

NASA/TM—2013-216572



# Statistical Analyses of Raw Material Data for MTM45-1/CF7442A-36% RW: CMH Cure Cycle

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December 2013

## Acknowledgments

This work is supported by Advanced Exploration Systems under NASA's Exploration Program.

## Supplementary Notes

Prepared for MMSEV (Multi Mission Space Exploration Vehicle) Task January 2013.

This report contains preliminary findings,  
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## **Summary**

This report describes statistical characterization of physical properties of the composite material system MTM45-1/CF7442A, which has been tested and is currently being considered for use on spacecraft structures. This composite system is made of 6K plain weave graphite fibers in a highly toughened resin system. This report summarizes the distribution types and statistical details of the tests and the conditions for the experimental data generated. These distributions will be used in multivariate regression analyses to help determine material and design allowables for similar material systems and to establish a procedure for other material systems. Additionally, these distributions will be used in future probabilistic analyses of spacecraft structures. The specific properties that are characterized are the ultimate strength, modulus, and Poisson's ratio by using a commercially available statistical package. Results are displayed using graphical and semigraphical methods and are included in the accompanying appendixes.

## **Introduction**

The work described in this report is based on the database entitled "NPN100101 AITR1615-IMPW MTM45-1 IM7 6K PW RAW DATA REPORT" (Ref. 1, internal database). Material MTM45-1 is a composite with 6K plain weave IM7 (Hexcel Corporation) graphite fibers, in a highly toughened resin system 36 percent by weight and is currently being considered for spacecraft structures. The primary objective is to determine the underlying statistical distributions for the various properties that were experimentally determined and reported. These distributions will be used in multivariate regression analyses to help determine material and design allowables for similar material systems and to establish a procedure for other material systems. Additionally, these distributions will be used in future probabilistic analyses of spacecraft structures. This document summarizes the distribution types as well as the details of the tests and conditions for the experimental data generated for the material characterized as MTM45-1/CF7442A-36% RW: CMH Cure Cycle. The material form and CMH (condensed medium-temperature cure/high-temperature postcure) cure cycle are described in Reference 2. The document summarizes the distribution types and details of the tests and conditions for the experimental data generated for the material characterized as provided in the database. The distribution types for material physical properties such as ultimate strength, modulus, and Poisson's ratio are determined using the commercially available statistical discovery software JMP Pro (Ref. 3). The distributions are displayed using graphical and semigraphical methods and are included in Appendix A of this report. For stiffness-critical applications, the measured modulus variability becomes important, and tailoring of sections with appropriate orientations becomes a design consideration in order to quantify and minimize the uncertainty. However, for those structural components where failures due to inadequate strength becomes critical, one needs to address various types of failure modes and the appropriate strengths initiating those failure modes. Here the uncertainty in strength could decrease the reliability, and therefore one must execute extra caution and factor of safety. Furthermore, an a priori knowledge of these issues can be utilized to tailor manufacturing and testing of the material with the goal of reducing the uncertainty as much as possible. Discussion of such optimization is beyond the scope of the current project.

## Statistical Details for Distribution Analysis

The Excel spreadsheet “NPN100101 AITR1615-IMPW MTM45-1 IM7 6K PW RAW DATA REPORT,” containing the test data was imported into JMP Pro software. Variables such as “Ultimate Strength Measured in ksi,” “Elastic Modulus Measured in Msi,” “Poisson’s ratio,” “Strength Initial Peak,” “Ultimate Strength,” “Strength at 2% Offset,” and “Strength at 4% Offset,” were declared “Continuous variables.” For analyzing the distributions, the “Continuous Fit ALL” option was used for each test temperature. In the “Compare Distributions” report, the “Show Distribution” list is sorted by the “Corrected Akaike’s Information Criterion (*AICc*)” (Ref. 3) in ascending order. Distributions with the smaller *AICc* values indicate the best fit. They are computed as

$$AICc = -2\log(\text{likelihood}) + 2k \left( \frac{n}{n-k-1} \right) \quad (1)$$

where *likelihood* is the value of the likelihood function at best fit parameters, *k* is the number of estimated parameters in the model, and *n* is the number of observations in the data set.

Appendix A presents the results of each distribution analysis performed using graphical and semigraphical methods. The graphical methods depict the “Normal Quantile Plot” to assist in visualizing the extent to which a variable is normally distributed. The normal quantile plot also shows Lilliefors confidence bounds and Probability Normal Quantile Scales (Ref. 3). The “Outlier Box Plot” identifies possible outliers. The vertical line within the box represents the median sample value. The confidence diamond represents the upper and lower 95 percent of the mean. A line through the middle of the diamond represents the mean. The ends of the box represent the 25th and 75th quantiles, and the bracket outside of the box identifies the shortest half, which is the most dense 50 percent of the observations.

The data are displayed using histograms, which show a bar for grouped values of the continuous variable and a line graph depicting the best distribution fit. Summary statistics for each distribution are given in terms of the mean, standard deviation, the standard error of the mean. The upper 95 percent mean and lower 95 percent mean confidence limits about the mean define the interval that is likely to contain the true sample mean.

A comparison of the distribution is depicted next in the appendix including the *AICc* as given in Equation (1). This value may be compared with those from other models to determine the best-fitting model for the data. The model having the smallest *AICc* value, as discussed in Reference 3, is usually the preferred model.

The best-fitting distribution report includes a “Diagnostic Plot” with “Goodness-of-Fit” statistics displayed. The diagnostic plot creates a quantile or probability plot. Depending on the fitted distribution, the plot is in one of the formats listed in Table 1.

The “Parameter Estimates” table shows the estimates of the parameters in the model and a test for the hypothesis that each parameter is zero. Confidence limits are also displayed.

TABLE 1.—DISTRIBUTION PLOT FORMATS

Plot format	Distribution
Fitted probability versus data	Normal
	Exponential
Fitted probability versus data on log scale	Weibull
	Lognormal
	Extreme value
Fitted quantiles versus data	Gamma
	Poisson



The “Goodness-of-Fit” test is also shown in the appendix. Analogous to lack-of-fit tests, they test for adequacy of the model by computing the goodness-of-fit for the fitted distribution. In the JMP software, the goodness-of-fit tests are not chi-square tests, but are empirical distribution function (EDF) tests. EDF tests offer advantages over the chi-square tests, including improved power and invariance with respect to histogram midpoints (Ref. 3).

Analysis of the distribution was performed using the JMP software of each variable, and comparison was performed using the option “Continuous Fit All.” The best-fit distribution is selected and plotted as shown in the charts in the appendix. However, in the cases where the best distribution fit was of the type Normal 2 Mixture or Normal 3 Mixture or any of the Johnson options such as Johnson Su, Johnson Sb, and Johnson Sl, the next-best fit was chosen instead. This choice was made in anticipation for future use of NASA/NESSUS 6.2c code (Ref. 4) for further sensitivity analysis because these types of distributions are not available in NESSUS 6.2c. NASA/NESSUS 6.2c is a general-purpose, probabilistic analysis program that accounts for variations and uncertainties in loads, geometry, material behavior, and other user-defined inputs, and it computes probability of failure and probabilistic sensitivity measures of engineered systems. A brief description of the different statistical distribution types that are also available in the NASA/NESSUS 6.2c version follows.

## **Overview of Distribution Types**

The following sections give descriptions of the distribution types in the JMP software that are used in the analyses in this report.

### **Gaussian or Normal Distribution**

The normal distribution is a continuous probability distribution defined on the entire real line often used to model measures that are symmetric with most of the values falling in the middle of the curve. It has a bell-shaped probability density function, given as

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} \exp\left[-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2\right], \text{ for } -\infty < x < \infty \quad (2)$$

The parameter  $\mu$  is the mean and  $\sigma$  is the standard deviation. The standard normal distribution is with  $\mu = 0$  and variance  $\sigma^2 = 1$  in a general normal distribution.

### **Lognormal Distribution**

The lognormal distribution is a continuous probability distribution of a random variable whose logarithm is normally distributed. A variable  $Y$  is lognormal if and only if  $X = \ln(Y)$  is normal. Lognormal is often used to model values that can only take positive values and if negative values are inadmissible. The lognormal distribution can be obtained by substituting “ $\ln(x)$ ” for “ $x$ ” in the above equation for the normal distribution. The lognormal fitting option estimates the parameters  $\mu$  (scale) and  $\sigma$  (shape).

$$f(x; \mu, \sigma) = \frac{1}{x\sigma\sqrt{2\pi}} \exp\left[-\frac{(\ln x - \mu)^2}{2\sigma^2}\right], \text{ for } x > 0 \quad (3)$$

## Weibull Distribution

The Weibull distribution is a continuous probability distribution that often provides a good model for estimating the length of life. The probability density function of a Weibull random variable  $x$  is

$$f(x; \alpha, \beta) = \begin{cases} \frac{\beta}{\alpha} \left(\frac{x}{\alpha}\right)^{\beta-1} \exp\left(-\left(\frac{x}{\alpha}\right)^\beta\right) & x \geq 0 \\ 0 & x < 0 \end{cases} \quad (4)$$

where  $\alpha > 0$  is the scale parameter and  $\beta > 0$  is the shape parameter of the distribution.

## Exponential Distribution

The exponential distribution is useful for describing events that randomly occur over time. The probability density function of an exponential distribution  $f$  is

$$f(x; \alpha) = \begin{cases} \alpha \exp(-\alpha x) & x \geq 0 \\ 0 & x < 0 \end{cases} \quad (5)$$

where  $\alpha > 0$  is the scale parameter of the distribution.

## Normal Mixtures Distribution

The normal mixtures distribution fits a mixture of normal distributions. This flexible distribution is capable of fitting multimodal data. The probability density function generated from a mixture of two normal distributions for a random variable  $x$  is given by

$$f(x; p, \mu_1, \mu_2, \sigma_1^2, \sigma_2^2) = \frac{p}{\sqrt{2\pi\sigma_1^2}} \exp\left[-\frac{(x-\mu_1)^2}{2\sigma_1^2}\right] + \frac{1-p}{\sqrt{2\pi\sigma_2^2}} \exp\left[-\frac{(x-\mu_2)^2}{2\sigma_2^2}\right] \quad (6)$$

where parameters  $\mu_1$  and  $\mu_2$  are the two means,  $\sigma_1$  and  $\sigma_2$  are two standard deviations, and  $p$  is the probability.

## Johnson Su, Johnson Sb, and Johnson SI Distributions

The Johnson system of distributions contains three distributions that are all based on a transformed normal distribution: Johnson Su, which is unbounded for  $Y$ ; the Johnson Sb, which is bounded on both tails ( $0 < Y < 1$ ); and the Johnson SI distribution leading to the lognormal family of distributions. All three Johnson system distributions are useful for their data-fitting capabilities because they support every possible combination of skewness and kurtosis. More details on the Johnson system can be found in Reference 3.

## Data Analysis Details

The actual experimental data for the MTM45-1/CF7442A-36% RW, 6K plain weave IM7 fabric, 196 g/m<sup>2</sup>, 36% RW (resin weight) material was analyzed. The elastic modulus and ultimate strength of the material were obtained for the test conditions and test types as defined in Tables 2 and 3.

TABLE 2.—TEST CONDITIONS

CTD	-65±5 °F (18±3 °C), ambient moisture cold temperature dry
RTD	Room temperature, ambient dry
RTW	Room temperature, wet (equilibrium moisture content)
ETD1	220±5 °F (104±3 °C), elevated temperature dry
ETD2	350±5 °F (177±3 °C), elevated temperature dry
ETW	180±5 °F (82±3 °C), elevated temperature wet (equilibrium moisture)
ETW2	250±5 °F (121±3 °C), elevated temperature wet (equilibrium moisture)

TABLE 3.—TESTS RUN ON  
MTM45-1/CF7442A-36% RW: CMH CURE CYCLE  
WITH CORRESPONDING CODES FOR  
JMP PRO SOFTWARE ANALYSIS

Test code	Test
FC	Fill compression
FHC1	Quasi filled hole compression
FHC2	Soft filled hole compression
FHC3	Hard filled hole compression
FHT1	Quasi isotropic filled hole tension
FHT2	Soft filled hole tension
FHT3	Hard filled hole tension
FSM	Warp flexure strength and modulus
FT	Fill tension
ILT1	Quasi isotropic interlaminar tension
IPS1	In plane shear (11.5 inches length)
OHC1	Quasi isotropic open hole compression
OHC2	Soft open hole compression
OHC3	Hard open hole compression
OHT1	Quasi isotropic open hole tension
OHT2	Soft open hole tension
OHT3	Hard open hole tension
PB1	Quasi isotropic pin bearing
PB2	Soft pin bearing
PB3	Hard pin bearing
SBS	Short beam strength
SBS1	Quasi isotropic short beam strength
UNC0	0/90 compression
UNC1	Quasi isotropic compression
UNC2	Soft compression
UNC3	Hard compression
UNT0	0/90 tension
UNT1	Quasi isotropic tension
UNT2	Soft tension
UNT3	Hard tension
WC	Warp compression
WT	Warp tension

## Test Methods and Test Types

All testing was executed in accordance with nationally recognized standard methods and procedures. Details of the specific test methods used are defined in Reference 2, together with relevant specimen nominal geometry and configurations. Table 4 presents the 10 ASTM Standard Test Methods used for this data.

Distribution analyses and comparisons were performed for variables such as “Ultimate Strength Measured in ksi,” “Elastic Modulus Measured in Msi,” “Poisson’s ratio,” “Strength Initial Peak,” “Ultimate Strength,” “Strength at 2% Offset,” and “Strength at 4% Offset.” Importing the data in JMP involved combining and concatenating data across batches and test conditions for each property type.

The distribution type for each of these variables at each available test temperature was analyzed separately. Ninety-four tests of the MTM45-1/CF7442A-36% RW material were performed, as described and summarized in Reference 2. Results of the distribution types by property and test temperature are summarized in the next section and in Appendix A. The tables depict the distribution types along with the parameter types and estimates for each distribution type as given in Table 5. Appendix A provides the

TABLE 4.—ASTM STANDARD TEST METHODS USED FOR  
MTM45-1/CF7442A-36% RW: CMH CURE CYCLE MATERIAL TESTS

Test code	ASTM test method	ASTM test description
SBS SBS1	ASTMD2344	Standard test method for short-beam strength of polymer-matrix-composite materials and their laminates
WT FT UNT1 UNT2 UNT3	ASTMD3039	Standard test method for tensile properties of polymer-matrix-composite materials
IPS1	ASTMD3518	Standard test method for in-plane shear response of polymer-matrix-composite materials by tensile test of a $\pm 45^\circ$ laminate
OHT1 OHT2 OHT3	ASTMD5766	Standard test method for open-hole tensile strength of polymer-matrix-composite laminates
PB1 PB2 PB3	ASTMD5961	Standard test method for bearing response of polymer-matrix-composite laminates
ILT1	ASTMD6415	Standard test method for measuring the curved-beam strength of a fiber-reinforced polymer-matrix composite
OHC1 OHC2 OHC3	ASTMD6484	Standard test method for open-hole compressive strength of polymer-matrix-composite laminates
WC FC UNC1 UNC2 UNC3	ASTMD6641	Standard test method for determining the compressive properties of polymer-matrix-composite laminates using a combined loading compression test fixture
FHT1 FHT2 FHT3 FHC1 FHC2 FHC3	ASTMD6742	Standard test method for filled-hole tension and compression testing of polymer-matrix-composite laminates
FSM	ASTMD790	Standard test method for flexural properties of unreinforced and reinforced plastics and electrical insulating materials

TABLE 5.—DISTRIBUTION PARAMETER TYPES

Distribution	Parameter type
Normal	(Location $\mu$ , dispersion $\sigma$ )
Lognormal	(Scale $\mu$ , shape $\sigma$ )
Weibull	(Scale $\alpha$ , shape $\beta$ )
Exponential	Scale $\alpha$

“Summary Statistics,” such as the mean and standard deviation, the standard error mean, and upper 95 percent of the mean, and lower 95 percent of the mean for each test type and variable, as well as a comparison table of all the distribution types ranging from the smallest value of *AICc* to the biggest value. The “Fitted Parameter Estimate” for the best fit distribution, the “Goodness-of-Fit Test,” and the “Diagnostic Plot” are also displayed in the appendix.

### Summary of Distributions by Test

The best fit distribution type for the data was compared with the normal distribution to determine how significantly they differ from one another. The comparison was done by calculating the percent change of the Akaike’s Information Criterion value (*AICc*) with respect to the *AICc* of the normal distribution. As mentioned in the previous section, *AICc* is a measure of the relative goodness-of-fit for a specific statistical distribution and provides a rationale for the distribution type selection. The *AICc* values for all properties and tests are provided in Appendix A. In the subsequent discussions for each specific property we make note on the tables that normal distribution can be assumed if the percent change of the best fit distribution is less than 2 percent, based on the *AICc* criteria.

**Fill Compression (FC):** The distribution types for the Fill Compression (FC) tests are shown in Table 6 and Appendix A.1. For cold temperature dry (CTD) conditions the best fit distribution type for ultimate strength, modulus, and Poisson’s ratio is Weibull. For all other temperature conditions the distribution types vary. Comparing the percent change of the *AICc* value for the best-fit distribution type with respect to normal distribution is less than 2 percent for both ultimate strength and Poisson’s ratio.

**Quasi Filled Hole Compression (FHC1):** The distribution types for the Quasi Filled Hole Compression (FHC1) properties are shown in Table 7 and Appendix A.2. For room temperature dry (RTD) conditions the distribution for ultimate strength is lognormal, and for 250±5 °F elevated temperature wet (ETW2) conditions it is normal. However, in comparing the *AICc* value for these distributions, the strength at RTD = 37.772 ksi (260.43 MPa) for lognormal and 38.157 ksi (263.08 MPa) for normal, the percent difference is 1.02 percent; therefore, normal distribution can be considered for the RTD condition. Modulus data were not available. For the FHC1 properties, the percent change of the *AICc* value with respect to normal for ultimate strength at the RTD condition is 1.02 percent.

**Soft Filled Hole Compression (FHC2):** The distribution types for the Soft Filled Hole Compression (FHC2) properties are shown in Table 8 and Appendix A.3. For RTD conditions the distribution for ultimate strength is lognormal and for the ETW2 condition it is Weibull. The scale and shape parameters for these distributions are given in the table. Modulus test data were not available. The maximum percent change of the *AICc* value with respect to normal for ultimate strength at both temperature conditions is 1.21 percent.

**Hard Filled Hole Compression (FHC3):** The distribution types for the Hard Filled Hole Compression (FHC3) properties are shown in Table 9 and Appendix A.4. For RTD conditions the distribution for ultimate strength is lognormal, and for the ETW2 condition it is normal. The scale and shape parameters for these distributions are given in Table 9. For RTD, the percent difference of the *AICc* value between lognormal (43.971 ksi, 303.17 MPa) and normal (44.160 ksi, 304.47 MPa) is small at 0.43 percent; thus normal can be considered as the distribution for ultimate strength for both test temperature conditions. Modulus test data were not available. For the FHC3 properties, the percent change of the *AICc* value with respect to normal for ultimate strength at the RTD condition is less than 0.5 percent.

TABLE 6.—BEST-FIT DISTRIBUTION TYPES FOR FILL COMPRESSION (FC) TEST PROPERTIES FOR MTM45-1/CF7442A-36% RW: CMH CURE CYCLE  
[Graphical results in Appendix A.1.]

Test temperature condition <sup>a</sup>	Property <sup>b</sup>		
	Ultimate strength (ksi), measured	Modulus (Msi)	Poisson's ratio
CTD	Weibull (106.301, 17.198) or normal	Weibull (9.441, 18.381)	Weibull (0.058, 9.746) or normal
RTD	Weibull (83.806, 22.070) or normal	Lognormal (2.146, 0.080) or normal	Lognormal (-2.964, 0.060) or normal
RTW	Normal (70.028, 6.523)	Weibull (9.161, 71.045)	Lognormal (-3.309, 0.098) or normal
ETD1	Weibull (69.341, 16.841) or normal	Weibull (9.299, 14.094)	Lognormal (-3.137, 0.117) or normal
ETD2	Lognormal (3.981, 0.121) or normal	Lognormal (2.129, 0.099)	Weibull (0.036, 7.699) or normal
ETW	Weibull (62.210, 8.994) or normal	Lognormal (2.253, 0.046) or normal	Normal (0.039, 0.006)
ETW2	Lognormal (3.981, 0.121) or normal	Weibull (9.493, 17.059)	Weibull (0.044, 8.077) or normal

<sup>a</sup>Conditions are defined in Table 2.

<sup>b</sup>Parameters displayed with each distribution type are described in the Section "Overview of Distribution Types."

TABLE 7.—BEST-FIT DISTRIBUTION TYPES FOR QUASI FILLED HOLE COMPRESSION (FHC1) TEST PROPERTIES FOR MTM45-1/CF7442A-36% RW: CMH CURE CYCLE  
[Graphical results in Appendix A.2.]

Test temperature condition <sup>a</sup>	Property <sup>b</sup>	
	Ultimate strength (ksi)	Modulus (Msi)
RTD	Lognormal (4.018, 0.031) or normal	Excluded or not tested
ETW2	Normal (38.870, 3.303)	Excluded or not tested

<sup>a</sup>Conditions are defined in Table 2.

<sup>b</sup>Parameters displayed with each distribution type are described in the Section "Overview of Distribution Types."

TABLE 8.—BEST-FIT DISTRIBUTION TYPES FOR SOFT FILLED HOLE COMPRESSION (FHC2) TEST PROPERTIES FOR MTM45-1/CF7442A-36% RW: CMH CURE CYCLE  
[Graphical results in Appendix A.3.]

Test temperature condition <sup>a</sup>	Property <sup>b</sup>	
	Ultimate strength (ksi)	Modulus (Msi)
RTD	Lognormal (3.841, 0.019) or normal	Excluded or not tested
ETW2	Weibull (33.837, 23.123) or normal	Excluded or not tested

<sup>a</sup>Conditions are defined in Table 2.

<sup>b</sup>Parameters displayed with each distribution type are described in the Section "Overview of Distribution Types."

TABLE 9.—BEST-FIT DISTRIBUTION TYPES FOR HARD FILLED HOLE COMPRESSION (FHC3) TEST PROPERTIES FOR MTM45-1/CF7442A-36% RW: CMH CURE CYCLE  
[Graphical results in Appendix A.4.]

Test temperature condition <sup>a</sup>	Property <sup>b</sup>	
	Ultimate strength (ksi)	Modulus (Msi)
RTD	Lognormal (4.067, 0.043) or normal	Excluded or not tested
ETW2	Normal (42.977, 3.826)	Excluded or not tested

<sup>a</sup>Conditions are defined in Table 2.

<sup>b</sup>Parameters displayed with each distribution type are described in the Section “Overview of Distribution Types.”

TABLE 10.—BEST-FIT DISTRIBUTION TYPES FOR QUASI ISOTROPIC FILLED HOLE TENSION (FHT1) TEST PROPERTIES FOR MTM45-1/CF7442A-36% RW: CMH CURE CYCLE  
[Graphical results in Appendix A.5.]

Test temperature condition <sup>a</sup>	Property <sup>b</sup>	
	Ultimate strength (ksi)	Modulus (Msi)
CTD	Lognormal (4.135, 0.037) or normal	Excluded or not tested
RTD	Lognormal (4.102, 0.019) or normal	Excluded or not tested

<sup>a</sup>Conditions are defined in Table 2.

<sup>b</sup>Parameters displayed with each distribution type are described in the Section “Overview of Distribution Types.”

**Quasi Isotropic Filled Hole Tension (FHT1):** The distribution types for the Quasi Filled Hole Tension (FHT1) properties are shown in Table 10 and Appendix A.5. Both temperature conditions, RTD and ETW2 give a lognormal distribution with minor differences in the scale and shape parameters. For the FHT1 properties, the percent change of *AICc* value with respect to normal for ultimate strength at the CTD temperature condition is 0.08 percent, and for RTD it is 0.76 percent.

**Soft Filled Hole Tension (FHT2):** The distribution types for the Soft Filled Hole Tension (FHT2) properties are shown in Table 11 and Appendix A.6. Temperature conditions CTD and RTD give a Weibull distribution with minor differences in the scale and shape parameters, whereas ETW2 is lognormal. For the FHT2 properties, the percent change of the *AICc* value with respect to normal for ultimate strength at CTD and RTD temperature conditions is significantly different at 11 percent. However, for ETW2 the *AICc* value change is 0.32 percent between lognormal and normal distributions.

**Hard Filled Hole Tension (FHT3):** The distribution types for the Hard Filled Hole Tension (FHT3) properties are shown in Table 12 and Appendix A.7. Both temperature conditions, CTD and RTD, give a lognormal distribution with minor differences in the scale and shape parameters. Test data for modulus are not available. The percent change of the *AICc* value with respect to normal for ultimate strength at the CTD and RTD conditions is 0.34 and 0.15 percent, respectively.

**Warp Flexure Strength and Modulus (FSM):** The distribution types for the Warp Flexure Strength and Modulus (FSM) properties are shown in Table 13 and Appendix A.8. The RTD condition gives a Weibull distribution for ultimate strength and normal for modulus. The difference of the *AICc* for Weibull (151.529 ksi, 1044.76 MPa) and normal (151.643 ksi, 1045.54 MPa) is minor at 0.08 percent; thus, normal distribution can be considered for ultimate strength, for RTD. The percent change of the *AICc* value with respect to normal for ultimate strength at the 180±5 °F elevated temperature wet (ETW) condition is 0.7. The modulus for ETW is different at 2.33 percent with respect to normal distribution.

TABLE 11.—BEST-FIT DISTRIBUTION TYPES FOR SOFT FILLED HOLE TENSION (FHT2) TEST PROPERTIES FOR MTM45-1/CF7442A-36% RW: CMH CURE CYCLE  
[Graphical results in Appendix A.6.]

Test temperature condition <sup>a</sup>	Property <sup>b</sup>	
	Ultimate strength (ksi)	Modulus (Msi)
CTD	Weibull (50.952, 71.599)	Excluded or not tested
RTD	Weibull (45.116, 69.277)	Excluded or not tested
ETW2	Lognormal (3.556, 0.032) or normal	Excluded or not tested

<sup>a</sup>Conditions are defined in Table 2.

<sup>b</sup>Parameters displayed with each distribution type are described in the Section “Overview of Distribution Types.”

TABLE 12.—BEST-FIT DISTRIBUTION TYPES FOR HARD FILLED HOLE TENSION (FHT3) TEST PROPERTIES FOR MTM45-1/CF7442A-36% RW: CMH CURE CYCLE  
[Graphical results in Appendix A.7.]

Test temperature condition <sup>a</sup>	Property <sup>b</sup>	
	Ultimate strength (ksi)	Modulus (Msi)
CTD	Lognormal (4.310, 0.029) or normal	Excluded or not tested
RTD	Lognormal (4.361, 0.038) or normal	Excluded or not tested

<sup>a</sup>Conditions are defined in Table 2.

<sup>b</sup>Parameters displayed with each distribution type are described in the Section “Overview of Distribution Types.”

TABLE 13.—BEST-FIT DISTRIBUTION TYPES FOR WARP FLEXURE STRENGTH AND MODULUS (FSM) TEST PROPERTIES FOR MTM45-1/CF7442A-36% RW: CMH CURE CYCLE  
[Graphical results in Appendix A.8.]

Test temperature condition <sup>a</sup>	Property <sup>b</sup>		
	Ultimate strength (ksi), measured	Modulus (Msi), measured	Poisson’s ratio
RTD	Weibull (117.573, 8.949) or normal	Excluded or not tested	Not tested
ETW	Lognormal (4.489, 0.077) or normal	Excluded or not tested	Not tested

<sup>a</sup>Conditions are defined in Table 2.

<sup>b</sup>Parameters displayed with each distribution type are described in the Section “Overview of Distribution Types.”



**Fill Tension (FT):** The distribution types for the Fill Tension (FT) properties are shown in Table 14 and Appendix A.9. There is variation in the distribution types for the different test temperatures and response variables. However, when comparing the *AICc* values for each of these distributions with those for normal distribution, the differences are small—less than 2 percent difference—thus normal distribution can be considered. However, the difference in the variations for ETW condition for ultimate strength is 2.45 percent, and for modulus it is 4.51 percent. The percent difference of the modulus for the 350±5 °F elevated temperature dry (ETD2) condition is 2.58 percent.

**In-Plane Shear (11.5 Inches Length) (IPS1):** The distribution types for the In-Plane Shear (IPS1) properties are shown in Table 15 and Appendix A.10. The response variables are shear strength measured at 2 percent offset, 5 percent offset, and maximum shear, as well as modulus. There is variation in the distribution types between the test temperatures and the response variables. Normal distribution can be assumed for a few of the test temperatures and properties as noted in the table.

**Quasi Isotropic Open Hole Compression (OHC1):** The distribution types for the Quasi Isotropic Open Hole Compression (OHC1) properties are shown in Table 16 and Appendix A.11. The response variables are ultimate strength and modulus. Normal distribution can be assumed for ultimate strength and modulus for the different test temperature conditions, as noted in the table.

**Soft Open Hole Compression (OHC2):** The distribution types for the Soft Open Hole Compression (OHC2) properties are shown in Table 17 and Appendix A.12. The distribution type for ultimate strength is Weibull. Data were not available for modulus. Normal distribution cannot be assumed for these properties since the percent variation of the *AICc* value is 6.86 percent for RTD and 5.14 percent for ETW2.

TABLE 14.—BEST-FIT DISTRIBUTION TYPES FOR FILL TENSION (FT) TEST PROPERTIES  
FOR MTM45-1/CF7442A-36% RW: CMH CURE CYCLE  
[Graphical results in Appendix A.9.]

Test temperature condition <sup>a</sup>	Property <sup>b</sup>		
	Ultimate strength (ksi), measured	Modulus (Msi), measured	Poisson's ratio
CTD	Weibull (141.923, 25.610) or normal	Weibull (10.615, 25.841) or normal	Normal (0.0690, 0.012)
RTD	Lognormal (4.878, 0.057) or normal	Normal (9.628, 0.678)	Lognormal (-2.899, 0.189)
RTW	Lognormal (4.814, 0.062) or normal	Lognormal (2.295, 0.033) or normal	Lognormal (-2.959, 0.0981) or normal
ETD1	Weibull (120.861, 11.814) or normal	Lognormal (2.170, 0.032) or normal	Weibull (0.0459, 5.993) or normal
ETD2	Weibull (110.091, 10.944) or normal	Lognormal (2.0915, 0.046)	N < 4
ETW	Weibull (115.277, 21.907)	Weibull (10.585, 32.659) or normal	Lognormal (-3.091, 0.220) or normal
ETW2	Lognormal (4.689, 0.057) or normal	Lognormal (2.347, 0.055)	Weibull (0.0618, 6.685) or normal

<sup>a</sup>Conditions are defined in Table 2.

<sup>b</sup>Parameters displayed with each distribution type are described in the Section "Overview of Distribution Types."

TABLE 15.—BEST-FIT DISTRIBUTION TYPES FOR IN PLANE SHEAR (11.5 INCHES LENGTH) (IPS1)  
TEST PROPERTIES FOR MTM45-1/CF7442A-36% RW: CMH CURE CYCLE  
[Graphical results in Appendix A.10.]

Test temperature condition <sup>a</sup>	Property <sup>b</sup>			
	Shear strength (ksi), at 0.2% offset	Shear strength (ksi), at 5% offset	Shear strength (ksi), maximum	Modulus (Msi), measured
CTD	Normal (8.903,0.892)	Lognormal (2.646, 0.058) or normal	Lognormal (2.908, 0.079) or normal	Normal (0.683, 0.032)
RTD	Lognormal (1.737, 0.051) or normal	Lognormal (2.373, 0.066) or normal	Lognormal (2.673, 0.062) or normal	Weibull (0.598, 16.574)
ETD1	Lognormal (1.436,0.060)	Lognormal (1.955, 0.037) or normal	Lognormal (2.272, 0.020)	Lognormal (−0.841, 0.081) or normal
ETD2	Gage error	Gage error	Weibull (7.207, 48.6)	Gage error
ETW	Lognormal (1.426, 0.08)	Weibull (6.912, 86.099)	Lognormal (2.221, 0.036) or normal	Lognormal (−0.824, 0.083) or normal
ETW2	Lognormal (1.187, 0.081)	N < 2	Lognormal (2.077, 0.028)	Lognormal (−1.086, 0.109)

<sup>a</sup>Conditions are defined in Table 2.

<sup>b</sup>Parameters displayed with each distribution type are described in the Section “Overview of Distribution Types.”

TABLE 16.—BEST-FIT DISTRIBUTION TYPES FOR QUASI ISOTROPIC OPEN HOLE COMPRESSION (OHC1) TEST PROPERTIES FOR MTM45-1/CF7442A-36% RW: CMH CURE CYCLE  
[Graphical results in Appendix A.11.]

Test temperature condition <sup>a</sup>	Property <sup>b</sup>	
	Ultimate strength (ksi)	Modulus (Msi)
RTD	Lognormal (3.727, 0.032) or normal	Normal (5.136, 0.240)
ETD2	Weibull (31.380, 19.852)	Lognormal (1.685, 0.112) or normal
ETW	Lognormal (3.504, 0.029) or normal	Gage error
ETW2	Lognormal (3.441, 0.034) or normal	Lognormal (1.926, 0.093)

<sup>a</sup>Conditions are defined in Table 2.

<sup>b</sup>Parameters displayed with each distribution type are described in the Section “Overview of Distribution Types.”

TABLE 17.—BEST-FIT DISTRIBUTION TYPES FOR SOFT OPEN HOLE COMPRESSION (OHC2) TEST PROPERTIES FOR MTM45-1/CF7442A-36% RW: CMH CURE CYCLE  
[Graphical results in Appendix A.12.]

Test temperature condition <sup>a</sup>	Property <sup>b</sup>	
	Ultimate strength (ksi)	Modulus (Msi)
RTD	Weibull (36.831, 69.938)	Excluded or not tested
ETW2	Weibull (26.489, 27.357)	Excluded or not tested

<sup>a</sup>Conditions are defined in Table 2.

<sup>b</sup>Parameters displayed with each distribution type are described in the Section “Overview of Distribution Types.”

**Hard Open Hole Compression (OHC3):** The distribution types for the Hard Open Hole Compression (OHC3) properties are shown in Table 18 and Appendix A.13. The distribution type for ultimate strength is lognormal; however, normal can also be assumed. Data were not available for modulus.

**Quasi Isotropic Open Hole Tension (OHT1):** The distribution types for the Quasi Isotropic Open Hole Tension (OHT1) properties are shown in Table 19 and Appendix A.14. The distribution types vary for ultimate strength and test temperatures. For the modulus, the distribution types are lognormal for all test temperatures. Normal distribution can also be assumed as noted in the table.

**Soft Open Hole Tension (OHT2):** The distribution types for the Soft Open Hole Tension (OHT2) properties are shown in Table 20 and Appendix A.15. The distribution types for ultimate strength are evaluated as lognormal or normal for CTD, Weibull or normal for RTD, and Weibull for ETW2, with their respective shape and scale parameters, as given in Table 20. Data for modulus were not available.

**Hard Open Hole Tension (OHT3):** The distribution types for the Hard Open Hole Tension (OHT3) properties are shown in Table 21 and Appendix A.16. The distribution types for ultimate strength are evaluated as lognormal for RTD and ETW2 and Weibull for CTD. However, normal can also be assumed. Data for modulus were not available.

TABLE 18.—BEST-FIT DISTRIBUTION TYPES FOR HARD OPEN HOLE COMPRESSION (OHC3) TEST PROPERTIES FOR MTM45-1/CF7442A-36% RW: CMH CURE CYCLE  
[Graphical results in Appendix A.13.]

Test temperature condition <sup>a</sup>	Property <sup>b</sup>	
	Ultimate strength (ksi)	Modulus (Msi)
RTD	Lognormal (3.771, 0.039) or normal	Excluded or not tested
ETW2	Lognormal (3.408, 0.050) or normal	Excluded or not tested

<sup>a</sup>Conditions are defined in Table 2.

<sup>b</sup>Parameters displayed with each distribution type are described in the Section “Overview of Distribution Types.”

TABLE 19.—BEST-FIT DISTRIBUTION TYPES FOR QUASI ISOTROPIC OPEN HOLE TENSION (OHT1) TEST PROPERTIES FOR MTM45-1/CF7442A-36% RW: CMH CURE CYCLE  
[Graphical results in Appendix A.14.]

Test temperature condition <sup>a</sup>	Property <sup>b</sup>	
	Ultimate strength (ksi)	Modulus (Msi)
CTD	Normal (60.356, 1.997)	Lognormal (2.046, 0.061) or normal
RTD	Lognormal (4.114, 0.040) or normal	Lognormal (2.016, 0.021)
ETD2	Lognormal (3.820, 0.033) or normal	Lognormal (1.892, 0.046) or normal
ETW	Weibull (59.233, 54.230)	Lognormal (2.046, 0.026)
ETW2	Normal (57.725, 3.290)	Lognormal (2.054, 0.023) or normal

<sup>a</sup>Conditions are defined in Table 2.

<sup>b</sup>Parameters displayed with each distribution type are described in the Section “Overview of Distribution Types.”

TABLE 20.—BEST-FIT DISTRIBUTION TYPES FOR SOFT OPEN HOLE TENSION (OHT2) TEST PROPERTIES FOR MTM45-1/CF7442A-36% RW: CMH CURE CYCLE  
[Graphical results in Appendix A.15.]

Test temperature condition <sup>a</sup>	Property <sup>b</sup>	
	Ultimate strength (ksi)	Modulus (Msi)
CTD	Normal (60.356, 1.997)	Lognormal (2.046, 0.061) or normal
RTD	Lognormal (4.114, 0.040) or normal	Lognormal (2.016, 0.021)
ETW2	Lognormal (3.820, 0.033) or normal	Lognormal (1.892, 0.046) or normal

<sup>a</sup>Conditions are defined in Table 2.

<sup>b</sup>Parameters displayed with each distribution type are described in the Section “Overview of Distribution Types.”

TABLE 21.—BEST-FIT DISTRIBUTION TYPES FOR HARD OPEN HOLE TENSION (OHT3) TEST PROPERTIES FOR MTM45-1/CF7442A-36% RW: CMH CURE CYCLE  
[Graphical results in Appendix A.16.]

Test temperature condition <sup>a</sup>	Property <sup>b</sup>	
	Ultimate strength (ksi)	Modulus (Msi)
CTD	Weibull (76.321, 15.912) or normal	Not tested
RTD	Lognormal (4.359, 0.044) or normal	Not tested
ETW2	Lognormal (4.311, 0.032) or normal	Not tested

<sup>a</sup>Conditions are defined in Table 2.

<sup>b</sup>Parameters displayed with each distribution type are described in the Section “Overview of Distribution Types.”

**Quasi Isotropic Pin Bearing (PB1):** The distribution types for the Quasi Isotropic Pin Bearing (PB1) properties are shown in Table 22 and Appendix A.17. For RTD, the distribution type for ultimate strength, strength at 2 percent offset, and strength at 4 percent offset is Weibull with the scale and shape parameters given in the table. For the ETW2 condition, the distribution types are evaluated as lognormal for the strength at initial peak and Weibull for the ultimate, 2 percent offset, and 4 percent offset. Normal distribution can be assumed as noted in the table.

**Soft Pin Bearing (PB2):** The distribution types for the Soft Pin Bearing (PB2) properties are shown in Table 23 and Appendix A.18. The response variables are strength initial peak, ultimate strength, strength at 2 percent offset, and strength at 4 percent offset. The distribution types vary for RTD and ETW2. However, normal distribution can be assumed for these property conditions.

**Hard Pin Bearing (PB3):** The distribution types for the Hard Pin Bearing (PB3) properties are shown in Table 24 and Appendix A.19. The response variables are strength initial peak, ultimate strength, strength at 2 percent offset, and strength at 4 percent offset. The distribution types are lognormal for RTD and ETW2 test temperatures and Weibull for the 4-percent-offset strength. The percent change between the best fit distributions with respect to normal is less than 2 percent; therefore, normal can also be assumed for these properties.

**Short Beam Strength (SBS):** The distribution types for the Short Beam Strength (SBS) properties are shown in Table 25 and Appendix A.20. For ultimate strength, the distribution varies between lognormal and Weibull as shown in the table. Normal can be assumed for CTD only.

TABLE 22.—BEST-FIT DISTRIBUTION TYPES FOR QUASI ISOTROPIC PIN BEARING (PB1) TEST PROPERTIES FOR MTM45-1/CF7442A-36% RW: CMH CURE CYCLE  
[Graphical results in Appendix A.17.]

Test temperature condition <sup>a</sup>	Property <sup>b</sup>			
	Initial peak strength (ksi)	Ultimate strength (ksi)	2% offset strength (ksi)	4% offset strength (ksi)
RTD	No result	Weibull (128.987, 27.58) or normal	Weibull (83.138, 10.013) or normal	Weibull (97.352, 16.242)
ETW2	Lognormal (4.423, 0.084) or normal	Weibull (105.228, 25.917)	Weibull (81.878, 12.259)	Weibull (87.516, 17.625) or normal

<sup>a</sup>Conditions are defined in Table 2.

<sup>b</sup>Parameters displayed with each distribution type are described in the Section “Overview of Distribution Types.”

TABLE 23.—BEST-FIT DISTRIBUTION TYPES FOR SOFT PIN BEARING (PB2) TEST PROPERTIES FOR MTM45-1/CF7442A-36% RW: CMH CURE CYCLE  
[Graphical results in Appendix A.18.]

Test temperature condition <sup>a</sup>	Property <sup>b</sup>			
	Initial peak strength (ksi)	Ultimate strength (ksi)	2% Offset strength (ksi)	4% Offset strength (ksi)
RTD	No result	Weibull (121.662, 40.553) or normal	Lognormal (4.447, 0.049) or normal	Lognormal (4.541, 0.051) or Normal
ETW2	Normal (81.442, 7.203)	Lognormal (4.516, 0.037) or normal	Weibull (68.039, 12.645) or normal	Normal (74.470, 3.60)

<sup>a</sup>Conditions are defined in Table 2.

<sup>b</sup>Parameters displayed with each distribution type are described in the Section “Overview of Distribution Types.”

TABLE 24.—BEST-FIT DISTRIBUTION TYPES FOR HARD PIN BEARING (PB3) TEST PROPERTIES FOR MTM45-1/CF7442A-36% RW: CMH CURE CYCLE  
[Graphical results in Appendix A.19.]

Test temperature condition <sup>a</sup>	Property <sup>b</sup>			
	Initial peak strength (ksi)	Ultimate strength (ksi)	2% Offset strength (ksi)	4% Offset strength (ksi)
RTD	Lognormal (4.671, 0.069) or normal	Lognormal (4.810, 0.054) or normal	Lognormal (4.320, 0.154) or normal	Weibull (97.163, 9.308) or normal
ETW2	Lognormal (4.246, 0.100) or normal	Lognormal (4.533, 0.060) or normal	Lognormal (3.997, 0.203) or normal	Weibull (68.510, 10.652) or normal

<sup>a</sup>Conditions are defined in Table 2.

<sup>b</sup>Parameters displayed with each distribution type are described in the Section “Overview of Distribution Types.”

TABLE 25.—BEST-FIT DISTRIBUTION TYPES FOR SHORT BEAM STRENGTH (SBS) TEST PROPERTIES FOR MTM45-1/CF7442A-36% RW: CMH CURE CYCLE  
[Graphical results in Appendix A.20.]

Test temperature condition <sup>a</sup>	Property <sup>b</sup>
	Ultimate strength (ksi), measured
CTD	Lognormal (2.433, 0.046) or normal
RTD	Weibull (9.564, 38.118)
ETD1	Lognormal (1.962, 0.032)
ETW	Weibull (6.506, 25.324)
ETW2	Lognormal (1.600, 0.049)

<sup>a</sup>Conditions are defined in Table 2.

<sup>b</sup>Parameters displayed with each distribution type are described in the Section “Overview of Distribution Types.”

**Quasi Isotropic Short Beam Strength (SBS1):** The distribution types for the Quasi Isotropic Short Beam Strength (SBS1) properties are shown in Table 26 and Appendix A.21. For ultimate strength, the distribution is Weibull for all three test temperature conditions. Normal distribution cannot be assumed for any of these properties, since the difference in the *AICc* value is in the range 4.45 to 26.13 percent.

**Quasi Isotropic Compression (UNC1):** The distribution types for the Quasi Isotropic Compression (UNC1) properties are shown in Table 27 and Appendix A.22. For ultimate strength and modulus, the distribution is Weibull for ETW2 and lognormal for ETW test conditions. RTD has a normal distribution for ultimate strength and lognormal for modulus; however, normal distribution is acceptable. Poisson’s ratio data are not available.

**Soft Compression (UNC2):** The distribution types for the Soft Compression (UNC2) properties are shown in Table 28 and Appendix A.23. For ultimate strength, the distribution is lognormal or normal for RTD and Weibull for ETW2. For modulus the distribution type is Weibull for RTD and lognormal for ETW2. Poisson’s ratio data are not available.

**Hard Compression (UNC3):** The distribution types for the Hard Compression (UNC3) properties are shown in Table 29 and Appendix 24. For RTD ultimate strength the distribution is Weibull for RTD and lognormal for ETW2. For ETW2 the distribution type is lognormal or normal for ultimate strength and Weibull for modulus. Poisson’s ratio data are not available.

**Quasi Isotropic Tension (UNT1):** The distribution types for the Quasi Isotropic Tension (UNT1) properties are shown in Table 30 and Appendix A.25. For ultimate strength the distribution varies between the three test temperatures and for modulus the distribution is lognormal for CTD and ETW2 and Weibull for RTD. Poisson’s ratio data are not available.

**Soft Tension (UNT2):** The distribution types for the Soft Tension (UNT2) properties are shown in Table 31 and Appendix A.26. For ultimate strength and modulus response variables, the distributions are lognormal with the exception of RTD ultimate strength with a Weibull distribution. Poisson’s ratio data are not available. Normal distribution can be assumed for ultimate strength and modulus, as noted in the table.

TABLE 26.—BEST-FIT DISTRIBUTION TYPES FOR QUASI ISOTROPIC SHORT BEAM STRENGTH (SBS1) TEST PROPERTIES FOR MTM45-1/CF7442A-36% RW: CMH CURE CYCLE  
[Graphical results in Appendix A.21.]

Test temperature condition <sup>a</sup>	Property <sup>b</sup>
	Ultimate strength (ksi), measured
RTD	Weibull (8.606, 34.978)
ETW	Weibull (6.114, 17.023)
ETW2	Weibull (4.70, 22.380)

<sup>a</sup>Conditions are defined in Table 2.

<sup>b</sup>Parameters displayed with each distribution type are described in the Section “Overview of Distribution Types.”

TABLE 27.—BEST-FIT DISTRIBUTION TYPES FOR QUASI ISOTROPIC COMPRESSION (UNC1) TEST PROPERTIES FOR MTM45-1/CF7442A-36% RW: CMH CURE CYCLE  
[Graphical results in Appendix A.22.]

Test temperature condition <sup>a</sup>	Property <sup>b</sup>	
	Ultimate strength (ksi), measured	Modulus (Msi), measured
RTD	Normal (67.523, 3.823)	Lognormal (1.847, 0.032)
ETW	Lognormal (3.957, 0.036) or normal	Lognormal (1.911, 0.034)
ETW2	Weibull (46.421, 20.814) or normal	Weibull (6.946, 27.106)

<sup>a</sup>Conditions are defined in Table 2.

<sup>b</sup>Parameters displayed with each distribution type are described in the Section “Overview of Distribution Types.”

TABLE 28.—BEST-FIT DISTRIBUTION TYPES FOR SOFT COMPRESSION (UNC2)  
TEST PROPERTIES FOR MTM45-1/CF7442A-36% RW: CMH CURE CYCLE  
[Graphical results in Appendix A.23.]

Test temperature condition <sup>a</sup>	Property <sup>b</sup>	
	Ultimate strength (ksi), measured	Modulus (Msi), measured
RTD	Lognormal (3.891, 0.030) or normal	Weibull (4.372, 103.167)
ETW2	Weibull (35.332, 37.019)	Lognormal (1.405, 0.041)

<sup>a</sup>Conditions are defined in Table 2.

<sup>b</sup>Parameters displayed with each distribution type are described in the Section “Overview of Distribution Types.”

TABLE 29.—BEST-FIT DISTRIBUTION TYPES FOR HARD COMPRESSION (UNC3)  
TEST PROPERTIES FOR MTM45-1/CF7442A-36% RW: CMH CURE CYCLE  
[Graphical results in Appendix A.24.]

Test temperature condition <sup>a</sup>	Property <sup>b</sup>	
	Ultimate strength (ksi), measured	Modulus (Msi), measured
RTD	Weibull (81.148, 50.142)	Lognormal (2.143, 0.033)
ETW2	Lognormal (4.068, 0.072) or normal	Weibull (8.785, 95.155)

<sup>a</sup>Conditions are defined in Table 2.

<sup>b</sup>Parameters displayed with each distribution type are described in the Section “Overview of Distribution Types.”

TABLE 30.—BEST-FIT DISTRIBUTION TYPES FOR QUASI ISOTROPIC TENSION (UNT1) TEST PROPERTIES FOR MTM45-1/CF7442A-36% RW: CMH CURE CYCLE  
[Graphical results in Appendix A.25.]

Test temperature condition <sup>a</sup>	Property <sup>b</sup>	
	Ultimate strength (ksi), measured	Modulus (Msi), measured
CTD	Normal (105.729, 5.941)	Lognormal (2.092, 0.039)
RTD	Lognormal (4.618, 0.048) or normal	Weibull (7.271, 58.429)
ETW2	Weibull (73.847, 39.746)	Lognormal (2.00, 0.023)

<sup>a</sup>Conditions are defined in Table 2.

<sup>b</sup>Parameters displayed with each distribution type are described in the Section “Overview of Distribution Types.”

TABLE 31.—BEST-FIT DISTRIBUTION TYPES FOR SOFT TENSION (UNT2) TEST PROPERTIES FOR MTM45-1/CF7442A-36% RW: CMH CURE CYCLE  
[Graphical results in Appendix A.26.]

Test temperature condition <sup>a</sup>	Property <sup>b</sup>	
	Ultimate strength (ksi), measured	Modulus (Msi), measured
CTD	Lognormal (4.176, 0.015) or normal	Lognormal (1.420, 0.034)
RTD	Weibull (59.029, 42.698) or normal	Lognormal (1.522, 0.017) or normal
ETW2	Lognormal (3.703, 0.025) or normal	Lognormal (1.422, 0.033)

<sup>a</sup>Conditions are defined in Table 2.

<sup>b</sup>Parameters displayed with each distribution type are described in the Section “Overview of Distribution Types.”

**Hard Tension (UNT3):** The distribution types for the Hard Tension (UNT3) properties are shown in Table 32 and Appendix A.27. For ultimate strength the distributions are Weibull and lognormal and for modulus the distributions are lognormal. Poisson’s ratio data are not available. Normal distribution can be assumed for RTD and ETW2 for ultimate strength.

**Warp Compression (WC):** The distribution types for the Warp Compression (WC) properties are shown in Table 33 and Appendix A.28. For the ETW temperature condition the distribution is Weibull for all three response variables. For test temperature ETW2, the distributions are lognormal for all three response variables. For CTD and RTD the distributions vary as shown in the table. For both ultimate strength and Poisson’s ratio, normal distribution can be assumed for all temperature conditions.

**Warp Tension (WT):** The distribution types for the Warp Tension (WT) properties are shown in Table 34 and Appendix A.29. For ETW2 the distribution is lognormal for both ultimate strength and modulus response variables. Comparing the *AICc* values for CTD, RTD, and ETW the difference is less than 1 percent; therefore, either distribution can be assumed, as noted in the table. Data for Poisson’s ratio are not available.

TABLE 32.—BEST-FIT DISTRIBUTION TYPES FOR HARD TENSION (UNT3)  
TEST PROPERTIES FOR MTM45-1/CF7442A-36% RW: CMH CURE CYCLE

[Graphical results in Appendix A.27.]

Test temperature condition <sup>a</sup>	Property <sup>b</sup>	
	Ultimate strength (ksi), measured	Modulus (Msi), measured
CTD	Weibull (139.818, 26.967)	Lognormal (2.113, 0.025)
RTD	Lognormal (4.877, 0.042) or normal	Lognormal (2.232, 0.022)
ETW2	Weibull (106.552, 31.986) or normal	Lognormal (2.246, 0.012)

<sup>a</sup>Conditions are defined in Table 2.

<sup>b</sup>Parameters displayed with each distribution type are described in the Section “Overview of Distribution Types.”

TABLE 33.—BEST-FIT DISTRIBUTION TYPES FOR WARP COMPRESSION (WC)  
TEST PROPERTIES FOR MTM45-1/CF7442A-36% RW: CMH CURE CYCLE

[Graphical results in Appendix A.28.]

Test temperature condition <sup>a</sup>	Property <sup>b</sup>		
	Ultimate strength (ksi), measured	Modulus (Msi), measured	Poisson’s ratio
CTD	Lognormal (4.731, 0.066) or normal	Weibull (9.517, 26.959)	Lognormal (–2.951, 0.164) or normal
RTD	Lognormal (4.399, 0.066) or normal	Normal (8.611, 0.384)	Lognormal (–3.177, 0.167) or normal
ETW	Weibull (65.778, 11.128) or normal	Weibull (10.051, 26.983)	Weibull (0.046, 6.353) or normal
ETW2	Lognormal (4.051, 0.087) or normal	Lognormal (2.279, 0.057) or normal	Lognormal (–3.247, 0.148) or normal

<sup>a</sup>Conditions are defined in Table 2.

<sup>b</sup>Parameters displayed with each distribution type are described in the Section “Overview of Distribution Types.”

TABLE 34.—BEST-FIT DISTRIBUTION TYPES FOR WARP TENSION (WT)  
TEST PROPERTIES FOR MTM45-1/CF7442A-36% RW: CMH CURE CYCLE

[Graphical results in Appendix A.29.]

Test temperature condition <sup>a</sup>	Property <sup>b</sup>	
	Ultimate strength (ksi), measured	Modulus (Msi), measured
CTD	Lognormal (4.984, 0.069) or normal	Normal (10.286, 0.557)
RTD	Normal (141.518, 8.840)	Lognormal (2.326, 0.029)
ETW	Normal (124.661, 8.533)	Lognormal (2.345, 0.017) or normal
ETW2	Lognormal (4.803, 0.075) or normal	Lognormal (2.362, 0.033)

<sup>a</sup>Conditions are defined in Table 2.

<sup>b</sup>Parameters displayed with each distribution type are described in the Section “Overview of Distribution Types.”



## Concluding Remarks

Statistical distributions were investigated for the material reported in “NPN100101 AITR1615-IMPW MTM45-1 IM7 6K PW RAW DATA REPORT.” The best-fitted distributions that are obtained using the JPM software will be utilized in future probabilistic analyses of spacecraft structures. A comparison table for all distributions was generated and the Akaike’s Information Criterion (*AICc*) value is depicted for each type in ascending order, along with the Summary Distributions for each fitted distribution type, Diagnostic Plots, and Goodness-of-Fit Tests. Distribution types with the smaller *AICc* values indicate the best fit. In many cases, as noted in the tables, the difference of the *AICc* values compared with the normal distribution was very small, namely less than 2 percent, indicating that various test temperature conditions and properties can fit a normal distribution. For these cases there is no need to choose only one particular distribution, which eliminates the problems of making incorrect assumptions of the chosen distribution.

## Forward Work

We recommend a building block analysis approach to study material combinations and their effects on the performance of structural components accounting for the scatter in stiffness and strength of the composite material. To this end we can start with simple beams and plates and consider their stability, vibrations, and strength. We can explore how the performance is affected because of the measured variability in the properties and arrive at recommendations regarding the extent of material uncertainties that can be endured without adversely affecting the performance and reliability.

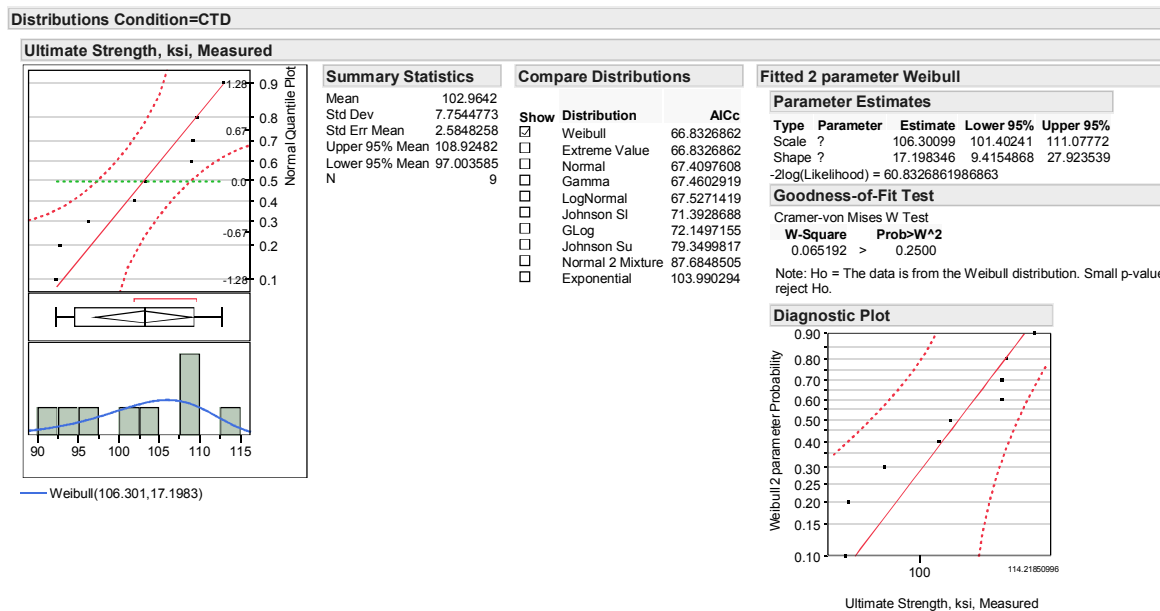


## Appendix A

The distribution types for material physical properties such as ultimate strength, modulus, and Poisson's ratio are determined using the commercially available statistical discovery software JMP Pro (Ref. 3). This appendix presents the best-fit distributions for each test type described in the report, using JMP's graphical and semigraphical methods. The "Distribution Condition" is shown on the top bar followed by the material property, such as "Ultimate Strength, ksi, Measured," and the corresponding results. The graphical methods depict the "Normal Quantile Plot" to assist in visualizing the extent to which a variable is normally distributed. The normal quantile plot also shows confidence bounds and Probability Normal Quantile Scales. The "Outlier Box Plot" identifies possible outliers. The vertical line within the box represents the median sample value. The confidence diamond represents the upper and lower 95 percent of the mean. A line through the middle of the diamond represents the mean. The ends of the box represent the 25th and 75th quantiles, and the bracket outside of the box identifies the shortest half, which is the most dense 50 percent of the observations. The data are displayed using histograms that show a bar for grouped values of the continuous variable and a line graph depicting the best distribution fit. "Summary Statistics" for each distribution are given in terms of the mean, standard deviation, and the standard error of the mean. The upper and lower 95 percent mean confidence limits about the mean define the interval that is likely to contain the true sample mean. Next to Summary Statistics, a "Compare Distributions" table including the *AICc* value is provided. The fitted "Parameter Estimates" along with the "Goodness-of-Fit" test statistics and a "Diagnostic Plot" is displayed for the best fit distribution.

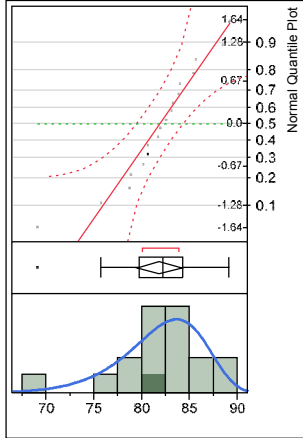
### A.1 Fill Compression (FC)

The determination of statistical distribution types for the Fill Compression (FC) test results is presented here.



Distributions Condition=RTD

Ultimate Strength, ksi, Measured



Weibull(63.8064,22.0702)

Summary Statistics

Mean	81.826125
Std Dev	4.6436514
Std Err Mean	1.0945191
Upper 95% Mean	84.135359
Lower 95% Mean	79.516892
N	18

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Weibull	108.174923
<input type="checkbox"/>	Extreme Value	108.174923
<input type="checkbox"/>	Normal	110.159823
<input type="checkbox"/>	Gamma	110.834483
<input type="checkbox"/>	Johnson SI	111.035983
<input type="checkbox"/>	LogNormal	111.222155
<input type="checkbox"/>	Johnson Su	113.87813
<input type="checkbox"/>	GLog	114.136441
<input type="checkbox"/>	Normal 2 Mixture	121.072207
<input type="checkbox"/>	Normal 3 Mixture	138.116225
<input type="checkbox"/>	Exponential	196.815477

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	83.806354	81.824308	85.730533
Shape	$\beta$	22.070228	14.946579	30.443801

-2log(Likelihood) = 103.37492301562

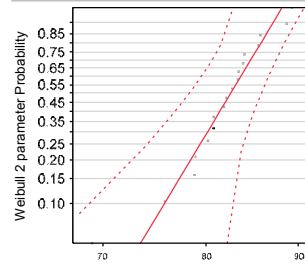
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square	Prob>W*2
0.044386	> 0.2500

Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

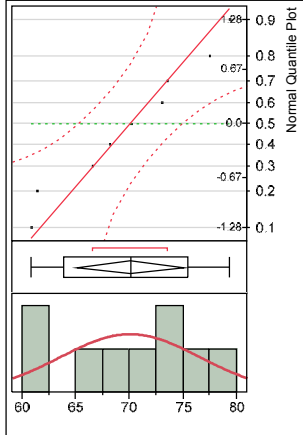
Diagnostic Plot



Ultimate Strength, ksi, Measured

Distributions Condition=RTW

Ultimate Strength, ksi, Measured



Normal(70.0283,6.52319)

Summary Statistics

Mean	70.028328
Std Dev	6.5231911
Std Err Mean	2.174397
Upper 95% Mean	75.042497
Lower 95% Mean	65.01416
N	9

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Normal	64.29744
<input type="checkbox"/>	Gamma	64.2977561
<input type="checkbox"/>	Weibull	64.3014483
<input type="checkbox"/>	Extreme Value	64.3014483
<input type="checkbox"/>	LogNormal	64.3496235
<input type="checkbox"/>	Johnson SI	68.9868501
<input type="checkbox"/>	GLog	69.0373944
<input type="checkbox"/>	Johnson Su	76.2375728
<input type="checkbox"/>	Normal 2 Mixture	90.5327293
<input type="checkbox"/>	Exponential	97.0516259

Fitted Normal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Location	$\mu$	70.028328	65.01416	75.042497
Dispersion	$\sigma$	6.5231911	4.4061353	12.49694

-2log(Likelihood) = 58.29744400057054

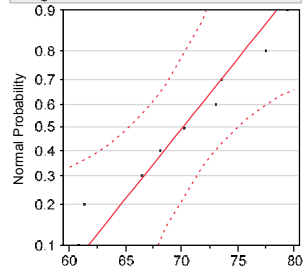
Goodness-of-Fit Test

Shapiro-Wilk W Test

W	Prob<W
0.953510	0.7286

Note: Ho = The data is from the Normal distribution. Small p-values reject Ho.

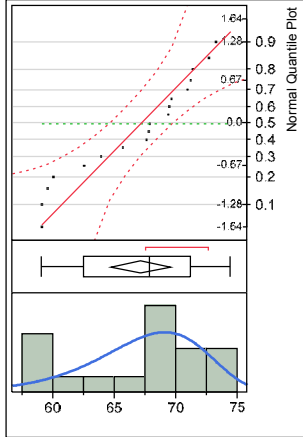
Diagnostic Plot



Ultimate Strength, ksi, Measured

Distributions Condition=ETD1

Ultimate Strength, ksi, Measured



— Weibull(69.3412,16.8409)

Summary Statistics

Mean	67.122806
Std Dev	5.0751023
Std Err Mean	1.1643083
Upper 95% Mean	69.568927
Lower 95% Mean	64.676685
N	19

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Weibull	117.773164
<input type="checkbox"/>	Extreme Value	117.773164
<input type="checkbox"/>	Normal	119.394838
<input type="checkbox"/>	Gamma	119.760773
<input type="checkbox"/>	LogNormal	119.987156
<input type="checkbox"/>	Normal 2 Mixture	120.009362
<input type="checkbox"/>	Johnson SI	120.363902
<input type="checkbox"/>	GLog	122.217562
<input type="checkbox"/>	Johnson Su	125.474932
<input type="checkbox"/>	Normal 3 Mixture	141.456769
<input type="checkbox"/>	Exponential	200.083201

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	69.341186	67.239362	71.375537
Shape	$\beta$	16.840938	11.323675	23.629987

-2log(Likelihood) = 113.023164199787

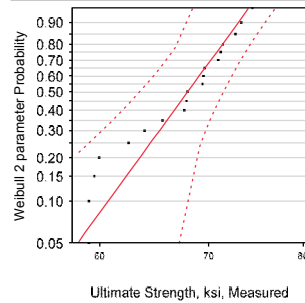
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square	Prob>W^2
0.052964	> 0.2500

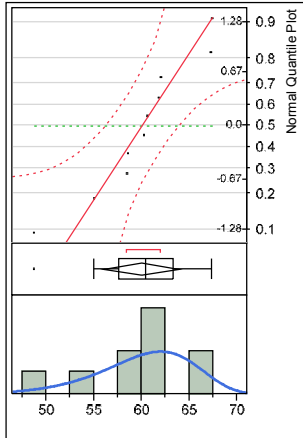
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETD2

Ultimate Strength, ksi, Measured



— Weibull(62.3335,13.6774)

Summary Statistics

Mean	60.024976
Std Dev	5.5233889
Std Err Mean	1.7466489
Upper 95% Mean	63.976171
Lower 95% Mean	56.073782
N	10

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Weibull	66.6275685
<input type="checkbox"/>	Extreme Value	66.6275685
<input type="checkbox"/>	Normal	67.2728883
<input type="checkbox"/>	Gamma	67.5939338
<input type="checkbox"/>	LogNormal	67.8186591
<input type="checkbox"/>	Johnson SI	70.8892992
<input type="checkbox"/>	GLog	72.1043734
<input type="checkbox"/>	Johnson Su	76.8643241
<input type="checkbox"/>	Normal 2 Mixture	87.6616434
<input type="checkbox"/>	Exponential	104.395215
<input type="checkbox"/>	Normal 3 Mixture	215.482317

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	62.33352	59.010354	65.627482
Shape	$\beta$	13.677406	7.8873973	21.102266

-2log(Likelihood) = 60.913282757481

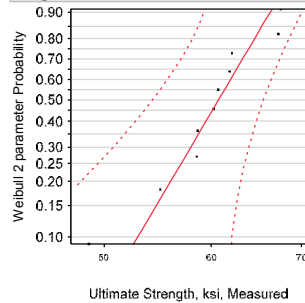
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square	Prob>W^2
0.051448	> 0.2500

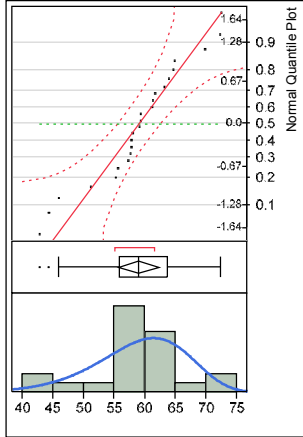
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW

Ultimate Strength, ksi, Measured



— Weibull(62.2101, 8.99402)

Summary Statistics

Mean	58.979914
Std Dev	7.6749415
Std Err Mean	1.5666409
Upper 95% Mean	62.220757
Lower 95% Mean	55.73907
N	24

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Weibull	169.157586
<input type="checkbox"/>	Extreme Value	169.157586
<input type="checkbox"/>	Normal	169.502591
<input type="checkbox"/>	Gamma	170.508413
<input type="checkbox"/>	LogNormal	171.221497
<input type="checkbox"/>	Johnson S1	171.554508
<input type="checkbox"/>	Normal 2 Mixture	172.28768
<input type="checkbox"/>	GLog	173.850068
<input type="checkbox"/>	Johnson Su	174.301194
<input type="checkbox"/>	Normal 3 Mixture	185.785356
<input type="checkbox"/>	Exponential	245.887271

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	62.210105	59.167315	65.246818
Shape	$\beta$	8.9940202	6.4516386	11.921339

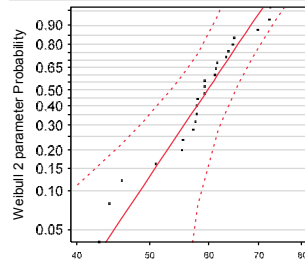
-2log(Likelihood) = 164.586157218167

Goodness-of-Fit Test

Cramer-von Mises W Test	
W-Square	0.084519
Prob>W^2	0.1726

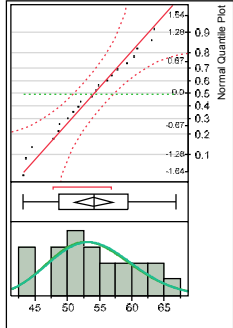
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Ultimate Strength, ksi, Measured



— LogNormal(3.99149, 0.12105)  
— Gamma(68.80069, 0.78471, 0)

Summary Statistics

Mean	53.986892
Std Dev	6.64232
Std Err Mean	1.4181474
Upper 95% Mean	56.933732
Lower 95% Mean	51.043653
N	22

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Gamma	149.270242
<input checked="" type="checkbox"/>	LogNormal	149.343541
<input type="checkbox"/>	Normal	149.377172
<input type="checkbox"/>	Weibull	150.525259
<input type="checkbox"/>	Extreme Value	150.525259
<input type="checkbox"/>	Johnson S1	151.952773
<input type="checkbox"/>	GLog	152.045296
<input type="checkbox"/>	Johnson Su	155.012381
<input type="checkbox"/>	Normal 2 Mixture	159.557995
<input type="checkbox"/>	Normal 3 Mixture	174.502965
<input type="checkbox"/>	Exponential	221.796083

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	-3.9914937	-3.9289148	-4.0549645
Shape	$\sigma$	0.1210536	0.0925003	0.1679912

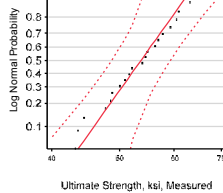
-2log(Likelihood) = 144.711982393925

Goodness-of-Fit Test

Kolmogorov's D	
D	0.075312
Prob>D	> 0.1500

Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Fitted Gamma

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Shape	$\alpha$	68.80069	35.005194	117.71403
Scale	$\beta$	0.7847093	0.4575491	1.5129237
Threshold	$\theta$	0		

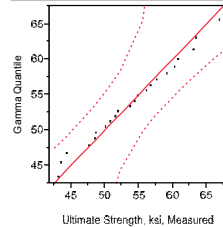
-2log(Likelihood) = 144.63868351897

Goodness-of-Fit Test

Cramer-von Mises W Test	
W-Square	
Prob>W^2	

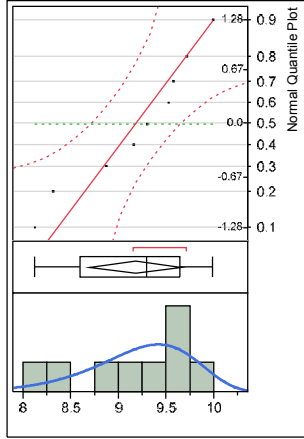
Note: Ho = The data is from the Gamma distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=CTD

Modulus, Msi, Measured



Summary Statistics	
Mean	9.1732222
Std Dev	0.6359406
Std Err Mean	0.2119802
Upper 95% Mean	9.6620494
Lower 95% Mean	8.684395
N	9

Compare Distributions		
Show	Distribution	AICc
<input checked="" type="checkbox"/>	Weibull	21.3026056
<input type="checkbox"/>	Extreme Value	21.3026056
<input type="checkbox"/>	Normal	22.3931915
<input type="checkbox"/>	Gamma	22.5486853
<input type="checkbox"/>	LogNormal	22.6681611
<input type="checkbox"/>	Johnson S1	25.9005041
<input type="checkbox"/>	GLog	27.1331443
<input type="checkbox"/>	Johnson Su	34.3332214
<input type="checkbox"/>	Normal 2 Mixture	42.2768204
<input type="checkbox"/>	Exponential	60.4646236

Fitted 2 parameter Weibull

Parameter Estimates				
Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	9.4410662	9.0553678	9.8171343
Shape	$\beta$	19.38115	10.59482	31.253161
-2log(Likelihood) = 15.3026056170336				

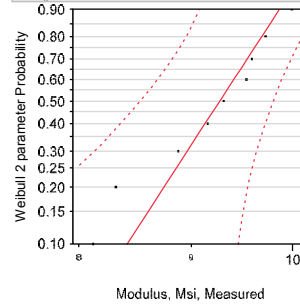
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square	Prob>W*2
0.025876	> 0.2500

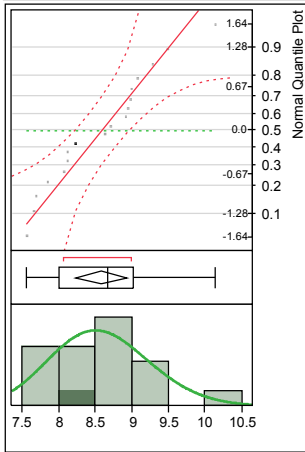
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=RTD

Modulus, Msi, Measured



Summary Statistics	
Mean	8.5793889
Std Dev	0.7142993
Std Err Mean	0.1683619
Upper 95% Mean	8.9346016
Lower 95% Mean	8.2241762
N	18

Compare Distributions		
Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	42.3703752
<input type="checkbox"/>	Gamma	42.4653374
<input type="checkbox"/>	Normal	42.7694692
<input type="checkbox"/>	Johnson S1	45.0075529
<input type="checkbox"/>	Weibull	45.2211344
<input type="checkbox"/>	Extreme Value	45.2211344
<input type="checkbox"/>	GLog	45.2846609
<input type="checkbox"/>	Johnson Su	48.3701903
<input type="checkbox"/>	Normal 2 Mixture	51.1199646
<input type="checkbox"/>	Normal 3 Mixture	67.010997
<input type="checkbox"/>	Exponential	115.627057

Fitted LogNormal

Parameter Estimates				
Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	2.1461215	2.106934	2.1853091
Shape	$\sigma$	0.0803439	0.05984	0.1159046
-2log(Likelihood) = 37.5703751997931				

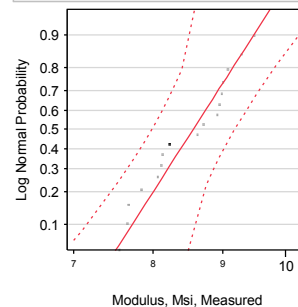
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.143169	> 0.1500

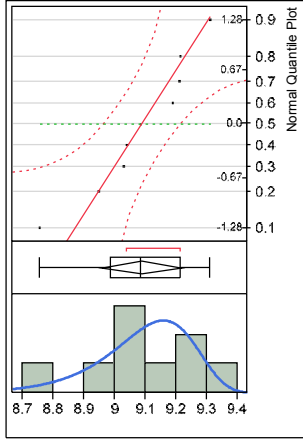
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=RTW

Modulus, Msi, Measured



— Weibull(9.16113,71.045)

Summary Statistics

Mean	9.0876667
Std Dev	0.1691353
Std Err Mean	0.0563784
Upper 95% Mean	9.2176756
Lower 95% Mean	8.9576578
N	9

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Weibull	-2.5228106
<input type="checkbox"/>	Extreme Value	-2.5228106
<input type="checkbox"/>	Normal	-1.4461196
<input type="checkbox"/>	Gamma	-1.4375203
<input type="checkbox"/>	LogNormal	-1.4021157
<input type="checkbox"/>	Johnson S1	2.20232897
<input type="checkbox"/>	GLog	3.39788431
<input type="checkbox"/>	Johnson Su	9.40232748
<input type="checkbox"/>	Normal 2 Mixture	23.6524697
<input type="checkbox"/>	Exponential	60.2959559

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	9.1611337	9.0580572	9.2588758
Shape	$\beta$	71.044951	39.255059	113.14177

-2log(Likelihood) = -8.52281060061778

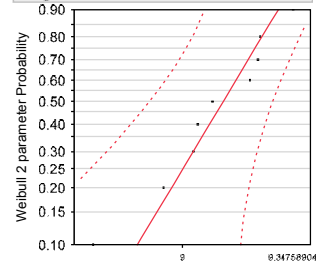
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square	Prob>W^2
0.034505	> 0.2500

Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

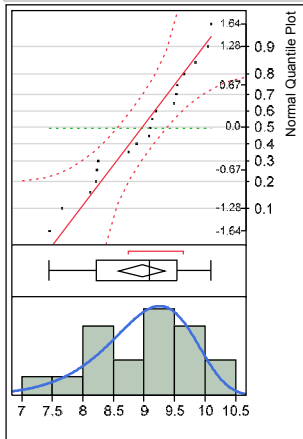
Diagnostic Plot



Modulus, Msi, Measured

Distributions Condition=ETD1

Modulus, Msi, Measured



— Weibull(9.29897,14.094)

Summary Statistics

Mean	8.9555789
Std Dev	0.7889968
Std Err Mean	0.1810083
Upper 95% Mean	9.3358632
Lower 95% Mean	8.5752947
N	19

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Weibull	47.5530653
<input type="checkbox"/>	Extreme Value	47.5530653
<input type="checkbox"/>	Normal	48.6839289
<input type="checkbox"/>	Gamma	49.0663557
<input type="checkbox"/>	LogNormal	49.3280143
<input type="checkbox"/>	Johnson S1	50.3500157
<input type="checkbox"/>	GLog	51.4866518
<input type="checkbox"/>	Johnson Su	54.7439009
<input type="checkbox"/>	Normal 2 Mixture	56.6175123
<input type="checkbox"/>	Normal 3 Mixture	71.9107113
<input type="checkbox"/>	Exponential	123.541808

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	9.2989695	8.963568	9.6257111
Shape	$\beta$	14.09398	9.520877	19.67904

-2log(Likelihood) = 42.8030653365142

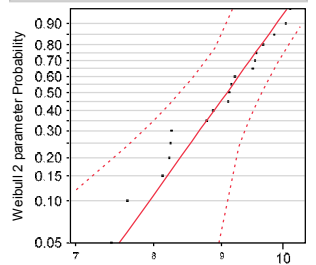
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square	Prob>W^2
0.040878	> 0.2500

Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot

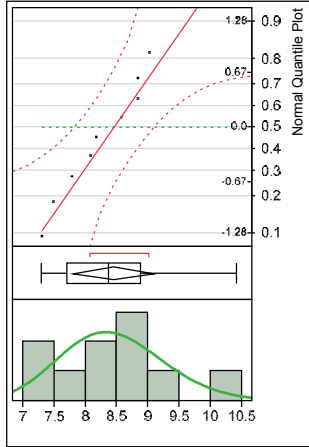


Modulus, Msi, Measured



Distributions Condition=ETD2

Modulus, Msi, Measured



LogNormal(2.12886,0.09959)

Summary Statistics

Mean	8.4479
Std Dev	0.9139743
Std Err Mean	0.289024
Upper 95% Mean	9.1017178
Lower 95% Mean	7.7940822
N	10

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	30.5374332
<input type="checkbox"/>	Gamma	30.7432478
<input type="checkbox"/>	Normal	31.2939995
<input type="checkbox"/>	Weibull	33.4674708
<input type="checkbox"/>	Extreme Value	33.4674708
<input type="checkbox"/>	Johnson SI	33.8887035
<input type="checkbox"/>	GLog	34.8231475
<input type="checkbox"/>	Johnson Su	39.8887035
<input type="checkbox"/>	Normal 2 Mixture	51.6827545
<input type="checkbox"/>	Exponential	65.1783578
<input type="checkbox"/>	Normal 3 Mixture	177.890803

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	2.1288637	2.0607042	2.1970232
Shape	$\sigma$	0.0995948	0.0679345	0.1663149

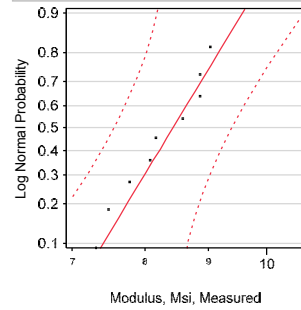
-2log(Likelihood) = 24.8231474939328

Goodness-of-Fit Test

Kolmogorov's D	
D	Prob>D
0.141341	> 0.1500

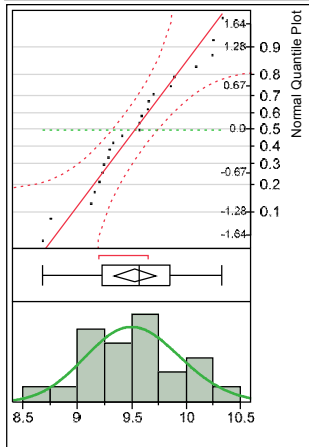
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW

Modulus, Msi, Measured



LogNormal(2.25283,0.04569)

Summary Statistics

Mean	9.5246087
Std Dev	0.445315
Std Err Mean	0.0928546
Upper 95% Mean	9.7171773
Lower 95% Mean	9.3320401
N	23

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	31.5553775
<input type="checkbox"/>	Gamma	31.5689715
<input type="checkbox"/>	Normal	31.6583948
<input type="checkbox"/>	Johnson SI	34.2139994
<input type="checkbox"/>	GLog	34.2185354
<input type="checkbox"/>	Weibull	34.2300447
<input type="checkbox"/>	Extreme Value	34.2300447
<input type="checkbox"/>	Normal 2 Mixture	36.8800082
<input type="checkbox"/>	Johnson Su	37.1730637
<input type="checkbox"/>	Normal 3 Mixture	50.9093363
<input type="checkbox"/>	Exponential	151.868903

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	2.2528346	2.2333528	2.2723165
Shape	$\sigma$	0.0456941	0.0351049	0.0629084

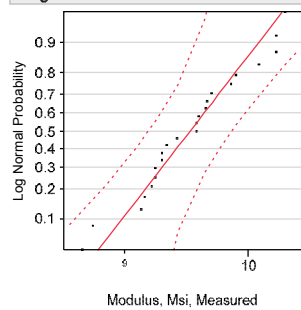
-2log(Likelihood) = 26.9553774982871

Goodness-of-Fit Test

Kolmogorov's D	
D	Prob>D
0.105903	> 0.1500

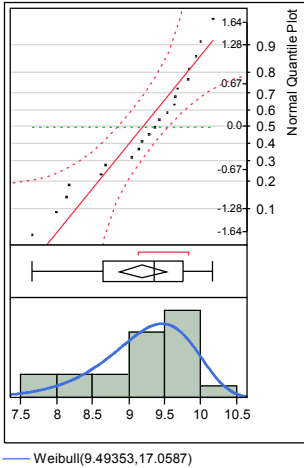
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Modulus, Msi, Measured

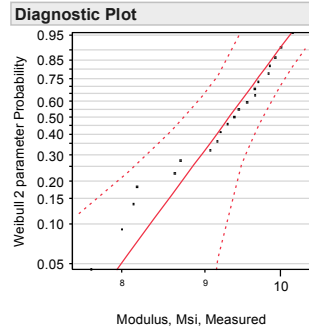


Summary Statistics	
Mean	9.1860476
Std Dev	0.7221574
Std Err Mean	0.1575877
Upper 95% Mean	9.5147697
Lower 95% Mean	8.8573255
N	21

Compare Distributions		
Show	Distribution	AICc
<input checked="" type="checkbox"/>	Weibull	46.3296897
<input type="checkbox"/>	Extreme Value	46.3296897
<input type="checkbox"/>	Johnson S1	48.036456
<input type="checkbox"/>	Normal	49.5905759
<input type="checkbox"/>	Gamma	50.3409609
<input type="checkbox"/>	LogNormal	50.7696594
<input type="checkbox"/>	GLog	52.3110807
<input type="checkbox"/>	Normal 2 Mixture	53.6132781
<input type="checkbox"/>	Johnson Su	55.3994399
<input type="checkbox"/>	Normal 3 Mixture	68.692667
<input type="checkbox"/>	Exponential	137.353329

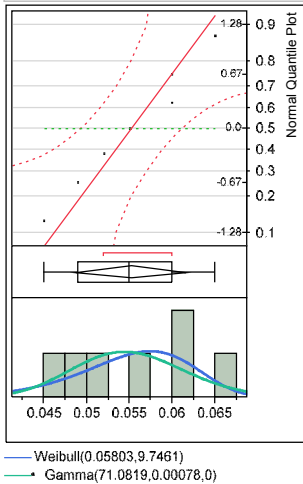
Fitted 2 parameter Weibull				
Parameter Estimates				
Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	9.4935349	9.225184	9.753752
Shape	$\beta$	17.058671	11.64229	23.694769
-2log(Likelihood) = 41.6630230713182				

Goodness-of-Fit Test		
Cramer-von Mises W Test		
W-Square	Prob>W^2	
0.047108	>	0.2500
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.		



Distributions Condition=CTD

Poisson's Ratio

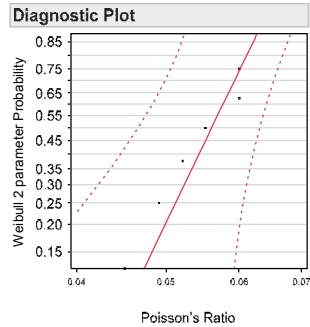


Summary Statistics	
Mean	0.0551429
Std Dev	0.0070102
Std Err Mean	0.0026496
Upper 95% Mean	0.0616262
Lower 95% Mean	0.0486595
N	7

Compare Distributions		
Show	Distribution	AICc
<input checked="" type="checkbox"/>	Gamma	-43.617161
<input checked="" type="checkbox"/>	Weibull	-43.614919
<input type="checkbox"/>	Extreme Value	-43.614919
<input type="checkbox"/>	Normal	-43.580314
<input type="checkbox"/>	LogNormal	-43.565909
<input type="checkbox"/>	Johnson S1	-36.67553
<input type="checkbox"/>	GLog	-36.659369
<input type="checkbox"/>	Exponential	-23.769593
<input type="checkbox"/>	Johnson Su	-22.659367
<input type="checkbox"/>	Normal 2 Mixture	20.3501782

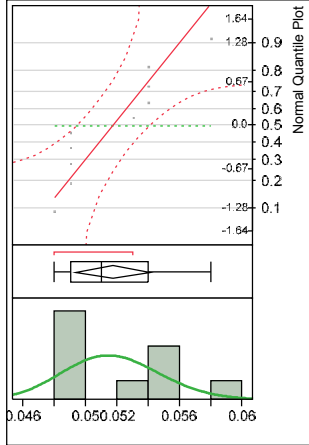
Fitted 2 parameter Weibull				
Parameter Estimates				
Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	0.0580318	0.0526728	0.063548
Shape	$\beta$	9.746096	4.9441635	16.389552
-2log(Likelihood) = -50.6149192239701				

Goodness-of-Fit Test		
Cramer-von Mises W Test		
W-Square	Prob>W^2	
0.033958	>	0.2500
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.		



Distributions Condition=RTD

Poisson's Ratio



Summary Statistics

Mean	0.0517
Std Dev	0.003335
Std Err Mean	0.0010546
Upper 95% Mean	0.0540857
Lower 95% Mean	0.0493143
N	10

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	-81.317241
<input type="checkbox"/>	Gamma	-81.227357
<input type="checkbox"/>	Normal	-80.972598
<input type="checkbox"/>	Johnson SI	-79.818905
<input type="checkbox"/>	Weibull	-79.292794
<input type="checkbox"/>	Extreme Value	-79.292794
<input type="checkbox"/>	GLog	-76.740489
<input type="checkbox"/>	Normal 2 Mixture	-72.402689
<input type="checkbox"/>	Johnson Su	-70.740558
<input type="checkbox"/>	Exponential	-36.74595

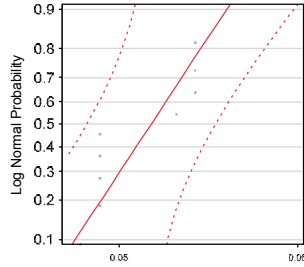
Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	-2.964138	-3.00549	-2.922786
Shape	$\sigma$	0.0604235	0.0412154	0.1009021

-2log(Likelihood) = -87.0315262907022

Diagnostic Plot



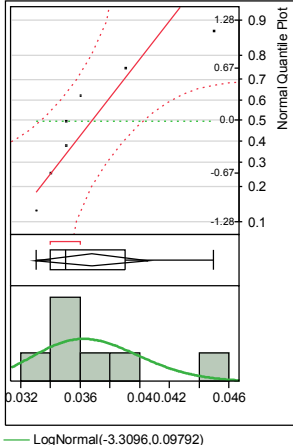
Goodness-of-Fit Test

Kolmogorov's D	D	Prob>D
	0.304340	< 0.0100*

Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Distributions Condition=RTW

Poisson's Ratio



Summary Statistics

Mean	0.0367143
Std Dev	0.0041115
Std Err Mean	0.001554
Upper 95% Mean	0.0405168
Lower 95% Mean	0.0329117
N	7

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	-51.999195
<input type="checkbox"/>	Gamma	-51.72261
<input type="checkbox"/>	Normal	-51.050267
<input type="checkbox"/>	Weibull	-49.16161
<input type="checkbox"/>	Extreme Value	-49.16161
<input type="checkbox"/>	Johnson SI	-49.101622
<input type="checkbox"/>	GLog	-44.999195
<input type="checkbox"/>	Johnson Su	-35.101622
<input type="checkbox"/>	Exponential	-29.464251
<input type="checkbox"/>	Normal 2 Mixture	8.48464204

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	-3.309569	-3.393297	-3.22584
Shape	$\sigma$	0.0979206	0.0626703	0.1845148

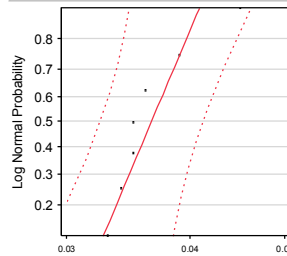
-2log(Likelihood) = -58.9991945533725

Goodness-of-Fit Test

Kolmogorov's D	D	Prob>D
	0.273822	0.1106

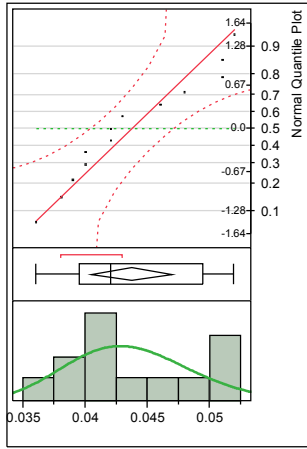
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETD1

Poisson's Ratio



LogNormal(-3.1375,0.11697)

Summary Statistics

Mean	0.0436923
Std Dev	0.0053756
Std Err Mean	0.0014909
Upper 95% Mean	0.0469408
Lower 95% Mean	0.0404438
N	13

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	-95.273264
<input type="checkbox"/>	Gamma	-95.156169
<input type="checkbox"/>	Normal	-94.780448
<input type="checkbox"/>	Weibull	-93.740999
<input type="checkbox"/>	Extreme Value	-93.740999
<input type="checkbox"/>	Johnson S1	-92.28621
<input type="checkbox"/>	GLog	-91.354337
<input type="checkbox"/>	Johnson Su	-87.021028
<input type="checkbox"/>	Normal 2 Mixture	-84.911139
<input type="checkbox"/>	Exponential	-53.031527
<input type="checkbox"/>	Normal 3 Mixture	-48.896992

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	-3.13747	-3.206056	-3.068885
Shape	$\sigma$	0.1169716	0.0831878	0.1817334

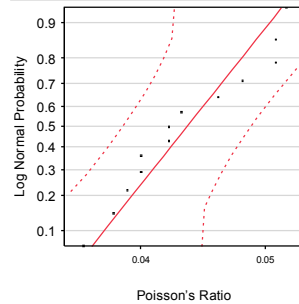
-2log(Likelihood) = -100.473264159044

Goodness-of-Fit Test

Kolmogorov's D	D	Prob>D
	0.148274	> 0.1500

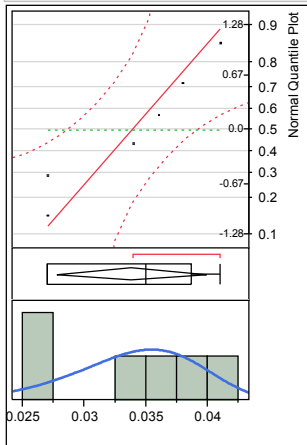
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETD2

Poisson's Ratio



Weibull(0.03608,7.69979)

Summary Statistics

Mean	0.0338333
Std Dev	0.0057764
Std Err Mean	0.0023582
Upper 95% Mean	0.0398953
Lower 95% Mean	0.0277714
N	6

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Weibull	-38.177132
<input type="checkbox"/>	Extreme Value	-38.177132
<input type="checkbox"/>	Normal	-37.820457
<input type="checkbox"/>	Gamma	-37.79147
<input type="checkbox"/>	LogNormal	-37.692452
<input type="checkbox"/>	Johnson S1	-28.176897
<input type="checkbox"/>	GLog	-27.914386
<input type="checkbox"/>	Exponential	-25.635705
<input type="checkbox"/>	Johnson Su	2.0856179

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	0.0360779	0.0314521	0.0410474
Shape	$\beta$	7.6997903	3.5991169	13.7165

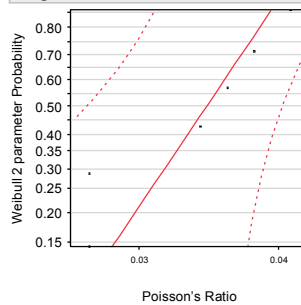
-2log(Likelihood) = -46.1771316330355

Goodness-of-Fit Test

Cramer-von Mises W Test	W-Square	Prob>W^2
	0.041610	> 0.2500

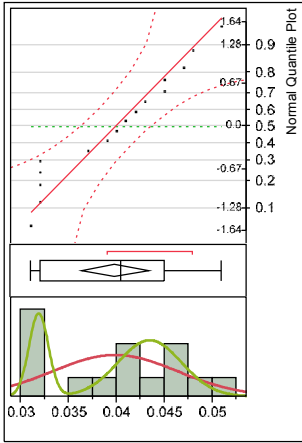
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW

Poisson's Ratio



— Normal(0.03981, 0.00655)  
 • Normal 2 Mixture

Summary Statistics

Mean 0.0398125  
 Std Dev 0.0065546  
 Std Err Mean 0.0016386  
 Upper 95% Mean 0.0433052  
 Lower 95% Mean 0.0363198  
 N 16

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Normal 2 Mixture	-112.37037
<input checked="" type="checkbox"/>	Gamma	-111.59193
<input checked="" type="checkbox"/>	Normal	-111.55382
<input type="checkbox"/>	LogNormal	-111.47826
<input type="checkbox"/>	Weibull	-111.47208
<input type="checkbox"/>	Extreme Value	-111.47208
<input type="checkbox"/>	Johnson S1	-108.53626
<input type="checkbox"/>	GLog	-108.50951
<input type="checkbox"/>	Johnson Su	-104.87316
<input type="checkbox"/>	Normal 3 Mixture	-93.315655
<input type="checkbox"/>	Exponential	-68.868665

Fitted Normal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Location	$\mu$	0.0398125	0.0363198	0.0433052
Dispersion	$\sigma$	0.0065546	0.0048419	0.0101445

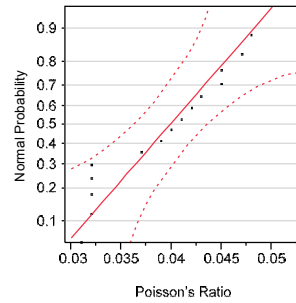
-2log(Likelihood) = -116.476893590064

Goodness-of-Fit Test

Shapiro-Wilk W Test  
 W 0.920809  
 Prob<W 0.1738

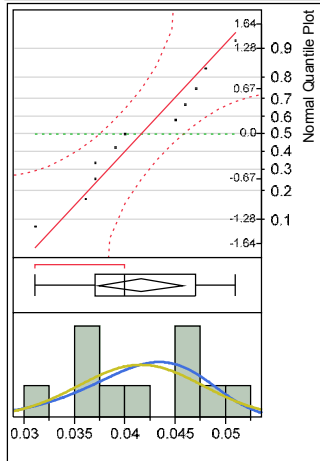
Note: Ho = The data is from the Normal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Poisson's Ratio



— Weibull(0.04412, 8.0766)  
 • Johnson S1(-4.1e+7, 4015740, -24830, 1)

Summary Statistics

Mean 0.0415455  
 Std Dev 0.0062026  
 Std Err Mean 0.0018702  
 Upper 95% Mean 0.0457124  
 Lower 95% Mean 0.0373785  
 N 11

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Johnson S1	-77.245031
<input checked="" type="checkbox"/>	Weibull	-76.145776
<input type="checkbox"/>	Extreme Value	-76.145776
<input type="checkbox"/>	Normal	-76.104523
<input type="checkbox"/>	Gamma	-76.055423
<input type="checkbox"/>	LogNormal	-75.93097
<input type="checkbox"/>	GLog	-72.224363
<input type="checkbox"/>	Johnson Su	-66.986855
<input type="checkbox"/>	Normal 2 Mixture	-62.209744
<input type="checkbox"/>	Exponential	-45.536833
<input type="checkbox"/>	Normal 3 Mixture	4.30345746

Fitted 2 parameter Weibull

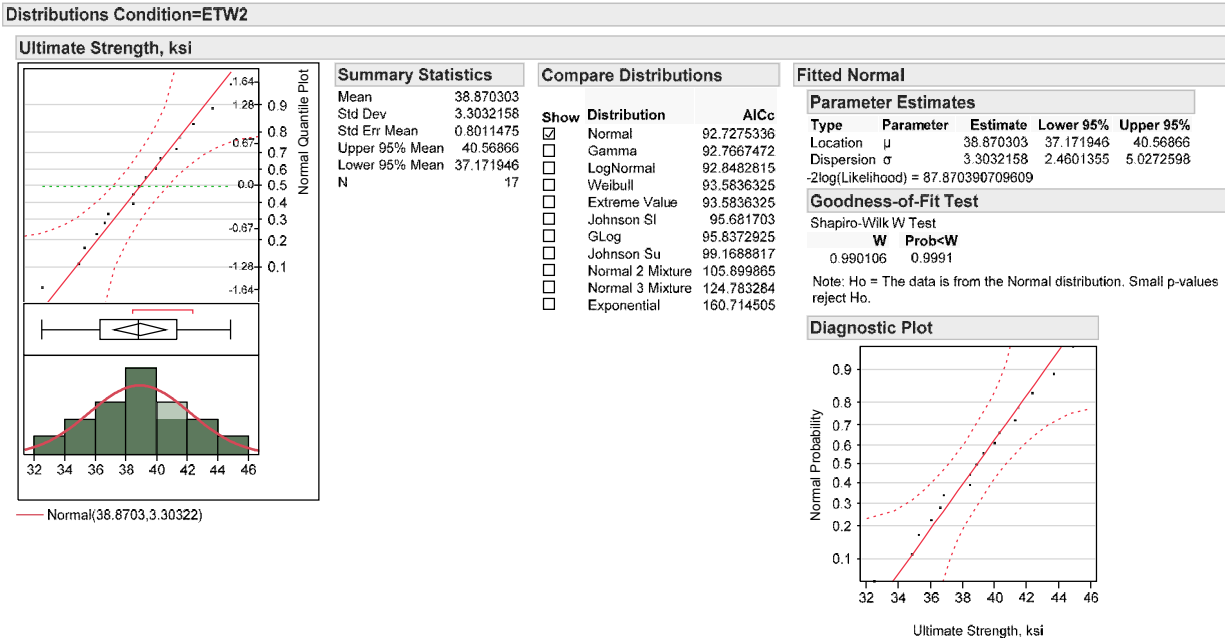
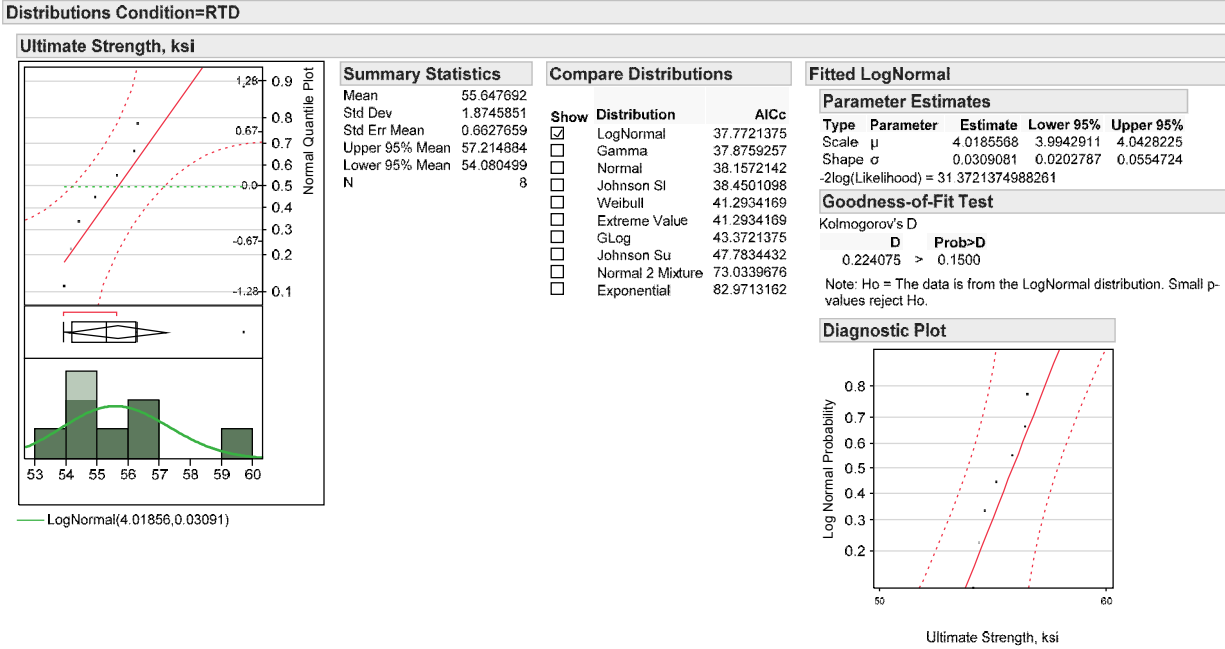
Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	0.0441176	0.0403922	0.047903
Shape	$\beta$	8.0765981	4.7774865	12.368843

-2log(Likelihood) = -81.6457758880339

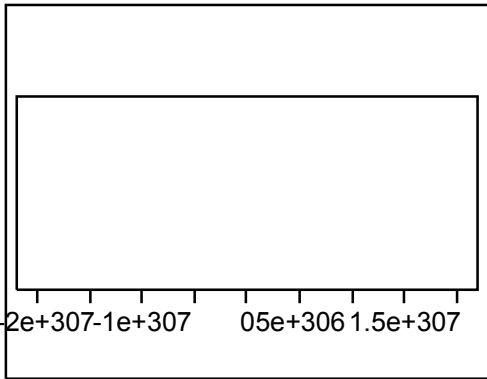
## A.2 Quasi Filled Hole Compression (FHC1)

The determination of statistical distribution types for the Quasi Filled Hole Compression (FHC1) test results is presented here.



**Distributions Condition=ETW2**

**Modulus, Msi**



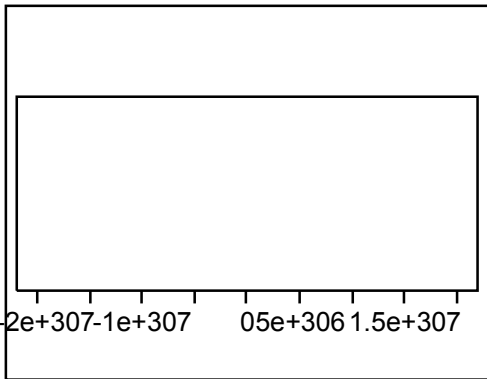
**Quantiles**

**Summary Statistics**

Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

**Distributions Condition=RTD**

**Modulus, Msi**



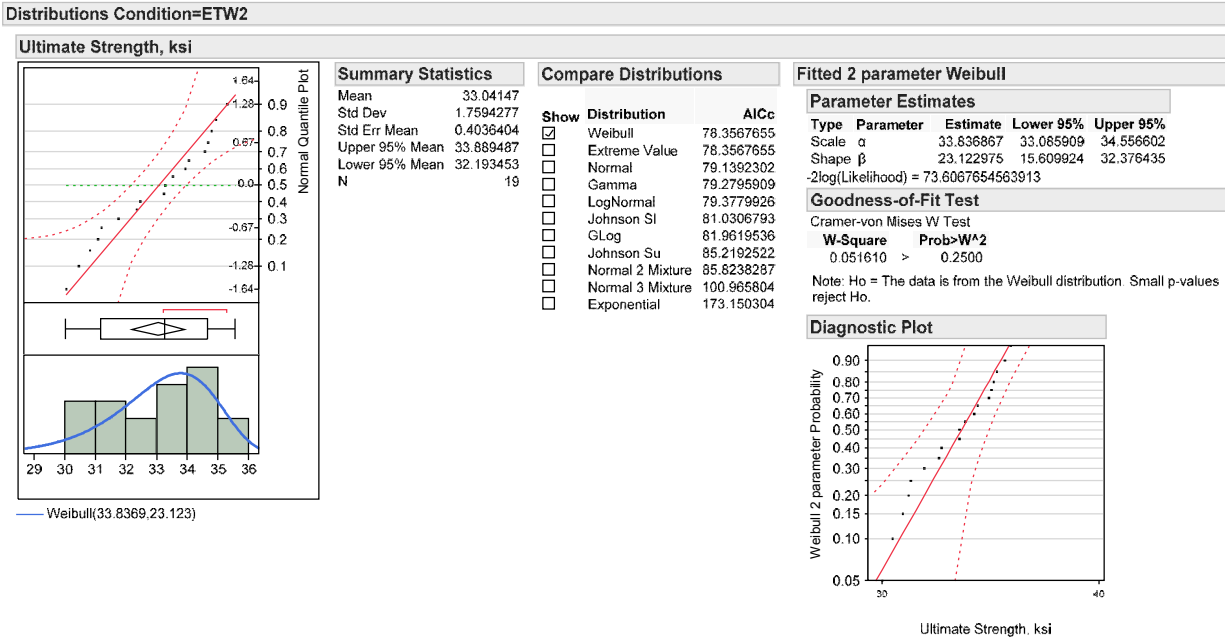
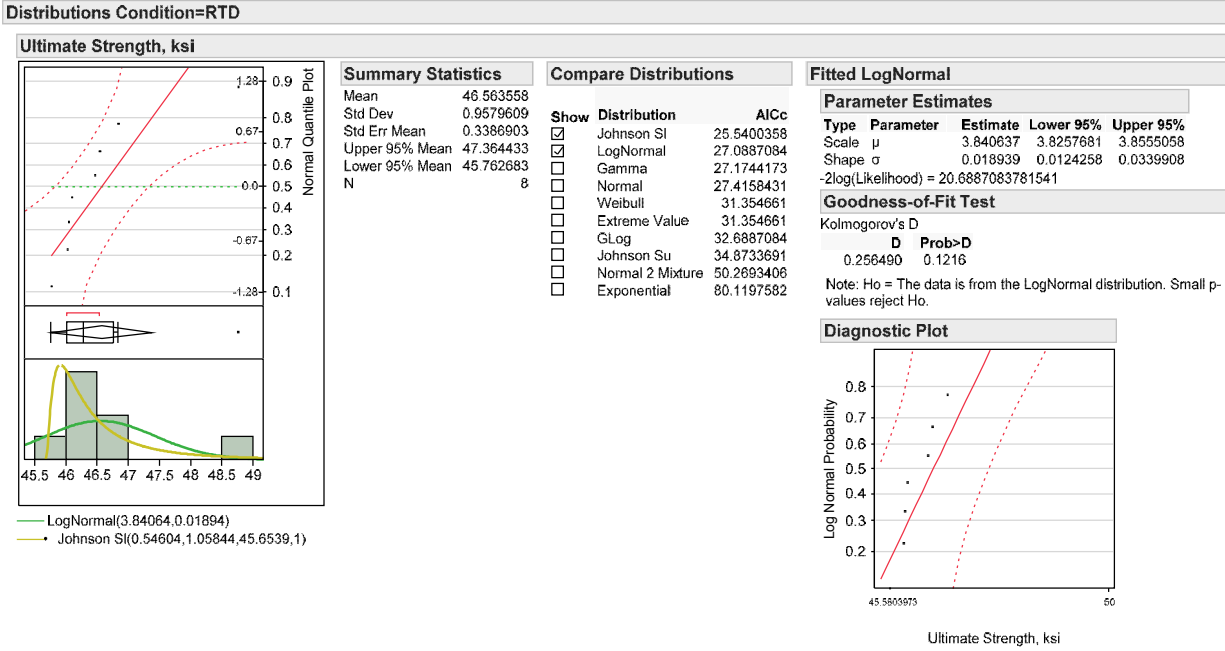
**Quantiles**

**Summary Statistics**

Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

### A.3 Soft Filled Hole Compression (FHC2)

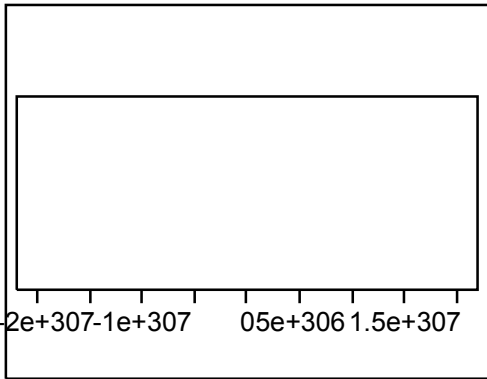
The determination of statistical distribution types for the Soft Filled Hole Compression (FHC2) test results is presented here.





**Distributions Condition=ETW2**

**Modulus, Msi**



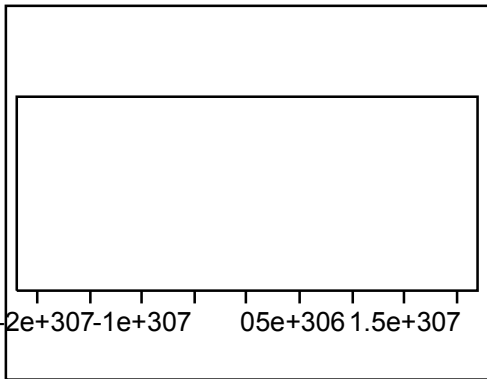
**Quantiles**

**Summary Statistics**

Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

**Distributions Condition=RTD**

**Modulus, Msi**



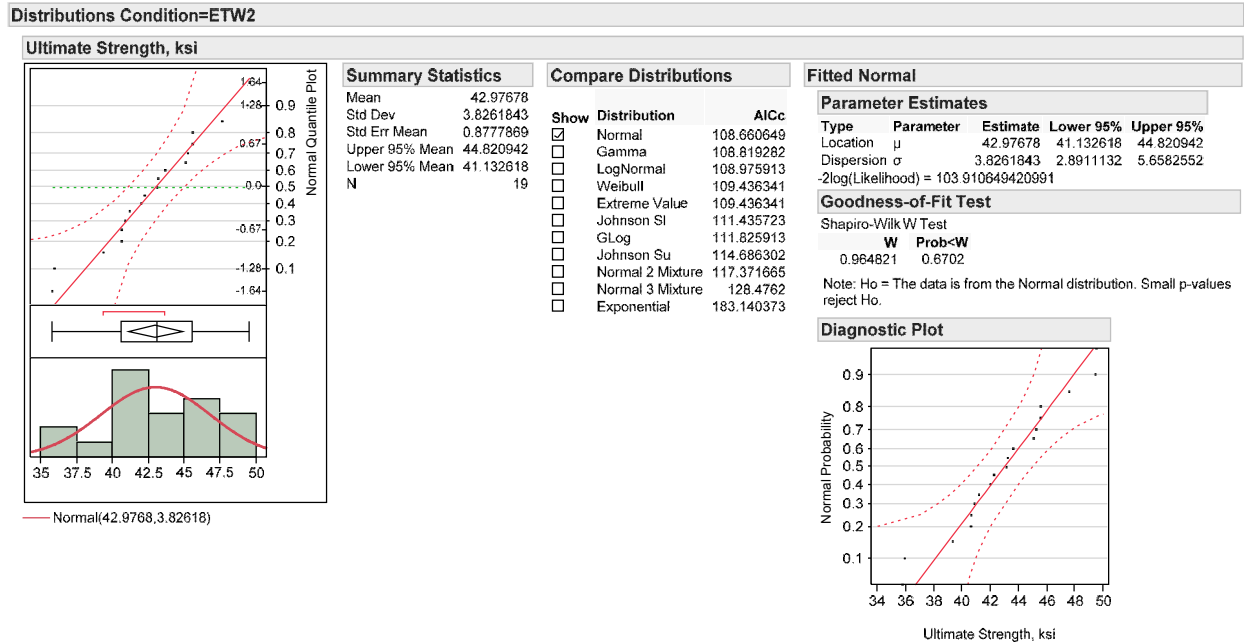
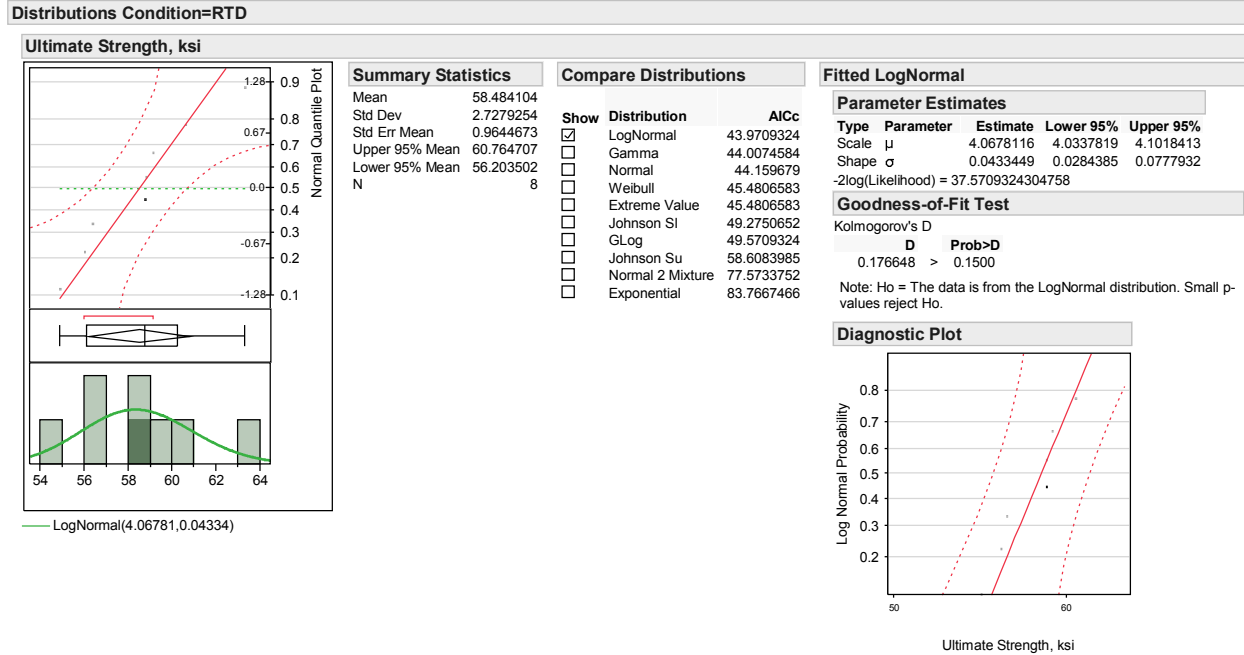
**Quantiles**

**Summary Statistics**

Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

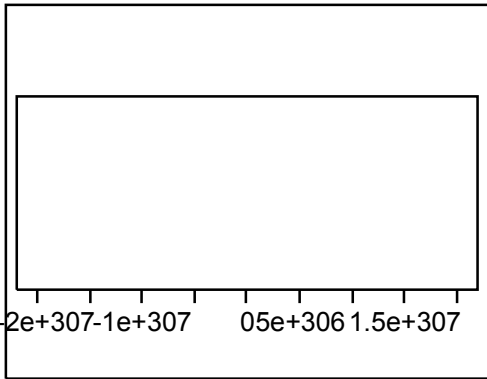
## A.4 Hard Filled Hole Compression (FHC3)

The determination of statistical distribution types for the Hard Filled Hole Compression (FHC3) test results is presented here.



**Distributions Condition=ETW2**

**Modulus, Msi**



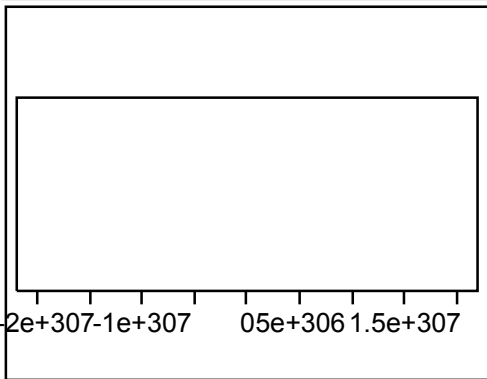
**Quantiles**

**Summary Statistics**

Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

**Distributions Condition=RTD**

**Modulus, Msi**



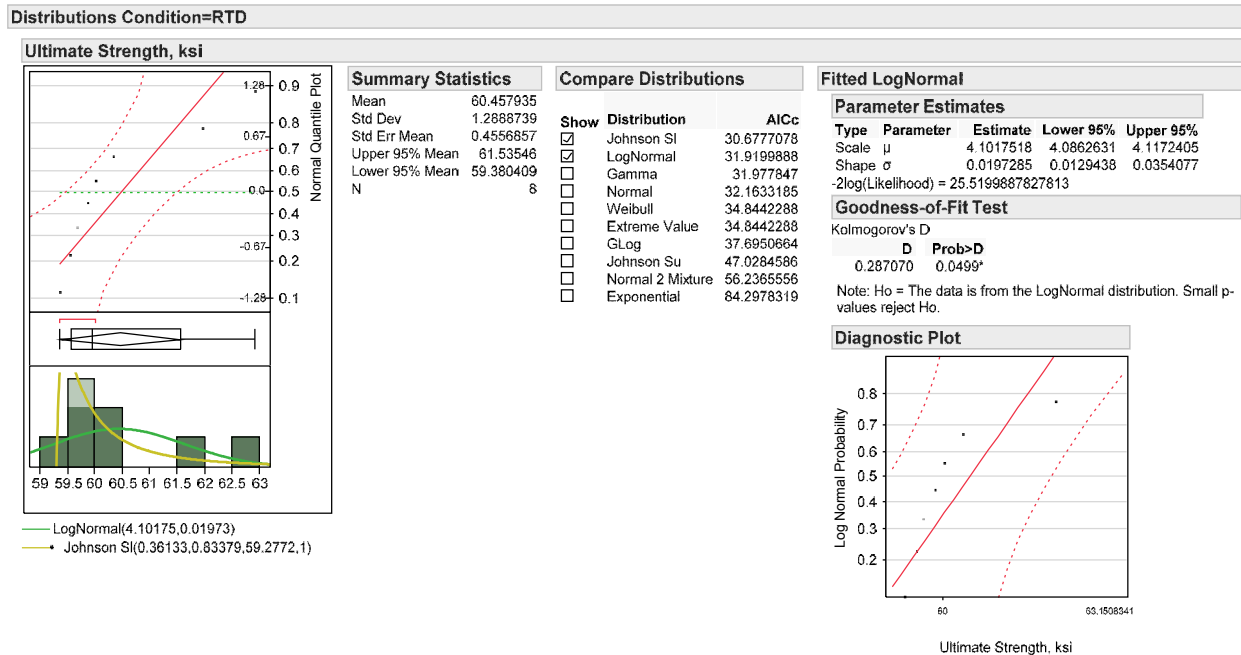
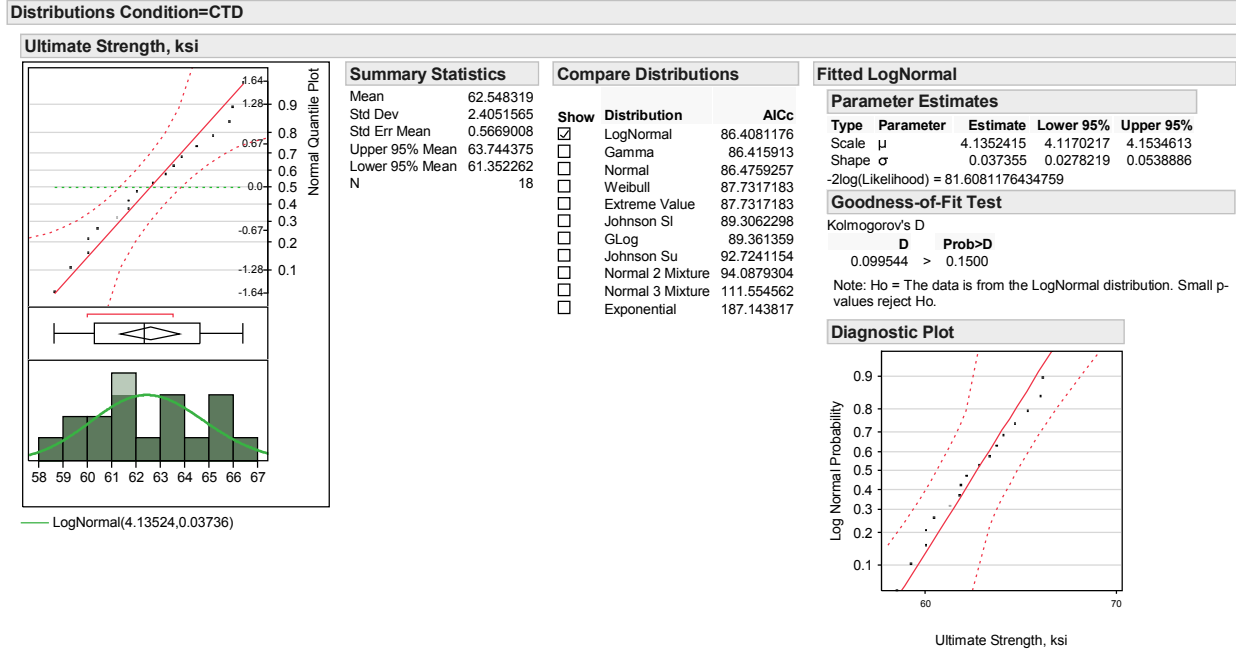
**Quantiles**

**Summary Statistics**

Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

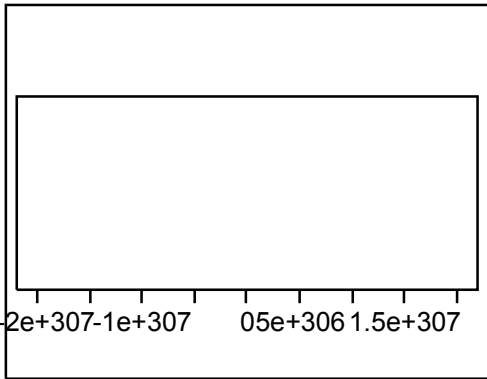
## A.5 Quasi Isotropic Filled Hole Tension (FHT1)

The determination of statistical distribution types for the Quasi Isotropic Filled Hole Tension (FHT1) test results is presented here.



**Distributions Condition=CTD**

**Modulus, Msi**



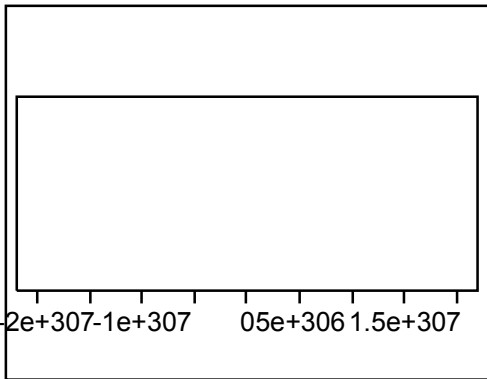
**Quantiles**

**Summary Statistics**

Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

**Distributions Condition=RTD**

**Modulus, Msi**



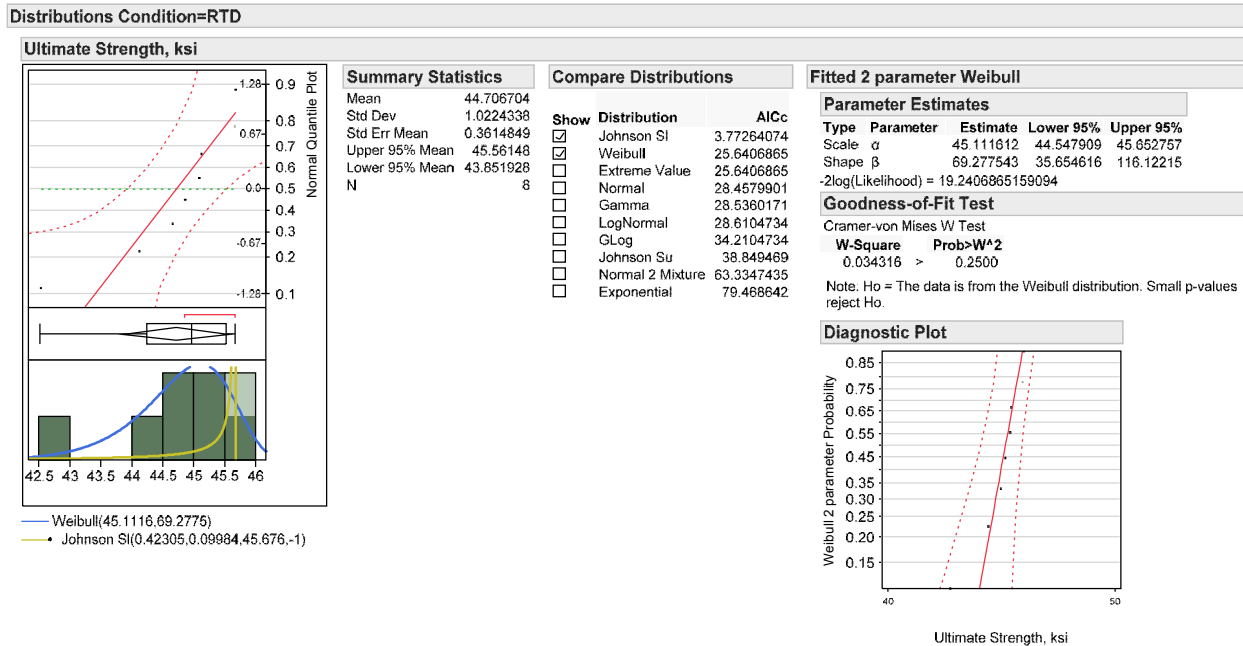
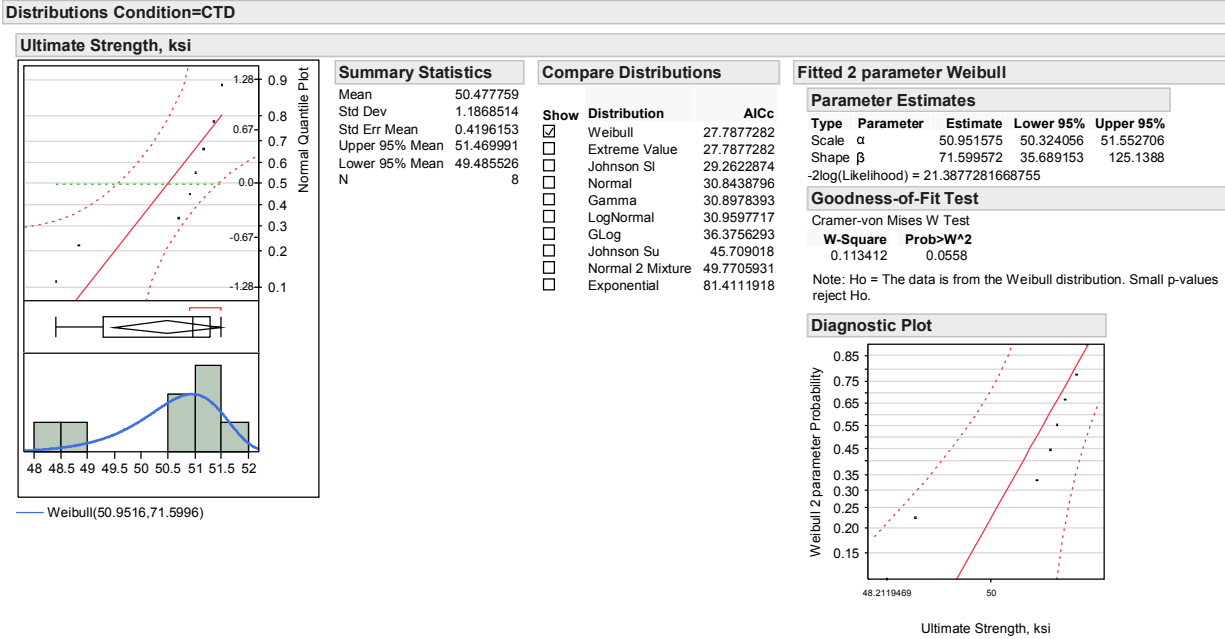
**Quantiles**

**Summary Statistics**

Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

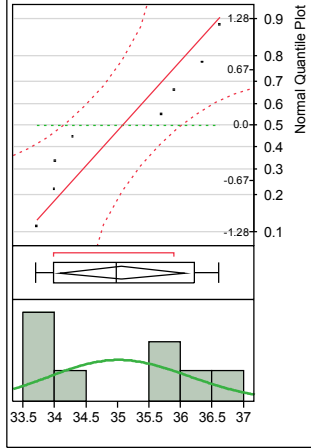
## A.6 Soft Filled Hole Tension (FHT2)

The determination of statistical distribution types for the Soft Filled Hole Tension (FHT2) test results is presented here.



Distributions Condition=ETW2

Ultimate Strength, ksi



— LogNormal(3.5566,0.03171)

Summary Statistics

Mean	35.061472
Std Dev	1.1900886
Std Err Mean	0.4207598
Upper 95% Mean	36.056411
Lower 95% Mean	34.066533
N	8

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	30.79006
<input type="checkbox"/>	Gamma	30.7986522
<input type="checkbox"/>	Normal	30.8874602
<input type="checkbox"/>	Weibull	31.1738178
<input type="checkbox"/>	Extreme Value	31.1738178
<input type="checkbox"/>	Johnson SI	35.0375688
<input type="checkbox"/>	GLog	36.4192087
<input type="checkbox"/>	Johnson Su	45.7526009
<input type="checkbox"/>	Normal 2 Mixture	53.5310544
<input type="checkbox"/>	Exponential	75.5803127

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	3.5565997	3.5317053	3.5814941
Shape	$\sigma$	0.0317088	0.0208041	0.0569095

-2log(Likelihood) = 24.3900600490189

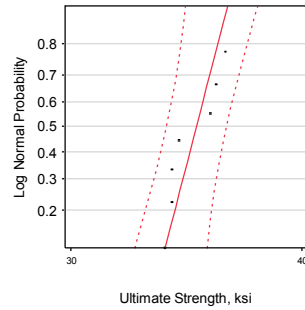
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.256788	0.1206

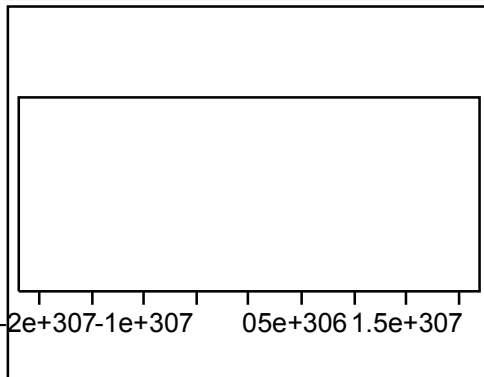
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



**Distributions Condition=CTD**

**Modulus, Msi**



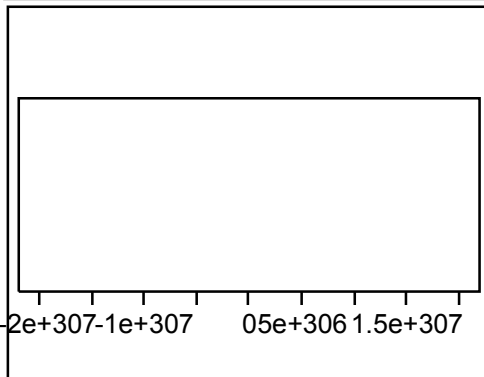
**Quantiles**

**Summary Statistics**

Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

**Distributions Condition=ETW2**

**Modulus, Msi**



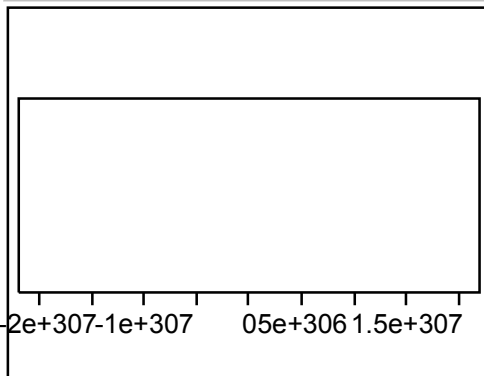
**Quantiles**

**Summary Statistics**

Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

**Distributions Condition=RTD**

**Modulus, Msi**



**Quantiles**

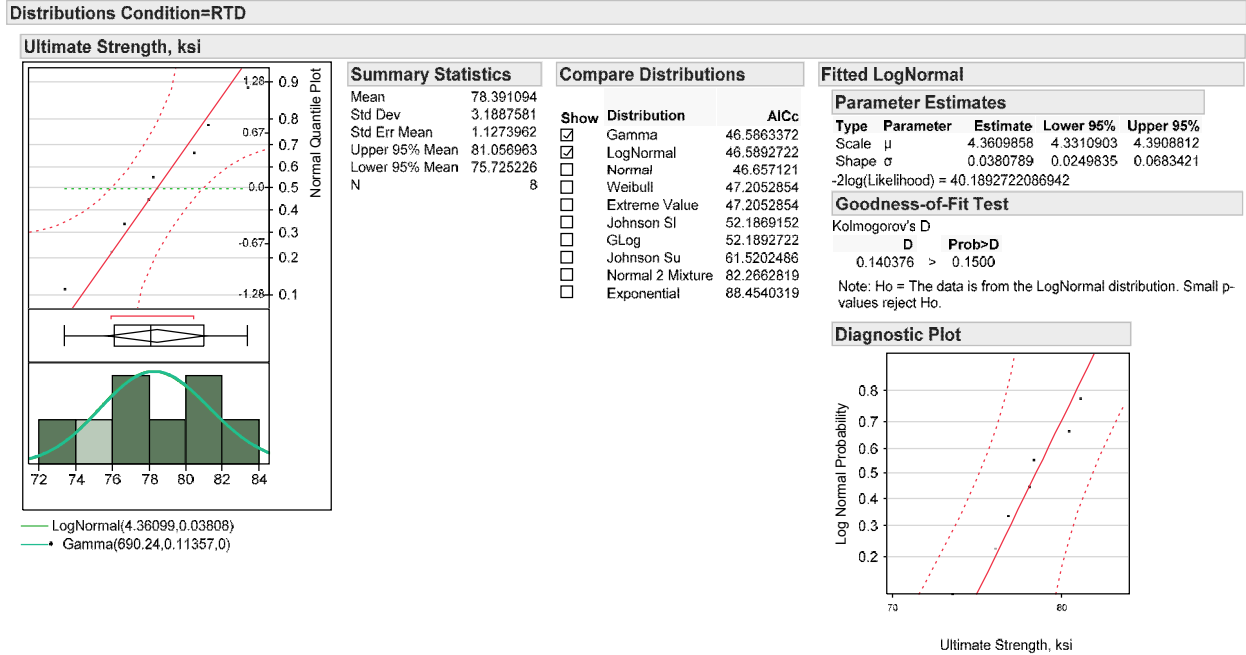
**Summary Statistics**

Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0



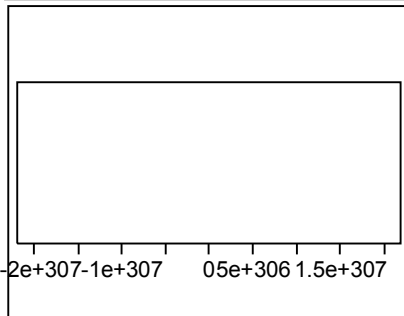
## A.7 Hard Filled Hole Tension (FHT3)

The determination of statistical distribution types for the Hard Filled Hole Tension (FHT3) test results is presented here.



**Distributions Condition=CTD**

**Modulus, Msi**



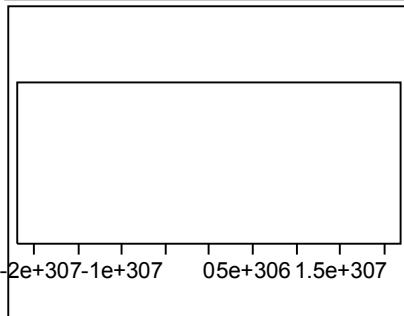
**Quantiles**

**Summary Statistics**

Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

**Distributions Condition=RTD**

**Modulus, Msi**



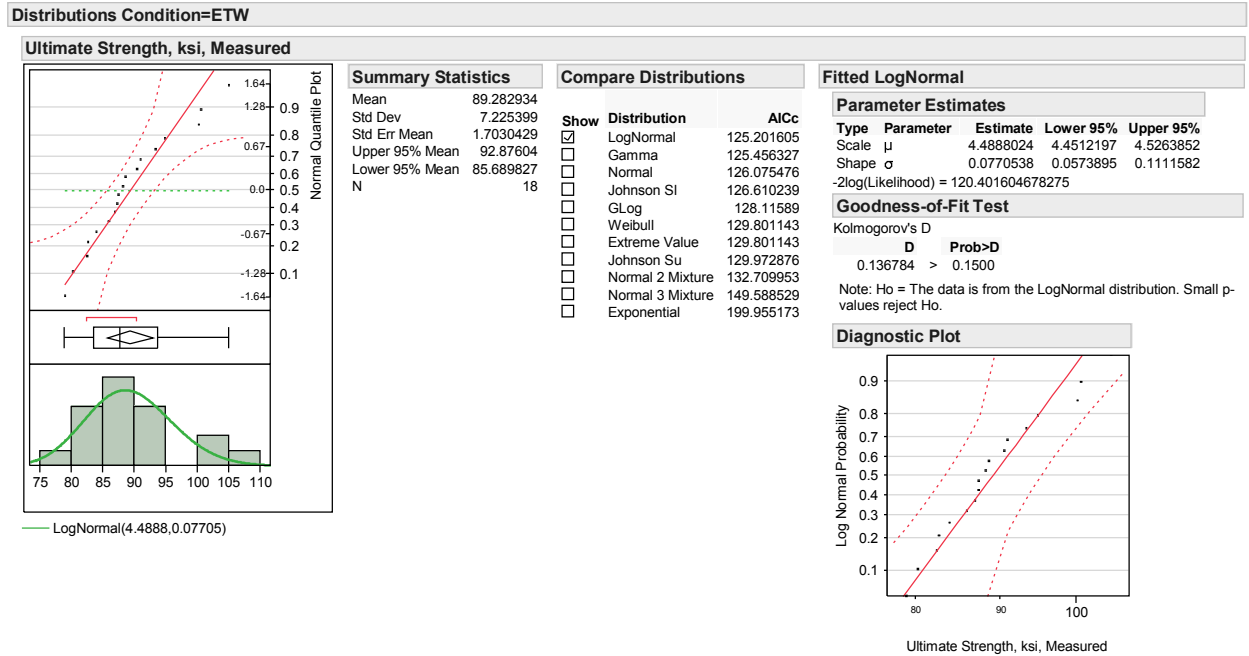
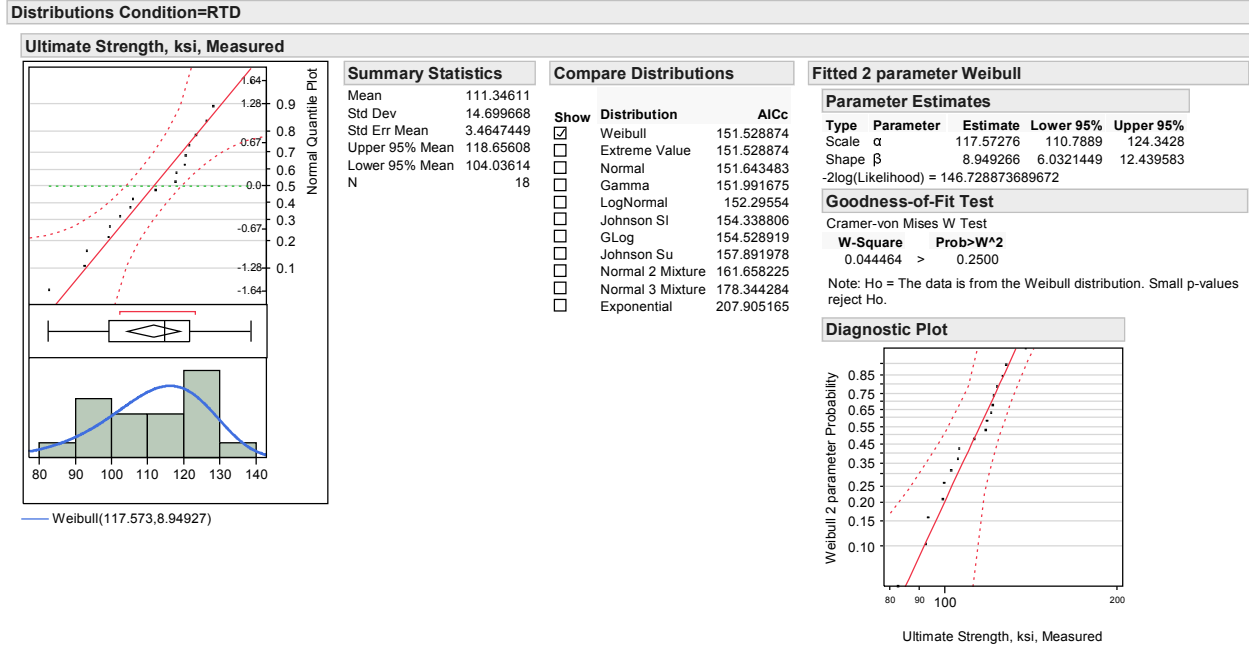
**Quantiles**

**Summary Statistics**

Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

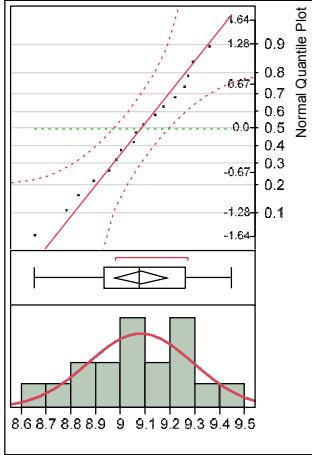
## A.8 Warp Flexure Strength and Modulus (FSM)

The determination of statistical distribution types for the Warp Flexure Strength and Modulus (FSM) test results is presented here.



Distributions Condition=RTD

Modulus, Msi, Measured



Summary Statistics

Mean	9.08
Std Dev	0.2124645
Std Err Mean	0.0500784
Upper 95% Mean	9.1856561
Lower 95% Mean	8.9743439
N	18

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Normal	-0.8815008
<input type="checkbox"/>	Gamma	-0.8477253
<input type="checkbox"/>	LogNormal	-0.8127796
<input type="checkbox"/>	Weibull	-0.4695032
<input type="checkbox"/>	Extreme Value	-0.4695032
<input type="checkbox"/>	Johnson S1	1.75951281
<input type="checkbox"/>	GLog	2.10150618
<input type="checkbox"/>	Johnson Su	4.99333596
<input type="checkbox"/>	Normal 2 Mixture	11.0309231
<input type="checkbox"/>	Normal 3 Mixture	29.4191266
<input type="checkbox"/>	Exponential	117.668671

Fitted Normal

Parameter Estimates

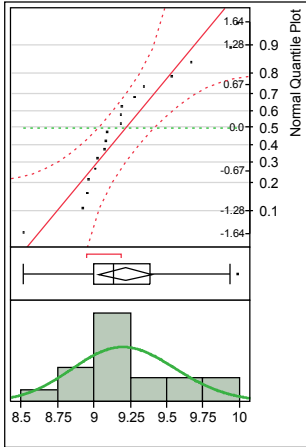
Type	Parameter	Estimate	Lower 95%	Upper 95%
Location	$\mu$	9.08	8.9743439	9.1856561
Dispersion	$\sigma$	0.2124645	0.1594307	0.3185149

-2log(Likelihood) = -5.68150081869083

— Normal(9.06, 0.21246)

Distributions Condition=ETW

Modulus, Msi, Measured



Summary Statistics

Mean	9.2172222
Std Dev	0.3685872
Std Err Mean	0.0868768
Upper 95% Mean	9.4005163
Lower 95% Mean	9.0339281
N	18

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	18.5197326
<input type="checkbox"/>	Gamma	18.6452833
<input type="checkbox"/>	Normal	18.9509822
<input type="checkbox"/>	Johnson S1	20.7046183
<input type="checkbox"/>	Johnson Su	21.2930624
<input type="checkbox"/>	GLog	21.4340183
<input type="checkbox"/>	Normal 2 Mixture	23.3876238
<input type="checkbox"/>	Weibull	23.6105094
<input type="checkbox"/>	Extreme Value	23.6105094
<input type="checkbox"/>	Normal 3 Mixture	39.4772122
<input type="checkbox"/>	Exponential	118.208654

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	2.2203292	2.2015709	2.2390874
Shape	$\sigma$	0.0384589	0.0286441	0.0554811

-2log(Likelihood) = 13.719732573022

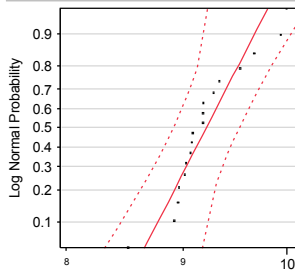
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.189612	0.0858

Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

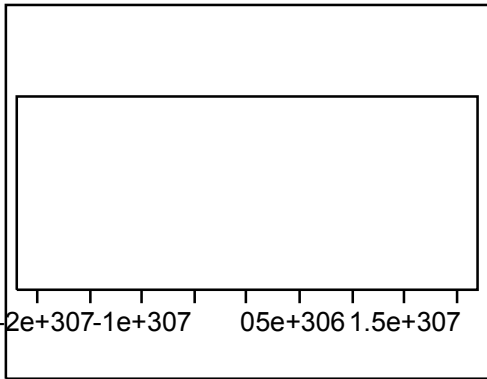
Diagnostic Plot



Modulus, Msi, Measured

**Distributions Condition=ETW**

**Poisson's Ratio**



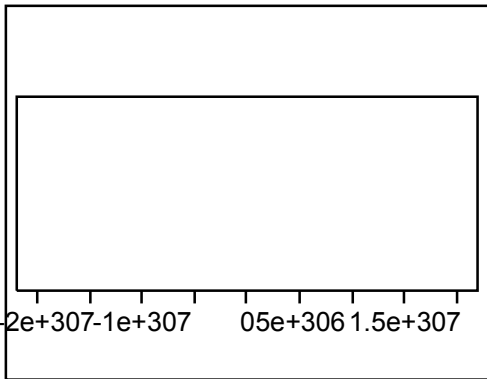
**Quantiles**

**Summary Statistics**

Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

**Distributions Condition=RTD**

**Poisson's Ratio**



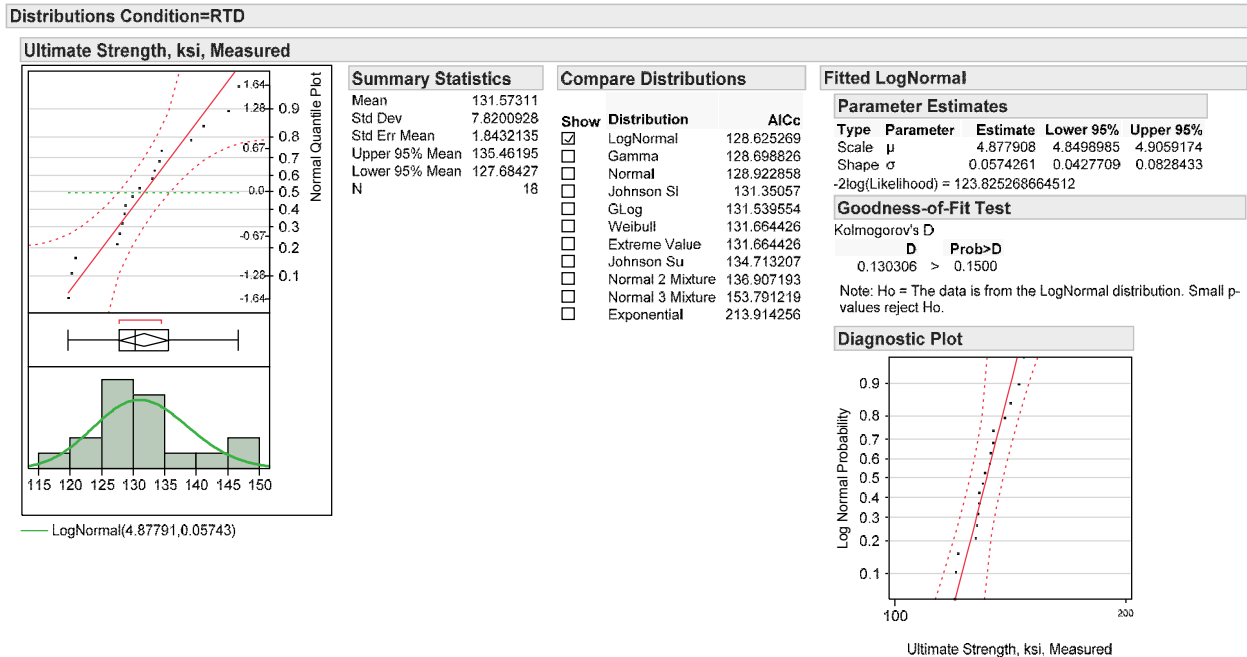
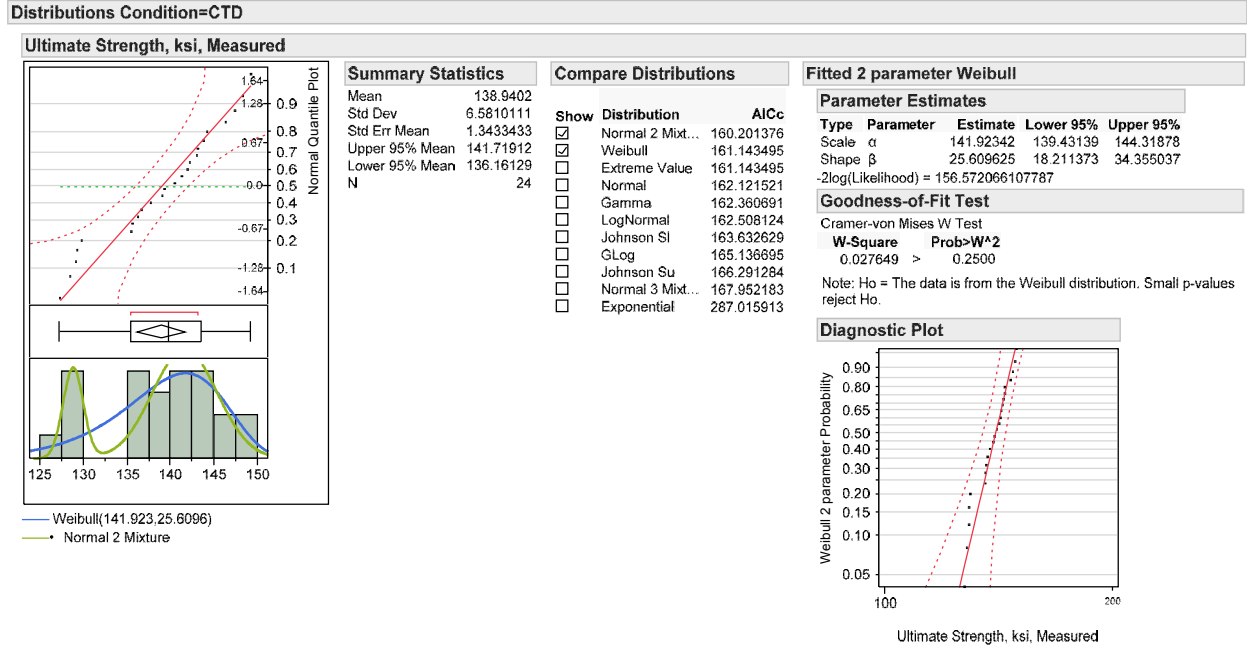
**Quantiles**

**Summary Statistics**

Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

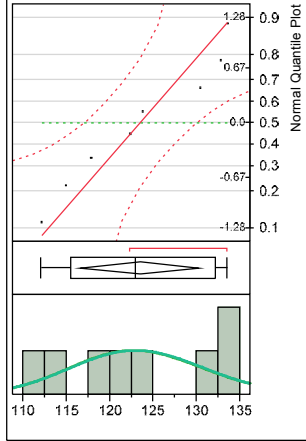
## A.9 Fill Tension (FT)

The determination of statistical distribution types for the Fill Tension (FT) test results is presented here.



Distributions Condition=RTW

Ultimate Strength, ksi, Measured



LogNormal(4.81387, 0.06256)  
Gamma(256.165, 0.48191, 0)

Summary Statistics

Mean 123.448  
Std Dev 8.2326769  
Std Err Mean 2.9106908  
Upper 95% Mean 130.33069  
Lower 95% Mean 116.56531  
N 8

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Gamma	61.7687309
<input checked="" type="checkbox"/>	LogNormal	61.7789606
<input type="checkbox"/>	Normal	61.832798
<input type="checkbox"/>	Weibull	61.8866177
<input type="checkbox"/>	Extreme Value	61.8866177
<input type="checkbox"/>	Johnson SI	67.3606506
<input type="checkbox"/>	GLog	67.3645504
<input type="checkbox"/>	Johnson Su	76.6979734
<input type="checkbox"/>	Normal 2 Mixture	91.3087574
<input type="checkbox"/>	Exponential	95.7197867

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	4.8138669	4.7647511	4.8629826
Shape	$\sigma$	0.0625606	0.0410458	0.1122806

-2log(Likelihood) = 55.3789606007606

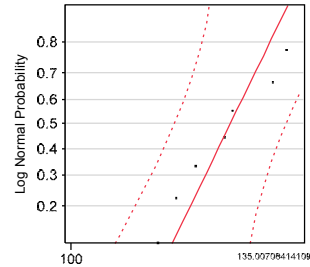
Goodness-of-Fit Test

Kolmogorov's D

D Prob>D  
0.191756 > 0.1500

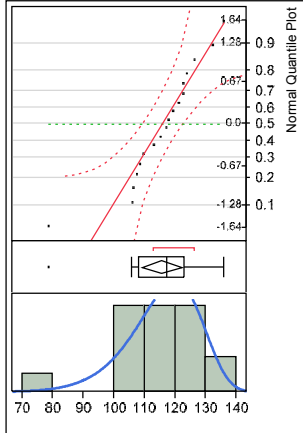
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETD1

Ultimate Strength, ksi, Measured



Weibull(120.881, 11.8137)

Summary Statistics

Mean 115.76595  
Std Dev 12.737478  
Std Err Mean 3.0022523  
Upper 95% Mean 122.10014  
Lower 95% Mean 109.43175  
N 18

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Weibull	143.777936
<input type="checkbox"/>	Extreme Value	143.777936
<input type="checkbox"/>	Normal	146.485539
<input type="checkbox"/>	Johnson SI	146.603737
<input type="checkbox"/>	Gamma	148.347129
<input type="checkbox"/>	LogNormal	149.454984
<input type="checkbox"/>	Johnson Su	149.535344
<input type="checkbox"/>	GLog	152.36927
<input type="checkbox"/>	Normal 2 Mixture	157.397923
<input type="checkbox"/>	Normal 3 Mixture	172.232099
<input type="checkbox"/>	Exponential	209.306536

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	120.88058	115.58574	126.10136
Shape	$\beta$	11.813687	7.950725	16.378032

-2log(Likelihood) = 138.977935503883

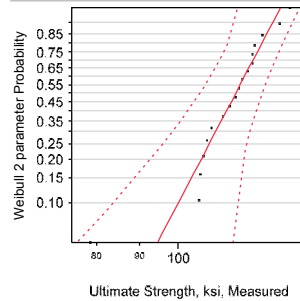
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square Prob>W^2  
0.033698 > 0.2500

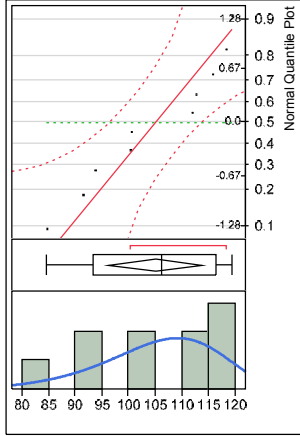
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETD2

Ultimate Strength, ksi, Measured



— Weibull(110.091,10.944)

Summary Statistics

Mean	104.91013
Std Dev	12.396111
Std Err Mean	3.9199945
Upper 95% Mean	113.77778
Lower 95% Mean	96.042491
N	10

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Weibull	82.7623116
<input type="checkbox"/>	Extreme Value	82.7623116
<input type="checkbox"/>	Normal	83.4407123
<input type="checkbox"/>	Gamma	83.6070905
<input type="checkbox"/>	LogNormal	83.7526555
<input type="checkbox"/>	Johnson SI	86.2841011
<input type="checkbox"/>	GLog	87.6728233
<input type="checkbox"/>	Johnson Su	93.6731922
<input type="checkbox"/>	Normal 2 Mixture	97.3681744
<input type="checkbox"/>	Exponential	115.562082
<input type="checkbox"/>	Normal 3 Mixture	229.35043

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	110.09095	102.69492	117.4535
Shape	$\beta$	10.944048	6.1829015	17.475423

-2log(Likelihood) = 77.048025902865

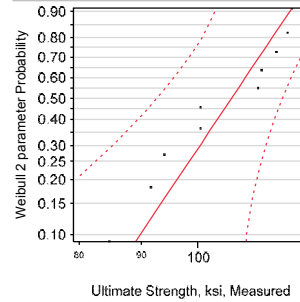
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square	Prob>W^2
0.075614	0.2117

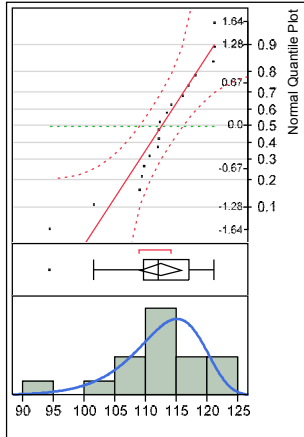
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW

Ultimate Strength, ksi, Measured



— Weibull(115.277,21.9072)

Summary Statistics

Mean	112.43185
Std Dev	6.7624125
Std Err Mean	1.5939159
Upper 95% Mean	115.79472
Lower 95% Mean	109.06898
N	18

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Weibull	120.734411
<input type="checkbox"/>	Extreme Value	120.734411
<input type="checkbox"/>	Johnson SI	123.514405
<input type="checkbox"/>	Normal	123.691457
<input type="checkbox"/>	Gamma	124.450487
<input type="checkbox"/>	LogNormal	124.879927
<input type="checkbox"/>	Johnson Su	126.877001
<input type="checkbox"/>	GLog	127.794212
<input type="checkbox"/>	Normal 2 Mixture	130.961542
<input type="checkbox"/>	Normal 3 Mixture	144.382255
<input type="checkbox"/>	Exponential	208.254501

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	115.27683	112.5211	117.94644
Shape	$\beta$	21.907241	14.679937	30.620533

-2log(Likelihood) = 115.934411163005

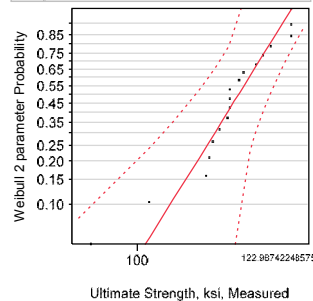
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square	Prob>W^2
0.064170	> 0.2500

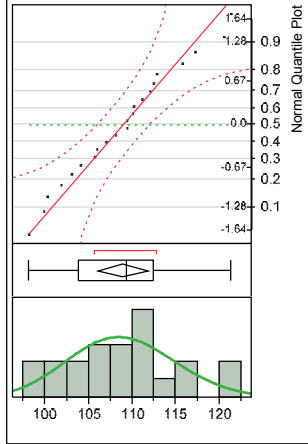
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Ultimate Strength, ksi, Measured



LogNormal(4.68907,0.05713)

Summary Statistics

Mean	108.92947
Std Dev	6.3892846
Std Err Mean	1.3622
Upper 95% Mean	111.76232
Lower 95% Mean	106.09662
N	22

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	147.44042
<input type="checkbox"/>	Gamma	147.489919
<input type="checkbox"/>	Normal	147.668256
<input type="checkbox"/>	Johnson SI	150.062722
<input type="checkbox"/>	GLog	150.142174
<input type="checkbox"/>	Weibull	150.475338
<input type="checkbox"/>	Extreme Value	150.475338
<input type="checkbox"/>	Johnson Su	153.08233
<input type="checkbox"/>	Normal 2 Mixture	156.105677
<input type="checkbox"/>	Normal 3 Mixture	169.65785
<input type="checkbox"/>	Exponential	252.590826

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	4.6890656	4.66411	4.7140213
Shape	$\sigma$	0.0571344	0.0436578	0.0792877

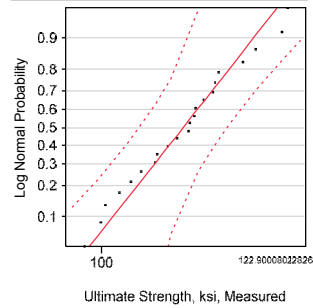
-2log(Likelihood) = 142.808840746088

Goodness-of-Fit Test

Kolmogorov's D  
**D**      **Prob>D**  
 0.083251      > 0.1500

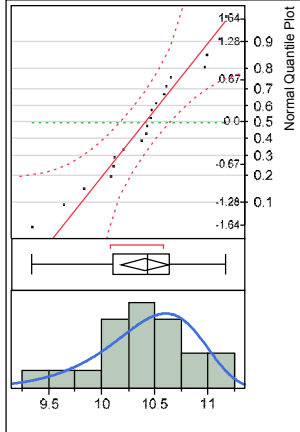
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=CTD

Modulus, Msi, Measured



Weibull(10.6148,25.8415)

Summary Statistics

Mean	10.4007
Std Dev	0.4720825
Std Err Mean	0.1055609
Upper 95% Mean	10.621641
Lower 95% Mean	10.179759
N	20

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Weibull	30.3513528
<input type="checkbox"/>	Extreme Value	30.3513528
<input type="checkbox"/>	Normal	30.4393645
<input type="checkbox"/>	Gamma	30.6504935
<input type="checkbox"/>	LogNormal	30.7871993
<input type="checkbox"/>	Johnson SI	32.6535118
<input type="checkbox"/>	GLog	33.5813169
<input type="checkbox"/>	Johnson Su	35.8191428
<input type="checkbox"/>	Normal 2 Mixture	39.9449053
<input type="checkbox"/>	Normal 3 Mixture	50.541782
<input type="checkbox"/>	Exponential	135.897147

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	10.614822	10.411131	10.810835
Shape	$\beta$	25.841463	17.8896866	35.242032

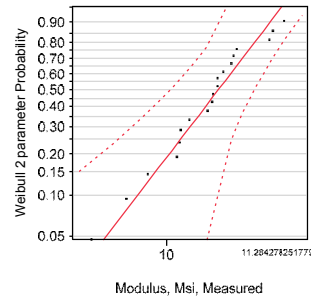
-2log(Likelihood) = 25.6454704054196

Goodness-of-Fit Test

Cramer-von Mises W Test  
**W-Square**      **Prob>W^2**  
 0.062498      > 0.2500

Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

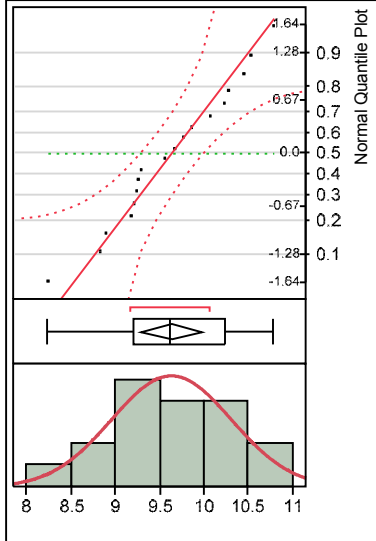
Diagnostic Plot





Distributions Condition=RTD

Modulus, Msi, Measured



Normal(9.62833,0.67767)

Summary Statistics

Mean	9.6283333
Std Dev	0.6776712
Std Err Mean	0.1597286
Upper 95% Mean	9.9653313
Lower 95% Mean	9.2913354
N	18

Fitted Normal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Location	$\mu$	9.6283333	9.2913354	9.9653313
Dispersion	$\sigma$	0.6776712	0.5085161	1.0159267

-2log(Likelihood) = 36.0744360916319

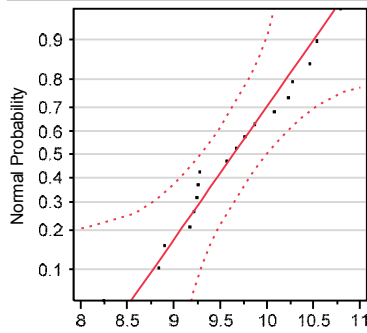
Goodness-of-Fit Test

Shapiro-Wilk W Test

W	Prob<W
0.975621	0.8941

Note: Ho = The data is from the Normal distribution. Small p-values reject Ho.

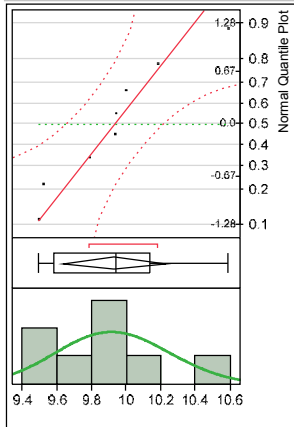
Diagnostic Plot



Modulus, Msi, Measured

Distributions Condition=RTW

Modulus, Msi, Measured



LogNormal(2.29498,0.03329)

Summary Statistics

Mean	9.92975
Std Dev	0.3559232
Std Err Mean	0.1258379
Upper 95% Mean	10.227309
Lower 95% Mean	9.6321907
N	8

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	11.3846224
<input type="checkbox"/>	Gamma	11.4227682
<input type="checkbox"/>	Normal	11.5743738
<input type="checkbox"/>	Weibull	13.2629543
<input type="checkbox"/>	Extreme Value	13.2629543
<input type="checkbox"/>	Johnson S1	16.5604991
<input type="checkbox"/>	GLog	16.9846224
<input type="checkbox"/>	Johnson Su	28.4508138
<input type="checkbox"/>	Normal 2 Mixture	46.4511272
<input type="checkbox"/>	Exponential	55.3952315

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	2.2949785	2.2688397	2.3211174
Shape	$\sigma$	0.033294	0.0218441	0.0597544

-2log(Likelihood) = 4.98462243479453

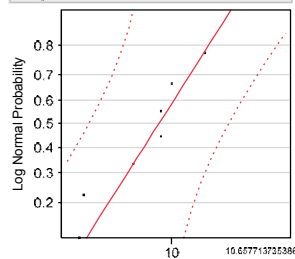
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.161978	> 0.1500

Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

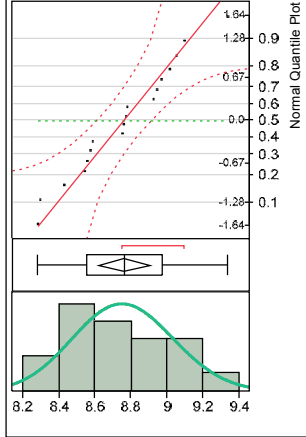
Diagnostic Plot



Modulus, Msi, Measured

Distributions Condition=ETD1

Modulus, Msi, Measured



— LogNormal(2.16959,0.03195)  
 — Gamma(979.8,0.00894,0)

Summary Statistics

Mean	8.7591667
Std Dev	0.2879375
Std Err Mean	0.0678675
Upper 95% Mean	8.9023546
Lower 95% Mean	8.6159787
N	18

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Gamma	10.0208933
<input checked="" type="checkbox"/>	LogNormal	10.022139
<input type="checkbox"/>	Normal	10.0613666
<input type="checkbox"/>	Weibull	11.9100352
<input type="checkbox"/>	Extreme Value	11.9100352
<input type="checkbox"/>	Johnson S1	12.9359616
<input type="checkbox"/>	GLog	12.9364018
<input type="checkbox"/>	Johnson Su	16.298599
<input type="checkbox"/>	Normal 2 Mixture	22.1367208
<input type="checkbox"/>	Normal 3 Mixture	34.1937206
<input type="checkbox"/>	Exponential	116.373628

Fitted LogNormal

**Parameter Estimates**

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	2.1695904	2.1540051	2.1851757
Shape	$\sigma$	0.0319536	0.023799	0.0460965

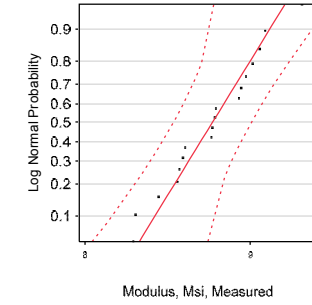
-2log(Likelihood) = 5.22213902504784

Goodness-of-Fit Test

Kolmogorov's D  
**D** **Prob>D**  
 0.113967 > 0.1500

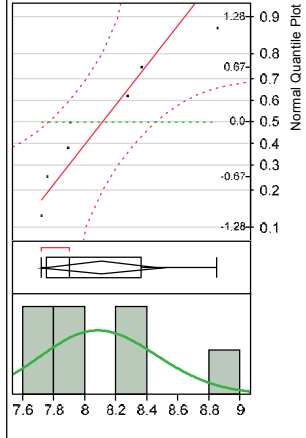
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETD2

Modulus, Msi, Measured



— LogNormal(2.09154,0.04622)

Summary Statistics

Mean	8.1061429
Std Dev	0.4117784
Std Err Mean	0.1558376
Upper 95% Mean	8.4869744
Lower 95% Mean	7.7253113
N	7

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	13.1048594
<input type="checkbox"/>	Gamma	13.1884048
<input type="checkbox"/>	Normal	13.4433614
<input type="checkbox"/>	Weibull	15.1614443
<input type="checkbox"/>	Extreme Value	15.1614443
<input type="checkbox"/>	Johnson S1	16.3244626
<input type="checkbox"/>	GLog	20.1048594
<input type="checkbox"/>	Johnson Su	30.3244626
<input type="checkbox"/>	Exponential	46.0967101
<input type="checkbox"/>	Normal 2 Mixture	72.9266894

Fitted LogNormal

**Parameter Estimates**

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	2.0915417	2.0520236	2.1310599
Shape	$\sigma$	0.0462165	0.0295791	0.0870871

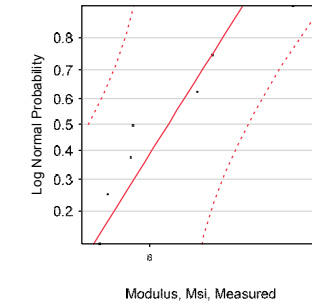
-2log(Likelihood) = 6.10485937700793

Goodness-of-Fit Test

Kolmogorov's D  
**D** **Prob>D**  
 0.274753 0.1074

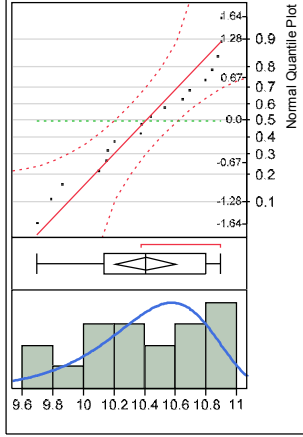
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW

Modulus, Msi, Measured



Summary Statistics

Mean	10.404611
Std Dev	0.3957282
Std Err Mean	0.093274
Upper 95% Mean	10.601402
Lower 95% Mean	10.20782
N	18

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Weibull	20.5806657
<input type="checkbox"/>	Extreme Value	20.5806657
<input type="checkbox"/>	Normal	21.5087948
<input type="checkbox"/>	Gamma	21.6194341
<input type="checkbox"/>	LogNormal	21.6967553
<input type="checkbox"/>	Johnson S1	23.1337104
<input type="checkbox"/>	GLog	24.3942293
<input type="checkbox"/>	Normal 2 Mixture	26.9801391
<input type="checkbox"/>	Johnson Su	27.7569578
<input type="checkbox"/>	Normal 3 Mixture	41.3799829
<input type="checkbox"/>	Exponential	122.570967

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	10.584689	10.412589	10.748472
Shape	$\beta$	32.659459	21.774066	46.208115

-2log(Likelihood) = 15.7806657011021

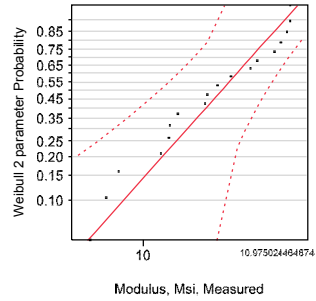
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square	Prob>W*2
0.060320	> 0.2500

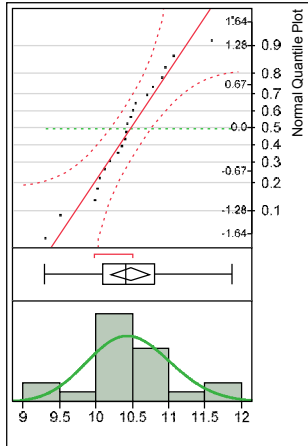
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Modulus, Msi, Measured



Summary Statistics

Mean	10.473409
Std Dev	0.5924109
Std Err Mean	0.1263024
Upper 95% Mean	10.736069
Lower 95% Mean	10.210749
N	22

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	42.6382157
<input type="checkbox"/>	Gamma	42.7356922
<input type="checkbox"/>	Normal	43.0284668
<input type="checkbox"/>	Johnson S1	45.2191426
<input type="checkbox"/>	GLog	45.3399701
<input type="checkbox"/>	Johnson Su	47.3715043
<input type="checkbox"/>	Weibull	47.7974405
<input type="checkbox"/>	Extreme Value	47.7974405
<input type="checkbox"/>	Normal 2 Mixture	49.1550783
<input type="checkbox"/>	Normal 3 Mixture	66.5770852
<input type="checkbox"/>	Exponential	149.548941

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	2.3473274	2.3233534	2.3713013
Shape	$\sigma$	0.054887	0.0419405	0.0761689

-2log(Likelihood) = 38.0066367690468

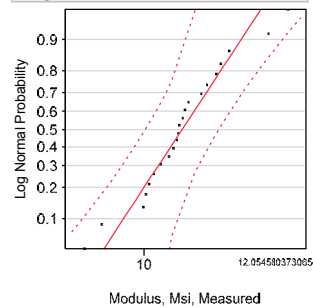
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.128369	> 0.1500

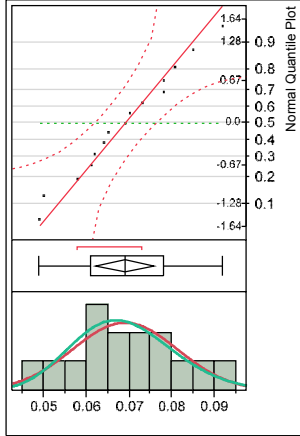
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=CTD

Poisson's Ratio



Summary Statistics

Mean	0.06898
Std Dev	0.0123545
Std Err Mean	0.0031899
Upper 95% Mean	0.0758217
Lower 95% Mean	0.0621383
N	15

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Gamma	-85.300507
<input checked="" type="checkbox"/>	Normal	-85.243803
<input type="checkbox"/>	LogNormal	-85.136804
<input type="checkbox"/>	Weibull	-84.811104
<input type="checkbox"/>	Extreme Value	-84.811104
<input type="checkbox"/>	Johnson S1	-82.133616
<input type="checkbox"/>	GLog	-81.954986
<input type="checkbox"/>	Johnson Su	-78.315434
<input type="checkbox"/>	Normal 2 Mixture	-71.317196
<input type="checkbox"/>	Exponential	-47.910468
<input type="checkbox"/>	Normal 3 Mixture	-46.867237

Fitted Normal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Location	$\mu$	0.06898	0.0621383	0.0758217
Dispersion	$\sigma$	0.0123545	0.0090451	0.0194843
-2log(Likelihood) = -90.243802735415				

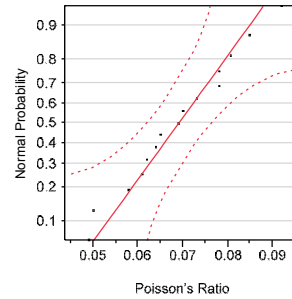
Goodness-of-Fit Test

Shapiro-Wilk W Test

W	Prob<W
0.979496	0.9660

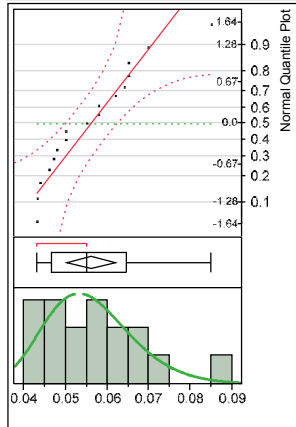
Note: Ho = The data is from the Normal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=RTD

Poisson's Ratio



Summary Statistics

Mean	0.0560588
Std Dev	0.0114754
Std Err Mean	0.0027832
Upper 95% Mean	0.0619589
Lower 95% Mean	0.0501587
N	17

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	-102.04055
<input type="checkbox"/>	Gamma	-101.45968
<input type="checkbox"/>	Johnson S1	-101.44844
<input type="checkbox"/>	Normal	-99.795762
<input type="checkbox"/>	GLog	-99.051542
<input type="checkbox"/>	Johnson Su	-97.95126
<input type="checkbox"/>	Weibull	-97.772177
<input type="checkbox"/>	Extreme Value	-97.772177
<input type="checkbox"/>	Normal 2 Mixture	-93.711196
<input type="checkbox"/>	Normal 3 Mixture	-74.659158
<input type="checkbox"/>	Exponential	-61.69936

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	-2.899827	-2.995264	-2.80439
Shape	$\sigma$	0.1895368	0.1400871	0.2767173
-2log(Likelihood) = -106.897696086961				

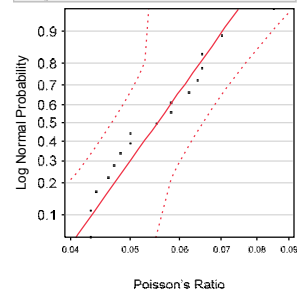
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.164158	> 0.1500

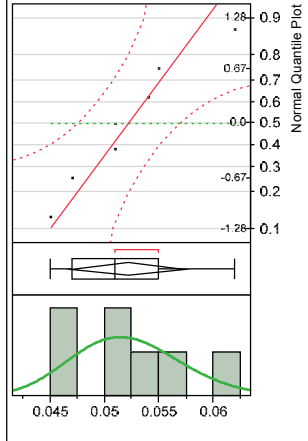
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=RTW

Poisson's Ratio



— LogNormal(-2.9586,0.09809)

Summary Statistics

Mean	0.0521429
Std Dev	0.0056104
Std Err Mean	0.0021205
Upper 95% Mean	0.0573316
Lower 95% Mean	0.0469541
N	7

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	-47.061436
<input type="checkbox"/>	Gamma	-46.983913
<input type="checkbox"/>	Normal	-46.698815
<input type="checkbox"/>	Weibull	-45.705039
<input type="checkbox"/>	Extreme Value	-45.705039
<input type="checkbox"/>	Johnson S1	-40.310785
<input type="checkbox"/>	GLog	-40.061436
<input type="checkbox"/>	Johnson Su	-26.310785
<input type="checkbox"/>	Exponential	-24.552753
<input type="checkbox"/>	Normal 2 Mixture	20.2042993

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	-2.958625	-3.0425	-2.874749
Shape	$\sigma$	0.0980925	0.0627803	0.1846386

-2log(Likelihood) = -54.061436306655

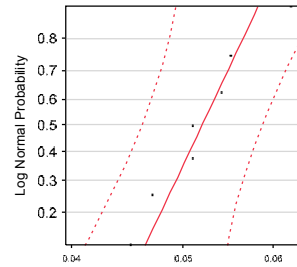
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.144270	> 0.1500

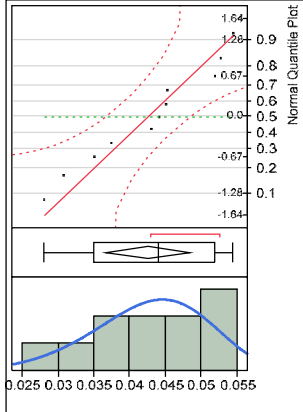
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETD1

Poisson's Ratio



— Weibull(0.04589,5.99289)

Summary Statistics

Mean	0.0424636
Std Dev	0.0088274
Std Err Mean	0.0026616
Upper 95% Mean	0.0483939
Lower 95% Mean	0.0365333
N	11

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Weibull	-68.842301
<input type="checkbox"/>	Extreme Value	-68.842301
<input type="checkbox"/>	Normal	-68.3411
<input type="checkbox"/>	Gamma	-67.974398
<input type="checkbox"/>	LogNormal	-67.620192
<input type="checkbox"/>	Johnson S1	-64.833325
<input type="checkbox"/>	GLog	-64.46094
<input type="checkbox"/>	Johnson Su	-59.223416
<input type="checkbox"/>	Normal 2 Mixture	-51.694583
<input type="checkbox"/>	Exponential	-45.055914
<input type="checkbox"/>	Normal 3 Mixture	2.71286836

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	0.0458896	0.0407338	0.0512939
Shape	$\beta$	5.9928887	3.5076461	9.2689488

-2log(Likelihood) = -74.3423007398136

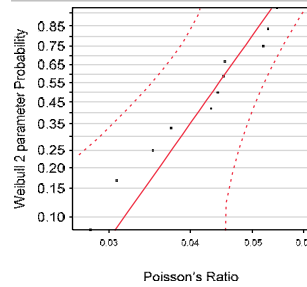
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square	Prob>W*2
0.044310	> 0.2500

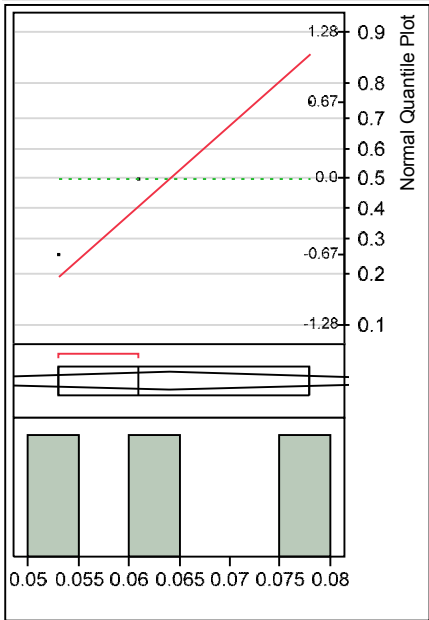
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETD2

Poisson's Ratio



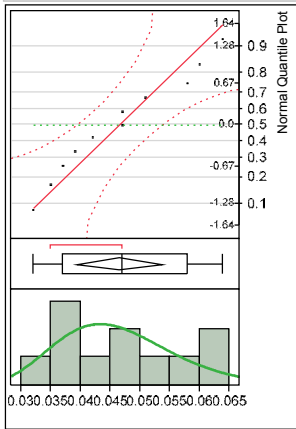
Summary Statistics

Mean	0.064
Std Dev	0.0127671
Std Err Mean	0.0073711
Upper 95% Mean	0.0957153
Lower 95% Mean	0.0322847
N	3

- All fits require at least 4 points

Distributions Condition=ETW

Poisson's Ratio



Summary Statistics

Mean	0.0465455
Std Dev	0.0107272
Std Err Mean	0.0032344
Upper 95% Mean	0.0537521
Lower 95% Mean	0.0393388
N	11

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	-64.6026
<input type="checkbox"/>	Gamma	-64.539278
<input type="checkbox"/>	Normal	-64.052761
<input type="checkbox"/>	Weibull	-63.841963
<input type="checkbox"/>	Extreme Value	-63.841963
<input type="checkbox"/>	Johnson S1	-60.784336
<input type="checkbox"/>	GLog	-60.172601
<input type="checkbox"/>	Johnson Su	-54.934502
<input type="checkbox"/>	Normal 2 Mixture	-50.05472
<input type="checkbox"/>	Exponential	-43.036726
<input type="checkbox"/>	Normal 3 Mixture	14.1065287

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	-3.09148	-3.233738	-2.949223
Shape	$\sigma$	0.2200413	0.152459	0.357426

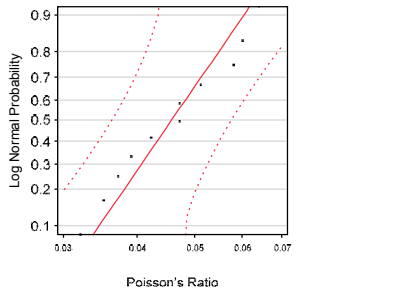
-2log(Likelihood) = -70.1026001500065

Goodness-of-Fit Test

Kolmogorov's D	D	Prob>D
	0.139152	> 0.1500

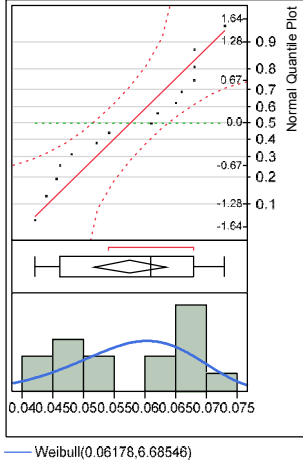
Note. Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Poisson's Ratio



Summary Statistics

Mean	0.0575
Std Dev	0.0105689
Std Err Mean	0.0027289
Upper 95% Mean	0.0633529
Lower 95% Mean	0.0516471
N	15

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Weibull	-90.464723
<input type="checkbox"/>	Extreme Value	-90.464723
<input type="checkbox"/>	Normal	-89.92706
<input type="checkbox"/>	Gamma	-89.770435
<input type="checkbox"/>	LogNormal	-89.55398
<input type="checkbox"/>	Johnson S1	-87.207291
<input type="checkbox"/>	GLog	-86.780135
<input type="checkbox"/>	Normal 2 Mixture	-86.419898
<input type="checkbox"/>	Johnson Su	-82.961947
<input type="checkbox"/>	Normal 3 Mixture	-66.739822
<input type="checkbox"/>	Exponential	-53.371418

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	0.0617842	0.0565135	0.0671423
Shape	$\beta$	6.6854558	4.2527765	9.8068886
$-2\log(\text{Likelihood}) = -95.4647231727737$				

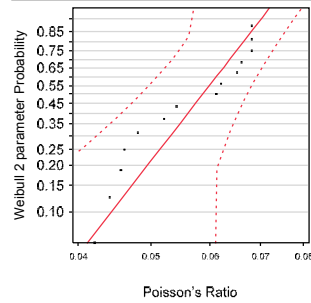
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square	Prob>W*2
0.104084	0.0830

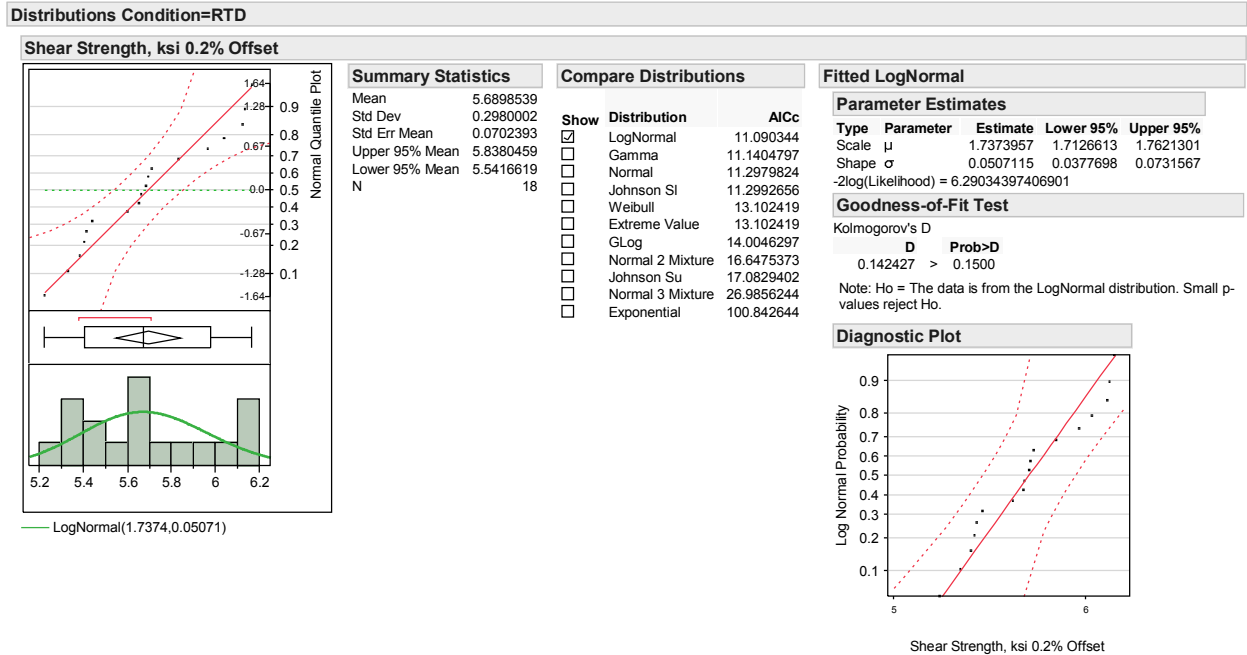
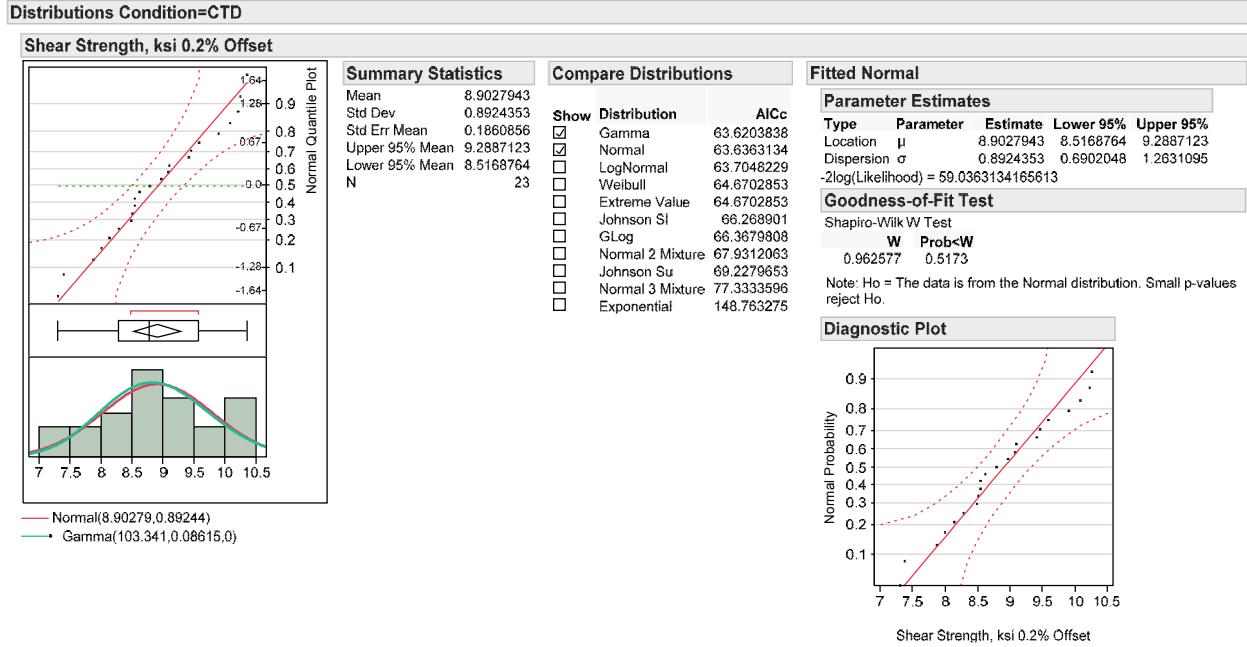
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



## A.10 In-Plane Shear (IPS1)

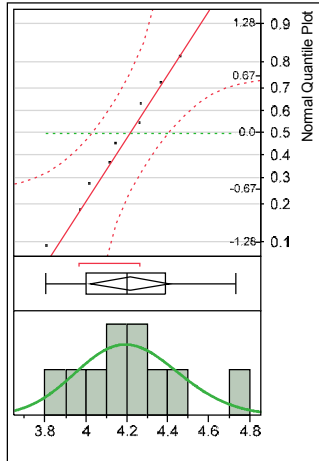
The determination of statistical distribution types for the In-Plane Shear (IPS1) test results is presented here.





Distributions Condition=ETD1

Shear Strength, ksi 0.2% Offset



Summary Statistics	
Mean	4.21188
Std Dev	0.2669401
Std Err Mean	0.0844139
Upper 95% Mean	4.4028374
Lower 95% Mean	4.0209226
N	10

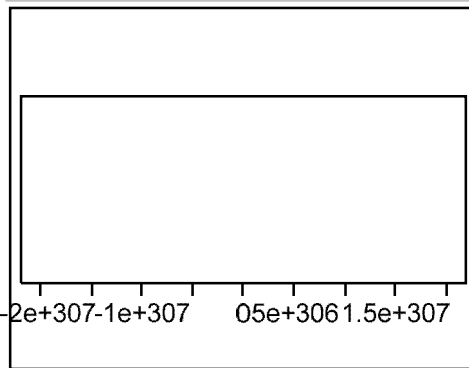
Compare Distributions		
Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	6.42142875
<input type="checkbox"/>	Gamma	6.47928096
<input type="checkbox"/>	Normal	6.67843674
<input type="checkbox"/>	Weibull	8.41914426
<input type="checkbox"/>	Extreme Value	8.41914426
<input type="checkbox"/>	Johnson S1	10.5233434
<input type="checkbox"/>	GLog	10.707143
<input type="checkbox"/>	Johnson Su	16.5233434
<input type="checkbox"/>	Normal 2 Mixture	28.5106416
<input type="checkbox"/>	Exponential	51.2581821
<input type="checkbox"/>	Normal 3 Mixture	165.398145

Fitted LogNormal				
Parameter Estimates				
Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	1.4361224	1.3953179	1.4769269
Shape	$\sigma$	0.0596236	0.0406698	0.0995663
-2log(Likelihood) = 0.707143032862561				

— LogNormal(1.43612,0.05962)

Distributions Condition=ETD2

Shear Strength, ksi 0.2% Offset



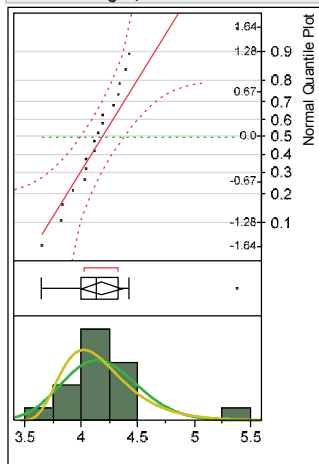
Quantiles

Summary Statistics

Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

Distributions Condition=ETW

Shear Strength, ksi 0.2% Offset



Summary Statistics	
Mean	4.1760828
Std Dev	0.3661239
Std Err Mean	0.0862962
Upper 95% Mean	4.3581519
Lower 95% Mean	3.9940136
N	18

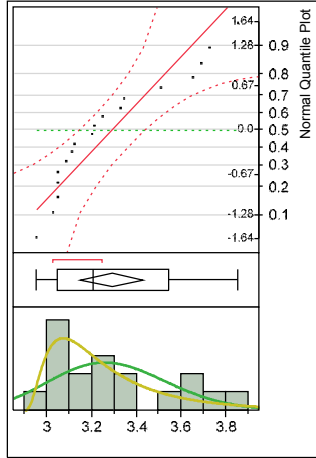
Compare Distributions		
Show	Distribution	AICc
<input checked="" type="checkbox"/>	Johnson S1	15.7230173
<input checked="" type="checkbox"/>	LogNormal	16.2941025
<input type="checkbox"/>	Gamma	17.0341388
<input type="checkbox"/>	Johnson Su	17.6743273
<input type="checkbox"/>	Normal	18.7095829
<input type="checkbox"/>	GLog	19.2083882
<input type="checkbox"/>	Weibull	26.8106808
<input type="checkbox"/>	Extreme Value	26.8106808
<input type="checkbox"/>	Normal 2 Mixture	29.6219669
<input type="checkbox"/>	Normal 3 Mixture	29.92891
<input type="checkbox"/>	Exponential	89.7074522

Fitted LogNormal				
Parameter Estimates				
Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	1.4260429	1.387022	1.4650638
Shape	$\sigma$	0.0900022	0.0595855	0.1154117
-2log(Likelihood) = 11.4941024697866				

— LogNormal(1.42604,0.09)  
 — Johnson S1(0.45938,2.80935,3.26977,1)

Distributions Condition=ETW2

Shear Strength, ksi 0.2% Offset



Summary Statistics

Mean	3.288715
Std Dev	0.2796277
Std Err Mean	0.065956
Upper 95% Mean	3.4278701
Lower 95% Mean	3.1495599
N	18

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Johnson SI	5.6654058
<input checked="" type="checkbox"/>	LogNormal	7.9509062
<input type="checkbox"/>	Gamma	8.28047453
<input type="checkbox"/>	Normal	9.03286629
<input type="checkbox"/>	Normal 2 Mixture	10.7355538
<input type="checkbox"/>	GLog	11.9183005
<input type="checkbox"/>	Weibull	12.5651697
<input type="checkbox"/>	Extreme Value	12.5651697
<input type="checkbox"/>	Johnson Su	15.281016
<input type="checkbox"/>	Normal 3 Mixture	26.5478162
<input type="checkbox"/>	Exponential	81.1078888

Fitted LogNormal

Parameter Estimates

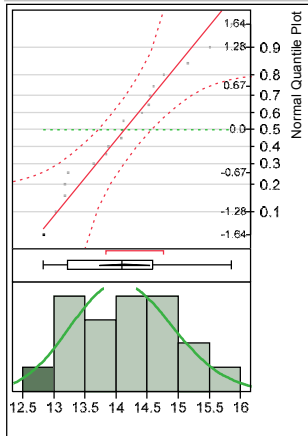
Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	1.1871947	1.147896	1.2264933
Shape	$\sigma$	0.0805717	0.0600096	0.1162331

-2log(Likelihood) = 3.15090062284904

— LogNormal(1.18719,0.08057)  
 • Johnson SI(1.59015,1.36707,2.88819,1)

Distributions Condition=CTD

Shear Strength, ksi @5% Strain



Summary Statistics

Mean	14.123158
Std Dev	0.8477831
Std Err Mean	0.1944948
Upper 95% Mean	14.531776
Lower 95% Mean	13.71454
N	19

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	51.0876063
<input type="checkbox"/>	Gamma	51.1649741
<input type="checkbox"/>	Normal	51.3947058
<input type="checkbox"/>	Johnson SI	53.6567301
<input type="checkbox"/>	GLog	53.9376063
<input type="checkbox"/>	Weibull	54.1452856
<input type="checkbox"/>	Extreme Value	54.1452856
<input type="checkbox"/>	Johnson Su	56.9138729
<input type="checkbox"/>	Normal 2 Mixture	57.9783668
<input type="checkbox"/>	Normal 3 Mixture	72.5593334
<input type="checkbox"/>	Exponential	140.852297

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	2.6461223	2.6186217	2.6736229
Shape	$\sigma$	0.0580965	0.0435789	0.0828999

-2log(Likelihood) = 46.3378063309685

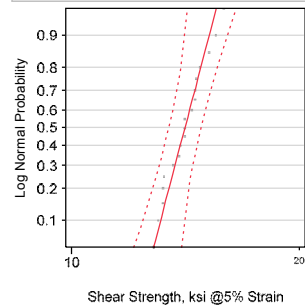
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.129022	> 0.1500

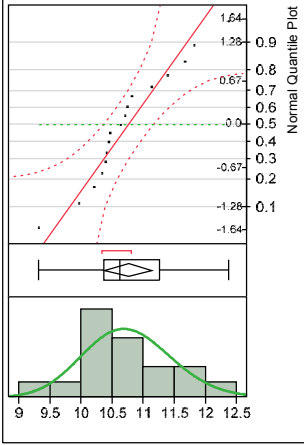
Note. Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=RTD

Shear Strength, ksi @5% Strain



LogNormal(2.37283,0.06631)

Summary Statistics

Mean	10.751412
Std Dev	0.7414415
Std Err Mean	0.178826
Upper 95% Mean	11.132626
Lower 95% Mean	10.370198
N	17

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	41.5185795
<input type="checkbox"/>	Gamma	41.6204638
<input type="checkbox"/>	Normal	41.9296468
<input type="checkbox"/>	Johnson SI	44.364603
<input type="checkbox"/>	GLog	44.5075905
<input type="checkbox"/>	Weibull	45.1650214
<input type="checkbox"/>	Extreme Value	45.1650214
<input type="checkbox"/>	Johnson Su	47.0516176
<input type="checkbox"/>	Normal 2 Mixture	52.8647135
<input type="checkbox"/>	Normal 3 Mixture	72.2794104
<input type="checkbox"/>	Exponential	117.017927

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	2.3728273	2.3394411	2.4062135
Shape	$\sigma$	0.0663051	0.0490058	0.0968022

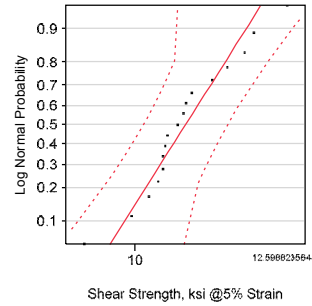
-2log(Likelihood) = 36.6614366784075

Goodness-of-Fit Test

Kolmogorov's D	D	Prob>D
	0.155020	> 0.1500

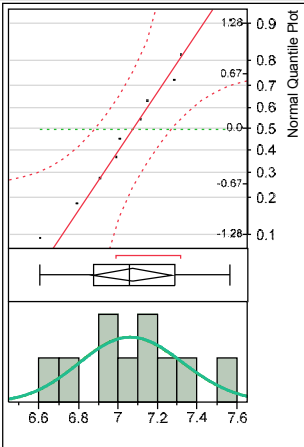
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETD1

Shear Strength, ksi @5% Strain



LogNormal(1.95541,0.03719)  
Gamma(723.469,0.00977,0)

Summary Statistics

Mean	7.0717
Std Dev	0.2771622
Std Err Mean	0.0876464
Upper 95% Mean	7.2699699
Lower 95% Mean	6.8734301
N	10

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Gamma	7.36527577
<input checked="" type="checkbox"/>	LogNormal	7.36548535
<input type="checkbox"/>	Normal	7.43001062
<input type="checkbox"/>	Weibull	8.50396862
<input type="checkbox"/>	Extreme Value	8.50396862
<input type="checkbox"/>	Johnson SI	11.650982
<input type="checkbox"/>	GLog	11.6511966
<input type="checkbox"/>	Johnson Su	17.650982
<input type="checkbox"/>	Normal 2 Mixture	30.1702268
<input type="checkbox"/>	Exponential	61.6220181
<input type="checkbox"/>	Normal 3 Mixture	166.683081

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	1.9554096	1.9295598	1.9808594
Shape	$\sigma$	0.0371873	0.0253658	0.0620996

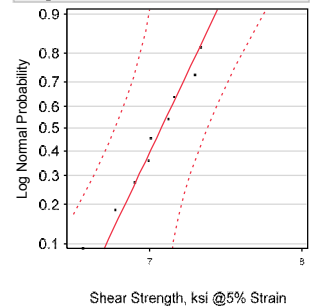
-2log(Likelihood) = 1.65119963674144

Goodness-of-Fit Test

Kolmogorov's D	D	Prob>D
	0.091890	> 0.1500

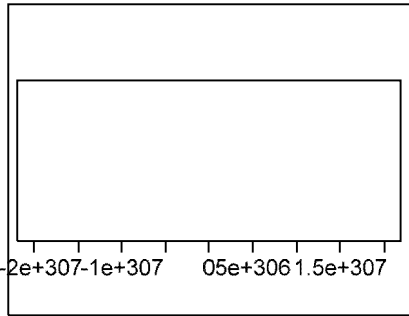
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



**Distributions Condition=ETD2**

**Shear Strength, ksi @5% Strain**



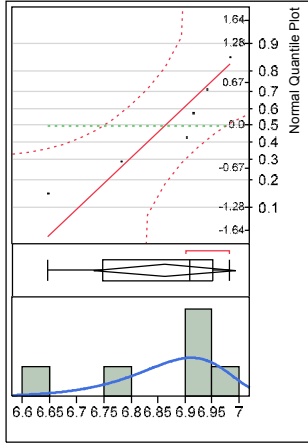
**Quantiles**

**Summary Statistics**

Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

**Distributions Condition=ETW**

**Shear Strength, ksi @5% Strain**



**Summary Statistics**

Mean	6.8616667
Std Dev	0.1255224
Std Err Mean	0.0512443
Upper 95% Mean	6.9933943
Lower 95% Mean	6.729939
N	6

**Compare Distributions**

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Weibull	-2.6303616
<input type="checkbox"/>	Extreme Value	-2.6303616
<input type="checkbox"/>	Gamma	-0.9093714
<input type="checkbox"/>	LogNormal	-0.8786403
<input type="checkbox"/>	Normal	-0.8759926
<input type="checkbox"/>	Johnson SI	6.09944765
<input type="checkbox"/>	GLog	9.03007822
<input type="checkbox"/>	Exponential	38.1114044
<input type="checkbox"/>	Johnson Su	39.0301041

**Fitted 2 parameter Weibull**

**Parameter Estimates**

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	6.9121949	6.8269374	6.994019
Shape	$\beta$	86.099462	39.013189	157.54994

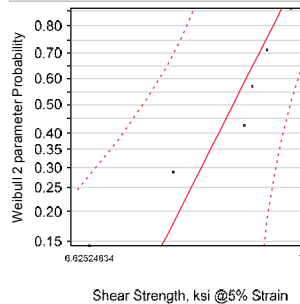
-2log(Likelihood) = -10.6303615593938

**Goodness-of-Fit Test**

Cramer-von Mises W Test	
<b>W-Square</b>	<b>Prob&gt;W^2</b>
0.054064	> 0.2500

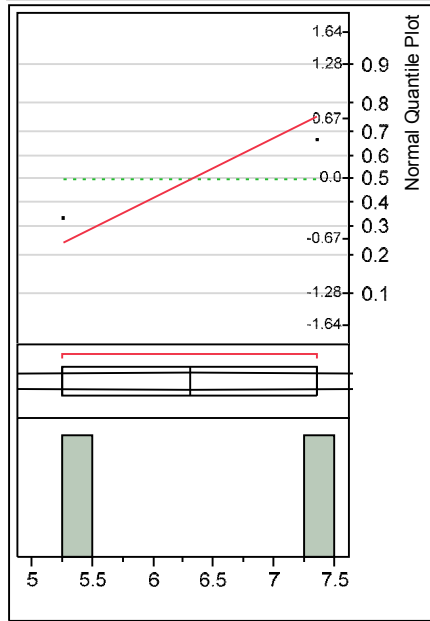
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

**Diagnostic Plot**



Distributions Condition=ETW2

Shear Strength, ksi @5% Strain

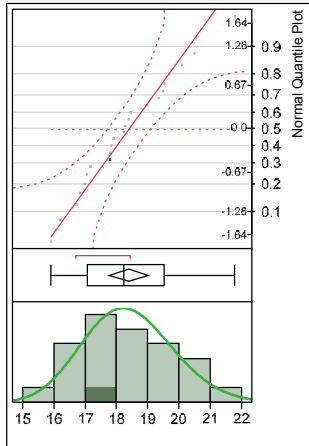


**Summary Statistics**

Mean	6.304
Std Dev	1.4849242
Std Err Mean	1.05
Upper 95% Mean	19.645515
Lower 95% Mean	-7.037515
N	2

Distributions Condition=CTD

Shear Strength, ksi Maximum



LogNormal(2.9079,0.07948)

**Summary Statistics**

Mean	18.376519
Std Dev	1.5036632
Std Err Mean	0.306934
Upper 95% Mean	19.01146
Lower 95% Mean	17.741577
N	24

**Compare Distributions**

Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	90.7141189
<input type="checkbox"/>	Gamma	90.8501458
<input type="checkbox"/>	Normal	91.2598827
<input type="checkbox"/>	Johnson S1	93.033162
<input type="checkbox"/>	GLog	93.3426903
<input type="checkbox"/>	Weibull	94.6574619
<input type="checkbox"/>	Extreme Value	94.6574619
<input type="checkbox"/>	Johnson Su	95.9384251
<input type="checkbox"/>	Normal 2 Mixture	100.940661
<input type="checkbox"/>	Normal 3 Mixture	110.551441
<input type="checkbox"/>	Exponential	189.913355

**Fitted LogNormal**

**Parameter Estimates**

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	2.9079002	2.8747847	2.9410158
Shape	$\sigma$	0.079484	0.061375	0.1086183

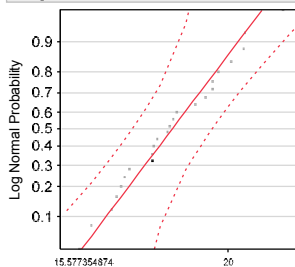
-2log(Likelihood) = 86.1426903213622

**Goodness-of-Fit Test**

Kolmogorov's D	D	Prob>D
	0.088870	> 0.1500

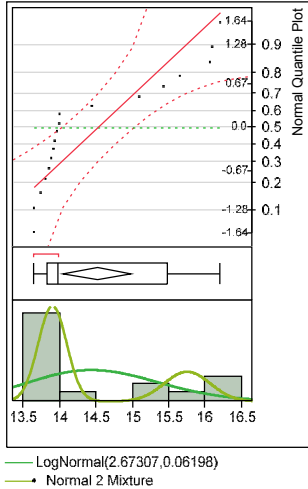
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

**Diagnostic Plot**



Distributions Condition=RTD

Shear Strength, ksi Maximum



Summary Statistics

Mean	14.512688
Std Dev	0.9471151
Std Err Mean	0.2232372
Upper 95% Mean	14.983678
Lower 95% Mean	14.041699
N	18

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Normal 2 Mixture	40.2779722
<input type="checkbox"/>	Johnson SI	40.3013071
<input checked="" type="checkbox"/>	LogNormal	51.9999083
<input type="checkbox"/>	Gamma	52.2888086
<input type="checkbox"/>	Normal	52.9257403
<input type="checkbox"/>	Normal 3 Mixture	53.0433895
<input type="checkbox"/>	GLog	55.8111743
<input type="checkbox"/>	Weibull	56.7572675
<input type="checkbox"/>	Extreme Value	56.7572675
<input type="checkbox"/>	Johnson Su	59.173952
<input type="checkbox"/>	Exponential	134.55094

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	2.6730726	2.6428408	2.7033044
Shape	$\sigma$	0.0619825	0.0461644	0.0894164

-2log(Likelihood) = 47.1999082516045

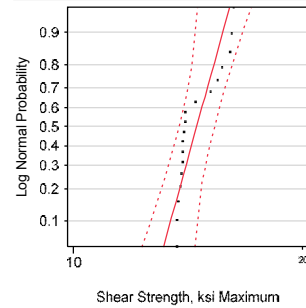
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.322190	< 0.0100*

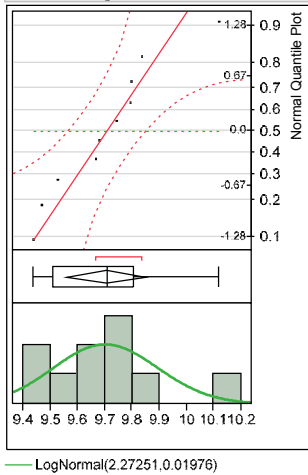
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETD1

Shear Strength, ksi Maximum



Summary Statistics

Mean	9.705632
Std Dev	0.203091
Std Err Mean	0.064223
Upper 95% Mean	9.8509145
Lower 95% Mean	9.5603494
N	10

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	1.06414629
<input type="checkbox"/>	Gamma	1.09410268
<input type="checkbox"/>	Normal	1.21103445
<input type="checkbox"/>	Weibull	3.68487897
<input type="checkbox"/>	Extreme Value	3.68487897
<input type="checkbox"/>	Johnson SI	4.84449661
<input type="checkbox"/>	GLog	5.34986057
<input type="checkbox"/>	Johnson Su	10.8444966
<input type="checkbox"/>	Normal 2 Mixture	19.4190891
<input type="checkbox"/>	Exponential	67.9541267
<input type="checkbox"/>	Normal 3 Mixture	155.103555

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	2.2725105	2.2589855	2.2860355
Shape	$\sigma$	0.0197628	0.0134804	0.0330021

-2log(Likelihood) = -4.65013942903228

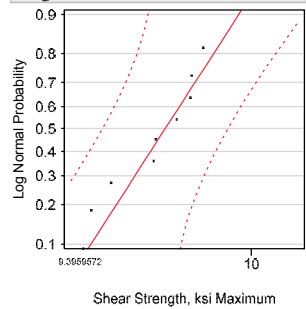
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.148650	> 0.1500

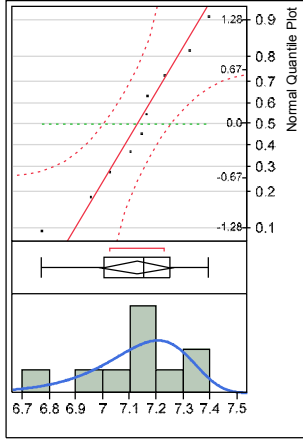
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETD2

Shear Strength, ksi Maximum



— Weibull(7.20694,48.6001)

Summary Statistics

Mean	7.1268986
Std Dev	0.1801442
Std Err Mean	0.0569666
Upper 95% Mean	7.255768
Lower 95% Mean	6.9980312
N	10

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Weibull	-1.5489182
<input type="checkbox"/>	Extreme Value	-1.5489182
<input type="checkbox"/>	Normal	-1.1868928
<input type="checkbox"/>	Gamma	-1.1635484
<input type="checkbox"/>	LogNormal	-1.1225696
<input type="checkbox"/>	Johnson S1	2.56654316
<input type="checkbox"/>	GLog	3.16314467
<input type="checkbox"/>	Johnson Su	8.5563816
<input type="checkbox"/>	Normal 2 Mixture	19.2018623
<input type="checkbox"/>	Exponential	61.7775232
<input type="checkbox"/>	Normal 3 Mixture	153.242935

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	7.2069417	7.0967961	7.3119097
Shape	$\beta$	48.600094	28.200035	74.487401

-2log(Likelihood) = -7.26320393154998

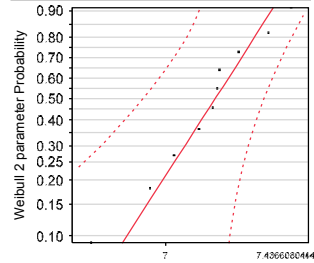
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square	Prob>W <sup>2</sup>
0.031486	> 0.2500

Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

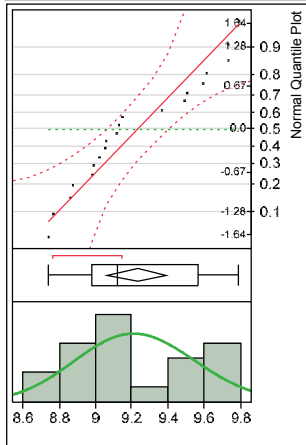
Diagnostic Plot



Shear Strength, ksi Maximum

Distributions Condition=ETW

Shear Strength, ksi Maximum



— LogNormal(2.22133,0.03605)

Summary Statistics

Mean	9.2256347
Std Dev	0.3427942
Std Err Mean	0.0766511
Upper 95% Mean	9.3860674
Lower 95% Mean	9.0652021
N	20

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	17.4055801
<input type="checkbox"/>	Gamma	17.4698339
<input type="checkbox"/>	Normal	17.6384277
<input type="checkbox"/>	Normal 2 Mixture	18.5686287
<input type="checkbox"/>	Johnson S1	19.1086747
<input type="checkbox"/>	Weibull	20.0121606
<input type="checkbox"/>	Extreme Value	20.0121606
<input type="checkbox"/>	GLog	20.4066793
<input type="checkbox"/>	Johnson Su	23.5734175
<input type="checkbox"/>	Normal 3 Mixture	29.5361119
<input type="checkbox"/>	Exponential	131.101662

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	2.2213342	2.2047438	2.2379245
Shape	$\sigma$	0.0360525	0.0272225	0.0509311

-2log(Likelihood) = 12.6996977024128

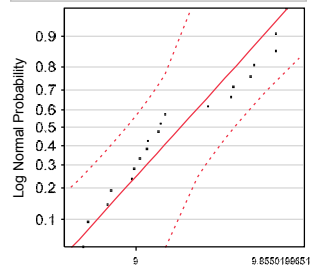
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.185213	0.0719

Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

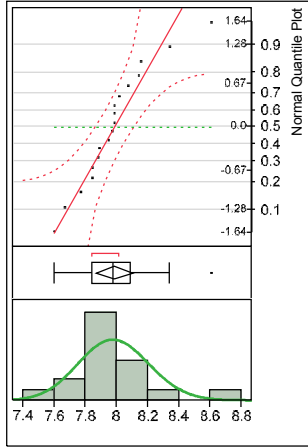
Diagnostic Plot



Shear Strength, ksi Maximum

Distributions Condition=ETW2

Shear Strength, ksi Maximum



LogNormal(2.07692,0.02636)

Summary Statistics

Mean	7.9830989
Std Dev	0.2357081
Std Err Mean	0.0555569
Upper 95% Mean	8.1003138
Lower 95% Mean	7.8658841
N	18

Compare Distributions

Show Distribution	AICc
<input checked="" type="checkbox"/> LogNormal	2.39630435
<input type="checkbox"/> Gamma	2.53442653
<input type="checkbox"/> Normal	2.85598076
<input type="checkbox"/> Johnson SI	3.78946021
<input type="checkbox"/> GLog	5.31059007
<input type="checkbox"/> Johnson Su	6.61092724
<input type="checkbox"/> Weibull	9.4647064
<input type="checkbox"/> Extreme Value	9.4647064
<input type="checkbox"/> Normal 2 Mixture	13.7683647
<input type="checkbox"/> Normal 3 Mixture	26.7184687
<input type="checkbox"/> Exponential	113.03376

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	2.0769214	2.0630868	2.0907559
Shape	$\sigma$	0.0283642	0.0211256	0.0409183

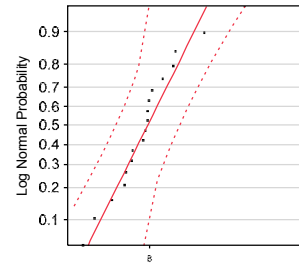
-2log(Likelihood) = -2.40369564575545

Goodness-of-Fit Test

Kolmogorov's D	D	Prob>D
	0.167565	> 0.1500

Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

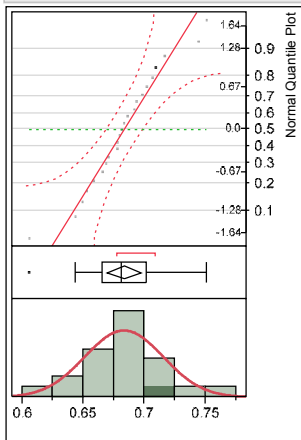
Diagnostic Plot



Shear Strength, ksi Maximum

Distributions Condition=CTD

Modulus, Msi, Measured



Normal(0.68317,0.03218)

Summary Statistics

Mean	0.6831739
Std Dev	0.0321808
Std Err Mean	0.0067102
Upper 95% Mean	0.6970899
Lower 95% Mean	0.6692579
N	23

Compare Distributions

Show Distribution	AICc
<input checked="" type="checkbox"/> Normal	-89.202531
<input type="checkbox"/> Gamma	-89.169872
<input type="checkbox"/> LogNormal	-89.112537
<input type="checkbox"/> Johnson SI	-86.562062
<input type="checkbox"/> GLog	-86.449379
<input type="checkbox"/> Weibull	-86.081679
<input type="checkbox"/> Extreme Value	-86.081679
<input type="checkbox"/> Johnson Su	-84.396422
<input type="checkbox"/> Normal 2 Mixture	-83.2923
<input type="checkbox"/> Normal 3 Mixture	-64.262715
<input type="checkbox"/> Exponential	30.6642084

Fitted Normal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Location	$\mu$	0.6831739	0.6692579	0.6970899
Dispersion	$\sigma$	0.0321808	0.0248885	0.0455472

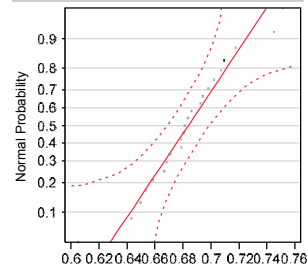
-2log(Likelihood) = -93.8025312640474

Goodness-of-Fit Test

Shapiro-Wilk W Test	W	Prob<W
	0.974288	0.7901

Note: Ho = The data is from the Normal distribution. Small p-values reject Ho.

Diagnostic Plot

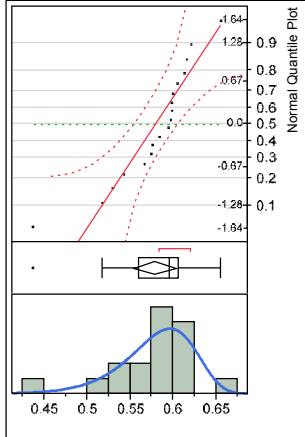


Modulus, Msi, Measured



Distributions Condition=RTD

Modulus, Msi, Measured



Summary Statistics

Mean	0.5791667
Std Dev	0.0487638
Std Err Mean	0.0114937
Upper 95% Mean	0.6034164
Lower 95% Mean	0.554917
N	18

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Weibull	-58.290827
<input type="checkbox"/>	Extreme Value	-58.290827
<input type="checkbox"/>	Johnson S1	-55.473445
<input type="checkbox"/>	Johnson Su	-54.322358
<input type="checkbox"/>	Normal	-53.865799
<input type="checkbox"/>	Gamma	-52.35367
<input type="checkbox"/>	LogNormal	-51.507739
<input type="checkbox"/>	GLog	-48.593453
<input type="checkbox"/>	Normal 2 Mixture	-46.223214
<input type="checkbox"/>	Normal 3 Mixture	-25.909398
<input type="checkbox"/>	Exponential	18.5880604

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	0.598504	0.5797895	0.6169113
Shape	$\beta$	16.574189	11.078366	23.054533

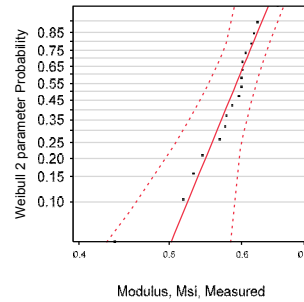
-2log(Likelihood) = -63.090827369034

Goodness-of-Fit Test

Cramer-von Mises W Test	
W-Square	0.064912
Prob>W*2	> 0.2500

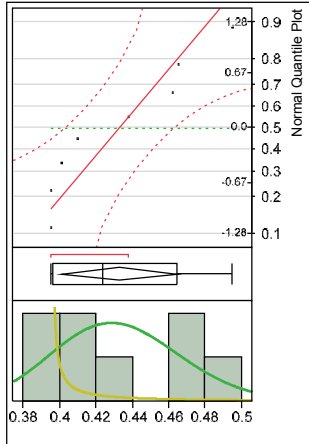
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETD1

Modulus, Msi, Measured



Summary Statistics

Mean	0.432625
Std Dev	0.0381236
Std Err Mean	0.0134787
Upper 95% Mean	0.4644971
Lower 95% Mean	0.4007529
N	8

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Johnson S1	-104.86484
<input checked="" type="checkbox"/>	LogNormal	-24.502095
<input type="checkbox"/>	Gamma	-24.422325
<input type="checkbox"/>	Normal	-24.167722
<input type="checkbox"/>	Weibull	-23.251826
<input type="checkbox"/>	Extreme Value	-23.251826
<input type="checkbox"/>	GLog	-18.635973
<input type="checkbox"/>	Johnson Su	-9.3026242
<input type="checkbox"/>	Normal 2 Mixture	3.34400165
<input type="checkbox"/>	Exponential	5.26052303

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	-0.841222	-0.905082	-0.777361
Shape	$\sigma$	0.0813416	0.053368	0.1459879

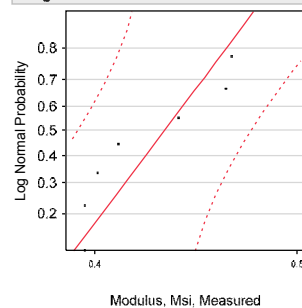
-2log(Likelihood) = -30.9020950433832

Goodness-of-Fit Test

Kolmogorov's D	
D	0.232147
Prob>D	> 0.1500

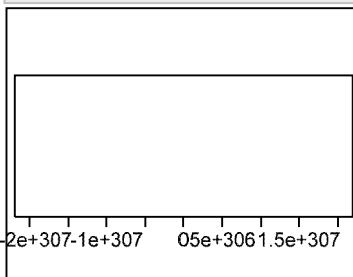
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETD2

Modulus, Msi, Measured



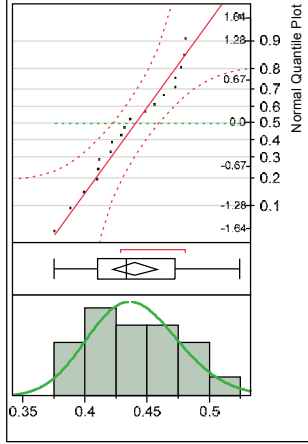
Quantiles

Summary Statistics

Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

Distributions Condition=ETW

Modulus, Msi, Measured



LogNormal(-0.8242,0.08294)

Summary Statistics

Mean	0.4401
Std Dev	0.0376226
Std Err Mean	0.0084127
Upper 95% Mean	0.4577079
Lower 95% Mean	0.4224921
N	20

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	-71.091052
<input type="checkbox"/>	Gamma	-71.019732
<input type="checkbox"/>	Normal	-70.742546
<input type="checkbox"/>	Johnson SI	-68.376417
<input type="checkbox"/>	GLog	-68.296935
<input type="checkbox"/>	Weibull	-68.190891
<input type="checkbox"/>	Extreme Value	-68.190891
<input type="checkbox"/>	Johnson Su	-65.20975
<input type="checkbox"/>	Normal 2 Mixture	-60.299675
<input type="checkbox"/>	Normal 3 Mixture	-44.314049
<input type="checkbox"/>	Exponential	9.39209002

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	-0.824201	-0.862367	-0.786035
Shape	$\sigma$	0.0829381	0.0626249	0.1171681

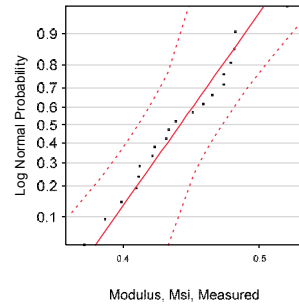
-2log(Likelihood) = -75.7969348359132

Goodness-of-Fit Test

Kolmogorov's D	
D	0.112001
Prob>D	> 0.1500

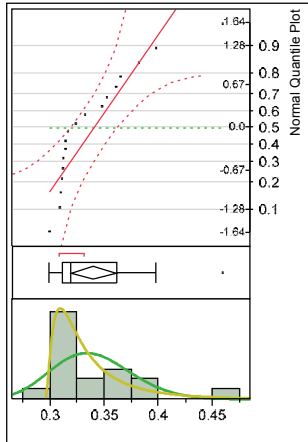
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Modulus, Msi, Measured



LogNormal(-1.0856,0.10957)

Johnson SI(3.94434,1.139,0.29465,1)

Summary Statistics

Mean	0.3398333
Std Dev	0.0411557
Std Err Mean	0.0097005
Upper 95% Mean	0.3602996
Lower 95% Mean	0.3193671
N	18

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Johnson SI	-70.556946
<input type="checkbox"/>	Johnson Su	-67.194309
<input type="checkbox"/>	Normal 2 Mixture	-64.586917
<input checked="" type="checkbox"/>	LogNormal	-62.802301
<input type="checkbox"/>	Gamma	-61.927848
<input type="checkbox"/>	Normal	-59.972329
<input type="checkbox"/>	GLog	-59.888015
<input type="checkbox"/>	Weibull	-54.345448
<input type="checkbox"/>	Extreme Value	-54.345448
<input type="checkbox"/>	Normal 3 Mixture	-48.552725
<input type="checkbox"/>	Exponential	-0.6047992

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	-1.085588	-1.139031	-1.032146
Shape	$\sigma$	0.10957	0.0816075	0.1580663

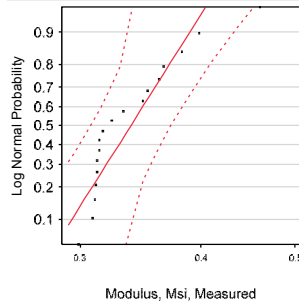
-2log(Likelihood) = -67.6023007264374

Goodness-of-Fit Test

Kolmogorov's D	
D	0.227819
Prob>D	0.0194*

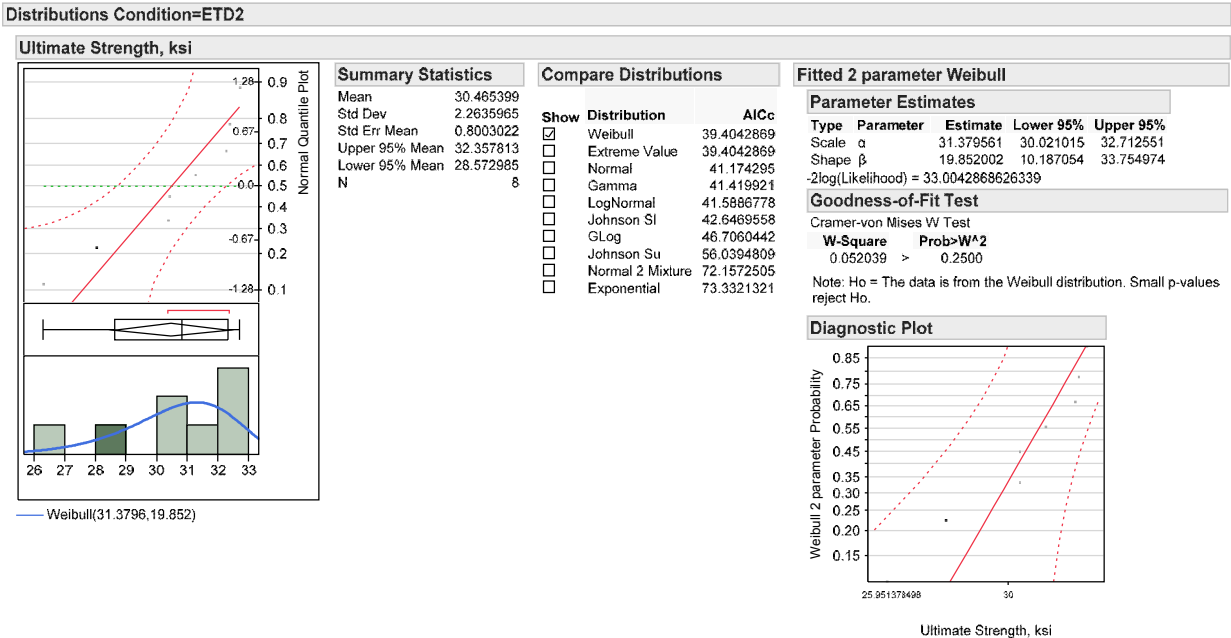
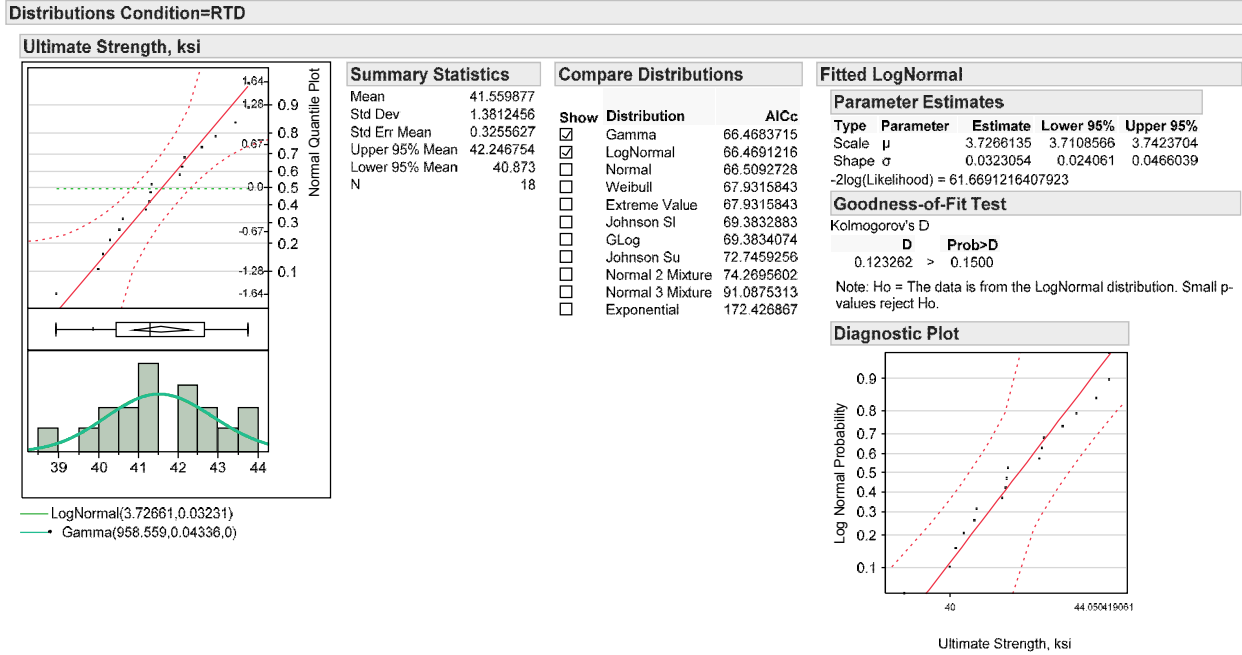
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



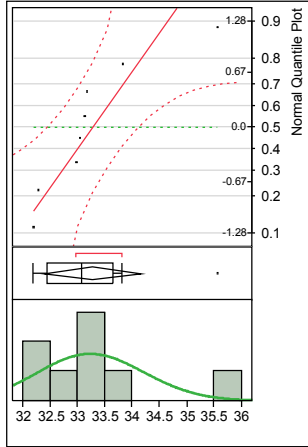
## A.11 Quasi Isotropic Open Hole Compression (OHC1)

The determination of statistical distribution types for the Quasi Isotropic Open Hole Compression (OHC1) test results is presented here.



Distributions Condition=ETW

Ultimate Strength, ksi



LogNormal(3.50401,0.02933)

Summary Statistics

Mean	33.26303
Std Dev	1.0617758
Std Err Mean	0.3753944
Upper 95% Mean	34.150697
Lower 95% Mean	32.375363
N	8

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	28.7006695
<input type="checkbox"/>	Gamma	28.7966404
<input type="checkbox"/>	Normal	29.0621012
<input type="checkbox"/>	Johnson SI	31.2265986
<input type="checkbox"/>	Weibull	32.2003241
<input type="checkbox"/>	Extreme Value	32.2003241
<input type="checkbox"/>	GLog	34.3006695
<input type="checkbox"/>	Johnson Su	40.7666132
<input type="checkbox"/>	Normal 2 Mixture	63.9388546
<input type="checkbox"/>	Exponential	74.7378118

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	3.5040113	3.4809849	3.5270378
Shape	$\sigma$	0.0293296	0.0192431	0.0526393

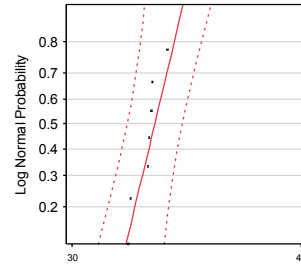
-2log(Likelihood) = 22.3006694642085

Goodness-of-Fit Test

Kolmogorov's D	
D	0.281746
Prob>D	0.0607

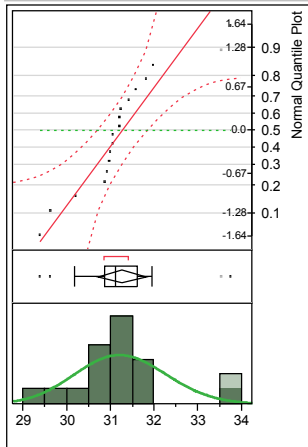
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Ultimate Strength, ksi



LogNormal(3.44148,0.03367)

Summary Statistics

Mean	31.250989
Std Dev	1.0943175
Std Err Mean	0.2579331
Upper 95% Mean	31.79518
Lower 95% Mean	30.706798
N	18

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	57.6990457
<input type="checkbox"/>	Gamma	57.8243251
<input type="checkbox"/>	Normal	58.1264986
<input type="checkbox"/>	Johnson Su	58.5312456
<input type="checkbox"/>	Normal 2 Mixture	59.5067793
<input type="checkbox"/>	Johnson SI	59.7754848
<input type="checkbox"/>	GLog	60.6133314
<input type="checkbox"/>	Weibull	63.6705162
<input type="checkbox"/>	Extreme Value	63.6705162
<input type="checkbox"/>	Normal 3 Mixture	69.6229151
<input type="checkbox"/>	Exponential	162.163837

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	3.4414802	3.4250553	3.457905
Shape	$\sigma$	0.033675	0.025081	0.0485797

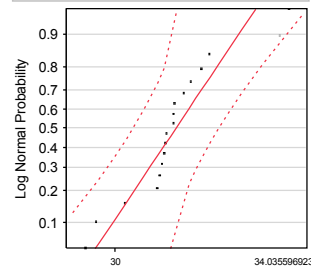
-2log(Likelihood) = 52.8990457023508

Goodness-of-Fit Test

Kolmogorov's D	
D	0.186236
Prob>D	0.0957

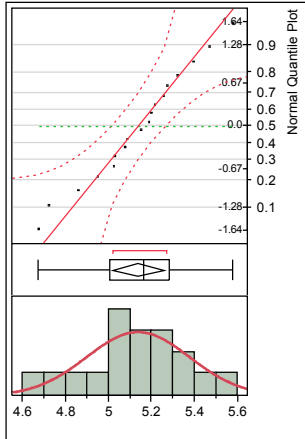
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=RTD

Modulus, Msi



Normal(5.13639,0.23984)

Summary Statistics

Mean	5.1363889
Std Dev	0.2398439
Std Err Mean	0.0565317
Upper 95% Mean	5.2556604
Lower 95% Mean	5.0171173
N	18

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Normal	3.48216914
<input type="checkbox"/>	Gamma	3.5888807
<input type="checkbox"/>	LogNormal	3.67267649
<input type="checkbox"/>	Weibull	4.11273534
<input type="checkbox"/>	Extreme Value	4.11273534
<input type="checkbox"/>	Johnson SI	6.18115242
<input type="checkbox"/>	GLog	6.36760327
<input type="checkbox"/>	Johnson Su	9.09757148
<input type="checkbox"/>	Normal 2 Mixture	11.2856766
<input type="checkbox"/>	Normal 3 Mixture	27.5012415
<input type="checkbox"/>	Exponential	97.1586101

Fitted Normal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Location	$\mu$	5.1363889	5.0171173	5.2556604
Dispersion	$\sigma$	0.2398439	0.1799759	0.3595605

-2log(Likelihood) = -1.31783086055385

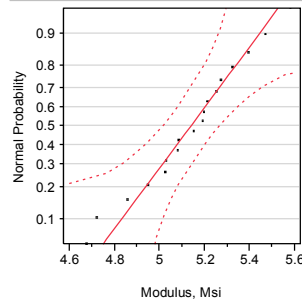
Goodness-of-Fit Test

Shapiro-Wilk W Test

W	Prob>W
0.982085	0.9689

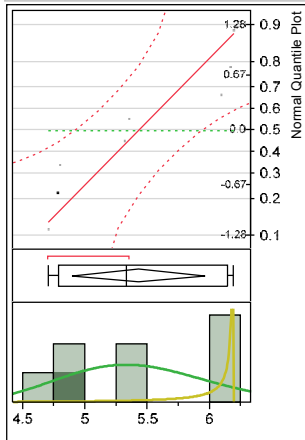
Note: Ho = The data is from the Normal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETD2

Modulus, Msi



LogNormal(1.68497,0.11175)  
Johnson SI(0.44337,0.09414,6.198,-1)

Summary Statistics

Mean	5.426125
Std Dev	0.6496528
Std Err Mean	0.2296869
Upper 95% Mean	5.9692483
Lower 95% Mean	4.8830017
N	8

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Johnson SI	-2.8433162
<input checked="" type="checkbox"/>	LogNormal	20.9986795
<input type="checkbox"/>	Gamma	21.0287933
<input type="checkbox"/>	Normal	21.2019399
<input type="checkbox"/>	Weibull	21.3952255
<input type="checkbox"/>	Extreme Value	21.3952255
<input type="checkbox"/>	GLog	26.7336887
<input type="checkbox"/>	Johnson Su	36.0670725
<input type="checkbox"/>	Exponential	45.7262707
<input type="checkbox"/>	Normal 2 Mixture	45.8926238

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	1.6849707	1.5972368	1.7727047
Shape	$\sigma$	0.1117499	0.0733189	0.2005632

-2log(Likelihood) = 14.598679486637

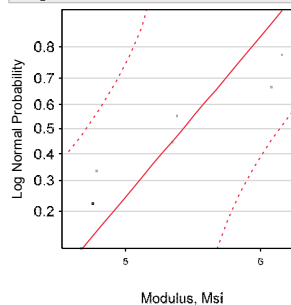
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.237534	> 0.1500

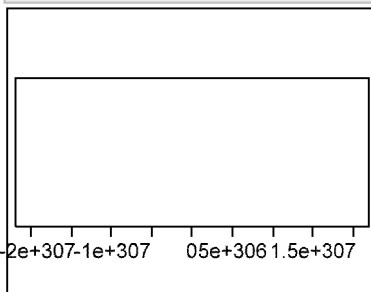
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW

Modulus, Msi



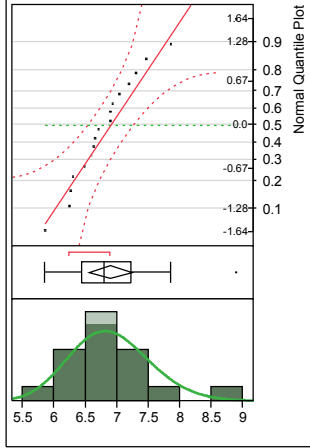
Quantiles

Summary Statistics

Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

Distributions Condition=ETW2

Modulus, Msi



LogNormal(1.92635,0.09329)

Summary Statistics

Mean	6.8952222
Std Dev	0.6939245
Std Err Mean	0.1635596
Upper 95% Mean	7.2403028
Lower 95% Mean	6.5501417
N	18

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	39.8384022
<input type="checkbox"/>	Gamma	40.4003525
<input type="checkbox"/>	Johnson SI	40.5372028
<input type="checkbox"/>	Normal	41.7276722
<input type="checkbox"/>	GLog	42.7526879
<input type="checkbox"/>	Johnson Su	43.6604407
<input type="checkbox"/>	Weibull	47.531398
<input type="checkbox"/>	Extreme Value	47.531398
<input type="checkbox"/>	Normal 2 Mixture	52.6400561
<input type="checkbox"/>	Normal 3 Mixture	67.9275567
<input type="checkbox"/>	Exponential	107.759835

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	1.9263455	1.8808414	1.9718496
Shape	$\sigma$	0.0932944	0.0694855	0.134587

-2log(Likelihood) = 35.038402226102

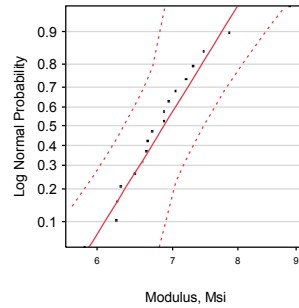
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.124212	> 0.1500

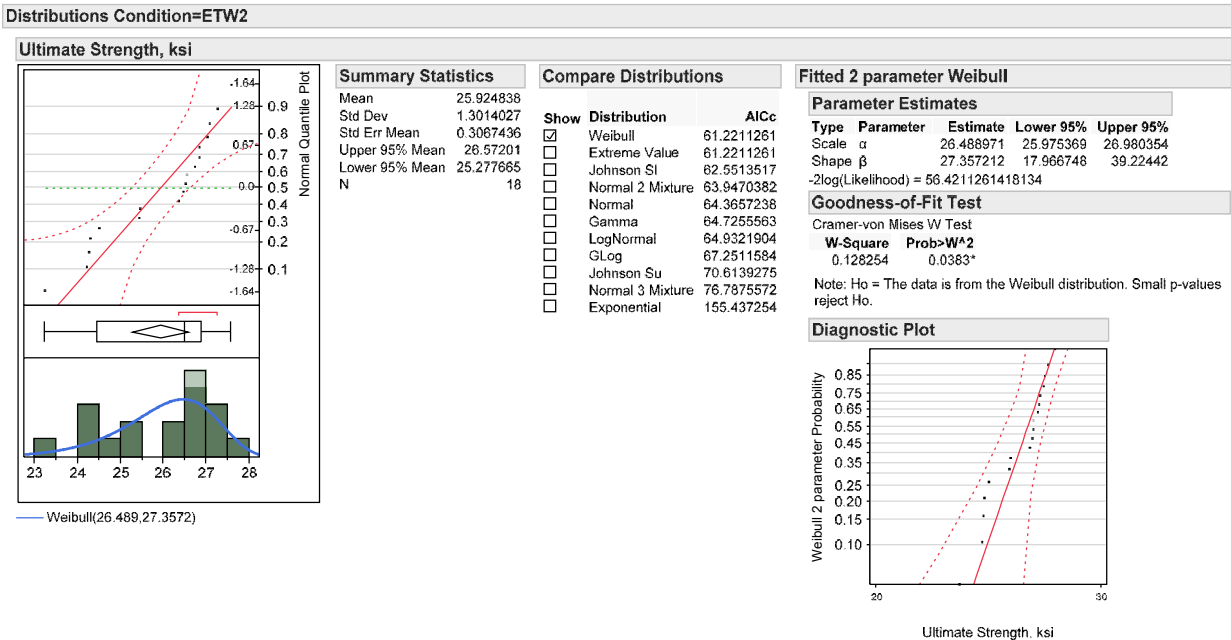
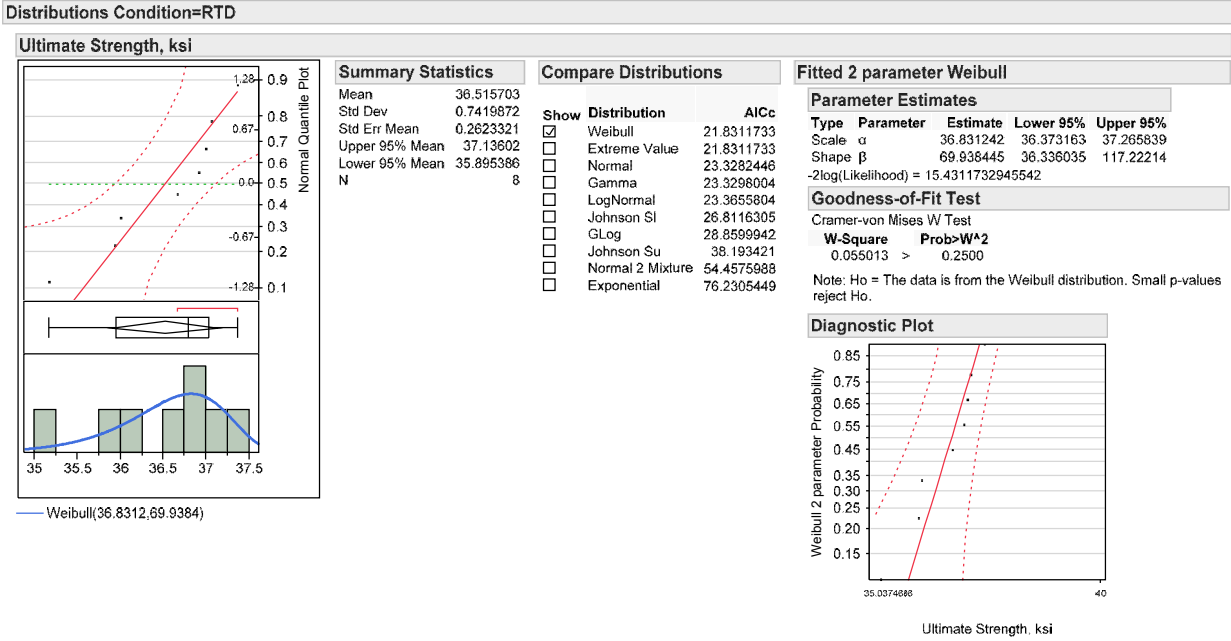
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



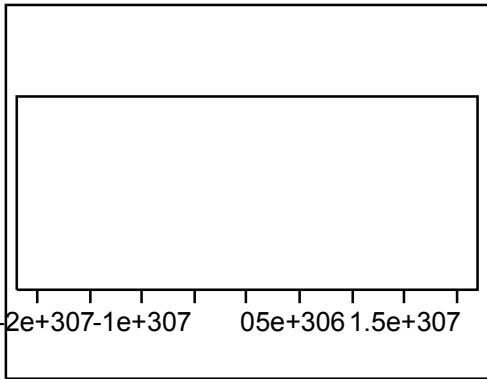
## A.12 Soft Open Hole Compression (OHC2)

The determination of statistical distribution types for the Soft Open Hole Compression (OHC2) test results is presented here.



**Distributions Condition=ETW2**

**Modulus, Msi**



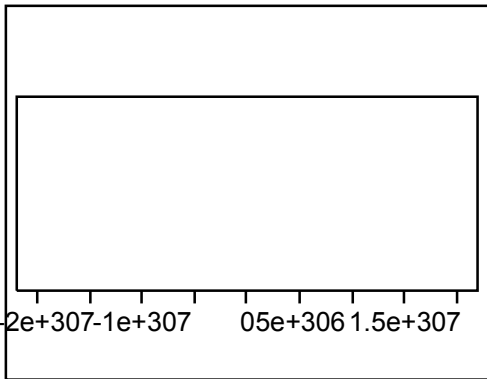
**Quantiles**

**Summary Statistics**

Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

**Distributions Condition=RTD**

**Modulus, Msi**



**Quantiles**

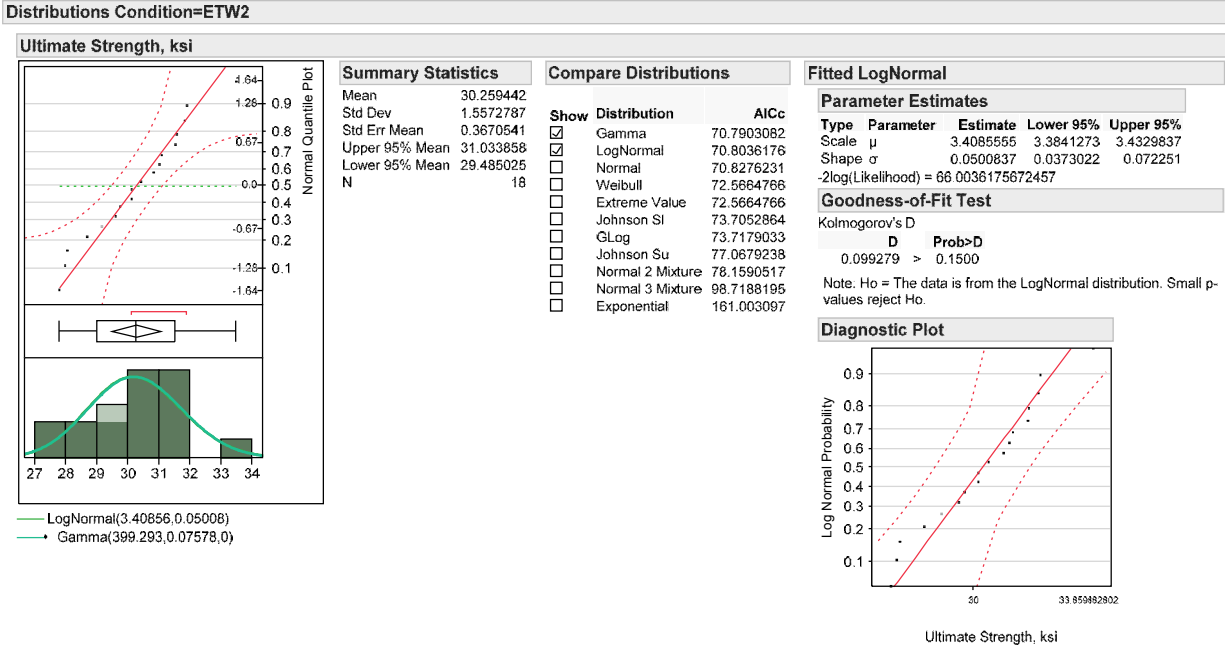
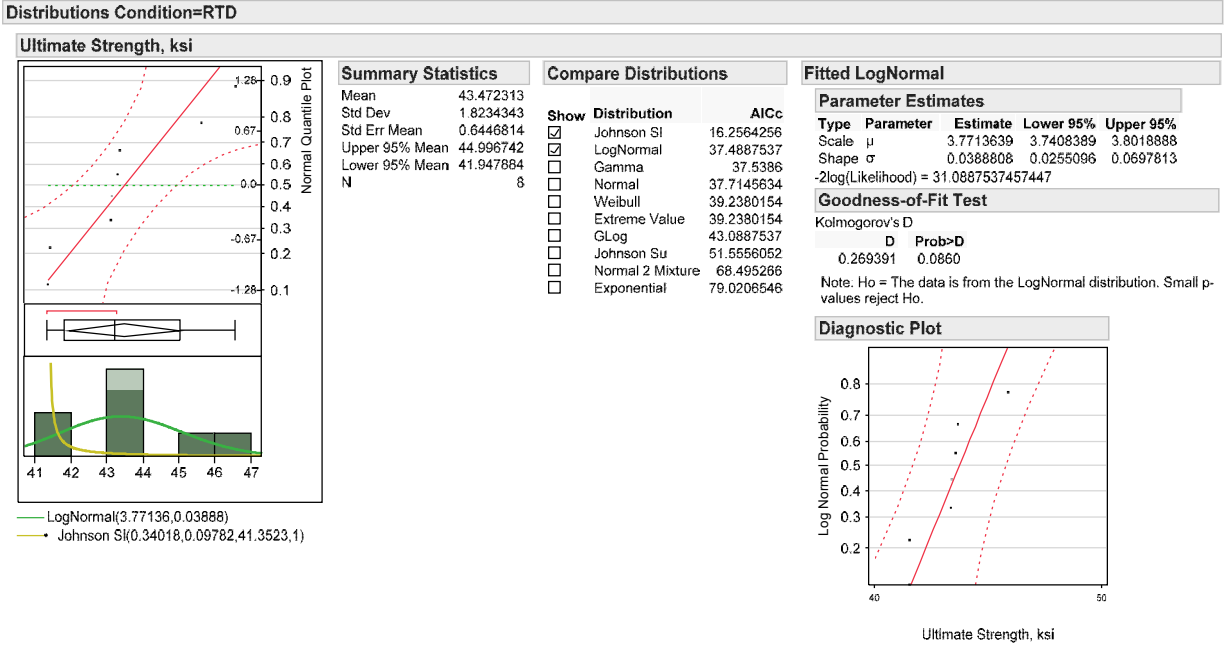
**Summary Statistics**

Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0



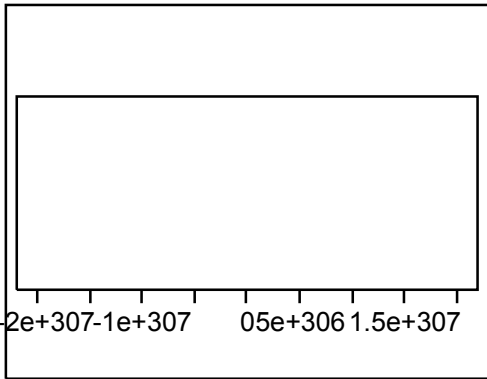
### A.13 Hard Open Hole Compression (OHC3)

The determination of statistical distribution types for the Hard Open Hole Compression (OHC3) test results is presented here.



**Distributions Condition=ETW2**

**Modulus, Msi**



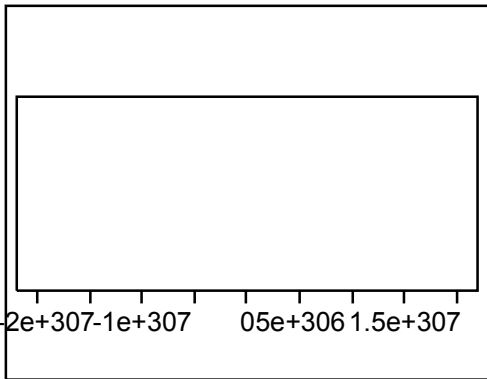
**Quantiles**

**Summary Statistics**

Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

**Distributions Condition=RTD**

**Modulus, Msi**



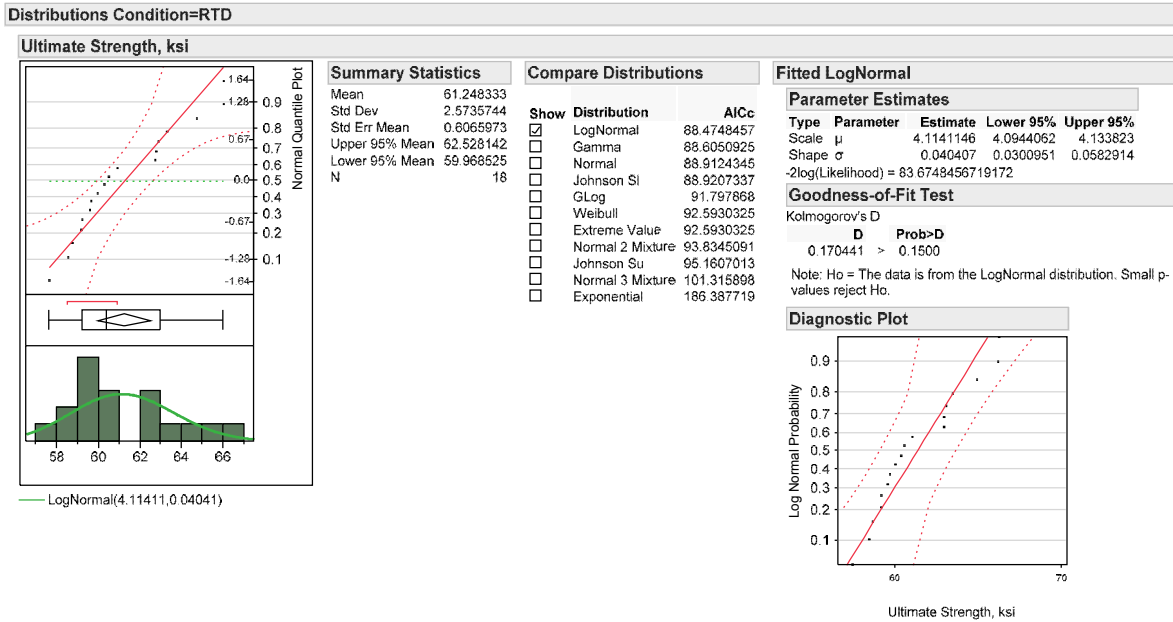
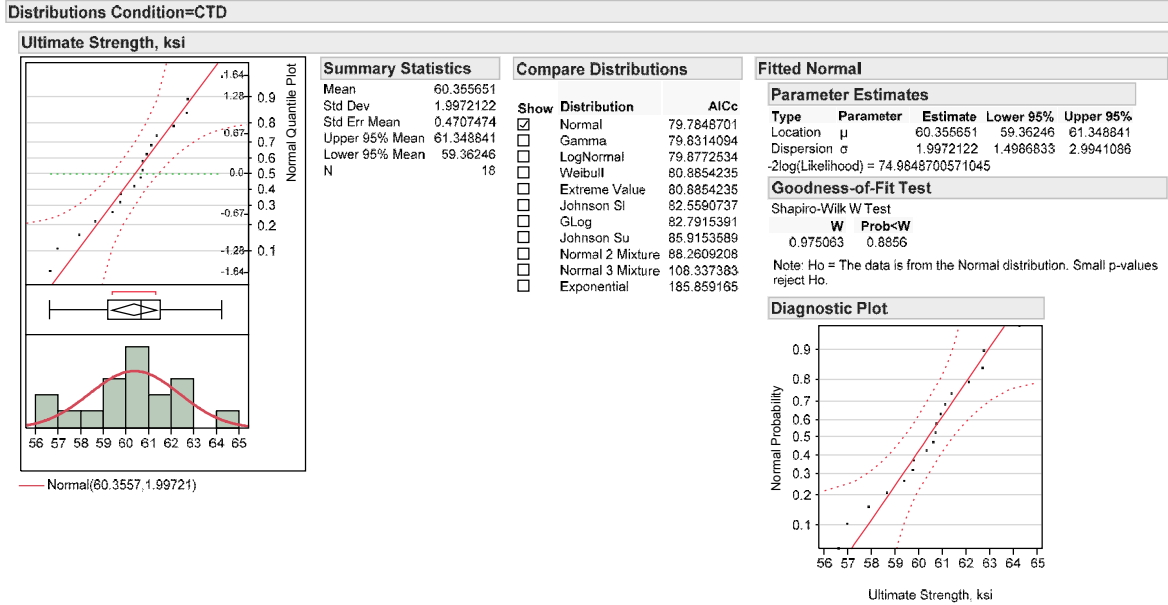
**Quantiles**

**Summary Statistics**

Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

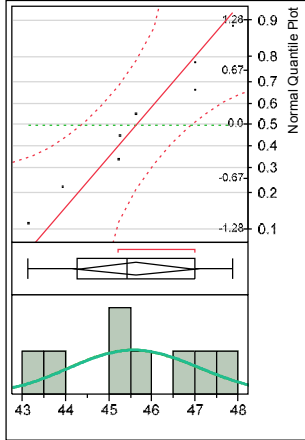
## A.14 Quasi Isotropic Open Hole Tension (OHT1)

The determination of statistical distribution types for the Quasi Isotropic Open Hole Tension (OHT1) test results is presented here.



Distributions Condition=ETD2

Ultimate Strength, ksi



LogNormal(3.81994,0.0332)  
Gamma(909.702,0.05016,0)

Summary Statistics

Mean	45.626636
Std Dev	1.6137888
Std Err Mean	0.5705605
Upper 95% Mean	46.975797
Lower 95% Mean	44.277475
N	8

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Gamma	35.7200828
<input checked="" type="checkbox"/>	LogNormal	35.736852
<input type="checkbox"/>	Weibull	35.7571015
<input type="checkbox"/>	Extreme Value	35.7571015
<input type="checkbox"/>	Normal	35.7603723
<input type="checkbox"/>	Johnson S1	41.1949679
<input type="checkbox"/>	GLog	41.2921217
<input type="checkbox"/>	Johnson Su	50.6255111
<input type="checkbox"/>	Normal 2 Mixture	68.8634968
<input type="checkbox"/>	Exponential	79.7945334

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	3.8199419	3.7938801	3.8460038
Shape	$\sigma$	0.033196	0.0217798	0.0595785

-2log(Likelihood) = 29.3368520354281

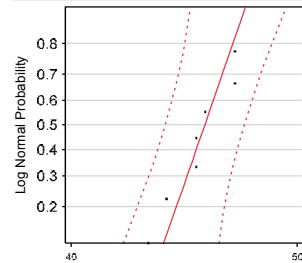
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.191896	> 0.1500

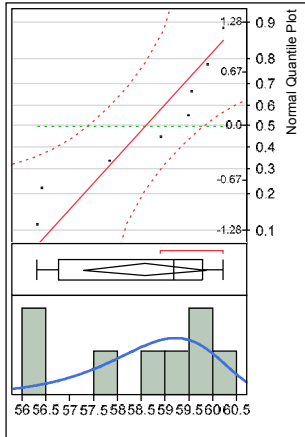
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW

Ultimate Strength, ksi



Weibull(59.2334,54.2301)

Summary Statistics

Mean	58.573675
Std Dev	1.5447152
Std Err Mean	0.5461393
Upper 95% Mean	59.865089
Lower 95% Mean	57.282226
N	8

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Weibull	33.6130029
<input checked="" type="checkbox"/>	Extreme Value	33.6130029
<input type="checkbox"/>	Normal	35.0604491
<input type="checkbox"/>	Gamma	35.0672269
<input type="checkbox"/>	LogNormal	35.1059012
<input type="checkbox"/>	Johnson S1	37.8528906
<input type="checkbox"/>	GLog	40.5921993
<input type="checkbox"/>	Johnson Su	49.9256583
<input type="checkbox"/>	Normal 2 Mixture	64.4232151
<input type="checkbox"/>	Exponential	83.7912324

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	59.233419	58.279718	60.139198
Shape	$\beta$	54.230147	27.966682	92.110315

-2log(Likelihood) = 27.2130029226801

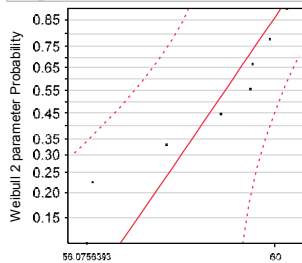
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square	Prob>W^2
0.064013	> 0.2500

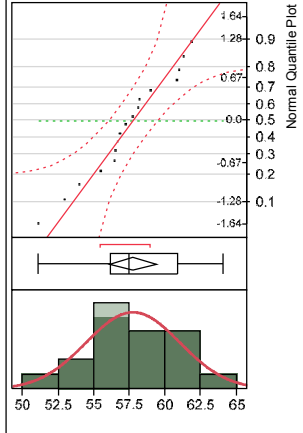
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Ultimate Strength, ksi



Normal(57.7247, 3.28967)

Summary Statistics

Mean	57.724716
Std Dev	3.2896735
Std Err Mean	0.7753835
Upper 95% Mean	59.360633
Lower 95% Mean	56.0888
N	18

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Normal	97.7501665
<input type="checkbox"/>	Gamma	97.7895084
<input type="checkbox"/>	LogNormal	97.8484858
<input type="checkbox"/>	Weibull	99.060731
<input type="checkbox"/>	Extreme Value	99.060731
<input type="checkbox"/>	Johnson S1	100.621844
<input type="checkbox"/>	GLog	100.762771
<input type="checkbox"/>	Johnson Su	103.984481
<input type="checkbox"/>	Normal 2 Mixture	109.898655
<input type="checkbox"/>	Normal 3 Mixture	123.926128
<input type="checkbox"/>	Exponential	184.254676

Fitted Normal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Location	$\mu$	57.724716	56.0988	59.360633
Dispersion	$\sigma$	3.2896735	2.4685302	4.9316942
-2log(Likelihood) = 92.9501665456753				

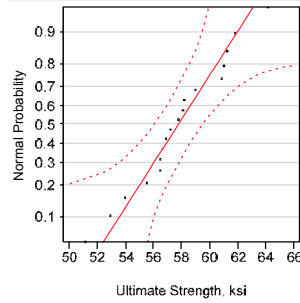
Goodness-of-Fit Test

Shapiro-Wilk W Test

W	Prob<W
0.980348	0.9535

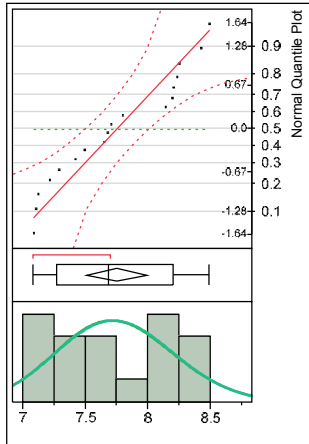
Note: Ho = The data is from the Normal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=CTD

Modulus, Msi



LogNormal(2.04565, 0.06109)  
Gamma(268.335, 0.02888, 0)

Summary Statistics

Mean	7.7486111
Std Dev	0.4865878
Std Err Mean	0.1146898
Upper 95% Mean	7.9905855
Lower 95% Mean	7.5086367
N	18

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Gamma	28.8872849
<input checked="" type="checkbox"/>	LogNormal	28.8882443
<input type="checkbox"/>	Normal	28.9496202
<input type="checkbox"/>	Weibull	29.572477
<input type="checkbox"/>	Extreme Value	29.572477
<input type="checkbox"/>	Normal 2 Mixture	31.3674989
<input type="checkbox"/>	Johnson S1	31.7957767
<input type="checkbox"/>	GLog	31.8350545
<input type="checkbox"/>	Johnson Su	35.1977307
<input type="checkbox"/>	Normal 3 Mixture	43.8251589
<input type="checkbox"/>	Exponential	111.96049

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	2.0456491	2.0158545	2.0754437
Shape	$\sigma$	0.0610862	0.0454968	0.0881232
-2log(Likelihood) = 24.0882442881548				

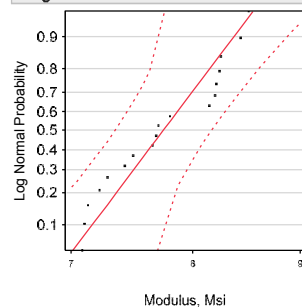
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.189338	0.0866

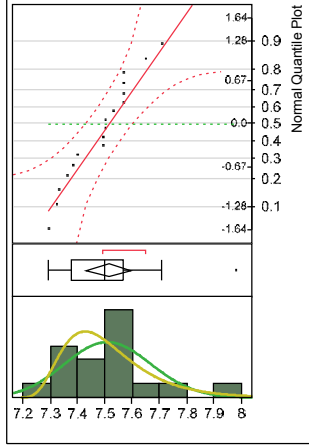
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=RTD

Modulus, Msi



Summary Statistics

Mean	7.5116667
Std Dev	0.165325
Std Err Mean	0.0389675
Upper 95% Mean	7.5938809
Lower 95% Mean	7.4294525
N	18

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Johnson S1	-10.645528
<input checked="" type="checkbox"/>	LogNormal	-10.349582
<input type="checkbox"/>	Gamma	-10.216561
<input type="checkbox"/>	Normal	-9.9125282
<input type="checkbox"/>	GLog	-7.4352962
<input type="checkbox"/>	Johnson Su	-7.2828902
<input type="checkbox"/>	Weibull	-2.1218025
<input type="checkbox"/>	Extreme Value	-2.1218025
<input type="checkbox"/>	Normal 2 Mixture	0.99985571
<input type="checkbox"/>	Normal 3 Mixture	15.9263922
<input type="checkbox"/>	Exponential	110.842465

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	2.016232	2.0059149	2.0265491
Shape	$\sigma$	0.0211526	0.0157544	0.0305149

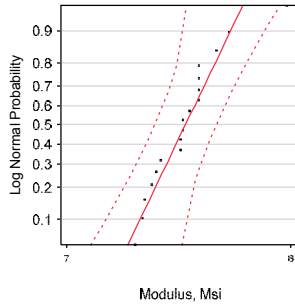
-2log(Likelihood) = -15.1495818756557

Goodness-of-Fit Test

Kolmogorov's D	
D	Prob>D
0.186857	0.0944

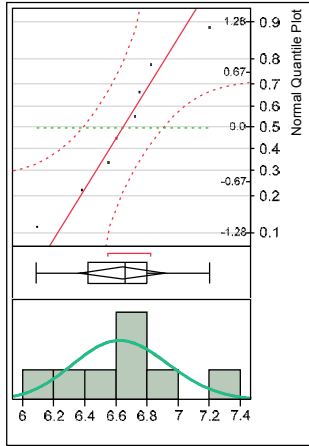
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETD2

Modulus, Msi



Summary Statistics

Mean	6.6385
Std Dev	0.3270784
Std Err Mean	0.1156397
Upper 95% Mean	6.9119444
Lower 95% Mean	6.3650556
N	8

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Gamma	10.1636686
<input checked="" type="checkbox"/>	LogNormal	10.1765727
<input type="checkbox"/>	Normal	10.2221309
<input type="checkbox"/>	Weibull	11.0124096
<input type="checkbox"/>	Extreme Value	11.0124096
<input type="checkbox"/>	GLog	15.7538811
<input type="checkbox"/>	Johnson S1	15.7538825
<input type="checkbox"/>	Johnson Su	25.0872132
<input type="checkbox"/>	Normal 2 Mixture	45.0988843
<input type="checkbox"/>	Exponential	48.9528432

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	1.8918208	1.8555477	1.9280939
Shape	$\sigma$	0.0462024	0.0303133	0.0829218

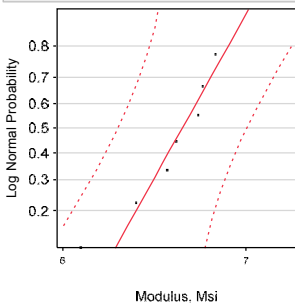
-2log(Likelihood) = 3.77657267833019

Goodness-of-Fit Test

Kolmogorov's D	
D	Prob>D
0.146970	> 0.1500

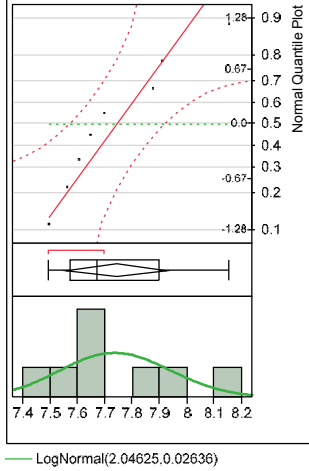
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW

Modulus, Msi



Summary Statistics

Mean	7.7415
Std Dev	0.2201954
Std Err Mean	0.0778508
Upper 95% Mean	7.9255879
Lower 95% Mean	7.5574121
N	8

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	3.6704477
<input type="checkbox"/>	Gamma	3.72009908
<input type="checkbox"/>	Normal	3.89117507
<input type="checkbox"/>	Weibull	5.94138864
<input type="checkbox"/>	Extreme Value	5.94138864
<input type="checkbox"/>	Johnson SI	7.29261096
<input type="checkbox"/>	GLog	9.42292383
<input type="checkbox"/>	Johnson Su	18.7562979
<input type="checkbox"/>	Normal 2 Mixture	36.4190266
<input type="checkbox"/>	Exponential	51.4121941

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	2.0462458	2.0255482	2.0669435
Shape	$\sigma$	0.0263633	0.0172969	0.0473156

-2log(Likelihood) = -2.7295523027947

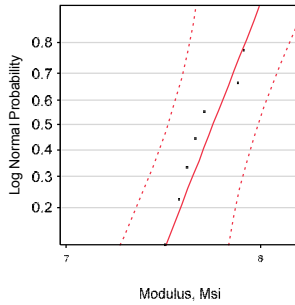
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.204447	> 0.1500

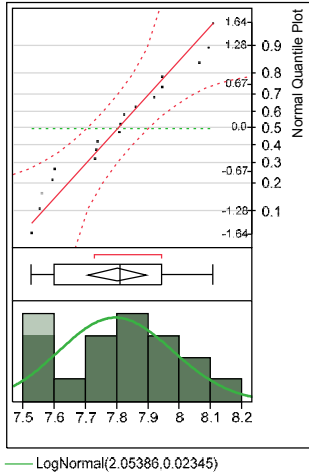
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Modulus, Msi



Summary Statistics

Mean	7.8000556
Std Dev	0.1884146
Std Err Mean	0.0444097
Upper 95% Mean	7.8937519
Lower 95% Mean	7.7063592
N	18

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	-5.2789914
<input type="checkbox"/>	Gamma	-5.2664415
<input type="checkbox"/>	Normal	-5.2061911
<input type="checkbox"/>	Weibull	-3.4882966
<input type="checkbox"/>	Extreme Value	-3.4882966
<input type="checkbox"/>	Johnson SI	-2.4443215
<input type="checkbox"/>	GLog	-2.320757
<input type="checkbox"/>	Normal 2 Mixture	-0.7638526
<input type="checkbox"/>	Johnson Su	1.04192375
<input type="checkbox"/>	Normal 3 Mixture	14.7681133
<input type="checkbox"/>	Exponential	112.198711

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	2.0538557	2.0424166	2.0652947
Shape	$\sigma$	0.0234528	0.0174676	0.0338331

-2log(Likelihood) = -10.078991443549

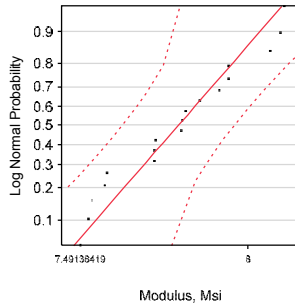
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.141268	> 0.1500

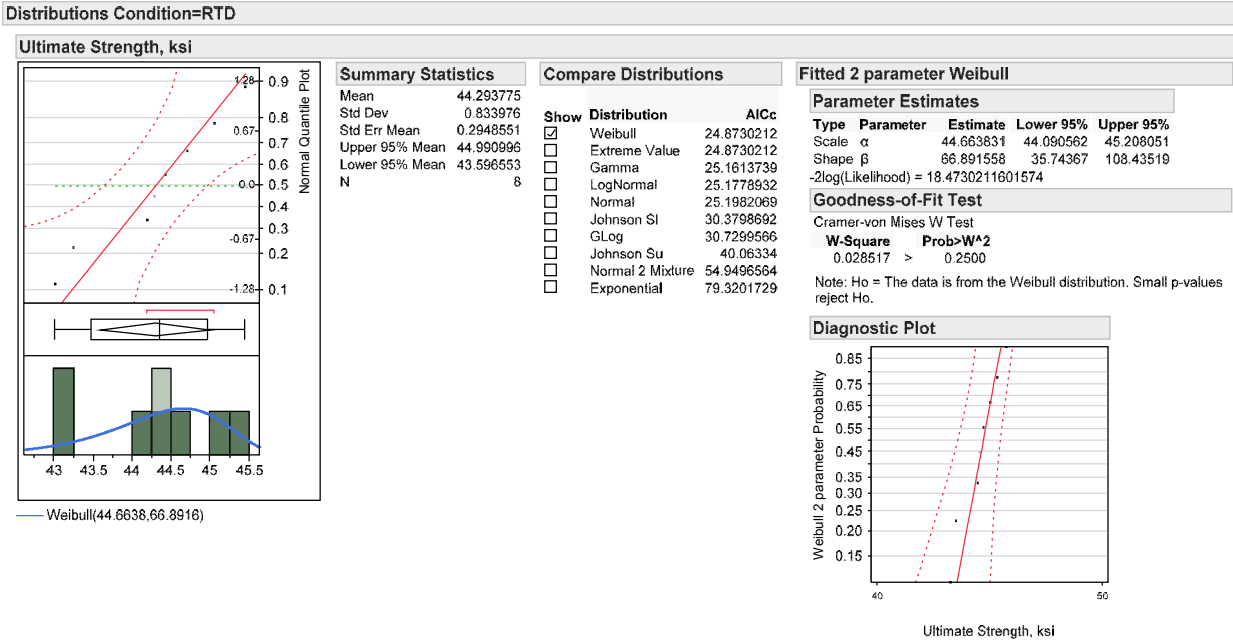
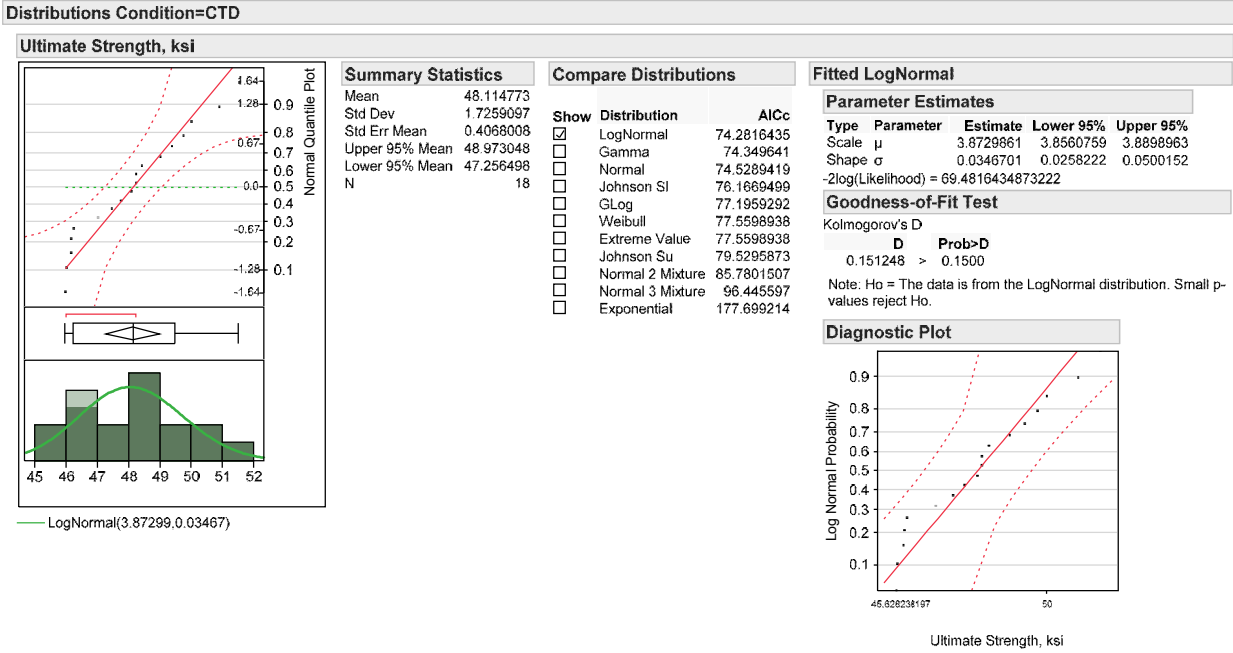
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



## A.15 Soft Open Hole Tension (OHT2)

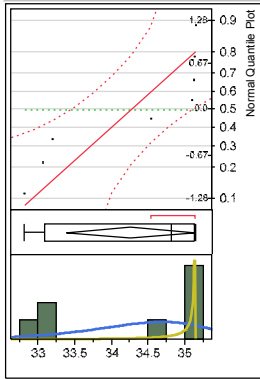
The determination of statistical distribution types for the Soft Open Hole Tension (OHT2) test results is presented here.





Distributions Condition=ETW2

Ultimate Strength, ksi



— Weibull(34.715, 46.8722)  
 — Johnson S1(0.50586, 0.10155, 35.1451, -1)

Summary Statistics

Mean	34.252489
Std Dev	1.0502653
Std Err Mean	0.3713252
Upper 95% Mean	35.140514
Lower 95% Mean	33.384424
N	8

Compare Distributions

Show Distribution	Number of Parameters	-2*LogLikelihood	AICc
<input checked="" type="checkbox"/> Johnson S1	3	-20.40532	-8.4053203
<input checked="" type="checkbox"/> Weibull	2	21.1311674	27.5311674
<input type="checkbox"/> Extreme Value	2	21.1311674	27.5311674
<input type="checkbox"/> Gamma	2	22.487199	28.887199
<input type="checkbox"/> Normal	2	22.4877163	28.8877163
<input type="checkbox"/> LogNormal	2	22.5223291	28.9223291
<input type="checkbox"/> GLog	3	22.4194658	34.4194658
<input type="checkbox"/> Johnson Su	4	22.4195562	43.7528895
<input type="checkbox"/> Normal 2 Mixture	5	8.0365668	48.0365668
<input type="checkbox"/> Exponential	1	72.5448089	75.2114756

Fitted 2 parameter Weibull

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	34.715012	34.064007	35.332268
Shape	$\beta$	46.872157	23.956386	81.356041

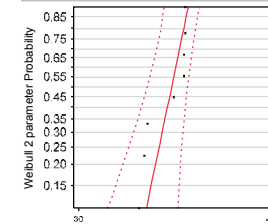
-2log(Likelihood) = 21.1311674256277

Goodness-of-Fit Test

Cramer-von Mises W Test	
W-Square	0.155342
Prob>W <sup>2</sup>	0.0123*

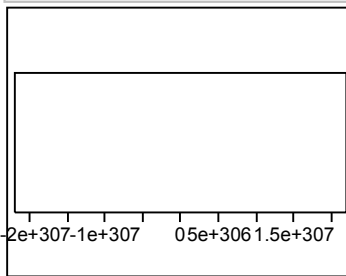
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=CTD

Modulus, Msi



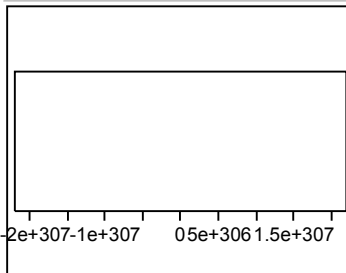
Quantiles

Summary Statistics

Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

Distributions Condition=ETW2

Modulus, Msi



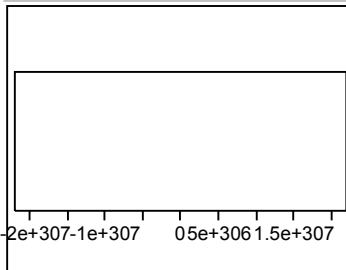
Quantiles

Summary Statistics

Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

Distributions Condition=RTD

Modulus, Msi



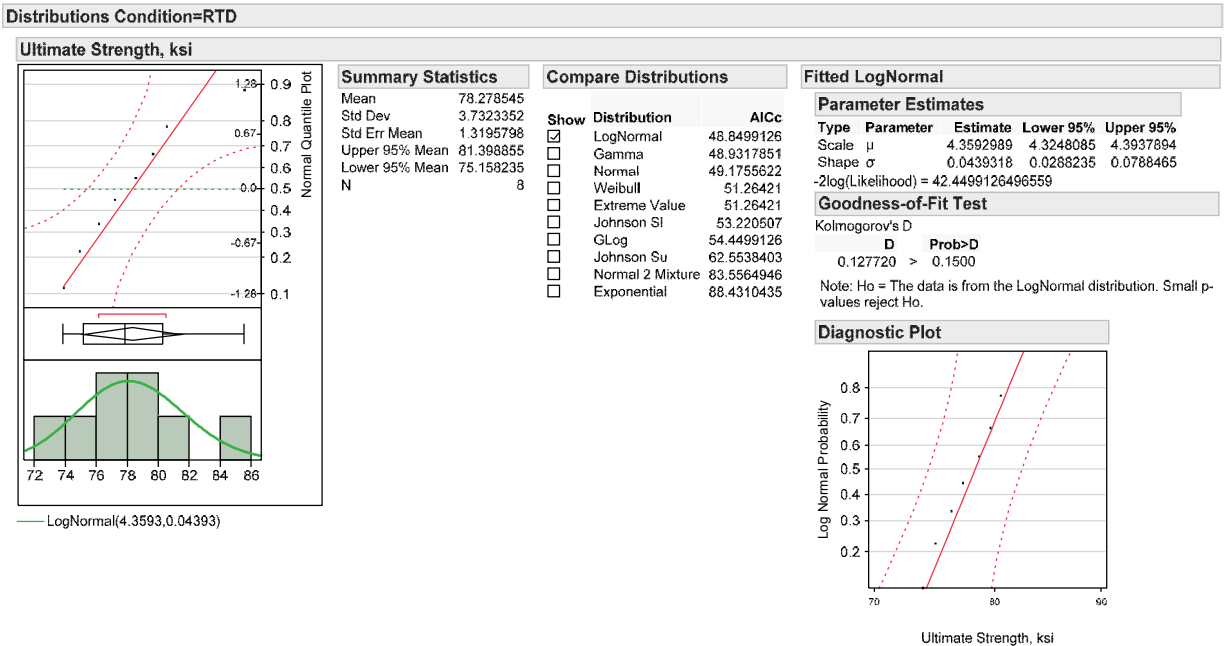
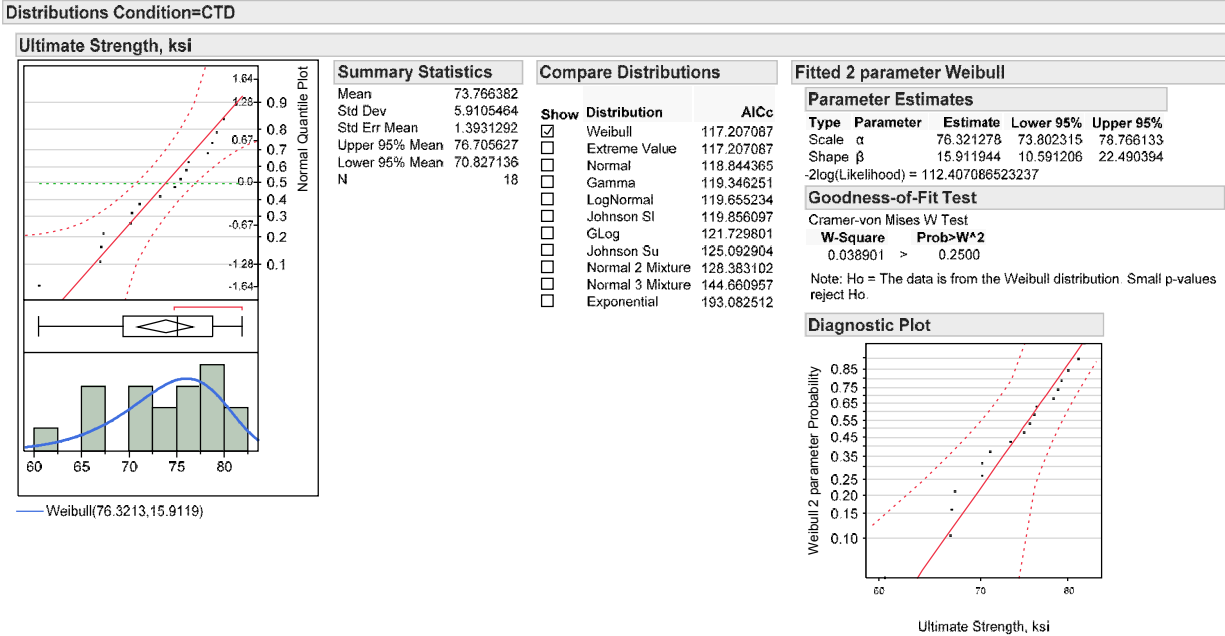
Quantiles

Summary Statistics

Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

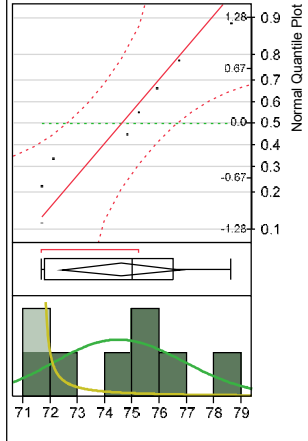
## A.16 Hard Open Hole Tension (OHT3)

The determination of statistical distribution types for the Hard Open Hole Tension (OHT3) test results is presented here.



Distributions Condition=ETW2

Ultimate Strength, ksi



— LogNormal(4.31158,0.03221)  
 • Johnson SI(0.35637,0.09892,71.6691,1)

Summary Statistics

Mean 74.596713  
 Std Dev 2.5713606  
 Std Err Mean 0.9091132  
 Upper 95% Mean 76.746424  
 Lower 95% Mean 72.447002  
 N 8

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Johnson SI	14.0783046
<input checked="" type="checkbox"/>	LogNormal	43.1201188
<input type="checkbox"/>	Gamma	43.1270545
<input type="checkbox"/>	Normal	43.2139791
<input type="checkbox"/>	Weibull	43.8258417
<input type="checkbox"/>	Extreme Value	43.8258417
<input type="checkbox"/>	GLog	48.7457223
<input type="checkbox"/>	Johnson Su	58.0792009
<input type="checkbox"/>	Normal 2 Mixture	70.1460465
<input type="checkbox"/>	Exponential	87.6602098

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	4.3115774	4.2862903	4.3368644
Shape	$\sigma$	0.032209	0.0211323	0.0578072

-2log(Likelihood) = 36.7201187561912

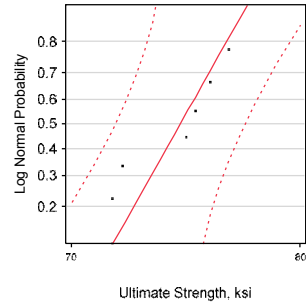
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.225088	> 0.1500

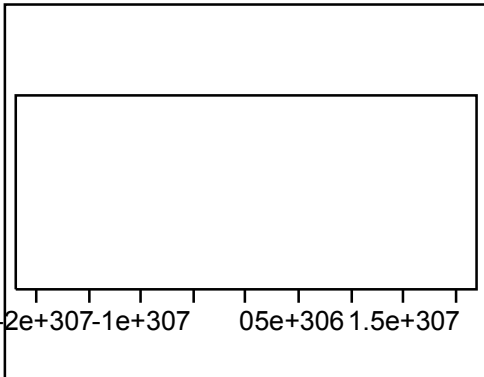
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



**Distributions Condition=CTD**

**Modulus, Msi**



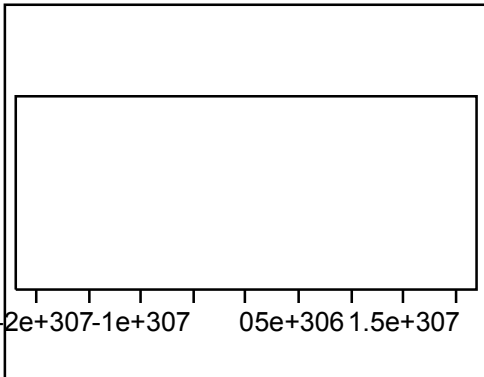
**Quantiles**

**Summary Statistics**

Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

**Distributions Condition=ETW2**

**Modulus, Msi**



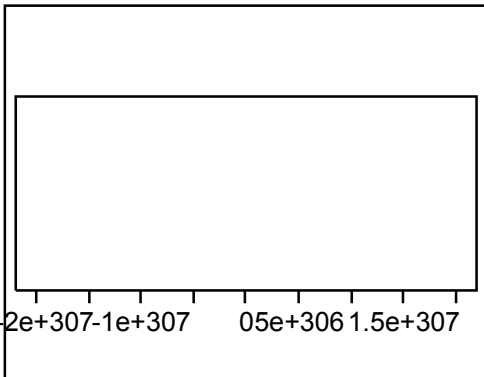
**Quantiles**

**Summary Statistics**

Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

**Distributions Condition=RTD**

**Modulus, Msi**



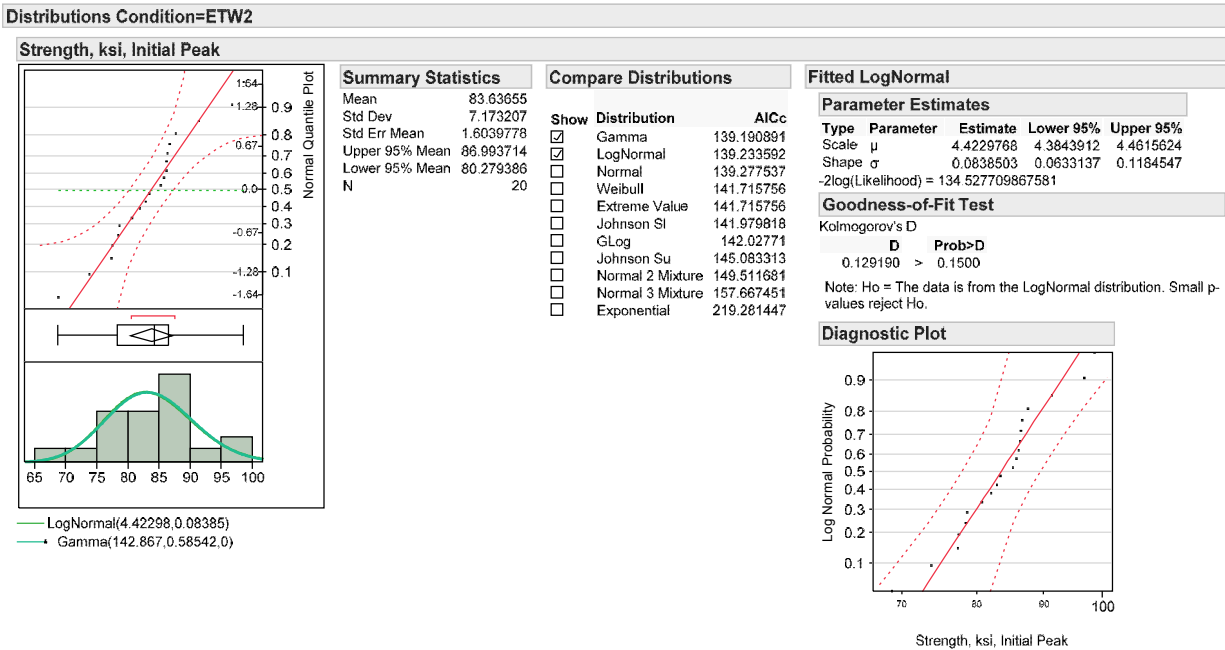
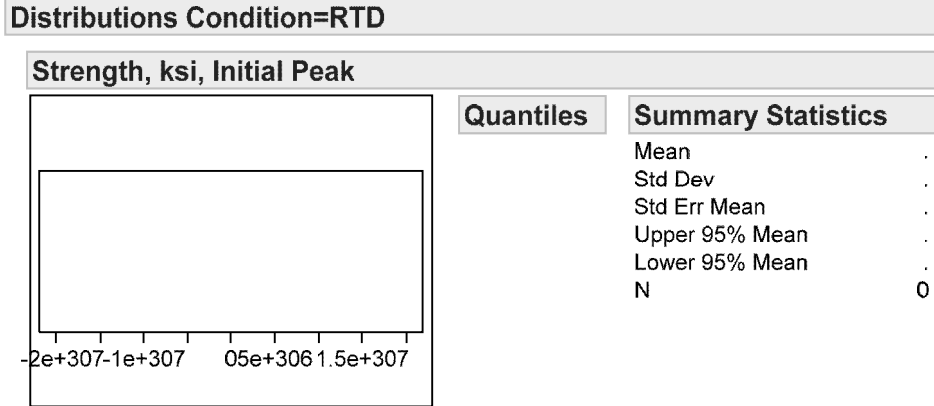
**Quantiles**

**Summary Statistics**

Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

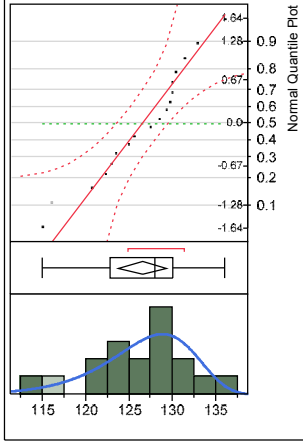
## A.17 Quasi Isotropic Pin Bearing (PB1)

The determination of statistical distribution types for the Quasi Isotropic Pin Bearing (PB1) test results is presented here.



Distributions Condition=RTD

Strength, ksi, Ultimate



Summary Statistics

Mean	126.48297
Std Dev	5.6427575
Std Err Mean	1.3300107
Upper 95% Mean	129.28904
Lower 95% Mean	123.67689
N	18

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Weibull	116.009408
<input type="checkbox"/>	Extreme Value	116.009408
<input type="checkbox"/>	Normal	117.17521
<input type="checkbox"/>	Gamma	117.433914
<input type="checkbox"/>	LogNormal	117.591383
<input type="checkbox"/>	Johnson S1	118.860638
<input type="checkbox"/>	GLog	120.505668
<input type="checkbox"/>	Johnson Su	122.065577
<input type="checkbox"/>	Normal 2 Mixture	128.381178
<input type="checkbox"/>	Normal 3 Mixture	138.487918
<input type="checkbox"/>	Exponential	212.493875

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	128.98714	126.52888	131.35209
Shape	$\beta$	27.579969	18.589995	38.259478

-2log(Likelihood) = 111.20940840272

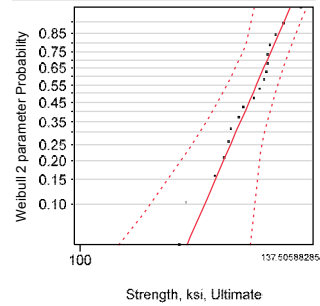
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square	Prob>W^2
0.033673	> 0.2500

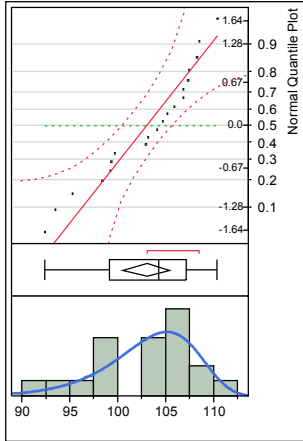
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Strength, ksi, Ultimate



Summary Statistics

Mean	102.93165
Std Dev	5.2551515
Std Err Mean	1.1750876
Upper 95% Mean	105.39113
Lower 95% Mean	100.47216
N	20

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Weibull	124.010989
<input type="checkbox"/>	Extreme Value	124.010989
<input type="checkbox"/>	Johnson S1	126.169611
<input type="checkbox"/>	Normal	126.831777
<input type="checkbox"/>	Gamma	127.232743
<input type="checkbox"/>	LogNormal	127.462395
<input type="checkbox"/>	GLog	129.60003
<input type="checkbox"/>	Normal 2 Mixture	132.410274
<input type="checkbox"/>	Johnson Su	132.767009
<input type="checkbox"/>	Normal 3 Mixture	137.640437
<input type="checkbox"/>	Exponential	227.584828

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	105.22814	103.20519	107.16885
Shape	$\beta$	25.91675	17.561829	36.172378

-2log(Likelihood) = 119.30510688805

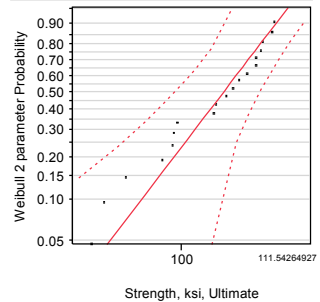
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square	Prob>W^2
0.055909	> 0.2500

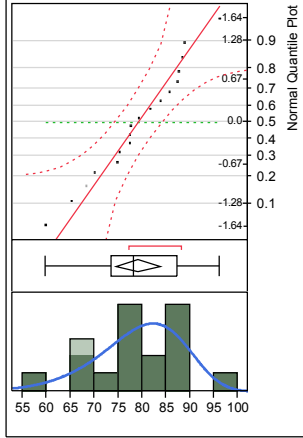
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=RTD

Strength, ksi, 2% Offset



— Weibull(83.1379,10.0129)

Summary Statistics

Mean	79.138667
Std Dev	9.3987053
Std Err Mean	2.2152961
Upper 95% Mean	83.812533
Lower 95% Mean	74.4648
N	18

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Weibull	135.243107
<input type="checkbox"/>	Extreme Value	135.243107
<input type="checkbox"/>	Normal	135.542377
<input type="checkbox"/>	Gamma	136.020108
<input type="checkbox"/>	LogNormal	136.376512
<input type="checkbox"/>	Johnson S1	138.056533
<input type="checkbox"/>	GLog	139.290798
<input type="checkbox"/>	Johnson Su	141.412084
<input type="checkbox"/>	Normal 2 Mixture	147.952757
<input type="checkbox"/>	Normal 3 Mixture	161.216487
<input type="checkbox"/>	Exponential	195.613257

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	83.137943	78.842744	87.403746
Shape	$\beta$	10.012917	6.7554852	13.894341

-2log(Likelihood) = 130.443106892178

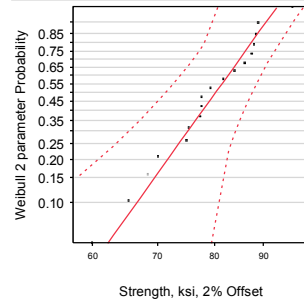
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square	Prob>W*2
0.031126	> 0.2500

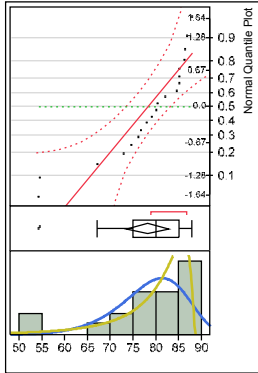
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Strength, ksi, 2% Offset



— Weibull(81.8783,12.269)  
 — Johnson S1(-2.0665,1.05122,88.8683,-1)

Summary Statistics

Mean	78.15605
Std Dev	9.8102717
Std Err Mean	2.1936434
Upper 95% Mean	82.747398
Lower 95% Mean	73.564702
N	20

Compare Distributions

Show	Distribution	Number of Parameters	-2*LogLikelihood	AICc
<input checked="" type="checkbox"/>	Johnson S1	3	133.391705	140.891705
<input type="checkbox"/>	Johnson Su	4	133.351638	144.016305
<input checked="" type="checkbox"/>	Weibull	2	140.794437	145.500319
<input type="checkbox"/>	Extreme Value	2	140.794437	145.500319
<input type="checkbox"/>	Normal 2 Mixture	5	133.065223	147.293938
<input type="checkbox"/>	Normal	2	147.09474	151.800622
<input type="checkbox"/>	Normal 3 Mixture	8	123.694046	152.784955
<input type="checkbox"/>	Gamma	2	149.661449	154.367331
<input type="checkbox"/>	LogNormal	2	151.088349	155.794231
<input type="checkbox"/>	GLog	3	151.088349	158.588349
<input type="checkbox"/>	Exponential	1	214.348299	216.570521

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	81.878255	78.61664	85.119283
Shape	$\beta$	12.269029	8.1276244	17.46099

-2log(Likelihood) = 140.794436747444

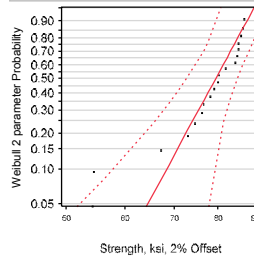
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square	Prob>W*2
0.085076	0.1679

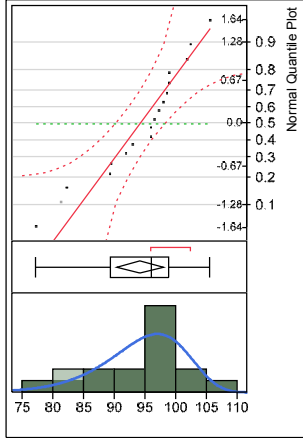
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=RTD

Strength, ksi, 4% Offset



— Weibull(97.3524,16.242)

Summary Statistics

Mean	94.119167
Std Dev	7.702332
Std Err Mean	1.8154571
Upper 95% Mean	97.949446
Lower 95% Mean	90.288887
N	18

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Weibull	125.62332
<input type="checkbox"/>	Extreme Value	125.62332
<input type="checkbox"/>	Johnson S1	128.348254
<input type="checkbox"/>	Normal	128.37682
<input type="checkbox"/>	Gamma	129.143333
<input type="checkbox"/>	LogNormal	129.585167
<input type="checkbox"/>	Johnson Su	131.710225
<input type="checkbox"/>	GLog	132.499452
<input type="checkbox"/>	Normal 2 Mixture	132.870849
<input type="checkbox"/>	Normal 3 Mixture	149.403163
<input type="checkbox"/>	Exponential	201.854222

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	97.352383	94.218232	100.40851
Shape	$\beta$	16.24204	10.798656	22.851603

-2log(Likelihood) = 120.823319752886

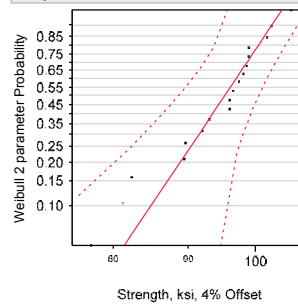
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square	Prob>W*2
0.046804	> 0.2500

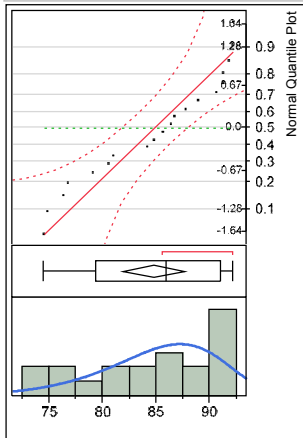
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Strength, ksi, 4% Offset



— Weibull(87.5162,17.6249)

Summary Statistics

Mean	84.8109
Std Dev	6.1369877
Std Err Mean	1.3722722
Upper 95% Mean	87.683099
Lower 95% Mean	81.938701
N	20

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Weibull	131.377915
<input type="checkbox"/>	Extreme Value	131.377915
<input type="checkbox"/>	Johnson S1	132.880749
<input type="checkbox"/>	Normal	133.036785
<input type="checkbox"/>	Gamma	133.366963
<input type="checkbox"/>	LogNormal	133.572932
<input type="checkbox"/>	GLog	135.805039
<input type="checkbox"/>	Normal 2 Mixture	137.690178
<input type="checkbox"/>	Johnson Su	138.972121
<input type="checkbox"/>	Normal 3 Mixture	143.701162
<input type="checkbox"/>	Exponential	219.839185

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	87.516202	85.045322	89.899156
Shape	$\beta$	17.624906	11.946533	24.678832

-2log(Likelihood) = 126.672032584705

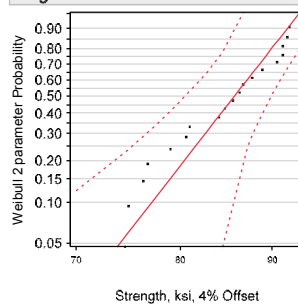
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square	Prob>W*2
0.069063	> 0.2500

Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

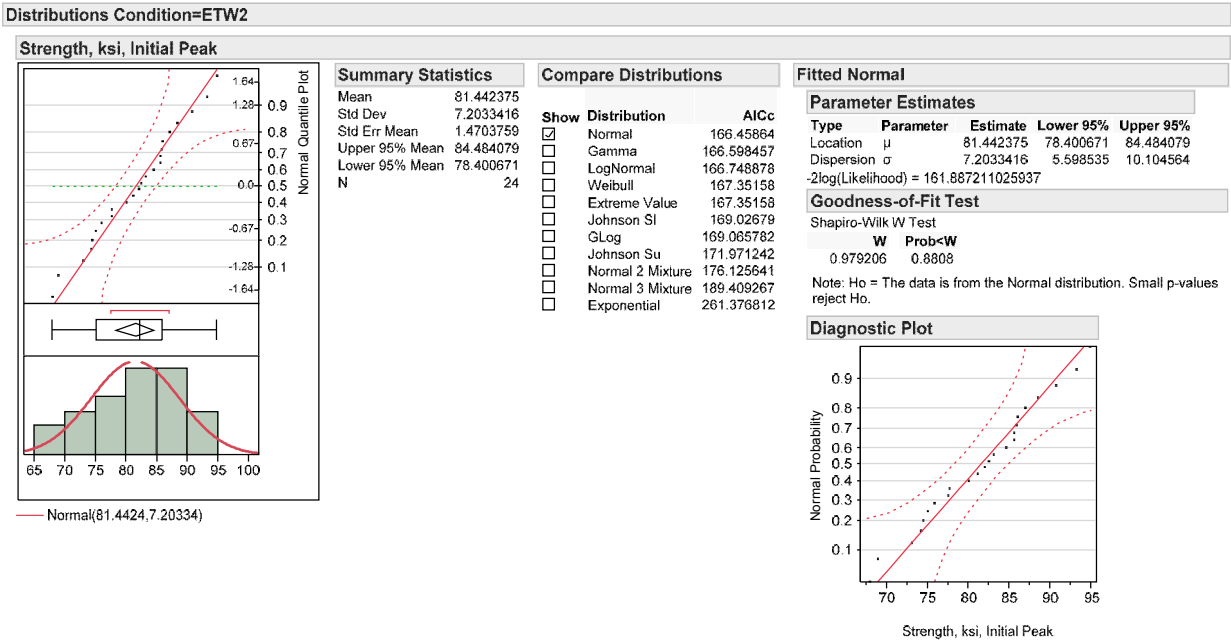
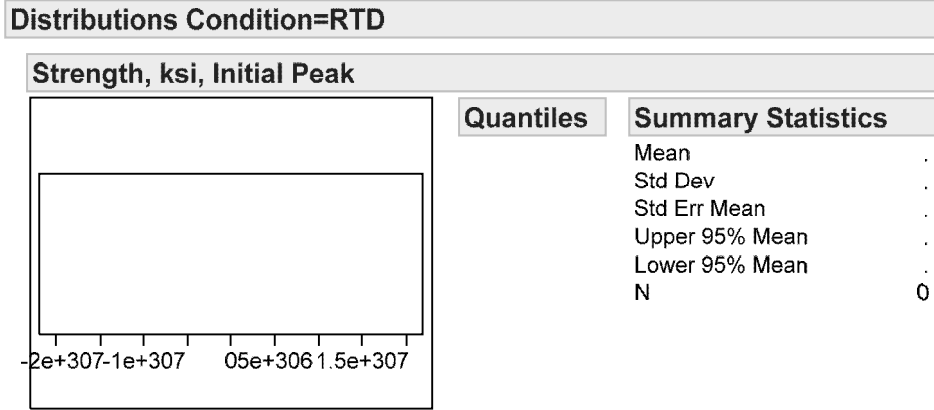
Diagnostic Plot





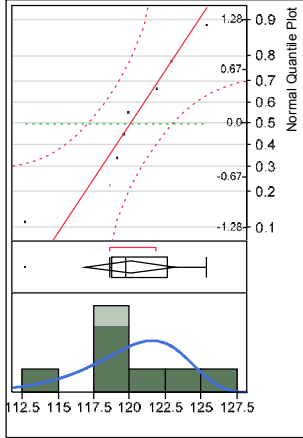
## A.18 Soft Pin Bearing (PB2)

The determination of statistical distribution types for the Soft Pin Bearing (PB2) test results is presented here.



Distributions Condition=RTD

Strength, ksi, Ultimate



Summary Statistics

Mean	120.01013
Std Dev	3.7431703
Std Err Mean	1.3234105
Upper 95% Mean	123.13949
Lower 95% Mean	116.88076
N	8

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Weibull	48.6870625
<input type="checkbox"/>	Extreme Value	48.6870625
<input type="checkbox"/>	Normal	49.2219433
<input type="checkbox"/>	Gamma	49.2539362
<input type="checkbox"/>	LogNormal	49.3073026
<input type="checkbox"/>	Johnson S1	54.197056
<input type="checkbox"/>	GLog	54.9073026
<input type="checkbox"/>	Johnson Su	63.8959805
<input type="checkbox"/>	Normal 2 Mixture	84.0986967
<input type="checkbox"/>	Exponential	95.2678847

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	121.6216	119.07658	124.06983
Shape	$\beta$	40.552904	21.841112	64.84487

-2log(Likelihood) = 42.287062535154

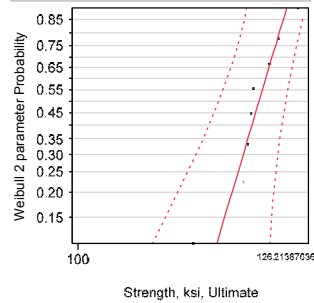
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square	Prob>W*2
0.047213	> 0.2500

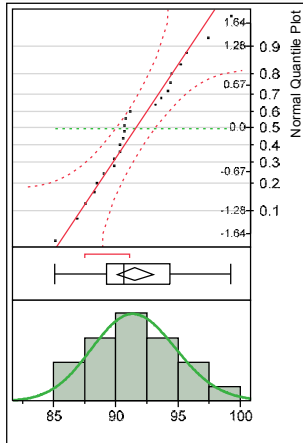
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Strength, ksi, Ultimate



Summary Statistics

Mean	91.51211
Std Dev	3.4821854
Std Err Mean	0.7067156
Upper 95% Mean	92.974063
Lower 95% Mean	90.050157
N	24

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	130.985797
<input type="checkbox"/>	Gamma	131.071572
<input type="checkbox"/>	Normal	131.291679
<input type="checkbox"/>	Johnson S1	133.169059
<input type="checkbox"/>	GLog	133.898818
<input type="checkbox"/>	Weibull	135.810943
<input type="checkbox"/>	Extreme Value	135.810943
<input type="checkbox"/>	Johnson Su	136.804332
<input type="checkbox"/>	Normal 2 Mixture	140.395337
<input type="checkbox"/>	Normal 3 Mixture	145.448912
<input type="checkbox"/>	Exponential	266.972441

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	4.5157903	4.5004405	4.5311402
Shape	$\sigma$	0.0368428	0.0284488	0.0503472

-2log(Likelihood) = 126.414368242301

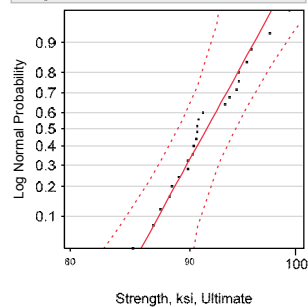
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.169307	0.0749

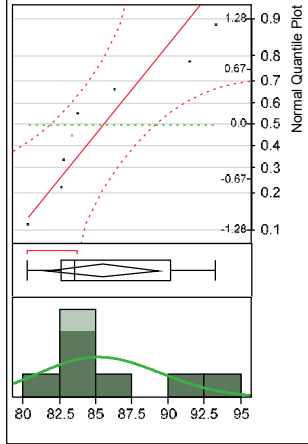
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=RTD

Strength, ksi, 2% Offset



LogNormal(4.44684,0.04931)

Summary Statistics

Mean	85.461875
Std Dev	4.5867769
Std Err Mean	1.6216705
Upper 95% Mean	89.296516
Lower 95% Mean	81.627234
N	8

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	52.0993005
<input type="checkbox"/>	Gamma	52.1979969
<input type="checkbox"/>	Normal	52.4738579
<input type="checkbox"/>	Weibull	54.2628097
<input type="checkbox"/>	Extreme Value	54.2628097
<input type="checkbox"/>	Johnson SI	55.3888423
<input type="checkbox"/>	GLog	57.6993005
<input type="checkbox"/>	Johnson Su	65.0014412
<input type="checkbox"/>	Normal 2 Mixture	79.013823
<input type="checkbox"/>	Exponential	89.8357926

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	4.4468399	4.4081249	4.485555
Shape	$\sigma$	0.0493128	0.032354	0.0885041

-2log(Likelihood) = 45.6993004654104

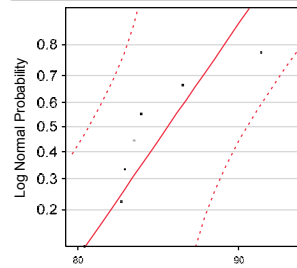
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.274840	0.0749

Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

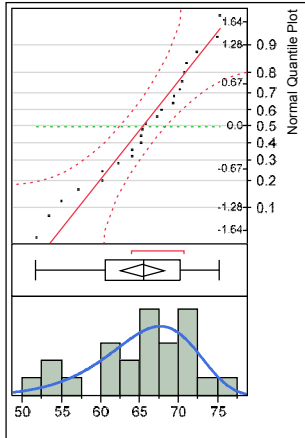
Diagnostic Plot



Strength, ksi, 2% Offset

Distributions Condition=ETW2

Strength, ksi, 2% Offset



Weibull(68.0394,12.6453)

Summary Statistics

Mean	65.277292
Std Dev	6.4615711
Std Err Mean	1.3189627
Upper 95% Mean	68.005774
Lower 95% Mean	62.548809
N	24

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Weibull	159.259511
<input type="checkbox"/>	Extreme Value	159.259511
<input type="checkbox"/>	Normal	161.242358
<input type="checkbox"/>	Johnson SI	161.884187
<input type="checkbox"/>	Gamma	162.133139
<input type="checkbox"/>	LogNormal	162.678175
<input type="checkbox"/>	Johnson Su	164.789436
<input type="checkbox"/>	GLog	165.306747
<input type="checkbox"/>	Normal 2 Mixture	166.454622
<input type="checkbox"/>	Normal 3 Mixture	179.3038
<input type="checkbox"/>	Exponential	250.756741

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	68.039368	65.64594	70.385334
Shape	$\beta$	12.645319	8.9602062	17.002979

-2log(Likelihood) = 154.688082704086

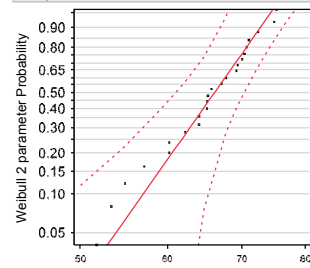
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square	Prob>W^2
0.025285	> 0.2500

Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

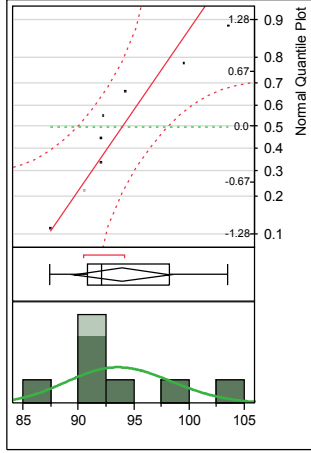
Diagnostic Plot



Strength, ksi, 2% Offset

Distributions Condition=RTD

Strength, ksi, 4% Offset



LogNormal(4.54092,0.05092)

Summary Statistics

Mean	93.900375
Std Dev	5.206868
Std Err Mean	1.8409058
Upper 95% Mean	98.253426
Lower 95% Mean	89.547324
N	8

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	54.118501
<input type="checkbox"/>	Gamma	54.2192225
<input type="checkbox"/>	Normal	54.5026729
<input type="checkbox"/>	Weibull	56.4508678
<input type="checkbox"/>	Extreme Value	56.4508678
<input type="checkbox"/>	Johnson S1	58.3837708
<input type="checkbox"/>	GLog	59.718501
<input type="checkbox"/>	Johnson Su	65.6200218
<input type="checkbox"/>	Normal 2 Mixture	84.986588
<input type="checkbox"/>	Exponential	91.3424167

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	4.540922	4.5009433	4.5809007
Shape	$\sigma$	0.0509223	0.03341	0.0913928

-2log(Likelihood) = 47.7185009648236

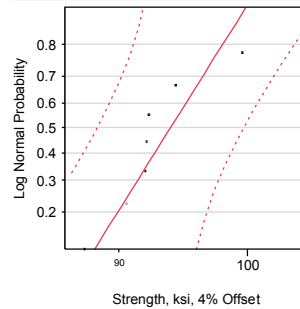
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.259561	0.1107

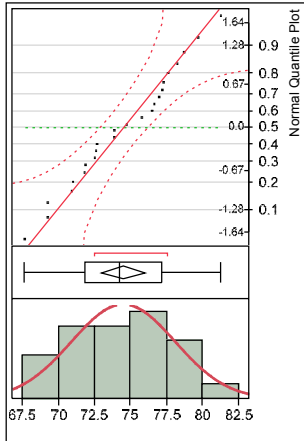
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Strength, ksi, 4% Offset



Normal(74.4705,3.60083)

Summary Statistics

Mean	74.470458
Std Dev	3.6008272
Std Err Mean	0.7350158
Upper 95% Mean	75.990954
Lower 95% Mean	72.949962
N	24

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Normal	133.176331
<input type="checkbox"/>	Gamma	133.219464
<input type="checkbox"/>	LogNormal	133.270576
<input type="checkbox"/>	Weibull	134.219912
<input type="checkbox"/>	Extreme Value	134.219912
<input type="checkbox"/>	Johnson S1	135.739522
<input type="checkbox"/>	GLog	135.783473
<input type="checkbox"/>	Johnson Su	138.688901
<input type="checkbox"/>	Normal 2 Mixture	140.730923
<input type="checkbox"/>	Normal 3 Mixture	153.810572
<input type="checkbox"/>	Exponential	257.081139

Fitted Normal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Location	$\mu$	74.470458	72.949962	75.990954
Dispersion	$\sigma$	3.6008272	2.7986118	5.0510986

-2log(Likelihood) = 128.604902234364

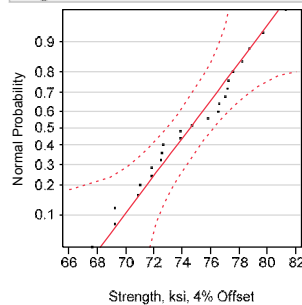
Goodness-of-Fit Test

Shapiro-Wilk W Test

W	Prob<W
0.974210	0.7703

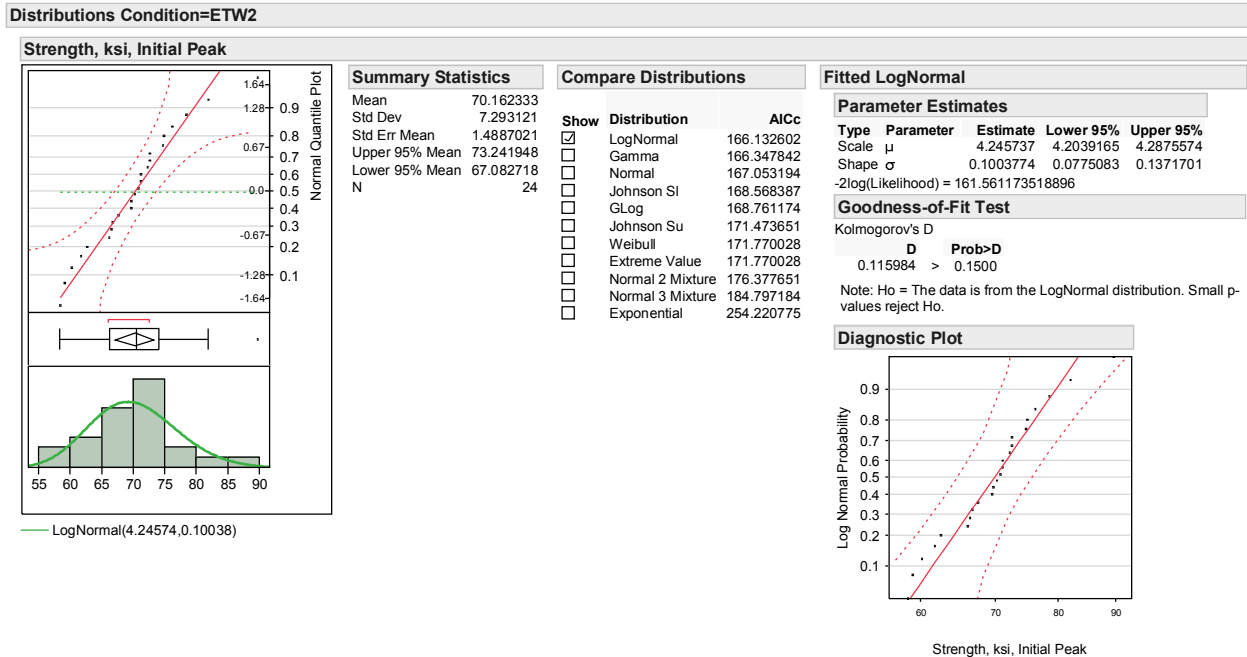
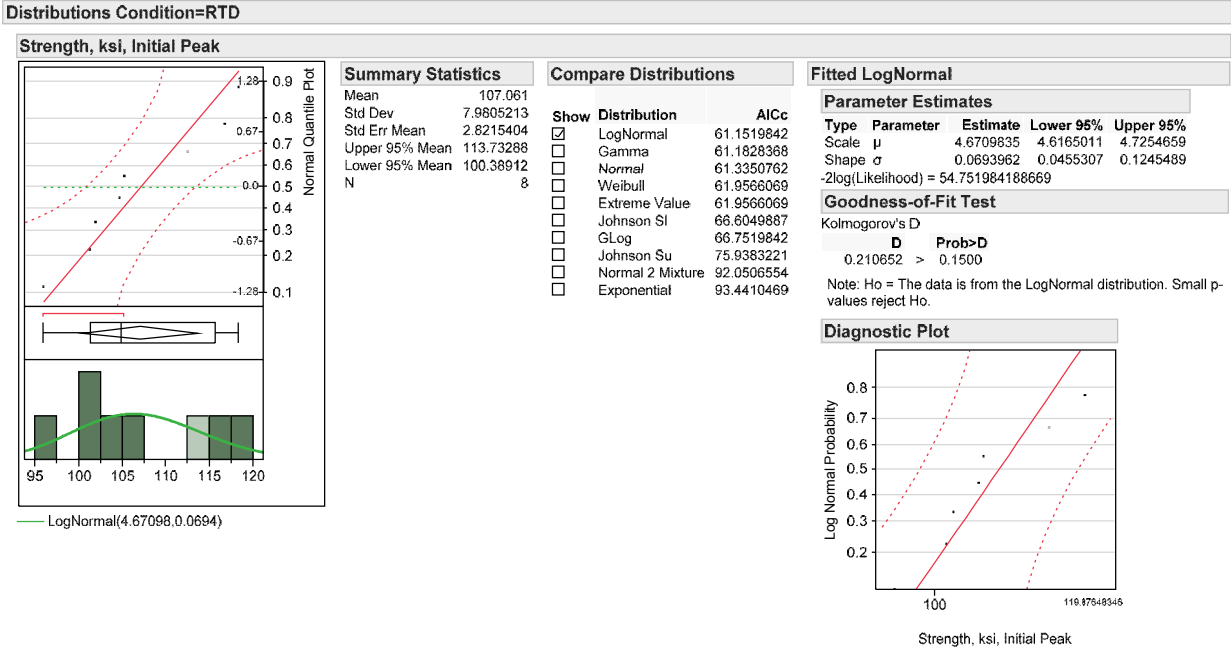
Note: Ho = The data is from the Normal distribution. Small p-values reject Ho.

Diagnostic Plot



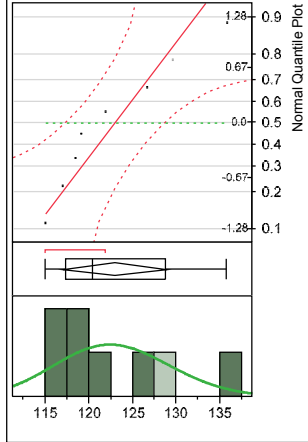
## A.19 Hard Pin Bearing (PB3)

The determination of statistical distribution types for the Hard Pin Bearing (PB3) test results is presented here.



Distributions Condition=RTD

Strength, ksi, Ultimate



LogNormal(4.81005,0.05367)

Summary Statistics

Mean	122.91676
Std Dev	7.1687529
Std Err Mean	2.5345369
Upper 95% Mean	128.90999
Lower 95% Mean	116.92354
N	8

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	59.2641706
<input type="checkbox"/>	Gamma	59.3551116
<input type="checkbox"/>	Normal	59.6187237
<input type="checkbox"/>	Weibull	61.283356
<input type="checkbox"/>	Extreme Value	61.283356
<input type="checkbox"/>	Johnson S1	62.7792928
<input type="checkbox"/>	GLog	65.1504695
<input type="checkbox"/>	Johnson Su	74.4841193
<input type="checkbox"/>	Normal 2 Mixture	91.6344167
<input type="checkbox"/>	Exponential	95.6507853

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	4.8100516	4.7679191	4.8521842
Shape	$\sigma$	0.0536658	0.03521	0.0963167

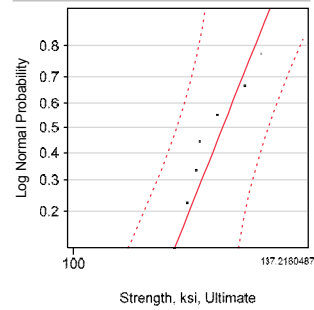
-2log(Likelihood) = 52.8641706147957

Goodness-of-Fit Test

Kolmogorov's D  
**D**    **Prob>D**  
 0.213708    > 0.1500

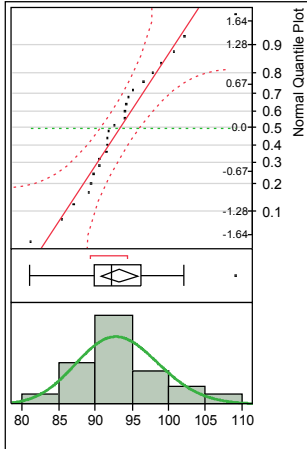
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Strength, ksi, Ultimate



LogNormal(4.53336,0.06026)

Summary Statistics

Mean	93.240806
Std Dev	5.8127094
Std Err Mean	1.1865143
Upper 95% Mean	95.695297
Lower 95% Mean	90.786314
N	24

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	155.448097
<input type="checkbox"/>	Gamma	155.643274
<input type="checkbox"/>	Normal	156.162725
<input type="checkbox"/>	Johnson S1	157.743697
<input type="checkbox"/>	GLog	158.076668
<input type="checkbox"/>	Johnson Su	159.221725
<input type="checkbox"/>	Weibull	162.615268
<input type="checkbox"/>	Extreme Value	162.615268
<input type="checkbox"/>	Normal 2 Mixture	165.487182
<input type="checkbox"/>	Normal 3 Mixture	176.96016
<input type="checkbox"/>	Exponential	267.87072

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	4.5333559	4.5082482	4.5584636
Shape	$\sigma$	0.0602634	0.0465335	0.0823525

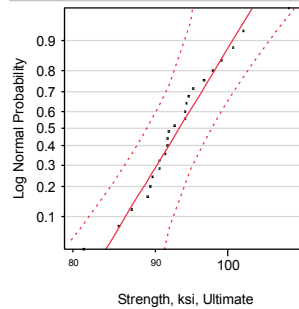
-2log(Likelihood) = 150.876668203408

Goodness-of-Fit Test

Kolmogorov's D  
**D**    **Prob>D**  
 0.116687    > 0.1500

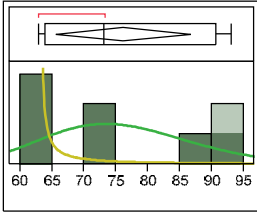
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=RTD

Strength, ksi, 2% Offset



— LogNormal(4.31972,0.15437)  
 • Johnson SI(0.18511,0.09281,63.002,1)

Summary Statistics

Mean 76.077375  
 Std Dev 12.727302  
 Std Err Mean 4.4997809  
 Upper 95% Mean 86.717666  
 Lower 95% Mean 65.437084  
 N 8

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Johnson SI	40.8260082
<input checked="" type="checkbox"/>	LogNormal	68.3245033
<input type="checkbox"/>	Gamma	68.4316866
<input type="checkbox"/>	Normal	68.8030081
<input type="checkbox"/>	Weibull	69.1725556
<input type="checkbox"/>	Extreme Value	69.1725556
<input type="checkbox"/>	GLog	74.3347562
<input type="checkbox"/>	Johnson Su	83.668336
<input type="checkbox"/>	Exponential	87.9746813
<input type="checkbox"/>	Normal 2 Mixture	96.9896824

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	4.3197228	4.1985254	4.4409202
Shape	$\sigma$	0.1543736	0.1012841	0.2770621

-2log(Likelihood) = 61.924503290666

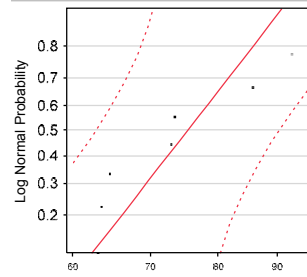
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.213964	> 0.1500

Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

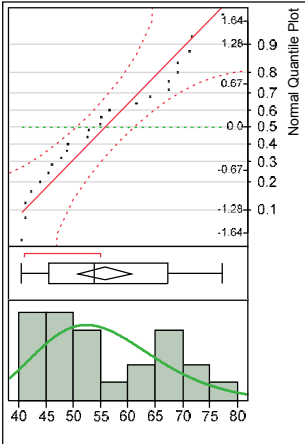
Diagnostic Plot



Strength, ksi, 2% Offset

Distributions Condition=ETW2

Strength, ksi, 2% Offset



— LogNormal(3.99714,0.20322)

Summary Statistics

Mean 55.580208  
 Std Dev 11.579606  
 Std Err Mean 2.3636773  
 Upper 95% Mean 60.469847  
 Lower 95% Mean 50.690569  
 N 24

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	188.056844
<input type="checkbox"/>	Gamma	188.263843
<input type="checkbox"/>	Normal	189.244261
<input type="checkbox"/>	Johnson SI	189.952573
<input type="checkbox"/>	Weibull	189.968498
<input type="checkbox"/>	Extreme Value	189.968498
<input type="checkbox"/>	Normal 2 Mixture	190.429328
<input type="checkbox"/>	GLog	191.851402
<input type="checkbox"/>	Johnson Su	194.757139
<input type="checkbox"/>	Normal 3 Mixture	198.791104
<input type="checkbox"/>	Exponential	243.037522

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	3.9971418	3.912474	4.0818096
Shape	$\sigma$	0.2032197	0.1569198	0.2777085

-2log(Likelihood) = 183.485415803695

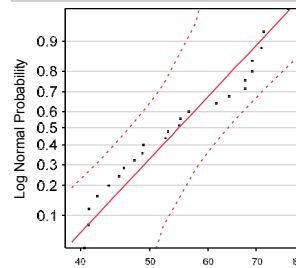
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.144728	> 0.1500

Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

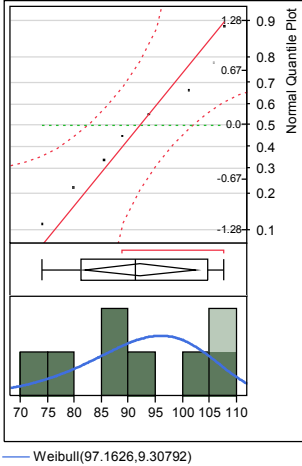
Diagnostic Plot



Strength, ksi, 2% Offset

Distributions Condition=RTD

Strength, ksi, 4% Offset



Summary Statistics

Mean	92.07375
Std Dev	12.299935
Std Err Mean	4.3486836
Upper 95% Mean	102.35675
Lower 95% Mean	81.790747
N	8

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Weibull	68.1382857
<input type="checkbox"/>	Extreme Value	68.1382857
<input type="checkbox"/>	Gamma	68.2437048
<input type="checkbox"/>	Normal	68.2565195
<input type="checkbox"/>	LogNormal	68.3083558
<input type="checkbox"/>	Johnson SI	73.7443359
<input type="checkbox"/>	GLog	73.7882714
<input type="checkbox"/>	Johnson Su	83.1218246
<input type="checkbox"/>	Exponential	91.0281048
<input type="checkbox"/>	Normal 2 Mixture	100.068356

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	97.162615	88.488672	106.02002
Shape	$\beta$	9.3079175	4.9380084	15.367119

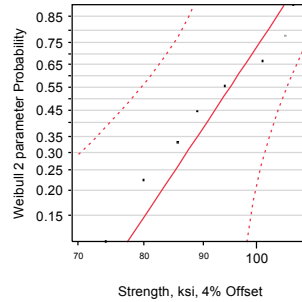
-2log(Likelihood) = 61.738285737615

Goodness-of-Fit Test

Cramer-von Mises W Test	
W-Square	0.037526
Prob>W^2	> 0.2500

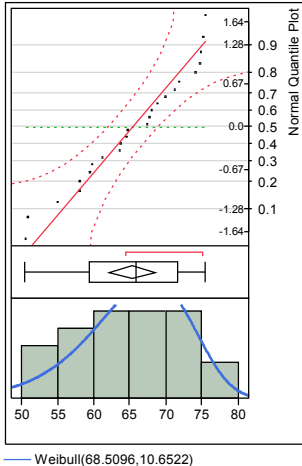
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Strength, ksi, 4% Offset



Summary Statistics

Mean	65.270292
Std Dev	7.5753936
Std Err Mean	1.5463208
Upper 95% Mean	68.4691
Lower 95% Mean	62.071483
N	24

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Weibull	167.472605
<input type="checkbox"/>	Extreme Value	167.472605
<input type="checkbox"/>	Normal	168.875933
<input type="checkbox"/>	Gamma	169.617813
<input type="checkbox"/>	Johnson SI	169.965627
<input type="checkbox"/>	LogNormal	170.114126
<input type="checkbox"/>	GLog	172.742697
<input type="checkbox"/>	Johnson Su	172.870876
<input type="checkbox"/>	Normal 2 Mixture	172.959384
<input type="checkbox"/>	Normal 3 Mixture	187.751228
<input type="checkbox"/>	Exponential	250.751593

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	68.509631	65.648423	71.322796
Shape	$\beta$	10.652223	7.5276395	14.408265

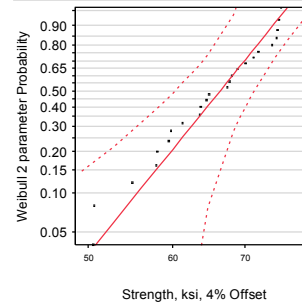
-2log(Likelihood) = 162.901176094753

Goodness-of-Fit Test

Cramer-von Mises W Test	
W-Square	0.039524
Prob>W^2	> 0.2500

Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

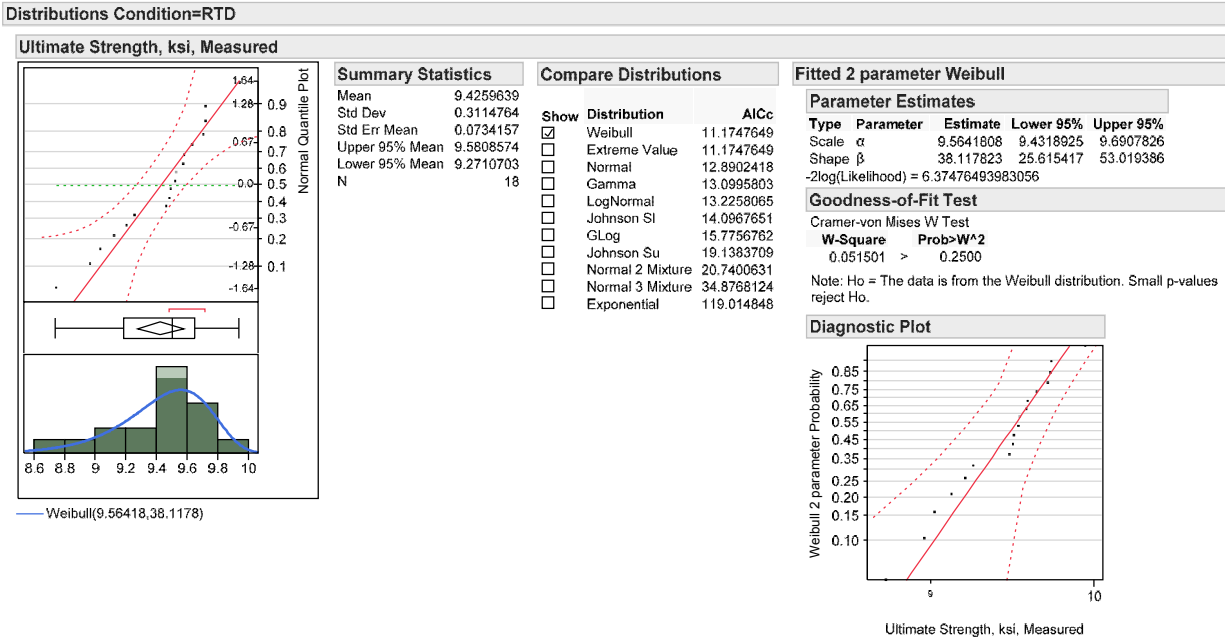
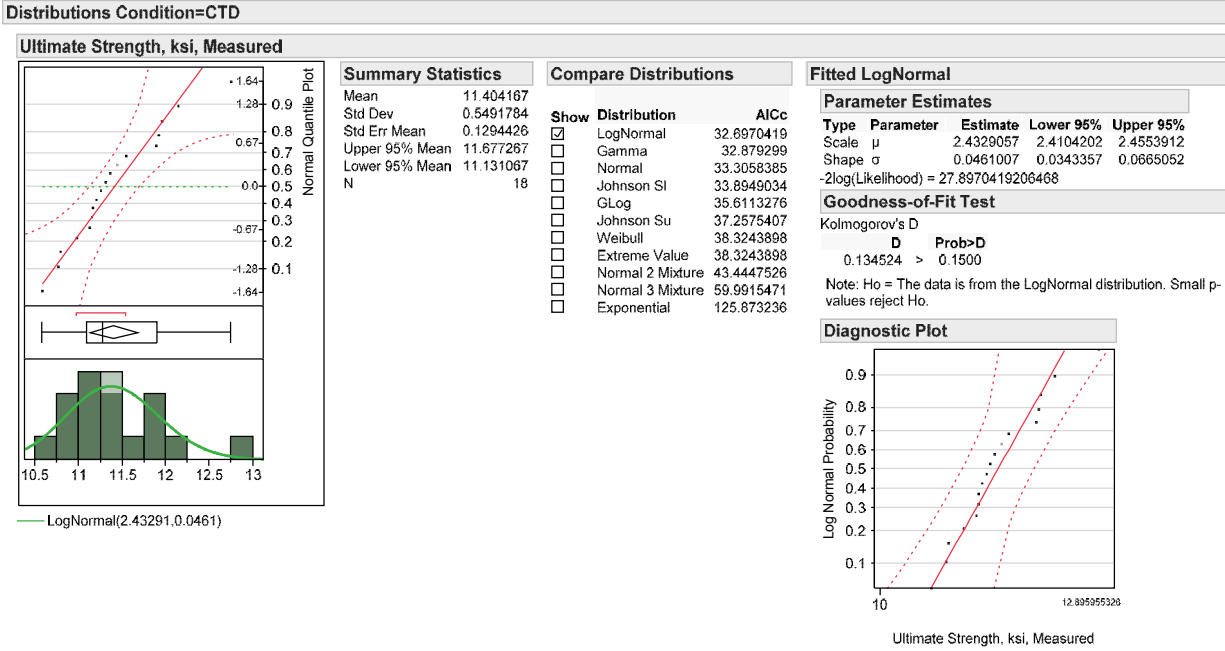
Diagnostic Plot





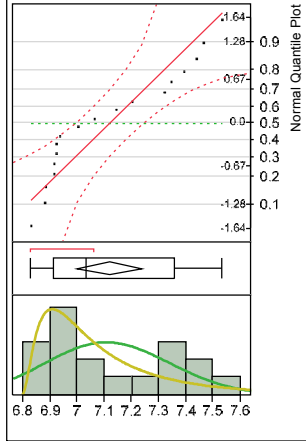
## A.20 Short Beam Strength (SBS)

The determination of statistical distribution types for the Short Beam Strength (SBS) test results is presented here.



Distributions Condition=ETD1

Ultimate Strength, ksi, Measured



Summary Statistics

Mean	7.1171171
Std Dev	0.2400565
Std Err Mean	0.0565819
Upper 95% Mean	7.2364944
Lower 95% Mean	6.9977398
N	18

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Johnson S1	1.46049593
<input type="checkbox"/>	Normal 2 Mixture	2.38582594
<input checked="" type="checkbox"/>	LogNormal	3.2292608
<input type="checkbox"/>	Gamma	3.31153809
<input type="checkbox"/>	Normal	3.51407473
<input type="checkbox"/>	Weibull	6.23203046
<input type="checkbox"/>	Extreme Value	6.23203046
<input type="checkbox"/>	GLog	6.39950892
<input type="checkbox"/>	Johnson Su	9.76220807
<input type="checkbox"/>	Normal 3 Mixture	16.6693793
<input type="checkbox"/>	Exponential	108.900099

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	1.9619702	1.9460871	1.9778533
Shape	$\sigma$	0.0325642	0.0242538	0.0469774

-2Log(Likelihood) = -1.57073919851314

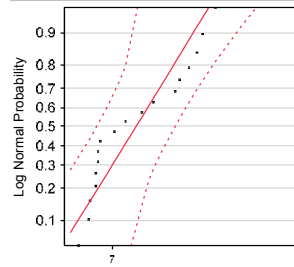
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.224595	0.0248*

Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

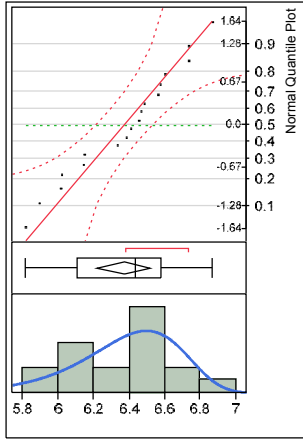
Diagnostic Plot



Ultimate Strength, ksi, Measured

Distributions Condition=ETW

Ultimate Strength, ksi, Measured



Summary Statistics

Mean	6.3690326
Std Dev	0.3028771
Std Err Mean	0.0713888
Upper 95% Mean	6.5196498
Lower 95% Mean	6.2184153
N	18

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Weibull	11.4437337
<input type="checkbox"/>	Extreme Value	11.4437337
<input type="checkbox"/>	Normal	11.8823751
<input type="checkbox"/>	Gamma	12.022872
<input type="checkbox"/>	LogNormal	12.1205305
<input type="checkbox"/>	Johnson S1	14.1842137
<input type="checkbox"/>	GLog	14.7678095
<input type="checkbox"/>	Johnson Su	18.1304978
<input type="checkbox"/>	Normal 2 Mixture	19.8124927
<input type="checkbox"/>	Normal 3 Mixture	36.8892626
<input type="checkbox"/>	Exponential	104.902113

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	6.505938	6.3705479	6.6359514
Shape	$\beta$	25.323932	17.039729	35.307889

-2log(Likelihood) = 6.64373369388252

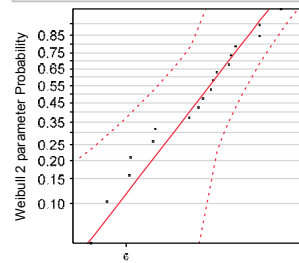
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square	Prob>W^2
0.031846	> 0.2500

Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

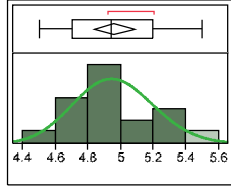
Diagnostic Plot



Ultimate Strength, ksi, Measured

Distributions Condition=ETW2

Ultimate Strength, ksi, Measured



Quantiles	
100.0%	maximum 5.50186
99.5%	5.50186
97.5%	5.50186
90.0%	5.29761
75.0%	quartile 5.1938
50.0%	median 4.94359
25.0%	quartile 4.70419
10.0%	4.65107
2.5%	4.50548
0.5%	4.50548
0.0%	minimum 4.50548

Summary Statistics	
Mean	4.9613053
Std Dev	0.25333669
Std Err Mean	0.0597239
Upper 95% Mean	5.0873117
Lower 95% Mean	4.835299
N	18

Compare Distributions		
Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	5.30237182
<input type="checkbox"/>	Gamma	5.33274597
<input type="checkbox"/>	Normal	5.45963147
<input type="checkbox"/>	Weibull	8.01611116
<input type="checkbox"/>	Extreme Value	8.01611116
<input type="checkbox"/>	Johnson S1	8.10064811
<input type="checkbox"/>	GLog	8.21665753
<input type="checkbox"/>	Johnson Su	11.5434855
<input type="checkbox"/>	Normal 2 Mixture	18.6494622
<input type="checkbox"/>	Normal 3 Mixture	20.6425012
<input type="checkbox"/>	Exponential	95.9100796

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	1.6004413	1.5762892	1.6245934
Shape	$\sigma$	0.0495177	0.0368807	0.0714345

-2log(Likelihood) = 0.502371818739782

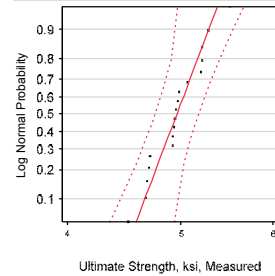
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.165186	> 0.1500

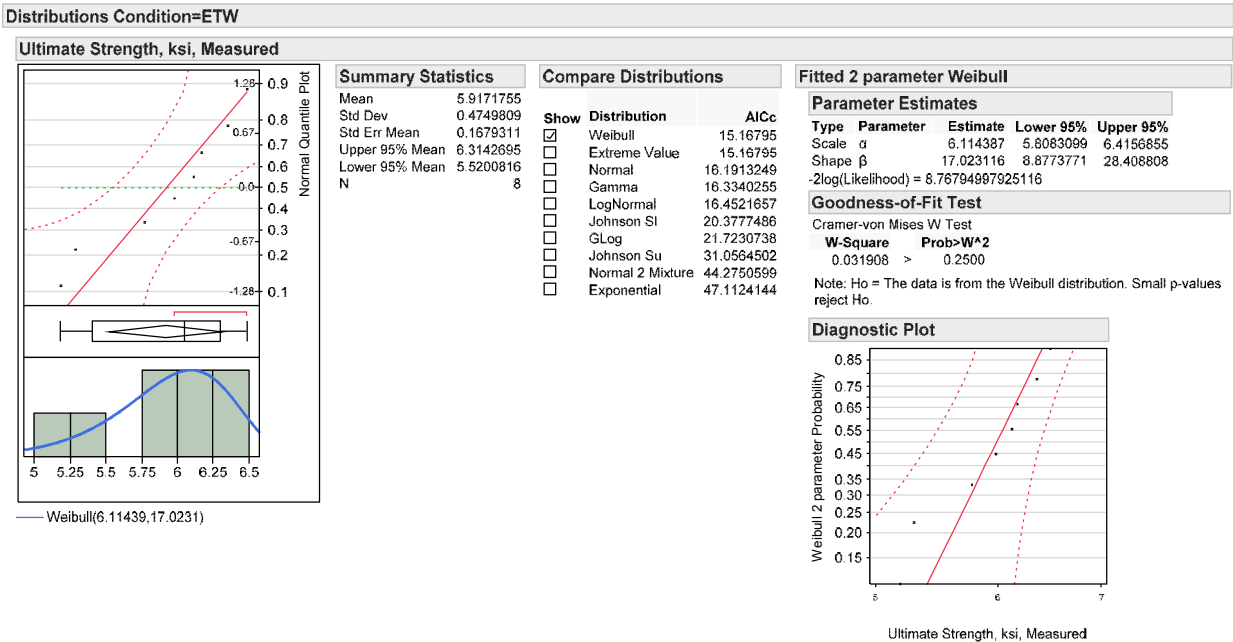
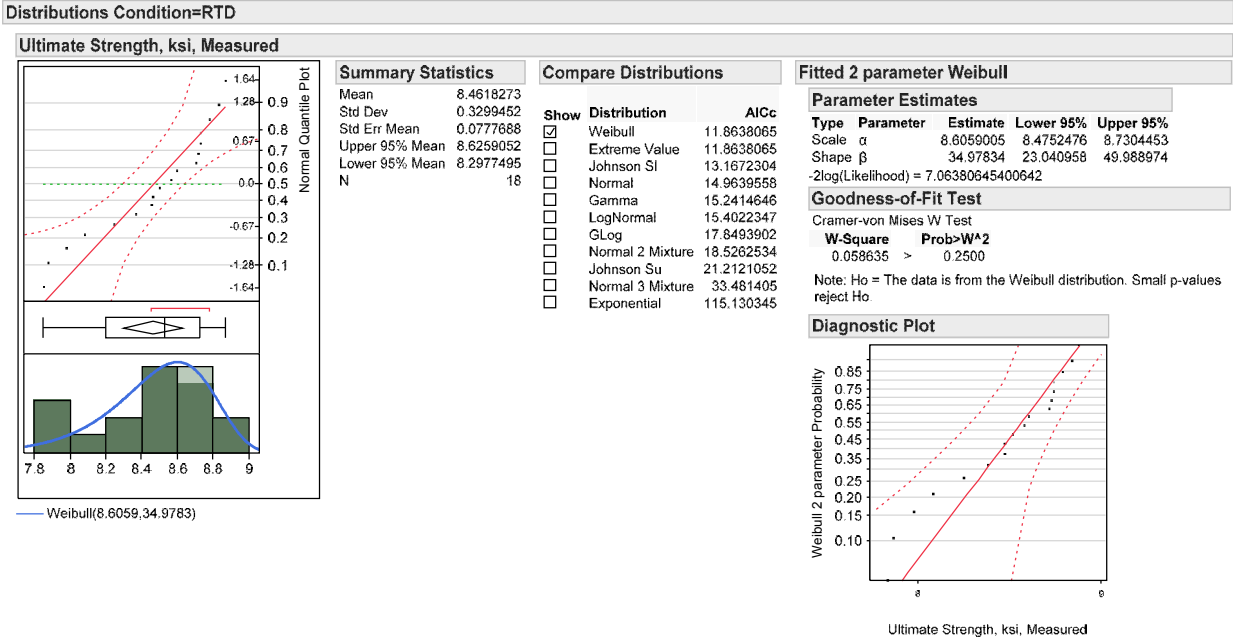
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



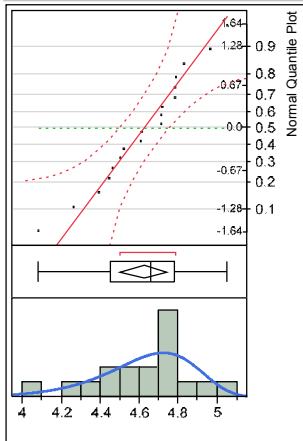
## A.21 Quasi Isotropic Short Beam Strength (SBS1)

The determination of statistical distribution types for the Quasi Isotropic Short Beam Strength (SBS1) test results is presented here.



Distributions Condition=ETW2

Ultimate Strength, ksi, Measured



— Weibull(4.73053,22.3806)

Summary Statistics

Mean	4.6215246
Std Dev	0.2432296
Std Err Mean	0.0573298
Upper 95% Mean	4.7424798
Lower 95% Mean	4.5005694
N	18

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Weibull	3.81711694
<input type="checkbox"/>	Extreme Value	3.81711694
<input type="checkbox"/>	Normal	3.98680326
<input type="checkbox"/>	Gamma	4.21798862
<input type="checkbox"/>	LogNormal	4.36968779
<input type="checkbox"/>	Johnson S1	6.33484539
<input type="checkbox"/>	GLog	7.28397351
<input type="checkbox"/>	Johnson Su	9.69748272
<input type="checkbox"/>	Normal 2 Mixture	17.0288789
<input type="checkbox"/>	Normal 3 Mixture	31.4957027
<input type="checkbox"/>	Exponential	93.3560872

Fitted 2 parameter Weibull

Parameter Estimates

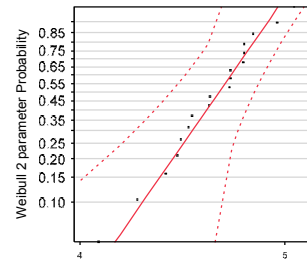
Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	4.7305261	4.6197464	4.8375763
Shape	$\beta$	22.380588	15.174926	30.892601
-2log(Likelihood) = -0.98288305807497				

Goodness-of-Fit Test

Cramer-von Mises W Test	
<b>W-Square</b>	<b>Prob&gt;W^2</b>
0.031662	> 0.2500

Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

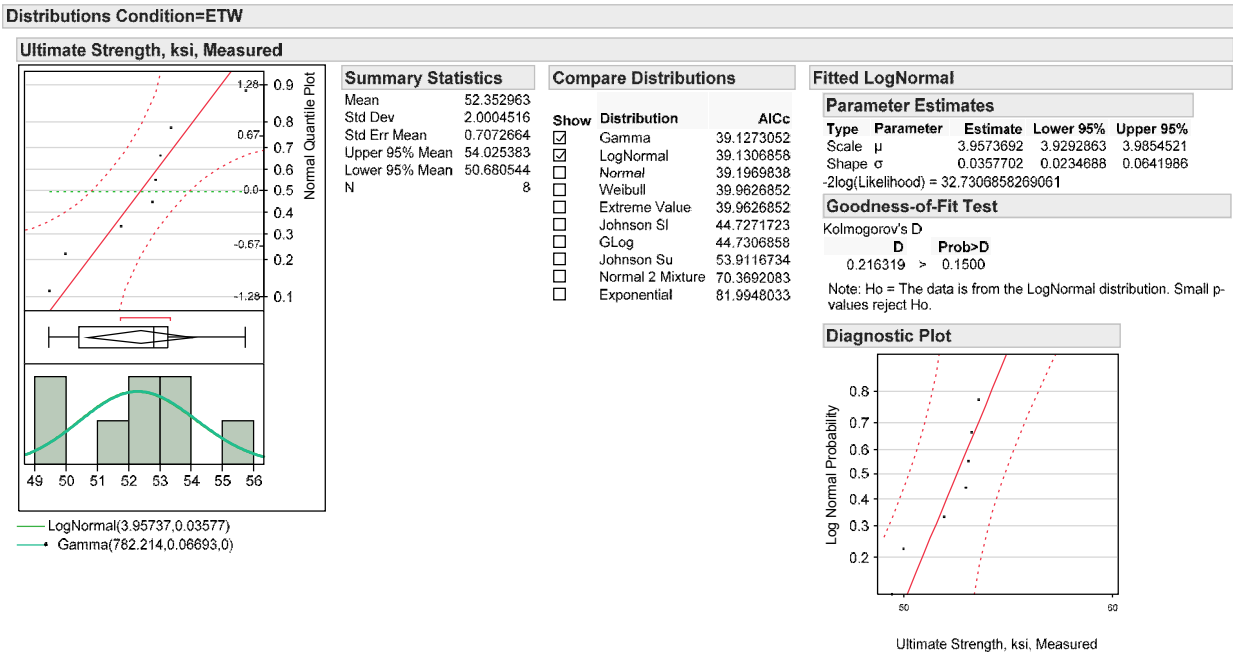
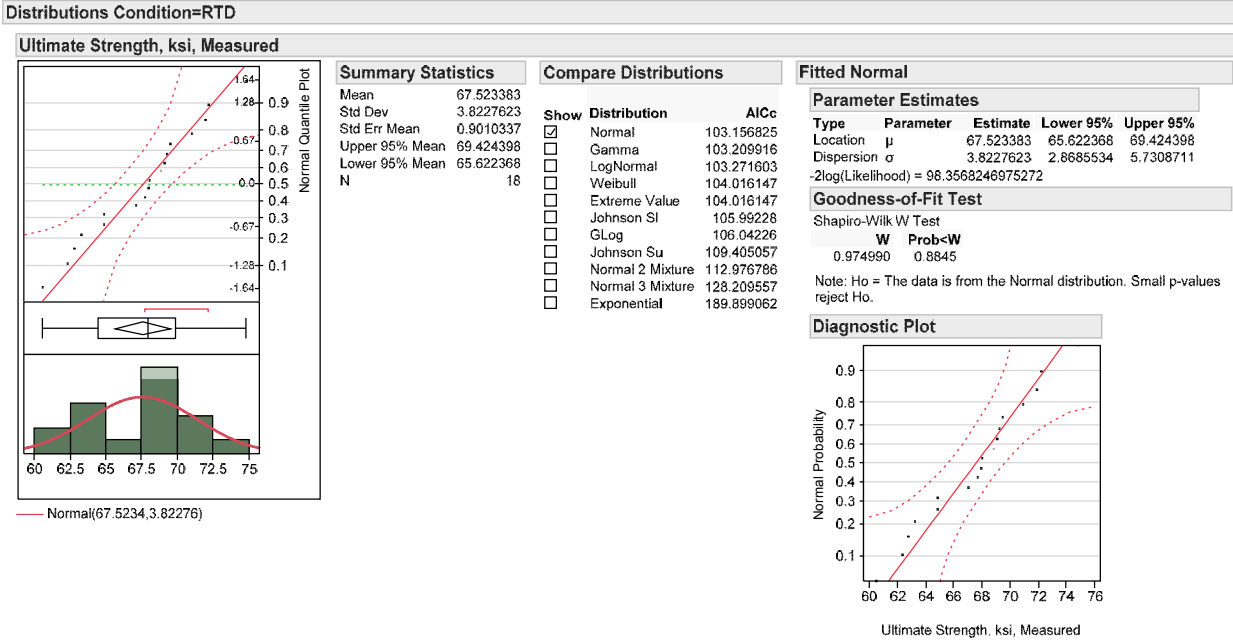
Diagnostic Plot



Ultimate Strength, ksi, Measured

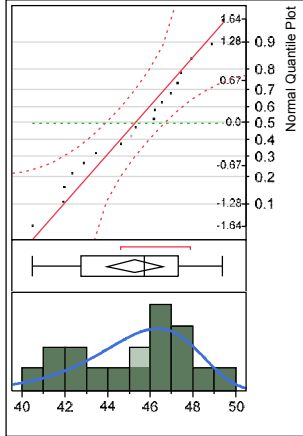
## A.22 Quasi Isotropic Compression (UNC1)

The determination of statistical distribution types for the Quasi Isotropic Compression (UNC1) test results is presented here.



Distributions Condition=ETW2

Ultimate Strength, ksi, Measured



— Weibull(46.4211,20.814)

Summary Statistics

Mean	45.244582
Std Dev	2.6080181
Std Err Mean	0.6147158
Upper 95% Mean	48.541519
Lower 95% Mean	43.947645
N	18

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Weibull	89.1196858
<input type="checkbox"/>	Extreme Value	89.1196858
<input type="checkbox"/>	Normal	89.3910488
<input type="checkbox"/>	Gamma	89.5205532
<input type="checkbox"/>	LogNormal	89.6179853
<input type="checkbox"/>	Johnson S1	91.8613164
<input type="checkbox"/>	GLog	92.2764839
<input type="checkbox"/>	Johnson Su	95.6393043
<input type="checkbox"/>	Normal 2 Mixture	97.1367991
<input type="checkbox"/>	Normal 3 Mixture	114.033324
<input type="checkbox"/>	Exponential	175.484985

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	46.421075	45.246704	47.552258
Shape	$\beta$	20.813962	13.985887	29.099666

-2log(Likelihood) = 84.3196857917777

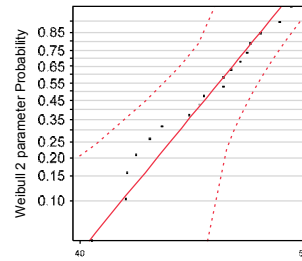
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square	Prob>W*2
0.029769	> 0.2500

Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

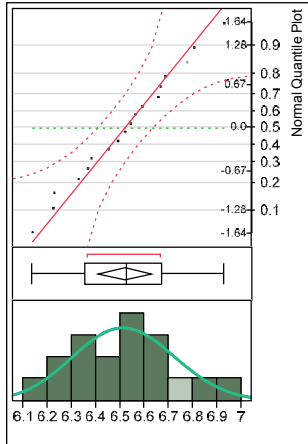
Diagnostic Plot



Ultimate Strength, ksi, Measured

Distributions Condition=RTD

Modulus, Msi, Measured



— LogNormal(1.87418,0.03233)  
 • Gamma(957.646,0.00681,0)

Summary Statistics

Mean	6.5188889
Std Dev	0.2166689
Std Err Mean	0.0510693
Upper 95% Mean	6.6266358
Lower 95% Mean	6.411142
N	18

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Gamma	-0.2020151
<input checked="" type="checkbox"/>	LogNormal	-0.1935161
<input type="checkbox"/>	Normal	-0.1760743
<input type="checkbox"/>	Weibull	1.34566942
<input type="checkbox"/>	Extreme Value	1.34566942
<input type="checkbox"/>	Johnson S1	2.70911527
<input type="checkbox"/>	GLog	2.70935818
<input type="checkbox"/>	Johnson Su	4.4815946
<input type="checkbox"/>	Normal 2 Mixture	9.44783618
<input type="checkbox"/>	Normal 3 Mixture	29.6535329
<input type="checkbox"/>	Exponential	105.739342

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	1.8741817	1.858414	1.8899495
Shape	$\sigma$	0.0323278	0.0240776	0.0466362

-2log(Likelihood) = -4.99351607804734

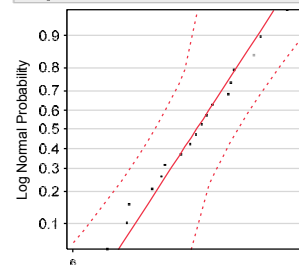
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.084545	> 0.1500

Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

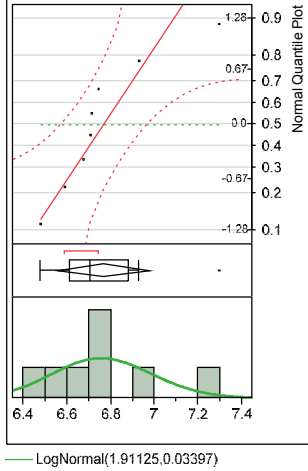
Diagnostic Plot



Modulus, Msi, Measured

Distributions Condition=ETW

Modulus, Msi, Measured



Summary Statistics

Mean	6.7655
Std Dev	0.2505041
Std Err Mean	0.0885666
Upper 95% Mean	6.9749266
Lower 95% Mean	6.5560734
N	8

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	5.56816402
<input type="checkbox"/>	Gamma	5.67188144
<input type="checkbox"/>	Normal	5.95453432
<input type="checkbox"/>	Johnson SI	6.43080078
<input type="checkbox"/>	Weibull	8.88515765
<input type="checkbox"/>	Extreme Value	8.88515765
<input type="checkbox"/>	GLog	11.168164
<input type="checkbox"/>	Johnson Su	17.9733826
<input type="checkbox"/>	Normal 2 Mixture	38.9339635
<input type="checkbox"/>	Exponential	49.2560454

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	1.9112517	1.8845795	1.9379238
Shape	$\sigma$	0.0339733	0.0222898	0.0609736

-2log(Likelihood) = -0.831835975328959

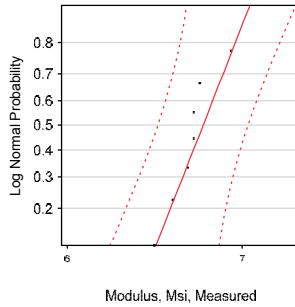
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.283955	0.0562

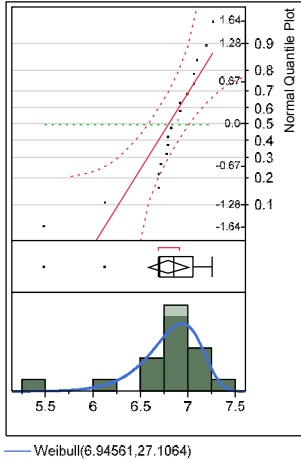
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Modulus, Msi, Measured



Summary Statistics

Mean	6.7924444
Std Dev	0.4138382
Std Err Mean	0.0975426
Upper 95% Mean	6.9982413
Lower 95% Mean	6.5866476
N	18

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Weibull	14.5378167
<input type="checkbox"/>	Extreme Value	14.5378167
<input type="checkbox"/>	Johnson SI	15.2931216
<input type="checkbox"/>	Johnson Su	18.6199892
<input type="checkbox"/>	Normal 2 Mixture	20.4442111
<input type="checkbox"/>	Normal	23.1196968
<input type="checkbox"/>	Gamma	24.6345699
<input type="checkbox"/>	LogNormal	25.4414818
<input type="checkbox"/>	GLog	28.3557675
<input type="checkbox"/>	Normal 3 Mixture	38.0941232
<input type="checkbox"/>	Exponential	107.219192

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	6.9456077	6.8124147	7.07603
Shape	$\beta$	27.106375	17.815969	38.389585

-2log(Likelihood) = 9.73781670495931

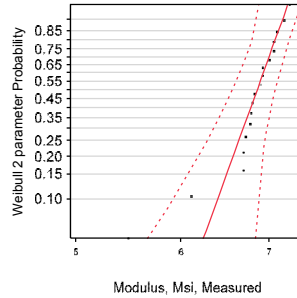
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square	Prob>W^2
0.069768	0.2497

Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

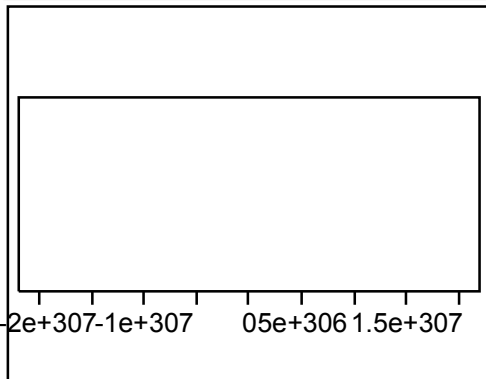
Diagnostic Plot





**Distributions Condition=ETW**

**Poisson's Ratio**



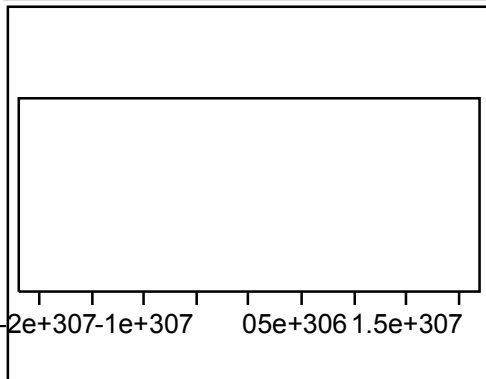
**Quantiles**

**Summary Statistics**

Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

**Distributions Condition=ETW2**

**Poisson's Ratio**



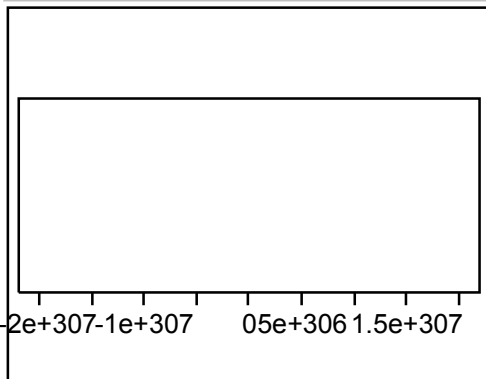
**Quantiles**

**Summary Statistics**

Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

**Distributions Condition=RTD**

**Poisson's Ratio**



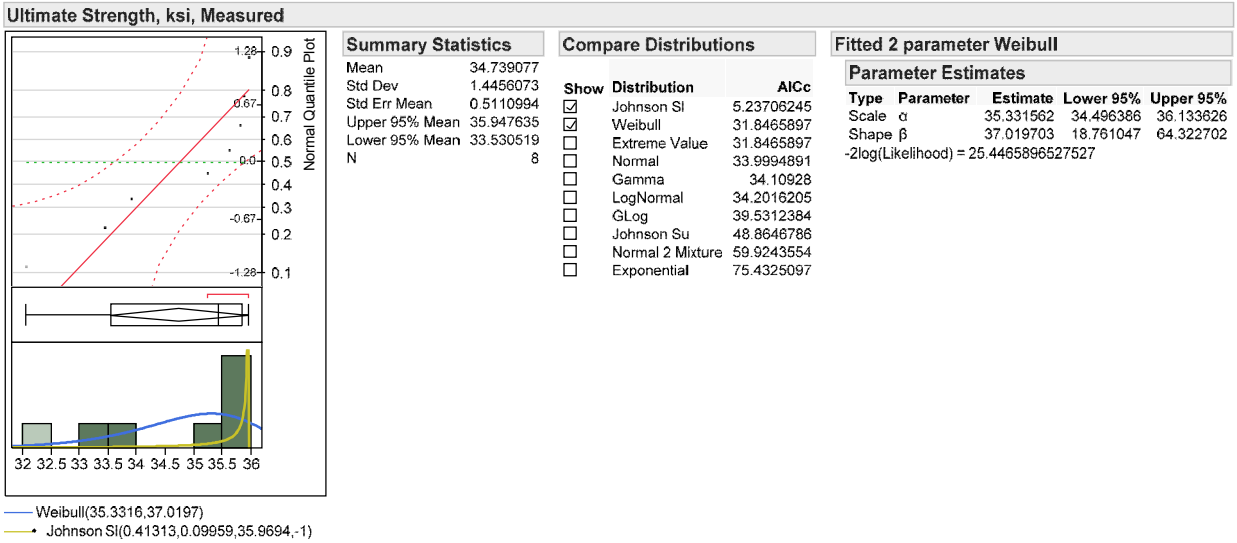
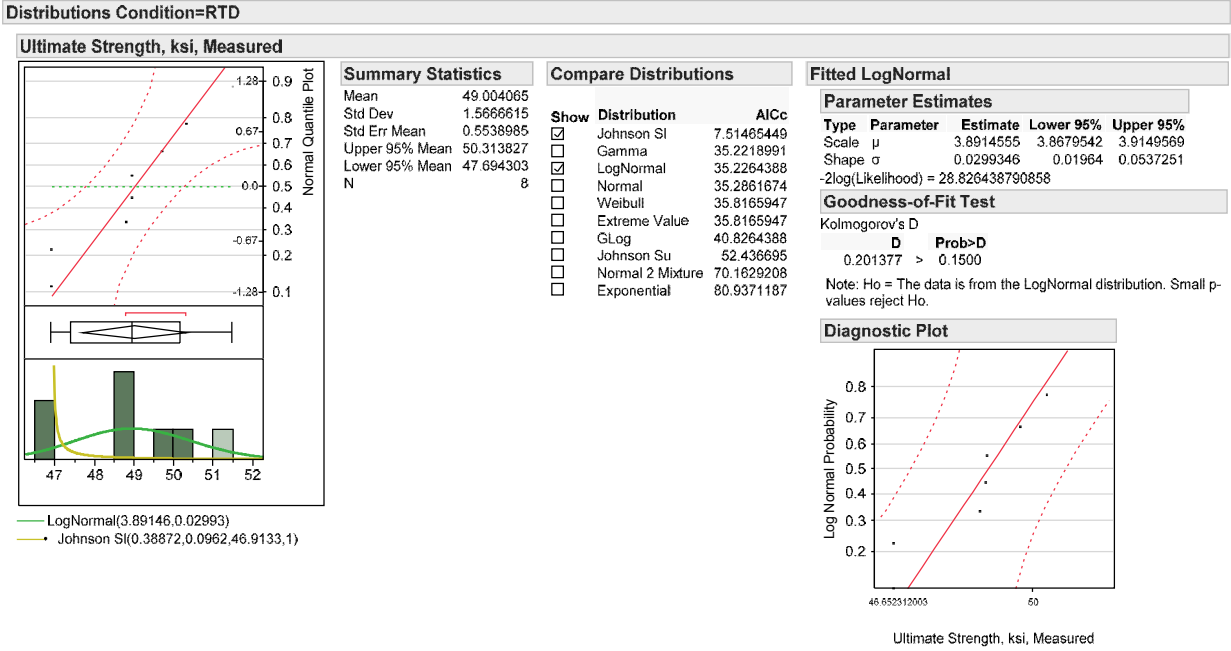
**Quantiles**

**Summary Statistics**

Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

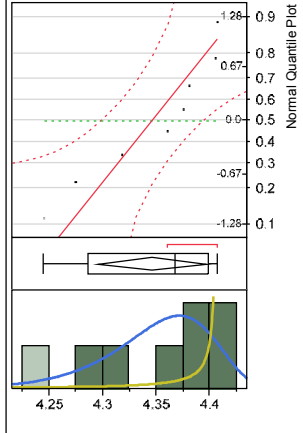
## A.23 Soft Compression (UNC2)

The determination of statistical distribution types for the Soft Compression (UNC2) test results is presented here.



Distributions Condition=RTD

Modulus, Msi, Measured



— Weibull(4.37175,103.167)  
 — Johnson SI(0.70522,0.10216,4.407,-1)

Summary Statistics

Mean 4.345875  
 Std Dev 0.0603784  
 Std Err Mean 0.021347  
 Upper 95% Mean 4.3963526  
 Lower 95% Mean 4.2953974  
 N 8

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Johnson SI	-39.251936
<input checked="" type="checkbox"/>	Weibull	-18.335101
<input type="checkbox"/>	Extreme Value	-18.335101
<input type="checkbox"/>	Gamma	-16.835974
<input type="checkbox"/>	LogNormal	-16.814004
<input type="checkbox"/>	Normal	-16.81096
<input type="checkbox"/>	GLog	-11.279211
<input type="checkbox"/>	Johnson Su	-1.9458601
<input type="checkbox"/>	Normal 2 Mixture	13.6834028
<input type="checkbox"/>	Exponential	42.1743006

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	4.3717532	4.3346759	4.4067345
Shape	$\beta$	103.16674	53.32365	174.62786

-2log(Likelihood) = -24.7351014695616

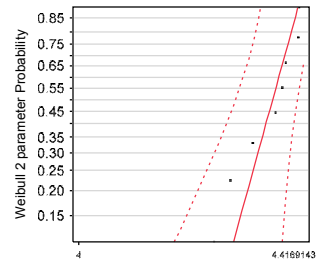
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square	Prob>W^2
0.051749	> 0.2500

Note: Ho = The data is from the Weibull distribution Small p-values reject Ho.

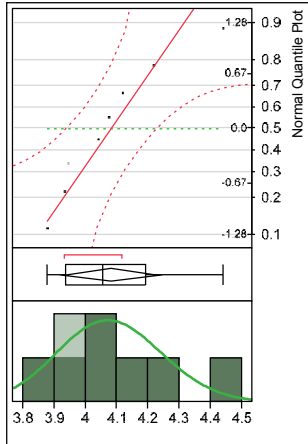
Diagnostic Plot



Modulus, Msi, Measured

Distributions Condition=ETW2

Modulus, Msi, Measured



— LogNormal(1.40533,0.04117)

Summary Statistics

Mean 4.080375  
 Std Dev 0.182594  
 Std Err Mean 0.0645567  
 Upper 95% Mean 4.2330274  
 Lower 95% Mean 3.9277226  
 N 8

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	0.54893142
<input type="checkbox"/>	Gamma	0.63836999
<input type="checkbox"/>	Normal	0.89517015
<input type="checkbox"/>	Weibull	3.14793407
<input type="checkbox"/>	Extreme Value	3.14793407
<input type="checkbox"/>	Johnson SI	4.19237732
<input type="checkbox"/>	GLog	6.14893142
<input type="checkbox"/>	Johnson Su	13.5257107
<input type="checkbox"/>	Normal 2 Mixture	36.005805
<input type="checkbox"/>	Exponential	41.165689

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	1.405332	1.3730071	1.4376569
Shape	$\sigma$	0.0411734	0.0270138	0.073896

-2log(Likelihood) = -5.85106857540664

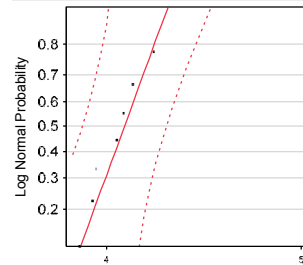
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.162752	> 0.1500

Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

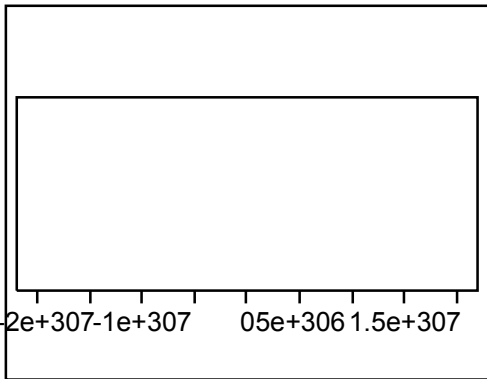
Diagnostic Plot



Modulus, Msi, Measured

**Distributions Condition=ETW2**

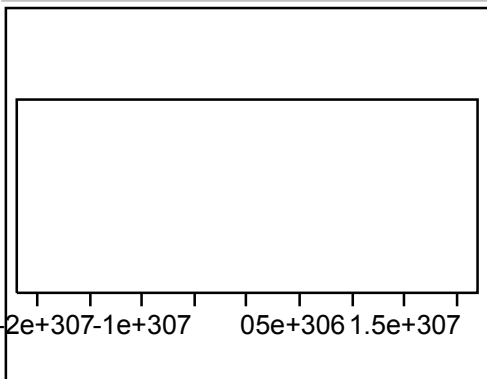
**Poisson's Ratio**



Quantiles	Summary Statistics
	Mean .
	Std Dev .
	Std Err Mean .
	Upper 95% Mean .
	Lower 95% Mean .
	N 0

**Distributions Condition=RTD**

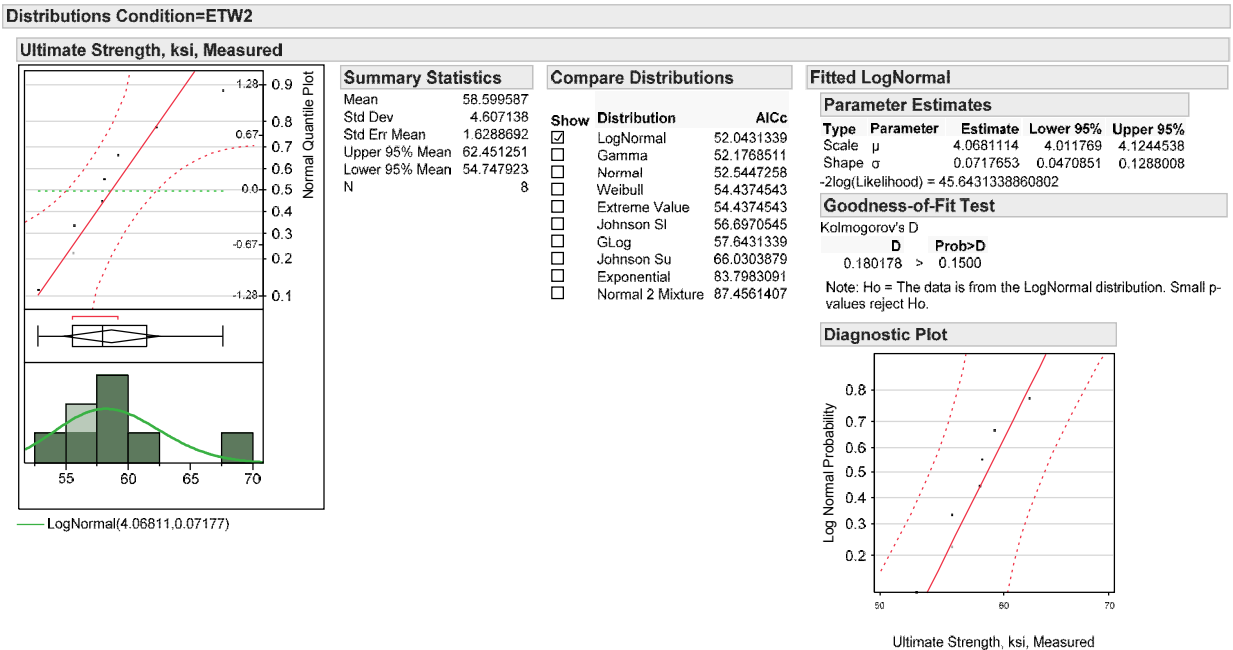
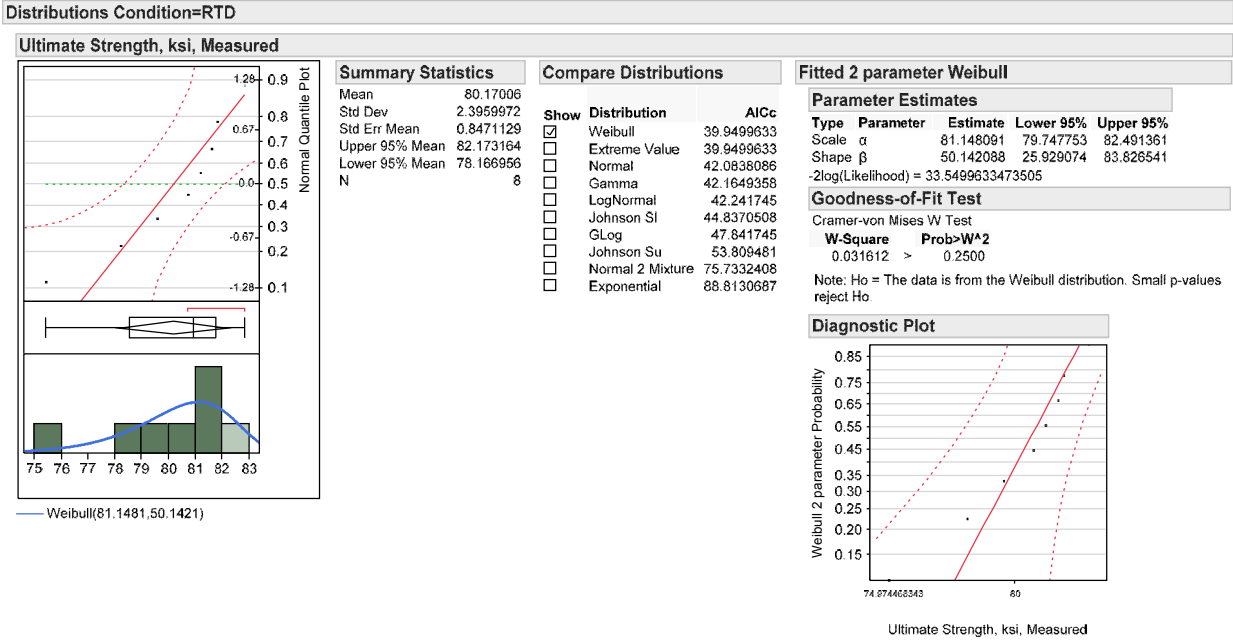
**Poisson's Ratio**



Quantiles	Summary Statistics
	Mean .
	Std Dev .
	Std Err Mean .
	Upper 95% Mean .
	Lower 95% Mean .
	N 0

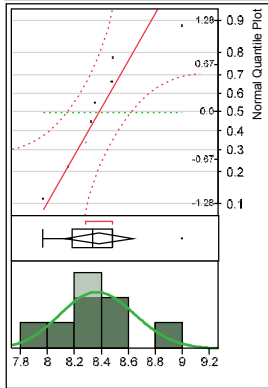
## A.24 Hard Compression (UNC3)

The determination of statistical distribution types for the Hard Compression (UNC3) test results is presented here.



Distributions Condition=RTD

Modulus, Msi, Measured



LogNormal(2.12482,0.03338)

Quantiles

100.0%	maximum	8.996
99.5%		8.996
97.5%		8.996
90.0%		8.996
75.0%	quartile	8.48025
50.0%	median	8.335
25.0%	quartile	8.1805
10.0%		7.962
2.5%		7.962
0.5%		7.962
0.0%	minimum	7.962

Summary Statistics

Mean	8.376125
Std Dev	0.3028255
Std Err Mean	0.107065
Upper 95% Mean	8.6292934
Lower 95% Mean	8.1229596
N	8

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	8.70284659
<input type="checkbox"/>	Gamma	8.77285824
<input type="checkbox"/>	Normal	8.98943842
<input type="checkbox"/>	Weibull	11.4876478
<input type="checkbox"/>	Extreme Value	11.4876478
<input type="checkbox"/>	Johnson S1	13.457927
<input type="checkbox"/>	GLog	14.3028466
<input type="checkbox"/>	Johnson Su	22.7971509
<input type="checkbox"/>	Normal 2 Mixture	43.8661918
<input type="checkbox"/>	Exponential	52.672633

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	2.1248235	2.0986181	2.151029
Shape	$\sigma$	0.0333788	0.0218998	0.0599066

-2log(Likelihood) = 2.302846590039

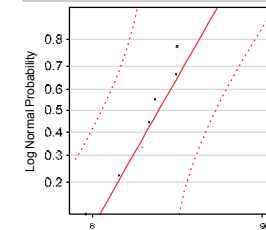
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.220803	> 0.1500

Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

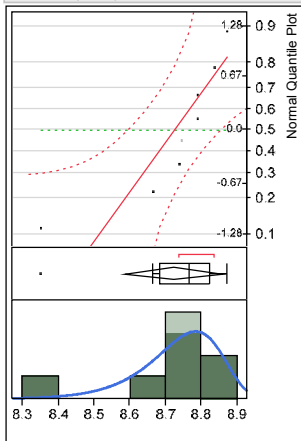
Diagnostic Plot



Modulus, Msi, Measured

Distributions Condition=ETW2

Modulus, Msi, Measured



Weibull(8.78466,95.1553)

Summary Statistics

Mean	8.72375
Std Dev	0.1636222
Std Err Mean	0.0578492
Upper 95% Mean	8.8605416
Lower 95% Mean	8.5869584
N	8

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Weibull	-5.0022197
<input type="checkbox"/>	Extreme Value	-5.0022197
<input type="checkbox"/>	Johnson S1	-1.30711
<input type="checkbox"/>	Normal	-0.8601091
<input type="checkbox"/>	Gamma	-0.7726175
<input type="checkbox"/>	LogNormal	-0.6939473
<input type="checkbox"/>	GLog	4.90605272
<input type="checkbox"/>	Johnson Su	8.02613944
<input type="checkbox"/>	Normal 2 Mixture	34.0166443
<input type="checkbox"/>	Exponential	53.3234537

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	8.7846571	8.7047807	8.8620978
Shape	$\beta$	95.155289	48.20442	160.53069

-2log(Likelihood) = -11.4022197358113

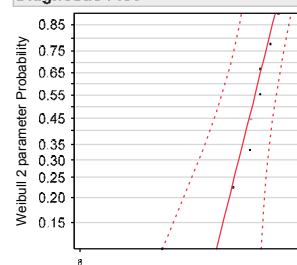
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square	Prob>W^2
0.048440	> 0.2500

Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

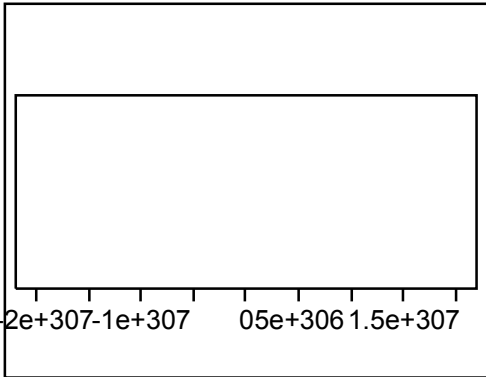
Diagnostic Plot



Modulus, Msi, Measured

**Distributions Condition=ETW2**

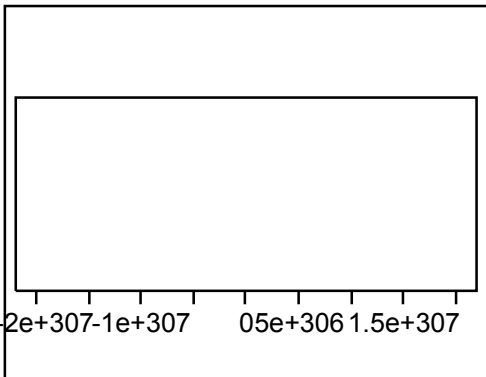
**Poisson's Ratio**



Quantiles	Summary Statistics
	Mean .
	Std Dev .
	Std Err Mean .
	Upper 95% Mean .
	Lower 95% Mean .
	N 0

**Distributions Condition=RTD**

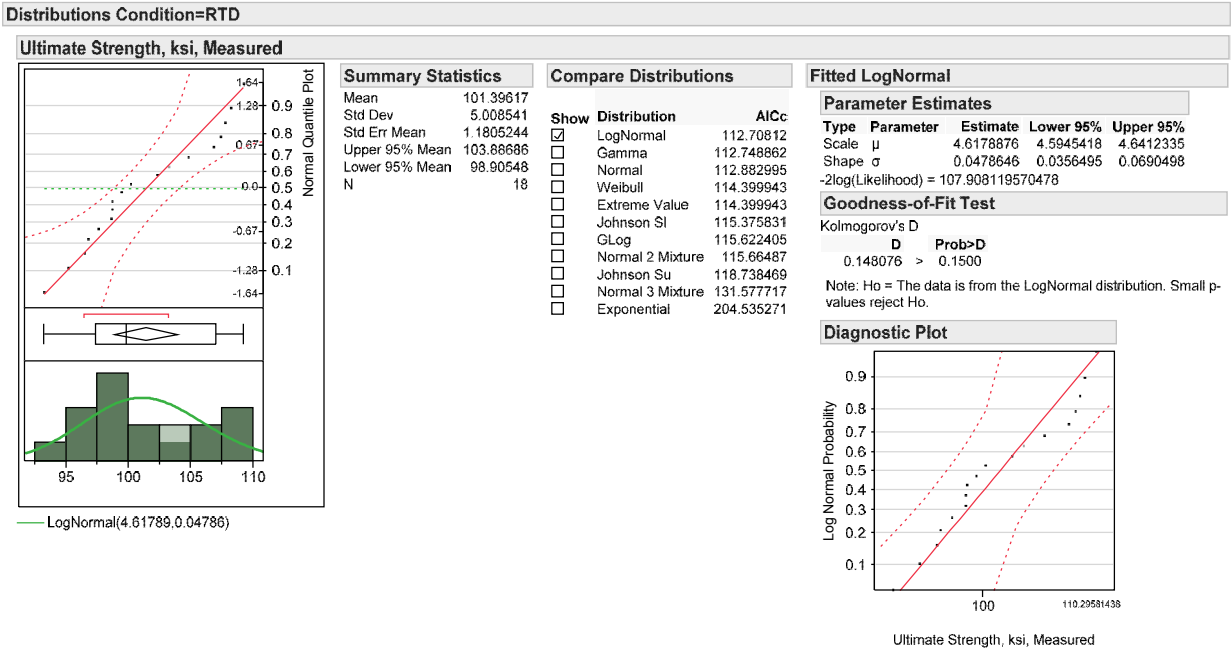
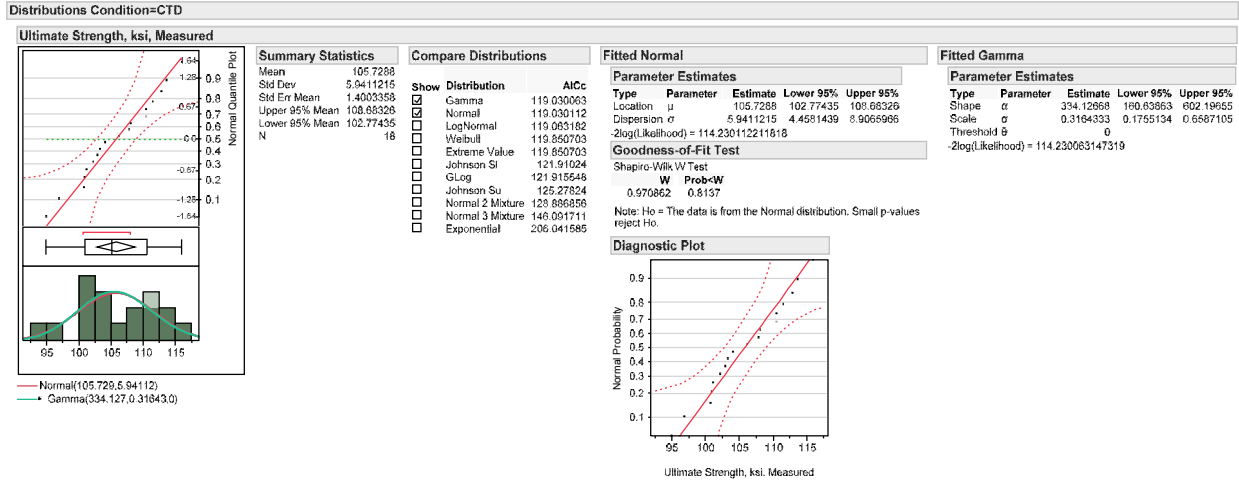
**Poisson's Ratio**



Quantiles	Summary Statistics
	Mean .
	Std Dev .
	Std Err Mean .
	Upper 95% Mean .
	Lower 95% Mean .
	N 0

## A.25 Quasi Isotropic Tension (UNT1)

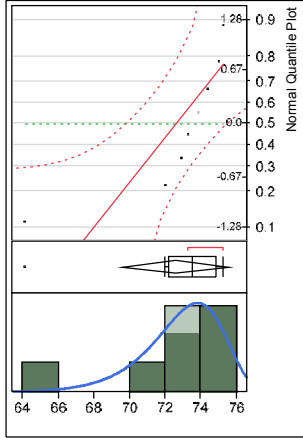
The determination of statistical distribution types for the Quasi Isotropic Tension (UNT1) test results is presented here.





Distributions Condition=ETW2

Ultimate Strength, ksi, Measured



Summary Statistics

Mean	72.59488
Std Dev	3.5920418
Std Err Mean	1.2699786
Upper 95% Mean	75.597902
Lower 95% Mean	69.591858
N	8

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Weibull	43.6241715
<input type="checkbox"/>	Extreme Value	43.6241715
<input type="checkbox"/>	Johnson SI	44.134183
<input type="checkbox"/>	Normal	48.5625491
<input type="checkbox"/>	Gamma	48.973499
<input type="checkbox"/>	LogNormal	49.2180962
<input type="checkbox"/>	Johnson Su	53.4675111
<input type="checkbox"/>	GLog	54.8180962
<input type="checkbox"/>	Normal 2 Mixture	68.6689247
<input type="checkbox"/>	Exponential	87.224877

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	73.847523	72.24853	75.443068
Shape	$\beta$	39.746038	19.658096	68.564268

-2log(Likelihood) = 37.2241715294315

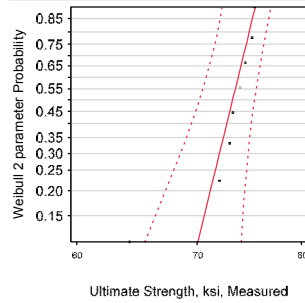
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square	Prob>W*2
0.064348	> 0.2500

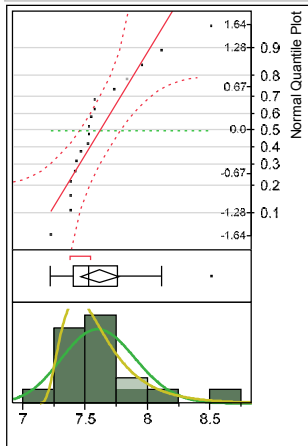
Note: Ho = The data is from the Weibull distribution Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=CTD

Modulus, Msi, Measured



Summary Statistics

Mean	7.6136111
Std Dev	0.3148101
Std Err Mean	0.0742015
Upper 95% Mean	7.7701625
Lower 95% Mean	7.4570597
N	18

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Johnson SI	7.9528521
<input type="checkbox"/>	Johnson Su	10.0059762
<input checked="" type="checkbox"/>	LogNormal	12.2179937
<input type="checkbox"/>	Gamma	12.5523678
<input type="checkbox"/>	Normal	13.273508
<input type="checkbox"/>	GLog	15.1322795
<input type="checkbox"/>	Normal 2 Mixture	15.1605369
<input type="checkbox"/>	Weibull	21.2828356
<input type="checkbox"/>	Extreme Value	21.2828356
<input type="checkbox"/>	Normal 3 Mixture	33.5498494
<input type="checkbox"/>	Exponential	111.327753

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	2.0291597	2.0100966	2.0492228
Shape	$\sigma$	0.039084	0.0291096	0.0563828

-2log(Likelihood) = 7.41799373605048

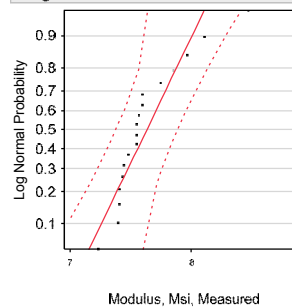
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.266090	< 0.0100*

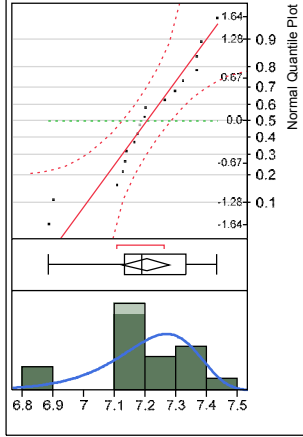
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=RTD

Modulus, Msi, Measured



— Weibull(7.27109,58.429)

Summary Statistics

Mean	7.2025
Std Dev	0.1515152
Std Err Mean	0.0357125
Upper 95% Mean	7.2778467
Lower 95% Mean	7.1271533
N	18

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Weibull	-14.189771
<input type="checkbox"/>	Extreme Value	-14.189771
<input type="checkbox"/>	Normal	-13.052711
<input type="checkbox"/>	Gamma	-12.94066
<input type="checkbox"/>	LogNormal	-12.866858
<input type="checkbox"/>	Johnson S1	-11.449113
<input type="checkbox"/>	GLog	-9.9525722
<input type="checkbox"/>	Normal 2 Mixture	-9.2523088
<input type="checkbox"/>	Johnson Su	-8.0864759
<input type="checkbox"/>	Normal 3 Mixture	-1.7772542
<input type="checkbox"/>	Exponential	109.329415

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	7.2710899	7.2051946	7.333714
Shape	$\beta$	58.428971	39.347269	81.445322
$-2\log(\text{Likelihood}) = -18.9897712349578$				

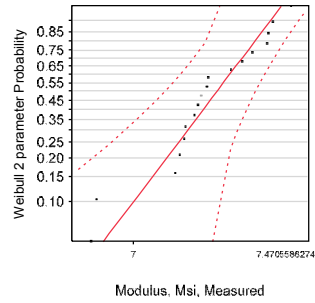
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square	Prob>W*2
0.073990	0.2268

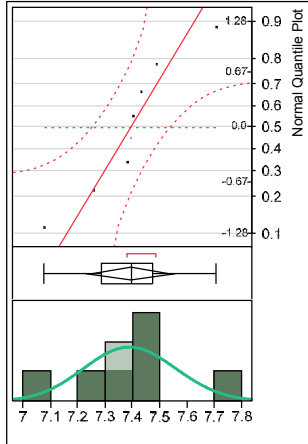
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Modulus, Msi, Measured



— LogNormal(2.0001,0.02291)  
 • Gamma(1907.23,0.00389,0)

Summary Statistics

Mean	7.39175
Std Dev	0.1808399
Std Err Mean	0.0639366
Upper 95% Mean	7.5429359
Lower 95% Mean	7.2405641
N	8

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Gamma	0.67980484
<input checked="" type="checkbox"/>	LogNormal	0.68414934
<input type="checkbox"/>	Normal	0.74072631
<input type="checkbox"/>	Weibull	1.74593637
<input type="checkbox"/>	Extreme Value	1.74593637
<input type="checkbox"/>	Johnson S1	6.27158202
<input type="checkbox"/>	GLog	6.28414934
<input type="checkbox"/>	Johnson Su	13.8698747
<input type="checkbox"/>	Normal 2 Mixture	35.6174797
<input type="checkbox"/>	Exponential	50.6724989

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	2.0001023	1.9821177	2.018067
Shape	$\sigma$	0.0229077	0.0150297	0.0411136
$-2\log(\text{Likelihood}) = -5.71585066461721$				

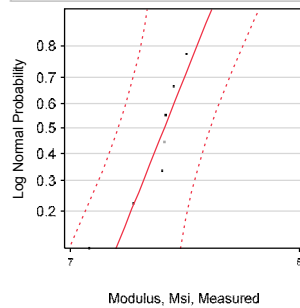
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.229230	> 0.1500

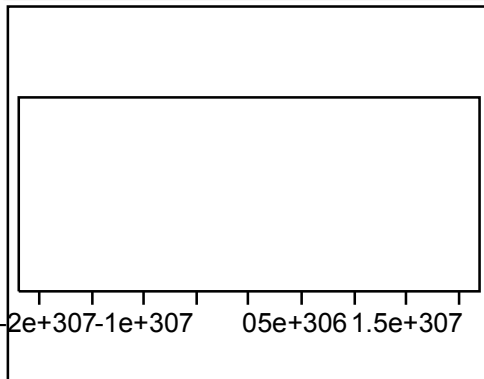
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



**Distributions Condition=CTD**

**Poisson's Ratio**



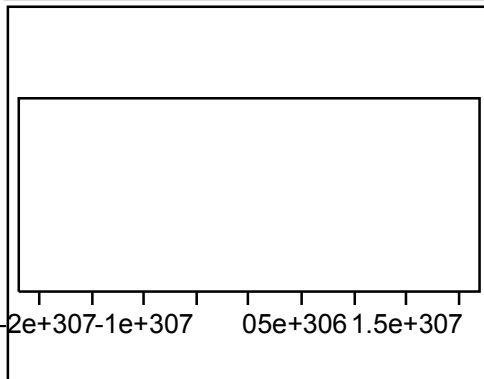
**Quantiles**

**Summary Statistics**

Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

**Distributions Condition=ETW2**

**Poisson's Ratio**



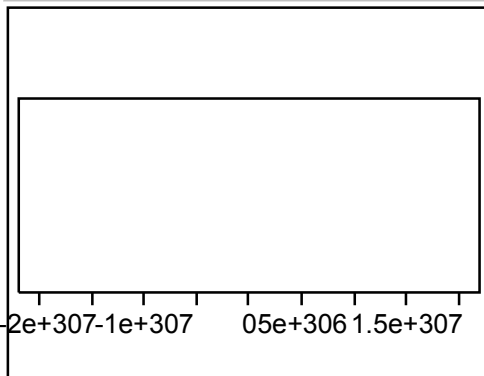
**Quantiles**

**Summary Statistics**

Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

**Distributions Condition=RTD**

**Poisson's Ratio**



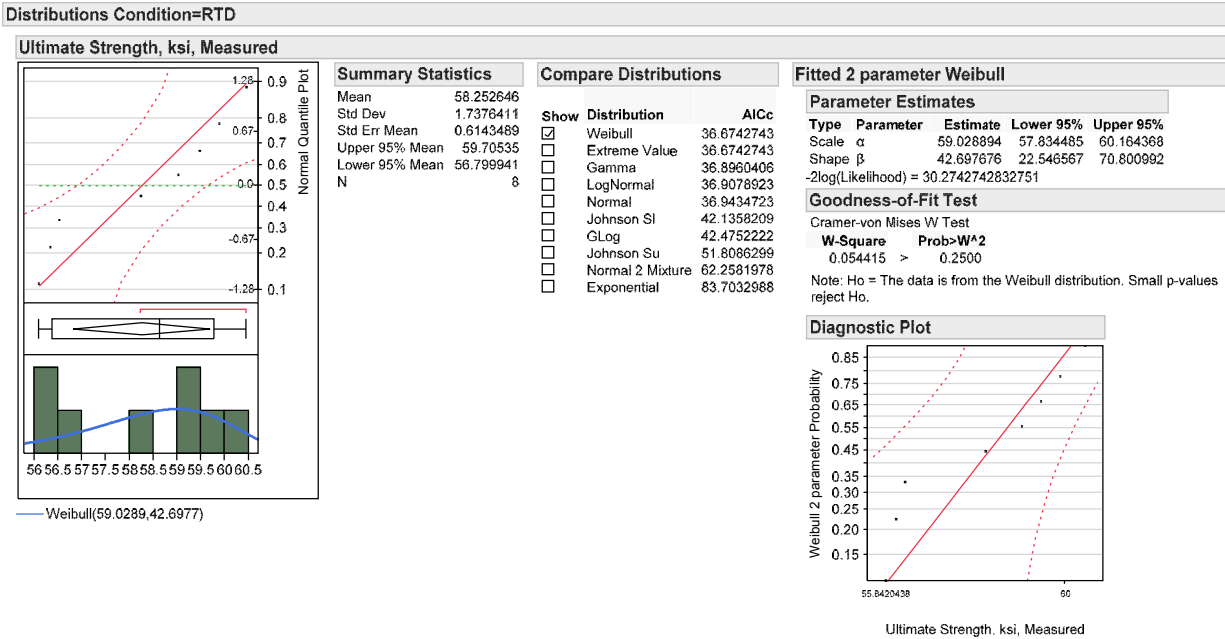
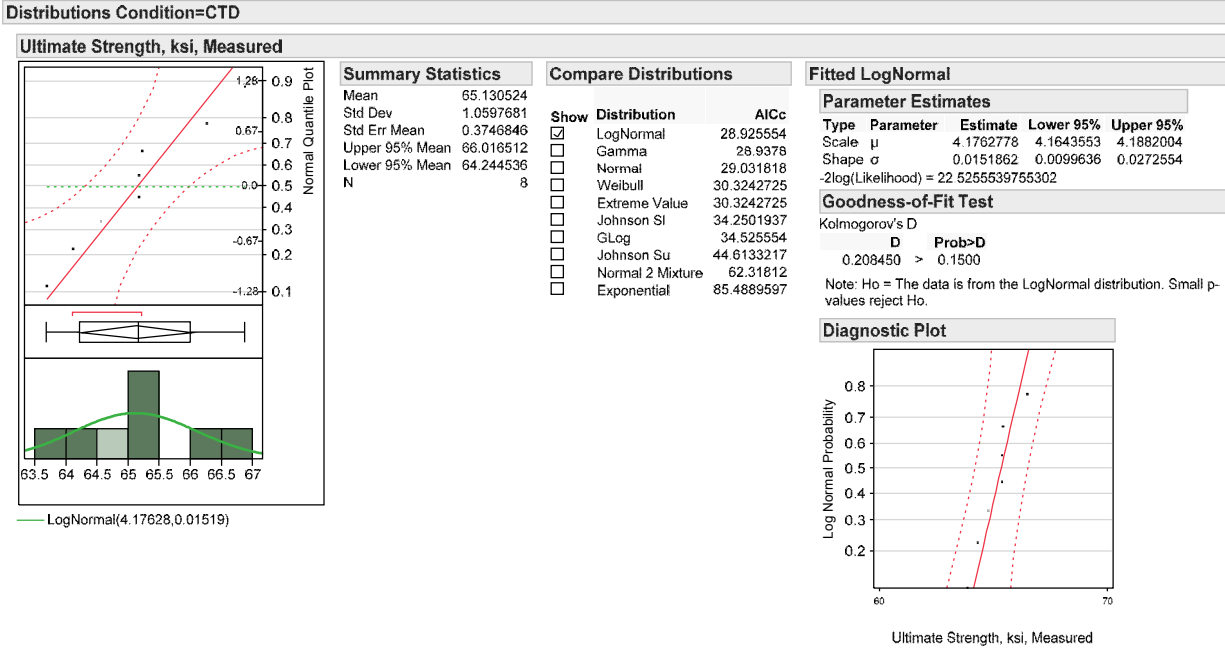
**Quantiles**

**Summary Statistics**

Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

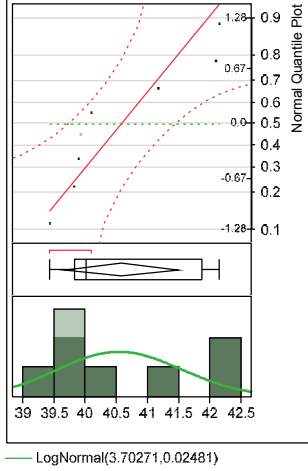
## A.26 Soft Tension (UNT2)

The determination of statistical distribution types for the Soft Tension (UNT2) test results is presented here.



Distributions Condition=ETW2

Ultimate Strength, ksi, Measured



Summary Statistics

Mean	40.569496
Std Dev	1.0840932
Std Err Mean	0.3832848
Upper 95% Mean	41.47582
Lower 95% Mean	39.663171
N	8

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	29.204796
<input type="checkbox"/>	Gamma	29.2446873
<input type="checkbox"/>	Normal	29.3949182
<input type="checkbox"/>	Weibull	30.9141992
<input type="checkbox"/>	Extreme Value	30.9141992
<input type="checkbox"/>	Johnson SI	31.8416724
<input type="checkbox"/>	GLog	34.804796
<input type="checkbox"/>	Johnson Su	41.8278141
<input type="checkbox"/>	Normal 2 Mixture	54.5393575
<input type="checkbox"/>	Exponential	77.9149298

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	3.7027071	3.6832258	3.7221884
Shape	$\sigma$	0.024814	0.0162804	0.044535

-2log(Likelihood) = 22.8047959742424

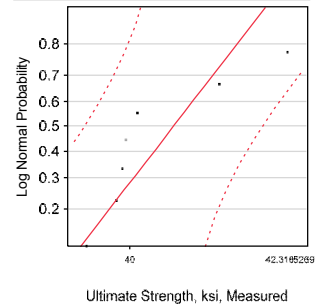
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.307294	0.0341*

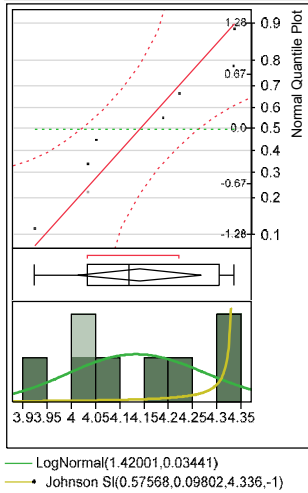
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=CTD

Modulus, Msi, Measured



Summary Statistics

Mean	4.139625
Std Dev	0.1524176
Std Err Mean	0.0538878
Upper 95% Mean	4.2670493
Lower 95% Mean	4.0122007
N	8

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Johnson SI	-22.1047
<input checked="" type="checkbox"/>	LogNormal	-2.0863238
<input type="checkbox"/>	Gamma	-2.0804018
<input type="checkbox"/>	Normal	-1.9950819
<input type="checkbox"/>	Weibull	-1.5688279
<input type="checkbox"/>	Extreme Value	-1.5688279
<input type="checkbox"/>	GLog	3.5366669
<input type="checkbox"/>	Johnson Su	12.8700198
<input type="checkbox"/>	Normal 2 Mixture	29.8519896
<input type="checkbox"/>	Exponential	41.3963499

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	1.4200128	1.3929961	1.4470295
Shape	$\sigma$	0.0344121	0.0225777	0.0617612

-2log(Likelihood) = -8.48632379817445

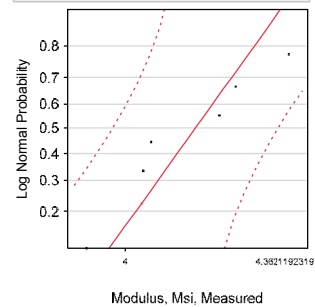
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.231992	> 0.1500

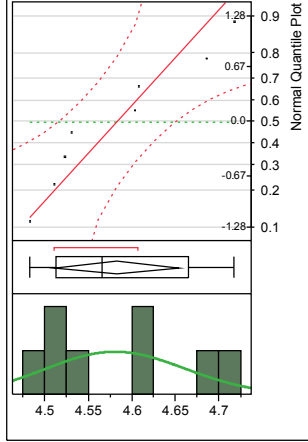
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=RTD

Modulus, Msi, Measured



Summary Statistics

Mean	4.58225
Std Dev	0.0858067
Std Err Mean	0.0303372
Upper 95% Mean	4.6539862
Lower 95% Mean	4.5105138
N	8

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	-11.318561
<input type="checkbox"/>	Gamma	-11.298065
<input type="checkbox"/>	Normal	-11.187519
<input type="checkbox"/>	Weibull	-9.8413971
<input type="checkbox"/>	Extreme Value	-9.8413971
<input type="checkbox"/>	Johnson S1	-7.1231858
<input type="checkbox"/>	GLog	-5.6657701
<input type="checkbox"/>	Johnson Su	3.67759132
<input type="checkbox"/>	Normal 2 Mixture	19.3168362
<input type="checkbox"/>	Exponential	43.021709

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	1.5220375	1.5083372	1.5357378
Shape	$\sigma$	0.0174505	0.0114492	0.0313193

-2log(Likelihood) = -17.7185612005223

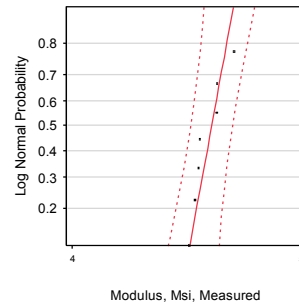
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.241649	> 0.1500

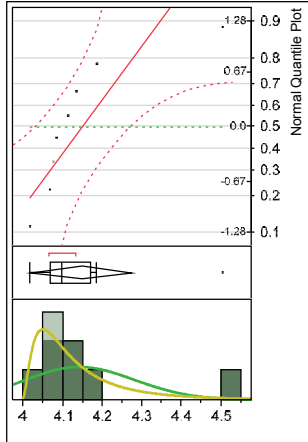
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Modulus, Msi, Measured



Summary Statistics

Mean	4.147375
Std Dev	0.152545
Std Err Mean	0.0539328
Upper 95% Mean	4.2749058
Lower 95% Mean	4.0198442
N	8

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Johnson S1	-3.6745553
<input checked="" type="checkbox"/>	LogNormal	-2.531521
<input type="checkbox"/>	Gamma	-2.3727657
<input type="checkbox"/>	Normal	-1.981712
<input type="checkbox"/>	Weibull	1.86142413
<input type="checkbox"/>	Extreme Value	1.86142413
<input type="checkbox"/>	GLog	3.068479
<input type="checkbox"/>	Johnson Su	5.34479354
<input type="checkbox"/>	Normal 2 Mixture	19.3381472
<input type="checkbox"/>	Exponential	41.4262763

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	1.4219066	1.395681	1.4481322
Shape	$\sigma$	0.0334045	0.0219166	0.0599527

-2log(Likelihood) = -8.93152099645391

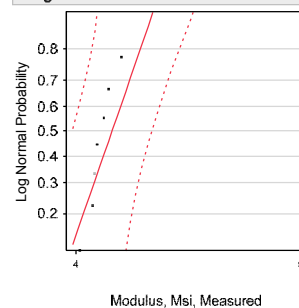
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.287505	0.0496*

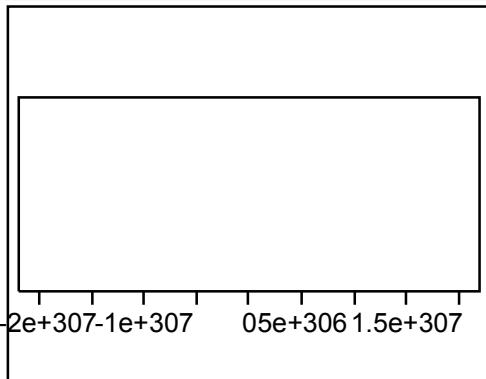
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



**Distributions Condition=CTD**

**Poisson's Ratio**



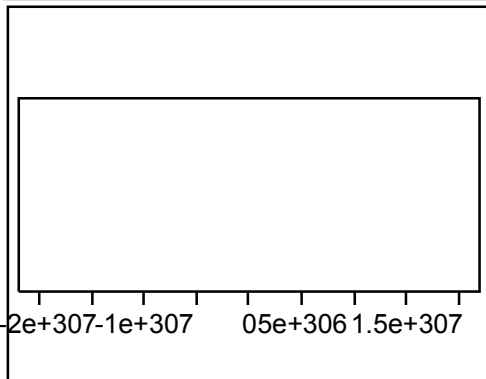
**Quantiles**

**Summary Statistics**

Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

**Distributions Condition=ETW2**

**Poisson's Ratio**



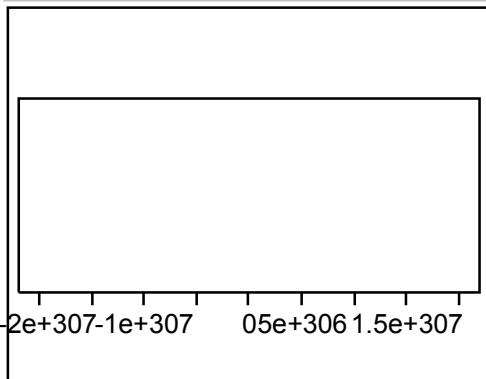
**Quantiles**

**Summary Statistics**

Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

**Distributions Condition=RTD**

**Poisson's Ratio**



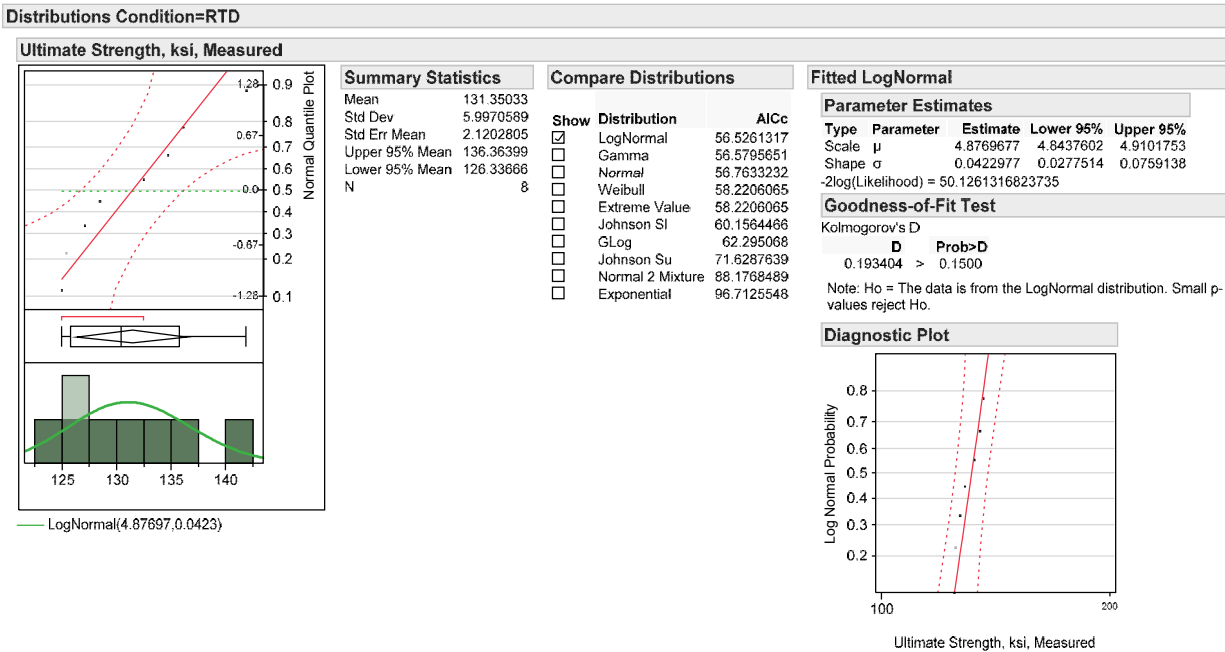
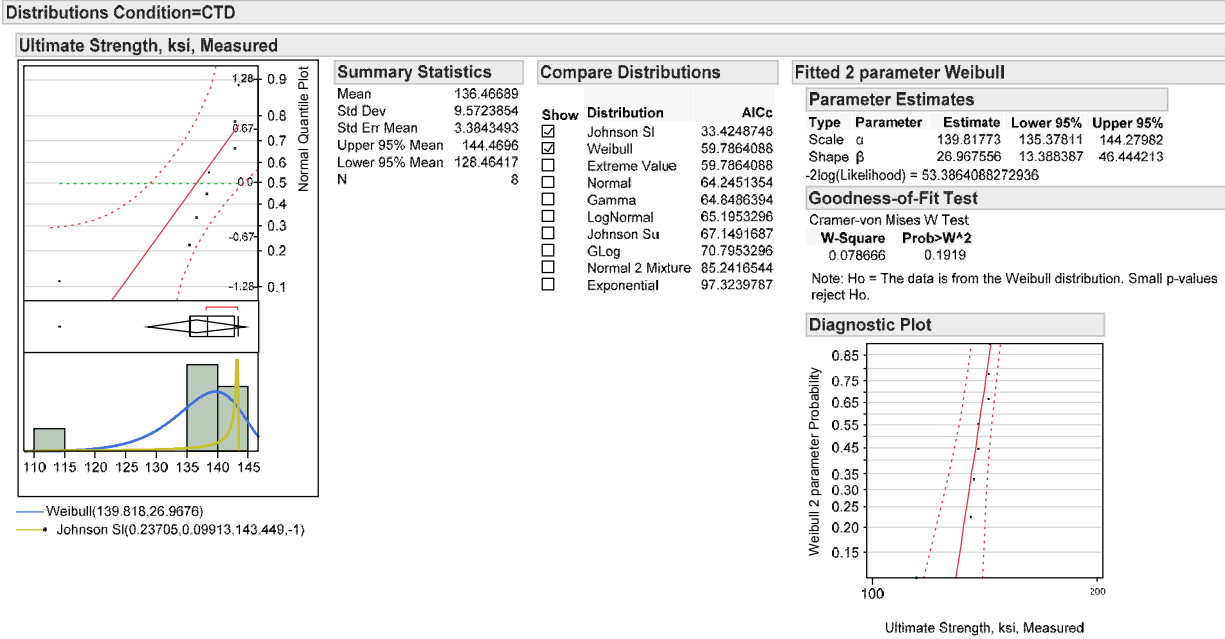
**Quantiles**

**Summary Statistics**

Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

## A.27 Hard Tension (UNT3)

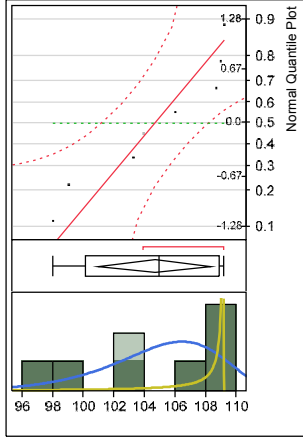
The determination of statistical distribution types for the Hard Tension (UNT3) test results is presented here.





Distributions Condition=ETW2

Ultimate Strength, ksi, Measured



— Weibull(106.552,31.9856)  
 — Johnson S1(0.27803,0.09802,109.194,-1)

Summary Statistics

Mean	104.64531
Std Dev	4.4132084
Std Err Mean	1.5603048
Upper 95% Mean	108.33485
Lower 95% Mean	100.95578
N	8

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Johnson S1	26.4609758
<input checked="" type="checkbox"/>	Weibull	50.9944881
<input type="checkbox"/>	Extreme Value	50.9944881
<input type="checkbox"/>	Normal	51.8566478
<input type="checkbox"/>	Gamma	51.8734204
<input type="checkbox"/>	LogNormal	51.919248
<input type="checkbox"/>	GLog	57.3883981
<input type="checkbox"/>	Johnson Su	66.7218847
<input type="checkbox"/>	Normal 2 Mixture	81.1143714
<input type="checkbox"/>	Exponential	93.0758935

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	106.55173	103.6712	109.31184
Shape	$\beta$	31.985595	16.695969	53.815991

-2log(Likelihood) = 44.5944881151855

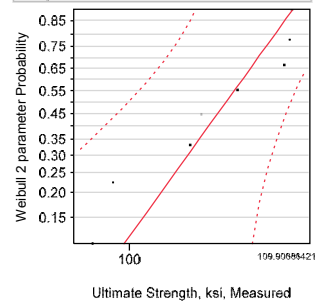
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square	Prob>W^2
0.058238	> 0.2500

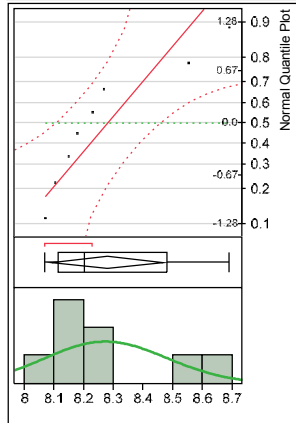
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=CTD

Modulus, Msi, Measured



— LogNormal(2.11342,0.02497)

Summary Statistics

Mean	8.279125
Std Dev	0.2236856
Std Err Mean	0.0790848
Upper 95% Mean	8.4861309
Lower 95% Mean	8.0921191
N	8

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	3.87877221
<input type="checkbox"/>	Gamma	3.9432013
<input type="checkbox"/>	Normal	4.14279921
<input type="checkbox"/>	Johnson S1	4.49662911
<input type="checkbox"/>	Weibull	6.52166906
<input type="checkbox"/>	Extreme Value	6.52166906
<input type="checkbox"/>	GLog	9.67454794
<input type="checkbox"/>	Johnson Su	19.0079057
<input type="checkbox"/>	Normal 2 Mixture	29.4283387
<input type="checkbox"/>	Exponential	52.4864633

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	2.113423	2.0938164	2.1330295
Shape	$\sigma$	0.0249735	0.0163851	0.0448213

-2log(Likelihood) = -2.52122778926093

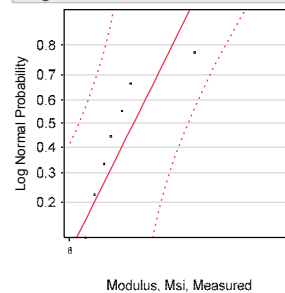
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.272245	0.0802

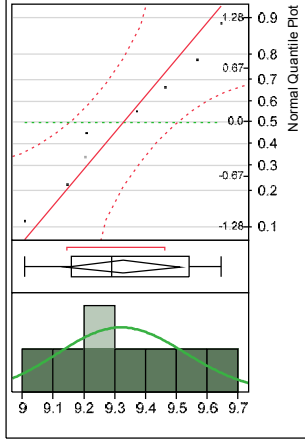
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=RTD

Modulus, Msi, Measured



Summary Statistics

Mean	9.32575
Std Dev	0.222169
Std Err Mean	0.0785486
Upper 95% Mean	9.5114879
Lower 95% Mean	9.1400121
N	8

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	3.95020246
<input type="checkbox"/>	Gamma	3.95459341
<input type="checkbox"/>	Normal	4.03394684
<input type="checkbox"/>	Weibull	4.56982624
<input type="checkbox"/>	Extreme Value	4.56982624
<input type="checkbox"/>	Johnson S1	9.51774206
<input type="checkbox"/>	GLog	9.56569551
<input type="checkbox"/>	Johnson Su	18.8990565
<input type="checkbox"/>	Normal 2 Mixture	37.6428516
<input type="checkbox"/>	Exponential	54.3911369

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	2.2325313	2.2150485	2.2500141
Shape	$\sigma$	0.0222685	0.0146103	0.0399664

-2log(Likelihood) = -2.44979754299592

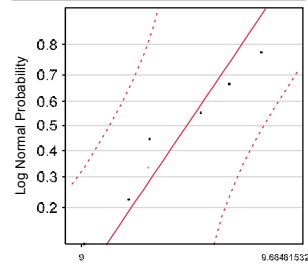
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.213743	> 0.1500

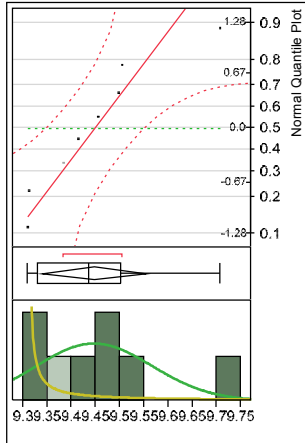
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Modulus, Msi, Measured



Summary Statistics

Mean	9.448125
Std Dev	0.1289445
Std Err Mean	0.0455888
Upper 95% Mean	9.5559253
Lower 95% Mean	9.3403247
N	8

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Johnson S1	-26.047308
<input checked="" type="checkbox"/>	LogNormal	-4.8274082
<input type="checkbox"/>	Gamma	-4.7983449
<input type="checkbox"/>	Normal	-4.6709487
<input type="checkbox"/>	Weibull	-2.0173951
<input type="checkbox"/>	Extreme Value	-2.0173951
<input type="checkbox"/>	GLog	0.77259177
<input type="checkbox"/>	Johnson Su	8.31258874
<input type="checkbox"/>	Normal 2 Mixture	30.2058047
<input type="checkbox"/>	Exponential	54.5997276

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	2.2457354	2.2357671	2.2557037
Shape	$\sigma$	0.012697	0.0083305	0.022788

-2log(Likelihood) = -11.2274082334546

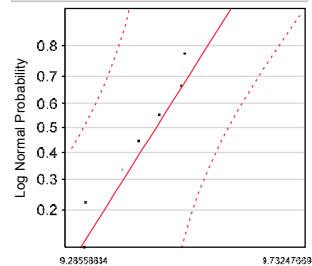
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.190950	> 0.1500

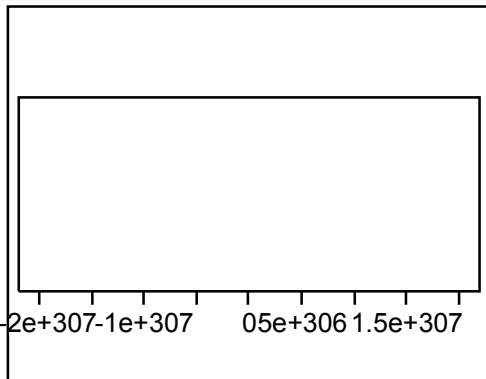
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



**Distributions Condition=CTD**

**Poisson's Ratio**



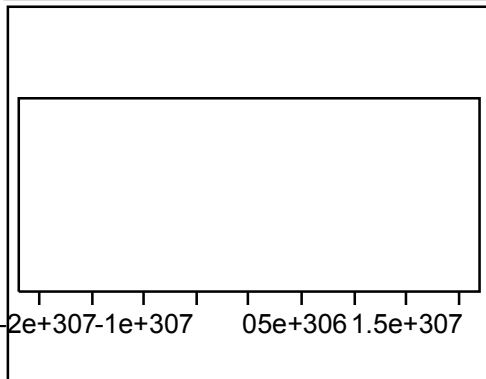
**Quantiles**

**Summary Statistics**

Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

**Distributions Condition=ETW2**

**Poisson's Ratio**



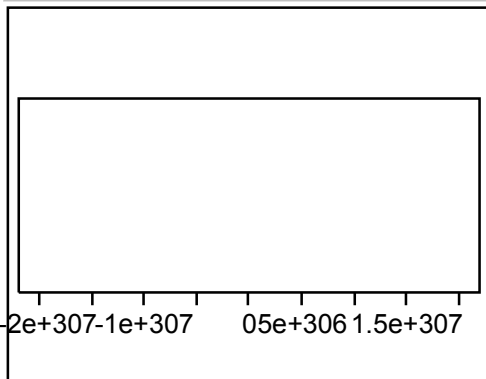
**Quantiles**

**Summary Statistics**

Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

**Distributions Condition=RTD**

**Poisson's Ratio**



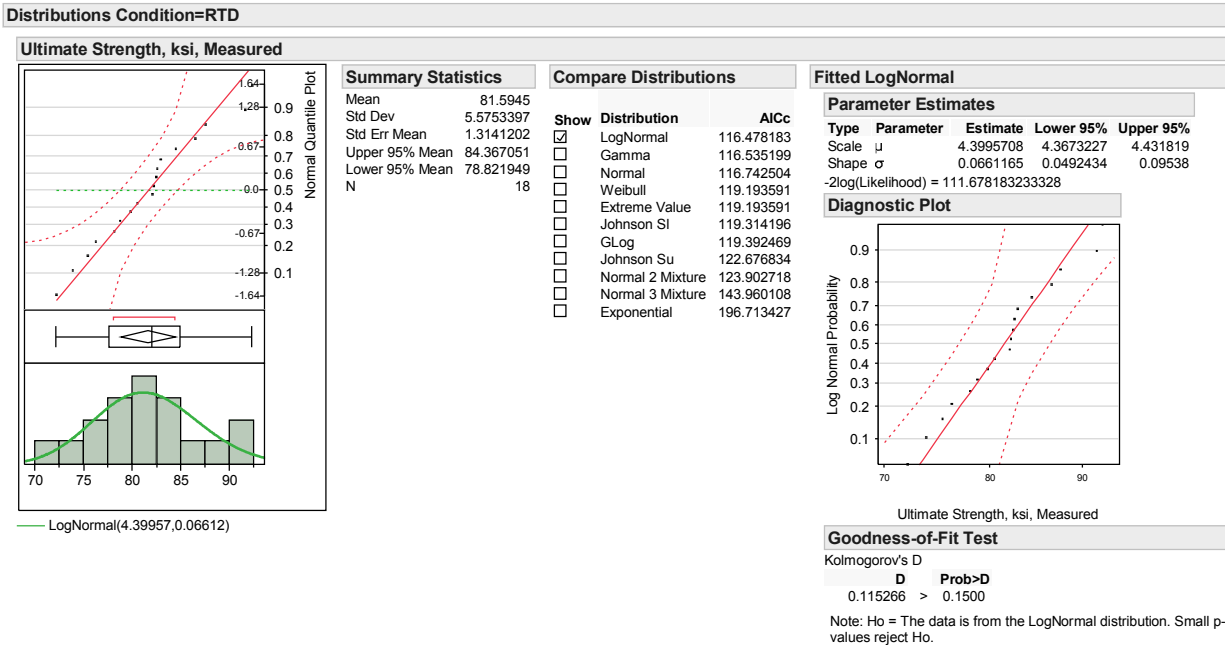
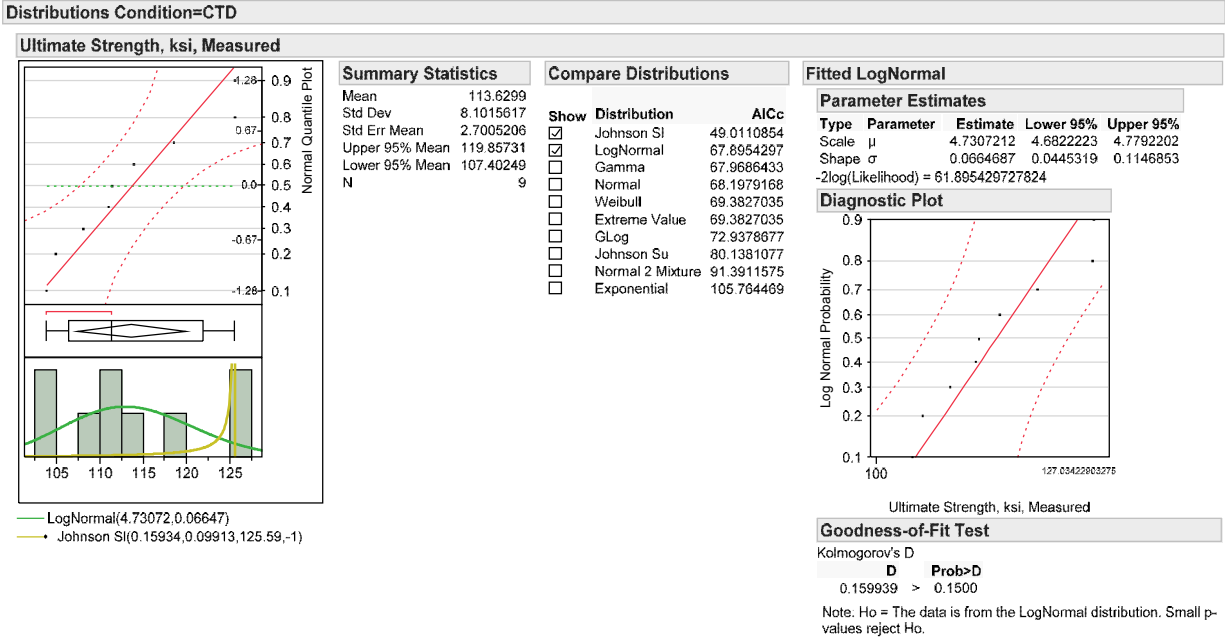
**Quantiles**

**Summary Statistics**

Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

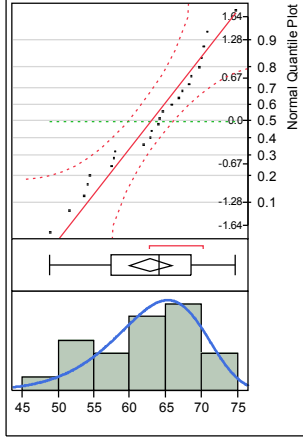
## A.28 Warp Compression (WC)

The determination of statistical distribution types for the Warp Compression (WC) test results is presented here.



Distributions Condition=ETW

Ultimate Strength, ksi, Measured



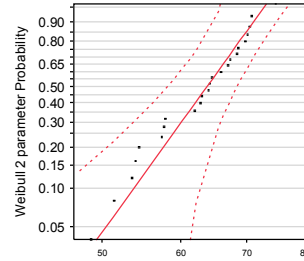
Summary Statistics	
Mean	62.798566
Std Dev	6.9537937
Std Err Mean	1.4194372
Upper 95% Mean	65.734895
Lower 95% Mean	59.862236
N	24

Compare Distributions		
Show	Distribution	AICc
<input checked="" type="checkbox"/>	Weibull	163.371169
<input type="checkbox"/>	Extreme Value	163.371169
<input type="checkbox"/>	Normal	164.766272
<input type="checkbox"/>	Gamma	165.471274
<input type="checkbox"/>	LogNormal	165.933628
<input type="checkbox"/>	Johnson SI	166.064578
<input type="checkbox"/>	GLog	167.373414
<input type="checkbox"/>	Normal 2 Mixture	170.011375
<input type="checkbox"/>	Johnson Su	170.279114
<input type="checkbox"/>	Normal 3 Mixture	180.091138
<input type="checkbox"/>	Exponential	248.898565

Fitted 2 parameter Weibull

Parameter Estimates				
Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	65.778426	63.151268	68.361678
Shape	$\beta$	11.127807	7.882501	14.976333
-2log(Likelihood) = 158.799740642437				

Diagnostic Plot



Ultimate Strength, ksi, Measured

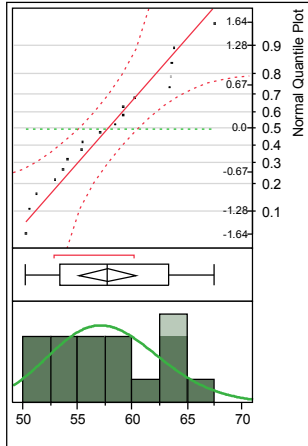
Goodness-of-Fit Test

Cramer-von Mises W Test	
W-Square	Prob>W*2
0.043897	> 0.2500

Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Distributions Condition=ETW2

Ultimate Strength, ksi, Measured



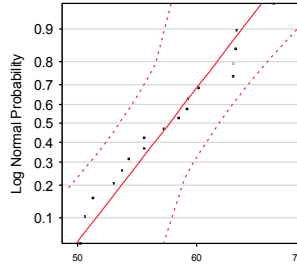
Summary Statistics	
Mean	57.688655
Std Dev	5.1970767
Std Err Mean	1.2249627
Upper 95% Mean	60.2731
Lower 95% Mean	55.10421
N	18

Compare Distributions		
Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	113.946876
<input type="checkbox"/>	Gamma	113.997401
<input type="checkbox"/>	Normal	114.213254
<input type="checkbox"/>	Weibull	115.667179
<input type="checkbox"/>	Extreme Value	115.667179
<input type="checkbox"/>	Johnson SI	116.7403
<input type="checkbox"/>	GLog	117.098687
<input type="checkbox"/>	Johnson Su	120.461646
<input type="checkbox"/>	Normal 2 Mixture	123.733506
<input type="checkbox"/>	Normal 3 Mixture	137.70519
<input type="checkbox"/>	Exponential	184.232179

Fitted LogNormal

Parameter Estimates				
Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	4.0512434	4.0086596	4.0938272
Shape	$\sigma$	0.087307	0.0650261	0.1259496
-2log(Likelihood) = 109.146875873784				

Diagnostic Plot



Ultimate Strength, ksi, Measured

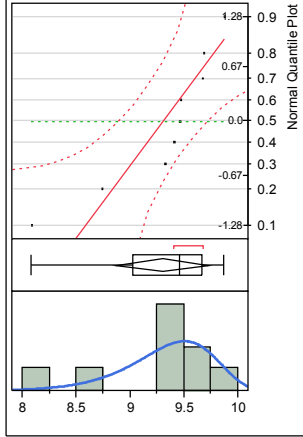
Goodness-of-Fit Test

Kolmogorov's D	
D	Prob>D
0.146777	> 0.1500

Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Distributions Condition=CTD

Modulus, Msi, Measured



— Weibull(9.5173,26.9595)

Summary Statistics

Mean	9.3014444
Std Dev	0.5588741
Std Err Mean	0.1862914
Upper 95% Mean	9.7310331
Lower 95% Mean	8.8718558
N	9

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Weibull	16.7689771
<input type="checkbox"/>	Extreme Value	16.7689771
<input type="checkbox"/>	Johnson S1	19.8487198
<input type="checkbox"/>	Normal	20.0679351
<input type="checkbox"/>	Gamma	20.4685008
<input type="checkbox"/>	LogNormal	20.7086011
<input type="checkbox"/>	GLog	25.5086011
<input type="checkbox"/>	Johnson Su	27.0487194
<input type="checkbox"/>	Normal 2 Mixture	38.6843608
<input type="checkbox"/>	Exponential	60.7144833

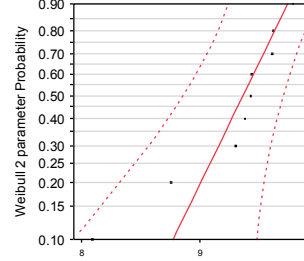
Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	9.5172957	9.2358369	9.7928128
Shape	$\beta$	26.959492	14.312231	44.386224

-2log(Likelihood) = 10.768977134893

Diagnostic Plot



Modulus, Msi, Measured

Goodness-of-Fit Test

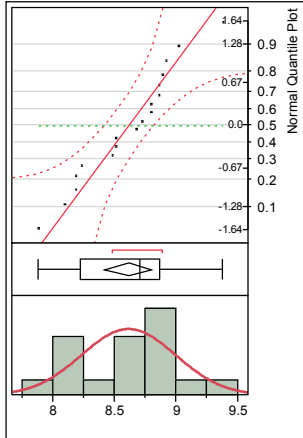
Cramer-von Mises W Test

W-Square	Prob>W^2
0.070908	0.2364

Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Distributions Condition=RTD

Modulus, Msi, Measured



— Normal(8.61056,0.3838)

Summary Statistics

Mean	8.6105556
Std Dev	0.3837964
Std Err Mean	0.0904617
Upper 95% Mean	8.801413
Lower 95% Mean	8.4196981
N	18

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Normal	20.4066361
<input type="checkbox"/>	Gamma	20.4618702
<input type="checkbox"/>	LogNormal	20.5174549
<input type="checkbox"/>	Weibull	21.4233448
<input type="checkbox"/>	Extreme Value	21.4233448
<input type="checkbox"/>	Johnson S1	23.2095762
<input type="checkbox"/>	GLog	23.2920705
<input type="checkbox"/>	Johnson Su	26.6547603
<input type="checkbox"/>	Normal 2 Mixture	29.5534211
<input type="checkbox"/>	Normal 3 Mixture	44.0191378
<input type="checkbox"/>	Exponential	115.757598

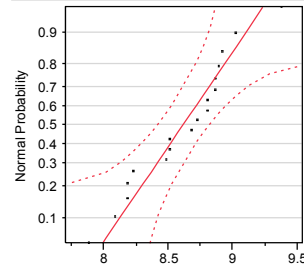
Fitted Normal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Location	$\mu$	8.6105556	8.4196981	8.801413
Dispersion	$\sigma$	0.3837964	0.2879961	0.5753661

-2log(Likelihood) = 15.6066360615726

Diagnostic Plot



Modulus, Msi, Measured

Goodness-of-Fit Test

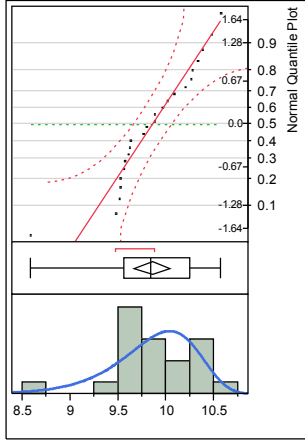
Shapiro-Wilk W Test

W	Prob<W
0.963114	0.6627

Note: Ho = The data is from the Normal distribution. Small p-values reject Ho.

Distributions Condition=ETW

Modulus, Msi, Measured



— Weibull(10.051,26.9833)

Summary Statistics

Mean	9.8546667
Std Dev	0.4387218
Std Err Mean	0.0895537
Upper 95% Mean	10.039923
Lower 95% Mean	9.6694107
N	24

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Weibull	30.9856534
<input type="checkbox"/>	Extreme Value	30.9856534
<input type="checkbox"/>	Normal	32.1337716
<input type="checkbox"/>	Gamma	32.6227978
<input type="checkbox"/>	LogNormal	32.9080286
<input type="checkbox"/>	Johnson S1	33.2609699
<input type="checkbox"/>	GLog	35.5366
<input type="checkbox"/>	Johnson Su	36.097228
<input type="checkbox"/>	Normal 2 Mixture	40.1088066
<input type="checkbox"/>	Normal 3 Mixture	45.185561
<input type="checkbox"/>	Exponential	160.003184

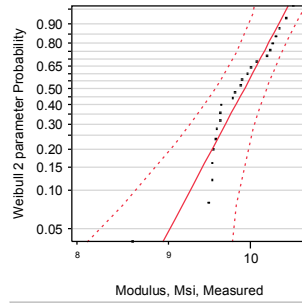
Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	10.051008	9.8838519	10.21195
Shape	$\beta$	26.983329	19.30739	35.971483

-2log(Likelihood) = 26.4142248445334

Diagnostic Plot



Goodness-of-Fit Test

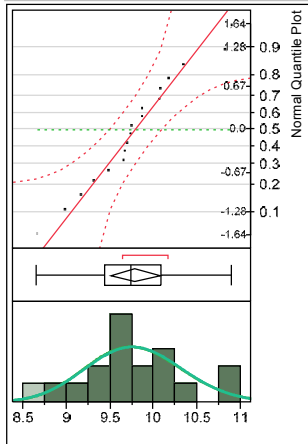
Cramer-von Mises W Test

W-Square	Prob>W^2
0.098828	0.0980

Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Distributions Condition=ETW2

Modulus, Msi, Measured



— LogNormal(2.27934,0.05708)  
— Gamma(307.33,0.03184,0)

Summary Statistics

Mean	9.7861111
Std Dev	0.5745408
Std Err Mean	0.1354206
Upper 95% Mean	10.071824
Lower 95% Mean	9.5003987
N	18

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Gamma	34.8548031
<input checked="" type="checkbox"/>	LogNormal	34.8591859
<input type="checkbox"/>	Normal	34.931159
<input type="checkbox"/>	Weibull	37.220886
<input type="checkbox"/>	Extreme Value	37.220886
<input type="checkbox"/>	Johnson S1	37.7689501
<input type="checkbox"/>	GLog	37.7734516
<input type="checkbox"/>	Johnson Su	41.1315875
<input type="checkbox"/>	Normal 2 Mixture	41.9261368
<input type="checkbox"/>	Normal 3 Mixture	63.132723
<input type="checkbox"/>	Exponential	120.364709

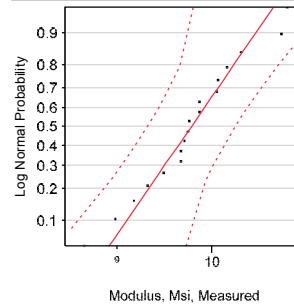
Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	2.2793364	2.2514956	2.3071771
Shape	$\sigma$	0.0570802	0.0425132	0.0823442

-2log(Likelihood) = 30.0591658512553

Diagnostic Plot



Goodness-of-Fit Test

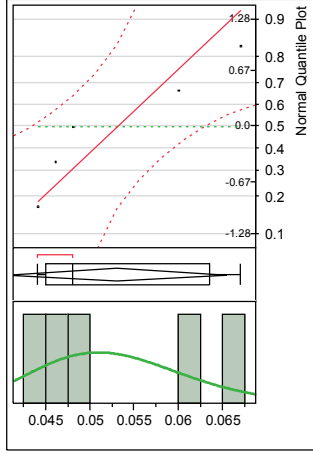
Kolmogorov's D

D	Prob>D
0.140629	> 0.1500

Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Distributions Condition=CTD

Poisson's Ratio



LogNormal(-2.9511,0.16366)

Summary Statistics

Mean	0.053
Std Dev	0.01
Std Err Mean	0.0044721
Upper 95% Mean	0.0654166
Lower 95% Mean	0.0405834
N	5

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	-23.42196
<input type="checkbox"/>	Gamma	-23.293356
<input type="checkbox"/>	Normal	-22.862317
<input type="checkbox"/>	Weibull	-22.584921
<input type="checkbox"/>	Extreme Value	-22.584921
<input type="checkbox"/>	Exponential	-16.0413
<input type="checkbox"/>	GLog	-2.9780343

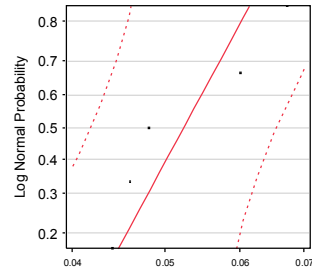
Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	-2.951141	-3.127105	-2.775177
Shape	$\sigma$	0.1636553	0.0978595	0.3565927

-2log(Likelihood) = -33.4219597631823

Diagnostic Plot



Goodness-of-Fit Test

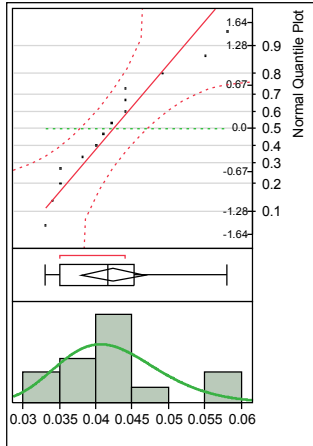
Kolmogorov's D

D	Prob>D
0.299132	0.1448

Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Distributions Condition=RTD

Poisson's Ratio



LogNormal(-3.1775,0.16662)

Summary Statistics

Mean	0.0422857
Std Dev	0.0075898
Std Err Mean	0.0020284
Upper 95% Mean	0.0486679
Lower 95% Mean	0.0379035
N	14

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	-94.326771
<input type="checkbox"/>	Gamma	-93.938327
<input type="checkbox"/>	Normal	-92.845576
<input type="checkbox"/>	Johnson S1	-92.423818
<input type="checkbox"/>	Weibull	-91.148198
<input type="checkbox"/>	Extreme Value	-91.148198
<input type="checkbox"/>	GLog	-91.01768
<input type="checkbox"/>	Johnson Su	-88.379374
<input type="checkbox"/>	Normal 2 Mixture	-84.728158
<input type="checkbox"/>	Exponential	-58.239234
<input type="checkbox"/>	Normal 3 Mixture	-57.874337

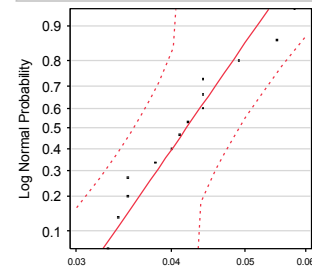
Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	-3.17751	-3.271131	-3.083889
Shape	$\sigma$	0.1666166	0.1198104	0.2541814

-2log(Likelihood) = -99.4176804223509

Diagnostic Plot



Goodness-of-Fit Test

Kolmogorov's D

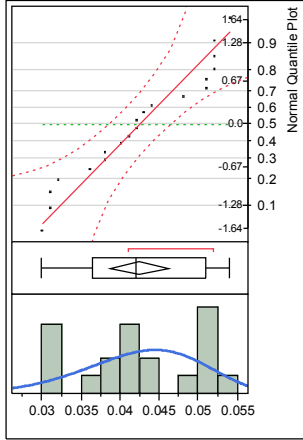
D	Prob>D
0.158773	> 0.1500

Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.



Distributions Condition=ETW

Poisson's Ratio



— Weibull(0.04564,6.35318)

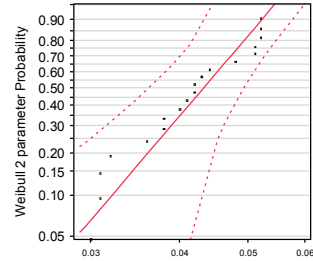
Summary Statistics	
Mean	0.0424
Std Dev	0.0079565
Std Err Mean	0.0017791
Upper 95% Mean	0.0461237
Lower 95% Mean	0.0386763
N	20

Compare Distributions		
Show	Distribution	AICc
<input checked="" type="checkbox"/>	Weibull	-133.23608
<input type="checkbox"/>	Extreme Value	-133.23608
<input type="checkbox"/>	Normal	-132.88742
<input type="checkbox"/>	Gamma	-132.66937
<input type="checkbox"/>	LogNormal	-132.33704
<input type="checkbox"/>	Normal 2 Mixture	-131.75539
<input type="checkbox"/>	Johnson S1	-130.22145
<input type="checkbox"/>	GLog	-129.54292
<input type="checkbox"/>	Johnson Su	-127.05479
<input type="checkbox"/>	Normal 3 Mixture	-118.88925
<input type="checkbox"/>	Exponential	-84.202054

Fitted 2 parameter Weibull

Parameter Estimates				
Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\alpha$	0.0456391	0.0421573	0.0491676
Shape	$\beta$	6.3531777	4.3401018	8.8227653
-2log(Likelihood) = -137.941961099895				

Diagnostic Plot



Poisson's Ratio

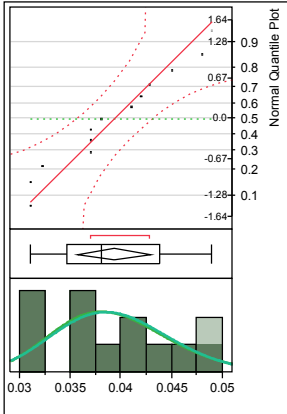
Goodness-of-Fit Test

Cramer-von Mises W Test	
W-Square	Prob>W^2
0.080276	0.1938

Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Distributions Condition=ETW2

Poisson's Ratio



— LogNormal(-3.2472,0.14763)  
 — Gamma(46.3575,0.00085,0)

Summary Statistics

Mean	0.0393077
Std Dev	0.0059892
Std Err Mean	0.0016611
Upper 95% Mean	0.0429269
Lower 95% Mean	0.0356884
N	13

Compare Distributions

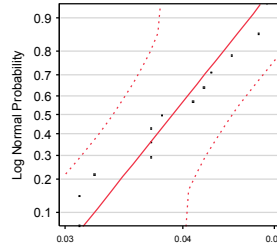
Show	Distribution	AICc
<input checked="" type="checkbox"/>	Gamma	-92.113257
<input checked="" type="checkbox"/>	LogNormal	-92.073239
<input type="checkbox"/>	Normal	-91.97024
<input type="checkbox"/>	Weibull	-91.528633
<input type="checkbox"/>	Extreme Value	-91.528633
<input type="checkbox"/>	Johnson S1	-88.618823
<input type="checkbox"/>	GLog	-88.544128
<input type="checkbox"/>	Johnson Su	-84.210791
<input type="checkbox"/>	Normal 2 Mixture	-76.669368
<input type="checkbox"/>	Exponential	-55.781075
<input type="checkbox"/>	Normal 3 Mixture	-45.986853

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	-3.24716	-3.33372	-3.160599
Shape	$\sigma$	0.1476283	0.1049903	0.2293634
-2log(Likelihood) = -97.2732385832574				

Diagnostic Plot



Poisson's Ratio

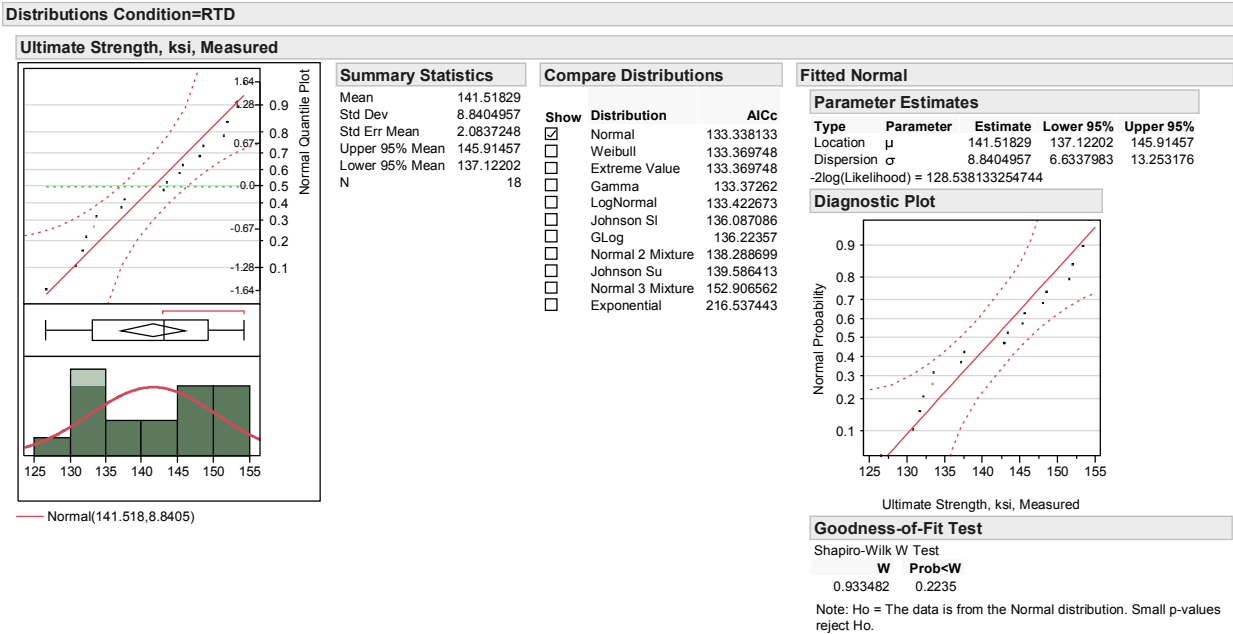
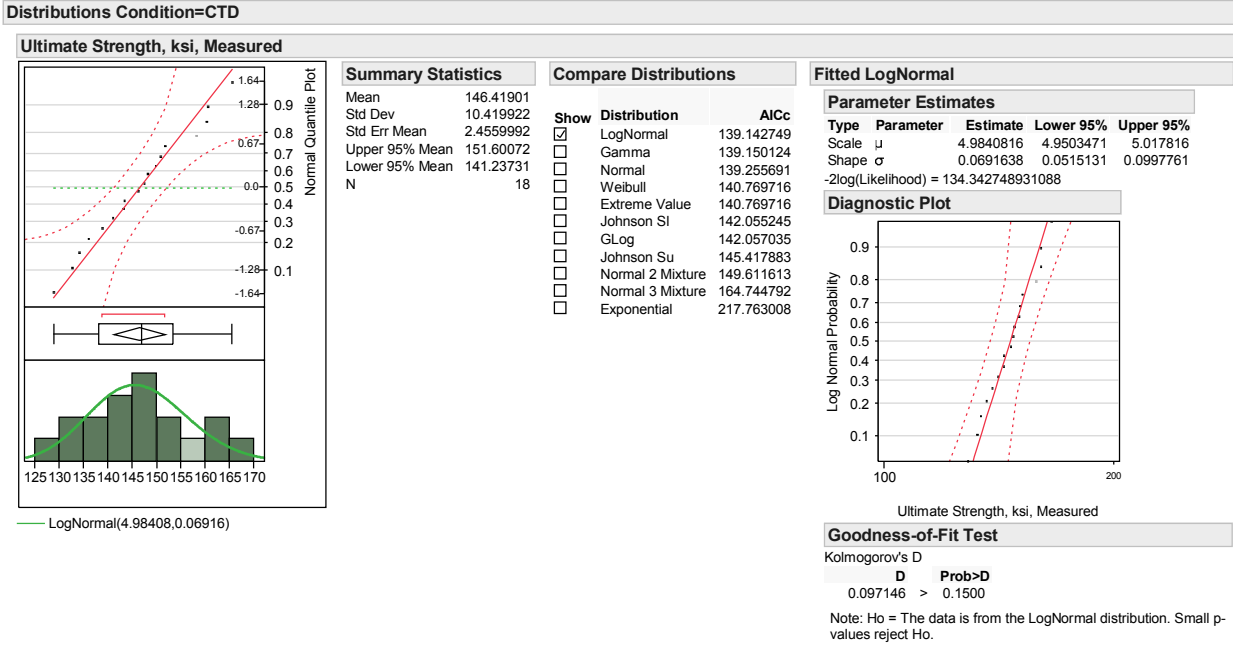
Goodness-of-Fit Test

Kolmogorov's D	
D	Prob>D
0.137475	> 0.1500

Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

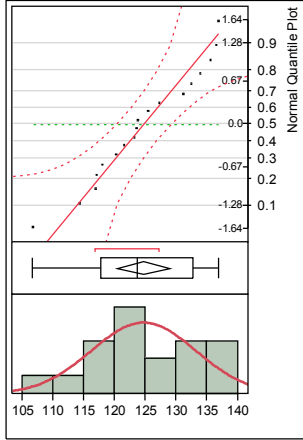
## A.29 Warp Tension (WT)

The determination of statistical distribution types for the Warp Tension (WT) test results is presented here.



Distributions Condition=ETW

Ultimate Strength, ksi, Measured



Summary Statistics

Mean	124.66089
Std Dev	8.532784
Std Err Mean	2.0111965
Upper 95% Mean	128.90414
Lower 95% Mean	120.41763
N	18

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Normal	132.062752
<input type="checkbox"/>	Weibull	132.14456
<input type="checkbox"/>	Extreme Value	132.14456
<input type="checkbox"/>	Gamma	132.207765
<input type="checkbox"/>	LogNormal	132.326403
<input type="checkbox"/>	Johnson S1	134.740502
<input type="checkbox"/>	GLog	135.240689
<input type="checkbox"/>	Johnson Su	137.404211
<input type="checkbox"/>	Normal 2 Mixture	138.307975
<input type="checkbox"/>	Normal 3 Mixture	156.184566
<input type="checkbox"/>	Exponential	211.971497

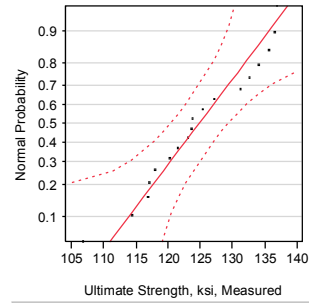
Fitted Normal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Location	$\mu$	124.66089	120.41763	128.90414
Dispersion	$\sigma$	8.532784	6.4028952	12.791872

-2log(Likelihood) = 127.262751744163

Diagnostic Plot



Goodness-of-Fit Test

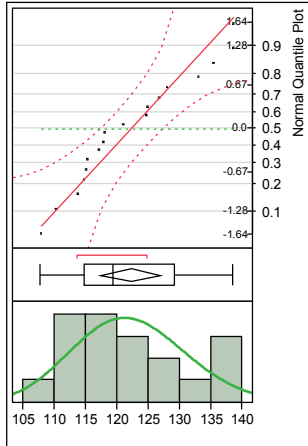
Shapiro-Wilk W Test

W	Prob<W
0.957124	0.5472

Note: Ho = The data is from the Normal distribution. Small p-values reject Ho.

Distributions Condition=ETW2

Ultimate Strength, ksi, Measured



Summary Statistics

Mean	122.19208
Std Dev	9.5431794
Std Err Mean	2.249349
Upper 95% Mean	128.93779
Lower 95% Mean	117.44637
N	18

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	135.561308
<input type="checkbox"/>	Gamma	135.707259
<input type="checkbox"/>	Normal	136.091548
<input type="checkbox"/>	Johnson S1	137.598237
<input type="checkbox"/>	Weibull	138.497169
<input type="checkbox"/>	Extreme Value	138.497169
<input type="checkbox"/>	GLog	138.976981
<input type="checkbox"/>	Johnson Su	142.340014
<input type="checkbox"/>	Normal 2 Mixture	144.400914
<input type="checkbox"/>	Normal 3 Mixture	155.611047
<input type="checkbox"/>	Exponential	211.251393

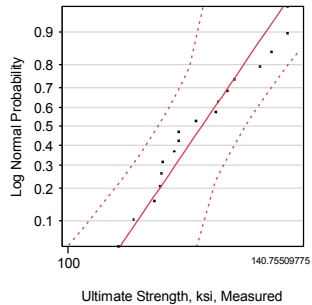
Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	4.8027568	4.7661454	4.8393683
Shape	$\sigma$	0.0750623	0.0559062	0.1082853

-2log(Likelihood) = 130.76130798584

Diagnostic Plot



Goodness-of-Fit Test

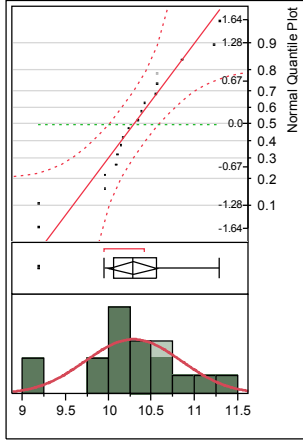
Kolmogorov's D

D	Prob>D
0.170986	> 0.1500

Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Distributions Condition=CTD

Modulus, Msi, Measured



Summary Statistics

Mean	10.285667
Std Dev	0.5566855
Std Err Mean	0.131212
Upper 95% Mean	10.5625
Lower 95% Mean	10.008833
N	18

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Normal	33.794611
<input type="checkbox"/>	Gamma	33.9633186
<input type="checkbox"/>	LogNormal	34.0888782
<input type="checkbox"/>	Weibull	34.7643346
<input type="checkbox"/>	Extreme Value	34.7643346
<input type="checkbox"/>	Johnson St	36.5099713
<input type="checkbox"/>	GLog	37.0031639
<input type="checkbox"/>	Normal 2 Mixture	38.5924425
<input type="checkbox"/>	Johnson Su	39.1988449
<input type="checkbox"/>	Normal 3 Mixture	45.7082995
<input type="checkbox"/>	Exponential	122.157048

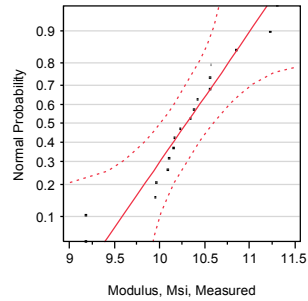
Fitted Normal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Location	$\mu$	10.285667	10.008833	10.5625
Dispersion	$\sigma$	0.5566855	0.4177299	0.8345517

-2log(Likelihood) = 28.9946109732572

Diagnostic Plot



Goodness-of-Fit Test

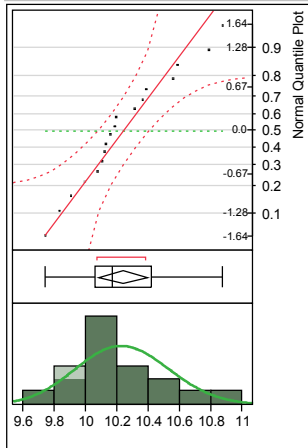
Shapiro-Wilk W Test

W	Prob<W
0.935318	0.2406

Note: Ho = The data is from the Normal distribution. Small p-values reject Ho.

Distributions Condition=RTD

Modulus, Msi, Measured



Summary Statistics

Mean	10.238167
Std Dev	0.3112323
Std Err Mean	0.0733582
Upper 95% Mean	10.392939
Lower 95% Mean	10.083394
N	18

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	12.5809436
<input type="checkbox"/>	Gamma	12.6609445
<input type="checkbox"/>	Normal	12.8620246
<input type="checkbox"/>	Johnson St	14.5683917
<input type="checkbox"/>	GLog	15.4952293
<input type="checkbox"/>	Weibull	16.8531999
<input type="checkbox"/>	Extreme Value	16.8531999
<input type="checkbox"/>	Johnson Su	17.9310291
<input type="checkbox"/>	Normal 2 Mixture	22.6267106
<input type="checkbox"/>	Normal 3 Mixture	39.1696944
<input type="checkbox"/>	Exponential	121.990412

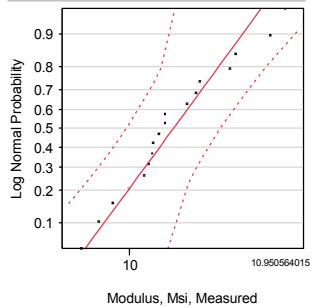
Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	2.32569	2.311375	2.340005
Shape	$\sigma$	0.0293492	0.0218592	0.0423393

-2log(Likelihood) = 7.78094358749449

Diagnostic Plot



Goodness-of-Fit Test

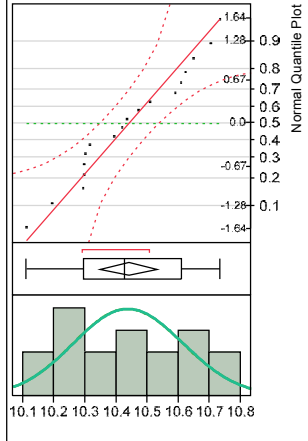
Kolmogorov's D

D	Prob>D
0.166486	> 0.1500

Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Distributions Condition=ETW

Modulus, Msi, Measured



— LogNormal(2.3455, 0.01692)  
 — Gamma(3493.49, 0.00299, 0)

Summary Statistics

Mean	10.439944
Std Dev	0.1817521
Std Err Mean	0.0428394
Upper 95% Mean	10.530328
Lower 95% Mean	10.349561
N	18

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	Gamma	-6.5344418
<input checked="" type="checkbox"/>	LogNormal	-6.5344331
<input type="checkbox"/>	Normal	-6.5022338
<input type="checkbox"/>	Weibull	-5.2928735
<input type="checkbox"/>	Extreme Value	-5.2928735
<input type="checkbox"/>	Johnson S1	-3.620169
<input type="checkbox"/>	GLog	-3.6167996
<input type="checkbox"/>	Johnson Su	-0.2541465
<input type="checkbox"/>	Normal 2 Mixture	1.26321488
<input type="checkbox"/>	Normal 3 Mixture	19.480577
<input type="checkbox"/>	Exponential	122.693013

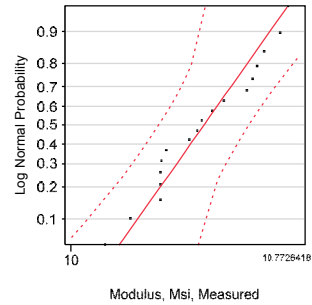
Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	2.3454961	2.3372436	2.3537486
Shape	$\sigma$	0.0169196	0.0126017	0.0244084

-2log(Likelihood) = -11.3344331116937

Diagnostic Plot



Goodness-of-Fit Test

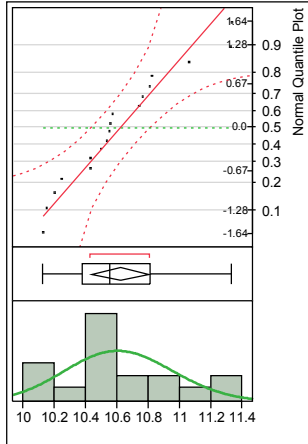
Kolmogorov's D

D	Prob>D
0.151463	> 0.1500

Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Distributions Condition=ETW2

Modulus, Msi, Measured



— LogNormal(2.36206, 0.03273)

Summary Statistics

Mean	10.6185
Std Dev	0.3607184
Std Err Mean	0.0850222
Upper 95% Mean	10.797881
Lower 95% Mean	10.439119
N	18

Compare Distributions

Show	Distribution	AICc
<input checked="" type="checkbox"/>	LogNormal	17.8138818
<input type="checkbox"/>	Gamma	17.9194187
<input type="checkbox"/>	Normal	18.1741149
<input type="checkbox"/>	Johnson S1	19.1955403
<input type="checkbox"/>	GLog	20.7281676
<input type="checkbox"/>	Weibull	22.4615367
<input type="checkbox"/>	Extreme Value	22.4615367
<input type="checkbox"/>	Johnson Su	22.5581777
<input type="checkbox"/>	Normal 2 Mixture	23.2824751
<input type="checkbox"/>	Normal 3 Mixture	40.4301139
<input type="checkbox"/>	Exponential	123.303519

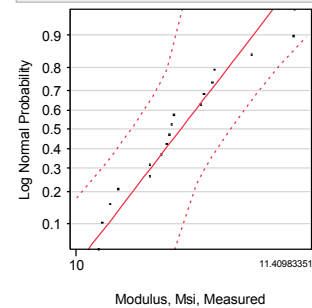
Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	$\mu$	2.3620591	2.3460958	2.3780225
Shape	$\sigma$	0.0327288	0.0243763	0.0472147

-2log(Likelihood) = 13.013881844361

Diagnostic Plot

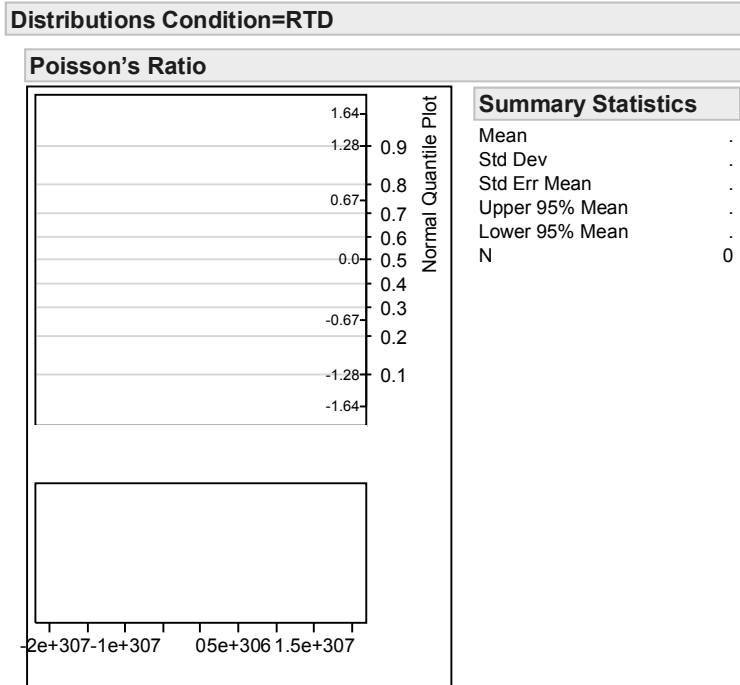
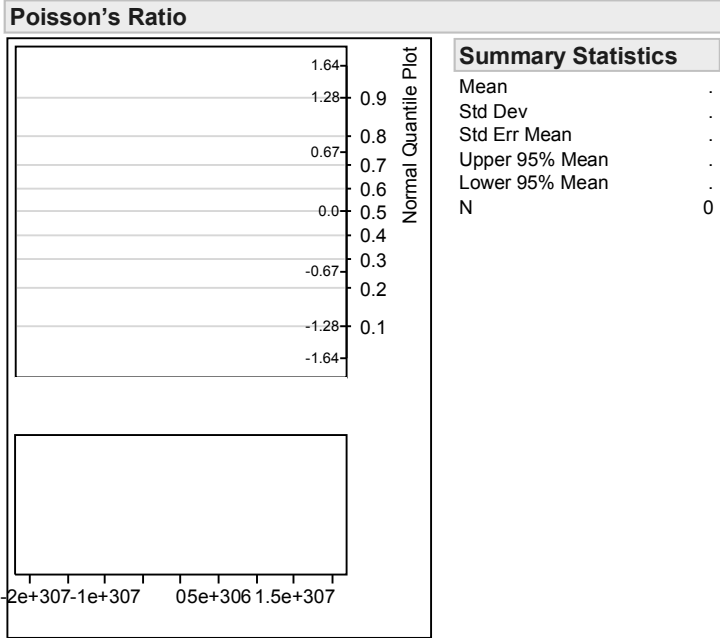


Goodness-of-Fit Test

Kolmogorov's D

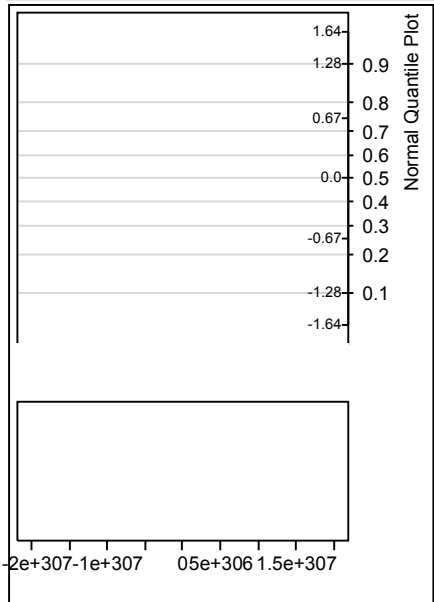
D	Prob>D
0.156788	> 0.1500

Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.



**Distributions Condition=ETW**

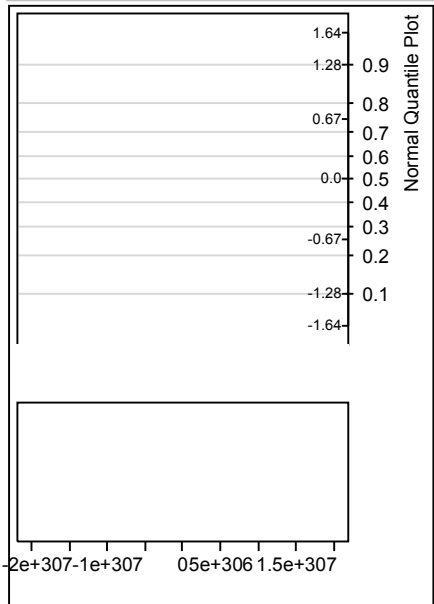
**Poisson's Ratio**



Summary Statistics	
Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

**Distributions Condition=ETW2**

**Poisson's Ratio**



Summary Statistics	
Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

## References

1. Lowry David R.: NPN100101 AITR1615-IMPW MTM45-1 IM7 6K PW RAW DATA REPORT\_files. NASA internal database, 2012.
2. Advanced Composites Group: A Data Acquisition and Test Plan for MTM45-1 Prepregs. AI/TR/1615 Initial Release, Feb. 2009.
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4. Pai, Shantaram S., et al.: NASA/NESSUS 6.2c Probabilistic Structural Analysis Software. NASA Tech Brief LEW-18229-1, 2012.





