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

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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

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

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

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

The parameter μ is the mean and σ is the standard deviation. The standard normal distribution is with μ = 0 and variance σ^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 μ (scale) and σ (shape).

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

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

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

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

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

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

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

where parameters μ_1 and μ_2 are the two means, σ_1 and σ_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^2, 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 ±45° 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 μ, dispersion σ)
Lognormal	(Scale μ, shape σ)
Weibull	(Scale α, shape β)
Exponential	Scale α

"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[a]	Property[b]		
	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

[a]Conditions are defined in Table 2.
[b]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[a]	Property[b]	
	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

[a]Conditions are defined in Table 2.
[b]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[a]	Property[b]	
	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

[a]Conditions are defined in Table 2.
[b]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[a]	Property[b]	
	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

[a]Conditions are defined in Table 2.
[b]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[a]	Property[b]	
	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

[a]Conditions are defined in Table 2.
[b]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[a]	Property[b]	
	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

[a]Conditions are defined in Table 2.
[b]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[a]	Property[b]	
	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

[a]Conditions are defined in Table 2.
[b]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[a]	Property[b]		
	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

[a]Conditions are defined in Table 2.
[b]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[a]	Property[b]		
	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

[a]Conditions are defined in Table 2.
[b]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[a]	Property[b]			
	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)

[a]Conditions are defined in Table 2.
[b]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[a]	Property[b]	
	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)

[a]Conditions are defined in Table 2.
[b]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[a]	Property[b]	
	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

[a]Conditions are defined in Table 2.
[b]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[a]	Property[b]	
	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

[a]Conditions are defined in Table 2.
[b]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[a]	Property[b]	
	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

[a]Conditions are defined in Table 2.
[b]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[a]	Property[b]	
	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

[a]Conditions are defined in Table 2.
[b]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[a]	Property[b]	
	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

[a]Conditions are defined in Table 2.
[b]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[a]	Property[b]			
	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

[a]Conditions are defined in Table 2.
[b]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[a]	Property[b]			
	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)

[a]Conditions are defined in Table 2.
[b]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[a]	Property[b]			
	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

[a]Conditions are defined in Table 2.
[b]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[a]	Property[b]
	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)

[a]Conditions are defined in Table 2.
[b]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[a]	Property[b]
	Ultimate strength (ksi), measured
RTD	Weibull (8.606, 34.978)
ETW	Weibull (6.114, 17.023)
ETW2	Weibull (4.70, 22.380)

[a]Conditions are defined in Table 2.
[b]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[a]	Property[b]	
	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)

[a]Conditions are defined in Table 2.
[b]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[a]	Property[b]	
	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)

[a]Conditions are defined in Table 2.
[b]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[a]	Property[b]	
	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)

[a]Conditions are defined in Table 2.
[b]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[a]	Property[b]	
	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)

[a]Conditions are defined in Table 2.
[b]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[a]	Property[b]	
	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)

[a]Conditions are defined in Table 2.
[b]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[a]	Property[b]	
	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)

[a]Conditions are defined in Table 2.
[b]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[a]	Property[b]		
	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

[a]Conditions are defined in Table 2.
[b]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[a]	Property[b]	
	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)

[a]Conditions are defined in Table 2.
[b]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

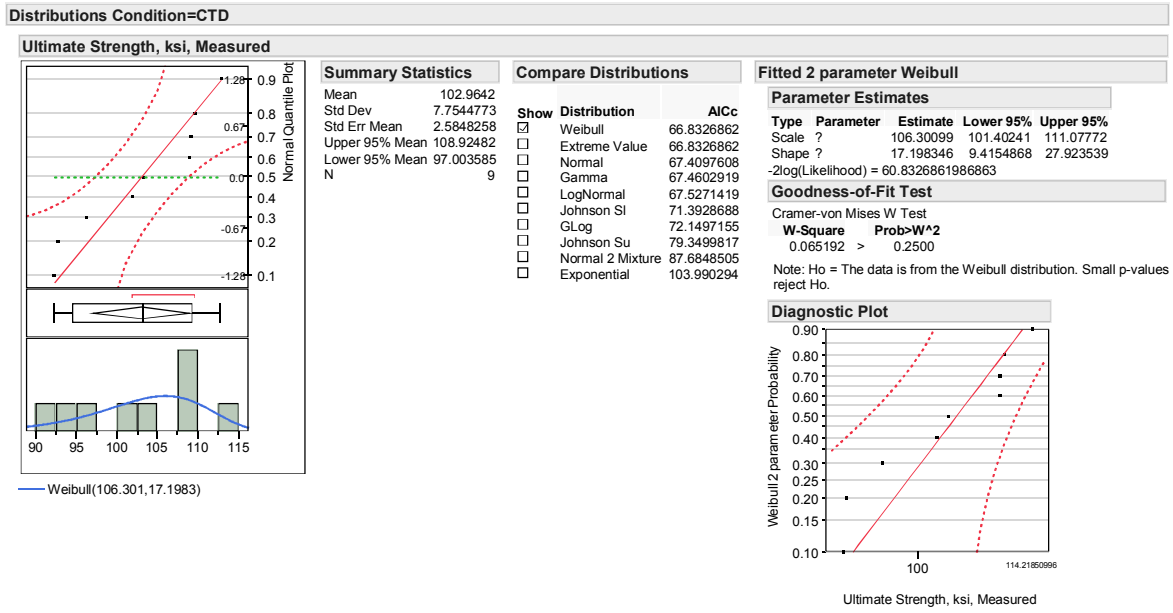
We recommend a building block analysis approach to study material combinations and their effects on the performance of structural components accounting for the scatter in stiffness and strength of the composite material. To this end we can start with simple beams and plates and consider their stability, 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.

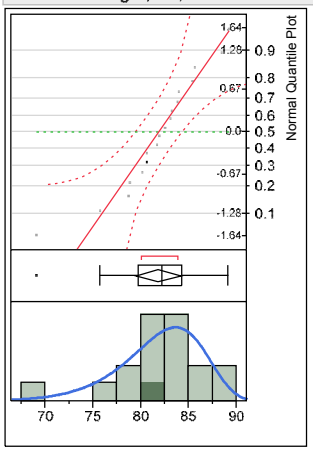
A.1 Fill Compression (FC)

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



Distributions Condition=RTD

Ultimate Strength, ksi, Measured



Weibull(83.8064,22.0702)

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
☑	Weibull	108.174923
☐	Extreme Value	108.174923
☐	Normal	110.159823
☐	Gamma	110.834483
☐	Johnson SI	111.035983
☐	LogNormal	111.222155
☐	Johnson Su	113.87813
☐	GLog	114.136441
☐	Normal 2 Mixture	121.072207
☐	Normal 3 Mixture	138.116225
☐	Exponential	196.815477

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	83.806354	81.824308	85.730533
Shape	β	22.070228	14.946579	30.443801

-2log(Likelihood) = 103.37492301562

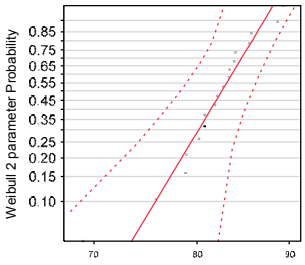
Goodness-of-Fit Test

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.

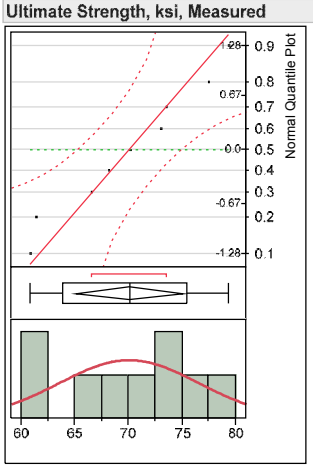
Diagnostic Plot



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
☑	Normal	64.29744
☐	Gamma	64.2977561
☐	Weibull	64.3014483
☐	Extreme Value	64.3014483
☐	LogNormal	64.3496235
☐	Johnson SI	68.9868501
☐	GLog	69.0373944
☐	Johnson Su	76.2375728
☐	Normal 2 Mixture	90.5327293
☐	Exponential	97.0516259

Fitted Normal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Location	μ	70.028328	65.01416	75.042497
Dispersion	σ	6.5231911	4.4061353	12.49694

-2log(Likelihood) = 58.2974400057054

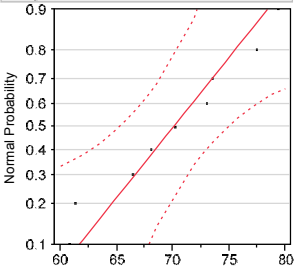
Goodness-of-Fit Test

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.

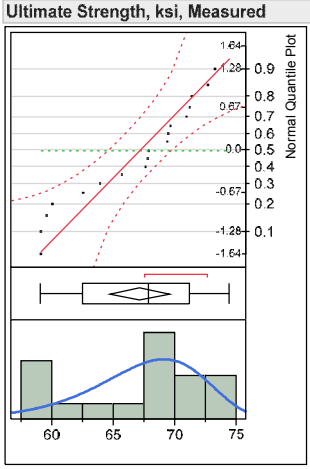
Diagnostic Plot



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
☑	Weibull	117.773164
☐	Extreme Value	117.773164
☐	Normal	119.394838
☐	Gamma	119.760773
☐	LogNormal	119.987156
☐	Normal 2 Mixture	120.009362
☐	Johnson SI	120.363902
☐	GLog	122.217562
☐	Johnson Su	125.474932
☐	Normal 3 Mixture	141.456769
☐	Exponential	200.083201

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	69.341186	67.239362	71.375537
Shape	β	16.840938	11.323675	23.629987

-2log(Likelihood) = 113.023164199787

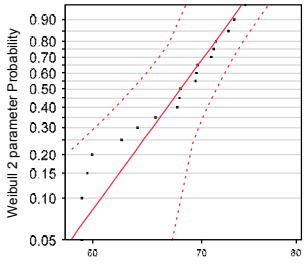
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square		Prob>W^2
0.052964	>	0.2500

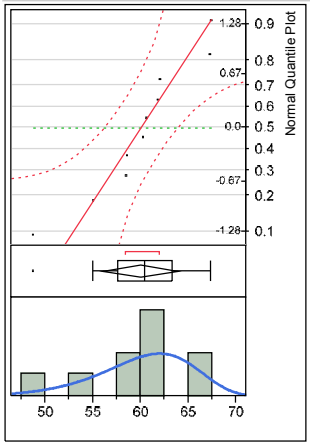
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

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
☑	Weibull	66.6275685
☐	Extreme Value	66.6275685
☐	Normal	67.2728883
☐	Gamma	67.5939338
☐	LogNormal	67.8186591
☐	Johnson SI	70.8892992
☐	GLog	72.1043734
☐	Johnson Su	76.8643241
☐	Normal 2 Mixture	87.6616434
☐	Exponential	104.395215
☐	Normal 3 Mixture	215.482317

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	62.33352	59.010354	65.627482
Shape	β	13.677406	7.8873973	21.102266

-2log(Likelihood) = 60.913282757481

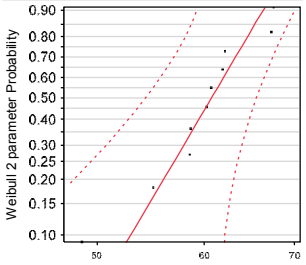
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square		Prob>W^2
0.051448	>	0.2500

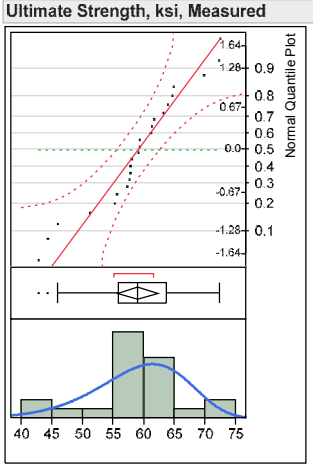
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW

Ultimate Strength, ksi, Measured



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
☑	Weibull	169.157586
☐	Extreme Value	169.157586
☐	Normal	169.502591
☐	Gamma	170.508413
☐	LogNormal	171.221497
☐	Johnson SI	171.554508
☐	Normal 2 Mixture	172.28768
☐	GLog	173.850068
☐	Johnson Su	174.301194
☐	Normal 3 Mixture	185.785356
☐	Exponential	245.887271

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	62.210105	59.167315	65.246818
Shape	β	8.9940202	6.4516386	11.921339

-2log(Likelihood) = 164.586157218167

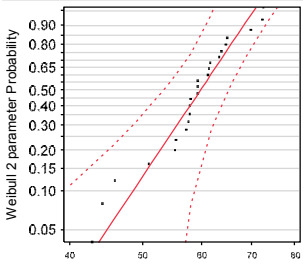
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square	Prob>W^2
0.084519	0.1726

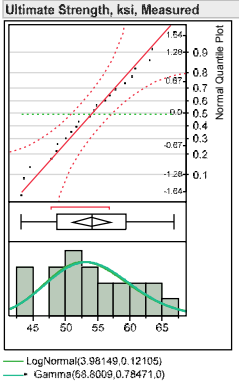
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Ultimate Strength, ksi, Measured



Summary Statistics

Mean	63.986692
Std Dev	6.64232
Std Err Mean	1.4161474
Upper 95% Mean	66.933732
Lower 95% Mean	61.043653
N	22

Compare Distributions

Show	Distribution	AICc
☑	Gamma	149.270242
☑	LogNormal	149.343541
☐	Normal	149.377172
☐	Weibull	150.525259
☐	Extreme Value	150.525259
☐	Johnson SI	151.992773
☐	GLog	152.045296
☐	Johnson Su	155.012381
☐	Normal 2 Mixture	159.557985
☐	Normal 3 Mixture	174.502986
☐	Exponential	221.706083

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	3.9814897	3.9266148	4.0363645
Shape	σ	0.1210538	0.0825003	0.1679912

-2log(Likelihood) = 144.711962393825

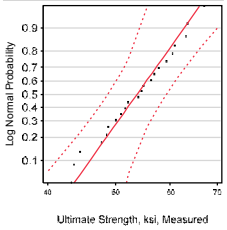
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.075312	>	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	α	68.80088	35.805194	117.71403
Scale	σ	0.7847093	0.4579491	1.5129237
Threshold	θ	0		

-2log(Likelihood) = 144.63866351897

Goodness-of-Fit Test

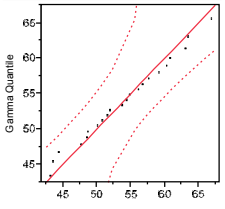
Cramer-von Mises W Test

W-Square	Prob>W^2
.	.

Test not defined for Gamma & Beta with non-fixed parameters.

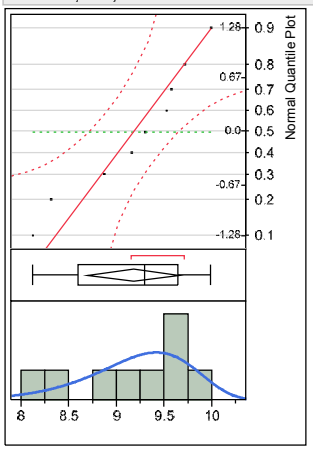
Note: Ho = The data is from the Gamma distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=CTD

Modulus, Msi, Measured



Weibull(9.44107,19.3812)

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
☑	Weibull	21.3026056
☐	Extreme Value	21.3026056
☐	Normal	22.3931915
☐	Gamma	22.5486853
☐	LogNormal	22.6681611
☐	Johnson SI	25.9005041
☐	GLog	27.1331443
☐	Johnson Su	34.3332214
☐	Normal 2 Mixture	42.2768204
☐	Exponential	60.4646236

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	9.4410662	9.0553678	9.8171343
Shape	β	19.38115	10.59482	31.253161

-2log(Likelihood) = 15.3026056170336

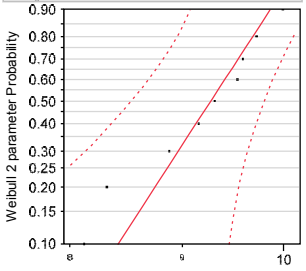
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square		Prob>W^2
0.025876	>	0.2500

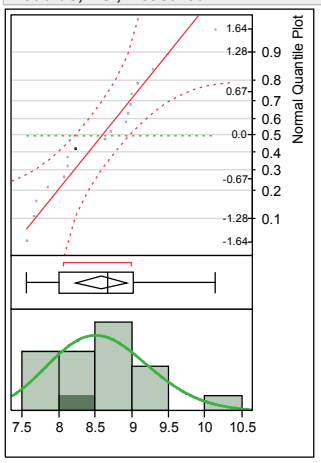
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=RTD

Modulus, Msi, Measured



LogNormal(2.14612,0.08034)

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
☑	LogNormal	42.3703752
☐	Gamma	42.4653374
☐	Normal	42.7694692
☐	Johnson SI	45.0075529
☐	Weibull	45.2211344
☐	Extreme Value	45.2211344
☐	GLog	45.2846609
☐	Johnson Su	48.3701903
☐	Normal 2 Mixture	51.1199646
☐	Normal 3 Mixture	67.010997
☐	Exponential	115.627057

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	2.1461215	2.106934	2.1853091
Shape	σ	0.0803439	0.05984	0.1159046

-2log(Likelihood) = 37.5703751997931

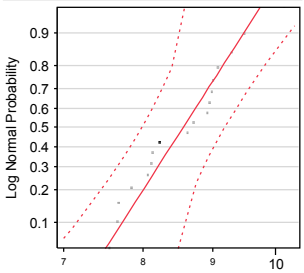
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.143169	>	0.1500

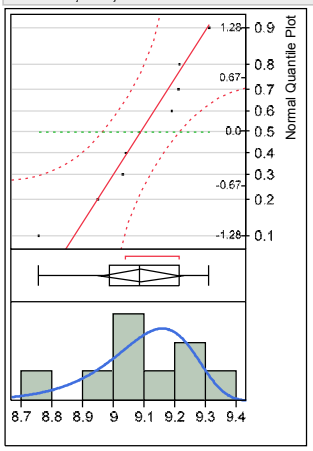
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

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
☑	Weibull	-2.5228106
☐	Extreme Value	-2.5228106
☐	Normal	-1.4481196
☐	Gamma	-1.4375203
☐	LogNormal	-1.4021157
☐	Johnson SI	2.20232897
☐	GLog	3.39788431
☐	Johnson Su	9.40232748
☐	Normal 2 Mixture	23.6524697
☐	Exponential	60.2959559

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	9.1611337	9.0580572	9.2588758
Shape	β	71.044951	39.255059	113.14177

-2log(Likelihood) = -8.52281060061778

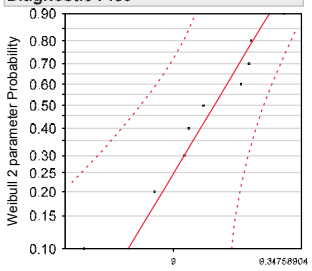
Goodness-of-Fit Test

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.

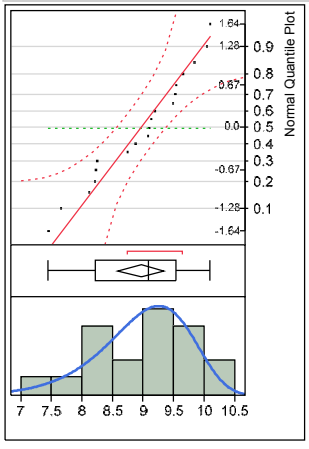
Diagnostic Plot



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
☑	Weibull	47.5530653
☐	Extreme Value	47.5530653
☐	Normal	48.6639289
☐	Gamma	49.0663557
☐	LogNormal	49.3290143
☐	Johnson SI	50.3500157
☐	GLog	51.4866518
☐	Johnson Su	54.7439009
☐	Normal 2 Mixture	56.6175123
☐	Normal 3 Mixture	71.9107113
☐	Exponential	123.541808

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	9.2989695	8.963568	9.6257111
Shape	β	14.09398	9.520877	19.67904

-2log(Likelihood) = 42.8030653365142

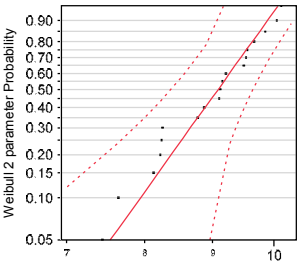
Goodness-of-Fit Test

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.

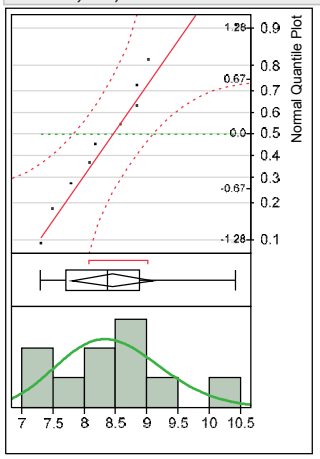
Diagnostic Plot



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
☑	LogNormal	30.5374332
☐	Gamma	30.7432478
☐	Normal	31.2939995
☐	Weibull	33.4674708
☐	Extreme Value	33.4674708
☐	Johnson SI	33.8887035
☐	GLog	34.8231475
☐	Johnson Su	39.8887035
☐	Normal 2 Mixture	51.6827545
☐	Exponential	65.1783578
☐	Normal 3 Mixture	177.890803

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	2.1288637	2.0607042	2.1970232
Shape	σ	0.0995948	0.0679345	0.1663149

-2log(Likelihood) = 24.8231474939328

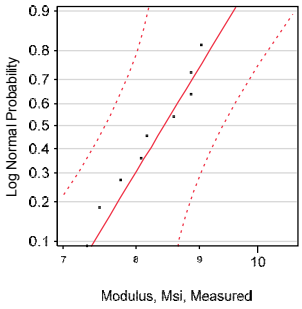
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.141341	>	0.1500

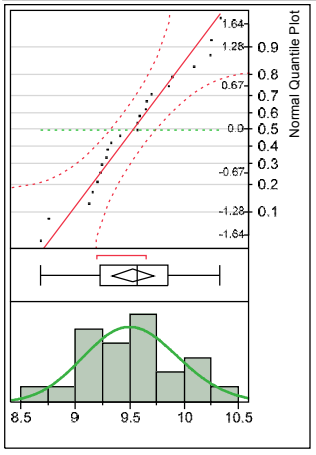
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

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
☑	LogNormal	31.5553775
☐	Gamma	31.5689715
☐	Normal	31.6583948
☐	Johnson SI	34.2139994
☐	GLog	34.2185354
☐	Weibull	34.2300447
☐	Extreme Value	34.2300447
☐	Normal 2 Mixture	36.8800082
☐	Johnson Su	37.1730637
☐	Normal 3 Mixture	50.9093363
☐	Exponential	151.868903

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	2.2528346	2.2333528	2.2723165
Shape	σ	0.0456941	0.0351049	0.0629084

-2log(Likelihood) = 26.9553774982871

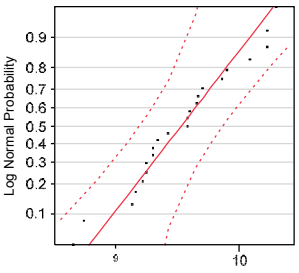
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.105903	>	0.1500

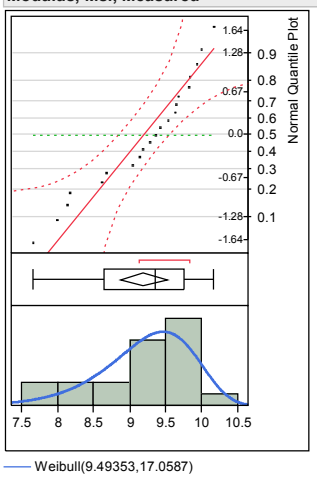
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

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
☑	Weibull	46.3296897
☐	Extreme Value	46.3296897
☐	Johnson SI	48.036456
☐	Normal	49.5905759
☐	Gamma	50.3409609
☐	LogNormal	50.7696594
☐	GLog	52.3110807
☐	Normal 2 Mixture	53.6132781
☐	Johnson Su	55.3994399
☐	Normal 3 Mixture	68.692667
☐	Exponential	137.353329

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	9.4935349	9.225184	9.753752
Shape	β	17.058671	11.64229	23.694769

-2log(Likelihood) = 41.6630230713182

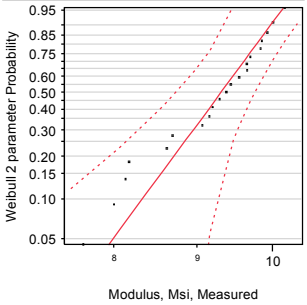
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square		Prob>W^2
0.047108	>	0.2500

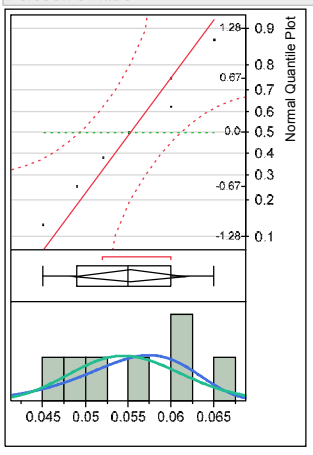
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



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
☑	Gamma	-43.617161
☑	Weibull	-43.614919
☐	Extreme Value	-43.614919
☐	Normal	-43.580314
☐	LogNormal	-43.565909
☐	Johnson SI	-36.67553
☐	GLog	-36.659369
☐	Exponential	-23.769593
☐	Johnson Su	-22.659367
☐	Normal 2 Mixture	20.3501782

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	0.0580318	0.0526728	0.063548
Shape	β	9.746096	4.9441635	16.389552

-2log(Likelihood) = -50.6149192239701

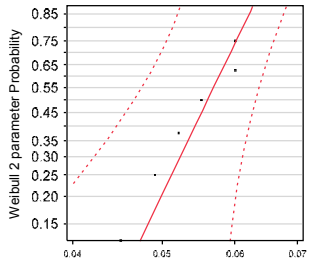
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square		Prob>W^2
0.033958	>	0.2500

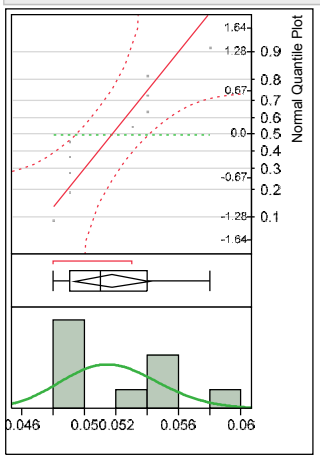
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=RTD

Poisson's Ratio



LogNormal(-2.9641,0.06042)

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
☑	LogNormal	-81.317241
☐	Gamma	-81.227357
☐	Normal	-80.972598
☐	Johnson SI	-79.818905
☐	Weibull	-79.292794
☐	Extreme Value	-79.292794
☐	GLog	-76.740489
☐	Normal 2 Mixture	-72.402689
☐	Johnson Su	-70.740558
☐	Exponential	-36.74595

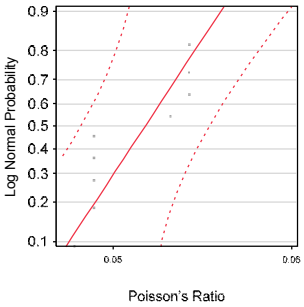
Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	-2.964138	-3.00549	-2.922786
Shape	σ	0.0604235	0.0412154	0.1009021

-2log(Likelihood) = -87.0315262907022

Diagnostic Plot



Goodness-of-Fit Test

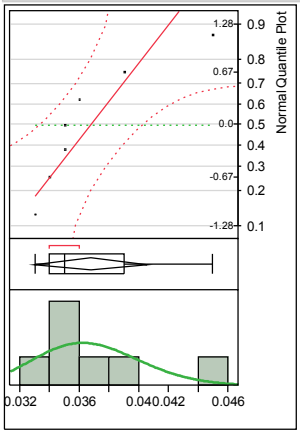
Kolmogorov's D

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



LogNormal(-3.3096,0.09792)

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
☑	LogNormal	-51.999195
☐	Gamma	-51.72261
☐	Normal	-51.050267
☐	Weibull	-49.16161
☐	Extreme Value	-49.16161
☐	Johnson SI	-49.101622
☐	GLog	-44.999195
☐	Johnson Su	-35.101622
☐	Exponential	-29.464251
☐	Normal 2 Mixture	8.48464204

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	-3.309569	-3.393297	-3.22584
Shape	σ	0.0979206	0.0626703	0.1845148

-2log(Likelihood) = -58.9991945533725

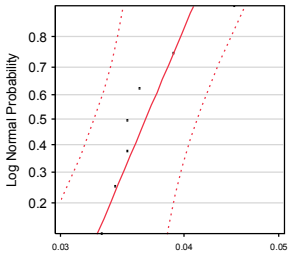
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.273822	0.1106

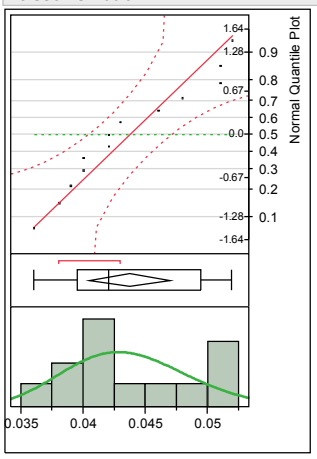
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

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
☑	LogNormal	-95.273264
☐	Gamma	-95.156169
☐	Normal	-94.780448
☐	Weibull	-93.740999
☐	Extreme Value	-93.740999
☐	Johnson SI	-92.28621
☐	GLog	-91.354337
☐	Johnson Su	-87.021028
☐	Normal 2 Mixture	-84.911139
☐	Exponential	-53.031527
☐	Normal 3 Mixture	-48.896992

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	-3.13747	-3.206056	-3.068885
Shape	σ	0.1169716	0.0831878	0.1817334

-2log(Likelihood) = -100.473264159044

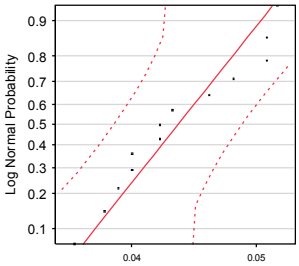
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.148274	>	0.1500

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

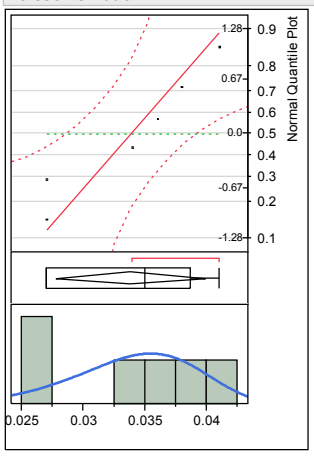
Diagnostic Plot



Poisson's Ratio

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
☑	Weibull	-38.177132
☐	Extreme Value	-38.177132
☐	Normal	-37.820457
☐	Gamma	-37.79147
☐	LogNormal	-37.692452
☐	Johnson SI	-28.176897
☐	GLog	-27.914386
☐	Exponential	-25.635705
☐	Johnson Su	2.0856179

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	0.0360779	0.0314521	0.0410474
Shape	β	7.6997903	3.5991169	13.7165

-2log(Likelihood) = -46.1771316330355

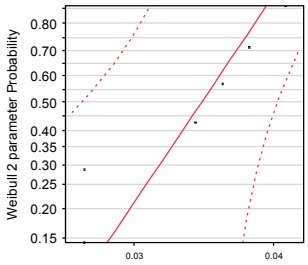
Goodness-of-Fit Test

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.

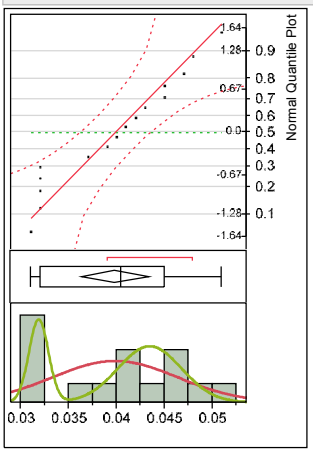
Diagnostic Plot



Poisson's Ratio

Distributions Condition=ETW

Poisson's Ratio



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
☑	Normal 2 Mixture	-112.37037
☐	Gamma	-111.59193
☑	Normal	-111.55382
☐	LogNormal	-111.47826
☐	Weibull	-111.47208
☐	Extreme Value	-111.47208
☐	Johnson SI	-108.53626
☐	GLog	-108.50951
☐	Johnson Su	-104.87316
☐	Normal 3 Mixture	-93.315655
☐	Exponential	-68.868665

Fitted Normal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Location	μ	0.0398125	0.0363198	0.0433052
Dispersion	σ	0.0065546	0.0048419	0.0101445

-2log(Likelihood) = -116.476893590064

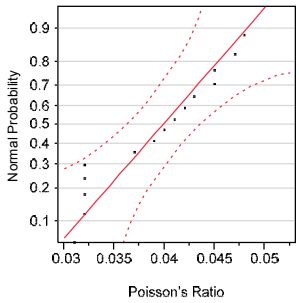
Goodness-of-Fit Test

Shapiro-Wilk W Test

W	Prob<W
0.920809	0.1738

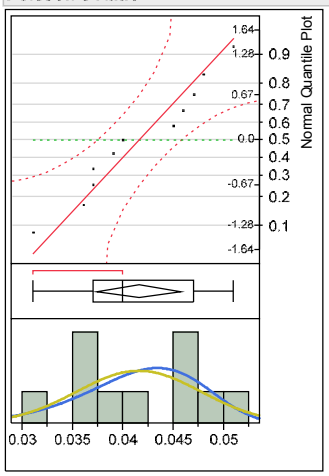
Note: Ho = The data is from the Normal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Poisson's Ratio



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
☑	Johnson SI	-77.245031
☑	Weibull	-76.145776
☐	Extreme Value	-76.145776
☐	Normal	-76.104523
☐	Gamma	-76.055423
☐	LogNormal	-75.93097
☐	GLog	-72.224363
☐	Johnson Su	-66.986855
☐	Normal 2 Mixture	-62.209744
☐	Exponential	-45.536833
☐	Normal 3 Mixture	4.30345746

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	0.0441176	0.0403922	0.047903
Shape	β	8.0765981	4.7774865	12.368843

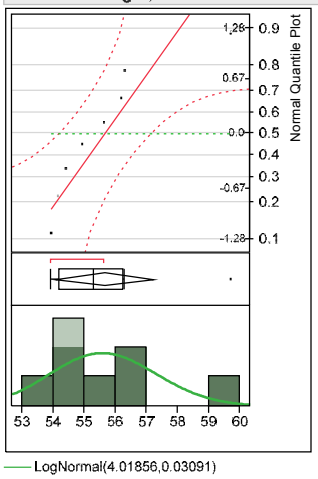
-2log(Likelihood) = -81.6457758880339

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=RTD

Ultimate Strength, ksi



Summary Statistics

Mean	55.647692
Std Dev	1.8745851
Std Err Mean	0.6627659
Upper 95% Mean	57.214884
Lower 95% Mean	54.080499
N	8

Compare Distributions

Show	Distribution	AICc
☑	LogNormal	37.7721375
☐	Gamma	37.8759257
☐	Normal	38.1572142
☐	Johnson SI	38.4501098
☐	Weibull	41.2934169
☐	Extreme Value	41.2934169
☐	GLog	43.3721375
☐	Johnson Su	47.7834432
☐	Normal 2 Mixture	73.0339676
☐	Exponential	82.9713162

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	4.0185568	3.9942911	4.0428225
Shape	σ	0.0309081	0.0202787	0.0554724

-2log(Likelihood) = 31.3721374988261

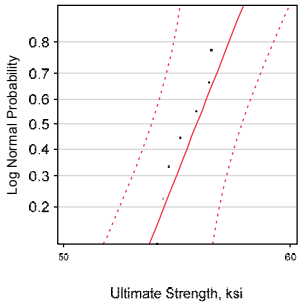
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.224075	>	0.1500

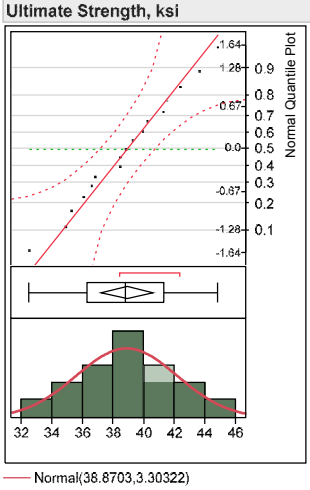
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Ultimate Strength, ksi



Summary Statistics

Mean	38.870303
Std Dev	3.3032158
Std Err Mean	0.8011475
Upper 95% Mean	40.56866
Lower 95% Mean	37.171946
N	17

Compare Distributions

Show	Distribution	AICc
☑	Normal	92.7275336
☐	Gamma	92.7667472
☐	LogNormal	92.8482815
☐	Weibull	93.5836325
☐	Extreme Value	93.5836325
☐	Johnson SI	95.681703
☐	GLog	95.8372925
☐	Johnson Su	99.1688817
☐	Normal 2 Mixture	105.899865
☐	Normal 3 Mixture	124.783284
☐	Exponential	160.714505

Fitted Normal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Location	μ	38.870303	37.171946	40.56866
Dispersion	σ	3.3032158	2.4601355	5.0272598

-2log(Likelihood) = 87.870390709609

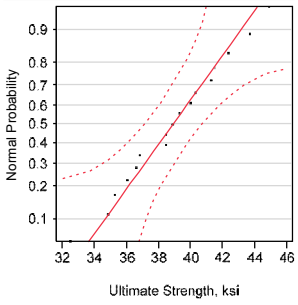
Goodness-of-Fit Test

Shapiro-Wilk W Test

W	Prob<W
0.990106	0.9991

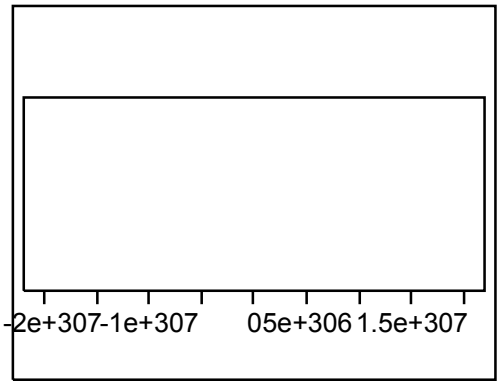
Note: Ho = The data is from the Normal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Modulus, Msi



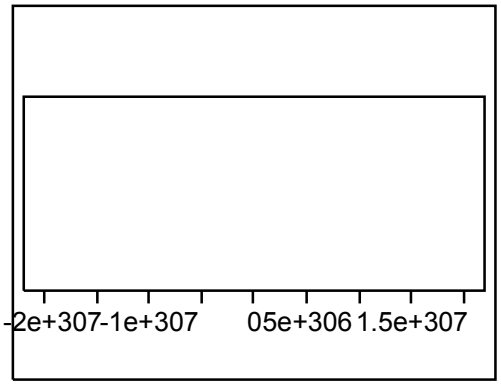
Quantiles

Summary Statistics

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

Distributions Condition=RTD

Modulus, Msi



Quantiles

Summary Statistics

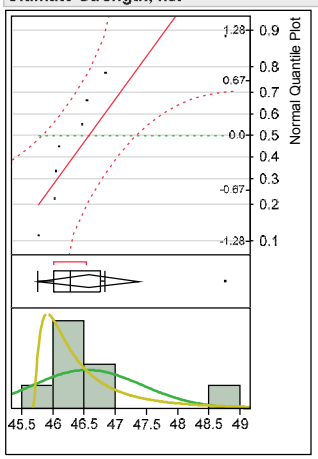
Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

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=RTD

Ultimate Strength, ksi



Summary Statistics

Mean	46.563558
Std Dev	0.9579609
Std Err Mean	0.3386903
Upper 95% Mean	47.364433
Lower 95% Mean	45.762683
N	8

Compare Distributions

Show	Distribution	AICc
☑	Johnson SI	25.5400358
☑	LogNormal	27.0887084
☐	Gamma	27.1744173
☐	Normal	27.4158431
☐	Weibull	31.354661
☐	Extreme Value	31.354661
☐	GLog	32.6887084
☐	Johnson Su	34.8733691
☐	Normal 2 Mixture	50.2693406
☐	Exponential	80.1197582

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	3.840637	3.8257681	3.8555058
Shape	σ	0.018939	0.0124258	0.0339908

-2log(Likelihood) = 20.6887083781541

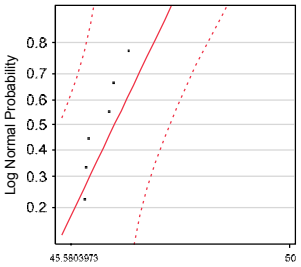
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.256490	0.1216

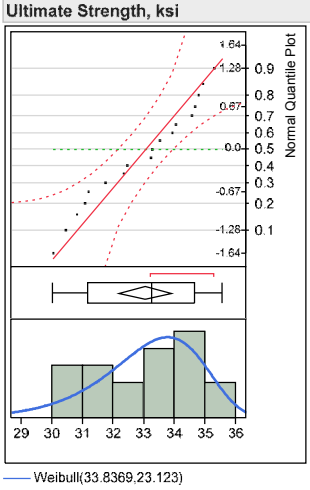
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Ultimate Strength, ksi



Summary Statistics

Mean	33.04147
Std Dev	1.7594277
Std Err Mean	0.4036404
Upper 95% Mean	33.889487
Lower 95% Mean	32.193453
N	19

Compare Distributions

Show	Distribution	AICc
☑	Weibull	78.3567655
☐	Extreme Value	78.3567655
☐	Normal	79.1392302
☐	Gamma	79.2795909
☐	LogNormal	79.3779926
☐	Johnson SI	81.0306793
☐	GLog	81.9619536
☐	Johnson Su	85.2192522
☐	Normal 2 Mixture	85.8238287
☐	Normal 3 Mixture	100.965804
☐	Exponential	173.150304

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	33.836867	33.085909	34.556602
Shape	β	23.122975	15.609924	32.376435

-2log(Likelihood) = 73.6067654563913

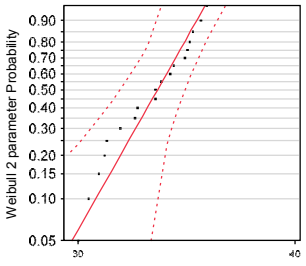
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square	Prob>W^2
0.051610 >	0.2500

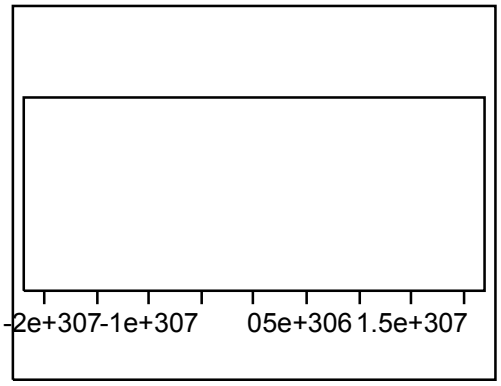
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Modulus, Msi



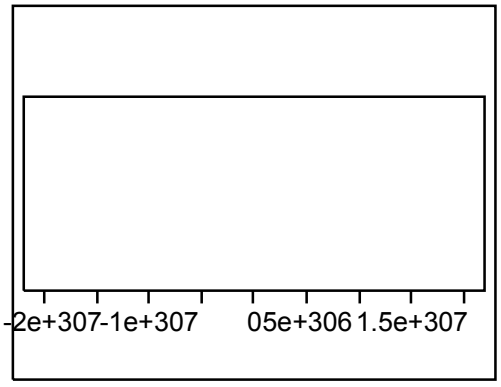
Quantiles

Summary Statistics

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

Distributions Condition=RTD

Modulus, Msi



Quantiles

Summary Statistics

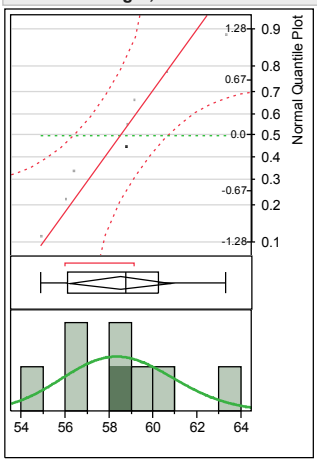
Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

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=RTD

Ultimate Strength, ksi



Summary Statistics

Mean	58.484104
Std Dev	2.7279254
Std Err Mean	0.9644673
Upper 95% Mean	60.764707
Lower 95% Mean	56.203502
N	8

Compare Distributions

Show	Distribution	AICc
☑	LogNormal	43.9709324
☐	Gamma	44.0074584
☐	Normal	44.159679
☐	Weibull	45.4806583
☐	Extreme Value	45.4806583
☐	Johnson SI	49.2750652
☐	GLog	49.5709324
☐	Johnson Su	58.6083985
☐	Normal 2 Mixture	77.5733752
☐	Exponential	83.7667466

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	4.0678116	4.0337819	4.1018413
Shape	σ	0.0433449	0.0284385	0.0777932

-2log(Likelihood) = 37.5709324304758

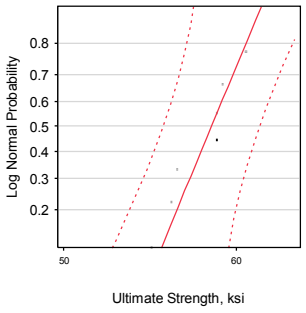
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.176648	>	0.1500

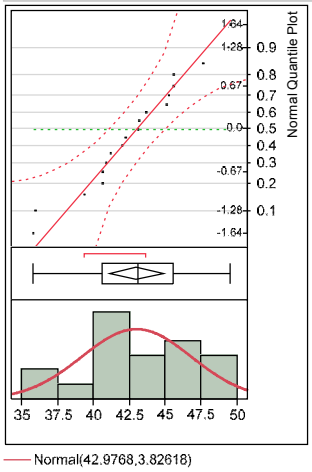
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Ultimate Strength, ksi



Summary Statistics

Mean	42.97678
Std Dev	3.8261843
Std Err Mean	0.8777869
Upper 95% Mean	44.820942
Lower 95% Mean	41.132618
N	19

Compare Distributions

Show	Distribution	AICc
☑	Normal	108.660649
☐	Gamma	108.819282
☐	LogNormal	108.975913
☐	Weibull	109.436341
☐	Extreme Value	109.436341
☐	Johnson SI	111.435723
☐	GLog	111.825913
☐	Johnson Su	114.686302
☐	Normal 2 Mixture	117.371665
☐	Normal 3 Mixture	128.4762
☐	Exponential	183.140373

Fitted Normal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Location	μ	42.97678	41.132618	44.820942
Dispersion	σ	3.8261843	2.8911132	5.6582552

-2log(Likelihood) = 103.910649420991

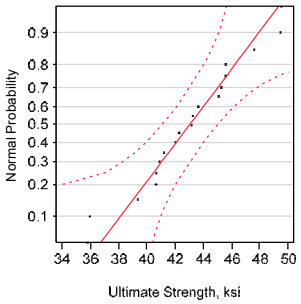
Goodness-of-Fit Test

Shapiro-Wilk W Test

W	Prob<W
0.964821	0.6702

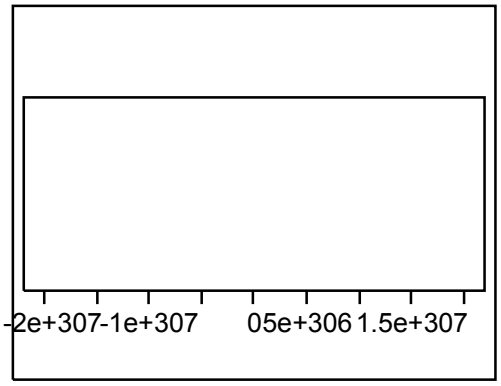
Note: Ho = The data is from the Normal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Modulus, Msi



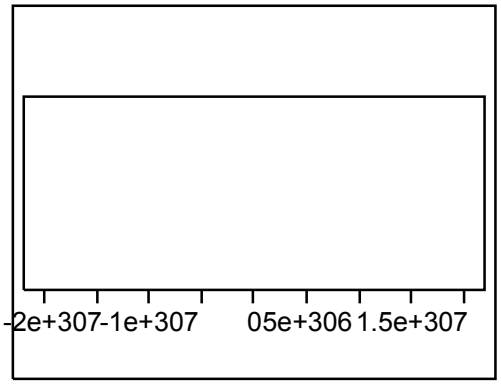
Quantiles

Summary Statistics

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

Distributions Condition=RTD

Modulus, Msi



Quantiles

Summary Statistics

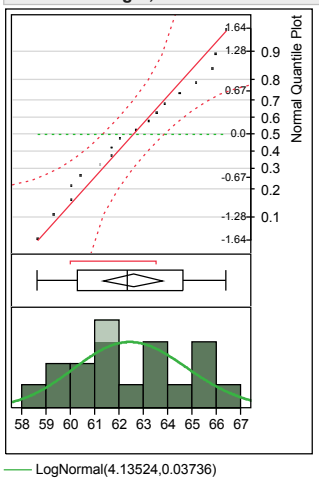
Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

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

Ultimate Strength, ksi



Summary Statistics

Mean	62.548319
Std Dev	2.4051565
Std Err Mean	0.5669008
Upper 95% Mean	63.744375
Lower 95% Mean	61.352262
N	18

Compare Distributions

Show	Distribution	AICc
☑	LogNormal	86.4081176
☐	Gamma	86.415913
☐	Normal	86.4759257
☐	Weibull	87.7317183
☐	Extreme Value	87.7317183
☐	Johnson SI	89.3062298
☐	GLog	89.361359
☐	Johnson Su	92.7241154
☐	Normal 2 Mixture	94.0879304
☐	Normal 3 Mixture	111.554562
☐	Exponential	187.143817

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	4.1352415	4.1170217	4.1534613
Shape	σ	0.037355	0.0278219	0.0538886

-2log(Likelihood) = 81.6081176434759

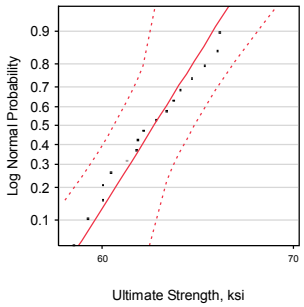
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.099544	>	0.1500

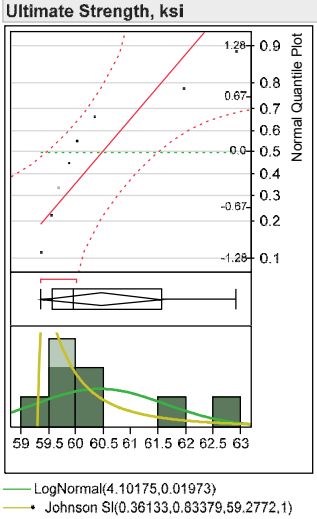
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=RTD

Ultimate Strength, ksi



Summary Statistics

Mean	60.457935
Std Dev	1.2888739
Std Err Mean	0.4556857
Upper 95% Mean	61.53546
Lower 95% Mean	59.380409
N	8

Compare Distributions

Show	Distribution	AICc
☑	Johnson SI	30.6777078
☑	LogNormal	31.9199888
☐	Gamma	31.977847
☐	Normal	32.1633185
☐	Weibull	34.8442288
☐	Extreme Value	34.8442288
☐	GLog	37.6950664
☐	Johnson Su	47.0284586
☐	Normal 2 Mixture	56.2365556
☐	Exponential	84.2978319

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	4.1017518	4.0862631	4.1172405
Shape	σ	0.0197285	0.0129438	0.0354077

-2log(Likelihood) = 25.5199887827813

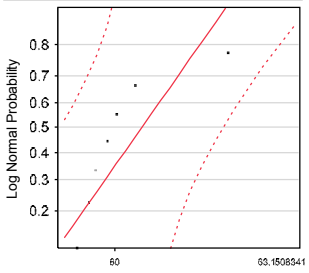
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.287070	0.0499*

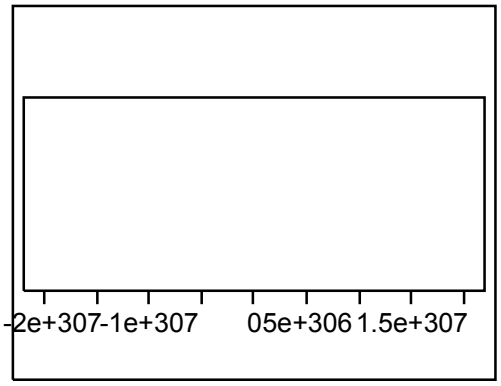
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=CTD

Modulus, Msi



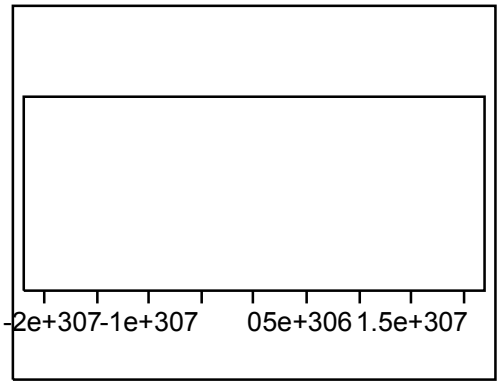
Quantiles

Summary Statistics

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

Distributions Condition=RTD

Modulus, Msi



Quantiles

Summary Statistics

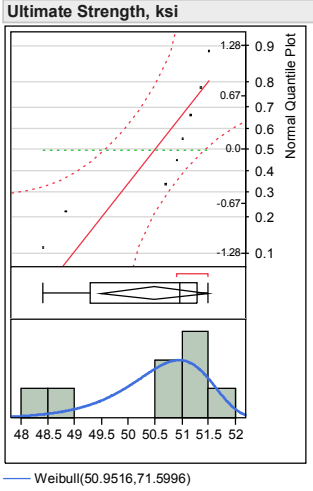
Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

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=CTD

Ultimate Strength, ksi



Summary Statistics

Mean	50.477759
Std Dev	1.1868514
Std Err Mean	0.4196153
Upper 95% Mean	51.469991
Lower 95% Mean	49.485526
N	8

Compare Distributions

Show	Distribution	AICc
☑	Weibull	27.7877282
☐	Extreme Value	27.7877282
☐	Johnson SI	29.2622874
☐	Normal	30.8438796
☐	Gamma	30.8978393
☐	LogNormal	30.9597717
☐	GLog	36.3756293
☐	Johnson Su	45.709018
☐	Normal 2 Mixture	49.7705931
☐	Exponential	81.4111918

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	50.951575	50.324056	51.552706
Shape	β	71.599572	35.689153	125.1388

-2log(Likelihood) = 21.3877281668755

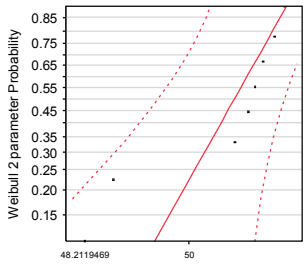
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square	Prob>W^2
0.113412	0.0558

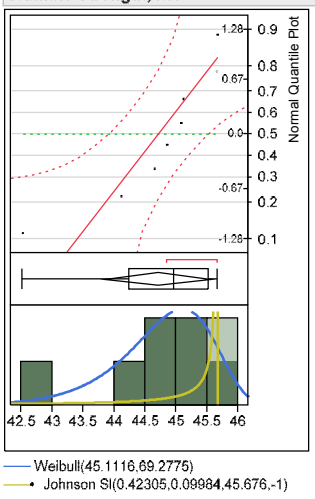
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=RTD

Ultimate Strength, ksi



Summary Statistics

Mean	44.706704
Std Dev	1.0224338
Std Err Mean	0.3614849
Upper 95% Mean	45.56148
Lower 95% Mean	43.851928
N	8

Compare Distributions

Show	Distribution	AICc
☑	Johnson SI	3.77264074
☑	Weibull	25.6406865
☐	Extreme Value	25.6406865
☐	Normal	28.4579901
☐	Gamma	28.5360171
☐	LogNormal	28.6104734
☐	GLog	34.2104734
☐	Johnson Su	38.849469
☐	Normal 2 Mixture	63.3347435
☐	Exponential	79.468642

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	45.111612	44.547909	45.652757
Shape	β	69.277543	35.654616	116.12215

-2log(Likelihood) = 19.2406865159094

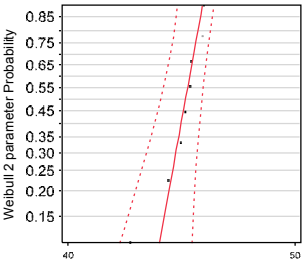
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square		Prob>W^2
0.034316	>	0.2500

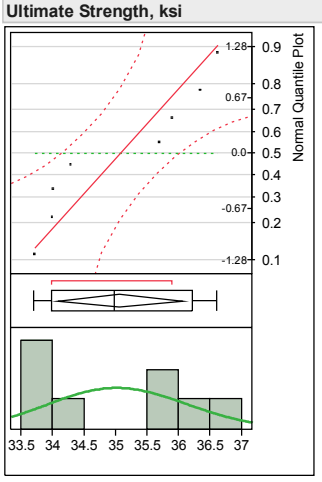
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Ultimate Strength, ksi



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
☑	LogNormal	30.79006
☐	Gamma	30.7986522
☐	Normal	30.8874602
☐	Weibull	31.1738178
☐	Extreme Value	31.1738178
☐	Johnson SI	35.0375688
☐	GLog	36.4192087
☐	Johnson Su	45.7526009
☐	Normal 2 Mixture	53.5310544
☐	Exponential	75.5803127

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	3.5565997	3.5317053	3.5814941
Shape	σ	0.0317088	0.0208041	0.0569095

-2log(Likelihood) = 24.3900600490189

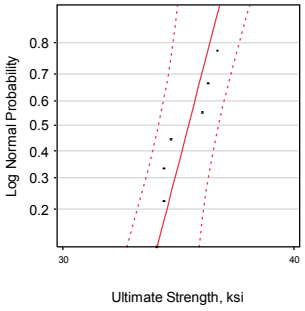
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.256788	0.1206

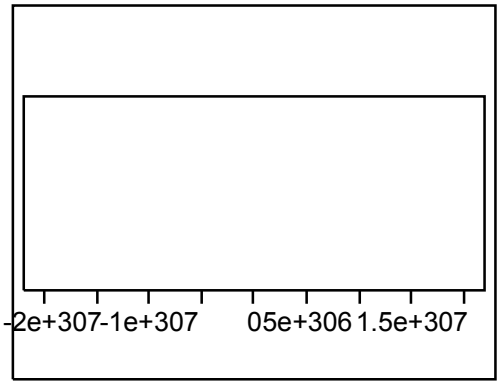
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=CTD

Modulus, Msi



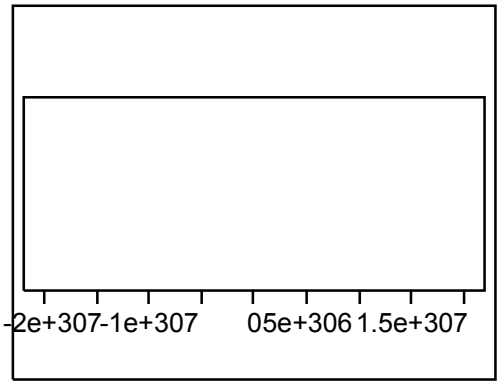
Quantiles

Summary Statistics

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

Distributions Condition=ETW2

Modulus, Msi



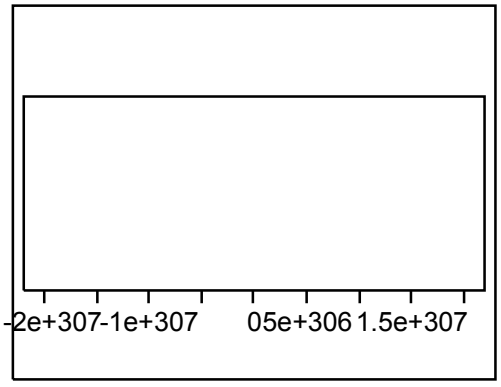
Quantiles

Summary Statistics

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

Distributions Condition=RTD

Modulus, Msi



Quantiles

Summary Statistics

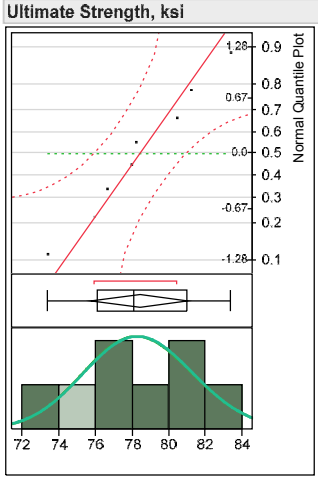
Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

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=RTD

Ultimate Strength, ksi



Summary Statistics	
Mean	78.391094
Std Dev	3.1887581
Std Err Mean	1.1273962
Upper 95% Mean	81.056963
Lower 95% Mean	75.725226
N	8

Compare Distributions		
Show	Distribution	AICc
☑	Gamma	46.5863372
☑	LogNormal	46.5892722
☐	Normal	46.657121
☐	Weibull	47.2052854
☐	Extreme Value	47.2052854
☐	Johnson SI	52.1869152
☐	GLog	52.1892722
☐	Johnson Su	61.5202486
☐	Normal 2 Mixture	82.2662819
☐	Exponential	88.4540319

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	4.3609858	4.3310903	4.3908812
Shape	σ	0.0380789	0.0249835	0.0683421

-2log(Likelihood) = 40.1892722086942

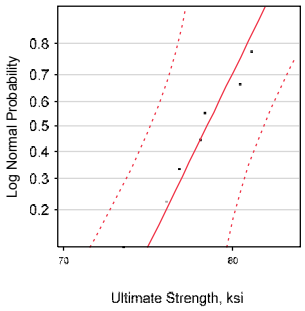
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.140376	>	0.1500

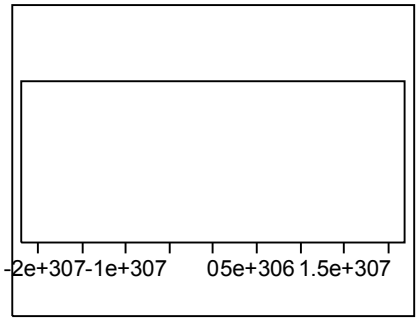
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=CTD

Modulus, Msi

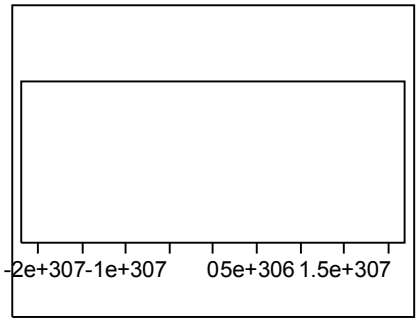


Quantiles	

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

Distributions Condition=RTD

Modulus, Msi



Quantiles	

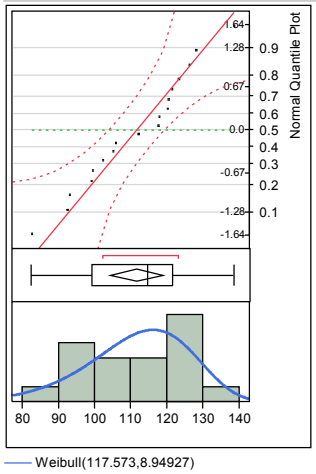
Summary Statistics	
Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

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

Ultimate Strength, ksi, Measured



Weibull(117.573,8.94927)

Summary Statistics

Mean	111.34611
Std Dev	14.699668
Std Err Mean	3.4647449
Upper 95% Mean	118.65608
Lower 95% Mean	104.03614
N	18

Compare Distributions

Show	Distribution	AICc
☑	Weibull	151.528874
☐	Extreme Value	151.528874
☐	Normal	151.643483
☐	Gamma	151.991675
☐	LogNormal	152.29554
☐	Johnson SI	154.338806
☐	GLog	154.528919
☐	Johnson Su	157.891978
☐	Normal 2 Mixture	161.658225
☐	Normal 3 Mixture	178.344284
☐	Exponential	207.905165

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	117.57276	110.7889	124.3428
Shape	β	8.949266	6.0321449	12.439583

-2log(Likelihood) = 146.728873689672

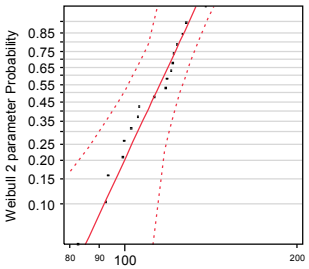
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square		Prob>W^2
0.044464	>	0.2500

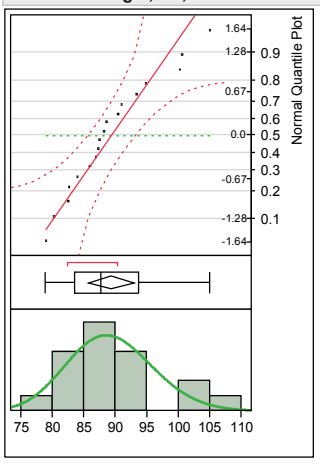
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW

Ultimate Strength, ksi, Measured



LogNormal(4.4888,0.07705)

Summary Statistics

Mean	89.282934
Std Dev	7.225399
Std Err Mean	1.7030429
Upper 95% Mean	92.87604
Lower 95% Mean	85.689827
N	18

Compare Distributions

Show	Distribution	AICc
☑	LogNormal	125.201605
☐	Gamma	125.456327
☐	Normal	126.075476
☐	Johnson SI	126.610239
☐	GLog	128.11589
☐	Weibull	129.801143
☐	Extreme Value	129.801143
☐	Johnson Su	129.972876
☐	Normal 2 Mixture	132.709953
☐	Normal 3 Mixture	149.588529
☐	Exponential	199.955173

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	4.4888024	4.4512197	4.5263852
Shape	σ	0.0770538	0.0573895	0.1111582

-2log(Likelihood) = 120.401604678275

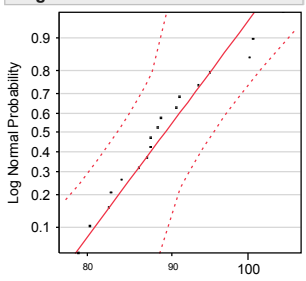
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.136784	>	0.1500

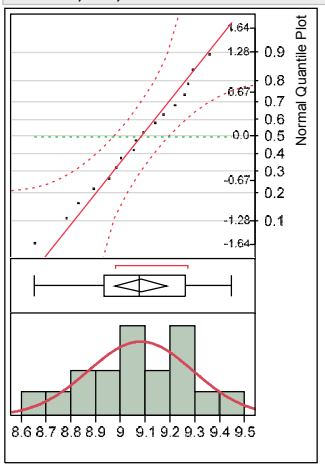
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=RTD

Modulus, Msi, Measured



Summary Statistics

Mean	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
☑	Normal	-0.8815008
☐	Gamma	-0.8477253
☐	LogNormal	-0.8127796
☐	Weibull	-0.4695032
☐	Extreme Value	-0.4695032
☐	Johnson SI	1.75951281
☐	GLog	2.10150616
☐	Johnson Su	4.99333596
☐	Normal 2 Mixture	11.0309231
☐	Normal 3 Mixture	29.4191266
☐	Exponential	117.668671

Fitted Normal

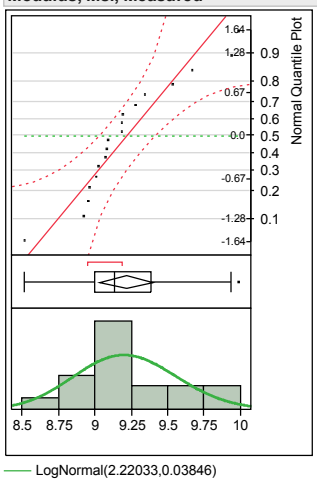
Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Location	μ	9.08	8.9743439	9.1856561
Dispersion	σ	0.2124645	0.1594307	0.3185149

-2log(Likelihood) = -5.681500818690 83

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
☑	LogNormal	18.5197326
☐	Gamma	18.6452833
☐	Normal	18.9509822
☐	Johnson SI	20.7046183
☐	Johnson Su	21.2930624
☐	GLog	21.4340183
☐	Normal 2 Mixture	23.3876238
☐	Weibull	23.6105094
☐	Extreme Value	23.6105094
☐	Normal 3 Mixture	39.4772122
☐	Exponential	118.208654

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	2.2203292	2.2015709	2.2390874
Shape	σ	0.0384589	0.0286441	0.0554811

-2log(Likelihood) = 13.719732573022

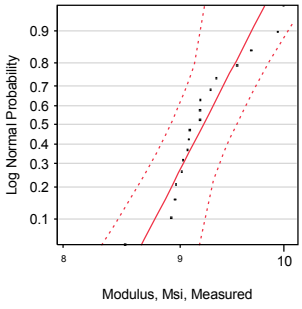
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.189612	0.0858

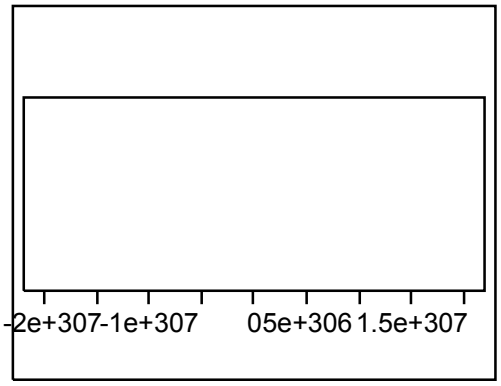
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW

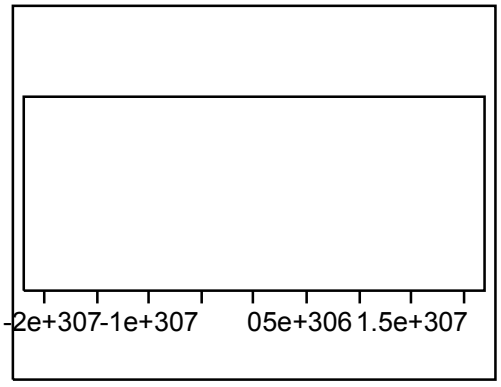
Poisson's Ratio



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

Distributions Condition=RTD

Poisson's Ratio



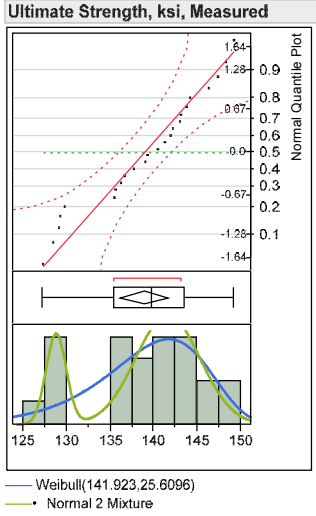
Quantiles	Summary Statistics	
	Mean	.
	Std Dev	.
	Std Err Mean	.
	Upper 95% Mean	.
	Lower 95% Mean	.
	N	0

A.9 Fill Tension (FT)

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

Distributions Condition=CTD

Ultimate Strength, ksi, Measured



Summary Statistics

Mean	138.9402
Std Dev	6.5810111
Std Err Mean	1.3433433
Upper 95% Mean	141.71912
Lower 95% Mean	136.16129
N	24

Compare Distributions

Show	Distribution	AICc
☑	Normal 2 Mixt...	160.201376
☑	Weibull	161.143495
☐	Extreme Value	161.143495
☐	Normal	162.121521
☐	Gamma	162.360691
☐	LogNormal	162.508124
☐	Johnson Sl	163.632629
☐	GLog	165.136695
☐	Johnson Su	166.291284
☐	Normal 3 Mixt...	167.952183
☐	Exponential	287.015913

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	141.92342	139.43139	144.31878
Shape	β	25.609625	18.211373	34.355037

-2log(Likelihood) = 156.572066107787

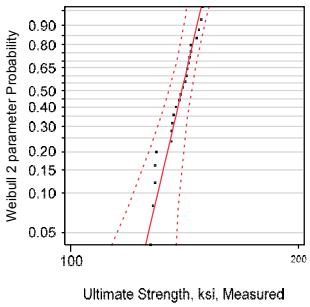
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square		Prob>W^2
0.027649	>	0.2500

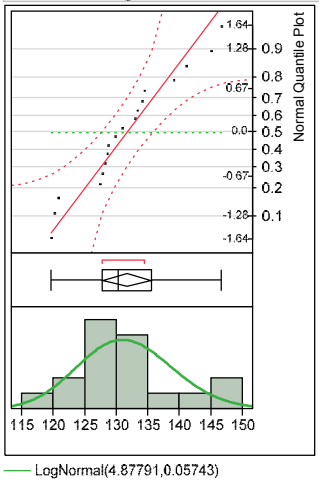
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=RTD

Ultimate Strength, ksi, Measured



Summary Statistics

Mean	131.57311
Std Dev	7.8200928
Std Err Mean	1.8432135
Upper 95% Mean	135.46195
Lower 95% Mean	127.68427
N	18

Compare Distributions

Show	Distribution	AICc
☑	LogNormal	128.625269
☐	Gamma	128.698826
☐	Normal	128.922858
☐	Johnson Sl	131.35057
☐	GLog	131.539554
☐	Weibull	131.664426
☐	Extreme Value	131.664426
☐	Johnson Su	134.713207
☐	Normal 2 Mixture	136.907193
☐	Normal 3 Mixture	153.791219
☐	Exponential	213.914256

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	4.877908	4.8498985	4.9059174
Shape	σ	0.0574261	0.0427709	0.0828433

-2log(Likelihood) = 123.825268664512

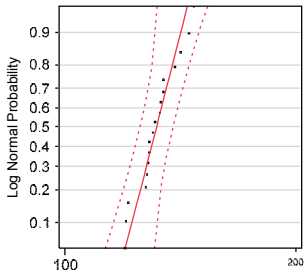
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.130306	>	0.1500

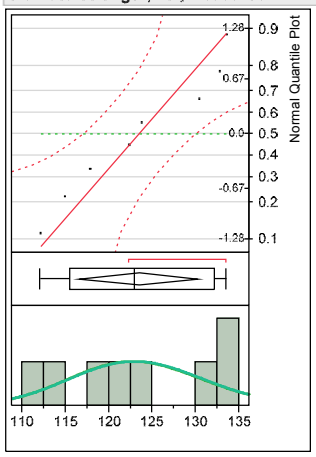
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=RTW

Ultimate Strength, ksi, Measured



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
☑	Gamma	61.7687309
☑	LogNormal	61.7789606
☐	Normal	61.832796
☐	Weibull	61.8866177
☐	Extreme Value	61.8866177
☐	Johnson SI	67.3606506
☐	GLog	67.3645504
☐	Johnson Su	76.6979734
☐	Normal 2 Mixture	91.3087574
☐	Exponential	95.7197867

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	4.8138669	4.7647511	4.8629826
Shape	σ	0.0625606	0.0410458	0.1122806

-2log(Likelihood) = 55.3789606007606

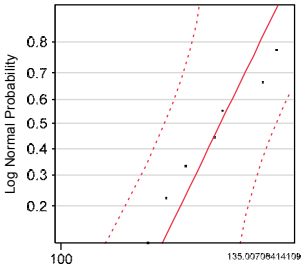
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.191756	>	0.1500

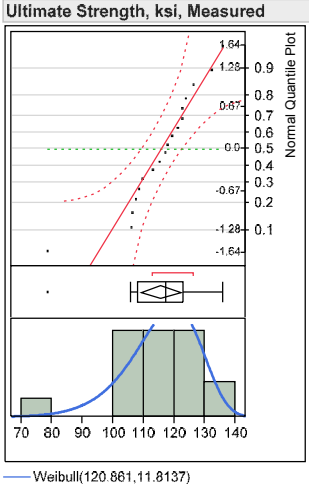
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETD1

Ultimate Strength, ksi, Measured



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
☑	Weibull	143.777936
☐	Extreme Value	143.777936
☐	Normal	146.485539
☐	Johnson SI	146.603737
☐	Gamma	148.347129
☐	LogNormal	149.454984
☐	Johnson Su	149.535344
☐	GLog	152.36927
☐	Normal 2 Mixture	157.397923
☐	Normal 3 Mixture	172.232099
☐	Exponential	209.306536

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	120.86058	115.58574	126.10136
Shape	β	11.813687	7.950725	16.378032

-2log(Likelihood) = 138.977935503863

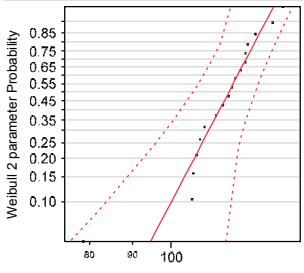
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square		Prob>W^2
0.033698	>	0.2500

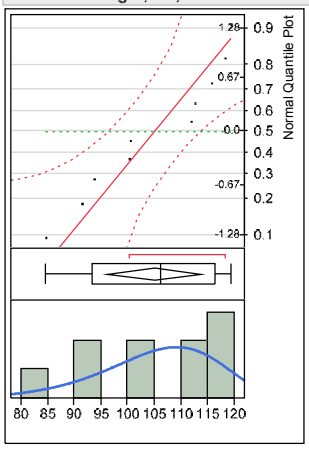
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

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
☑	Weibull	82.7623116
☐	Extreme Value	82.7623116
☐	Normal	83.4407123
☐	Gamma	83.6070905
☐	LogNormal	83.7526555
☐	Johnson SI	86.2841011
☐	GLog	87.6728233
☐	Johnson Su	93.6731922
☐	Normal 2 Mixture	97.3681744
☐	Exponential	115.562082
☐	Normal 3 Mixture	229.35043

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	110.09095	102.69492	117.4535
Shape	β	10.944048	6.1829015	17.475423

-2log(Likelihood) = 77.048025902865

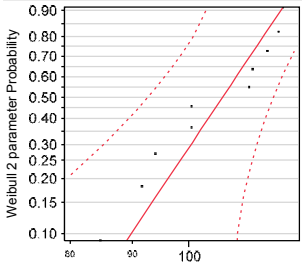
Goodness-of-Fit Test

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.

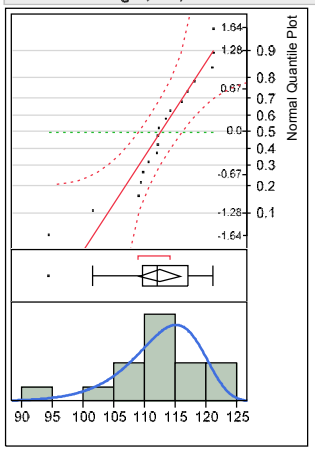
Diagnostic Plot



Ultimate Strength, ksi, Measured

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
☑	Weibull	120.734411
☐	Extreme Value	120.734411
☐	Johnson SI	123.514405
☐	Normal	123.691457
☐	Gamma	124.450487
☐	LogNormal	124.879927
☐	Johnson Su	126.877001
☐	GLog	127.794212
☐	Normal 2 Mixture	130.961542
☐	Normal 3 Mixture	144.382255
☐	Exponential	208.254501

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	115.27683	112.5211	117.94644
Shape	β	21.907241	14.679937	30.620533

-2log(Likelihood) = 115.934411163005

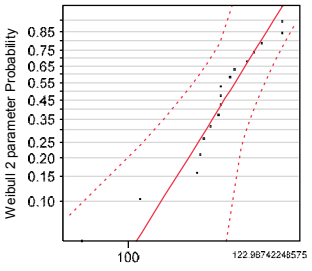
Goodness-of-Fit Test

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.

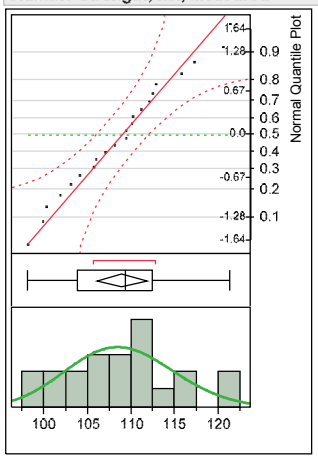
Diagnostic Plot



Ultimate Strength, ksi, Measured

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
☑	LogNormal	147.44042
☐	Gamma	147.489919
☐	Normal	147.668256
☐	Johnson SI	150.062722
☐	GLog	150.142174
☐	Weibull	150.475338
☐	Extreme Value	150.475338
☐	Johnson Su	153.08233
☐	Normal 2 Mixture	156.105677
☐	Normal 3 Mixture	169.65785
☐	Exponential	252.590826

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	4.6890656	4.66411	4.7140213
Shape	σ	0.0571344	0.0436578	0.0792877

-2log(Likelihood) = 142.808840746088

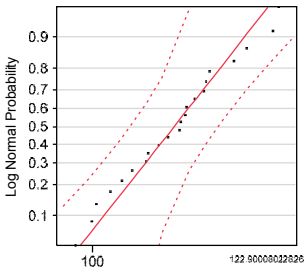
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.083251	>	0.1500

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

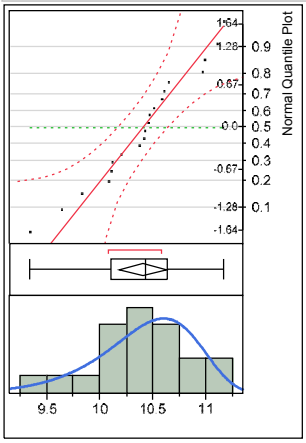
Diagnostic Plot



Ultimate Strength, ksi, Measured

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
☑	Weibull	30.3513528
☐	Extreme Value	30.3513528
☐	Normal	30.4393645
☐	Gamma	30.6504935
☐	LogNormal	30.7871993
☐	Johnson SI	32.6535118
☐	GLog	33.5813169
☐	Johnson Su	35.8191428
☐	Normal 2 Mixture	39.9449053
☐	Normal 3 Mixture	50.541782
☐	Exponential	135.897147

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	10.614822	10.411131	10.810835
Shape	β	25.841463	17.889686	35.242032

-2log(Likelihood) = 25.6454704054196

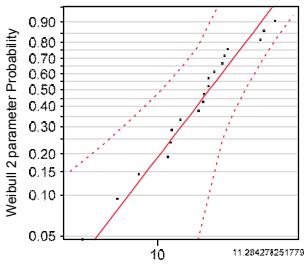
Goodness-of-Fit Test

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.

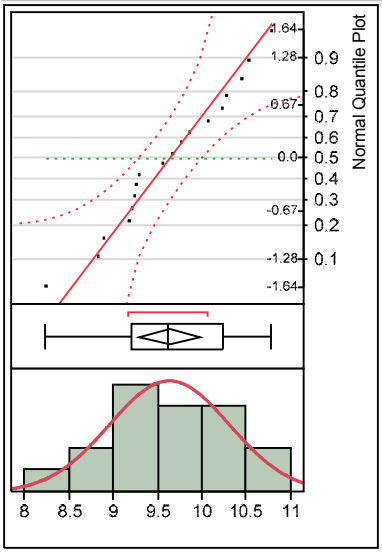
Diagnostic Plot



Modulus, Msi, Measured

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	μ	9.6283333	9.2913354	9.9653313
Dispersion	σ	0.6776712	0.5085161	1.0159267

-2log(Likelihood) = 36.0744360916319

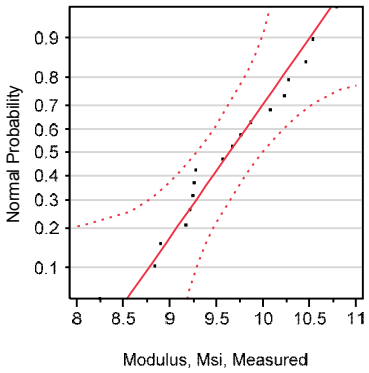
Goodness-of-Fit Test

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.

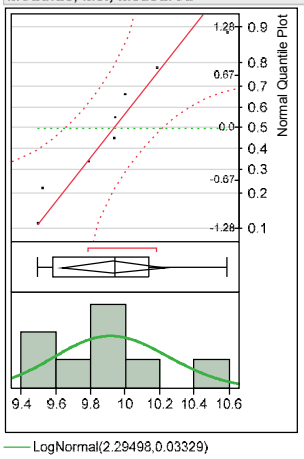
Diagnostic Plot



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
☑	LogNormal	11.3846224
☐	Gamma	11.4227682
☐	Normal	11.5743738
☐	Weibull	13.2629543
☐	Extreme Value	13.2629543
☐	Johnson SI	16.5604991
☐	GLog	16.9846224
☐	Johnson Su	28.4508136
☐	Normal 2 Mixture	46.4511272
☐	Exponential	55.3952315

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	2.2949785	2.2688397	2.3211174
Shape	σ	0.033294	0.0218441	0.0597544

-2log(Likelihood) = 4.98462243479453

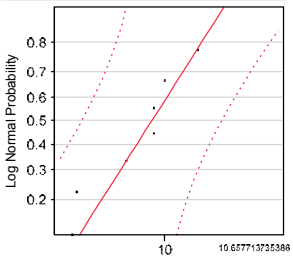
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.161978 >	0.1500

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

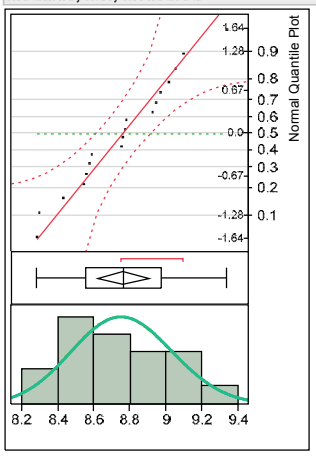
Diagnostic Plot



Modulus, Msi, Measured

Distributions Condition=ETD1

Modulus, Msi, Measured



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
☑	Gamma	10.0208933
☑	LogNormal	10.022139
☐	Normal	10.0613666
☐	Weibull	11.9100352
☐	Extreme Value	11.9100352
☐	Johnson SI	12.9359616
☐	GLog	12.9364018
☐	Johnson Su	16.298599
☐	Normal 2 Mixture	22.1367208
☐	Normal 3 Mixture	34.1937206
☐	Exponential	116.373628

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	2.1695904	2.1540051	2.1851757
Shape	σ	0.0319536	0.023799	0.0460965

-2log(Likelihood) = 5.22213902504784

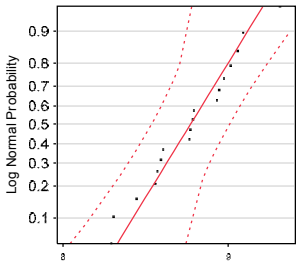
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.113967	>	0.1500

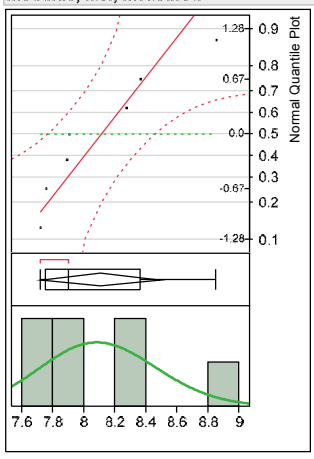
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETD2

Modulus, Msi, Measured



Summary Statistics

Mean	8.1061429
Std Dev	0.4117784
Std Err Mean	0.1556376
Upper 95% Mean	8.4869744
Lower 95% Mean	7.7253113
N	7

Compare Distributions

Show	Distribution	AICc
☑	LogNormal	13.1048594
☐	Gamma	13.1884048
☐	Normal	13.4433614
☐	Weibull	15.1614443
☐	Extreme Value	15.1614443
☐	Johnson SI	16.3244626
☐	GLog	20.1048594
☐	Johnson Su	30.3244626
☐	Exponential	46.0967101
☐	Normal 2 Mixture	72.9266894

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	2.0915417	2.0520236	2.1310599
Shape	σ	0.0462165	0.0295791	0.0870871

-2log(Likelihood) = 6.10485937700793

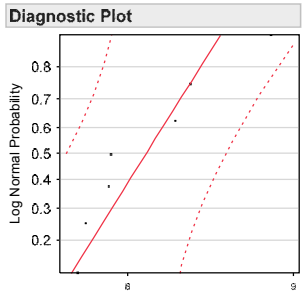
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.274753	0.1074

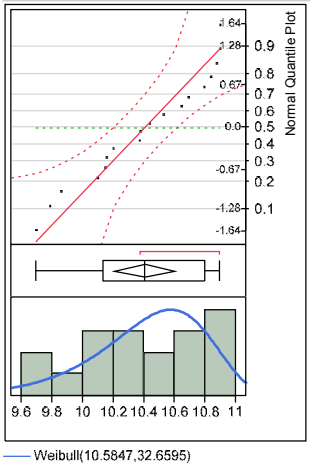
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW

Modulus, Msi, Measured



Weibull(10.5847,32.6595)

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
☑	Weibull	20.5806657
☐	Extreme Value	20.5806657
☐	Normal	21.5087948
☐	Gamma	21.6194341
☐	LogNormal	21.6967553
☐	Johnson SI	23.1337104
☐	GLog	24.3942293
☐	Normal 2 Mixture	26.9801391
☐	Johnson Su	27.7569578
☐	Normal 3 Mixture	41.3799829
☐	Exponential	122.570967

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	10.584689	10.412589	10.748472
Shape	β	32.659459	21.774066	46.208115

-2log(Likelihood) = 15.7806657011021

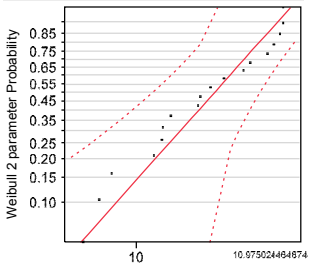
Goodness-of-Fit Test

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.

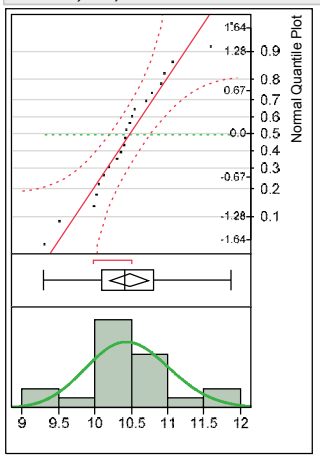
Diagnostic Plot



Modulus, Msi, Measured

Distributions Condition=ETW2

Modulus, Msi, Measured



LogNormal(2.34733,0.05489)

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
☑	LogNormal	42.6382157
☐	Gamma	42.7356922
☐	Normal	43.0284668
☐	Johnson SI	45.2191426
☐	GLog	45.3399701
☐	Johnson Su	47.3715043
☐	Weibull	47.7974405
☐	Extreme Value	47.7974405
☐	Normal 2 Mixture	49.1550783
☐	Normal 3 Mixture	66.5770852
☐	Exponential	149.548941

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	2.3473274	2.3233534	2.3713013
Shape	σ	0.054887	0.0419405	0.0761689

-2log(Likelihood) = 38.0066367690468

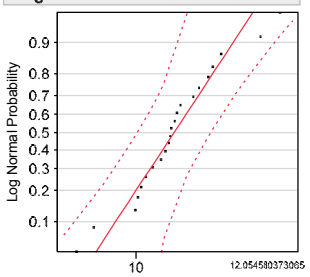
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.128369	>	0.1500

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

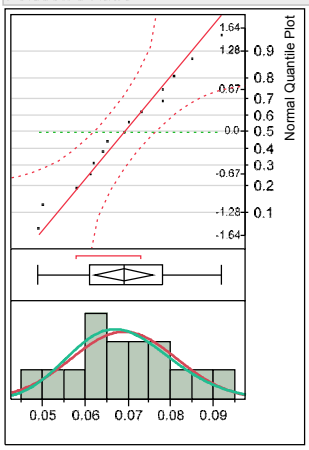
Diagnostic Plot



Modulus, Msi, Measured

Distributions Condition=CTD

Poisson's Ratio



Normal(0.06898,0.01235)
Gamma(32.7707,0.0021,0)

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
☑	Gamma	-85.300507
☑	Normal	-85.243803
☐	LogNormal	-85.136804
☐	Weibull	-84.811104
☐	Extreme Value	-84.811104
☐	Johnson Sl	-82.133616
☐	GLog	-81.954986
☐	Johnson Su	-78.315434
☐	Normal 2 Mixture	-71.317196
☐	Exponential	-47.910468
☐	Normal 3 Mixture	-46.867237

Fitted Normal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Location	μ	0.06898	0.0621383	0.0758217
Dispersion	σ	0.0123545	0.0090451	0.0194843

-2log(Likelihood) = -90.243802735415

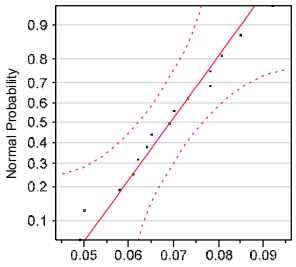
Goodness-of-Fit Test

Shapiro-Wilk W Test

W	Prob<W
0.979496	0.9660

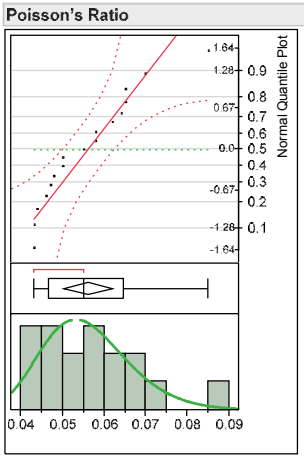
Note: Ho = The data is from the Normal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=RTD

Poisson's Ratio



LogNormal(-2.8998,0.18954)

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
☑	LogNormal	-102.04055
☐	Gamma	-101.45966
☐	Johnson Sl	-101.44844
☐	Normal	-99.795762
☐	GLog	-99.051542
☐	Johnson Su	-97.96126
☐	Weibull	-97.772177
☐	Extreme Value	-97.772177
☐	Normal 2 Mixture	-93.711196
☐	Normal 3 Mixture	-74.659158
☐	Exponential	-61.69936

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	-2.899827	-2.995264	-2.80439
Shape	σ	0.1895388	0.1400871	0.2767173

-2log(Likelihood) = -106.897696086961

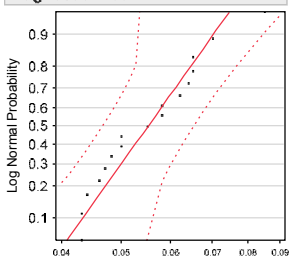
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.164158	>	0.1500

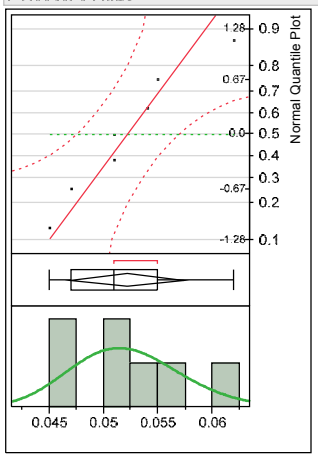
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

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
☑	LogNormal	-47.061436
☐	Gamma	-46.983913
☐	Normal	-46.698815
☐	Weibull	-45.705039
☐	Extreme Value	-45.705039
☐	Johnson SI	-40.310785
☐	GLog	-40.061436
☐	Johnson Su	-26.310785
☐	Exponential	-24.552753
☐	Normal 2 Mixture	20.2042993

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	-2.958625	-3.0425	-2.874749
Shape	σ	0.0980925	0.0627803	0.1848386

-2log(Likelihood) = -54.061436306655

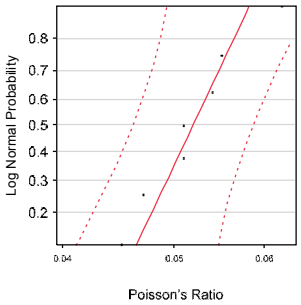
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.144270	>	0.1500

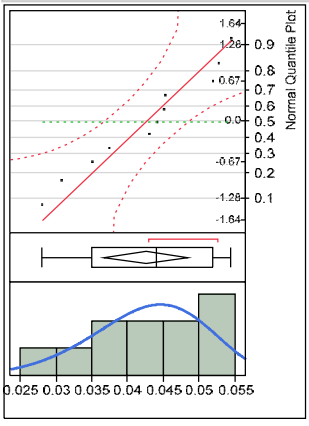
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

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
☑	Weibull	-68.842301
☐	Extreme Value	-68.842301
☐	Normal	-68.3411
☐	Gamma	-67.974398
☐	LogNormal	-67.620192
☐	Johnson SI	-64.833325
☐	GLog	-64.46094
☐	Johnson Su	-59.223416
☐	Normal 2 Mixture	-51.694583
☐	Exponential	-45.055914
☐	Normal 3 Mixture	2.71286836

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	0.0458896	0.0407338	0.0512939
Shape	β	5.9928887	3.5076461	9.2689488

-2log(Likelihood) = -74.3423007398136

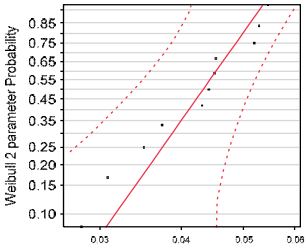
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square		Prob>W^2
0.044310	>	0.2500

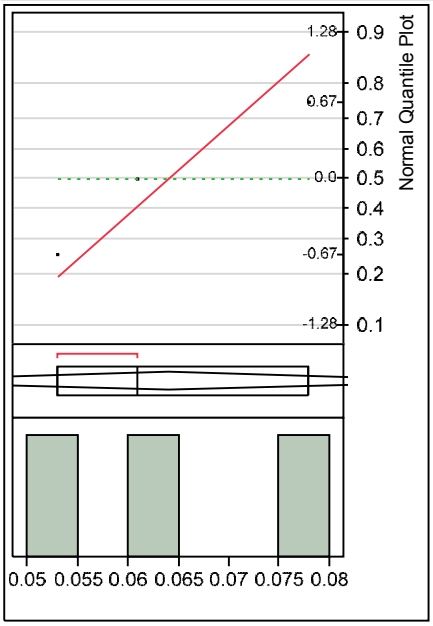
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETD2

Poisson's Ratio



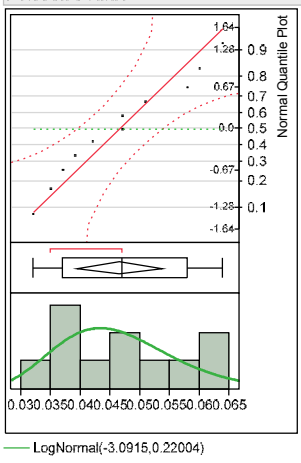
Summary Statistics

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
☑	LogNormal	-64.6026
☐	Gamma	-64.539276
☐	Normal	-64.052761
☐	Weibull	-63.841963
☐	Extreme Value	-63.841963
☐	Johnson SI	-60.784336
☐	GLog	-60.172601
☐	Johnson Su	-54.934502
☐	Normal 2 Mixture	-50.05472
☐	Exponential	-43.036726
☐	Normal 3 Mixture	14.1065287

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	-3.09148	-3.233738	-2.949223
Shape	σ	0.2200413	0.152459	0.357426

-2log(Likelihood) = -70.10260015000065

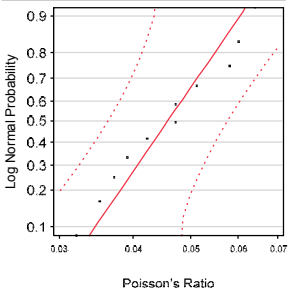
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.139152	>	0.1500

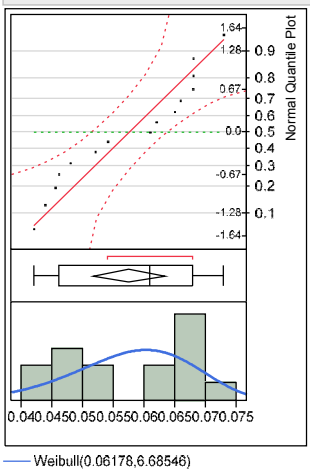
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

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
☑	Weibull	-90.464723
☐	Extreme Value	-90.464723
☐	Normal	-89.92706
☐	Gamma	-89.770435
☐	LogNormal	-89.55398
☐	Johnson SI	-87.207291
☐	GLog	-86.780135
☐	Normal 2 Mixture	-86.419898
☐	Johnson Su	-82.961947
☐	Normal 3 Mixture	-66.739822
☐	Exponential	-53.371418

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	0.0617842	0.0565135	0.0671423
Shape	β	6.6854558	4.2527765	9.8066886

-2log(Likelihood) = -95.4647231727737

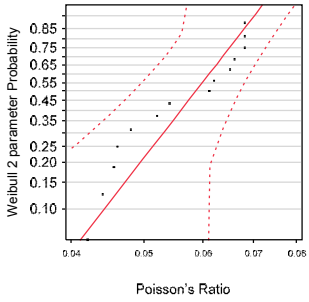
Goodness-of-Fit Test

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

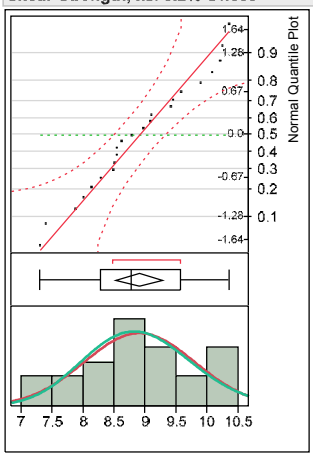


A.10 In-Plane Shear (IPS1)

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

Distributions Condition=CTD

Shear Strength, ksi 0.2% Offset



Summary Statistics

Mean	8.9027943
Std Dev	0.8924353
Std Err Mean	0.1860856
Upper 95% Mean	9.2887123
Lower 95% Mean	8.5168764
N	23

Compare Distributions

Show	Distribution	AICc
☑	Gamma	63.6203838
☑	Normal	63.6363134
☐	LogNormal	63.7048229
☐	Weibull	64.6702853
☐	Extreme Value	64.6702853
☐	Johnson SI	66.268901
☐	GLog	66.3679808
☐	Normal 2 Mixture	67.9312063
☐	Johnson Su	69.2279653
☐	Normal 3 Mixture	77.3333596
☐	Exponential	148.763275

Fitted Normal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Location	μ	8.9027943	8.5168764	9.2887123
Dispersion	σ	0.8924353	0.6902048	1.2631095

-2log(Likelihood) = 59.0363134165613

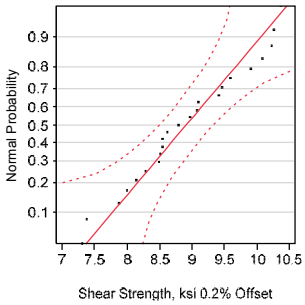
Goodness-of-Fit Test

Shapiro-Wilk W Test

W	Prob<W
0.962577	0.5173

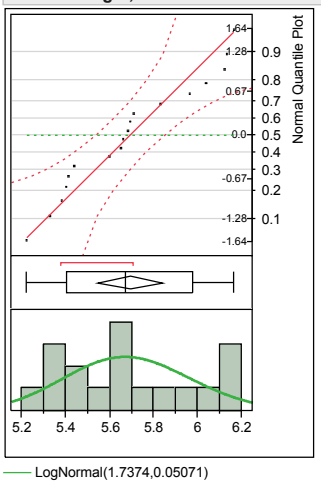
Note: Ho = The data is from the Normal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=RTD

Shear Strength, ksi 0.2% Offset



Summary Statistics

Mean	5.6898539
Std Dev	0.2980002
Std Err Mean	0.0702393
Upper 95% Mean	5.8380459
Lower 95% Mean	5.5416619
N	18

Compare Distributions

Show	Distribution	AICc
☑	LogNormal	11.090344
☐	Gamma	11.1404797
☐	Normal	11.2979824
☐	Johnson SI	11.2992656
☐	Weibull	13.102419
☐	Extreme Value	13.102419
☐	GLog	14.0046297
☐	Normal 2 Mixture	16.6475373
☐	Johnson Su	17.0829402
☐	Normal 3 Mixture	26.9856244
☐	Exponential	100.842644

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	1.7373957	1.7126613	1.7621301
Shape	σ	0.0507115	0.0377698	0.0731567

-2log(Likelihood) = 6.29034397406901

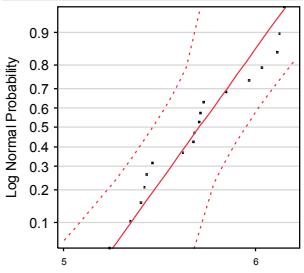
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.142427	>	0.1500

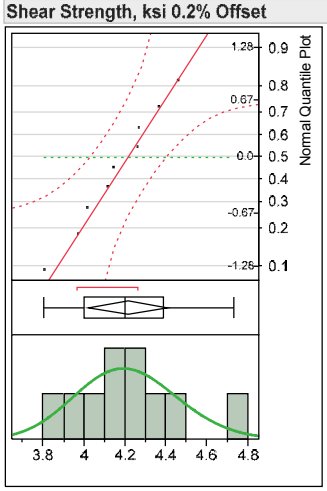
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETD1

Shear Strength, ksi 0.2% Offset



LogNormal(1.43612,0.05962)

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
☑	LogNormal	6.42142875
☐	Gamma	6.47928096
☐	Normal	6.67843674
☐	Weibull	8.41914426
☐	Extreme Value	8.41914426
☐	Johnson SI	10.5233434
☐	GLog	10.707143
☐	Johnson Su	16.5233434
☐	Normal 2 Mixture	28.5106416
☐	Exponential	51.2581821
☐	Normal 3 Mixture	165.398145

Fitted LogNormal

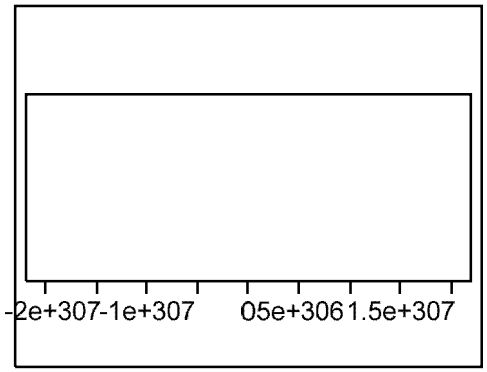
Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	1.4361224	1.3953179	1.4769269
Shape	σ	0.0596236	0.0406698	0.0995663

-2log(Likelihood) = 0.707143032862561

Distributions Condition=ETD2

Shear Strength, ksi 0.2% Offset



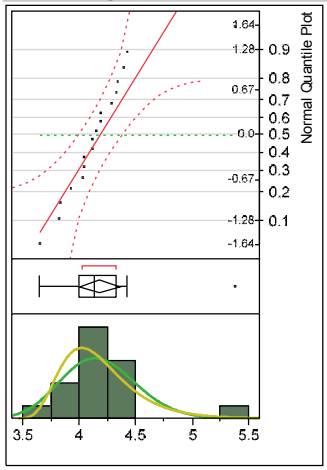
Quantiles

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



LogNormal(1.42604,0.08)
Johnson SI(0.45938,2.80935,3.26977,1)

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
☑	Johnson SI	15.7230173
☑	LogNormal	16.2941025
☐	Gamma	17.0341388
☐	Johnson Su	17.6743273
☐	Normal	18.7095829
☐	GLog	19.2083882
☐	Weibull	26.8106808
☐	Extreme Value	26.8106808
☐	Normal 2 Mixture	29.6219669
☐	Normal 3 Mixture	29.92891
☐	Exponential	89.7074522

Fitted LogNormal

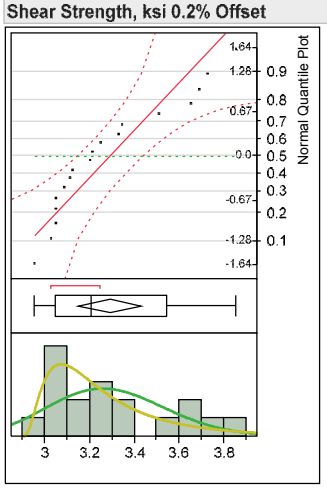
Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	1.4260429	1.387022	1.4650638
Shape	σ	0.0800022	0.0595855	0.1154117

-2log(Likelihood) = 11.4941024697866

Distributions Condition=ETW2

Shear Strength, ksi 0.2% Offset



Summary Statistics

Mean	3.288715
Std Dev	0.2798277
Std Err Mean	0.065956
Upper 95% Mean	3.4278701
Lower 95% Mean	3.1495599
N	18

Compare Distributions

Show	Distribution	AICc
☑	Johnson SI	5.6654058
☑	LogNormal	7.95090062
☐	Gamma	8.28047453
☐	Normal	9.03286629
☐	Normal 2 Mixture	10.7355536
☐	GLog	11.9183005
☐	Weibull	12.5651697
☐	Extreme Value	12.5651697
☐	Johnson Su	15.281016
☐	Normal 3 Mixture	28.5478162
☐	Exponential	81.1078888

Fitted LogNormal

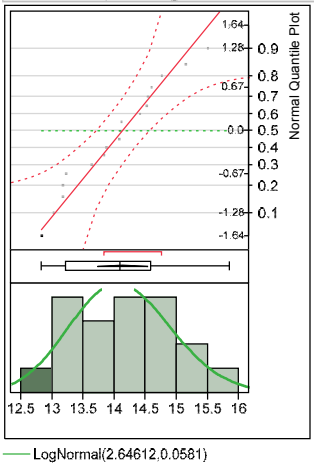
Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	1.1871947	1.147696	1.2264933
Shape	σ	0.0805717	0.0600096	0.1162331

-2log(Likelihood) = 3.15090062284904

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
☑	LogNormal	51.0876063
☐	Gamma	51.1649741
☐	Normal	51.3947058
☐	Johnson SI	53.6567301
☐	GLog	53.9376063
☐	Weibull	54.1452856
☐	Extreme Value	54.1452856
☐	Johnson Su	56.9138729
☐	Normal 2 Mixture	57.9783668
☐	Normal 3 Mixture	72.5593334
☐	Exponential	140.852297

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	2.6461223	2.6186217	2.6736229
Shape	σ	0.0580965	0.0435789	0.0828999

-2log(Likelihood) = 46.3376063309685

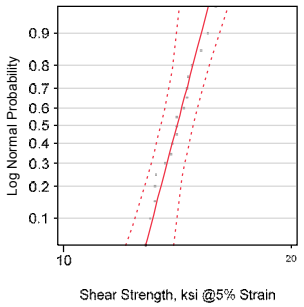
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.129022	>	0.1500

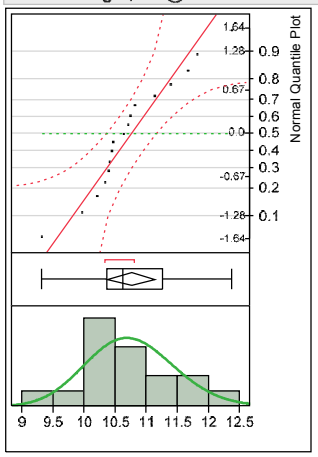
Note. Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=RTD

Shear Strength, ksi @5% Strain



Summary Statistics

Mean	10.751412
Std Dev	0.7414415
Std Err Mean	0.179826
Upper 95% Mean	11.132626
Lower 95% Mean	10.370198
N	17

Compare Distributions

Show	Distribution	AICc
☑	LogNormal	41.5185795
☐	Gamma	41.6204638
☐	Normal	41.9296468
☐	Johnson SI	44.364603
☐	GLog	44.5075905
☐	Weibull	45.1650214
☐	Extreme Value	45.1650214
☐	Johnson Su	47.0516176
☐	Normal 2 Mixture	52.8647135
☐	Normal 3 Mixture	72.2794104
☐	Exponential	117.017927

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	2.3728273	2.3394411	2.4062135
Shape	σ	0.0663051	0.0490058	0.0968022

-2log(Likelihood) = 36.6614366784075

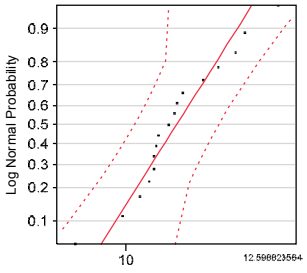
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.155020	>	0.1500

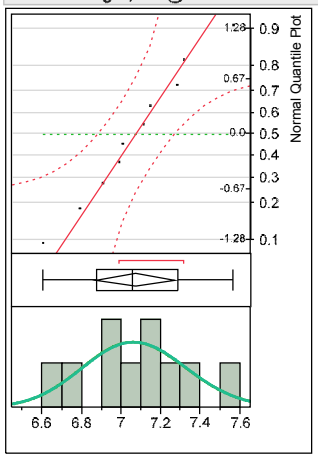
Note. Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETD1

Shear Strength, ksi @5% Strain



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
☑	Gamma	7.36527577
☑	LogNormal	7.36548535
☐	Normal	7.43001062
☐	Weibull	8.50396862
☐	Extreme Value	8.50396862
☐	Johnson SI	11.650982
☐	GLog	11.6511996
☐	Johnson Su	17.650982
☐	Normal 2 Mixture	30.1702268
☐	Exponential	61.6220181
☐	Normal 3 Mixture	166.683081

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	1.9554096	1.9299598	1.9808594
Shape	σ	0.0371873	0.0253658	0.0620996

-2log(Likelihood) = 1.65119963674144

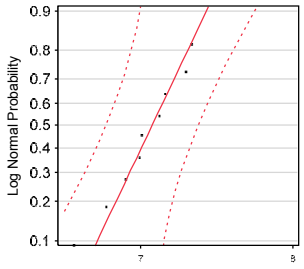
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.091890	>	0.1500

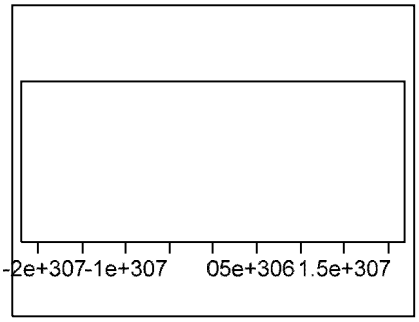
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETD2

Shear Strength, ksi @5% Strain



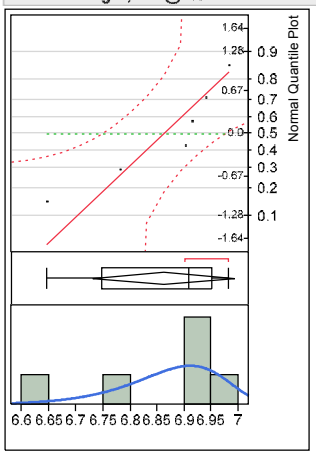
Quantiles

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
☑	Weibull	-2.6303616
☐	Extreme Value	-2.6303616
☐	Gamma	-0.9093714
☐	LogNormal	-0.8786403
☐	Normal	-0.8759926
☐	Johnson Sl	6.09944765
☐	GLog	9.03007822
☐	Exponential	38.1114044
☐	Johnson Su	39.0301041

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	6.9121949	6.8269374	6.994019
Shape	β	86.099462	39.013189	157.54994

-2log(Likelihood) = -10.6303615593938

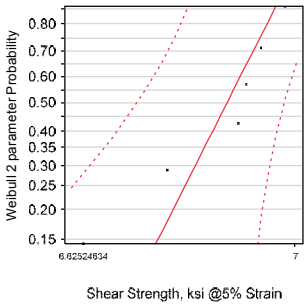
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square		Prob>W^2
0.054064	>	0.2500

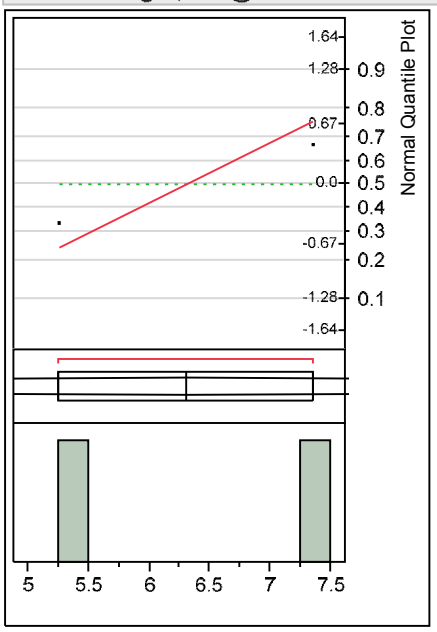
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Shear Strength, ksi @5% Strain

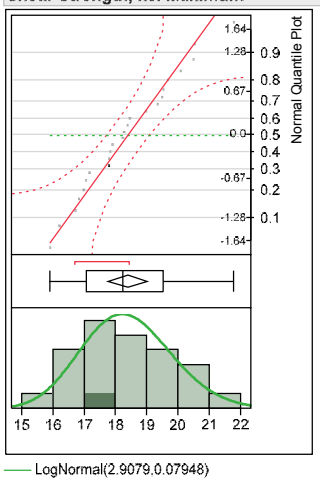


Summary Statistics

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



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
☑	LogNormal	90.7141189
☐	Gamma	90.8501458
☐	Normal	91.2598827
☐	Johnson SI	93.033162
☐	GLog	93.3426903
☐	Weibull	94.6574619
☐	Extreme Value	94.6574619
☐	Johnson Su	95.9384251
☐	Normal 2 Mixture	100.940661
☐	Normal 3 Mixture	110.551441
☐	Exponential	189.913355

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	2.9079002	2.8747847	2.9410158
Shape	σ	0.079484	0.061375	0.1086183

-2log(Likelihood) = 86.1426903213622

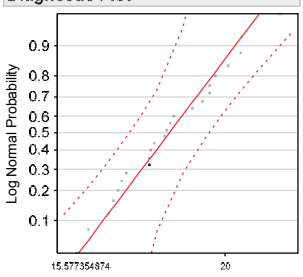
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.088870	>	0.1500

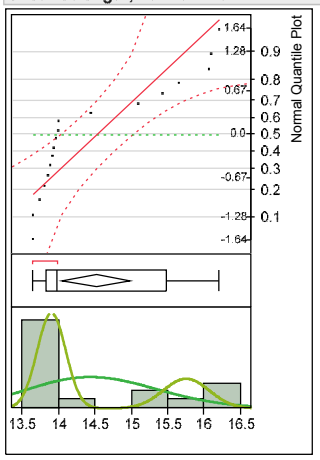
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

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
☑	Normal 2 Mixture	40.2779722
☐	Johnson SI	40.3013071
☑	LogNormal	51.9999083
☐	Gamma	52.2888086
☐	Normal	52.9257403
☐	Normal 3 Mixture	53.0433895
☐	GLog	55.8111743
☐	Weibull	56.7572675
☐	Extreme Value	56.7572675
☐	Johnson Su	59.173952
☐	Exponential	134.55084

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	2.6730726	2.6428408	2.7033044
Shape	σ	0.0619825	0.0461644	0.0894164

-2log(Likelihood) = 47.1999082516045

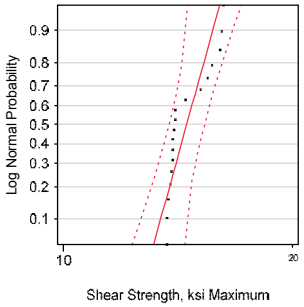
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.322190	<	0.0100*

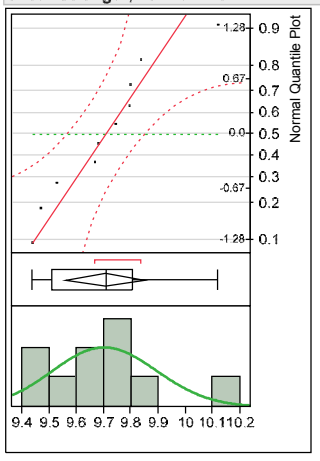
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

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
☑	LogNormal	1.06414629
☐	Gamma	1.09410268
☐	Normal	1.21103445
☐	Weibull	3.68487897
☐	Extreme Value	3.68487897
☐	Johnson SI	4.84449661
☐	GLog	5.34986057
☐	Johnson Su	10.8444966
☐	Normal 2 Mixture	19.4190891
☐	Exponential	67.9541267
☐	Normal 3 Mixture	155.103555

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	2.2725105	2.2589855	2.2860355
Shape	σ	0.0197628	0.0134804	0.0330021

-2log(Likelihood) = -4.65013942903228

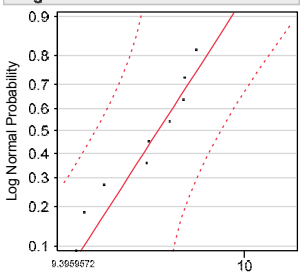
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.148650	>	0.1500

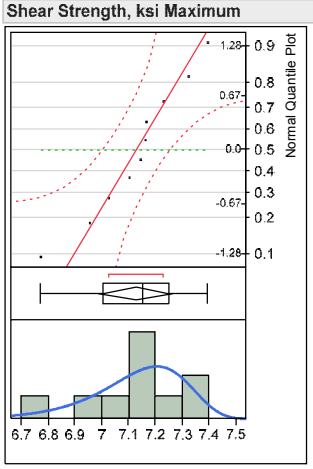
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

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	7.255766
Lower 95% Mean	6.9980312
N	10

Compare Distributions

Show	Distribution	AICc
☑	Weibull	-1.5489182
☐	Extreme Value	-1.5489182
☐	Normal	-1.1868928
☐	Gamma	-1.1635484
☐	LogNormal	-1.1225696
☐	Johnson SI	2.56654316
☐	GLog	3.16314467
☐	Johnson Su	8.5563816
☐	Normal 2 Mixture	19.2018623
☐	Exponential	61.7775232
☐	Normal 3 Mixture	153.242935

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	7.2069417	7.0967961	7.3119097
Shape	β	48.600094	28.200035	74.487401

-2log(Likelihood) = -7.26320393154998

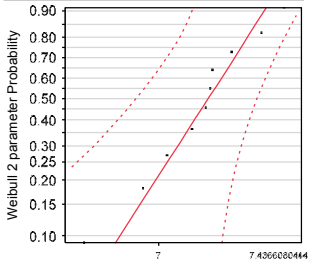
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square		Prob>W^2
0.031486	>	0.2500

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

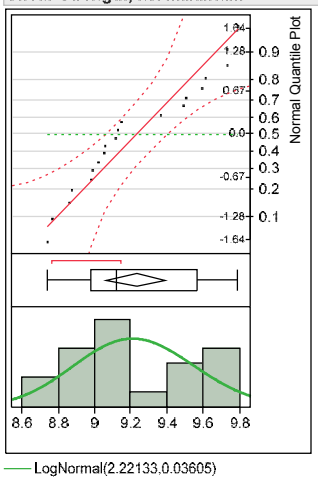
Diagnostic Plot



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
☑	LogNormal	17.4055801
☐	Gamma	17.4698339
☐	Normal	17.6384277
☐	Normal 2 Mixture	18.5686287
☐	Johnson SI	19.1086747
☐	Weibull	20.0121606
☐	Extreme Value	20.0121606
☐	GLog	20.4066793
☐	Johnson Su	23.5734175
☐	Normal 3 Mixture	29.5361119
☐	Exponential	131.101662

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	2.2213342	2.2047438	2.2379245
Shape	σ	0.0360525	0.0272225	0.0509311

-2log(Likelihood) = 12.6996977024128

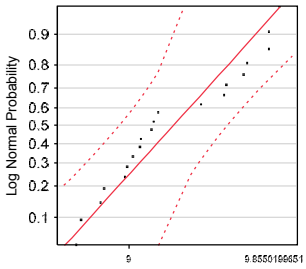
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.185213	0.0719

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

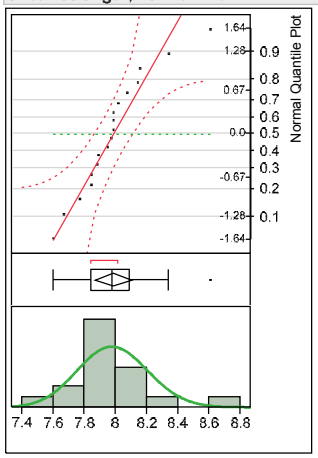
Diagnostic Plot



Shear Strength, ksi Maximum

Distributions Condition=ETW2

Shear Strength, ksi Maximum



LogNormal(2.07692,0.02836)

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
☑	LogNormal	2.39630435
☐	Gamma	2.53442653
☐	Normal	2.85598076
☐	Johnson SI	3.78946021
☐	GLog	5.31059007
☐	Johnson Su	6.61092724
☐	Weibull	9.4647064
☐	Extreme Value	9.4647064
☐	Normal 2 Mixture	13.7683647
☐	Normal 3 Mixture	26.7184687
☐	Exponential	113.03376

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	2.0769214	2.0630868	2.0907559
Shape	σ	0.0283642	0.0211256	0.0409183

-2log(Likelihood) = -2.40369564575545

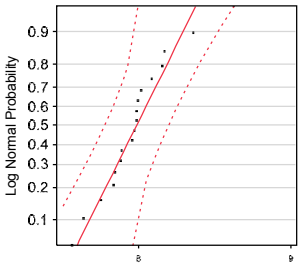
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.167565	>	0.1500

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

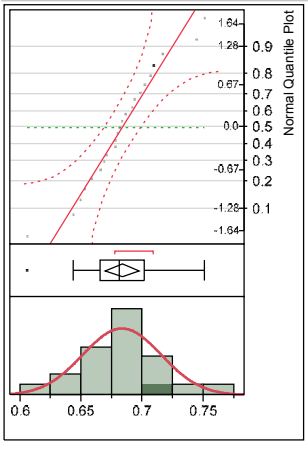
Diagnostic Plot



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
☑	Normal	-89.202531
☐	Gamma	-89.169872
☐	LogNormal	-89.112537
☐	Johnson SI	-86.562062
☐	GLog	-86.449379
☐	Weibull	-86.081679
☐	Extreme Value	-86.081679
☐	Johnson Su	-84.398422
☐	Normal 2 Mixture	-83.2923
☐	Normal 3 Mixture	-64.262715
☐	Exponential	30.6642084

Fitted Normal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Location	μ	0.6831739	0.6692579	0.6970899
Dispersion	σ	0.0321808	0.0248885	0.0455472

-2log(Likelihood) = -93.8025312640474

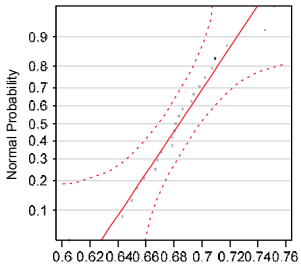
Goodness-of-Fit Test

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.

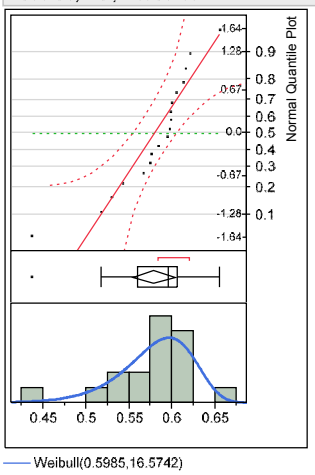
Diagnostic Plot



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
☑	Weibull	-58.290827
☐	Extreme Value	-58.290827
☐	Johnson SI	-55.473445
☐	Johnson Su	-54.322358
☐	Normal	-53.865799
☐	Gamma	-52.35367
☐	LogNormal	-51.507739
☐	GLog	-48.593453
☐	Normal 2 Mixture	-46.223214
☐	Normal 3 Mixture	-25.909398
☐	Exponential	18.5880604

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	0.598504	0.5797895	0.6169113
Shape	β	16.574189	11.078366	23.054533

-2log(Likelihood) = -63.090827369034

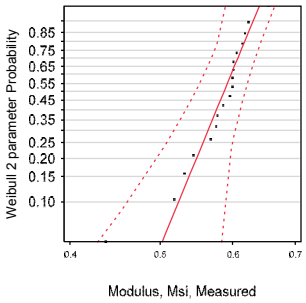
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square		Prob>W^2
0.064912	>	0.2500

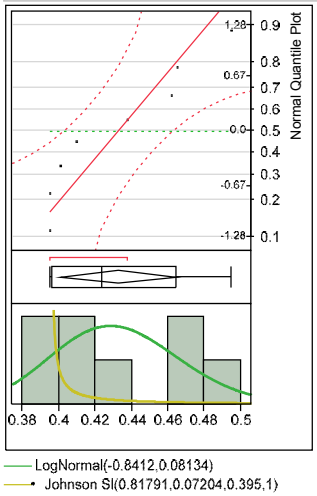
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

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
☑	Johnson SI	-104.86484
☑	LogNormal	-24.502095
☐	Gamma	-24.422325
☐	Normal	-24.167722
☐	Weibull	-23.251826
☐	Extreme Value	-23.251826
☐	GLog	-18.635973
☐	Johnson Su	-9.3026242
☐	Normal 2 Mixture	3.34400165
☐	Exponential	5.26052303

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	-0.841222	-0.905082	-0.777361
Shape	σ	0.0813416	0.053368	0.1459879

-2log(Likelihood) = -30.9020950433832

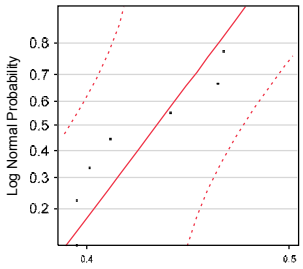
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.232147	>	0.1500

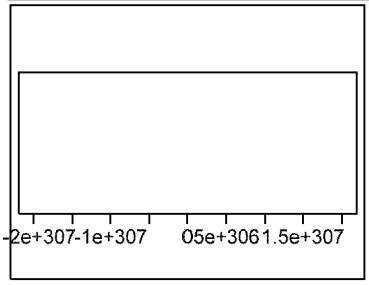
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETD2

Modulus, Msi, Measured



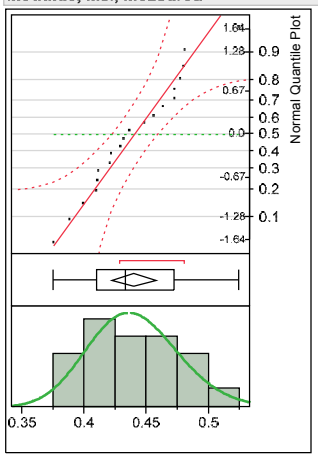
Quantiles

Summary Statistics

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

Distributions Condition=ETW

Modulus, Msi, Measured



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
☑	LogNormal	-71.091052
☐	Gamma	-71.019732
☐	Normal	-70.742546
☐	Johnson SI	-68.376417
☐	GLog	-68.296935
☐	Weibull	-68.190891
☐	Extreme Value	-68.190891
☐	Johnson Su	-65.20975
☐	Normal 2 Mixture	-60.299675
☐	Normal 3 Mixture	-44.314049
☐	Exponential	9.39209002

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	-0.824201	-0.862367	-0.786035
Shape	σ	0.0829381	0.0626249	0.1171661

-2log(Likelihood) = -75.7969348359132

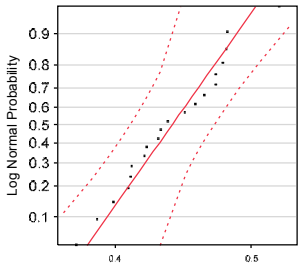
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.112001	>	0.1500

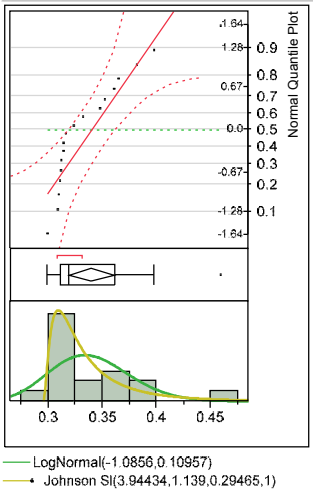
Note. Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Modulus, Msi, Measured



Summary Statistics

Mean	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
☑	Johnson SI	-70.556946
☐	Johnson Su	-67.194309
☐	Normal 2 Mixture	-64.586917
☑	LogNormal	-62.802301
☐	Gamma	-61.927848
☐	Normal	-59.972329
☐	GLog	-59.888015
☐	Weibull	-54.345448
☐	Extreme Value	-54.345448
☐	Normal 3 Mixture	-48.552725
☐	Exponential	-0.6047992

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	-1.085588	-1.139031	-1.032146
Shape	σ	0.10957	0.0816075	0.1580663

-2log(Likelihood) = -67.6023007264374

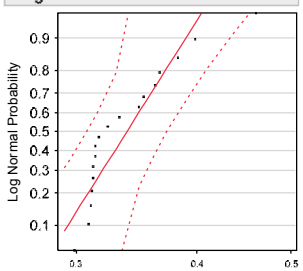
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.227819	0.0194*

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

Diagnostic Plot

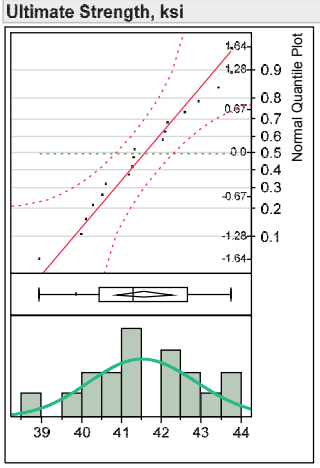


A.11 Quasi Isotropic Open Hole Compression (OHC1)

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

Distributions Condition=RTD

Ultimate Strength, ksi



Summary Statistics	
Mean	41.559877
Std Dev	1.3812456
Std Err Mean	0.3255627
Upper 95% Mean	42.246754
Lower 95% Mean	40.873
N	18

Compare Distributions

Show	Distribution	AICc
☑	Gamma	66.4683715
☑	LogNormal	66.4691216
☐	Normal	66.5092728
☐	Weibull	67.9315843
☐	Extreme Value	67.9315843
☐	Johnson SI	69.3832883
☐	GLog	69.3834074
☐	Johnson Su	72.7459256
☐	Normal 2 Mixture	74.2695602
☐	Normal 3 Mixture	91.0875313
☐	Exponential	172.426867

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	3.7266135	3.7108566	3.7423704
Shape	σ	0.0323054	0.024061	0.0466039

-2log(Likelihood) = 61.6691216407923

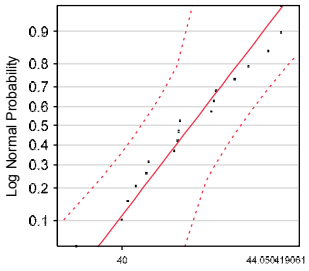
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.123262	>	0.1500

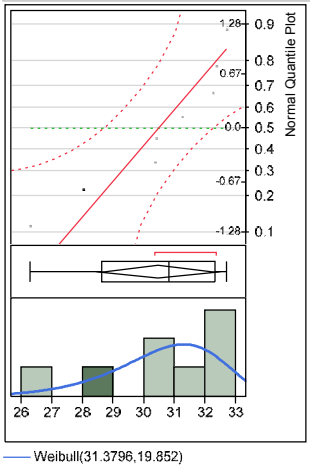
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETD2

Ultimate Strength, ksi



Summary Statistics	
Mean	30.465399
Std Dev	2.2635965
Std Err Mean	0.8003022
Upper 95% Mean	32.357813
Lower 95% Mean	28.572985
N	8

Compare Distributions

Show	Distribution	AICc
☑	Weibull	39.4042869
☐	Extreme Value	39.4042869
☐	Normal	41.174295
☐	Gamma	41.419921
☐	LogNormal	41.5886778
☐	Johnson SI	42.6469558
☐	GLog	46.7060442
☐	Johnson Su	56.0394809
☐	Normal 2 Mixture	72.1572505
☐	Exponential	73.3321321

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	31.379561	30.021015	32.712551
Shape	β	19.852002	10.187054	33.754974

-2log(Likelihood) = 33.0042868626339

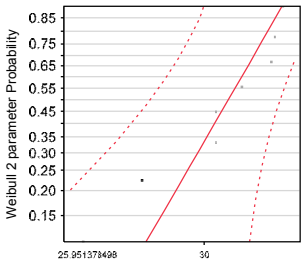
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square		Prob>W^2
0.052039	>	0.2500

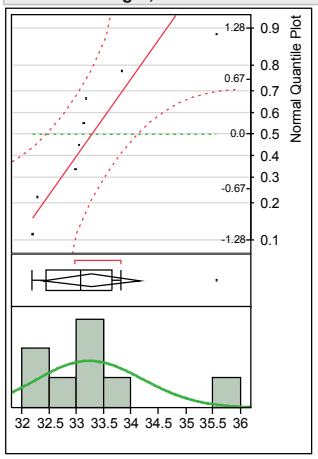
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



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
☑	LogNormal	28.7006695
☐	Gamma	28.7966404
☐	Normal	29.0621012
☐	Johnson SI	31.2265986
☐	Weibull	32.2003241
☐	Extreme Value	32.2003241
☐	GLog	34.3006695
☐	Johnson Su	40.7666132
☐	Normal 2 Mixture	63.9388546
☐	Exponential	74.7378118

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	3.5040113	3.4809849	3.5270378
Shape	σ	0.0293296	0.0192431	0.0526393

-2log(Likelihood) = 22.3006694642085

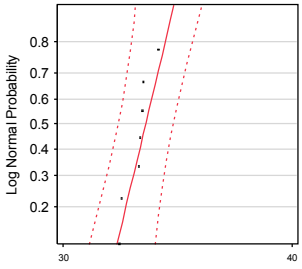
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.281746	0.0607

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

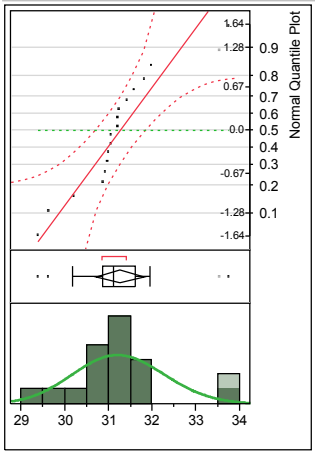
Diagnostic Plot



Ultimate Strength, ksi

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
☑	LogNormal	57.6990457
☐	Gamma	57.8243251
☐	Normal	58.1264986
☐	Johnson Su	58.5312456
☐	Normal 2 Mixture	59.5067793
☐	Johnson SI	59.7754848
☐	GLog	60.6133314
☐	Weibull	63.6705162
☐	Extreme Value	63.6705162
☐	Normal 3 Mixture	69.6229151
☐	Exponential	162.163837

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	3.4414802	3.4250553	3.457905
Shape	σ	0.033675	0.025081	0.0485797

-2log(Likelihood) = 52.8990457023508

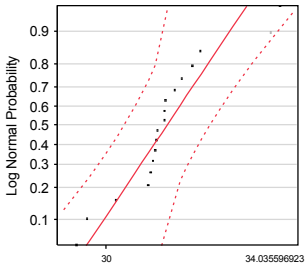
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.186236	0.0957

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

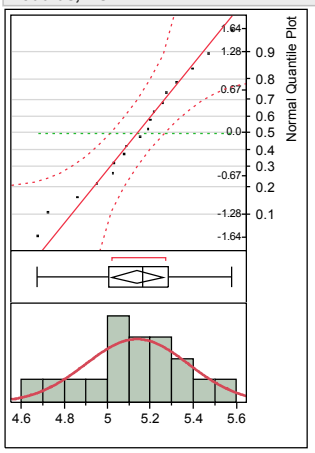
Diagnostic Plot



Ultimate Strength, ksi

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
☑	Normal	3.48216914
☐	Gamma	3.5888807
☐	LogNormal	3.67267649
☐	Weibull	4.11273534
☐	Extreme Value	4.11273534
☐	Johnson SI	6.18115242
☐	GLog	6.36760327
☐	Johnson Su	9.09757148
☐	Normal 2 Mixture	11.2856766
☐	Normal 3 Mixture	27.5012415
☐	Exponential	97.1586101

Fitted Normal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Location	μ	5.1363889	5.0171173	5.2556604
Dispersion	σ	0.2398439	0.1799759	0.3595605

-2log(Likelihood) = -1.31783086055385

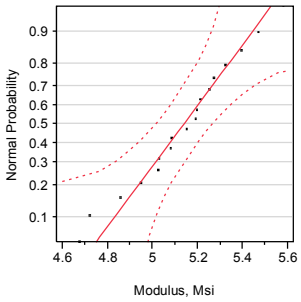
Goodness-of-Fit Test

Shapiro-Wilk W Test

W	Prob<W
0.982085	0.9689

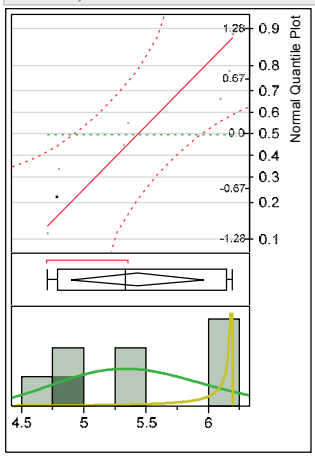
Note: Ho = The data is from the Normal distribution. Small p-values reject Ho.

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
☑	Johnson SI	-2.8433162
☑	LogNormal	20.9986795
☐	Gamma	21.0287933
☐	Normal	21.2019399
☐	Weibull	21.3952255
☐	Extreme Value	21.3952255
☐	GLog	26.7336887
☐	Johnson Su	36.0670725
☐	Exponential	45.7262707
☐	Normal 2 Mixture	45.8926238

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	1.6849707	1.5972368	1.7727047
Shape	σ	0.1117499	0.0733189	0.2005632

-2log(Likelihood) = 14.598679468637

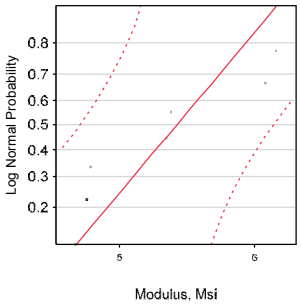
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.237534	>	0.1500

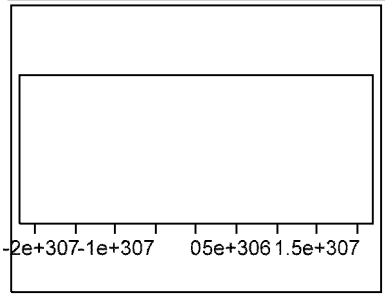
Note. Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW

Modulus, Msi



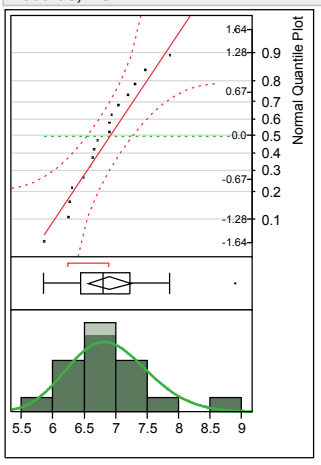
Quantiles

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
☑	LogNormal	39.8384022
☐	Gamma	40.4003525
☐	Johnson SI	40.5372028
☐	Normal	41.7276722
☐	GLog	42.7526879
☐	Johnson Su	43.6604407
☐	Weibull	47.531398
☐	Extreme Value	47.531398
☐	Normal 2 Mixture	52.6400561
☐	Normal 3 Mixture	67.9275567
☐	Exponential	107.759835

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	1.9263455	1.8808414	1.9718496
Shape	σ	0.0932944	0.0694855	0.134587

-2log(Likelihood) = 35.038402226102

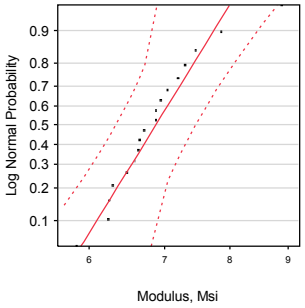
Goodness-of-Fit Test

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

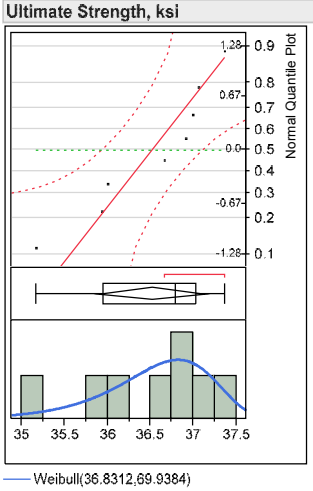


A.12 Soft Open Hole Compression (OHC2)

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

Distributions Condition=RTD

Ultimate Strength, ksi



Summary Statistics

Mean	36.515703
Std Dev	0.7419872
Std Err Mean	0.2623321
Upper 95% Mean	37.13602
Lower 95% Mean	35.895386
N	8

Compare Distributions

Show	Distribution	AICc
☑	Weibull	21.8311733
☐	Extreme Value	21.8311733
☐	Normal	23.3282446
☐	Gamma	23.3298004
☐	LogNormal	23.3655804
☐	Johnson SI	26.8116305
☐	GLog	28.8599942
☐	Johnson Su	38.193421
☐	Normal 2 Mixture	54.4575988
☐	Exponential	76.2305449

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	36.831242	36.373163	37.265839
Shape	β	69.938445	36.336035	117.22214

-2log(Likelihood) = 15.4311732945542

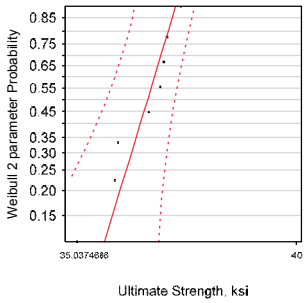
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square	Prob>W^2
0.055013 >	0.2500

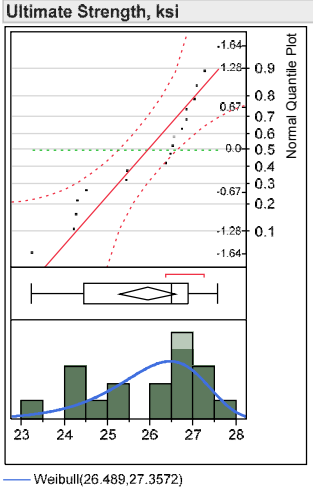
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Ultimate Strength, ksi



Summary Statistics

Mean	25.924838
Std Dev	1.3014027
Std Err Mean	0.3067436
Upper 95% Mean	26.57201
Lower 95% Mean	25.277665
N	18

Compare Distributions

Show	Distribution	AICc
☑	Weibull	61.2211261
☐	Extreme Value	61.2211261
☐	Johnson SI	62.5513517
☐	Normal 2 Mixture	63.9470382
☐	Normal	64.3657238
☐	Gamma	64.7255563
☐	LogNormal	64.9321904
☐	GLog	67.2511584
☐	Johnson Su	70.6139275
☐	Normal 3 Mixture	76.7875572
☐	Exponential	155.437254

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	26.488971	25.975369	26.980354
Shape	β	27.357212	17.966748	39.22442

-2log(Likelihood) = 56.4211261418134

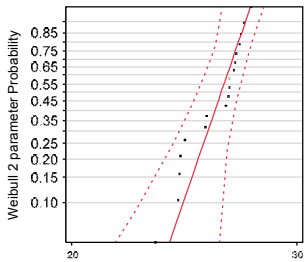
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square	Prob>W^2
0.128254	0.0383*

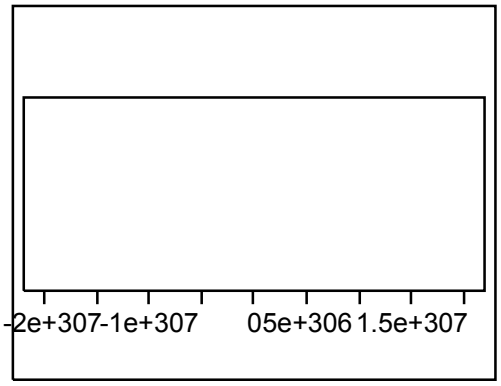
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Modulus, Msi



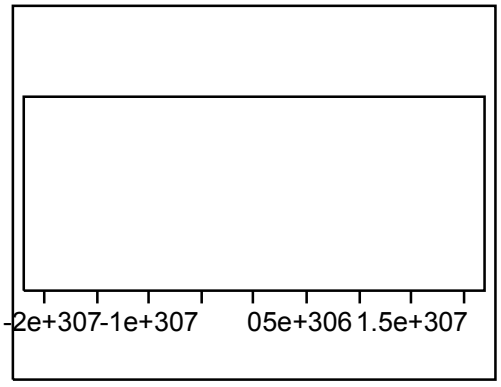
Quantiles

Summary Statistics

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

Distributions Condition=RTD

Modulus, Msi



Quantiles

Summary Statistics

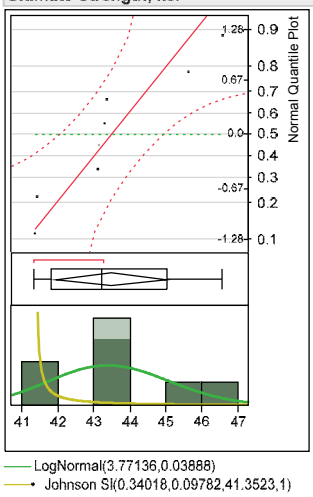
Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

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=RTD

Ultimate Strength, ksi



Summary Statistics	
Mean	43.472313
Std Dev	1.8234343
Std Err Mean	0.6446814
Upper 95% Mean	44.996742
Lower 95% Mean	41.947884
N	8

Compare Distributions

Show	Distribution	AICc
☑	Johnson SI	16.2564256
☑	LogNormal	37.4887537
☐	Gamma	37.5386
☐	Normal	37.7145634
☐	Weibull	39.2380154
☐	Extreme Value	39.2380154
☐	GLog	43.0887537
☐	Johnson Su	51.5556052
☐	Normal 2 Mixture	68.495266
☐	Exponential	79.0206546

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	3.7713639	3.7408389	3.8018888
Shape	σ	0.0388808	0.0255096	0.0697813

-2log(Likelihood) = 31.0887537457447

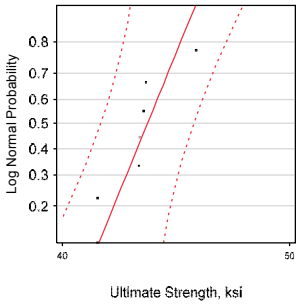
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.269391	0.0860

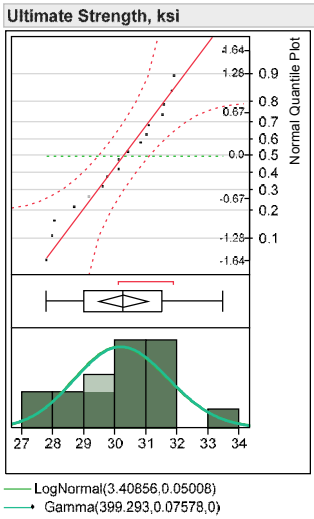
Note. Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Ultimate Strength, ksi



Summary Statistics	
Mean	30.259442
Std Dev	1.5572787
Std Err Mean	0.3670541
Upper 95% Mean	31.033858
Lower 95% Mean	29.485025
N	18

Compare Distributions

Show	Distribution	AICc
☑	Gamma	70.7903082
☑	LogNormal	70.8036176
☐	Normal	70.8276231
☐	Weibull	72.5664766
☐	Extreme Value	72.5664766
☐	Johnson SI	73.7052864
☐	GLog	73.7179033
☐	Johnson Su	77.0679238
☐	Normal 2 Mixture	78.1590517
☐	Normal 3 Mixture	98.7188195
☐	Exponential	161.003097

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	3.4085555	3.3841273	3.4329837
Shape	σ	0.0500837	0.0373022	0.072251

-2log(Likelihood) = 66.0036175672457

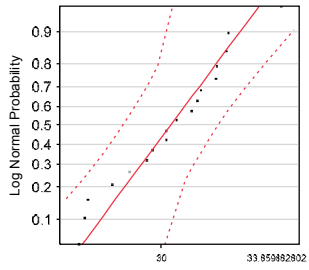
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.099279	>	0.1500

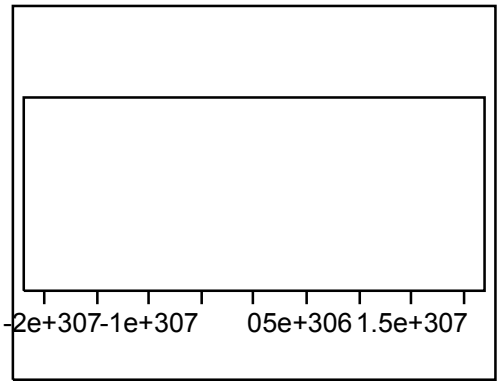
Note. Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Modulus, Msi



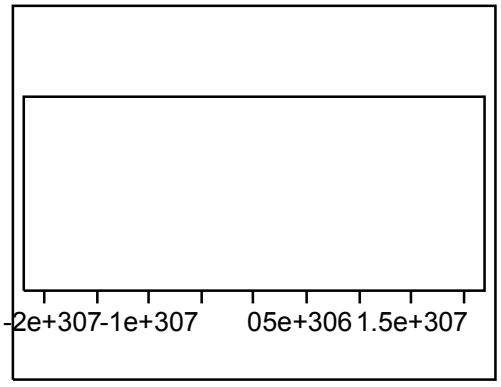
Quantiles

Summary Statistics

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

Distributions Condition=RTD

Modulus, Msi



Quantiles

Summary Statistics

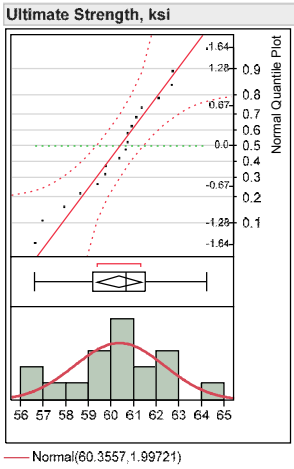
Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

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=CTD

Ultimate Strength, ksi



Summary Statistics

Mean	60.355651
Std Dev	1.9972122
Std Err Mean	0.4707474
Upper 95% Mean	61.348841
Lower 95% Mean	59.36246
N	18

Compare Distributions

Show	Distribution	AICc
☑	Normal	79.7848701
☐	Gamma	79.8314094
☐	LogNormal	79.8772534
☐	Weibull	80.8854235
☐	Extreme Value	80.8854235
☐	Johnson SI	82.5590737
☐	GLog	82.7915391
☐	Johnson Su	85.9153589
☐	Normal 2 Mixture	88.2609208
☐	Normal 3 Mixture	108.337383
☐	Exponential	185.859165

Fitted Normal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Location	μ	60.355651	59.36246	61.348841
Dispersion	σ	1.9972122	1.4986833	2.9941086

-2log(Likelihood) = 74.9848700571045

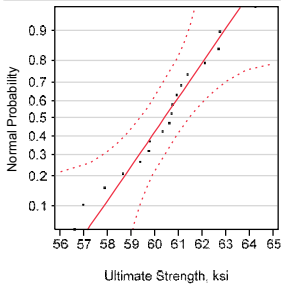
Goodness-of-Fit Test

Shapiro-Wilk W Test

W	Prob<W
0.975063	0.8856

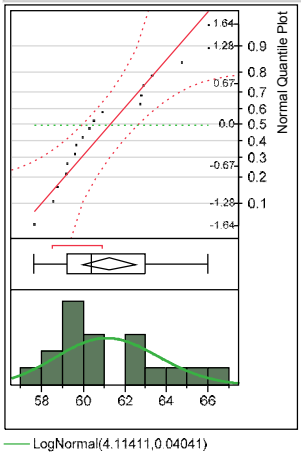
Note: Ho = The data is from the Normal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=RTD

Ultimate Strength, ksi



Summary Statistics

Mean	61.248333
Std Dev	2.5735744
Std Err Mean	0.6065973
Upper 95% Mean	62.528142
Lower 95% Mean	59.968525
N	18

Compare Distributions

Show	Distribution	AICc
☑	LogNormal	88.4748457
☐	Gamma	88.6050925
☐	Normal	88.9124345
☐	Johnson SI	88.9207337
☐	GLog	91.797868
☐	Weibull	92.5930325
☐	Extreme Value	92.5930325
☐	Normal 2 Mixture	93.8345091
☐	Johnson Su	95.1607013
☐	Normal 3 Mixture	101.315898
☐	Exponential	186.387719

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	4.1141146	4.0944062	4.133823
Shape	σ	0.040407	0.0300951	0.0582914

-2log(Likelihood) = 83.6748456719172

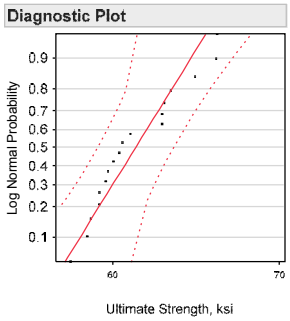
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.170441	> 0.1500

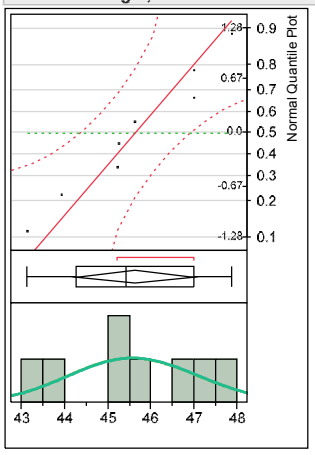
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETD2

Ultimate Strength, ksi



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
☑	Gamma	35.7200828
☑	LogNormal	35.736852
☐	Weibull	35.7571015
☐	Extreme Value	35.7571015
☐	Normal	35.7603723
☐	Johnson SI	41.1949679
☐	GLog	41.2921217
☐	Johnson Su	50.6255111
☐	Normal 2 Mixture	68.8634968
☐	Exponential	79.7945334

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	3.8199419	3.7938801	3.8460038
Shape	σ	0.033196	0.0217798	0.0595785

-2log(Likelihood) = 29.3368520354281

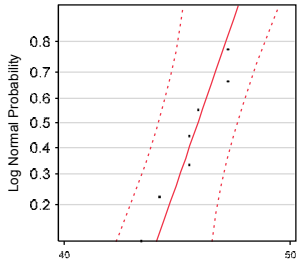
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.191896	>	0.1500

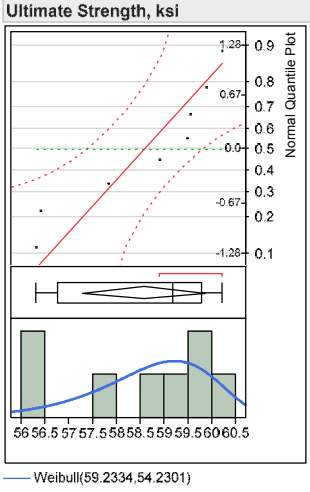
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW

Ultimate Strength, ksi



Summary Statistics

Mean	58.573675
Std Dev	1.5447152
Std Err Mean	0.5461393
Upper 95% Mean	59.865089
Lower 95% Mean	57.28226
N	8

Compare Distributions

Show	Distribution	AICc
☑	Weibull	33.6130029
☐	Extreme Value	33.6130029
☐	Normal	35.0604491
☐	Gamma	35.0672269
☐	LogNormal	35.1059012
☐	Johnson SI	37.8528906
☐	GLog	40.5921993
☐	Johnson Su	49.9256583
☐	Normal 2 Mixture	64.4232151
☐	Exponential	83.7912324

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	59.233419	58.279716	60.139198
Shape	β	54.230147	27.966682	92.110315

-2log(Likelihood) = 27.2130029226801

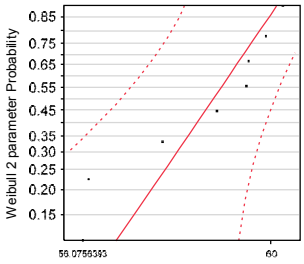
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square		Prob>W^2
0.064013	>	0.2500

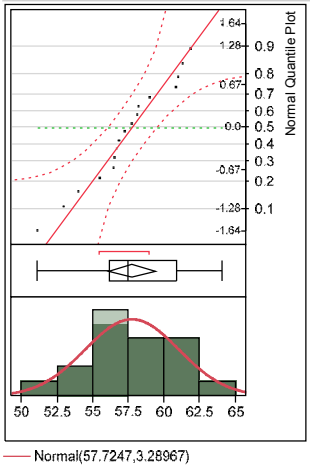
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Ultimate Strength, ksi



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
☑	Normal	97.7501665
☐	Gamma	97.7895084
☐	LogNormal	97.8484858
☐	Weibull	99.060731
☐	Extreme Value	99.060731
☐	Johnson SI	100.621844
☐	GLog	100.762771
☐	Johnson Su	103.984481
☐	Normal 2 Mixture	109.898655
☐	Normal 3 Mixture	123.926128
☐	Exponential	184.254676

Fitted Normal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Location	μ	57.724716	56.0888	59.360633
Dispersion	σ	3.2896735	2.4685302	4.9316942

-2log(Likelihood) = 92.9501665456753

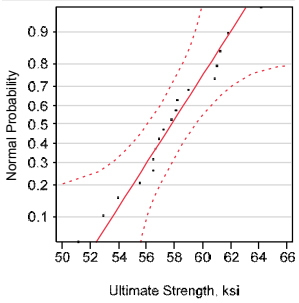
Goodness-of-Fit Test

Shapiro-Wilk W Test

W	Prob<W
0.980348	0.9535

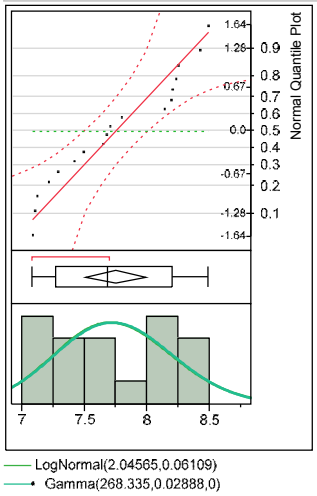
Note: Ho = The data is from the Normal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=CTD

Modulus, Msi



Summary Statistics

Mean	7.7486111
Std Dev	0.4865878
Std Err Mean	0.1146898
Upper 95% Mean	7.9905855
Lower 95% Mean	7.5066367
N	18

Compare Distributions

Show	Distribution	AICc
☑	Gamma	28.8872849
☑	LogNormal	28.8882443
☐	Normal	28.9496202
☐	Weibull	29.572477
☐	Extreme Value	29.572477
☐	Normal 2 Mixture	31.3674989
☐	Johnson SI	31.7957767
☐	GLog	31.8350545
☐	Johnson Su	35.1977307
☐	Normal 3 Mixture	43.8251589
☐	Exponential	111.96049

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	2.0456491	2.0158545	2.0754437
Shape	σ	0.0610862	0.0454968	0.0881232

-2log(Likelihood) = 24.0882442881548

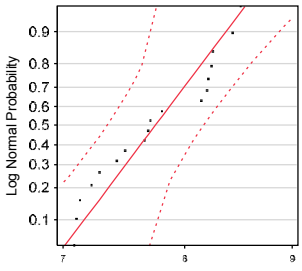
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.189338	0.0866

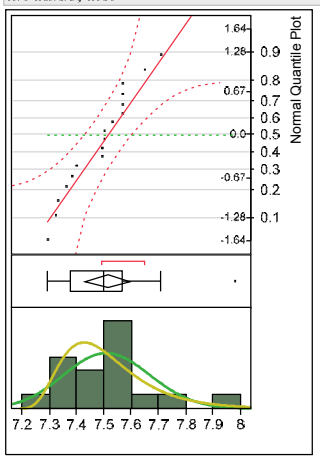
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=RTD

Modulus, Msi



Summary Statistics

Mean	7.5116667
Std Dev	0.165325
Std Err Mean	0.0389675
Upper 95% Mean	7.5936809
Lower 95% Mean	7.4294525
N	18

Compare Distributions

Show	Distribution	AICc
☑	Johnson SI	-10.645528
☑	LogNormal	-10.349582
☐	Gamma	-10.216561
☐	Normal	-9.9125282
☐	GLog	-7.4352962
☐	Johnson Su	-7.2828902
☐	Weibull	-2.1218025
☐	Extreme Value	-2.1218025
☐	Normal 2 Mixture	0.99985571
☐	Normal 3 Mixture	15.9263922
☐	Exponential	110.842465

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	2.016232	2.0059149	2.0265491
Shape	σ	0.0211526	0.0157544	0.0305149

-2log(Likelihood) = -15.1495818756557

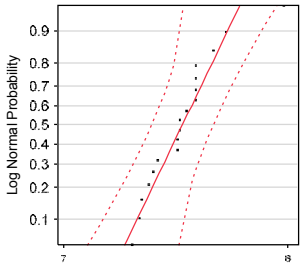
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.186657	0.0944

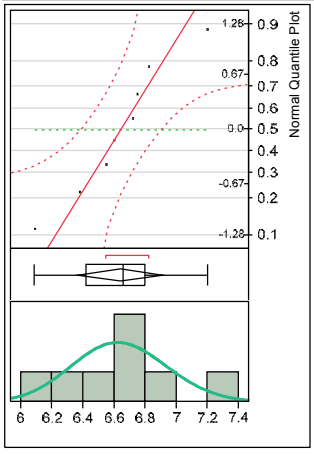
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

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
☑	Gamma	10.1636686
☑	LogNormal	10.1765727
☐	Normal	10.2221309
☐	Weibull	11.0124096
☐	Extreme Value	11.0124096
☐	GLog	15.7538811
☐	Johnson SI	15.7538825
☐	Johnson Su	25.0872132
☐	Normal 2 Mixture	45.0988843
☐	Exponential	48.9528432

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	1.8918208	1.8555477	1.9280939
Shape	σ	0.0462024	0.0303133	0.0829218

-2log(Likelihood) = 3.77657267833019

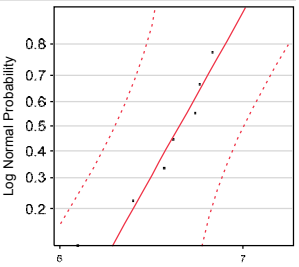
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.146970	>	0.1500

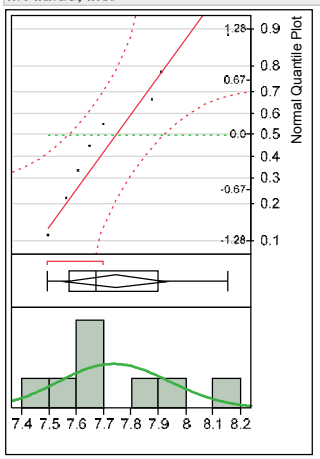
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW

Modulus, Msi



LogNormal(2.04625,0.02636)

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
☑	LogNormal	3.6704477
☐	Gamma	3.72009908
☐	Normal	3.89117507
☐	Weibull	5.94138864
☐	Extreme Value	5.94138864
☐	Johnson SI	7.29261096
☐	GLog	9.42292383
☐	Johnson Su	18.7562979
☐	Normal 2 Mixture	36.4190266
☐	Exponential	51.4121941

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	2.0462458	2.0255482	2.0669435
Shape	σ	0.0263633	0.0172969	0.0473156

-2log(Likelihood) = -2.7295523027947

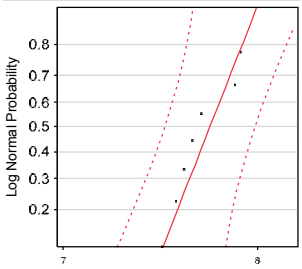
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.204447	>	0.1500

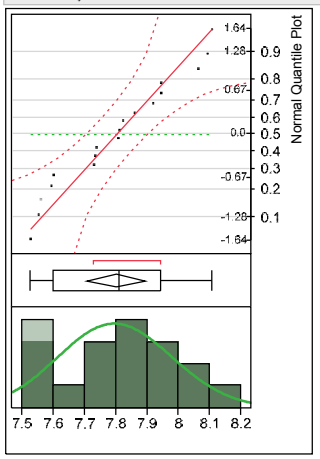
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Modulus, Msi



LogNormal(2.05386,0.02345)

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
☑	LogNormal	-5.2789914
☐	Gamma	-5.2664415
☐	Normal	-5.2061911
☐	Weibull	-3.4882966
☐	Extreme Value	-3.4882966
☐	Johnson SI	-2.4443215
☐	GLog	-2.320757
☐	Normal 2 Mixture	-0.7638526
☐	Johnson Su	1.04192375
☐	Normal 3 Mixture	14.7681133
☐	Exponential	112.198711

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	2.0538557	2.0424166	2.0652947
Shape	σ	0.0234528	0.0174676	0.0338331

-2log(Likelihood) = -10.078991443549

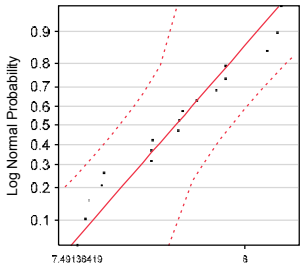
Goodness-of-Fit Test

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

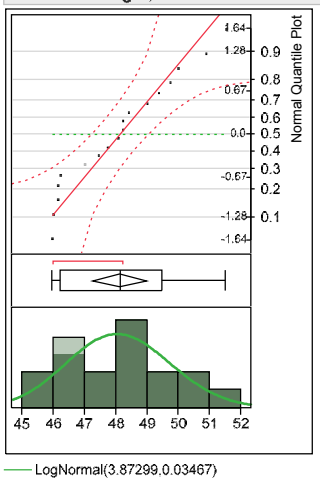


A.15 Soft Open Hole Tension (OHT2)

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

Distributions Condition=CTD

Ultimate Strength, ksi



Summary Statistics	
Mean	48.114773
Std Dev	1.7259097
Std Err Mean	0.4068008
Upper 95% Mean	48.973048
Lower 95% Mean	47.256498
N	18

Compare Distributions

Show	Distribution	AICc
☑	LogNormal	74.2816435
☐	Gamma	74.349641
☐	Normal	74.5289419
☐	Johnson SI	76.1669499
☐	GLog	77.1959292
☐	Weibull	77.5598938
☐	Extreme Value	77.5598938
☐	Johnson Su	79.5295873
☐	Normal 2 Mixture	85.7801507
☐	Normal 3 Mixture	96.445597
☐	Exponential	177.699214

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	3.8729861	3.8560759	3.8898963
Shape	σ	0.0346701	0.0258222	0.0500152

-2log(Likelihood) = 69.4816434873222

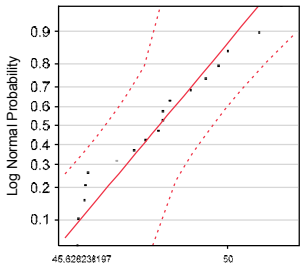
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.151248	>	0.1500

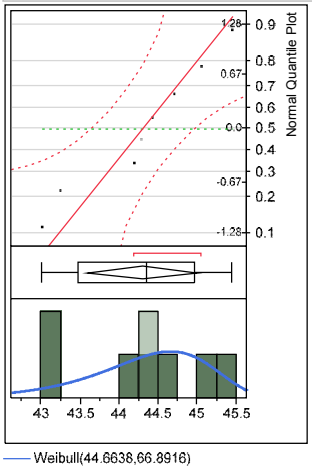
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=RTD

Ultimate Strength, ksi



Summary Statistics	
Mean	44.293775
Std Dev	0.833976
Std Err Mean	0.2948551
Upper 95% Mean	44.990996
Lower 95% Mean	43.596553
N	8

Compare Distributions

Show	Distribution	AICc
☑	Weibull	24.8730212
☐	Extreme Value	24.8730212
☐	Gamma	25.1613739
☐	LogNormal	25.1778932
☐	Normal	25.1982069
☐	Johnson SI	30.3798692
☐	GLog	30.7299566
☐	Johnson Su	40.06334
☐	Normal 2 Mixture	54.9496564
☐	Exponential	79.3201729

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	44.663831	44.090562	45.208051
Shape	β	66.891558	35.74367	108.43519

-2log(Likelihood) = 18.4730211601574

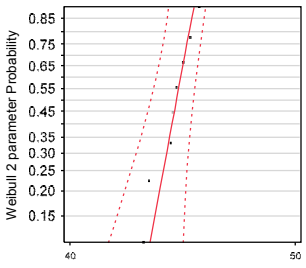
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square		Prob>W^2
0.028517	>	0.2500

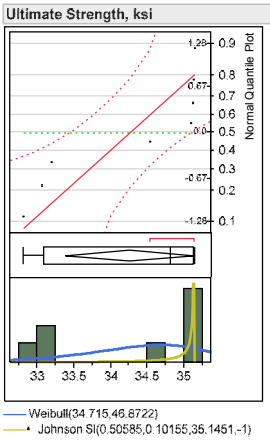
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Ultimate Strength, ksi



Summary Statistics

Mean	34.262469
Std Dev	1.0502663
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
☑	Johnson Sl	3	-20.40532	-8.4053203
☑	Weibull	2	21.1311674	27.5311674
☐	Extreme Value	2	21.1311674	27.5311674
☐	Gamma	2	22.467199	28.867199
☐	Normal	2	22.4877163	28.8877163
☐	LogNormal	2	22.5223291	28.9223291
☐	GLog	3	22.4194658	34.4194658
☐	Johnson Su	4	22.4195562	43.7528895
☐	Normal 2 Mixture	5	8.0365668	48.0365668
☐	Exponential	1	72.5448089	75.2114756

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	34.715012	34.064007	35.332266
Shape	β	46.872157	23.956386	81.356041

-2log(Likelihood) = 21.1311674256277

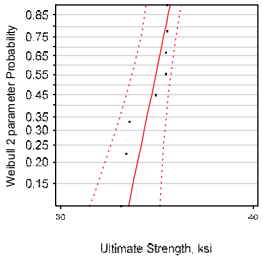
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square	Prob>W^2
0.159342	0.0123*

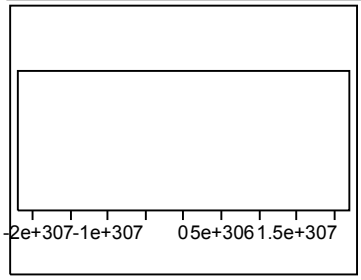
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=CTD

Modulus, Msi



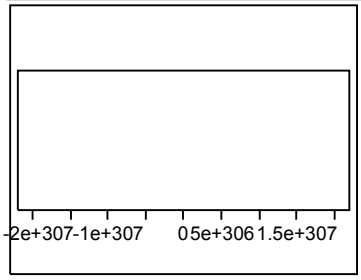
Quantiles

Summary Statistics

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

Distributions Condition=ETW2

Modulus, Msi



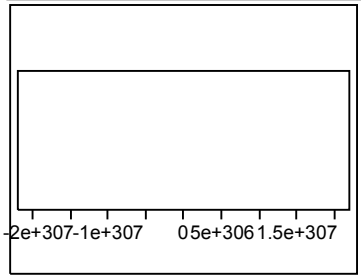
Quantiles

Summary Statistics

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

Distributions Condition=RTD

Modulus, Msi



Quantiles

Summary Statistics

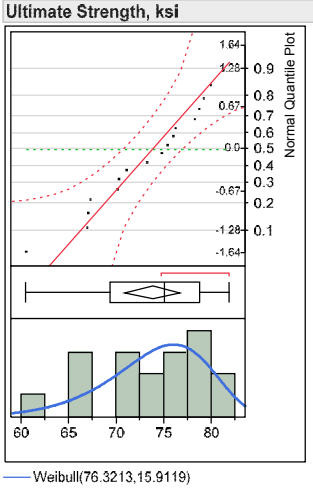
Mean	.
Std Dev	.
Std Err Mean	.
Upper 95% Mean	.
Lower 95% Mean	.
N	0

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=CTD

Ultimate Strength, ksi



Summary Statistics

Mean	73.766382
Std Dev	5.9105464
Std Err Mean	1.3931292
Upper 95% Mean	76.705627
Lower 95% Mean	70.827136
N	18

Compare Distributions

Show	Distribution	AICc
☑	Weibull	117.207087
☐	Extreme Value	117.207087
☐	Normal	118.844365
☐	Gamma	119.346251
☐	LogNormal	119.655234
☐	Johnson SI	119.856097
☐	GLog	121.729801
☐	Johnson Su	125.092904
☐	Normal 2 Mixture	128.383102
☐	Normal 3 Mixture	144.660957
☐	Exponential	193.082512

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	76.321278	73.802315	78.766133
Shape	β	15.911944	10.591206	22.490394

-2log(Likelihood) = 112.407086523237

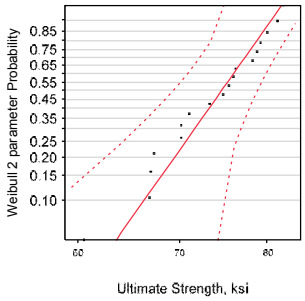
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square		Prob>W^2
0.038901	>	0.2500

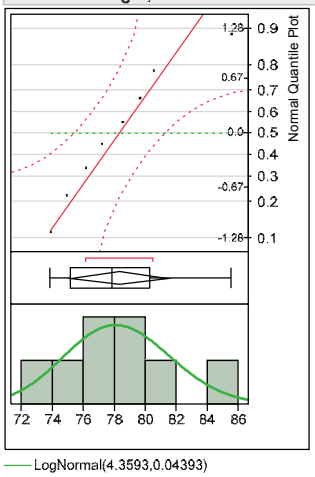
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=RTD

Ultimate Strength, ksi



Summary Statistics

Mean	78.278545
Std Dev	3.7323352
Std Err Mean	1.3195798
Upper 95% Mean	81.398855
Lower 95% Mean	75.158235
N	8

Compare Distributions

Show	Distribution	AICc
☑	LogNormal	48.8499126
☐	Gamma	48.9317851
☐	Normal	49.1755622
☐	Weibull	51.26421
☐	Extreme Value	51.26421
☐	Johnson SI	53.220507
☐	GLog	54.4499126
☐	Johnson Su	62.5538403
☐	Normal 2 Mixture	83.5564946
☐	Exponential	88.4310435

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	4.3592989	4.3248085	4.3937894
Shape	σ	0.0439318	0.0288235	0.0788465

-2log(Likelihood) = 42.4499126496559

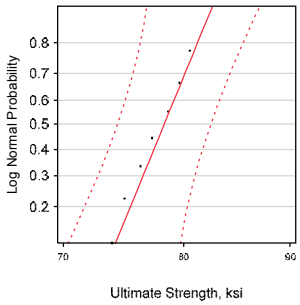
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.127720	>	0.1500

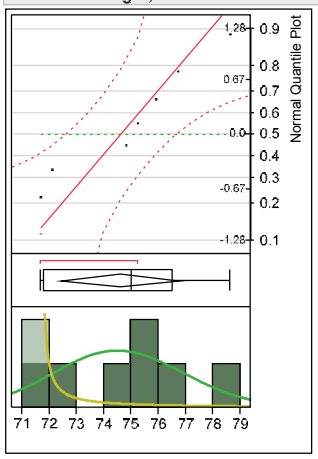
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Ultimate Strength, ksi



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
☑	Johnson SI	14.0783046
☑	LogNormal	43.1201188
☐	Gamma	43.1270545
☐	Normal	43.2139791
☐	Weibull	43.8258417
☐	Extreme Value	43.8258417
☐	GLog	48.7457223
☐	Johnson Su	58.0792009
☐	Normal 2 Mixture	70.1460485
☐	Exponential	87.6602098

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	4.3115774	4.2862903	4.3368644
Shape	σ	0.032209	0.0211323	0.0578072

-2log(Likelihood) = 36.7201187561912

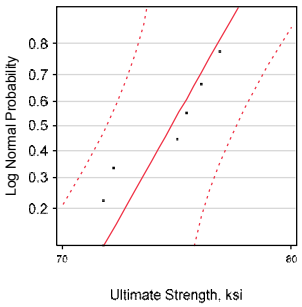
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.225088	>	0.1500

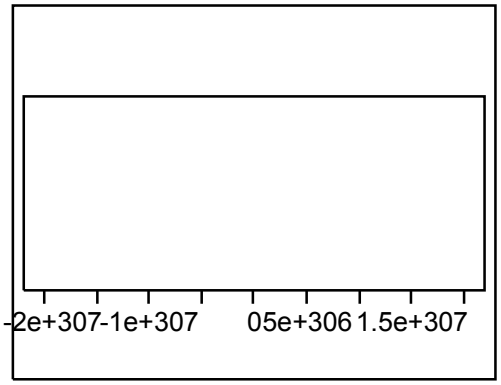
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=CTD

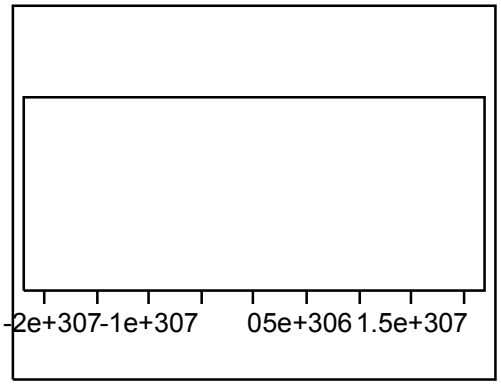
Modulus, Msi



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

Distributions Condition=ETW2

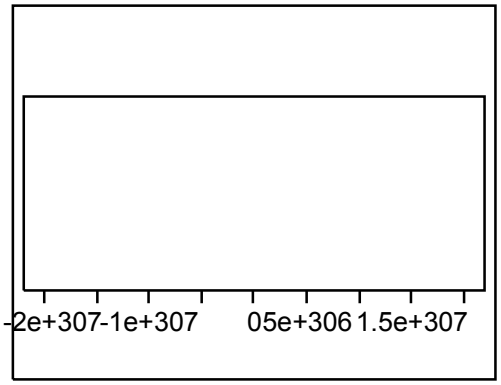
Modulus, Msi



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

Distributions Condition=RTD

Modulus, Msi



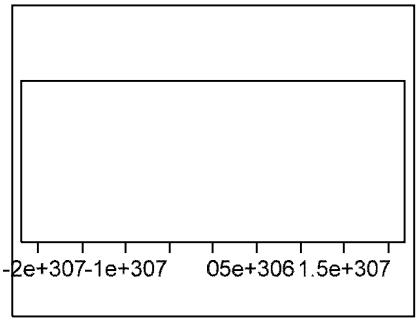
Quantiles	Summary Statistics	
	Mean	.
	Std Dev	.
	Std Err Mean	.
	Upper 95% Mean	.
	Lower 95% Mean	.
	N	0

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, Initial Peak



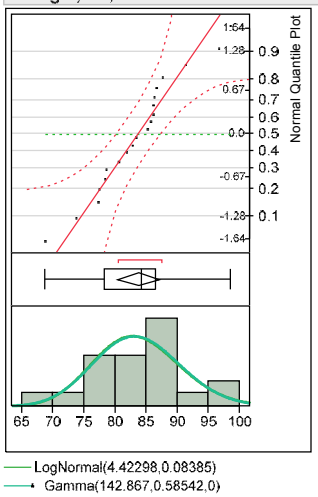
Quantiles

Summary Statistics

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

Distributions Condition=ETW2

Strength, ksi, Initial Peak



Summary Statistics

Mean	83.63655
Std Dev	7.173207
Std Err Mean	1.6039778
Upper 95% Mean	86.993714
Lower 95% Mean	80.279386
N	20

Compare Distributions

Show	Distribution	AICc
☑	Gamma	139.190891
☑	LogNormal	139.233592
☐	Normal	139.277537
☐	Weibull	141.715756
☐	Extreme Value	141.715756
☐	Johnson SI	141.979818
☐	GLog	142.02771
☐	Johnson Su	145.083313
☐	Normal 2 Mixture	149.511681
☐	Normal 3 Mixture	157.667451
☐	Exponential	219.281447

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	4.4229768	4.3843912	4.4615624
Shape	σ	0.0838503	0.0633137	0.1184547

-2log(Likelihood) = 134.527709867581

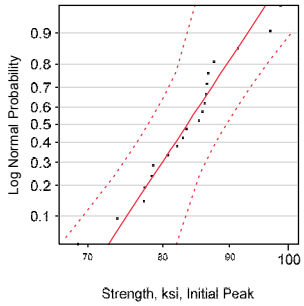
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.129190	>	0.1500

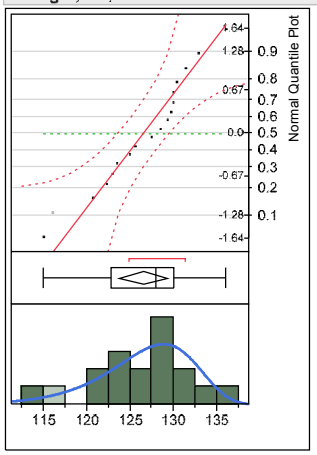
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



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
☑	Weibull	116.009408
☐	Extreme Value	116.009408
☐	Normal	117.17521
☐	Gamma	117.433914
☐	LogNormal	117.591383
☐	Johnson SI	118.860638
☐	GLog	120.505668
☐	Johnson Su	122.065577
☐	Normal 2 Mixture	128.381178
☐	Normal 3 Mixture	138.487918
☐	Exponential	212.493875

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	128.98714	126.52888	131.35209
Shape	β	27.579969	18.589995	38.259478

-2log(Likelihood) = 111.20940840272

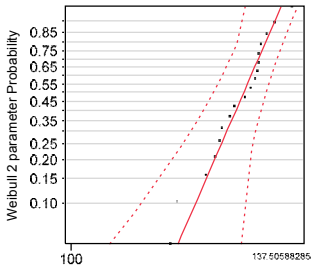
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square		Prob>W^2
0.033673	>	0.2500

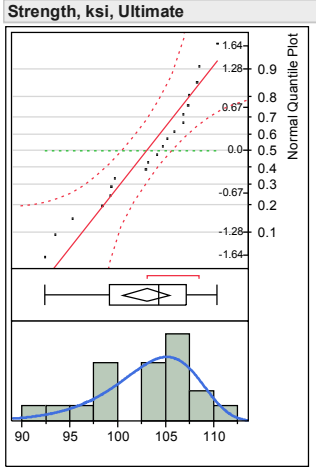
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

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
☑	Weibull	124.010989
☐	Extreme Value	124.010989
☐	Johnson SI	126.169611
☐	Normal	126.831777
☐	Gamma	127.232743
☐	LogNormal	127.462395
☐	GLog	129.60003
☐	Normal 2 Mixture	132.410274
☐	Johnson Su	132.767009
☐	Normal 3 Mixture	137.640437
☐	Exponential	227.584828

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	105.22814	103.20519	107.16885
Shape	β	25.91675	17.561829	36.172378

-2log(Likelihood) = 119.30510688805

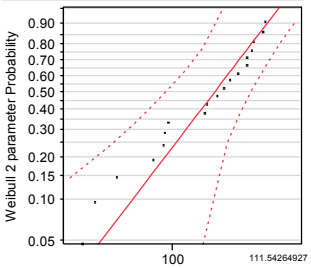
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square		Prob>W^2
0.055909	>	0.2500

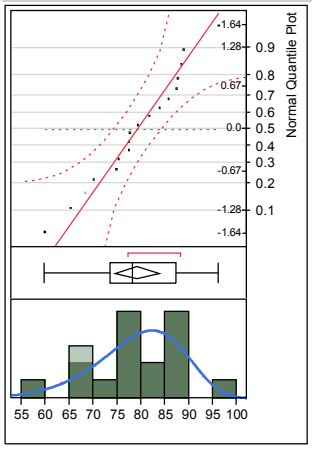
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

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
☑	Weibull	135.243107
☐	Extreme Value	135.243107
☐	Normal	135.542377
☐	Gamma	136.020108
☐	LogNormal	136.376512
☐	Johnson SI	138.056533
☐	GLog	139.290798
☐	Johnson Su	141.412084
☐	Normal 2 Mixture	147.952757
☐	Normal 3 Mixture	161.216487
☐	Exponential	195.613257

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	83.137943	78.842744	87.403746
Shape	β	10.012917	6.7554852	13.894341

-2log(Likelihood) = 130.443106892178

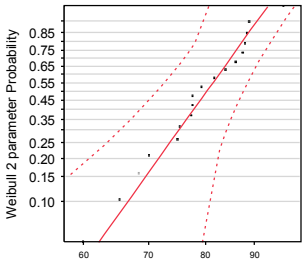
Goodness-of-Fit Test

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.

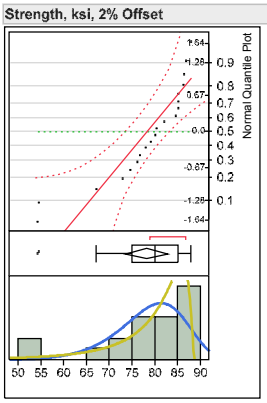
Diagnostic Plot



Strength, ksi, 2% Offset

Distributions Condition=ETW2

Strength, ksi, 2% Offset



Weibull(81.8783,12.269)
Johnson SI(-2.0665,1.05122,88.8663,-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
☑	Johnson SI	3	133.391705	140.891705
☐	Johnson Su	4	133.351636	144.018305
☑	Weibull	2	140.794437	145.500319
☐	Extreme Value	2	140.794437	145.500319
☐	Normal 2 Mixture	5	133.008223	147.293938
☐	Normal	2	147.09474	151.800622
☐	Normal 3 Mixture	8	123.694046	152.784955
☐	Gamma	2	149.661449	154.367331
☐	LogNormal	2	151.088349	155.794231
☐	GLog	3	151.088349	158.588349
☐	Exponential	1	214.348299	216.570521

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	81.878255	78.61654	85.119283
Shape	β	12.269029	8.1376244	17.45099

-2log(Likelihood) = 140.794436747444

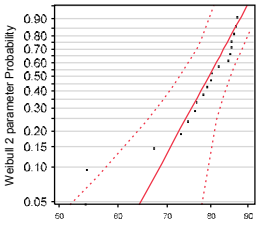
Goodness-of-Fit Test

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.

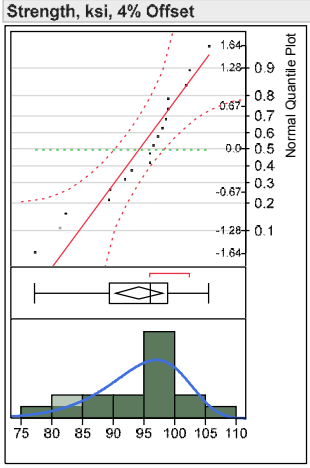
Diagnostic Plot



Strength, ksi, 2% Offset

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
☑	Weibull	125.62332
☐	Extreme Value	125.62332
☐	Johnson Sl	128.348254
☐	Normal	128.37662
☐	Gamma	129.143333
☐	LogNormal	129.585167
☐	Johnson Su	131.710225
☐	GLog	132.499452
☐	Normal 2 Mixture	132.870849
☐	Normal 3 Mixture	149.403163
☐	Exponential	201.854222

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	97.352383	94.218232	100.40851
Shape	β	16.24204	10.798656	22.851603

-2log(Likelihood) = 120.823319752886

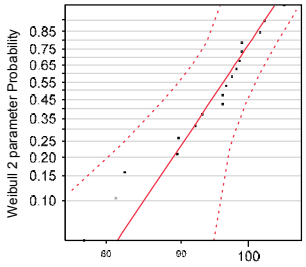
Goodness-of-Fit Test

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.

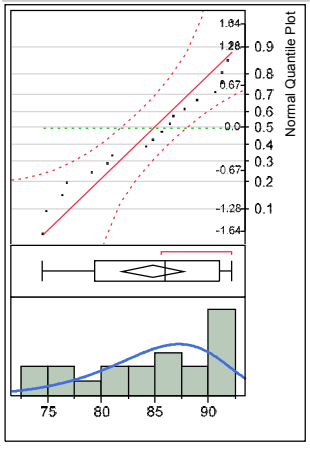
Diagnostic Plot



Strength, ksi, 4% Offset

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
☑	Weibull	131.377915
☐	Extreme Value	131.377915
☐	Johnson Sl	132.880749
☐	Normal	133.036785
☐	Gamma	133.366963
☐	LogNormal	133.572932
☐	GLog	135.805039
☐	Normal 2 Mixture	137.690178
☐	Johnson Su	138.972121
☐	Normal 3 Mixture	143.701162
☐	Exponential	219.839185

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	87.516202	85.045322	89.899156
Shape	β	17.624906	11.946533	24.678832

-2log(Likelihood) = 126.672032584705

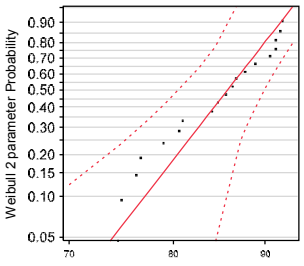
Goodness-of-Fit Test

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



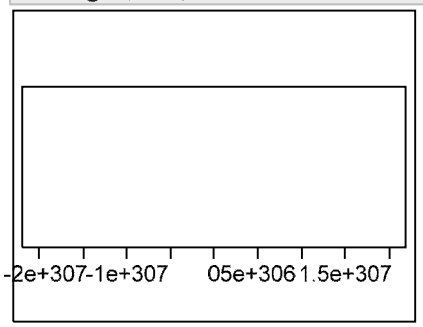
Strength, ksi, 4% Offset

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, Initial Peak



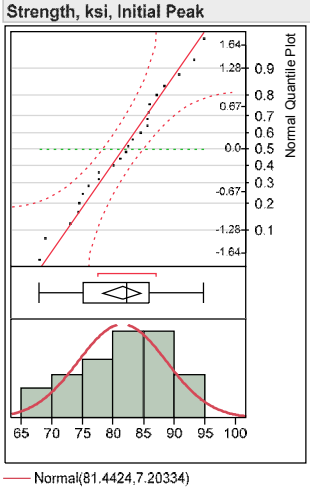
Quantiles

Summary Statistics

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

Distributions Condition=ETW2

Strength, ksi, Initial Peak



Summary Statistics

Mean	81.442375
Std Dev	7.2033416
Std Err Mean	1.4703759
Upper 95% Mean	84.484079
Lower 95% Mean	78.400671
N	24

Compare Distributions

Show	Distribution	AICc
☑	Normal	166.45864
☐	Gamma	166.598457
☐	LogNormal	166.748878
☐	Weibull	167.35158
☐	Extreme Value	167.35158
☐	Johnson SI	169.02679
☐	GLog	169.065782
☐	Johnson Su	171.971242
☐	Normal 2 Mixture	176.125641
☐	Normal 3 Mixture	189.409267
☐	Exponential	261.376812

Fitted Normal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Location	μ	81.442375	78.400671	84.484079
Dispersion	σ	7.2033416	5.598535	10.104564

-2log(Likelihood) = 161.887211025937

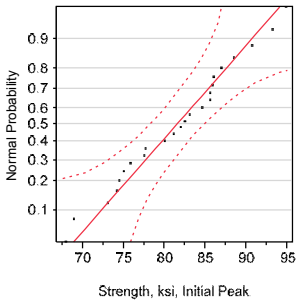
Goodness-of-Fit Test

Shapiro-Wilk W Test

W	Prob<W
0.979206	0.8808

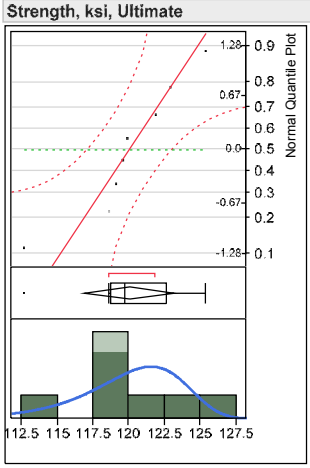
Note: Ho = The data is from the Normal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=RTD

Strength, ksi, Ultimate



Weibull(121.622,40.5529)

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
☑	Weibull	48.6870625
☐	Extreme Value	48.6870625
☐	Normal	49.2219433
☐	Gamma	49.2539362
☐	LogNormal	49.3073026
☐	Johnson SI	54.197056
☐	GLog	54.9073026
☐	Johnson Su	63.8959805
☐	Normal 2 Mixture	84.0986967
☐	Exponential	95.2678847

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	121.6216	119.07658	124.06983
Shape	β	40.552904	21.841112	64.84487

-2log(Likelihood) = 42.287062535154

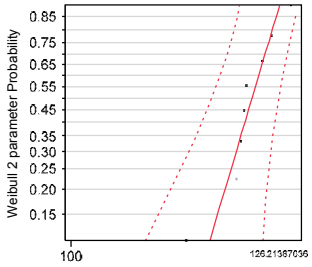
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square		Prob>W^2
0.047213	>	0.2500

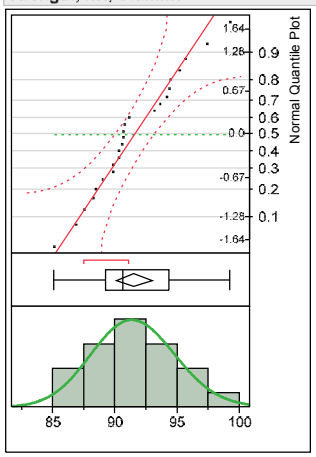
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Strength, ksi, Ultimate



LogNormal(4.51579,0.03684)

Summary Statistics

Mean	91.51211
Std Dev	3.4621854
Std Err Mean	0.7067156
Upper 95% Mean	92.974063
Lower 95% Mean	90.050157
N	24

Compare Distributions

Show	Distribution	AICc
☑	LogNormal	130.985797
☐	Gamma	131.071572
☐	Normal	131.291679
☐	Johnson SI	133.169059
☐	GLog	133.898818
☐	Weibull	135.810943
☐	Extreme Value	135.810943
☐	Johnson Su	136.804332
☐	Normal 2 Mixture	140.395337
☐	Normal 3 Mixture	145.448912
☐	Exponential	266.972441

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	4.5157903	4.5004405	4.5311402
Shape	σ	0.0368428	0.0284488	0.0503472

-2log(Likelihood) = 126.414368242301

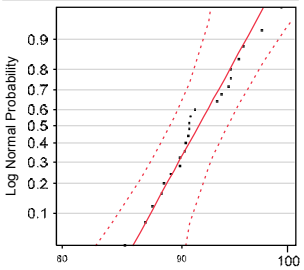
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.169307	0.0749

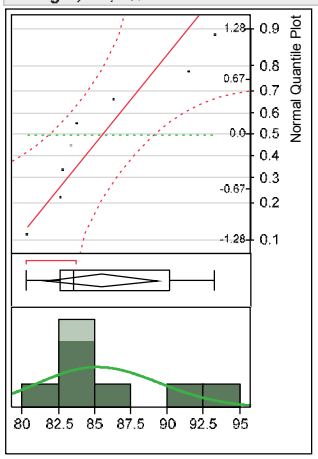
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

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
☑	LogNormal	52.0993005
☐	Gamma	52.1979969
☐	*Normal*	52.4738579
☐	Weibull	54.2628097
☐	Extreme Value	54.2628097
☐	Johnson SI	55.3888423
☐	GLog	57.6993005
☐	Johnson Su	65.0014412
☐	Normal 2 Mixture	79.013823
☐	Exponential	89.8357926

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	4.4468399	4.4081249	4.485555
Shape	σ	0.0493128	0.032354	0.0885041

-2log(Likelihood) = 45.6993004654104

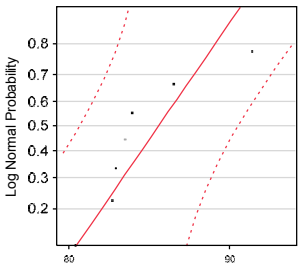
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.274840	0.0749

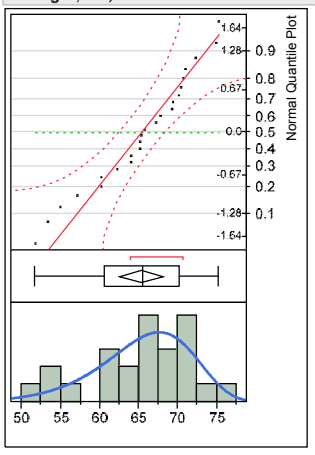
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



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
☑	Weibull	159.259511
☐	Extreme Value	159.259511
☐	Normal	161.242358
☐	Johnson SI	161.884187
☐	Gamma	162.133139
☐	LogNormal	162.678175
☐	Johnson Su	164.789436
☐	GLog	165.306747
☐	Normal 2 Mixture	166.454622
☐	Normal 3 Mixture	179.3038
☐	Exponential	250.756741

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	68.039368	65.64594	70.385334
Shape	β	12.645319	8.9602062	17.002979

-2log(Likelihood) = 154.688082704086

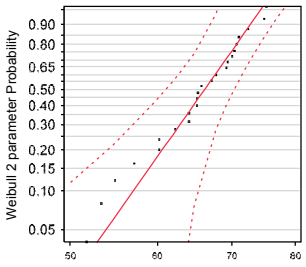
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square		Prob>W^2
0.025285	>	0.2500

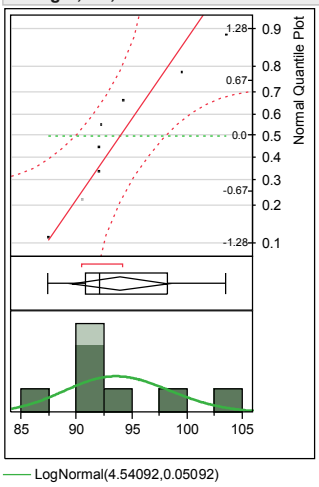
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=RTD

Strength, ksi, 4% Offset



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
☑	LogNormal	54.118501
☐	Gamma	54.2192225
☐	Normal	54.5026729
☐	Weibull	56.4508678
☐	Extreme Value	56.4508678
☐	Johnson SI	58.3837708
☐	GLog	59.718501
☐	Johnson Su	65.6200218
☐	Normal 2 Mixture	84.986588
☐	Exponential	91.3424167

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	4.540922	4.5009433	4.5809007
Shape	σ	0.0509223	0.03341	0.0913928

-2log(Likelihood) = 47.7185009648236

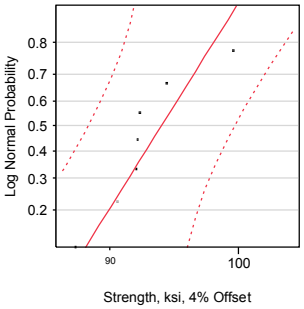
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.259561	0.1107

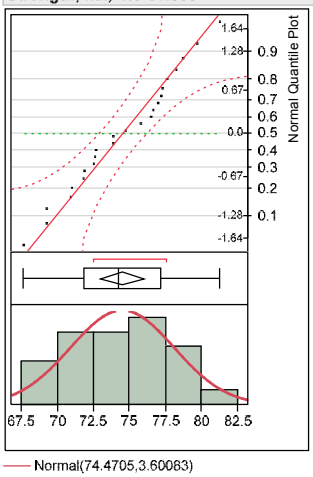
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Strength, ksi, 4% Offset



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
☑	Normal	133.176331
☐	Gamma	133.219464
☐	LogNormal	133.270576
☐	Weibull	134.219912
☐	Extreme Value	134.219912
☐	Johnson SI	135.739522
☐	GLog	135.783473
☐	Johnson Su	138.688901
☐	Normal 2 Mixture	140.730923
☐	Normal 3 Mixture	153.810572
☐	Exponential	257.081139

Fitted Normal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Location	μ	74.470458	72.949962	75.990954
Dispersion	σ	3.6008272	2.7986118	5.0510986

-2log(Likelihood) = 128.604902234364

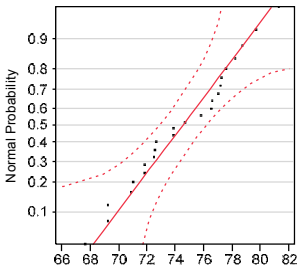
Goodness-of-Fit Test

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

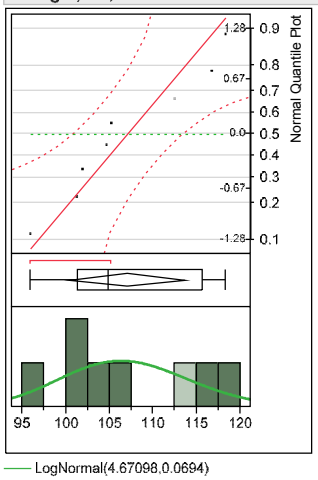


A.19 Hard Pin Bearing (PB3)

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

Distributions Condition=RTD

Strength, ksi, Initial Peak



Summary Statistics

Mean	107.061
Std Dev	7.9805213
Std Err Mean	2.8215404
Upper 95% Mean	113.73288
Lower 95% Mean	100.38912
N	8

Compare Distributions

Show	Distribution	AICc
☑	LogNormal	61.1519842
☐	Gamma	61.1828368
☐	Normal	61.3350762
☐	Weibull	61.9566069
☐	Extreme Value	61.9566069
☐	Johnson SI	66.6049887
☐	GLog	66.7519842
☐	Johnson Su	75.9383221
☐	Normal 2 Mixture	92.0506554
☐	Exponential	93.4410469

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	4.6709835	4.6165011	4.7254659
Shape	σ	0.0693962	0.0455307	0.1245489

-2log(Likelihood) = 54.751984188669

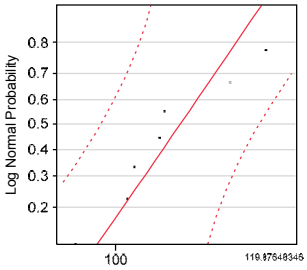
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.210652	>	0.1500

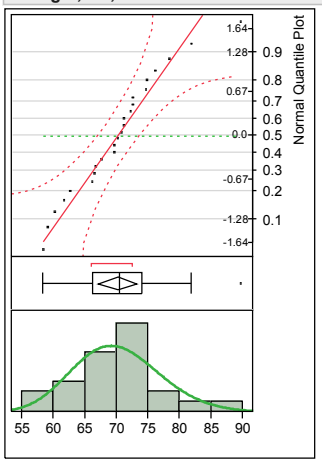
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Strength, ksi, Initial Peak



Summary Statistics

Mean	70.162333
Std Dev	7.293121
Std Err Mean	1.4887021
Upper 95% Mean	73.241948
Lower 95% Mean	67.082718
N	24

Compare Distributions

Show	Distribution	AICc
☑	LogNormal	166.132602
☐	Gamma	166.347842
☐	Normal	167.053194
☐	Johnson SI	168.568387
☐	GLog	168.761174
☐	Johnson Su	171.473651
☐	Weibull	171.770028
☐	Extreme Value	171.770028
☐	Normal 2 Mixture	176.377651
☐	Normal 3 Mixture	184.797184
☐	Exponential	254.220775

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	4.245737	4.2039165	4.2875574
Shape	σ	0.1003774	0.0775083	0.1371701

-2log(Likelihood) = 161.561173518896

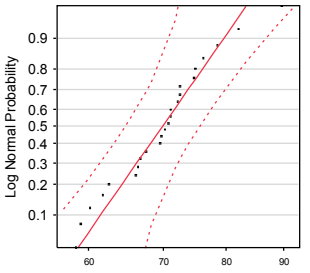
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.115984	>	0.1500

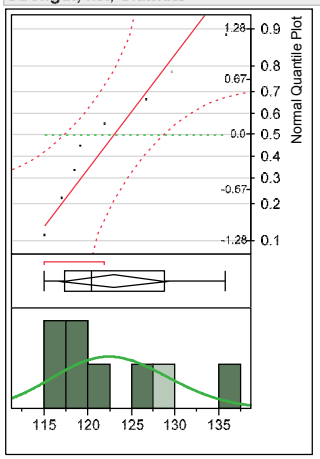
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



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
☑	LogNormal	59.2641706
☐	Gamma	59.3551116
☐	*Normal*	59.6187237
☐	Weibull	61.283356
☐	Extreme Value	61.283356
☐	Johnson SI	62.7792928
☐	GLog	65.1504695
☐	Johnson Su	74.4841193
☐	Normal 2 Mixture	91.6344167
☐	Exponential	95.6507853

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	4.8100516	4.7679191	4.8521842
Shape	σ	0.0536658	0.03521	0.0963167

-2log(Likelihood) = 52.8641706147957

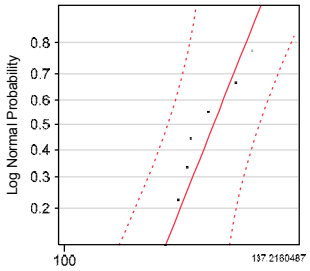
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.213708	>	0.1500

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

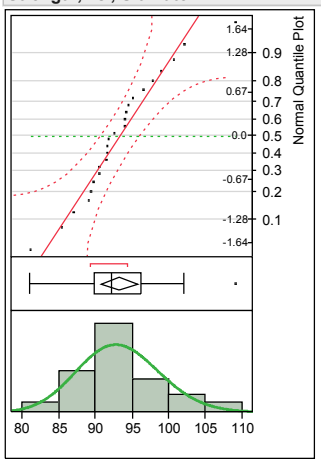
Diagnostic Plot



Strength, ksi, Ultimate

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
☑	LogNormal	155.448097
☐	Gamma	155.643274
☐	Normal	156.162725
☐	Johnson SI	157.743697
☐	GLog	158.076668
☐	Johnson Su	159.221725
☐	Weibull	162.615268
☐	Extreme Value	162.615268
☐	Normal 2 Mixture	165.487182
☐	Normal 3 Mixture	176.96016
☐	Exponential	267.87072

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	4.5333559	4.5082482	4.5584636
Shape	σ	0.0602634	0.0465335	0.0823525

-2log(Likelihood) = 150.876668203408

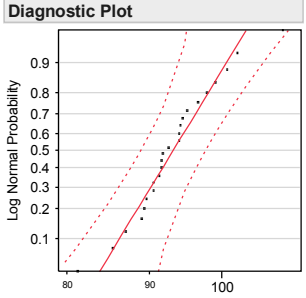
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.116687	>	0.1500

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

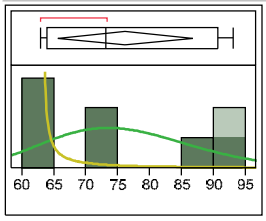
Diagnostic Plot



Strength, ksi, Ultimate

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
☑	Johnson SI	40.8260082
☑	LogNormal	68.3245033
☐	Gamma	68.4316866
☐	Normal	68.8030081
☐	Weibull	69.1725556
☐	Extreme Value	69.1725556
☐	GLog	74.3347562
☐	Johnson Su	83.668336
☐	Exponential	87.9746813
☐	Normal 2 Mixture	96.9896824

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	4.3197228	4.1985254	4.4409202
Shape	σ	0.1543736	0.1012841	0.2770621

-2log(Likelihood) = 61.924503290666

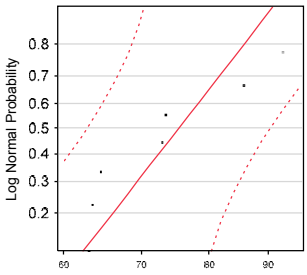
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.213954	>	0.1500

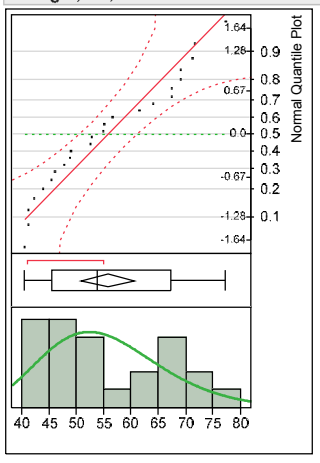
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



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
☑	LogNormal	188.056844
☐	Gamma	188.263843
☐	Normal	189.244261
☐	Johnson SI	189.952573
☐	Weibull	189.968498
☐	Extreme Value	189.968498
☐	Normal 2 Mixture	190.429328
☐	GLog	191.851402
☐	Johnson Su	194.757139
☐	Normal 3 Mixture	198.791104
☐	Exponential	243.037522

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	3.9971418	3.912474	4.0818096
Shape	σ	0.2032197	0.1569198	0.2777085

-2log(Likelihood) = 183.485415803695

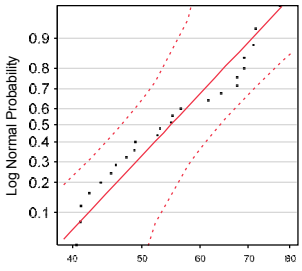
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.144728	>	0.1500

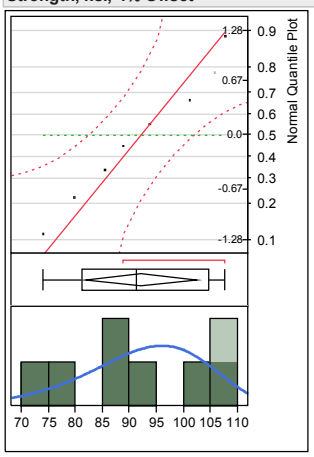
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=RTD

Strength, ksi, 4% Offset



Weibull(97.1626,9.30792)

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
☑	Weibull	68.1382857
☐	Extreme Value	68.1382857
☐	Gamma	68.2437048
☐	Normal	68.2565195
☐	LogNormal	68.3083558
☐	Johnson SI	73.7443359
☐	GLog	73.7882714
☐	Johnson Su	83.1218246
☐	Exponential	91.0281048
☐	Normal 2 Mixture	100.068356

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	97.162615	88.488672	106.02002
Shape	β	9.3079175	4.9380084	15.367119

-2log(Likelihood) = 61.738285737615

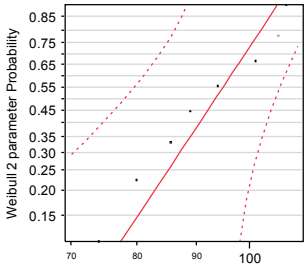
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square		Prob>W^2
0.037526	>	0.2500

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

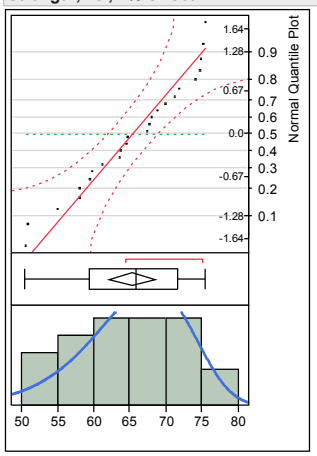
Diagnostic Plot



Strength, ksi, 4% Offset

Distributions Condition=ETW2

Strength, ksi, 4% Offset



Weibull(68.5096,10.6522)

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
☑	Weibull	167.472605
☐	Extreme Value	167.472605
☐	Normal	168.875933
☐	Gamma	169.617813
☐	Johnson SI	169.965627
☐	LogNormal	170.114126
☐	GLog	172.742697
☐	Johnson Su	172.870876
☐	Normal 2 Mixture	172.959384
☐	Normal 3 Mixture	187.751228
☐	Exponential	250.751593

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	68.509631	65.648423	71.322796
Shape	β	10.652223	7.5276395	14.408265

-2log(Likelihood) = 162.901176094753

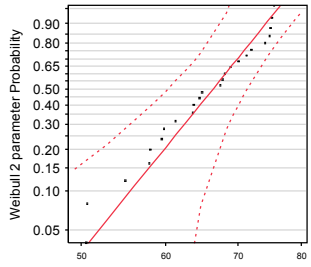
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square		Prob>W^2
0.039524	>	0.2500

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

Diagnostic Plot



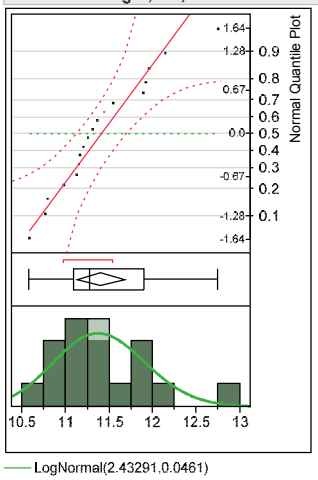
Strength, ksi, 4% Offset

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=CTD

Ultimate Strength, ksi, Measured



Summary Statistics

Mean	11.404167
Std Dev	0.5491784
Std Err Mean	0.1294426
Upper 95% Mean	11.677267
Lower 95% Mean	11.131067
N	18

Compare Distributions

Show	Distribution	AICc
☑	LogNormal	32.6970419
☐	Gamma	32.879299
☐	Normal	33.3058385
☐	Johnson SI	33.8949034
☐	GLog	35.6113276
☐	Johnson Su	37.2575407
☐	Weibull	38.3243898
☐	Extreme Value	38.3243898
☐	Normal 2 Mixture	43.4447526
☐	Normal 3 Mixture	59.9915471
☐	Exponential	125.873236

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	2.4329057	2.4104202	2.4553912
Shape	σ	0.0461007	0.0343357	0.0665052

-2log(Likelihood) = 27.8970419206468

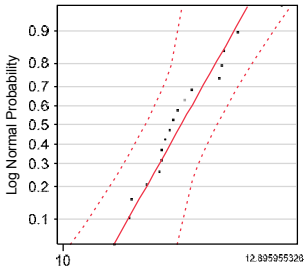
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.134524	>	0.1500

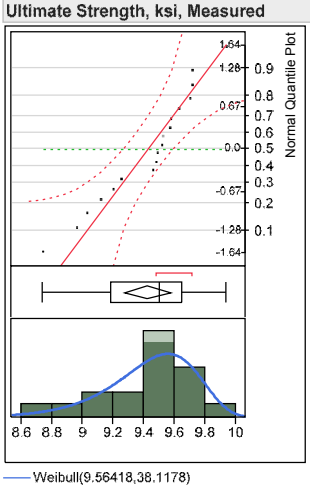
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=RTD

Ultimate Strength, ksi, Measured



Summary Statistics

Mean	9.4259639
Std Dev	0.3114764
Std Err Mean	0.0734157
Upper 95% Mean	9.5808574
Lower 95% Mean	9.2710703
N	18

Compare Distributions

Show	Distribution	AICc
☑	Weibull	11.1747649
☐	Extreme Value	11.1747649
☐	Normal	12.8902418
☐	Gamma	13.0995803
☐	LogNormal	13.2258065
☐	Johnson SI	14.0967651
☐	GLog	15.7756762
☐	Johnson Su	19.1383709
☐	Normal 2 Mixture	20.7400631
☐	Normal 3 Mixture	34.8768124
☐	Exponential	119.014848

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	9.5641808	9.4318925	9.6907826
Shape	β	38.117823	25.615417	53.019386

-2log(Likelihood) = 6.37476493983056

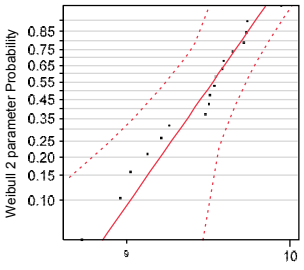
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square		Prob>W^2
0.051501	>	0.2500

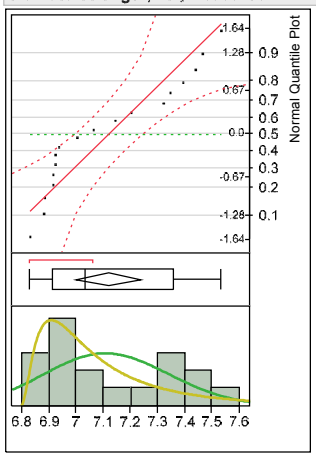
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETD1

Ultimate Strength, ksi, Measured



LogNormal(1.96197,0.03256)
Johnson Sl(1.6873,1.18773,6.7875,1)

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
☑	Johnson Sl	1.46049593
☐	Normal 2 Mixture	2.38582594
☑	LogNormal	3.2292608
☐	Gamma	3.31153809
☐	Normal	3.51407473
☐	Weibull	6.23203046
☐	Extreme Value	6.23203046
☐	GLog	6.39950892
☐	Johnson Su	9.76220807
☐	Normal 3 Mixture	16.6693793
☐	Exponential	108.900099

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	1.9619702	1.9460871	1.9778533
Shape	σ	0.0325642	0.0242538	0.0469774

-2log(Likelihood) = -1.57073919851314

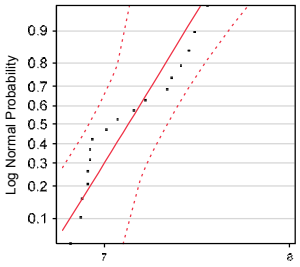
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.224595	0.0248*

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

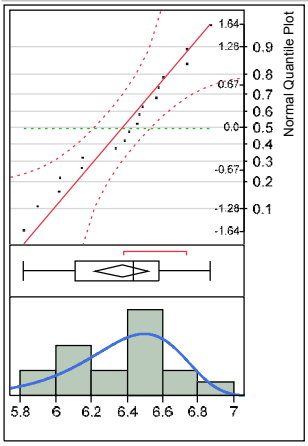
Diagnostic Plot



Ultimate Strength, ksi, Measured

Distributions Condition=ETW

Ultimate Strength, ksi, Measured



Weibull(6.50594,25.3239)

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
☑	Weibull	11.4437337
☐	Extreme Value	11.4437337
☐	Normal	11.8823751
☐	Gamma	12.022872
☐	LogNormal	12.1205305
☐	Johnson Sl	14.1842137
☐	GLog	14.7678095
☐	Johnson Su	18.1304978
☐	Normal 2 Mixture	19.8124927
☐	Normal 3 Mixture	36.8892626
☐	Exponential	104.902113

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	6.505938	6.3705479	6.6359514
Shape	β	25.323932	17.039729	35.307889

-2log(Likelihood) = 6.64373369388252

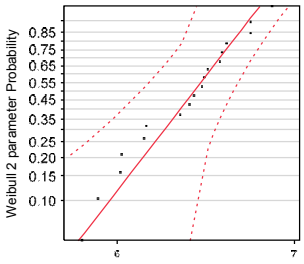
Goodness-of-Fit Test

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.

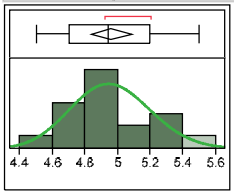
Diagnostic Plot



Ultimate Strength, ksi, Measured

Distributions Condition=ETW2

Ultimate Strength, ksi, Measured



LogNormal(1.60044,0.04952)

Quantiles

100.0%	maximum	5.50186
99.5%		5.50186
97.5%		5.50186
90.0%		5.29761
75.0%	quartile	5.1988
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	0.2533869
Std Err Mean	0.0597239
Upper 95% Mean	5.0873117
Lower 95% Mean	4.835299
N	18

Compare Distributions

Show	Distribution	AICc
☑	LogNormal	5.30237182
☐	Gamma	5.33274697
☐	Normal	5.45963147
☐	Weibull	8.01611116
☐	Extreme Value	8.01611116
☐	Johnson SI	8.18084811
☐	GLog	8.21665753
☐	Johnson Su	11.5434855
☐	Normal 2 Mixture	18.6494622
☐	Normal 3 Mixture	20.6425012
☐	Exponential	95.9100796

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	1.6004413	1.5762892	1.6245934
Shape	σ	0.0495177	0.0368807	0.0714345

-2log(Likelihood) = 0.502371818739782

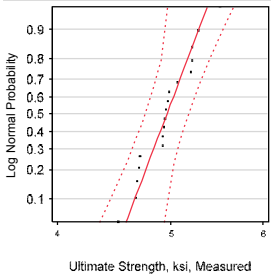
Goodness-of-Fit Test

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

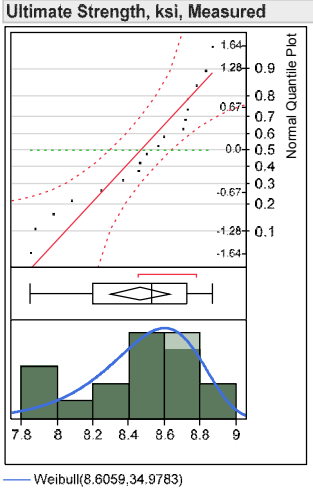


A.21 Quasi Isotropic Short Beam Strength (SBS1)

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

Distributions Condition=RTD

Ultimate Strength, ksi, Measured



Summary Statistics

Mean	8.4618273
Std Dev	0.3299452
Std Err Mean	0.0777688
Upper 95% Mean	8.6259052
Lower 95% Mean	8.2977495
N	18

Compare Distributions

Show	Distribution	AICc
☑	Weibull	11.8638065
☐	Extreme Value	11.8638065
☐	Johnson SI	13.1672304
☐	Normal	14.9639558
☐	Gamma	15.2414646
☐	LogNormal	15.4022347
☐	GLog	17.8493902
☐	Normal 2 Mixture	18.5262534
☐	Johnson Su	21.2121052
☐	Normal 3 Mixture	33.481405
☐	Exponential	115.130345

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	8.6059005	8.4752476	8.7304453
Shape	β	34.97834	23.040958	49.988974

-2log(Likelihood) = 7.06380645400642

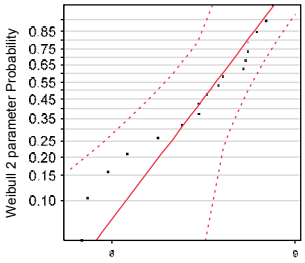
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square		Prob>W^2
0.058635	>	0.2500

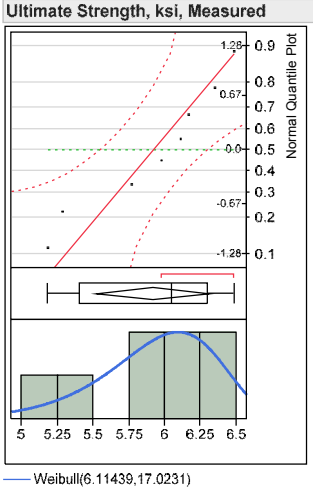
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho

Diagnostic Plot



Distributions Condition=ETW

Ultimate Strength, ksi, Measured



Summary Statistics

Mean	5.9171755
Std Dev	0.4749809
Std Err Mean	0.1679311
Upper 95% Mean	6.3142695
Lower 95% Mean	5.5200816
N	8

Compare Distributions

Show	Distribution	AICc
☑	Weibull	15.16795
☐	Extreme Value	15.16795
☐	Normal	16.1913249
☐	Gamma	16.3340255
☐	LogNormal	16.4521657
☐	Johnson SI	20.3777486
☐	GLog	21.7230738
☐	Johnson Su	31.0564502
☐	Normal 2 Mixture	44.2750599
☐	Exponential	47.1124144

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	6.114387	5.8083099	6.4156855
Shape	β	17.023116	8.8773771	28.408808

-2log(Likelihood) = 8.76794997925116

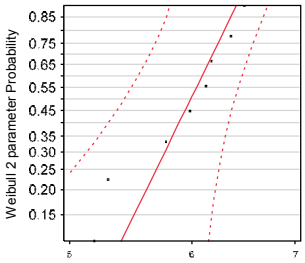
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square		Prob>W^2
0.031908	>	0.2500

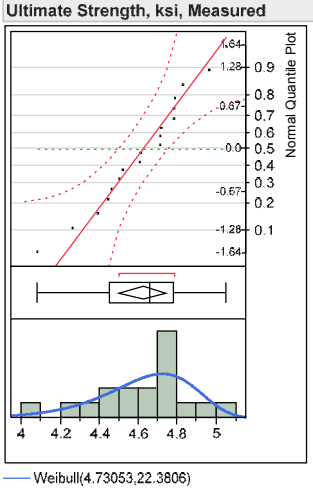
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Ultimate Strength, ksi, Measured



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
☑	Weibull	3.81711694
☐	Extreme Value	3.81711694
☐	Normal	3.98680326
☐	Gamma	4.21798862
☐	LogNormal	4.36968779
☐	Johnson SI	6.33484539
☐	GLog	7.28397351
☐	Johnson Su	9.69748272
☐	Normal 2 Mixture	17.0288789
☐	Normal 3 Mixture	31.4957027
☐	Exponential	93.3560872

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	4.7305261	4.6197464	4.8375763
Shape	β	22.380588	15.174926	30.892601

-2log(Likelihood) = -0.98288305807497

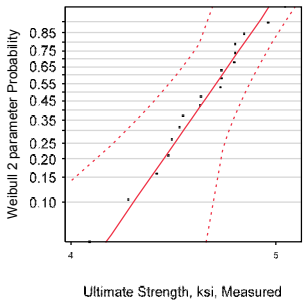
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square		Prob>W^2
0.031662	>	0.2500

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

Diagnostic Plot

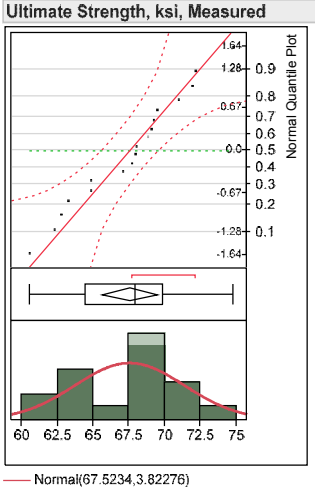


A.22 Quasi Isotropic Compression (UNC1)

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

Distributions Condition=RTD

Ultimate Strength, ksi, Measured



Summary Statistics

Mean	67.523383
Std Dev	3.8227623
Std Err Mean	0.9010337
Upper 95% Mean	69.424398
Lower 95% Mean	65.622368
N	18

Compare Distributions

Show	Distribution	AICc
☑	Normal	103.156825
☐	Gamma	103.209916
☐	LogNormal	103.271603
☐	Weibull	104.016147
☐	Extreme Value	104.016147
☐	Johnson SI	105.99228
☐	GLog	106.04226
☐	Johnson Su	109.405057
☐	Normal 2 Mixture	112.976786
☐	Normal 3 Mixture	128.209557
☐	Exponential	189.899062

Fitted Normal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Location	μ	67.523383	65.622368	69.424398
Dispersion	σ	3.8227623	2.8685534	5.7308711

-2log(Likelihood) = 98.3568246975272

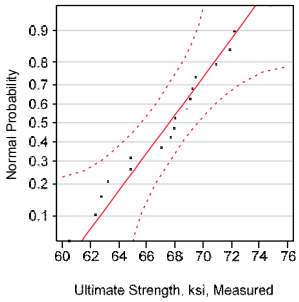
Goodness-of-Fit Test

Shapiro-Wilk W Test

W	Prob<W
0.974990	0.8845

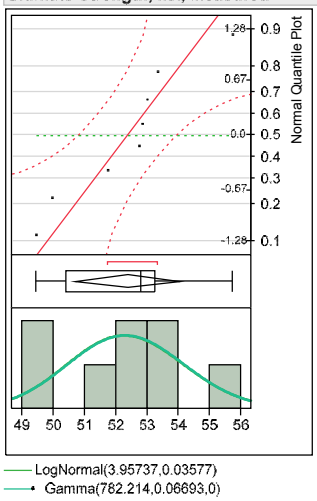
Note: Ho = The data is from the Normal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW

Ultimate Strength, ksi, Measured



Summary Statistics

Mean	52.352963
Std Dev	2.0004516
Std Err Mean	0.7072664
Upper 95% Mean	54.025383
Lower 95% Mean	50.680544
N	8

Compare Distributions

Show	Distribution	AICc
☑	Gamma	39.1273052
☑	LogNormal	39.1306858
☐	Normal	39.1969838
☐	Weibull	39.9626852
☐	Extreme Value	39.9626852
☐	Johnson SI	44.7271723
☐	GLog	44.7306858
☐	Johnson Su	53.9116734
☐	Normal 2 Mixture	70.3692083
☐	Exponential	81.9948033

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	3.9573692	3.9292863	3.9854521
Shape	σ	0.0357702	0.0234688	0.0641986

-2log(Likelihood) = 32.7306858269061

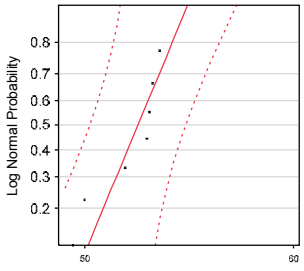
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.216319	> 0.1500

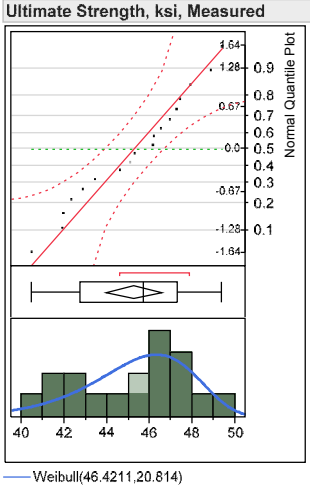
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Ultimate Strength, ksi, Measured



Summary Statistics

Mean	45.244582
Std Dev	2.6080181
Std Err Mean	0.6147158
Upper 95% Mean	46.541519
Lower 95% Mean	43.947645
N	18

Compare Distributions

Show	Distribution	AICc
☑	Weibull	89.1196858
☐	Extreme Value	89.1196858
☐	Normal	89.3910488
☐	Gamma	89.5205532
☐	LogNormal	89.6179853
☐	Johnson SI	91.8613164
☐	GLog	92.2764839
☐	Johnson Su	95.6393043
☐	Normal 2 Mixture	97.1367991
☐	Normal 3 Mixture	114.033324
☐	Exponential	175.484985

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	46.421075	45.246704	47.552258
Shape	β	20.813962	13.985887	29.099666

-2log(Likelihood) = 84.3196857917777

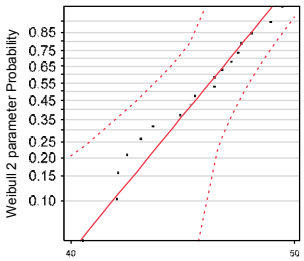
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square		Prob>W^2
0.029769	>	0.2500

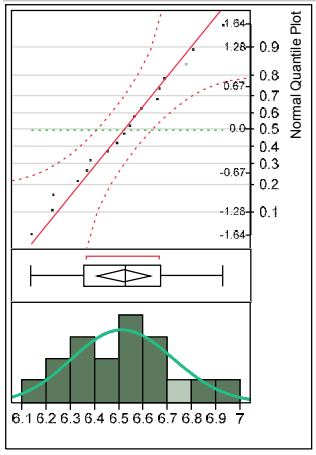
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=RTD

Modulus, Msi, Measured



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
☑	Gamma	-0.2020151
☑	LogNormal	-0.1935161
☐	Normal	-0.1760743
☐	Weibull	1.34566942
☐	Extreme Value	1.34566942
☐	Johnson SI	2.70911527
☐	GLog	2.70935818
☐	Johnson Su	4.4815946
☐	Normal 2 Mixture	9.44783618
☐	Normal 3 Mixture	29.6535329
☐	Exponential	105.739342

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	1.8741817	1.858414	1.8899495
Shape	σ	0.0323278	0.0240776	0.0466362

-2log(Likelihood) = -4.99351607804734

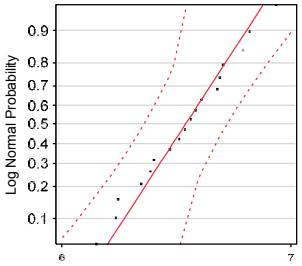
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.084545	>	0.1500

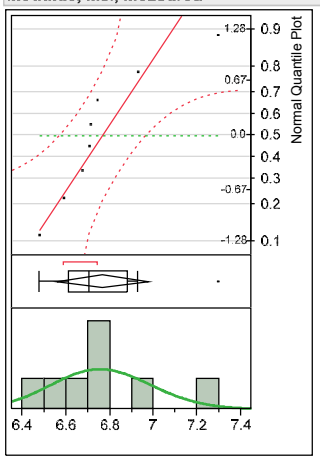
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW

Modulus, Msi, Measured



LogNormal(1.91125,0.03397)

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
☑	LogNormal	5.56816402
☐	Gamma	5.67188144
☐	Normal	5.95453432
☐	Johnson SI	6.43080078
☐	Weibull	8.88515765
☐	Extreme Value	8.88515765
☐	GLog	11.168164
☐	Johnson Su	17.9733826
☐	Normal 2 Mixture	38.9339635
☐	Exponential	49.2560454

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	1.9112517	1.8845795	1.9379238
Shape	σ	0.0339733	0.0222898	0.0609736

-2log(Likelihood) = -0.831835975328959

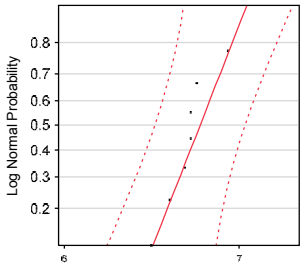
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.283955	0.0562

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

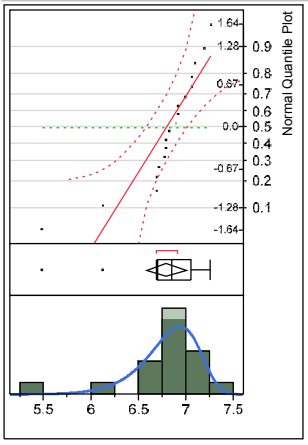
Diagnostic Plot



Modulus, Msi, Measured

Distributions Condition=ETW2

Modulus, Msi, Measured



Weibull(6.94561,27.1064)

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
☑	Weibull	14.5378167
☐	Extreme Value	14.5378167
☐	Johnson SI	15.2931216
☐	Johnson Su	18.6199892
☐	Normal 2 Mixture	20.4442111
☐	Normal	23.1196968
☐	Gamma	24.6345699
☐	LogNormal	25.4414818
☐	GLog	28.3557675
☐	Normal 3 Mixture	38.0941232
☐	Exponential	107.219192

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	6.9456077	6.8124147	7.07603
Shape	β	27.106375	17.815969	38.389585

-2log(Likelihood) = 9.73781670495931

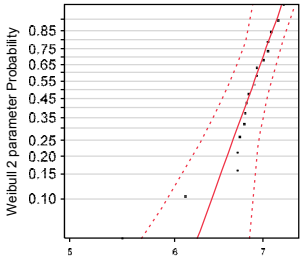
Goodness-of-Fit Test

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.

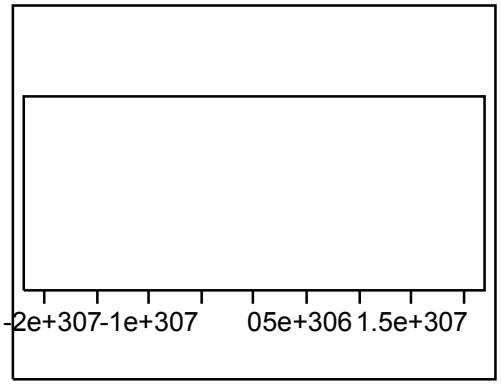
Diagnostic Plot



Modulus, Msi, Measured

Distributions Condition=ETW

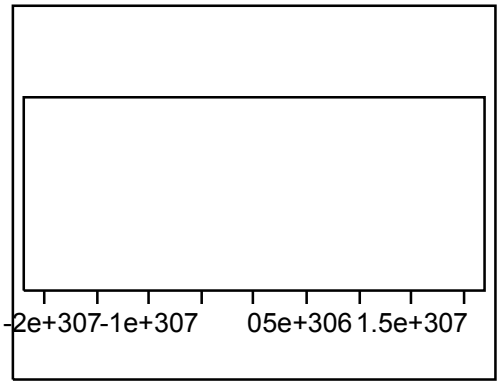
Poisson's Ratio



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

Distributions Condition=ETW2

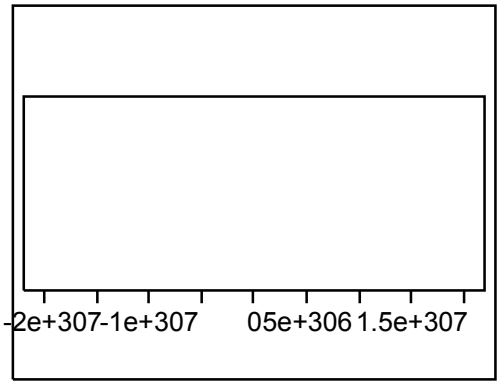
Poisson's Ratio



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

Distributions Condition=RTD

Poisson's Ratio



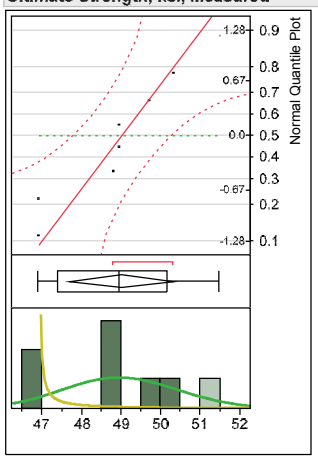
Quantiles	Summary Statistics	
	Mean	.
	Std Dev	.
	Std Err Mean	.
	Upper 95% Mean	.
	Lower 95% Mean	.
	N	0

A.23 Soft Compression (UNC2)

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

Distributions Condition=RTD

Ultimate Strength, ksi, Measured



Summary Statistics	
Mean	49.004065
Std Dev	1.5666615
Std Err Mean	0.5538985
Upper 95% Mean	50.313827
Lower 95% Mean	47.694303
N	8

Compare Distributions

Show	Distribution	AICc
☑	Johnson SI	7.51465449
☐	Gamma	35.2218991
☑	LogNormal	35.2264388
☐	Normal	35.2861674
☐	Weibull	35.8165947
☐	Extreme Value	35.8165947
☐	GLog	40.8264388
☐	Johnson Su	52.436695
☐	Normal 2 Mixture	70.1629208
☐	Exponential	80.9371187

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	3.8914555	3.8679542	3.9149569
Shape	σ	0.0299346	0.01964	0.0537251

-2log(Likelihood) = 28.826438790858

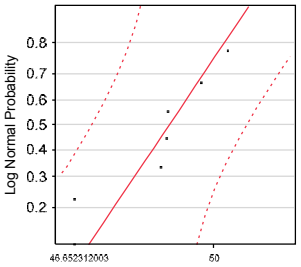
Goodness-of-Fit Test

Kolmogorov's D

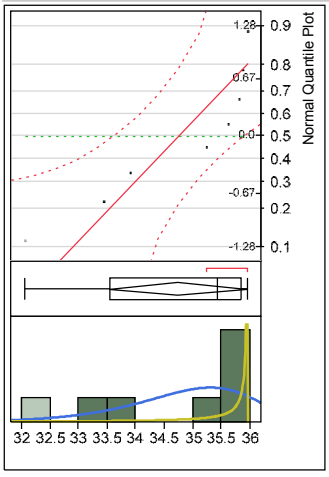
D		Prob>D
0.201377	>	0.1500

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

Diagnostic Plot



Ultimate Strength, ksi, Measured



Summary Statistics	
Mean	34.739077
Std Dev	1.4456073
Std Err Mean	0.5110994
Upper 95% Mean	35.947635
Lower 95% Mean	33.530519
N	8

Compare Distributions

Show	Distribution	AICc
☑	Johnson SI	5.23706245
☑	Weibull	31.8465897
☐	Extreme Value	31.8465897
☐	Normal	33.9994891
☐	Gamma	34.10928
☐	LogNormal	34.2016205
☐	GLog	39.5312384
☐	Johnson Su	48.8646786
☐	Normal 2 Mixture	59.9243554
☐	Exponential	75.4325097

Fitted 2 parameter Weibull

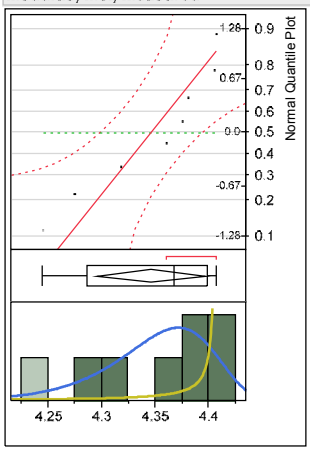
Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	35.331562	34.496386	36.133626
Shape	β	37.019703	18.761047	64.322702

-2log(Likelihood) = 25.4465896527527

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
☑	Johnson SI	-39.251936
☑	Weibull	-18.335101
☐	Extreme Value	-18.335101
☐	Gamma	-16.835974
☐	LogNormal	-16.814004
☐	Normal	-16.81096
☐	GLog	-11.279211
☐	Johnson Su	-1.9458601
☐	Normal 2 Mixture	13.6834028
☐	Exponential	42.1743006

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	4.3717532	4.3346759	4.4067345
Shape	β	103.16674	53.32365	174.62786

-2log(Likelihood) = -24.7351014695616

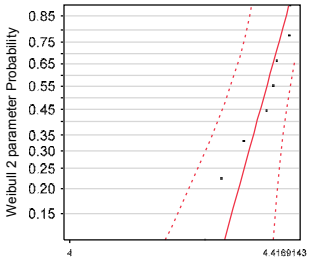
Goodness-of-Fit Test

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.

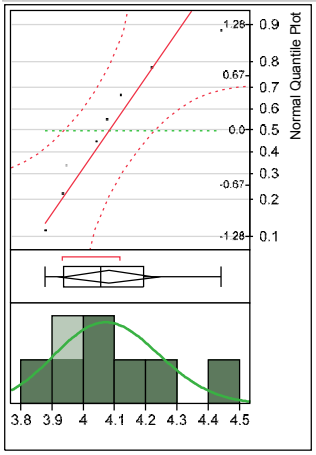
Diagnostic Plot



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
☑	LogNormal	0.54893142
☐	Gamma	0.63836999
☐	Normal	0.89517015
☐	Weibull	3.14793407
☐	Extreme Value	3.14793407
☐	Johnson SI	4.19237732
☐	GLog	6.14893142
☐	Johnson Su	13.5257107
☐	Normal 2 Mixture	36.005805
☐	Exponential	41.165689

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	1.405332	1.3730071	1.4376569
Shape	σ	0.0411734	0.0270138	0.073896

-2log(Likelihood) = -5.85106857540664

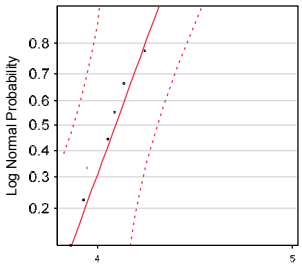
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.162752	>	0.1500

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

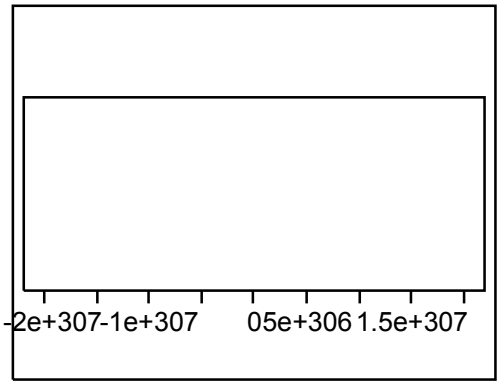
Diagnostic Plot



Modulus, Msi, Measured

Distributions Condition=ETW2

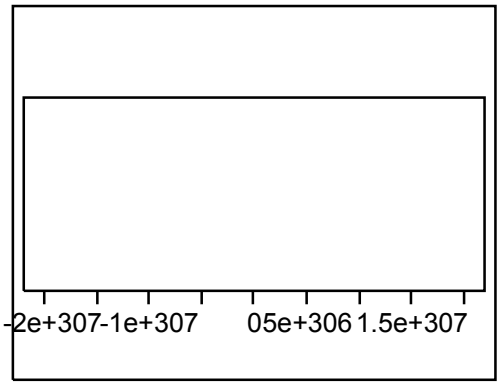
Poisson's Ratio



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

Distributions Condition=RTD

Poisson's Ratio



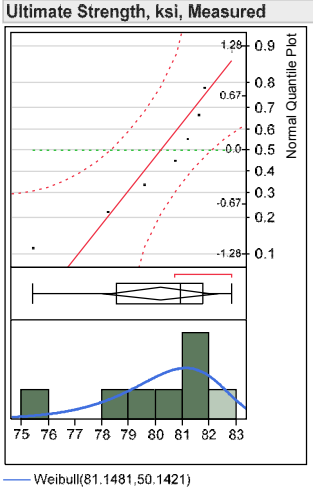
Quantiles	Summary Statistics	
	Mean	.
	Std Dev	.
	Std Err Mean	.
	Upper 95% Mean	.
	Lower 95% Mean	.
	N	0

A.24 Hard Compression (UNC3)

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

Distributions Condition=RTD

Ultimate Strength, ksi, Measured



Summary Statistics

Mean	80.17006
Std Dev	2.3959972
Std Err Mean	0.8471129
Upper 95% Mean	82.173164
Lower 95% Mean	78.166956
N	8

Compare Distributions

Show	Distribution	AICc
☑	Weibull	39.9499633
☐	Extreme Value	39.9499633
☐	Normal	42.0838086
☐	Gamma	42.1649358
☐	LogNormal	42.241745
☐	Johnson SI	44.8370508
☐	GLog	47.841745
☐	Johnson Su	53.809481
☐	Normal 2 Mixture	75.7332408
☐	Exponential	88.8130687

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	81.148091	79.747753	82.491361
Shape	β	50.142088	25.929074	83.826541

-2log(Likelihood) = 33.5499633473505

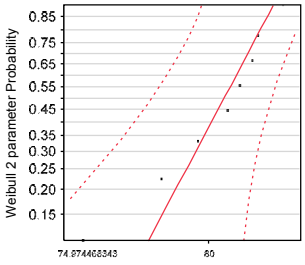
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square		Prob>W^2
0.031612	>	0.2500

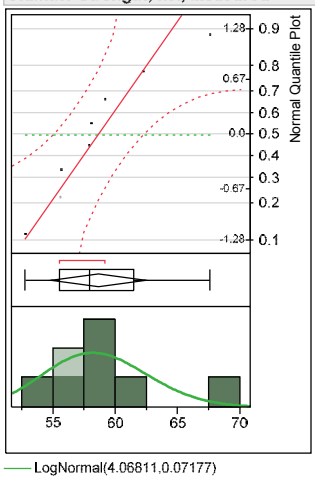
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho

Diagnostic Plot



Distributions Condition=ETW2

Ultimate Strength, ksi, Measured



Summary Statistics

Mean	58.599587
Std Dev	4.607138
Std Err Mean	1.6288692
Upper 95% Mean	62.451251
Lower 95% Mean	54.747923
N	8

Compare Distributions

Show	Distribution	AICc
☑	LogNormal	52.0431339
☐	Gamma	52.1768511
☐	Normal	52.5447258
☐	Weibull	54.4374543
☐	Extreme Value	54.4374543
☐	Johnson SI	56.6970545
☐	GLog	57.6431339
☐	Johnson Su	66.0303879
☐	Exponential	83.7983091
☐	Normal 2 Mixture	87.4561407

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	4.0681114	4.011769	4.1244538
Shape	σ	0.0717653	0.0470851	0.1288008

-2log(Likelihood) = 45.6431338860802

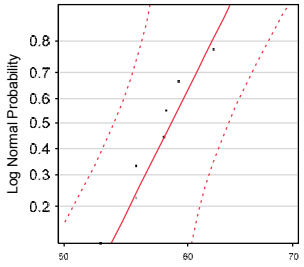
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.180178	>	0.1500

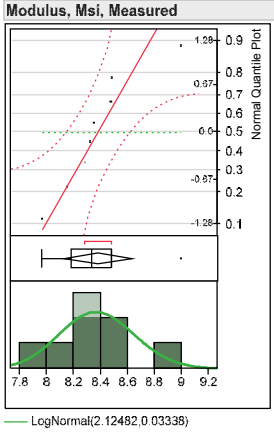
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



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	8.1229566
N	8

Compare Distributions

Show	Distribution	AICc
☑	LogNormal	8.70284659
☐	Gamma	8.77285824
☐	Normal	8.98943842
☐	Weibull	11.4876478
☐	Extreme Value	11.4876478
☐	Johnson SI	13.457927
☐	GLog	14.3028466
☐	Johnson Su	22.7971509
☐	Normal 2 Mixture	43.8681918
☐	Exponential	52.672833

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	2.1248235	2.0986181	2.151029
Shape	σ	0.0333788	0.0218998	0.0599066

-2log(Likelihood) = 2.3028465860039

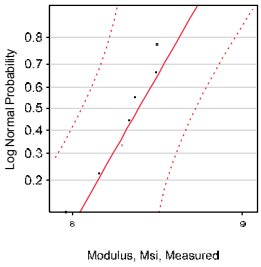
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.220803	>	0.1500

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

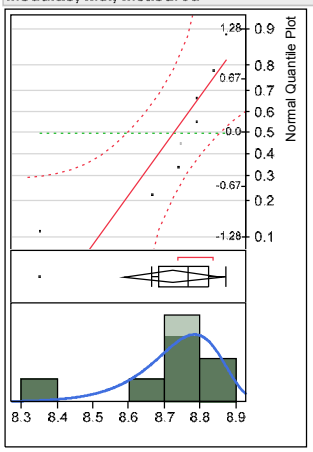
Diagnostic Plot



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
☑	Weibull	-5.0022197
☐	Extreme Value	-5.0022197
☐	Johnson SI	-1.30711
☐	Normal	-0.8601091
☐	Gamma	-0.7726175
☐	LogNormal	-0.6939473
☐	GLog	4.90605272
☐	Johnson Su	8.02613944
☐	Normal 2 Mixture	34.0166443
☐	Exponential	53.3234537

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	8.7846571	8.7047807	8.8620978
Shape	β	95.155289	48.20442	160.53069

-2log(Likelihood) = -11.4022197358113

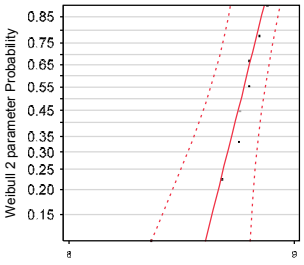
Goodness-of-Fit Test

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.

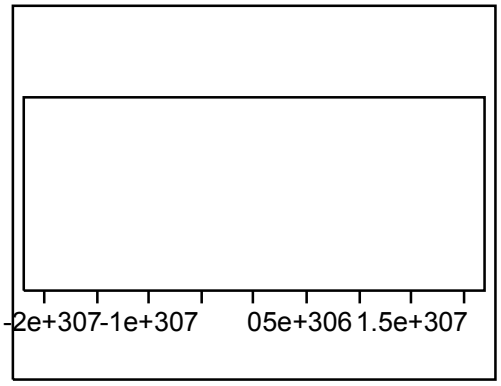
Diagnostic Plot



Modulus, Msi, Measured

Distributions Condition=ETW2

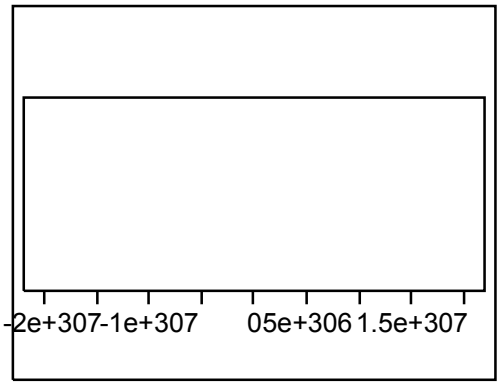
Poisson's Ratio



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

Distributions Condition=RTD

Poisson's Ratio



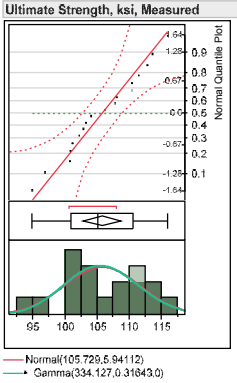
Quantiles	Summary Statistics	
	Mean	.
	Std Dev	.
	Std Err Mean	.
	Upper 95% Mean	.
	Lower 95% Mean	.
	N	0

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=CTD

Ultimate Strength, ksi, Measured



Summary Statistics

Mean	105.7288
Std Dev	5.9411215
Std Err Mean	1.4003358
Upper 95% Mean	108.68326
Lower 95% Mean	102.77435
N	18

Compare Distributions

Show	Distribution	AICc
☑	Gamma	119.030063
☑	Normal	119.030112
☐	LogNormal	119.063182
☐	Weibull	119.850703
☐	Extreme Value	119.850703
☐	Johnson SI	121.91024
☐	GLog	121.915548
☐	Johnson Su	125.27824
☐	Normal 2 Mixture	128.886856
☐	Normal 3 Mixture	146.091711
☐	Exponential	206.041585

Fitted Normal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Location	μ	105.7288	102.77435	108.68326
Dispersion	σ	5.9411215	4.4581439	8.9065986

-2log(Likelihood) = 114.230112211818

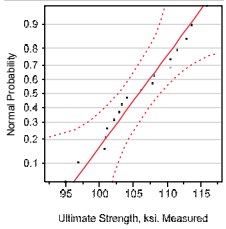
Goodness-of-Fit Test

Shapiro-Wilk W Test

W	Prob<W
0.970862	0.8137

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

Diagnostic Plot



Fitted Gamma

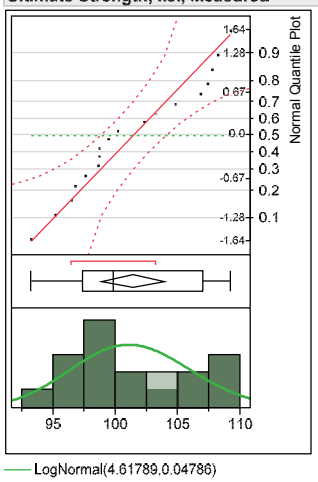
Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Shape	α	334.12668	160.63663	602.19655
Scale	σ	0.3164333	0.1755134	0.6587105
Threshold	θ	0		

-2log(Likelihood) = 114.230063147319

Distributions Condition=RTD

Ultimate Strength, ksi, Measured



Summary Statistics

Mean	101.39617
Std Dev	5.008541
Std Err Mean	1.1805244
Upper 95% Mean	103.88686
Lower 95% Mean	98.90548
N	18

Compare Distributions

Show	Distribution	AICc
☑	LogNormal	112.70812
☐	Gamma	112.748862
☐	Normal	112.882995
☐	Weibull	114.399943
☐	Extreme Value	114.399943
☐	Johnson SI	115.375831
☐	GLog	115.622405
☐	Normal 2 Mixture	115.66487
☐	Johnson Su	118.738469
☐	Normal 3 Mixture	131.577717
☐	Exponential	204.535271

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	4.6178876	4.5945418	4.6412335
Shape	σ	0.0478646	0.0356495	0.0690498

-2log(Likelihood) = 107.908119570478

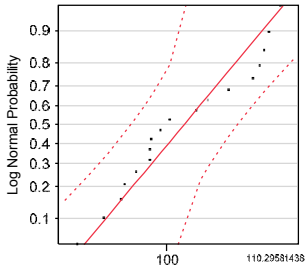
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.148076	>	0.1500

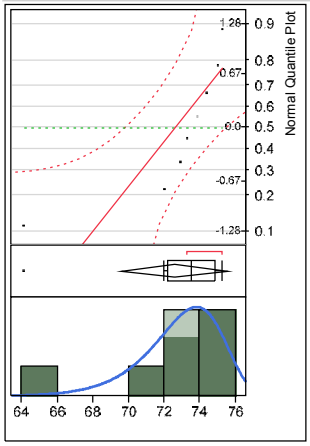
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Ultimate Strength, ksi, Measured



Weibull(73.8475,39.746)

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
☑	Weibull	43.6241715
☐	Extreme Value	43.6241715
☐	Johnson SI	44.134183
☐	Normal	48.5625491
☐	Gamma	48.973499
☐	LogNormal	49.2180962
☐	Johnson Su	53.4675111
☐	GLog	54.8180962
☐	Normal 2 Mixture	68.6689247
☐	Exponential	87.224977

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	73.847523	72.24853	75.443068
Shape	β	39.746038	19.658096	68.564268

-2log(Likelihood) = 37.2241715294315

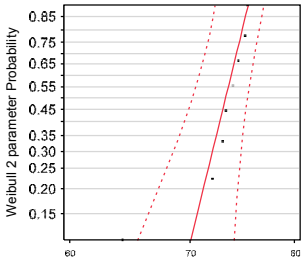
Goodness-of-Fit Test

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.

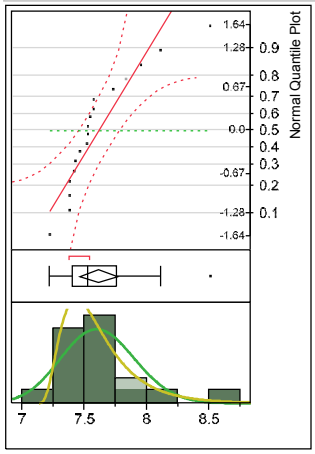
Diagnostic Plot



Ultimate Strength, ksi, Measured

Distributions Condition=CTD

Modulus, Msi, Measured



LogNormal(2.02916,0.03908)
Johnson SI(1.46664,1.88777,7.0833,1)

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
☑	Johnson SI	7.9528521
☐	Johnson Su	10.0059762
☑	LogNormal	12.2179937
☐	Gamma	12.5523678
☐	Normal	13.273508
☐	GLog	15.1322795
☐	Normal 2 Mixture	15.1605369
☐	Weibull	21.2828356
☐	Extreme Value	21.2828356
☐	Normal 3 Mixture	33.5498494
☐	Exponential	111.327753

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	2.0291597	2.0100966	2.0482228
Shape	σ	0.039084	0.0291096	0.0563828

-2log(Likelihood) = 7.41799373605048

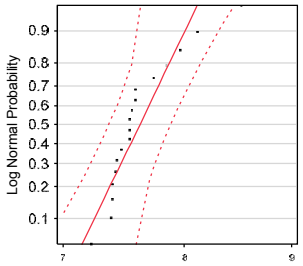
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.266090	<	0.0100*

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

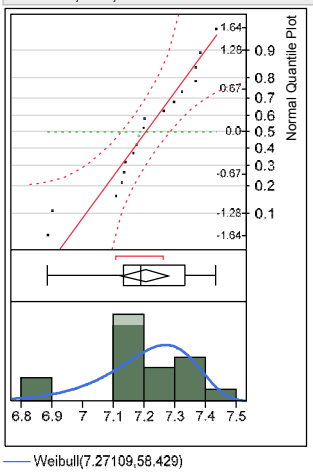
Diagnostic Plot



Modulus, Msi, Measured

Distributions Condition=RTD

Modulus, Msi, Measured



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
☑	Weibull	-14.189771
☐	Extreme Value	-14.189771
☐	Normal	-13.052711
☐	Gamma	-12.94066
☐	LogNormal	-12.866858
☐	Johnson SI	-11.449113
☐	GLog	-9.9525722
☐	Normal 2 Mixture	-9.2523088
☐	Johnson Su	-8.0864759
☐	Normal 3 Mixture	-1.7772542
☐	Exponential	109.329415

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	7.2710899	7.2051946	7.333714
Shape	β	58.428971	39.347269	81.445322

-2log(Likelihood) = -18.9897712349578

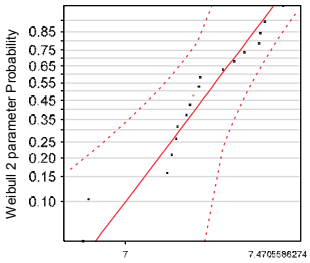
Goodness-of-Fit Test

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.

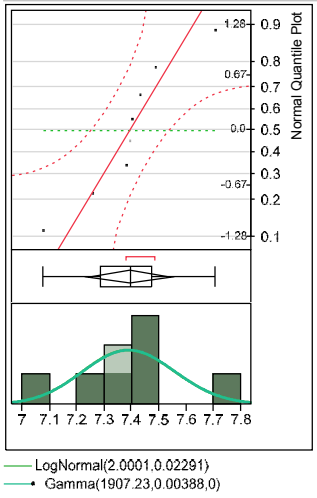
Diagnostic Plot



Modulus, Msi, Measured

Distributions Condition=ETW2

Modulus, Msi, Measured



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
☑	Gamma	0.67880484
☑	LogNormal	0.68414934
☐	Normal	0.74072631
☐	Weibull	1.74593637
☐	Extreme Value	1.74593637
☐	Johnson SI	6.27158202
☐	GLog	6.28414934
☐	Johnson Su	13.8698747
☐	Normal 2 Mixture	35.6174797
☐	Exponential	50.6724989

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	2.0001023	1.9821177	2.018087
Shape	σ	0.0229077	0.0150297	0.0411136

-2log(Likelihood) = -5.71585066461721

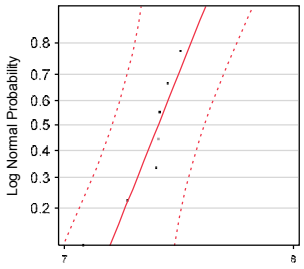
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.229230	>	0.1500

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

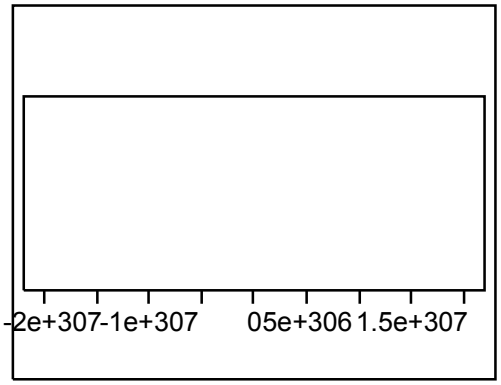
Diagnostic Plot



Modulus, Msi, Measured

Distributions Condition=CTD

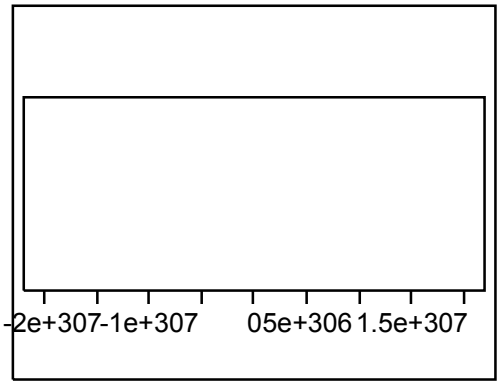
Poisson's Ratio



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

Distributions Condition=ETW2

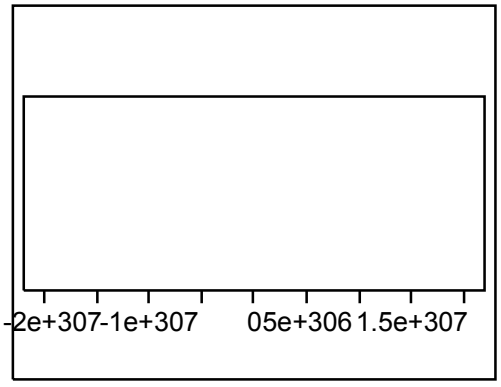
Poisson's Ratio



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

Distributions Condition=RTD

Poisson's Ratio



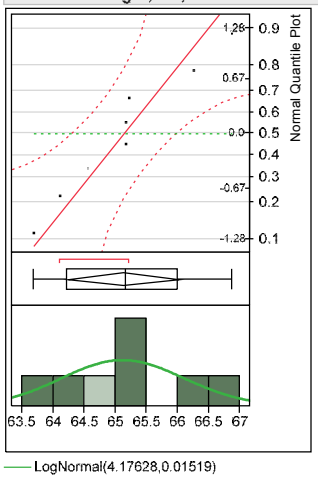
Quantiles	Summary Statistics	
	Mean	.
	Std Dev	.
	Std Err Mean	.
	Upper 95% Mean	.
	Lower 95% Mean	.
	N	0

A.26 Soft Tension (UNT2)

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

Distributions Condition=CTD

Ultimate Strength, ksi, Measured



Summary Statistics

Mean	65.130524
Std Dev	1.0597681
Std Err Mean	0.3746846
Upper 95% Mean	66.016512
Lower 95% Mean	64.244536
N	8

Compare Distributions

Show	Distribution	AICc
☑	LogNormal	28.925554
☐	Gamma	28.9378
☐	Normal	29.031818
☐	Weibull	30.3242725
☐	Extreme Value	30.3242725
☐	Johnson SI	34.2501937
☐	GLog	34.525554
☐	Johnson Su	44.6133217
☐	Normal 2 Mixture	62.31812
☐	Exponential	85.4889597

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	4.1762778	4.1643553	4.1882004
Shape	σ	0.0151862	0.0099636	0.0272554

-2log(Likelihood) = 22.5255539755302

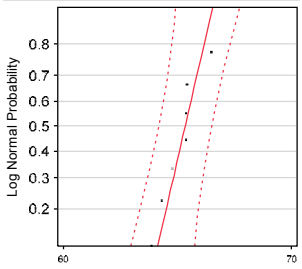
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.208450	>	0.1500

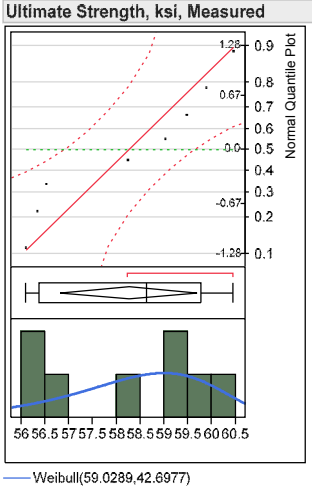
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=RTD

Ultimate Strength, ksi, Measured



Summary Statistics

Mean	58.252646
Std Dev	1.7376411
Std Err Mean	0.6143489
Upper 95% Mean	59.70535
Lower 95% Mean	56.799941
N	8

Compare Distributions

Show	Distribution	AICc
☑	Weibull	36.6742743
☐	Extreme Value	36.6742743
☐	Gamma	36.8960406
☐	LogNormal	36.9078923
☐	Normal	36.9434723
☐	Johnson SI	42.1358209
☐	GLog	42.4752222
☐	Johnson Su	51.8086299
☐	Normal 2 Mixture	62.2581978
☐	Exponential	83.7032988

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	59.028894	57.834485	60.164368
Shape	β	42.697676	22.546567	70.800992

-2log(Likelihood) = 30.2742742832751

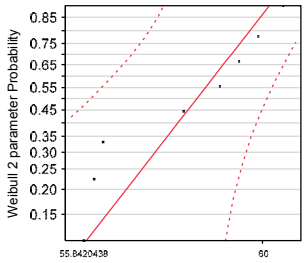
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square		Prob>W^2
0.054415	>	0.2500

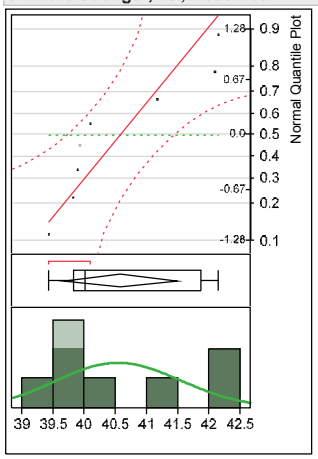
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Ultimate Strength, ksi, Measured



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
☑	LogNormal	29.204796
☐	Gamma	29.2446873
☐	Normal	29.3949182
☐	Weibull	30.9141992
☐	Extreme Value	30.9141992
☐	Johnson SI	31.8416724
☐	GLog	34.804796
☐	Johnson Su	41.8278141
☐	Normal 2 Mixture	54.5393575
☐	Exponential	77.9149298

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	3.7027071	3.6832258	3.7221884
Shape	σ	0.024814	0.0162804	0.044535

-2log(Likelihood) = 22.8047959742424

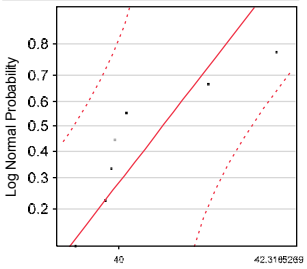
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.307294	0.0341*

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

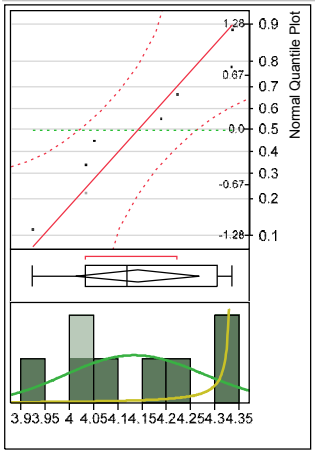
Diagnostic Plot



Ultimate Strength, ksi, Measured

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
☑	Johnson SI	-22.1047
☑	LogNormal	-2.0863238
☐	Gamma	-2.0804018
☐	Normal	-1.9950819
☐	Weibull	-1.5688279
☐	Extreme Value	-1.5688279
☐	GLog	3.5366669
☐	Johnson Su	12.8700198
☐	Normal 2 Mixture	29.8519896
☐	Exponential	41.3963499

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	1.4200128	1.3929961	1.4470295
Shape	σ	0.0344121	0.0225777	0.0617612

-2log(Likelihood) = -8.48632379817445

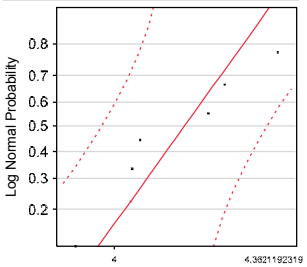
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.231992	>	0.1500

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

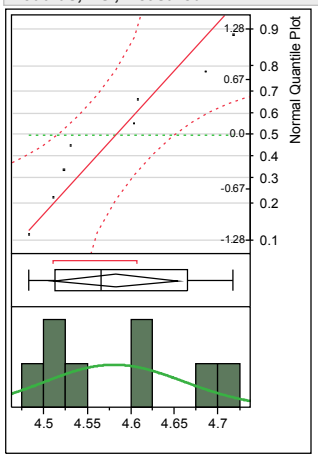
Diagnostic Plot



Modulus, Msi, Measured

Distributions Condition=RTD

Modulus, Msi, Measured



LogNormal(1.52204,0.01745)

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
☑	LogNormal	-11.318561
☐	Gamma	-11.298065
☐	Normal	-11.187519
☐	Weibull	-9.8413971
☐	Extreme Value	-9.8413971
☐	Johnson SI	-7.1231858
☐	GLog	-5.6557701
☐	Johnson Su	3.67759132
☐	Normal 2 Mixture	19.3168362
☐	Exponential	43.021709

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	1.5220375	1.5083372	1.5357378
Shape	σ	0.0174505	0.0114492	0.0313193

-2log(Likelihood) = -17.7185612005223

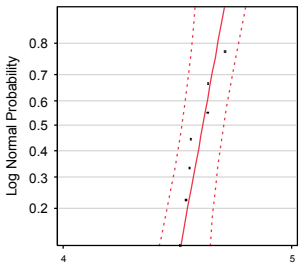
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.241649	>	0.1500

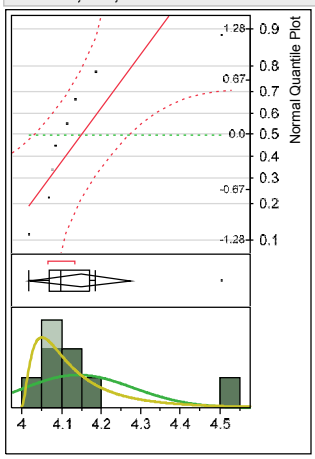
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Modulus, Msi, Measured



LogNormal(1.42191,0.0334)
Johnson SI(2.67992,1.21686,3.99253,1)

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
☑	Johnson SI	-3.6745553
☑	LogNormal	-2.531521
☐	Gamma	-2.3727657
☐	Normal	-1.981712
☐	Weibull	1.86142413
☐	Extreme Value	1.86142413
☐	GLog	3.068479
☐	Johnson Su	5.34479354
☐	Normal 2 Mixture	19.3381472
☐	Exponential	41.4262763

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	1.4219066	1.395681	1.4481322
Shape	σ	0.0334045	0.0219166	0.0599527

-2log(Likelihood) = -8.93152099645391

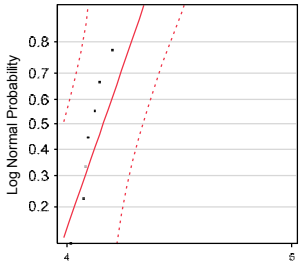
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.287505	0.0496*

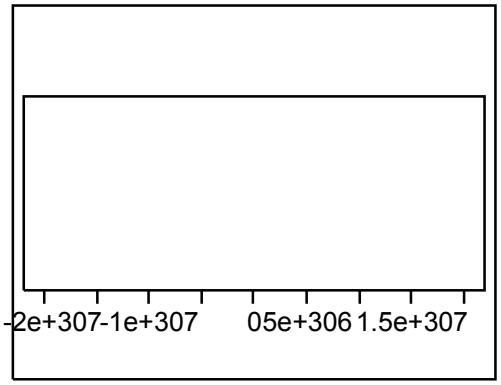
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=CTD

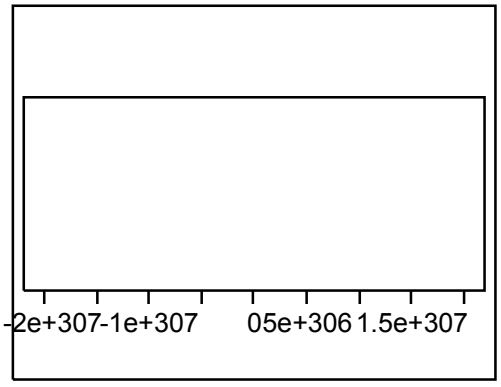
Poisson's Ratio



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

Distributions Condition=ETW2

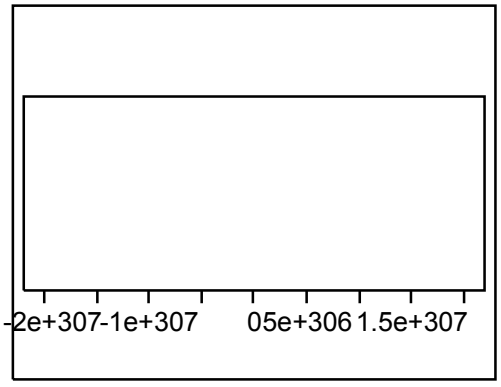
Poisson's Ratio



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

Distributions Condition=RTD

Poisson's Ratio



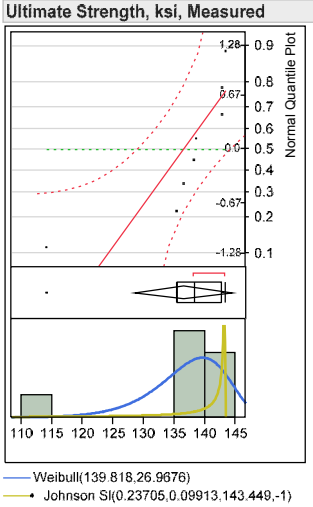
Quantiles	Summary Statistics	
	Mean	.
	Std Dev	.
	Std Err Mean	.
	Upper 95% Mean	.
	Lower 95% Mean	.
	N	0

A.27 Hard Tension (UNT3)

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

Distributions Condition=CTD

Ultimate Strength, ksi, Measured



Summary Statistics	
Mean	136.46689
Std Dev	9.5723854
Std Err Mean	3.3843493
Upper 95% Mean	144.4696
Lower 95% Mean	128.46417
N	8

Compare Distributions

Show	Distribution	AICc
☑	Johnson SI	33.4248748
☑	Weibull	59.7864088
☐	Extreme Value	59.7864088
☐	Normal	64.2451354
☐	Gamma	64.8486394
☐	LogNormal	65.1953296
☐	Johnson Su	67.1491687
☐	GLog	70.7953296
☐	Normal 2 Mixture	85.2416544
☐	Exponential	97.3239787

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	139.81773	135.37811	144.27982
Shape	β	26.967556	13.388387	46.444213

-2log(Likelihood) = 53.3864088272936

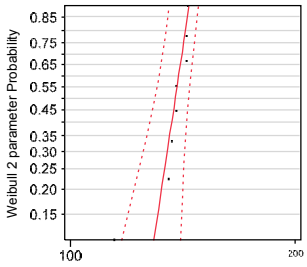
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square	Prob>W^2
0.078666	0.1919

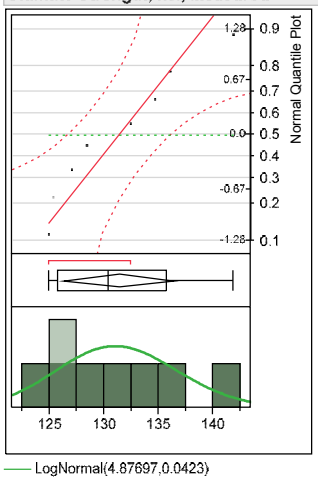
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=RTD

Ultimate Strength, ksi, Measured



Summary Statistics	
Mean	131.35033
Std Dev	5.9970589
Std Err Mean	2.1202805
Upper 95% Mean	136.36399
Lower 95% Mean	126.33666
N	8

Compare Distributions

Show	Distribution	AICc
☑	LogNormal	56.5261317
☐	Gamma	56.5795651
☐	Normal	56.7633232
☐	Weibull	58.2206065
☐	Extreme Value	58.2206065
☐	Johnson SI	60.1564466
☐	GLog	62.295068
☐	Johnson Su	71.6287639
☐	Normal 2 Mixture	88.1768489
☐	Exponential	96.7125548

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	4.8769677	4.8437602	4.9101753
Shape	σ	0.0422977	0.0277514	0.0759138

-2log(Likelihood) = 50.1261316823735

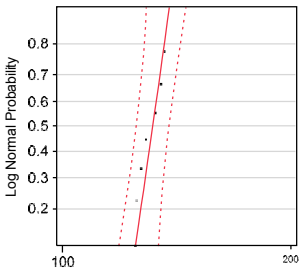
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.193404	>	0.1500

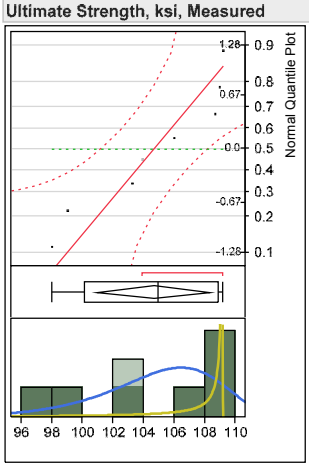
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=ETW2

Ultimate Strength, ksi, Measured



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
☑	Johnson SI	26.4809758
☑	Weibull	50.9944881
☐	Extreme Value	50.9944881
☐	Normal	51.8566478
☐	Gamma	51.8734204
☐	LogNormal	51.919248
☐	GLog	57.3883981
☐	Johnson Su	66.7218847
☐	Normal 2 Mixture	81.1143714
☐	Exponential	93.0758935

Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	106.55173	103.6712	109.31184
Shape	β	31.985595	16.695969	53.815991

-2log(Likelihood) = 44.5944881151855

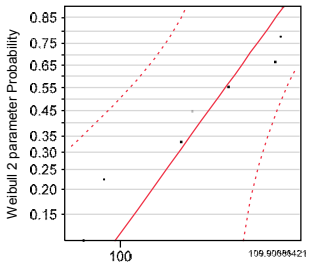
Goodness-of-Fit Test

Cramer-von Mises W Test

W-Square		Prob>W^2
0.058238	>	0.2500

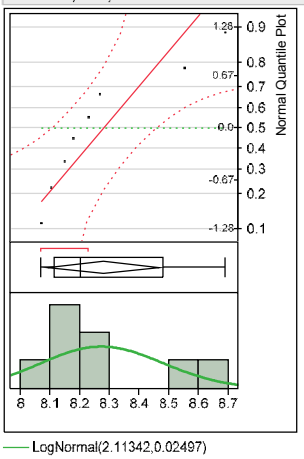
Note: Ho = The data is from the Weibull distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=CTD

Modulus, Msi, Measured



Summary Statistics

Mean	8.279125
Std Dev	0.2236856
Std Err Mean	0.0790848
Upper 95% Mean	8.4661309
Lower 95% Mean	8.0921191
N	8

Compare Distributions

Show	Distribution	AICc
☑	LogNormal	3.87877221
☐	Gamma	3.9432013
☐	Normal	4.14279921
☐	Johnson SI	4.49662911
☐	Weibull	6.52166906
☐	Extreme Value	6.52166906
☐	GLog	9.67454794
☐	Johnson Su	19.0079057
☐	Normal 2 Mixture	29.4283387
☐	Exponential	52.4864633

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	2.113423	2.0938164	2.1330295
Shape	σ	0.0249735	0.0163851	0.0448213

-2log(Likelihood) = -2.52122778926093

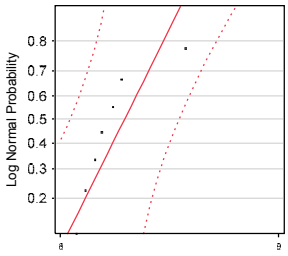
Goodness-of-Fit Test

Kolmogorov's D

D	Prob>D
0.272245	0.0802

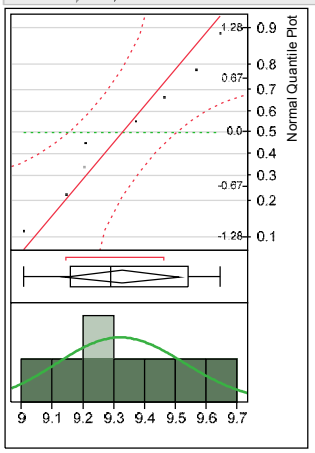
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

Diagnostic Plot



Distributions Condition=RTD

Modulus, Msi, Measured



LogNormal(2.23253,0.02227)

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
☑	LogNormal	3.95020246
☐	Gamma	3.95459341
☐	Normal	4.03394684
☐	Weibull	4.56982624
☐	Extreme Value	4.56982624
☐	Johnson SI	9.51774206
☐	GLog	9.56569551
☐	Johnson Su	18.8990565
☐	Normal 2 Mixture	37.6428516
☐	Exponential	54.3911369

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	2.2325313	2.2150485	2.2500141
Shape	σ	0.0222685	0.0146103	0.0399664

-2log(Likelihood) = -2.44979754299592

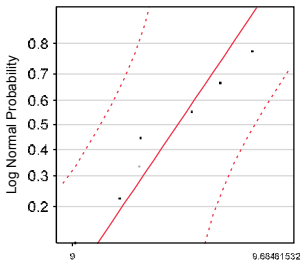
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.213743	>	0.1500

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

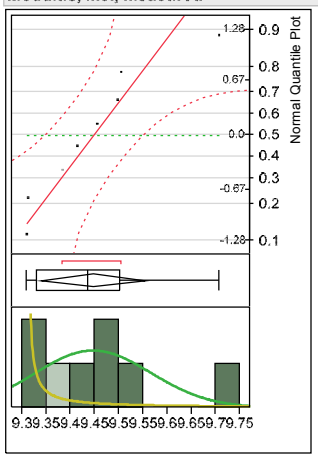
Diagnostic Plot



Modulus, Msi, Measured

Distributions Condition=ETW2

Modulus, Msi, Measured



LogNormal(2.24574,0.0127)
Johnson SI(0.61777,0.10154,9.309,1)

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
☑	Johnson SI	-26.047308
☑	LogNormal	-4.8274082
☐	Gamma	-4.7963449
☐	Normal	-4.6709487
☐	Weibull	-2.0173951
☐	Extreme Value	-2.0173951
☐	GLog	0.77259177
☐	Johnson Su	8.31258874
☐	Normal 2 Mixture	30.2058047
☐	Exponential	54.5997276

Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	2.2457354	2.2357671	2.2557037
Shape	σ	0.012697	0.0083305	0.022788

-2log(Likelihood) = -11.2274082334546

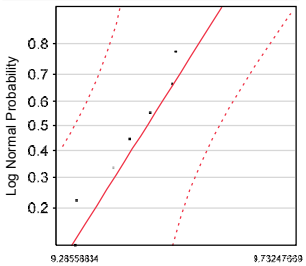
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.190950	>	0.1500

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

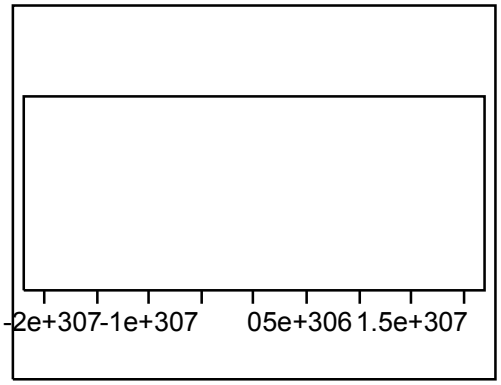
Diagnostic Plot



Modulus, Msi, Measured

Distributions Condition=CTD

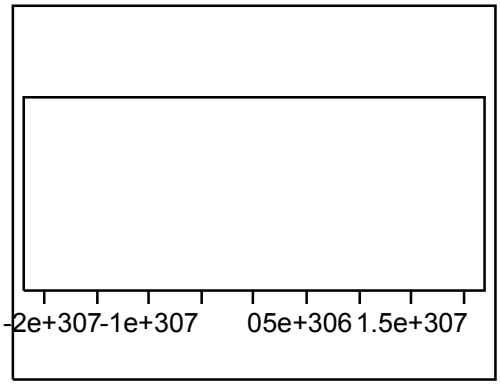
Poisson's Ratio



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

Distributions Condition=ETW2

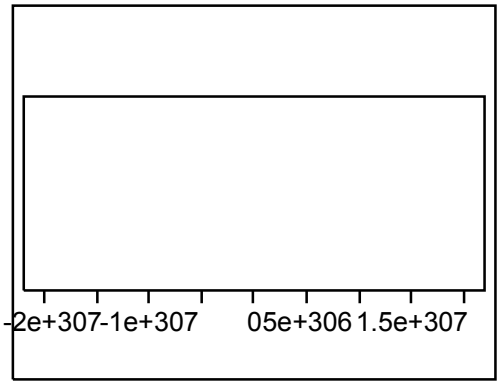
Poisson's Ratio



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

Distributions Condition=RTD

Poisson's Ratio



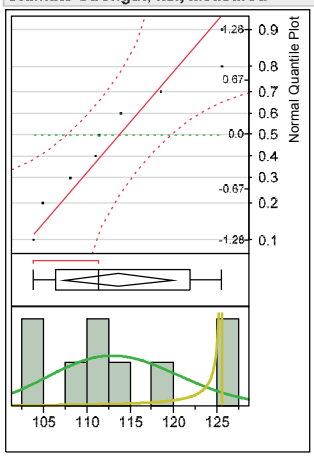
Quantiles	Summary Statistics	
	Mean	.
	Std Dev	.
	Std Err Mean	.
	Upper 95% Mean	.
	Lower 95% Mean	.
	N	0

A.28 Warp Compression (WC)

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

Distributions Condition=CTD

Ultimate Strength, ksi, Measured



LogNormal(4.73072,0.06647)
Johnson SI(0.15934,0.09913,125.59,-1)

Summary Statistics

Mean	113.6299
Std Dev	8.1015617
Std Err Mean	2.7005206
Upper 95% Mean	119.85731
Lower 95% Mean	107.40249
N	9

Compare Distributions

Show	Distribution	AICc
☑	Johnson SI	49.0110854
☑	LogNormal	67.8954297
☐	Gamma	67.9686433
☐	Normal	68.1979168
☐	Weibull	69.3827035
☐	Extreme Value	69.3827035
☐	GLog	72.9378677
☐	Johnson Su	80.1381077
☐	Normal 2 Mixture	91.3911575
☐	Exponential	105.764469

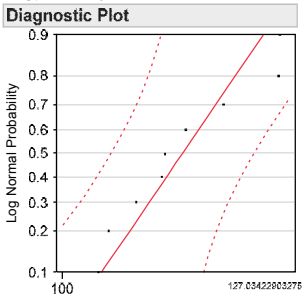
Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	4.7307212	4.6822223	4.7792202
Shape	σ	0.0664687	0.0445319	0.1146853

-2log(Likelihood) = 61.895429727824

Diagnostic Plot



Ultimate Strength, ksi, Measured

Goodness-of-Fit Test

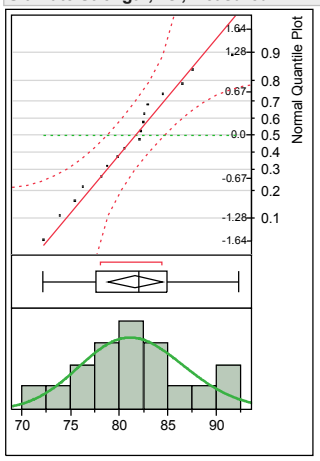
Kolmogorov's D

D		Prob>D
0.159939	>	0.1500

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

Distributions Condition=RTD

Ultimate Strength, ksi, Measured



LogNormal(4.39957,0.06612)

Summary Statistics

Mean	81.5945
Std Dev	5.5753397
Std Err Mean	1.3141202
Upper 95% Mean	84.367051
Lower 95% Mean	78.821949
N	18

Compare Distributions

Show	Distribution	AICc
☑	LogNormal	116.478183
☐	Gamma	116.535199
☐	Normal	116.742504
☐	Weibull	119.193591
☐	Extreme Value	119.193591
☐	Johnson SI	119.314196
☐	GLog	119.392469
☐	Johnson Su	122.676834
☐	Normal 2 Mixture	123.902718
☐	Normal 3 Mixture	143.960108
☐	Exponential	196.713427

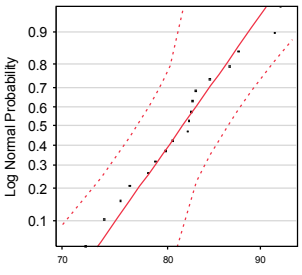
Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	4.3995708	4.3673227	4.431819
Shape	σ	0.0661165	0.0492434	0.09538

-2log(Likelihood) = 111.678183233328

Diagnostic Plot



Ultimate Strength, ksi, Measured

Goodness-of-Fit Test

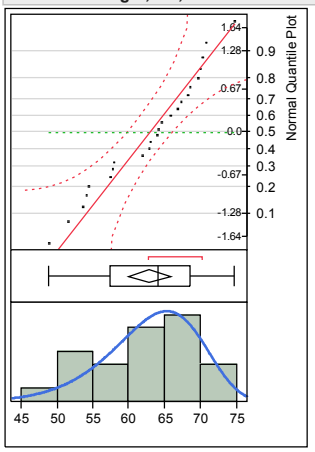
Kolmogorov's D

D		Prob>D
0.115266	>	0.1500

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

Distributions Condition=ETW

Ultimate Strength, ksi, Measured



Weibull(65.7784,11.1278)

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
☑	Weibull	163.371169
☐	Extreme Value	163.371169
☐	Normal	164.766272
☐	Gamma	165.471274
☐	LogNormal	165.933628
☐	Johnson SI	166.064578
☐	GLog	167.373414
☐	Normal 2 Mixture	170.011375
☐	Johnson Su	170.279114
☐	Normal 3 Mixture	180.091138
☐	Exponential	248.898565

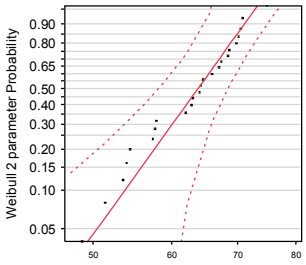
Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	65.778426	63.151268	68.361678
Shape	β	11.127807	7.882501	14.976333

-2log(Likelihood) = 158.799740642437

Diagnostic Plot



Ultimate Strength, ksi, Measured

Goodness-of-Fit Test

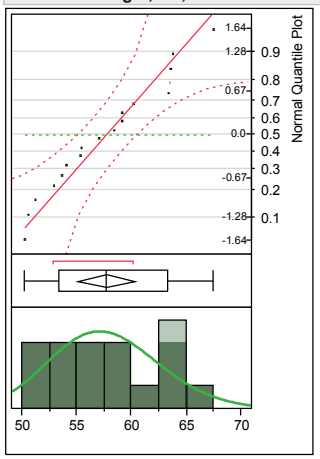
Cramer-von Mises W Test

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



LogNormal(4.05124,0.08731)

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
☑	LogNormal	113.946876
☐	Gamma	113.997401
☐	Normal	114.213254
☐	Weibull	115.667179
☐	Extreme Value	115.667179
☐	Johnson SI	116.7403
☐	GLog	117.098687
☐	Johnson Su	120.461646
☐	Normal 2 Mixture	123.733506
☐	Normal 3 Mixture	137.70519
☐	Exponential	184.232179

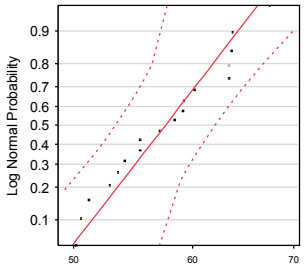
Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	4.0512434	4.0086596	4.0938272
Shape	σ	0.087307	0.0650261	0.1259496

-2log(Likelihood) = 109.146875873784

Diagnostic Plot



Ultimate Strength, ksi, Measured

Goodness-of-Fit Test

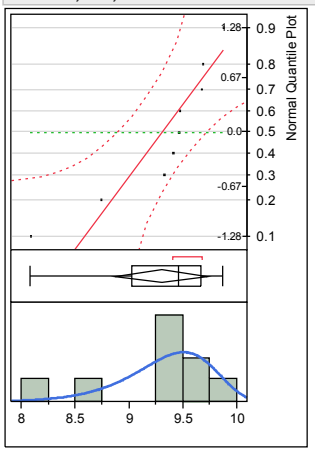
Kolmogorov's D

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
☑	Weibull	16.7689771
☐	Extreme Value	16.7689771
☐	Johnson SI	19.8487198
☐	Normal	20.0679351
☐	Gamma	20.4685008
☐	LogNormal	20.7086011
☐	GLog	25.5086011
☐	Johnson Su	27.0487194
☐	Normal 2 Mixture	38.6843608
☐	Exponential	60.7144833

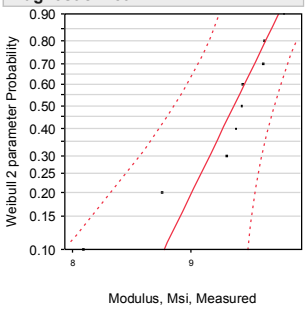
Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	9.5172957	9.2358369	9.7928128
Shape	β	26.959492	14.312231	44.386224

-2log(Likelihood) = 10.768977134893

Diagnostic Plot



Goodness-of-Fit Test

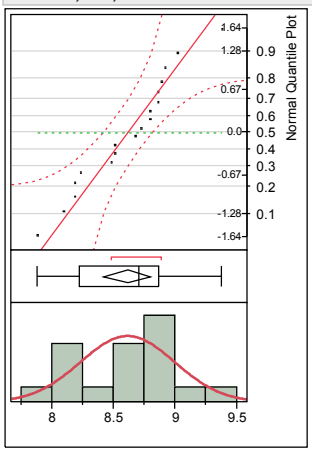
Cramer-von Mises W Test

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
☑	Normal	20.4066361
☐	Gamma	20.4618702
☐	LogNormal	20.5174549
☐	Weibull	21.4233448
☐	Extreme Value	21.4233448
☐	Johnson SI	23.2095762
☐	GLog	23.2920705
☐	Johnson Su	26.6547603
☐	Normal 2 Mixture	29.5534211
☐	Normal 3 Mixture	44.0191378
☐	Exponential	115.757598

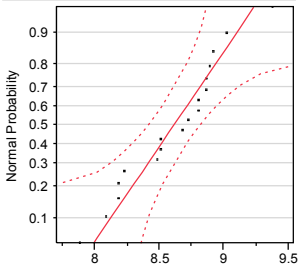
Fitted Normal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Location	μ	8.6105556	8.4196981	8.801413
Dispersion	σ	0.3837964	0.2879961	0.5753661

-2log(Likelihood) = 15.6066360615726

Diagnostic Plot



Goodness-of-Fit Test

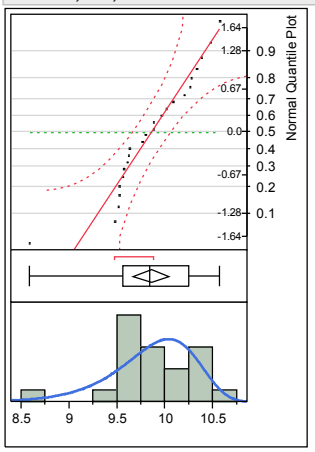
Shapiro-Wilk W Test

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
☑	Weibull	30.9856534
☐	Extreme Value	30.9856534
☐	Normal	32.1337716
☐	Gamma	32.6227978
☐	LogNormal	32.9080286
☐	Johnson SI	33.2609699
☐	GLog	35.5366
☐	Johnson Su	36.097228
☐	Normal 2 Mixture	40.1088066
☐	Normal 3 Mixture	45.185561
☐	Exponential	160.003184

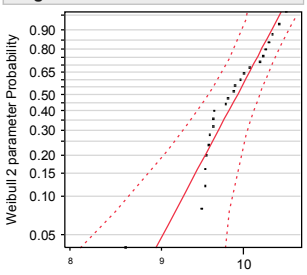
Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	10.051008	9.8838519	10.21195
Shape	β	26.983329	19.30739	35.971483

-2log(Likelihood) = 26.4142248445334

Diagnostic Plot



Modulus, Msi, Measured

Goodness-of-Fit Test

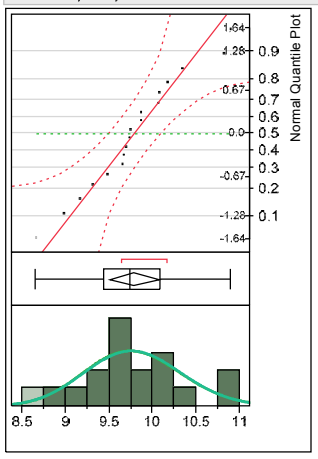
Cramer-von Mises W Test

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
☑	Gamma	34.8548031
☑	LogNormal	34.8591659
☐	Normal	34.931159
☐	Weibull	37.220886
☐	Extreme Value	37.220886
☐	Johnson SI	37.7689501
☐	GLog	37.7734516
☐	Johnson Su	41.1315875
☐	Normal 2 Mixture	41.9261368
☐	Normal 3 Mixture	63.132723
☐	Exponential	120.364709

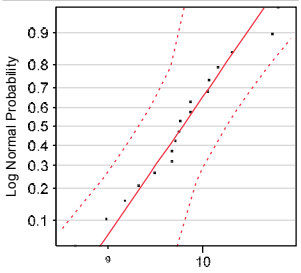
Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	2.2793364	2.2514956	2.3071771
Shape	σ	0.0570802	0.0425132	0.0823442

-2log(Likelihood) = 30.0591658512553

Diagnostic Plot



Modulus, Msi, Measured

Goodness-of-Fit Test

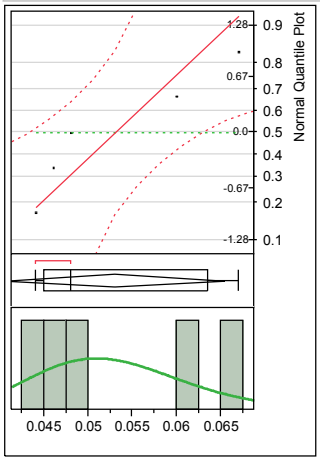
Kolmogorov's D

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
☑	LogNormal	-23.42196
☐	Gamma	-23.293356
☐	Normal	-22.862317
☐	Weibull	-22.584921
☐	Extreme Value	-22.584921
☐	Exponential	-16.0413
☐	GLog	-2.9780343

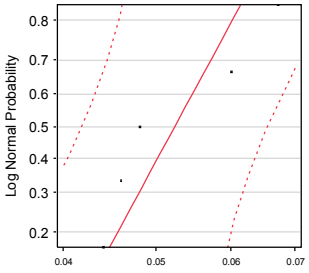
Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	-2.951141	-3.127105	-2.775177
Shape	σ	0.1636553	0.0978595	0.3565927

-2log(Likelihood) = -33.4219597631823

Diagnostic Plot



Goodness-of-Fit Test

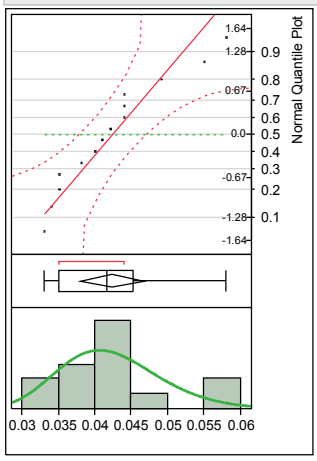
Kolmogorov's D

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	0.0466679
Lower 95% Mean	0.0379035
N	14

Compare Distributions

Show	Distribution	AICc
☑	LogNormal	-94.326771
☐	Gamma	-93.938327
☐	Normal	-92.845576
☐	Johnson SI	-92.423818
☐	Weibull	-91.148198
☐	Extreme Value	-91.148198
☐	GLog	-91.01768
☐	Johnson Su	-88.379374
☐	Normal 2 Mixture	-84.728158
☐	Exponential	-58.239234
☐	Normal 3 Mixture	-57.874337

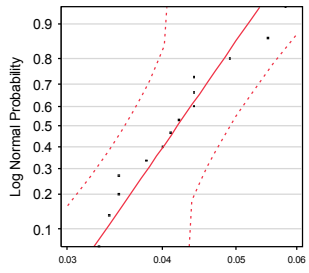
Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	-3.17751	-3.271131	-3.083889
Shape	σ	0.1666166	0.1198104	0.2541814

-2log(Likelihood) = -99.4176804223509

Diagnostic Plot



Goodness-of-Fit Test

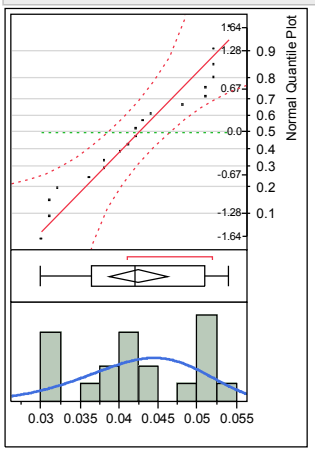
Kolmogorov's D

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
☑	Weibull	-133.23608
☐	Extreme Value	-133.23608
☐	Normal	-132.88742
☐	Gamma	-132.66937
☐	LogNormal	-132.33704
☐	Normal 2 Mixture	-131.75539
☐	Johnson Sl	-130.22145
☐	GLog	-129.54292
☐	Johnson Su	-127.05479
☐	Normal 3 Mixture	-118.88925
☐	Exponential	-84.202054

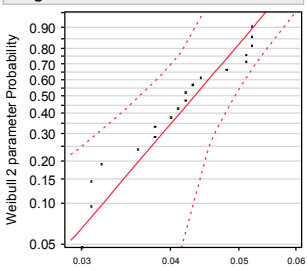
Fitted 2 parameter Weibull

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	α	0.0456391	0.0421573	0.0491676
Shape	β	6.3531777	4.3401018	8.8227653

-2log(Likelihood) = -137.941961099895

Diagnostic Plot



Goodness-of-Fit Test

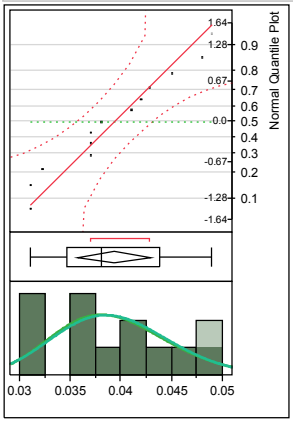
Cramer-von Mises W Test

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
☑	Gamma	-92.113257
☑	LogNormal	-92.073239
☐	Normal	-91.97024
☐	Weibull	-91.528633
☐	Extreme Value	-91.528633
☐	Johnson Sl	-88.618823
☐	GLog	-88.544128
☐	Johnson Su	-84.210791
☐	Normal 2 Mixture	-76.669368
☐	Exponential	-55.781075
☐	Normal 3 Mixture	-45.986853

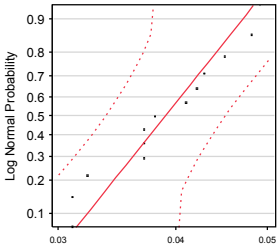
Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	-3.24716	-3.33372	-3.160599
Shape	σ	0.1476283	0.1049903	0.2293634

-2log(Likelihood) = -97.2732385832574

Diagnostic Plot



Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.137475	>	0.1500

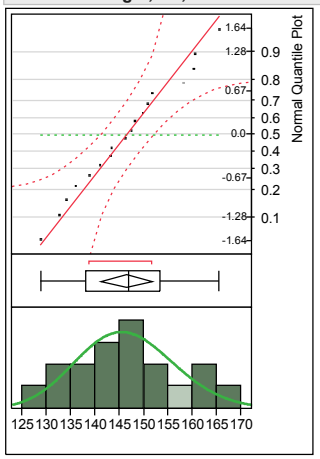
Note: Ho = The data is from the LogNormal distribution. Small p-values reject Ho.

A.29 Warp Tension (WT)

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

Distributions Condition=CTD

Ultimate Strength, ksi, Measured



LogNormal(4.98408,0.06916)

Summary Statistics

Mean	146.41901
Std Dev	10.419922
Std Err Mean	2.4559992
Upper 95% Mean	151.60072
Lower 95% Mean	141.23731
N	18

Compare Distributions

Show	Distribution	AICc
☑	LogNormal	139.142749
☐	Gamma	139.150124
☐	Normal	139.255691
☐	Weibull	140.769716
☐	Extreme Value	140.769716
☐	Johnson SI	142.055245
☐	GLog	142.057035
☐	Johnson Su	145.417883
☐	Normal 2 Mixture	149.611613
☐	Normal 3 Mixture	164.744792
☐	Exponential	217.763008

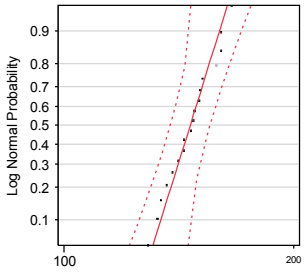
Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	4.9840816	4.9503471	5.017816
Shape	σ	0.0691638	0.0515131	0.0997761

-2log(Likelihood) = 134.342748931088

Diagnostic Plot



Goodness-of-Fit Test

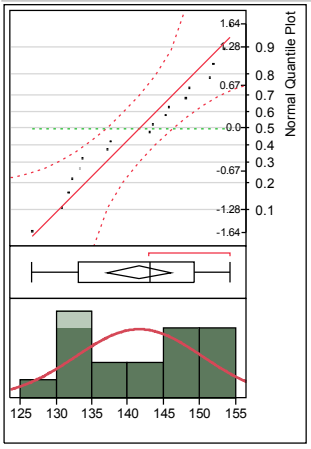
Kolmogorov's D

D		Prob>D
0.097146	>	0.1500

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

Distributions Condition=RTD

Ultimate Strength, ksi, Measured



Normal(141.518,8.8405)

Summary Statistics

Mean	141.51829
Std Dev	8.8404957
Std Err Mean	2.0837248
Upper 95% Mean	145.91457
Lower 95% Mean	137.12202
N	18

Compare Distributions

Show	Distribution	AICc
☑	Normal	133.338133
☐	Weibull	133.369748
☐	Extreme Value	133.369748
☐	Gamma	133.37262
☐	LogNormal	133.422673
☐	Johnson SI	136.087086
☐	GLog	136.22357
☐	Normal 2 Mixture	138.288699
☐	Johnson Su	139.586413
☐	Normal 3 Mixture	152.906562
☐	Exponential	216.537443

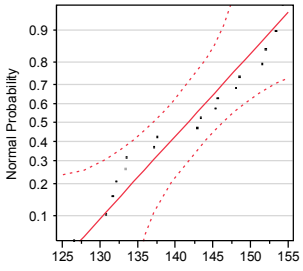
Fitted Normal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Location	μ	141.51829	137.12202	145.91457
Dispersion	σ	8.8404957	6.6337983	13.253176

-2log(Likelihood) = 128.538133254744

Diagnostic Plot



Goodness-of-Fit Test

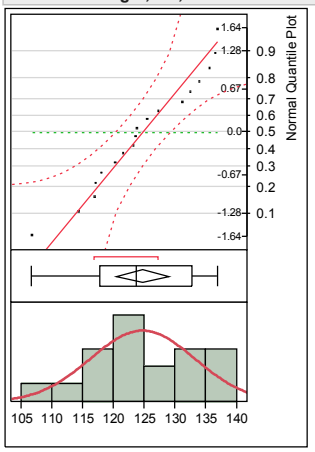
Shapiro-Wilk W Test

W	Prob<W
0.933482	0.2235

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

Distributions Condition=ETW

Ultimate Strength, ksi, Measured



Normal(124.661,8.53278)

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
☑	Normal	132.062752
☐	Weibull	132.14456
☐	Extreme Value	132.14456
☐	Gamma	132.207765
☐	LogNormal	132.326403
☐	Johnson SI	134.740502
☐	GLog	135.240689
☐	Johnson Su	137.404211
☐	Normal 2 Mixture	138.307975
☐	Normal 3 Mixture	156.184566
☐	Exponential	211.971497

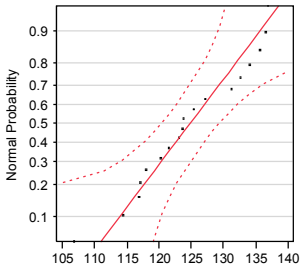
Fitted Normal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Location	μ	124.66089	120.41763	128.90414
Dispersion	σ	8.532784	6.4028952	12.791872

-2log(Likelihood) = 127.262751744163

Diagnostic Plot



Goodness-of-Fit Test

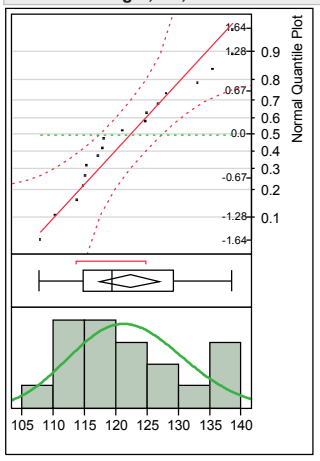
Shapiro-Wilk W Test

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



LogNormal(4.80276,0.07506)

Summary Statistics

Mean	122.19208
Std Dev	9.5431794
Std Err Mean	2.249349
Upper 95% Mean	126.93779
Lower 95% Mean	117.44637
N	18

Compare Distributions

Show	Distribution	AICc
☑	LogNormal	135.561308
☐	Gamma	135.707259
☐	Normal	136.091548
☐	Johnson SI	137.598237
☐	Weibull	138.497169
☐	Extreme Value	138.497169
☐	GLog	138.976981
☐	Johnson Su	142.340014
☐	Normal 2 Mixture	144.400914
☐	Normal 3 Mixture	155.611047
☐	Exponential	211.251393

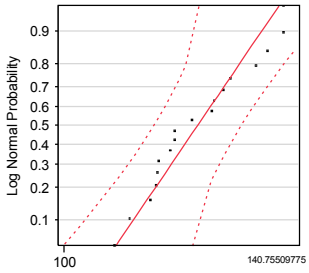
Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	4.8027568	4.7661454	4.8393683
Shape	σ	0.0750623	0.0559062	0.1082853

-2log(Likelihood) = 130.76130798584

Diagnostic Plot



Goodness-of-Fit Test

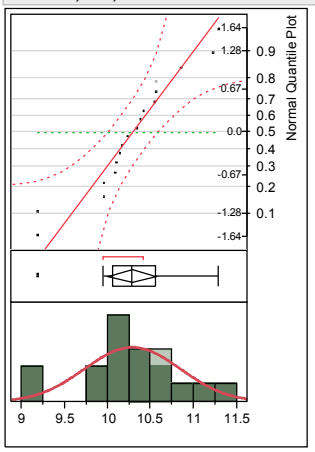
Kolmogorov's D

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



Normal(10.2857,0.55669)

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
☑	Normal	33.794611
☐	Gamma	33.9633186
☐	LogNormal	34.0888782
☐	Weibull	34.7643346
☐	Extreme Value	34.7643346
☐	Johnson SI	36.5099713
☐	GLog	37.0031639
☐	Normal 2 Mixture	38.5924425
☐	Johnson Su	39.1988449
☐	Normal 3 Mixture	45.7082995
☐	Exponential	122.157048

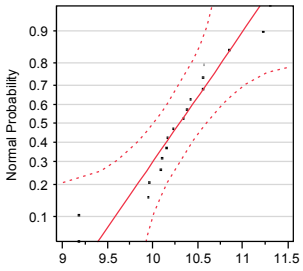
Fitted Normal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Location	μ	10.285667	10.008833	10.5625
Dispersion	σ	0.5566855	0.4177299	0.8345517

-2log(Likelihood) = 28.9946109732572

Diagnostic Plot



Goodness-of-Fit Test

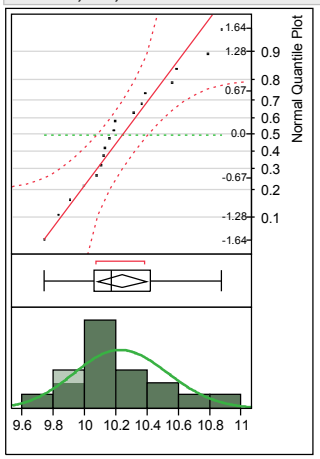
Shapiro-Wilk W Test

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



LogNormal(2.32569,0.02935)

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
☑	LogNormal	12.5809436
☐	Gamma	12.6609445
☐	Normal	12.8620246
☐	Johnson SI	14.5683917
☐	GLog	15.4952293
☐	Weibull	16.8531999
☐	Extreme Value	16.8531999
☐	Johnson Su	17.9310291
☐	Normal 2 Mixture	22.6267106
☐	Normal 3 Mixture	39.1696944
☐	Exponential	121.990412

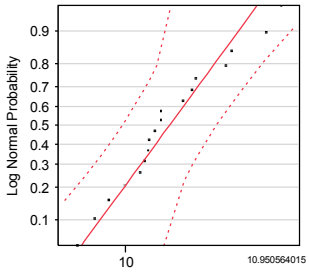
Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	2.32569	2.311375	2.340005
Shape	σ	0.0293492	0.0218592	0.0423393

-2log(Likelihood) = 7.78094358749449

Diagnostic Plot



Goodness-of-Fit Test

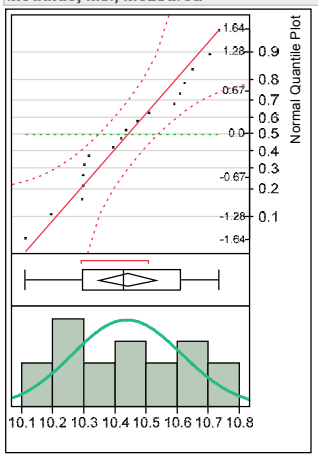
Kolmogorov's D

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
☑	Gamma	-6.5344418
☑	LogNormal	-6.5344331
☐	Normal	-6.5022338
☐	Weibull	-5.2928735
☐	Extreme Value	-5.2928735
☐	Johnson SI	-3.620169
☐	GLog	-3.6167996
☐	Johnson Su	-0.2541465
☐	Normal 2 Mixture	1.26321488
☐	Normal 3 Mixture	19.480577
☐	Exponential	122.693013

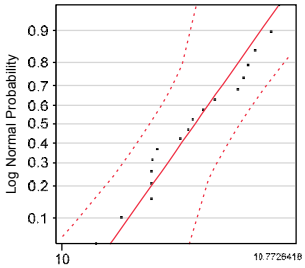
Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	2.3454961	2.3372436	2.3537486
Shape	σ	0.0169196	0.0126017	0.0244084

-2log(Likelihood) = -11.3344331116937

Diagnostic Plot



Modulus, Msi, Measured

Goodness-of-Fit Test

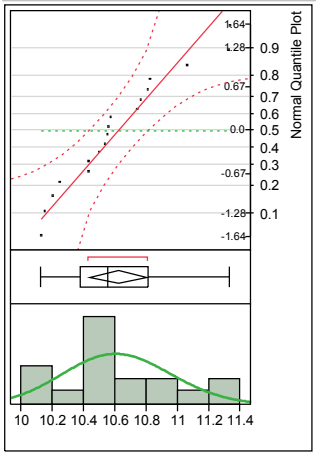
Kolmogorov's D

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
☑	LogNormal	17.8138818
☐	Gamma	17.9194187
☐	Normal	18.1741149
☐	Johnson SI	19.1955403
☐	GLog	20.7281676
☐	Weibull	22.4615367
☐	Extreme Value	22.4615367
☐	Johnson Su	22.5581777
☐	Normal 2 Mixture	23.2824751
☐	Normal 3 Mixture	40.4301139
☐	Exponential	123.303519

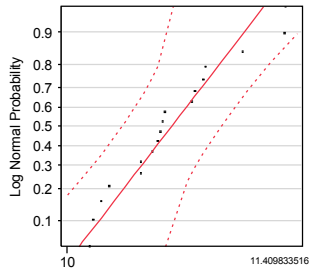
Fitted LogNormal

Parameter Estimates

Type	Parameter	Estimate	Lower 95%	Upper 95%
Scale	μ	2.3620591	2.3460958	2.3780225
Shape	σ	0.0327288	0.0243763	0.0472147

-2log(Likelihood) = 13.013881844361

Diagnostic Plot



Modulus, Msi, Measured

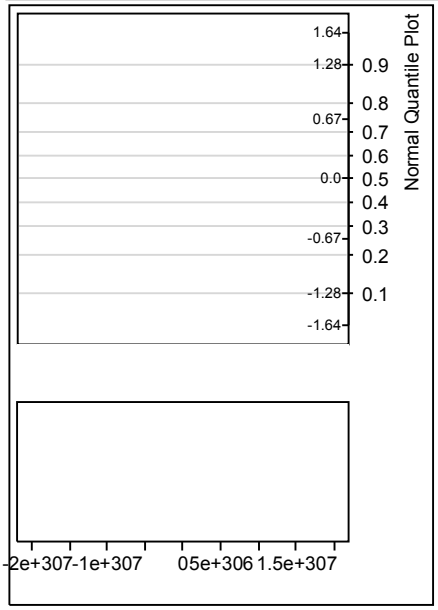
Goodness-of-Fit Test

Kolmogorov's D

D		Prob>D
0.156788	>	0.1500

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

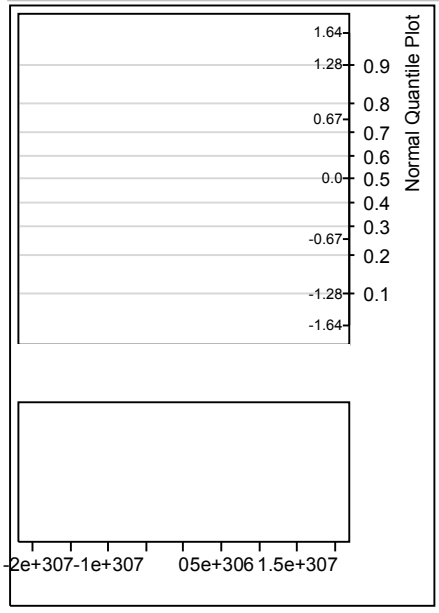
Poisson's Ratio



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

Distributions Condition=RTD

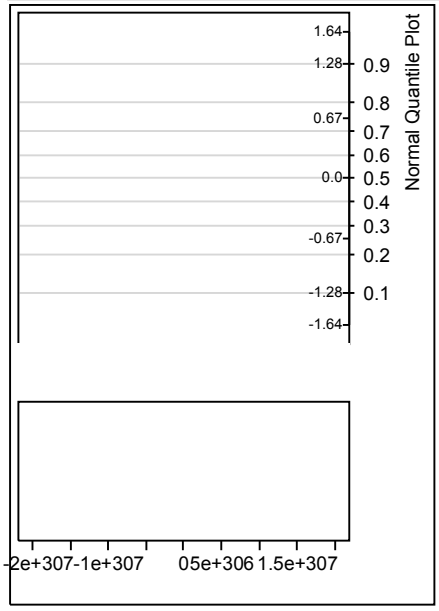
Poisson's Ratio



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

Distributions Condition=ETW

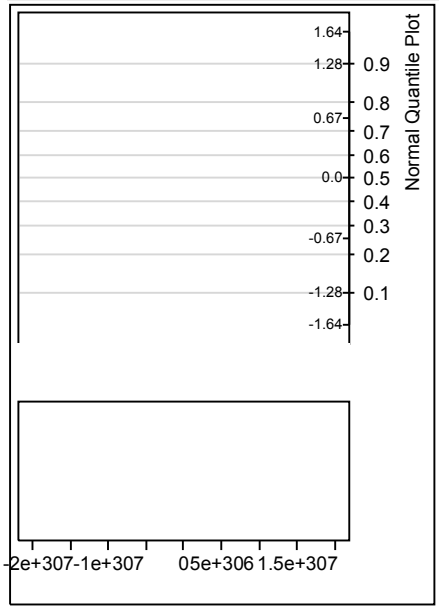
Poisson's Ratio



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.
3. JMP Pro Software: SAS Institute Inc. http://www.jmp.com Accessed Nov. 21, 2013.
4. Pai, Shantaram S., et al.: NASA/NESSUS 6.2c Probabilistic Structural Analysis Software. NASA Tech Brief LEW–18229–1, 2012.