Syensqo (Formerly Solvay) EP2190 T650 3K PW Fabric RC 37% Material Allowables Statistical Analysis Report Phase 1, 2, and 3

NCAMP Project Number: NPN 021901

NCAMP Report Number: NCP-RP-2022-003 Rev -

Report Date: September 3rd, 2025

Sylvina Castillo
National Center for Advanced Materials Performance (NCAMP)
National Institute for Aviation Research
Wichita State University
Wichita, KS 67260-0093

Testing Facility:

Solvay
1440 N Kraemer Blvd
Anaheim, CA 92806

Test Panel Fabrication Facility:

Solvay
1440 N Kraemer Blvd
Anaheim, CA 92806

Prepared by:

Sylvina Castillo
Digitally signed by Sylvina Castillo
Date: 2025.09.29 12:52:30 -05'00'

Sylvina Castillo

Reviewed by:

Nicole Stahl
Digitally signed by Nicole Stahl
Date: 2025.09.29 12:59:14 -05'00'

Nicole Stahl

Jorge Chavez-Salas
Digitally signed by Jorge Chavez-Salas
DN: cn=Jorge Chavez-Salas, o=WSU, ou=NIAR, email=jchavezsalas@niar.wichita.edu, c=US
Date: 2025.09.29 14:26:38 -05'00'

Jorge Chavez-Salas

Approved by:

Royal Lovingfoss
Digitally signed by Royal Lovingfoss
Date: 2025.09.30 07:30:00 -05'00'

Royal Lovingfoss

Rev	By	Date	Pages Revised or Added
-	Sylvina Castillo	09/03/2025	Document Initial Release

Table of Contents

List of Figures

List of Tables

1. Introduction

This report contains statistical analysis of the Solvay EP2190 T650 3K PW prepreg, material property data published in NCAMP Test Report CAM-RP-2022-002 Rev -. The lamina and laminate material property data have been generated with NCAMP oversight NCAMP Project Number NPN 021901 and meet the requirements outlined in NCAMP Standard Operating Procedure NSP 100. The test panels, test specimens, and test setups have been inspected by NCAMP Authorized Inspection Representatives (AER), and the testing has been witnessed by the NCAMP Authorized Inspection Representatives (AER).

B-Basis values, A-estimates, and B-estimates were calculated using a variety of techniques that are detailed in section two.

The qualification material was procured to a proprietary material specification which is equivalent to NCAMP Material Specification NMS 219/2 Rev Initial Release dated November 4, 2021. The qualification test panels were fabricated per a proprietary process specification which is equivalent to NCAMP process Specification NPS 82190 Rev A dated April 1, 2022 using baseline cure cycle "C". The panels were fabricated, and the testing was performed at Solvay, 1440 N Kraemer Blvd, Anaheim, CA 92806. The NCAMP Test Plan NTP 2191Q1 was used for this qualification program.

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

The applicability 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-17-1H. The applicability of equivalency process must be evaluated on a 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-17-1H are adequate for the given program.

Aircraft companies should not use the data published in this report without specifying NCAMP Material Specification NMS 219/2. NMS 219/2 has additional requirements that are listed in its prepreg process control document (PCD), fiber specification, fiber PCD, and other raw material specifications and PCDs which impose essential quality controls on the raw materials and raw material manufacturing equipment and processes. *Aircraft companies and certifying agencies should assume that the material property data published in this report is not applicable when the material is not procured to NCAMP Material Specification NMS 219/2.* NMS 219/2 is a free, publicly available, non-proprietary aerospace industry material specification.

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

1.1 Symbols and Abbreviations

Test Property	Abbreviation
Warp Compression Strength	WCS
Warp Compression Modulus	WCM
Warp Tension	WT
Fill Compression Strength	FCS
Fill Compression Modulus	FCM
Fill Tension	FT
In-Plane Shear	IPS
Short Beam Strength	SBS
0° Flexural	0FLEX
90° Flexural	90FLEX
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
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 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 Tension Strength	F_2^{tu}
Fill Tension Modulus	E_2^{t}
Fill Tension Poisson's Ratio	ν_{12}^{t}
In-Plane Shear Ultimate Strength	F_{12}^{su}
In-Plane Shear Strength at 5% strain	$F_{12}^{s5\% \text{ strain}}$
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 Ambient	CTA	−67±5°F
Room Temperature Ambient	RTA	75±5°F
Elevated Temperature Ambient	ETA2	225±5°F
Elevated Temperature Ambient	ETA3	250±5°F
Elevated Temperature Wet	ETW1	180±5°F
Elevated Temperature Wet	ETW2	225±5°F
Elevated Temperature Wet	ETW3	250±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-2022-002 Rev -.

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: 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 the variability that will be encountered when the material is being produced in larger amounts over a lengthy period. 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 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-17-1H. 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 when there is minimal data available. When enough 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-17-1H guidelines. If pooling is not permissible, the results of a single point analysis provided by CMH17 STATS are included instead. If the data does not meet CMH-17-1H 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 for computing a pooled standard deviation is given below:

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

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

2.1.2.2 Pooled Coefficient of Variation

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

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

2.1.3 Basis Value Computations

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

$$\textbf{Basis Values:} \quad \begin{aligned} A-basis &= \bar{X} - K_a S \\ B-basis &= \bar{X} - K_b S \end{aligned} \qquad \textbf{Equation 6}$$

2.1.3.1 K-factor computations

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

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

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

Where

r = the number of environments being pooled together
n_j = number of data values for environment j

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

$$f = N - r$$

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

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

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

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

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

2.1.4 Modified Coefficient of Variation

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

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

This is converted to percent by multiplying by 100%.

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

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

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

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

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:

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

$$C_i = \frac{S_i^*}{S_i}$$ **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-17-1H.

$$MNR = \frac{\max_{all\ i}\left|X_i - \bar{X}\right|}{S}, i = 1 \ldots n$$ **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 an outlier. If an outlier exists, then the X_i associated with the MNR is dropped from the dataset and the MNR procedure is applied again. This process is repeated until no outliers are detected. Additional information on this procedure can be found in references 1 and 2.

2.1.6 The k-Sample Anderson Darling Test for Batch Equivalency

The k-sample Anderson-Darling test is a nonparametric statistical procedure that tests the hypothesis that the populations from which two or more groups of data were drawn are identical. The distinct values in the combined data set are ordered from smallest to largest, denoted $z_{(1)}, z_{(2)}, \ldots z_{(L)}$, where L will be less than n if there are tied observations. These rankings are used to compute the test statistic.

The k-sample Anderson-Darling test statistic is:

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

Where

n_i = the number of test specimens in each batch

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

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

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

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

The critical value for the test statistic at $1-\alpha$ 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.

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

$$a = (4g-6)(k-1) + (10-6g)S$$
$$b = (2g-4)k^2 + 8Tk + (2g-14T-4)S - 8T + 4g - 6$$
$$c = (6T+2g-2)k^2 + (4T-4g+6)k + (2T-6)S + 4T$$

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

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

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

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

where $x_{(i)}$ is the smallest sample observation, $\bar{x}$ 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

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

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

2.1.8 Levene's Test for Equality of Coefficient of Variation

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

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

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

2.1.9 Distribution Tests

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

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

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

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

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

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

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

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

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 non-centrality parameter $2.326\sqrt{n}$ and n − 1 degrees of freedom (Reference 11). Since this is not a calculation that Excel can handle easily, the following approximation to the k_A values is used:

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

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

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

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

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

2.1.9.3.1 Estimating Weibull Parameters

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

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

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

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

2.1.9.3.2 Goodness-of-fit test for the Weibull distribution

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

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

The Anderson-Darling test statistic is

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

and the observed significance level is

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

where

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

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

2.1.9.3.3 Basis value calculations for the Weibull distribution

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

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

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 the 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:

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

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:

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

The A-basis value is:

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

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-17-1H, 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 assumes 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-17-1H 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.

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

2.3 Lamina Variability Method (LVM)

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

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

Table 2-4: B-Basis factors for small datasets using variability of corresponding large dataset

2.4 Specification Limits

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

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

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

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

Then we define:

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

We compute these as the following:

$$W_{\text{mean}} = \overline{x} - k_n^{\text{mean}}.S \quad \textbf{Equation 64}$$
$$W_{\text{min indiv}} = \overline{x} - k_n^{\text{min indiv}}.S \quad \textbf{Equation 65}$$

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

For modulus properties we define:

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

We compute these as the following:

$$W_{\text{lower}} = \overline{x} - k.S \quad \textbf{Equation 66}$$
$$W_{\text{upper}} = \overline{x} + k.S \quad \textbf{Equation 67}$$

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

$$k = t_c.\sqrt{(\frac{1}{N} + \frac{1}{n})} \quad \textbf{Equation 68}$$

and

$$t_c = t.INV(\alpha, N) \quad \textbf{Equation 69}$$

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

2.4.1.1 Specification Limits for the Program

The qualification data statistics and specification limits are summarized for Strength properties in Table 2-5 and for Modulus properties in Table 2-6.

Test Property	Test Condition	Mean [ksi]	CV (%)	Mod CV (%)	k_mean	k_min indiv	As-is		Mod CV		Notes
							W_mean [ksi]	W_min indiv [ksi]	W_mean [ksi]	W_min indiv [ksi]	
90° (fill) Compression (FC)	ETA3 (250°F)	79.75	6.897	7.449	1.143	3.072	73.46	62.85	72.96	61.50	Qualification Data Only
90° (fill) Tension (FT)	RTD (75°F)	122.5	4.276	6.138	1.143	3.072	116.5	106.4	113.9	99.41	Qualification Data Only
Short Beam Strength	RTD (75°F)	12.13	0.3595	6.000	1.143	3.072	11.72	11.02	11.30	9.892	Qualification Data Only

Table 2-5: Qualification Data Statistics and Specification Limits for Strength

Test Property	Test Condition	Mean [Msi]	CV (%)	Mod CV (%)	t_statistic	As-is		Mod CV		Notes
						Lower Limit [Msi]	Upper Limit [Msi]	Lower Limit [Msi]	Upper Limit [Msi]	
90° (fill) Compression (FC)	ETA3 (250°F)	8.719	4.853	6.426	2.898	8.099	9.339	7.917	9.521	Qualification Data Only
90° (fill) Tension (FT)	RTD (70°F)	9.394	2.004	6.000	2.807	9.135	9.654	8.627	10.16	Qualification Data Only

Table 2-6: Qualification Data Statistics and Specification Limits for Modulus

3. Summary of Results

The B-basis values for all tests are summarized in the following tables. The NCAMP recommended B-basis values meet all requirements of CMH-17-1H. However, not all test data meets those requirements. The summary tables provide a complete listing of all computed B-basis values and estimates of basis values. Data that does not meet the requirements of CMH-17-1H 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-17-1H are recommended.
2. Modified CV basis values are preferred. Recommended values will be the modified CV basis value when available. The CV provided with the recommended basis value will be the one used in the computation of the basis value.
3. Only normalized basis values are given for properties that are normalized.
4. ANOVA values are not recommended since only three batches of material are available and CMH-17-1H 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 appears questionable (e.g. when the CTA-RTA-ETW trend of the basis values is not consistent with the CTA-RTA-ETW trend of the average values), then the B-basis values will not be recommended.

NCAMP Recommended B-Basis Values for
Solvay EP2190 T650 3K PW Fabric RC 37%
All B-Basis Values in this Table Meet the Standards for Publication in the CMH-17-1H Handbook
Values Are for Normalized Data Unless Noted

Lamina Strength Tests

Environment	Statistic	WT	WC	FT	FC	0FLEX	90FLEX	IPS*			SBS*
								0.2% Offset Strength	Strength at 5% Strain	Ultimate Strength	
CTA (-67°F)	B-Basis	101.0	NA:A	95.30	NA:A			8.608	15.54	24.17	NA:I
	Mean	114.5	131.9	108.2	126.6			10.86	17.82	26.82	14.75
	CV	6.505	6.017	6.695	5.662			12.69	6.767	6.000	2.816
RTA (75°F)	B-Basis	114.7	NA:A	109.7	101.6	132.3	NA:A	6.276	11.86	18.77	11.46
	Mean	128.2	112.3	122.5	112.9	150.5	153.8	7.061	13.34	21.40	12.13
	CV	6.564	6.252	6.138	6.000	6.529	3.931	6.000	6.000	6.566	2.964
ETA2 (225°F)	B-Basis		NA:I		NA:I	NA:I	NA:I				NA:I
	Mean		86.55		85.82	119.3	123.9				7.907
	CV		5.588		3.912	5.082	6.771				2.838
ETA3 (250°F)	B-Basis	112.1	68.49	105.8	NA:A	95.76	96.94	NA:I	NA:I	NA:I	6.261
	Mean	126.0	77.09	119.0	79.75	109.5	110.4	4.083	7.388	15.62	7.182
	CV	6.152	9.733	7.019	6.897	6.343	6.167	4.811	3.907	6.030	6.491
ETW1 (180°F)	B-Basis	116.0	75.19	111.2	77.65			4.227	5.207	12.68	6.694
	Mean	129.9	88.13	124.4	89.29			4.795	6.398	14.39	7.594
	CV	6.111	7.432	6.136	6.754			6.000	9.434	6.000	6.000
ETW2 (225°F)	B-Basis	112.1	58.42	107.3	60.14	82.11	82.04	3.164	NA:A	10.73	5.092
	Mean	126.0	69.80	120.5	70.85	95.05	93.79	3.631	4.185	12.17	5.776
	CV	6.964	8.256	6.479	7.658	6.896	6.345	6.507	12.06	6.000	6.000
ETW3 (250°F)	B-Basis		52.49					NA:A	NA:A	9.499	4.176
	Mean		61.24					2.959	3.182	10.80	4.737
	CV		7.237					7.616	11.68	6.102	6.000

Notes: The modified CV B-Basis value is recommended when available.
The CV provided corresponds with the B-Basis value given.
NA implies that tests were run but data did not meet NCAMP's recommended requirements.
"NA:A" indicates ANOVA with 3 batches. "NA:I" indicates insufficient data points.
Shaded empty boxes indicate that test data is not available for that property and condition.
* 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
Solvay EP2190 T650 3K PW Fabric RC 37%
All B-Basis Values in this Table Meet the Standards for Publication in the CMH-17-1H Handbook
Values Are for Normalized Data Unless Noted

Laminate Strength Tests

Layup	Environment	Statistic	UNT	UNC	OHT	FHT	OHC	FHC	SSB		CAI
									2% Offset Strength	Ultimate Strength	
25/50/25	CTA (-67°F)	B-Basis	NA:I	NA:I	NA:A	49.52	47.95	85.71	126.5	139.9	
		Mean	94.85	97.52	47.84	55.79	52.63	94.07	139.1	158.7	
		CV	2.707	2.862	5.221	6.190	6.000	6.030	6.684	6.000	
	RTA (75°F)	B-Basis	86.48	72.41	42.84	49.67	40.26	67.63	106.8	124.0	41.67
		Mean	96.53	80.04	48.72	55.94	44.93	76.03	119.4	136.1	46.44
		CV	6.000	6.000	6.514	6.856	6.000	7.366	6.000	6.000	6.269
	ETA2 (225°F)	B-Basis	NA:I	NA:I	NA:I		NA:I				NA:I
		Mean	98.35	64.34	48.87		36.45				38.40
		CV	0.6773	3.121	2.561		2.523				2.936
	ETA3 (250°F)	B-Basis	NA:I	NA:I	45.49		31.86				
		Mean	89.70	62.47	51.72		34.11				
		CV	2.488	2.429	6.103		3.344				
	ETW1 (180°F)	B-Basis	83.73	53.06	45.84	53.05	30.69	47.51	94.40	103.6	32.51
		Mean	94.03	60.89	51.86	59.32	35.50	55.92	107.0	115.6	37.28
		CV	6.000	6.000	6.890	6.000	6.000	7.556	6.943	6.123	6.142
	ETW2 (225°F)	B-Basis	79.17	43.73	NA:A	51.88	26.30	36.04	87.61	91.68	28.05
		Mean	89.81	49.62	52.41	58.15	29.84	44.45	100.2	103.7	32.50
		CV	6.000	6.010	6.552	6.037	6.000	7.457	6.128	6.000	6.937
	ETW3 (250°F)	B-Basis		36.10			NA:A		79.13	83.13	
		Mean		40.96			26.62		91.75	95.16	
		CV		6.000			4.533		6.480	6.164	
10/80/10	CTA (-67°F)	B-Basis	57.75		45.27	50.29					
		Mean	63.59		50.45	56.03					
		CV	6.024		6.000	6.000					
	RTA (75°F)	B-Basis	54.49	51.98	38.99	42.96	36.99	48.99	101.0	118.2	
		Mean	60.33	57.57	44.17	48.70	40.97	55.57	111.4	129.7	
		CV	6.000	6.000	6.000	6.000	6.000	6.000	6.000	6.000	
	ETA2 (225°F)	B-Basis		NA:I			NA:I				
		Mean		47.89			33.08				
		CV		1.066			1.574				
	ETA3 (250°F)	B-Basis		NA:I			NA:I				
		Mean		45.29			30.94				
		CV		2.653			1.128				
	ETW1 (180°F)	B-Basis	45.39	38.31	NA:I	NA:I	27.26	NA:I	90.12	100.7	
		Mean	51.23	43.90	36.30	42.16	31.24	40.54	100.5	112.3	
		CV	6.000	6.000	1.930	3.002	6.000	1.677	6.000	6.000	
	ETW2 (225°F)	B-Basis	40.00	30.55	28.79	33.33	23.35	28.61	82.72	89.95	
		Mean	45.84	35.22	32.66	37.81	26.52	32.95	93.13	101.5	
		CV	6.000	6.715	6.000	6.000	6.067	6.670	6.000	6.000	
	ETW3 (250°F)	B-Basis		NA:A			20.21		76.48	81.51	
		Mean		29.04			22.93		86.89	93.05	
		CV		12.93			6.000		6.318	6.061	

Table 3-2: NCAMP Recommended B-Basis Values for Laminate Test Data (Part A)

Layup	Environment	Statistic	UNT	UNC	OHT	FHT	OHC	FHC	SSB	
									2% Offset Strength	Ultimate Strength
40/20/40	CTA (-67°F)	B-Basis	106.0		50.13	56.44				
		Mean	118.5		56.84	63.67				
		CV	6.000		6.019	6.000				
	RTA (75°F)	B-Basis	108.8	78.31	51.02	54.91	42.62	NA:A	92.41	113.0
		Mean	121.3	87.28	57.73	62.14	47.23	78.80	102.7	124.5
		CV	6.254	6.388	6.806	6.620	6.000	4.762	6.258	6.000
	ETA2 (225°F)	B-Basis		NA:I			NA:I			
		Mean		71.72			38.17			
		CV		5.171			2.426			
	ETA3 (250°F)	B-Basis		NA:I			NA:I			
		Mean		66.52			35.95			
		CV		6.068			3.210			
	ETW1 (180°F)	B-Basis	104.8	58.31	NA:I	NA:I	31.82	NA:I	82.68	92.67
		Mean	117.3	67.28	62.68	68.20	36.43	62.11	93.01	104.2
		CV	6.000	6.204	5.078	2.626	6.000	3.361	6.722	6.000
	ETW2 (225°F)	B-Basis	102.2	47.31	55.41	54.60	27.04	41.91	75.57	82.70
		Mean	114.6	54.71	62.86	62.39	31.06	49.13	85.90	94.21
		CV	6.006	6.850	6.000	6.330	6.567	7.446	6.293	6.000
	ETW3 (250°F)	B-Basis		40.46			24.36		67.27	76.87
		Mean		46.72			27.75		77.60	87.20
		CV		6.784			6.200		7.128	6.000

Notes: The modified CV B-Basis value is recommended when available.
The CV provided corresponds with the B-Basis value given.
NA implies that tests were run but data did not meet NCAMP's recommended requirements.
"NA:A" indicates ANOVA with 3 batches. "NA:I" indicates insufficient data points.
Shaded empty boxes indicate that test data is not available for that property and condition.

Table 3-3: NCAMP Recommended B-Basis Values for Laminate Strength Data (Part B)

3.2 Lamina and Laminate Summary Tables

Prepreg Material:	Solvay EP2190 T650 3K PW Fabric RC 37%
Material Specification:	NMS 219/2
Process Specification:	NPS 82190
Fiber:	T650 3K PW Fabric **Resin:** EP2190

Solvay EP2190 T650 3K PW Fabric RC 37% Lamina Properties Summary

***Tg(dry):** 339.5 °F **Tg(wet):** 274.9 °F **Tg METHOD:** ASTM D7028

	Lot 1			Lot 2			Lot 3		
	Phase 1	Phase 2	Phase 3	Phase 1	Phase 2	Phase 3	Phase 1	Phase 2	Phase 3
Date of fiber manufacture	11/5/2018			11/14/2018			4/24/2017		
Date of resin manufacture	12/7/2018	3/30/2021	12/6/2021	10/18/2018	1/21/2021	9/8/2021	10/30/2018	9/27/2021	9/23/2022
Date of prepreg manufacture	1/15/2019	4/8/2021	12/23/2021	1/16/2019	1/31/2022	10/4/2021	1/17/2019	10/4/2021	10/26/2021
	Phase 1			Phase 2			Phase 3		
Date of composite manufacture	10/1/2019 - 6/19/2020			3/23/2022 - 5/11/2022			6/14/2022 - 2/8/2023		
Date of testing	10/18/2019 - 8/15/2020			7/19/2022 - 9/18/2023			9/22/2022 - 11/9/2023		
Date of data submittal	December 2021			June 2024			June 2024		
Date of analysis	March 2022			December 2024 - January 2025					

LAMINA MECHANICAL PROPERTY B-BASIS SUMMARY

Data reported: As-Measured Followed by Normalized Values in Parentheses. Normalizing CPT: 0.007900 in

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

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

Test Condition	**CTA (-67 °F)**			**RTA (75°F)**			**ETA2 (225°F)**			**ETA3 (250°F)**		
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}	102.2	99.58	113.0	115.5	112.9	126.3				92.41	110.4	124.2
(ksi)	(103.8)	(101.0)	(114.5)	(117.5)	(114.7)	(128.2)				(94.02)	(112.1)	(126.0)
E_1^t			9.460			9.399						9.641
(Msi)			(9.586)			(9.539)						(9.780)
ν_{12}^t			0.05971			0.05279						0.05139
F_2^{tu}	88.74	93.89	106.8	111.3	108.2	121.0				101.7	100.0	116.8
(ksi)	(89.75)	(95.30)	(108.2)	(113.3)	(109.7)	(122.5)				(104.8)	(105.8)	(119.0)
E_2^t			9.407			9.283						9.647
(Msi)			(9.528)			(9.394)						(9.833)
ν_{21}^t			0.05746			0.04642						0.05550
F_1^{cu}	95.56	NA	130.3	80.09	NA	110.7	70.44	65.09	85.90	39.17	NA	75.82
(ksi)	(99.75)	NA	(131.9)	(84.27)	NA	(112.3)	(71.90)	(65.58)	(86.55)	(68.49)	NA	(77.09)
E_1^c			8.508			8.563			8.979			8.633
(Msi)			(8.598)			(8.677)			(8.981)			(8.770)
F_2^{cu}	90.42	NA	124.7	94.37	99.83	111.2	75.34	64.60	85.27	39.47	NA	78.88
(ksi)	(96.81)	NA	(126.6)	(99.98)	(101.6)	(112.9)	(75.65)	(65.02)	(85.82)	(47.73)	NA	(79.75)
E_2^c			8.419			8.485			8.802			8.616
(Msi)			(8.480)			(8.552)			(8.796)			(8.719)
$F_{12}^{s0.2\%}$ (ksi)	8.608	NA	10.86	6.300	6.276	7.061				3.488	3.094	4.083
$F_{12}^{s5\%strain}$ (ksi)	15.96	15.54	17.82	12.75	11.86	13.34				6.514	5.598	7.388
F_{12}^{su} (ksi)	25.11	24.17	26.82	18.80	18.77	21.40				12.77	11.84	15.62
G_{12}^s (Msi)			0.7037			0.6440						0.4203
SBS (ksi)	13.83	12.14	14.75	11.46	NA	12.13	7.227	5.991	7.907	5.231	6.261	7.182
0° Flex Strength				135.1	130.7	148.2	105.6	90.84	119.9	72.19	91.83	106.1
(ksi)				(136.4)	(132.3)	(150.5)	(100.9)	(90.39)	(119.3)	(99.34)	(95.76)	(109.5)
0° Flex Modulus						9.111			8.713			8.399
(Msi)						(9.064)			(8.668)			(8.662)
90° Flex Strength				140.5	134.2	151.0	100.9	93.86	123.9	80.95	93.03	107.0
(ksi)				(134.4)	NA	(153.8)	(98.47)	(93.86)	(123.9)	(100.9)	(96.94)	(110.4)
90° Flex Modulus						9.262			8.827			8.280
(Msi)						(9.278)			(8.824)			(8.554)

***Specimens might absorb moisture at ambient condition prior to testing which resulted in lower dry Tg, DMA testing took place weeks/months after panel fabrication. Based on Syensqo's batch release historical data, dry Tg is ~181°C [359°F] to 202°C [396°F]."**

Table 3-4: Summary of Test Results for Lamina Data (CTA, RTA, ETA2, ETA3)

Test Condition	ETW1 (180°F)			ETW2 (225°F)			ETW3 (250°F)		
Property	B-Basis	Modified CV B-Basis	Mean	B-Basis	Modified CV B-Basis	Mean	B-Basis	Modified CV B-Basis	Mean
F_1^{tu} (ksi)	117.5 (118.9)	114.8 (116.0)	128.6 (129.9)	113.6 (115.0)	110.9 (112.1)	124.7 (126.0)			
E_1^t (Msi)			9.629 (9.724)			9.427 (9.525)			
ν_{12}^t			0.04833			0.04961			
F_2^{tu} (ksi)	91.51 (114.9)	109.7 (111.2)	122.9 (124.4)	82.35 (90.43)	NA (107.3)	119.0 (120.5)			
E_2^t (Msi)			9.608 (9.731)			9.417 (9.541)			
ν_{21}^t			0.04689			0.04472			
F_1^{cu} (ksi)	50.24 (76.18)	NA (75.19)	87.99 (88.13)	56.72 (58.42)	56.72 (58.42)	69.20 (69.80)	33.01 (41.08)	NA (52.49)	60.98 (61.24)
E_1^c (Msi)			9.098 (9.100)			8.915 (8.979)			8.779 (8.812)
F_2^{cu} (ksi)	77.66 (79.58)	76.48 (77.65)	88.10 (89.29)	42.32 (60.62)	NA (60.14)	69.89 (70.85)			
E_2^c (Msi)			8.938 (9.058)			8.804 (8.905)			
$F_{12}^{s0.2\%}$ (ksi)	4.424	4.227	4.795	2.601	3.164	3.631	2.011	NA	2.959
$F_{12}^{s5\%strain}$ (ksi)	5.207	5.207	6.398	1.129	NA	4.185	1.624	NA	3.182
F_{12}^{su} (ksi)	13.52	12.68	14.39	11.56	10.73	12.17	9.904	9.499	10.80
G_{12}^s (Msi)			0.5312			0.4099			0.3272
SBS (ksi)	6.419	6.694	7.594	5.282	5.092	5.776	4.418	4.176	4.737
0° Flex Strength (ksi)				62.59 (84.18)	79.30 (82.11)	93.34 (95.05)			
0° Flex Modulus (Msi)						8.303 (8.466)			
90° Flex Strength (ksi)				56.28 (68.78)	NA (82.04)	92.14 (93.79)			
90° Flex Modulus (Msi)						8.322 (8.481)			

Table 3-5: Summary of Test Results for Lamina Data (ETW1, ETW2, ETW3)

Prepreg Material:	Solvay EP2190 T650 3K PW Fabric RC 37%
Material Specification:	NMS 219/2
Process Specification:	NPS 82190
Fiber:	T650 3K PW Fabric **Resin:** EP2190

Solvay EP2190 T650 3K PW Fabric RC 37% Laminate Properties Summary

***Tg(dry):** 339.5 °F **Tg(wet):** 274.9 °F **Tg METHOD:** ASTM D7028

	Lot 1			Lot 2			Lot 3		
	Phase 1	Phase 2	Phase 3	Phase 1	Phase 2	Phase 3	Phase 1	Phase 2	Phase 3
Date of fiber manufacture	11/5/2018			11/14/2018			4/24/2017		
Date of resin manufacture	12/7/2018	3/30/2021	12/6/2021	10/18/2018	1/21/2021	9/8/2021	10/30/2018	9/27/2021	9/23/2022
Date of prepreg manufacture	1/15/2019	4/8/2021	12/23/2021	1/16/2019	1/31/2022	10/4/2021	1/17/2019	10/4/2021	10/26/2021
	Phase 1			Phase 2			Phase 3		
Date of composite manufacture	10/1/2019 - 6/19/2020			3/23/2022 - 5/11/2022			6/14/2022 - 2/8/2023		
Date of testing	10/18/2019 - 8/15/2020			7/19/2022 - 9/18/2023			9/22/2022 - 11/9/2023		
Date of data submittal	December 2021			June 2024			June 2024		
Date of analysis	March 2022			December 2024 - January 2025					

LAMINATE MECHANICAL PROPERTY B-BASIS SUMMARY
Data Reported Normalized, Unless Noted, Normalizing CPT: 0.007900 in
Values Shown in Shaded Boxes do not Meet CMH-17H Requirements and are Estimates Only
These Values may not be Used for Certification Unless Specifically Allowed by the Certifying Agency

Test	Property	Layup:	Quasi Isotropic 25/50/25			"Soft" 10/80/10			"Hard" 40/20/40		
		Test Condition	B-Basis	Modified CV B-Basis	Mean	B-Basis	Modified CV B-Basis	Mean	B-Basis	Modified CV B-Basis	Mean
OHT	Strength [ksi]	CTA (-67°F)	37.33	NA	47.84	38.45	45.27	50.45	51.72	50.13	56.84
		RTA (75°F)	39.53	42.84	48.72	41.41	38.99	44.17	52.61	51.02	57.73
		ETA2 (225°F)	45.08	37.03	48.87						
		ETA3(250°F)	39.85	45.49	51.72						
		ETW1 (180°F)	36.80	45.84	51.86	34.18	27.51	36.30	53.03	47.49	62.68
		ETW2 (225°F)	29.63	NA	52.41	30.93	28.79	32.66	58.35	55.41	62.86
OHC	Strength [ksi]	CTA (-67°F)	50.38	47.95	52.63						
		RTA (75°F)	42.69	40.26	44.93	39.60	36.99	40.97	45.39	42.62	47.23
		ETA2 (225°F)	33.67	27.62	36.45	31.50	25.06	33.08	35.37	28.92	38.17
		ETA3(250°F)	31.86	NA	34.11	29.88	23.44	30.94	32.45	27.24	35.95
		ETW1 (180°F)	33.19	30.69	35.50	29.87	27.26	31.24	34.59	31.82	36.43
		ETW2 (225°F)	22.27	26.30	29.84	20.77	23.35	26.52	23.18	27.04	31.06
		ETW3 (250°F)	18.89	NA	26.62	18.95	20.21	22.93	23.16	24.36	27.75
UNT	Strength [ksi]	CTA (-67°F)	89.16	78.04	94.85	49.83	57.75	63.59	112.4	106.0	118.5
	Modulus [Msi]				7.031			4.556			8.490
	Strength [ksi]	RTA (75°F)	90.98	86.48	96.53	58.41	54.49	60.33	112.9	108.8	121.3
	Modulus [Msi]				6.825			4.362			8.554
	Strength [ksi]	ETA2 (225°F)	96.33	74.52	98.35						
	Modulus [Msi]				6.824						
	Strength [ksi]	ETA3(250°F)	82.94	67.96	89.70						
	Modulus [Msi]				6.711						
	Strength [ksi]	ETW1 (180°F)	88.34	83.73	94.03	49.31	45.39	51.23	108.9	104.8	117.3
	Modulus [Msi]				6.669			4.042			8.533
	Strength [ksi]	ETW2 (225°F)	83.99	79.17	89.81	43.92	40.00	45.84	90.03	102.2	114.6
	Modulus [Msi]				6.215			3.654			8.365
UNC	Strength [ksi]	CTA (-67°F)	91.34	80.24	97.52						
	Modulus [Msi]				6.370						
	Strength [ksi]	RTA (75°F)	76.07	72.41	80.04	55.49	51.98	57.57	69.16	78.31	87.28
	Modulus [Msi]				6.353			4.184			7.915
	Strength [ksi]	ETA2 (225°F)	58.26	48.75	64.34	46.34	36.28	47.89	60.49	54.34	71.72
	Modulus [Msi]				6.319			4.110			8.038
	Strength [ksi]	ETA3(250°F)	57.87	47.33	62.47	41.65	34.31	45.29	54.29	50.40	66.52
	Modulus [Msi]				6.406			4.032			8.070
	Strength [ksi]	ETW1 (180°F)	56.82	53.06	60.89	36.86	38.31	43.90	52.30	58.31	67.28
	Modulus [Msi]				6.372			3.753			7.508
	Strength [ksi]	ETW2 (225°F)	38.71	43.73	49.62	27.04	30.55	35.22	48.56	47.31	54.71
	Modulus [Msi]				5.992			3.748			7.892
	Strength [ksi]	ETW3 (250°F)	38.42	36.10	40.96	6.388	NA	29.04	41.58	40.46	46.72
	Modulus [Msi]				5.683			3.434			7.614

***Specimens might absorb moisture at ambient condition prior to testing which resulted in lower dry Tg, DMA testing took place weeks/months after panel fabrication. Based on Syensqo's batch release historical data, dry Tg is ~181°C [359°F] to 202°C [396°F]."**

Table 3-6: Summary of Test Results for Laminate Data (Part A)

Test	Property	Layup:	Quasi Isotropic 25/50/25			"Soft" 10/80/10			"Hard" 40/20/40		
		Test Condition	B-Basis	Modified CV B-Basis	Mean	B-Basis	Modified CV B-Basis	Mean	B-Basis	Modified CV B-Basis	Mean
FHT	Strength [ksi]	CTA (-67°F)	50.97	49.52	55.79	50.17	50.29	56.03	58.61	56.44	63.67
		RTA (75°F)	41.04	49.67	55.94	45.72	42.96	48.70	57.08	54.91	62.14
		ETW1 (180°F)	55.60	53.05	59.32	38.33	31.94	42.16	62.77	51.67	68.20
		ETW2 (225°F)	44.34	51.88	58.15	34.90	33.33	37.81	49.73	54.60	62.39
FHC	Strength [ksi]	CTA (-67°F)	76.82	85.71	94.07						
		RTA (75°F)	58.93	67.63	76.03	52.87	48.99	55.57	56.62	NA	78.80
		ETW1 (180°F)	48.07	47.51	55.92	38.48	30.72	40.54	55.79	47.06	62.11
		ETW2 (225°F)	38.46	36.04	44.45	30.77	28.61	32.95	42.44	41.91	49.13
Single Shear Bearing	2% Offset Strength [ksi]	CTA (-67°F)	124.3	126.5	139.1						
		RTA (75°F)	110.6	106.8	119.4	105.8	101.0	111.4	94.65	92.41	102.7
		ETW1 (180°F)	98.21	94.40	107.0	94.92	90.12	100.5	84.92	82.68	93.01
		ETW2 (225°F)	91.42	87.61	100.2	87.52	82.72	93.13	77.81	75.57	85.90
		ETW3 (250°F)	70.72	79.13	91.75	79.99	76.48	86.89	53.13	67.27	77.60
	Ultimate Strength [ksi]	CTA (-67°F)	128.1	139.9	158.7						
		RTA (75°F)	114.7	124.0	136.1	115.1	118.2	129.7	115.6	113.0	124.5
		ETW1 (180°F)	105.9	103.6	115.6	105.2	100.7	112.3	96.99	92.67	104.2
		ETW2 (225°F)	96.49	91.68	103.7	95.57	89.95	101.5	89.93	82.70	94.21
		ETW3 (250°F)	74.04	83.13	95.16	85.48	81.51	93.05	70.96	76.87	87.20
	Chord Stiffness [Msi]	CTA (-67°F)			1.333						
		RTA (75°F)			1.539			1.032			1.252
		ETW1 (180°F)			1.159			0.9103			1.161
		ETW2 (225°F)			1.128			0.8793			1.098
		ETW3 (250°F)			1.148			0.8791			1.069
CAI	Strength [ksi]	RTA (75°F)	42.28	41.67	46.44						
		ETA2 (225°F)	34.99	29.10	38.40						
		ETW1 (180°F)	27.26	32.51	37.28						
		ETW2 (225°F)	28.73	28.05	32.50						

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

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

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

All individual specimen results are graphed for each test by batch and environmental condition with a line indicating the recommended basis values for each environmental condition. The data is jittered (moved slightly to the left or right) 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. For B-basis values to be computed using the ANOVA method, data from five batches are required. Since this qualification dataset consists of four batches or less, the basis values computed using ANOVA are considered estimates. 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-17-1H section 8.4.4.

4.1 Warp Tension (WT)

The WT data is normalized, so both normalized and as-measured results were provided. Testing was done in five environmental conditions: CTA, RTA, ETA3, ETW1 and ETW2.

The results were identical for the normalized and the as-measured datasets. The ETA3 condition failed the ADK test for batch equivalency. ANOVA was used to compute estimates for that condition. The remaining conditions met all the requirements for pooling. Applying the modified CV, there were no diagnostic test failures, therefore all conditions were pooled.

There was one statistical outlier. The lowest value in batch C of the RTA condition was a condition outlier for both the normalized and as-measures datasets. It was retained for this analysis.

Statistics, estimates and basis values are given for the WT strength data in Table 4-1 and Table 4-3 and statistics for modulus in Table 4-3 and Table 4-4. The normalized data, B-estimates and B-basis values are shown graphically in Figure 4-1.

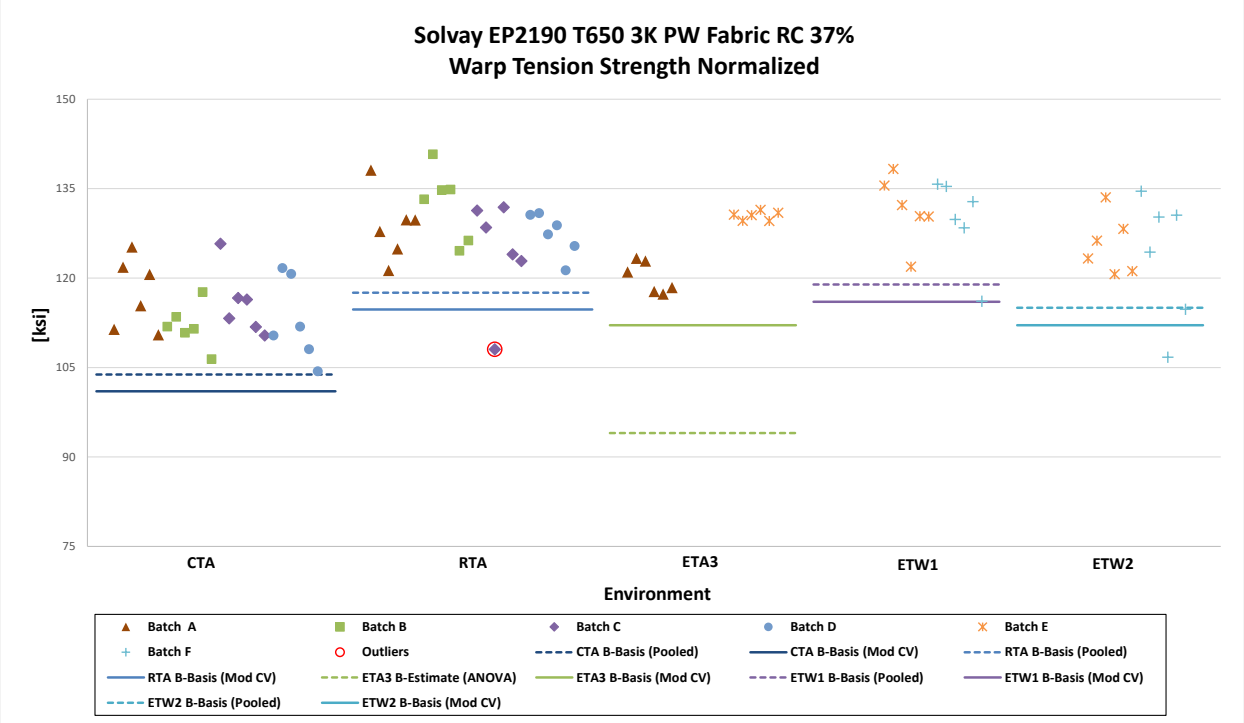

Figure 4-1: Batch Plot for WT Normalized Strength

Normalized Warp Tension (WT) Basis Values and Statistics					
Environment	CTA	RTA	ETA3	ETW1	ETW2
Mean	114.5	128.2	126.0	129.9	126.0
Stdev	5.737	6.575	5.424	5.484	7.469
CV	5.009	5.128	4.305	4.221	5.928
Mod CV	6.505	6.564	6.152	6.111	6.964
Min	104.4	108.1	117.3	116.1	106.7
Max	125.8	140.8	133.0	138.3	135.6
No. Batches	4	4	3	3	3
No. Spec.	24	24	18	18	18
Basis Values and Estimates					
B-Basis Value	103.8	117.5		118.9	115.0
B-Estimate			94.02		
A-Estimate	96.59	110.3	71.21	111.7	107.8
Method	Pooled	Pooled	ANOVA	Pooled	Pooled
Modified CV Basis Values and Estimates					
B-Basis Value	101.0	114.7	112.1	116.0	112.1
A-Estimate	91.92	105.6	103.1	107.0	103.1
Method	Pooled	Pooled	Pooled	Pooled	Pooled

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

As-Measured Warp Tension (WT) Basis Values and Statistics					
Environment	CTA	RTA	ETA3	ETW1	ETW2
Mean	113.0	126.3	124.2	128.6	124.7
Stdev	5.935	6.158	5.394	5.736	7.857
CV	5.251	4.875	4.343	4.459	6.300
Mod CV	6.626	6.437	6.172	6.230	7.150
Min	103.2	107.1	114.7	116.8	107.6
Max	125.0	136.1	133.5	136.4	136.0
No. Batches	4	4	3	3	3
No. Spec.	24	24	18	18	18
Basis Values and Estimates					
B-Basis Value	102.2	115.5		117.5	113.6
B-Estimate			92.41		
A-Estimate	94.87	108.2	69.72	110.2	106.3
Method	Pooled	Pooled	ANOVA	Pooled	Pooled
Modified CV Basis Values and Estimates					
B-Basis Value	99.58	112.9	110.4	114.8	110.9
A-Estimate	90.52	103.8	101.4	105.8	101.9
Method	Pooled	Pooled	Pooled	Pooled	Pooled

Table 4-2: Statistics and Basis Values for WT As-measured Strength Data

Normalized Warp Tension (WT) Modulus Statistics					
Environment	CTA	RTA	ETA3	ETW1	ETW2
Mean	9.586	9.539	9.780	9.724	9.525
Stdev	0.09569	0.09145	0.2636	0.08082	0.1411
CV	0.9982	0.9588	2.695	0.8311	1.482
Min	9.420	9.331	9.511	9.577	9.320
Max	9.803	9.751	10.45	9.905	9.765
No. Batches	4	4	3	3	3
No. Spec.	24	24	18	18	18

Table 4-3: Statistics for WT Normalized Modulus Data

As-Measured Warp Tension (WT) Modulus Statistics					
Environment	CTA	RTA	ETA3	ETW1	ETW2
Mean	9.460	9.399	9.641	9.629	9.427
Stdev	0.1660	0.1142	0.2754	0.2193	0.2422
CV	1.754	1.215	2.857	2.277	2.569
Min	9.227	9.228	9.309	9.228	9.038
Max	9.803	9.610	10.29	9.968	9.815
No. Batches	4	4	3	3	3
No. Spec.	24	24	18	18	18

Table 4-4: Statistics for WT As-measured Modulus Data

4.2 Fill Tension (FT)

The FT data is normalized, so both normalized and as-measured results were provided. Testing was done in five environmental conditions: CTA, RTA, ETA3, ETW1 and ETW3.

For the normalized dataset, the CTA and ETW2 conditions failed the ADK test for batch equivalency. ANOVA was used to compute estimates for those conditions. The RTA and ETW1 conditions met all the requirements for pooling and the single point normal method was used for ETA3. Applying the modified CV, there were no diagnostic test failures, therefore all conditions were pooled.

For the as-measured dataset, the CTA, ETW1, and ETW2 conditions failed the ADK test for batch equivalency. ANOVA was used to compute estimates for those conditions. The single point normal method was used for RTA and ETA3. Applying the modified CV, ETW2 failed the ADK test, therefore basis values were not computed for ETW2. The normal method for modified CV was used for ETA3, and the remaining conditions met all the requirements for pooling.

There were no statistical outliers.

Statistics, estimates and basis values are given for the FT strength data in Table 4-5 and Table 4-6 for the FT modulus data in Table 4-7 and Table 4-8. The normalized data, B-estimates and the B-basis values are shown graphically in Figure 4-2.

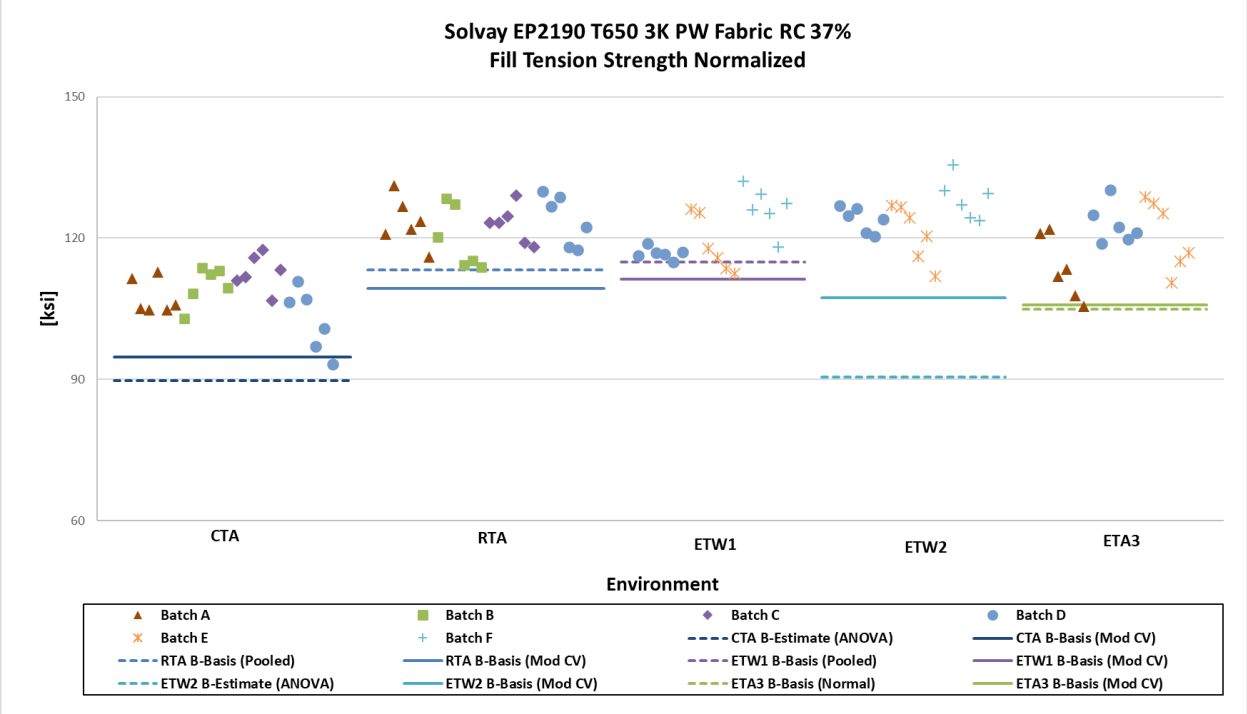

Figure 4-2: Batch Plot for FT Normalized Strength

Normalized Fill Tension (FT) Basis Values and Statistics					
Environment	CTA	RTA	ETW1	ETW2	ETA3
Mean	108.2	122.5	124.4	120.5	119.0
Stdev	5.829	5.239	5.316	5.976	7.187
CV	5.390	4.276	4.273	4.958	6.038
Mod CV	6.695	6.138	6.136	6.479	7.019
Min	93.24	113.9	111.8	112.5	105.4
Max	117.5	131.2	135.5	132.1	130.3
No. Batches	4	4	3	3	3
No. Spec.	24	24	18	18	18
Basis Values and Estimates					
B-Basis Value		113.3	114.9		104.8
B-Estimate	89.75			90.43	
A-Estimate	76.89	106.8	108.5	68.96	94.79
Method	ANOVA	Pooled	Pooled	ANOVA	Normal
Modified CV Basis Values and Estimates					
B-Basis Value	95.30	109.7	111.2	107.3	105.8
A-Estimate	86.64	101.0	102.6	98.71	97.19
Method	Pooled	Pooled	Pooled	Pooled	Pooled

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

As-Measured Fill Tension (FT) Basis Values and Statistics					
Environment	CTA	RTA	ETW1	ETW2	ETA3
Mean	106.8	121.0	122.9	119.0	116.8
Stdev	5.903	5.272	6.344	6.804	7.659
CV	5.528	4.355	5.162	5.717	6.558
Mod CV	6.764	6.178	6.581	6.858	7.279
Min	91.96	111.4	108.1	109.0	103.7
Max	116.3	129.1	135.5	133.1	129.9
No. Batches	4	4	3	3	3
No. Spec.	24	24	18	18	18
Basis Values and Estimates					
B-Basis Value		111.3			101.7
B-Estimate	88.74		91.51	82.35	
A-Estimate	76.12	104.3	69.13	56.19	90.95
Method	ANOVA	Normal	ANOVA	ANOVA	Normal
Modified CV Basis Values and Estimates					
B-Basis Value	93.89	108.2	109.7	NA	100.0
A-Estimate	85.08	99.36	100.9		88.11
Method	Pooled	Pooled	Pooled		Normal

Table 4-6: Statistics and Basis Values for FT As-measured Strength

Normalized Fill Tension (FT) Modulus Statistics					
Environment	CTA	RTA	ETA3	ETW1	ETW2
Mean	9.528	9.394	9.833	9.731	9.541
Stdev	0.1449	0.1883	0.3085	0.1256	0.1846
CV	1.521	2.004	3.138	1.290	1.935
Min	9.301	9.129	9.417	9.518	9.156
Max	9.787	9.806	10.40	9.968	9.910
No. Batches	4	4	3	3	3
No. Spec.	24	24	18	18	18

Table 4-7: Statistics for FT Normalized Modulus Data

As-Measured Fill Tension (FT) Modulus Statistics					
Environment	CTA	RTA	ETA3	ETW1	ETW2
Mean	9.407	9.283	9.647	9.608	9.417
Stdev	0.1927	0.2406	0.3609	0.1919	0.2295
CV	2.048	2.592	3.742	1.997	2.437
Min	9.105	8.871	9.131	9.296	9.064
Max	9.744	9.708	10.23	9.930	9.798
No. Batches	4	4	3	3	3
No. Spec.	24	24	18	18	18

Table 4-8: Statistics for FT As-measured Modulus Data

4.3 Warp Compression (WC)

The WC data is normalized, so both normalized and as-measured results were provided. Testing was done in seven environmental conditions: CTA, RTA, ETA2, ETA3, ETW1, ETW2, and ETW3. The ETA2 condition tested specimens from one batch of material, so only basis value estimates were provided for that condition.

For the normalized dataset, the CTA, RTA, and ETW3 conditions failed the ADK test for batch equivalency. ANOVA was used to compute estimates for those conditions. The ETA3 condition failed all the distributions tests, therefore the single point non-parametric approach was used for ETA3, and the single point normal method was used for the remaining conditions. Applying the modified CV, CTA, RTA and ETA3 failed the ADK test, therefore basis values were not computed for those conditions. The normal method for modified CV was used for the remaining conditions.

For the as-measured dataset, the CTA, RTA, ETA3, ETW1, and ETW3 conditions failed the ADK test for batch equivalency. ANOVA was used to compute estimates for those conditions. The single point normal method was used for ETA2 and ETW2. Applying the modified CV, the CTA, RTA, ETA3, ETW1, and ETW3 conditions failed the ADK test, therefore basis values were not computed for those conditions and the normal method for modified CV was used for ETA2 and ETW2.

There were three statistical outliers. The lowest value in batch B of the CTA condition was a batch outlier for the normalized dataset. The highest value in batch A of the ETA3 condition was a batch outlier for both the normalized and as-measured datasets. The lowest value in batch E of the ETW2 condition was a batch outlier for both the normalized and as-measured datasets. They were retained for this analysis.

Statistics, basis values and estimates are given for the WC strength data in Table 4-9 and Table 4-10 and for the WC modulus data in Table 4-11 and Table 4-12. The normalized data, B-estimates and B-basis values are shown graphically in Figure 4-3 and Figure 4-4.

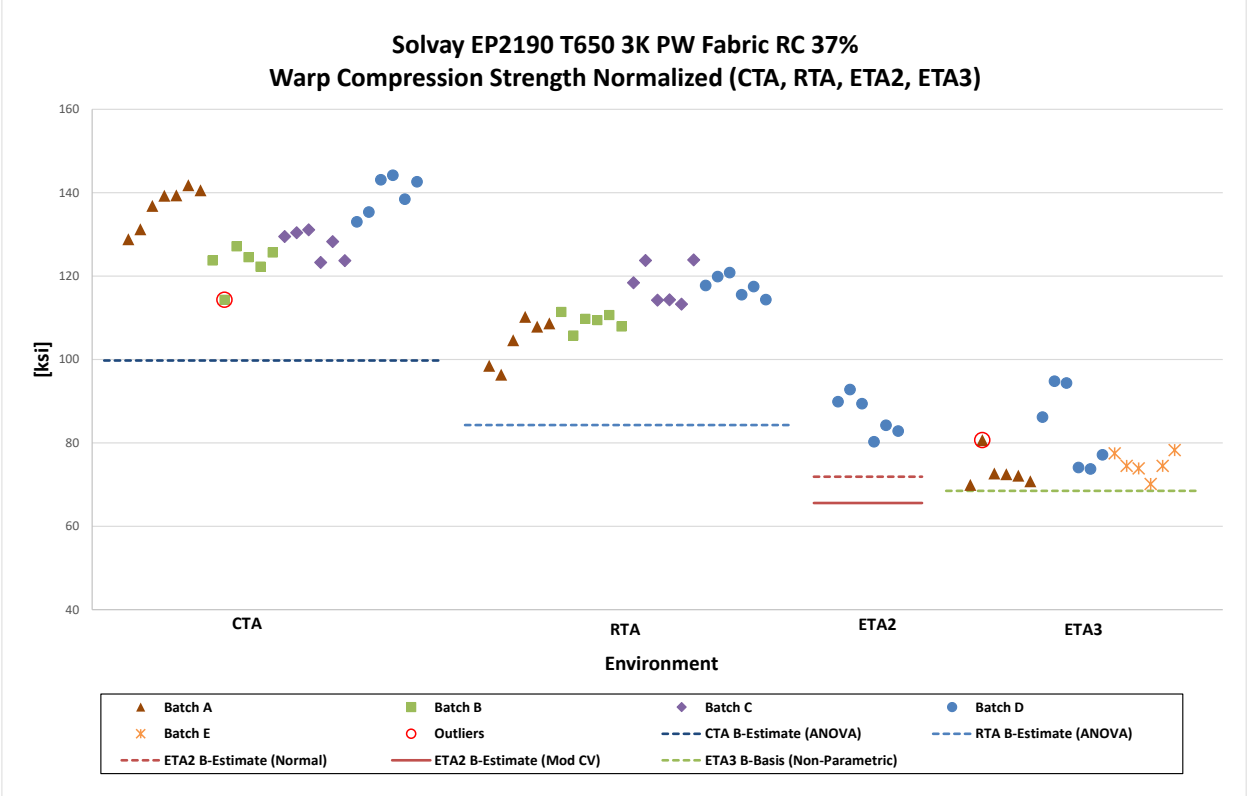

Figure 4-3: Batch Plot for WC Normalized Strength (CTA, RTA, ETA2, ETA3)

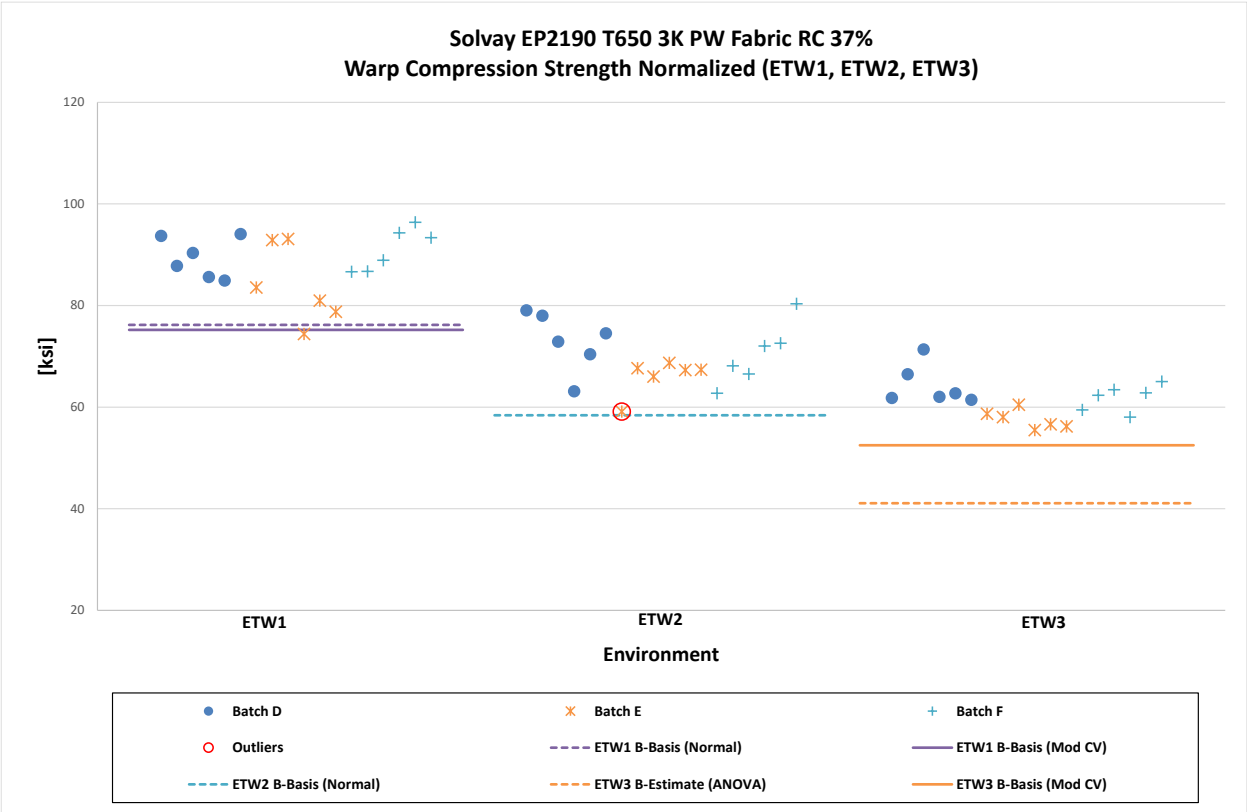

Figure 4-4: Batch Plot for WC Normalized Strength (ETW1, ETW2, ETW3)

Normalized Warp Compression (WC) Basis Values and Statistics							
Environment	CTA	RTA	ETA2	ETA3	ETW1	ETW2	ETW3
Mean	131.9	112.3	86.55	77.09	88.13	69.80	61.24
Stdev	7.939	7.020	4.837	7.503	6.049	5.762	3.965
CV	6.017	6.252	5.588	9.733	6.865	8.256	6.475
Mod CV	7.008	7.126	8.000	9.733	7.432	8.256	7.237
Min	114.3	96.36	80.24	69.91	74.38	59.10	55.46
Max	144.2	123.9	92.77	94.78	96.35	80.34	71.36
No. Batches	4	4	1	3	3	3	3
No. Spec.	25	24	6	18	18	18	18
Basis Values and Estimates							
B-Basis Value				68.49	76.18	58.42	
B-Estimate	99.75	84.27	71.90				41.08
A-Estimate	77.40	64.82	61.49	44.33	67.72	50.36	26.70
Method	ANOVA	ANOVA	Normal	Non-Parm.	Normal	Normal	ANOVA
Modified CV Basis Values and Estimates							
B-Basis Value	NA	NA		NA	75.19	58.42	52.49
B-Estimate			65.58				
A-Estimate			50.67		66.03	50.36	46.29
Method			Normal		Normal	Normal	Normal

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

As Measured Warp Compression (WC) Basis Values and Statistics							
Environment	CTA	RTA	ETA2	ETA3	ETW1	ETW2	ETW3
Mean	130.3	110.7	85.90	75.82	87.99	69.20	60.98
Stdev	8.394	7.470	5.103	8.008	7.434	6.323	4.949
CV	6.441	6.750	5.940	10.56	8.449	9.137	8.115
Mod CV	7.221	7.375	8.000	10.56	8.449	9.137	8.115
Min	111.9	94.64	79.30	68.20	72.26	56.94	52.75
Max	142.9	122.0	92.40	94.78	99.91	81.44	71.76
No. Batches	4	4	1	3	3	3	3
No. Spec.	25	24	6	18	18	18	18
Basis Values and Estimates							
B-Basis Value						56.72	
B-Estimate	95.56	80.09	70.44	39.17	50.24		33.01
A-Estimate	71.44	58.87	59.45	13.05	23.32	47.87	13.05
Method	ANOVA	ANOVA	Normal	ANOVA	ANOVA	Normal	ANOVA
Modified CV Basis Values and Estimates							
B-Basis Value	NA	NA		NA	NA	56.72	NA
B-Estimate			65.09				
A-Estimate			50.28			47.87	
Method			Normal			Normal	

Table 4-10: Statistics and Basis Values for WC As-Measured Strength Data

Normalized Warp Compression (WC) Modulus Statistics							
Environment	CTA	RTA	ETA2	ETA3	ETW1	ETW2	ETW3
Mean	8.598	8.677	8.981	8.770	9.100	8.979	8.812
Stdev	0.1819	0.2156	0.03070	0.2891	0.08764	0.09043	0.1310
CV	2.116	2.484	0.3418	3.297	0.9630	1.007	1.487
Min	8.326	8.235	8.948	8.099	8.843	8.856	8.584
Max	8.961	8.987	9.033	9.107	9.263	9.199	9.063
No. Batches	4	4	1	3	3	3	3
No. Spec.	24	24	6	18	18	18	18

Table 4-11: Statistics from WC Normalized Modulus Data

As-Measured Warp Compression (WC) Modulus Statistics							
Environment	CTA	RTA	ETA2	ETA3	ETW1	ETW2	ETW3
Mean	8.508	8.563	8.979	8.633	9.098	8.915	8.779
Stdev	0.2376	0.2805	0.07154	0.3141	0.2077	0.2155	0.1446
CV	2.792	3.275	0.7967	3.638	2.283	2.418	1.647
Min	8.146	7.989	8.889	7.985	8.837	8.605	8.395
Max	8.971	9.042	9.062	9.035	9.589	9.302	8.989
No. Batches	4	4	1	3	3	3	3
No. Spec.	24	24	6	18	18	18	18

Table 4-12: Statistics for WC As-Measured Modulus Data

4.4 Fill Compression (FC)

The FC data is normalized, so both normalized and as-measured results were provided. Testing was done in six environmental conditions: CTA, RTA, ETA2, ETA3, ETW1 and ETW2. The ETA2 condition tested specimens from one batch of material, so only basis value estimates were provided for that condition.

For the normalized dataset, the CTA, RTA, and ETA3 conditions failed the ADK test for batch equivalency. ANOVA was used to compute estimates for those conditions. The single point normal method was used for the remaining conditions. Applying the modified CV, the CTA and ETA3 conditions failed the ADK test, therefore basis values were not computed for those conditions. RTA and ETW1 met all requirements for pooling and the normal method for modified CV was used for ETA2 and ETW2.

For the as-measured dataset, the CTA, RTA, ETA3, and ETW2 conditions failed the ADK test for batch equivalency. ANOVA was used to compute estimates for those conditions. The single point normal method was used for ETA2 and ETW1. Applying the modified CV, the CTA, ETA3, and ETW2 conditions failed the ADK test, therefore basis values were not computed for those conditions. RTA and ETW1 met all requirements for pooling and the normal method was used for ETA2.

There was one statistical outlier. The lowest value in batch F of the ETW2 condition was a batch outlier for both the normalized and as-measured datasets. It was retained for this analysis.

Statistics, basis values and estimates are given for the FC strength data in Table 4-13 and Table 4-14 and for the FC modulus data in Table 4-15 and Table 4-16. The normalized data and B-basis values are shown graphically in Figure 4-5 and Figure 4-6.

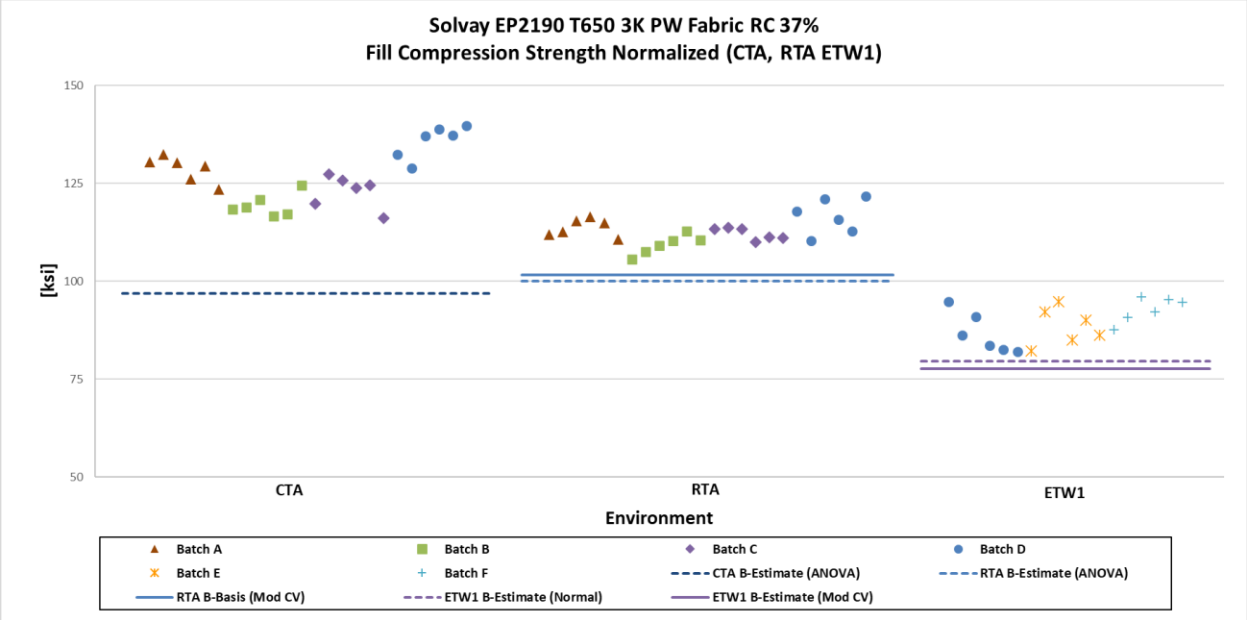

Figure 4-5: Batch Plot for FC Normalized Strength (CTA, RTA, ETW1)

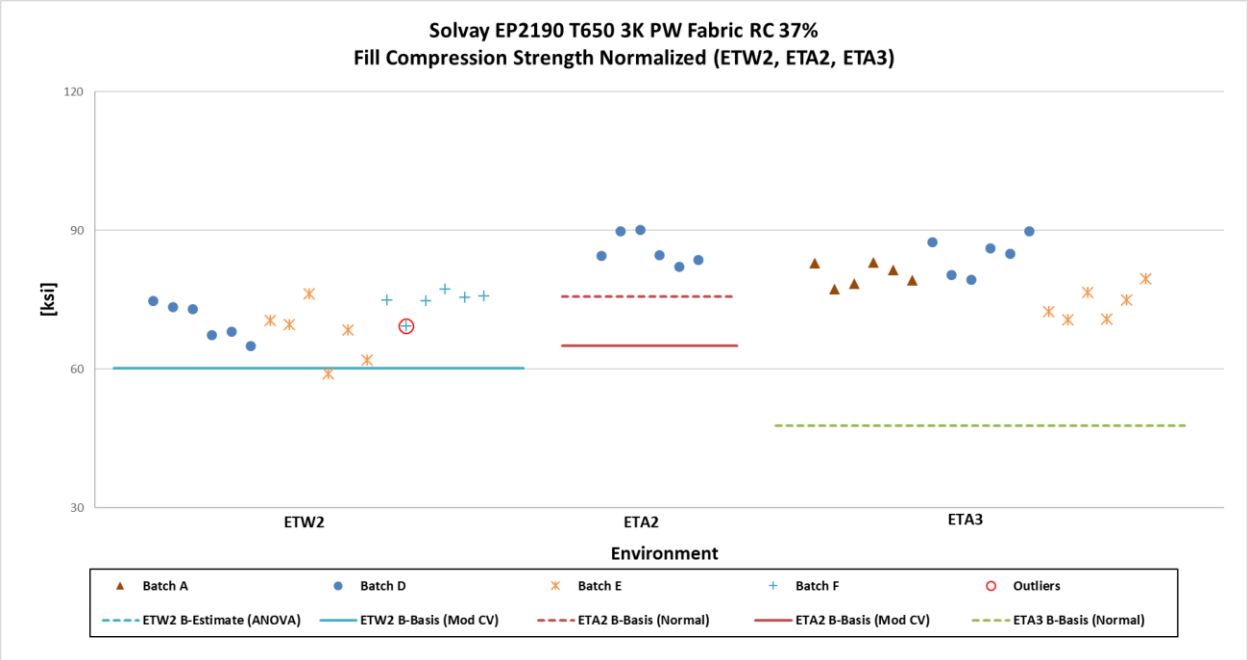

Figure 4-6: Batch Plot for FC Normalized Strength (ETW2, ETA2, ETA3)

Normalized Fill Compression (FC) Basis Values and Statistics						
Environment	**CTA**	**RTA**	**ETW1**	**ETW2**	**ETA2**	**ETA3**
Mean	126.6	112.9	89.29	70.85	85.82	79.75
Stdev	7.171	3.818	4.917	5.183	3.358	5.500
CV	5.662	3.382	5.507	7.316	3.912	6.897
Mod CV	6.831	6.000	6.754	7.658	8.000	7.449
Min	116.1	105.7	82.09	59.01	82.12	70.61
Max	139.8	121.7	95.98	77.25	90.17	89.81
No. Batches	4	4	3	3	1	3
No. Spec.	24	24	18	18	6	18
Basis Values and Estimates						
B-Basis Value			79.58	60.62		
B-Estimate	96.81	99.98			75.65	47.73
A-Estimate	76.11	90.97	72.70	53.37	68.42	24.89
Method	ANOVA	ANOVA	Normal	Normal	Normal	ANOVA
Modified CV Basis Values and Estimates						
B-Basis Value	NA	101.6	77.65	60.14		NA
B-Estimate					65.02	
A-Estimate		93.64	69.80	52.55	50.24	
Method		Pooled	Pooled	Normal	Normal	

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

As-Measured Fill Compression (FC) Basis Values and Statistics						
Environment	CTA	RTA	ETW1	ETW2	ETA2	ETA3
Mean	124.7	111.2	88.10	69.89	85.27	78.88
Stdev	8.046	4.430	5.284	5.597	3.278	6.316
CV	6.451	3.985	5.998	8.009	3.844	8.008
Mod CV	7.225	6.000	6.999	8.009	8.000	8.008
Min	112.6	102.5	78.90	57.38	81.67	68.13
Max	139.3	120.9	95.12	77.13	89.39	88.69
No. Batches	4	4	3	3	1	3
No. Spec.	24	24	18	18	6	18
Basis Values and Estimates						
B-Basis Value			77.66			
B-Estimate	90.42	94.37		42.32	75.34	39.47
A-Estimate	66.63	82.70	70.27	22.65	68.28	11.34
Method	ANOVA	ANOVA	Normal	ANOVA	Normal	ANOVA
Modified CV Basis Values and Estimates						
B-Basis Value	NA	99.83	76.48	NA		NA
B-Estimate					64.60	
A-Estimate		91.92	68.64		49.91	
Method		Pooled	Pooled		Normal	

Table 4-14: Statistics and Basis Values for FC As-Measured Strength Data

Normalized Fill Compression (FC) Modulus Statistics						
Environment	CTA	RTA	ETA2	ETA3	ETW1	ETW2
Mean	8.480	8.552	8.796	8.719	9.058	8.905
Stdev	0.2246	0.2737	0.1461	0.4231	0.1729	0.2291
CV	2.649	3.200	1.661	4.853	1.909	2.572
Min	8.083	8.102	8.617	7.703	8.804	8.553
Max	8.942	9.133	8.949	9.142	9.312	9.301
No. Batches	4	4	1	3	3	3
No. Spec.	24	24	6	18	18	18

Table 4-15: Statistics for FC Normalized Modulus Data

As-Measured Fill Compression (FC) Modulus Statistics						
Environment	CTA	RTA	ETA2	ETA3	ETW1	ETW2
Mean	8.419	8.485	8.802	8.616	8.938	8.804
Stdev	0.2694	0.3503	0.09497	0.3922	0.09846	0.1391
CV	3.200	4.129	1.079	4.552	1.102	1.580
Min	7.982	7.794	8.672	7.619	8.818	8.587
Max	8.900	9.083	8.900	9.015	9.105	8.990
No. Batches	4	4	1	3	3	3
No. Spec.	24	24	6	18	18	18

Table 4-16: Statistics for FC As-Measured Modulus Data

4.5 Lamina Short-Beam Strength (SBS)

The Short Beam Strength data is not normalized. Testing was done in seven environmental conditions: CTA, RTA, ETA2, ETA3, ETW1, ETW2, and ETW3. The CTA condition tested specimens from two batches of material and the ETA2 condition had data available from one batch, so only basis value estimates were provided for those three conditions.

The ETA3 and ETW1 conditions failed the ADK test for batch equivalency. ANOVA was used to compute estimates for those conditions. The ETW2 conditions failed all the distributions tests, therefore the single point non-parametric method was used for ETW2, and the single point normal method was used for the remaining conditions. Applying the modified CV, the RTA condition failed the normality test, therefore basis values were not computed for RTA. The normal method for modified CV was used for the remaining conditions.

There was one statistical outlier. The highest value in batch D of the ETA3 condition was a batch outlier. It was retained for this analysis.

Statistics, basis values and estimates are given for SBS data in Table 4-17. The as-measured data, B-estimates and B-basis values are shown graphically in Figure 4-7 and Figure 4-8.

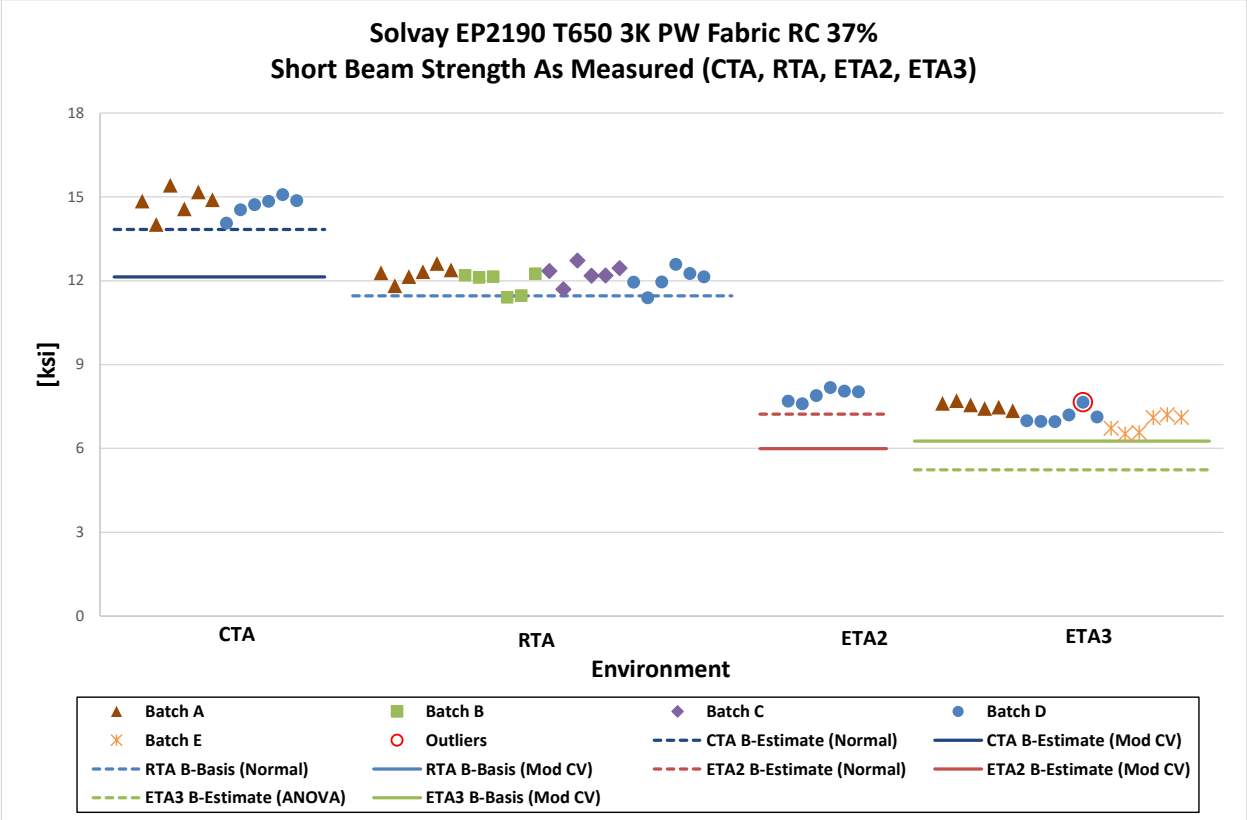

Figure 4-7: Batch Plot for SBS As-Measured (CTA, RTA, ETA2, ETA3)

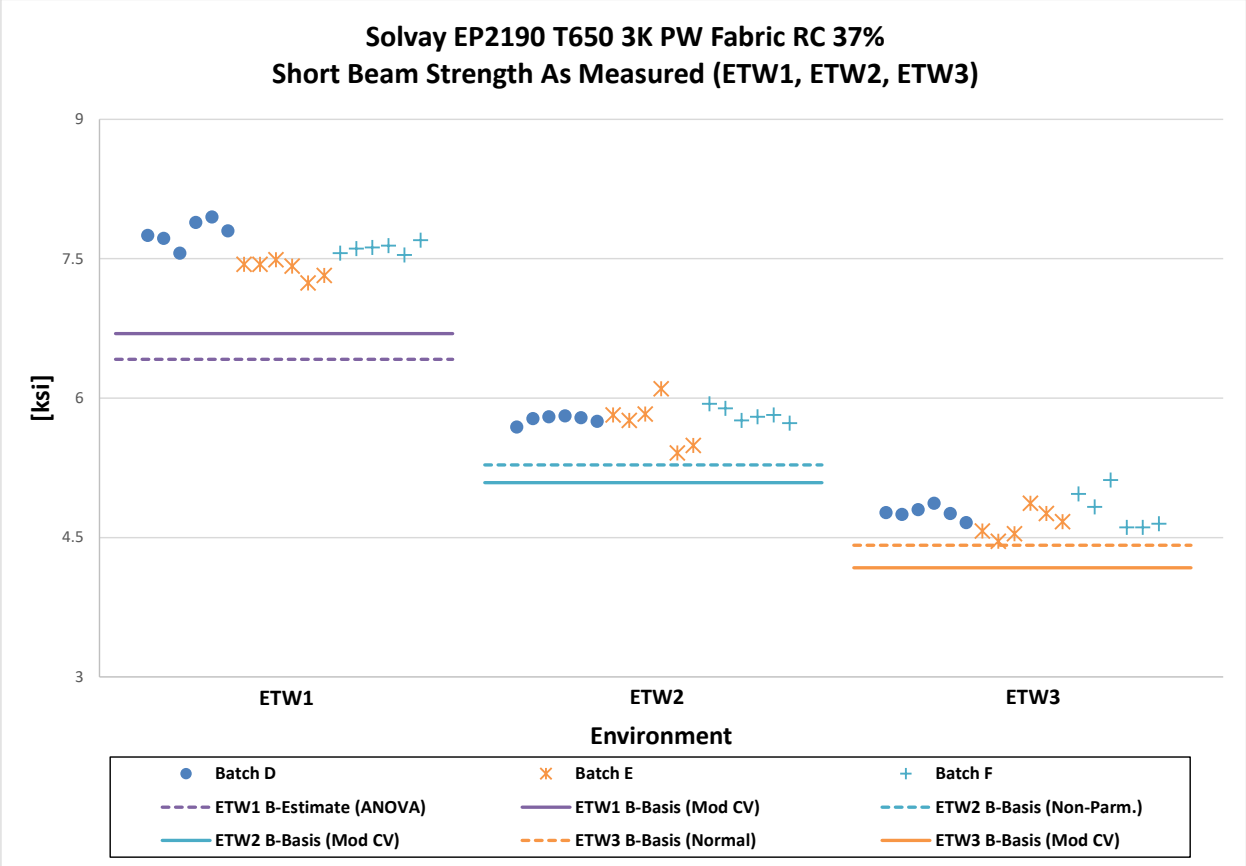

Figure 4-8: Batch Plot for SBS As-Measured (ETW1, ETW2, ETW3)

Short Beam Strength (SBS) As-Measured Basis Values and Statistics							
Environment	CTA	RTA	ETA2	ETA3	ETW1	ETW2	ETW3
Mean	14.75	12.13	7.907	7.182	7.594	5.776	4.737
Stdev	0.4155	0.3595	0.2244	0.3577	0.1887	0.1496	0.1618
CV	2.816	2.964	2.838	4.981	2.485	2.591	3.415
Mod CV	8.000	6.000	8.000	6.491	6.000	6.000	6.000
Min	14.01	11.39	7.600	6.520	7.240	5.410	4.460
Max	15.42	12.72	8.180	7.710	7.950	6.100	5.120
No. Batches	2	4	1	3	3	3	3
No. Spec.	12	24	6	18	18	18	18
Basis Values and Estimates							
B-Basis Value		11.46				5.282	4.418
B-Estimate	13.83		7.227	5.231	6.419		
A-Estimate	13.19	10.98	6.744	3.839	5.580	4.520	4.191
Method	Normal	Normal	Normal	ANOVA	ANOVA	Non-Parm.	Normal
Modified CV Basis Values and Estimates							
B-Basis Value		NA		6.261	6.694	5.092	4.176
B-Estimate	12.14		5.991				
A-Estimate	10.31		4.628	5.609	6.057	4.607	3.778
Method	Normal		Normal	Normal	Normal	Normal	Normal

Table 4-17: Statistics and Basis Values for SBS Data

4.6 0° Flexural (0FLEX)

The 0FLEX data is normalized, so both normalized and as-measured results were provided. Testing was done in four environmental conditions: RTA, ETA2, ETA3, and ETW2. The ETA2 condition tested specimens from one batch of material, so only basis value estimates were provided for that condition.

For the normalized dataset, the normal method was used for all conditions with the non-modified and modified CV.

For the as-measured dataset, the ETA3 and ETW2 conditions failed the ADK test for batch equivalency. ANOVA was used to compute estimates for those conditions. The single point normal method was used for the remaining conditions. Applying the modified CV, the normal method for modified CV was used for all conditions.

There were no statistical outliers.

Statistics, basis values and estimates are given for 0FLEX strength data in Table 4-18 and Table 4-19. The normalized data, B-estimates and B-basis values are shown graphically in Figure 4-9.

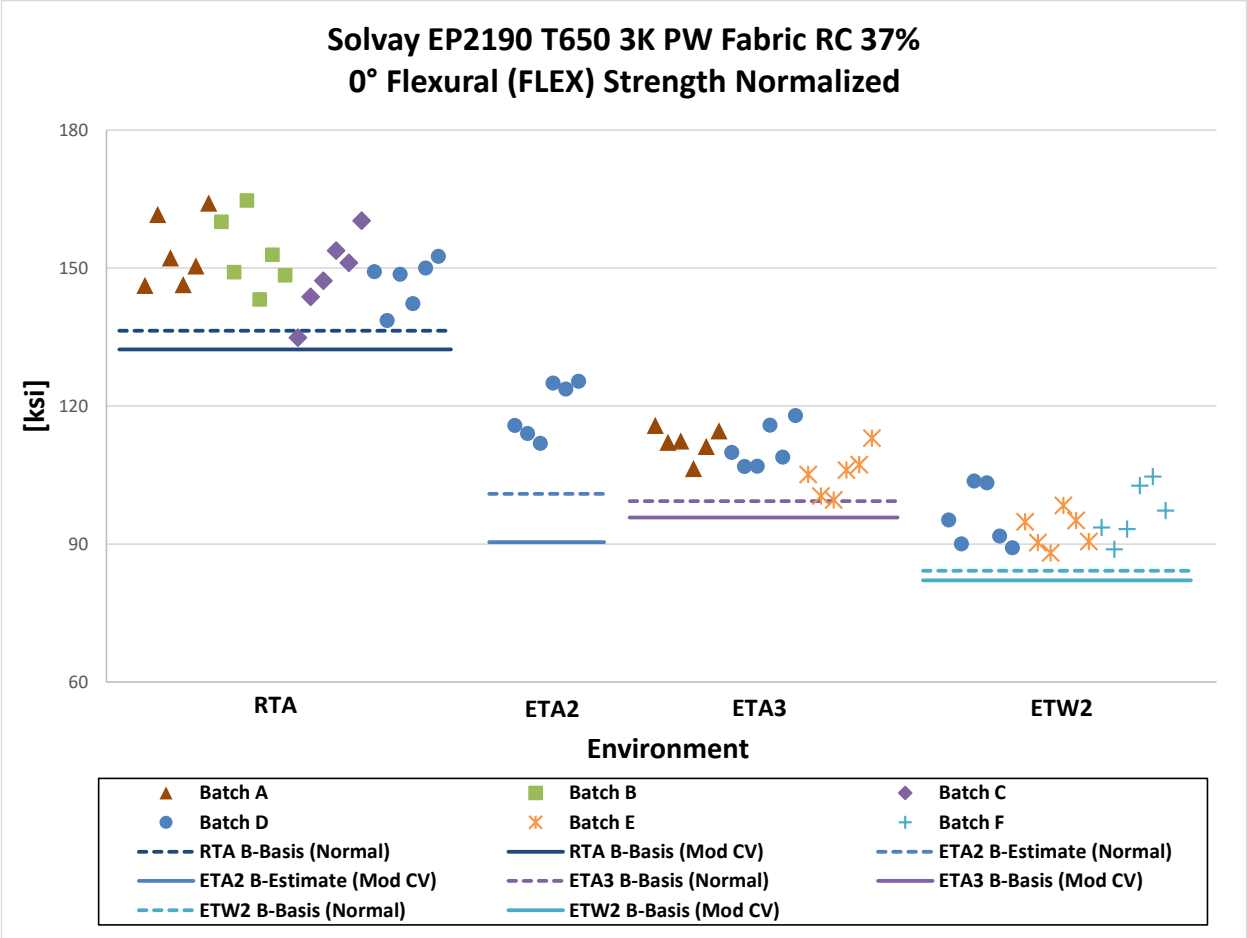

Figure 4-9: Batch plot for 0FLEX normalized strength

Normalized 0° Flexural (0FLEX) Strength Basis Values and Statistics				
Environment	RTA	ETA2	ETA3	ETW2
Mean	150.5	119.3	109.5	95.05
Stdev	7.613	6.063	5.130	5.505
CV	5.059	5.082	4.687	5.792
Mod CV	6.529	8.000	6.343	6.896
Min	134.9	111.9	99.60	88.09
Max	164.7	125.4	117.9	104.7
No. Batches	4	1	3	3
No. Spec.	24	6	18	18
Basis Values and Estimates				
B-Basis Value	136.4		99.34	84.18
B-Estimate		100.9		
A-Estimate	126.3	87.88	92.16	76.48
Method	Normal	Normal	Normal	Normal
Modified CV Basis Values and Estimates				
B-Basis Value	132.3		95.76	82.11
B-Estimate		90.39		
A-Estimate	119.2	69.84	86.04	72.94
Method	Normal	Normal	Normal	Normal

Table 4-18: Statistics and Basis Values for 0FLEX Normalized Strength Data

As-Measured 0° Flexural (0FLEX) Strength Basis Values and Statistics				
Environment	RTA	ETA2	ETA3	ETW2
Mean	148.2	119.9	106.1	93.34
Stdev	7.100	4.730	5.942	6.759
CV	4.790	3.945	5.602	7.242
Mod CV	6.395	8.000	6.801	7.621
Min	132.1	113.6	93.58	82.43
Max	159.3	125.4	116.0	105.9
No. Batches	4	1	3	3
No. Spec.	24	6	18	18
Basis Values and Estimates				
B-Basis Value	135.1			
B-Estimate		105.6	72.19	62.59
A-Estimate	125.6	95.38	48.02	40.67
Method	Normal	Normal	ANOVA	ANOVA
Modified CV Basis Values and Estimates				
B-Basis Value	130.7		91.83	79.30
B-Estimate		90.84		
A-Estimate	118.1	70.18	81.74	69.34
Method	Normal	Normal	Normal	Normal

Table 4-19: Statistics and Basis Values for 0FLEX As-Measured Strength Data

Normalized 0° Flexural (0FLEX) Modulus Statistics				
Environment	RTA	ETA2	ETA3	ETW2
Mean	9.064	8.668	8.662	8.466
Stdev	0.1861	0.2275	0.1677	0.2742
CV	2.053	2.625	1.936	3.239
Min	8.836	8.396	8.456	8.178
Max	9.236	8.932	8.928	9.088
No. Batches	1	1	2	3
No. Spec.	6	6	12	18

Table 4-20: Statistics for 0FLEX Normalized Modulus Data

As Measured 0° Flexural (0FLEX) Modulus Statistics				
Environment	RTA	ETA2	ETA3	ETW2
Mean	9.111	8.713	8.399	8.303
Stdev	0.2809	0.1211	0.2437	0.1721
CV	3.083	1.389	2.902	2.073
Min	8.725	8.563	8.019	8.020
Max	9.364	8.840	8.645	8.632
No. Batches	1	1	2	3
No. Spec.	6	6	12	18

Table 4-21: Statistics for 0FLEX As-Measured Modulus Data

4.7 90° Flexural (90FLEX)

The 90FLEX data is normalized, so both normalized and as-measured results were provided. Testing was done in four environmental conditions: RTA, ETA2, ETA3, and ETW2. The ETA2 condition tested specimens from one batch of material, so only basis value estimates were provided for that condition.

For the normalized dataset, the RTA and ETW2 conditions failed the ADK test for batch equivalency. ANOVA was used to compute estimates for those conditions. The single point normal method was used for ETA2 and ETA3. Applying the modified CV, the RTA condition failed the normality test, therefore basis values could not be computed for that condition. The normal method for modified CV was used for the remaining conditions.

For the as-measured dataset, the ETA3 and ETW2 conditions failed the ADK test for batch equivalency. ANOVA was used to compute estimates for those conditions. The single point normal method was used for RTA and ETA2. Applying the modified CV, the ETW2 condition failed the ADK test, therefore basis values could not be computed for ETW2. The normal method for modified CV was used for the remaining conditions.

There were no statistical outliers.

Statistics, basis values and estimates are given for 90FLEX strength data in Table 4-22 and Table 4-23. The normalized data, B-estimates and B-basis values are shown graphically in Figure 4-10.

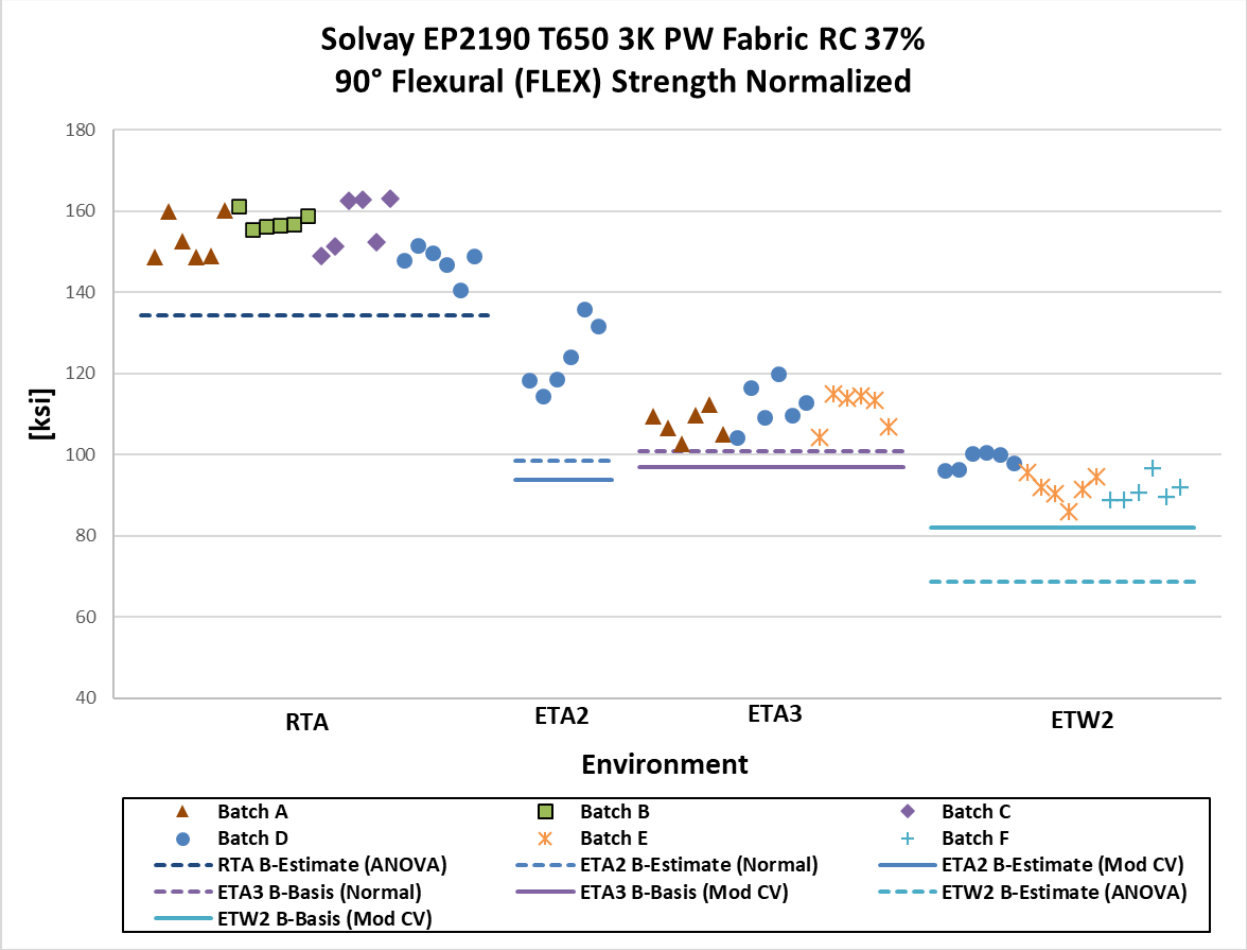

Figure 4-10: Batch Plot for 90FLEX Normalized Strength

Normalized 90° Flexural (90FLEX) Strength Basis Values and Statistics				
Environment	RTA	ETA2	ETA3	ETW2
Mean	153.8	123.9	110.4	93.79
Stdev	6.048	8.388	4.784	4.399
CV	3.931	6.771	4.334	4.691
Mod CV	6.000	8.000	6.167	6.345
Min	140.6	114.5	102.7	86.04
Max	163.2	135.9	120.0	100.5
No. Batches	4	1	3	3
No. Spec.	24	6	18	18
Basis Values and Estimates				
B-Basis Value			100.9	
B-Estimate	134.4	98.47		68.78
A-Estimate	120.7	80.41	94.24	50.93
Method	ANOVA	Normal	Normal	ANOVA
Modified CV Basis Values and Estimates				
B-Basis Value	NA		96.94	82.04
B-Estimate		93.86		
A-Estimate		72.52	87.42	73.71
Method		Normal	Normal	Normal

Table 4-22: Statistics and Basis Values for 90FLEX Normalized Strength Data

As Measured 90° Flexural (90FLEX) Strength Basis Values and Statistics				
Environment	RTA	ETA2	ETA3	ETW2
Mean	151.0	123.9	107.0	92.14
Stdev	5.667	7.586	5.564	5.511
CV	3.754	6.123	5.201	5.981
Mod CV	6.000	8.000	6.601	6.991
Min	142.7	115.0	97.70	83.21
Max	163.9	135.1	118.8	100.8
No. Batches	4	1	3	3
No. Spec.	24	6	18	18
Basis Values and Estimates				
B-Basis Value	140.5			
B-Estimate		100.9	80.95	56.28
A-Estimate	133.0	84.57	62.41	30.68
Method	Normal	Normal	ANOVA	ANOVA
Modified CV Basis Values and Estimates				
B-Basis Value	134.2		93.03	NA
B-Estimate		93.86		
A-Estimate	122.2	72.52	83.15	
Method	Normal	Normal	Normal	

Table 4-23: Statistics and Basis Values for 90FLEX As-Measured Strength Data

Normalized 90° Flexural (90FLEX) Modulus Statistics				
Environment	RTA	ETA2	ETA3	ETW2
Mean	9.278	8.824	8.554	8.481
Stdev	0.1911	0.3998	0.1215	0.3674
CV	2.060	4.531	1.420	4.332
Min	9.017	8.587	8.356	7.717
Max	9.495	9.630	8.775	8.901
No. Batches	1	1	2	3
No. Spec.	6	6	12	18

Table 4-24: Statistics for 90FLEX Normalized Modulus Data

As Measured 90° Flexural (90FLEX) Modulus Statistics				
Environment	RTA	ETA2	ETA3	ETW2
Mean	9.262	8.827	8.280	8.322
Stdev	0.1815	0.3742	0.2847	0.2306
CV	1.959	4.239	3.439	2.771
Min	9.036	8.533	7.845	7.816
Max	9.480	9.569	8.677	8.688
No. Batches	1	1	2	3
No. Spec.	6	6	12	18

Table 4-25: Statistics for 90FLEX As-Measured Modulus Data

4.8 In-Plane Shear (IPS)

In Plane Shear data is not normalized. Testing was done in six environmental conditions: CTA, RTA, ETA3, ETW1, ETW2, and ETW3.

The ETA 3 condition consists of a single batch with six specimens, therefore only estimates were computed for that condition.

For the 0.2% offset strength dataset, the RTA, ETW2, and ETW3 conditions failed the ADK test for batch equivalency. ANOVA was used to compute estimates for these conditions. The CTA condition failed the normality test, but the lognormal distribution was a good fit for the dataset. The single point normal method was used for ETA3 and ETW1.Applying the modified CV, the CTA condition failed normality and the ETW3 condition failed the ADK test, therefore modified CV basis values were not computed for these conditions. The normal method for modified CV was used for the remaining conditions.

For the Strength at 5% Strain dataset, the RTA, ETW2, and ETW3 conditions failed the ADK test for batch equivalency. ANOVA was used to compute estimates for these conditions. The single point normal method was used for CTA, ETA3, and ETW1. Applying the modified CV, the ETW2, and ETW3 conditions failed the ADK test, therefore modified CV basis values could not be computed for those conditions. The normal method for modified CV was used for the remaining conditions.

For the Ultimate Strength dataset, the CTA and RTA conditions failed the ADK test for batch equivalency. ANOVA was used to compute estimates for these conditions. The single point normal method was used for the remaining conditions. Applying the modified CV, the CTA and RTA conditions met all requirements for pooling and the normal method for modified CV was used for the remaining conditions.

There were seven statistical outliers. The highest value in batch B of the CTA condition, the highest value in batch D of the RTA condition and the lowest value in batch F of the ETW3 condition were condition outliers in the 0.2% offset strength dataset. The lowest value in batch C of the CTA condition was a batch outlier for the strength at 5% strain and ultimate strength datasets. The highest value in batch A of the RTA condition was a batch outlier for the strength at 5% strain dataset. The highest value in batch B of the RTA condition was a batch and condition outlier in the ultimate strength dataset. The lowest value in batch D of the ETW1 condition was a condition outlier for the ultimate strength dataset. They were retained for this analysis.

Statistics, basis values and estimates are given for the IPS strength data in Table 4-26, Table 4-27 and Table 4-28, and Modulus data in Table 4-29. The as-measured data, B-basis values and B-estimates are shown graphically for IPS strength data in Figure 4-11 through Figure 4-16.

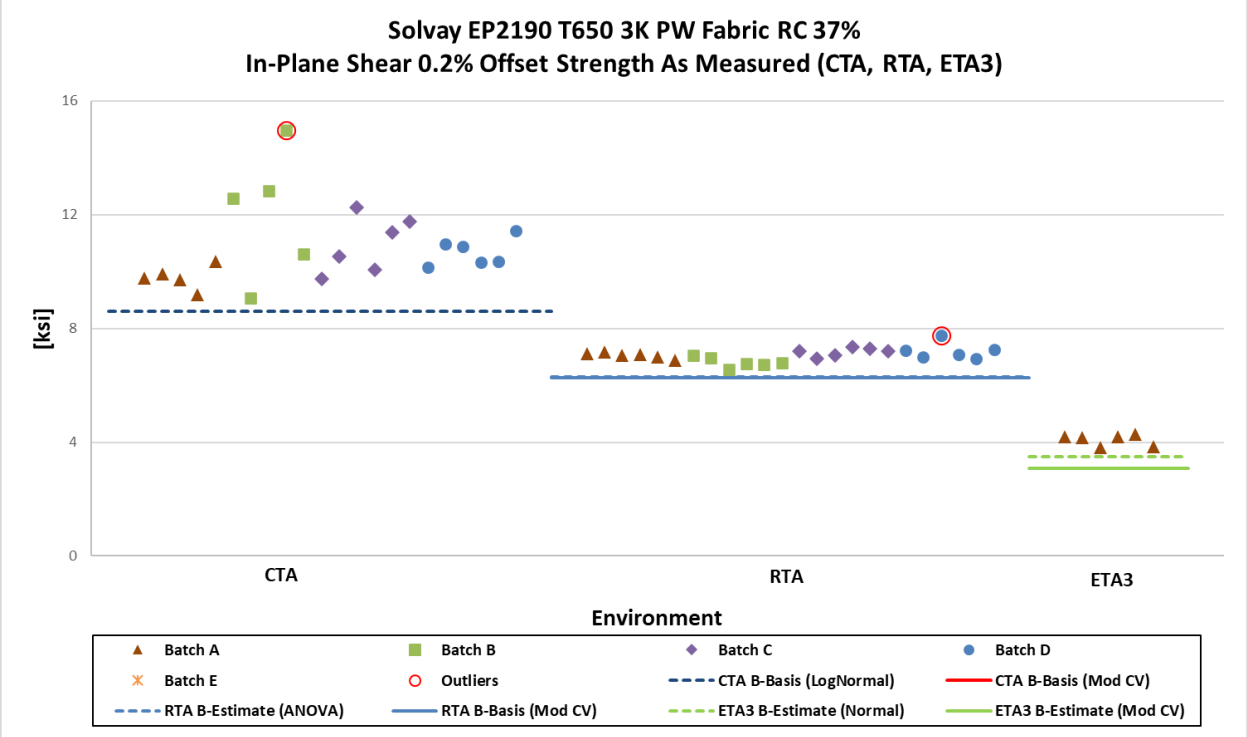

Figure 4-11: Batch Plot for IPS 0.2% Offset Strength As-Measured (CTA, RTA, ETA3)

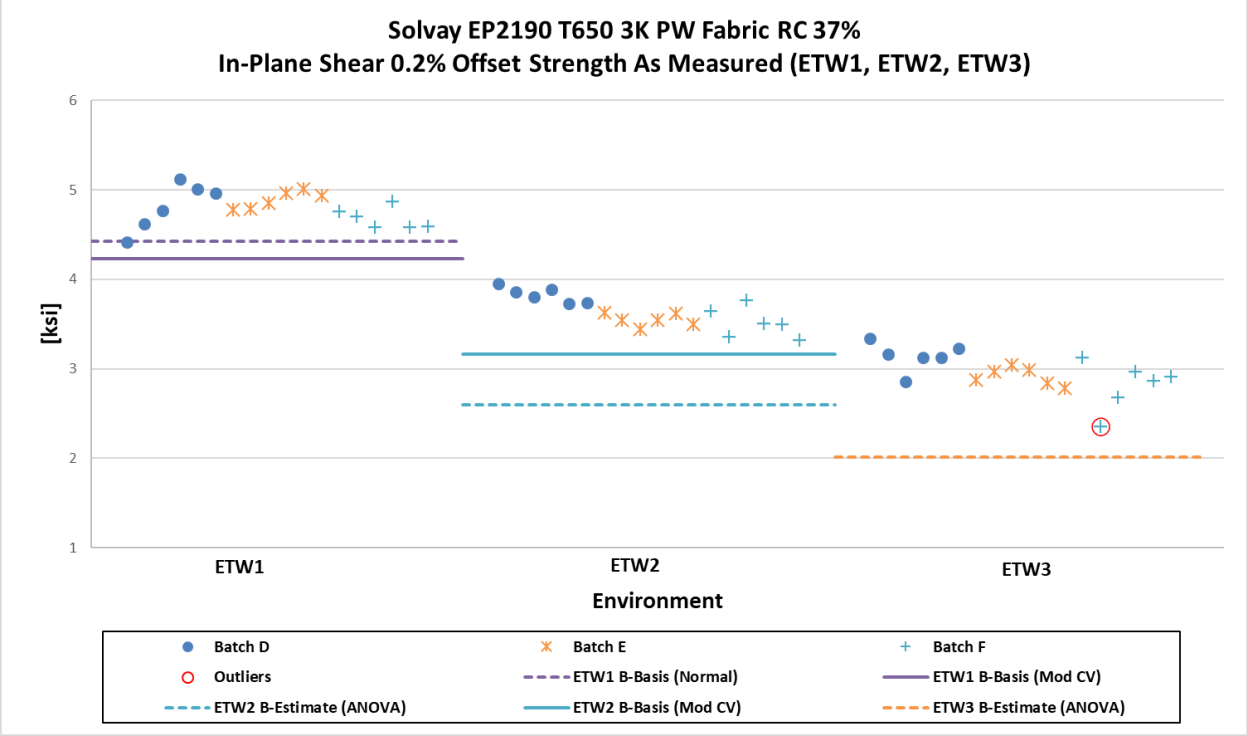

Figure 4-12: Batch Plot for IPS 0.2% Offset Strength As-Measured (ETW1, ETW2, ETW3)

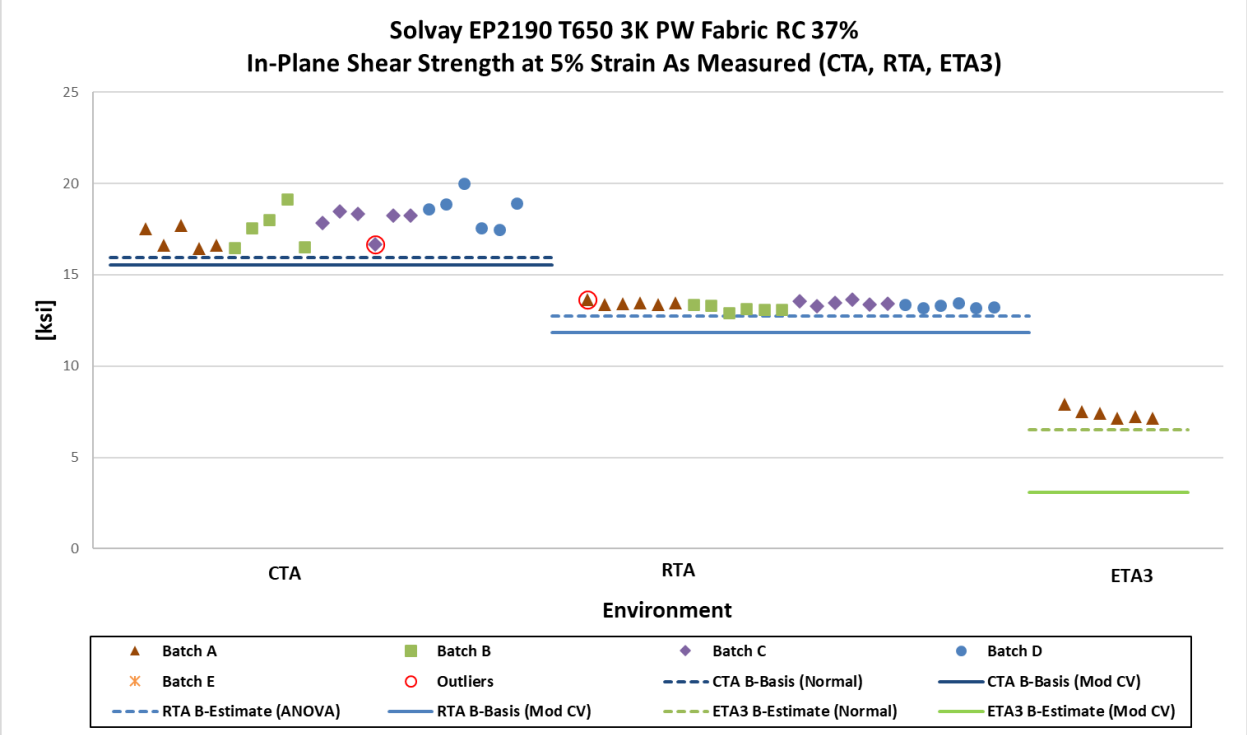

Figure 4-13: Batch Plot for IPS Strength at 5% Strain As-Measured (CTA, RTA, ETA3)

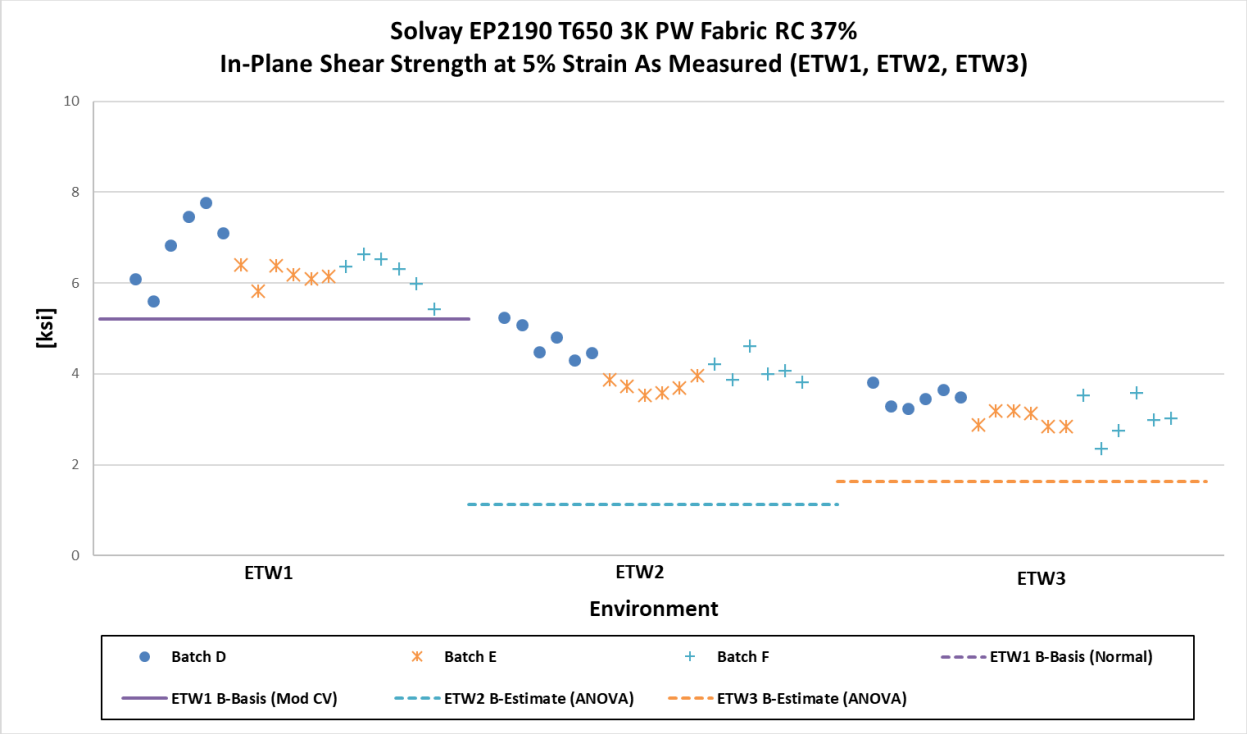

Figure 4-14: Batch Plot for IPS Strength at 5% Strain As-Measured (ETW1, ETW2, ETW3)

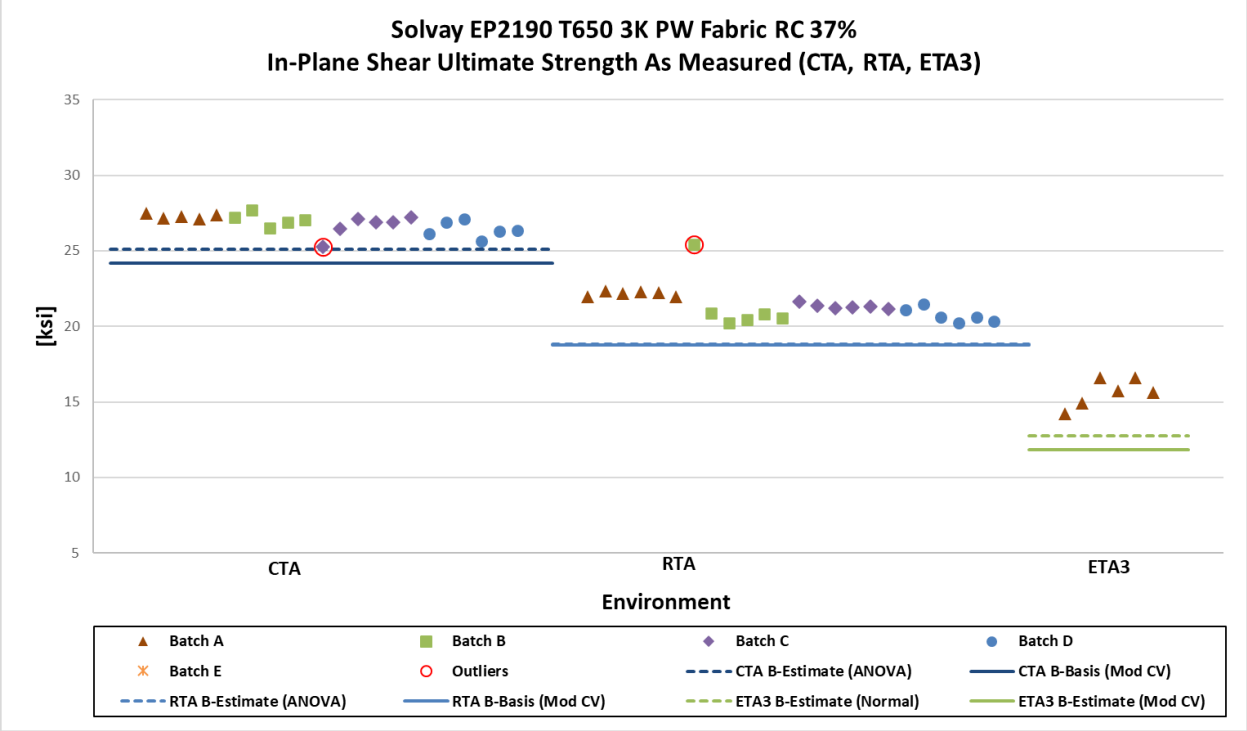

Figure 4-15: Batch Plot for IPS Ultimate Strength As-Measured (CTA, RTA, ETA3)

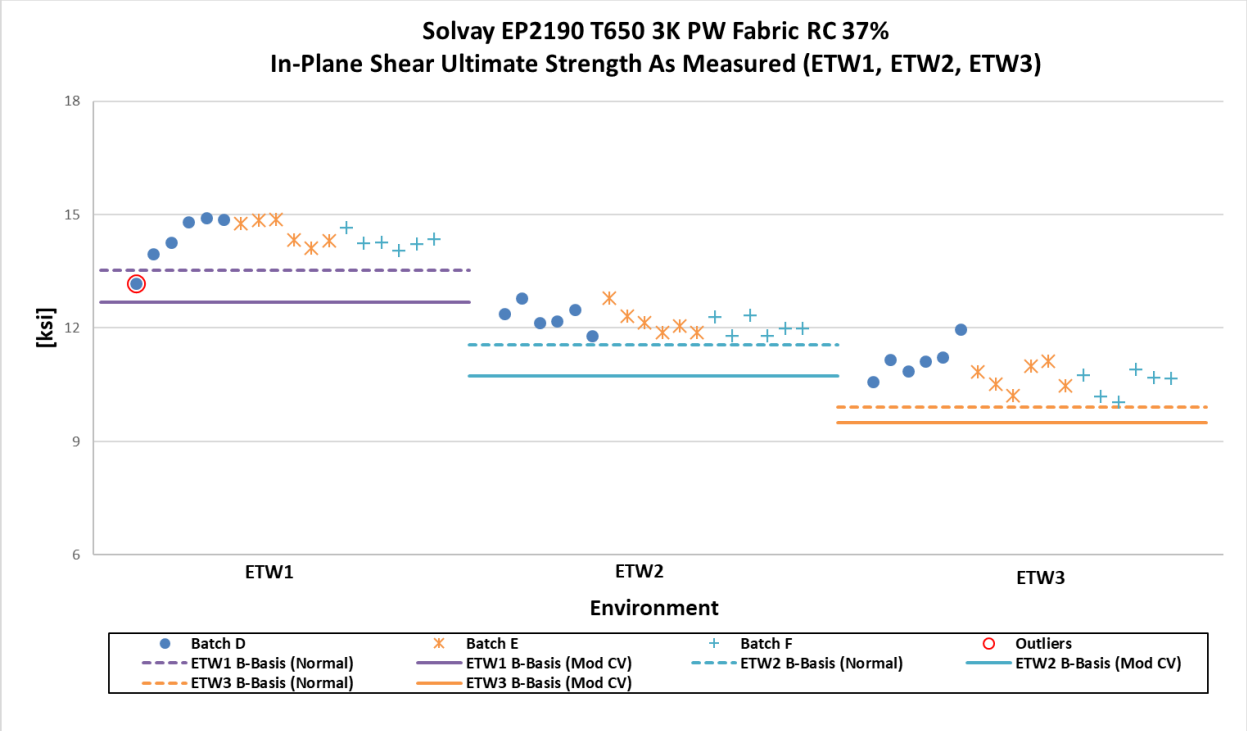

Figure 4-16: Batch Plot for IPS Ultimate Strength As-Measured (ETW1, ETW2, ETW3)

In Plane Shear Strength Basis Values and Statistics						
0.2% Offset Strength						
Environment	CTA	RTA	ETA3	ETW1	ETW2	ETW3
Mean	10.86	7.061	4.083	4.795	3.631	2.959
Stdev	1.378	0.2413	0.1964	0.1877	0.1821	0.2254
CV	12.69	3.417	4.811	3.915	5.015	7.616
Mod CV	12.69	6.000	8.000	6.000	6.507	7.808
Min	9.080	6.550	3.820	4.420	3.320	2.360
Max	14.98	7.750	4.280	5.120	3.950	3.340
No. Batches	4	4	1	3	3	3
No. Spec.	22	24	6	18	18	18
Basis Values and Estimates						
B-Basis Value	8.608			4.424		
B-Estimate		6.300	3.488		2.601	2.011
A-Estimate	7.328	5.767	3.065	4.162	1.867	1.334
Method	Log Normal	ANOVA	Normal	Normal	ANOVA	ANOVA
Modified CV Basis Values and Estimates						
B-Basis Value	NA	6.276		4.227	3.164	NA
B-Estimate			3.094			
A-Estimate		5.714	2.390	3.824	2.834	
Method		Normal	Normal	Normal	Normal	

Table 4-26: Statistics and Basis Values for IPS 0.2% Offset Strength Data

In Plane Shear Strength Basis Values and Statistics						
Strength at 5% Strain						
Environment	CTA	RTA	ETA3	ETW1	ETW2	ETW3
Mean	17.82	13.34	7.388	6.398	4.185	3.182
Stdev	0.9858	0.1726	0.2887	0.6036	0.5049	0.3716
CV	5.533	1.293	3.907	9.434	12.06	11.68
Mod CV	6.767	6.000	8.000	9.434	12.06	11.68
Min	16.46	12.93	7.140	5.430	3.530	2.360
Max	20.01	13.66	7.900	7.770	5.240	3.820
No. Batches	4	4	1	3	3	3
No. Spec.	22	24	6	18	18	18
Basis Values and Estimates						
B-Basis Value	15.96			5.207		
B-Estimate		12.75	6.514		1.129	1.624
A-Estimate	14.63	12.34	5.892	4.362	0.000	0.5141
Method	Normal	ANOVA	Normal	Normal	ANOVA	ANOVA
Modified CV Basis Values and Estimates						
B-Basis Value	15.54	11.86		5.207	NA	NA
			5.598			
A-Estimate	13.92	10.80	4.325	4.362		
Method	Normal	Normal	Normal	Normal		

Table 4-27: Statistics and Basis Values for IPS Strength at 5% Strain Data

In Plane Shear Strength Basis Values and Statistics						
Ultimate Strength						
Environment	CTA	RTA	ETA3	ETW1	ETW2	ETW3
Mean	26.82	21.40	15.62	14.39	12.17	10.80
Stdev	0.5952	1.098	0.9420	0.4390	0.3105	0.4540
CV	2.220	5.131	6.030	3.051	2.552	4.204
Mod CV	6.000	6.566	8.000	6.000	6.000	6.102
Min	25.29	20.20	14.21	13.18	11.79	10.03
Max	27.70	25.43	16.62	14.92	12.80	11.97
No. Batches	4	4	1	3	3	3
No. Spec.	22	24	6	18	18	18
Basis Values and Estimates						
B-Basis Value				13.52	11.56	9.904
B-Estimate	25.11	18.80	12.77			
A-Estimate	23.91	16.96	10.74	12.91	11.12	9.269
Method	ANOVA	ANOVA	Normal	Normal	Normal	Normal
Modified CV Basis Values and Estimates						
B-Basis Value	24.17	18.77		12.68	10.73	9.499
			11.84			
A-Estimate	22.36	16.95	9.145	11.48	9.706	8.577
Method	Pooled	Pooled	Normal	Normal	Normal	Normal

Table 4-28: Statistics and Basis Values for IPS Ultimate Strength Data

In Plane Shear As-Measured Modulus Statistics						
Environment	CTA	RTA	ETA3	ETW1	ETW2	ETW3
Mean	0.7037	0.6440	0.4203	0.5312	0.4099	0.3272
Stdev	0.07527	0.03246	0.04394	0.02322	0.02260	0.01728
CV	10.70	5.040	10.45	4.370	5.515	5.282
Min	0.5090	0.5740	0.3560	0.4800	0.3680	0.2880
Max	0.7960	0.6960	0.4700	0.5610	0.4450	0.3600
No. Batches	4	4	1	3	3	3
No. Spec.	22	24	6	18	18	18

Table 4-29: Statistics for IPS Modulus Data

4.9 "25/50/25" Unnotched Tension 1 (UNT1)

The UNT1 data is normalized, so both normalized and as-measured results were provided. Testing was done in six environmental conditions: CTA, RTA, ETA2, ETA3, ETW1 and ETW2. The CTA condition tested specimens from two batches of material, and the ETA2 and ETA3 conditions tested specimens from one batch of material, so only basis value estimates were provided for those conditions.

For the normalized dataset, the RTA and ETW1 conditions met all requirements for pooling, while the single point normal method was used for the remaining conditions. Applying the modified CV, the RTA and ETW1 conditions met all requirements for pooling while the normal method for modified CV was used for the remaining conditions.

For the as-measured dataset, pooling was not possible because all combinations failed Levene's test for equality of variances. The single point normal method was used for all conditions. Applying the modified CV, the RTA and ETW1 conditions met all requirements for pooling while the normal method for modified CV was used for the remaining conditions.

There were two statistical outliers. The highest value in batch D of the CTA condition was a batch outlier for the normalized dataset. The lowest value in batch F of the ETW1 condition was a batch outlier for both the normalized and as-measured datasets. They were retained for this analysis.

Statistics, basis values and estimates are given for UNT1 strength data in Table 4-30 and Table 4-31 and for the UNT1 modulus data in Table 4-32 and Table 4-33. The normalized data, B-estimates and B-basis values are shown graphically in Figure 4-17 and Figure 4-18.

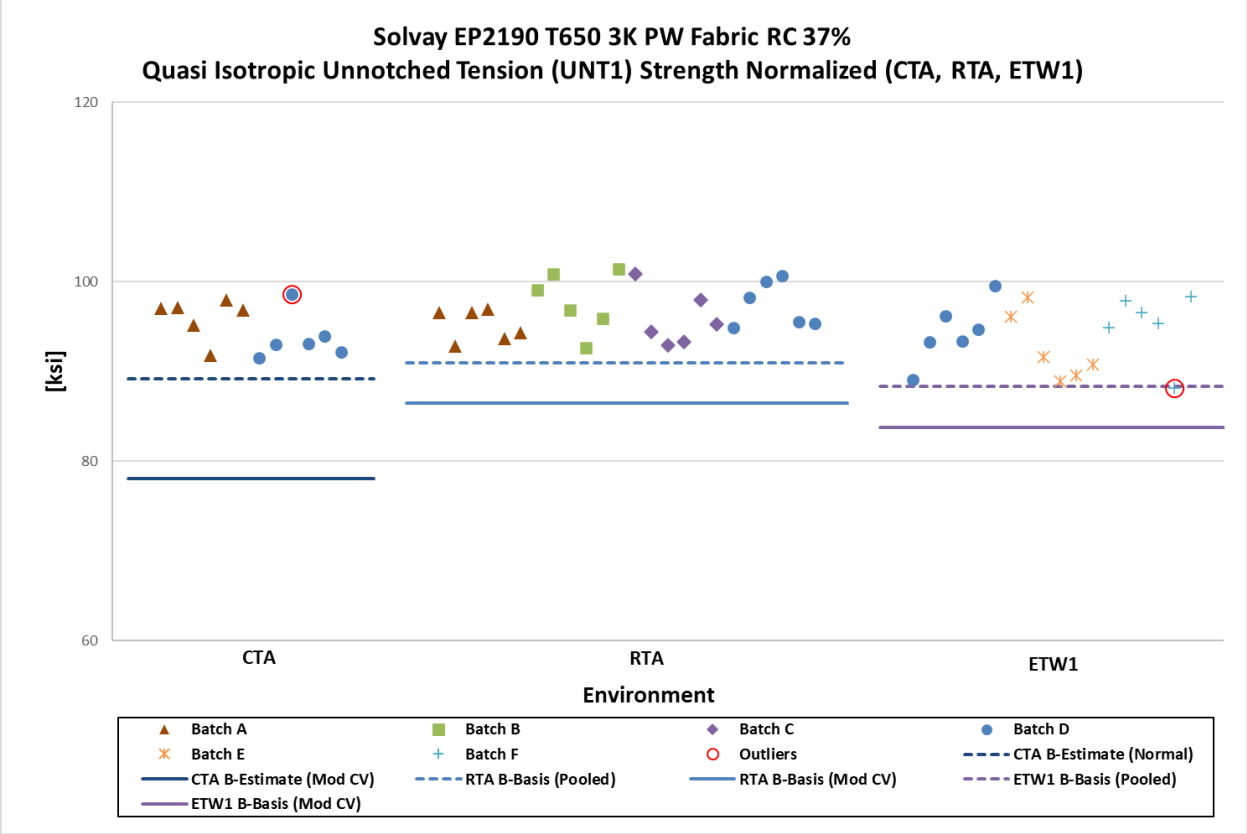

Figure 4-17: Batch Plot for UNT1 Normalized Strength (CTA, RTA, ETW1)

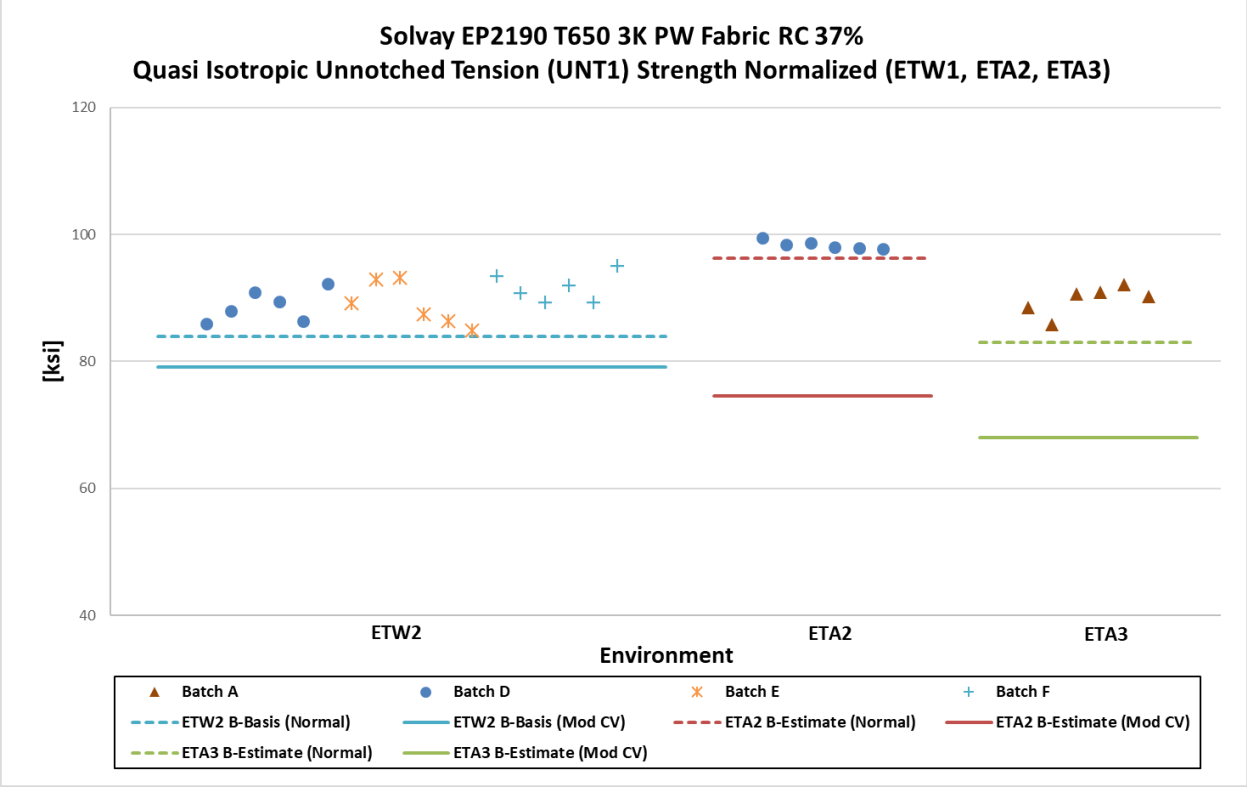

Figure 4-18: Batch Plot for UNT1 Normalized Strength (ETW2, ETA2, ETA3)

Normalized Unnotched Tension 1 (UNT1) Basis Values and Statistics						
Environment	CTA	RTA	ETW1	ETW2	ETA2	ETA3
Mean	94.85	96.53	94.03	89.81	98.35	89.70
Stdev	2.568	2.796	3.603	2.950	0.6662	2.232
CV	2.707	2.896	3.832	3.285	0.6773	2.488
Mod CV	6.000	6.000	6.000	6.000	8.000	8.000
Min	91.54	92.62	88.19	84.91	97.78	85.83
Max	98.61	101.4	99.52	95.13	99.52	92.06
No. Batches	2	4	3	3	1	1
No. Spec.	12	24	18	18	6	6
Basis Values and Estimates						
B-Basis Value		90.98	88.34	83.99		
B-Estimate	89.16				96.33	82.94
A-Estimate	85.18	87.11	84.50	79.86	94.90	78.14
Method	Normal	Pooled	Pooled	Normal	Normal	Normal
Modified CV Basis Values and Estimates						
B-Basis Value		86.48	83.73	79.17		
B-Estimate	78.04				74.52	67.96
A-Estimate	66.27	79.47	76.77	71.63	57.57	52.51
Method	Normal	Pooled	Pooled	Normal	Normal	Normal

Table 4-30: Statistics and Basis Values for UNT1 Normalized Strength Data

As-Measured Unnotched Tension 1 (UNT1) Basis Values and Statistics						
Environment	CTA	RTA	ETW1	ETW2	ETA2	ETA3
Mean	93.86	95.87	93.09	88.84	97.63	87.67
Stdev	2.639	2.813	4.365	3.480	0.3968	2.088
CV	2.812	2.934	4.688	3.917	0.4064	2.382
Mod CV	6.000	6.000	6.344	6.000	8.000	8.000
Min	89.83	90.61	85.80	82.18	97.03	84.10
Max	97.31	101.4	99.21	95.28	97.97	89.93
No. Batches	2	4	3	3	1	1
No. Spec.	12	24	18	18	6	6
Basis Values and Estimates						
B-Basis Value		90.66	84.48	81.97		
B-Estimate	88.01				96.43	81.34
A-Estimate	83.91	86.92	78.37	77.10	95.57	76.84
Method	Normal	Normal	Normal	Normal	Normal	Normal
Modified CV Basis Values and Estimates						
B-Basis Value		85.66	82.63	78.32		
B-Estimate	77.22				73.97	66.42
A-Estimate	65.57	78.54	75.57	70.86	57.15	51.32
Method	Normal	Pooled	Pooled	Normal	Normal	Normal

Table 4-31: Statistics and Basis Values for UNT1 As-Measured Strength Data

Normalized Unnotched Tension 1 (UNT1) Modulus Statistics						
Environment	CTA	RTA	ETA2	ETA3	ETW1	ETW2
Mean	7.031	6.825	6.824	6.711	6.669	6.215
Stdev	0.07321	0.1127	0.1327	0.1251	0.08212	0.3873
CV	1.041	1.651	1.945	1.864	1.231	6.232
Min	6.887	6.609	6.602	6.575	6.519	5.435
Max	7.104	7.020	6.976	6.944	6.884	6.605
No. Batches	2	4	1	1	3	3
No. Spec.	12	24	6	6	18	18

Table 4-32: Statistics for UNT1 Normalized Modulus Data

As-Measured Unnotched Tension 1 (UNT1) Modulus Statistics						
Environment	CTA	RTA	ETA2	ETA3	ETW1	ETW2
Mean	6.957	6.778	6.774	6.559	6.601	6.146
Stdev	0.08123	0.1211	0.09223	0.1305	0.1364	0.3758
CV	1.168	1.787	1.362	1.989	2.066	6.114
Min	6.790	6.516	6.612	6.423	6.319	5.461
Max	7.085	7.011	6.867	6.804	6.776	6.615
No. Batches	2	4	1	1	3	3
No. Spec.	12	24	6	6	18	18

Table 4-33: Statistics for UNT1 As-Measured Modulus Data

4.10 “10/80/10” Unnotched Tension 2 (UNT2)

The UNT2 data is normalized, so both normalized and as-measured results were provided. Testing was done in four environmental conditions: CTA, RTA, ETW1 and ETW2.

For the normalized dataset, the CTA conditions failed the ADK test for batch equivalency. ANOVA was used to compute estimates for CTA. The remaining conditions met all requirements for pooling. Applying the modified CV, there were no diagnostic test failures, therefore all conditions were pooled.

For the as-measured dataset, the CTA and ETW1 conditions failed the ADK test for batch equivalency. ANOVA was used to compute estimates for those conditions. The single point normal method was used for RTA and ETW2. Applying the modified CV, there were no diagnostic test failures, therefore all conditions were pooled.

There was one statistical outlier. The lowest value in batch D of the ETW2 condition was a batch outlier for the normalized dataset. It was retained for this analysis.

Statistics, basis values and estimates are given for UNT2 strength data in Table 4-34 and Table 4-35 and for the UNT1 modulus data in Table 4-36 and Table 4-37. The normalized data, B-estimates and B-basis values are shown graphically in Figure 4-19.

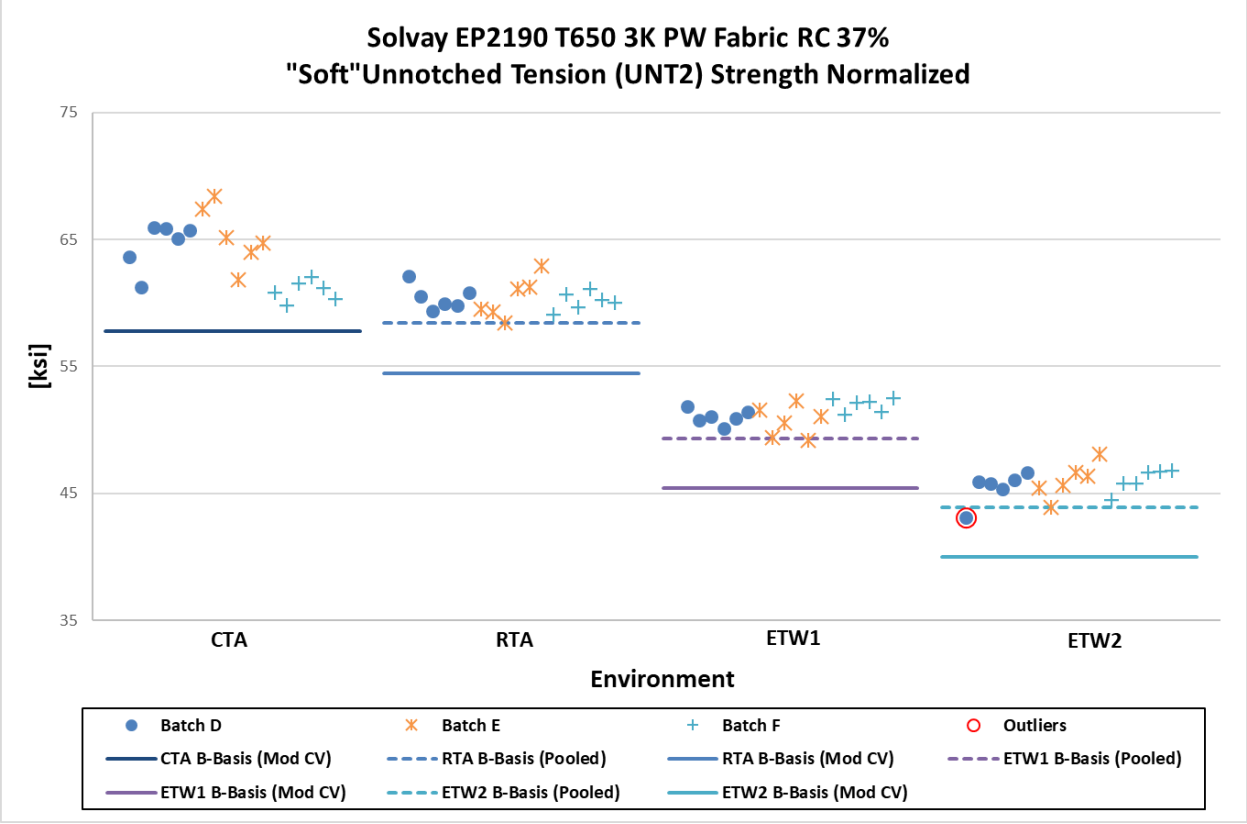

Figure 4-19: Batch Plot for UNT2 Normalized Strength

Normalized Unnotched Tension 2 (UNT2) Basis Values and Statistics				
Environment	CTA	RTA	ETW1	ETW2
Mean	63.59	60.33	51.23	45.84
Stdev	2.574	1.119	0.9764	1.148
CV	4.047	1.855	1.906	2.504
Mod CV	6.024	6.000	6.000	6.000
Min	59.80	58.41	49.17	43.12
Max	68.40	62.94	52.53	48.06
No. Batches	3	3	3	3
No. Spec.	18	18	18	18
Basis Values and Estimates				
B-Basis Value		58.41	49.31	43.92
B-Estimate	49.83			
A-Estimate	40.01	57.13	48.03	42.64
Method	ANOVA	Pooled	Pooled	Pooled
Modified CV Basis Values and Estimates				
B-Basis Value	57.75	54.49	45.39	40.00
A-Estimate	53.90	50.64	41.54	36.15
Method	Pooled	Pooled	Pooled	Pooled

Table 4-34: Statistics and Basis Values for UNT2 Normalized Strength Data

As-Measured Normalized Unnotched Tension 2 (UNT2) Basis Values and Statistics				
Environment	CTA	RTA	ETW1	ETW2
Mean	63.12	59.92	50.86	45.49
Stdev	2.294	1.385	1.342	1.337
CV	3.635	2.312	2.638	2.940
Mod CV	6.000	6.000	6.000	6.000
Min	60.03	57.84	48.66	42.47
Max	68.23	62.86	52.85	47.94
No. Batches	3	3	3	3
No. Spec.	18	18	18	18
Basis Values and Estimates				
B-Basis Value		57.19		42.85
B-Estimate	50.89		44.07	
A-Estimate	42.17	55.25	39.23	40.98
Method	ANOVA	Normal	ANOVA	Normal
Modified CV Basis Values and Estimates				
B-Basis Value	57.33	54.13	45.07	39.70
A-Estimate	53.51	50.32	41.25	35.88
Method	Pooled	Pooled	Pooled	Pooled

Table 4-35: Statistics and Basis Values for UNT2 As-Measured Strength Data

Normalized Unnotched Tension 2 (UNT2) Modulus Statistics				
Environment	CTA	RTA	ETW1	ETW2
Mean	4.556	4.362	4.042	3.654
Stdev	0.07137	0.05079	0.08299	0.09485
CV	1.566	1.164	2.053	2.596
Min	4.441	4.276	3.930	3.465
Max	4.680	4.449	4.179	3.778
No. Batches	3	3	3	3
No. Spec.	18	18	18	18

Table 4-36:Statistics for UNT2 Normalized Modulus Data

As-Measured Unnotched Tension 2 (UNT2) Modulus Statistics				
Environment	CTA	RTA	ETW1	ETW2
Mean	4.523	4.333	4.012	3.626
Stdev	0.07950	0.07383	0.05700	0.08455
CV	1.758	1.704	1.421	2.332
Min	4.355	4.170	3.920	3.455
Max	4.656	4.431	4.105	3.766
No. Batches	3	3	3	3
No. Spec.	18	18	18	18

Table 4-37: Statistics for UNT2 As-Measured Modulus Data

4.11 "40/20/40" Unnotched Tension 3 (UNT3)

The UNT3 data is normalized, so both normalized and as-measured results were provided. Testing was done in four environmental conditions: CTA, RTA, ETW1 and ETW2.

For the normalized dataset, the ETW2 condition failed the ADK test for batch equivalency. ANOVA was used to compute estimates for ETW2. The RTA and ETW1 conditions met all requirements for pooling and the single point normal method was used for CTA. Applying the modified CV, there were no diagnostic test failures, therefore all conditions were pooled.

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

There was one statistical outlier. The lowest value in batch F of the ETW2 condition was a batch outlier for both the normalized and as-measured datasets. It was retained for this analysis.

Statistics, basis values and estimates are given for UNT3 strength data in Table 4-38 and Table 4-39 and for the UNT1 modulus data in Table 4-40 and Table 4-41. The normalized data, B-estimates and B-basis values are shown graphically in Figure 4-20.

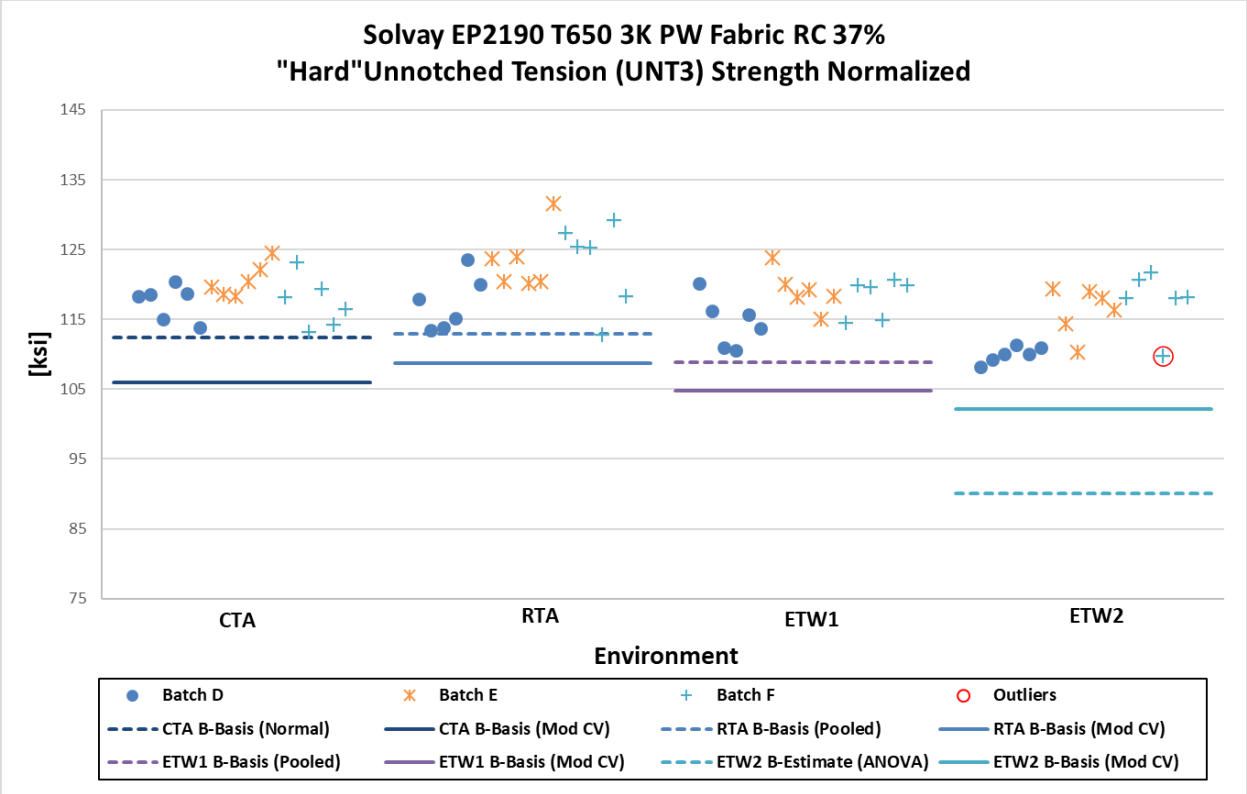

Figure 4-20: Batch Plot for UNT3 Strength Normalized

Normalized Unnotched Tension 3 (UNT3) Basis Values and Statistics				
Environment	CTA	RTA	ETW1	ETW2
Mean	118.5	121.3	117.3	114.6
Stdev	3.106	5.467	3.543	4.599
CV	2.621	4.509	3.021	4.011
Mod CV	6.000	6.254	6.000	6.006
Min	113.2	112.7	110.6	108.2
Max	124.5	131.6	123.9	121.7
No. Batches	3	3	3	3
No. Spec.	18	18	18	18
Basis Values and Estimates				
B-Basis Value	112.4	112.9	108.9	
B-Estimate				90.03
A-Estimate	108.0	107.2	103.2	72.48
Method	Normal	Pooled	Pooled	ANOVA
Modified CV Basis Values and Estimates				
B-Basis Value	106.0	108.8	104.8	102.2
A-Estimate	97.78	100.5	96.57	93.92
Method	Pooled	Pooled	Pooled	Pooled

Table 4-38: Statistics and Basis Values for UNT3 Normalized Strength Data

As-Measured Unnotched Tension 3 (UNT3) Basis Values and Statistics				
Environment	CTA	RTA	ETW1	ETW2
Mean	118.1	120.7	116.7	114.3
Stdev	3.736	5.975	4.208	5.385
CV	3.162	4.949	3.606	4.713
Mod CV	6.000	6.475	6.000	6.356
Min	111.5	111.8	107.7	106.6
Max	124.7	131.5	123.9	121.6
No. Batches	3	3	3	3
No. Spec.	18	18	18	18
Basis Value Estimates				
B-Estimate	100.6	94.25	95.49	80.98
A-Estimate	88.06	75.37	80.37	57.22
Method	ANOVA	ANOVA	ANOVA	ANOVA
Modified CV Basis Values and Estimates				
B-Basis Value	105.4	108.0	103.9	101.5
A-Estimate	96.99	99.60	95.55	93.13
Method	Pooled	Pooled	Pooled	Pooled

Table 4-39: Statistics and Basis Values for UNT3 As-Measured Strength Data

Normalized Unnotched Tension 3 (UNT3) Modulus Statistics				
Environment	CTA	RTA	ETW1	ETW2
Mean	8.490	8.554	8.533	8.365
Stdev	0.1207	0.1191	0.1788	0.2217
CV	1.422	1.392	2.096	2.651
Min	8.176	8.256	8.264	7.882
Max	8.737	8.746	8.784	8.662
No. Batches	3	3	3	3
No. Spec.	18	18	18	18

Table 4-40: Statistics for UNT3 Normalized Modulus Data

As-Measured Unnotched Tension 3 (UNT3) Modulus Statistics				
Environment	CTA	RTA	ETW1	ETW2
Mean	8.462	8.515	8.485	8.334
Stdev	0.1328	0.1050	0.1449	0.2211
CV	1.570	1.233	1.708	2.652
Min	8.166	8.340	8.276	7.892
Max	8.633	8.794	8.784	8.722
No. Batches	3	3	3	3
No. Spec.	18	18	18	18

Table 4-41: Statistics for UNT3 As-Measured Modulus Data

4.12 “25/50/25” Unnotched Compression 1 (UNC1)

The UNC1 data is normalized, so both normalized and as-measured results were provided. Testing was done in seven environmental conditions: CTA, RTA, ETA2, ETA3, ETW1, ETW2, and ETW3. The CTA conditions tested specimens from two batches, and the ETA2 and ETA3 conditions tested specimens from one batch of material, so only basis value estimates were provided for those conditions.

For the normalized dataset, the ETW2 condition failed the ADK test for batch equivalency. ANOVA was used to compute estimates for ETW2. The RTA and ETW1 conditions met all requirements for pooling and the single point normal method was used for the remaining conditions. Applying the modified CV, the RTA and ETW1 met all requirements for pooling and the normal method for modified CV was used for the remaining conditions.

For the as-measured dataset, the ETW1 and ETW2 conditions failed the ADK test for batch equivalency. ANOVA was used to compute estimates for those conditions. The single point normal method was used for the remaining conditions. Applying the modified CV, the ETW2 condition failed the ADK test, therefore basis values could not be computed for ETW2. The RTA and ETW1 conditions met all requirements for pooling and the normal method for modified CV was used for the remaining conditions.

There were three statistical outliers. The highest value in batch D of the CTA condition was condition outlier for both the normalized and as-measured datasets. The lowest value in batch C of the RTA condition was a batch outlier for the normalized dataset. The lowest value in batch E of the ETW3 condition was a condition outlier for the as-measured dataset. They were retained for this analysis.

Statistics, basis values and estimates are given for the UNC1 strength data in Table 4-42 and Table 4-43 and for the UNC1 modulus data in Table 4-44 and Table 4-45. The normalized data and B-basis values are shown graphically in Figure 4-21 and Figure 4-22.

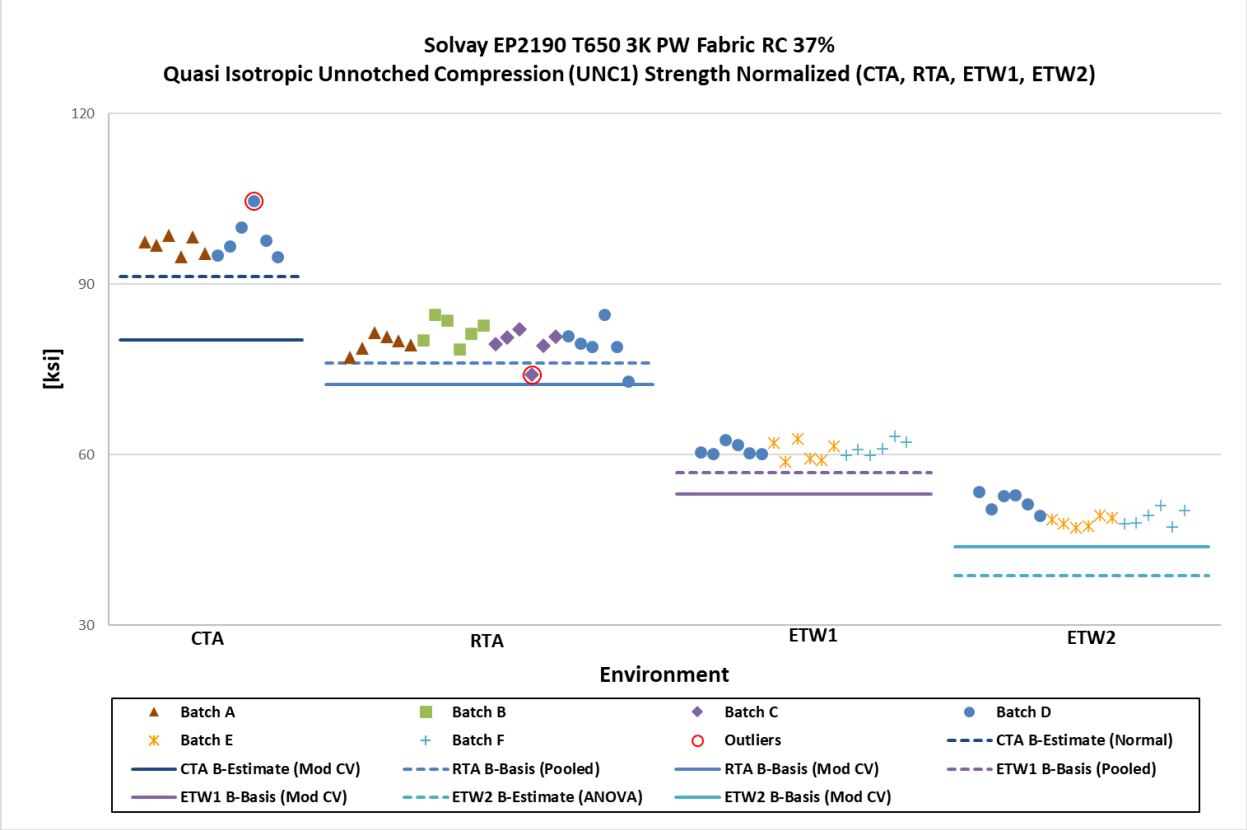

Figure 4-21: Batch Plot for UNC1 Normalized Strength (CTA, RTA, ETW1, ETW2)

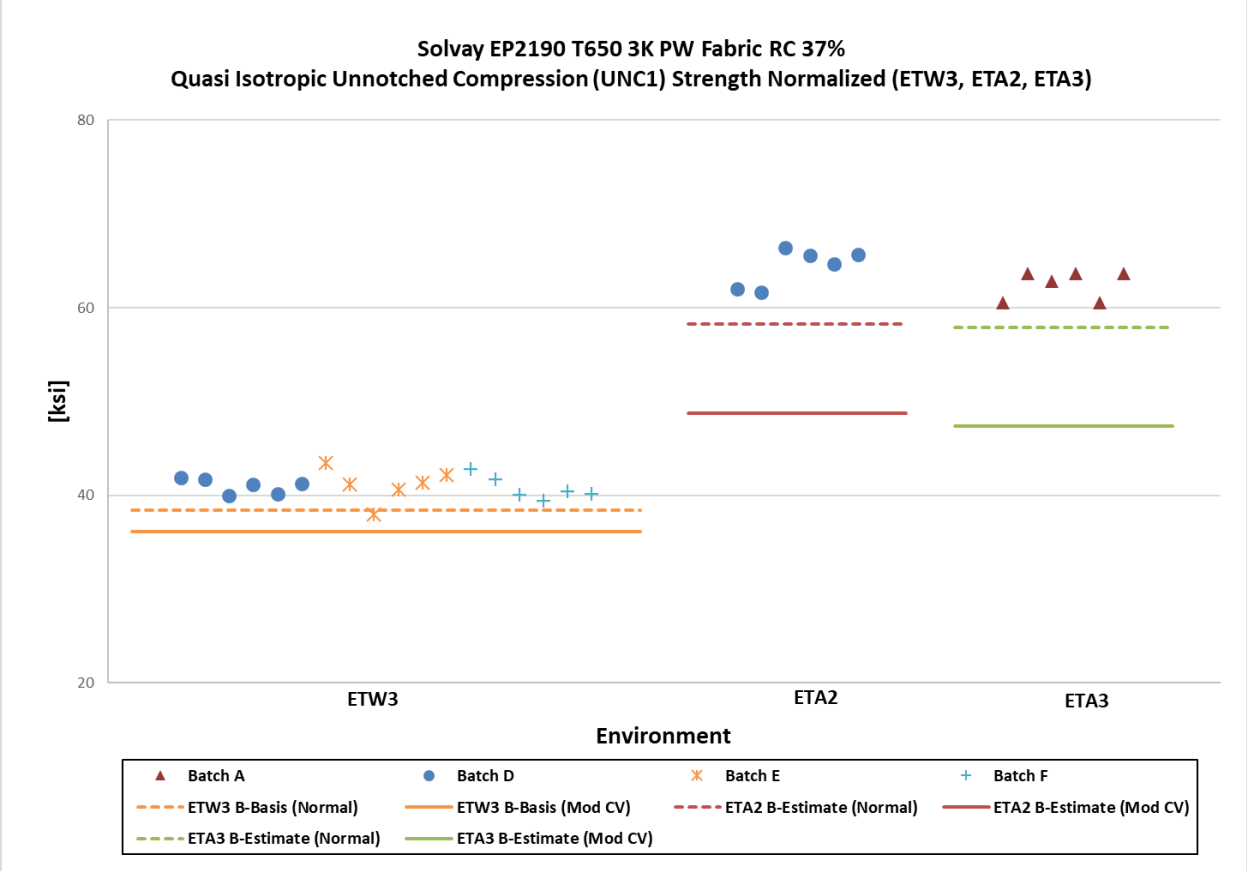

Figure 4-22: Batch Plot for UNC1 Normalized Strength (ETW3, ETA2, ETA3)

Normalized Unnotched Compression 1 (UNC1) Basis Values and Statistics							
Environment	CTA	RTA	ETW1	ETW2	ETW3	ETA2	ETA3
Mean	97.52	80.04	60.89	49.62	40.96	64.34	62.47
Stdev	2.791	2.765	1.313	1.994	1.286	2.008	1.518
CV	2.862	3.455	2.156	4.019	3.140	3.121	2.429
Mod CV	6.000	6.000	6.000	6.010	6.000	8.000	8.000
Min	94.75	72.93	58.76	47.14	37.95	61.64	60.53
Max	104.6	84.69	63.15	53.48	43.44	66.37	63.67
No. Batches	2	4	3	3	3	1	1
No. Spec.	12	24	18	18	18	6	6
Basis Values and Estimates							
B-Basis Value		76.07	56.82		38.42		
B-Estimate	91.34			38.71		58.26	57.87
A-Estimate	87.01	73.30	54.07	30.93	36.62	53.93	54.61
Method	Normal	Pooled	Pooled	ANOVA	Normal	Normal	Normal
Modified CV Basis Values and Estimates							
B-Basis Value		72.41	53.06	43.73	36.10		
B-Estimate	80.24					48.75	47.33
A-Estimate	68.13	67.08	47.78	39.56	32.67	37.66	36.57
Method	Normal	Pooled	Pooled	Normal	Normal	Normal	Normal

Table 4-42: Statistics and Basis Values for UNC1 Normalized Strength Data

As-Measured Unnotched Compression 1 (UNC1) Basis Values and Statistics							
Environment	CTA	RTA	ETW1	ETW2	ETW3	ETA2	ETA3
Mean	96.49	79.09	60.13	49.02	40.45	64.22	61.32
Stdev	2.915	2.677	1.720	2.558	1.490	1.744	1.438
CV	3.021	3.385	2.861	5.219	3.684	2.716	2.345
Mod CV	6.000	6.000	6.000	6.609	6.000	8.000	8.000
Min	93.15	72.53	56.57	45.45	36.48	61.74	59.45
Max	103.7	83.83	62.68	53.78	42.94	66.48	62.58
No. Batches	2	4	3	3	3	1	1
No. Spec.	12	24	18	18	18	6	6
Basis Values and Estimates							
B-Basis Value		74.13			37.51		
B-Estimate	90.03		51.20	33.45		58.93	56.97
A-Estimate	85.51	70.57	44.82	22.35	35.42	55.17	53.87
Method	Normal	Normal	ANOVA	ANOVA	Normal	Normal	Normal
Modified CV Basis Values and Estimates							
B-Basis Value		71.55	52.40	NA	35.66		
B-Estimate	79.38					48.65	46.46
A-Estimate	67.41	66.29	47.18		32.26	37.59	35.90
Method	Normal	Pooled	Pooled		Normal	Normal	Normal

Table 4-43: Statistics and Basis Values for UNC1 As-Measured Strength Data

Normalized Unnotched Compression 1 (UNC1) Modulus Statistics							
Environment	CTA	RTA	ETA2	ETA3	ETW1	ETW2	ETW3
Mean	6.370	6.353	6.319	6.406	6.372	5.992	5.683
Stdev	0.05904	0.09210	0.06198	0.08499	0.05310	0.3450	0.4331
CV	0.9267	1.450	0.9808	1.327	0.8334	5.757	7.621
Min	6.294	6.182	6.215	6.285	6.257	5.309	5.036
Max	6.482	6.545	6.388	6.490	6.449	6.383	6.131
No. Batches	2	4	1	1	3	3	3
No. Spec.	12	24	6	6	18	18	18

Table 4-44: Statistics for UNC1 Normalized Modulus Data

As-Measured Unnotched Compression 1 (UNC1) Modulus Statistics							
Environment	CTA	RTA	ETA2	ETA3	ETW1	ETW2	ETW3
Mean	6.303	6.278	6.308	6.288	6.292	5.918	5.610
Stdev	0.06929	0.08747	0.07188	0.07086	0.09804	0.3541	0.4023
CV	1.099	1.393	1.139	1.127	1.558	5.983	7.170
Min	6.179	6.083	6.225	6.182	6.109	5.343	4.993
Max	6.426	6.403	6.428	6.349	6.441	6.353	6.088
No. Batches	2	4	1	1	3	3	3
No. Spec.	12	24	6	6	18	18	18

Table 4-45: Statistics for UNC1 As-Measured Modulus Data

4.13 “10/80/10” Unnotched Compression 2 (UNC2)

The UNC2 data is normalized, so both normalized and as-measured results were provided. Testing was done in six environmental conditions: RTA, ETA2, ETA3, ETW1, ETW2, and ETW3. The ETA2 and ETA3 conditions tested specimens from one batch of material, so only basis value estimates were provided for those conditions.

For the normalized dataset, the ETW1, ETW2, and ETW3 conditions failed the ADK test for batch equivalency. ANOVA was used to compute estimates for those conditions. The single point normal method was used for the remaining conditions. Applying the modified CV, the ETW3 condition failed the ADK test, therefore basis values could not be computed for that condition. The RTA and ETW1 conditions met all requirements for pooling, and the normal method for modified CV was used for the remaining conditions.

For the as-measured dataset, the ETW3 condition failed the ADK test for batch equivalency. ANOVA was used to compute estimates for ETW3. The ETW2 condition failed all the distribution tests, therefore the single point non-parametric method was used for ETW2. RTA and ETW1 could not be pooled because the pooled dataset failed Levene’s test for equality of variances. The single point normal method was used for the remaining conditions. Applying the modified CV, the ETW3 condition failed the ADK test, therefore basis values could not be computed for that condition. The RTA and ETW1 conditions met all requirements for pooling, and the normal method for modified CV was used for the remaining conditions.

There were no statistical outliers.

Statistics, basis values and estimates are given for the UNC2 strength data in Table 4-46 and Table 4-47 and for the UNC2 modulus data in Table 4-48 and Table 4-49. The normalized data and B-basis values are shown graphically in Figure 4-23 and Figure 4-24.

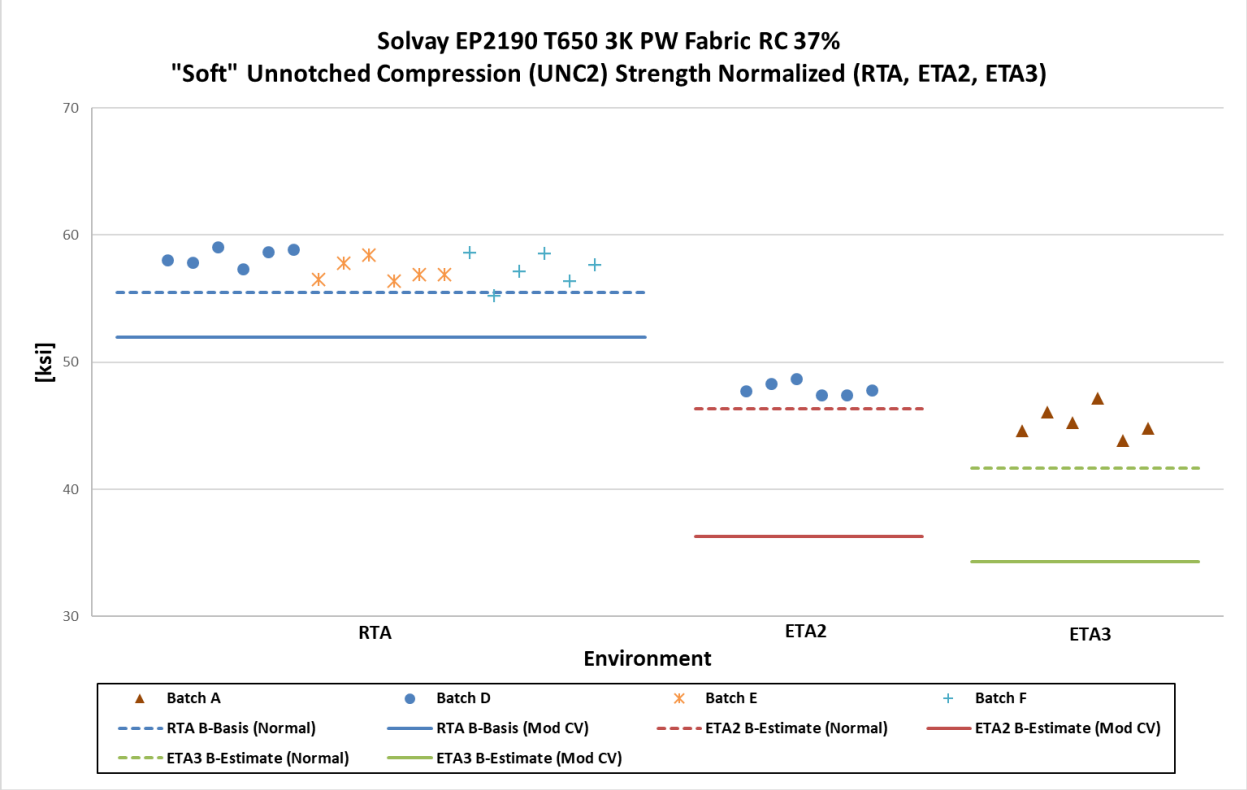

Figure 4-23: Batch Plot for UNC2 Normalized Strength (RTA, ETA2, ETA3)

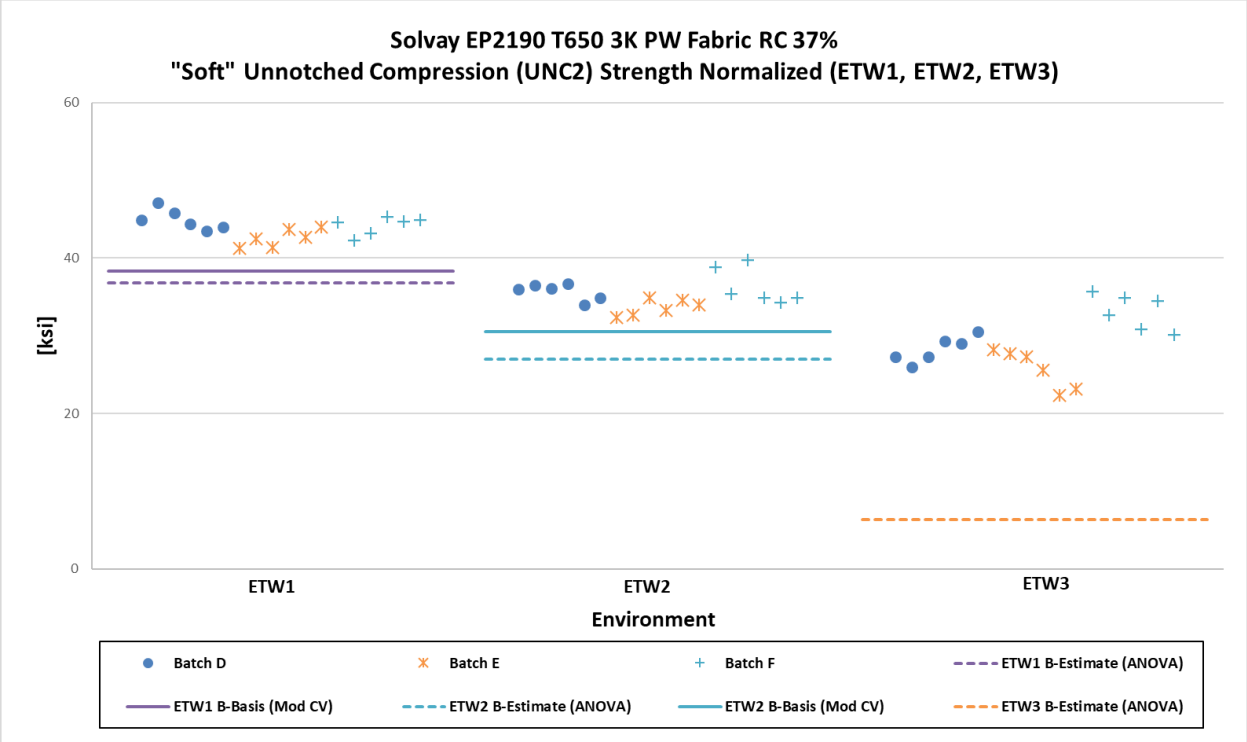

Figure 4-24: Batch Plot for UNC2 Normalized Strength (ETW1, ETW2, ETW3)

Normalized Unnotched Compression 2 (UNC2) Basis Values and Statistics						
Environment	RTA	ETA2	ETA3	ETW1	ETW2	ETW3
Mean	57.57	47.89	45.29	43.90	35.22	29.04
Stdev	1.055	0.5104	1.201	1.528	1.913	3.755
CV	1.833	1.066	2.653	3.481	5.430	12.93
Mod CV	6.000	8.000	8.000	6.000	6.715	12.93
Min	55.22	47.41	43.81	41.29	32.40	22.38
Max	59.07	48.70	47.20	47.09	39.78	35.69
No. Batches	3	1	1	3	3	3
No. Spec.	18	6	6	18	18	18
Basis Values and Estimates						
B-Basis Value	55.49					
B-Estimate		46.34	41.65	36.86	27.04	6.388
A-Estimate	54.01	45.24	39.06	31.83	21.21	0.000
Method	Normal	Normal	Normal	ANOVA	ANOVA	ANOVA
Modified CV Basis Values and Estimates						
B-Basis Value	51.98			38.31	30.55	NA
B-Estimate		36.28	34.31			
A-Estimate	48.17	28.03	26.51	34.50	27.25	
Method	Pooled	Normal	Normal	Pooled	Normal	

Table 4-46: Statistics and Basis Values for UNC2 Normalized Strength Data

As-Measured Unnotched Compression 2 (UNC2) Basis Values and Statistics						
Environment	RTA	ETA2	ETA3	ETW1	ETW2	ETW3
Mean	57.19	46.57	44.14	43.47	34.91	28.78
Stdev	0.9805	0.9975	1.396	1.459	1.956	3.786
CV	1.714	2.142	3.162	3.357	5.605	13.15
Mod CV	6.000	8.000	8.000	6.000	6.803	13.15
Min	55.25	45.59	42.16	41.26	32.55	22.44
Max	58.73	47.85	45.78	46.30	39.81	35.96
No. Batches	3	1	1	3	3	3
No. Spec.	18	6	6	18	18	18
Basis Values and Estimates						
B-Basis Value	55.25			40.59	31.80	
B-Estimate		43.55	39.91			5.734
A-Estimate	53.88	41.40	36.91	38.55	24.08	0.000
Method	Normal	Normal	Normal	Normal	Non-Parm.	ANOVA
Modified CV Basis Values and Estimates						
B-Basis Value	51.64			37.92	30.22	NA
B-Estimate		35.29	33.44			
A-Estimate	47.86	27.26	25.84	34.15	26.90	
Method	Pooled	Normal	Normal	Pooled	Normal	

Table 4-47: Statistics and Basis Values for UNC2 As-Measured Strength Data

Normalized Unnotched Compression 2 (UNC2) Modulus Statistics						
Environment	RTA	ETA2	ETA3	ETW1	ETW2	ETW3
Mean	4.184	4.110	4.032	3.753	3.748	3.434
Stdev	0.06642	0.02754	0.04048	0.4262	0.08804	0.1635
CV	1.587	0.6700	1.004	11.36	2.349	4.762
Min	4.091	4.066	3.978	2.962	3.610	3.178
Max	4.289	4.142	4.090	4.115	3.902	3.754
No. Batches	3	1	1	3	3	3
No. Spec.	18	6	6	18	18	18

Table 4-48: Statistics for UNC2 Normalized Modulus Data

As-Measured Unnotched Compression 2 (UNC2) Modulus Statistics						
Environment	RTA	ETA2	ETA3	ETW1	ETW2	ETW3
Mean	4.156	3.997	3.929	3.713	3.714	3.404
Stdev	0.04336	0.05750	0.03708	0.3901	0.08588	0.1817
CV	1.043	1.439	0.9437	10.51	2.313	5.336
Min	4.074	3.934	3.878	3.000	3.598	3.119
Max	4.220	4.072	3.970	4.055	3.904	3.783
No. Batches	3	1	1	3	3	3
No. Spec.	18	6	6	18	18	18

Table 4-49: Statistics for UNC2 As-Measured Modulus Data

4.14 “40/20/40” Unnotched Compression 3 (UNC3)

The UNC3 data is normalized, so both normalized and as-measured results were provided. Testing was done in six environmental conditions: RTA, ETA2, ETA3, ETW1, ETW2, and ETW3. The ETA2 and ETA3 conditions tested specimens from one batch of material, so only basis value estimates were provided for those conditions.

For the normalized dataset, the RTA and ETW1 conditions failed the ADK test for batch equivalency. ANOVA was used to compute estimates for those conditions. The single point normal method was used for the remaining conditions. Applying the modified CV, the RTA and ETW1 conditions met all requirements for pooling and the normal method for modified CV was used for the remaining conditions.

For the as-measured dataset, the RTA and ETW1 conditions met all requirements for pooling. The ETW3 condition failed all the distributions tests, so the single point non-parametric method was used for ETW3. The single point normal method was used for the remaining conditions. Applying the modified CV, the RTA and ETW1 conditions met all requirements for pooling and the normal method for modified CV was used for the remaining conditions.

There was one statistical outlier. The highest value in batch E of the RTA condition was a batch outlier for the normalized dataset and a batch and condition outlier for the as-measured dataset. It was retained for this analysis.

Statistics, basis values and estimates are given for the UNC3 strength data in Table 4-50 and Table 4-51 and for the UNC3 modulus data in Table 4-52 and Table 4-53. The normalized data and B-basis values are shown graphically in Figure 4-25 and Figure 4-26.

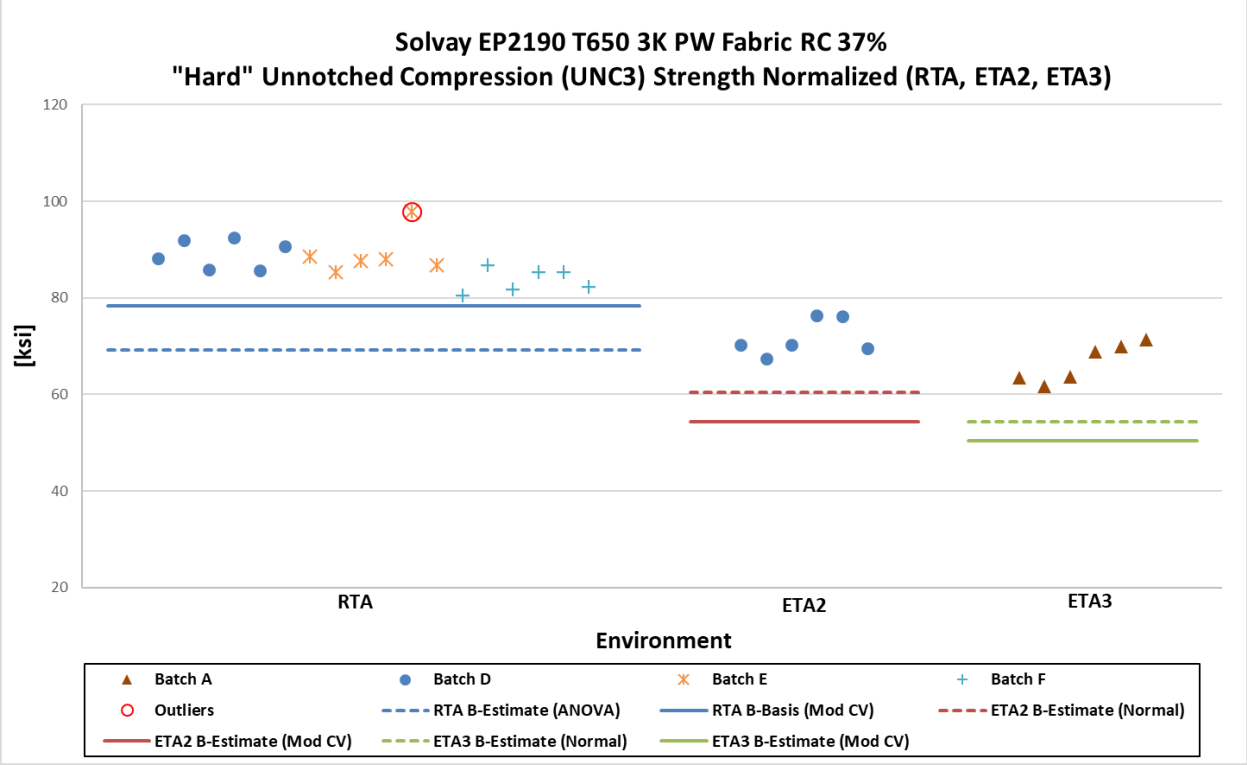

Figure 4-25: Batch Plot for UNC3 Normalized Strength (RTA, ETA2, ETA3)

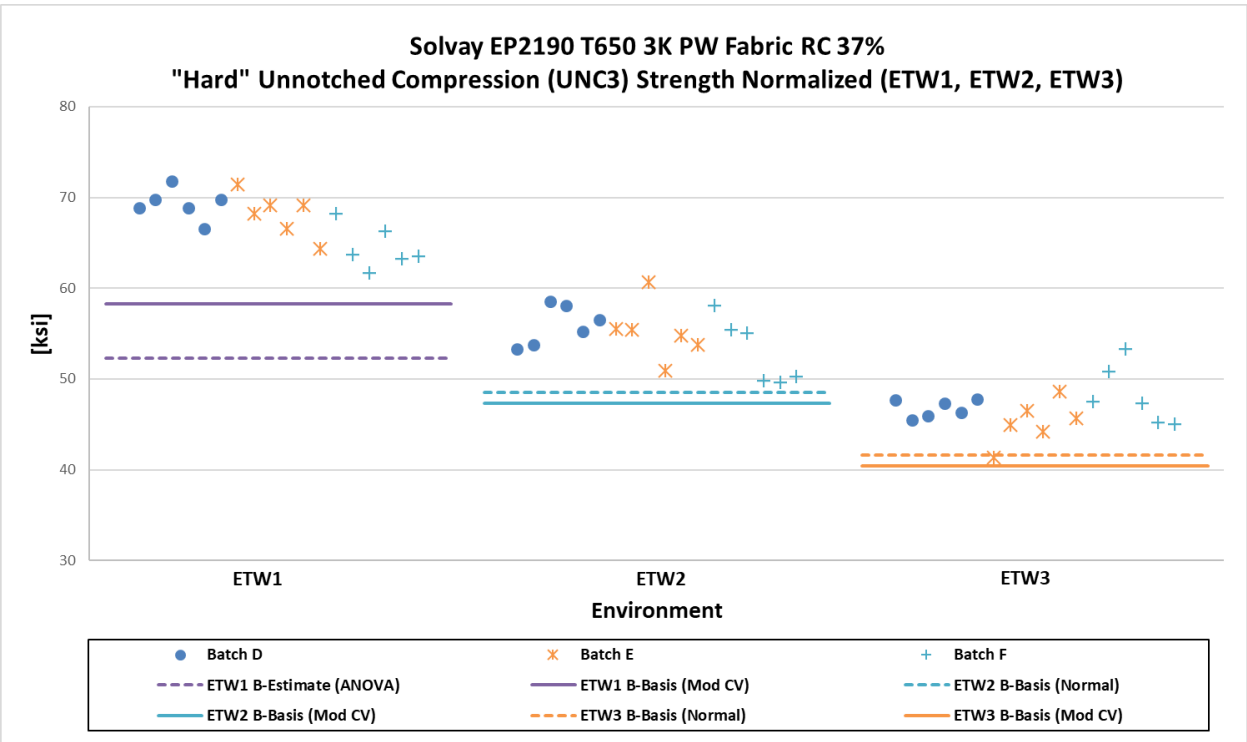

Figure 4-26: Batch Plot for UNC3 Normalized Strength (ETW1, ETW2, ETW3)

Normalized Unnotched Compression 3 (UNC3) Basis Values and Statistics						
Environment	RTA	ETA2	ETA3	ETW1	ETW2	ETW3
Mean	87.28	71.72	66.52	67.28	54.71	46.72
Stdev	4.168	3.709	4.037	2.966	3.118	2.602
CV	4.776	5.171	6.068	4.408	5.699	5.568
Mod CV	6.388	8.000	8.000	6.204	6.850	6.784
Min	80.46	67.43	61.76	61.67	49.66	41.34
Max	97.95	76.41	71.43	71.80	60.65	53.35
No. Batches	3	1	1	3	3	3
No. Spec.	18	6	6	18	18	18
Basis Values and Estimates						
B-Basis Value					48.56	41.58
B-Estimate	69.16	60.49	54.29	52.30		
A-Estimate	56.24	52.50	45.60	41.62	44.19	37.94
Method	ANOVA	Normal	Normal	ANOVA	Normal	Normal
Modified CV Basis Values and Estimates						
B-Basis Value	78.31			58.31	47.31	40.46
B-Estimate		54.34	50.40			
A-Estimate	72.21	41.98	38.94	52.21	42.07	36.03
Method	Pooled	Normal	Normal	Pooled	Normal	Normal

Table 4-50: Statistics and Basis Values for UNC3 Normalized Strength Data

As-Measured Unnotched Compression 3 (UNC3) Basis Values and Statistics						
Environment	RTA	ETA2	ETA3	ETW1	ETW2	ETW3
Mean	86.67	69.95	65.02	66.81	54.37	46.48
Stdev	4.107	3.256	3.577	2.775	3.097	2.755
CV	4.738	4.656	5.501	4.153	5.696	5.927
Mod CV	6.369	8.000	8.000	6.077	6.848	6.964
Min	80.66	66.42	60.68	62.06	49.57	41.52
Max	98.83	74.02	69.75	71.79	60.31	53.62
No. Batches	3	1	1	3	3	3
No. Spec.	18	6	6	18	18	18
Basis Values and Estimates						
B-Basis Value	80.29			60.43	48.26	40.10
B-Estimate		60.08	54.19			
A-Estimate	75.94	53.07	46.49	56.08	43.92	28.32
Method	Pooled	Normal	Normal	Pooled	Normal	Non-Parm.
Modified CV Basis Values and Estimates						
B-Basis Value	77.84			57.98	47.02	40.09
B-Estimate		53.00	49.27			
A-Estimate	71.84	40.95	38.06	51.98	41.81	35.56
Method	Pooled	Normal	Normal	Pooled	Normal	Normal

Table 4-51: Statistics and Basis Values for UNC3 As-Measured Strength Data

Normalized Unnotched Compression 3 (UNC3) Modulus Statistics						
Environment	RTA	ETA2	ETA3	ETW1	ETW2	ETW3
Mean	7.915	8.038	8.070	7.508	7.892	7.614
Stdev	0.04276	0.04788	0.05671	0.8338	0.07475	0.2482
CV	0.5402	0.5957	0.7027	11.11	0.9471	3.260
Min	7.824	7.985	8.014	5.862	7.744	7.215
Max	7.984	8.096	8.152	8.252	8.005	7.896
No. Batches	3	1	1	3	3	3
No. Spec.	18	6	6	18	18	18

Table 4-52: Statistics for UNC3 Normalized Modulus Data

As-Measured Unnotched Compression 3 (UNC3) Modulus Statistics						
Environment	RTA	ETA2	ETA3	ETW1	ETW2	ETW3
Mean	7.860	7.841	7.890	7.450	7.844	7.575
Stdev	0.1077	0.02295	0.08978	0.7709	0.1410	0.2842
CV	1.371	0.2927	1.138	10.35	1.797	3.752
Min	7.684	7.811	7.754	5.877	7.564	7.081
Max	8.074	7.866	8.015	8.103	8.192	7.958
No. Batches	3	1	1	3	3	3
No. Spec.	18	6	6	18	18	18

Table 4-53: Statistics for UNC3 As-Measured Modulus Data

4.15 “25/50/25” Open-Hole Tension (OHT1)

The OHT1 data is normalized, so both normalized and as-measured results were provided. Testing was done in six environmental conditions: CTA, RTA, ETA2, ETA3, ETW1, and ETW2. The ETA2 condition tested specimens from one batch of material, so only basis value estimates were provided for that condition.

For the normalized dataset, the single point normal method was used to compute estimates for ETA2. The remaining conditions failed the ADK test for batch equivalency. ANOVA was used to compute estimates for CTA, RTA, ETA3, ETW1, and ETW2. Applying the modified CV, the CTA and ETW2 conditions failed the ADK test, therefore basis values could not be computed for those conditions. The RTA and ETW1 conditions met all requirements for pooling and the normal method for modified CV was used for ETA2 and ETA3.

For the as-measured dataset, the single point normal method was used to compute estimates for ETA2. The remaining conditions failed the ADK test for batch equivalency. ANOVA was used to compute estimates for CTA, RTA, ETA3, ETW1, and ETW2. Applying the modified CV, the CTA, ETW1 and ETW2 conditions failed the ADK test, therefore basis values could not be computed for those conditions. The normal method for modified CV was used for the remaining conditions.

There was one statistical outlier. The lowest value in batch F of the ETW1 condition was a batch outlier in both the normalized and as-measured datasets. It was retained for this analysis.

Statistics, basis values and estimates are given for OHT1 strength data in Table 4-54 and Table 4-55. The normalized data, B-basis values and B-estimates are shown graphically in Figure 4-27 and Figure 4-28.

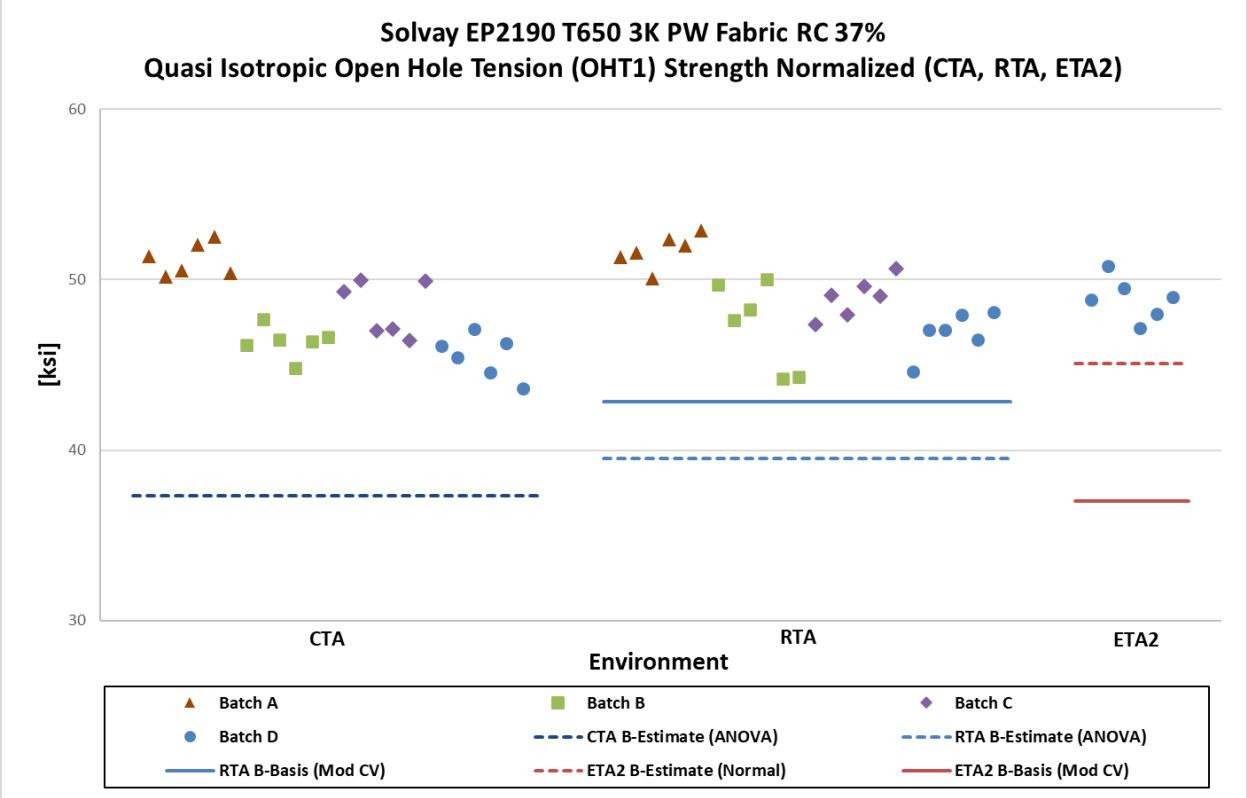

Figure 4-27: Batch Plot for OHT1 Normalized Strength (CTA, RTA, ETA2)

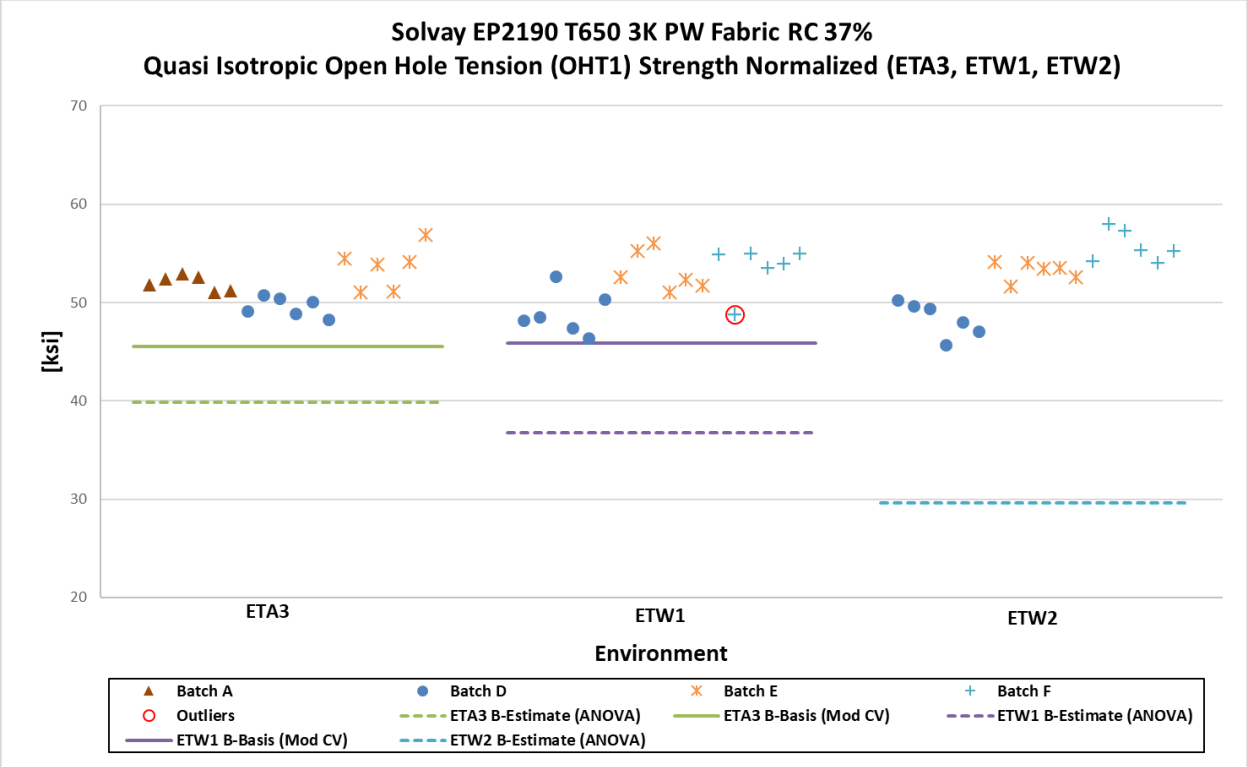

Figure 4-28: Batch Plot for OHT1 Normalized Strength (ETA3, ETW1, ETW2)

Normalized Open Hole Tension 1 (OHT1) Strength Basis Values and Statistics						
Environment	CTA	RTA	ETA2	ETA3	ETW1	ETW2
Mean	47.84	48.72	48.87	51.72	51.86	52.41
Stdev	2.497	2.449	1.252	2.176	2.997	3.434
CV	5.221	5.028	2.561	4.207	5.779	6.552
Mod CV	6.610	6.514	8.000	6.103	6.890	7.276
Min	43.61	44.18	47.14	48.26	46.36	45.68
Max	52.54	52.88	50.78	56.90	56.02	58.00
No. Batches	4	4	1	3	3	3
No. Spec.	24	24	6	18	18	18
Basis Value Estimates						
B-Estimate	37.33	39.53	45.08	39.85	36.80	29.63
A-Estimate	30.04	33.14	42.38	31.38	26.05	13.37
Method	ANOVA	ANOVA	Normal	ANOVA	ANOVA	ANOVA
Modified CV Basis Values and Estimates						
B-Basis Value	NA	42.84		45.49	45.84	NA
B-Estimate			37.03			
A-Estimate		38.74	28.61	41.07	41.77	
Method		Pooled	Normal	Normal	Pooled	

Table 4-54: Statistics and Basis Values for OHT1 Normalized Strength Data

As-Measured Open Hole Tension 1 (OHT1) Strength Basis Values and Statistics						
Environment	CTA	RTA	ETA2	ETA3	ETW1	ETW2
Mean	47.37	48.58	48.61	50.72	51.27	51.79
Stdev	2.539	2.633	0.8739	1.601	3.122	3.501
CV	5.359	5.419	1.798	3.157	6.088	6.760
Mod CV	6.679	6.710	8.000	6.000	7.044	7.380
Min	43.61	43.22	47.36	48.18	45.85	45.75
Max	51.72	52.63	49.83	54.57	55.52	58.18
No. Batches	4	4	1	3	3	3
No. Spec.	24	24	6	18	18	18
Basis Values and Estimates						
B-Estimate	36.43	38.53	45.96	43.44	35.27	28.35
A-Estimate	28.84	31.54	44.08	38.25	23.85	11.63
Method	ANOVA	ANOVA	Normal	ANOVA	ANOVA	ANOVA
Modified CV Basis Values and Estimates						
B-Basis Value	NA	42.55		44.71	NA	NA
B-Estimate			36.83			
A-Estimate		38.22	28.45	40.45		
Method		Normal	Normal	Normal		

Table 4-55: Statistics and Basis Values for OHT1 As-Measured Strength Data

4.16 "10/80/10" Open-Hole Tension (OHT2)

The OHT2 data is normalized, so both normalized and as-measured results were provided. Testing was done in four environmental conditions: CTA, RTA, ETW1, and ETW2. The ETW1 condition tested specimens from one batch of material, so only basis value estimates were provided for that condition.

The results are identical for both the normalized and as-measured datasets. The CTA condition failed the ADK test for batch equivalency. ANOVA was used to compute estimates for CTA. The single point normal method was used for the remaining conditions. Applying the modified CV, the CTA and RTA conditions met all the requirements for pooling and the normal method for modified CV was used for ETW1 and ETW2.

There was one statistical outlier. The highest value in batch D of the ETW2 condition was a batch outlier for both the normalized and as-measured datasets. It was retained for this analysis.

Statistics, basis values and estimates are given for OHT2 strength data in Table 4-56 and Table 4-57. The normalized data, B-basis values and B-estimates are shown graphically in Figure 4-29.

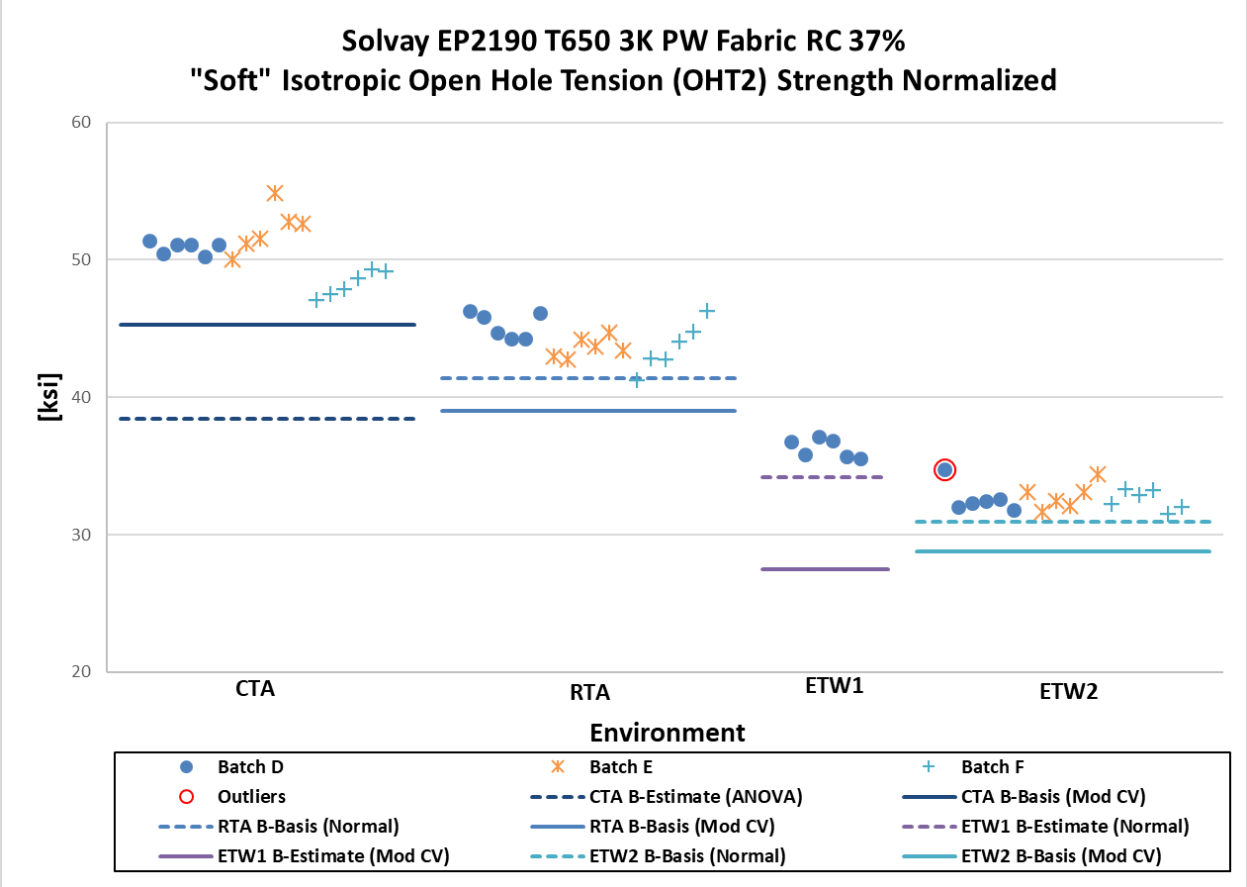

Figure 4-29: Batch Plot for OHT2 Normalized Strength

Normalized Open Hole Tension 2 (OHT2) Strength Basis Values and Statistics				
Environment	CTA	RTA	ETW1	ETW2
Mean	50.45	44.17	36.30	32.66
Stdev	1.978	1.400	0.7007	0.8776
CV	3.920	3.169	1.930	2.687
Mod CV	6.000	6.000	8.000	6.000
Min	47.09	41.22	35.53	31.49
Max	54.88	46.30	37.15	34.74
No. Batches	3	3	1	3
No. Spec.	18	18	6	18
Basis Values and Estimates				
B-Basis Value		41.41		30.93
B-Estimate	38.45		34.18	
A-Estimate	29.88	39.45	32.67	29.70
Method	ANOVA	Normal	Normal	Normal
Modified CV Basis Values and Estimates				
B-Basis Value	45.27	38.99		28.79
B-Estimate			27.51	
A-Estimate	41.74	35.46	21.25	26.05
Method	Pooled	Pooled	Normal	Normal

Table 4-56: Statistics and Basis Values for OHT2 Normalized Strength Data

As-Measured Open Hole Tension 2 (OHT2) Strength Basis Values and Statistics				
Environment	CTA	RTA	ETW1	ETW2
Mean	50.01	43.95	35.42	32.51
Stdev	1.900	1.158	0.8003	1.015
CV	3.799	2.635	2.259	3.123
Mod CV	6.000	6.000	8.000	6.000
Min	47.27	41.91	34.52	30.80
Max	54.60	46.26	36.46	34.47
No. Batches	3	3	1	3
No. Spec.	18	18	6	18
Basis Values and Estimates				
B-Basis Value		41.67		30.51
B-Estimate	38.79		33.00	
A-Estimate	30.79	40.05	31.28	29.09
Method	ANOVA	Normal	Normal	Normal
Modified CV Basis Values and Estimates				
B-Basis Value	44.86	38.81		28.66
B-Estimate			26.84	
A-Estimate	41.36	35.31	20.74	25.93
Method	Pooled	Pooled	Normal	Normal

Table 4-57: Statistics and Basis Values for OHT2 As-Measured Strength Data

4.17 "40/20/40" Open-Hole Tension (OHT3)

The OHT3 data is normalized, so both normalized and as-measured results were provided. Testing was done in four environmental conditions: CTA, RTA, ETW1, and ETW2. The ETW1 condition tested specimens from one batch of material, so only basis value estimates were provided for that condition.

For the normalized dataset, using the non-modified and modified CV, the CTA and RTA conditions met all requirements for pooling and the single point normal method was used for ETW1 and ETW2.

For the as-measured dataset, the ETW2 conditions failed the ADK test for batch equivalency. ANOVA was used to compute estimates for ETW2. The CTA and RTA conditions met all requirements for pooling and the single point normal method was used for ETW1. Applying the modified CV, the CTA and RTA conditions met all requirements for pooling and the normal method for modified CV was used for ETW1 and ETW2.

There were no statistical outliers.

Statistics, basis values and estimates are given for OHT3 strength data in Table 4-58 and Table 4-59. The normalized data, B-basis values and B-estimates are shown graphically in Figure 4-30.

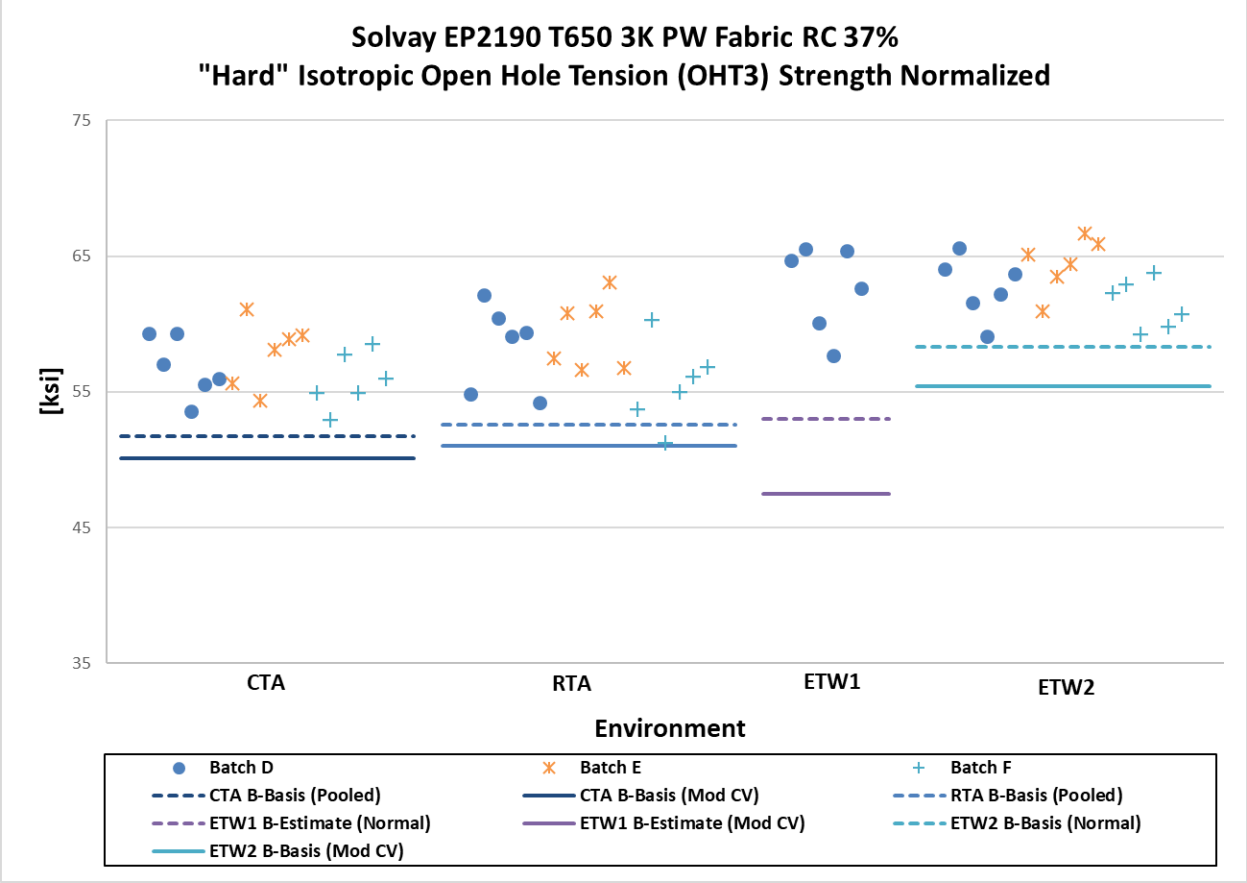

Figure 4-30: Batch Plot for OHT3 Normalized Strength

Normalized Open Hole Tension 3 (OHT3) Strength Basis Values and Statistics				
Environment	CTA	RTA	ETW1	ETW2
Mean	56.84	57.73	62.68	62.86
Stdev	2.295	3.240	3.183	2.286
CV	4.037	5.612	5.078	3.637
Mod CV	6.019	6.806	8.000	6.000
Min	52.92	51.23	57.72	59.13
Max	61.10	63.07	65.51	66.65
No. Batches	3	3	1	3
No. Spec.	18	18	6	18
Basis Values and Estimates				
B-Basis Value	51.72	52.61		58.35
B-Estimate			53.03	
A-Estimate	48.25	49.14	46.18	55.15
Method	Pooled	Pooled	Normal	Normal
Modified CV Basis Values and Estimates				
B-Basis Value	50.13	51.02		55.41
B-Estimate			47.49	
A-Estimate	45.56	46.45	36.69	50.14
Method	Pooled	Pooled	Normal	Normal

Table 4-58: Statistics and Basis Values for OHT3 Normalized Strength Data

As Measured Open Hole Tension 3 (OHT3) Strength Basis Values and Statistics				
Environment	CTA	RTA	ETW1	ETW2
Mean	56.64	57.74	61.36	62.74
Stdev	2.351	3.236	3.119	2.528
CV	4.150	5.604	5.083	4.030
Mod CV	6.075	6.802	8.000	6.015
Min	53.05	51.49	56.50	57.88
Max	61.10	63.55	64.17	67.16
No. Batches	3	3	1	3
No. Spec.	18	18	6	18
Basis Values and Estimates				
B-Basis Value	51.48	52.58		
B-Estimate			51.91	51.46
A-Estimate	47.98	49.08	45.19	43.42
Method	Pooled	Pooled	Normal	ANOVA
Modified CV Basis Values and Estimates				
B-Basis Value	49.91	51.01		55.29
B-Estimate			46.49	
A-Estimate	45.34	46.44	35.92	50.01
Method	Pooled	Pooled	Normal	Normal

Table 4-59: Statistics and Basis Values for OHT3 As-Measured Strength Data

4.18 "25/50/25" Filled-Hole Tension 1 (FHT1)

The FHT1 data is normalized, so both normalized and as-measured results were provided. Testing was done in four environmental conditions: CTA, RTA, ETW1, and ETW2.

For the normalized dataset, the RTA and ETW2 conditions failed the ADK test for batch equivalency. ANOVA was used to compute estimates for those conditions. The single point normal method was used for CTA and ETW1. Applying the modified CV, there were no diagnostic test failures, therefore all conditions were pooled.

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

There was one statistical outlier. The lowest value in batch F of the ETW2 condition was a batch outlier for the normalized dataset. It was retained for this analysis.

Statistics, basis values and estimates are given for FHT1 strength data in Table 4-60 and Table 4-61. The normalized data and B-basis values are shown graphically in Figure 4-31.

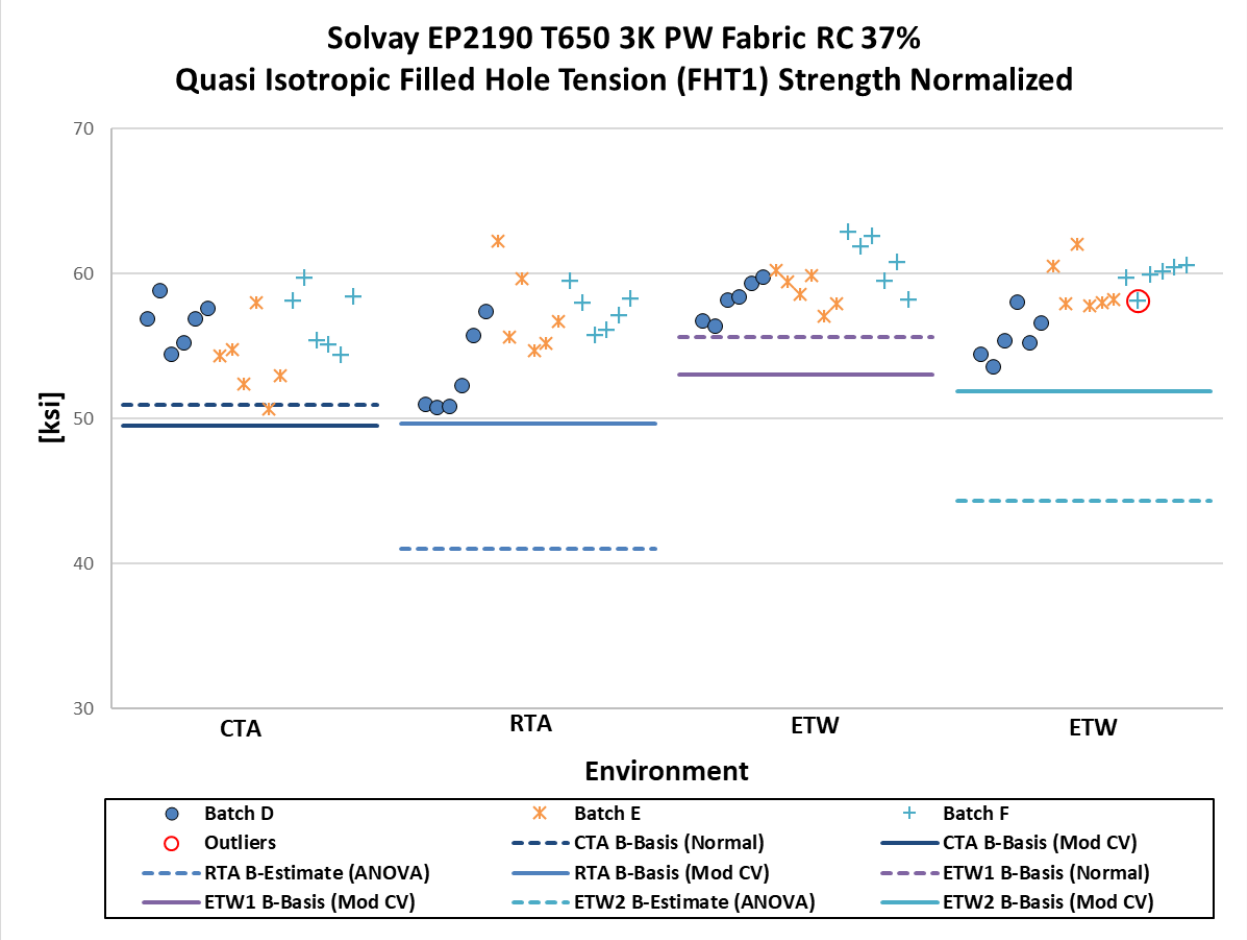

Figure 4-31: Batch plot for FHT1 Normalized Strength

Normalized Filled-Hole Tension 1 (FHT1) Strength Basis Values and Statistics				
Environment	CTA	RTA	ETW1	ETW2
Mean	55.79	55.94	59.32	58.15
Stdev	2.444	3.195	1.885	2.369
CV	4.380	5.711	3.178	4.074
Mod CV	6.190	6.856	6.000	6.037
Min	50.63	50.77	56.35	53.58
Max	59.70	62.27	62.93	62.04
No. Batches	3	3	3	3
No. Spec.	18	18	18	18
Basis Values and Estimates				
B-Basis Value	50.97		55.60	
B-Estimate		41.04		44.34
A-Estimate	47.55	30.41	52.96	34.48
Method	Normal	ANOVA	Normal	ANOVA
Modified CV Basis Values and Estimates				
B-Basis Value	49.52	49.67	53.05	51.88
A-Estimate	45.39	45.54	48.92	47.75
Method	Pooled	Pooled	Pooled	Pooled

Table 4-60: Statistics and Basis Values for FHT1 Normalized Strength Data

As-Measured Filled-Hole Tension 1 (FHT1) Strength Basis Values and Statistics				
Environment	CTA	RTA	ETW1	ETW2
Mean	55.18	55.19	58.65	57.47
Stdev	3.127	3.207	2.476	2.443
CV	5.667	5.810	4.222	4.252
Mod CV	6.834	6.905	6.111	6.126
Min	48.63	50.21	54.89	52.75
Max	59.98	60.27	63.43	60.46
No. Batches	3	3	3	3
No. Spec.	18	18	18	18
Basis Value Estimates				
B-Estimate	38.66	41.42	45.35	43.78
A-Estimate	26.89	31.60	35.87	34.02
Method	ANOVA	ANOVA	ANOVA	ANOVA
Modified CV Basis Values and Estimates				
B-Basis Value	48.76	48.78	52.24	51.05
A-Estimate	44.54	44.55	48.01	46.83
Method	Pooled	Pooled	Pooled	Pooled

Table 4-61: Statistics and Basis Values for FHT1 As-Measured Strength Data

4.19 “10/80/10” Filled-Hole Tension 2 (FHT2)

The FHT2 data is normalized, so both normalized and as-measured results were provided. Testing was done in four environmental conditions: CTA, RTA, ETW1, and ETW2. The ETW1 condition tested specimens from one batch, therefore only basis value estimates are provided for that condition.

The results are identical for both the normalized and as-measured datasets. The CTA condition failed the ADK test for batch equivalency. ANOVA was used to compute estimates for CTA. The single point normal method was used for the remaining conditions. Applying the modified CV, the CTA and RTA conditions met all requirements for pooling and the normal method for modified CV was used for ETW1 and ETW2.

There were two statistical outliers. The highest value in batch E of the ETW2 condition was a batch outlier for both the normalized and as-measured datasets. The lowest value in batch three of the RTA condition was a condition outlier for the as-measured dataset. They were retained for this analysis.

Statistics, basis values and estimates are given for FHT2 strength data in Table 4-62 and Table 4-63. The normalized data and B-basis values are shown graphically in Figure 4-32.

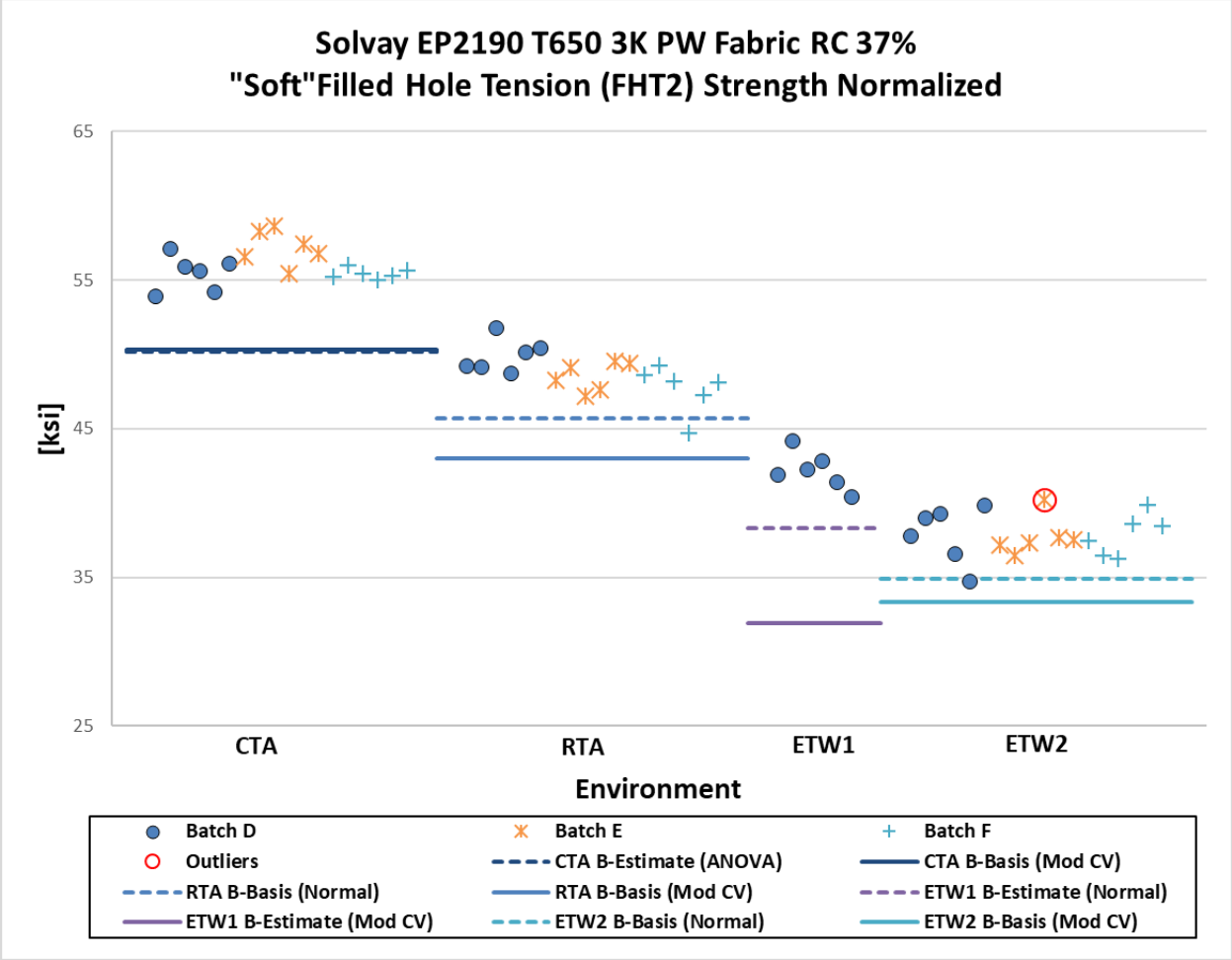

Figure 4-32: Batch Plot for FHT2 Normalized Strength

Normalized Filled-Hole Tension 2 (FHT2) Strength Basis Values and Statistics				
Environment	CTA	RTA	ETW1	ETW2
Mean	56.03	48.70	42.16	37.81
Stdev	1.268	1.509	1.265	1.471
CV	2.264	3.098	3.002	3.891
Mod CV	6.000	6.000	8.000	6.000
Min	53.88	44.74	40.42	34.69
Max	58.60	51.77	44.14	40.19
No. Batches	3	3	1	3
No. Spec.	18	18	6	18
Basis Values and Estimates				
B-Basis Value		45.72		34.90
B-Estimate	50.17		38.33	
A-Estimate	45.99	43.61	35.60	32.85
Method	ANOVA	Normal	Normal	Normal
Modified CV Basis Values and Estimates				
B-Basis Value	50.29	42.96		33.33
B-Estimate			31.94	
A-Estimate	46.39	39.06	24.68	30.16
Method	Pooled	Pooled	Normal	Normal

Table 4-62: Statistics and Basis Values for FHT2 Normalized Strength Data

As-Measured Filled-Hole Tension 2 (FHT2) Strength Basis Values and Statistics				
Environment	CTA	RTA	ETW1	ETW2
Mean	55.45	48.34	40.91	37.54
Stdev	1.545	1.096	1.400	1.722
CV	2.787	2.268	3.422	4.587
Mod CV	6.000	6.000	8.000	6.293
Min	52.37	45.31	39.04	33.46
Max	58.30	50.55	43.10	40.50
No. Batches	3	3	1	3
No. Spec.	18	18	6	18
Basis Value Estimates				
B-Basis Value		46.18		34.14
B-Estimate	46.72		36.67	
A-Estimate	40.49	44.64	33.65	31.73
Method	ANOVA	Normal	Normal	Normal
Modified CV Basis Values and Estimates				
B-Basis Value	49.77	42.66		32.88
B-Estimate			30.99	
A-Estimate	45.90	38.79	23.94	29.57
Method	Pooled	Pooled	Normal	Normal

Table 4-63: Statistics and Basis Values for FHT2 As-Measured Strength Data

4.20 “40/20/40” Filled-Hole Tension 3 (FHT3)

The FHT3 data is normalized, so both normalized and as-measured results were provided. Testing was done in four environmental conditions: CTA, RTA, ETW1, and ETW2. The ETW1 condition tested specimens from one batch, therefore only basis value estimates are provided for that condition.

For the normalized dataset, the ETW2 condition failed the ADK test for batch equivalency. ANOVA was used to compute estimates for ETW2. The CTA and RTA conditions met all requirements for pooling. The single point normal method was used for ETW1. Applying the modified CV, the CTA and RTA condition met all requirements for pooling and the normal method for modified CV was used for ETW1 and ETW2.

For the as-measured dataset, the CTA condition failed the ADK test for batch equivalency. ANOVA was used to compute estimates for CTA. The single point normal method was used for the remaining conditions. Applying the modified CV, the CTA and RTA condition met all requirements for pooling and the normal method for modified CV was used for ETW1 and ETW2.

There were no statistical outliers.

Statistics, basis values and estimates are given for FHT3 strength data in Table 4-64 and Table 4-65. The normalized data and B-basis values are shown graphically in Figure 4-33.

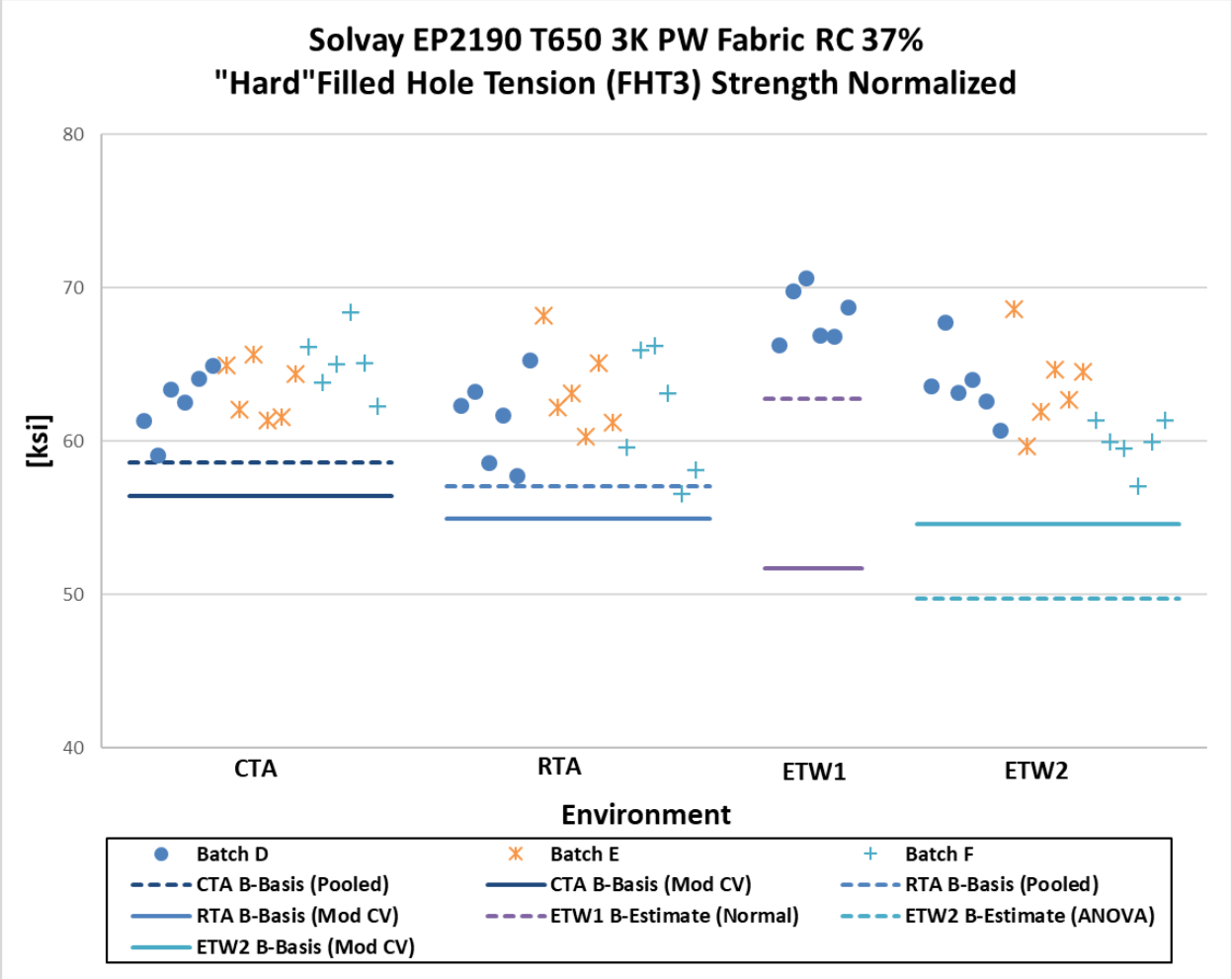

Figure 4-33: Batch Plot for FHT3 Strength Normalized

Normalized Filled-Hole Tension 3 (FHT3) Strength Basis Values and Statistics				
Environment	CTA	RTA	ETW1	ETW2
Mean	63.67	62.14	68.20	62.39
Stdev	2.202	3.256	1.791	2.907
CV	3.458	5.240	2.626	4.659
Mod CV	6.000	6.620	8.000	6.330
Min	59.09	56.52	66.27	57.06
Max	68.40	68.18	70.65	68.62
No. Batches	3	3	1	3
No. Spec.	18	18	6	18
Basis Values and Estimates				
B-Basis Value	58.61	57.08		
B-Estimate			62.77	49.73
A-Estimate	55.16	53.63	58.92	40.71
Method	Pooled	Pooled	Normal	ANOVA
Modified CV Basis Values and Estimates				
B-Basis Value	56.44	54.91		54.60
B-Estimate			51.67	
A-Estimate	51.52	49.99	39.92	49.07
Method	Pooled	Pooled	Normal	Normal

Table 4-64: Statistics and Basis Values for FHT3 Normalized Strength Data

As-Measured Filled-Hole Tension 3 (FHT3) Strength Basis Values and Statistics				
Environment	CTA	RTA	ETW1	ETW2
Mean	63.44	61.87	66.89	62.22
Stdev	2.606	3.326	1.665	2.627
CV	4.107	5.376	2.489	4.222
Mod CV	6.053	6.688	8.000	6.111
Min	58.13	56.55	65.20	58.16
Max	68.84	68.53	69.16	68.45
No. Batches	3	3	1	3
No. Spec.	18	18	6	18
Basis Value Estimates				
B-Basis Value		55.31		57.04
B-Estimate	51.49		61.84	
A-Estimate	42.97	50.65	58.26	53.36
Method	ANOVA	Normal	Normal	Normal
Modified CV Basis Values and Estimates				
B-Basis Value	56.17	54.60		54.72
B-Estimate			50.68	
A-Estimate	51.22	49.66	39.15	49.40
Method	Pooled	Pooled	Normal	Normal

Table 4-65: Statistics and Basis Values for FHT3 As-Measured Strength Data

4.21 "25/50/25" Open-Hole Compression 1 (OHC1)

The OHC1 data is normalized, so both normalized and as-measured results were provided. Testing was done in seven environmental conditions: CTA, RTA, ETA2, ETA3, ETW1, ETW2, and ETW3. The ETA2 condition tested specimens from one batch of material, so only basis value estimates are provided for that condition.

For the normalized dataset, the ETW2 and ETW3 conditions failed the ADK test for batch equivalency. ANOVA was used to compute estimates for those conditions. The CTA, RTA and ETW1 conditions met all requirements for pooling. The single point normal method was used for ETA2 and ETA3. Applying the modified CV, the ETA3 condition failed the normality test and the ETW3 failed the ADK test, therefore basis values could not be computed for those conditions. The CTA, RTA and ETW1 condition met all requirements for pooling and the single method for modified CV was used for ETA2 and ETW2.

For the as-measured dataset, the ETW1, ETW2 and ETW3 conditions failed the ADK test for batch equivalency. ANOVA was used to compute estimates for those conditions. The CTA and RTA conditions met all requirements for pooling. The single point normal method was used for ETA2 and ETA3. Applying the modified CV, the CTA, RTA and ETW1 conditions met all requirements for pooling and the normal method for modified CV was used for the remaining conditions.

There were two statistical outliers. The lowest value in batch D of the CTA condition was a batch outlier for the normalized dataset. The lowest value in batch E of the ETA3 condition was a batch outlier for the normalized dataset. They were retained for this analysis.

Statistics, B-basis values and estimates are given for OHC1 strength data in Table 4-66 and Table 4-67. The normalized data, B-estimates and B-basis values are shown graphically in Figure 4-34 and Figure 4-35.

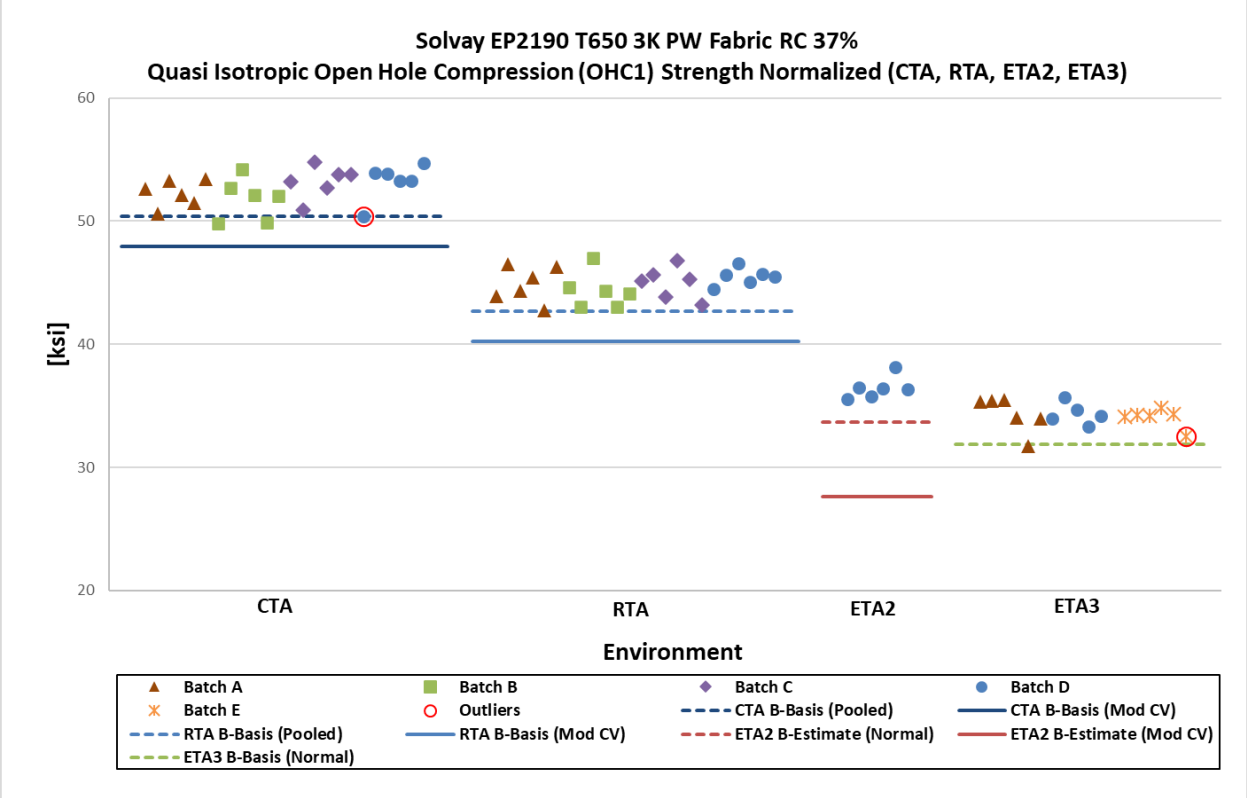

Figure 4-34: Batch Plot for OHC1 Normalized Strength (CTA, RTA, ETA2, ETA3)

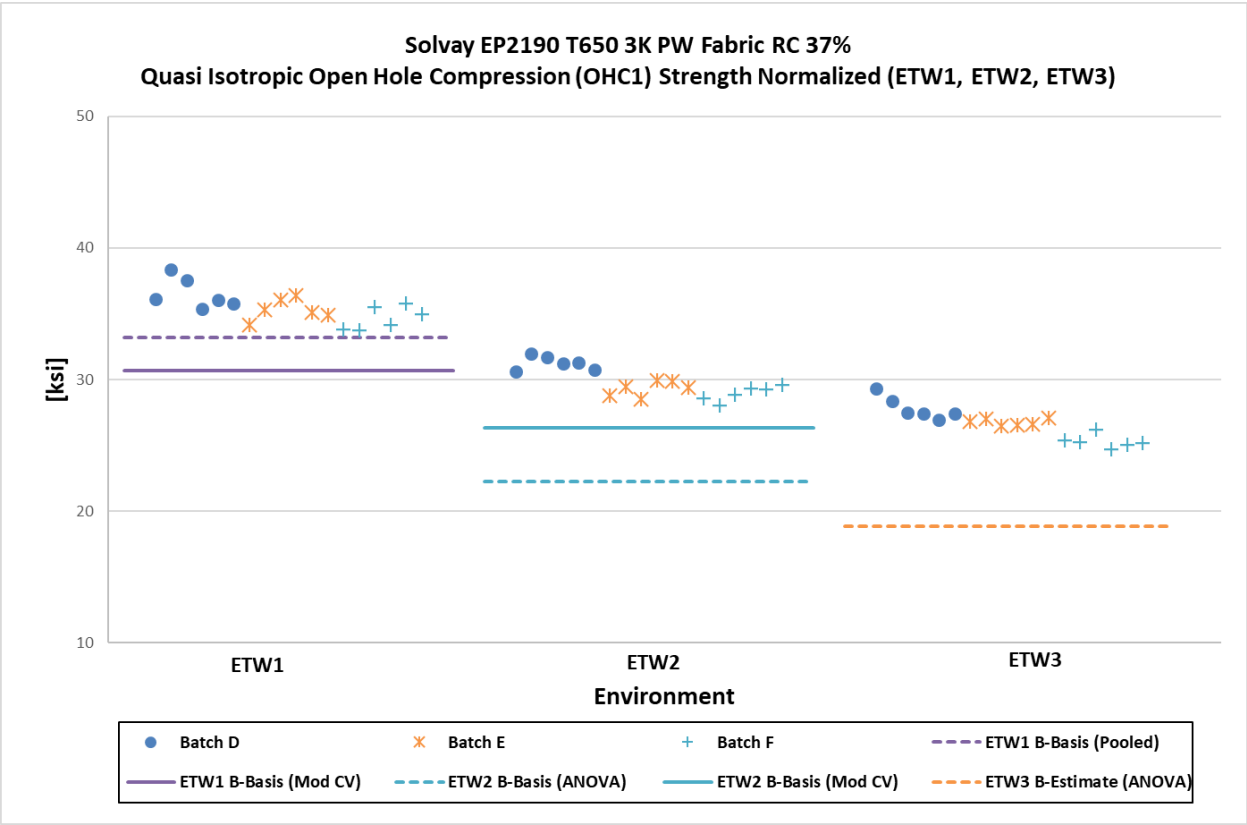

Figure 4-35: Batch Plot for OHC1 Normalized Strength (ETW1, ETW2, ETW3)

Normalized Open Hole Compression 1 (OHC1) Strength Basis Values and Statistics							
Environment	CTA	RTA	ETA2	ETA3	ETW1	ETW2	ETW3
Mean	52.63	44.93	36.45	34.11	35.50	29.84	26.62
Stdev	1.462	1.247	0.9195	1.141	1.206	1.165	1.207
CV	2.779	2.776	2.523	3.344	3.399	3.905	4.533
Mod CV	6.000	6.000	8.000	6.000	6.000	6.000	6.267
Min	49.84	42.78	35.53	31.73	33.75	28.02	24.68
Max	54.81	47.04	38.15	35.70	38.38	31.95	29.32
No. Batches	4	4	1	3	3	3	3
No. Spec.	24	24	6	18	18	18	18
Basis Values and Estimates							
B-Basis Value	50.38	42.69		31.86	33.19		
B-Estimate			33.67			22.27	18.89
A-Estimate	48.84	41.15	31.69	30.26	31.66	16.87	13.37
Method	Pooled	Pooled	Normal	Normal	Pooled	ANOVA	ANOVA
Modified CV Basis Values and Estimates							
B-Basis Value	47.95	40.26		NA	30.69	26.30	NA
B-Estimate			27.62				
A-Estimate	44.75	37.06	21.34		27.52	23.80	
Method	Pooled	Pooled	Normal		Pooled	Normal	

Table 4-66: Statistics and Basis Values for OHC1 Normalized Strength Data

As-Measured Open Hole Compression 1 (OHC1) Strength Basis Values and Statistics							
Environment	CTA	RTA	ETA2	ETA3	ETW1	ETW2	ETW3
Mean	52.14	44.57	36.13	33.47	34.96	29.39	26.20
Stdev	1.473	1.227	0.9668	1.239	1.269	1.314	1.170
CV	2.824	2.754	2.676	3.701	3.629	4.473	4.467
Mod CV	6.000	6.000	8.000	6.000	6.000	6.236	6.233
Min	49.29	42.42	35.14	31.32	33.09	27.40	24.58
Max	54.34	46.46	37.85	35.39	37.96	31.53	29.00
No. Batches	4	4	1	3	3	3	3
No. Spec.	24	24	6	18	18	18	18
Basis Values and Estimates							
B-Basis Value	49.79	42.21		31.03			
B-Estimate			33.20		28.60	20.45	18.78
A-Estimate	48.16	40.58	31.11	29.29	24.07	14.07	13.48
Method	Pooled	Pooled	Normal	Normal	ANOVA	ANOVA	ANOVA
Modified CV Basis Values and Estimates							
B-Basis Value	47.52	39.94		29.51	30.20	25.77	22.98
B-Estimate			27.37				
A-Estimate	44.35	36.77	21.15	26.70	27.06	23.20	20.69
Method	Pooled	Pooled	Normal	Normal	Pooled	Normal	Normal

Table 4-67: Statistics and Basis Values for OHC1 As-Measured Strength Data

4.22 "10/80/10" Open-Hole Compression 2 (OHC2)

The OHC2 data is normalized, so both normalized and as-measured results were provided. Testing was done in six environmental conditions: RTA, ETA2, ETA3, ETW1, ETW2, and ETW3. The ETA2 and ETA3 conditions tested specimens from one batch of material, so only basis value estimates are provided for those conditions.

The results are identical for both the normalized and as-measured datasets. The ETW2 and ETW3 conditions failed the ADK test for batch equivalency. ANOVA was used to compute estimates for those conditions. The RTA and ETW1 conditions met all requirements for pooling. The single point normal method was used for ETA2 and ETA3. Applying the modified CV, the RTA and ETW1 conditions met all requirements for pooling and the normal method for modified CV was used for the remaining conditions.

There was one statistical outlier. The lowest value in batch F of the RTA condition was a batch outlier for the normalized dataset. It was retained for this analysis.

Statistics, B-basis values and estimates are given for OHC2 strength data in Table 4-68 and Table 4-69. The normalized data, B-estimates and B-basis values are shown graphically in Figure 4-36 and Figure 4-37.

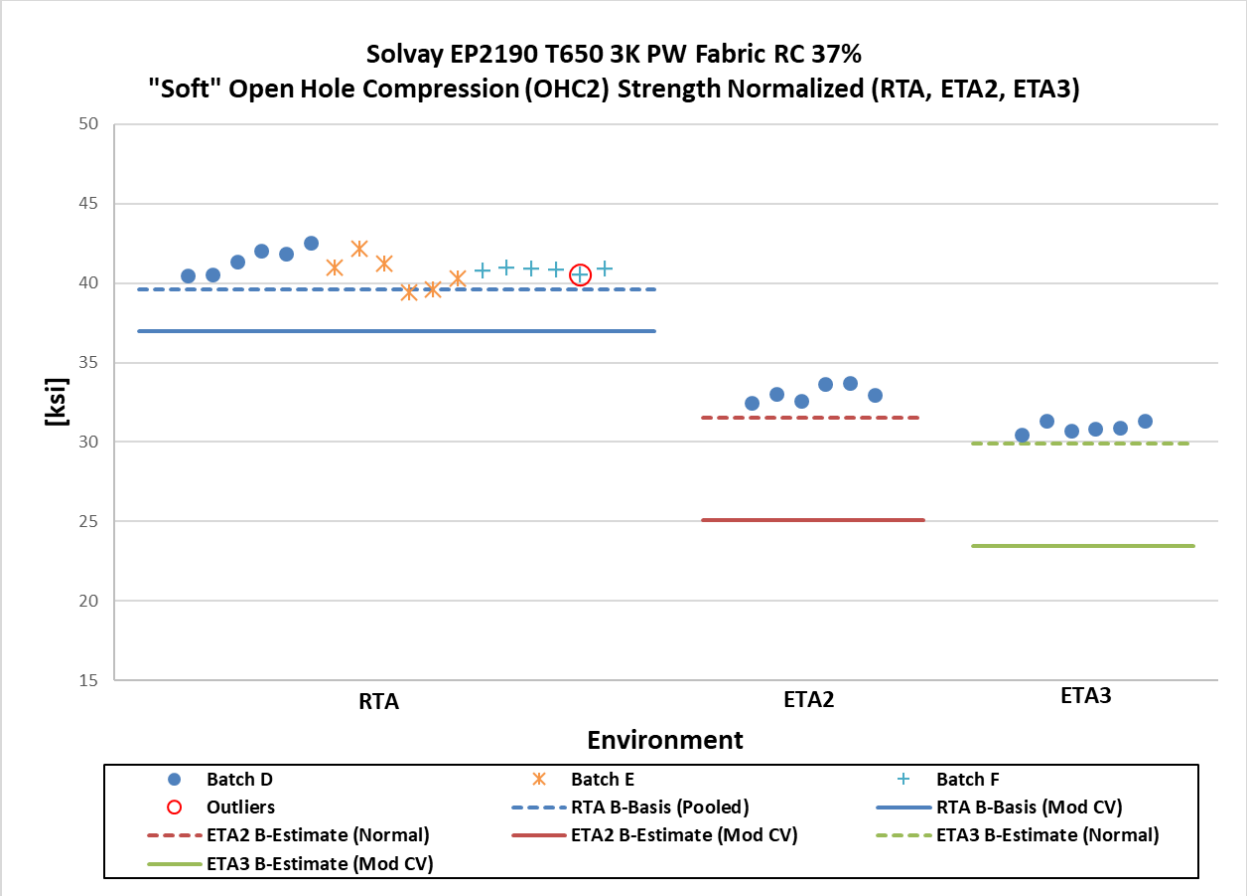

Figure 4-36: Batch Plot for OHC2 Normalized Strength (RTA, ETA2, ETA3)

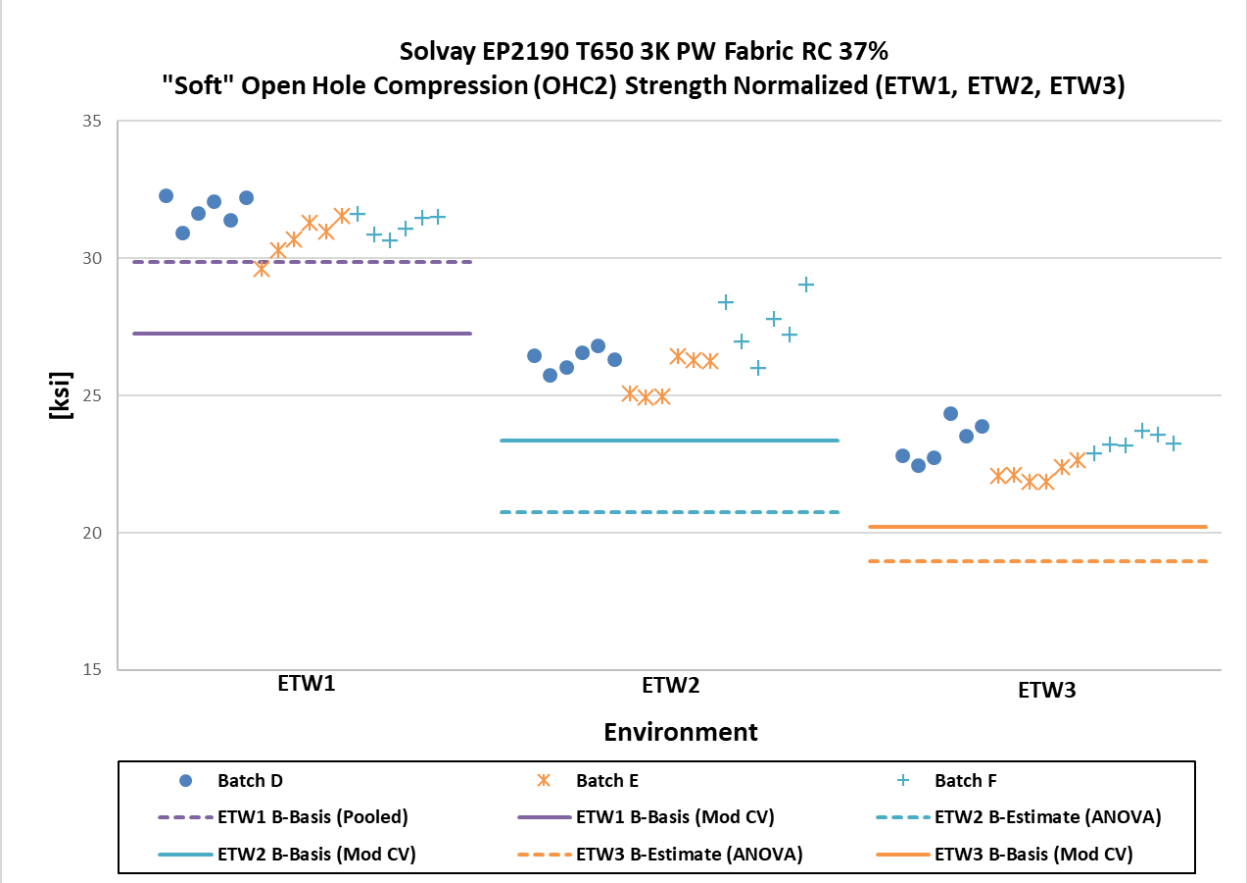

Figure 4-37: Batch Plot for OHC2 Normalized Strength (ETW1, ETW2, ETW3)

Normalized Open Hole Compression 2 (OHC2) Strength Basis Values and Statistics						
Environment	RTA	ETA2	ETA3	ETW1	ETW2	ETW3
Mean	40.97	33.08	30.94	31.24	26.52	22.93
Stdev	0.8176	0.5207	0.3489	0.6810	1.096	0.7304
CV	1.996	1.574	1.128	2.180	4.134	3.186
Mod CV	6.000	8.000	8.000	6.000	6.067	6.000
Min	39.44	32.47	30.48	29.63	24.94	21.85
Max	42.52	33.69	31.37	32.30	29.05	24.37
No. Batches	3	1	1	3	3	3
No. Spec.	18	6	6	18	18	18
Basis Values and Estimates						
B-Basis Value	39.60			29.87		
B-Estimate		31.50	29.88		20.77	18.95
A-Estimate	38.67	30.38	29.13	28.94	16.66	16.12
thod	Pooled	Normal	Normal	Pooled	ANOVA	ANOVA
Modified CV Basis Values and Estimates						
B-Basis Value	36.99			27.26	23.35	20.21
B-Estimate		25.06	23.44			
A-Estimate	34.28	19.36	18.11	24.55	21.09	18.29
thod	Pooled	Normal	Normal	Pooled	Normal	Normal

Table 4-68: Statistics and Basis Values for OHC2 Normalized Strength Data

As-Measured Open Hole Compression 2 (OHC2) Strength Basis Values and Statistics						
Environment	RTA	ETA2	ETA3	ETW1	ETW2	ETW3
Mean	40.79	32.37	30.27	31.08	26.34	22.79
Stdev	0.6672	0.2867	0.3700	0.5552	1.222	0.6436
CV	1.636	0.8856	1.222	1.786	4.640	2.824
Mod CV	6.000	8.000	8.000	6.000	6.320	6.000
Min	39.73	32.08	29.94	30.05	24.83	21.85
Max	42.21	32.68	30.90	32.08	29.01	23.88
No. Batches	3	1	1	3	3	3
No. Spec.	18	6	6	18	18	18
Basis Values and Estimates						
B-Basis Value	39.67			29.96		
B-Estimate		31.50	29.15		19.19	18.98
A-Estimate	38.91	30.89	28.36	29.20	14.09	16.25
thod	Pooled	Normal	Normal	Pooled	ANOVA	ANOVA
Modified CV Basis Values and Estimates						
B-Basis Value	36.82			27.11	23.05	20.09
B-Estimate		24.53	22.94			
A-Estimate	34.13	18.95	17.72	24.42	20.72	18.18
thod	Pooled	Normal	Normal	Pooled	Normal	Normal

Table 4-69: Statistics and Basis Values for OHC2 As-Measured Strength Data

4.23 “40/20/40” Open-Hole Compression 3 (OHC3)

The OHC3 data is normalized, so both normalized and as-measured results were provided. Testing was done in six environmental conditions: RTA, ETA2, ETA3, ETW1, ETW2, and ETW3. The ETA2 and ETA3 conditions tested specimens from one batch of material, so only basis value estimates are provided for those conditions.

For the normalized dataset, the ETW2 and ETW3 conditions failed the ADK test for batch equivalency. ANOVA was used to compute estimates for those conditions. RTA and ETW1 met all requirements for pooling. The single point normal method was used for ETA2 and ETA3. Applying the modified CV, the RTA and ETW1 conditions met all requirements for pooling. The normal method for modified CV was used for the remaining conditions.

For the as-measured dataset, the ETW2 condition failed the ADK test for batch equivalency. ANOVA was used to compute estimates for that condition. RTA and ETW1 met all requirements for pooling. The single point normal method was used for the remaining conditions. Applying the modified CV, the RTA and ETW1 conditions met all requirements for pooling. The normal method for modified CV was used for the remaining conditions.

There were two statistical outliers. The lowest value in batch F of the ETW1 condition was a batch outlier for both the normalized and as-measured datasets. The highest value in batch F of the ETW3 condition was a condition outlier for the as-measured dataset. They were retained for this analysis.

Statistics, B-basis values and estimates are given for OHC3 strength data in Table 4-70 and Table 4-71. The normalized data, B-estimates and B-basis values are shown graphically in Figure 4-38 and Figure 4-39.

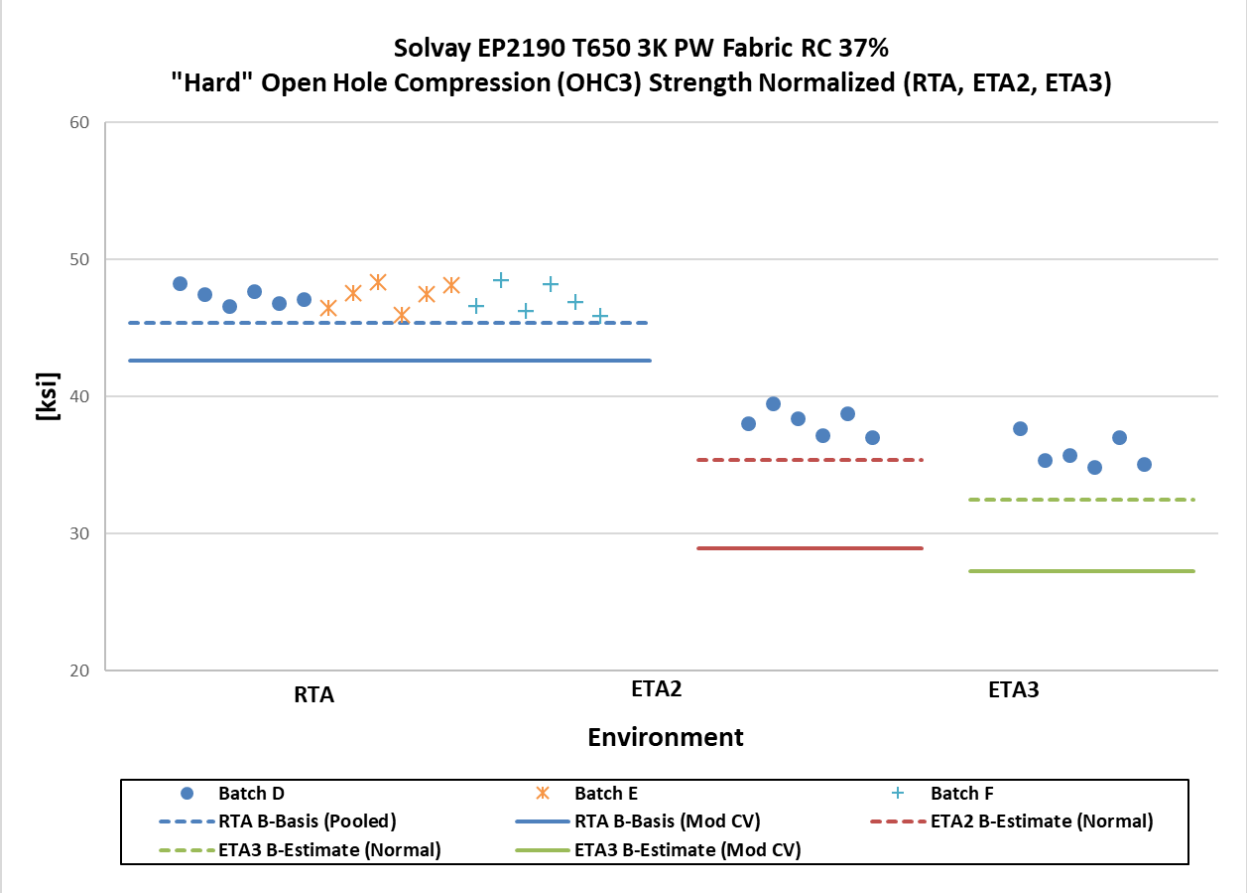

Figure 4-38: Batch Plot for OHC3 Normalized Strength (RTA, ETA2, ETA3)

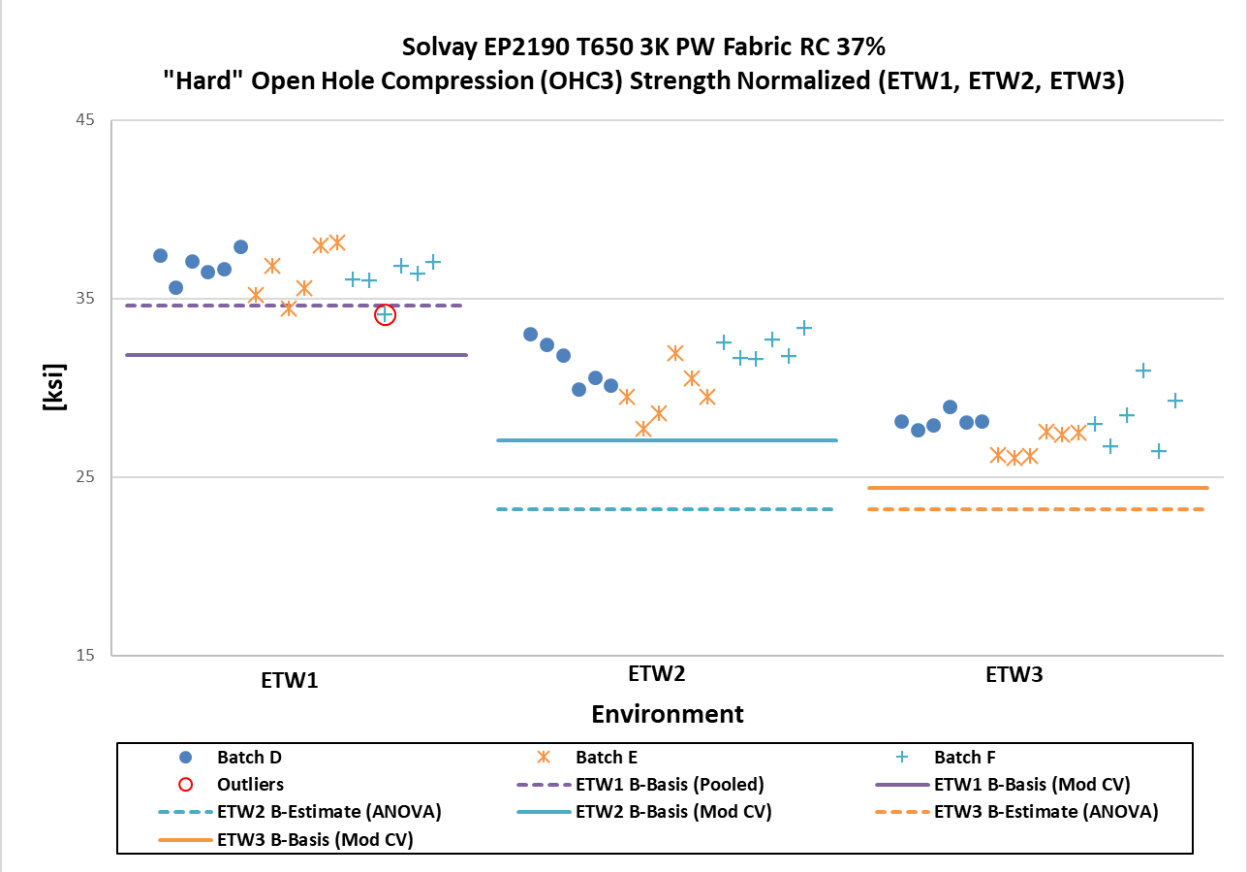

Figure 4-39: Batch Plot for OHC3 Normalized Strength (ETW1, ETW2, ETW3)

Normalized Open Hole Compression 3 (OHC3) Strength Basis Values and Statistics						
Environment	RTA	ETA2	ETA3	ETW1	ETW2	ETW3
Mean	47.23	38.17	35.95	36.43	31.06	27.75
Stdev	0.8518	0.9260	1.154	1.146	1.595	1.221
CV	1.804	2.426	3.210	3.146	5.134	4.399
Mod CV	6.000	8.000	8.000	6.000	6.567	6.200
Min	45.88	37.07	34.86	34.09	27.70	26.08
Max	48.50	39.47	37.72	38.14	33.34	30.93
No. Batches	3	1	1	3	3	3
No. Spec.	18	6	6	18	18	18
Basis Values and Estimates						
B-Basis Value	45.39			34.59		
B-Estimate		35.37	32.45		23.18	23.16
A-Estimate	44.14	33.38	29.97	33.34	17.56	19.89
Method	Pooled	Normal	Normal	Pooled	ANOVA	ANOVA
Modified CV Basis Values and Estimates						
B-Basis Value	42.62			31.82	27.04	24.36
B-Estimate		28.92	27.24			
A-Estimate	39.48	22.35	21.04	28.68	24.18	21.95
Method	Pooled	Normal	Normal	Pooled	Normal	Normal

Table 4-70: Statistics and Basis Values for OHC3 Normalized Strength Data

As-Measured Open Hole Compression 3 (OHC3) Strength Basis Values and Statistics						
Environment	RTA	ETA2	ETA3	ETW1	ETW2	ETW3
Mean	46.93	37.25	35.08	36.19	30.77	27.54
Stdev	1.026	1.017	1.259	1.093	1.670	1.252
CV	2.187	2.729	3.589	3.019	5.428	4.545
Mod CV	6.000	8.000	8.000	6.000	6.714	6.273
Min	45.30	36.00	33.81	34.18	27.56	25.96
Max	48.75	38.66	37.20	38.12	33.15	31.15
No. Batches	3	1	1	3	3	3
No. Spec.	18	6	6	18	18	18
Basis Values and Estimates						
B-Basis Value	44.99			34.26		25.07
B-Estimate		34.17	31.27		22.47	
A-Estimate	43.68	31.98	28.56	32.95	16.55	23.32
Method	Pooled	Normal	Normal	Pooled	ANOVA	Normal
Modified CV Basis Values and Estimates						
B-Basis Value	42.35			31.61	26.69	24.13
B-Estimate		28.22	26.58			
A-Estimate	39.23	21.80	20.54	28.50	23.80	21.71
Method	Pooled	Normal	Normal	Pooled	Normal	Normal

Table 4-71: Statistics and Basis Values for OHC3 As-Measured Strength Data

4.24 “25/50/25” Filled-Hole Compression 1 (FHC1)

The FHC1 data is normalized, so both normalized and as-measured results were provided. Testing was done in four environmental conditions: CTA, RTA, ETW1, and ETW2.

For the normalized dataset, the CTA and RTA conditions failed the ADK test for batch equivalency. ANOVA was used to compute estimates for those conditions. The ETW2 condition failed the normality test, but the Weibull distribution was a good fit for the dataset. The single point normal method was used for ETW1. Applying the modified CV, there were no diagnostic test failures, therefore all conditions were pooled.

For the as-measured dataset, the ETW2 condition failed the ADK test for batch equivalency. ANOVA was used to compute estimates for that condition. The RTA condition failed the normality test, but the Weibull distribution was a good fit for the dataset. The single point normal method was used for CTA and ETW1. Applying the modified CV, there were no diagnostic test failures, therefore all conditions were pooled.

There were five statistical outliers. The lowest value in batch D of the RTA condition was a batch outlier for the normalized dataset and a batch and condition outlier for the as-measured dataset. The highest value in batch E of the RTA condition was a batch outlier for the as-measured dataset. The lowest value in batch F of the RTA condition was a batch outlier for both the normalized and as-measured datasets. The lowest value in batch D of the ETW2 condition was a batch outlier for both the normalized and as-measured datasets. The lowest value in batch F of the ETW1 condition was a batch and condition outlier for both the normalized and as-measured datasets. They were retained for this analysis.

Statistics, B-basis values and estimates are given for FHC1 strength data in Table 4-72 and Table 4-73. The normalized data, B-estimates and B-basis values are shown graphically in Figure 4-40.

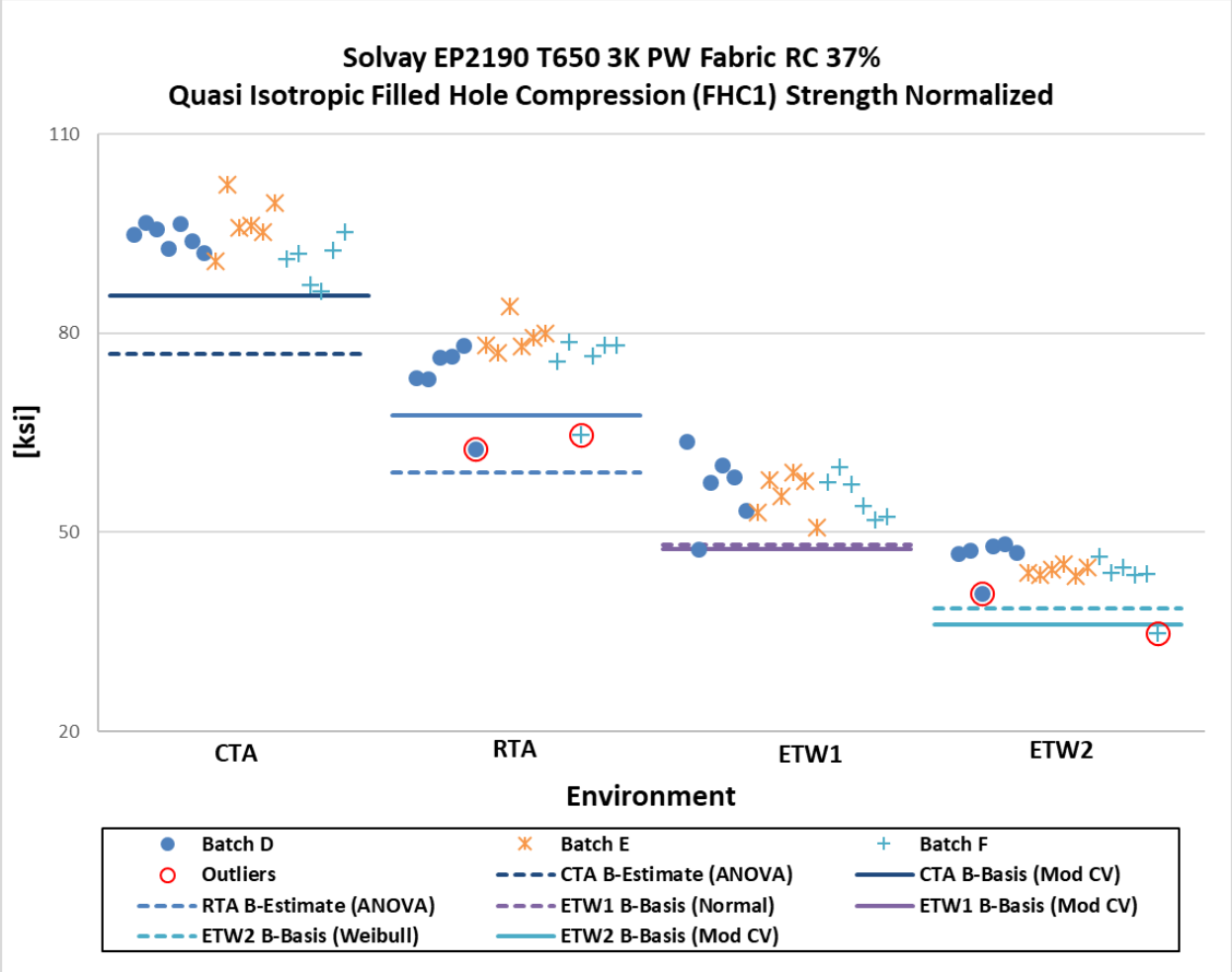

Figure 4-40: Batch Plot for FHC1 Normalized Strength

Normalized Filled-Hole Compression 1 (FHC1) Strength Basis Values and Statistics				
Environment	CTA	RTA	ETW1	ETW2
Mean	94.07	76.03	55.92	44.45
Stdev	3.820	5.118	3.977	3.073
CV	4.060	6.732	7.112	6.914
Mod CV	6.030	7.366	7.556	7.457
Min	86.35	62.63	47.53	34.85
Max	102.3	84.04	63.64	48.35
No. Batches	3	3	3	3
No. Spec.	19	18	18	18
Basis Values and Estimates				
B-Basis Value			48.07	38.46
B-Estimate	76.82	58.93		
A-Estimate	64.52	46.75	42.50	32.58
Method	ANOVA	ANOVA	Normal	Weibull
Modified CV Basis Values and Estimates				
B-Basis Value	85.71	67.63	47.51	36.04
A-Estimate	80.17	62.09	41.98	30.50
Method	Pooled	Pooled	Pooled	Pooled

Table 4-72: Statistics and Basis Values for FHC1 Normalized Strength Data

As-Measured Filled-Hole Compression 1 (FHC1) Strength Basis Values and Statistics				
Environment	CTA	RTA	ETW1	ETW2
Mean	93.02	74.87	55.03	43.79
Stdev	3.828	4.684	4.131	3.190
CV	4.116	6.256	7.506	7.286
Mod CV	6.058	7.128	7.753	7.643
Min	86.69	62.04	47.08	34.71
Max	102.2	81.09	62.94	48.08
No. Batches	3	3	3	3
No. Spec.	19	18	18	18
Basis Values and Estimates				
B-Basis Value	85.56	66.37	46.88	
B-Estimate				33.37
A-Estimate	80.26	57.74	41.10	25.96
Method	Normal	Weibull	Normal	ANOVA
Modified CV Basis Values and Estimates				
B-Basis Value	84.79	66.59	46.75	35.50
A-Estimate	79.32	61.13	41.30	30.05
Method	Pooled	Pooled	Pooled	Pooled

Table 4-73: Statistics and Basis Values for FHC1 As-Measured Strength Data

4.25 “10/80/10” Filled-Hole Compression 2 (FHC2)

The FHC2 data is normalized, so both normalized and as-measured results were provided. Testing was done in three environmental conditions: RTA, ETW1, and ETW2. The ETW1 condition tested specimen from one batch, so only basis value estimates are provided for that condition.

For the normalized dataset, the ETW2 condition failed all the distributions tests. The single point non-parametric method was used for that condition. The single point normal method was used for RTA and ETW1. Applying the modified CV, the normal method for modified CV was used for all conditions.

For the as-measured dataset, the CTA and ETW2 conditions failed the ADK test for batch equivalency. ANOVA was used to compute estimates for those conditions. The single point normal method was used for ETW1. Applying the modified CV, the normal method for modified CV was used for all conditions.

There were no statistical outliers.

Statistics, B-basis values and estimates are given for FHC2 strength data in Table 4-74. The normalized data, B-estimates and B-basis values are shown graphically in Figure 4-41.

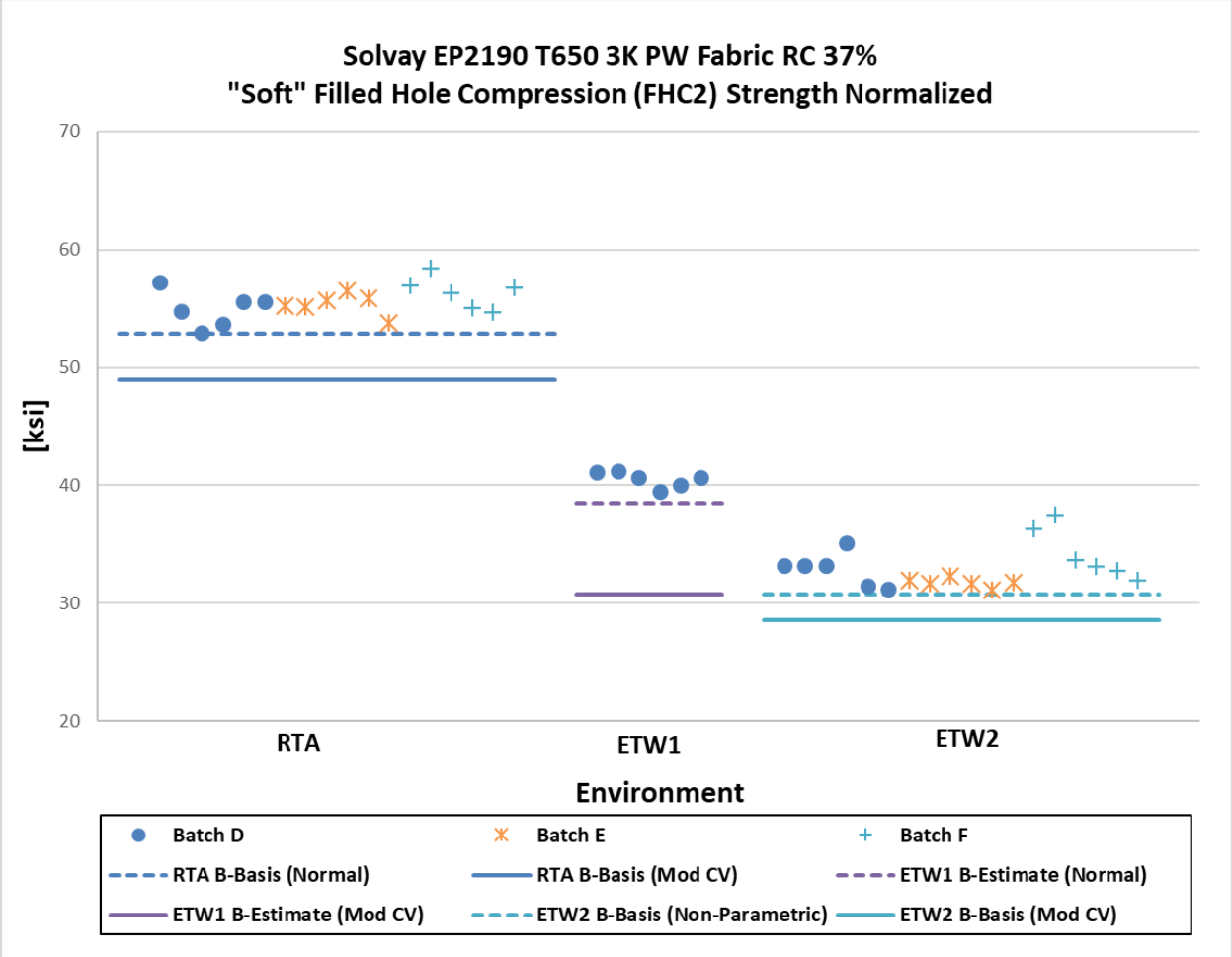

Figure 4-41: Batch Plot for FHC2 Normalized Strength

Filled Hole Compression 2 (FHC2)Strength Basis Values and Statistics						
	Normalized			As-Measured		
Environment	RTA	ETW1	ETW2	RTA	ETW1	ETW2
Mean	55.57	40.54	32.95	55.15	39.48	32.66
Stdev	1.365	0.6797	1.760	1.816	1.034	1.871
CV	2.456	1.677	5.341	3.293	2.620	5.729
Mod CV	6.000	8.000	6.670	6.000	8.000	6.865
Min	52.98	39.47	31.16	51.96	38.05	30.02
Max	58.42	41.22	37.49	58.75	40.54	37.51
No. Batches	3	1	3	3	1	3
No. Spec.	18	6	18	18	6	18
Basis Values and Estimates						
B-Basis Value	52.87		30.77			
B-Estimate		38.48		46.52	36.35	24.52
A-Estimate	50.97	37.02	23.63	40.37	34.12	18.73
Method	Normal	Normal	Non-Parm.	ANOVA	Normal	ANOVA
Modified CV Basis Values and Estimates						
B-Basis Value	48.99		28.61	48.61		28.23
B-Estimate		30.72			29.92	
A-Estimate	44.32	23.73	25.54	43.99	23.11	25.09
Method	Normal	Normal	Normal	Normal	Normal	Normal

Table 4-74: Statistics and Basis Values for FHC2 Strength Data

4.26 "40/20/40" Filled-Hole Compression 3 (FHC3)

The FHC3 data is normalized, so both normalized and as-measured results were provided. Testing was done in three environmental conditions: RTA, ETW1, and ETW2. The ETW1 condition tested specimen from one batch, so only basis value estimates are provided for that condition.

Results were identical for both the normalized and as-measured datasets. The RTA condition failed the ADK test for batch equivalency. ANOVA was used to compute estimates for that condition. The single point normal method was used for ETW1 and ETW2. Applying the modified CV, the RTA condition failed the ADK test, therefore basis value could not be computed for that condition. The normal method for modified CV was used for ETW1 and ETW2.

There was one statistical outlier. The lowest value in batch F of the RTA condition was a batch outlier for the as-measured dataset. It was retained for this analysis.

Statistics, B-basis values and estimates are given for FHC3 strength data in Table 4-75. The normalized data, B-estimates and B-basis values are shown graphically in Figure 4-42.

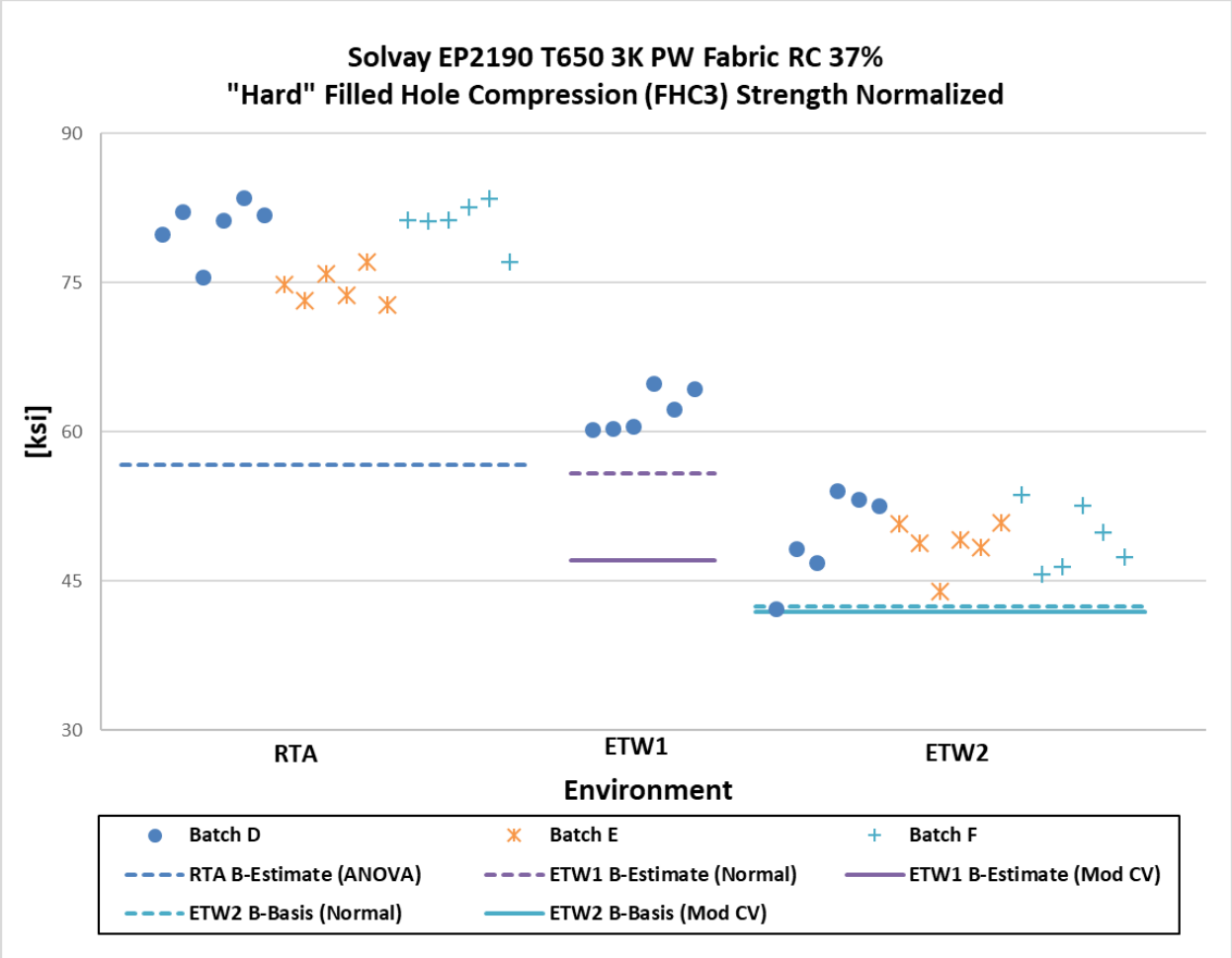

Figure 4-42: Batch Plot for FHC3 Normalized Strength

Filled Hole Compression 3 (FHC3)Strength Basis Values and Statistics						
	Normalized			As-Measured		
Environment	RTA	ETW1	ETW2	RTA	ETW1	ETW2
Mean	78.80	62.11	49.13	78.47	60.83	48.83
Stdev	3.753	2.088	3.386	3.610	1.584	3.243
CV	4.762	3.361	6.892	4.601	2.605	6.641
Mod CV	6.381	8.000	7.446	6.301	8.000	7.320
Min	72.72	60.22	42.17	72.81	59.36	41.67
Max	83.55	64.91	54.05	83.66	63.11	54.01
No. Batches	3	1	3	3	1	3
No. Spec.	18	6	18	18	6	18
Basis Values and Estimates						
B-Basis Value			42.44			42.43
B-Estimate	56.62	55.79		56.51	56.03	
A-Estimate	40.79	51.30	37.71	40.84	52.62	37.89
Method	ANOVA	Normal	Normal	ANOVA	Normal	Normal
Modified CV Basis Values and Estimates						
B-Basis Value	NA		41.91	NA		41.77
B-Estimate		47.06			46.09	
A-Estimate		36.36	36.79		35.61	36.77
Method		Normal	Normal		Normal	Normal

Table 4-75: Statistics and Basis Values for FHC3 Strength Data

4.27 “25/50/25” Single-Shear Bearing 1 (SSB1)

The SSB1 data is normalized, so both normalized and as-measured results were provided. Testing was done in five environmental conditions: CTA, RTA, ETW1, ETW2, and ETW3.

For the 2% offset strength property, results are identical for the normalized and as-measured datasets. The ETW3 condition failed the ADK test for batch equivalency. ANOVA was used to compute estimates for that condition. Pooling the remaining condition was not possible because the pooled dataset failed the Levene’s test for equality of variances. RTA, ETW1, and ETW2 met all requirements for pooling. The single point normal method was used for CTA. Applying the modified CV, there were no diagnostic test failures, therefore all conditions were pooled.

For the ultimate strength dataset, for the normalized dataset, the CTA, RTA, and ETW3 conditions failed the ADK test for batch equivalency. ANOVA was used to compute estimates for those conditions. The single point normal method was used for ETW1 and ETW2. Applying the modified CV, pooling all conditions was not possible because the pooled dataset failed the normality test. RTA, ETW1, ETW2, and ETW3 met all requirements for pooling and the normal method for modified CV was used for CTA.

For the ultimate strength dataset, for the as-measured dataset, the CTA and ETW3 conditions failed the ADK test for batch equivalency. ANOVA was used to compute estimates for those conditions. The remaining conditions met all requirements for pooling. Applying the modified CV, there were no diagnostic test failures, therefore all conditions were pooled.

There were no statistical outliers.

Statistics, B-basis values and estimates are given for SSB1 strength data in Table 4-76, Table 4-77, Table 4-78, Table 4-79 and for SSB1 chord stiffness data in Table 4-80 and Table 4-81. The normalized data, B-estimates and B-basis values are shown graphically for 2% offset strength in Figure 4-43 and for ultimate strength in Figure 4-44.

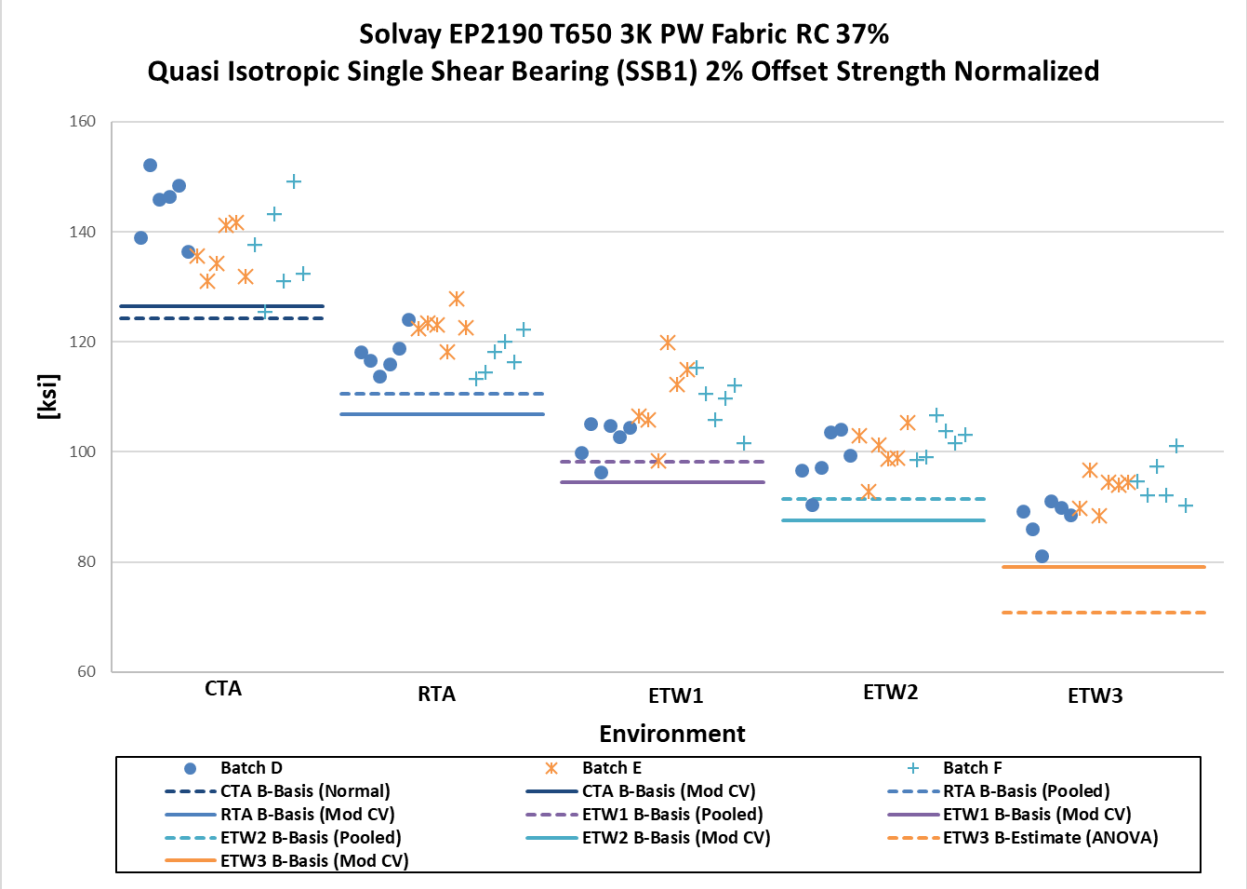

Figure 4-43: Batch Plot for SSB1 Normalized 2% Offset Strength

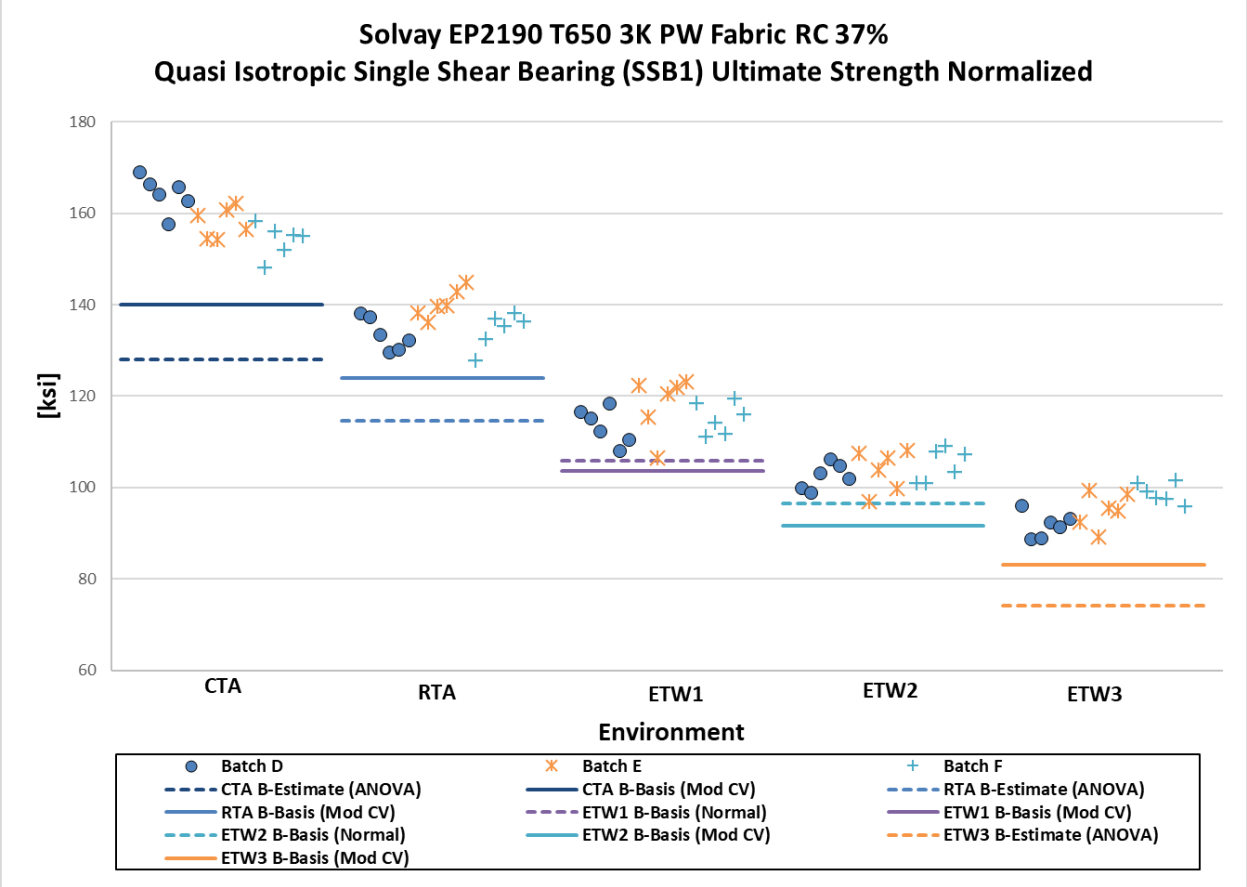

Figure 4-44: Batch Plot for SSB1 Normalized Ultimate Strength

Normalized Single Shear Bearing 1 (SSB1) 2% Offset Strength Basis Values and Statistics					
Environment	CTA	RTA	ETW1	ETW2	ETW3
Mean	139.1	119.4	107.0	100.2	91.75
Stdev	7.465	4.043	6.300	4.265	4.551
CV	5.368	3.385	5.887	4.255	4.960
Mod CV	6.684	6.000	6.943	6.128	6.480
Min	125.4	113.2	96.42	90.37	81.16
Max	152.2	127.9	119.9	106.6	101.1
No. Batches	3	3	3	3	3
No. Spec.	18	18	18	18	18
Basis Values and Estimates					
B-Basis Value	124.3	110.6	98.21	91.42	
B-Estimate					70.72
A-Estimate	113.9	104.7	92.34	85.54	55.72
Method	Normal	Pooled	Pooled	Pooled	ANOVA
Modified CV Basis Values and Estimates					
B-Basis Value	126.5	106.8	94.40	87.61	79.13
A-Estimate	118.2	98.55	86.15	79.36	70.88
Method	Pooled	Pooled	Pooled	Pooled	Pooled

Table 4-76: Statistics and Basis Values for SSB1 Normalized 2% Offset Strength Data

As-Measured Single Shear Bearing 1 (SSB1) 2% Offset Strength Basis Values and Statistics					
Environment	CTA	RTA	ETW1	ETW2	ETW3
Mean	137.1	118.2	105.9	98.98	90.73
Stdev	7.586	3.205	6.074	4.644	4.776
CV	5.533	2.712	5.736	4.692	5.264
Mod CV	6.766	6.000	6.868	6.346	6.632
Min	125.9	112.8	95.51	89.73	80.46
Max	149.9	123.9	115.9	107.2	101.2
No. Batches	3	3	3	3	3
No. Spec.	18	18	18	18	18
Basis Values and Estimates					
B-Basis Value	122.1	109.7	97.41	90.50	
B-Estimate					67.84
A-Estimate	111.5	104.0	91.76	84.85	51.52
Method	Normal	Pooled	Pooled	Pooled	ANOVA
Modified CV Basis Values and Estimates					
B-Basis Value	124.5	105.6	93.30	86.38	78.14
A-Estimate	116.3	97.35	85.06	78.15	69.91
Method	Pooled	Pooled	Pooled	Pooled	Pooled

Table 4-77: Statistics and Basis Values for SSB1 As-Measured 2% Offset Strength Data

Normalized Single Shear Bearing 1 (SSB1) Ultimate Strength Basis Values and Statistics					
Environment	CTA	RTA	ETW1	ETW2	ETW3
Mean	158.7	136.1	115.6	103.7	95.16
Stdev	5.478	4.522	4.910	3.653	4.119
CV	3.451	3.324	4.246	3.522	4.329
Mod CV	6.000	6.000	6.123	6.000	6.164
Min	148.1	127.8	106.6	96.88	88.57
Max	169.0	144.9	123.1	109.2	101.6
No. Batches	3	3	3	3	3
No. Spec.	18	18	18	18	18
Basis Values and Estimates					
B-Basis Value			105.9	96.49	
B-Estimate	128.1	114.7			74.04
A-Estimate	106.2	99.46	99.08	91.38	58.98
Method	ANOVA	ANOVA	Normal	Normal	ANOVA
Modified CV Basis Values and Estimates					
B-Basis Value	139.9	124.0	103.6	91.68	83.13
A-Estimate	126.6	116.1	95.69	83.75	75.21
Method	Normal	Pooled	Pooled	Pooled	Pooled

Table 4-78: Statistics and Basis Values for SSB1 Normalized Ultimate Strength Data

As-Measured Single Shear Bearing 1 (SSB1) Ultimate Strength Basis Values and Statistics					
Environment	CTA	RTA	ETW1	ETW2	ETW3
Mean	156.5	134.6	114.4	102.4	94.12
Stdev	5.446	3.342	4.489	3.943	4.625
CV	3.479	2.483	3.924	3.851	4.914
Mod CV	6.000	6.000	6.000	6.000	6.457
Min	148.7	128.8	103.5	94.05	86.74
Max	167.6	139.9	120.4	108.7	101.8
No. Batches	3	3	3	3	3
No. Spec.	18	18	18	18	18
Basis Values and Estimates					
B-Basis Value		127.6	107.4	95.40	
B-Estimate	126.6				67.80
A-Estimate	105.3	123.0	102.7	90.73	49.02
Method	ANOVA	Pooled	Pooled	Pooled	ANOVA
Modified CV Basis Values and Estimates					
B-Basis Value	143.7	121.8	101.6	89.57	81.28
A-Estimate	135.3	113.4	93.18	81.17	72.89
Method	Pooled	Pooled	Pooled	Pooled	Pooled

Table 4-79: Statistics and Basis Values for SSB1 As-Measured Ultimate Strength Data

Normalized Single Shear Bearing 1 (SSB1) Chord Stiffness Statistics					
Environment	CTA	RTA	ETW1	ETW2	ETW3
Mean	1.333	1.539	1.159	1.128	1.148
Stdev	0.2239	0.2196	0.1040	0.06037	0.08428
CV	16.79	14.27	8.977	5.351	7.344
Min	1.124	1.260	1.014	1.001	1.045
Max	2.122	1.902	1.371	1.231	1.390
No. Batches	3	3	3	3	3
No. Spec.	18	18	18	18	18

Table 4-80: Statistics for SSB1 Normalized Chord Stiffness Data

As-Measured Single Shear Bearing 1 (SSB1) Chord Stiffness Statistics					
Environment	CTA	RTA	ETW1	ETW2	ETW3
Mean	1.280	1.520	1.146	1.114	1.134
Stdev	0.1117	0.1947	0.09673	0.06714	0.07533
CV	8.724	12.81	8.441	6.025	6.641
Min	1.128	1.263	1.019	0.9640	1.036
Max	1.565	1.837	1.378	1.219	1.343
No. Batches	3	3	3	3	3
No. Spec.	18	18	18	18	18

Table 4-81: Statistics for SSB1 As-Measured Chord Stiffness Data

4.28 "10/80/10" Single-Shear Bearing 2 (SSB2)

The SSB2 data is normalized, so both normalized and as-measured results were provided. Testing was done in four environmental conditions: RTA, ETW1, ETW2, and ETW3.

For the 2% offset strength property, for the normalized dataset, the ETW3 condition failed the normality test but the Weibull distribution was a good fit for the dataset. The remaining conditions met all requirements for pooling.

For the 2% offset strength property, for the as-measured dataset, the RTA condition failed the ADK test for batch equivalency. ANOVA was used to compute estimates for that condition. The ETW3 condition failed the normality test but the Weibull distribution was a good fit for the dataset. The single point normal method was used for ETW1 and ETW2.

For the ultimate strength dataset, for the normalized dataset, the RTA condition failed the ADK test for batch equivalency. ANOVA was used to compute estimates for that condition. The single point normal method was used for the remaining conditions.

For the ultimate strength dataset, for the as-measured dataset, all conditions could not be pooled because the pooled dataset failed the normality test. The RTA, ETW1, and ETW2 conditions met all requirements for pooling. The single point normal method was used for ETW3.

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

There were four statistical outliers. The highest value in batch D of the RTA condition was a batch outlier for the normalized 2% offset strength dataset. The lowest value in batch D of the ETW3 condition was a condition outlier for the normalized 2% offset strength dataset, the as-measured 2% offset strength dataset and for the as-measured ultimate strength dataset. The lowest value in batch F of the ETW1 condition was a condition outlier for the normalized ultimate strength dataset and a batch and condition outlier for the as-measured ultimate strength dataset. The highest value in batch F of the ETW2 condition was a batch outlier in both the normalized and as-measured ultimate strength datasets. They were retained for this analysis.

Statistics, B-basis values and estimates are given for SSB2 strength data in Table 4-82, Table 4-83, Table 4-84, and Table 4-85 and for SSB2 chord stiffness data in Table 4-86 and Table 4-87. The normalized data, B-estimates and B-basis values are shown graphically for 2% offset strength in Figure 4-45 and for ultimate strength in Figure 4-46.

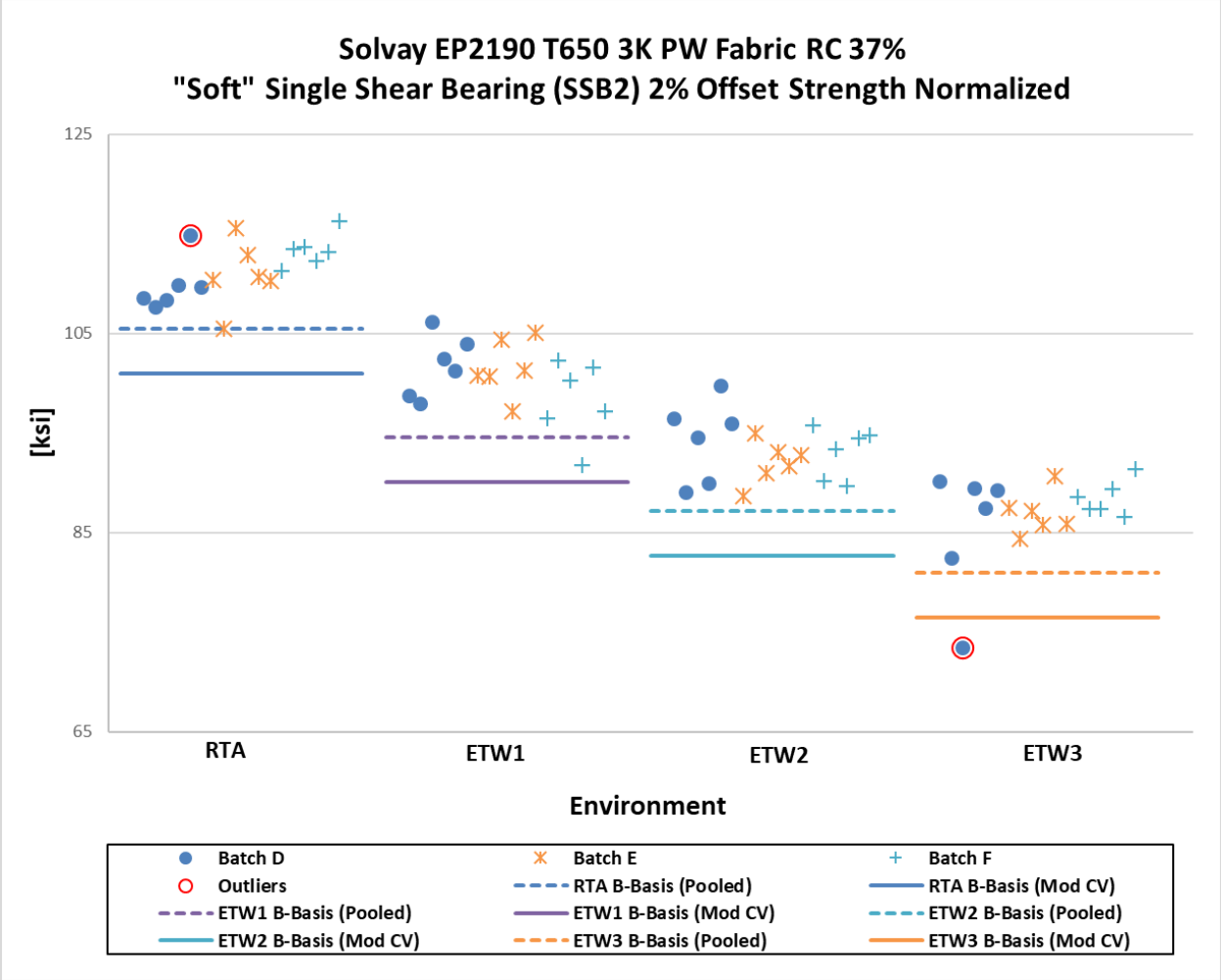

Figure 4-45: Batch Plot for SSB2 Normalized 2% Offset Strength

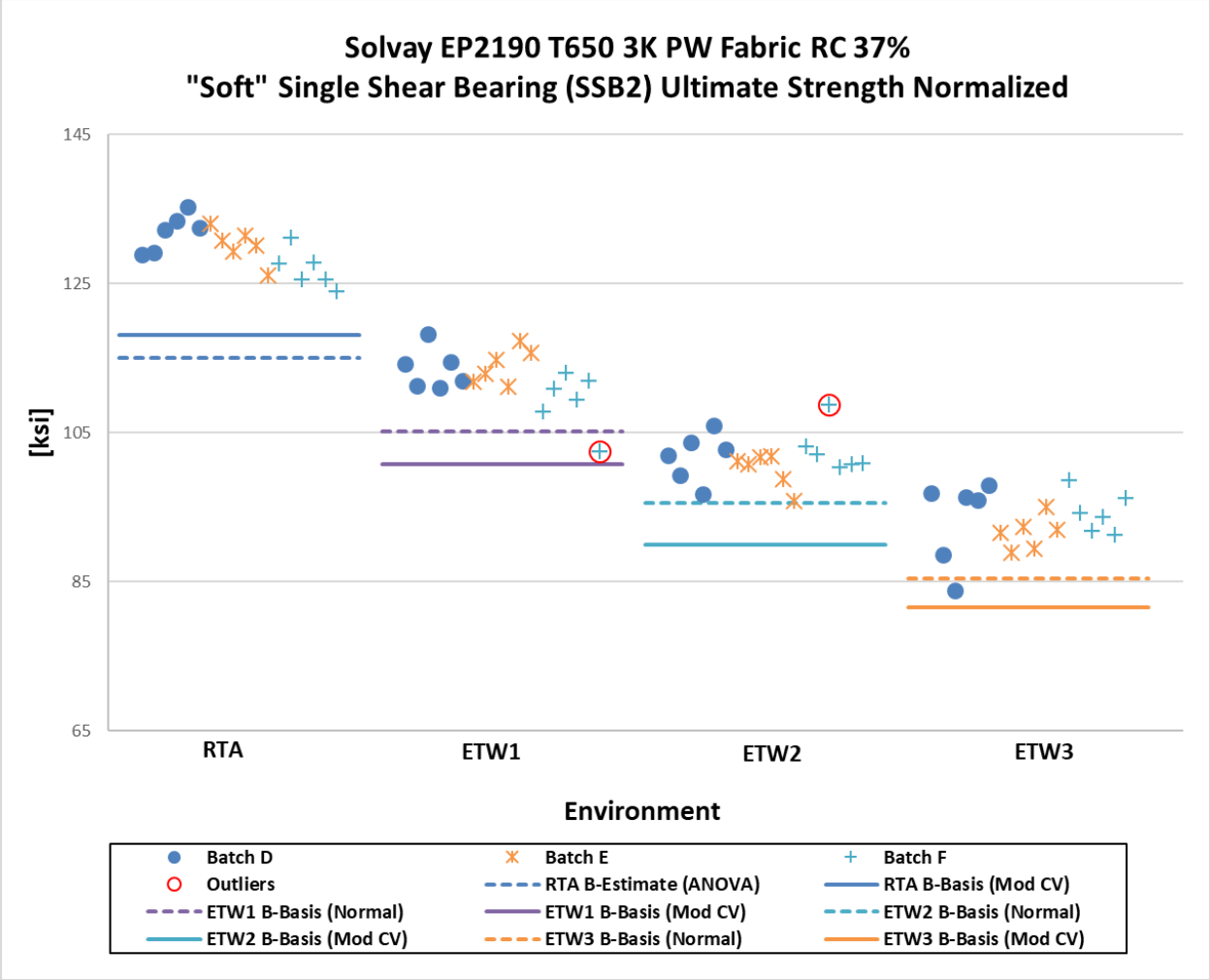

Figure 4-46: Batch Plot for SSB2 Normalized Ultimate Strength

Normalized Single Shear Bearing 2 (SSB2) 2% Offset Strength Basis Values and Statistics				
Environment	RTA	ETW1	ETW2	ETW3
Mean	111.4	100.5	93.13	86.89
Stdev	2.912	3.549	3.006	4.028
CV	2.615	3.530	3.228	4.636
Mod CV	6.000	6.000	6.000	6.318
Min	105.4	91.74	88.69	73.44
Max	116.3	106.2	99.75	91.34
No. Batches	3	3	3	3
No. Spec.	18	18	18	18
Basis Values and Estimates				
B-Basis Value	105.8	94.92	87.52	79.99
A-Estimate	102.0	91.18	83.78	72.64
Method	Pooled	Pooled	Pooled	Weibull
Modified CV Basis Values and Estimates				
B-Basis Value	101.0	90.12	82.72	76.48
A-Estimate	94.09	83.25	75.85	69.62
Method	Pooled	Pooled	Pooled	Pooled

Table 4-82: Statistics and Basis Values for SSB2 Normalized 2% Offset Strength Data

As-Measured Single Shear Bearing 2 (SSB2) 2% Offset Strength Basis Values and Statistics				
Environment	RTA	ETW1	ETW2	ETW3
Mean	110.7	99.98	92.65	86.47
Stdev	3.544	3.158	2.709	4.354
CV	3.202	3.158	2.923	5.035
Mod CV	6.000	6.000	6.000	6.518
Min	105.2	92.68	87.57	71.98
Max	116.3	104.8	96.81	91.40
No. Batches	3	3	3	3
No. Spec.	18	18	18	18
Basis Values and Estimates				
B-Basis Value		93.75	87.31	78.95
B-Estimate	92.29			
A-Estimate	79.18	89.33	83.52	71.03
Method	ANOVA	Normal	Normal	Weibull
Modified CV Basis Values and Estimates				
B-Basis Value	100.2	89.56	82.23	76.05
A-Estimate	93.37	82.69	75.36	69.17
Method	Pooled	Pooled	Pooled	Pooled

Table 4-83: Statistics and Basis Values for SSB2 As-Measured 2% Offset Strength Data

Normalized Single Shear Bearing 2 (SSB2) Ultimate Strength Basis Values and Statistics				
Environment	RTA	ETW1	ETW2	ETW3
Mean	129.7	112.3	101.5	93.05
Stdev	3.106	3.596	2.997	3.836
CV	2.395	3.203	2.953	4.122
Mod CV	6.000	6.000	6.000	6.061
Min	124.0	102.4	95.90	83.78
Max	135.3	118.3	108.8	98.59
No. Batches	3	3	3	3
No. Spec.	18	18	18	18
Basis Values and Estimates				
B-Basis Value		105.2	95.57	85.48
B-Estimate	115.1			
A-Estimate	104.7	100.1	91.37	80.11
Method	ANOVA	Normal	Normal	Normal
Modified CV Basis Values and Estimates				
B-Basis Value	118.2	100.7	89.95	81.51
A-Estimate	110.5	93.13	82.34	73.91
Method	Pooled	Pooled	Pooled	Pooled

Table 4-84: Statistics and Basis Values for SSB2 Normalized Ultimate Strength Data

As-Measured Single Shear Bearing 2 (SSB2) Ultimate Strength Basis Values and Statistics				
Environment	RTA	ETW1	ETW2	ETW3
Mean	128.8	111.7	101.0	92.59
Stdev	2.618	3.301	3.080	3.927
CV	2.032	2.956	3.050	4.242
Mod CV	6.000	6.000	6.000	6.121
Min	124.0	102.8	95.08	82.12
Max	133.0	117.1	109.0	100.2
No. Batches	3	3	3	3
No. Spec.	18	18	18	18
Basis Values and Estimates				
B-Basis Value	123.5	106.3	95.64	84.83
A-Estimate	119.9	102.8	92.08	79.34
Method	Pooled	Pooled	Pooled	Normal
Modified CV Basis Values and Estimates				
B-Basis Value	117.3	100.2	89.48	81.09
A-Estimate	109.8	92.60	81.91	73.52
Method	Pooled	Pooled	Pooled	Pooled

Table 4-85: Statistics and Basis Values for SSB2 As-Measured Ultimate Strength Data

Normalized Single Shear Bearing 2 (SSB2) Chord Stiffness Statistics				
Environment	RTA	ETW1	ETW2	ETW3
Mean	1.032	0.9103	0.8793	0.8791
Stdev	0.1086	0.09800	0.07529	0.1197
CV	10.53	10.77	8.563	13.61
Min	0.8880	0.7485	0.7381	0.7765
Max	1.218	1.148	1.057	1.312
No. Batches	3	3	3	3
No. Spec.	18	18	18	18

Table 4-86: Statistics for SSB2 Normalized Chord Stiffness Data

As-Measured Single Shear Bearing 2 (SSB2) Chord Stiffness Statistics				
Environment	RTA	ETW1	ETW2	ETW3
Mean	1.024	0.9052	0.8745	0.8747
Stdev	0.09695	0.09467	0.07004	0.1195
CV	9.466	10.46	8.009	13.66
Min	0.8880	0.7260	0.7390	0.7780
Max	1.201	1.130	1.039	1.311
No. Batches	3	3	3	3
No. Spec.	18	18	18	18

Table 4-87: Statistics for SSB2 As-Measured Chord Stiffness Data

4.29 “40/20/40” Single-Shear Bearing 3 (SSB3)

The SSB3 data is normalized, so both normalized and as-measured results were provided. Testing was done in four environmental conditions: RTA, ETW1, ETW2, and ETW3.

For the 2% offset strength property, for the normalized dataset, the ETW3 condition failed the ADK test for batch equivalency. ANOVA was used to compute estimates for that condition. The remaining conditions met all requirements for pooling. Applying the modified CV, there were no diagnostic test failures, therefore all conditions were pooled.

For the 2% offset strength property, for the as-measured dataset, the RTA and ETW3 conditions failed the ADK test for batch equivalency. ANOVA was used to compute estimates for those conditions. The single point normal method was used for ETW1 and ETW2. Applying the modified CV, there were no diagnostic test failures, therefore all conditions were pooled.

For the ultimate strength dataset, for the normalized dataset, the ETW3 condition failed the ADK test for batch equivalency. ANOVA was used to compute estimates for that condition. Pooling the remaining conditions was not possible because every combined dataset failed either the normality test or the Levene’s test for equality of variances. The single point normal method was used for the remaining conditions. Applying the modified CV, pooling all condition was not possible because the pooled dataset failed the normality test. The RTA, ETW1, and ETW2 conditions met all requirements for pooling. The normal method for modified CV was used for ETW3.

For the ultimate strength dataset, for the as-measured dataset, pooling all conditions was not possible because the pooled dataset failed the Levene’s test for equality of variances. RTA and ETW1 met all requirements for pooling. The single point normal method was used for ETW2 and ETW3. Applying the modified CV, there were no diagnostic test failures, therefore all conditions were pooled.

There was one statistical outlier. The highest value in batch E of the ETW1 condition was a batch outlier for both the normalized and as-measured 2% offset strength datasets. It was retained for this analysis.

Statistics, B-basis values and estimates are given for SSB3 strength data in Table 4-88, Table 4-89, Table 4-90, and Table 4-91 and for SSB3 chord stiffness data in Table 4-92 and Table 4-93. The normalized data, B-estimates and B-basis values are shown graphically for 2% offset strength in Figure 4-47 and for ultimate strength in Figure 4-48.

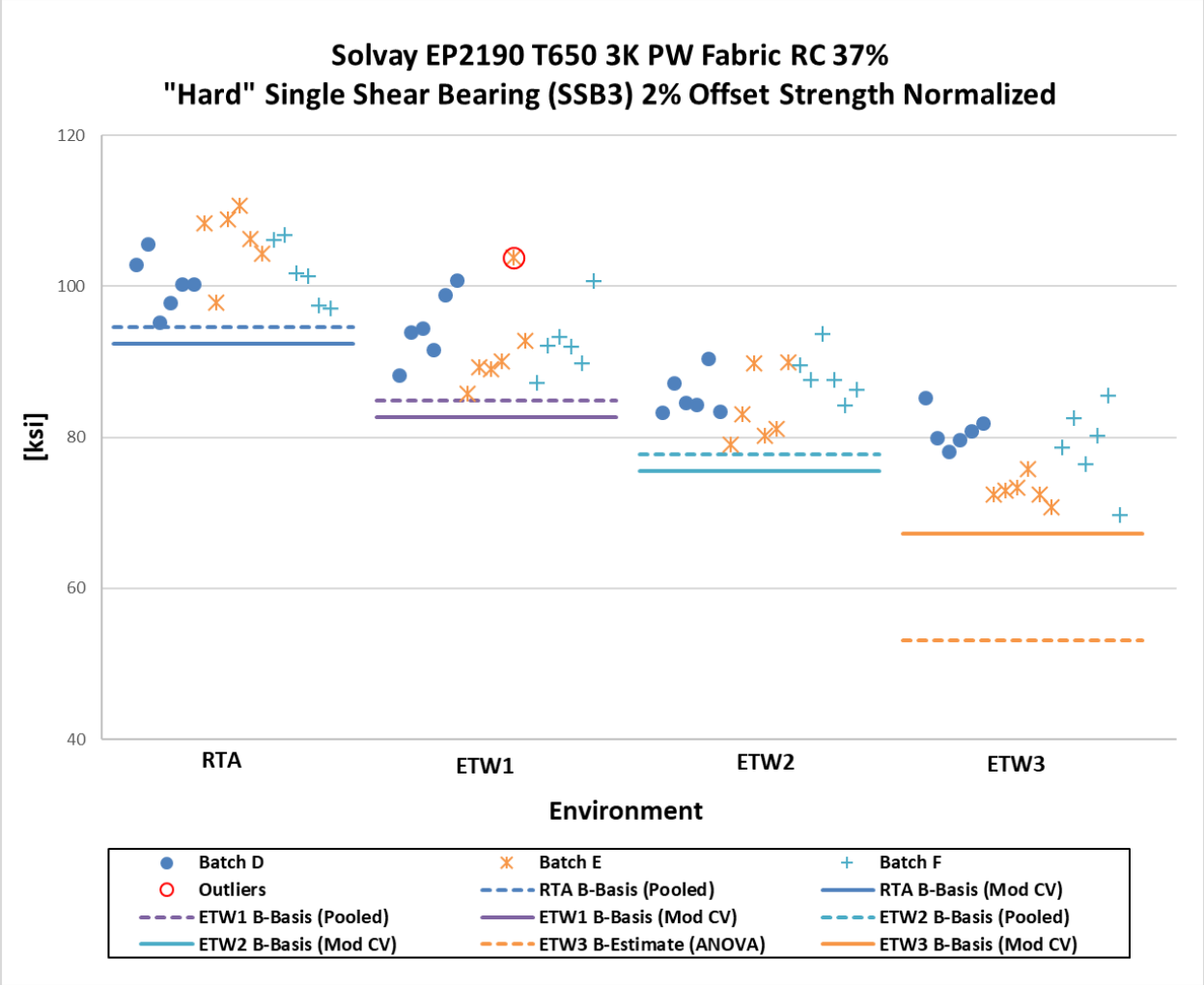

Figure 4-47: Batch Plot for SSB3 Normalized 2% Offset Strength

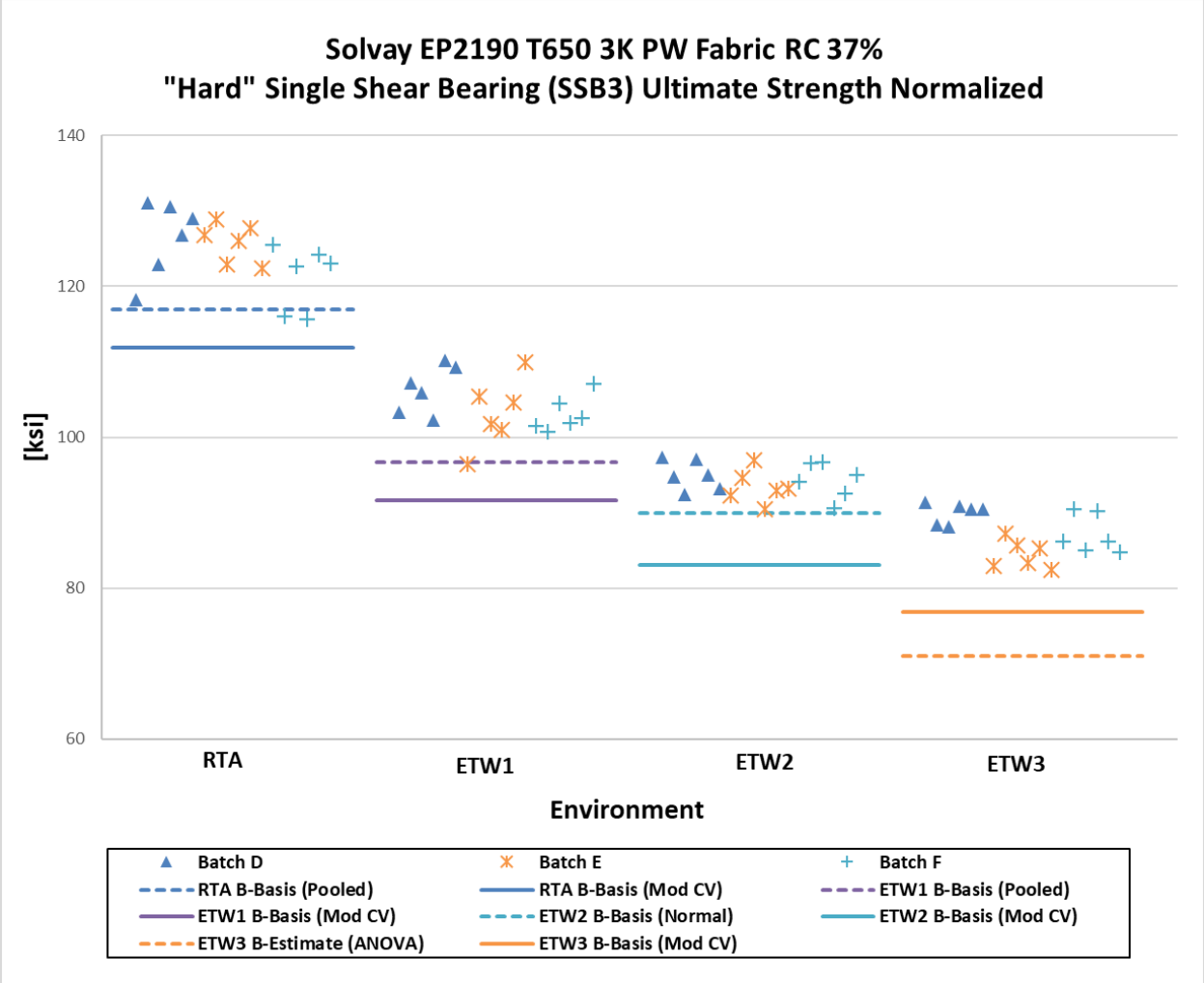

Figure 4-48: Batch Plot for SSB3 Normalized Ultimate Strength

Normalized Single Shear Bearing 3 (SSB3) 2% Offset Strength Basis Values and Statistics				
Environment	RTA	ETW1	ETW2	ETW3
Mean	102.7	93.01	85.90	77.60
Stdev	4.640	5.064	3.939	4.855
CV	4.516	5.444	4.586	6.256
Mod CV	6.258	6.722	6.293	7.128
Min	95.22	85.79	79.10	69.66
Max	110.8	103.8	93.73	85.57
No. Batches	3	3	3	3
No. Spec.	18	18	18	18
Basis Values and Estimates				
B-Basis Value	94.65	84.92	77.81	
B-Estimate				53.13
A-Estimate	89.25	79.52	72.41	35.68
Method	Pooled	Pooled	Pooled	ANOVA
Modified CV Basis Values and Estimates				
B-Basis Value	92.41	82.68	75.57	67.27
A-Estimate	85.60	75.87	68.75	60.46
Method	Pooled	Pooled	Pooled	Pooled

Table 4-88: Statistics and Basis Values for SSB3 Normalized 2% Offset Strength Data

As-Measured Single Shear Bearing 3 (SSB3) 2% Offset Strength Basis Values and Statistics				
Environment	RTA	ETW1	ETW2	ETW3
Mean	102.4	92.61	85.59	77.31
Stdev	5.244	4.866	4.064	4.550
CV	5.121	5.254	4.749	5.885
Mod CV	6.561	6.627	6.374	6.942
Min	93.27	85.74	79.50	69.79
Max	111.8	104.2	93.85	86.11
No. Batches	3	3	3	3
No. Spec.	18	18	18	18
Basis Values and Estimates				
B-Basis Value		83.00	77.56	
B-Estimate	78.60			56.94
A-Estimate	61.63	76.19	71.88	42.42
Method	ANOVA	Normal	Normal	ANOVA
Modified CV Basis Values and Estimates				
B-Basis Value	92.02	82.23	75.21	66.94
A-Estimate	85.18	75.39	68.37	60.10
Method	Pooled	Pooled	Pooled	Pooled

Table 4-89: Statistics and Basis Values for SSB3 As-Measured 2% Offset Strength Data

Normalized Single Shear Bearing 3 (SSB3) Ultimate Strength Basis Values and Statistics				
Environment	RTA	ETW1	ETW2	ETW3
Mean	124.5	104.2	94.21	87.20
Stdev	4.513	3.642	2.170	2.951
CV	3.625	3.496	2.303	3.385
Mod CV	6.000	6.000	6.000	6.000
Min	115.7	96.41	90.41	82.43
Max	131.1	110.1	97.32	91.36
No. Batches	3	3	3	3
No. Spec.	18	18	18	18
Basis Values and Estimates				
B-Basis Value	115.6	96.99	89.93	
B-Estimate				70.96
A-Estimate	109.3	91.90	86.89	59.37
Method	Normal	Normal	Normal	ANOVA
Modified CV Basis Values and Estimates				
B-Basis Value	113.0	92.67	82.70	76.87
A-Estimate	105.3	84.99	75.02	69.55
Method	Pooled	Pooled	Pooled	Normal

Table 4-90: Statistics and Basis Values for SSB3 Normalized Ultimate Strength Data

As-Measured Single Shear Bearing 3 (SSB3) Ultimate Strength Basis Values and Statistics				
Environment	RTA	ETW1	ETW2	ETW3
Mean	124.0	103.7	93.86	86.88
Stdev	4.422	3.262	1.981	2.424
CV	3.566	3.145	2.111	2.790
Mod CV	6.000	6.000	6.000	6.000
Min	116.0	96.35	90.82	82.43
Max	130.3	109.9	97.00	91.11
No. Batches	3	3	3	3
No. Spec.	18	18	18	18
Basis Values and Estimates				
B-Basis Value	116.9	96.65	89.95	82.09
A-Estimate	112.1	91.83	87.18	78.70
Method	Pooled	Pooled	Normal	Normal
Modified CV Basis Values and Estimates				
B-Basis Value	113.2	92.93	83.07	76.08
A-Estimate	106.1	85.82	75.95	68.97
Method	Pooled	Pooled	Pooled	Pooled

Table 4-91: Statistics and Basis Values for SSB3 As-Measured Ultimate Strength Data

Normalized Single Shear Bearing 3 (SSB3) Chord Stiffness Statistics				
Environment	RTA	ETW1	ETW2	ETW3
Mean	1.252	1.161	1.098	1.069
Stdev	0.1224	0.05533	0.06103	0.06150
CV	9.780	4.767	5.559	5.754
Min	1.083	1.003	0.9593	0.9613
Max	1.452	1.259	1.191	1.183
No. Batches	3	3	3	3
No. Spec.	18	18	18	18

Table 4-92: Statistics for SSB3 Normalized Chord Stiffness Data

As-Measured Single Shear Bearing 3 (SSB3) Chord Stiffness Statistics				
Environment	RTA	ETW1	ETW2	ETW3
Mean	1.246	1.156	1.094	1.065
Stdev	0.1077	0.05157	0.06095	0.05845
CV	8.645	4.462	5.572	5.488
Min	1.093	1.003	0.9630	0.9680
Max	1.422	1.235	1.202	1.194
No. Batches	3	3	3	3
No. Spec.	18	18	18	18

Table 4-93: Statistics for SSB3 As-Measured Chord Stiffness Data

4.30 "25/50/25" Compression After Impact 1 (CAI1)

The CAI1 data is normalized, so both normalized and as-measured results were provided. Testing was done in four environmental conditions: RTA, ETA2, ETW1, and ETW2. The ETA2 condition tested specimens from one batch, so only basis value estimates are provided for that condition.

The results are identical for both the normalized and as-measured datasets. The ETW1 condition failed the ADK test for batch equivalency. ANOVA was used to compute estimates for that condition. The single point normal method was used for the remaining conditions. Applying the modified CV, the RTA and ETW1 condition met all requirements for pooling. The normal method for modified CV was used for ETA2 and ETW2.

There was one statistical outlier. The lowest value in batch C of the RTA condition was a batch outlier for both the normalized and as-measured datasets. It was retained for this analysis.

Statistics, B-basis values and estimates are given for CAI1 strength data in Table 4-94 and Table 4-95. The normalized data, B-estimates and B-basis values are shown graphically in Figure 4-49.

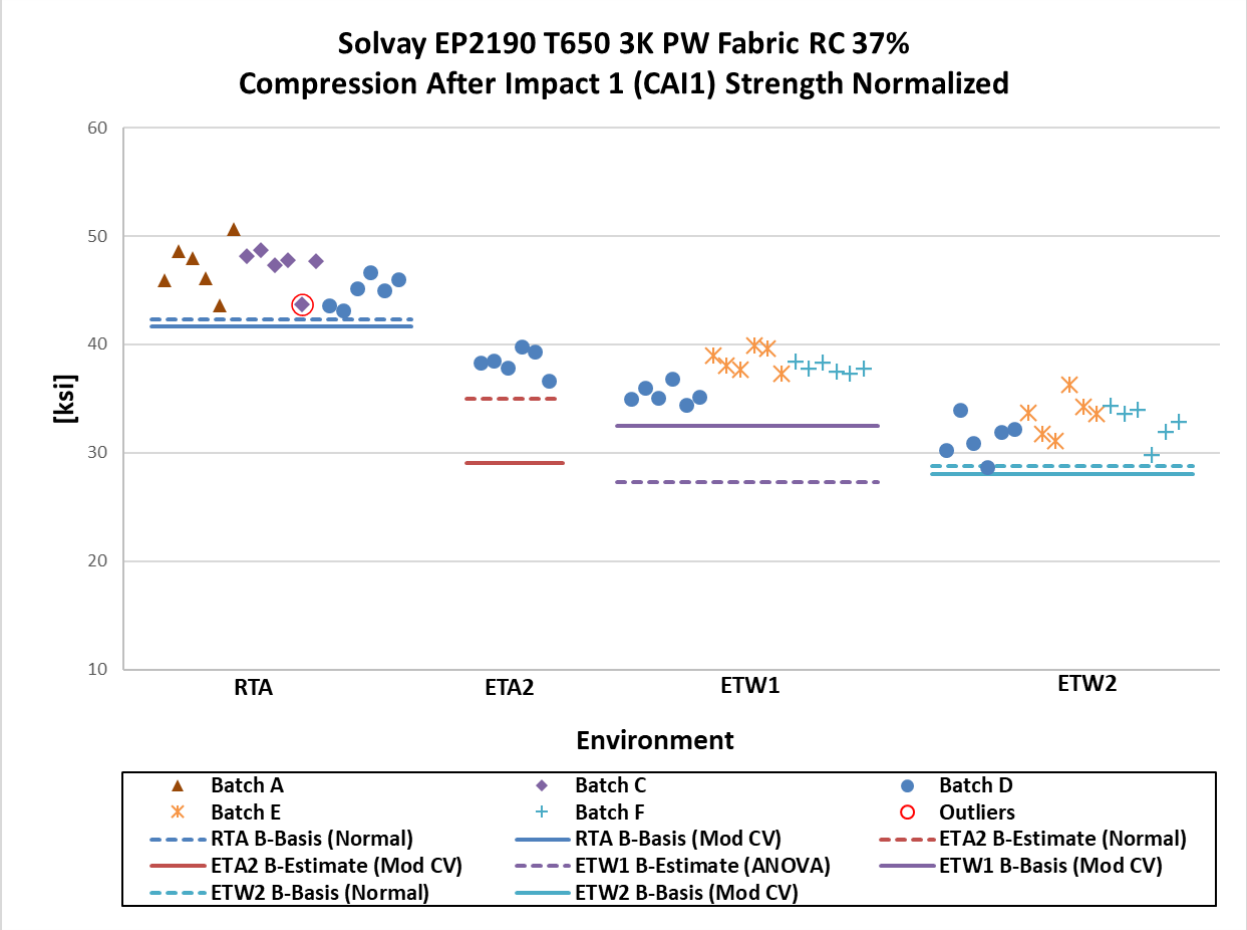

Figure 4-49: Plot for CAI1 Normalized Strength

Normalized Compression After Impact (CAI1) Strength Basis Values and Statistics				
Environment	RTA	ETA2	ETW1	ETW2
Mean	46.44	38.40	37.28	32.50
Stdev	2.107	1.127	1.597	1.909
CV	4.538	2.936	4.283	5.873
Mod CV	6.269	8.000	6.142	6.937
Min	43.13	36.64	34.40	28.71
Max	50.68	39.79	39.92	36.29
No. Batches	3	1	3	3
No. Spec.	18	6	18	18
Basis Values and Estimates				
B-Basis Value	42.28			28.73
B-Estimate		34.99	27.26	
A-Estimate	39.33	32.56	20.11	26.06
Method	Normal	Normal	ANOVA	Normal
Modified CV Basis Values and Estimates				
B-Basis Value	41.67		32.51	28.05
B-Estimate		29.10		
A-Estimate	38.43	22.48	29.26	24.90
Method	Pooled	Normal	Pooled	Normal

Table 4-94: Statistics and Basis Values for CAI1 Normalized Strength Data

As-Measured Compression After Impact (CAI1) Strength Basis Values and Statistics				
Environment	RTA	ETA2	ETW1	ETW2
Mean	45.75	37.99	36.79	32.09
Stdev	2.176	1.106	1.400	1.824
CV	4.756	2.911	3.806	5.685
Mod CV	6.378	8.000	6.000	6.842
Min	42.30	36.05	34.47	28.77
Max	50.10	39.21	38.62	34.80
No. Batches	3	1	3	3
No. Spec.	18	6	18	18
Basis Values and Estimates				
B-Basis Value	41.46			28.48
B-Estimate		34.64	28.35	
A-Estimate	38.41	32.26	22.33	25.93
Method	Normal	Normal	ANOVA	Normal
Modified CV Basis Values and Estimates				
B-Basis Value	41.04		32.08	27.75
B-Estimate		28.78		
A-Estimate	37.83	22.24	28.88	24.68
Method	Pooled	Normal	Pooled	Normal

Table 4-95: Statistics and Basis Values for CAI1 As-Measured Strength 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-17-1H. An outlier may be an outlier for 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-2022-002 Rev -.

Outliers for which no causes could be identified are listed in Table 5-1. These outliers were included in the analysis for their respective test properties.

Lamina Tests	Condition	Batch	Specimen No.	Value	Type	Outlier		
						High/Low	Batch	Condition
WT	RTA	C	TR8346132-P2-WT-C-C1-RTA-3	108.1	Normalized	Low	No	Yes
				107.1	As Measured	Low	No	Yes
WC	CTA	B	TR8345661-P1-WCS-B-C1-CTA-2	114.3	Normalized	Low	Yes	No
	ETA3	A	TR8669860-P1-WCS-A-C1-ETA3-2	80.64	Normalized	High	Yes	No
				79.08	As Measured	High	Yes	No
	ETW2	E	NTP2191Q1-WRX-PW-SOL-WCS-E-C1-1-ETW2-1	59.10	Normalized	Low	Yes	No
				56.94	As Measured	Low	Yes	No
FC	ETW2	F	NTP2191Q1-WRX-PW-SOL-FCM-F-C1-1-ETW2-2	69.38	Normalized	Low	Yes	No
				69.55	As Measured	Low	Yes	No
IPS 0.2% Offset	CTA	B	TR8345678-P2-IPS-B-C1-CTA-4	14.98	As Measured	High	No	Yes
	RTA	D	NTP2191Q1-WRX-PW-SOL-IPS-D-C1-1-RTA-4	7.750	As Measured	High	No	Yes
	ETW3	F	NTP2191Q1-WRX-PW-SOL-IPS-F-C1-1-ETW3-2	2.360	As Measured	Low	No	Yes
IPS Strength at 5% Strain	CTA	C	TR8346144-P1-IPS-C-C1-CTA-4	16.67	As Measured	Low	Yes	No
	RTA	A	TR8331112-P1-IPS-A-C1-RTA-1	13.66	As Measured	High	Yes	No
IPS Ultimate Strength	CTA	C	TR8346144-P1-IPS-C-C1-CTA-1	25.29	As Measured	Low	Yes	No
	RTA	B	TR8345678-P2-IPS-B-C1-RTA-1	25.43	As Measured	High	Yes	Yes
	ETW1	D	NTP2191Q1-WRX-PW-SOL-IPS-D-C1-1-ETW1-3	13.18	As Measured	Low	No	Yes
SBS	ETA3	D	NTP2191Q1-WRX-PW-SOL-SBS-D-C2-1-ETA3-2	7.650	As Measured	High	Yes	No

Table 5-1: List of Outliers – Lamina Tests

Laminate Tests	Condition	Batch	Specimen No.	Value	Type	Outlier		
						High/Low	Batch	Condition
UNT1	CTA	D	NTP2191Q1-WRX-PW-SOL-UNT1-D-C1-1-CTA-3	98.61	Normalized	High	Yes	No
	ETW1	F	NTP2191Q1-WRX-PW-SOL-UNT1-F-C2-1-ETW1-2	88.19	Normalized	Low	Yes	No
				88.89	As Measured	Low	Yes	No
UNT2	ETW2	D	NTP2191Q1-WRX-PW-SOL-UNT2-D-C1-1-ETW2-1	43.12	Normalized	Low	Yes	No
UNT3	ETW2	F	NTP2191Q1-WRX-PW-SOL-UNT3-F-C4-1-ETW2-1	109.8	Normalized	Low	Yes	No
				111.6	As Measured	Low	Yes	No
UNC1	CTA	D	NTP2191Q1-WRX-PW-SOL-UNC1-D-C2-1-CTA-1	104.6	Normalized	High	No	Yes
				103.7	As Measured	High	No	Yes
	RTA	C	TR8347612-P3-UNC1-C-C1-RTA-5	74.11	Normalized	Low	Yes	No
	ETW3	E	NTP2191Q1-WRX-PW-SOL-UNC1-E-C1-1-ETW3-3	36.48	As Measured	Low	No	Yes
UNC3	RTA	E	NTP2191Q1-WRX-PW-SOL-UNC3-E-C2-1-RTA-2	97.95	Normalized	High	Yes	No
				98.83	As Measured	High	Yes	Yes
OHT1	ETW1	F	NTP2191Q1-WRX-PW-SOL-OHT1-F-C1-1-ETW1-2	48.76	Normalized	Low	Yes	No
				49.07	As Measured	Low	Yes	No
OHT2	ETW2	D	NTP2191Q1-WRX-PW-SOL-OHT2-D-C1-1-ETW2-1	34.74	Normalized	High	Yes	No
				34.01	As Measured	High	Yes	No
FHT1	ETW2	F	NTP2191Q1-WRX-PW-SOL-FHT1-F-C1-1-ETW2-2	58.17	Normalized	Low	Yes	No
FHT2	ETW2	E	NTP2191Q1-WRX-PW-SOL-FHT2-E-C2-1-ETW2-1	40.19	Normalized	High	Yes	No
				40.50	As Measured	High	Yes	No
	RTA	F	NTP2191Q1-WRX-PW-SOL-FHT2-F-C4-1-RTA-1	45.31	As Measured	Low	No	Yes
OHC1	CTA	D	NTP2191Q1-WRX-PW-SOL-OHC1-D-C1-1-CTA-1	50.42	Normalized	Low	Yes	No
	ETA3	E	NTP2191Q1-WRX-PW-SOL-OHC1-E-C2-1-ETA3-3	32.56	Normalized	Low	Yes	No
OHC2	RTA	F	NTP2191Q1-WRX-PW-SOL-OHC2-F-C4-1-RTA-2	40.54	Normalized	Low	Yes	No
OHC3	ETW1	F	NTP2190Q1-WRX-PW-SOL-OHC3-F-C3-1-ETW1-3	34.09	Normalized	Low	Yes	No
				34.18	As Measured	Low	Yes	No
	ETW3	F	NTP2191Q1-WRX-PW-SOL-OHC3-F-C4-1-ETW3-1	31.15	As Measured	High	No	Yes
FHC1	RTA	D	NTP2191Q1-WRX-PW-SOL-FHC1-D-C2-1-RTA-5	62.63	Normalized	Low	Yes	No
				62.04	As Measured	Low	Yes	Yes
		E	NTP2191Q1-WRX-PW-SOL-FHC1-E-C1-1-RTA-4	81.09	As Measured	High	Yes	No
		F	NTP2191Q1-WRX-PW-SOL-FHC1-F-C1-1-RTA-3	64.68	Normalized	Low	Yes	No
				64.73	As Measured	Low	Yes	No
	ETW2	D	NTP2191Q1-WRX-PW-SOL-FHC1-D-C1-1-ETW2-4	40.79	Normalized	Low	Yes	No
				40.41	As Measured	Low	Yes	No
		F	NTP2191Q1-WRX-PW-SOL-FHC1-F-C2-1-ETW2-4	34.85	Normalized	Low	Yes	Yes
				34.71	As Measured	Low	Yes	Yes
FHC3	RTA	F	NTP2191Q1-WRX-PW-SOL-FHC3-F-C4-1-RTA-5	77.37	As Measured	Low	Yes	No
SSB2 2% Offset Strength	RTA	D	NTP2191Q1-WRX-PW-SOL-SSB2-D-C2-1-RTA-2	114.9	Normalized	High	Yes	No
	ETW3	D	NTP2191Q1-WRX-PW-SOL-SSB2-D-C1-1-ETW3-3	73.44	Normalized	Low	No	Yes
				71.98	As Measured	Low	No	Yes
SSB2 Ultimate Strength	ETW1	F	NTP2191Q1-WRX-PW-SOL-SSB2-F-C4-1-ETW1-3	102.4	Normalized	Low	No	Yes
				102.8	As Measured	Low	Yes	Yes
	ETW2	F	NTP2191Q1-WRX-PW-SOL-SSB2-F-C3-1-ETW2-3	108.8	Normalized	High	Yes	No
				109.0	As Measured	High	Yes	No
	ETW3	D	NTP2191Q1-WRX-PW-SOL-SSB2-D-C1-1-ETW3-3	82.12	As Measured	Low	No	Yes
SSB3 2% Offset Strength	ETW1	E	NTP2191Q1-WRX-PW-SOL-SSB3-E-C2-1-ETW1-2	103.8	Normalized	High	Yes	No
				104.2	As Measured	High	Yes	No
CAI1	RTA	C	TR8676393-P1-CAI1-C-C1-RTA-5	43.72	Normalized	Low	Yes	No
				43.31	As Measured	Low	Yes	No

Table 5-2: List of Outliers - Laminate Tests

6. References

1. Snedecor, G.W. and Cochran, W.G., *Statistical Methods*, 7th ed., The Iowa State University Press, 1980, pp. 252-253.
2. Stefansky, W., "Rejecting Outliers in Factorial Designs," *Technometrics*, Vol. 14, 1972, pp. 469-479.
3. Scholz, F.W. and Stephens, M.A., "K-Sample Anderson-Darling Tests of Fit," *Journal of the American Statistical Association*, Vol. 82, 1987, pp. 918-924.
4. Lehmann, E.L., *Testing Statistical Hypotheses*, John Wiley & Sons, 1959, pp. 274-275.
5. Levene, H., "Robust Tests for Equality of Variances," in *Contributions to Probability and Statistics*, ed. I. Olkin, Palo, Alto, CA: Stanford University Press, 1960.
6. Lawless, J.F., *Statistical Models and Methods for Lifetime Data*, John Wiley & Sons, 1982, pp. 150, 452-460.
7. *Metallic Materials and Elements for Aerospace Vehicle Structures*, MIL-HDBK-5E, Naval Publications and Forms Center, Philadelphia, Pennsylvania, 1 June 1987, pp. 9-166,9-167.
8. Hanson, D.L. and Koopmans, L.H., "Tolerance Limits for the Class of Distribution with Increasing Hazard Rates," *Annals of Math. Stat.*, Vol 35, 1964, pp. 1561-1570.
9. Vangel, M.G., "One-Sided Nonparametric Tolerance Limits," *Communications in Statistics: Simulation and Computation*, Vol. 23, 1994, p. 1137.
10. Vangel, M.G., "New Methods for One-Sided Tolerance Limits for a One-Way Balanced Random Effects ANOVA Model," *Technometrics*, Vol 34, 1992, pp. 176-185.
11. Odeh, R.E. and Owen, D.B., *Tables of Normal Tolerance Limits, Sampling Plans and Screening*, Marcel Dekker, 1980.
12. Tomblin, John and Seneviratne, Waruna, *Laminate Statistical Allowable Generation for Fiber-Reinforced Composites Material: Lamina Variability Method,* U.S. Department of Transportation, Federal Aviation Administration, May 2006.
13. Tomblin, John, Ng, Yeow and Raju, K. Suresh, *Material Qualification and Equivalency for Polymer Matrix Composite Material Systems: Updated Procedure,* U.S. Department of Transportation, Federal Aviation Administration, September 2003.
14. CMH-17 Rev H, Volume 1, 2022. SAE International, 400 Commonwealth Drive, Warrendale, PA 15096