Pilbara Standards

Iron Ore Certified Reference Material: Certificate of Analysis

ST 101

Table 1: ST 101 Certified Values

Analyte	unit	Assigned Value	Standard Deviation		95% Confidence Interval			Coeff of Var.	Number of Laboratories	Number of Analytes
			Absolute SD	SD within lab	Interval	lower	upper			
Fe	%	60.74	0.227	0.166	0.19	60.55	60.93	0.4%	8	48
SiO2	%	5.52	0.076	0.076	0.06	5.46	5.58	1.4%	8	48
Al2O3	%	2.49	0.038	0.035	0.03	2.46	2.52	1.5%	8	48
TiO2	%	0.123	0.007	0.004	0.005	0.118	0.128	5.7%	10	60
Mn	%	0.391	0.008	0.004	0.006	0.385	0.397	2.1%	9	54
P	%	0.038	0.001	0.001	0.001	0.037	0.039	3.7%	10	60
S	%	0.037	0.002	0.001	0.002	0.035	0.039	6.3%	9	54
LOI371	%	5.44	0.110	0.049	0.09	5.35	5.53	2.1%	8	48
LOI650	%	6.14	0.090	0.046	0.09	6.05	6.23	1.5%	7	42
LOI1000	%	6.33	0.110	0.055	0.09	6.24	6.42	1.8%	9	52

Table 2: ST 101 Provisional Values

Analyte	unit	Assigned Value	Standard Deviation		95% Confidence Interval			Coeff of Var.	Number of Laboratories	Number of Analytes
			Absolute SD	SD within lab	Interval	lower	upper			
CaO	%	0.036	0.005	0.004	0.003	0.033	0.039	13.2%	10	59
MgO	%	0.055	0.010	0.005	0.007	0.048	0.062	18.6%	10	60
K2O	%	0.024	0.005	0.004	0.004	0.020	0.028	21.1%	10	59
Zn	%	0.015	0.001	0.001	0.001	0.014	0.016	8.2%	7	42

Table 3: ST 101 Informational Values

Analyte	unit	Assigned Value	Coeff of Var.	Number of Laboratories	Number of Analytes
Na2O	%	0.016	34.0%	6	36
Pb	%	0.002	63.4%	2	7
Cu	%	0.003	21.9%	1	6
Ba	%	0.006	32.9%	7	41
Cl	%	0.007	24.2%	6	36
As	%	0.003	78.6%	3	18

Introduction

This document specifies preparation, analysis, and certification of coarse reference material ST 101.

Origin of Material

The source material is from an iron ore deposit in the Pilbara region of Western Australia.

Method of preparation

Approximately 3.6 tonnes of iron ore material was used. All material was oven dried at 105C for 24hours, and multi-stage crushed and screened to pass a 4mm sieve.

To ensure complete blending and homogenisation of the material, about 3.6 tonnes was passed through a 12 section rotary sample divider two times, to provide 12 x 288kg cuts. Each of the 12 x 288kg cuts was subdivided into 24 x 144kg cuts using a smaller 12 section rotary sample divider.

These 144kg cuts were further divided into 12 x 12kg divisions using the same 12 section rotary sample divider. The 12kg divisions were in turn split and bagged into 6 x 2kg samples on a 6 section rotary sample divider. The 1,728 x 2kg sample bags were heat sealed. The bags were uniquely numbered with the batch number, order of division and sample number.

During the bagging process 60 samples were randomly selected for use in the certification process and marked prior to bagging. These samples were removed from the sample bagging stream during the bagging and sealing process. The selection of laboratory for each sample was again randomised, prior to the samples being boxed and sent to the respective laboratories (6 samples per laboratory).

Measurement techniques used for certification

Ten laboratories were each given 6 x 2kg samples for drying (105°C), sample preparation, and analysis via fusion XRF for the following:

Fe, SiO2, Al2O3, TiO2, Mn, CaO, P, S, MgO, K2O, Na2O, Ba, As, Cu, Pb, Zn, Cl

Results are quoted as **un-normalised**.

In addition, loss on Ignition (LOI) was requested via Thermal gravimetric analysis (TGA) at 371°C, 650°C and 1,000°C.

Method of Certification

Outlier laboratory group results are detected by modified Z-scores >2.5 and excised from the certification process. This is confirmed by reference to box and whisker plots. Remaining individual results identified as outliers using a α=0.05 on a two-tailed Grubbs test by laboratory group, data is plotted in grade distribution curves to identify extreme individual values with Z-score >3. Results identified as outliers are shown with bold font in Appendix 1.

Results have been grouped in Certified, Provisional, and Informational on the below general criteria:

- Certified values show good agreement with a low (<10%) coefficient of variation (CoV = Std. Deviation / Mean) is a good measure of the variability relative to the mean.
- Provisional are CoV 10% to 20%, or with significant disagreement between laboratories which cannot be resolved using statistical review techniques alone.

- Informational values are typically near the detection limit for the analysis. As such conventional standard deviation and confidence intervals are not appropriate controls. In these cases it is likely that more appropriate analysis techniques are required for the analyte concentrations.

All reported values are calculated after removal of laboratory and individual outliers. The Assigned Value is calculated from the mean of laboratory means, standard deviation is calculated as the standard deviation of all results, inter-laboratory standard deviation is calculated from ANOVA analysis of the laboratory grouped results. Confidence interval is derived at the α=0.05 from the Students t-distribution for the number of participating laboratories. The confidence interval is a measure of the reliability of the consensus value. In this case, it is a measure of the reliability of the certified value. For example, a 95% CI for Fe could be interpreted as there is a 0.95 probability that the certified value is between (mean ± CI). The narrower the interval, the more precise the certified value. A 95% CI is distinct from the lower limit and upper limit at 2SD which provides an estimate of the range of values for 95% of individual measurements for a given analyte. In the case of Fe, approximately 95% of replicates are expected to be between two SDs either side of the certified value. The above calculations are in accordance with ISO 11459.

Summary data of assigned values, standard deviations and confidence intervals, and number of laboratories and analysis used in calculating the values are shown in Table 1 for Certified Values, Table 2 for Provisional Values, and Table 3 for Informational Values.

Participating laboratories

Laboratories used in the certification process are listed in Table 4, along with batch number.

Table 4: ST 101 Participating Laboratories

Lab	Description	Job #
1	Activation Laboratories, Ancaster, Canada	
2	ALS Brisbane, QLD	
3	ALS Minerals, Wangara, WA	
4	Bureau Veritas- Ultratrace, Canning Vale, WA	
5	Bureau Veritas, Wingfield SA	
6	Intertek Jakarta, Indonesia	
7	Intertek Genalysis, Maddington, WA	
8	Nagrom, Kelmscot, WA	
9	SGS Lakefield, Canada	
10	SGS Newburn, WA	

Preparer and supplier of reference material

The iron ore reference material ST 101 has been prepared and certified, and is certified by:

Pilbara Standards Pty Ltd
Unit 6, 190 Star St,
Carlisle, WA 6101
Australia

www.pilbarastandards.com.au

The material has been supplied in 2kg heat sealed plastic bags with unique labels showing batch number, order of division and sample number.

Intended use

The coarse iron ore reference material will be used to quantify a laboratory's ability to prepare, sub-sample and analyse coarse samples. Pulp iron ore reference materials are used to determine the laboratory's ability to analyse only (removing the preparation step). The combination of coarse and pulp iron ore reference materials permits the quantification of errors at the laboratory.

Stability and storage instructions

ST 101 is an oxidised reference material and is stable in the sealed plastic bags under normal conditions of storage.

Instructions for the correct use of the reference material

The recommended values for ST 101 refer to the concentration levels after removal of hygroscopic moisture by drying in air to constant mass at 105°C. If the reference material is not dried prior to analysis, the recommended value should be corrected to the moisture bearing basis.

Legal notice

Pilbara Standards Pty Ltd has prepared and statistically evaluated the property values of this reference material to the best of ability. The purchaser by receipt hereof releases and indemnifies Pilbara Standards Pty Ltd from and against all liability and costs from the use of this material and information.

Certifying officer

Bruce Armstrong

Certification date

18th February 2019

References

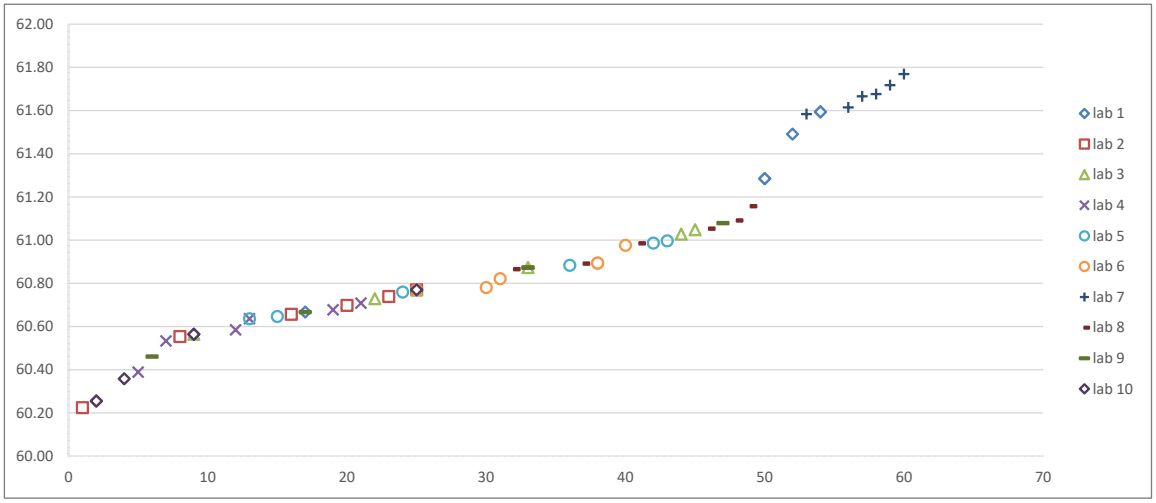
ISO11459: 1997. Iron Ores- Certified reference materials – preparation and certification for use in chemical analysis.

Appendix 1

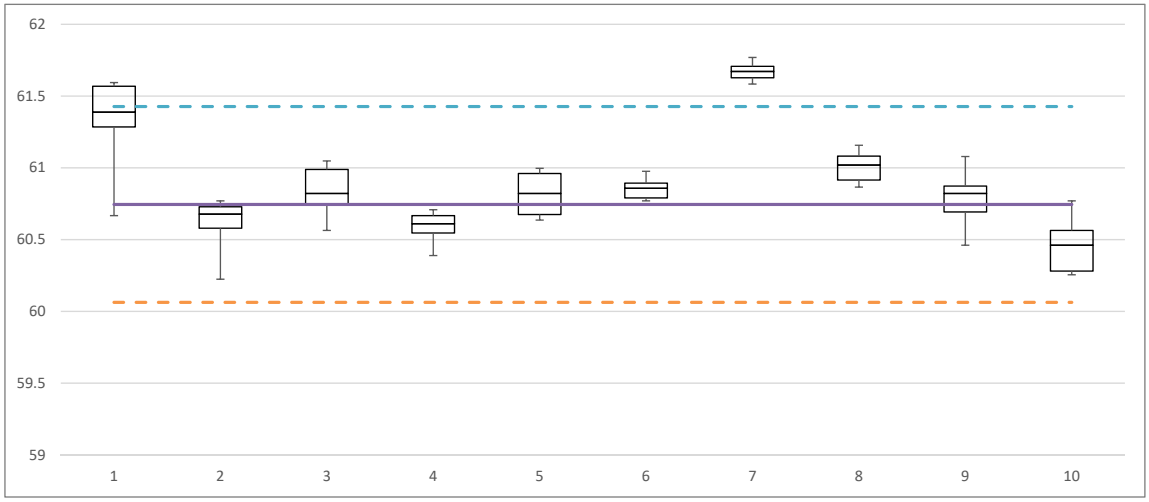
Tabulated and graphical presentation of certification data.

Fe % Analysis Results

	Lab #										
Replicate No	1	2	3	4	5	6	7	8	9	10	Overall
1	60.67	60.70	61.05	60.53	60.65	60.89	61.77	60.87	60.67	60.26	
2	61.49	60.77	60.73	60.58	60.64	60.82	61.72	60.89	60.46	60.77	
3	61.29	60.22	60.56	60.39	60.88	60.98	61.61	61.16	60.87	60.56	
4	61.59	60.74	60.87	60.64	60.99	60.78	61.68	61.05	60.87	60.56	
5	61.59	60.55	61.03	60.71	60.76	60.77	61.58	60.99	60.77	60.36	
6	61.29	60.66	60.77	60.68	61.00	60.89	61.67	61.09	61.08	60.26	
Count		6	6	6	6	6		6	6	6	48
Minimum	60.67	60.22	60.56	60.39	60.64	60.77	61.58	60.87	60.46	60.26	60.22
Maximum	61.59	60.77	61.05	60.71	61.00	60.98	61.77	61.16	61.08	60.77	61.16
Mean	~~61.32~~	60.61	60.84	60.59	60.82	60.86	~~61.67~~	61.01	60.79	60.46	60.74
Median	61.39	60.68	60.82	60.61	60.82	60.86	61.67	61.02	60.82	60.46	60.82
Std Dev		0.20	0.19	0.12	0.16	0.08		0.11	0.21	0.21	0.227
95% Confidence Interval											0.190
Coeff. Variation		0.33%	0.31%	0.19%	0.27%	0.13%		0.19%	0.35%	0.34%	0.37%
Dev from Cert. mean		-0.23%	0.15%	-0.26%	0.12%	0.18%		0.43%	0.07%	-0.47%	N/A
Std Dev Within Lab											0.166
Std Dev Between Labs											0.435



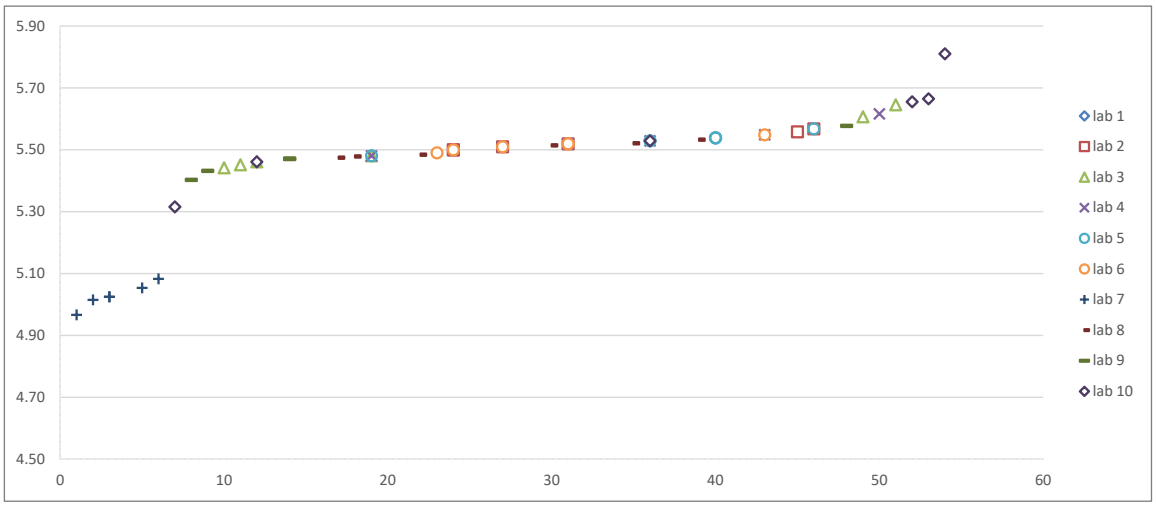
Graph of ranked raw values, showing grade distribution with no outlier removal.



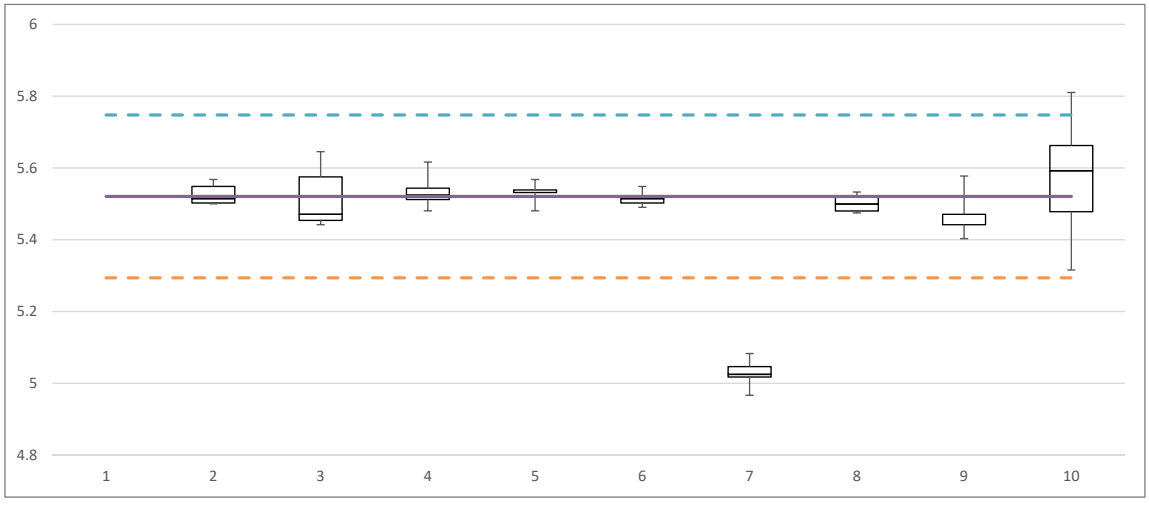
Box and Whisker graph showing median, quartile ranges, and minimum and maximum assay values by laboratory, including outliers. Mean and +/- 3SD is also displayed as solid and dashed lines respectively.

SiO2 % Analysis Results

	Lab #										
Replicate No	1	2	3	4	5	6	7	8	9	10	Overall
1		5.57	5.65	5.62	5.54	5.55	4.97	5.53	5.40	5.66	
2		5.56	5.61	5.53	5.54	5.52	5.05	5.52	5.43	5.32	
3		5.52	5.44	5.51	5.54	5.52	5.02	5.47	5.47	5.53	
4		5.50	5.46	5.52	5.53	5.51	5.02	5.48	5.47	5.46	
5		5.50	5.48	5.55	5.57	5.50	5.08	5.48	5.47	5.66	
6		5.51	5.45	5.48	5.48	5.49	5.01	5.51	5.58	5.81	
Count		6	6	6	6	6		6	6	6	48
Minimum		5.50	5.44	5.48	5.48	5.49	4.97	5.47	5.40	5.32	5.32
Maximum		5.57	5.65	5.62	5.57	5.55	5.08	5.53	5.58	5.81	5.81
Mean		5.53	5.51	5.53	5.53	5.51	~~5.03~~	5.50	5.47	5.57	5.52
Std Dev		0.03	0.09	0.05	0.03	0.02		0.02	0.06	0.17	0.076
95% Confidence Interval											0.063
Coeff. Variation		0.54%	1.60%	0.84%	0.52%	0.36%		0.45%	1.08%	3.13%	1.37%
Dev from Cert. mean		0.09%	-0.11%	0.24%	0.21%	-0.11%		-0.36%	-0.90%	0.94%	N/A
Std Dev Within Lab											0.076
Std Dev Between Labs											0.072



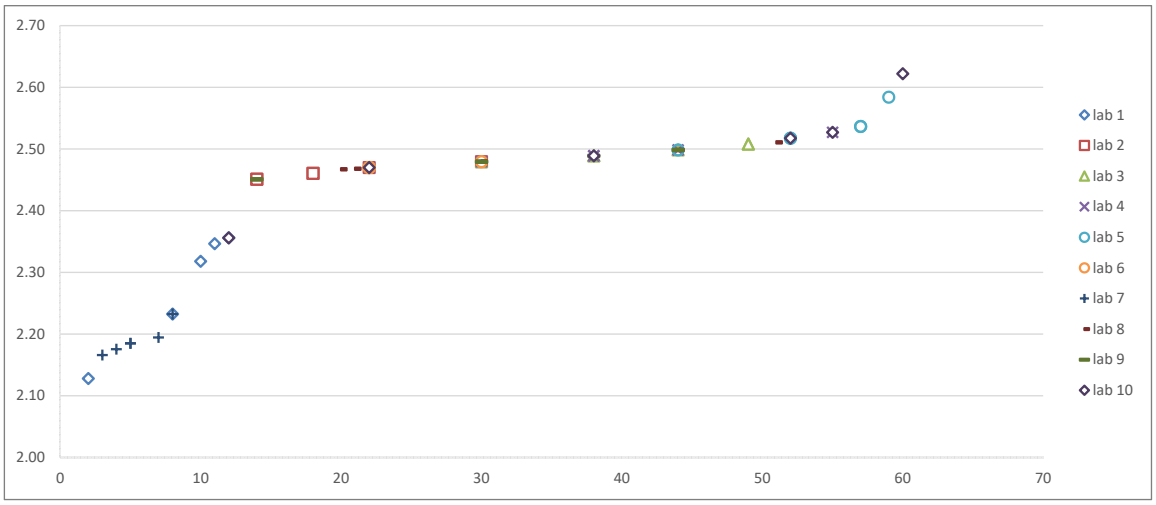
Graph of ranked raw values, showing grade distribution with no outlier removal.



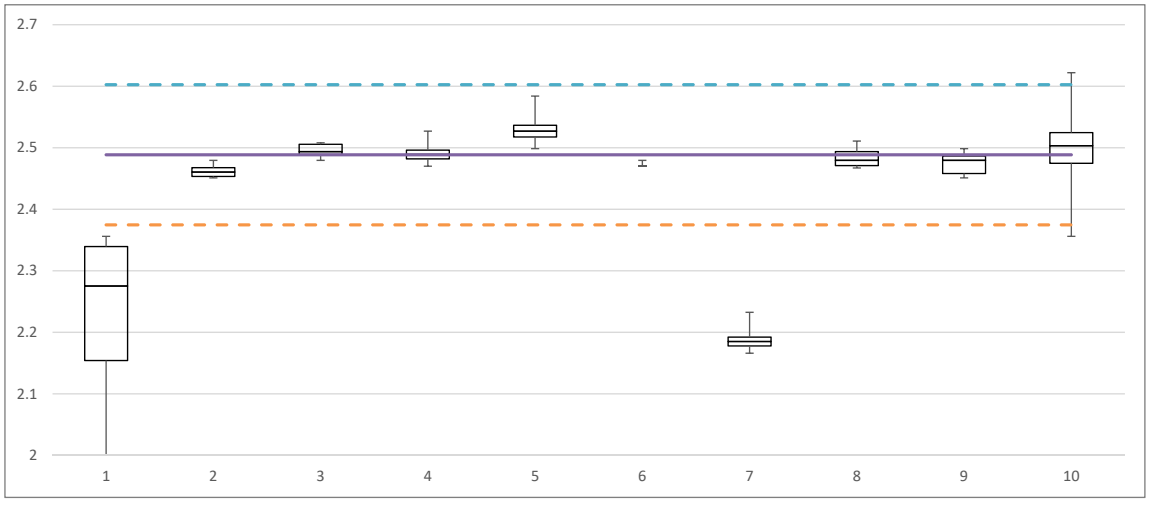
Box and Whisker graph showing median, quartile ranges, and minimum and maximum assay values by laboratory, including outliers. Mean and +/- 3SD is also displayed as solid and dashed lines respectively.

Al2O3 % Analysis Results

	Lab #										
Replicate No	1	2	3	4	5	6	7	8	9	10	Overall
1	2.32	2.47	2.51	2.53	2.54	2.47	2.17	2.47	2.45	2.52	
2	2.23	2.46	2.49	2.49	2.52	2.47	2.18	2.51	2.45	2.36	
3	2.35	2.45	2.48	2.48	2.52	2.48	2.19	2.47	2.48	2.47	
4	2.36	2.45	2.50	2.49	2.54	2.47	2.19	2.48	2.48	2.49	
5	**1.99**	2.46	2.51	2.50	2.58	2.47	2.23	2.48	2.50	2.53	
6	2.13	2.48	2.49	2.47	2.50	2.47	2.19	2.50	2.49	2.62	
Count		6	6	6	6	6		6	6	6	48
Minimum	1.99	2.45	2.48	2.47	2.50	2.47	2.17	2.47	2.45	2.36	2.36
Maximum	2.36	2.48	2.51	2.53	2.58	2.48	2.23	2.51	2.50	2.62	2.62
Mean	~~**2.23**~~	2.46	2.50	2.49	2.53	2.47	~~**2.19**~~	2.48	2.47	2.50	2.49
Std Dev		0.01	0.01	0.02	0.03	0.00		0.017	0.020	0.09	0.038
95% Confidence Interval											0.032
Coeff. Variation		0.45%	0.46%	0.79%	1.16%	0.16%		0.70%	0.80%	3.47%	1.53%
Dev from Cert. mean		-1.06%	0.27%	0.14%	1.74%	-0.68%		-0.19%	-0.56%	0.34%	N/A
Std Dev Within Lab											0.035
Std Dev Between Labs											0.052



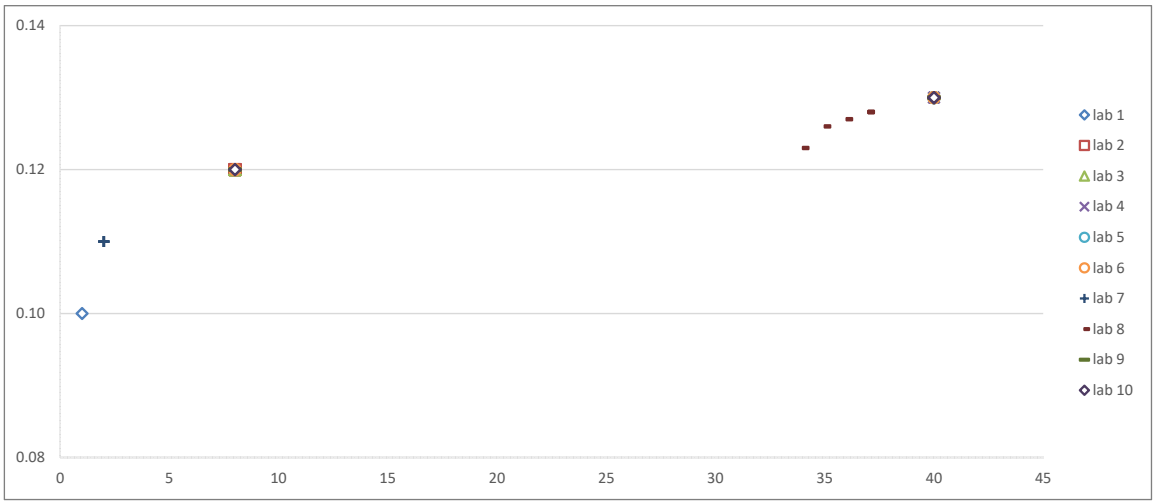
Graph of ranked raw values, showing grade distribution with no outlier removal.



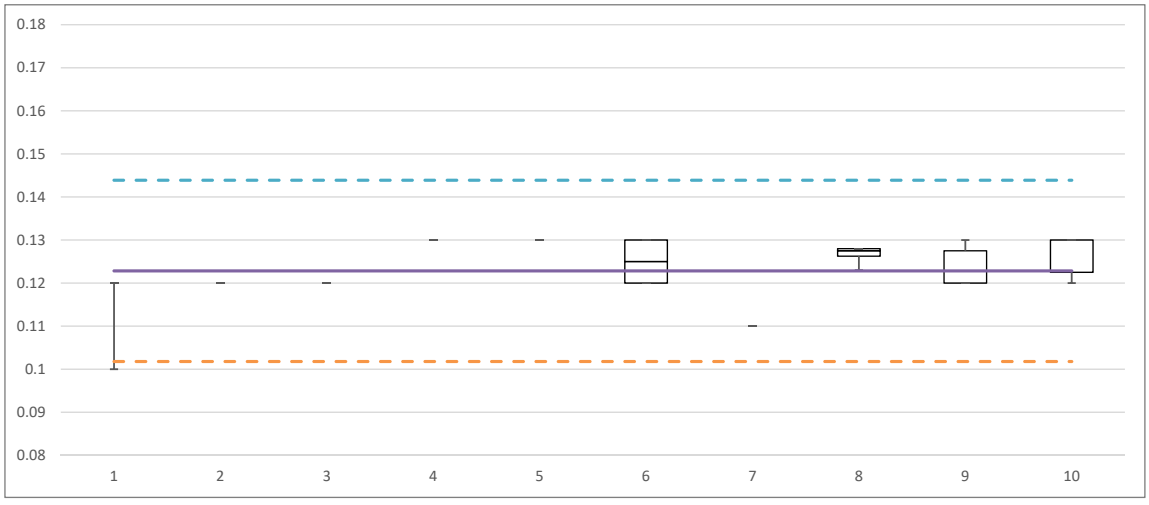
Box and Whisker graph showing median, quartile ranges, and minimum and maximum assay values by laboratory, including outliers. Mean and +/- 3SD is also displayed as solid and dashed lines respectively.

TiO2 % Analysis Results

	Lab #										
Replicate No	1	2	3	4	5	6	7	8	9	10	Overall
1	0.12	0.12	0.12	0.13	0.13	0.13	0.11	0.13	0.12	0.13	
2	0.12	0.12	0.12	0.13	0.13	0.12	0.11	0.13	0.12	0.12	
3	0.12	0.12	0.12	0.13	0.13	0.13	0.11	0.12	0.12	0.13	
4	0.12	0.12	0.12	0.13	0.13	0.13	0.11	0.13	0.13	0.12	
5	**0.10**	0.12	0.12	0.13	0.13	0.12	0.11	0.13	0.12	0.13	
6	0.12	0.12	0.12	0.13	0.13	0.12	0.11	0.13	0.13	0.13	
Count	6	6	6	6	6	6	6	6	6	6	60
Minimum	0.10	0.12	0.12	0.13	0.13	0.12	0.11	0.12	0.12	0.12	0.10
Maximum	0.12	0.12	0.12	0.13	0.13	0.13	0.11	0.13	0.13	0.13	0.13
Mean	0.12	0.12	0.12	0.13	0.13	0.13	0.11	0.13	0.12	0.13	0.12
Std Dev	0.008	0.000	0.000	0.000	0.000	0.005	0.000	0.002	0.005	0.005	0.007
95% Confidence Interval											0.005
Coeff. Variation	7.00%	0.00%	0.00%	0.00%	0.00%	4.38%	0.00%	1.55%	4.19%	4.08%	5.71%
Dev from Cert. mean	-5.02%	-2.31%	-2.31%	5.83%	5.83%	1.76%	-10.45%	3.12%	0.41%	3.12%	N/A
Std Dev Within Lab											0.004
Std Dev Between Labs											0.015



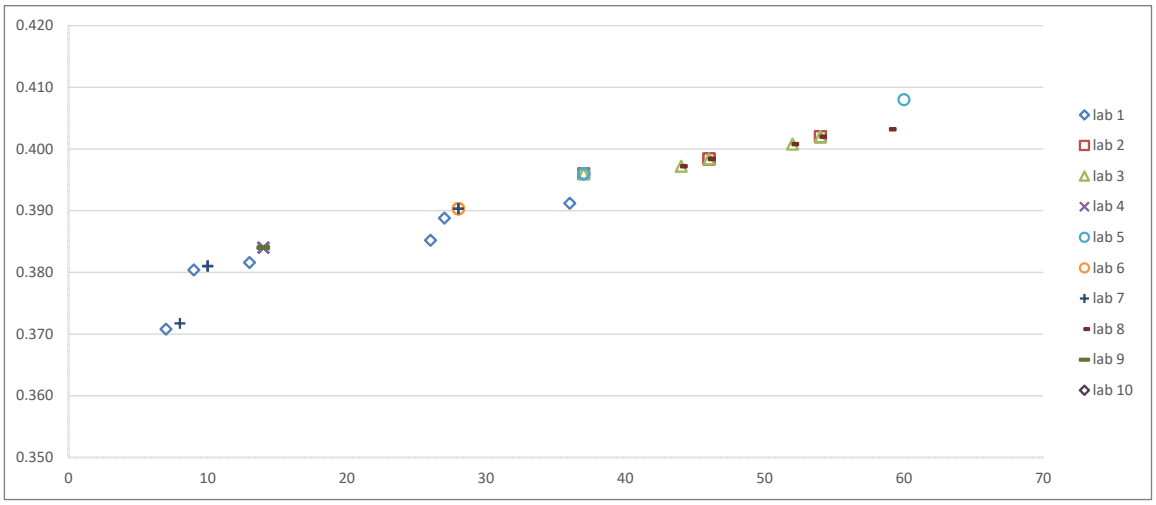
Graph of ranked raw values, showing grade distribution with no outlier removal.



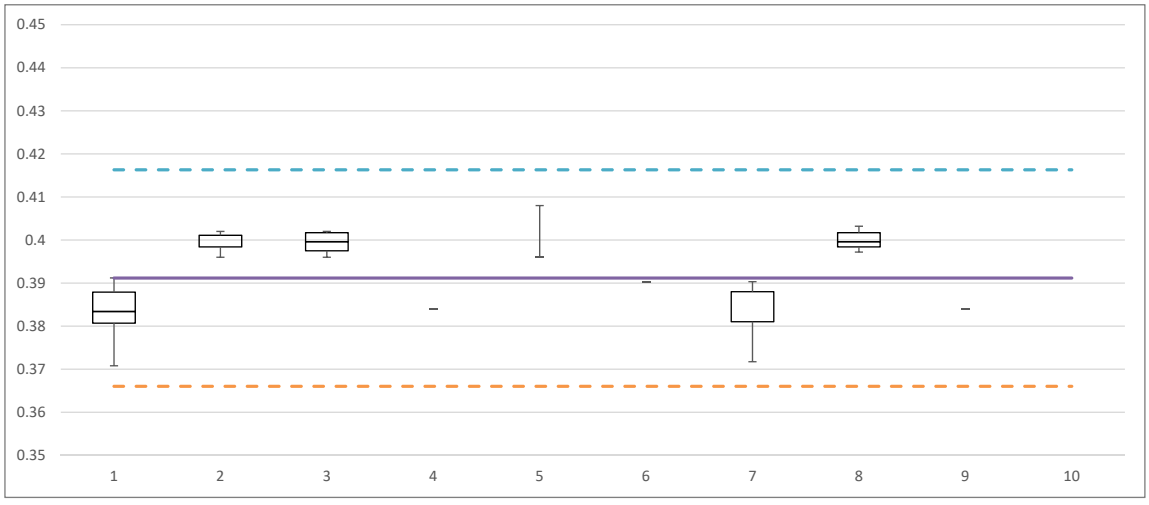
Box and Whisker graph showing median, quartile ranges, and minimum and maximum assay values by laboratory, including outliers. Mean and +/- 3SD is also displayed as solid and dashed lines respectively.

Mn % Analysis Results

	Lab #										
Replicate No	1	2	3	4	5	6	7	8	9	10	Overall
1	0.385	0.398	0.40	0.38	0.40	0.39	0.38	0.40	0.38	0.08	
2	0.380	0.402	0.40	0.38	0.40	0.39	0.38	0.40	0.38	0.08	
3	0.389	0.398	0.40	0.38	0.40	0.39	0.38	0.40	0.38	0.08	
4	0.391	0.398	0.40	0.38	0.40	0.39	0.37	0.40	0.38	0.08	
5	0.371	0.396	0.40	0.38	0.40	0.39	0.39	0.40	0.38	0.08	
6	0.382	0.402	0.40	0.38	0.41	0.39	0.39	0.40	0.38	0.08	
Count	6	6	6	6	6	6	6	6	6		54
Minimum	0.371	0.396	0.40	0.38	0.40	0.39	0.37	0.40	0.38	0.08	0.37
Maximum	0.391	0.402	0.40	0.38	0.41	0.39	0.39	0.40	0.38	0.08	0.41
Mean	0.383	0.399	0.40	0.38	0.40	0.39	0.38	0.40	0.38	~~0.08~~	0.39
Std Dev	0.007	0.002	0.00	0.00	0.00	0.00	0.007	0.002	0.000		0.008
95% Confidence Interval											0.006
Coeff. Variation	1.89%	0.59%	0.64%	0.00%	1.23%	0.00%	1.83%	0.59%	0.00%		2.14%
Dev from Cert. mean	-2.09%	2.05%	2.10%	-1.83%	1.75%	-0.22%	-2.19%	2.26%	-1.83%		N/A
Std Dev Within Lab											0.004
Std Dev Between Labs											0.019



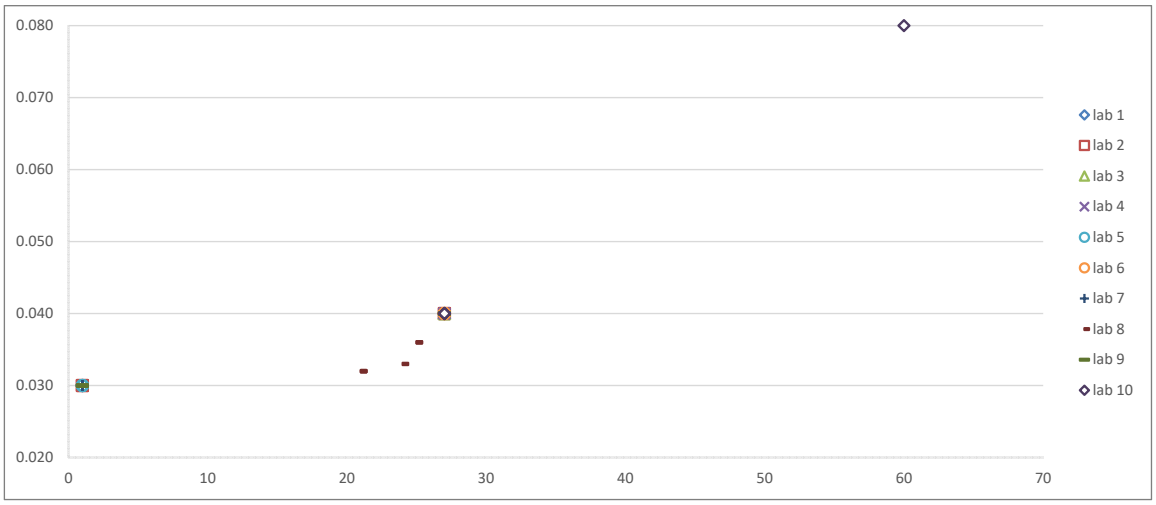
Graph of ranked raw values, showing grade distribution with no outlier removal.



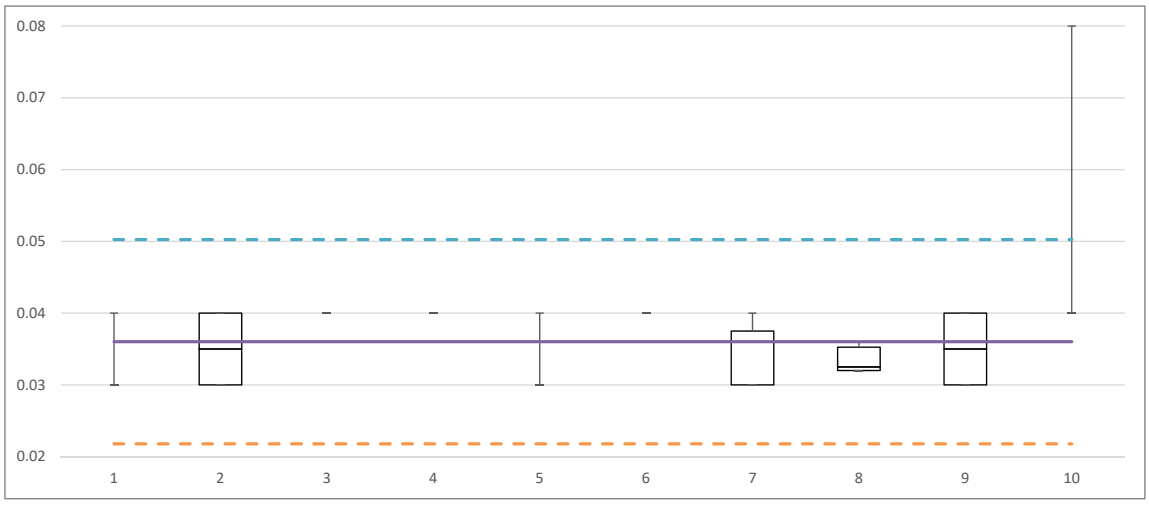
Box and Whisker graph showing median, quartile ranges, and minimum and maximum assay values by laboratory, including outliers. Mean and +/- 3SD is also displayed as solid and dashed lines respectively.

CaO % Analysis Results

	Lab #										
Replicate No	1	2	3	4	5	6	7	8	9	10	Overall
1	0.03	0.04	0.04	0.04	0.03	0.04	0.04	0.04	0.03	~~0.08~~	
2	0.04	0.04	0.04	0.04	0.03	0.04	0.04	0.03	0.03	0.04	
3	0.03	0.04	0.04	0.04	0.03	0.04	0.03	0.03	0.03	0.04	
4	0.03	0.03	0.04	0.04	0.04	0.04	0.03	0.04	0.04	0.04	
5	0.03	0.03	0.04	0.04	0.03	0.04	0.03	0.03	0.04	0.04	
6	0.03	0.03	0.04	0.04	0.03	0.04	0.03	0.03	0.04	0.04	
Count	6	6	6	6	6	6	6	6	6	5	59
Minimum	0.03	0.03	0.04	0.04	0.03	0.04	0.03	0.03	0.03	0.04	0.03
Maximum	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Mean	0.03	0.04	0.04	0.04	0.03	0.04	0.03	0.03	0.04	0.04	0.036
Std Dev	0.004	0.005	0.000	0.000	0.004	0.000	0.005	0.002	0.005	0.000	0.005
95% Confidence Interval											0.003
Coeff. Variation	12.89%	15.65%	0.00%	0.00%	12.89%	0.00%	15.49%	5.90%	15.65%	0.00%	13.17%
Dev from Cert. mean	-12.08%	-2.82%	11.06%	11.06%	-12.08%	11.06%	-7.45%	-6.99%	-2.82%	11.06%	N/A
Std Dev Within Lab											0.004
Std Dev Between Labs											0.009



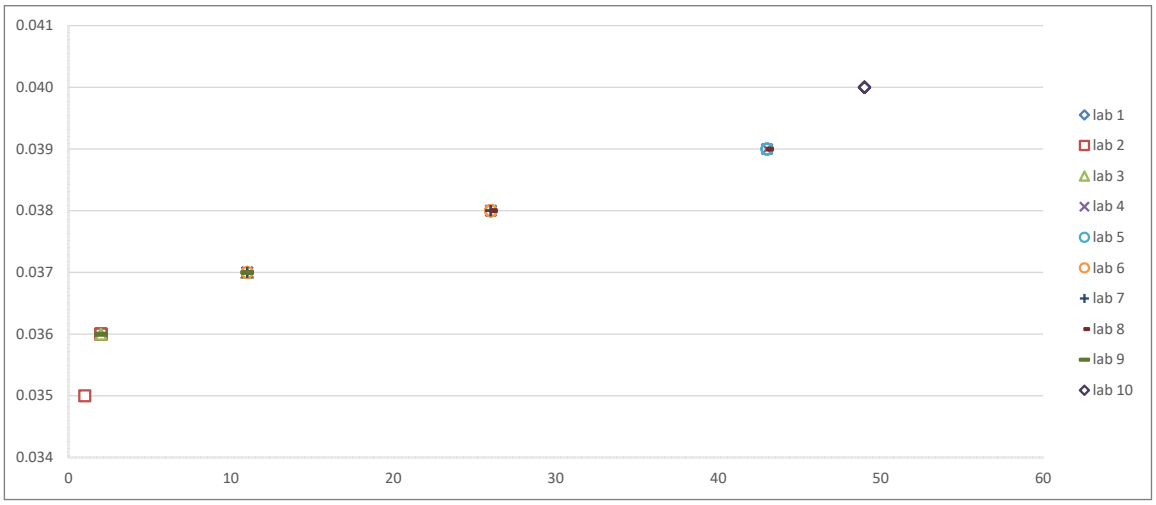
Graph of ranked raw values, showing grade distribution with no outlier removal.



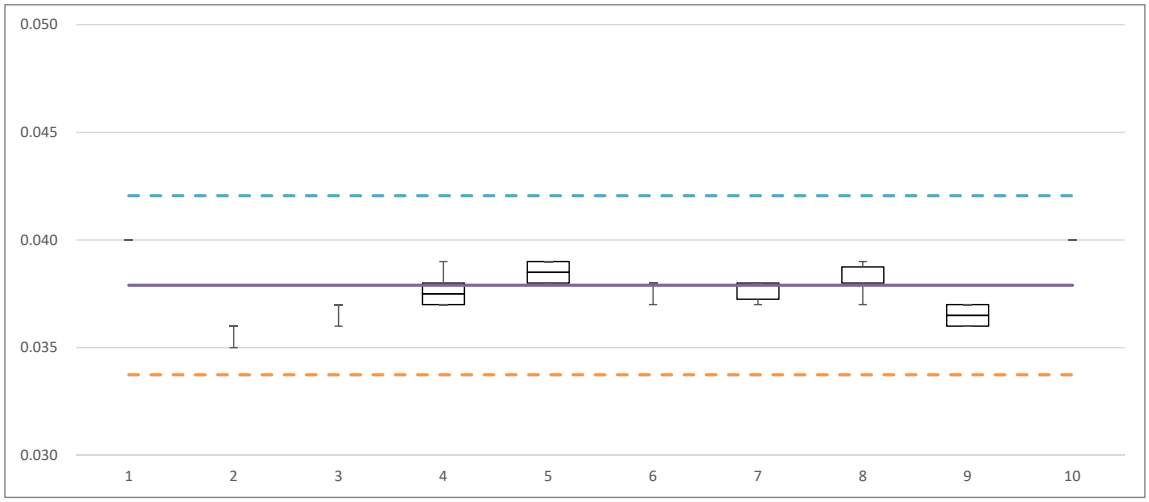
Box and Whisker graph showing median, quartile ranges, and minimum and maximum assay values by laboratory, including outliers. Mean and +/- 3SD is also displayed as solid and dashed lines respectively.

P % Analysis Results

	Lab #										
Replicate No	1	2	3	4	5	6	7	8	9	10	Overall
1	0.040	0.036	0.037	0.038	0.039	0.038	0.038	0.039	0.036	0.040	
2	0.040	0.036	0.036	0.037	0.039	0.038	0.037	0.037	0.036	0.040	
3	0.040	0.036	0.037	0.038	0.038	0.038	0.037	0.038	0.036	0.040	
4	0.040	0.036	0.037	0.037	0.038	0.038	0.038	0.039	0.037	0.040	
5	0.040	0.035	0.037	0.039	0.039	0.037	0.038	0.038	0.037	0.040	
6	0.040	0.036	0.037	0.037	0.038	0.038	0.038	0.038	0.037	0.040	
Count	6	6	6	6	6	6	6	6	6	6	60
Minimum	0.040	0.035	0.036	0.037	0.038	0.037	0.037	0.037	0.036	0.040	0.035
Maximum	0.040	0.036	0.037	0.039	0.039	0.038	0.038	0.039	0.037	0.040	0.040
Mean	0.040	0.036	0.037	0.038	0.039	0.038	0.038	0.038	0.037	0.040	0.038
Std Dev	0.000	0.000	0.000	0.001	0.001	0.000	0.001	0.001	0.001	0.000	0.0014
95% Confidence Interval											0.001
Coeff. Variation	0.00%	1.14%	1.11%	2.17%	1.42%	1.08%	1.37%	1.97%	1.50%	0.00%	3.66%
Dev from Cert. mean	5.54%	-5.45%	-2.81%	-0.62%	1.58%	-0.18%	-0.62%	0.70%	-3.69%	5.54%	N/A
Std Dev Within Lab											0.001
Std Dev Between Labs											0.003



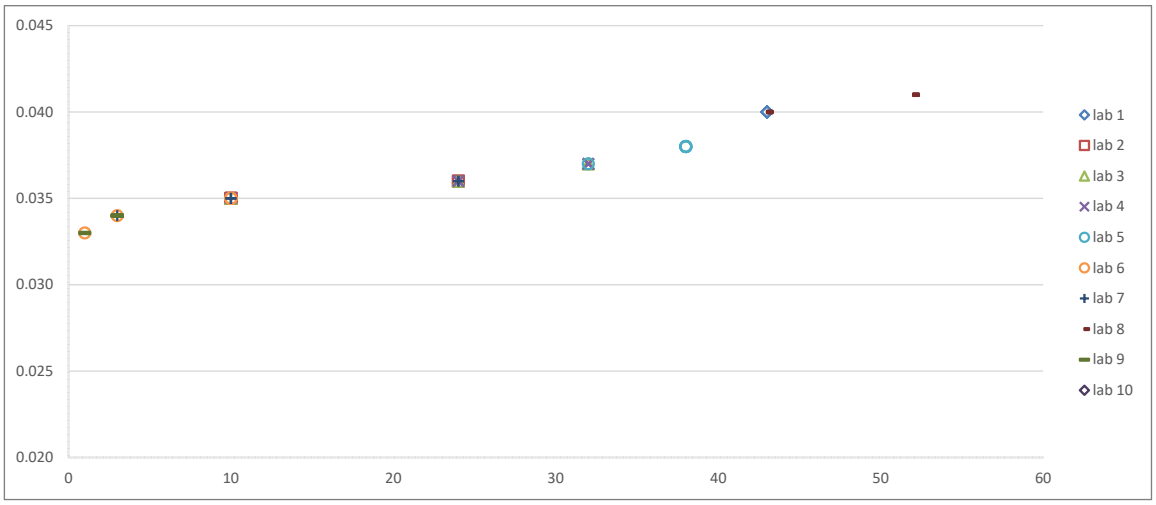
Graph of ranked raw values, showing grade distribution with no outlier removal.



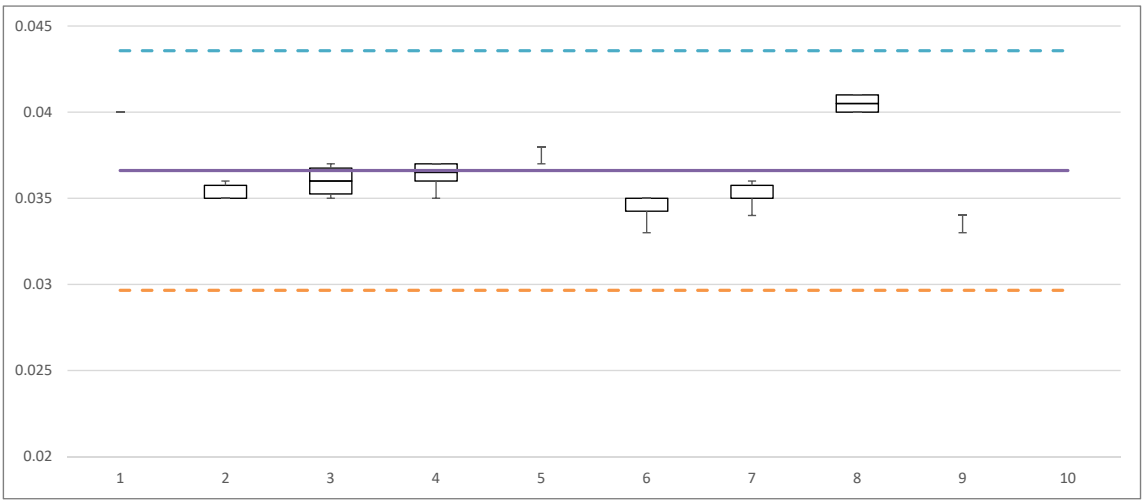
Box and Whisker graph showing median, quartile ranges, and minimum and maximum assay values by laboratory, including outliers. Mean and +/- 3SD is also displayed as solid and dashed lines respectively.

S % Analysis Results

	Lab #										
Replicate No	1	2	3	4	5	6	7	8	9	10	Overall
1	0.040	0.035	0.037	0.037	0.038	0.035	0.036	0.041	0.034		
2	0.040	0.036	0.037	0.036	0.038	0.035	0.035	0.041	0.033		
3	0.040	0.035	0.035	0.036	0.038	0.033	0.035	0.041	0.034		
4	0.040	0.035	0.036	0.037	0.037	0.034	0.036	0.040	0.034		
5	0.040	0.036	0.035	0.037	0.038	0.035	0.035	0.040	0.034		
6	0.040	0.035	0.036	0.035	0.038	0.035	0.034	0.040	0.034		
Count	6	6	6	6	6	6	6	6	6		54
Minimum	0.040	0.035	0.035	0.035	0.037	0.033	0.034	0.040	0.033		0.033
Maximum	0.040	0.036	0.037	0.037	0.038	0.035	0.036	0.041	0.034		0.041
Mean	0.040	0.035	0.036	0.036	0.038	0.035	0.035	0.041	0.034		0.037
Std Dev	0.0000	0.0005	0.0009	0.0008	0.0004	0.0008	0.0008	0.0005	0.0004		0.0023
95% Confidence Interval											0.0018
Coeff. Variation	0.00%	1.46%	2.48%	2.25%	1.08%	2.43%	2.14%	1.35%	1.21%		6.33%
Dev from Cert. mean	9.26%	-3.49%	-1.67%	-0.76%	3.34%	-5.77%	-3.95%	10.62%	-7.59%		N/A
Std Dev Within Lab											0.0006
Std Dev Between Labs											0.0058



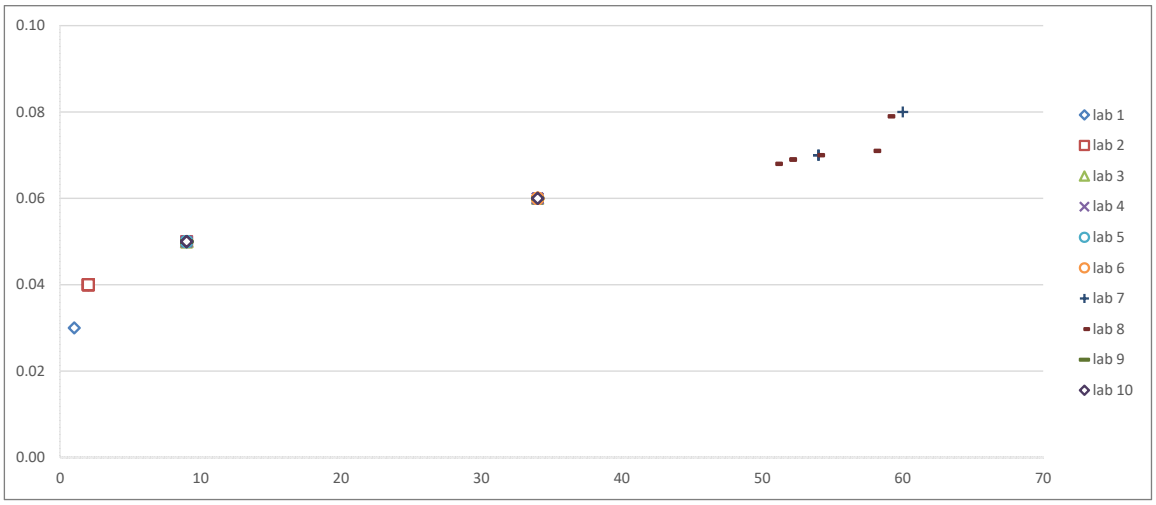
Graph of ranked raw values, showing grade distribution with no outlier removal.



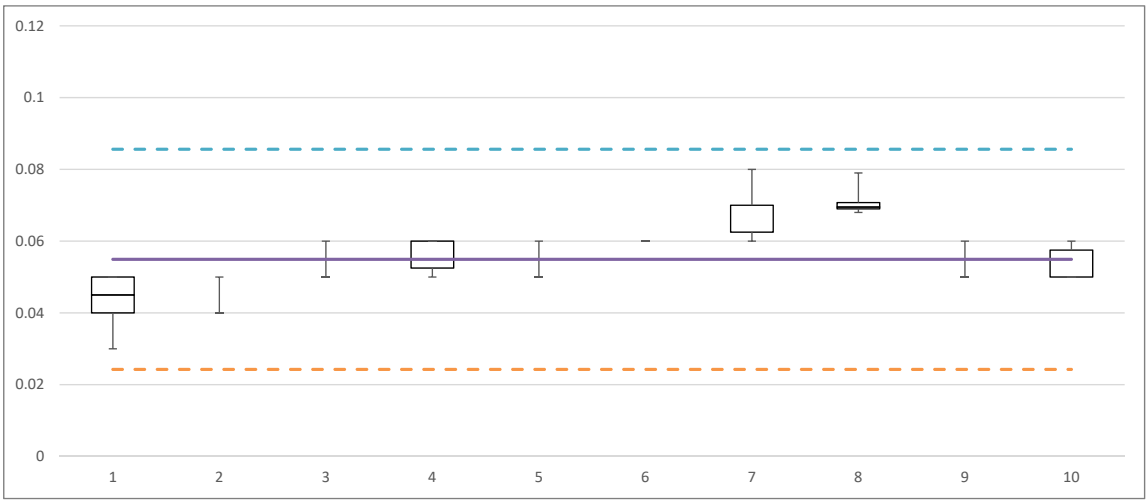
Box and Whisker graph showing median, quartile ranges, and minimum and maximum assay values by laboratory, including outliers. Mean and +/- 3SD is also displayed as solid and dashed lines respectively.

MgO % Analysis Results

	Lab #										
Replicate No	1	2	3	4	5	6	7	8	9	10	Overall
1	0.04	0.05	0.06	0.06	0.05	0.06	0.06	0.07	0.05	0.05	
2	0.05	0.04	0.05	0.06	0.05	0.06	0.07	0.07	0.05	0.05	
3	0.05	0.04	0.05	0.06	0.05	0.06	0.06	0.07	0.05	0.05	
4	0.05	0.04	0.05	0.06	0.05	0.06	0.08	0.07	0.05	0.06	
5	0.04	0.04	0.05	0.05	0.05	0.06	0.07	0.07	0.05	0.05	
6	0.03	0.04	0.05	0.05	0.06	0.06	0.07	0.08	0.06	0.06	
Count	6	6	6	6	6	6	6	6	6	6	60
Minimum	0.03	0.04	0.05	0.05	0.05	0.06	0.06	0.07	0.05	0.05	0.03
Maximum	0.05	0.05	0.06	0.06	0.06	0.06	0.08	0.08	0.06	0.06	0.08
Mean	0.04	0.04	0.05	0.06	0.05	0.06	0.07	0.07	0.05	0.05	0.05
Std Dev	0.008	0.004	0.004	0.005	0.004	0.000	0.008	0.004	0.004	0.005	0.010
95% Confidence Interval											0.007
Coeff. Variation	18.84%	9.80%	7.90%	9.11%	7.90%	0.00%	11.02%	5.70%	7.90%	9.68%	18.61%
Dev from Cert. mean	-21.12%	-24.15%	-5.95%	3.16%	-5.95%	9.22%	24.39%	29.25%	-5.95%	-2.91%	N/A
Std Dev Within Lab											0.005
Std Dev Between Labs											0.023



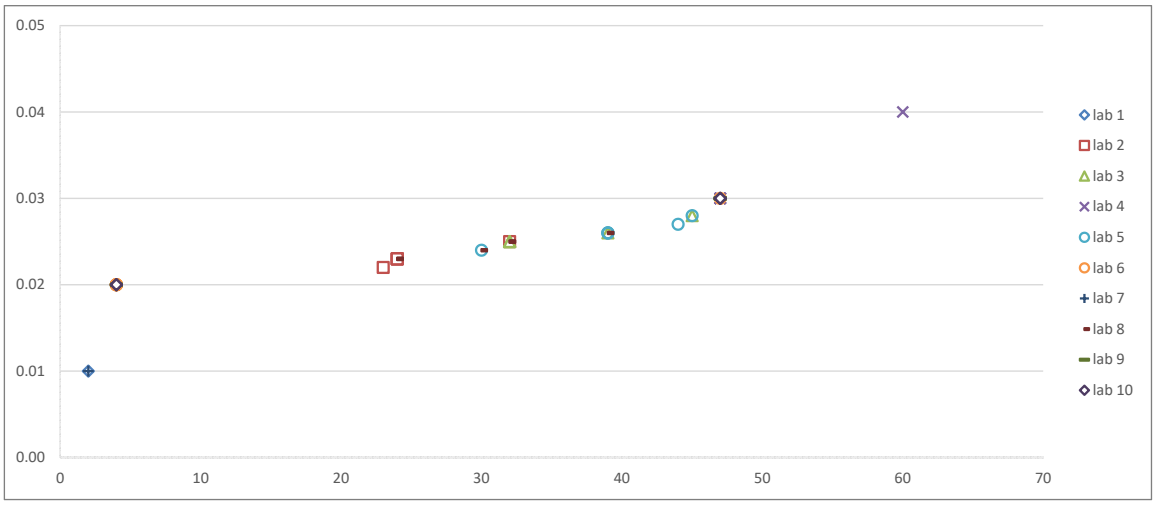
Graph of ranked raw values, showing grade distribution with no outlier removal.



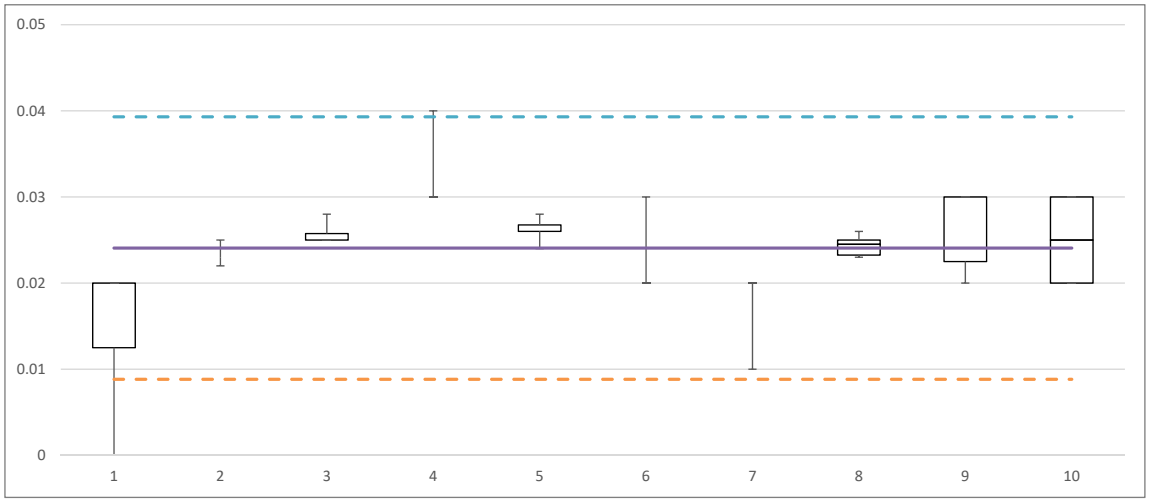
Box and Whisker graph showing median, quartile ranges, and minimum and maximum assay values by laboratory, including outliers. Mean and +/- 3SD is also displayed as solid and dashed lines respectively.

K2O % Analysis Results

	Lab #										
Replicate No	1	2	3	4	5	6	7	8	9	10	Overall
1	0.02	0.025	0.028	0.04	0.027	0.03	0.02	0.025	0.02	0.03	
2	0.01	0.023	0.026	0.03	0.028	0.02	0.02	0.026	0.02	0.02	
3	0.02	0.023	0.025	0.03	0.026	0.02	0.02	0.023	0.03	0.02	
4	0.02	0.022	0.025	0.03	0.026	0.02	0.01	0.025	0.03	0.02	
5	-0.01	0.023	0.025	0.03	0.026	0.02	0.02	0.024	0.03	0.03	
6	0.02	0.023	0.025	0.03	0.024	0.02	0.02	0.023	0.03	0.03	
Count	5	6	6	6	6	6	6	6	6	6	59
Minimum	0.01	0.022	0.025	0.03	0.024	0.02	0.01	0.023	0.02	0.02	0.010
Maximum	0.02	0.025	0.028	0.04	0.028	0.03	0.02	0.026	0.03	0.03	0.040
Mean	0.02	0.023	0.026	0.03	0.026	0.02	0.02	0.024	0.03	0.03	0.024
Std Dev	0.004	0.001	0.001	0.004	0.001	0.004	0.004	0.001	0.005	0.005	0.0051
95% Confidence Interval											0.004
Coeff. Variation	24.85%	4.24%	4.72%	12.89%	5.08%	18.84%	22.27%	4.98%	19.36%	0.219	21.10%
Dev from Cert. mean	-25.21%	-3.74%	6.65%	31.58%	8.73%	-9.97%	-23.82%	1.11%	10.80%	0.039	N/A
Std Dev Within Lab											0.004
Std Dev Between Labs											0.010



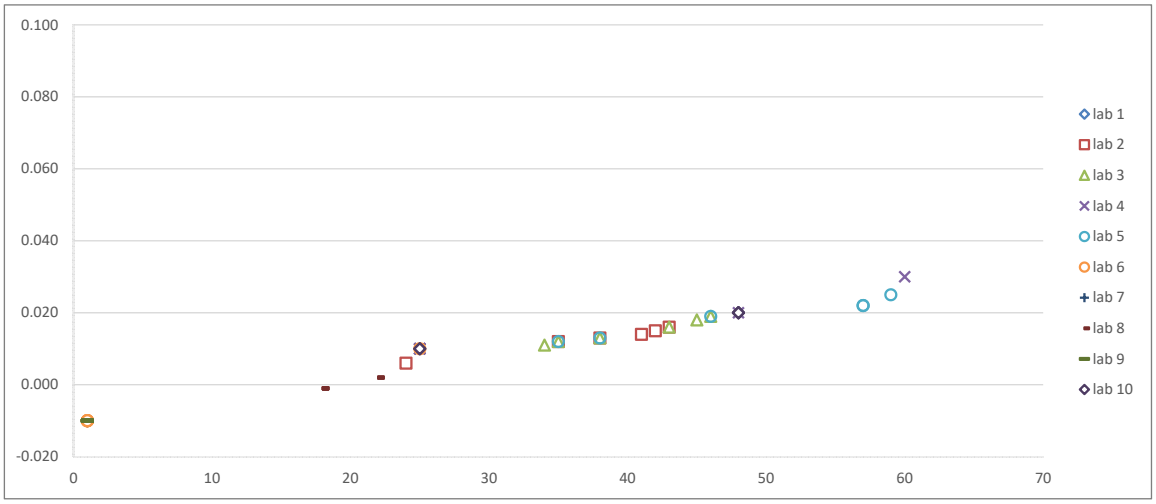
Graph of ranked raw values, showing grade distribution with no outlier removal.



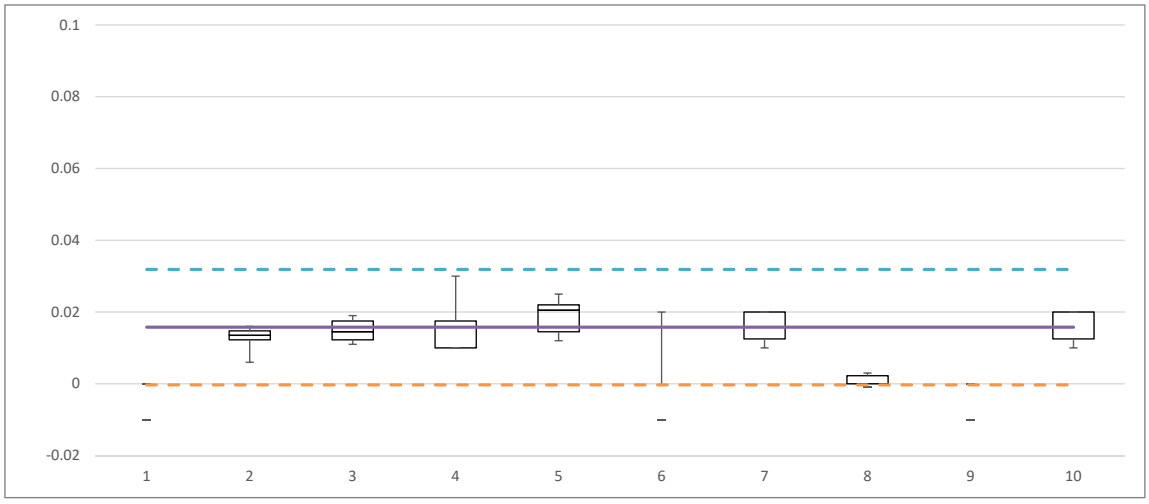
Box and Whisker graph showing median, quartile ranges, and minimum and maximum assay values by laboratory, including outliers. Mean and +/- 3SD is also displayed as solid and dashed lines respectively.

Na2O % Analysis Results

	Lab #										
Replicate No	1	2	3	4	5	6	7	8	9	10	Overall
1	-0.010	0.013	0.013	0.010	0.013	0.01	0.02	0.002	-0.010	0.02	
2	-0.010	0.016	0.019	0.030	0.019	-0.01	0.01	-0.001	-0.010	0.01	
3	-0.010	0.015	0.018	0.010	0.022	-0.01	0.01	-0.001	-0.010	0.01	
4	-0.010	0.014	0.011	0.010	0.012	-0.01	0.02	-0.001	-0.010	0.02	
5	-0.010	0.012	0.016	0.020	0.022	-0.01	0.02	-0.001	-0.010	0.02	
6	-0.010	0.006	0.012	0.010	0.025	-0.01	0.02	0.002	-0.010	0.02	
Count		6	6	6	6		6				36
Minimum	-0.010	0.006	0.011	0.010	0.012	-0.010	0.01	-0.001	-0.010	0.010	0.006
Maximum	-0.010	0.016	0.019	0.030	0.025	0.010	0.02	0.002	-0.010	0.020	0.030
Mean	~~-0.010~~	0.013	0.015	0.015	0.019	~~-0.007~~	0.02	~~0.000~~	~~-0.010~~	~~0.017~~	0.016
Std Dev		0.004	0.003	0.008	0.005		0.005				0.005
95% Confidence Interval											0.007
Coeff. Variation		28.10%	22.33%	55.78%	27.98%		30.98%				33.98%
Dev from Cert. mean		-19.72%	-5.99%	-4.93%	19.37%		5.63%				N/A
Std Dev Within Lab											0.005
Std Dev Between Labs											0.005



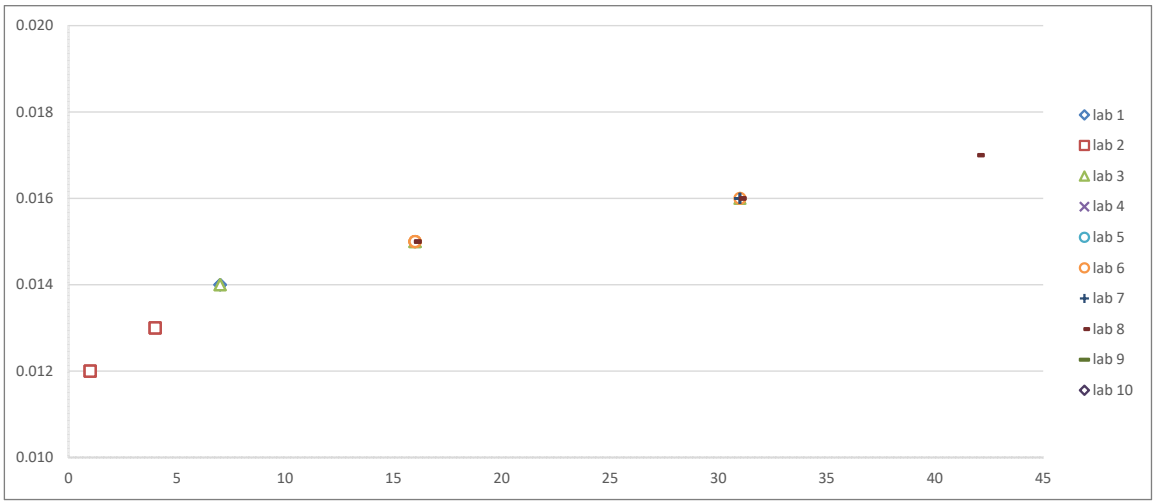
Graph of ranked raw values, showing grade distribution with no outlier removal.



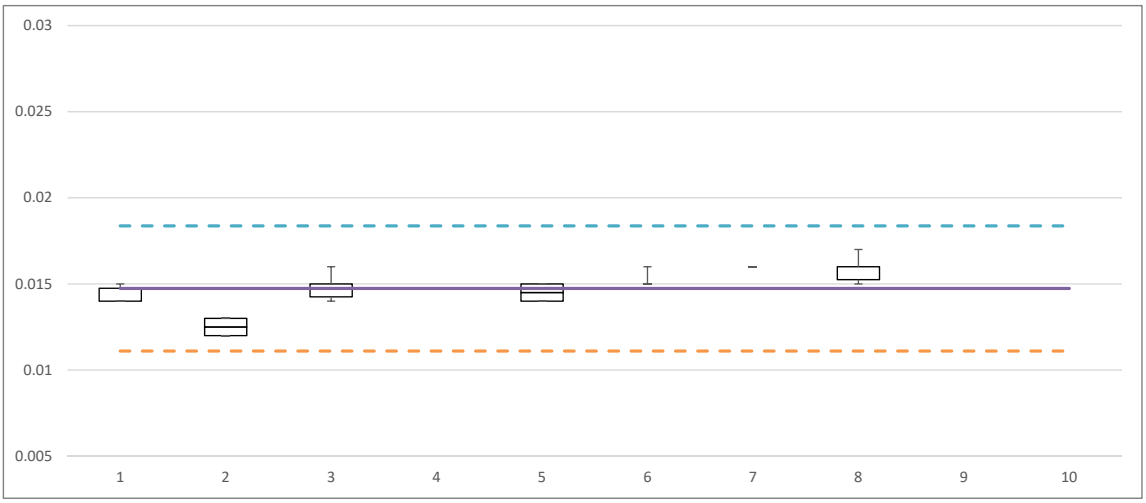
Box and Whisker graph showing median, quartile ranges, and minimum and maximum assay values by laboratory, including outliers. Mean and +/- 3SD is also displayed as solid and dashed lines respectively.

Zn % Analysis Results

	Lab #										
Replicate No	1	2	3	4	5	6	7	8	9	10	Overall
1	0.014	0.013	0.015		0.014	0.015	0.016	0.015			
2	0.014	0.013	0.014		0.014	0.016	0.016	0.017			
3	0.014	0.012	0.014		0.015	0.015	0.016	0.016			
4	0.015	0.013	0.015		0.015	0.015	0.016	0.016			
5	0.014	0.012	0.015		0.014	0.015	0.016	0.015			
6	0.015	0.012	0.016		0.015	0.015	0.016	0.016			
Count	6	6	6		6	6	6	6			42
Minimum	0.014	0.012	0.014		0.014	0.015	0.016	0.015			0.012
Maximum	0.015	0.013	0.016		0.015	0.016	0.016	0.017			0.017
Mean	0.014	0.013	0.015		0.015	0.015	0.016	0.016			0.015
Std Dev	0.001	0.001	0.001		0.001	0.000	0.000	0.001			0.001
95% Confidence Interval											0.001
Coeff. Variation	3.60%	4.38%	5.07%		3.78%	2.69%	0.00%	4.75%			8.22%
Dev from Cert. mean	-2.75%	-15.19%	0.65%		-1.62%	2.91%	8.56%	7.43%			N/A
Std Dev Within Lab											0.001
Std Dev Between Labs											0.003



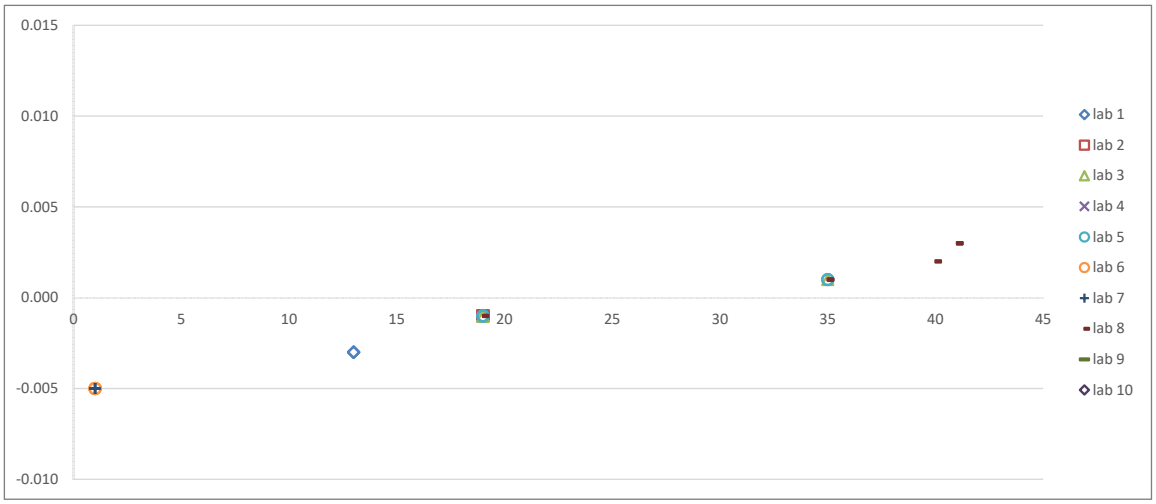
Graph of ranked raw values, showing grade distribution with no outlier removal.



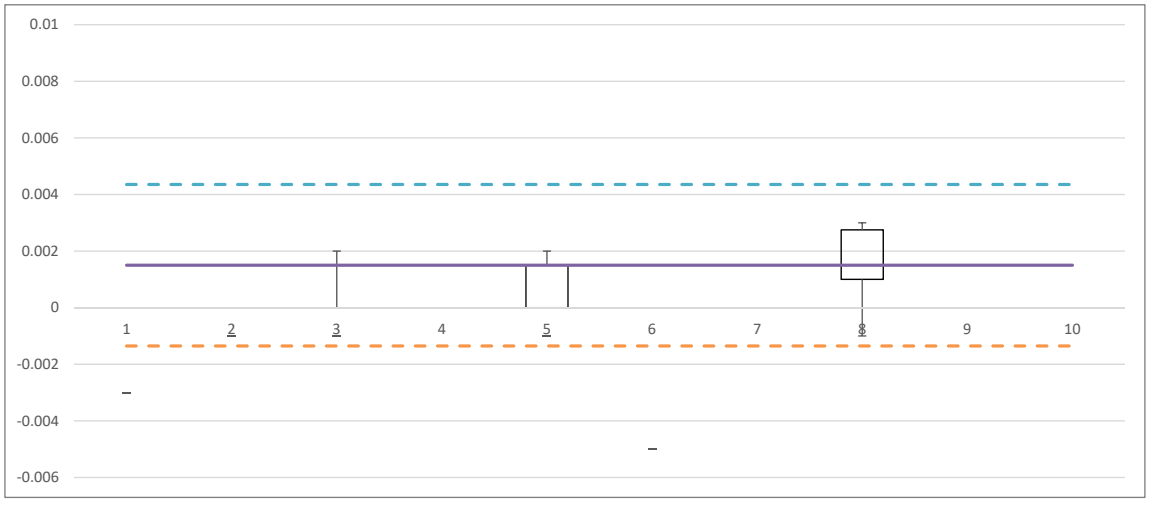
Box and Whisker graph showing median, quartile ranges, and minimum and maximum assay values by laboratory, including outliers. Mean and +/- 3SD is also displayed as solid and dashed lines respectively.

Pb % Analysis Results

	Lab #										
Replicate No	1	2	3	4	5	6	7	8	9	10	Overall
1	-0.003	-0.001	-0.001		-0.001	-0.005	-0.005	0.002			
2	-0.003	-0.001	-0.001		-0.001	-0.005	-0.005	-0.001			
3	-0.003	-0.001	-0.001		0.001	-0.005	-0.005	0.001			
4	-0.003	-0.001	-0.001		0.001	-0.005	-0.005	0.001			
5	-0.003	-0.001	-0.001		-0.001	-0.005	-0.005	0.003			
6	-0.003	-0.001	0.001		-0.001	-0.005	-0.005	0.003			
Count					2			5			7
Minimum	-0.003	-0.001	-0.001		0.001	-0.005	-0.005	0.001			0.001
Maximum	-0.003	-0.001	0.001		0.001	-0.005	-0.005	0.003			0.003
Mean	**-0.003**	~~**-0.001**~~	~~**-0.001**~~		0.001	~~**-0.005**~~	~~**-0.005**~~	0.002			0.002
Std Dev					0.0000			0.0010			0.0010
95% Confidence Interval											0.0085
Coeff. Variation					0.00%			50.00%			63.41%
Dev from Cert. mean					-33.33%			33.33%			N/A
Std Dev Within Lab											0.0009
Std Dev Between Labs											0.0012



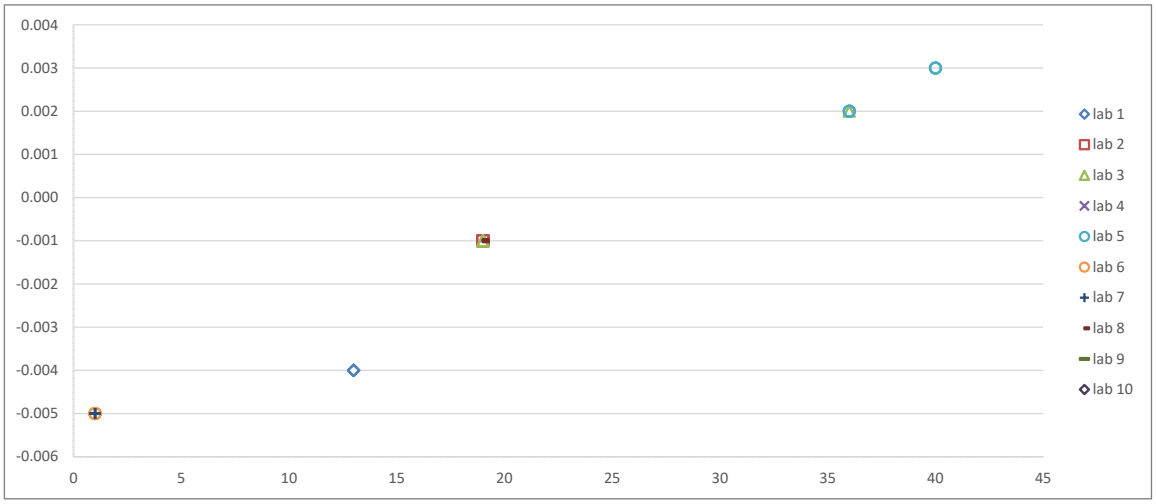
Graph of ranked raw values, showing grade distribution with no outlier removal.



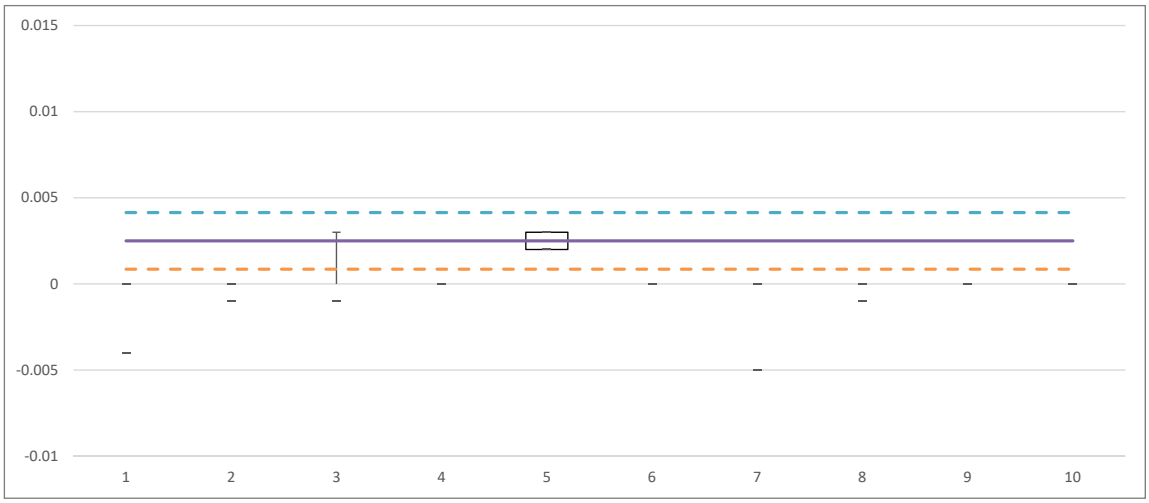
Box and Whisker graph showing median, quartile ranges, and minimum and maximum assay values by laboratory, including outliers. Mean and +/- 3SD is also displayed as solid and dashed lines respectively.

Cu % Analysis Results

	Lab #										
Replicate No	1	2	3	4	5	6	7	8	9	10	Overall
1	-0.004	-0.001	-0.001		0.002	-0.005	-0.005	-0.001			
2	-0.004	-0.001	-0.001		0.002	-0.005	-0.005	-0.001			
3	-0.004	-0.001	-0.001		0.002	-0.005	-0.005	-0.001			
4	-0.004	-0.001	-0.001		0.003	-0.005	-0.005	-0.001			
5	-0.004	-0.001	-0.001		0.003	-0.005	-0.005	-0.001			
6	-0.004	-0.001	0.002		0.003	-0.005	-0.005	-0.001			
Count					6						6
Minimum	-0.004	-0.001	-0.001		0.002	-0.005	-0.005	-0.001			0.002
Maximum	-0.004	-0.001	0.002		0.003	-0.005	-0.005	-0.001			0.003
Mean	~~-0.004~~	~~-0.001~~	~~-0.001~~		0.003	~~-0.005~~	~~-0.005~~	~~-0.001~~			0.003
Std Dev					0.0005						0.001
95% Confidence Interval											#DIV/0!
Coeff. Variation					21.91%						21.91%
Dev from Cert. mean					0.00%						N/A
Std Dev Within Lab											0.001
Std Dev Between Labs											#DIV/0!



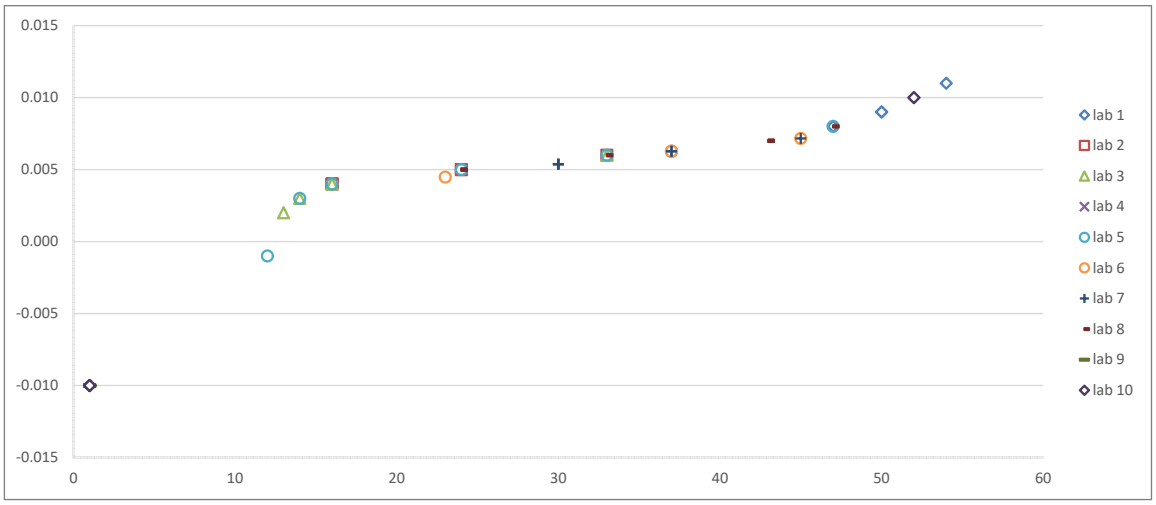
Graph of ranked raw values, showing grade distribution with no outlier removal.



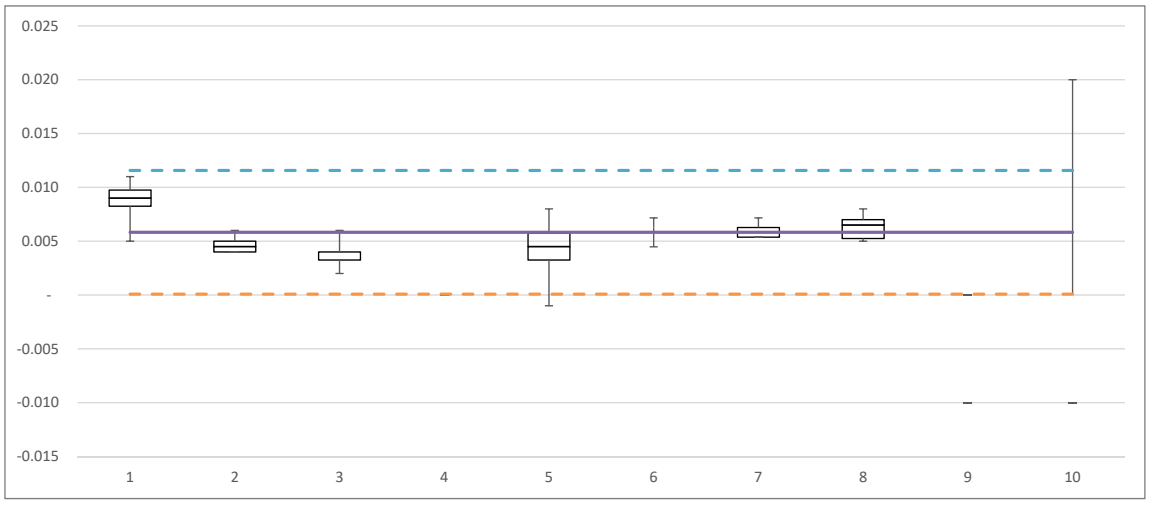
Box and Whisker graph showing median, quartile ranges, and minimum and maximum assay values by laboratory, including outliers. Mean and +/- 3SD is also displayed as solid and dashed lines respectively.

Ba % Analysis Results

	Lab #										
Replicate No	1	2	3	4	5	6	6	8	9	10	Overall
1	0.010	0.005	0.006		0.003	0.006	0.006	0.005	-0.010	-0.01	
2	0.005	0.004	0.003		0.004	0.007	0.005	0.006	-0.010	-0.01	
3	0.009	0.006	0.002		0.005	0.006	0.005	0.007	-0.010	0.01	
4	0.011	0.004	0.004		0.006	0.006	0.005	0.008	-0.010	-0.01	
5	0.009	0.005	0.004		-0.001	0.004	0.007	0.007	-0.010	-0.01	
6	0.008	0.004	0.004		0.008	0.006	0.006	0.005	-0.010	-0.01	
Count	6	6	6		5	6	6	6			41
Minimum	0.005	0.004	0.002		0.003	0.004	0.005	0.005	-0.010	-0.010	0.002
Maximum	0.011	0.006	0.006		0.008	0.007	0.007	0.008	-0.010	0.010	0.011
Mean	0.009	0.005	0.004		0.005	0.006	0.006	0.006	~~-0.010~~	~~-0.007~~	0.006
Std Dev	0.002	0.001	0.001		0.002	0.001	0.001	0.001			0.002
95% Confidence Interval											0.002
Coeff. Variation	23.83%	17.50%	34.67%		36.99%	14.39%	12.25%	19.12%			32.86%
Dev from Cert. mean	48.72%	-19.92%	-34.22%		-10.77%	5.03%	2.47%	8.68%			N/A
Std Dev Within Lab											0.001
Std Dev Between Labs											0.004



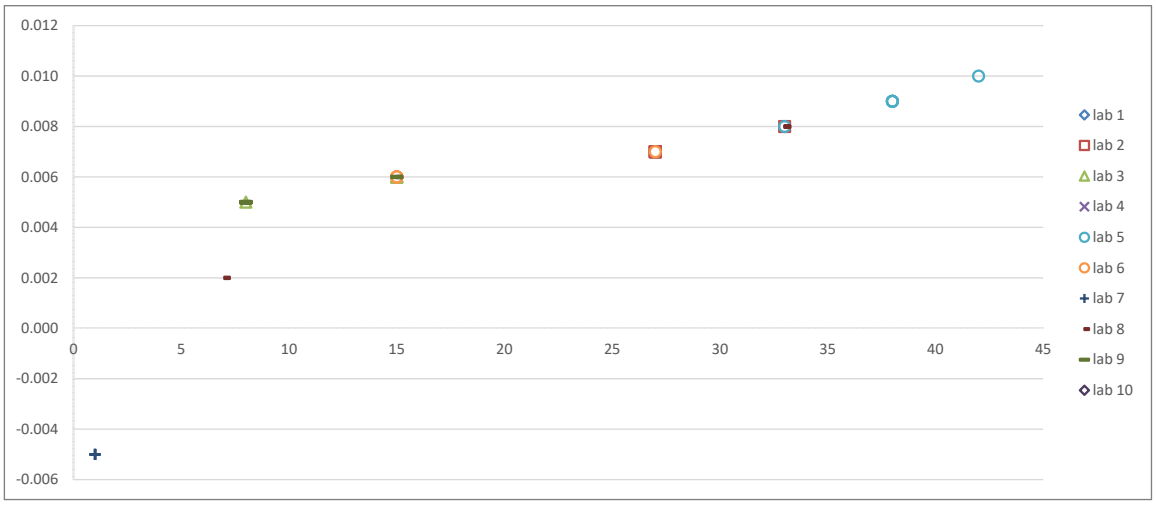
Graph of ranked raw values, showing grade distribution with no outlier removal.



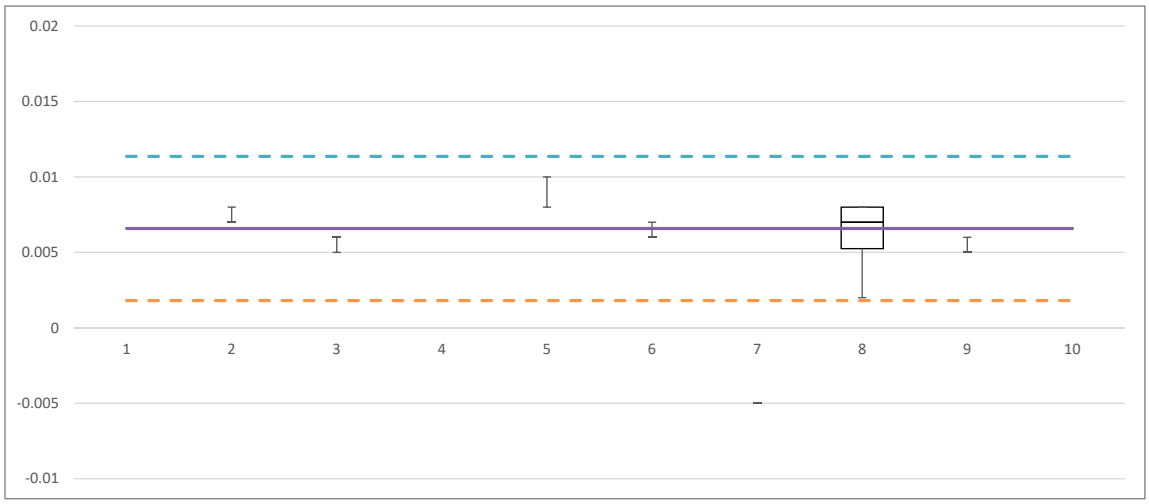
Box and Whisker graph showing median, quartile ranges, and minimum and maximum assay values by laboratory, including outliers. Mean and +/- 3SD is also displayed as solid and dashed lines respectively.

Cl % Analysis Results

	Lab #										
Replicate No	1	2	3	4	5	6	7	8	9	10	Overall
1		0.007	0.006		0.009	0.007	-0.005	0.008	0.006		
2		0.008	0.006		0.009	0.006	-0.005	0.008	0.005		
3		0.007	0.006		0.009	0.006	-0.005	0.005	0.005		
4		0.007	0.005		0.010	0.006	-0.005	0.006	0.005		
5		0.007	0.006		0.008	0.006	-0.005	0.008	0.005		
6		0.007	0.006		0.009	0.006	-0.005	0.002	0.005		
Count		6	6		6	6		6	6		36
Minimum		0.007	0.005		0.008	0.006	-0.005	0.002	0.005		0.002
Maximum		0.008	0.006		0.010	0.007	-0.005	0.008	0.006		0.010
Mean		0.007	0.006		0.009	0.006	~~-0.005~~	0.006	0.005		0.007
Std Dev		0.000	0.000		0.001	0.000		0.002	0.000		0.002
95% Confidence Interval											0.002
Coeff. Variation		5.70%	7.00%		7.03%	6.62%		38.94%	7.90%		24.19%
Dev from Cert. mean		8.86%	-11.39%		36.71%	-6.33%		-6.33%	-21.52%		N/A
Std Dev Within Lab											0.001
Std Dev Between Labs											0.003



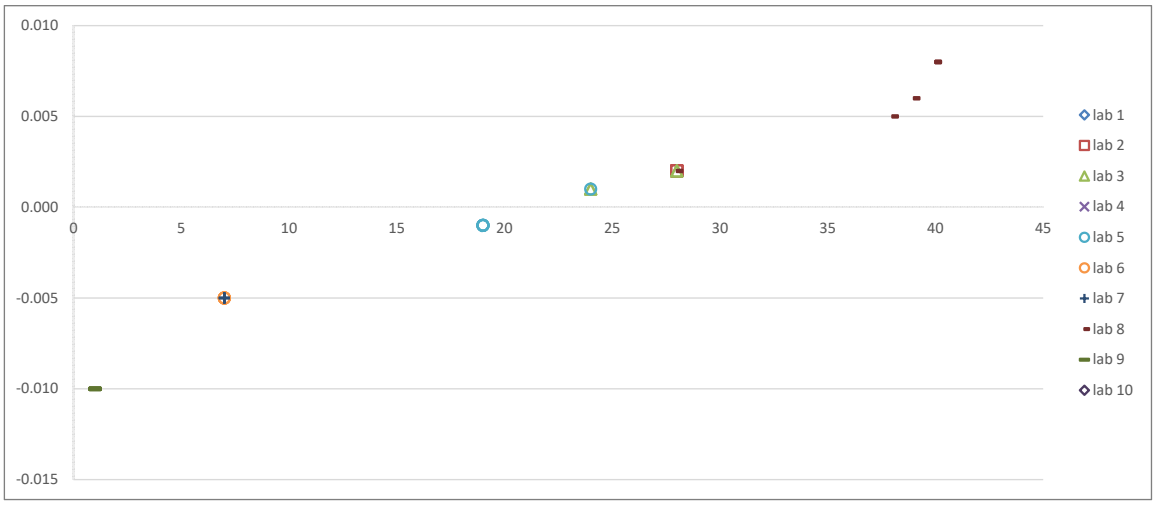
Graph of ranked raw values, showing grade distribution with no outlier removal.



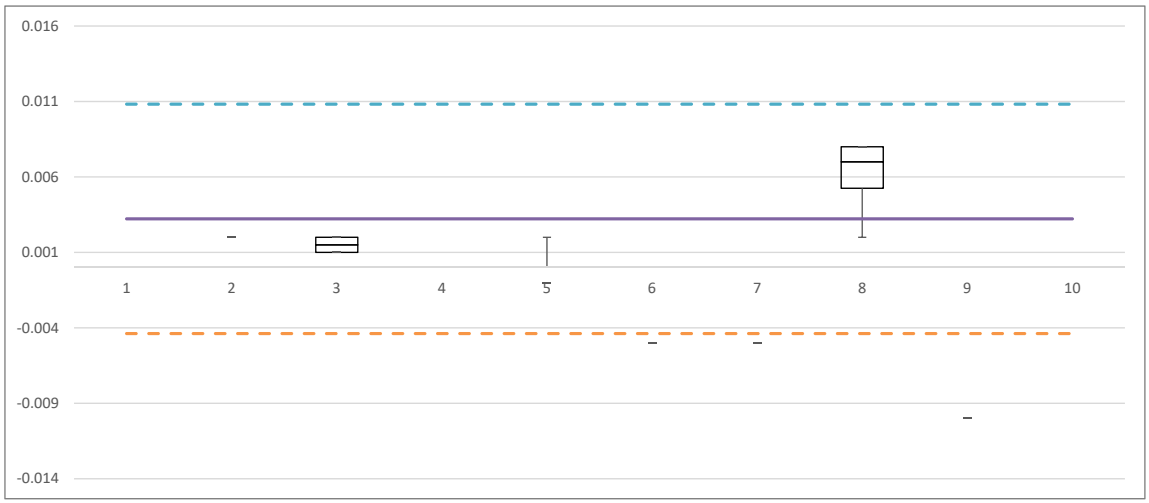
Box and Whisker graph showing median, quartile ranges, and minimum and maximum assay values by laboratory, including outliers. Mean and +/- 3SD is also displayed as solid and dashed lines respectively.

As % Analysis Results

	Lab #										
Replicate No	1	2	3	4	5	6	7	8	9	10	Overall
1		0.002	0.001		-0.001	-0.005	-0.005	0.008	-0.010		
2		0.002	0.001		-0.001	-0.005	-0.005	0.008	-0.010		
3		0.002	0.002		-0.001	-0.005	-0.005	0.005	-0.010		
4		0.002	0.002		-0.001	-0.005	-0.005	0.006	-0.010		
5		0.002	0.001		0.001	-0.005	-0.005	0.008	-0.010		
6		0.002	0.002		-0.001	-0.005	-0.005	0.002	-0.010		
Count		6	6					6			18
Minimum		0.002	0.001		-0.001	-0.005	-0.005	0.002	-0.010		0.001
Maximum		0.002	0.002		0.001	-0.005	-0.005	0.008	-0.010		0.008
Mean		0.002	0.002		~~-0.001~~	~~-0.005~~	~~-0.005~~	0.006	~~-0.010~~		0.003
Std Dev		0.000	0.001					0.002			0.0025
95% Confidence Interval											0.0063
Coeff. Variation		0.00%	36.51%					38.94%			78.62%
Dev from Cert. mean		-37.93%	-53.45%					91.38%			N/A
Std Dev Within Lab											0.0014
Std Dev Between Labs											0.0063



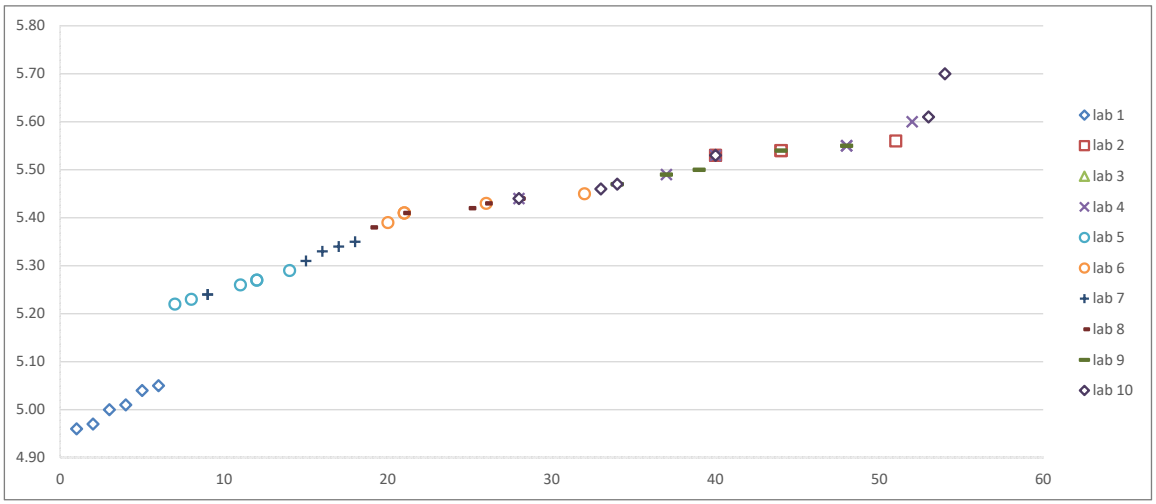
Graph of ranked raw values, showing grade distribution with no outlier removal.



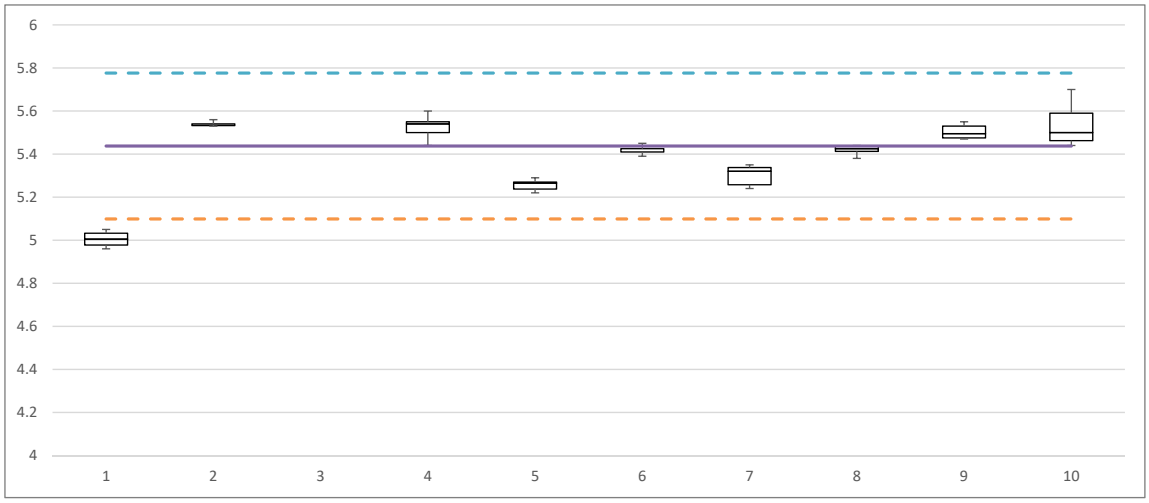
Box and Whisker graph showing median, quartile ranges, and minimum and maximum assay values by laboratory, including outliers. Mean and +/- 3SD is also displayed as solid and dashed lines respectively.

LOI 371°C % Analysis Results

	Lab #										
Replicate No	1	2	3	4	5	6	7	8	9	10	Overall
1	5.01	5.53		5.53	5.23	5.43	5.24	5.44	5.54	5.70	
2	5.05	5.53		5.44	5.22	5.39	5.31	5.42	5.50	5.61	
3	4.97	5.54		5.55	5.27	5.41	5.35	5.41	5.49	5.46	
4	5.00	5.54		5.49	5.27	5.41	5.33	5.43	5.55	5.53	
5	5.04	5.54		5.60	5.26	5.45	5.24	5.44	5.47	5.47	
6	4.96	5.56		5.55	5.29	5.41	5.34	5.38	5.47	5.44	
Count		6		6	6	6	6	6	6	6	48
Minimum	4.96	5.53		5.44	5.22	5.39	5.24	5.38	5.47	5.44	5.22
Maximum	5.05	5.56		5.60	5.29	5.45	5.35	5.44	5.55	5.70	5.70
Mean	~~5.01~~	5.54		5.53	5.26	5.42	5.30	5.42	5.50	5.54	5.44
Std Dev		0.01		0.06	0.03	0.02	0.05	0.02	0.03	0.10	0.113
95% Confidence Interval											0.094
Coeff. Variation		0.20%		1.00%	0.51%	0.38%	0.93%	0.42%	0.63%	1.84%	2.08%
Dev from Cert. mean		1.89%		1.64%	-3.33%	-0.38%	-2.50%	-0.32%	1.21%	1.79%	N/A
Std Dev Within Lab											0.049
Std Dev Between Labs											0.269



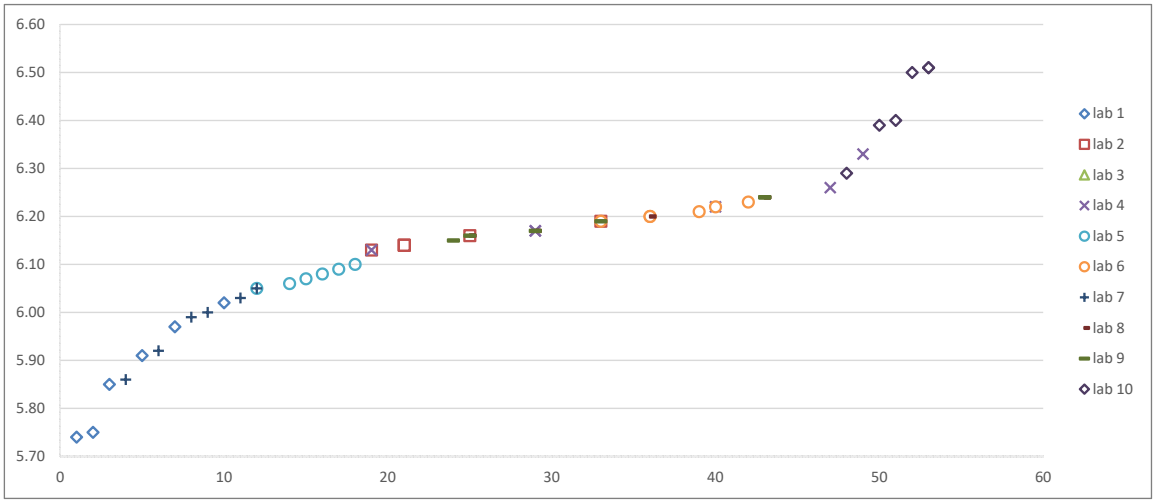
Graph of ranked raw values, showing grade distribution with no outlier removal.



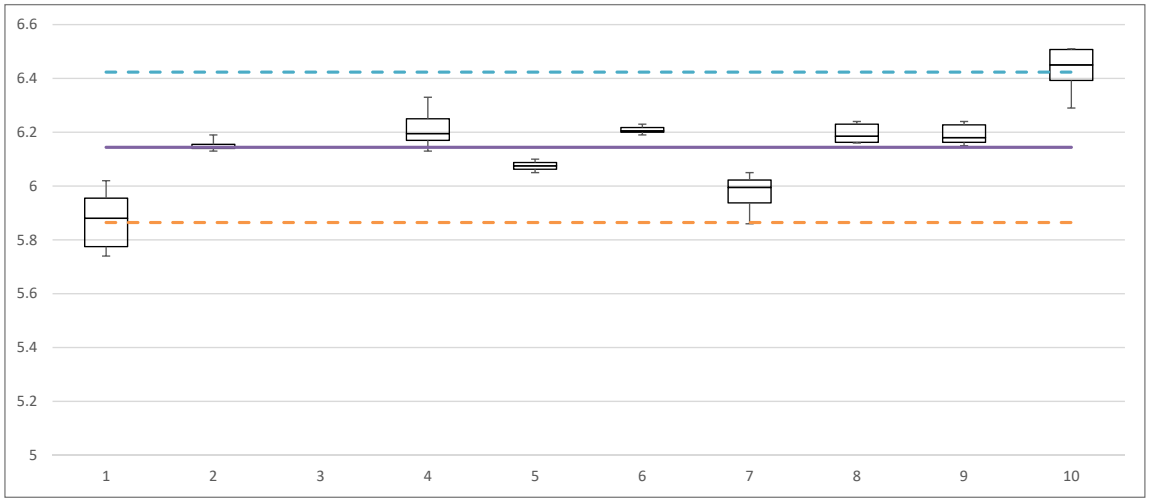
Box and Whisker graph showing median, quartile ranges, and minimum and maximum assay values by laboratory, including outliers. Mean and +/- 3SD is also displayed as solid and dashed lines respectively.

LOI 650°C % Analysis Results

	Lab #										
Replicate No	1	2	3	4	5	6	7	8	9	10	Overall
1	5.91	6.14		6.26	6.07	6.22	5.86	6.24	6.24	6.51	
2	6.02	6.13		6.13	6.06	6.20	6.00	6.17	6.17	6.51	
3	5.85	6.16		6.22	6.09	6.19	6.05	6.16	6.16	6.40	
4	5.97	6.14		6.17	6.05	6.21	5.99	6.24	6.24	6.50	
5	5.75	6.14		6.33	6.10	6.23	5.92	6.20	6.19	6.39	
6	5.74	6.19		6.17	6.08	6.20	6.03	6.16	6.15	6.29	
Count		6		6	6	6	6	6	6		42
Minimum	5.74	6.13		6.13	6.05	6.19	5.86	6.16	6.15	6.29	5.86
Maximum	6.02	6.19		6.33	6.10	6.23	6.05	6.24	6.24	6.51	6.33
Mean	~~5.87~~	6.15		6.21	6.08	6.21	5.98	6.20	6.19	~~6.43~~	6.14
Std Dev		0.02		0.07	0.02	0.01	0.07	0.04	0.04		0.093
95% Confidence Interval											0.086
Coeff. Variation		0.36%		1.17%	0.31%	0.24%	1.20%	0.61%	0.64%		1.52%
Dev from Cert. mean		0.10%		1.13%	-1.12%	1.05%	-2.75%	0.83%	0.78%		N/A
Std Dev Within Lab											0.046
Std Dev Between Labs											0.217



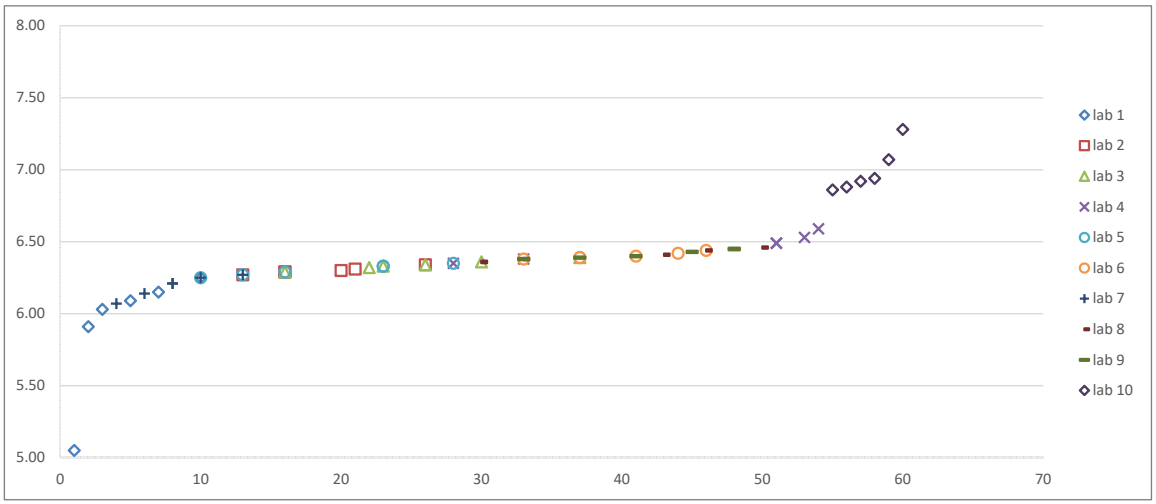
Graph of ranked raw values, showing grade distribution with no outlier removal.



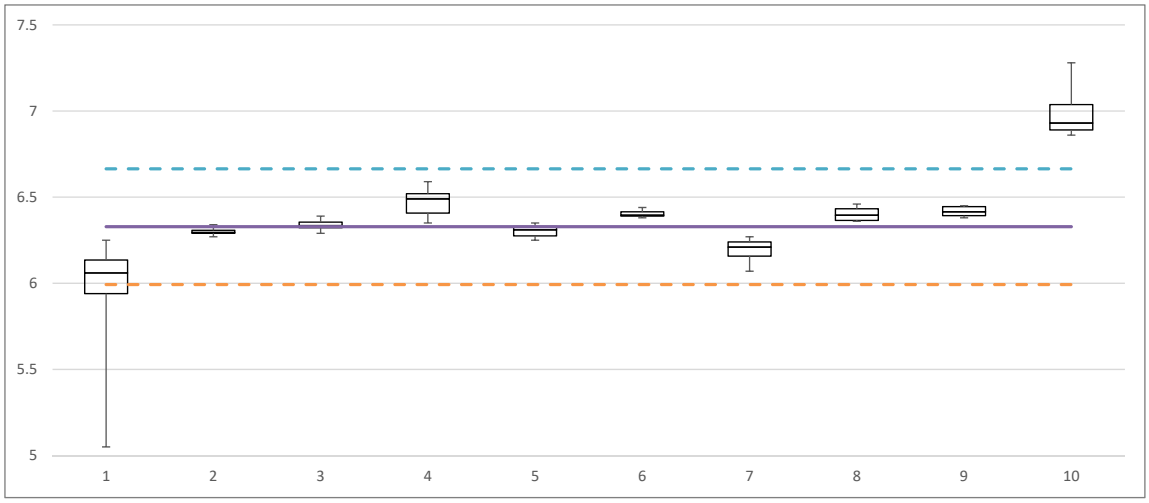
Box and Whisker graph showing median, quartile ranges, and minimum and maximum assay values by laboratory, including outliers. Mean and +/- 3SD is also displayed as solid and dashed lines respectively.

LOI 1000°C % Analysis Results

	Lab #										
Replicate No	1	2	3	4	5	6	7	8	9	10	Overall
1	~~5.91~~	6.27	6.39	6.49	6.27	6.42	6.07	6.44	6.45	7.07	
2	~~5.05~~	6.29	6.29	6.35	6.25	6.39	6.21	6.36	6.39	6.94	
3	6.03	6.30	6.36	6.59	6.33	6.38	6.27	6.36	6.40	6.86	
4	6.15	6.31	6.33	6.38	6.29	6.40	6.21	6.46	6.45	7.28	
5	6.25	6.29	6.34	6.53	6.35	6.44	6.14	6.41	6.43	6.92	
6	6.09	6.34	6.32	6.49	6.33	6.39	6.25	6.38	6.38	6.88	
Count	4	6	6	6	6	6	6	6	6		52
Minimum	6.03	6.27	6.29	6.35	6.25	6.38	6.07	6.36	6.38	6.86	6.03
Maximum	6.25	6.34	6.39	6.59	6.35	6.44	6.27	6.46	6.45	7.28	6.59
Mean	6.13	6.30	6.34	6.47	6.30	6.40	6.19	6.40	6.42	~~6.99~~	6.33
Std Dev	0.09	0.02	0.03	0.09	0.04	0.02	0.07	0.04	0.03		0.112
95% Confidence Interval											0.086
Coeff. Variation	1.53%	0.38%	0.54%	1.40%	0.62%	0.35%	1.20%	0.66%	0.48%		1.77%
Dev from Cert. mean	-3.14%	-0.45%	0.16%	2.26%	-0.40%	1.18%	-2.16%	1.16%	1.39%		N/A
Std Dev Within Lab											0.055
Std Dev Between Labs											0.253



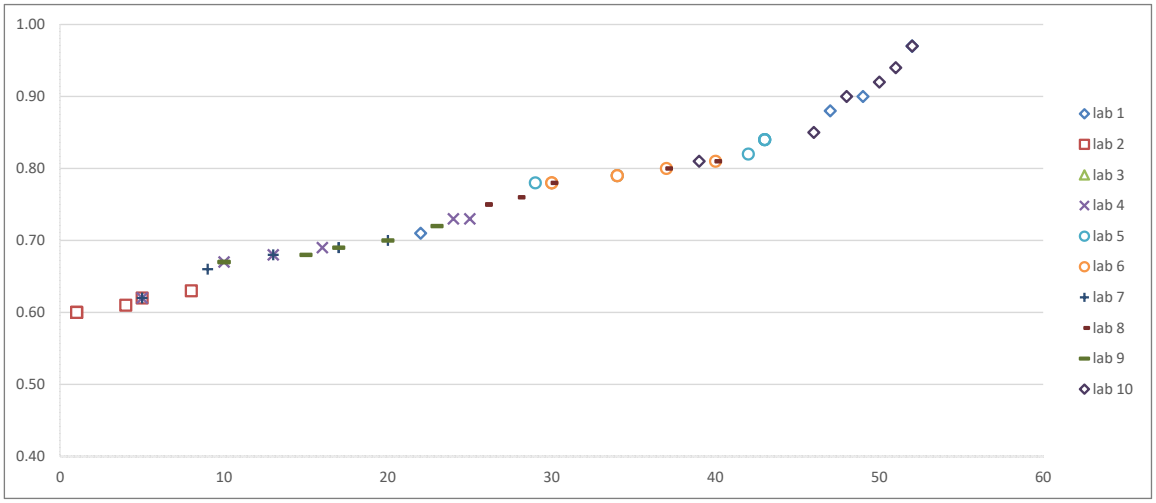
Graph of ranked raw values, showing grade distribution with no outlier removal.



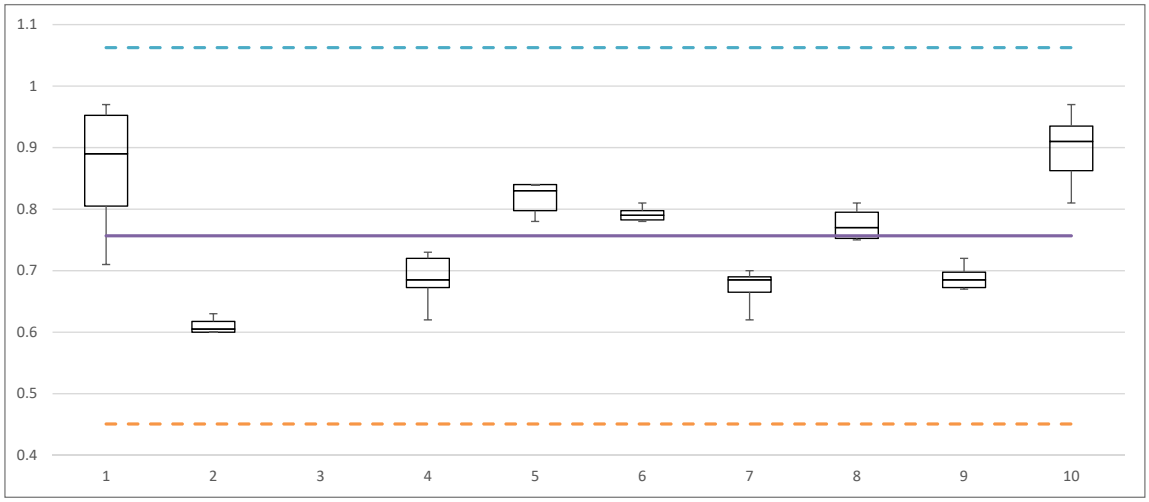
Box and Whisker graph showing median, quartile ranges, and minimum and maximum assay values by laboratory, including outliers. Mean and +/- 3SD is also displayed as solid and dashed lines respectively.

LOI 650-371°C % Analysis Results

	Lab #										
Replicate No	1	2	3	4	5	6	7	8	9	10	Overall
1	0.90	0.61		0.73	0.84	0.79	0.62	0.80	0.70	0.81	
2	0.97	0.60		0.69	0.84	0.81	0.69	0.75	0.67	0.90	
3	0.88	0.62		0.67	0.82	0.78	0.70	0.75	0.67	0.94	
4	0.97	0.60		0.68	0.78	0.80	0.66	0.81	0.69	0.97	
5	0.71	0.60		0.73	0.84	0.78	0.68	0.76	0.72	0.92	
6	0.78	0.63		0.62	0.79	0.79	0.69	0.78	0.68	0.85	
Count	6	6		6	6	6	6	6	6	6	54
Minimum	0.71	0.60		0.62	0.78	0.78	0.62	0.75	0.67	0.81	0.60
Maximum	0.97	0.63		0.73	0.84	0.81	0.70	0.81	0.72	0.97	0.97
Mean	0.87	0.61		0.69	0.82	0.79	0.67	0.78	0.69	0.90	0.76
Std Dev	0.10	0.01		0.04	0.03	0.01	0.03	0.03	0.02	0.06	0.102
95% Confidence Interval											0.078
Coeff. Variation	12.04%	2.07%		6.02%	3.32%	1.48%	4.37%	3.34%	2.82%	6.58%	13.48%
Dev from Cert. mean	14.76%	-19.38%		-9.25%	8.15%	4.63%	-11.01%	2.42%	-9.03%	18.72%	N/A
Std Dev Within Lab											0.046
Std Dev Between Labs											0.239



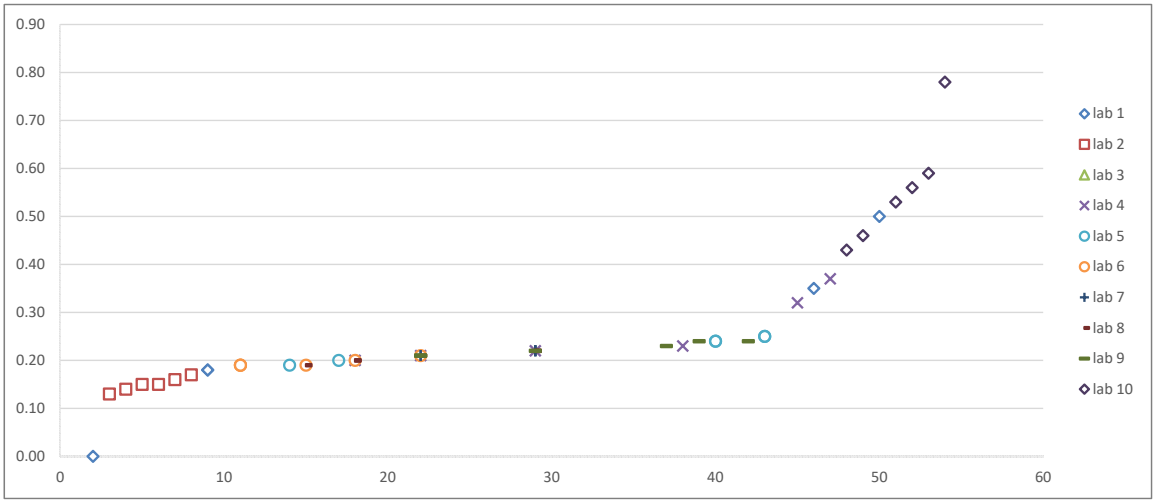
Graph of ranked raw values, showing grade distribution with no outlier removal.



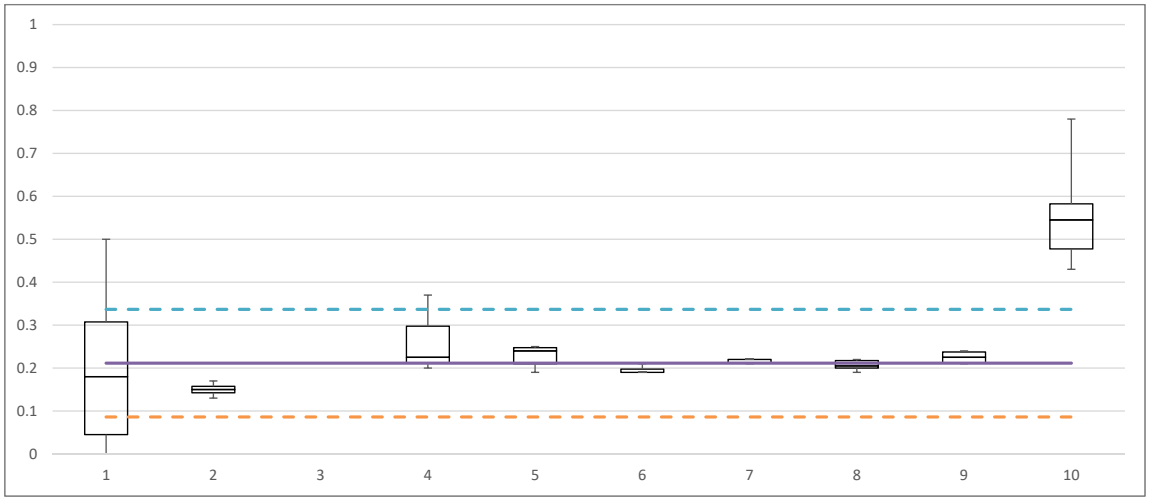
Box and Whisker graph showing median, quartile ranges, and minimum and maximum assay values by laboratory, including outliers. Mean and +/- 3SD is also displayed as solid and dashed lines respectively.

LOI 1000-650°C % Analysis Results

	Lab #										
Replicate No	1	2	3	4	5	6	7	8	9	10	Overall
1	0.00	0.13		0.23	0.20	0.20	0.21	0.20	0.21	0.56	
2	-0.97	0.16		0.22	0.19	0.19	0.21	0.19	0.22	0.43	
3	0.18	0.14		0.37	0.24	0.19	0.22	0.20	0.24	0.46	
4	0.18	0.17		0.21	0.24	0.19	0.22	0.22	0.21	0.78	
5	0.50	0.15		0.20	0.25	0.21	0.22	0.21	0.24	0.53	
6	0.35	0.15		0.32	0.25	0.19	0.22	0.22	0.23	0.59	
Count		6		6	6	6	6	6	6		42
Minimum	-0.97	0.13		0.20	0.19	0.19	0.21	0.19	0.21	0.43	0.13
Maximum	0.50	0.17		0.37	0.25	0.21	0.22	0.22	0.24	0.78	0.37
Mean	~~0.04~~	0.15		0.26	0.23	0.20	0.22	0.21	0.23	~~0.56~~	0.21
Std Dev		0.01		0.07	0.03	0.01	0.01	0.01	0.01		0.042
95% Confidence Interval											0.039
Coeff. Variation		9.43%		26.98%	11.56%	4.29%	2.38%	5.86%	6.13%		19.75%
Dev from Cert. mean		-29.05%		22.18%	8.00%	-7.77%	2.48%	-2.25%	6.42%		N/A
Std Dev Within Lab											0.030
Std Dev Between Labs											0.082



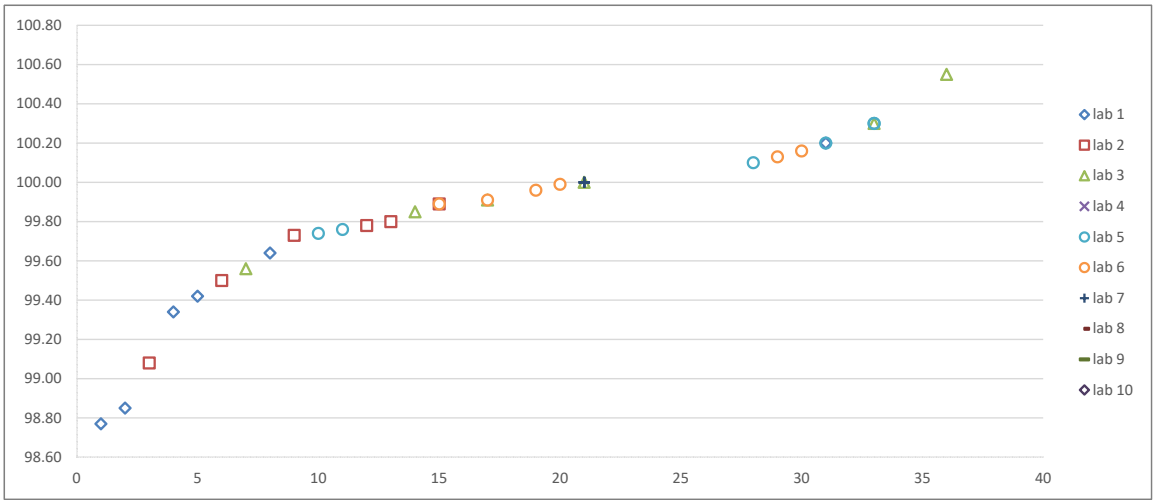
Graph of ranked raw values, showing grade distribution with no outlier removal.



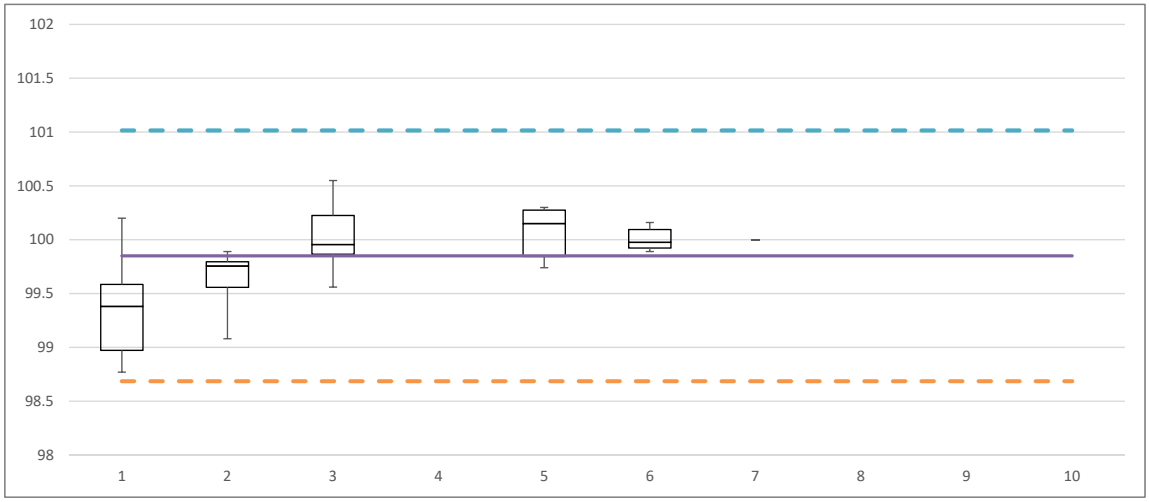
Box and Whisker graph showing median, quartile ranges, and minimum and maximum assay values by laboratory, including outliers. Mean and +/- 3SD is also displayed as solid and dashed lines respectively.

Total Values % Analysis Results

	Lab #										
Replicate No	1	2	3	4	5	6	7	8	9	10	Overall
1	98.85	99.80	100.55		99.76	100.13	100.0				
2	98.77	99.89	99.91		99.74	99.96	100.0				
3	99.64	99.08	99.56		100.20	100.16	100.0				
4	100.20	99.78	100.00		100.30	99.89	100.0				
5	99.42	99.50	100.30		100.10	99.91	100.0				
6	99.34	99.73	99.85		100.30	99.99	100.0				
Count	6	6	6		6	6	6				36
Minimum	98.77	99.08	99.56		99.74	99.89	100.0				98.77
Maximum	100.20	99.89	100.55		100.30	100.16	100.0				100.55
Mean	99.37	99.63	100.03		100.07	100.01	100.0				99.85
Std Dev	0.53	0.30	0.35		0.26	0.11	0.0				0.388
95% Confidence Interval											0.407
Coeff. Variation	0.53%	0.30%	0.35%		0.26%	0.11%	0.00%				0.39%
Dev from Cert. mean	-0.48%	-0.22%	0.18%		0.22%	0.16%	0.15%				N/A
Std Dev Within Lab											0.308
Std Dev Between Labs											0.697



Graph of ranked raw values, showing grade distribution with no outlier removal.



Box and Whisker graph showing median, quartile ranges, and minimum and maximum assay values by laboratory, including outliers. Mean and +/- 3SD is also displayed as solid and dashed lines respectively.