

Cole Steel (MW-12) PCE

General Statistics

Total Number of Observations	7	Number of Distinct Observations	7
Number of Detects	6	Number of Non-Detects	1
Number of Distinct Detects	6	Number of Distinct Non-Detects	1
Minimum Detect	0.58	Minimum Non-Detect	0.47
Maximum Detect	0.9	Maximum Non-Detect	0.47
Variance Detects	0.0198	Percent Non-Detects	14.29%
Mean Detects	0.767	SD Detects	0.141
Median Detects	0.825	CV Detects	0.184
Skewness Detects	-0.757	Kurtosis Detects	-1.86
Mean of Logged Detects	-0.281	SD of Logged Detects	0.195

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach, refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,

but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes ($n < 7$).

The Chebyshev UCL often results in gross overestimates of the mean.

Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.825	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.713	Detected Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.26	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.373	Detected Data appear Normal at 1% Significance Level	
Detected Data appear Normal at 1% Significance Level			
Note GOF tests may be unreliable for small sample sizes			

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.724	KM Standard Error of Mean	0.0654
90KM SD	0.158	95% KM (BCA) UCL	0.821
95% KM (t) UCL	0.851	95% KM (Percentile Bootstrap) UCL	0.824
95% KM (z) UCL	0.832	95% KM Bootstrap t UCL	0.824
90% KM Chebyshev UCL	0.92	95% KM Chebyshev UCL	1.009
97.5% KM Chebyshev UCL	1.133	99% KM Chebyshev UCL	1.375

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.656	Anderson-Darling GOF Test	
5% A-D Critical Value	0.697	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.286	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.332	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Note GOF tests may be unreliable for small sample sizes			

Gamma Statistics on Detected Data Only

k hat (MLE)	32.91	k star (bias corrected MLE)	16.57
Theta hat (MLE)	0.0233	Theta star (bias corrected MLE)	0.0463
nu hat (MLE)	394.9	nu star (bias corrected)	198.8
Mean (detects)	0.767		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.468	Mean	0.724
Maximum	0.9	Median	0.8
SD	0.171	CV	0.236
k hat (MLE)	19.15	k star (bias corrected MLE)	11.04
Theta hat (MLE)	0.0378	Theta star (bias corrected MLE)	0.0656
nu hat (MLE)	268	nu star (bias corrected)	154.5
Adjusted Level of Significance (β)	0.0158		
Approximate Chi Square Value (154.50, α)	126.8	Adjusted Chi Square Value (154.50, β)	119.2
95% Gamma Approximate UCL	0.882	95% Gamma Adjusted UCL	0.939

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.724	SD (KM)	0.158
Variance (KM)	0.0249	SE of Mean (KM)	0.0654
k hat (KM)	21.04	k star (KM)	12.12
nu hat (KM)	294.5	nu star (KM)	169.6
theta hat (KM)	0.0344	theta star (KM)	0.0598
80% gamma percentile (KM)	0.891	90% gamma percentile (KM)	1
95% gamma percentile (KM)	1.097	99% gamma percentile (KM)	1.294

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (169.61, α)	140.5	Adjusted Chi Square Value (169.61, β)	132.5
95% KM Approximate Gamma UCL	0.874	95% KM Adjusted Gamma UCL	0.927

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.806	Shapiro Wilk GOF Test	
10% Shapiro Wilk Critical Value	0.826	Detected Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.283	Lilliefors GOF Test	
10% Lilliefors Critical Value	0.298	Detected Data appear Lognormal at 10% Significance Level	
Detected Data appear Approximate Lognormal at 10% Significance Level			
Note GOF tests may be unreliable for small sample sizes			

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.726	Mean in Log Scale	-0.346
SD in Original Scale	0.168	SD in Log Scale	0.247
95% t UCL (assumes normality of ROS data)	0.849	95% Percentile Bootstrap UCL	0.82
95% BCA Bootstrap UCL	0.813	95% Bootstrap t UCL	0.834
95% H-UCL (Log ROS)	0.9		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-0.349	KM Geo Mean	0.706
KM SD (logged)	0.234	95% Critical H Value (KM-Log)	2.055
KM Standard Error of Mean (logged)	0.0969	95% H-UCL (KM -Log)	0.882
KM SD (logged)	0.234	95% Critical H Value (KM-Log)	2.055
KM Standard Error of Mean (logged)	0.0969		

DL/2 Statistics

DL/2 Normal	DL/2 Log-Transformed		
Mean in Original Scale	0.691	Mean in Log Scale	-0.448
SD in Original Scale	0.239	SD in Log Scale	0.476
95% t UCL (Assumes normality)	0.866	95% H-Stat UCL	1.143

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 1% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.851
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Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Cole Steel (MW-12) Cis-1,2 DCE

General Statistics

Total Number of Observations	7	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	7.4	Mean	13.6
Maximum	18	Median	16
SD	4.213	Std. Error of Mean	1.592
Coefficient of Variation	0.31	Skewness	-0.627

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach, refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance, but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes ($n < 7$). The Chebyshev UCL often results in gross overestimates of the mean. Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

Normal GOF Test

Shapiro Wilk Test Statistic	0.875	Shapiro Wilk GOF Test	
1% Shapiro Wilk Critical Value	0.73	Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.287	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.35	Data appear Normal at 1% Significance Level	
Data appear Normal at 1% Significance Level			
Note GOF tests may be unreliable for small sample sizes			

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	16.69	95% Adjusted-CLT UCL (Chen-1995)	15.82
		95% Modified-t UCL (Johnson-1978)	16.63

Gamma GOF Test

A-D Test Statistic	0.559	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.708	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.311	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.312	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Note GOF tests may be unreliable for small sample sizes			

Gamma Statistics

k hat (MLE)	10.44	k star (bias corrected MLE)	6.061
Theta hat (MLE)	1.303	Theta star (bias corrected MLE)	2.244
nu hat (MLE)	146.2	nu star (bias corrected)	84.86
MLE Mean (bias corrected)	13.6	MLE Sd (bias corrected)	5.524
		Approximate Chi Square Value (0.05)	64.62
Adjusted Level of Significance	0.0158	Adjusted Chi Square Value	59.32

Assuming Gamma Distribution

95% Approximate Gamma UCL	17.86	95% Adjusted Gamma UCL	19.46
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.852	Shapiro Wilk Lognormal GOF Test	
10% Shapiro Wilk Critical Value	0.838	Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.298	Lilliefors Lognormal GOF Test	
10% Lilliefors Critical Value	0.28	Data Not Lognormal at 10% Significance Level	
Data appear Approximate Lognormal at 10% Significance Level			
Note GOF tests may be unreliable for small sample sizes			

Lognormal Statistics

Minimum of Logged Data	2.001	Mean of logged Data	2.561
Maximum of Logged Data	2.89	SD of logged Data	0.351

Assuming Lognormal Distribution

95% H-UCL	19.08	90% Chebyshev (MVUE) UCL	19.11
95% Chebyshev (MVUE) UCL	21.58	97.5% Chebyshev (MVUE) UCL	25
99% Chebyshev (MVUE) UCL	31.74		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs			
95% CLT UCL	16.22	95% BCA Bootstrap UCL	15.86
95% Standard Bootstrap UCL	16.12	95% Bootstrap-t UCL	16.35
95% Hall's Bootstrap UCL	15.53	95% Percentile Bootstrap UCL	16
90% Chebyshev(Mean, Sd) UCL	18.38	95% Chebyshev(Mean, Sd) UCL	20.54
97.5% Chebyshev(Mean, Sd) UCL	23.54	99% Chebyshev(Mean, Sd) UCL	29.44

Suggested UCL to Use

95% Student's-t UCL 16.69

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness using results from simulation studies. However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.