Toray 3960 T1100GC 24K 71E Unidirectional Prepreg at 192 gsm & 33.5% RC Qualification Statistical Analysis Report

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1. Introduction

This report contains statistical analysis of the Toray 3960 T1100GC 24K 71E Unidirectional Prepreg at 192 gsm & 33.5% RC material property data published in NCAMP Test Report CAM-RP-2024-004 Rev N/C. The lamina and laminate material property data have been generated with NCAMP oversight through NCAMP Special Project Number NPN 101901 and also 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 (AIR) and the testing has been witnessed by NCAMP Authorized Engineering Representative (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 NCAMP Material Specification NMS 397/1 Form 1 Revision A dated March 3, 2025. The qualification test panels were fabricated in accordance with NCAMP Process Specification NPS 83961 Revision A Rev - dated September 9, 2020 using baseline cure cycle "C". The NCAMP Test Plan NTP 3963Q1 Rev B was used for this qualification program.

The panels were fabricated at Toray Composite Materials America in Tacoma, WA and Bell Textron, Inc. in Fort Worth, TX. Testing was performed at Toray Composite Materials America in Tacoma, Washington.

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 Rev H).

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 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 397/1 Form 1. NMS 397/1 Form 1 has additional requirements that are listed in its prepreg process control document (PCD), fiber specification, fiber PCD, and other raw material specifications and PCDs which impose essential quality controls on the raw materials and raw material manufacturing equipment and processes. *Aircraft companies and certifying agencies should assume that the material property data published in this report is not applicable*

when the material is not procured to NCAMP Material Specification NMS 397/1 Form 1. NMS 397/1 Form 1 is a free, publicly available, nonproprietary aerospace industry material specification.

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

1.1 Symbols and Abbreviations

Test Property	Abbreviation
Longitudinal Compression	LC
Longitudinal Tension	LT
Transverse Compression	TC
Transverse Tension	TT
In-Plane Shear	IPS
Short Beam Strength	SBS
Laminate Short Beam Strength	SBS1
Unnotched Tension	UNT
Unnotched Compression	UNC
Filled Hole Tension	FHT
Filled Hole Compression	FHC
Open Hole Tension	OHT
Open Hole Compression	OHC
Single Shear Bearing	SSB
Interlaminar Tension	ILT
Curved Beam Strength	CBS
Compression After Impact	CAI

Table 1-1: Test Property Abbreviations

Test Property	Symbol
Longitudinal Compression Strength	F_1^{cu}
Longitudinal Compression Modulus	E_1^{c}
Longitudinal Compression Poisson's Ratio	ν_{12}^{c}
Longitudinal Tension Strength	F_1^{tu}
Longitudinal Tension Modulus	E_1^{t}
Longitudinal Tension Poisson's Ratio	ν_{12}^{t}
Transverse Compression Strength	F_2^{cu}
Transverse Compression Modulus	E_2^{c}
Transverse Tension Strength	F_2^{tu}
Transverse Tension Modulus	E_2^{t}
In-Plane Shear Ultimate Peak 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	–65° F
Room Temperature Ambient	RTA	70° F
Elevated Temperature Ambient	ETA1	180° F
Elevated Temperature Ambient	ETA2	250° F
Elevated Temperature Wet	ETW1	180° F
Elevated Temperature Wet	ETW2	250° 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 50/40/10 layup. This is also referred to as "Hard"

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

Detailed information about the test methods and conditions used is given in NCAMP Test Report CAM-RP-2024-004 Rev NC.

1.2 Pooling Across Environments

When pooling across environments was allowable, the pooled co-efficient of variation was used. CMH17 STATS (CMH17 Approved **S**tatistical 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 2.0.

1.4 Modified Coefficient of Variation (CV) Method

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

The modified Coefficient of Variation (CV) used in this report is in accordance with section 8.4.4 of CMH-17-1H. 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 of time when there is minimal data available. When a sufficient number of production batches (approximately 8 to 15) have been produced and tested, the as-measured CV may be used so that the basis values and specification limits may be adjusted higher.

The material allowables in this report are calculated using both the as-measured CV and modified CV, so users have the choice of using either one. When the measured CV is greater than 8%, the

modified CV method does not change the basis value. NCAMP recommended values make use of the modified CV method when it is appropriate for the data.

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

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

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

2. Background

Statistical computations are performed with CMH17 STATS. Pooling across environments will be used whenever it is permissible according to CMH-17-1H guidelines. If pooling is not permissible, the results of a single point analysis provided by CMH17 STATS is included instead. If the data does not meet CMH-17-1H 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 to compute a pooled standard deviation is given below:

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

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

2.1.2.2 Pooled Coefficient of Variation

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

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

2.1.3 Basis Value Computations

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

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

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

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

$$f = N - r$$

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

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

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

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

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

2.1.4 Modified Coefficient of Variation

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

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

This is converted to percent by multiplying by 100%.

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

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

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

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

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:

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

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

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

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

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

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

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

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

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

2.1.5 Determination of Outliers

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

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

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

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

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

2.1.6 The k-Sample Anderson Darling Test for Batch Equivalency

The k-sample Anderson-Darling test is a nonparametric statistical procedure that tests the hypothesis that the populations from which two or more groups of data were drawn are identical. The distinct values in the combined data set are ordered from smallest to largest, denoted $z_{(1)}$, $z_{(2)}$, … $z_{(L)}$, 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.

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

With

$$a = (4g-6)(k-1) + (10-6g)S$$
$$b = (2g-4)k^2 + 8Tk + (2g-14T-4)S - 8T + 4g - 6$$
$$c = (6T+2g-2)k^2 + (4T-4g+6)k + (2T-6)S + 4T$$
$$d = (2T+6)k^2 - 4Tk$$
$$S = \sum_{i=1}^{k} \frac{1}{n_i}$$
$$T = \sum_{i=1}^{n-1} \frac{1}{i}$$
$$g = \sum_{i=1}^{n-2} \sum_{j=i+1}^{n-1} \frac{1}{(n-i)\,j}$$

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

2.1.7 The Anderson Darling Test for Normality

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

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

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

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

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

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:

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

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

2.1.9 Distribution Tests

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

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

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

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

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

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

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

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

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

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

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

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

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

2.1.9.3 Two-parameter Weibull Distribution

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

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

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

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

2.1.9.3.1 Estimating Weibull Parameters

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

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

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

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

2.1.9.3.2 Goodness-of-fit test for the Weibull distribution

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

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

The Anderson-Darling test statistic is

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

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

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

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

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

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.

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

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

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 $(0 < a < b < \infty)$ is given by the area under the normal distribution between ln(a) and ln(b).

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

2.1.9.4.1 Goodness-of-fit test for the Lognormal distribution

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

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

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

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

2.1.9.4.2 Basis value calculations for the Lognormal distribution

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

2.1.10 Non-parametric Basis Values

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

2.1.10.1 Non-parametric Basis Values for large samples

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

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

For B-basis values:

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

For A-Basis values:

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

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 makes the assumption that the different batches have equal variances, the data is checked to make sure the assumption is valid. Levene's test for equality of variance is used (see section 2.1.8). If the dataset fails Levene's test, the basis values computed are likely to be conservative. Thus this method can still be used but the values produced will be listed as estimates.

2.1.11.1 Calculation of basis values using ANOVA

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

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

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

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

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

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

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

Next, the mean sums of squares are computed:

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

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

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

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

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

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

Two k-factors are computed using the methodology of section 8.3.5 of CMH-17-1H 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.

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

2.3 0º Lamina Strength Derivation

Lamina strength values in the 0º direction were not obtained directly for any conditions during compression tests. They are derived from the cross-ply lamina test results using a back out formula. Unless stated otherwise, the 0° lamina strength values were derived using the following formula:

$F^{u}_{0^\circ} = F^{u}_{0^\circ/90^\circ} \cdot BF$ where BF is the backout factor.

$F^{u}_{0^\circ/90^\circ}$ =UNC0 or UNT0 strength values

$$BF = \frac{E_1\left[V_0E_2 + (1-V_0)E_1\right] - (\nu_{12}E_2)^2}{\left[V_0E_1 + (1-V_0)E_2\right]\left[V_0E_2 + (1-V_0)E_1\right] - (\nu_{12}E_2)^2} \qquad \textbf{Equation 62}$$

V_0=fraction of 0º plies in the cross-ply laminate (½ for UNT0 and 1/3 for UNC0)

E_1 = Average across of batches of modulus for LC and LT as appropriate

E_2 = Average across of batches of modulus for TC and TT as appropriate

ν_{12} = major Poisson's ratio of 0º plies from an average of all batches

In computing these strength values, the values for each environment are computed separately. The compression values are computed using only compression data, the tension values are computed using only tension data. Both normalized and as-measured computations are done using the as-measured and normalized strength values from the UNC0 and UNT0 strength values.

2.3.1 0º Lamina Strength Derivation (Alternate Formula)

In some cases, the previous formula cannot be used. For example, if there were no ETA tests run for transverse tension and compression, the value for E_2 would not be available. In that case, this alternative formula is used to compute the strength values for longitudinal tension and compression. It is similar to, but not quite the same as the formula detailed above. It requires the UNC0 and UNT0 strength and modulus data in addition to the LC and LT modulus data.

The 0° lamina strength values for the LC ETA condition were derived using the formula:

$$F^{cu}_{0^\circ} = F^{cu}_{0^\circ/90^\circ}\frac{E^{c}_{1}}{E^{c}_{0^\circ/90^\circ}}, \quad F^{tu}_{0^\circ} = F^{tu}_{0^\circ/90^\circ}\frac{E^{t}_{1}}{E^{t}_{0^\circ/90^\circ}} \qquad \textbf{Equation 63}$$

with

$F^{cu}_{0^\circ}$, $F^{tu}_{0^\circ}$ the derived mean lamina strength value for compression and tension respectively

$F^{cu}_{0^\circ/90^\circ}$, $F^{tu}_{0^\circ/90^\circ}$ are the mean strength values for UNC0 and UNT0 respectively

E^{c}_{1}, E^{t}_{1} are the modulus values for LC and LT respectively

$E^{c}_{0^\circ/90^\circ}$, $E^{t}_{0^\circ/90^\circ}$ are the modulus values for UNC0 and UNT0 respectively

3. Summary of Results

The basis values for all tests are summarized in the following tables. The NCAMP recommended A-basis and B-basis values meet all requirements of CMH-17-1H. However, not all test data meets those requirements. Basis values computed with the modified coefficient of variation (CV) are presented whenever possible. If not then original (non-modified) CV B-basis are shown in shaded boxes.

3.1 NCAMP Recommended Basis Values

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

1. Recommended values are NEVER estimates. Only A-basis and 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. A-basis values are not recommended when less than five batches of material are available or less than 55 specimens are available according to what CMH-17-1H recommends when computing basis values.
5. ANOVA B-basis values are not recommended when less than five batches of material are available according to what CMH-17-1H recommends when computing basis values with the ANOVA method.
6. 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.
7. There is no A-basis table for Laminate properties because of sample size requirements. There is only A-basis table for Lamina properties.

NCAMP Recommended A-basis Values for
Toray 3960 T1100GC 24K 71E Unidirectional Prepeg at 192 gsm & 33.5% RC
All A-basis values in this table meet the standards for publication in CMH-17-1H Handbook
Values are for normalized data unless otherwise noted

Lamina Strength Tests

Environment	Statistic	LT [ksi]	TT* [ksi]	TC* [ksi]	SBS* [ksi]	LC [ksi]	IPST* [ksi]			IPSV* [ksi]		UNC0 [ksi]
							0.2% Offset	5% Strain	Ultimate Strain	0.2% Offset	5% Strain	
CTA (-65˚ F)	A-basis	466.1	NA:I	NA:I	NA:I	NA:I	NA:I		NA:A	NA:I	NA:I	NA:I
	Mean	548.0	9.186	50.42	22.45	313.9	11.54		16.83	12.83	19.57	119.1
	CV %	3.756	10.78	6.000	6.000	6.000	6.000		2.046	6.000	6.028	6.000
RTA (70˚ F)	A-basis	461.0	7.713	30.85	13.50	237.3	6.799	10.82		7.884	12.81	88.88
	Mean	547.7	9.890	37.53	16.47	298.9	8.176	13.01		9.606	15.54	111.9
	CV %	6.000	7.842	6.000	6.000	4.486	6.000	6.000		6.000	6.000	4.486
ETA1 (180˚ F)	A-basis	NA:I	5.160	23.47	10.20	236.7	4.240	7.222		5.445	9.479	87.78
	Mean	554.8	9.048	28.23	12.26	284.6	6.012	9.487		7.225	11.40	105.6
	CV %	6.000	9.823	6.000	6.000	6.000	4.900	3.915		4.610	6.000	6.000
ETA2 (250˚ F)	A-basis	NA:I	4.418	16.85	7.497	202.8	3.044	4.973		5.441	8.038	74.84
	Mean	541.2	7.728	23.03	9.015	272.7	4.980	7.279		6.543	9.666	100.6
	CV %	6.305	9.018	4.901	6.000	5.171	6.599	5.286		6.000	6.000	5.171
ETW1 (180˚ F)	A-basis	448.6	1.555	19.69	8.095	225.6	4.672	6.719		4.991	7.174	83.52
	Mean	535.0	5.303	23.68	10.78	273.8	5.618	8.080		6.651	9.850	101.4
	CV %	6.000	13.42	6.000	6.079	6.276	6.000	6.000		4.521	4.722	6.276
ETW2 (250˚ F)	A-basis	278.6	2.193	13.35	4.796	157.2	1.201	2.598		3.629	5.331	57.11
	Mean	489.7	3.623	16.03	6.853	199.5	2.873	4.617		4.375	6.416	72.49
	CV %	7.561	7.694	6.000	6.573	7.534	12.02	7.668		5.509	6.000	7.534

Notes: The modified CV A-basis value is recommended when available.
White boxes with values indicate modified CV A-basis values.
Shaded boxes with values indicate non-modified (original) CV A-basis values.
The CV provided corresponds with the A-basis value given.
NA implies that tests were run but data did not meet NCAMP recommended requirements.
"NA: A" indicates ANOVA with 3 batches, "NA: I" indicates insufficient data
Shaded empty boxes indicate that no test data is available for that property and condition.
* Data is as-measured rather than normalized

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

NCAMP Recommended B-basis Values for

Toray 3960 T1100GC 24K 71E Unidirectional Prepeg at 192 gsm & 33.5% RC Lamina data

All B-basis values in this table meet the standards for publication in CMH-17-1H Handbook

Values are for normalized data unless otherwise noted

Lamina Strength Tests

Environment	Statistic	LT [ksi]	TT* [ksi]	TC* [ksi]	SBS* [ksi]	LC [ksi]	IPST* [ksi]			IPSV* [ksi]		UNC0 [ksi]
							0.2% Offset	5% Strain	Ultimate Strain	0.2% Offset	5% Strain	
CTA (-65˚ F)	B-basis	500.1	NA	46.19	20.57	276.7	10.18		NA:A	11.75	17.84	105.0
	Mean	548.0	9.186	50.42	22.45	313.9	11.54		16.83	12.83	19.57	119.1
	CV %	3.756	10.78	6.000	6.000	6.000	6.000		2.046	6.000	6.028	6.000
RTA (70˚ F)	B-basis	497.4	8.642	33.69	14.76	262.7	7.387	11.75		8.616	13.97	98.38
	Mean	547.7	9.890	37.53	16.47	298.9	8.176	13.01		9.606	15.54	111.9
	CV %	6.000	7.842	6.000	6.000	4.486	6.000	6.000		6.000	6.000	4.486
ETA1 (180˚ F)	B-basis	499.1	6.767	25.50	11.08	257.2	4.961	8.144		6.173	10.30	95.37
	Mean	554.8	9.048	28.23	12.26	284.6	6.012	9.487		7.225	11.40	105.6
	CV %	6.000	9.823	6.000	6.000	6.000	4.900	3.915		4.610	6.000	6.000
ETA2 (250˚ F)	B-basis	485.8	5.780	19.38	8.145	231.5	3.833	5.912		5.912	8.733	85.44
	Mean	541.2	7.728	23.03	9.015	272.7	4.980	7.279		6.543	9.666	100.6
	CV %	6.305	9.018	4.901	6.000	5.171	6.599	5.286		6.000	6.000	5.171
ETW1 (180˚ F)	B-basis	485.2	3.090	21.40	9.190	246.2	5.075	7.300		5.669	8.266	91.13
	Mean	534.8	5.303	23.68	10.78	273.8	5.618	8.080		6.651	9.850	101.4
	CV %	6.000	13.42	6.000	6.079	6.276	6.000	6.000		4.521	4.722	6.276
ETW2 (250˚ F)	B-basis	364.8	2.779	14.49	5.635	175.2	1.888	3.422		3.944	5.794	63.67
	Mean	489.7	3.623	16.03	6.853	199.5	2.873	4.617		4.375	6.416	72.49
	CV %	7.561	7.694	6.000	6.573	7.534	12.02	7.668		5.509	6.000	7.534

Notes: The modified CV B-basis value is recommended when available.

White boxes with values indicate modified CV B-basis values.

Shaded boxes with values indicate non-modified (original) CV B-basis values.

The CV provided corresponds with the B-basis value given.

NA implies that tests were run but data did not meet NCAMP recommended requirements.

"NA: A" indicates ANOVA with 3 batches, "NA: I" indicates insufficient data

Shaded empty boxes indicate that no test data is available for that property and condition.

* Data is as-measured rather than normalized

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

NCAMP Recommended B-Basis Values for
Toray 3960 T1100GC 24K 71E Unidirectional Prepeg at 192 gsm & 33.5% RC Laminate data
All B-basis values in this table meet the standards for publication in CMH-17-1H Handbook
Values are for normalized data unless otherwise noted

Lay-up	ENV	Statistic	OHT	OHC	FHT	FHC	UNT	UNC	SSB		DSB	SBS1*	CAI1-C
									2% Offset Strength	Initial Peak Strength	2% Offset Strength		
25/50/25	CTA (-65˚F)	B-basis	76.40		83.59		142.6						
		Mean	86.63		93.64		158.9						
		CV	6.000		6.000		6.000						
	RTA (70˚F)	B-basis	84.76	44.48	89.60	65.64	161.0	101.6	109.1	98.69	118.0	11.41	43.48
		Mean	94.99	48.79	99.65	72.69	177.2	114.3	124.1	112.6	133.6	12.77	49.07
		CV	6.000	6.000	6.000	6.000	6.063	5.682	6.000	6.960	6.563	6.000	6.419
	ETW1 (180˚F)	B-basis	94.59	38.81	96.56	59.21	153.1	76.10	93.04	77.29	76.61	6.619	
		Mean	104.8	43.11	106.6	66.26	169.3	94.16	108.0	97.49	107.9	8.204	
		CV	6.219	6.000	6.000	6.070	6.000	6.100	9.104	11.45	12.58	5.348	
	ETW2 (250˚F)	B-basis	107.7	31.42	99.79	36.10	139.4	61.00	82.46	68.30	66.84	3.132	
		Mean	118.0	35.72	109.8	50.87	155.5	68.77	97.49	85.87	99.12	3.506	
		CV	6.304	6.364	6.000	9.287	6.000	6.398	10.16	10.50	13.39	6.000	
10/80/10	CTA (-65˚F)	B-basis	54.64		60.46		83.08						
		Mean	60.43		66.35		91.09						
		CV	6.000		6.000		6.000						
	RTA (70˚F)	B-basis	54.53	37.98	57.92	52.97	77.53	68.71	111.6	NA:I	125.4		
		Mean	60.32	41.43	63.81	58.40	85.55	75.67	124.2	117.6	140.2		
		CV	6.000	6.000	6.000	6.000	6.000	6.000	6.000	3.881	6.000		
	ETW1 (180˚F)	B-basis	53.10	30.50	52.83	43.43	70.49	54.77	96.51	82.81	82.00		
		Mean	58.89	33.95	58.72	48.86	78.51	61.74	109.2	99.78	113.4		
		CV	6.000	6.000	6.000	6.000	6.000	6.000	7.795	8.705	9.088		
	ETW2 (250˚F)	B-basis	50.86	23.47	44.68	24.31	62.89	39.06	85.87	NA:I	87.94		
		Mean	56.65	26.92	50.57	37.77	70.91	44.28	98.52	88.49	100.7		
		CV	6.000	6.249	6.249	10.30	6.000	6.677	7.086	8.153	7.152		
50/40/10	CTA (-65˚F)	B-basis	128.7		130.3		249.5						
		Mean	144.1		146.0		278.1						
		CV	6.000		6.065		6.000						
	RTA (70˚F)	B-basis	140.3	60.80	138.1	87.29	269.0	160.0	113.3	NA:I	125.4		
		Mean	160.7	67.66	153.8	96.72	297.6	174.8	124.8	113.0	140.4		
		CV	6.000	6.222	6.000	6.000	6.000	6.000	6.000	6.766	6.000		
	ETW1 (180˚F)	B-basis	187.9	54.50	157.7	76.01	272.8	130.0	96.91	NA:I	79.97		
		Mean	208.2	61.36	173.4	85.45	301.4	144.7	108.4	99.19	111.1		
		CV	6.358	6.760	6.000	4.671	6.010	6.000	6.831	8.646	10.08		
	ETW2 (250˚F)	B-basis	209.3	44.01	154.0	38.70	262.2	84.69	81.27	NA:I	67.97		
		Mean	229.7	50.88	197.2	66.36	290.9	99.26	92.76	79.89	93.32		
		CV	6.000	8.133	9.159	11.86	6.000	7.774	6.354	6.015	8.850		

Lay-up	ENV	Statistic	CBS*	ILT*
100/0/0	CTA (-65˚F)	B-basis	NA:I	NA:I
		Mean	665.0	19.50
		CV	11.11	11.63
	RTA (70˚F)	B-basis	241.7	7.365
		Mean	480.7	14.79
		CV	16.39	16.88
	ETW1 (180˚F)	B-basis	91.41	2.786
		Mean	226.8	6.915
		CV	19.60	19.49
	ETW2 (250˚F)	B-basis	75.09	2.474
		Mean	100.9	3.080
		CV	11.31	11.07

Notes:
The modified CV B-basis value is recommended when available.
White boxes with values indicate modified CV B-basis values.
Shaded boxes with values indicate non-modified (original) CV B-basis values.
The CV provided corresponds with the B-basis value given.
Empty boxes indicate that no test data is available for that property and condition.
* Data is as-measured rather than normalized

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

4. Test Results, Statistics, Basis Values, and Graphs

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

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

When a dataset fails the Anderson-Darling k-sample (ADK) test for batch-to-batch variation, an ANOVA analysis is required. In order for B-basis values to be computed using the ANOVA method, data from five batches are required. Since this qualification dataset has only three batches, the basis values computed using ANOVA are considered estimates only. However, the basis values resulting from the ANOVA method using only three batches may be overly conservative. The ADK test is performed again after a transformation of the data according to the assumptions of the modified CV method (see section 2.1.4 for details). If the dataset still passes the ADK test at this point, modified CV basis values are provided. If the dataset does not pass the ADK test after the transformation, estimates may be computed using the modified CV method per the guidelines in CMH-17 Vol 1 Chapter 8 section 8.4.4.

4.1 Longitudinal Tension (LT)

Longitudinal Tension (LT) tests were performed at six different environmental conditions CTA, RTA, ETA1, ETA2, ETW1, and ETW2. There are four properties Strength as-measured, Strength normalized, Modulus as-measured and Modulus normalized. The LT properties are fiber dominated, so both the as-measured and normalized by cured ply thickness values are provided.

With respect to computing for the as-measured strength data using original CV, ANOVA method was used for all environments except ETA1, which uses Normal method. For modified CV, conditions RTA, ETA2 and ETW2 failed ADK so allowables are Not Available (NA) for these, while the rest of the conditions passed the ADK test and normality test, so normal method was used.

For the normalized strength data using original CV, ANOVA method was used for all environments except ETA1 and ETA2 which used the Normal method. For modified CV, CTA failed the normality test and ETW failed the ADK test, therefore allowables are not available for these conditions. The remaining conditions were pooled.

Three outliers were detected. The lowest normalized value in batch A of the ETA1 condition was an outlier for the condition but not for the batch. It was not an outlier in the as-measured dataset. The lowest as-measured value in batch D of the CTA condition was an outlier for the batch but not for the condition. The highest as-measured value in batch C of the ETA2 condition was an outlier for the batch but not for the condition. The outliers were retained for this analysis.

Statistics, basis values, and estimates are given for strength data in Table 4-1 and Table 4-2 and for the modulus data in Table 4-3 and Table 4-4. The normalized data and B-basis values are shown graphically in Figure 4-1 and Figure 4-2.

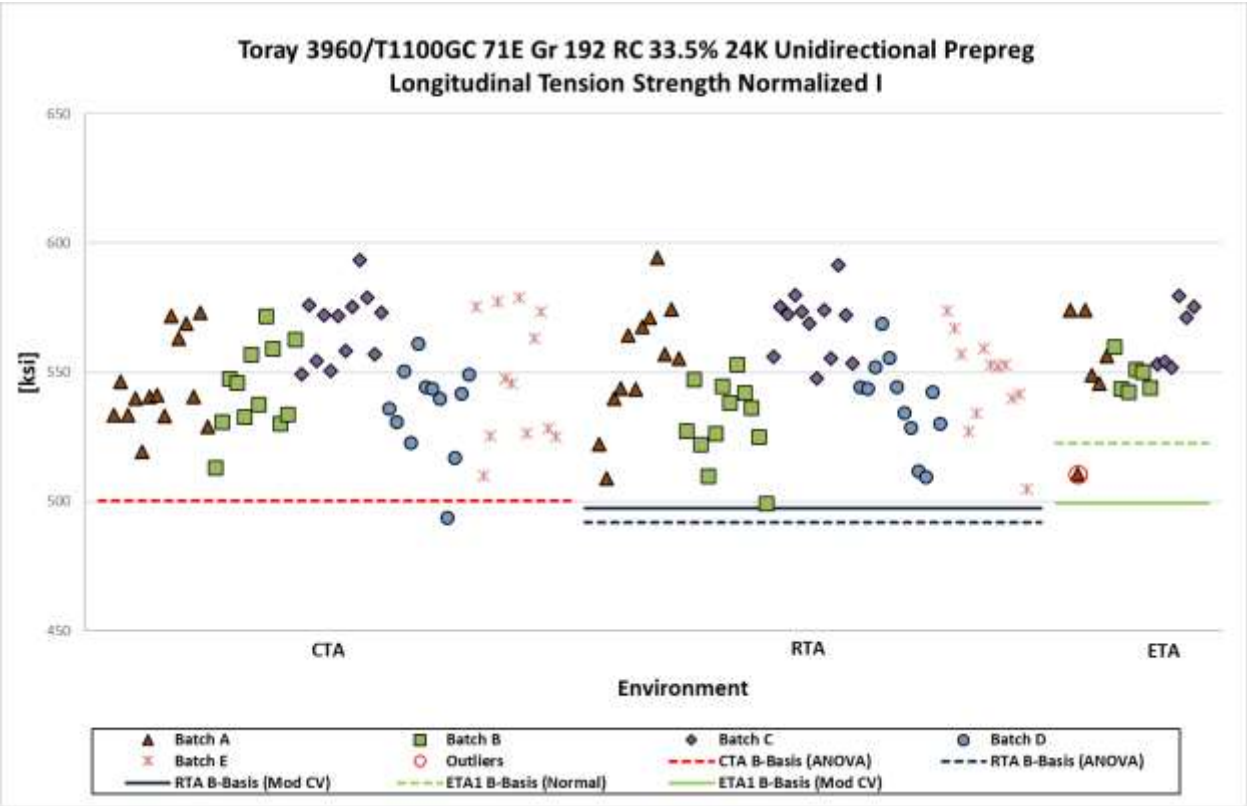

Figure 4-1 Batch plot for LT strength normalized (CTA, RTA, ETA1)

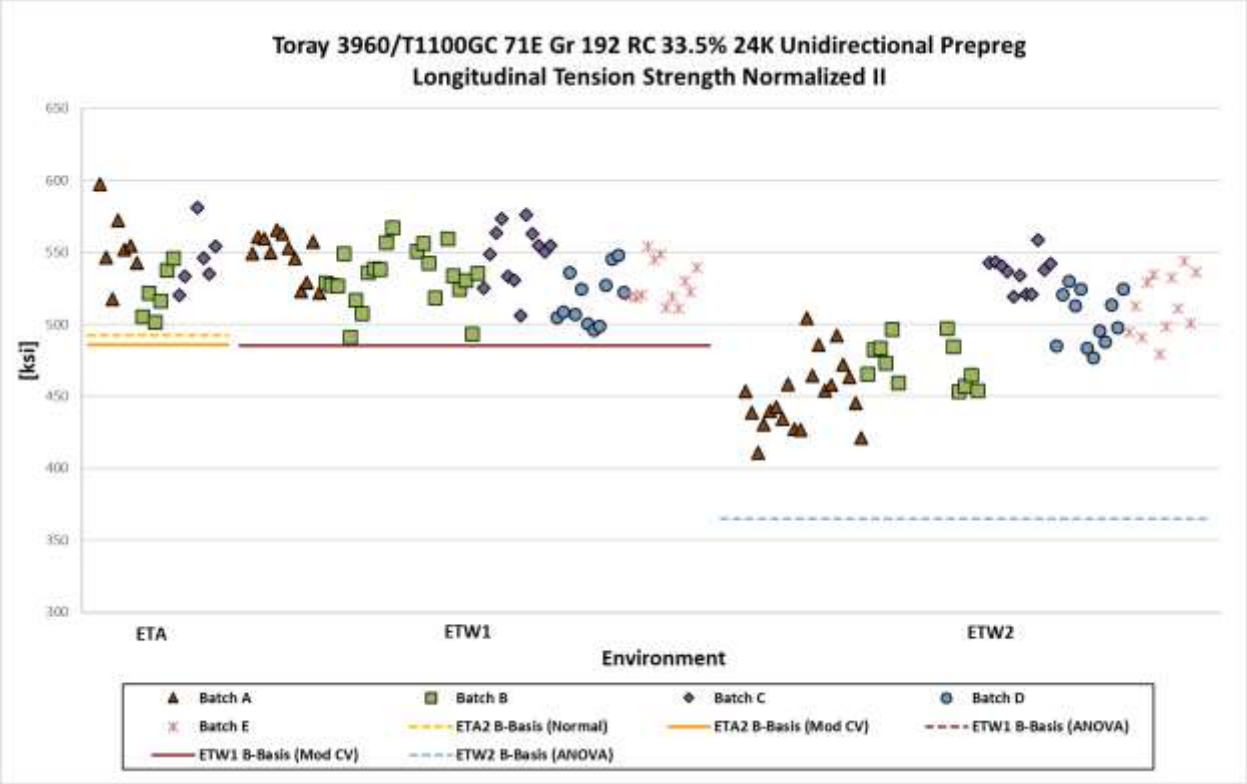

Figure 4-2 Batch plot for LT strength normalized (ETA2, ETW1, ETW2)

As Measured Longitudinal Tension Strength Basis Values and Statistics						
Environment	**CTA**	**RTA**	**ETA1**	**ETA2**	**ETW1**	**ETW2**
Mean	544.7	544.8	544.2	533.5	533.5	487.3
Stdev	22.46	25.68	22.70	31.43	22.35	39.67
CV	4.122	4.714	4.171	5.891	4.189	8.141
Mod CV	6.061	6.357	6.086	6.945	6.095	8.141
Min	480.5	487.0	511.4	483.1	488.4	408.5
Max	588.5	606.3	583.8	590.0	581.7	562.0
No. Batches	5	5	3	3	5	5
No. Spec.	62	60	18	19	70	67
Basis Values and Estimates						
B-Basis Value	486.3	466.8	499.4		476.1	353.2
B-Estimate				351.8		
A-Basis Value	445.2	412.6			435.5	260.8
A-Estimate			467.7	222.1		
Method	ANOVA	ANOVA	Normal	ANOVA	ANOVA	ANOVA
Modified CV Basis Values and Estimates						
B-Basis Value	491.8	NA	478.9	NA	482.1	NA
A-Basis Value	452.4				443.6	
A-Estimate			432.6			
Method	Normal		Normal		Normal	

Table 4-1 Statistics and Basis values for LT Strength as-measured

Normalized Longitudinal Tension Strength Basis Values and Statistics						
Environment	CTA	RTA	ETA1	ETA2	ETW1	ETW2
Mean	548.0	547.7	554.8	541.2	535.0	489.7
Stdev	20.58	21.63	16.40	24.95	20.86	37.03
CV	3.756	3.950	2.956	4.610	3.898	7.561
Mod CV	6.000	6.000	6.000	6.305	6.000	7.781
Min	493.9	499.2	510.5	501.9	491.2	410.9
Max	593.5	594.4	579.4	597.5	576.3	558.3
No. Batches	5	5	3	3	5	5
No. Spec.	62	60	18	19	70	67
Basis Values and Estimates						
B-Basis Value	500.1	491.8	522.4	492.5	485.2	364.8
A-Basis Value	466.1	452.5			449.8	278.6
A-Estimate			499.5	458.0		
Method	ANOVA	ANOVA	Normal	Normal	ANOVA	ANOVA
Modified CV Basis Values and Estimates						
B-Basis Value	NA	497.4	499.1	485.8	485.2	NA
A-Basis Value		461.0			448.6	
A-Estimate			463.4	450.1		
Method		Pooled	Pooled	Pooled	Pooled	

Table 4-2 Statistics and Basis values for LT Strength normalized

As Measured Longitudinal Tension Modulus Statistics						
Environment	CTA	RTA	ETA1	ETA2	ETW1	ETW2
Mean	25.00	24.82	24.13	24.13	24.50	23.95
Stdev	0.8656	1.131	0.7500	1.013	0.5336	0.8506
CV	3.463	4.558	3.108	4.197	2.178	3.551
Min	22.86	22.85	22.65	22.38	23.50	21.48
Max	27.82	27.54	25.41	26.42	26.03	26.48
No. Batches	5	5	3	3	5	5
No. Spec.	60	59	18	20	72	77

Table 4-3 Statistics for LT Modulus as-measured

Normalized Longitudinal Tension Modulus Statistics						
Environment	CTA	RTA	ETA1	ETA2	ETW1	ETW2
Mean	25.15	24.94	24.60	24.53	24.60	24.17
Stdev	0.7246	0.8125	0.3634	1.093	0.5796	0.7110
CV	2.881	3.258	1.477	4.454	2.357	2.942
Min	24.04	23.42	24.00	22.91	23.58	22.38
Max	27.22	27.00	25.16	27.10	26.80	26.05
No. Batches	5	5	3	3	5	5
No. Spec.	60	59	18	20	72	77

Table 4-4 Statistics for LT Modulus normalized

4.2 Transverse Tension (TT)

Transverse Tension (TT) tests were performed at six different environmental conditions CTA, RTA, ETA1, ETA2, ETW1 and ETW2. The TT properties are two, Strength and Modulus.

With respect to computing allowables for the original CV strength data, ANOVA method was used for all environments except for RTA, which passed ADK and normality tests, so it uses normal method. For modified CV, all conditions but RTA failed ADK so allowables are Not Available (NA) for these, while RTA condition passed the ADK and normality tests, so normal method was used.

Three outliers were detected for TT strength property. The lowest value in batch A of the RTA condition was an outlier for the batch but not for the condition. The lowest value in batch C of the ETA1 condition was an outlier for the batch but not for the condition. The lowest value in batch D of the ETA1 condition was an outlier for the condition but not for the batch. The outliers were retained for this analysis.

Statistics, basis values and estimates are given for strength data in Table 4-5 and for the modulus data in Table 4-6. The data, B-basis values and B-estimates are shown graphically in Figure 4-3 and Figure 4-4.

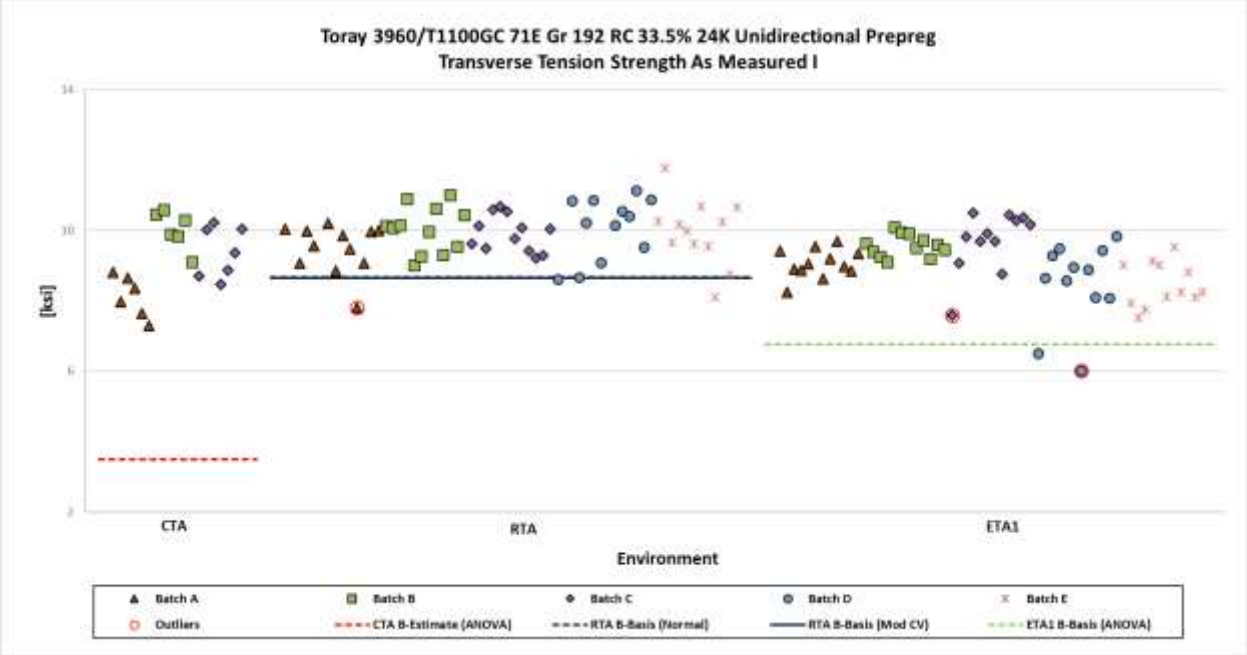

Figure 4-3 Batch plot for TT strength (CTA, RTA, ETA1)

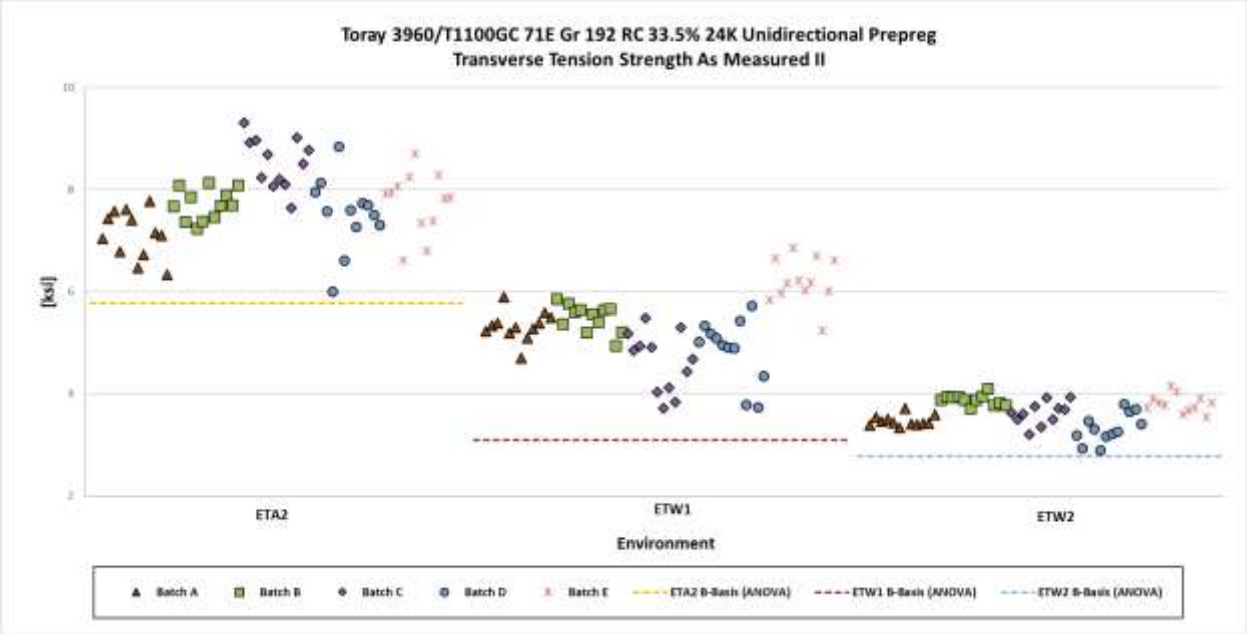

Figure 4-4 Batch plot for TT strength (ETA2, ETW1, ETW2)

Transverse Tension Strength Basis Values and Statistics						
Environment	**CTA**	**RTA**	**ETA1**	**ETA2**	**ETW1**	**ETW2**
Mean	9.186	9.890	9.048	7.728	5.303	3.623
Stdev	0.9904	0.7598	0.8888	0.6968	0.7118	0.2788
CV	10.78	7.683	9.823	9.018	13.42	7.694
Mod CV	10.78	7.842	9.823	9.018	13.42	7.847
Min	7.290	7.810	6.010	6.010	3.720	2.900
Max	10.58	11.78	10.50	9.310	6.860	4.150
No. Batches	3	5	5	5	5	5
No. Spec.	19	60	60	60	60	59
Basis Values and Estimates						
B-Basis Value		8.667	6.767	5.780	3.090	2.779
B-Estimate	3.496					
A-Basis Value		7.757	5.160	4.418	1.555	2.193
A-Estimate	0.000					
Method	ANOVA	Normal	ANOVA	ANOVA	ANOVA	ANOVA
Modified CV Basis Values and Estimates						
B-Basis Value	NA	8.642	NA	NA	NA	NA
A-Basis Value		7.713				
Method		Normal				

Table 4-5 Statistics and Basis Values for TT strength

Transverse Tension Modulus Statistics						
Environment	CTA	RTA	ETA1	ETA2	ETW1	ETW2
Mean	1.456	1.335	1.164	1.053	1.129	0.6963
Stdev	0.05066	0.02588	0.02084	0.03724	0.02866	0.04234
CV	3.479	1.939	1.790	3.537	2.538	6.081
Min	1.360	1.280	1.120	0.9700	1.080	0.6100
Max	1.580	1.390	1.210	1.150	1.180	0.8200
No. Batches	3	5	5	5	5	5
No. Spec.	18	64	60	60	60	59

Table 4-6 Statistics for TT Modulus

4.3 Longitudinal Compression (LC)

Longitudinal Compression (LC) tests were performed at six different environmental conditions. Four material properties are available, strength as-measured, strength normalized, modulus as-measured and modulus normalized. The LC properties are fiber dominated, so both the as-measured and normalized by cured ply thickness values are provided. Modulus properties don't require allowables, so only basic statistics are provided for these. Modulus data was obtained from LC test while Strength data was obtained by backout factor calculation from UNC0 dataset.

With respect to computing allowables for the original CV strength as-measured data, all environments but CTA failed ADK test, so ANOVA method was used for all environments except for CTA, which passed ADK and normality tests, so it uses normal method. For modified CV, all conditions but CTA and ETA1 failed ADK, so allowables are Not Available (NA) for these, while CTA and ETA1 conditions passed the ADK and normality tests, so normal method was used for these ones.

With respect to computing allowables for the original CV strength normalized data, all environments but CTA and ETW2 failed ADK test, so ANOVA method was used for all environments except for CTA and ETW2, which passed ADK and normality tests, so they use normal method. For modified CV, the RTA condition failed the normality test and the ETA2 condition failed the ADK test, therefore allowables are not available for these conditions. The normal method was used for the remaining conditions.

Three outliers were detected for LC strength data. The lowest normalized value in batch B of the ETW2 condition was an outlier for the batch and for the condition. In the as-measured dataset it was an outlier for the batch but not for the condition. The lowest normalized value in batch D of the ETW2 condition was an outlier for the batch but not for the condition. It was also an outlier in the as-measured dataset. The highest normalized value in batch E of the ETW2 condition was an outlier for the batch but not for the condition. It was also an outlier in the as-measured dataset. They were retained for this analysis.

Statistics, basis values and estimates are given for strength as-measured in Table 4-7, for strength normalized in Table 4-8, for modulus as-measured in Table 4-9 and for modulus normalized in Table 4-10. The normalized data and B-basis values Figure 4-5 and Figure 4-6.

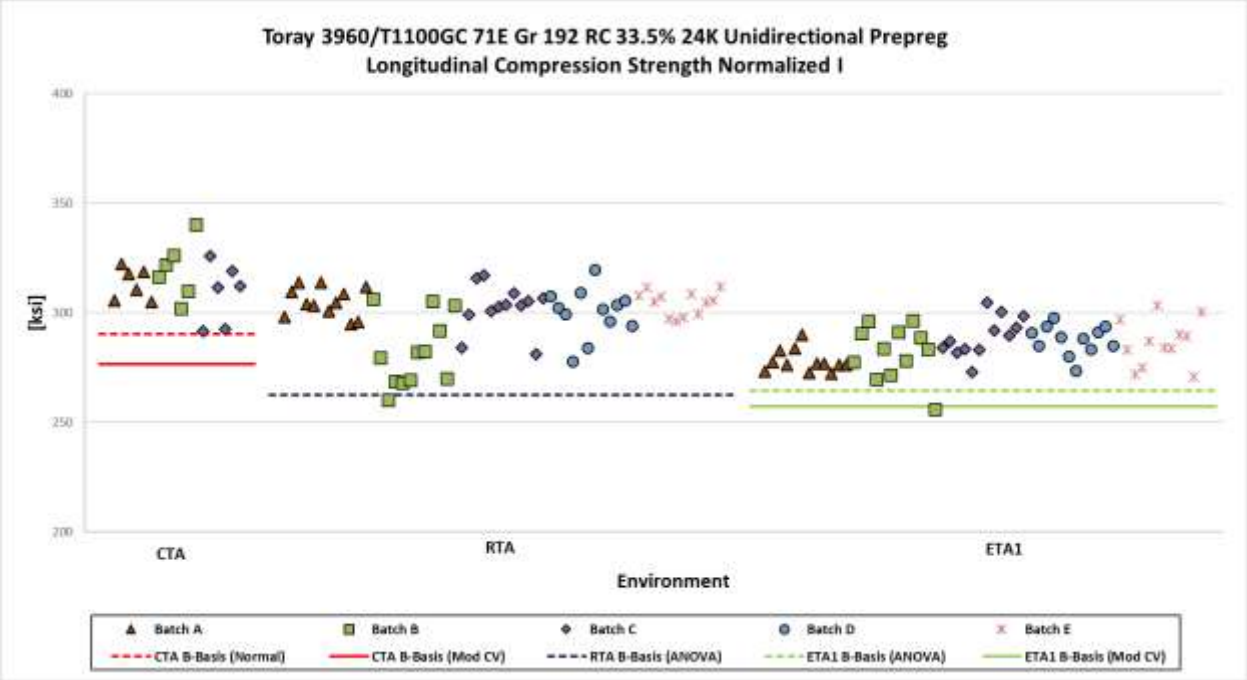

Figure 4-5 Batch plot for LC strength normalized (CTA, RTA, ETA1)

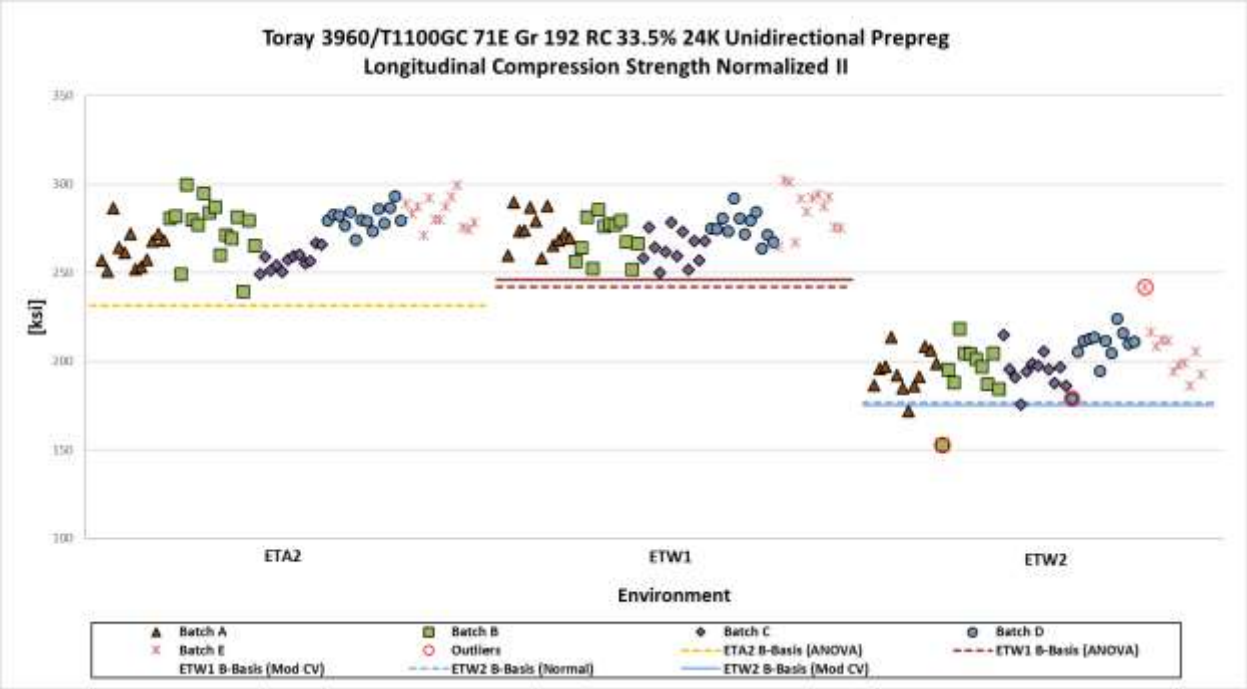

Figure 4-6 Batch plot for LC strength normalized (ETA2, ETW1, ETW2)

As Measured Longitudinal Compression Strength Basis Values and Statistics						
Environment	CTA	RTA	ETA1	ETA2	ETW1	ETW2
Mean	307.0	293.6	279.0	268.0	269.6	196.5
Stdev	11.68	14.37	9.904	14.60	13.13	14.43
CV	3.804	4.895	3.550	5.446	4.869	7.342
Mod CV	6.000	6.447	6.000	6.723	6.434	7.671
Min	286.5	257.0	250.1	232.7	244.5	150.6
Max	334.7	317.2	296.9	296.2	299.7	241.5
No. Batches	3	5	5	5	5	5
No. Spec.	18	60	60	67	60	58
Basis Values and Estimates						
B-Basis Value	284.0	252.2	255.7	224.6	232.8	163.6
A-Basis Value		223.3	239.1	194.3	207.1	140.2
A-Estimate	267.6					
Method	Normal	ANOVA	ANOVA	ANOVA	ANOVA	ANOVA
Modified CV Basis Values and Estimates						
B-Basis Value	270.7	NA	252.1	NA	NA	NA
A-Basis Value			232.0			
A-Estimate	244.9					
Method	Normal		Normal			

Table 4-7: Statistics, Basis Vales and Estimates for As Measured LC Strength Data

Normalized Longitudinal Compression Strength Basis Values and Statistics						
Environment	CTA	RTA	ETA1	ETA2	ETW1	ETW2
Mean	313.9	298.9	284.6	272.7	273.8	199.5
Stdev	12.03	13.41	9.656	14.10	12.46	14.10
CV	3.833	4.486	3.392	5.171	4.551	7.067
Mod CV	6.000	6.243	6.000	6.585	6.276	7.534
Min	291.7	260.4	256.1	239.4	249.9	152.7
Max	340.3	319.7	304.6	299.9	302.5	242.0
No. Batches	3	5	5	5	5	5
No. Spec.	18	60	60	67	60	58
Basis Values and Estimates						
B-Basis Value	290.2	262.7	264.4	231.5	241.9	176.7
A-Basis Value		237.3	249.8	202.8	219.4	159.8
A-Estimate	273.3					
Method	Normal	ANOVA	ANOVA	ANOVA	ANOVA	Normal
Modified CV Basis Values and Estimates						
B-Basis Value	276.7	NA	257.2	NA	246.2	175.2
A-Basis Value			236.7		225.6	157.2
A-Estimate	250.4					
Method	Normal		Normal		Normal	Normal

Table 4-8: Statistics, Basis Values and Estimates for Normalized LC Strength Data

As Measured Longitudinal Compression Modulus Statistics						
Environment	CTA	RTA	ETA1	ETA2	ETW1	ETW2
Mean	22.42	21.87	22.53	23.04	22.43	22.29
Stdev	0.3866	0.4467	0.6753	0.9108	0.5327	0.8025
CV	1.724	2.043	2.997	3.953	2.375	3.600
Min	21.79	20.67	20.82	21.35	21.43	20.22
Max	23.02	23.10	23.99	25.50	23.59	24.62
No. Batches	3	5	5	5	5	5
No. Spec.	18	60	59	53	60	54

Table 4-9: Statistics for As Measured LC Modulus Data

Normalized Longitudinal Compression Modulus Statistics						
Environment	CTA	RTA	ETA1	ETA2	ETW1	ETW2
Mean	22.59	22.18	22.77	23.23	22.70	22.49
Stdev	0.4704	0.4537	0.6174	0.9169	0.5674	0.8163
CV	2.082	2.045	2.712	3.947	2.500	3.630
Min	21.92	21.26	21.51	21.21	21.69	20.58
Max	23.55	23.55	24.45	25.72	24.02	25.26
No. Batches	3	5	5	5	5	5
No. Spec.	18	60	59	53	60	54

Table 4-10: Statistics for Normalized LC Modulus Data

4.4 Transverse Compression (TC)

Transverse Compression (TC) tests were performed at six different environmental conditions CTA, RTA, ETA1, ETA2, ETW1 and ETW2. The TC properties are two, Strength and Modulus.

With respect to computing allowables for the original CV strength data, ANOVA method was used for all environments except for CTA, which passed ADK and normality tests, so normal method is used for it. Environments using ANOVA method have more than 5 batches and more than 55 specimens, so A-Basis values, rather than estimates, are provided. For modified CV, CTA and RTA were pooled, the ETA2 condition failed the ADK test, therefore allowables were not computed for ETA2, and the normal method was used for the remaining conditions.

Three outliers were detected for TC strength property. The lowest value in batch B of the CTA condition was an outlier for the condition but not for the batch. The lowest value in batch B of the ETA2 condition was an outlier for the batch but not for the condition. The highest value in batch C of the ETA2 condition was an outlier for the batch but not for the condition. The outliers were retained for this analysis.

Statistics, basis values and estimates are given for strength data in Table 4-11 and for modulus data in Table 4-12. The data, B-basis values and B-estimates are shown graphically in Figure 4-7 and Figure 4-8.

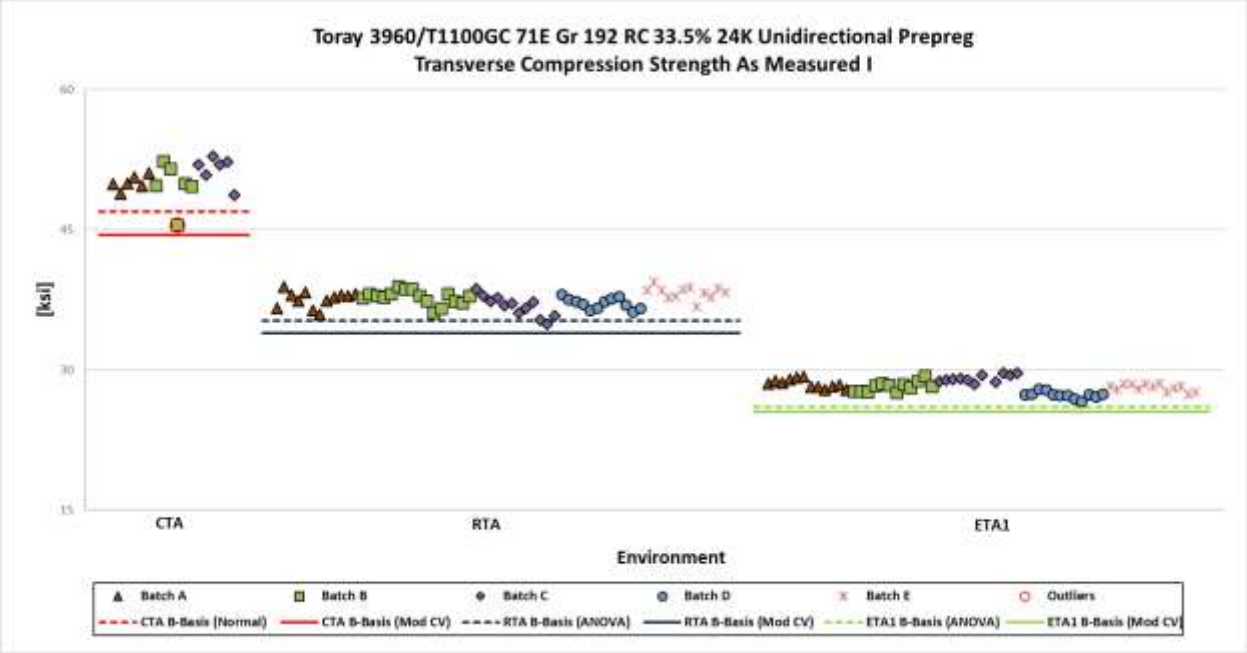

Figure 4-7 Batch Plot for TC Strength Data (CTA, RTA, ETA1)

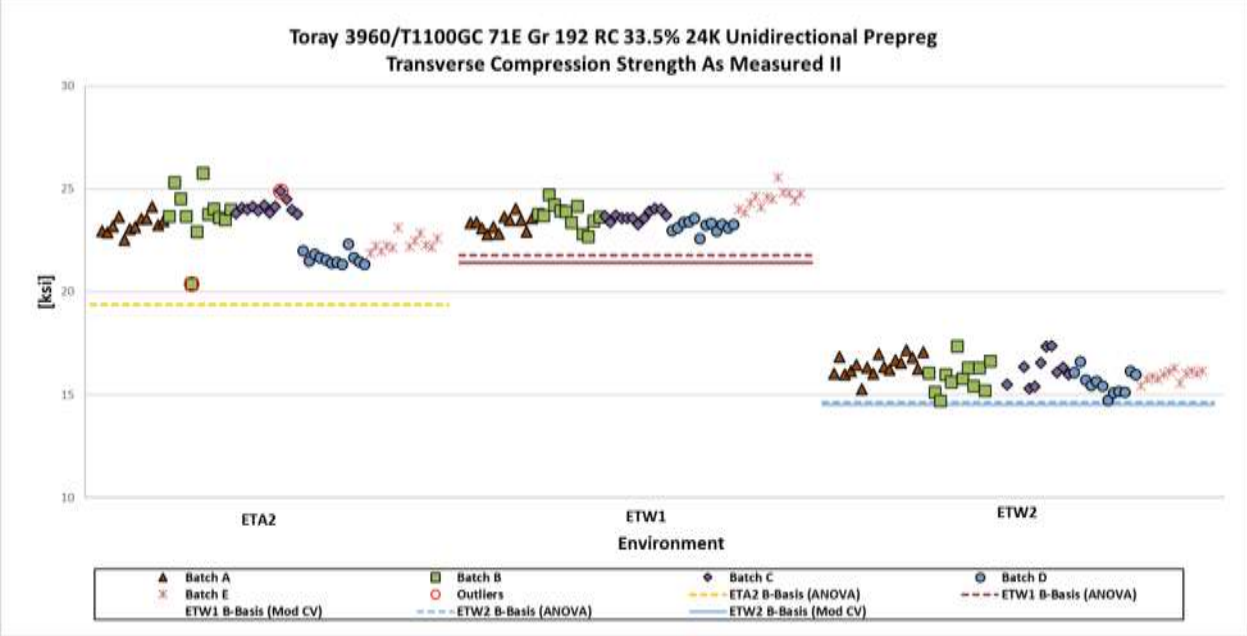

Figure 4-8 Batch plot for TC strength (ETA2, ETW1, ETW2)

Transverse Compression Strength Basis Values and Statistics						
Environment	CTA	RTA	ETA1	ETA2	ETW1	ETW2
Mean	50.42	37.53	28.23	23.03	23.68	16.03
Stdev	1.741	0.9360	0.7030	1.129	0.6125	0.6204
CV	3.453	2.494	2.491	4.901	2.586	3.870
Mod CV	6.000	6.000	6.000	6.450	6.000	6.000
Min	45.53	34.89	26.59	20.40	22.59	14.69
Max	52.87	39.40	29.65	25.77	25.56	17.38
No. Batches	3	5	5	5	5	5
No. Spec.	18	64	60	60	60	63
Basis Values and Estimates						
B-Basis Value	46.98	35.26	25.99	19.38	21.78	14.63
A-Basis Value		33.65	24.44	16.85	20.45	13.62
A-Estimate	44.54					
Method	Normal	ANOVA	ANOVA	ANOVA	ANOVA	ANOVA
Modified CV Basis Values and Estimates						
B-Basis Value	46.19	33.69	25.50	NA	21.40	14.49
A-Basis Value		30.85	23.47		19.69	13.35
A-Estimate	43.42					
Method	Pooled	Pooled	Normal		Normal	Normal

Table 4-11 Statistics, Basis Values and Estimates for TC strength

Transverse Compression Modulus Statistics						
Environment	CTA	RTA	ETA1	ETA2	ETW1	ETW2
Mean	1.582	1.386	1.294	1.257	1.270	1.023
Stdev	0.06682	0.02118	0.03681	0.05111	0.03367	0.04359
CV	4.223	1.528	2.844	4.067	2.652	4.261
Min	1.510	1.340	1.250	1.170	1.190	0.9100
Max	1.820	1.440	1.430	1.370	1.340	1.140
No. Batches	3	5	5	5	5	5
No. Spec.	18	57	61	61	60	67

Table 4-12 Statistics for TC modulus

4.5 Short-Beam Strength (SBS)

SBS tests were performed at six different environmental conditions. The SBS properties are not fiber dominated, so the data is not normalized and only the as-measured values are provided.

With respect to computing for the original CV data, all environments failed the Anderson Darling k-sample (ADK) test for batch-to-batch variability, therefore using the ANOVA method was required. Only CTA environment does not satisfy the data size requirements (5 batches and 55 specimens minimum) for A-basis, so an A-estimate is provided instead, for the rest of environments A-basis and B-basis are provided. For modified CV data, CTA and RTA were pooled, since they satisfy the necessary tests (ADK test, normality test, Levene's test), while ETA1 and ETA2 use the normal method for computing the allowables and ETW1 and ETW2 have Not Available values (NA) since they both fail the ADK test. For CTA only A-estimate is provided, since it has less than 5 batches.

There was one statistical outlier. The lowest value in condition ETA1 and batch D was a batch outlier. It was retained for this analysis.

Statistics and basis values are given for SBS data in Table 4-13. The data, B-basis values and B-estimates are shown graphically in Figure 4-9 and Figure 4-10.

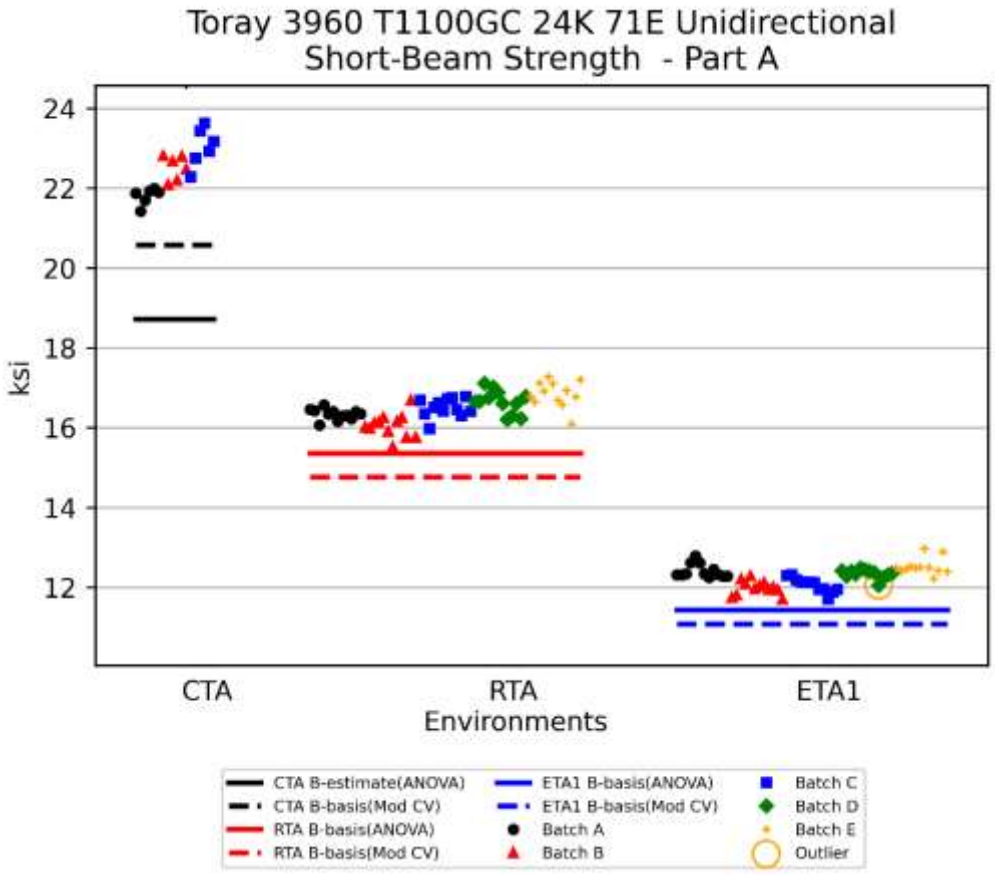

Figure 4-9 Batch plot for SBS strength

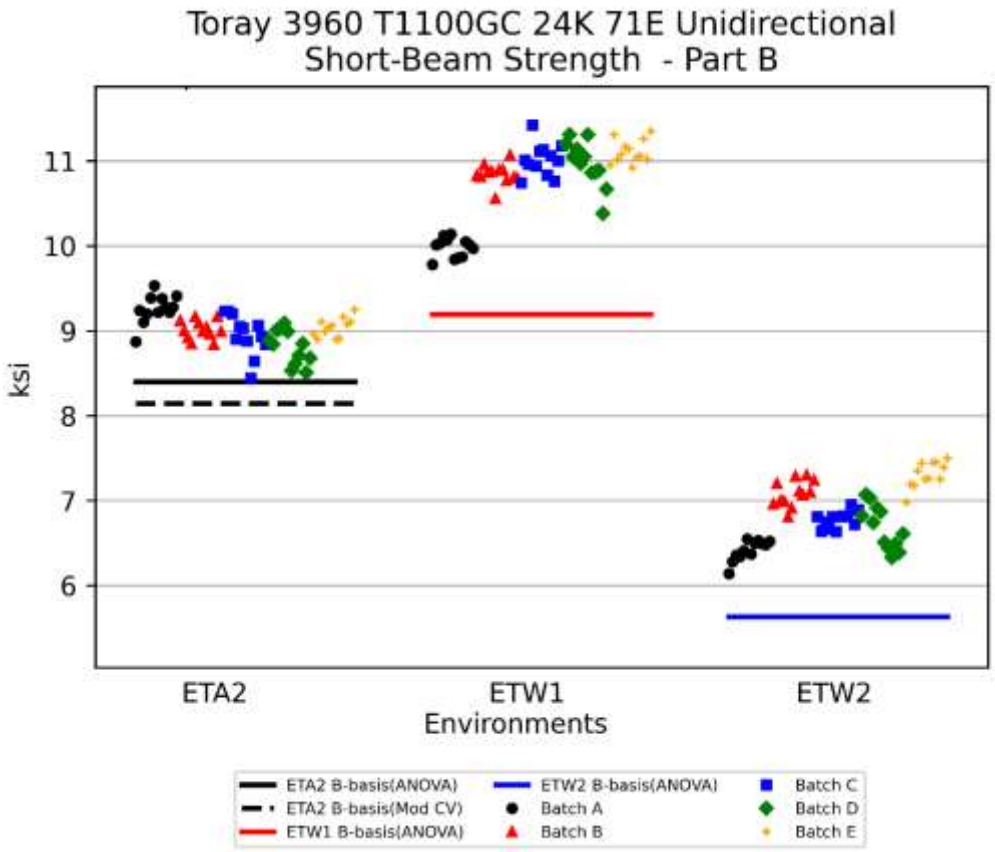

Figure 4-10 Batch plot for SBS strength

Short-Beam Strength Basis Values and Statistics						
	Strength [ksi]					
Env	CTA(-65°F)	RTA(70°F)	ETA1(180°F)	ETA2(250°F)	ETW1(180°F)	ETW2(250°F)
Mean	22.45	16.47	12.26	9.015	10.78	6.853
Stdev	0.6174	0.3748	0.2652	0.2225	0.4485	0.3526
CV	2.750	2.275	2.163	2.468	4.159	5.145
Mod CV	6.000	6.000	6.000	6.000	6.079	6.573
Min	21.42	15.52	11.70	8.440	9.780	6.140
Max	23.63	17.28	12.97	9.530	11.42	7.500
No. Batches	3	5	5	5	5	5
No. Spec.	18	60	60	60	60	60
Basis Values and Estimates						
B-Basis		15.36	11.44	8.399	9.190	5.635
B-Estimate	18.72					
A-Basis		14.59	10.87	7.968	8.095	4.796
A-Estimate	16.06					
Method	ANOVA	ANOVA	ANOVA	ANOVA	ANOVA	ANOVA
Modified CV Basis Values and Estimates						
B-Basis	20.57	14.76	11.08	8.145	NA	NA
A-Basis		13.50	10.20	7.497		
A-Estimate	19.34					
Method	Pooled	Pooled	Normal	Normal		

Table 4-13 Statistics and Basis Values for SBS strength

4.6 In-Plane Shear Tension (IPST)

In-Plane Shear Tension (IPST) tests were performed at six different environmental conditions and for four material properties 0.2% Offset Strength, Strength at 5% Strain, Ultimate Strength Strain and Modulus. The IPS properties are not fiber dominated, so the data is not normalized and only the as-measured values are provided.

With respect to computing allowables for 0.2% Offset Strength property using original CV data, CTA condition passes ADK test and normality test, so normal method was used. The rest of the conditions fail ADK test, so ANOVA method was used. Since each condition for which ANOVA was used has 5 batches and 60 specimens, ANOVA method provides B-basis and A-basis values, rather than estimates. For 0.2% Offset Strength property using modified CV data, CTA, RTA and ETW1 conditions pass ADK test and normality test, so normal method was used. The rest of the conditions fail ADK test, so allowables are Not Available (NA) for these.

For Ultimate Strength property using original CV data, condition CTA failed ADK test, so ANOVA method was used. Since CTA condition has less than 5 batches and less than 55 specimens, ANOVA produces only estimates rather than basis values. For Ultimate Strength property using modified CV data, CTA condition passed the ADK test and the normal method for modified CV was used to compute values.

For Strength at 5% Strain property using original CV data, all conditions failed ADK test, so ANOVA method was used. Since all conditions have 5 batches and 60 specimens, ANOVA method provides B-basis and A-basis values, rather than estimates for these. For Strength at 5% Strain property using modified CV data, RTA and ETW1 conditions pass ADK test and normality test, so normal method was used. The rest of the conditions failed the ADK test, so allowables are Not Available (NA) for these.

There were eight statistical outliers for 0.2% Offset Strength. The two highest values in batch B of the RTA condition were outlier for the condition but not for the batch. The lowest value in batch A of the ETA1 condition was an outlier for the batch but not for the condition. The highest value in batch A of the ETA2 condition was an outlier for the batch but nor for the condition. The highest value in batch D of the ETA2 condition was an outlier for the batch but not for the condition. The highest value in batch B of the ETW2 condition was an outlier for the batch but not for the condition. The lowest value in batch C of the ETW2 condition was an outlier for the batch but not for the condition. The highest value in batch D of the ETW2 condition was an outlier for the batch but not for the condition. They were retained for this analysis.

There were three statistical outliers for Strength at 5% Strain. The highest value in batch D of the ETA2 condition was an outlier for the batch but not for the condition. The lowest value in batch B of the ETW2 condition was an outlier for the batch but not for the condition. The highest value in batch D of the ETW2 condition was an outlier for the batch but not for the condition. They were retained for this analysis.

Statistics, estimates and basis values are given for the 0.2% offset strength data in Table 4-14, for the strength at 5% strain and ultimate strength strain data in Table 4-15 and for modulus data in Table 4-16. The data, B-estimates, and B-basis values are shown graphically for the 0.2% offset

strength in Figure 4-11 and Figure 4-12 and for ultimate strength strain and Strength at 5% Strain in Figure 4-13 and Figure 4-14.

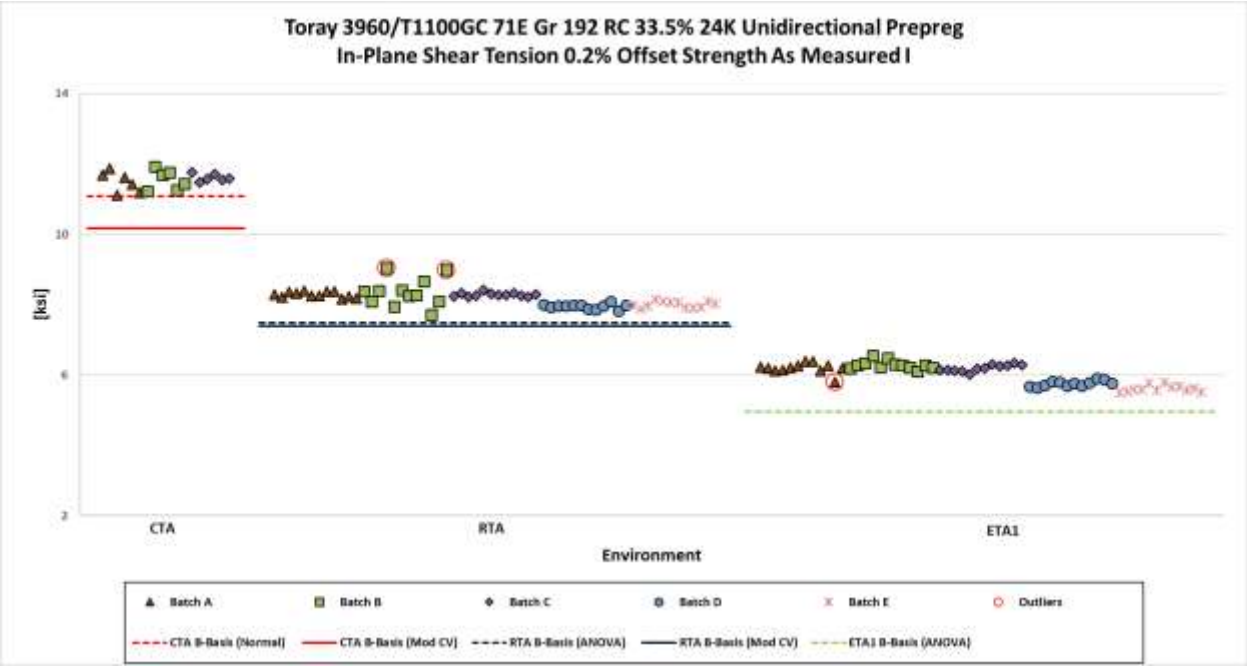

Figure 4-11 Batch plot for IPST for 0.2% Offset Strength (CTA, RTA, ETA1)

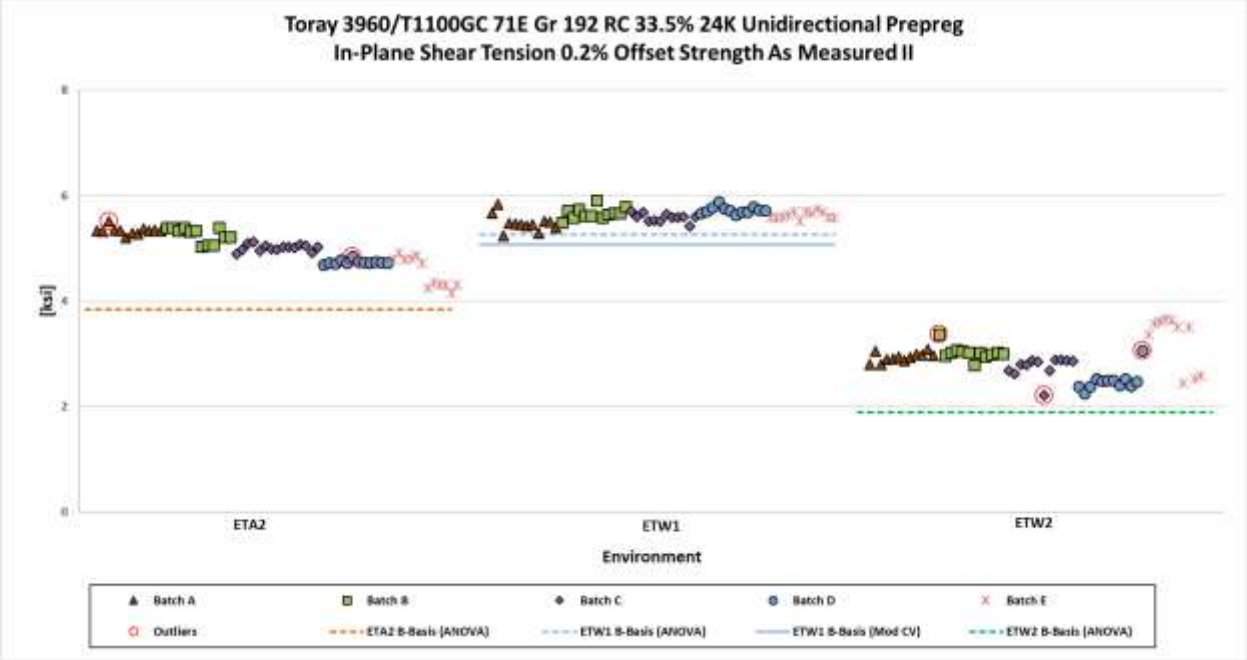

Figure 4-12 Batch plot for IPST for 0.2% Offset Strength (ETA2, ETW1, ETW2)

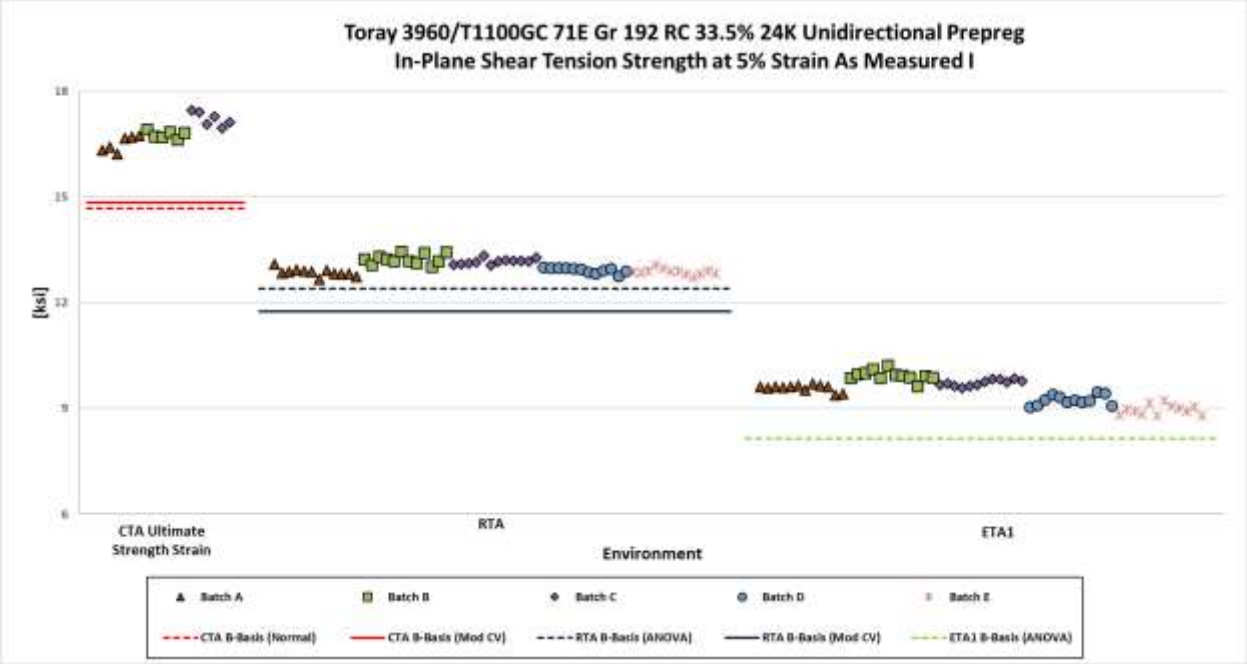

Figure 4-13 Batch plot for IPST Ultimate Strength Strain (CTA, RTA, ETA1)

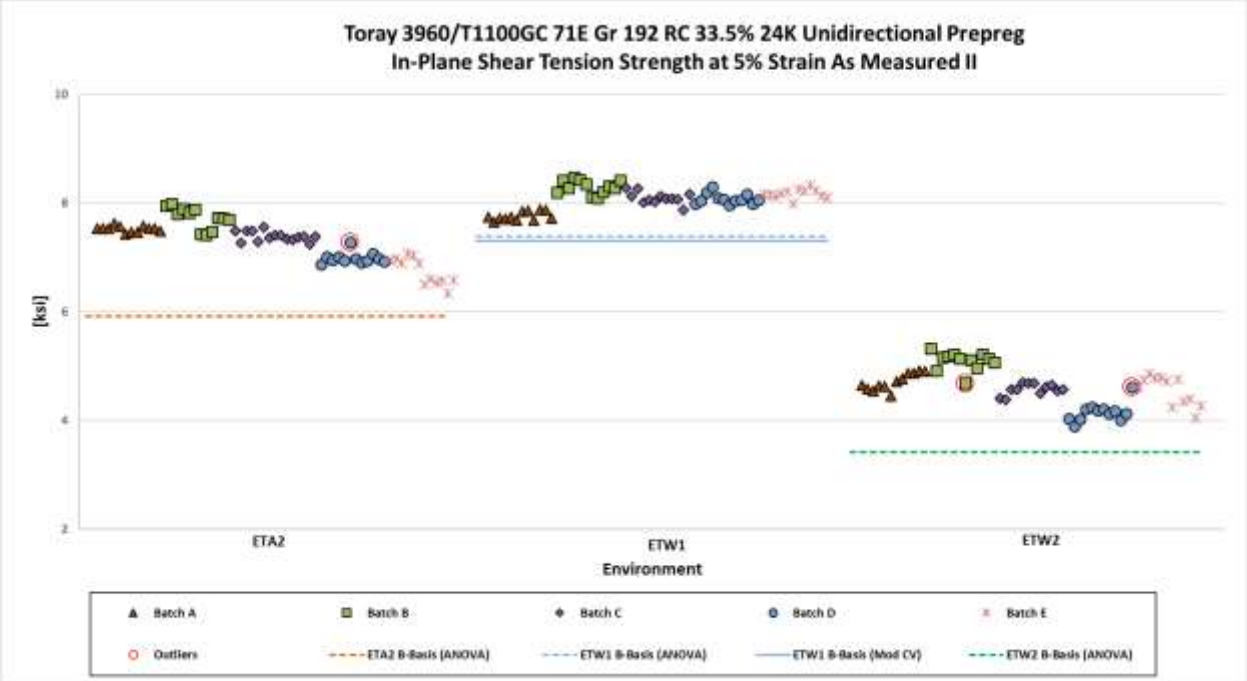

Figure 4-14 Batch plot for IPST Ultimate Strength Strain (ETA2, ETW1, ETW2)

In Plane Shear Tension Strength Basis Values and Statistics						
0.2% Offset Strength						
Environment	CTA	RTA	ETA1	ETA2	ETW1	ETW2
Mean	11.54	8.176	6.012	4.980	5.618	2.873
Stdev	0.2345	0.2449	0.2946	0.3287	0.1304	0.3453
CV	2.032	2.996	4.900	6.599	2.322	12.02
Mod CV	6.000	6.000	6.450	7.300	6.000	12.02
Min	11.12	7.710	5.500	4.150	5.240	2.210
Max	11.92	9.040	6.560	5.520	5.910	3.660
No. Batches	3	5	5	5	5	5
No. Spec.	18	60	60	63	60	60
Basis Values and Estimates						
B-Basis Value	11.08	7.488	4.961	3.833	5.257	1.888
A-Basis Value		7.008	4.240	3.044	5.005	1.201
A-Estimate	10.75					
Method	Normal	ANOVA	ANOVA	ANOVA	ANOVA	ANOVA
Modified CV Basis Values and Estimates						
B-Basis Value	10.18	7.387	NA	NA	5.075	NA
A-Basis Value		6.799			4.672	
A-Estimate	9.209					
Method	Normal	Normal			Normal	

Table 4-14 Statistics and Basis Values for IPST for 0.2% Offset Strength

In Plane Shear Tension Strength Basis Values and Statistics						
	Ult. Strength Strain	Strength at 5% Strain				
Environment	CTA	RTA	ETA1	ETA2	ETW1	ETW2
Mean	16.83	13.01	9.487	7.279	8.080	4.617
Stdev	0.3442	0.1863	0.3714	0.3848	0.2042	0.3540
CV	2.046	1.432	3.915	5.286	2.528	7.668
Mod CV	6.000	6.000	6.000	6.643	6.000	7.834
Min	16.22	12.66	8.780	6.340	7.650	3.890
Max	17.46	13.45	10.22	7.980	8.470	5.330
No. Batches	3	5	5	5	5	5
No. Spec.	18	60	60	63	60	60
Basis Values and Estimates						
B-Basis Value		12.39	8.144	5.912	7.382	3.422
B-Estimate	14.68					
A-Basis Value		11.95	7.222	4.973	6.902	2.598
A-Estimate	13.14					
Method	ANOVA	ANOVA	ANOVA	ANOVA	ANOVA	ANOVA
Modified CV Basis Values and Estimates						
B-Basis Value	14.84	11.75	NA	NA	7.300	NA
B-Estimate						
A-Basis Value		10.82			6.719	
A-Estimate	13.42					
Method	Normal	Normal			Normal	

Table 4-15 Statistics and Basis Values for IPST Ultimate Strength Strain and Strength at 5% Strain

In Plane Shear Tension As-Measured Modulus Statistics						
Environment	CTA	RTA	ETA1	ETA2	ETW1	ETW2
Mean	0.8764	0.7219	0.5424	0.4588	0.5127	0.2858
Stdev	0.02056	0.01675	0.02534	0.02452	0.01774	0.04709
CV	2.346	2.320	4.672	5.345	3.460	16.48
Min	0.8350	0.6570	0.4730	0.3970	0.4440	0.2100
Max	0.9240	0.7610	0.5850	0.5330	0.5440	0.3990
No. Batches	3	5	5	5	5	5
No. Spec.	18	60	60	63	60	60

Table 4-16 Statistics from IPST Modulus

4.7 In-Plane Shear V-Notched (IPSV)

In-Plane Shear V-Notched (IPSV) tests were performed at six different environmental conditions and for three material properties 0.2% Offset Strength, Strength at 5% Strain and Modulus. The IPS properties are not fiber dominated, so the data is not normalized and only the as-measured values are provided.

With respect to computing allowables for 0.2% Offset Strength property using original CV data, CTA condition passes ADK test and normality test, so normal method was used. The rest of the conditions fail ADK test, so ANOVA method was used. Since each condition using ANOVA method has 5 batches and 60 specimens, the method produces B-basis and A-basis values, rather than estimates. For 0.2% Offset Strength property using modified CV data, CTA, RTA and ETA2 conditions pass ADK test and normality test, CTA and RTA were pooled, and the normal method was used for ETA2. The rest of the conditions fail ADK test, so allowables are Not Available (NA) for those.

For Strength at 5% strain property using original CV data, all conditions fail ADK test, so ANOVA method was used. Since CTA condition has less than 5 batches and less than 55 specimens, ANOVA produces only estimates rather than basis values for this condition. The rest of the conditions have 5 batches and more than 55 specimens, so ANOVA method produces B-basis and A-basis values, rather than estimates for these. For Strength at 5% strain property using modified CV data, CTA and RTA conditions pass pooling tests, so pooling method was used. Conditions ETA1, ETA2 and ETW2 pass the normality test, so normal method was used. ETW1 failed the ADK test, so allowables are Not Available (NA) for ETW1.

There were seven statistical outliers for 0.2% Offset Strength. The lowest value in batch A of the CTA condition was an outlier for the condition but not for the batch. The highest value in batch E of the RTA condition was an outlier for the batch but not for the condition. The highest value in batch E of the ETA1 condition was an outlier for the batch but not for the condition. The highest value in batch D of the ETW1 condition was an outlier for the batch but not for the condition. The highest and lowest values in batch D of the ETW2 condition were outliers for the condition but not for the batch. The highest value in batch E of the ETW2 condition was an outlier for the batch but not for the condition. All outliers were retained for analysis.

There were four statistical outliers for Strength at 5% Strain. The lowest value in batch B of the ETA2 condition was an outlier for the batch but not for the condition. The highest value in batch E of the ETA2 condition was an outlier for the batch but not for the condition. The lowest value in batch C of the ETW1 condition was an outlier for the batch but not for the condition. The highest value in batch D of the ETW1 condition was an outlier for the batch but not for the condition. All outliers were retained for analysis.

Statistics, estimates, and basis values are given for the 0.2% offset strength data in Table 4-17, the strength at 5% strain data in Table 4-18 and modulus data in Table 4-19. The data, B-estimates, and B-basis values are shown graphically for the 0.2% offset strength in Figure 4-15 and Figure 4-16 and for strength at 5% strain in Figure 4-17 and Figure 4-18.

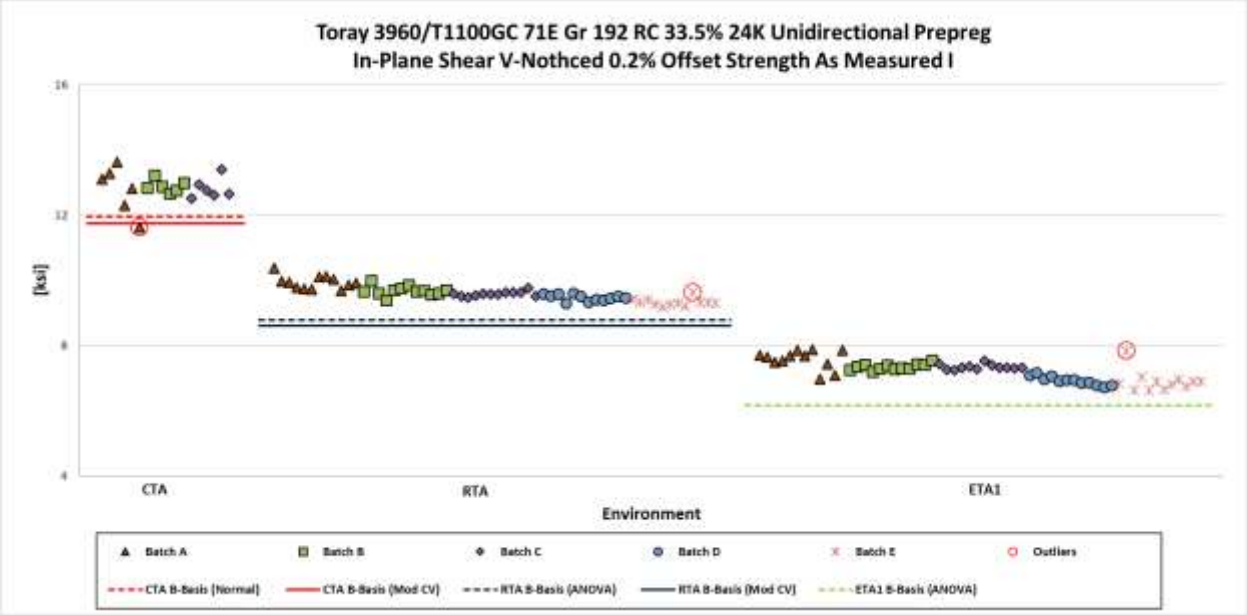

Figure 4-15 Batch plot for IPSV for 0.2% Offset Strength (CTA, RTA, ETA1)

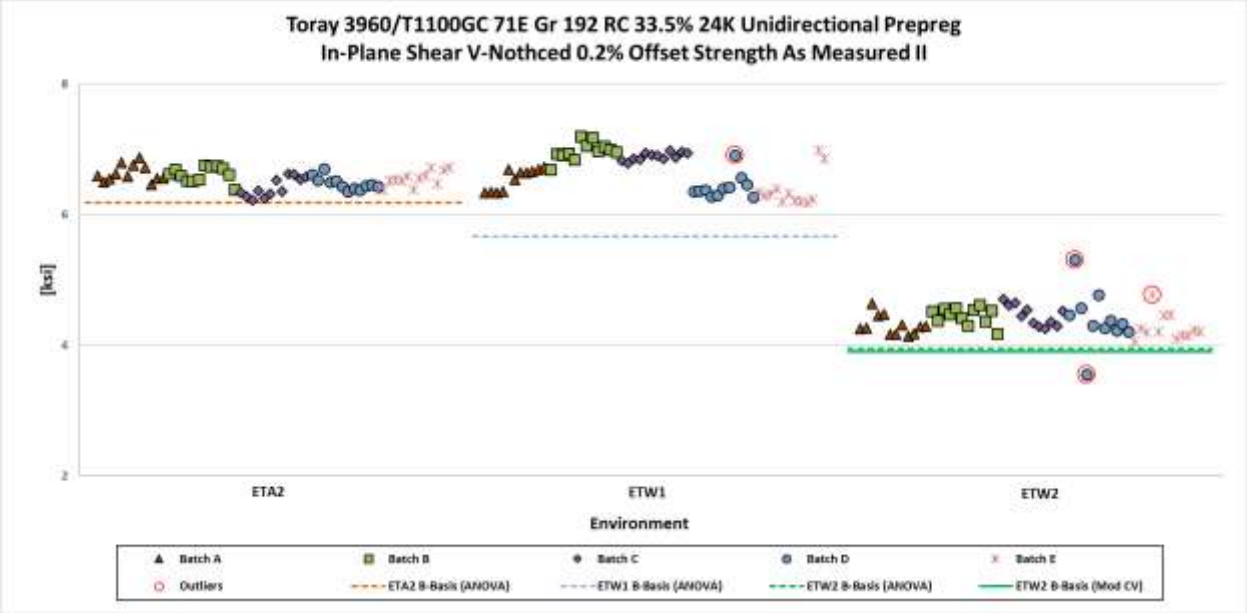

Figure 4-16 Batch plot for IPSV for 0.2% Offset Strength (ETA2, ETW1, ETW2)

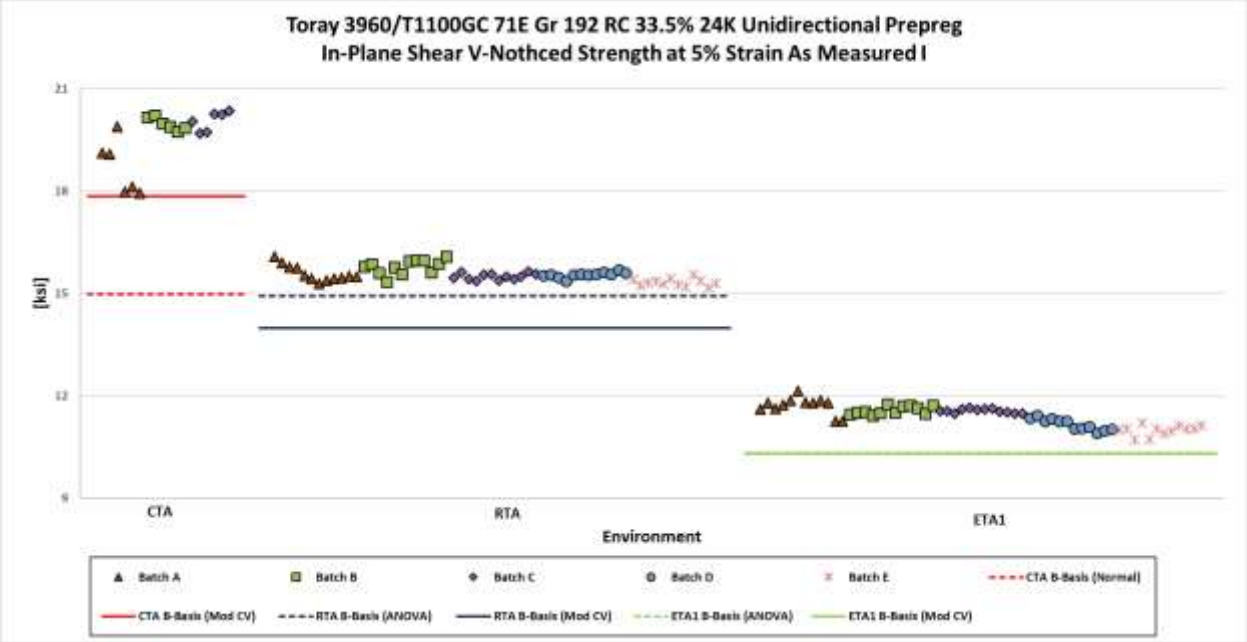

Figure 4-17 Batch plot for IPSV Strength at 5% Strain (CTA, RTA, ETA1)

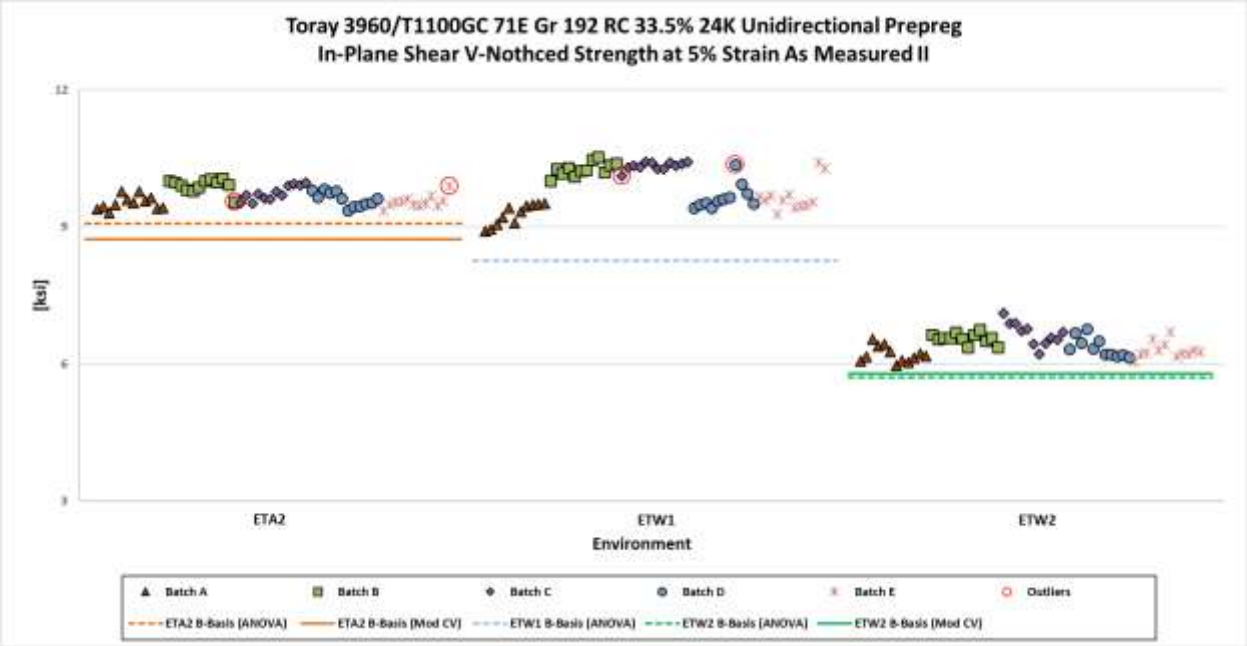

Figure 4-18 Batch plot for IPSV Strength at 5% Strain (ETA2, ETW1, ETW2)

In Plane Shear V-Notched Strength Basis Values and Statistics						
0.2% Offset Strength						
Environment	CTA	RTA	ETA1	ETA2	ETW1	ETW2
Mean	12.83	9.606	7.225	6.543	6.651	4.375
Stdev	0.4449	0.2453	0.3331	0.1442	0.3007	0.2410
CV	3.468	2.554	4.610	2.203	4.521	5.509
Mod CV	6.000	6.000	6.305	6.000	6.261	6.754
Min	11.63	9.180	6.630	6.220	6.180	3.550
Max	13.63	10.38	7.880	6.880	7.200	5.310
No. Batches	3	5	5	5	5	5
No. Spec.	18	60	60	60	58	58
Basis Values and Estimates						
B-Basis Value	11.95	8.792	6.173	6.180	5.669	3.944
A-Basis Value		8.230	5.445	5.924	4.991	3.629
A-Estimate	11.33					
Method	Normal	ANOVA	ANOVA	ANOVA	ANOVA	ANOVA
Modified CV Basis Values and Estimates						
B-Basis Value	11.75	8.616	NA	5.912	NA	NA
A-Basis Value		7.884		5.441		
A-Estimate	11.03					
Method	Pooled	Pooled		Normal		

Table 4-17 Statistics and Basis Values for IPSV for 0.2% Offset Strength

In Plane Shear V-Notched Strength Basis Values and Statistics						
Strength at 5% Strain						
Environment	CTA	RTA	ETA1	ETA2	ETW1	ETW2
Mean	19.57	15.54	11.40	9.666	9.850	6.416
Stdev	0.7936	0.2161	0.3166	0.2036	0.4651	0.2489
CV	4.056	1.391	2.777	2.106	4.722	3.879
Mod CV	6.028	6.000	6.000	6.000	6.361	6.000
Min	17.94	15.16	10.71	9.300	8.910	5.960
Max	20.34	16.08	12.13	10.06	10.53	7.110
No. Batches	3	5	5	5	5	5
No. Spec.	18	60	60	60	58	58
Basis Values and Estimates						
B-Basis Value		14.92	10.32	9.073	8.266	5.711
B-Estimate	14.98					
A-Basis Value		14.48	9.583	8.659	7.174	5.219
A-Estimate	11.70					
Method	ANOVA	ANOVA	ANOVA	ANOVA	ANOVA	ANOVA
Modified CV Basis Values and Estimates						
B-Basis Value	17.84	13.97	10.30	8.733	NA	5.794
A-Basis Value		12.81	9.479	8.038		5.331
A-Estimate	16.71					
Method	Pooled	Pooled	Normal	Normal		Normal

Table 4-18 Statistics and Basis Values for IPSV Strength at 5% Strain

In Plane Shear V-Notched As-Measured Modulus Statistics						
Environment	CTA	RTA	ETA1	ETA2	ETW1	ETW2
Mean	0.9156	0.7782	0.6172	0.5590	0.5747	0.3847
Stdev	0.04609	0.01641	0.03225	0.02445	0.01913	0.02663
CV	5.034	2.109	5.225	4.375	3.329	6.922
Min	0.8680	0.7410	0.5110	0.4900	0.5270	0.2890
Max	1.022	0.8190	0.7820	0.6120	0.6070	0.4700
No. Batches	3	5	5	5	5	5
No. Spec.	18	60	60	60	58	58

Table 4-19 Statistics from IPSV Modulus

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

Unnotched Tension 1 (UNT1) tests were performed at four different environmental conditions CTA, RTA, ETW1 and ETW2 and for four material properties Strength as-measured, Strength normalized, Modulus as-measured and Modulus normalized. The UNT properties are fiber dominated, so the data is normalized.

With respect to computing allowables for Strength as-measured property using original CV data, CTA and RTA conditions pass pooling tests, so pooling method was used for these. Condition ETW1 fail ADK test, so ANOVA method was used. Since ETW1 has 5 batches but less than 55 specimens, the method produces B-basis value but A-estimate value. Condition ETW2 passes normality test, so normal method is used. For Strength as-measured property using modified CV data, all four conditions pass pooling tests, so pooling method was used.

For Strength normalized property using original CV data, conditions CTA, RTA and ETW1 pass pooling tests, so pooling method was used. Condition ETW2 failed all distributions tests, so non-parametric method was used for this one. For Strength normalized property using modified CV data, all four conditions pass pooling tests, so pooling method was used.

There were two statistical outliers for Strength as-measured. One low batch outlier in batch E and condition ETW1. One low batch outlier in batch D and condition ETW2. There were two statistical outliers for Strength normalized. One low batch and condition outlier in batch E and condition ETW1. One low condition outlier in batch C and condition ETW2. All outliers were retained for analysis.

Statistics, estimates and basis values are given for the strength as-measured data in Table 4-20, for the strength normalized data in Table 4-21, modulus as-measured data in Table 4-22 and modulus normalized Table 4-23. The data, B-estimates and B-basis values are shown graphically for the strength as-measured in Figure 4-19 and for strength normalized in Figure 4-20.

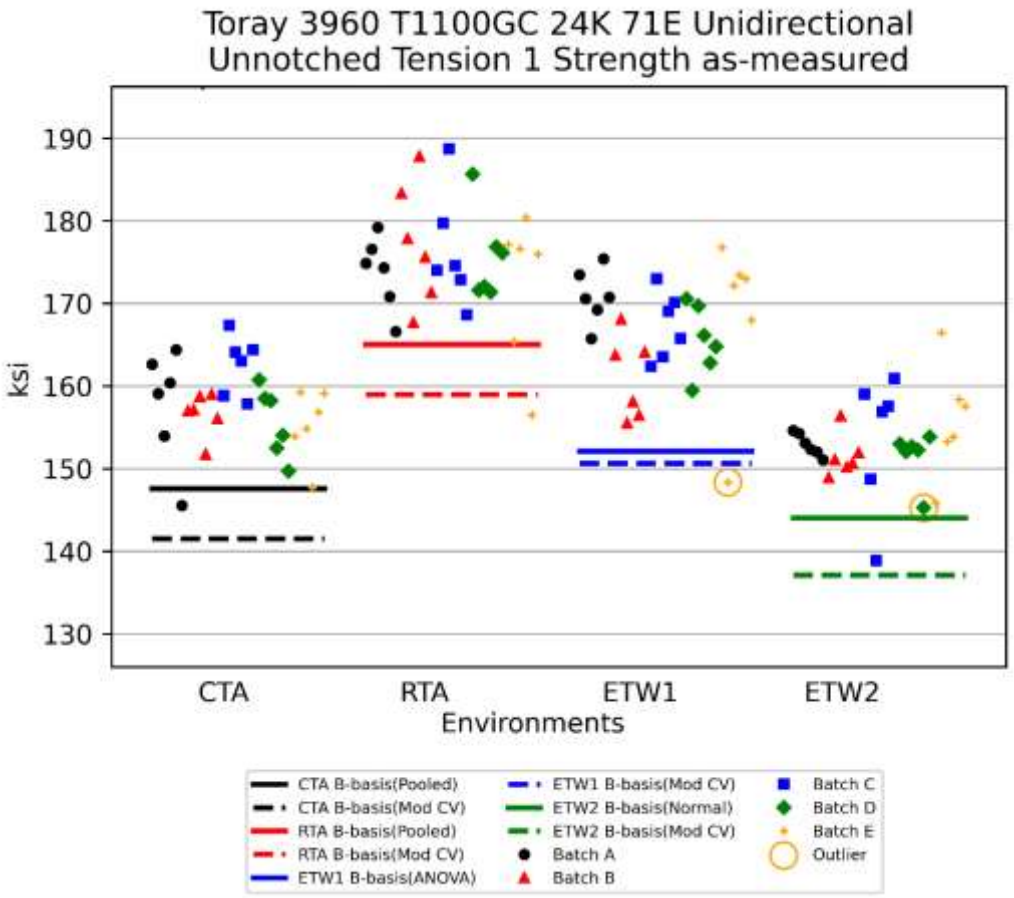

Figure 4-19 Batch plot for UNT1 Strength as-measured

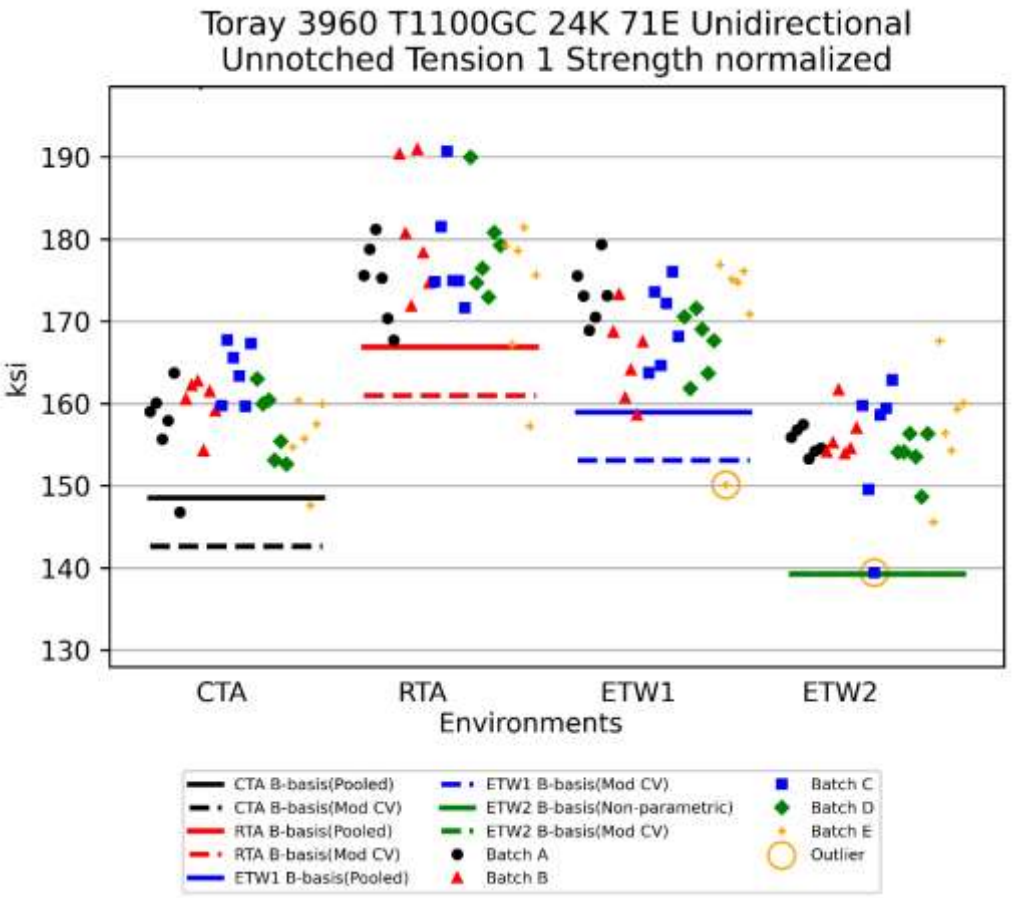

Figure 4-20 Batch plot for UNT1 Strength normalized

Unnotched Tension 1 Basis Values and Statistics				
	Strength as-measured [ksi]			
Env	CTA(-65°F)	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	157.5	175.0	166.7	153.1
Stdev	5.025	6.695	6.480	5.099
CV	3.190	3.826	3.888	3.331
Mod CV	6.000	6.000	6.000	6.000
Min	145.6	156.5	148.3	138.9
Max	167.4	188.7	176.8	166.5
No. Batches	5	5	5	5
No. Spec.	30	30	30	30
Basis Values and Estimates				
B-Basis	147.6	165.0	152.1	144.0
A-Estimate	140.6	158.0	141.9	137.5
Method	Pooled	Pooled	ANOVA	Normal
Modified CV Basis Values and Estimates				
B-Basis	141.6	159.0	150.7	137.1
A-Estimate	130.6	148.0	139.7	126.1
Method	Pooled	Pooled	Pooled	Pooled

Table 4-20 Statistics and Basis Values for UNT1 for Strength as-measured

Unnotched Tension 1 Basis Values and Statistics				
	Strength normalized [ksi]			
Env	CTA(-65°F)	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	158.9	177.2	169.3	155.5
Stdev	4.988	7.314	6.343	5.217
CV	3.139	4.127	3.746	3.355
Mod CV	6.000	6.063	6.000	6.000
Min	146.8	157.2	150.1	139.4
Max	167.7	190.9	179.3	167.6
No. Batches	5	5	5	5
No. Spec.	30	30	30	30
Basis Values and Estimates				
B-Basis	148.5	166.9	159.0	139.4
A-Estimate	141.4	159.7	151.8	116.6
Method	Pooled	Pooled	Pooled	Non-parametric
Modified CV Basis Values and Estimates				
B-Basis	142.6	161.0	153.1	139.4
A-Estimate	131.5	149.8	141.9	128.1
Method	Pooled	Pooled	Pooled	Pooled

Table 4-21 Statistics and Basis Values for UNT1 for Strength normalized

Unnotched Tension 1 Statistics				
	Modulus as-measured [Msi]			
Env	CTA(-65°F)	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	9.133	9.067	8.723	8.277
Stdev	0.2578	0.3183	0.1505	0.1981
CV	2.823	3.510	1.725	2.394
Min	8.420	8.750	8.390	7.910
Max	9.600	10.57	9.110	8.650
No. Batches	5	5	5	5
No. Spec.	30	30	30	30

Table 4-22 Statistics from UNT1 Modulus as-measured

Unnotched Tension 1 Statistics				
	Modulus normalized [Msi]			
Env	CTA(-65°F)	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	9.210	9.183	8.862	8.406
Stdev	0.2306	0.3275	0.1289	0.2304
CV	2.503	3.567	1.455	2.741
Min	8.493	8.947	8.659	7.961
Max	9.657	10.735	9.142	8.898
No. Batches	5	5	5	5
No. Spec.	30	30	30	30

Table 4-23 Statistics from UNT1 Modulus normalized

4.9 “10/80/10” Unnotched Tension 2 (UNT2)

Unnotched Tension 2 (UNT2) tests were performed at four different environmental conditions CTA, RTA, ETW1 and ETW2 and for four material properties Strength as-measured, Strength normalized, Modulus as-measured and Modulus normalized. The UNT properties are fiber dominated, so the data is normalized.

With respect to computing allowables for Strength as-measured property using original CV data, CTA failed normality test but passed lognormal test, so lognormal method was used for this condition. Conditions RTA failed ADK test, so ANOVA method was used. Since RTA and ETW1 have 5 batches but less than 55 specimens, the method produces B-basis values but A-estimate values. Conditions ETW1 and ETW2 pass normality test, so normal method is used. For Strength as-measured property using modified CV data, all four conditions pass pooling tests, so pooling method was used.

For Strength normalized property using original CV data, conditions CTA, ETW1 and ETW2 pass normality test, so normal method was used for these ones. Condition RTA failed ADK test, so ANOVA method was used for this one. Since RTA condition has 5 batches and less than 55 specimens, ANOVA produces a B-basis value but an A-estimate value only. For Strength normalized property using modified CV data, all four conditions pass pooling tests, so pooling method was used.

There were three statistical outliers for Strength as-measured. One high condition outlier in batch B and condition CTA. One high batch outlier in batch A and condition ETW1. One low batch outlier in batch D and condition ETW2. There was one statistical outlier for Strength normalized. One low batch outlier in batch D and condition ETW1. All outliers were retained for analysis.

Statistics, estimates and basis values are given for the strength as-measured data in Table 4-24, for the strength normalized data in Table 4-25, modulus as-measured data in Table 4-26 and modulus normalized in Table 4-27. The data, B-estimates and B-basis values are shown graphically for the strength as-measured in Figure 4-21 and for strength normalized in Figure 4-22.

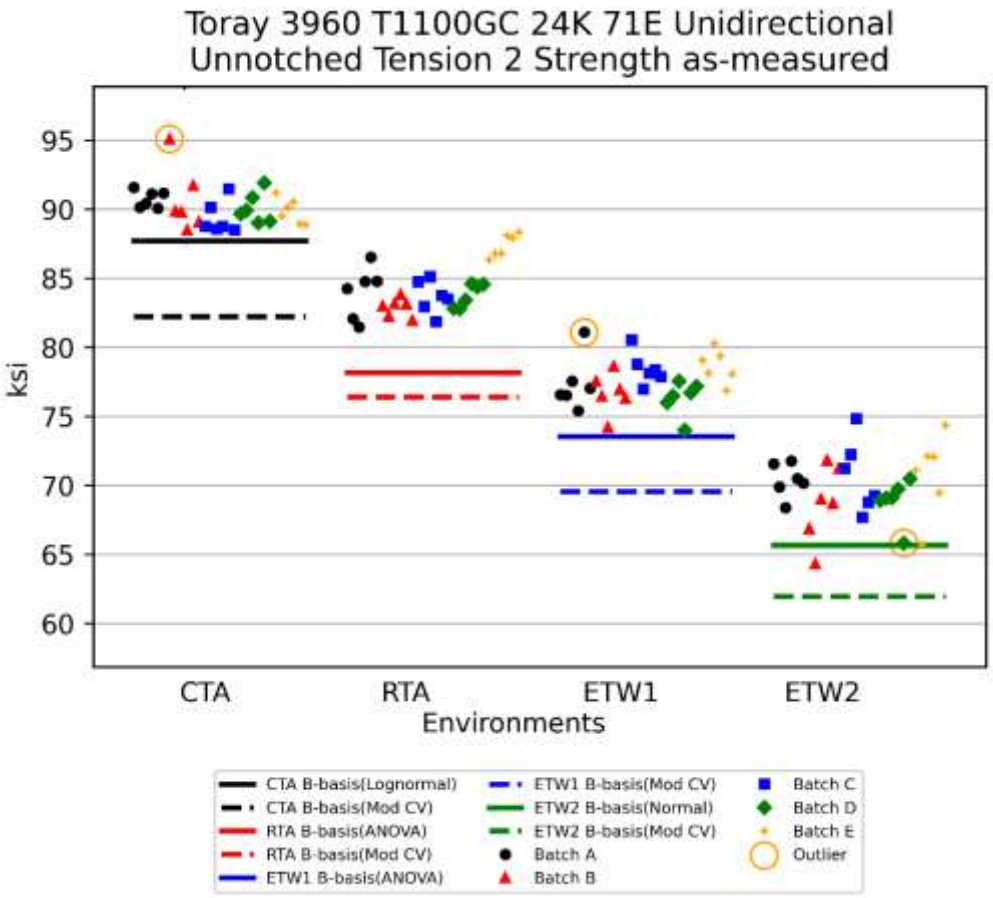

Figure 4-21 Batch plot for UNT2 Strength as-measured

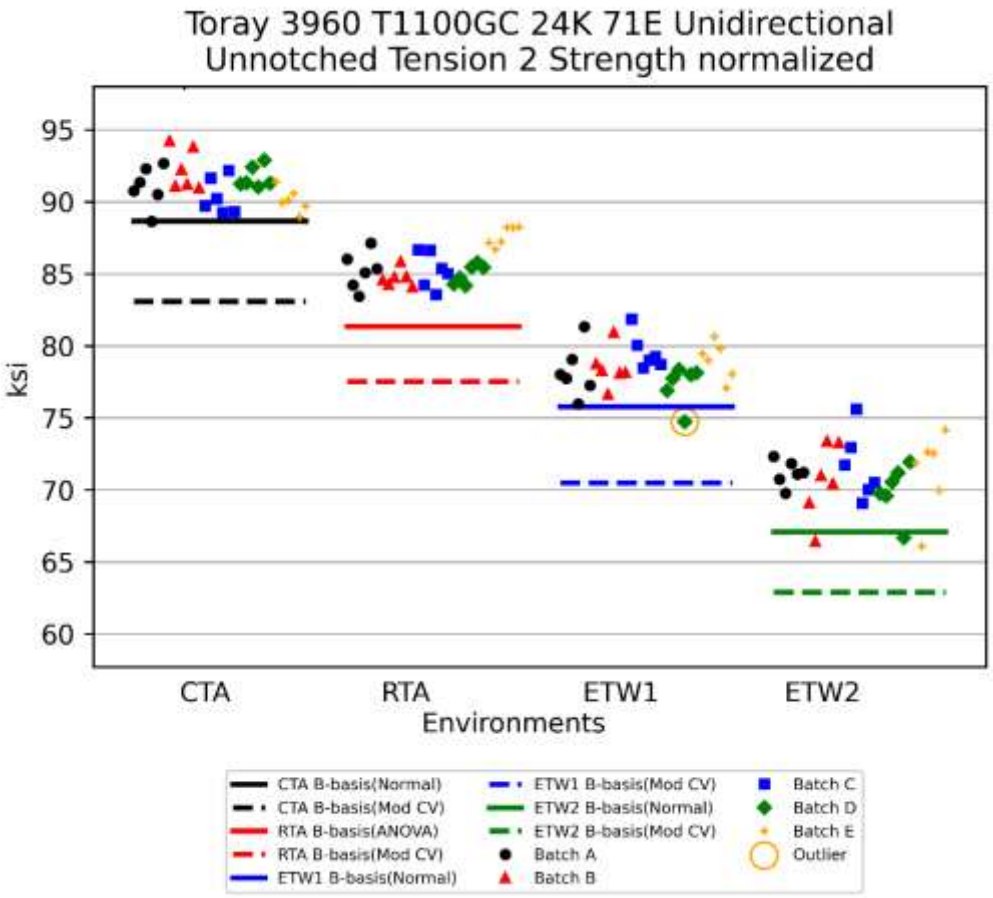

Figure 4-22 Batch plot for UNT2 Strength normalized

Unnotched Tension 2 Basis Values and Statistics				
	Strength as-measured [ksi]			
Env	CTA(-65°F)	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	90.15	84.33	77.49	69.87
Stdev	1.400	1.928	1.636	2.370
CV	1.553	2.286	2.112	3.392
Mod CV	6.000	6.000	6.000	6.000
Min	88.49	81.48	74.00	64.33
Max	95.09	88.34	81.09	74.83
No. Batches	5	5	5	5
No. Spec.	30	30	30	30
Basis Values and Estimates				
B-Basis	87.71	78.17	74.58	65.66
A-Estimate	85.99	73.91	72.48	62.62
Method	Lognormal	ANOVA	Normal	Normal
Modified CV Basis Values and Estimates				
B-Basis	82.23	76.42	69.58	61.96
A-Estimate	76.80	70.99	64.14	56.53
Method	Pooled	Pooled	Pooled	Pooled

Table 4-24 Statistics and Basis Values for UNT2 for Strength as-measured

Unnotched Tension 2 Basis Values and Statistics				
	Strength normalized [ksi]			
Env	CTA(-65°F)	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	91.09	85.55	78.51	70.91
Stdev	1.367	1.392	1.538	2.149
CV	1.500	1.628	1.958	3.031
Mod CV	6.000	6.000	6.000	6.000
Min	88.64	83.44	74.72	66.09
Max	94.23	88.24	81.84	75.58
No. Batches	5	5	5	5
No. Spec.	30	30	30	30
Basis Values and Estimates				
B-Basis	88.66	81.35	75.78	67.09
A-Estimate	86.91	78.44	73.80	64.33
Method	Normal	ANOVA	Normal	Normal
Modified CV Basis Values and Estimates				
B-Basis	83.08	77.53	70.49	62.89
A-Estimate	77.57	72.03	64.99	57.39
Method	Pooled	Pooled	Pooled	Pooled

Table 4-25 Statistics and Basis Values for UNT2 for Strength normalized

Unnotched Tension 2 Statistics				
	Modulus as-measured [ksi]			
Env	CTA(-65°F)	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	5.884	5.622	5.144	4.478
Stdev	0.1450	0.07294	0.08411	0.1440
CV	2.463	1.297	1.635	3.216
Min	5.490	5.440	4.880	4.260
Max	6.240	5.760	5.310	4.830
No. Batches	5	5	5	5
No. Spec.	30	30	30	30

Table 4-26 Statistics from UNT2 Modulus as-measured

Unnotched Tension 2 Statistics				
	Modulus normalized [Msi]			
Env	CTA(-65°F)	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	5.945	5.704	5.212	4.545
Stdev	0.1363	0.08134	0.07749	0.1625
CV	2.292	1.426	1.487	3.576
Min	5.604	5.541	4.953	4.335
Max	6.184	5.898	5.329	4.934
No. Batches	5	5	5	5
No. Spec.	30	30	30	30

Table 4-27 Statistics from UNT2 Modulus normalized

4.10 “50/40/10” Unnotched Tension 3 (UNT3)

Unnotched Tension 3 (UNT3) tests were performed at four different environmental conditions CTA, RTA, ETW1 and ETW2 and for four material properties Strength as-measured, Strength normalized, Modulus as-measured and Modulus normalized. The UNT properties are fiber dominated, so the data is normalized.

With respect to computing allowables for Strength as-measured property using original CV data, all four conditions pass pooling tests, so pooling method was used. For modified CV data, all four conditions pass pooling tests, so pooling method was used.

For Strength normalized property using original CV data, all conditions passed the pooling test, so pooling method was used. For modified CV data, all four conditions pass pooling tests, so pooling method was used.

There were two statistical outliers for Strength as-measured. One low condition outlier in batch E and condition RTA. One high batch outlier in batch B and condition ETW2. There were two statistical outliers for Strength normalized. One low batch and condition outlier in batch E and condition RTA. One high batch outlier in batch B and condition ETW2. All outliers were retained for analysis.

Statistics, estimates and basis values are given for the strength as-measured data in Table 4-28, for the strength normalized data in Table 4-29, modulus as-measured data in Table 4-30 and modulus normalized Table 4-31. The data, B-estimates and B-basis values are shown graphically for the strength as-measured in Figure 4-23 and for strength normalized in Figure 4-24.

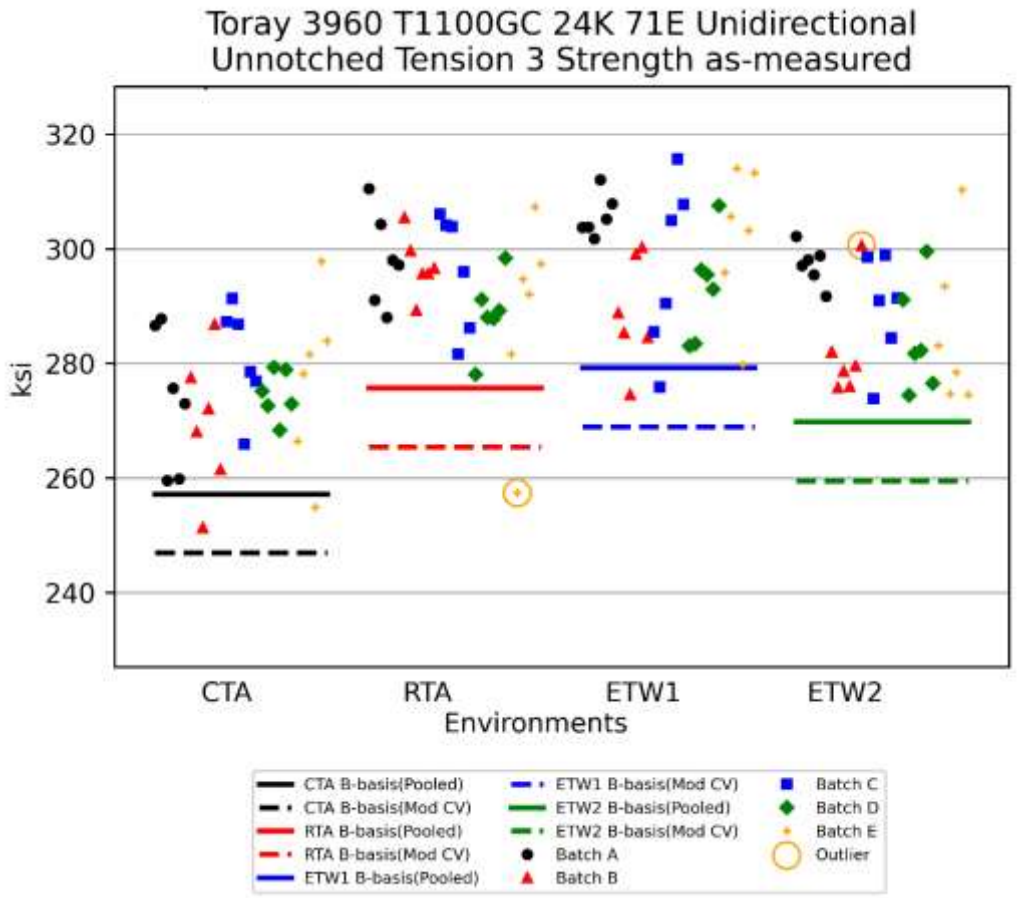

Figure 4-23 Batch plot for UNT3 Strength as-measured

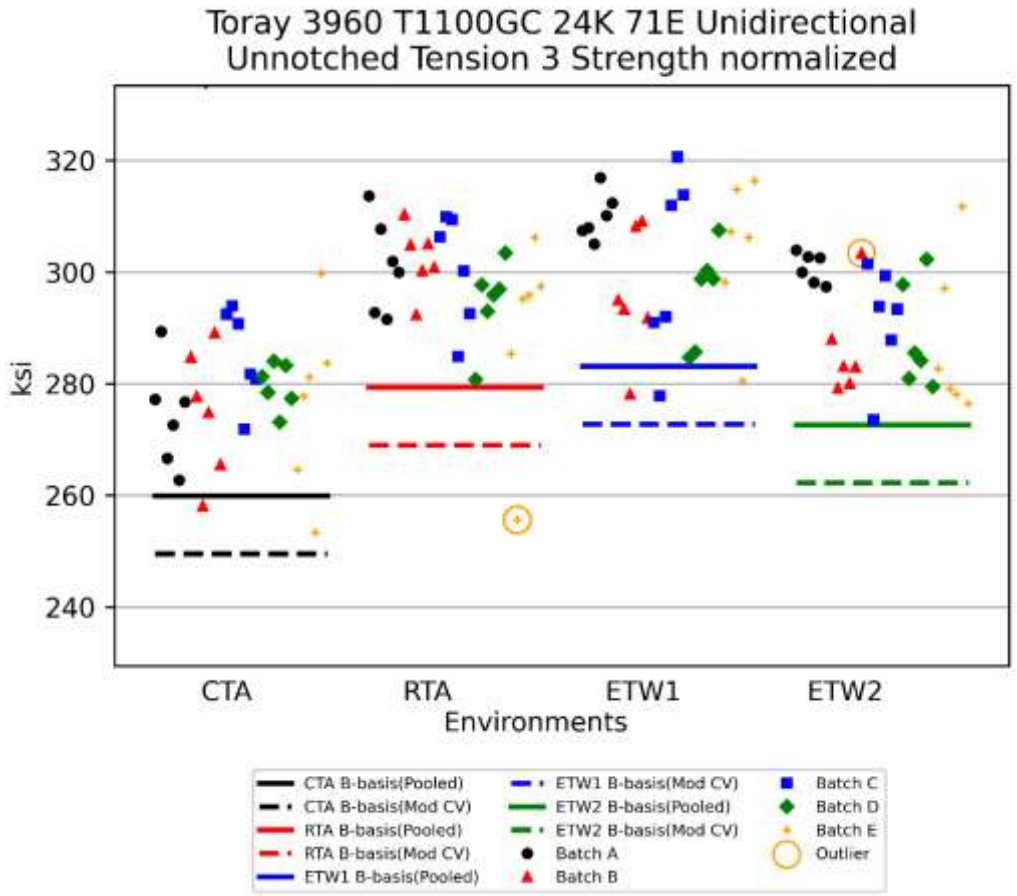

Figure 4-24 Batch plot for UNT3 Strength normalized

Unnotched Tension 3 Basis Values and Statistics				
	Strength as-measured [ksi]			
Env	CTA(-65°F)	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	275.2	293.7	297.2	287.8
Stdev	11.13	10.62	11.78	10.53
CV	4.043	3.616	3.965	3.659
Mod CV	6.022	6.000	6.000	6.000
Min	251.3	257.4	274.5	273.9
Max	297.8	310.5	315.7	310.2
No. Batches	5	5	5	5
No. Spec.	30	30	30	30
Basis Values and Estimates				
B-Basis	257.2	275.7	279.2	269.8
A-Estimate	244.9	263.4	266.9	257.4
Method	Pooled	Pooled	Pooled	Pooled
Modified CV Basis Values and Estimates				
B-Basis	246.9	265.4	269.0	259.5
A-Estimate	227.5	246.0	249.5	240.1
Method	Pooled	Pooled	Pooled	Pooled

Table 4-28 Statistics and Basis Values for UNT3 for Strength as-measured

Unnotched Tension 3 Basis Values and Statistics				
	Strength normalized [ksi]			
Env	CTA(-65°F)	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	278.1	297.6	301.4	290.9
Stdev	10.75	11.23	12.11	10.53
CV	3.864	3.775	4.020	3.620
Mod CV	6.000	6.000	6.010	6.000
Min	253.3	255.6	277.8	273.5
Max	299.8	313.6	320.6	311.7
No. Batches	5	5	5	5
No. Spec.	30	30	30	30
Basis Values and Estimates				
B-Basis	259.9	279.4	283.2	272.6
A-Estimate	247.4	266.9	270.6	260.1
Method	Pooled	Pooled	Pooled	Pooled
Modified CV Basis Values and Estimates				
B-Basis	249.5	269.0	272.8	262.2
A-Estimate	229.9	249.3	253.1	242.6
Method	Pooled	Pooled	Pooled	Pooled

Table 4-29 Statistics and Basis Values for UNT3 for Strength normalized

Unnotched Tension 3 Statistics				
	Modulus as-measured [Msi]			
Env	CTA(-65°F)	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	14.27	14.26	13.96	13.68
Stdev	0.3702	0.4065	0.3164	0.3743
CV	2.595	2.851	2.267	2.736
Min	13.19	13.68	13.42	12.98
Max	15.03	15.67	14.82	14.72
No. Batches	5	5	5	5
No. Spec.	30	30	30	30

Table 4-30 Statistics from UNT3 Modulus as-measured

Unnotched Tension 3 Statistics				
	Modulus normalized [Msi]			
Env	CTA(-65°F)	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	14.42	14.44	14.15	13.83
Stdev	0.4104	0.4101	0.2901	0.4063
CV	2.845	2.839	2.051	2.939
Min	13.48	13.91	13.62	12.96
Max	15.20	15.85	14.90	14.86
No. Batches	5	5	5	5
No. Spec.	30	30	30	30

Table 4-31 Statistics from UNT3 Modulus normalized

4.11 “33/0/67” Unnotched Compression 0 (UNC0)

Unnotched Compression 0 (UNC0) tests were performed at all six different environmental conditions and for four material properties Strength as-measured, Strength normalized, Modulus as-measured and Modulus normalized. The UNC0 properties are fiber dominated, so the data is normalized.

With respect to computing allowables for Strength as-measured property using original CV data, CTA condition passed the ADK and normality test, so normal method was used. Since CTA has 3 batches and 18 specimens, the normal method produces a B-basis value but an A-estimate value rather than a A-basis value. The remaining conditions failed the ADK test, so ANOVA method was used for these. Since all of them have 5 batches and more than 55 specimens, the ANOVA method produces A-basis and B-basis values. For modified CV data, conditions CTA and ETA1 passed the ADK test and normality test, so normal method was used for these. Since condition ETA1 has 5 batches and 60 specimens, the normal method produces B-basis and A-basis values. The remaining environmental conditions failed the ADK test, so allowables are Not Available (NA) for these.

For Strength normalized property using original CV data, CTA and ETW2 conditions passed ADK test and normality test, so normal method was used for these. The rest of the environments failed the ADK test, so ANOVA method was used. Since, each one of them have 5 batches and more than 55 specimens, the results are A-basis and B-basis values and not estimates. For modified CV data, RTA failed the normality test and ETA2 failed the ADK test, therefore allowables were not computed for these conditions. The normal method was used for the remaining conditions.

There were three statistical outliers. The lowest normalized value in batch B of the ETW2 condition was an outlier for the batch and for the condition. In the as-measured dataset, it was an outlier for the batch only. The lowest normalized value in batch D of the ETW2 condition was an outlier for the batch but not for the condition. It was also an outlier in the as-measured dataset. The highest normalized value in batch E of the ETW2 condition was an outlier for the batch but not for the condition. It was also an outlier in the as-measured dataset. All the outliers were retained for computations.

Statistics, estimates and basis values are given for the strength as-measured data in Table 4-32, for the strength normalized data in Table 4-33, modulus as-measured data in Table 4-34 and modulus normalized in Table 4-35. The normalized data, B-estimates and B-basis values are shown graphically for the strength in Figure 4-25 and Figure 4-26Figure 4-25.

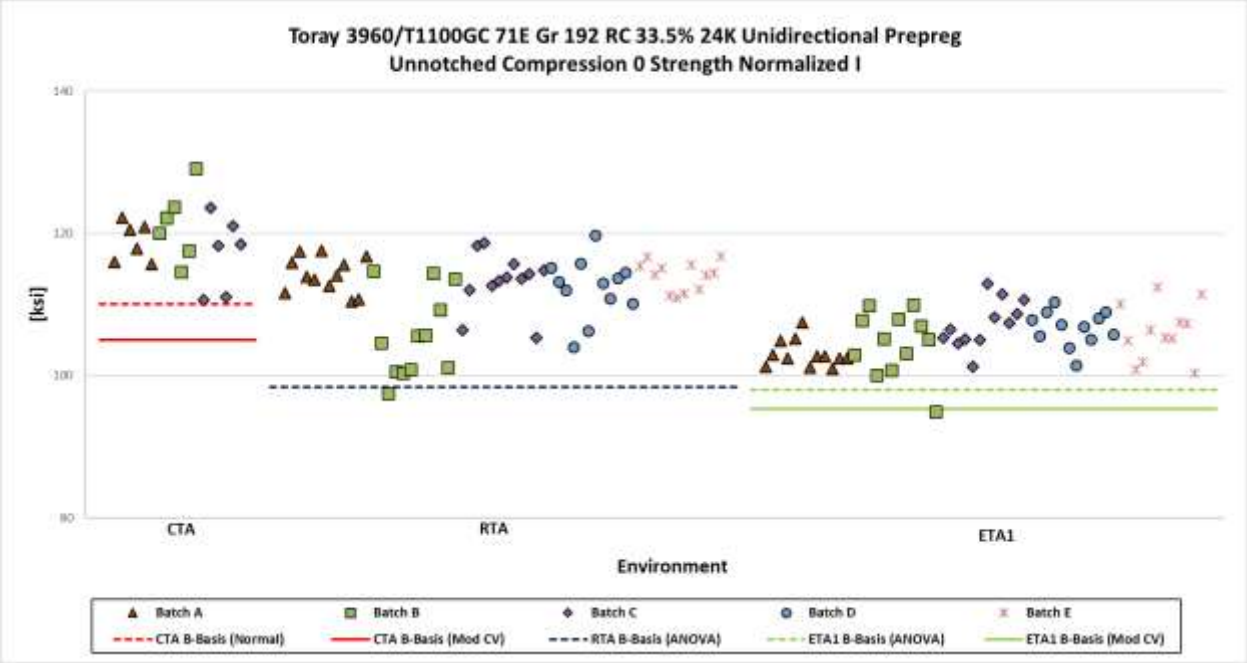

Figure 4-25 Batch plot for UNC0 Strength normalized (CTA, RTA, ETA1)

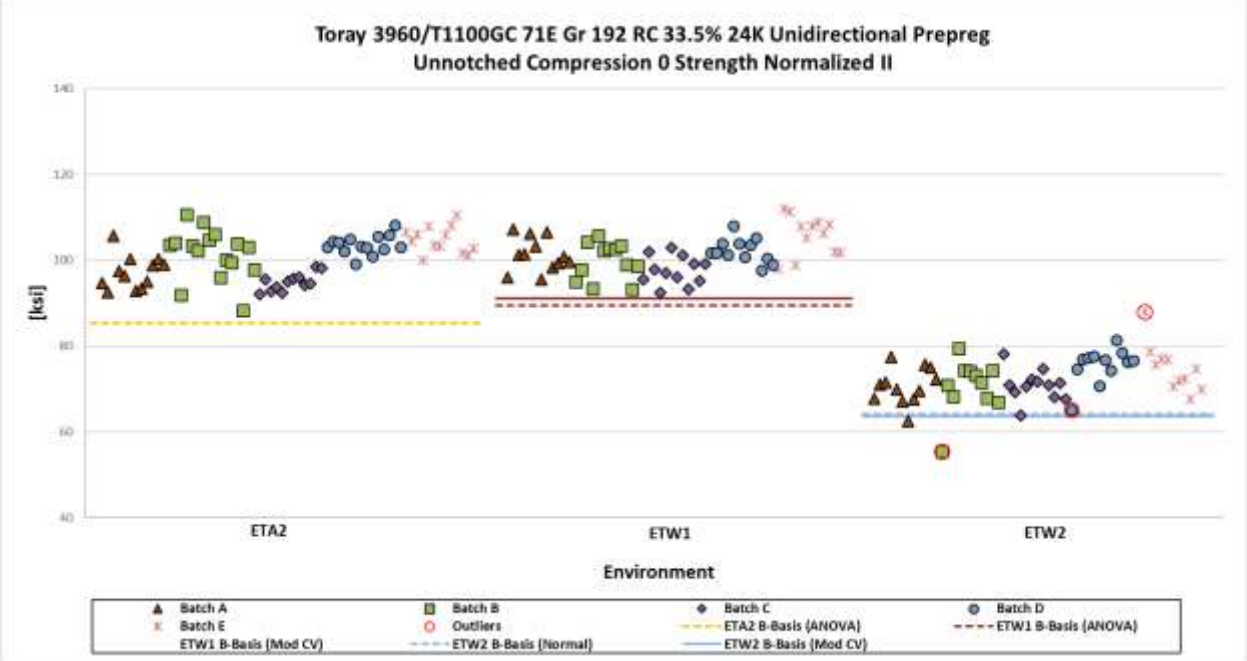

Figure 4-26 Batch plot for UNC0 Strength normalized (ETA2, ETW1, ETW2)

As Measured Unnotched Compression 0 Strength Basis Values and Statistics						
Environment	CTA	RTA	ETA1	ETA2	ETW1	ETW2
Mean	116.6	110.1	103.6	98.98	99.93	71.45
Stdev	4.435	5.389	3.677	5.391	4.865	5.246
CV	3.804	4.895	3.550	5.446	4.869	7.342
Mod CV	6.000	6.447	6.000	6.723	6.434	7.671
Min	108.8	96.41	92.83	85.92	90.62	54.77
Max	127.1	119.0	110.2	109.4	111.1	87.81
No. Batches	3	5	5	5	5	5
No. Spec.	18	60	60	67	60	58
Basis Values and Estimates						
B-Basis Value	107.8	94.59	94.92	82.93	86.28	59.49
A-Basis Value		83.77	88.77	71.76	76.74	50.97
A-Estimate	101.6					
Method	Normal	ANOVA	ANOVA	ANOVA	ANOVA	ANOVA
Modified CV Basis Values and Estimates						
B-Basis Value	102.8	NA	93.58	NA	NA	NA
A-Basis Value			86.14			
A-Estimate	93.01					
Method	Normal		Normal			

Table 4-32 Statistics and Basis Values for UNC0 for Strength as-measured

Normalized Unnotched Compression 0 Strength Basis Values and Statistics						
Environment	CTA	RTA	ETA1	ETA2	ETW1	ETW2
Mean	119.1	111.9	105.6	100.6	101.4	72.49
Stdev	4.564	5.021	3.581	5.204	4.614	5.123
CV	3.833	4.486	3.392	5.171	4.551	7.067
Mod CV	6.000	6.243	6.000	6.585	6.276	7.534
Min	110.7	97.52	94.96	88.33	92.49	55.48
Max	129.1	119.7	113.0	110.7	112.0	87.93
No. Batches	3	5	5	5	5	5
No. Spec.	18	60	60	67	60	58
Basis Values and Estimates						
B-Basis Value	110.1	98.38	98.03	85.44	89.55	64.21
A-Basis Value		88.88	92.62	74.84	81.23	58.06
A-Estimate	103.7					
Method	Normal	ANOVA	ANOVA	ANOVA	ANOVA	Normal
Modified CV Basis Values and Estimates						
B-Basis Value	105.0	NA	95.37	NA	91.13	63.67
A-Basis Value			87.78		83.52	57.11
A-Estimate	95.00					
Method	Normal		Normal		Normal	Normal

Table 4-33 Statistics and Basis Values for UNC0 for Strength normalized

As Measured Unnotched Compression 0 Modulus Statistics						
Environment	CTA	RTA	ETA1	ETA2	ETW1	ETW2
Mean	8.208	8.137	8.481	8.665	8.487	8.434
Stdev	0.1300	0.1531	0.2737	0.3745	0.1851	0.1882
CV	1.584	1.882	3.228	4.321	2.181	2.232
Min	8.000	7.870	7.920	7.970	8.110	7.920
Max	8.480	8.530	9.240	9.470	9.120	8.840
No. Batches	3	5	5	5	5	5
No. Spec.	18	60	60	59	60	59

Table 4-34 Statistics from UNC0 Modulus as-measured

Normalized Unnotched Compression 0 Modulus Statistics						
Environment	CTA	RTA	ETA1	ETA2	ETW1	ETW2
Mean	8.383	8.272	8.640	8.809	8.611	8.557
Stdev	0.1328	0.1649	0.2585	0.3949	0.2060	0.2489
CV	1.584	1.993	2.992	4.483	2.393	2.909
Min	8.153	8.031	8.136	8.103	8.228	7.978
Max	8.578	8.910	9.362	9.737	9.150	9.271
No. Batches	3	5	5	5	5	5
No. Spec.	18	60	60	59	60	59

Table 4-35 Statistics from UNC0 Modulus normalized

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

Unnotched Compression 1 (UNC1) tests were performed at three different environmental conditions RTA, ETW1, ETW2 and for four material properties Strength as-measured, Strength normalized, Modulus as-measured and Modulus normalized. The UNC1 properties are fiber dominated, so the data is normalized.

With respect to computing allowables for Strength as-measured property using original CV data, RTA and ETW1 conditions failed ADK test, so ANOVA method was used. Since each of these conditions have 5 batches and less than 55 specimens, the ANOVA method produces B-basis values and A-estimates value. ETW2 condition passed ADK test, so normal method was used for this one. Since ETW2 condition has 5 batches and less than 55 specimens, the normal method produces B-basis value and A-estimate. For modified CV data, conditions RTA and ETW1 failed ADK test, so allowables are not available (NA) for these. ETW2 environmental condition passed ADK test and normality test, so normal method was used for this one.

For Strength normalized property using original CV data, RTA and ETW1 conditions failed ADK test, so ANOVA method was used. Since each of these conditions have 5 batches and less than 55 specimens, the ANOVA method produces B-basis values and A-estimates value. ETW2 condition passed ADK test, so normal method was used for this one. Since ETW2 condition has 5 batches and less than 55 specimens, the normal method produces B-basis value and A-estimate. For modified CV data, conditions RTA and ETW1 failed ADK test, so allowables are not available (NA) for these. ETW2 environmental condition passed ADK test and normality test, so normal method was used for this one.

There were three statistical outliers for Strength as measured. One low batch outlier in batch A and condition RTA. One low batch outlier in batch B and condition ETW1. One low batch outlier in batch C and condition ETW1. There were three statistical outliers for Strength normalized. One low batch outlier in batch A and condition RTA. One low batch outlier in batch D and condition RTA. One low batch outlier in batch B and condition ETW1. All the outliers were retained for computations.

Statistics, estimates, and basis values are given for the strength as-measured data in Table 4-36, for the strength normalized data in Table 4-37, modulus as-measured data in Table 4-38, and modulus normalized in Table 4-39. The data, B-estimates, and B-basis values are shown graphically for the strength as-measured in Figure 4-27 and for strength normalized in Figure 4-28.

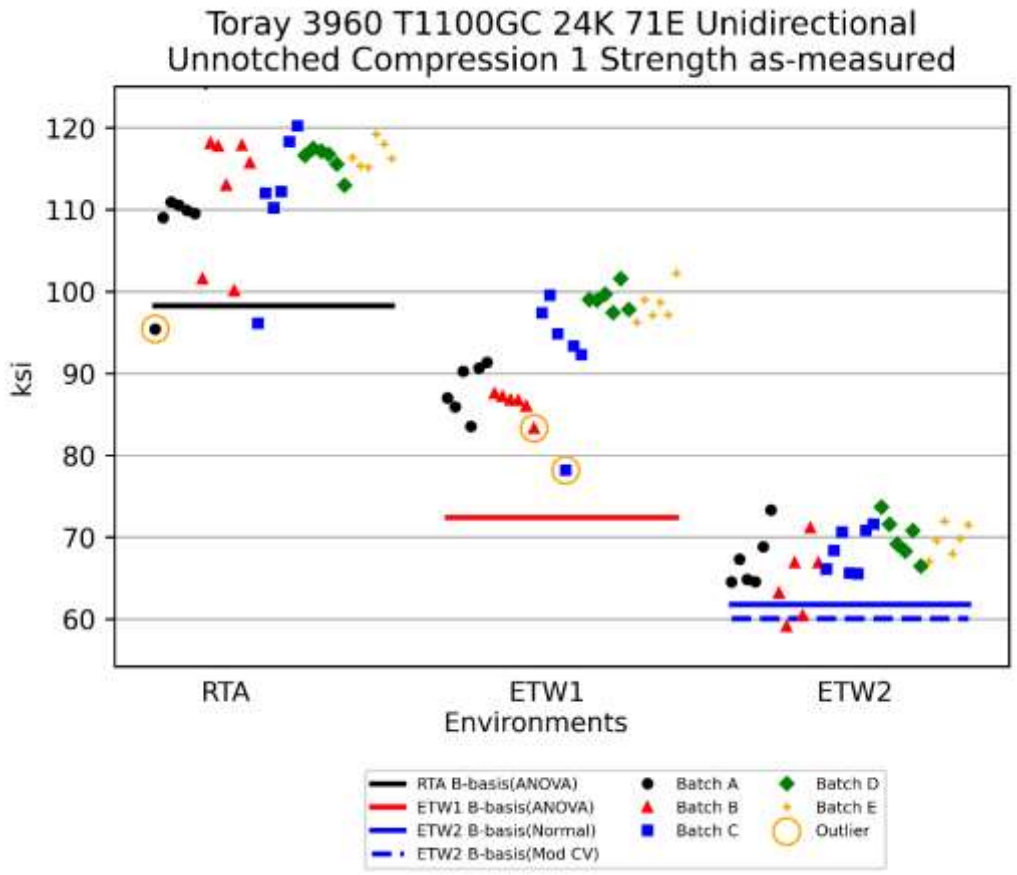

Figure 4-27 Batch plot for UNC1 Strength as-measured

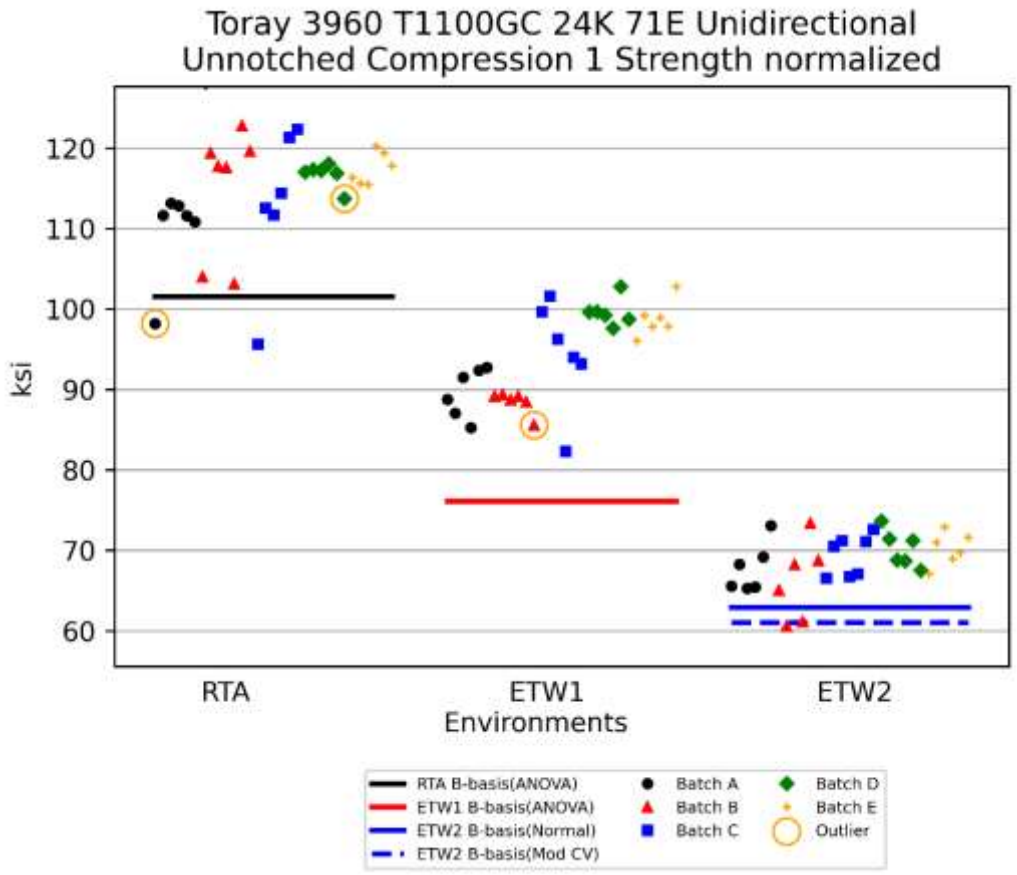

Figure 4-28 Batch plot for UNC1 Strength normalized

Unnotched Compression 1 Basis Values and Statistics			
	Strength as-measured [ksi]		
Env	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	112.8	92.89	68.00
Stdev	6.512	6.408	3.512
CV	5.775	6.898	5.164
Mod CV	6.887	7.449	6.582
Min	95.43	78.18	59.10
Max	120.3	102.2	73.70
No. Batches	5	5	5
No. Spec.	31	30	31
Basis Values and Estimates			
B-Basis	98.28	72.42	61.79
A-Estimate	88.01	58.29	57.30
Method	ANOVA	ANOVA	Normal
Modified CV Basis Values and Estimates			
B-Basis	NA	NA	60.09
A-Estimate			54.36
Method			Normal

Table 4-36 Statistics and Basis Values for UNC1 for Strength as-measured

Unnotched Compression 1 Basis Values and Statistics			
	Strength normalized [ksi]		
Env	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	114.3	94.16	68.77
Stdev	6.498	5.743	3.299
CV %	5.682	6.100	4.796
Mod CV %	6.841	7.050	6.398
Min	95.63	82.29	60.56
Max	122.8	102.8	73.62
No. Batches	5	5	5
No. Spec.	31	30	31
Basis Values and Estimates			
B-Basis	101.6	76.10	62.95
A-Estimate	92.44	63.62	58.72
Method	ANOVA	ANOVA	Normal
Modified CV Basis Values and Estimates			
B-Basis	NA	NA	61.00
A-Estimate			55.37
Method			Normal

Table 4-37 Statistics and Basis Values for UNC1 for Strength normalized

Unnotched Compression 1 Statistics			
	Modulus as-measured [Msi]		
Env	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	8.098	8.247	7.997
Stdev	0.1154	0.2881	0.1587
CV	1.425	3.493	1.984
Min	7.900	7.730	7.670
Max	8.330	9.060	8.360
No. Batches	5	5	5
No. Spec.	30	30	32

Table 4-38 Statistics from UNC1 Modulus as-measured

Unnotched Compression 1 Statistics			
	Modulus normalized [Msi]		
Env	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	8.217	8.363	8.089
Stdev	0.1703	0.2832	0.1744
CV	2.072	3.386	2.155
Min	7.950	7.828	7.787
Max	8.541	9.147	8.498
No. Batches	5	5	5
No. Spec.	30	30	32

Table 4-39 Statistics from UNC1 Modulus normalized

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

Unnotched Compression 2 (UNC2) tests were performed at three different environmental conditions RTA, ETW1, ETW2 and for four material properties Strength as-measured, Strength normalized, Modulus as-measured and Modulus normalized. The UNC2 properties are fiber dominated, so the data is normalized.

With respect to computing allowables for Strength as-measured property using original CV data, ETW1 and ETW2 conditions failed ADK test, so ANOVA method was used. Since each of these conditions have 5 batches and less than 55 specimens, the ANOVA method produces B-basis values and A-estimates values. RTA condition passed ADK test and normality test, so normal method was used for this one. Since RTA condition has 5 batches and less than 55 specimens, the normal method produces B-basis value and A-estimate value. For modified CV data, conditions RTA and ETW1 passed all the pooling tests, so pooling method was used for these. ETW2 environmental condition passed ADK test and normality test, so normal method was used for this one.

For Strength normalized property using original CV data, all conditions passed ADK test and normality test, so normal method was used for them. Since each of these conditions have 5 batches and less than 55 specimens, the normal method produces B-basis values and A-estimates values. For modified CV data, conditions RTA and ETW1 pass pooling test, so allowables are computed using pooling method for these. ETW2 environmental condition passed ADK test and normality test, so normal method was used for this one.

There were two statistical outliers. The lowest normalized value in batch D of the RTA condition was an outlier for the batch but not for the condition. It was also an outlier in the as-measured dataset. The highest as-measured value in batch E of the ETW1 condition was an outlier for the batch but not for the condition. Both outliers were retained for computations.

Statistics, estimates and basis values are given for the strength as- data in Table 4-40 and for the modulus data in Table 4-41. The normalized data, B-estimates and B-basis values are shown graphically for strength in Figure 4-29.

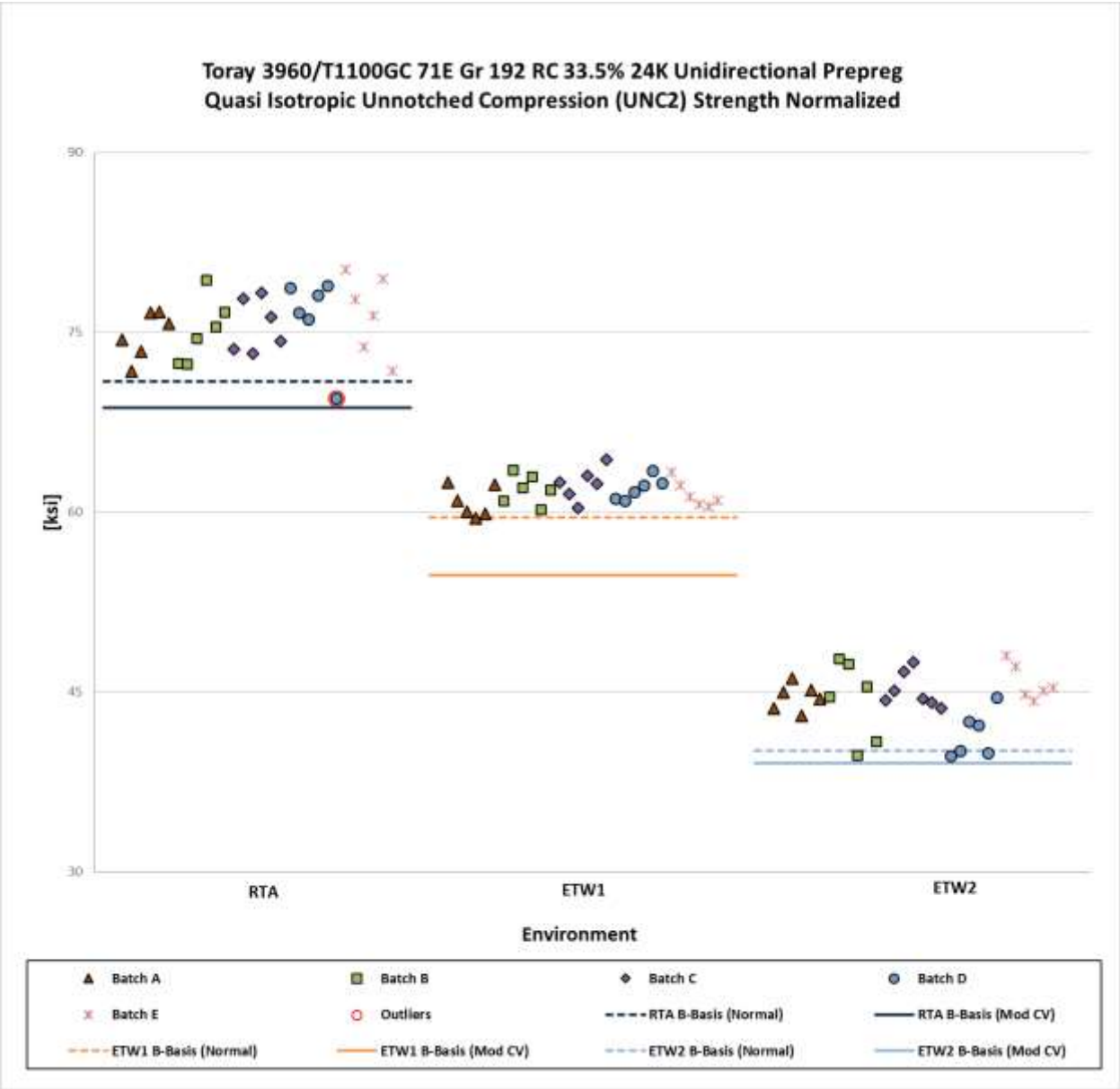

Figure 4-29 Batch plot for UNC2 Strength normalized

Unnotched Compression 2 Strength Basis Values and Statistics						
	Normalized			As Measured		
Environment	RTA	ETW1	ETW2	RTA	ETW1	ETW2
Mean	75.67	61.74	44.28	74.80	60.85	43.50
Stdev	2.688	1.219	2.371	2.768	1.331	2.296
CV	3.553	1.974	5.353	3.700	2.187	5.278
Mod CV	6.000	6.000	6.677	6.000	6.000	6.639
Min	69.49	59.50	39.71	68.75	58.35	38.94
Max	80.22	64.38	48.06	79.52	63.62	47.48
No. Batches	5	5	5	5	5	5
No. Spec.	30	30	31	30	30	31
Basis Values and Estimates						
B-Basis Value	70.90	59.57	40.10	69.88	57.34	37.60
A-Estimate	67.44	58.00	37.06	66.33	54.89	33.48
Method	Normal	Normal	Normal	Normal	ANOVA	ANOVA
Modified CV Basis Values and Estimates						
B-Basis Value	68.71	54.77	39.06	67.92	53.97	38.40
A-Estimate	63.81	49.87	35.28	63.09	49.13	34.70
Method	Pooled	Pooled	Normal	Pooled	Pooled	Normal

Table 4-40 Statistics, Basis Values and estimates for UNC2 Strength Data

Unnotched Compression 2 Modulus Statistics						
	Normalized			As Measured		
Environment	RTA	ETW1	ETW2	RTA	ETW1	ETW2
Mean	5.051	4.802	4.451	4.992	4.733	4.373
Stdev	0.07609	0.1483	0.1741	0.07485	0.1640	0.1815
CV	1.506	3.089	3.911	1.499	3.464	4.150
Min	4.917	4.464	4.143	4.860	4.350	3.970
Max	5.160	5.101	4.800	5.160	5.090	4.740
No. Batches	5	5	5	5	5	5
No. Spec.	29	30	31	29	30	31

Table 4-41 Statistics from UNC2 Modulus Data

4.14 “50/40/10” Unnotched Compression 3 (UNC3)

Unnotched Compression 3 (UNC3) tests were performed at three different environmental conditions RTA, ETW1, ETW2 and for four material properties Strength as-measured, Strength normalized, Modulus as-measured and Modulus normalized. The UNC3 properties are fiber dominated, so the data is normalized.

With respect to computing allowables for Strength as-measured property using original CV data, RTA condition failed ADK test, so ANOVA method was used. Since each RTA condition has 5 batches and less than 55 specimens, the ANOVA method produces B-basis values and A-estimates values. ETW1 and ETW2 conditions passed ADK test and normality test, so normal method was used for these. Since the condition have 5 batches and less than 55 specimens, the normal method produces B-basis values and A-estimate values. For modified CV data, all three conditions passed all the pooling tests, so pooling method was used for these.

For Strength normalized property using original CV data, RTA and ETW1 conditions passed the pooling tests, so pooling method was used for these, while condition ETW2 passed ADK test and normality test, so normal method was used for this one. Since ETW2 condition has 5 batches and less than 55 specimens, the normal method produces B-basis value and A-estimate value. For modified CV data, all three conditions pass pooling tests, so allowables are computed using pooling method for these.

There was one statistical outlier for Strength as-measured. One high batch outlier in batch E and condition ETW1. The outlier was retained for computations.

Statistics, estimates, and basis values are given for the strength as-measured data in Table 4-42, for the strength normalized data in Table 4-43 modulus as-measured data in Table 4-44 and modulus normalized in Table 4-45. The data, B-estimates and B-basis values are shown graphically for the strength as-measured in Figure 4-30 and for strength normalized in Figure 4-31.

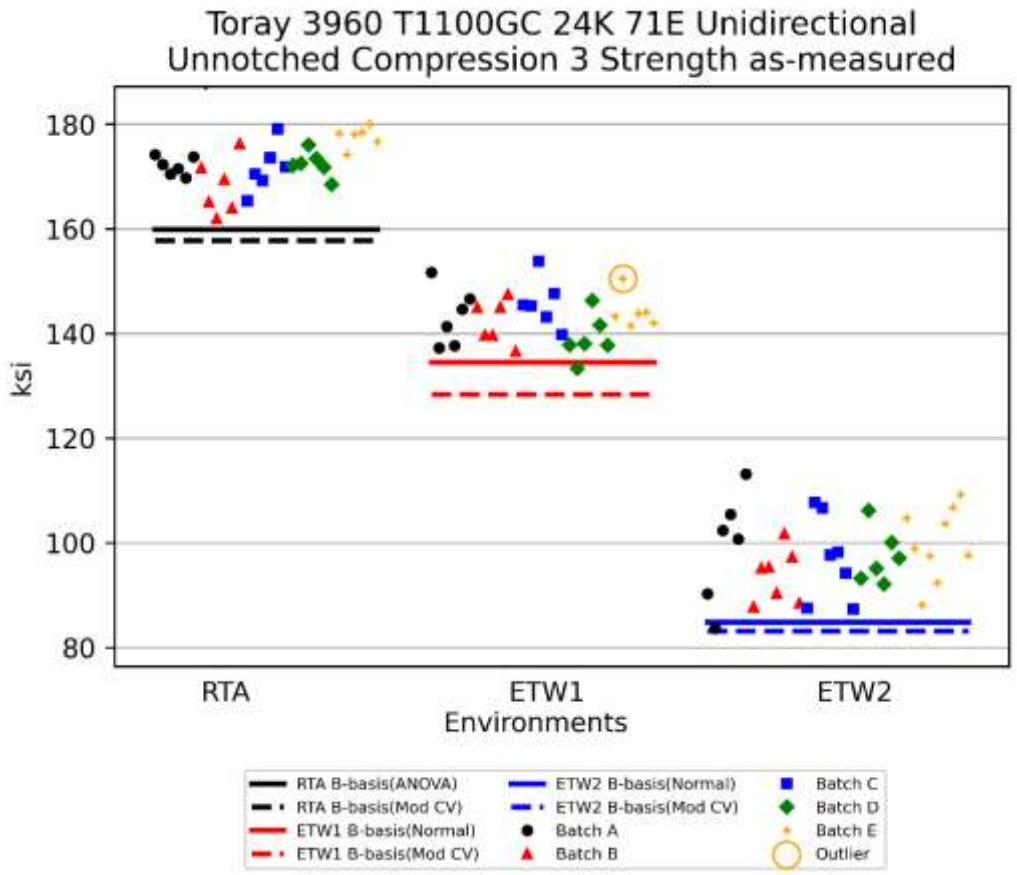

Figure 4-30 Batch plot for UNC3 Strength as-measured

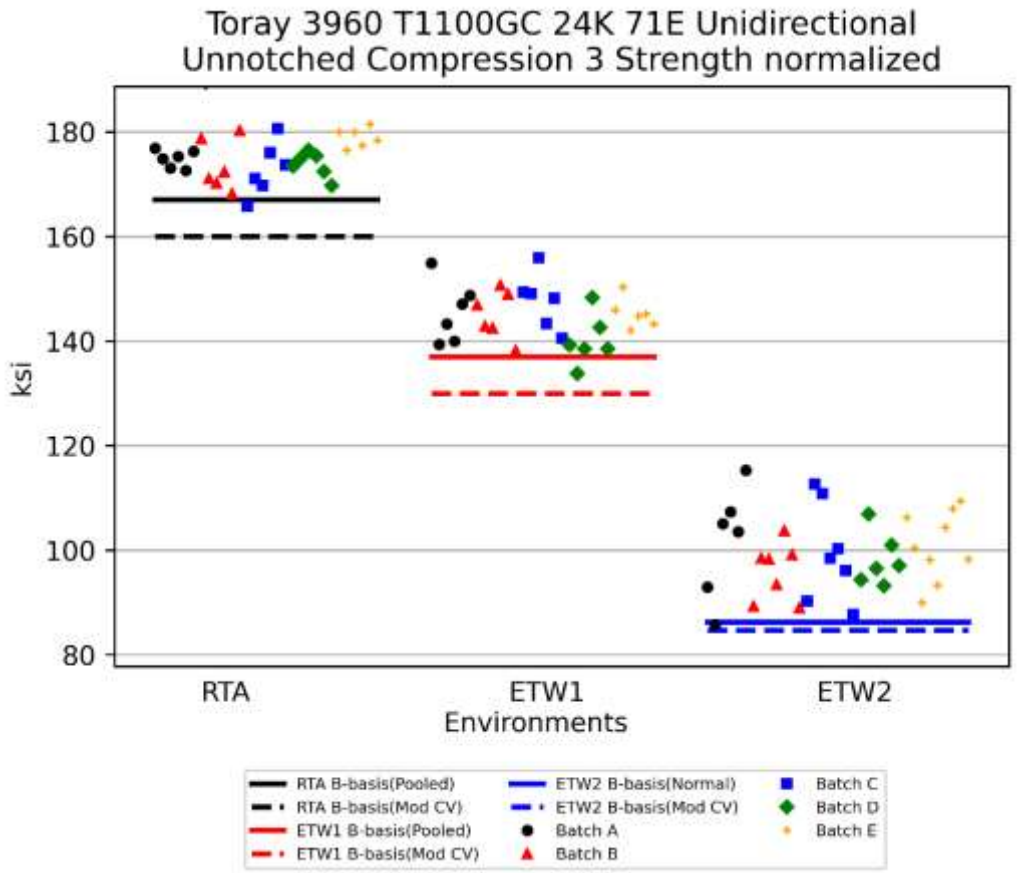

Figure 4-31 Batch plot for UNC3 Strength normalized

Unnotched Compression 3 Basis Values and Statistics			
	Strength as-measured [ksi]		
Env	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	172.3	142.9	97.54
Stdev	4.526	4.744	7.293
CV	2.626	3.319	7.477
Mod CV	6.000	6.000	7.738
Min	162.0	133.4	83.70
Max	180.0	153.8	113.2
No. Batches	5	5	5
No. Spec.	30	30	35
Basis Values and Estimates			
B-Basis	159.9	134.5	84.92
A-Estimate	151.2	128.4	75.72
Method	ANOVA	Normal	Normal
Modified CV Basis Values and Estimates			
B-Basis	157.8	128.4	83.20
A-Estimate	147.8	118.4	73.12
Method	Pooled	Pooled	Pooled

Table 4-42 Statistics and Basis Values for UNC3 for Strength as-measured

Unnotched Compression 3 Basis Values and Statistics			
	Strength normalized [ksi]		
Env	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	174.8	144.7	99.26
Stdev	3.971	5.155	7.492
CV	2.272	3.562	7.547
Mod CV	6.000	6.000	7.774
Min	165.8	133.8	85.81
Max	181.5	155.9	115.3
No. Batches	5	5	5
No. Spec.	30	30	35
Basis Values and Estimates			
B-Basis	167.0	137.0	86.29
A-Estimate	161.6	131.6	76.84
Method	Pooled	Pooled	Normal
Modified CV Basis Values and Estimates			
B-Basis	160.0	130.0	84.69
A-Estimate	149.8	119.8	74.46
Method	Pooled	Pooled	Pooled

Table 4-43 Statistics and Basis Values for UNC3 for Strength normalized

Unnotched Compression 3 Statistics			
	Modulus as-measured [Msi]		
Env	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	12.46	12.73	12.50
Stdev	0.2122	0.2710	0.3310
CV	1.703	2.129	2.648
Min	11.97	12.10	11.98
Max	13.06	13.27	13.24
No. Batches	5	5	5
No. Spec.	30	30	36

Table 4-44 Statistics from UNC3 Modulus as-measured

Unnotched Compression 3 Statistics			
	Modulus normalized [Msi]		
Env	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	12.63	12.89	12.67
Stdev	0.2162	0.2725	0.3407
CV	1.712	2.114	2.688
Min	12.25	12.27	12.04
Max	13.40	13.44	13.36
No. Batches	5	5	5
No. Spec.	30	30	36

Table 4-45 Statistics from UNC3 Modulus normalized

4.15 “25/50/25” Laminate Short-Beam Strength (SBS1)

Short-Beam Strength (SBS1) tests were performed at three different environmental conditions RTA, ETW1 and ETW2; and for only one Strength property. The SBS1 properties are not fiber dominated, so the data is not normalized and only the as-measured values are provided.

With respect to computing allowables for Strength property using original CV data, all three conditions failed ADK test, so ANOVA method was used. Since each condition has 5 batches and less than 55 specimens, the ANOVA method produces B-basis values and A-estimates values. For modified CV data, RTA and ETW2 conditions passed ADK test and normality test, so normal method was used for these. Since RTA and ETW2 conditions have 5 batches and less than 55 specimens, the normal method produces B-basis values and A-estimates values. Condition ETW1 failed ADK test, therefore allowables are not available (NA) for this one.

There were no statistical outliers for Strength property.

Statistics, estimates and basis values are given for the strength data in Table 4-46. The data, B-estimates and B-basis values are shown graphically for the strength in Figure 4-32.

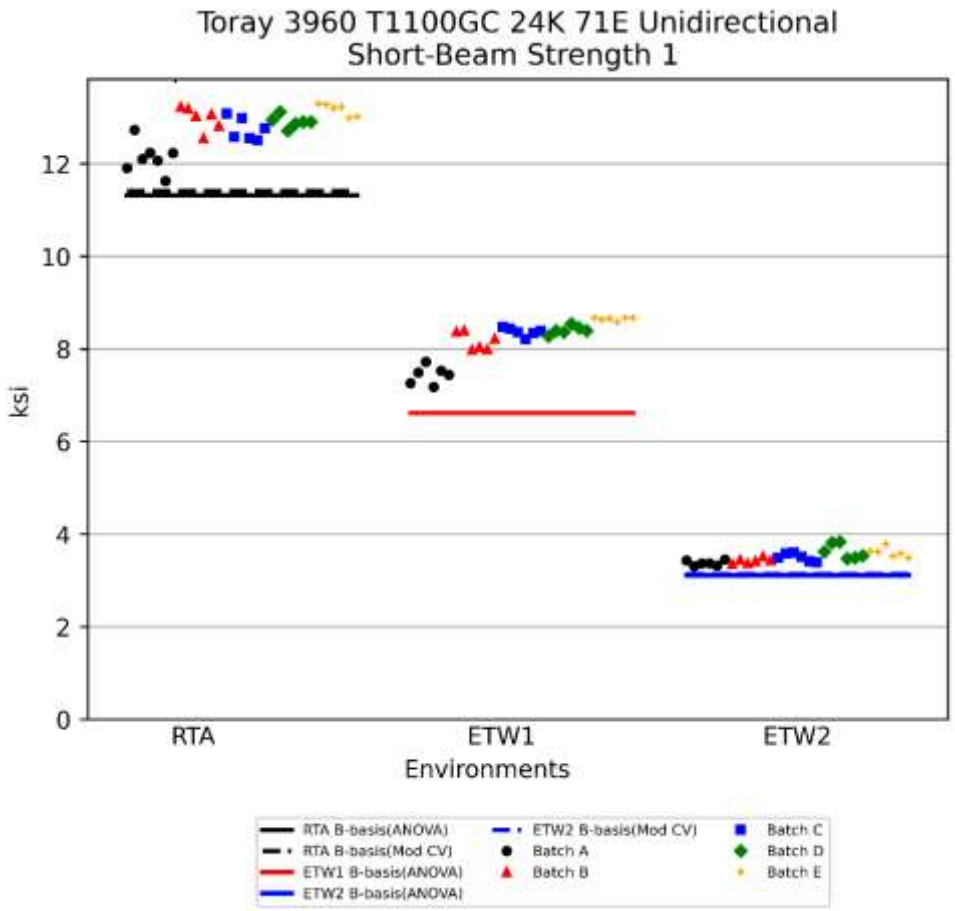

Figure 4-32 Batch plot for SBS1 Strength

Short-Beam Strength 1 Basis Values and Statistics			
	Strength [ksi]		
Env	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	12.77	8.204	3.506
Stdev	0.4357	0.4388	0.1360
CV	3.413	5.348	3.880
Mod CV	6.000	6.674	6.000
Min	11.63	7.180	3.310
Max	13.30	8.680	3.830
No. Batches	5	5	5
No. Spec.	31	30	30
Basis Values and Estimates			
B-Basis	11.32	6.619	3.113
A-Estimate	10.33	5.532	2.840
Method	ANOVA	ANOVA	ANOVA
Modified CV Basis Values and Estimates			
B-Basis	11.41	NA	3.132
A-Estimate	10.43		2.862
Method	Normal		Normal

Table 4-46 Statistics and Basis Values for SBS1 for Strength

4.16 “25/50/25” Open-Hole Tension 1 (OHT1)

Open-Hole Tension 1 (OHT1) tests were performed at four different environmental conditions CTA, RTA, ETW1, ETW2 and for two material properties Strength as-measured and Strength normalized. The OHT1 properties are fiber dominated, so the data is normalized.

With respect to computing allowables for Strength as-measured property using original CV data, the single point normal method was used for CTA and the remaining conditions, RTA, ETW1 and ETW2, passed pooling tests, so pooling method was used for these. For modified CV data, all four conditions passed all the pooling tests, so pooling method was used.

For Strength normalized property using original CV data, condition CTA failed ADK test, so ANOVA method was used. Since CTA condition has 5 batches and less than 55 specimens, the ANOVA method produces B-basis value and A-estimate value. Conditions RTA, ETW1 and ETW2 passed the pooling tests, so pooling method was used for these. For modified CV data, all four conditions pass pooling tests, so allowables are computed using pooling method for these.

There was one statistical outlier for Strength as-measured. One high condition outlier in batch A and condition CTA. There were two statistical outliers for Strength normalized. One low batch outlier in batch C and condition CTA. One low condition outlier in batch E and condition ETW2. All the outliers were retained for computations.

Statistics, estimates and basis values are given for the strength as-measured data in Table 4-47 and for the strength normalized data in Table 4-48. The data, B-estimates and B-basis values are shown graphically for the strength as-measured in Figure 4-33 and for strength normalized in Figure 4-34.

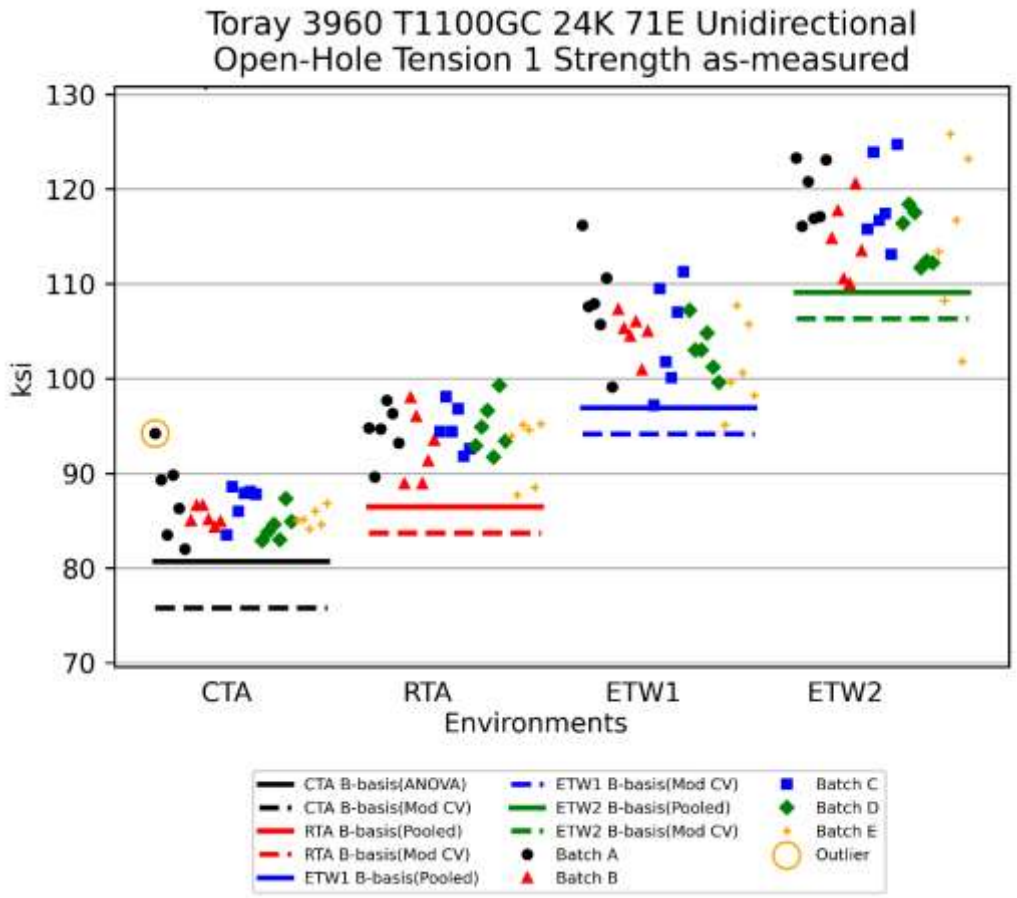

Figure 4-33 Batch Plot for OHT1 strength as-measured

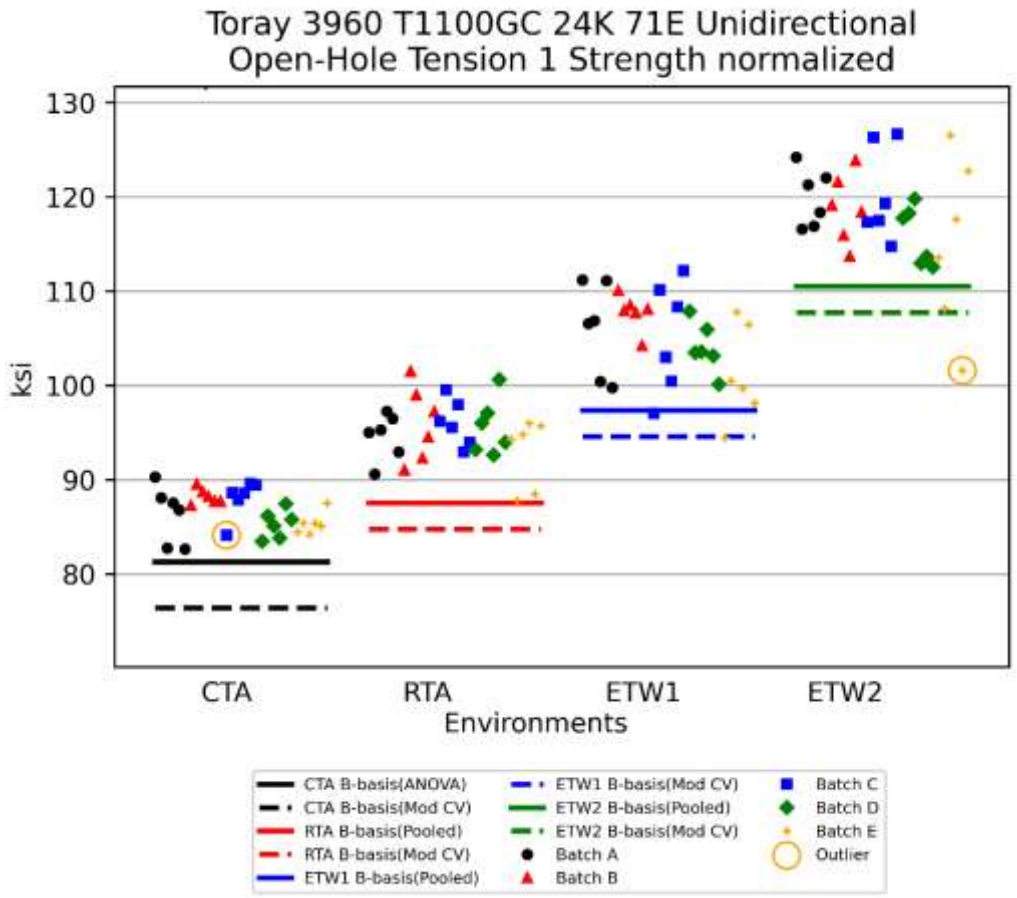

Figure 4-34 Batch Plot for OHT1 strength normalized

Open-Hole Tension 1 Basis Values and Statistics				
	Strength as-measured [ksi]			
Env	CTA(-65°F)	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	85.92	93.83	104.3	116.5
Stdev	2.505	3.029	4.667	5.386
CV	2.915	3.228	4.475	4.625
Mod CV	6.000	6.000	6.238	6.312
Min	82.00	87.70	95.10	101.8
Max	94.20	99.30	116.20	125.8
No. Batches	5	5	5	5
No. Spec.	30	30	30	30
Basis Values and Estimates				
B-Basis	81.47	86.46	96.92	109.1
A-Estimate	78.25	81.35	91.82	104.0
Method	Normal	Pooled	Pooled	Pooled
Modified CV Basis Values and Estimates				
B-Basis	75.77	83.68	94.14	106.3
A-Estimate	68.81	76.72	87.18	99.35
Method	Pooled	Pooled	Pooled	Pooled

Table 4-47 Statistics and Basis Values for OHT1 Strength as-measured

Open-Hole Tension 1 Basis Values and Statistics				
	Strength normalized [ksi]			
Env	CTA(-65°F)	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	86.63	94.99	104.8	118.0
Stdev	2.173	3.201	4.652	5.436
CV	2.509	3.370	4.438	4.608
Mod CV	6.000	6.000	6.219	6.304
Min	82.64	87.81	94.45	101.59
Max	90.30	101.5	112.2	126.6
No. Batches	5	5	5	5
No. Spec.	30	30	30	30
Basis Values and Estimates				
B-Basis	81.29	87.53	97.36	110.5
A-Estimate	77.53	82.36	92.19	105.3
Method	ANOVA	Pooled	Pooled	Pooled
Modified CV Basis Values and Estimates				
B-Basis	76.40	84.76	94.59	107.7
A-Estimate	69.38	77.73	87.56	100.7
Method	Pooled	Pooled	Pooled	Pooled

Table 4-48 Statistics and Basis Values for OHT1 Strength normalized

4.17 “10/80/10” Open-Hole Tension 2 (OHT2)

Open-Hole Tension 2 (OHT2) tests were performed at four different environmental conditions CTA, RTA, ETW1, ETW2 and for two material properties Strength as-measured and Strength normalized. The OHT2 properties are fiber dominated, so the data is normalized.

With respect to computing allowables for Strength as-measured property using original CV data, CTA and ETW2 condition failed all the distributions tests, so the non-parametric method was used. RTA and ETW1 passed pooling tests, so pooling method was used for these. For modified CV data, all four conditions passed all the pooling tests, so pooling method was used.

For Strength normalized property using original CV data, conditions CTA, RTA and ET1 passed pooling tests, so pooling method was used. Condition ETW2 passed the Weibull test, so Weibull method was used for these. For modified CV data, all four conditions pass pooling tests, so allowables are computed using pooling method for these.

There were two statistical outliers for Strength as-measured. One low batch outlier in batch C and condition CTA. One low batch and condition outlier in batch D and condition ETW2. There were two statistical outliers for Strength normalized. One low batch outlier in batch C and condition CTA. One low batch and condition outlier in batch D and condition ETW2. All the outliers were retained for computations.

Statistics, estimates and basis values are given for the strength as-measured data in Table 4-49 and for the strength normalized data in Table 4-50. The data, B-estimates and B-basis values are shown graphically for the strength as-measured in Figure 4-35 and for strength normalized in Figure 4-36.

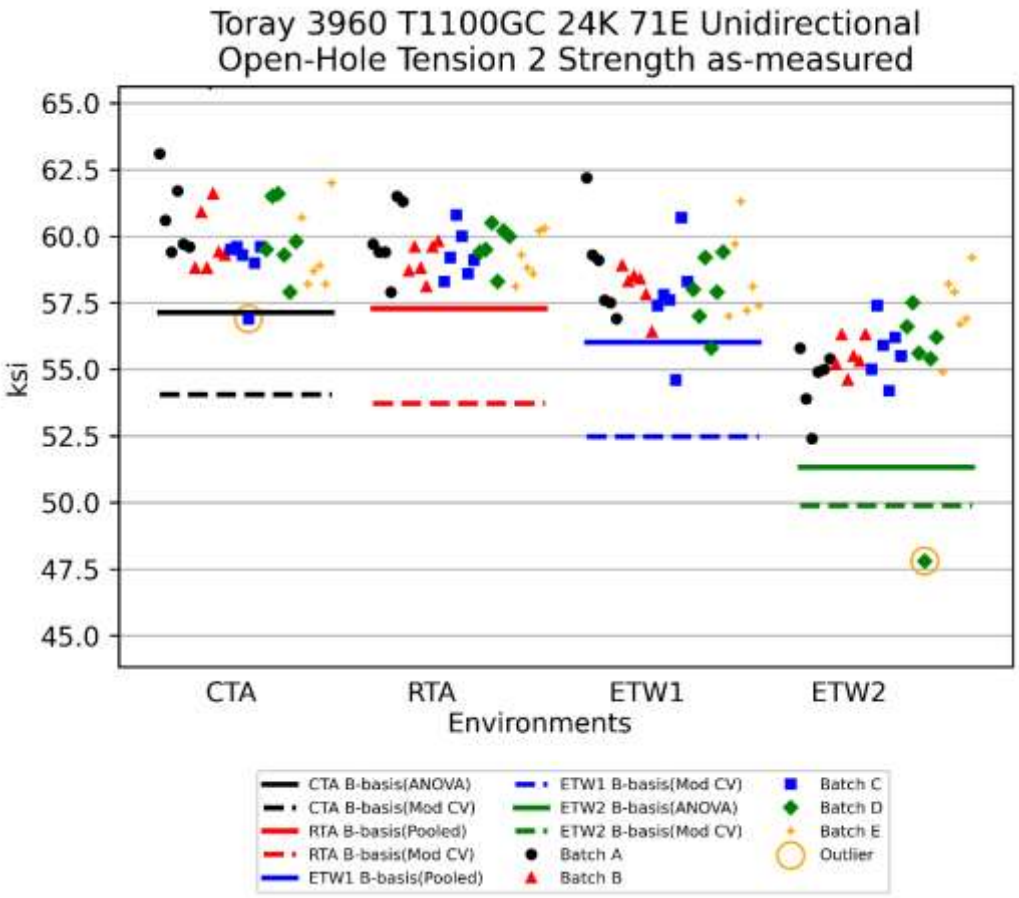

Figure 4-35 Batch Plot for OHT2 strength as-measured

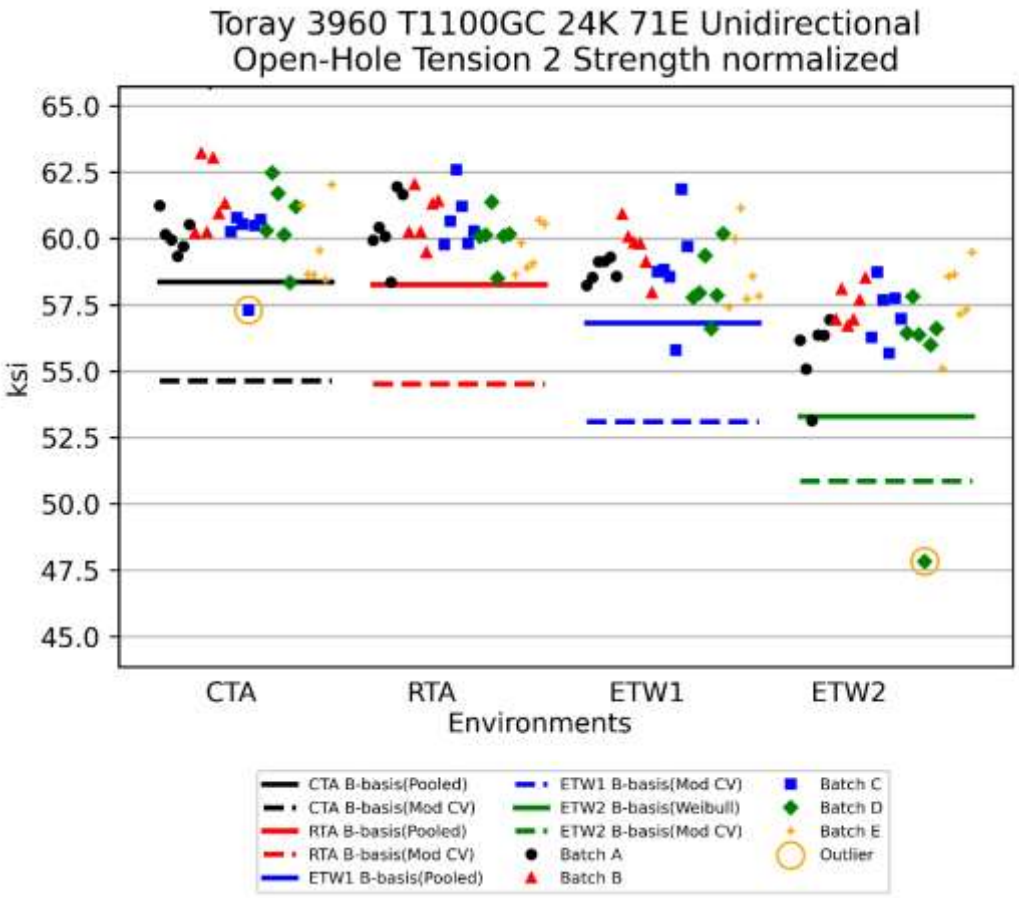

Figure 4-36 Batch Plot for OHT2 strength normalized

Open-Hole Tension 2 Basis Values and Statistics				
	Strength as-measured [ksi]			
Env	CTA(-65°F)	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	59.77	59.43	58.18	55.59
Stdev	1.371	0.9282	1.550	2.005
CV	2.294	1.562	2.664	3.607
Mod CV	6.000	6.000	6.000	6.000
Min	56.90	57.90	54.60	47.80
Max	63.10	61.50	62.20	59.20
No. Batches	5	5	5	5
No. Spec.	30	30	30	30
Basis Values and Estimates				
B-Basis	56.90	57.29	56.03	47.80
A-Estimate	51.47	55.78	54.52	38.85
Method	Non-parametric	Pooled	Pooled	Non-parametric
Modified CV Basis Values and Estimates				
B-Basis	54.07	53.73	52.47	49.89
A-Estimate	50.15	49.81	48.56	45.97
Method	Pooled	Pooled	Pooled	Pooled

Table 4-49 Statistics and Basis Values for OHT2 Strength as-measured

Open-Hole Tension 2 Basis Values and Statistics				
	Strength normalized [ksi]			
Env	CTA(-65°F)	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	60.43	60.32	58.89	56.65
Stdev	1.360	1.058	1.309	2.104
CV	2.250	1.754	2.224	3.714
Mod CV	6.000	6.000	6.000	6.000
Min	57.31	58.36	55.79	47.83
Max	63.21	62.59	61.86	59.49
No. Batches	5	5	5	5
No. Spec.	30	30	30	30
Basis Values and Estimates				
B-Basis	58.37	58.26	56.83	53.31
A-Estimate	56.94	56.83	55.40	49.57
Method	Pooled	Pooled	Pooled	Weibull
Modified CV Basis Values and Estimates				
B-Basis	54.64	54.53	53.10	50.86
A-Estimate	50.67	50.56	49.13	46.89
Method	Pooled	Pooled	Pooled	Pooled

Table 4-50 Statistics and Basis Values for OHT2 Strength normalized

4.18 “50/40/10” Open-Hole Tension 3 (OHT3)

Open-Hole Tension 3 (OHT3) tests were performed at four different environmental conditions CTA, RTA, ETW1, ETW2 and for two material properties Strength as-measured and Strength normalized. The OHT3 properties are fiber dominated, so the data is normalized.

With respect to computing allowables for Strength as-measured property using original CV data, CTA, ETW1 and ETW2 conditions failed ADK test, so ANOVA method was used. Since each condition has 5 batches and less than 55 specimens, the ANOVA method produces B-basis values and A-estimates values. Condition RTA passed normality tests, so normal method was used for this. For modified CV data, RTA, ETW1 and ETW2 conditions passed all the pooling tests, so pooling method was used, while the normal method for modified CV was used for CTA.

For Strength normalized property using original CV data, conditions CTA, ETW1 and ETW2 failed ADK test, so ANOVA method was used. Since each of these conditions have 5 batches and less than 55 specimens, the produced results are B-basis and A-estimates values. Condition RTA passed ADK test and normality test, so normal method was used for this. For modified CV data, conditions RTA, ETW1, and ETW2 passed all pooling tests, so these datasets were pooled while, the normal method for modified CV was used for CTA.

There was one statistical outlier for Strength as-measured. One low batch and condition outlier in batch E and condition ETW2. There were two statistical outliers for Strength normalized. One low batch outlier in batch E and condition CTA. One low batch and condition outlier in batch E and condition ETW2. All the outliers were retained for computations.

Statistics, estimates, and basis values are given for the strength as-measured data in Table 4-51 and for the strength normalized data in Table 4-52. The data, B-estimates and B-basis values are shown graphically for the strength as-measured in Figure 4-37 and for strength normalized in Figure 4-38.

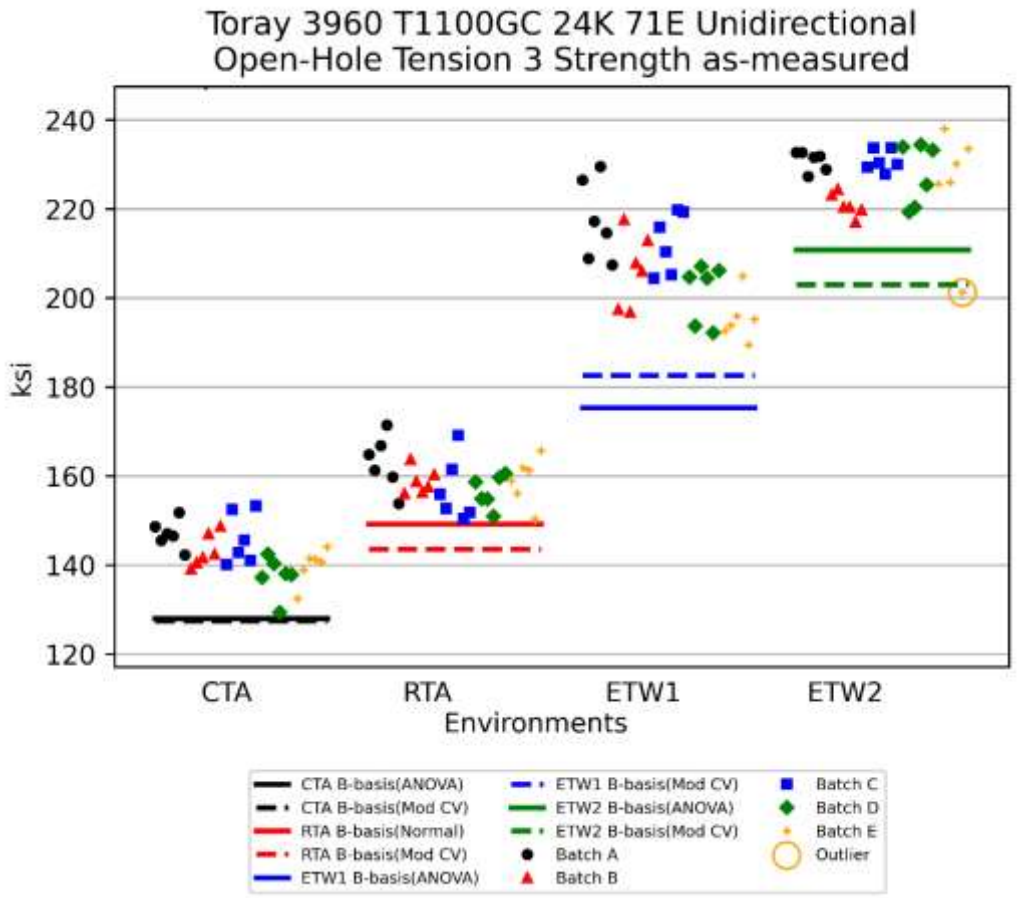

Figure 4-37 Batch Plot for OHT3 strength as-measured

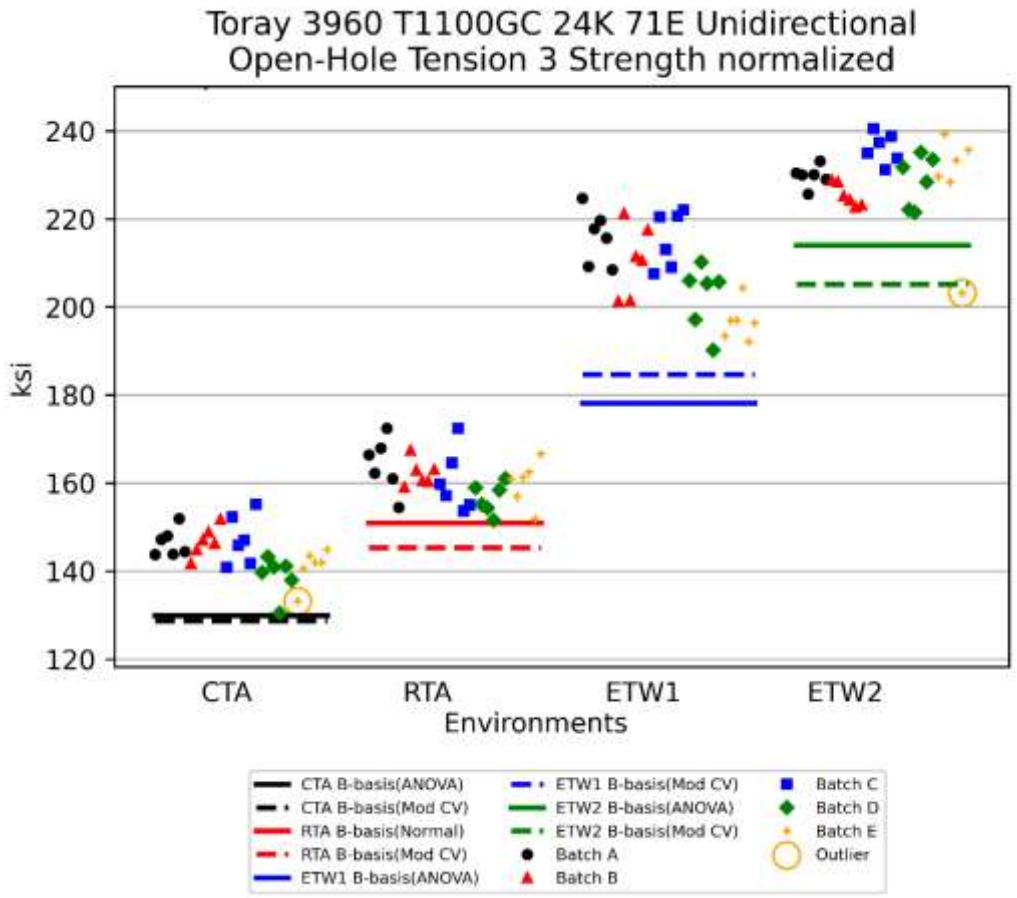

Figure 4-38 Batch Plot for OHT3 strength normalized

Open-Hole Tension 3 Basis Values and Statistics				
	Strength as-measured [ksi]			
Env	CTA(-65°F)	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	142.7	158.8	206.6	227.2
Stdev	5.417	5.418	10.46	7.378
CV	3.797	3.411	5.065	3.248
Mod CV	6.000	6.000	6.533	6.000
Min	129.3	150.3	189.4	201.2
Max	153.3	171.4	229.5	238.0
No. Batches	5	5	5	5
No. Spec.	30	30	30	30
Basis Values and Estimates				
B-Basis	128.0	149.2	175.3	210.8
A-Estimate	117.7	142.3	153.6	199.3
Method	ANOVA	Normal	ANOVA	ANOVA
Modified CV Basis Values and Estimates				
B-Basis	127.5	138.5	186.2	206.8
A-Estimate	116.5	124.3	172.1	192.7
Method	Normal	Pooled	Pooled	Pooled

Table 4-51 Statistics and Basis Values for OHT3 Strength as-measured

Open-Hole Tension 3 Basis Values and Statistics				
	Strength normalized [ksi]			
Env	CTA(-65°F)	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	144.1	160.7	208.2	229.7
Stdev	5.286	5.464	9.819	7.189
CV	3.669	3.401	4.715	3.130
Mod CV	6.000	6.000	6.358	6.000
Min	130.5	151.6	190.2	203.2
Max	155.2	172.5	224.7	240.5
No. Batches	5	5	5	5
No. Spec.	30	30	30	30
Basis Values and Estimates				
B-Basis	129.9	151.0	178.2	214.0
A-Estimate	120.0	143.9	157.5	203.0
Method	ANOVA	Normal	ANOVA	ANOVA
Modified CV Basis Values and Estimates				
B-Basis	128.7	140.3	187.9	209.3
A-Estimate	117.6	126.2	173.7	195.2
Method	Normal	Pooled	Pooled	Pooled

Table 4-52 Statistics and Basis Values for OHT3 Strength normalized

4.19 “25/50/25” Filled-Hole Tension 1 (FHT1)

Filled-Hole Tension 1 (FHT1) tests were performed at four different environmental conditions CTA, RTA, ETW1, ETW2 and for two material properties Strength as-measured and Strength normalized. The FHT1 properties are fiber dominated, so the data is normalized.

With respect to computing allowables for Strength as-measured property using original CV data, the RTA condition failed the ADK test, so ANOVA method was used. Since each condition has 5 batches and less than 55 specimens, the ANOVA method produces B-basis values and A-estimates values. Conditions CTA, ETW1 and ETW2 passed ADK and normality tests, so the normal method was used for these. For modified CV data, all four conditions passed all the pooling tests, so pooling method was used.

For Strength normalized property using original CV data, condition ETW2 failed ADK test, so ANOVA method was used. Since ETW2 condition has 5 batches and less than 55 specimens, the ANOVA method produces B-basis and A-estimate values. Conditions CTA, RTA and ETW1 passed the pooling tests, so pooling method was used for these. For modified CV data, all four conditions pass pooling tests, so allowables are computed using pooling method for these.

There were two statistical outliers for Strength as-measured. One high batch outlier in batch C and condition ETW1. One high batch outlier in batch D and condition ETW2. There were two statistical outliers for Strength normalized. One high batch outlier in batch C and condition ETW1. One high condition outlier in batch D and condition ETW2. All the outliers were retained for computations.

Statistics, estimates and basis values are given for the strength as-measured data in Table 4-53 and for the strength normalized data in Table 4-54. The data, B-estimates and B-basis values are shown graphically for the strength as-measured in Figure 4-39 and for strength normalized in Figure 4-40.

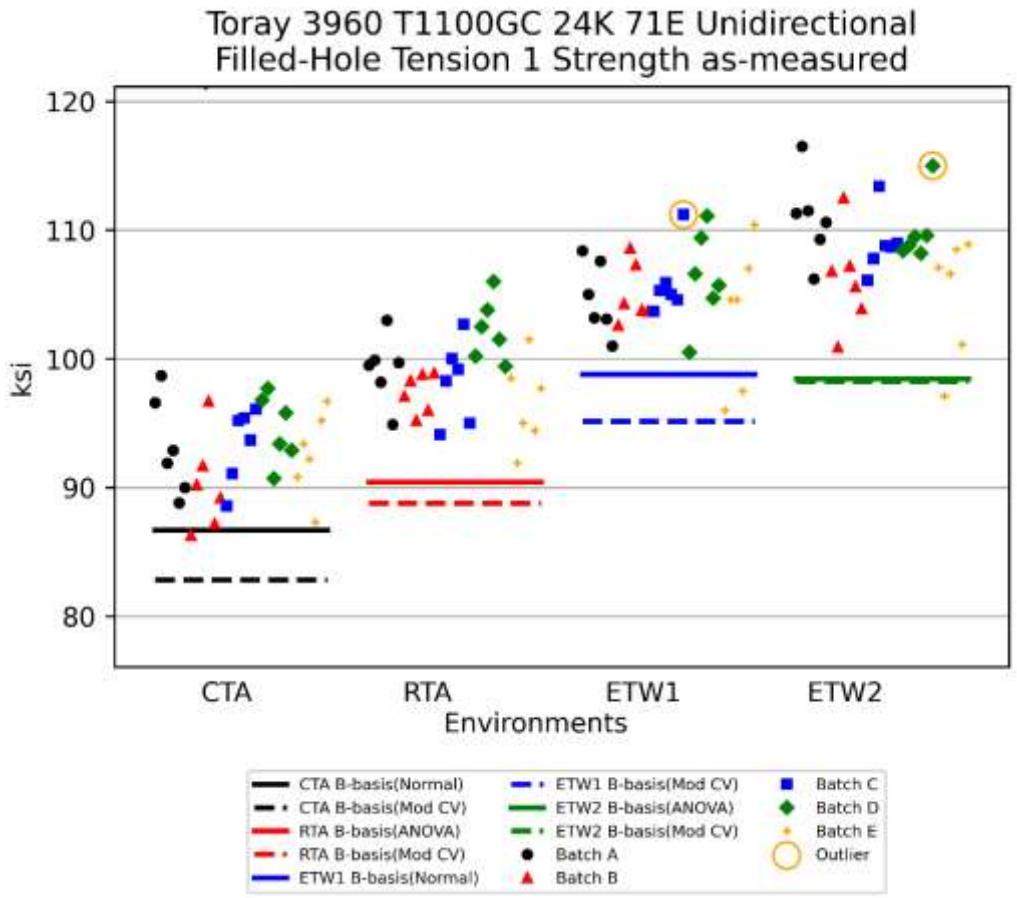

Figure 4-39 Batch Plot for FHT1 strength as-measured

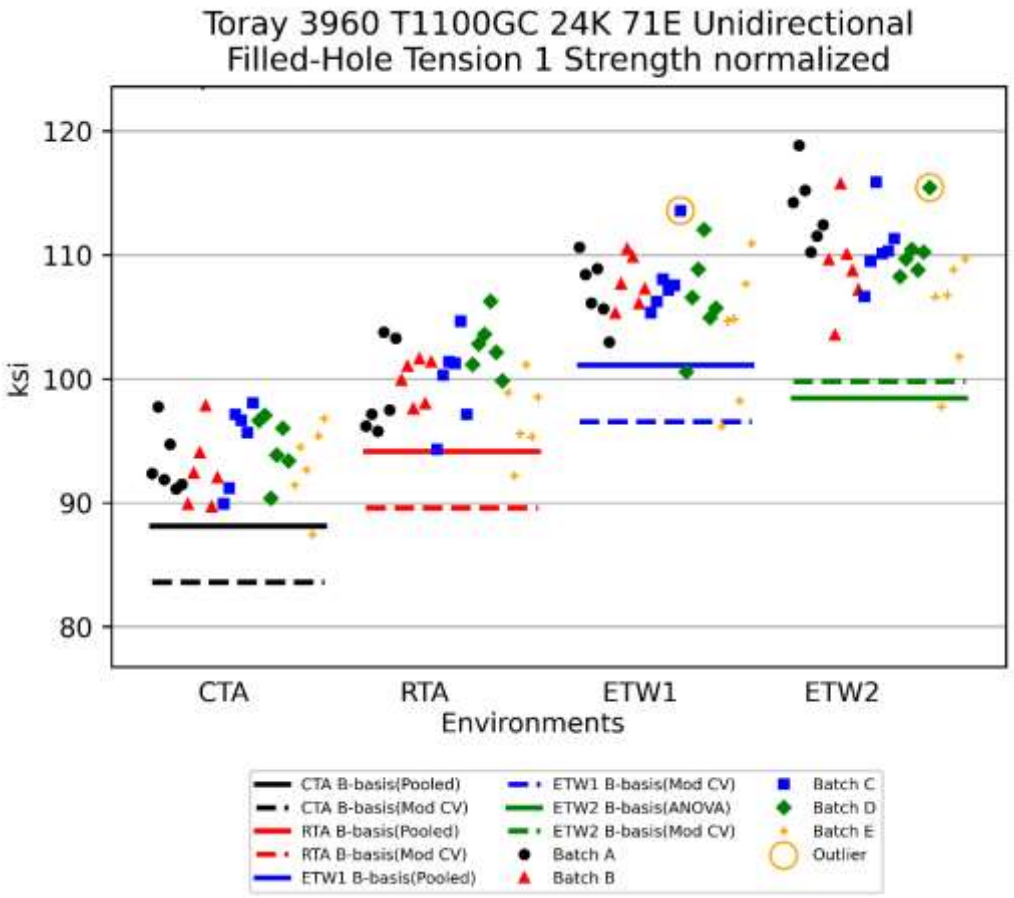

Figure 4-40 Batch Plot for FHT1 strength normalized

Filled-Hole Tension 1 Basis Values and Statistics				
	Strength as-measured [ksi]			
Env	CTA(-65°F)	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	92.77	98.71	105.1	108.2
Stdev	3.415	3.233	3.526	3.989
CV %	3.681	3.275	3.355	3.688
Mod CV %	6.000	6.000	6.000	6.000
Min	86.30	91.90	96.00	97.10
Max	98.70	106.0	111.2	116.5
No. Batches	5	5	5	5
No. Spec.	30	30	30	30
Basis Values and Estimates				
B-Basis	86.71	90.45	98.82	101.1
A-Estimate	82.32	84.66	94.28	95.95
Method	Normal	ANOVA	Normal	Normal
Modified CV Basis Values and Estimates				
B-Basis	82.85	88.78	95.16	98.24
A-Estimate	76.04	81.97	88.34	91.43
Method	Pooled	Pooled	Pooled	Pooled

Table 4-53 Statistics and Basis Values for FHT1 Strength as-measured

Filled-Hole Tension 1 Basis Values and Statistics				
	Strength normalized [ksi]			
Env	CTA(-65°F)	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	93.64	99.65	106.6	109.8
Stdev	2.907	3.332	3.723	4.310
CV	3.105	3.344	3.492	3.924
Mod CV	6.000	6.000	6.000	6.000
Min	87.44	92.18	96.18	97.73
Max	98.06	106.2	113.6	118.8
No. Batches	5	5	5	5
No. Spec.	30	30	30	30
Basis Values and Estimates				
B-Basis	88.14	94.15	101.1	98.43
A-Estimate	84.33	90.34	97.29	90.47
Method	Pooled	Pooled	Pooled	ANOVA
Modified CV Basis Values and Estimates				
B-Basis	83.59	89.60	96.56	99.79
A-Estimate	76.69	82.71	89.66	92.89
Method	Pooled	Pooled	Pooled	Pooled

Table 4-54 Statistics and Basis Values for FHT1 Strength normalized

4.20 “10/80/10” Filled-Hole Tension 2 (FHT2)

Filled-Hole Tension 2 (FHT2) tests were performed at four different environmental conditions CTA, RTA, ETW1, ETW2 and for two material properties Strength as-measured and Strength normalized. The FHT2 properties are fiber dominated, so the data is normalized.

With respect to computing allowables for Strength as-measured property with original CV data, the ETW2 condition failed ADK test, so ANOVA method was used. Since the dataset has 5 batches and less than 55 specimens, the ANOVA method produces B-basis values and A-estimate values. Conditions CTA, RTA and ETW1 passed pooling tests, so pooling method was used for these. For modified CV data, all conditions but ETW2 passed the pooling tests, so pooling method was used, while ETW2 failed ADK test, so allowables are not available for this one.

For Strength normalized property using original CV dataset, condition ETW2 failed ADK test, so ANOVA method was used. Since ETW2 condition has 5 batches and less than 55 specimens, the ANOVA method produces B-basis and A-estimate values. Conditions CTA, RTA and ETW1 passed the pooling tests, so pooling method was used for these. For modified CV data, all four conditions pass pooling tests, so allowables are computed using pooling method for these.

There was one statistical outlier for Strength as-measured. One low batch outlier in batch B and condition CTA. The outlier was retained for computations.

Statistics, estimates and basis values are given for the strength as-measured data in Table 4-55 and for the strength normalized data in Table 4-56. The data, B-estimates and B-basis values are shown graphically for the strength as-measured in Figure 4-41 and for strength normalized in Figure 4-42.

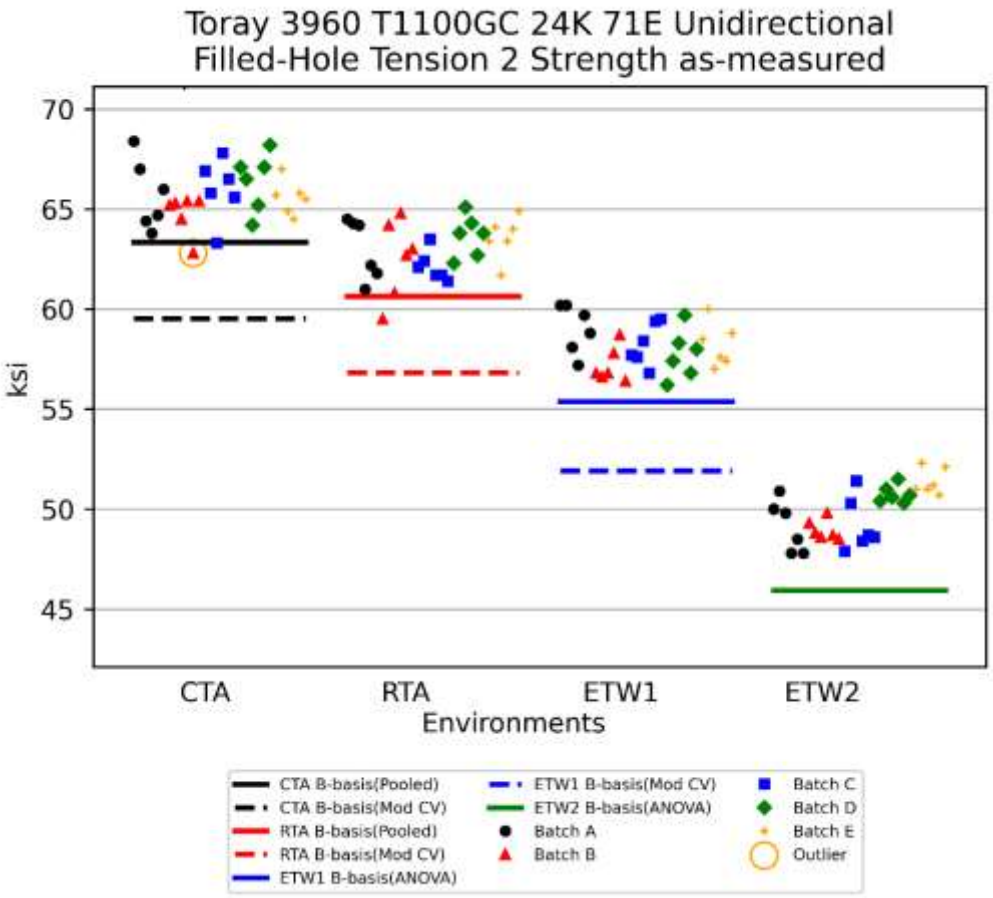

Figure 4-41 Batch Plot for FHT2 strength as-measured

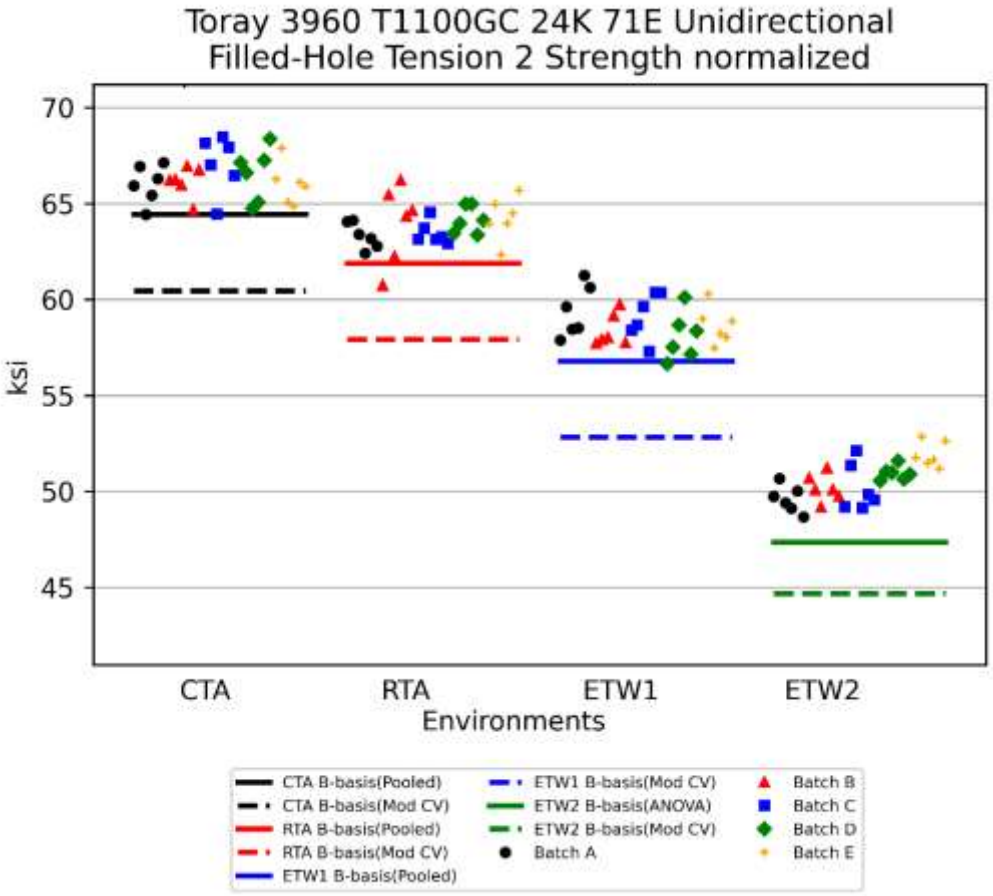

Figure 4-42 Batch Plot for FHT2 strength normalized

Filled-Hole Tension 2 Basis Values and Statistics				
	Strength as-measured [ksi]			
Env	CTA(-65°F)	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	65.68	62.98	58.08	49.89
Stdev	1.380	1.395	1.205	1.325
CV	2.100	2.215	2.074	2.656
Mod CV	6.000	6.000	6.000	6.000
Min	62.80	59.50	56.20	47.80
Max	68.40	65.10	60.20	52.30
No. Batches	5	5	5	5
No. Spec.	30	30	30	30
Basis Values and Estimates				
B-Basis	63.49	60.79	55.89	45.93
A-Estimate	61.97	59.27	54.37	43.20
Method	Pooled	Pooled	Pooled	ANOVA
Modified CV Basis Values and Estimates				
B-Basis	59.52	56.81	51.92	NA
A-Estimate	55.25	52.54	47.65	
Method	Pooled	Pooled	Pooled	

Table 4-55 Statistics and Basis Values for FHT2 Strength as-measured

Filled-Hole Tension 2 Basis Values and Statistics				
	Strength normalized [ksi]			
Env	CTA(-65°F)	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	66.35	63.81	58.72	50.57
Stdev	1.172	1.151	1.167	1.097
CV	1.766	1.803	1.987	2.170
Mod CV	6.000	6.000	6.000	6.000
Min	64.42	60.73	56.64	48.67
Max	68.46	66.21	61.25	52.86
No. Batches	5	5	5	5
No. Spec.	30	30	30	30
Basis Values and Estimates				
B-Basis	64.43	61.89	56.80	47.35
A-Estimate	63.11	60.57	55.47	45.11
Method	Pooled	Pooled	Pooled	ANOVA
Modified CV Basis Values and Estimates				
B-Basis	60.46	57.92	52.83	44.68
A-Estimate	56.42	53.88	48.78	40.63
Method	Pooled	Pooled	Pooled	Pooled

Table 4-56 Statistics and Basis Values for FHT2 Strength normalized

4.21 “50/40/10” Filled-Hole Tension 3 (FHT3)

Filled-Hole Tension 3 (FHT3) tests were performed at four different environmental conditions CTA, RTA, ETW1, ETW2 and for two material properties Strength as-measured and Strength normalized. The FHT2 properties are fiber dominated, so the data is normalized.

With respect to computing allowables for Strength as-measured property with original CV data, ETW1 condition failed ADK test, so ANOVA method was used. Since the dataset has 5 batches and less than 55 specimens, the ANOVA method produces B-basis values and A-estimate values. The ETW2 condition failed all the distribution tests so the non-parametric method was used for that condition. Conditions CTA and RTA passed pooling tests, so pooling method was used for these. For modified CV data, CTA, RTA and ETW1 passed the pooling tests, so pooling method was used, while ETW2 failed the normality test, so allowables are not available for this one.

For Strength normalized property, the results are identical to those of the as-measured dataset.

There was one statistical outlier for Strength as-measured. One high batch outlier in batch D and condition RTA. There was one statistical outlier for Strength normalized. One high batch outlier in batch D and condition RTA. All the outliers were retained for computations.

Statistics, estimates and basis values are given for the strength as-measured data in Table 4-57 and for the strength normalized data in Table 4-58. The data, B-estimates and B-basis values are shown graphically for the strength as-measured in Figure 4-43 and for strength normalized in Figure 4-44.

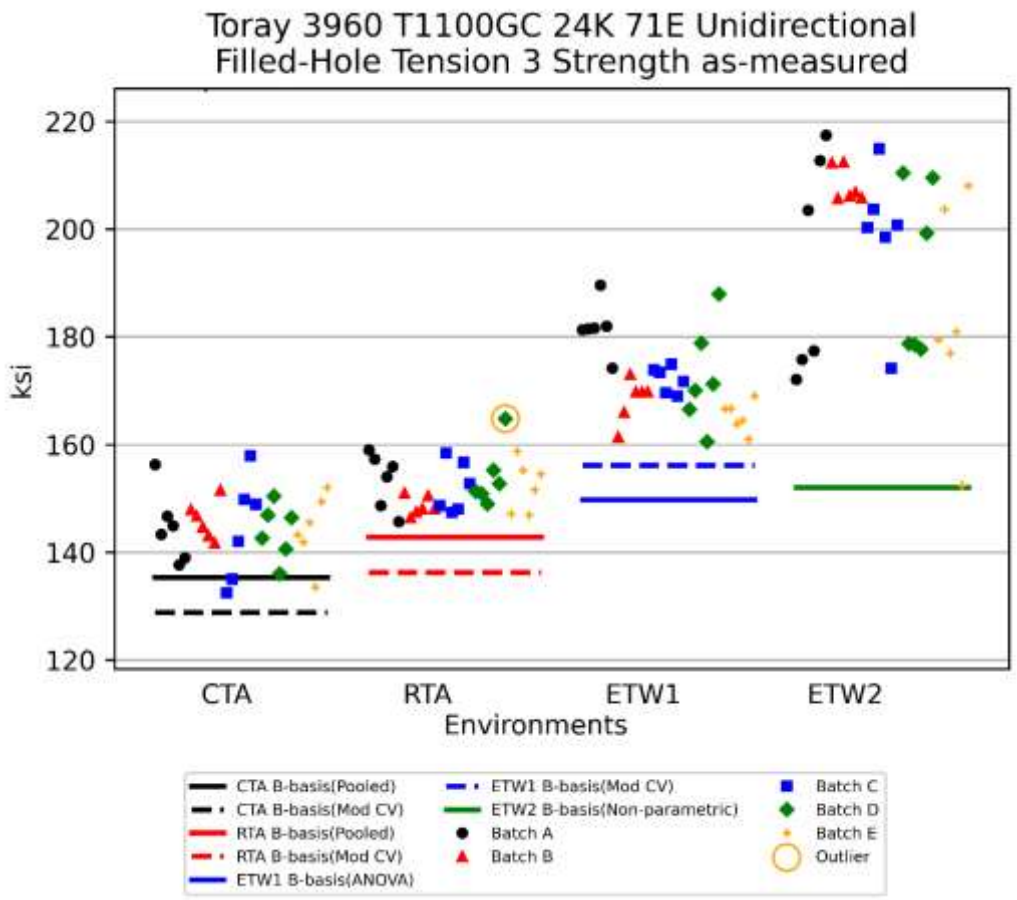

Figure 4-43 Batch Plot for FHT3 strength as-measured

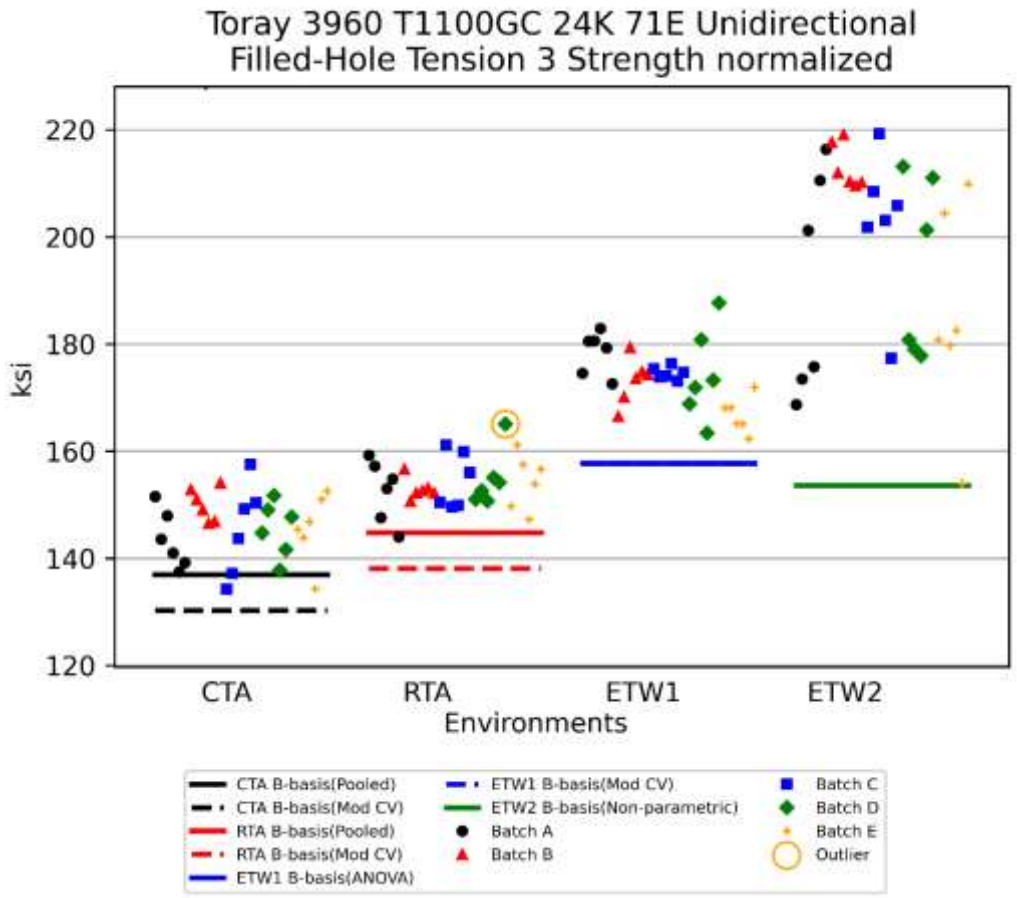

Figure 4-44 Batch Plot for FHT3 strength normalized

Filled-Hole Tension 3 Basis Values and Statistics				
	Strength as-measured [ksi]			
Env	CTA(-65°F)	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	144.6	152.1	172.0	195.2
Stdev	6.188	4.705	7.551	16.91
CV %	4.280	3.094	4.391	8.665
Mod CV %	6.140	6.000	6.196	8.665
Min	132.5	145.7	160.5	152.4
Max	157.9	164.8	189.6	217.4
No. Batches	5	5	5	5
No. Spec.	30	30	30	30
Basis Values and Estimates				
B-Basis	135.4	142.8	149.7	152.4
A-Estimate	128.9	136.3	134.3	108.0
Method	Pooled	Pooled	ANOVA	Non-parametric
Modified CV Basis Values and Estimates				
B-Basis	128.8	136.3	156.2	NA
A-Estimate	117.9	125.3	145.2	
Method	Pooled	Pooled	Pooled	

Table 4-57 Statistics and Basis Values for FHT3 Strength as-measured

Filled-Hole Tension 3 Basis Values and Statistics				
	Strength normalized [ksi]			
Env	CTA(-65°F)	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	146.0	153.8	173.4	197.2
Stdev	6.028	4.650	5.996	18.06
CV %	4.129	3.023	3.457	9.159
Mod CV %	6.065	6.000	6.000	9.159
Min	134.2	144.0	162.3	154.0
Max	157.5	165.0	187.6	219.3
No. Batches	5	5	5	5
No. Spec.	30	30	30	30
Basis Values and Estimates				
B-Basis	136.9	144.8	157.8	154.0
A-Estimate	130.6	138.4	146.8	109.3
Method	Pooled	Pooled	ANOVA	Non-parametric
Modified CV Basis Values and Estimates				
B-Basis	130.3	138.1	157.7	NA
A-Estimate	119.4	127.3	146.9	
Method	Pooled	Pooled	Pooled	

Table 4-58 Statistics and Basis Values for FHT3 Strength normalized

4.22 “25/50/25” Open-Hole Compression 1 (OHC1)

Open-Hole Compression 1 (OHC1) tests were performed at three different environmental conditions RTA, ETW1, ETW2 and for two material properties Strength as-measured and Strength normalized. The OHC1 properties are fiber dominated, so the data is normalized.

With respect to computing allowables for Strength as-measured property with original CV data, ETW2 condition failed ADK test, so ANOVA method was used. Since the condition has 5 batches and less than 55 specimens, the ANOVA method produces B-basis values and A-estimates values. Pooling was acceptable for RTA and ETW1. For the modified CV data, pooling was acceptable for the three conditions.

For Strength normalized property, the results are identical to those for the as-measured dataset.

There was one statistical outlier for Strength as-measured. One high batch outlier in batch E and condition RTA. There were two statistical outliers for Strength normalized. One high batch outlier in batch E and condition RTA. One low batch outlier in batch D and condition ETW2. All the outliers were retained for computations.

Statistics, estimates and basis values are given for the strength as-measured data in Table 4-59 and for the strength normalized data in Table 4-60. The data, B-estimates and B-basis values are shown graphically for the strength as-measured in Figure 4-45 and for strength normalized in Figure 4-46.

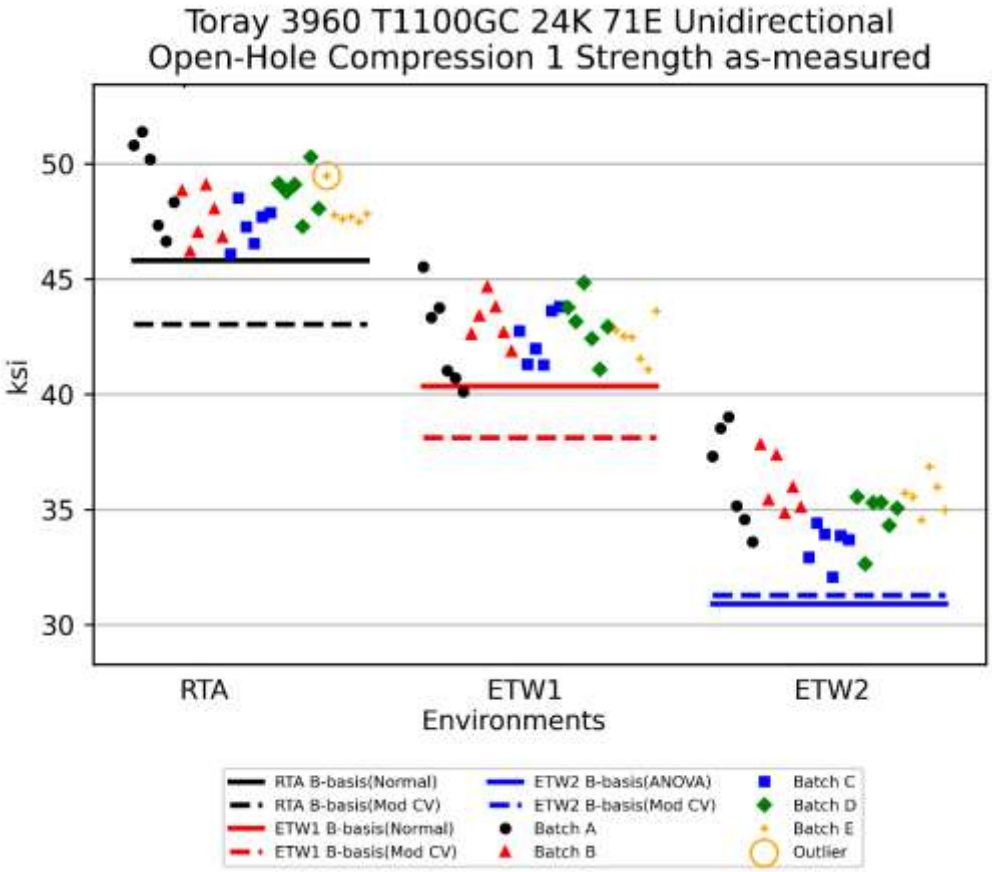

Figure 4-45 Batch Plot for OHC1 strength as-measured

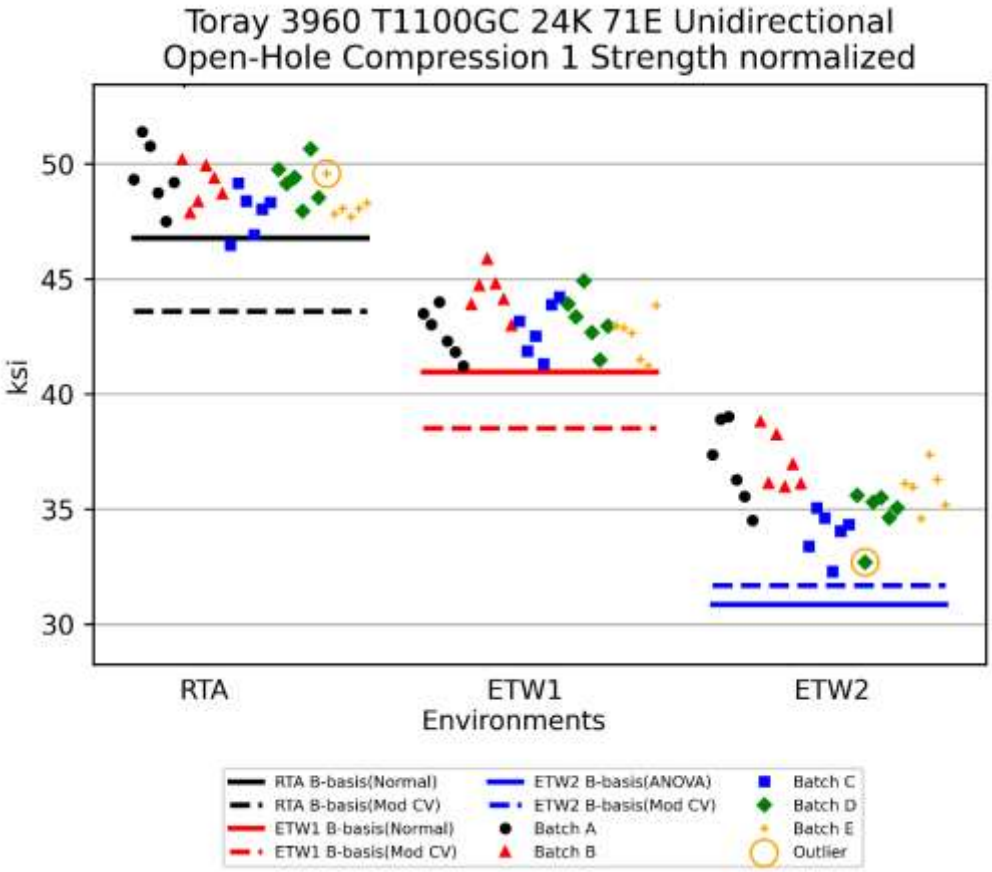

Figure 4-46 Batch Plot for OHC1 strength normalized

Open-Hole Compression 1 Basis Values and Statistics			
	Strength as-measured [ksi]		
Env	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	48.17	42.68	35.24
Stdev	1.333	1.303	1.643
CV	2.767	3.053	4.662
Mod CV	6.000	6.000	6.331
Min	46.09	40.12	32.07
Max	51.39	45.53	39.02
No. Batches	5	5	5
No. Spec.	30	30	30
Basis Values and Estimates			
B-Basis	45.96	40.46	30.91
A-Estimate	44.40	38.90	27.87
Method	Pooled	Pooled	ANOVA
Modified CV Basis Values and Estimates			
B-Basis	43.93	38.43	31.00
A-Estimate	40.99	35.49	28.06
Method	Pooled	Pooled	Pooled

Table 4-59 Statistics and Basis Values for OHC1 Strength as-measured

Open-Hole Compression 1 Basis Values and Statistics			
	Strength normalized [ksi]		
Env	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	48.79	43.11	35.72
Stdev	1.132	1.208	1.689
CV	2.321	2.801	4.727
Mod CV	6.000	6.000	6.364
Min	46.47	41.21	32.29
Max	51.40	45.85	39.02
No. Batches	5	5	5
No. Spec.	30	30	30
Basis Values and Estimates			
B-Basis	46.82	41.14	30.87
A-Estimate	45.43	39.76	27.50
Method	Pooled	Pooled	ANOVA
Modified CV Basis Values and Estimates			
B-Basis	44.48	38.81	31.42
A-Estimate	41.50	35.83	28.44
Method	Pooled	Pooled	Pooled

Table 4-60 Statistics and Basis Values for OHC1 Strength normalized

4.23 “10/80/10” Open-Hole Compression 2 (OHC2)

Open-Hole Compression 2 (OHC2) tests were performed at three different environmental conditions RTA, ETW1, ETW2 and for two material properties Strength as-measured and Strength normalized. The OHC2 properties are fiber dominated, so the data is normalized.

With respect to computing allowables for Strength as-measured property with original CV data, ETW1 and ETW2 conditions failed ADK test, so ANOVA method was used. Since the conditions have 5 batches and less than 55 specimens, the ANOVA method produces B-basis values and A-estimates values. Conditions RTA passed normality test, so normal method was used. For modified CV data, RTA and ETW2 passed normality test, so normal method was used, while ETW1 failed ADK test, so allowables are not available (NA).

For Strength normalized property using original CV dataset, ETW1 and ETW2 conditions failed ADK test, so ANOVA method was used. Since the conditions have 5 batches and less than 55 specimens, the ANOVA method produces B-basis values and A-estimates values. Condition RTA passed normality test, so normal method was used. For modified CV data, pooling all three conditions was acceptable.

There were two statistical outliers for Strength normalized. One high condition outlier in batch B and condition RTA. One low batch outlier in batch A and condition ETW2. All the outliers were retained for computations.

Statistics, estimates, and basis values are given for the strength as-measured data in Table 4-61 and for the strength normalized data in Table 4-62. The data, B-estimates and B-basis values are shown graphically for the strength as-measured in Figure 4-47 and for strength normalized in Figure 4-48.

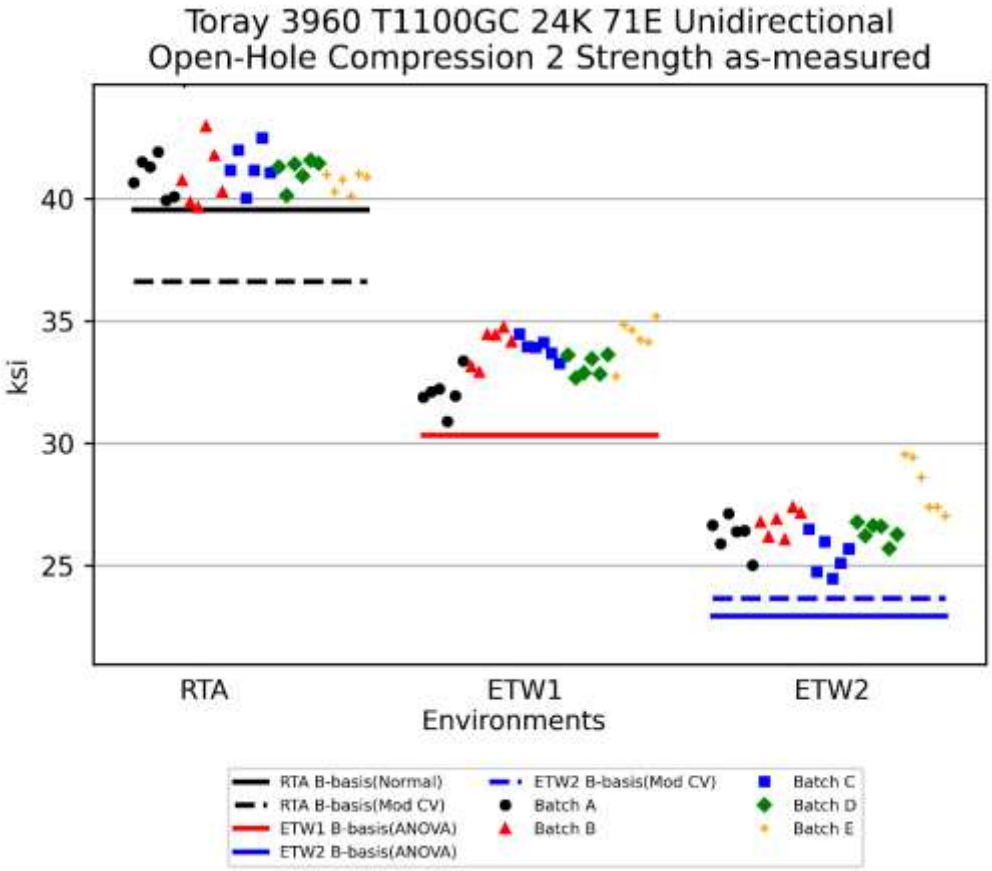

Figure 4-47 Batch Plot for OHC2 strength as-measured

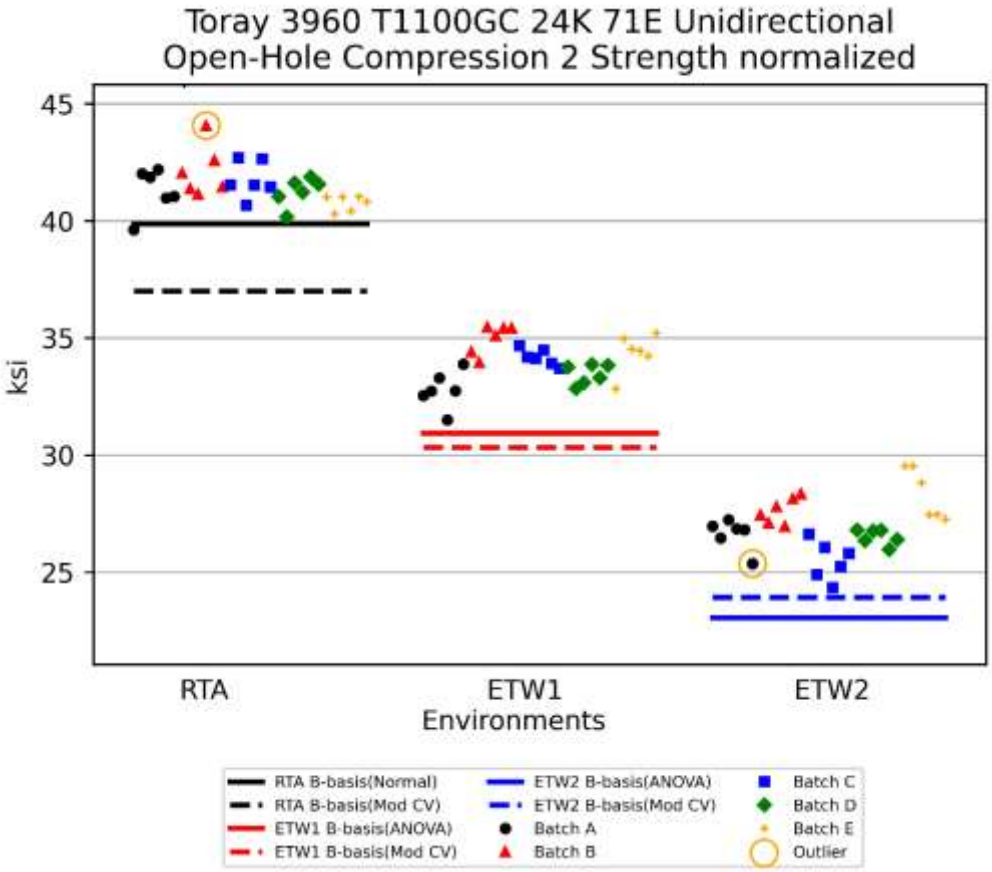

Figure 4-48 Batch Plot for OHC2 strength normalized

Open-Hole Compression 2 Basis Values and Statistics			
	Strength as-measured [ksi]		
Env	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	40.98	33.48	26.59
Stdev	0.8005	1.023	1.169
CV	1.953	3.056	4.395
Mod CV	6.000	6.000	6.198
Min	39.65	30.89	24.46
Max	42.96	35.18	29.54
No. Batches	5	5	5
No. Spec.	30	30	30
Basis Values and Estimates			
B-Basis	39.56	30.33	22.93
A-Estimate	38.53	28.15	20.41
Method	Normal	ANOVA	ANOVA
Modified CV Basis Values and Estimates			
B-Basis	36.61	NA	23.66
A-Estimate	33.45		21.55
Method	Normal		Normal

Table 4-61 Statistics and Basis Values for OHC2 Strength as-measured

Open-Hole Compression 2 Basis Values and Statistics			
	Strength normalized [ksi]		
Env	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	41.43	33.95	26.92
Stdev	0.8788	0.9714	1.211
CV %	2.121	2.861	4.498
Mod CV %	6.000	6.000	6.249
Min	39.62	31.51	24.35
Max	44.06	35.47	29.54
No. Batches	5	5	5
No. Spec.	30	30	30
Basis Values and Estimates			
B-Basis	39.87	30.95	23.06
A-Estimate	38.74	28.87	20.39
Method	Normal	ANOVA	ANOVA
Modified CV Basis Values and Estimates			
B-Basis	37.98	30.50	23.47
A-Estimate	35.59	28.11	21.08
Method	Pooled	Pooled	Pooled

Table 4-62 Statistics and Basis Values for OHC2 Strength normalized

4.24 “50/40/10” Open-Hole Compression 3 (OHC3)

Open-Hole Compression 3 (OHC3) tests were performed at three different environmental conditions RTA, ETW1, ETW2 and for two material properties Strength as-measured and Strength normalized. The OHC3 properties are fiber dominated, so the data is normalized.

With respect to computing allowables for Strength as-measured property with original CV data, RTA and ETW2 conditions failed ADK test, so ANOVA method was used. Since the conditions have 5 batches and less than 55 specimens, the ANOVA method produces B-basis values and A-estimates values. Condition ETW1 passed normality test, so normal method was used. For modified CV data, pooling was acceptable for RTA and ETW1, while ETW2 failed ADK test, so allowables are not available (NA).

For Strength normalized property using original CV dataset, RTA and ETW1 conditions failed ADK test, so ANOVA method was used. Since the conditions have 5 batches and less than 55 specimens, the ANOVA method produces B-basis values and A-estimates values. Condition ETW2 passed the normality test, so normal method was used. For modified CV data, pooling all three conditions was acceptable.

No statistical outliers for OHC3 were detected.

Statistics, estimates and basis values are given for the strength as-measured data in Table 4-63 and for the strength normalized data in Table 4-64. The data, B-estimates and B-basis values are shown graphically for the strength as-measured in Figure 4-49 and for strength normalized in Figure 4-50.

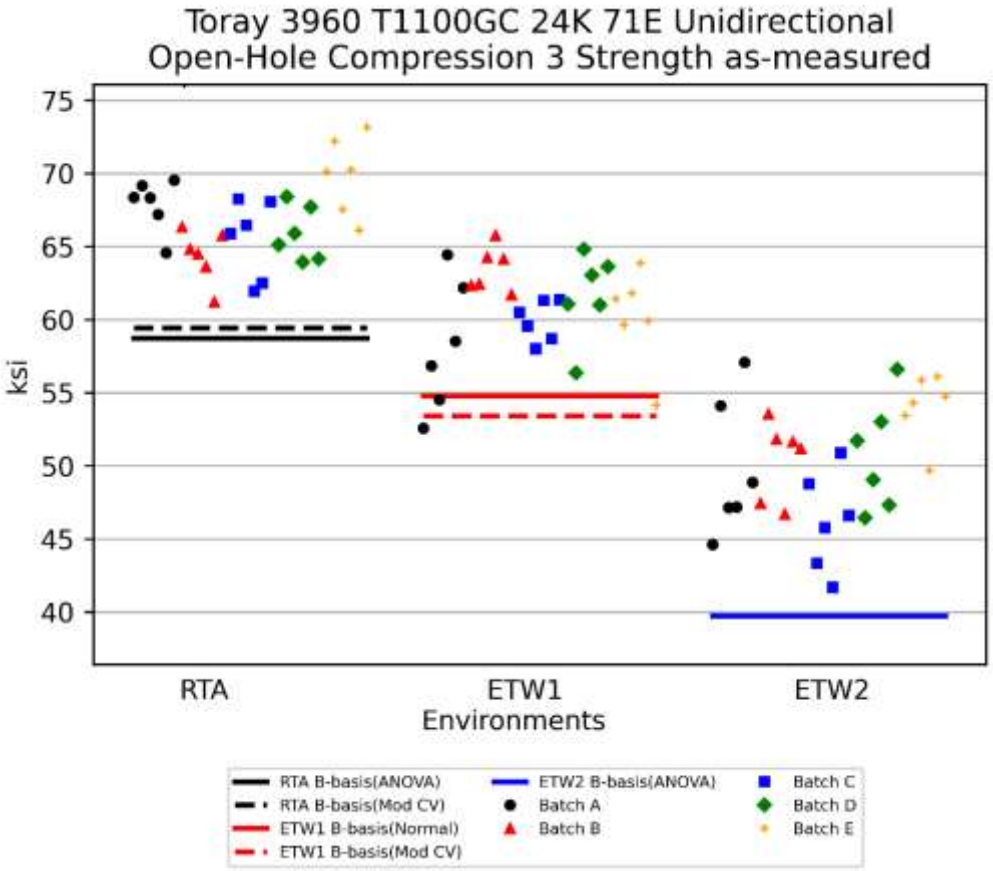

Figure 4-49 Batch Plot for OHC3 strength as-measured

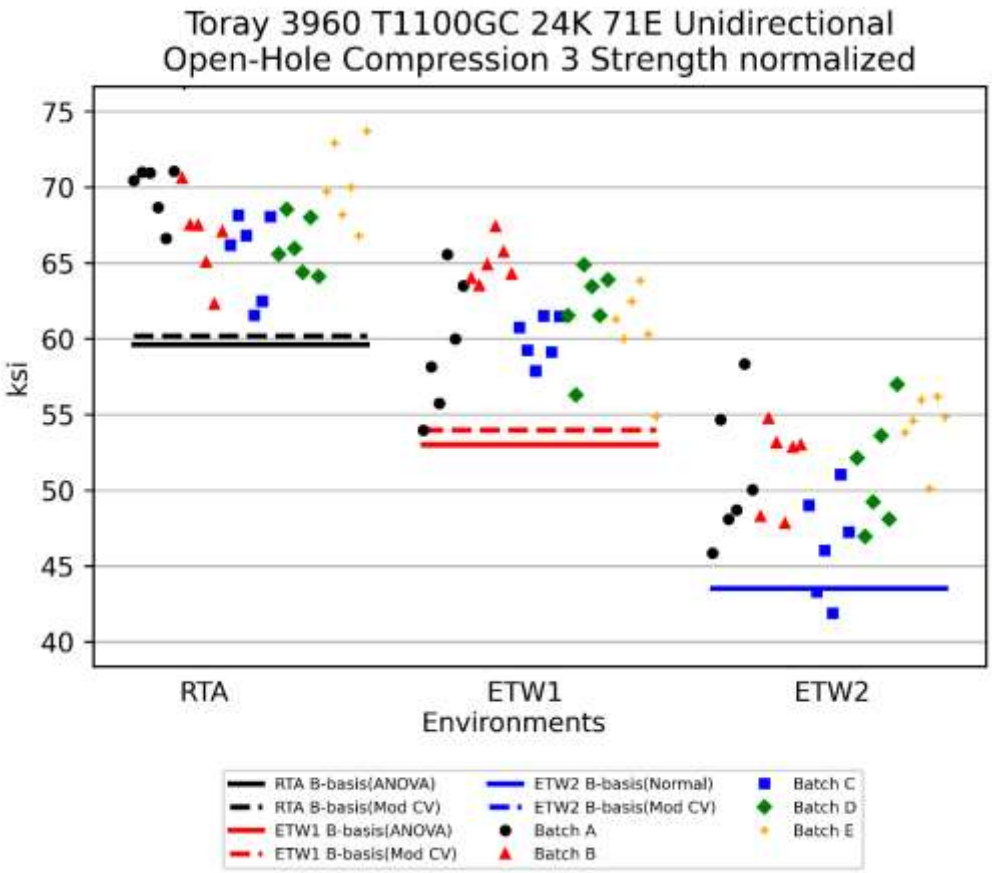

Figure 4-50 Batch Plot for OHC3 strength normalized

Open-Hole Compression 3 Basis Values and Statistics			
	Strength as-measured [ksi]		
Env	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	66.70	60.66	50.22
Stdev	2.862	3.303	4.135
CV %	4.290	5.445	8.234
Mod CV %	6.145	6.722	8.234
Min	61.19	52.56	41.68
Max	73.16	65.76	57.08
No. Batches	5	5	5
No. Spec.	30	30	30
Basis Values and Estimates			
B-Basis	58.73	54.79	39.74
A-Estimate	53.19	50.54	32.40
Method	ANOVA	Normal	ANOVA
Modified CV Basis Values and Estimates			
B-Basis	59.82	53.78	NA
A-Estimate	54.99	48.95	
Method	Pooled	Pooled	

Table 4-63 Statistics and Basis Values for OHC3 Strength as-measured

Open-Hole Compression 3 Basis Values and Statistics			
	Strength normalized [ksi]		
Env	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	67.66	61.36	50.88
Stdev	3.006	3.387	4.138
CV	4.443	5.520	8.133
Mod CV	6.222	6.760	8.133
Min	61.54	53.96	41.87
Max	73.71	67.40	58.33
No. Batches	5	5	5
No. Spec.	30	30	30
Basis Values and Estimates			
B-Basis	59.62	53.01	43.53
A-Estimate	54.01	47.14	38.21
Method	ANOVA	ANOVA	Normal
Modified CV Basis Values and Estimates			
B-Basis	60.80	54.50	44.01
A-Estimate	56.04	49.74	39.25
Method	Pooled	Pooled	Pooled

Table 4-64 Statistics and Basis Values for OHC3 Strength normalized

4.25 “25/50/25” Filled-Hole Compression 1 (FHC1)

Filled-Hole Compression 1 (FHC1) tests were performed at three different environmental conditions RTA, ETW1, ETW2 and for two material properties Strength as-measured and Strength normalized. The FHC1 properties are fiber dominated, so the data is normalized.

With respect to computing allowables for Strength as-measured property with original CV data, all three conditions failed ADK test, so ANOVA method was used. Since the conditions have 5 batches and less than 55 specimens, the ANOVA method produces B-basis values and A-estimates values. For modified CV data, pooling RTA and ETW1was acceptable, while ETW2 failed ADK test, so allowables are not available (NA) for this one.

For Strength normalized property using original CV dataset, ETW1 and ETW2 conditions failed ADK test, so ANOVA method was used. Since the conditions have 5 batches and less than 55 specimens, the ANOVA method produces B-basis values and A-estimates values. Condition RTA passed normality test, so normal method was used. For modified CV data, pooling RTA and ETW1was acceptable, while ETW2 failed ADK test, so allowables are not available (NA) for this one.

One statistical outlier was detected for both properties Strength as-measured and Strength normalized. A low batch outlier in batch E and condition ETW2.

Statistics, estimates and basis values are given for the strength as-measured data in Table 4-65 and for the strength normalized data in Table 4-66. The data, B-estimates and B-basis values are shown graphically for the strength as-measured in Figure 4-51 and for strength normalized in Figure 4-52.

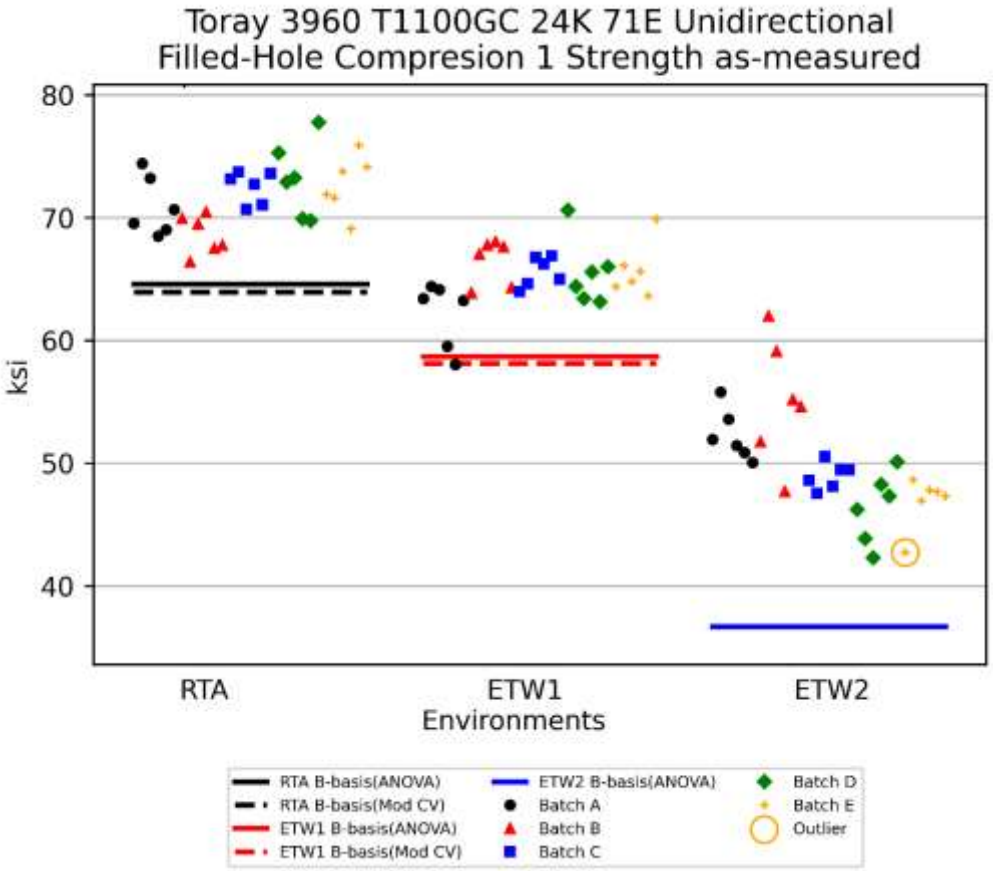

Figure 4-51 Batch Plot for FHC1 strength as-measured

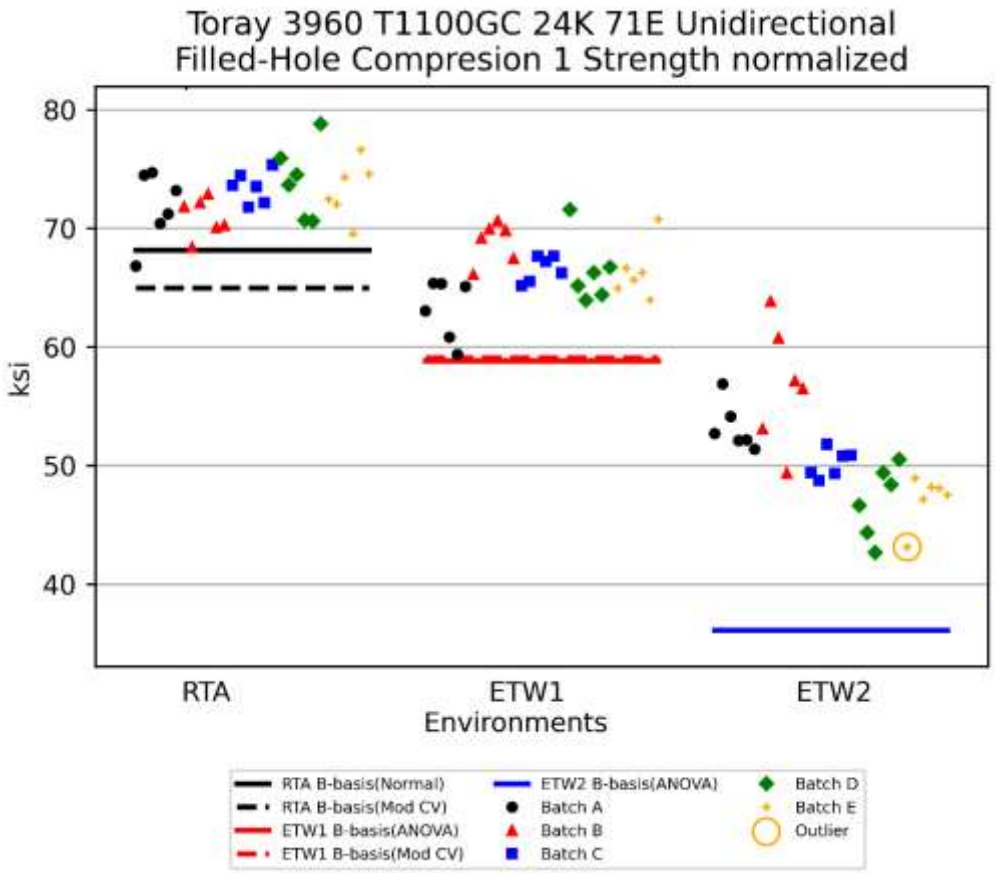

Figure 4-52 Batch Plot for FHC1 strength normalized

Filled-Hole Compresion 1 Basis Values and Statistics			
	Strength as-measured		
Env	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	71.57	65.08	49.90
Stdev	2.695	2.566	4.358
CV	3.766	3.942	8.735
Mod CV	6.000	6.000	8.735
Min	66.39	58.03	42.29
Max	77.75	70.62	61.97
No. Batches	5	5	5
No. Spec.	30	30	30
Basis Values and Estimates			
B-Basis	64.59	58.70	36.69
A-Estimate	59.71	54.23	27.54
Method	ANOVA	ANOVA	ANOVA
Modified CV Basis Values and Estimates			
B-Basis	64.67	58.18	NA
A-Estimate	59.82	53.33	
Method	Pooled	Pooled	

Table 4-65 Statistics and Basis Values for FHC1 Strength as-measured

Filled-Hole Compresion 1 Basis Values and Statistics			
	Strength normalized [ksi]		
Env	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	72.69	66.26	50.87
Stdev	2.543	2.743	4.724
CV	3.498	4.139	9.287
Mod CV	6.000	6.070	9.287
Min	66.81	59.37	42.66
Max	78.81	71.56	63.83
No. Batches	5	5	5
No. Spec.	30	30	30
Basis Values and Estimates			
B-Basis	68.18	58.84	36.10
A-Estimate	64.91	53.66	25.89
Method	Normal	ANOVA	ANOVA
Modified CV Basis Values and Estimates			
B-Basis	65.64	59.21	NA
A-Estimate	60.68	54.25	
Method	Pooled	Pooled	

Table 4-66 Statistics and Basis Values for FHC1 Strength normalized

4.26 “10/80/10” Filled-Hole Compression 2 (FHC2)

Filled-Hole Compression 2 (FHC2) tests were performed at three different environmental conditions RTA, ETW1, ETW2 and for two material properties Strength as-measured and Strength normalized. The FHC2 properties are fiber dominated, so the data is normalized.

With respect to computing allowables for Strength as-measured property with original CV data, conditions ETW1 and ETW2 failed ADK test, so ANOVA method was used. Since the conditions have 5 batches and less than 55 specimens, the ANOVA method produces B-basis values and A-estimates values. Condition RTA passed ADK but failed normality test, so Weibull method was used. For modified CV data, pooling RTA and ETW1was acceptable, while ETW2 failed ADK test, so allowables are not available (NA) for this one.

For Strength normalized property using original CV dataset, ETW1 and ETW2 conditions failed ADK test, so ANOVA method was used. Since the conditions have 5 batches and less than 55 specimens, the ANOVA method produces B-basis values and A-estimates values. Condition RTA passed normality test, so normal method was used. For modified CV data, pooling RTA and ETW1was acceptable, while ETW2 failed ADK test, so allowables are not available (NA) for this one.

One statistical outlier was detected for both properties Strength as-measured and Strength normalized. A low batch outlier in batch B and condition ETW2.

Statistics, estimates and basis values are given for the strength as-measured data in Table 4-67 and for the strength normalized data in Table 4-68. The data, B-estimates and B-basis values are shown graphically for the strength as-measured in Figure 4-53 and for strength normalized in Figure 4-54.

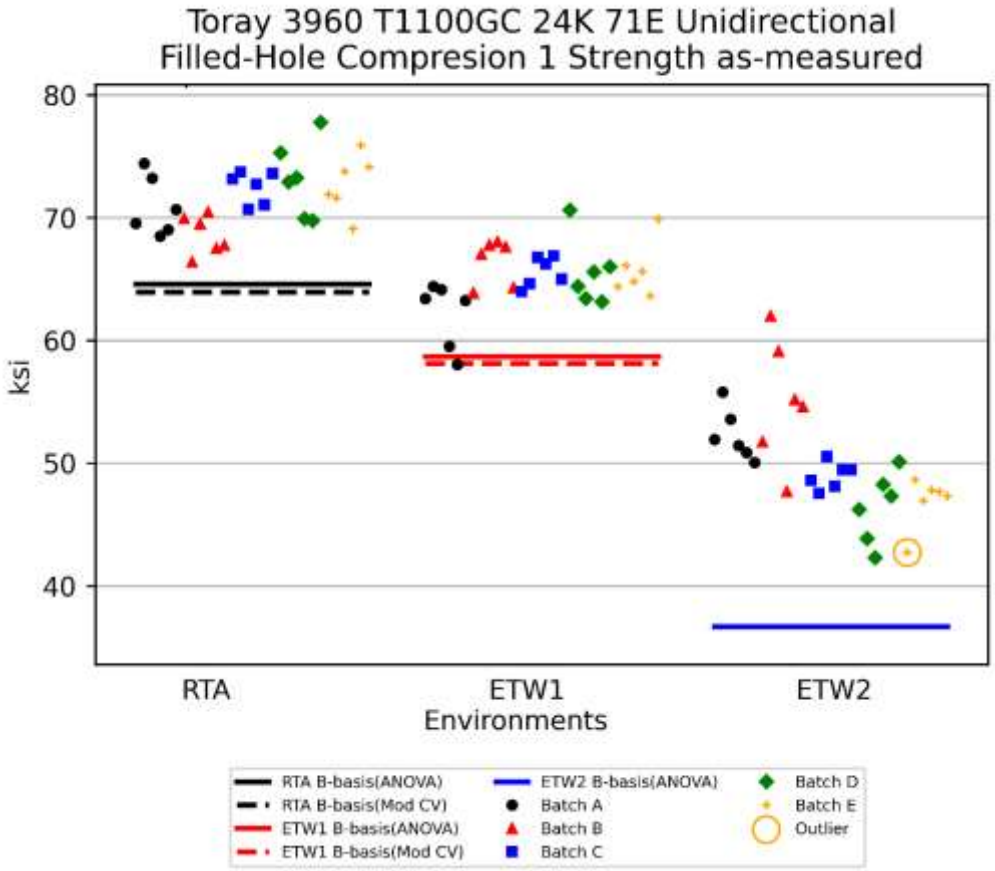

Figure 4-53 Batch Plot for FHC2 strength as-measured

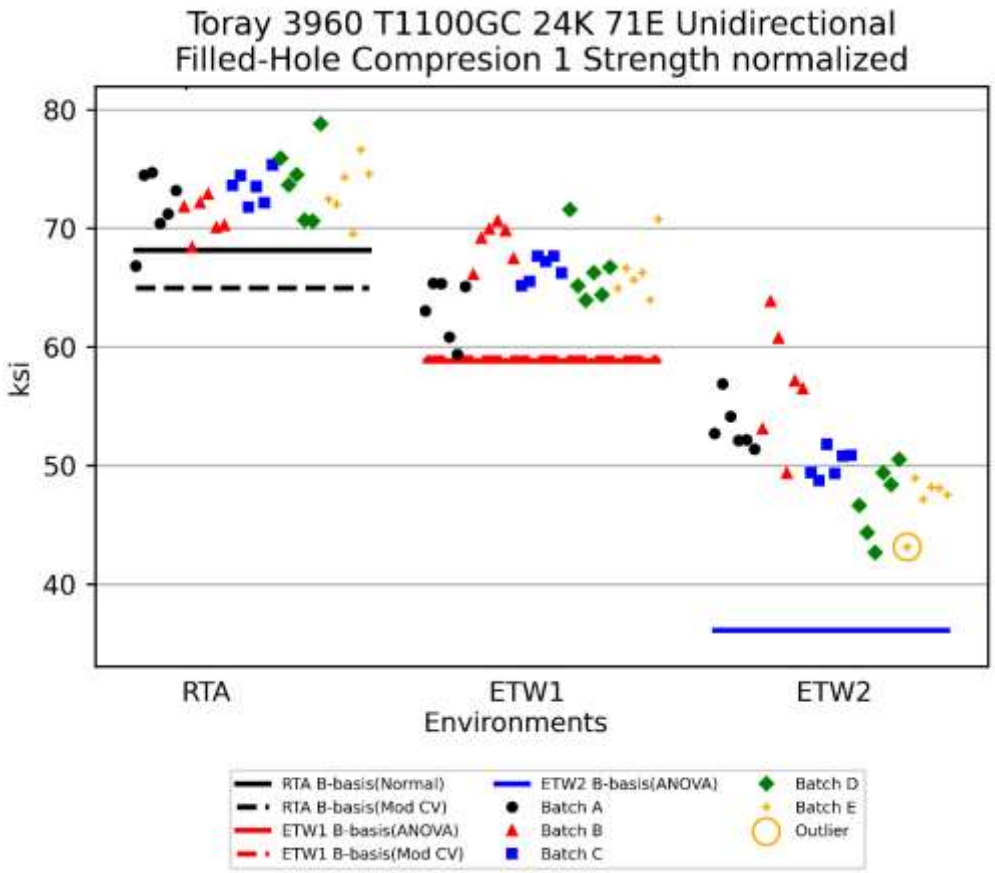

Figure 4-54 Batch Plot for FHC2 strength normalized

Filled-Hole Compresion 2 Basis Values and Statistics			
	Strength as-measured [ksi]		
Env	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	57.47	48.08	37.18
Stdev	1.620	1.534	3.821
CV %	2.818	3.190	10.28
Mod CV %	6.000	6.000	10.28
Min	53.15	44.95	32.82
Max	59.68	51.44	45.98
No. Batches	5	5	5
No. Spec.	30	30	30
Basis Values and Estimates			
B-Basis	54.49	44.16	24.07
A-Estimate	51.12	41.42	15.05
Method	Weibull	ANOVA	ANOVA
Modified CV Basis Values and Estimates			
B-Basis	52.13	42.74	NA
A-Estimate	48.37	38.98	
Method	Pooled	Pooled	

Table 4-67 Statistics and Basis Values for FHC2 Strength as-measured

Filled-Hole Compresion 2 Basis Values and Statistics			
	Strength normalized [ksi]		
Env	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	58.40	48.86	37.77
Stdev	1.644	1.547	3.889
CV %	2.815	3.166	10.30
Mod CV %	6.000	6.000	10.30
Min	54.46	45.31	33.02
Max	60.84	52.49	46.87
No. Batches	5	5	5
No. Spec.	30	30	30
Basis Values and Estimates			
B-Basis	55.48	44.80	24.31
A-Estimate	53.37	41.96	15.06
Method	Normal	ANOVA	ANOVA
Modified CV Basis Values and Estimates			
B-Basis	52.97	43.43	NA
A-Estimate	49.15	39.61	
Method	Pooled	Pooled	

Table 4-68 Statistics and Basis Values for FHC2 Strength normalized

4.27 “50/40/10” Filled-Hole Compression 3 (FHC3)

Filled-Hole Compression 3 (FHC3) tests were performed at three different environmental conditions RTA, ETW1, ETW2 and for two material properties Strength as-measured and Strength normalized. The FHC3 properties are fiber dominated, so the data is normalized.

With respect to computing allowables for Strength as-measured property with original CV data, conditions ETW2 failed ADK test, so ANOVA method was used. Since the condition has 5 batches and less than 55 specimens, the ANOVA method produces B-basis values and A-estimates values. Pooling RTA and ETW1 was acceptable. For modified CV data, pooling RTA and ETW1was acceptable, while ETW2 failed ADK test, so allowables are not available (NA) for this one.

For Strength normalized property the results are identical to those of the as-measured dataset.

No statistical outliers were detected.

Statistics, estimates and basis values are given for the strength as-measured data in Table 4-69 and for the strength normalized data in Table 4-70. The data, B-estimates and B-basis values are shown graphically for the strength as-measured in Figure 4-55 and for strength normalized in Figure 4-56.

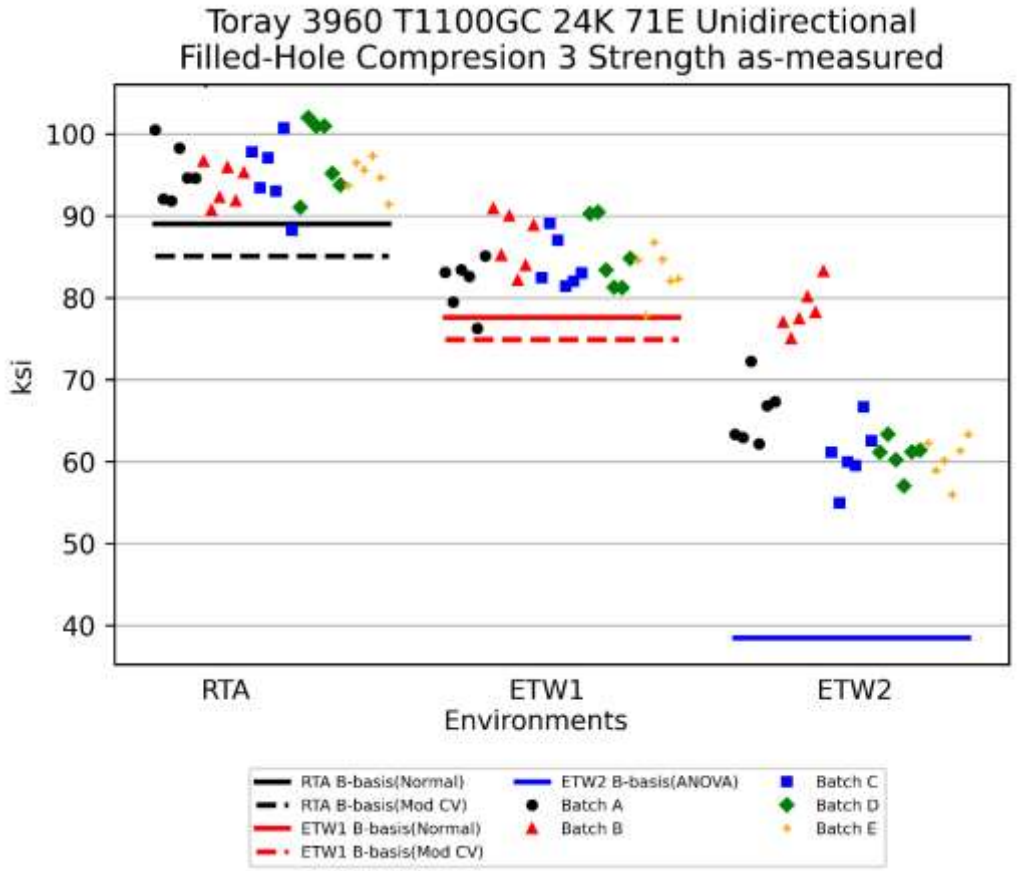

Figure 4-55 Batch Plot for FHC3 strength as-measured

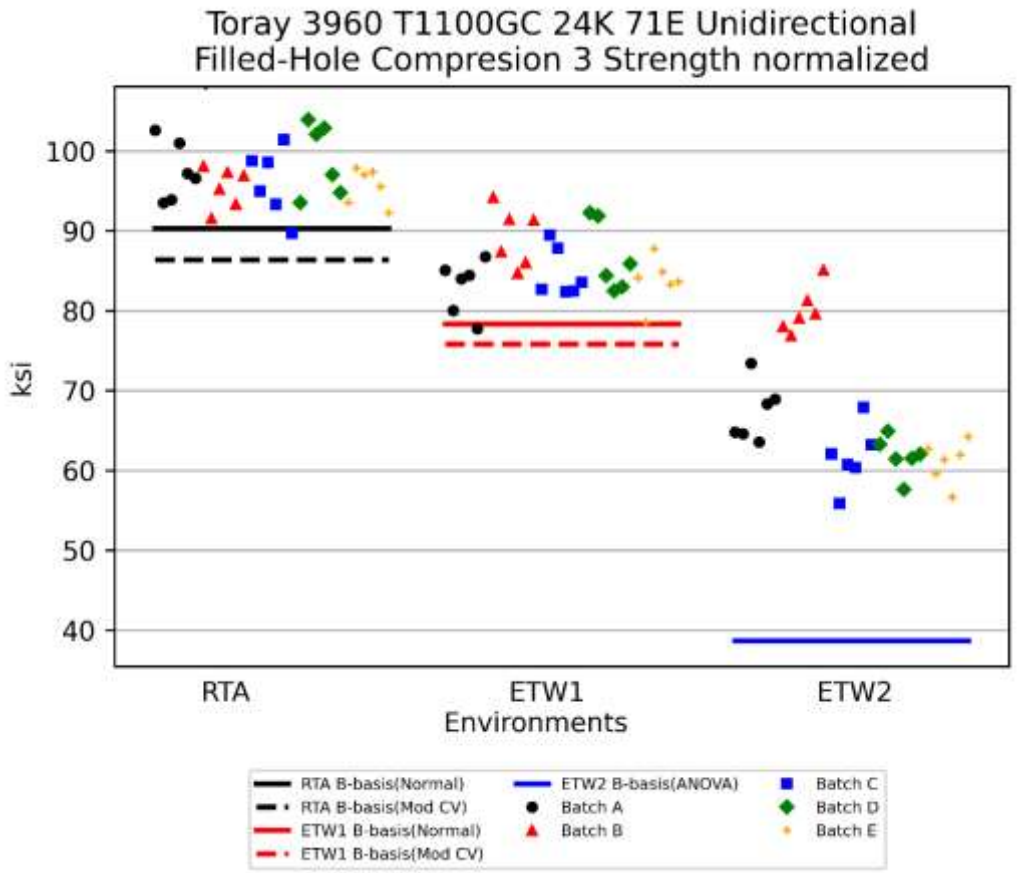

Figure 4-56 Batch Plot for FHC3 strength normalized

Filled-Hole Compresion 3 Basis Values and Statistics			
	Strength as-measured [ksi]		
Env	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	95.27	84.18	65.23
Stdev	3.494	3.691	7.630
CV %	3.668	4.385	11.70
Mod CV %	6.000	6.192	11.70
Min	88.27	76.27	54.97
Max	102.0	90.90	83.24
No. Batches	5	5	5
No. Spec.	30	30	30
Basis Values and Estimates			
B-Basis	89.23	78.14	38.46
A-Estimate	84.98	73.89	20.07
Method	Pooled	Pooled	ANOVA
Modified CV Basis Values and Estimates			
B-Basis	86.07	74.99	NA
A-Estimate	79.61	68.52	
Method	Pooled	Pooled	

Table 4-69 Statistics and Basis Values for FHC3 Strength as-measured

Filled-Hole Compresion 3 Basis Values and Statistics			
	Strength normalized [ksi]		
Env	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	96.72	85.45	66.36
Stdev	3.592	3.991	7.869
CV %	3.714	4.671	11.86
Mod CV %	6.000	6.335	11.86
Min	89.68	77.75	55.87
Max	103.9	94.18	85.09
No. Batches	5	5	5
No. Spec.	30	30	30
Basis Values and Estimates			
B-Basis	90.34	79.06	38.70
A-Estimate	85.85	74.58	19.71
Method	Pooled	Pooled	ANOVA
Modified CV Basis Values and Estimates			
B-Basis	87.29	76.01	NA
A-Estimate	80.66	69.38	
Method	Pooled	Pooled	

Table 4-70 Statistics and Basis Values for FHC3 Strength normalized

4.28 “25/50/25” Single-Shear Bearing 1 (SSB1)

Single-Shear Bearing 1 (SSB1) tests were performed at three different environmental conditions RTA, ETW1, ETW2 and for the following properties: 2% offset strength and initial peak strength. The SSB1 properties are fiber dominated, so the data is normalized.

With respect to computing allowables for 2% Offset Strength as-measured property with original CV data, conditions ETW1 and ETW2 failed ADK test, so ANOVA method was used. Since the conditions have 5 batches and less than 55 specimens, the ANOVA method produces B-basis values and A-estimates values. Condition RTA passed ADK test and normality test, so normal method was used. For modified CV data, RTA and ETW2 passed normality test, so normal method was used, while ETW1 failed ADK test, so allowables are not available (NA) for this case.

For initial peak strength as-measured property using original CV dataset, RTA and ETW1 were pooled, and the normal method was used for ETW2. For the modified CV data, the normal method was used for all conditions.

For 2% Offset Strength normalized property with original CV dataset, all conditions passed ADK test but ETW2 passed Weibull distribution test before normality test, so RTA and ETW1 use normal method and ETW2 uses Weibull method. For modified CV data, all conditions were pooled.

For initial peak Strength normalized property using original CV dataset, RTA and ETW1were pooled and the normal method was used for ETW2. For modified CV data, the normal method was used for all conditions.

There were two statistical outliers. The highest normalized value in batch C of the ETW1 for the initial peak strength dataset was an outlier for the batch but not for the condition. It was also an outlier in the initial peak strength as-measured dataset. The lowest as-measured value in batch A of the ETW1 condition for 2% offset strength dataset was an outlier for the batch but not for the condition. It was only an outlier in the as-measured dataset. They were retained for this analysis.

Statistics, estimates, and basis values are given for the as-measured data in Table 4-71 and for the normalized data in Table 4-72. The data, B-estimates and B-basis values are shown graphically for the 2% Offset Strength normalized in Figure 4-57 and for initial peak Strength normalized in Figure 4-58.

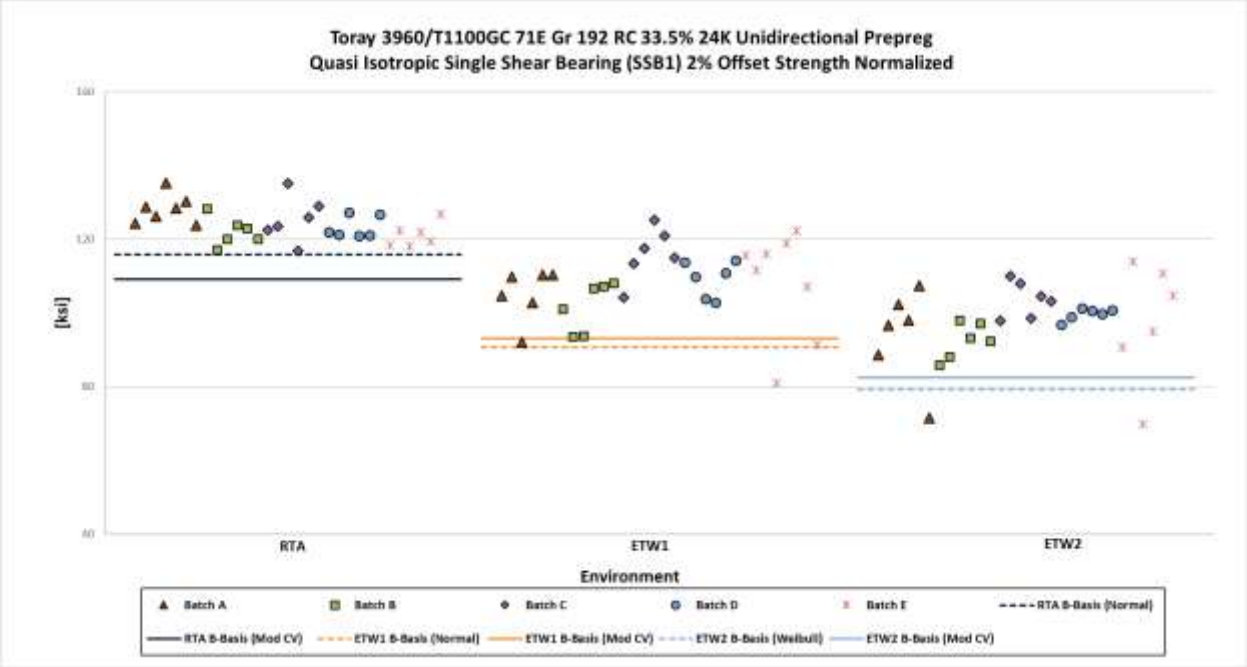

Figure 4-57 Batch Plot for SSB1 2% Offset Strength normalized

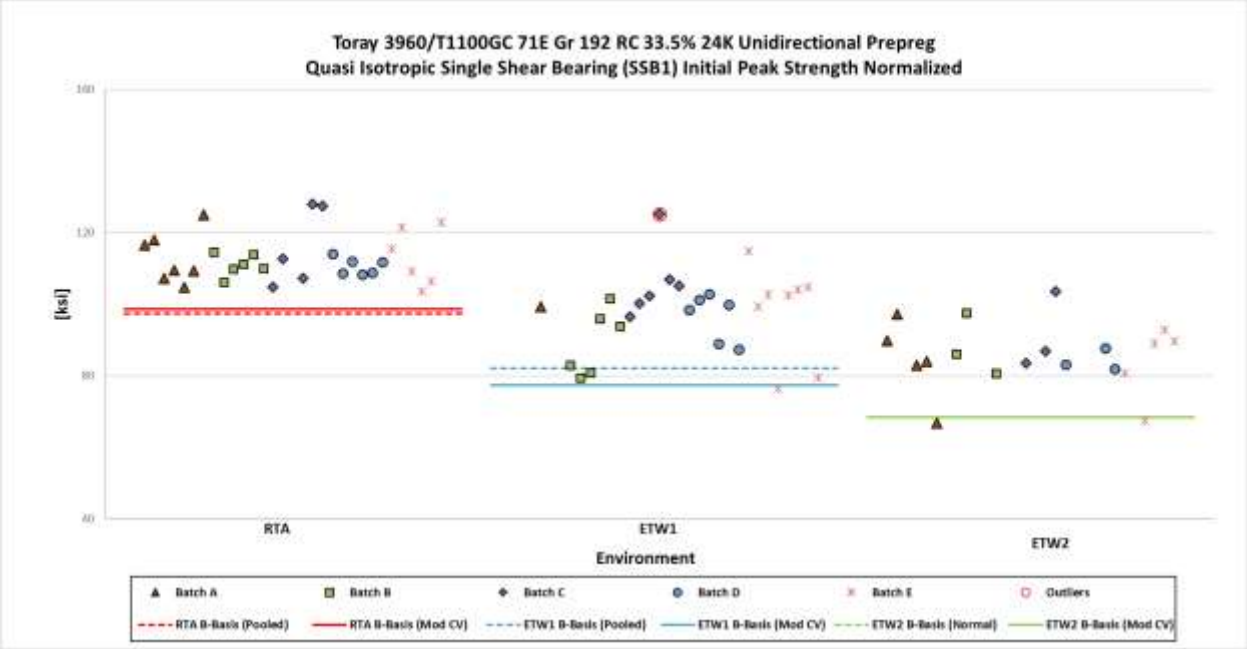

Figure 4-58 Batch Plot for SSB1 Initial Peak Strength normalized

As Measured Single Shear Bearing 1 (SSB1) Strength Basis Values and Statistics						
Property	2% Offset Strength			Initial Peak Strength		
Environment	RTA	ETW1	ETW2	RTA	ETW1	ETW2
Mean	122.6	106.6	96.19	111.3	96.40	84.70
Stdev	4.507	10.06	9.958	6.708	11.45	8.869
CV	3.677	9.438	10.35	6.029	11.88	10.47
Mod CV	6.000	9.438	10.35	7.015	11.88	10.47
Min	115.6	80.37	69.01	102.8	75.88	65.91
Max	133.2	125.4	112.7	127.4	125.4	101.9
No. Batches	5	5	5	5	5	5
No. Spec.	31	32	30	30	27	19
Basis Values and Estimates						
B-Basis Value	114.6	84.02	76.51	95.63	80.66	67.41
A-Estimate	108.9	68.01	62.42	84.63	69.69	55.14
Method	Normal	ANOVA	ANOVA	Pooled	Pooled	Normal
Modified CV Basis Values and Estimates						
B-Basis Values	109.6	NA	78.50	97.39	75.67	67.41
A-Estimate	100.2		65.70	87.36	60.72	55.15
Method	Normal		Normal	Normal	Normal	Normal

Table 4-71 Statistics and Basis Values for SSB1 properties as-measured

Normalized Single Shear Bearing 1 (SSB1) Strength Basis Values and Statistics						
Property	2% Offset Strength			Initial Peak Strength		
Environment	RTA	ETW1	ETW2	RTA	ETW1	ETW2
Mean	124.1	108.0	97.49	112.6	97.49	85.87
Stdev	4.721	9.833	9.901	6.667	11.16	9.013
CV	3.803	9.104	10.16	5.920	11.45	10.50
Mod CV	6.000	9.104	10.16	6.960	11.45	10.50
Min	116.9	80.93	69.85	103.6	76.41	66.77
Max	135.3	125.2	113.9	127.9	125.2	103.6
No. Batches	5	5	5	5	5	5
No. Spec.	31	32	30	30	27	19
Basis Values and Estimates						
B-Basis Values	115.8	90.72	79.32	97.31	82.06	68.30
A-Estimate	109.8	78.19	62.30	86.53	71.31	55.83
Method	Normal	Normal	Weibull	Pooled	Pooled	Normal
Modified CV Basis Values and Estimates						
B-Basis Values	109.1	93.04	82.46	98.69	77.29	68.30
A-Estimate	98.74	82.63	72.06	88.62	62.73	55.85
Method	Pooled	Pooled	Pooled	Normal	Normal	Normal

Table 4-72 Statistics and Basis Values for SSB1 properties normalized

4.29 “10/80/10” Single-Shear Bearing 2 (SSB2)

Single-Shear Bearing 2 (SSB2) tests were performed at three different environmental conditions RTA, ETW1, ETW2 and for four material properties 2% Offset Strength as-measured, 2% Offset Strength normalized, Initial Peak Strength as-measured and Initial Peak Strength normalized. The SSB2 properties are fiber dominated, so the data is normalized.

With respect to computing allowables for 2% Offset Strength as-measured property with original CV data, all conditions failed the ADK test for batch equivalency, therefore ANOVA was used for all conditions. The three datasets consist of 5 batches and 55 specimens, which results in b-basis values and a-estimates for all conditions. For the modified CV, pooling all conditions was acceptable.

For the 2% offset strength normalized property, the ETW1 condition passed the normality test so the single point normal method was used for ETW1. RTA and ETW2 failed ADK test for batch equivalency, therefore ANOVA was used for those conditions. Both datasets consist of 5 batches and less than 55 specimens, which results in b-basis values and a-estimates for those conditions. For modified CV, pooling all conditions was acceptable.

For initial peak strength as-measured, RTA and ETW2 fail to meet the minimum batch and specimen count required for basis values so only estimates were computed for those conditions. The normal method was used to compute basis values and estimates using non-modified and modified CV. For the initial peak strength normalized datasets, the results are identical to those of the as-measured dataset.

There were three statistical outliers. For the 2% offset strength property, the highest normalized value in batch A of the ETW1 condition was a batch outlier. For the initial peak strength property, the lowest normalized value in batch A of the ETW1 condition was a batch outlier. It was also an outlier in the as-measured dataset. The lowest as-measured value in batch B f the ETW1 condition was a condition outlier. They were retained for this analysis.

Statistics, estimates, and basis values are given for the 2% Offset Strength as-measured data in Table 4-73, 2% Offset Strength normalized data in Table 4-74, and for initial peak strength data in Table 4-75 and Table 4-76. The data, B-estimates and B-basis values are shown graphically for the 2% Offset Strength normalized in Figure 4-59 and for Initial Peak Strength normalized in Figure 4-60.

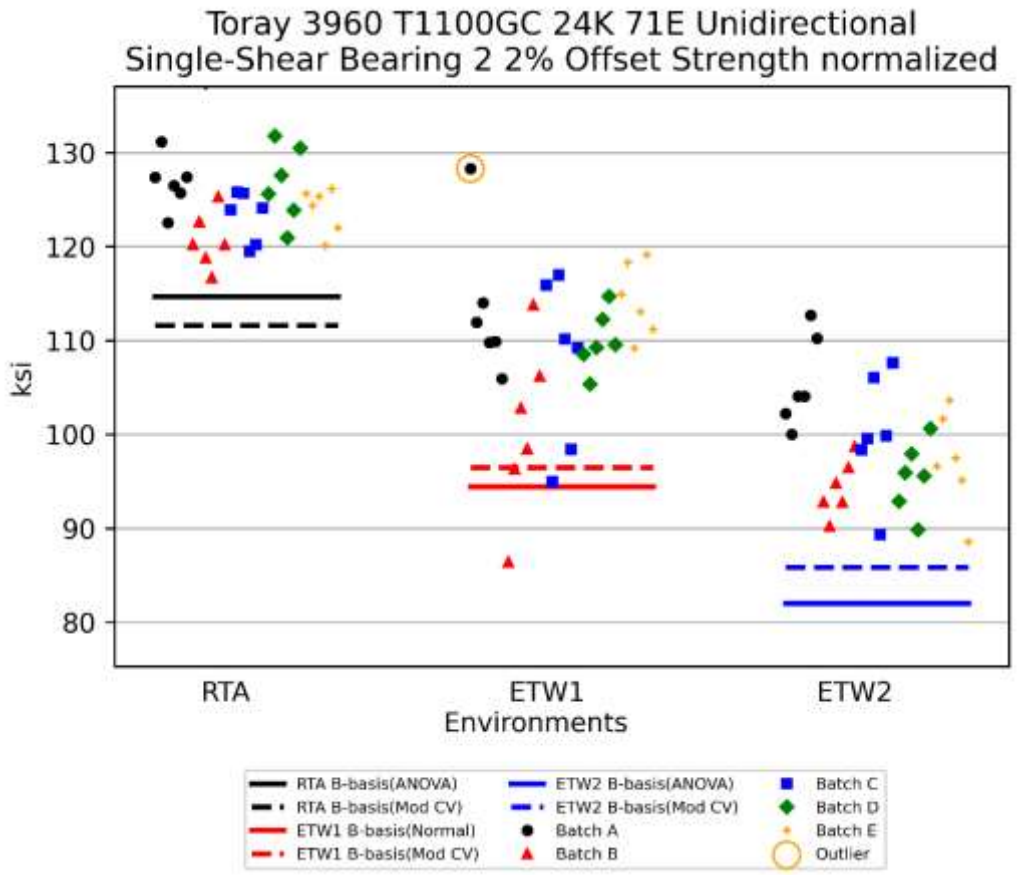

Figure 4-59 Batch Plot for SSB2 2% Offset Strength normalized

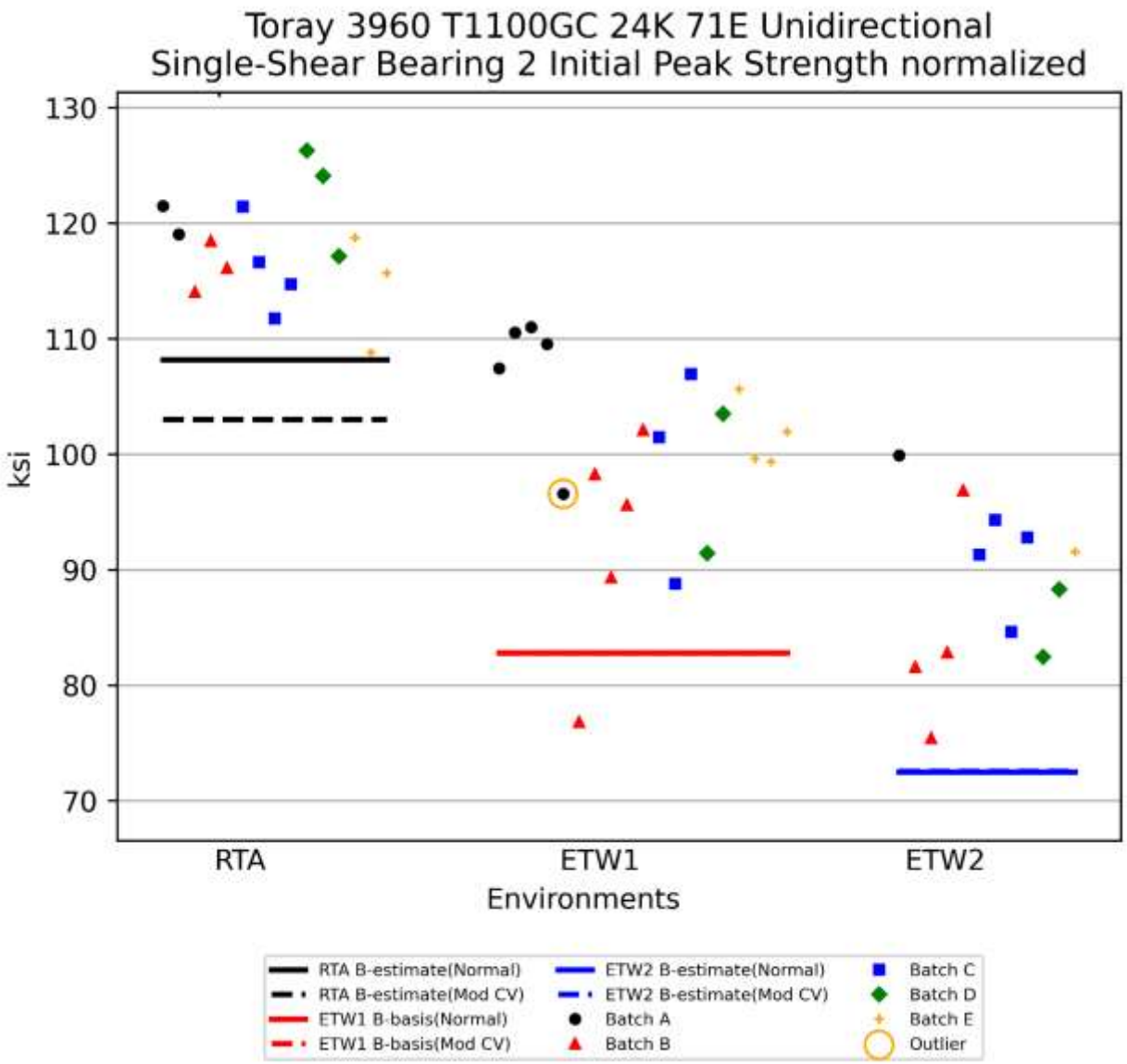

Figure 4-60 Batch Plot for SSB2 Initial Peak Strength Normalized

Single-Shear Bearing 2 Basis Values and Statistics			
	2% Offset Strength as-measured [ksi]		
Env	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	122.4	107.5	97.01
Stdev	3.716	8.192	5.998
CV %	3.037	7.619	6.183
Mod CV %	6.000	7.809	7.091
Min	114.0	84.80	87.35
Max	129.1	125.2	111.0
No. Batches	5	5	5
No. Spec.	30	30	30
Basis Values and Estimates			
B-Basis	112.5	86.57	80.61
A-Estimate	105.5	71.90	69.18
Method	ANOVA	ANOVA	ANOVA
Modified CV Basis Values and Estimates			
B-Basis	109.9	95.05	84.54
A-Estimate	101.3	86.41	75.90
Method	Pooled	Pooled	Pooled

Table 4-73 Statistics and Basis Values for SSB2 2% Offset Strength as-measured

Single-Shear Bearing 2 Basis Values and Statistics			
	2% Offset Strength normalized [ksi]		
Env	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	124.2	109.2	98.52
Stdev	3.680	8.285	6.081
CV %	2.962	7.590	6.172
Mod CV %	6.000	7.795	7.086
Min	116.7	86.40	88.55
Max	131.8	128.3	112.7
No. Batches	5	5	5
No. Spec.	30	30	30
Basis Values and Estimates			
B-Basis	114.7	94.44	82.02
A-Estimate	108.0	83.79	70.50
Method	ANOVA	Normal	ANOVA
Modified CV Basis Values and Estimates			
B-Basis	111.6	96.51	85.87
A-Estimate	102.8	87.75	77.11
Method	Pooled	Pooled	Pooled

Table 4-74 Statistics and Basis Values for SSB2 2% Offset Strength normalized

Single-Shear Bearing 2 Basis Values and Statistics			
	Initial Peak Strength as-measured [ksi]		
Env	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	116.0	98.04	87.14
Stdev	4.722	8.368	7.415
CV	4.072	8.535	8.509
Mod CV	6.036	8.535	8.509
Min	107.3	75.40	73.24
Max	124.6	108.0	98.64
No. Batches	5	5	5
No. Spec.	15	19	12
Basis Values and Estimates			
B-Basis		81.74	
B-Estimate	106.2		70.71
A-Estimate	99.31	70.16	59.21
Method	Normal	Normal	Normal
Modified CV Basis Values and Estimates			
B-Basis		81.73	
B-Estimate	101.5		70.75
A-Estimate	91.33	70.17	59.35
Method	Normal	Normal	Normal

Table 4-75 Statistics and Basis Values for SSB2 Initial Peak Strength as-measured

Single-Shear Bearing 2 Basis Values and Statistics			
	Initial Peak Strength normalized [ksi]		
Env	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	117.6	99.78	88.49
Stdev	4.564	8.705	7.215
CV	3.881	8.725	8.153
Mod CV	6.000	8.725	8.153
Min	108.8	76.82	75.42
Max	126.3	111.0	99.91
No. Batches	5	5	5
No. Spec.	15	19	12
Basis Values and Estimates			
B-Basis		82.81	
B-Estimate	108.2		72.50
A-Estimate	101.5	70.76	61.31
Method	Normal	Normal	Normal
Modified CV Basis Values and Estimates			
B-Basis		82.81	
B-Estimate	103.0		72.54
A-Basis			
A-Estimate	92.77	70.78	61.45
Method	Normal	Normal	Normal

Table 4-76 Statistics and Basis Values for SSB2 Initial Peak Strength normalized

4.30 “50/40/10” Single-Shear Bearing 3 (SSB3)

Single-Shear Bearing 3 (SSB3) tests were performed at three different environmental conditions RTA, ETW1, ETW2 and for four material properties 2% Offset Strength as-measured, 2% Offset Strength normalized, Initial Peak Strength as-measured and Initial Peak Strength normalized. The SSB3 properties are fiber dominated, so the data is normalized.

With respect to computing allowables for 2% Offset Strength as-measured property with original CV data, all three conditions failed ADK test, so ANOVA method was used. Since each condition has 5 batches and less than 55 specimens, the ANOVA method produces B-basis and A-estimates values. For modified CV data, RTA and ETW2 passed normality test, so normal method was used, while ETW1 failed ADK test, so allowables are not available (NA) in this case.

For 2% Offset Strength normalized property with original CV dataset, all conditions failed ADK test, so ANOVA method was used. Since each condition has 5 batches and less than 55 specimens, the ANOVA method produces B-basis and A-estimate values. For modified CV data, pooling all conditions was acceptable.

For the initial peak strength property none of the conditions meets the requirement of number of batch and specimens to compute basis values, therefore only estimates are provided. For both the as-measured and normalized dataset, the normal method was used using the non-modified CV and the modified CV.

There were two statistical outliers. For the 2% offset strength property, the highest as-measured value in batch E of the ETW2 condition was a batch outlier. For the initial peak strength dataset, the lowest normalized value in batch B of the ETW1 condition was a condition outlier, it was also found in the as-measured dataset. The were retained for this analysis.

Statistics, estimates and basis values are given for the 2% Offset Strength as-measured data in Table 4-77, 2% Offset Strength normalized data in Table 4-78, and for initial peak strength in Table 4-79 and Table 4-80. The data, B-estimates and B-basis values are shown graphically for the 2% Offset Strength normalized in Figure 4-61 and for Initial Peak Strength normalized in Figure 4-62.

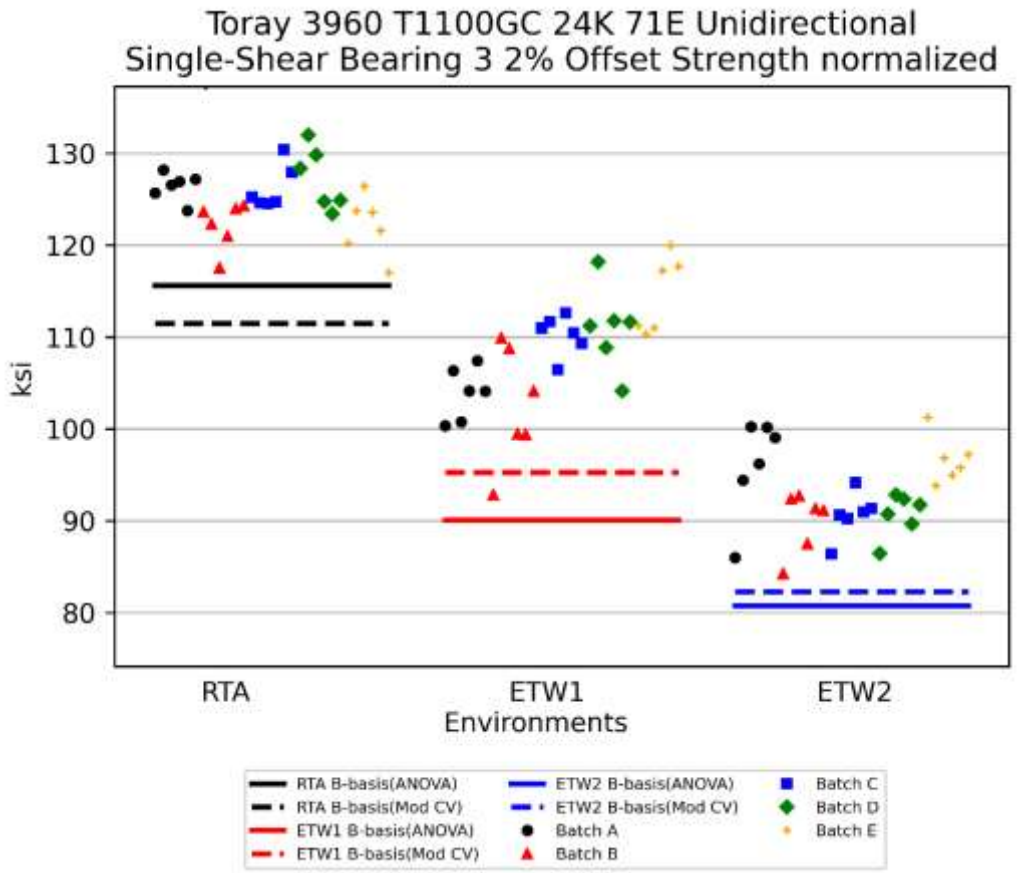

Figure 4-61 Batch Plot for SSB3 2% Offset Strength normalized

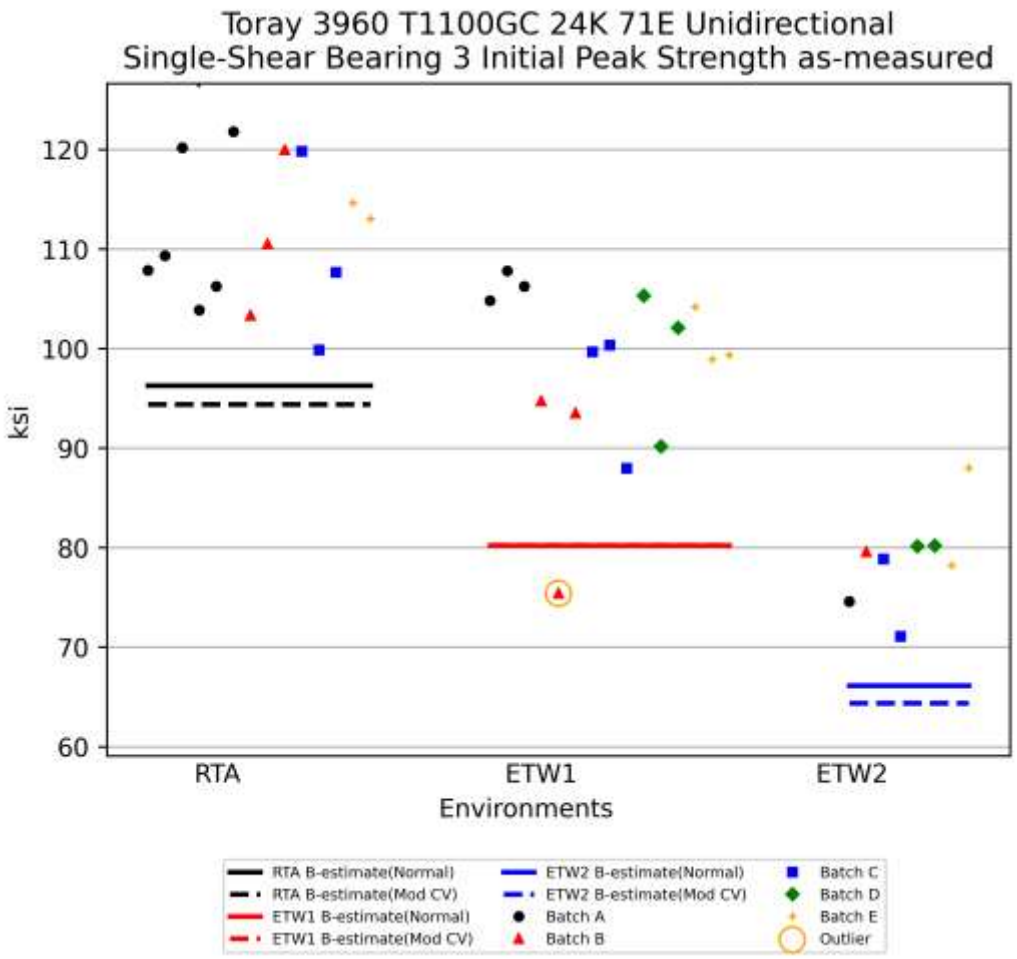

Figure 4-62 Batch Plot for SSB3 Initial Peak Strength normalized

Single-Shear Bearing 3 Basis Values and Statistics			
	2% Offset Strength as-measured [ksi]		
Env	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	123.1	107.3	91.50
Stdev	3.695	6.333	4.449
CV	3.002	5.905	4.862
Mod CV	6.000	6.953	6.431
Min	114.8	90.63	82.91
Max	130.2	118.3	100.7
No. Batches	5	5	5
No. Spec.	30	30	30
Basis Values and Estimates			
B-Basis	112.9	88.23	78.74
A-Estimate	105.7	75.05	69.87
Method	ANOVA	ANOVA	ANOVA
Modified CV Basis Values and Estimates			
B-Basis	110.0	NA	81.05
A-Estimate	100.5		73.48
Method	Normal		Normal

Table 4-77 Statistics and Basis Values for SSB3 2% Offset Strength as-measured

Single-Shear Bearing 3 Basis Values and Statistics			
	2% Offset Strength normalized [ksi]		
Env	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	124.8	108.4	92.76
Stdev	3.390	6.138	4.366
CV %	2.717	5.663	4.707
Mod CV %	6.000	6.831	6.354
Min	117.0	92.82	84.24
Max	132.0	120.0	101.3
No. Batches	5	5	5
No. Spec.	30	30	30
Basis Values and Estimates			
B-Basis	115.6	90.09	80.76
A-Estimate	109.2	77.41	72.40
Method	ANOVA	ANOVA	ANOVA
Modified CV Basis Values and Estimates			
B-Basis	113.3	96.91	81.27
A-Estimate	105.3	88.96	73.32
Method	Pooled	Pooled	Pooled

Table 4-78 Statistics and Basis Values for SSB3 2% Offset Strength normalized

Single-Shear Bearing 3 Basis Values and Statistics			
	Initial Peak Strength as-measured [ksi]		
Env	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	111.3	98.03	78.82
Stdev	7.099	8.593	4.880
CV	6.379	8.766	6.191
Mod CV	7.189	8.766	7.095
Min	99.85	75.40	71.07
Max	121.8	107.8	87.99
No. Batches	4	5	5
No. Spec.	14	15	8
Basis Values and Estimates			
B-Estimate	96.30	80.24	66.14
A-Estimate	85.76	67.71	57.26
Method	Normal	Normal	Normal
Modified CV Basis Values and Estimates			
B-Estimate	94.41	80.25	64.37
A-Estimate	82.60	67.78	54.45
Method	Normal	Normal	Normal

Table 4-79 Statistics and Basis Values for SSB3 Initial Peak Strength as-measured

Single-Shear Bearing 3 Basis Values and Statistics			
	Initial Peak Strength normalized [ksi]		
Env	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	113.0	99.19	79.89
Stdev	7.645	8.576	4.805
CV	6.766	8.646	6.015
Mod CV	7.383	8.646	7.007
Min	101.3	76.97	71.56
Max	125.5	108.5	88.37
No. Batches	4	5	5
No. Spec.	14	15	8
Basis Values and Estimates			
B-Estimate	96.84	81.43	67.40
A-Estimate	85.50	68.93	58.66
Method	Normal	Normal	Normal
Modified CV Basis Values and Estimates			
B-Estimate	95.39	81.44	65.42
A-Estimate	83.08	68.99	55.49
Method	Normal	Normal	Normal

Table 4-80 Statistics and Basis Values for SSB3 Initial Peak Strength normalized

4.31 “25/50/25” Compression After Impact 1 (CAI1)

Compression After Impact Layup 1 (CAI1) tests were performed at one environmental condition (RTA), for two material properties (Strength as-measured, Strength normalized) and at four different impact energy levels (A,B,C,D).

Impact energy level A corresponds to 500 in.lb/in. Impact energy level B corresponds to 1000 in.lb/in. Impact energy level C corresponds to 1500 in.lb/in. Impact energy level D corresponds to 2000 in.lb/in.

At impact level C there were enough batches to compute B-Basis values and A-Estimates. For both, the normalized and as measured datasets, the normal method was used to compute allowables.

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

Basic statistics for Strength as–measured data are given in Table 4-81 and for Strength normalized data in Table 4-82. The values are shown graphically for the CAI1A normalized in Figure 4-63, for CAI1B normalized in Figure 4-64, for CAI1C normalized in Figure 4-65 and for CAI1D normalized in Figure 4-66.

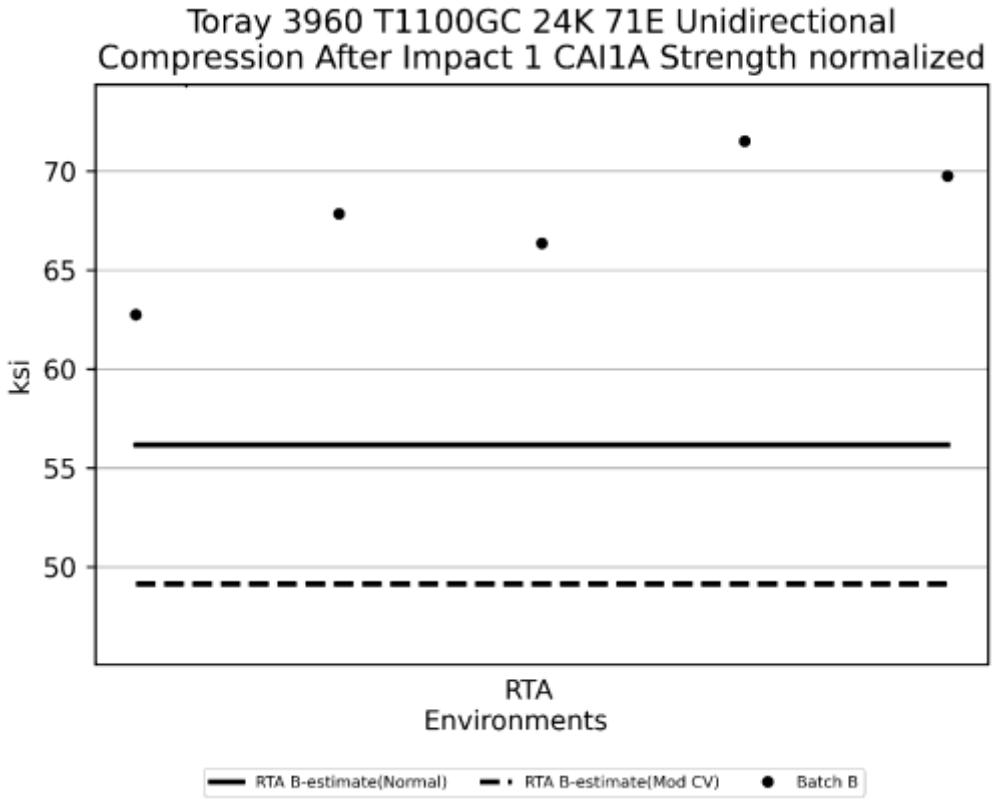

Figure 4-63 Batch Plot for CAI1A Strength normalized

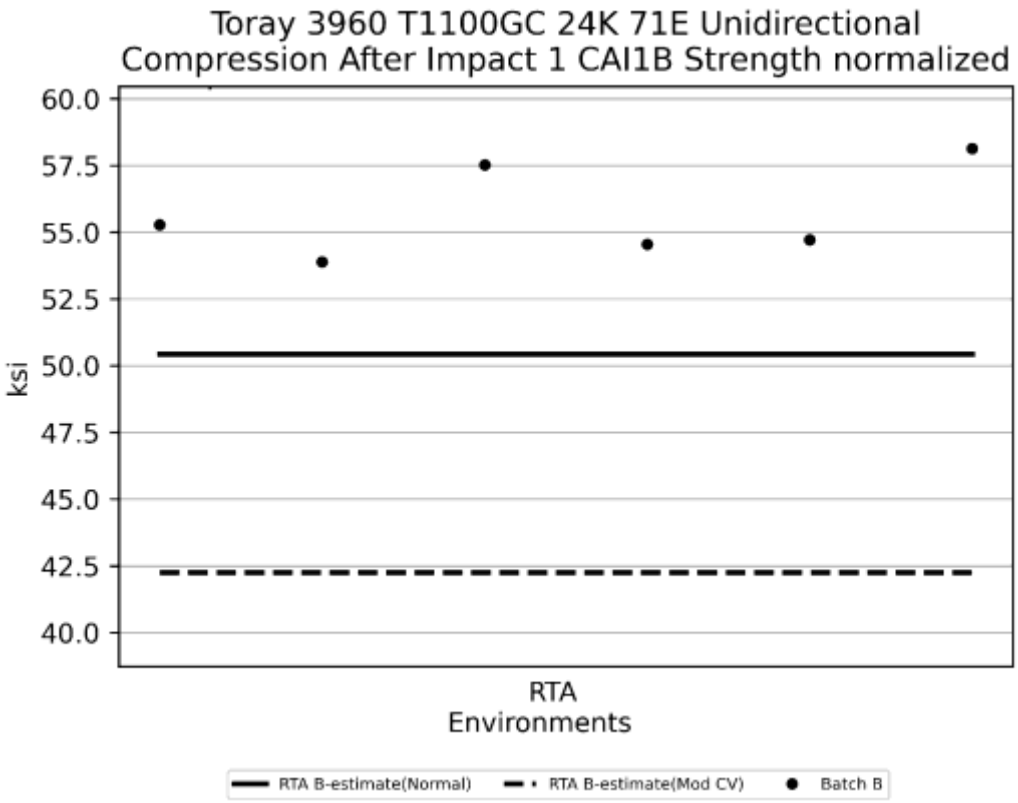

Figure 4-64 Batch Plot for CAI1B Strength normalized

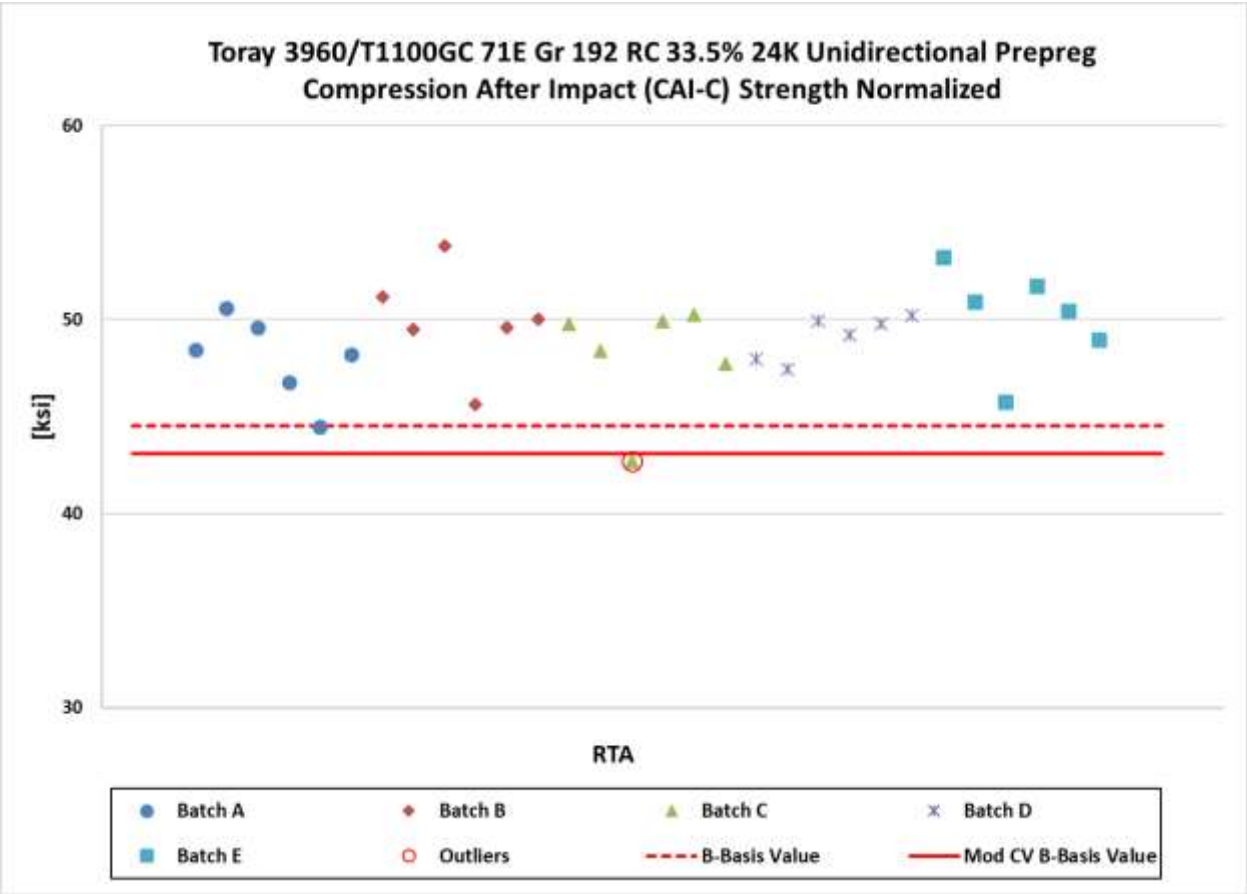

Figure 4-65 Batch Plot for CAI1C Strength normalized

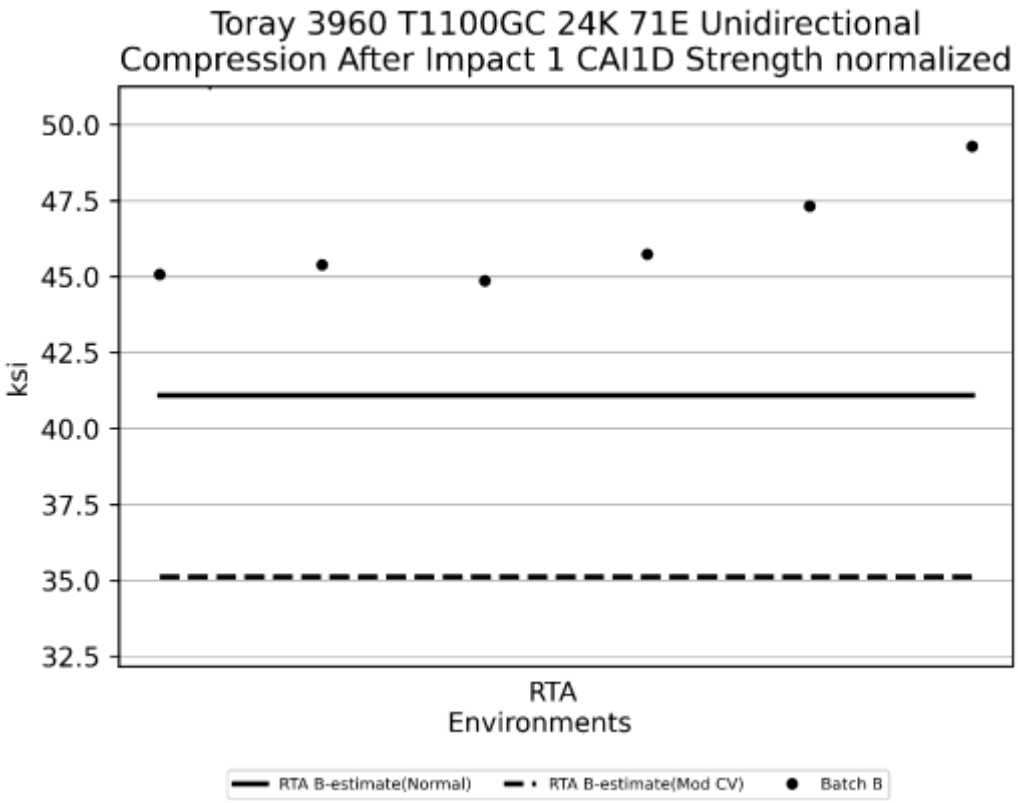

Figure 4-66 Batch Plot for CAI1D Strength normalized

As Measured Compression After Impact (CAI) Strength (ksi) Basis Values and Statistics				
	CAI1A	CAI1B	CAI1C	CAI1D
Environment	RTA			
Mean	66.58	54.80	48.61	45.45
Stdev	3.171	1.731	2.308	1.491
CV	4.763	3.159	4.748	3.280
Mod CV	8.000	8.000	6.374	8.000
Min	61.40	52.70	42.60	43.70
Max	69.90	56.80	53.00	48.00
No. Batches	1	1	5	1
No. Spec.	5	6	30	6
Basis Values and Estimates				
B-Basis Value			44.51	
A-Estimate	55.74	49.56		40.93
A-Estimate	47.87	45.83	41.55	37.72
Method	Normal	Normal	Normal	Normal
Modified CV Basis Values and Estimates				
B-Basis Value			43.11	
B-Estimate	48.37	41.59		34.50
A-Estimate	35.88	32.56	39.13	27.00
Method	Normal	Normal	Normal	Normal

Table 4-81 Statistics for CAI1 Strength as-measured

Normalized Compression After Impact (CAI) Strength (ksi) Basis Values and Statistics				
	CAI1A	CAI1B	CAI1C	CAI1D
Environment	RTA			
Mean	67.64	55.68	49.07	46.28
Stdev	3.359	1.733	2.374	1.713
CV	4.965	3.112	4.837	3.700
Mod CV	8.000	8.000	6.419	8.000
Min	62.75	53.89	42.71	44.86
Max	71.52	58.13	53.82	49.29
No. Batches	1	1	5	1
No. Spec.	5	6	30	6
Basis Values and Estimates				
B-Basis Value			44.85	
B-Estimate	56.16	50.43		41.09
A-Estimate	47.83	46.70	41.80	37.40
Method	Normal	Normal	Normal	Normal
Modified CV Basis Values and Estimates				
B-Basis Value			43.48	
B-Estimate	49.15	42.26	39.43	35.13
A-Estimate	36.45	33.08	39.13	27.49
Method	Normal	Normal	Normal	Normal

Table 4-82 Statistics for CAI1 Strength normalized

4.32 “100/0/0” Interlaminar Tension and Curved Beam Strength (ILT and CBS)

Interlaminar Tension (ILT) and Curved Beam Strength (CBS) tests were performed at four environmental conditions (CTA, RTA, ETW1 and ETW2).

For ILT strength non-modified CV dataset, condition CTA passed normality test so normal method was used. Condition RTA passed ADK test but failed distribution tests, so non-parametric method was used for this. Conditions ETW1 and ETW2 failed ADK test so ANOVA method was used, since each condition has 5 batches and 30 specimens, ANOVA method produces B-Basis values but A-estimates only. For modified CV dataset, conditions CTA & ETW2 passed normality test so normal method was used for these. Conditions RTA & ETW1 failed ADK test so allowables are not available (NA) for these.

For CBS strength non-modified CV dataset, condition CTA passed normality test so normal method was used. Condition RTA passed ADK test but failed distribution tests, so non-parametric method was used for this. Conditions ETW1 and ETW2 failed ADK test so ANOVA method was used, since each condition has 5 batches and 30 specimens, ANOVA method produces B-Basis values but A-estimates only. For modified CV dataset, conditions CTA passed normality test so normal method was used for this. Conditions RTA, ETW1 & ETW2 failed ADK test so allowables are not available (NA) for these.

Three statistical outliers were detected. The lowest value in batch B and condition RTA is a condition outlier for Curved Beam Strength. The lowest value in batch B and condition RTA is a condition outlier for Interlaminar Tension Strength. The lowest value in batch E and condition ETW1 is a batch outlier for Curved Beam Strength.

Basic statistics are given for the ILT data in Table 4-83 and for CBS data in Table 4-84. The values are shown graphically for the ILT in Figure 4-67 and for CBS in Figure 4-68.

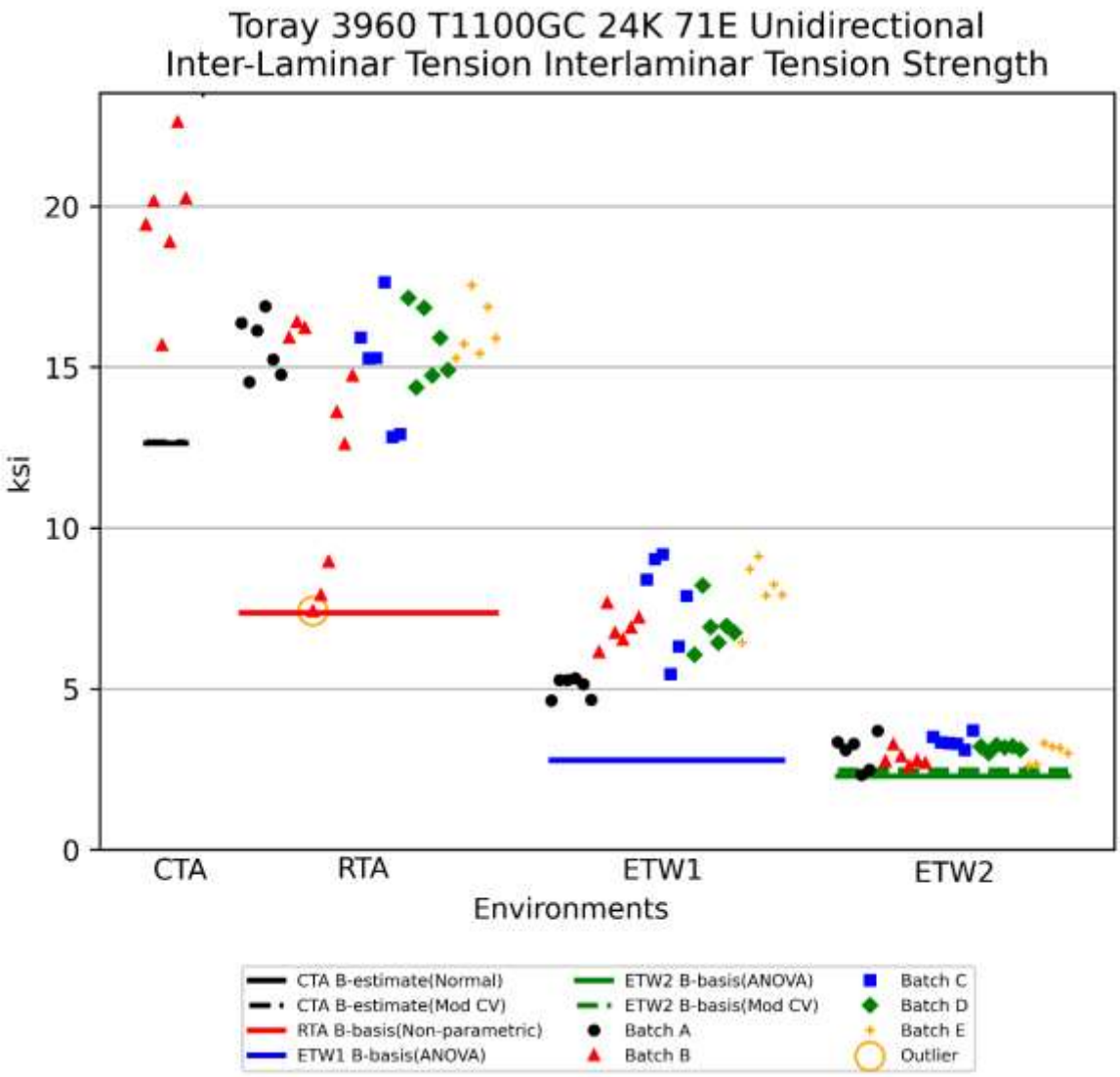

Figure 4-67 Batch Plot for ILT

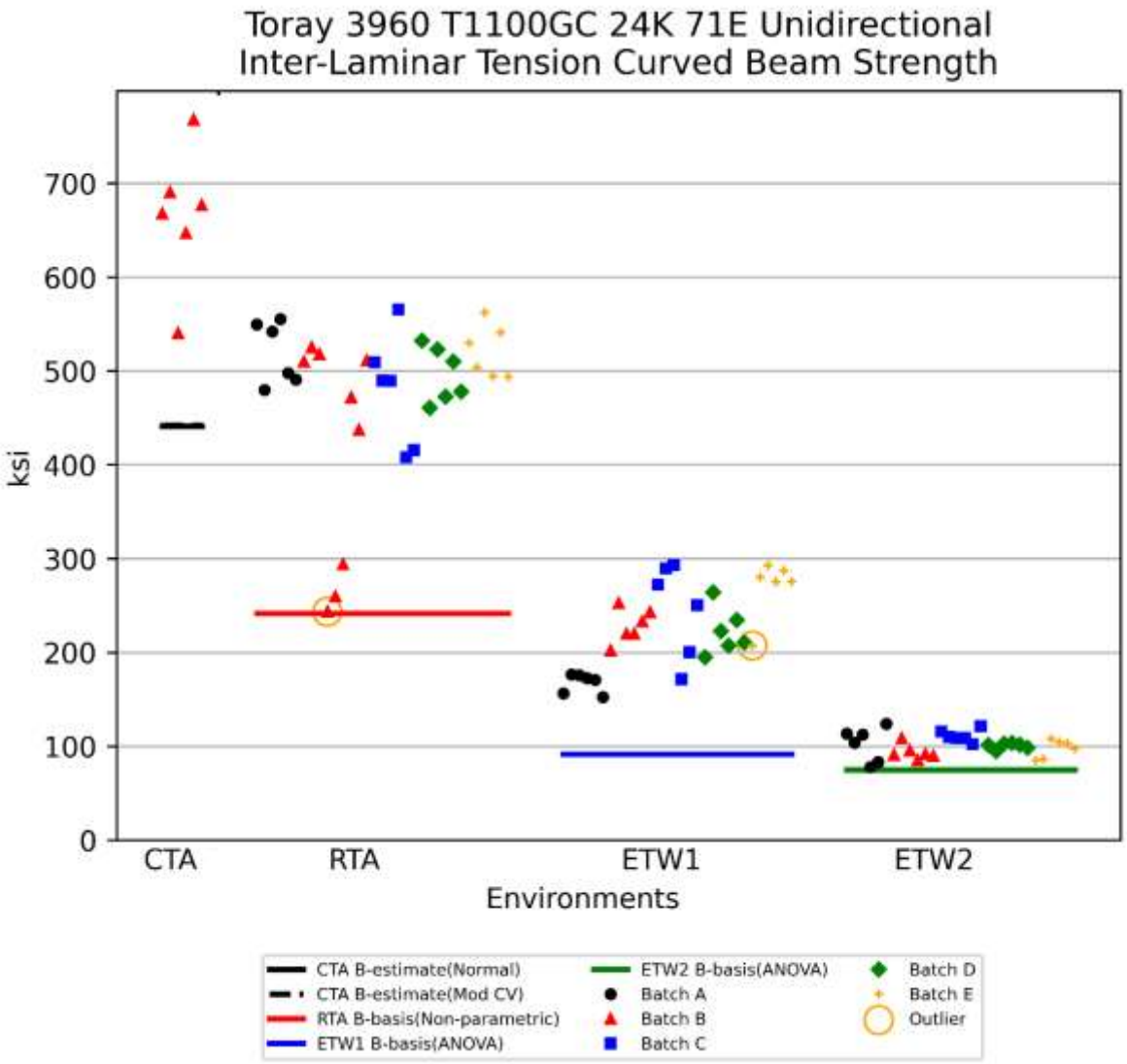

Figure 4-68 Batch Plot for CBS

Inter-Laminar Tension Basis Values and Statistics				
	Interlaminar Tension Strength [ksi]			
Env	CTA(-65°F)	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	19.50	14.79	6.915	3.080
Stdev	2.268	2.498	1.347	0.3409
CV	11.63	16.88	19.49	11.07
Mod CV	11.63	16.88	19.49	11.07
Min	15.68	7.415	4.643	2.326
Max	22.62	17.63	9.175	3.701
No. Batches	1	5	5	5
No. Spec.	6	33	30	30
Basis Values and Estimates				
B-Basis		7.365	2.786	2.295
B-Estimate	12.63			
A-Estimate	7.749	3.192	0.000	1.741
Method	Normal	Non-parametric	ANOVA	ANOVA
Modified CV Basis Values and Estimates				
B-Basis		NA	NA	2.474
B-Estimate	12.67			
A-Estimate	7.996			2.036
Method	Normal			Normal

Table 4-83 Statistics for ILT

Inter-Laminar Tension Basis Values and Statistics				
	Curved Beam Strength [lb]			
Env	CTA(-65°F)	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	665.0	480.7	226.8	100.9
Stdev	73.85	78.80	44.43	11.42
CV	11.11	16.39	19.60	11.31
Mod CV	11.11	16.39	19.60	11.31
Min	540.2	243.4	152.2	77.81
Max	767.9	565.6	293.1	123.9
No. Batches	1	5	5	5
No. Spec.	6	33	30	30
Basis Values and Estimates				
B-Basis		241.7	91.41	75.09
B-Estimate	441.3			
A-Estimate	282.2	107.1	0.00	56.81
Method	Normal	Non-parametric	ANOVA	ANOVA
Modified CV Basis Values and Estimates				
B-Estimate	442.5	NA	NA	NA
A-Estimate	290.3			
Method	Normal			

Table 4-84 Statistics for CBS

4.33 “25/50/25” Double-Shear Bearing (DSB1)

Double-Shear Bearing 1 (DSB1) tests were performed at three different environmental conditions RTA, ETW1, ETW2 and for two material properties 2% Offset Strength as-measured, 2% Offset Strength normalized. The DSB1 properties are fiber dominated, so the data is normalized.

For 2% Offset Strength as-measured property with original CV data, RTA and ETW2 conditions failed ADK test, so ANOVA method was used. Since each condition has 5 batches and less than 55 specimens, the ANOVA method produces B-basis and A-estimates values. Condition ETW1 passed ADK test but failed the distribution-fitting tests, so nonparametric method was used. For modified CV data, RTA passed normality test, so normal method was used, while ETW1 and ETW2 failed ADK test, so allowables are not available (NA) in these cases.

For 2% Offset Strength normalized property with original CV dataset, RTA and ETW2 conditions failed ADK test, so ANOVA method was used. Since each condition has 5 batches and less than 55 specimens, the ANOVA method produces B-basis and A-estimates values. Condition ETW1 passed ADK test but failed the distribution-fitting tests, so nonparametric method was used. For modified CV data, RTA passed normality test, so normal method was used, while ETW1 and ETW2 failed ADK test, so allowables are not available (NA) in these cases.

Two statistical outliers were detected. The lowest normalized value in batch B of the ETW1 conditions was a batch outlier. It was also an outlier in the as-measured dataset. The lowest normalized value in batch C of the ETW2 condition, was a condition outlier. It was also an outlier in the as-measured dataset. Thet were retained for this analysis.

Statistics, estimates and basis values are given for the 2% Offset Strength as-measured data in Table 4-85 and 2% Offset Strength normalized data in Table 4-86. The data, B-estimates and B-basis values are shown graphically for the 2% Offset Strength normalized in Figure 4-69.

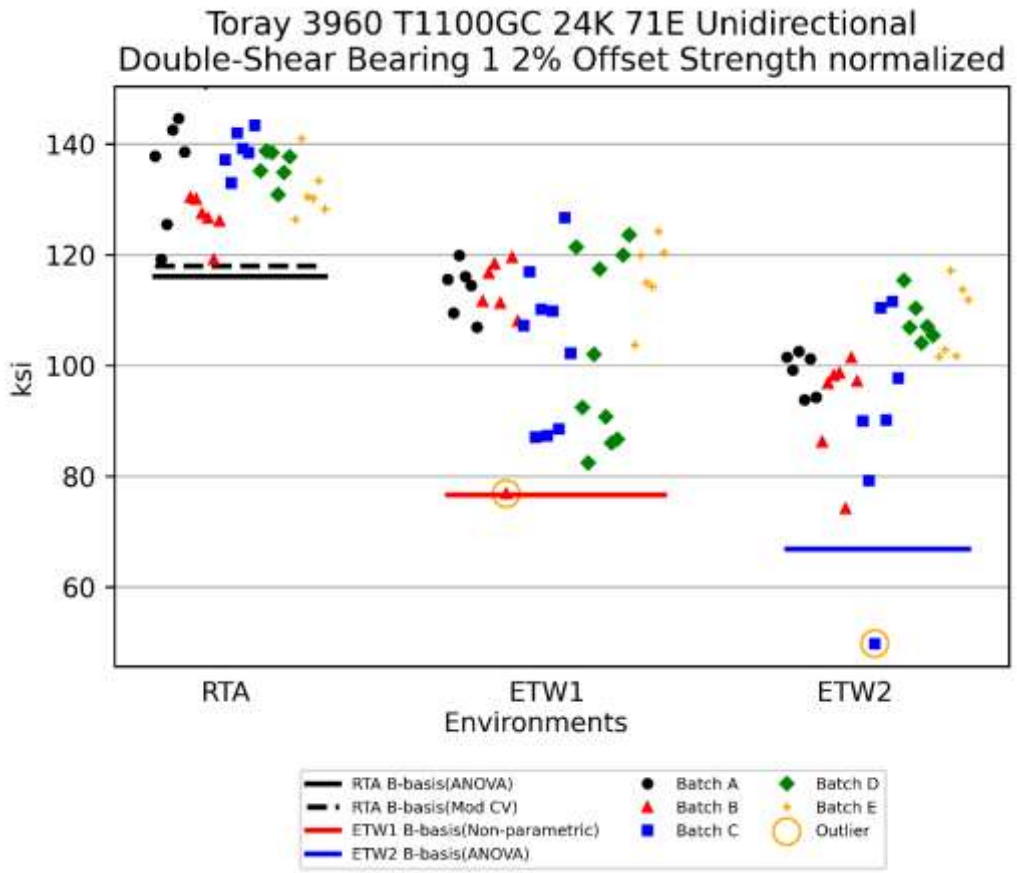

Figure 4-69 Batch Plot for DSB1 2% Offset Strength normalized

Double-Shear Bearing 1 Basis Values and Statistics			
	2% Offset Strength as-measured [ksi]		
Env	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	131.7	106.2	97.83
Stdev	7.479	13.22	13.14
CV	5.678	12.45	13.43
Mod CV	6.839	12.45	13.43
Min	116.4	75.02	49.20
Max	143.2	126.4	115.8
No. Batches	5	5	5
No. Spec.	30	38	32
Basis Values and Estimates			
B-Basis	111.0	74.79	65.67
A-Estimate	96.63	48.11	43.06
Method	ANOVA	Non-parametric	ANOVA
Modified CV Basis Values and Estimates			
B-Basis	115.7	NA	NA
A-Estimate	104.1		
Method	Normal		

Table 4-85 Statistics and Basis Values for DSB1 2% Offset Strength as-measured

Double-Shear Bearing 1 Basis Values and Statistics			
	2% Offset Strength normalized [ksi]		
Env	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	133.6	107.9	99.12
Stdev	6.846	13.58	13.27
CV	5.126	12.58	13.39
Mod CV	6.563	12.58	13.39
Min	119.1	76.84	49.78
Max	144.6	126.7	117.1
No. Batches	5	5	5
No. Spec.	30	38	32
Basis Values and Estimates			
B-Basis	116.1	76.61	66.84
A-Estimate	103.9	49.72	44.12
Method	ANOVA	Non-parametric	ANOVA
Modified CV Basis Values and Estimates			
B-Basis	118.0	NA	NA
A-Estimate	106.7		
Method	Normal		

Table 4-86 Statistics and Basis Values for DSB1 2% Offset Strength normalized

4.34 “10/80/10” Double-Shear Bearing (DSB2)

Double-Shear Bearing 2 (DSB2) tests were performed at three different environmental conditions RTA, ETW1, ETW2 and for two material properties 2% Offset Strength as-measured and 2% Offset Strength normalized. The DSB properties are fiber dominated, so the data is normalized.

For 2% Offset Strength as-measured property with original CV data, RTA and ETW2 conditions failed ADK test, so ANOVA method was used. Since each condition has 5 batches and less than 55 specimens, the ANOVA method produces B-basis and A-estimates values. Condition ETW1 passed ADK test but failed normality test, so Weibull method was used. For modified CV data, the ETW1 condition has an original CV greater than 8%, therefore no modification was necessary and the dataset failed the normality test, so modified CV basis values were not computed for ETW. The normal method for modified CV was used for the RTA and ETW2.

For 2% Offset Strength normalized property with original CV dataset, the RTA and ETW2 conditions failed ADK test, so ANOVA method was used. Since each condition has 5 batches and less than 55 specimens, the ANOVA method produces B-basis and A-estimates values. Condition ETW1 passed ADK test but failed the distribution-fitting tests, so nonparametric method was used. For modified CV data, the ETW1 condition has an original CV greater than 8%, therefore no modification was necessary and the dataset failed the normality test, so modified CV basis values were not computed for ETW. The normal method for modified CV was used for the RTA and ETW2.

Three statistical outliers were detected. The lowest value in batch C and condition ETW1 is a batch and condition outlier for 2% Offset Strength as-measured. The lowest value in batch C and condition ETW1 is a batch and condition outlier for 2% Offset Strength normalized. The lowest value in batch A and condition ETW1 is a batch outlier for 2% Offset Strength normalized.

Statistics, estimates and basis values are given for the 2% Offset Strength as-measured data in Table 4-87 and 2% Offset Strength normalized data in Table 4-88. The data, B-estimates and B-basis values are shown graphically for the 2% Offset Strength normalized in Figure 4-70.

Figure 4-70 Batch Plot for DSB2 2% Offset Strength normalized

Double Shear Bearing 2 (DSB2) Strength Basis Values and Statistics			
Property	As-Measured 2% Offset Strength		
Environment	RTA	ETW1	ETW2
Mean	138.5	111.9	99.50
Stdev	4.921	10.21	6.493
CV	3.552	9.126	6.526
Mod CV	6.000	9.126	7.263
Min	128.7	81.09	85.67
Max	148.9	124.0	116.7
No. Batches	5	5	5
No. Spec.	31	31	30
Basis Values and Estimates			
B-Basis Value	125.7	95.46	82.49
A-Estimate	116.8	78.93	70.60
Method	ANOVA	Weibull	ANOVA
Modified CV Basis Values and Estimates			
B-Basis Value	123.8	NA	86.66
A-Estimate	113.2		77.37
Method	Normal		Normal

Table 4-87 Statistics and Basis Values for DSB2 2% Offset Strength as-measured

Double Shear Bearing 2 (DSB2) Strength Basis Values and Statistics			
Property	Normalized 2% Offset Strength		
Environment	RTA	ETW1	ETW2
Mean	140.2	113.4	100.7
Stdev	4.373	10.30	6.350
CV	3.119	9.088	6.303
Mod CV	6.000	9.088	7.152
Min	131.0	82.00	87.13
Max	147.5	125.8	117.6
No. Batches	5	5	5
No. Spec.	31	31	30
Basis Values and Estimates			
B-Basis Value	129.3	82.00	84.54
A-Estimate	121.7	54.77	73.20
Method	ANOVA	Non-Parm.	ANOVA
Modified CV Basis Values and Estimates			
B-Basis Value	125.4	NA	87.94
A-Estimate	114.6		78.68
Method	Normal		Normal

Table 4-88 Statistics and Basis Values for DSB2 2% Offset Strength normalized

4.35 “50/40/10” Double-Shear Bearing (DSB3)

Double-Shear Bearing 3 (DSB3) tests were performed at three different environmental conditions RTA, ETW1, ETW2 and for two material properties 2% Offset Strength as-measured and 2% Offset Strength normalized, Ultimate Strength normalized. The DSB properties are fiber dominated, so the data is normalized.

For 2% Offset Strength as-measured property with original CV data, ETW1 and ETW2 conditions failed ADK test, so ANOVA method was used. Since each condition has 5 batches and less than 55 specimens, the ANOVA method produces B-basis and A-estimates values. Condition RTA passed ADK test and normality test, so normal method was used. For modified CV data, ETW1 and ETW2 conditions failed ADK test so allowables are not available (NA) in this case. Condition RTA passed ADK test and normality test, so normal method was used.

For 2% Offset Strength normalized property with original CV data, ETW1 and ETW2 conditions failed ADK test, so ANOVA method was used. Since each condition has 5 batches and less than 55 specimens, the ANOVA method produces B-basis and A-estimates values. Condition RTA passed ADK test and normality test, so normal method was used. For modified CV data, ETW1 and ETW2 conditions failed ADK test so allowables are not available (NA) in this case. Condition RTA passed ADK test and normality test, so normal method was used.

Three statistical outliers were detected. The lowest value in batch E and condition RTA is a batch and condition outlier for 2% Offset Strength as-measured. The highest value in batch B and condition RTA is a batch outlier for 2% Offset Strength as-measured. The lowest value in batch E and condition RTA is a batch and condition outlier for 2% Offset Strength normalized.

Statistics, estimates and basis values are given for the 2% Offset Strength as-measured data in Table 4-89 and 2% Offset Strength normalized data in Table 4-90. The data, B-estimates and B-basis values are shown graphically for the 2% Offset Strength normalized in Figure 4-71.

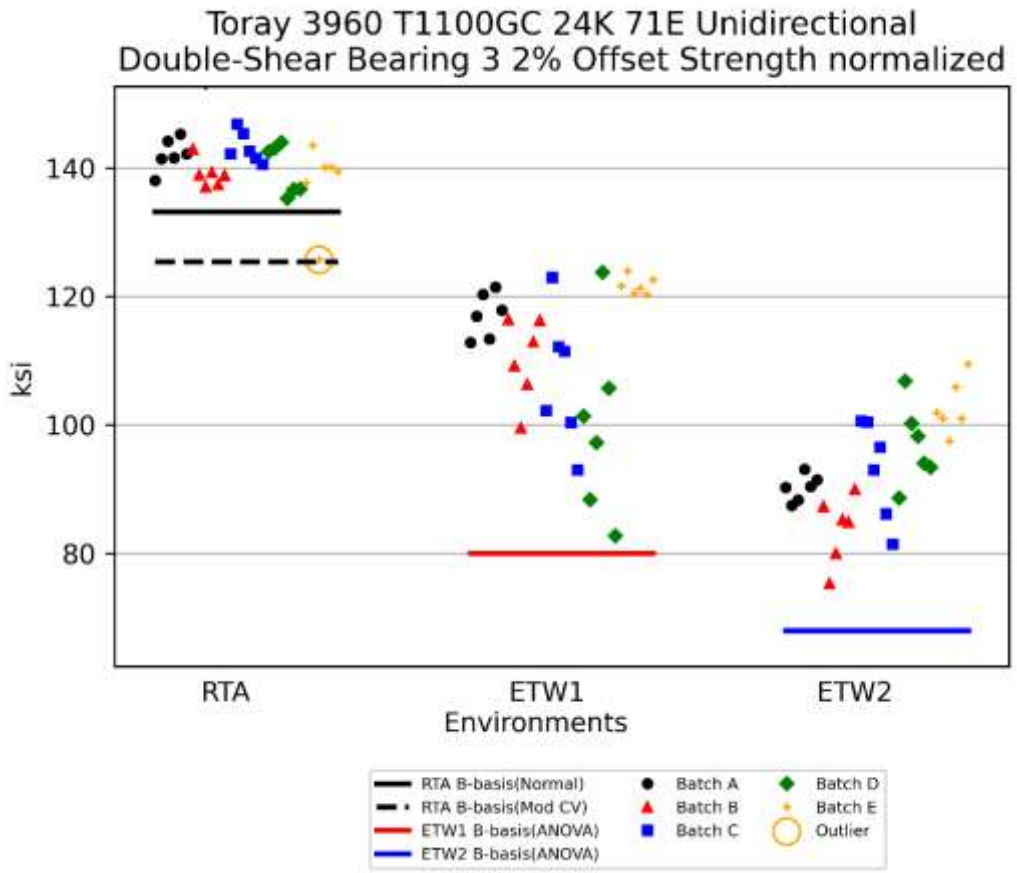

Figure 4-71 Batch Plot for DSB3 2% Offset Strength normalized

Double-Shear Bearing 3 Basis Values and Statistics			
	2% Offset Strength as-measured [ksi]		
Env	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	138.5	109.7	92.18
Stdev	4.045	11.06	8.542
CV	2.922	10.08	9.267
Mod CV	6.000	10.08	9.267
Min	124.2	82.02	73.95
Max	146.2	123.4	109.2
No. Batches	5	5	5
No. Spec.	30	30	30
Basis Values and Estimates			
B-Basis	131.3	79.03	65.87
A-Estimate	126.1	57.64	47.67
Method	Normal	ANOVA	ANOVA
Modified CV Basis Values and Estimates			
B-Basis	123.7	NA	NA
A-Estimate	113.0		
Method	Normal		

Table 4-89 Statistics and Basis Values for DSB3 2% Offset Strength as-measured

Double-Shear Bearing 3 Basis Values and Statistics			
	2% Offset Strength normalized [ksi]		
Env	RTA(70°F)	ETW1(180°F)	ETW2(250°F)
Mean	140.4	111.1	93.32
Stdev	4.027	11.20	8.259
CV	2.869	10.08	8.850
Mod CV	6.000	10.08	8.850
Min	125.7	82.72	75.30
Max	146.8	124.0	109.5
No. Batches	5	5	5
No. Spec.	30	30	30
Basis Values and Estimates			
B-Basis	133.2	79.97	67.97
A-Estimate	128.0	58.27	50.44
Method	Normal	ANOVA	ANOVA
Modified CV Basis Values and Estimates			
B-Basis	125.4	NA	NA
A-Estimate	114.6		
Method	Normal		

Table 4-90 Statistics and Basis Values for DSB3 2% Offset Strength normalized

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 in the normalized data, the as-measured data, or both. A specimen may be an outlier for the batch only (before pooling the three batches within a condition together) or for the condition (after pooling the three batches within a condition together) or both.

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

All outliers identified were investigated to determine if a cause could be found. Outliers with causes were removed from the dataset and the remaining specimens were analyzed for this report. Information about specimens that were removed from the dataset along with the cause for removal is documented in the material property data report, NCAMP Test Report CAM-RP-2024-004 Rev NC.

Outliers for which no causes could be identified are listed in Tables 5-1 through 5-16. These outliers were included in the analysis for their respective test properties.

Test Method	Condition	Batch	Specimen Number	Property	Value	High/Low	Batch Outlier	Condition Outlier
SBS	ETA1(180)	D	NTP3961Q1-TC-T01-TC-SBS-D-C20-3-ETA1-3	Strength	12.05	Low	Yes	No
CAI1	RTA(70)	C	NTP3961Q1-TC-T01-TC-CAI1C-C-C41-1-RTA-3	Strength as-measured	42.60	Low	Yes	No
CAI1	RTA(70)	C	NTP3961Q1-TC-T01-TC-CAI1C-C-C41-1-RTA-3	Strength normalized	42.71	Low	Yes	No

Table 5-1 List of Outliers for CAI1 & SBS

Test Method	Condition	Batch	Specimen Number	Property	Value	High/Low	Batch Outlier	Condition Outlier
DSB1	ETW1(180)	B	NTP3961Q1-TC-T01-BT-DSB1-B-C18-1-ETW1-4	2% Offset Strength as-measured	75.02	Low	Yes	No
DSB1	ETW2(250)	C	NTP3961Q1-TC-T01-TC-DSB1-C-C35-2-ETW2-3	2% Offset Strength as-measured	49.20	Low	No	Yes
DSB1	ETW1(180)	B	NTP3961Q1-TC-T01-BT-DSB1-B-C18-1-ETW1-4	2% Offset Strength normalized	76.84	Low	Yes	No
DSB1	ETW2(250)	C	NTP3961Q1-TC-T01-TC-DSB1-C-C35-2-ETW2-3	2% Offset Strength normalized	49.78	Low	No	Yes
DSB2	ETW1(180)	C	NTP3961Q1-TC-T01-TC-DSB2-C-C38-1-ETW1-3	2% Offset Strength as-measured	81.09	Low	Yes	Yes
DSB2	ETW1(180)	C	NTP3961Q1-TC-T01-TC-DSB2-C-C38-1-ETW1-3	2% Offset Strength normalized	82.00	Low	Yes	Yes
DSB2	ETW1(180)	A	NTP3961Q1-TC-T01-BT-DSB2-A-C16-1-ETW1-1	2% Offset Strength normalized	107.8	Low	Yes	No
DSB3	RTA(70)	E	NTP3961Q1-TC-T01-TC-DSB3-E-C39-1-RTA-3	2% Offset Strength as-measured	124.2	Low	Yes	Yes
DSB3	RTA(70)	B	NTP3961Q1-TC-T01-BT-DSB3-B-C17-1-RTA-1	2% Offset Strength as-measured	140.2	High	Yes	No
DSB3	RTA(70)	E	NTP3961Q1-TC-T01-TC-DSB3-E-C39-1-RTA-3	2% Offset Strength normalized	125.7	Low	Yes	Yes

Table 5-2 List of Outliers for DSB

Test Method	Condition	Batch	Specimen Number	Property	Value	High/Low	Batch Outlier	Condition Outlier
FHC1	ETW2(250)	E	NTP3961Q1-TC-T01-TC-FHC1-E-C27-1-ETW2-1	Strength as-measured	42.72	Low	Yes	No
FHC1	ETW2(250)	E	NTP3961Q1-TC-T01-TC-FHC1-E-C27-1-ETW2-1	Strength normalized	43.13	Low	Yes	No
FHC2	ETW2(250)	B	NTP3961Q1-TC-T01-BT-FHC2-B-C22-2-ETW2-2	Strength as-measured	37.82	Low	Yes	No
FHC2	ETW2(250)	B	NTP3961Q1-TC-T01-BT-FHC2-B-C22-2-ETW2-2	Strength normalized	38.86	Low	Yes	No

Table 5-3 List of Outliers for FHC

Test Method	Condition	Batch	Specimen Number	Property	Value	High/Low	Batch Outlier	Condition Outlier
FHT1	ETW1(180)	C	NTP3961Q1-TC-T01-TC-FHT1-C-C16-2-ETW1-3	Strength as-measured	111.2	High	Yes	No
FHT1	ETW2(250)	D	NTP3961Q1-TC-T01-TC-FHT1-D-C16-2-ETW2-3	Strength as-measured	115.0	High	Yes	No
FHT1	ETW1(180)	C	NTP3961Q1-TC-T01-TC-FHT1-C-C16-2-ETW1-3	Strength normalized	113.6	High	Yes	No
FHT1	ETW2(250)	D	NTP3961Q1-TC-T01-TC-FHT1-D-C16-2-ETW2-3	Strength normalized	115.4	High	Yes	No
FHT2	CTA(-65)	B	NTP3961Q1-TC-T01-BT-FHT2-B-C14-1-CTA-2	Strength as-measured	62.80	Low	Yes	No
FHT3	RTA(70)	D	NTP3961Q1-TC-T01-TC-FHT3-D-C19-2-RTA-3	Strength as-measured	164.8	High	Yes	No
FHT3	RTA(70)	D	NTP3961Q1-TC-T01-TC-FHT3-D-C19-2-RTA-3	Strength normalized	165.0	High	Yes	No

Table 5-4 List of Outliers for FHT

Test Method	Condition	Batch	Specimen Number	Property	Value	High/Low	Batch Outlier	Condition Outlier
IPST	RTA(70)	B	NTP3961Q1-TC-T01-BT-IPST-B-C5-1-RTA-5	0.2% Offset Strength	9.040	High	No	Yes
IPST	RTA(70)	B	NTP3961Q1-TC-T01-BT-IPST-B-C7-1-RTA-6	0.2% Offset Strength	8.980	High	No	Yes
IPST	ETA1(180)	A	NTP3961Q1-TC-T01-BT-IPST-A-C9-1-ETA1-5	0.2% Offset Strength	5.810	Low	Yes	No
IPST	ETA2(250)	A	NTP3961Q1-TC-T01-BT-IPST-A-C6-2-ETA2-3	0.2% Offset Strength	5.520	High	Yes	No
IPST	ETA2(250)	D	NTP3961Q1-TC-T01-TC-IPST-D-C3-1-ETA2-6	0.2% Offset Strength	4.840	High	Yes	No
IPST	ETW2(250)	B	NTP3961Q1-TC-T01-BT-IPST-B-C6-3-ETW2-1	0.2% Offset Strength	3.370	High	Yes	No
IPST	ETW2(250)	C	NTP3961Q1-TC-T01-TC-IPST-C-C7-1-ETW2-1	0.2% Offset Strength	2.210	Low	Yes	No
IPST	ETW2(250)	D	NTP3961Q1-TC-T01-TC-IPST-D-C7-1-ETW2-6	0.2% Offset Strength	3.060	High	Yes	No
IPST	ETA2(250)	D	NTP3961Q1-TC-T01-TC-IPST-D-C3-1-ETA2-6	Strength at 5% Strain	7.280	High	Yes	No
IPST	ETW2(250)	B	NTP3961Q1-TC-T01-BT-IPST-B-C13-1-ETW2-1	Strength at 5% Strain	4.680	Low	Yes	No
IPST	ETW2(250)	D	NTP3961Q1-TC-T01-TC-IPST-D-C7-1-ETW2-6	Strength at 5% Strain	4.610	High	Yes	No

Table 5-5 List of Outliers for IPST

Test Method	Condition	Batch	Specimen Number	Property	Value	High/Low	Batch Outlier	Condition Outlier
IPSV	CTA	A	NTP3961Q1-TC-T01-BT-IPSV-A-C7-1-CTA-1	0.2% Offset Strength	11.63	Low	No	Yes
IPSV	RTA	E	NTP3961Q1-TC-T01-TC-IPSV-E-C18-3-RTA-3	0.2% Offset Strength	9.640	High	Yes	No
IPSV	ETA1	E	NTP3961Q1-TC-T01-TC-IPSV-E-C17-3-ETA1-2	0.2% Offset Strength	7.850	High	Yes	No
IPSV	ETW1	D	NTP3961Q1-TC-T01-TC-IPSV-D-C18-3-ETW1-2	0.2% Offset Strength	6.910	High	Yes	No
IPSV	ETW2	D	NTP3961Q1-TC-T01-TC-IPSV-D-C17-3-ETW2-3	0.2% Offset Strength	5.310	High	No	Yes
IPSV	ETW2	D	NTP3961Q1-TC-T01-TC-IPSV-D-C17-3-ETW2-5	0.2% Offset Strength	3.550	Low	No	Yes
IPSV	ETW2	E	NTP3961Q1-TC-T01-TC-IPSV-E-C17-3-ETW2-4	0.2% Offset Strength	4.770	High	Yes	No
IPSV	ETA2	B	NTP3961Q1-TC-T01-BT-IPSV-B-C10-1-ETA2-7	Strength at 5% Strain	9.550	Low	Yes	No
IPSV	ETA2	E	NTP3961Q1-TC-T01-TC-IPSV-E-C18-3-ETA2-6	Strength at 5% Strain	9.890	High	Yes	No
IPSV	ETW1	C	NTP3961Q1-TC-T01-TC-IPSV-C-C44-1-ETW1-1	Strength at 5% Strain	10.12	Low	Yes	No
IPSV	ETW1	D	NTP3961Q1-TC-T01-TC-IPSV-D-C18-3-ETW1-2	Strength at 5% Strain	10.36	High	Yes	No

Table 5-6 List of Outliers for IPSV

Test Method	Condition	Batch	Specimen Number	Property	Value	High/Low	Batch Outlier	Condition Outlier
CBS	RTA(70)	B	NTP3961Q1-TC-T01-TC-ILT-B-C2-2-RTA-1	Curved Beam Strength	243.4	Low	No	Yes
CBS	ETW1(180)	E	NTP3961Q1-TC-T01-TC-ILT-E-C37-3-ETW1-1	Curved Beam Strength	207.3	Low	Yes	No
ILT	RTA(70)	B	NTP3961Q1-TC-T01-TC-ILT-B-C2-2-RTA-1	Interlaminar Tension Strength	7.415	Low	No	Yes

Table 5-7 List of Outliers for ILT & CBS

Test Method	Condition	Batch	Specimen Number	Property	Value	High/Low	Batch Outlier	Condition Outlier
LT	CTA(-65)	D	NTP3961Q1-TC-T01-TC-LT-D-C42-1-CTA-3	Strength as-measured	487.6	Low	Yes	No
LT	ETA2(250)	C	NTP3961Q1-TC-T01-TC-LT-C-C1-1-ETA2-4	Strength as-measured	576.6	High	Yes	No
LT	ETA1(180)	A	NTP3961Q1-TC-T01-BT-LT-A-C1-1-ETA1-2	Strength normalized	510.5	Low	No	Yes

Table 5-8 List of Outliers for LT

Test Method	Condition	Batch	Specimen Number	Property	Value	High/Low	Batch Outlier	Condition Outlier
OHC1	RTA(70)	E	NTP3961Q1-TC-T01-TC-OHC1-E-C1-2-RTA-1	Strength as-measured	49.48	High	Yes	No
OHC1	RTA(70)	E	NTP3961Q1-TC-T01-TC-OHC1-E-C1-2-RTA-1	Strength normalized	49.57	High	Yes	No
OHC1	ETW2(250)	D	NTP3961Q1-TC-T01-TC-OHC1-D-C11-2-ETW2-2	Strength normalized	32.69	Low	Yes	No
OHC2	RTA(70)	B	NTP3961Q1-TC-T01-BT-OHC2-B-C16-1-RTA-1	Strength normalized	44.06	High	No	Yes
OHC2	ETW2(250)	A	NTP3961Q1-TC-T01-BT-OHC2-A-C21-1-ETW2-3	Strength normalized	25.37	Low	Yes	No

Table 5-9 List of Outliers for OHC

Test Method	Condition	Batch	Specimen Number	Property	Value	High/Low	Batch Outlier	Condition Outlier
OHT1	CTA(-65)	A	NTP3961Q1-TC-T01-BT-OHT1-A-C7-1-CTA-1	Strength as-measured	94.20	High	No	Yes
OHT1	CTA(-65)	C	NTP3961Q1-TC-T01-TC-OHT1-C-C8-1-CTA-1	Strength normalized	84.12	Low	Yes	No
OHT1	ETW2(250)	E	NTP3961Q1-TC-T01-TC-OHT1-E-C12-1-ETW2-2	Strength normalized	101.6	Low	No	Yes
OHT2	CTA(-65)	C	NTP3961Q1-TC-T01-TC-OHT2-C-C10-2-CTA-1	Strength as-measured	56.90	Low	Yes	No
OHT2	ETW2(250)	D	NTP3961Q1-TC-T01-TC-OHT2-D-C12-2-ETW2-1	Strength as-measured	47.80	Low	Yes	Yes
OHT2	CTA(-65)	C	NTP3961Q1-TC-T01-TC-OHT2-C-C10-2-CTA-1	Strength normalized	57.31	Low	Yes	No
OHT2	ETW2(250)	D	NTP3961Q1-TC-T01-TC-OHT2-D-C12-2-ETW2-1	Strength normalized	47.83	Low	Yes	Yes
OHT3	ETW2(250)	E	NTP3961Q1-TC-T01-TC-OHT3-E-C16-1-ETW2-2	Strength as-measured	201.2	Low	Yes	Yes
OHT3	CTA(-65)	E	NTP3961Q1-TC-T01-TC-OHT3-E-C13-1-CTA-1	Strength normalized	133.1	Low	Yes	No
OHT3	ETW2(250)	E	NTP3961Q1-TC-T01-TC-OHT3-E-C16-1-ETW2-2	Strength normalized	203.2	Low	Yes	Yes

Table 5-10 List of Outliers for OHT

Test Method	Condition	Batch	Specimen Number	Property	Value	High/Low	Batch Outlier	Condition Outlier
SSB1	ETW1(180)	A	NTP3961Q1-TC-T01-BT-SSB1-A-C11-1-ETW1-3	2% Offset Strength as-measured	90.10	Low	Yes	No
SSB1	ETW1(180)	C	NTP3961Q1-TC-T01-TC-SSB1-C-C32-2-ETW1-1	Initial Peak Strength as-measured	125.4	High	Yes	No
SSB1	ETW1(180)	C	NTP3961Q1-TC-T01-TC-SSB1-C-C32-2-ETW1-1	Initial Peak Strength normalized	125.2	High	Yes	No
SSB2	ETW1(180)	A	NTP3961Q1-TC-T01-BT-SSB2-A-C12-1-ETW1-2	2% Offset Strength normalized	128.3	High	Yes	No
SSB3	ETW2(250)	E	NTP3961Q1-TC-T01-TC-SSB3-E-C35-1-ETW2-2	2% Offset Strength as-measured	100.7	High	Yes	No

Table 5-11 List of Outliers for SSB

Test Method	Condition	Batch	Specimen Number	Property	Value	High/Low	Batch Outlier	Condition Outlier
TC	CTA(-65)	B	NTP3961Q1-TC-T01-BT-TC-B-C2-1-CTA-1	Strength	45.53	Low	No	Yes
TC	ETA2(250)	B	NTP3961Q1-TC-T01-BT-TC-B-C1-2-ETA2-7	Strength	20.40	Low	Yes	No
TC	ETA2(250)	C	NTP3961Q1-TC-T01-TC-TC-C-C12-3-ETA2-3	Strength	24.90	High	Yes	No
TT	RTA(70)	A	NTP3961Q1-TC-T01-BT-TT-A-C5-2-RTA-3	Strength	7.810	Low	Yes	No
TT	ETA1(180)	D	NTP3961Q1-TC-T01-TC-TT-D-C6-3-ETA1-1	Strength	6.010	Low	No	Yes
TT	ETA1(180)	C	NTP3961Q1-TC-T01-TC-TT-C-C3-3-ETA1-1	Strength	7.580	Low	Yes	No
SBS	ETA1(180)	D	NTP3961Q1-TC-T01-TC-SBS-D-C20-3-ETA1-3	Strength as-measured	12.05	Low	Yes	No

Table 5-12 List of Outliers for TC, TT & SBS

Test Method	Condition	Batch	Specimen Number	Property	Value	High/Low	Batch Outlier	Condition Outlier
UNC0	ETW2(250)	B	NTP3961Q1-TC-T01-BT-UNC0-B-C1-2-ETW2-2	Strength as-measured	54.77	Low	Yes	No
UNC0	ETW2(250)	D	NTP3961Q1-TC-T01-TC-UNC0-D-C14-3-ETW2-1	Strength as-measured	63.66	Low	Yes	No
UNC0	ETW2(250)	E	NTP3961Q1-TC-T01-TC-UNC0-E-C14-3-ETW2-2	Strength as-measured	87.81	High	Yes	No
UNC0	ETW2(250)	B	NTP3961Q1-TC-T01-BT-UNC0-B-C1-2-ETW2-2	Strength normalized	55.48	Low	Yes	Yes
UNC0	ETW2(250)	D	NTP3961Q1-TC-T01-TC-UNC0-D-C14-3-ETW2-1	Strength normalized	65.17	Low	Yes	No
UNC0	ETW2(250)	E	NTP3961Q1-TC-T01-TC-UNC0-E-C14-3-ETW2-2	Strength normalized	87.93	High	Yes	No
UNC1	RTA(70)	A	NTP3961Q1-TC-T01-BT-UNC1-A-C9-1-RTA-1	Strength as-measured	95.43	Low	Yes	No
UNC1	ETW1(180)	B	NTP3961Q1-TC-T01-BT-UNC1-B-C4-1-ETW1-3	Strength as-measured	83.30	Low	Yes	No
UNC1	ETW1(180)	C	NTP3961Q1-TC-T01-TC-UNC1-C-C23-3-ETW1-1	Strength as-measured	78.18	Low	Yes	No
UNC1	RTA(70)	A	NTP3961Q1-TC-T01-BT-UNC1-A-C9-1-RTA-1	Strength normalized	98.17	Low	Yes	No
UNC1	RTA(70)	D	NTP3961Q1-TC-T01-TC-UNC1-D-C23-3-RTA-3	Strength normalized	113.7	Low	Yes	No
UNC1	ETW1(180)	B	NTP3961Q1-TC-T01-BT-UNC1-B-C4-1-ETW1-3	Strength normalized	85.55	Low	Yes	No
UNC2	RTA(70)	D	NTP3961Q1-TC-T01-TC-UNC2-D-C25-3-RTA-3	Strength as-measured	68.75	Low	Yes	No
UNC2	ETW1(180)	E	NTP3961Q1-TC-T01-TC-UNC2-E-C24-3-ETW1-1	Strength as-measured	62.67	High	Yes	No
UNC2	RTA(70)	D	NTP3961Q1-TC-T01-TC-UNC2-D-C25-3-RTA-3	Strength normalized	69.49	Low	Yes	No
UNC3	ETW1(180)	E	NTP3961Q1-TC-T01-TC-UNC3-E-C26-3-ETW1-2	Strength as-measured	150.5	High	Yes	No

Table 5-13 List of Outliers for UNC

Test Method	Condition	Batch	Specimen Number	Property	Value	High/Low	Batch Outlier	Condition Outlier
UNT1	ETW1(180)	E	NTP3961Q1-TC-T01-TC-UNT1-E-C2-2-ETW1-2	Strength as-measured	148.3	Low	Yes	No
UNT1	ETW2(250)	D	NTP3961Q1-TC-T01-TC-UNT1-D-C3-2-ETW2-2	Strength as-measured	145.3	Low	Yes	No
UNT1	ETW1(180)	E	NTP3961Q1-TC-T01-TC-UNT1-E-C2-2-ETW1-2	Strength normalized	150.1	Low	Yes	Yes
UNT1	ETW2(250)	C	NTP3961Q1-TC-T01-TC-UNT1-C-C2-2-ETW2-3	Strength normalized	139.4	Low	No	Yes
UNT2	CTA(-65)	B	NTP3961Q1-TC-T01-BT-UNT2-B-C7-1-CTA-1	Strength as-measured	95.09	High	No	Yes
UNT2	ETW1(180)	A	NTP3961Q1-TC-T01-BT-UNT2-A-C19-1-ETW1-2	Strength as-measured	81.09	High	Yes	No
UNT2	ETW2(250)	D	NTP3961Q1-TC-T01-TC-UNT2-D-C5-2-ETW2-2	Strength as-measured	65.82	Low	Yes	No
UNT2	ETW1(180)	D	NTP3961Q1-TC-T01-TC-UNT2-D-C5-2-ETW1-1	Strength normalized	74.72	Low	Yes	No
UNT3	RTA(70)	E	NTP3961Q1-TC-T01-TC-UNT3-E-C6-2-RTA-2	Strength as-measured	257.4	Low	No	Yes
UNT3	ETW2(250)	B	NTP3961Q1-TC-T01-BT-UNT3-B-C9-1-ETW2-3	Strength as-measured	300.6	High	Yes	No
UNT3	RTA(70)	E	NTP3961Q1-TC-T01-TC-UNT3-E-C6-2-RTA-2	Strength normalized	255.6	Low	Yes	Yes
UNT3	ETW2(250)	B	NTP3961Q1-TC-T01-BT-UNT3-B-C9-1-ETW2-3	Strength normalized	303.4	High	Yes	No

Table 5-14 List of Outliers for UNT

Test Method	Condition	Batch	Specimen Number	Property	Value	High/Low	Batch Outlier	Condition Outlier
LC	ETW2	B	NTP3961Q1-TC-T01-BT-UNC0-B-C1-2-ETW2-2	Strength as-measured	150.6	Low	Yes	No
LC	ETW2	D	NTP3961Q1-TC-T01-TC-UNC0-D-C14-3-ETW2-1	Strength as-measured	175.1	Low	Yes	No
LC	ETW2	E	NTP3961Q1-TC-T01-TC-UNC0-E-C14-3-ETW2-2	Strength as-measured	241.5	High	Yes	No
LC	ETW2	B	NTP3961Q1-TC-T01-BT-UNC0-B-C1-2-ETW2-2	Strength normalized	152.7	Low	Yes	Yes
LC	ETW2	D	NTP3961Q1-TC-T01-TC-UNC0-D-C14-3-ETW2-1	Strength normalized	179.3	Low	Yes	No
LC	ETW2	E	NTP3961Q1-TC-T01-TC-UNC0-E-C14-3-ETW2-2	Strength normalized	242.0	High	Yes	No

Table 5-15 List of Outliers for LC

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