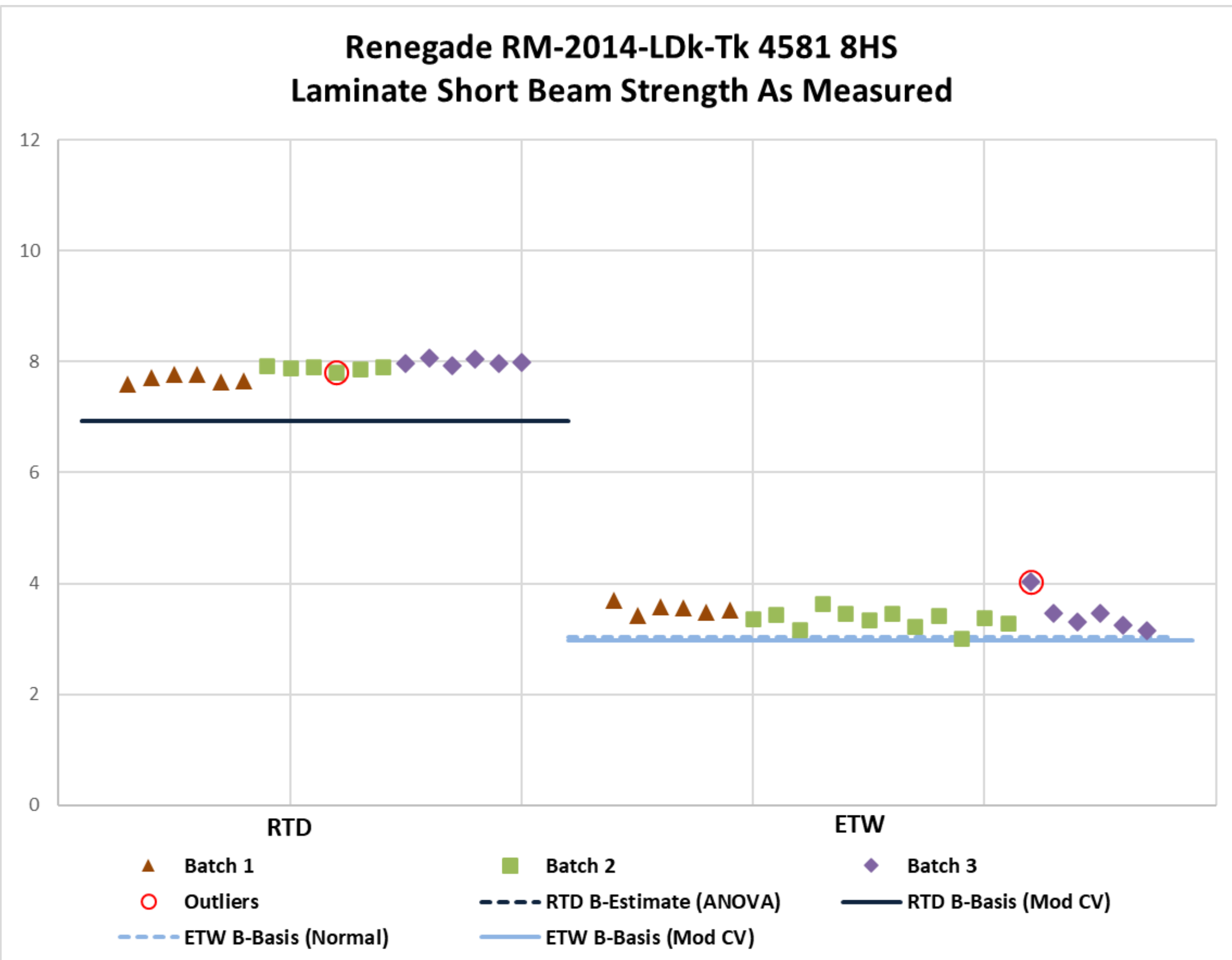

Figure 4-14: Batch Plot for SBS1 As Measured

Short Beam Strength 1 (SBS1) As Measured		
Env	RTD	ETW
Mean	7.857	3.423
Stdev	0.1389	0.2075
CV	1.768	6.063
Mod CV	6.000	7.031
Min	7.590	3.010
Max	8.070	4.040
No. Batches	3	3
No. Spec.	18	24
Basis Value Estimates		
B-Basis Value		3.038
B-Estimate	6.930	
A-Estimate	6.268	2.763
Method	ANOVA	Normal
Modified CV Basis Value Estimates		
B-Estimate	6.927	2.977
A-Estimate	6.268	2.657
Method	Normal	Normal

Table 4-24: Statistics and Basis Values for SBS1 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: CTD, RTD, ETD, and ETW.

For the normalized dataset, the ETW environment failed the ADK test for batch equivalency. ANOVA was used to compute its basis value, and with three batches of data available, this is an estimate. Pooling was acceptable for the CTD, RTD, and ETD environments. Applying the modified CV, there were no diagnostic test failures, so pooling the four environments was acceptable.

For the as-measured dataset, the ETW environment failed the ADK test for batch equivalency. ANOVA was used to compute its basis value, and with three batches of data available, this is an estimate. Pooling was acceptable for the RTD and ETD environments. Applying the modified CV, there were no diagnostic test failures, so pooling the four environments was acceptable.

There were no statistical outliers.

Statistics, basis values and estimates are given for the OHT1 strength data in Table 4-25. The normalized data, B-basis values and B-estimates are shown graphically in Figure 4-15.

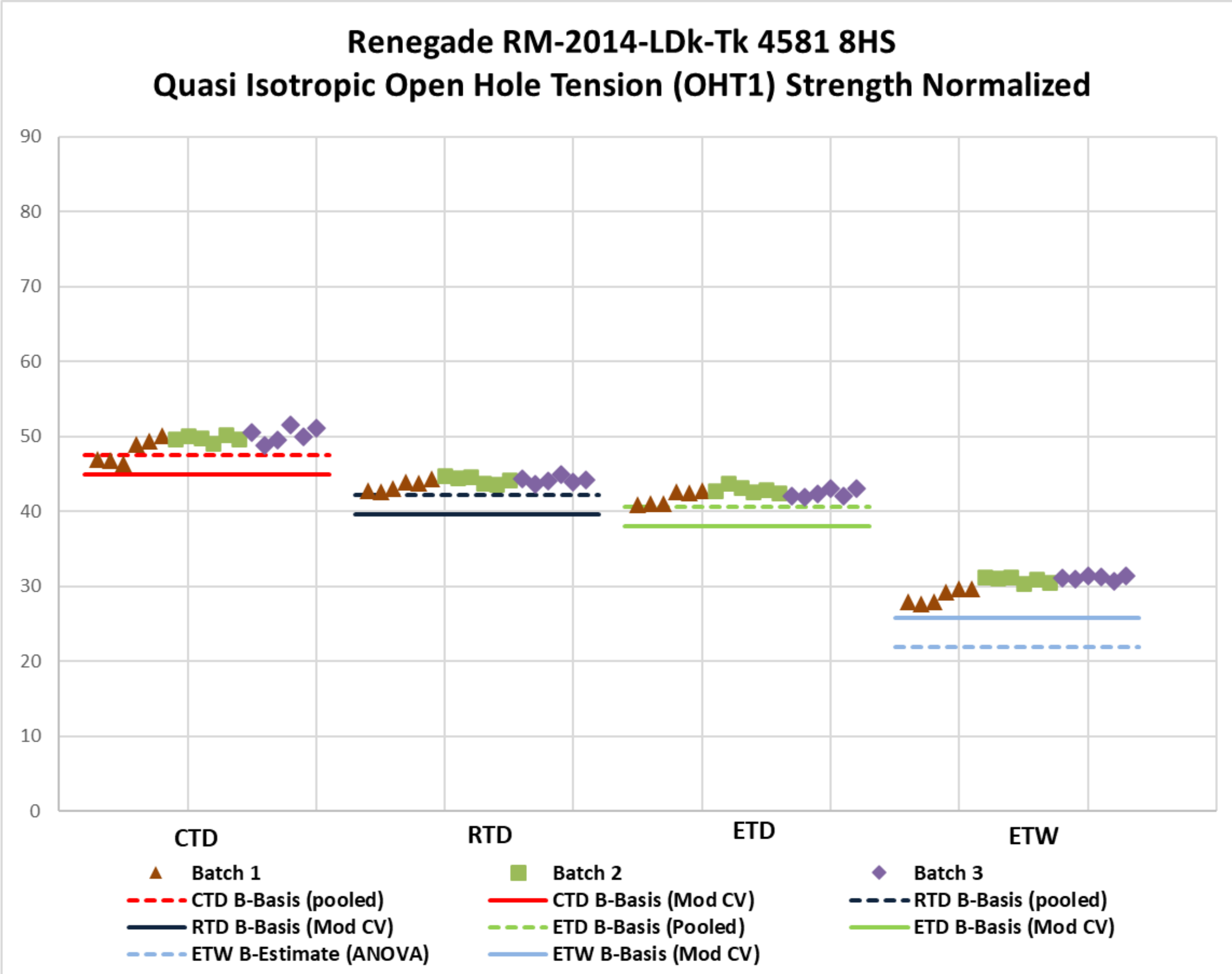

Figure 4-15: Batch Plot for OHT1 Normalized Strength

Open Hole Tension 1 (OHT1) Strength Basis Values and Statistics								
	Normalized				As-Measured			
Env	CTD	RTD	ETD	ETW	CTD	RTD	ETD	ETW
Mean	49.37	43.95	42.39	30.26	49.20	43.74	42.28	30.01
Stdev	1.406	0.6514	0.8090	1.283	1.291	0.4090	0.3507	1.041
CV	2.849	1.482	1.908	4.240	2.623	0.9351	0.8296	3.470
Mod CV	6.000	6.000	6.000	6.120	6.000	6.000	6.000	6.000
Min	46.35	42.56	40.89	27.61	46.49	43.10	41.50	27.90
Max	51.61	44.97	43.84	31.47	51.54	44.60	42.70	31.30
No. Batches	3	3	3	3	3	3	3	3
No. Spec.	18	18	18	18	18	18	18	18
Basis Value Estimates								
B-basis Value	47.59	42.16	40.61		46.65	43.05	41.58	
B-Estimate				21.97				23.26
A-Estimate	46.39	40.97	39.41	16.04	44.85	42.58	41.11	18.45
Method	Pooled	Pooled	Pooled	ANOVA	Normal	Pooled	Pooled	ANOVA
Modified CV Basis Value Estimates								
B-basis Value	44.96	39.53	37.98	25.84	44.81	39.36	37.89	25.62
A-Estimate	42.04	36.62	35.06	22.93	41.92	36.46	35.00	22.73
Method	Pooled	Pooled	Pooled	Pooled	Pooled	Pooled	Pooled	Pooled

Table 4-25: Statistics and Basis Values 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: CTD, RTD, and ETW.

For the normalized dataset, the ETD environment failed the ADK test for batch equivalency. ANOVA was used to compute its basis value, and with three batches of data available this is an estimate. The CTD and RTD environments were pooled. Applying the modified CV, there were no diagnostic test failures, so pooling for the three environments was acceptable.

For the as-measured dataset, the RTD and ETD 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, pooling the three environments failed the Levene's test for equality of variances but the CTD and RTD environments were acceptable for pooling.

There was one statistical outlier. The lowest as-measured value in batch two of the CTD environment was an outlier for the batch and for the environment. It was an outlier in the as-measured dataset but not in the normalized dataset. It was retained for this analysis.

Statistics, basis values and estimates are given for the OHT2 strength data in Table 4-26. The normalized data and B-basis values are shown graphically in Figure 4-16.

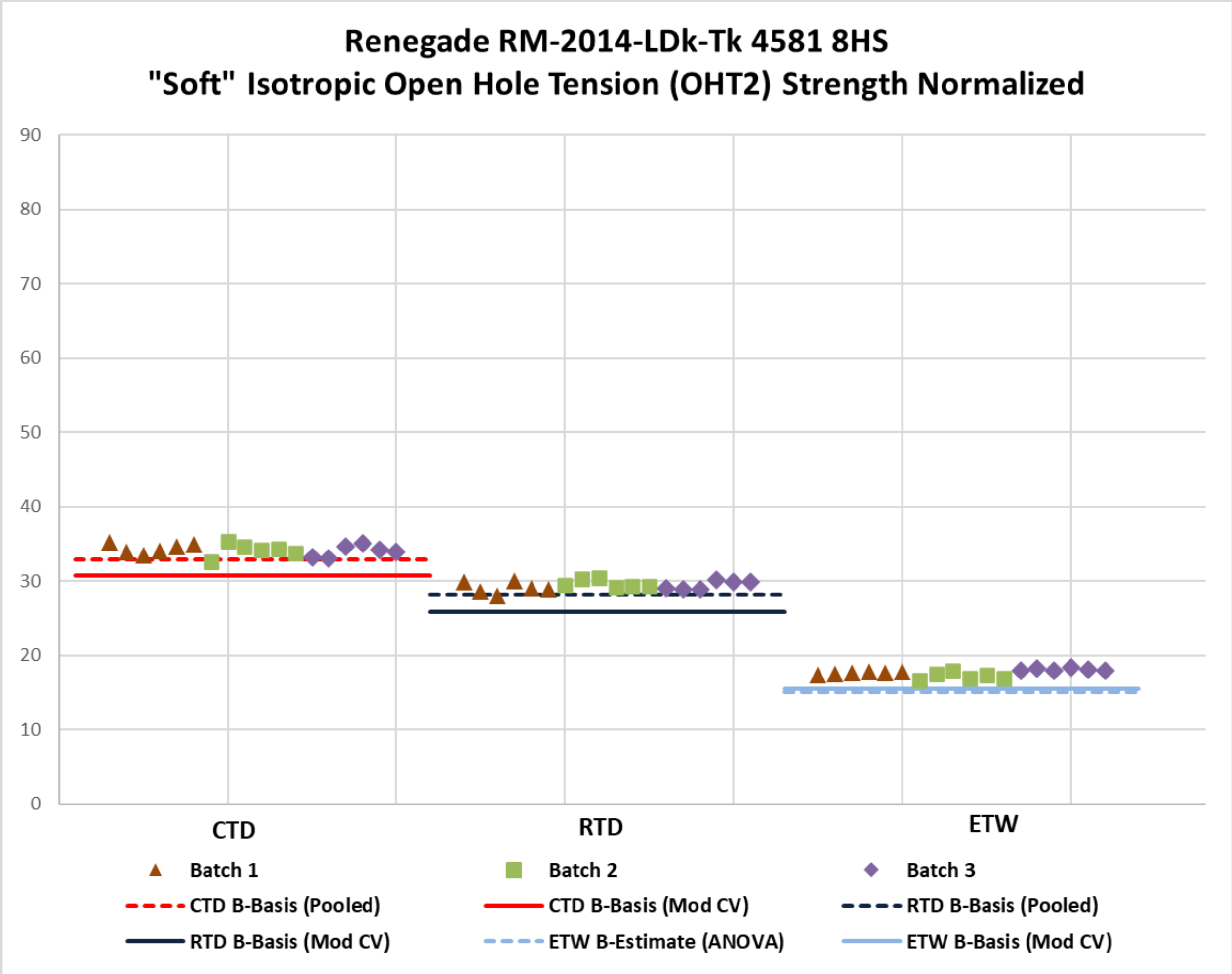

Figure 4-16: Batch Plot for OHT2 Normalized Strength

Open Hole Tension 2 (OHT2) Strength Basis Values and Statistics						
	Normalized			As-Measured		
Env	CTD	RTD	ETD	CTD	RTD	ETD
Mean	34.20	29.43	17.67	34.39	29.56	17.72
Stdev	0.7424	0.6621	0.4564	0.6354	0.4767	0.7571
CV	2.171	2.250	2.583	1.847	1.613	4.274
Mod CV	6.000	6.000	6.000	6.000	6.000	6.137
Min	32.69	28.09	16.74	32.68	28.60	16.30
Max	35.32	30.54	18.33	35.51	30.20	18.80
No. Batches	3	3	3	3	3	3
No. Spec.	18	18	18	18	18	18
Basis Value Estimates						
B-basis Value	32.92	28.15		33.14		
B-Estimate			15.05		27.49	12.47
A-Estimate	32.05	27.28	13.18	32.25	26.01	8.725
Method	Pooled	Pooled	ANOVA	Normal	ANOVA	ANOVA
Modified CV Basis Value Estimates						
B-basis Value	30.71	25.94	15.57	30.89	26.06	15.57
A-Estimate	28.34	23.57	14.09	28.50	23.67	14.05
Method	Pooled	Pooled	Normal	Pooled	Pooled	Normal

Table 4-26: Statistics and Basis Values 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: CTD, RTD, and ETD.

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 RTD environment failed the ADK test for batch equivalency, therefore, basis values were not computed for this environment and pooling was not acceptable.

There were two statistical outliers. The lowest normalized value in batch one of the RTD environment was an outlier for the batch but not for the environment. It was an outlier in the normalized dataset as well as in the as-measured dataset. The lowest as-measured value in batch three of the ETW environment was an outlier for the batch but not for the environment. 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 OHT3 strength data in Table 4-27. The normalized data, B-estimates and B-basis values are shown graphically in Figure 4-17.

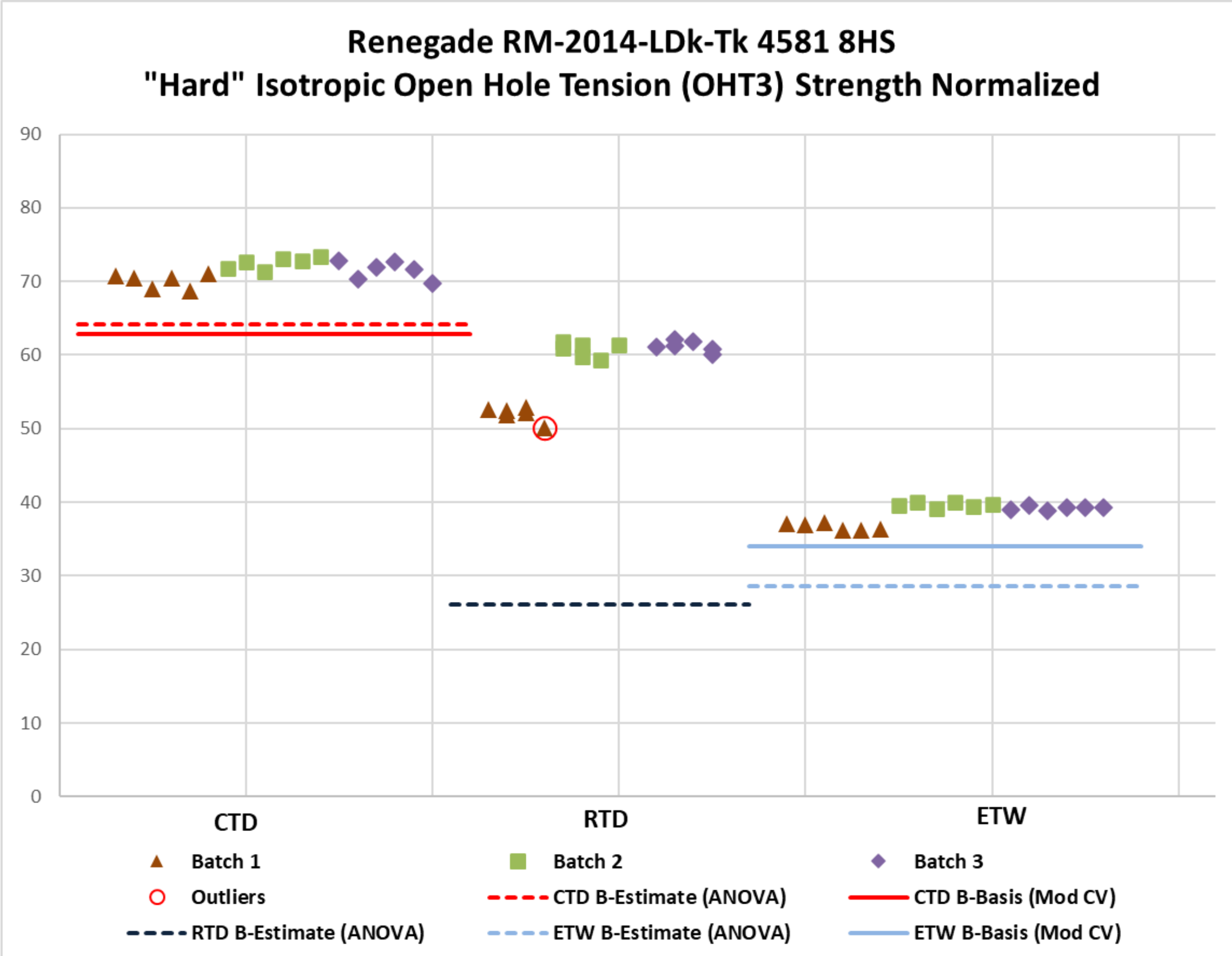

Figure 4-17: Batch Plot for OHT3 Normalized Strength

Open Hole Tension 3 (OHT3) Strength Basis Values and Statistics						
	Normalized			As-Measured		
Env	CTD	RTD	ETW	CTD	RTD	ETD
Mean	71.37	58.00	38.52	71.52	58.06	38.72
Stdev	1.403	4.454	1.392	1.466	5.043	1.404
CV	1.966	7.679	3.613	2.050	8.686	3.626
Mod CV	6.000	7.840	6.000	6.000	8.686	6.000
Min	68.73	50.04	36.17	68.89	49.60	36.50
Max	73.35	62.17	40.05	73.95	63.30	40.00
No. Batches	3	3	3	3	3	3
No. Spec.	18	18	18	18	18	18
Basis Value Estimates						
B-Estimate	64.13	26.06	28.66	63.80	21.77	28.65
A-Estimate	58.97	3.261	21.61	58.29	NA	21.46
Method	ANOVA	ANOVA	ANOVA	ANOVA	ANOVA	ANOVA
Modified CV Basis Value Estimates						
B-basis Value	62.91	NA	33.96	63.05	NA	NA
A-Estimate	56.93		30.73	57.05		
Method	Normal		Normal	Normal		

Table 4-27: Statistics and Basis Values 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: CTD, RTD, and ETW.

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, there were no diagnostic test failures so pooling the three environments was acceptable.

There was one statistical outlier. The lowest normalized value in batch three for the CTD environment was an outlier for the batch but not for the environment. It was an outlier in the normalized dataset but not in the as-measured dataset. It was retained for this analysis.

Statistics, basis values and estimates are given for the FHT1 strength data in Table 4-28. The normalized data, B-estimates and B-basis values are shown graphically in Figure 4-18.

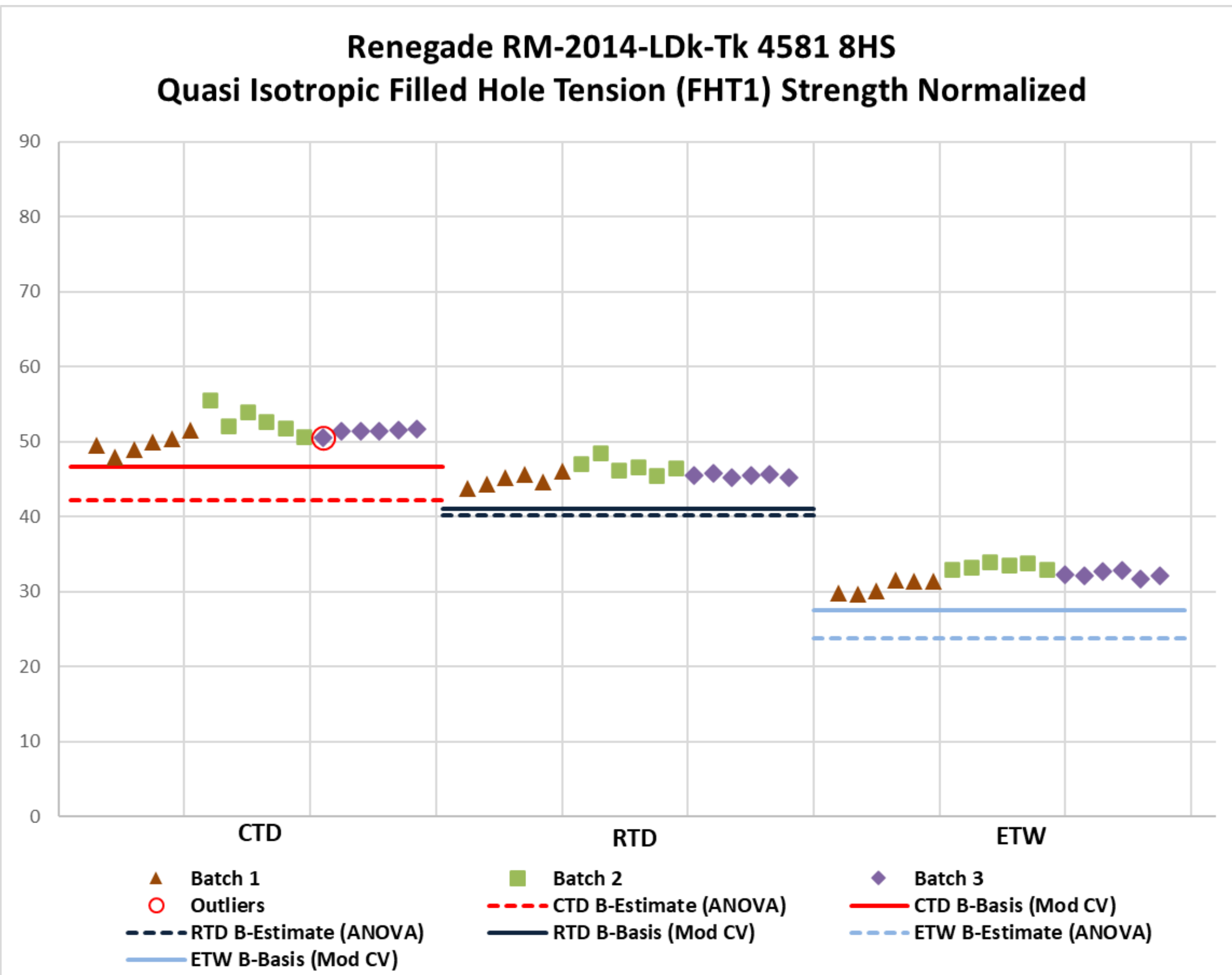

Figure 4-18: Batch Plot for FHT1 Normalized Strength

Filled-Hole Tension 1 (FHT1) Strength Basis Values and Statistics						
	Normalized			As-Measured		
Env	CTD	RTD	ETW	CTD	RTD	ETW
Mean	51.30	45.72	32.13	50.70	45.37	31.73
Stdev	1.736	1.064	1.295	1.739	1.055	1.068
CV	3.384	2.326	4.031	3.431	2.326	3.366
Mod CV	6.000	6.000	6.016	6.000	6.000	6.000
Min	47.92	43.71	29.73	47.32	43.20	29.60
Max	55.55	48.47	33.99	54.73	47.90	33.10
No. Batches	3	3	3	3	3	3
No. Spec.	18	18	18	18	18	18
Basis Value Estimates						
B-Estimate	42.19	40.15	23.73	41.33	39.77	25.24
A-Estimate	35.69	36.17	17.74	34.65	35.77	20.61
Method	ANOVA	ANOVA	ANOVA	ANOVA	ANOVA	ANOVA
Modified CV Basis Value Estimates						
B-Basis Value	46.64	41.07	27.47	46.09	40.77	27.13
A-Estimate	43.54	37.96	24.37	43.02	37.70	24.06
Method	Pooled	Pooled	Pooled	Pooled	Pooled	Pooled

Table 4-28: Statistics and Basis Values 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: CTD, RTD, and ETW.

For the normalized dataset, the RTD environment failed the ADK test for batch equivalency. ANOVA was used to compute its basis value, and with three batches of data available this is an estimate. Applying the modified CV, any combination of environments was acceptable for pooling.

For the as-measured dataset, the ETW environment failed the ADK test for batch equivalency. ANOVA was used to compute its basis value, and with three batches of data available this is an estimates. The CTD and RTD environments were not acceptable for pooling because the pooled dataset failed the Levene's test for equality of variances. Applying the modified CV, pooling the three environments was not acceptable because the pooled dataset failed the Levene's test for equality of variances. The CTD and RTD environments were acceptable for pooling.

There were two statistical outliers. The lowest normalized value in batch two of the RTD environment was an outlier for the batch but not for the environment. It was an outlier in the normalized dataset but not in the as-measured dataset. The lowest normalized value in batch one of the ETW environment was an outlier for the batch as well as for the environment. It was an outlier in the normalized dataset but not in the as-measured dataset. They were retained for this analysis.

Statistics, basis values and estimates are given for the FHT2 strength data in Table 4-29. The normalized data, B-estimates and B-basis values are shown graphically in Figure 4-19.

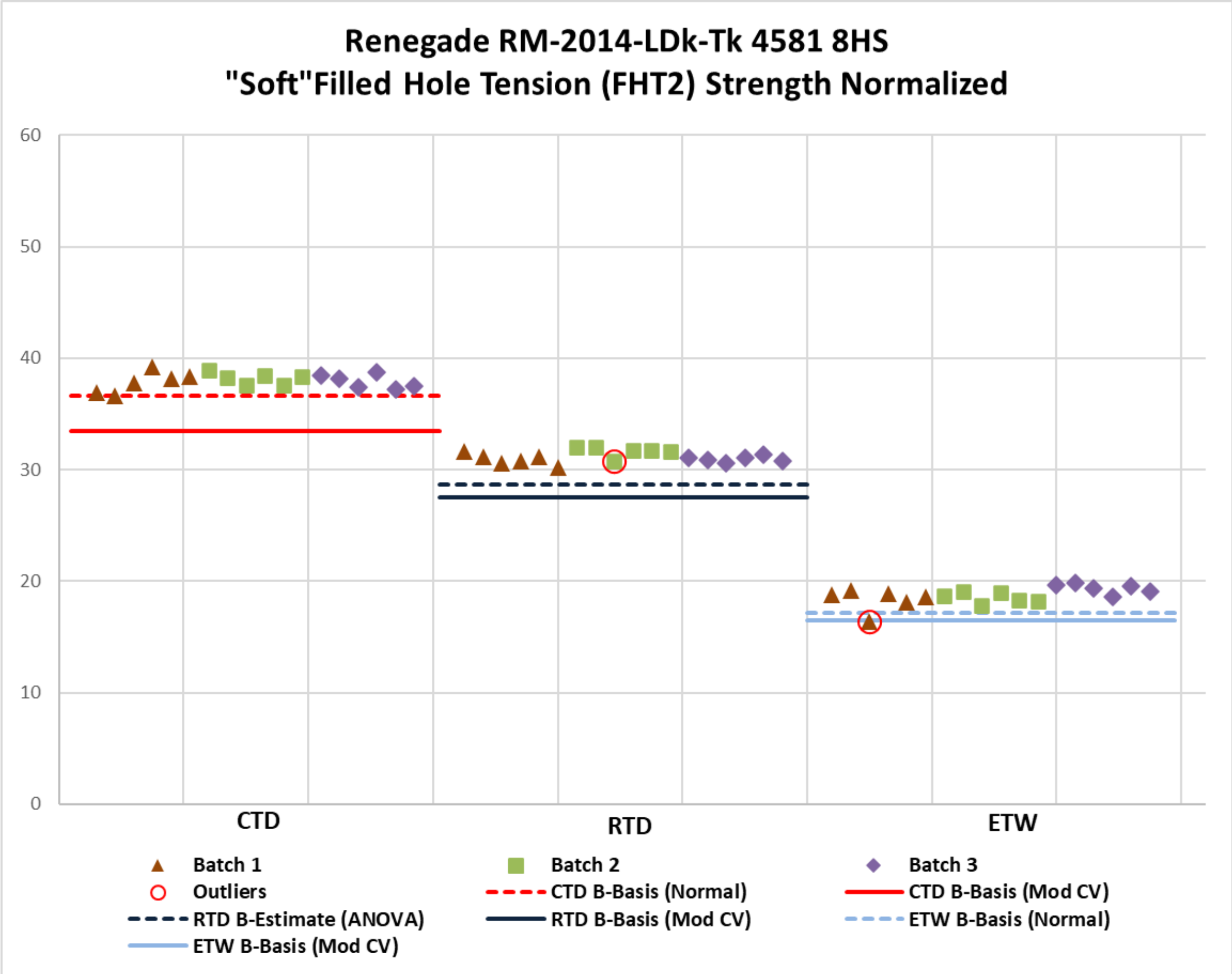

Figure 4-19: Batch plot for FHT2 Normalized Strength

Filled-Hole Tension 2 (FHT2) Strength Basis Values and Statistics						
	Normalized			As-Measured		
Env	CTD	RTD	ETW	CTD	RTD	ETW
Mean	37.97	31.15	18.71	38.34	31.40	18.90
Stdev	0.6973	0.5251	0.8037	0.7784	0.4243	0.8239
CV	1.837	1.686	4.295	2.030	1.351	4.359
Mod CV	6.000	6.000	6.148	6.000	6.000	6.180
Min	36.61	30.23	16.35	37.08	30.50	16.80
Max	39.19	32.00	19.82	39.62	32.20	20.20
No. Batches	3	3	3	3	3	3
No. Spec.	18	18	18	18	18	18
Basis Value Estimates						
B-Basis Value	36.59		17.12	36.81	30.56	
B-Estimate		28.69				15.75
A-Estimate	35.62	26.93	16.00	35.72	29.97	13.50
Method	Normal	ANOVA	Normal	Normal	Normal	ANOVA
Modified CV Basis Value Estimates						
B-Basis Value	33.47	27.46	16.44	34.51	27.57	16.59
A-Estimate	30.29	24.85	14.83	31.91	24.96	14.96
Method	Normal	Normal	Normal	Pooled	Pooled	Normal

Table 4-29: Statistics and Basis Values for FHT2 Strength Data

4.19 "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: CTD, RTD, and ETW.

For both the normalized and as-measured datasets, the three conditions 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 ETW environment failed the ADK test for batch equivalency so basis values were not computed. The CTD and RTD environments were acceptable for pooling.

There were no statistical outliers.

Statistics, basis values and estimates are given for the FHT3 strength data in Table 4-30. The normalized data, B-estimates and B-basis values are shown graphically in Figure 4-20.

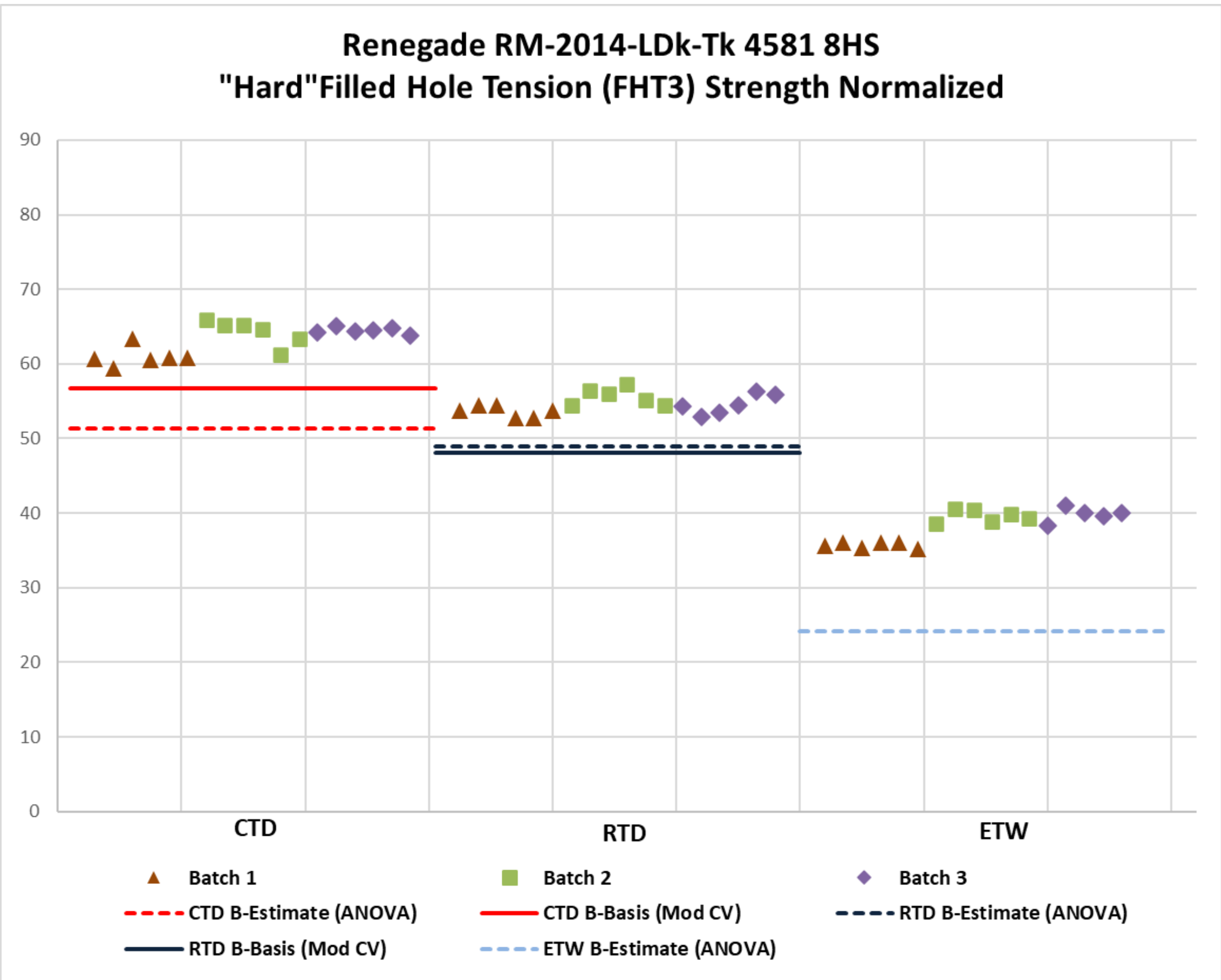

Figure 4-20: Batch plot for FHT3 Normalized Strength

Filled-Hole Tension 3 (FHT3) Strength Basis Values and Statistics						
	Normalized			As-Measured		
Env	CTD	RTD	ETW	CTD	RTD	ETW
Mean	63.23	54.60	38.41	63.15	54.71	38.51
Stdev	2.036	1.333	2.076	2.066	1.152	2.112
CV	3.220	2.442	5.406	3.271	2.106	5.484
Mod CV	6.000	6.000	6.703	6.000	6.000	6.742
Min	59.46	52.73	35.20	59.16	52.80	35.20
Max	65.85	57.31	41.00	65.61	56.80	41.00
No. Batches	3	3	3	3	3	3
No. Spec.	18	18	18	18	18	18
Basis Value Estimates						
B-Estimate	51.36	48.89	24.16	51.02	49.56	24.08
A-Estimate	42.89	44.81	13.99	42.36	45.89	13.78
Method	ANOVA	ANOVA	ANOVA	ANOVA	ANOVA	ANOVA
Modified CV Basis Value Estimates						
B-Basis Value	56.77	48.15	NA	56.69	48.25	NA
A-Estimate	52.38	43.76		52.30	43.86	
Method	Pooled	Pooled		Pooled	Pooled	

Table 4-30: Statistics and Basis Values for FHT3 Strength Data

4.20 "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: RTD, ETD, and ETW.

For the normalized dataset, the ETD environment failed the ADK test for batch equivalency. ANOVA was used to compute its basis value, and with three batches of data available this is an estimate. Pooling was not acceptable for the RTD and ETW environments. Applying the modified CV, there were no diagnostic test failures so pooling the three environments was acceptable.

For the as-measured dataset, pooling the three environments was not acceptable because the pooled dataset failed the Anderson Darling test for normality but the RTD and ETD environments were acceptable for pooling. 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 one of the RTD environment was an outlier for the environment but not for the batch. It was an outlier in the normalized dataset as well as in the as-measured dataset. The highest value in batch three of the RTD environment was an outlier for the batch but not for the environment. It was an outlier in the normalized dataset as well as in the as-measured dataset. The highest normalized value in batch two of the ETW environment was an outlier for the batch and for the environment. It was an outlier in the normalized dataset as well as in the as-measured dataset. They were retained for this analysis.

Statistics, basis values and estimates are given for the OHC1 strength data in Table 4-31. The normalized data, B-estimates and B-basis values are shown graphically in Figure 4-21.

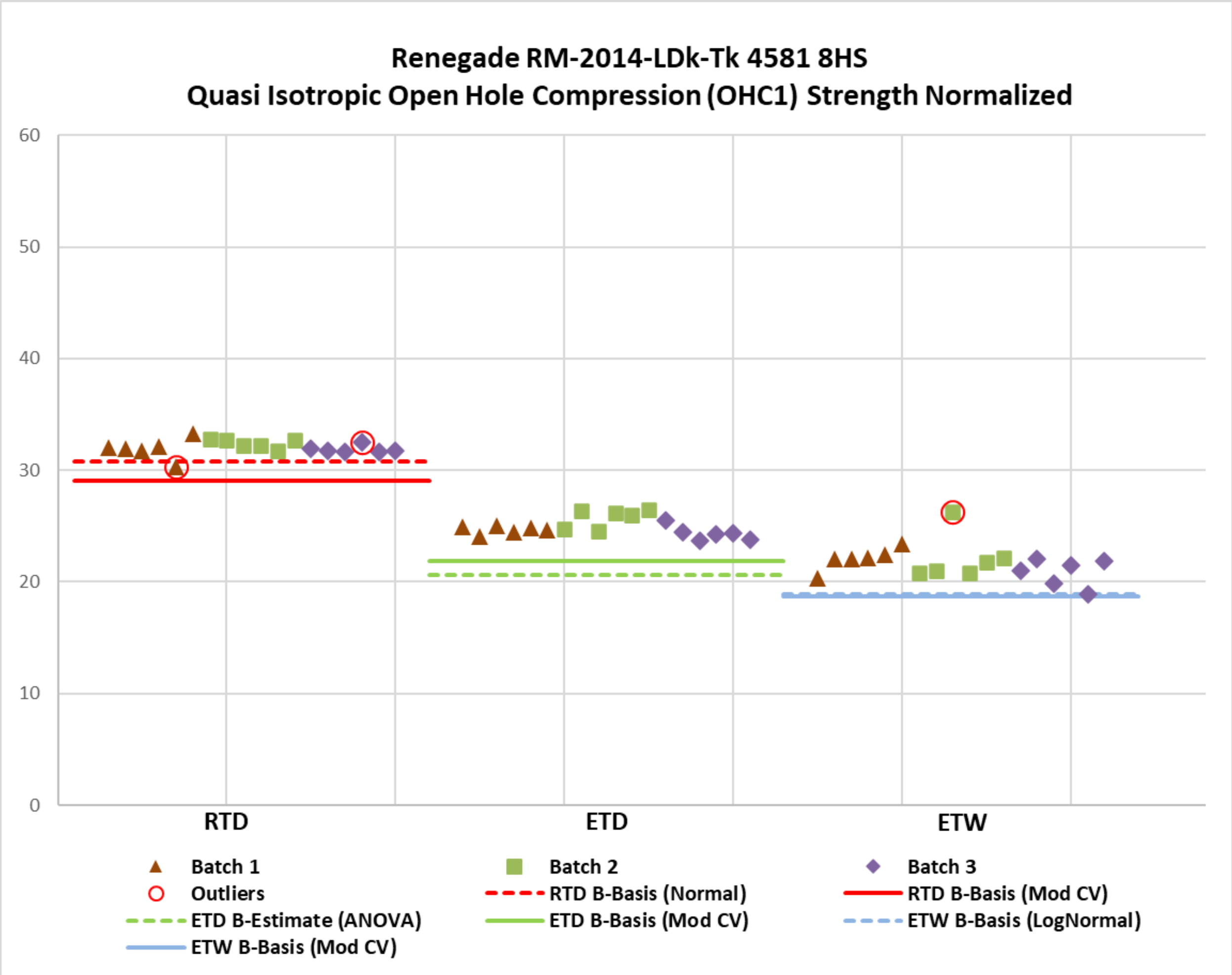

Figure 4-21: Batch Plot for OHC1 Normalized Strength

Open Hole Compression 1 (OHC1) Strength Basis Values and Statistics						
	Normalized			As-Measured		
Env	RTD	ETD	ETW	RTD	ETD	ETW
Mean	32.05	24.91	21.69	31.79	24.74	21.58
Stdev	0.6480	0.8711	1.556	0.6194	0.7548	1.465
CV	2.022	3.497	7.171	1.948	3.050	6.788
Mod CV	6.000	6.000	7.586	6.000	6.000	7.394
Min	30.30	23.73	18.90	29.94	23.80	19.10
Max	33.27	26.50	26.31	32.90	26.00	26.00
No. Batches	3	3	3	3	3	3
No. Spec.	18	18	18	18	18	18
Basis Values and Estimates						
B-basis Value	30.77		18.86	30.53	23.49	18.26
B-Estimate		20.59				
A-Estimate	29.86	17.51	17.11	29.68	22.63	12.04
Method	Normal	ANOVA	LogNormal	Pooled	Pooled	Non-Parametric
Modified CV Basis Values and Estimates						
B-basis Value	29.04	21.90	18.69	28.83	21.78	18.62
A-Estimate	27.04	19.90	16.68	26.85	19.81	16.65
Method	Pooled	Pooled	Pooled	Pooled	Pooled	Pooled

Table 4-31: Statistics and Basis Values for OHC1 Strength Data

4.21 "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: RTD and ETW.

For the normalized dataset, both 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, environments were not acceptable for pooling because the pooled dataset failed the Levene's test for equality of variances.

For the as-measured dataset, the ETW environment failed the ADK test for batch equivalency. ANOVA was used to compute its basis value, and with three batches of data available this is an estimate. Applying the modified CV, the environments are not acceptable for pooling because the pooled dataset failed the Levene's test for equality of variances.

There were no statistical outliers.

Statistics, basis values and estimates are given for the OHC2 strength data in Table 4-32. The normalized data, B-estimates and B-basis values are shown graphically in Figure 4-22.

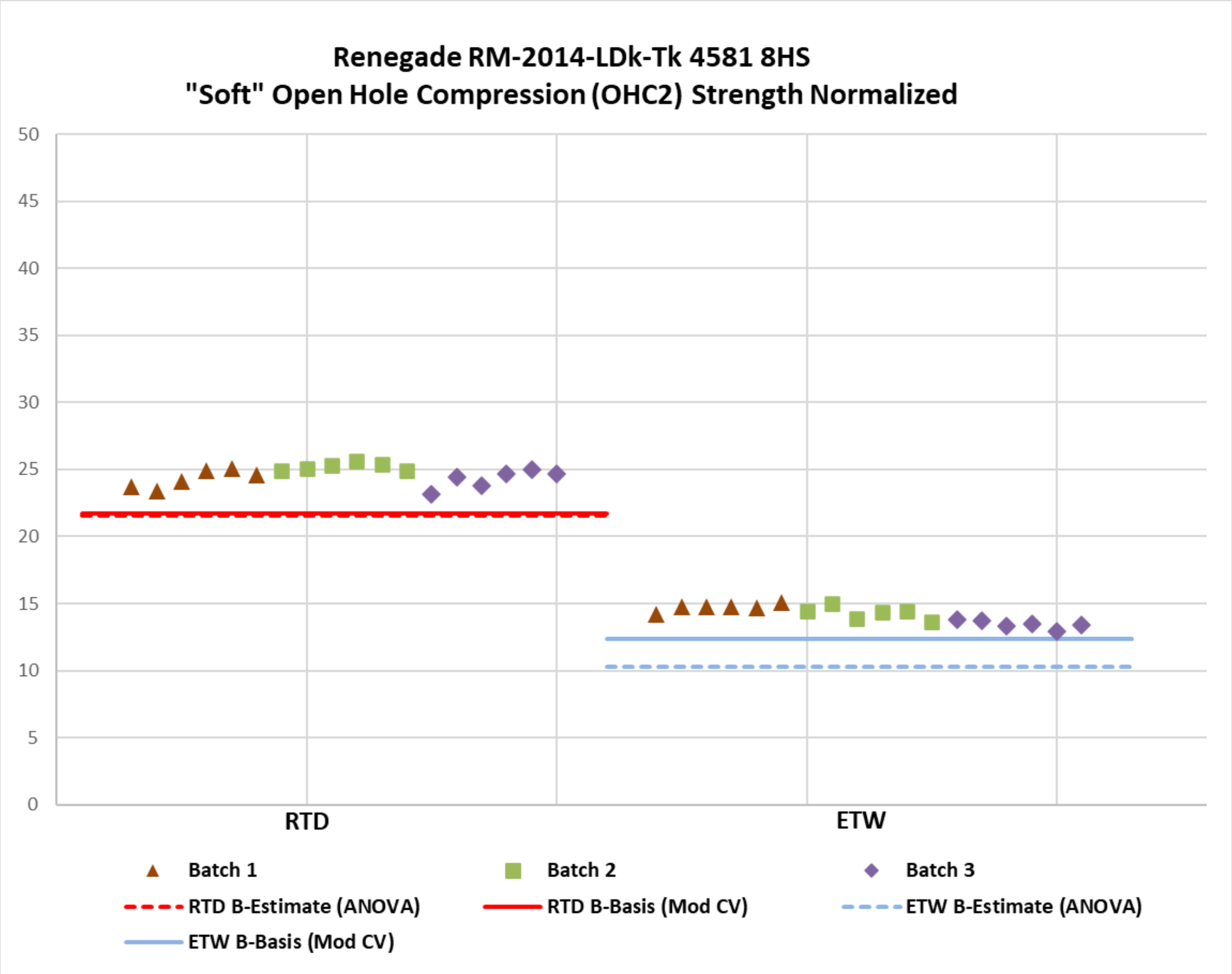

Figure 4-22: Batch Plot for OHC2 Normalized Strength

Open Hole Compression 2 (OHC2) Strength Basis Values and Statistics				
	Normalized		As-Measured	
Env	RTD	ETW	RTD	ETW
Mean	24.60	14.14	24.77	14.26
Stdev	0.7019	0.6424	0.5881	0.7147
CV	2.854	4.542	2.375	5.011
Mod CV	6.000	6.271	6.000	6.506
Min	23.18	12.90	23.60	12.90
Max	25.60	15.06	25.60	15.30
No. Batches	3	3	3	3
No. Spec.	18	18	18	18
Basis Values and Estimates				
B-basis Value			23.53	
B-Estimate	21.53	10.27		9.862
A-Estimate	19.35	7.509	22.17	6.723
Method	ANOVA	ANOVA	Weibull	ANOVA
Modified CV Basis Values and Estimates				
B-basis Value	21.68	12.39	21.83	12.43
A-Estimate	19.62	11.15	19.76	11.13
Method	Normal	Normal	Normal	Normal

Table 4-32: Statistics and Basis Values for OHC2 Strength Data

4.22 "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: RTD and ETW.

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

There were no statistical outliers.

Statistics, basis values and estimates are given for the OHC3 strength data in Table 4-33. The normalized data, B-estimates and B-basis values are shown graphically in Figure 4-23.

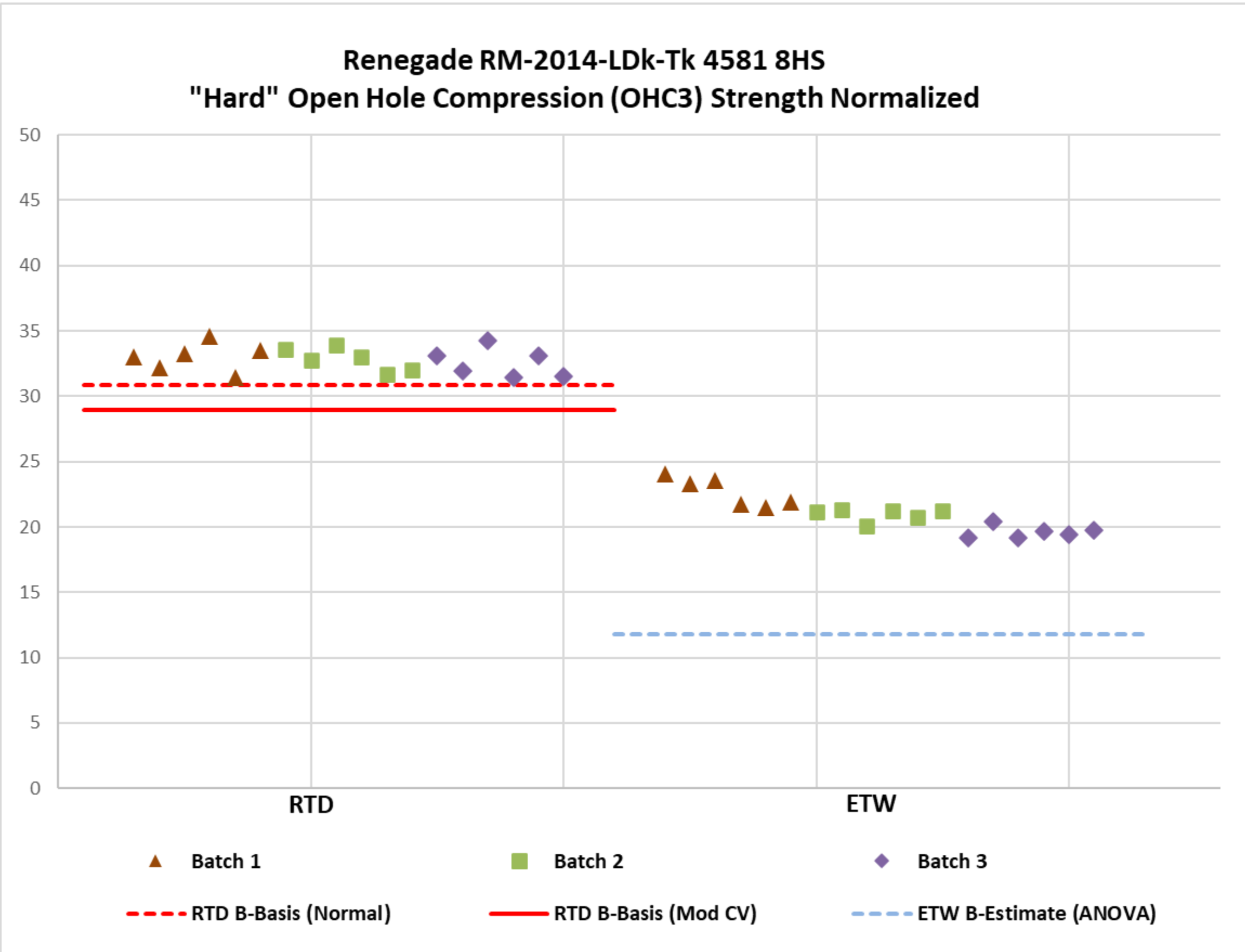

Figure 4-23: Batch Plot for OHC3 Normalized Strength

Open Hole Compression 3 (OHC3) Strength Basis Values and Statistics				
	Normalized		As-Measured	
Env	RTD	ETW	RTD	ETW
Mean	32.80	21.08	33.20	21.41
Stdev	0.9885	1.463	0.9098	1.473
CV	3.014	6.939	2.741	6.884
Mod CV	6.000	7.470	6.000	7.442
Min	31.41	19.15	31.13	19.50
Max	34.61	24.04	34.61	24.70
No. Batches	3	3	3	3
No. Spec.	18	18	18	18
Basis Values and Estimates				
B-basis Value	30.85		31.40	
B-Estimate		11.76		12.41
A-Estimate	29.47	5.105	30.13	5.992
Method	Normal	ANOVA	Normal	ANOVA
Modified CV Basis Values and Estimates				
B-basis Value	28.91	NA	29.26	NA
A-Estimate	26.17		26.48	
Method	Normal		Normal	

Table 4-33: Statistics and Basis Values for OHC3 Strength Data

4.23 "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: RTD and ETW.

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

There were no statistical outliers.

Statistics, basis values and estimates are given for the FHC1 strength data in Table 4-34. The normalized data, B-estimates and B-basis values are shown graphically in Figure 4-24.

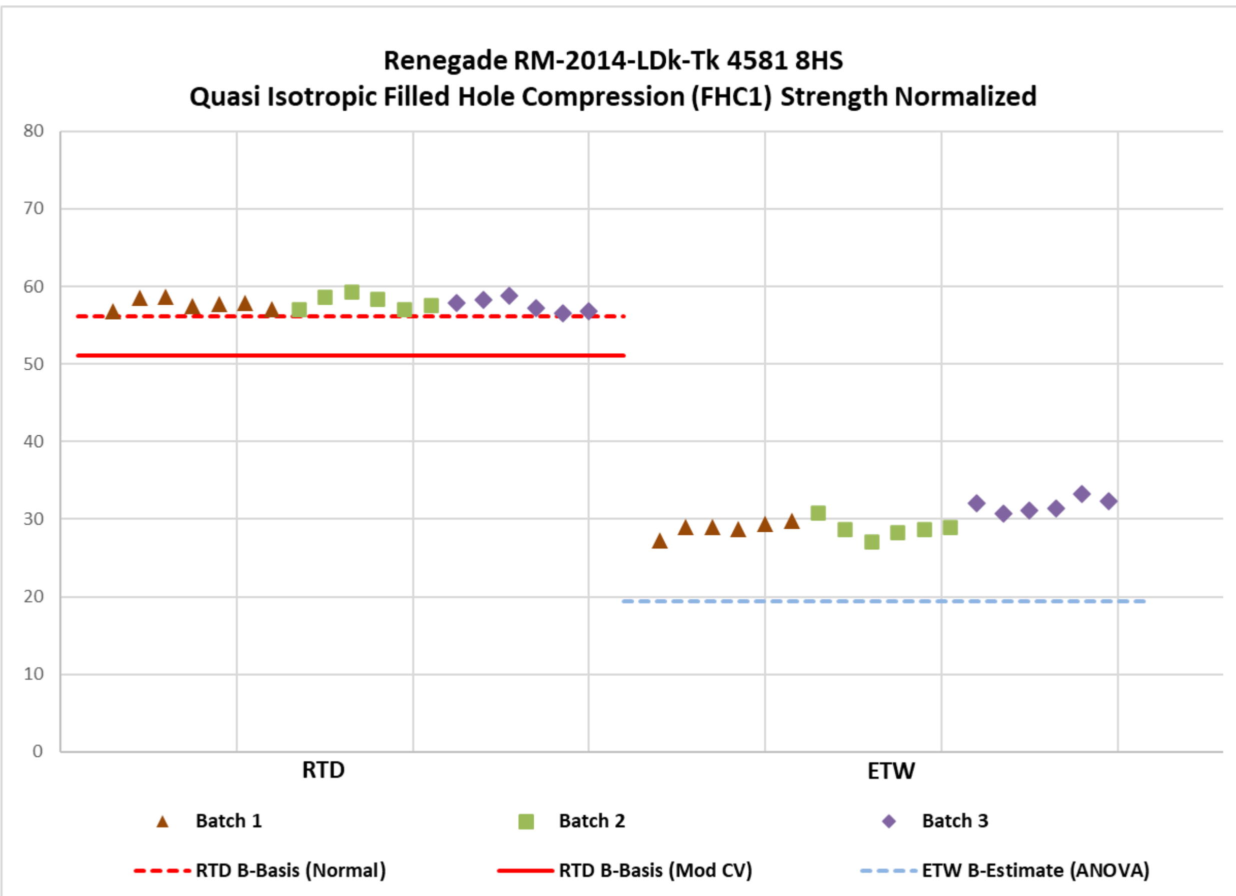

Figure 4-24: Batch plot for FHC1 Normalized Strength

Filled-Hole Compression 1 (FHC1) Strength Basis Values and Statistics				
	Normalized		As-Measured	
Env	RTD	ETW	RTD	ETW
Mean	57.77	29.83	57.65	29.70
Stdev	0.8143	1.737	0.8703	1.892
CV	1.409	5.822	1.510	6.370
Mod CV	6.000	6.911	6.000	7.185
Min	56.59	27.10	56.04	26.49
Max	59.35	33.31	59.12	33.69
No. Batches	3	3	3	3
No. Spec.	19	18	19	18
Basis Value Estimates				
B-Basis Value	56.19		55.95	
B-Estimate		19.39		17.99
A-Estimate	55.06	11.94	54.74	9.638
Method	Normal	ANOVA	Normal	ANOVA
Modified CV Basis Value Estimates				
B-Basis Value	51.02	NA	50.90	NA
A-Estimate	46.23		46.12	
Method	Normal		Normal	

Table 4-34: Statistics and Basis Values for FHC1 Strength Data

4.24 "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: RTD and ETW.

For the normalized dataset, the RTD environment failed the ADK test for batch equivalency. ANOVA was used to compute its basis value, and with three batches of data available this is an estimate. Applying the modified CV, both environments were not acceptable for pooling because the pooled dataset failed the Levene's test for equality of variances.

For the as-measured dataset, both environments were not acceptable for pooling because the pooled dataset failed the Anderson Darling test for normality. Applying the modified CV, both environments were not acceptable for pooling because the pooled dataset failed the Levene's test for equality of variances.

There was one statistical outlier. The lowest normalized value in batch one of the RTD environment was an outlier for the batch but not for the environment. It was an outlier in the normalized dataset as well as in the as-measured dataset. It was retained for this analysis.

Statistics are given for the FHC2 strength data in Table 4-35. The normalized specimen data are shown graphically in Figure 4-25.

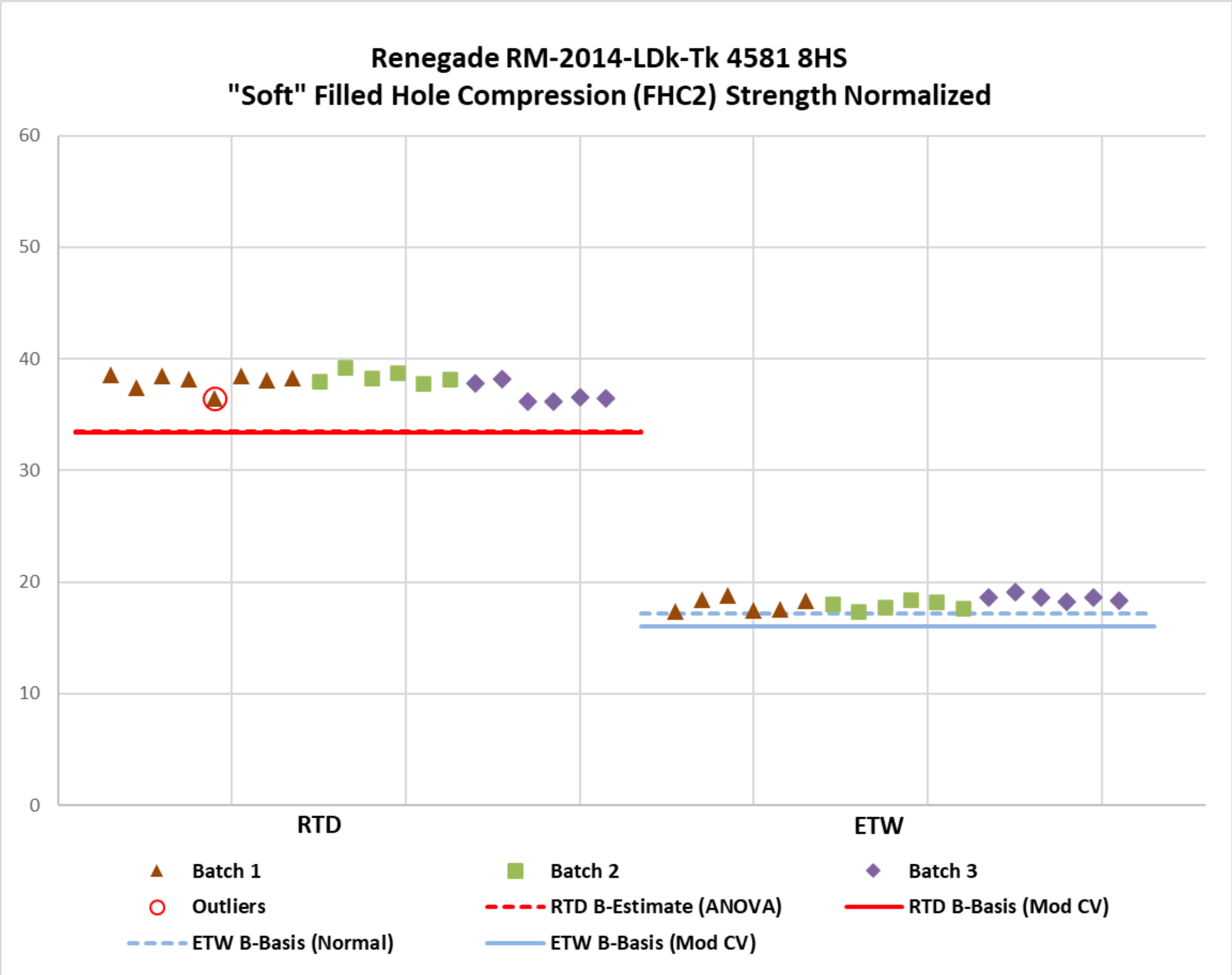

Figure 4-25: Batch plot for FHC2 Normalized Strength

Filled-Hole Compression 2 (FHC2) Strength Basis Values and Statistics				
	Normalized		As-Measured	
Env	RTD	ETW	RTD	ETW
Mean	37.79	18.16	38.15	18.24
Stdev	0.9216	0.5180	0.8499	0.6107
CV	2.439	2.852	2.228	3.347
Mod CV	6.000	6.000	6.000	6.000
Min	36.16	17.33	36.34	17.15
Max	39.27	19.12	39.38	19.17
No. Batches	3	3	3	3
No. Spec.	20	18	20	18
Basis Value Estimates				
B-Basis Value		17.14	36.51	17.04
B-Estimate	33.45			
A-Estimate	30.35	16.42	35.34	16.18
Method	ANOVA	Normal	Normal	Normal
Modified CV Basis Value Estimates				
B-Basis Value	33.42	16.01	33.74	16.08
A-Estimate	30.32	14.49	30.60	14.55
Method	Normal	Normal	Normal	Normal

Table 4-35: Statistics and Basis Values for FHC2 Strength Data

4.25 "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: RTD and ETW.

For the normalized dataset, the RTD environment failed the ADK test for batch equivalency. ANOVA was used to compute its basis value, and with three batches of data available this is an estimate. Using the modified CV, there were no diagnostic test failures and both environments were acceptable for pooling.

For the as-measured dataset, the RTD environment failed the ADK test for batch equivalency. ANOVA was used to compute its basis value, and with three batches of data available this is an estimate. Using the modified CV, both environments were not acceptable for pooling because the pooled dataset failed the Levene's test for equality of variances.

There were three statistical outliers. The lowest normalized value in batch two of the RTD environment was an outlier for the batch and for the environment. It was an outlier in the normalized dataset as well as in the as-measured dataset. The lowest normalized value in batch one of the RTD environment was an outlier for the batch but not for the environment. It was an outlier in the normalized dataset but not in the as-measured dataset. The lowest normalized value in batch one of the ETW environment was an outlier for the batch but not for the environment. It was an outlier in the normalized dataset but not in the as-measured dataset. They were retained for this analysis.

Statistics, basis values and estimates are given for the FHC3 strength data in Table 4-36. The normalized data, B-estimates and B-basis values are shown graphically in Figure 4-26.

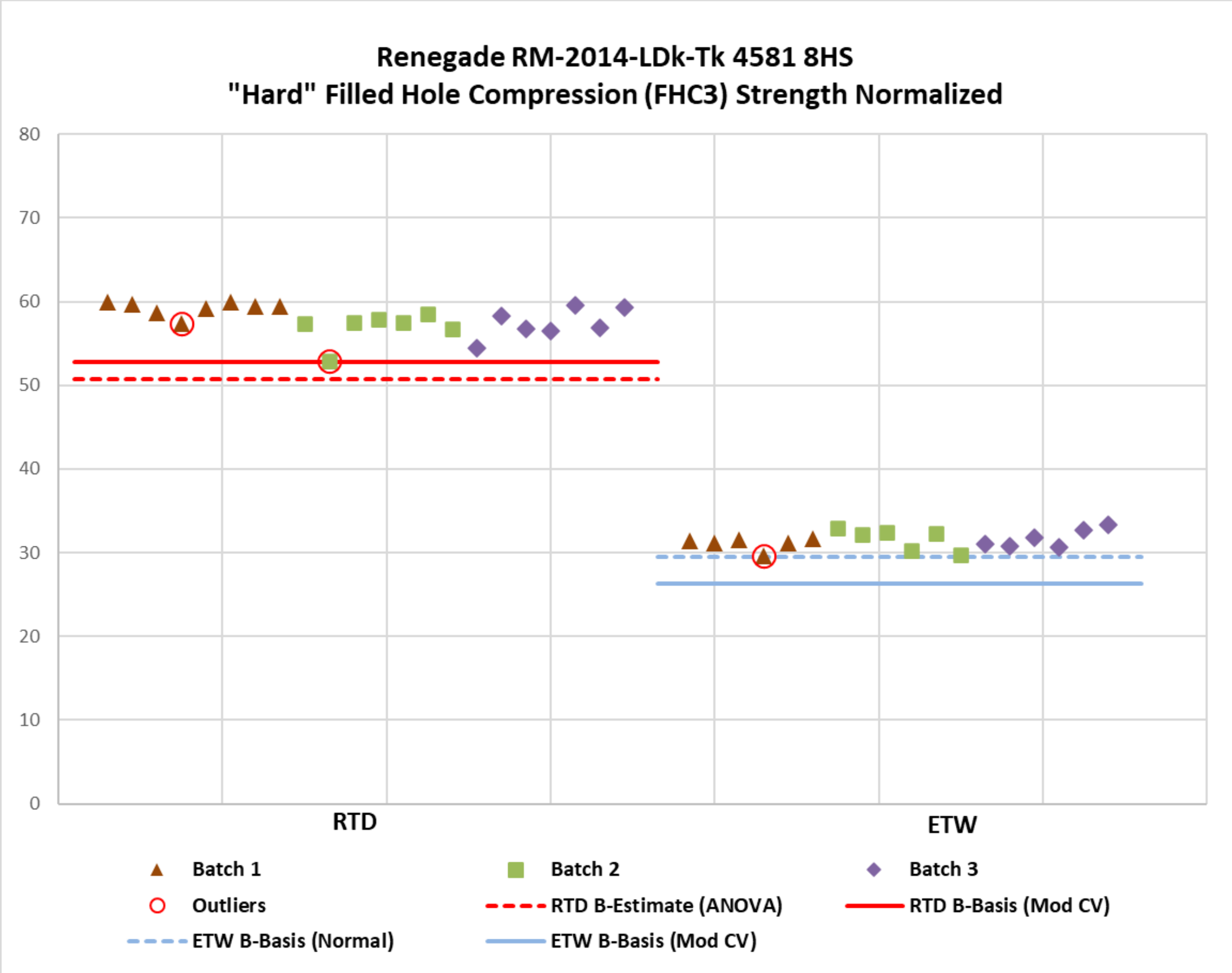

Figure 4-26: Batch Plot for FHC3 Normalized Strength

Filled-Hole Compression 3 (FHC3) Strength Basis Values and Statistics				
	Normalized		As-Measured	
Env	RTD	ETW	RTD	ETW
Mean	57.89	31.48	58.56	31.81
Stdev	1.783	1.037	1.960	1.021
CV	3.080	3.294	3.347	3.210
Mod CV	6.000	6.000	6.000	6.000
Min	52.87	29.67	52.97	30.02
Max	59.96	33.28	61.39	33.41
No. Batches	3	3	3	3
No. Spec.	22	18	22	18
Basis Value Estimates				
B-Basis Value		29.44		29.80
B-Estimate	50.69		50.87	
A-Estimate	45.54	27.99	45.37	28.37
Method	ANOVA	Normal	ANOVA	Normal
Modified CV Basis Value Estimates				
B-Basis Value	52.79	26.29	51.93	28.05
A-Estimate	49.26	22.78	47.20	25.38
Method	Pooled	Pooled	Normal	Normal

Table 4-36: Statistics and Basis Values for FHC3 Strength Data

4.26 "25/50/25" Single-Shear Bearing 1 (SSB1)

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: RTD and ETW.

For the normalized datasets, the ultimate strength test in the RTD condition failed the ADK test for batch equivalency. ANOVA was used to compute its basis value, and with three batches of data available this is an estimate. Applying the modified CV, there were no diagnostic test failures, so both environmental conditions were acceptable for pooling for 2% offset strength and ultimate strength.

For the as-measured datasets, the environments were not acceptable for pooling for either of the properties because the pooled datasets failed the Levene's test for equality of variances. Applying the modified CV, there were no diagnostic test failures, so both environmental conditions were acceptable for pooling for 2% offset strength and ultimate strength.

There were two statistical outliers. The lowest normalized value in batch one of the 2% offset strength property, RTD environment was an outlier for the environment but not for the batch. It was outlier in the normalized dataset but in for the as-measured dataset. The lowest normalized value in batch three of the ultimate strength property, RTD environment was an outlier for the batch but not for the environment. It was an outlier in the normalized dataset but not in the as-measured dataset. They were retained for this analysis.

Statistics, basis values and estimates are given for the SSB1 strength data in Table 4-37. The normalized data, B-estimates and B-basis values are shown graphically in Figure 4-27.

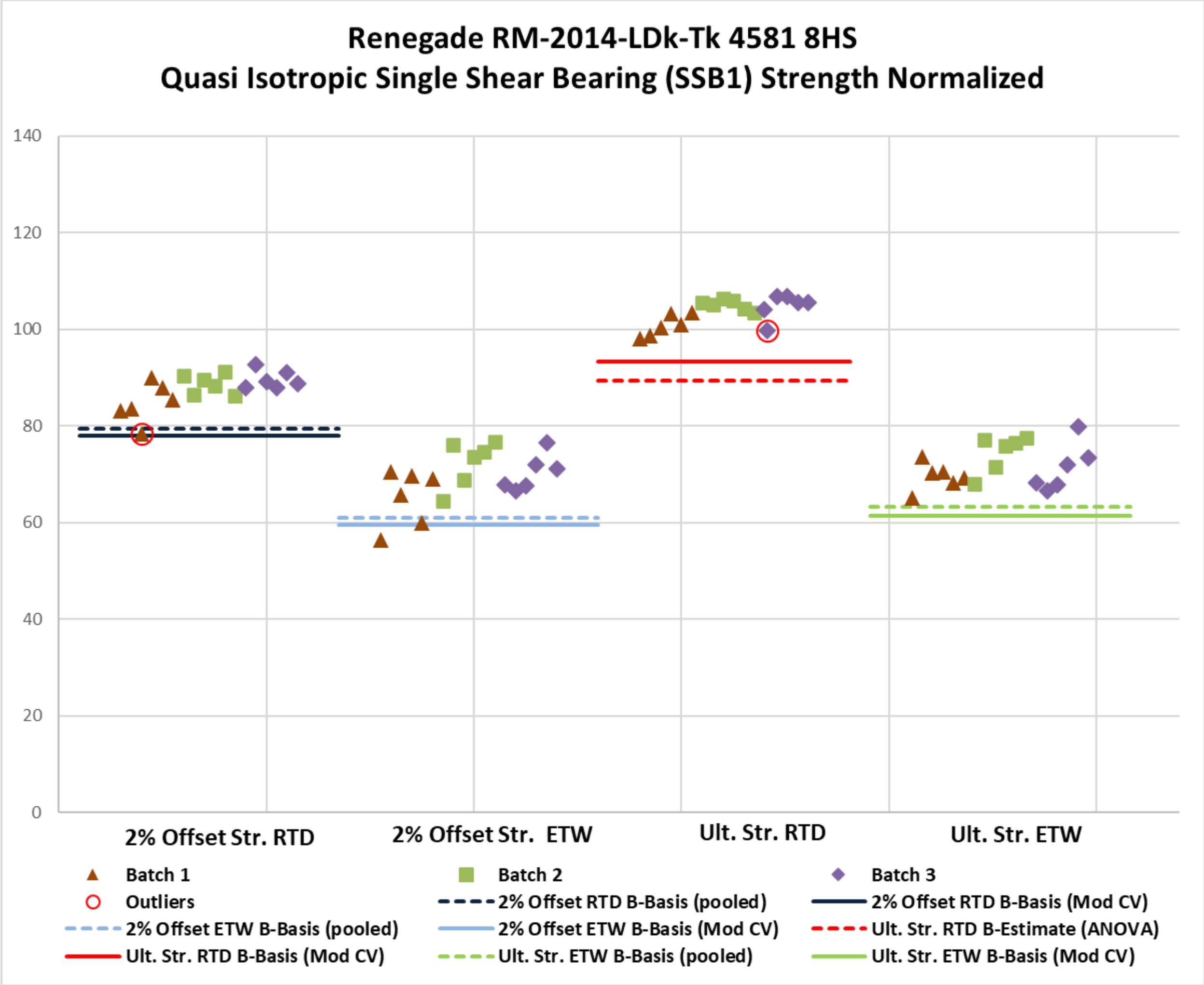

Figure 4-27: Batch Plot for SSB1 Normalized Strength

Single Shear Bearing 1 (SSB1) Strength Basis Values and Statistics								
	Normalized				As-Measured			
Property	2% Offset Strength		Ultimate Strength		2% Offset Strength		Ultimate Strength	
Env	RTD	ETW	RTD	ETW	RTD	ETW	RTD	ETW
Mean	87.73	69.32	103.6	71.77	86.45	68.35	102.1	70.80
Stdev	3.444	5.490	2.811	4.252	2.191	4.915	1.963	3.990
CV	3.926	7.920	2.713	5.924	2.535	7.192	1.922	5.636
Mod CV	6.000	7.960	6.000	6.962	6.000	7.596	6.000	6.818
Min	78.43	56.46	98.11	65.15	80.77	58.72	97.03	64.87
Max	92.74	76.67	106.9	79.86	90.16	75.02	105.1	77.38
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	79.38	60.97		63.38	82.12	58.64	98.26	62.92
B-Estimate			89.50					
A-Estimate	73.70	55.29	79.42	57.43	79.06	51.77	95.52	57.34
Method	Pooled	Pooled	ANOVA	Normal	Normal	Normal	Normal	Normal
Modified CV Basis Values and Estimates								
B-basis Value	77.91	59.50	93.35	61.50	77.00	58.89	92.09	60.75
A-Estimate	71.23	52.82	86.36	54.51	70.57	52.46	85.26	53.91
Method	Pooled	Pooled	Pooled	Pooled	Pooled	Pooled	Pooled	Pooled

Table 4-37: Statistics and Basis Values for SSB1 Strength Data

4.27 "10/80/10" Single-Shear Bearing 2 (SSB2)

The SSB2 data is normalized by cured ply thickness. Both normalized and as-measured statistics are provided. Tests were conducted in the following environmental conditions: RTD and ETW.

For the normalized datasets, the ultimate strength test in the RTD environment failed the ADK test for batch equivalency. ANOVA was used to compute its basis value, and with three batches of data available this is an estimate. Applying the modified CV there were no diagnostic test failures so both environments were acceptable for pooling. For the 2% offset strength test, both environments were not acceptable for pooling because the pooled dataset failed the Levene's test for equality of variances. Applying the modified CV there were no diagnostic test failures so both environments were acceptable for pooling.

For the as-measured datasets, there were no diagnostic test failures for the ultimate strength test so both environments were acceptable for pooling. Applying the modified CV, the pooled dataset failed the Levene's test for equality of variances. The 2% offset strength pooled dataset failed the Levene's test for equality of variances, so environments were not acceptable for pooling. Applying the modified CV there were no diagnostic test failures so both environments were acceptable for pooling.

There were no statistical outliers.

Statistics, basis values and estimates are given for the SSB2 strength data in Table 4-38. The normalized data, B-estimates and B-basis values are shown graphically in Figure 4-28.

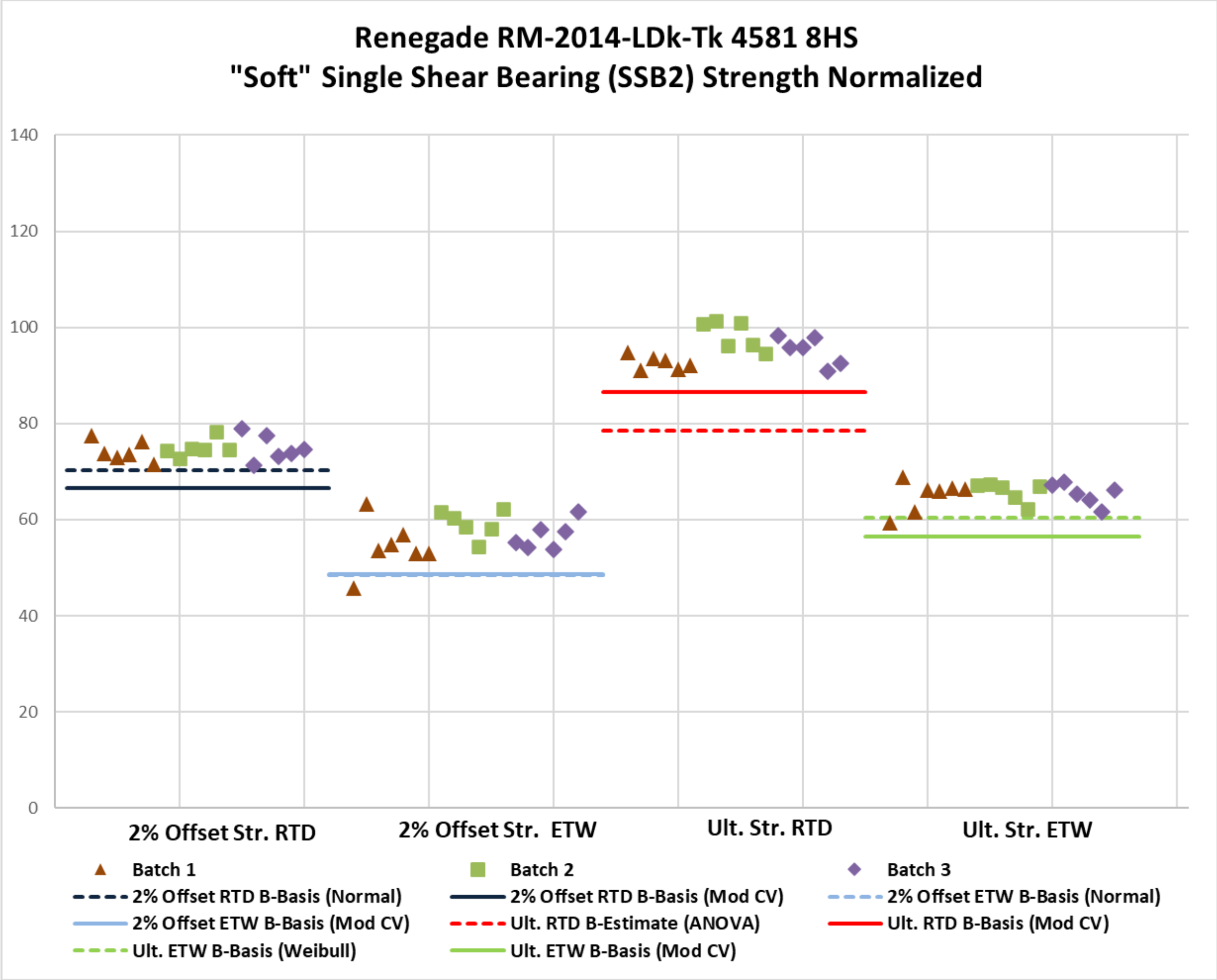

Figure 4-28: Batch Plot for SSB2 Normalized Strength

Single Shear Bearing 2 (SSB2) Strength Basis Values and Statistics								
	Normalized				As-Measured			
Property	2% Offset Strength		Ultimate Strength		2% Offset Strength		Ultimate Strength	
Env	RTD	ETW	RTD	ETW	RTD	ETW	RTD	ETW
Mean	74.67	56.63	95.42	65.39	74.45	56.50	95.13	65.25
Stdev	2.214	4.247	3.408	2.512	2.087	4.140	2.942	2.570
CV	2.965	7.500	3.572	3.841	2.803	7.328	3.092	3.939
Mod CV	6.000	7.750	6.000	6.000	6.000	7.664	6.000	6.000
Min	71.22	45.68	90.86	59.42	71.45	46.16	90.52	60.05
Max	78.90	63.23	101.4	68.92	78.24	64.17	100.2	69.94
No. Batches	3	3	3	3	3	3	3	3
No. Spec.	18	19	18	19	18	19	18	19
Basis Values and Estimates								
B-basis Value	70.30	48.35		60.36	70.33	48.43	90.12	60.27
B-Estimate			78.56					
A-Estimate	67.20	42.48	66.53	55.00	67.41	42.70	86.72	56.86
Method	Normal	Normal	ANOVA	Weibull	Normal	Normal	Pooled	Pooled
Modified CV Basis Values and Estimates								
B-basis Value	66.61	48.61	86.54	56.56	66.46	48.55	83.86	NA
A-Estimate	61.14	43.13	80.52	50.53	61.04	43.11	75.89	
Method	Pooled	Pooled	Pooled	Pooled	Pooled	Pooled	Normal	

Table 4-38: Statistics and Basis Values for SSB2 Strength Data

4.28 "40/20/40" Single-Shear Bearing 3 (SSB3)

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: RTD and ETW.

For both the normalized datasets, there were no diagnostic test failures in the ultimate strength test so both environment were acceptable for pooling. In the 2% offset strength test, the RTD environment failed the ADK test for batch equivalency. ANOVA was used to compute its basis value, and with three batches of data available this is an estimate. Applying the modified CV, there were no diagnostic test failures, so both environments were acceptable for pooling for the two tests.

For the as-measured datasets, for the ultimate strength test, environments were not acceptable for pooling because the pooled dataset failed the Levene's test for equality of variances. For the 2% offset strength test, the RTD environment failed the ADK test for batch equivalency. ANOVA was used to compute its basis value, and with three batches of data available this is an estimate. Applying the modified CV, there were no diagnostic test failures so both environments were acceptable for pooling for the two tests.

There was one statistical outlier. The lowest normalized value in batch one of the 2% offset dataset, ETW environment was an outlier for the batch but not for the environment. It was an outlier in the normalized dataset as well as in the as-measured dataset. It was retained for this analysis.

Statistics, basis values and estimates are given for the SSB3 strength data in Table 4-39. The normalized data, B-estimates and B-basis values are shown graphically in Figure 4-29.

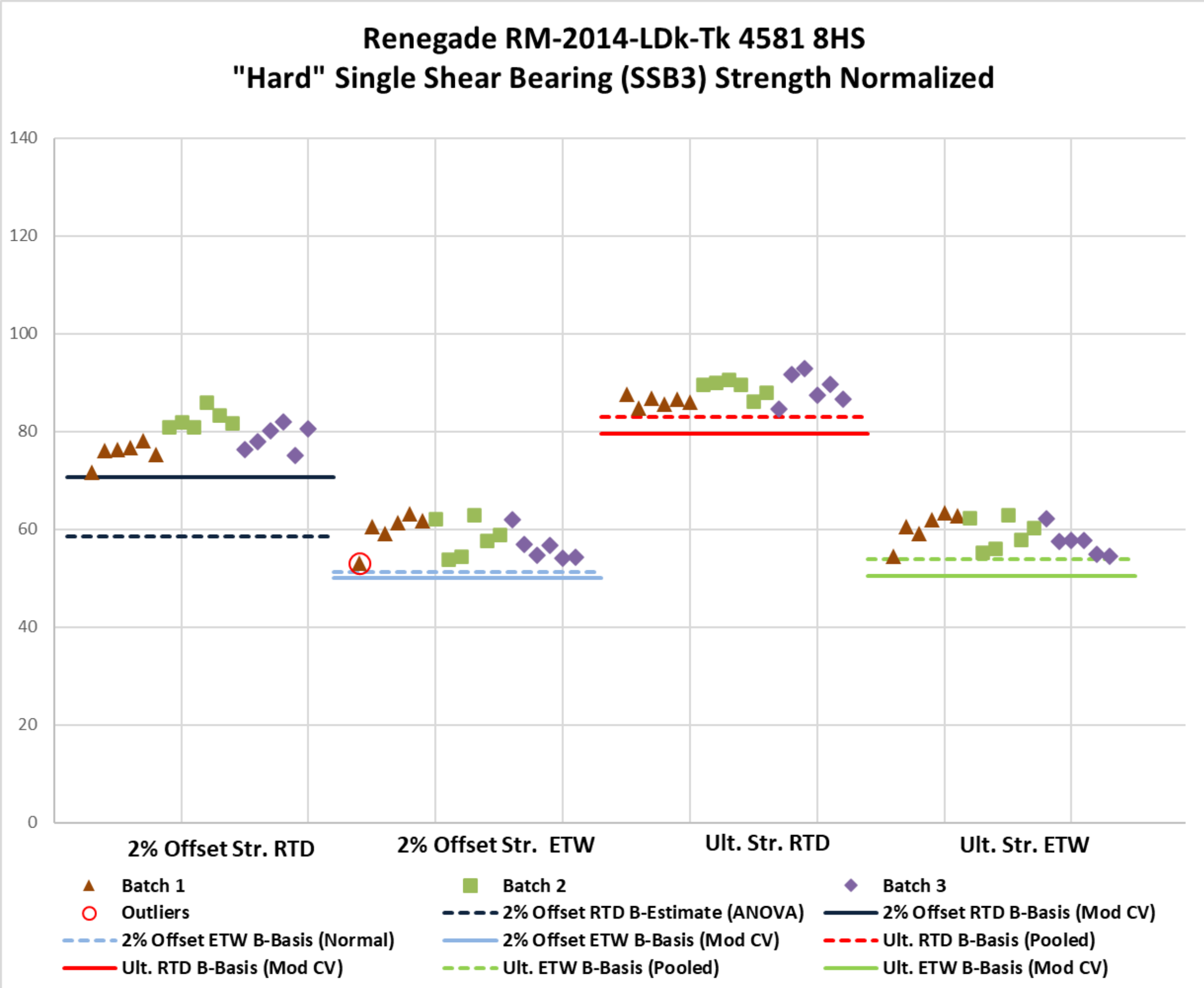

Figure 4-29: Batch Plot for SSB3 Normalized Strength

Single Shear Bearing 3 (SSB3) Strength Basis Values and Statistics								
	Normalized				As-Measured			
Property	2% Offset Strength		Ultimate Strength		2% Offset Strength		Ultimate Strength	
Env	RTD	ETW	RTD	ETW	RTD	ETW	RTD	ETW
Mean	78.97	58.26	88.06	59.04	78.56	57.85	87.60	58.63
Stdev	3.571	3.526	2.385	3.170	3.376	3.459	2.177	3.090
CV	4.522	6.051	2.709	5.370	4.297	5.979	2.485	5.270
Mod CV	6.261	7.026	6.000	6.685	6.149	6.989	6.000	6.635
Min	71.59	53.13	84.66	54.42	71.91	52.67	84.51	54.09
Max	85.95	63.22	92.87	63.40	85.07	62.52	92.34	62.70
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		51.30	82.95	53.93		51.02	83.31	52.53
B-Estimate	58.47				61.44			
A-Estimate	43.83	46.37	79.47	50.46	49.23	46.19	80.26	48.20
Method	ANOVA	Normal	Pooled	Pooled	ANOVA	Normal	Normal	Normal
Modified CV Basis Values and Estimates								
B-basis Value	70.71	50.00	79.56	50.55	70.45	49.74	79.18	50.20
A-Estimate	65.08	44.37	73.78	44.77	64.93	44.22	73.45	44.47
Method	Pooled	Pooled	Pooled	Pooled	Pooled	Pooled	Pooled	Pooled

Table 4-39: Statistics and Basis Values for SSB3 Strength Data

4.29 “25/50/25” Compression After Impact 1 (CAI1)

The CAI1 data is normalized by cured ply thickness. Basis values are not computed for this property. Testing is done only for the RTD condition. Only one batch of material was tested. There was no statistical analysis. Summary statistics are presented in Table 4-40 and the data are displayed graphically in Figure 4-30.

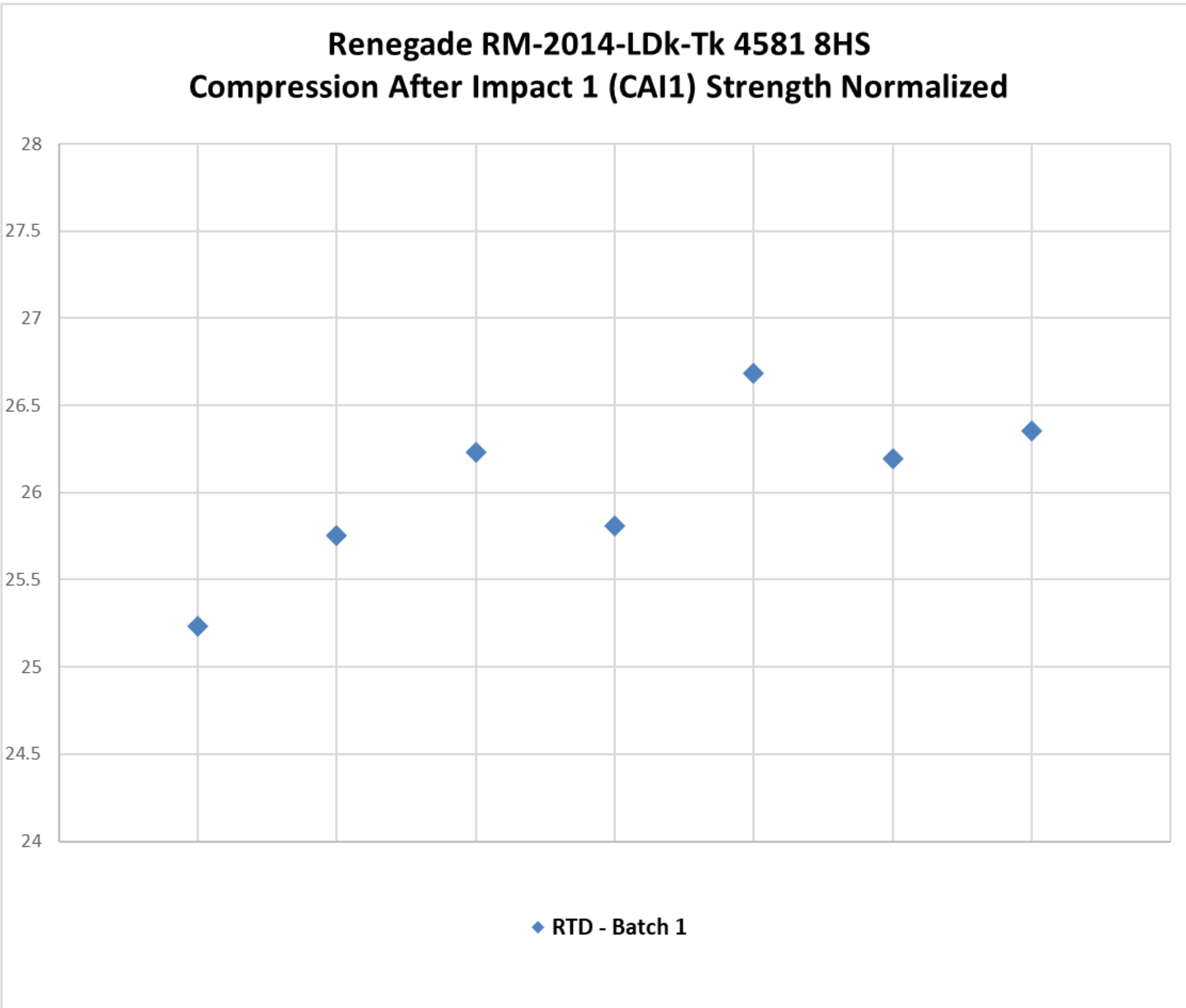

Figure 4-30: Plot for Compression After Impact Normalized Strength

Compression After Impact (CAI1) Strength		
	Normalized	As-Measured
Env	RTD	RTD
Mean	26.04	25.77
Stdev	0.4757	0.4724
CV	1.827	1.833
Mod CV	6.000	6.000
Min	25.23	24.94
Max	26.69	26.43
No. Batches	1	1
No. Spec.	7	7

Table 4-40: Statistics for Compression After Impact Strength Data

4.30 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 CTD, RTD and ETW conditions. Only one batch of material was tested. There was no statistical analysis. Basis values are not computed for these properties. Summary statistics are presented in Table 4-41 and the as-measured data are displayed graphically in Figure 4-31.

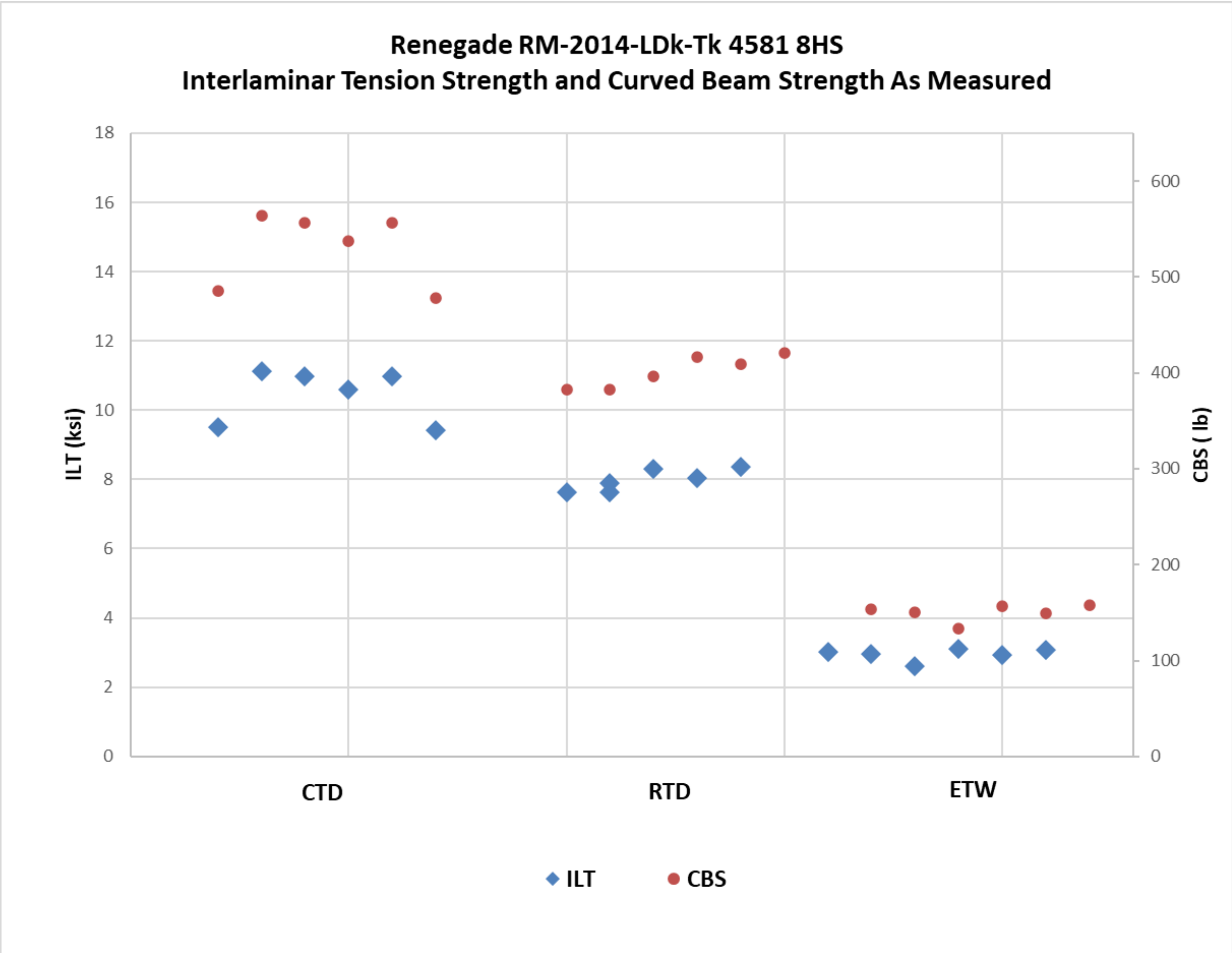

Figure 4-31: Plot for Interlaminar Tension and Curved Beam Strength

Interlaminar Tension (ILT) Strength Statistics						
	Interlaminar Tension Strength (ksi)			Curved Beam Strength (lb)		
Env	CTD	RTD	ETW	CTD	RTD	ETW
Mean	10.39	7.979	2.949	527.3	401.4	150.1
Stdev	0.7086	0.3139	0.1836	35.31	16.63	9.060
CV	6.823	3.935	6.227	6.696	4.143	6.035
Mod CV	7.411	6.000	7.114	7.348	6.072	7.018
Min	9.423	7.636	2.601	478.5	382.6	133.1
Max	11.11	8.364	3.116	564.3	420.9	158.2
No. Batches	1	1	1	1	1	1
No. Spec.	7	6	6	7	6	6

Table 4-41: Statistics for ILT and CBS 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-17-1G. 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-2024-007 Rev N/C. 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.	Strength				Outlier		
				Normalized	Value	As Measured	Value	High/Low	Batch	Condition
FC	CTD	C	FC-C-C2-1-CTD-11	Not an Outlier		Yes	71.55	High	Yes	No
FHC2	RTD	A	FHC2-A-C2-1-RTD-1	Yes	36.46	Yes	36.84	Low	Yes	No
FHC3	RTD	B	FHC3-B-C1-1-RTD-2	Yes	52.87	Yes	52.97	Low	Yes	Yes
FHC3	RTD	A	FHC3-A-C1-1-RTD-4	Yes	57.42	Not an Outlier		Low	Yes	No
FHC3	ETW	A	FHC3-A-C2-1-ETW-1	Yes	29.67	Not an Outlier		Low	Yes	No
FHT1	CTD	C	FHT1-C-C1-1-CTD-1	Yes	50.53	Not an Outlier		Low	Yes	No
FHT2	RTD	B	FHT2-B-C1-1-RTD-8	Yes	30.80	Not an Outlier		Low	Yes	No
FHT2	ETW	A	FHT2-A-C1-1-ETW-12	Yes	16.35	Not an Outlier		Low	Yes	Yes
IPS 0.2% Offset	ETW	C	IPS-C-C2-1-ETW-4	NA		Yes	1.830	High	Yes	No
IPS 5% Strain	ETD	C	IPS-C-C2-1-ETD-3			Yes	4.990	High	Yes	No
OHC1	RTD	A	OHC1-A-C2-1-RTD-4	Yes	30.30	Yes	29.94	Low	No	Yes
OHC1	RTD	C	OHC1-C-C2-1-RTD-1	Yes	32.56	Yes	32.90	High	Yes	No
OHC1	ETW	B	OHC1-B-C1-1-ETW-9	Yes	26.31	Yes	26.00	High	Yes	Yes
OHT2	CTD	B	OHT2-B-C1-1-CTD-1	Not an Outlier		Yes	32.68	Low	Yes	Yes
OHT3	RTD	A	OHT3-A-C2-1-RTD-8	Yes	50.04	Yes	49.60	Low	Yes	No
OHT3	ETW	C	OHT3-C-C1-1-ETW-8	Not an Outlier		Yes	39.60	Low	Yes	No
SBS1	RTD	B	SBS1-B-C2-1-RTD-1	NA		Yes	7.810	Low	Yes	No
SBS1	ETW	C	SBS1-C-C1-1-ETW-2			Yes	4.040	High	No	Yes
SSB1 2% Offset	RTD	A	SSB1-A-C1-1-RTD-3	Yes	78.43	Not an Outlier		Low	No	Yes
SSB1 Ult. Str.	RTD	C	SSB1-C-C1-1-RTD-2	Yes	99.80	Not an Outlier		Low	Yes	No
SSB3 2% Offset	ETW	A	SSB3-A-C1-1-ETW-1	Yes	53.13	Yes	53.32	Low	Yes	No
UNC1	ETW	B	UNC1-B-C2-1-ETW-8	Yes	24.11	Not an Outlier		Low	No	Yes
UNT2	RTD	C	UNT2-C-C2-1-RTD-11	Yes	37.76	Yes	38.80	Low	Yes	No
UNT3	RTD	C	UNT3-C-C1-1-RTD-8	Yes	90.55	Not an Outlier		Low	Yes	No
WC	ETD	B	WC-B-C1-1-ETD-13	Not an Outlier		Yes	57.50	High	Yes	No
WC	ETD	C	WC-C-C1-1-ETD-3	Not an Outlier		Yes	47.10	Low	No	Yes
WT	CTD	B	WT-B-C2-1-CTD-1	Yes	125.3	Not an Outlier		High	Yes	No
WT	RTD	C	WT-C-C1-1-RTD-2	Yes	114.5	Not an Outlier		High	Yes	No

NA: Property not normalized

Table 5-1: List of Outliers

6. References

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