MATRIX 2 RESULTS OF THE FY07 ENHANCED DOE HIGH-LEVEL WASTE MELTER THROUGHPUT STUDIES AT SRNL

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October 2008

Environmental & Chemical Process Technology
Savannah River National Laboratory
Aiken, SC 29808

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EXECUTIVE SUMMARY

High-level waste (HLW) throughput (i.e., the amount of waste processed per unit time) is a function of two critical parameters: waste loading (WL) and melt rate. For the Waste Treatment and Immobilization Plant (WTP) at the Hanford Site and the Defense Waste Processing Facility (DWPF) at the Savannah River Site (SRS), increasing HLW throughput would significantly reduce the overall mission life cycle costs for the Department of Energy (DOE).

The objective of this study was to generate supplemental validation data that could be used to determine the applicability of the current liquidus temperature (T_L) model to expanded DWPF glass composition regions of interest based on higher WLs. Two specific flowsheets were used in this study to provide such insight:

(1) Higher WL glasses (45 and 50%) based on future sludge batches that have (and have not) undergone the Al-dissolution process.

(2) Coupled operations supported by the Salt Waste Processing Facility (SWPF), which increase the TiO_2 concentration in glass to greater than 2 wt%.

Glasses were also selected to address technical issues associated with Al_2O_3 solubility, nepheline formation, and homogeneity issues for coupled operations. A test matrix of 28 glass compositions was developed to provide insight into these issues. The glasses were fabricated and characterized using chemical composition analysis, X-ray Diffraction (XRD), T_L measurement and the Product Consistency Test (PCT).

The results of this study are summarized below:

- TiO_2 concentrations up to ~ 3.5 wt% were retained in DWPF type glasses, where retention is defined as the absence of crystalline TiO_2 (i.e., unreacted or undissolved) in the as-fabricated glasses. Although this TiO_2 content does not bound the projected SWPF high output flowsheet (up to 6 wt% TiO_2 may be required in glass), these data demonstrate the potential for increasing the TiO_2 limit in glass above the current limit of 2 wt% (based strictly on retention or solubility).

- For those study glasses that had very close compositional overlap with the model development and/or model validation ranges of the current DWPF T_L model (except TiO_2 and MgO concentrations), there was very little difference in the predicted and measured T_L values. Even though the TiO_2 concentrations were above the 2 wt% upper limit, the results indicate that the current T_L model is applicable in this compositional region with TiO_2 contents up to approximately 3.5 wt%.

- As the target glass compositions diverge from the model development and validation ranges, the T_L data suggest that the model under-predicted the measured values. These discrepancies imply that there are individual oxides or oxide combinations that need to be accounted for in the model. These oxides include B_2O_3, SiO_2, MnO, TiO_2 and/or their combinations.

    - More data would be required to fill in these anticipated DWPF compositional regions for higher WL glasses so that the model coefficients could be refit to account for these differences.

- Based on PCT response of HWL-21 and HWL-22 (two glasses that were prone to nepheline formation) it appears that increasing the B_2O_3 concentration in glass does not consistently suppress the formation of nepheline in glasses with higher Al_2O_3 and/or Na_2O content. Although the chemical durabilities of the quenched versions of these glasses were very acceptable, the canister centerline cooled (ccc) glasses exhibited a considerable decrease in durability and were found to contain nepheline via XRD. In fact, one of the glasses had a release that was 5 times greater than that of the Environmental Assessment (EA) benchmark glass.
    - These results suggest a need for a more fundamental understanding of the compositional and kinetic effects of nepheline formation in high WL glasses.

- Data have been generated in support of the replacement of the homogeneity constraint with the Al_2O_3 and/or sum of alkali constraints for coupled operations as previously completed for sludge-only operations. This strategy should be pursued for either the compositional region anticipated for coupled operations or as part of the variability study for each sludge batch. The PCT responses of the study glasses suggest a high probability that this strategy could be defended at some later date.

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LIST OF ABBREVIATIONS

ARM	Approved Reference Material
ccc	Canister Centerline Cooled
CPC	Chemical Processing Cell
DOE	Department of Energy
DWPF	Defense Waste Processing Facility
EA	Environmental Assessment
HLW	High Level Waste
HWL	High Waste Loading
ICP-AES	Inductively Coupled Plasma – Atomic Energy Spectroscopy
LM	Lithium Metaborate
MAR	Measurement Acceptability Region
MST	Monosodium Titanate
NBS	National Bureau of Standards
NL	Normalized Leachate
PCCS	Product Composition Control System
PCT	Product Consistency Test
PF	Peroxide Fusion
PNNL	Pacific Northwest National Laboratory
PSAL	Process Science Analytical Laboratory
RMSE	Root Mean Squared Error
SB	Sludge Batch
SME	Slurry Mix Evaporptor
SMR	Sludge Mass Reduction
SRNL	Savannah River National Laboratory
SRS	Savannah River Site
SWPF	Salt Waste Processing Facility
T_L	Liquidus Temperature
WL	Waste Loading
WTP	Waste Treatment Plant
XRD	X-ray Diffraction

1.0 Introduction

High-level waste (HLW) throughput (i.e., the amount of waste processed per unit time) is a function of several parameters, two of which are extremely critical: waste loading (WL) and melt rate. For the Waste Treatment and Immobilization Plant (WTP) at the Hanford Site and the Defense Waste Processing Facility (DWPF) at the Savannah River Site (SRS), increasing HLW throughput would significantly reduce the overall mission life cycle costs for the Department of Energy (DOE).

Significant increases in waste throughput have been achieved at DWPF for Sludge Batch 3 (SB3) and Sludge Batch 4 (SB4). Key technical and operational initiatives that supported increased waste throughput included improvements in facility attainment, the Chemical Processing Cell (CPC) flowsheet, process control models and frit formulations.[1,2] As a result of these key initiatives, DWPF increased WLs from a nominal 28% for Sludge Batch 2 (SB2) to ~38% for SB3 while maintaining or slightly improving canister fill times. Although considerable improvements in waste throughput were obtained, the process control models allowed DWPF to target even higher WLs (i.e., 40% and greater), implying that additional improvement in waste throughput could be achieved. Actual facility data have shown that melt rate is significantly reduced at higher WLs, thus adversely impacting waste throughput. Based on these trends, DWPF has elected to target an intermediate waste loading to optimize waste throughput.

The historical trends observed at DWPF among melt rate and waste throughput as a function of WL are conceptually shown in Figure 1. The shaded gray area highlights the WL interval that is allowed by the current process control model, but is not accessed due to the decrease in melt rate.

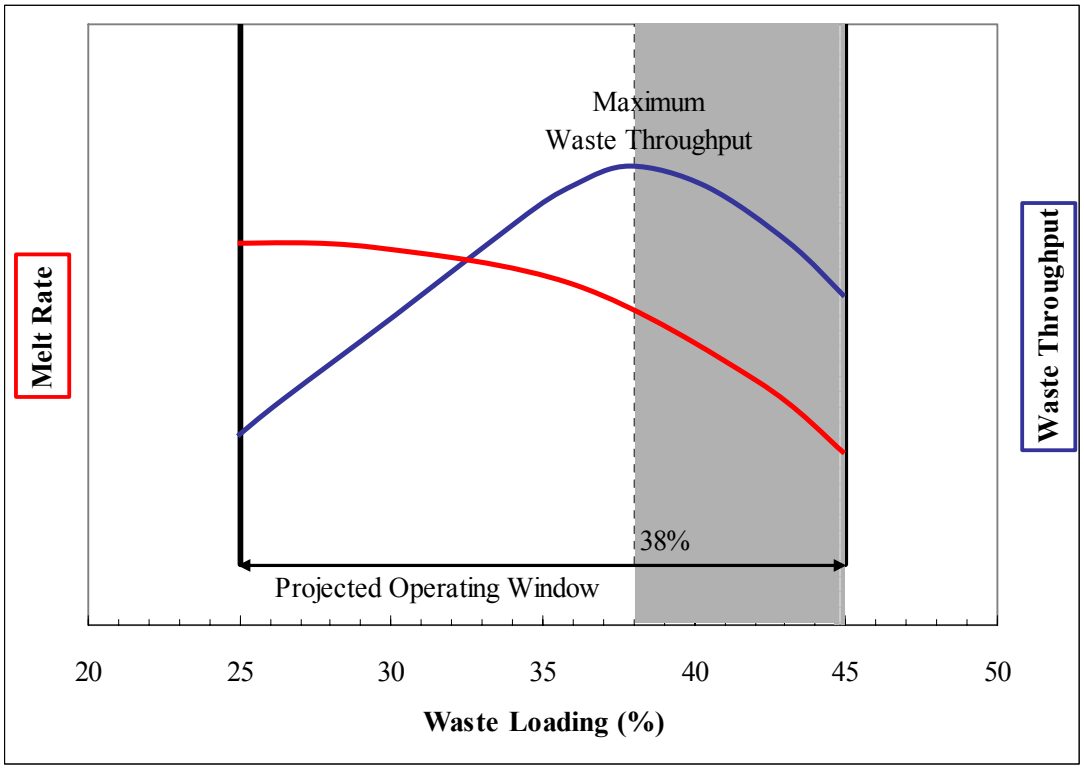

Figure 1. General trend between melt rate and waste throughput as a function of waste loading.

As discussed in WSRC-STI-20076-00652, there are alternative strategies that could allow DWPF to achieve higher WLs (45-55%), while minimizing or eliminating the negative impacts on melt rate.[3] For example, implementation of a forced convection system into the DWPF melter could essentially lessen or even eliminate the dependence of melt rate on WL, resulting in higher waste throughputs (assuming that the CPC unit operations could maintain feed to the melter). WL targets at DWPF could then be limited by current process control model predictions rather than melt rate or waste throughput. In this scenario, there would be a need to identify any conservatism in the current process control models and/or generate data in new compositional regions over which the current models were not formally developed.

Brown et al. summarized the compositional region over which the current DWPF liquidus temperature (T_L) model was developed.[1] Table 1 provides the minimum and maximum oxide concentrations (wt%) for the model development data.

Table 1. Model Development Ranges for Current DWPF T_L Model (wt%)

Oxide	Minimum	Maximum
Al_2O_3	0.9900	14.1620
B_2O_3	4.8930	12.6520
CaO	0.3053	2.0070
Cr_2O_3	0.0000	0.3008
Fe_2O_3	3.4520	17.6000
K_2O	0.0000	3.8846
Li_2O	2.4901	6.1576
MgO	0.4700	2.6502
MnO	0.7392	3.2500
Na_2O	5.9890	14.9010
NiO	0.0379	3.0450
SiO_2	41.7950	58.2300
TiO_2	0.0000	1.8549
U_3O_8	0.0000	5.1378
ZrO_2	0.0000	0.9700

Data from the Pacific Northwest National Laboratory (PNNL) was also used to validate the DWPF T_L model over a broader compositional region.[1] The validation process resulted in the following statements:

> It is surprising that the model in Equation 16 adequately describes these PNNL glasses as these describe a much larger composition space than that expected for DWPF glasses (and covered by the model data). It is not surprising that as the concentrations of Cr_2O_3 and ZrO_2 increase above the maximum from those in model data or the Fe_2O_3 concentration falls below the minimum from the model data that large prediction biases appear. However, the above data do appear to indicate that the basic liquidus temperature response has been captured by the proposed model. That is, the proposed model, despite being semi-empirical, appears to describe adequately glasses whose compositions far exceed the model presented in Table IX[a] (which cover the expected DWPF ranges).

[a] Table IX in the report by Brown et al. is the same as Table 1 of this report.

The compositional ranges of the PNNL glasses used for validation are summarized in Table 2.[b]

Table 2. Model Validation Ranges for Current DWPF T_L Model

Oxide	Minimum	Maximum
Al_2O_3	0.0000	16.3740
B_2O_3	0.0000	19.9960
CaO	0.0000	5.0030
Cr_2O_3	0.0000	1.2000
Fe_2O_3	4.9910	22.9920
K_2O	0.0000	4.0020
Li_2O	0.0000	7.4990
MgO	0.0000	6.0200
MnO	0.0000	4.0000
Na_2O	4.9960	22.737
NiO	0.0000	3.0050
SiO_2	29.9790	60.0000
TiO_2	0.0000	5.0030
U_3O_8	0.0000	5.5900
ZrO_2	0.0000	8.0000

Although validated through the use of existing PNNL data, it is possible that there are compositional gaps (beyond the model *development* ranges) over which the current model has not been validated. These compositional gaps may be a result of several factors:

- Combinations of oxides not covered by the validation data
- Higher waste loadings that increase specific oxide concentrations above those of the validation data
  - e.g., Fe_2O_3, MnO, Cr_2O_3, NiO, all of which can have a significant impact on T_L
- Increased TiO_2 concentrations due to the addition of the Monosodium Titanate (MST) stream that is used to remove actinides from the salt waste stream
- Increased Al_2O_3 concentrations as higher Al-based waste streams are considered

As a specific example, projections of future sludge batches suggest that the TiO_2 concentrations in glass after the addition of the MST stream could be on the order of 5-6 wt% based on Salt Waste Processing Facility (SWPF) high output operations. The current T_L model was developed using glasses containing a maximum of approximately 2 wt% TiO_2 (1.8549 wt% in Table 1) and has been validated with certain compositions up to 5 wt%; however, the glasses used for validation may not necessarily cover the anticipated DWPF glass region of interest. Thus, additional data are needed to assess the applicability of the current T_L model at higher TiO_2 concentrations. Additional T_L data could extend the compositional region over which the current T_L model is applicable and identify compositional regions outside of the model development region in which the current T_L model is not applicable. In this case the new data could be used to adjust the empirically-estimated coefficients by refitting the model if necessary.

[b] Table 2 is the same as Table XIV in the Brown et al. report.

Another example of a potential mismatch between the compositional region over which models were developed and future DWPF operations is based on the intent of DOE to accelerate the cleanup mission by targeting higher WL glasses (45-55%). As previously mentioned, future sludge compositions and higher WLs may increase the concentration of some of the sludge components (e.g., Fe_2O_3, MnO, Cr_2O_3, NiO, and/or Al_2O_3 etc.) in glass above the maximum values over which the model was developed and/or lead to compositional combinations that extend beyond the validation ranges of the current T_L model. Again, data in these new compositional regions would be used to determine if the current T_L model is applicable (extending the model validation range) or if adjustments to the model coefficients are necessary.

A test matrix of 28 glass compositions was developed to provide insight into these issues. The glasses were fabricated and characterized using chemical composition analysis, X-ray Diffraction (XRD), liquidus temperature (T_L) measurement and the Product Consistency Test (PCT).

2.0 Objectives

The objective of this study was to generate supplemental validation data that could be used to determine the applicability of the current DWPF T_L model to expanded DWPF glass regions of interest based on higher WLs. Two specific flowsheets were used in this study to provide such insight:

(1) Higher WL glasses (45 and 50%) based on future sludge batches that have (and have not) undergone the Al-dissolution process.

(2) Coupled operations[c] supported by SWPF, which increase the TiO_2 concentration in glass to greater than 2 wt%.

Glasses were also selected to address technical issues associated with Al_2O_3 solubility, nepheline formation, and homogeneity issues for coupled operations.

3.0 Experimental Procedure

3.1 Target Glass Compositions

Target glass compositions are presented in Tables 3-5. The first set of glasses (HWL-01 through HWL-22) is comprised of the non-radioactive glasses designed to evaluate Al-dissolution, coupled operations and nepheline formation issues. The second set of glasses (HWL-23 through HWL-28) is radioactive and is focused on the homogeneity constraint.[d] These test matrix glasses were based on five different sludge compositions.[4-6] The terminologies used for sludge types are defined as follows:

[c] The coupled operations flowsheet refers to the introduction of the MST stream (high in TiO_2) to DWPF from SWPF, which is a result of cesium and actinide separation from the salt/supernate waste. This removal process limits the transuranic concentrations in the Saltstone low activity vaults.

[d] As discussed in WSRC-STI-2007-00652, the non-radioactive counterparts of these glasses do not challenge the homogeneity constraints, thus the radioactive version of each glass was prepared and characterized.

1. Cluster 2 avg[e] - representing, in general, future sludge batches without Al-dissolution[4,5]
2. Cluster 4 avg[f] - representing, in general, future sludge batches with Al-dissolution[4,5]
3. MSP-001/SB8 - Coupled operations using the SB8 projection[6]
4. MSP-001/SB9 - Coupled operations using the SB9 projection[6]
5. WOALD-SB19 - SB19 projection that has the highest Al_2O_3 content (without Al-dissolution)[5]

3.1.1 Summary of Glass Selection Strategy

A detailed explanation of the glass selection strategy can be found in WSRC-STI-2007-00652.[3] Only a summary will be provided in this section. Note that the frits selected for these glasses may not be optimized and the final glass compositional regions may be different once implemented in DWPF.

HWL-01 through HWL-08 are based on the average of future sludge batches both with and without Al-dissolution. These glasses target WLs of 45 and 50% when combined with a specific frit and would be processable in the current DWPF melter, with the exception of T_L predictions. That is, the selected glasses pass current Product Composition Control System (PCCS) Measurement Acceptability Region (MAR) criteria with the exception of T_L. This series of glasses provides insight into the applicability of the current T_L model at high WLs for flowsheets with and without Al-dissolution.

HWL-09 through HWL-20 are focused on the coupled operations flowsheet for SB8 and SB9. The TiO_2 content of each of these glasses exceeds the current DWPF PCCS limit (2 wt% in glass) even at WLs as low as 32%. Fabrication and characterization of these glasses also provide insight into TiO_2 retention[f] as well as the applicability of the current T_L model to this specific compositional region. The impact of higher TiO_2 contents on durability will also be assessed. In addition to failing the current TiO_2 limit, two glasses (HLW-11 and HWL-17) also fail the T_L MAR criterion of the DWPF PCCS.

HWL-21 and HWL-22 are based on recent SB19 projections that contain ~35 wt% Al_2O_3 (currently the highest Al_2O_3 content projected for future sludge batches at DWPF). Previous data suggest that glasses with as much as 26 wt% Al_2O_3 could be fabricated without the formation of nepheline (after slow cooling) by adding B_2O_3 at high concentrations.[7] The current study glasses target 50% and 55% WL and only fail the nepheline discriminator MAR criterion. These glasses will provide insight into the ability to target higher WLs while minimizing the formation of nepheline through increased B_2O_3 concentration in glass.

HWL-23 through HWL-28 are the radioactive versions of select glasses of the HWL-09 through HWL-20 series, which fail the homogeneity constraint and associated low frit constraints. The data from these glasses will be used to determine if the homogeneity and associated low frit constraint can be ignored for coupled operations for those respective glass forming systems. It should be noted that the non-radioactive counterparts of these glasses do not challenge these constraints.

[e] Newell et al. developed two average sludge compositions based on the fourteen sludge batches without Al-dissolution and twelve sludge batches with Al-dissolution identified as input for the Sludge Mass Reduction (SMR) task. See WSRC-STI-2007-00504 and WSRC-STI-2007-00688 for more details.
[f] Retention is defined as the absence of crystalline TiO_2 (undissolved or unreacted) in the as-fabricated glasses.

Table 3. Non-Radioactive Compositions (wt%) of Test Matrix 2 Glasses

Sludge	Cluster 2 avg				Cluster 4 avg				MSP-001 / SB8		
Frit	B-14;Li-9;Na-1;Si-76		B-18;Li-8;Na-1;Si-73		B-14;Li-9;Na-1;Si-76		B-9;Li-9;Na-4;Si-78		B-18;Li-8;Na-1;Si-73		
WL (%)	45	50	45	50	45	50	45	50	35	40	45
Glass ID	HWL-01	HWL-02	HWL-03	HWL-04	HWL-05	HWL-06	HWL-07	HWL-08	HWL-09	HWL-10	HWL-11
Al_2O_3	10.80	12.06	10.80	12.06	6.82	7.61	6.82	7.61	4.50	5.16	5.82
B_2O_3	8.00	7.31	10.29	9.40	7.99	7.29	5.13	4.69	11.92	11.03	10.14
BaO	0.10	0.11	0.10	0.11	0.12	0.13	0.12	0.13	0.08	0.09	0.10
CaO	1.23	1.37	1.23	1.37	1.52	1.70	1.52	1.70	0.87	1.00	1.13
Ce_2O_3	0.26	0.29	0.26	0.29	0.27	0.30	0.27	0.30	0.19	0.21	0.24
Cr_2O_3	0.12	0.14	0.12	0.14	0.16	0.18	0.16	0.18	0.10	0.11	0.13
CuO	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.03	0.03	0.04
Fe_2O_3	14.41	16.08	14.41	16.08	16.41	18.31	16.41	18.31	10.40	11.92	13.44
K_2O	0.09	0.10	0.09	0.10	0.11	0.12	0.11	0.12	0.06	0.07	0.08
La_2O_3	0.09	0.10	0.09	0.10	0.10	0.11	0.10	0.11	0.07	0.08	0.09
Li_2O	5.15	4.70	4.57	4.18	5.13	4.69	5.13	4.69	5.30	4.90	4.51
MgO	0.19	0.21	0.19	0.21	0.22	0.24	0.22	0.24	0.14	0.16	0.18
MnO	1.87	2.09	1.87	2.09	2.41	2.69	2.41	2.69	3.36	3.85	4.34
Na_2O	10.04	11.09	10.04	11.09	10.47	11.56	12.18	13.13	7.96	8.97	9.99
Nb_2O_3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.81	0.93	1.05
NiO	0.54	0.61	0.54	0.61	0.60	0.66	0.60	0.66	0.67	0.77	0.87
PbO	0.11	0.13	0.11	0.13	0.12	0.13	0.12	0.13	0.11	0.13	0.14
SO_4	0.09	0.10	0.09	0.10	0.12	0.13	0.12	0.13	0.00	0.00	0.00
SiO_2	45.02	41.42	43.30	39.86	45.73	42.23	46.87	43.27	50.29	46.97	43.64
TiO_2	1.54	1.72	1.54	1.72	1.29	1.44	1.29	1.44	2.34	2.69	3.03
ZnO	0.06	0.07	0.06	0.07	0.08	0.08	0.08	0.08	0.04	0.04	0.05
ZrO_2	0.24	0.26	0.24	0.26	0.29	0.32	0.29	0.32	0.77	0.89	1.00
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table 4. Non-radioactive Compositions (wt%) of Test Matrix 2 Glasses

Sludge	MSP-001 / SB8			MSP-001 / SB9						WOALD - SB19	
Frit	B-8;Li-8;Na-8;Si-76 (Frit 418)			B-18;Li-6;Na-1;Si-75			B-8;Li-8;Na-8;Si-76 (Frit 418)			B-18;Li-8;Na-1;Si-73	
WL (%)	35	40	45	32	37	42	32	37	42	50	55
Glass ID	HWL-12	HWL-13	HWL-14	HWL-15	HWL-16	HWL-17	HWL-18	HWL-19	HWL-20	HWL-21	HWL-22
Al_2O_3	4.50	5.16	5.82	3.83	4.44	5.05	3.83	4.44	5.05	17.20	18.93
B_2O_3	5.30	4.90	4.51	12.40	11.51	10.62	5.51	5.12	4.72	9.02	8.12
BaO	0.08	0.09	0.10	0.07	0.08	0.09	0.07	0.08	0.09	0.09	0.10
CaO	0.87	1.00	1.13	0.89	1.03	1.17	0.89	1.03	1.17	1.42	1.57
Ce_2O_3	0.19	0.21	0.24	0.23	0.27	0.30	0.23	0.27	0.30	0.10	0.11
Cr_2O_3	0.10	0.11	0.13	0.08	0.10	0.11	0.08	0.10	0.11	0.16	0.18
CuO	0.03	0.03	0.04	0.02	0.03	0.03	0.02	0.03	0.03	0.04	0.05
Fe_2O_3	10.40	11.92	13.44	10.68	12.38	14.08	10.68	12.38	14.08	9.38	10.32
K_2O	0.06	0.07	0.08	0.05	0.06	0.07	0.05	0.06	0.07	0.11	0.12
La_2O_3	0.07	0.08	0.09	0.08	0.09	0.10	0.08	0.09	0.10	0.05	0.06
Li_2O	5.30	4.90	4.51	4.13	3.84	3.54	5.51	5.12	4.72	4.01	3.61
MgO	0.14	0.16	0.18	0.15	0.17	0.19	0.15	0.17	0.19	0.19	0.21
MnO	3.36	3.85	4.34	2.31	2.67	3.04	2.31	2.67	3.04	0.90	0.99
Na_2O	12.59	13.26	13.94	7.52	8.55	9.59	12.34	13.03	13.72	14.47	15.82
Nb_2O_3	0.81	0.93	1.05	0.54	0.62	0.71	0.54	0.62	0.71	0.00	0.00
NiO	0.67	0.77	0.87	0.31	0.35	0.40	0.31	0.35	0.40	0.16	0.18
PbO	0.11	0.13	0.14	0.12	0.14	0.15	0.12	0.14	0.15	0.04	0.04
SO_4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.09
SiO_2	52.27	48.81	45.33	53.29	49.85	46.39	53.98	50.49	46.98	40.75	37.51
TiO_2	2.34	2.69	3.03	2.70	3.13	3.56	2.70	3.13	3.56	1.55	1.71
ZnO	0.04	0.04	0.05	0.02	0.03	0.03	0.02	0.03	0.03	0.05	0.05
ZrO_2	0.77	0.89	1.00	0.57	0.66	0.75	0.57	0.66	0.75	0.24	0.26
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table 5. Radioactive Compositions (wt%) of Test Matrix 2 Glasses

Sludge	MSP-001 / SB8		MSP-001 / SB9			
Frit	B-18;Li-8;Na-1;Si-73	B-8;Li-8;Na-8;Si-76 (Frit 418)	B-18;Li-6;Na-1;Si-75		B-8;Li-8;Na-8;Si-76 (Frit 418)	
WL (%)	35	35	32	37	32	37
Glass ID	HWL-23	HWL-24	HWL-25	HWL-26	HWL-27	HWL-28
Al_2O_3	4.42	4.42	3.79	4.38	3.79	4.38
B_2O_3	11.70	5.20	12.24	11.34	5.44	5.04
BaO	0.08	0.08	0.07	0.08	0.07	0.08
CaO	0.86	0.86	0.87	1.01	0.87	1.01
Ce_2O_3	0.18	0.18	0.23	0.26	0.23	0.26
Cr_2O_3	0.10	0.10	0.08	0.10	0.08	0.10
CuO	0.03	0.03	0.02	0.03	0.02	0.03
Fe_2O_3	10.21	10.21	10.55	12.19	10.55	12.19
K_2O	0.06	0.06	0.05	0.06	0.05	0.06
La_2O_3	0.07	0.07	0.08	0.09	0.08	0.09
Li_2O	5.20	5.20	4.08	3.78	5.44	5.04
MgO	0.14	0.14	0.15	0.17	0.15	0.17
MnO	3.30	3.30	2.28	2.63	2.28	2.63
Na_2O	7.81	12.36	7.42	8.43	12.18	12.84
Nb_2O_3	0.79	0.79	0.53	0.61	0.53	0.61
NiO	0.66	0.66	0.30	0.35	0.30	0.35
PbO	0.11	0.11	0.12	0.13	0.12	0.13
SO_4	0.00	0.00	0.00	0.00	0.00	0.00
SiO_2	49.35	51.30	52.61	49.11	53.29	49.74
ThO_2	0.96	0.96	0.85	0.99	0.85	0.99
TiO_2	2.30	2.30	2.67	3.09	2.67	3.09
U_3O_8	0.90	0.90	0.43	0.49	0.43	0.49
ZnO	0.04	0.04	0.02	0.03	0.02	0.03
ZrO_2	0.76	0.76	0.56	0.65	0.56	0.65
Total	100.00	100.00	100.00	100.00	100.00	100.00

3.2 Glass Fabrication

Each glass was prepared from the proper proportions of reagent-grade metal oxides, carbonates, H_3BO_3, and salts in 300 g batches.[8] The raw materials were thoroughly mixed and placed into a platinum alloy crucible. Batched materials were placed into a high-temperature furnace at the target melt temperature.[9] Specific melting conditions of the HWL-01 through HWL-22 glasses are listed in Table 6; HWL-23 through HWL-28 were melted at 1150°C for 1 hour. The molten glass was quenched by pouring the liquid onto a clean, stainless steel plate for all samples except for the third melt of HWL-02 and the second melt of HWL-04. The molten glass of these two samples was poured directly into an ice bath.[g] The glass pour patties were used as a sampling stock for the various property measurements (i.e., chemical composition, durability testing and XRD).[h]

Approximately 25 g of each glass was heat-treated to simulate cooling along the centerline of a DWPF-type canister to gauge the effects of thermal history on product performance.[10] This cooling schedule is referred to as the canister centerline cooling (ccc) curve.

Table 6. Melting Conditions of HWL-01 Through HWL-22

Sample	First Melt	Second Melt	Third Melt
HWL-01	1150°C, 1 hour	1200°C, 1 hour	
HWL-02			1200°C, 1 hour*
HWL-03			
HWL-04	1200°C, 1 hour	1200°C, 1 hour*	
HWL-05			
HWL-06			
HWL-07			
HWL-08			
HWL-09	1150°C, 1 hour		
HWL-10			
HWL-11			
HWL-12			
HWL-13			
HWL-14			
HWL-15			
HWL-16			
HWL-17			
HWL-18			
HWL-19			
HWL-20			
HWL-21			
HWL-22			

[g] The first melt of HWL-02 and HWL-04 resulted in the formation of crystals, which could result in inaccurate measurements of liquidus temperature and viscosity. HWL-02 was then melted at 1200°C in an attempt to avoid crystallization; however, crystals still formed. An ice bath was used in the third attempt (second attempt for HWL-04) to achieve a faster cooling rate than pouring the glass onto the steel plate.

[h] It should be noted that HWL-02 and HWL-04 consisted of glass fragments rather than a patty since the molten glass was poured directly into the ice bath.

3.3 Property Measurements

3.3.1 Chemical Composition

To confirm that the as-fabricated glasses met the target compositions, a representative sample from each glass was submitted to the Savannah River National Laboratory (SRNL) Process Science Analytical Laboratory (PSAL) for chemical analysis under the auspices of two analytical plans: SRNL-SCS-2007-00060 for the non-radioactive glasses (HWL-01 through HWL-22) and SRNL-SCS-2008-00003 for the glasses containing uranium and thorium (HWL-23 through HWL-28).[11,12] Two dissolution techniques were utilized by PSAL, sodium peroxide fusion (PF) and lithium metaborate fusion (LM). Each glass was prepared in duplicate for each cation dissolution technique (PF and LM). All of the prepared samples were analyzed (twice for each element of interest) by Inductively Coupled Plasma-Atomic Emission Spectroscopy (ICP-AES) with the instrumentation being re-calibrated between the duplicate analyses. Each analytical plan was developed in such a way as to provide the opportunity to evaluate potential sources of bias and error. Glass standards were also intermittently measured to assess the performance of the ICP-AES instrument over the course of these analyses.

The elemental concentrations were converted to oxide concentrations by multiplying the values for each element by the gravimetric factor for the corresponding oxide. During this process, an elemental concentration that was determined to be below the detection limit of the analytical procedures used by the PSAL was reduced to half of that detection limit as the oxide concentration was determined.

3.3.2 Product Consistency Test (PCT)

The PCT was performed in triplicate on each quenched and ccc glass to assess chemical durability using Method A of the PCT procedure (ASTM C1285-02 (2008).[13] Also included in the experimental test matrix was the Environmental Assessment (EA) glass, the Approved Reference Material (ARM) glass, and blanks from the sample cleaning batch.[14] Samples were ground, washed, and prepared according to the standard procedure.[15] The resulting solutions were sampled (filtered and acidified) and analyzed by PSAL under the auspices of two analytical plans: SRNL-SCS-2007-00061 for the non-radioactive samples and SRNL-SCS-2008-00005 for those samples containing uranium and thorium.[16,17] Samples of a multi-element, standard solution were also included in the analytical plan (as a check on the accuracy of the ICP-AES instrument).

PCT leachate concentrations were normalized using the measured cation composition (expressed as a weight percent) in the glass to obtain a grams-per-liter (g/L) leachate concentration. For completeness, the target cation and the measured bias-corrected cation compositions were also used to conduct this normalization.

3.3.3 X-ray Diffraction (XRD)[i]

The amount and type of crystalline phases that formed during the ccc heat treatment on twenty two glass samples were analyzed by powdered XRD according to the PNNL procedures APEL-PAD-V and GDL-XRD.[18,19] Samples were prepared by mixing 5 wt% CaF_2 (internal standard) with approximately 1.5 to 2.5 g of glass. The glass/CaF_2 mixture was milled to a fine powder for 2 minutes in a 10 cm^3 tungsten carbide disc mill. Samples were then loaded in round aluminum XRD sample holders and mounted in the automated 12 stage XRD sample platform. Each XRD scan was processed at a scan rate of 0.04°2θ between 10 and 70°2θ, with a 4 s dwell time. Data were analyzed

[i] XRD patterns of non-radioactive ccc samples were collected and analyzed at PNNL.

with Jade 6.0 Software (MDI, Inc.) for phase identification. Full-pattern Rietveld refinement using Riqas 4 (MDI, Inc.) was performed to quantify the crystalline content of three of the samples that had the highest crystal content.

3.3.4 Liquidus Temperature (T_L)[j]

The T_L and equilibrium crystal fraction as a function of temperature were measured in Pt-alloy crucibles with tight-fitting lids (to avoid volatility) according to PNNL procedure GDL-LQT.[20] The heat treatment times were roughly 24 h or longer to ensure equilibrium was achieved without excessive volatilization. Samples were quenched and analyzed to determine the type and quantity of crystalline phases (semi-quantitative analyses) according to PNNL procedure GDL-XRD.[19] The temperature was varied so that the temperature at 0% crystals could be determined to within 10°C for the T_L. For the equilibrium crystal fraction as a function of temperature, heat treatments were performed for the temperature range from the T_L down to the approximate temperature of maximum crystallization. Notes were taken on the location of crystals within the crucible to distinguish between surface and bulk crystallization.

A National Bureau of Standards (NBS) liquidus temperature standard glass (SRM-773) was used to validate the T_L measurement technique and verify furnace temperatures. Based on the SRM-773 standard measurements (tested in all furnaces used to support the T_L measurements), the T_L values reported for the study glasses are estimated to be within ±5 to 10°C of the actual values. Additional calibrations and/or functional verifications on the multi-channel temperature monitoring devices, thermocouples, and furnaces were also performed.[k]

4.0 Results and Discussion

4.1 Crystallization

4.1.1 Visual Observations

Prior to discussing the visual observations, a brief explanation of the terms used to describe the as-fabricated (quenched) and ccc glasses is necessary. "Surface" refers to the top of the sample that has not touched the steel plate during quenching or the walls of the crucible during the ccc treatment. The term "bulk" refers to the cross-section of the glass sample. Other terms such as "haze", "clusters", and/or "silver/metallic patches" imply that the surface or bulk of the glass contains crystals or some other characteristic feature. "Black and shiny" implies that crystallization is not apparent to the un-aided eye. "Homogeneous" indicates that there is no crystallization evident in the bulk of the glass. A summary of the visual observations of the quenched and ccc glasses is listed in Tables 7-9.

In general, the surfaces of the glasses appeared to be free of crystallization ("black and shiny"); however, there were some exceptions, which include HWL-08, -14 and -18 that contained a small amount of crystallization (silver "haze" and "patches"). In addition, the surfaces of some of the fragments of HWL-02 and HWL-04 appeared to contain crystals due to the matte "chocolate brown" appearance. The bulk of each glass, except HWL-02 and HWL-04, appeared to be homogeneous. Some fragments of HWL-02 and HWL-04 contained the same matte "chocolate brown" appearance

[j] The T_L values of the non-radioactive samples were measured at PNNL. The T_L values of the six radioactive glasses were not measured because the primary objective of these glasses was to assess the homogeneity and associated low frit constraints for coupled operations, which can be evaluated by the PCT response.
[k] A communication from Brian Riley, which discusses the T_L measurement, is included in laboratory notebook WSRC-NB-2003-00050.

of the surface throughout the entire sample. There was no evidence of crystallization on either the surface or in the bulk of any of the radioactive glasses (HWL-22 through HWL-28).

Each of the ccc versions of the glasses contained some degree of crystallization on the surface, except for HWL-18, -25 (radioactive) and -27 (radioactive), which appeared to be "black and shiny." Approximately half of the non-radioactive ccc glasses developed visible crystallization in the bulk. The remainder of the non-radioactive ccc glasses, as well as all of the radioactive glasses (HWL-22 through HWL-28), appeared to be homogenous.

4.1.2 XRD

A summary of the types of crystals present is provided in Table 10 and XRD patterns of the ccc non-radioactive glasses are shown in Figures 2-23. In general, the XRD results correspond well to the visual observations. There were a few cases (HWL-07, -10 and -11) in which crystals were detected by XRD even though a majority of the sample seemed to be homogeneous. Spinels formed in glasses that had a WL of at least 45%, while no crystals were detected in any of the glasses that had a WL of 40% or less (HWL-09, -12, -13 and HWL-15 through HWL-20). Optical microscopy of samples of HWL-12 and HWL-13 confirmed that these samples were amorphous. Isolated spinel crystals were observed in ccc samples of HWL-9, -13 and -15, whereas crystals were found frequently in samples HWL-16, -17, -19 and -20 from sub-micron particles (HWL-17) to >1 mm (HWL-19). Nepheline was detected by XRD in samples HWL-21 and HWL-22; however, this result was to be expected as nepheline was predicted by the PCCS.

Calcium fluorite was mixed with the samples in order to determine the relative crystalline content of the samples. PNNL performed semi-quantitative analysis on three of the samples (HWL-03, -06 and -21). Both HWL-03 and -06 contain approximately 6 wt% crystals, which is similar to the crystalline content of HWL-01, -02 and -04. HWL-21 has by far the highest crystalline content; approximately 35 wt% consisting mostly of nepheline. Examination of some of the other patterns suggests that HWL-05, -07, -10, -11 and -14 contain approximately 0.5-2.0 wt% crystals, and HWL-08 and HWL-22 contain approximately 3-4 wt% crystals after slow cooling.

Table 7. Visual observations of the quenched non-radioactive glasses.

Glass ID	Sludge Type	Visual Observations (quenched)	
		Surface	Bulk
HWL-01	Cluster 2 avg	First melt: Metallic swirls*	NA
		Second melt: Black and shiny	Homogeneous
HWL-02		First melt: Metallic swirls*	NA
		Second melt: Light chocolate brown swirls*	Chocolate brown crystals
		Third melt**: Smaller fragments - black and shiny, larger pieces - chocolate brown	Homogeneous
HWL-03		First melt: Metallic swirls*	NA
		Second melt: Black and shiny	Homogeneous
HWL-04		First melt: Chocolate brown*	Chocolate brown crystals
		Second Melt**: Smaller fragments - black and shiny, larger pieces - chocolate brown	Homogeneous
HWL-05	Cluster 4 avg	Black and shiny	Homogeneous
HWL-06		Black and shiny	Homogeneous
HWL-07		Black and shiny	Homogeneous
HWL-08		Silver haze	Homogeneous
HWL-09	MSP-001/SB8	Black and shiny	Homogeneous
HWL-10		Black and shiny	Homogeneous
HWL-11		Black and shiny	Homogeneous
HWL-12		Black and shiny	Homogeneous
HWL-13		Black and shiny	Homogeneous
HWL-14		Silver haze	Homogeneous
HWL-15	MSP-001/SB9	Black and shiny	Homogeneous
HWL-16		Black and shiny	Homogeneous
HWL-17		Black and shiny	Homogeneous
HWL-18		Black and shiny with a few light silver patches	Homogeneous
HWL-19		Black and shiny	Homogeneous
HWL-20		Black and shiny	Homogeneous
HWL-21	WOALD/SB19	Black and shiny	Homogeneous
HWL-22		Black and shiny	Homogeneous

* First melt contained undissolved solids in the crucible. **Quench in ice bath resulted in fragments rather than patty.

Table 8. Visual observation of the ccc non-radioactive glasses.

Glass ID	Sludge Type	Visual Observations (ccc)	
		Surface	Bulk
HWL-01	Cluster 2 avg	Crystals across entire surface	Crystallized
HWL-02		Metallic/silver layer around entire melt line. Light crystals across rest of surface	Crystallized
HWL-03		Crystals across entire surface	Crystallized
HWL-04		Metallic/silver layer around entire melt line. Light crystals across rest of surface	Crystallized
HWL-05	Cluster 4 avg	Crystals across entire surface	Crystallized
HWL-06		Metallic/silver haze around part of the melt line. Crystals across rest of surface	Crystallized
HWL-07		Crystals across entire surface	Homogeneous
HWL-08		Crystals across entire surface	Crystallized
HWL-09	MSP-001/SB8	Small clusters of crystals	Homogeneous
HWL-10		Small clusters of crystals	Homogeneous
HWL-11		Small clusters of crystals	Homogeneous
HWL-12		Silver haze	Homogeneous
HWL-13		Silver haze	Homogeneous
HWL-14		Dull silver haze	Possibly crystallized
HWL-15	MSP-001/SB9	Small clusters of crystals	Homogeneous
HWL-16		Small clusters of crystals	Homogeneous
HWL-17		Crystals across entire surface	Homogeneous
HWL-18		Black and shiny	Homogeneous
HWL-19		Silver haze	Homogeneous
HWL-20		Dull silver haze	Homogeneous
HWL-21	WOALD-SB19	Haze with a lot of crystal patches	Crystallized (chocolate brown)
HWL-22		Crystallized (dull and matte)	Crystallized

Table 9. Visual observations of the quenched and ccc radioactive glasses.

Glass ID	Sludge Type	Visual Observations (quenched)	
		Surface	Bulk
HWL-23	MSP-001/SB8	Black and shiny	Homogeneous
HWL-24		Black and shiny	Homogeneous
HWL-25	MSP-001/SB9	Black and shiny	Homogeneous
HWL-26		Black and shiny	Homogeneous
HWL-27		Black and shiny	Homogeneous
HWL-28		Black and shiny	Homogeneous

Glass ID	Sludge Type	Visual Observations (ccc)	
		Surface	Bulk
HWL-23	MSP-001/SB8	Light amount of crystals	Homogeneous
HWL-24		Dull crystals	Homogeneous
HWL-25	MSP-001/SB9	Black and shiny	Homogeneous
HWL-26		Small amount of crystals	Homogeneous
HWL-27		Black and shiny	Homogeneous
HWL-28		Cloudy/milky haze	Homogeneous

Table 10. Crystals Detected by XRD

Glass ID	Sludge Type	XRD (ccc)
HWL-01	Cluster 2 avg	Chromite ($FeCr_2O_4$)
HWL-02		Chromite ($FeCr_2O_4$)
HWL-03		Chromite ($FeCr_2O_4$)
HWL-04		Chromite ($FeCr_2O_4$)
HWL-05	Cluster 4 avg	Chromite ($FeCr_2O_4$)
HWL-06		Chromite ($FeCr_2O_4$)
HWL-07		Maghemite (Fe_2O_3)
HWL-08		Chromite ($FeCr_2O_4$)
HWL-09	MSP-001/SB8	No crystals detected
HWL-10		Trevorite ($NiFe_2O_4$)
HWL-11		Chromite ($FeCr_2O_4$)
HWL-12		No crystals detected
HWL-13		No crystals detected
HWL-14		Magnetite (Fe_3O_4)
HWL-15	MSP-001/SB9	No crystals detected
HWL-16		No crystals detected
HWL-17		No crystals detected
HWL-18		No crystals detected
HWL-19		No crystals detected
HWL-20		No crystals detected
HWL-21	WOALD-SB19	Nepheline ($NaAlSiO_4$), Chromite ($FeCr_2O_4$)
HWL-22		Nepheline ($NaAlSiO_4$), Magnesium Iron Oxide ($MgFe_2O_4$)

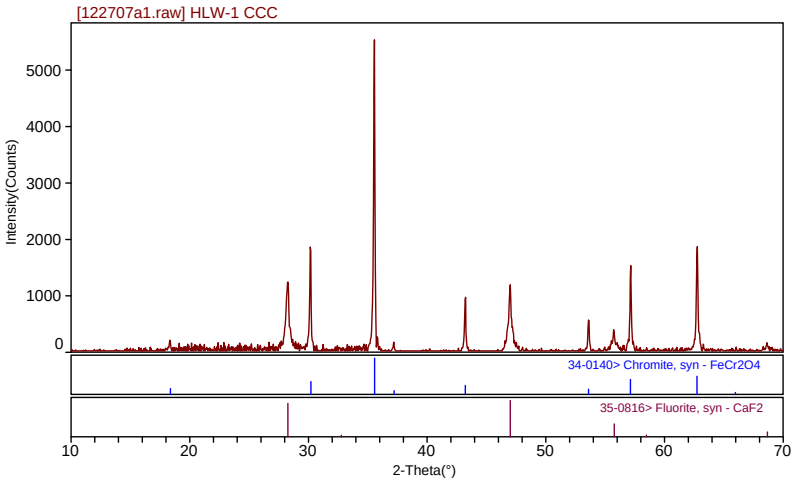

Figure 2. XRD pattern of HWL-01 ccc.

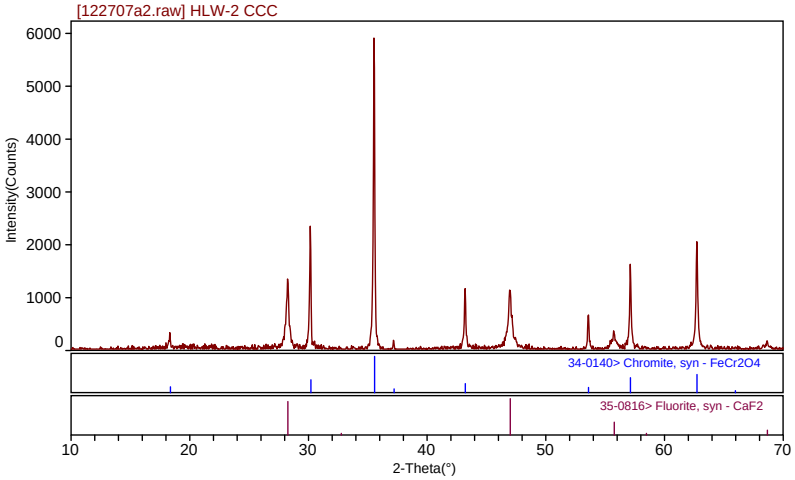

Figure 3. XRD pattern of HWL-02 ccc.

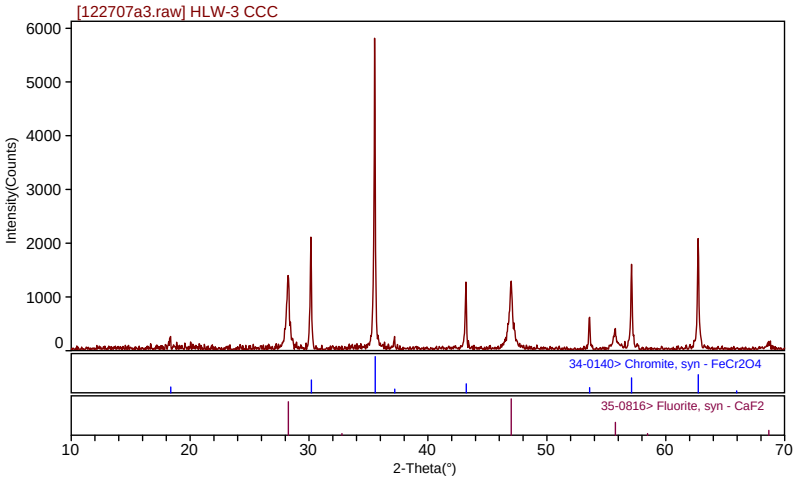

Figure 4. XRD pattern of HWL-03 ccc.

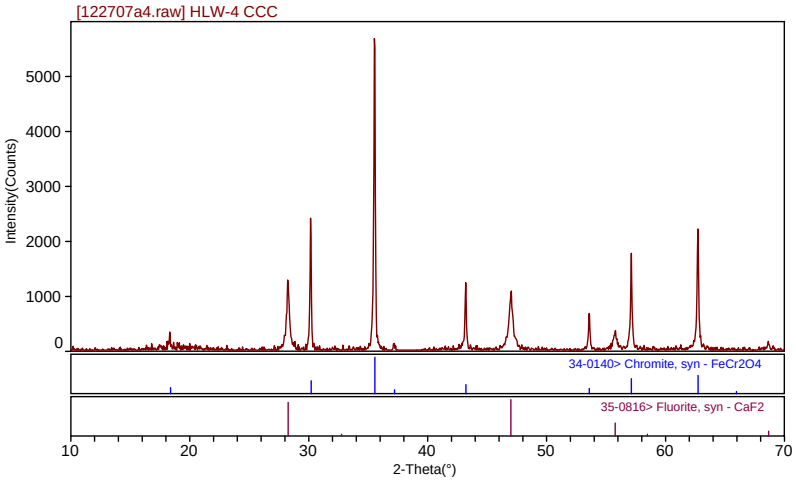

Figure 5. XRD pattern of HWL-04 ccc.

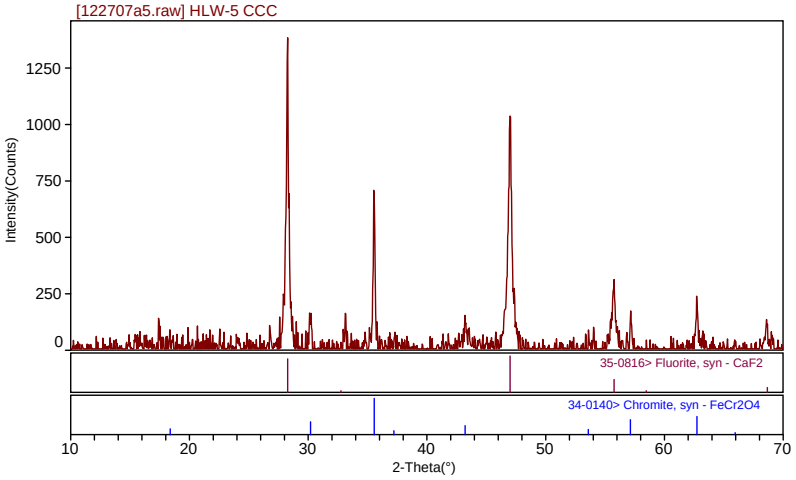

Figure 6. XRD pattern of HWL-05 ccc.

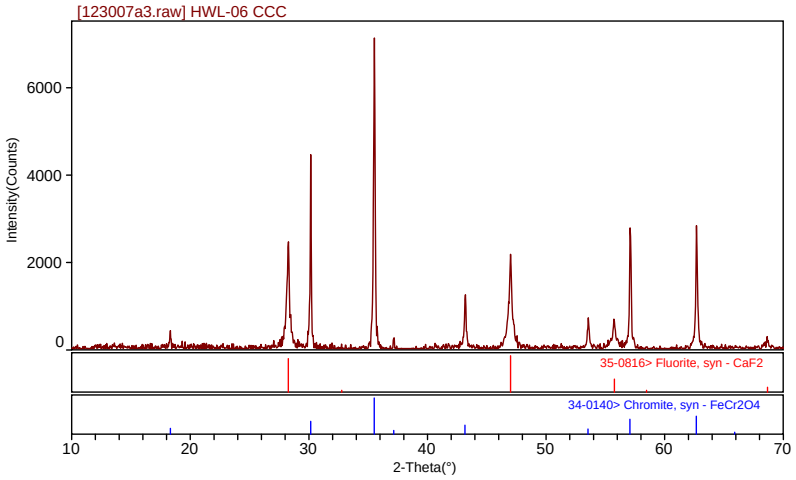

Figure 7. XRD pattern of HWL-06 ccc.

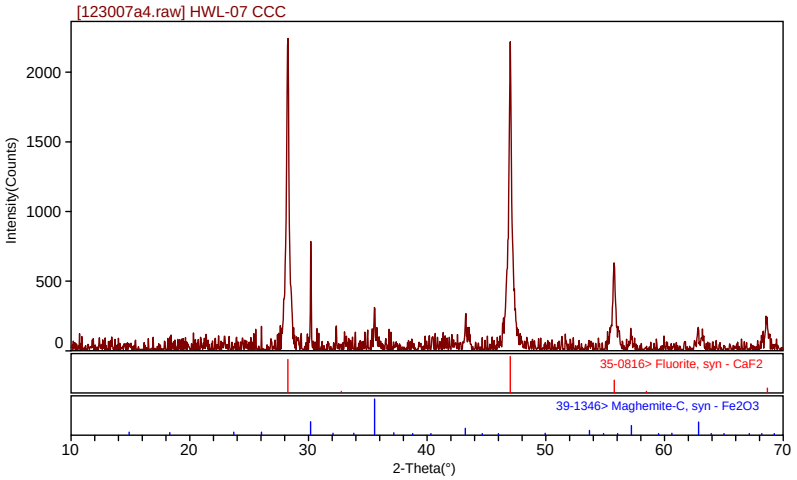

Figure 8. XRD pattern of HWL-07 ccc.

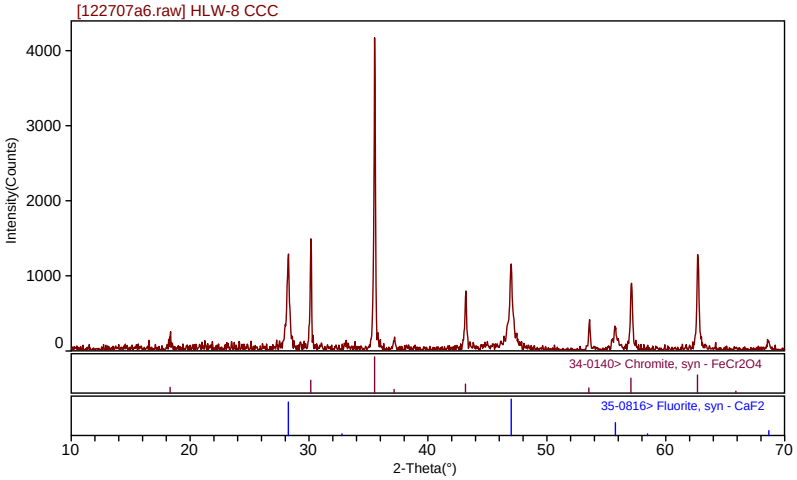

Figure 9. XRD pattern of HWL-08 ccc.

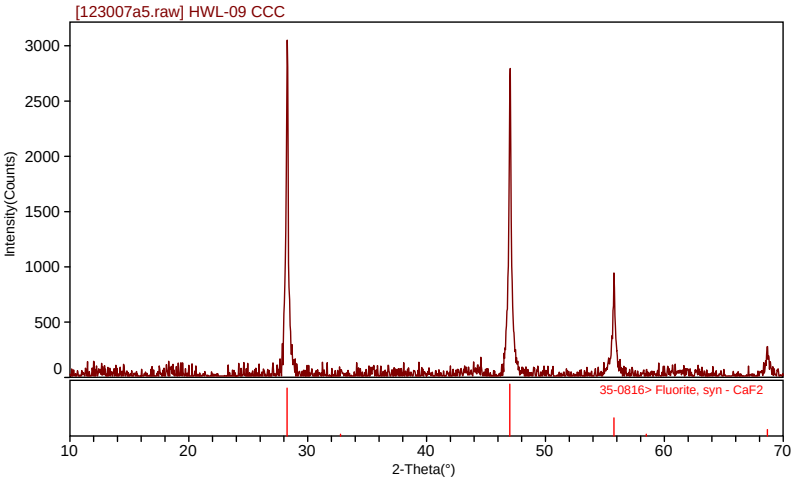

Figure 10. XRD pattern of HWL-09 ccc.

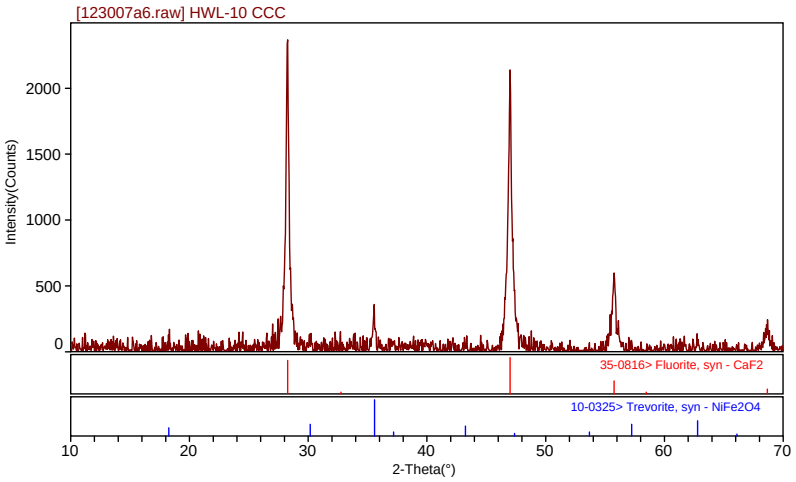

Figure 11. XRD pattern of HWL-10 ccc.

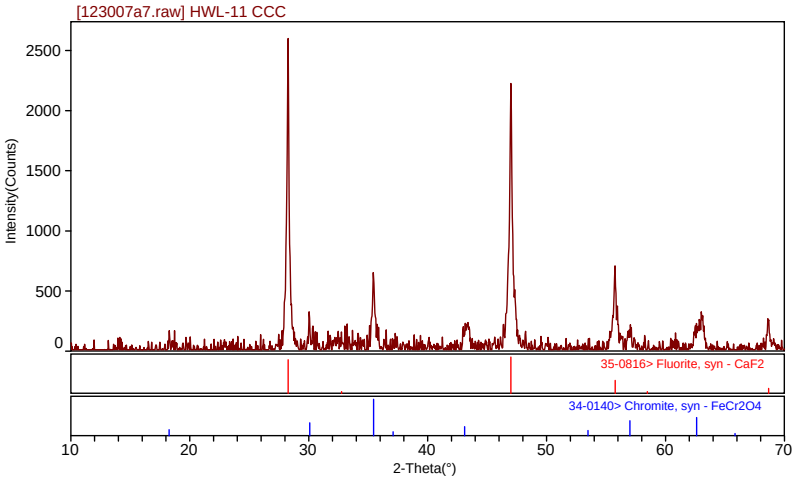

Figure 12. XRD pattern of HWL-11 ccc.

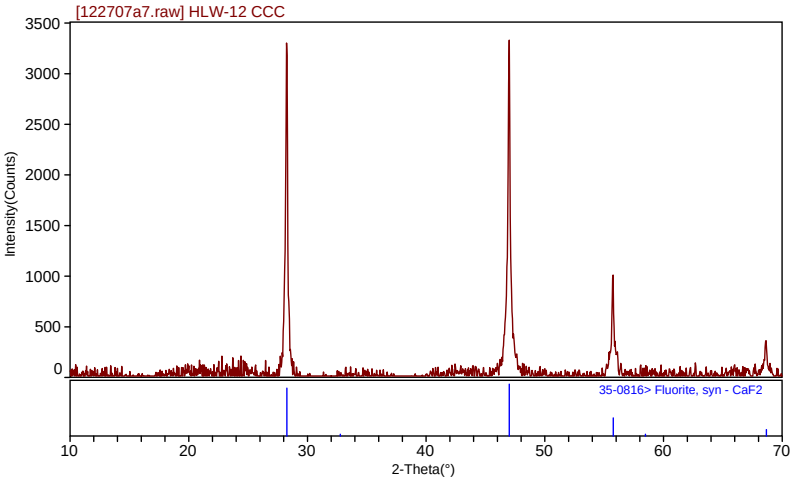

Figure 13. XRD pattern of HWL-12 ccc.

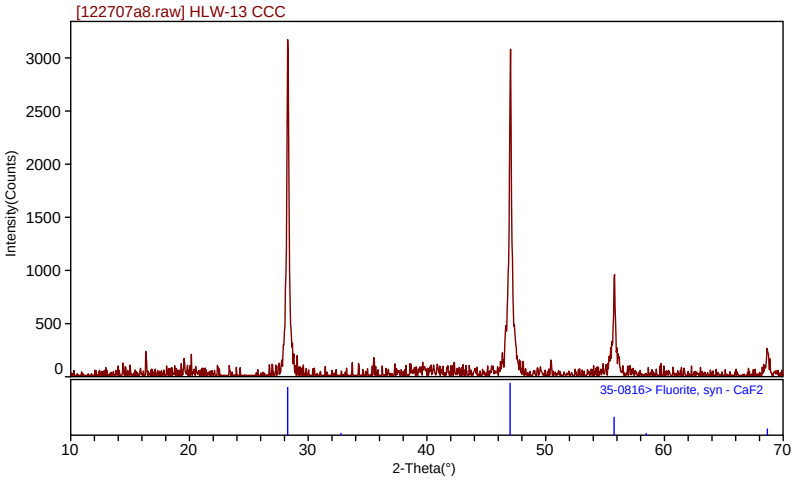

Figure 14. XRD pattern of HWL-13 ccc.

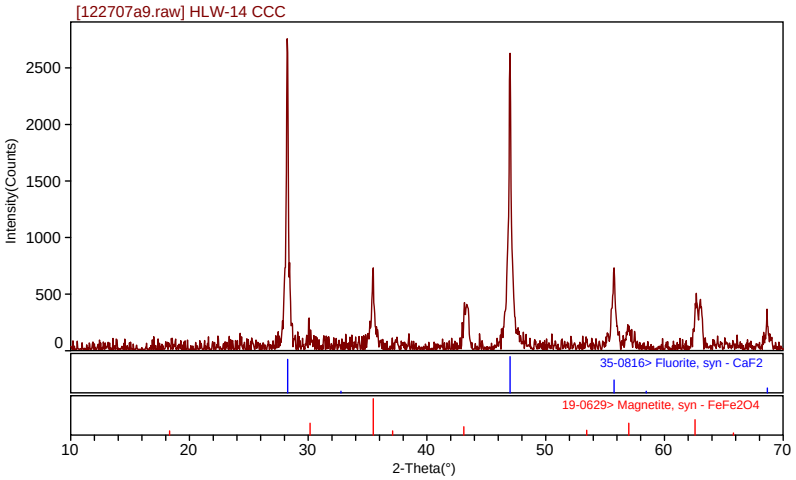

Figure 15. XRD pattern of HWL-14 ccc.

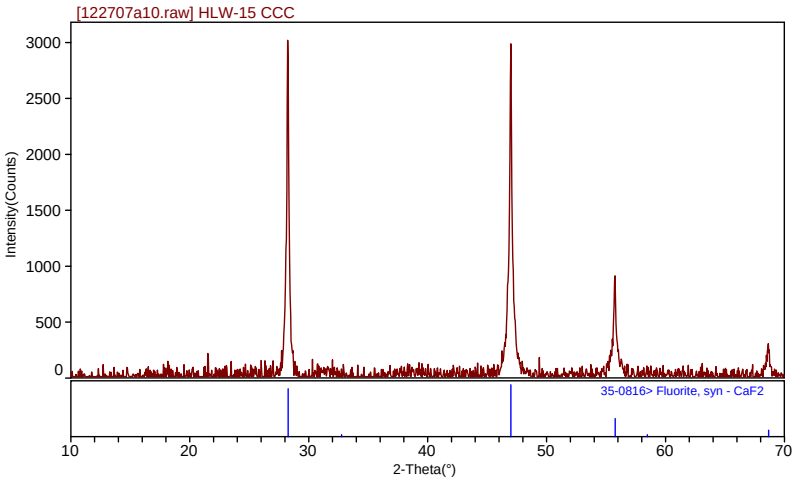

Figure 16. XRD pattern of HWL-15 ccc.

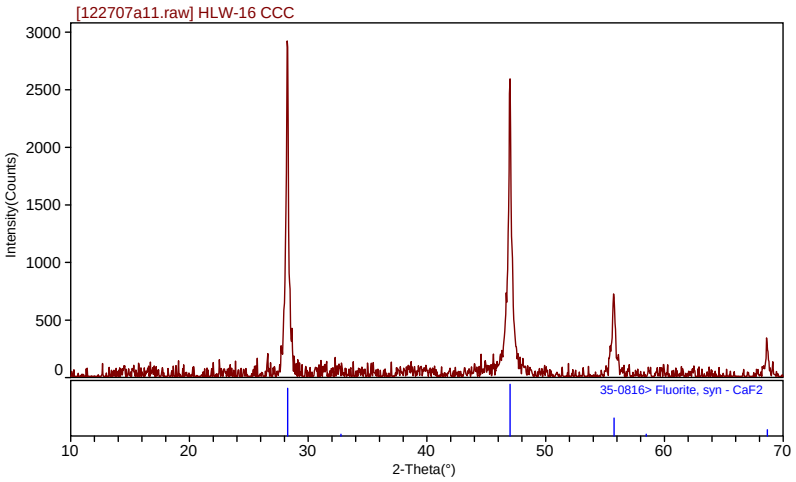

Figure 17. XRD pattern of HWL-16 ccc.

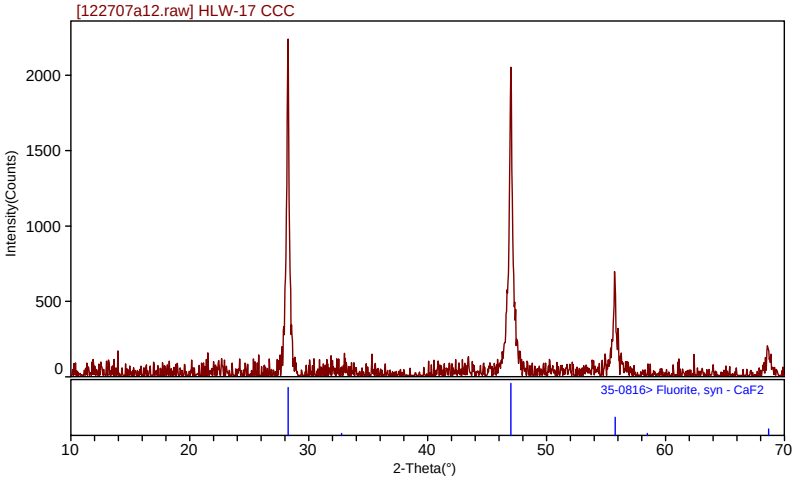

Figure 18. XRD pattern of HWL-17 ccc.

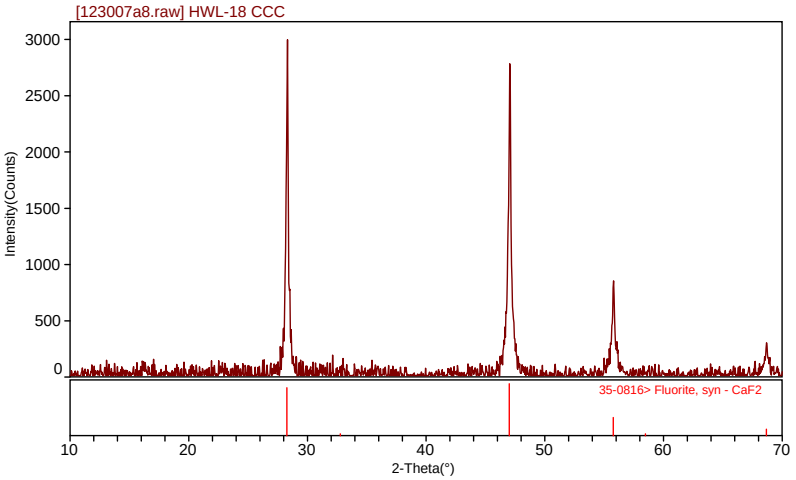

Figure 19. XRD pattern of HWL-18 ccc.

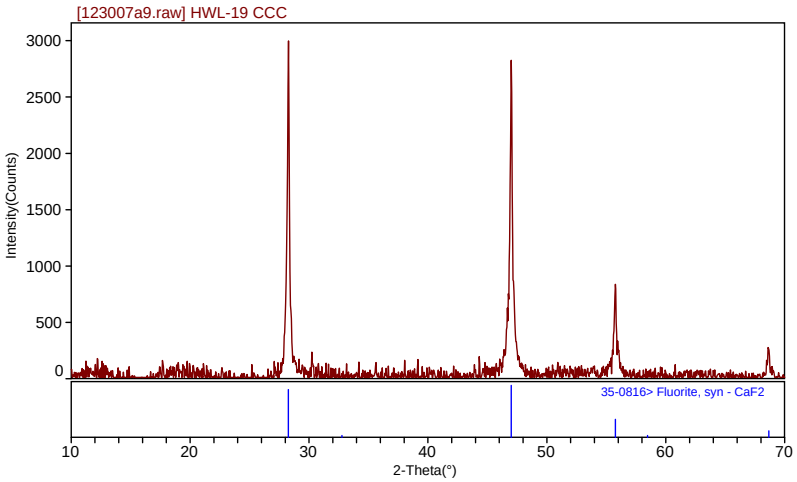

Figure 20. XRD pattern of HWL-19 ccc.

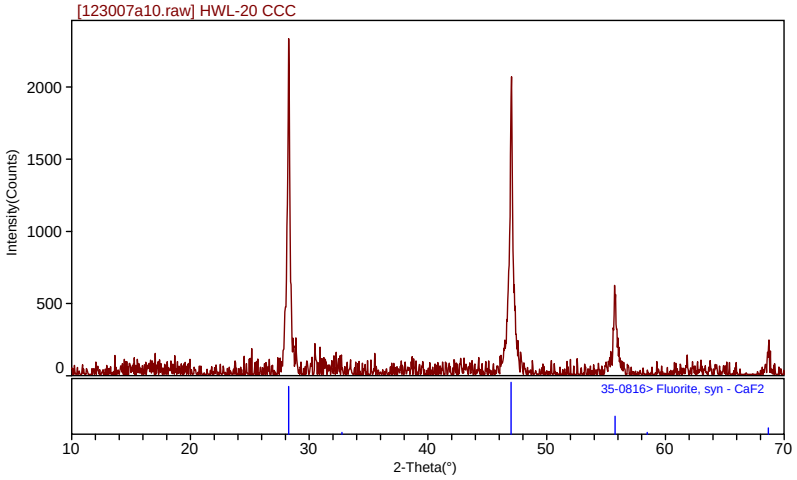

Figure 21. XRD pattern of HWL-20 ccc.

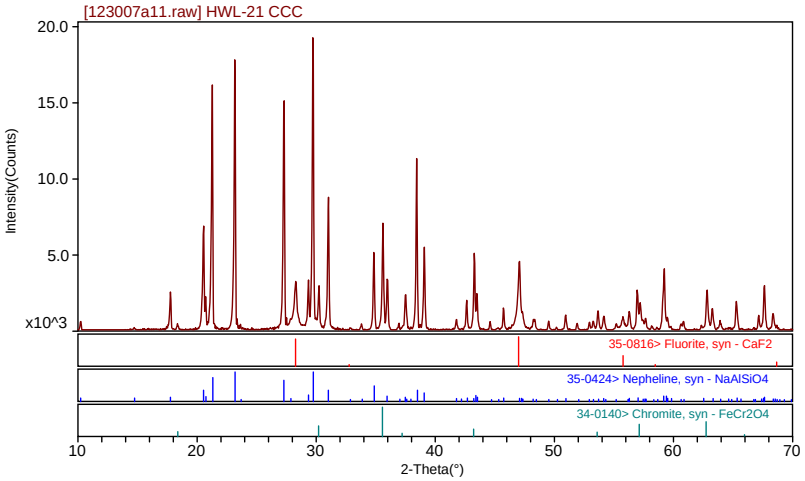

Figure 22. XRD pattern of HWL-21 ccc.

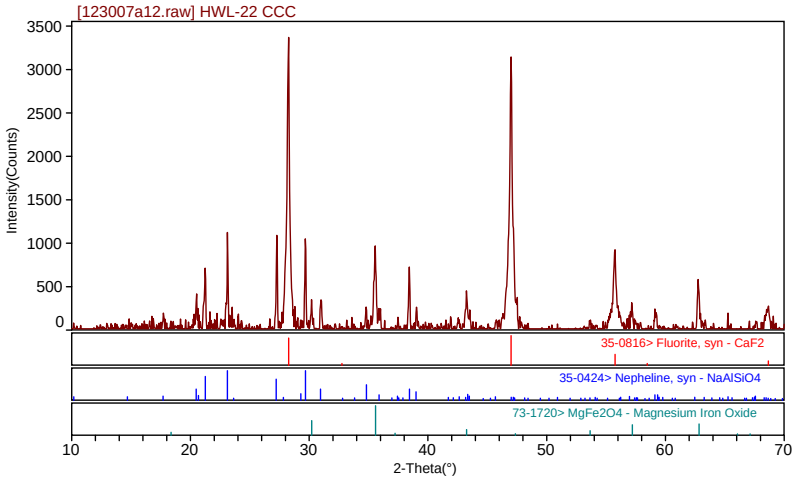

Figure 23. XRD pattern of HWL-22 ccc.

4.2 A Statistical Review of the Chemical Composition Measurements

Table A1 (in two parts) in Appendix A provides the elemental concentration measurements from the glasses *without* uranium and thorium that were prepared using LM and Table A2 in Appendix A provides the measurements from the samples of these glasses prepared using PF. Measurements for samples of the standard (Batch 1) are also provided in these two tables. Table A3 (in two parts) in Appendix A provides the elemental concentration measurements of glasses batched *with* uranium and thorium that were prepared using LM and Table A4 in Appendix A provides the measurements from the samples of these glasses prepared using PF. Measurements for samples of Batch 1 and the uranium standard (U_{std}) glass are also provided in these two tables. In the Set #3 results, the glasses from another study (i.e., glasses SB5-13 through SB5-20 in Tables A3 and A4) are included in these tables given they were run under the same analytical plan, but can be ignored with respect to this study.

4.2.1 Measurements in Analytical Sequence

Figure A1 in Appendix A provides plots of the measurements generated by the PSAL for samples by preparation method (i.e., LM and PF) and analytical set. The plots are in analytical sequence over the three sets of measurements. Different symbols and colors are used to represent each of the study and standard glasses. These plots include all of the measurement data from Tables A1 through A4. While identifying patterns in these plots is difficult, there do not appear to be any obvious patterns or trends in the analytical process over the course of these measurements. A better opportunity for a review of the measurements for each glass is provided in the discussions that follow.

4.2.2 Composition Measurements by Glass Identifier

Figure A2 in Appendix A provides plots of the oxide concentration measurements by Glass ID (including Batch 1) by analytical solution or Lab ID for each analytical set. Different symbols and colors are used to represent the different glasses. These plots contain the individual measurements across the duplicates of each preparation method and the two ICP-AES calibrations for each glass within each analytical set. A review of the plots reveals the repeatability of the four individual values for each oxide for each glass. In general, there appears to be good repeatability of these measurements for each of the oxides with the exception of Fe_2O_3 and SiO_2, which had more variation

among their repeated measurements than most of the other major oxides. Also, note that there was a Lab ID (H11LM12) that was inadvertently duplicated (i.e., it was used to label two sets of measurements) for the glass HWL-11 in the LM results. No problems were caused by any of these observations from Figure A2.

4.2.3 Batch 1 and Uranium Standard Results

Figure A3 in Appendix A provides statistical analyses of the Batch 1 and U_{std} (for Set #3) results by calibration block for each oxide of interest over both preparation methods. Reference values for the oxide concentrations of the standards are given in the header for each set of measurements in the figure. The results include analysis of variance (ANOVA) investigations, which determine if statistically significant differences exist among the means of these groups for each of the oxides for each of the standards. Batch 1 standard results may be summarized as follows: Al_2O_3, BaO, CaO, Ce_2O_3 (probably a detection limit effect), Cr_2O_3, Fe_2O_3, K_2O, Li_2O, MnO, Nb_2O_5 (probably a detection limit effect), NiO, PbO (probably a detection limit effect), SiO_2, and TiO_2 have measurements that indicate a significant ICP-AES calibration effect on the block averages at the 5% significance level. For the U_{std} of Set #3, Al_2O_3, K_2O, Na_2O, Nb_2O_5 (probably a detection limit effect), and U_3O_8 have measurements that indicate a significant ICP-AES calibration effect on the block averages at the 5% significance level.

Some of the results from the statistical analyses provide incentive for adjusting the measurements for the effects of the ICP-AES calibration. Therefore, the oxide measurements of the glasses were bias corrected for the effect of the ICP-AES calibration on each of the analytical blocks and sub-blocks. The average measurement of Batch 1 results for each set/ICP-AES block/sub-block was used to bias correct the Al_2O_3, B_2O_3, BaO, CaO, Cr_2O_3, CuO, Fe_2O_3, Li_2O, MgO, MnO, Na_2O, NiO, SiO_2, and TiO_2. The average measurements for U_{std} for the Set #3/block/sub-block combinations were used to bias correct U_3O_8 only. The Batch 1 results were used to conduct the bias correction as long as the reference value for the oxide concentration in the Batch 1 glass was greater than or equal to 0.1 wt%.

The bias correction was conducted as follows. For each oxide, let $\bar{a}_{ij}$ be the average measurement for the i^{th} oxide at analytical block j for Batch 1 (or U_{std} for uranium), and let t_i be the reference value for the i^{th} oxide for Batch 1 (or for U_{std} if uranium). (The averages and reference values are provided in Figures A3). Let $\bar{c}_{ijk}$ be the average measurement for the i^{th} oxide at analytical block j for the k^{th} glass. The bias adjustment was conducted as follows

$$\bar{c}_{ijk} \bullet \left(1 - \frac{\bar{a}_{ij} - t_i}{\bar{a}_{ij}}\right) = \bar{c}_{ijk} \bullet \frac{t_i}{\bar{a}_{ij}}$$

Bias-corrected measurements are indicated by a "bc" suffix, and such adjustments were performed for all of the oxides of this study except for CdO, Ce_2O_3, La_2O_3, Nb_2O_5, PbO, SO_4, ThO_2, ZnO, and ZrO_2. Both measured and measured "bc" values are included in the discussion that follows. In these discussions, bias-corrected values for CdO, Ce_2O_3, La_2O_3, Nb_2O_5, PbO, SO_4, ThO_2, ZnO, and ZrO_2, which are the same as the original values, are included for completeness (e.g., to allow a sum of oxides to be computed for the bias-corrected results).

4.2.4 Composition Measurements by Glass Identifier with Target Compositions

Figure A4 in Appendix A provides plots of the oxide concentration measurements by Glass ID (including Batch 1 and U_{std}) by Lab ID within Glass ID sorted by target concentrations for each set of analyses. A review of the plots reveals the repeatability of the individual, oxide values for each glass. The target concentration for each of the oxides for each of the study glasses and the reference values for the standards provide a useful benchmark for the measurements. For the Set #1 results, there appears to be more scatter in the Fe_2O_3 measurements than in the measurements for the other oxides. In addition, there is a considerable amount of scatter in the SiO_2 measurements for HWL-04. For the Set #2 results, there appears to be more scatter in the measurements for both Fe_2O_3 and SiO_2 than in the measurements of the other oxides. The scatter in the SiO_2 measurements for Set #2 was somewhat reduced by the bias correction. For Set #3, once again the scatter in the Fe_2O_3 measurements appears to be greater than in the measurements for the other oxides.

Overall, a review of these results led to the conclusion that all of the values presented in this figure should be used in the determination of the chemical compositions of the study glass and the standards for this report. The measured and measured bias-corrected compositional views should also be considered along with the target compositional view in evaluating the study glasses.

4.2.5 Measured versus Target Compositions

All of the measurements for each oxide for each glass (i.e., all of the measurements in Tables A1 through A4) were averaged to determine a representative chemical composition for each glass. These determinations were conducted both for the measured and for the bias-corrected data. A sum of oxides was also computed for each glass based upon both the measured and bias-corrected values. Figure A5 in Appendix A provides plots that contain the results by oxide for each glass in order to highlight the comparisons among the measured, bias-corrected, and target values. In general, the measured/measured bias-corrected values are comparable to the target concentrations. There is some scatter in the measurements for Fe_2O_3 and SiO_2 and the measured NiO values for some of the study glasses are below their target values.

Table A5 in Appendix A provides a summary of the measured and measured bc compositions as well as the target compositions. Also included in the table are relative differences between the measured or bias-corrected values and the target values, which are shaded when they are greater than or equal to 5%. Notice that the target sums of oxides for the standard glasses are not 100% due to incomplete coverage of the oxides in the Batch 1 and U_{std} glasses. The sums of oxides (both measured and bias-corrected) for each of the study glasses fall within the interval of 95 to 105 wt%. Overall, there are only minor differences between the measured and target compositions, none of which will impact the outcome of this study.

4.2.6 MAR Assessment

As discussed in Section 3.1, glasses were selected for this study to investigate issues of concern for future DWPF processing (based on target compositions). The results of the MAR assessment of the measured and measured bias-corrected compositions for these glasses are presented in Table 11 along with the results for the target compositions. The columns in the table give the glass identifier with compositional view, the ΔG_p value for boron (B Del G_p Value), the normalized leachate for boron in grams/Liter (NL[B (g/L)]), the liquidus temperature prediction in degrees Celsius (T_L Pred (ºC)), the viscosity prediction in Poise (Visc Pred (P)), the sum of oxides (in wt%), the nepheline value, and the overall MAR assessment excluding any limitation on Na_2SO_4. The MAR Status column indicates the

constraints that do not pass the Slurry Mix Evaporator (SME) acceptability process at the MAR for each compositional view. Nomenclatures used in this column include: T_L (fails the liquidus temperature criteria), TiO_2 (exceeds the current 2 wt% limit), newlv (fails the low viscosity constraint), Neph (fails the nepheline discriminator value of 0.62), Homg (fails the homogeneity constraint), and lFrit (fails the low frit constraint associated with homogeneity or durability).

Table 11. MAR Assessment Results for the Target, Measured and Measured Bias-Corrected Compositional Views

Glass ID	Comp View	B Del G_p Value	NL [B (g/L)]	T_L Pred (oC)	Visc Pred (P)	TiO_2 wt%	Homog wt%	Neph Value	MAR Status
HWL-01	Measured	-6.625	0.199	1030.4	41.7	1.418	256.0	0.677	T_L
HWL-01	Measured bc	-6.303	0.174	1042.7	46.5	1.450	261.3	0.682	T_L
HWL-01	Targeted	-6.345	0.177	1054.3	44.9	1.540	260.9	0.683	T_L
HWL-02	Measured	-6.607	0.198	1071.4	34.2	1.613	273.4	0.640	T_L
HWL-02	Measured bc	-6.273	0.172	1083.6	38.1	1.649	279.2	0.645	T_L
HWL-02	Targeted	-6.492	0.188	1085.4	33.8	1.719	272.5	0.641	T_L
HWL-03	Measured	-6.370	0.179	1045.5	41.0	1.471	253.1	0.667	T_L
HWL-03	Measured bc	-6.053	0.157	1057.3	45.8	1.505	258.2	0.672	T_L
HWL-03	Targeted	-6.343	0.177	1065.6	39.6	1.540	260.9	0.675	T_L
HWL-04	Measured	-7.000	0.233	1064.2	25.5	1.620	266.6	0.626	T_L Neph
HWL-04	Measured bc	-6.669	0.203	1076.3	28.8	1.657	272.1	0.632	T_L
HWL-04	Targeted	-6.490	0.188	1095.0	29.5	1.719	272.5	0.633	T_L
HWL-05	Measured	-8.499	0.435	1033.3	26.3	1.227	252.0	0.719	T_L
HWL-05	Measured bc	-8.187	0.382	1047.7	29.3	1.255	257.6	0.724	T_L
HWL-05	Targeted	-8.265	0.395	1057.6	26.3	1.293	253.3	0.726	T_L
HWL-06	Measured	-8.921	0.519	1072.0	17.0	1.383	260.3	0.683	T_L newlv
HWL-06	Measured bc	-8.602	0.454	1086.4	19.1	1.414	266.2	0.689	T_L newlv
HWL-06	Targeted	-8.634	0.460	1093.7	17.8	1.443	264.0	0.688	T_L newlv
HWL-07	Measured	-9.225	0.589	1010.4	27.8	1.248	250.2	0.708	
HWL-07	Measured bc	-8.902	0.515	1024.8	30.9	1.277	255.9	0.714	T_L
HWL-07	Targeted	-9.226	0.589	1020.1	27.3	1.293	253.3	0.712	T_L
HWL-08	Measured	-9.565	0.679	1032.3	20.8	1.373	256.1	0.670	T_L newlv
HWL-08	Measured bc	-9.239	0.593	1046.8	23.3	1.404	262.0	0.676	T_L newlv
HWL-08	Targeted	-9.512	0.664	1060.2	18.7	1.443	264.0	0.676	T_L newlv
HWL-09	Measured	-7.995	0.353	935.2	43.3	2.248	210.1	0.798	TiO_2 Homg
HWL-09	Measured bc	-7.892	0.338	943.6	45.2	2.295	210.9	0.796	TiO_2 Homg
HWL-09	Targeted	-7.748	0.318	954.4	48.5	2.343	211.6	0.801	TiO_2
HWL-10	Measured	-8.545	0.444	969.7	31.5	2.581	217.1	0.766	TiO_2
HWL-10	Measured bc	-8.449	0.426	977.9	32.9	2.636	217.9	0.764	TiO_2
HWL-10	Targeted	-8.140	0.375	999.4	37.0	2.685	219.1	0.769	TiO_2
HWL-11	Measured	-8.864	0.507	994.1	24.6	2.890	221.9	0.735	newlv TiO_2
HWL-11	Measured bc	-8.776	0.488	1002.1	25.6	2.951	222.9	0.733	TiO_2
HWL-11	Targeted	-8.533	0.441	1038.1	27.0	3.029	226.6	0.734	T_L TiO_2
HWL-12	Measured	-10.846	1.159	837.5	39.9	2.256	210.9	0.752	TiO_2
HWL-12	Measured bc	-10.796	1.135	844.6	40.9	2.304	211.9	0.750	TiO_2
HWL-12	Targeted	-10.593	1.043	856.0	43.9	2.343	211.6	0.754	TiO_2
HWL-13	Measured	-11.196	1.341	876.7	27.5	2.623	214.2	0.718	TiO_2
HWL-13	Measured bc	-11.155	1.318	883.7	28.2	2.678	215.4	0.716	TiO_2
HWL-13	Targeted	-10.773	1.124	908.0	33.9	2.685	219.1	0.726	TiO_2
HWL-14	Measured	-11.293	1.396	922.9	22.2	2.815	223.7	0.692	newlv TiO_2
HWL-14	Measured bc	-11.253	1.373	929.9	22.8	2.874	225.0	0.690	newlv TiO_2
HWL-14	Targeted	-10.954	1.212	954.5	25.1	3.029	226.6	0.696	TiO_2
HWL-15	Measured	-6.526	0.191	928.6	68.9	2.569	210.4	0.818	TiO_2 Homg
HWL-15	Measured bc	-6.434	0.184	934.1	71.4	2.623	211.1	0.817	TiO_2
HWL-15	Targeted	-6.125	0.162	947.8	81.4	2.703	212.8	0.824	TiO_2
HWL-16	Measured	-6.994	0.232	964.9	52.5	2.919	216.1	0.788	TiO_2 lFrit
HWL-16	Measured bc	-6.910	0.224	969.9	54.3	2.980	217.0	0.786	TiO_2 lFrit
HWL-16	Targeted	-6.568	0.194	989.6	61.7	3.131	221.2	0.793	TiO_2
HWL-17	Measured	-7.152	0.248	1006.6	42.9	3.349	225.5	0.759	TiO_2
HWL-17	Measured bc	-7.074	0.240	1011.6	44.2	3.419	226.5	0.757	TiO_2
HWL-17	Targeted	-7.013	0.234	1025.3	44.8	3.562	229.5	0.760	T_L TiO_2
HWL-18	Measured	-10.605	1.048	806.9	37.7	2.623	208.9	0.763	TiO_2 Homg
HWL-18	Measured bc	-10.558	1.028	812.3	38.6	2.678	209.8	0.761	TiO_2 Homg
HWL-18	Targeted	-10.284	0.916	820.4	44.6	2.703	212.8	0.769	TiO_2
HWL-19	Measured	-10.802	1.137	852.2	31.8	2.932	216.7	0.739	TiO_2
HWL-19	Measured bc	-10.762	1.119	857.5	32.6	2.993	217.8	0.737	TiO_2
HWL-19	Targeted	-10.430	0.974	872.6	34.0	3.131	221.2	0.743	TiO_2

Table 11 cont. MAR Assessment Results for the Target, Measured and Measured Bias-Corrected Compositional Views

1.

Glass ID	Comp View	B Del G_p Value	NL [B (g/L)]	T_L Pred (oC)	Visc Pred (P)	TiO_2 wt%	Homog wt%	Neph Value	MAR Status
HWL-20	Measured	-10.736	1.107	903.5	23.4	3.282	224.5	0.713	newlv TiO_2
HWL-20	Measured bc	-10.696	1.088	908.7	23.9	3.351	225.7	0.711	newlv TiO_2
HWL-20	Targeted	-10.577	1.035	919.0	24.9	3.562	229.5	0.714	TiO_2
HWL-21	Measured	-7.597	0.299	913.7	54.9	1.465	264.2	0.559	Neph
HWL-21	Measured bc	-7.229	0.256	920.4	62.8	1.498	268.3	0.564	Neph
HWL-21	Targeted	-7.459	0.282	932.1	55.0	1.552	268.6	0.563	Neph
HWL-22	Measured	-7.717	0.314	934.3	46.5	1.663	275.9	0.519	Neph
HWL-22	Measured bc	-7.336	0.268	941.0	53.6	1.701	280.2	0.524	Neph
HWL-22	Targeted	-7.698	0.312	946.8	44.6	1.708	279.5	0.519	Neph
HWL-23	Measured	-7.757	0.319	942.7	50.0	2.085	208.4	0.797	TiO_2 Homg
HWL-23	Measured bc	-7.785	0.323	940.1	44.8	2.144	202.4	0.793	TiO_2 Homg lFrit
HWL-23	Targeted	-7.560	0.294	954.3	48.5	2.300	207.7	0.801	TiO_2 Homg
HWL-24	Measured	-10.296	0.921	859.1	41.4	2.210	207.8	0.752	TiO_2 Homg lFrit
HWL-24	Measured bc	-10.461	0.987	860.7	38.1	2.298	208.3	0.748	TiO_2 Homg lFrit
HWL-24	Targeted	-10.352	0.943	855.9	43.9	2.300	207.7	0.754	TiO_2 Homg
HWL-25	Measured	-6.059	0.157	954.8	85.6	2.540	215.4	0.821	TiO_2
HWL-25	Measured bc	-6.102	0.160	950.0	78.8	2.612	208.9	0.818	TiO_2 Homg
HWL-25	Targeted	-5.996	0.153	947.9	81.4	2.668	210.1	0.824	TiO_2 Homg
HWL-26	Measured	-6.802	0.214	964.9	57.6	2.869	212.2	0.787	TiO_2 lFrit
HWL-26	Measured bc	-6.937	0.227	965.5	53.4	2.983	212.9	0.784	TiO_2 lFrit
HWL-26	Targeted	-6.413	0.182	989.8	61.7	3.085	217.9	0.793	TiO_2 lFrit
HWL-27	Measured	-10.204	0.886	821.9	42.3	2.535	210.8	0.764	TiO_2 Homg
HWL-27	Measured bc	-10.310	0.927	823.0	40.1	2.636	210.8	0.761	TiO_2 Homg
HWL-27	Targeted	-10.103	0.850	820.4	44.6	2.668	210.1	0.769	TiO_2 Homg
HWL-28	Measured	-10.189	0.881	882.7	32.6	2.898	221.8	0.745	TiO_2 lFrit
HWL-28	Measured bc	-10.266	0.909	877.3	28.1	2.980	215.7	0.740	TiO_2 lFrit
HWL-28	Targeted	-10.218	0.891	872.7	34.0	3.085	217.9	0.743	TiO_2 lFrit

A review of the MAR assessments based on the different compositional views indicates that most of the glasses challenge the intended constraint(s). For example, three glasses (HWL-01, -02, and -03) were selected to provide insight into the applicability of the T_L model to a broader compositional region based on target compositions. Based on the MAR results using the measured and measured bias corrected views, T_L remains the only criterion that fails. There are a few exceptions which include:

- HWL-04: The measured compositional view suggests that the glass is prone to nepheline formation, while the target and measured bc views only fail the T_L constraint.
- HWL-07: The measured compositional view met all of the MAR constraints, while the target and measured bc views fail the T_L constraint.
- HWL-09: The measured and measured bc views indicate that the homogeneity criterion is not met (in addition to the TiO_2 limit of 2%), while only the TiO_2 limit is of concern based on the target composition.
- HWL-11: T_L and TiO_2 are the only criteria that fail based on the target composition. When the measured composition is used, only the TiO_2 limit is exceeded and when measured-bc compositional view is used low viscosity is failed along with the TiO_2 limit. The T_L constraint does not fail either the measured or measured bc view.
- HWL-15: Both the target and measured-bc compositional views indicate that only the TiO_2 limit is exceeded, but the measured compositional view also suggests that homogeneity would be challenged for coupled operations.

- HWL-16: The target composition suggests that the TiO_2 limit is exceeded, but the measured and measured-bc assessments suggest that low frit (a constraint associated with homogeneity) is not met as well as TiO_2.
- HWL-18: The target composition suggests that only the TiO_2 limit is exceeded, but the measured and measured-bc assessments suggest the homogeneity constraint also is not met.
- HWL-23 and HWL-24: The target compositional view fails both TiO_2 and homogeneity constraint, while the measured for HWL-24 and measured-bc views for both also fail low frit (a constraint associated with homogeneity).

The differences observed in the MAR assessments based on the three compositional views indicate that some of the target compositions were extremely close to a secondary constraint, which was not satisfied for some of the other compositional views. Although these differences will be monitored with respect to the interpretation of the data, at this point they do not pose a significant issue on meeting the task objectives.

4.3 Liquidus Temperature

4.3.1 Impact of High TiO_2 Concentration from Coupled Operations

As stated in Section 4.2 and shown in Figure 24, the measured TiO_2 concentrations were consistent with the target compositions suggesting that TiO_2 retention (or solubility) is not an issue within this compositional region. In this section, the impact of these higher TiO_2 concentration glasses will be evaluated with respect to extending the validation range and assessing the applicability of the current T_L model.

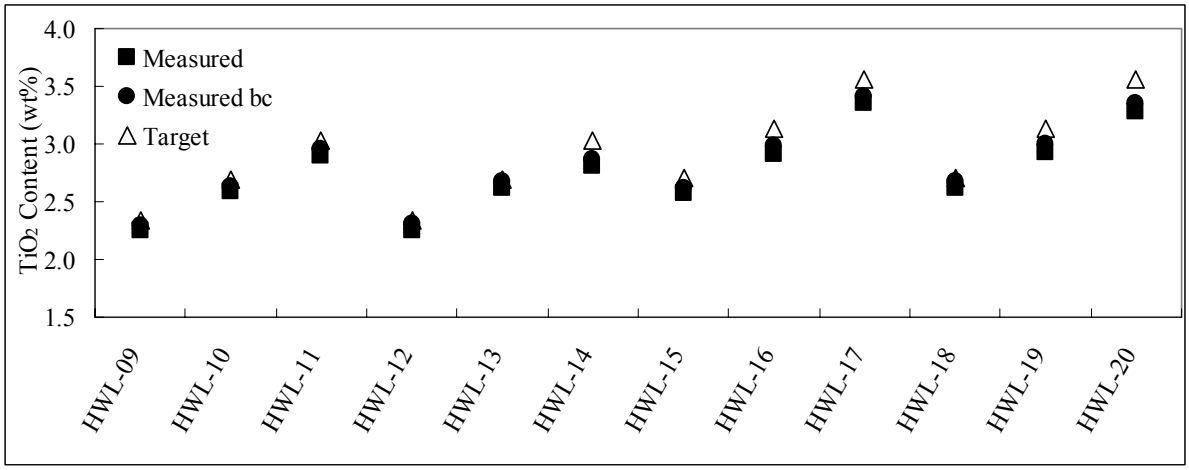

Figure 24. A comparison of the target, measured and measured bc TiO_2 content.

4.3.1.a SB9 Coupled Operations Glasses

The predicted and measured T_L measurements for the series of high TiO_2 glasses resulting from coupled operations for SB9 and SB8, respectively, are shown in Table 12. To support assessments of the applicability of the current T_L model to these compositional regions, one must first establish a baseline from which comparisons can be made. Brown et al. report a root mean squared error (RMSE) of approximately 38°C for the current model predictions.[1] This suggests that the difference between the model prediction and actual measurements could be as large as ±38°C (one sigma). The

authors will use this estimated error to gauge the applicability of the T_L model to the new glass compositional regions of interest.

There is very little difference between the predicted (based on target compositions) and measured T_L values for the series of SB9 coupled operations glasses based on the high B_2O_3 content (18 wt%) frit (i.e., HWL-15, -16, and -17). The differences observed are well within the T_L model prediction uncertainty of ~38°C (as defined by Brown et al). A comparison of the model development and target glass compositional regions suggest complete overlap with the exception of the TiO_2 and MgO concentrations as shown in Table 13. The TiO_2 content is greater than the model range, while the MgO content is below the model range. These results indicate that not only are higher TiO_2 concentrations possible with respect to retention or solubility, but that the T_L model is applicable in this compositional region.

When comparing the measured T_L to the predicted T_L of the lower B_2O_3 concentration SB9 glasses (8 wt%), the differences range from 17°C (HWL-18 targeting 32% WL) to 110°C (HWL-20 targeting 42%WL). In general, the data suggest that there is a shift in the compositional region (especially at the higher WLs) over which the applicability of the current T_L model becomes questionable (i.e., the difference between predicted and measured values is greater then the RMSE of 38°C). A comparison of the compositional overlap (Table 13) identifies only TiO_2 and MgO differences between the model data and target glass compositional ranges for all glasses and a difference in the B_2O_3 content of HWL-20. The red highlighted boxes indicate those target glass components that are outside of the model development ranges. The compositional gaps for HWL-18 and HWL-19 (similar to those observed in HWL-15 through HWL-17) translate into T_L differences of 17 and 41°C, respectively. These differences are well within or close to the reported RMSE of 38°c for the current T_L model. The target B_2O_3 content of HWL-20 is lower than the model development ranges, which could be the primary driver for the significant difference (110°C) between the measured and predicted T_L in that glass system.

For the SB9 coupled operations study glasses, the T_L model appears to be very applicable for compositions that have a higher B_2O_3 content. The differences between predicted and measured T_L values are extremely small and well within the RMSE of the current model. Larger differences are observed between the measured and predicted T_L values in glasses with a lower B_2O_3 concentration. Although these glasses are within the model validation ranges, individual components or combinations of oxides being explored by these glasses are not in a region where the model has been validated. Thus, there is a need to generate additional data in these new compositional regions from which the T_L model coefficients could then be refined in order to more accurately predict T_L for glasses with combinations of oxides that are beyond those considered during model development and/or the validation process.

Table 12. Predicted and Measured T_L Data for High TiO_2 SB9 Glasses (Coupled Operations)

Glass ID	Frit 18-8-1-73[l]	MAR Result	TiO_2 (wt%, target)	T_L Predicted (°C)	T_L Measured (°C)	Measured - Predicted (°C)	Compositional Assessment Relative to Model Development Ranges
HWL-15	32% WL	TiO_2	2.7	947	951	4	HWL glass: lower in MgO and higher in TiO_2
HWL-16	37% WL	TiO_2	3.13	989	997	8	
HWL-17	42% WL	TiO_2, T_L	3.56	1025	1030	5	
Glass ID	**Frit 8-8-8-76[m]**	**MAR Result**	**TiO_2 (wt%, target)**	**T_L Predicted (°C)**	**T_L Measured (°C)**	**Measured - Predicted (°C)**	**Compositional Assessment Relative to Model Development Ranges**
HWL-18	32% WL	TiO_2	2.7	820	837	17	HWL glass: lower in MgO and higher in TiO_2
HWL-19	37% WL	TiO_2	3.13	873	914	41	HWL glass: lower in MgO and higher in TiO_2
HWL-20	42% WL	TiO_2	3.56	919	1029	110	HWL glass: lower in MgO, lower in B_2O_3, and higher in TiO_2

[l] $18B_2O_3 – 8Li_2O – 1Na_2O – 73SiO_2$ (wt%)
[m] $8B_2O_3 – 8Li_2O – 8Na_2O – 76SiO_2$ (Frit 418) (wt%)

Table 13. Target Compositions Compared to Model Development Ranges for the SB9 Glasses (Coupled Operations)

Sludge	MSP-001 / SB9					
Frit	B-18;Li-6;Na-1;Si-75			B-8;Li-8;Na-8;Si-76 (Frit 418)		
WL (%)	32	37	42	32	37	42
Glass ID	HWL-15	HWL-16	HWL-17	HWL-18	HWL-19	HWL-20
Al_2O_3	3.83	4.44	5.05	3.83	4.44	5.05
B_2O_3	12.40	11.51	10.62	5.51	5.12	4.72
BaO	0.07	0.08	0.09	0.07	0.08	0.09
CaO	0.89	1.03	1.17	0.89	1.03	1.17
Ce_2O_3	0.23	0.27	0.30	0.23	0.27	0.30
Cr_2O_3	0.08	0.10	0.11	0.08	0.10	0.11
CuO	0.02	0.03	0.03	0.02	0.03	0.03
Fe_2O_3	10.68	12.38	14.08	10.68	12.38	14.08
K_2O	0.05	0.06	0.07	0.05	0.06	0.07
La_2O_3	0.08	0.09	0.10	0.08	0.09	0.10
Li_2O	4.13	3.84	3.54	5.51	5.12	4.72
MgO	0.15	0.17	0.19	0.15	0.17	0.19
MnO	2.31	2.67	3.04	2.31	2.67	3.04
Na_2O	7.52	8.55	9.59	12.34	13.03	13.72
Nb_2O_3	0.54	0.62	0.71	0.54	0.62	0.71
NiO	0.31	0.35	0.40	0.31	0.35	0.40
PbO	0.12	0.14	0.15	0.12	0.14	0.15
SO_4	0.00	0.00	0.00	0.00	0.00	0.00
SiO_2	53.29	49.85	46.39	53.98	50.49	46.98
TiO_2	2.70	3.13	3.56	2.70	3.13	3.56
ZnO	0.02	0.03	0.03	0.02	0.03	0.03
ZrO_2	0.57	0.66	0.75	0.57	0.66	0.75
Total	100.00	100.00	100.00	100.00	100.00	100.00

4.3.1.b SB8 Coupled Operations Glasses

A review of the target versus measured T_L values for the SB8 coupled operations high B_2O_3 content glasses (HWL-09 through HWL-11) indicates that the differences are higher for this series of glasses as compared to the series of SB9 high B_2O_3 content glasses (Table 14). Although the differences between predicted and measured T_Ls fall within or close to the RMSE of the current model prediction of 38°C for these glasses. There appear to be larger differences between the predicted and measured T_L values for HWL-12 through HWL-14, which are based on the lower B_2O_3 concentration frit. This trend is similar to that observed in the SB9 based glasses that were discussed in the previous section. On average, the differences for the SB8 based glasses are approximately 38°C and 116°C for the high and low B_2O_3 concentrations, respectively.

An evaluation of potential compositional differences between the target SB8 glass compositional region as compared to the model development region does provide some insight into these larger differences. Table 15 summarizes these compositional comparisons. The red highlighted boxes indicate those target glass components that are outside of the model development ranges. Similar to the SB9 glasses, the TiO_2 and MgO contents of the SB8 study glasses are outside of the model development ranges; however, unlike the SB9 glasses, the MnO values for the SB8 glasses are also outside of the model development ranges. Each of the MnO target concentrations is greater than 3.36 wt% in glass as compared to the upper bound of 3.25 wt% in the model development ranges, which potentially leads to the larger differences for this series of glasses. In addition to MnO, the concentrations of ZrO_2 and/or B_2O_3 are beyond the model development ranges for HWL-11 and HWL-14. The larger difference exhibited by HWL-14 may be due to the presence of surface crystals ("silver haze") on the quenched glass.

As pointed out by Brown et al., the T_L model was validated with glasses whose compositions exceeded the model development ranges, but these data suggest that the combinations of the SB8 based glasses may be in a different glass compositional region (e.g., high MnO, low B_2O_3, and/or high TiO_2 concentrations).[1] The SB8 data are consistent with recent glass formulation efforts in support of the Cold Crucible Induction Melter (CCIM) demonstrations. The T_L of Frit 202-A11 glasses (targeting 50% WL) was predicted to be approximately 1130°C, but measured to be approximately 1260°C.[21] A comparison of the target composition with the model development ranges indicated that the B_2O_3, Fe_2O_3, and MnO contents were also outside of the T_L model development ranges.

Table 14. Predicted and Measured T_L Data for High TiO_2 SB8 Glasses (Coupled Operations)

Glass ID	Frit 18-8-1-73[n]	MAR Result	TiO_2 (wt%, target)	T_L Predicted (°C)	T_L Measured (°C)	Measured - Predicted (°C)	Compositional Assessment Relative to Model Development Ranges
HWL-09	35% WL	TiO_2	2.34	954	987	33	HWL glass: lower in MgO, higher in TiO_2, and higher in MnO
HWL-10	40% WL	TiO_2	2.69	999	1031	32	
HWL-11	45% WL	TiO_2, T_L	3.03	1038	1086	48	HWL glass: lower in MgO, higher in TiO_2, higher in MnO, and higher ZrO_2
Glass ID	**Frit 8-8-8-76[o]**	**MAR Result**	**TiO_2 (wt%, target)**	**T_L Predicted (°C)**	**T_L Measured (°C)**	**Measured - Predicted (°C)**	**Compositional Assessment Relative to Model Development Ranges**
HWL-12	35% WL	TiO_2	2.34	856	957	101	HWL glass: lower in MgO, higher in TiO_2, and higher in MnO
HWL-13	40% WL	TiO_2	2.69	907	1023	116	
HWL-14	45% WL	TiO_2	3.03	954	1086	132	HWL glass: lower in MgO, higher in TiO_2, higher in MnO, higher ZrO_2 and lower B_2O_3

[n] $18B_2O_3 – 8Li_2O – 1Na_2O – 73SiO_2$ (wt%)
[o] $8B_2O_3 – 8Li_2O – 8Na_2O – 76SiO_2$ (Frit 418) (wt%)

Table 15. Target Compositions Compared to Model Development Ranges for the SB8 Couple Operations Glasses

Sludge	MSP-001 / SB8					
Frit	B-18;Li-8;Na-1;Si-73			B-8;Li-8;Na-8;Si-76 (Frit 418)		
WL (%)	35	40	45	45	40	45
Glass ID	HWL-09	HWL-10	HWL-11	HWL-14	HWL-13	HWL-14
Al_2O_3	4.50	5.16	5.82	4.50	5.16	5.82
B_2O_3	11.92	11.03	10.14	5.30	4.90	4.51
BaO	0.08	0.09	0.10	0.08	0.09	0.10
CaO	0.87	1.00	1.13	0.87	1.00	1.13
Ce_2O_3	0.19	0.21	0.24	0.19	0.21	0.24
Cr_2O_3	0.10	0.11	0.13	0.10	0.11	0.13
CuO	0.03	0.03	0.04	0.03	0.03	0.04
Fe_2O_3	10.40	11.92	13.44	10.40	11.92	13.44
K_2O	0.06	0.07	0.08	0.06	0.07	0.08
La_2O_3	0.07	0.08	0.09	0.07	0.08	0.09
Li_2O	5.30	4.90	4.51	5.30	4.90	4.51
MgO	0.14	0.16	0.18	0.14	0.16	0.18
MnO	3.36	3.85	4.34	3.36	3.85	4.34
Na_2O	7.96	8.97	9.99	12.59	13.26	13.94
Nb_2O_3	0.81	0.93	1.05	0.81	0.93	1.05
NiO	0.67	0.77	0.87	0.67	0.77	0.87
PbO	0.11	0.13	0.14	0.11	0.13	0.14
SO_4	0.00	0.00	0.00	0.00	0.00	0.00
SiO_2	50.29	46.97	43.64	52.27	48.81	45.33
TiO_2	2.34	2.69	3.03	2.34	2.69	3.03
ZnO	0.04	0.04	0.05	0.04	0.04	0.05
ZrO_2	0.77	0.89	1.00	0.77	0.89	1.00
Total	100	100	100	100.00	100.00	100.00

4.3.2 T_L Predictions (With and Without Al-Dissolution)

Table 16 summarizes the predicted and measured T_L values for the Cluster #2 ("average" composition without Al-dissolution) and Cluster #4 ("average" composition with Al-dissolution) glasses. A relatively large discrepancy exists between the predicted and measured T_L values for this glass series. The measured values for this series of glasses are consistently higher than the predicted values and greater than the 38°C RMSE for the model. As with the previous series of glasses, the model appears to under-predict the T_Ls for both with and without Al-dissolution flowsheet glasses. With respect to overlap between the glass compositions and the model development ranges, each of the glasses has a lower MgO concentration than the model development range; however, based on the results in previous sections, MgO is not thought to be the cause of the considerable differences. The target SiO_2 concentrations of HWL-02 and HWL-04 are lower than the model development ranges and could be the primary cause for the differences observed in these two glasses. For HWL-08, both the B_2O_3 and Fe_2O_3 target concentrations are outside the model development ranges (but within the validation ranges as defined by Table 2), which causes some concern over the applicability of the model in this specific compositional region (or combinations of oxides). In addition, HWL-02 and -04 (targeting 50% WL) were water quenched during the fabrication process. Some of the larger fragments did appear to contain crystals, which may have caused the larger differences between the model predictions and measured values. It should be noted that HWL-18 was also characterized by a "few silver patches" on the surface of the quenched glass, but the difference in predicted and measured T_L for this glass was only 17°C.

Table 16. Predicted and Measured T_L Data for HWL-01 through HWL-08

Glass ID	Frit 14-9-1-76[p]	MAR Result	T_L Predicted (°C)	T_L Measured (°C)	Measured - Predicted (°C)	Compositional Assessment Relative to Model Development Ranges
HWL-01	45% WL	T_L	1054	1152	98	HWL glass: lower in MgO
HWL-02	50% WL	T_L	1085	1203	118	HWL glass: lower in MgO, lower in SiO_2
Glass ID	**Frit 18-8-1-73[q]**	**MAR Result**	**T_L Predicted (°C)**	**T_L Measured (°C)**	**Measured - Predicted (°C)**	**Compositional Assessment Relative to Model Development Ranges**
HWL-03	45% WL	T_L	1066	1143	77	HWL glass: lower in MgO
HWL-04	50% WL	T_L	1095	1193	98	HWL glass: lower in MgO, lower in SiO_2
Glass ID	**Frit 14-9-1-76**	**MAR Result**	**T_L Predicted (°C)**	**T_L Measured (°C)**	**Measured - Predicted (°C)**	**Compositional Assessment Relative to Model Development Ranges**
HWL-05	45% WL	T_L	1058	1143	85	HWL glass: lower in MgO
HWL-06	50% WL	T_L	1094	1165	71	HWL glass: lower in MgO
Glass ID	**Frit 9-9-4-78[r]**	**MAR Result**	**T_L Predicted (°C)**	**T_L Measured (°C)**	**Measured - Predicted (°C)**	**Compositional Assessment Relative to Model Development Ranges**
HWL-07	45% WL	T_L	1020	1113	93	HWL glass: lower in MgO
HWL-08	50% WL	T_L	1060	1152	92	HWL glass: lower in MgO, low B_2O_3, high Fe_2O_3

[p] $14B_2O_3 – 9Li_2O – 1Na_2O – 76SiO_2$ (wt%)
[q] $18B_2O_3 – 8Li_2O – 1Na_2O – 73SiO_2$ (wt%)
[r] $9B_2O_3 – 9Li_2O – 4Na_2O – 78SiO_2$ (wt%)

4.4 A Statistical Review of the PCT Results

Table B1 in Appendix B provides the elemental leachate concentration measurements determined by the PSAL for the solution samples generated by the PCTs. Any measurement in Table B1 below the detection limit of the analytical procedure (indicated by a "<") was replaced by ½ of the detection limit in subsequent analyses. The measured solution-weight loss over the course of the 7-day test did not indicate a solution-weight loss problem for any of the samples. The ARM results for each set of PCTs are within the control limits of THERMO for B, Li, Na and Si.[22]

In addition to adjustments for detection limits, the values were adjusted for the dilution factors: the values for the study glasses, the blanks, and the ARM glass in Table B1 were multiplied by 1.6667 to determine the values in parts per million (ppm) and the values for EA were multiplied by 16.6667. Table B2 in Appendix B provides the resulting measurements.

4.4.1 Measurements in Analytical Sequence

Figure B1 in Appendix B provides plots of the leachate (ppm) concentrations in analytical sequence as generated by the PSAL for all of the data from all three sets of PCTs. A different color and symbol are used for each study glass or standard. No issues are seen in these plots.

4.4.2 Results for the Samples of the Multi-Element Solution Standard

Figure B2 in Appendix B provides analyses of the PSAL measurements of the samples of the multi-element solution standard by analytical set and ICP-AES calibration block. An ANOVA was used to determine the presence of any statistically significant differences among the block averages for these samples for each element of interest. A statistically significant difference (at a 5% level) among the averages of these measurements was indicated for Li, Na, and Si. However, averaging the ppm values for each set of triplicates helps to minimize the impact of any potential instrumentation effects.

Table 17 summarizes the average measurements and the reference values for the 4 elements of interest. The results indicate consistent and accurate measurements from the PSAL processes used to conduct these analyses.

4.4.3 Measurements by Glass Identifier

Figure B3 in Appendix B provide plots of the leachate concentrations for each type of submitted sample: the study glasses by heat treatment and the standards (EA, ARM, the multi-element solution standard, and blanks). Two units of measure are used in these plots: ppm and the common logarithms of the ppm values. The common logarithm plots allow for the assessment of the repeatability of the measurements. Some scatter is observed in the triplicate values for the analytes of some of the glasses. The differences between the values for the two heat treatments for HWL-21 and HWL-22 should also be noted.

Table 17. Results from Samples of the Multi-element Standard Solution

Analytical Set/Block	Avg B (ppm)	Avg Li (ppm)	Avg Na (ppm)	Avg Si (ppm)
1/1	21.0	10.3	79.8	49.4
1/2	20.0	10.1	80.4	47.8
1/3	20.1	9.8	78.1	47.4
2/1	20.4	9.8	79.6	48.4
2/2	19.3	9.6	79.6	46.8
2/3	19.9	9.7	78.7	45.9
3/1	20.6	9.8	81.3	52.4
3/2	19.8	9.6	79.2	50.9
3/3	20.4	9.9	80.9	52.8
Grand Average	20.2	9.8	79.7	49.1
Reference Value	20	10	81	50
% difference	-0.9%	1.7%	1.6%	1.9%

4.4.4 Normalized PCT Results

PCT leachate concentrations are typically normalized using the cation composition (expressed as a weight percent) in the glass to obtain a grams-per-liter (g/L) leachate concentration. The normalization of the PCTs is usually conducted using the measured compositions of the glasses. For completeness, the target cation and the bias-corrected cation compositions were also used to conduct this normalization.

The common logarithm of the normalized PCT (normalized leachate, NL) for each element of interest was determined and used for comparison. To accomplish this computation, one must

1. Determine the common logarithm of the elemental parts per million (ppm) leachate concentration for each of the triplicates and each of the elements of interest (these values are provided in Table B1 of Appendix B),

2. Average the common logarithms over the triplicates for each element of interest, and then

Normalizing Using Measured Composition (preferred method)

3. Subtract a quantity equal to 1 plus the common logarithm of the average cation measured concentration (expressed as a weight percent of the glass) from the average computed in step 2.

Or Normalizing Using Target Composition

3. Subtract a quantity equal to 1 plus the common logarithm of the target cation concentration (expressed as a weight percent of the glass) from the average computed in step 2.

Or Normalizing Using Measured Bias-Corrected Composition

3. Subtract a quantity equal to 1 plus the common logarithm of the measured bias-corrected cation concentration (expressed as a weight percent of the glass) from the average computed in step 2.

All combinations of the normalizations of the PCTs (i.e., those generated using the target, measured, and bias-corrected compositional views) and both heat treatments are represented in the series of scatter plots as shown in Figure B4 in Appendix B. Consistency in the leaching across the elements is typically demonstrated by a high degree of linear correlation among the values for pairs of these elements. The smallest correlation in this plot is ~88.5% for Li and Si, indicating good linear correlation.

Table 18 summarizes the normalized PCTs results, which are listed by heat treatment and compositional view for each glass.

Table 18. Normalized PCTs by Glass ID/Compositional View

Glass ID	Heat Treatment	Comp View	log NL [B (g/L)]	log NL [Li(g/L)]	log NL [Na (g/L)]	log NL [Si (g/L)]	NL B(g/L)	NL Li (g/L)	NL Na (g/L)	NL Si (g/L)
ARM	ref	reference	-0.3121	-0.2475	-0.3424	-0.5817	0.49	0.57	0.45	0.26
ARM	ref	reference	-0.2982	-0.2393	-0.3014	-0.5751	0.50	0.58	0.50	0.27
ARM	ref	reference	-0.2904	-0.2262	-0.2799	-0.5247	0.51	0.59	0.52	0.30
EA	ref	reference	1.2516	0.9794	1.1132	0.5749	17.85	9.54	12.98	3.76
EA	ref	reference	1.2338	0.9627	1.1120	0.5634	17.13	9.18	12.94	3.66
EA	ref	reference	1.2591	0.9642	1.1229	0.6115	18.16	9.21	13.27	4.09
HWL-01	ccc	Measured	-0.3167	-0.2592	-0.4075	-0.4451	0.48	0.55	0.39	0.36
HWL-01	ccc	Measured bc	-0.3087	-0.2545	-0.4022	-0.4550	0.49	0.56	0.40	0.35
HWL-01	ccc	Targeted	-0.3257	-0.2494	-0.4026	-0.4538	0.47	0.56	0.40	0.35
HWL-01	quenched	Measured	-0.1937	-0.1714	-0.3204	-0.4242	0.64	0.67	0.48	0.38
HWL-01	quenched	Measured bc	-0.1858	-0.1666	-0.3151	-0.4341	0.65	0.68	0.48	0.37
HWL-01	quenched	Targeted	-0.2027	-0.1615	-0.3155	-0.4330	0.63	0.69	0.48	0.37
HWL-02	ccc	Measured	-0.3028	-0.2729	-0.3315	-0.4714	0.50	0.53	0.47	0.34
HWL-02	ccc	Measured bc	-0.2948	-0.2682	-0.3263	-0.4812	0.51	0.54	0.47	0.33
HWL-02	ccc	Targeted	-0.3149	-0.2764	-0.3246	-0.4700	0.48	0.53	0.47	0.34
HWL-02	quenched	Measured	-0.1407	-0.1008	-0.2244	-0.4121	0.72	0.79	0.60	0.39
HWL-02	quenched	Measured bc	-0.1328	-0.0961	-0.2192	-0.4219	0.74	0.80	0.60	0.38
HWL-02	quenched	Targeted	-0.1528	-0.1043	-0.2175	-0.4107	0.70	0.79	0.61	0.39
HWL-03	ccc	Measured	-0.3359	-0.2355	-0.4299	-0.4577	0.46	0.58	0.37	0.35
HWL-03	ccc	Measured bc	-0.3279	-0.2307	-0.4246	-0.4675	0.47	0.59	0.38	0.34
HWL-03	ccc	Targeted	-0.3520	-0.2553	-0.4252	-0.4701	0.44	0.56	0.38	0.34
HWL-03	quenched	Measured	-0.2254	-0.1469	-0.3550	-0.4605	0.60	0.71	0.44	0.35
HWL-03	quenched	Measured bc	-0.2174	-0.1421	-0.3498	-0.4703	0.61	0.72	0.45	0.34
HWL-03	quenched	Targeted	-0.2415	-0.1667	-0.3503	-0.4728	0.57	0.68	0.45	0.34
HWL-04	ccc	Measured	-0.3613	-0.3114	-0.3878	-0.4875	0.44	0.49	0.41	0.33
HWL-04	ccc	Measured bc	-0.3533	-0.3067	-0.3825	-0.4973	0.44	0.49	0.41	0.32
HWL-04	ccc	Targeted	-0.3644	-0.2944	-0.3783	-0.4959	0.43	0.51	0.42	0.32
HWL-04	quenched	Measured	-0.1527	-0.1230	-0.2518	-0.4557	0.70	0.75	0.56	0.35
HWL-04	quenched	Measured bc	-0.1447	-0.1182	-0.2466	-0.4656	0.72	0.76	0.57	0.34
HWL-04	quenched	Targeted	-0.1558	-0.1059	-0.2423	-0.4641	0.70	0.78	0.57	0.34
HWL-05	ccc	Measured	-0.1339	-0.1142	-0.2173	-0.3752	0.73	0.77	0.61	0.42
HWL-05	ccc	Measured bc	-0.1259	-0.1094	-0.2120	-0.3851	0.75	0.78	0.61	0.41
HWL-05	ccc	Targeted	-0.1573	-0.1136	-0.2051	-0.3778	0.70	0.77	0.62	0.42
HWL-05	quenched	Measured	-0.0836	-0.0892	-0.1818	-0.3695	0.82	0.81	0.66	0.43
HWL-05	quenched	Measured bc	-0.0756	-0.0845	-0.1766	-0.3793	0.84	0.82	0.67	0.42
HWL-05	quenched	Targeted	-0.1070	-0.0887	-0.1696	-0.3720	0.78	0.82	0.68	0.42
HWL-06	ccc	Measured	-0.1820	-0.1482	-0.1787	-0.3623	0.66	0.71	0.66	0.43
HWL-06	ccc	Measured bc	-0.1740	-0.1435	-0.1734	-0.3722	0.67	0.72	0.67	0.42
HWL-06	ccc	Targeted	-0.1813	-0.1407	-0.1742	-0.3665	0.66	0.72	0.67	0.43
HWL-06	quenched	Measured	-0.0058	-0.0244	-0.0820	-0.3364	0.99	0.95	0.83	0.46
HWL-06	quenched	Measured bc	0.0022	-0.0196	-0.0767	-0.3462	1.01	0.96	0.84	0.45
HWL-06	quenched	Targeted	-0.0051	-0.0168	-0.0775	-0.3405	0.99	0.96	0.84	0.46
HWL-07	ccc	Measured	-0.0610	-0.0691	-0.1229	-0.3119	0.87	0.85	0.75	0.49
HWL-07	ccc	Measured bc	-0.0530	-0.0642	-0.1176	-0.3217	0.89	0.86	0.76	0.48
HWL-07	ccc	Targeted	-0.0810	-0.0717	-0.1234	-0.3166	0.83	0.85	0.75	0.48
HWL-07	quenched	Measured	-0.0286	-0.0619	-0.0896	-0.3023	0.94	0.87	0.81	0.50
HWL-07	quenched	Measured bc	-0.0206	-0.0570	-0.0843	-0.3121	0.95	0.88	0.82	0.49
HWL-07	quenched	Targeted	-0.0486	-0.0646	-0.0901	-0.3069	0.89	0.86	0.81	0.49
HWL-08	ccc	Measured	-0.1019	-0.0490	-0.0613	-0.2876	0.79	0.89	0.87	0.52
HWL-08	ccc	Measured bc	-0.0939	-0.0442	-0.0560	-0.2974	0.81	0.90	0.88	0.50
HWL-08	ccc	Targeted	-0.1362	-0.0620	-0.0582	-0.2930	0.73	0.87	0.87	0.51
HWL-08	quenched	Measured	0.0348	-0.0015	-0.0205	-0.2662	1.08	1.00	0.95	0.54
HWL-08	quenched	Measured bc	0.0428	0.0033	-0.0152	-0.2760	1.10	1.01	0.97	0.53
HWL-08	quenched	Targeted	0.0005	-0.0145	-0.0174	-0.2716	1.00	0.97	0.96	0.54
HWL-09	ccc	Measured	-0.2140	-0.1892	-0.3348	-0.4370	0.61	0.65	0.46	0.37
HWL-09	ccc	Measured bc	-0.2037	-0.1834	-0.3386	-0.4378	0.63	0.66	0.46	0.36
HWL-09	ccc	Targeted	-0.2142	-0.1794	-0.3326	-0.4450	0.61	0.66	0.46	0.36
HWL-09	quenched	Measured	-0.2024	-0.1691	-0.3393	-0.4347	0.63	0.68	0.46	0.37
HWL-09	quenched	Measured bc	-0.1922	-0.1633	-0.3431	-0.4355	0.64	0.69	0.45	0.37
HWL-09	quenched	Targeted	-0.2026	-0.1592	-0.3371	-0.4427	0.63	0.69	0.46	0.36

Table 18 cont. Normalized PCTs by Glass ID/Compositional View

Glass ID	Heat Treatment	Comp View	log NL [B (g/L)]	log NL [Li(g/L)]	log NL [Na (g/L)]	log NL [Si (g/L)]	NL B(g/L)	NL Li (g/L)	NL Na (g/L)	NL Si (g/L)
HWL-10	ccc	Measured	-0.1893	-0.1791	-0.2731	-0.4362	0.65	0.66	0.53	0.37
HWL-10	ccc	Measured bc	-0.1790	-0.1733	-0.2768	-0.4370	0.66	0.67	0.53	0.37
HWL-10	ccc	Targeted	-0.1861	-0.1551	-0.2723	-0.4428	0.65	0.70	0.53	0.36
HWL-10	quenched	Measured	-0.1775	-0.1619	-0.2744	-0.4316	0.66	0.69	0.53	0.37
HWL-10	quenched	Measured bc	-0.1673	-0.1561	-0.2782	-0.4324	0.68	0.70	0.53	0.37
HWL-10	quenched	Targeted	-0.1743	-0.1379	-0.2736	-0.4382	0.67	0.73	0.53	0.36
HWL-11	ccc	Measured	-0.2179	-0.2014	-0.2567	-0.4329	0.61	0.63	0.55	0.37
HWL-11	ccc	Measured bc	-0.2077	-0.1956	-0.2605	-0.4336	0.62	0.64	0.55	0.37
HWL-11	ccc	Targeted	-0.2183	-0.1770	-0.2626	-0.4377	0.60	0.67	0.55	0.36
HWL-11	quenched	Measured	-0.1384	-0.1419	-0.2087	-0.4327	0.73	0.72	0.62	0.37
HWL-11	quenched	Measured bc	-0.1282	-0.1360	-0.2125	-0.4334	0.74	0.73	0.61	0.37
HWL-11	quenched	Targeted	-0.1388	-0.1174	-0.2146	-0.4375	0.73	0.76	0.61	0.37
HWL-12	ccc	Measured	-0.1646	-0.1188	-0.1335	-0.3136	0.68	0.76	0.74	0.49
HWL-12	ccc	Measured bc	-0.1544	-0.1130	-0.1373	-0.3144	0.70	0.77	0.73	0.48
HWL-12	ccc	Targeted	-0.1602	-0.0949	-0.1376	-0.3178	0.69	0.80	0.73	0.48
HWL-12	quenched	Measured	-0.1448	-0.1072	-0.0979	-0.2951	0.72	0.78	0.80	0.51
HWL-12	quenched	Measured bc	-0.1346	-0.1014	-0.1017	-0.2958	0.73	0.79	0.79	0.51
HWL-12	quenched	Targeted	-0.1404	-0.0834	-0.1020	-0.2993	0.72	0.83	0.79	0.50
HWL-13	ccc	Measured	-0.1038	-0.0776	-0.0938	-0.2779	0.79	0.84	0.81	0.53
HWL-13	ccc	Measured bc	-0.0936	-0.0718	-0.0976	-0.2787	0.81	0.85	0.80	0.53
HWL-13	ccc	Targeted	-0.1083	-0.0568	-0.0934	-0.2938	0.78	0.88	0.81	0.51
HWL-13	quenched	Measured	-0.1149	-0.0984	-0.0831	-0.2869	0.77	0.80	0.83	0.52
HWL-13	quenched	Measured bc	-0.1046	-0.0926	-0.0869	-0.2877	0.79	0.81	0.82	0.52
HWL-13	quenched	Targeted	-0.1194	-0.0775	-0.0827	-0.3028	0.76	0.84	0.83	0.50
HWL-14	ccc	Measured	-0.1198	-0.0700	-0.0645	-0.2837	0.76	0.85	0.86	0.52
HWL-14	ccc	Measured bc	-0.1096	-0.0642	-0.0682	-0.2845	0.78	0.86	0.85	0.52
HWL-14	ccc	Targeted	-0.1245	-0.0539	-0.0661	-0.2928	0.75	0.88	0.86	0.51
HWL-14	quenched	Measured	-0.0700	-0.0817	-0.0472	-0.2833	0.85	0.83	0.90	0.52
HWL-14	quenched	Measured bc	-0.0597	-0.0759	-0.0509	-0.2840	0.87	0.84	0.89	0.52
HWL-14	quenched	Targeted	-0.0746	-0.0656	-0.0488	-0.2924	0.84	0.86	0.89	0.51
HWL-15	ccc	Measured	-0.2892	-0.2347	-0.4517	-0.4674	0.51	0.58	0.35	0.34
HWL-15	ccc	Measured bc	-0.2789	-0.2289	-0.4554	-0.4682	0.53	0.59	0.35	0.34
HWL-15	ccc	Targeted	-0.2850	-0.2110	-0.4478	-0.4795	0.52	0.62	0.36	0.33
HWL-15	quenched	Measured	-0.2863	-0.2141	-0.4944	-0.4691	0.52	0.61	0.32	0.34
HWL-15	quenched	Measured bc	-0.2761	-0.2083	-0.4981	-0.4699	0.53	0.62	0.32	0.34
HWL-15	quenched	Targeted	-0.2822	-0.1904	-0.4905	-0.4812	0.52	0.65	0.32	0.33
HWL-16	ccc	Measured	-0.2916	-0.2288	-0.3977	-0.4748	0.51	0.59	0.40	0.34
HWL-16	ccc	Measured bc	-0.2814	-0.2230	-0.4015	-0.4756	0.52	0.60	0.40	0.33
HWL-16	ccc	Targeted	-0.2822	-0.2062	-0.3962	-0.4876	0.52	0.62	0.40	0.33
HWL-16	quenched	Measured	-0.2719	-0.2054	-0.4042	-0.4789	0.53	0.62	0.39	0.33
HWL-16	quenched	Measured bc	-0.2617	-0.1996	-0.4080	-0.4797	0.55	0.63	0.39	0.33
HWL-16	quenched	Targeted	-0.2626	-0.1828	-0.4026	-0.4917	0.55	0.66	0.40	0.32
HWL-17	ccc	Measured	-0.2375	-0.2022	-0.3176	-0.4814	0.58	0.63	0.48	0.33
HWL-17	ccc	Measured bc	-0.2273	-0.1964	-0.3213	-0.4821	0.59	0.64	0.48	0.33
HWL-17	ccc	Targeted	-0.2395	-0.1877	-0.3235	-0.4877	0.58	0.65	0.47	0.33
HWL-17	quenched	Measured	-0.2213	-0.1755	-0.3140	-0.4831	0.60	0.67	0.49	0.33
HWL-17	quenched	Measured bc	-0.2110	-0.1696	-0.3178	-0.4839	0.62	0.68	0.48	0.33
HWL-17	quenched	Targeted	-0.2233	-0.1609	-0.3200	-0.4894	0.60	0.69	0.48	0.32
HWL-18	ccc	Measured	-0.1575	-0.1030	-0.1355	-0.2903	0.70	0.79	0.73	0.51
HWL-18	ccc	Measured bc	-0.1472	-0.0972	-0.1392	-0.2911	0.71	0.80	0.73	0.51
HWL-18	ccc	Targeted	-0.1547	-0.0871	-0.1348	-0.3040	0.70	0.82	0.73	0.50
HWL-18	quenched	Measured	-0.1497	-0.0940	-0.1043	-0.2761	0.71	0.81	0.79	0.53
HWL-18	quenched	Measured bc	-0.1394	-0.0882	-0.1081	-0.2769	0.73	0.82	0.78	0.53
HWL-18	quenched	Targeted	-0.1468	-0.0781	-0.1037	-0.2898	0.71	0.84	0.79	0.51
HWL-19	ccc	Measured	-0.1264	-0.0841	-0.1108	-0.2856	0.75	0.82	0.77	0.52
HWL-19	ccc	Measured bc	-0.1162	-0.0783	-0.1146	-0.2864	0.77	0.84	0.77	0.52
HWL-19	ccc	Targeted	-0.1247	-0.0712	-0.1073	-0.2902	0.75	0.85	0.78	0.51
HWL-19	quenched	Measured	-0.1395	-0.1012	-0.0921	-0.3012	0.73	0.79	0.81	0.50
HWL-19	quenched	Measured bc	-0.1292	-0.0954	-0.0958	-0.3020	0.74	0.80	0.80	0.50
HWL-19	quenched	Targeted	-0.1378	-0.0883	-0.0885	-0.3058	0.73	0.82	0.82	0.49

Table 18 cont. Normalized PCTs by Glass ID/Compositional View

Glass ID	Heat Treatment	Comp View	log NL [B (g/L)]	log NL [Li(g/L)]	log NL [Na (g/L)]	log NL [Si (g/L)]	NL B(g/L)	NL Li (g/L)	NL Na (g/L)	NL Si (g/L)
HWL-20	ccc	Measured	-0.0956	-0.0759	-0.0829	-0.3019	0.80	0.84	0.83	0.50
HWL-20	ccc	Measured bc	-0.0854	-0.0701	-0.0866	-0.3027	0.82	0.85	0.82	0.50
HWL-20	ccc	Targeted	-0.0936	-0.0612	-0.0891	-0.3096	0.81	0.87	0.81	0.49
HWL-20	quenched	Measured	-0.0917	-0.0884	-0.0570	-0.2905	0.81	0.82	0.88	0.51
HWL-20	quenched	Measured bc	-0.0815	-0.0826	-0.0607	-0.2912	0.83	0.83	0.87	0.51
HWL-20	quenched	Targeted	-0.0897	-0.0737	-0.0632	-0.2982	0.81	0.84	0.86	0.50
HWL-21	ccc	Measured	0.6751	0.5546	0.1770	-0.2337	4.73	3.59	1.50	0.58
HWL-21	ccc	Measured bc	0.6830	0.5593	0.1823	-0.2435	4.82	3.62	1.52	0.57
HWL-21	ccc	Targeted	0.6641	0.5562	0.1788	-0.2394	4.61	3.60	1.51	0.58
HWL-21	quenched	Measured	-0.2978	-0.2473	-0.2835	-0.4611	0.50	0.57	0.52	0.35
HWL-21	quenched	Measured bc	-0.2898	-0.2425	-0.2782	-0.4709	0.51	0.57	0.53	0.34
HWL-21	quenched	Targeted	-0.3088	-0.2457	-0.2817	-0.4668	0.49	0.57	0.52	0.34
HWL-22	ccc	Measured	1.9492	1.8003	1.2500	0.4416	88.96	63.15	17.78	2.76
HWL-22	ccc	Measured bc	1.9572	1.8051	1.2553	0.4318	90.61	63.84	18.00	2.70
HWL-22	ccc	Targeted	1.9369	1.8132	1.2469	0.4401	86.47	65.04	17.66	2.76
HWL-22	quenched	Measured	-0.2429	-0.2398	-0.2019	-0.4510	0.57	0.58	0.63	0.35
HWL-22	quenched	Measured bc	-0.2349	-0.2351	-0.1967	-0.4609	0.58	0.58	0.64	0.35
HWL-22	quenched	Targeted	-0.2552	-0.2269	-0.2050	-0.4525	0.56	0.59	0.62	0.35
HWL-23	ccc	Measured	-0.1608	-0.1272	-0.2884	-0.3786	0.69	0.75	0.51	0.42
HWL-23	ccc	Measured bc	-0.1490	-0.1380	-0.2804	-0.3627	0.71	0.73	0.52	0.43
HWL-23	ccc	Targeted	-0.1597	-0.1332	-0.2754	-0.3762	0.69	0.74	0.53	0.42
HWL-23	quenched	Measured	-0.1456	-0.0983	-0.3085	-0.3721	0.72	0.80	0.49	0.42
HWL-23	quenched	Measured bc	-0.1338	-0.1091	-0.3005	-0.3561	0.73	0.78	0.50	0.44
HWL-23	quenched	Targeted	-0.1446	-0.1043	-0.2956	-0.3696	0.72	0.79	0.51	0.43
HWL-24	ccc	Measured	-0.1296	-0.0392	-0.0710	-0.2408	0.74	0.91	0.85	0.57
HWL-24	ccc	Measured bc	-0.1377	-0.0536	-0.0731	-0.2379	0.73	0.88	0.85	0.58
HWL-24	ccc	Targeted	-0.1216	-0.0384	-0.0784	-0.2487	0.76	0.92	0.83	0.56
HWL-24	quenched	Measured	-0.0941	-0.0179	-0.0086	-0.2204	0.81	0.96	0.98	0.60
HWL-24	quenched	Measured bc	-0.1022	-0.0323	-0.0107	-0.2175	0.79	0.93	0.98	0.61
HWL-24	quenched	Targeted	-0.0861	-0.0171	-0.0160	-0.2283	0.82	0.96	0.96	0.59
HWL-25	ccc	Measured	-0.2573	-0.1734	-0.4240	-0.4383	0.55	0.67	0.38	0.36
HWL-25	ccc	Measured bc	-0.2456	-0.1842	-0.4162	-0.4224	0.57	0.65	0.38	0.38
HWL-25	ccc	Targeted	-0.2601	-0.1729	-0.4130	-0.4294	0.55	0.67	0.39	0.37
HWL-25	quenched	Measured	-0.2415	-0.1333	-0.4571	-0.4330	0.57	0.74	0.35	0.37
HWL-25	quenched	Measured bc	-0.2298	-0.1441	-0.4492	-0.4172	0.59	0.72	0.36	0.38
HWL-25	quenched	Targeted	-0.2442	-0.1327	-0.4461	-0.4242	0.57	0.74	0.36	0.38
HWL-26	ccc	Measured	-0.2462	-0.1779	-0.3410	-0.4219	0.57	0.66	0.46	0.38
HWL-26	ccc	Measured bc	-0.2545	-0.1923	-0.3431	-0.4190	0.56	0.64	0.45	0.38
HWL-26	ccc	Targeted	-0.2410	-0.1653	-0.3353	-0.4301	0.57	0.68	0.46	0.37
HWL-26	quenched	Measured	-0.2310	-0.1408	-0.3839	-0.4088	0.59	0.72	0.41	0.39
HWL-26	quenched	Measured bc	-0.2393	-0.1552	-0.3860	-0.4060	0.58	0.70	0.41	0.39
HWL-26	quenched	Targeted	-0.2257	-0.1282	-0.3783	-0.4171	0.59	0.74	0.42	0.38
HWL-27	ccc	Measured	-0.1118	-0.0183	-0.0598	-0.2203	0.77	0.96	0.87	0.60
HWL-27	ccc	Measured bc	-0.1001	-0.0291	-0.0619	-0.2174	0.79	0.94	0.87	0.61
HWL-27	ccc	Targeted	-0.1034	-0.0225	-0.0557	-0.2262	0.79	0.95	0.88	0.59
HWL-27	quenched	Measured	-0.0647	0.0100	-0.0228	-0.1942	0.86	1.02	0.95	0.64
HWL-27	quenched	Measured bc	-0.0530	-0.0008	-0.0250	-0.1913	0.89	1.00	0.94	0.64
HWL-27	quenched	Targeted	-0.0562	0.0058	-0.0187	-0.2001	0.88	1.01	0.96	0.63
HWL-28	ccc	Measured	-0.1036	-0.0192	-0.0257	-0.2278	0.79	0.96	0.94	0.59
HWL-28	ccc	Measured bc	-0.1119	-0.0337	-0.0177	-0.2119	0.77	0.93	0.96	0.61
HWL-28	ccc	Targeted	-0.0755	-0.0098	-0.0337	-0.2273	0.84	0.98	0.93	0.59
HWL-28	quenched	Measured	-0.0848	-0.0163	-0.0016	-0.2151	0.82	0.96	1.00	0.61
HWL-28	quenched	Measured bc	-0.0930	-0.0307	0.0064	-0.1992	0.81	0.93	1.01	0.63
HWL-28	quenched	Targeted	-0.0566	-0.0069	-0.0096	-0.2147	0.88	0.98	0.98	0.61

4.4.5 Effects of Heat Treatment on PCTs

Figure B5 in Appendix B provides a series of plots and statistical comparisons that show the effects of heat treatment on the common logarithm ppm-responses of the triplicate PCTs for each element. The quenched version of a given glass yielded measurements indicating a significantly different mean log(ppm) response (at the 5% significance level) than the ccc version of the glass for a given element if the **Prob>|t|** value in the figure is 0.05 or smaller. A comparison of the quenched and ccc versions of the glasses for each element is shown in Table 19.

Many of these glasses exhibited a statistically significant difference between the ccc and quenched versions for one or more of the PCT elements. In a few cases, the ccc and quenched versions of the glasses were statistically different for all four elements (B, Li, Na and Si). As discussed in the previous section, although statistically significant, there is little if any practical difference between the quenched and ccc versions of the glasses with the exception of HWL-21 and HWL-22. Figure B6 in Appendix B provides plots of the normalized PCT responses that compare the quenched and ccc versions of the glass. These plots provide a basis for judging the practical impact of the differences in the PCT response due to the heat treatment of the glass.

Table 19. Samples Exhibiting a Statistically Significant Difference (at the 5% level)

Glass ID	B	Li	Na	Si
HWL-01	Q	Q	ccc	
HWL-02	Q	Q	Q	Q
HWL-03	Q	Q	Q	
HWL-04	Q	Q	Q	Q
HWL-05				
HWL-06	Q	Q	Q	Q
HWL-07				
HWL-08	Q	Q	Q	
HWL-09		Q		
HWL-10		Q		
HWL-11	Q	Q	Q	
HWL-12			Q	
HWL-13				
HWL-14	Q			
HWL-15				
HWL-16				
HWL-17		Q		
HWL-18			Q	
HWL-19		ccc	Q	
HWL-20				
HWL-21	ccc	ccc	ccc	ccc
HWL-22	ccc	ccc	ccc	ccc
HWL-23		Q	ccc	
HWL-24	Q	Q	Q	Q
HWL-25		Q	ccc	
HWL-26	Q	Q	ccc	
HWL-27	Q	Q	Q	Q
HWL-28			Q	

4.4.6 Acceptability of Study Glasses

With respect to the durability of the study glasses, there were two glasses of primary interest: HWL-21 and HWL-22. These two glasses target 50 and 55% WL, respectively, and were prone to nepheline formation based on the current discriminator value of 0.62. SRNL and PNNL have previously produced multiple glasses, which were prone to nepheline formation based on the 0.62 value, which did not yield nepheline upon slow cooling and showed no significant increase in PCT relative to their quenched counterparts. In fact, some of the glasses produced had discriminator values as low as 0.4 with Al_2O_3 concentrations of ~ 26 wt%.[7] These data indicated that the nepheline discriminator, although very effective at isolating glasses prone to nepheline formation, could be conservative leading to limitations in glass compositional regions that could improve waste loading (for high Al_2O_3 concentration sludges) or melt rate. A key driver for suppressing nepheline formation in these glasses was the targeting of higher B_2O_3 contents. Therefore, HWL-21 and HWL-22 were selected to provide more insight into the use of higher B_2O_3 contents to suppress nepheline formation. The PCT results of the quenched versions of HWL-21 and HWL-22 were ~0.5 to 0.6 g/L with respect to NL [B]. The glasses are very durable after a rapid cooling schedule, which is consistent with previous data indicating that the formation of nepheline occurs upon slow cooling. When evaluating the PCT response of the ccc version of these two glasses, there is both a statistical and practical difference as compared to their quenched counterparts. The NL [B] for these two glasses are approximately 4.7 and 90.0 g/L, respectively. The PCT response of HWL-21ccc is acceptable relative to the EA glass (16.695 g/L), whereas the NL [B] release of HWL-22 ccc exceeds the EA value by a factor of 5. The XRD data (see Figure 22 and 23) indicate nepheline formation in both glasses. The trends in the PCT response suggest that as WL increases in this system, the glasses become less durable upon canister centerline cooling, suggesting that the volume percent of nepheline increases with increased WL; however, the semi-quantitative XRD results indicate that there is more nepheline in the lower WL glass (HWL-21) as compared to the higher WL glass (HWL-22). It is probable that either the XRD samples were switched or there was some other controlling factor in addition to nepheline formation that is unknown at this time.

All of the other study glasses (both radioactive and non-radioactive) were very acceptable relative to the EA glass benchmark with NL [B] releases ranging from 0.5 to 1.1 g/L for the quenched glasses and 0.4 to 0.9 g/L for the ccc versions. This is not surprising given that the selection of glasses for HWL-01 through HWL-20 were primarily chosen in order to gain insight into T_L issues and were not intended to challenge durability. The study glasses (HWL-23 through HWL-29) challenging the homogeneity and/or associated constraints are discussed in Section 4.4.8.

4.4.7 Predicted versus Measured PCTs

Although not a major focus of the study, an assessment was made of the applicability of the current durability model to the study glasses. Figure B7 in Appendix B provides plots of the DWPF models that relate the logarithm of the normalized PCT (for each element of interest) to a linear function of a free energy of hydration term (ΔG_p, kcal/100g glass) derived from each of the glass compositional views and heat treatments.[22] Prediction limits (at a 95% confidence) for an individual PCT result are plotted along with the linear fit. The EA and ARM results are also included in these plots. Figure 25 shows the free energy of hydration versus log NL [B] for all the study glasses.

Some observations with respect to Figure 25 include:

(1) Two of the glasses (HWL-21ccc and HWL-22ccc) fall above the 95% confidence intervals, which is not surprising due to the formation of nepheline in these glasses and the known negative impact nepheline crystallization on durability.[23] The current durability model does

not account for nepheline formation; however, these glasses would not have been processed through DWPF due to their predicted nepheline discriminator values (see Table 11).

(2) A series of glasses also falls above the upper 95% confidence band. These points have more positive ΔG_p values and are of little concern. The normalized PCT values are very acceptable when compared to the values of EA, and this type of behavior for ΔG_p-model predictions has been frequently seen in glass variability studies supporting the DWPF process.[24]

(3) A majority of the glasses fall within the 95% confidence bands, which indicates that the model is applicable to the compositional region evaluated in this study. Although not surprising, additional insight has been gained concerning the applicability of the durability model for glasses containing up to ~ 3.5 wt% TiO_2 as well as those glasses failing homogeneity for coupled operations (as will be discussed in Section 4.4.8).

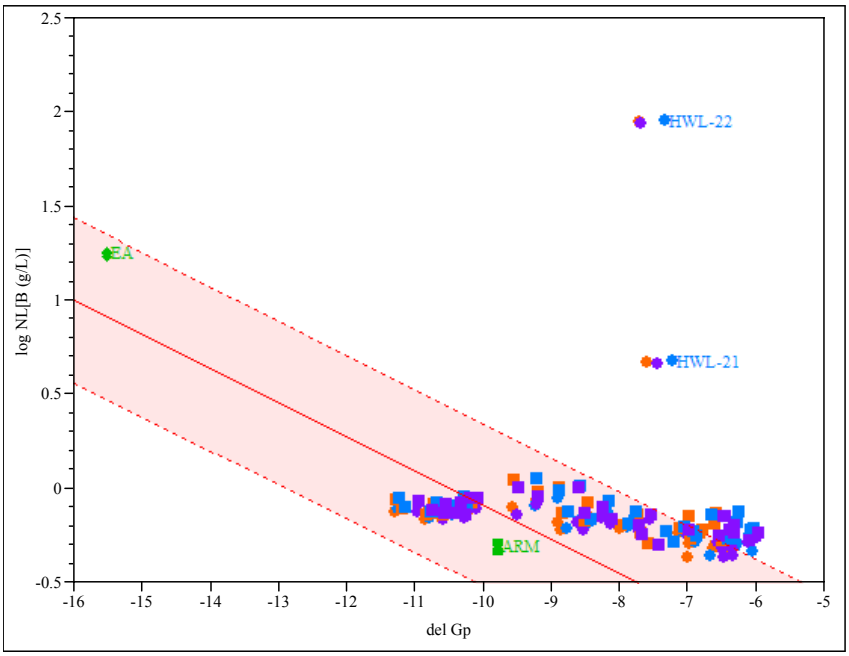

Figure 25. log NL[B (g/L)] versus the del Gp (ΔGp) model with a 95% confidence interval for individual PCTs.

4.4.8 Assessment of Homogeneity for Coupled Operations

HWL-23 through HWL-28 were designed and selected to provide insight into the potential replacement of the homogeneity constraint for coupled operations. This information will not provide the technical basis for actual PCCS implementation of that replacement due to the limited coverage in compositional space. As shown in Table 11, all of these glasses fail the homogeneity constraint and/or an associated durability constraint (i.e., low frit). They also exceed the upper TiO_2 concentration limit of 2 wt% currently in PCCS. The primary measure for assessing the possible replacement of the homogeneity constraint with the Al_2O_3 and/or sum of alkali constraints[s] is the durability response.[25]

[s] Herman et al. determined that the homogeneity constraint can be replaced by an Al_2O_3 and/or sum or alkali constraint for sludge-only operations. If the Al_2O_3 content of the glass is greater than 4 wt%, there is no upper alkali constraint (over the range evaluated). If the Al_2O_3 content is less than 4 wt%, but greater than 3 wt%, there is an upper alkali content of 19.3 wt% (in glass) that is activated.

The PCT data indicate that the NL [B] for this series of glasses ranges from approximately 0.5 to 0.9 g/L regardless of thermal history (quenched or ccc) or compositional view (target, measured, or measured-bc). These glasses are very durable (as well as acceptable; see Figure 25) and could be processed in DWPF. Thus, the probability of replacing the homogeneity constraint with the Al_2O_3 and/or sum of alkali constraints is high for coupled operations. It should be noted that this series of glasses would comply with the alternative constraints (e.g., Al_2O_3 and/or sum or alkali).

5.0 Summary

Twenty-one glasses were fabricated to provide insight into primary and secondary test objectives. The primary objective of this study was to generate supplemental validation data that could be used to determine the applicability of the current T_L model to expanded DWPF glass regions of interest based on higher WLs or various flowsheet options under consideration. Two specific flowsheets were used to generate the test matrix glasses:

(1) Higher WL glasses (45 and 50%) based on future sludge batches that have (and have not) undergone the Al-dissolution process.

(2) Coupled operations supported by SWPF, which increases the TiO_2 concentration in glass to greater than 2 wt%.

Glasses were also selected to address technical issues associated with Al_2O_3 solubility, nepheline formation, and homogeneity issues from coupled operations.

The results of this study are summarized below:

- TiO_2 concentrations up to ~ 3.5 wt% were retained in DWPF type glasses, where retention is defined as the absence of crystalline TiO_2 (undissolved or unreacted) in the as-fabricated glasses. Although this TiO_2 content does not bound the projected SWPF high output flowsheet (up to 6 wt% TiO_2 may be required in glass), these data indicate the potential for increasing the TiO_2 limit in glass from the current limit of 2 wt% (based strictly on retention or solubility).

- For those study glasses which had very close compositional overlap with the model development and/or model validation ranges (except TiO_2 and MgO concentrations), there was very little difference in the predicted and measured T_L values, even though the TiO_2 contents were above the 2 wt% upper limit. The results indicate that the current T_L model is applicable in these compositional regions.

- As the compositional overlap between the model validation ranges diverged from the target glass compositions, the T_L data suggest that the model under-predicted the measured values (i.e., differences greater than the RMSE of 38°C for the model predictions). These discrepancies imply that there are individual oxides or their combinations that were outside of the model development and/or validation range over which the model was previously assessed. These oxides include B_2O_3, SiO_2, MnO, TiO_2 and/or their combinations.
    - More data would be required to fill in these anticipated DWPF compositional regions so that the model coefficients could be refit to account for these differences.

- Based on the PCT responses of HWL-21 and HWL-22 (two glasses that were prone to nepheline formation) it appears that increased B_2O_3 concentration in glass does not

consistently suppress the formation of nepheline in glasses with higher Al_2O_3 and/or Na_2O content. Although the quenched versions of these glasses were very acceptable, the ccc glasses exhibited a considerable decrease in durability. In fact, one of the glasses had a release that was 5 times greater than the EA benchmark glass.

- These results suggest a need for a more fundamental understanding of the compositional and kinetic effects of nepheline formation in high WL glasses.

- Data have been generated to support the replacement of the homogeneity constraint with the Al_2O_3 and/or sum of alkali constraints for coupled operations as previously completed for sludge-only operations. This strategy should be pursued for either the compositional region anticipated for coupled operations or as part of the variability study for each sludge batch. The PCT responses suggest a high probability that this strategy could be defended at some later date.

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Appendix A:

Tables and Figures Supporting the Analysis of the Chemical Composition Measurements of the Test Matrix 2 Glasses

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Table A1. Measured Elemental Concentrations (wt%) for the Test Matrix 2 Glasses without Uranium Prepared Using Lithium Metaborate (part 1)

Set	Glass ID	Block	Sequence	Lab ID	Al (wt%)	Ba (wt%)	Ca (wt%)	Ce (wt%)	Cr (wt%)	Cu (wt%)	Fe (wt%)	K (wt%)	La (wt%)	Mg (wt%)
1	Batch 1	1	1	BCHLM1111	2.51	0.13	0.851	<0.010	0.076	0.305	8.82	2.44	<0.010	0.831
1	HWL-03	1	2	G01LM21	5.7	0.087	0.854	0.203	0.07	0.035	9.72	0.075	0.075	0.118
1	HWL-22	1	3	G08LM11	10.1	0.092	1.14	0.088	0.106	0.042	6.86	0.098	0.046	0.128
1	HWL-21	1	4	G03LM21	9.01	0.08	1.01	0.078	0.087	0.037	6.33	0.095	0.041	0.113
1	HWL-07	1	5	G05LM21	3.68	0.101	1.09	0.212	0.102	0.04	11.5	0.09	0.078	0.132
1	HWL-02	1	6	G06LM21	6.4	0.107	0.974	0.223	0.077	0.036	11.8	0.085	0.081	0.132
1	HWL-06	1	7	G02LM21	4.05	0.112	1.22	0.236	0.113	0.047	12.5	0.102	0.09	0.148
1	HWL-06	1	8	G02LM11	4.06	0.11	1.25	0.23	0.111	0.046	11.9	0.111	0.089	0.145
1	HWL-01	1	9	G09LM11	5.82	0.083	0.868	0.194	0.069	0.033	9.67	0.086	0.071	0.113
1	HWL-22	1	10	G08LM21	10	0.094	1.14	0.089	0.11	0.041	6.67	0.099	0.047	0.13
1	HWL-05	1	11	G10LM11	3.72	0.105	1.12	0.215	0.097	0.043	11.7	0.099	0.082	0.133
1	Batch 1	1	12	BCHLM1112	2.59	0.13	0.891	<0.010	0.076	0.311	8.73	2.46	<0.010	0.823
1	HWL-04	1	13	G04LM11	6.43	0.096	0.971	0.227	0.075	0.04	11.3	0.087	0.083	0.13
1	HWL-04	1	14	G04LM21	6.17	0.093	0.957	0.222	0.072	0.035	9.95	0.081	0.081	0.126
1	HWL-01	1	15	G09LM21	5.64	0.084	0.848	0.198	0.072	0.033	9.45	0.079	0.071	0.113
1	HWL-08	1	16	G07LM21	4.11	0.117	1.25	0.235	0.101	0.047	11.6	0.117	0.09	0.145
1	HWL-07	1	17	G05LM11	3.6	0.101	1.08	0.217	0.103	0.042	10.8	0.092	0.079	0.133
1	HWL-02	1	18	G06LM11	6.43	0.094	0.975	0.223	0.076	0.036	11	0.094	0.08	0.127
1	HWL-08	1	19	G07LM11	4.13	0.113	1.24	0.238	0.102	0.047	12.5	0.109	0.091	0.144
1	HWL-05	1	20	G10LM21	3.69	0.103	1.12	0.216	0.085	0.043	10.7	0.098	0.081	0.128
1	HWL-21	1	21	G03LM11	9.06	0.08	1.02	0.078	0.088	0.039	6	0.099	0.041	0.113
1	HWL-03	1	22	G01LM11	5.73	0.085	0.859	0.203	0.07	0.036	9.36	0.077	0.074	0.116
1	Batch 1	1	23	BCHLM1113	2.58	0.131	0.904	<0.010	0.076	0.316	8.49	2.51	<0.010	0.827
1	Batch 1	2	1	BCHLM1121	2.52	0.131	0.872	<0.010	0.076	0.311	8.53	2.41	<0.010	0.849
1	HWL-08	2	2	G07LM12	4.12	0.115	1.3	0.235	0.103	0.045	11.7	0.105	0.09	0.148
1	HWL-08	2	3	G07LM22	4.11	0.115	1.27	0.229	0.099	0.045	11.7	0.113	0.087	0.144
1	HWL-22	2	4	G08LM22	10.1	0.091	1.17	0.087	0.107	0.04	6.64	0.098	0.044	0.128
1	HWL-21	2	5	G03LM12	9.24	0.079	1.04	0.076	0.087	0.037	6.31	0.096	0.039	0.114
1	HWL-07	2	6	G05LM12	3.65	0.1	1.09	0.213	0.102	0.04	11.4	0.09	0.077	0.133
1	HWL-04	2	7	G04LM12	6.51	0.094	1	0.221	0.074	0.037	11	0.084	0.08	0.13
1	HWL-07	2	8	G05LM22	3.71	0.102	1.12	0.213	0.102	0.039	11.1	0.091	0.077	0.135
1	HWL-22	2	9	G08LM12	10	0.09	1.14	0.086	0.105	0.041	6.94	0.098	0.044	0.128
1	HWL-02	2	10	G06LM22	6.38	0.105	1	0.221	0.076	0.034	10.8	0.086	0.079	0.131
1	HWL-06	2	11	G02LM22	4.04	0.111	1.23	0.234	0.111	0.046	12.3	0.103	0.088	0.148
1	Batch 1	2	12	BCHLM1122	2.53	0.129	0.902	<0.010	0.075	0.307	8.72	2.41	<0.010	0.829
1	HWL-05	2	13	G10LM22	3.73	0.104	1.14	0.213	0.086	0.041	10.9	0.095	0.08	0.132
1	HWL-21	2	14	G03LM22	9.13	0.08	1.05	0.076	0.087	0.036	5.89	0.095	0.039	0.115
1	HWL-03	2	15	G01LM12	5.73	0.086	0.879	0.202	0.069	0.034	9.32	0.075	0.073	0.118
1	HWL-01	2	16	G09LM22	5.71	0.083	0.873	0.196	0.071	0.032	9.32	0.079	0.07	0.113
1	HWL-04	2	17	G04LM22	6.23	0.093	0.97	0.221	0.071	0.034	10.5	0.081	0.078	0.126
1	HWL-05	2	18	G10LM12	3.75	0.103	1.14	0.213	0.094	0.042	11.6	0.1	0.079	0.133
1	HWL-01	2	19	G09LM12	5.91	0.082	0.892	0.193	0.068	0.032	10	0.087	0.069	0.112
1	HWL-02	2	20	G06LM12	6.5	0.094	0.992	0.22	0.075	0.035	11.6	0.09	0.079	0.129
1	HWL-06	2	21	G02LM12	4.13	0.111	1.27	0.231	0.112	0.046	12.6	0.113	0.088	0.148
1	HWL-03	2	22	G01LM22	5.77	0.086	0.877	0.204	0.07	0.035	9.44	0.077	0.074	0.119
1	Batch 1	2	23	BCHLM1212	2.59	0.13	0.921	<0.010	0.076	0.312	8.2	2.44	<0.010	0.838
2	Batch 1	1	1	BCHLM2111	2.52	0.125	0.885	<0.010	0.073	0.303	9.02	2.36	0.001	0.821
2	HWL-16	1	2	H12LM11	2.34	0.065	0.706	0.207	0.052	0.027	8.38	0.052	0.068	0.098
2	HWL-09	1	3	H06LM11	2.37	0.066	0.586	0.147	0.053	0.03	7.42	0.055	0.049	0.077
2	HWL-20	1	4	H05LM11	2.7	0.076	0.825	0.226	0.072	0.03	9.54	0.068	0.075	0.109
2	HWL-19	1	5	H07LM21	2.37	0.068	0.713	0.205	0.064	0.027	8.19	0.066	0.066	0.096
2	HWL-18	1	6	H08LM21	2.05	0.058	0.594	0.182	0.05	0.025	7.4	0.044	0.059	0.085
2	HWL-15	1	7	H01LM21	2.06	0.058	0.62	0.181	0.042	0.024	7.41	0.046	0.058	0.085
2	HWL-18	1	8	H08LM11	2.07	0.058	0.595	0.183	0.05	0.023	7.5	0.043	0.059	0.087
2	HWL-19	1	9	H07LM11	2.37	0.068	0.711	0.208	0.064	0.028	8.45	0.057	0.067	0.096
2	HWL-17	1	10	H04LM11	2.7	0.075	0.829	0.231	0.055	0.03	9.68	0.061	0.077	0.114
2	HWL-13	1	11	H03LM11	2.75	0.09	0.704	0.165	0.052	0.033	8.27	0.064	0.058	0.096
2	HWL-12	1	12	H02LM21	2.44	0.065	0.599	0.147	0.056	0.03	7.53	0.054	0.051	0.085
2	HWL-10	1	13	H10LM11	2.72	0.077	0.707	0.168	0.061	0.033	8.48	0.063	0.058	0.095
2	Batch 1	1	14	BCHLM2112	2.53	0.126	0.864	<0.010	0.073	0.308	9.23	2.4	0.001	0.82
2	HWL-13	1	15	H03LM21	2.74	0.089	0.697	0.166	0.051	0.034	8.31	0.07	0.058	0.094
2	HWL-11	1	16	H11LM21	3.02	0.085	0.799	0.192	0.055	0.036	9.09	0.072	0.066	0.107
2	HWL-09	1	17	H06LM21	2.41	0.065	0.595	0.152	0.052	0.029	7.36	0.053	0.05	0.077
2	HWL-16	1	18	H12LM21	2.36	0.063	0.708	0.205	0.052	0.031	8.65	0.058	0.067	0.097
2	HWL-20	1	19	H05LM21	2.67	0.075	0.811	0.231	0.069	0.03	9.92	0.065	0.076	0.108
2	HWL-15	1	20	H01LM11	2.06	0.056	0.608	0.178	0.042	0.025	7.71	0.049	0.057	0.083

Table A1. Measured Elemental Concentrations (wt%) for the Test Matrix 2 Glasses without Uranium Prepared Using Lithium Metaborate (part 1)

Set	Glass ID	Block	Sequence	Lab ID	Al (wt%)	Ba (wt%)	Ca (wt%)	Ce (wt%)	Cr (wt%)	Cu (wt%)	Fe (wt%)	K (wt%)	La (wt%)	Mg (wt%)
2	HWL-14	1	21	H09LM11	3.1	0.084	0.802	0.184	0.06	0.035	9.56	0.078	0.064	0.104
2	HWL-17	1	22	H04LM21	2.67	0.078	0.807	0.239	0.059	0.03	10.19	0.061	0.079	0.117
2	HWL-12	1	23	H02LM11	2.44	0.063	0.593	0.147	0.056	0.03	7.49	0.057	0.051	0.082
2	HWL-14	1	24	H09LM21	3.11	0.084	0.801	0.187	0.06	0.036	9.63	0.08	0.064	0.103
2	HWL-10	1	25	H10LM21	2.7	0.075	0.683	0.17	0.06	0.033	8.6	0.062	0.057	0.093
2	HWL-11	1	26	H11LM11	3.04	0.084	0.787	0.196	0.054	0.038	9.73	0.071	0.067	0.106
2	Batch 1	1	27	BCHLM2113	2.49	0.126	0.823	<0.010	0.073	0.311	9.48	2.41	0.001	0.816
2	Batch 1	2	1	BCHLM2121	2.53	0.127	0.895	<0.010	0.074	0.308	8.81	2.42	0.001	0.833
2	HWL-10	2	2	H10LM22	2.69	0.078	0.701	0.17	0.062	0.03	7.92	0.057	0.058	0.097
2	HWL-09	2	3	H06LM12	2.4	0.066	0.61	0.148	0.053	0.028	7.18	0.052	0.049	0.079
2	HWL-12	2	4	H02LM22	2.46	0.066	0.619	0.149	0.056	0.028	6.95	0.05	0.052	0.087
2	HWL-14	2	5	H09LM12	3.11	0.086	0.827	0.185	0.061	0.032	8.86	0.075	0.064	0.106
2	HWL-15	2	6	H01LM22	2.07	0.059	0.632	0.185	0.042	0.022	7.26	0.043	0.059	0.086
2	HWL-11	2	7	H11LM12	3.06	0.086	0.818	0.196	0.055	0.036	8.94	0.067	0.067	0.109
2	HWL-19	2	8	H07LM22	2.37	0.068	0.73	0.206	0.064	0.024	7.91	0.062	0.067	0.097
2	HWL-19	2	9	H07LM12	2.37	0.07	0.721	0.212	0.066	0.026	8.1	0.052	0.068	0.1
2	HWL-13	2	10	H03LM22	2.73	0.092	0.71	0.166	0.052	0.032	7.87	0.065	0.058	0.098
2	HWL-18	2	11	H08LM22	2.07	0.059	0.62	0.184	0.05	0.023	6.98	0.04	0.06	0.089
2	HWL-16	2	12	H12LM12	2.36	0.067	0.724	0.214	0.053	0.025	8	0.05	0.07	0.102
2	HWL-20	2	13	H05LM12	2.71	0.075	0.842	0.228	0.072	0.028	9.08	0.066	0.076	0.108
2	Batch 1	2	14	BCHLM2122	2.53	0.129	0.932	<0.010	0.075	0.311	8.47	2.42	0.001	0.837
2	HWL-20	2	15	H05LM22	2.67	0.076	0.829	0.235	0.07	0.028	9.1	0.065	0.077	0.111
2	HWL-13	2	16	H03LM12	2.73	0.092	0.715	0.17	0.052	0.032	7.73	0.063	0.059	0.098
2	HWL-14	2	17	H09LM22	3.09	0.087	0.819	0.189	0.062	0.033	8.74	0.076	0.066	0.108
2	HWL-09	2	18	H06LM22	2.41	0.068	0.603	0.155	0.054	0.027	7.06	0.049	0.051	0.081
2	HWL-17	2	19	H04LM22	2.67	0.077	0.827	0.242	0.059	0.028	9.13	0.059	0.079	0.117
2	HWL-12	2	20	H02LM12	2.45	0.064	0.62	0.148	0.056	0.028	6.77	0.055	0.051	0.084
2	HWL-17	2	21	H04LM12	2.66	0.077	0.827	0.241	0.055	0.029	9.09	0.061	0.079	0.117
2	HWL-16	2	22	H12LM22	2.37	0.066	0.726	0.211	0.053	0.029	8	0.056	0.069	0.102
2	HWL-15	2	23	H01LM12	2.08	0.059	0.626	0.183	0.043	0.023	7.07	0.045	0.059	0.087
2	HWL-10	2	24	H10LM12	2.72	0.08	0.715	0.174	0.063	0.032	7.83	0.06	0.059	0.099
2	HWL-11	2	25	H11LM12	2.95	0.084	0.794	0.191	0.054	0.034	8.19	0.067	0.065	0.108
2	HWL-18	2	26	H08LM12	2.08	0.06	0.605	0.19	0.051	0.022	7.14	0.04	0.061	0.09
2	Batch 1	2	27	BCHLM2123	2.54	0.127	0.877	<0.010	0.073	0.313	8.45	2.42	0.001	0.826

Table A1. Measured Elemental Concentrations (wt%) for the Test Matrix 2 Glasses without Uranium Prepared Using Lithium Metaborate (part 2)

Set	Glass ID	Block	Sequence	Lab ID	Mn (wt%)	Na (wt%)	Nb (wt%)	Ni (wt%)	Pb (wt%)	Si (wt%)	Ti (wt%)	Zn (wt%)	Zr (wt%)
1	Batch 1	1	1	BCHLM1111	1.36	6.61	<0.100	0.554	<0.010	23.1	0.393	<0.010	0.065
1	HWL-03	1	2	G01LM21	1.49	7.51	<0.100	0.374	0.097	19.8	0.877	0.049	0.171
1	HWL-22	1	3	G08LM11	0.804	11.6	<0.100	0.127	0.037	17.5	0.991	0.04	0.178
1	HWL-21	1	4	G03LM21	0.733	10.6	<0.100	0.109	0.03	18.9	0.873	0.035	0.162
1	HWL-07	1	5	G05LM21	2	8.99	<0.100	0.419	0.099	21.9	0.739	0.058	0.199
1	HWL-02	1	6	G06LM21	1.8	8.35	<0.100	0.407	0.105	19.6	0.968	0.051	0.187
1	HWL-06	1	7	G02LM21	2.2	8.51	<0.100	0.452	0.099	19.6	0.836	0.065	0.223
1	HWL-06	1	8	G02LM11	2.1	8.76	<0.100	0.441	0.097	19.3	0.815	0.064	0.219
1	HWL-01	1	9	G09LM11	1.49	7.52	<0.100	0.346	0.088	20.8	0.842	0.045	0.162
1	HWL-22	1	10	G08LM21	0.778	11.5	<0.100	0.129	0.039	17.3	0.999	0.041	0.181
1	HWL-05	1	11	G10LM11	2	7.89	<0.100	0.41	0.102	21.6	0.74	0.061	0.207
1	Batch 1	1	12	BCHLM1112	1.36	6.79	<0.100	0.552	<0.010	23.1	0.395	<0.010	0.066
1	HWL-04	1	13	G04LM11	1.73	8.19	<0.100	0.398	0.106	18.8	0.979	0.053	0.189
1	HWL-04	1	14	G04LM21	1.53	8.44	<0.100	0.379	0.102	17.6	0.955	0.05	0.186
1	HWL-01	1	15	G09LM21	1.43	7.42	<0.100	0.363	0.091	20.3	0.853	0.045	0.164
1	HWL-08	1	16	G07LM21	2.06	9.7	<0.100	0.443	0.11	19.9	0.817	0.066	0.219
1	HWL-07	1	17	G05LM11	1.88	8.9	<0.100	0.422	0.099	21.2	0.745	0.059	0.203
1	HWL-02	1	18	G06LM11	1.68	8.27	<0.100	0.392	0.101	19.3	0.952	0.05	0.185
1	HWL-08	1	19	G07LM11	2.22	9.75	<0.100	0.451	0.111	20.3	0.822	0.065	0.22
1	HWL-05	1	20	G10LM21	1.9	7.93	<0.100	0.355	0.101	20.8	0.727	0.059	0.201
1	HWL-21	1	21	G03LM11	0.688	10.7	<0.100	0.108	0.03	18.6	0.872	0.035	0.162
1	HWL-03	1	22	G01LM11	1.43	7.49	<0.100	0.368	0.095	19.6	0.87	0.048	0.172
1	Batch 1	1	23	BCHLM1113	1.31	6.82	<0.100	0.556	<0.010	22.9	0.394	<0.010	0.068
1	Batch 1	2	1	BCHLM1121	1.24	6.72	<0.100	0.562	<0.010	22.9	0.403	<0.010	0.064
1	HWL-08	2	2	G07LM12	2.01	9.9	<0.100	0.46	0.112	19.8	0.839	0.065	0.217
1	HWL-08	2	3	G07LM22	2.02	9.88	<0.100	0.44	0.107	19.9	0.814	0.064	0.213
1	HWL-22	2	4	G08LM22	0.697	11.8	<0.100	0.125	0.037	17.5	0.997	0.039	0.177
1	HWL-21	2	5	G03LM12	0.65	11	<0.100	0.107	0.029	19.1	0.886	0.033	0.161
1	HWL-07	2	6	G05LM12	1.93	9.04	<0.100	0.42	0.097	21.8	0.753	0.057	0.2
1	HWL-04	2	7	G04LM12	1.62	8.43	<0.100	0.394	0.105	18.7	0.983	0.051	0.186
1	HWL-07	2	8	G05LM22	1.87	9.17	<0.100	0.424	0.099	21.8	0.756	0.057	0.203
1	HWL-22	2	9	G08LM12	0.732	11.7	<0.100	0.125	0.037	17.6	1.001	0.039	0.178
1	HWL-02	2	10	G06LM22	1.59	8.48	<0.100	0.404	0.103	19.1	0.976	0.049	0.185
1	HWL-06	2	11	G02LM22	2.1	8.56	<0.100	0.451	0.098	19.5	0.835	0.063	0.222
1	Batch 1	2	12	BCHLM1122	1.28	6.7	<0.100	0.553	<0.010	23	0.395	<0.010	0.065
1	HWL-05	2	13	G10LM22	1.88	8.09	<0.100	0.362	0.101	21	0.732	0.058	0.198
1	HWL-21	2	14	G03LM22	0.604	10.8	<0.100	0.108	0.031	18.6	0.882	0.034	0.16
1	HWL-03	2	15	G01LM12	1.36	7.54	<0.100	0.374	0.095	19.6	0.887	0.047	0.171
1	HWL-01	2	16	G09LM22	1.35	7.58	<0.100	0.362	0.089	20.3	0.86	0.043	0.162
1	HWL-04	2	17	G04LM22	1.54	8.59	<0.100	0.379	0.102	18	0.968	0.048	0.184
1	HWL-05	2	18	G10LM12	1.93	8.04	<0.100	0.406	0.1	21.6	0.744	0.059	0.204
1	HWL-01	2	19	G09LM12	1.47	7.62	<0.100	0.341	0.086	21.1	0.845	0.043	0.16
1	HWL-02	2	20	G06LM12	1.71	8.35	<0.100	0.395	0.101	19.7	0.971	0.049	0.183
1	HWL-06	2	21	G02LM12	2.16	8.84	<0.100	0.446	0.097	19.8	0.83	0.064	0.22
1	HWL-03	2	22	G01LM22	1.38	7.59	<0.100	0.376	0.096	19.7	0.894	0.048	0.174
1	Batch 1	2	23	BCHLM1212	1.21	6.92	<0.100	0.557	<0.010	22.7	0.401	<0.010	0.066
2	Batch 1	1	1	BCHLM2111	1.38	6.68	<0.100	0.546	0.003	23.5	0.39	<0.010	0.064
2	HWL-16	1	2	H12LM11	2.11	6.34	0.486	0.243	0.107	22.6	1.75	0.016	0.438
2	HWL-09	1	3	H06LM11	2.71	5.83	0.616	0.464	0.091	23	1.32	0.026	0.514
2	HWL-20	1	4	H05LM11	2.45	10.1	0.541	0.28	0.12	21.8	1.97	0.022	0.483
2	HWL-19	1	5	H07LM21	2.15	9.71	0.483	0.25	0.108	23.4	1.74	0.018	0.453
2	HWL-18	1	6	H08LM21	1.86	9.22	0.418	0.216	0.099	24.6	1.56	0.014	0.363
2	HWL-15	1	7	H01LM21	1.87	5.66	0.419	0.211	0.091	24.3	1.54	0.013	0.393
2	HWL-18	1	8	H08LM11	1.88	9.04	0.42	0.218	0.101	24.9	1.56	0.014	0.366
2	HWL-19	1	9	H07LM11	2.2	9.77	0.486	0.252	0.109	23.8	1.76	0.017	0.458
2	HWL-17	1	10	H04LM11	2.47	7.13	0.544	0.277	0.124	21.6	1.97	0.02	0.506
2	HWL-13	1	11	H03LM11	3.14	9.94	0.702	0.519	0.109	22.3	1.56	0.031	0.527
2	HWL-12	1	12	H02LM21	2.88	9.26	0.617	0.467	0.089	24.7	1.36	0.024	0.458
2	HWL-10	1	13	H10LM11	3.17	6.77	0.712	0.511	0.106	22	1.53	0.032	0.598
2	Batch 1	1	14	BCHLM2112	1.4	6.68	<0.100	0.547	0.002	24	0.394	<0.010	0.068
2	HWL-13	1	15	H03LM21	3.16	9.75	0.7	0.516	0.108	22.3	1.57	0.03	0.529
2	HWL-11	1	16	H11LM21	3.56	7.36	0.805	0.564	0.114	20.5	1.72	0.035	0.638
2	HWL-09	1	17	H06LM21	2.8	5.99	0.632	0.466	0.092	23.6	1.34	0.026	0.536
2	HWL-16	1	18	H12LM21	2.2	6.36	0.477	0.233	0.103	23.2	1.71	0.016	0.434
2	HWL-20	1	19	H05LM21	2.53	9.88	0.541	0.277	0.12	22	1.97	0.02	0.489
2	HWL-15	1	20	H01LM11	1.94	5.53	0.415	0.204	0.089	24.9	1.51	0.012	0.387

Table A1. Measured Elemental Concentrations (wt%) for the Test Matrix 2 Glasses without Uranium Prepared Using Lithium Metaborate (part 2)

Set	Glass ID	Block	Sequence	Lab ID	Mn (wt%)	Na (wt%)	Nb (wt%)	Ni (wt%)	Pb (wt%)	Si (wt%)	Ti (wt%)	Zn (wt%)	Zr (wt%)
2	HWL-14	1	21	H09LM11	3.75	10.2	0.754	0.555	0.113	21.1	1.68	0.031	0.596
2	HWL-17	1	22	H04LM21	2.58	6.93	0.559	0.284	0.127	22	2.01	0.02	0.521
2	HWL-12	1	23	H02LM11	2.88	9.1	0.609	0.448	0.085	24.6	1.34	0.022	0.455
2	HWL-14	1	24	H09LM21	3.75	10.2	0.767	0.551	0.113	21.2	1.68	0.032	0.604
2	HWL-10	1	25	H10LM21	3.24	6.53	0.71	0.503	0.104	22.1	1.53	0.029	0.602
2	HWL-11	1	26	H11LM11	3.76	7.25	0.812	0.563	0.113	20.9	1.75	0.035	0.638
2	Batch 1	1	27	BCHLM2113	1.45	6.35	<0.100	0.543	0.002	23.9	0.4	<0.010	0.068
2	Batch 1	2	1	BCHLM2121	1.32	6.68	<0.100	0.555	0.003	23.2	0.399	<0.010	0.063
2	HWL-10	2	2	H10LM22	2.97	6.64	0.725	0.52	0.107	21.2	1.55	0.028	0.601
2	HWL-09	2	3	H06LM12	2.61	5.92	0.626	0.468	0.094	22.7	1.34	0.024	0.523
2	HWL-12	2	4	H02LM22	2.66	9.39	0.629	0.471	0.091	23.9	1.37	0.021	0.463
2	HWL-14	2	5	H09LM12	3.44	10.5	0.768	0.564	0.115	20.4	1.68	0.03	0.6
2	HWL-15	2	6	H01LM22	1.8	5.72	0.428	0.212	0.093	24	1.56	0.011	0.401
2	HWL-11	2	7	H11LM12	3.44	7.48	0.825	0.576	0.116	20.1	1.75	0.034	0.645
2	HWL-19	2	8	H07LM22	2.04	9.75	0.488	0.249	0.107	23	1.74	0.016	0.457
2	HWL-19	2	9	H07LM12	2.08	9.75	0.498	0.258	0.111	23.2	1.79	0.016	0.465
2	HWL-13	2	10	H03LM22	2.98	9.84	0.711	0.528	0.112	21.8	1.57	0.029	0.53
2	HWL-18	2	11	H08LM22	1.72	9.39	0.428	0.22	0.101	24.1	1.57	0.012	0.369
2	HWL-16	2	12	H12LM12	2	6.37	0.502	0.251	0.111	22.4	1.78	0.014	0.453
2	HWL-20	2	13	H05LM12	2.31	10.2	0.544	0.276	0.118	21.4	1.95	0.019	0.485
2	Batch 1	2	14	BCHLM2122	1.27	6.71	<0.100	0.558	0.002	23.1	0.401	<0.010	0.066
2	HWL-20	2	15	H05LM22	2.31	9.95	0.553	0.282	0.123	21.1	1.98	0.019	0.493
2	HWL-13	2	16	H03LM12	2.95	9.86	0.72	0.524	0.111	21.6	1.59	0.029	0.538
2	HWL-14	2	17	H09LM22	3.41	10.3	0.792	0.574	0.119	20.3	1.71	0.031	0.616
2	HWL-09	2	18	H06LM22	2.67	5.99	0.652	0.481	0.097	23	1.39	0.025	0.55
2	HWL-17	2	19	H04LM22	2.3	7.02	0.561	0.282	0.127	21	2.04	0.018	0.522
2	HWL-12	2	20	H02LM12	2.59	9.27	0.619	0.454	0.086	23.6	1.34	0.021	0.46
2	HWL-17	2	21	H04LM12	2.3	6.99	0.563	0.28	0.125	20.9	2.01	0.018	0.523
2	HWL-16	2	22	H12LM22	2.01	6.4	0.491	0.242	0.106	22.3	1.76	0.014	0.446
2	HWL-15	2	23	H01LM12	1.76	5.6	0.428	0.211	0.093	23.7	1.55	0.011	0.397
2	HWL-10	2	24	H10LM12	2.96	6.73	0.735	0.524	0.109	21.2	1.58	0.031	0.616
2	HWL-11	2	25	H11LM12	3.22	7.16	0.804	0.561	0.112	19.2	1.71	0.033	0.632
2	HWL-18	2	26	H08LM12	1.76	9.02	0.435	0.224	0.103	24.2	1.6	0.012	0.381
2	Batch 1	2	27	BCHLM2123	1.26	6.63	<0.100	0.551	0.002	22.9	0.401	<0.010	0.067

Table A2. Measured Elemental Concentrations (wt%) for the Test Matrix 2 Glasses without Uranium Prepared Using Peroxide Fusion

Set	Glass ID	Block	Sequence	Lab ID	B (wt%)	Li (wt%)
1	Batch 1	1	1	BCHPF1111	2.55	2.06
1	HWL-22	1	2	G08PF11	2.49	1.73
1	HWL-04	1	3	G04PF11	2.88	2.01
1	HWL-02	1	4	G06PF21	2.26	2.15
1	HWL-05	1	5	G10PF21	2.36	2.37
1	HWL-02	1	6	G06PF11	2.15	2.12
1	HWL-08	1	7	G07PF21	1.41	2.16
1	HWL-06	1	8	G02PF11	2.26	2.16
1	HWL-06	1	9	G02PF21	2.25	2.21
1	HWL-01	1	10	G09PF21	2.49	2.46
1	HWL-04	1	11	G04PF21	2.88	1.98
1	Batch 1	1	12	BCHPF1112	2.41	2.04
1	HWL-07	1	13	G05PF21	1.53	2.31
1	HWL-05	1	14	G10PF11	2.32	2.33
1	HWL-22	1	15	G08PF21	2.4	1.7
1	HWL-03	1	16	G01PF11	3.13	2.08
1	HWL-21	1	17	G03PF21	2.76	1.85
1	HWL-21	1	18	G03PF11	2.69	1.86
1	HWL-01	1	19	G09PF11	2.33	2.36
1	HWL-07	1	20	G05PF11	1.45	2.3
1	HWL-08	1	21	G07PF11	1.25	1.99
1	HWL-03	1	22	G01PF21	2.88	1.89
1	Batch 1	1	23	BCHPF1113	2.38	2.04
1	Batch 1	2	1	BCHPF1121	2.5	2.07
1	HWL-07	2	2	G05PF22	1.57	2.42
1	HWL-03	2	3	G01PF12	3.28	2.16
1	HWL-21	2	4	G03PF22	2.76	1.87
1	HWL-21	2	5	G03PF12	2.72	1.9
1	HWL-02	2	6	G06PF22	2.17	2.14
1	HWL-05	2	7	G10PF22	2.33	2.41
1	HWL-08	2	8	G07PF22	1.42	2.22
1	HWL-07	2	9	G05PF12	1.54	2.45
1	HWL-02	2	10	G06PF12	2.25	2.25
1	HWL-01	2	11	G09PF22	2.53	2.52
1	Batch 1	2	12	BCHPF1122	2.46	2.14
1	HWL-22	2	13	G08PF22	2.44	1.74
1	HWL-22	2	14	G08PF12	2.48	1.74
1	HWL-06	2	15	G02PF12	2.27	2.23
1	HWL-06	2	16	G02PF22	2.29	2.26
1	HWL-04	2	17	G04PF12	2.95	2.06
1	HWL-04	2	18	G04PF22	2.88	2.02
1	HWL-01	2	19	G09PF12	2.39	2.44
1	HWL-08	2	20	G07PF12	1.3	2.08
1	HWL-05	2	21	G10PF12	2.39	2.44
1	HWL-03	2	22	G01PF22	3.03	1.99
1	Batch 1	2	23	BCHPF1212	2.46	2.13
2	Batch 1	1	1	BCHPF2111	2.58	2.1
2	HWL-13	1	2	H03PF21	1.54	2.41
2	HWL-20	1	3	H05PF11	1.46	2.23
2	HWL-12	1	4	H02PF11	1.6	2.58
2	HWL-16	1	5	H12PF21	3.49	1.84
2	HWL-10	1	6	H10PF11	3.4	2.36
2	HWL-14	1	7	H09PF21	1.36	2.15
2	HWL-15	1	8	H01PF11	3.81	1.98
2	HWL-18	1	9	H08PF21	1.69	2.6
2	HWL-09	1	10	H06PF21	3.57	2.5
2	HWL-17	1	11	H04PF21	3.26	1.72
2	HWL-12	1	12	H02PF21	1.6	2.55
2	HWL-10	1	13	H10PF21	3.42	2.4
2	Batch 1	1	14	BCHPF2112	2.51	2.12

Table A2. Measured Elemental Concentrations (wt%) for the Test Matrix 2 Glasses without Uranium Prepared Using Peroxide Fusion

Set	Glass ID	Block	Sequence	Lab ID	B (wt%)	Li (wt%)
2	HWL-11	1	15	H11PF11	3.22	2.21
2	HWL-19	1	16	H07PF11	1.56	2.4
2	HWL-14	1	17	H09PF11	1.36	2.17
2	HWL-15	1	18	H01PF21	3.77	2.01
2	HWL-20	1	19	H05PF21	1.47	2.27
2	HWL-19	1	20	H07PF21	1.6	2.47
2	HWL-18	1	21	H08PF11	1.73	2.67
2	HWL-13	1	22	H03PF11	1.47	2.37
2	HWL-09	1	23	H06PF11	3.64	2.47
2	HWL-16	1	24	H12PF11	3.57	1.84
2	HWL-11	1	25	H11PF21	3.05	2.18
2	HWL-17	1	26	H04PF11	3.26	1.66
2	Batch 1	1	27	BCHPF2113	2.38	2.05
2	Batch 1	2	1	BCHPF2121	2.63	2.1
2	HWL-12	2	2	H02PF22	1.77	2.64
2	HWL-09	2	3	H06PF12	3.82	2.53
2	HWL-19	2	4	H07PF22	1.66	2.5
2	HWL-09	2	5	H06PF22	3.77	2.57
2	HWL-12	2	6	H02PF12	1.68	2.63
2	HWL-18	2	7	H08PF22	1.72	2.63
2	HWL-11	2	8	H11PF22	3.08	2.22
2	HWL-17	2	9	H04PF22	3.33	1.73
2	HWL-14	2	10	H09PF12	1.42	2.19
2	HWL-20	2	11	H05PF12	1.45	2.27
2	HWL-10	2	12	H10PF22	3.41	2.41
2	HWL-19	2	13	H07PF12	1.56	2.42
2	Batch 1	2	14	BCHPF2122	2.35	2.07
2	HWL-15	2	15	H01PF12	3.93	2.03
2	HWL-13	2	16	H03PF12	1.51	2.37
2	HWL-18	2	17	H08PF12	1.75	2.72
2	HWL-10	2	18	H10PF12	3.58	2.46
2	HWL-16	2	19	H12PF12	3.82	1.92
2	HWL-15	2	20	H01PF22	4.04	2.09
2	HWL-16	2	21	H12PF22	3.73	1.91
2	HWL-20	2	22	H05PF22	1.51	2.3
2	HWL-11	2	23	H11PF12	3.24	2.25
2	HWL-14	2	24	H09PF22	1.4	2.18
2	HWL-17	2	25	H04PF12	3.28	1.69
2	HWL-13	2	26	H03PF22	1.51	2.41
2	Batch 1	2	27	BCHPF2123	2.39	2.07

Table A3. Measured Elemental Concentrations (wt%) for the Test Matrix 2 Glasses with Uranium Prepared Using Lithium Metaborate (part 1)

Set	Glass ID	Block	Sub-Block	Sequence	Lab ID	Al (wt%)	Ba (wt%)	Ca (wt%)	Cd (wt%)	Ce (wt%)	Co (wt%)	Cr (wt%)	Cu (wt%)	Fe (wt%)	K (wt%)	La (wt%)	Mg (wt%)	Mn (wt%)
3	Batch 1	1	1	1	BCHLM3-111	2.58	0.125	0.841	<0.010	0.013	<0.010	0.072	0.305	9.37	2.54	<0.100	0.817	1.4
3	U std	1	1	2	UstdLM3-111	2.14	<0.010	0.904	<0.010	<0.010	<0.010	0.156	<0.010	9.7	2.38	<0.100	0.681	2.31
3	HWL-28	1	1	3	P11LM11	2.38	0.066	0.702	<0.010	0.188	<0.010	0.067	0.041	8.93	0.05	<0.100	0.091	2.26
3	HWL-25	1	1	4	P05LM21	2.16	0.058	0.606	<0.010	0.213	<0.010	0.057	0.034	7.68	0.048	<0.100	0.089	1.94
3	SB5-14	1	1	5	P08LM21	3.93	0.049	1.55	<0.010	0.069	<0.010	0.061	0.031	7.62	0.077	<0.100	0.268	1.93
3	SB5-20	1	1	6	P01LM11	3.94	0.052	0.584	<0.010	0.075	<0.010	0.06	0.029	7.72	0.063	<0.100	0.29	1.98
3	SB5-14	1	1	7	P08LM11	3.88	0.051	1.52	<0.010	0.073	<0.010	0.064	0.032	7.89	0.066	<0.100	0.282	2
3	SB5-20	1	1	8	P01LM21	3.96	0.052	0.591	<0.010	0.14	<0.010	0.06	0.029	7.82	0.067	<0.100	0.289	2
3	HWL-25	1	1	9	P05LM11	2.17	0.059	0.613	<0.010	0.145	<0.010	0.056	0.033	7.83	0.043	<0.100	0.092	2.05
3	Batch 1	1	1	10	BCHLM3-112	2.6	0.13	0.817	<0.010	0.013	<0.010	0.075	0.303	9.82	2.45	<0.100	0.853	1.48
3	U std	1	1	11	UstdLM3-112	2.16	<0.010	0.874	<0.010	<0.010	<0.010	0.163	<0.010	10.07	2.28	<0.100	0.716	2.42
3	SB5-18	1	1	12	P09LM21	5.31	0.034	0.494	0.015	0.11	<0.010	0.086	<0.010	7.09	0.018	<0.100	0.288	1.75
3	SB5-18	1	1	13	P09LM11	5.29	0.036	0.498	0.016	0.114	<0.010	0.089	0.01	7.12	0.016	<0.100	0.301	1.77
3	HWL-23	1	1	14	P10LM11	2.49	0.063	0.577	<0.010	0.12	<0.010	0.07	0.042	7.32	0.047	<0.100	0.088	2.84
3	HWL-23	1	1	15	P10LM21	2.49	0.06	0.572	<0.010	0.115	<0.010	0.066	0.042	7.14	0.052	<0.100	0.084	2.79
3	SB5-13	1	1	16	P14LM11	4.01	0.058	2.57	<0.010	0.075	<0.010	0.066	0.029	7.94	0.06	<0.100	0.291	2.05
3	HWL-28	1	1	17	P11LM21	2.43	0.068	0.673	<0.010	0.172	<0.010	0.067	0.041	9.26	0.045	<0.100	0.095	2.34
3	SB5-13	1	1	18	P14LM21	4.03	0.057	2.59	<0.010	0.085	<0.010	0.065	0.029	7.85	0.061	<0.100	0.288	2.02
3	Batch 1	1	1	19	BCHLM3-113	2.65	0.13	0.807	<0.010	0.012	<0.010	0.075	0.3	9.48	2.401	<0.100	0.855	1.43
3	U std	1	1	20	UstdLM3-113	2.16	<0.010	0.862	<0.010	<0.010	<0.010	0.163	<0.010	9.78	2.248	<0.100	0.715	2.33
3	Batch 1	1	2	1	BCHLM3-121	2.54	0.128	0.849	<0.010	0.012	<0.010	0.074	0.307	9.1	2.61	<0.100	0.833	1.37
3	U std	1	2	2	UstdLM3-121	2.1	<0.010	0.887	<0.010	<0.010	<0.010	0.158	<0.010	9.17	2.41	<0.100	0.691	2.18
3	HWL-23	1	2	3	P10LM12	2.41	0.061	0.596	<0.010	0.121	<0.010	0.069	0.041	6.74	0.048	<0.100	0.086	2.61
3	SB5-14	1	2	4	P08LM12	3.82	0.049	1.52	<0.010	0.071	<0.010	0.062	0.029	7.37	0.068	<0.100	0.272	1.85
3	HWL-23	1	2	5	P10LM22	2.39	0.059	0.607	<0.010	0.118	<0.010	0.066	0.042	7.02	0.057	<0.100	0.082	2.72
3	HWL-28	1	2	6	P11LM22	2.32	0.068	0.729	<0.010	0.179	<0.010	0.067	0.04	9.25	0.051	<0.100	0.095	2.31
3	SB5-13	1	2	7	P14LM12	3.85	0.058	2.42	<0.010	0.077	<0.010	0.065	0.029	8	0.067	<0.100	0.289	2.04
3	SB5-20	1	2	8	P01LM12	3.84	0.053	0.626	<0.010	0.077	<0.010	0.061	0.028	8.18	0.07	<0.100	0.291	2.08
3	SB5-18	1	2	9	P09LM22	5.06	0.034	0.541	0.016	0.114	<0.010	0.086	<0.010	7.64	0.02	<0.100	0.287	1.88
3	Batch 1	1	2	10	BCHLM3-122	2.56	0.129	0.889	<0.010	0.012	<0.010	0.075	0.319	9.92	2.73	<0.100	0.844	1.48
3	U std	1	2	11	UstdLM3-122	2.16	<0.010	0.914	<0.010	<0.010	<0.010	0.16	<0.010	10.55	2.48	<0.100	0.697	2.49
3	HWL-25	1	2	12	P05LM12	2.17	0.058	0.636	<0.010	0.147	<0.010	0.055	0.031	7.41	0.045	<0.100	0.09	1.93
3	SB5-20	1	2	13	P01LM22	3.97	0.051	0.608	<0.010	0.141	<0.010	0.059	0.027	7.44	0.069	<0.100	0.285	1.93
3	HWL-25	1	2	14	P05LM22	2.13	0.059	0.629	<0.010	0.219	<0.010	0.058	0.033	7.53	0.05	<0.100	0.09	1.9
3	HWL-28	1	2	15	P11LM12	2.35	0.066	0.74	<0.010	0.195	<0.010	0.068	0.041	8.39	0.054	<0.100	0.092	2.12
3	SB5-13	1	2	16	P14LM22	3.85	0.056	2.51	<0.010	0.087	<0.010	0.064	0.028	7.29	0.068	<0.100	0.28	1.88
3	SB5-14	1	2	17	P08LM22	3.86	0.048	1.55	<0.010	0.069	<0.010	0.061	0.029	7.04	0.08	<0.100	0.265	1.79
3	SB5-18	1	2	18	P09LM12	5.1	0.036	0.534	0.016	0.116	<0.010	0.089	<0.010	6.69	0.017	<0.100	0.296	1.65
3	Batch 1	1	2	19	BCHLM3-123	2.56	0.128	0.858	<0.010	0.011	<0.010	0.075	0.302	8.96	2.65	<0.100	0.838	1.35
3	U std	1	2	20	UstdLM3-123	2.13	<0.010	0.923	<0.010	<0.010	<0.010	0.162	<0.010	9.29	2.5	<0.100	0.7	2.22
3	Batch 1	2	1	1	BCHLM3-211	2.5	0.126	0.826	<0.010	0.01	<0.010	0.072	0.3	9.48	2.54	<0.100	0.829	1.43
3	U std	2	1	2	UstdLM3-211	2.06	<0.010	0.877	<0.010	<0.010	<0.010	0.158	<0.010	9.77	2.36	<0.100	0.691	2.31
3	HWL-27	2	1	3	P13LM11	2.12	0.057	0.631	<0.010	0.16	<0.010	0.055	0.033	7.66	0.037	<0.100	0.081	1.94
3	HWL-27	2	1	4	P13LM21	2.15	0.055	0.644	<0.010	0.164	<0.010	0.053	0.032	7.56	0.042	<0.100	0.079	1.92

Table A3. Measured Elemental Concentrations (wt%) for the Test Matrix 2 Glasses with Uranium Prepared Using Lithium Metaborate (part 1)

Set	Glass ID	Block	Sub-Block	Sequence	Lab ID	Al (wt%)	Ba (wt%)	Ca (wt%)	Cd (wt%)	Ce (wt%)	Co (wt%)	Cr (wt%)	Cu (wt%)	Fe (wt%)	K (wt%)	La (wt%)	Mg (wt%)	Mn (wt%)
3	HWL-26	2	1	5	P03LM11	2.4	0.065	0.729	<0.010	0.167	<0.010	0.059	0.038	8.31	0.045	<0.100	0.093	2.2
3	HWL-24	2	1	6	P07LM11	2.39	0.065	0.606	<0.010	0.089	<0.010	0.06	0.042	7.36	0.041	<0.100	0.082	2.74
3	SB5-16	2	1	7	P06LM11	3.87	0.051	0.591	<0.010	0.077	<0.010	0.059	0.027	7.55	0.055	<0.100	0.291	1.91
3	HWL-24	2	1	8	P07LM21	2.4	0.065	0.612	<0.010	0.089	<0.010	0.062	0.045	7.77	0.045	<0.100	0.082	2.89
3	SB5-19	2	1	9	P04LM11	4.23	0.031	0.555	0.018	0.123	<0.010	0.097	<0.010	7.77	0.014	<0.100	0.317	1.89
3	Batch 1	2	1	10	BCHLM3-212	2.53	0.127	0.838	<0.010	0.01	<0.010	0.073	0.303	10.21	2.58	<0.100	0.836	1.52
3	U std	2	1	11	UstdLM3-212	2.11	<0.010	0.91	<0.010	<0.010	<0.010	0.159	<0.010	10.29	2.43	<0.100	0.698	2.44
3	SB5-15	2	1	12	P12LM21	3.8	0.05	1.53	<0.010	0.075	<0.010	0.063	0.026	7.3	0.06	<0.100	0.28	1.8
3	SB5-19	2	1	13	P04LM21	4.23	0.031	0.569	0.018	0.19	<0.010	0.096	<0.010	7.04	0.013	<0.100	0.316	1.7
3	SB5-16	2	1	14	P06LM21	3.84	0.05	0.601	<0.010	0.147	<0.010	0.058	0.027	7.21	0.059	<0.100	0.287	1.84
3	HWL-26	2	1	15	P03LM21	2.36	0.066	0.731	<0.010	0.252	<0.010	0.059	0.038	7.62	0.046	<0.100	0.094	2.02
3	SB5-15	2	1	16	P12LM11	3.83	0.052	1.6	<0.010	0.076	<0.010	0.064	0.026	6.73	0.058	<0.100	0.289	1.71
3	SB5-17	2	1	17	P02LM11	5.85	0.031	0.477	0.012	0.104	<0.010	0.075	<0.010	5.64	0.013	<0.100	0.266	1.39
3	SB5-17	2	1	18	P02LM21	5.74	0.032	0.479	0.013	0.179	<0.010	0.078	<0.010	5.69	0.009	<0.100	0.279	1.4
3	Batch 1	2	1	19	BCHLM3-213	2.51	0.127	0.865	<0.010	0.01	<0.010	0.073	0.309	8.62	2.63	<0.100	0.826	1.3
3	U std	2	1	20	UstdLM3-213	2.08	<0.010	0.905	<0.010	<0.010	<0.010	0.157	<0.010	8.24	2.42	<0.100	0.686	1.97
3	Batch 1	2	2	1	BCHLM3-221	2.56	0.126	0.858	<0.010	0.011	<0.010	0.073	0.309	8.79	2.63	<0.100	0.817	1.33
3	U std	2	2	2	UstdLM3-221	2.08	<0.010	0.877	<0.010	<0.010	<0.010	0.157	<0.010	9.47	2.36	<0.100	0.684	2.27
3	HWL-24	2	2	3	P07LM12	2.36	0.066	0.587	<0.010	0.088	<0.010	0.06	0.043	7.09	0.043	<0.100	0.081	2.67
3	SB5-19	2	2	4	P04LM12	4.2	0.032	0.546	0.019	0.122	<0.010	0.096	<0.010	7.27	0.016	<0.100	0.313	1.78
3	HWL-24	2	2	5	P07LM22	2.39	0.065	0.587	<0.010	0.087	<0.010	0.061	0.045	7.25	0.045	<0.100	0.081	2.71
3	SB5-16	2	2	6	P06LM22	3.83	0.052	0.566	<0.010	0.142	<0.010	0.058	0.027	7.29	0.056	<0.100	0.284	1.87
3	SB5-17	2	2	7	P02LM12	5.86	0.032	0.455	0.013	0.101	<0.010	0.074	<0.010	6.09	0.014	<0.100	0.262	1.5
3	SB5-19	2	2	8	P04LM22	4.21	0.033	0.538	0.019	0.186	<0.010	0.097	<0.010	7.08	0.015	<0.100	0.314	1.74
3	SB5-15	2	2	9	P12LM12	3.82	0.053	1.56	<0.010	0.075	<0.010	0.064	0.026	6.97	0.057	<0.100	0.283	1.78
3	Batch 1	2	2	10	BCHLM3-222	2.52	0.125	0.804	<0.010	0.01	<0.010	0.072	0.293	8.88	2.5	<0.100	0.824	1.35
3	U std	2	2	11	UstdLM3-222	2.05	<0.010	0.874	<0.010	<0.010	<0.010	0.157	<0.010	9.32	2.35	<0.100	0.692	2.24
3	HWL-26	2	2	12	P03LM12	2.38	0.067	0.723	<0.010	0.168	<0.010	0.06	0.039	7.84	0.048	<0.100	0.093	2.1
3	SB5-17	2	2	13	P02LM22	5.82	0.034	0.471	0.014	0.178	<0.010	0.079	<0.010	5.95	0.012	<0.100	0.279	1.47
3	SB5-15	2	2	14	P12LM22	3.77	0.052	1.51	<0.010	0.074	<0.010	0.063	0.027	7.4	0.059	<0.100	0.279	1.86
3	HWL-26	2	2	15	P03LM22	2.32	0.066	0.709	<0.010	0.248	<0.010	0.058	0.039	7.83	0.047	<0.100	0.092	2.09
3	HWL-27	2	2	16	P13LM12	2.06	0.057	0.62	<0.010	0.159	<0.010	0.055	0.033	7.1	0.04	<0.100	0.08	1.81
3	SB5-16	2	2	17	P06LM12	3.74	0.053	0.588	<0.010	0.078	<0.010	0.059	0.028	7.58	0.059	<0.100	0.291	1.73
3	HWL-27	2	2	18	P13LM22	2.09	0.056	0.631	<0.010	0.165	<0.010	0.054	0.033	7.56	0.044	<0.100	0.078	1.7
3	Batch 1	2	2	19	BCHLM3-223	2.47	0.128	0.839	<0.010	0.011	<0.010	0.073	0.3	8.24	2.58	<0.100	0.832	1.24
3	U std	2	2	20	UstdLM3-223	2.05	<0.010	0.891	<0.010	<0.010	<0.010	0.158	<0.010	8.13	2.42	<0.100	0.697	1.95

Table A3. Measured Elemental Concentrations (wt%) for the Test Matrix 2 Glasses with Uranium Prepared Using Lithium Metaborate (part 2)

Set	Glass ID	Block	Sub-Block	Sequence	Lab ID	Na (wt%)	Nb (wt%)	Ni (wt%)	P (wt%)	Pb (wt%)	S (wt%)	Si (wt%)	Sr (wt%)	Th (wt%)	Ti (wt%)	U (wt%)	Zn (wt%)	Zr (wt%)
3	Batch 1	1	1	1	BCHLM3-111	6.79	0.033	0.549	<0.100	<0.020	<0.100	24.4	<0.010	<0.100	0.388	<0.100	<0.010	0.063
3	U std	1	1	2	UstdLM3-111	8.98	0.049	0.763	<0.100	<0.020	<0.100	21.9	<0.010	<0.100	0.55	2.07	<0.010	<0.010
3	HWL-28	1	1	3	P11LM11	9.35	0.512	0.251	<0.100	0.109	<0.100	23.2	<0.010	0.806	1.71	0.417	0.017	0.441
3	HWL-25	1	1	4	P05LM21	5.56	0.419	0.29	<0.100	0.095	<0.100	25.2	<0.010	0.713	1.51	0.375	0.016	0.369
3	SB5-14	1	1	5	P08LM21	10.85	0.022	0.782	<0.100	0.034	0.165	22.2	<0.010	<0.100	0.194	2.49	0.033	0.08
3	SB5-20	1	1	6	P01LM11	10.83	0.021	0.856	<0.100	0.034	0.169	22.2	<0.010	<0.100	0.199	2.53	0.033	0.078
3	SB5-14	1	1	7	P08LM11	10.77	0.023	0.837	<0.100	0.037	0.172	22.2	<0.010	<0.100	0.203	2.49	0.033	0.081
3	SB5-20	1	1	8	P01LM21	10.91	0.021	0.851	<0.100	0.034	0.17	22.5	<0.010	<0.100	0.199	2.52	0.034	0.078
3	HWL-25	1	1	9	P05LM11	5.78	0.455	0.23	<0.100	0.097	<0.100	25.4	<0.010	0.716	1.51	0.374	0.017	0.397
3	Batch 1	1	1	10	BCHLM3-112	6.8	0.034	0.57	<0.100	<0.020	<0.100	24.9	<0.010	<0.100	0.395	<0.100	<0.010	0.066
3	U std	1	1	11	UstdLM3-112	9.07	0.05	0.797	<0.100	<0.020	<0.100	22.2	<0.010	<0.100	0.559	2.11	<0.010	<0.010
3	SB5-18	1	1	12	P09LM21	10.93	<0.020	0.764	<0.100	<0.020	<0.100	21.8	0.101	<0.100	0.013	2.76	<0.010	0.071
3	SB5-18	1	1	13	P09LM11	10.89	<0.020	0.806	<0.100	<0.020	0.102	21.9	0.1	<0.100	0.013	2.77	<0.010	0.073
3	HWL-23	1	1	14	P10LM11	6.14	0.585	0.486	<0.100	0.088	<0.100	23.8	<0.010	0.791	1.27	0.752	0.028	0.513
3	HWL-23	1	1	15	P10LM21	6.04	0.554	0.458	<0.100	0.083	<0.100	23.7	<0.010	0.755	1.21	0.715	0.027	0.492
3	SB5-13	1	1	16	P14LM11	11.15	0.026	0.875	<0.100	0.038	0.181	22.3	<0.010	<0.100	0.217	2.6	0.036	0.085
3	HWL-28	1	1	17	P11LM21	9.75	0.521	0.259	<0.100	0.112	<0.100	24	<0.010	0.819	1.73	0.413	0.017	0.446
3	SB5-13	1	1	18	P14LM21	11.18	0.026	0.866	<0.100	0.038	0.179	22.2	<0.010	<0.100	0.215	2.59	0.036	0.084
3	Batch 1	1	1	19	BCHLM3-113	7.13	0.033	0.57	<0.100	<0.020	<0.100	24.8	<0.010	<0.100	0.393	<0.100	<0.010	0.065
3	U std	1	1	20	UstdLM3-113	8.99	0.05	0.798	<0.100	<0.020	<0.100	22	<0.010	<0.100	0.556	2.1	<0.010	<0.010
3	Batch 1	1	2	1	BCHLM3-121	6.74	0.031	0.561	<0.100	<0.020	<0.100	23.8	<0.010	<0.100	0.393	<0.100	<0.010	0.064
3	U std	1	2	2	UstdLM3-121	8.7	0.048	0.78	<0.100	<0.020	<0.100	21.2	<0.010	<0.100	0.551	2.02	<0.010	<0.010
3	HWL-23	1	2	3	P10LM12	5.9	0.599	0.475	<0.100	0.086	<0.100	22.5	<0.010	0.792	1.28	0.776	0.027	0.513
3	SB5-14	1	2	4	P08LM12	10.49	0.02	0.816	<0.100	0.036	0.17	21.3	<0.010	<0.100	0.201	2.38	0.032	0.08
3	HWL-23	1	2	5	P10LM22	5.79	0.577	0.455	<0.100	0.082	<0.100	22.8	<0.010	0.765	1.24	0.751	0.027	0.5
3	HWL-28	1	2	6	P11LM22	9	0.548	0.261	<0.100	0.112	<0.100	23.2	<0.010	0.839	1.73	0.437	0.017	0.46
3	SB5-13	1	2	7	P14LM12	10.31	0.024	0.876	<0.100	0.039	0.183	21.6	<0.010	<0.100	0.222	2.45	0.035	0.087
3	SB5-20	1	2	8	P01LM12	10.32	0.019	0.868	<0.100	0.035	0.179	22.3	<0.010	<0.100	0.205	2.46	0.033	0.08
3	SB5-18	1	2	9	P09LM22	10.09	<0.020	0.767	<0.100	<0.020	0.101	21.7	0.109	<0.100	0.013	2.65	<0.010	0.074
3	Batch 1	1	2	10	BCHLM3-122	6.63	0.031	0.569	<0.100	<0.020	<0.100	24.5	<0.010	<0.100	0.401	<0.100	<0.010	0.066
3	U std	1	2	11	UstdLM3-122	8.44	0.048	0.782	<0.100	<0.020	<0.100	22.2	<0.010	<0.100	0.561	2.05	<0.010	<0.010
3	HWL-25	1	2	12	P05LM12	5.76	0.468	0.227	<0.100	0.097	<0.100	24.8	<0.010	0.723	1.53	0.383	0.017	0.4
3	SB5-20	1	2	13	P01LM22	11.12	0.019	0.844	<0.100	0.033	0.175	22.2	<0.010	<0.100	0.2	2.52	0.033	0.079
3	HWL-25	1	2	14	P05LM22	5.49	0.44	0.294	<0.100	0.097	<0.100	25	<0.010	0.729	1.54	0.388	0.016	0.377
3	HWL-28	1	2	15	P11LM12	9.29	0.539	0.254	<0.100	0.109	<0.100	22.7	<0.010	0.828	1.78	0.436	0.017	0.457
3	SB5-13	1	2	16	P14LM22	10.72	0.024	0.846	<0.100	0.037	0.183	21.1	<0.010	<0.100	0.216	2.47	0.034	0.085
3	SB5-14	1	2	17	P08LM22	10.84	0.019	0.784	<0.100	0.036	0.173	21.3	<0.010	<0.100	0.196	2.42	0.032	0.08
3	SB5-18	1	2	18	P09LM12	10.5	<0.020	0.797	<0.100	<0.020	0.104	21	0.105	<0.100	0.013	2.64	<0.010	0.074
3	Batch 1	1	2	19	BCHLM3-123	6.72	0.031	0.567	<0.100	<0.020	<0.100	23.7	<0.010	<0.100	0.398	<0.100	<0.010	0.065
3	U std	1	2	20	UstdLM3-123	8.85	0.049	0.788	<0.100	<0.020	<0.100	21.4	<0.010	<0.100	0.562	2.05	<0.010	<0.010
3	Batch 1	2	1	1	BCHLM3-211	6.47	0.036	0.557	<0.100	<0.020	<0.100	23.9	<0.010	<0.100	0.388	<0.100	<0.010	0.062
3	U std	2	1	2	UstdLM3-211	8.51	0.052	0.775	<0.100	<0.020	<0.100	21.4	<0.010	<0.100	0.547	1.98	<0.010	<0.010
3	HWL-27	2	1	3	P13LM11	9.18	0.461	0.225	<0.100	0.1	<0.100	24.8	<0.010	0.714	1.54	0.375	0.017	0.39
3	HWL-27	2	1	4	P13LM21	9.22	0.447	0.218	<0.100	0.096	<0.100	24.9	<0.010	0.696	1.51	0.369	0.015	0.382

Table A3. Measured Elemental Concentrations (wt%) for the Test Matrix 2 Glasses with Uranium Prepared Using Lithium Metaborate (part 2)

Set	Glass ID	Block	Sub-Block	Sequence	Lab ID	Na (wt%)	Nb (wt%)	Ni (wt%)	P (wt%)	Pb (wt%)	S (wt%)	Si (wt%)	Sr (wt%)	Th (wt%)	Ti (wt%)	U (wt%)	Zn (wt%)	Zr (wt%)
3	HWL-26	2	1	5	P03LM11	6.35	0.521	0.253	<0.100	0.109	<0.100	23.1	<0.010	0.818	1.72	0.432	0.016	0.443
3	HWL-24	2	1	6	P07LM11	9.04	0.598	0.488	<0.100	0.086	<0.100	23.4	<0.010	0.809	1.33	0.754	0.028	0.505
3	SB5-16	2	1	7	P06LM11	11.16	0.026	0.881	<0.100	0.036	0.172	21.2	<0.010	<0.100	0.212	2.48	0.034	0.085
3	HWL-24	2	1	8	P07LM21	9.05	0.602	0.483	<0.100	0.087	<0.100	24.1	<0.010	0.811	1.34	0.756	0.028	0.507
3	SB5-19	2	1	9	P04LM11	11.17	0.009	0.867	<0.100	<0.020	0.105	21	0.108	<0.100	0.011	2.82	<0.010	0.078
3	Batch 1	2	1	10	BCHLM3-212	6.48	0.035	0.559	<0.100	<0.020	<0.100	24.8	<0.010	<0.100	0.391	<0.100	<0.010	0.063
3	U std	2	1	11	UstdLM3-212	8.65	0.053	0.78	<0.100	<0.020	<0.100	22.1	<0.010	<0.100	0.557	2.05	<0.010	<0.010
3	SB5-15	2	1	12	P12LM21	10.7	0.028	0.845	<0.100	0.034	0.174	21	<0.010	<0.100	0.217	2.41	0.032	0.081
3	SB5-19	2	1	13	P04LM21	11.27	0.01	0.865	<0.100	<0.020	0.104	20.3	0.11	<0.100	0.013	2.81	<0.010	0.077
3	SB5-16	2	1	14	P06LM21	11.03	0.026	0.856	<0.100	0.035	0.165	20.7	<0.010	<0.100	0.211	2.44	0.033	0.083
3	HWL-26	2	1	15	P03LM21	6.45	0.529	0.255	<0.100	0.108	<0.100	22.1	<0.010	0.829	1.73	0.438	0.017	0.448
3	SB5-15	2	1	16	P12LM11	10.99	0.029	0.868	<0.100	0.035	0.173	20.3	<0.010	<0.100	0.223	2.45	0.033	0.087
3	SB5-17	2	1	17	P02LM11	9.17	<0.020	0.705	<0.100	<0.020	<0.100	20.8	0.092	<0.100	<0.010	2.37	<0.010	0.067
3	SB5-17	2	1	18	P02LM21	8.8	<0.020	0.753	<0.100	<0.020	<0.100	20.6	0.09	<0.100	<0.010	2.33	<0.010	0.07
3	Batch 1	2	1	19	BCHLM3-213	6.7	0.036	0.558	<0.100	<0.020	<0.100	23.2	<0.010	<0.100	0.396	<0.100	<0.010	0.064
3	U std	2	1	20	UstdLM3-213	8.81	0.052	0.769	<0.100	<0.020	<0.100	20.2	<0.010	<0.100	0.552	1.98	<0.010	<0.010
3	Batch 1	2	2	1	BCHLM3-221	6.92	0.038	0.554	<0.100	<0.020	<0.100	23.8	<0.010	<0.100	0.391	<0.100	<0.010	0.063
3	U std	2	2	2	UstdLM3-221	8.61	0.053	0.767	<0.100	<0.020	<0.100	21.5	<0.010	<0.100	0.546	2.04	<0.010	<0.010
3	HWL-24	2	2	3	P07LM12	8.93	0.587	0.482	<0.100	0.086	<0.100	23.2	<0.010	0.795	1.32	0.737	0.029	0.49
3	SB5-19	2	2	4	P04LM12	11.17	<0.020	0.856	<0.100	<0.020	0.102	20.7	0.107	<0.100	0.011	2.79	<0.010	0.077
3	HWL-24	2	2	5	P07LM22	9.03	0.588	0.479	<0.100	0.085	<0.100	23.5	<0.010	0.79	1.31	0.731	0.029	0.49
3	SB5-16	2	2	6	P06LM22	11.11	0.028	0.851	<0.100	0.037	0.165	20.9	<0.010	<0.100	0.204	2.42	0.034	0.083
3	SB5-17	2	2	7	P02LM12	8.86	<0.020	0.696	<0.100	<0.020	<0.100	21.5	0.088	<0.100	<0.010	2.37	<0.010	0.066
3	SB5-19	2	2	8	P04LM22	11.4	<0.020	0.857	<0.100	<0.020	0.104	20.5	0.105	<0.100	0.013	2.78	<0.010	0.076
3	SB5-15	2	2	9	P12LM12	11.01	0.03	0.858	<0.100	0.036	0.169	20.7	<0.010	<0.100	0.219	2.45	0.034	0.085
3	Batch 1	2	2	10	BCHLM3-222	6.68	0.037	0.551	<0.100	<0.020	<0.100	23.5	<0.010	<0.100	0.384	<0.100	<0.010	0.062
3	U std	2	2	11	UstdLM3-222	8.51	0.053	0.773	<0.100	<0.020	<0.100	21.1	<0.010	<0.100	0.552	1.99	<0.010	<0.010
3	HWL-26	2	2	12	P03LM12	6.34	0.524	0.257	<0.100	0.11	<0.100	22.7	<0.010	0.822	1.72	0.432	0.018	0.44
3	SB5-17	2	2	13	P02LM22	8.89	<0.020	0.755	<0.100	<0.020	<0.100	21.3	0.09	<0.100	<0.010	2.38	<0.010	0.072
3	SB5-15	2	2	14	P12LM22	10.64	0.03	0.844	<0.100	0.036	0.168	20.8	<0.010	<0.100	0.217	2.41	0.033	0.082
3	HWL-26	2	2	15	P03LM22	6.19	0.519	0.253	<0.100	0.109	<0.100	22.2	<0.010	0.811	1.71	0.428	0.017	0.438
3	HWL-27	2	2	16	P13LM12	8.96	0.454	0.223	<0.100	0.098	<0.100	24	<0.010	0.704	1.53	0.369	0.018	0.387
3	SB5-16	2	2	17	P06LM12	10.98	0.029	0.882	<0.100	0.037	0.174	20.1	<0.010	<0.100	0.211	2.39	0.035	0.085
3	HWL-27	2	2	18	P13LM22	9.13	0.444	0.217	<0.100	0.097	<0.100	24.6	<0.010	0.692	1.5	0.365	0.016	0.377
3	Batch 1	2	2	19	BCHLM3-223	6.64	0.038	0.561	<0.100	<0.020	<0.100	22.6	<0.010	<0.100	0.392	<0.100	<0.010	0.065
3	U std	2	2	20	UstdLM3-223	8.71	0.054	0.777	<0.100	<0.020	<0.100	21	<0.010	<0.100	0.553	1.96	<0.010	<0.010

Table A4. Measured Elemental Concentrations (wt%) for the Test Matrix 2 Glasses with Uranium Prepared Using Peroxide Fusion

Set	Glass ID	Block	Sequence	Lab ID	B (wt%)	Li (wt%)
3	Batch 1	1	1	BCHPF3-111	2.57	2.01
3	U std	1	2	UstdPF3-111	2.80	1.37
3	SB5-19	1	3	P04PF21	2.88	1.39
3	SB5-17	1	4	P02PF21	2.98	2.58
3	HWL-23	1	5	P10PF21	3.80	2.39
3	SB5-13	1	6	P14PF11	2.08	2.03
3	SB5-13	1	7	P14PF21	2.08	2.03
3	SB5-19	1	8	P04PF11	2.96	1.45
3	SB5-18	1	9	P09PF21	2.73	1.99
3	Batch 1	1	10	BCHPF3-112	2.46	1.99
3	U std	1	11	UstdPF3-112	2.88	1.38
3	SB5-17	1	12	P02PF11	3.04	2.56
3	HWL-27	1	13	P13PF11	1.84	2.54
3	HWL-25	1	14	P05PF21	3.66	1.89
3	SB5-18	1	15	P09PF11	2.74	1.99
3	HWL-27	1	16	P13PF21	1.67	2.45
3	HWL-23	1	17	P10PF11	3.71	2.39
3	HWL-25	1	18	P05PF11	4.06	1.93
3	Batch 1	1	19	BCHPF3-113	2.63	2.02
3	U std	1	20	UstdPF3-113	3.00	1.42
3	Batch 1	1	1	BCHPF3-121	2.52	2.01
3	U std	1	2	UstdPF3-121	2.87	1.41
3	SB5-18	1	3	P09PF12	2.79	2.04
3	HWL-23	1	4	P10PF12	3.56	2.39
3	SB5-17	1	5	P02PF12	2.86	2.53
3	SB5-19	1	6	P04PF12	2.85	1.45
3	HWL-25	1	7	P05PF22	3.62	1.89
3	HWL-27	1	8	P13PF12	1.71	2.51
3	SB5-17	1	9	P02PF22	2.95	2.60
3	Batch 1	1	10	BCHPF3-122	2.43	2.03
3	U std	1	11	UstdPF3-122	2.75	1.39
3	HWL-25	1	12	P05PF12	3.77	1.88
3	SB5-13	1	13	P14PF22	1.95	2.00
3	SB5-13	1	14	P14PF12	1.98	2.03
3	SB5-19	1	15	P04PF22	2.80	1.41
3	HWL-27	1	16	P13PF22	1.67	2.51
3	HWL-23	1	17	P10PF22	3.50	2.36
3	SB5-18	1	18	P09PF22	2.62	1.99
3	Batch 1	1	19	BCHPF3-123	2.28	1.98
3	U std	1	20	UstdPF3-123	2.70	1.38
3	Batch 1	2	1	BCHPF3-211	2.36	1.95
3	U std	2	2	UstdPF3-211	2.81	1.38
3	HWL-24	2	3	P07PF21	1.72	2.46
3	SB5-14	2	4	P08PF11	2.14	2.05
3	HWL-26	2	5	P03PF21	3.58	1.82
3	HWL-24	2	6	P07PF11	1.68	2.40
3	SB5-20	2	7	P01PF11	2.95	1.12
3	SB5-20	2	8	P01PF21	3.10	1.18
3	SB5-16	2	9	P06PF11	2.95	1.39
3	Batch 1	2	10	BCHPF3-212	2.40	2.01
3	U std	2	11	UstdPF3-212	2.86	1.39
3	SB5-14	2	12	P08PF21	2.13	2.00
3	SB5-15	2	13	P12PF21	2.59	1.68
3	HWL-28	2	14	P11PF11	1.68	2.38

Table A4. Measured Elemental Concentrations (wt%) for the Test Matrix 2 Glasses with Uranium Prepared Using Peroxide Fusion

Set	Glass ID	Block	Sequence	Lab ID	B (wt%)	Li (wt%)
3	SB5-15	2	15	P12PF11	2.60	1.69
3	SB5-16	2	16	P06PF21	3.11	1.44
3	HWL-28	2	17	P11PF21	1.66	2.38
3	HWL-26	2	18	P03PF11	3.64	1.82
3	Batch 1	2	19	BCHPF3-213	2.43	2.02
3	U std	2	20	UstdPF3-213	2.82	1.40
3	Batch 1	2	1	BCHPF3-221	2.46	2.02
3	U std	2	2	UstdPF3-221	2.76	1.38
3	HWL-26	2	3	P03PF22	3.60	1.83
3	SB5-16	2	4	P06PF12	2.96	1.40
3	SB5-15	2	5	P12PF22	2.58	1.67
3	SB5-14	2	6	P08PF12	2.10	2.04
3	SB5-20	2	7	P01PF12	3.06	1.18
3	HWL-28	2	8	P11PF22	1.67	2.40
3	SB5-14	2	9	P08PF22	2.11	2.01
3	Batch 1	2	10	BCHPF3-222	2.34	1.99
3	U std	2	11	UstdPF3-222	2.65	1.38
3	HWL-28	2	12	P11PF12	1.67	2.41
3	HWL-26	2	13	P03PF12	3.44	1.76
3	HWL-24	2	14	P07PF12	1.61	2.40
3	SB5-16	2	15	P06PF22	2.92	1.43
3	HWL-24	2	16	P07PF22	1.57	2.42
3	SB5-15	2	17	P12PF12	2.65	1.70
3	SB5-20	2	18	P01PF22	2.92	1.17
3	Batch 1	2	19	BCHPF3-223	2.23	1.95
3	U std	2	20	UstdPF3-223	2.67	1.38

Table A5. Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by Glass ID

				Measured					
			Measured	Bias-Corrected	Targeted	Diff of	Diff of	% Diff of	% Diff of
1	Batch 1	Al2O3 (wt%)	4.8245	4.8770	4.8770	-0.0525	0.0%	-1.1%	0.0%
1	Batch 1	B2O3 (wt%)	7.9210	7.7770	7.7770	0.1440	0.0000	1.9%	0.0%
1	Batch 1	BaO (wt%)	0.1453	0.1510	0.1510	-0.0057	0.0000	-3.8%	0.0%
1	Batch 1	CaO (wt%)	1.2455	1.2200	1.2200	0.0255	0.0000	2.1%	0.0%
1	Batch 1	Ce2O3 (wt%)	0.0059	0.0059	0.0000	0.0059	0.0059		
1	Batch 1	Cr2O3 (wt%)	0.1108	0.1070	0.1070	0.0038	0.0000	3.6%	0.0%
1	Batch 1	CuO (wt%)	0.3885	0.3990	0.3990	-0.0105	0.0000	-2.6%	0.0%
1	Batch 1	Fe2O3 (wt%)	12.2692	12.8390	12.8390	-0.5698	0.0000	-4.4%	0.0%
1	Batch 1	K2O (wt%)	2.9452	3.3270	3.3270	-0.3818	0.0000	-11.5%	0.0%
1	Batch 1	La2O3 (wt%)	0.0059	0.0059	0.0000	0.0059	0.0059		
1	Batch 1	Li2O (wt%)	4.4780	4.4290	4.4290	0.0490	0.0000	1.1%	0.0%
1	Batch 1	MgO (wt%)	1.3811	1.4190	1.4190	-0.0379	0.0000	-2.7%	0.0%
1	Batch 1	MnO (wt%)	1.6700	1.7260	1.7260	-0.0560	0.0000	-3.2%	0.0%
1	Batch 1	Na2O (wt%)	9.1125	9.0030	9.0030	0.1095	0.0000	1.2%	0.0%
1	Batch 1	Nb2O5 (wt%)	0.0715	0.0715	0.1470	-0.0755	-0.0755	-51.3%	-51.3%
1	Batch 1	NiO (wt%)	0.7071	0.7510	0.7510	-0.0439	0.0000	-5.8%	0.0%
1	Batch 1	PbO (wt%)	0.0054	0.0054	0.0000	0.0054	0.0054		
1	Batch 1	SiO2 (wt%)	49.0969	50.2200	50.2200	-1.1231	0.0000	-2.2%	0.0%
1	Batch 1	TiO2 (wt%)	0.6619	0.6770	0.6770	-0.0151	0.0000	-2.2%	0.0%
1	Batch 1	ZnO (wt%)	0.0062	0.0062	0.0000	0.0062	0.0062		
1	Batch 1	ZrO2 (wt%)	0.0887	0.0887	0.0980	-0.0093	-0.0093	-9.5%	-9.5%
1	Batch 1	Sum	97.1411	99.1056	99.1670	-2.0259	-0.0614	-2.0%	-0.1%
1	HWL-01	Al2O3 (wt%)	10.9024	11.0213	10.8040	0.0984	0.2173	0.9%	2.0%
1	HWL-01	B2O3 (wt%)	7.8405	7.6978	8.0042	-0.1637	-0.3064	-2.0%	-3.8%
1	HWL-01	BaO (wt%)	0.0927	0.0963	0.0988	-0.0061	-0.0025	-6.2%	-2.5%
1	HWL-01	CaO (wt%)	1.2177	1.1926	1.2289	-0.0112	-0.0363	-0.9%	-2.9%
1	HWL-01	Ce2O3 (wt%)	0.2287	0.2287	0.2589	-0.0302	-0.0302	-11.7%	-11.7%
1	HWL-01	Cr2O3 (wt%)	0.1023	0.0988	0.1244	-0.0221	-0.0256	-17.8%	-20.6%
1	HWL-01	CuO (wt%)	0.0407	0.0418	0.0379	0.0028	0.0039	7.3%	10.3%
1	HWL-01	Fe2O3 (wt%)	13.7394	14.3802	14.4108	-0.6714	-0.0306	-4.7%	-0.2%
1	HWL-01	K2O (wt%)	0.0997	0.1126	0.0852	0.0145	0.0274	17.0%	32.2%
1	HWL-01	La2O3 (wt%)	0.0824	0.0824	0.0931	-0.0107	-0.0107	-11.5%	-11.5%
1	HWL-01	Li2O (wt%)	5.2638	5.2063	5.1456	0.1182	0.0607	2.3%	1.2%
1	HWL-01	MgO (wt%)	0.1870	0.1921	0.1923	-0.0053	-0.0002	-2.8%	-0.1%
1	HWL-01	MnO (wt%)	1.8529	1.9166	1.8692	-0.0163	0.0474	-0.9%	2.5%
1	HWL-01	Na2O (wt%)	10.1572	10.0350	10.0446	0.1126	-0.0096	1.1%	-0.1%
1	HWL-01	Nb2O5 (wt%)	0.0715	0.0715	0.0000	0.0715	0.0715		
1	HWL-01	NiO (wt%)	0.4492	0.4771	0.5421	-0.0929	-0.0650	-17.1%	-12.0%
1	HWL-01	PbO (wt%)	0.0953	0.0953	0.1124	-0.0171	-0.0171	-15.2%	-15.2%
1	HWL-01	SiO2 (wt%)	44.1231	45.1335	45.0190	-0.8959	0.1145	-2.0%	0.3%
1	HWL-01	TiO2 (wt%)	1.4178	1.4501	1.5404	-0.1226	-0.0903	-8.0%	-5.9%
1	HWL-01	ZnO (wt%)	0.0548	0.0548	0.0585	-0.0037	-0.0037	-6.4%	-6.4%
1	HWL-01	ZrO2 (wt%)	0.2188	0.2188	0.2361	-0.0173	-0.0173	-7.3%	-7.3%
1	HWL-01	Sum	98.2378	99.8038	99.9064	-1.6686	-0.1026	-1.7%	-0.1%
1	HWL-02	Al2O3 (wt%)	12.1448	12.2770	12.0573	0.0875	0.2197	0.7%	1.8%
1	HWL-02	B2O3 (wt%)	7.1079	6.9789	7.3086	-0.2007	-0.3297	-2.7%	-4.5%
1	HWL-02	BaO (wt%)	0.1117	0.1160	0.1103	0.0014	0.0057	1.2%	5.2%
1	HWL-02	CaO (wt%)	1.3786	1.3503	1.3714	0.0072	-0.0211	0.5%	-1.5%
1	HWL-02	Ce2O3 (wt%)	0.2597	0.2597	0.2890	-0.0293	-0.0293	-10.1%	-10.1%
1	HWL-02	Cr2O3 (wt%)	0.1111	0.1072	0.1389	-0.0278	-0.0317	-20.0%	-22.8%
1	HWL-02	CuO (wt%)	0.0441	0.0453	0.0424	0.0017	0.0029	4.1%	6.9%
1	HWL-02	Fe2O3 (wt%)	16.1556	16.9064	16.0826	0.0730	0.8238	0.5%	5.1%
1	HWL-02	K2O (wt%)	0.1069	0.1208	0.0951	0.0118	0.0257	12.4%	27.0%
1	HWL-02	La2O3 (wt%)	0.0935	0.0935	0.1040	-0.0105	-0.0105	-10.1%	-10.1%
1	HWL-02	Li2O (wt%)	4.6610	4.6102	4.6984	-0.0374	-0.0882	-0.8%	-1.9%
1	HWL-02	MgO (wt%)	0.2152	0.2211	0.2147	0.0005	0.0064	0.2%	3.0%
1	HWL-02	MnO (wt%)	2.1886	2.2631	2.0862	0.1024	0.1769	4.9%	8.5%
1	HWL-02	Na2O (wt%)	11.2727	11.1371	11.0938	0.1789	0.0433	1.6%	0.4%
1	HWL-02	Nb2O5 (wt%)	0.0715	0.0715	0.0000	0.0715	0.0715		

Table A5. Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by Glass ID

				Measured					
			Measured	Bias-Corrected	Targeted	Diff of	Diff of	% Diff of	% Diff of
1	HWL-02	NiO (wt%)	0.5084	0.5399	0.6050	-0.0966	-0.0651	-16.0%	-10.8%
1	HWL-02	PbO (wt%)	0.1104	0.1104	0.1255	-0.0151	-0.0151	-12.0%	-12.0%
1	HWL-02	SiO2 (wt%)	41.5559	42.5068	41.4248	0.1311	1.0820	0.3%	2.6%
1	HWL-02	TiO2 (wt%)	1.6125	1.6493	1.7192	-0.1067	-0.0699	-6.2%	-4.1%
1	HWL-02	ZnO (wt%)	0.0619	0.0619	0.0653	-0.0034	-0.0034	-5.2%	-5.2%
1	HWL-02	ZrO2 (wt%)	0.2499	0.2499	0.2635	-0.0136	-0.0136	-5.2%	-5.2%
1	HWL-02	Sum	100.0219	101.6765	99.8960	0.1259	1.7805	0.1%	1.8%
1	HWL-03	Al2O3 (wt%)	10.8316	10.9495	10.8040	0.0276	0.1455	0.3%	1.3%
1	HWL-03	B2O3 (wt%)	9.9173	9.7361	10.2911	-0.3738	-0.5550	-3.6%	-5.4%
1	HWL-03	BaO (wt%)	0.0960	0.0998	0.0988	-0.0028	0.0010	-2.8%	1.0%
1	HWL-03	CaO (wt%)	1.2135	1.1886	1.2289	-0.0154	-0.0403	-1.3%	-3.3%
1	HWL-03	Ce2O3 (wt%)	0.2378	0.2378	0.2589	-0.0211	-0.0211	-8.2%	-8.2%
1	HWL-03	Cr2O3 (wt%)	0.1019	0.0984	0.1244	-0.0225	-0.0260	-18.0%	-20.9%
1	HWL-03	CuO (wt%)	0.0438	0.0450	0.0379	0.0059	0.0071	15.6%	18.7%
1	HWL-03	Fe2O3 (wt%)	13.5250	14.1536	14.4108	-0.8858	-0.2572	-6.1%	-1.8%
1	HWL-03	K2O (wt%)	0.0915	0.1034	0.0852	0.0063	0.0182	7.5%	21.4%
1	HWL-03	La2O3 (wt%)	0.0868	0.0868	0.0931	-0.0063	-0.0063	-6.8%	-6.8%
1	HWL-03	Li2O (wt%)	4.3704	4.3221	4.5738	-0.2034	-0.2517	-4.4%	-5.5%
1	HWL-03	MgO (wt%)	0.1953	0.2006	0.1923	0.0030	0.0083	1.5%	4.3%
1	HWL-03	MnO (wt%)	1.8270	1.8889	1.8692	-0.0422	0.0197	-2.3%	1.1%
1	HWL-03	Na2O (wt%)	10.1538	10.0318	10.0446	0.1092	-0.0128	1.1%	-0.1%
1	HWL-03	Nb2O5 (wt%)	0.0715	0.0715	0.0000	0.0715	0.0715		
1	HWL-03	NiO (wt%)	0.4746	0.5041	0.5421	-0.0675	-0.0380	-12.4%	-7.0%
1	HWL-03	PbO (wt%)	0.1031	0.1031	0.1124	-0.0093	-0.0093	-8.2%	-8.2%
1	HWL-03	SiO2 (wt%)	42.0907	43.0539	43.3039	-1.2132	-0.2500	-2.8%	-0.6%
1	HWL-03	TiO2 (wt%)	1.4712	1.5047	1.5404	-0.0692	-0.0357	-4.5%	-2.3%
1	HWL-03	ZnO (wt%)	0.0598	0.0598	0.0585	0.0013	0.0013	2.1%	2.1%
1	HWL-03	ZrO2 (wt%)	0.2323	0.2323	0.2361	-0.0038	-0.0038	-1.6%	-1.6%
1	HWL-03	Sum	97.1950	98.6717	99.9064	-2.7114	-1.2347	-2.7%	-1.2%
1	HWL-04	Al2O3 (wt%)	11.9700	12.1004	12.0573	-0.0873	0.0431	-0.7%	0.4%
1	HWL-04	B2O3 (wt%)	9.3297	9.1601	9.3968	-0.0671	-0.2367	-0.7%	-2.5%
1	HWL-04	BaO (wt%)	0.1050	0.1090	0.1103	-0.0053	-0.0013	-4.8%	-1.1%
1	HWL-04	CaO (wt%)	1.3635	1.3356	1.3714	-0.0079	-0.0358	-0.6%	-2.6%
1	HWL-04	Ce2O3 (wt%)	0.2609	0.2609	0.2890	-0.0281	-0.0281	-9.7%	-9.7%
1	HWL-04	Cr2O3 (wt%)	0.1067	0.1030	0.1389	-0.0322	-0.0359	-23.2%	-25.8%
1	HWL-04	CuO (wt%)	0.0457	0.0469	0.0424	0.0033	0.0045	7.8%	10.7%
1	HWL-04	Fe2O3 (wt%)	15.2799	15.9927	16.0826	-0.8027	-0.0899	-5.0%	-0.6%
1	HWL-04	K2O (wt%)	0.1003	0.1133	0.0951	0.0052	0.0182	5.4%	19.1%
1	HWL-04	La2O3 (wt%)	0.0944	0.0944	0.1040	-0.0096	-0.0096	-9.2%	-9.2%
1	HWL-04	Li2O (wt%)	4.3435	4.2963	4.1763	0.1672	0.1200	4.0%	2.9%
1	HWL-04	MgO (wt%)	0.2123	0.2181	0.2147	-0.0024	0.0034	-1.1%	1.6%
1	HWL-04	MnO (wt%)	2.0724	2.1438	2.0862	-0.0138	0.0576	-0.7%	2.8%
1	HWL-04	Na2O (wt%)	11.3401	11.2035	11.0938	0.2463	0.1097	2.2%	1.0%
1	HWL-04	Nb2O5 (wt%)	0.0715	0.0715	0.0000	0.0715	0.0715		
1	HWL-04	NiO (wt%)	0.4931	0.5237	0.6050	-0.1119	-0.0813	-18.5%	-13.4%
1	HWL-04	PbO (wt%)	0.1118	0.1118	0.1255	-0.0137	-0.0137	-10.9%	-10.9%
1	HWL-04	SiO2 (wt%)	39.0957	39.9911	39.8587	-0.7630	0.1324	-1.9%	0.3%
1	HWL-04	TiO2 (wt%)	1.6200	1.6570	1.7192	-0.0992	-0.0622	-5.8%	-3.6%
1	HWL-04	ZnO (wt%)	0.0629	0.0629	0.0653	-0.0024	-0.0024	-3.7%	-3.7%
1	HWL-04	ZrO2 (wt%)	0.2516	0.2516	0.2635	-0.0119	-0.0119	-4.5%	-4.5%
1	HWL-04	Sum	98.3308	99.8476	99.8960	-1.5652	-0.0484	-1.6%	0.0%
1	HWL-05	Al2O3 (wt%)	7.0337	7.1103	6.8214	0.2123	0.2889	3.1%	4.2%
1	HWL-05	B2O3 (wt%)	7.5668	7.4293	7.9861	-0.4193	-0.5568	-5.3%	-7.0%
1	HWL-05	BaO (wt%)	0.1158	0.1204	0.1172	-0.0014	0.0032	-1.2%	2.7%
1	HWL-05	CaO (wt%)	1.5811	1.5487	1.5202	0.0609	0.0285	4.0%	1.9%
1	HWL-05	Ce2O3 (wt%)	0.2510	0.2510	0.2720	-0.0210	-0.0210	-7.7%	-7.7%
1	HWL-05	Cr2O3 (wt%)	0.1323	0.1277	0.1593	-0.0270	-0.0316	-17.0%	-19.8%
1	HWL-05	CuO (wt%)	0.0529	0.0543	0.0491	0.0038	0.0052	7.7%	10.6%
1	HWL-05	Fe2O3 (wt%)	16.0484	16.7963	16.4145	-0.3661	0.3818	-2.2%	2.3%

Table A5. Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by Glass ID

				Measured					
			Measured	Bias-Corrected	Targeted	Diff of	Diff of	% Diff of	% Diff of
1	HWL-05	K2O (wt%)	0.1181	0.1334	0.1065	0.0116	0.0269	10.8%	25.2%
1	HWL-05	La2O3 (wt%)	0.0944	0.0944	0.1017	-0.0073	-0.0073	-7.2%	-7.2%
1	HWL-05	Li2O (wt%)	5.1400	5.0838	5.1339	0.0061	-0.0501	0.1%	-1.0%
1	HWL-05	MgO (wt%)	0.2181	0.2241	0.2176	0.0005	0.0065	0.2%	3.0%
1	HWL-05	MnO (wt%)	2.4888	2.5750	2.4138	0.0750	0.1612	3.1%	6.7%
1	HWL-05	Na2O (wt%)	10.7672	10.6376	10.4690	0.2982	0.1686	2.8%	1.6%
1	HWL-05	Nb2O5 (wt%)	0.0715	0.0715	0.0000	0.0715	0.0715		
1	HWL-05	NiO (wt%)	0.4877	0.5180	0.5960	-0.1083	-0.0780	-18.2%	-13.1%
1	HWL-05	PbO (wt%)	0.1088	0.1088	0.1190	-0.0102	-0.0102	-8.6%	-8.6%
1	HWL-05	SiO2 (wt%)	45.4601	46.5010	45.7297	-0.2696	0.7713	-0.6%	1.7%
1	HWL-05	TiO2 (wt%)	1.2272	1.2552	1.2933	-0.0661	-0.0381	-5.1%	-2.9%
1	HWL-05	ZnO (wt%)	0.0738	0.0738	0.0758	-0.0020	-0.0020	-2.7%	-2.7%
1	HWL-05	ZrO2 (wt%)	0.2735	0.2735	0.2866	-0.0131	-0.0131	-4.6%	-4.6%
1	HWL-05	Sum	99.3110	100.9880	99.8827	-0.5717	1.1053	-0.6%	1.1%
1	HWL-06	Al2O3 (wt%)	7.6903	7.7740	7.6108	0.0795	0.1632	1.0%	2.1%
1	HWL-06	B2O3 (wt%)	7.3011	7.1684	7.2902	0.0109	-0.1218	0.1%	-1.7%
1	HWL-06	BaO (wt%)	0.1239	0.1288	0.1308	-0.0069	-0.0020	-5.3%	-1.6%
1	HWL-06	CaO (wt%)	1.7385	1.7029	1.6960	0.0425	0.0069	2.5%	0.4%
1	HWL-06	Ce2O3 (wt%)	0.2726	0.2726	0.3034	-0.0308	-0.0308	-10.1%	-10.1%
1	HWL-06	Cr2O3 (wt%)	0.1633	0.1577	0.1778	-0.0145	-0.0201	-8.1%	-11.3%
1	HWL-06	CuO (wt%)	0.0579	0.0595	0.0548	0.0031	0.0047	5.6%	8.5%
1	HWL-06	Fe2O3 (wt%)	17.6211	18.4440	18.3139	-0.6928	0.1301	-3.8%	0.7%
1	HWL-06	K2O (wt%)	0.1292	0.1460	0.1188	0.0104	0.0272	8.7%	22.9%
1	HWL-06	La2O3 (wt%)	0.1041	0.1041	0.1135	-0.0094	-0.0094	-8.3%	-8.3%
1	HWL-06	Li2O (wt%)	4.7687	4.7166	4.6866	0.0821	0.0300	1.8%	0.6%
1	HWL-06	MgO (wt%)	0.2442	0.2509	0.2428	0.0014	0.0081	0.6%	3.3%
1	HWL-06	MnO (wt%)	2.7632	2.8597	2.6931	0.0701	0.1666	2.6%	6.2%
1	HWL-06	Na2O (wt%)	11.6838	11.5434	11.5647	0.1191	-0.0213	1.0%	-0.2%
1	HWL-06	Nb2O5 (wt%)	0.0715	0.0715	0.0000	0.0715	0.0715		
1	HWL-06	NiO (wt%)	0.5694	0.6048	0.6650	-0.0956	-0.0602	-14.4%	-9.1%
1	HWL-06	PbO (wt%)	0.1053	0.1053	0.1328	-0.0275	-0.0275	-20.7%	-20.7%
1	HWL-06	SiO2 (wt%)	41.8233	42.7814	42.2268	-0.4035	0.5546	-1.0%	1.3%
1	HWL-06	TiO2 (wt%)	1.3828	1.4143	1.4429	-0.0601	-0.0286	-4.2%	-2.0%
1	HWL-06	ZnO (wt%)	0.0797	0.0797	0.0846	-0.0049	-0.0049	-5.8%	-5.8%
1	HWL-06	ZrO2 (wt%)	0.2985	0.2985	0.3197	-0.0212	-0.0212	-6.6%	-6.6%
1	HWL-06	Sum	98.9924	100.6840	99.8690	-0.8766	0.8150	-0.9%	0.8%
1	HWL-07	Al2O3 (wt%)	6.9156	6.9909	6.8214	0.0942	0.1695	1.4%	2.5%
1	HWL-07	B2O3 (wt%)	4.9023	4.8128	5.1339	-0.2316	-0.3211	-4.5%	-6.3%
1	HWL-07	BaO (wt%)	0.1128	0.1172	0.1172	-0.0044	0.0000	-3.8%	0.0%
1	HWL-07	CaO (wt%)	1.5321	1.5007	1.5202	0.0119	-0.0195	0.8%	-1.3%
1	HWL-07	Ce2O3 (wt%)	0.2504	0.2504	0.2720	-0.0216	-0.0216	-8.0%	-8.0%
1	HWL-07	Cr2O3 (wt%)	0.1494	0.1443	0.1593	-0.0099	-0.0150	-6.2%	-9.4%
1	HWL-07	CuO (wt%)	0.0504	0.0517	0.0491	0.0013	0.0026	2.6%	5.4%
1	HWL-07	Fe2O3 (wt%)	16.0126	16.7593	16.4145	-0.4019	0.3448	-2.4%	2.1%
1	HWL-07	K2O (wt%)	0.1093	0.1235	0.1065	0.0028	0.0170	2.6%	16.0%
1	HWL-07	La2O3 (wt%)	0.0912	0.0912	0.1017	-0.0105	-0.0105	-10.3%	-10.3%
1	HWL-07	Li2O (wt%)	5.1024	5.0456	5.1339	-0.0315	-0.0883	-0.6%	-1.7%
1	HWL-07	MgO (wt%)	0.2210	0.2270	0.2176	0.0034	0.0094	1.5%	4.3%
1	HWL-07	MnO (wt%)	2.4791	2.5651	2.4138	0.0653	0.1513	2.7%	6.3%
1	HWL-07	Na2O (wt%)	12.1657	12.0193	12.1803	-0.0146	-0.1610	-0.1%	-1.3%
1	HWL-07	Nb2O5 (wt%)	0.0715	0.0715	0.0000	0.0715	0.0715		
1	HWL-07	NiO (wt%)	0.5360	0.5693	0.5960	-0.0600	-0.0267	-10.1%	-4.5%
1	HWL-07	PbO (wt%)	0.1061	0.1061	0.1190	-0.0129	-0.0129	-10.8%	-10.8%
1	HWL-07	SiO2 (wt%)	46.3693	47.4316	46.8706	-0.5013	0.5610	-1.1%	1.2%
1	HWL-07	TiO2 (wt%)	1.2481	1.2765	1.2933	-0.0452	-0.0168	-3.5%	-1.3%
1	HWL-07	ZnO (wt%)	0.0719	0.0719	0.0758	-0.0039	-0.0039	-5.2%	-5.2%
1	HWL-07	ZrO2 (wt%)	0.2718	0.2718	0.2866	-0.0148	-0.0148	-5.1%	-5.1%
1	HWL-07	Sum	98.7691	100.4979	99.8827	-1.1136	0.6152	-1.1%	0.6%
1	HWL-08	Al2O3 (wt%)	7.7800	7.8647	7.6108	0.1692	0.2539	2.2%	3.3%

Table A5. Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by Glass ID

				Measured					
			Measured	Bias-Corrected	Targeted	Diff of	Diff of	% Diff of	% Diff of
1	HWL-08	B2O3 (wt%)	4.3308	4.2519	4.6866	-0.3558	-0.4347	-7.6%	-9.3%
1	HWL-08	BaO (wt%)	0.1284	0.1334	0.1308	-0.0024	0.0026	-1.8%	2.0%
1	HWL-08	CaO (wt%)	1.7700	1.7336	1.6960	0.0740	0.0376	4.4%	2.2%
1	HWL-08	Ce2O3 (wt%)	0.2744	0.2744	0.3034	-0.0290	-0.0290	-9.6%	-9.6%
1	HWL-08	Cr2O3 (wt%)	0.1480	0.1429	0.1778	-0.0298	-0.0349	-16.8%	-19.6%
1	HWL-08	CuO (wt%)	0.0576	0.0591	0.0548	0.0028	0.0043	5.1%	7.9%
1	HWL-08	Fe2O3 (wt%)	16.9777	17.7655	18.3139	-1.3362	-0.5484	-7.3%	-3.0%
1	HWL-08	K2O (wt%)	0.1337	0.1510	0.1188	0.0149	0.0322	12.6%	27.1%
1	HWL-08	La2O3 (wt%)	0.1050	0.1050	0.1135	-0.0085	-0.0085	-7.5%	-7.5%
1	HWL-08	Li2O (wt%)	4.5480	4.4981	4.6866	-0.1386	-0.1885	-3.0%	-4.0%
1	HWL-08	MgO (wt%)	0.2409	0.2475	0.2428	-0.0019	0.0047	-0.8%	1.9%
1	HWL-08	MnO (wt%)	2.6825	2.7734	2.6931	-0.0106	0.0803	-0.4%	3.0%
1	HWL-08	Na2O (wt%)	13.2205	13.0615	13.1268	0.0937	-0.0653	0.7%	-0.5%
1	HWL-08	Nb2O5 (wt%)	0.0715	0.0715	0.0000	0.0715	0.0715		
1	HWL-08	NiO (wt%)	0.5707	0.6062	0.6650	-0.0943	-0.0588	-14.2%	-8.8%
1	HWL-08	PbO (wt%)	0.1185	0.1185	0.1328	-0.0143	-0.0143	-10.8%	-10.8%
1	HWL-08	SiO2 (wt%)	42.7325	43.7096	43.2683	-0.5358	0.4413	-1.2%	1.0%
1	HWL-08	TiO2 (wt%)	1.3728	1.4041	1.4429	-0.0701	-0.0388	-4.9%	-2.7%
1	HWL-08	ZnO (wt%)	0.0809	0.0809	0.0846	-0.0037	-0.0037	-4.4%	-4.4%
1	HWL-08	ZrO2 (wt%)	0.2935	0.2935	0.3197	-0.0262	-0.0262	-8.2%	-8.2%
1	HWL-08	Sum	97.6377	99.3461	99.8690	-2.2313	-0.5229	-2.2%	-0.5%
1	HWL-21	Al2O3 (wt%)	17.2133	17.4011	17.2006	0.0127	0.2005	0.1%	1.2%
1	HWL-21	B2O3 (wt%)	8.7984	8.6386	9.0245	-0.2261	-0.3859	-2.5%	-4.3%
1	HWL-21	BaO (wt%)	0.0890	0.0925	0.0917	-0.0027	0.0008	-2.9%	0.9%
1	HWL-21	CaO (wt%)	1.4412	1.4116	1.4224	0.0188	-0.0108	1.3%	-0.8%
1	HWL-21	Ce2O3 (wt%)	0.0902	0.0902	0.0983	-0.0081	-0.0081	-8.3%	-8.3%
1	HWL-21	Cr2O3 (wt%)	0.1275	0.1231	0.1619	-0.0344	-0.0388	-21.2%	-24.0%
1	HWL-21	CuO (wt%)	0.0466	0.0479	0.0426	0.0040	0.0053	9.5%	12.4%
1	HWL-21	Fe2O3 (wt%)	8.7676	9.1755	9.3779	-0.6103	-0.2024	-6.5%	-2.2%
1	HWL-21	K2O (wt%)	0.1159	0.1310	0.1068	0.0091	0.0242	8.6%	22.6%
1	HWL-21	La2O3 (wt%)	0.0469	0.0469	0.0526	-0.0057	-0.0057	-10.8%	-10.8%
1	HWL-21	Li2O (wt%)	4.0259	3.9824	4.0109	0.0150	-0.0285	0.4%	-0.7%
1	HWL-21	MgO (wt%)	0.1886	0.1938	0.1880	0.0006	0.0058	0.3%	3.1%
1	HWL-21	MnO (wt%)	0.8635	0.8916	0.8954	-0.0319	-0.0038	-3.6%	-0.4%
1	HWL-21	Na2O (wt%)	14.5247	14.3498	14.4657	0.0590	-0.1159	0.4%	-0.8%
1	HWL-21	Nb2O5 (wt%)	0.0715	0.0715	0.0000	0.0715	0.0715		
1	HWL-21	NiO (wt%)	0.1374	0.1460	0.1599	-0.0225	-0.0139	-14.1%	-8.7%
1	HWL-21	PbO (wt%)	0.0323	0.0323	0.0351	-0.0028	-0.0028	-7.9%	-7.9%
1	HWL-21	SiO2 (wt%)	40.2188	41.1398	40.7459	-0.5271	0.3939	-1.3%	1.0%
1	HWL-21	TiO2 (wt%)	1.4649	1.4983	1.5522	-0.0873	-0.0539	-5.6%	-3.5%
1	HWL-21	ZnO (wt%)	0.0426	0.0426	0.0461	-0.0035	-0.0035	-7.5%	-7.5%
1	HWL-21	ZrO2 (wt%)	0.2178	0.2178	0.2371	-0.0193	-0.0193	-8.1%	-8.1%
1	HWL-21	Sum	98.5250	99.7243	99.9156	-1.3906	-0.1913	-1.4%	-0.2%
1	HWL-22	Al2O3 (wt%)	18.9895	19.1962	18.9257	0.0638	0.2705	0.3%	1.4%
1	HWL-22	B2O3 (wt%)	7.8968	7.7534	8.1242	-0.2274	-0.3708	-2.8%	-4.6%
1	HWL-22	BaO (wt%)	0.1024	0.1064	0.1010	0.0014	0.0054	1.4%	5.4%
1	HWL-22	CaO (wt%)	1.6056	1.5727	1.5651	0.0405	0.0076	2.6%	0.5%
1	HWL-22	Ce2O3 (wt%)	0.1025	0.1025	0.1081	-0.0056	-0.0056	-5.2%	-5.2%
1	HWL-22	Cr2O3 (wt%)	0.1564	0.1510	0.1782	-0.0218	-0.0272	-12.2%	-15.3%
1	HWL-22	CuO (wt%)	0.0513	0.0527	0.0469	0.0044	0.0058	9.4%	12.4%
1	HWL-22	Fe2O3 (wt%)	9.6898	10.1413	10.3185	-0.6287	-0.1772	-6.1%	-1.7%
1	HWL-22	K2O (wt%)	0.1184	0.1337	0.1175	0.0009	0.0162	0.7%	13.8%
1	HWL-22	La2O3 (wt%)	0.0531	0.0531	0.0580	-0.0049	-0.0049	-8.5%	-8.5%
1	HWL-22	Li2O (wt%)	3.7191	3.6789	3.6107	0.1084	0.0682	3.0%	1.9%
1	HWL-22	MgO (wt%)	0.2131	0.2190	0.2069	0.0062	0.0121	3.0%	5.8%
1	HWL-22	MnO (wt%)	0.9720	1.0041	0.9852	-0.0132	0.0189	-1.3%	1.9%
1	HWL-22	Na2O (wt%)	15.7042	15.5153	15.8163	-0.1121	-0.3010	-0.7%	-1.9%
1	HWL-22	Nb2O5 (wt%)	0.0715	0.0715	0.0000	0.0715	0.0715		
1	HWL-22	NiO (wt%)	0.1610	0.1710	0.1760	-0.0150	-0.0050	-8.5%	-2.9%

Table A5. Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by Glass ID

				Measured					
			Measured	Bias-Corrected	Targeted	Diff of	Diff of	% Diff of	% Diff of
1	HWL-22	PbO (wt%)	0.0404	0.0404	0.0386	0.0018	0.0018	4.7%	4.7%
1	HWL-22	SiO2 (wt%)	37.3843	38.2405	37.5107	-0.1264	0.7298	-0.3%	1.9%
1	HWL-22	TiO2 (wt%)	1.6630	1.7010	1.7079	-0.0449	-0.0069	-2.6%	-0.4%
1	HWL-22	ZnO (wt%)	0.0495	0.0495	0.0508	-0.0013	-0.0013	-2.6%	-2.6%
1	HWL-22	ZrO2 (wt%)	0.2411	0.2411	0.2610	-0.0199	-0.0199	-7.6%	-7.6%
1	HWL-22	Sum	98.9848	100.1952	99.9073	-0.9225	0.2879	-0.9%	0.3%
2	Batch 1	Al2O3 (wt%)	4.7678	4.8770	4.8770	-0.1092	0.0000	-2.2%	0.0%
2	Batch 1	B2O3 (wt%)	7.9639	7.7770	7.7770	0.1869	0.0000	2.4%	0.0%
2	Batch 1	BaO (wt%)	0.1414	0.1510	0.1510	-0.0096	0.0000	-6.3%	0.0%
2	Batch 1	CaO (wt%)	1.2304	1.2200	1.2200	0.0104	0.0000	0.8%	0.0%
2	Batch 1	Ce2O3 (wt%)	0.0059	0.0059	0.0000	0.0059	0.0059		
2	Batch 1	Cr2O3 (wt%)	0.1074	0.1070	0.1070	0.0004	0.0000	0.4%	0.0%
2	Batch 1	CuO (wt%)	0.3868	0.3990	0.3990	-0.0122	0.0000	-3.1%	0.0%
2	Batch 1	Fe2O3 (wt%)	12.7386	12.8390	12.8390	-0.1004	0.0000	-0.8%	0.0%
2	Batch 1	K2O (wt%)	2.8971	3.3270	3.3270	-0.4299	0.0000	-12.9%	0.0%
2	Batch 1	La2O3 (wt%)	0.0012	0.0012	0.0000	0.0012	0.0012		
2	Batch 1	Li2O (wt%)	4.4888	4.4290	4.4290	0.0598	0.0000	1.4%	0.0%
2	Batch 1	MgO (wt%)	1.3689	1.4190	1.4190	-0.0501	0.0000	-3.5%	0.0%
2	Batch 1	MnO (wt%)	1.7388	1.7260	1.7260	0.0128	0.0000	0.7%	0.0%
2	Batch 1	Na2O (wt%)	8.9260	9.0030	9.0030	-0.0770	0.0000	-0.9%	0.0%
2	Batch 1	Nb2O5 (wt%)	0.0715	0.0715	0.1470	-0.0755	-0.0755	-51.3%	-51.3%
2	Batch 1	NiO (wt%)	0.6999	0.7510	0.7510	-0.0511	0.0000	-6.8%	0.0%
2	Batch 1	PbO (wt%)	0.0025	0.0025	0.0000	0.0025	0.0025		
2	Batch 1	SiO2 (wt%)	50.1309	50.2200	50.2200	-0.0891	0.0000	-0.2%	0.0%
2	Batch 1	TiO2 (wt%)	0.6630	0.6770	0.6770	-0.0140	0.0000	-2.1%	0.0%
2	Batch 1	ZnO (wt%)	0.0062	0.0062	0.0000	0.0062	0.0062		
2	Batch 1	ZrO2 (wt%)	0.0892	0.0892	0.0980	-0.0088	-0.0088	-9.0%	-9.0%
2	Batch 1	Sum	98.4263	99.0985	99.1670	-0.7407	-0.0685	-0.7%	-0.1%
2	HWL-09	Al2O3 (wt%)	4.5301	4.6338	4.5000	0.0301	0.1338	0.7%	3.0%
2	HWL-09	B2O3 (wt%)	11.9136	11.6366	11.9211	-0.0075	-0.2845	-0.1%	-2.4%
2	HWL-09	BaO (wt%)	0.0740	0.0790	0.0793	-0.0053	-0.0003	-6.7%	-0.4%
2	HWL-09	CaO (wt%)	0.8374	0.8306	0.8723	-0.0349	-0.0417	-4.0%	-4.8%
2	HWL-09	Ce2O3 (wt%)	0.1763	0.1763	0.1859	-0.0096	-0.0096	-5.2%	-5.2%
2	HWL-09	Cr2O3 (wt%)	0.0775	0.0772	0.0982	-0.0207	-0.0210	-21.1%	-21.4%
2	HWL-09	CuO (wt%)	0.0357	0.0368	0.0300	0.0057	0.0068	18.9%	22.7%
2	HWL-09	Fe2O3 (wt%)	10.3725	10.4616	10.3992	-0.0267	0.0624	-0.3%	0.6%
2	HWL-09	K2O (wt%)	0.0629	0.0723	0.0624	0.0005	0.0099	0.9%	15.9%
2	HWL-09	La2O3 (wt%)	0.0583	0.0583	0.0668	-0.0085	-0.0085	-12.7%	-12.7%
2	HWL-09	Li2O (wt%)	5.4199	5.3479	5.2983	0.1216	0.0496	2.3%	0.9%
2	HWL-09	MgO (wt%)	0.1302	0.1349	0.1416	-0.0114	-0.0067	-8.1%	-4.7%
2	HWL-09	MnO (wt%)	3.4830	3.4615	3.3575	0.1255	0.1040	3.7%	3.1%
2	HWL-09	Na2O (wt%)	7.9970	8.0663	7.9560	0.0410	0.1103	0.5%	1.4%
2	HWL-09	Nb2O5 (wt%)	0.9034	0.9034	0.8089	0.0945	0.0945	11.7%	11.7%
2	HWL-09	NiO (wt%)	0.5978	0.6414	0.6695	-0.0717	-0.0281	-10.7%	-4.2%
2	HWL-09	PbO (wt%)	0.1007	0.1007	0.1121	-0.0114	-0.0114	-10.2%	-10.2%
2	HWL-09	SiO2 (wt%)	49.3643	49.4566	50.2878	-0.9235	-0.8312	-1.8%	-1.7%
2	HWL-09	TiO2 (wt%)	2.2476	2.2949	2.3433	-0.0957	-0.0484	-4.1%	-2.1%
2	HWL-09	ZnO (wt%)	0.0314	0.0314	0.0371	-0.0057	-0.0057	-15.3%	-15.3%
2	HWL-09	ZrO2 (wt%)	0.7169	0.7169	0.7727	-0.0558	-0.0558	-7.2%	-7.2%
2	HWL-09	Sum	99.1306	99.2185	100.0000	-0.8694	-0.7815	-0.9%	-0.8%
2	HWL-10	Al2O3 (wt%)	5.1158	5.2331	5.1568	-0.0410	0.0763	-0.8%	1.5%
2	HWL-10	B2O3 (wt%)	11.1167	10.8572	11.0339	0.0828	-0.1767	0.8%	-1.6%
2	HWL-10	BaO (wt%)	0.0865	0.0924	0.0909	-0.0044	0.0015	-4.8%	1.6%
2	HWL-10	CaO (wt%)	0.9815	0.9737	0.9996	-0.0181	-0.0259	-1.8%	-2.6%
2	HWL-10	Ce2O3 (wt%)	0.1997	0.1997	0.2130	-0.0133	-0.0133	-6.2%	-6.2%
2	HWL-10	Cr2O3 (wt%)	0.0899	0.0895	0.1126	-0.0227	-0.0231	-20.2%	-20.5%
2	HWL-10	CuO (wt%)	0.0401	0.0413	0.0343	0.0058	0.0070	16.8%	20.5%
2	HWL-10	Fe2O3 (wt%)	11.7343	11.8253	11.9169	-0.1826	-0.0916	-1.5%	-0.8%
2	HWL-10	K2O (wt%)	0.0729	0.0837	0.0715	0.0014	0.0122	1.9%	17.1%

Table A5. Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by Glass ID

				Measured					
			Measured	Bias-Corrected	Targeted	Diff of	Diff of	% Diff of	% Diff of
2	HWL-10	La2O3 (wt%)	0.0680	0.0680	0.0765	-0.0085	-0.0085	-11.1%	-11.1%
2	HWL-10	Li2O (wt%)	5.1831	5.1142	4.9040	0.2791	0.2102	5.7%	4.3%
2	HWL-10	MgO (wt%)	0.1592	0.1650	0.1623	-0.0031	0.0027	-1.9%	1.7%
2	HWL-10	MnO (wt%)	3.9834	3.9555	3.8476	0.1358	0.1079	3.5%	2.8%
2	HWL-10	Na2O (wt%)	8.9878	9.0657	8.9713	0.0165	0.0944	0.2%	1.1%
2	HWL-10	Nb2O5 (wt%)	1.0307	1.0307	0.9270	0.1037	0.1037	11.2%	11.2%
2	HWL-10	NiO (wt%)	0.6547	0.7025	0.7673	-0.1126	-0.0648	-14.7%	-8.4%
2	HWL-10	PbO (wt%)	0.1147	0.1147	0.1284	-0.0137	-0.0137	-10.7%	-10.7%
2	HWL-10	SiO2 (wt%)	46.2624	46.3417	46.9728	-0.7104	-0.6311	-1.5%	-1.3%
2	HWL-10	TiO2 (wt%)	2.5812	2.6355	2.6853	-0.1041	-0.0498	-3.9%	-1.9%
2	HWL-10	ZnO (wt%)	0.0373	0.0373	0.0425	-0.0052	-0.0052	-12.1%	-12.1%
2	HWL-10	ZrO2 (wt%)	0.8162	0.8162	0.8855	-0.0693	-0.0693	-7.8%	-7.8%
2	HWL-10	Sum	99.3161	99.4430	100.0000	-0.6839	-0.5570	-0.7%	-0.6%
2	HWL-11	Al2O3 (wt%)	5.7016	5.8323	5.8171	-0.1155	0.0152	-2.0%	0.3%
2	HWL-11	B2O3 (wt%)	10.1346	9.8975	10.1419	-0.0073	-0.2444	-0.1%	-2.4%
2	HWL-11	BaO (wt%)	0.0946	0.1010	0.1025	-0.0079	-0.0015	-7.7%	-1.4%
2	HWL-11	CaO (wt%)	1.1187	1.1097	1.1276	-0.0089	-0.0179	-0.8%	-1.6%
2	HWL-11	Ce2O3 (wt%)	0.2269	0.2269	0.2403	-0.0134	-0.0134	-5.6%	-5.6%
2	HWL-11	Cr2O3 (wt%)	0.0797	0.0793	0.1270	-0.0473	-0.0477	-37.3%	-37.5%
2	HWL-11	CuO (wt%)	0.0451	0.0465	0.0387	0.0064	0.0078	16.4%	20.1%
2	HWL-11	Fe2O3 (wt%)	12.8494	12.9460	13.4430	-0.5936	-0.4970	-4.4%	-3.7%
2	HWL-11	K2O (wt%)	0.0834	0.0958	0.0807	0.0027	0.0151	3.4%	18.7%
2	HWL-11	La2O3 (wt%)	0.0777	0.0777	0.0864	-0.0087	-0.0087	-10.1%	-10.1%
2	HWL-11	Li2O (wt%)	4.7687	4.7053	4.5075	0.2612	0.1978	5.8%	4.4%
2	HWL-11	MgO (wt%)	0.1783	0.1848	0.1831	-0.0048	0.0017	-2.6%	0.9%
2	HWL-11	MnO (wt%)	4.5127	4.4794	4.3402	0.1725	0.1392	4.0%	3.2%
2	HWL-11	Na2O (wt%)	9.8573	9.9428	9.9920	-0.1348	-0.0492	-1.3%	-0.5%
2	HWL-11	Nb2O5 (wt%)	1.1609	1.1609	1.0457	0.1152	0.1152	11.0%	11.0%
2	HWL-11	NiO (wt%)	0.7202	0.7729	0.8654	-0.1452	-0.0925	-16.8%	-10.7%
2	HWL-11	PbO (wt%)	0.1225	0.1225	0.1449	-0.0224	-0.0224	-15.4%	-15.4%
2	HWL-11	SiO2 (wt%)	43.1604	43.2300	43.6400	-0.4796	-0.4100	-1.1%	-0.9%
2	HWL-11	TiO2 (wt%)	2.8898	2.9509	3.0291	-0.1393	-0.0782	-4.6%	-2.6%
2	HWL-11	ZnO (wt%)	0.0426	0.0426	0.0479	-0.0053	-0.0053	-11.0%	-11.0%
2	HWL-11	ZrO2 (wt%)	0.8621	0.8621	0.9989	-0.1368	-0.1368	-13.7%	-13.7%
2	HWL-11	Sum	98.6872	98.8672	99.9999	-1.3127	-1.1327	-1.3%	-1.1%
2	HWL-12	Al2O3 (wt%)	4.6246	4.7304	4.5000	0.1246	0.2304	2.8%	5.1%
2	HWL-12	B2O3 (wt%)	5.3531	5.2290	5.2983	0.0548	-0.0693	1.0%	-1.3%
2	HWL-12	BaO (wt%)	0.0720	0.0769	0.0793	-0.0073	-0.0024	-9.2%	-3.0%
2	HWL-12	CaO (wt%)	0.8504	0.8433	0.8723	-0.0219	-0.0290	-2.5%	-3.3%
2	HWL-12	Ce2O3 (wt%)	0.1731	0.1731	0.1859	-0.0128	-0.0128	-6.9%	-6.9%
2	HWL-12	Cr2O3 (wt%)	0.0818	0.0815	0.0982	-0.0164	-0.0167	-16.7%	-17.0%
2	HWL-12	CuO (wt%)	0.0363	0.0375	0.0300	0.0063	0.0075	21.0%	24.8%
2	HWL-12	Fe2O3 (wt%)	10.2724	10.3503	10.3992	-0.1268	-0.0489	-1.2%	-0.5%
2	HWL-12	K2O (wt%)	0.0650	0.0747	0.0624	0.0026	0.0123	4.2%	19.7%
2	HWL-12	La2O3 (wt%)	0.0601	0.0601	0.0668	-0.0067	-0.0067	-10.0%	-10.0%
2	HWL-12	Li2O (wt%)	5.5975	5.5232	5.2983	0.2992	0.2249	5.6%	4.2%
2	HWL-12	MgO (wt%)	0.1401	0.1452	0.1416	-0.0015	0.0036	-1.0%	2.6%
2	HWL-12	MnO (wt%)	3.5540	3.5280	3.3575	0.1965	0.1705	5.9%	5.1%
2	HWL-12	Na2O (wt%)	12.4757	12.5833	12.5920	-0.1163	-0.0087	-0.9%	-0.1%
2	HWL-12	Nb2O5 (wt%)	0.8848	0.8848	0.8089	0.0759	0.0759	9.4%	9.4%
2	HWL-12	NiO (wt%)	0.5854	0.6281	0.6695	-0.0841	-0.0414	-12.6%	-6.2%
2	HWL-12	PbO (wt%)	0.0945	0.0945	0.1121	-0.0176	-0.0176	-15.7%	-15.7%
2	HWL-12	SiO2 (wt%)	51.7711	51.8607	52.2746	-0.5035	-0.4139	-1.0%	-0.8%
2	HWL-12	TiO2 (wt%)	2.2560	2.3036	2.3433	-0.0873	-0.0397	-3.7%	-1.7%
2	HWL-12	ZnO (wt%)	0.0274	0.0274	0.0371	-0.0097	-0.0097	-26.2%	-26.2%
2	HWL-12	ZrO2 (wt%)	0.6200	0.6200	0.7727	-0.1527	-0.1527	-19.8%	-19.8%
2	HWL-12	Sum	99.5953	99.8556	100.0000	-0.4047	-0.1444	-0.4%	-0.1%
2	HWL-13	Al2O3 (wt%)	5.1725	5.2911	5.1568	0.0157	0.1343	0.3%	2.6%
2	HWL-13	B2O3 (wt%)	4.8540	4.7404	4.9040	-0.0500	-0.1636	-1.0%	-3.3%

Table A5. Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by Glass ID

				Measured					
			Measured	Bias-Corrected	Targeted	Diff of	Diff of	% Diff of	% Diff of
2	HWL-13	BaO (wt%)	0.1013	0.1082	0.0909	0.0104	0.0173	11.5%	19.0%
2	HWL-13	CaO (wt%)	0.9885	0.9806	0.9996	-0.0111	-0.0190	-1.1%	-1.9%
2	HWL-13	Ce2O3 (wt%)	0.1953	0.1953	0.2130	-0.0177	-0.0177	-8.3%	-8.3%
2	HWL-13	Cr2O3 (wt%)	0.0756	0.0753	0.1126	-0.0370	-0.0373	-32.8%	-33.1%
2	HWL-13	CuO (wt%)	0.0410	0.0423	0.0343	0.0067	0.0080	19.5%	23.3%
2	HWL-13	Fe2O3 (wt%)	11.5019	11.5956	11.9169	-0.4150	-0.3213	-3.5%	-2.7%
2	HWL-13	K2O (wt%)	0.0789	0.0906	0.0715	0.0074	0.0191	10.4%	26.8%
2	HWL-13	La2O3 (wt%)	0.0683	0.0683	0.0765	-0.0082	-0.0082	-10.7%	-10.7%
2	HWL-13	Li2O (wt%)	5.1454	5.0769	4.9040	0.2414	0.1729	4.9%	3.5%
2	HWL-13	MgO (wt%)	0.1600	0.1659	0.1623	-0.0023	0.0036	-1.4%	2.2%
2	HWL-13	MnO (wt%)	3.9478	3.9218	3.8476	0.1002	0.0742	2.6%	1.9%
2	HWL-13	Na2O (wt%)	13.2744	13.3897	13.2622	0.0122	0.1275	0.1%	1.0%
2	HWL-13	Nb2O5 (wt%)	1.0132	1.0132	0.9270	0.0862	0.0862	9.3%	9.3%
2	HWL-13	NiO (wt%)	0.6639	0.7124	0.7673	-0.1034	-0.0549	-13.5%	-7.2%
2	HWL-13	PbO (wt%)	0.1185	0.1185	0.1284	-0.0099	-0.0099	-7.7%	-7.7%
2	HWL-13	SiO2 (wt%)	47.0646	47.1497	48.8118	-1.7472	-1.6621	-3.6%	-3.4%
2	HWL-13	TiO2 (wt%)	2.6229	2.6782	2.6853	-0.0624	-0.0071	-2.3%	-0.3%
2	HWL-13	ZnO (wt%)	0.0370	0.0370	0.0425	-0.0055	-0.0055	-12.9%	-12.9%
2	HWL-13	ZrO2 (wt%)	0.7173	0.7173	0.8855	-0.1682	-0.1682	-19.0%	-19.0%
2	HWL-13	Sum	97.8426	98.1684	100.0000	-2.1574	-1.8316	-2.2%	-1.8%
2	HWL-14	Al2O3 (wt%)	5.8622	5.9965	5.8171	0.0451	0.1794	0.8%	3.1%
2	HWL-14	B2O3 (wt%)	4.4596	4.3556	4.5075	-0.0479	-0.1519	-1.1%	-3.4%
2	HWL-14	BaO (wt%)	0.0952	0.1016	0.1025	-0.0073	-0.0009	-7.1%	-0.9%
2	HWL-14	CaO (wt%)	1.1365	1.1273	1.1276	0.0089	-0.0003	0.8%	0.0%
2	HWL-14	Ce2O3 (wt%)	0.2182	0.2182	0.2403	-0.0221	-0.0221	-9.2%	-9.2%
2	HWL-14	Cr2O3 (wt%)	0.0888	0.0884	0.1270	-0.0382	-0.0386	-30.1%	-30.4%
2	HWL-14	CuO (wt%)	0.0426	0.0439	0.0387	0.0039	0.0052	10.0%	13.5%
2	HWL-14	Fe2O3 (wt%)	13.1497	13.2504	13.4430	-0.2933	-0.1926	-2.2%	-1.4%
2	HWL-14	K2O (wt%)	0.0931	0.1069	0.0807	0.0124	0.0262	15.3%	32.4%
2	HWL-14	La2O3 (wt%)	0.0756	0.0756	0.0864	-0.0108	-0.0108	-12.4%	-12.4%
2	HWL-14	Li2O (wt%)	4.6772	4.6150	4.5075	0.1697	0.1075	3.8%	2.4%
2	HWL-14	MgO (wt%)	0.1745	0.1809	0.1831	-0.0086	-0.0022	-4.7%	-1.2%
2	HWL-14	MnO (wt%)	4.6322	4.5984	4.3402	0.2920	0.2582	6.7%	5.9%
2	HWL-14	Na2O (wt%)	13.8844	14.0040	13.9361	-0.0517	0.0679	-0.4%	0.5%
2	HWL-14	Nb2O5 (wt%)	1.1018	1.1018	1.0457	0.0561	0.0561	5.4%	5.4%
2	HWL-14	NiO (wt%)	0.7139	0.7660	0.8654	-0.1515	-0.0994	-17.5%	-11.5%
2	HWL-14	PbO (wt%)	0.1239	0.1239	0.1449	-0.0210	-0.0210	-14.5%	-14.5%
2	HWL-14	SiO2 (wt%)	44.3905	44.4668	45.3303	-0.9398	-0.8635	-2.1%	-1.9%
2	HWL-14	TiO2 (wt%)	2.8148	2.8741	3.0291	-0.2144	-0.1550	-7.1%	-5.1%
2	HWL-14	ZnO (wt%)	0.0386	0.0386	0.0479	-0.0093	-0.0093	-19.4%	-19.4%
2	HWL-14	ZrO2 (wt%)	0.8159	0.8159	0.9989	-0.1830	-0.1830	-18.3%	-18.3%
2	HWL-14	Sum	98.5889	98.9498	99.9999	-1.4110	-1.0501	-1.4%	-1.1%
2	HWL-15	Al2O3 (wt%)	3.9065	3.9960	3.8348	0.0717	0.1612	1.9%	4.2%
2	HWL-15	B2O3 (wt%)	12.5174	12.2262	12.3984	0.1190	-0.1722	1.0%	-1.4%
2	HWL-15	BaO (wt%)	0.0648	0.0691	0.0693	-0.0045	-0.0002	-6.6%	-0.2%
2	HWL-15	CaO (wt%)	0.8696	0.8626	0.8852	-0.0156	-0.0226	-1.8%	-2.6%
2	HWL-15	Ce2O3 (wt%)	0.2129	0.2129	0.2311	-0.0182	-0.0182	-7.9%	-7.9%
2	HWL-15	Cr2O3 (wt%)	0.0618	0.0615	0.0839	-0.0221	-0.0224	-26.4%	-26.7%
2	HWL-15	CuO (wt%)	0.0294	0.0304	0.0241	0.0053	0.0063	22.1%	25.9%
2	HWL-15	Fe2O3 (wt%)	10.5262	10.6133	10.6832	-0.1570	-0.0699	-1.5%	-0.7%
2	HWL-15	K2O (wt%)	0.0551	0.0633	0.0545	0.0006	0.0088	1.1%	16.2%
2	HWL-15	La2O3 (wt%)	0.0683	0.0683	0.0779	-0.0096	-0.0096	-12.3%	-12.3%
2	HWL-15	Li2O (wt%)	4.3650	4.3070	4.1328	0.2322	0.1742	5.6%	4.2%
2	HWL-15	MgO (wt%)	0.1414	0.1465	0.1474	-0.0060	-0.0009	-4.1%	-0.6%
2	HWL-15	MnO (wt%)	2.3790	2.3630	2.3062	0.0728	0.0568	3.2%	2.5%
2	HWL-15	Na2O (wt%)	7.5859	7.6514	7.5185	0.0674	0.1329	0.9%	1.8%
2	HWL-15	Nb2O5 (wt%)	0.6044	0.6044	0.5381	0.0663	0.0663	12.3%	12.3%
2	HWL-15	NiO (wt%)	0.2666	0.2861	0.3056	-0.0390	-0.0195	-12.8%	-6.4%
2	HWL-15	PbO (wt%)	0.0986	0.0986	0.1174	-0.0188	-0.0188	-16.0%	-16.0%

Table A5. Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by Glass ID

				Measured					
			Measured	Bias-Corrected	Targeted	Diff of	Diff of	% Diff of	% Diff of
2	HWL-15	SiO2 (wt%)	51.8245	51.9168	53.2931	-1.4686	-1.3763	-2.8%	-2.6%
2	HWL-15	TiO2 (wt%)	2.5687	2.6228	2.7027	-0.1340	-0.0799	-5.0%	-3.0%
2	HWL-15	ZnO (wt%)	0.0146	0.0146	0.0237	-0.0091	-0.0091	-38.3%	-38.3%
2	HWL-15	ZrO2 (wt%)	0.5329	0.5329	0.5720	-0.0391	-0.0391	-6.8%	-6.8%
2	HWL-15	Sum	98.6935	98.7477	99.9999	-1.3064	-1.2522	-1.3%	-1.3%
2	HWL-16	Al2O3 (wt%)	4.4545	4.5565	4.4429	0.0116	0.1136	0.3%	2.6%
2	HWL-16	B2O3 (wt%)	11.7607	11.4878	11.5101	0.2506	-0.0223	2.2%	-0.2%
2	HWL-16	BaO (wt%)	0.0729	0.0778	0.0803	-0.0074	-0.0025	-9.3%	-3.1%
2	HWL-16	CaO (wt%)	1.0018	0.9937	1.0256	-0.0238	-0.0319	-2.3%	-3.1%
2	HWL-16	Ce2O3 (wt%)	0.2451	0.2451	0.2678	-0.0227	-0.0227	-8.5%	-8.5%
2	HWL-16	Cr2O3 (wt%)	0.0767	0.0764	0.0972	-0.0205	-0.0208	-21.1%	-21.4%
2	HWL-16	CuO (wt%)	0.0351	0.0362	0.0279	0.0072	0.0083	25.6%	29.6%
2	HWL-16	Fe2O3 (wt%)	11.8057	11.9015	12.3775	-0.5718	-0.4760	-4.6%	-3.8%
2	HWL-16	K2O (wt%)	0.0650	0.0747	0.0631	0.0019	0.0116	3.1%	18.4%
2	HWL-16	La2O3 (wt%)	0.0803	0.0803	0.0902	-0.0099	-0.0099	-10.9%	-10.9%
2	HWL-16	Li2O (wt%)	4.0421	3.9884	3.8367	0.2054	0.1517	5.4%	4.0%
2	HWL-16	MgO (wt%)	0.1654	0.1714	0.1708	-0.0054	0.0006	-3.2%	0.4%
2	HWL-16	MnO (wt%)	2.6857	2.6673	2.6719	0.0138	-0.0046	0.5%	-0.2%
2	HWL-16	Na2O (wt%)	8.5834	8.6578	8.5523	0.0311	0.1055	0.4%	1.2%
2	HWL-16	Nb2O5 (wt%)	0.6995	0.6995	0.6235	0.0760	0.0760	12.2%	12.2%
2	HWL-16	NiO (wt%)	0.3083	0.3308	0.3541	-0.0458	-0.0233	-12.9%	-6.6%
2	HWL-16	PbO (wt%)	0.1150	0.1150	0.1360	-0.0210	-0.0210	-15.4%	-15.4%
2	HWL-16	SiO2 (wt%)	48.4017	48.4903	49.8506	-1.4489	-1.3603	-2.9%	-2.7%
2	HWL-16	TiO2 (wt%)	2.9190	2.9804	3.1314	-0.2124	-0.1510	-6.8%	-4.8%
2	HWL-16	ZnO (wt%)	0.0187	0.0187	0.0274	-0.0087	-0.0087	-31.9%	-31.9%
2	HWL-16	ZrO2 (wt%)	0.5981	0.5981	0.6628	-0.0647	-0.0647	-9.8%	-9.8%
2	HWL-16	Sum	98.1346	98.2477	100.0001	-1.8655	-1.7524	-1.9%	-1.8%
2	HWL-17	Al2O3 (wt%)	5.0544	5.1703	5.0536	0.0008	0.1167	0.0%	2.3%
2	HWL-17	B2O3 (wt%)	10.5693	10.3222	10.6181	-0.0488	-0.2959	-0.5%	-2.8%
2	HWL-17	BaO (wt%)	0.0857	0.0915	0.0913	-0.0056	0.0002	-6.1%	0.2%
2	HWL-17	CaO (wt%)	1.1508	1.1417	1.1665	-0.0157	-0.0248	-1.3%	-2.1%
2	HWL-17	Ce2O3 (wt%)	0.2791	0.2791	0.3046	-0.0255	-0.0255	-8.4%	-8.4%
2	HWL-17	Cr2O3 (wt%)	0.0833	0.0830	0.1106	-0.0273	-0.0276	-24.7%	-25.0%
2	HWL-17	CuO (wt%)	0.0366	0.0378	0.0317	0.0049	0.0061	15.5%	19.2%
2	HWL-17	Fe2O3 (wt%)	13.6143	13.7186	14.0786	-0.4643	-0.3600	-3.3%	-2.6%
2	HWL-17	K2O (wt%)	0.0729	0.0837	0.0718	0.0011	0.0119	1.5%	16.6%
2	HWL-17	La2O3 (wt%)	0.0921	0.0921	0.1027	-0.0106	-0.0106	-10.4%	-10.4%
2	HWL-17	Li2O (wt%)	3.6599	3.6112	3.5394	0.1205	0.0718	3.4%	2.0%
2	HWL-17	MgO (wt%)	0.1928	0.1998	0.1943	-0.0015	0.0055	-0.8%	2.8%
2	HWL-17	MnO (wt%)	3.1150	3.0921	3.0392	0.0758	0.0529	2.5%	1.7%
2	HWL-17	Na2O (wt%)	9.4596	9.5419	9.5903	-0.1307	-0.0484	-1.4%	-0.5%
2	HWL-17	Nb2O5 (wt%)	0.7964	0.7964	0.7092	0.0872	0.0872	12.3%	12.3%
2	HWL-17	NiO (wt%)	0.3573	0.3834	0.4028	-0.0455	-0.0194	-11.3%	-4.8%
2	HWL-17	PbO (wt%)	0.1355	0.1355	0.1547	-0.0192	-0.0192	-12.4%	-12.4%
2	HWL-17	SiO2 (wt%)	45.7275	45.8057	46.3940	-0.6665	-0.5883	-1.4%	-1.3%
2	HWL-17	TiO2 (wt%)	3.3485	3.4190	3.5617	-0.2132	-0.1427	-6.0%	-4.0%
2	HWL-17	ZnO (wt%)	0.0237	0.0237	0.0312	-0.0075	-0.0075	-24.2%	-24.2%
2	HWL-17	ZrO2 (wt%)	0.6997	0.6997	0.7538	-0.0541	-0.0541	-7.2%	-7.2%
2	HWL-17	Sum	98.5544	98.7284	100.0001	-1.4457	-1.2717	-1.4%	-1.3%
2	HWL-18	Al2O3 (wt%)	3.9065	3.9960	3.8348	0.0717	0.1612	1.9%	4.2%
2	HWL-18	B2O3 (wt%)	5.5463	5.4166	5.5104	0.0359	-0.0938	0.7%	-1.7%
2	HWL-18	BaO (wt%)	0.0656	0.0700	0.0693	-0.0037	0.0007	-5.3%	1.1%
2	HWL-18	CaO (wt%)	0.8444	0.8375	0.8852	-0.0408	-0.0477	-4.6%	-5.4%
2	HWL-18	Ce2O3 (wt%)	0.2164	0.2164	0.2311	-0.0147	-0.0147	-6.4%	-6.4%
2	HWL-18	Cr2O3 (wt%)	0.0734	0.0732	0.0839	-0.0105	-0.0107	-12.5%	-12.8%
2	HWL-18	CuO (wt%)	0.0291	0.0300	0.0241	0.0050	0.0059	20.8%	24.6%
2	HWL-18	Fe2O3 (wt%)	10.3725	10.4583	10.6832	-0.3107	-0.2249	-2.9%	-2.1%
2	HWL-18	K2O (wt%)	0.0503	0.0578	0.0545	-0.0042	0.0033	-7.7%	6.0%
2	HWL-18	La2O3 (wt%)	0.0701	0.0701	0.0779	-0.0078	-0.0078	-10.0%	-10.0%

Table A5. Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by Glass ID

				Measured					
			Measured	Bias-Corrected	Targeted	Diff of	Diff of	% Diff of	% Diff of
2	HWL-18	Li2O (wt%)	5.7159	5.6399	5.5104	0.2055	0.1295	3.7%	2.4%
2	HWL-18	MgO (wt%)	0.1455	0.1508	0.1474	-0.0019	0.0034	-1.3%	2.3%
2	HWL-18	MnO (wt%)	2.3306	2.3146	2.3062	0.0244	0.0084	1.1%	0.4%
2	HWL-18	Na2O (wt%)	12.3578	12.4648	12.3401	0.0177	0.1247	0.1%	1.0%
2	HWL-18	Nb2O5 (wt%)	0.6083	0.6083	0.5381	0.0702	0.0702	13.0%	13.0%
2	HWL-18	NiO (wt%)	0.2793	0.2997	0.3056	-0.0263	-0.0059	-8.6%	-1.9%
2	HWL-18	PbO (wt%)	0.1088	0.1088	0.1174	-0.0086	-0.0086	-7.3%	-7.3%
2	HWL-18	SiO2 (wt%)	52.3059	52.4016	53.9819	-1.6760	-1.5803	-3.1%	-2.9%
2	HWL-18	TiO2 (wt%)	2.6229	2.6782	2.7027	-0.0798	-0.0245	-3.0%	-0.9%
2	HWL-18	ZnO (wt%)	0.0162	0.0162	0.0237	-0.0075	-0.0075	-31.7%	-31.7%
2	HWL-18	ZrO2 (wt%)	0.4995	0.4995	0.5720	-0.0725	-0.0725	-12.7%	-12.7%
2	HWL-18	Sum	98.1654	98.4083	99.9999	-1.8345	-1.5916	-1.8%	-1.6%
2	HWL-19	Al2O3 (wt%)	4.4781	4.5807	4.4429	0.0352	0.1378	0.8%	3.1%
2	HWL-19	B2O3 (wt%)	5.1357	5.0158	5.1156	0.0201	-0.0998	0.4%	-2.0%
2	HWL-19	BaO (wt%)	0.0765	0.0817	0.0803	-0.0038	0.0014	-4.8%	1.7%
2	HWL-19	CaO (wt%)	1.0057	0.9976	1.0256	-0.0199	-0.0280	-1.9%	-2.7%
2	HWL-19	Ce2O3 (wt%)	0.2433	0.2433	0.2678	-0.0245	-0.0245	-9.1%	-9.1%
2	HWL-19	Cr2O3 (wt%)	0.0943	0.0939	0.0972	-0.0029	-0.0033	-3.0%	-3.4%
2	HWL-19	CuO (wt%)	0.0329	0.0339	0.0279	0.0050	0.0060	17.8%	21.5%
2	HWL-19	Fe2O3 (wt%)	11.6699	11.7699	12.3775	-0.7076	-0.6076	-5.7%	-4.9%
2	HWL-19	K2O (wt%)	0.0714	0.0820	0.0631	0.0083	0.0189	13.1%	29.9%
2	HWL-19	La2O3 (wt%)	0.0786	0.0786	0.0902	-0.0116	-0.0116	-12.9%	-12.9%
2	HWL-19	Li2O (wt%)	5.2692	5.1991	5.1156	0.1536	0.0835	3.0%	1.6%
2	HWL-19	MgO (wt%)	0.1613	0.1672	0.1708	-0.0095	-0.0036	-5.6%	-2.1%
2	HWL-19	MnO (wt%)	2.7341	2.7165	2.6719	0.0622	0.0446	2.3%	1.7%
2	HWL-19	Na2O (wt%)	13.1363	13.2503	13.0284	0.1079	0.2219	0.8%	1.7%
2	HWL-19	Nb2O5 (wt%)	0.6992	0.6992	0.6235	0.0757	0.0757	12.1%	12.1%
2	HWL-19	NiO (wt%)	0.3210	0.3444	0.3541	-0.0331	-0.0097	-9.4%	-2.7%
2	HWL-19	PbO (wt%)	0.1171	0.1171	0.1360	-0.0189	-0.0189	-13.9%	-13.9%
2	HWL-19	SiO2 (wt%)	49.9527	50.0453	50.4900	-0.5373	-0.4447	-1.1%	-0.9%
2	HWL-19	TiO2 (wt%)	2.9315	2.9933	3.1314	-0.1999	-0.1381	-6.4%	-4.4%
2	HWL-19	ZnO (wt%)	0.0209	0.0209	0.0274	-0.0065	-0.0065	-23.9%	-23.9%
2	HWL-19	ZrO2 (wt%)	0.6190	0.6190	0.6628	-0.0438	-0.0438	-6.6%	-6.6%
2	HWL-19	Sum	98.8485	99.1497	100.0000	-1.1515	-0.8503	-1.2%	-0.9%
2	HWL-20	Al2O3 (wt%)	5.0780	5.1944	5.0536	0.0244	0.1408	0.5%	2.8%
2	HWL-20	B2O3 (wt%)	4.7413	4.6304	4.7192	0.0221	-0.0888	0.5%	-1.9%
2	HWL-20	BaO (wt%)	0.0843	0.0900	0.0913	-0.0070	-0.0013	-7.7%	-1.4%
2	HWL-20	CaO (wt%)	1.1568	1.1475	1.1665	-0.0097	-0.0190	-0.8%	-1.6%
2	HWL-20	Ce2O3 (wt%)	0.2694	0.2694	0.3046	-0.0352	-0.0352	-11.6%	-11.6%
2	HWL-20	Cr2O3 (wt%)	0.1034	0.1030	0.1106	-0.0072	-0.0076	-6.5%	-6.9%
2	HWL-20	CuO (wt%)	0.0363	0.0375	0.0317	0.0046	0.0058	14.5%	18.2%
2	HWL-20	Fe2O3 (wt%)	13.4535	13.5612	14.0786	-0.6251	-0.5174	-4.4%	-3.7%
2	HWL-20	K2O (wt%)	0.0795	0.0913	0.0718	0.0077	0.0195	10.7%	27.2%
2	HWL-20	La2O3 (wt%)	0.0891	0.0891	0.1027	-0.0136	-0.0136	-13.2%	-13.2%
2	HWL-20	Li2O (wt%)	4.8817	4.8168	4.7192	0.1625	0.0976	3.4%	2.1%
2	HWL-20	MgO (wt%)	0.1808	0.1874	0.1943	-0.0135	-0.0069	-7.0%	-3.6%
2	HWL-20	MnO (wt%)	3.0989	3.0774	3.0392	0.0597	0.0382	2.0%	1.3%
2	HWL-20	Na2O (wt%)	13.5238	13.6409	13.7195	-0.1957	-0.0786	-1.4%	-0.6%
2	HWL-20	Nb2O5 (wt%)	0.7793	0.7793	0.7092	0.0701	0.0701	9.9%	9.9%
2	HWL-20	NiO (wt%)	0.3547	0.3806	0.4028	-0.0481	-0.0222	-11.9%	-5.5%
2	HWL-20	PbO (wt%)	0.1295	0.1295	0.1547	-0.0252	-0.0252	-16.3%	-16.3%
2	HWL-20	SiO2 (wt%)	46.1554	46.2378	46.9839	-0.8285	-0.7461	-1.8%	-1.6%
2	HWL-20	TiO2 (wt%)	3.2818	3.3511	3.5617	-0.2799	-0.2106	-7.9%	-5.9%
2	HWL-20	ZnO (wt%)	0.0249	0.0249	0.0312	-0.0063	-0.0063	-20.2%	-20.2%
2	HWL-20	ZrO2 (wt%)	0.6585	0.6585	0.7538	-0.0953	-0.0953	-12.6%	-12.6%
2	HWL-20	Sum	98.1609	98.4980	100.0001	-1.8392	-1.5021	-1.8%	-1.5%
3	Batch 1	Al2O3 (wt%)	4.8151	4.8770	4.8770	-0.0619	0.0000	-1.3%	0.0%
3	Batch 1	B2O3 (wt%)	7.8109	7.7770	7.7770	0.0339	0.0000	0.4%	0.0%
3	Batch 1	BaO (wt%)	0.1423	0.1510	0.1510	-0.0087	0.0000	-5.8%	0.0%

Table A5. Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by Glass ID

				Measured					
			Measured	Bias-Corrected	Targeted	Diff of	Diff of	% Diff of	% Diff of
3	Batch 1	CaO (wt%)	1.1766	1.2200	1.2200	-0.0434	0.0000	-3.6%	0.0%
3	Batch 1	CdO (wt%)	0.0057	0.0057	0.0000	0.0057	0.0057		
3	Batch 1	Ce2O3 (wt%)	0.0132	0.0132	0.0000	0.0132	0.0132		
3	Batch 1	Cr2O3 (wt%)	0.1074	0.1070	0.1070	0.0004	0.0000	0.4%	0.0%
3	Batch 1	CuO (wt%)	0.3808	0.3990	0.3990	-0.0182	0.0000	-4.6%	0.0%
3	Batch 1	Fe2O3 (wt%)	13.2092	12.8390	12.8390	0.3702	0.0000	2.9%	0.0%
3	Batch 1	K2O (wt%)	3.0959	3.3270	3.3270	-0.2311	0.0000	-6.9%	0.0%
3	Batch 1	La2O3 (wt%)	0.0586	0.0586	0.0000	0.0586	0.0586		
3	Batch 1	Li2O (wt%)	4.3022	4.4290	4.4290	-0.1268	0.0000	-2.9%	0.0%
3	Batch 1	MgO (wt%)	1.3825	1.4190	1.4190	-0.0365	0.0000	-2.6%	0.0%
3	Batch 1	MnO (wt%)	1.7948	1.7260	1.7260	0.0688	0.0000	4.0%	0.0%
3	Batch 1	Na2O (wt%)	9.0653	9.0030	9.0030	0.0623	0.0000	0.7%	0.0%
3	Batch 1	Nb2O5 (wt%)	0.0492	0.0492	0.0000	0.0492	0.0492		
3	Batch 1	NiO (wt%)	0.7132	0.7510	0.7510	-0.0378	0.0000	-5.0%	0.0%
3	Batch 1	PbO (wt%)	0.0108	0.0108	0.0000	0.0108	0.0108		
3	Batch 1	SiO2 (wt%)	51.3254	50.2200	50.2200	1.1054	0.0000	2.2%	0.0%
3	Batch 1	SO4 (wt%)	0.1498	0.1498	0.0000	0.1498	0.1498		
3	Batch 1	ThO2 (wt%)	0.0569	0.0569	0.0000	0.0569	0.0569		
3	Batch 1	TiO2 (wt%)	0.6547	0.6770	0.6770	-0.0223	0.0000	-3.3%	0.0%
3	Batch 1	U3O8 (wt%)	0.0590	0.0592	0.0000	0.0590	0.0592		
3	Batch 1	ZnO (wt%)	0.0062	0.0062	0.0000	0.0062	0.0062		
3	Batch 1	ZrO2 (wt%)	0.0865	0.0865	0.0980	-0.0115	-0.0115	-11.8%	-11.8%
3	Batch 1	Sum	100.4721	99.4181	99.0200	1.4521	0.3981	1.5%	0.4%
3	HWL-23	Al2O3 (wt%)	4.6198	4.6184	4.4165	0.2033	0.2019	4.6%	4.6%
3	HWL-23	B2O3 (wt%)	11.7285	11.4141	11.7000	0.0285	-0.2859	0.2%	-2.4%
3	HWL-23	BaO (wt%)	0.0678	0.0715	0.0778	-0.0100	-0.0063	-12.8%	-8.1%
3	HWL-23	CaO (wt%)	0.8227	0.8505	0.8561	-0.0334	-0.0056	-3.9%	-0.7%
3	HWL-23	CdO (wt%)	0.0057	0.0057	0.0000	0.0057	0.0057		
3	HWL-23	Ce2O3 (wt%)	0.1388	0.1388	0.1825	-0.0437	-0.0437	-23.9%	-23.9%
3	HWL-23	Cr2O3 (wt%)	0.0990	0.0975	0.0964	0.0026	0.0011	2.7%	1.2%
3	HWL-23	CuO (wt%)	0.0523	0.0544	0.0294	0.0229	0.0250	77.8%	85.2%
3	HWL-23	Fe2O3 (wt%)	10.0865	9.5921	10.2063	-0.1198	-0.6142	-1.2%	-6.0%
3	HWL-23	K2O (wt%)	0.0614	0.0662	0.0613	0.0002	0.0050	0.3%	8.1%
3	HWL-23	La2O3 (wt%)	0.0586	0.0586	0.0656	-0.0070	-0.0070	-10.6%	-10.6%
3	HWL-23	Li2O (wt%)	5.1293	5.2585	5.2000	-0.0707	0.0585	-1.4%	1.1%
3	HWL-23	MgO (wt%)	0.1410	0.1436	0.1390	0.0020	0.0046	1.4%	3.3%
3	HWL-23	MnO (wt%)	3.5379	3.3337	3.2952	0.2427	0.0385	7.4%	1.2%
3	HWL-23	Na2O (wt%)	8.0442	7.8982	7.8084	0.2358	0.0898	3.0%	1.2%
3	HWL-23	Nb2O5 (wt%)	0.8279	0.8279	0.7939	0.0340	0.0340	4.3%	4.3%
3	HWL-23	NiO (wt%)	0.5962	0.6235	0.6571	-0.0609	-0.0336	-9.3%	-5.1%
3	HWL-23	PbO (wt%)	0.0913	0.0913	0.1100	-0.0187	-0.0187	-17.0%	-17.0%
3	HWL-23	SiO2 (wt%)	49.6318	47.8418	49.3549	0.2769	-1.5131	0.6%	-3.1%
3	HWL-23	SO4 (wt%)	0.1498	0.1498	0.0000	0.1498	0.1498		
3	HWL-23	ThO2 (wt%)	0.8827	0.8827	0.9562	-0.0735	-0.0735	-7.7%	-7.7%
3	HWL-23	TiO2 (wt%)	2.0850	2.1442	2.2998	-0.2148	-0.1556	-9.3%	-6.8%
3	HWL-23	U3O8 (wt%)	0.8826	0.8718	0.8988	-0.0162	-0.0270	-1.8%	-3.0%
3	HWL-23	ZnO (wt%)	0.0339	0.0339	0.0364	-0.0025	-0.0025	-6.8%	-6.8%
3	HWL-23	ZrO2 (wt%)	0.6815	0.6815	0.7584	-0.0769	-0.0769	-10.1%	-10.1%
3	HWL-23	Sum	100.4563	97.7504	99.9999	0.4563	-2.2495	0.5%	-2.2%
3	HWL-24	Al2O3 (wt%)	4.5065	4.6249	4.4165	0.0900	0.2084	2.0%	4.7%
3	HWL-24	B2O3 (wt%)	5.2967	5.3966	5.2000	0.0967	0.1966	1.9%	3.8%
3	HWL-24	BaO (wt%)	0.0729	0.0779	0.0778	-0.0049	0.0001	-6.4%	0.1%
3	HWL-24	CaO (wt%)	0.8367	0.8702	0.8561	-0.0194	0.0141	-2.3%	1.6%
3	HWL-24	CdO (wt%)	0.0057	0.0057	0.0000	0.0057	0.0057		
3	HWL-24	Ce2O3 (wt%)	0.1034	0.1034	0.1825	-0.0791	-0.0791	-43.3%	-43.3%
3	HWL-24	Cr2O3 (wt%)	0.0888	0.0895	0.0964	-0.0076	-0.0069	-7.9%	-7.2%
3	HWL-24	CuO (wt%)	0.0548	0.0577	0.0294	0.0254	0.0283	86.3%	96.4%
3	HWL-24	Fe2O3 (wt%)	10.5333	10.4756	10.2063	0.3270	0.2693	3.2%	2.6%
3	HWL-24	K2O (wt%)	0.0524	0.0562	0.0613	-0.0088	-0.0051	-14.4%	-8.3%

Table A5. Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by Glass ID

				Measured					
			Measured	Bias-Corrected	Targeted	Diff of	Diff of	% Diff of	% Diff of
3	HWL-24	La2O3 (wt%)	0.0586	0.0586	0.0656	-0.0070	-0.0070	-10.6%	-10.6%
3	HWL-24	Li2O (wt%)	5.2100	5.3860	5.2000	0.0100	0.1860	0.2%	3.6%
3	HWL-24	MgO (wt%)	0.1352	0.1398	0.1390	-0.0038	0.0008	-2.8%	0.6%
3	HWL-24	MnO (wt%)	3.5540	3.4915	3.2952	0.2588	0.1963	7.9%	6.0%
3	HWL-24	Na2O (wt%)	12.1489	12.2078	12.3584	-0.2096	-0.1506	-1.7%	-1.2%
3	HWL-24	Nb2O5 (wt%)	0.8494	0.8494	0.7939	0.0554	0.0554	7.0%	7.0%
3	HWL-24	NiO (wt%)	0.6146	0.6516	0.6571	-0.0425	-0.0055	-6.5%	-0.8%
3	HWL-24	PbO (wt%)	0.0926	0.0926	0.1100	-0.0174	-0.0174	-15.8%	-15.8%
3	HWL-24	SiO2 (wt%)	50.3805	50.0469	51.3049	-0.9244	-1.2580	-1.8%	-2.5%
3	HWL-24	SO4 (wt%)	0.1498	0.1498	0.0000	0.1498	0.1498		
3	HWL-24	ThO2 (wt%)	0.9117	0.9117	0.9562	-0.0445	-0.0445	-4.6%	-4.6%
3	HWL-24	TiO2 (wt%)	2.2101	2.2981	2.2998	-0.0897	-0.0017	-3.9%	-0.1%
3	HWL-24	U3O8 (wt%)	0.8779	0.8956	0.8988	-0.0209	-0.0032	-2.3%	-0.4%
3	HWL-24	ZnO (wt%)	0.0355	0.0355	0.0364	-0.0009	-0.0009	-2.5%	-2.5%
3	HWL-24	ZrO2 (wt%)	0.6727	0.6727	0.7584	-0.0857	-0.0857	-11.3%	-11.3%
3	HWL-24	Sum	99.4527	99.6453	99.9999	-0.5473	-0.3547	-0.5%	-0.4%
3	HWL-25	Al2O3 (wt%)	4.0766	4.0760	3.7858	0.2908	0.2902	7.7%	7.7%
3	HWL-25	B2O3 (wt%)	12.1632	11.8403	12.2400	-0.0768	-0.3997	-0.6%	-3.3%
3	HWL-25	BaO (wt%)	0.0653	0.0688	0.0684	-0.0031	0.0004	-4.5%	0.6%
3	HWL-25	CaO (wt%)	0.8689	0.8984	0.8739	-0.0050	0.0245	-0.6%	2.8%
3	HWL-25	CdO (wt%)	0.0057	0.0057	0.0000	0.0057	0.0057		
3	HWL-25	Ce2O3 (wt%)	0.2120	0.2120	0.2282	-0.0162	-0.0162	-7.1%	-7.1%
3	HWL-25	Cr2O3 (wt%)	0.0826	0.0813	0.0828	-0.0002	-0.0015	-0.3%	-1.8%
3	HWL-25	CuO (wt%)	0.0410	0.0427	0.0238	0.0172	0.0189	72.3%	79.5%
3	HWL-25	Fe2O3 (wt%)	10.8836	10.3508	10.5467	0.3369	-0.1959	3.2%	-1.9%
3	HWL-25	K2O (wt%)	0.0560	0.0604	0.0538	0.0022	0.0066	4.1%	12.3%
3	HWL-25	La2O3 (wt%)	0.0586	0.0586	0.0769	-0.0183	-0.0183	-23.7%	-23.7%
3	HWL-25	Li2O (wt%)	4.0851	4.1881	4.0800	0.0051	0.1081	0.1%	2.6%
3	HWL-25	MgO (wt%)	0.1497	0.1525	0.1455	0.0042	0.0070	2.9%	4.8%
3	HWL-25	MnO (wt%)	2.5243	2.3788	2.2767	0.2476	0.1021	10.9%	4.5%
3	HWL-25	Na2O (wt%)	7.6128	7.4766	7.4224	0.1904	0.0542	2.6%	0.7%
3	HWL-25	Nb2O5 (wt%)	0.6373	0.6373	0.5313	0.1060	0.1060	20.0%	20.0%
3	HWL-25	NiO (wt%)	0.3312	0.3463	0.3017	0.0295	0.0446	9.8%	14.8%
3	HWL-25	PbO (wt%)	0.1039	0.1039	0.1159	-0.0120	-0.0120	-10.3%	-10.3%
3	HWL-25	SiO2 (wt%)	53.6964	51.7716	52.6121	1.0843	-0.8405	2.1%	-1.6%
3	HWL-25	SO4 (wt%)	0.1498	0.1498	0.0000	0.1498	0.1498		
3	HWL-25	ThO2 (wt%)	0.8196	0.8196	0.8519	-0.0323	-0.0323	-3.8%	-3.8%
3	HWL-25	TiO2 (wt%)	2.5395	2.6116	2.6682	-0.1287	-0.0566	-4.8%	-2.1%
3	HWL-25	U3O8 (wt%)	0.4481	0.4425	0.4258	0.0223	0.0167	5.2%	3.9%
3	HWL-25	ZnO (wt%)	0.0205	0.0205	0.0234	-0.0029	-0.0029	-12.2%	-12.2%
3	HWL-25	ZrO2 (wt%)	0.5211	0.5211	0.5647	-0.0436	-0.0436	-7.7%	-7.7%
3	HWL-25	Sum	102.1529	99.3154	99.9998	2.1531	-0.6844	2.2%	-0.7%
3	HWL-26	Al2O3 (wt%)	4.4687	4.5861	4.3773	0.0914	0.2088	2.1%	4.8%
3	HWL-26	B2O3 (wt%)	11.4789	11.6981	11.3400	0.1389	0.3581	1.2%	3.2%
3	HWL-26	BaO (wt%)	0.0737	0.0788	0.0791	-0.0054	-0.0003	-6.8%	-0.4%
3	HWL-26	CaO (wt%)	1.0116	1.0521	1.0104	0.0012	0.0417	0.1%	4.1%
3	HWL-26	CdO (wt%)	0.0057	0.0057	0.0000	0.0057	0.0057		
3	HWL-26	Ce2O3 (wt%)	0.2445	0.2445	0.2638	-0.0193	-0.0193	-7.3%	-7.3%
3	HWL-26	Cr2O3 (wt%)	0.0862	0.0869	0.0958	-0.0096	-0.0089	-10.0%	-9.3%
3	HWL-26	CuO (wt%)	0.0482	0.0508	0.0275	0.0207	0.0233	75.3%	84.8%
3	HWL-26	Fe2O3 (wt%)	11.2946	11.2420	12.1946	-0.9000	-0.9526	-7.4%	-7.8%
3	HWL-26	K2O (wt%)	0.0560	0.0600	0.0622	-0.0062	-0.0022	-9.9%	-3.5%
3	HWL-26	La2O3 (wt%)	0.0586	0.0586	0.0889	-0.0303	-0.0303	-34.0%	-34.0%
3	HWL-26	Li2O (wt%)	3.8914	4.0228	3.7800	0.1114	0.2428	2.9%	6.4%
3	HWL-26	MgO (wt%)	0.1542	0.1595	0.1683	-0.0141	-0.0088	-8.4%	-5.2%
3	HWL-26	MnO (wt%)	2.7147	2.6690	2.6324	0.0823	0.0366	3.1%	1.4%
3	HWL-26	Na2O (wt%)	8.5362	8.5785	8.4259	0.1103	0.1526	1.3%	1.8%
3	HWL-26	Nb2O5 (wt%)	0.7485	0.7485	0.6143	0.1342	0.1342	21.9%	21.9%
3	HWL-26	NiO (wt%)	0.3239	0.3433	0.3489	-0.0250	-0.0056	-7.2%	-1.6%

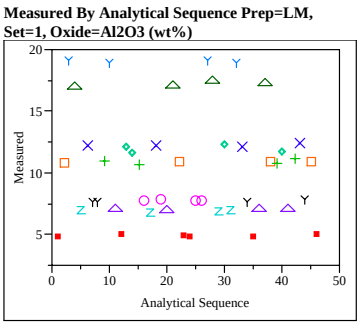
Table A5. Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by Glass ID

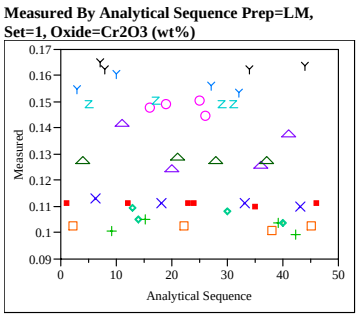
				Measured					
			Measured	Bias-Corrected	Targeted	Diff of	Diff of	% Diff of	% Diff of
3	HWL-26	PbO (wt%)	0.1174	0.1174	0.1340	-0.0166	-0.0166	-12.4%	-12.4%
3	HWL-26	SiO2 (wt%)	48.1877	47.8721	49.1140	-0.9263	-1.2419	-1.9%	-2.5%
3	HWL-26	SO4 (wt%)	0.1498	0.1498	0.0000	0.1498	0.1498		
3	HWL-26	ThO2 (wt%)	0.9331	0.9331	0.9850	-0.0519	-0.0519	-5.3%	-5.3%
3	HWL-26	TiO2 (wt%)	2.8690	2.9832	3.0851	-0.2161	-0.1019	-7.0%	-3.3%
3	HWL-26	U3O8 (wt%)	0.5100	0.5203	0.4924	0.0176	0.0279	3.6%	5.7%
3	HWL-26	ZnO (wt%)	0.0212	0.0212	0.0270	-0.0058	-0.0058	-21.6%	-21.6%
3	HWL-26	ZrO2 (wt%)	0.5974	0.5974	0.6530	-0.0556	-0.0556	-8.5%	-8.5%
3	HWL-26	Sum	98.5813	98.8799	99.9999	-1.4186	-1.1199	-1.4%	-1.1%
3	HWL-27	Al2O3 (wt%)	3.9774	4.0820	3.7858	0.1916	0.2962	5.1%	7.8%
3	HWL-27	B2O3 (wt%)	5.5463	5.3995	5.4400	0.1063	-0.0405	2.0%	-0.7%
3	HWL-27	BaO (wt%)	0.0628	0.0671	0.0684	-0.0056	-0.0013	-8.2%	-1.8%
3	HWL-27	CaO (wt%)	0.8836	0.9190	0.8739	0.0097	0.0451	1.1%	5.2%
3	HWL-27	CdO (wt%)	0.0057	0.0057	0.0000	0.0057	0.0057		
3	HWL-27	Ce2O3 (wt%)	0.1898	0.1898	0.2282	-0.0384	-0.0384	-16.8%	-16.8%
3	HWL-27	Cr2O3 (wt%)	0.0793	0.0799	0.0828	-0.0035	-0.0029	-4.2%	-3.5%
3	HWL-27	CuO (wt%)	0.0410	0.0432	0.0238	0.0172	0.0194	72.3%	81.6%
3	HWL-27	Fe2O3 (wt%)	10.6799	10.6251	10.5467	0.1332	0.0784	1.3%	0.7%
3	HWL-27	K2O (wt%)	0.0491	0.0526	0.0538	-0.0047	-0.0012	-8.7%	-2.2%
3	HWL-27	La2O3 (wt%)	0.0586	0.0586	0.0769	-0.0183	-0.0183	-23.7%	-23.7%
3	HWL-27	Li2O (wt%)	5.3876	5.5234	5.4400	-0.0524	0.0834	-1.0%	1.5%
3	HWL-27	MgO (wt%)	0.1318	0.1364	0.1455	-0.0137	-0.0091	-9.4%	-6.3%
3	HWL-27	MnO (wt%)	2.3790	2.3348	2.2767	0.1023	0.0581	4.5%	2.6%
3	HWL-27	Na2O (wt%)	12.2971	12.3577	12.1824	0.1147	0.1753	0.9%	1.4%
3	HWL-27	Nb2O5 (wt%)	0.6459	0.6459	0.5313	0.1146	0.1146	21.6%	21.6%
3	HWL-27	NiO (wt%)	0.2809	0.2978	0.3017	-0.0208	-0.0039	-6.9%	-1.3%
3	HWL-27	PbO (wt%)	0.1053	0.1053	0.1159	-0.0106	-0.0106	-9.1%	-9.1%
3	HWL-27	SiO2 (wt%)	52.5733	52.2232	53.2921	-0.7188	-1.0689	-1.3%	-2.0%
3	HWL-27	SO4 (wt%)	0.1498	0.1498	0.0000	0.1498	0.1498		
3	HWL-27	ThO2 (wt%)	0.7982	0.7982	0.8519	-0.0537	-0.0537	-6.3%	-6.3%
3	HWL-27	TiO2 (wt%)	2.5354	2.6363	2.6682	-0.1328	-0.0319	-5.0%	-1.2%
3	HWL-27	U3O8 (wt%)	0.4357	0.4445	0.4258	0.0099	0.0187	2.3%	4.4%
3	HWL-27	ZnO (wt%)	0.0205	0.0205	0.0234	-0.0029	-0.0029	-12.2%	-12.2%
3	HWL-27	ZrO2 (wt%)	0.5187	0.5187	0.5647	-0.0460	-0.0460	-8.1%	-8.1%
3	HWL-27	Sum	99.8328	99.7151	99.9998	-0.1671	-0.2847	-0.2%	-0.3%
3	HWL-28	Al2O3 (wt%)	4.4781	4.4770	4.3773	0.1008	0.0997	2.3%	2.3%
3	HWL-28	B2O3 (wt%)	5.3772	5.4807	5.0400	0.3372	0.4407	6.7%	8.7%
3	HWL-28	BaO (wt%)	0.0748	0.0788	0.0791	-0.0043	-0.0003	-5.4%	-0.3%
3	HWL-28	CaO (wt%)	0.9948	1.0282	1.0104	-0.0156	0.0178	-1.5%	1.8%
3	HWL-28	CdO (wt%)	0.0057	0.0057	0.0000	0.0057	0.0057		
3	HWL-28	Ce2O3 (wt%)	0.2149	0.2149	0.2638	-0.0489	-0.0489	-18.5%	-18.5%
3	HWL-28	Cr2O3 (wt%)	0.0983	0.0968	0.0958	0.0025	0.0010	2.6%	1.0%
3	HWL-28	CuO (wt%)	0.0510	0.0531	0.0275	0.0235	0.0256	85.5%	93.3%
3	HWL-28	Fe2O3 (wt%)	12.8065	12.1801	12.1946	0.6119	-0.0145	5.0%	-0.1%
3	HWL-28	K2O (wt%)	0.0602	0.0649	0.0622	-0.0020	0.0027	-3.2%	4.3%
3	HWL-28	La2O3 (wt%)	0.0586	0.0586	0.0889	-0.0303	-0.0303	-34.0%	-34.0%
3	HWL-28	Li2O (wt%)	5.1508	5.3249	5.0400	0.1108	0.2849	2.2%	5.7%
3	HWL-28	MgO (wt%)	0.1546	0.1575	0.1683	-0.0137	-0.0108	-8.1%	-6.4%
3	HWL-28	MnO (wt%)	2.9149	2.7470	2.6324	0.2825	0.1146	10.7%	4.4%
3	HWL-28	Na2O (wt%)	12.6004	12.3716	12.8359	-0.2355	-0.4643	-1.8%	-3.6%
3	HWL-28	Nb2O5 (wt%)	0.7582	0.7582	0.6143	0.1439	0.1439	23.4%	23.4%
3	HWL-28	NiO (wt%)	0.3261	0.3410	0.3489	-0.0228	-0.0079	-6.5%	-2.3%
3	HWL-28	PbO (wt%)	0.1190	0.1190	0.1340	-0.0150	-0.0150	-11.2%	-11.2%
3	HWL-28	SiO2 (wt%)	49.7922	48.0032	49.7440	0.0482	-1.7408	0.1%	-3.5%
3	HWL-28	SO4 (wt%)	0.1498	0.1498	0.0000	0.1498	0.1498		
3	HWL-28	ThO2 (wt%)	0.9365	0.9365	0.9850	-0.0485	-0.0485	-4.9%	-4.9%
3	HWL-28	TiO2 (wt%)	2.8982	2.9804	3.0851	-0.1870	-0.1047	-6.1%	-3.4%
3	HWL-28	U3O8 (wt%)	0.5020	0.4959	0.4924	0.0096	0.0035	2.0%	0.7%
3	HWL-28	ZnO (wt%)	0.0212	0.0212	0.0270	-0.0058	-0.0058	-21.6%	-21.6%

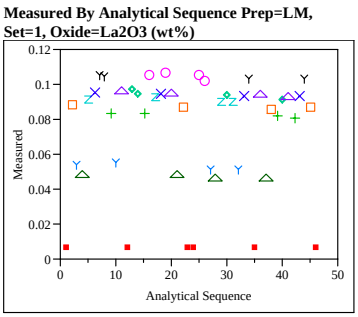
Table A5. Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by Glass ID

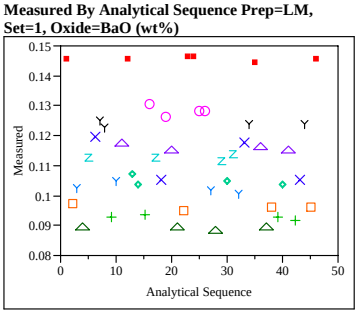
				Measured					
			Measured	Bias-Corrected	Targeted	Diff of	Diff of	% Diff of	% Diff of
3	HWL-28	ZrO2 (wt%)	0.6092	0.6092	0.6530	-0.0438	-0.0438	-6.7%	-6.7%
3	HWL-28	Sum	101.1534	98.7542	99.9999	1.1536	-1.2457	1.2%	-1.2%
3	U std	Al2O3 (wt%)	3.9805	4.0317	4.1000	-0.1195	-0.0683	-2.9%	-1.7%
3	U std	B2O3 (wt%)	9.0077	8.9709	9.2090	-0.2013	-0.2381	-2.2%	-2.6%
3	U std	BaO (wt%)	0.0056	0.0059	0.0000	0.0056	0.0059		
3	U std	CaO (wt%)	1.2474	1.2935	1.3010	-0.0536	-0.0075	-4.1%	-0.6%
3	U std	CdO (wt%)	0.0057	0.0057	0.0000	0.0057	0.0057		
3	U std	Ce2O3 (wt%)	0.0059	0.0059	0.0000	0.0059	0.0059		
3	U std	Cr2O3 (wt%)	0.2324	0.2315	0.0000	0.2324	0.2315		
3	U std	CuO (wt%)	0.0063	0.0066	0.0000	0.0063	0.0066		
3	U std	Fe2O3 (wt%)	13.5559	13.1797	13.1960	0.3599	-0.0163	2.7%	-0.1%
3	U std	K2O (wt%)	2.8748	3.0897	2.9990	-0.1242	0.0907	-4.1%	3.0%
3	U std	La2O3 (wt%)	0.0586	0.0586	0.0000	0.0586	0.0586		
3	U std	Li2O (wt%)	2.9889	3.0770	3.0570	-0.0681	0.0200	-2.2%	0.7%
3	U std	MgO (wt%)	1.1536	1.1841	1.2100	-0.0564	-0.0259	-4.7%	-2.1%
3	U std	MnO (wt%)	2.9192	2.8081	2.8920	0.0272	-0.0839	0.9%	-2.9%
3	U std	Na2O (wt%)	11.7759	11.6960	11.7950	-0.0191	-0.0990	-0.2%	-0.8%
3	U std	Nb2O5 (wt%)	0.0728	0.0728	0.0000	0.0728	0.0728		
3	U std	NiO (wt%)	0.9914	1.0439	1.1200	-0.1286	-0.0761	-11.5%	-6.8%
3	U std	PbO (wt%)	0.0108	0.0108	0.0000	0.0108	0.0108		
3	U std	SiO2 (wt%)	46.0306	45.0456	45.3530	0.6776	-0.3074	1.5%	-0.7%
3	U std	SO4 (wt%)	0.1498	0.1498	0.0000	0.1498	0.1498		
3	U std	ThO2 (wt%)	0.0569	0.0569	0.0000	0.0569	0.0569		
3	U std	TiO2 (wt%)	0.9238	0.9553	1.0490	-0.1252	-0.0937	-11.9%	-8.9%
3	U std	U3O8 (wt%)	2.3977	2.4060	2.4060	-0.0083	0.0000	-0.3%	0.0%
3	U std	ZnO (wt%)	0.0062	0.0062	0.0000	0.0062	0.0062		
3	U std	ZrO2 (wt%)	0.0068	0.0068	0.0000	0.0068	0.0068		
3	U std	Sum	100.4652	99.3990	99.6870	0.7782	-0.2880	0.8%	-0.3%

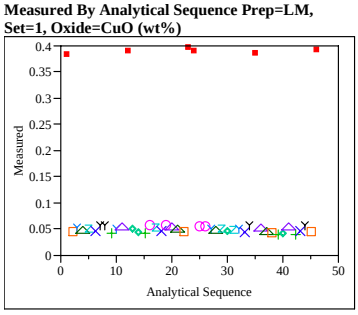
Figure A1. Measurements in Analytical Sequence for Samples by Oxide by Prep Method and by Analytical Set

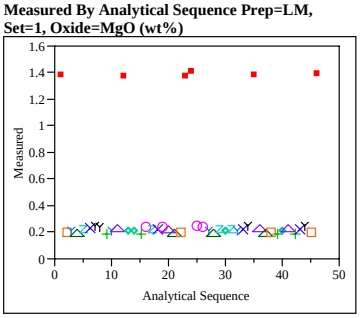


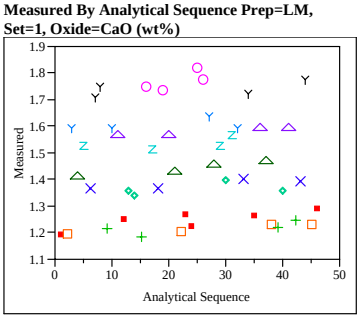


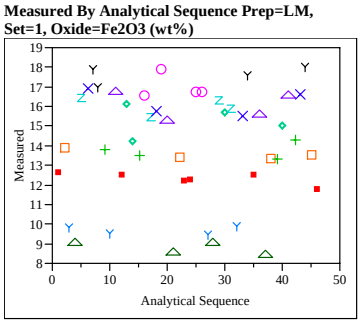


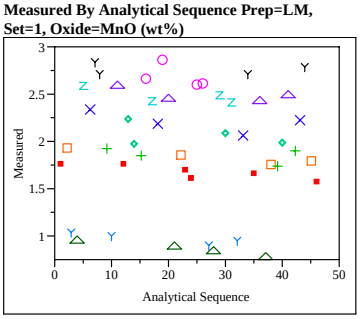


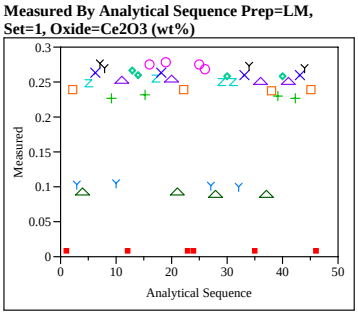


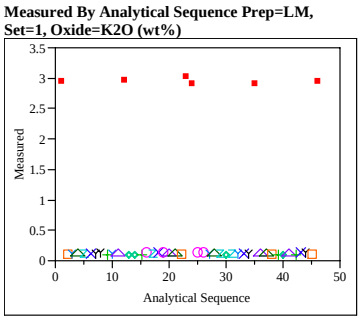












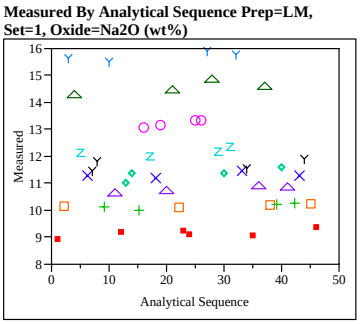
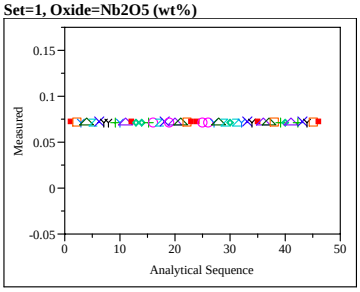
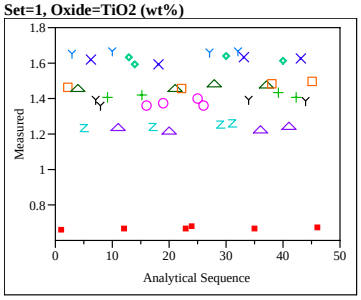


Figure A1. Measurements in Analytical Sequence for Samples by Oxide by Prep Method and by Analytical Set

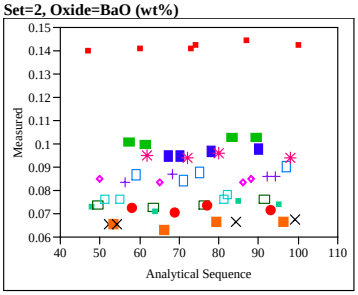
Measured By Analytical Sequence Prep=LM, Set=1, Oxide=Nb2O5 (wt%)



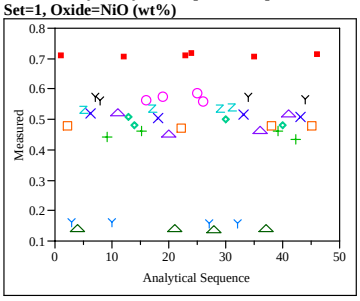
Measured By Analytical Sequence Prep=LM, Set=1, Oxide=TiO2 (wt%)



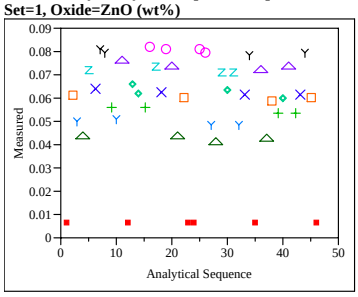
Measured By Analytical Sequence Prep=LM, Set=2, Oxide=BaO (wt%)



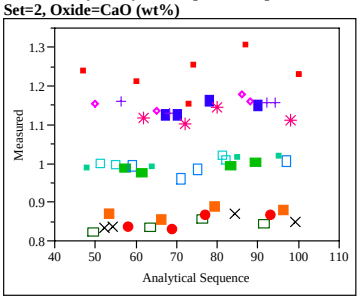
Measured By Analytical Sequence Prep=LM, Set=1, Oxide=NiO (wt%)



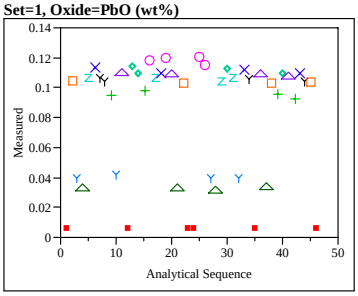
Measured By Analytical Sequence Prep=LM, Set=1, Oxide=ZnO (wt%)



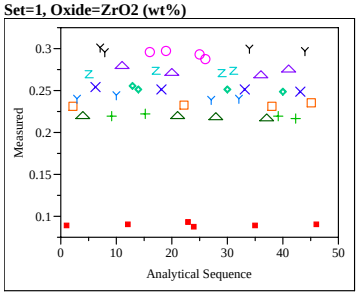
Measured By Analytical Sequence Prep=LM, Set=2, Oxide=CaO (wt%)



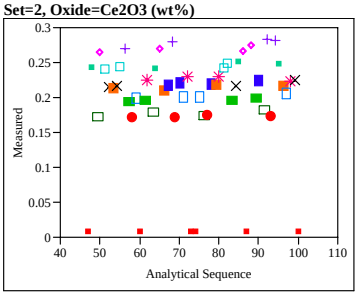
Measured By Analytical Sequence Prep=LM, Set=1, Oxide=PbO (wt%)



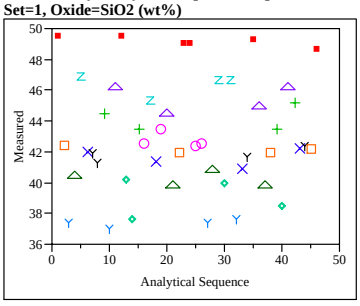
Measured By Analytical Sequence Prep=LM, Set=1, Oxide=ZrO2 (wt%)



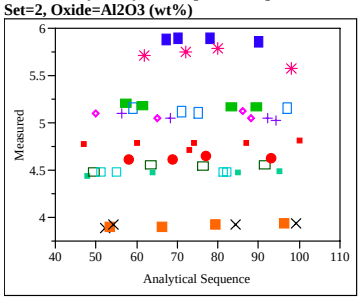
Measured By Analytical Sequence Prep=LM, Set=2, Oxide=Ce2O3 (wt%)



Measured By Analytical Sequence Prep=LM, Set=1, Oxide=SiO2 (wt%)



Measured By Analytical Sequence Prep=LM, Set=2, Oxide=Al2O3 (wt%)



Measured By Analytical Sequence Prep=LM, Set=2, Oxide=Cr2O3 (wt%)

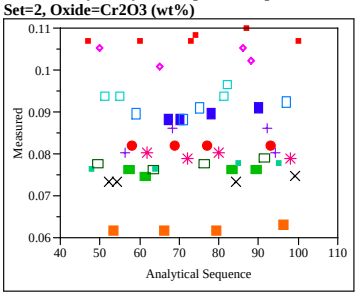
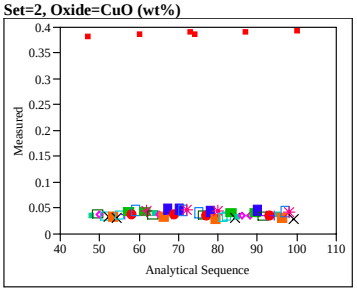
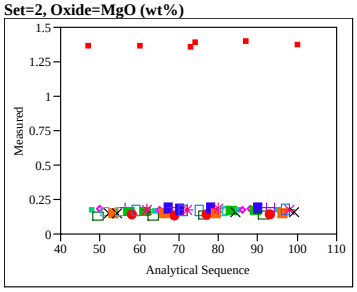


Figure A1. Measurements in Analytical Sequence for Samples by Oxide by Prep Method and by Analytical Set

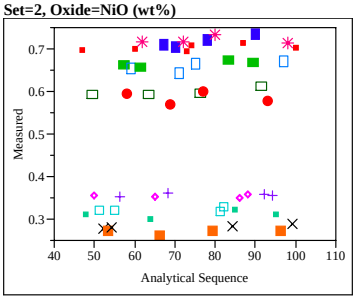
Measured By Analytical Sequence Prep=LM, Set=2, Oxide=CuO (wt%)



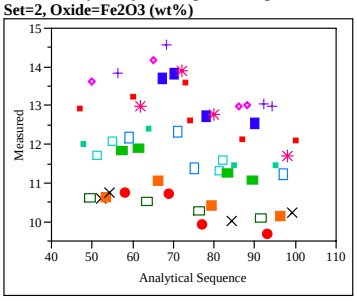
Measured By Analytical Sequence Prep=LM, Set=2, Oxide=MgO (wt%)



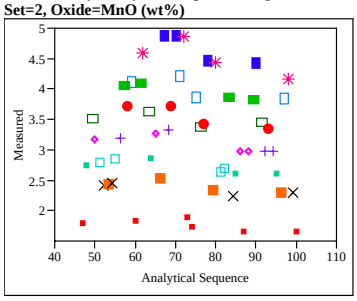
Measured By Analytical Sequence Prep=LM, Set=2, Oxide=NiO (wt%)



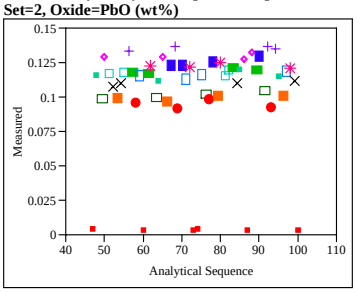
Measured By Analytical Sequence Prep=LM, Set=2, Oxide=Fe2O3 (wt%)



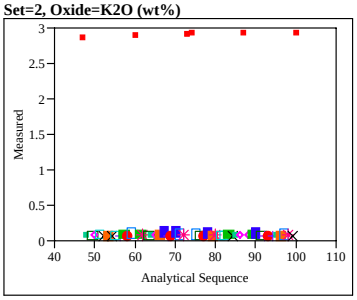
Measured By Analytical Sequence Prep=LM, Set=2, Oxide=MnO (wt%)



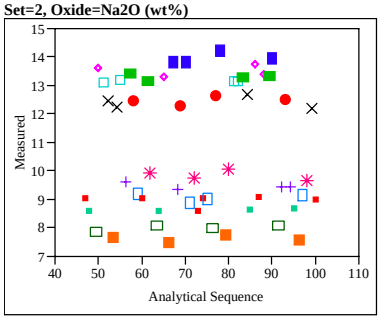
Measured By Analytical Sequence Prep=LM, Set=2, Oxide=PbO (wt%)



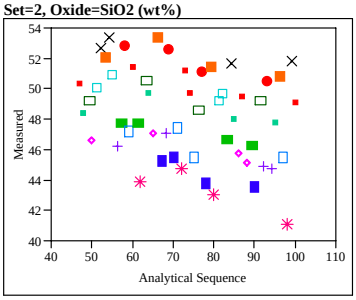
Measured By Analytical Sequence Prep=LM, Set=2, Oxide=K2O (wt%)



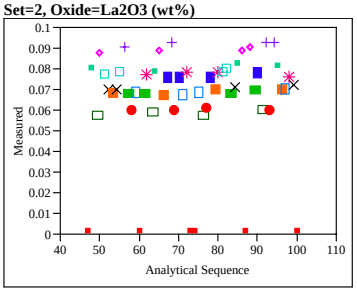
Measured By Analytical Sequence Prep=LM, Set=2, Oxide=Na2O (wt%)



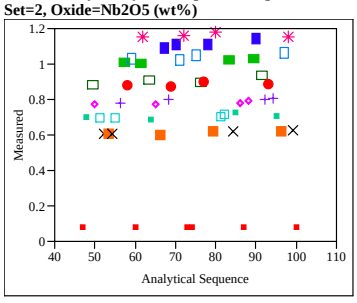
Measured By Analytical Sequence Prep=LM, Set=2, Oxide=SiO2 (wt%)



Measured By Analytical Sequence Prep=LM, Set=2, Oxide=La2O3 (wt%)



Measured By Analytical Sequence Prep=LM, Set=2, Oxide=Nb2O5 (wt%)



Measured By Analytical Sequence Prep=LM, Set=2, Oxide=TiO2 (wt%)

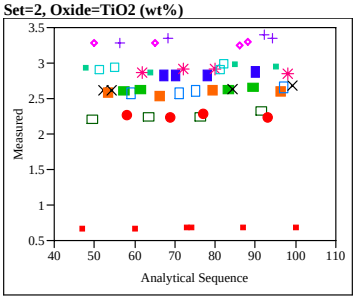
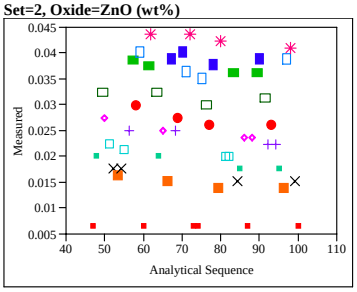
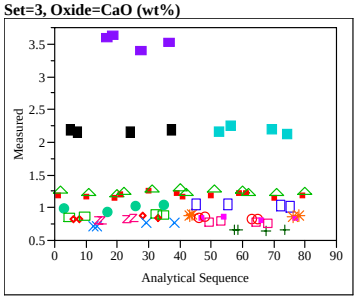


Figure A1. Measurements in Analytical Sequence for Samples by Oxide by Prep Method and by Analytical Set

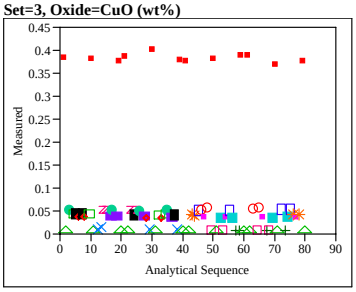
Measured By Analytical Sequence Prep=LM, Set=2, Oxide=ZnO (wt%)



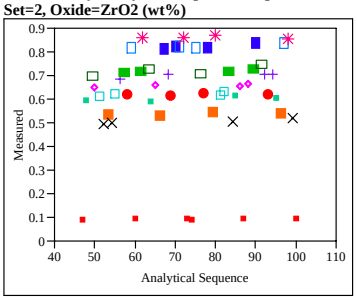
Measured By Analytical Sequence Prep=LM, Set=3, Oxide=CaO (wt%)



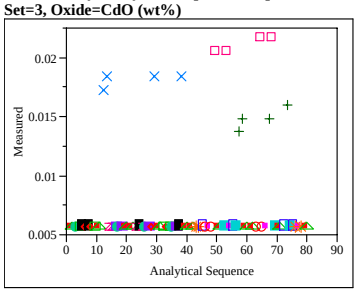
Measured By Analytical Sequence Prep=LM, Set=3, Oxide=CuO (wt%)



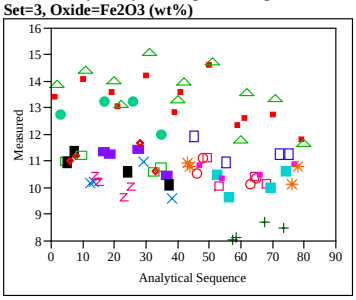
Measured By Analytical Sequence Prep=LM, Set=2, Oxide=ZrO2 (wt%)



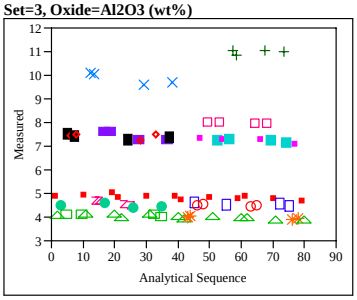
Measured By Analytical Sequence Prep=LM, Set=3, Oxide=CdO (wt%)



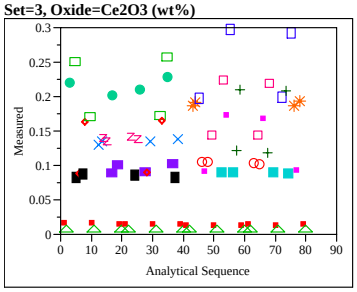
Measured By Analytical Sequence Prep=LM, Set=3, Oxide=Fe2O3 (wt%)



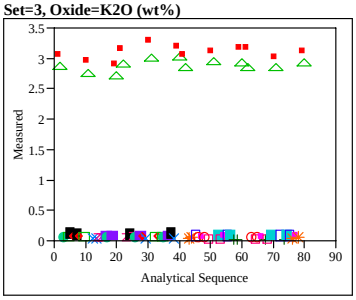
Measured By Analytical Sequence Prep=LM, Set=3, Oxide=Al2O3 (wt%)



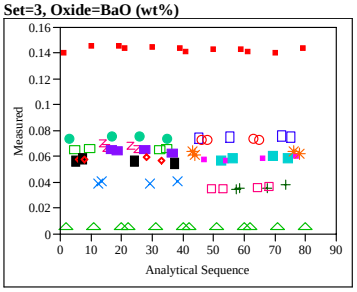
Measured By Analytical Sequence Prep=LM, Set=3, Oxide=Ce2O3 (wt%)



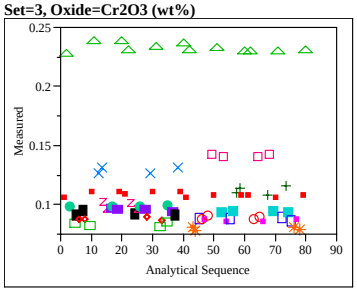
Measured By Analytical Sequence Prep=LM, Set=3, Oxide=K2O (wt%)



Measured By Analytical Sequence Prep=LM, Set=3, Oxide=BaO (wt%)



Measured By Analytical Sequence Prep=LM, Set=3, Oxide=Cr2O3 (wt%)



Measured By Analytical Sequence Prep=LM, Set=3, Oxide=La2O3 (wt%)

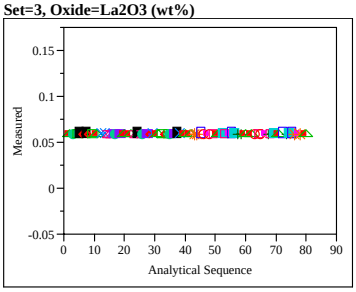
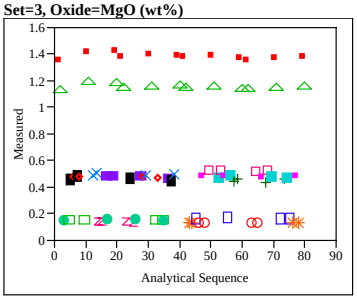
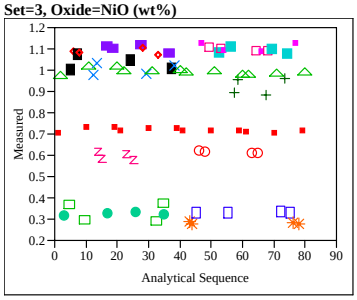


Figure A1. Measurements in Analytical Sequence for Samples by Oxide by Prep Method and by Analytical Set

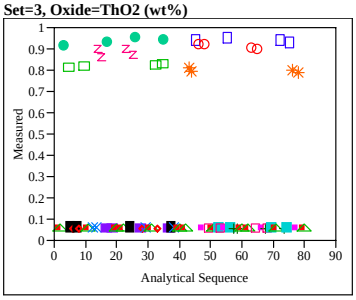
Measured By Analytical Sequence Prep=LM, Set=3, Oxide=MgO (wt%)



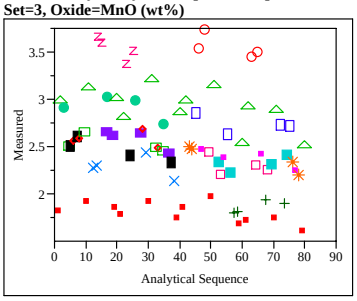
Measured By Analytical Sequence Prep=LM, Set=3, Oxide=NiO (wt%)



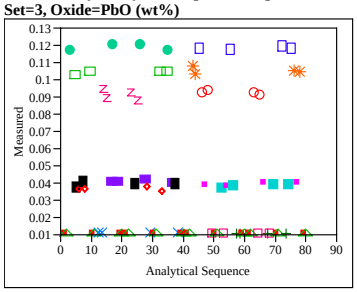
Measured By Analytical Sequence Prep=LM, Set=3, Oxide=ThO2 (wt%)



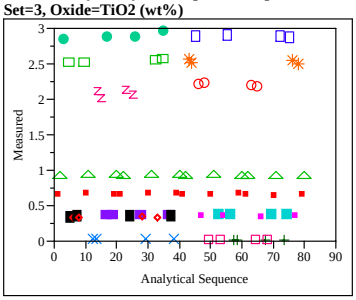
Measured By Analytical Sequence Prep=LM, Set=3, Oxide=MnO (wt%)



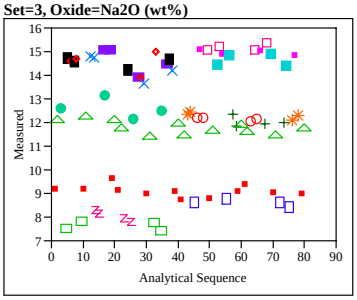
Measured By Analytical Sequence Prep=LM, Set=3, Oxide=PbO (wt%)



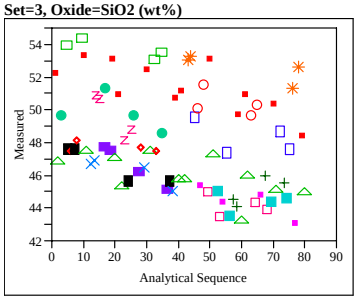
Measured By Analytical Sequence Prep=LM, Set=3, Oxide=TiO2 (wt%)



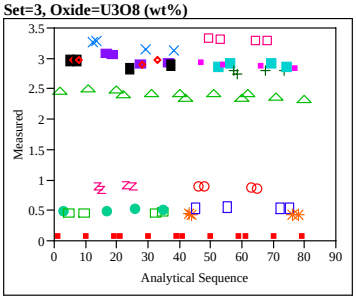
Measured By Analytical Sequence Prep=LM, Set=3, Oxide=Na2O (wt%)



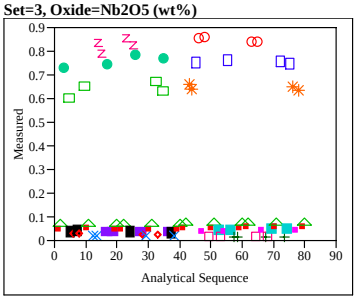
Measured By Analytical Sequence Prep=LM, Set=3, Oxide=SiO2 (wt%)



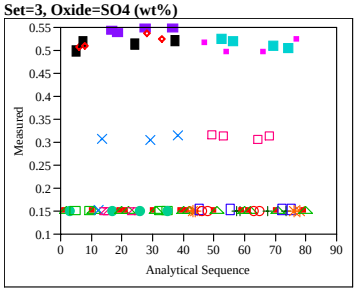
Measured By Analytical Sequence Prep=LM, Set=3, Oxide=U3O8 (wt%)



Measured By Analytical Sequence Prep=LM, Set=3, Oxide=Nb2O5 (wt%)



Measured By Analytical Sequence Prep=LM, Set=3, Oxide=SO4 (wt%)



Measured By Analytical Sequence Prep=LM, Set=3, Oxide=ZnO (wt%)

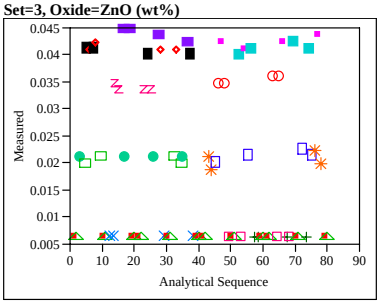
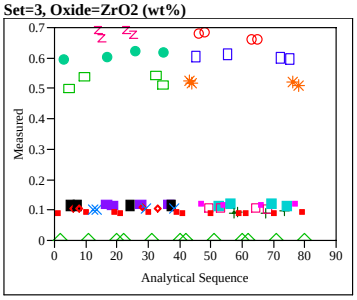
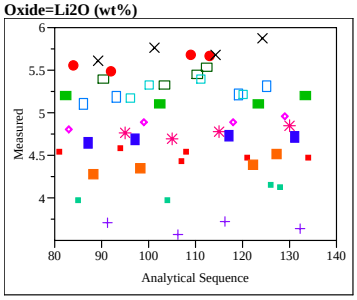


Figure A1. Measurements in Analytical Sequence for Samples by Oxide by Prep Method and by Analytical Set

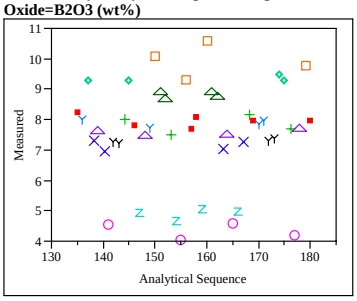
Measured By Analytical Sequence Prep=LM, Set=3, Oxide=ZrO2 (wt%)



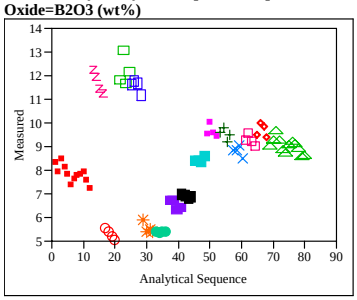
Measured By Analytical Sequence Prep=PF, Set=2, Oxide=Li2O (wt%)



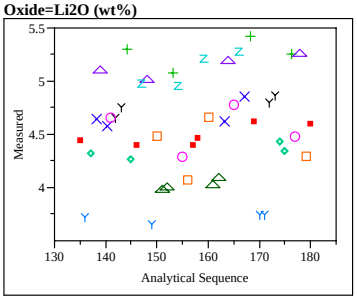
Measured By Analytical Sequence Prep=PF, Set=1, Oxide=B2O3 (wt%)



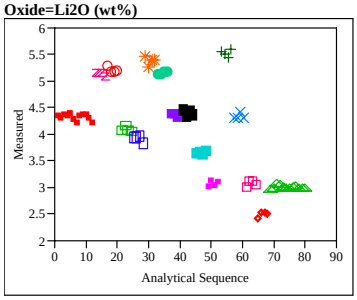
Measured By Analytical Sequence Prep=PF, Set=3, Oxide=B2O3 (wt%)



Measured By Analytical Sequence Prep=PF, Set=1, Oxide=Li2O (wt%)



Measured By Analytical Sequence Prep=PF, Set=3, Oxide=Li2O (wt%)



Measured By Analytical Sequence Prep=PF, Set=2, Oxide=B2O3 (wt%)

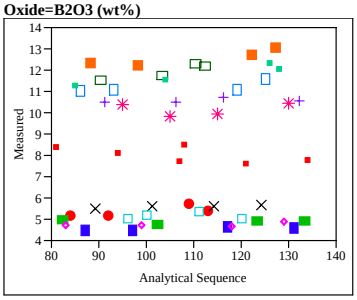
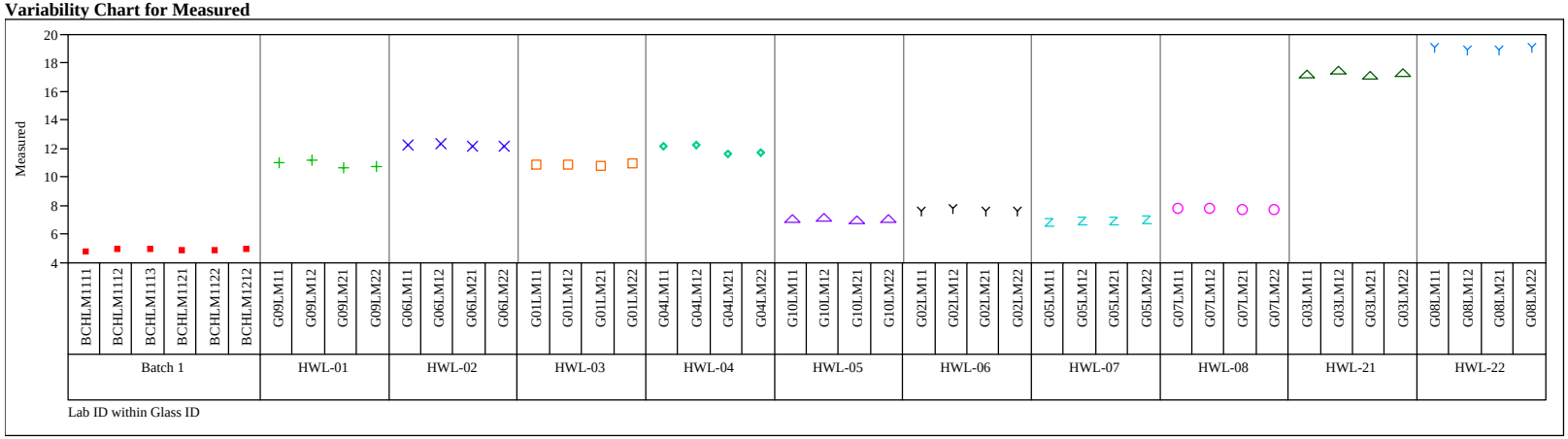


Figure A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=1, Oxide=Al2O3 (wt%)
Variability Chart for Measured



Set=1, Oxide=B2O3 (wt%)
Variability Chart for Measured

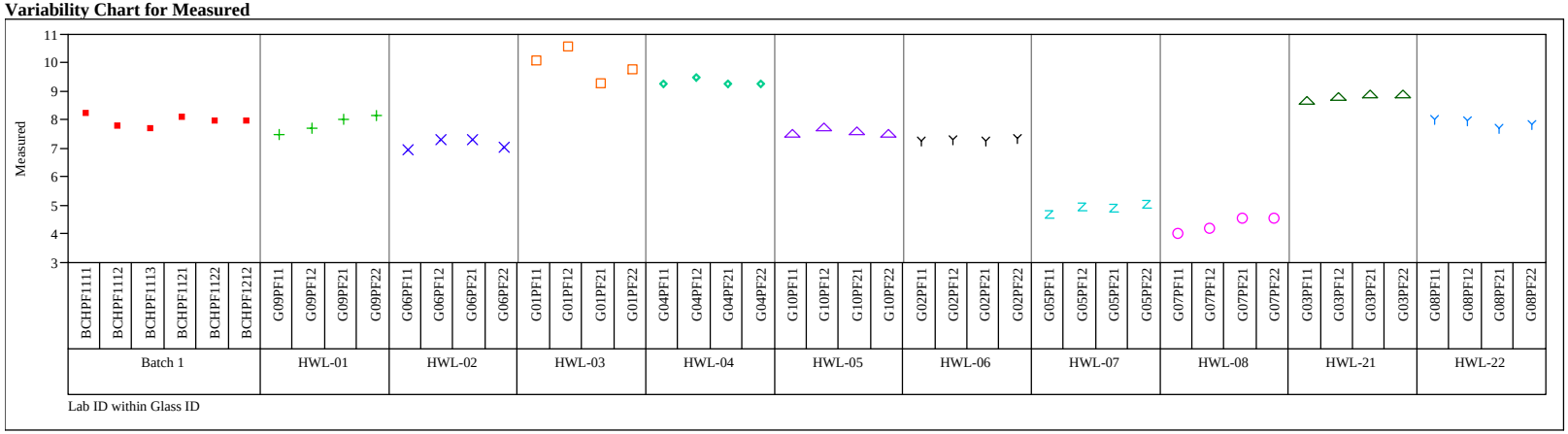
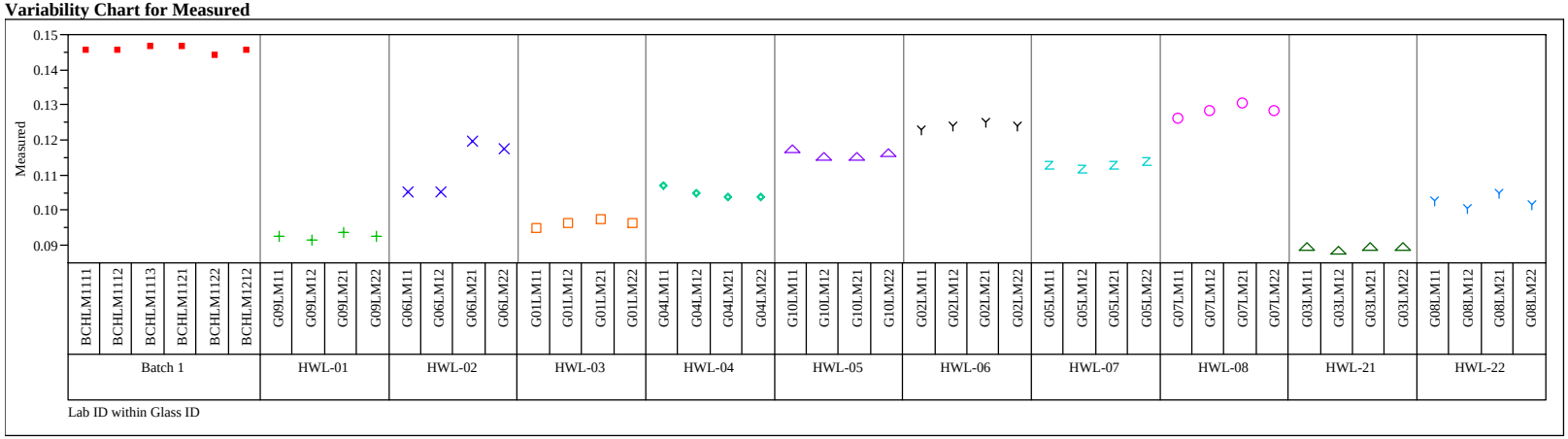


Figure A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=1, Oxide=BaO (wt%)
Variability Chart for Measured



Set=1, Oxide=CaO (wt%)
Variability Chart for Measured

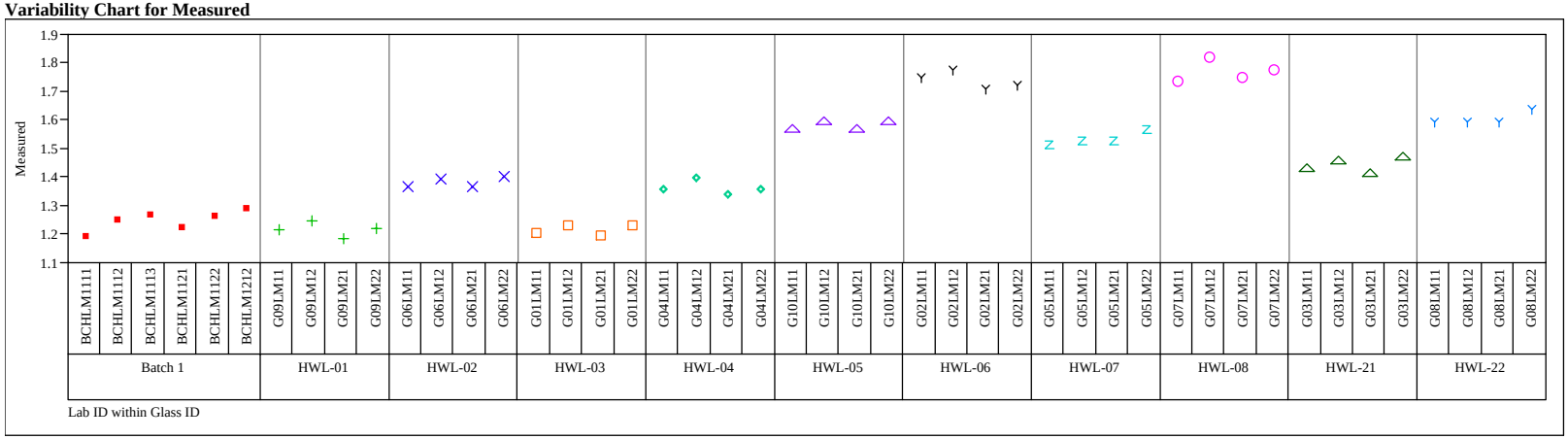
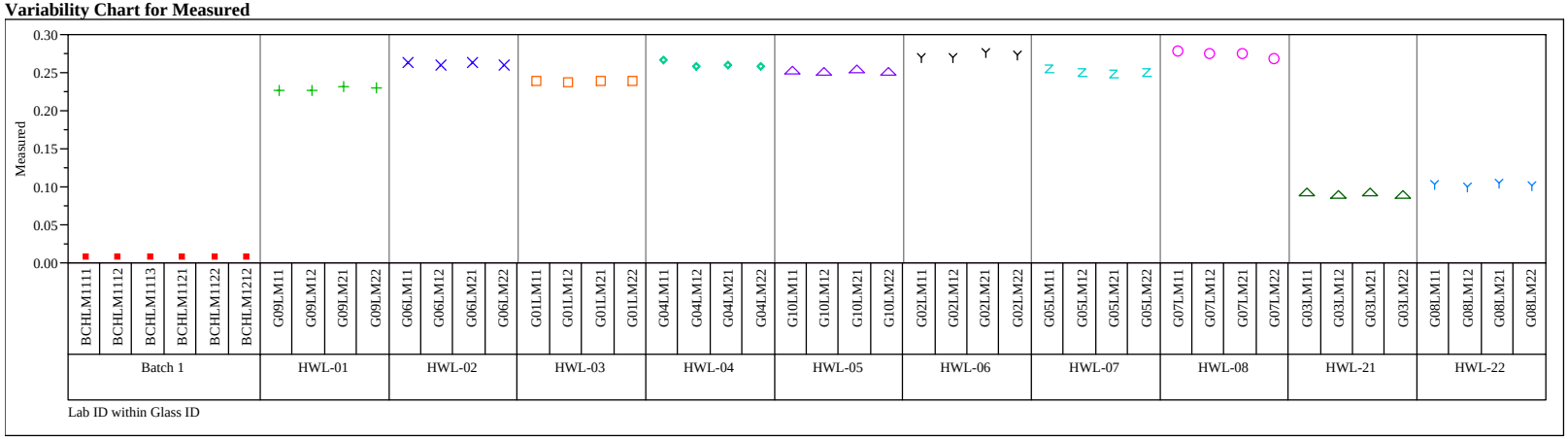


Figure A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=1, Oxide=Ce2O3 (wt%)
Variability Chart for Measured



Set=1, Oxide=Cr2O3 (wt%)
Variability Chart for Measured

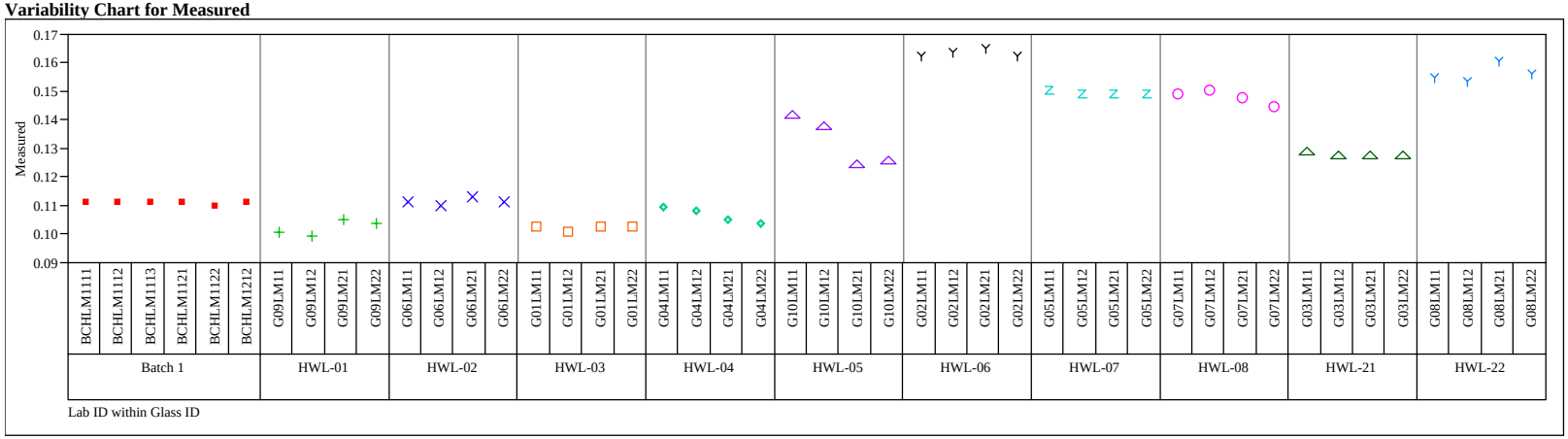
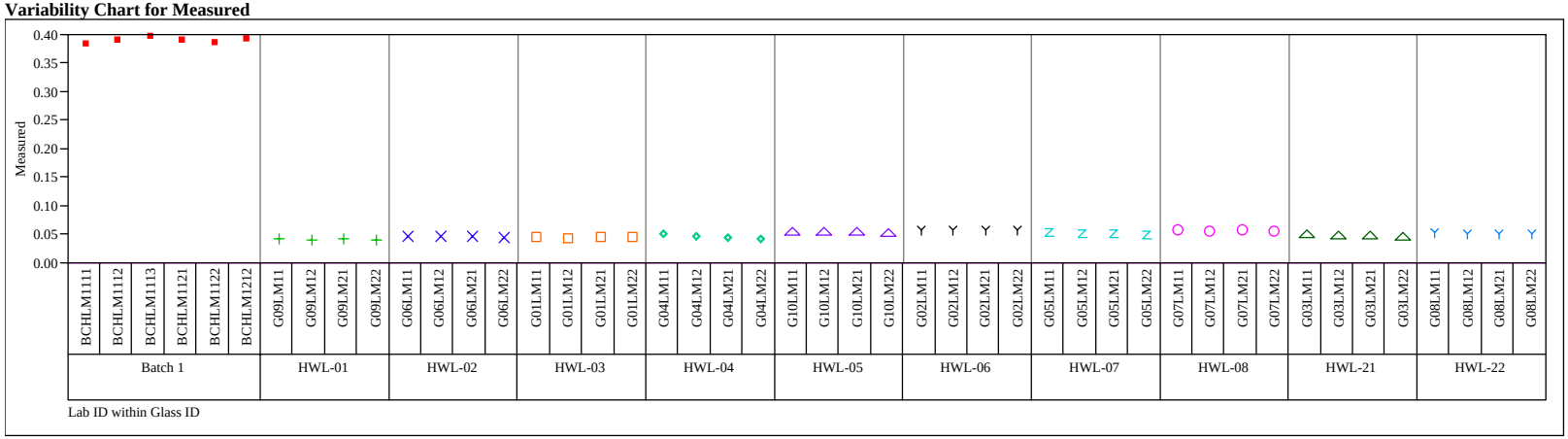


Figure A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=1, Oxide=CuO (wt%)
Variability Chart for Measured



Set=1, Oxide=Fe2O3 (wt%)
Variability Chart for Measured

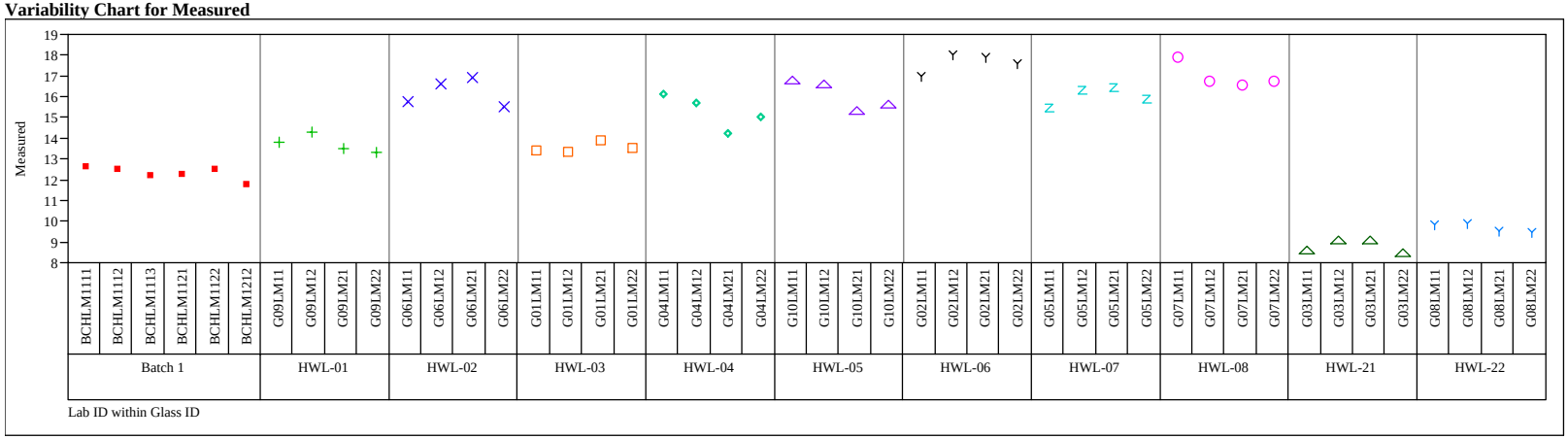
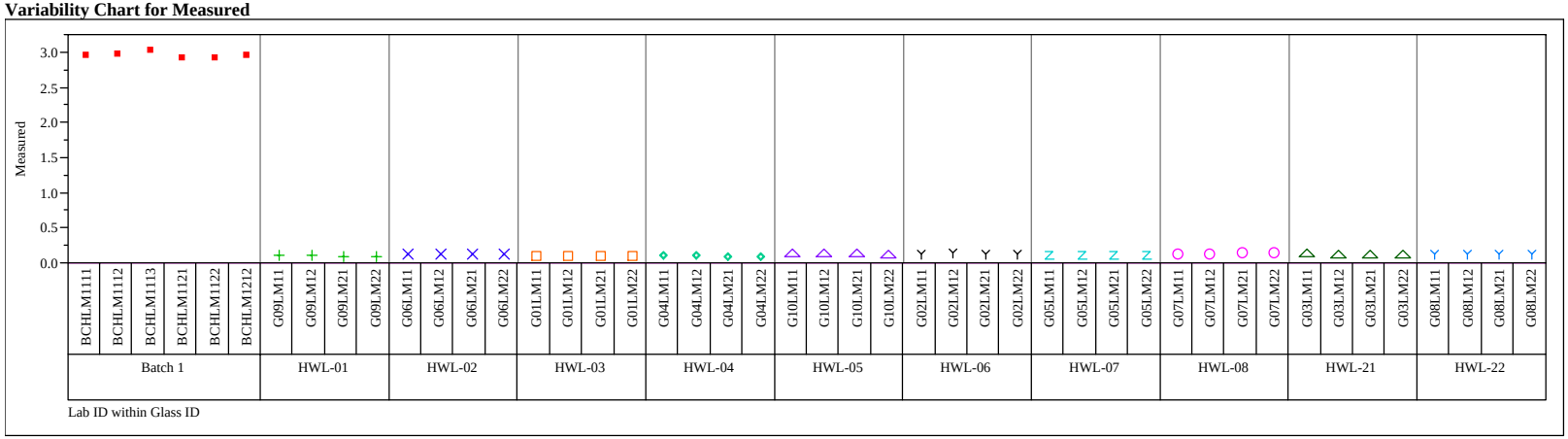


Figure A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=1, Oxide=K2O (wt%)
Variability Chart for Measured



Set=1, Oxide=La2O3 (wt%)
Variability Chart for Measured

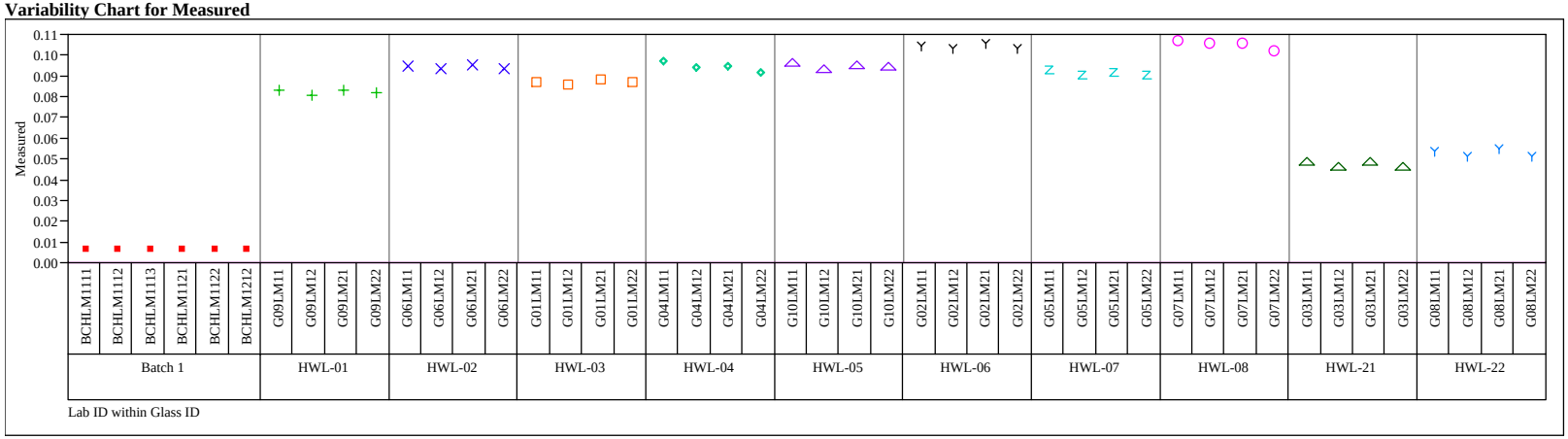
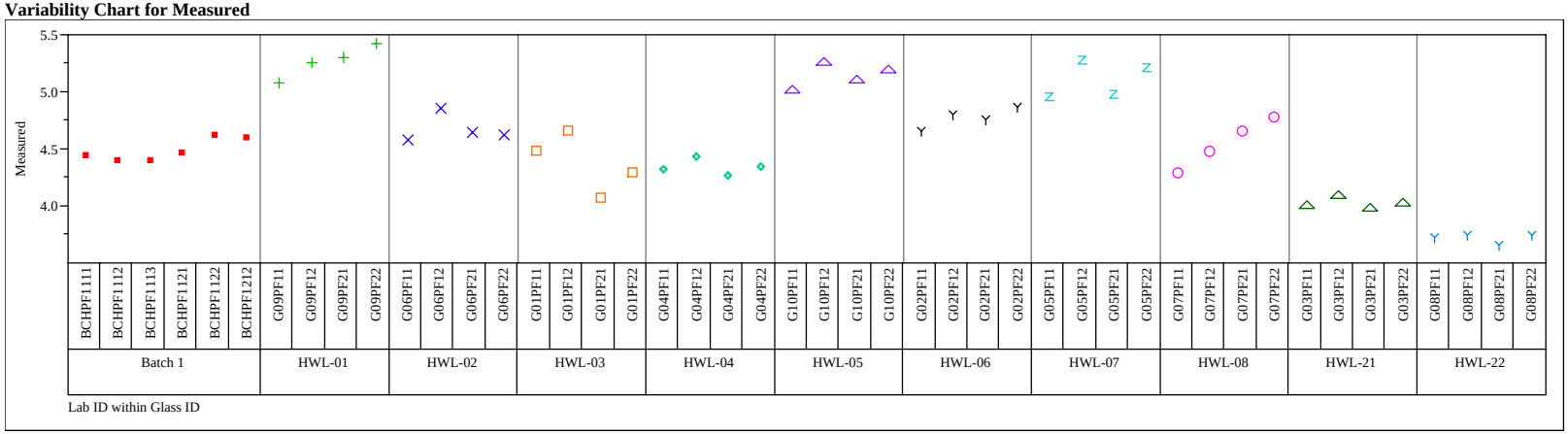


Figure A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=1, Oxide=Li2O (wt%)
Variability Chart for Measured



Set=1, Oxide=MgO (wt%)
Variability Chart for Measured

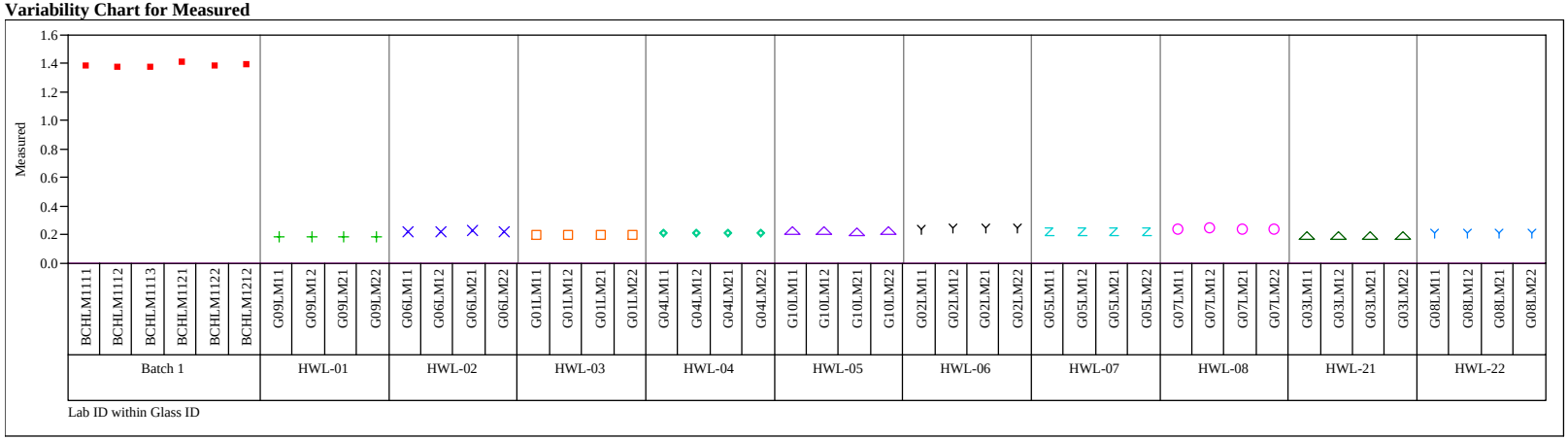
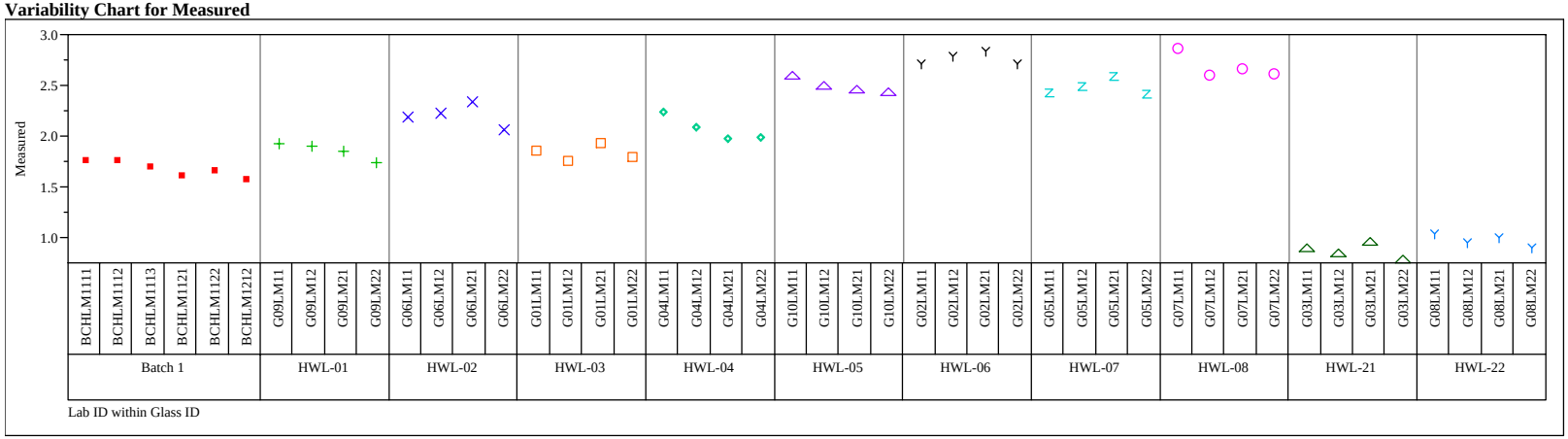


Figure A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=1, Oxide=MnO (wt%)
Variability Chart for Measured



Set=1, Oxide=Na2O (wt%)
Variability Chart for Measured

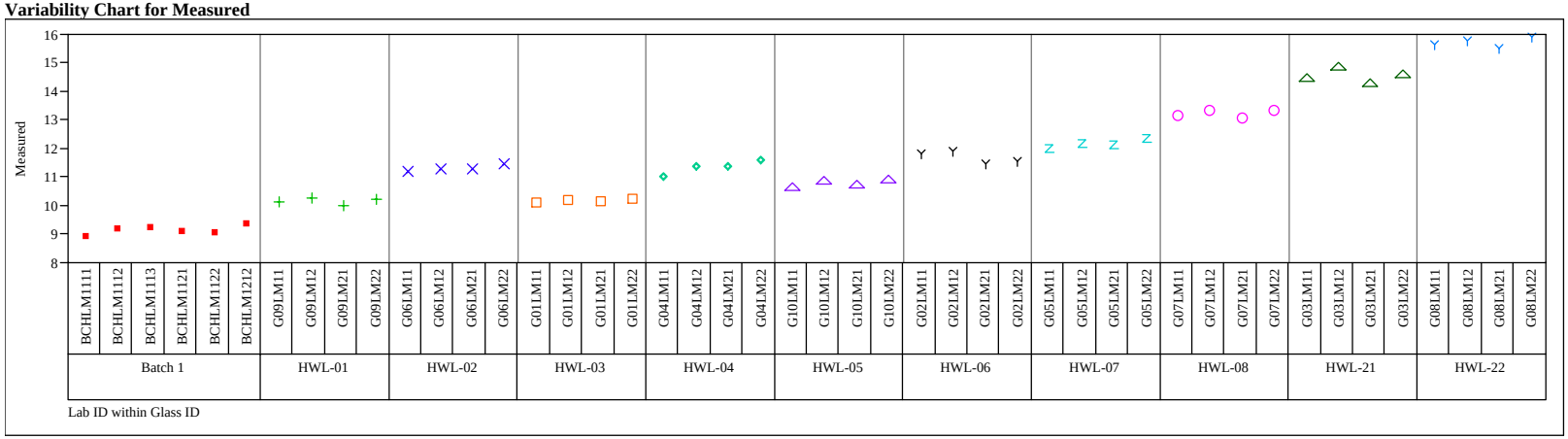
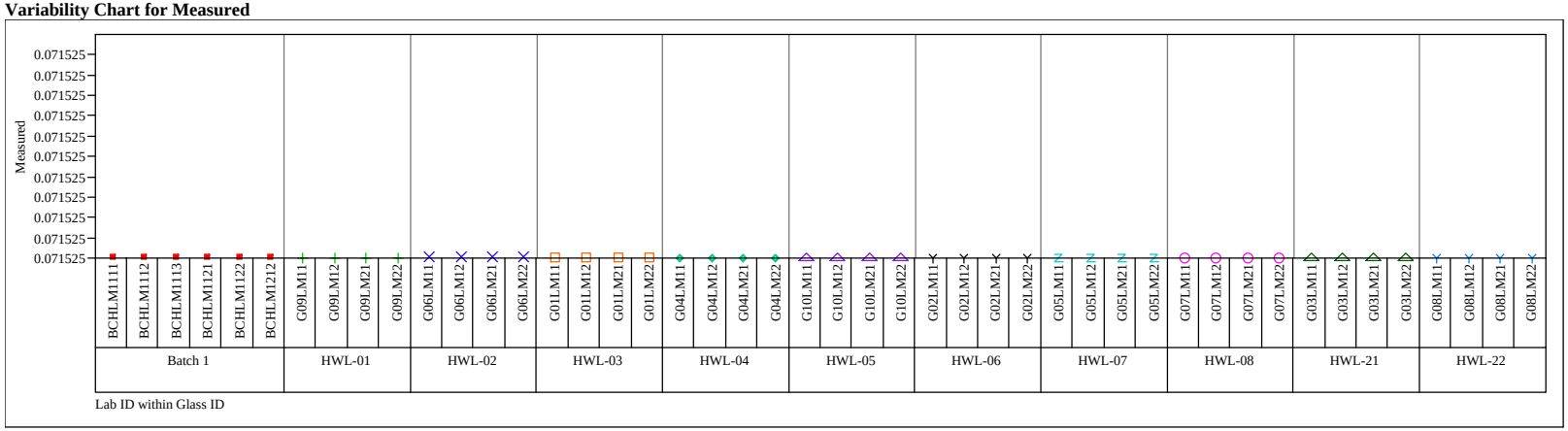


Figure A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=1, Oxide=Nb2O5 (wt%)
Variability Chart for Measured



Set=1, Oxide=NiO (wt%)
Variability Chart for Measured

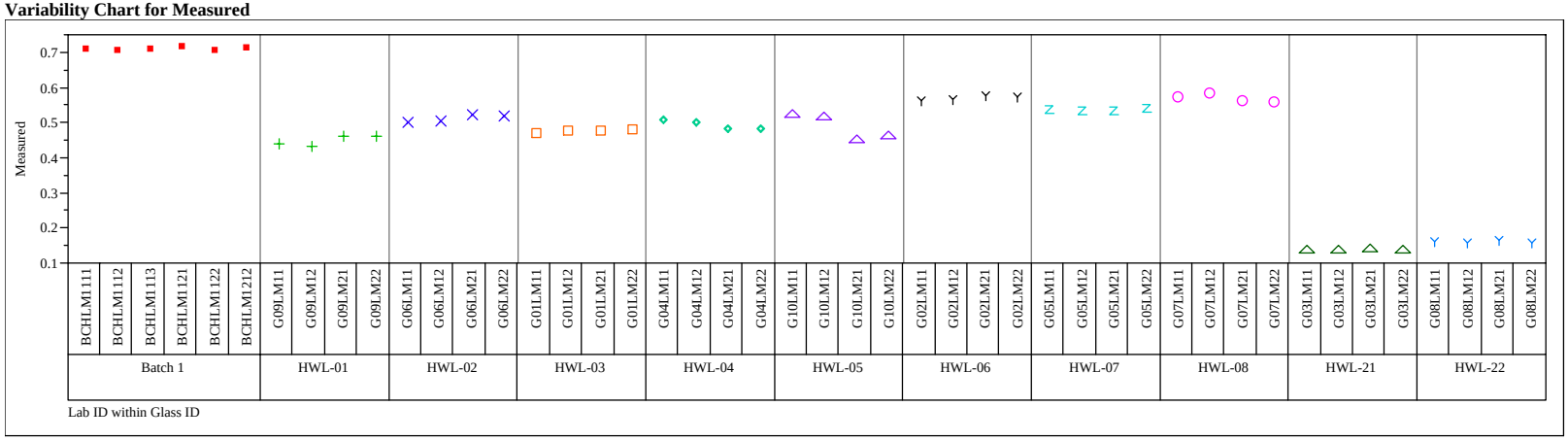
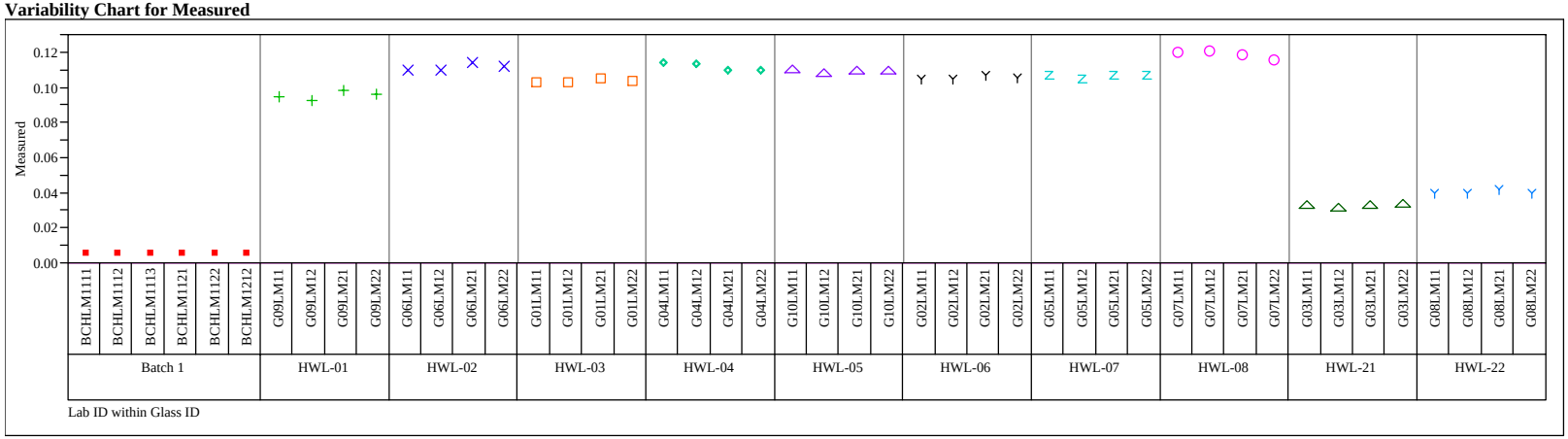


Figure A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=1, Oxide=PbO (wt%)
Variability Chart for Measured



Set=1, Oxide=SiO2 (wt%)
Variability Chart for Measured

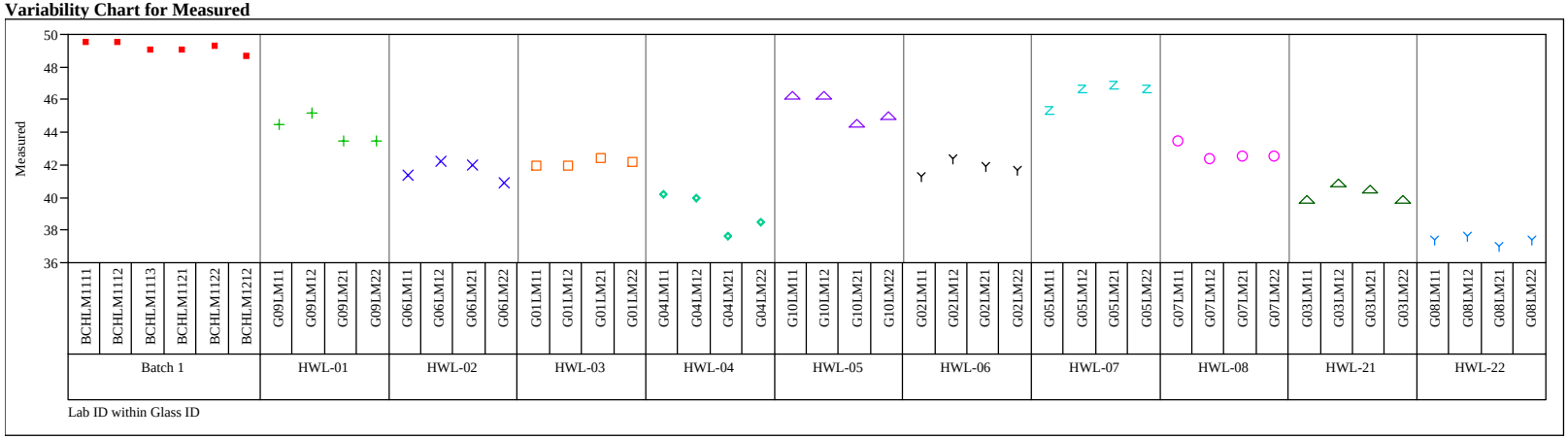
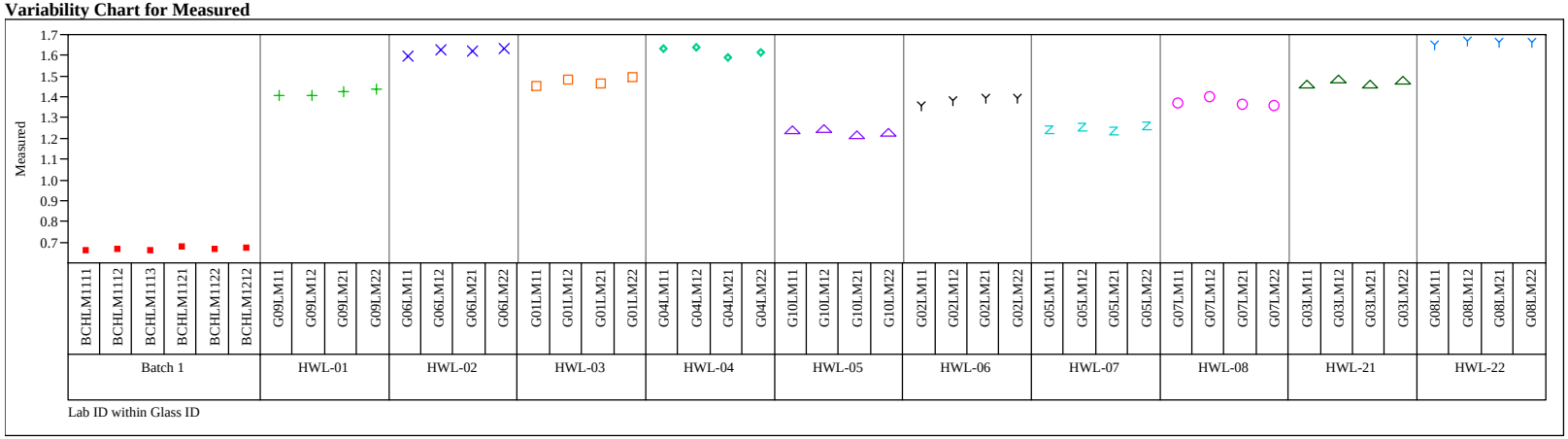


Figure A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=1, Oxide=TiO2 (wt%)
Variability Chart for Measured



Set=1, Oxide=ZnO (wt%)
Variability Chart for Measured

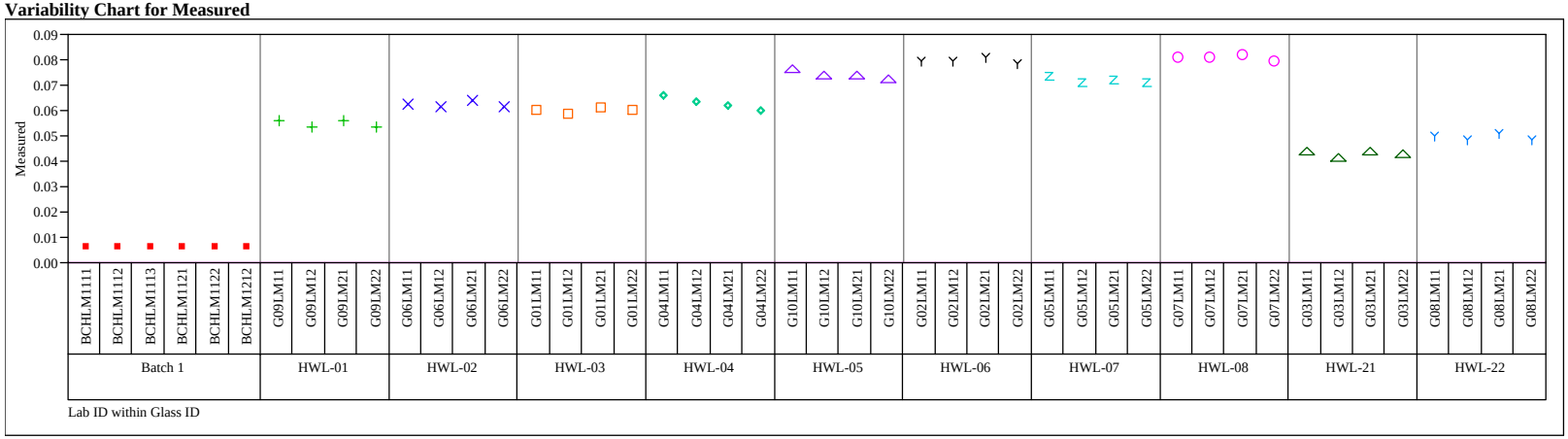
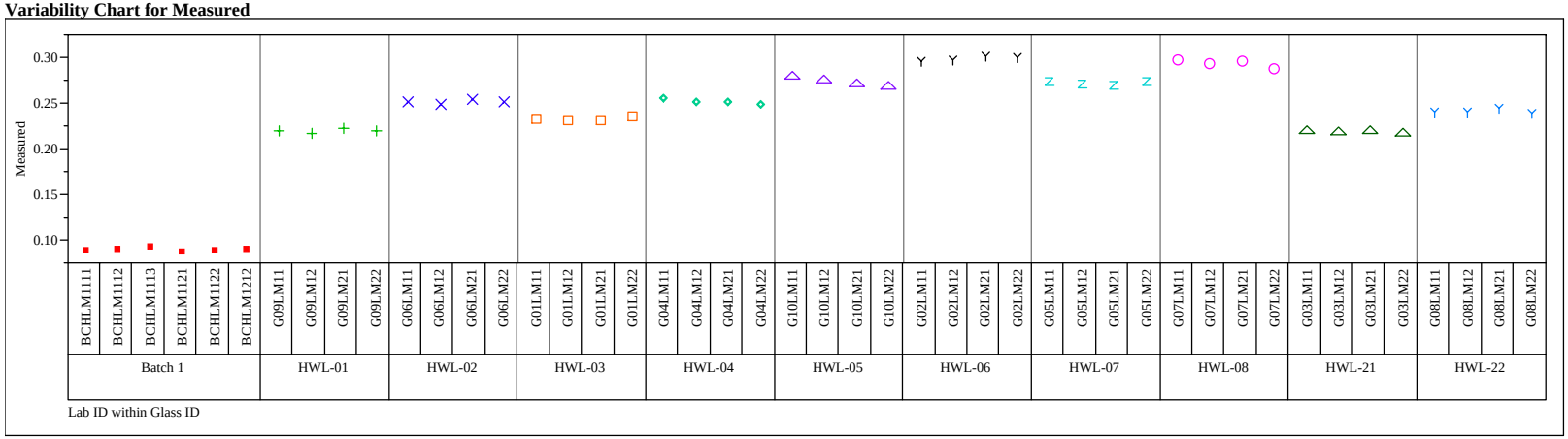


Figure A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=1, Oxide=ZrO2 (wt%)
Variability Chart for Measured



Set=2, Oxide=Al2O3 (wt%)
Variability Chart for Measured

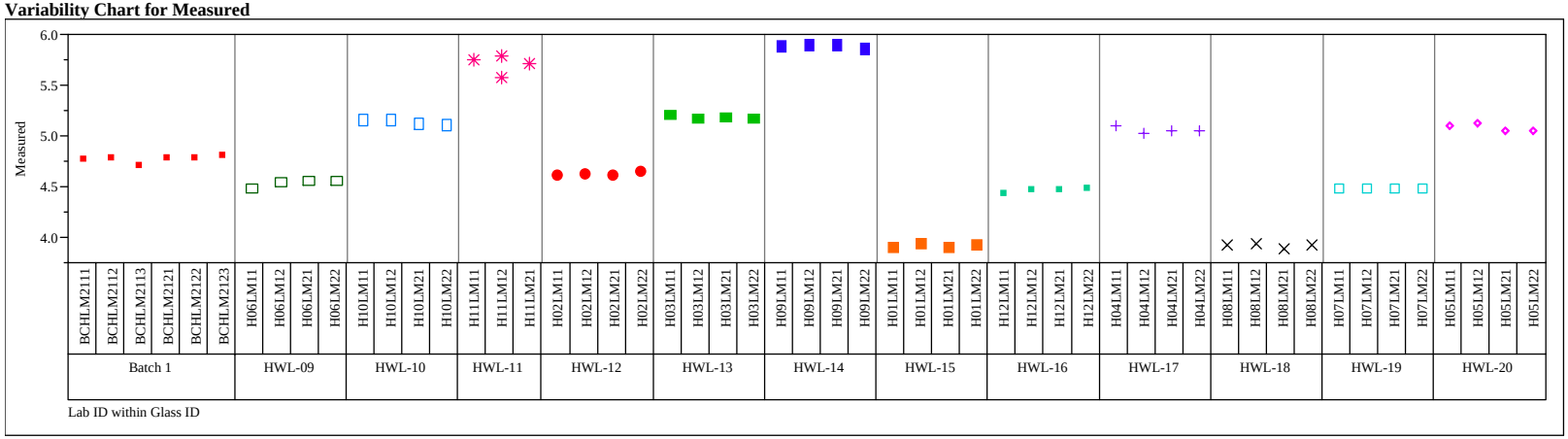
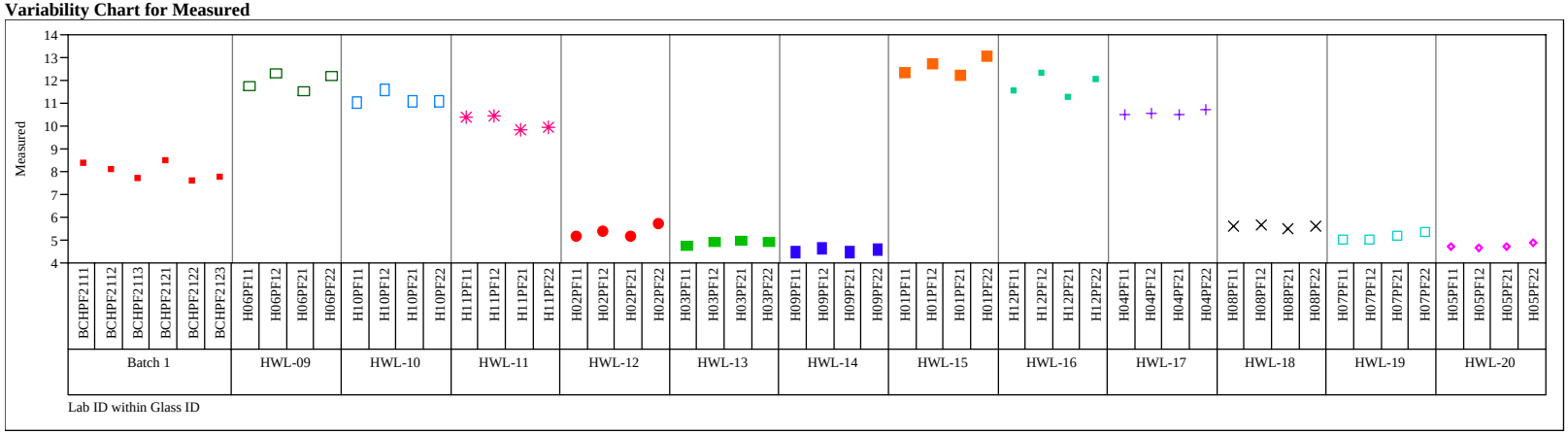


Figure A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=2, Oxide=B2O3 (wt%)
Variability Chart for Measured



Set=2, Oxide=BaO (wt%)
Variability Chart for Measured

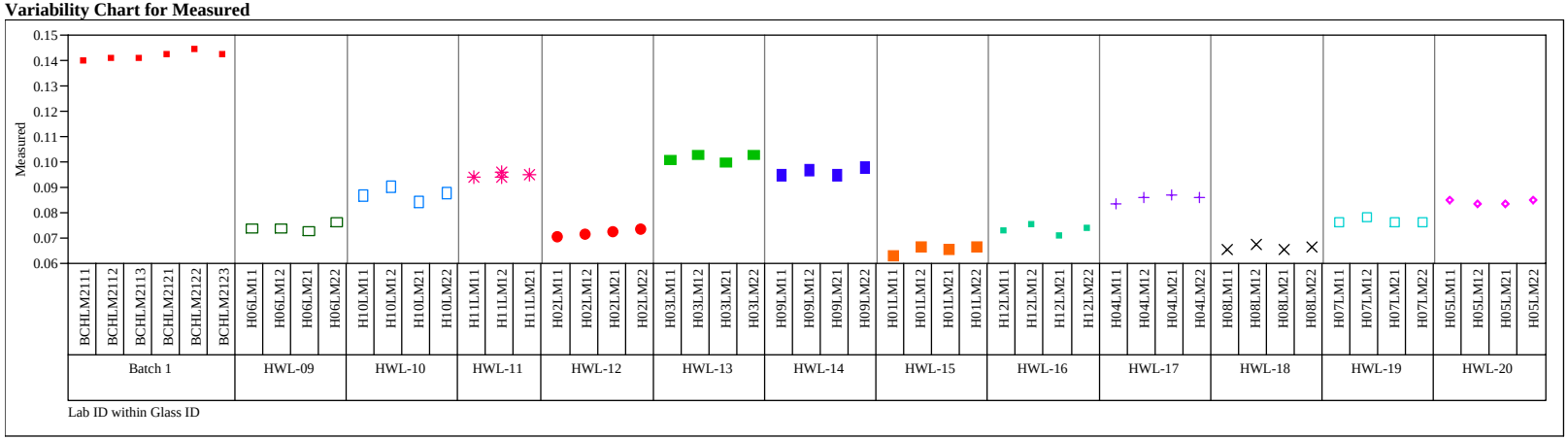
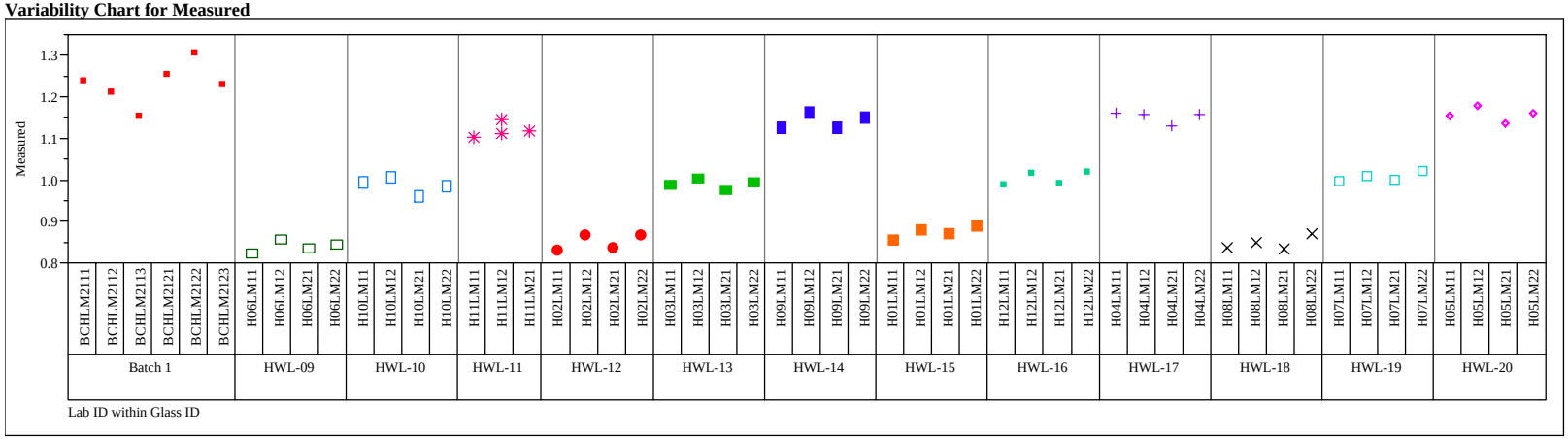


Figure A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=2, Oxide=CaO (wt%)
Variability Chart for Measured



Set=2, Oxide=Ce2O3 (wt%)
Variability Chart for Measured

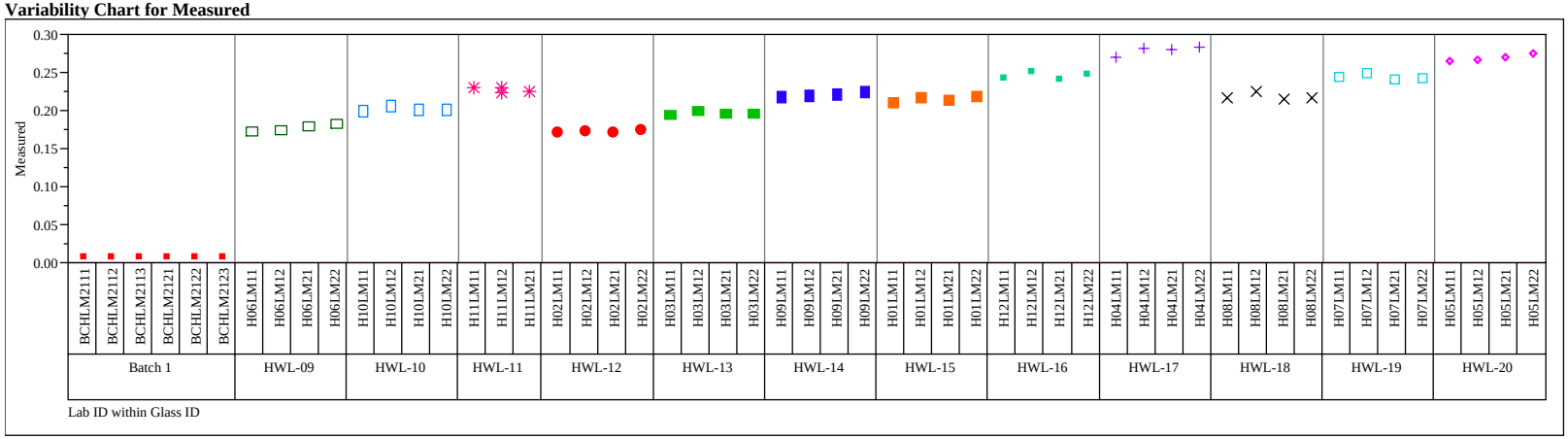
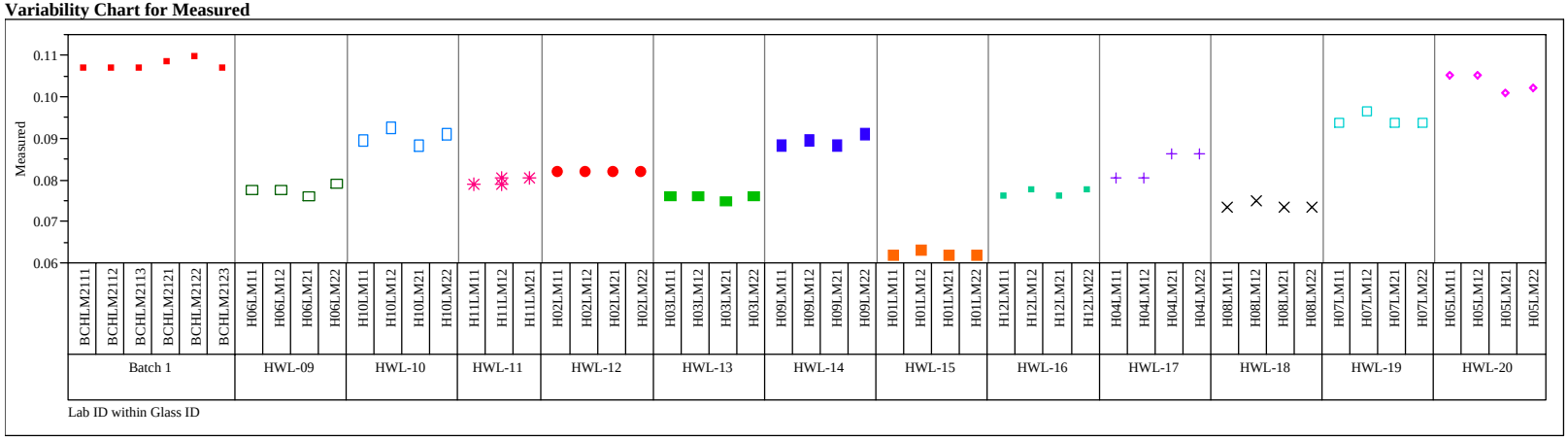


Figure A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=2, Oxide=Cr2O3 (wt%)
Variability Chart for Measured



Set=2, Oxide=CuO (wt%)
Variability Chart for Measured

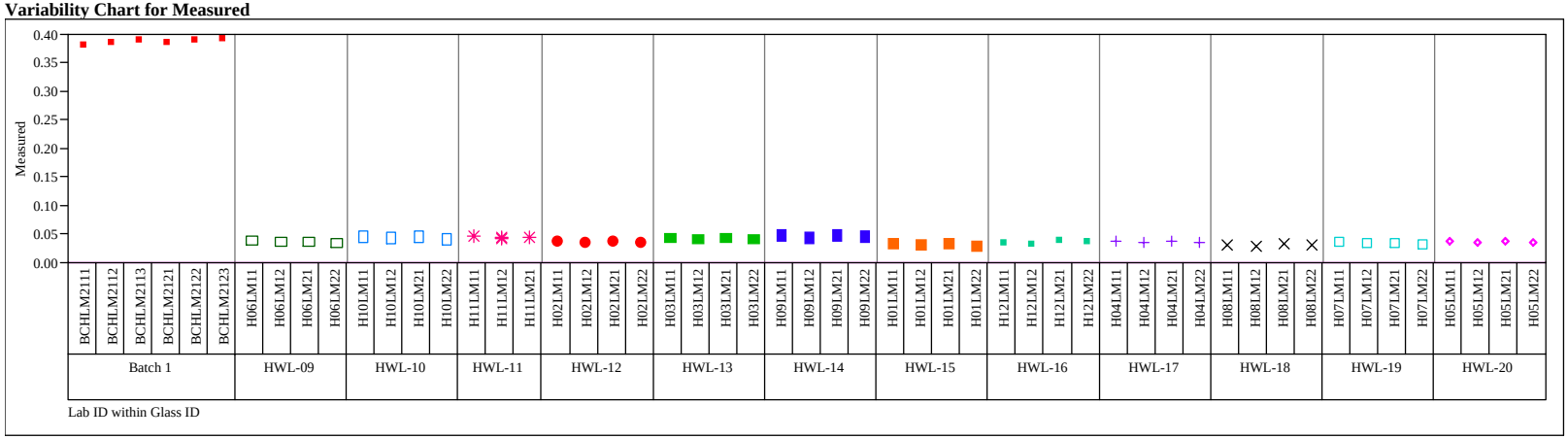
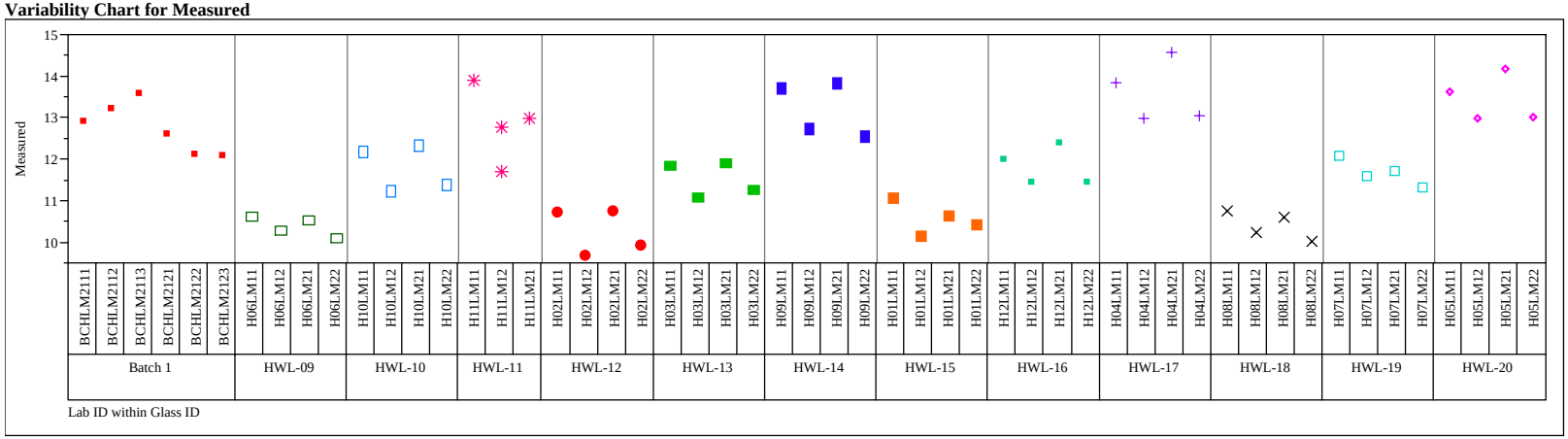


Figure A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=2, Oxide=Fe2O3 (wt%)
Variability Chart for Measured



Set=2, Oxide=K2O (wt%)
Variability Chart for Measured

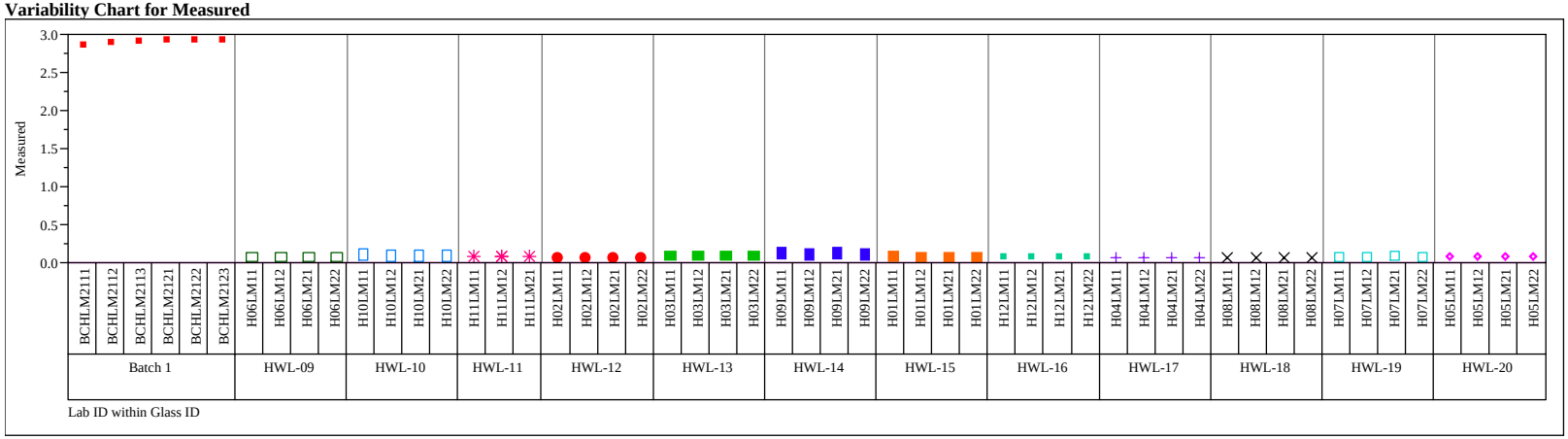
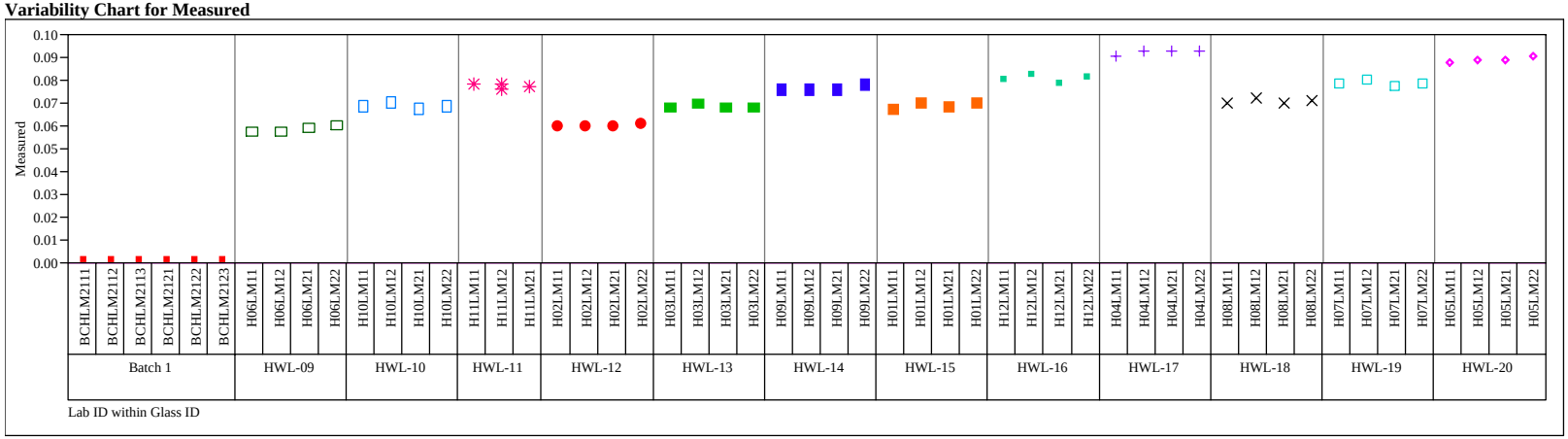


Figure A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=2, Oxide=La2O3 (wt%)
Variability Chart for Measured



Set=2, Oxide=Li2O (wt%)
Variability Chart for Measured

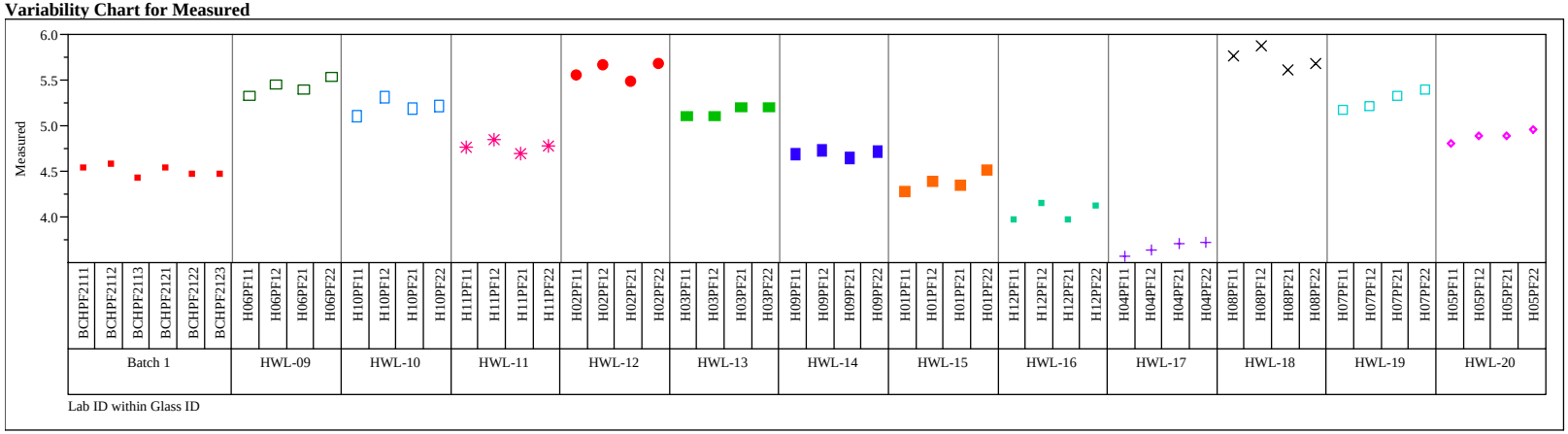
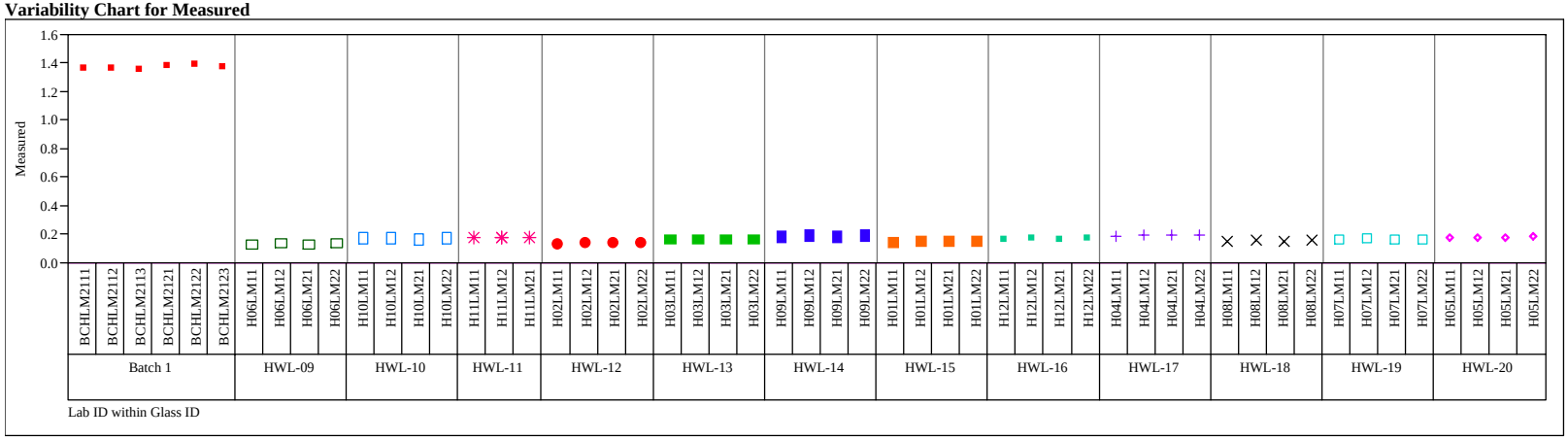


Figure A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=2, Oxide=MgO (wt%)
Variability Chart for Measured



Set=2, Oxide=MnO (wt%)
Variability Chart for Measured

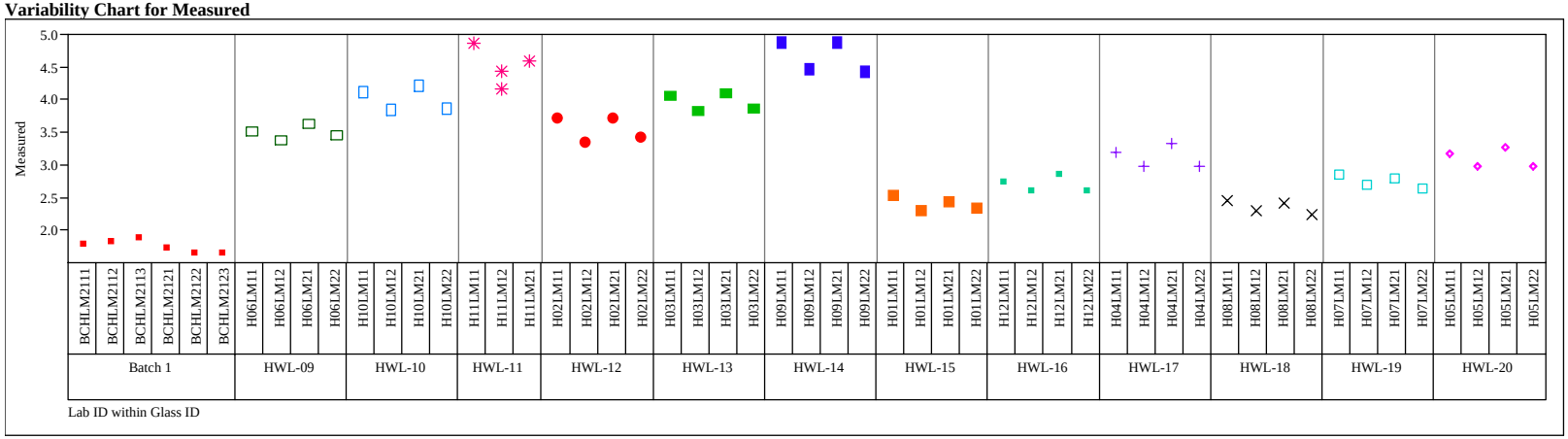
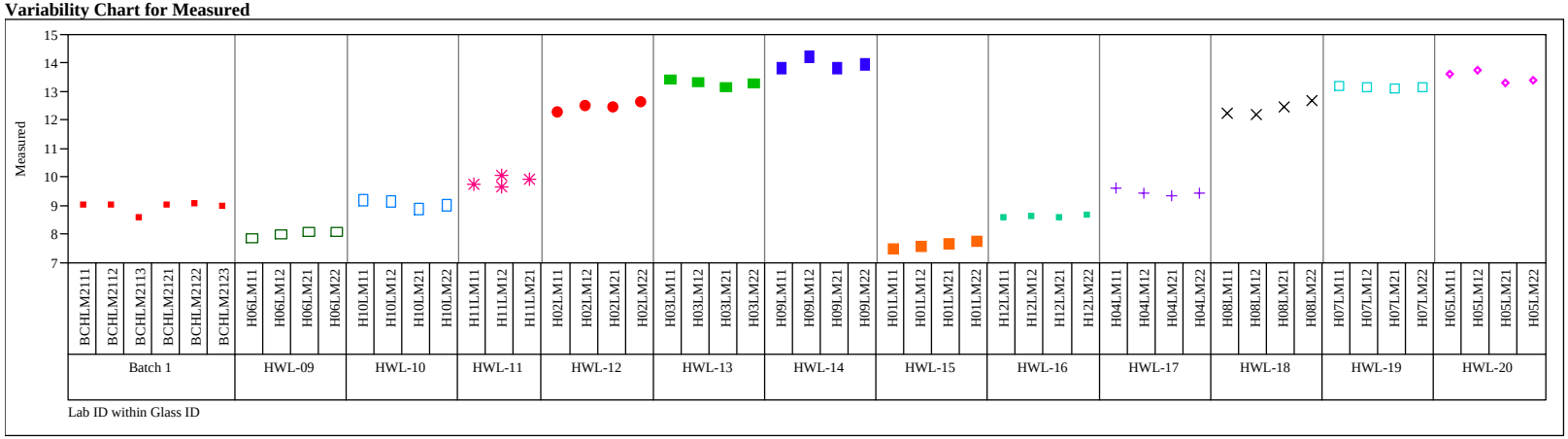


Figure A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=2, Oxide=Na2O (wt%)
Variability Chart for Measured



Set=2, Oxide=Nb2O5 (wt%)
Variability Chart for Measured

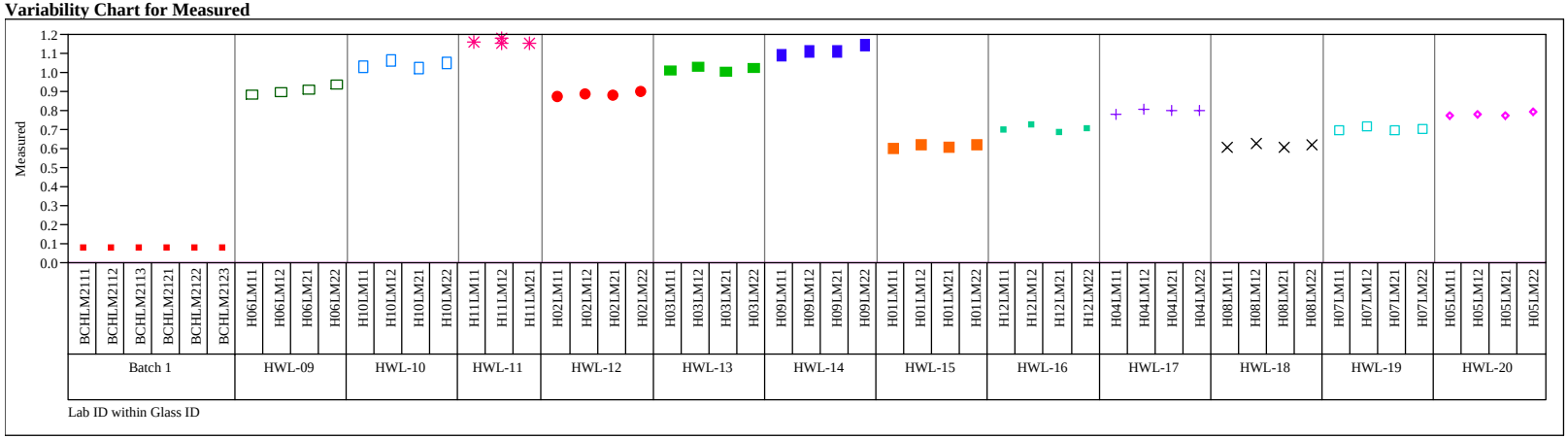
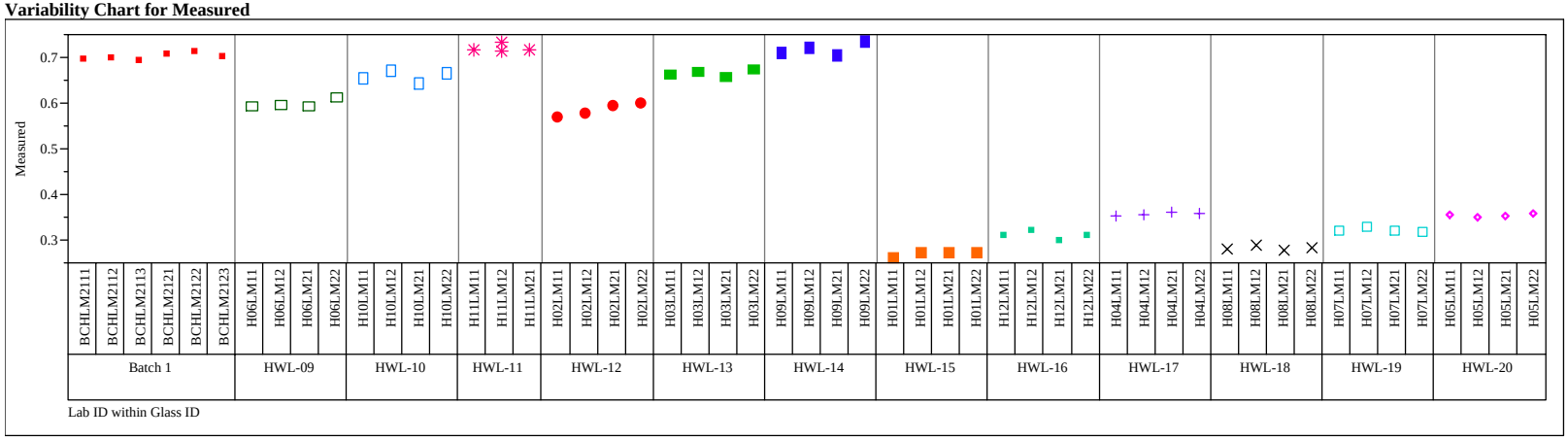


Figure A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=2, Oxide=NiO (wt%)
Variability Chart for Measured



Set=2, Oxide=PbO (wt%)
Variability Chart for Measured

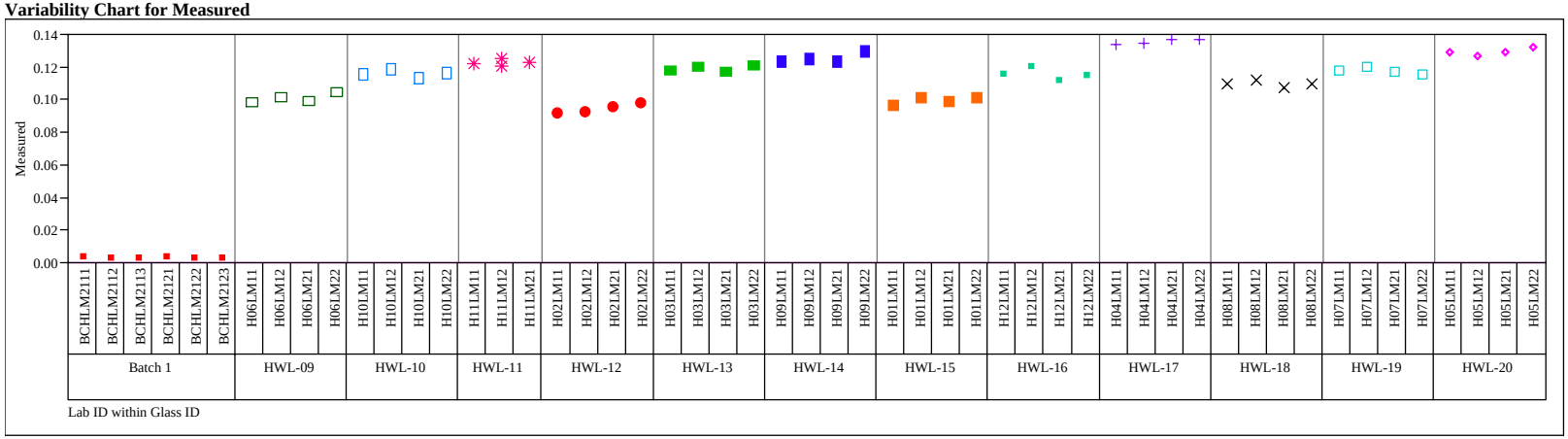
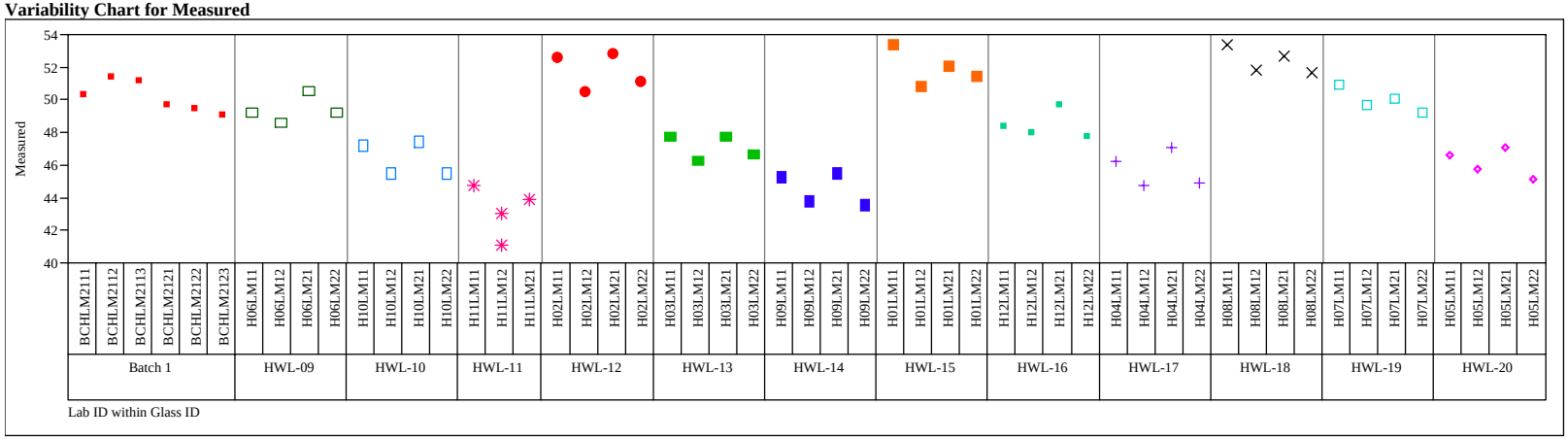


Figure A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=2, Oxide=SiO2 (wt%)
Variability Chart for Measured



Set=2, Oxide=TiO2 (wt%)
Variability Chart for Measured

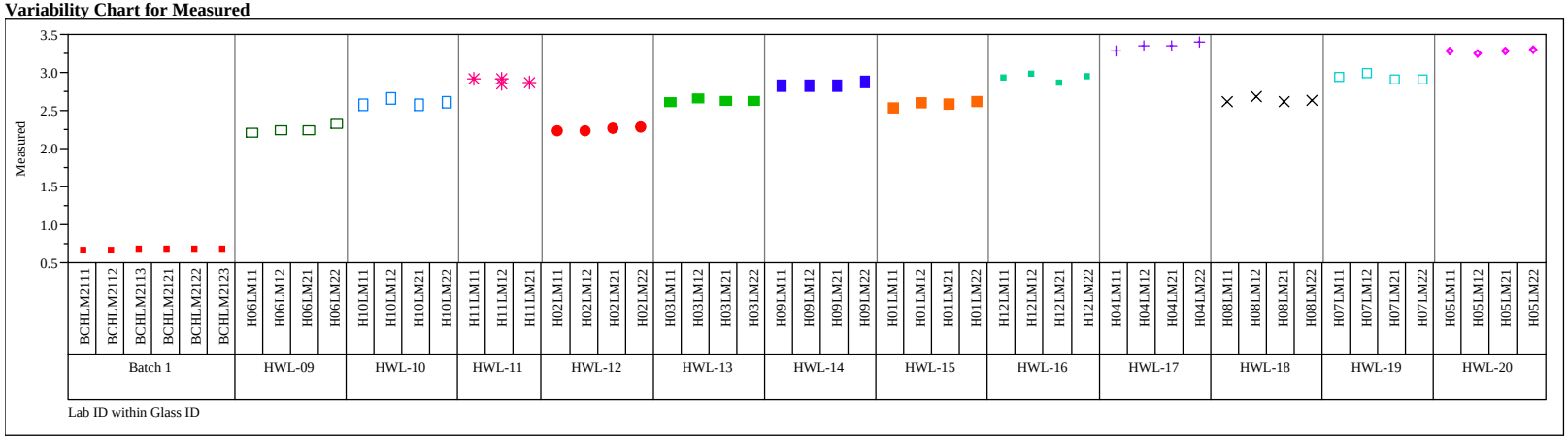
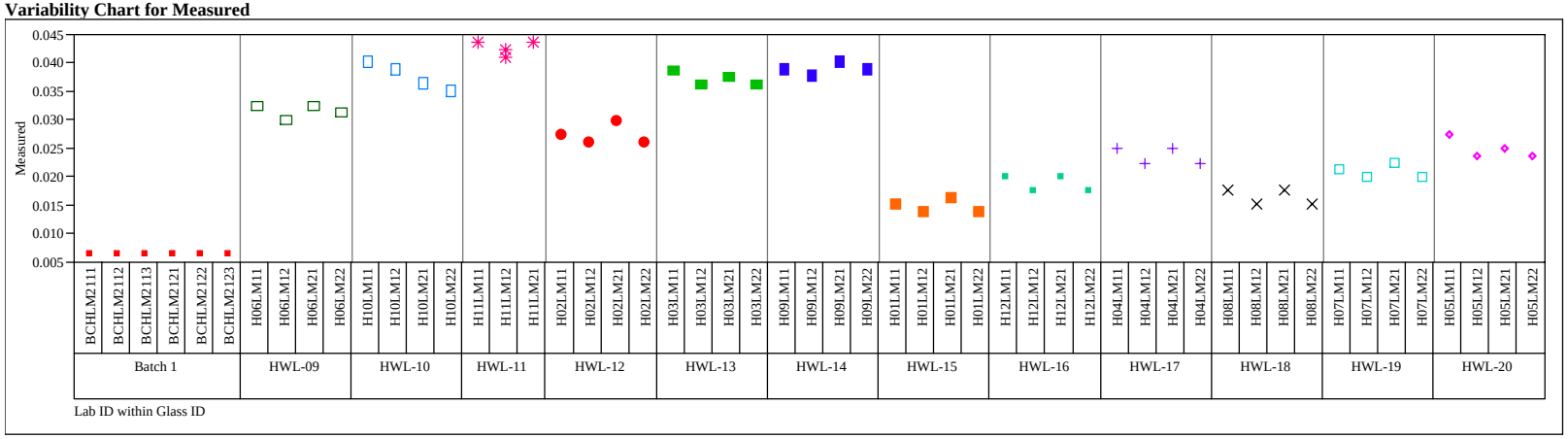


Figure A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=2, Oxide=ZnO (wt%)
Variability Chart for Measured



Set=2, Oxide=ZrO2 (wt%)
Variability Chart for Measured

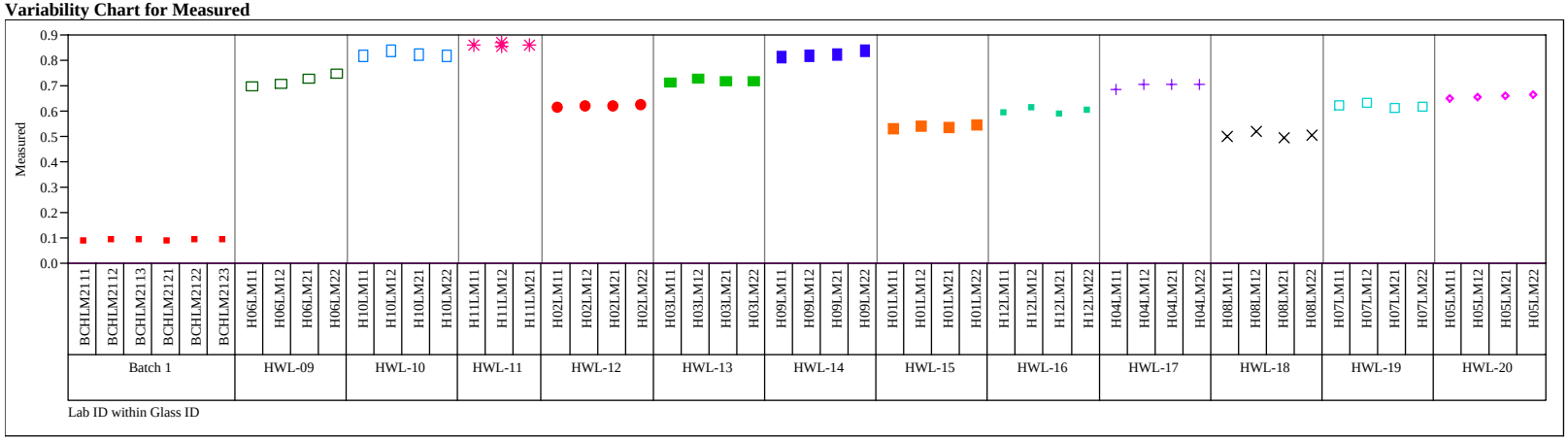
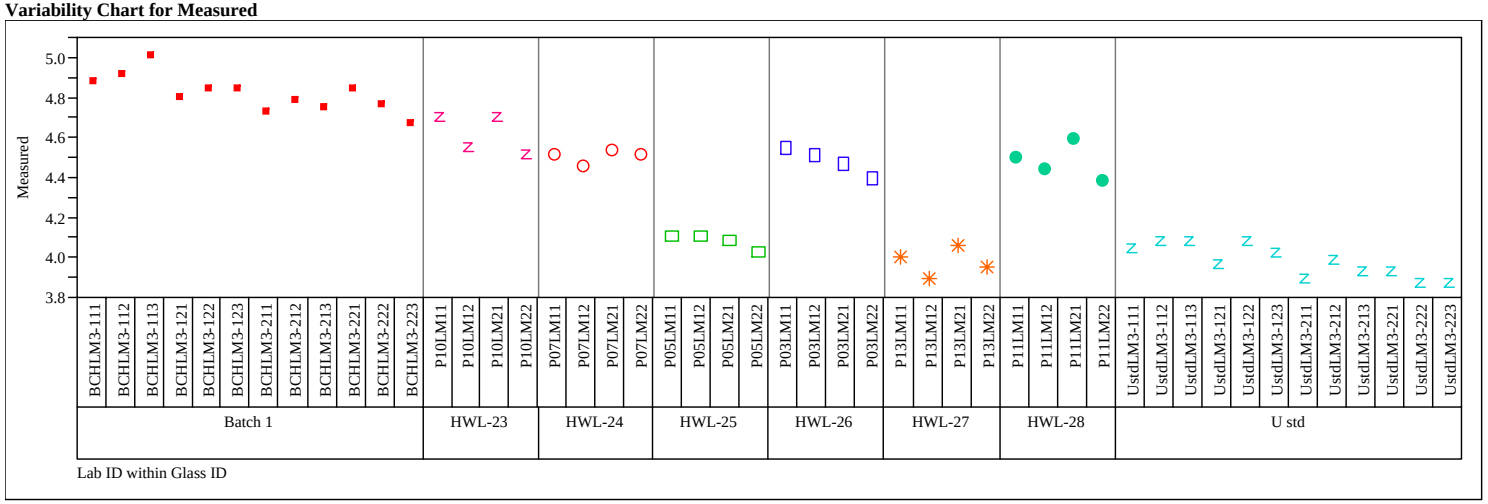


Figure A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=3, Oxide=Al2O3 (wt%)
Variability Chart for Measured



Set=3, Oxide=B2O3 (wt%)
Variability Chart for Measured

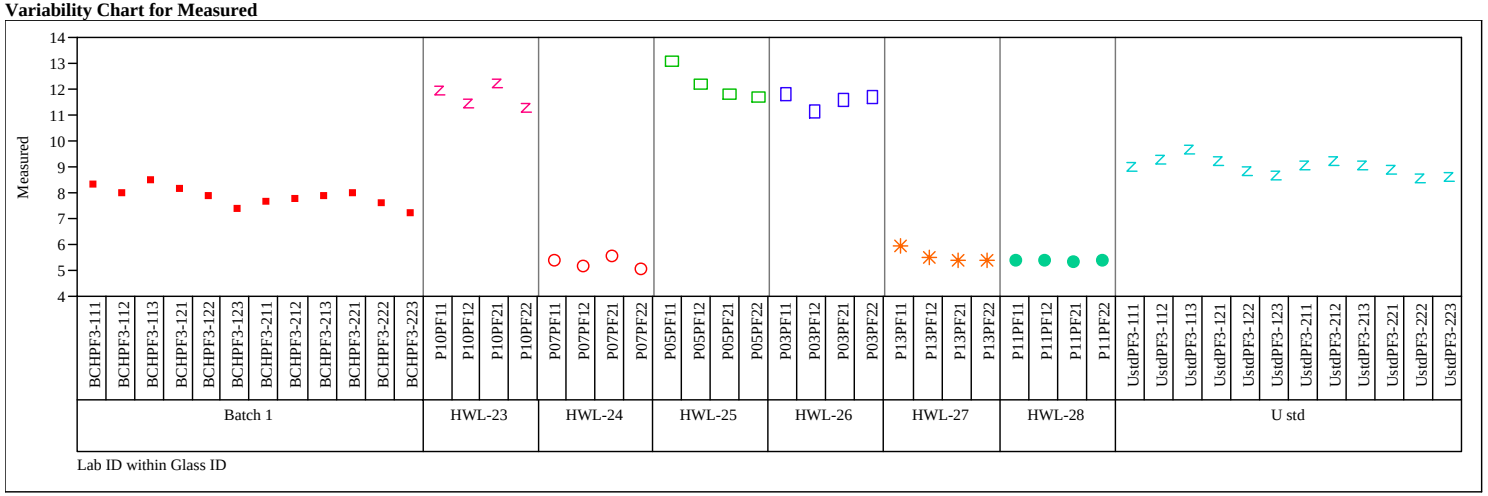
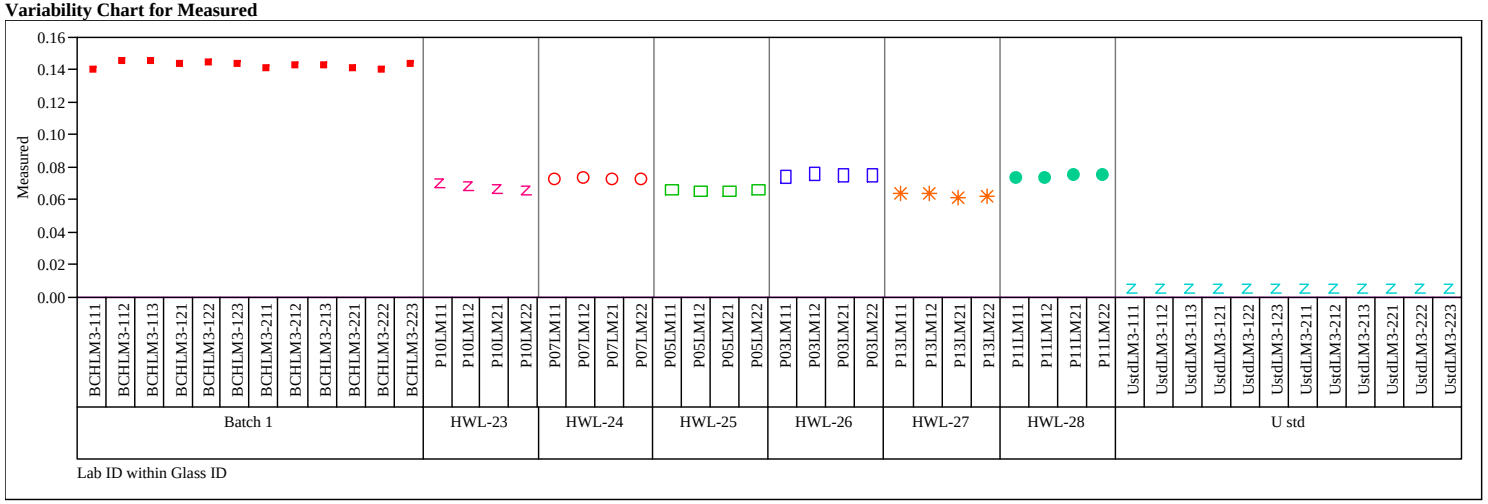


Figure A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=3, Oxide=BaO (wt%)
Variability Chart for Measured



Set=3, Oxide=CaO (wt%)
Variability Chart for Measured

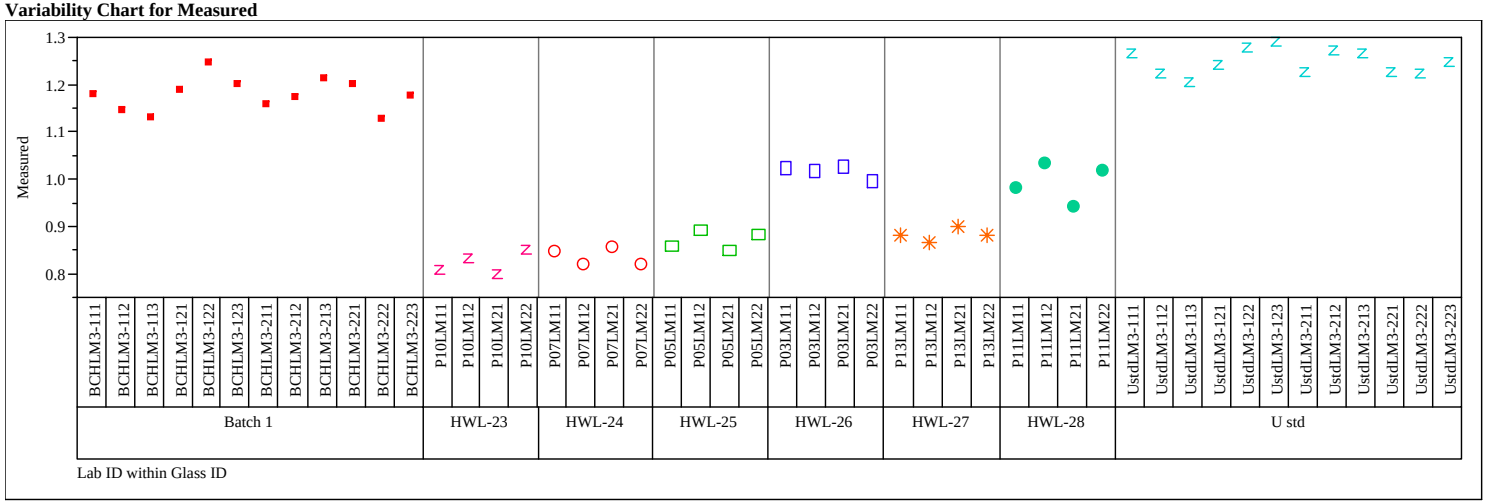
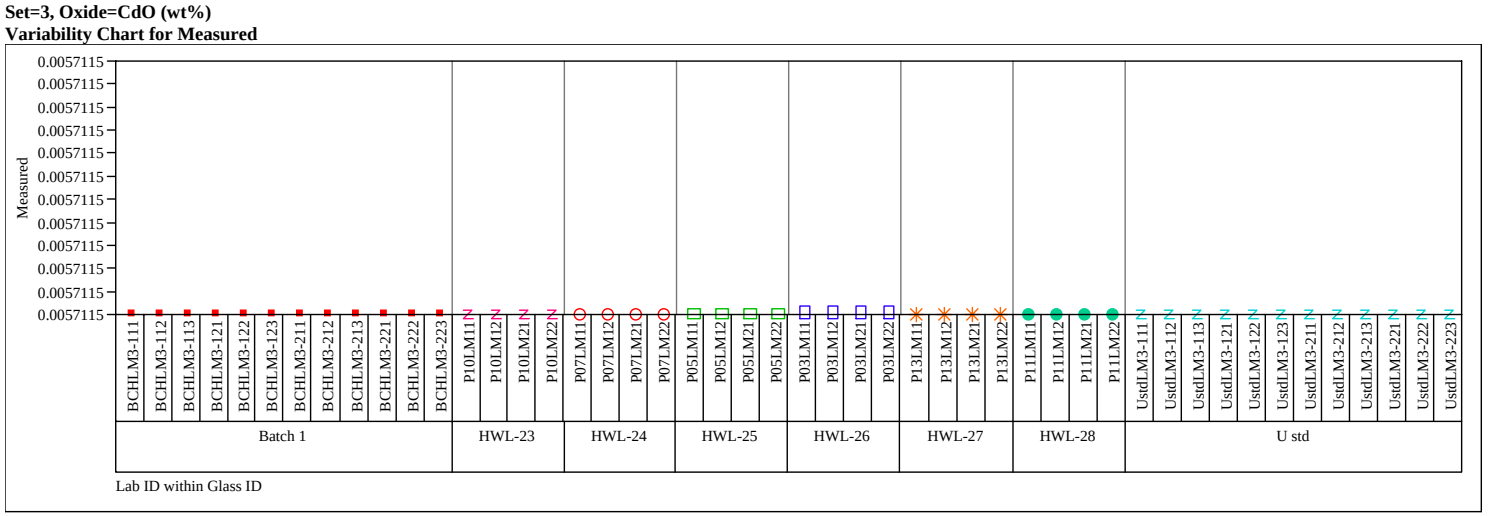


Figure A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set



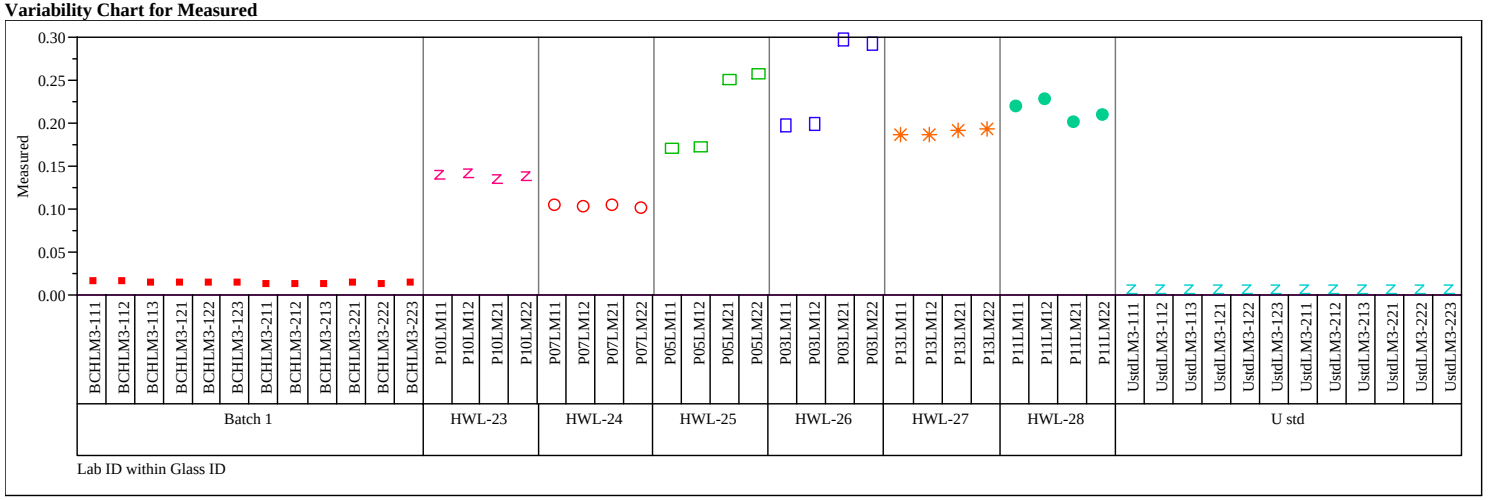
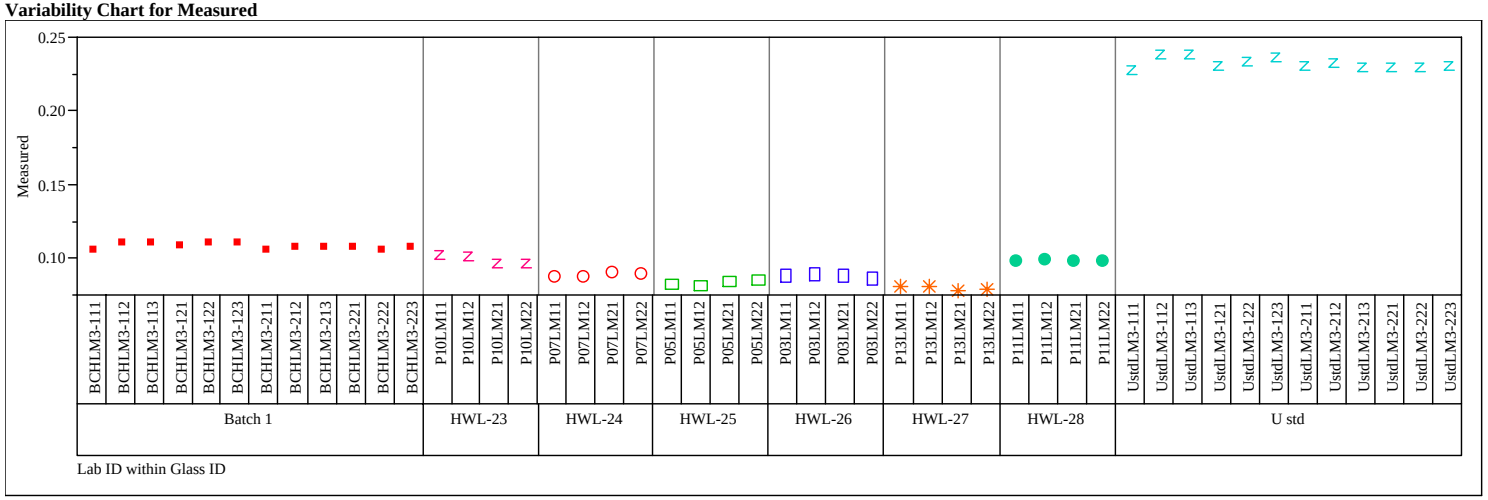


Figure A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=3, Oxide=Cr2O3 (wt%)
Variability Chart for Measured



Set=3, Oxide=CuO (wt%)
Variability Chart for Measured

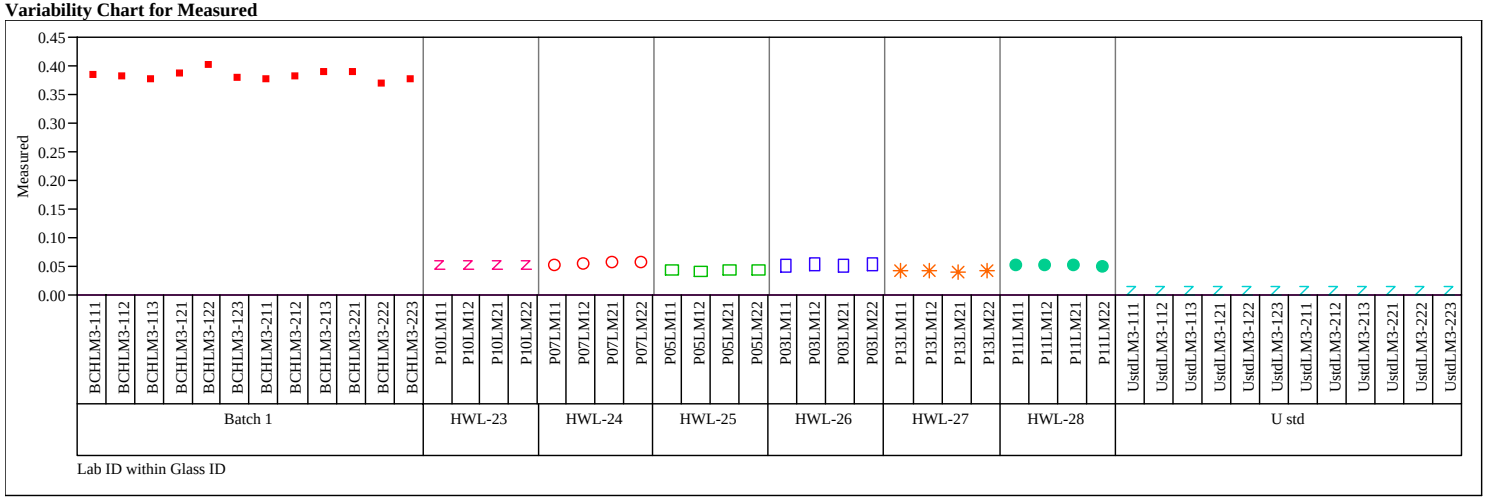
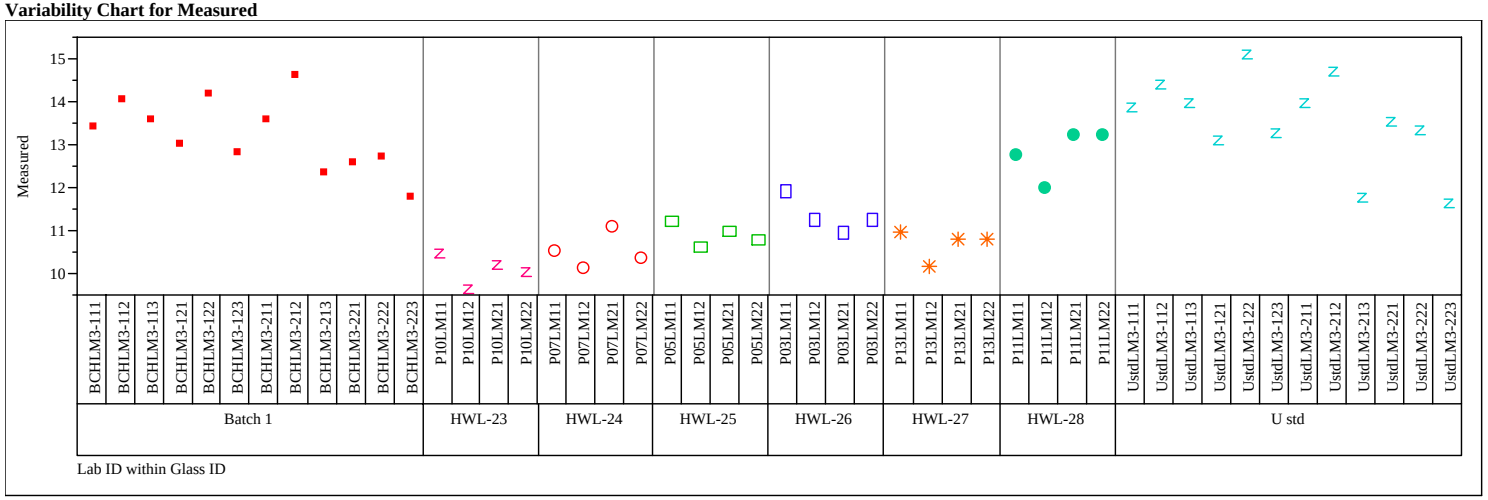


Figure A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=3, Oxide=Fe2O3 (wt%)
Variability Chart for Measured



Set=3, Oxide=K2O (wt%)
Variability Chart for Measured

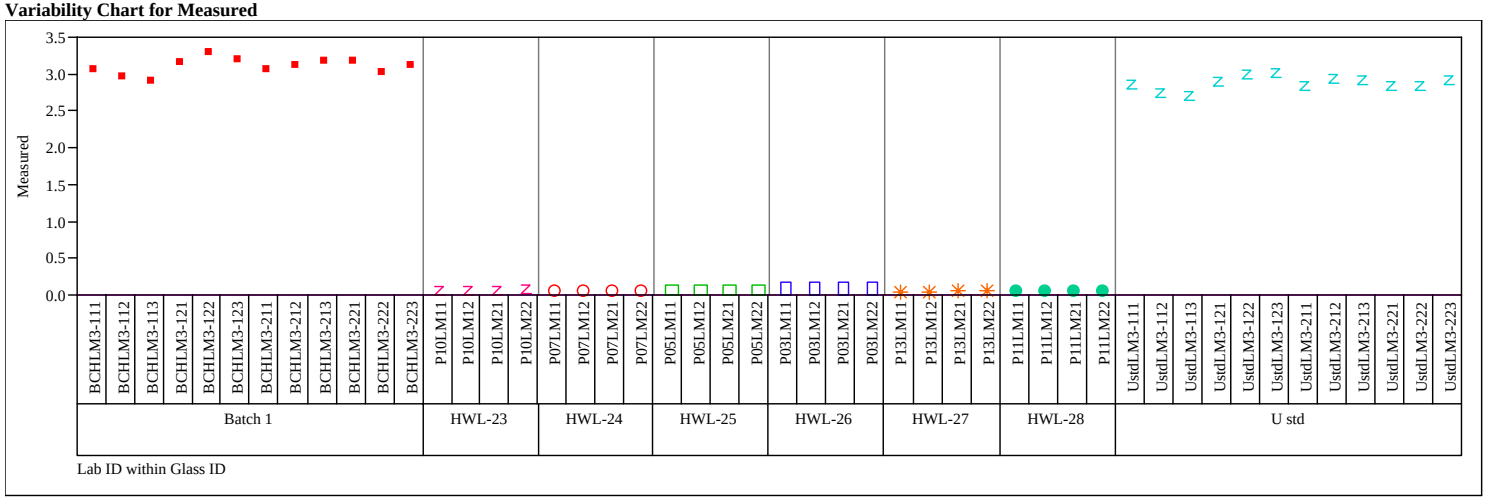
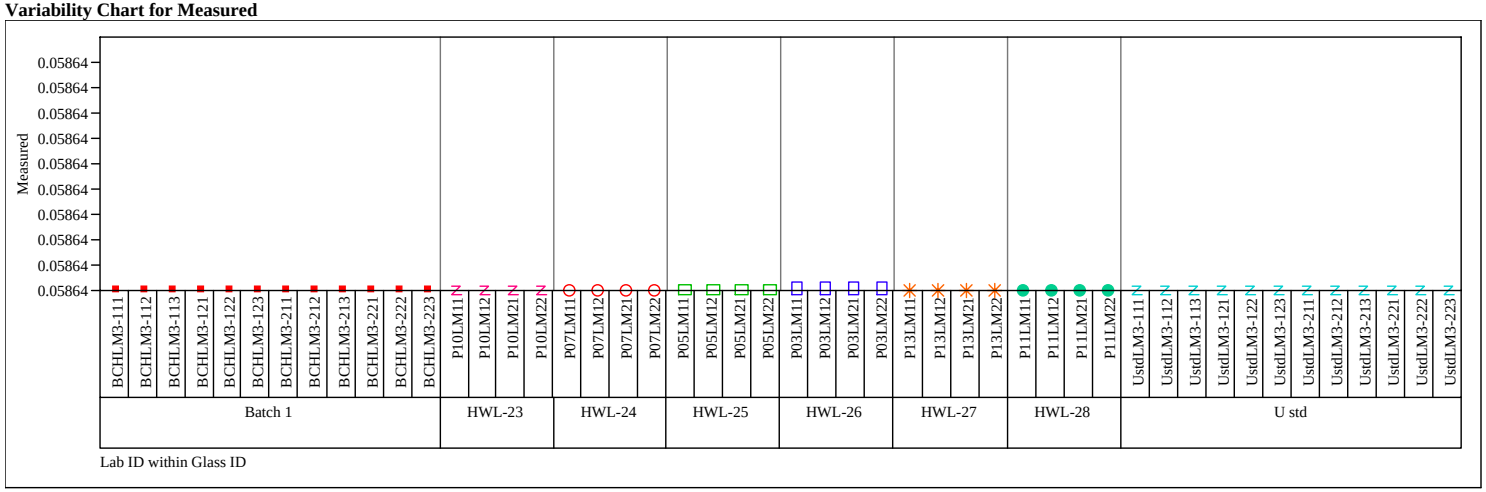


Figure A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=3, Oxide=La2O3 (wt%)
Variability Chart for Measured



Set=3, Oxide=Li2O (wt%)
Variability Chart for Measured

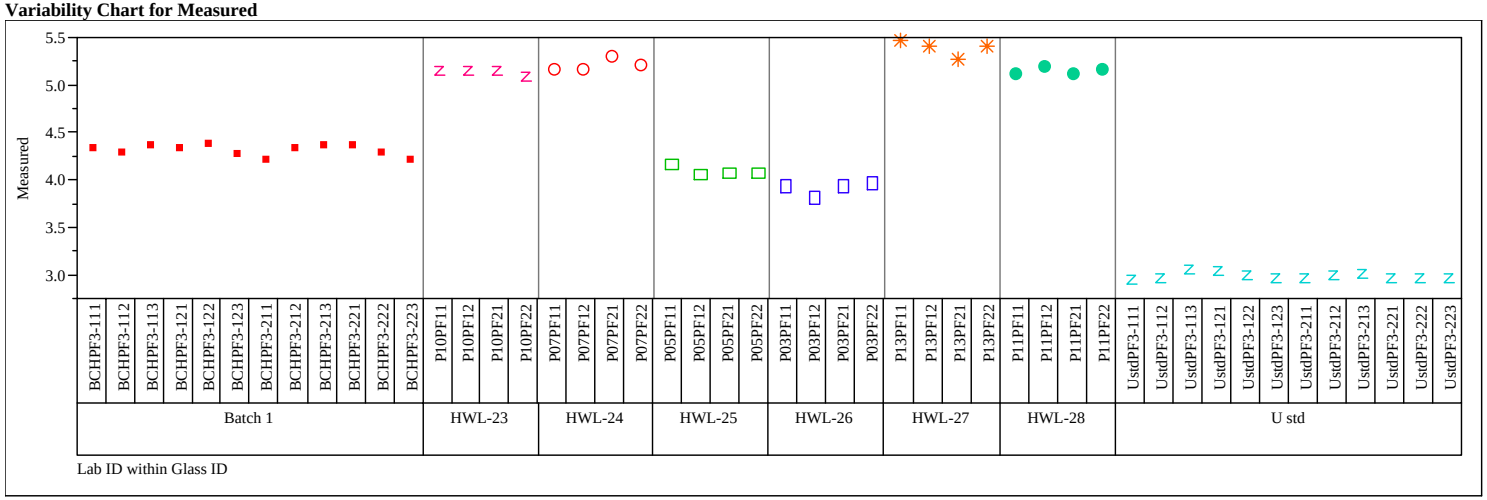
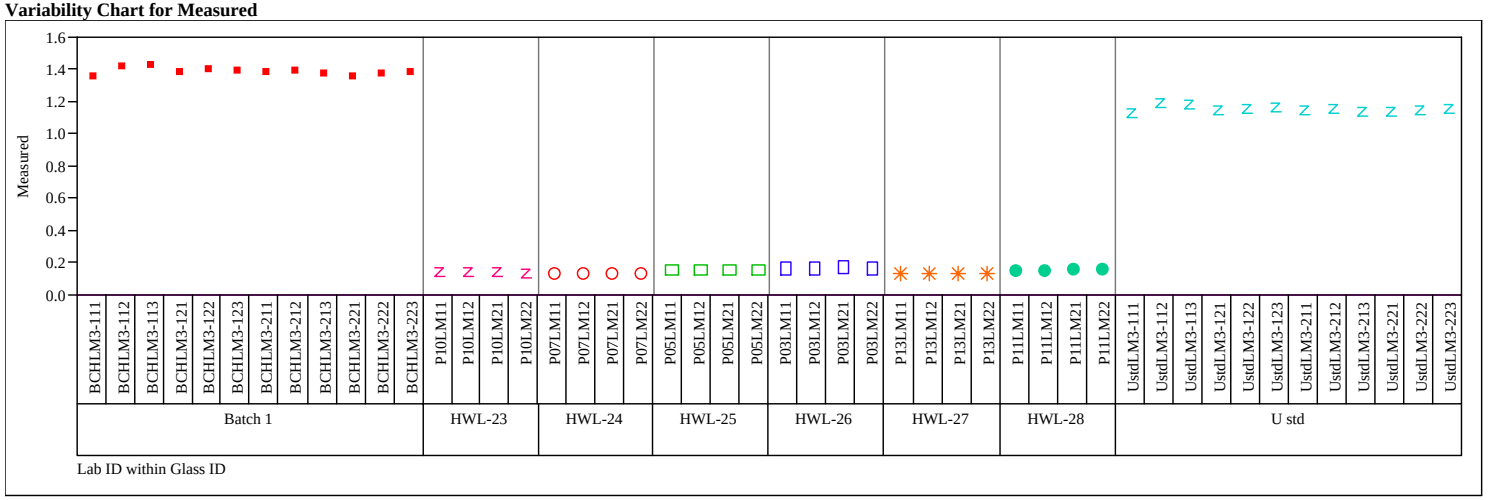


Figure A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=3, Oxide=MgO (wt%)
Variability Chart for Measured



Set=3, Oxide=MnO (wt%)
Variability Chart for Measured

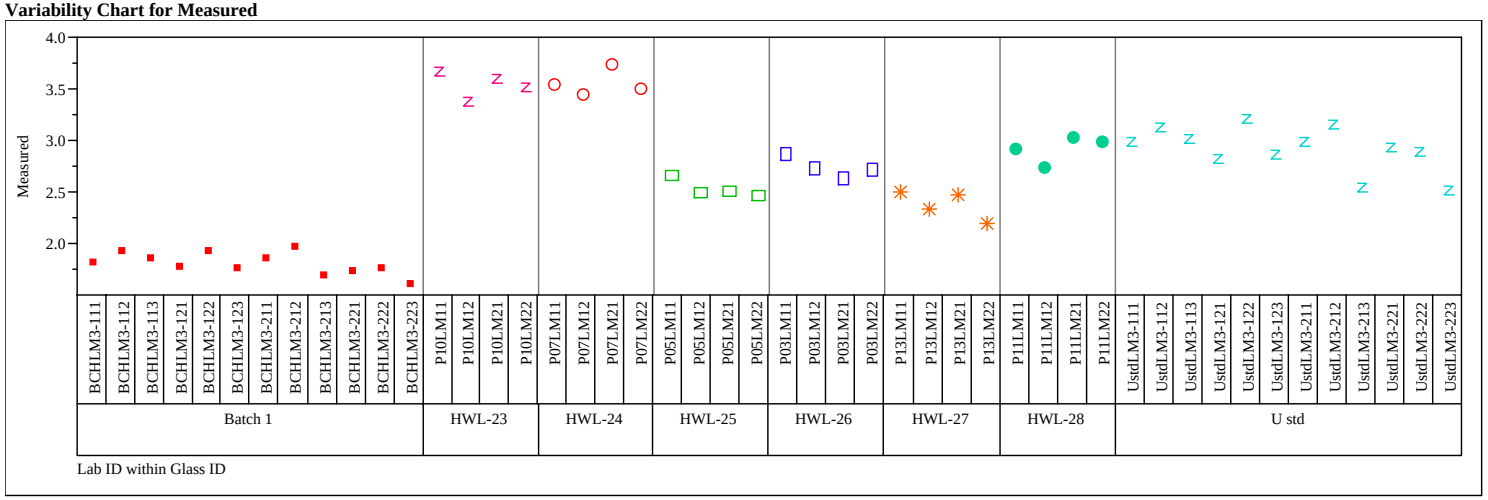
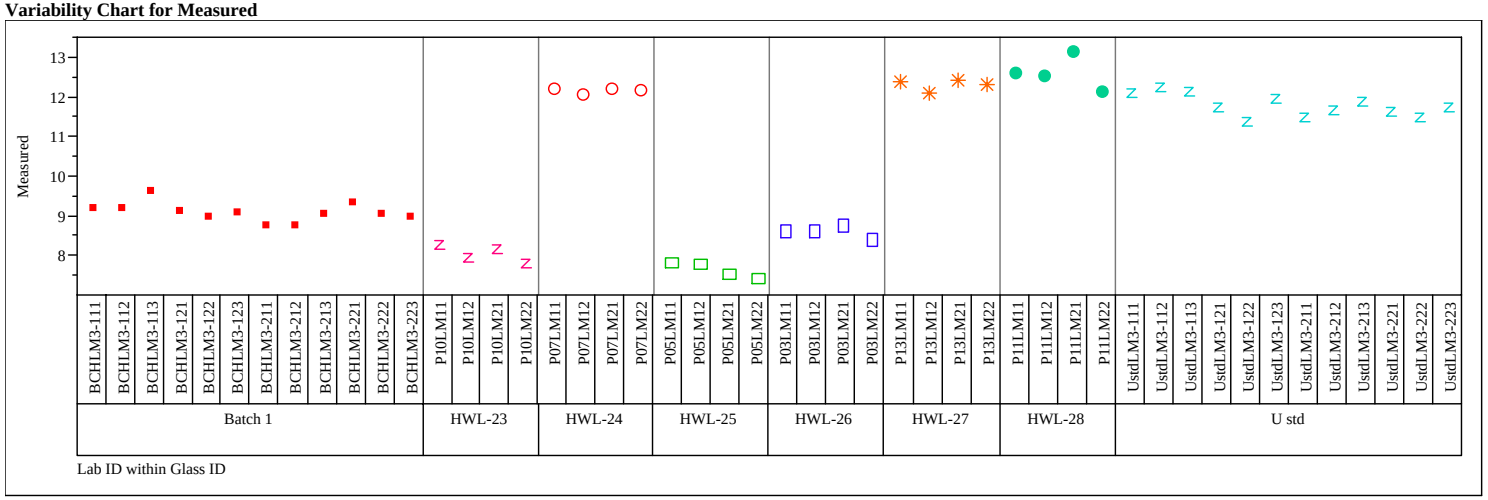


Figure A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=3, Oxide=Na2O (wt%)
Variability Chart for Measured



Set=3, Oxide=Nb2O5 (wt%)
Variability Chart for Measured

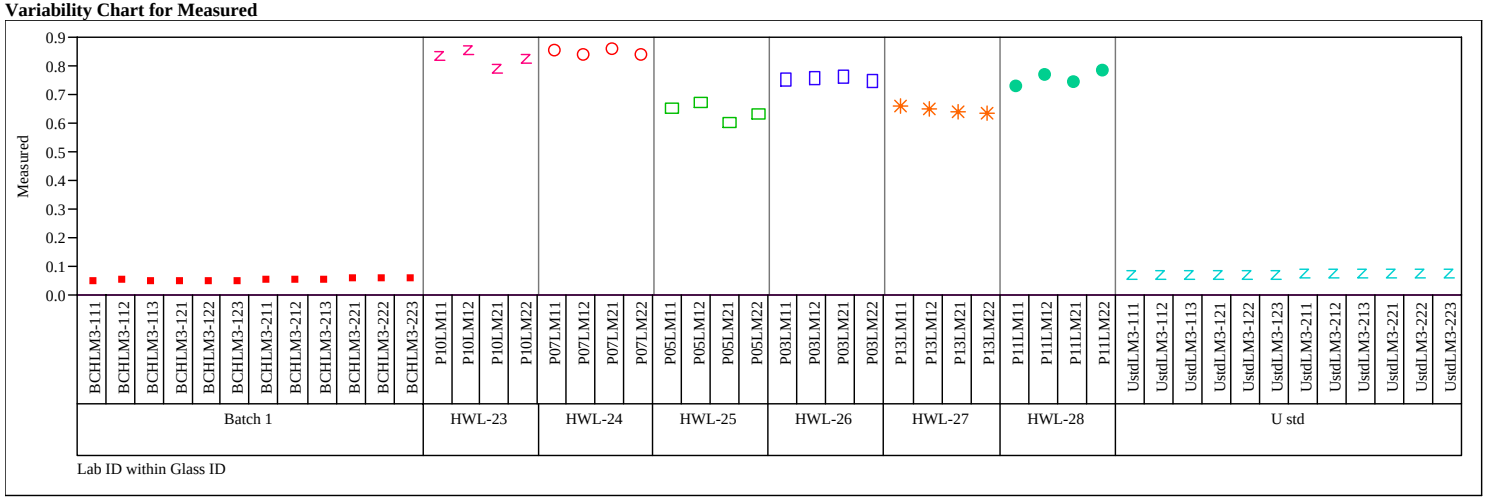
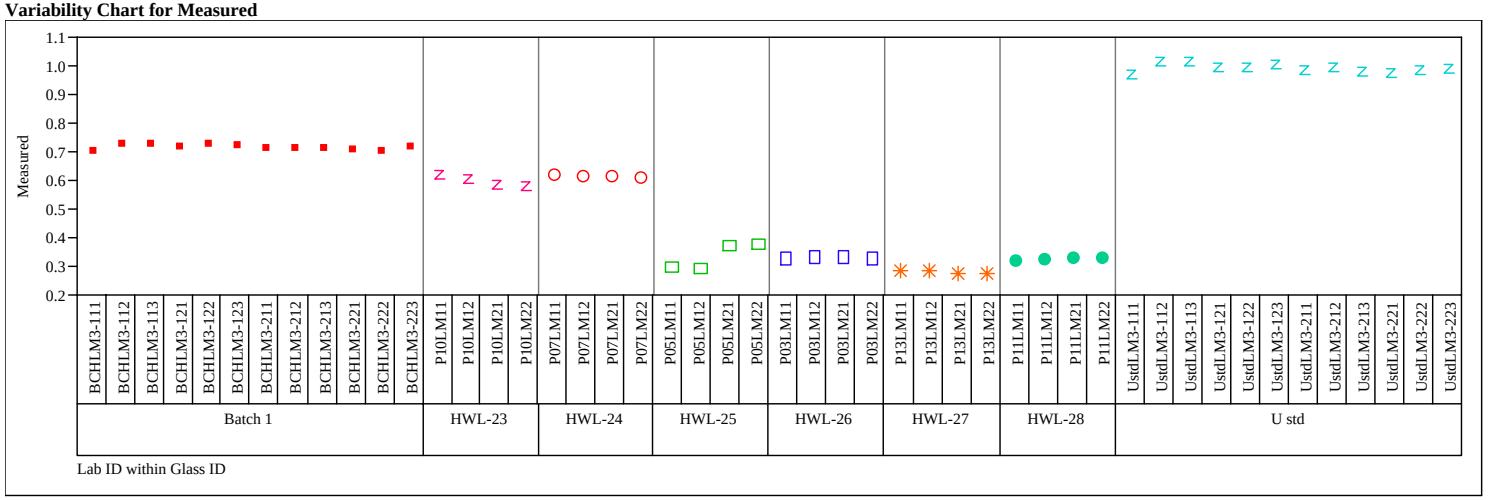


Figure A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=3, Oxide=NiO (wt%)
Variability Chart for Measured



Set=3, Oxide=PbO (wt%)
Variability Chart for Measured

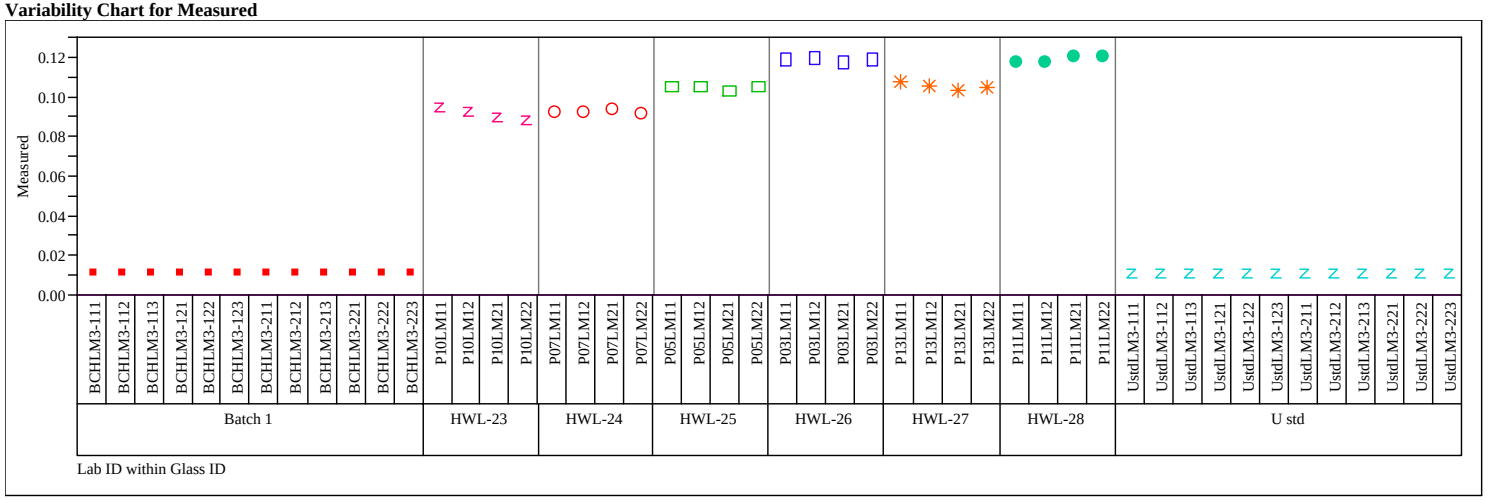
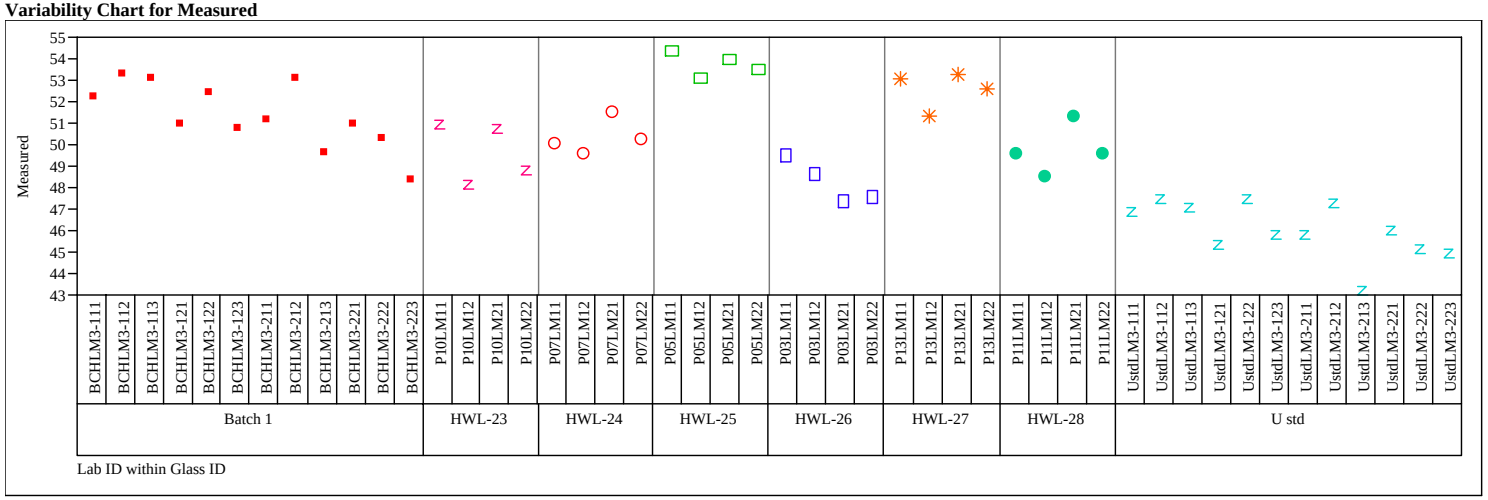


Figure A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=3, Oxide=SiO2 (wt%)
Variability Chart for Measured



Set=3, Oxide=SO4 (wt%)
Variability Chart for Measured

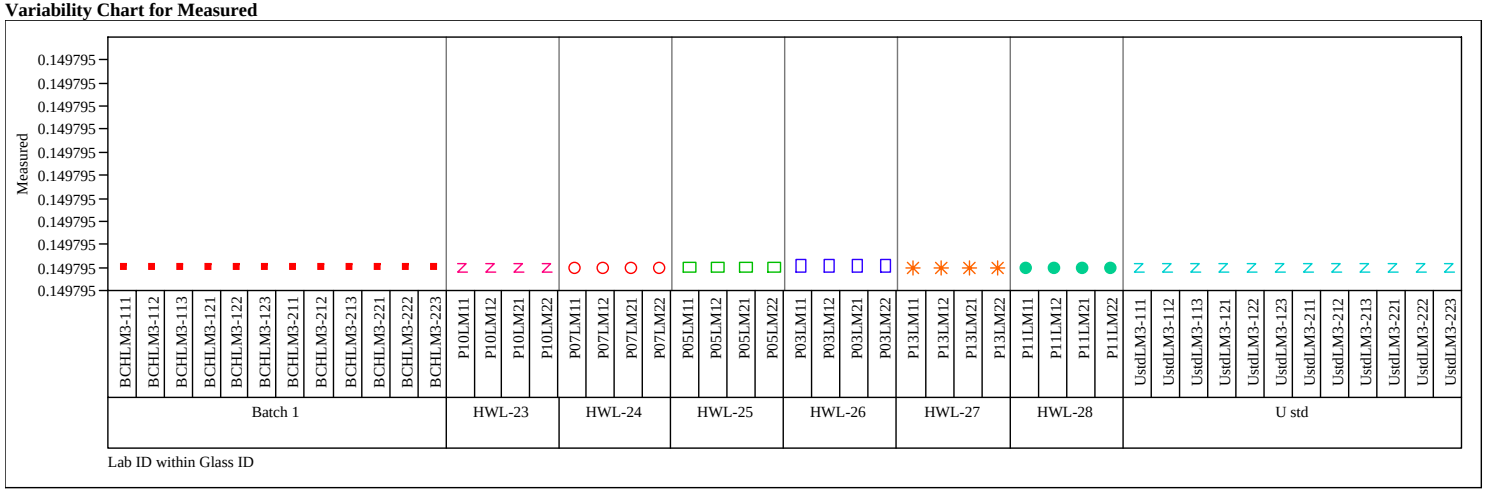
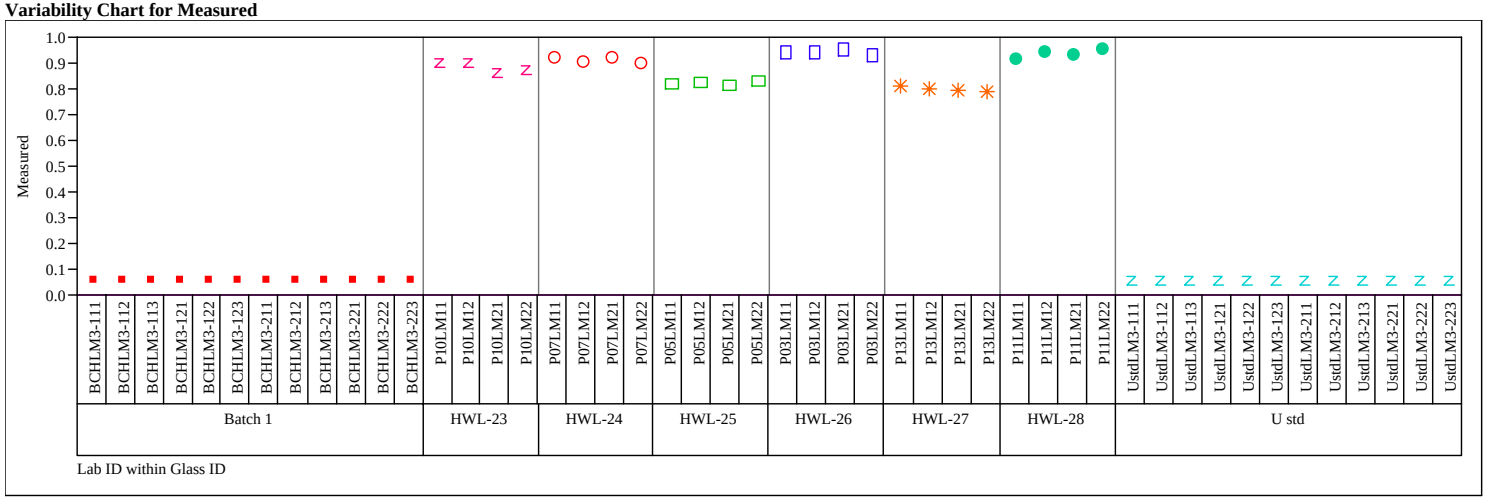


Figure A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=3, Oxide=ThO2 (wt%)
Variability Chart for Measured



Set=3, Oxide=TiO2 (wt%)
Variability Chart for Measured

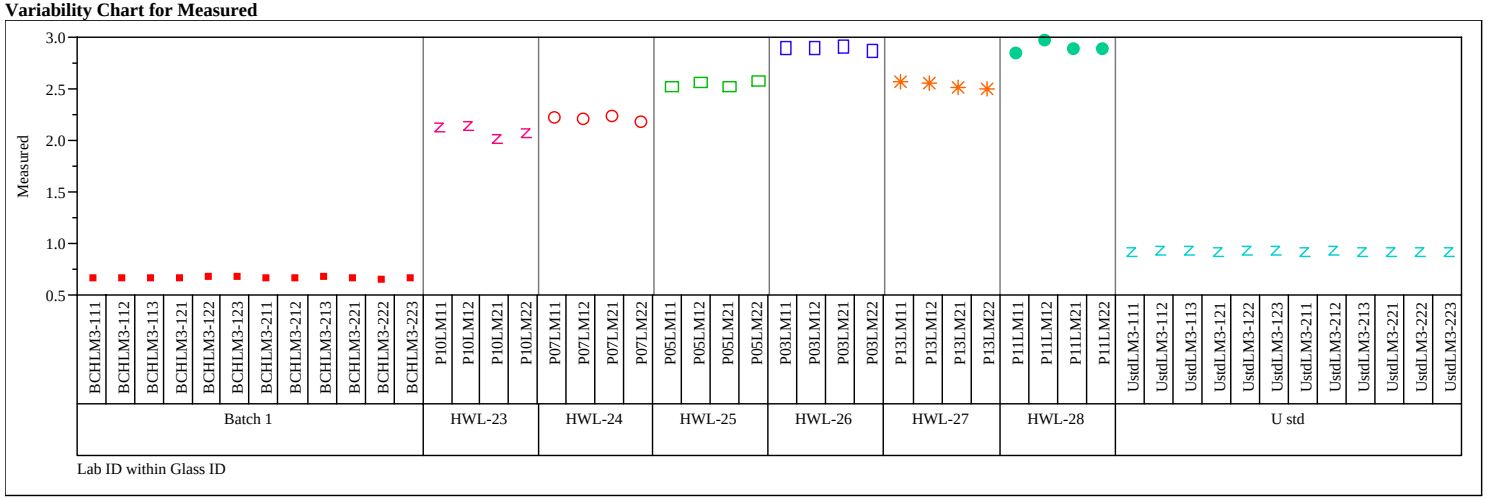
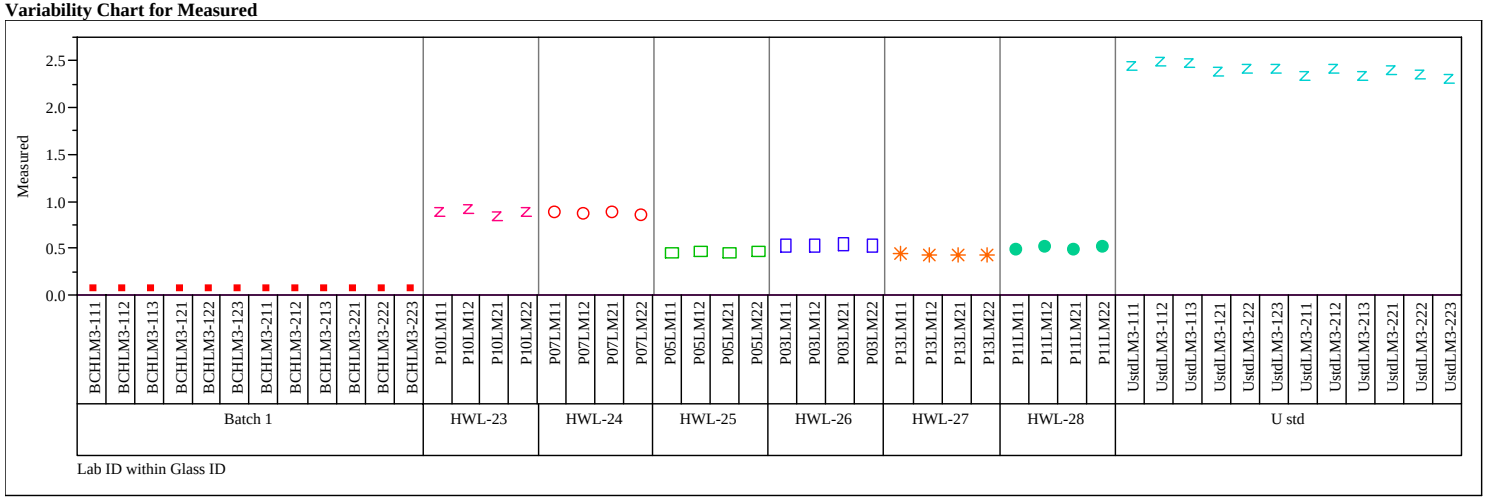


Figure A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=3, Oxide=U3O8 (wt%)
Variability Chart for Measured



Set=3, Oxide=ZnO (wt%)
Variability Chart for Measured

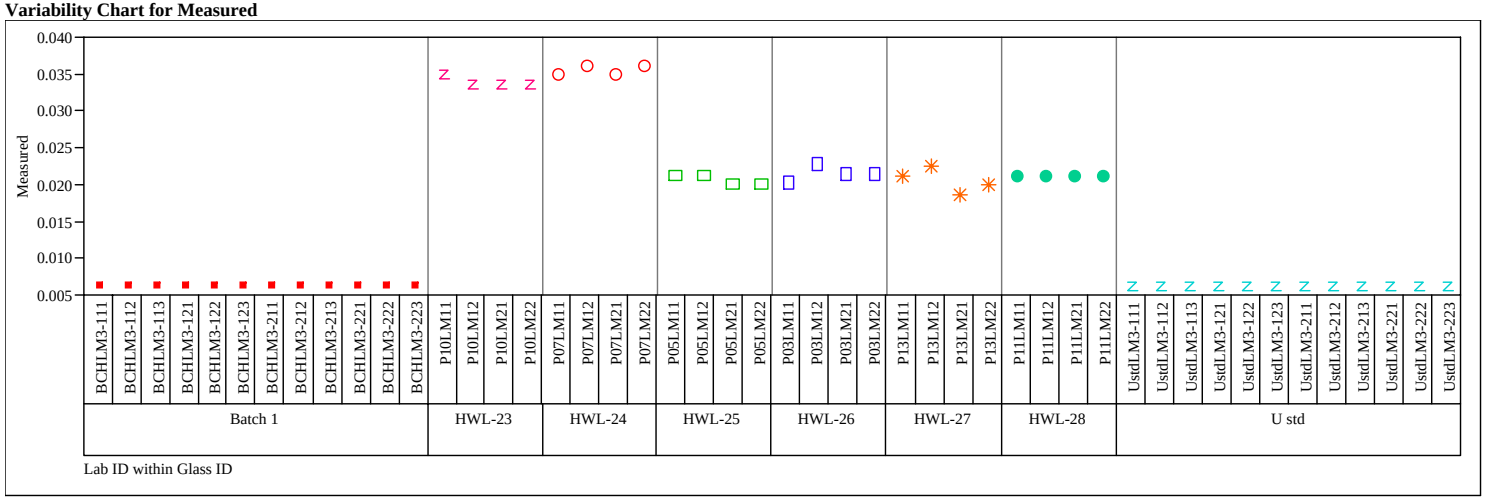


Figure A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

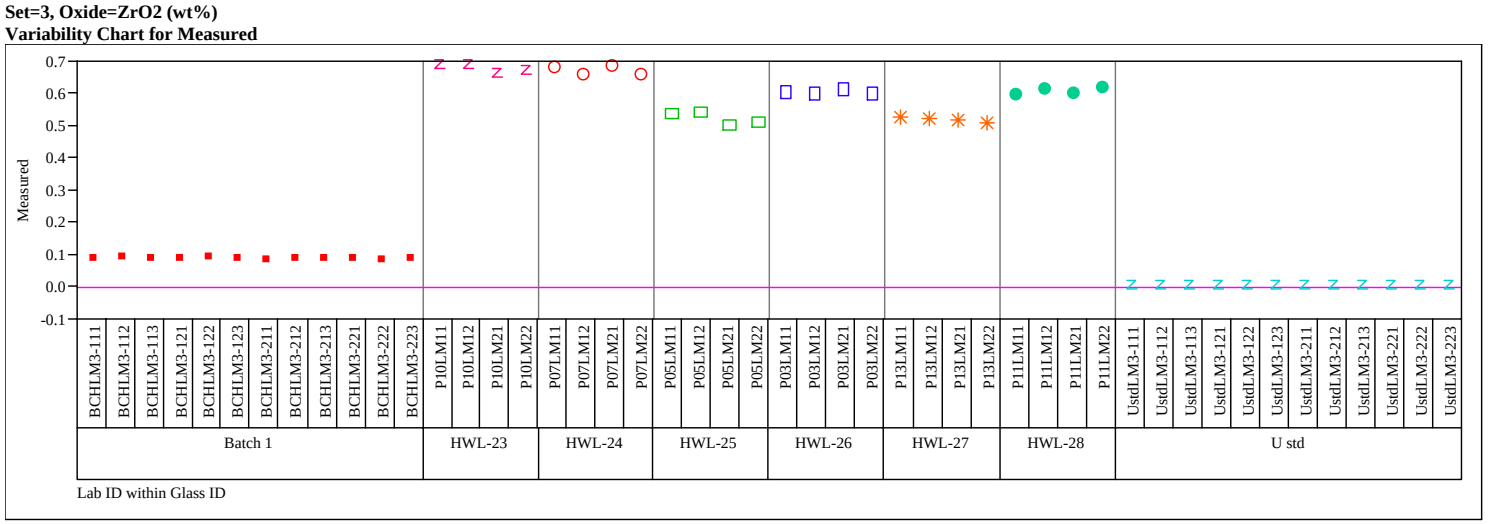
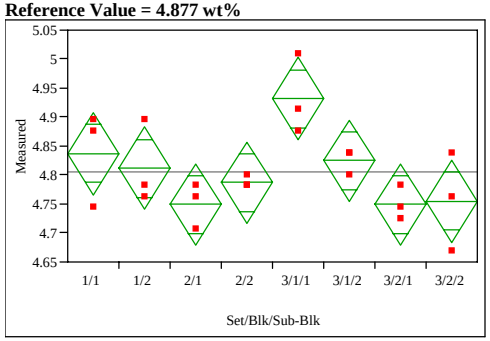


Figure A3. PSAL Measurements by Analytical Set, Block, and Sub-Block for Samples of the Batch 1 and Ustd Standards by Oxide

Oneway Analysis of Measured By Set/Blk/Sub-Blk Glass ID=Batch 1, Oxide=Al2O3 (wt%)
Reference Value = 4.877 wt%



Oneway Anova
Summary of Fit

Rsquare	0.598214
Adj Rsquare	0.422433
Root Mean Square Error	0.057854
Mean of Response	4.805628
Observations (or Sum Wgts)	24

Analysis of Variance

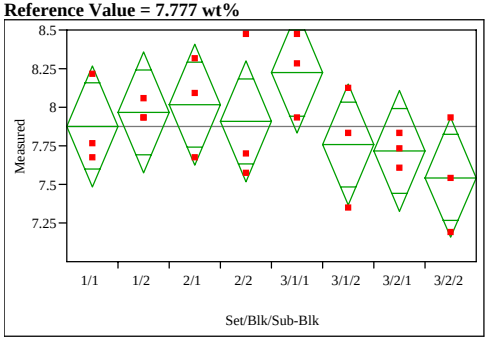
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	7	0.07973470	0.011391	3.4032	0.0201
Error	16	0.05355315	0.003347		
C. Total	23	0.13328785			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1	3	4.83712	0.03340	4.7663	4.9079
1/2	3	4.81193	0.03340	4.7411	4.8827
2/1	3	4.74894	0.03340	4.6781	4.8198
2/2	3	4.78673	0.03340	4.7159	4.8575
3/1/1	3	4.93160	0.03340	4.8608	5.0024
3/1/2	3	4.82452	0.03340	4.7537	4.8953
3/2/1	3	4.74894	0.03340	4.6781	4.8198
3/2/2	3	4.75524	0.03340	4.6844	4.8261

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measured By Set/Blk/Sub-Blk Glass ID=Batch 1, Oxide=B2O3 (wt%)
Reference Value = 7.777 wt%



Oneway Anova
Summary of Fit

Rsquare	0.352987
Adj Rsquare	0.069918
Root Mean Square Error	0.31916
Mean of Response	7.87668
Observations (or Sum Wgts)	24

Analysis of Variance

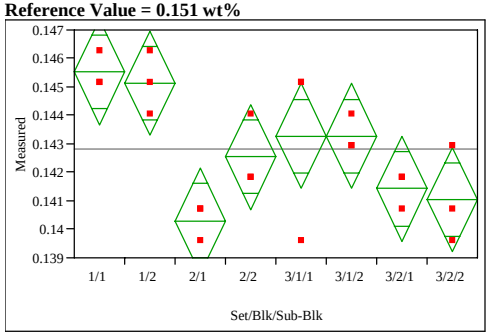
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	7	0.8891647	0.127024	1.2470	0.3352
Error	16	1.6298112	0.101863		
C. Total	23	2.5189759			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1	3	7.87802	0.18427	7.4874	8.2687
1/2	3	7.96389	0.18427	7.5733	8.3545
2/1	3	8.01755	0.18427	7.6269	8.4082
2/2	3	7.91022	0.18427	7.5196	8.3009
3/1/1	3	8.22148	0.18427	7.8308	8.6121
3/1/2	3	7.75996	0.18427	7.3693	8.1506
3/2/1	3	7.71703	0.18427	7.3264	8.1077
3/2/2	3	7.54530	0.18427	7.1547	7.9359

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measured By Set/Blk/Sub-Blk Glass ID=Batch 1, Oxide=BaO (wt%)
Reference Value = 0.151 wt%



Oneway Anova
Summary of Fit

Rsquare	0.673624
Adj Rsquare	0.530835
Root Mean Square Error	0.001494
Mean of Response	0.142819
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	7	0.00007376	0.000011	4.7176	0.0049
Error	16	0.00003574	2.233e-6		
C. Total	23	0.00010949			

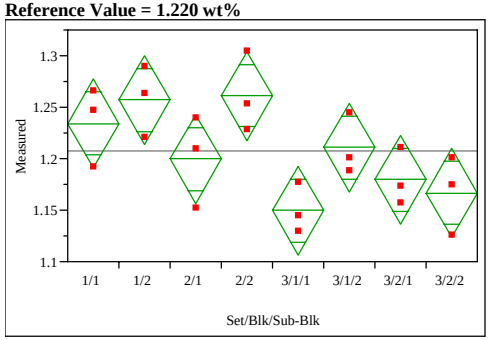
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1	3	0.145517	0.00086	0.14369	0.14735
1/2	3	0.145145	0.00086	0.14332	0.14697
2/1	3	0.140307	0.00086	0.13848	0.14214
2/2	3	0.142540	0.00086	0.14071	0.14437
3/1/1	3	0.143284	0.00086	0.14146	0.14511
3/1/2	3	0.143284	0.00086	0.14146	0.14511
3/2/1	3	0.141423	0.00086	0.13959	0.14325
3/2/2	3	0.141051	0.00086	0.13922	0.14288

Std Error uses a pooled estimate of error variance

Figure A3. PSAL Measurements by Analytical Set, Block, and Sub-Block for Samples of the Batch 1 and Ustd Standards by Oxide

Oneway Analysis of Measured By Set/Blk/Sub-Blk Glass ID=Batch 1, Oxide=CaO (wt%)
Reference Value = 1.220 wt%



Oneway Anova
Summary of Fit

Rsquare	0.643851
Adj Rsquare	0.488036
Root Mean Square Error	0.035151
Mean of Response	1.207276
Observations (or Sum Wgts)	24

Analysis of Variance

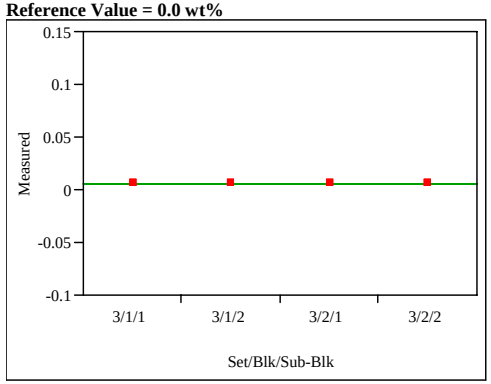
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	7	0.03573957	0.005106	4.1322	0.0089
Error	16	0.01976947	0.001236		
C. Total	23	0.05550904			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1	3	1.23409	0.02029	1.1911	1.2771
1/2	3	1.25695	0.02029	1.2139	1.3000
2/1	3	1.19958	0.02029	1.1566	1.2426
2/2	3	1.26115	0.02029	1.2181	1.3042
3/1/1	3	1.14968	0.02029	1.1067	1.1927
3/1/2	3	1.21077	0.02029	1.1678	1.2538
3/2/1	3	1.17953	0.02029	1.1365	1.2225
3/2/2	3	1.16647	0.02029	1.1234	1.2095

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measured By Set/Blk/Sub-Blk Glass ID=Batch 1, Oxide=CdO (wt%)
Reference Value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	.
Adj Rsquare	.
Root Mean Square Error	0
Mean of Response	0.005712
Observations (or Sum Wgts)	12

Analysis of Variance

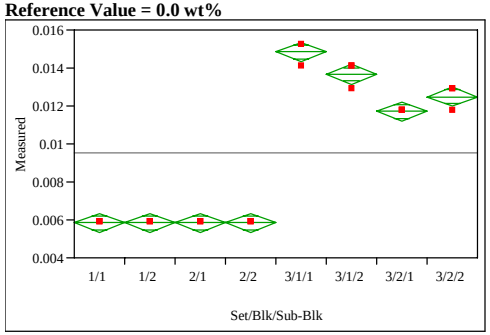
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	3	0	0	.	.
Error	8	0	0		
C. Total	11	0			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
3/1/1	3	0.005712	0	0.00571	0.00571
3/1/2	3	0.005712	0	0.00571	0.00571
3/2/1	3	0.005712	0	0.00571	0.00571
3/2/2	3	0.005712	0	0.00571	0.00571

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measured By Set/Blk/Sub-Blk Glass ID=Batch 1, Oxide=Ce2O3 (wt%)
Reference Value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	0.991956
Adj Rsquare	0.988436
Root Mean Square Error	0.000414
Mean of Response	0.009517
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	7	0.00033836	0.000048	281.8571	<.0001
Error	16	0.00000274	1.715e-7		
C. Total	23	0.00034110			

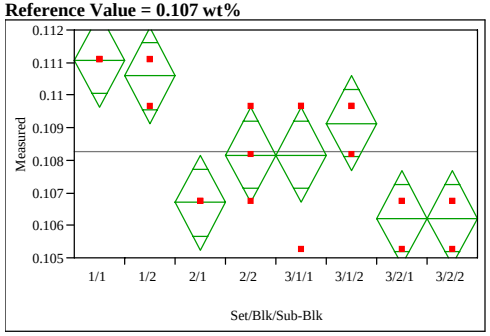
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1	3	0.005857	0.00024	0.00535	0.00636
1/2	3	0.005857	0.00024	0.00535	0.00636
2/1	3	0.005857	0.00024	0.00535	0.00636
2/2	3	0.005857	0.00024	0.00535	0.00636
3/1/1	3	0.014836	0.00024	0.01433	0.01534
3/1/2	3	0.013665	0.00024	0.01316	0.01417
3/2/1	3	0.011713	0.00024	0.01121	0.01222
3/2/2	3	0.012494	0.00024	0.01199	0.01300

Std Error uses a pooled estimate of error variance

Figure A3. PSAL Measurements by Analytical Set, Block, and Sub-Block for Samples of the Batch 1 and Ustd Standards by Oxide

Oneway Analysis of Measured By Set/Blk/Sub-Blk Glass ID=Batch 1, Oxide=Cr2O3 (wt%)
Reference Value = 0.107 wt%



Oneway Anova
Summary of Fit

Rsquare	0.767273
Adj Rsquare	0.665455
Root Mean Square Error	0.001193
Mean of Response	0.10828
Observations (or Sum Wgts)	24

Analysis of Variance

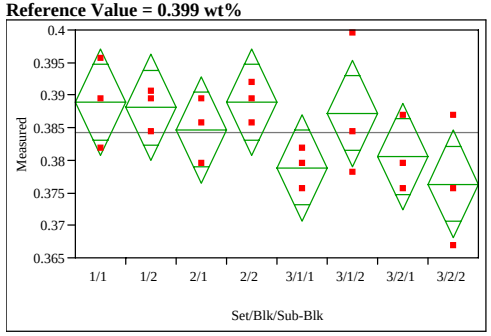
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	7	0.00007513	0.000011	7.5357	0.0004
Error	16	0.00002279	1.424e-6		
C. Total	23	0.00009791			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1	3	0.111082	0.00069	0.10962	0.11254
1/2	3	0.110594	0.00069	0.10913	0.11206
2/1	3	0.106697	0.00069	0.10524	0.10816
2/2	3	0.108158	0.00069	0.10670	0.10962
3/1/1	3	0.108158	0.00069	0.10670	0.10962
3/1/2	3	0.109133	0.00069	0.10767	0.11059
3/2/1	3	0.106210	0.00069	0.10475	0.10767
3/2/2	3	0.106210	0.00069	0.10475	0.10767

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measured By Set/Blk/Sub-Blk Glass ID=Batch 1, Oxide=CuO (wt%)
Reference Value = 0.399 wt%



Oneway Anova
Summary of Fit

Rsquare	0.418244
Adj Rsquare	0.163725
Root Mean Square Error	0.006683
Mean of Response	0.384198
Observations (or Sum Wgts)	24

Analysis of Variance

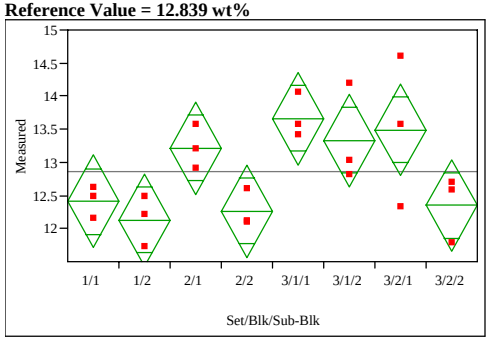
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	7	0.00051372	0.000073	1.6433	0.1940
Error	16	0.00071455	0.000045		
C. Total	23	0.00122827			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1	3	0.388893	0.00386	0.38071	0.39707
1/2	3	0.388058	0.00386	0.37988	0.39624
2/1	3	0.384720	0.00386	0.37654	0.39290
2/2	3	0.388893	0.00386	0.38071	0.39707
3/1/1	3	0.378878	0.00386	0.37070	0.38706
3/1/2	3	0.387223	0.00386	0.37904	0.39540
3/2/1	3	0.380547	0.00386	0.37237	0.38873
3/2/2	3	0.376375	0.00386	0.36820	0.38455

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measured By Set/Blk/Sub-Blk Glass ID=Batch 1, Oxide=Fe2O3 (wt%)
Reference Value = 12.839 wt%



Oneway Anova
Summary of Fit

Rsquare	0.614019
Adj Rsquare	0.445152
Root Mean Square Error	0.569582
Mean of Response	12.85658
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	7	8.257487	1.17964	3.6361	0.0154
Error	16	5.190777	0.32442		
C. Total	23	13.448264			

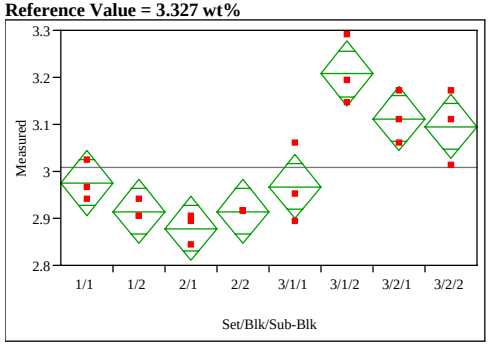
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1	3	12.4098	0.32885	11.713	13.107
1/2	3	12.1286	0.32885	11.431	12.826
2/1	3	13.2152	0.32885	12.518	13.912
2/2	3	12.2621	0.32885	11.565	12.959
3/1/1	3	13.6632	0.32885	12.966	14.360
3/1/2	3	13.3343	0.32885	12.637	14.031
3/2/1	3	13.4916	0.32885	12.794	14.189
3/2/2	3	12.3478	0.32885	11.651	13.045

Std Error uses a pooled estimate of error variance

Figure A3. PSAL Measurements by Analytical Set, Block, and Sub-Block for Samples of the Batch 1 and Ustd Standards by Oxide

Oneway Analysis of Measured By Set/Blk/Sub-Blk Glass ID=Batch 1, Oxide=K2O (wt%)
Reference Value = 3.327 wt%



Oneway Anova
Summary of Fit

Rsquare	0.850192
Adj Rsquare	0.784651
Root Mean Square Error	0.056077
Mean of Response	3.008539
Observations (or Sum Wgts)	24

Analysis of Variance

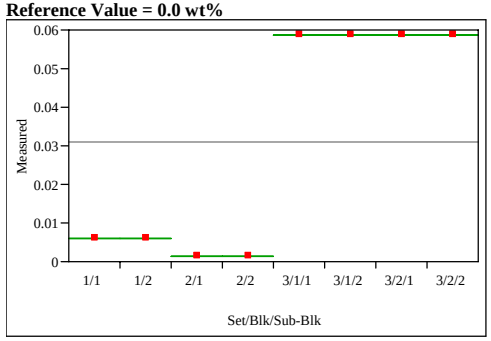
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	7	0.28554266	0.040792	12.9719	<.0001
Error	16	0.05031409	0.003145		
C. Total	23	0.33585675			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1	3	2.97536	0.03238	2.9067	3.0440
1/2	3	2.91513	0.03238	2.8465	2.9838
2/1	3	2.87899	0.03238	2.8104	2.9476
2/2	3	2.91513	0.03238	2.8465	2.9838
3/1/1	3	2.96773	0.03238	2.8991	3.0364
3/1/2	3	3.20825	0.03238	3.1396	3.2769
3/2/1	3	3.11188	0.03238	3.0432	3.1805
3/2/2	3	3.09582	0.03238	3.0272	3.1645

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measured By Set/Blk/Sub-Blk Glass ID=Batch 1, Oxide=La2O3 (wt%)
Reference Value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	1
Adj Rsquare	1
Root Mean Square Error	0
Mean of Response	0.031079
Observations (or Sum Wgts)	24

Analysis of Variance

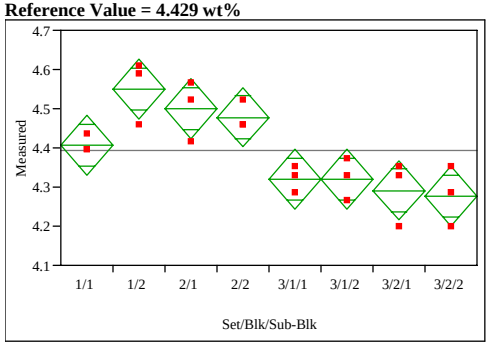
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	7	0.01829637	0.002614	.	.
Error	16	0.00000000	0.000000		
C. Total	23	0.01829637			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1	3	0.005864	0	0.00586	0.00586
1/2	3	0.005864	0	0.00586	0.00586
2/1	3	0.001173	0	0.00117	0.00117
2/2	3	0.001173	0	0.00117	0.00117
3/1/1	3	0.058640	0	0.05864	0.05864
3/1/2	3	0.058640	0	0.05864	0.05864
3/2/1	3	0.058640	0	0.05864	0.05864
3/2/2	3	0.058640	0	0.05864	0.05864

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measured By Set/Blk/Sub-Blk Glass ID=Batch 1, Oxide=Li2O (wt%)
Reference Value = 4.429 wt%



Oneway Anova
Summary of Fit

Rsquare	0.789625
Adj Rsquare	0.697586
Root Mean Square Error	0.062304
Mean of Response	4.392813
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	7	0.23312010	0.033303	8.5792	0.0002
Error	16	0.06210871	0.003882		
C. Total	23	0.29522881			

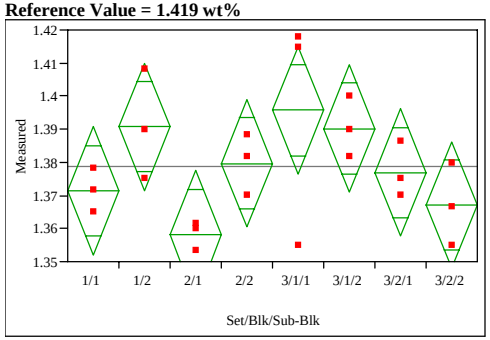
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1	3	4.40627	0.03597	4.3300	4.4825
1/2	3	4.54980	0.03597	4.4735	4.6261
2/1	3	4.49956	0.03597	4.4233	4.5758
2/2	3	4.47803	0.03597	4.4018	4.5543
3/1/1	3	4.32015	0.03597	4.2439	4.3964
3/1/2	3	4.32015	0.03597	4.2439	4.3964
3/2/1	3	4.29145	0.03597	4.2152	4.3677
3/2/2	3	4.27709	0.03597	4.2008	4.3534

Std Error uses a pooled estimate of error variance

Figure A3. PSAL Measurements by Analytical Set, Block, and Sub-Block for Samples of the Batch 1 and Ustd Standards by Oxide

Oneway Analysis of Measured By Set/Blk/Sub-Blk
Glass ID=Batch 1, Oxide=MgO (wt%)
Reference Value = 1.419 wt%



Oneway Anova
Summary of Fit

Rsquare	0.4714
Adj Rsquare	0.240137
Root Mean Square Error	0.015783
Mean of Response	1.378738
Observations (or Sum Wgts)	24

Analysis of Variance

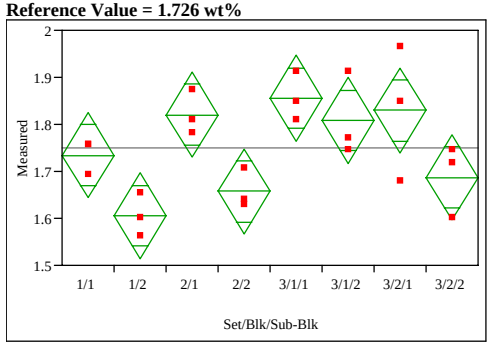
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	7	0.00355432	0.000508	2.0384	0.1129
Error	16	0.00398561	0.000249		
C. Total	23	0.00753993			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1	3	1.37141	0.00911	1.3521	1.3907
1/2	3	1.39076	0.00911	1.3714	1.4101
2/1	3	1.35815	0.00911	1.3388	1.3775
2/2	3	1.37971	0.00911	1.3604	1.3990
3/1/1	3	1.39574	0.00911	1.3764	1.4151
3/1/2	3	1.39021	0.00911	1.3709	1.4095
3/2/1	3	1.37694	0.00911	1.3576	1.3963
3/2/2	3	1.36699	0.00911	1.3477	1.3863

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measured By Set/Blk/Sub-Blk
Glass ID=Batch 1, Oxide=MnO (wt%)
Reference Value = 1.726 wt%



Oneway Anova
Summary of Fit

Rsquare	0.6675
Adj Rsquare	0.522031
Root Mean Square Error	0.074454
Mean of Response	1.749576
Observations (or Sum Wgts)	24

Analysis of Variance

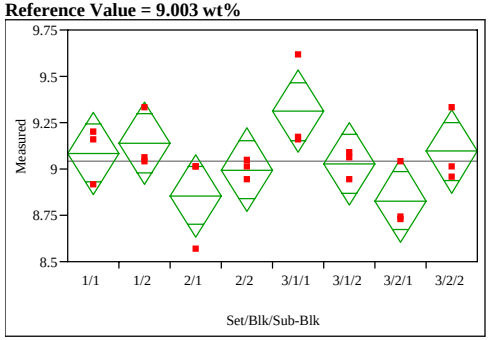
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	7	0.17805669	0.025437	4.5886	0.0055
Error	16	0.08869490	0.005543		
C. Total	23	0.26675159			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1	3	1.73451	0.04299	1.6434	1.8256
1/2	3	1.60539	0.04299	1.5143	1.6965
2/1	3	1.82059	0.04299	1.7295	1.9117
2/2	3	1.65704	0.04299	1.5659	1.7482
3/1/1	3	1.85502	0.04299	1.7639	1.9462
3/1/2	3	1.80768	0.04299	1.7166	1.8988
3/2/1	3	1.82920	0.04299	1.7381	1.9203
3/2/2	3	1.68717	0.04299	1.5960	1.7783

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measured By Set/Blk/Sub-Blk
Glass ID=Batch 1, Oxide=Na2O (wt%)
Reference Value = 9.003 wt%



Oneway Anova
Summary of Fit

Rsquare	0.486726
Adj Rsquare	0.262169
Root Mean Square Error	0.182313
Mean of Response	9.042272
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	7	0.5042994	0.072043	2.1675	0.0948
Error	16	0.5318058	0.033238		
C. Total	23	1.0361051			

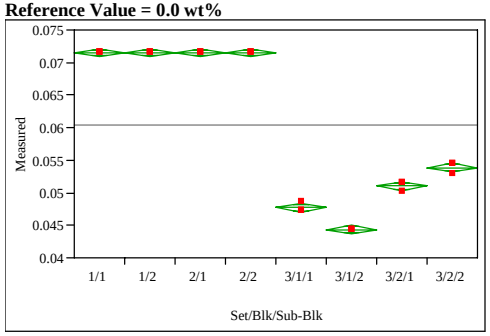
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1	3	9.08552	0.10526	8.8624	9.3087
1/2	3	9.13944	0.10526	8.9163	9.3626
2/1	3	8.85636	0.10526	8.6332	9.0795
2/2	3	8.99565	0.10526	8.7725	9.2188
3/1/1	3	9.31019	0.10526	9.0870	9.5333
3/1/2	3	9.02711	0.10526	8.8040	9.2502
3/2/1	3	8.82940	0.10526	8.6063	9.0525
3/2/2	3	9.09451	0.10526	8.8714	9.3176

Std Error uses a pooled estimate of error variance

Figure A3. PSAL Measurements by Analytical Set, Block, and Sub-Block for Samples of the Batch 1 and Ustd Standards by Oxide

Oneway Analysis of Measured By Set/Blk/Sub-Blk
Glass ID=Batch 1, Oxide=Nb2O5 (wt%)
Reference Value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	0.998696
Adj Rsquare	0.998126
Root Mean Square Error	0.000506
Mean of Response	0.060379
Observations (or Sum Wgts)	24

Analysis of Variance

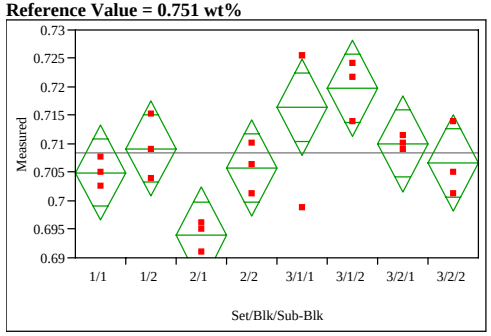
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	7	0.00313489	0.000448	1750.810	<.0001
Error	16	0.00000409	2.558e-7		
C. Total	23	0.00313899			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1	3	0.071525	0.00029	0.07091	0.07214
1/2	3	0.071525	0.00029	0.07091	0.07214
2/1	3	0.071525	0.00029	0.07091	0.07214
2/2	3	0.071525	0.00029	0.07091	0.07214
3/1/1	3	0.047683	0.00029	0.04706	0.04830
3/1/2	3	0.044346	0.00029	0.04373	0.04496
3/2/1	3	0.051021	0.00029	0.05040	0.05164
3/2/2	3	0.053882	0.00029	0.05326	0.05450

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measured By Set/Blk/Sub-Blk
Glass ID=Batch 1, Oxide=NiO (wt%)
Reference Value = 0.751 wt%



Oneway Anova
Summary of Fit

Rsquare	0.630492
Adj Rsquare	0.468833
Root Mean Square Error	0.006862
Mean of Response	0.708358
Observations (or Sum Wgts)	24

Analysis of Variance

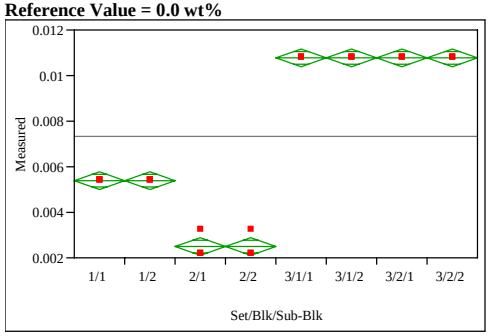
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	7	0.00128569	0.000184	3.9001	0.0115
Error	16	0.00075349	0.000047		
C. Total	23	0.00203918			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1	3	0.704965	0.00396	0.69657	0.71336
1/2	3	0.709207	0.00396	0.70081	0.71761
2/1	3	0.693937	0.00396	0.68554	0.70234
2/2	3	0.705813	0.00396	0.69741	0.71421
3/1/1	3	0.716418	0.00396	0.70802	0.72482
3/1/2	3	0.719811	0.00396	0.71141	0.72821
3/2/1	3	0.710055	0.00396	0.70166	0.71845
3/2/2	3	0.706662	0.00396	0.69826	0.71506

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measured By Set/Blk/Sub-Blk
Glass ID=Batch 1, Oxide=PbO (wt%)
Reference Value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	0.994937
Adj Rsquare	0.992722
Root Mean Square Error	0.000311
Mean of Response	0.007361
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	7	0.00030401	0.000043	449.1429	<.0001
Error	16	0.00000155	9.67e-8		
C. Total	23	0.00030556			

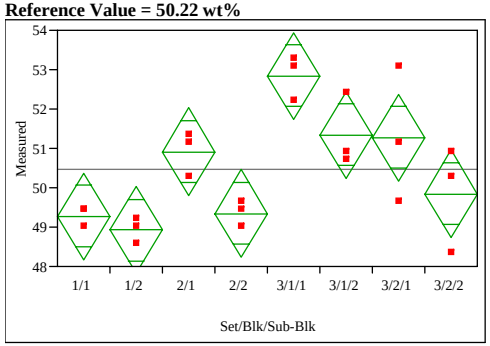
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1	3	0.005386	0.00018	0.00501	0.00577
1/2	3	0.005386	0.00018	0.00501	0.00577
2/1	3	0.002513	0.00018	0.00213	0.00289
2/2	3	0.002513	0.00018	0.00213	0.00289
3/1/1	3	0.010772	0.00018	0.01039	0.01115
3/1/2	3	0.010772	0.00018	0.01039	0.01115
3/2/1	3	0.010772	0.00018	0.01039	0.01115
3/2/2	3	0.010772	0.00018	0.01039	0.01115

Std Error uses a pooled estimate of error variance

Figure A3. PSAL Measurements by Analytical Set, Block, and Sub-Block for Samples of the Batch 1 and Ustd Standards by Oxide

Oneway Analysis of Measured By Set/Blk/Sub-Blk
Glass ID=Batch 1, Oxide=SiO2 (wt%)
Reference Value = 50.22 wt%



Oneway Anova
Summary of Fit

Rsquare	0.745341
Adj Rsquare	0.633927
Root Mean Square Error	0.90236
Mean of Response	50.46965
Observations (or Sum Wgts)	24

Analysis of Variance

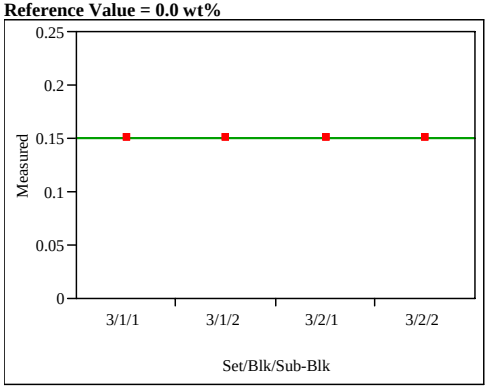
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	7	38.130743	5.44725	6.6899	0.0008
Error	16	13.028067	0.81425		
C. Total	23	51.158811			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1	3	49.2752	0.52098	48.171	50.380
1/2	3	48.9187	0.52098	47.814	50.023
2/1	3	50.9153	0.52098	49.811	52.020
2/2	3	49.3465	0.52098	48.242	50.451
3/1/1	3	52.8407	0.52098	51.736	53.945
3/1/2	3	51.3432	0.52098	50.239	52.448
3/2/1	3	51.2719	0.52098	50.167	52.376
3/2/2	3	49.8457	0.52098	48.741	50.950

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measured By Set/Blk/Sub-Blk
Glass ID=Batch 1, Oxide=SO4 (wt%)
Reference Value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	.
Adj Rsquare	.
Root Mean Square Error	0
Mean of Response	0.149795
Observations (or Sum Wgts)	12

Analysis of Variance

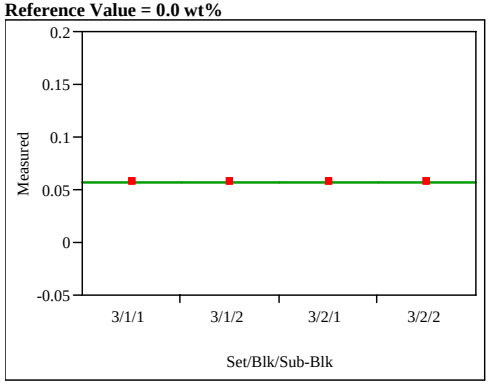
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	3	0	0	.	.
Error	8	0	0		
C. Total	11	0			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
3/1/1	3	0.149795	0	0.14980	0.14980
3/1/2	3	0.149795	0	0.14980	0.14980
3/2/1	3	0.149795	0	0.14980	0.14980
3/2/2	3	0.149795	0	0.14980	0.14980

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measured By Set/Blk/Sub-Blk
Glass ID=Batch 1, Oxide=ThO2 (wt%)
Reference Value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	.
Adj Rsquare	.
Root Mean Square Error	0
Mean of Response	0.056895
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	3	0	0	.	.
Error	8	0	0		
C. Total	11	0			

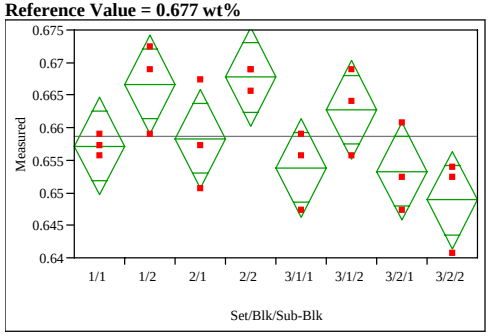
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
3/1/1	3	0.056895	0	0.05690	0.05690
3/1/2	3	0.056895	0	0.05690	0.05690
3/2/1	3	0.056895	0	0.05690	0.05690
3/2/2	3	0.056895	0	0.05690	0.05690

Std Error uses a pooled estimate of error variance

Figure A3. PSAL Measurements by Analytical Set, Block, and Sub-Block for Samples of the Batch 1 and Ustd Standards by Oxide

Oneway Analysis of Measured By Set/Blk/Sub-Blk
Glass ID=Batch 1, Oxide=TiO2 (wt%)
Reference Value = 0.677 wt%



Oneway Anova
Summary of Fit

Rsquare	0.606459
Adj Rsquare	0.434285
Root Mean Square Error	0.006176
Mean of Response	0.658582
Observations (or Sum Wgts)	24

Analysis of Variance

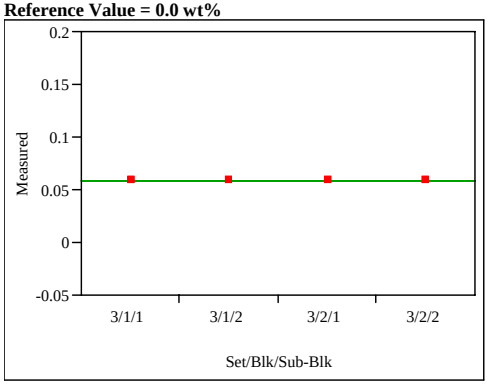
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	7	0.00094039	0.000134	3.5224	0.0175
Error	16	0.00061023	0.000038		
C. Total	23	0.00155063			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1	3	0.657192	0.00357	0.64963	0.66475
1/2	3	0.666644	0.00357	0.65909	0.67420
2/1	3	0.658304	0.00357	0.65075	0.66586
2/2	3	0.667756	0.00357	0.66020	0.67531
3/1/1	3	0.653856	0.00357	0.64630	0.66141
3/1/2	3	0.662752	0.00357	0.65519	0.67031
3/2/1	3	0.653300	0.00357	0.64574	0.66086
3/2/2	3	0.648852	0.00357	0.64129	0.65641

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measured By Set/Blk/Sub-Blk
Glass ID=Batch 1, Oxide=U3O8 (wt%)
Reference Value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	.
Adj Rsquare	.
Root Mean Square Error	0
Mean of Response	0.05896
Observations (or Sum Wgts)	12

Analysis of Variance

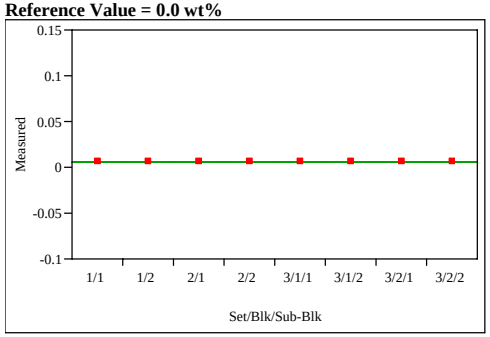
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	3	0	0	.	.
Error	8	0	0		
C. Total	11	0			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
3/1/1	3	0.058960	0	0.05896	0.05896
3/1/2	3	0.058960	0	0.05896	0.05896
3/2/1	3	0.058960	0	0.05896	0.05896
3/2/2	3	0.058960	0	0.05896	0.05896

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measured By Set/Blk/Sub-Blk
Glass ID=Batch 1, Oxide=ZnO (wt%)
Reference Value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	.
Adj Rsquare	.
Root Mean Square Error	0
Mean of Response	0.006224
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	7	0	0	.	.
Error	16	0	0		
C. Total	23	0			

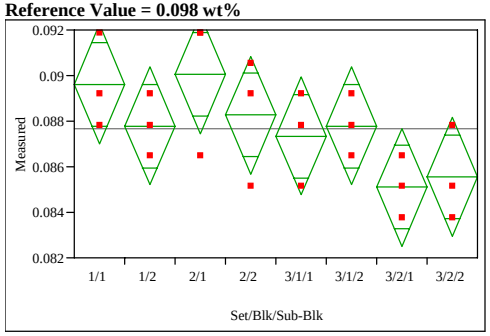
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1	3	0.006224	0	0.00622	0.00622
1/2	3	0.006224	0	0.00622	0.00622
2/1	3	0.006224	0	0.00622	0.00622
2/2	3	0.006224	0	0.00622	0.00622
3/1/1	3	0.006224	0	0.00622	0.00622
3/1/2	3	0.006224	0	0.00622	0.00622
3/2/1	3	0.006224	0	0.00622	0.00622
3/2/2	3	0.006224	0	0.00622	0.00622

Std Error uses a pooled estimate of error variance

Figure A3. PSAL Measurements by Analytical Set, Block, and Sub-Block for Samples of the Batch 1 and Ustd Standards by Oxide

Oneway Analysis of Measured By Set/Blk/Sub-Blk
Glass ID=Batch 1, Oxide=ZrO2 (wt%)
Reference Value = 0.098 wt%



Oneway Anova
Summary of Fit

Rsquare	0.467269
Adj Rsquare	0.234199
Root Mean Square Error	0.002118
Mean of Response	0.087689
Observations (or Sum Wgts)	24

Analysis of Variance

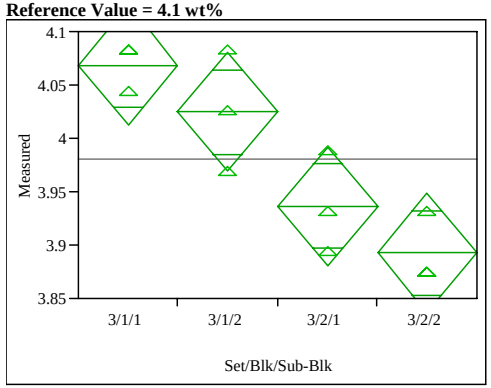
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	7	0.00006295	8.993e-6	2.0048	0.1181
Error	16	0.00007177	4.4856e-6		
C. Total	23	0.00013472			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1	3	0.089603	0.00122	0.08701	0.09220
1/2	3	0.087802	0.00122	0.08521	0.09039
2/1	3	0.090053	0.00122	0.08746	0.09265
2/2	3	0.088252	0.00122	0.08566	0.09084
3/1/1	3	0.087352	0.00122	0.08476	0.08994
3/1/2	3	0.087802	0.00122	0.08521	0.09039
3/2/1	3	0.085100	0.00122	0.08251	0.08769
3/2/2	3	0.085551	0.00122	0.08296	0.08814

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measured By Set/Blk/Sub-Blk
Glass ID=U std, Oxide=Al2O3 (wt%)
Reference Value = 4.1 wt%



Oneway Anova
Summary of Fit

Rsquare	0.805921
Adj Rsquare	0.733141
Root Mean Square Error	0.041897
Mean of Response	3.980547
Observations (or Sum Wgts)	12

Analysis of Variance

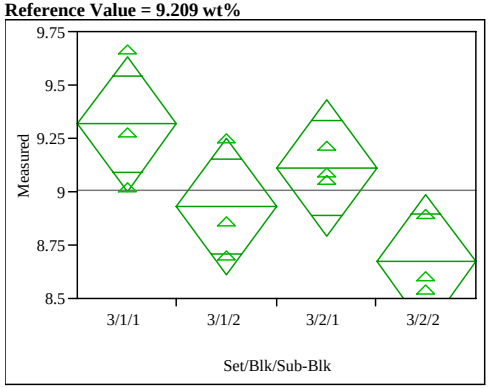
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	3	0.05831343	0.019438	11.0734	0.0032
Error	8	0.01404283	0.001755		
C. Total	11	0.07235626			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
3/1/1	3	4.06872	0.02419	4.0129	4.1245
3/1/2	3	4.02464	0.02419	3.9689	4.0804
3/2/1	3	3.93646	0.02419	3.8807	3.9922
3/2/2	3	3.89237	0.02419	3.8366	3.9482

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measured By Set/Blk/Sub-Blk
Glass ID=U std, Oxide=B2O3 (wt%)
Reference Value = 9.209 wt%



Oneway Anova
Summary of Fit

Rsquare	0.597519
Adj Rsquare	0.446589
Root Mean Square Error	0.238251
Mean of Response	9.00767
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	3	0.6741633	0.224721	3.9589	0.0531
Error	8	0.4541077	0.056763		
C. Total	11	1.1282710			

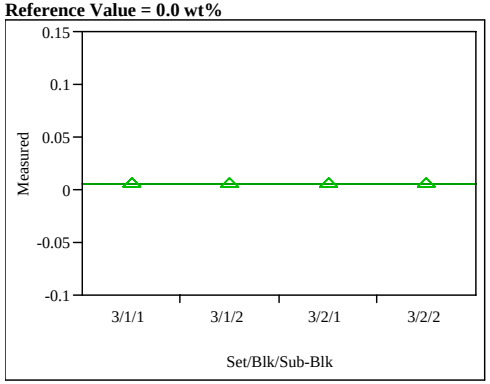
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
3/1/1	3	9.31624	0.13755	8.9990	9.6334
3/1/2	3	8.92986	0.13755	8.6127	9.2471
3/2/1	3	9.11232	0.13755	8.7951	9.4295
3/2/2	3	8.67226	0.13755	8.3551	8.9895

Std Error uses a pooled estimate of error variance

Figure A3. PSAL Measurements by Analytical Set, Block, and Sub-Block for Samples of the Batch 1 and Ustd Standards by Oxide

Oneway Analysis of Measured By Set/Blk/Sub-Blk
Glass ID=U std, Oxide=BaO (wt%)
Reference Value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	.
Adj Rsquare	.
Root Mean Square Error	0
Mean of Response	0.005583
Observations (or Sum Wgts)	12

Analysis of Variance

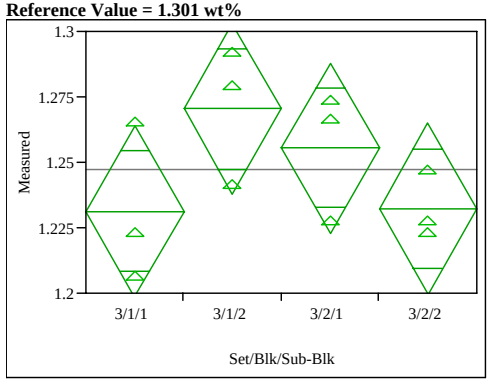
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	3	0	0	.	.
Error	8	0	0		
C. Total	11	0			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
3/1/1	3	0.005583	0	0.00558	0.00558
3/1/2	3	0.005583	0	0.00558	0.00558
3/2/1	3	0.005583	0	0.00558	0.00558
3/2/2	3	0.005583	0	0.00558	0.00558

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measured By Set/Blk/Sub-Blk
Glass ID=U std, Oxide=CaO (wt%)
Reference Value = 1.301 wt%



Oneway Anova
Summary of Fit

Rsquare	0.406451
Adj Rsquare	0.18387
Root Mean Square Error	0.024413
Mean of Response	1.247387
Observations (or Sum Wgts)	12

Analysis of Variance

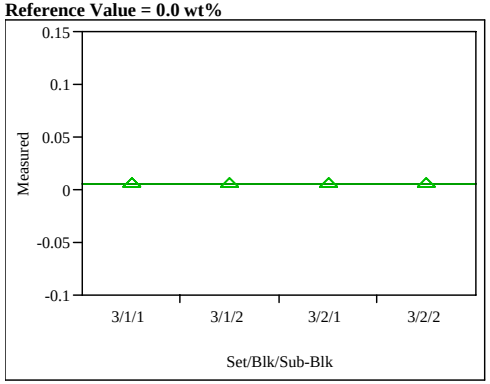
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	3	0.00326489	0.001088	1.8261	0.2205
Error	8	0.00476780	0.000596		
C. Total	11	0.00803269			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
3/1/1	3	1.23130	0.01409	1.1988	1.2638
3/1/2	3	1.27047	0.01409	1.2380	1.3030
3/2/1	3	1.25555	0.01409	1.2230	1.2881
3/2/2	3	1.23223	0.01409	1.1997	1.2647

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measured By Set/Blk/Sub-Blk
Glass ID=U std, Oxide=CdO (wt%)
Reference Value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	.
Adj Rsquare	.
Root Mean Square Error	0
Mean of Response	0.005712
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	3	0	0	.	.
Error	8	0	0		
C. Total	11	0			

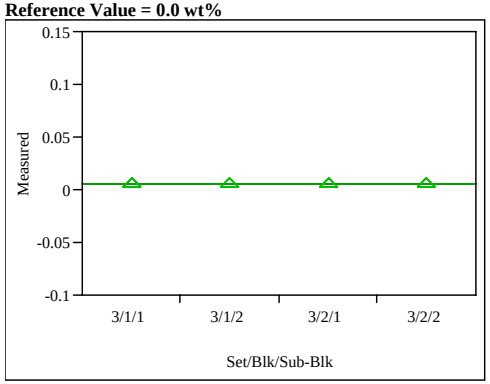
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
3/1/1	3	0.005712	0	0.00571	0.00571
3/1/2	3	0.005712	0	0.00571	0.00571
3/2/1	3	0.005712	0	0.00571	0.00571
3/2/2	3	0.005712	0	0.00571	0.00571

Std Error uses a pooled estimate of error variance

Figure A3. PSAL Measurements by Analytical Set, Block, and Sub-Block for Samples of the Batch 1 and Ustd Standards by Oxide

Oneway Analysis of Measured By Set/Blk/Sub-Blk
Glass ID=U std, Oxide=Ce2O3 (wt%)
Reference Value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	.
Adj Rsquare	.
Root Mean Square Error	0
Mean of Response	0.005857
Observations (or Sum Wgts)	12

Analysis of Variance

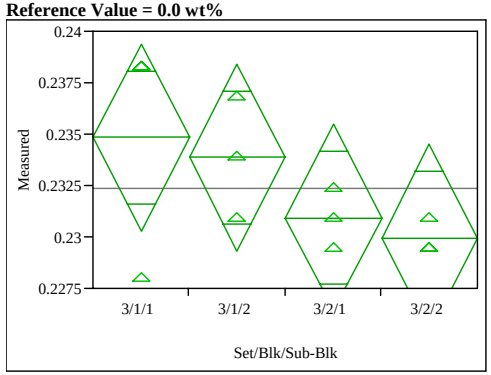
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	3	0	0	.	.
Error	8	0	0		
C. Total	11	0			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
3/1/1	3	0.005857	0	0.00586	0.00586
3/1/2	3	0.005857	0	0.00586	0.00586
3/2/1	3	0.005857	0	0.00586	0.00586
3/2/2	3	0.005857	0	0.00586	0.00586

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measured By Set/Blk/Sub-Blk
Glass ID=U std, Oxide=Cr2O3 (wt%)
Reference Value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	0.343434
Adj Rsquare	0.097222
Root Mean Square Error	0.003402
Mean of Response	0.232394
Observations (or Sum Wgts)	12

Analysis of Variance

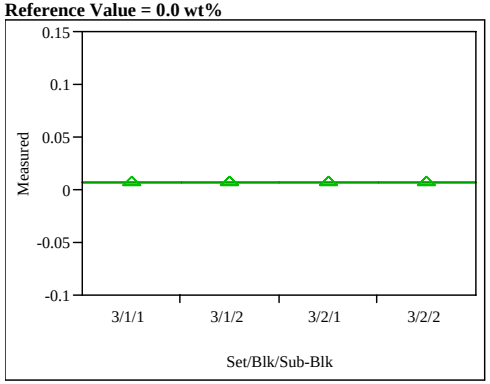
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	3	0.00004842	0.000016	1.3949	0.3132
Error	8	0.00009257	0.000012		
C. Total	11	0.00014099			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
3/1/1	3	0.234830	0.00196	0.23030	0.23936
3/1/2	3	0.233856	0.00196	0.22933	0.23838
3/2/1	3	0.230933	0.00196	0.22640	0.23546
3/2/2	3	0.229958	0.00196	0.22543	0.23449

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measured By Set/Blk/Sub-Blk
Glass ID=U std, Oxide=CuO (wt%)
Reference Value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	.
Adj Rsquare	.
Root Mean Square Error	0
Mean of Response	0.006259
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	3	0	0	.	.
Error	8	0	0		
C. Total	11	0			

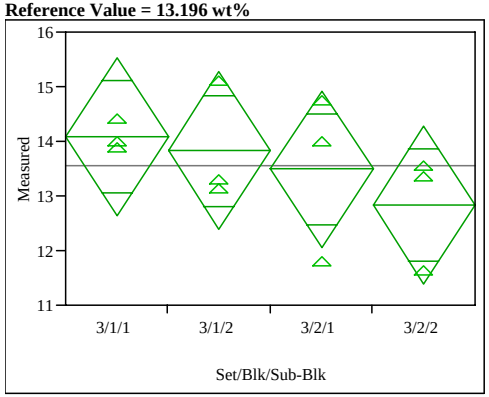
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
3/1/1	3	0.006259	0	0.00626	0.00626
3/1/2	3	0.006259	0	0.00626	0.00626
3/2/1	3	0.006259	0	0.00626	0.00626
3/2/2	3	0.006259	0	0.00626	0.00626

Std Error uses a pooled estimate of error variance

Figure A3. PSAL Measurements by Analytical Set, Block, and Sub-Block for Samples of the Batch 1 and Ustd Standards by Oxide

Oneway Analysis of Measured By Set/Blk/Sub-Blk
Glass ID=U std, Oxide=Fe2O3 (wt%)
Reference Value = 13.196 wt%



Oneway Anova
Summary of Fit

Rsquare	0.219988
Adj Rsquare	-0.07252
Root Mean Square Error	1.083409
Mean of Response	13.55594
Observations (or Sum Wgts)	12

Analysis of Variance

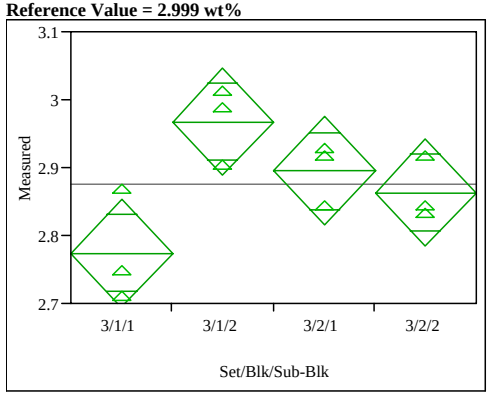
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	3	2.648329	0.88278	0.7521	0.5513
Error	8	9.390193	1.17377		
C. Total	11	12.038522			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
3/1/1	3	14.0825	0.62551	12.640	15.525
3/1/2	3	13.8252	0.62551	12.383	15.268
3/2/1	3	13.4868	0.62551	12.044	14.929
3/2/2	3	12.8292	0.62551	11.387	14.272

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measured By Set/Blk/Sub-Blk
Glass ID=U std, Oxide=K2O (wt%)
Reference Value = 2.999 wt%



Oneway Anova
Summary of Fit

Rsquare	0.669848
Adj Rsquare	0.546041
Root Mean Square Error	0.05975
Mean of Response	2.874778
Observations (or Sum Wgts)	12

Analysis of Variance

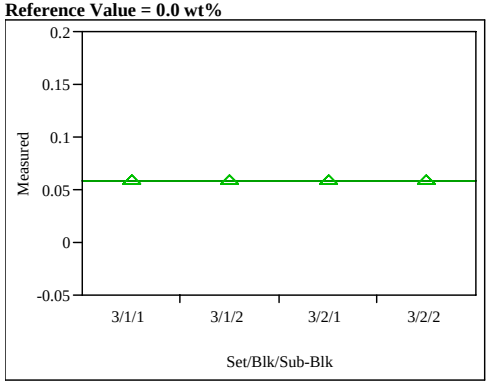
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	3	0.05794716	0.019316	5.4104	0.0251
Error	8	0.02856075	0.003570		
C. Total	11	0.08650791			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
3/1/1	3	2.77379	0.03450	2.6942	2.8533
3/1/2	3	2.96733	0.03450	2.8878	3.0469
3/2/1	3	2.89506	0.03450	2.8155	2.9746
3/2/2	3	2.86293	0.03450	2.7834	2.9425

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measured By Set/Blk/Sub-Blk
Glass ID=U std, Oxide=La2O3 (wt%)
Reference Value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	.
Adj Rsquare	.
Root Mean Square Error	0
Mean of Response	0.05864
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	3	0	0	.	.
Error	8	0	0		
C. Total	11	0			

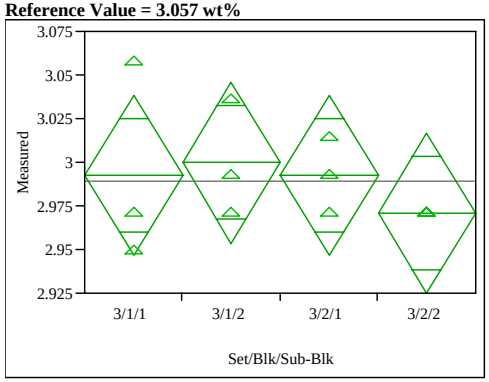
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
3/1/1	3	0.058640	0	0.05864	0.05864
3/1/2	3	0.058640	0	0.05864	0.05864
3/2/1	3	0.058640	0	0.05864	0.05864
3/2/2	3	0.058640	0	0.05864	0.05864

Std Error uses a pooled estimate of error variance

Figure A3. PSAL Measurements by Analytical Set, Block, and Sub-Block for Samples of the Batch 1 and Ustd Standards by Oxide

Oneway Analysis of Measured By Set/Blk/Sub-Blk
Glass ID=U std, Oxide=Li2O (wt%)
Reference Value = 3.057 wt%



Oneway Anova
Summary of Fit

Rsquare	0.126761
Adj Rsquare	-0.2007
Root Mean Square Error	0.034603
Mean of Response	2.988943
Observations (or Sum Wgts)	12

Analysis of Variance

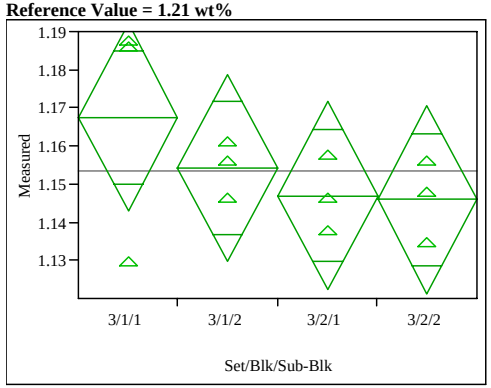
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	3	0.00139049	0.000463	0.3871	0.7655
Error	8	0.00957896	0.001197		
C. Total	11	0.01096945			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
3/1/1	3	2.99253	0.01998	2.9465	3.0386
3/1/2	3	2.99971	0.01998	2.9536	3.0458
3/2/1	3	2.99253	0.01998	2.9465	3.0386
3/2/2	3	2.97100	0.01998	2.9249	3.0171

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measured By Set/Blk/Sub-Blk
Glass ID=U std, Oxide=MgO (wt%)
Reference Value = 1.21 wt%



Oneway Anova
Summary of Fit

Rsquare	0.244557
Adj Rsquare	-0.03873
Root Mean Square Error	0.018491
Mean of Response	1.153624
Observations (or Sum Wgts)	12

Analysis of Variance

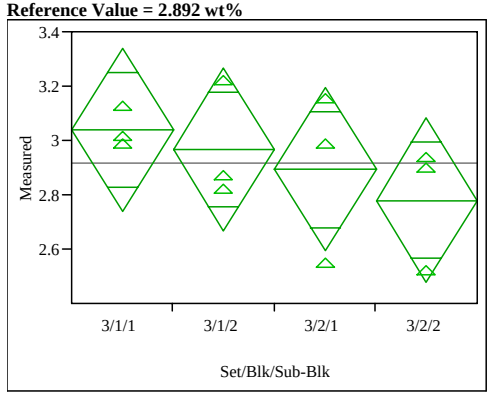
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	3	0.00088549	0.000295	0.8633	0.4985
Error	8	0.00273529	0.000342		
C. Total	11	0.00362078			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
3/1/1	3	1.16744	0.01068	1.1428	1.1921
3/1/2	3	1.15418	0.01068	1.1296	1.1788
3/2/1	3	1.14699	0.01068	1.1224	1.1716
3/2/2	3	1.14589	0.01068	1.1213	1.1705

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measured By Set/Blk/Sub-Blk
Glass ID=U std, Oxide=MnO (wt%)
Reference Value = 2.892 wt%



Oneway Anova
Summary of Fit

Rsquare	0.21161
Adj Rsquare	-0.08404
Root Mean Square Error	0.225498
Mean of Response	2.919188
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	3	0.10918754	0.036396	0.7158	0.5697
Error	8	0.40679618	0.050850		
C. Total	11	0.51598371			

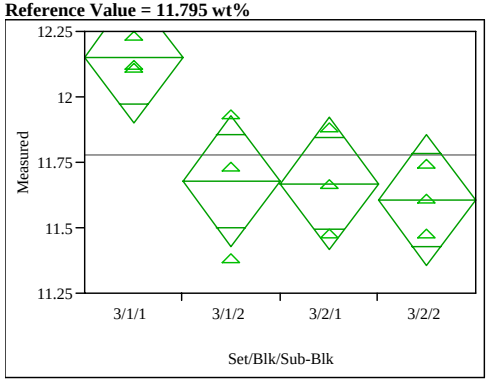
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
3/1/1	3	3.03862	0.13019	2.7384	3.3388
3/1/2	3	2.96546	0.13019	2.6652	3.2657
3/2/1	3	2.89229	0.13019	2.5921	3.1925
3/2/2	3	2.78038	0.13019	2.4802	3.0806

Std Error uses a pooled estimate of error variance

Figure A3. PSAL Measurements by Analytical Set, Block, and Sub-Block for Samples of the Batch 1 and Ustd Standards by Oxide

Oneway Analysis of Measured By Set/Blk/Sub-Blk
Glass ID=U std, Oxide=Na2O (wt%)
Reference Value = 11.795 wt%



Oneway Anova
Summary of Fit

Rsquare	0.667442
Adj Rsquare	0.542733
Root Mean Square Error	0.188238
Mean of Response	11.7759
Observations (or Sum Wgts)	12

Analysis of Variance

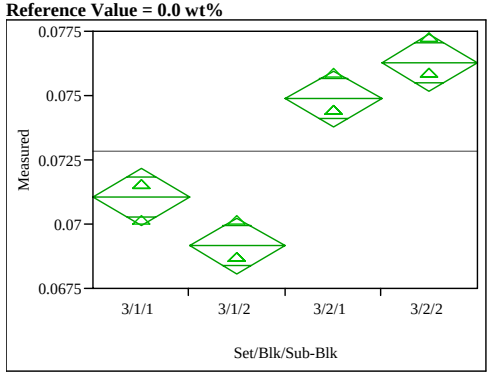
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	3	0.56892012	0.189640	5.3520	0.0258
Error	8	0.28346822	0.035434		
C. Total	11	0.85238834			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
3/1/1	3	12.1500	0.10868	11.899	12.401
3/1/2	3	11.6782	0.10868	11.428	11.929
3/2/1	3	11.6692	0.10868	11.419	11.920
3/2/2	3	11.6063	0.10868	11.356	11.857

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measured By Set/Blk/Sub-Blk
Glass ID=U std, Oxide=Nb2O5 (wt%)
Reference Value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	0.947627
Adj Rsquare	0.927987
Root Mean Square Error	0.000826
Mean of Response	0.072836
Observations (or Sum Wgts)	12

Analysis of Variance

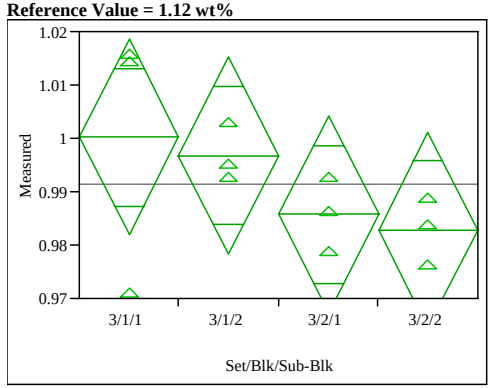
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	3	0.00009874	0.000033	48.2500	<.0001
Error	8	0.00000546	6.821e-7		
C. Total	11	0.00010419			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
3/1/1	3	0.071048	0.00048	0.06995	0.07215
3/1/2	3	0.069141	0.00048	0.06804	0.07024
3/2/1	3	0.074863	0.00048	0.07376	0.07596
3/2/2	3	0.076293	0.00048	0.07519	0.07739

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measured By Set/Blk/Sub-Blk
Glass ID=U std, Oxide=NiO (wt%)
Reference Value = 1.12 wt%



Oneway Anova
Summary of Fit

Rsquare	0.29478
Adj Rsquare	0.030322
Root Mean Square Error	0.013794
Mean of Response	0.991384
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	3	0.00063623	0.000212	1.1147	0.3986
Error	8	0.00152210	0.000190		
C. Total	11	0.00215833			

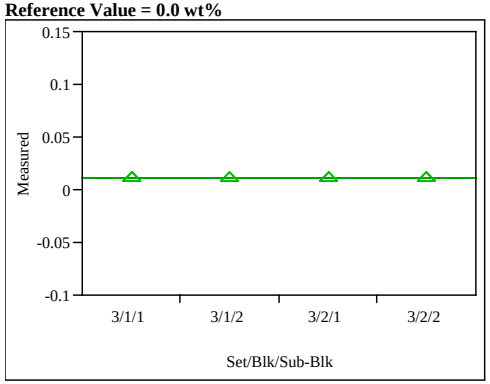
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
3/1/1	3	1.00019	0.00796	0.98182	1.0185
3/1/2	3	0.99679	0.00796	0.97843	1.0152
3/2/1	3	0.98576	0.00796	0.96740	1.0041
3/2/2	3	0.98279	0.00796	0.96443	1.0012

Std Error uses a pooled estimate of error variance

Figure A3. PSAL Measurements by Analytical Set, Block, and Sub-Block for Samples of the Batch 1 and Ustd Standards by Oxide

Oneway Analysis of Measured By Set/Blk/Sub-Blk
Glass ID=U std, Oxide=PbO (wt%)
Reference Value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	0
Adj Rsquare	-0.375
Root Mean Square Error	2.12e-18
Mean of Response	0.010772
Observations (or Sum Wgts)	12

Analysis of Variance

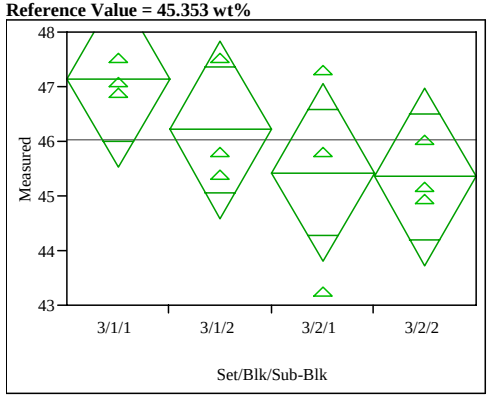
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	3	0	0	0.0000	1.0000
Error	8	3.6111e-35	4.514e-36		
C. Total	11	3.6111e-35			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
3/1/1	3	0.010772	1.227e-18	0.01077	0.01077
3/1/2	3	0.010772	1.227e-18	0.01077	0.01077
3/2/1	3	0.010772	1.227e-18	0.01077	0.01077
3/2/2	3	0.010772	1.227e-18	0.01077	0.01077

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measured By Set/Blk/Sub-Blk
Glass ID=U std, Oxide=SiO2 (wt%)
Reference Value = 45.353 wt%



Oneway Anova
Summary of Fit

Rsquare	0.344566
Adj Rsquare	0.098778
Root Mean Square Error	1.218024
Mean of Response	46.03061
Observations (or Sum Wgts)	12

Analysis of Variance

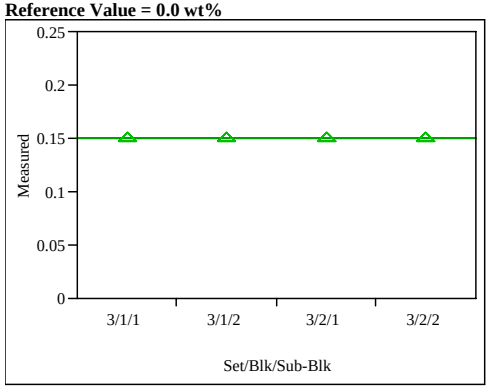
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	3	6.239437	2.07981	1.4019	0.3114
Error	8	11.868661	1.48358		
C. Total	11	18.108098			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
3/1/1	3	47.1359	0.70323	45.514	48.758
3/1/2	3	46.2089	0.70323	44.587	47.831
3/2/1	3	45.4245	0.70323	43.803	47.046
3/2/2	3	45.3532	0.70323	43.732	46.975

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measured By Set/Blk/Sub-Blk
Glass ID=U std, Oxide=SO4 (wt%)
Reference Value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	.
Adj Rsquare	.
Root Mean Square Error	0
Mean of Response	0.149795
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	3	0	0	.	.
Error	8	0	0		
C. Total	11	0			

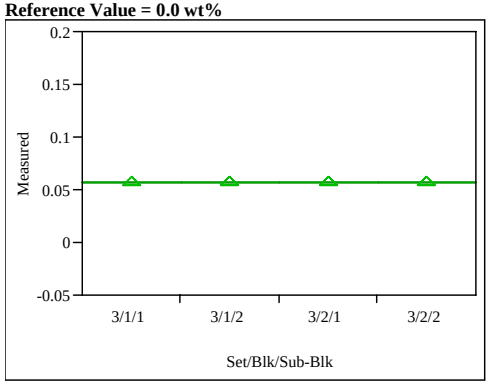
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
3/1/1	3	0.149795	0	0.14980	0.14980
3/1/2	3	0.149795	0	0.14980	0.14980
3/2/1	3	0.149795	0	0.14980	0.14980
3/2/2	3	0.149795	0	0.14980	0.14980

Std Error uses a pooled estimate of error variance

Figure A3. PSAL Measurements by Analytical Set, Block, and Sub-Block for Samples of the Batch 1 and Ustd Standards by Oxide

Oneway Analysis of Measured By Set/Blk/Sub-Blk
Glass ID=U std, Oxide=ThO2 (wt%)
Reference Value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	.
Adj Rsquare	.
Root Mean Square Error	0
Mean of Response	0.056895
Observations (or Sum Wgts)	12

Analysis of Variance

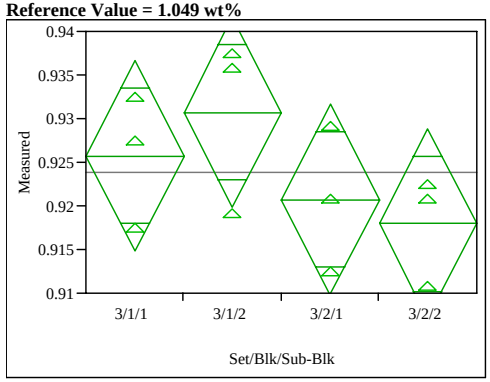
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	3	0	0	.	.
Error	8	0	0		
C. Total	11	0			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
3/1/1	3	0.056895	0	0.05690	0.05690
3/1/2	3	0.056895	0	0.05690	0.05690
3/2/1	3	0.056895	0	0.05690	0.05690
3/2/2	3	0.056895	0	0.05690	0.05690

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measured By Set/Blk/Sub-Blk
Glass ID=U std, Oxide=TiO2 (wt%)
Reference Value = 1.049 wt%



Oneway Anova
Summary of Fit

Rsquare	0.346025
Adj Rsquare	0.100784
Root Mean Square Error	0.008228
Mean of Response	0.923794
Observations (or Sum Wgts)	12

Analysis of Variance

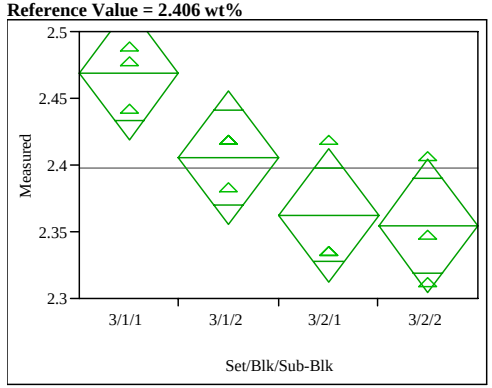
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	3	0.00028657	0.000096	1.4110	0.3090
Error	8	0.00054161	0.000068		
C. Total	11	0.00082818			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
3/1/1	3	0.925740	0.00475	0.91479	0.93669
3/1/2	3	0.930744	0.00475	0.91979	0.94170
3/2/1	3	0.920736	0.00475	0.90978	0.93169
3/2/2	3	0.917956	0.00475	0.90700	0.92891

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measured By Set/Blk/Sub-Blk
Glass ID=U std, Oxide=U3O8 (wt%)
Reference Value = 2.406 wt%



Oneway Anova
Summary of Fit

Rsquare	0.688312
Adj Rsquare	0.571429
Root Mean Square Error	0.03729
Mean of Response	2.397707
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	3	0.02456572	0.008189	5.8889	0.0201
Error	8	0.01112410	0.001391		
C. Total	11	0.03568982			

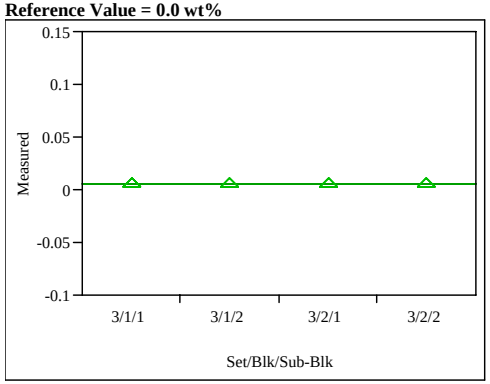
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
3/1/1	3	2.46846	0.02153	2.4188	2.5181
3/1/2	3	2.40557	0.02153	2.3559	2.4552
3/2/1	3	2.36233	0.02153	2.3127	2.4120
3/2/2	3	2.35447	0.02153	2.3048	2.4041

Std Error uses a pooled estimate of error variance

Figure A3. PSAL Measurements by Analytical Set, Block, and Sub-Block for Samples of the Batch 1 and Ustd Standards by Oxide

Oneway Analysis of Measured By Set/Blk/Sub-Blk
Glass ID=U std, Oxide=ZnO (wt%)
Reference Value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	.
Adj Rsquare	.
Root Mean Square Error	0
Mean of Response	0.006224
Observations (or Sum Wgts)	12

Analysis of Variance

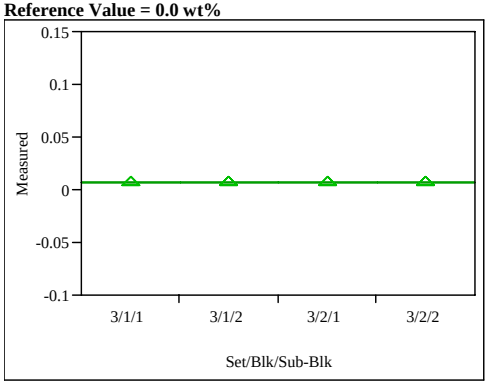
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	3	0	0	.	.
Error	8	0	0		
C. Total	11	0			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
3/1/1	3	0.006224	0	0.00622	0.00622
3/1/2	3	0.006224	0	0.00622	0.00622
3/2/1	3	0.006224	0	0.00622	0.00622
3/2/2	3	0.006224	0	0.00622	0.00622

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measured By Set/Blk/Sub-Blk
Glass ID=U std, Oxide=ZrO2 (wt%)
Reference Value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	.
Adj Rsquare	.
Root Mean Square Error	0
Mean of Response	0.006754
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Blk/Sub-Blk	3	0	0	.	.
Error	8	0	0		
C. Total	11	0			

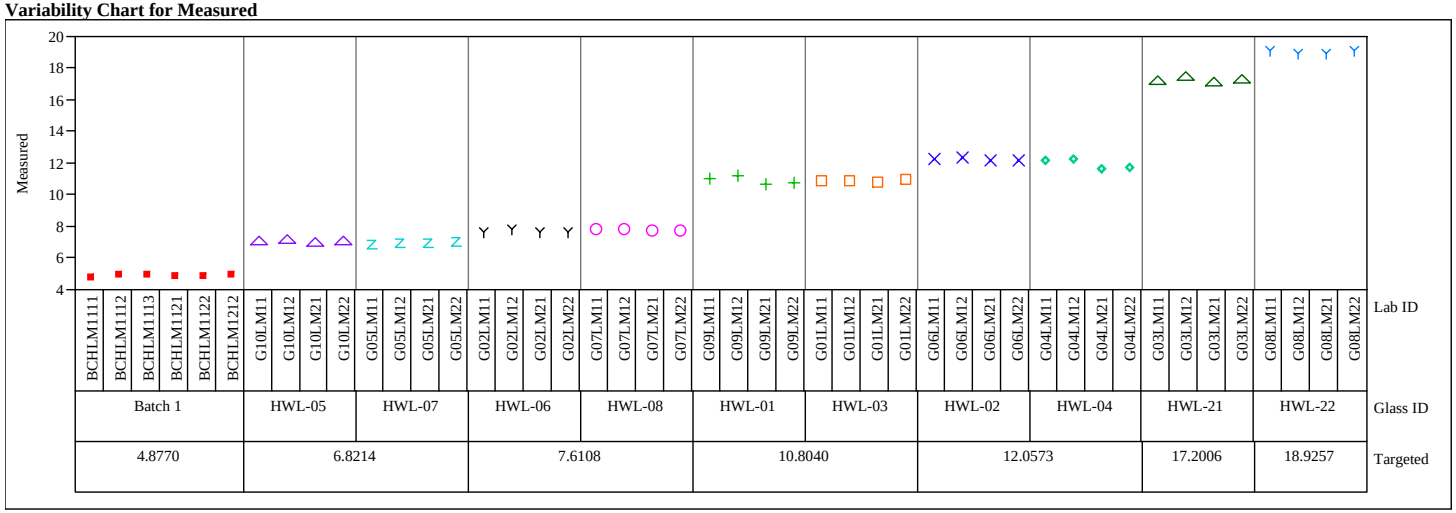
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
3/1/1	3	0.006754	0	0.00675	0.00675
3/1/2	3	0.006754	0	0.00675	0.00675
3/2/1	3	0.006754	0	0.00675	0.00675
3/2/2	3	0.006754	0	0.00675	0.00675

Std Error uses a pooled estimate of error variance

Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=1, Oxide=Al2O3 (wt%)
Variability Chart for Measured



Set=1, Oxide=Al2O3 (wt%)
Variability Chart for Measured bc

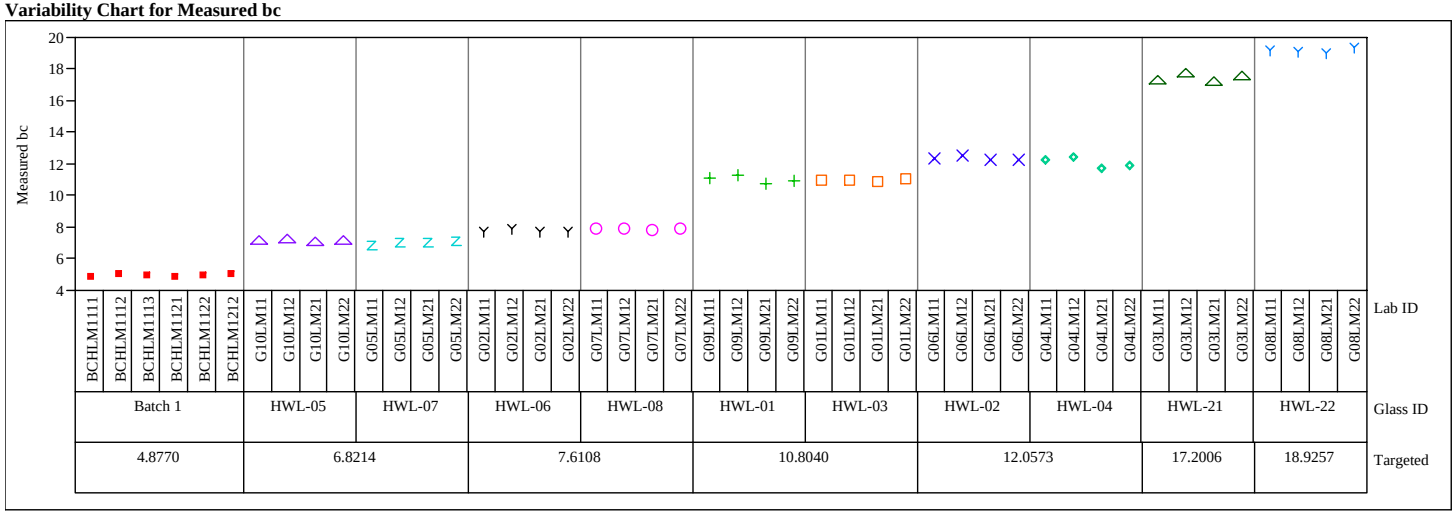
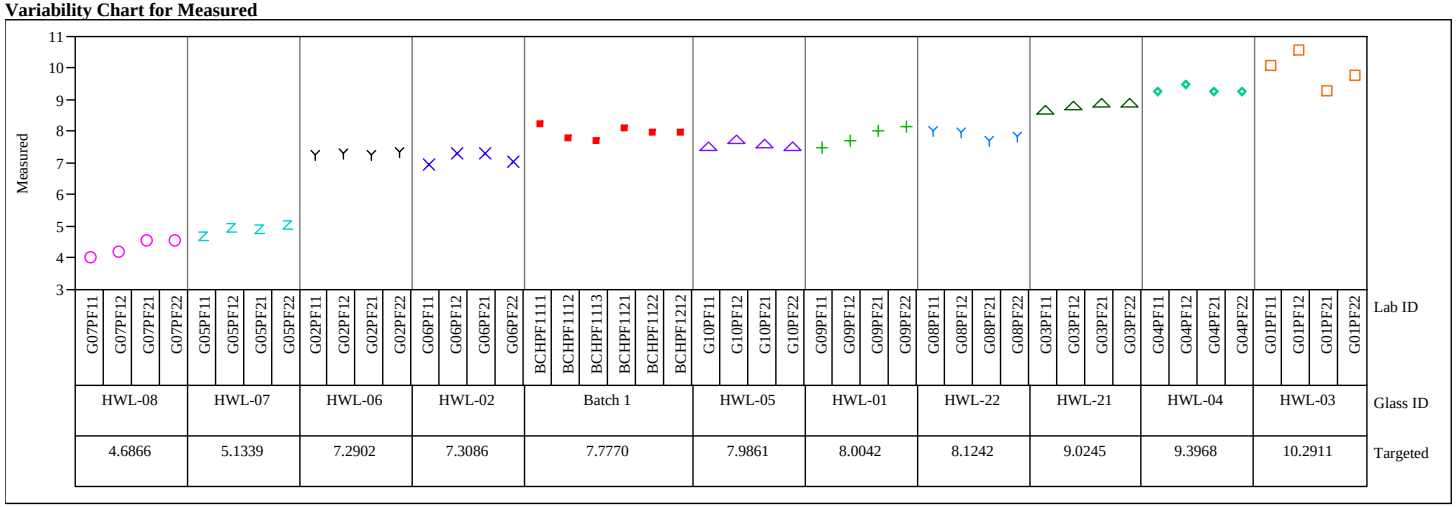


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=1, Oxide=B2O3 (wt%)
Variability Chart for Measured



Set=1, Oxide=B2O3 (wt%)
Variability Chart for Measured bc

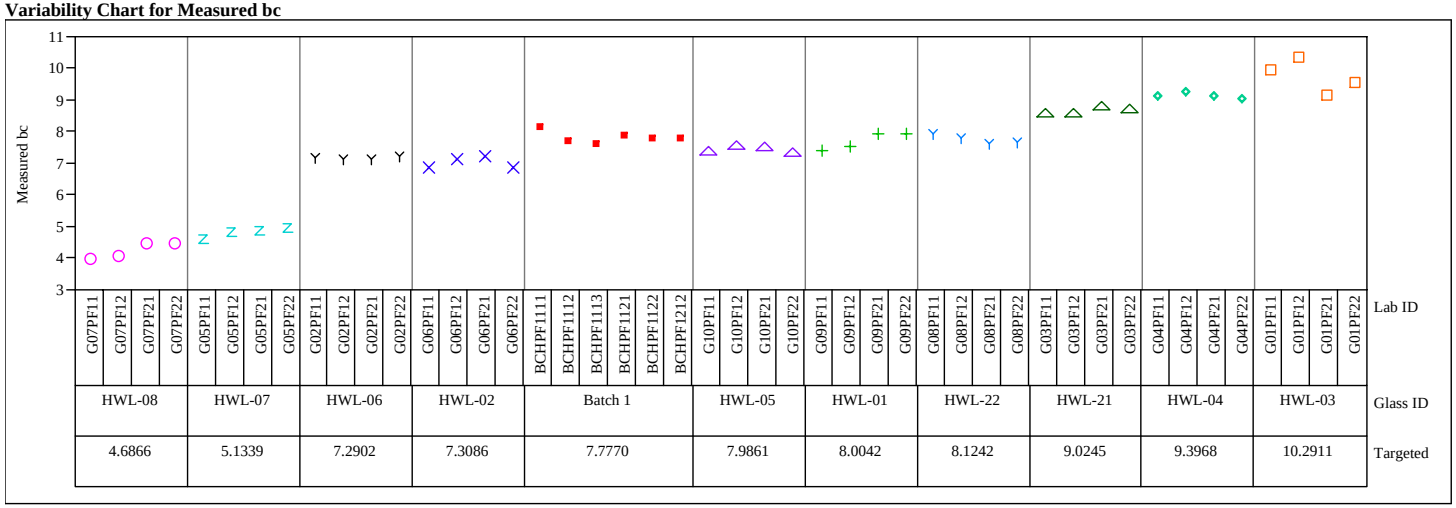
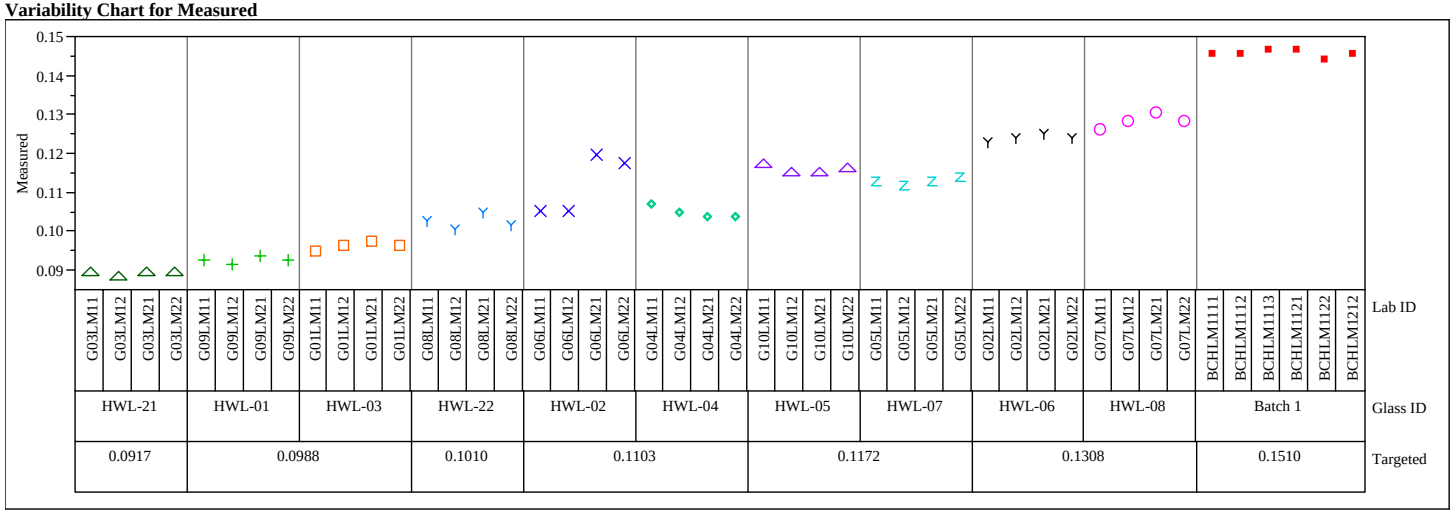


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=1, Oxide=BaO (wt%)
Variability Chart for Measured



Set=1, Oxide=BaO (wt%)
Variability Chart for Measured bc

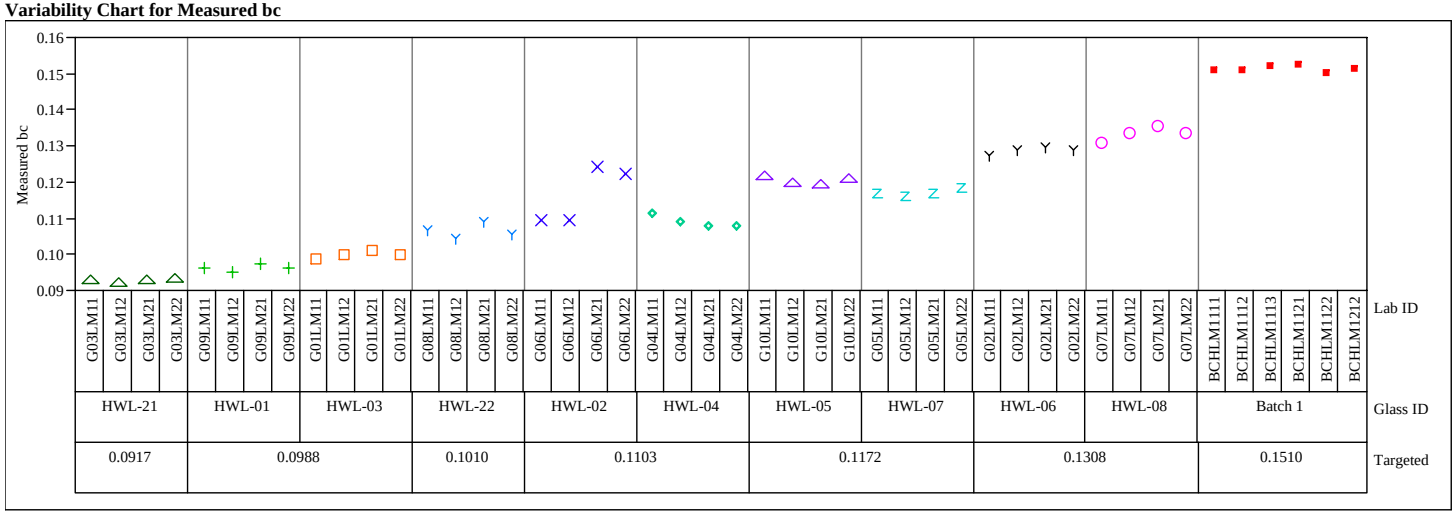
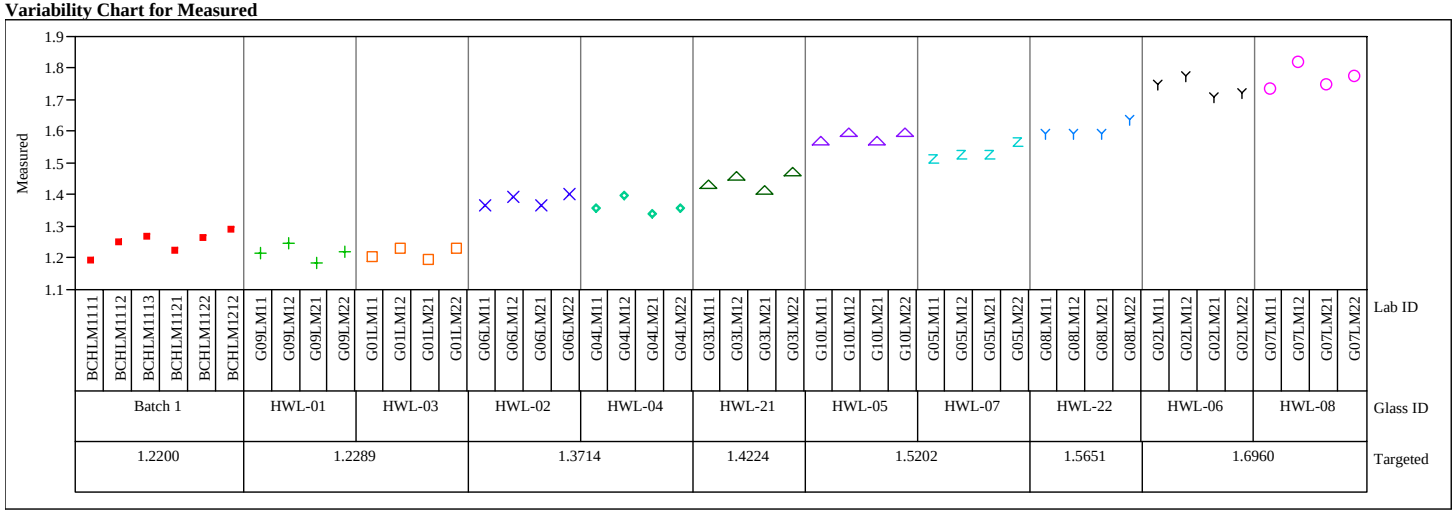


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=1, Oxide=CaO (wt%)
Variability Chart for Measured



Set=1, Oxide=CaO (wt%)
Variability Chart for Measured bc

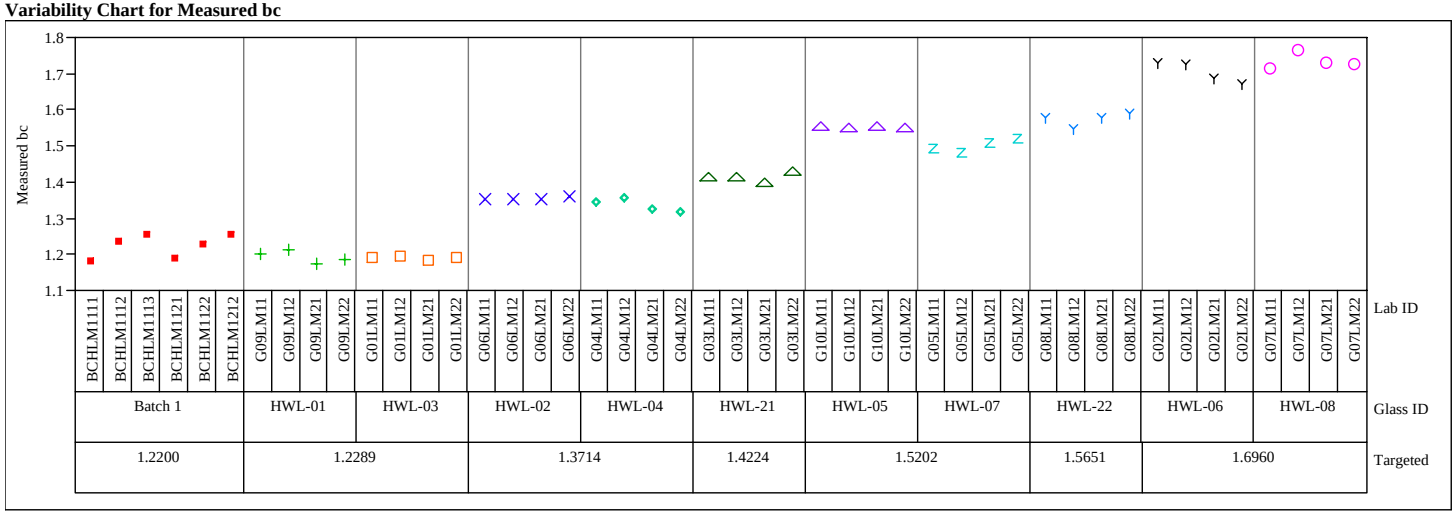
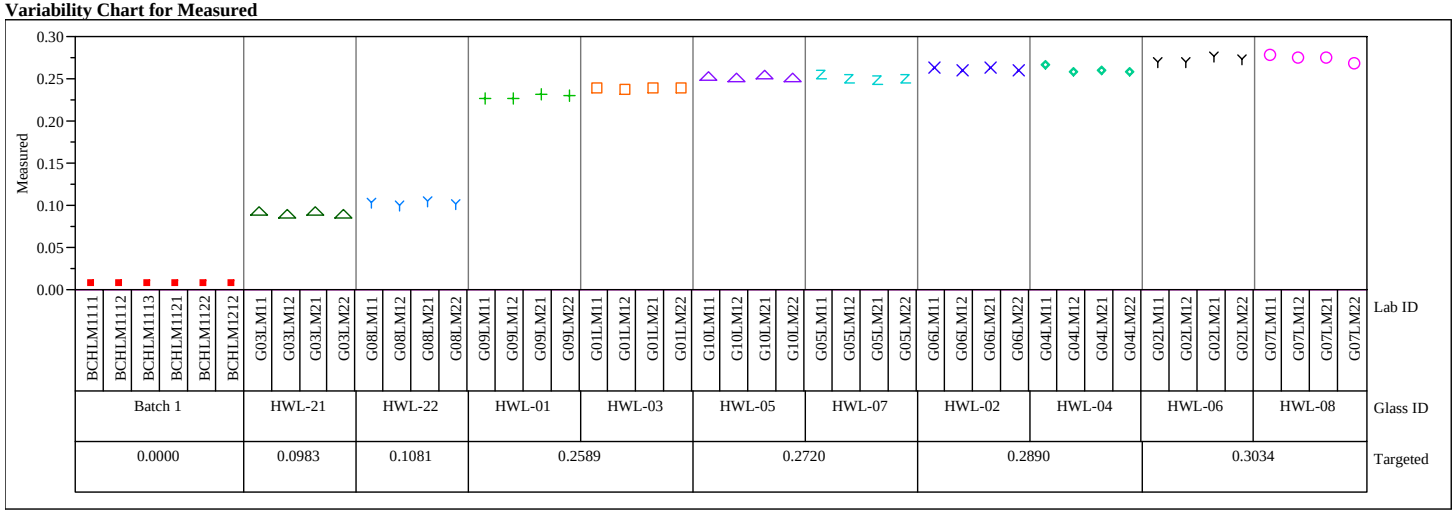


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=1, Oxide=Ce2O3 (wt%)
Variability Chart for Measured



Set=1, Oxide=Ce2O3 (wt%)
Variability Chart for Measured bc

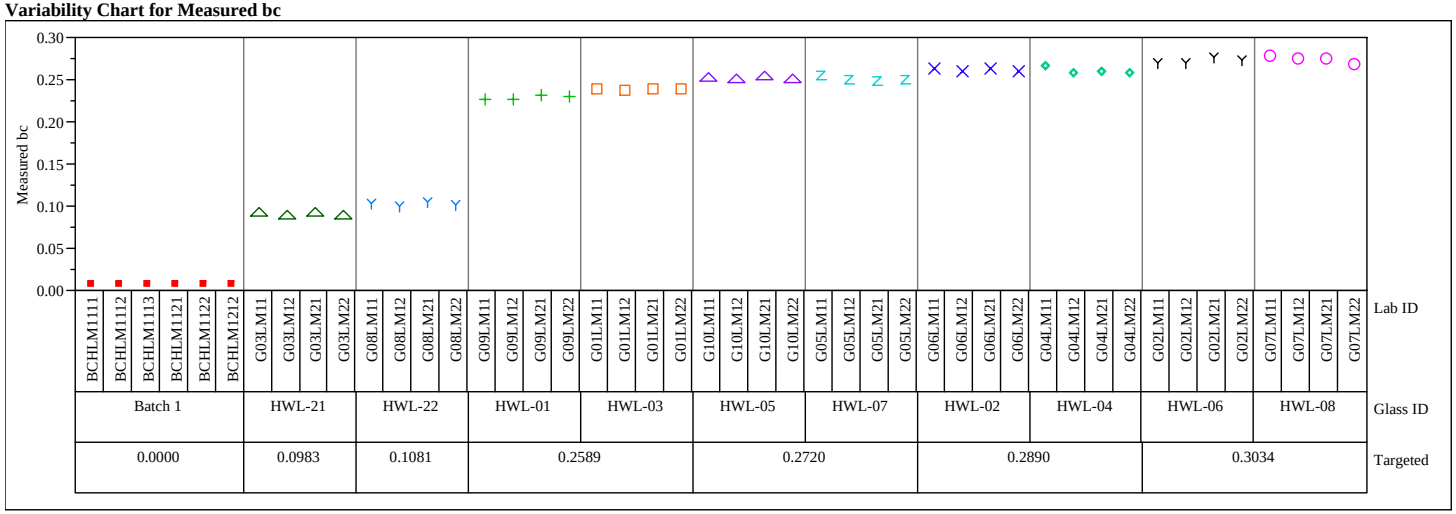
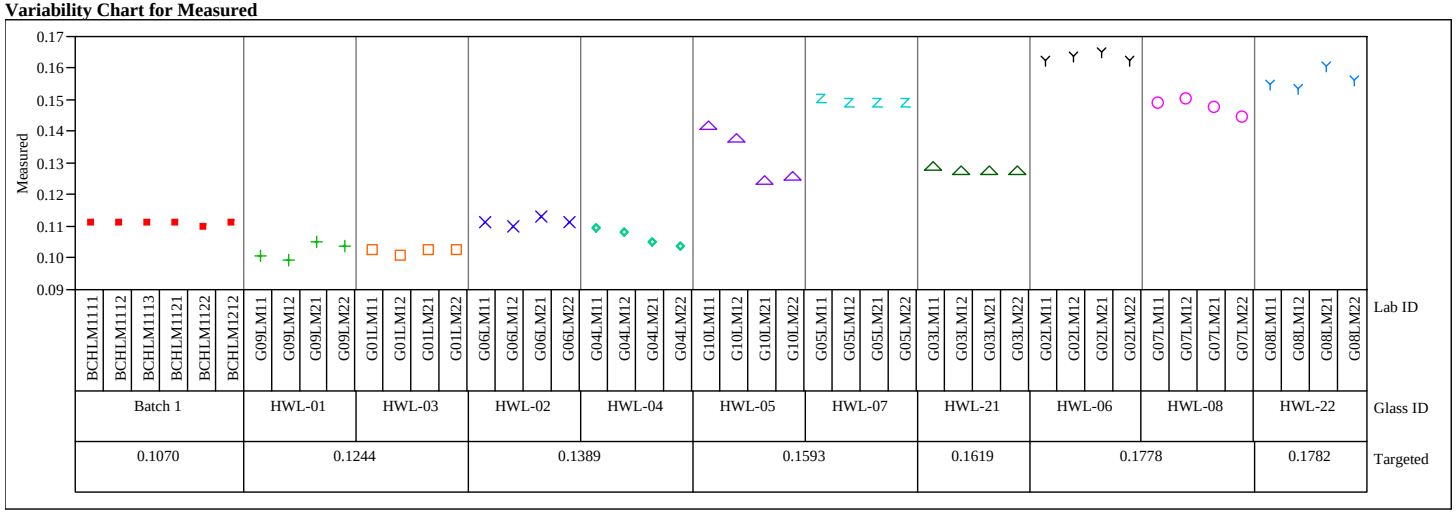


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=1, Oxide=Cr2O3 (wt%)
Variability Chart for Measured



Set=1, Oxide=Cr2O3 (wt%)
Variability Chart for Measured bc

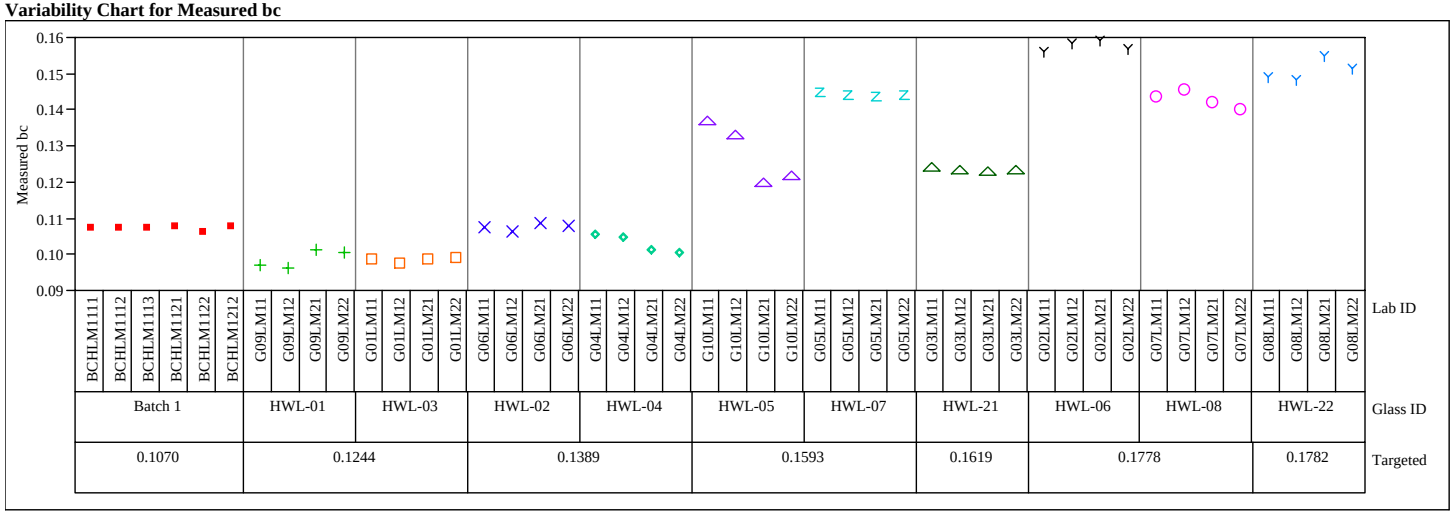
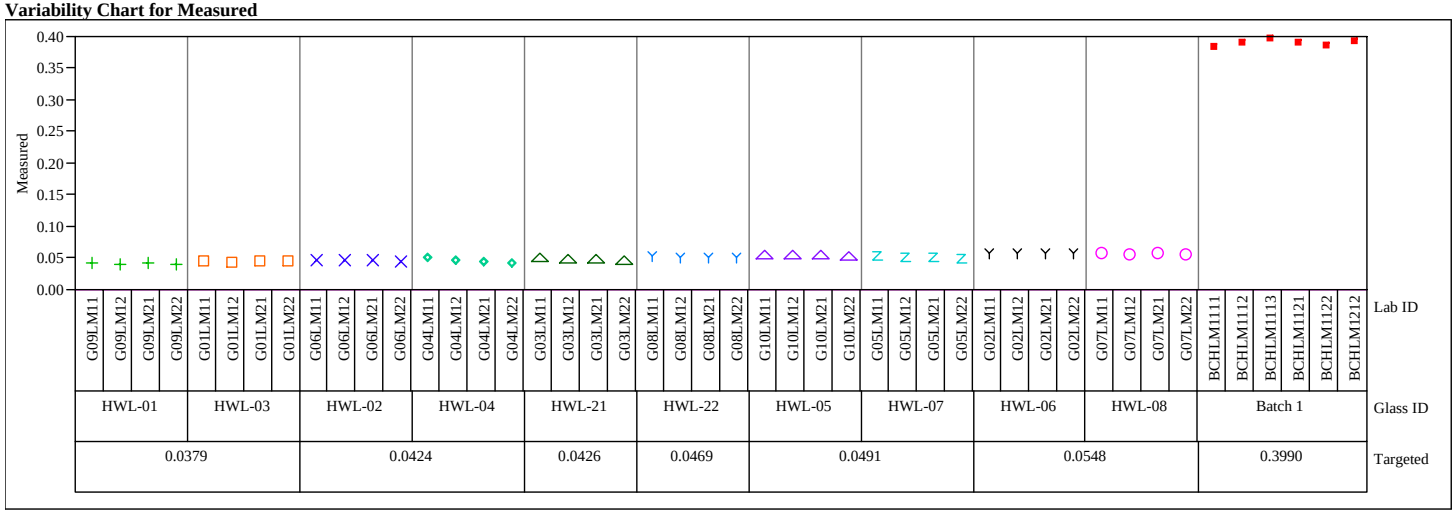


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=1, Oxide=CuO (wt%)
Variability Chart for Measured



Set=1, Oxide=CuO (wt%)
Variability Chart for Measured bc

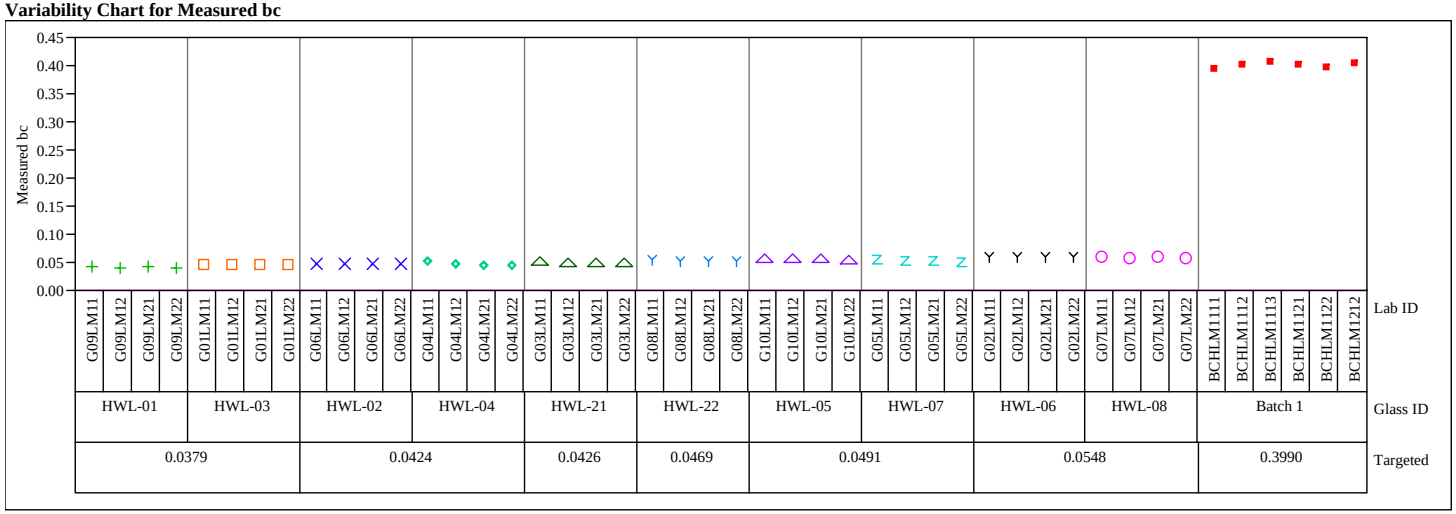
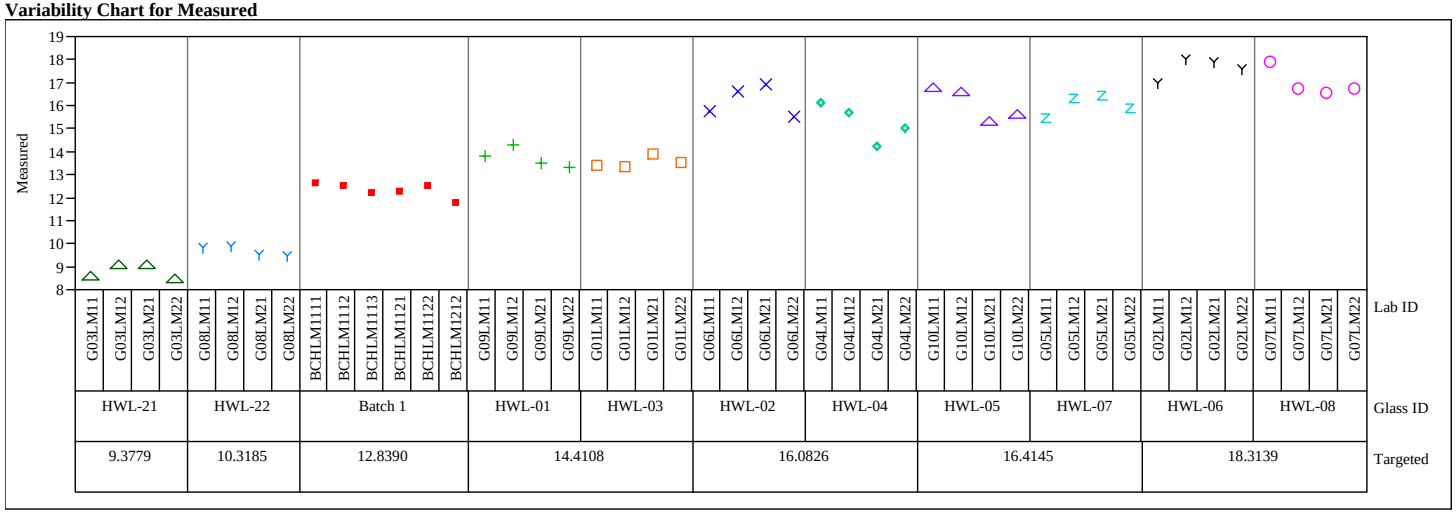


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=1, Oxide=Fe2O3 (wt%)
Variability Chart for Measured



Set=1, Oxide=Fe2O3 (wt%)
Variability Chart for Measured bc

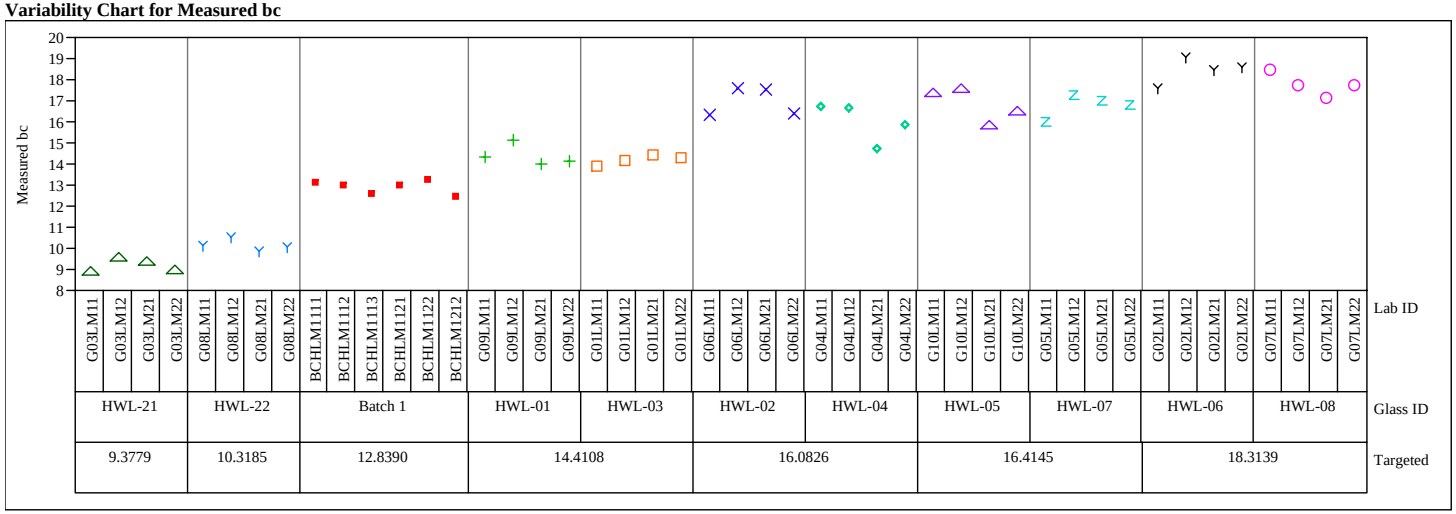
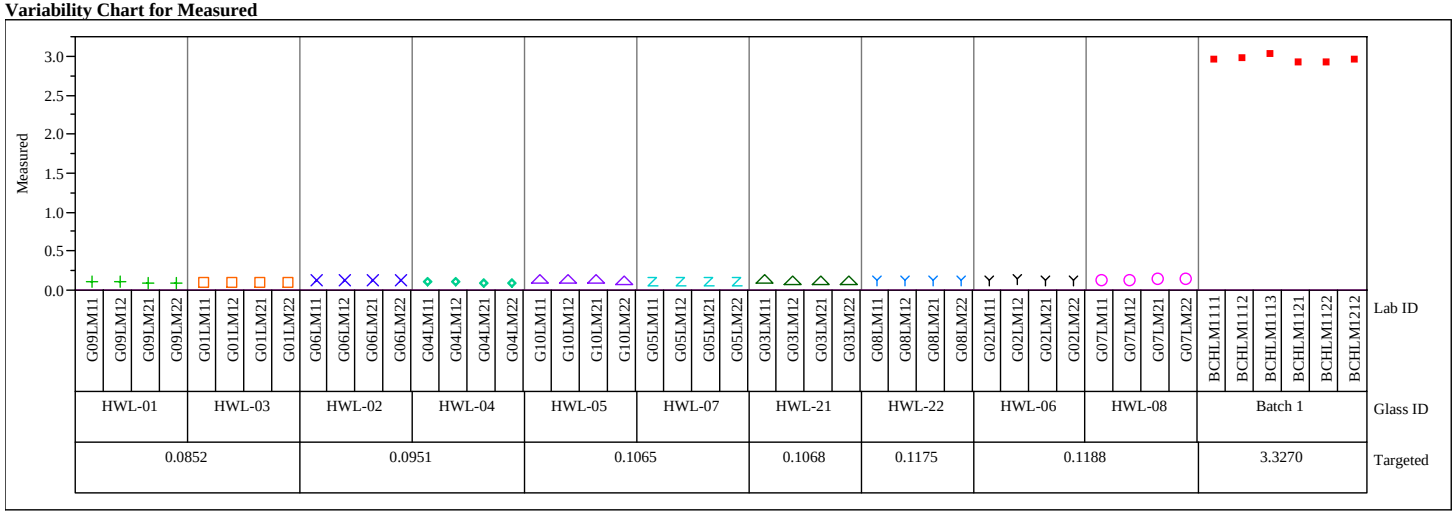


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=1, Oxide=K2O (wt%)
Variability Chart for Measured



Set=1, Oxide=K2O (wt%)
Variability Chart for Measured bc

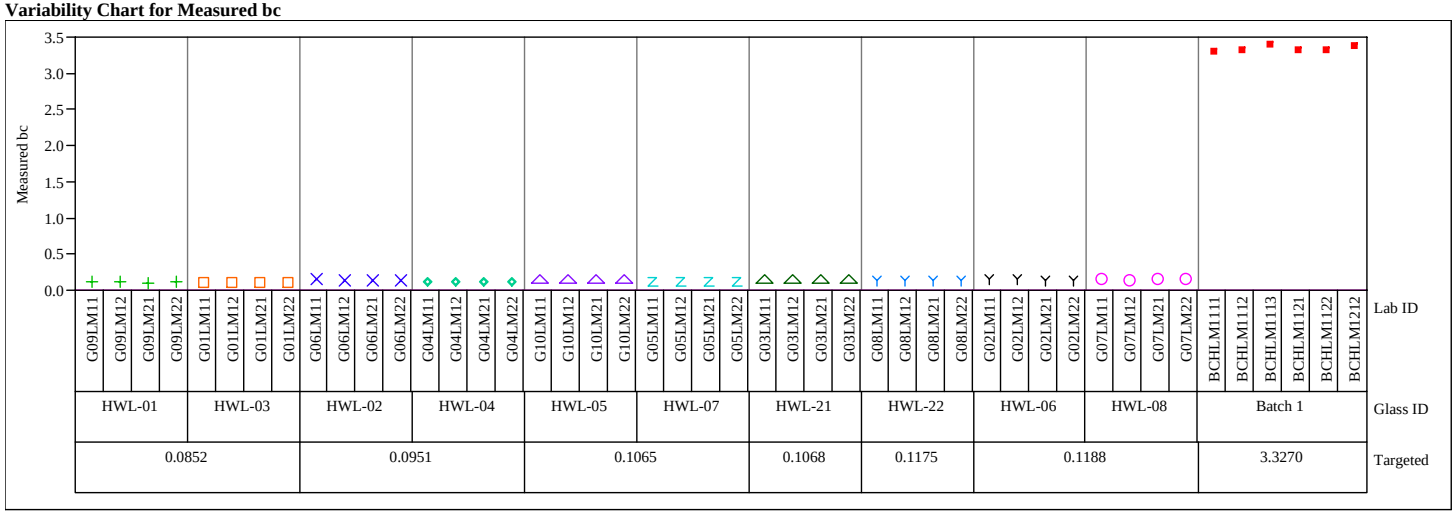
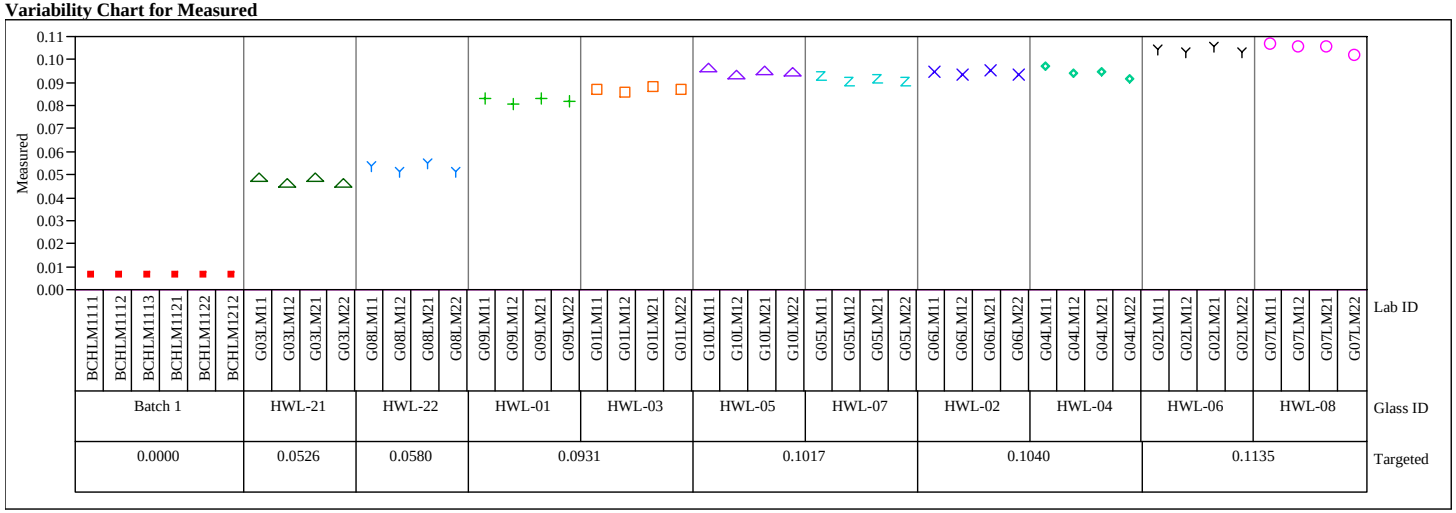


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=1, Oxide=La2O3 (wt%)
Variability Chart for Measured



Set=1, Oxide=La2O3 (wt%)
Variability Chart for Measured bc

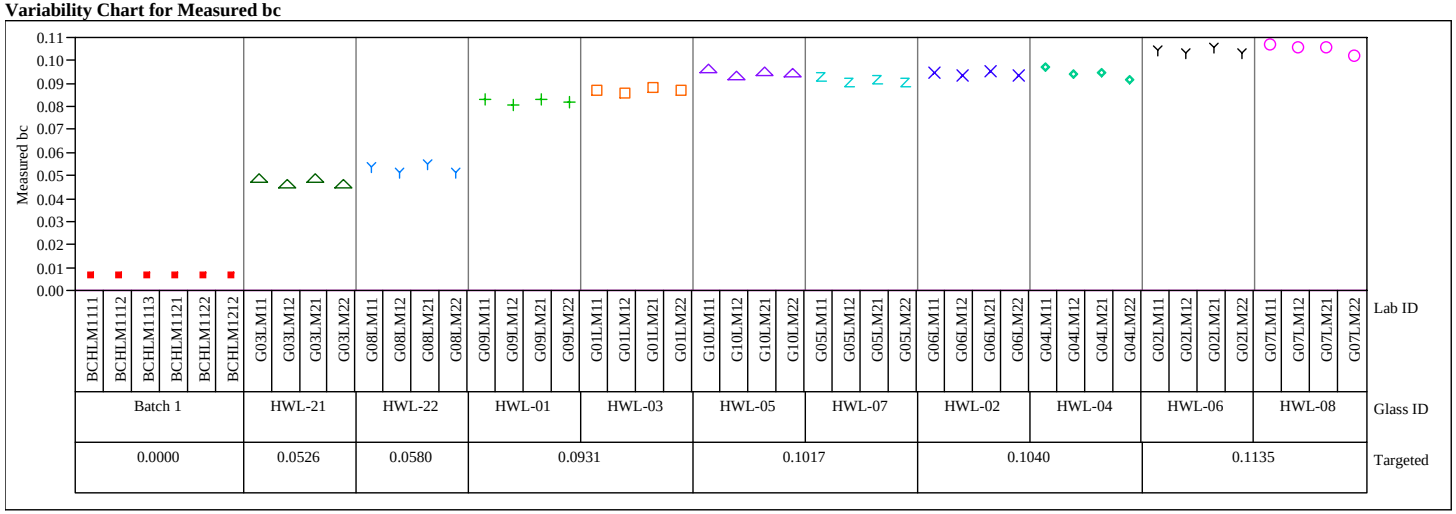
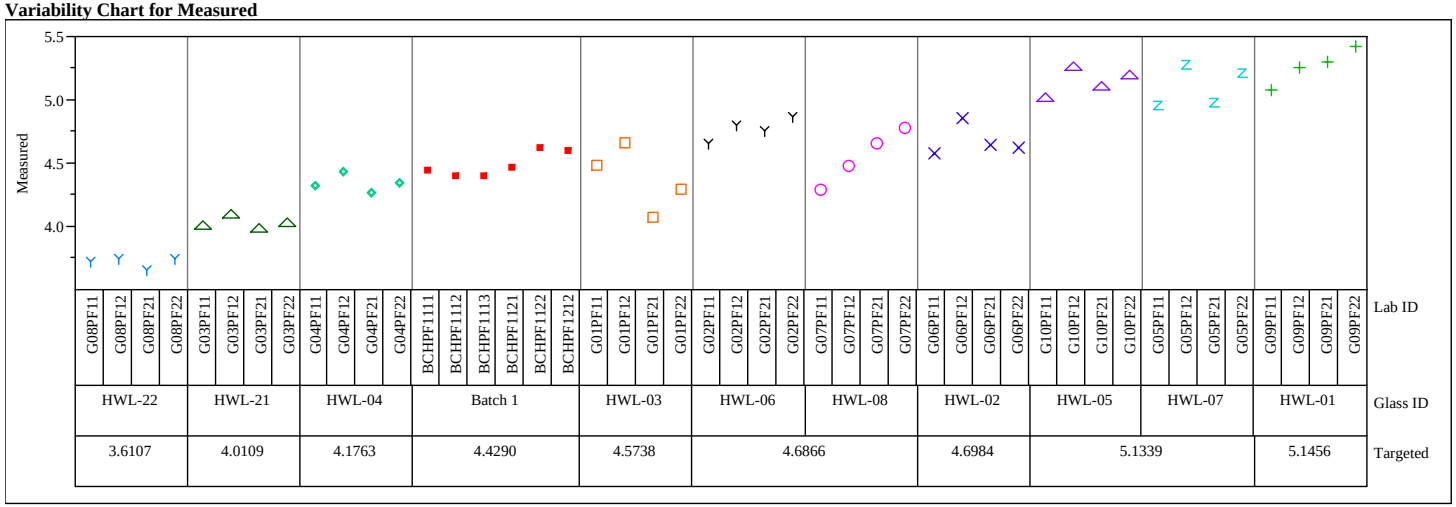


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=1, Oxide=Li2O (wt%)
Variability Chart for Measured



Set=1, Oxide=Li2O (wt%)
Variability Chart for Measured bc

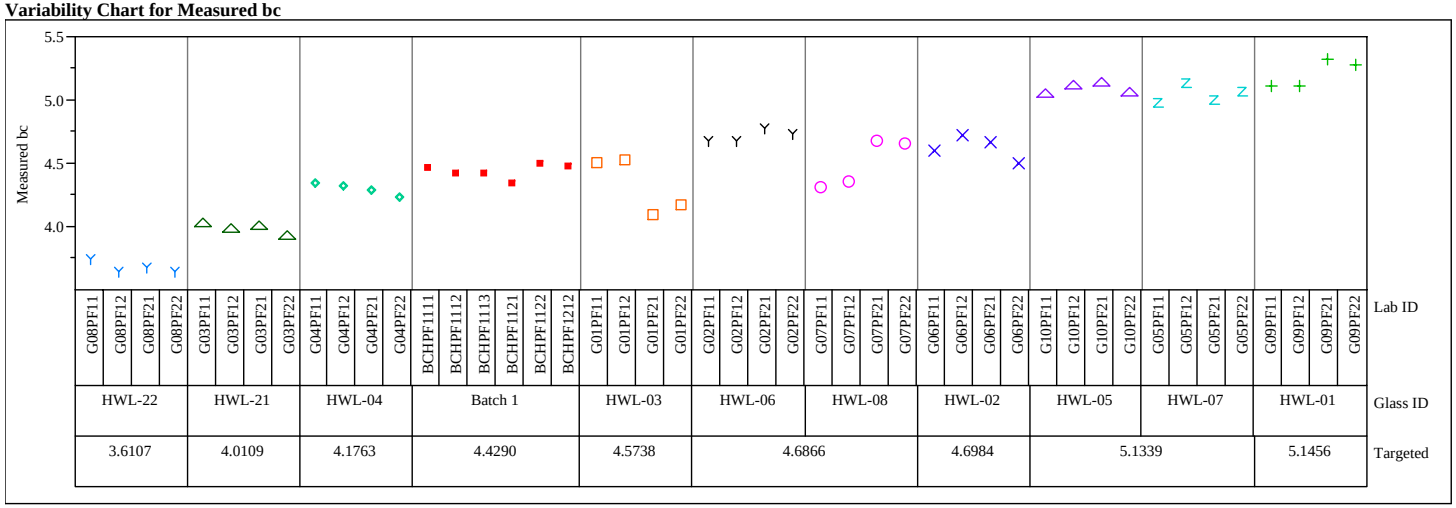
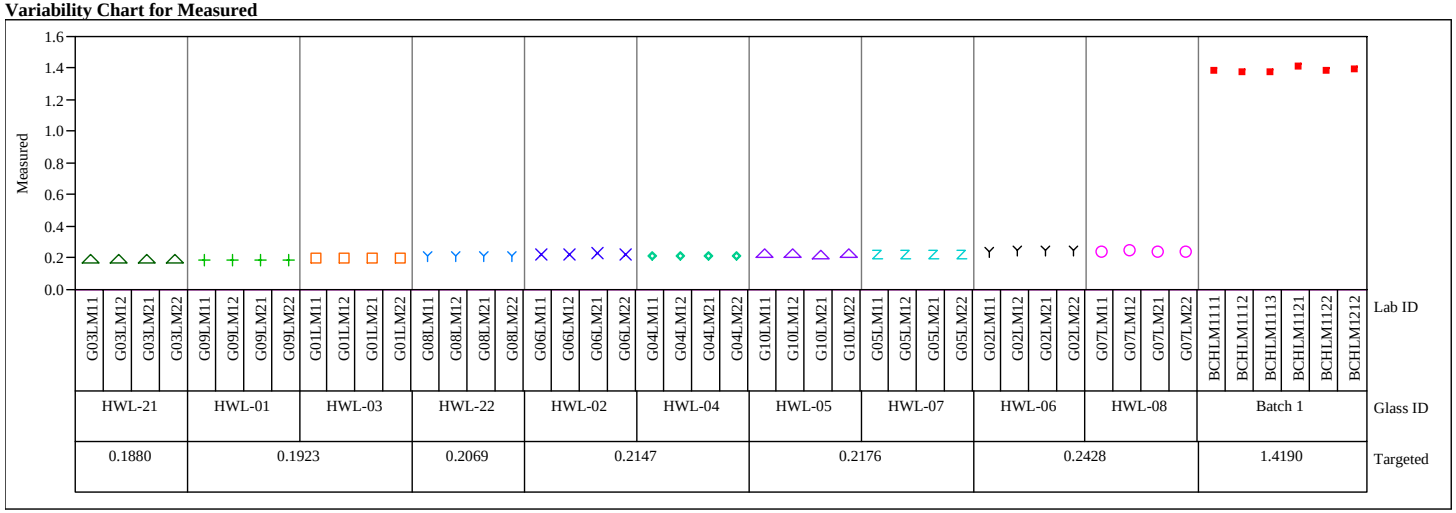


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=1, Oxide=MgO (wt%)
Variability Chart for Measured



Set=1, Oxide=MgO (wt%)
Variability Chart for Measured bc

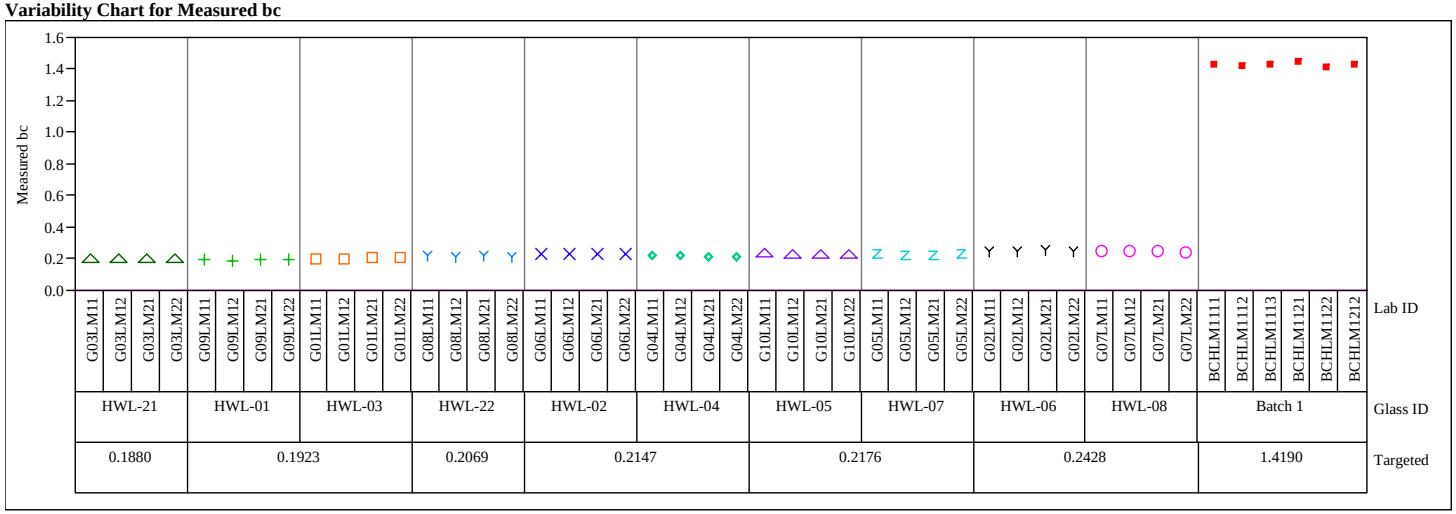
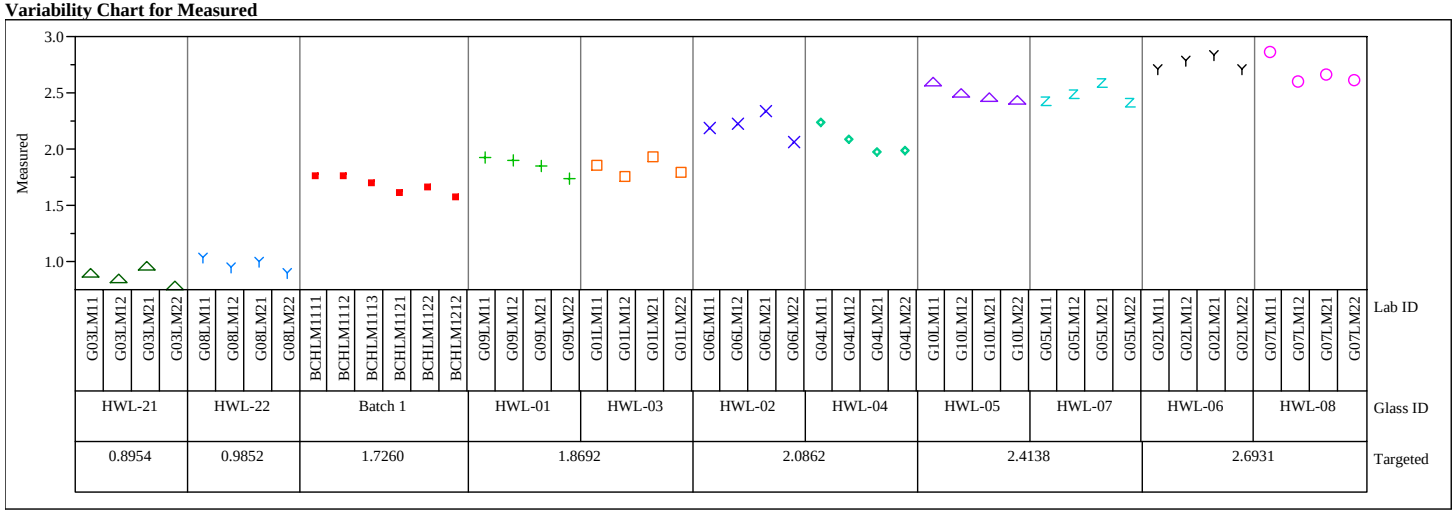


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=1, Oxide=MnO (wt%)
Variability Chart for Measured



Set=1, Oxide=MnO (wt%)
Variability Chart for Measured bc

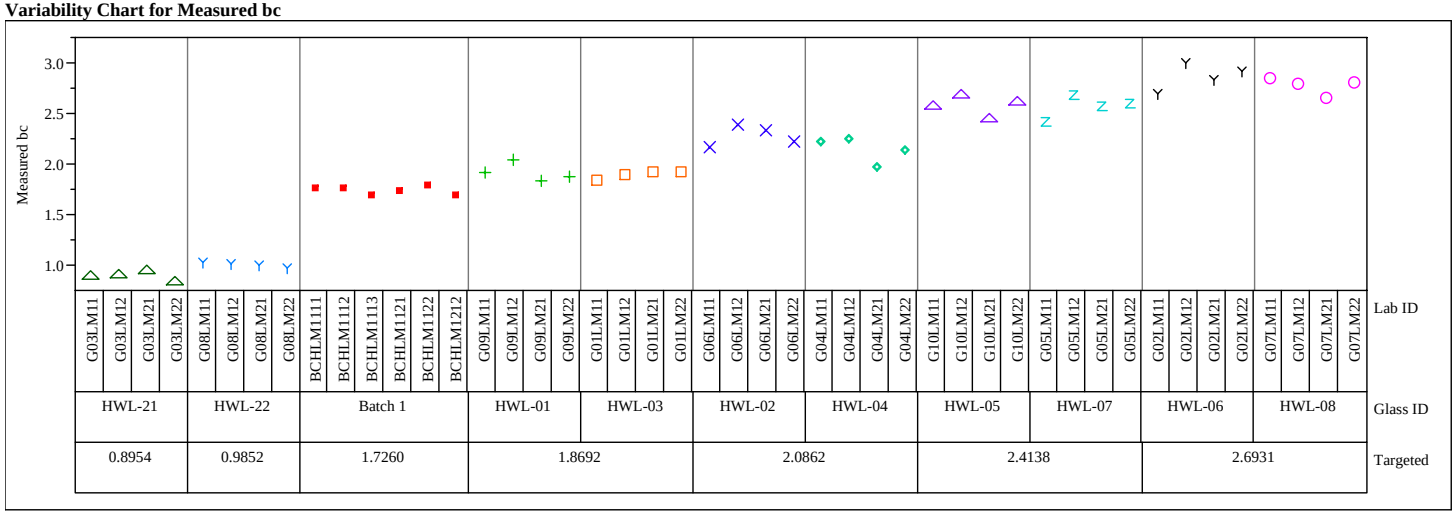
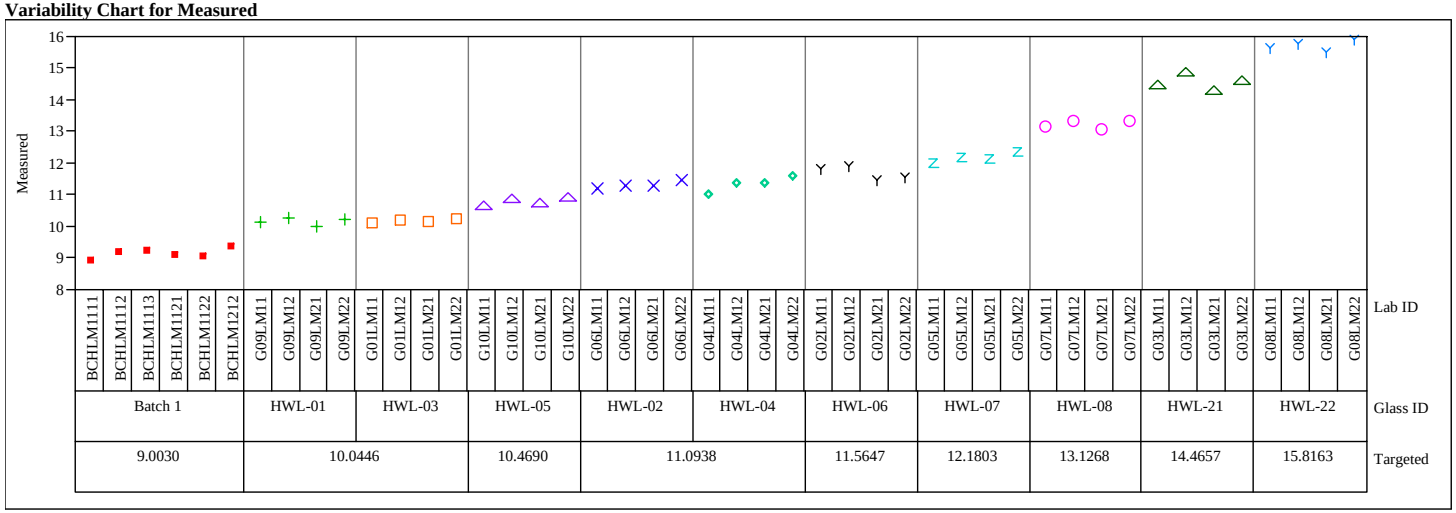


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=1, Oxide=Na2O (wt%)
Variability Chart for Measured



Set=1, Oxide=Na2O (wt%)
Variability Chart for Measured bc

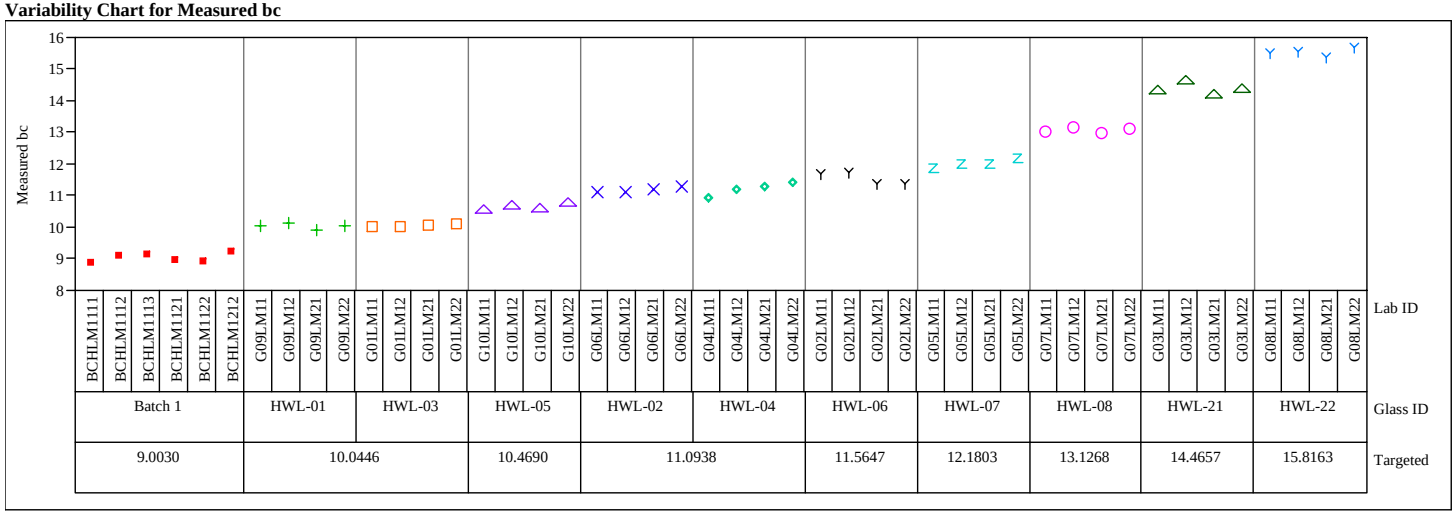
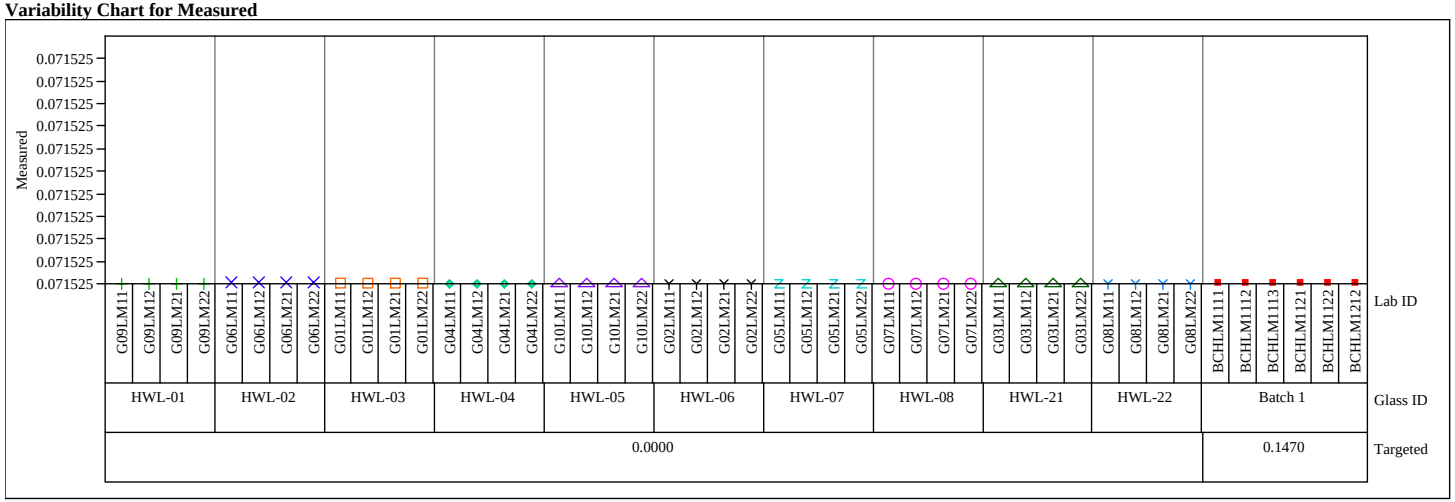


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=1, Oxide=Nb2O5 (wt%)
Variability Chart for Measured



Set=1, Oxide=Nb2O5 (wt%)
Variability Chart for Measured bc

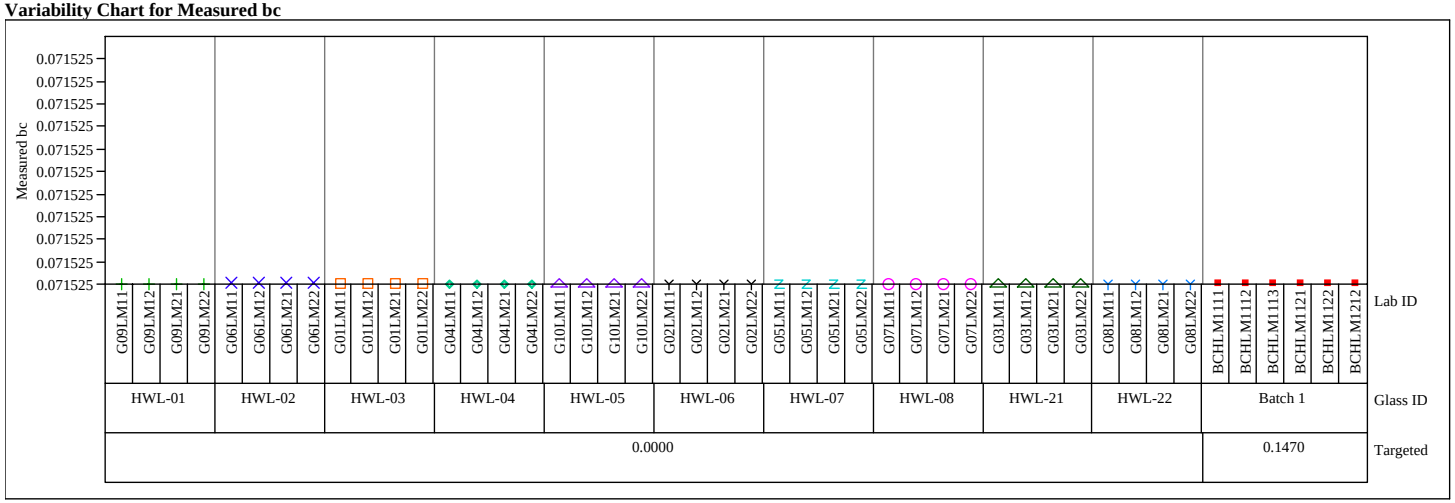
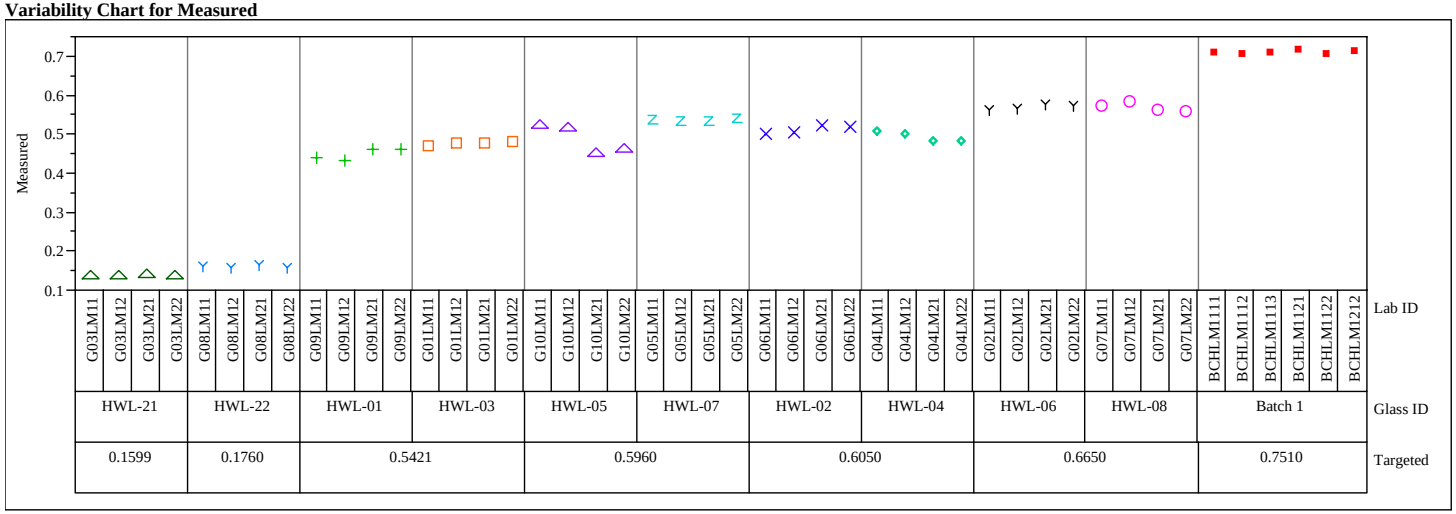


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=1, Oxide=NiO (wt%)
Variability Chart for Measured



Set=1, Oxide=NiO (wt%)
Variability Chart for Measured bc

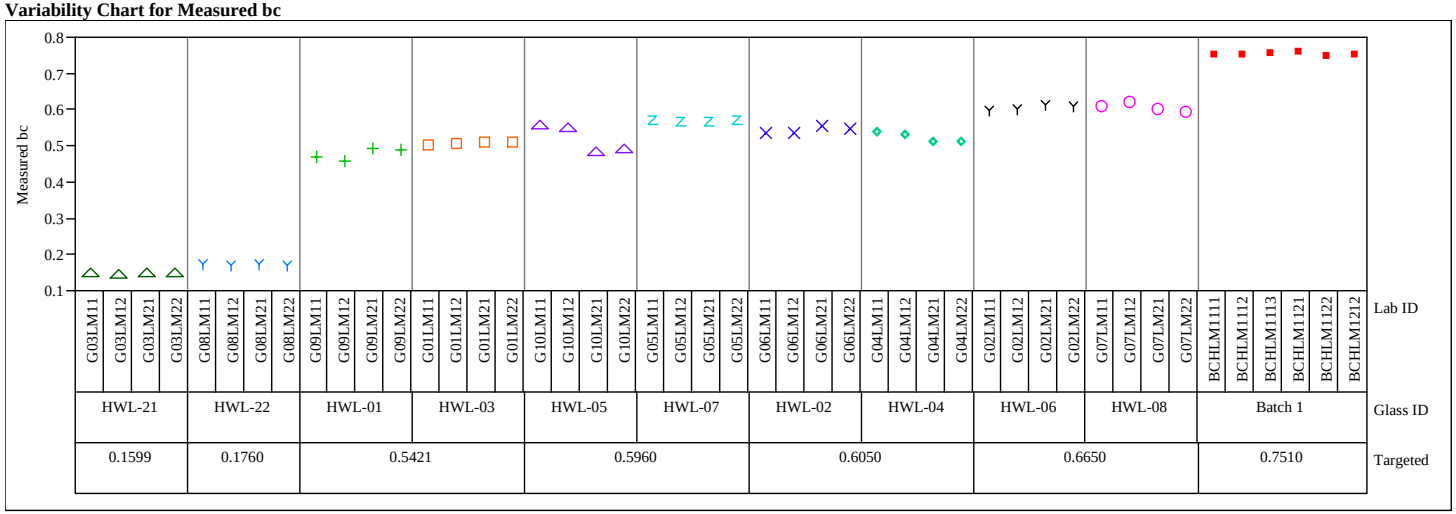
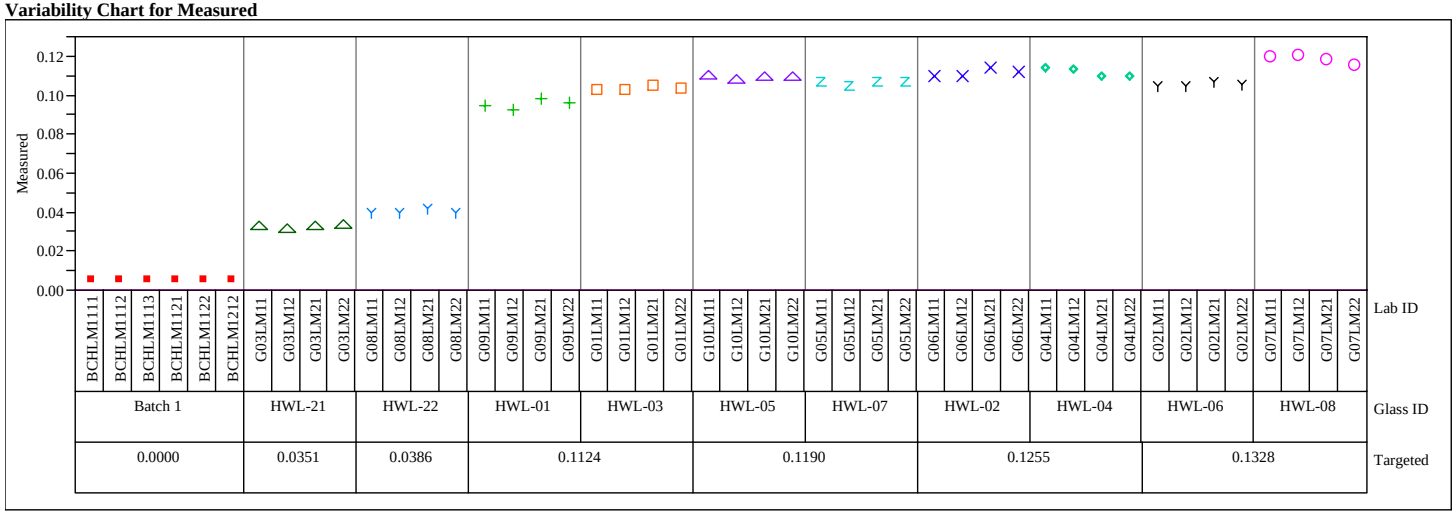


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=1, Oxide=PbO (wt%)
Variability Chart for Measured



Set=1, Oxide=PbO (wt%)
Variability Chart for Measured bc

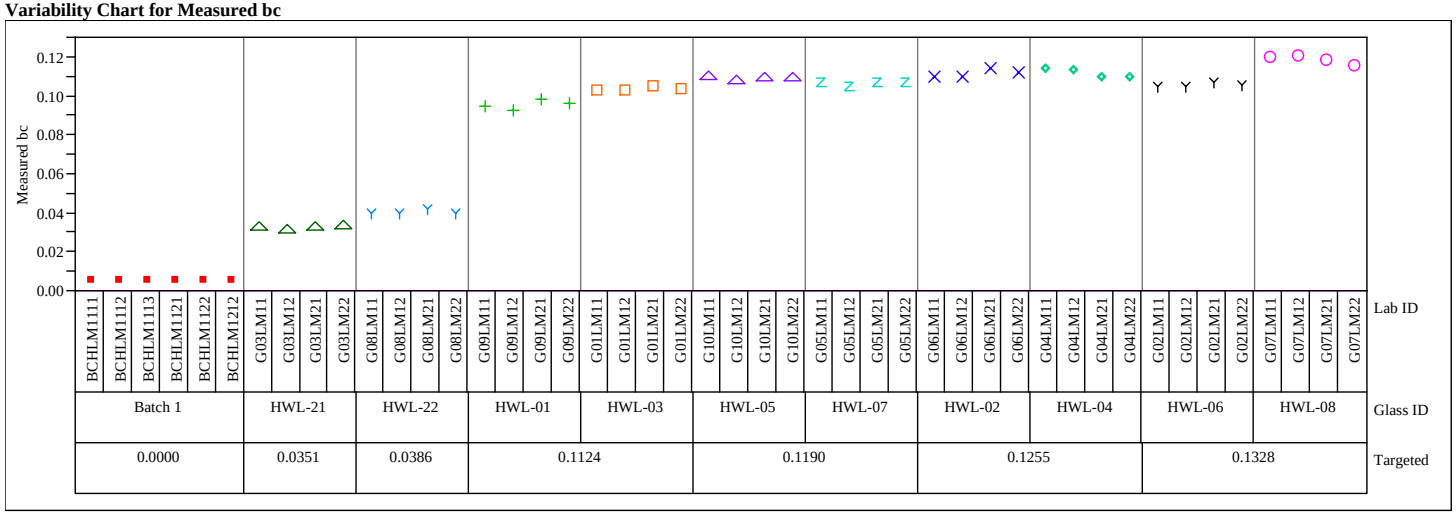
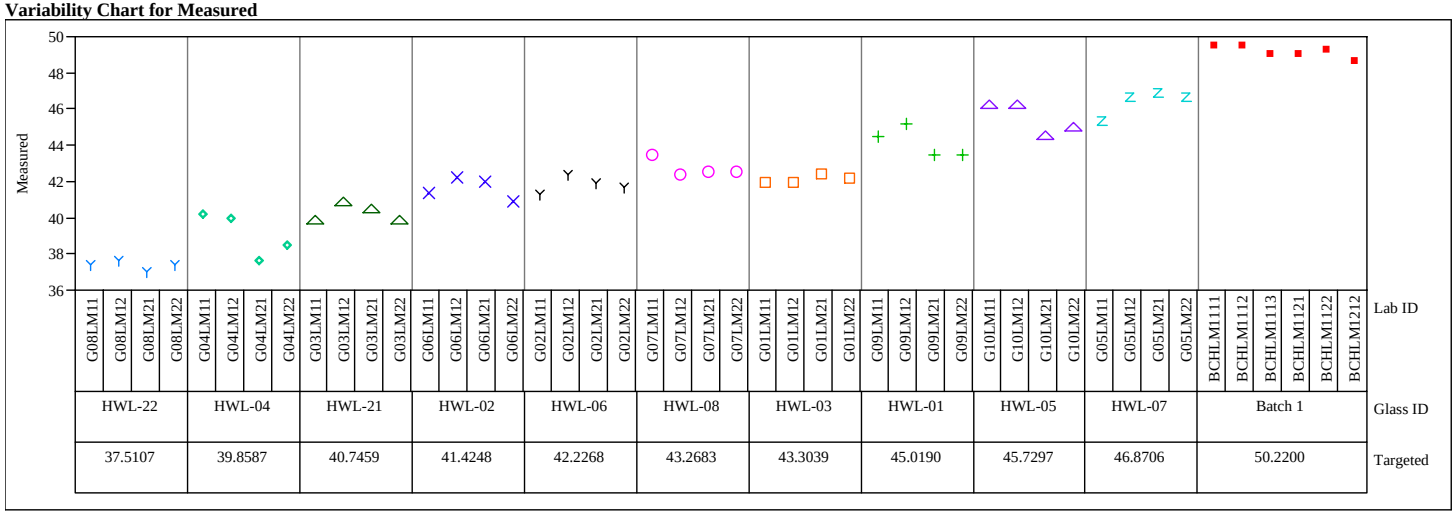


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=1, Oxide=SiO2 (wt%)
Variability Chart for Measured



Set=1, Oxide=SiO2 (wt%)
Variability Chart for Measured bc

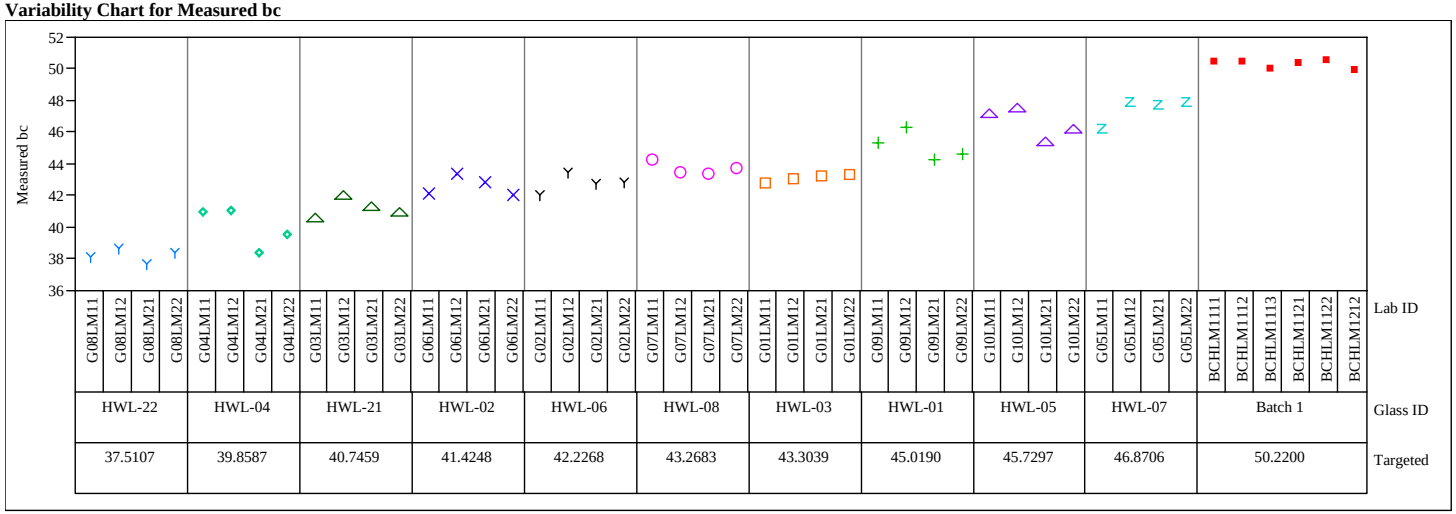
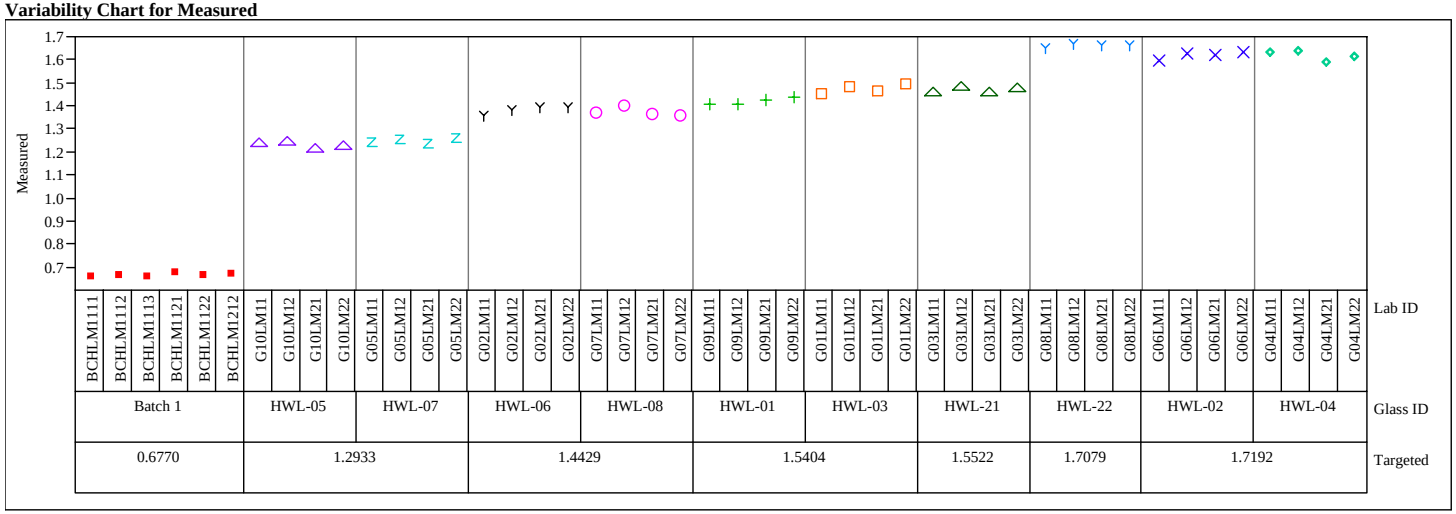


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=1, Oxide=TiO2 (wt%)
Variability Chart for Measured



Set=1, Oxide=TiO2 (wt%)
Variability Chart for Measured bc

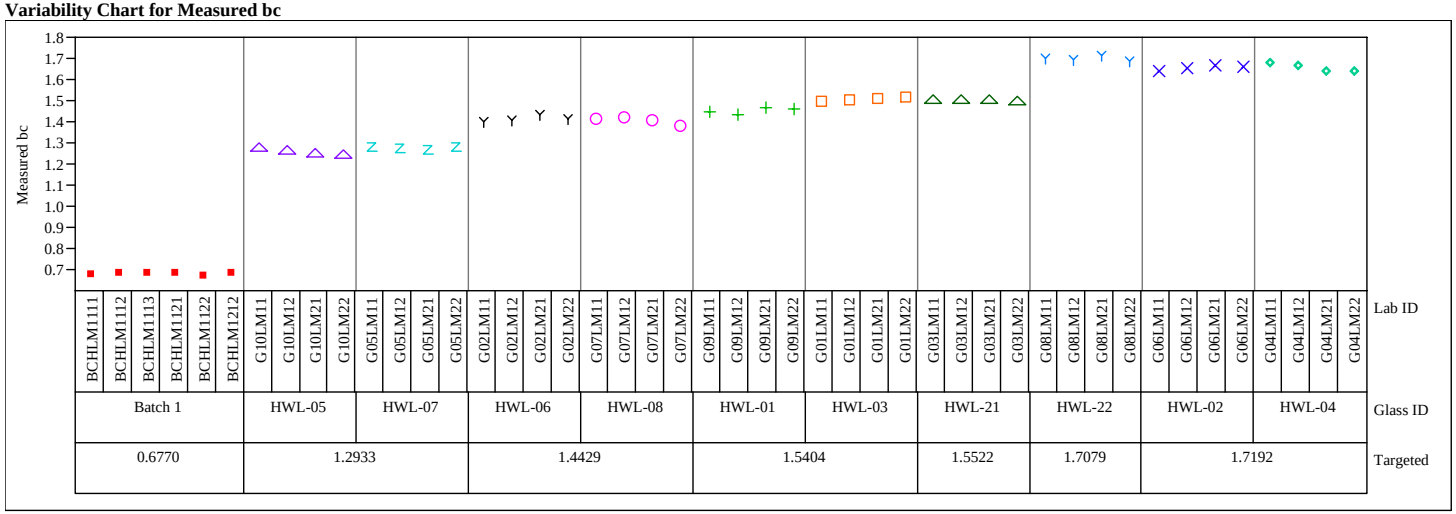
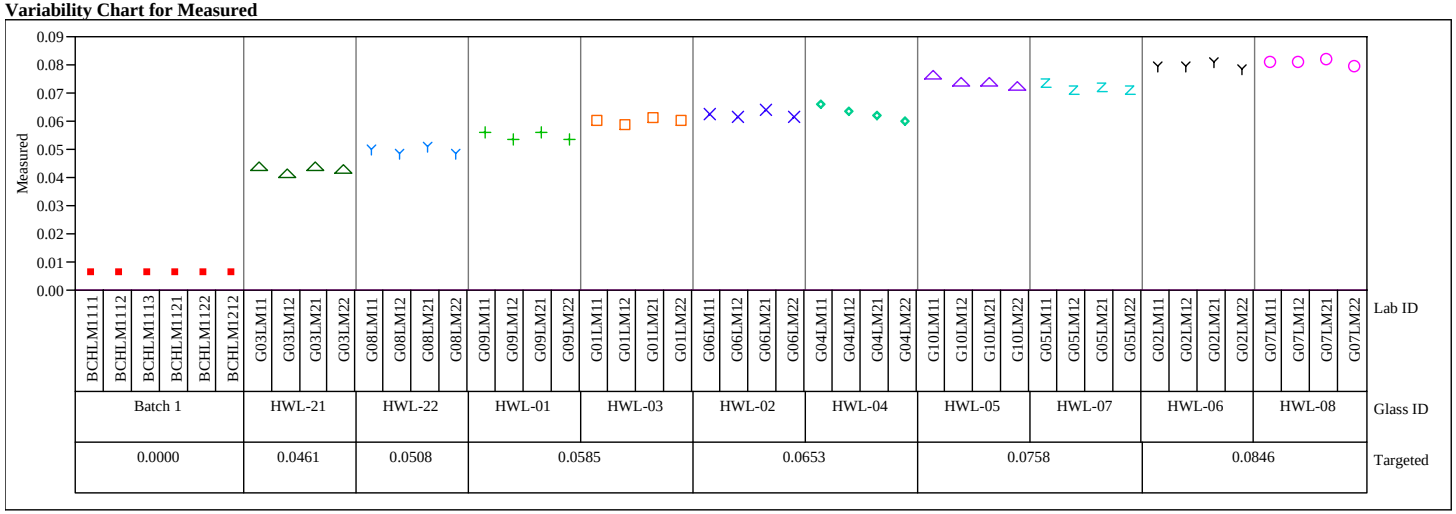


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=1, Oxide=ZnO (wt%)
Variability Chart for Measured



Set=1, Oxide=ZnO (wt%)
Variability Chart for Measured bc

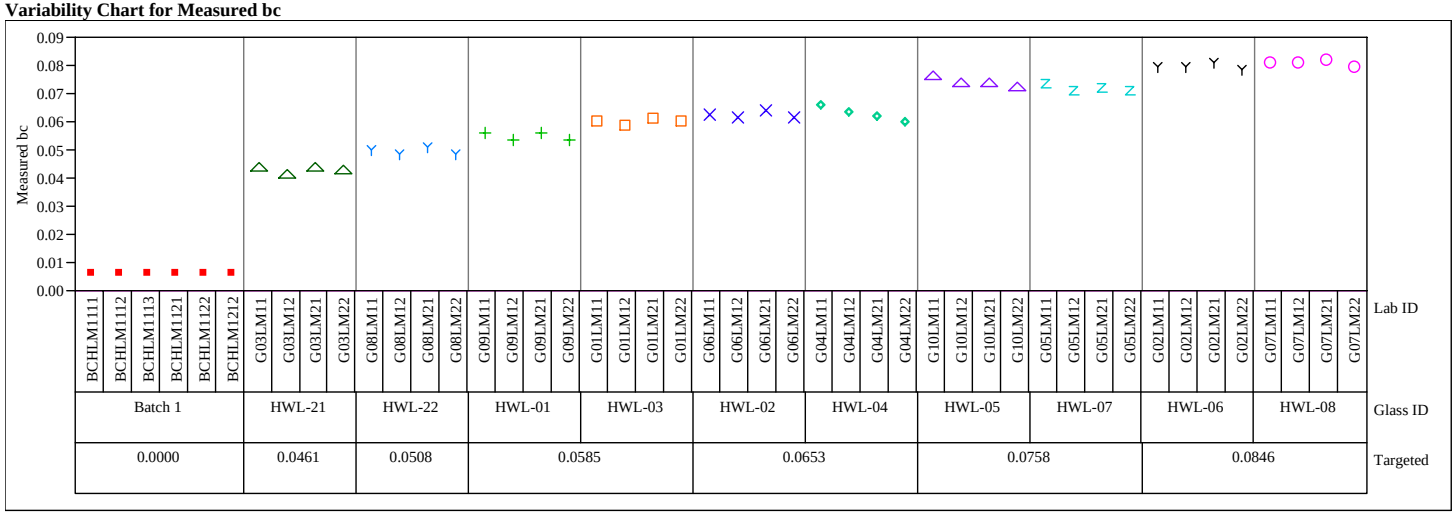
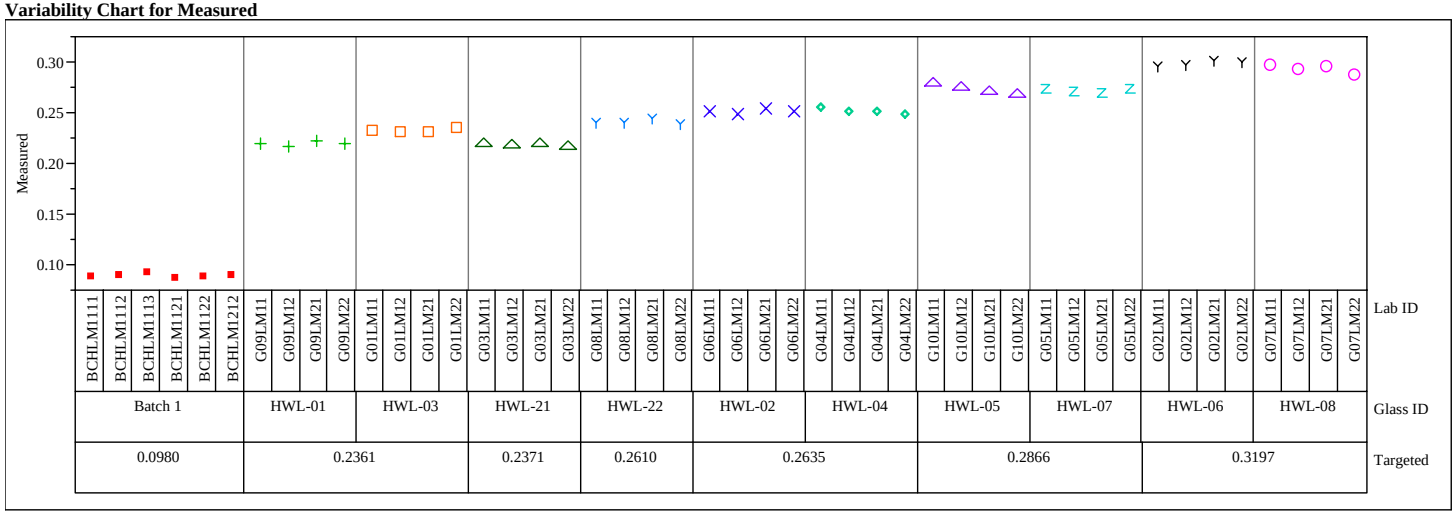


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=1, Oxide=ZrO2 (wt%)
Variability Chart for Measured



Set=1, Oxide=ZrO2 (wt%)
Variability Chart for Measured bc

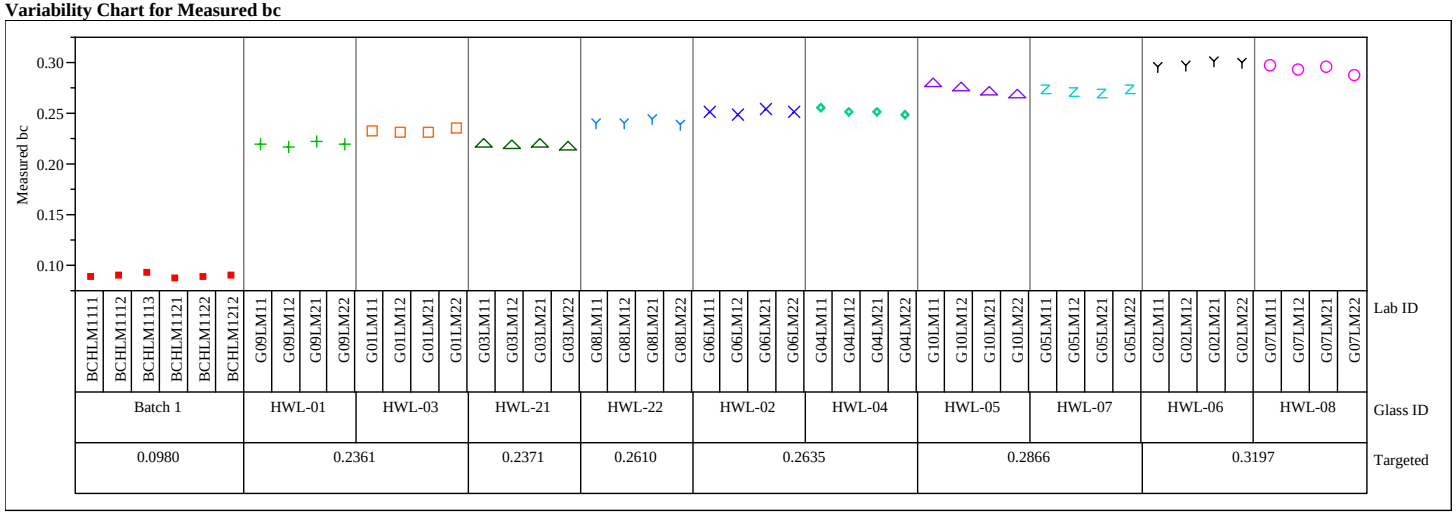
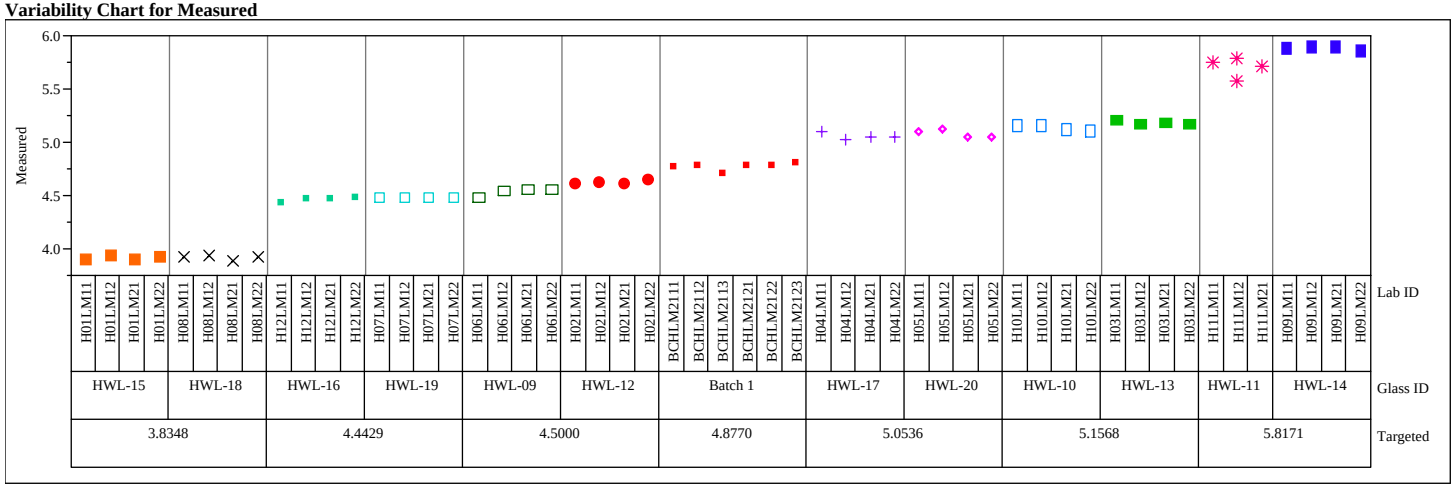


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=2, Oxide=Al2O3 (wt%)
Variability Chart for Measured



Set=2, Oxide=Al2O3 (wt%)
Variability Chart for Measured bc

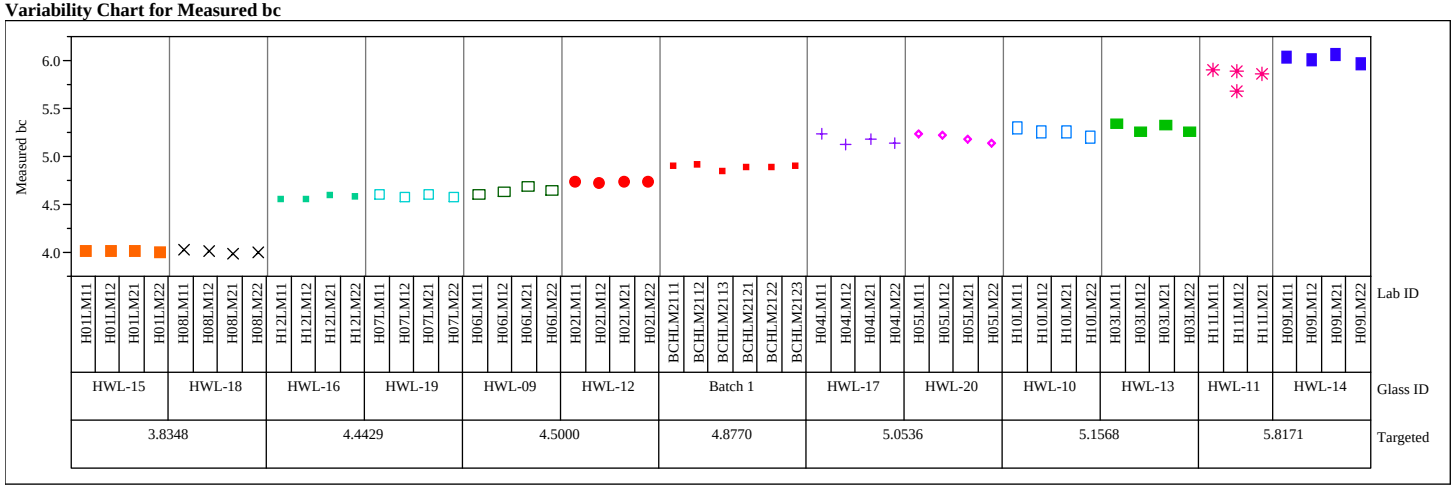
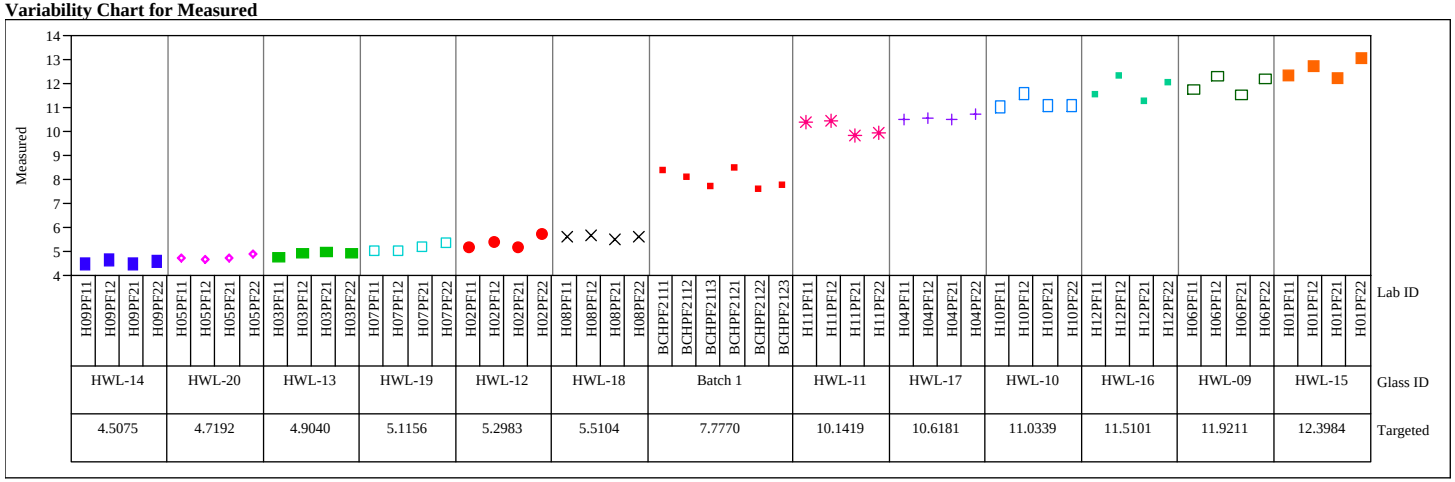


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=2, Oxide=B2O3 (wt%)
Variability Chart for Measured



Set=2, Oxide=B2O3 (wt%)
Variability Chart for Measured bc

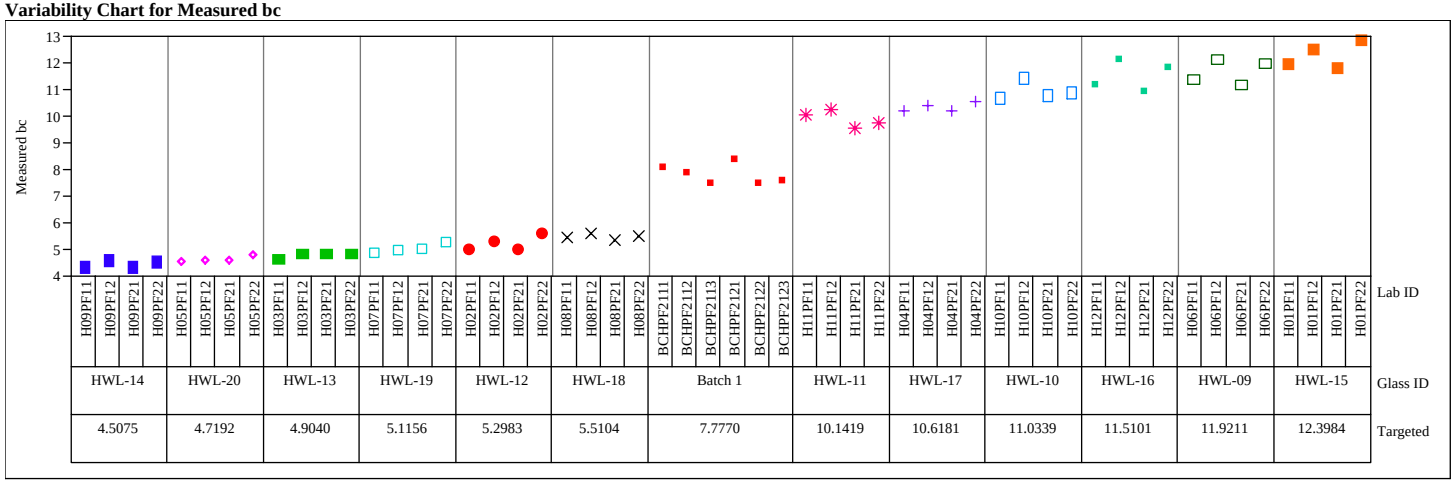
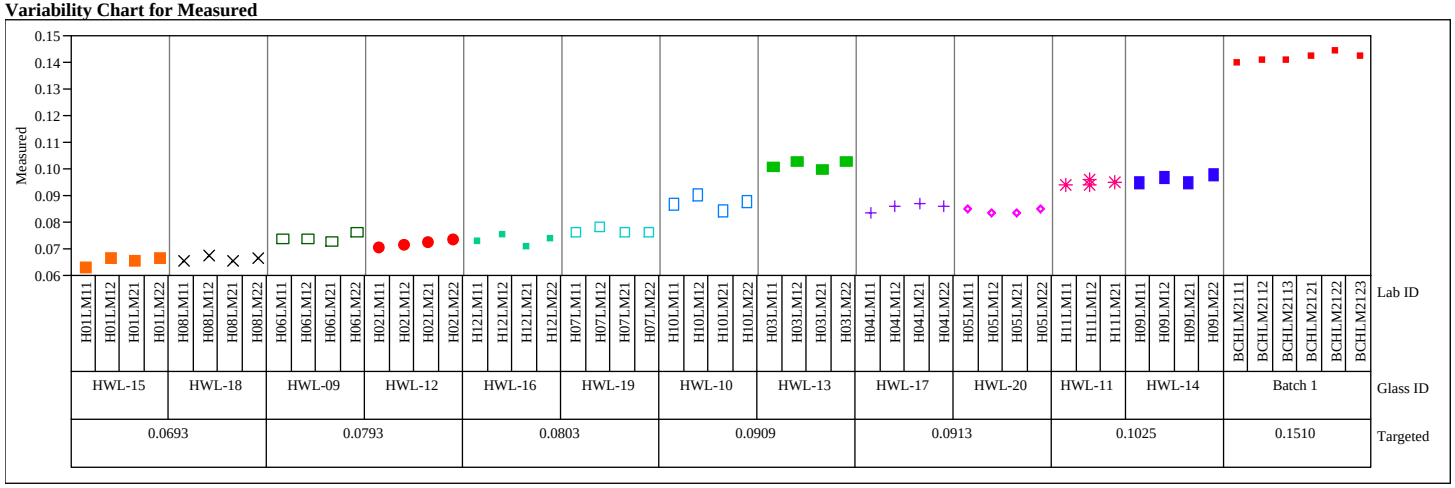


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=2, Oxide=BaO (wt%)
Variability Chart for Measured



Set=2, Oxide=BaO (wt%)
Variability Chart for Measured bc

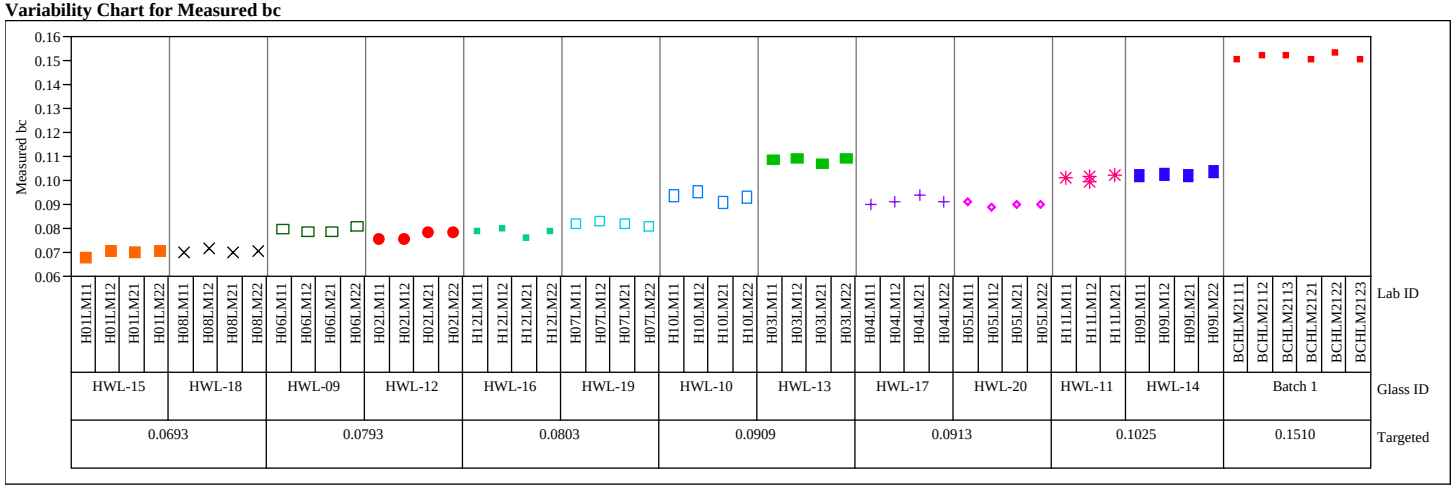
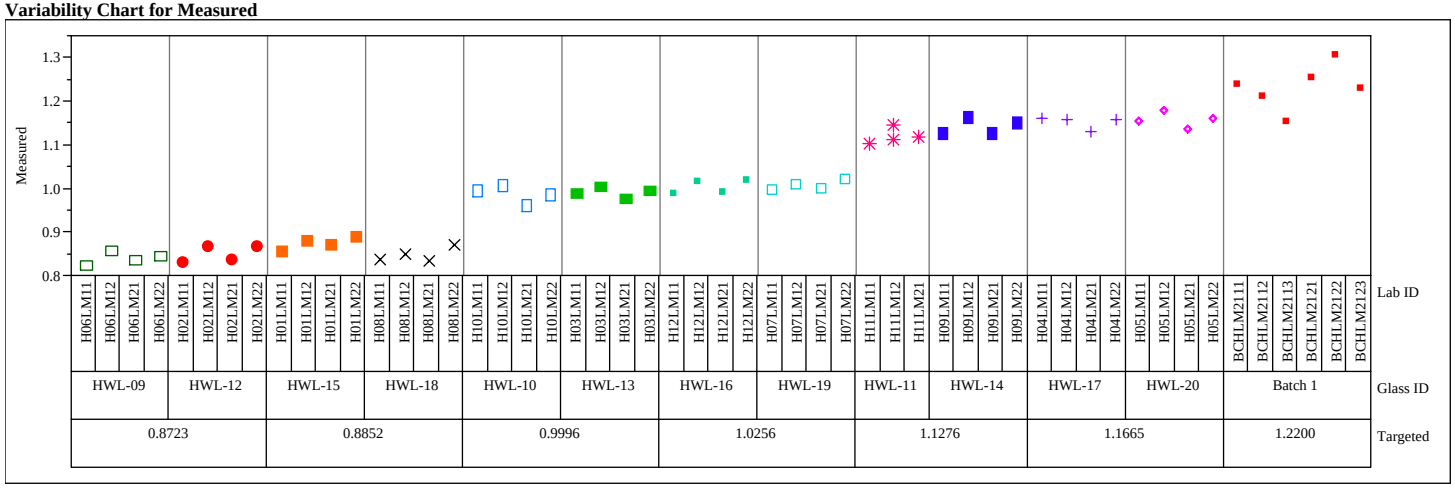


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=2, Oxide=CaO (wt%)
Variability Chart for Measured



Set=2, Oxide=CaO (wt%)
Variability Chart for Measured bc

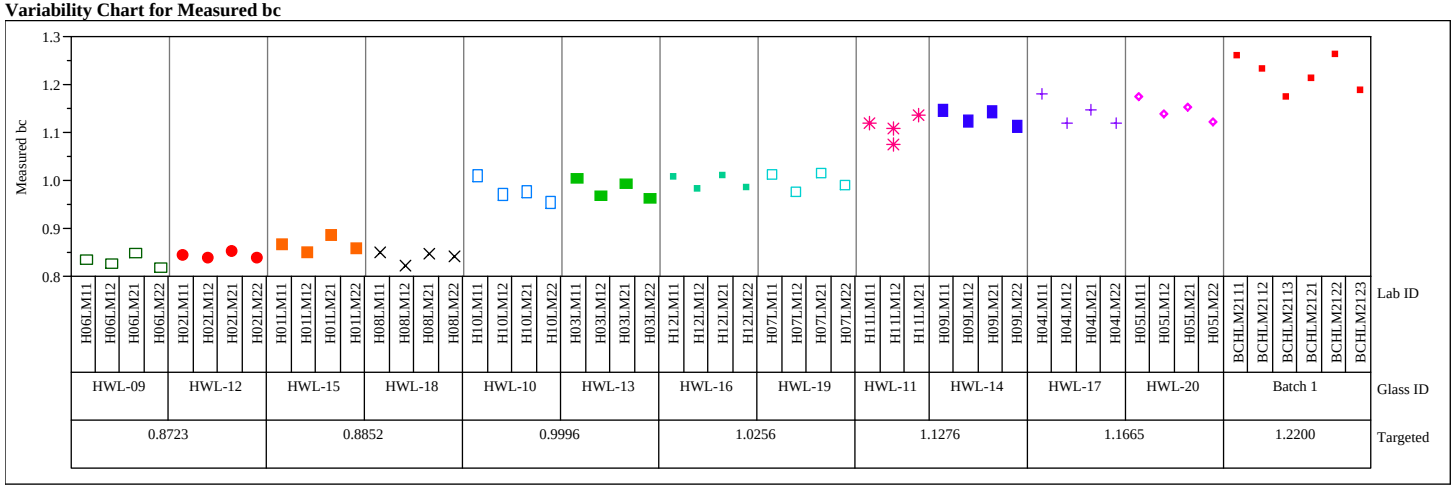
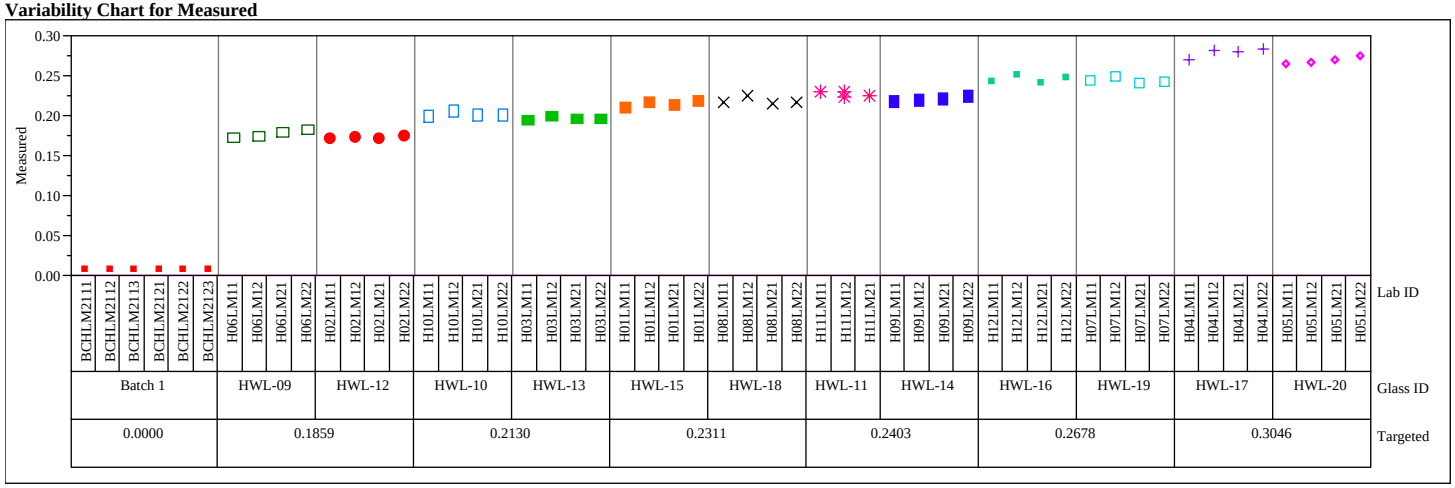


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=2, Oxide=Ce2O3 (wt%)
Variability Chart for Measured



Set=2, Oxide=Ce2O3 (wt%)
Variability Chart for Measured bc

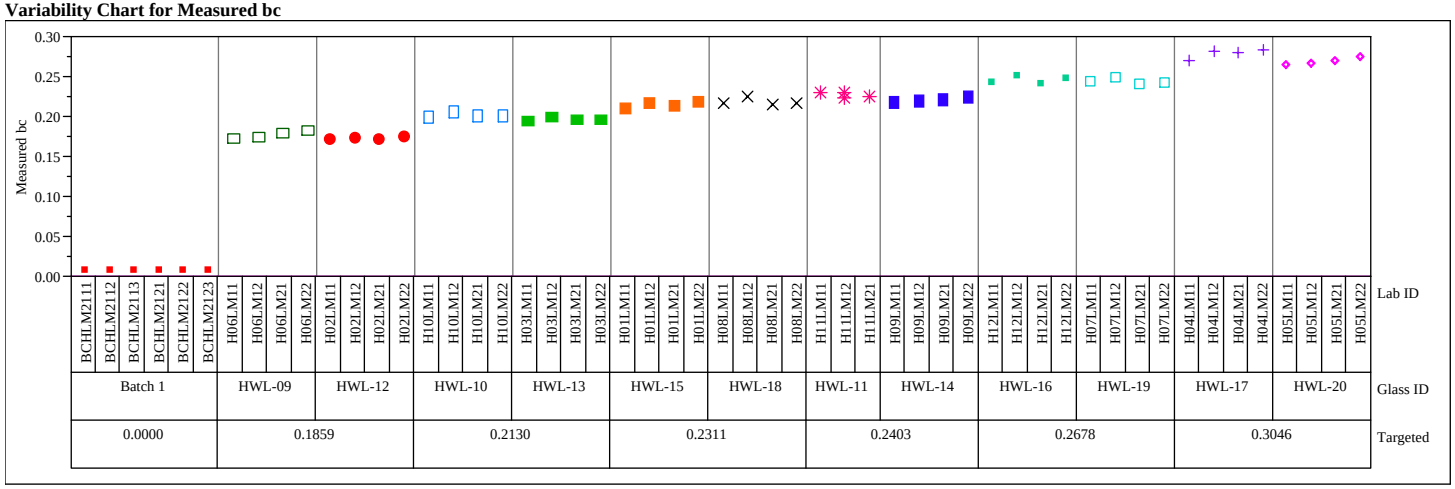
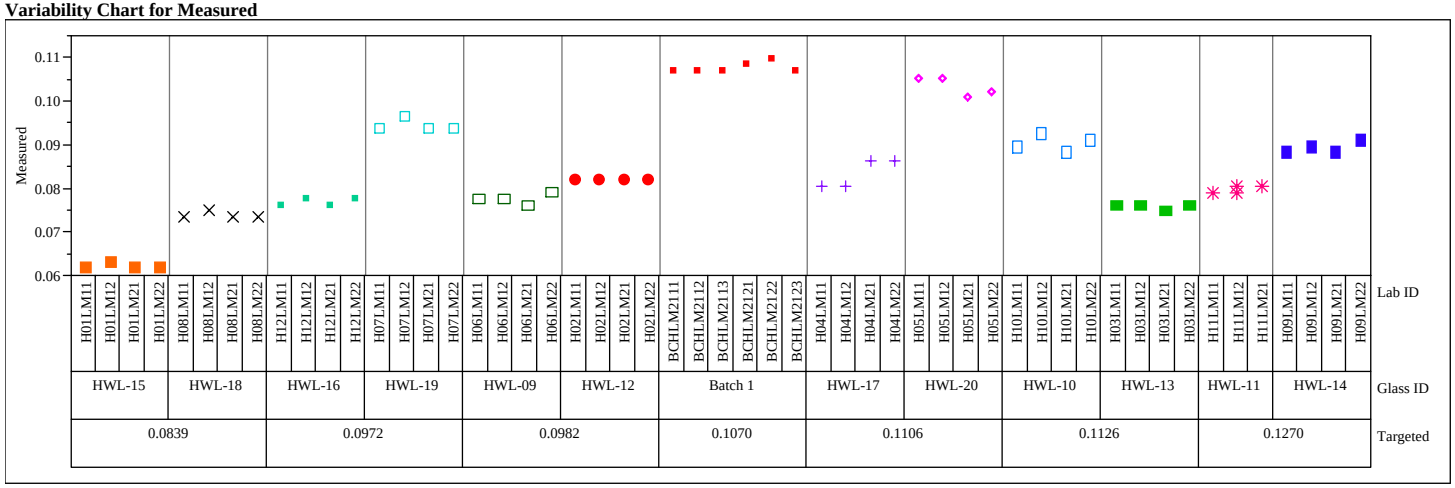


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=2, Oxide=Cr2O3 (wt%)
Variability Chart for Measured



Set=2, Oxide=Cr2O3 (wt%)
Variability Chart for Measured bc

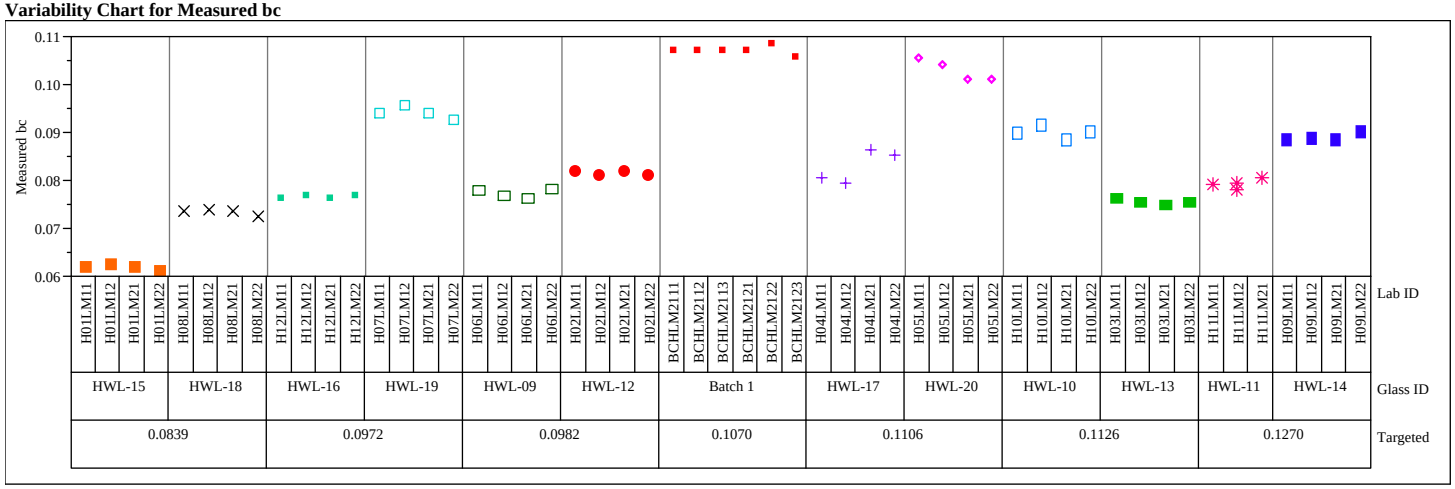
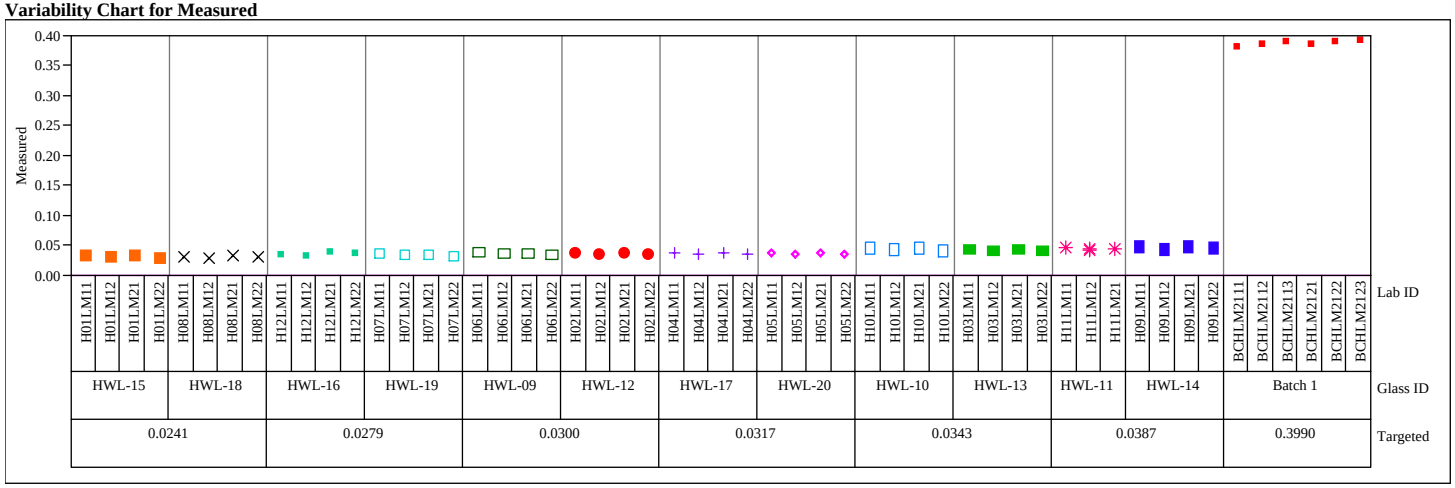


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=2, Oxide=CuO (wt%)
Variability Chart for Measured



Set=2, Oxide=CuO (wt%)
Variability Chart for Measured bc

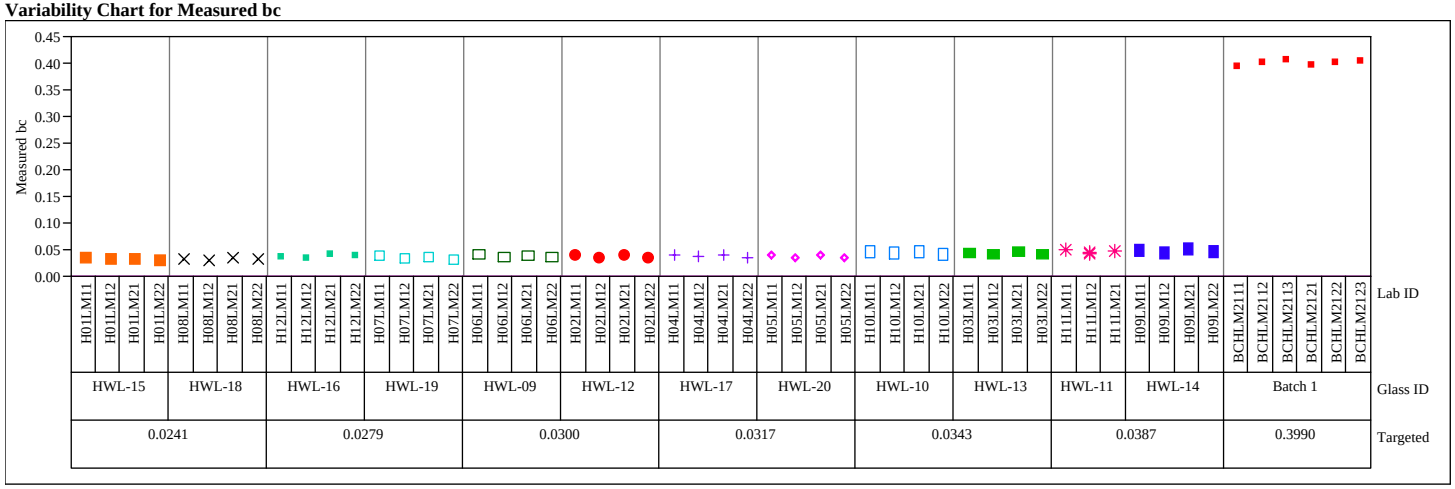
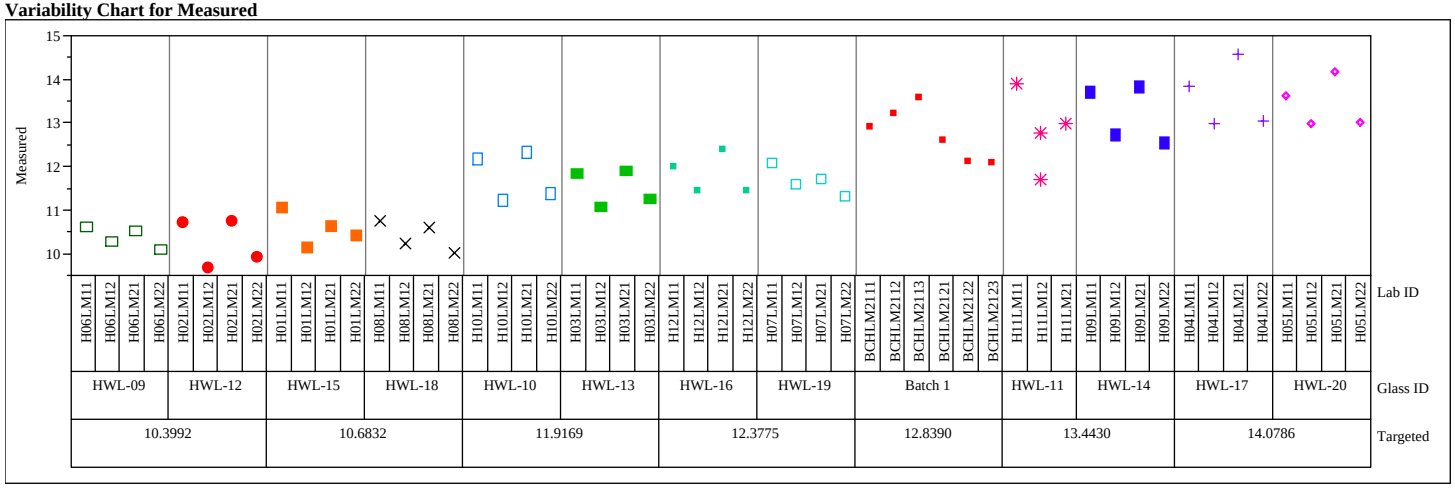


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=2, Oxide=Fe2O3 (wt%)
Variability Chart for Measured



Set=2, Oxide=Fe2O3 (wt%)
Variability Chart for Measured bc

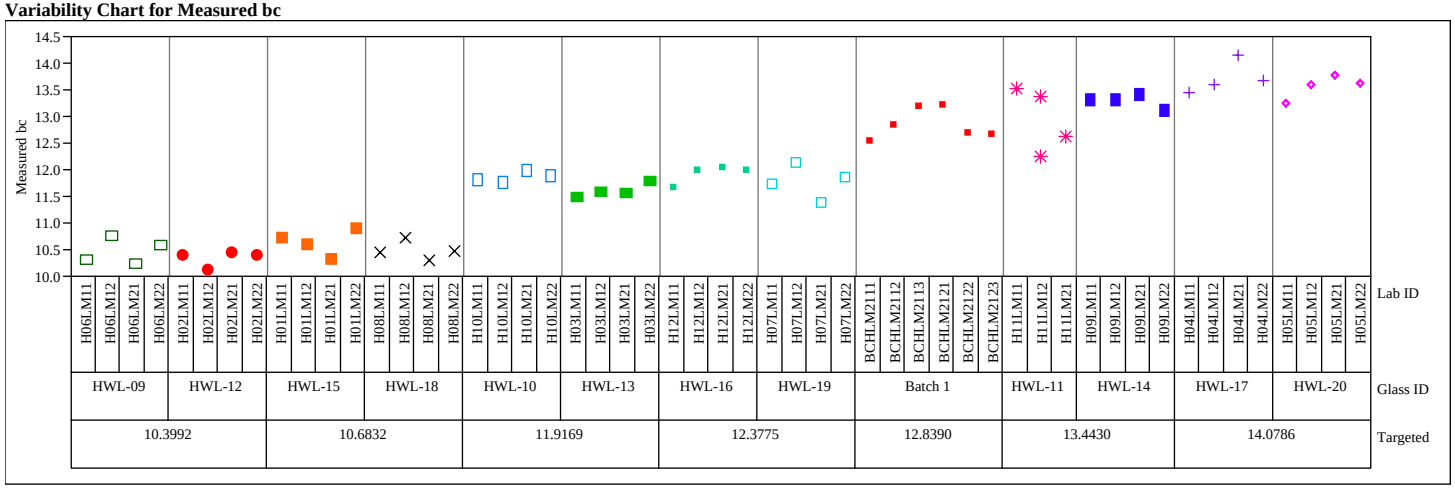
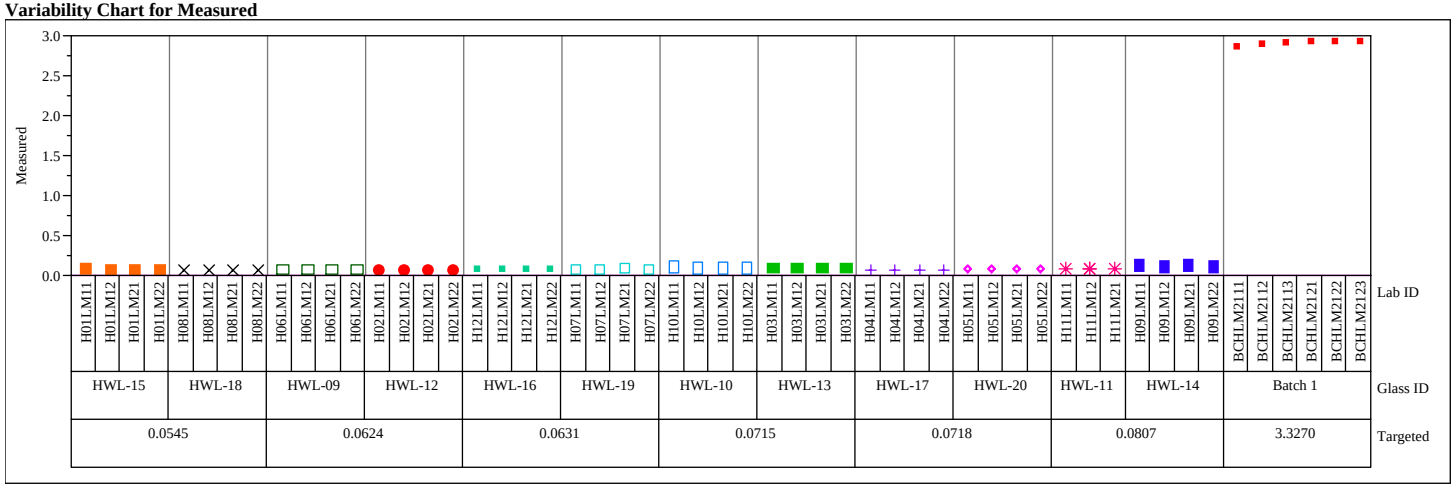


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=2, Oxide=K2O (wt%)
Variability Chart for Measured



Set=2, Oxide=K2O (wt%)
Variability Chart for Measured bc

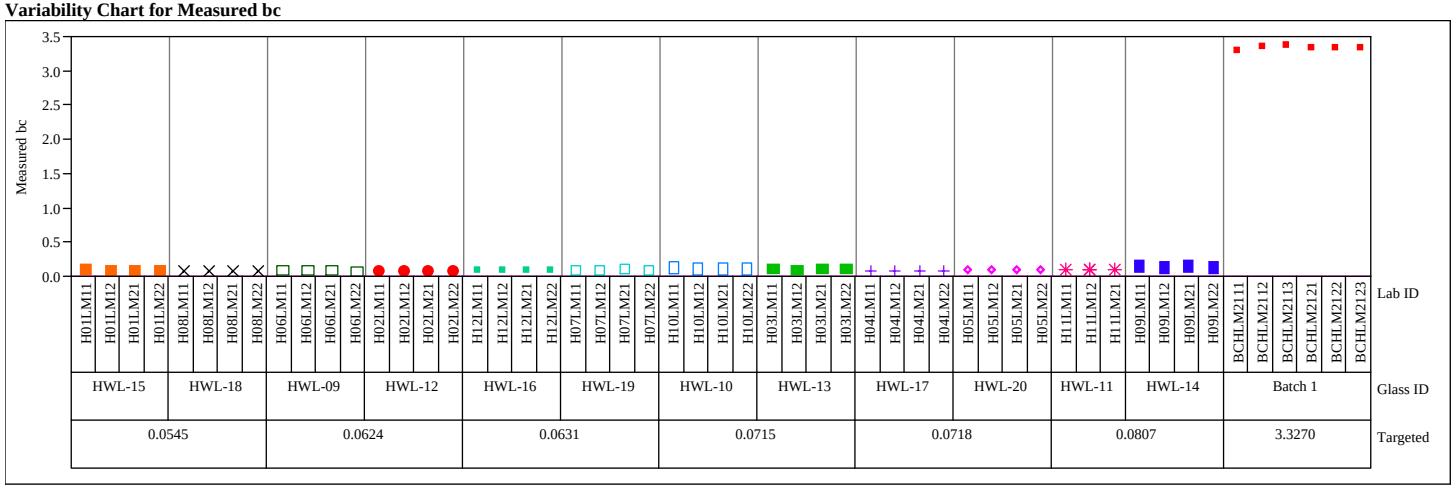
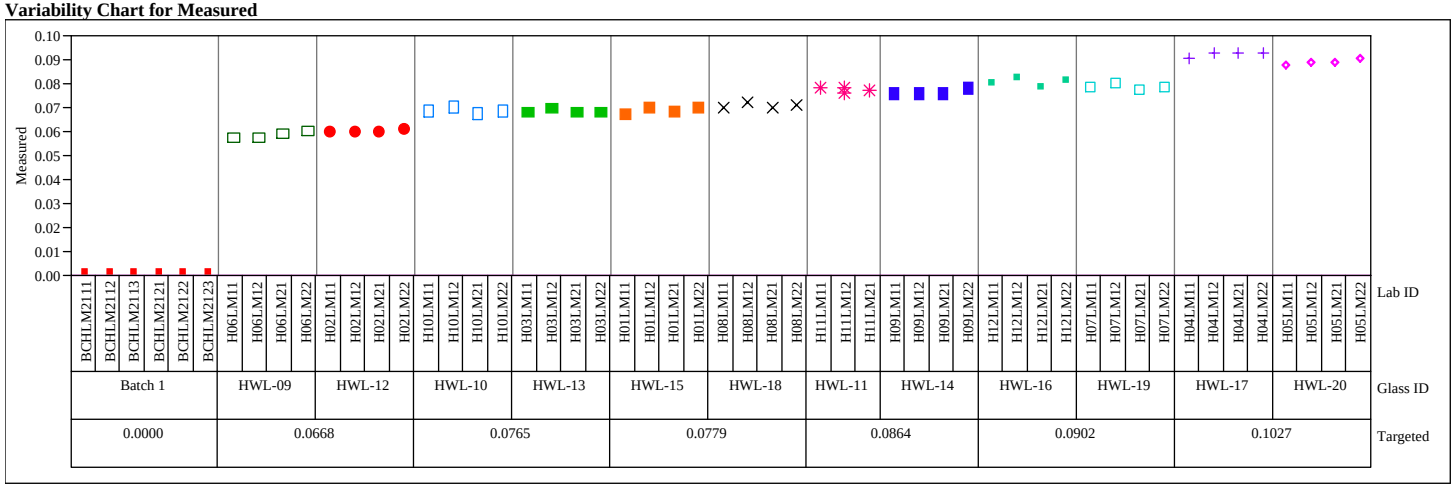


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=2, Oxide=La2O3 (wt%)
Variability Chart for Measured



Set=2, Oxide=La2O3 (wt%)
Variability Chart for Measured bc

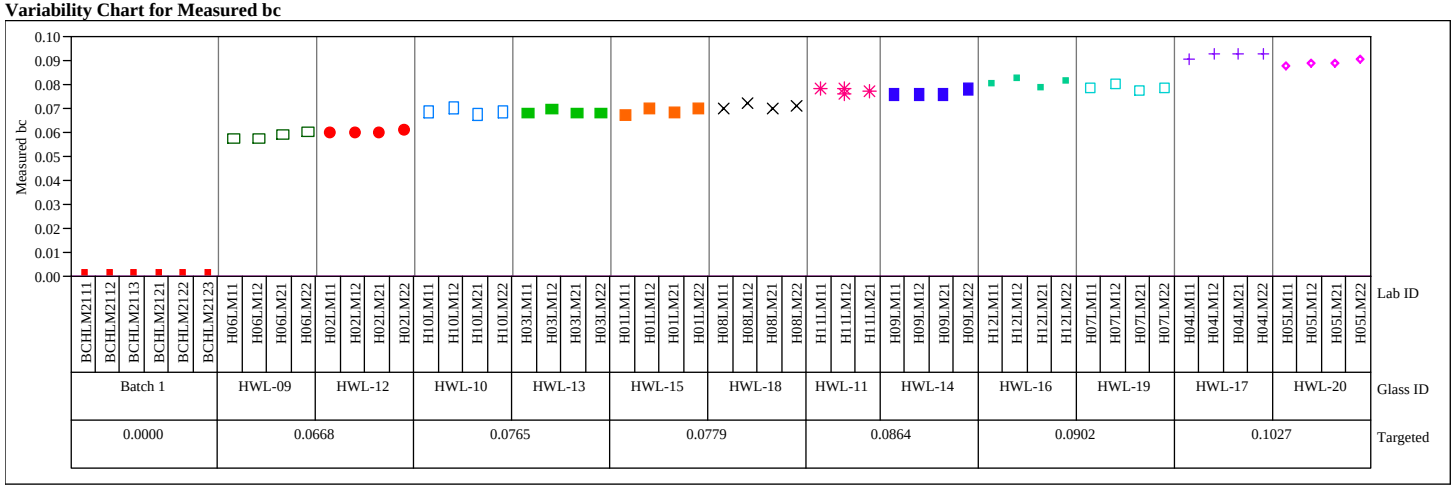
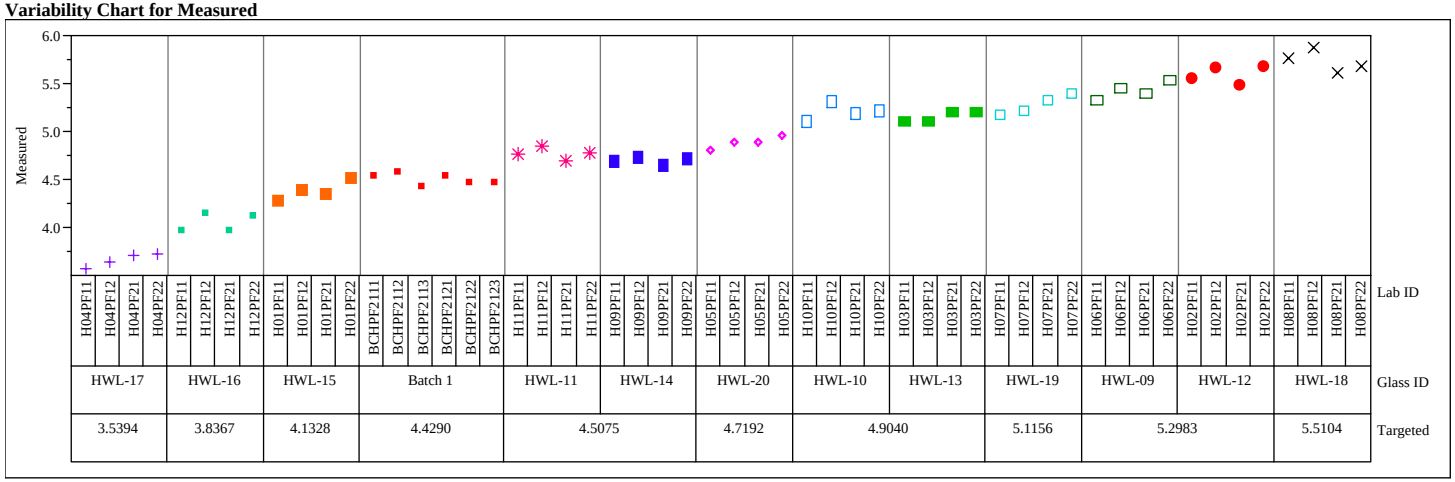


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=2, Oxide=Li2O (wt%)
Variability Chart for Measured



Set=2, Oxide=Li2O (wt%)
Variability Chart for Measured bc

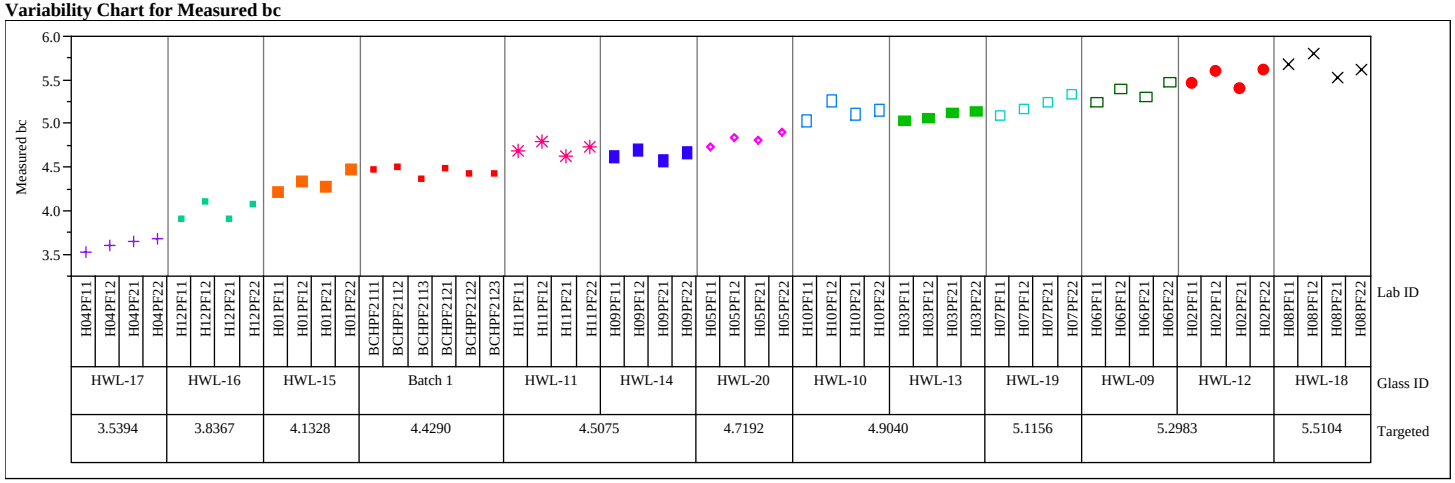
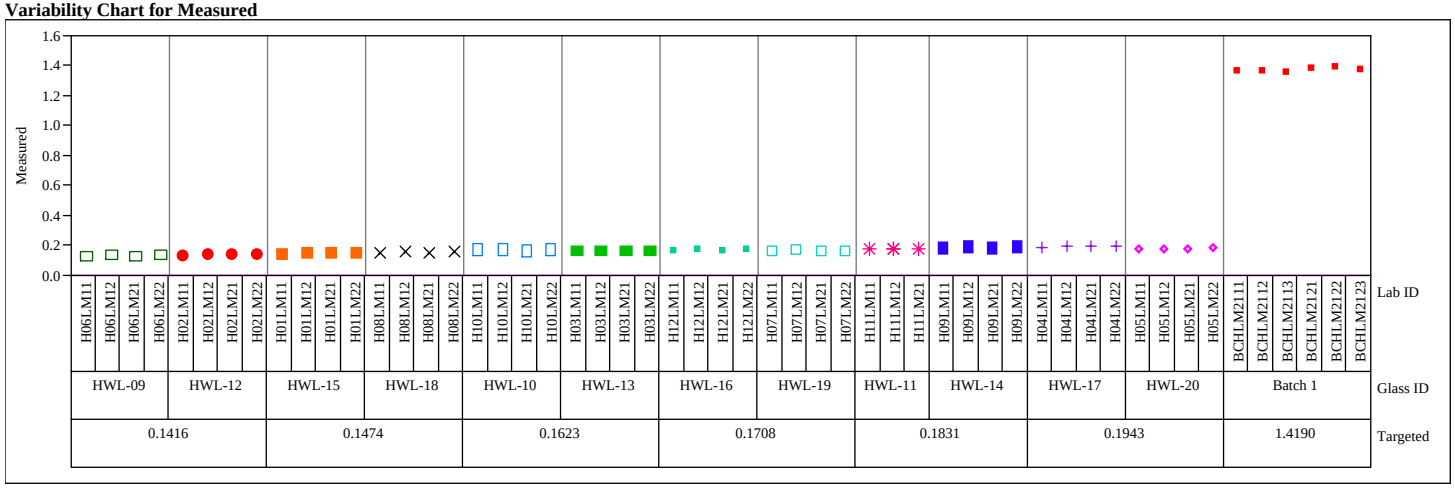


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=2, Oxide=MgO (wt%)
Variability Chart for Measured



Set=2, Oxide=MgO (wt%)
Variability Chart for Measured bc

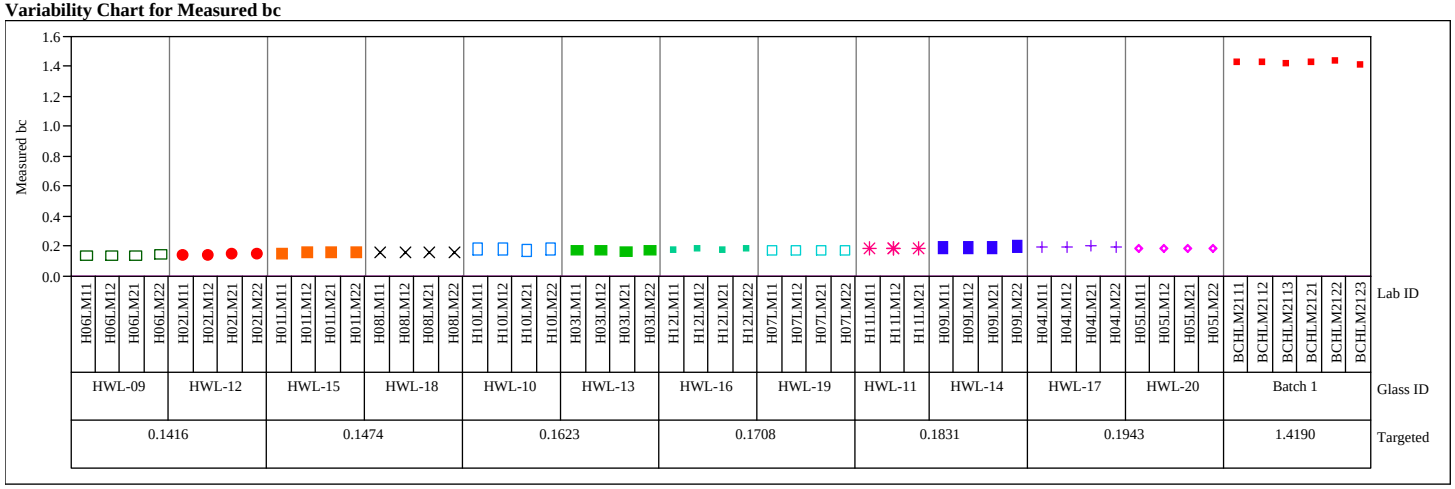
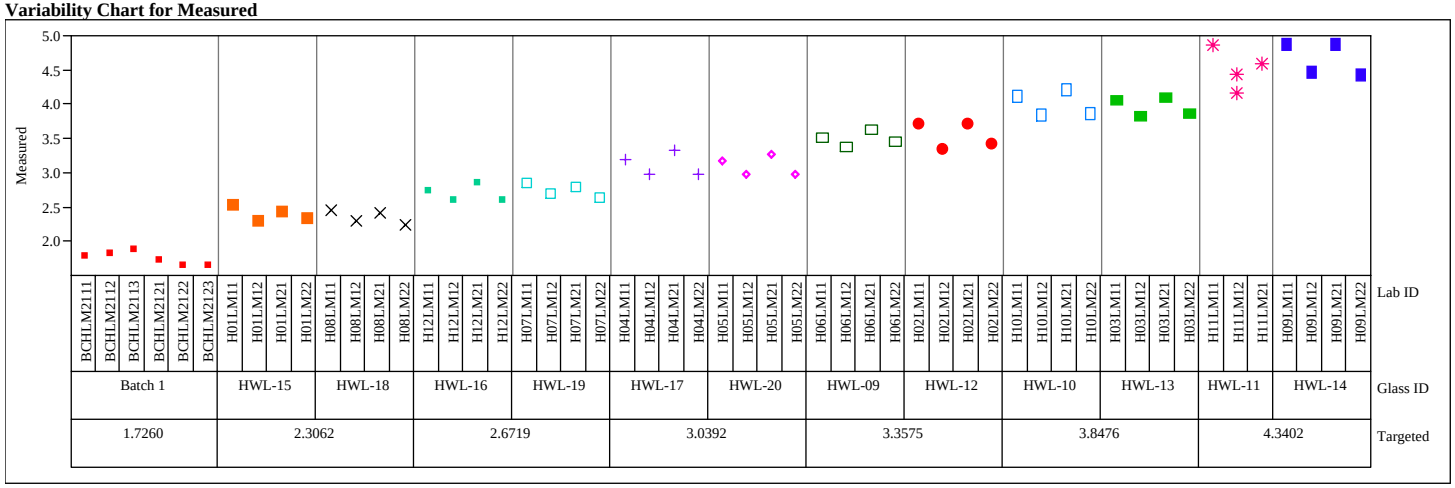


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=2, Oxide=MnO (wt%)
Variability Chart for Measured



Set=2, Oxide=MnO (wt%)
Variability Chart for Measured bc

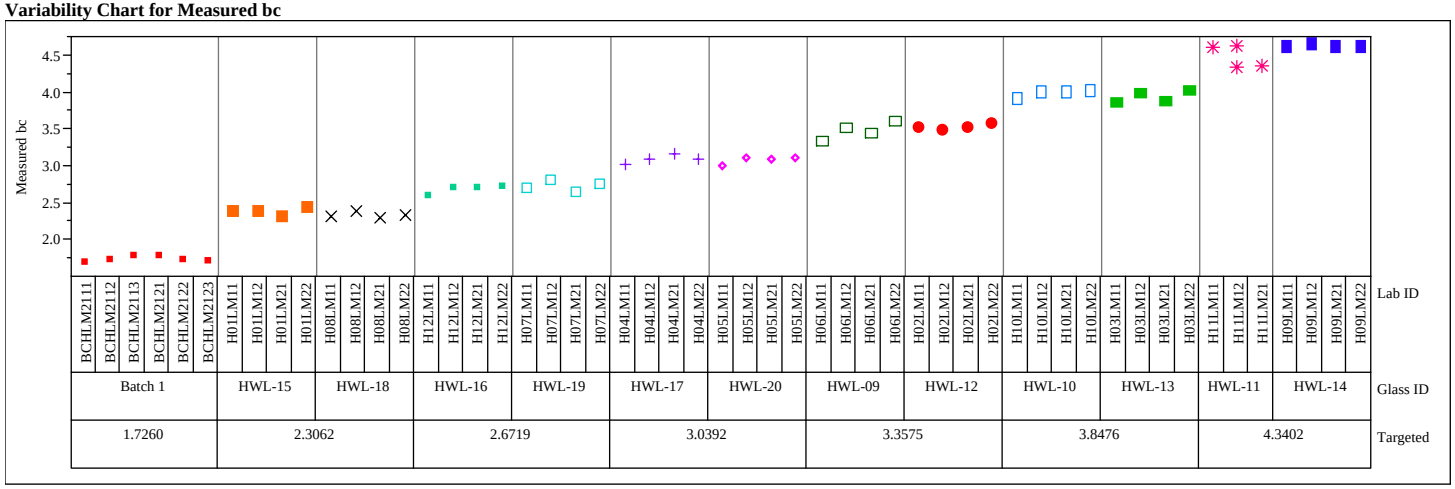
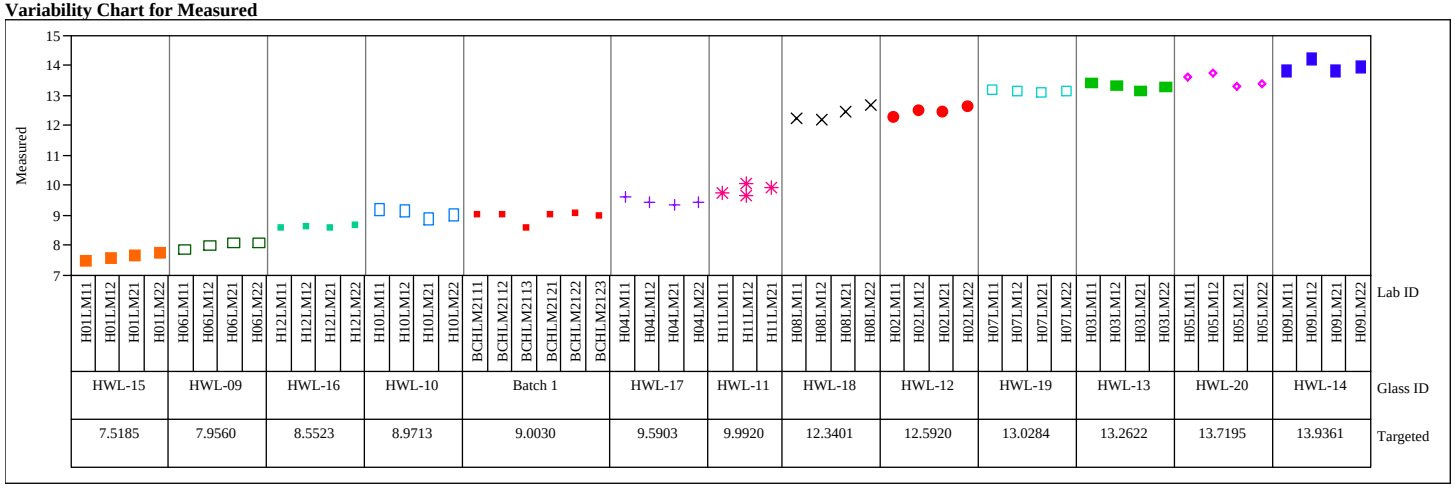


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=2, Oxide=Na2O (wt%)
Variability Chart for Measured



Set=2, Oxide=Na2O (wt%)
Variability Chart for Measured bc

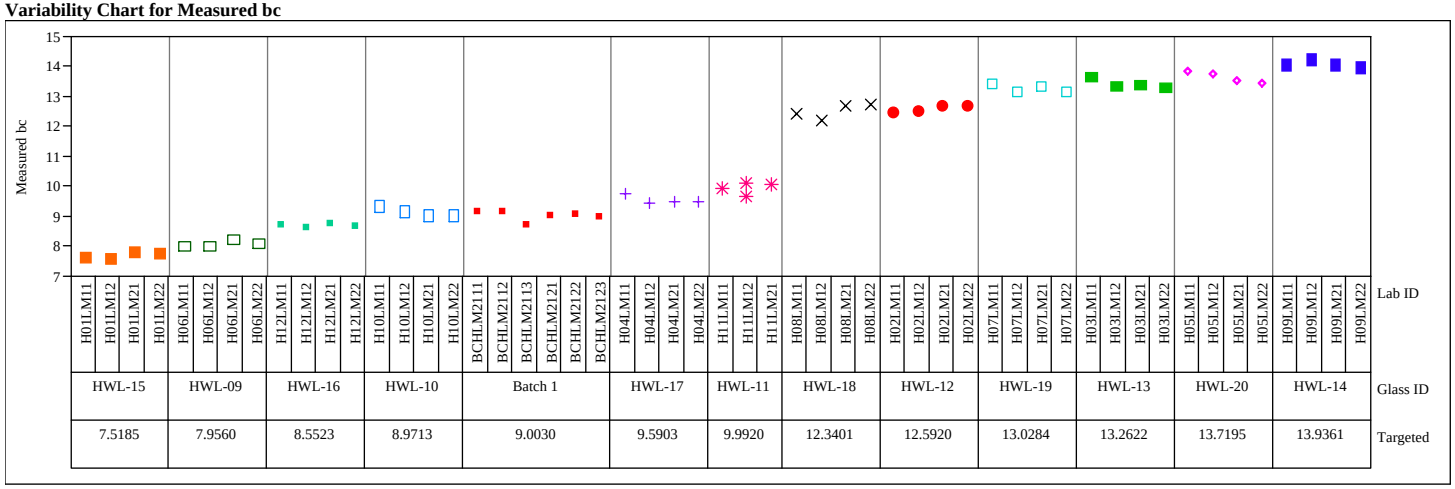
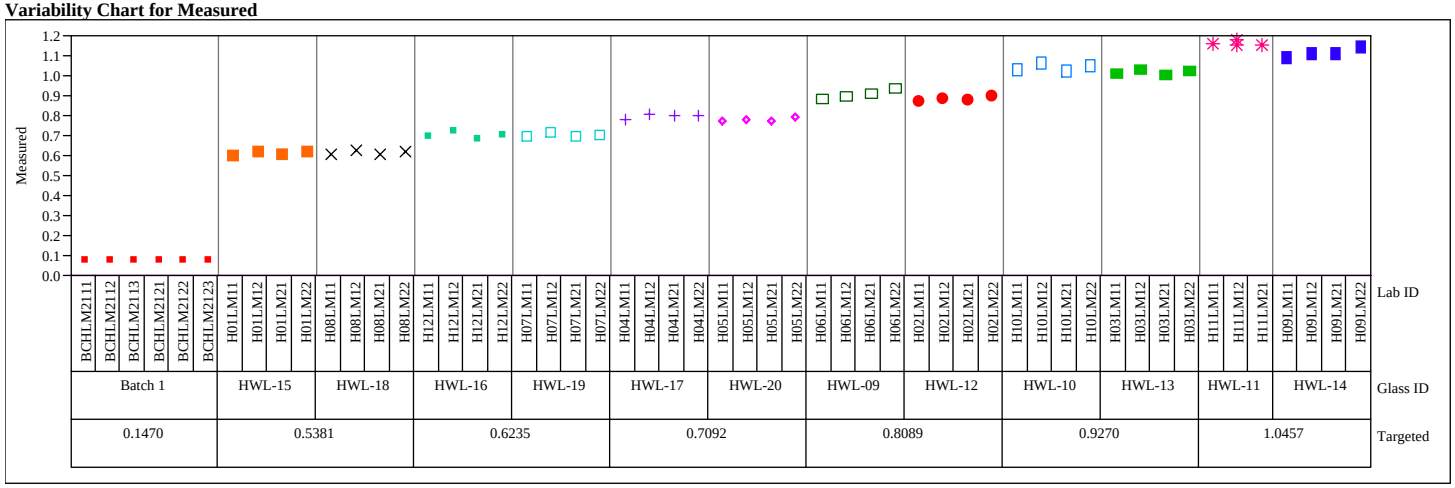


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=2, Oxide=Nb2O5 (wt%)
Variability Chart for Measured



Set=2, Oxide=Nb2O5 (wt%)
Variability Chart for Measured bc

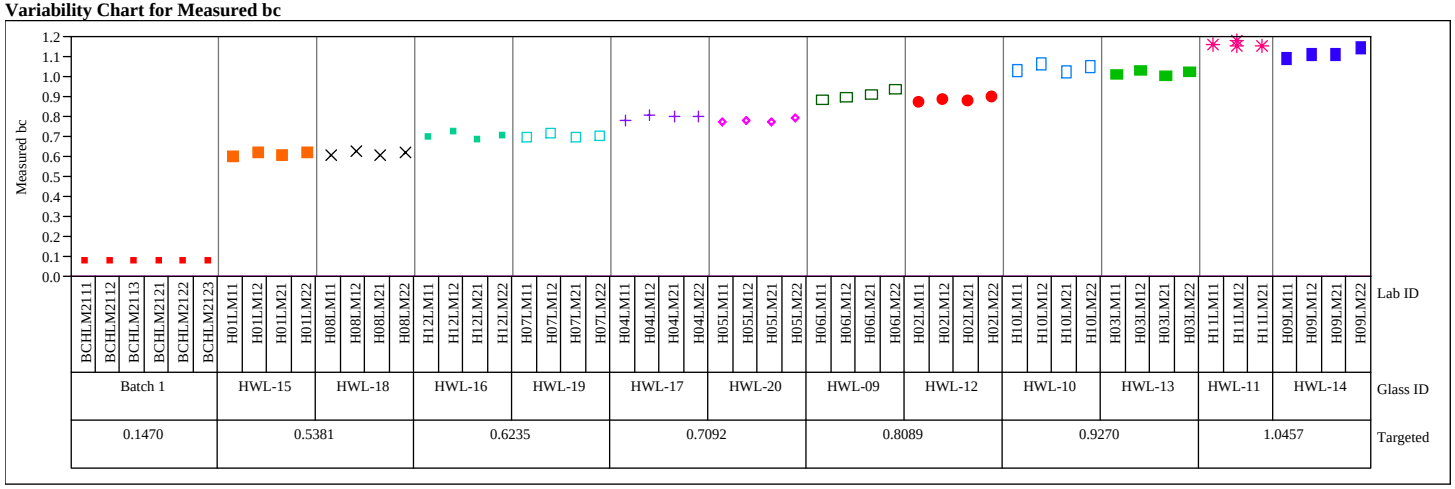
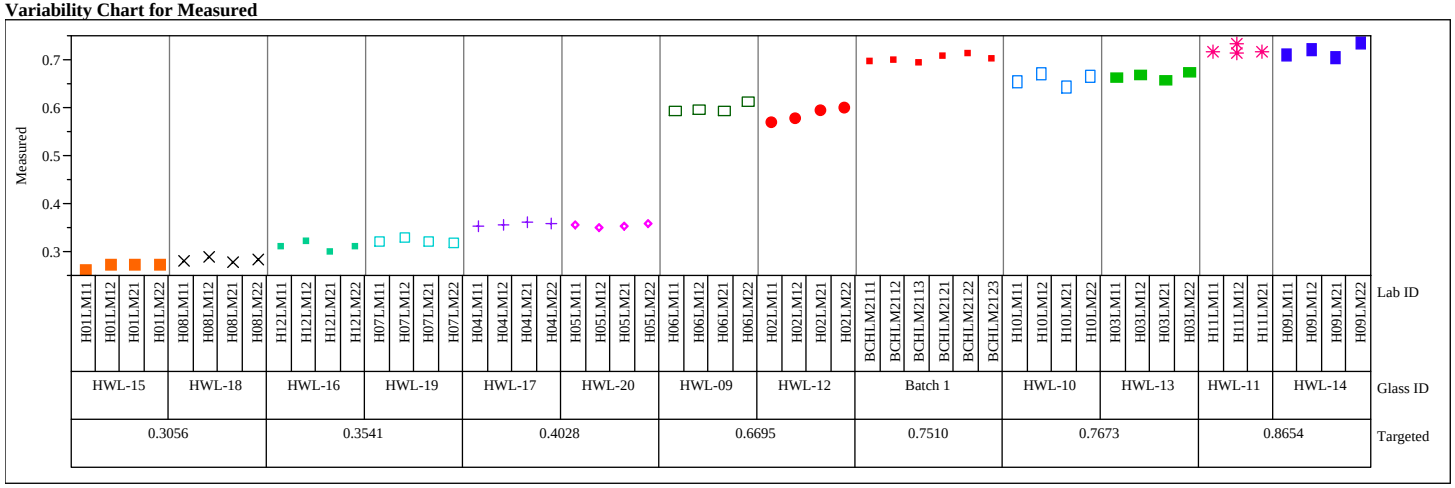


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=2, Oxide=NiO (wt%)
Variability Chart for Measured



Set=2, Oxide=NiO (wt%)
Variability Chart for Measured bc

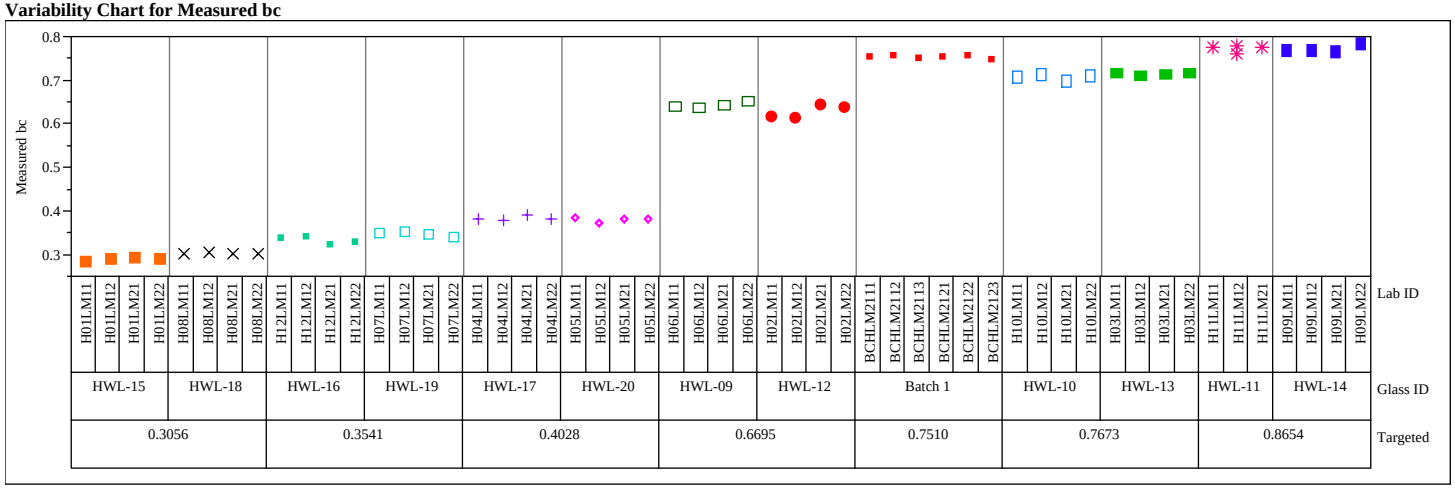
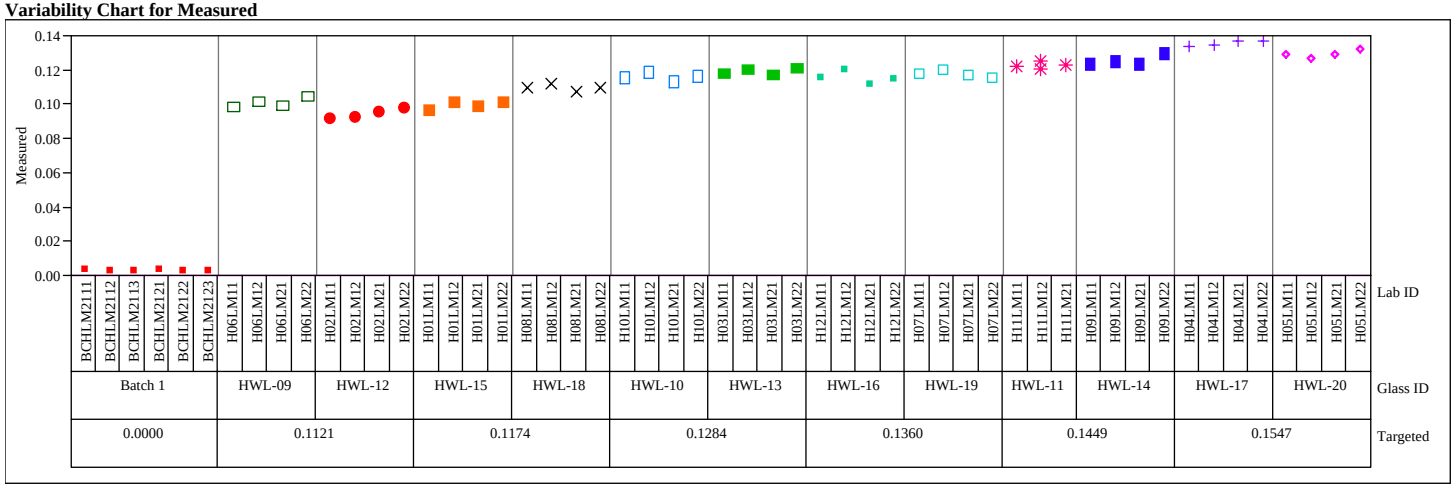


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=2, Oxide=PbO (wt%)
Variability Chart for Measured



Set=2, Oxide=PbO (wt%)
Variability Chart for Measured bc

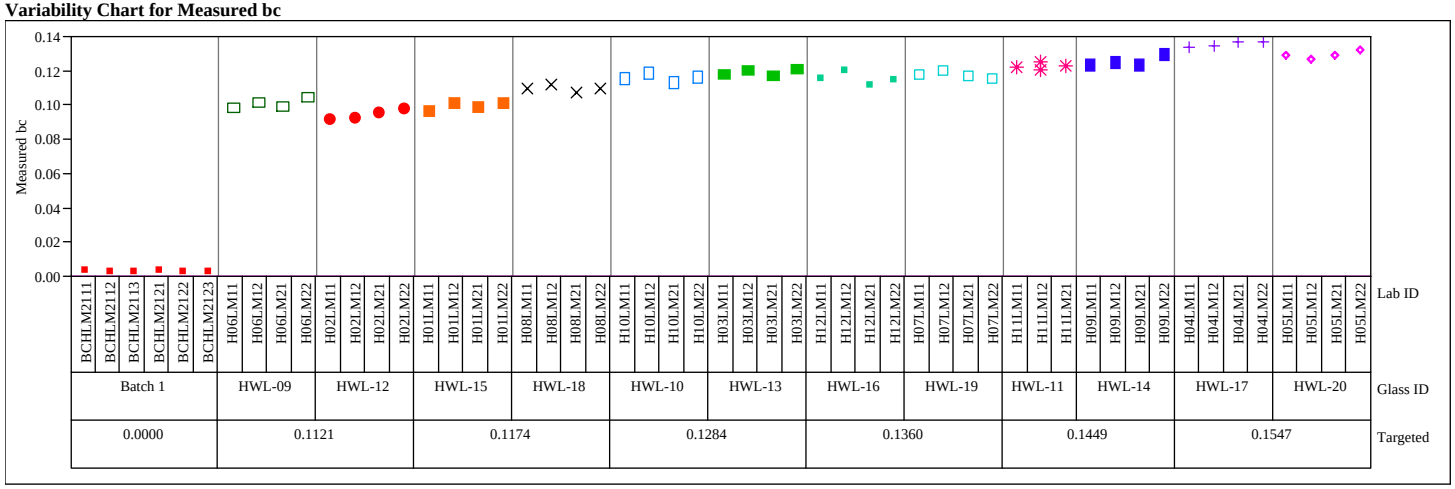
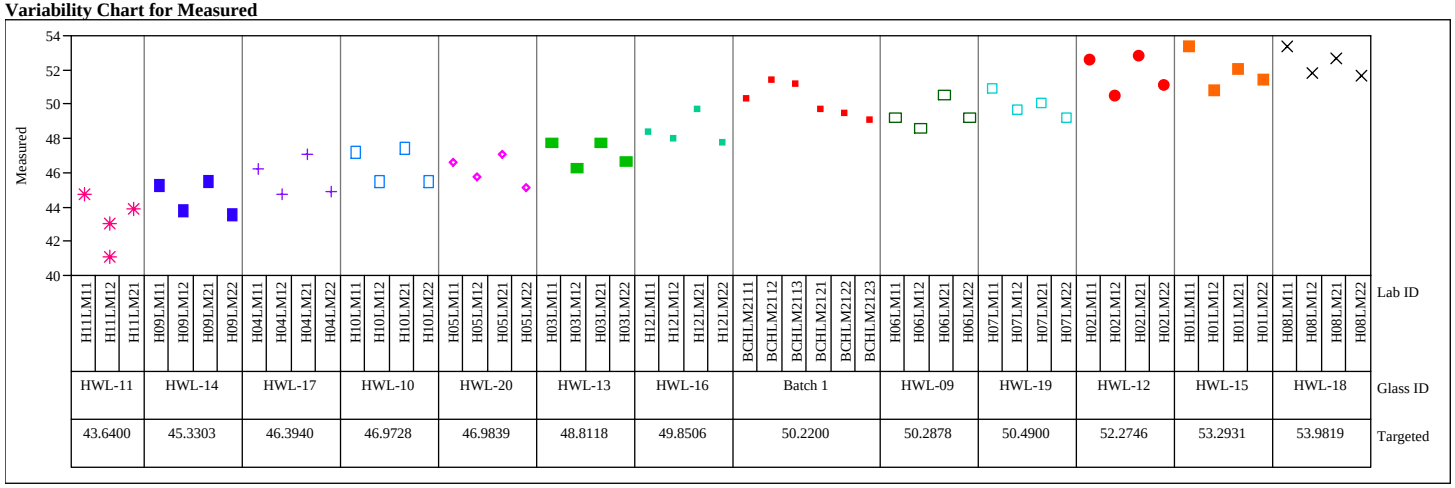


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=2, Oxide=SiO2 (wt%)
Variability Chart for Measured



Set=2, Oxide=SiO2 (wt%)
Variability Chart for Measured bc

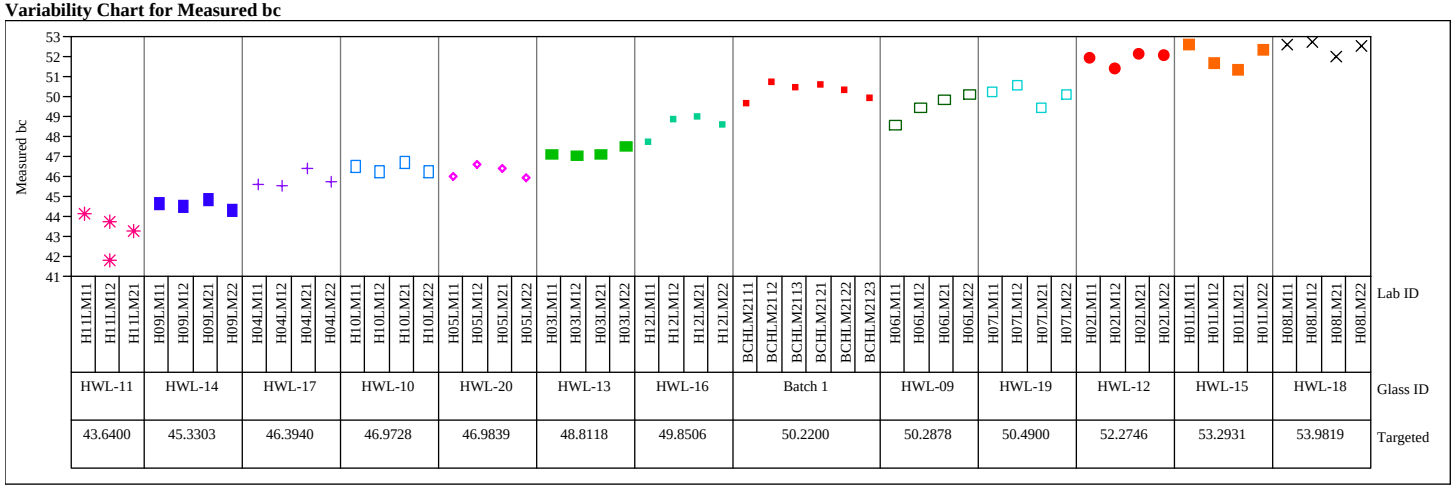
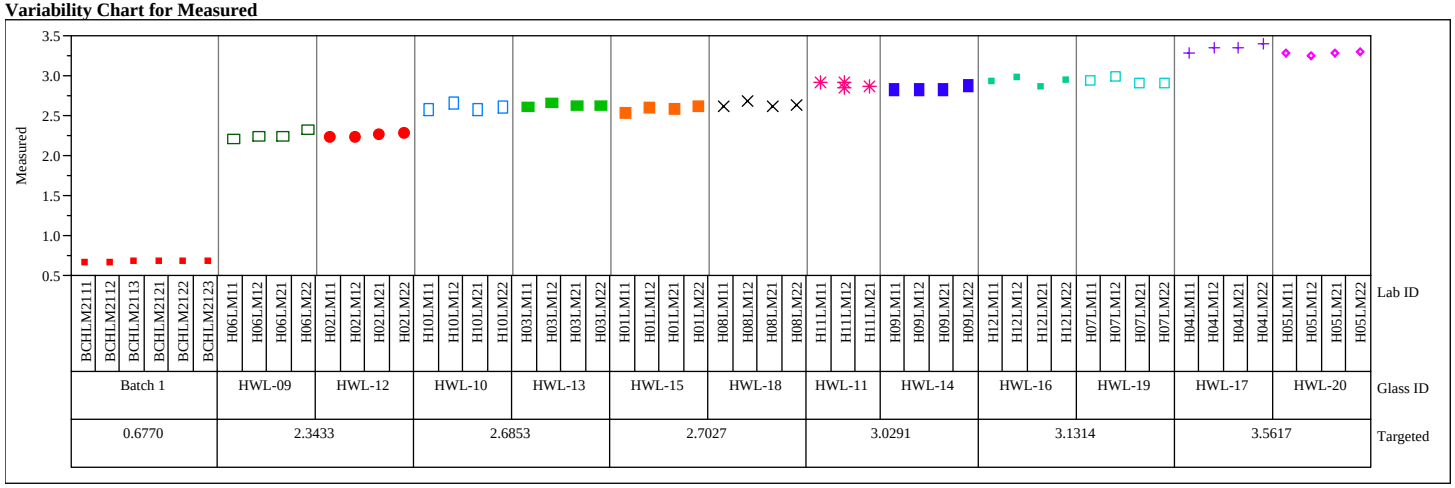


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=2, Oxide=TiO2 (wt%)
Variability Chart for Measured



Set=2, Oxide=TiO2 (wt%)
Variability Chart for Measured bc

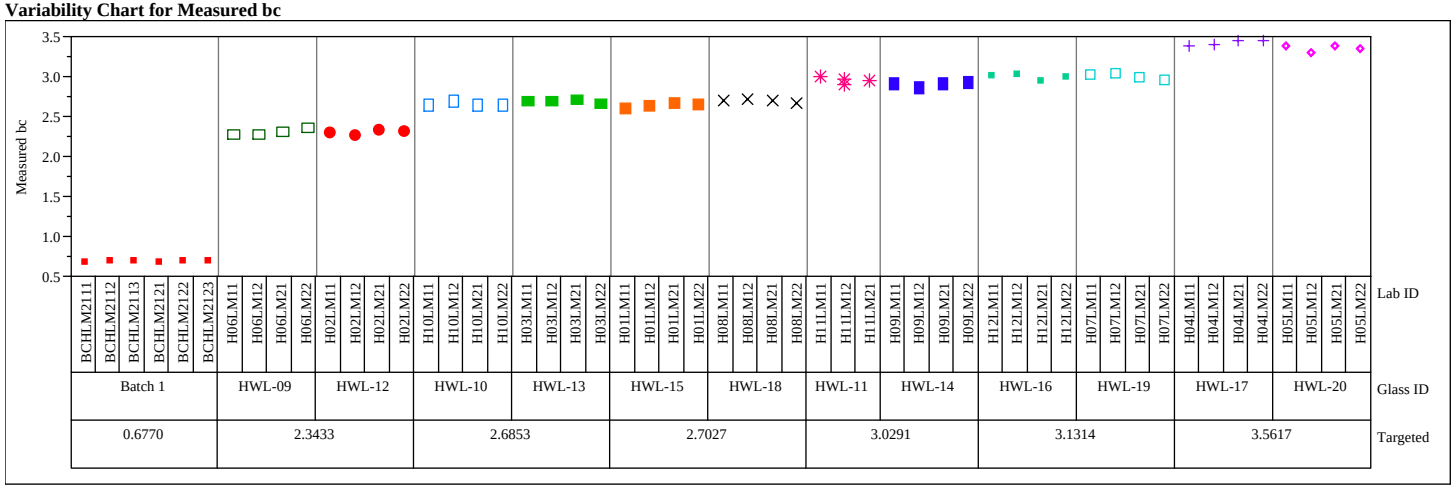
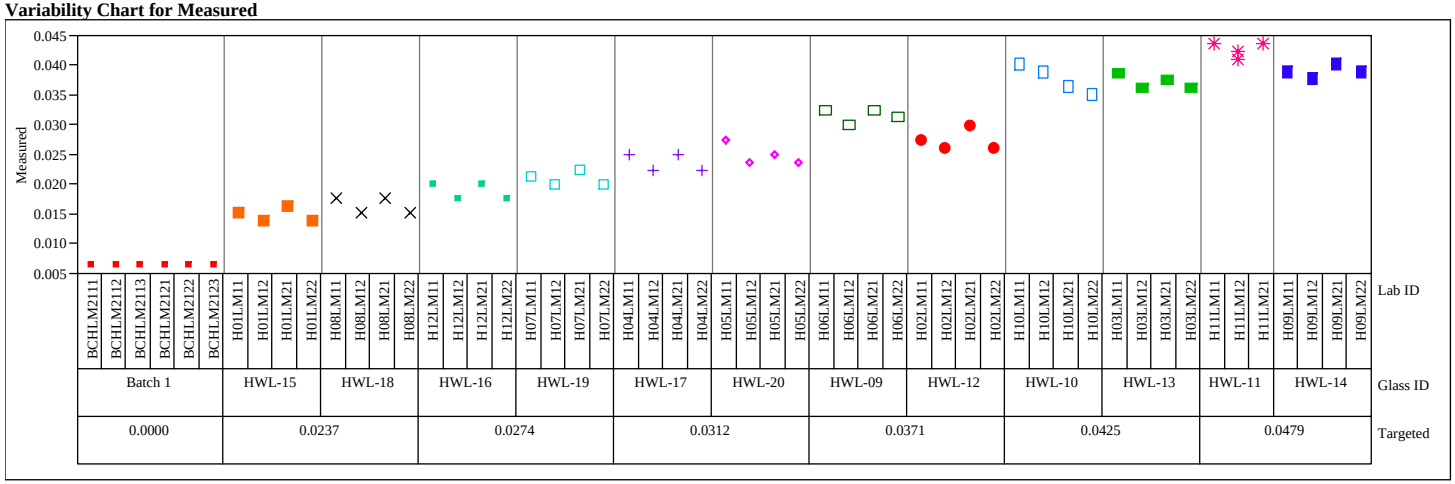


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=2, Oxide=ZnO (wt%)
Variability Chart for Measured



Set=2, Oxide=ZnO (wt%)
Variability Chart for Measured bc

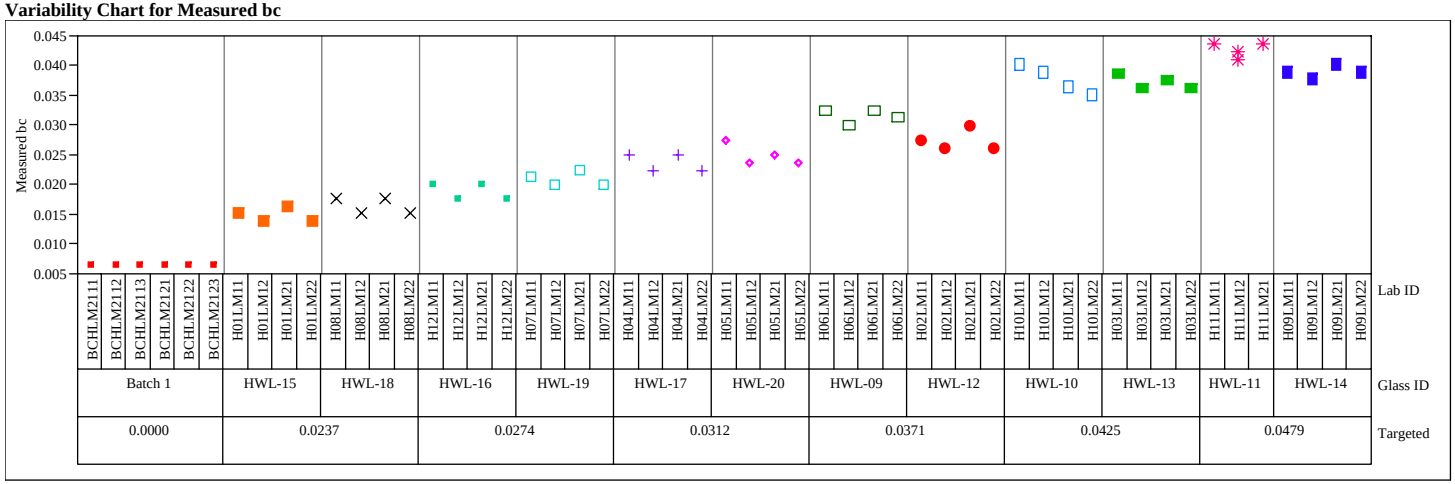
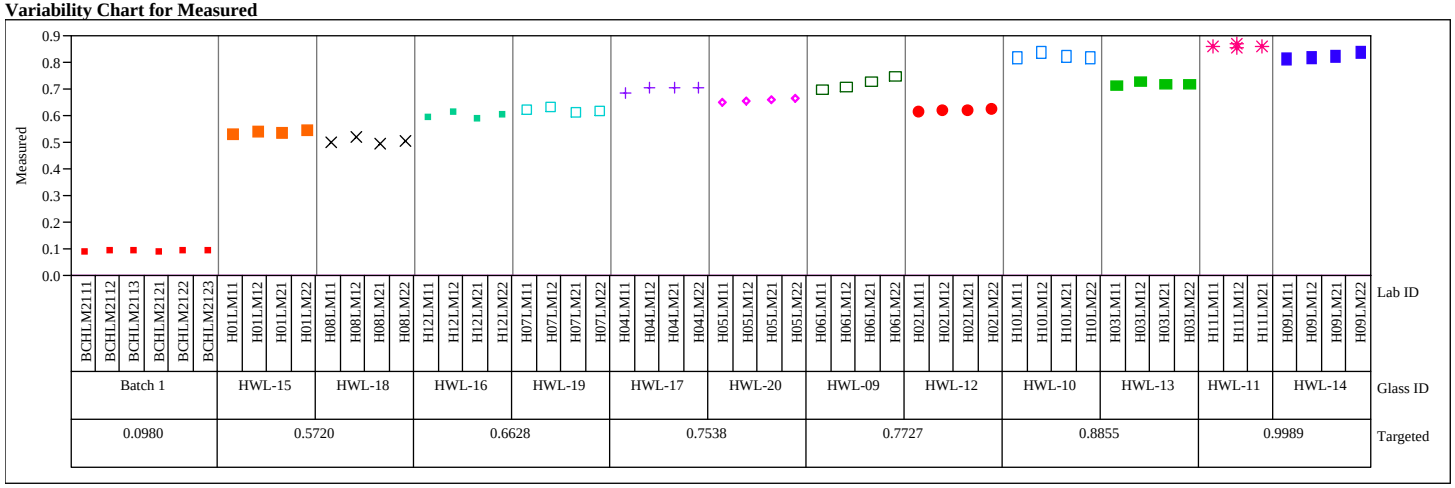


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=2, Oxide=ZrO2 (wt%)
Variability Chart for Measured



Set=2, Oxide=ZrO2 (wt%)
Variability Chart for Measured bc

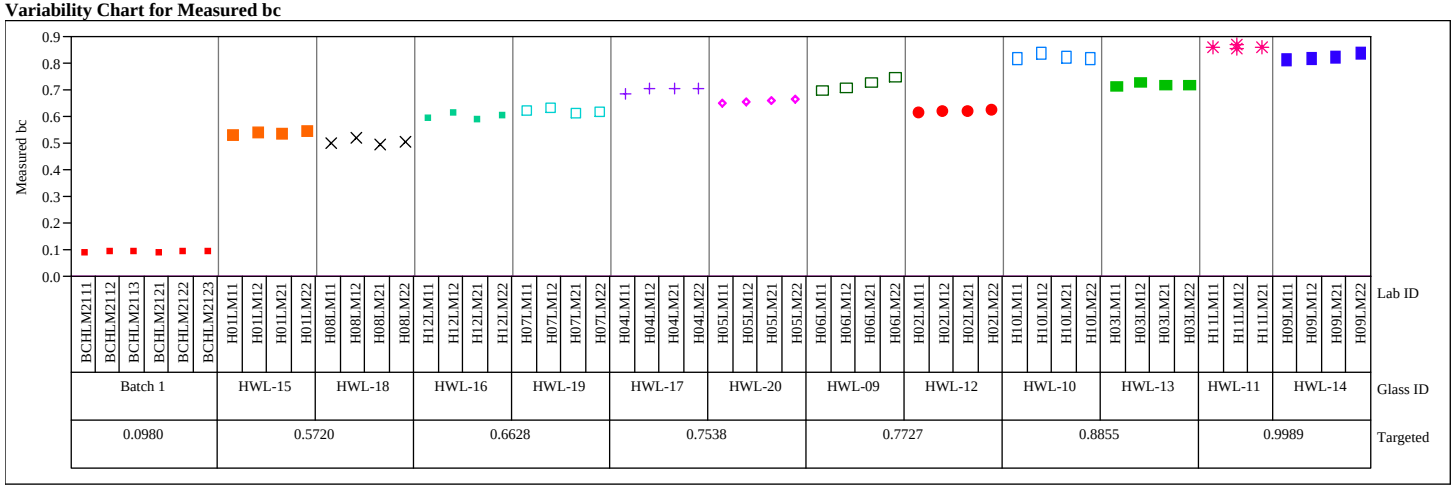
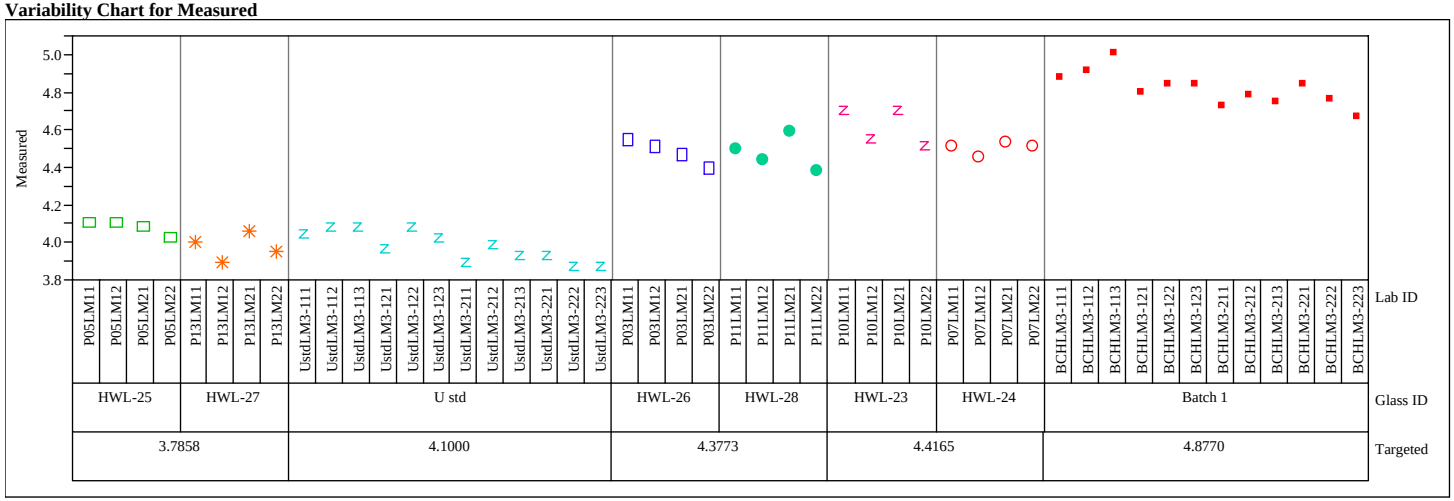


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=3, Oxide=Al2O3 (wt%)
Variability Chart for Measured



Set=3, Oxide=Al2O3 (wt%)
Variability Chart for Measured bc

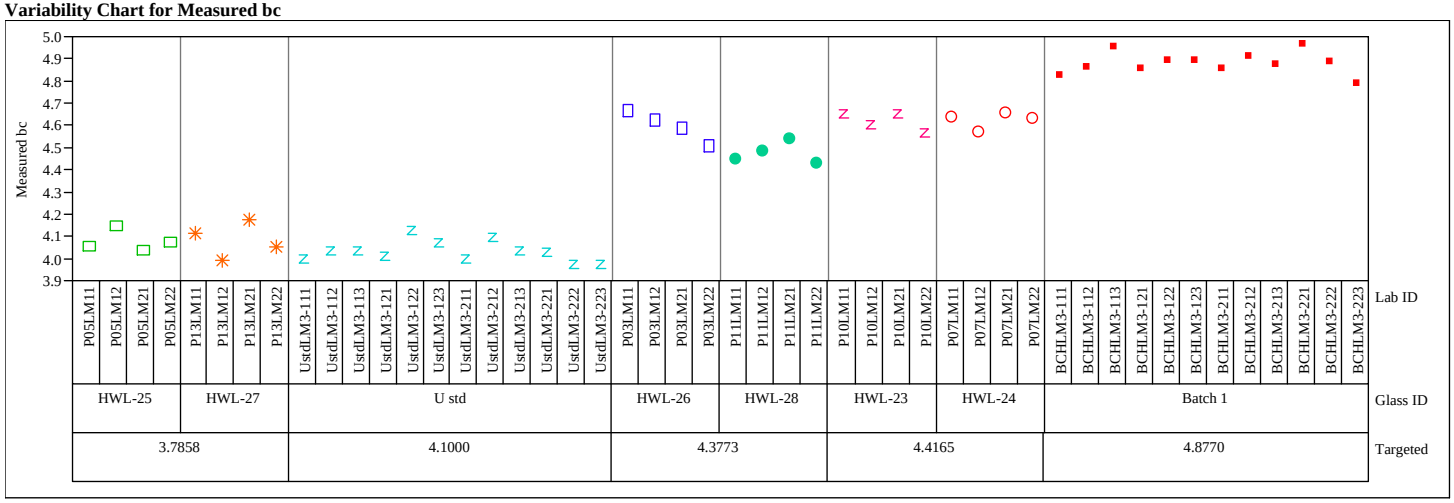
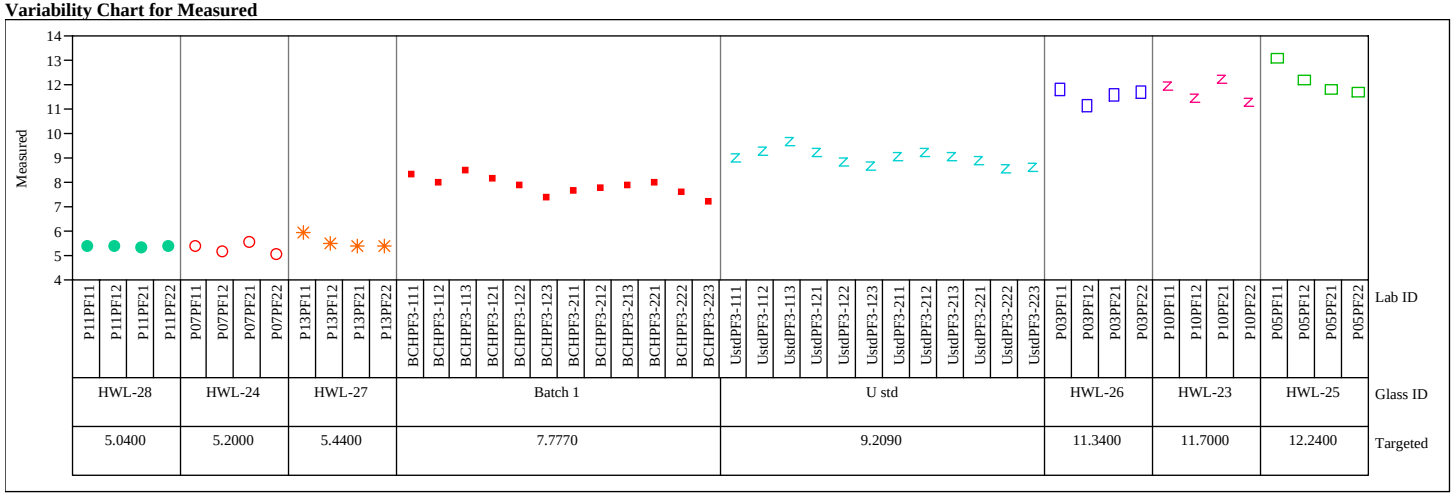


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=3, Oxide=B2O3 (wt%)
Variability Chart for Measured



Set=3, Oxide=B2O3 (wt%)
Variability Chart for Measured bc

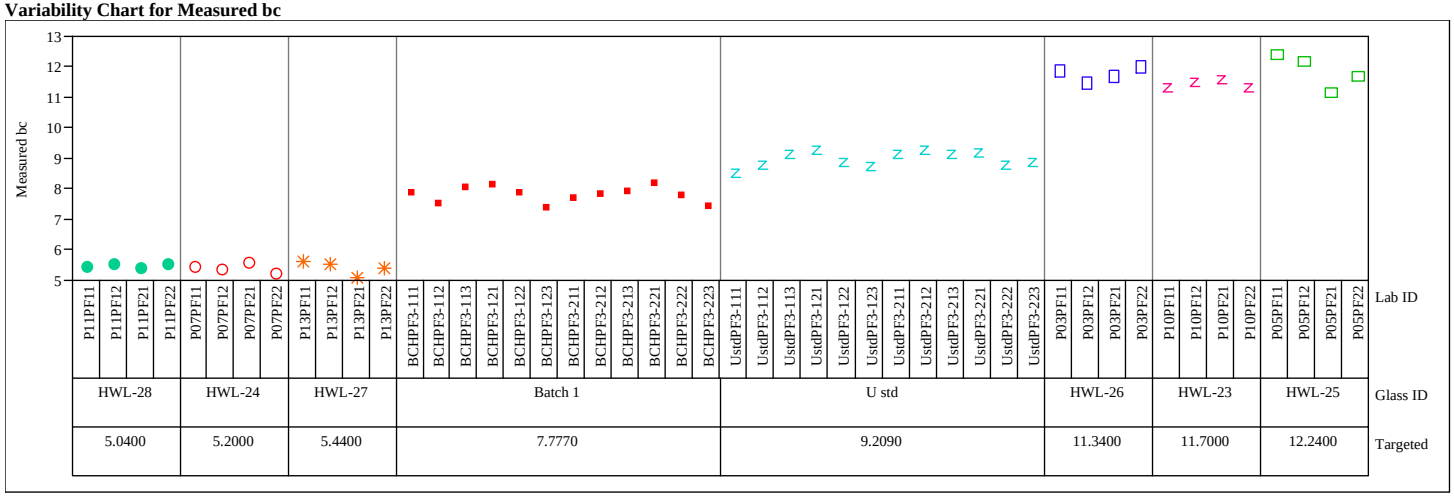
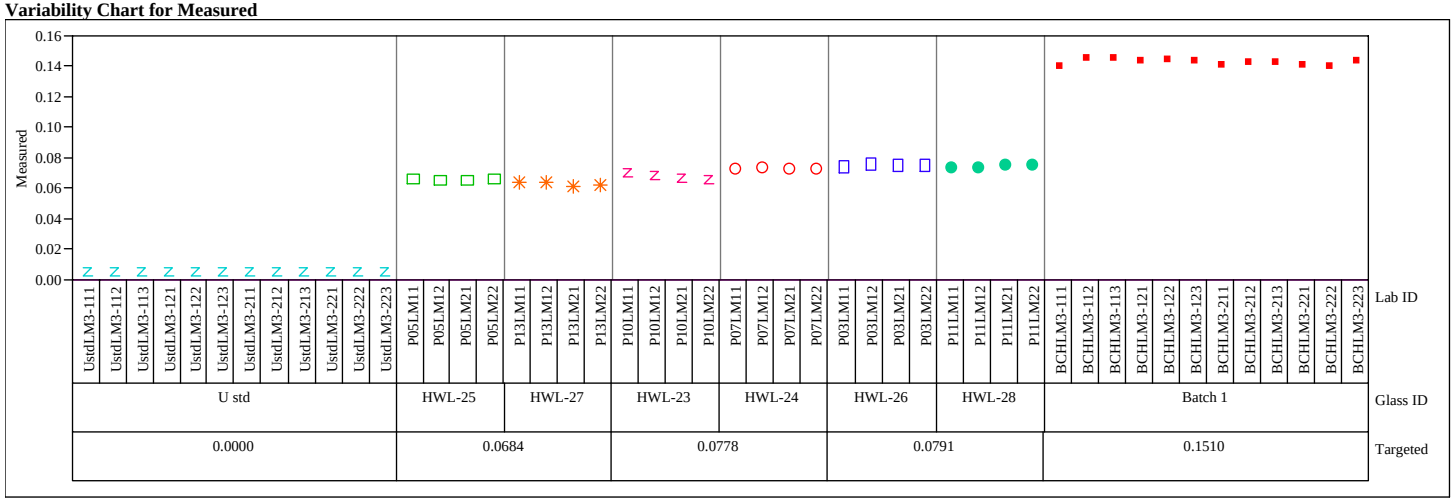


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=3, Oxide=BaO (wt%)
Variability Chart for Measured



Set=3, Oxide=BaO (wt%)
Variability Chart for Measured bc

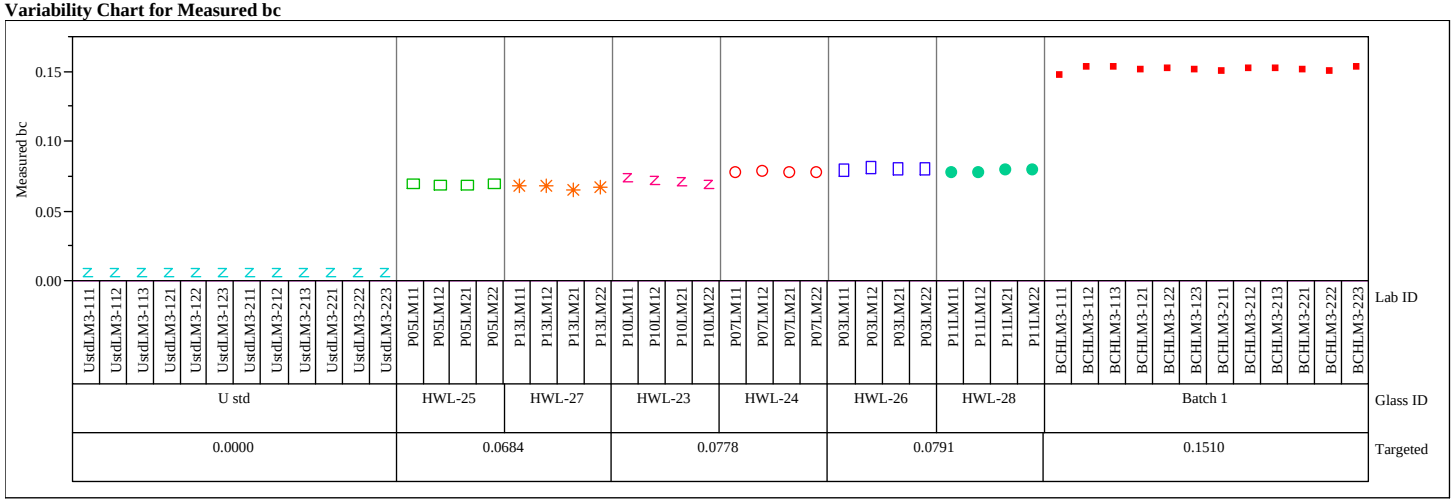
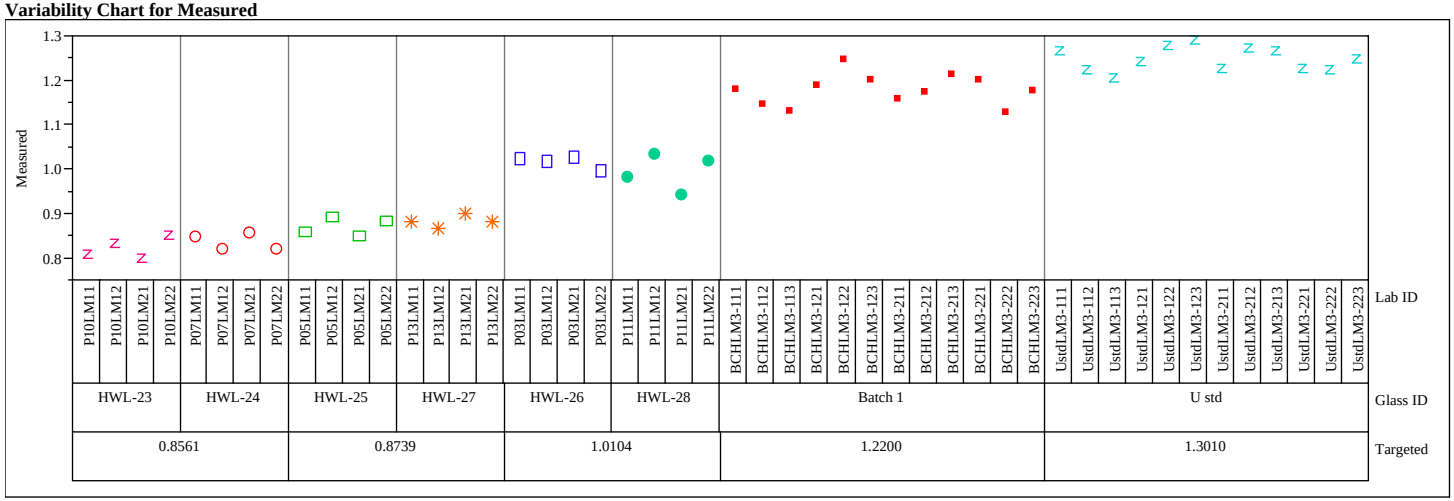


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=3, Oxide=CaO (wt%)
Variability Chart for Measured



Set=3, Oxide=CaO (wt%)
Variability Chart for Measured bc

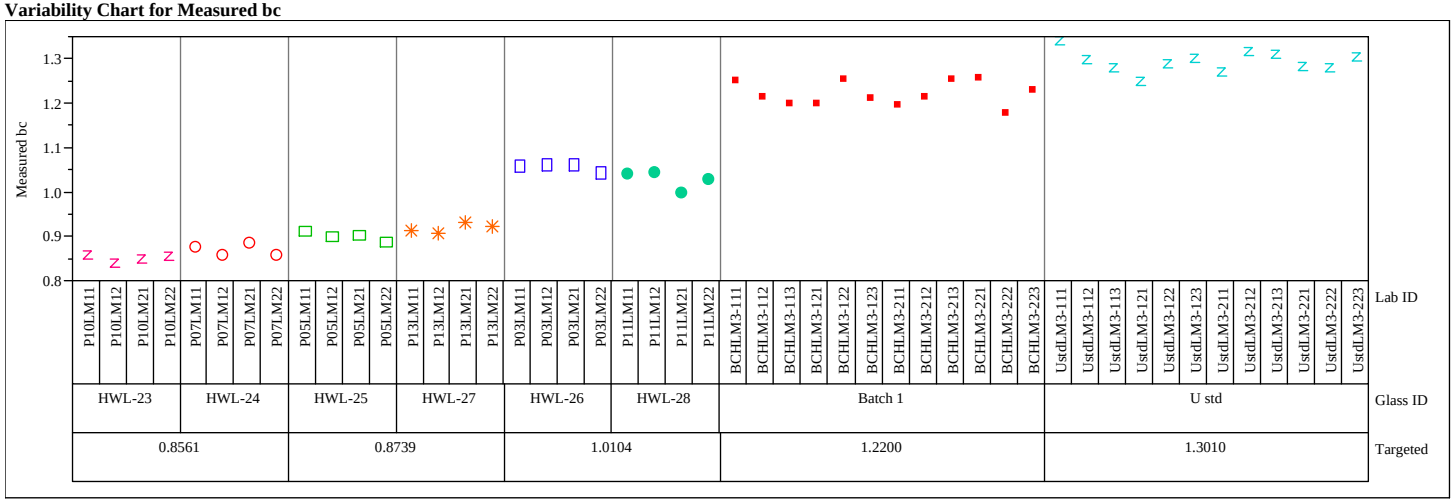
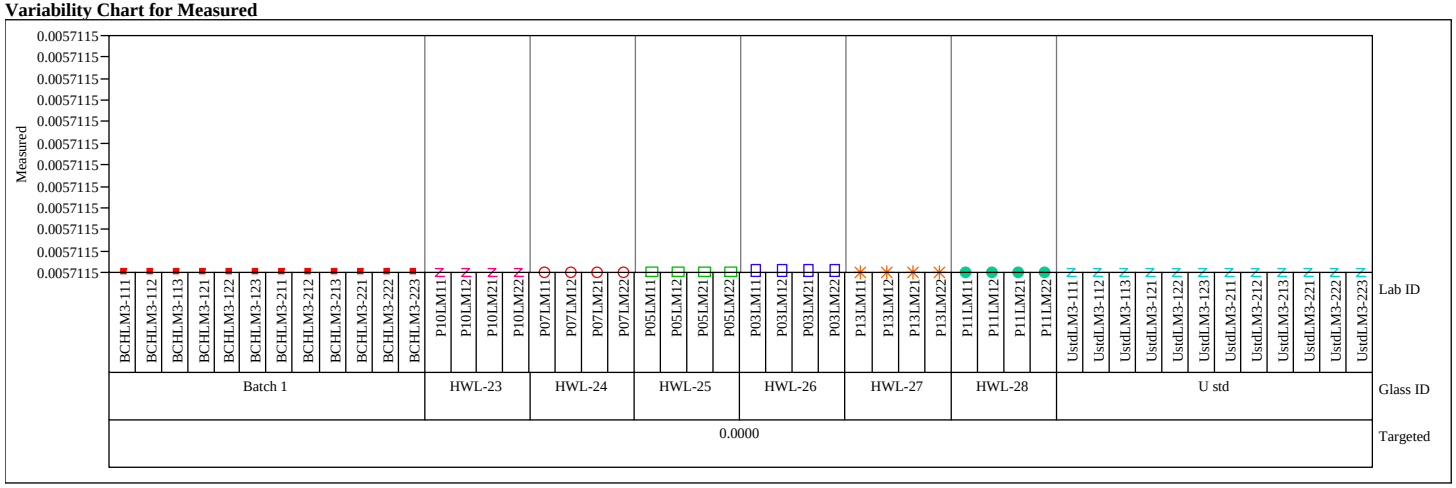


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=3, Oxide=CdO (wt%)
Variability Chart for Measured



Set=3, Oxide=CdO (wt%)
Variability Chart for Measured bc

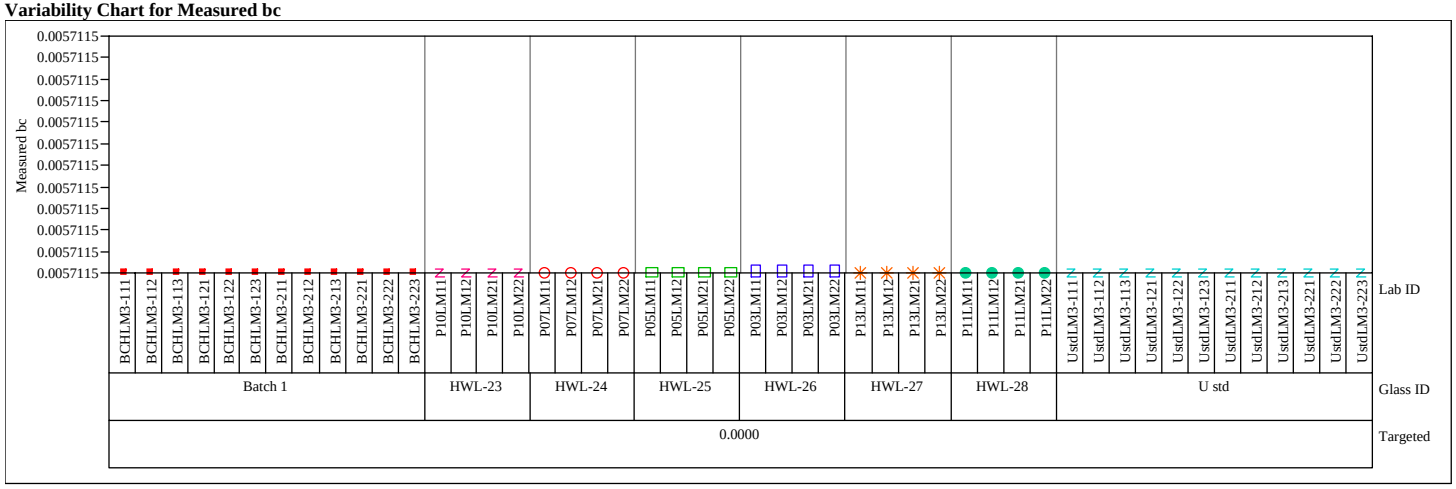
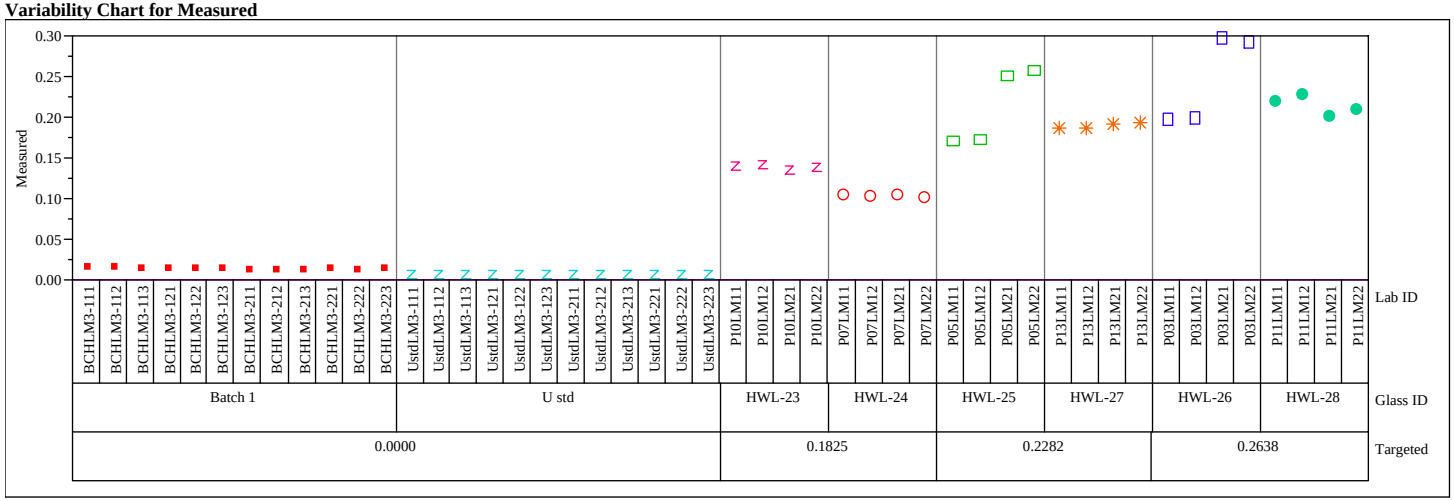


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=3, Oxide=Ce2O3 (wt%)
Variability Chart for Measured



Set=3, Oxide=Ce2O3 (wt%)
Variability Chart for Measured bc

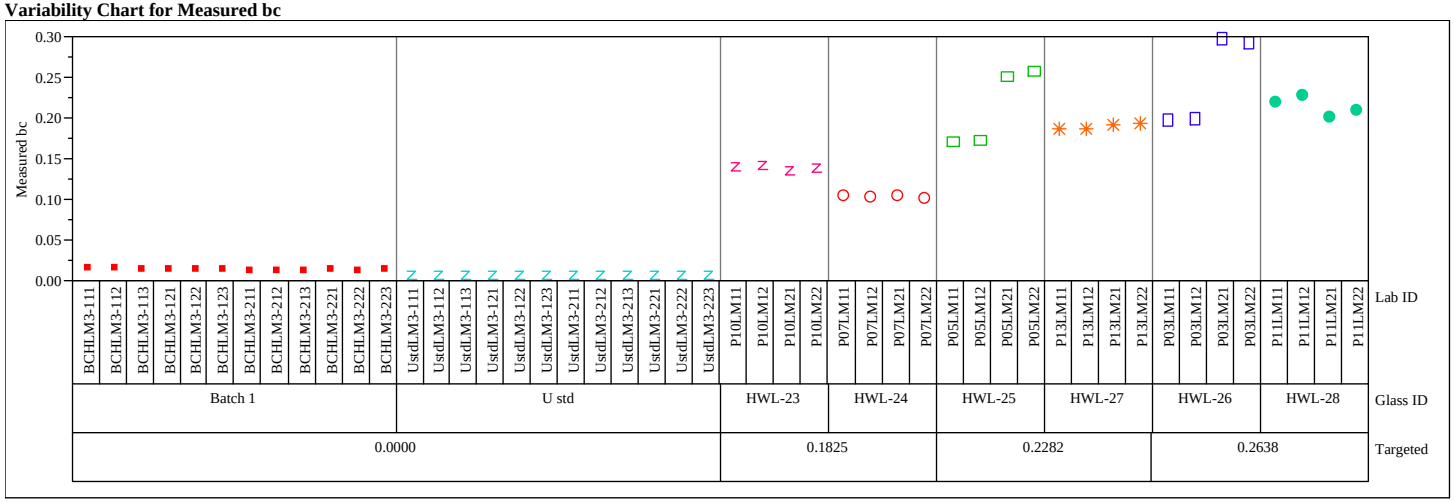
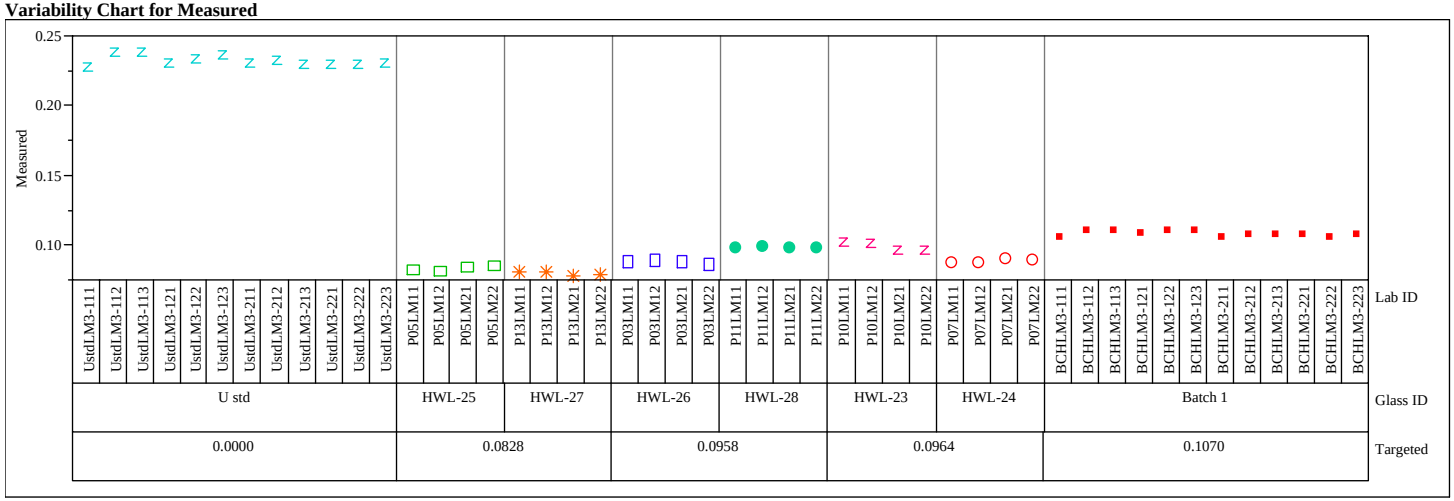


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=3, Oxide=Cr2O3 (wt%)
Variability Chart for Measured



Set=3, Oxide=Cr2O3 (wt%)
Variability Chart for Measured bc

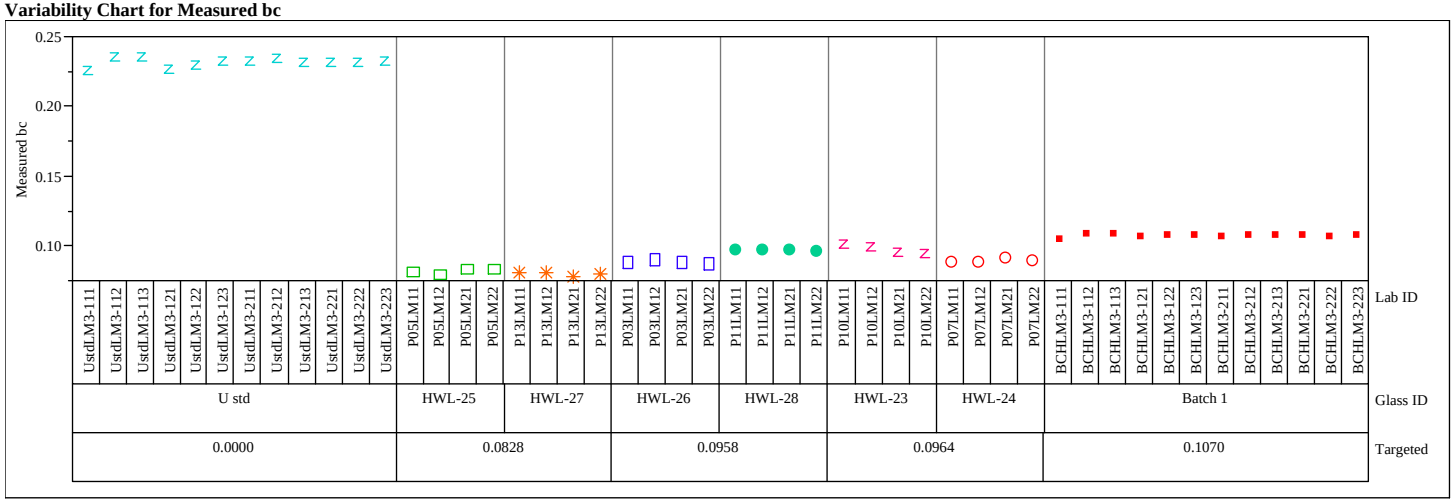
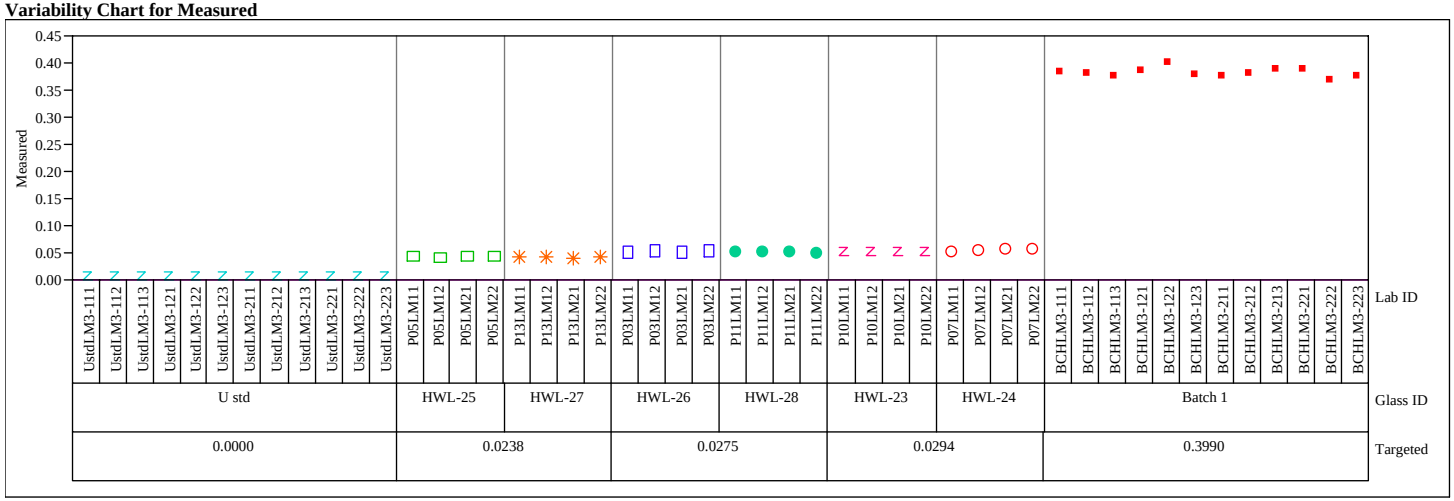


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=3, Oxide=CuO (wt%)
Variability Chart for Measured



Set=3, Oxide=CuO (wt%)
Variability Chart for Measured bc

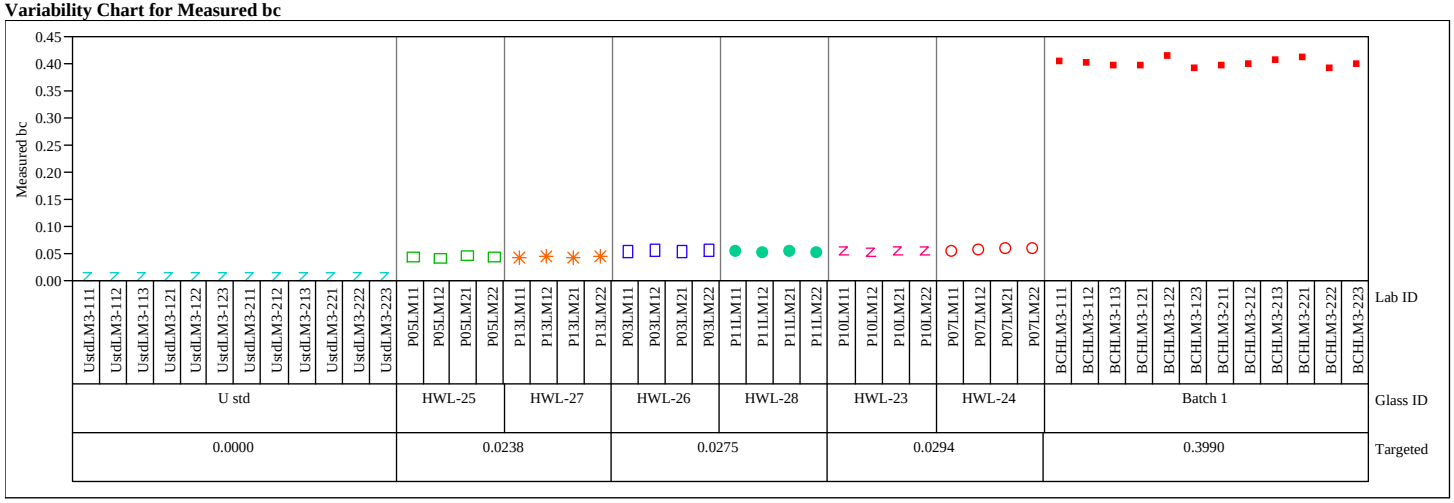
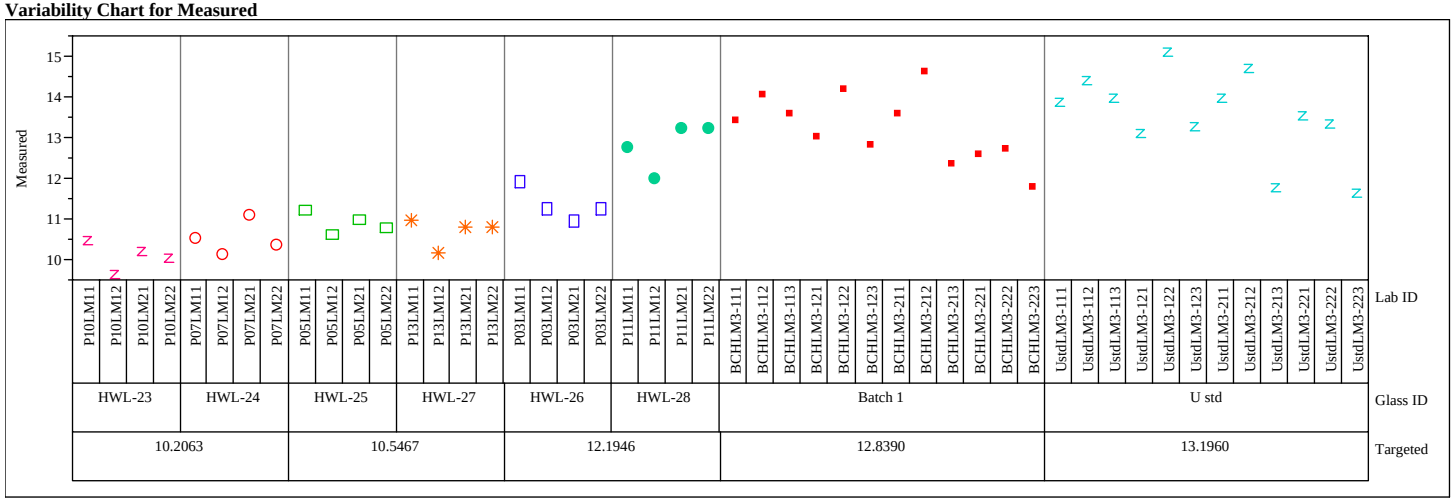


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=3, Oxide=Fe2O3 (wt%)
Variability Chart for Measured



Set=3, Oxide=Fe2O3 (wt%)
Variability Chart for Measured bc

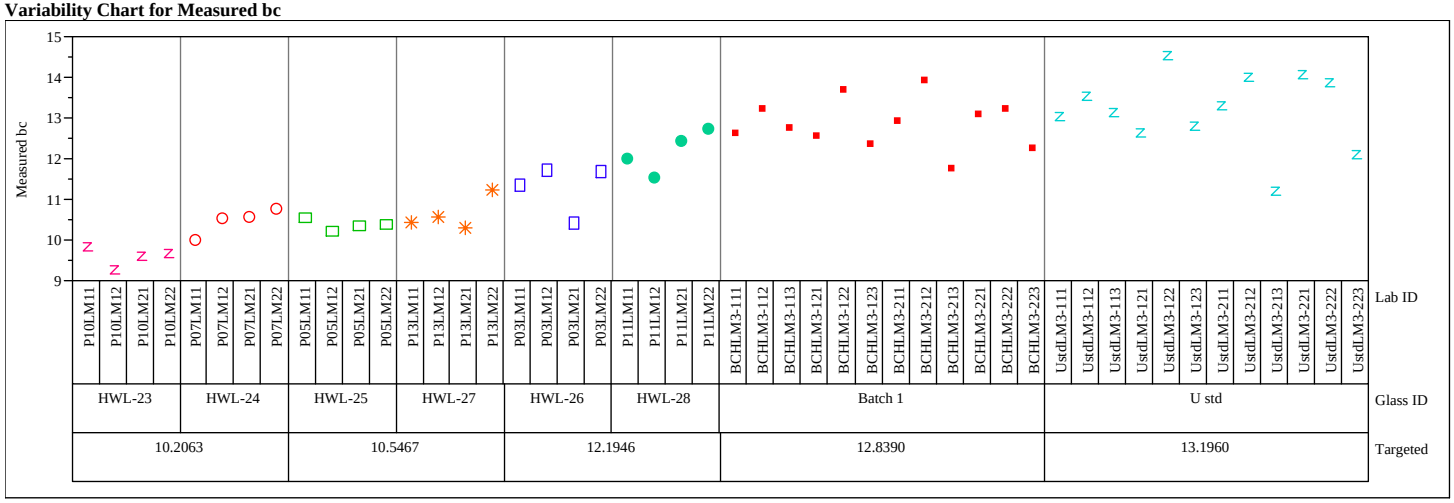
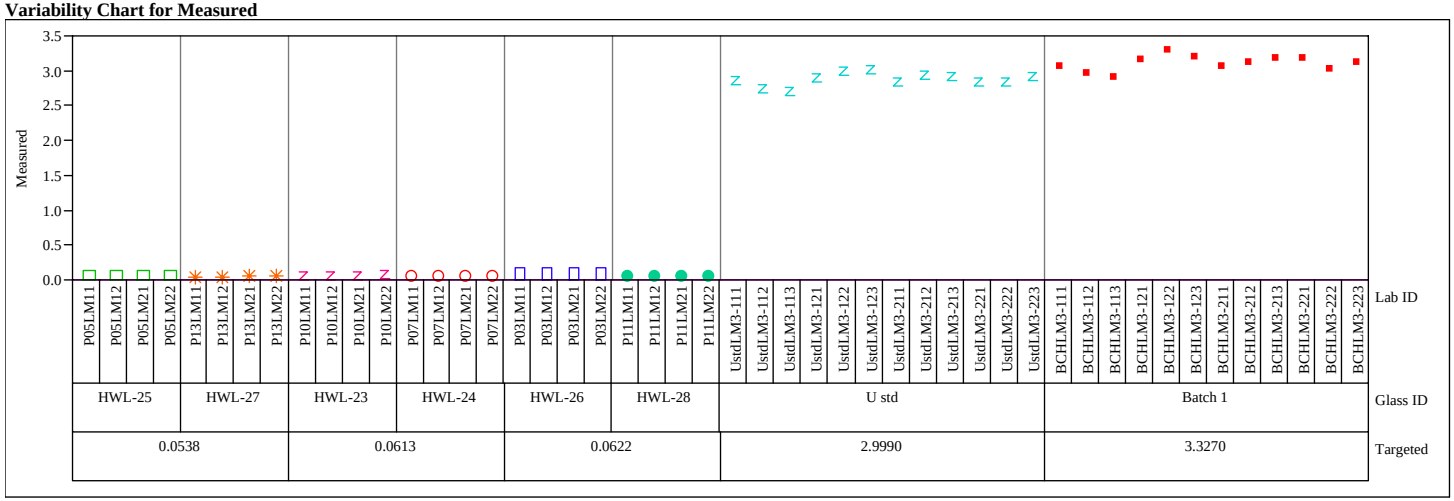


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=3, Oxide=K2O (wt%)
Variability Chart for Measured



Set=3, Oxide=K2O (wt%)
Variability Chart for Measured bc

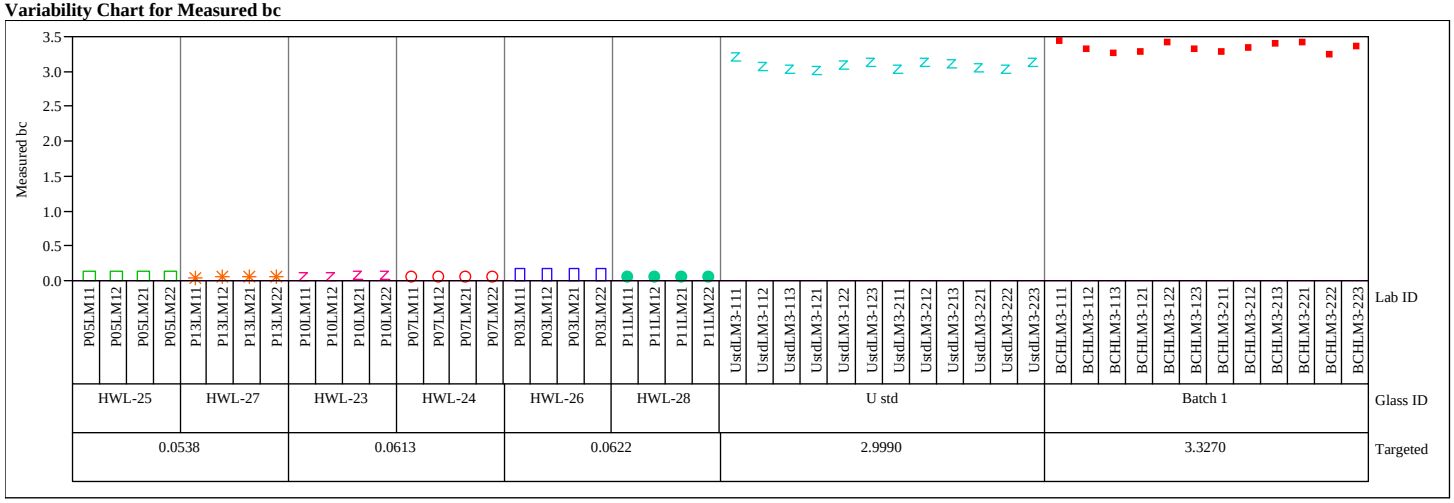
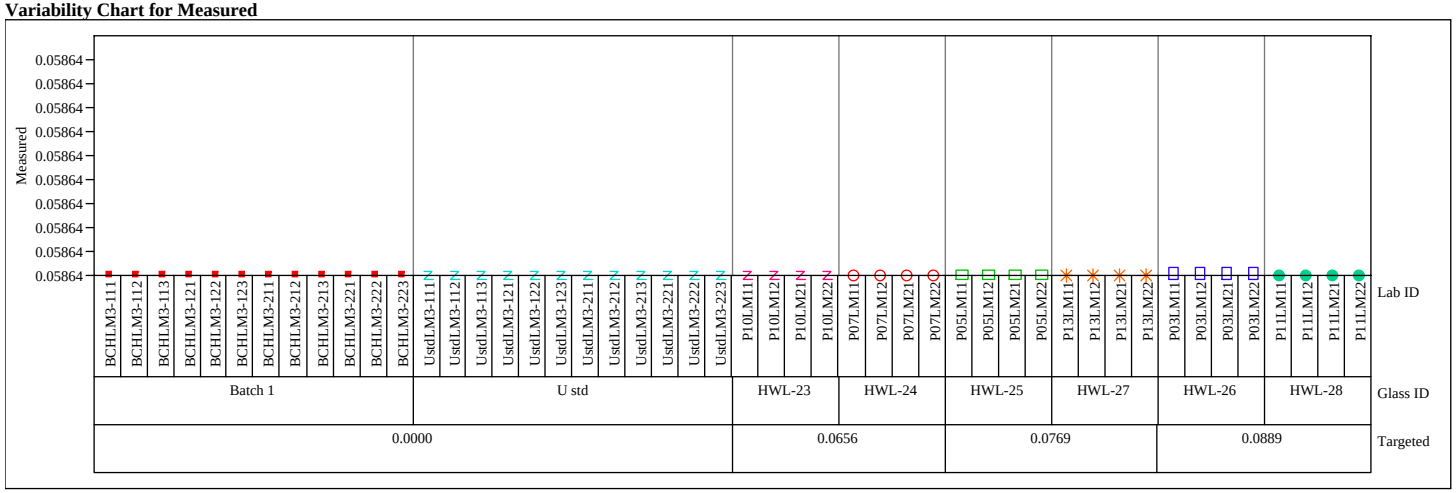


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=3, Oxide=La2O3 (wt%)
Variability Chart for Measured



Set=3, Oxide=La2O3 (wt%)
Variability Chart for Measured bc

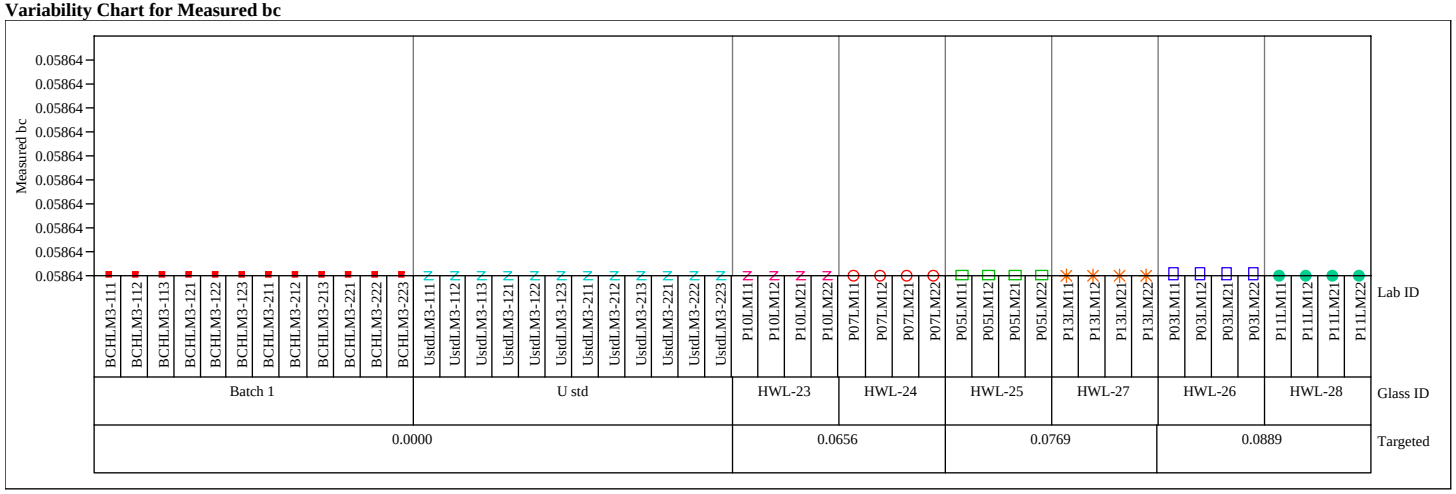
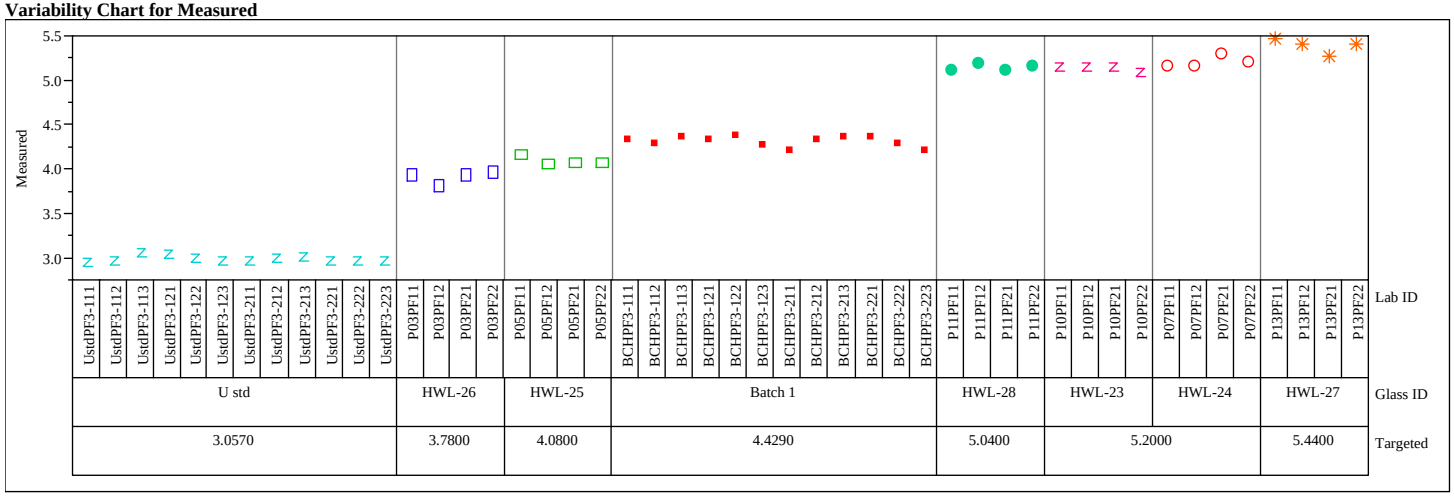


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=3, Oxide=Li2O (wt%)
Variability Chart for Measured



Set=3, Oxide=Li2O (wt%)
Variability Chart for Measured bc

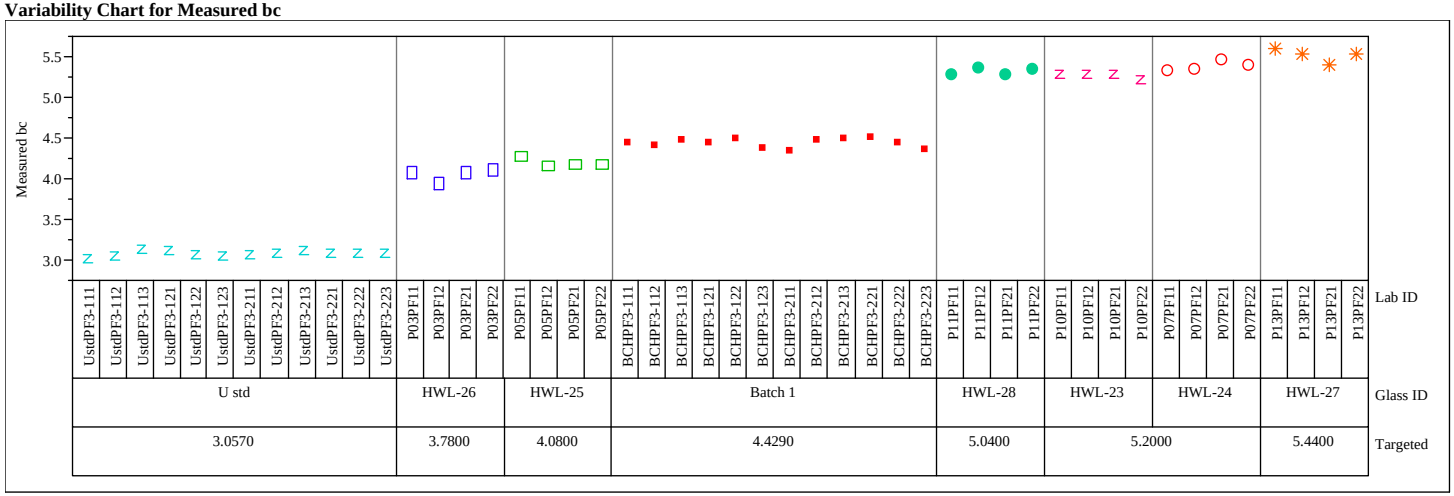
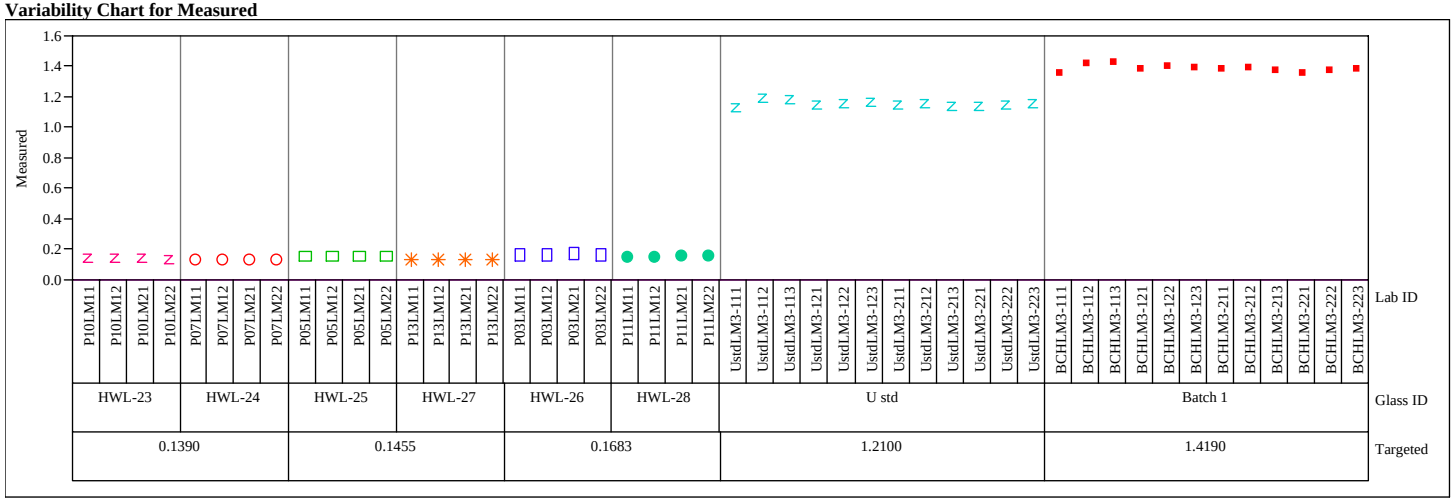


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=3, Oxide=MgO (wt%)
Variability Chart for Measured



Set=3, Oxide=MgO (wt%)
Variability Chart for Measured bc

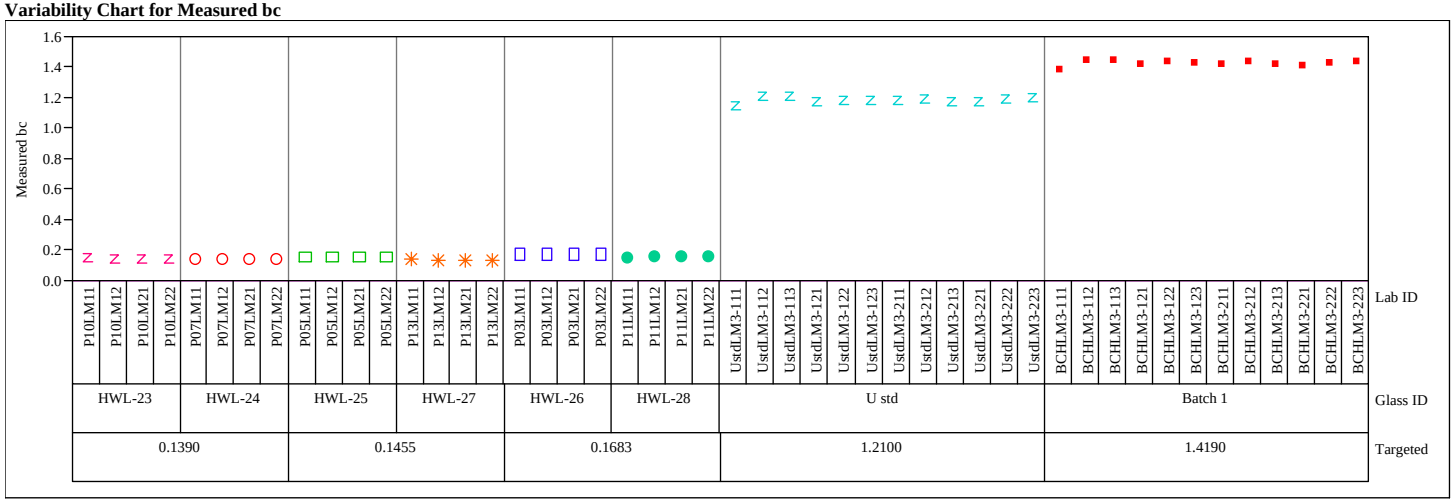
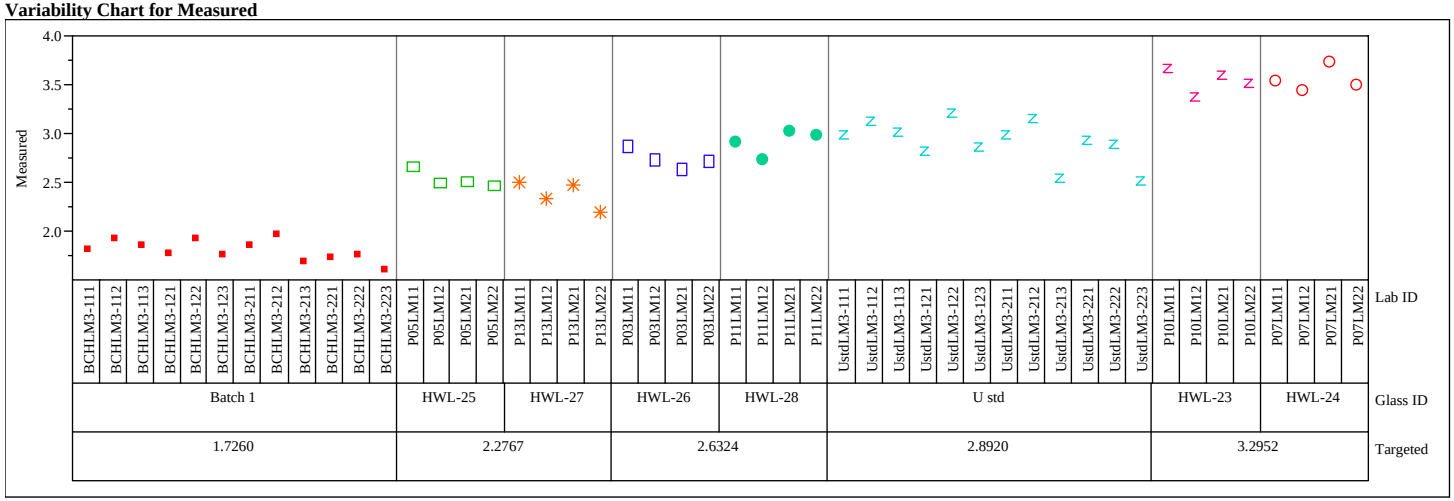


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=3, Oxide=MnO (wt%)
Variability Chart for Measured



Set=3, Oxide=MnO (wt%)
Variability Chart for Measured bc

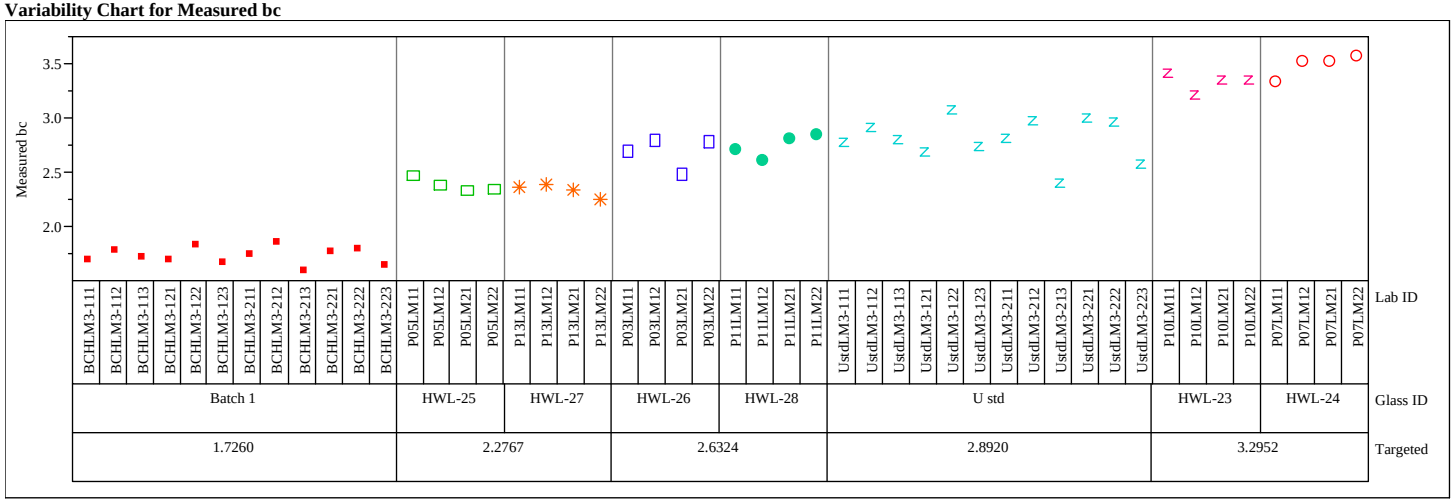
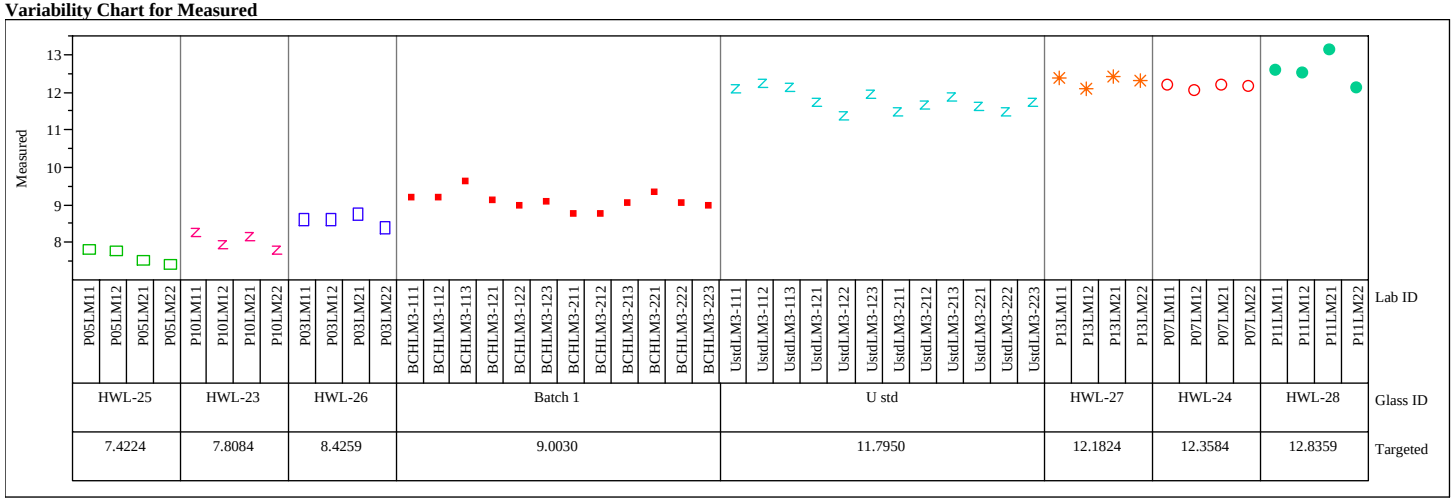


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=3, Oxide=Na2O (wt%)
Variability Chart for Measured



Set=3, Oxide=Na2O (wt%)
Variability Chart for Measured bc

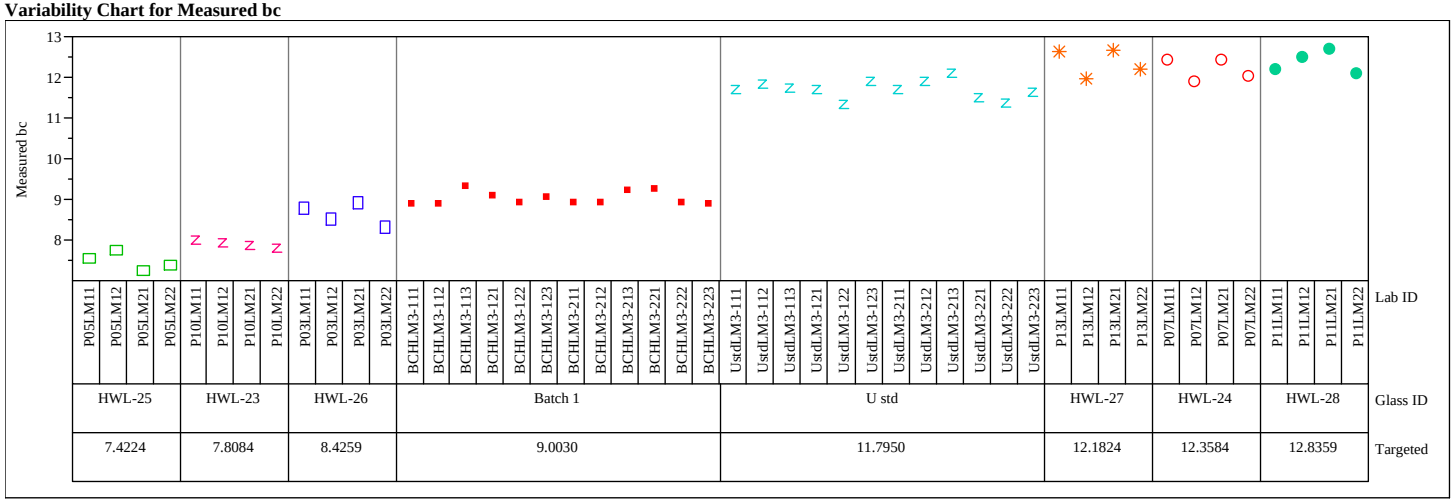
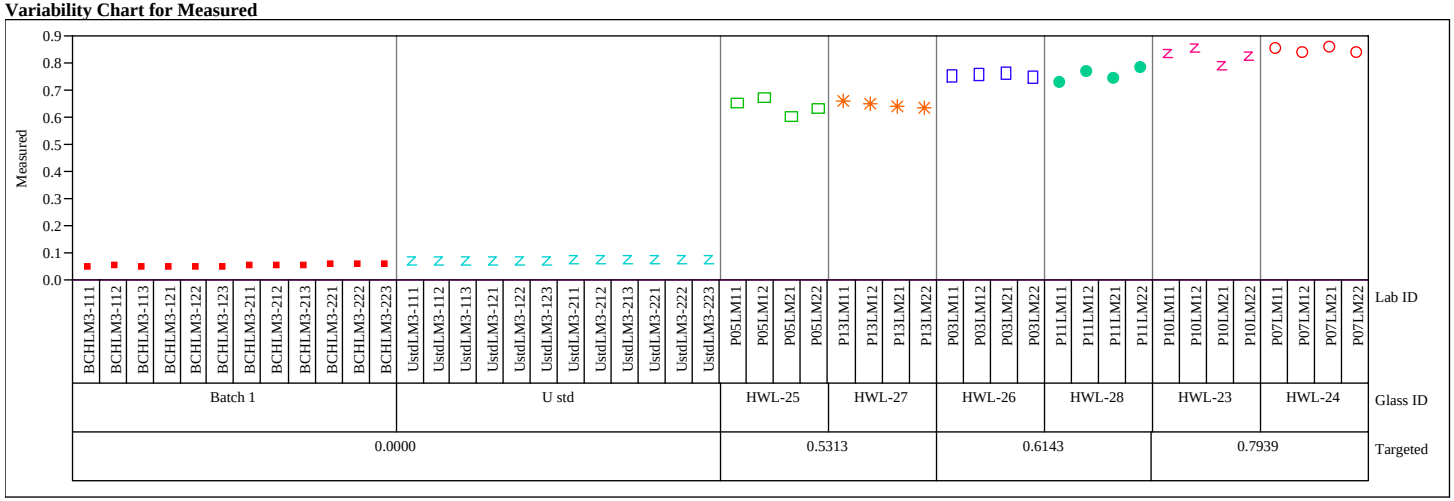


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=3, Oxide=Nb2O5 (wt%)
Variability Chart for Measured



Set=3, Oxide=Nb2O5 (wt%)
Variability Chart for Measured bc

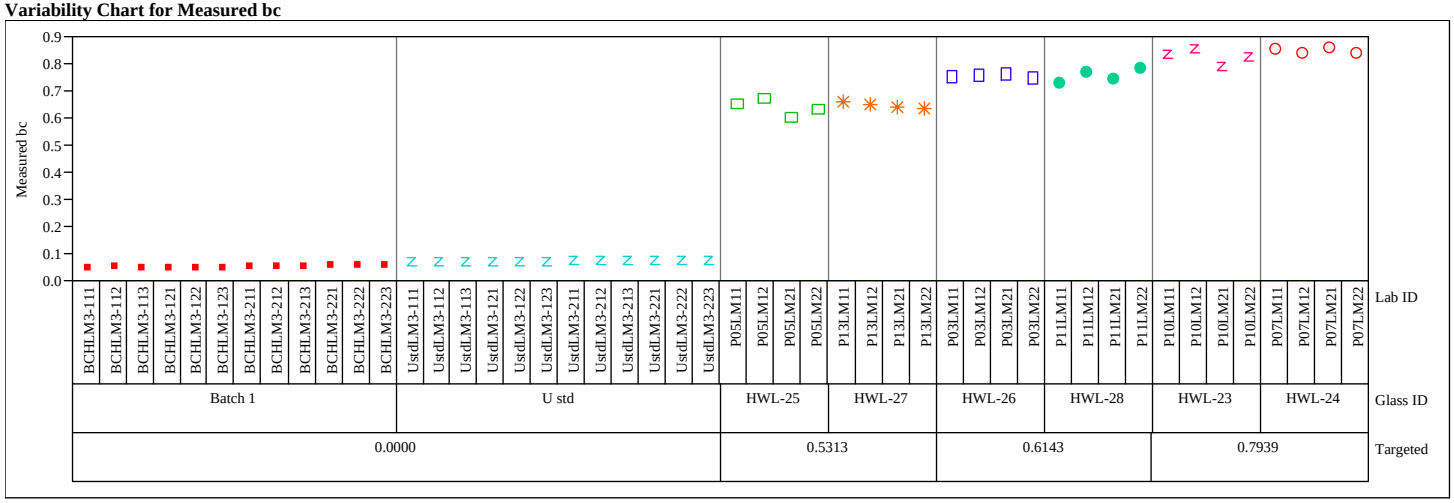
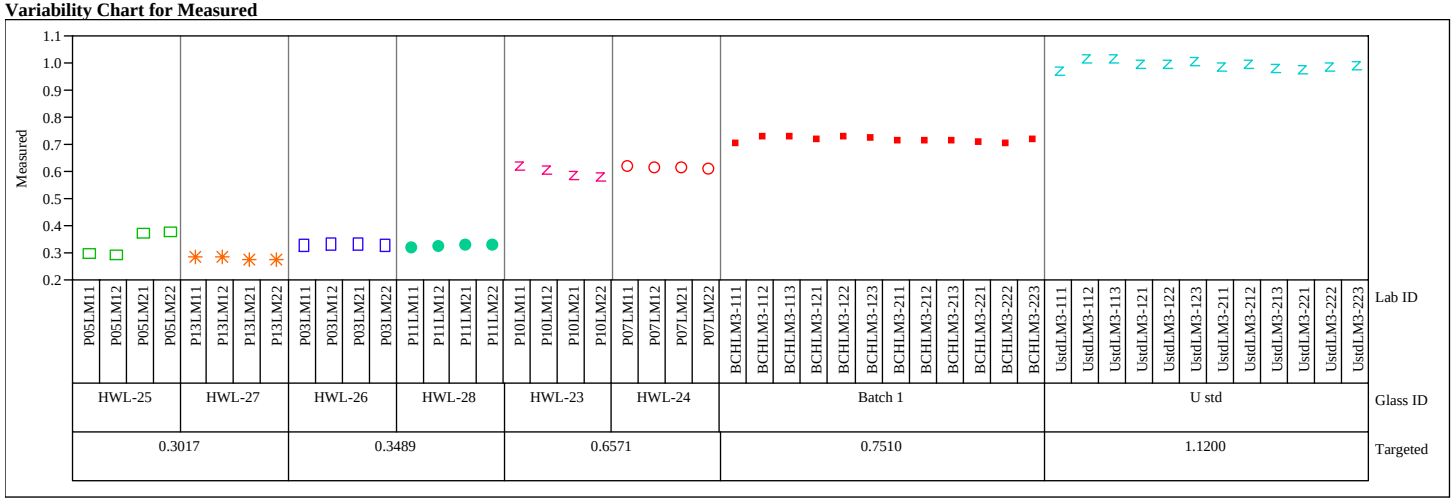


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=3, Oxide=NiO (wt%)
Variability Chart for Measured



Set=3, Oxide=NiO (wt%)
Variability Chart for Measured bc

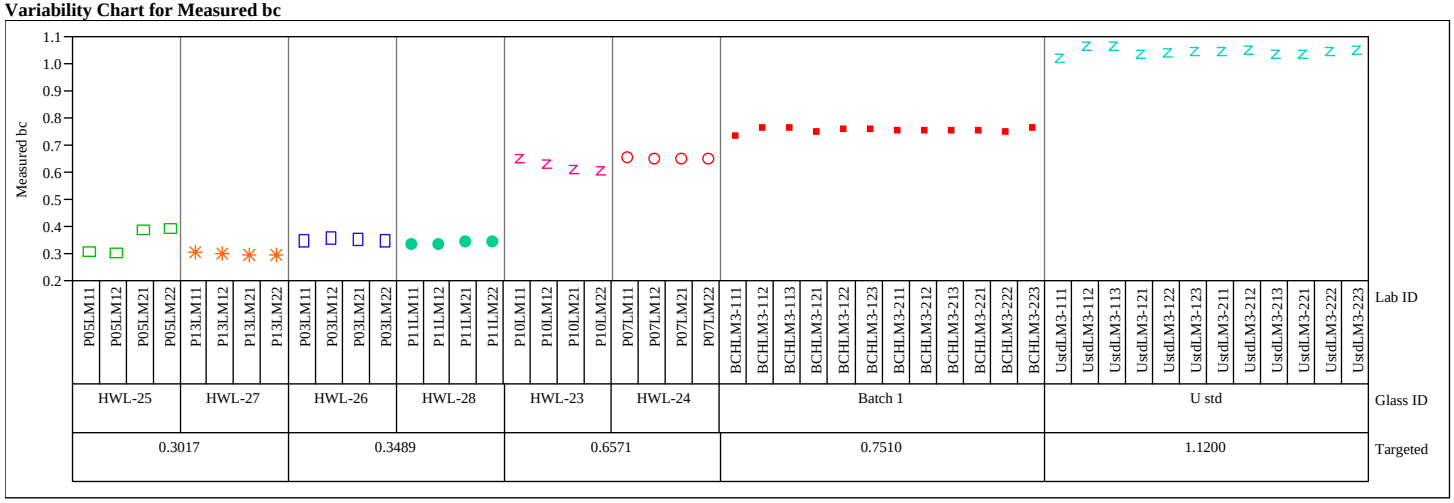
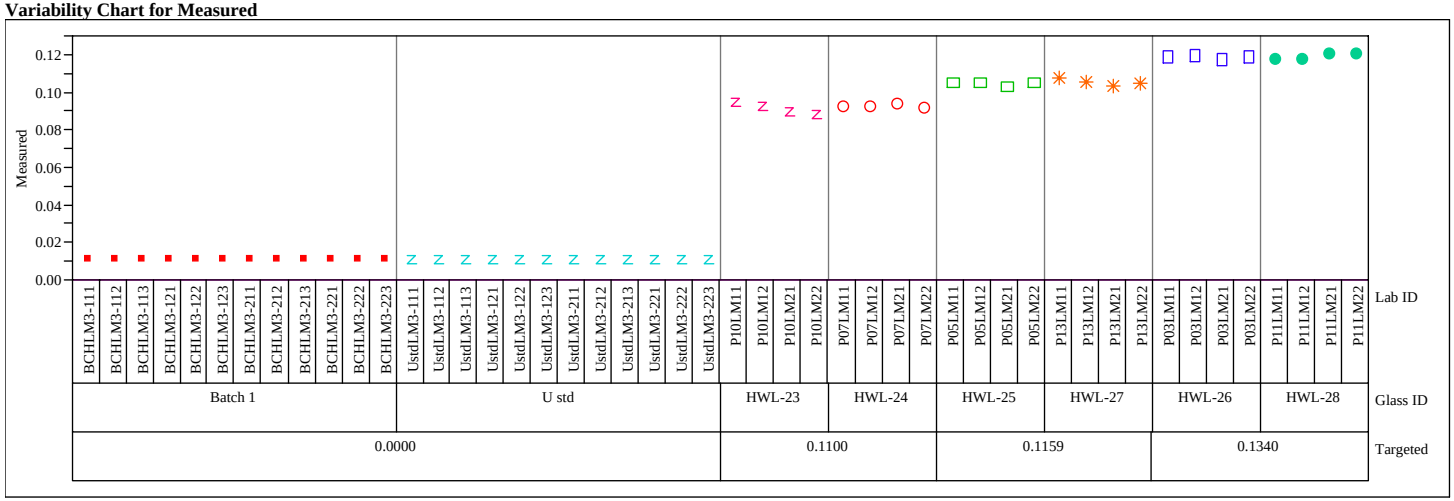


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=3, Oxide=PbO (wt%)
Variability Chart for Measured



Set=3, Oxide=PbO (wt%)
Variability Chart for Measured bc

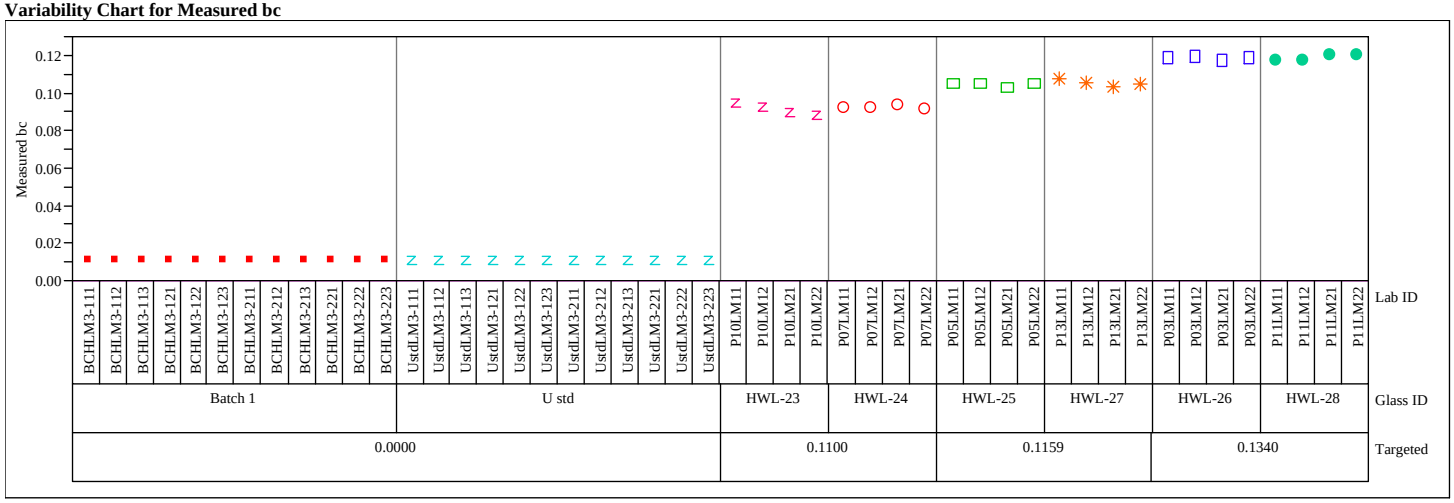
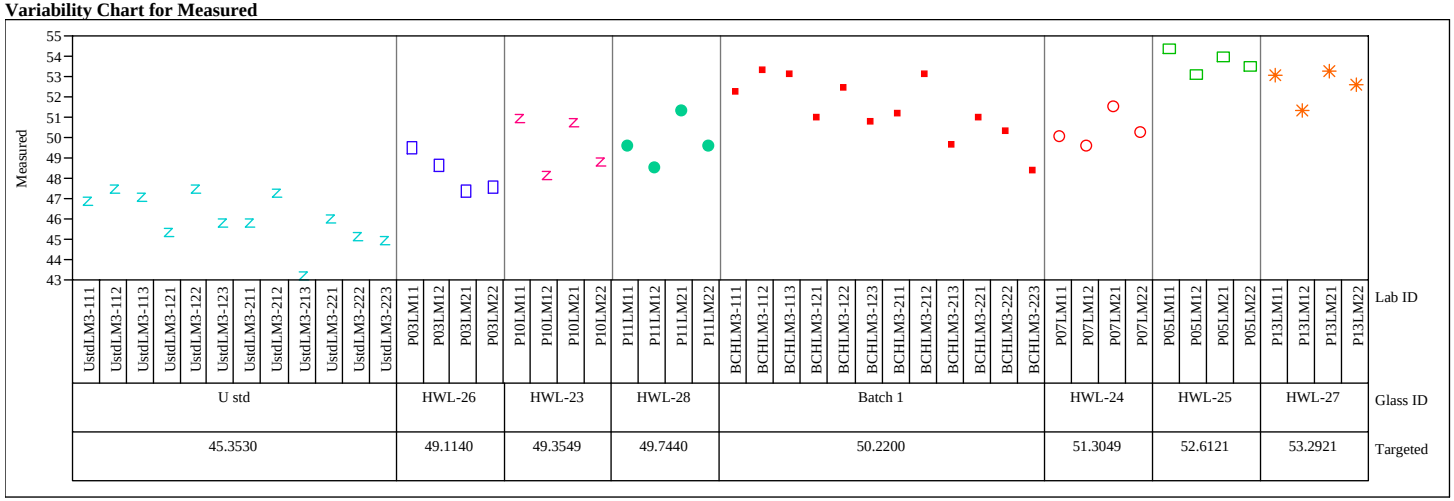


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=3, Oxide=SiO2 (wt%)
Variability Chart for Measured



Set=3, Oxide=SiO2 (wt%)
Variability Chart for Measured bc

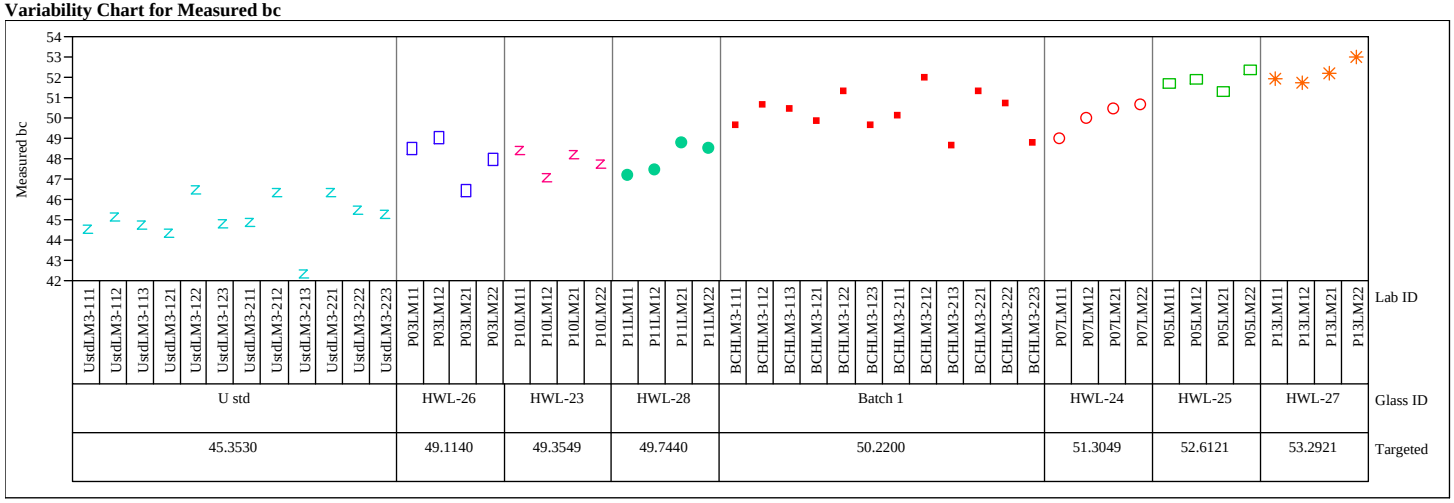
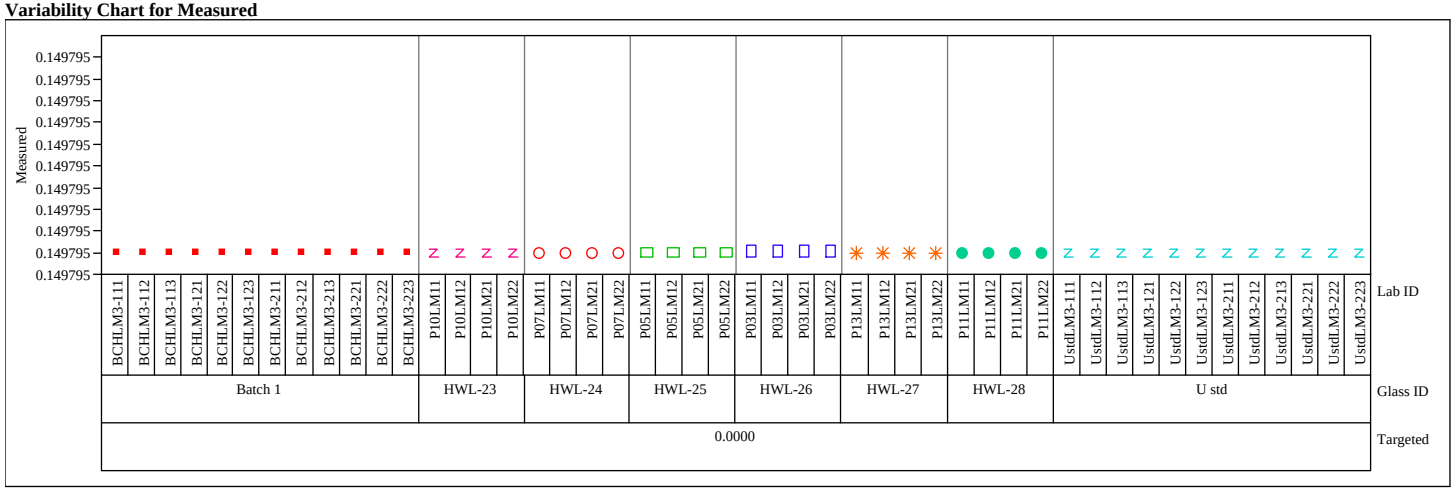


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=3, Oxide=SO4 (wt%)
Variability Chart for Measured



Set=3, Oxide=SO4 (wt%)
Variability Chart for Measured bc

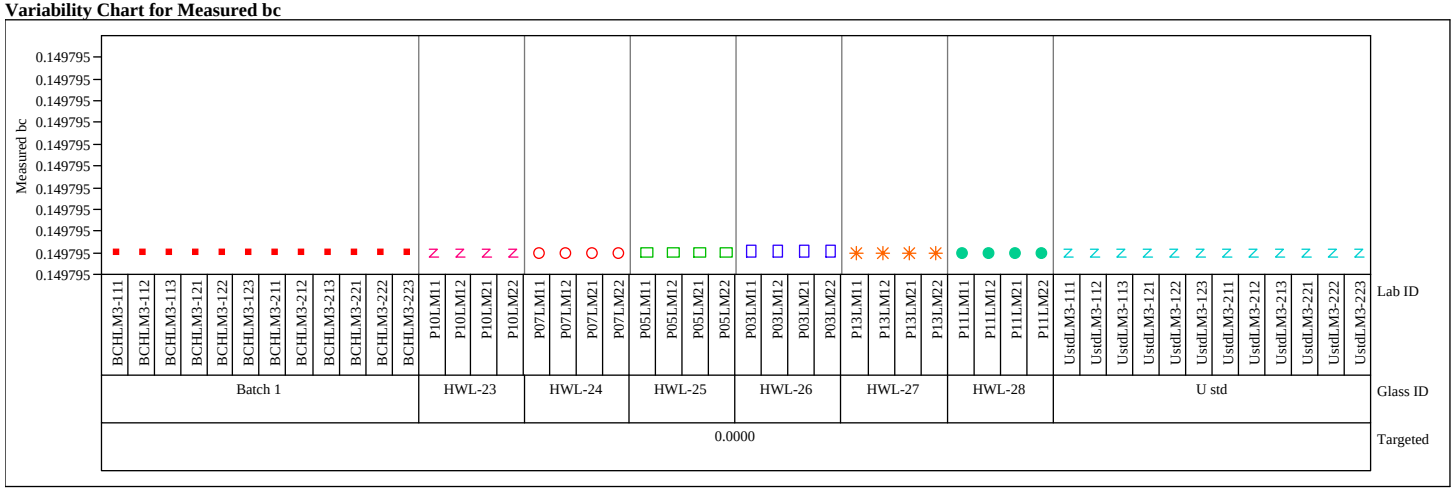
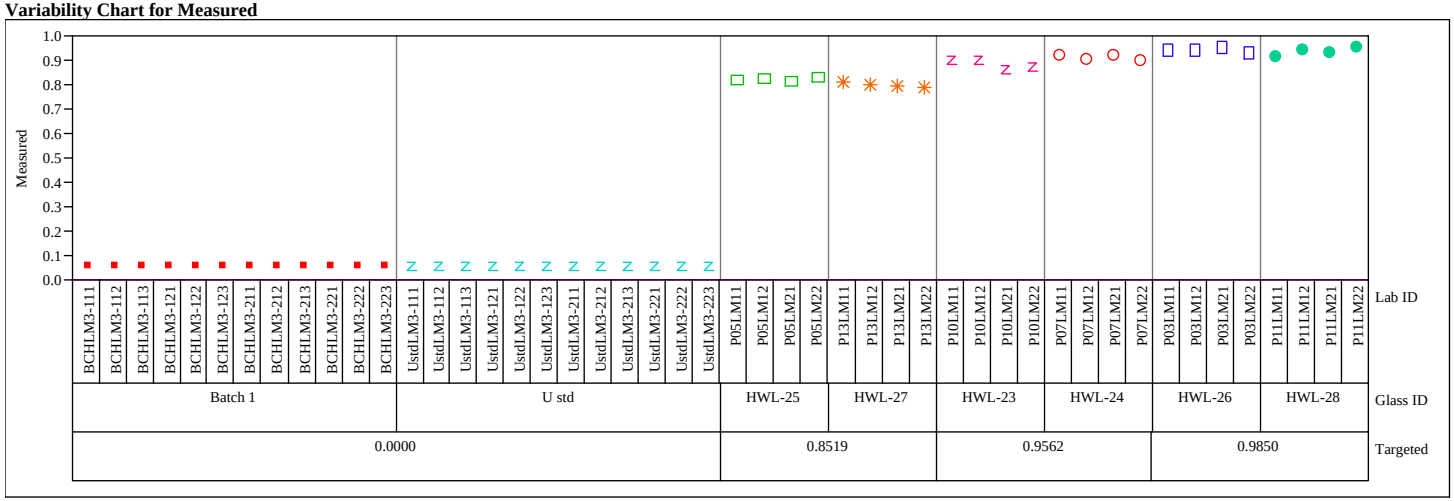


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=3, Oxide=ThO2 (wt%)
Variability Chart for Measured



Set=3, Oxide=ThO2 (wt%)
Variability Chart for Measured bc

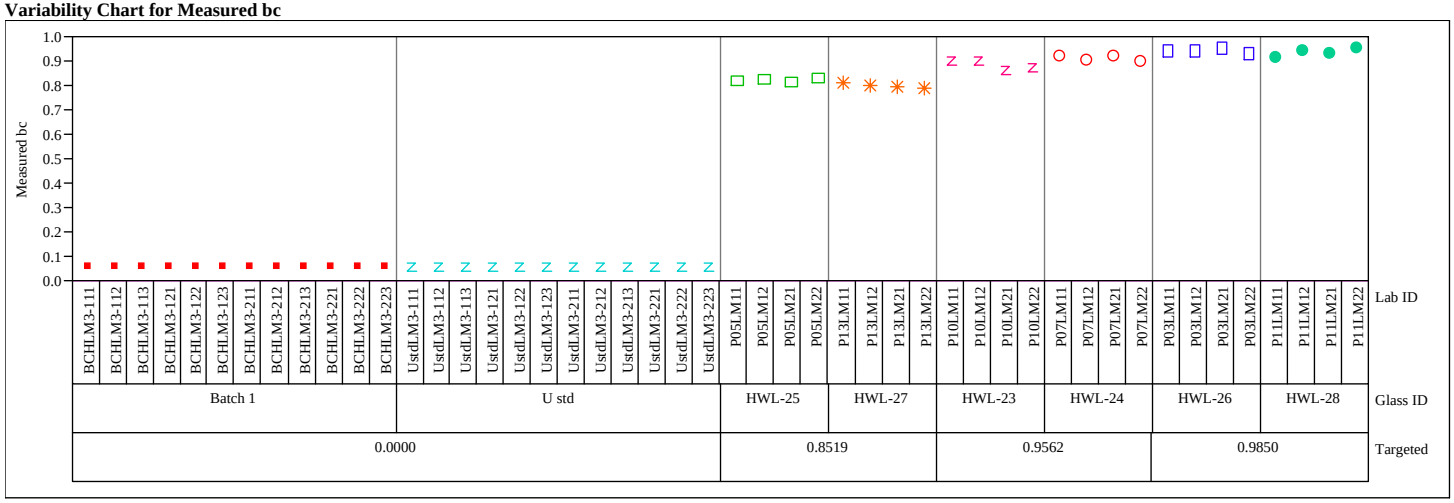
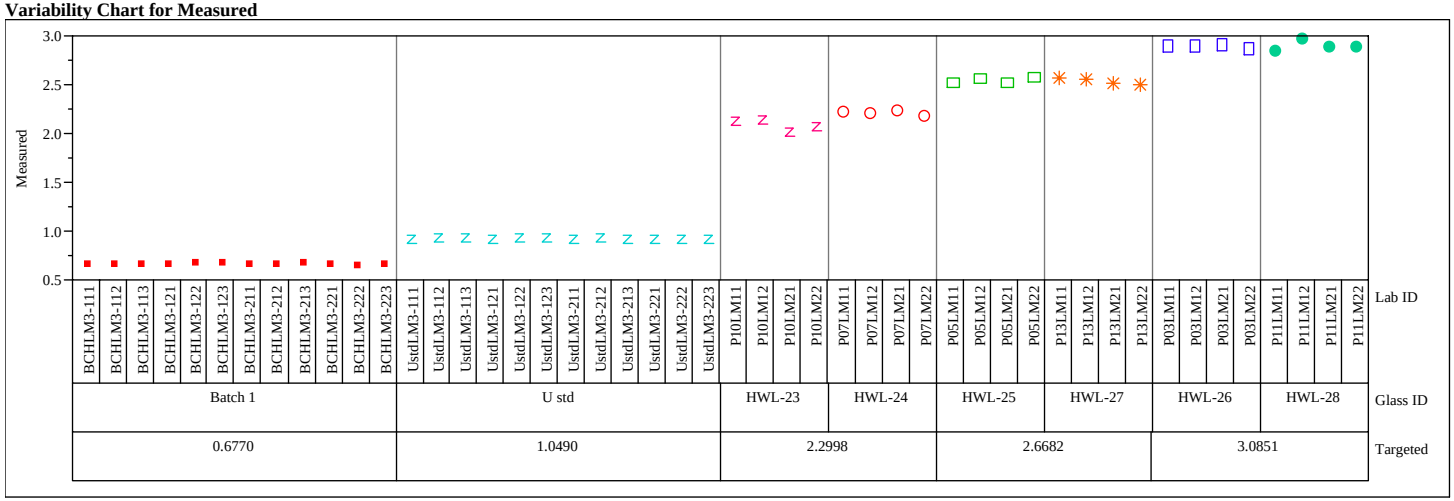


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=3, Oxide=TiO2 (wt%)
Variability Chart for Measured



Set=3, Oxide=TiO2 (wt%)
Variability Chart for Measured bc

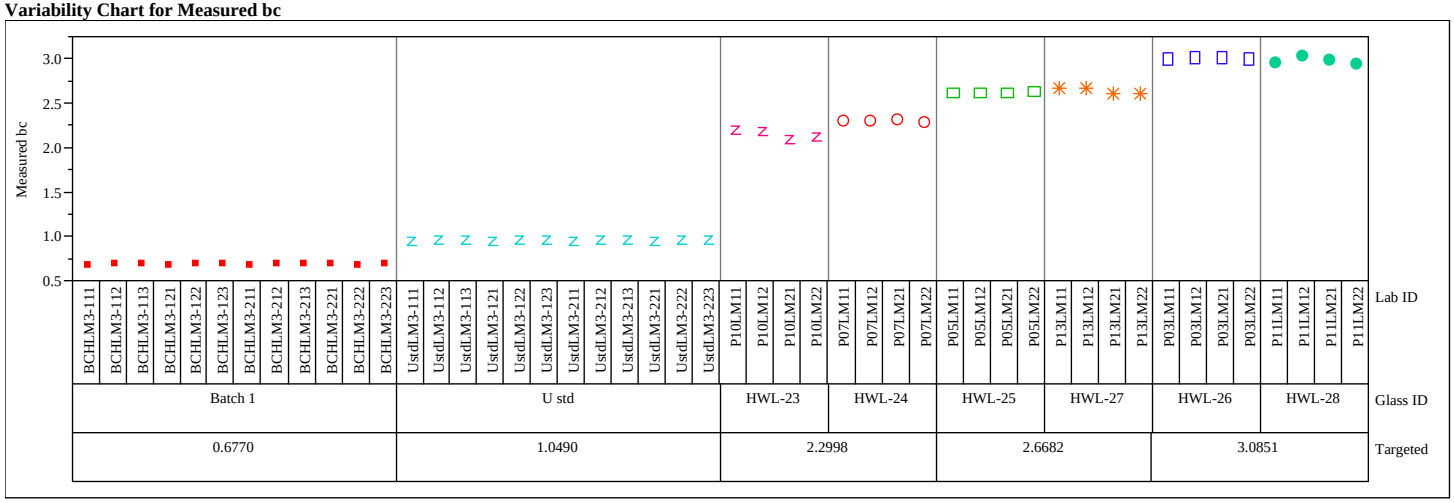
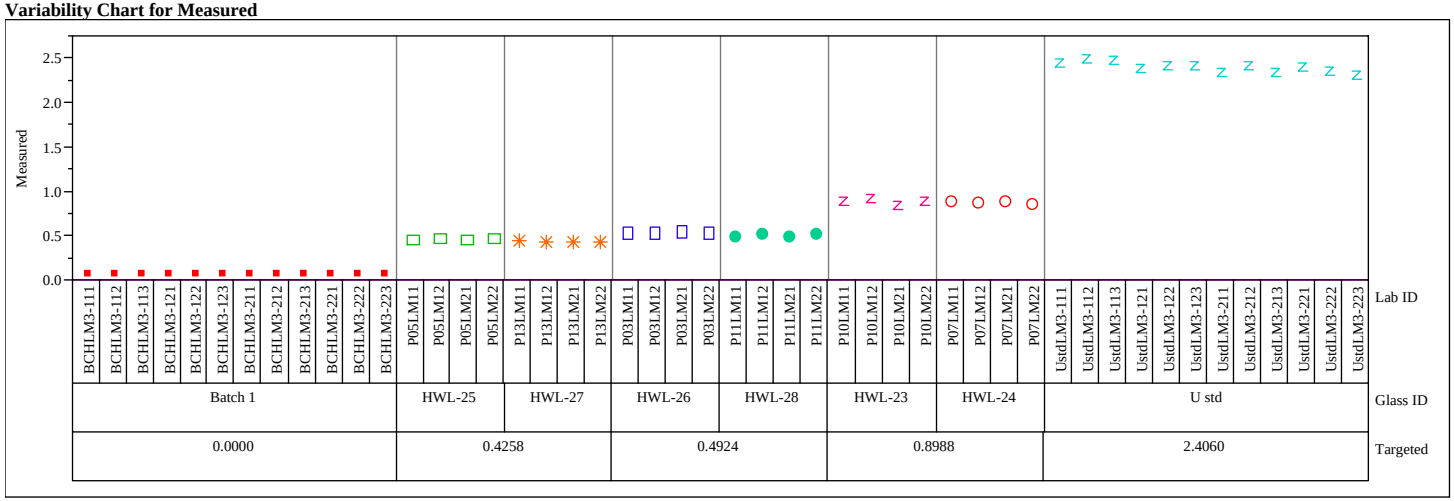


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=3, Oxide=U3O8 (wt%)
Variability Chart for Measured



Set=3, Oxide=U3O8 (wt%)
Variability Chart for Measured bc

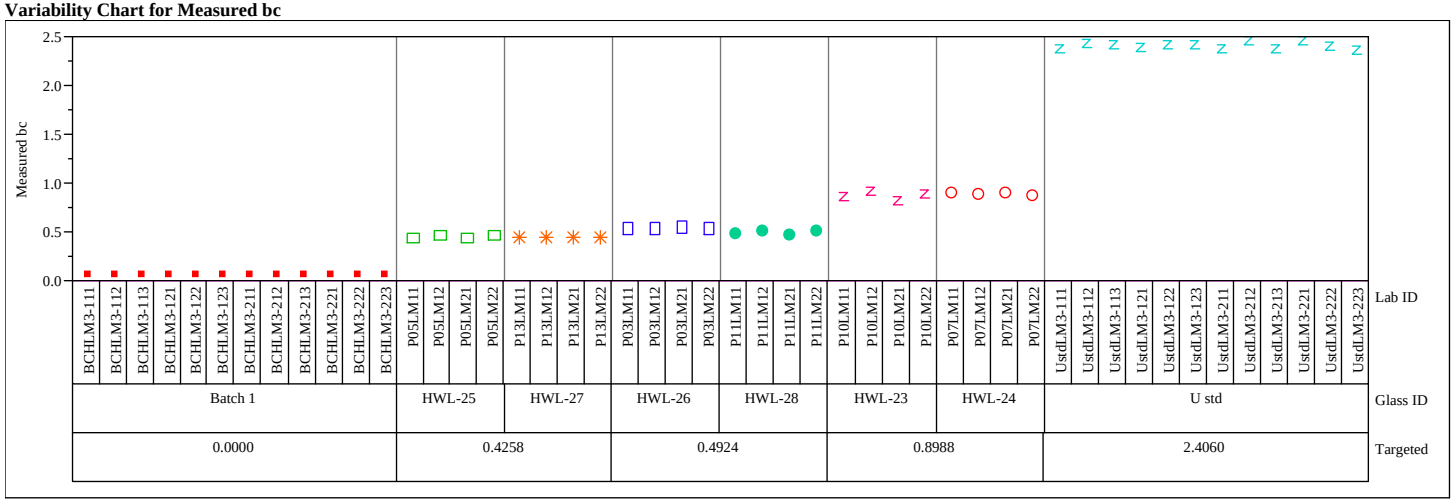
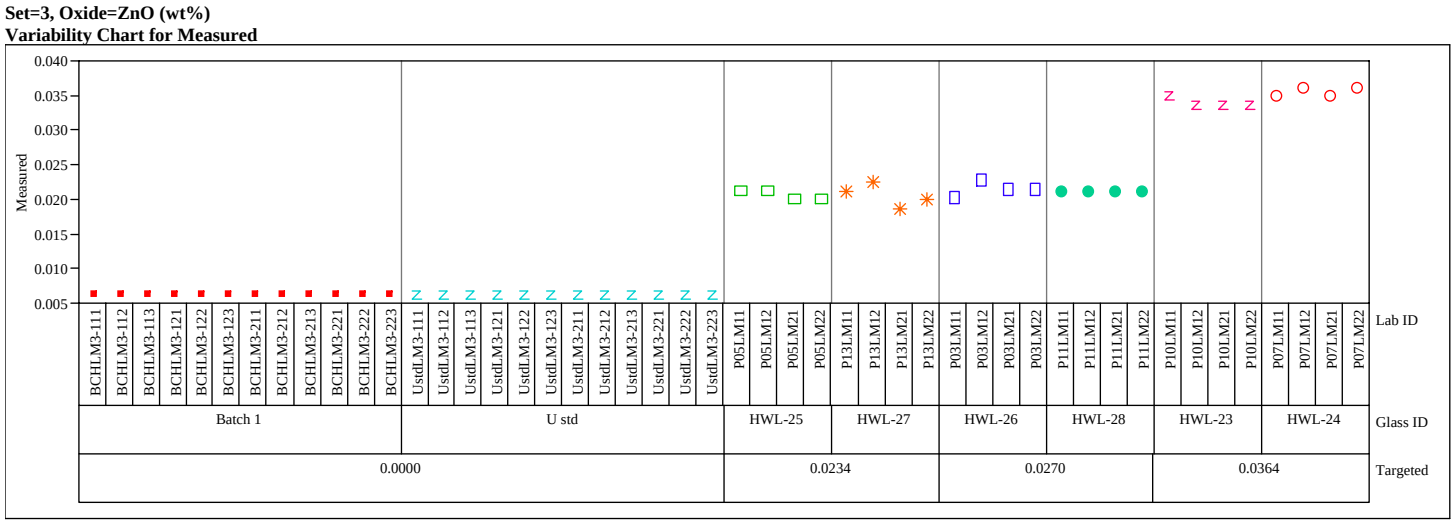


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations



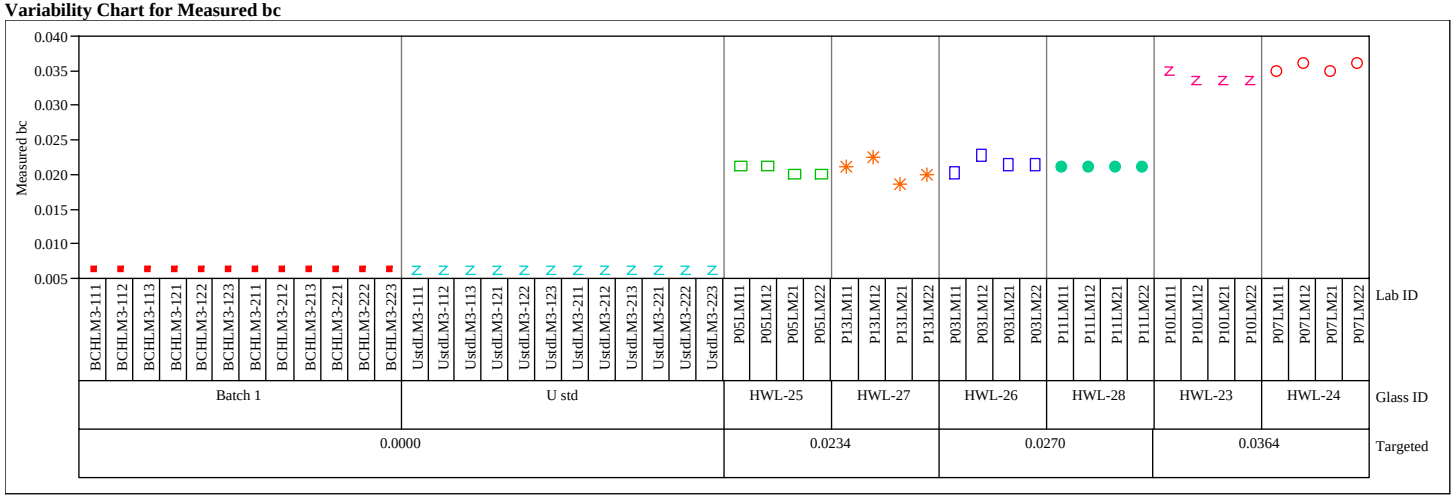
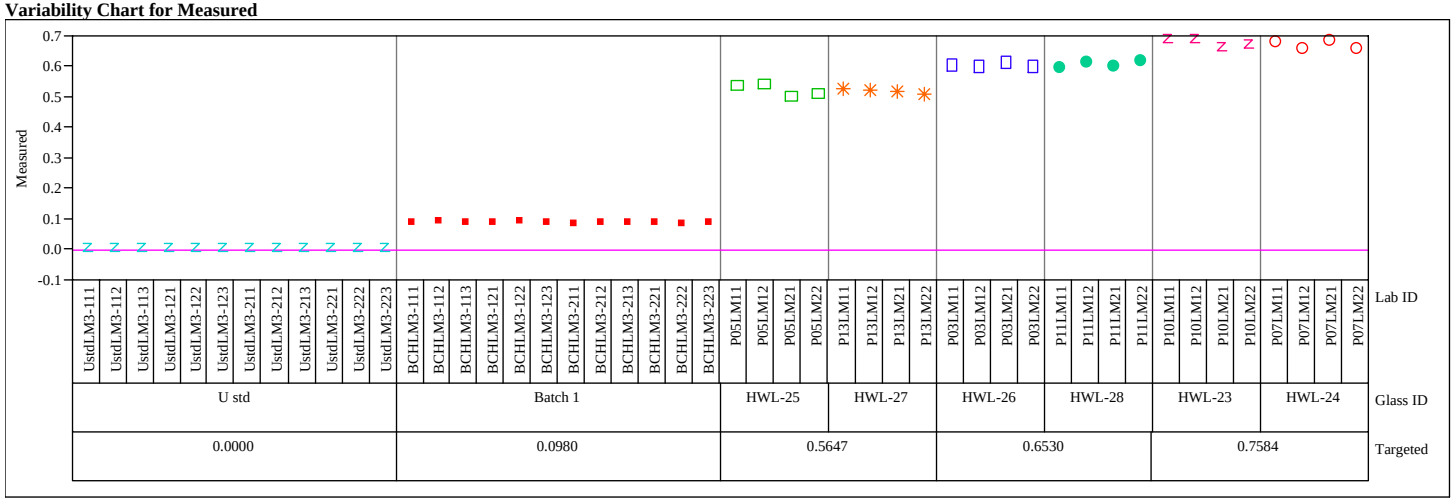


Figure A4. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=3, Oxide=ZrO2 (wt%)
Variability Chart for Measured



Set=3, Oxide=ZrO2 (wt%)
Variability Chart for Measured bc

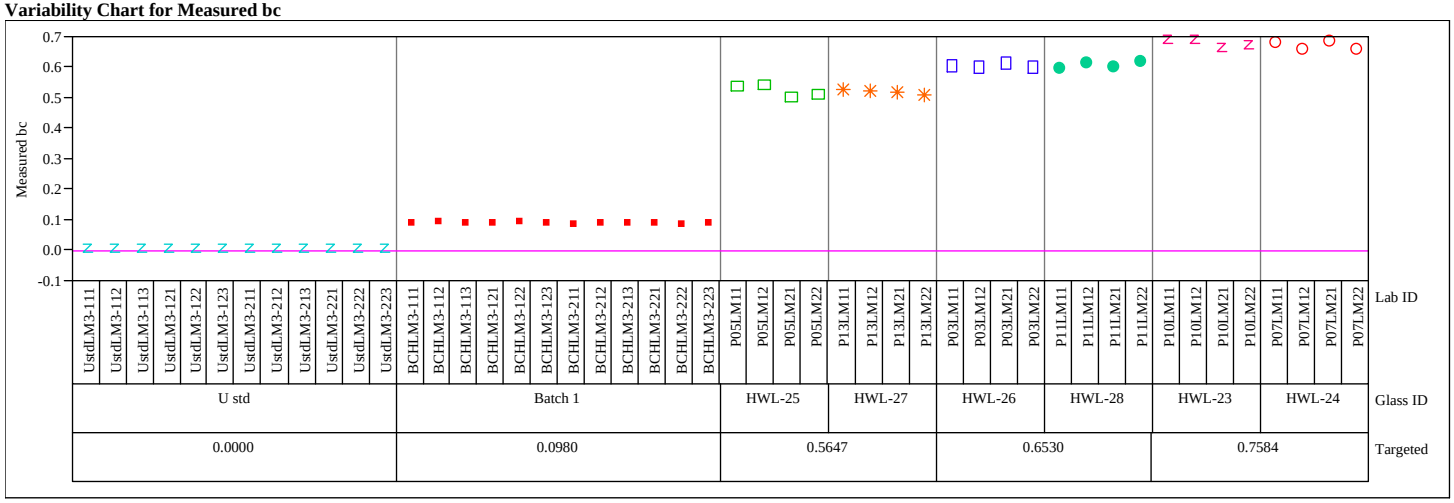


Figure A5. Average Measured and Bias-Corrected (bc) Versus Targeted Compositions by Glass ID by Oxide

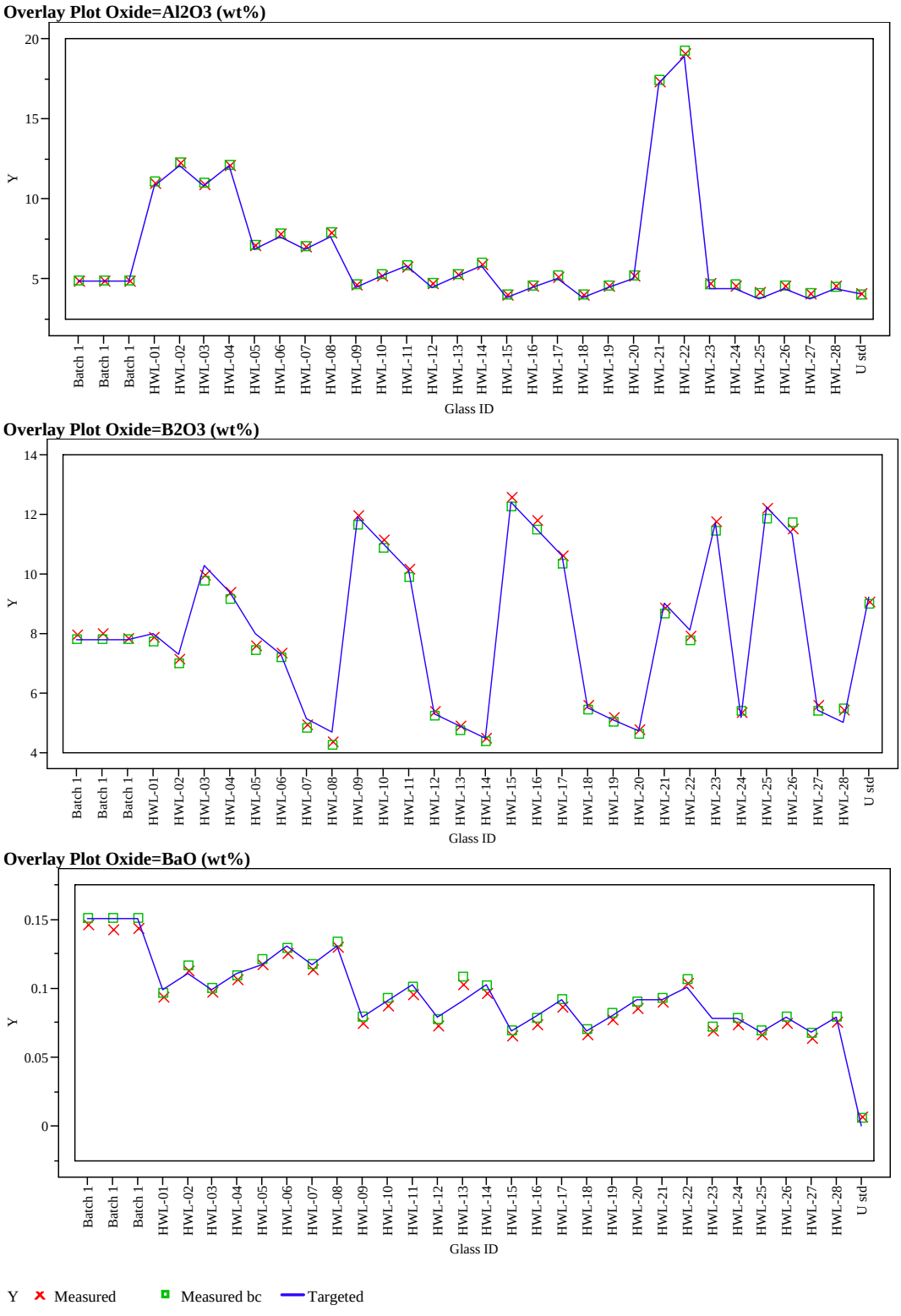


Figure A5. Average Measured and Bias-Corrected (bc) Versus Targeted Compositions by Glass ID by Oxide

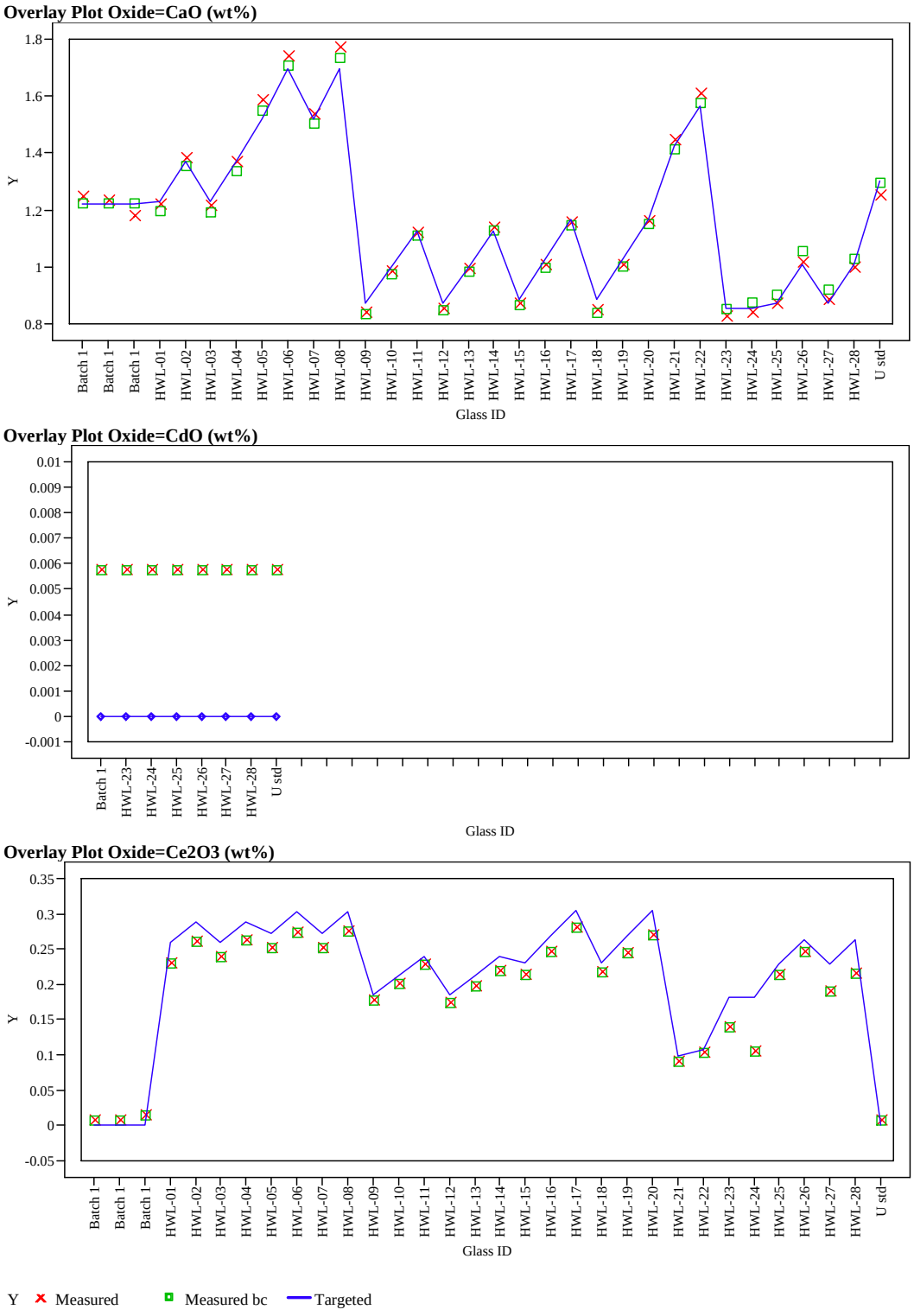


Figure A5. Average Measured and Bias-Corrected (bc) Versus Targeted Compositions by Glass ID by Oxide

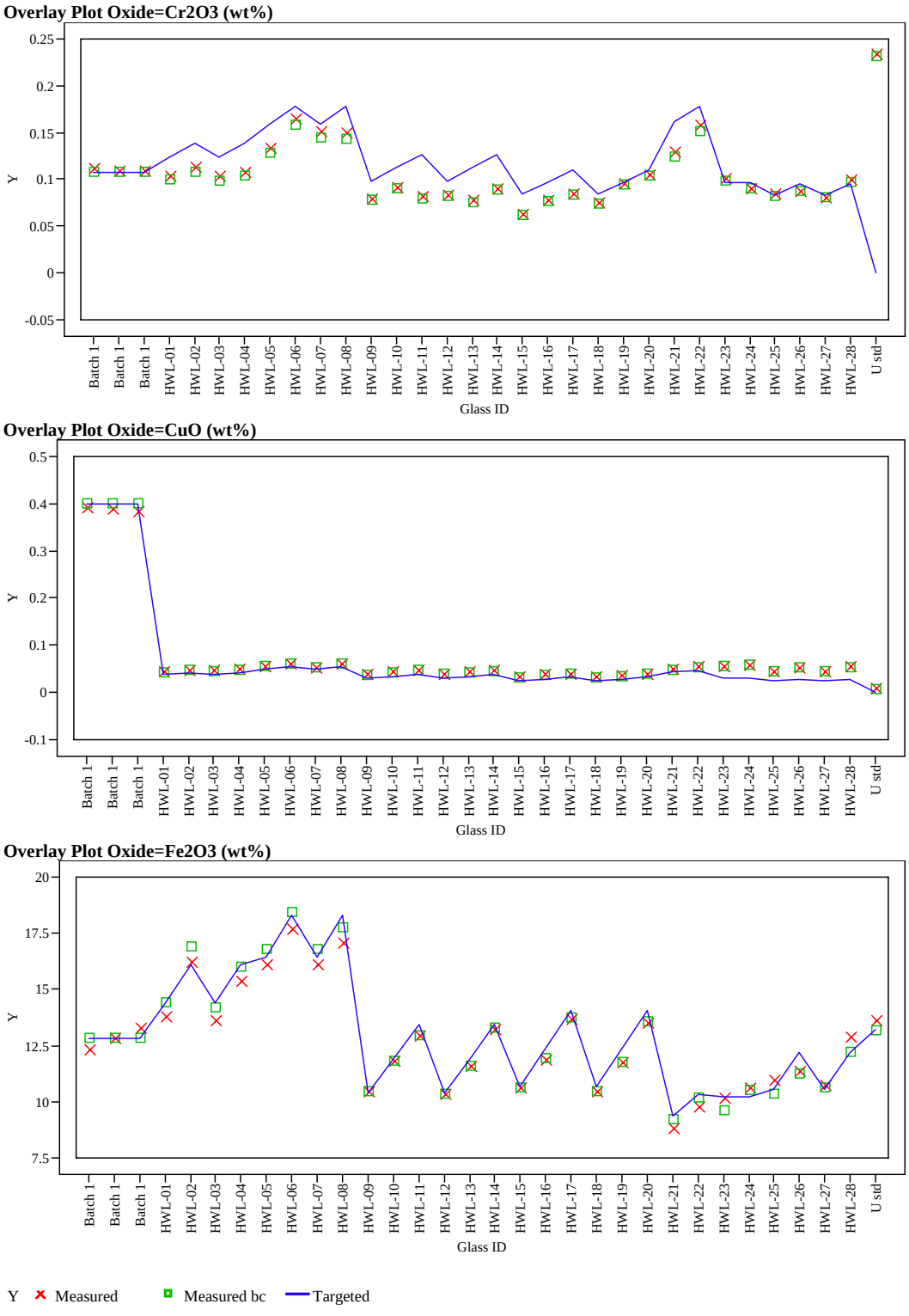


Figure A5. Average Measured and Bias-Corrected (bc) Versus Targeted Compositions by Glass ID by Oxide

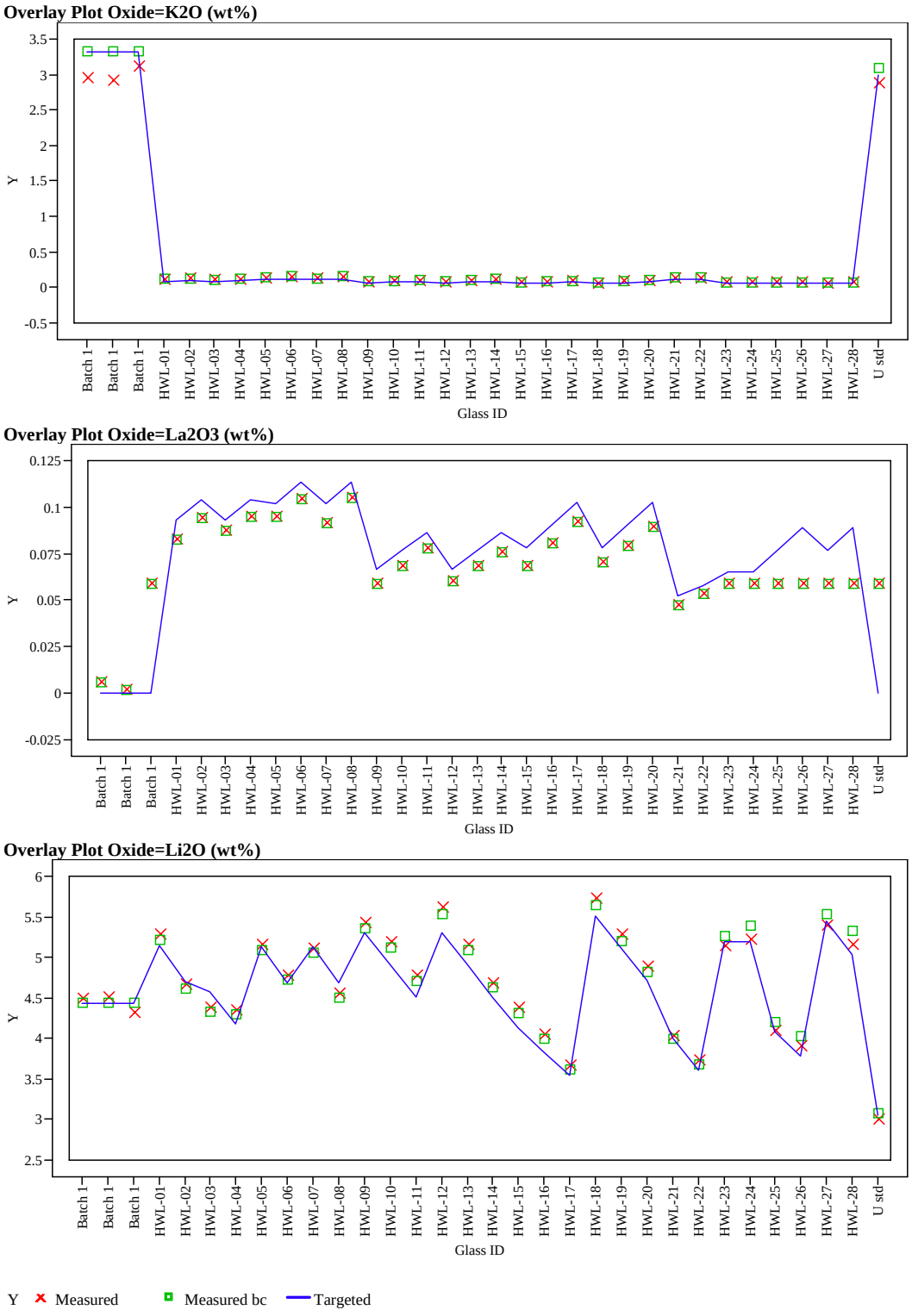


Figure A5. Average Measured and Bias-Corrected (bc) Versus Targeted Compositions by Glass ID by Oxide

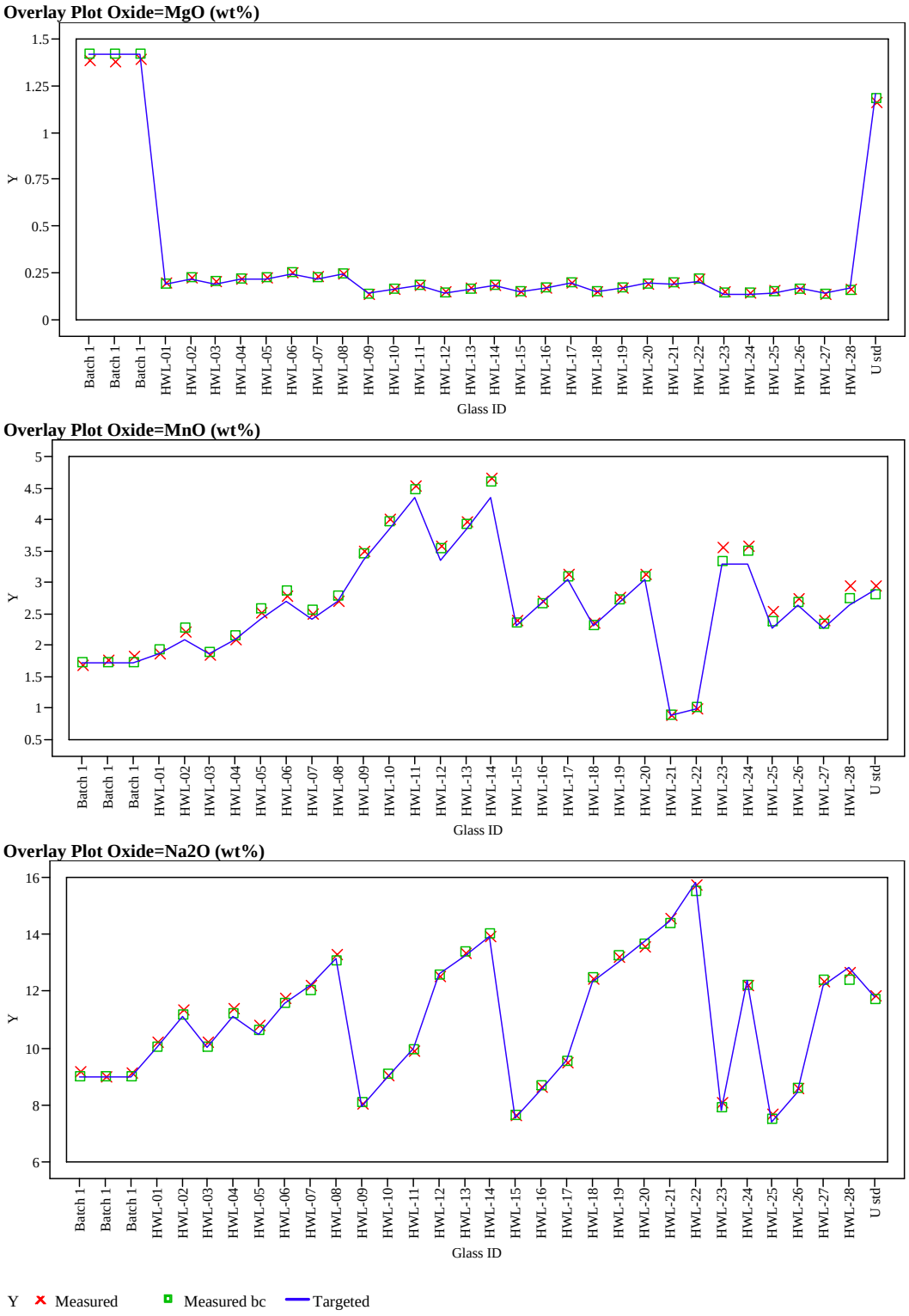


Figure A5. Average Measured and Bias-Corrected (bc) Versus Targeted Compositions by Glass ID by Oxide

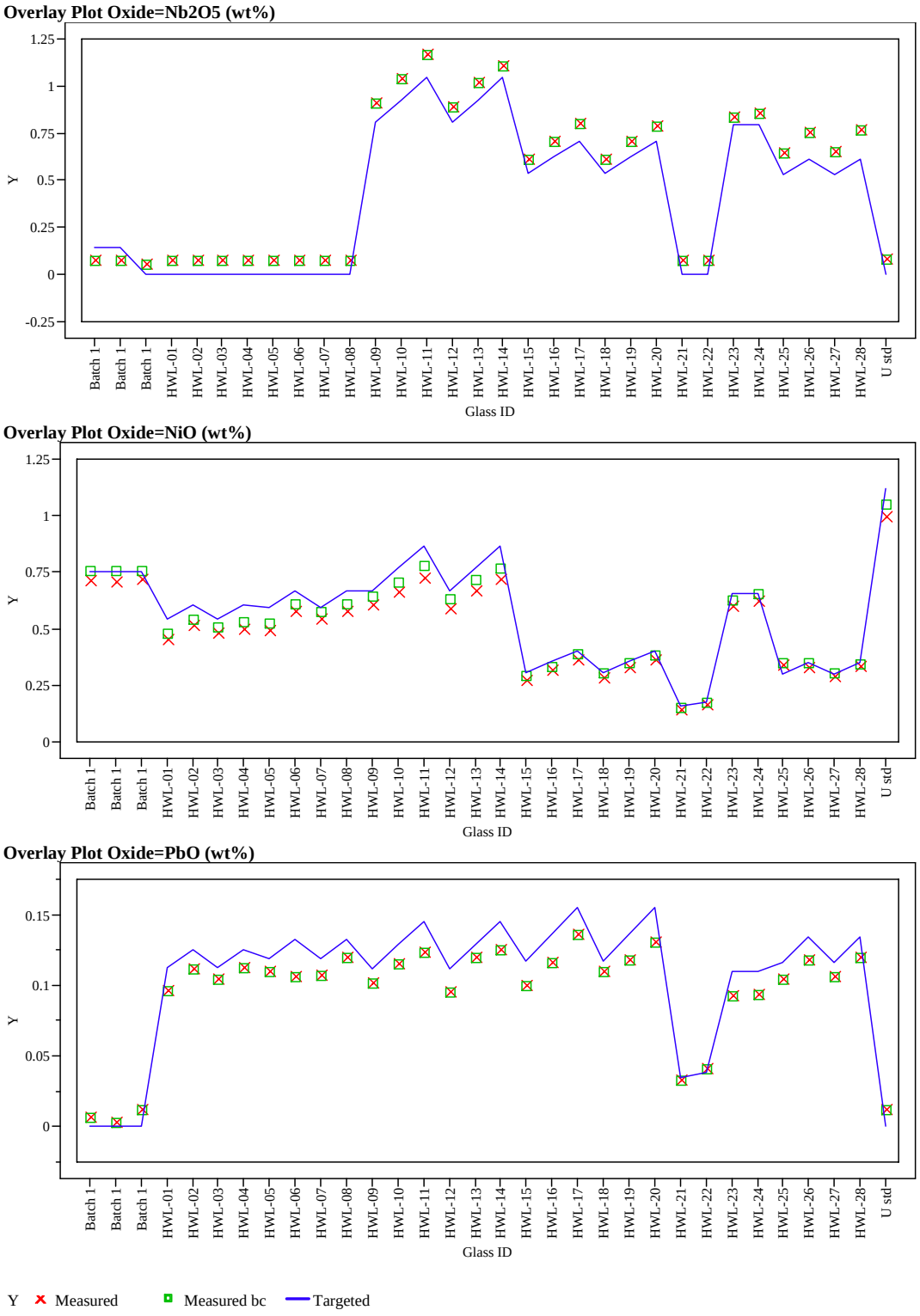


Figure A5. Average Measured and Bias-Corrected (bc) Versus Targeted Compositions by Glass ID by Oxide

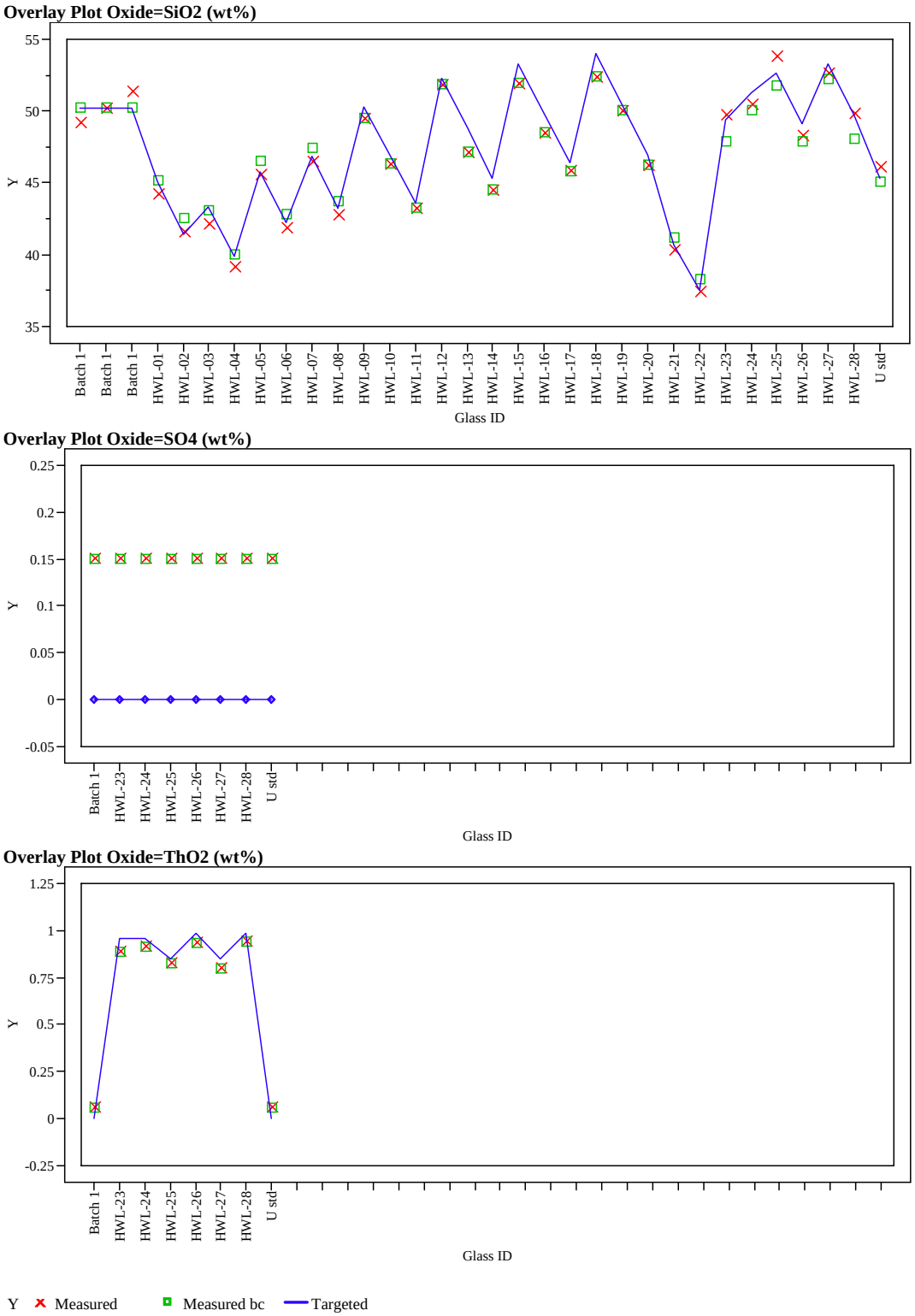


Figure A5. Average Measured and Bias-Corrected (bc) Versus Targeted Compositions by Glass ID by Oxide

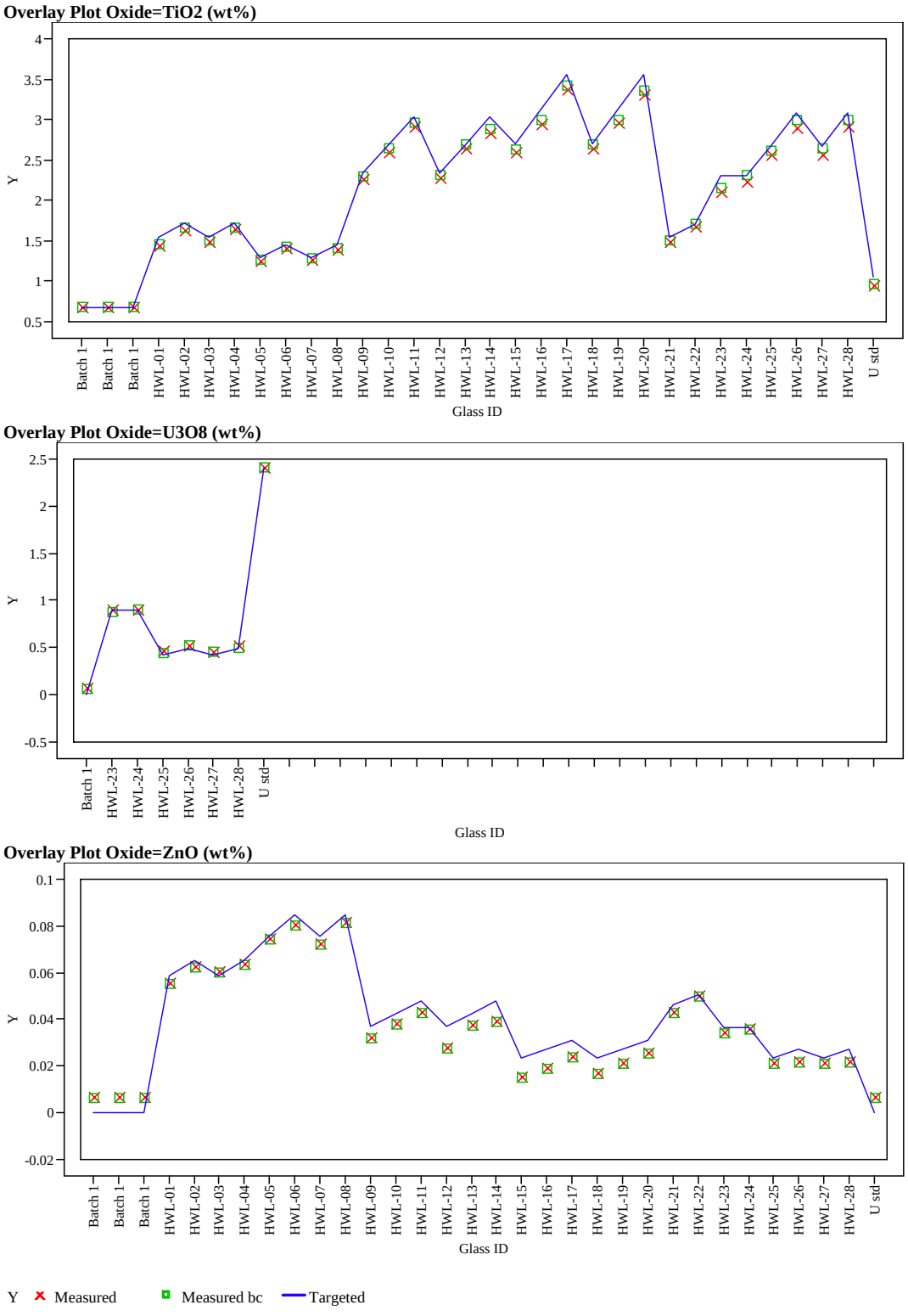
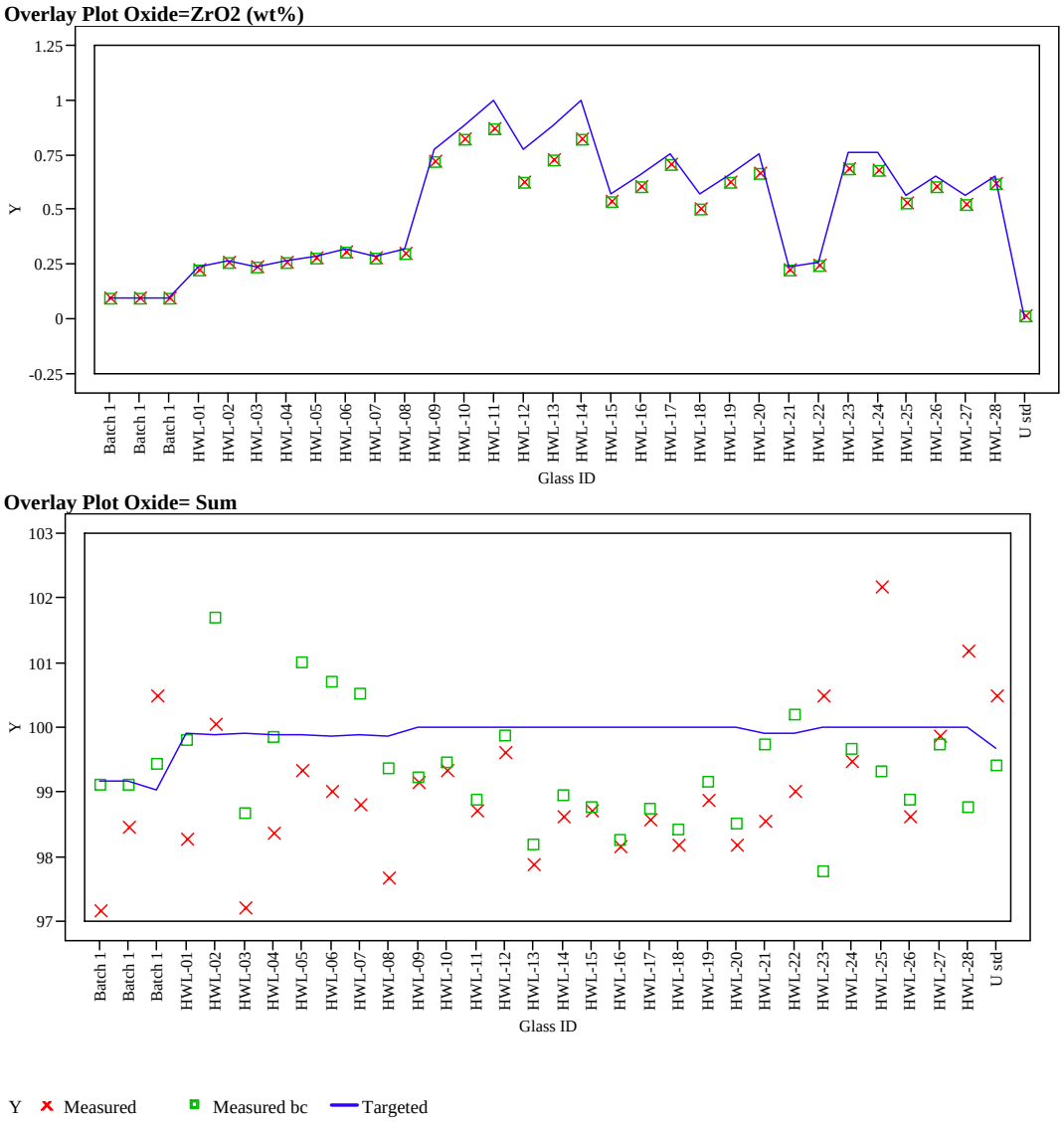


Figure A5. Average Measured and Bias-Corrected (bc) Versus Targeted Compositions by Glass ID by Oxide



Appendix B:

Tables and Figures Supporting the Analysis of the PCT Results for the Test Matrix 2 Glasses

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Table B1. PSAL Measurements of the PCT Solutions As-Received (ar) and After Appropriate Adjustments (in ppm)

Set	Glass ID	Heat Treatment	Block	Seq	Lab ID	B ar	Li ar	Na ar	Si ar	B (ppm)	Li (ppm)	Na (ppm)	Si (ppm)
1	Soln Std	ref	1	1	STD-11-1	21.4	10.3	79.5	49.2	21.40	10.30	79.50	49.20
1	HWL-21	quenched	1	2	i29	8.85	6.67	34.7	40.7	14.75	11.12	57.83	67.83
1	HWL-02	ccc	1	3	i14	6.29	7	22.3	38.9	10.48	11.67	37.17	64.83
1	HWL-03	quenched	1	4	i54	11.3	8.94	20.4	41.9	18.83	14.90	34.00	69.83
1	HWL-05	quenched	1	5	i38	11.8	12	32	55.9	19.67	20.00	53.33	93.17
1	HWL-04	ccc	1	6	i48	7.56	6.05	20.5	36.2	12.60	10.08	34.17	60.33
1	EA	ref	1	7	i53	39.3	11.9	101	54.1	655.00	198.33	1683.34	901.67
1	HWL-04	quenched	1	8	i66	12.5	9.24	27.9	38.8	20.83	15.40	46.50	64.67
1	blank	ref	1	9	i26	<1.00	<1.00	<0.100	<0.100	0.83	0.83	0.08	0.08
1	HWL-08	ccc	1	10	i40	6.16	11.4	48.7	62	10.27	19.00	81.17	103.34
1	HWL-22	quenched	1	11	i05	8.33	6.07	43.9	37.1	13.88	10.12	73.17	61.83
1	HWL-02	quenched	1	12	i67	9.52	10.5	29.8	46	15.87	17.50	49.67	76.67
1	HWL-08	quenched	1	13	i20	8.75	12.9	56.7	66.1	14.58	21.50	94.50	110.17
1	Soln Std	ref	1	14	STD-11-2	20.7	10.3	80.2	49.4	20.70	10.30	80.20	49.40
1	HWL-03	ccc	1	15	i52	8.99	7.34	16.7	42.9	14.98	12.23	27.83	71.50
1	HWL-07	ccc	1	16	i02	7.92	12.4	40.9	65.1	13.20	20.67	68.17	108.50
1	ARM-1	ref	1	17	i36	10.1	8.17	19.4	34.5	16.83	13.62	32.33	57.50
1	HWL-21	ccc	1	18	i13	79.3	40.6	98.9	66.9	132.17	67.67	164.84	111.50
1	HWL-06	ccc	1	19	i08	9.5	9.74	34.7	52.1	15.83	16.23	57.83	86.84
1	HWL-22	ccc	1	20	i63	1380	675	1270	293	2300.05	1125.02	2116.71	488.34
1	HWL-07	quenched	1	21	i11	9.11	12.1	43.3	63.2	15.18	20.17	72.17	105.34
1	HWL-01	quenched	1	22	i09	10.1	10.1	21.6	47.9	16.83	16.83	36.00	79.83
1	HWL-06	quenched	1	23	i49	14.1	12.7	43.3	54.4	23.50	21.17	72.17	90.67
1	HWL-05	ccc	1	24	i60	11.4	11.9	30.9	59.1	19.00	19.83	51.50	98.50
1	HWL-01	ccc	1	25	i32	7.12	8.52	18.4	46.7	11.87	14.20	30.67	77.83
1	Soln Std	ref	1	26	STD-11-3	20.9	10.3	79.8	49.5	20.90	10.30	79.80	49.50
1	Soln Std	ref	2	1	STD-12-1	20.6	10.1	79.5	47.6	20.60	10.10	79.50	47.60
1	HWL-08	ccc	2	2	i56	7.01	11.9	52	63.9	11.68	19.83	86.67	106.50
1	EA	ref	2	3	i15	36.9	11.4	98.6	51	615.00	190.00	1643.34	850.00
1	HWL-05	quenched	2	4	i47	11.7	11.6	31.6	54	19.50	19.33	52.67	90.00
1	HWL-21	quenched	2	5	i51	7.84	6.27	32.9	37.5	13.07	10.45	54.83	62.50
1	ARM-1	ref	2	6	i46	10.1	8.1	19.8	34.2	16.83	13.50	33.00	57.00
1	HWL-22	quenched	2	7	i18	8.63	6.33	45.8	38.6	14.38	10.55	76.33	64.33
1	HWL-06	quenched	2	8	i64	13	12.7	43.8	54.3	21.67	21.17	73.00	90.50
1	HWL-03	ccc	2	9	i50	8.23	7.19	17.3	40.6	13.72	11.98	28.83	67.67
1	HWL-22	ccc	2	10	i16	1270	640	1250	300	2116.71	1066.69	2083.38	500.01
1	HWL-07	ccc	2	11	i39	8.4	12.3	42.7	63.4	14.00	20.50	71.17	105.67
1	HWL-04	quenched	2	12	i28	12.1	9.11	28.7	37.4	20.17	15.18	47.83	62.33
1	HWL-01	quenched	2	13	i33	9.33	10.3	22.6	48.1	15.55	17.17	37.67	80.17
1	Soln Std	ref	2	14	STD-12-2	20	10.2	80.4	48.2	20.00	10.20	80.40	48.20
1	HWL-04	ccc	2	15	i27	7.51	5.9	20.8	34.4	12.52	9.83	34.67	57.33
1	HWL-02	quenched	2	16	i45	9.5	10.3	30.8	44.5	15.83	17.17	51.33	74.17
1	HWL-06	ccc	2	17	i62	8.52	9.47	35	50.4	14.20	15.78	58.33	84.00
1	HWL-21	ccc	2	18	i37	75.6	39.6	97.6	64.4	126.00	66.00	162.67	107.34
1	HWL-01	ccc	2	19	i57	6.93	8.06	17.7	43	11.55	13.43	29.50	71.67
1	HWL-08	quenched	2	20	i41	8.84	12.6	56.2	64.4	14.73	21.00	93.67	107.34
1	HWL-07	quenched	2	21	i03	8.07	12.3	43.6	63.9	13.45	20.50	72.67	106.50
1	HWL-03	quenched	2	22	i34	11	8.88	20.5	41.3	18.33	14.80	34.17	68.83
1	HWL-05	ccc	2	23	i30	9.75	10.9	29.3	52.3	16.25	18.17	48.83	87.17
1	HWL-02	ccc	2	24	i01	6.09	7.19	24	40.1	10.15	11.98	40.00	66.83
1	Soln Std	ref	2	25	STD-12-3	19.3	10	81.2	47.5	19.30	10.00	81.20	47.50
1	Soln Std	ref	3	1	STD-13-1	20.8	9.91	79.2	48.2	20.80	9.91	79.20	48.20
1	ARM-1	ref	3	2	i42	10.6	7.76	19.5	33.8	17.67	12.93	32.50	56.33
1	HWL-07	quenched	3	3	i35	8.51	12.6	45.3	67.5	14.18	21.00	75.50	112.50
1	HWL-07	ccc	3	4	i58	7.52	11.7	38.9	61.8	12.53	19.50	64.83	103.00
1	HWL-21	quenched	3	5	i21	8.12	6.12	33.4	38.9	13.53	10.20	55.67	64.83
1	HWL-04	ccc	3	6	i19	7.63	5.78	20.7	36.5	12.72	9.63	34.50	60.83
1	HWL-04	quenched	3	7	i55	12.1	9.01	28.2	39	20.17	15.02	47.00	65.00
1	HWL-08	quenched	3	8	i17	8.64	12.4	55.5	64.3	14.40	20.67	92.50	107.17
1	HWL-08	ccc	3	9	i04	6.02	10.7	52.7	59.6	10.03	17.83	87.84	99.34
1	HWL-06	quenched	3	10	i59	13.2	12.3	42.1	53.5	22.00	20.50	70.17	89.17
1	HWL-21	ccc	3	11	i06	77.9	40.5	95.1	66.3	129.84	67.50	158.50	110.50
1	EA	ref	3	12	i43	36.6	10.7	91.8	49.1	610.00	178.33	1530.00	818.33
1	HWL-01	ccc	3	13	i24	7.09	7.67	17	43.6	11.82	12.78	28.33	72.67
1	Soln Std	ref	3	14	STD-13-2	20.2	9.83	78.1	47.8	20.20	9.83	78.10	47.80
1	HWL-05	ccc	3	15	i68	10	10.3	27.1	50.2	16.67	17.17	45.17	83.67

Table B1. PSAL Measurements of the PCT Solutions As-Received (ar) and After Appropriate Adjustments (in ppm)

Set	Glass ID	Heat Treatment	Block	Seq	Lab ID	B ar	Li ar	Na ar	Si ar	B (ppm)	Li (ppm)	Na (ppm)	Si (ppm)
1	HWL-03	ccc	3	16	i65	8.38	6.73	16.4	40	13.97	11.22	27.33	66.67
1	HWL-06	ccc	3	17	i12	8.85	9.14	33.7	50.3	14.75	15.23	56.17	83.84
1	HWL-22	quenched	3	18	i07	8.28	5.53	42.1	35.7	13.80	9.22	70.17	59.50
1	HWL-03	quenched	3	19	i31	10.7	8.25	19	39.5	17.83	13.75	31.67	65.83
1	HWL-22	ccc	3	20	i22	1280	649	1210	277	2133.38	1081.69	2016.71	461.68
1	HWL-02	ccc	3	21	i25	7.49	6.61	23.9	39.1	12.48	11.02	39.83	65.17
1	blank	ref	3	22	i10	1.19	<1.00	<0.100	<0.100	1.98	0.83	0.08	0.08
1	HWL-02	quenched	3	23	i61	9.72	10.1	29.2	44.9	16.20	16.83	48.67	74.83
1	HWL-05	quenched	3	24	i23	11.4	11.4	31	53.5	19.00	19.00	51.67	89.17
1	HWL-01	quenched	3	25	i44	8.68	9.29	20.7	43.9	14.47	15.48	34.50	73.17
1	Soln Std	ref	3	26	STD-13-3	19.4	9.6	76.9	46.2	19.40	9.60	76.90	46.20
2	Soln Std	ref	1	1	STD-21-1	20.9	9.78	80	48.3	20.90	9.78	80.00	48.30
2	HWL-15	quenched	1	2	j48	11.9	7.12	10	47.9	19.83	11.87	16.67	79.83
2	HWL-16	quenched	1	3	j05	12.4	7.16	15	47.4	20.67	11.93	25.00	79.00
2	HWL-10	ccc	1	4	j22	13.8	9.7	21.4	48.9	23.00	16.17	35.67	81.50
2	HWL-11	quenched	1	5	j55	13.9	9.57	27	45.2	23.17	15.95	45.00	75.33
2	HWL-20	ccc	1	6	j09	7.32	11.8	51.1	67.5	12.20	19.67	85.17	112.50
2	HWL-13	ccc	1	7	j64	6.92	11.7	46.4	68.1	11.53	19.50	77.33	113.50
2	HWL-18	ccc	1	8	j61	7.22	12.6	39.8	75.8	12.03	21.00	66.33	126.34
2	ARM-1	ref	1	9	j73	10.9	8.26	21.4	35.6	18.17	13.77	35.67	59.33
2	HWL-20	quenched	1	10	j20	6.9	10.9	51.7	65.5	11.50	18.17	86.17	109.17
2	HWL-17	quenched	1	11	j67	11.8	6.78	20.4	42.5	19.67	11.30	34.00	70.83
2	blank	ref	1	12	j28	<1.00	<1.00	<0.100	<0.100	0.83	0.83	0.08	0.08
2	HWL-18	quenched	1	13	j11	7.64	13.3	44.5	80.1	12.73	22.17	74.17	133.50
2	HWL-10	quenched	1	14	j01	13.9	10	21.2	48.7	23.17	16.67	35.33	81.17
2	Soln Std	ref	1	15	STD-21-2	20.3	9.85	79.6	48.4	20.30	9.85	79.60	48.40
2	HWL-15	ccc	1	16	j78	12.8	7.24	11.9	51.5	21.33	12.07	19.83	85.84
2	HWL-11	ccc	1	17	j75	11.4	8.14	24	43.8	19.00	13.57	40.00	73.00
2	HWL-19	ccc	1	18	j43	7.24	12.1	45.5	73.4	12.07	20.17	75.83	122.34
2	HWL-19	quenched	1	19	j17	7.09	11.7	47	71.4	11.82	19.50	78.33	119.00
2	HWL-16	ccc	1	20	j74	11.4	6.73	15.3	47.2	19.00	11.22	25.50	78.67
2	HWL-12	ccc	1	21	j46	6.82	12	40.3	71.8	11.37	20.00	67.17	119.67
2	HWL-17	ccc	1	22	j58	11.3	6.35	20.1	42.9	18.83	10.58	33.50	71.50
2	HWL-14	ccc	1	23	j62	6.36	11.1	52.1	66.4	10.60	18.50	86.84	110.67
2	HWL-09	ccc	1	24	j39	13.7	9.84	16.2	51.9	22.83	16.40	27.00	86.50
2	EA	ref	1	25	j65	37.1	11.1	97	51.6	618.33	185.00	1616.67	860.00
2	HWL-09	quenched	1	26	j59	14.3	10.3	15.8	52.5	23.83	17.17	26.33	87.50
2	HWL-13	quenched	1	27	j57	7.05	11.6	48.5	70.3	11.75	19.33	80.83	117.17
2	HWL-12	quenched	1	28	j76	7.47	13	45.8	80.9	12.45	21.67	76.33	134.84
2	HWL-14	quenched	1	29	j35	7.14	10.9	55.2	66.5	11.90	18.17	92.00	110.84
2	Soln Std	ref	1	30	STD-21-3	20	9.76	79.1	48.4	20.00	9.76	79.10	48.40
2	Soln Std	ref	2	1	STD-22-1	19.8	9.53	79.2	46.8	19.80	9.53	79.20	46.80
2	HWL-12	quenched	2	2	j14	7.05	11.7	44	70.2	11.75	19.50	73.33	117.00
2	HWL-16	quenched	2	3	j71	10.9	6.69	14.7	43.1	18.17	11.15	24.50	71.83
2	HWL-09	quenched	2	4	j34	13.7	10.2	16.4	50.7	22.83	17.00	27.33	84.50
2	HWL-12	ccc	2	5	j16	6.62	11.8	41.1	70.7	11.03	19.67	68.50	117.84
2	HWL-20	quenched	2	6	j56	6.96	11.3	54.1	68.4	11.60	18.83	90.17	114.00
2	HWL-14	ccc	2	7	j50	6.3	11.5	55.6	66.9	10.50	19.17	92.67	111.50
2	HWL-13	quenched	2	8	j04	6.6	11.4	49.8	68.2	11.00	19.00	83.00	113.67
2	EA	ref	2	9	j47	34.3	10.5	94.7	48.3	571.67	175.00	1578.34	805.00
2	HWL-17	ccc	2	10	j06	11.2	6.32	20.2	42	18.67	10.53	33.67	70.00
2	HWL-19	ccc	2	11	j70	7.03	12.1	45.2	73.8	11.72	20.17	75.33	123.00
2	HWL-18	ccc	2	12	j66	6.99	12.6	40.5	76.5	11.65	21.00	67.50	127.50
2	HWL-16	ccc	2	13	j37	11.3	6.79	16	47.6	18.83	11.32	26.67	79.33
2	HWL-14	quenched	2	14	j31	6.8	10.8	55.7	65.4	11.33	18.00	92.84	109.00
2	Soln Std	ref	2	15	STD-22-2	19.1	9.59	79.9	47	19.10	9.59	79.90	47.00
2	HWL-20	ccc	2	16	j13	6.73	10.8	47.3	61.9	11.22	18.00	78.83	103.17
2	HWL-17	quenched	2	17	j49	11.7	6.81	20.7	42.8	19.50	11.35	34.50	71.33
2	HWL-15	quenched	2	18	j52	11.9	7.6	11.2	50.9	19.83	12.67	18.67	84.84
2	HWL-15	ccc	2	19	j21	11.4	6.96	12	48.9	19.00	11.60	20.00	81.50
2	ARM-1	ref	2	20	j24	10.3	8.07	21.5	34.7	17.17	13.45	35.83	57.83
2	HWL-10	ccc	2	21	j69	13	9.46	21.5	47.5	21.67	15.77	35.83	79.17
2	HWL-11	quenched	2	22	j26	13.3	9.56	27.5	44.8	22.17	15.93	45.83	74.67
2	HWL-11	ccc	2	23	j40	11.5	8.61	25.1	47	19.17	14.35	41.83	78.33
2	HWL-10	quenched	2	24	j15	13.4	9.91	21.2	48.4	22.33	16.52	35.33	80.67
2	HWL-13	ccc	2	25	j68	7.11	12.6	50	73.8	11.85	21.00	83.34	123.00

Table B1. PSAL Measurements of the PCT Solutions As-Received (ar) and After Appropriate Adjustments (in ppm)

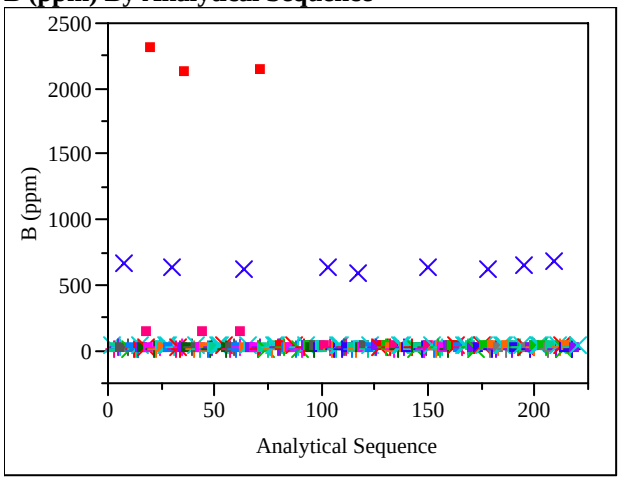
Set	Glass ID	Heat Treatment	Block	Seq	Lab ID	B ar	Li ar	Na ar	Si ar	B (ppm)	Li (ppm)	Na (ppm)	Si (ppm)
2	HWL-18	quenched	2	26	j38	7.02	12.6	42.7	76.7	11.70	21.00	71.17	127.84
2	HWL-09	ccc	2	27	j79	13.2	9.74	16.6	50.8	22.00	16.23	27.67	84.67
2	HWL-19	quenched	2	28	j77	6.7	11.6	47.6	70.2	11.17	19.33	79.33	117.00
2	Soln Std	ref	2	29	STD-22-3	19	9.59	79.6	46.5	19.00	9.59	79.60	46.50
2	Soln Std	ref	3	1	STD-23-1	20.6	9.73	78.8	46.7	20.60	9.73	78.80	46.70
2	HWL-15	quenched	3	2	j63	12.4	7.58	11.3	49.3	20.67	12.63	18.83	82.17
2	HWL-13	ccc	3	3	j53	7.34	11.7	46.5	67.1	12.23	19.50	77.50	111.84
2	HWL-12	ccc	3	4	j32	7.05	11.8	41.1	69.1	11.75	19.67	68.50	115.17
2	HWL-17	ccc	3	5	j10	11.7	6.54	20.5	42.1	19.50	10.90	34.17	70.17
2	HWL-10	quenched	3	6	j07	14	9.94	21.4	47	23.33	16.57	35.67	78.33
2	blank	ref	3	7	j12	<1.00	<1.00	<0.100	<0.100	0.83	0.83	0.08	0.08
2	HWL-19	ccc	3	8	j80	7.19	12.1	45.2	70.6	11.98	20.17	75.33	117.67
2	HWL-14	ccc	3	9	j19	6.26	10.7	52.2	61.2	10.43	17.83	87.00	102.00
2	HWL-12	quenched	3	10	j23	6.93	11.9	43.2	70.2	11.55	19.83	72.00	117.00
2	HWL-18	quenched	3	11	j51	7.32	12.6	42.6	76.3	12.20	21.00	71.00	127.17
2	HWL-16	quenched	3	12	j72	11.9	7.22	15.5	44.8	19.83	12.03	25.83	74.67
2	EA	ref	3	13	j33	36.9	11.1	98.7	50.2	615.00	185.00	1645.00	836.67
2	HWL-09	ccc	3	14	j44	13.8	9.73	16.6	49.2	23.00	16.22	27.67	82.00
2	Soln Std	ref	3	15	STD-23-2	19.5	9.58	78.8	45.4	19.50	9.58	78.80	45.40
2	HWL-20	quenched	3	16	j30	7.62	11.1	52.6	65.1	12.70	18.50	87.67	108.50
2	HWL-13	quenched	3	17	j36	7.19	11.3	48.1	66.1	11.98	18.83	80.17	110.17
2	HWL-11	quenched	3	18	j27	14	9.63	26.9	44.1	23.33	16.05	44.83	73.50
2	HWL-14	quenched	3	19	j41	7.29	10.7	55.4	62.7	12.15	17.83	92.34	104.50
2	HWL-17	quenched	3	20	j60	12	6.84	20.2	41.2	20.00	11.40	33.67	68.67
2	HWL-18	ccc	3	21	j29	7.37	12.5	40.5	73.3	12.28	20.83	67.50	122.17
2	HWL-19	quenched	3	22	j42	7.04	11.6	47.3	68.5	11.73	19.33	78.83	114.17
2	HWL-15	ccc	3	23	j18	11.8	7.06	11.9	48.3	19.67	11.77	19.83	80.50
2	HWL-16	ccc	3	24	j45	10.9	6.44	14.6	41.9	18.17	10.73	24.33	69.83
2	HWL-11	ccc	3	25	j03	11.4	8.33	23.8	43.3	19.00	13.88	39.67	72.17
2	ARM-1	ref	3	26	j25	10.6	8.15	21.6	33.8	17.67	13.58	36.00	56.33
2	HWL-10	ccc	3	27	j54	13.4	9.53	21.1	46.2	22.33	15.88	35.17	77.00
2	HWL-20	ccc	3	28	j08	7.23	11.7	50.9	64.5	12.05	19.50	84.84	107.50
2	HWL-09	quenched	3	29	j02	13.8	10.2	16.7	49.5	23.00	17.00	27.83	82.50
2	Soln Std	ref	3	30	STD-23-3	19.6	9.66	78.5	45.6	19.60	9.66	78.50	45.60
3	Soln Std	ref	1	1	STD-41-1	20.3	9.62	79.8	50.5	20.30	9.62	79.80	50.50
3	HWL-26	quenched	1	2	T26	12.7	7.72	15.3	51.3	21.17	12.87	25.50	85.50
3	HWL-23	quenched	1	3	T43	16.1	11.6	18	59.8	26.83	19.33	30.00	99.67
3	HWL-26	ccc	1	4	T30	12.2	7.15	16.8	50.3	20.33	11.92	28.00	83.84
3	HWL-27	ccc	1	5	T32	8.06	14	46.8	86.9	13.43	23.33	78.00	144.84
3	blank	ref	1	6	T25	<1.00	<1.00	<1.00	<0.100	0.83	0.83	0.83	0.08
3	HWL-24	ccc	1	7	T13	7.61	13.3	45.7	81.9	12.68	22.17	76.17	136.50
3	ARM-1	ref	1	8	T33	10.6	8.25	22.3	38.3	17.67	13.75	37.17	63.83
3	Soln Std	ref	1	9	STD-41-2	21.1	10.1	82.7	54.2	21.10	10.10	82.70	54.20
3	HWL-23	ccc	1	10	T31	15	10.5	18.2	56.9	25.00	17.50	30.33	94.84
3	EA	ref	1	11	T11	36.3	10.7	98	53.4	605.00	178.33	1633.34	890.00
3	HWL-28	quenched	1	12	T12	8.09	13.3	54.7	81	13.48	22.17	91.17	135.00
3	HWL-24	quenched	1	13	T06	8.23	14	55.1	85.1	13.72	23.33	91.84	141.84
3	HWL-25	ccc	1	14	T24	12.7	7.6	12.9	54.4	21.17	12.67	21.50	90.67
3	HWL-27	quenched	1	15	T17	8.99	15.1	51.6	93	14.98	25.17	86.00	155.00
3	HWL-25	quenched	1	16	T19	13.3	8.45	12.3	56.2	22.17	14.08	20.50	93.67
3	HWL-28	ccc	1	17	T29	7.95	13.6	53.5	80.8	13.25	22.67	89.17	134.67
3	Soln Std	ref	1	18	STD-41-3	20.4	9.8	81.3	52.4	20.40	9.80	81.30	52.40
3	Soln Std	ref	2	1	STD-42-1	20.6	9.72	79.2	52.2	20.60	9.72	79.20	52.20
3	HWL-28	quenched	2	2	T04	8.59	14.4	57.8	89.1	14.32	24.00	96.34	148.50
3	HWL-25	ccc	2	3	T36	12.6	7.7	13	55.7	21.00	12.83	21.67	92.84
3	HWL-27	quenched	2	4	T37	8.7	15.5	52.2	94.5	14.50	25.83	87.00	157.50
3	HWL-26	ccc	2	5	T35	12.2	7.29	17.3	52.2	20.33	12.15	28.83	87.00
3	HWL-24	ccc	2	6	T08	7.31	13.3	47.2	81.7	12.18	22.17	78.67	136.17
3	HWL-23	quenched	2	7	T38	15.2	11.3	17.6	58.3	25.33	18.83	29.33	97.17
3	HWL-26	quenched	2	8	T02	12.3	7.84	15.8	52.7	20.50	13.07	26.33	87.84
3	Soln Std	ref	2	9	STD-42-2	20.2	9.82	80	52.6	20.20	9.82	80.00	52.60
3	EA	ref	2	10	T09	38.5	11	99.9	56.1	641.67	183.33	1665.00	935.00
3	ARM-1	ref	2	11	T34	10.3	8.21	22.1	38.7	17.17	13.68	36.83	64.50
3	HWL-28	ccc	2	12	T28	7.98	13.8	52.5	83.9	13.30	23.00	87.50	139.84
3	HWL-24	quenched	2	13	T40	7.75	13.9	51.8	84.2	12.92	23.17	86.34	140.34
3	HWL-27	ccc	2	14	T39	8.02	14.7	48.2	90.4	13.37	24.50	80.33	150.67

Table B1. PSAL Measurements of the PCT Solutions As-Received (ar) and After Appropriate Adjustments (in ppm)

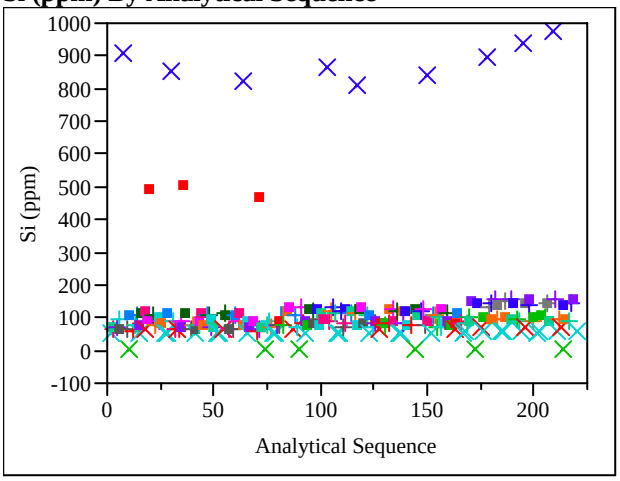
Set	Glass ID	Heat Treatment	Block	Seq	Lab ID	B ar	Li ar	Na ar	Si ar	B (ppm)	Li (ppm)	Na (ppm)	Si (ppm)
3	HWL-25	quenched	2	15	T23	12.7	8.35	11.5	54.9	21.17	13.92	19.17	91.50
3	HWL-23	ccc	2	16	T01	14.6	10.6	18.5	57.3	24.33	17.67	30.83	95.50
3	Soln Std	ref	2	17	STD-42-3	18.7	9.29	78.4	47.8	18.70	9.29	78.40	47.80
3	Soln Std	ref	3	1	STD-43-1	20.7	9.83	80.7	52	20.70	9.83	80.70	52.00
3	HWL-23	ccc	3	2	T27	15.7	10.9	18.6	60.5	26.17	18.17	31.00	100.84
3	HWL-23	quenched	3	3	T05	15.6	11.3	17.2	59.2	26.00	18.83	28.67	98.67
3	HWL-28	quenched	3	4	T18	8.06	13.8	55.2	85.4	13.43	23.00	92.00	142.34
3	HWL-28	ccc	3	5	T42	7.75	13.8	52.6	83.3	12.92	23.00	87.67	138.84
3	HWL-26	ccc	3	6	T03	12	7.16	17.9	51	20.00	11.93	29.83	85.00
3	EA	ref	3	7	T15	40	11.1	99.8	58.2	666.67	185.00	1663.34	970.00
3	HWL-27	quenched	3	8	T07	9.03	15.5	52	95.4	15.05	25.83	86.67	159.00
3	Soln Std	ref	3	9	STD-43-2	20.3	9.89	80.6	53.2	20.30	9.89	80.60	53.20
3	HWL-25	quenched	3	10	T10	13	8.33	11.7	55.6	21.67	13.88	19.50	92.67
3	ARM-1	ref	3	11	T41	11.5	8.78	23.4	39.9	19.17	14.63	39.00	66.50
3	blank	ref	3	12	T14	<1.00	<1.00	2.21	<0.100	0.83	0.83	3.68	0.08
3	HWL-24	ccc	3	13	T21	7.06	13.2	44.9	79.9	11.77	22.00	74.83	133.17
3	HWL-25	ccc	3	14	T22	12.3	7.61	12.4	54.6	20.50	12.68	20.67	91.00
3	HWL-26	quenched	3	15	T20	12.7	7.97	16	54.2	21.17	13.28	26.67	90.34
3	HWL-24	quenched	3	16	T44	7.87	13.9	52.2	85.9	13.12	23.17	87.00	143.17
3	HWL-27	ccc	3	17	T16	7.89	14.5	48.1	89.1	13.15	24.17	80.17	148.50
3	Soln Std	ref	3	18	STD-43-3	20.3	9.91	81.3	53.2	20.30	9.91	81.30	53.20

Figure B1. PCT Measurements in Analytical Sequence over All of the Analytical Plans

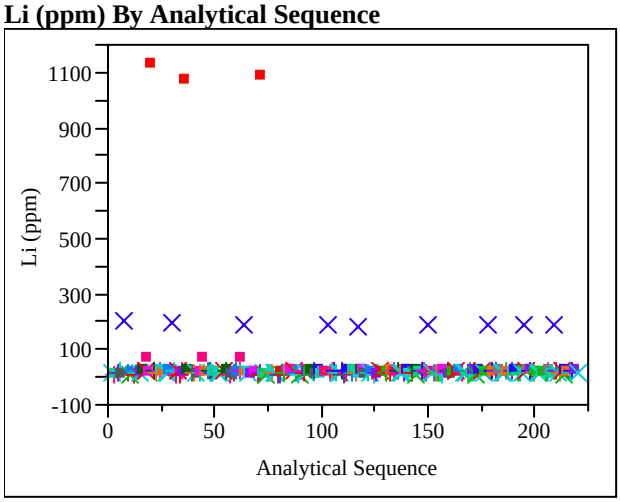
B (ppm) By Analytical Sequence



Si (ppm) By Analytical Sequence



Li (ppm) By Analytical Sequence



Na (ppm) By Analytical Sequence

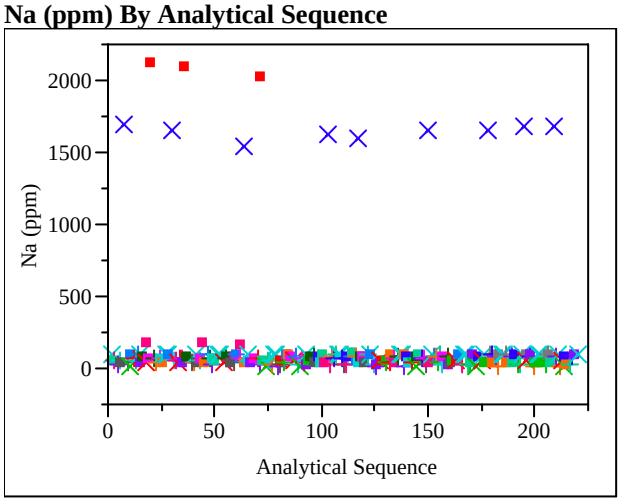
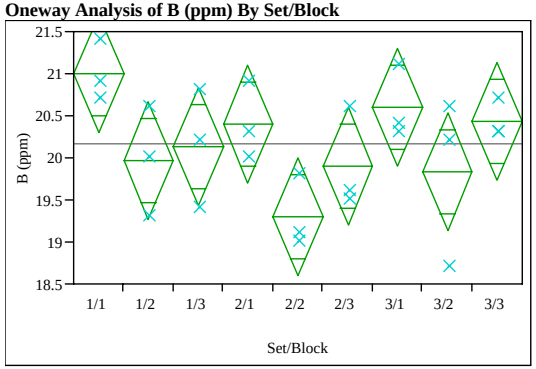


Figure B2. Measurements of the Multi-Element Solution Standard by ICP Block

Oneway Analysis of B (ppm) By Set/Block



Oneway Anova
Summary of Fit

Rsquare	0.492483
Adj Rsquare	0.26692
Root Mean Square Error	0.583413
Mean of Response	20.17407
Observations (or Sum Wgts)	27

Analysis of Variance

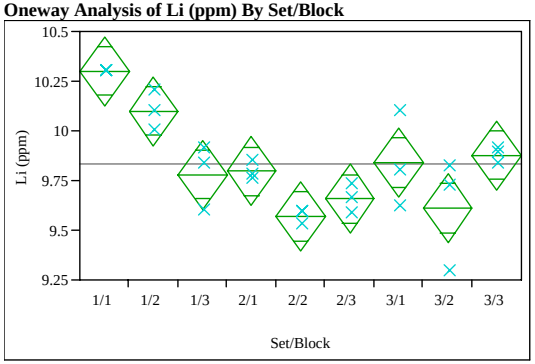
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block	8	5.945185	0.743148	2.1834	0.0805
Error	18	6.126667	0.340370		
C. Total	26	12.071852			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1	3	21.0000	0.33683	20.292	21.708
1/2	3	19.9667	0.33683	19.259	20.674
1/3	3	20.1333	0.33683	19.426	20.841
2/1	3	20.4000	0.33683	19.692	21.108
2/2	3	19.3000	0.33683	18.592	20.008
2/3	3	19.9000	0.33683	19.192	20.608
3/1	3	20.6000	0.33683	19.892	21.308
3/2	3	19.8333	0.33683	19.126	20.541
3/3	3	20.4333	0.33683	19.726	21.141

Std Error uses a pooled estimate of error variance

Oneway Analysis of Li (ppm) By Set/Block



Oneway Anova
Summary of Fit

Rsquare	0.783302
Adj Rsquare	0.686992
Root Mean Square Error	0.143295
Mean of Response	9.836667
Observations (or Sum Wgts)	27

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block	8	1.3360000	0.167000	8.1331	0.0001
Error	18	0.3696000	0.020533		
C. Total	26	1.7056000			

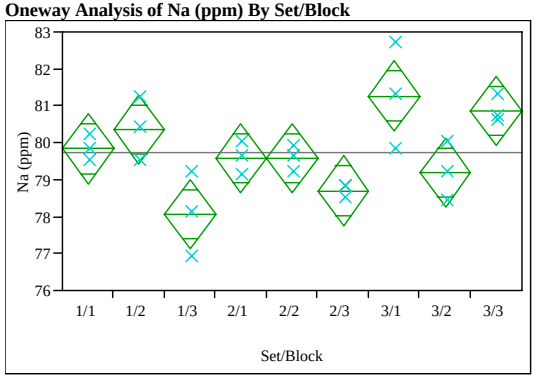
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1	3	10.3000	0.08273	10.126	10.474
1/2	3	10.1000	0.08273	9.926	10.274
1/3	3	9.7800	0.08273	9.606	9.954
2/1	3	9.7967	0.08273	9.623	9.970
2/2	3	9.5700	0.08273	9.396	9.744
2/3	3	9.6567	0.08273	9.483	9.830
3/1	3	9.8400	0.08273	9.666	10.014
3/2	3	9.6100	0.08273	9.436	9.784
3/3	3	9.8767	0.08273	9.703	10.050

Std Error uses a pooled estimate of error variance

Figure B2. Measurements of the Multi-Element Solution Standard by ICP Block

Oneway Analysis of Na (ppm) By Set/Block



Oneway Anova
Summary of Fit

Rsquare	0.695144
Adj Rsquare	0.559653
Root Mean Square Error	0.775552
Mean of Response	79.71481
Observations (or Sum Wgts)	27

Analysis of Variance

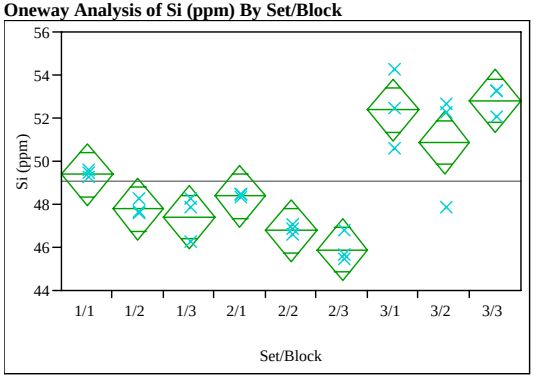
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block	8	24.687407	3.08593	5.1305	0.0019
Error	18	10.826667	0.60148		
C. Total	26	35.514074			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1	3	79.8333	0.44777	78.893	80.774
1/2	3	80.3667	0.44777	79.426	81.307
1/3	3	78.0667	0.44777	77.126	79.007
2/1	3	79.5667	0.44777	78.626	80.507
2/2	3	79.5667	0.44777	78.626	80.507
2/3	3	78.7000	0.44777	77.759	79.641
3/1	3	81.2667	0.44777	80.326	82.207
3/2	3	79.2000	0.44777	78.259	80.141
3/3	3	80.8667	0.44777	79.926	81.807

Std Error uses a pooled estimate of error variance

Oneway Analysis of Si (ppm) By Set/Block



Oneway Anova
Summary of Fit

Rsquare	0.849807
Adj Rsquare	0.783055
Root Mean Square Error	1.194432
Mean of Response	49.06667
Observations (or Sum Wgts)	27

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block	8	145.30000	18.1625	12.7307	<.0001
Error	18	25.68000	1.4267		
C. Total	26	170.98000			

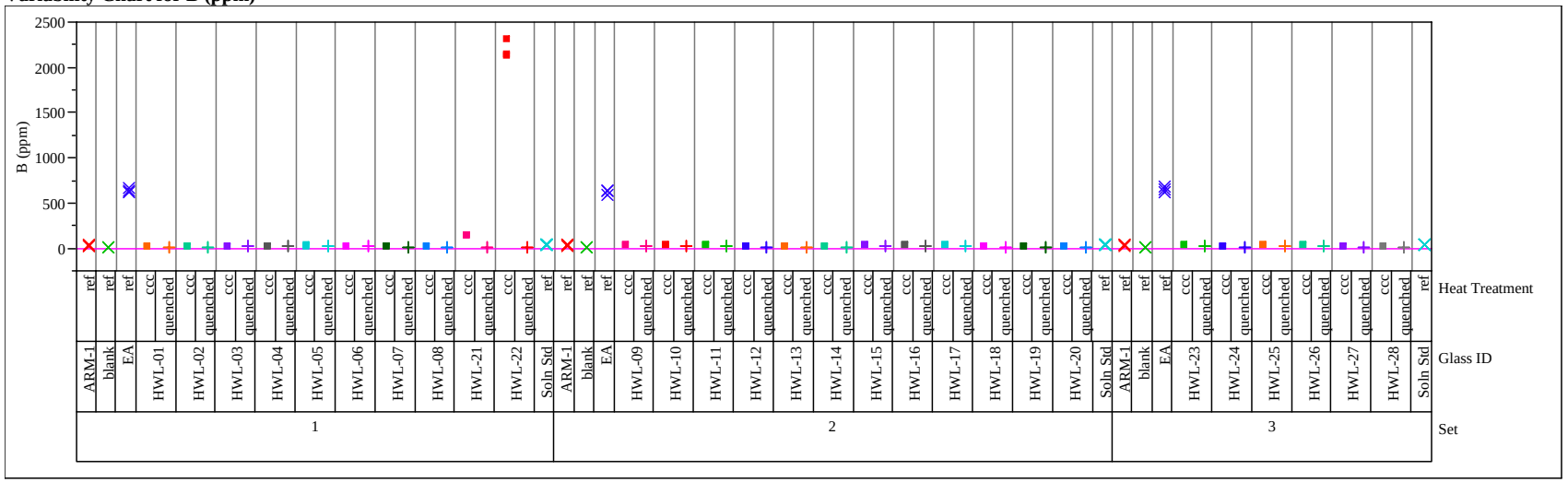
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1	3	49.3667	0.68961	47.918	50.815
1/2	3	47.7667	0.68961	46.318	49.215
1/3	3	47.4000	0.68961	45.951	48.849
2/1	3	48.3667	0.68961	46.918	49.815
2/2	3	46.7667	0.68961	45.318	48.215
2/3	3	45.9000	0.68961	44.451	47.349
3/1	3	52.3667	0.68961	50.918	53.815
3/2	3	50.8667	0.68961	49.418	52.315
3/3	3	52.8000	0.68961	51.351	54.249

Std Error uses a pooled estimate of error variance

Figure B3. Laboratory PCT Measurements by Glass Identifier for Study Glasses and Standards

Variability Chart for B (ppm)



Variability Chart for Li (ppm)

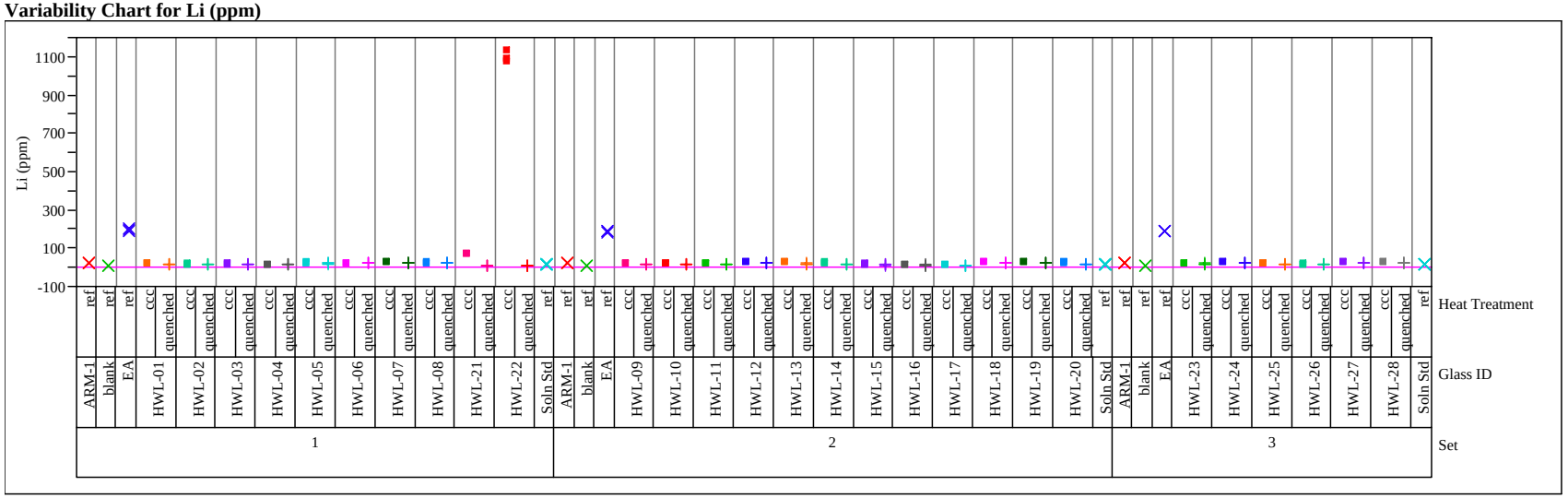


Figure B3. Laboratory PCT Measurements by Glass Identifier for Study Glasses and Standards

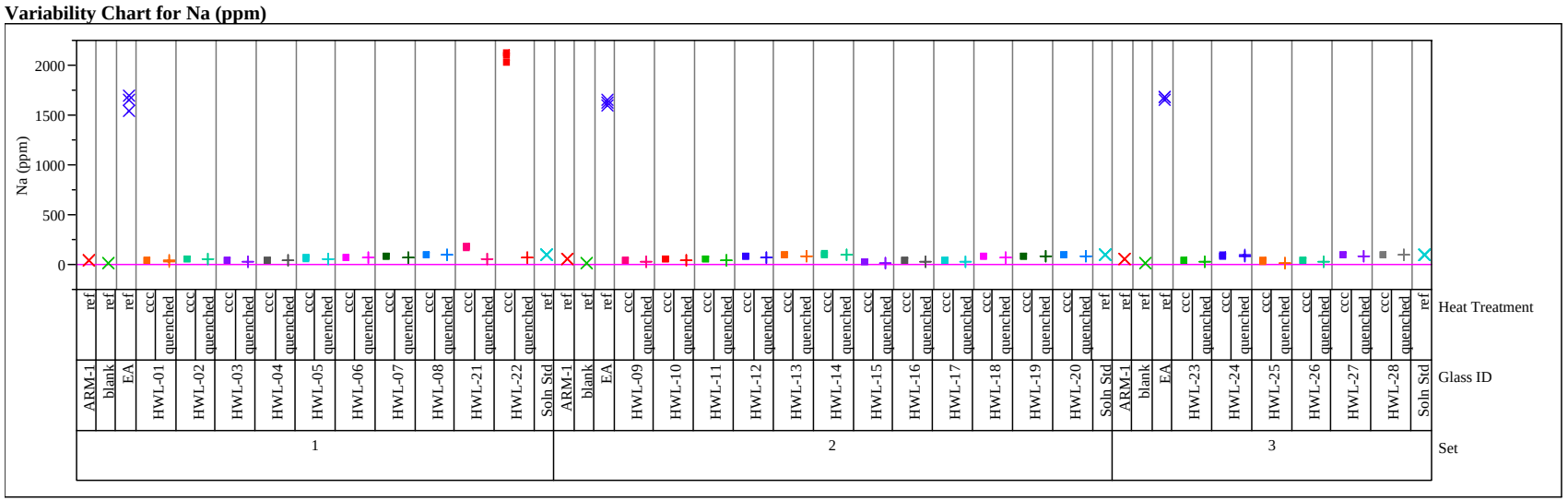
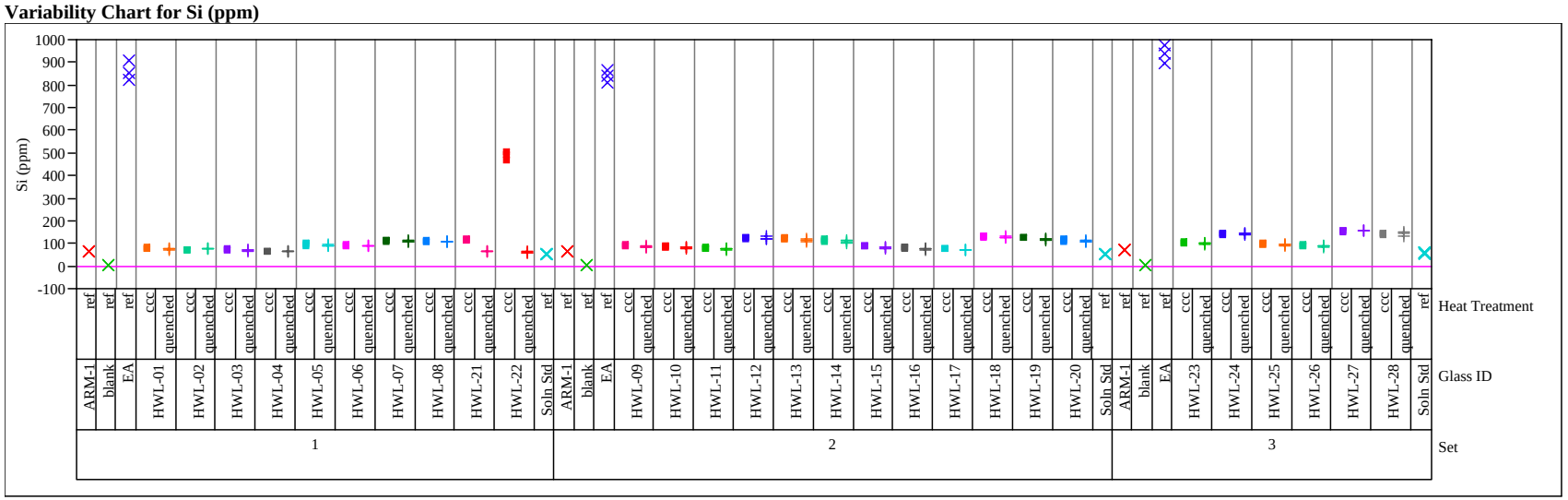


Figure B3. Laboratory PCT Measurements by Glass Identifier for Study Glasses and Standards



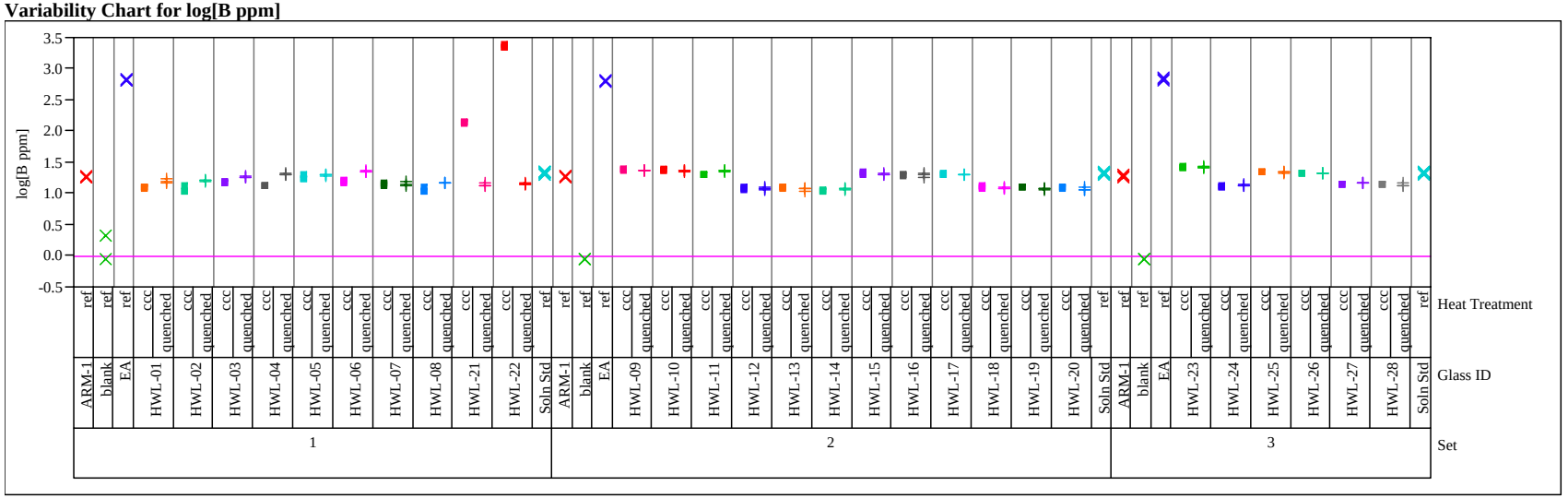


Figure B3. Laboratory PCT Measurements by Glass Identifier for Study Glasses and Standards

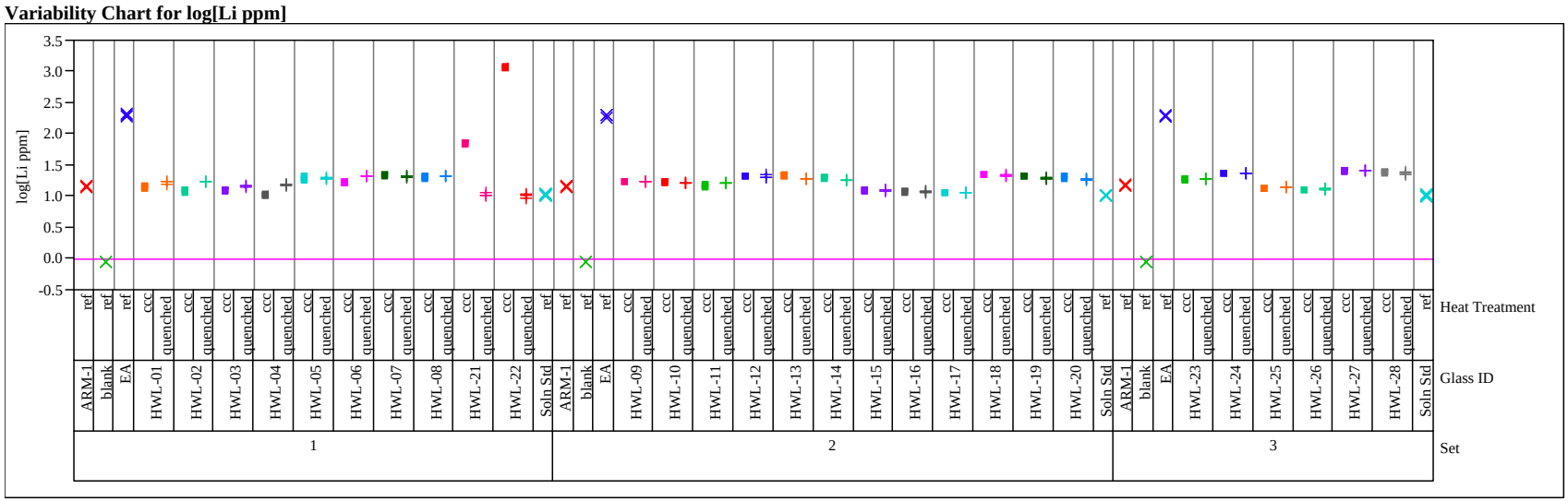
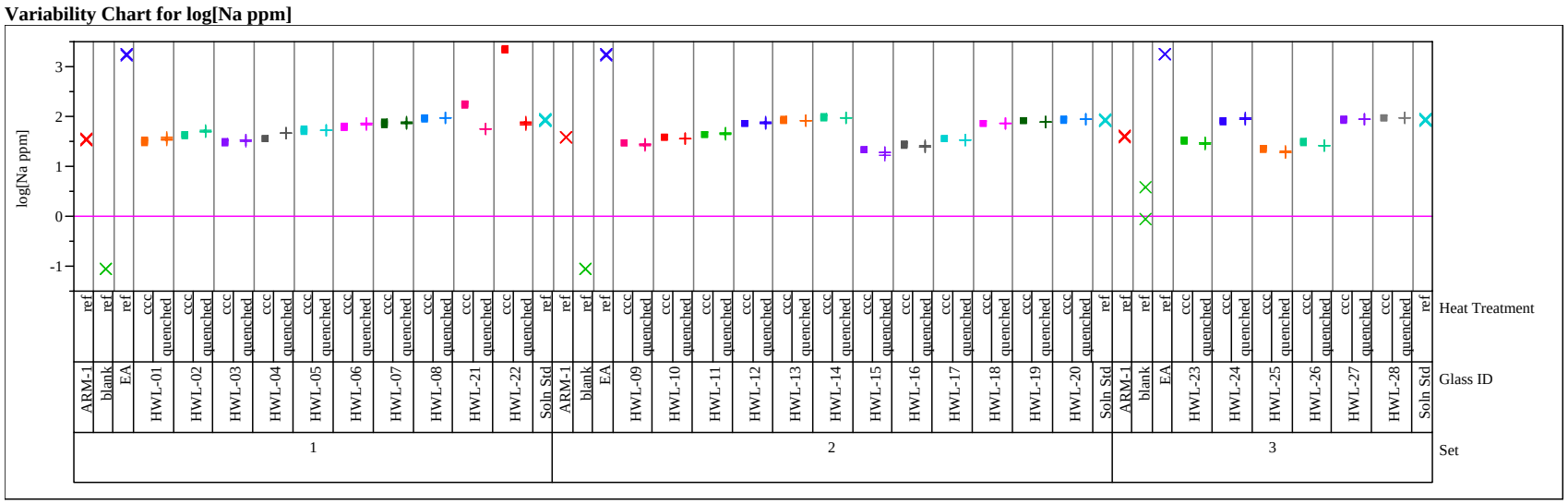


Figure B3. Laboratory PCT Measurements by Glass Identifier for Study Glasses and Standards



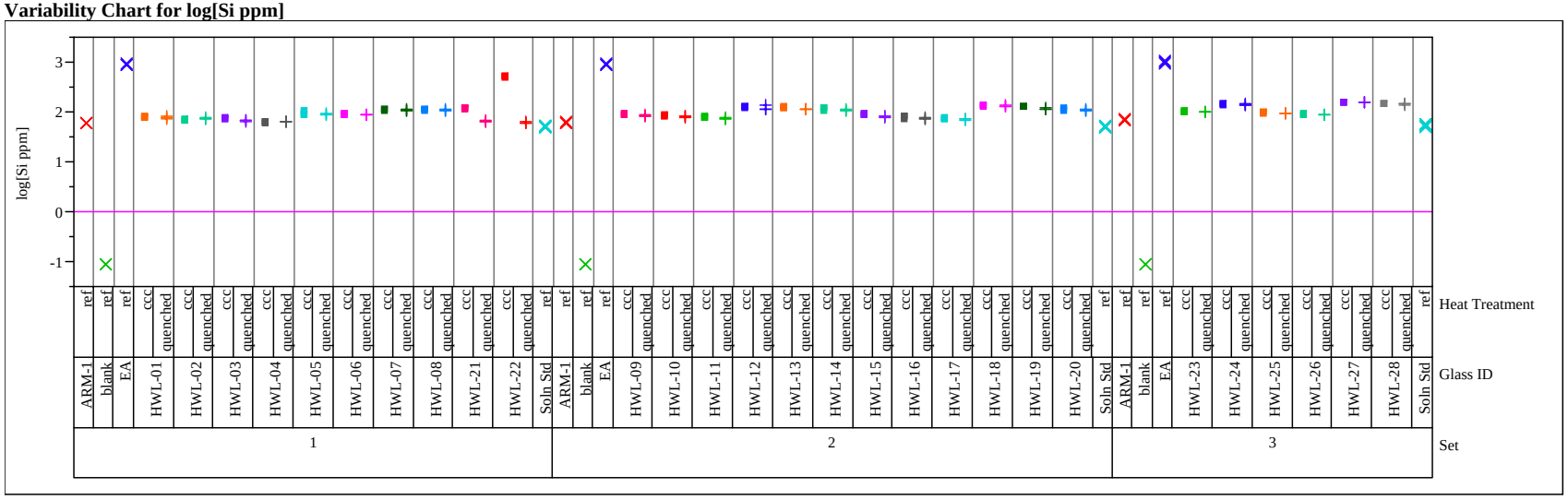


Figure B3. Laboratory PCT Measurements by Glass Identifier for Study Glasses and Standards

Figure B4. Correlations and Scatter Plots of Normalized PCTs Over All Compositional Views and Heat Treatments

Multivariate Correlations

	log NL[B (g/L)]	log NL[Li(g/L)]	log NL[Na (g/L)]	log NL[Si (g/L)]
log NL[B (g/L)]	1.0000	0.9935	0.9393	0.8919
log NL[Li(g/L)]	0.9935	1.0000	0.9281	0.8853
log NL[Na (g/L)]	0.9393	0.9281	1.0000	0.9641
log NL[Si (g/L)]	0.8919	0.8853	0.9641	1.0000

Scatterplot Matrix

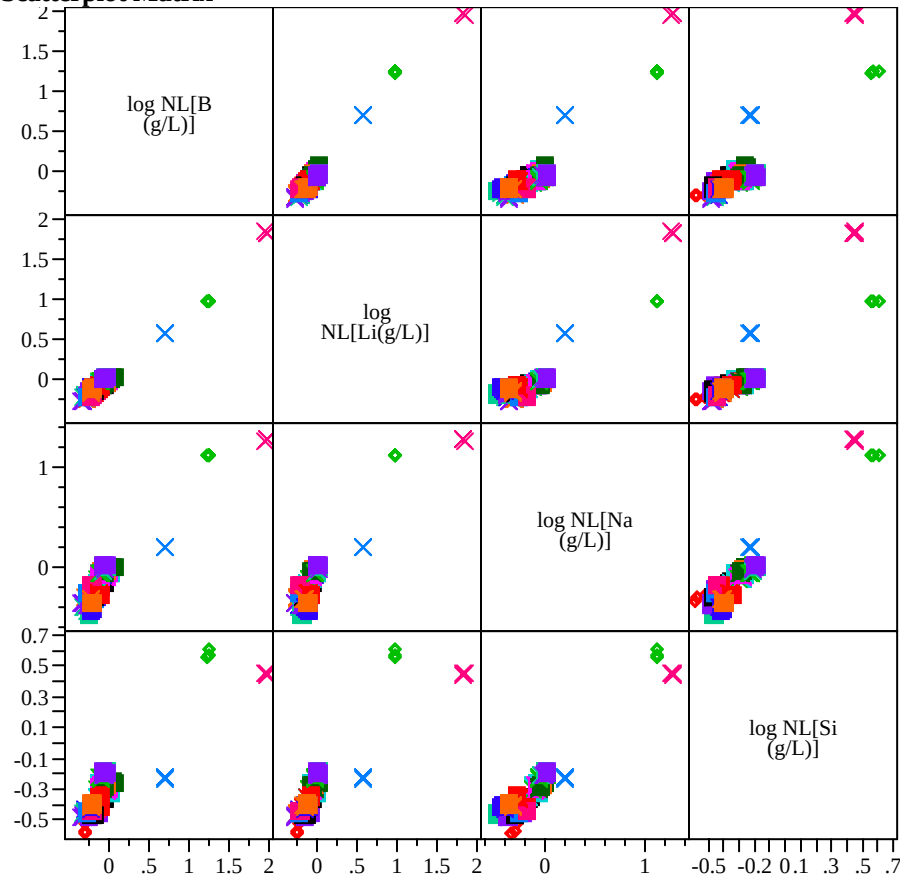
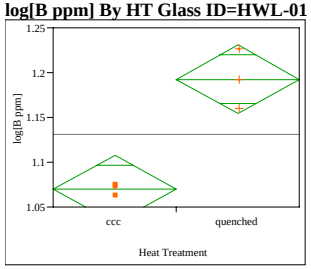


Figure B5. Effects of Heat Treatment (HT) on PCT log(ppm) Response of TM2 Glasses

log[B ppm] By HT Glass ID=HWL-01



Oneway Anova
Summary of Fit

Rsquare	0.909867
Adj Rsquare	0.887334
Root Mean Square Error	0.023698
Mean of Response	1.131288
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.122954	t Ratio	6.354454
Std Err Dif	0.019349	DF	4
Upper CL Dif	0.176677	Prob > |t|	0.0031
Lower CL Dif	0.069232	Prob > t	0.0016
Confidence	0.95	Prob < t	0.9984

Analysis of Variance

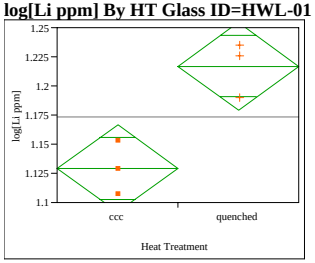
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.02267669	0.022677	40.3791	0.0031
Error	4	0.00224638	0.000562		
C. Total	5	0.02492307			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.06981	0.01368	1.0318	1.1078
quenched	3	1.19277	0.01368	1.1548	1.2308

Std Error uses a pooled estimate of error variance

log[Li ppm] By HT Glass ID=HWL-01



Oneway Anova
Summary of Fit

Rsquare	0.841829
Adj Rsquare	0.802286
Root Mean Square Error	0.023324
Mean of Response	1.172981
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.087868	t Ratio	4.614008
Std Err Dif	0.019044	DF	4
Upper CL Dif	0.140742	Prob > |t|	0.0099
Lower CL Dif	0.034994	Prob > t	0.0050
Confidence	0.95	Prob < t	0.9950

Analysis of Variance

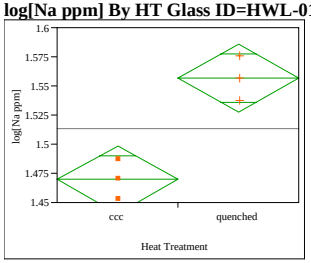
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.01158121	0.011581	21.2891	0.0099
Error	4	0.00217599	0.000544		
C. Total	5	0.01375720			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.12905	0.01347	1.0917	1.1664
quenched	3	1.21692	0.01347	1.1795	1.2543

Std Error uses a pooled estimate of error variance

log[Na ppm] By HT Glass ID=HWL-01



Oneway Anova
Summary of Fit

Rsquare	0.896183
Adj Rsquare	0.870229
Root Mean Square Error	0.018153
Mean of Response	1.513153
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.087098	t Ratio	5.87618
Std Err Dif	0.014822	DF	4
Upper CL Dif	0.128250	Prob > |t|	0.0042
Lower CL Dif	0.045945	Prob > t	0.0021
Confidence	0.95	Prob < t	0.9979

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.01137896	0.011379	34.5295	0.0042
Error	4	0.00131817	0.000330		
C. Total	5	0.01269714			

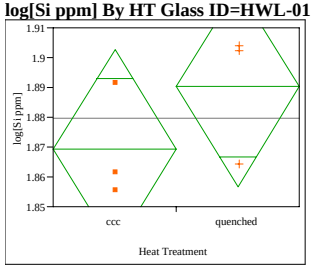
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.46960	0.01048	1.4405	1.4987
quenched	3	1.55670	0.01048	1.5276	1.5858

Std Error uses a pooled estimate of error variance

Figure B5. Effects of Heat Treatment (HT) on PCT log(ppm) Response of TM2 Glasses

log[Si ppm] By HT Glass ID=HWL-01



Oneway Anova
Summary of Fit

Rsquare	0.27326
Adj Rsquare	0.091575
Root Mean Square Error	0.020863
Mean of Response	1.879727
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.02089	t Ratio	1.22639
Std Err Dif	0.01703	DF	4
Upper CL Dif	0.06819	Prob > |t|	0.2873
Lower CL Dif	-0.02640	Prob > t	0.1437
Confidence	0.95	Prob < t	0.8563

Analysis of Variance

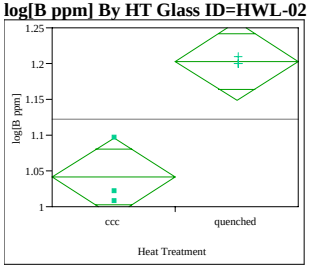
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00065466	0.000655	1.5040	0.2873
Error	4	0.00174107	0.000435		
C. Total	5	0.00239573			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.86928	0.01205	1.8358	1.9027
quenched	3	1.89017	0.01205	1.8567	1.9236

Std Error uses a pooled estimate of error variance

log[B ppm] By HT Glass ID=HWL-02



Oneway Anova
Summary of Fit

Rsquare	0.892748
Adj Rsquare	0.865935
Root Mean Square Error	0.034405
Mean of Response	1.122154
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.162092	t Ratio	5.770203
Std Err Dif	0.028091	DF	4
Upper CL Dif	0.240086	Prob > |t|	0.0045
Lower CL Dif	0.084098	Prob > t	0.0022
Confidence	0.95	Prob < t	0.9978

Analysis of Variance

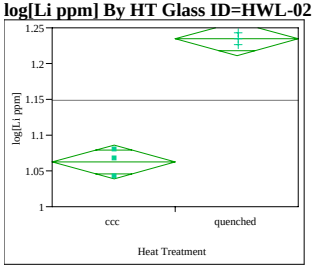
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.03941090	0.039411	33.2952	0.0045
Error	4	0.00473472	0.001184		
C. Total	5	0.04414561			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.04111	0.01986	0.9860	1.0963
quenched	3	1.20320	0.01986	1.1480	1.2583

Std Error uses a pooled estimate of error variance

log[Li ppm] By HT Glass ID=HWL-02



Oneway Anova
Summary of Fit

Rsquare	0.981473
Adj Rsquare	0.976841
Root Mean Square Error	0.01448
Mean of Response	1.148587
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.172107	t Ratio	14.55671
Std Err Dif	0.011823	DF	4
Upper CL Dif	0.204933	Prob > |t|	0.0001
Lower CL Dif	0.139280	Prob > t	<.0001
Confidence	0.95	Prob < t	0.9999

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.04443097	0.044431	211.8978	0.0001
Error	4	0.00083872	0.000210		
C. Total	5	0.04526970			

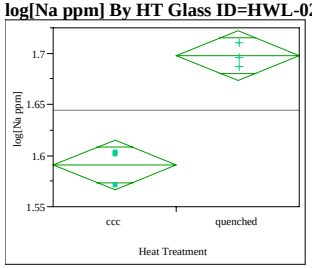
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.06253	0.00836	1.0393	1.0857
quenched	3	1.23464	0.00836	1.2114	1.2579

Std Error uses a pooled estimate of error variance

Figure B5. Effects of Heat Treatment (HT) on PCT log(ppm) Response of TM2 Glasses

log[Na ppm] By HT Glass ID=HWL-02



Oneway Anova
Summary of Fit

Rsquare	0.949448
Adj Rsquare	0.93681
Root Mean Square Error	0.01513
Mean of Response	1.644368
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.107079	t Ratio	8.667576
Std Err Dif	0.012354	DF	4
Upper CL Dif	0.141379	Prob > |t|	0.0010
Lower CL Dif	0.072779	Prob > t	0.0005
Confidence	0.95	Prob < t	0.9995

Analysis of Variance

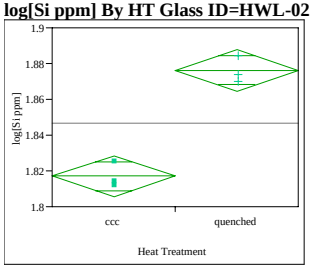
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.01719874	0.017199	75.1269	0.0010
Error	4	0.00091572	0.000229		
C. Total	5	0.01811446			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.59083	0.00874	1.5666	1.6151
quenched	3	1.69791	0.00874	1.6737	1.7222

Std Error uses a pooled estimate of error variance

log[Si ppm] By HT Glass ID=HWL-02



Oneway Anova
Summary of Fit

Rsquare	0.961661
Adj Rsquare	0.952076
Root Mean Square Error	0.007259
Mean of Response	1.84663
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.059364	t Ratio	10.01661
Std Err Dif	0.005927	DF	4
Upper CL Dif	0.075819	Prob > |t|	0.0006
Lower CL Dif	0.042910	Prob > t	0.0003
Confidence	0.95	Prob < t	0.9997

Analysis of Variance

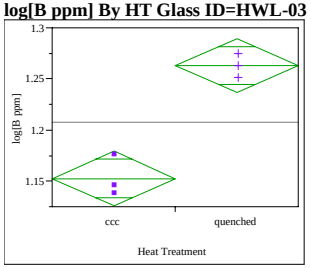
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00528621	0.005286	100.3325	0.0006
Error	4	0.00021075	0.000053		
C. Total	5	0.00549696			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.81695	0.00419	1.8053	1.8286
quenched	3	1.87631	0.00419	1.8647	1.8879

Std Error uses a pooled estimate of error variance

log[B ppm] By HT Glass ID=HWL-03



Oneway Anova
Summary of Fit

Rsquare	0.943224
Adj Rsquare	0.92903
Root Mean Square Error	0.016599
Mean of Response	1.207901
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.110484	t Ratio	8.151838
Std Err Dif	0.013553	DF	4
Upper CL Dif	0.148114	Prob > |t|	0.0012
Lower CL Dif	0.072854	Prob > t	0.0006
Confidence	0.95	Prob < t	0.9994

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.01831000	0.018310	66.4525	0.0012
Error	4	0.00110214	0.000276		
C. Total	5	0.01941214			

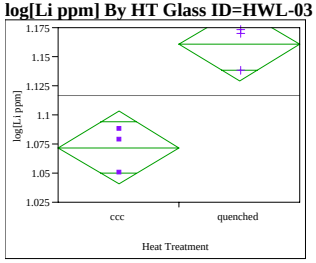
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.15266	0.00958	1.1261	1.1793
quenched	3	1.26314	0.00958	1.2365	1.2898

Std Error uses a pooled estimate of error variance

Figure B5. Effects of Heat Treatment (HT) on PCT log(ppm) Response of TM2 Glasses

log[Li ppm] By HT Glass ID=HWL-03



Oneway Anova
Summary of Fit

Rsquare	0.885387
Adj Rsquare	0.856734
Root Mean Square Error	0.019518
Mean of Response	1.116298
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.088588	t Ratio	5.55879
Std Err Dif	0.015937	DF	4
Upper CL Dif	0.132835	Prob > |t|	0.0051
Lower CL Dif	0.044341	Prob > t	0.0026
Confidence	0.95	Prob < t	0.9974

Analysis of Variance

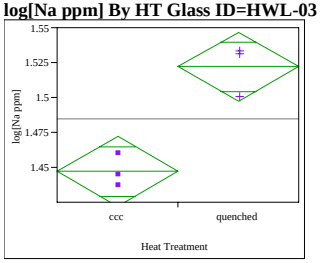
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.01177179	0.011772	30.9001	0.0051
Error	4	0.00152385	0.000381		
C. Total	5	0.01329564			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.07200	0.01127	1.0407	1.1033
quenched	3	1.16059	0.01127	1.1293	1.1919

Std Error uses a pooled estimate of error variance

log[Na ppm] By HT Glass ID=HWL-03



Oneway Anova
Summary of Fit

Rsquare	0.897391
Adj Rsquare	0.871739
Root Mean Square Error	0.015498
Mean of Response	1.484481
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.074844	t Ratio	5.914648
Std Err Dif	0.012654	DF	4
Upper CL Dif	0.109977	Prob > |t|	0.0041
Lower CL Dif	0.039711	Prob > t	0.0020
Confidence	0.95	Prob < t	0.9980

Analysis of Variance

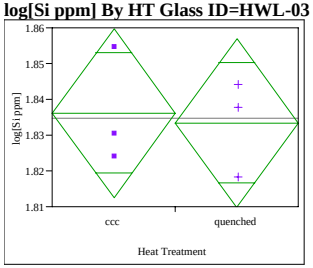
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00840238	0.008402	34.9831	0.0041
Error	4	0.00096074	0.000240		
C. Total	5	0.00936311			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.44706	0.00895	1.4222	1.4719
quenched	3	1.52190	0.00895	1.4971	1.5467

Std Error uses a pooled estimate of error variance

log[Si ppm] By HT Glass ID=HWL-03



Oneway Anova
Summary of Fit

Rsquare	0.012977
Adj Rsquare	-0.23378
Root Mean Square Error	0.014744
Mean of Response	1.834825
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	-0.00276	t Ratio	-0.22933
Std Err Dif	0.01204	DF	4
Upper CL Dif	0.03066	Prob > |t|	0.8299
Lower CL Dif	-0.03618	Prob > t	0.5851
Confidence	0.95	Prob < t	0.4149

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00001143	0.000011	0.0526	0.8299
Error	4	0.00086950	0.000217		
C. Total	5	0.00088094			

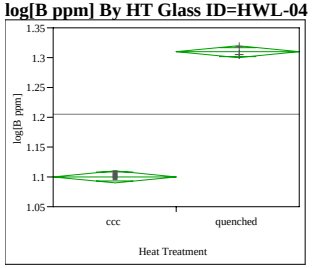
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.83621	0.00851	1.8126	1.8598
quenched	3	1.83344	0.00851	1.8098	1.8571

Std Error uses a pooled estimate of error variance

Figure B5. Effects of Heat Treatment (HT) on PCT log(ppm) Response of TM2 Glasses

log[B ppm] By HT Glass ID=HWL-04



Oneway Anova
Summary of Fit

Rsquare	0.997602
Adj Rsquare	0.997002
Root Mean Square Error	0.006263
Mean of Response	1.205052
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.208598	t Ratio	40.79041
Std Err Dif	0.005114	DF	4
Upper CL Dif	0.222797	Prob > |t|	<.0001
Lower CL Dif	0.194400	Prob > t	<.0001
Confidence	0.95	Prob < t	1.0000

Analysis of Variance

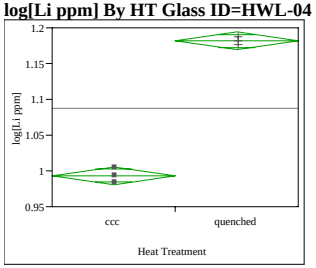
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.06526979	0.065270	1663.858	<.0001
Error	4	0.00015691	0.000039		
C. Total	5	0.06542670			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.10075	0.00362	1.0907	1.1108
quenched	3	1.30935	0.00362	1.2993	1.3194

Std Error uses a pooled estimate of error variance

log[Li ppm] By HT Glass ID=HWL-04



Oneway Anova
Summary of Fit

Rsquare	0.995191
Adj Rsquare	0.993989
Root Mean Square Error	0.008023
Mean of Response	1.087599
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.188460	t Ratio	28.77072
Std Err Dif	0.006550	DF	4
Upper CL Dif	0.206647	Prob > |t|	<.0001
Lower CL Dif	0.170273	Prob > t	<.0001
Confidence	0.95	Prob < t	1.0000

Analysis of Variance

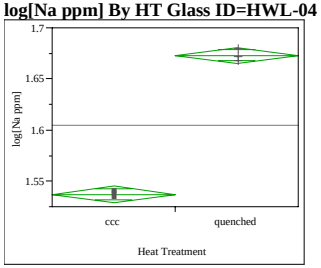
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.05327574	0.053276	827.7543	<.0001
Error	4	0.00025745	0.000064		
C. Total	5	0.05353319			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	0.99337	0.00463	0.9805	1.0062
quenched	3	1.18183	0.00463	1.1690	1.1947

Std Error uses a pooled estimate of error variance

log[Na ppm] By HT Glass ID=HWL-04



Oneway Anova
Summary of Fit

Rsquare	0.996497
Adj Rsquare	0.995621
Root Mean Square Error	0.004937
Mean of Response	1.605111
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.135983	t Ratio	33.73052
Std Err Dif	0.004031	DF	4
Upper CL Dif	0.147176	Prob > |t|	<.0001
Lower CL Dif	0.124789	Prob > t	<.0001
Confidence	0.95	Prob < t	1.0000

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.02773688	0.027737	1137.748	<.0001
Error	4	0.00009752	0.000024		
C. Total	5	0.02783440			

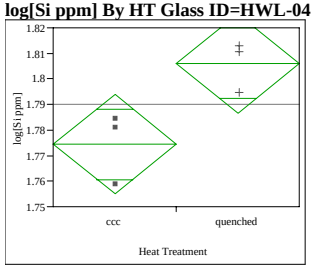
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.53712	0.00285	1.5292	1.5450
quenched	3	1.67310	0.00285	1.6652	1.6810

Std Error uses a pooled estimate of error variance

Figure B5. Effects of Heat Treatment (HT) on PCT log(ppm) Response of TM2 Glasses

log[Si ppm] By HT Glass ID=HWL-04



Oneway Anova
Summary of Fit

Rsquare	0.720701
Adj Rsquare	0.650876
Root Mean Square Error	0.012098
Mean of Response	1.790245
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.031736	t Ratio	3.212721
Std Err Dif	0.009878	DF	4
Upper CL Dif	0.059162	Prob > |t|	0.0325
Lower CL Dif	0.004310	Prob > t	0.0163
Confidence	0.95	Prob < t	0.9837

Analysis of Variance

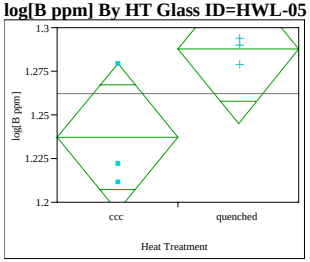
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00151076	0.001511	10.3216	0.0325
Error	4	0.00058548	0.000146		
C. Total	5	0.00209624			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.77438	0.00698	1.7550	1.7938
quenched	3	1.80611	0.00698	1.7867	1.8255

Std Error uses a pooled estimate of error variance

log[B ppm] By HT Glass ID=HWL-05



Oneway Anova
Summary of Fit

Rsquare	0.577877
Adj Rsquare	0.472346
Root Mean Square Error	0.026355
Mean of Response	1.262338
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.05035	t Ratio	2.340064
Std Err Dif	0.02152	DF	4
Upper CL Dif	0.11010	Prob > |t|	0.0794
Lower CL Dif	-0.00939	Prob > t	0.0397
Confidence	0.95	Prob < t	0.9603

Analysis of Variance

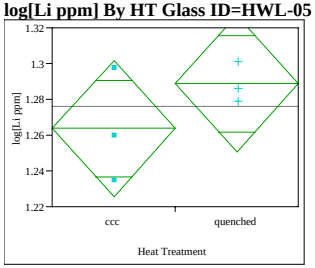
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00380335	0.003803	5.4759	0.0794
Error	4	0.00277825	0.000695		
C. Total	5	0.00658160			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.23716	0.01522	1.1949	1.2794
quenched	3	1.28752	0.01522	1.2453	1.3298

Std Error uses a pooled estimate of error variance

log[Li ppm] By HT Glass ID=HWL-05



Oneway Anova
Summary of Fit

Rsquare	0.292323
Adj Rsquare	0.115404
Root Mean Square Error	0.023735
Mean of Response	1.27625
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.02491	t Ratio	1.285418
Std Err Dif	0.01938	DF	4
Upper CL Dif	0.07872	Prob > |t|	0.2680
Lower CL Dif	-0.02890	Prob > t	0.1340
Confidence	0.95	Prob < t	0.8660

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00093085	0.000931	1.6523	0.2680
Error	4	0.00225346	0.000563		
C. Total	5	0.00318431			

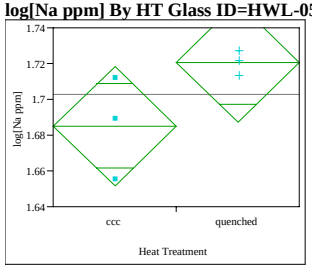
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.26379	0.01370	1.2257	1.3018
quenched	3	1.28871	0.01370	1.2507	1.3268

Std Error uses a pooled estimate of error variance

Figure B5. Effects of Heat Treatment (HT) on PCT log(ppm) Response of TM2 Glasses

log[Na ppm] By HT Glass ID=HWL-05



Oneway Anova
Summary of Fit

Rsquare	0.52029
Adj Rsquare	0.400362
Root Mean Square Error	0.020855
Mean of Response	1.702856
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.03547	t Ratio	2.082875
Std Err Dif	0.01703	DF	4
Upper CL Dif	0.08275	Prob > |t|	0.1057
Lower CL Dif	-0.01181	Prob > t	0.0528
Confidence	0.95	Prob < t	0.9472

Analysis of Variance

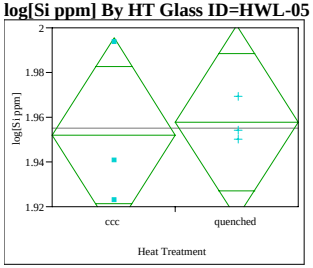
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00188695	0.001887	4.3384	0.1057
Error	4	0.00173977	0.000435		
C. Total	5	0.00362672			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.68512	0.01204	1.6517	1.7186
quenched	3	1.72059	0.01204	1.6872	1.7540

Std Error uses a pooled estimate of error variance

log[Si ppm] By HT Glass ID=HWL-05



Oneway Anova
Summary of Fit

Rsquare	0.016915
Adj Rsquare	-0.22886
Root Mean Square Error	0.027025
Mean of Response	1.955016
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.00579	t Ratio	0.26234
Std Err Dif	0.02207	DF	4
Upper CL Dif	0.06705	Prob > |t|	0.8060
Lower CL Dif	-0.05548	Prob > t	0.4030
Confidence	0.95	Prob < t	0.5970

Analysis of Variance

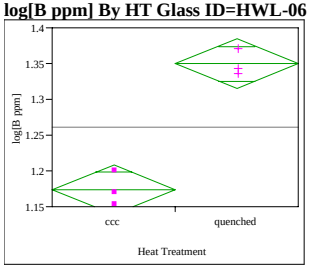
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00005027	0.000050	0.0688	0.8060
Error	4	0.00292148	0.000730		
C. Total	5	0.00297175			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.95212	0.01560	1.9088	1.9954
quenched	3	1.95791	0.01560	1.9146	2.0012

Std Error uses a pooled estimate of error variance

log[B ppm] By HT Glass ID=HWL-06



Oneway Anova
Summary of Fit

Rsquare	0.961701
Adj Rsquare	0.952126
Root Mean Square Error	0.021534
Mean of Response	1.261665
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.176210	t Ratio	10.02201
Std Err Dif	0.017582	DF	4
Upper CL Dif	0.225026	Prob > |t|	0.0006
Lower CL Dif	0.127394	Prob > t	0.0003
Confidence	0.95	Prob < t	0.9997

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.04657493	0.046575	100.4407	0.0006
Error	4	0.00185482	0.000464		
C. Total	5	0.04842976			

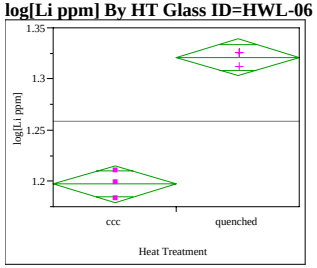
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.17356	0.01243	1.1390	1.2081
quenched	3	1.34977	0.01243	1.3153	1.3843

Std Error uses a pooled estimate of error variance

Figure B5. Effects of Heat Treatment (HT) on PCT log(ppm) Response of TM2 Glasses

log[Li ppm] By HT Glass ID=HWL-06



Oneway Anova
Summary of Fit

Rsquare	0.978256
Adj Rsquare	0.97282
Root Mean Square Error	0.011311
Mean of Response	1.259085
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.123886	t Ratio	13.41478
Std Err Dif	0.009235	DF	4
Upper CL Dif	0.149526	Prob > |t|	0.0002
Lower CL Dif	0.098245	Prob > t	<.0001
Confidence	0.95	Prob < t	0.9999

Analysis of Variance

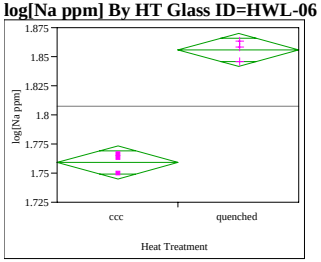
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.02302154	0.023022	179.9562	0.0002
Error	4	0.00051171	0.000128		
C. Total	5	0.02353325			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.19714	0.00653	1.1790	1.2153
quenched	3	1.32103	0.00653	1.3029	1.3392

Std Error uses a pooled estimate of error variance

log[Na ppm] By HT Glass ID=HWL-06



Oneway Anova
Summary of Fit

Rsquare	0.978737
Adj Rsquare	0.973422
Root Mean Square Error	0.008732
Mean of Response	1.807569
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.096739	t Ratio	13.56925
Std Err Dif	0.007129	DF	4
Upper CL Dif	0.116533	Prob > |t|	0.0002
Lower CL Dif	0.076945	Prob > t	<.0001
Confidence	0.95	Prob < t	0.9999

Analysis of Variance

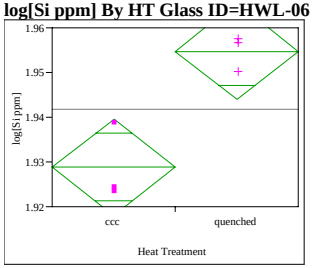
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.01403762	0.014038	184.1245	0.0002
Error	4	0.00030496	0.000076		
C. Total	5	0.01434258			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.75920	0.00504	1.7452	1.7732
quenched	3	1.85594	0.00504	1.8419	1.8699

Std Error uses a pooled estimate of error variance

log[Si ppm] By HT Glass ID=HWL-06



Oneway Anova
Summary of Fit

Rsquare	0.849884
Adj Rsquare	0.812355
Root Mean Square Error	0.006684
Mean of Response	1.941789
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.025972	t Ratio	4.758793
Std Err Dif	0.005458	DF	4
Upper CL Dif	0.041125	Prob > |t|	0.0089
Lower CL Dif	0.010819	Prob > t	0.0045
Confidence	0.95	Prob < t	0.9955

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00101182	0.001012	22.6461	0.0089
Error	4	0.00017872	0.000045		
C. Total	5	0.00119054			

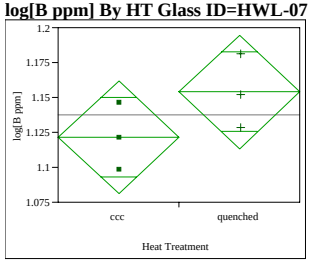
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.92880	0.00386	1.9181	1.9395
quenched	3	1.95477	0.00386	1.9441	1.9655

Std Error uses a pooled estimate of error variance

Figure B5. Effects of Heat Treatment (HT) on PCT log(ppm) Response of TM2 Glasses

log[B ppm] By HT Glass ID=HWL-07



Oneway Anova
Summary of Fit

Rsquare	0.381334
Adj Rsquare	0.226668
Root Mean Square Error	0.025246
Mean of Response	1.137781
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.03237	t Ratio	1.5702
Std Err Dif	0.02061	DF	4
Upper CL Dif	0.08960	Prob > |t|	0.1915
Lower CL Dif	-0.02486	Prob > t	0.0957
Confidence	0.95	Prob < t	0.9043

Analysis of Variance

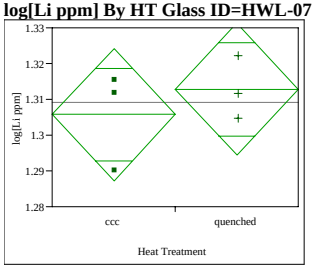
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00157137	0.001571	2.4655	0.1915
Error	4	0.00254935	0.000637		
C. Total	5	0.00412073			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.12160	0.01458	1.0811	1.1621
quenched	3	1.15396	0.01458	1.1135	1.1944

Std Error uses a pooled estimate of error variance

log[Li ppm] By HT Glass ID=HWL-07



Oneway Anova
Summary of Fit

Rsquare	0.127385
Adj Rsquare	-0.09077
Root Mean Square Error	0.011512
Mean of Response	1.309286
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.00718	t Ratio	0.764147
Std Err Dif	0.00940	DF	4
Upper CL Dif	0.03328	Prob > |t|	0.4874
Lower CL Dif	-0.01892	Prob > t	0.2437
Confidence	0.95	Prob < t	0.7563

Analysis of Variance

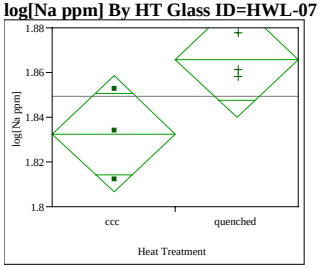
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00007739	0.000077	0.5839	0.4874
Error	4	0.00053013	0.000133		
C. Total	5	0.00060752			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.30569	0.00665	1.2872	1.3241
quenched	3	1.31288	0.00665	1.2944	1.3313

Std Error uses a pooled estimate of error variance

log[Na ppm] By HT Glass ID=HWL-07



Oneway Anova
Summary of Fit

Rsquare	0.614725
Adj Rsquare	0.518406
Root Mean Square Error	0.016155
Mean of Response	1.84922
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.03332	t Ratio	2.526301
Std Err Dif	0.01319	DF	4
Upper CL Dif	0.06995	Prob > |t|	0.0649
Lower CL Dif	-0.00330	Prob > t	0.0325
Confidence	0.95	Prob < t	0.9675

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00166573	0.001666	6.3822	0.0649
Error	4	0.00104398	0.000261		
C. Total	5	0.00270971			

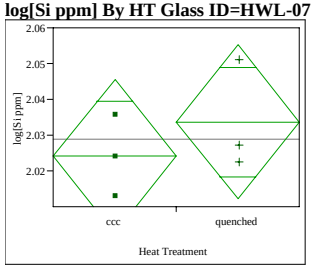
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.83256	0.00933	1.8067	1.8585
quenched	3	1.86588	0.00933	1.8400	1.8918

Std Error uses a pooled estimate of error variance

Figure B5. Effects of Heat Treatment (HT) on PCT log(ppm) Response of TM2 Glasses

log[Si ppm] By HT Glass ID=HWL-07



Oneway Anova
Summary of Fit

Rsquare	0.160893
Adj Rsquare	-0.04888
Root Mean Square Error	0.013455
Mean of Response	2.028888
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.00962	t Ratio	0.875768
Std Err Dif	0.01099	DF	4
Upper CL Dif	0.04012	Prob > |t|	0.4306
Lower CL Dif	-0.02088	Prob > t	0.2153
Confidence	0.95	Prob < t	0.7847

Analysis of Variance

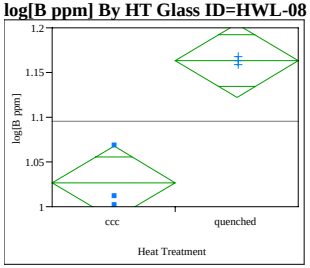
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00013885	0.000139	0.7670	0.4306
Error	4	0.00072412	0.000181		
C. Total	5	0.00086297			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	2.02408	0.00777	2.0025	2.0456
quenched	3	2.03370	0.00777	2.0121	2.0553

Std Error uses a pooled estimate of error variance

log[B ppm] By HT Glass ID=HWL-08



Oneway Anova
Summary of Fit

Rsquare	0.915389
Adj Rsquare	0.894237
Root Mean Square Error	0.025449
Mean of Response	1.095169
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.136693	t Ratio	6.578398
Std Err Dif	0.020779	DF	4
Upper CL Dif	0.194385	Prob > |t|	0.0028
Lower CL Dif	0.079001	Prob > t	0.0014
Confidence	0.95	Prob < t	0.9986

Analysis of Variance

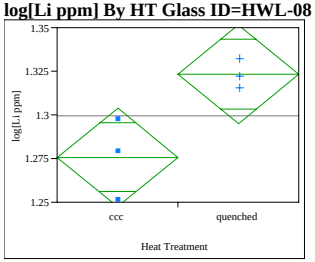
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.02802744	0.028027	43.2753	0.0028
Error	4	0.00259062	0.000648		
C. Total	5	0.03061806			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.02682	0.01469	0.9860	1.0676
quenched	3	1.16352	0.01469	1.1227	1.2043

Std Error uses a pooled estimate of error variance

log[Li ppm] By HT Glass ID=HWL-08



Oneway Anova
Summary of Fit

Rsquare	0.733917
Adj Rsquare	0.667396
Root Mean Square Error	0.01752
Mean of Response	1.29956
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.047515	t Ratio	3.321578
Std Err Dif	0.014305	DF	4
Upper CL Dif	0.087233	Prob > |t|	0.0293
Lower CL Dif	0.007798	Prob > t	0.0147
Confidence	0.95	Prob < t	0.9853

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00338658	0.003387	11.0329	0.0293
Error	4	0.00122781	0.000307		
C. Total	5	0.00461439			

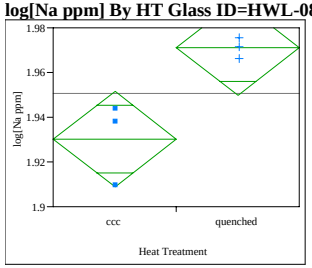
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.27580	0.01012	1.2477	1.3039
quenched	3	1.32332	0.01012	1.2952	1.3514

Std Error uses a pooled estimate of error variance

Figure B5. Effects of Heat Treatment (HT) on PCT log(ppm) Response of TM2 Glasses

log[Na ppm] By HT Glass ID=HWL-08



Oneway Anova
Summary of Fit

Rsquare	0.776583
Adj Rsquare	0.720728
Root Mean Square Error	0.013387
Mean of Response	1.950683
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.040756	t Ratio	3.728767
Std Err Dif	0.010930	DF	4
Upper CL Dif	0.071104	Prob > |t|	0.0203
Lower CL Dif	0.010409	Prob > t	0.0102
Confidence	0.95	Prob < t	0.9898

Analysis of Variance

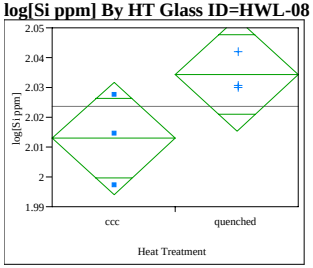
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00249164	0.002492	13.9037	0.0203
Error	4	0.00071683	0.000179		
C. Total	5	0.00320846			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.93031	0.00773	1.9088	1.9518
quenched	3	1.97106	0.00773	1.9496	1.9925

Std Error uses a pooled estimate of error variance

log[Si ppm] By HT Glass ID=HWL-08



Oneway Anova
Summary of Fit

Rsquare	0.55453
Adj Rsquare	0.443163
Root Mean Square Error	0.011738
Mean of Response	2.023597
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.02139	t Ratio	2.231431
Std Err Dif	0.00958	DF	4
Upper CL Dif	0.04800	Prob > |t|	0.0895
Lower CL Dif	-0.00522	Prob > t	0.0447
Confidence	0.95	Prob < t	0.9553

Analysis of Variance

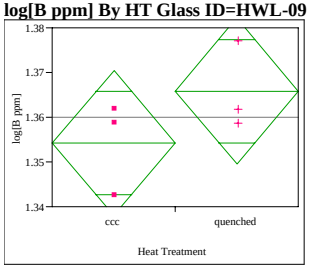
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00068607	0.000686	4.9793	0.0895
Error	4	0.00055114	0.000138		
C. Total	5	0.00123722			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	2.01290	0.00678	1.9941	2.0317
quenched	3	2.03429	0.00678	2.0155	2.0531

Std Error uses a pooled estimate of error variance

log[B ppm] By HT Glass ID=HWL-09



Oneway Anova
Summary of Fit

Rsquare	0.327834
Adj Rsquare	0.159793
Root Mean Square Error	0.01016
Mean of Response	1.360042
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.01159	t Ratio	1.396751
Std Err Dif	0.00830	DF	4
Upper CL Dif	0.03462	Prob > |t|	0.2350
Lower CL Dif	-0.01145	Prob > t	0.1175
Confidence	0.95	Prob < t	0.8825

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00020140	0.000201	1.9509	0.2350
Error	4	0.00041294	0.000103		
C. Total	5	0.00061434			

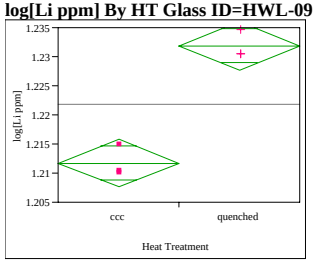
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.35425	0.00587	1.3380	1.3705
quenched	3	1.36584	0.00587	1.3495	1.3821

Std Error uses a pooled estimate of error variance

Figure B5. Effects of Heat Treatment (HT) on PCT log(ppm) Response of TM2 Glasses

log[Li ppm] By HT Glass ID=HWL-09



Oneway Anova
Summary of Fit

Rsquare	0.958137
Adj Rsquare	0.947672
Root Mean Square Error	0.002576
Mean of Response	1.221808
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.020124	t Ratio	9.56819
Std Err Dif	0.002103	DF	4
Upper CL Dif	0.025963	Prob > |t|	0.0007
Lower CL Dif	0.014284	Prob > t	0.0003
Confidence	0.95	Prob < t	0.9997

Analysis of Variance

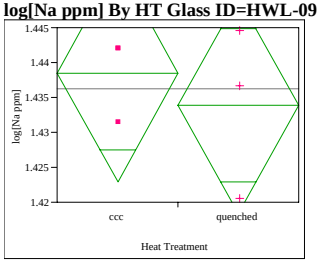
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00060744	0.000607	91.5503	0.0007
Error	4	0.00002654	6.635e-6		
C. Total	5	0.00063398			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.21175	0.00149	1.2076	1.2159
quenched	3	1.23187	0.00149	1.2277	1.2360

Std Error uses a pooled estimate of error variance

log[Na ppm] By HT Glass ID=HWL-09



Oneway Anova
Summary of Fit

Rsquare	0.074932
Adj Rsquare	-0.15633
Root Mean Square Error	0.009692
Mean of Response	1.436182
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	-0.00450	t Ratio	-0.56922
Std Err Dif	0.00791	DF	4
Upper CL Dif	0.01747	Prob > |t|	0.5996
Lower CL Dif	-0.02648	Prob > t	0.7002
Confidence	0.95	Prob < t	0.2998

Analysis of Variance

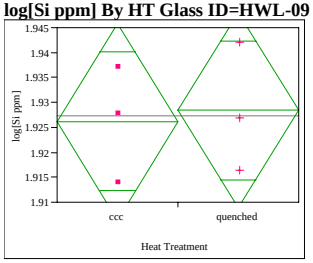
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00003044	0.000030	0.3240	0.5996
Error	4	0.00037576	0.000094		
C. Total	5	0.00040619			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.43843	0.00560	1.4229	1.4540
quenched	3	1.43393	0.00560	1.4184	1.4495

Std Error uses a pooled estimate of error variance

log[Si ppm] By HT Glass ID=HWL-09



Oneway Anova
Summary of Fit

Rsquare	0.012533
Adj Rsquare	-0.23433
Root Mean Square Error	0.012278
Mean of Response	1.927319
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.00226	t Ratio	0.225322
Std Err Dif	0.01002	DF	4
Upper CL Dif	0.03009	Prob > |t|	0.8328
Lower CL Dif	-0.02557	Prob > t	0.4164
Confidence	0.95	Prob < t	0.5836

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00000765	7.653e-6	0.0508	0.8328
Error	4	0.00060296	0.000151		
C. Total	5	0.00061061			

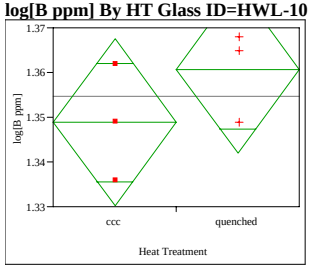
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.92619	0.00709	1.9065	1.9459
quenched	3	1.92845	0.00709	1.9088	1.9481

Std Error uses a pooled estimate of error variance

Figure B5. Effects of Heat Treatment (HT) on PCT log(ppm) Response of TM2 Glasses

log[B ppm] By HT Glass ID=HWL-10



Oneway Anova
Summary of Fit

Rsquare	0.276303
Adj Rsquare	0.095379
Root Mean Square Error	0.011668
Mean of Response	1.35472
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.01177	t Ratio	1.23579
Std Err Dif	0.00953	DF	4
Upper CL Dif	0.03822	Prob > |t|	0.2842
Lower CL Dif	-0.01468	Prob > t	0.1421
Confidence	0.95	Prob < t	0.8579

Analysis of Variance

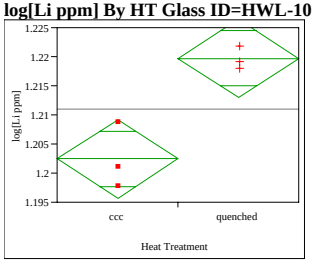
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00020792	0.000208	1.5272	0.2842
Error	4	0.00054459	0.000136		
C. Total	5	0.00075251			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.34883	0.00674	1.3301	1.3675
quenched	3	1.36061	0.00674	1.3419	1.3793

Std Error uses a pooled estimate of error variance

log[Li ppm] By HT Glass ID=HWL-10



Oneway Anova
Summary of Fit

Rsquare	0.863346
Adj Rsquare	0.829182
Root Mean Square Error	0.004199
Mean of Response	1.21106
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.017235	t Ratio	5.02702
Std Err Dif	0.003428	DF	4
Upper CL Dif	0.026754	Prob > |t|	0.0073
Lower CL Dif	0.007716	Prob > t	0.0037
Confidence	0.95	Prob < t	0.9963

Analysis of Variance

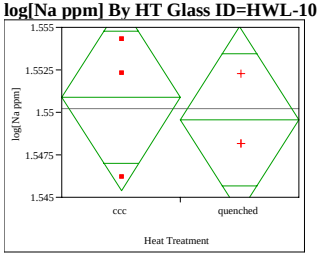
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00044556	0.000446	25.2709	0.0073
Error	4	0.00007052	0.000018		
C. Total	5	0.00051608			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.20244	0.00242	1.1957	1.2092
quenched	3	1.21968	0.00242	1.2129	1.2264

Std Error uses a pooled estimate of error variance

log[Na ppm] By HT Glass ID=HWL-10



Oneway Anova
Summary of Fit

Rsquare	0.054774
Adj Rsquare	-0.18153
Root Mean Square Error	0.003434
Mean of Response	1.550227
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	-0.00135	t Ratio	-0.48145
Std Err Dif	0.00280	DF	4
Upper CL Dif	0.00643	Prob > |t|	0.6554
Lower CL Dif	-0.00913	Prob > t	0.6723
Confidence	0.95	Prob < t	0.3277

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00000273	2.733e-6	0.2318	0.6554
Error	4	0.00004716	0.000012		
C. Total	5	0.00004989			

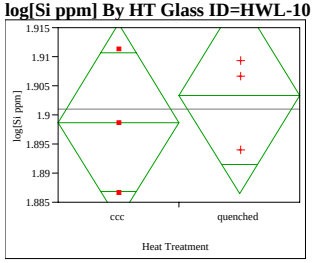
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.55090	0.00198	1.5454	1.5564
quenched	3	1.54955	0.00198	1.5440	1.5551

Std Error uses a pooled estimate of error variance

Figure B5. Effects of Heat Treatment (HT) on PCT log(ppm) Response of TM2 Glasses

log[Si ppm] By HT Glass ID=HWL-10



Oneway Anova
Summary of Fit

Rsquare	0.067504
Adj Rsquare	-0.16562
Root Mean Square Error	0.010491
Mean of Response	1.901044
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.00461	t Ratio	0.538109
Std Err Dif	0.00857	DF	4
Upper CL Dif	0.02839	Prob > |t|	0.6190
Lower CL Dif	-0.01917	Prob > t	0.3095
Confidence	0.95	Prob < t	0.6905

Analysis of Variance

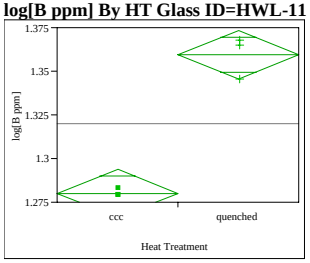
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00003187	0.000032	0.2896	0.6190
Error	4	0.00044022	0.000110		
C. Total	5	0.00047209			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.89874	0.00606	1.8819	1.9156
quenched	3	1.90335	0.00606	1.8865	1.9202

Std Error uses a pooled estimate of error variance

log[B ppm] By HT Glass ID=HWL-11



Oneway Anova
Summary of Fit

Rsquare	0.969259
Adj Rsquare	0.961574
Root Mean Square Error	0.00867
Mean of Response	1.319774
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.079496	t Ratio	11.23035
Std Err Dif	0.007079	DF	4
Upper CL Dif	0.099149	Prob > |t|	0.0004
Lower CL Dif	0.059842	Prob > t	0.0002
Confidence	0.95	Prob < t	0.9998

Analysis of Variance

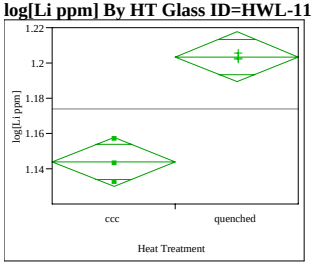
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00947934	0.009479	126.1207	0.0004
Error	4	0.00030064	0.000075		
C. Total	5	0.00977998			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.28003	0.00501	1.2661	1.2939
quenched	3	1.35952	0.00501	1.3456	1.3734

Std Error uses a pooled estimate of error variance

log[Li ppm] By HT Glass ID=HWL-11



Oneway Anova
Summary of Fit

Rsquare	0.945617
Adj Rsquare	0.932021
Root Mean Square Error	0.008749
Mean of Response	1.173736
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.059575	t Ratio	8.339809
Std Err Dif	0.007143	DF	4
Upper CL Dif	0.079408	Prob > |t|	0.0011
Lower CL Dif	0.039741	Prob > t	0.0006
Confidence	0.95	Prob < t	0.9994

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00532369	0.005324	69.5524	0.0011
Error	4	0.00030617	0.000077		
C. Total	5	0.00562985			

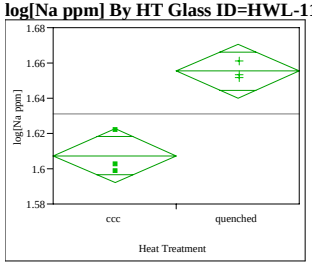
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.14395	0.00505	1.1299	1.1580
quenched	3	1.20352	0.00505	1.1895	1.2175

Std Error uses a pooled estimate of error variance

Figure B5. Effects of Heat Treatment (HT) on PCT log(ppm) Response of TM2 Glasses

log[Na ppm] By HT Glass ID=HWL-11



Oneway Anova
Summary of Fit

Rsquare	0.90538
Adj Rsquare	0.881726
Root Mean Square Error	0.009501
Mean of Response	1.631343
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.047996	t Ratio	6.186642
Std Err Dif	0.007758	DF	4
Upper CL Dif	0.069535	Prob > |t|	0.0035
Lower CL Dif	0.026456	Prob > t	0.0017
Confidence	0.95	Prob < t	0.9983

Analysis of Variance

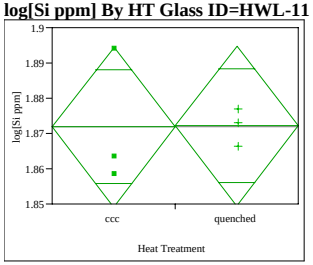
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00345537	0.003455	38.2745	0.0035
Error	4	0.00036111	0.000090		
C. Total	5	0.00381648			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.60734	0.00549	1.5921	1.6226
quenched	3	1.65534	0.00549	1.6401	1.6706

Std Error uses a pooled estimate of error variance

log[Si ppm] By HT Glass ID=HWL-11



Oneway Anova
Summary of Fit

Rsquare	0.000131
Adj Rsquare	-0.24984
Root Mean Square Error	0.014162
Mean of Response	1.87201
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.00027	t Ratio	0.022922
Std Err Dif	0.01156	DF	4
Upper CL Dif	0.03237	Prob > |t|	0.9828
Lower CL Dif	-0.03184	Prob > t	0.4914
Confidence	0.95	Prob < t	0.5086

Analysis of Variance

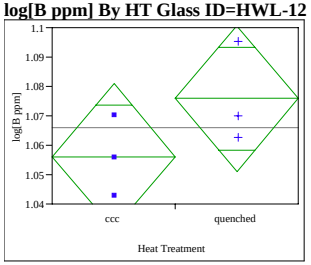
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00000011	1.054e-7	0.0005	0.9828
Error	4	0.00080230	0.000201		
C. Total	5	0.00080241			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.87188	0.00818	1.8492	1.8946
quenched	3	1.87214	0.00818	1.8494	1.8948

Std Error uses a pooled estimate of error variance

log[B ppm] By HT Glass ID=HWL-12



Oneway Anova
Summary of Fit

Rsquare	0.380723
Adj Rsquare	0.225903
Root Mean Square Error	0.015467
Mean of Response	1.066037
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.01980	t Ratio	1.568165
Std Err Dif	0.01263	DF	4
Upper CL Dif	0.05487	Prob > |t|	0.1919
Lower CL Dif	-0.01526	Prob > t	0.0960
Confidence	0.95	Prob < t	0.9040

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00058829	0.000588	2.4591	0.1919
Error	4	0.00095690	0.000239		
C. Total	5	0.00154519			

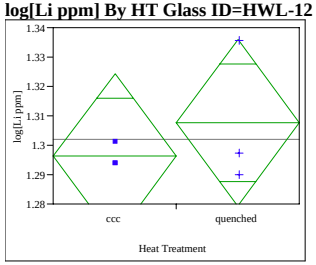
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.05613	0.00893	1.0313	1.0809
quenched	3	1.07594	0.00893	1.0511	1.1007

Std Error uses a pooled estimate of error variance

Figure B5. Effects of Heat Treatment (HT) on PCT log(ppm) Response of TM2 Glasses

log[Li ppm] By HT Glass ID=HWL-12



Oneway Anova
Summary of Fit

Rsquare	0.139227
Adj Rsquare	-0.07597
Root Mean Square Error	0.017628
Mean of Response	1.301961
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.01158	t Ratio	0.804356
Std Err Dif	0.01439	DF	4
Upper CL Dif	0.05154	Prob > |t|	0.4663
Lower CL Dif	-0.02838	Prob > t	0.2331
Confidence	0.95	Prob < t	0.7669

Analysis of Variance

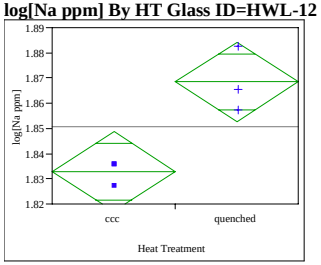
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00020104	0.000201	0.6470	0.4663
Error	4	0.00124292	0.000311		
C. Total	5	0.00144396			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.29617	0.01018	1.2679	1.3244
quenched	3	1.30775	0.01018	1.2795	1.3360

Std Error uses a pooled estimate of error variance

log[Na ppm] By HT Glass ID=HWL-12



Oneway Anova
Summary of Fit

Rsquare	0.831416
Adj Rsquare	0.78927
Root Mean Square Error	0.009818
Mean of Response	1.850656
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.035604	t Ratio	4.441509
Std Err Dif	0.008016	DF	4
Upper CL Dif	0.057861	Prob > |t|	0.0113
Lower CL Dif	0.013348	Prob > t	0.0057
Confidence	0.95	Prob < t	0.9943

Analysis of Variance

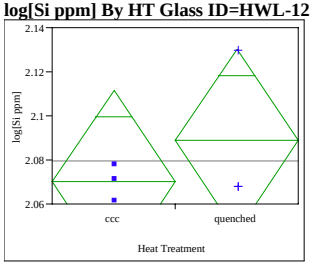
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00190151	0.001902	19.7270	0.0113
Error	4	0.00038556	0.000096		
C. Total	5	0.00228708			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.83285	0.00567	1.8171	1.8486
quenched	3	1.86846	0.00567	1.8527	1.8842

Std Error uses a pooled estimate of error variance

log[Si ppm] By HT Glass ID=HWL-12



Oneway Anova
Summary of Fit

Rsquare	0.161711
Adj Rsquare	-0.04786
Root Mean Square Error	0.025841
Mean of Response	2.079465
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.01853	t Ratio	0.878423
Std Err Dif	0.02110	DF	4
Upper CL Dif	0.07711	Prob > |t|	0.4293
Lower CL Dif	-0.04005	Prob > t	0.2147
Confidence	0.95	Prob < t	0.7853

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00051524	0.000515	0.7716	0.4293
Error	4	0.00267094	0.000668		
C. Total	5	0.00318618			

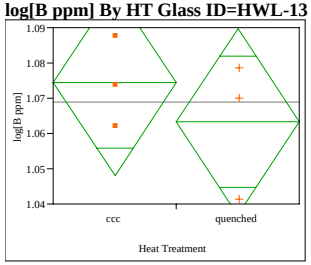
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	2.07020	0.01492	2.0288	2.1116
quenched	3	2.08873	0.01492	2.0473	2.1302

Std Error uses a pooled estimate of error variance

Figure B5. Effects of Heat Treatment (HT) on PCT log(ppm) Response of TM2 Glasses

log[B ppm] By HT Glass ID=HWL-13



Oneway Anova
Summary of Fit

Rsquare	0.144659
Adj Rsquare	-0.06918
Root Mean Square Error	0.016484
Mean of Response	1.06888
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	-0.01107	t Ratio	-0.82249
Std Err Dif	0.01346	DF	4
Upper CL Dif	0.02630	Prob > |t|	0.4570
Lower CL Dif	-0.04844	Prob > t	0.7715
Confidence	0.95	Prob < t	0.2285

Analysis of Variance

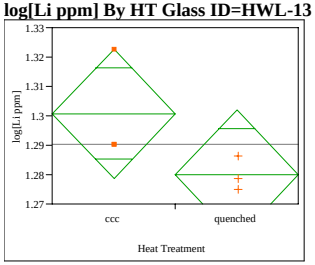
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00018382	0.000184	0.6765	0.4570
Error	4	0.00108686	0.000272		
C. Total	5	0.00127068			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.07441	0.00952	1.0480	1.1008
quenched	3	1.06334	0.00952	1.0369	1.0898

Std Error uses a pooled estimate of error variance

log[Li ppm] By HT Glass ID=HWL-13



Oneway Anova
Summary of Fit

Rsquare	0.460582
Adj Rsquare	0.325727
Root Mean Square Error	0.013763
Mean of Response	1.290388
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	-0.02077	t Ratio	-1.84808
Std Err Dif	0.01124	DF	4
Upper CL Dif	0.01043	Prob > |t|	0.1383
Lower CL Dif	-0.05197	Prob > t	0.9309
Confidence	0.95	Prob < t	0.0691

Analysis of Variance

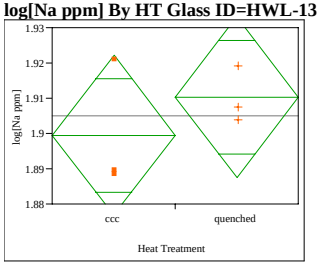
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00064690	0.000647	3.4154	0.1383
Error	4	0.00075763	0.000189		
C. Total	5	0.00140453			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.30077	0.00795	1.2787	1.3228
quenched	3	1.28000	0.00795	1.2579	1.3021

Std Error uses a pooled estimate of error variance

log[Na ppm] By HT Glass ID=HWL-13



Oneway Anova
Summary of Fit

Rsquare	0.176218
Adj Rsquare	-0.02973
Root Mean Square Error	0.0142
Mean of Response	1.904867
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.01073	t Ratio	0.925017
Std Err Dif	0.01159	DF	4
Upper CL Dif	0.04292	Prob > |t|	0.4073
Lower CL Dif	-0.02147	Prob > t	0.2037
Confidence	0.95	Prob < t	0.7963

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00017254	0.000173	0.8557	0.4073
Error	4	0.00080659	0.000202		
C. Total	5	0.00097913			

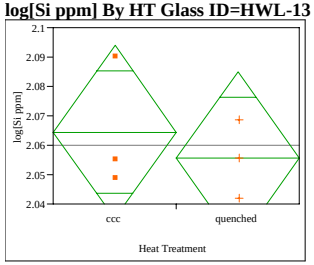
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.89950	0.00820	1.8767	1.9223
quenched	3	1.91023	0.00820	1.8875	1.9330

Std Error uses a pooled estimate of error variance

Figure B5. Effects of Heat Treatment (HT) on PCT log(ppm) Response of TM2 Glasses

log[Si ppm] By HT Glass ID=HWL-13



Oneway Anova
Summary of Fit

Rsquare	0.082631
Adj Rsquare	-0.14671
Root Mean Square Error	0.018353
Mean of Response	2.060002
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	-0.00899	t Ratio	-0.60024
Std Err Dif	0.01499	DF	4
Upper CL Dif	0.03261	Prob > |t|	0.5807
Lower CL Dif	-0.05060	Prob > t	0.7097
Confidence	0.95	Prob < t	0.2903

Analysis of Variance

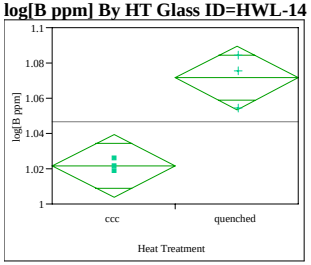
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00012136	0.000121	0.3603	0.5807
Error	4	0.00134739	0.000337		
C. Total	5	0.00146875			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	2.06450	0.01060	2.0351	2.0939
quenched	3	2.05550	0.01060	2.0261	2.0849

Std Error uses a pooled estimate of error variance

log[B ppm] By HT Glass ID=HWL-14



Oneway Anova
Summary of Fit

Rsquare	0.880659
Adj Rsquare	0.850824
Root Mean Square Error	0.011239
Mean of Response	1.046575
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.049854	t Ratio	5.432987
Std Err Dif	0.009176	DF	4
Upper CL Dif	0.075331	Prob > |t|	0.0056
Lower CL Dif	0.024377	Prob > t	0.0028
Confidence	0.95	Prob < t	0.9972

Analysis of Variance

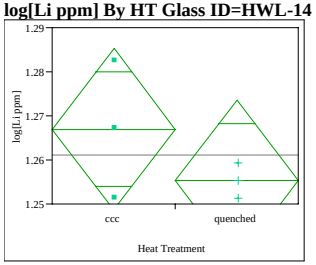
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00372816	0.003728	29.5173	0.0056
Error	4	0.00050522	0.000126		
C. Total	5	0.00423338			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.02165	0.00649	1.0036	1.0397
quenched	3	1.07150	0.00649	1.0535	1.0895

Std Error uses a pooled estimate of error variance

log[Li ppm] By HT Glass ID=HWL-14



Oneway Anova
Summary of Fit

Rsquare	0.282861
Adj Rsquare	0.103577
Root Mean Square Error	0.011431
Mean of Response	1.261131
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	-0.01172	t Ratio	-1.25607
Std Err Dif	0.00933	DF	4
Upper CL Dif	0.01419	Prob > |t|	0.2774
Lower CL Dif	-0.03764	Prob > t	0.8613
Confidence	0.95	Prob < t	0.1387

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00020616	0.000206	1.5777	0.2774
Error	4	0.00052268	0.000131		
C. Total	5	0.00072884			

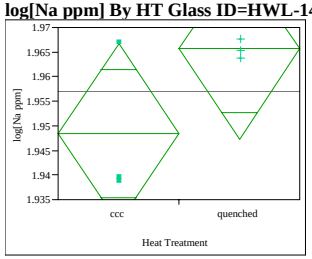
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.26699	0.00660	1.2487	1.2853
quenched	3	1.25527	0.00660	1.2369	1.2736

Std Error uses a pooled estimate of error variance

Figure B5. Effects of Heat Treatment (HT) on PCT log(ppm) Response of TM2 Glasses

log[Na ppm] By HT Glass ID=HWL-14



Oneway Anova
Summary of Fit

Rsquare	0.459656
Adj Rsquare	0.32457
Root Mean Square Error	0.011447
Mean of Response	1.957005
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.01724	t Ratio	1.844637
Std Err Dif	0.00935	DF	4
Upper CL Dif	0.04319	Prob > |t|	0.1388
Lower CL Dif	-0.00871	Prob > t	0.0694
Confidence	0.95	Prob < t	0.9306

Analysis of Variance

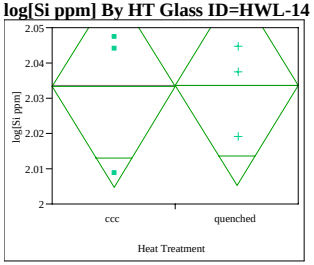
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00044584	0.000446	3.4027	0.1388
Error	4	0.00052411	0.000131		
C. Total	5	0.00096995			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.94839	0.00661	1.9300	1.9667
quenched	3	1.96563	0.00661	1.9473	1.9840

Std Error uses a pooled estimate of error variance

log[Si ppm] By HT Glass ID=HWL-14



Oneway Anova
Summary of Fit

Rsquare	0.00023
Adj Rsquare	-0.24971
Root Mean Square Error	0.017798
Mean of Response	2.033526
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.00044	t Ratio	0.030307
Std Err Dif	0.01453	DF	4
Upper CL Dif	0.04079	Prob > |t|	0.9773
Lower CL Dif	-0.03991	Prob > t	0.4886
Confidence	0.95	Prob < t	0.5114

Analysis of Variance

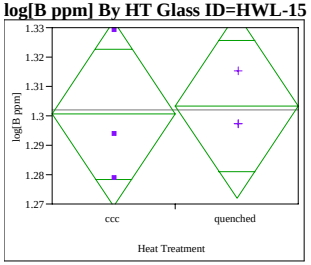
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00000029	2.91e-7	0.0009	0.9773
Error	4	0.00126715	0.000317		
C. Total	5	0.00126744			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	2.03331	0.01028	2.0048	2.0618
quenched	3	2.03375	0.01028	2.0052	2.0623

Std Error uses a pooled estimate of error variance

log[B ppm] By HT Glass ID=HWL-15



Oneway Anova
Summary of Fit

Rsquare	0.007756
Adj Rsquare	-0.2403
Root Mean Square Error	0.019668
Mean of Response	1.301943
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.00284	t Ratio	0.176823
Std Err Dif	0.01606	DF	4
Upper CL Dif	0.04743	Prob > |t|	0.8682
Lower CL Dif	-0.04175	Prob > t	0.4341
Confidence	0.95	Prob < t	0.5659

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00001209	0.000012	0.0313	0.8682
Error	4	0.00154733	0.000387		
C. Total	5	0.00155943			

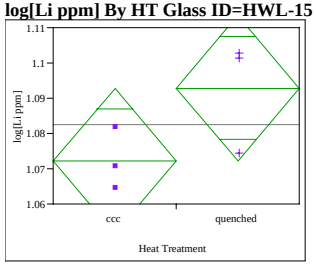
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.30052	0.01136	1.2690	1.3321
quenched	3	1.30336	0.01136	1.2718	1.3349

Std Error uses a pooled estimate of error variance

Figure B5. Effects of Heat Treatment (HT) on PCT log(ppm) Response of TM2 Glasses

log[Li ppm] By HT Glass ID=HWL-15



Oneway Anova
Summary of Fit

Rsquare	0.489187
Adj Rsquare	0.361484
Root Mean Square Error	0.012893
Mean of Response	1.082543
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.02060	t Ratio	1.957207
Std Err Dif	0.01053	DF	4
Upper CL Dif	0.04983	Prob > |t|	0.1219
Lower CL Dif	-0.00862	Prob > t	0.0610
Confidence	0.95	Prob < t	0.9390

Analysis of Variance

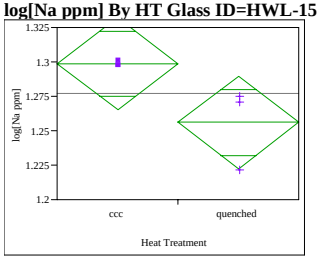
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00063675	0.000637	3.8307	0.1219
Error	4	0.00066490	0.000166		
C. Total	5	0.00130165			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.07224	0.00744	1.0516	1.0929
quenched	3	1.09285	0.00744	1.0722	1.1135

Std Error uses a pooled estimate of error variance

log[Na ppm] By HT Glass ID=HWL-15



Oneway Anova
Summary of Fit

Rsquare	0.607949
Adj Rsquare	0.509936
Root Mean Square Error	0.020978
Mean of Response	1.277286
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	-0.04266	t Ratio	-2.49053
Std Err Dif	0.01713	DF	4
Upper CL Dif	0.00490	Prob > |t|	0.0674
Lower CL Dif	-0.09022	Prob > t	0.9663
Confidence	0.95	Prob < t	0.0337

Analysis of Variance

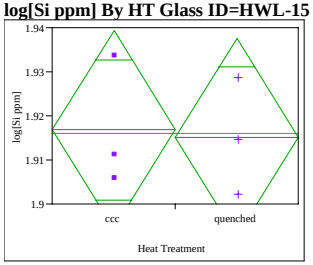
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00272976	0.002730	6.2028	0.0674
Error	4	0.00176035	0.000440		
C. Total	5	0.00449011			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.29862	0.01211	1.2650	1.3322
quenched	3	1.25596	0.01211	1.2223	1.2896

Std Error uses a pooled estimate of error variance

log[Si ppm] By HT Glass ID=HWL-15



Oneway Anova
Summary of Fit

Rsquare	0.005625
Adj Rsquare	-0.24297
Root Mean Square Error	0.014012
Mean of Response	1.916018
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	-0.00172	t Ratio	-0.15043
Std Err Dif	0.01144	DF	4
Upper CL Dif	0.03004	Prob > |t|	0.8877
Lower CL Dif	-0.03349	Prob > t	0.5561
Confidence	0.95	Prob < t	0.4439

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00000444	4.443e-6	0.0226	0.8877
Error	4	0.00078536	0.000196		
C. Total	5	0.00078980			

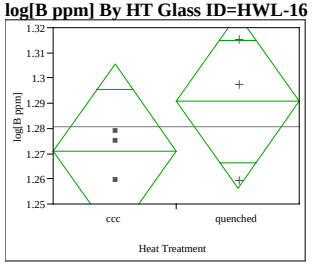
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.91688	0.00809	1.8944	1.9393
quenched	3	1.91516	0.00809	1.8927	1.9376

Std Error uses a pooled estimate of error variance

Figure B5. Effects of Heat Treatment (HT) on PCT log(ppm) Response of TM2 Glasses

log[B ppm] By HT Glass ID=HWL-16



Oneway Anova
Summary of Fit

Rsquare	0.238738
Adj Rsquare	0.048422
Root Mean Square Error	0.0215
Mean of Response	1.280825
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.01966	t Ratio	1.120014
Std Err Dif	0.01755	DF	4
Upper CL Dif	0.06840	Prob > |t|	0.3254
Lower CL Dif	-0.02908	Prob > t	0.1627
Confidence	0.95	Prob < t	0.8373

Analysis of Variance

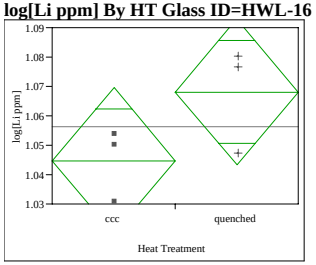
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00057988	0.000580	1.2544	0.3254
Error	4	0.00184906	0.000462		
C. Total	5	0.00242893			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.27099	0.01241	1.2365	1.3055
quenched	3	1.29066	0.01241	1.2562	1.3251

Std Error uses a pooled estimate of error variance

log[Li ppm] By HT Glass ID=HWL-16



Oneway Anova
Summary of Fit

Rsquare	0.459722
Adj Rsquare	0.324653
Root Mean Square Error	0.015513
Mean of Response	1.056465
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.02337	t Ratio	1.844885
Std Err Dif	0.01267	DF	4
Upper CL Dif	0.05854	Prob > |t|	0.1388
Lower CL Dif	-0.01180	Prob > t	0.0694
Confidence	0.95	Prob < t	0.9306

Analysis of Variance

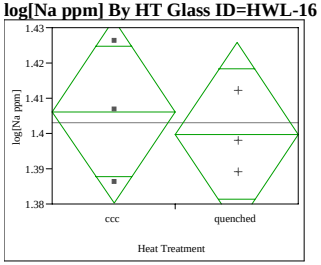
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00081913	0.000819	3.4036	0.1388
Error	4	0.00096267	0.000241		
C. Total	5	0.00178180			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.04478	0.00896	1.0199	1.0696
quenched	3	1.06815	0.00896	1.0433	1.0930

Std Error uses a pooled estimate of error variance

log[Na ppm] By HT Glass ID=HWL-16



Oneway Anova
Summary of Fit

Rsquare	0.055967
Adj Rsquare	-0.18004
Root Mean Square Error	0.016284
Mean of Response	1.403008
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	-0.00647	t Ratio	-0.48697
Std Err Dif	0.01330	DF	4
Upper CL Dif	0.03044	Prob > |t|	0.6518
Lower CL Dif	-0.04339	Prob > t	0.6741
Confidence	0.95	Prob < t	0.3259

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00006288	0.000063	0.2371	0.6518
Error	4	0.00106066	0.000265		
C. Total	5	0.00112354			

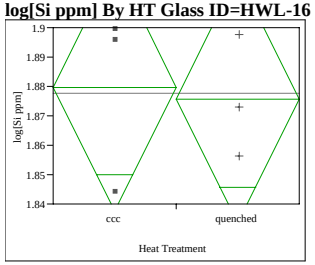
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.40625	0.00940	1.3801	1.4323
quenched	3	1.39977	0.00940	1.3737	1.4259

Std Error uses a pooled estimate of error variance

Figure B5. Effects of Heat Treatment (HT) on PCT log(ppm) Response of TM2 Glasses

log[Si ppm] By HT Glass ID=HWL-16



Oneway Anova
Summary of Fit

Rsquare	0.00888
Adj Rsquare	-0.2389
Root Mean Square Error	0.026372
Mean of Response	1.87774
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	-0.00408	t Ratio	-0.18931
Std Err Dif	0.02153	DF	4
Upper CL Dif	0.05571	Prob > |t|	0.8591
Lower CL Dif	-0.06386	Prob > t	0.5705
Confidence	0.95	Prob < t	0.4295

Analysis of Variance

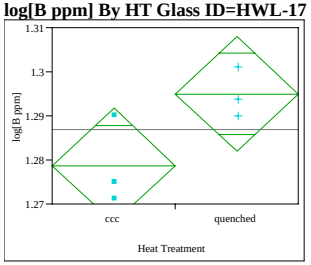
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00002493	0.000025	0.0358	0.8591
Error	4	0.00278197	0.000695		
C. Total	5	0.00280689			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.87978	0.01523	1.8375	1.9221
quenched	3	1.87570	0.01523	1.8334	1.9180

Std Error uses a pooled estimate of error variance

log[B ppm] By HT Glass ID=HWL-17



Oneway Anova
Summary of Fit

Rsquare	0.6006
Adj Rsquare	0.500749
Root Mean Square Error	0.008118
Mean of Response	1.286813
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.01626	t Ratio	2.452552
Std Err Dif	0.00663	DF	4
Upper CL Dif	0.03466	Prob > |t|	0.0703
Lower CL Dif	-0.00215	Prob > t	0.0351
Confidence	0.95	Prob < t	0.9649

Analysis of Variance

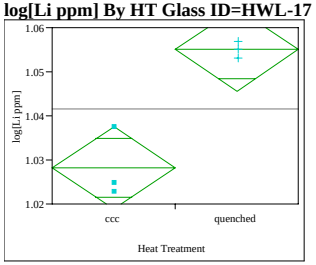
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00039637	0.000396	6.0150	0.0703
Error	4	0.00026358	0.000066		
C. Total	5	0.00065995			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.27868	0.00469	1.2657	1.2917
quenched	3	1.29494	0.00469	1.2819	1.3080

Std Error uses a pooled estimate of error variance

log[Li ppm] By HT Glass ID=HWL-17



Oneway Anova
Summary of Fit

Rsquare	0.887101
Adj Rsquare	0.858876
Root Mean Square Error	0.005852
Mean of Response	1.041608
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.026788	t Ratio	5.606232
Std Err Dif	0.004778	DF	4
Upper CL Dif	0.040055	Prob > |t|	0.0050
Lower CL Dif	0.013521	Prob > t	0.0025
Confidence	0.95	Prob < t	0.9975

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00107640	0.001076	31.4298	0.0050
Error	4	0.00013699	0.000034		
C. Total	5	0.00121340			

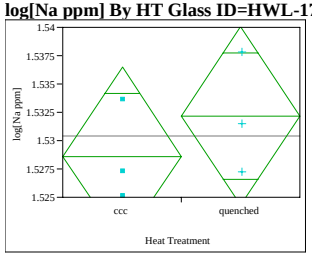
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.02821	0.00338	1.0188	1.0376
quenched	3	1.05500	0.00338	1.0456	1.0644

Std Error uses a pooled estimate of error variance

Figure B5. Effects of Heat Treatment (HT) on PCT log(ppm) Response of TM2 Glasses

log[Na ppm] By HT Glass ID=HWL-17



Oneway Anova
Summary of Fit

Rsquare	0.163517
Adj Rsquare	-0.0456
Root Mean Square Error	0.004917
Mean of Response	1.5304
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.00355	t Ratio	0.884267
Std Err Dif	0.00401	DF	4
Upper CL Dif	0.01470	Prob > |t|	0.4265
Lower CL Dif	-0.00760	Prob > t	0.2133
Confidence	0.95	Prob < t	0.7867

Analysis of Variance

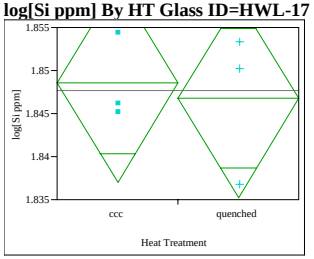
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00001891	0.000019	0.7819	0.4265
Error	4	0.00009671	0.000024		
C. Total	5	0.00011562			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.52862	0.00284	1.5207	1.5365
quenched	3	1.53217	0.00284	1.5243	1.5401

Std Error uses a pooled estimate of error variance

log[Si ppm] By HT Glass ID=HWL-17



Oneway Anova
Summary of Fit

Rsquare	0.02189
Adj Rsquare	-0.22264
Root Mean Square Error	0.007175
Mean of Response	1.847644
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	-0.00175	t Ratio	-0.2992
Std Err Dif	0.00586	DF	4
Upper CL Dif	0.01451	Prob > |t|	0.7797
Lower CL Dif	-0.01802	Prob > t	0.6102
Confidence	0.95	Prob < t	0.3898

Analysis of Variance

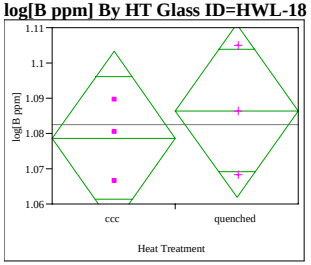
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00000461	4.609e-6	0.0895	0.7797
Error	4	0.00020594	0.000051		
C. Total	5	0.00021055			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.84852	0.00414	1.8370	1.8600
quenched	3	1.84677	0.00414	1.8353	1.8583

Std Error uses a pooled estimate of error variance

log[B ppm] By HT Glass ID=HWL-18



Oneway Anova
Summary of Fit

Rsquare	0.088545
Adj Rsquare	-0.13932
Root Mean Square Error	0.015364
Mean of Response	1.082595
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.00782	t Ratio	0.623368
Std Err Dif	0.01254	DF	4
Upper CL Dif	0.04265	Prob > |t|	0.5668
Lower CL Dif	-0.02701	Prob > t	0.2834
Confidence	0.95	Prob < t	0.7166

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00009173	0.000092	0.3886	0.5668
Error	4	0.00094420	0.000236		
C. Total	5	0.00103593			

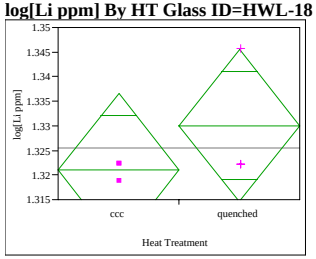
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.07868	0.00887	1.0541	1.1033
quenched	3	1.08650	0.00887	1.0619	1.1111

Std Error uses a pooled estimate of error variance

Figure B5. Effects of Heat Treatment (HT) on PCT log(ppm) Response of TM2 Glasses

log[Li ppm] By HT Glass ID=HWL-18



Oneway Anova
Summary of Fit

Rsquare	0.24364
Adj Rsquare	0.05455
Root Mean Square Error	0.00969
Mean of Response	1.325565
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.00898	t Ratio	1.135114
Std Err Dif	0.00791	DF	4
Upper CL Dif	0.03095	Prob > |t|	0.3197
Lower CL Dif	-0.01299	Prob > t	0.1599
Confidence	0.95	Prob < t	0.8401

Analysis of Variance

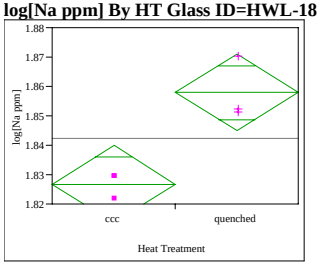
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00012098	0.000121	1.2885	0.3197
Error	4	0.00037556	0.000094		
C. Total	5	0.00049653			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.32107	0.00559	1.3055	1.3366
quenched	3	1.33006	0.00559	1.3145	1.3456

Std Error uses a pooled estimate of error variance

log[Na ppm] By HT Glass ID=HWL-18



Oneway Anova
Summary of Fit

Rsquare	0.845619
Adj Rsquare	0.807024
Root Mean Square Error	0.008146
Mean of Response	1.842356
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.031135	t Ratio	4.680805
Std Err Dif	0.006652	DF	4
Upper CL Dif	0.049603	Prob > |t|	0.0094
Lower CL Dif	0.012667	Prob > t	0.0047
Confidence	0.95	Prob < t	0.9953

Analysis of Variance

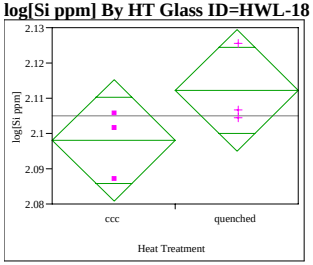
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00145406	0.001454	21.9099	0.0094
Error	4	0.00026546	0.000066		
C. Total	5	0.00171952			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.82679	0.00470	1.8137	1.8398
quenched	3	1.85792	0.00470	1.8449	1.8710

Std Error uses a pooled estimate of error variance

log[Si ppm] By HT Glass ID=HWL-18



Oneway Anova
Summary of Fit

Rsquare	0.396112
Adj Rsquare	0.245139
Root Mean Square Error	0.010716
Mean of Response	2.105089
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.01417	t Ratio	1.619796
Std Err Dif	0.00875	DF	4
Upper CL Dif	0.03847	Prob > |t|	0.1806
Lower CL Dif	-0.01012	Prob > t	0.0903
Confidence	0.95	Prob < t	0.9097

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00030129	0.000301	2.6237	0.1806
Error	4	0.00045933	0.000115		
C. Total	5	0.00076063			

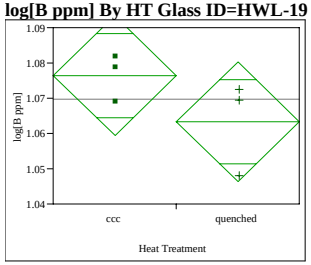
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	2.09800	0.00619	2.0808	2.1152
quenched	3	2.11217	0.00619	2.0950	2.1294

Std Error uses a pooled estimate of error variance

Figure B5. Effects of Heat Treatment (HT) on PCT log(ppm) Response of TM2 Glasses

log[B ppm] By HT Glass ID=HWL-19



Oneway Anova
Summary of Fit

Rsquare	0.363007
Adj Rsquare	0.203758
Root Mean Square Error	0.01058
Mean of Response	1.06981
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	-0.01304	t Ratio	-1.5098
Std Err Dif	0.00864	DF	4
Upper CL Dif	0.01094	Prob > |t|	0.2056
Lower CL Dif	-0.03703	Prob > t	0.8972
Confidence	0.95	Prob < t	0.1028

Analysis of Variance

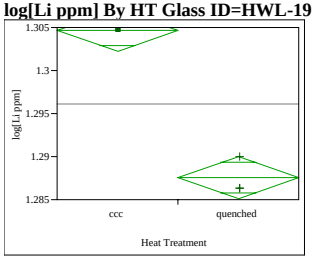
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00025518	0.000255	2.2795	0.2056
Error	4	0.00044778	0.000112		
C. Total	5	0.00070296			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.07633	0.00611	1.0594	1.0933
quenched	3	1.06329	0.00611	1.0463	1.0802

Std Error uses a pooled estimate of error variance

log[Li ppm] By HT Glass ID=HWL-19



Oneway Anova
Summary of Fit

Rsquare	0.979278
Adj Rsquare	0.974098
Root Mean Square Error	0.001522
Mean of Response	1.2961
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	-0.01708	t Ratio	-13.7489
Std Err Dif	0.00124	DF	4
Upper CL Dif	-0.01363	Prob > |t|	0.0002
Lower CL Dif	-0.02053	Prob > t	0.9999
Confidence	0.95	Prob < t	<.0001

Analysis of Variance

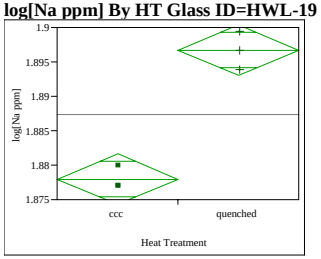
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00043783	0.000438	189.0332	0.0002
Error	4	0.00000926	2.316e-6		
C. Total	5	0.00044710			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.30464	0.00088	1.3022	1.3071
quenched	3	1.28756	0.00088	1.2851	1.2900

Std Error uses a pooled estimate of error variance

log[Na ppm] By HT Glass ID=HWL-19



Oneway Anova
Summary of Fit

Rsquare	0.962304
Adj Rsquare	0.95288
Root Mean Square Error	0.002274
Mean of Response	1.887333
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.018759	t Ratio	10.10507
Std Err Dif	0.001856	DF	4
Upper CL Dif	0.023913	Prob > |t|	0.0005
Lower CL Dif	0.013605	Prob > t	0.0003
Confidence	0.95	Prob < t	0.9997

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00052786	0.000528	102.1124	0.0005
Error	4	0.00002068	5.169e-6		
C. Total	5	0.00054854			

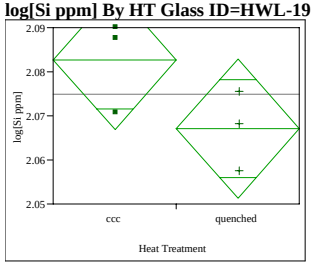
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.87795	0.00131	1.8743	1.8816
quenched	3	1.89671	0.00131	1.8931	1.9004

Std Error uses a pooled estimate of error variance

Figure B5. Effects of Heat Treatment (HT) on PCT log(ppm) Response of TM2 Glasses

log[Si ppm] By HT Glass ID=HWL-19



Oneway Anova
Summary of Fit

Rsquare	0.48739
Adj Rsquare	0.359237
Root Mean Square Error	0.009804
Mean of Response	2.074905
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	-0.01561	t Ratio	-1.95018
Std Err Dif	0.00800	DF	4
Upper CL Dif	0.00661	Prob > |t|	0.1229
Lower CL Dif	-0.03783	Prob > t	0.9385
Confidence	0.95	Prob < t	0.0615

Analysis of Variance

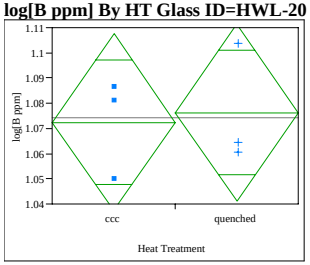
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00036553	0.000366	3.8032	0.1229
Error	4	0.00038444	0.000096		
C. Total	5	0.00074997			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	2.08271	0.00566	2.0670	2.0984
quenched	3	2.06710	0.00566	2.0514	2.0828

Std Error uses a pooled estimate of error variance

log[B ppm] By HT Glass ID=HWL-20



Oneway Anova
Summary of Fit

Rsquare	0.011861
Adj Rsquare	-0.23517
Root Mean Square Error	0.02189
Mean of Response	1.07437
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.00392	t Ratio	0.219121
Std Err Dif	0.01787	DF	4
Upper CL Dif	0.05354	Prob > |t|	0.8373
Lower CL Dif	-0.04571	Prob > t	0.4186
Confidence	0.95	Prob < t	0.5814

Analysis of Variance

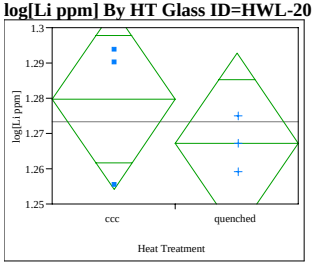
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00002301	0.000023	0.0480	0.8373
Error	4	0.00191661	0.000479		
C. Total	5	0.00193961			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.07241	0.01264	1.0373	1.1075
quenched	3	1.07633	0.01264	1.0412	1.1114

Std Error uses a pooled estimate of error variance

log[Li ppm] By HT Glass ID=HWL-20



Oneway Anova
Summary of Fit

Rsquare	0.187746
Adj Rsquare	-0.01532
Root Mean Square Error	0.015991
Mean of Response	1.273411
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	-0.01255	t Ratio	-0.96154
Std Err Dif	0.01306	DF	4
Upper CL Dif	0.02370	Prob > |t|	0.3907
Lower CL Dif	-0.04881	Prob > t	0.8046
Confidence	0.95	Prob < t	0.1954

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00023643	0.000236	0.9246	0.3907
Error	4	0.00102286	0.000256		
C. Total	5	0.00125929			

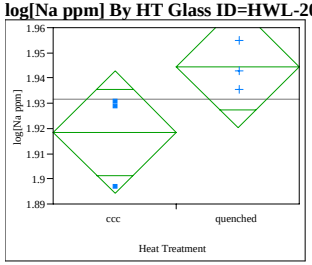
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.27969	0.00923	1.2541	1.3053
quenched	3	1.26713	0.00923	1.2415	1.2928

Std Error uses a pooled estimate of error variance

Figure B5. Effects of Heat Treatment (HT) on PCT log(ppm) Response of TM2 Glasses

log[Na ppm] By HT Glass ID=HWL-20



Oneway Anova
Summary of Fit

Rsquare	0.524238
Adj Rsquare	0.405298
Root Mean Square Error	0.015104
Mean of Response	1.93147
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.02589	t Ratio	2.099421
Std Err Dif	0.01233	DF	4
Upper CL Dif	0.06013	Prob > |t|	0.1037
Lower CL Dif	-0.00835	Prob > t	0.0519
Confidence	0.95	Prob < t	0.9481

Analysis of Variance

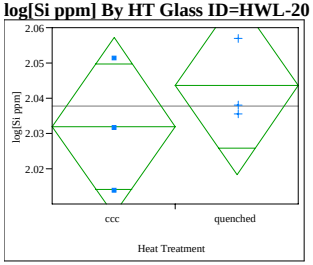
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00100553	0.001006	4.4076	0.1037
Error	4	0.00091255	0.000228		
C. Total	5	0.00191809			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.91852	0.00872	1.8943	1.9427
quenched	3	1.94442	0.00872	1.9202	1.9686

Std Error uses a pooled estimate of error variance

log[Si ppm] By HT Glass ID=HWL-20



Oneway Anova
Summary of Fit

Rsquare	0.166631
Adj Rsquare	-0.04171
Root Mean Square Error	0.015669
Mean of Response	2.037763
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.01144	t Ratio	0.894314
Std Err Dif	0.01279	DF	4
Upper CL Dif	0.04696	Prob > |t|	0.4217
Lower CL Dif	-0.02408	Prob > t	0.2109
Confidence	0.95	Prob < t	0.7891

Analysis of Variance

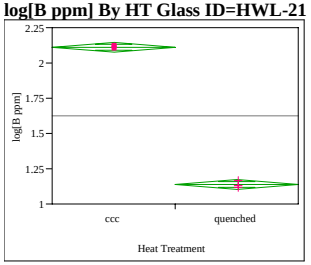
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00019636	0.000196	0.7998	0.4217
Error	4	0.00098204	0.000246		
C. Total	5	0.00117840			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	2.03204	0.00905	2.0069	2.0572
quenched	3	2.04348	0.00905	2.0184	2.0686

Std Error uses a pooled estimate of error variance

log[B ppm] By HT Glass ID=HWL-21



Oneway Anova
Summary of Fit

Rsquare	0.998813
Adj Rsquare	0.998517
Root Mean Square Error	0.020534
Mean of Response	1.625215
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	-0.9728	t Ratio	-58.0258
Std Err Dif	0.0168	DF	4
Upper CL Dif	-0.9263	Prob > |t|	<.0001
Lower CL Dif	-1.0194	Prob > t	1.0000
Confidence	0.95	Prob < t	<.0001

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	1.4196237	1.41962	3366.993	<.0001
Error	4	0.0016865	0.00042		
C. Total	5	1.4213102			

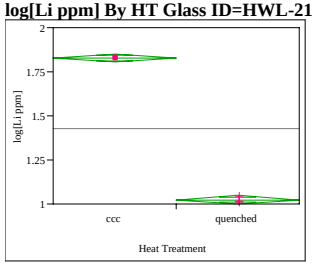
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	2.11163	0.01186	2.0787	2.1445
quenched	3	1.13880	0.01186	1.1059	1.1717

Std Error uses a pooled estimate of error variance

Figure B5. Effects of Heat Treatment (HT) on PCT log(ppm) Response of TM2 Glasses

log[Li ppm] By HT Glass ID=HWL-21



Oneway Anova
Summary of Fit

Rsquare	0.999157
Adj Rsquare	0.998946
Root Mean Square Error	0.014267
Mean of Response	1.425494
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	-0.80184	t Ratio	-68.8347
Std Err Dif	0.01165	DF	4
Upper CL Dif	-0.76950	Prob > |t|	<.0001
Lower CL Dif	-0.83419	Prob > t	1.0000
Confidence	0.95	Prob < t	<.0001

Analysis of Variance

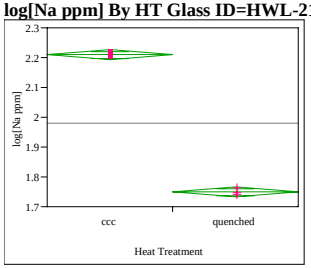
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.96443026	0.964430	4738.221	<.0001
Error	4	0.00081417	0.000204		
C. Total	5	0.96524443			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.82642	0.00824	1.8035	1.8493
quenched	3	1.02457	0.00824	1.0017	1.0474

Std Error uses a pooled estimate of error variance

log[Na ppm] By HT Glass ID=HWL-21



Oneway Anova
Summary of Fit

Rsquare	0.998637
Adj Rsquare	0.998296
Root Mean Square Error	0.010419
Mean of Response	1.979207
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	-0.46052	t Ratio	-54.1344
Std Err Dif	0.00851	DF	4
Upper CL Dif	-0.43690	Prob > |t|	<.0001
Lower CL Dif	-0.48414	Prob > t	1.0000
Confidence	0.95	Prob < t	<.0001

Analysis of Variance

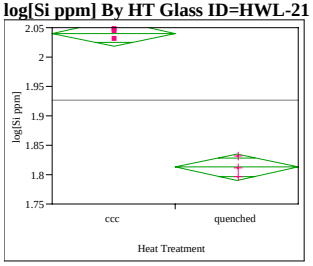
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.31811560	0.318116	2930.536	<.0001
Error	4	0.00043421	0.000109		
C. Total	5	0.31854981			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	2.20947	0.00602	2.1928	2.2262
quenched	3	1.74895	0.00602	1.7322	1.7656

Std Error uses a pooled estimate of error variance

log[Si ppm] By HT Glass ID=HWL-21



Oneway Anova
Summary of Fit

Rsquare	0.989993
Adj Rsquare	0.987492
Root Mean Square Error	0.014001
Mean of Response	1.926758
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	-0.22742	t Ratio	-19.8932
Std Err Dif	0.01143	DF	4
Upper CL Dif	-0.19568	Prob > |t|	<.0001
Lower CL Dif	-0.25916	Prob > t	1.0000
Confidence	0.95	Prob < t	<.0001

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.07757756	0.077578	395.7375	<.0001
Error	4	0.00078413	0.000196		
C. Total	5	0.07836170			

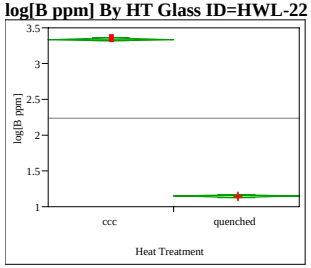
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	2.04047	0.00808	2.0180	2.0629
quenched	3	1.81305	0.00808	1.7906	1.8355

Std Error uses a pooled estimate of error variance

Figure B5. Effects of Heat Treatment (HT) on PCT log(ppm) Response of TM2 Glasses

log[B ppm] By HT Glass ID=HWL-22



Oneway Anova
Summary of Fit

Rsquare	0.999864
Adj Rsquare	0.99983
Root Mean Square Error	0.01567
Mean of Response	2.242787
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	-2.1921	t Ratio	-171.33
Std Err Dif	0.0128	DF	4
Upper CL Dif	-2.1565	Prob > |t|	<.0001
Lower CL Dif	-2.2276	Prob > t	1.0000
Confidence	0.95	Prob < t	<.0001

Analysis of Variance

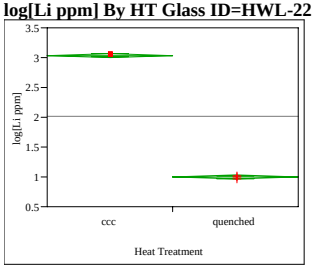
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	7.2077490	7.20775	29354.02	<.0001
Error	4	0.0009822	0.00025		
C. Total	5	7.2087312			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	3.33882	0.00905	3.3137	3.3639
quenched	3	1.14675	0.00905	1.1216	1.1719

Std Error uses a pooled estimate of error variance

log[Li ppm] By HT Glass ID=HWL-22



Oneway Anova
Summary of Fit

Rsquare	0.999665
Adj Rsquare	0.999581
Root Mean Square Error	0.022867
Mean of Response	2.017698
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	-2.0401	t Ratio	-109.269
Std Err Dif	0.0187	DF	4
Upper CL Dif	-1.9883	Prob > |t|	<.0001
Lower CL Dif	-2.0920	Prob > t	1.0000
Confidence	0.95	Prob < t	<.0001

Analysis of Variance

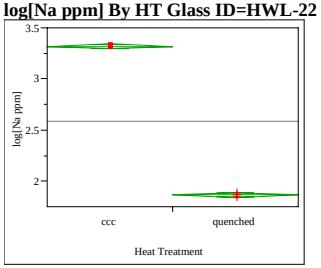
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	6.2432383	6.24324	11939.71	<.0001
Error	4	0.0020916	0.00052		
C. Total	5	6.2453299			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	3.03777	0.01320	3.0011	3.0744
quenched	3	0.99763	0.01320	0.9610	1.0343

Std Error uses a pooled estimate of error variance

log[Na ppm] By HT Glass ID=HWL-22



Oneway Anova
Summary of Fit

Rsquare	0.999716
Adj Rsquare	0.999645
Root Mean Square Error	0.01499
Mean of Response	2.590376
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	-1.4520	t Ratio	-118.633
Std Err Dif	0.0122	DF	4
Upper CL Dif	-1.4180	Prob > |t|	<.0001
Lower CL Dif	-1.4859	Prob > t	1.0000
Confidence	0.95	Prob < t	<.0001

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	3.1622919	3.16229	14073.71	<.0001
Error	4	0.0008988	0.00022		
C. Total	5	3.1631907			

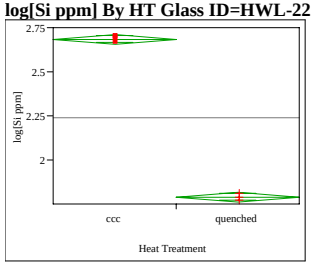
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	3.31636	0.00865	3.2923	3.3404
quenched	3	1.86439	0.00865	1.8404	1.8884

Std Error uses a pooled estimate of error variance

Figure B5. Effects of Heat Treatment (HT) on PCT log(ppm) Response of TM2 Glasses

log[Si ppm] By HT Glass ID=HWL-22



Oneway Anova
Summary of Fit

Rsquare	0.99899
Adj Rsquare	0.998737
Root Mean Square Error	0.017383
Mean of Response	2.237707
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	-0.89261	t Ratio	-62.8921
Std Err Dif	0.01419	DF	4
Upper CL Dif	-0.85321	Prob > |t|	<.0001
Lower CL Dif	-0.93202	Prob > t	1.0000
Confidence	0.95	Prob < t	<.0001

Analysis of Variance

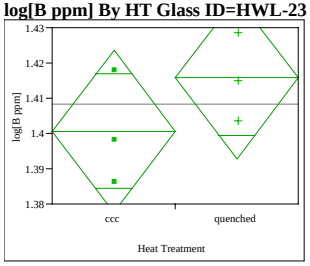
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	1.1951371	1.19514	3955.419	<.0001
Error	4	0.0012086	0.00030		
C. Total	5	1.1963457			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	2.68401	0.01004	2.6561	2.7119
quenched	3	1.79140	0.01004	1.7635	1.8193

Std Error uses a pooled estimate of error variance

log[B ppm] By HT Glass ID=HWL-23



Oneway Anova
Summary of Fit

Rsquare	0.29533
Adj Rsquare	0.119162
Root Mean Square Error	0.014331
Mean of Response	1.408214
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.01515	t Ratio	1.294764
Std Err Dif	0.01170	DF	4
Upper CL Dif	0.04764	Prob > |t|	0.2651
Lower CL Dif	-0.01734	Prob > t	0.1325
Confidence	0.95	Prob < t	0.8675

Analysis of Variance

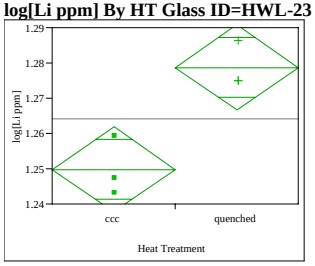
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00034429	0.000344	1.6764	0.2651
Error	4	0.00082149	0.000205		
C. Total	5	0.00116578			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.40064	0.00827	1.3777	1.4236
quenched	3	1.41579	0.00827	1.3928	1.4388

Std Error uses a pooled estimate of error variance

log[Li ppm] By HT Glass ID=HWL-23



Oneway Anova
Summary of Fit

Rsquare	0.845536
Adj Rsquare	0.80692
Root Mean Square Error	0.007564
Mean of Response	1.26428
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.028898	t Ratio	4.679321
Std Err Dif	0.006176	DF	4
Upper CL Dif	0.046044	Prob > |t|	0.0095
Lower CL Dif	0.011751	Prob > t	0.0047
Confidence	0.95	Prob < t	0.9953

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00125262	0.001253	21.8960	0.0095
Error	4	0.00022883	0.000057		
C. Total	5	0.00148145			

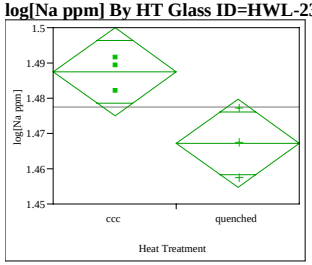
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.24983	0.00437	1.2377	1.2620
quenched	3	1.27873	0.00437	1.2666	1.2909

Std Error uses a pooled estimate of error variance

Figure B5. Effects of Heat Treatment (HT) on PCT log(ppm) Response of TM2 Glasses

log[Na ppm] By HT Glass ID=HWL-23



Oneway Anova
Summary of Fit

Rsquare	0.714524
Adj Rsquare	0.643155
Root Mean Square Error	0.007799
Mean of Response	1.477369
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	-0.02015	t Ratio	-3.16412
Std Err Dif	0.00637	DF	4
Upper CL Dif	-0.00247	Prob > |t|	0.0340
Lower CL Dif	-0.03783	Prob > t	0.9830
Confidence	0.95	Prob < t	0.0170

Analysis of Variance

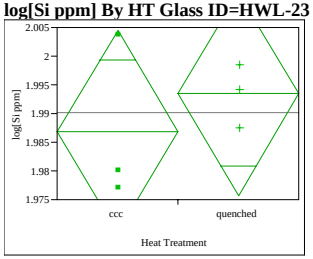
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00060888	0.000609	10.0117	0.0340
Error	4	0.00024327	0.000061		
C. Total	5	0.00085215			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.48744	0.00450	1.4749	1.4999
quenched	3	1.46730	0.00450	1.4548	1.4798

Std Error uses a pooled estimate of error variance

log[Si ppm] By HT Glass ID=HWL-23



Oneway Anova
Summary of Fit

Rsquare	0.116902
Adj Rsquare	-0.10387
Root Mean Square Error	0.011035
Mean of Response	1.990143
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.00656	t Ratio	0.727673
Std Err Dif	0.00901	DF	4
Upper CL Dif	0.03157	Prob > |t|	0.5071
Lower CL Dif	-0.01846	Prob > t	0.2536
Confidence	0.95	Prob < t	0.7464

Analysis of Variance

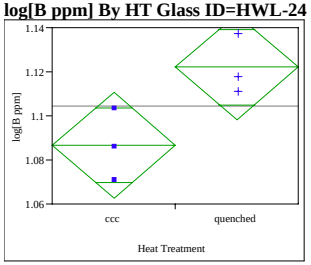
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00006448	0.000064	0.5295	0.5071
Error	4	0.00048709	0.000122		
C. Total	5	0.00055157			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.98686	0.00637	1.9692	2.0046
quenched	3	1.99342	0.00637	1.9757	2.0111

Std Error uses a pooled estimate of error variance

log[B ppm] By HT Glass ID=HWL-24



Oneway Anova
Summary of Fit

Rsquare	0.677915
Adj Rsquare	0.597394
Root Mean Square Error	0.014994
Mean of Response	1.104321
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.035523	t Ratio	2.901568
Std Err Dif	0.012243	DF	4
Upper CL Dif	0.069515	Prob > |t|	0.0440
Lower CL Dif	0.001532	Prob > t	0.0220
Confidence	0.95	Prob < t	0.9780

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00189284	0.001893	8.4191	0.0440
Error	4	0.00089931	0.000225		
C. Total	5	0.00279215			

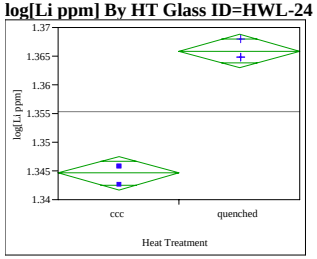
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.08656	0.00866	1.0625	1.1106
quenched	3	1.12208	0.00866	1.0980	1.1461

Std Error uses a pooled estimate of error variance

Figure B5. Effects of Heat Treatment (HT) on PCT log(ppm) Response of TM2 Glasses

log[Li ppm] By HT Glass ID=HWL-24



Oneway Anova
Summary of Fit

Rsquare	0.980362
Adj Rsquare	0.975452
Root Mean Square Error	0.001846
Mean of Response	1.355263
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.021293	t Ratio	14.13103
Std Err Dif	0.001507	DF	4
Upper CL Dif	0.025477	Prob > |t|	0.0001
Lower CL Dif	0.017110	Prob > t	<.0001
Confidence	0.95	Prob < t	0.9999

Analysis of Variance

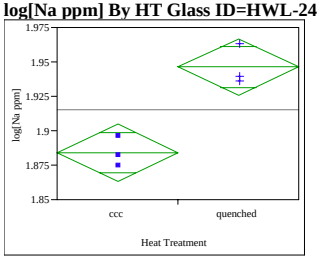
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00068012	0.000680	199.6861	0.0001
Error	4	0.00001362	3.406e-6		
C. Total	5	0.00069374			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.34462	0.00107	1.3417	1.3476
quenched	3	1.36591	0.00107	1.3630	1.3689

Std Error uses a pooled estimate of error variance

log[Na ppm] By HT Glass ID=HWL-24



Oneway Anova
Summary of Fit

Rsquare	0.897024
Adj Rsquare	0.87128
Root Mean Square Error	0.012936
Mean of Response	1.915067
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.062349	t Ratio	5.90289
Std Err Dif	0.010562	DF	4
Upper CL Dif	0.091675	Prob > |t|	0.0041
Lower CL Dif	0.033023	Prob > t	0.0021
Confidence	0.95	Prob < t	0.9979

Analysis of Variance

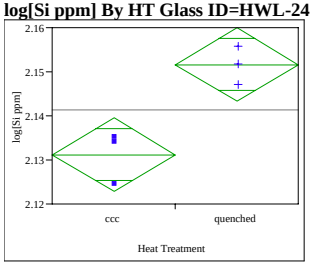
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00583112	0.005831	34.8441	0.0041
Error	4	0.00066939	0.000167		
C. Total	5	0.00650051			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.88389	0.00747	1.8632	1.9046
quenched	3	1.94624	0.00747	1.9255	1.9670

Std Error uses a pooled estimate of error variance

log[Si ppm] By HT Glass ID=HWL-24



Oneway Anova
Summary of Fit

Rsquare	0.852737
Adj Rsquare	0.815921
Root Mean Square Error	0.00519
Mean of Response	2.141405
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.020394	t Ratio	4.81272
Std Err Dif	0.004238	DF	4
Upper CL Dif	0.032159	Prob > |t|	0.0086
Lower CL Dif	0.008629	Prob > t	0.0043
Confidence	0.95	Prob < t	0.9957

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00062387	0.000624	23.1623	0.0086
Error	4	0.00010774	0.000027		
C. Total	5	0.00073161			

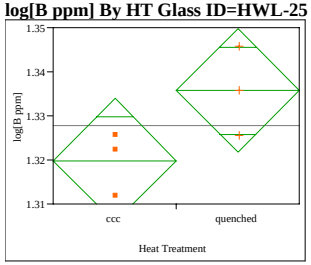
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	2.13121	0.00300	2.1229	2.1395
quenched	3	2.15160	0.00300	2.1433	2.1599

Std Error uses a pooled estimate of error variance

Figure B5. Effects of Heat Treatment (HT) on PCT log(ppm) Response of TM2 Glasses

log[B ppm] By HT Glass ID=HWL-25



Oneway Anova
Summary of Fit

Rsquare	0.551713
Adj Rsquare	0.439641
Root Mean Square Error	0.008744
Mean of Response	1.327804
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.01584	t Ratio	2.218751
Std Err Dif	0.00714	DF	4
Upper CL Dif	0.03566	Prob > |t|	0.0907
Lower CL Dif	-0.00398	Prob > t	0.0454
Confidence	0.95	Prob < t	0.9546

Analysis of Variance

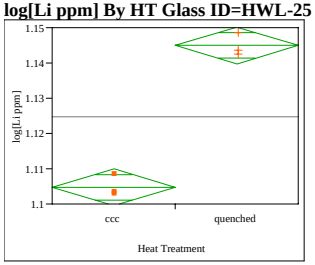
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00037635	0.000376	4.9229	0.0907
Error	4	0.00030580	0.000076		
C. Total	5	0.00068214			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.31988	0.00505	1.3059	1.3339
quenched	3	1.33572	0.00505	1.3217	1.3497

Std Error uses a pooled estimate of error variance

log[Li ppm] By HT Glass ID=HWL-25



Oneway Anova
Summary of Fit

Rsquare	0.98307
Adj Rsquare	0.978837
Root Mean Square Error	0.003228
Mean of Response	1.124837
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.040166	t Ratio	15.2403
Std Err Dif	0.002636	DF	4
Upper CL Dif	0.047484	Prob > |t|	0.0001
Lower CL Dif	0.032849	Prob > t	<.0001
Confidence	0.95	Prob < t	0.9999

Analysis of Variance

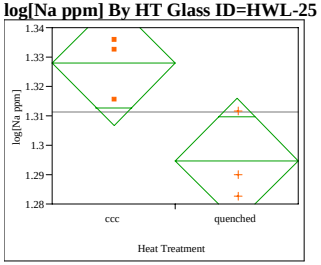
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00242001	0.002420	232.2667	0.0001
Error	4	0.00004168	0.000010		
C. Total	5	0.00246169			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.10475	0.00186	1.0996	1.1099
quenched	3	1.14492	0.00186	1.1397	1.1501

Std Error uses a pooled estimate of error variance

log[Na ppm] By HT Glass ID=HWL-25



Oneway Anova
Summary of Fit

Rsquare	0.699928
Adj Rsquare	0.624909
Root Mean Square Error	0.013254
Mean of Response	1.311315
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	-0.03306	t Ratio	-3.05452
Std Err Dif	0.01082	DF	4
Upper CL Dif	-0.00301	Prob > |t|	0.0379
Lower CL Dif	-0.06310	Prob > t	0.9811
Confidence	0.95	Prob < t	0.0189

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00163898	0.001639	9.3301	0.0379
Error	4	0.00070266	0.000176		
C. Total	5	0.00234164			

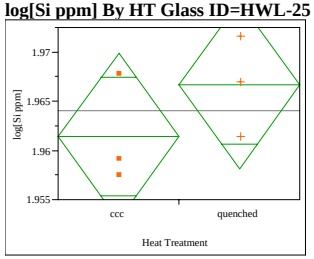
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.32784	0.00765	1.3066	1.3491
quenched	3	1.29479	0.00765	1.2735	1.3160

Std Error uses a pooled estimate of error variance

Figure B5. Effects of Heat Treatment (HT) on PCT log(ppm) Response of TM2 Glasses

log[Si ppm] By HT Glass ID=HWL-25



Oneway Anova
Summary of Fit

Rsquare	0.268067
Adj Rsquare	0.085084
Root Mean Square Error	0.005308
Mean of Response	1.964029
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.00525	t Ratio	1.210365
Std Err Dif	0.00433	DF	4
Upper CL Dif	0.01728	Prob > |t|	0.2928
Lower CL Dif	-0.00679	Prob > t	0.1464
Confidence	0.95	Prob < t	0.8536

Analysis of Variance

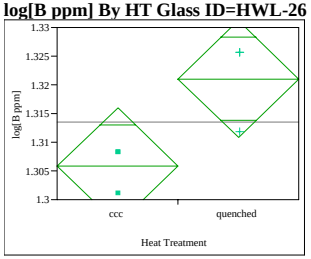
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00004127	0.000041	1.4650	0.2928
Error	4	0.00011269	0.000028		
C. Total	5	0.00015397			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.96141	0.00306	1.9529	1.9699
quenched	3	1.96665	0.00306	1.9581	1.9752

Std Error uses a pooled estimate of error variance

log[B ppm] By HT Glass ID=HWL-26



Oneway Anova
Summary of Fit

Rsquare	0.680046
Adj Rsquare	0.600058
Root Mean Square Error	0.006386
Mean of Response	1.313426
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.015204	t Ratio	2.915787
Std Err Dif	0.005214	DF	4
Upper CL Dif	0.029681	Prob > |t|	0.0434
Lower CL Dif	0.000727	Prob > t	0.0217
Confidence	0.95	Prob < t	0.9783

Analysis of Variance

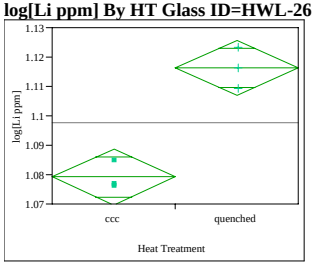
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00034674	0.000347	8.5018	0.0434
Error	4	0.00016314	0.000041		
C. Total	5	0.00050987			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.30582	0.00369	1.2956	1.3161
quenched	3	1.32103	0.00369	1.3108	1.3313

Std Error uses a pooled estimate of error variance

log[Li ppm] By HT Glass ID=HWL-26



Oneway Anova
Summary of Fit

Rsquare	0.936678
Adj Rsquare	0.920847
Root Mean Square Error	0.005915
Mean of Response	1.097747
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.037148	t Ratio	7.692132
Std Err Dif	0.004829	DF	4
Upper CL Dif	0.050557	Prob > |t|	0.0015
Lower CL Dif	0.023740	Prob > t	0.0008
Confidence	0.95	Prob < t	0.9992

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00207000	0.002070	59.1689	0.0015
Error	4	0.00013994	0.000035		
C. Total	5	0.00220994			

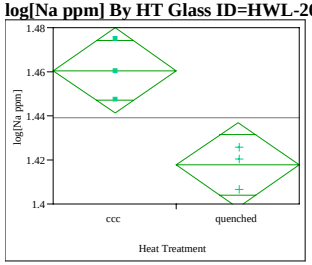
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.07917	0.00341	1.0697	1.0887
quenched	3	1.11632	0.00341	1.1068	1.1258

Std Error uses a pooled estimate of error variance

Figure B5. Effects of Heat Treatment (HT) on PCT log(ppm) Response of TM2 Glasses

log[Na ppm] By HT Glass ID=HWL-26



Oneway Anova
Summary of Fit

Rsquare	0.826264
Adj Rsquare	0.78283
Root Mean Square Error	0.01205
Mean of Response	1.439137
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	-0.04291	t Ratio	-4.36158
Std Err Dif	0.00984	DF	4
Upper CL Dif	-0.01560	Prob > |t|	0.0120
Lower CL Dif	-0.07023	Prob > t	0.9940
Confidence	0.95	Prob < t	0.0060

Analysis of Variance

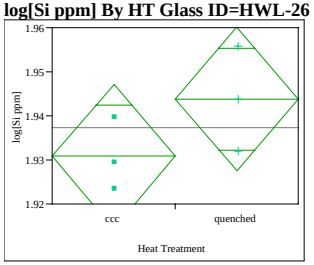
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00276233	0.002762	19.0234	0.0120
Error	4	0.00058083	0.000145		
C. Total	5	0.00334315			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.46059	0.00696	1.4413	1.4799
quenched	3	1.41768	0.00696	1.3984	1.4370

Std Error uses a pooled estimate of error variance

log[Si ppm] By HT Glass ID=HWL-26



Oneway Anova
Summary of Fit

Rsquare	0.379133
Adj Rsquare	0.223917
Root Mean Square Error	0.010218
Mean of Response	1.937313
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.01304	t Ratio	1.562885
Std Err Dif	0.00834	DF	4
Upper CL Dif	0.03620	Prob > |t|	0.1931
Lower CL Dif	-0.01013	Prob > t	0.0966
Confidence	0.95	Prob < t	0.9034

Analysis of Variance

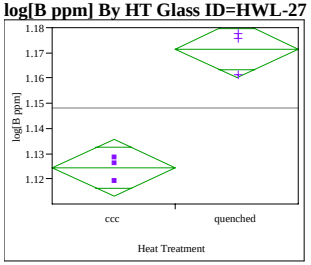
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00025504	0.000255	2.4426	0.1931
Error	4	0.00041766	0.000104		
C. Total	5	0.00067270			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.93079	0.00590	1.9144	1.9472
quenched	3	1.94383	0.00590	1.9275	1.9602

Std Error uses a pooled estimate of error variance

log[B ppm] By HT Glass ID=HWL-27



Oneway Anova
Summary of Fit

Rsquare	0.942593
Adj Rsquare	0.928241
Root Mean Square Error	0.007122
Mean of Response	1.14795
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.047127	t Ratio	8.104183
Std Err Dif	0.005815	DF	4
Upper CL Dif	0.063272	Prob > |t|	0.0013
Lower CL Dif	0.030981	Prob > t	0.0006
Confidence	0.95	Prob < t	0.9994

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00333140	0.003331	65.6778	0.0013
Error	4	0.00020289	0.000051		
C. Total	5	0.00353429			

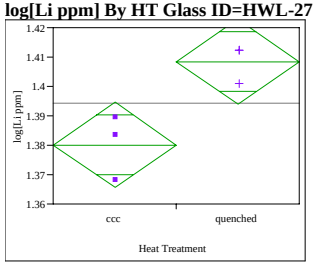
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.12439	0.00411	1.1130	1.1358
quenched	3	1.17151	0.00411	1.1601	1.1829

Std Error uses a pooled estimate of error variance

Figure B5. Effects of Heat Treatment (HT) on PCT log(ppm) Response of TM2 Glasses

log[Li ppm] By HT Glass ID=HWL-27



Oneway Anova
Summary of Fit

Rsquare	0.786869
Adj Rsquare	0.733587
Root Mean Square Error	0.009012
Mean of Response	1.394266
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.028276	t Ratio	3.842894
Std Err Dif	0.007358	DF	4
Upper CL Dif	0.048704	Prob > |t|	0.0184
Lower CL Dif	0.007847	Prob > t	0.0092
Confidence	0.95	Prob < t	0.9908

Analysis of Variance

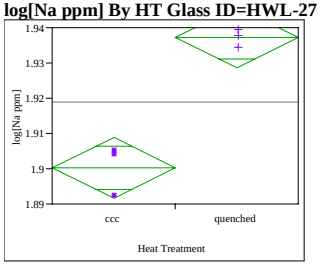
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00119927	0.001199	14.7678	0.0184
Error	4	0.00032483	0.000081		
C. Total	5	0.00152410			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.38013	0.00520	1.3657	1.3946
quenched	3	1.40840	0.00520	1.3940	1.4228

Std Error uses a pooled estimate of error variance

log[Na ppm] By HT Glass ID=HWL-27



Oneway Anova
Summary of Fit

Rsquare	0.94679
Adj Rsquare	0.933487
Root Mean Square Error	0.005366
Mean of Response	1.918818
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.036962	t Ratio	8.436448
Std Err Dif	0.004381	DF	4
Upper CL Dif	0.049126	Prob > |t|	0.0011
Lower CL Dif	0.024798	Prob > t	0.0005
Confidence	0.95	Prob < t	0.9995

Analysis of Variance

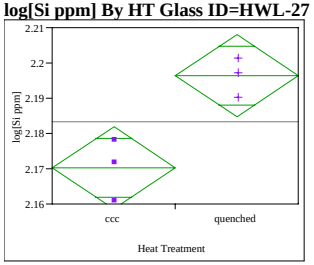
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00204927	0.002049	71.1737	0.0011
Error	4	0.00011517	0.000029		
C. Total	5	0.00216444			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.90034	0.00310	1.8917	1.9089
quenched	3	1.93730	0.00310	1.9287	1.9459

Std Error uses a pooled estimate of error variance

log[Si ppm] By HT Glass ID=HWL-27



Oneway Anova
Summary of Fit

Rsquare	0.827809
Adj Rsquare	0.784762
Root Mean Square Error	0.007299
Mean of Response	2.183279
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.026132	t Ratio	4.385209
Std Err Dif	0.005959	DF	4
Upper CL Dif	0.042678	Prob > |t|	0.0118
Lower CL Dif	0.009587	Prob > t	0.0059
Confidence	0.95	Prob < t	0.9941

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00102435	0.001024	19.2301	0.0118
Error	4	0.00021307	0.000053		
C. Total	5	0.00123743			

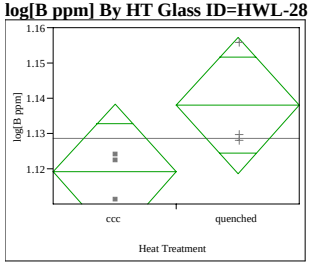
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	2.17021	0.00421	2.1585	2.1819
quenched	3	2.19635	0.00421	2.1846	2.2080

Std Error uses a pooled estimate of error variance

Figure B5. Effects of Heat Treatment (HT) on PCT log(ppm) Response of TM2 Glasses

log[B ppm] By HT Glass ID=HWL-28



Oneway Anova
Summary of Fit

Rsquare	0.480465
Adj Rsquare	0.350581
Root Mean Square Error	0.012015
Mean of Response	1.128516
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.01887	t Ratio	1.923329
Std Err Dif	0.00981	DF	4
Upper CL Dif	0.04611	Prob > |t|	0.1268
Lower CL Dif	-0.00837	Prob > t	0.0634
Confidence	0.95	Prob < t	0.9366

Analysis of Variance

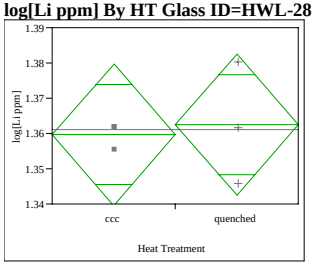
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00053402	0.000534	3.6992	0.1268
Error	4	0.00057745	0.000144		
C. Total	5	0.00111147			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.11908	0.00694	1.0998	1.1383
quenched	3	1.13795	0.00694	1.1187	1.1572

Std Error uses a pooled estimate of error variance

log[Li ppm] By HT Glass ID=HWL-28



Oneway Anova
Summary of Fit

Rsquare	0.020269
Adj Rsquare	-0.22466
Root Mean Square Error	0.012483
Mean of Response	1.361089
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.00293	t Ratio	0.287671
Std Err Dif	0.01019	DF	4
Upper CL Dif	0.03123	Prob > |t|	0.7879
Lower CL Dif	-0.02537	Prob > t	0.3939
Confidence	0.95	Prob < t	0.6061

Analysis of Variance

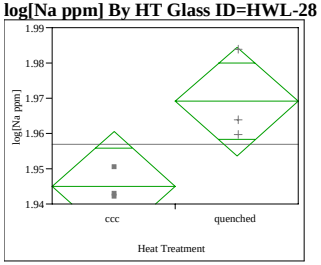
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00001290	0.000013	0.0828	0.7879
Error	4	0.00062330	0.000156		
C. Total	5	0.00063620			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.35962	0.00721	1.3396	1.3796
quenched	3	1.36256	0.00721	1.3425	1.3826

Std Error uses a pooled estimate of error variance

log[Na ppm] By HT Glass ID=HWL-28



Oneway Anova
Summary of Fit

Rsquare	0.702143
Adj Rsquare	0.627679
Root Mean Square Error	0.00962
Mean of Response	1.957083
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.024118	t Ratio	3.070714
Std Err Dif	0.007854	DF	4
Upper CL Dif	0.045926	Prob > |t|	0.0373
Lower CL Dif	0.002311	Prob > t	0.0186
Confidence	0.95	Prob < t	0.9814

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00087255	0.000873	9.4293	0.0373
Error	4	0.00037015	0.000093		
C. Total	5	0.00124270			

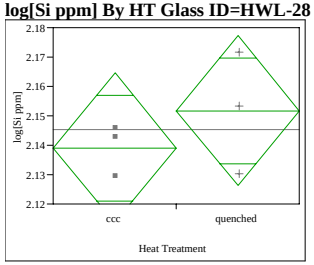
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	1.94502	0.00555	1.9296	1.9604
quenched	3	1.96914	0.00555	1.9537	1.9846

Std Error uses a pooled estimate of error variance

Figure B5. Effects of Heat Treatment (HT) on PCT log(ppm) Response of TM2 Glasses

log[Si ppm] By HT Glass ID=HWL-28



Oneway Anova
Summary of Fit

Rsquare	0.192317
Adj Rsquare	-0.0096
Root Mean Square Error	0.015897
Mean of Response	2.145464
Observations (or Sum Wgts)	6

t Test
quenched-ccc

Assuming equal variances

Difference	0.01267	t Ratio	0.975929
Std Err Dif	0.01298	DF	4
Upper CL Dif	0.04871	Prob > |t|	0.3844
Lower CL Dif	-0.02337	Prob > t	0.1922
Confidence	0.95	Prob < t	0.8078

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
HT	1	0.00024070	0.000241	0.9524	0.3844
Error	4	0.00101086	0.000253		
C. Total	5	0.00125156			

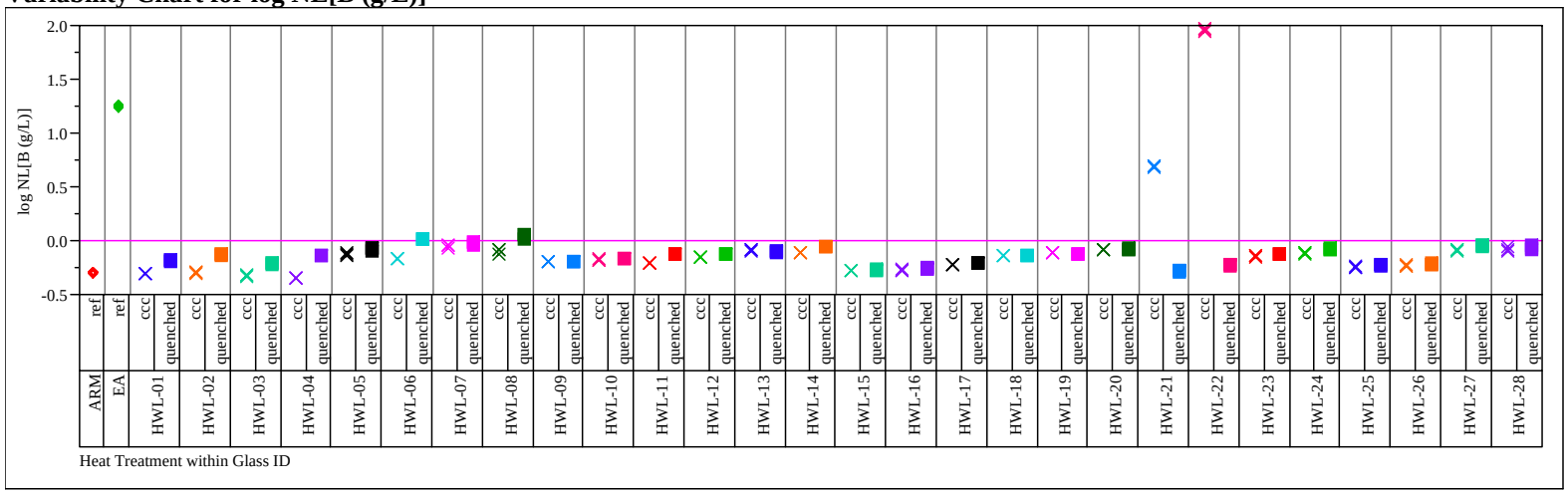
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
ccc	3	2.13913	0.00918	2.1136	2.1646
quenched	3	2.15180	0.00918	2.1263	2.1773

Std Error uses a pooled estimate of error variance

Figure B6. Effects of Heat Treatment for Study Glasses by Compositional View

Variability Chart for log NL[B (g/L)]



Variability Chart for log NL[Li(g/L)]

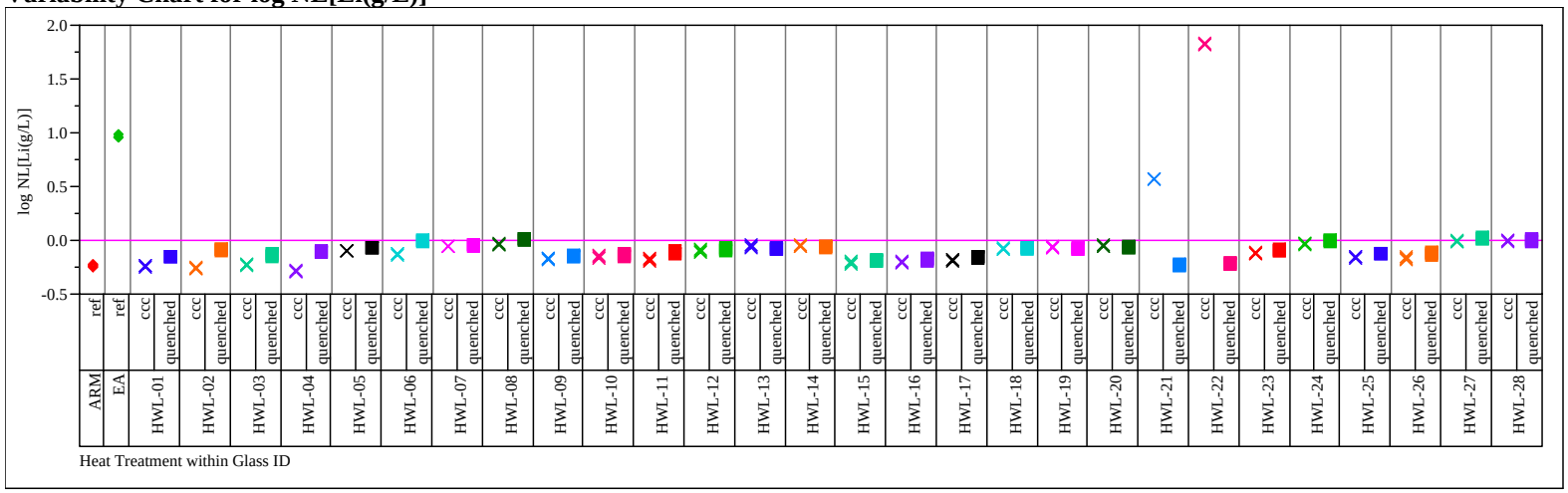
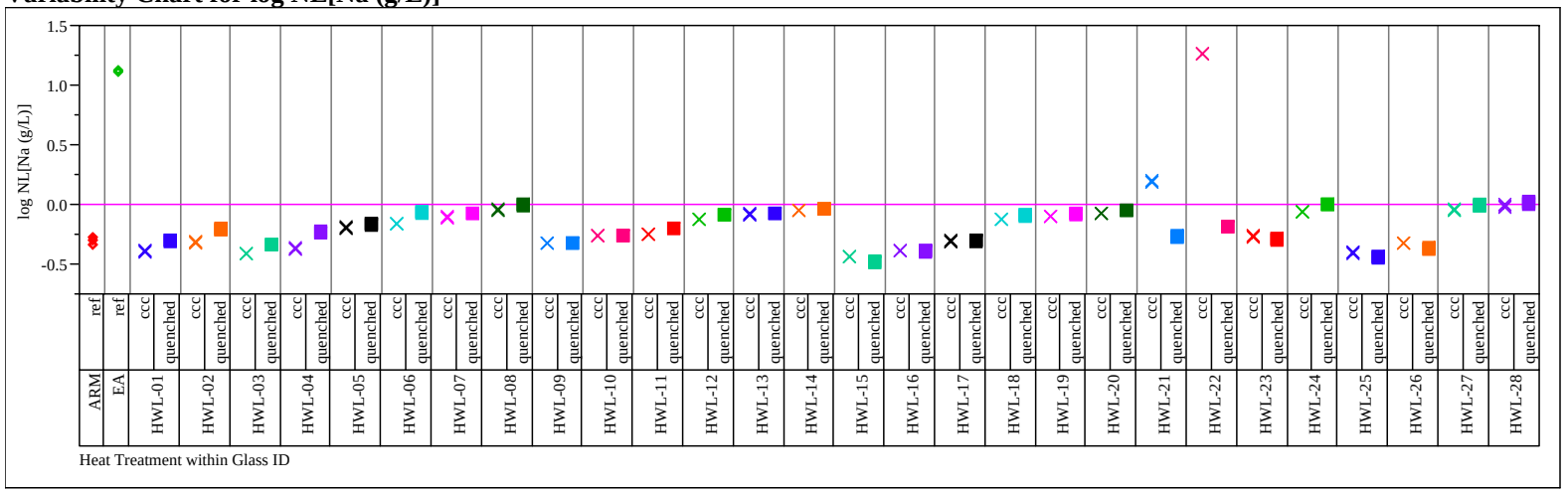


Figure B6. Effects of Heat Treatment for Study Glasses by Compositional View

Variability Chart for log NL[Na (g/L)]



Variability Chart for log NL[Si (g/L)]

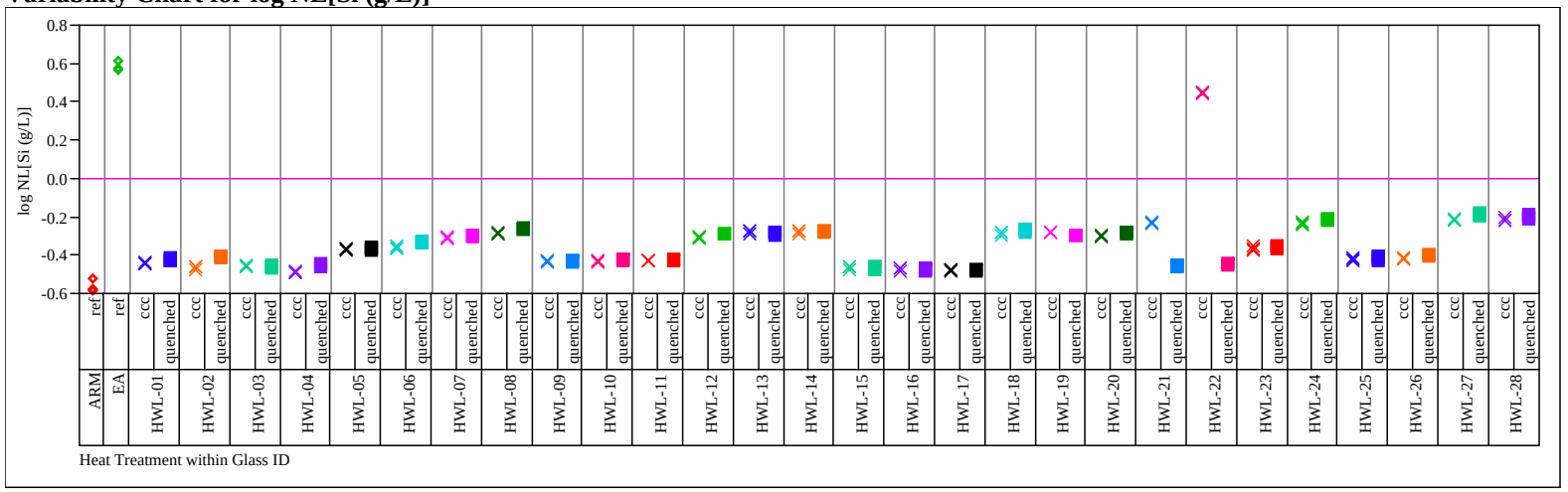
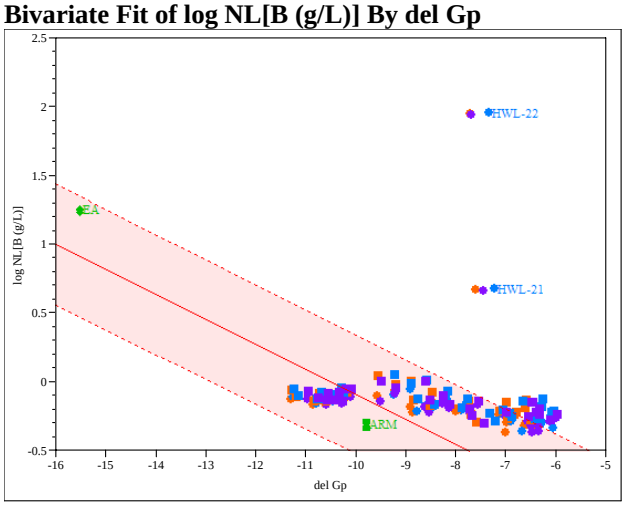


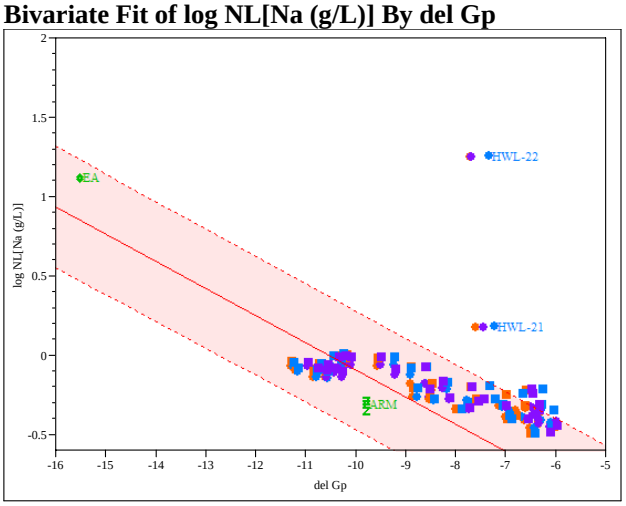
Exhibit B7. del Gp (ΔG_p) Predictions versus Common Logarithm Normalized Leachate (log NL[.]) for B, Li, Na, and Si Over All Compositional Views and Heat Treatments

Legend		Glass Standard or Heat Treatment-Compositional View
	1	ARM
	2	EA
	3	measured bc-ccc
	4	measured bc-quenched
	5	measured-ccc
	6	measured-quenched
	7	targeted-ccc
	8	targeted-quenched

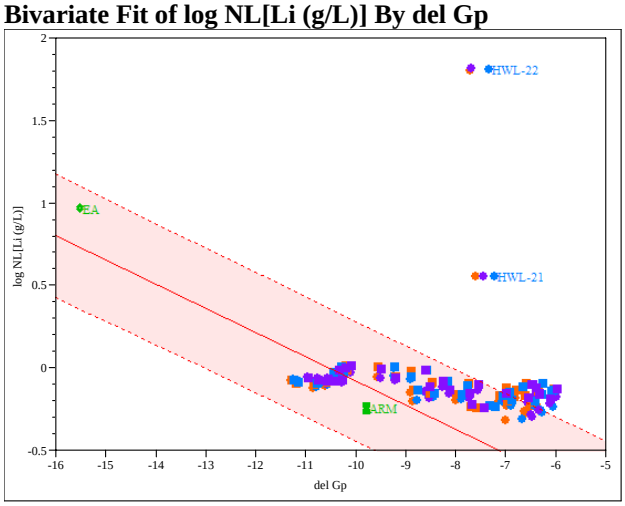
Bivariate Fit of log NL[B (g/L)] By del Gp



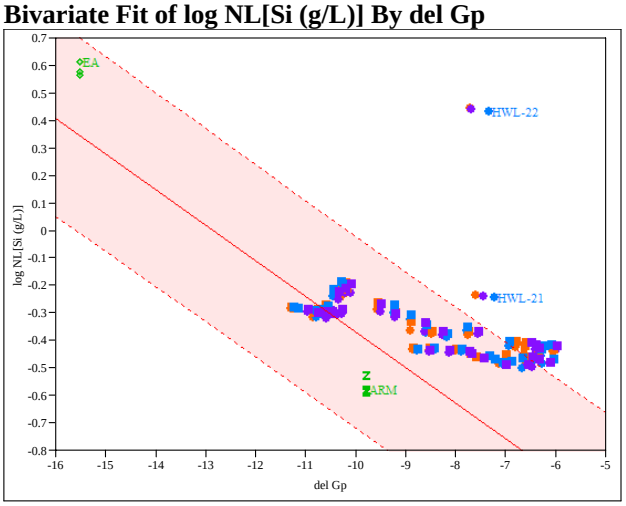
Bivariate Fit of log NL[Na (g/L)] By del Gp



Bivariate Fit of log NL[Li (g/L)] By del Gp



Bivariate Fit of log NL[Si (g/L)] By del Gp



Distribution:

A.B. Barnes, 999-W
A.S. Choi, 773-42A
T.B. Edwards, 999-W
K.M. Fox, 999-W
J.C. Griffin, 773-A
C.C. Herman, 999-W
C.M. Janzten, 773-A
J.E. Marra, 773-A
J.D. Newell, 999-W
D.K. Peeler, 999-W
F.C. Raszewski, 999-W
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P.C. Suggs, 766-H
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