Immobilization Technology Section
Savannah River Technology Center
Westinghouse Savannah River Company

WSRC-TR-2002-00549
Rev. 0

January 15, 2003

SLUDGE BATCH 3 PHASE 1 VARIABILITY STUDY

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PREPARED FOR THE U.S. DEPARTMENT OF ENERGY UNDER CONTRACT NO. DE-AC09-96SR18500

This document was prepared in conjunction with work accomplished under Contract No. DE-AC09-96SR18500 with the U. S. Department of Energy.

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This report was prepared by Westinghouse Savannah River Company (WSRC) for the United States Department of Energy under Contract No. DE-AC09-96SR18500 and is an account of work performed under that contract.

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Executive Summary

The objective of this task was to assess the applicability of the current Product Composition Control System (PCCS) durability model (ΔG_P) to the anticipated compositional region of interest to Sludge Batch 3 (SB3). The assessment of applicability was accomplished via a compositional variation study in which the durability response of various glasses was experimentally determined and compared to model predictions. Typically, variability studies are compositionally focused on a specific frit coupled with a known sludge composition over a waste loading range of interest. In the present study, various candidate frits were used with different sludge compositional views representing possible washing scenarios. Operating windows were defined for various glass systems using Defense Waste Processing Facility (DWPF) measurement acceptability criteria that formed the basis for the targeted glass compositions.

The experimental results demonstrated applicability (or conservatism) of the ΔG_P model for each of the 42 SB3 test matrix glasses when fabricated under oxidizing conditions. The Product Consistency Test (PCT) response for all glasses (both quenched and centerline cansiter cooled) were also acceptable being at least an order of magnitude more durable than the 16.695 g/L value for normalized boron release as reported for the Environmental Assessment (EA) glass.

In this phase of the variability study, only a limited assessment of the impact of reduction / oxidation (redox) on the PCT response was experimentally determined. Once again, the limited results indicated that the PCT responses from glasses that bound the acceptable redox range for DWPF were very acceptable with respect to the EA glass. In terms of predictability, the ΔG_P model was either predictable or conservative. However, model predictions suggest that the impact of redox on processability (i.e., the predicted ΔG_P value in relation to the acceptance criterion value) could have a detrimental effect on the projected operating windows. The projected negative impact would be most severe for glass systems whose upper waste loading is (or is nearly) PCT limited as redox transitions from the oxidized to the reduced state.

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Acronyms

AES	atomic emission spectroscopy
Am/Cm	americium/curium
ANOVA	analysis of variance
ARM	Approved Reference Material
ASTM	American Society for Testing and Materials
ccc	centerline canister cooled
ΔG_p	preliminary glass dissolution estimator based on free energy of hydration (in kcal/mol)
DWPF	Defense Waste Processing Facility
DWPF PE	Defense Waste Processing Facility Process Engineering
EA	Environmental Assessment
HLW	high-level waste
HLW PE	High Level Waste – Process Engineering
ICP	inductively coupled plasma
LM	lithium-metaborate
MAR	Measurement Acceptability Region
MRF	dry feed melt rate furnace
MST	monosodium titanate
$Na_2C_2O_4$	sodium oxalate
NL	normalized leachate
PAR	Property Acceptability Region
PCCS	Product Composition Control System
PCT	Product Consistency Test
PF	(Sodium) Peroxide Fusion

redox	reduction/oxidation
SB	sludge batch
SME	Slurry Mix Evaporator
SRAT	Sludge Receipt and Adjustment Tank
SRS	Savannah River Site
SRTC	Savannah River Technology Center
SRTC-ML	Savannah River Technology Center – Mobile Laboratory
T_L	liquidus temperature
THERMO™	Thermodynamic Hydration Energy Reaction Model
TTR	technical task request
u_{STD}	uranium standard glass
$\eta_{1150°C}$	melt viscosity at 1150°C
WCSystem	Waste Characterization System
WL	waste loading
WQR	Waste Qualification Report
XRD	X-ray diffraction

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1.0 Introduction

Approximately 130M L of sludge/supernate high-level radioactive waste (HLW) is currently stored in underground carbon steel tanks at the Savannah River Site (SRS) in Aiken, South Carolina. The Defense Waste Processing Facility (DWPF) began immobilizing these wastes in borosilicate glass in 1996. Currently, the radioactive glass is being produced as a "sludge-only" composition by combining washed high-level sludge with glass frit and melting. The molten glass is poured into stainless steel canisters that will eventually be disposed of in a permanent geological repository.

Currently, DWPF is processing Sludge Batch 2 (SB2) and is planning to start processing Sludge Batch 3 (SB3) in the spring of 2004 (WSRC 2001).[1] A sludge batch is defined as a single tank of sludge slurry or a combination of sludge slurries from different tanks that has been or will be qualified for eventual transfer to DWPF. Sludge Batch 3 will be primarily Tank 7 sludge mixed with the heel of Sludge Batch 1B (SB1B), contributions from Tanks 18 and 19, an H-Canyon slurry containing precipitated Pu with Gd (Jilani 2002), and Americium/Curium (Am/Cm) precipitate from F-Canyon (Patel 2002). The sludge from Tank 7 is expected to contain several components that are considered atypical of DWPF sludge to date including higher levels of noble metals than previously processed sludge batches (Peeler et al. 2002a), sand, coal, sodium oxalate, and zeolite (Jantzen et al. 2002). Based on the process history for Tank 7, it is estimated that significant quantities of sand/coal (~7723 kg) and sodium oxalate (~300,000 kg) have been added to this tank (Goslen 1984; Fowler 1980).

The quantities of sand, coal, and sodium oxalate may impact several processing parameters at the DWPF. DWPF Process Engineering (DWPF PE) has issued a Technical Task Request (TTR) requesting the Savannah River Technology Center (SRTC) to address these processing impacts (Rios-Armstrong 2002a). Fellinger (2002) provided a list of the various tasks that are currently being addressed prior to DWPF's acceptance of SB3. Studies have been and are being performed by SRTC to assess the effects of sand, coal, sodium oxalate, the Pu/Gd stream, and the higher levels of noble metals on various SB3 issues [Herman et al. (2002a); Peeler et al. (2002a); Bronikowski et al. (2002); Jantzen (2002); Herman (2002a); Herman (2002b); Lorier et al. 2003); Peeler and Edwards (2002)].

One of the tasks identified by Fellinger (2002) involved an evaluation of potential frits for SB3. Rios-Armstrong (2002b) issued a more specific TTR to address the frit development activity as well as a subsequent variability study.

Peeler and Edwards (2002) outlined an integrated methodology for developing and ultimately selecting a frit for SB3. Several key aspects or criteria that form the basis underlying this methodology include:

- Maximizing the Product Composition Control System (PCCS) projected operational window size over the anticipated SB3 composition region
- Providing a frit that is robust or insensitive to anticipated sludge composition variation
- Improving or maintaining high waste loadings (WLs)

[1] Although the current HLW System Plan (WSRC 2001) projects the initiation of SB3 processing in the spring of 2004, plans to expedite processing of SB3 are currently being assessed. If proven feasible, processing of SB3 could begin as soon as the spring/summer of 2003.

- Improving or maintaining high melt rates
- Providing a "frittable" additive or frit composition[2]

The criteria listed above are being used to guide the SB3 frit development task in an effort to establish a baseline flowsheet for SB3 in terms of ease of processing, waste loading, and/or melt rate.[3] The ability to maximize the size of the DWPF PCCS operational window provides flexibility in targeting waste loadings to meet processing goals. This is strictly an ease-of-processing goal targeted to provide as large of a compositional operating window and as much flexibility as possible. Given the five key criteria can be competing, the basis for not only developing but ultimately selecting a frit for SB3 is complex. The selection process should not be made based on a single criterion but on a collection of criteria that provide insight into the ease of processing SB3 while still making an acceptable glass.

Peeler and Edwards (2002) utilized model-based predictions to provide insight into the projected PCCS operational windows as a function of frit and sludge composition over a WL interval of interest. A unique, but technically sound, methodology was developed and implemented for that study to guide frit development activities. The methodology utilized was a sequential, iterative process capable of discerning the effects of frit composition on the projected PCCS operational windows and evaluating its robustness to sludge variation. That is, providing a frit that is robust or insensitive to relatively large variations in sludge composition (yields a relatively large processing window when accounting for composition variation) is a major advantage. A "robust" frit will reduce uncertainties or questions associated with how the frit will respond to SB3 once the qualification sample is obtained and compared to what is being used as the nominal or targeted composition in current testing. A viable frit should not only be able to process the nominal SB3 composition being used but should also be able to process (i.e., be robust to) realistic variations of that composition while still maintaining adequate processing and product characteristics. The degree of tolerance can be measured by the ability to produce acceptable glasses as one transitions from the nominal sludge case to compositions representing larger and larger variation about the nominal. Comparisons among both existing (Frit 202 and Frit 320) and alternative frits (the 400 series) were conducted using objective metrics that were developed to aid in this decision making process.

The model-based assessments indicated that judicious selection of the frit could yield processable and durable products at attractive waste loadings for all washing scenarios. The results provided support for the concept of developing unique frits for specific sludges to optimize PCCS operational windows and waste throughput. The results suggested that an aggressive washing strategy may not be required to assure processability or product quality as long as alternative frits are considered (assuming there are no other glass- or process-related restrictions such as anion solubility, H_2 generation, redox control, or rheological control issues). Peeler and Edwards (2002) stress that the assessments were based solely on PCCS model predictions, which did not include assessments of, melt rate or frittability that are part of the integrated testing methodology.

Including assessments of melt rate (Lorier et al. 2003) and frittability in the integrated strategy should lower the risk of introducing a feed into DWPF that although on paper is very attractive (in terms of waste loading) results in a very difficult feed to process (in terms of melt rate). In fact, this strategy should provide the basis for developing a decision matrix in which optimum waste throughput could be targeted.

[2] The term of "frittable" refers to the ability to produce a prefabricated frit (glass) from the proposed glass additives.
[3] Waste loading (WL) in this report is simply calculated as the HLW oxide fraction of the final glass.

The last criterion is the desire to have a "frittable" frit (i.e., the targeted frit composition will produce a glass that can be manufactured by a vendor). Use of a prefabricated frit instead of batch chemicals stems primarily from waste acceptance issues. The DWPF process control system imposes several constraints on the composition of the contents of the Slurry Mix Evaporator (SME) to define acceptability. These constraints relate process or product properties to composition via prediction models. A batch is deemed acceptable if its composition measurements lead to acceptable property predictions after accounting for modeling, analytic, and measurement uncertainties. The baseline document guiding the use of these data and models is Revision 4 of "SME Acceptability Determination for DWPF Process Control (U)" by Brown, Postles, and Edwards (2002). Currently, DWPF uses a frit that is ultimately blended with the sludge. Samples of this blend are taken from the SME, the compositions determined, and properties are predicted from the measured composition and are verified to a high confidence level to be within the processing window. Given the feed is acceptable in terms of various property predictions, the feed is transferred to the melter, converted to glass, and poured into canisters. This feed-forward process control strategy has been very effective in terms of assuring processability and product quality. Hence, frittability is an important criterion.

Although not a specific criterion listed above, the focus of this report is to demonstrate the applicability of the current PCCS durability model (referred to as ΔG_P – a preliminary glass dissolution estimator based on free energy of hydration (Jantzen et al. 1995)) to the anticipated composition region for SB3. Prior to acceptance and processing of a new sludge batch in DWPF, it must be confirmed that the sludge batch produces an acceptable glass via the PCCS. One of the phases of this waste qualification process is to complete a glass variability study as required by the DWPF Glass Product Control Program (Plodinec et al. 1995). In general, the objective of the variability study is to determine if the durability – ΔG_P correlation currently utilized by DWPF applies to the projected compositional region for the next sludge batch – for this study SB3.

Herman, Peeler, and Edwards (2002) indicated that the SB3 variability study might be performed in two phases. The first phase (henceforth referred to as Phase 1 and the subject of this report) will be based on the general assessments performed by Peeler and Edwards (2002). Phase 1 will assess applicability over a bounding or global composition region. The general composition region that will be assessed will be developed based on the latest Tank 7 compositional estimates or projections, candidate frit compositions, and a waste loading interval of interest. Due to the number of uncertainties in the SB3 integrated flowsheet, a more focused study may not be bounding in terms of compositional applicability. Phase 2 (if required) will be a more compositionally focused task. More specifically, as the washing scenario, acid addition and reduction/oxidation (redox) control strategies, and frit selection become more definitive, and the results of the SB3 waste qualification sample analysis are received, Phase 2 will be performed to back fill any data gaps resulting from the Phase 1 analysis or gaps not covered by existing and qualified data. The Phase 2 effort will focus in on a specific frit (or frits), Tank 51 waste qualification results (based on a targeted washing scenario), and a waste loading interval of interest. Uncertainties associated with the sludge composition will be addressed in that study as well. The results of Phase 2 are not covered in this report but will be documented in a subsequent report.[4]

4 The Phase 2 Variability study may not be required. This decision would be based on a review of the Tank 51 waste qualification analysis, the primary frit(s) of interest and the existing composition-property database. More specifically, the compositional space for SB3 would be projected and a review of existing data would be performed (including that from the current SB3 Phase 1 study) to assess the need to fill compositional gaps. One possible outcome of that review is a determination that the compositional region is adequately covered and the applicability of ΔG_P to the anticipated region can be technically defended.

Objectives for the SB3 Phase 1 Variability Study are specified in Section 2.0. In Section 3.0, the inputs from which the anticipated SB3 compositional region and glass selection processes were based are discussed. Section 4.0 discusses the use of the Measurement Acceptance Region (MAR) selection criteria to establish the test matrix glasses. The fabrication and testing (both physical and chemical) of the SB3 Phase 1 Variability Study glasses are discussed in Section 5.0. Section 6.0 summarizes the results of the compositional analysis (target vs. measured compositions), the assessment of the applicability of ΔG_P to SB3, and the impact of redox on the durability response measure. Section 7.0 provides a summary of the Phase 1 test results. Recommendations are presented in Section 8.0.

2.0 Objective

The objective of this task is to assess the applicability of the current PCCS durability model (ΔG_P) to the anticipated compositional region of interest to SB3. Specifically, this study will demonstrate the applicability of durability predictions (as measured by the Product Consistency Test) for specific SB3 compositions.

These results will be used during the frit selection process for SB3. As discussed in Section 1.0, the frit selection process should not be made based on a single criterion but rather on a collection of criteria that provide insight into both the economics and processability of SB3. This work has been prepared to address technical issues discussed in Technical Task Request HLW/DWPF/TTR-02-0027, Rev. 0 (Rios-Armstrong 2002b) and in accordance with the Task Technical and Quality Assurance Plan (Herman, Peeler, and Edwards 2002).

3.0 Compositional Basis for the Glass Selection Process

To assess the applicability of the current durability model to the anticipated SB3 composition region one must first establish the SB3 composition region of interest. Composition regions of interest typically are developed around three primary factors: (1) sludge or waste stream composition(s), (2) frit composition(s), and (3) waste loading intervals of interest. These three primary inputs are briefly discussed below. It should be noted that the Phase 1 Variability Study will be based on nominal sludge compositions – composition variation around the nominal wash/decant sludge composition was not taken into account.

3.1 Sludge Compositions

Two primary inputs were used to define the SB3 sludge composition region of interest: (1) linear washing scenarios and (2) decant information from HLW PE — both based on Waste Characterization System (WCSystem) information. Sludge compositions that form the basis for the SB3 Phase 1 Variability Study glasses are presented in Sections 3.1.1 and 3.1.2.

3.1.1 SB3 Compositions Based on Linear Washing Scenarios

At the time this task was initiated, uncertainties associated with the actual quantity of sodium oxalate ($Na_2C_2O_4$) in Tank 7 and the fraction that would ultimately be transferred to SB3 given the various washing scenarios under consideration were being addressed. From a glass formulation perspective, the unknown quantity of Na_2O resulting from the $Na_2C_2O_4$ would have a major impact on the overall sludge composition and ultimately the frit development efforts. Peeler and Edwards (2002) performed initial assessments using compositions based on a linear washing scheme prior to receiving projected sludge compositions as a function of washing (or decant) from HLW PE (see Section 3.1.2). That assessment based on model predictions demonstrated the need to compositionally compensate (by adjusting the frit composition) for the varying Na_2O concentrations present in the sludge as different washing schemes were considered.

Table 3-1 summarizes the nominal SB3 compositions for the linear washing scenarios (using the underlying assumptions as discussed by Peeler and Edwards (2002)). It also should be noted that these nominal SB3 compositions do not account for the potential introduction of a monosodium titanate (MST) stream (e.g., TiO_2 is not present in the projected sludge compositions). Based on HLW System Plan (WSRC 2001), it is anticipated that a limited volume of MST will be blended into SB3. However, given the current uncertainties of if, when, and/or how (e.g., blended over the entire SB3 campaign or spiked into a limited portion of the SB3 campaign) that stream would be blended with SB3; its contribution was not accounted for in the initial assessments by Peeler and Edwards (2002). The contribution of this secondary stream is accounted for in the decant information provided by Elder (see Section 3.1.2).[5]

[5] Personal communication with H.H. Elder via email dated 7/30/02. Appendix A provides the data transmitted in the personal communication (elemental wt%, calcine basis).

Table 3-1. Nominal Compositions of SB3 as a Function of Linear Washing Scenario (wt%, oxide basis).

Oxide	0% Washed	25% Washed	50% Washed	75% Washed	100% Washed
Ag_2O	0.000	0.000	0.000	0.000	0.001
Al_2O_3	13.140	14.110	15.230	16.540	18.100
AmO_2	0.003	0.003	0.003	0.004	0.004
BaO	0.182	0.195	0.211	0.229	0.250
CaO	2.610	2.800	3.030	3.290	3.600
Ce_2O_3	0.258	0.277	0.298	0.324	0.355
Cm_2O_3	0.000	0.000	0.000	0.000	0.001
Cr_2O_3	0.272	0.292	0.315	0.342	0.374
CuO	0.144	0.154	0.167	0.181	0.198
Eu_2O_3	0.003	0.004	0.004	0.004	0.005
Fe_2O_3	29.230	31.380	33.870	36.800	40.270
Gd_2O_3	0.037	0.040	0.043	0.046	0.051
K_2O	0.313	0.336	0.362	0.393	0.431
La_2O_3	0.149	0.160	0.173	0.188	0.206
Li_2O	0.002	0.002	0.003	0.003	0.003
MgO	0.137	0.147	0.158	0.172	0.188
MnO	5.210	5.590	6.040	6.560	7.180
Na_2O	35.130	30.360	24.830	18.340	10.630
Nd_2O_3	0.495	0.531	0.573	0.623	0.682
NiO	1.170	1.260	1.360	1.470	1.610
PbO	0.220	0.236	0.254	0.276	0.276
PdO	0.027	0.029	0.031	0.033	0.037
Pr_2O_3	0.135	0.145	0.157	0.170	0.186
PuO_2	0.038	0.041	0.044	0.048	0.052
RhO_2	0.056	0.061	0.065	0.071	0.078
RuO_2	0.202	0.217	0.234	0.254	0.278
SiO_2	2.430	2.610	2.810	3.050	3.340
Sm_2O_3	0.073	0.078	0.084	0.091	0.100
ThO_2	0.104	0.112	0.120	0.131	0.143
TiO_2	0.000	0.000	0.000	0.000	0.000
U_3O_8	7.390	7.940	8.570	9.310	10.190
ZnO	0.299	0.320	0.345	0.375	0.411
ZrO_2	0.540	0.579	0.625	0.679	0.743
Sum	100.00	100.00	100.00	100.00	100.00

3.1.2 SB3 Composition as a Function of Decant

As previously stated, assessments were initially performed using the linear washing schemes prior to receiving projected sludge compositions as a function of washing (or decant) from HLW PE. Elder provided the compositional estimates of SB3 as a function of decant (see Appendix A). The elemental concentrations provided by Elder were converted to an oxide basis (by multiplying by the appropriate gravimetric factor) and these data are presented in Table 3-2.

General observations of composition as a function of washing indicate that the Na_2O concentrations decrease with increased washing (or decanting). Initially, the Na_2O concentration decreases relatively quickly with the differences becoming smaller as the decant number increases. All other components trend in the opposite direction – increased concentration as the decant number increases. Although this trend was expected, the Na_2O concentration for the minimum washed sludge (Decant #5) is lower than that associated with the nominal 0% linear washed case (see Table 3-1), 31.205 versus 35.13 wt%, respectively. This difference is based on the assumptions made in the initial compositional projections given no washing models were available at the time. Communications with HLW PE indicated that a minimum wash/decant sequence must be performed in order to transfer Tank 7. This fact was not originally considered when the 0% linear washed case was established as a viable compositional endpoint.

It should also be noted that the compositional projections provided by Elder include significant quantities of TiO_2 ranging from 2.154% to 2.627% in Decant #5 to Decant #15, respectively. The TiO_2 results from the introduction of the MST stream. TiO_2 was considered as a major oxide when these sludges were evaluated by Peeler and Edwards (2002).

Table 3-2. Projected SB3 Compositions as a Function of Decant (oxide basis, wt%).

Oxide	Decant #5	Decant #6	Decant #7	Decant #8	Decant #9	Decant #10	Decant #11	Decant #12	Decant #13	Decant #14	Decant #15
Al_2O_3	13.844	14.348	14.777	15.139	15.467	15.743	16.006	16.253	16.458	16.669	16.886
BaO	0.192	0.198	0.204	0.209	0.214	0.218	0.221	0.225	0.228	0.231	0.234
CaO	2.755	2.855	2.940	3.012	3.077	3.132	3.185	3.234	3.274	3.316	3.360
Ce_2O_3	0.267	0.277	0.285	0.292	0.298	0.304	0.309	0.313	0.317	0.321	0.326
Cr_2O_3	0.283	0.293	0.302	0.310	0.316	0.322	0.327	0.332	0.337	0.341	0.345
CuO	0.152	0.157	0.162	0.166	0.169	0.172	0.175	0.178	0.180	0.183	0.185
Fe_2O_3	30.784	31.905	32.858	33.664	34.392	35.007	35.591	36.141	36.596	37.065	37.549
K_2O	0.329	0.341	0.352	0.360	0.368	0.375	0.381	0.387	0.392	0.397	0.402
La_2O_3	0.176	0.182	0.187	0.192	0.196	0.200	0.203	0.206	0.209	0.211	0.214
MgO	0.144	0.150	0.154	0.158	0.161	0.164	0.167	0.169	0.172	0.174	0.176
MnO	5.491	5.690	5.860	6.004	6.134	6.244	6.348	6.446	6.527	6.611	6.697
Na_2O	31.205	28.701	26.571	24.770	23.142	21.770	20.464	19.235	18.219	17.170	16.089
NiO	1.231	1.276	1.314	1.346	1.375	1.400	1.423	1.445	1.463	1.482	1.501
PbO	0.230	0.238	0.245	0.251	0.257	0.261	0.265	0.270	0.273	0.276	0.280
SiO_2	1.603	1.661	1.711	1.753	1.791	1.823	1.853	1.882	1.906	1.930	1.955
ThO_2	0.110	0.114	0.117	0.120	0.122	0.125	0.127	0.129	0.130	0.132	0.134
TiO_2	2.154	2.232	2.299	2.356	2.407	2.450	2.490	2.529	2.561	2.594	2.627
U_3O_8	7.792	8.075	8.316	8.520	8.705	8.860	9.008	9.147	9.262	9.381	9.504
ZnO	0.315	0.326	0.336	0.344	0.351	0.358	0.364	0.369	0.374	0.379	0.384
ZrO_2	0.568	0.589	0.607	0.622	0.635	0.646	0.657	0.667	0.676	0.684	0.693
Sum	99.624	99.610	99.598	99.588	99.579	99.572	99.565	99.558	99.553	99.547	99.541

Based on input from DWPF and HLW PE personnel, the SB3 Technical team decided to narrow the focus to span the range bounded by Decant #5 through Decant #9. The latter decision was made based on the lack of identifying any significant technical issues during the initial stages of the SB3 flowsheet development activities that would require significant sludge washing. Washing the sludge less does have advantages in terms of significant time and labor savings in the pretreatment/retrieval operation. A reduced washing campaign would also result in less water being sent to the evaporators. Conversely, targeting a more washed sludge would reduce the total number of canisters produced by some incremental amount and may minimize components that have potentially negative impacts to either WL or processability (such as SO_4). A cost-benefit analysis should be performed to fully understand the advantages and disadvantages of selecting a targeted washing scenario. Even though the SB3 team did not have access to a detailed cost-benefit analysis, they elected to narrow the decant/washing focus to span an interval covered by Decant #5 through Decant #9.

Although primarily interested in the decant information (given a more solid technical basis due to compositional projections being based on blending and washing models), the Phase 1 Variability Study also included glass compositions based on the linear washed sludge. The specific (and nominal) compositions used were based on the 0%, 25%, and 50% linear washed projections as shown in Table 3-1. The linear washing compositions extend the overall SB3 compositional region of interest in Phase 1 relative to the sole use of Decants #5 and #9 – supporting the global Phase 1 strategy as discussed in Section 1.0.

3.2 Frit Compositions

Although Elder (2002) has established Frit 202 and Frit 320 as “baseline” frits for specific SB3 decant compositions, Peeler and Edwards (2002) developed a series of frits that provided attractive PCCS operational windows (based on model predictions) for the linear washing and decant compositions. Implementation or use of these alternative frit compositions may provide benefit in terms of maximizing waste throughput for SB3. Table 3-3 summarizes the frit compositions of interest for SB3.[6]

Based on the assessments performed by Peeler and Edwards (2002), nine alternative (400 series) and two existing frits (Frit 202 and Frit 320) were classified as primary candidates (shaded in gray in Table 3-3) for the specific washing scenarios of interest. This classification was based on the response of each frit/sludge combination (for both nominal and nominal±10% variation based sludges) for the model-based assessments. Model-based predictions indicated these frits would have large PCCS windows at attractive WLs and are robust to compositional variation for specific washing scenarios.

[6] During the frit development process, an alphanumeric nomenclature or system was used to identify specific frit compositions. These alphanumeric identifiers have been converted to a numerical series (the 400 series). Appendix B provides the conversion chart.

**Table 3-3. Nominal Compositions of Candidate Frits (in wt% on an oxide basis).
(primary frit candidates shaded in gray)**

Frit ID	Al_2O_3	B_2O_3	Li_2O	Na_2O	SiO_2	MgO	Total
Frit 202	-	8	7	6	77	2	100
Frit 320	-	8	8	12	72	-	100
Frit 400	-	20	-	-	80	-	100
Frit 401	-	30	-	-	70	-	100
Frit 402	-	12	-	-	88	-	100
Frit 403	-	15	3	-	82	-	100
Frit 404	-	12	3	-	85	-	100
Frit 405	-	20	5	-	75	-	100
Frit 406	-	15	5	-	80	-	100
Frit 407	-	8	-	6	86	-	100
Frit 408	-	8	2	6	84	-	100
Frit 409	-	8	4	6	82	-	100
Frit 410	-	8	5	5	82	-	100
Frit 411	1	8	5	12	74	-	100
Frit 412	-	8	5	12	75	-	100
Frit 413	-	9	5	15	71	-	100
Frit 414	-	8	6	14	72	-	100
Frit 415	-	10	5	15	70	-	100
Frit 416	1	8	8	11	72	-	100
Frit 417	-	8	8	11	73	-	100
Frit 418	-	8	8	8	76	-	100
Frit 419	-	8	8	15	69	-	100
Frit 420	1	8	5	7	79	-	100
Frit 421	1	10	5	7	77	-	100
Frit 422	-	8	8	3	81	-	100
Frit 423	-	10	8	3	79	-	100

3.3 Waste Loading

Given definition of both sludge and frit compositions of interest, the last criterion needed prior to establishing specific SB3 Phase 1 glass compositions is a targeted WL or WL interval. Ultimately, the DWPF will utilize PCCS to determine the acceptability of each batch of SME product before processing in the melter. PCCS acceptability is determined by imposing several constraints on the measured composition of samples from the SME batch. The PCCS constraints are related to process or product properties, which are derived directly from the SME measurements or indirectly from them via model predictions. These predictions are generated using property– composition models (e.g., the durability – ΔG_P correlation). In addition, PCCS takes into account modeling, analytic, and measurement uncertainties as part of the acceptability determination. The uncertainties are accounted for in two steps. The first is the uncertainty due to the property model, which when accounted for provides the Property Acceptability Region (PAR). The second is the uncertainty due to sampling and analytical (grouped under the heading of measurement). This uncertainty is accounted for, when necessary, in addition to the property uncertainty, and the resulting (more restrictive) region defines the MAR. The baseline document guiding the use of these models is Revision 4 of "SME Acceptability Determination for DWPF Process Control" by Brown, Postles, and Edwards (2002). Ultimately, DWPF will utilize the PCCS MAR criteria to determine the acceptability of each batch of SME product before processing in the melter.

4.0 Selecting the Glasses for the SB3 Phase 1 Study

With respect to the SB3 frit development effort, Peeler and Edwards (2002) utilized the PAR criteria to provide a preliminary assessment of the performance of candidate frits over the WL interval of 25 – 60%. The authors also assessed the impact of applying the MAR criteria on the projected PAR operational windows over this WL range for select frit/sludge combinations. One purpose of that effort was to assure that a relatively large operational window provided by a PAR assessment was not reduced, via the MAR assessment, to an unmanageable interval (i.e., in terms of minimizing DWPF flexibility to the point of inoperability). A second benefit of the MAR assessment is that it provided the basis for the WL intervals used in this study. More specifically, the glass selection process for the Phase 1 Variability Study used the MAR criteria to establish upper and lower WL bounds for specific frit/sludge systems of interest.

The property predictions used to define the upper and lower WL for each system included durability (Product Consistency Test [PCT] [ASTM 1998] response in terms of ΔG_P), viscosity at 1150°C ($\eta_{1150°C}$), liquidus temperature (T_L)[7], homogeneity, and Al_2O_3 and alkali concentrations. Jantzen et al. (1995) and Brown et al. (2001) provide a more detailed discussion on the development of these models.

Appendices C1 and C2 provide assessments of the projected operational windows for various sludge (Decant #5, Decant #9 in Appendix C1 and 0% linear wash, 25% linear wash, and 50% linear wash in Appendix C2) and frit combinations based on the MAR criteria.[8] The columns identified as Frit-Decant and Frit-Washing in these appendices indicate the specific frit/sludge combination being evaluated. The "% WL" column provides the WL. The next five columns labeled as "Durability", "T_L", "Visc", "Frit", and "Homog", represent the MAR determinations (in terms of pass or fail) for durability, liquidus temperature, viscosity, low/high frit, and homogeneity, respectively. A "-" entry in a specific cell under these columns indicates that the predicted property satisfies the MAR. For "durability", "T_L", and "homog", a "NO" in the respective cell indicates that the predicted property fails the MAR and that particular frit/sludge combination is not acceptable at that WL. For "visc" and "Frit", if "high" or "low" is shown, this is an indication that the predicted property fails the MAR and on which side (high or low). The last 7 columns of these appendices provide property values of interest. For example, Table 4-1 summarizes the MAR assessment for Frit 202 and Decant #5 over the 25 – 60% WL interval. At 25% WL, predictions of high frit and an inhomogeneous product restrict processing. Predictions of homogeneity still restrict processing up through 32% WL. At 38% WL, model predictions indicate that durability will be unsatisfactory. All properties are satisfied (at the MAR) for WLs of 33 – 37% WL; hence the projected operational window for this particular nominal sludge and frit combination as shown in Table 4-2.

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[7] Liquidus temperature was assessed using the revised T_L model as described by Brown et al. (2001).

[8] These MAR assessments were made utilizing the same approach as that used in developing the test cases supporting the implementation of Version 4.2 of DWPF's PCCS system. The approach and resulting test cases are provided in Edwards, T. B., "Revision of DWPF's PCCS: An Overview of the Modifications and Associated Test Cases (U)," SRT-SCS-2002-00032, May 24, 2002. Appendix C2 also includes a 75% washed case with Frit 320.

**Table 4-1. MAR Assessment for Frit 202 and Decant #5.
(from Appendix C1)**

		MAR Assessment					Property Values							
Frit-Decant	% WL	Durability	T_L	Visc	Frit	Homog	Al_2O_3	Alkali	T_L	Visc	ΔG_P	Homog	Frit
202-Decant #5	25	-	-	-	High	NO	3.46	17.61	750.1	81.02	-10.646	198.96	81.76
202-Decant #5	26	-	-	-	-	NO	3.60	17.79	760.4	76.74	-10.788	200.63	81.11
202-Decant #5	27	-	-	-	-	NO	3.74	17.98	770.1	72.58	-10.929	202.31	80.46
202-Decant #5	28	-	-	-	-	NO	3.88	18.16	779.6	68.53	-11.071	203.98	79.81
202-Decant #5	29	-	-	-	-	NO	4.01	18.35	788.9	64.62	-11.212	205.65	79.16
202-Decant #5	30	-	-	-	-	NO	4.15	18.53	797.8	60.82	-11.354	207.33	78.51
202-Decant #5	31	-	-	-	-	NO	4.29	18.72	806.5	57.15	-11.496	209.00	77.86
202-Decant #5	32	-	-	-	-	NO	4.43	18.90	814.9	53.61	-11.637	210.67	77.21
202-Decant #5	33	-	-	-	-	-	4.57	19.09	823.0	50.20	-11.779	212.34	76.56
202-Decant #5	34	-	-	-	-	-	4.71	19.27	830.9	46.91	-11.921	214.02	75.92
202-Decant #5	35	-	-	-	-	-	4.85	19.45	838.6	43.75	-12.062	215.69	75.27
202-Decant #5	36	-	-	-	-	-	4.98	19.64	846.1	40.71	-12.204	217.36	74.62
202-Decant #5	37	-	-	-	-	-	5.12	19.82	853.4	37.80	-12.345	219.03	73.97
202-Decant #5	38	NO	-	-	-	-	5.26	20.01	860.5	35.02	-12.487	220.71	73.32
202-Decant #5	39	NO	-	-	-	-	5.40	20.19	867.3	32.37	-12.629	222.38	72.67
202-Decant #5	40	NO	-	-	-	-	5.54	20.38	874.1	29.84	-12.770	224.05	72.02
202-Decant #5	41	NO	-	-	-	-	5.68	20.56	880.6	27.43	-12.912	225.73	71.37
202-Decant #5	42	NO	-	-	-	-	5.81	20.75	886.9	25.15	-13.053	227.40	70.72
202-Decant #5	43	NO	-	Low	-	-	5.95	20.93	893.1	22.99	-13.195	229.07	70.07
202-Decant #5	44	NO	-	Low	-	-	6.09	21.11	899.2	20.96	-13.336	230.74	69.42
202-Decant #5	45	NO	-	Low	-	-	6.23	21.30	905.1	19.04	-13.478	232.42	68.77
202-Decant #5	46	NO	-	Low	-	-	6.37	21.48	910.8	17.23	-13.620	234.09	68.12
202-Decant #5	47	NO	-	Low	-	-	6.51	21.67	916.5	15.54	-13.761	235.76	67.47
202-Decant #5	48	NO	-	Low	-	-	6.65	21.85	921.9	13.97	-13.903	237.44	66.82
202-Decant #5	49	NO	-	Low	-	-	6.78	22.04	927.3	12.50	-14.045	239.11	66.17
202-Decant #5	50	NO	-	Low	-	-	6.92	22.22	932.5	11.14	-14.186	240.78	65.52
202-Decant #5	51	NO	-	Low	-	-	7.06	22.41	937.6	9.88	-14.328	242.45	64.87
202-Decant #5	52	NO	-	Low	-	-	7.20	22.59	942.6	8.73	-14.469	244.13	64.22
202-Decant #5	53	NO	-	Low	-	-	7.34	22.77	947.5	7.67	-14.611	245.80	63.57
202-Decant #5	54	NO	-	Low	-	-	7.48	22.96	952.3	6.70	-14.753	247.47	62.92
202-Decant #5	55	NO	-	Low	-	-	7.61	23.14	956.9	5.82	-14.894	249.14	62.27
202-Decant #5	56	NO	-	Low	-	-	7.75	23.33	961.5	5.02	-15.036	250.82	61.62
202-Decant #5	57	NO	-	Low	-	-	7.89	23.51	965.9	4.31	-15.177	252.49	60.98
202-Decant #5	58	NO	-	Low	-	-	8.03	23.70	970.3	3.67	-15.319	254.16	60.33
202-Decant #5	59	NO	-	Low	-	-	8.17	23.88	974.6	3.11	-15.461	255.83	59.68
202-Decant #5	60	NO	-	Low	-	-	8.31	24.06	978.8	2.60	-15.602	257.51	59.03

Table 4-2 summarizes the MAR assessments for the specific frit/sludge combinations of interest. Also listed in Table 4-2 is the property limiting both the upper and lower WLs. For example, for the Decant #5 / Frit 202 system, predictions of inhomogeneity limit WLs below 33% while durability predictions limit access to WLs exceeding 37%.

Given two WLs for the twenty specific frit/sludge combinations of interest (see Table 4-2), a total of 40 glasses were identified. It should be noted that the TTR (Rios-Armstrong 2002b) provided direction to fabricate and test a few glasses outside the acceptable region. This was taken into consideration during the glass selection process. Two SB3 glasses were selected even though they would be classified as unacceptable based on model predictions at the MAR. Specifically, SB3-13 (Frit 411 and 50% linear wash sludge at 25% WL) and SB3-35 (Frit 411 and Decant #9 at 25% WL). The MAR predictions (see Appendices C1 and C2) indicate that both glasses are inhomogeneous at 25% WL – yet they were included in the SB3 Phase 1 test matrix. For these two systems, glasses at 26% WL are predicted to be homogeneous which is reflected in the acceptable PCCS operating window as 26 – 39 and 26 – 45% WL for SB3-13 and SB3-35, respectively.

Herman, Peeler, and Edwards (2002) indicated that Frit 320 would also be evaluated in the Phase 1 study given its classification as a "baseline" frit by Elder (2002). Based on the paper study assessment (Peeler and Edwards 2002), Frit 320 is a viable frit for the more advanced washed sludges (e.g., 75% linear washing case, Decant #12 and above). Combining Frit 320 with less washed sludges is typically prohibited by predictions of durability or low viscosity (a direct result of the high alkali concentrations of both the sludge and frit). Given the emphasis on the "lesser" washed sludges and the direction set by the SB3 Technical team, use of Frit 320 would be prohibited for the nominal sludges (Decant #5 and Decant #9) being considered. To assess the applicability of the durability model to a Frit 320-based system, two glasses were added to the SB3 Phase 1 test matrix. SB3-41 and SB3-42 are Frit 320-based glasses with the 75% linear washed sludge at 26 and 41% WL, respectively. It should be noted that the upper and lower WLs for these two glasses are not based on the MAR criteria but on the less restrictive PAR. Peeler and Edwards (2002) indicate that the WL interval of interest for this system (nominal Frit 320 / 75% linear washing – see Appendix B of that report for details) is 26 – 41%. Predictions of homogeneity and low viscosity restrict access to lower and upper WLs respectively. They also indicate that PCCS operational windows based on the PAR tend to reduce in size once the MAR criteria are applied (given the additional uncertainties due to sampling and analytical).[9] Given the upper WL for this Frit 320 system is low viscosity limited at the PAR, once MAR uncertainties are included, one would expect the upper WL limit to be less than 41%. The MAR assessments for this system are shown in Appendix C2 and are repeated in Table 4-3. As seen there, the projected operational window for this frit/sludge combination is 26 – 39% WL. Therefore, fabrication and testing of SB3-42 (41% WL) should be "unacceptable" based on MAR criteria.

[9] Peeler and Edwards (2002) demonstrated that for T_L-limited systems the use of the 1010°C PAR criterion for T_L was "conservative." That is, for systems determined to be T_L-limited based upon a PAR criterion of 1010°C for T_L, application of the MAR did not reduce the size of the DWPF operational window.

Table 4-2. Summary of Waste Loading Ranges for Select Frit/Sludge Combinations Using the MAR Criteria.

		Frit 202	Frit 409	Frit 410	Frit 420	Frit 421	Frit 422	Frit 423	Frit 411	Frit 405	Frit 406
Decant #5	WL (nominal)	33 – 37	34 – 48	33 – 48	30 – 43	30 – 41	31 – 45	31 – 43	-	-	-
	Lower limit	Homog	High Vis	High Vis	Homog	Homog	Homog	Homog	-	-	-
	Upper limit	PCT	PCT	PCT	PCT	PCT	Low Vis	Low Vis	-	-	-
Decant #9	WL (nominal)	29 – 45	-	-	35 – 47	32 – 47	31 – 46	28 – 46	26 – 45	-	-
	Lower limit	Homog	-	-	High Vis	High Vis	High Vis	High Vis/ Homog	Homog	-	-
	Upper limit	T_L	-	-	T_L	T_L	T_L	T_L	Low Vis	-	-
0% Wash	WL (nominal)	-	-	-	-	-	-	-	-	32 – 43	32 – 46
	Lower limit	-	-	-	-	-	-	-	-	Homog	High Vis/ Homog
	Upper limit	-	-	-	-	-	-	-	-	Low Vis	PCT
25% Wash	WL (nominal)	31 – 38	-	-	-	-	-	-	-	30 – 46	35 – 50
	Lower limit	Homog	-	-	-	-	-	-	-	Homog	High Vis
	Upper limit	PCT	-	-	-	-	-	-	-	Low Vis	Low Vis
50% Wash	WL (nominal)	29 – 46	-	-	-	-	-	-	26 – 39	-	-
	Lower limit	Homog	-	-	-	-	-	-	Homog	-	-
	Upper limit	T_L	-	-	-	-	-	-	PCT	-	-

Table 4-3. MAR Assessment for Frit 320 and 75% Linear Washed Sludge. (from Appendix C2)

		MAR Assessments					Property Values						
Frit-Washing	**% WL**	**Durability**	**T_L**	**Visc**	**Frit**	**Homog**	**Al_2O_3**	**Alkali**	**T_L**	**Visc**	**ΔG_P**	**Homog**	**Frit**
320-75% Washed	25	-	-	-	-	NO	4.13	19.68	735.9	45.57	-12.230	210.56	80.45
320-75% Washed	26	-	-	-	-	-	4.30	19.67	751.7	43.97	-12.197	212.56	79.66
320-75% Washed	27	-	-	-	-	-	4.47	19.66	767.0	42.39	-12.163	214.57	78.88
320-75% Washed	28	-	-	-	-	-	4.63	19.65	782.2	40.82	-12.130	216.58	78.10
320-75% Washed	29	-	-	-	-	-	4.80	19.63	796.9	39.27	-12.097	218.59	77.32
320-75% Washed	30	-	-	-	-	-	4.96	19.62	811.3	37.75	-12.064	220.60	76.54
320-75% Washed	31	-	-	-	-	-	5.13	19.61	825.5	36.24	-12.030	222.61	75.75
320-75% Washed	32	-	-	-	-	-	5.29	19.60	839.4	34.75	-11.997	224.62	74.97
320-75% Washed	33	-	-	-	-	-	5.46	19.58	853.0	33.29	-11.964	226.62	74.19
320-75% Washed	34	-	-	-	-	-	5.62	19.57	866.3	31.85	-11.931	228.63	73.41
320-75% Washed	35	-	-	-	-	-	5.79	19.56	879.4	30.43	-11.897	230.64	72.63
320-75% Washed	36	-	-	-	-	-	5.95	19.55	892.3	29.03	-11.864	232.65	71.84
320-75% Washed	37	-	-	-	-	-	6.12	19.53	904.8	27.67	-11.831	234.66	71.06
320-75% Washed	38	-	-	-	-	-	6.29	19.52	917.2	26.32	-11.797	236.67	70.28
320-75% Washed	39	-	-	-	-	-	6.45	19.51	929.4	25.01	-11.764	238.67	69.50
320-75% Washed	40	-	-	Low	-	-	6.62	19.49	941.3	23.72	-11.731	240.68	68.71
320-75% Washed	41	-	-	Low	-	-	6.78	19.48	953.0	22.46	-11.698	242.69	67.93
320-75% Washed	42	-	-	Low	-	-	6.95	19.47	964.5	21.24	-11.664	244.70	67.15
320-75% Washed	43	-	-	Low	-	-	7.11	19.46	975.9	20.04	-11.631	246.71	66.37
320-75% Washed	44	-	-	Low	-	-	7.28	19.44	987.0	18.87	-11.598	248.72	65.59
320-75% Washed	45	-	-	Low	-	-	7.44	19.43	997.9	17.73	-11.565	250.72	64.80
320-75% Washed	46	-	-	Low	-	-	7.61	19.42	1008.6	16.63	-11.532	252.73	64.02
320-75% Washed	47	-	NO	Low	-	-	7.77	19.41	1019.2	15.56	-11.498	254.74	63.24
320-75% Washed	48	-	NO	Low	-	-	7.94	19.39	1029.6	14.53	-11.465	256.75	62.46
320-75% Washed	49	-	NO	Low	-	-	8.10	19.38	1039.8	13.53	-11.432	258.76	61.68
320-75% Washed	50	-	NO	Low	-	-	8.27	19.37	1049.8	12.57	-11.398	260.77	60.89
320-75% Washed	51	-	NO	Low	-	-	8.44	19.36	1059.7	11.64	-11.365	262.77	60.11
320-75% Washed	52	-	NO	Low	-	-	8.60	19.34	1069.4	10.75	-11.332	264.78	59.33
320-75% Washed	53	-	NO	Low	-	-	8.77	19.33	1079.1	9.90	-11.299	266.79	58.55
320-75% Washed	54	-	NO	Low	-	-	8.93	19.32	1088.5	9.08	-11.265	268.80	57.76
320-75% Washed	55	-	NO	Low	-	-	9.10	19.30	1097.7	8.31	-11.232	270.81	56.98
320-75% Washed	56	-	NO	Low	-	-	9.26	19.29	1106.9	7.57	-11.199	272.82	56.20
320-75% Washed	57	-	NO	Low	-	-	9.43	19.28	1115.9	6.87	-11.165	274.82	55.42
320-75% Washed	58	-	NO	Low	-	-	9.59	19.27	1124.7	6.21	-11.132	276.83	54.64
320-75% Washed	59	-	NO	Low	-	-	9.76	19.25	1133.4	5.59	-11.099	278.84	53.85
320-75% Washed	60	-	NO	Low	-	-	9.92	19.24	1142.0	5.00	-11.066	280.85	53.07

Table 4-4 summarizes the basis for the forty-two SB3 Phase 1 glass compositions. Table 4-5 summarizes the targeted compositions. The target compositions shown are a result of combining the nominal sludge (see Table 3-1 and Table 3-2) and frit compositions (see Table 3-3) at the selected upper and lower WLs.

Table 4-4. SB3 Phase 1 Glass Identifiers and Compositional Basis.

Glass Identification	Basis	Property Constraint[10]
SB3-1	Frit 405, 0% Wash, 32% WL	Homogeneity
SB3-2	Frit 405, 0% Wash, 43% WL	Low Viscosity
SB3-3	Frit 406, 0% Wash, 32% WL	High Viscosity / Homogeneous
SB3-4	Frit 406, 0% Wash, 46% WL	PCT
SB3-5	Frit 202, 25% Wash, 31% WL	Homogeneity
SB3-6	Frit 202, 25% Wash, 38% WL	PCT
SB3-7	Frit 405, 25% Wash, 30% WL	Homogeneity
SB3-8	Frit 405, 25% Wash, 46% WL	Low Viscosity
SB3-9	Frit 406, 25% Wash, 35% WL	High Viscosity
SB3-10	Frit 406, 25% Wash, 50% WL	Low Viscosity
SB3-11	Frit 202, 50% Wash, 29% WL	Homogeneity
SB3-12	Frit 202, 50% Wash, 46% WL	T_L
SB3-13	Frit 411, 50% Wash, 25% WL	Homogeneity
SB3-14	Frit 411, 50% Wash, 39% WL	PCT
SB3-15	Frit 202, Decant #5, 33% WL	Homogeneity
SB3-16	Frit 202, Decant #5, 37% WL	PCT
SB3-17	Frit 420, Decant #5, 30% WL	Homogeneity
SB3-18	Frit 420, Decant #5, 43% WL	PCT
SB3-19	Frit 421, Decant #5, 30% WL	Homogeneity
SB3-20	Frit 421, Decant #5, 41% WL	PCT
SB3-21	Frit 409, Decant #5, 34% WL	High Viscosity
SB3-22	Frit 409, Decant #5, 48% WL	PCT
SB3-23	Frit 410, Decant #5, 33% WL	High Viscosity
SB3-24	Frit 410, Decant #5, 48% WL	PCT
SB3-25	Frit 422, Decant #5, 31% WL	Homogeneity
SB3-26	Frit 422, Decant #5, 45% WL	Low Viscosity
SB3-27	Frit 423, Decant #5, 31% WL	Homogeneity
SB3-28	Frit 423, Decant #5, 43% WL	Low Viscosity
SB3-29	Frit 202, Decant #9, 29% WL	Homogeneity
SB3-30	Frit 202, Decant #9, 45% WL	T_L
SB3-31	Frit 420, Decant #9, 35% WL	High Viscosity
SB3-32	Frit 420, Decant #9, 47% WL	T_L
SB3-33	Frit 421, Decant #9, 32% WL	High Viscosity
SB3-34	Frit 421, Decant #9, 47% WL	T_L
SB3-35	Frit 411, Decant #9, 25% WL	Homogeneity
SB3-36	Frit 411, Decant #9, 45% WL	Low Viscosity
SB3-37	Frit 422, Decant #9, 31% WL	High Viscosity
SB3-38	Frit 422, Decant #9, 46% WL	T_L
SB3-39	Frit 423, Decant #9, 28% WL	High Viscosity / Homogeneous
SB3-40	Frit 423, Decant #9, 46% WL	T_L
SB3-41	Frit 320, 75% Wash, 26% WL	Homogeneity
SB3-42	Frit 320, 75% Wash, 41% WL	Low Viscosity

[10] The property listed is the constraint that restricts access to higher (for the maximum WL) or lower (for the minimum WL) waste loadings (from Table 4-2).

Table 4-5. Target Glass Compositions for the Forty-Two SB3 Phase 1 Variability Study Glasses. (in wt% on an calcined oxide basis)

Oxide	SB3-1	SB3-2	SB3-3	SB3-4	SB3-5	SB3-6	SB3-7	SB3-8	SB3-9	SB3-10
Al_2O_3	4.250	5.711	4.250	6.109	4.424	5.423	4.281	6.564	4.994	7.135
B_2O_3	13.600	11.400	10.200	8.100	5.520	4.960	14.000	10.8	9.750	7.500
CaO	0.845	1.136	0.845	1.215	0.880	1.078	0.851	1.305	0.993	1.419
Cr_2O_3	0.088	0.118	0.088	0.126	0.091	0.112	0.088	0.136	0.103	0.147
Fe_2O_3	9.455	12.705	9.455	13.591	9.841	12.063	9.523	14.603	11.111	15.872
K_2O	0.101	0.136	0.101	0.145	0.105	0.129	0.102	0.156	0.119	0.170
Li_2O	3.401	2.851	3.401	2.701	4.831	4.341	3.501	2.701	3.251	2.501
MnO	1.685	2.264	1.685	2.422	1.754	2.150	1.697	2.602	1.980	2.829
Na_2O	11.364	15.270	11.364	16.335	13.661	15.390	9.213	14.127	10.749	15.356
NiO	0.378	0.508	0.378	0.544	0.394	0.483	0.381	0.584	0.445	0.635
SiO_2	51.785	43.805	55.185	44.328	53.947	48.742	53.291	41.712	52.922	41.318
ThO_2	0.034	0.045	0.034	0.048	0.035	0.043	0.034	0.052	0.039	0.056
TiO_2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
U_3O_8	2.392	3.214	2.392	3.438	2.490	3.052	2.409	3.694	2.811	4.016
ZnO	0.097	0.130	0.097	0.139	0.100	0.123	0.097	0.149	0.113	0.162
ZrO_2	0.174	0.234	0.174	0.251	0.182	0.223	0.176	0.269	0.205	0.293
BaO	0.059	0.079	0.059	0.084	0.061	0.075	0.059	0.091	0.069	0.099
Ce_2O_3	0.083	0.112	0.083	0.120	0.087	0.106	0.084	0.129	0.098	0.140
CuO	0.047	0.063	0.047	0.067	0.048	0.059	0.047	0.072	0.055	0.078
La_2O_3	0.048	0.065	0.048	0.069	0.050	0.062	0.049	0.075	0.057	0.081
MgO	0.044	0.060	0.044	0.064	1.426	1.296	0.045	0.068	0.052	0.074
PbO	0.071	0.095	0.071	0.102	0.074	0.091	0.072	0.11	0.083	0.119
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table 4-5. Target Glass Compositions for the Forty-Two SB3 Phase 1 Variability Study Glasses. (continued)
(in wt% on an calcined oxide basis)

Oxide	SB3-11	SB3-12	SB3-13	SB3-14	SB3-15	SB3-16	SB3-17	SB3-18	SB3-19	SB3-20
Al_2O_3	4.471	7.092	4.604	6.623	4.586	5.142	4.869	6.546	4.869	6.288
B_2O_3	5.680	4.320	6.000	4.880	5.360	5.040	5.600	4.560	7.000	5.900
CaO	0.889	1.410	0.766	1.196	0.912	1.023	0.829	1.189	0.829	1.134
Cr_2O_3	0.092	0.147	0.080	0.124	0.094	0.105	0.085	0.122	0.085	0.117
Fe_2O_3	9.946	15.777	8.575	13.376	10.197	11.433	9.270	13.287	9.270	12.669
K_2O	0.106	0.169	0.092	0.143	0.109	0.122	0.099	0.142	0.099	0.136
Li_2O	4.971	3.781	3.751	3.051	4.690	4.410	3.500	2.850	3.500	2.950
MnO	1.773	2.812	1.528	2.384	1.819	2.039	1.653	2.370	1.653	2.260
Na_2O	11.550	14.804	15.285	17.124	14.357	15.370	14.297	17.459	14.297	16.973
NiO	0.398	0.631	0.343	0.535	0.408	0.457	0.371	0.531	0.371	0.507
SiO_2	55.496	42.890	56.212	46.251	52.121	49.105	55.783	45.722	54.383	46.090
ThO_2	0.035	0.056	0.030	0.048	0.036	0.041	0.033	0.047	0.033	0.045
TiO_2	0.000	0.000	0.000	0.000	0.714	0.800	0.649	0.930	0.649	0.887
U_3O_8	2.516	3.991	2.169	3.384	2.581	2.894	2.346	3.363	2.346	3.207
ZnO	0.102	0.161	0.088	0.137	0.104	0.117	0.095	0.136	0.095	0.129
ZrO_2	0.184	0.291	0.158	0.247	0.188	0.211	0.171	0.245	0.171	0.234
BaO	0.062	0.098	0.053	0.083	0.063	0.071	0.058	0.083	0.058	0.079
Ce_2O_3	0.088	0.139	0.076	0.118	0.088	0.099	0.080	0.115	0.080	0.110
CuO	0.049	0.078	0.042	0.066	0.050	0.056	0.046	0.065	0.046	0.062
La_2O_3	0.051	0.081	0.044	0.068	0.058	0.065	0.053	0.076	0.053	0.072
MgO	1.467	1.154	0.040	0.063	1.388	1.314	0.043	0.062	0.043	0.059
PbO	0.075	0.118	0.064	0.100	0.076	0.085	0.069	0.099	0.069	0.094
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table 4-5. Target Glass Compositions for the Forty-Two SB3 Phase 1 Variability Study Glasses. (continued)
(in wt% on an calcined oxide basis)

Oxide	SB3-21	SB3-22	SB3-23	SB3-24	SB3-25	SB3-26	SB3-27	SB3-28	SB3-29	SB3-30
Al_2O_3	4.725	6.670	4.586	6.670	4.308	6.253	4.308	5.976	4.504	6.990
B_2O_3	5.280	4.160	5.360	4.160	5.520	4.400	6.900	5.700	5.680	4.400
CaO	0.940	1.327	0.912	1.327	0.857	1.244	0.857	1.189	0.896	1.391
Cr_2O_3	0.097	0.136	0.094	0.136	0.088	0.128	0.088	0.122	0.092	0.143
Fe_2O_3	10.506	14.832	10.197	14.832	9.579	13.905	9.579	13.287	10.016	15.542
K_2O	0.112	0.159	0.109	0.159	0.103	0.149	0.103	0.142	0.107	0.166
Li_2O	2.640	2.080	3.350	2.600	5.520	4.400	5.520	4.560	4.970	3.850
MnO	1.874	2.645	1.819	2.645	1.709	2.480	1.709	2.370	1.786	2.772
Na_2O	14.610	18.155	13.687	17.635	11.780	15.745	11.780	15.179	11.000	13.758
NiO	0.420	0.593	0.408	0.593	0.383	0.556	0.383	0.531	0.401	0.621
SiO_2	54.667	43.412	55.471	43.412	56.389	45.274	55.009	45.722	55.192	43.159
ThO_2	0.037	0.053	0.036	0.053	0.034	0.049	0.034	0.047	0.036	0.055
TiO_2	0.735	1.038	0.714	1.038	0.670	0.973	0.670	0.930	0.701	1.088
U_3O_8	2.659	3.754	2.581	3.754	2.425	3.519	2.425	3.363	2.535	3.934
ZnO	0.107	0.152	0.104	0.152	0.098	0.142	0.098	0.136	0.102	0.159
ZrO_2	0.194	0.274	0.188	0.274	0.177	0.257	0.177	0.245	0.185	0.287
BaO	0.065	0.092	0.063	0.092	0.060	0.087	0.060	0.083	0.062	0.097
Ce_2O_3	0.091	0.129	0.088	0.129	0.083	0.121	0.083	0.115	0.087	0.135
CuO	0.052	0.073	0.050	0.073	0.047	0.069	0.047	0.065	0.049	0.077
La_2O_3	0.060	0.085	0.058	0.085	0.055	0.079	0.055	0.076	0.057	0.089
MgO	0.049	0.070	0.048	0.070	0.045	0.065	0.045	0.062	1.467	1.173
PbO	0.078	0.111	0.076	0.111	0.071	0.104	0.071	0.099	0.075	0.116
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Table 4-5. Target Glass Compositions for the Forty-Two SB3 Phase 1 Variability Study Glasses. (continued)
(in wt% on an calcined oxide basis)

Oxide	SB3-31	SB3-32	SB3-33	SB3-34	SB3-35	SB3-36	SB3-37	SB3-38	SB3-39	SB3-40	SB3-41	SB3-42
Al_2O_3	6.086	7.830	5.650	7.830	4.633	7.540	4.815	7.145	4.349	7.145	4.359	6.874
B_2O_3	5.200	4.240	6.800	5.300	6.000	4.400	5.520	4.320	7.200	5.400	5.920	4.720
CaO	1.082	1.452	0.989	1.452	0.773	1.391	0.958	1.422	0.865	1.422	0.867	1.367
Cr_2O_3	0.111	0.149	0.102	0.149	0.079	0.143	0.098	0.146	0.089	0.146	0.090	0.142
Fe_2O_3	12.088	16.233	11.052	16.233	8.634	15.542	10.707	15.887	9.671	15.887	9.697	15.292
K_2O	0.129	0.174	0.118	0.174	0.092	0.166	0.115	0.170	0.103	0.170	0.104	0.163
Li_2O	3.250	2.650	3.400	2.650	3.750	2.750	5.520	4.320	5.760	4.320	5.921	4.721
MnO	2.156	2.895	1.971	2.895	1.540	2.772	1.910	2.834	1.725	2.834	1.728	2.725
Na_2O	12.684	14.633	12.197	14.633	14.810	17.058	9.274	12.310	8.667	12.310	13.714	14.702
NiO	0.483	0.649	0.442	0.649	0.345	0.621	0.428	0.635	0.387	0.635	0.388	0.612
SiO_2	51.979	42.715	52.936	41.655	55.950	41.509	56.448	44.567	57.384	43.487	54.085	43.750
ThO_2	0.043	0.058	0.039	0.058	0.031	0.055	0.038	0.057	0.034	0.057	0.034	0.054
TiO_2	0.846	1.136	0.773	1.136	0.604	1.088	0.749	1.112	0.677	1.112	0.000	0.000
U_3O_8	3.060	4.109	2.797	4.109	2.185	3.934	2.710	4.021	2.448	4.021	2.453	3.869
ZnO	0.124	0.166	0.113	0.166	0.088	0.159	0.109	0.162	0.099	0.162	0.099	0.156
ZrO_2	0.223	0.300	0.204	0.300	0.159	0.287	0.198	0.293	0.179	0.293	0.179	0.282
BaO	0.075	0.101	0.069	0.101	0.054	0.097	0.067	0.099	0.060	0.099	0.060	0.095
Ce_2O_3	0.105	0.141	0.096	0.141	0.075	0.135	0.093	0.138	0.084	0.138	0.086	0.135
CuO	0.060	0.080	0.054	0.080	0.043	0.077	0.053	0.078	0.048	0.078	0.048	0.075
La_2O_3	0.069	0.093	0.063	0.093	0.049	0.089	0.061	0.091	0.055	0.091	0.049	0.078
MgO	0.057	0.076	0.052	0.076	0.040	0.073	0.050	0.074	0.045	0.074	0.045	0.072
PbO	0.090	0.121	0.082	0.121	0.064	0.116	0.080	0.118	0.072	0.118	0.073	0.115
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

5.0 Experimental

This section describes the experimental procedures used to fabricate and the analytical techniques used to physically and chemically characterize the SB3 Phase 1 Variability Study glasses.

5.1 Glass Fabrication

Table 4-5 identified the targeted compositions of the 42 SB3 glasses prepared for this study. Each glass was prepared from the proper proportions of reagent-grade metal oxides, carbonates, H_3BO_3, and salts in 150-g batches using SRTC technical procedure “Glass Batching – ITS-0001” (SRTC 2002a). Batch sheets were filled out as the materials were weighed.[11] Once batched, the glasses were melted using SRTC technical procedure “Glass Melting – ITS-0003” (SRTC 2002b). In general, the raw materials were thoroughly mixed and placed into a 95% Platinum/5% Gold 250-mL crucible. The batch was subsequently placed into a high-temperature furnace, and the temperature was increased at ~8°C/min until the target melt temperature (1150°C) was reached. After an isothermal hold at 1150°C for 1.0 h, the crucible was removed, and the glass was poured onto a clean stainless steel plate and allowed to air cool. Observations of the resulting pour patty and residual crucible glass were documented.

The pour patty and residual crucible glass were ground, and the crushed glass was subsequently transferred to its original 95% Platinum/5% Gold 250-mL crucible for a second melt at 1150°C. After an isothermal hold at 1150°C for 1.0 h, the crucible was removed, and the glass was poured onto a clean stainless steel plate and allowed to air cool. Observations of the resulting pour patty and residual crucible glass were documented.[12] Approximately 140 g of glass was removed (poured) from the crucible while ~10 g remained in the crucible along the walls. The pour patty was used as a sampling stock for the various heat treatments and property measurements (i.e., chemical composition and durability). Glasses were stored in marked containers (using the unique SB3 Phase 1 nomenclature as defined in Table 4-5).

To bound the effects of thermal history on the product performance, approximately 25 g of each SB3 glass were heat treated to simulate cooling along the centerline of a DWPF-type canister (Marra and Jantzen 1993). This cooling regime is commonly referred to as the centerline canister cooled (ccc) curve. This terminology will be used in this report to differentiate samples from different cooling regimes (quenched versus ccc).

5.2 Property Measurements

This section provides a general discussion of the analysis of chemical compositions and the PCT for each SB3 Phase 1 glass.

5.2.1 Chemical Composition Analysis

To confirm that the “as-fabricated” glasses corresponded to the defined target compositions, a representative sample from each SB3 glass pour patty was submitted to the SRTC Mobile Laboratory (SRTC-ML) for chemical analysis. Edwards (see Appendix D) provided an analytical plan that accompanied these samples. This plan identified the cations to be analyzed and the dissolution techniques (i.e., sodium peroxide fusion [PF] and lithium-metaborate [LM]) to be

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[11] Batch sheets can be found in WSRC-NB-2001-00060.

[12] Observations of homogeneity were documented in WSRC-NB-2001-00060 for both the pour patty and the residual crucible glass. No visual signs of undissolved solids or compositional inhomogeneities were observed.

used. Each glass was prepared in duplicate for the cation dissolution techniques (PF and LM). Concentrations (as mass %) for the cations of interest were measured by inductively coupled plasma – atomic emission spectroscopy (ICP – AES). The analytical plan was developed in such a way as to provide the opportunity to evaluate potential sources of error. Glass standards were intermittently run to assess the performance of the ICP – AES over the course of these analyses and for potential bias-correction needs. The measurements were conducted to assess whether or not the targeted glass compositions were adequately met (see Section 6.1).

5.2.2 Product Consistency Test

The PCT was performed on each glass to assess chemical durability using technical procedure "Nuclear Waste Glass Product Consistency Test (PCT) Method – GTOP-3-025" (ASTM 1998). The PCT was conducted in triplicate for each SB3 glass (both quenched and ccc versions). Also included in this experimental test matrix were the Environmental Assessment (EA) glass (Jantzen et al. 1993), the Approved Reference Material (ARM-1) glass, and blanks from the sample cleaning batch. Samples were ground, washed, and prepared according to procedure. Fifteen mL of Type I American Society for Testing and Materials (ASTM) water were added to 1.5 g of glass in stainless steel vessels. The vessels were closed, sealed, and placed in an oven at 90 ± 2°C where the samples were maintained for 7 days. The resulting solutions (once cooled) were sampled (filtered and acidified), labeled (according to the analytical plan), and analyzed. Edwards provided analytical plans for the SRTC-ML analysis (see Appendices E, F, and G). Due to the large number of vessels and limited space in a single PCT oven, three groups of tests were initiated. Groups were primarily based on washing scheme (e.g., Group #1 – SB3-1 through SB3-14 (both quenched and ccc) for the linear washing scenarios, Group #2 – SB3-15 through SB3-28 (both quenched and ccc) for Decant #5, and Group #3 – SB3-29 through SB3-42 (both quenched and ccc) for Decant #9) and each group contained the appropriate blanks and glass standards.[13] The overall philosophy of these plans was to provide an opportunity to assess the consistency (repeatability) of the PCT and analytical procedures in the effort to evaluate chemical durability of the SB3 glasses. Normalized release rates were calculated based on targeted, measured, and bias-corrected compositions using the average of the logs of the leachate concentrations (see Section 6.2).

5.3 Effect of Redox on PCT Response

The forty-two Phase 1 Variability Study glasses were batched and melted under conditions that promote oxidizing conditions resulting in fully oxidized glasses. This technique has been utilized in previous DWPF variability studies (Peeler 1996a; Peeler 1996b; Edwards and Brown 1998; Harbour et al. 2000; and Herman et al. 2001) with technical justification given the oxidizing nature of the DWPF flowsheet (e.g., excessive nitric acid). In fact, Brown, Postles, and Edwards (2002) indicate that the majority of elements considered in PCCS possess only a single corresponding oxide as indicated by Schreiber and Hockman (1987) – with one exception copper. DWPF does not currently measure the redox ratio for their SME feed due to highly oxidizing nature of the DWPF melt (i.e., $[Fe^{3+}] >> [Fe^{2+}]$). Therefore, the ratio of Fe^{2+}/Fe^{3+} has been assumed to be zero for previous DWPF use. More specifically, currently all Fe is converted to Fe_2O_3 for prediction considerations via PCCS.

Given the potential for the atypical components of coal and sodium oxalate (Goslen 1984; Fowler 1980) to be present in SB3 (and ultimately transferred to DWPF), redox control becomes a more critical issue. Herman (2002a) and Jantzen (2002) are performing specific studies to assess the impact of these components on the overall flowsheet with the objective of defining new acid

[13] Group #3 also contained SB3-41 and SB3-42 based on Frit 320 and the 75% linear washing scenario.

addition and redox control strategies for this specific sludge batch if deemed necessary. Control of glass redox is critical to melter life and melter performance.

With a potential change or shift in acid addition or redox control strategies, previous assumptions regarding the impact (or lack thereof) of redox on the PCT response needed to be reassessed. This was specifically identified by Rios-Armstrong (2002b) in the TTR. In this study, two approaches were taken. The first is primarily based on experimental assessments of durability with glasses produced under conditions that bound the acceptable redox range for DWPF. The second approach is strictly based on model predictions of durability for the SB3 Phase 1 glasses considering potential redox impacts. The objective and basis for both approaches are discussed in detail below.

5.3.1 Experimental Assessment of PCT as a Function of Redox

Research is currently in progress to develop or augment the acid addition strategy and/or redox correlation for SB3 (Herman (2002a) and Jantzen (2002)). Preliminary studies (Herman 2002b) to support SB3 processing were performed with a Tank 8 simulant to determine the effects of sand, coal, and sodium oxalate on Sludge Receipt and Adjustment Tank (SRAT) and SME processing. SRAT and SME runs were performed with 75, 50, and 25% of the anticipated levels of sodium oxalate, and the runs were identified as SB3-21, SB3-22, and SB3-23, respectively. Sand and coal were added at the anticipated or nominal levels for the sludge oxides (i.e., 1.12 wt% for sand and 0.72 wt% for coal). The SRAT and SME cycles were performed per run plans written by Koopman (2002a, 2002b, 2002c) and prototyped DWPF SRAT and SME cycles including the addition of canister decontamination water during the SME cycle. The purpose of the runs was to refine the acid addition strategy for SB3 at the different sodium oxalate levels. The runs used the latest acid addition strategy and redox equations to target a Fe^{2+}/ΣFe of 0.20.

A summary of the test parameters is provided in Table 5-1. The acid addition amounts were based on the liters of starting feed (i.e., sludge slurry with sodium oxalate, trim chemicals, and any flush water – see Herman et al. 2002b). The "% of Acid Stoichiometry" reflects the amount of acid added relative to the stoichiometric equivalent for the acid addition equation currently being used by DWPF (Koopman (2002a), Koopman (2002b), Koopman (2002c)). Both SB3-21 and SB3-23 contained the nominal levels of noble metals, while SB3-22 contained 10% of the nominal level of noble metals (Peeler et al. (2002a)).[14] The varying levels of noble metals required different amounts of acid to be added to meet SRAT processing acceptability (e.g., for nitrite destruction based on the demonstrated noble metals concentration and the nitrite destruction correlation). Based on the results of the testing, the acid addition amount used in Run SB3-21 was overly excessive resulting in the DWPF hydrogen limit to be exceeded. The nitrite was below 1000 mg/kg within the first 20 minutes of boiling; whereas, a lower level of acid addition may have taken the full boiling time. The other runs also had an overabundance of acid, but they did not result in the hydrogen limit being exceeded. Run SB3-22 had nitrite destroyed to less than 1000 mg/kg within the first 50 minutes of boiling, while nitrite was also below this level for Run SB3-23 within the first 20 minutes of boiling. The sludge compositions for each run were used to determine the proper frits to use in the SME cycle. Only frits readily available (Frits 202 and 320) were considered in the analyses. Based on this assessment, Frit 202 was selected for Run SB3-21, while Frit 320 was selected for the other runs. The frit selection results are slightly different than those that would be anticipated with actual SB3 simulant, because of the differences in composition of the Tank 8 and SB3 simulants. Different waste loading ranges were determined for each of the sodium oxalate cases/runs. However, to allow for a more equal

[14] Nominal concentrations of noble metals are: Ag = 5.42E-04 wt%; Pd = 2.76E-02 wt%, Rh = 5.11E-02 wt%, and Ru = 1.83E-01 wt%.

comparison of the processes, 30 wt% waste loading was selected for all runs since it represented the midpoint in each frit/sludge system's acceptable waste loading range. The final calcined solids content of the SME products ranged from 40 to 44 wt%. More details on the runs are given in Herman et al. (2003).

Table 5-1. SRAT/SME Parameters.

Run ID	Noble Metals Level	Nitric Added (moles/ L slurry)	Formic Added (moles/ L slurry)	% of Acid Stoichiometry	Frit Type and Amount
SB3-21-SME	Nominal	0.41	0.73	190%	70 wt% Frit 202
SB3-22-SME	10% of Nominal	0.35	0.70	160%	70 wt% Frit 320
SB3-23-SME	Nominal	0.29	0.68	130%	70 wt% Frit 320

Given Herman et al. (2003) used similar nomenclatures for the SME products as were used to identify the SB3 Phase 1 Variability Study glasses, the suffix "-SME" has been added to avoid confusion. It should also be noted that the targeted compositions for SB3-21-SME and SB3-21 (Phase 1 glass) are not the same. The same can be said about SB3-22-SME and SB3-23-SME. As mentioned above, SB3-21-SME was produced with Frit 202 at 30 wt% WL; while SB3-22-SME and SB3-23-SME were produced with Frit 320 at 30 wt% WL. One of the major differences between the SME products and SB3 Phase 1 glasses is the absence of ThO_2 and U_3O_8 in the SME products as non-radioactive products are required for testing.[15] Another difference alluded to above was the use of the Tank 8 simulant versus actual SB3 simulant. Tank 8 simulant contained twice as much Ni, half as much Mn, and slightly less Fe than its SB3 counterpart.

After characterization of the SME products were completed, they were subsequently dried, crushed, and then melted in the dry feed melt rate furnace (MRF). First, enough SME product for each run was measured out to produce approximately 500 grams of glass. The SME product was divided into 2 stainless-steel pans, placed in an oven with a setpoint of 110°C for drying (drying to completion), and then crushed and sieved (size 10 mesh). This sieved material was placed in a beaker for insertion into the MRF.

Lorier and McGrier (2002) provide a detailed discussion regarding the development, intended use, and operating procedures of the MRF. In general, the MRF was designed to mimic the heat transfer characteristics of a large-scale, joule-heated melter. That is, unidirectional heat transfer from the molten glass pool to the cold cap is simulated given this is the primary source of heat to convert the incoming melter feed to a glass product – thus controlling melt rate. The furnace inner chamber is approximately one cubic foot with 1925-watt plate heaters mounted on opposing walls. The insulation consists of approximately 6" of M-board on all sides of the furnace chamber. The top board has a 6" circular cutout through all layers of insulation to hold a 1200 mL stainless steel beaker and insulating sleeve in place. The tests were conducted with 6" deep stainless steel beakers inserted into the cutout so that the top flange of the beaker was just above the top of the furnace. The beaker bottom was approximately flush with the top of the inner furnace chamber. The furnace was heated to approximately 1150°C with the top opening covered with an insulating block. Once the furnace reached the setpoint temperature, the cover was removed and the beaker containing sufficient material to produce ~500 grams of glass was inserted.

[15] It should be reiterated that the Decant #5 feed used to support the MRF testing program was non-radioactive (Lorier et al. 2003). The two radioactive components removed were U_3O_8 and ThO_2 which constitute approximately 7.9 wt% of the Decant #5 sludge (see Table 3-2). There was no technical basis for spiking the feeds with a non-radioactive simulant. Therefore, the melt rates determined will be considered on a relative basis.

The first run (SB3-21-SME) was performed for approximately 1 hour to assure complete conversion of the batch into a single-phase glass. Incomplete conversion could result in a biased glass sample from which the durability response would be measured. This is slightly longer than the standard 42 minutes typically used to assess melt rate (Lorier and McGrier (2002)) due to the fact that very few SB3 batches had resulted in complete conversion with this standard time.[16] After 1 hour of melting, SB3-21-SME was completely converted to a single-phase glass and indications (based on thermocouple temperature review) were that the standard 42 minutes would have resulted in complete conversion. Thus, the subsequent two tests utilized or reverted to the 42-minute standard time, which allowed for direct melt rate comparisons between these tests and those being assessed for SB3 (Lorier et al. 2003). Differences in the rate of batch to glass conversion between the Tank 8 samples and the SB3 systems could be due to differences in sludge composition, acid addition strategy, or a combination of both.

It should be noted that the primary objective is not to assess or compare melt rates, but to produce glasses under conditions which mimic melter processing and result in bounding redox values over which PCT assessments can be made. Although the MRF is not a controlled atmosphere, partial oxidation of the melt could occur during the residence time.

After the allotted residence time, the samples were removed from the furnace and allowed to cool within the stainless beaker. Representative glass samples were then obtained and submitted for compositional and redox analysis. The PCT was performed on each Tank 8 glass (in triplicate) according to standard procedures (see Section 5.2.2 for more details).

5.3.2 Redox Dependent Predictions

To gain insight into the potential magnitude of the REDOX effect on PCT, predictions of durability for all 42 SB3 Phase 1 Variability Study glasses were made. For each glass, an assumption was made that the targeted $Fe^{2+}/\Sigma Fe$ would be 0.2 and controlled via an acid addition strategy below the upper redox acceptance limit as recommended by Schreiber and Hockman (1987) and Jantzen and Plodinec (1986). Based on this work, an acceptable iron redox ($Fe^{2+}/\Sigma Fe$) range was recommended to be $0.09 \leq Fe^{2+}/\Sigma Fe \leq 0.33$.[17]

Brown, Postles, and Edwards (2002) provided a revision of the SME acceptability decision criteria that included a redox dependent term for use with the durability model.[18] More specifically, the model had adjustable redox term(s) that partitioned the redox of select species (e.g., Fe) and assigned ΔG_i values accordingly per Jantzen et al. (1995). Given this model is available, one can easily predict the PCT response or ΔG_P values for the 42 SB3 glasses as a function of redox. In this study, three key $Fe^{2+}/\Sigma Fe$ targets are assessed: (1) $Fe^{2+}/\Sigma Fe = 0.0$ (fully oxidized), (2) $Fe^{2+}/\Sigma Fe = 0.2$ (assumed target), and (3) $Fe^{2+}/\Sigma Fe = 0.33$ (upper limit or bounding case). These predictions can then be used to ascertain the potential impact of redox on SME acceptability (e.g., relationship of ΔG_P to the DWPF SME acceptability criteria) and ultimately the projected operating window for the various frit/sludge systems of interest for SB3.

[16] Lorier et al. (2003) provide a detailed discussion on the study to assess melt rate as a function of frit composition for SB3.

[17] It should be noted that although a lower $Fe^{2+}/\Sigma Fe$ limit of 0.09 was recommended, this limit has not been implemented in DWPF.

[18] The modifications of the SME acceptability decision criteria necessary to reflect the effects of redox on the durability model were taken from Brown, K.G., "Changes Made to the DWPF PCCS Spreadsheet (U)," SRTC-GPD-2002-00059, May 16, 2002.

6.0 Results and Discussion

This section provides a detailed discussion of the chemical-composition measurements and an analysis of the PCT results.

6.1 A Statistical Review of the Chemical Composition Measurements

In this section, the measured versus targeted compositions of the 42 SB3 Phase 1 glasses (SB3-01 through SB3-42) are presented and compared. As stated earlier, the targeted compositions for these glasses are provided in Table 4-5. Chemical composition measurements for these glasses were conducted by the SRTC-ML following the analytical plan provided in Appendix D. Two dissolution methods were utilized in this plan: samples prepared by LM dissolution were used to measure elemental concentrations of barium (Ba), calcium (Ca), cerium (Ce), chromium (Cr), copper (Cu), iron (Fe), potassium (K), lanthanum (La), magnesium (Mg), manganese (Mn), sodium (Na), nickel (Ni), lead (Pb), thorium (Th), titanium (Ti), uranium (U), zinc (Zn), and zirconium (Zr) while samples prepared by PF dissolution were used to measure elemental concentrations of aluminum (Al), boron (B), lithium (Li), and silicon (Si). For each study glass, measurements were obtained from samples prepared in duplicate by each of these dissolution methods. All of the prepared samples were analyzed (twice for each element of interest) by ICP – AES (with the instrumentation being re-calibrated between the duplicate analyses).

Table H.1 in Appendix H provides the elemental concentration measurements derived from the samples prepared using LM, and Table H.2 in Appendix H provides the measurements derived from the samples prepared using PF. Measurements for standards (Batch 1 and a uranium standard, U_{std}, glass), that were included in the SRTC-ML analytical plans along with the SB3 glasses, are also provided in these two tables.

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 SRTC-ML was reduced to half of that detection limit as the oxide concentration was determined.

In the sections that follow, the analytical sequence of the measurements is explored, the measurements of the standards are investigated and used for bias correction, the measurements for each glass are reviewed, the average chemical compositions (measured and bias-corrected) for each glass are determined, and comparisons are made between these measurements and the targeted compositions for these glasses.

6.1.1 Measurements in Analytical Sequence

Exhibit H.1 in Appendix H provides plots of the measurements generated by the SRTC-ML for samples prepared using the LM method. These plots are in analytical sequence with different symbols and colors being used to represent each of the glasses (study glasses and standards) included in the analytical plan. Similar plots for samples prepared using the PF method are provided in Exhibit H.2 of Appendix H. These plots include all of the measurement data from Tables H.1 and H.2.

A review of these plots indicates no significant patterns or trends in the analytical process over the course of these measurements. No obvious outliers were evident in these chemical composition measurements with the exception of a pair of measurements (both from the same LM prep) on the minor components Ce_2O_3, La_2O_3, and ZrO_2 for one of the SB3 glasses (SB3-29).

6.1.2 Batch 1 and Uranium Standard Results

In this section, the SRTC-ML measurements of the chemical compositions of the Batch 1 and U_{std} glasses are reviewed. These measurements are investigated across the ICP analytical blocks, and the results are used to bias correct the measurements for the SB3 Phase1 glasses.

Exhibit H.3 provides statistical analyses of the Batch 1 and U_{std} results generated by the LM prep method by analytical block. The results include an analysis of variance (ANOVA) investigation looking for statistically significant differences among the block means for each of the standards. The results from these statistical tests for the Batch 1 standard may be summarized as follows: the BaO, CaO, Cr_2O_3, K_2O, MgO, Na_2O, NiO, TiO_2, and ZrO_2 measurements indicate a significant ICP calibration effect at the 5% significance level. For U_{std}, the CaO, Cr_2O_3, K_2O, MgO, MnO, Na_2O, NiO, ThO_2, and TiO_2 measurements indicate a significant ICP calibration effect at the 5% significance level. The reference values for the oxide concentrations of the standards are given in the header for each set of measurements in the exhibit.

Exhibit H.4 provides a similar set of analyses for the measurements derived from Batch 1 and U_{std} samples prepared via the PF method. In this exhibit, there is no indication of a statistically significant (at the 5% significance level) difference among the ICP analytical/calibration blocks for these data except for the U_{std} B_2O_3 measurements.

Overall, these results suggest that it may be helpful to bias correct the oxide measurements of the SB3 Phase 1 glasses for the effect of the ICP calibration on each of the analytical blocks. The basis for this bias correction is presented as part of Exhibits H.3 and H.4 – the average measurements for Batch 1 for each ICP block for each oxide except for U_3O_8. For U_3O_8, the average measurements for U_{std} for each ICP block for U_3O_8 was used. That is, the Batch 1 results served as the basis for bias correcting all of the oxides (that were bias corrected) except U_3O_8. The U_{std} results were used to bias correct the U_3O_8 values. For the other oxides, 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%. Thus, applying this approach and based upon the information in the exhibits, the Batch 1 results were used to bias correct the Al_2O_3, B_2O_3, BaO, CaO, Cr_2O_3, CuO, Fe_2O_3, Li_2O, K_2O, MgO, MnO, Na_2O, NiO, SiO_2, and TiO_2 measurements. No bias correction was conducted for Ce_2O_3, La_2O_3, PbO, ThO_2, ZnO, or ZrO_2.

The bias correction was conducted as follows. For each oxide, let $\bar{a}_{ij}$ be the average measurement for the ith oxide at analytical block j for Batch 1 (or U_{std} for U_3O_8), and let t_i be the reference value for the ith oxide for Batch 1 (or for U_{std} if U_3O_8). (The averages and reference values are provided in Exhibits H.3 and H.4.) Let $\bar{c}_{ijk}$ be the average measurement for the ith oxide at analytical block j for the kth 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 Ce_2O_3, La_2O_3, PbO, ThO_2, ZnO, or ZrO_2.

Both measured and measured "bc" values are included in the discussion that follows. In these discussions bias-corrected values for Ce_2O_3, La_2O_3, PbO, ThO_2, ZnO, or ZrO_2 are included for completeness (e.g., to allow a sum of oxides to be computed for the bias-corrected results). These bias-corrected values are the same as the original Ce_2O_3, La_2O_3, PbO, ThO_2, ZnO, or ZrO_2 values (i.e., once again, no bias correction was performed for these oxides).

6.1.3 Composition Measurements by Glass Number

Exhibits H.5 and H.6 in Appendix H provide plots of the oxide concentration measurements by Glass ID # (including both the Batch 1, labeled as glass number 100 and U_{std}, labeled as glass number 101) for the measured and bias-corrected (bc) values for the LM and PF preparation methods, respectively. Different symbols and colors are used to represent the different glasses. These plots show the individual measurements across the duplicates of each preparation method and the two ICP calibrations for each glass.

A review of the plots presented in these exhibits reveals the repeatability of the four individual oxide values for each glass. As stated previously, one of the LM prepared samples of glass SB3-29 generated measurements on some of the minor components that were larger than the measurements generated by the other LM prepared sample. The Cr_2O_3 measurements for one of the SB3-39 prepared samples was larger than those from the other prepared sample. One Fe_2O_3 value for SB3-18 was somewhat higher than the other three values. One TiO_2 value for SB3-17 was much lower than the other three values. Some scatter is seen in the Al_2O_3 values for glasses SB3-04 and SB3-30, in the Li_2O values for SB3-04, and in the SiO_2 values for SB3-04, SB3-05, and SB3-20.

More detailed discussions of the average, measured chemical compositions of the SB3 Phase 1 glasses are provided in the sections that follow.

6.1.4 Measured versus Targeted Compositions

The four measurements for each oxide for each glass (over both preparation methods) were averaged to determine a representative chemical composition for the glass. These determinations were conducted for the measured and bias-corrected data without excluding any of the measurements of Tables H.1 and H.2. A sum of oxides was also computed for each glass based upon both the measured and bias-corrected values. Exhibit H.7 in Appendix H provides plots for each glass for each oxide to help highlight the comparisons among the measured, bias-corrected, and targeted values.

Some observations from the plots of Exhibit H.7 are offered. The Al_2O_3 measurement averages were above the targeted levels for several of the SB3 Phase 1 glasses. The B_2O_3 measurement averages followed their corresponding targeted levels very closely. The Ce_2O_3 and La_2O_3 measurement averages for SB3-29 were substantially above the targeted levels for this glass. This was due to the larger values generated for these oxides by one of the LM prepared samples (as previously discussed). The average Fe_2O_3 measurement for SB3-42 was substantially less than the targeted Fe_2O_3 value for this glass. The Li_2O measurement average for SB3-42 was above the targeted value for this glass. The MgO measurement average for SB3-10 was above the targeted value for this glass. The Na_2O measurement average for SB3-32 was above the targeted value for this glass. The PbO measurement averages were consistently below their targeted levels for the Phase 1 glasses. Bias correcting the SiO_2 measurements appears to move the results farther away from the targeted levels. The ThO_2 measurement averages were consistently above their targeted levels for this Phase 1 glasses. The U_3O_8 measurement averages followed their corresponding targeted levels very closely. The ZnO measurement averages were predominately below their targeted levels for these Phase 1 glasses. And, finally, the ZrO_2 measurement average for SB3-38 was above it targeted level for this glass.

The review of these results prompted a request for the SRTC-ML to remeasure some of the prepared samples as well as to re-prep and measure new samples of SB3-29 and SB3-42. The results generated by the lab are presented in Table H.3 in Appendix H. As seen in this table, some of the re-measured values moved closer to their corresponding targets while others did not. The high ThO_2 measurements for these glasses are thought to be due to an interference with iron and zirconium at the Th283 wavelength. Based upon all of the information available, it was decided that the original measurements (those of Tables H.1 and H.2) are to be used to provide the measured and measured bias-corrected views of the compositions of these SB3 Phase 1 glasses.

Table H.4 in Appendix H provides a summary of the average compositions as well as the targeted compositions and some associated differences and relative differences. Notice that the targeted sums of oxides for the glasses do not sum to 100% for the Batch 1 U_{std} glasses due to an incomplete coverage of the oxides in these standard glasses. All of the sums of oxides (both measured and bias-corrected) fall within the interval of 95 to 105 wt% for the SB3 Phase 1 glasses with the exception of the bias-corrected measurements for SB3-04.

Entries in Table H.4 also show the relative differences between the measured or bias-corrected values and the targeted values. These differences are shaded when they are greater than or equal to 5%. Overall, these comparisons between the measured and targeted compositions suggest that there were no significant problems in the batching or fabrication of the SB3 Phase 1 glasses other than those noted in Section 6.1.3.

6.2 A Statistical Review of the PCT Measurements

As discussed in Section 5.2.2, the PCTs were conducted in three groups and analytical plans for the three groups of PCTs, presented in Appendices E, F, and G, were provided to the SRTC-ML to support the measurement of the compositions of the solutions resulting from these PCTs. Samples of a multi-element, standard solution were also included in all of these analytical plans (as a check on the accuracy of the ICP – AES used for these measurements). In this and following sections, the measurements generated by the SRTC-ML for these PCTs are presented and reviewed.

Table I.1 provides the elemental leachate concentration measurements determined by the SRTC-ML for the solution samples generated by the PCTs. The PCT results for the centerline, canister-cooled glasses are indicated by a "ccc" suffix. One of the quality control checkpoints for the PCT procedure is solution-weight loss over the course of the 7-day test. This criterion was satisfied for all of the PCT solutions generated for both the quenched and ccc versions for all the SB3 Phase 1 glasses. Any measurement in the as-reported columns of Table I.1 preceded by a "<" was below the reported corresponding elemental reported detection limit, and the measurement was replaced by ½ of the detection limit in the last seven columns of the table. The values in the last seven columns were also adjusted for the dilution factors by multiplying the values in the as-received columns by 1.6667 for the Phase 1 and ARM glasses and by 16.667 for the EA glass. Thus, the concentrations in the last seven columns reflect detection and dilution adjustments. Beyond these adjustments, no other modifications to these data were performed.

In the sections that follow, the analytical sequence of the measurements is explored, the measurements of the standards are investigated and used to assess the overall accuracy of the ICP measurement process, the measurements for each glass are reviewed, the quenched versus centerline-cooled results are compared, the PCTs are normalized using the compositions (targeted, measured, and bias-corrected) presented in Table H.4, and the normalized PCTs are compared to durability predictions for these compositions generated from the current DWPF durability models as described by Brown, Postles, and Edwards (2002).

6.2.1 PCT Measurements in Analytical Sequence

Exhibit I.1 and I.2 provide plots of the SRTC-ML measurements in analytical sequence (over all three groups) with and without the EA results, respectively. Different colors are used for each glass with a plus being used to represent results from quenched glasses while an open circle represents ccc results. No problems are seen in these plots.

6.2.2 Measurements of the Multi-Element Solution Standard

Exhibit I.3 provides an analysis of the SRTC-ML measurements of the samples of the multi-element solution standard by group by ICP analytical (or calibration) block for all three groups of PCTs. An ANOVA investigating for statistically significant differences among the block averages for these samples for each element of interest is included in these exhibits. The results indicate a statistically significant (at the 5% level) difference among the average measurements over these blocks for all of the analytes considered in this study. However, no bias correction of the PCT results for the study glasses was conducted. This approach was taken since the triplicate PCTs for a single study glass were placed in different ICP blocks. Averaging the ppm's for each set of triplicates helps to minimize the impact of the ICP effects.

Table 6-1 summarizes the average measurements and the reference values for the 4 elements of primary interest. The results indicate consistent and accurate measurements from the SRTC-ML processes used to conduct these analyses.

Table 6-1. Results from Samples of the Multi-Element Solution Standard.

PCT Group	Analytical Block	Avg B (ppm)	Avg Li (ppm)	Avg Na (ppm)	Avg Si (ppm)
1	1	20.7	9.2	79.4	49.7
	2	20.7	9.4	84.4	50.7
	3	21.3	9.7	87.2	50.7
	4	20.9	9.4	85.7	49.7
	5	20.9	9.5	85.2	49.9
	6	21.6	9.6	84.5	51.4
	Grand Average	21.0	9.5	84.4	50.3
	Reference Value	20.0	10.0	81.0	50.0
	% difference	5.1%	-5.2%	4.2%	0.7%
2	1	21.4	9.5	83.5	51.1
	2	21.1	9.5	85.6	50.6
	3	20.8	9.4	86.5	50.0
	4	20.6	9.4	84.5	49.1
	5	20.4	9.3	85.8	49.3
	6	20.7	9.4	84.9	49.6
	Grand Average	20.8	9.4	85.1	50.0
	Reference Value	20.0	10.0	81.0	50.0
	% difference	4.2%	-5.8%	5.1%	-0.1%
3	1	20.9	9.5	84.8	49.6
	2	20.8	9.5	86.2	49.9
	3	20.6	9.4	85.3	49.8
	4	20.8	9.5	86.7	49.4
	5	20.8	9.4	86.1	49.9
	6	20.5	9.3	83.5	49.0
	Grand Average	20.7	9.4	85.4	49.6
	Reference Value	20.0	10.0	81.0	50.0
	% difference	3.6%	-5.7%	5.5%	-0.8%

6.2.3 Measurements for Glass ID Number

Exhibits I.4 and I.5 provide plots of the leachate concentrations by type of sample with and without EA, respectively. These plots allow for the assessment of the repeatability of the measurements as well as preliminary comparisons between the quenched and ccc glasses. In these plots the quenched results are once again represented by a plus while the ccc results are represented by an open circle. For the primary elements (B, Li, Na, and Si), the results for SB3-42 show the most scatter among all of the glasses with the ccc results being higher than the quenched for B, Li, and Na. No other problems are seen among these data.

6.2.4 Quenched versus Centerline Canister Cooled

Exhibits I.6 (in both ppm and log ppm for all glasses) and I.7 (in ppm and log ppm for all glasses except SB3-42) provide a closer look at the quenched versus centerline-cooled results for the SB3 Phase 1 glasses, including a statistical comparison of the average differences due to heat treatment for each primary element of interest. These paired-t statistical tests indicate a statistically significant (at the 5% level) difference, on average, between the PCTs for the two heat treatments for B and Li in Exhibit I.6 over all of the data and for all elements except Li in

Exhibit I.7 where the results for SB3-42 are excluded. Although statistically significant differences are observed, no practical implications are projected.

An additional look at the log [B (ppm)] values is provided in Figure 6-1, which provides a plot of the ccc versus quenched results for the SB3 Phase 1 glasses. These results were derived using all of the PCTs (i.e., all three groups). A statistical difference (at the 5% significance level) is seen between the quenched and ccc average log [B (ppm)] results for these glasses. SB3-42 is labeled in this graph as well.

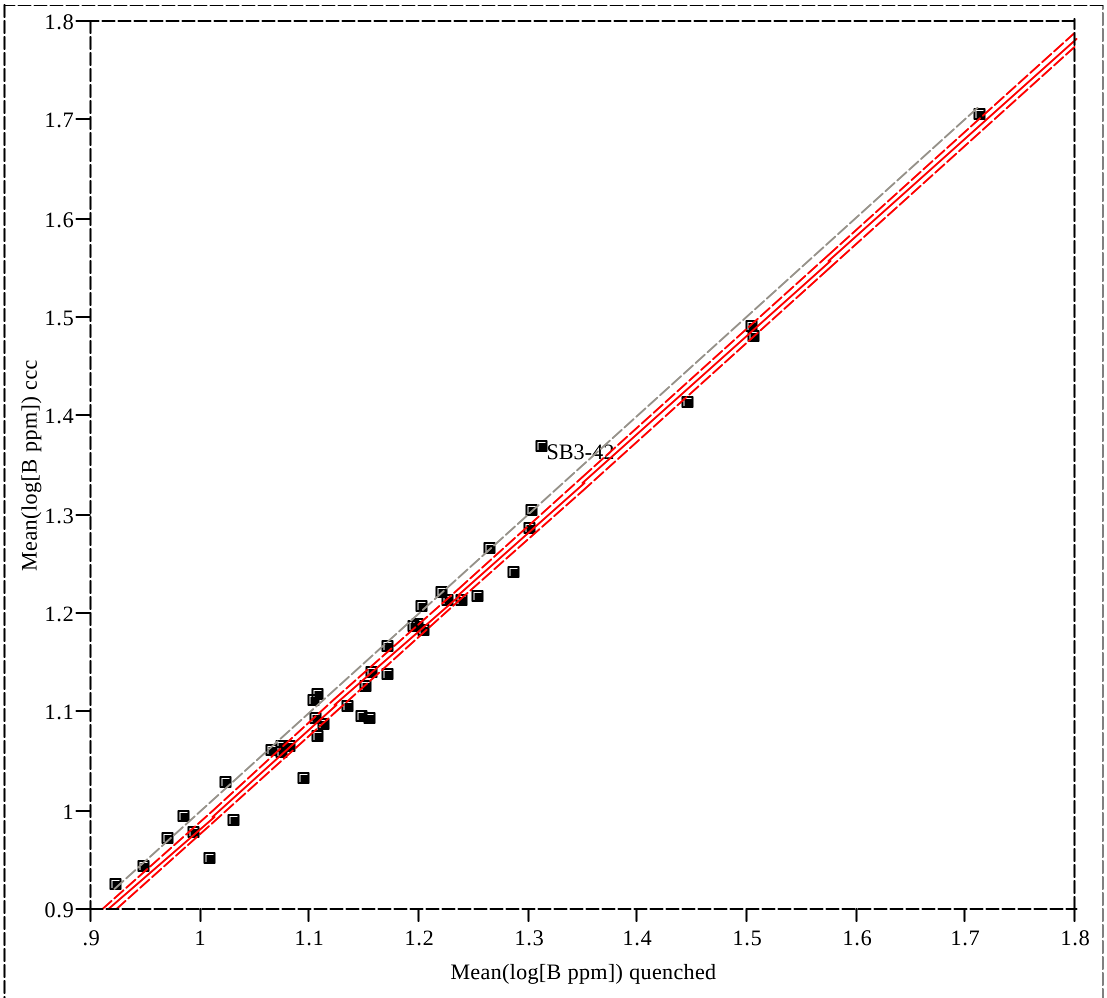

Figure 6-1 log [B (ppm)] for Quenched vs. CCC Glasses.

6.2.5 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. This is the preferred normalization process for the PCTs. For completeness, the targeted cation and the bias-corrected cation compositions will also be used to conduct this normalization.

As is the usual convention, the common logarithm of the normalized PCT (normalized leachate, NL) for each element of interest will be 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 H.1 of Appendix H),

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.

Exhibit I.8 provides scatter plots for these results and offers an opportunity to investigate the consistency in the leaching across the elements for the glasses of this study. All heat treatments (quenched and ccc versions) of the glasses and all compositional views (targeted, measured, and bias-corrected compositions) are represented in this set of plots. Consistency in the leaching (e.g., congruent dissolution) across the elements is typically demonstrated by a high degree of linear correlation among the values for pairs of these elements. A high degree of correlation is seen for these data for all pairs of the elements. The smallest correlation (~89%) is between Na and Li.

6.3 Applicability of ΔG_P to Projected SB3 Compositional Region

As mentioned in Section 2.0, the objective of this study is to assess the applicability of the PCCS durability model (ΔG_P) to the anticipated compositional region of interest to SB3. Specifically, this study will demonstrate the applicability of durability predictions for specific SB3 compositions.

Table 6-2 summarizes the PCT response for all 42 SB3 Phase 1 glasses. Normalized releases (in g/L) are provided for each glass based on three compositional views – target, measured, and measured bias-corrected. Normalized boron releases range from 0.499 g/L for SB3-33 (most durable) to a high of 1.593 g/L from SB3-42ccc (least durable). All glasses (both quenched and ccc) are acceptable being at least an order of magnitude more durable than the 16.695 g/L limit for NL [B] as reported for EA (Jantzen et al. 1993).

Table 6-2. PCT Results for the 42 SB3 Phase 1 Glasses.

Glass ID/HT	Comp View	NL B(g/L)	NL Li (g/L)	NL Na (g/L)	NL Si (g/L)
SB3-01	Targeted	1.225	1.174	0.883	0.463
SB3-01	Measured	1.268	1.232	0.885	0.473
SB3-01	Measured bc	1.280	1.191	0.914	0.449
SB3-01\ccc	Targeted	1.196	1.118	0.890	0.473
SB3-01\ccc	Measured	1.239	1.173	0.893	0.483
SB3-01\ccc	Measured bc	1.250	1.134	0.922	0.459
SB3-02	Measured	0.917	0.774	0.793	0.418
SB3-02	Targeted	0.907	0.760	0.826	0.415
SB3-02	Measured bc	0.934	0.750	0.848	0.388
SB3-02\ccc	Measured	0.860	0.783	0.754	0.426
SB3-02\ccc	targeted	0.850	0.769	0.785	0.423
SB3-02\ccc	Measured bc	0.875	0.758	0.806	0.396
SB3-03	Measured	0.607	0.694	0.501	0.399
SB3-03	targeted	0.612	0.674	0.529	0.402
SB3-03	Measured bc	0.627	0.668	0.535	0.371
SB3-03\ccc	Measured	0.545	0.623	0.477	0.383
SB3-03\ccc	targeted	0.549	0.604	0.504	0.387
SB3-03\ccc	Measured bc	0.563	0.599	0.510	0.356
SB3-04	Measured	0.759	0.626	0.850	0.470
SB3-04	targeted	0.795	0.698	0.865	0.493
SB3-04	Measured bc	0.772	0.607	0.904	0.437
SB3-04\ccc	Measured	0.731	0.657	0.792	0.456
SB3-04\ccc	targeted	0.766	0.732	0.806	0.478
SB3-04\ccc	Measured bc	0.744	0.636	0.843	0.424
SB3-05	targeted	0.935	0.921	1.025	0.607
SB3-05	Measured	0.911	0.963	1.003	0.626
SB3-05	Measured bc	0.939	0.930	1.044	0.599
SB3-05\ccc	targeted	0.886	0.876	0.896	0.584
SB3-05\ccc	Measured	0.863	0.917	0.877	0.602
SB3-05\ccc	Measured bc	0.889	0.885	0.912	0.576
SB3-06	targeted	1.128	1.008	1.245	0.695
SB3-06	Measured	1.104	1.055	1.225	0.694
SB3-06	Measured bc	1.141	1.015	1.303	0.646
SB3-06\ccc	targeted	1.056	0.961	1.093	0.650
SB3-06\ccc	Measured	1.032	1.005	1.076	0.649
SB3-06\ccc	Measured bc	1.067	0.967	1.144	0.604
SB3-07	Measured	0.741	0.837	0.507	0.381
SB3-07	targeted	0.736	0.822	0.516	0.381
SB3-07	Measured bc	0.754	0.810	0.528	0.354
SB3-07\ccc	Measured	0.713	0.768	0.521	0.372
SB3-07\ccc	targeted	0.709	0.755	0.530	0.371
SB3-07\ccc	Measured bc	0.726	0.744	0.542	0.346
SB3-08	targeted	0.831	0.765	0.755	0.413
SB3-08	Measured	0.837	0.797	0.758	0.416
SB3-08	Measured bc	0.863	0.769	0.782	0.398

Glass ID/HT	Comp View	NL B(g/L)	NL Li (g/L)	NL Na (g/L)	NL Si (g/L)
SB3-08\ccc	targeted	0.770	0.748	0.720	0.399
SB3-08\ccc	Measured	0.775	0.778	0.722	0.402
SB3-08\ccc	Measured bc	0.799	0.751	0.746	0.385
SB3-09	Measured	0.520	0.660	0.442	0.369
SB3-09	targeted	0.518	0.632	0.466	0.370
SB3-09	Measured bc	0.537	0.635	0.473	0.343
SB3-09\ccc	Measured	0.507	0.616	0.432	0.372
SB3-09\ccc	targeted	0.505	0.591	0.456	0.373
SB3-09\ccc	Measured bc	0.524	0.593	0.462	0.346
SB3-10	Measured	0.848	0.807	0.845	0.470
SB3-10	targeted	0.863	0.787	0.893	0.473
SB3-10	Measured bc	0.876	0.776	0.903	0.437
SB3-10\ccc	Measured	0.845	0.838	0.803	0.487
SB3-10\ccc	targeted	0.861	0.817	0.850	0.490
SB3-10\ccc	Measured bc	0.873	0.806	0.859	0.453
SB3-11	targeted	0.814	0.842	0.805	0.547
SB3-11	Measured	0.810	0.862	0.795	0.553
SB3-11	Measured bc	0.818	0.833	0.827	0.525
SB3-11\ccc	targeted	0.779	0.796	0.767	0.520
SB3-11\ccc	Measured	0.775	0.815	0.757	0.525
SB3-11\ccc	Measured bc	0.783	0.788	0.788	0.499
SB3-12	Measured	1.281	1.070	1.213	0.675
SB3-12	targeted	1.256	0.999	1.229	0.653
SB3-12	Measured bc	1.304	1.036	1.262	0.627
SB3-12\ccc	Measured	1.237	1.125	1.155	0.670
SB3-12\ccc	targeted	1.212	1.050	1.170	0.648
SB3-12\ccc	Measured bc	1.259	1.089	1.202	0.623
SB3-13	targeted	0.798	0.831	1.014	0.596
SB3-13	Measured	0.819	0.868	1.009	0.605
SB3-13	Measured bc	0.827	0.839	1.073	0.575
SB3-13\ccc	targeted	0.733	0.795	0.877	0.563
SB3-13\ccc	Measured	0.753	0.831	0.872	0.572
SB3-13\ccc	Measured bc	0.760	0.803	0.928	0.543
SB3-14	Measured	0.891	0.861	1.126	0.620
SB3-14	targeted	0.902	0.845	1.175	0.622
SB3-14	Measured bc	0.907	0.834	1.205	0.576
SB3-14\ccc	Measured	0.827	0.871	0.988	0.587
SB3-14\ccc	targeted	0.838	0.854	1.031	0.589
SB3-14\ccc	Measured bc	0.842	0.843	1.056	0.546
SB3-15	Measured	0.954	0.958	1.042	0.648
SB3-15	targeted	0.959	0.910	1.074	0.636
SB3-15	Measured bc	0.983	0.924	1.108	0.619
SB3-15\ccc	Measured	0.961	0.987	0.982	0.638
SB3-15\ccc	targeted	0.965	0.938	1.012	0.626
SB3-15\ccc	Measured bc	0.990	0.952	1.045	0.610
SB3-16	Measured	1.067	1.001	1.168	0.693
SB3-16	targeted	1.062	0.954	1.198	0.676
SB3-16	Measured bc	1.086	0.969	1.242	0.644

Glass ID/HT	Comp View	NL B(g/L)	NL Li (g/L)	NL Na (g/L)	NL Si (g/L)
SB3-16\ccc	Measured	1.065	1.039	1.085	0.689
SB3-16\ccc	targeted	1.059	0.990	1.114	0.672
SB3-16\ccc	Measured bc	1.084	1.005	1.155	0.640
SB3-17	targeted	0.567	0.671	0.761	0.471
SB3-17	Measured	0.574	0.692	0.754	0.480
SB3-17	Measured bc	0.580	0.668	0.779	0.456
SB3-17\ccc	targeted	0.545	0.647	0.689	0.447
SB3-17\ccc	Measured	0.551	0.666	0.683	0.456
SB3-17\ccc	Measured bc	0.557	0.644	0.705	0.433
SB3-18	Measured	0.838	0.832	1.093	0.598
SB3-18	targeted	0.840	0.789	1.135	0.596
SB3-18	Measured bc	0.866	0.801	1.128	0.556
SB3-18\ccc	Measured	0.816	0.871	0.985	0.577
SB3-18\ccc	targeted	0.818	0.826	1.023	0.575
SB3-18\ccc	Measured bc	0.843	0.838	1.017	0.537
SB3-19	targeted	0.597	0.646	0.716	0.457
SB3-19	Measured	0.598	0.667	0.713	0.463
SB3-19	Measured bc	0.609	0.646	0.742	0.430
SB3-19\ccc	targeted	0.561	0.622	0.655	0.448
SB3-19\ccc	Measured	0.562	0.643	0.652	0.454
SB3-19\ccc	Measured bc	0.572	0.623	0.678	0.422
SB3-20	Measured	0.773	0.759	1.022	0.547
SB3-20	targeted	0.774	0.738	1.031	0.538
SB3-20	Measured bc	0.787	0.735	1.087	0.508
SB3-20\ccc	Measured	0.724	0.751	0.891	0.512
SB3-20\ccc	targeted	0.725	0.731	0.899	0.504
SB3-20\ccc	Measured bc	0.736	0.727	0.948	0.476
SB3-21	Measured	0.539	0.644	0.732	0.455
SB3-21	targeted	0.541	0.625	0.727	0.440
SB3-21	Measured bc	0.556	0.621	0.761	0.435
SB3-21\ccc	Measured	0.530	0.632	0.659	0.435
SB3-21\ccc	targeted	0.532	0.613	0.655	0.421
SB3-21\ccc	Measured bc	0.546	0.609	0.686	0.416
SB3-22	Measured	0.910	0.803	1.187	0.590
SB3-22	targeted	0.902	0.785	1.192	0.587
SB3-22	Measured bc	0.941	0.772	1.270	0.550
SB3-22\ccc	Measured	0.897	0.870	1.113	0.584
SB3-22\ccc	targeted	0.888	0.850	1.118	0.581
SB3-22\ccc	Measured bc	0.927	0.837	1.191	0.544
SB3-23	Measured	0.557	0.708	0.719	0.462
SB3-23	targeted	0.560	0.669	0.728	0.454
SB3-23	Measured bc	0.575	0.683	0.748	0.442
SB3-23\ccc	Measured	0.558	0.695	0.659	0.461
SB3-23\ccc	targeted	0.560	0.657	0.667	0.454
SB3-23\ccc	Measured bc	0.575	0.671	0.686	0.441
SB3-24	Measured	0.954	0.881	1.160	0.635
SB3-24	targeted	0.986	0.857	1.235	0.634
SB3-24	Measured bc	0.983	0.850	1.241	0.607

Glass ID/HT	Comp View	NL B(g/L)	NL Li (g/L)	NL Na (g/L)	NL Si (g/L)
SB3-24\ccc	Measured	0.923	0.942	1.071	0.621
SB3-24\ccc	targeted	0.954	0.917	1.140	0.621
SB3-24\ccc	Measured bc	0.952	0.909	1.146	0.594
SB3-25	targeted	0.704	0.849	0.819	0.562
SB3-25	Measured	0.704	0.872	0.810	0.570
SB3-25	Measured bc	0.716	0.844	0.836	0.530
SB3-25\ccc	targeted	0.674	0.821	0.783	0.556
SB3-25\ccc	Measured	0.673	0.843	0.774	0.563
SB3-25\ccc	Measured bc	0.685	0.816	0.799	0.523
SB3-26	Measured	1.091	1.049	1.271	0.720
SB3-26	targeted	1.088	1.014	1.303	0.718
SB3-26	Measured bc	1.101	1.014	1.352	0.684
SB3-26\ccc	Measured	1.070	1.122	1.172	0.701
SB3-26\ccc	targeted	1.067	1.084	1.202	0.699
SB3-26\ccc	Measured bc	1.080	1.085	1.247	0.666
SB3-27	Measured	0.738	0.872	0.743	0.570
SB3-27	targeted	0.739	0.834	0.798	0.561
SB3-27	Measured bc	0.761	0.841	0.795	0.546
SB3-27\ccc	Measured	0.717	0.856	0.715	0.556
SB3-27\ccc	targeted	0.718	0.819	0.768	0.547
SB3-27\ccc	Measured bc	0.739	0.826	0.765	0.532
SB3-28	targeted	1.015	0.973	1.253	0.669
SB3-28	Measured	1.005	1.009	1.251	0.668
SB3-28	Measured bc	1.038	0.971	1.292	0.622
SB3-28\ccc	targeted	0.928	0.944	1.045	0.616
SB3-28\ccc	Measured	0.919	0.979	1.043	0.615
SB3-28\ccc	Measured bc	0.950	0.942	1.077	0.573
SB3-29	targeted	0.720	0.768	0.733	0.493
SB3-29	Measured	0.719	0.804	0.727	0.504
SB3-29	Measured bc	0.742	0.775	0.750	0.482
SB3-29\ccc	targeted	0.730	0.763	0.718	0.490
SB3-29\ccc	Measured	0.730	0.799	0.711	0.500
SB3-29\ccc	Measured bc	0.752	0.771	0.734	0.479
SB3-30	Measured	1.049	0.924	1.001	0.566
SB3-30	targeted	1.044	0.896	1.056	0.566
SB3-30	Measured bc	1.059	0.893	1.070	0.538
SB3-30\ccc	Measured	0.909	0.885	0.913	0.557
SB3-30\ccc	targeted	0.905	0.858	0.964	0.557
SB3-30\ccc	Measured bc	0.918	0.855	0.977	0.529
SB3-31	Measured	0.510	0.664	0.595	0.407
SB3-31	targeted	0.518	0.640	0.619	0.404
SB3-31	Measured bc	0.526	0.641	0.619	0.389
SB3-31\ccc	Measured	0.511	0.639	0.559	0.398
SB3-31\ccc	targeted	0.518	0.616	0.581	0.395
SB3-31\ccc	Measured bc	0.526	0.617	0.582	0.381
SB3-32	Measured	0.762	0.768	0.769	0.472
SB3-32	Measured bc	0.776	0.743	0.793	0.439
SB3-32	targeted	0.775	0.748	0.883	0.464

Glass ID/HT	Comp View	NL B(g/L)	NL Li (g/L)	NL Na (g/L)	NL Si (g/L)
SB3-32\ccc	Measured	0.664	0.778	0.715	0.470
SB3-32\ccc	Measured bc	0.676	0.753	0.739	0.437
SB3-32\ccc	targeted	0.676	0.758	0.822	0.462
SB3-33	Measured	0.499	0.633	0.545	0.394
SB3-33	targeted	0.499	0.605	0.560	0.391
SB3-33	Measured bc	0.515	0.609	0.568	0.367
SB3-33\ccc	Measured	0.503	0.629	0.535	0.396
SB3-33\ccc	targeted	0.503	0.601	0.549	0.393
SB3-33\ccc	Measured bc	0.520	0.605	0.557	0.368
SB3-34	Measured	0.736	0.754	0.824	0.450
SB3-34	targeted	0.756	0.737	0.847	0.448
SB3-34	Measured bc	0.758	0.728	0.858	0.430
SB3-34\ccc	Measured	0.633	0.738	0.743	0.440
SB3-34\ccc	targeted	0.651	0.721	0.763	0.438
SB3-34\ccc	Measured bc	0.653	0.712	0.773	0.421
SB3-35	Measured	0.634	0.749	0.823	0.515
SB3-35	targeted	0.638	0.714	0.873	0.510
SB3-35	Measured bc	0.655	0.720	0.875	0.479
SB3-35\ccc	Measured	0.608	0.737	0.740	0.495
SB3-35\ccc	targeted	0.612	0.702	0.784	0.490
SB3-35\ccc	Measured bc	0.628	0.709	0.787	0.460
SB3-36	Measured	0.911	0.829	1.085	0.565
SB3-36	targeted	0.939	0.815	1.127	0.572
SB3-36	Measured bc	0.942	0.798	1.154	0.526
SB3-36\ccc	Measured	0.841	0.893	1.029	0.563
SB3-36\ccc	targeted	0.866	0.878	1.069	0.569
SB3-36\ccc	Measured bc	0.869	0.859	1.094	0.524
SB3-37	Measured	0.581	0.752	0.485	0.475
SB3-37	targeted	0.563	0.719	0.517	0.462
SB3-37	Measured bc	0.586	0.727	0.519	0.451
SB3-37\ccc	Measured	0.591	0.741	0.505	0.477
SB3-37\ccc	targeted	0.573	0.709	0.539	0.465
SB3-37\ccc	Measured bc	0.596	0.716	0.540	0.453
SB3-38	targeted	0.801	0.819	0.843	0.505
SB3-38	Measured	0.808	0.852	0.822	0.511
SB3-38	Measured bc	0.816	0.824	0.849	0.485
SB3-38\ccc	targeted	0.727	0.824	0.808	0.508
SB3-38\ccc	Measured	0.733	0.857	0.788	0.514
SB3-38\ccc	Measured bc	0.740	0.829	0.814	0.488
SB3-39	targeted	0.572	0.723	0.489	0.468
SB3-39	Measured	0.571	0.752	0.478	0.474
SB3-39	Measured bc	0.590	0.724	0.498	0.442
SB3-39\ccc	targeted	0.584	0.708	0.524	0.472
SB3-39\ccc	Measured	0.583	0.737	0.513	0.478
SB3-39\ccc	Measured bc	0.603	0.709	0.533	0.445
SB3-40	Measured	0.824	0.872	0.816	0.513
SB3-40	targeted	0.839	0.853	0.861	0.513
SB3-40	Measured bc	0.839	0.844	0.868	0.477

Glass ID/HT	Comp View	NL B(g/L)	NL Li (g/L)	NL Na (g/L)	NL Si (g/L)
SB3-40\ccc	Measured	0.726	0.863	0.776	0.511
SB3-40\ccc	targeted	0.740	0.844	0.819	0.511
SB3-40\ccc	Measured bc	0.739	0.836	0.826	0.475
SB3-41	Measured	1.012	1.133	1.197	0.735
SB3-41	targeted	1.000	1.105	1.241	0.729
SB3-41	Measured bc	1.021	1.095	1.273	0.698
SB3-41\ccc	Measured	1.009	1.226	1.128	0.755
SB3-41\ccc	targeted	0.997	1.196	1.170	0.749
SB3-41\ccc	Measured bc	1.018	1.185	1.200	0.717
SB3-42	Measured	1.391	1.409	1.616	0.869
SB3-42	Measured bc	1.404	1.361	1.669	0.825
SB3-42	targeted	1.402	1.816	1.686	0.877
SB3-42\ccc	Measured	1.578	2.279	1.616	1.130
SB3-42\ccc	Measured bc	1.593	2.202	1.668	1.073
SB3-42\ccc	targeted	1.591	2.938	1.685	1.141

Figure 6-2 shows the measured log NL [B] versus ΔG_P for the SB3 Phase 1 glasses in an effort to assess predictability or applicability of ΔG_P to the anticipated compositional region of interest. In this report, predictability is based on the 95% two-sided confidence interval for an individual PCT response as generated by the Thermodynamic Hydration Energy Reaction Model (THERMO™) ΔG_P model (Jantzen et al. 1995). This definition is consistent with that used in recent variability studies (e.g., Harbour et al. 2000; Herman et al. 2001). A comparison is made of the actual leaching performance as determined by the PCT and the prediction limits for an individual glass generated by the THERMO™ model. The durability of a glass is considered predictable if its PCT response is within the 95% confidence interval.

In terms of predictability, 81 of 84 glasses (when considering both quenched and ccc) are predictable (i.e., lie within the upper and lower 95% confidence interval) based on targeted compositions. The exceptions are: SB3-04ccc, SB3-20, and SB3-20ccc. These three glasses lie below the lower 95% confidence band.

When using the measured or measured-bias corrected compositional views to assess predictability, two glasses lie above and eleven glasses fall below the upper and lower 95% confidence bands respectively. Both quenched and ccc versions of SB3-07 (based on the measured-bias corrected compositional view) are located near a ΔG_P value of -7 and outside the upper 95% confidence band in Figure 6-2. SB3-07 is a 30% WL (lower limit) glass based on the 25% washed sludge and Frit 405 (see Table 4-2). Historically, glasses observed in this region have been classified as "acceptable" in terms of DWPF processing (although unpredictable) given the positive ΔG_P value and the fact that the NL [B] release is well below the EA acceptance criteria. The same classification can be given to SB3-07. The NL [B] release for the quenched and ccc versions are 0.754 g/L and 0.726 g/L, respectively – well below the EA limit.

The eleven glasses falling below the lower 95% confidence band are: SB3-02ccc, SB3-04, SB3-04ccc, SB3-14, SB3-14ccc, SB3-18, SB3-18ccc, SB3-20, SB3-20ccc, SB3-24, and SB3-24ccc. (A total of six different targeted glass compositions). These glasses are classified as unpredictable and lie toward the more negative ΔG_P values (from approximately -12.5 to -13.5 kcal/mol). Although these glasses are unpredictable, their measured normalized boron releases are acceptable with the highest release (lowest durability) being 0.954 g/L from SB3-24 (compared to the 16.695 g/L for EA).

It should be noted that the ΔG_P model was developed for and is to be applied to homogeneous glasses (DWPF Waste Qualification Report [WQR] [Plodinec et al. 1995] and THERMO™ [Jantzen et al. 1995]). Of these eleven glasses, six are ccc versions which may (or at least are more likely to) have resulted in an inhomogeneous glass (with respect to crystallization).[19] Although X-ray diffraction (XRD) analysis was not performed on any glasses in this study, application to inhomogeneous glasses does have potential (and technical) merit, given that the impact of developing secondary phase(s) is minimal to the overall performance as discussed by Peeler et al. (2002b). In this report, it is assumed that the ΔG_P model applies to both quenched and ccc glasses.

[19] Amorphous phase separation is not considered to be an issue given predictions suggest that these glasses are predicted to be homogeneous.

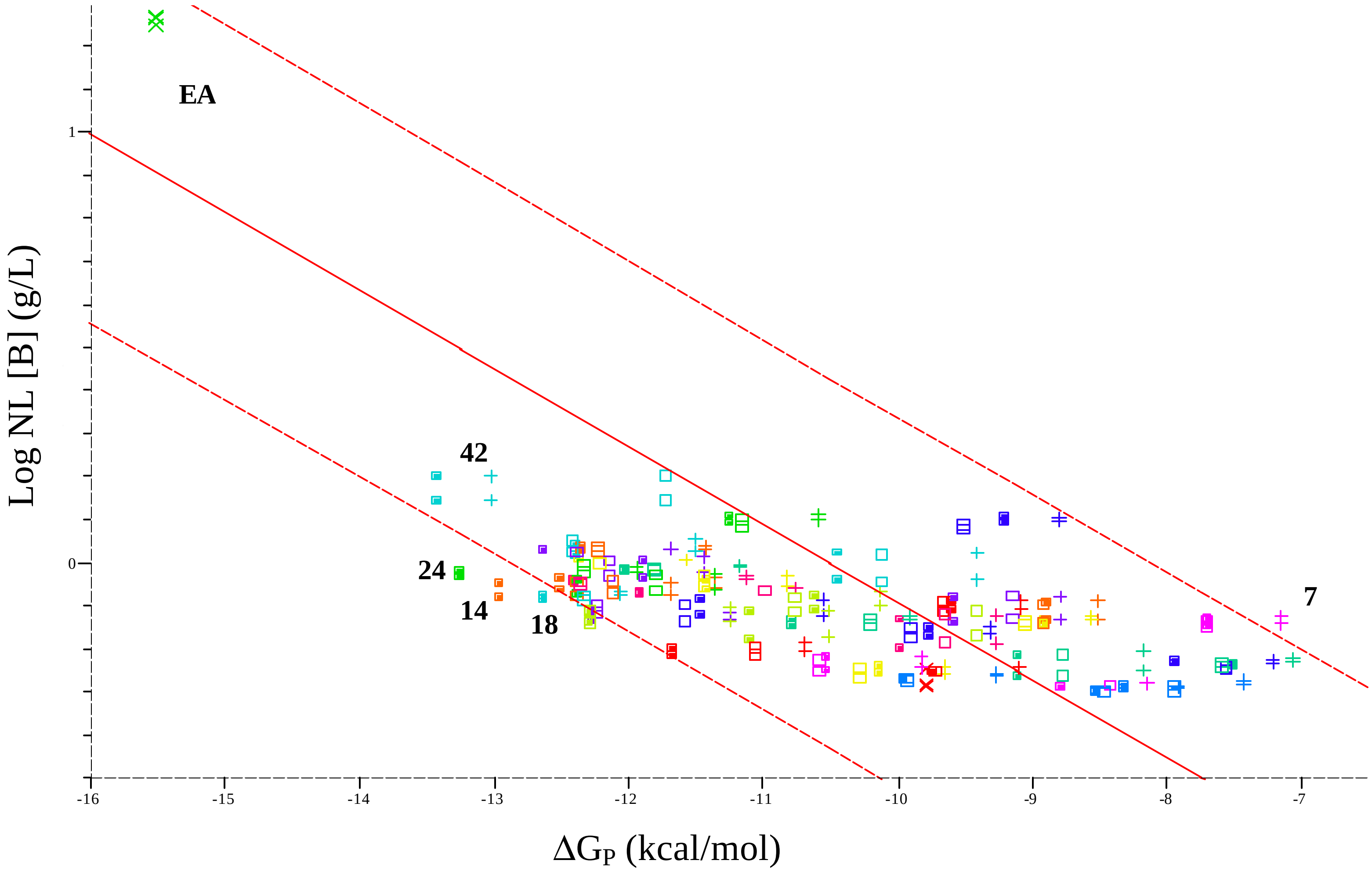

Figure 6-2. log NL [B] Versus DGP.
(both quenched and ccc glasses as well as the three compositional views are shown)

From Table 4-2, all six of these glasses represent the upper WL limit as defined by the MAR acceptance criteria. Further, access to higher WLs for five of the six glass systems is limited by predictions of durability (as noted by PCT being listed in Table 4-2 for the upper WL limit). The exception being SB3-02ccc (based on Frit 405 and the 0% linear washed sludge at 43% WL) which would be limited by low viscosity at 44% WL and higher. However, at 45% WL predictions indicate that durability becomes an issue.

Although these glasses appear to be approaching a durability level in which acceptability is questionable (in fact restricted based on he current ΔG_P criterion), the measured durability response seems to indicate that higher WLs may be potentially achievable prior to reaching an unacceptable level. The results of these glasses are very similar to that observed during the development of Frit 320 for SB2 (Peeler et al. 2001). More specifically, Frit 304 was shown to have a higher melt rate for SB2 (at 25% WL) compared to Frit 320. It was hypothesized that the increased alkali and/or lower SiO_2 concentration in Frit 304 relative to Frit 320 was the primary mechanism for this improved melt rate. However, predictions of durability indicated that the glass would be unacceptable and thus this frit was not recommended by Lambert et al. (2001) for further testing. Formal measurement of the PCT response for this glass (both quenched and ccc versions) indicated that all reportable elemental normalized releases were less than 2 g/L. As with some of the SB3 glasses (see Figure 6-2), although measured releases are acceptable, predictions of durability limit access to higher waste loadings and potentially implementation of a frit that could improve melt rate and/or throughput.

In general, the SB3 glasses that challenge ΔG_P predictions are higher alkali glasses. SB3-16 and SB3-22 are also PCT limited but produce acceptable glasses in terms of durability. This provides an indication that the model, although conservative, may unduly constrain compositional regions that could yield higher melt rates or access to lower washed sludges. The potential implications for SB3 and the frit selection process is to avoid (or at least rank low) frits that are predicted to be PCT limited based solely on model predictions that also have narrow projected operational windows. One case of particular interest is the Frit 202 / Decant #5 system. For that system, the PCCS operational window is relatively small but is limited on the upper WL side by predictions of durability. The question becomes: “How far can waste loading be increased before the PCT is measured to have an unacceptable behavior?”.

Assuming all other factors equal (such as melt rate or tolerance to compositional variation), the frit selection process may minimize (or even eliminate) the potential use of Frit 406, Frit 410, Frit 411, Frit 420, and/or Frit 421 as primary candidates for SB3 based on this effect. However, as previously mentioned, the frit selection process should not be made based on a single criterion but on a collection of criteria that provide insight into the ease of processing SB3 while still making an acceptable glass. Peeler and Edwards (2002) provide more detailed assessments of the operational window size and the impact of projected compositional variation for these systems.

6.4 “Unacceptable Glasses” Based on Model Predictions

6.4.1 Challenges to the Homogeneity Constraint (SB3-13 and SB3-35)

Rios-Armstrong (2002b) provided direction to fabricate and test a few glasses outside the acceptable region. This was taken into consideration during the glass selection process with the selection of SB3-13 and SB3-35 (both Frit 411 based). The MAR predictions (see Appendices C1 and C2) indicate that both glasses are inhomogeneous at 25% WL – yet they were included in the SB3 Phase 1 test matrix.

The PCT responses from both SB3-13 and SB3-35 (quenched and ccc versions) were predictable as well as acceptable. Normalized boron releases for SB3-13 and SB3-13ccc are 0.798 and 0.733 g/L (based on targeted composition), respectively. Normalized boron releases for SB3-35 and SB3-35ccc are 0.638 and 0.612 g/L (based on targeted composition), respectively. These glasses challenge the use and/or application of the homogeneity constraint to SB3 given they produced both acceptable and predictable glasses. These results reinforce the recommendations made by Herman et al. (2002c) specific to SB3 with respect to applicability of the homogeneity constraint for SB3.

6.4.2 Frit 320-Based Glasses

Herman, Peeler, and Edwards (2002) indicated that Frit 320 would be evaluated in the Phase 1 study given its classification as a "baseline" frit by Elder (2002). As mentioned in Section 4.0, Frit 320 is a viable frit for the more advanced washed sludges (e.g., 75% linear washing case, Decant #12 and above). SB3-42 is a Frit 320-based glass with the 75% linear washed sludge targeting a 41% WL. Higher WLs are prohibited by predictions of low viscosity based on the less restrictive PAR criteria. As discussed in Section 4.0, application of the MAR reduces the upper WL limit to 39% (see Table 4-3) thus yielding the 41% WL glass as "unacceptable". Predictions of homogeneity and low viscosity are still defining the projected operational window even at the MAR. It is noted that predictions of durability do not limit this system over the entire WL range of interest – therefore durability issues with this glass are not expected for a fully oxidized system.

Table 6-3 summarizes the elemental releases for SB3-42 (quenched and ccc). Although these glasses would be restricted from DWPF processing based on the MAR, their PCT responses are acceptable as well as predictable. The highest NL [B] release (or lowest durability) is 1.591 g/L from SB3-42ccc (based on the targeted composition). The NL [B] for EA is 16.695 g/L – more than an order of magnitude greater than the measured release of SB3-42ccc. Although this glass challenges the low viscosity constraint, the PCT response is predictable and acceptable and thus demonstrates the applicability of ΔG_P model in this compositional region. It should be noted that to obtain access to higher WLs for this particular system, the lower viscosity constraint would either have to be challenged or altered.

Table 6-3. Summary of PCT Results for SB3-42.

Glass ID/HT	Comp View	NL B(g/L)	NL Li (g/L)	NL Na (g/L)	NL Si (g/L)
SB3-42	Measured	1.391	1.409	1.616	0.869
SB3-42	Measured bc	1.404	1.361	1.669	0.825
SB3-42	Targeted	1.402	1.816	1.686	0.877
SB3-42\ccc	Measured	1.578	2.279	1.616	1.130
SB3-42\ccc	Measured bc	1.593	2.202	1.668	1.073
SB3-42\ccc	Targeted	1.591	2.938	1.685	1.141

6.5 Experimental Assessment of PCT as a Function of Redox

Glasses resulting from the MRF tests showed no visible signs of unreacted batch and appeared single-phased (crystallization or metallic species resulting from an overly reduced melt were not observed). Representative samples of each glass were submitted to the SRTC-ML for chemical analysis. The measured composition and redox of each Tank 8 based glass product are shown in Table 6-4. The measured redox values for the three glasses bound the iron redox ($Fe^{2+}/\Sigma Fe$) defined by Schreiber and Hockman (1987) of $0.09 \leq Fe^{2+}/\Sigma Fe \leq 0.33$. SB3-22-SME has a measured redox of 0.41 exceeding the upper 0.33 limit that minimizes the potential formation of nickel metal and/or nickel sulfide. SB3-23-SME has a measured redox of 0.04 which is lower than the 0.09 limit that is considered too oxidizing and can lead to foaming and increased refractory wear.

Table 6-4. Measured Compositions of the Tank 8 Glasses.

Element	SB3-21-SME	SB3-22-SME	SB3-23-SME	Oxide	SB3-21-SME	SB3-22-SME	SB3-23-SME
Al	2.81	3	3.12	Al_2O_3	5.309	5.669	5.895
B	1.65	1.55	1.59	B_2O_3	5.313	4.991	5.120
Ba	0.048	0.064	0.067	BaO	0.054	0.071	0.075
Ca	0.687	0.731	0.761	CaO	0.961	1.023	1.065
Cr	0.064	0.07	0.073	Cr_2O_3	0.094	0.102	0.107
Cu	0.031	0.039	0.04	CuO	0.039	0.049	0.050
Fe	6.94	7.61	7.53	Fe_2O_3	9.922	10.880	10.766
Gd	0.004	0.004	0.005	Gd_2O_3	0.005	0.005	0.006
Li	2.14	2.36	2.44	Li_2O	4.607	5.081	5.253
Mg	0.859	0.01	0.016	MgO	1.424	0.017	0.027
Mn	0.74	0.848	0.851	MnO	0.955	1.095	1.099
Na	9.49	11.8	9.95	Na_2O	12.793	15.906	13.413
Ni	0.716	0.817	0.826	NiO	0.911	1.040	1.051
P	0.027	0.026	0.017	P_2O_5	0.062	0.060	0.039
Pb	0.022	0.026	0.028	PbO	0.024	0.028	0.030
Pd	<0.010	<0.010	<0.010	PdO	0.006	0.006	0.006
Rh	0.011	<0.010	0.012	RhO_2	0.014	0.007	0.016
Ru	0.017	<0.010	0.02	RuO_2	0.022	0.007	0.026
Si	25.1	23.4	24.1	SiO_2	53.696	50.060	51.557
Sr	0.01	0.028	0.026	SrO	0.012	0.033	0.031
Zn	0.053	0.076	0.085	ZnO	0.066	0.095	0.106
Zr	0.135	0.144	0.145	ZrO_2	0.182	0.195	0.196
Total					96.471	96.42	95.934
Redox	0.1	0.41	0.04				
Noble Metals Levels	Nominal	10% of Nominal	Nominal				
Nitric Acid (moles/L)	0.41	0.35	0.29				
Formic Acid (moles/L)	0.73	0.70	0.68				
% of Acid Stoichiometry	190%	160%	130%				
Sand	1.12	1.12	1.12				
Coal	0.72	0.72	0.72				
Oxalate[20]	75%	50%	25%				

[20] Oxalate levels shown are the % of the anticipated level (based on the 330,000 kgs as reported by Goslen).

Representative samples of each glass were also subjected (in triplicate) to the PCT and the resulting solutions submitted to the SRTC-ML for analysis. Table 6-5 provides the measurements generated by the lab for these samples.

Table 6-5. PCTs (in ppm) for Tank 8 Glass Products and Standards.

	As Reported by the SRTC-ML						Values (in ppm) After Adjusting for Dilution Factor					
Sample	Al	B	Fe	Li	Na	Si	Al	B	Fe	Li	Na	Si
Std1	4.36	21.0	4.05	9.51	85.3	49.3	4.36	21.0	4.05	9.51	85.3	49.3
Blk1	0.0045	0.056	0.002	0.100	0.05	0.0395	0.015	0.187	0.007	0.167	0.017	0.132
Blk2	0.0085	0.042	0.002	0.100	0.05	0.0395	0.028	0.140	0.007	0.167	0.017	0.132
Arm1	3.11	10.7	<0.004	8.69	14.1	40.4	5.183	17.834	0.007	14.484	23.500	67.335
Arm2	3.10	11.1	<0.004	8.61	14.0	40.0	5.167	18.500	0.007	14.350	23.334	66.668
Arm3	3.28	11.1	<0.004	8.67	14.2	40.2	5.467	18.500	0.007	14.450	23.667	67.001
SB3-21-1	6.92	9.21	4.90	12.7	57.3	90.6	11.534	15.350	8.167	21.167	95.502	151.003
SB3-21-2	23.0	9.16	4.05	12.3	54.9	87.1	38.334	15.267	6.750	20.500	91.502	145.170
SB3-21-3	6.10	9.03	4.88	12.6	55.4	94.9	10.167	15.050	8.133	21.000	92.335	158.170
SB3-22-1	14.4	12.0	22.4	22.7	114	131	24.000	20.000	37.334	37.834	190.004	218.338
SB3-22-2	13.7	11.4	20.6	21.6	108	126	22.834	19.000	34.334	36.001	180.004	210.004
SB3-22-3	15.0	11.5	22.9	21.9	110	131	25.001	19.167	38.167	36.501	183.337	218.338
SB3-23-1	12.4	9.24	18.6	15.7	67.8	95.4	20.667	15.400	31.001	26.167	113.002	159.003
SB3-23-2	12.6	9.07	11.7	15.3	67.3	92.6	21.000	15.117	19.500	25.501	112.169	154.336
SB3-23-3	10.1	9.33	12.4	15.7	67.9	95.4	16.834	15.550	20.667	26.167	113.169	159.003

Table 6-6 summarizes the PCT results (normalized based on measured compositions – see Table 6-4) for each glass product. Also listed in Table 6-6 are the predicted normalized releases for each glass product based on the measured compositions, measured REDOX values, and partitioning the Fe accordingly in the PCCS model.

Table 6-6. Redox and PCT Response of Tank 8 Glass Products.

Measured	NL [B] g/L	NL [Li] g/L	NL [Na] g/L	NL [Si] g/L	$Fe^{2+}/\Sigma Fe$
SB3-21-SME	0.923	0.981	0.981	0.609	0.1
SB3-22-SME	1.251	1.559	1.563	0.921	0.41
SB3-23-SME	0.966	1.069	1.134	0.658	0.04
Predicted	NL [B] g/L	NL [Li] g/L	NL [Na] g/L	NL [Si] g/L	ΔG_p
SB3-21-SME	0.848	0.870	0.846	0.437	-10.1061
SB3-22-SME	4.637	3.460	4.212	1.468	-14.1839
SB3-23-SME	1.050	1.035	1.035	0.509	-10.6194

Regardless of the measured redox, all three glasses were very acceptable with respect to the EA limits. Note that the ΔG_P of -14.1839 for SB3-22-SME would not be processable by PCCS (e.g., more negative than the SME acceptability limit). The highest measured release (or lowest durability – NL [B] of 1.251 g/L) is from the SB3-22-SME glass that is the most reduced. Following proposed theory, this glass would have a higher portion of reduced iron and thus a negative impact on durability would be projected (i.e., the ΔG_i value for FeO being more negative than that for Fe_2O_3 – see Jantzen et al. 1995). If one were to control the redox of this glass within the acceptable limits ($Fe^{2+}/\Sigma Fe \leq 0.33$) thus yielding a more oxidized glass, one would anticipate the measured releases to decrease or durability to increase.

SB3-22-SME and SB3-23-SME are both Frit 320 based glasses targeting 30% WL. The main difference between these two glasses is the acid addition strategy, which is ultimately expressed through a significant difference in measured redox. Given the compositional measurements (see Table 6-4) provide a high degree of confidence that the two glasses are similar in composition, a basis for comparing the effect of redox on PCT response can be made. The redox of SB3-22-SME and SB3-23-SME are 0.41 and 0.04, respectively – bounding the acceptable redox values as defined by Schreiber and Hockman (1987). The measured NL [B] for SB3-22-SME and SB3-23-SME are 1.251 g/L and 0.966 g/L, respectively. These data suggest that as the glass becomes more reduced the durability decreases – following theory. Although the normalized releases suggest a reduction in durability, the difference is only 0.285 g/L over a very broad redox range. One could argue that the lower Na_2O and/or slightly higher SiO_2 or Al_2O_3 concentrations in SB3-23-SME could be responsible for this difference.

Also shown in Table 6-6 are the predicted normalized releases for these glasses based on the measured compositions and redox values. For the more oxidized glasses (SB3-21-SME and SB3-23-SME), the predicted NL [B] are in good agreement with the measured release. The prediction associated with SB3-21-SME product appears to slightly underestimate the measured release while that for SB3-23-SME slightly over predicts. For SB3-22-SME (the most reduced glass), the predicted boron release is 4.637 g/L, while the measured release is 1.251 g/L.

These data (albeit limited) suggest that the model prediction is extremely conservative toward the more reduced end of the redox spectrum. The latter statement regarding model conservatism assumes that the predicting data fall directly on the prediction line without accounting for uncertainties in the prediction (e.g., the upper and lower confidence bands were not applied).

6.6 Redox Dependent Predictions

Given the redox dependent model is available and was proven effective (or at least conservative for a limited dataset) in Section 6.4, its application to the 42 SB3 Phase 1 glasses will provide insight into the effect of redox on predicted PCT and/or PCCS acceptability. Durability predictions for each targeted glass composition were performed assuming three redox conditions: (1) $Fe^{2+}/\Sigma Fe = 0$ (fully oxidized), (2) $Fe^{2+}/\Sigma Fe = 0.2$ (assumed target), and (3) $Fe^{2+}/\Sigma Fe = 0.33$ (the upper acceptance limit). Given the trends observed with the SB3 SME glasses (see Section 6.4), one would expect that the predictions assuming a redox of 0.33 may be conservative (e.g., the predicted PCT response may be greater than the measured or actual release). It should be noted that the degree of conservatism observed with SB3-22-SME ($Fe^{2+}/\Sigma Fe \leq 0.41$ with a predicted and measured NL [B] of 4.637 g/L and 1.251 g/L, respectively) may not be as great given the targeted redox of 0.33.

Table 6-7 shows the predictions of normalized releases for each SB3 Phase 1 glass at 0.0, 0.2 and 0.33 $Fe^{2+}/\Sigma Fe$ ratios. Also included in Table 6-7 are the measured normalized releases for each glass which should be fully oxidized (assumed $Fe^{2+}/\Sigma Fe = 0.0$) given the raw material selection, exclusion of oxalate and/or coal, and fabrication technique.

When comparing the quenched (measured) PCT releases with their counterpart "fully oxidized" predicted values, the model appears to, depending on the glass, either over or under predict the boron release. This reflects the fact that the model provides a measure of the PCT response in the absence of uncertainties. The uncertainties associated with the model are represented by the 95% confidence bands (as shown in Figure 6-2). Therefore, observing measured values both above and below the predicted line is expected. Historically (and supported by the Phase 1 data), there is evidence that glasses lying at the more positive ΔG_P values are typically under predicted by the model while those lying toward the more negative ΔG_P values are over predicted.

As the $Fe^{2+}/\Sigma Fe$ ratio shifts from 0 to 0.33, Jantzen et al. (1995) indicate that the durability of the glass should decrease given the presence of FeO in the glass. This is reflected in the projected PCT responses. For example, consider SB3-01 and SB3-02 with predicted NL [B] releases of 0.66 g/L and 1.96 g/L (based on a fully oxidized system), respectively. The corresponding predicted NL [B] values for a $Fe^{2+}/\Sigma Fe$ ratio of 0.2 (for SB3-01 and SB3-02) increase to 0.88 g/L and 2.86 g/L, respectively. The magnitude of the predicted boron release shift is dependent on the overall glass composition but is highly influenced by the percentage of Fe present.

Proceeding to the more reduced glasses ($Fe^{2+}/\Sigma Fe = 0.33$), predictions indicate that the normalized releases increase (i.e., durability decreases) relative to their more oxidized counterparts. The corresponding predicted NL [B] values for a $Fe^{2+}/\Sigma Fe$ ratio of 0.33 (for SB3-01 and SB3-02) increases to 1.06 g/L and 3.66 g/L, respectively. The highest predicted NL [B] (4.50 g/L) is from SB3-22 assuming a $Fe^{2+}/\Sigma Fe = 0.33$. The more oxidizing SB3-22 glasses ($Fe^{2+}/\Sigma Fe$ of 0.0 and 0.2) have predicted NL [B] of 2.17 and 3.37 g/L, respectively. The measured NL [B] of SB3-22 (assumed to be fully oxidized) is 0.902 g/L – almost 2.5 times less than the predicted value of 2.17 g/L. Assuming the model becomes more conservative as the glass becomes more reduced, the measured normalized boron release for SB3-22 (with a $Fe^{2+}/\Sigma Fe = 0.33$) should be less than the predicted 4.50 g/L. Even if the model was not conservative, the predicted NL [B] of 4.50 g/L is well below the EA acceptance criteria (ignoring uncertainties).

Applying the redox effect over a range from 0.00 (fully oxidized) to 0.33 (upper acceptance limit), the ΔG_P predictions indicate that the durability decreases as the glasses become more reduced and the maximum release (or lowest durability) is 4.50 g/L which is still acceptable with respect to the EA criterion.

The issue of "acceptability" may give way to the issues of predictability or the classification of "processable". Acceptability being defined based on the measured normalized release compared to log NL [B] = 1.0 g/L – a threshold established by Edwards and Brown (1998) in a review of data to establish alternative criteria for the homogeneity constraint. Predictability being based on the 95% two-sided confidence interval for an individual PCT response as generated by the THERMO™ ΔG_P model (Jantzen et al. 1995). "Processable" being determined by the relationship of the measured SME products' predicted ΔG_P to the SME acceptability ΔG_P criterion of -12.7808 kcal/mol and ultimately the projected operating window.[21]

[21] This value is the SME Acceptability value at the PAR and will be used as a measure of acceptability in this section. The more restrictive MAR value is not used given it is depedent upon the glass composition and thus the value changes with each SB3 Phase 1 glass. It should be noted that a glass deemed unacceptable at the PAR would be classified as unacceptable at the MAR.

Table 6-7. Summary of Predicted and Measured NL [B] Releases (in g/L) for the SB3 Phase 1 Glasses for Various Redox Values Based Upon Targeted Compositional View.

Glass Identification	Predicted NL[B (g/L)]			Measured PCT[22]	
	$Fe^{2+}/\Sigma Fe = 0.0$ (assumed)	$Fe^{2+}/\Sigma Fe = 0.2$ (assumed target)	$Fe^{2+}/\Sigma Fe = 0.33$ (upper limit)	Quenched	CCC
SB3-1	0.66	0.88	1.06	1.225	1.196
SB3-2	1.96	2.86	3.66	0.907	0.850
SB3-3	0.49	0.65	0.78	0.612	0.549
SB3-4	2.06	3.09	4.02	0.795	0.766
SB3-5	1.48	1.98	2.40	0.935	0.886
SB3-6	2.22	3.19	4.03	1.128	1.056
SB3-7	0.31	0.41	0.50	0.736	0.709
SB3-8	1.11	1.72	2.29	0.831	0.770
SB3-9	0.35	0.48	0.60	0.518	0.505
SB3-10	1.22	1.96	2.67	0.863	0.861
SB3-11	0.70	0.95	1.15	0.814	0.779
SB3-12	1.31	2.10	2.85	1.256	1.212
SB3-13	1.57	2.03	2.39	0.798	0.733
SB3-14	2.19	3.27	4.24	0.902	0.838
SB3-15	1.73	2.34	2.86	0.959	0.965
SB3-16	2.19	3.09	3.85	1.062	1.059
SB3-17	0.91	1.20	1.44	0.567	0.545
SB3-18	2.15	3.20	4.14	0.840	0.818
SB3-19	1.03	1.36	1.63	0.597	0.561
SB3-20	2.10	3.06	3.92	0.774	0.725
SB3-21	0.79	1.08	1.32	0.541	0.532
SB3-22	2.17	3.37	4.50	0.902	0.888
SB3-23	0.72	0.98	1.19	0.560	0.560
SB3-24	2.14	3.34	4.45	0.986	0.954
SB3-25	0.78	1.04	1.25	0.704	0.674
SB3-26	2.05	3.11	4.08	1.088	1.067
SB3-27	0.88	1.17	1.41	0.739	0.718
SB3-28	1.98	2.95	3.82	1.015	0.928
SB3-29	0.55	0.74	0.89	0.720	0.730
SB3-30	0.85	1.36	1.84	1.044	0.905
SB3-31	0.42	0.60	0.76	0.518	0.518
SB3-32	0.64	1.03	1.42	0.775	0.676
SB3-33	0.43	0.60	0.74	0.499	0.503
SB3-34	0.70	1.14	1.56	0.756	0.651
SB3-35	1.26	1.63	1.93	0.638	0.612
SB3-36	1.71	2.73	3.69	0.939	0.866
SB3-37	0.29	0.40	0.50	0.563	0.573
SB3-38	0.52	0.83	1.13	0.801	0.727
SB3-39	0.30	0.40	0.48	0.572	0.584
SB3-40	0.57	0.92	1.25	0.839	0.740
SB3-41	2.04	2.73	3.29	1.000	0.997
SB3-42	1.66	2.62	3.53	1.402	1.591

[22] Given the conditions under which the Phase 1 glasses were melted, these redox of these glasses should be considered fully oxidized.

Hypothetically, consider a fully oxidized glass that is both predictable and processable. As the redox of this glass is shifted toward the more reduced state this glass could become unpredictable, unprocessable, both, or neither. Figure 6-3 illustrates this concept. Point A is a glass that falls with the 95% confidence bands (predictable) and has a predicted ΔG_P more positive than the -12.7808 kcal/mol PAR SME acceptance criterion. This glass would be deemed processable in DWPF. Point B is the same targeted glass composition with the exception that redox has shifted to a more reduced state and it has been assumed that there was no practical impact on the measured PCT response. Given the anticipated partitioning of both FeO and Fe_2O_3, this glass is now unpredictable (shifted outside the lower 95% confidence band) but would still be consider processable given its ΔG_P is more positive than the -12.7808 kcal/mol acceptance criteria.

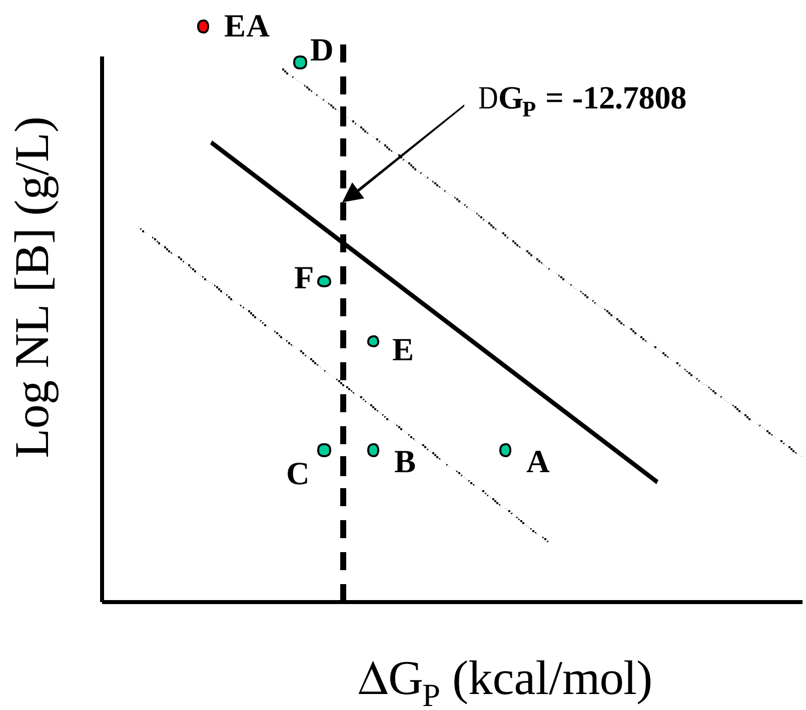

Figure 6-3. Schematic of ΔG_P vs. log NL [B] and Potential Prediction Scenarios.

The magnitude of the ΔG_P shift from Point A to Point B is solely dependent upon the application of the ΔG_i values for Fe_2O_3 and FeO, the concentration of Fe in the glass, and the glass redox. Appendix J provides a matrix of the ΔG_P impact as a function of Fe concentration in glass and redox. For example, consider an oxidized glass composition with a Fe concentration of 7 wt% and a predicted ΔG_P value of -10.0 kcal/mol. If the redox of that glass were shifted to 0.2 ($Fe^{2+}/\Sigma Fe$), the predicted impact or shift in terms of ΔG_P (strictly from partitioning and application of the ΔG_i values) would be -0.7172 kcal/mol – resulting in a predicted value for the more reduced version of that same glass of -10.7172 kcal/mol which would still be acceptable from a SME acceptability standpoint. Based on the values shown in Appendix J, the higher the Fe concentration in glass and the larger the redox difference, the higher the magnitude of the shift. Those glass systems whose ΔG_P value are already challenging the SME acceptability limit under oxidizing conditions, will have a high probability of being classified as “unacceptable” with a shift in redox.

The theory supporting the redox term in ΔG_P implies that the overall glass composition does not play a role in determining the magnitude of the shift but is strictly a function of the Fe concentration. Feng et al. (1990) studied the effect of redox on durability for West Valley waste glasses. It was concluded that the redox effects on durability are strongly dependent on glass composition – not just the Fe concentration. More specifically, the leach rate differed by a factor of 12 from the most oxidized to the most reduced glass at low Al_2O_3 concentrations (~3.3 wt%), while the factor fell to below 2 for glass compositions with higher Al_2O_3 concentrations (~5.7 wt% and ~9.9 wt%). Therefore, the application of the ΔG_i values without consideration of the overall glass composition may lead to a more significant ΔG_P shift (larger magnitude) than is real. This latter statement being based on the assumption that the potential interactive effects of components such as Al_2O_3 have not been accounted for in the overall ΔG_P prediction with the redox term activated. This does not suggest that there is not an effect of redox on durability, but the predicted effect may be conservative without consideration of other possible interactive effects. The PCT response (in terms of log NL [B]) determines the magnitude of the shift on the y-axis – this is a physical measurement; not theory-based.

If the $Fe^{2+}/\Sigma Fe$ ratio is increased (more reduced), there is a possibility that the glass would become both unpredictable and classified as "unprocessable" given the ΔG_P predicted value (again assuming no practical impact on the measured PCT). The fact that it is both unpredictable and unprocessable would be justified if the measured release challenged the EA acceptance criteria (Point D). If not, the conservatism in the model could limit access to both compositional and redox space that would produce an acceptable glass (Point C).

Points E and F conceptualize the option in which an increase in the measured NL [B] occurs as redox transitions from the oxidized to the reduced state. Both points are predictable (lie within the 95% confidence bands) but Point E is processable from a PCCS perspective while Point F is not.

Using the predicted ΔG_P values as a function of redox, the concept of acceptability (with respect to SME acceptability PAR criteria) can be applied to the SB3 Phase 1 glasses. Note, that the following discussion does not address the applicability of the model given no formal PCT measurements were taken for all 42 Phase 1 glasses under more reduced conditions. Tables 6-8, 6-9, and 6-10 provide a list of glasses whose predicted ΔG_P values are more negative than the -12.7808 kcal/mol PAR criteria for $Fe^{2+}/\Sigma Fe$ ratios of 0.0, 0.2, and 0.33, respectively. These glasses would ultimately be classified as "unprocessable" in DWPF. Based solely on the size of each table, a review indicates that as the glasses become more reduced the percentage of SB3 glasses that would be classified as unprocessable in DWPF increases. This trend is expected based on the theoretical nature of the ΔG_P model (i.e., the partitioning of Fe^{2+} and Fe^{3+}).

Based on these predicted values and taking a conservative approach, the projected impact on the operating window could be quite large. The projected operational windows presented in Section 4.0 were based on fully oxidized systems. Assuming the impact of redox is adequately captured by the model, for systems that are PCT limited (see Table 4-3), as REDOX shifts toward the more reduced state, more of the operating window will be eliminated. Even for systems that were not PCT limited as defined in Section 4.0, if PCT is a "close second" with respect to failing the MAR criteria and the $Fe^{2+}/\Sigma Fe$ ratio is highly reduced (yet still ≤ 0.33), the operating window could change. In both cases, the anticipated effect would be to restrict access to higher WLs – the degree of impact would vary depending upon the overall glass composition and the percent of Fe in the system.

For example, consider Table 6-10 ($Fe^{2+}/\Sigma Fe = 0.33$). A review of this table in relation to the systems that are PCT limited (or limited by low viscosity with PCT a close second – e.g., see SB3-02 in Table 4-4) indicates that there are a number of systems which would be classified as unprocessable by the current PCCS models (for all three compositional views). These include: SB3-02, SB3-04, SB3-14, SB3-16, SB3-22, SB3-24, SB3-26, SB3-28, SB3-36, and SB3-42. Each of these glasses is based on the upper WL limit as defined by the MAR acceptance criteria (for a fully oxidized system). Once redox is accounted for in the prediction, these glasses would not be processable. It is interesting to note that the Frit 202-based, Decant #5 glasses, SB3-15 (33% WL) and SB3-16 (37% WL), are classified as "unprocessable" (exception is the measured bias- corrected compositional view of SB3-15). Based on the assessment performed by Peeler and Edwards (2002), Frit 202 was a viable candidate for Decant #5 although the operational window was rather small compared to the use of Frit 202 with more advanced washed sludges. Their assessment was based on a fully oxidized system. The impact of redox on the predicted PCT response for that system essentially closes any opportunity for processing that system when the $Fe^{2+}/\Sigma Fe$ approaches the upper limit of 0.33. The potential implications to the SB3 frit selection process may be to avoid frits that drive the upper WLs to be PCT limited in an attempt to eliminate this issue.

The concern for the SB3 Frit Development team is the measured PCT responses (although limited) from the MRF glasses (see Section 6.4) as they compare to the predicted values. The predicted NL [B] for SB3-22-SME (with a measured $Fe^{2+}/\Sigma Fe = 0.41$) was 4.637 g/L while the measured NL [B] was 1.251 g/L. As previously discussed, these data suggest that the model may be conservative at the more reduced state in this compositional region. Assuming this is the case (and recognizing that the degree of conservatism may decrease as the system becomes more oxidized), one should question the extent to which the predictions (see Table 6-10 especially) are unduly constraining or restricting access to the SB3 composition region at the higher $Fe^{2+}/\Sigma Fe$ values. Although these glasses may be classified as "unprocessable" and even "unpredictable", they may yield acceptable glasses if the PCT is formally measured. For example, the ΔG_P for SB3-22-SME at $Fe^{2+}/\Sigma Fe$ ratios of 0.2 and 0.33 place this glass on the "unprocessable" list (see Tables 6-9 and 6-10 respectively). However, even with a $Fe^{2+}/\Sigma Fe$ ratio of 0.41, the measured NL [B] was 1.251 g/L – acceptable with respect to EA. Given theory suggests that as the glass becomes more oxidizing, durability should increase (forming more Fe_2O_3), and one would expect that the NL [B] for the 0.2 and 0.33 states would be less than the measured 1.251 g/L for boron.

Given activation of the redox term in PCCS, the result may be to eliminate candidate frits, which produce acceptable PCT results, from further consideration that may have led to the possibility of higher melt rates or total waste throughput. This latter statement being based on the fact that those systems that challenge PCT predictions are anticipated to have higher melt rates given the higher alkali contents.

Table 6-8. Predicted ΔG_P Values for SB3 Glasses Assuming $Fe^{2+}/\Sigma Fe = 0.00$ (Fully Oxidized).

Glass ID	Comp View	ΔG_P
SB3-42	Measured	-13.4256
SB3-24	Measured	-13.2645
SB3-42	Measured bc	-13.0332
SB3-14	Measured	-12.9674

Table 6-9 Predicted ΔG_P Values for SB3 Glasses Assuming $Fe^{2+}/\Sigma Fe$ = 0.2 (assumed targeted value).

Glass ID	Comp View	ΔG_P	Glass ID	Comp View	ΔG_P
SB3-42	Targeted	-12.8181	SB3-06	targeted	-13.2845
SB3-28	Measured	-12.8956	SB3-18	targeted	-13.2933
SB3-41	Targeted	-12.9083	SB3-26	Measured	-13.3296
SB3-36	Targeted	-12.9084	SB3-14	targeted	-13.3463
SB3-24	Measured bc	-12.9720	SB3-22-SME	Measured	-13.3715
SB3-10	Measured	-12.9956	SB3-24	targeted	-13.3933
SB3-02	targeted	-13.0231	SB3-02	Measured	-13.4011
SB3-41	Measured	-13.0675	SB3-22	Measured	-13.4058
SB3-18	Measured bc	-13.0814	SB3-16	Measured	-13.4108
SB3-28	targeted	-13.0976	SB3-22	targeted	-13.4204
SB3-20	targeted	-13.1890	SB3-36	Measured	-13.4409
SB3-16	targeted	-13.2065	SB3-18	Measured	-13.6926
SB3-04	targeted	-13.2073	SB3-14	Measured	-13.8659
SB3-20	Measured	-13.2156	SB3-42	Measured bc	-13.9166
SB3-26	targeted	-13.2271	SB3-24	Measured	-14.2793
SB3-04	Measured	-13.2404	SB3-42	Measured	-14.3377
SB3-06	Measured	-13.2521			

Table 6-10. Predicted ΔG_P Values for SB3 Glasses Assuming $Fe^{2+}/\Sigma Fe$ = 0.33 (Upper Acceptance Limit).

Glass ID	Comp View	ΔG_P	Glass ID	Comp View	ΔG_P
SB3-24	Measured	-14.939	SB3-10	Measured	-13.6939
SB3-42	Measured	-14.9306	SB3-24	Measured bc	-13.6416
SB3-42	Measured bc	-14.4909	SB3-36	targeted	-13.6324
SB3-14	Measured	-14.45	SB3-02	targeted	-13.6149
SB3-18	Measured	-14.3751	SB3-28	Measured	-13.5416
SB3-36	Measured	-14.1306	SB3-42	targeted	-13.5304
SB3-22	Targeted	-14.1113	SB3-41	Measured	-13.5222
SB3-24	Targeted	-14.0842	SB3-41	targeted	-13.36
SB3-22	Measured	-14.058	SB3-15	Measured	-13.2166
SB3-02	Measured	-13.9759	SB3-14	Measured bc	-13.2012
SB3-14	Targeted	-13.9693	SB3-36	Measured bc	-13.0905
SB3-26	Measured	-13.9639	SB3-28	Measured bc	-13.0339
SB3-16	Measured	-13.9136	SB3-26	Measured bc	-13.0314
SB3-18	Targeted	-13.9122	SB3-15	targeted	-13.022
SB3-22-SME	Measured	-13.8792	SB3-12	targeted	-13.0166
SB3-26	Targeted	-13.8748	SB3-32	Measured	-13.005
SB3-04	Measured	-13.8658	SB3-12	Measured	-13.0037
SB3-06	Targeted	-13.8464	SB3-16	Measured bc	-12.9517
SB3-04	Targeted	-13.8404	SB3-06	Measured bc	-12.9052
SB3-16	Targeted	-13.7391	SB3-10	targeted	-12.862
SB3-28	Targeted	-13.7165			

7.0 Summary

The objective of this task was to assess the applicability of the current PCCS durability model (ΔG_P) to the anticipated compositional region of interest to SB3. Specifically, the focus of this study was to demonstrate the applicability of durability predictions (as measured by the Product Consistency Test) for specific SB3 compositions. The SB3 composition region of interest was defined based on three primary factors: (1) sludge or waste stream composition(s), (2) frit composition(s), and (3) waste loading interval of interest.

Two primary inputs were used to define the SB3 sludge composition region of interest: (1) linear washing scenarios and (2) decant information from HLW PE — both based on WCSystems information. Based on input from DWPF and HLW PE personnel, the SB3 Technical team decided to narrow the focus to span the interval bounded by Decant #5 through Decant #9. The latter decision was made based on the lack of any significant technical issues being identified during the initial stages of the SB3 flowsheet development activities. Although primarily interested in the decant information (given a more solid technical basis due to compositional projections being based on blending and washing models), the Phase 1 Variability Study also included glass compositions based on the linear washed sludge. The specific (and nominal) compositions used were based on the 0%, 25%, and 50% linear washed projections. The linear washing compositions extend the overall SB3 compositional region of interest in Phase 1 relative to the sole use of Decants #5 and #9.

Based on the assessments performed by Peeler and Edwards (2002), nine alternative (400 series) and two existing frits (Frit 202 and Frit 320) were classified as primary candidates for the specific washing scenarios of interest. This classification was based on the response of each frit/sludge combination (for both nominal and nominal±10% variation based sludges) from the model-based assessments performed by Peeler and Edwards (2002). Model-based predictions indicated these frits would have large PCCS windows at attractive waste loadings and are robust to compositional variation for specific washing scenarios.

The glass selection process for the Phase 1 Variability Study used the MAR criteria to establish upper and lower WL bounds for specific frit/sludge systems of interest. The result was a 42-glass test matrix. This Phase 1 matrix assessed applicability of the ΔG_P model over a bounding or global composition region. The general composition region that was assessed was developed based on the Tank 7 compositional estimates or projections (provided by High Level Waste Process Engineering – see Appendix A), candidate frit composition, and a waste loading interval of interest. Due to the number of uncertainties in the SB3 integrated flowsheet, a more focused study may not be bounding in terms of compositional applicability. Phase 2 (if required) will be a more compositionally focused task. More specifically, as the washing scenario, acid addition and redox control strategies, and frit selection become more definitive, and the results of the Tank 7 sample analysis are received, Phase 2 may be performed to back fill any data gaps resulting from the Phase 1 analysis or gaps not covered by existing and qualified data.

The forty-two Phase 1 Variability Study glasses were batched and melted under conditions that promote oxidizing conditions. To confirm that the "as-fabricated" glasses corresponded to the defined target compositions, a representative sample from each SB3 glass pour patty was submitted to SRTC-ML for chemical analysis under the auspices of an analytical plan. Representative samples of each SB3 glass were subjected to the PCT (both quenched and ccc versions) to assess model applicability.

Given the potential for the atypical components of coal and sodium oxalate to be present in SB3 (and ultimately transferred to DWPF), redox control becomes a more critical issue. With a potential change or shift in acid addition or redox control strategies, previous assumptions regarding the impact (or lack thereof) of redox on the PCT response needed to be assessed. In this study, two approaches were taken. The first is primarily based on experimental assessments of durability with glasses produced under conditions that bound the acceptable redox range for DWPF. The second approach is strictly based on model predictions of durability for the SB3 Phase 1 glasses considering potential redox impacts. More specifically, the impact of redox on ΔG_P and its associated limit of -12.7808 kcal/mol was assessed which ultimately dictates the projected operational window. A summary of the Phase 1 Variability Study results is provided below.

Compositional Analysis

Comparisons were made with respect to target, measured, and measured-bias corrected compositional views for all 42 SB3 glasses. Overall, these comparisons suggest that there were no significant problems in the batching or fabrication of the SB3 Phase 1 Variability Study glasses.

PCT Results

A statistical comparison of the average differences due to heat treatment (quenched vs. ccc) for each primary element of interest was performed. These paired-t statistical tests indicate a statistically significant (at the 5% level) difference, on average, between the PCTs for the two heat treatments for B and Li over all of the data and for all elements except Li where the results for SB3-42 are excluded. Although a statistically significant difference is observed, no practical implications are projected.

Normalized boron releases range from 0.499 g/L for SB3-33 (most durable) to a high of 1.593 g/L from SB3-42ccc (least durable). All glasses (both quenched and ccc) are acceptable being at least an order of magnitude more durable than the 16.695 g/L value for NL [B] as reported for EA (Jantzen et al. 1993).

In terms of predictability, 81 of 84 glasses (when considering both quenched and ccc) are predictable (i.e., lie within the upper and lower 95% confidence interval) based on targeted compositions. The exceptions are: SB3-04ccc, SB3-20, and SB3-20ccc. These three glasses lie below the lower 95% confidence band, and thus, demonstrate the model's conservatism for these glass compositions.

When using the measured or measured-bias corrected compositional views to assess predictability, two glasses lie above and eleven glasses fall below the upper and lower 95% confidence bands respectively. Both quenched and ccc versions of SB3-07 (based on the measured-bias corrected compositional view) are located near a ΔG_P value of -7 and outside the upper 95% confidence band in Figure 6-2. SB3-07 is a 30% WL (lower limit) glass based on the 25% washed sludge and Frit 405 (see Table 4-2). Historically, glasses observed in this region have been classified as "acceptable" in terms of DWPF processing (although unpredictable) given the more positive ΔG_P value and the fact that the NL [B] release is well below the EA acceptance criteria. The same classification can be given to SB3-07. The NL [B] release for the quenched and ccc versions are 0.754 g/L and 0.726 g/L, respectively – well below the EA value.

The eleven glasses falling outside the lower 95% confidence band are: SB3-02ccc, SB3-04, SB3-04ccc, SB3-14, SB3-14ccc, SB3-18, SB3-18ccc, SB3-20, SB3-20ccc, SB3-24, and SB3-24ccc. (A total of six different targeted glass compositions.) These glasses are classified as unpredictable and lie toward the more negative ΔG_P values (from approximately -12.5 to -13.5 kcal/mol). Although these glasses are unpredictable, their measured normalized boron releases are very acceptable with the highest release (lowest durability) being 0.954 g/L from SB3-24 (compared to the 16.695 g/L for EA).

In general, the SB3 glasses that challenge ΔG_P predictions are higher alkali glasses. This provides an indication that the model, although conservative, may unduly constrain compositional regions that could yield higher melt rates or access to lower washed sludges. The potential implications for SB3 and the frit selection process are to avoid (or at least rank low) frits that are predicted to be PCT limited based solely on model predictions and that also have narrow projected operational windows. One case of particular interest is the Frit 202 / Decant #5 system. For that system, the PCCS operational window is relatively small but is limited on the upper WL side by predictions of durability. The question becomes: "How far can waste loading be increased before the PCT is measured to have an unacceptable behavior?".

The experimental results demonstrated applicability (or conservatism) of the ΔG_P model for each of the 42 SB3 test matrix glasses when fabricated under oxidizing conditions. The PCT response for all glasses (both quenched and centerline cansiter cooled) were also acceptable being at least an order of magnitude more durable than the 16.695 g/L value for normalized boron release as reported for the Environmental Assessment (EA) glass.

Challenges to Homogeneity

The PCT responses from both SB3-13 and SB3-35 (quenched and ccc versions) were predictable as well as acceptable even though these glasses were predicted to be inhomogeneous at the PAR. Normalized boron releases for SB3-13 and SB3-13ccc are 0.798 and 0.733 g/L (based on targeted composition), respectively. Normalized boron releases for SB3-35 and SB3-35ccc are 0.638 and 0.612 g/L (based on targeted composition), respectively. These glasses challenge the use of the homogeneity constraint but given they produced both acceptable and predictable glasses the results reinforce the recommendations made by Herman et al. (2002) specific to SB3 that support the elimination or replacement of the homogeneity constraint with proposed criteria for alumina and/or sum of alkali.

Redox Effect on PCT: Measurements

Regardless of the measured redox, all three SB3 MRF glasses are very acceptable with respect to the EA limits. The highest release (or lowest durability – NL [B] of 1.251 g/L) is from the SB3-22-SME glass that is the most reduced ($Fe^{2+}/\Sigma Fe = 0.41$). Following proposed theory, this glass would have a higher portion of reduced iron, and thus a negative impact on durability would be projected (i.e., the ΔG_i value for FeO being more negative than that for Fe_2O_3). These data (albeit limited) suggest that the model prediction is extremely conservative toward the more reduced end of the redox spectrum.

Redox Effect on* ΔG_P*: Predictions

The ΔG_P predictions indicate that the durability decreases as the glasses become more reduced. The maximum release (or lowest durability) predicted for the SB3 Phase 1 glasses is 4.499 g/L which is still acceptable with respect to the EA criterion.

Based on these predicted values and taking a conservative approach (e.g., assuming the redox would be controlled closer to the more reduced state for SB3), the projected impact on the operating window could be quite large. The projected operational windows presented in Section 4.0 were based on a fully oxidized system. Assuming the impact of redox is adequately captured by the model, for systems that are PCT limited (see Table 4-3), as redox shifts toward the more reduced state, more of the operating window will be eliminated. Even for systems that were not PCT limited as defined in Section 4.0, if PCT is a "close second" with respect to failing the MAR criteria and the $Fe^{2+}/\Sigma Fe$ ratio is highly reduced (yet still within the acceptance limits), the operating window could change. In both cases, the anticipated effect would be to restrict access to higher WLs – the degree of impact would vary depending upon the overall glass composition and the percent of Fe in the system. The potential implications to the SB3 frit selection process may be to avoid frits that drive the upper WLs to be PCT limited in an attempt to eliminate this issue.

The concern for the SB3 Frit Development team is the measured PCT responses (albeit limited) as compared to predicted values from the MRF glasses (see Section 6.4). The predicted NL [B] for SB3-22-SME (with a measured 0.41 $Fe^{2+}/\Sigma Fe$ ratio) was 4.637 g/L while the measured NL [B] was 1.251 g/L. As previously discussed, these data suggest that the model is conservative at the more reduced state. Assuming this is the case (and recognizing that the degree of conservatism may decrease as the system becomes more oxidized), one should question the extent to which the predictions (see Table 6-10 especially) are unduly constraining or restricting access to the SB3 composition region at the higher $Fe^{2+}/\Sigma Fe$ values. Although these glasses may be classified as "unprocessable" and even "unpredictable", they may yield acceptable glasses if the PCT is formally measured. For example, although the ΔG_P for SB3-22-SME was not predicted at a $Fe^{2+}/\Sigma Fe$ ratio = 0.41, its corresponding values at 0.09 and 0.33 place this glass on the "unprocessable" list (see Tables 6-9 and 6-10 respectively). However, even with a $Fe^{2+}/\Sigma Fe$ ratio of 0.41, the measured NL [B] was 1.251 g/L – very acceptable with respect to EA. Given theory suggest that as the glass becomes more oxidizing, durability should increase (forming more Fe_2O_3), one would expect that the NL [B] for the 0.09 and 0.33 states would be less than the measured 1.251 g/L for boron.

8.0 Recommendations

With respect to the SB3 frit selection process, the key criteria or aspects that will provide the technical basis for selecting a frit include: (1) maximizing the projected operational window size (i.e., the waste loading interval) over the anticipated SB3 composition region, (2) providing a frit that is robust or insensitive to anticipated sludge composition variation, (3) improving or maintaining high waste loadings (WLs), (4) improving or maintaining high melt rates, and (5) providing a "frittable" additive or frit composition. The results of the Phase 1 Variability Study should be used in this process as well. Given the five key criteria can be competing, the basis for not only developing but ultimately selecting a frit for SB3 is complex. The selection process should not be made based on a single criterion but a collection of criteria that provide insight into the economics of processing SB3. A balanced approach should be utilized in both the development and selection.

Based on the Phase 1 Variability Study results, the following recommendations are made:

- Perform a Phase 2 supplemental variability study based on the latest Tank 7 sample results to assess the applicability of the ΔG_P model while considering redox

  The Phase 2 Variability Study would be comprised of a paper study assessment and an experimental study. The paper study assessment would include a review or comparison of the measured Tank 7 composition as it relates to the projected decant or washing scenarios used in the SB3 Frit Development program. Based on that comparison, primary frits would be identified (or those that have been identified would be confirmed to be applicable to Tank 7). Projected operational windows for the primary frits of interest would be determined based on PCCS models. An evaluation of the impact of the redox term associated with the current durability model will be made as upper and lower WLs are defined for specific glass forming systems of interest.

  The objective of the experimental portion of the Phase 2 Variability Study will be to demonstrate the applicability of the ΔG_P for reduced glasses. The model-based predictions from the Phase 1 study indicated that activating the redox term in the durability model has potential negative impacts to the frit selection process. Although the ΔG_P model was applicable (or at least conservative) for the 42 Phase 1 glasses, the fact that they were made under oxidizing conditions did not allow for a complete experimental assessment of the impact of redox on PCT. The limited data that were presented indicated that the model may conservative for certain frit/sludge systems once redox is accounted for. To address this issue, it is recommended that the latest results from the Tank 7 samples be used to support this assessment. Specific frit/sludge systems will be selected based on the output of the Phase 2 paper study. Glasses will be produced targeting redox vaues of interest (input from the acid addition strategy team will be utilized to establish reasonable bounds) and PCT will be measured.

  The results of the Phase 2 experimental study would also provide insight into the potential conservatism of the current ΔG_p model with the redox term activated. More specifically, the measured releases will be used to assess if the ΔG_i value for FeO shifts the ΔG_P value more negatively than necessary for this compositional region.

- Decision on Phase 3 Variability Study

  The decision as to whether to perform a Phase 3 SB3 Variability Study would be based on two primary factors. First, an assessment of the SB3 qualification sample (as compared to the Tank 7 samples) may provide compositional justification to perform either a paper study assessment and/or an experimental study. The paper study assessment would provide assurance that the PCCS predictions allow for satisfactory processing windows for the specific frit and SB3 sludge combinations of interest. More specifically, as the washing scenario, acid addition and redox control strategies, and frit selection are established, and the results of the SB3 Tank 51 qualification sample analysis are received, Phase 3 may be performed to assess projected operational windows.

  Initiating the experimental portion of the Phase 3 Study could be based on two issues: (1) to back fill any data gaps resulting from the Phase 1 or the Phase 2 analysis or gaps not covered by existing and qualified data, or (2) to provide data from which the effect of redox on PCT can be validated for the specific compositional region of interest (if not fully addressed in Phase 2). If model predictions remain extremely conservative, an alternative approach for predictions of durability may be needed specific to SB3.

9.0 References

ASTM 1998. **Standard Test Methods for Determining Chemical Durability of Nuclear Waste Glasses: The Product Consistency Test (PCT),** ASTM C-1285-98, 1998.

Bronikowski, MG, MC Thompson, FR Graham, TL Fellinger, WR Wilmarth, and DT Hobbs, 2002. *Technical Task and Quality Assurance Plan for Assessing Downstream Effects of Plutonium/Gadolinium in Sludge Washing and SRAT*, WSRC-RP-2002-00178, Westinghouse Savannah River Company, Aiken, South Carolina.

Brown KG, CM Jantzen, and G Ritzhaupt. 2001. *Relating Liquidus Temperature to Composition for Defense Waste Processing Facility (DWPF) Process Control,* WSRC-TR-2001-00520, Westinghouse Savannah River Company, Aiken, South Carolina.

Brown, KG, RL Postles, and TB Edwards, 2002. *SME Acceptability Determination for DWPF Process Control*, WSRC-TR-95-0364, Revision 4, Westinghouse Savannah River Company, Aiken, South Carolina.

Brown, KG. 2002. *Changes Made to the DWPF PCCS Spreadsheet*, SRTC-GPD-2002-00059, Westinghouse Savannah River Company, Aiken, South Carolina.

Edwards TB, and KG Brown. 1998. *Evaluating the Glasses Batched for the Tank 42 Variability Study (U)*, SRT-SCS-98-017, Revision 0, Westinghouse Savannah River Company, Aiken, South Carolina.

Edwards TB. 2002. *Revision of DWPF's PCCS: An Overview of the Modifications and Assocaited Test Cases*, SRTC-SCS-2002-00032, Westinghouse Savannah River Company, Aiken, South Carolina.

Elder, HH. 2002. *Impact of Processing Americium and Curium in ESP, DWPF, and Saltstone, Savannah River Site, High Level Waste Process Engineering Position Paper,* HLW-SDT-2001-00244, Rev. 1.

Fellinger, TL. 2002. *Sludge Batch 3 – Overall Program View (U),* WSRC-RP-2002-00353, Westinghouse Savannah River Company, Aiken, South Carolina.

Feng, X, IL Pegg, E Saad, S Cucinell, A Barkatt. 1990. **Redox Effect on the Durability and Viscosity of Nuclear Waste Glasses**, In *Ceramic Transactions: Nuclear Waste Management III*, Edited by G.B. Mellinger, Vol. 9, pp. 165-174. American Ceramic Society, Westerville, Ohio.

Fowler, JR. 1980. "Estimate of Maximum Amount of Reducing Agents and Sand in the SRP Waste for DWPF TDS", Don't Say It Write Memo, September 9, 1980.

Goslen, AQ. 1984. "Estimated Sodium Oxalate in the Tank Farm", March 22, 1984.

Harbour, JR, TB Edwards, and RJ Workman. 2000. *Summary of Results for Macrobatch 3 Variability Study*, WSRC-TR-2000-00351, Revision 0, Westinghouse Savannah River Company, Aiken, South Carolina.

Herman, CC, TB Edwards, and DM Marsh. 2001. *Summary of Results for the Expanded Macrobatch 3 Variability Study*, WSRC-TR-2001-00511, Revision 0, Westinghouse Savannah River Company, Aiken, South Carolina.

Herman, CC, DK Peeler, and TB Edwards. 2002. *Task Technical and QA Plan: Sludge Batch 3 Variability Studies with Simulants*, WSRC-RP-2002-00386, Westinghouse Savannah River Company, Aiken, South Carolina.

Herman, CC, TL Fellinger, NE Bibler, and DC Koopman. 2002a. *Scoping SRAT Runs with Simulated Sludge Batch 3*, SRT-GPD-2002-00044, Westinghouse Savannah River Company, Aiken, South Carolina.

Herman, CC, TL Fellinger, NE Bibler, and DC Koopman. 2002b. *Scoping SRAT Runs with Simulated Sludge Batch 3*, SRT-GPD-2002-00044, Westinghouse Savannah River Company, Aiken, South Carolina.

Herman, CC, TB Edwards, DR Best, DM Marsh, and RJ Workman. 2002c. *Reduction of Constraints: Phase 2 Experimental Assessment for Sludge-Only Processing*, WSRC-TR-2002-00482, Rev. 0, Westinghouse Savannah River Company, Aiken, South Carolina.

Herman CC. 2002a. *Task Technical & QA Plan: Sludge Batch 3 Simulant Flowsheet Studies*, WSRC-RP-2002-00563, Westinghouse Savannah River Company, Aiken, South Carolina.

Herman CC. 2002b. *Task Technical & QA Plan: Oxalate Studies for Sludge Batch 3 – SRAT Processing*, WSRC-RP-2002-00320, Westinghouse Savannah River Company, Aiken, South Carolina.

Herman CC, TB Edwards, DR Best, JC George, DC Koopman, and MF Williams. 2003. *Data Summary from SRAT Runs SB3-19 to SB3-24 to Evaluate Sodium Oxalate Addition Levels and SME Processing*, SRT-GPD-2002-00200, January 3, 2003.

Jantzen CM and MJ Plodinec. 1986. *Composition and Redox Control of Waste Glasses: Recommendation for Process Control Limit*, DPST-86-773, E.I. duPont de Nemours and Company, Savannah River Laboratory, Aiken, South Carolina.

Jantzen CM, NE Bibler, DC Beam, CL Crawford, and MA Pickett. 1993. *Characterization of the DWPF Environmental Assessment (EA) Glass Standard Reference Material (U)*, WSRC-TR-92-346, Rev. 1, Westinghouse Savannah River Company, Aiken, SC.

Jantzen, CM, JB Pickett, KG Brown, TB Edwards, and DC Beam. 1995. *Process/Product Models for the Defense Waste Processing Facility (DWPF): Part I. Predicting Glass Durability from Composition Using a Thermodynamic Hydration Energy Reaction Model (THERMO) (U)*, WSRC-TR-93-672, Revision 1, Volume 1, Westinghouse Savannah River Company, Aiken, South Carolina.

Jantzen, CM, RF Swingle, and FG Smith. 2002. *Impact of Tank 19F Zeolite Mound on DWPF Vitrification of Sludge Batch 3*, WSRC-TR-2002-00288, Revision 0, Westinghouse Savannah River Company, Aiken, South Carolina.

Jantzen, CM. 2002. *REDOX Studies and Modeling for DWPF Sludge Batch 3,* WSRC-RP-2002-00341, Westinghouse Savannah River Company, Aiken, South Carolina.

Jilani, I. 2002. *Evaluation of Impact of HLW of Using Gadolinium as a Neutron Poison for Plutonium*, Technical Task Request, NMMD-HTS-2002-010, Westinghouse Savannah River Company, Aiken, South Carolina.

Koopman DC. 2002a. *Sludge Batch 3 - Run 21, SRAT/SME with 75% Residual Oxalate*, SRT-GPD-2002-00118, Westinghouse Savannah River Company, Aiken, South Carolina.

Koopman DC. 2002b. *Sludge Batch 3 - Run 22, SRAT/SME with 50% Residual Oxalate*, SRT-GPD-2002-00118, Westinghouse Savannah River Company, Aiken, South Carolina.

Koopman DC. 2002c. *Sludge Batch 3 - Run 23, SRAT/SME with 25% Residual Oxalate*, SRT-GPD-2002-00119, Westinghouse Savannah River Company, Aiken, South Carolina.

Lambert, DP, TH Lorier, DK Peeler, and ME Stone. 2001. *Melt Rate Improvement for DWPF MB3: Summary and Recommendations*, WSRC-TR-2001-00148, Westinghouse Savannah River Company, Aiken, South Carolina.

Lorier TH, DK Peeler, and DC Koopman. 2003. *Sludge Batch 3 Melt Rate Assessment*, WSRC-TR-2003-00027, Revision 0, Westinghouse Savannah River Company, Aiken, South Carolina.

Lorier, TH and PL McGrier. 2002. *Melt Rate Improvement for the DWPF: Higher Waste Loading Testing*, WSRC-TR-2002-00344, Revision 0, Westinghouse Savannah River Company, Aiken, South Carolina.

Marra SL, and CM Jantzen. 1993. *Characterization of Projected DWPF Glasses Heat Treated to Simulate Canister Centerline Cooling (U)*, WSRC-TR-92-142, Revision 1, Westinghouse Savannah River Company, Aiken, South Carolina.

Patel, PM. 2002. *Evaluation of Impacts of Sludge Containing "Americium/Curium" on H_2 Generation and Glass Quality*, Technical Assistance Request, HLW/DWPF-TAR-02-0007, Westinghouse Savannah River Company, Aiken, South Carolina.

Peeler, DK. 1996a. *Batch 1 Variability Study Using Twice Washed Tank 51 Sludge and Frit 200 (U),* WSRC-RP-96-0020, Revision 0, Westinghouse Savannah River Company, Aiken, South Carolina.

Peeler, DK. 1996b. *Batch 1 Variability Study Using Twice Washed Tank 51 Sludge (U),* WSRC-RP-95-1045, Revision 1, Westinghouse Savannah River Company, Aiken, South Carolina.

Peeler, DK, TH Lorier, DF Bickford, DC Witt, TB Edwards, KG Brown, IA Reamer, RJ Workman, JD Vienna. 2001. *Melt Rate Improvement for DWPF MB3: Frit Development and Model Assessment*, WSRC-TR-2001-00131, Revision 0, Westinghouse Savannah River Company, Aiken, South Carolina.

Peeler, DK, NE, Bibler, and TB Edwards. 2002a. *An Assessment of the Impacts of Adding Am/Cm and Pu/Gd Waste Streams to Sludge Batch 3 (SB3) on DWPF H_2 Generation Rates and Glass Properties*, WSRC-TR-2002-00145, Revision 0, Westinghouse Savannah River Company, Aiken, South Carolina.

Peeler DK, KG Brown, TB Edwards, DR Best, RJ Workman, and IA Reamer. 2002b. *Reduction of Constraints: Phase 1 Experimental Assessment of Centroid-Based Sludge-Only Glasses*, WSRC-TR-2002-00120, Revision 0, Westinghouse Savannah River Company, Aiken, South Carolina.

Peeler DK and TB Edwards. 2002. Frit Development for Sludge Batch 3, WSRC-TR-2002-00491, Revision 0, Westinghouse Savannah River Company, Aiken, South Carolina.

Plodinec MJ, KG Brown, SL Marra, CM Jantzen, and TB Edwards. 1995. "Technical Bases for the DWPF Glass Product Control Program", In: *Waste Qualification Report (WQR)*, WSRC-IM-91-116-5, Revision 1, Volume 5, Aiken, South Carolina.

Rios-Armstrong, MA. 2002a. Technical Task Request, *Sludge Batch 3 Carbon Content Analysis*, HLW/DWPF/TTR-02-0017, Westinghouse Savannah River Company, Aiken, South Carolina.

Rios-Armstrong, MA. 2002b. *Sludge Batch 3 Variability Studies with Simulants*, HLW/DWPF/TTR-02-0027, Westinghouse Savannah River Company, Aiken, South Carolina.

Schreiber, HD and AL Hockman. 1987. "REDOX Chemistry in Candidate Glasses for Nuclear Waste Immobilization," *J. Amer. Ceram. Soc*., Volume 70, No. 8, pp. 591 – 594.

Savannah River Technology Center (SRTC). 2002a. "Batching Procedure," SRTC Procedure Manual, L29, ITS-0001, Westinghouse Savannah River Company, Aiken, SC.

Savannah River Technology Center (SRTC). 2002b. "Melting Procedure," SRTC Procedure Manual, L29, ITS-0003, Westinghouse Savannah River Company, Aiken, SC.

Westinghouse Savannah River Company (WSRC). 2001. *Savannah River Site High Level Waste System Plan (HLW)*, HLW-2001-00040, Revision 13, Aiken, South Carolina.

Appendix A

Nominal Decant Compositions
(Personal Communication with H.H. Elder)

Elemental wt. %	Decant #5	Decant #6	Decant #7	Decant #8	Decant #9	Decant #10	Decant #11	Decant #12	Decant #13	Decant #14	Decant #15
Al	7.33	7.59	7.82	8.01	8.18	8.33	8.47	8.60	8.71	8.82	8.93
B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ba	0.17	0.18	0.18	0.19	0.19	0.19	0.20	0.20	0.20	0.21	0.21
Ca	1.97	2.04	2.10	2.15	2.20	2.24	2.28	2.31	2.34	2.37	2.40
Ce	0.23	0.24	0.24	0.25	0.25	0.26	0.26	0.27	0.27	0.27	0.28
Cr	0.19	0.20	0.21	0.21	0.22	0.22	0.22	0.23	0.23	0.23	0.24
Cs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cu	0.12	0.13	0.13	0.13	0.14	0.14	0.14	0.14	0.14	0.15	0.15
Fe	21.53	22.31	22.98	23.54	24.05	24.48	24.89	25.27	25.59	25.92	26.26
K	0.27	0.28	0.29	0.30	0.31	0.31	0.32	0.32	0.33	0.33	0.33
La	0.15	0.16	0.16	0.16	0.17	0.17	0.17	0.18	0.18	0.18	0.18
Li	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mg	0.09	0.09	0.09	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.11
Mn	4.25	4.41	4.54	4.65	4.75	4.84	4.92	4.99	5.06	5.12	5.19
Mo	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Na	23.15	21.29	19.71	18.38	17.17	16.15	15.18	14.27	13.52	12.74	11.94
Nb	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ni	0.97	1.00	1.03	1.06	1.08	1.10	1.12	1.14	1.15	1.16	1.18
Pb	0.21	0.22	0.23	0.23	0.24	0.24	0.25	0.25	0.25	0.26	0.26
Si	0.75	0.78	0.80	0.82	0.84	0.85	0.87	0.88	0.89	0.90	0.91
Th	0.10	0.10	0.10	0.11	0.11	0.11	0.11	0.11	0.11	0.12	0.12
Ti	1.29	1.34	1.38	1.41	1.44	1.47	1.49	1.52	1.54	1.55	1.58
U	6.61	6.85	7.05	7.23	7.38	7.51	7.64	7.76	7.86	7.96	8.06
Y	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Zn	0.25	0.26	0.27	0.28	0.28	0.29	0.29	0.30	0.30	0.30	0.31
Zr	0.44	0.45	0.46	0.48	0.49	0.49	0.50	0.51	0.52	0.52	0.53

Appendix B

Conversion Table of Frits Nomenclatures

Numeric	Alphanumeric
400	A
401	B
402	E
403	C
404	D
405	O
406	P
407	Q
408	F
409	S
410	T
411	G
412	I
413	H
414	K
415	L
416	320-M
417	M
418	N
419	R
420	202-M
421	202-M2
422	U
423	U2

Appendix C1

MAR Calculations for Various Frit/Decant Combinations

		MAR Assessments					Property Values						
Frit-Decant	**% WL**	**Durability**	**T_L**	**Visc**	**Frit**	**Homog**	**Al_2O_3**	**alkali**	**T_L**	**Visc**	**ΔG_P**	**Homog**	**Frit**
202-Decant #5	25	-	-	-	High	NO	3.46	17.61	750.1	81.02	-10.646	198.96	81.76
202-Decant #5	26	-	-	-	-	NO	3.60	17.79	760.4	76.74	-10.788	200.63	81.11
202-Decant #5	27	-	-	-	-	NO	3.74	17.98	770.1	72.58	-10.929	202.31	80.46
202-Decant #5	28	-	-	-	-	NO	3.88	18.16	779.6	68.53	-11.071	203.98	79.81
202-Decant #5	29	-	-	-	-	NO	4.01	18.35	788.9	64.62	-11.212	205.65	79.16
202-Decant #5	30	-	-	-	-	NO	4.15	18.53	797.8	60.82	-11.354	207.33	78.51
202-Decant #5	31	-	-	-	-	NO	4.29	18.72	806.5	57.15	-11.496	209.00	77.86
202-Decant #5	32	-	-	-	-	NO	4.43	18.90	814.9	53.61	-11.637	210.67	77.21
202-Decant #5	33	-	-	-	-	-	4.57	19.09	823.0	50.20	-11.779	212.34	76.56
202-Decant #5	34	-	-	-	-	-	4.71	19.27	830.9	46.91	-11.921	214.02	75.92
202-Decant #5	35	-	-	-	-	-	4.85	19.45	838.6	43.75	-12.062	215.69	75.27
202-Decant #5	36	-	-	-	-	-	4.98	19.64	846.1	40.71	-12.204	217.36	74.62
202-Decant #5	37	-	-	-	-	-	5.12	19.82	853.4	37.80	-12.345	219.03	73.97
202-Decant #5	38	NO	-	-	-	-	5.26	20.01	860.5	35.02	-12.487	220.71	73.32
202-Decant #5	39	NO	-	-	-	-	5.40	20.19	867.3	32.37	-12.629	222.38	72.67
202-Decant #5	40	NO	-	-	-	-	5.54	20.38	874.1	29.84	-12.770	224.05	72.02
202-Decant #5	41	NO	-	-	-	-	5.68	20.56	880.6	27.43	-12.912	225.73	71.37
202-Decant #5	42	NO	-	-	-	-	5.81	20.75	886.9	25.15	-13.053	227.40	70.72
202-Decant #5	43	NO	-	Low	-	-	5.95	20.93	893.1	22.99	-13.195	229.07	70.07
202-Decant #5	44	NO	-	Low	-	-	6.09	21.11	899.2	20.96	-13.336	230.74	69.42
202-Decant #5	45	NO	-	Low	-	-	6.23	21.30	905.1	19.04	-13.478	232.42	68.77
202-Decant #5	46	NO	-	Low	-	-	6.37	21.48	910.8	17.23	-13.620	234.09	68.12
202-Decant #5	47	NO	-	Low	-	-	6.51	21.67	916.5	15.54	-13.761	235.76	67.47
202-Decant #5	48	NO	-	Low	-	-	6.65	21.85	921.9	13.97	-13.903	237.44	66.82
202-Decant #5	49	NO	-	Low	-	-	6.78	22.04	927.3	12.50	-14.045	239.11	66.17
202-Decant #5	50	NO	-	Low	-	-	6.92	22.22	932.5	11.14	-14.186	240.78	65.52
202-Decant #5	51	NO	-	Low	-	-	7.06	22.41	937.6	9.88	-14.328	242.45	64.87
202-Decant #5	52	NO	-	Low	-	-	7.20	22.59	942.6	8.73	-14.469	244.13	64.22
202-Decant #5	53	NO	-	Low	-	-	7.34	22.77	947.5	7.67	-14.611	245.80	63.57
202-Decant #5	54	NO	-	Low	-	-	7.48	22.96	952.3	6.70	-14.753	247.47	62.92
202-Decant #5	55	NO	-	Low	-	-	7.61	23.14	956.9	5.82	-14.894	249.14	62.27
202-Decant #5	56	NO	-	Low	-	-	7.75	23.33	961.5	5.02	-15.036	250.82	61.62
202-Decant #5	57	NO	-	Low	-	-	7.89	23.51	965.9	4.31	-15.177	252.49	60.98
202-Decant #5	58	NO	-	Low	-	-	8.03	23.70	970.3	3.67	-15.319	254.16	60.33
202-Decant #5	59	NO	-	Low	-	-	8.17	23.88	974.6	3.11	-15.461	255.83	59.68
202-Decant #5	60	NO	-	Low	-	-	8.31	24.06	978.8	2.60	-15.602	257.51	59.03
202-M-Decant #5	25	-	-	High	High	NO	4.21	16.86	731.6	121.22	-9.459	204.40	82.51
202-M-Decant #5	26	-	-	High	High	NO	4.34	17.05	742.3	114.94	-9.616	206.00	81.85
202-M-Decant #5	27	-	-	High	-	NO	4.47	17.25	752.6	108.85	-9.774	207.60	81.19
202-M-Decant #5	28	-	-	High	-	NO	4.60	17.44	762.6	102.92	-9.931	209.20	80.53
202-M-Decant #5	29	-	-		-	NO	4.72	17.64	772.3	97.16	-10.089	210.80	79.87
202-M-Decant #5	30	-	-	-	-	-	4.85	17.83	781.6	91.58	-10.246	212.40	79.21
202-M-Decant #5	31	-	-	-	-	-	4.98	18.03	790.7	86.18	-10.403	214.00	78.55
202-M-Decant #5	32	-	-	-	-	-	5.11	18.22	799.5	80.95	-10.561	215.60	77.89
202-M-Decant #5	33	-	-	-	-	-	5.24	18.42	808.1	75.91	-10.718	217.20	77.23
202-M-Decant #5	34	-	-	-	-	-	5.37	18.61	816.4	71.04	-10.876	218.80	76.57
202-M-Decant #5	35	-	-	-	-	-	5.50	18.80	824.5	66.35	-11.033	220.40	75.92
202-M-Decant #5	36	-	-	-	-	-	5.62	19.00	832.3	61.85	-11.191	222.00	75.26
202-M-Decant #5	37	-	-	-	-	-	5.75	19.19	840.0	57.53	-11.348	223.60	74.60
202-M-Decant #5	38	-	-	-	-	-	5.88	19.39	847.4	53.39	-11.505	225.20	73.94
202-M-Decant #5	39	-	-	-	-	-	6.01	19.58	854.6	49.43	-11.663	226.80	73.28
202-M-Decant #5	40	-	-	-	-	-	6.14	19.78	861.7	45.65	-11.820	228.40	72.62

		MAR Assessments					Property Values							
Frit-Decant	% WL	Durability	T_L	Visc	Frit	Homog	Al_2O_3	alkali	T_L	Visc	ΔG_P	Homog	Frit
202-M-Decant #5	41	-	-	-	-	-	6.27	19.97	868.5	42.05	-11.978	230.00	71.96
202-M-Decant #5	42	-	-	-	-	-	6.39	20.17	875.1	38.63	-12.135	231.60	71.30
202-M-Decant #5	43	-	-	-	-	-	6.52	20.36	881.7	35.38	-12.293	233.20	70.64
202-M-Decant #5	44	NO	-	-	-	-	6.65	20.55	888.0	32.31	-12.450	234.80	69.98
202-M-Decant #5	45	NO	-	-	-	-	6.78	20.75	894.2	29.41	-12.608	236.41	69.32
202-M-Decant #5	46	NO	-	-	-	-	6.91	20.94	900.2	26.68	-12.765	238.00	68.66
202-M-Decant #5	47	NO	-	Low	-	-	7.04	21.14	906.1	24.12	-12.922	239.61	68.00
202-M-Decant #5	48	NO	-	Low	-	-	7.17	21.33	911.9	21.73	-13.080	241.21	67.34
202-M-Decant #5	49	NO	-	Low	-	-	7.29	21.53	917.5	19.49	-13.237	242.80	66.68
202-M-Decant #5	50	NO	-	Low	-	-	7.42	21.72	923.0	17.41	-13.395	244.41	66.02
202-M-Decant #5	51	NO	-	Low	-	-	7.55	21.92	928.4	15.49	-13.552	246.01	65.36
202-M-Decant #5	52	NO	-	Low	-	-	7.68	22.11	933.6	13.71	-13.709	247.61	64.70
202-M-Decant #5	53	NO	-	Low	-	-	7.81	22.30	938.7	12.08	-13.867	249.21	64.04
202-M-Decant #5	54	NO	-	Low	-	-	7.94	22.50	943.8	10.59	-14.024	250.81	63.38
202-M-Decant #5	55	NO	-	Low	-	-	8.06	22.69	948.7	9.22	-14.182	252.41	62.72
202-M-Decant #5	56	NO	-	Low	-	-	8.19	22.89	953.5	7.99	-14.339	254.01	62.06
202-M-Decant #5	57	NO	-	Low	-	-	8.32	23.08	958.2	6.88	-14.497	255.61	61.41
202-M-Decant #5	58	NO	-	Low	-	-	8.45	23.28	962.8	5.88	-14.654	257.21	60.75
202-M-Decant #5	59	NO	-	Low	-	-	8.58	23.47	967.3	4.99	-14.811	258.81	60.09
202-M-Decant #5	60	NO	-	Low	-	-	8.71	23.66	971.7	4.20	-14.969	260.41	59.43
202-M2-Decant #5	25	-	-	High	High	NO	4.21	16.86	733.4	104.37	-9.785	204.40	82.51
202-M2-Decant #5	26	-	-	-	High	NO	4.34	17.05	744.2	98.84	-9.938	206.00	81.85
202-M2-Decant #5	27	-	-	-	-	NO	4.47	17.25	754.4	93.47	-10.091	207.60	81.19
202-M2-Decant #5	28	-	-	-	-	NO	4.60	17.44	764.4	88.26	-10.244	209.20	80.53
202-M2-Decant #5	29	-	-	-	-	NO	4.72	17.64	774.0	83.20	-10.397	210.80	79.87
202-M2-Decant #5	30	-	-	-	-	-	4.85	17.83	783.4	78.31	-10.550	212.40	79.21
202-M2-Decant #5	31	-	-	-	-	-	4.98	18.03	792.5	73.58	-10.703	214.00	78.55
202-M2-Decant #5	32	-	-	-	-	-	5.11	18.22	801.3	69.01	-10.856	215.60	77.89
202-M2-Decant #5	33	-	-	-	-	-	5.24	18.42	809.8	64.61	-11.009	217.20	77.23
202-M2-Decant #5	34	-	-	-	-	-	5.37	18.61	818.0	60.37	-11.162	218.80	76.58
202-M2-Decant #5	35	-	-	-	-	-	5.50	18.80	826.1	56.29	-11.316	220.40	75.92
202-M2-Decant #5	36	-	-	-	-	-	5.62	19.00	834.0	52.38	-11.469	222.00	75.26
202-M2-Decant #5	37	-	-	-	-	-	5.75	19.19	841.6	48.64	-11.622	223.60	74.60
202-M2-Decant #5	38	-	-	-	-	-	5.88	19.39	848.9	45.05	-11.775	225.20	73.94
202-M2-Decant #5	39	-	-	-	-	-	6.01	19.58	856.1	41.63	-11.928	226.80	73.28
202-M2-Decant #5	40	-	-	-	-	-	6.14	19.78	863.2	38.37	-12.081	228.40	72.62
202-M2-Decant #5	41	-	-	-	-	-	6.27	19.97	869.9	35.27	-12.234	230.00	71.96
202-M2-Decant #5	42	NO	-	-	-	-	6.39	20.17	876.6	32.34	-12.387	231.60	71.30
202-M2-Decant #5	43	NO	-	-	-	-	6.52	20.36	883.1	29.56	-12.540	233.20	70.64
202-M2-Decant #5	44	NO	-	-	-	-	6.65	20.55	889.4	26.93	-12.693	234.80	69.98
202-M2-Decant #5	45	NO	-	-	-	-	6.78	20.75	895.6	24.46	-12.846	236.41	69.32
202-M2-Decant #5	46	NO	-	Low	-	-	6.91	20.94	901.6	22.14	-12.999	238.00	68.66
202-M2-Decant #5	47	NO	-	Low	-	-	7.04	21.14	907.4	19.96	-13.153	239.61	68.00
202-M2-Decant #5	48	NO	-	Low	-	-	7.17	21.33	913.2	17.94	-13.306	241.21	67.34
202-M2-Decant #5	49	NO	-	Low	-	-	7.29	21.53	918.8	16.05	-13.459	242.80	66.68
202-M2-Decant #5	50	NO	-	Low	-	-	7.42	21.72	924.2	14.30	-13.612	244.41	66.02
202-M2-Decant #5	51	NO	-	Low	-	-	7.55	21.92	929.6	12.68	-13.765	246.01	65.36
202-M2-Decant #5	52	NO	-	Low	-	-	7.68	22.11	934.8	11.20	-13.918	247.61	64.70
202-M2-Decant #5	53	NO	-	Low	-	-	7.81	22.30	939.9	9.83	-14.071	249.21	64.04
202-M2-Decant #5	54	NO	-	Low	-	-	7.94	22.50	944.9	8.59	-14.224	250.80	63.38
202-M2-Decant #5	55	NO	-	Low	-	-	8.06	22.69	949.7	7.46	-14.377	252.41	62.72
202-M2-Decant #5	56	NO	-	Low	-	-	8.19	22.89	954.6	6.44	-14.530	254.01	62.06
202-M2-Decant #5	57	NO	-	Low	-	-	8.32	23.08	959.2	5.52	-14.683	255.61	61.40
202-M2-Decant #5	58	NO	-	Low	-	-	8.45	23.28	963.8	4.70	-14.836	257.21	60.75

		MAR Assessments					Property Values						
Frit-Decant	**% WL**	**Durability**	**T_L**	**Visc**	**Frit**	**Homog**	**Al_2O_3**	**alkali**	**T_L**	**Visc**	**ΔG_P**	**Homog**	**Frit**
202-M2-Decant #5	59	NO	-	Low	-	-	8.58	23.47	968.3	3.98	-14.990	258.81	60.09
202-M2-Decant #5	60	NO	-	Low	-	-	8.71	23.66	972.7	3.34	-15.143	260.41	59.43
S-Decant #5	25	-		High	High	NO	3.46	15.36	735.3	164.40	-8.338	201.37	83.26
S-Decant #5	26	-	-	High	High	NO	3.60	15.57	746.5	156.18	-8.511	203.01	82.59
S-Decant #5	27	-	-	High	High	NO	3.74	15.79	757.2	148.17	-8.683	204.65	81.92
S-Decant #5	28	-	-	High	-	NO	3.88	16.00	767.6	140.37	-8.856	206.29	81.25
S-Decant #5	29	-	-	High	-	NO	4.01	16.22	777.6	132.78	-9.028	207.93	80.58
S-Decant #5	30	-	-	High	-	NO	4.15	16.43	787.3	125.41	-9.200	209.57	79.91
S-Decant #5	31	-	-	High	-	-	4.29	16.65	796.6	118.25	-9.373	211.21	79.24
S-Decant #5	32	-	-	High	-	-	4.43	16.86	805.7	111.32	-9.545	212.85	78.57
S-Decant #5	33	-	-	High	-	-	4.57	17.08	814.4	104.61	-9.717	214.49	77.90
S-Decant #5	34	-	-	-	-	-	4.71	17.29	822.8	98.13	-9.890	216.13	77.24
S-Decant #5	35	-	-	-	-	-	4.85	17.50	831.1	91.87	-10.062	217.77	76.57
S-Decant #5	36	-	-	-	-	-	4.98	17.72	839.1	85.84	-10.235	219.41	75.90
S-Decant #5	37	-	-	-	-	-	5.12	17.93	846.8	80.04	-10.407	221.05	75.23
S-Decant #5	38	-	-	-	-	-	5.26	18.15	854.3	74.46	-10.579	222.69	74.56
S-Decant #5	39	-	-	-	-	-	5.40	18.36	861.5	69.12	-10.752	224.34	73.89
S-Decant #5	40	-	-	-	-	-	5.54	18.58	868.7	64.01	-10.924	225.98	73.22
S-Decant #5	41	-	-	-	-	-	5.68	18.79	875.5	59.12	-11.096	227.62	72.55
S-Decant #5	42	-	-	-	-	-	5.81	19.01	882.2	54.47	-11.269	229.26	71.88
S-Decant #5	43	-	-	-	-	-	5.95	19.22	888.7	50.04	-11.441	230.90	71.21
S-Decant #5	44	-	-	-	-	-	6.09	19.43	895.0	45.83	-11.614	232.54	70.54
S-Decant #5	45	-	-	-	-	-	6.23	19.65	901.2	41.86	-11.786	234.18	69.87
S-Decant #5	46	-	-	-	-	-	6.37	19.86	907.2	38.10	-11.958	235.82	69.20
S-Decant #5	47	-	-	-	-	-	6.51	20.08	913.1	34.56	-12.131	237.46	68.53
S-Decant #5	48	-	-	-	-	-	6.65	20.29	918.8	31.24	-12.303	239.10	67.86
S-Decant #5	49	NO	-	-	-	-	6.78	20.51	924.3	28.13	-12.475	240.74	67.19
S-Decant #5	50	NO	-	-	-	-	6.92	20.72	929.7	25.22	-12.648	242.38	66.52
S-Decant #5	51	NO	-	Low	-	-	7.06	20.94	935.0	22.52	-12.820	244.03	65.85
S-Decant #5	52	NO	-	Low	-	-	7.20	21.15	940.2	20.02	-12.992	245.67	65.18
S-Decant #5	53	NO	-	Low	-	-	7.34	21.36	945.2	17.71	-13.165	247.31	64.51
S-Decant #5	54	NO	-	Low	-	-	7.48	21.58	950.2	15.59	-13.337	248.94	63.84
S-Decant #5	55	NO	-	Low	-	-	7.61	21.79	954.9	13.65	-13.510	250.59	63.17
S-Decant #5	56	NO	-	Low	-	-	7.75	22.01	959.7	11.88	-13.682	252.23	62.50
S-Decant #5	57	NO	-	Low	-	-	7.89	22.22	964.2	10.27	-13.854	253.87	61.84
S-Decant #5	58	NO	-	Low	-	-	8.03	22.44	968.7	8.83	-14.027	255.51	61.17
S-Decant #5	59	NO	-	Low	-	-	8.17	22.65	973.1	7.53	-14.199	257.15	60.50
S-Decant #5	60	NO	-	Low	-	-	8.31	22.86	977.4	6.38	-14.371	258.79	59.83
T-Decant #5	25	-	-	High	High	NO	3.46	15.36	735.7	150.39	-8.299	201.37	83.26
T-Decant #5	26	-	-	High	High	NO	3.60	15.57	747.0	142.86	-8.472	203.01	82.59
T-Decant #5	27	-	-	High	High	NO	3.74	15.79	757.7	135.54	-8.645	204.65	81.92
T-Decant #5	28	-	-	High	-	NO	3.88	16.00	768.1	128.41	-8.818	206.29	81.25
T-Decant #5	29	-	-	High	-	NO	4.01	16.22	778.1	121.47	-8.991	207.93	80.58
T-Decant #5	30	-	-	High	-	NO	4.15	16.43	787.8	114.73	-9.164	209.57	79.91
T-Decant #5	31	-	-	High	-	-	4.29	16.65	797.1	108.19	-9.337	211.21	79.24
T-Decant #5	32	-	-	High	-	-	4.43	16.86	806.2	101.85	-9.510	212.85	78.57
T-Decant #5	33	-	-	-	-	-	4.57	17.08	814.9	95.72	-9.683	214.49	77.90
T-Decant #5	34	-	-	-	-	-	4.71	17.29	823.4	89.79	-9.855	216.13	77.23
T-Decant #5	35	-	-	-	-	-	4.85	17.50	831.7	84.06	-10.028	217.77	76.57
T-Decant #5	36	-	-	-	-	-	4.98	17.72	839.6	78.55	-10.201	219.41	75.90
T-Decant #5	37	-	-	-	-	-	5.12	17.93	847.4	73.24	-10.374	221.05	75.23
T-Decant #5	38	-	-	-	-	-	5.26	18.15	854.9	68.15	-10.547	222.69	74.56
T-Decant #5	39	-	-	-	-	-	5.40	18.36	862.1	63.26	-10.720	224.34	73.89
T-Decant #5	40	-	-	-	-	-	5.54	18.58	869.2	58.58	-10.893	225.98	73.22

		MAR Assessments					Property Values						
Frit-Decant	**% WL**	**Durability**	**T_L**	**Visc**	**Frit**	**Homog**	**Al_2O_3**	**alkali**	**T_L**	**Visc**	**ΔG_P**	**Homog**	**Frit**
T-Decant #5	41	-	-	-	-	-	5.68	18.79	876.0	54.11	-11.066	227.62	72.55
T-Decant #5	42	-	-	-	-	-	5.81	19.01	882.7	49.85	-11.238	229.26	71.88
T-Decant #5	43	-	-	-	-	-	5.95	19.22	889.2	45.80	-11.412	230.90	71.21
T-Decant #5	44	-	-	-	-	--	6.09	19.43	895.6	41.96	-11.584	232.54	70.54
T-Decant #5	45	-	-	-	-	-	6.23	19.65	901.7	38.32	-11.757	234.18	69.87
T-Decant #5	46	-	-	-	-	-	6.37	19.86	907.7	34.88	-11.930	235.82	69.20
T-Decant #5	47	-	-		-	-	6.51	20.08	913.6	31.64	-12.103	237.46	68.53
T-Decant #5	48	-	-		-	-	6.65	20.29	919.3	28.60	-12.276	239.10	67.86
T-Decant #5	49	NO	-		-	-	6.78	20.51	924.8	25.75	-12.449	240.74	67.19
T-Decant #5	50	NO	-	Low	-	-	6.92	20.72	930.2	23.10	-12.622	242.38	66.52
T-Decant #5	51	NO	-	Low	-	-	7.06	20.94	935.5	20.63	-12.795	244.03	65.85
T-Decant #5	52	NO	-	Low	-	-	7.20	21.15	940.7	18.34	-12.967	245.67	65.18
T-Decant #5	53	NO	-	Low	-	-	7.34	21.36	945.7	16.22	-13.140	247.31	64.51
T-Decant #5	54	NO	-	Low	-	-	7.48	21.58	950.7	14.28	-13.313	248.94	63.84
T-Decant #5	55	NO	-	Low	-	-	7.61	21.79	955.4	12.50	-13.486	250.59	63.17
T-Decant #5	56	NO	-	Low	-	-	7.75	22.01	960.2	10.88	-13.659	252.23	62.50
T-Decant #5	57	NO	-	Low	-	-	7.89	22.22	964.7	9.41	-13.832	253.87	61.84
T-Decant #5	58	NO	-	Low	-	-	8.03	22.44	969.2	8.09	-14.005	255.51	61.17
T-Decant #5	59	NO	-	Low	-	-	8.17	22.65	973.6	6.90	-14.178	257.15	60.50
T-Decant #5	60	NO	-	Low	-	-	8.31	22.86	977.9	5.85	-14.351	258.79	59.83
U-Decant #5	25	-	-	High	High	NO	3.46	16.11	723.3	102.24	-8.876	201.37	83.26
U-Decant #5	26	-	-	-	High	NO	3.60	16.31	734.8	97.07	-9.041	203.01	82.59
U-Decant #5	27	-	-	-	High	NO	3.74	16.52	745.7	92.06	-9.206	204.65	81.92
U-Decant #5	28	-	-	-	-	NO	3.88	16.72	756.4	87.17	-9.371	206.29	81.25
U-Decant #5	29	-	-	-	-	NO	4.01	16.93	766.6	82.41	-9.536	207.93	80.58
U-Decant #5	30	-	-	-	-	NO	4.15	17.13	776.5	77.79	-9.702	209.57	79.91
U-Decant #5	31	-	-	-	-	-	4.29	17.34	786.1	73.32	-9.867	211.21	79.24
U-Decant #5	32	-	-	-	-	-	4.43	17.54	795.4	68.98	-10.032	212.85	78.57
U-Decant #5	33	-	-	-	-	-	4.57	17.75	804.4	64.79	-10.197	214.49	77.90
U-Decant #5	34	-	-	-	-	-	4.71	17.95	813.1	60.74	-10.362	216.13	77.23
U-Decant #5	35	-	-	-	-	-	4.85	18.15	821.6	56.83	-10.528	217.77	76.57
U-Decant #5	36	-	-	-	-	-	4.98	18.36	829.8	53.07	-10.693	219.42	75.90
U-Decant #5	37	-	-	-	-	-	5.12	18.56	837.8	49.45	-10.858	221.05	75.23
U-Decant #5	38	-	-	-	-	-	5.26	18.77	845.5	45.98	-11.023	222.69	74.56
U-Decant #5	39	-	-	-	-	-	5.40	18.97	853.0	42.65	-11.189	224.34	73.89
U-Decant #5	40	-	-	-	-	-	5.54	19.18	860.4	39.47	-11.354	225.98	73.22
U-Decant #5	41	-	-	-	-	-	5.68	19.38	867.4	36.43	-11.519	227.62	72.55
U-Decant #5	42	-	-	-	-	-	5.81	19.59	874.3	33.54	-11.684	229.26	71.88
U-Decant #5	43	-	-	-	-	-	5.95	19.79	881.0	30.79	-11.849	230.90	71.21
U-Decant #5	44	-	-	-	-	-	6.09	19.99	887.6	28.18	-12.014	232.54	70.54
U-Decant #5	45	-	-	-	-	-	6.23	20.20	894.0	25.71	-12.180	234.18	69.87
U-Decant #5	46	-	-	Low	-	-	6.37	20.40	900.2	23.39	-12.345	235.82	69.20
U-Decant #5	47	NO	-	Low	-	-	6.51	20.61	906.2	21.20	-12.510	237.46	68.53
U-Decant #5	48	NO	-	Low	-	-	6.65	20.81	912.2	19.14	-12.675	239.10	67.86
U-Decant #5	49	NO	-	Low	-	-	6.78	21.02	917.9	17.22	-12.841	240.74	67.19
U-Decant #5	50	NO	-	Low	-	-	6.92	21.22	923.5	15.43	-13.006	242.38	66.52
U-Decant #5	51	NO	-	Low	-	-	7.06	21.43	929.0	13.76	-13.171	244.03	65.85
U-Decant #5	52	NO	-	Low	-	-	7.20	21.63	934.4	12.22	-13.336	245.67	65.18
U-Decant #5	53	NO	-	Low	-	-	7.34	21.83	939.5	10.80	-13.501	247.31	64.51
U-Decant #5	54	NO	-	Low	-	-	7.48	22.04	944.7	9.50	-13.666	248.94	63.84
U-Decant #5	55	NO	-	Low	-	-	7.61	22.24	949.6	8.30	-13.832	250.59	63.17
U-Decant #5	56	NO	-	Low	-	-	7.75	22.45	954.6	7.22	-13.997	252.23	62.50
U-Decant #5	57	NO	-	Low	-	-	7.89	22.65	959.3	6.23	-14.162	253.87	61.84
U-Decant #5	58	NO	-	Low	-	-	8.03	22.86	963.9	5.35	-14.327	255.51	61.17

		MAR Assessments					Property Values						
Frit-Decant	**% WL**	**Durability**	**T_L**	**Visc**	**Frit**	**Homog**	**Al_2O_3**	**alkali**	**T_L**	**Visc**	**ΔG_P**	**Homog**	**Frit**
U-Decant #5	59	NO	-	Low	-	-	8.17	23.06	968.5	4.56	-14.493	257.15	60.50
U-Decant #5	60	NO	-	Low	-	-	8.31	23.26	973.0	3.86	-14.658	258.79	59.83
U2-Decant #5	25	-	-	-	High	NO	3.46	16.11	725.1	87.98	-9.201	201.37	83.26
U2-Decant #5	26	-	-	-	High	NO	3.60	16.31	736.5	83.44	-9.362	203.01	82.59
U2-Decant #5	27	-	-	-	High	NO	3.74	16.52	747.5	79.02	-9.523	204.65	81.92
U2-Decant #5	28	-	-	-	-	NO	3.88	16.72	758.1	74.73	-9.684	206.29	81.25
U2-Decant #5	29	-	-	-	-	NO	4.01	16.93	768.3	70.56	-9.845	207.93	80.58
U2-Decant #5	30	-	-	-	-	NO	4.15	17.13	778.2	66.51	-10.006	209.57	79.91
U2-Decant #5	31	-	-	-	-	-	4.29	17.34	787.8	62.59	-10.167	211.21	79.24
U2-Decant #5	32	-	-	-	-	-	4.43	17.54	797.1	58.81	-10.327	212.85	78.57
U2-Decant #5	33	-	-	-	-	-	4.57	17.75	806.0	55.15	-10.488	214.49	77.90
U2-Decant #5	34	-	-	-	-	-	4.71	17.95	814.7	51.62	-10.649	216.13	77.23
U2-Decant #5	35	-	-	-	-	-	4.85	18.15	823.2	48.23	-10.810	217.77	76.57
U2-Decant #5	36	-	-	-	-	-	4.98	18.36	831.4	44.96	-10.971	219.42	75.90
U2-Decant #5	37	-	-	-	-	-	5.12	18.56	839.3	41.82	-11.132	221.05	75.23
U2-Decant #5	38	-	-	-	-	-	5.26	18.77	847.0	38.82	-11.293	222.69	74.56
U2-Decant #5	39	-	-	-	-	-	5.40	18.97	854.5	35.95	-11.454	224.34	73.89
U2-Decant #5	40	-	-	-	-	-	5.54	19.18	861.8	33.20	-11.614	225.98	73.22
U2-Decant #5	41	-	-	-	-	-	5.68	19.38	868.8	30.59	-11.775	227.62	72.55
U2-Decant #5	42	-	-	-	-	-	5.81	19.59	875.7	28.10	-11.936	229.26	71.88
U2-Decant #5	43	-	-	-	-	-	5.95	19.79	882.4	25.75	-12.097	230.90	71.21
U2-Decant #5	44	-	-	Low	-	-	6.09	19.99	889.0	23.52	-12.258	232.54	70.54
U2-Decant #5	45	NO	-	Low	-	-	6.23	20.20	895.3	21.41	-12.419	234.18	69.87
U2-Decant #5	46	NO	-	Low	-	-	6.37	20.40	901.5	19.43	-12.579	235.82	69.20
U2-Decant #5	47	NO	-	Low	-	-	6.51	20.61	907.5	17.57	-12.740	237.46	68.53
U2-Decant #5	48	NO	-	Low	-	-	6.65	20.81	913.4	15.83	-12.901	239.10	67.86
U2-Decant #5	49	NO	-	Low	-	-	6.78	21.02	919.1	14.20	-13.062	240.74	67.19
U2-Decant #5	50	NO	-	Low	-	-	6.92	21.22	924.7	12.69	-13.223	242.38	66.52
U2-Decant #5	51	NO	-	Low	-	-	7.06	21.43	930.2	11.29	-13.384	244.03	65.85
U2-Decant #5	52	NO	-	Low	-	-	7.20	21.63	935.5	10.00	-13.545	245.67	65.18
U2-Decant #5	53	NO	-	Low	-	-	7.34	21.83	940.7	8.81	-13.706	247.31	64.51
U2-Decant #5	54	NO	-	Low	-	-	7.48	22.04	945.8	7.72	-13.866	248.94	63.84
U2-Decant #5	55	NO	-	Low	-	-	7.61	22.24	950.7	6.73	-14.027	250.59	63.17
U2-Decant #5	56	NO	-	Low	-	-	7.75	22.45	955.6	5.83	-14.188	252.23	62.50
U2-Decant #5	57	NO	-	Low	-	-	7.89	22.65	960.3	5.02	-14.349	253.87	61.84
U2-Decant #5	58	NO	-	Low	-	-	8.03	22.86	964.9	4.30	-14.510	255.51	61.17
U2-Decant #5	59	NO	-	Low	-	-	8.17	23.06	969.5	3.65	-14.671	257.15	60.50
U2-Decant #5	60	NO	-	Low	-	-	8.31	23.26	973.9	3.07	-14.832	258.79	59.83
202-Decant #9	25	-	-	High	-	NO	3.87	15.60	827.0	101.68	-8.759	203.77	79.80
202-Decant #9	26	-	-	-	-	NO	4.02	15.71	839.3	97.48	-8.826	205.63	79.07
202-Decant #9	27	-	-	-	-	NO	4.18	15.81	851.1	93.36	-8.892	207.50	78.34
202-Decant #9	28	-	-	-	-	NO	4.33	15.91	862.6	89.30	-8.958	209.36	77.62
202-Decant #9	29	-	-	-	-	-	4.49	16.02	873.8	85.32	-9.024	211.23	76.89
202-Decant #9	30	-	-	-	-	-	4.64	16.12	884.6	81.41	-9.090	213.09	76.16
202-Decant #9	31	-	-	-	-	-	4.79	16.23	895.1	77.58	-9.156	214.96	75.43
202-Decant #9	32	-	-	-	-	-	4.95	16.33	905.3	73.83	-9.222	216.82	74.70
202-Decant #9	33	-	-	-	-	-	5.10	16.43	915.3	70.16	-9.288	218.69	73.97
202-Decant #9	34	-	-	-	-	-	5.26	16.54	925.0	66.57	-9.355	220.55	73.25
202-Decant #9	35	-	-	-	-	-	5.41	16.64	934.4	63.07	-9.421	222.42	72.52
202-Decant #9	36	-	-	-	-	-	5.57	16.75	943.5	59.66	-9.487	224.28	71.79
202-Decant #9	37	-	-	-	-	-	5.72	16.85	952.4	56.33	-9.553	226.15	71.06
202-Decant #9	38	-	-	-	-	-	5.88	16.95	961.1	53.10	-9.619	228.02	70.33
202-Decant #9	39	-	-	-	-	-	6.03	17.06	969.5	49.95	-9.685	229.88	69.61
202-Decant #9	40	-	-	-	-	-	6.19	17.16	977.8	46.90	-9.751	231.74	68.88

		MAR Assessments					**Property Values**						
Frit-Decant	**% WL**	**Durability**	**T_L**	**Visc**	**Frit**	**Homog**	**Al_2O_3**	**alkali**	**T_L**	**Visc**	**ΔG_P**	**Homog**	**Frit**
202-Decant #9	41	-	-	-	-	-	6.34	17.27	985.8	43.95	-9.818	233.61	68.15
202-Decant #9	42	-	-	-	-	-	6.50	17.37	993.7	41.09	-9.884	235.47	67.42
202-Decant #9	43	-	-	-	-	-	6.65	17.47	1001.3	38.34	-9.950	237.34	66.69
202-Decant #9	44	-	-	-	-	-	6.81	17.58	1008.7	35.68	-10.016	239.20	65.97
202-Decant #9	45	-	-	-	-	-	6.96	17.68	1016.1	33.12	-10.082	241.07	65.24
202-Decant #9	46	-	NO	-	-	-	7.11	17.79	1023.1	30.67	-10.148	242.93	64.51
202-Decant #9	47	-	NO	-	-	-	7.27	17.89	1030.1	28.32	-10.214	244.80	63.78
202-Decant #9	48	-	NO	-	-	-	7.42	18.00	1036.9	26.07	-10.281	246.67	63.05
202-Decant #9	49	-	NO	Low	-	-	7.58	18.10	1043.5	23.93	-10.346	248.53	62.33
202-Decant #9	50	-	NO	Low	-	-	7.73	18.20	1050.0	21.89	-10.413	250.39	61.60
202-Decant #9	51	-	NO	Low	-	-	7.89	18.31	1056.3	19.96	-10.479	252.26	60.87
202-Decant #9	52	-	NO	Low	-	-	8.04	18.41	1062.5	18.13	-10.545	254.13	60.14
202-Decant #9	53	-	NO	Low	-	-	8.20	18.52	1068.6	16.40	-10.611	255.99	59.41
202-Decant #9	54	-	NO	Low	-	-	8.35	18.62	1074.5	14.78	-10.677	257.86	58.69
202-Decant #9	55	-	NO	Low	-	-	8.51	18.72	1080.3	13.26	-10.743	259.72	57.96
202-Decant #9	56	-	NO	Low	-	-	8.66	18.83	1086.0	11.84	-10.810	261.58	57.23
202-Decant #9	57	-	NO	Low	-	-	8.82	18.93	1091.5	10.52	-10.876	263.45	56.50
202-Decant #9	58	-	NO	Low	-	-	8.97	19.04	1097.0	9.29	-10.942	265.32	55.77
202-Decant #9	59	-	NO	Low	-	-	9.13	19.14	1102.4	8.17	-11.008	267.18	55.05
202-Decant #9	60	-	NO	Low	-	-	9.28	19.24	1107.6	7.13	-11.074	269.04	54.32
202-M-Decant #9	25	-	-	High	-	NO	4.62	14.85	805.7	151.21	-7.572	209.21	80.55
202-M-Decant #9	26	-	-	High	-	-	4.76	14.97	818.4	145.10	-7.654	211.00	79.81
202-M-Decant #9	27	-	-	High	-	-	4.91	15.08	830.7	139.08	-7.736	212.79	79.07
202-M-Decant #9	28	-	-	High	-	-	5.05	15.19	842.6	133.17	-7.818	214.58	78.34
202-M-Decant #9	29	-	-	High	-	-	5.20	15.31	854.2	127.35	-7.900	216.38	77.60
202-M-Decant #9	30	-	-	High	-	-	5.34	15.42	865.4	121.65	-7.982	218.17	76.86
202-M-Decant #9	31	-	-	High	-	-	5.48	15.54	876.3	116.03	-8.064	219.96	76.12
202-M-Decant #9	32	-	-	High	-	-	5.63	15.65	886.9	110.54	-8.146	221.75	75.38
202-M-Decant #9	33	-	-	High	-	-	5.77	15.76	897.2	105.16	-8.228	223.55	74.64
202-M-Decant #9	34	-	-	High	-	-	5.92	15.88	907.3	99.89	-8.310	225.34	73.91
202-M-Decant #9	35	-	-	-	-	-	6.06	15.99	917.0	94.74	-8.392	227.13	73.17
202-M-Decant #9	36	-	-	-	-	-	6.21	16.11	926.5	89.73	-8.474	228.93	72.43
202-M-Decant #9	37	-	-	-	-	-	6.35	16.22	935.8	84.82	-8.556	230.72	71.69
202-M-Decant #9	38	-	-	-	-	-	6.50	16.33	944.8	80.05	-8.638	232.51	70.95
202-M-Decant #9	39	-	-	-	-	-	6.64	16.45	953.6	75.41	-8.720	234.30	70.22
202-M-Decant #9	40	-	-	-	-	-	6.79	16.56	962.2	70.90	-8.801	236.09	69.48
202-M-Decant #9	41	-	-	-	-	-	6.93	16.68	970.5	66.52	-8.884	237.89	68.74
202-M-Decant #9	42	-	-	-	-	-	7.08	16.79	978.7	62.29	-8.966	239.68	68.00
202-M-Decant #9	43	-	-	-	-	-	7.22	16.90	986.6	58.19	-9.048	241.47	67.26
202-M-Decant #9	44	-	-	-	-	-	7.37	17.02	994.4	54.25	-9.129	243.26	66.53
202-M-Decant #9	45	-	-	-	-	-	7.51	17.13	1002.0	50.44	-9.211	245.06	65.79
202-M-Decant #9	46	-	-	-	-	-	7.65	17.25	1009.4	46.77	-9.293	246.85	65.05
202-M-Decant #9	47	-	-	-	-	-	7.80	17.36	1016.6	43.26	-9.375	248.64	64.31
202-M-Decant #9	48	-	NO	-	-	-	7.94	17.47	1023.7	39.89	-9.457	250.44	63.57
202-M-Decant #9	49	-	NO	-	-	-	8.09	17.59	1030.7	36.68	-9.539	252.23	62.84
202-M-Decant #9	50	-	NO	-	-	-	8.23	17.70	1037.5	33.62	-9.621	254.02	62.10
202-M-Decant #9	51	-	NO	-	-	-	8.38	17.82	1044.1	30.71	-9.703	255.81	61.36
202-M-Decant #9	52	-	NO	-	-	-	8.52	17.93	1050.6	27.94	-9.785	257.61	60.62
202-M-Decant #9	53	-	NO	-	-	-	8.67	18.05	1056.9	25.34	-9.867	259.40	59.88
202-M-Decant #9	54	-	NO	Low	-	-	8.81	18.16	1063.2	22.88	-9.949	261.19	59.15
202-M-Decant #9	55	-	NO	Low	-	-	8.96	18.27	1069.3	20.57	-10.031	262.98	58.41
202-M-Decant #9	56	-	NO	Low	-	-	9.10	18.39	1075.2	18.41	-10.113	264.78	57.67
202-M-Decant #9	57	-	NO	Low	-	-	9.25	18.50	1081.1	16.39	-10.195	266.57	56.93
202-M-Decant #9	58	-	NO	Low	-	-	9.39	18.62	1086.8	14.52	-10.277	268.36	56.19

		MAR Assessments					**Property Values**						
Frit-Decant	**% WL**	**Durability**	**T_L**	**Visc**	**Frit**	**Homog**	**Al_2O_3**	**alkali**	**T_L**	**Visc**	**ΔG_P**	**Homog**	**Frit**
202-M-Decant #9	59	-	NO	Low	-	-	9.54	18.73	1092.4	12.79	-10.359	270.15	55.46
202-M-Decant #9	60	-	NO	Low	-	-	9.68	18.84	1097.9	11.20	-10.441	271.95	54.72
202-M2-Decant #9	25	-	-	High	-	NO	4.62	14.85	808.0	130.95	-7.898	209.21	80.55
202-M2-Decant #9	26	-	-	High	-	-	4.76	14.97	820.7	125.54	-7.976	211.00	79.81
202-M2-Decant #9	27	-	-	High	-	-	4.91	15.08	832.9	120.21	-8.053	212.79	79.07
202-M2-Decant #9	28	-	-	High	-	-	5.05	15.19	844.9	114.97	-8.131	214.58	78.34
202-M2-Decant #9	29	-	-	High	-	-	5.20	15.31	856.4	109.84	-8.209	216.38	77.60
202-M2-Decant #9	30	-	-	High	-	-	5.34	15.42	867.6	104.80	-8.286	218.17	76.86
202-M2-Decant #9	31	-	-	High	-	-	5.48	15.54	878.5	99.85	-8.364	219.96	76.12
202-M2-Decant #9	32	-	-	-	-	-	5.63	15.65	889.1	95.01	-8.441	221.76	75.38
202-M2-Decant #9	33	-	-	-	-	-	5.77	15.76	899.4	90.28	-8.519	223.55	74.64
202-M2-Decant #9	34	-	-	-	-	-	5.92	15.88	909.4	85.65	-8.597	225.34	73.91
202-M2-Decant #9	35	-	-	-	-	-	6.06	15.99	919.1	81.13	-8.674	227.13	73.17
202-M2-Decant #9	36	-	-	-	-	-	6.21	16.11	928.5	76.73	-8.752	228.93	72.43
202-M2-Decant #9	37	-	-	-	-	-	6.35	16.22	937.8	72.44	-8.829	230.72	71.69
202-M2-Decant #9	38	-	-	-	-	-	6.50	16.33	946.8	68.27	-8.907	232.51	70.95
202-M2-Decant #9	39	-	-	-	-	-	6.64	16.45	955.5	64.22	-8.985	234.30	70.22
202-M2-Decant #9	40	-	-	-	-	-	6.79	16.56	964.1	60.29	-9.062	236.09	69.48
202-M2-Decant #9	41	-	-	-	-	-	6.93	16.68	972.4	56.48	-9.140	237.89	68.74
202-M2-Decant #9	42	-	-	-	-	-	7.08	16.79	980.5	52.81	-9.218	239.68	68.00
202-M2-Decant #9	43	-	-	-	-	-	7.22	16.90	988.4	49.25	-9.295	241.47	67.26
202-M2-Decant #9	44	-	-	-	-	-	7.37	17.02	996.2	45.83	-9.373	243.26	66.53
202-M2-Decant #9	45	-	-	-	-	-	7.51	17.13	1003.8	42.54	-9.450	245.06	65.79
202-M2-Decant #9	46	-	-	-	-	-	7.65	17.25	1011.1	39.38	-9.528	246.85	65.05
202-M2-Decant #9	47	-	-	-	-	-	7.80	17.36	1018.3	36.36	-9.606	248.64	64.31
202-M2-Decant #9	48	-	NO	-	-	-	7.94	17.47	1025.4	33.46	-9.683	250.44	63.57
202-M2-Decant #9	49	-	NO	-	-	-	8.09	17.59	1032.3	30.71	-9.761	252.23	62.84
202-M2-Decant #9	50	-	NO	-	-	-	8.23	17.70	1039.1	28.09	-9.838	254.02	62.10
202-M2-Decant #9	51	-	NO	-	-	-	8.38	17.82	1045.7	25.60	-9.916	255.81	61.36
202-M2-Decant #9	52	-	NO	Low	-	-	8.52	17.93	1052.1	23.24	-9.994	257.61	60.62
202-M2-Decant #9	53	-	NO	Low	-	-	8.67	18.05	1058.4	21.03	-10.071	259.40	59.88
202-M2-Decant #9	54	-	NO	Low	-	-	8.81	18.16	1064.6	18.94	-10.149	261.19	59.15
202-M2-Decant #9	55	-	NO	Low	-	-	8.96	18.27	1070.7	16.99	-10.227	262.98	58.41
202-M2-Decant #9	56	-	NO	Low	-	-	9.10	18.39	1076.6	15.16	-10.304	264.78	57.67
202-M2-Decant #9	57	-	NO	Low	-	-	9.25	18.50	1082.4	13.47	-10.382	266.57	56.93
202-M2-Decant #9	58	-	NO	Low	-	-	9.39	18.62	1088.1	11.90	-10.459	268.36	56.19
202-M2-Decant #9	59	-	NO	Low	-	-	9.54	18.73	1093.7	10.45	-10.537	270.15	55.46
202-M2-Decant #9	60	-	NO	Low	-	-	9.68	18.84	1099.2	9.12	-10.615	271.95	54.72
G-Decant #9	25	-	-	-	-	NO	4.62	18.60	745.2	80.63	-11.037	209.21	80.55
G-Decant #9	26	-	-	-	-	-	4.76	18.67	758.3	77.18	-11.073	211.00	79.81
G-Decant #9	27	-	-	-	-	-	4.91	18.73	771.0	73.80	-11.109	212.79	79.07
G-Decant #9	28	-	-	-	-	-	5.05	18.79	783.4	70.47	-11.144	214.58	78.34
G-Decant #9	29	-	-	-	-	-	5.20	18.86	795.5	67.21	-11.180	216.38	77.60
G-Decant #9	30	-	-	-	-	-	5.34	18.92	807.3	64.03	-11.216	218.17	76.86
G-Decant #9	31	-	-	-	-	-	5.48	18.99	818.8	60.90	-11.252	219.96	76.12
G-Decant #9	32	-	-	-	-	-	5.63	19.05	830.1	57.85	-11.287	221.75	75.38
G-Decant #9	33	-	-	-	-	-	5.77	19.11	841.1	54.87	-11.323	223.55	74.64
G-Decant #9	34	-	-	-	-	-	5.92	19.18	851.8	51.96	-11.359	225.34	73.91
G-Decant #9	35	-	-	-	-	-	6.06	19.24	862.3	49.12	-11.395	227.13	73.17
G-Decant #9	36	-	-	-	-	-	6.21	19.31	872.5	46.37	-11.430	228.93	72.43
G-Decant #9	37	-	-	-	-	-	6.35	19.37	882.6	43.69	-11.466	230.72	71.69
G-Decant #9	38	-	-	-	-	-	6.50	19.43	892.4	41.09	-11.502	232.51	70.95
G-Decant #9	39	-	-	-	-	-	6.64	19.50	902.0	38.57	-11.538	234.30	70.22
G-Decant #9	40	-	-	-	-	-	6.79	19.56	911.4	36.13	-11.574	236.09	69.48

		MAR Assessments					Property Values							
Frit-Decant	% WL	Durability	T_L	Visc	Frit	Homog	Al_2O_3	alkali	T_L	Visc	ΔG_P	Homog	Frit
G-Decant #9	41	-	-	-	-	-	6.93	19.63	920.5	33.77	-11.609	237.89	68.74
G-Decant #9	42	-	-	-	-	-	7.08	19.69	929.5	31.50	-11.645	239.68	68.00
G-Decant #9	43	-	-	-	-	-	7.22	19.75	938.3	29.31	-11.681	241.47	67.26
G-Decant #9	44	-	-	-	-	-	7.37	19.82	947.0	27.21	-11.717	243.26	66.53
G-Decant #9	45	-	-	-	-	-	7.51	19.88	955.5	25.19	-11.752	245.06	65.79
G-Decant #9	46	-	-	Low	-	-	7.65	19.95	963.8	23.26	-11.788	246.85	65.05
G-Decant #9	47	-	-	Low	-	-	7.80	20.01	971.9	21.41	-11.824	248.64	64.31
G-Decant #9	48	-	-	Low	-	-	7.94	20.07	979.9	19.65	-11.860	250.44	63.57
G-Decant #9	49	-	-	Low	-	-	8.09	20.14	987.7	17.98	-11.895	252.23	62.84
G-Decant #9	50	-	-	Low	-	-	8.23	20.20	995.4	16.40	-11.931	254.02	62.10
G-Decant #9	51	-	-	Low	-	-	8.38	20.27	1002.9	14.90	-11.967	255.81	61.36
G-Decant #9	52	-	-	Low	-	-	8.52	20.33	1010.3	13.48	-12.003	257.61	60.62
G-Decant #9	53	-	-	Low	-	-	8.67	20.40	1017.6	12.16	-12.038	259.40	59.88
G-Decant #9	54	-	NO	Low	-	-	8.81	20.46	1024.7	10.91	-12.074	261.19	59.15
G-Decant #9	55	-	NO	Low	-	-	8.96	20.52	1031.7	9.75	-12.110	262.98	58.41
G-Decant #9	56	-	NO	Low	-	-	9.10	20.59	1038.6	8.67	-12.146	264.78	57.67
G-Decant #9	57	-	NO	Low	-	-	9.25	20.65	1045.3	7.67	-12.181	266.57	56.93
G-Decant #9	58	-	NO	Low	-	-	9.39	20.72	1052.0	6.75	-12.217	268.36	56.19
G-Decant #9	59	-	NO	Low	-	-	9.54	20.78	1058.5	5.90	-12.253	270.15	55.46
G-Decant #9	60	-	NO	Low	-	-	9.68	20.84	1064.9	5.13	-12.289	271.95	54.72
U-Decant #9	25	-	-	High	-	NO	3.87	14.10	801.9	126.86	-6.989	206.17	81.30
U-Decant #9	26	-	-	High	-	NO	4.02	14.23	815.4	121.86	-7.079	208.01	80.55
U-Decant #9	27	-	-	High	-	NO	4.18	14.35	828.4	116.94	-7.168	209.84	79.80
U-Decant #9	28	-	-	High	-	-	4.33	14.47	841.0	112.09	-7.258	211.67	79.06
U-Decant #9	29	-	-	High	-	-	4.49	14.60	853.2	107.33	-7.348	213.51	78.31
U-Decant #9	30	-	-	High	-	-	4.64	14.72	865.0	102.63	-7.438	215.34	77.56
U-Decant #9	31	-	-	-	-	-	4.79	14.85	876.4	98.02	-7.528	217.17	76.81
U-Decant #9	32	-	-	-	-	-	4.95	14.97	887.5	93.50	-7.617	219.00	76.06
U-Decant #9	33	-	-	-	-	-	5.10	15.09	898.3	89.07	-7.707	220.84	75.31
U-Decant #9	34	-	-	-	-	-	5.26	15.22	908.7	84.72	-7.797	222.67	74.57
U-Decant #9	35	-	-	-	-	-	5.41	15.34	918.8	80.46	-7.886	224.50	73.82
U-Decant #9	36	-	-	-	-	-	5.57	15.47	928.7	76.30	-7.976	226.34	73.07
U-Decant #9	37	-	-	-	-	-	5.72	15.59	938.3	72.24	-8.066	228.17	72.32
U-Decant #9	38	-	-	-	-	-	5.88	15.71	947.6	68.28	-8.155	230.00	71.57
U-Decant #9	39	-	-	-	-	-	6.03	15.84	956.6	64.42	-8.245	231.83	70.83
U-Decant #9	40	-	-	-	-	-	6.19	15.96	965.5	60.66	-8.335	233.67	70.08
U-Decant #9	41	-	-	-	-	-	6.34	16.09	974.0	57.02	-8.425	235.50	69.33
U-Decant #9	42	-	-	-	-	-	6.50	16.21	982.4	53.48	-8.514	237.33	68.58
U-Decant #9	43	-	-	-	-	-	6.65	16.33	990.5	50.05	-8.604	239.17	67.83
U-Decant #9	44	-	-	-	-	-	6.81	16.46	998.5	46.73	-8.694	241.00	67.09
U-Decant #9	45	-	-	-	-	-	6.96	16.58	1006.2	43.54	-8.784	242.83	66.34
U-Decant #9	46	-	-	-	-	-	7.11	16.71	1013.7	40.45	-8.873	244.67	65.59
U-Decant #9	47	-	NO	-	-	-	7.27	16.83	1021.1	37.49	-8.963	246.50	64.84
U-Decant #9	48	-	NO	-	-	-	7.42	16.95	1028.3	34.64	-9.053	248.33	64.09
U-Decant #9	49	-	NO	-	-	-	7.58	17.08	1035.3	31.92	-9.143	250.17	63.35
U-Decant #9	50	-	NO	-	-	-	7.73	17.20	1042.2	29.32	-9.232	252.00	62.60
U-Decant #9	51	-	NO	-	-	-	7.89	17.33	1048.8	26.84	-9.322	253.83	61.85
U-Decant #9	52	-	NO	Low	-	-	8.04	17.45	1055.3	24.49	-9.412	255.67	61.10
U-Decant #9	53	-	NO	Low	-	-	8.20	17.58	1061.8	22.26	-9.502	257.50	60.35
U-Decant #9	54	-	NO	Low	-	-	8.35	17.70	1068.0	20.15	-9.591	259.33	59.61
U-Decant #9	55	-	NO	Low	-	-	8.51	17.82	1074.1	18.16	-9.681	261.16	58.86
U-Decant #9	56	-	NO	Low	-	-	8.66	17.95	1080.1	16.30	-9.771	263.00	58.11
U-Decant #9	57	-	NO	Low	-	-	8.82	18.07	1085.9	14.56	-9.860	264.83	57.36
U-Decant #9	58	-	NO	Low	-	-	8.97	18.20	1091.6	12.94	-9.950	266.66	56.61

		MAR Assessments					Property Values						
Frit-Decant	**% WL**	**Durability**	**T_L**	**Visc**	**Frit**	**Homog**	**Al_2O_3**	**alkali**	**T_L**	**Visc**	**ΔG_P**	**Homog**	**Frit**
U-Decant #9	59	-	NO	Low	-	-	9.13	18.32	1097.2	11.43	-10.040	268.49	55.87
U-Decant #9	60	-	NO	Low	-	-	9.28	18.44	1102.7	10.05	-10.130	270.33	55.12
U2-Decant #9	25	-	-	High	-	NO	3.87	14.10	804.1	109.77	-7.315	206.17	81.30
U2-Decant #9	26	-	-	High	-	NO	4.02	14.23	817.6	105.35	-7.400	208.01	80.55
U2-Decant #9	27	-	-	High	-	NO	4.18	14.35	830.6	101.00	-7.486	209.84	79.80
U2-Decant #9	28	-	-	-	-	-	4.33	14.47	843.2	96.72	-7.571	211.67	79.06
U2-Decant #9	29	-	-	-	-	-	4.49	14.60	855.4	92.51	-7.656	213.51	78.31
U2-Decant #9	30	-	-	-	-	-	4.64	14.72	867.1	88.37	-7.742	215.34	77.56
U2-Decant #9	31	-	-	-	-	-	4.79	14.85	878.5	84.31	-7.827	217.17	76.81
U2-Decant #9	32	-	-	-	-	-	4.95	14.97	889.6	80.33	-7.912	219.00	76.06
U2-Decant #9	33	-	-	-	-	-	5.10	15.09	900.3	76.43	-7.998	220.84	75.31
U2-Decant #9	34	-	-	-	-	-	5.26	15.22	910.8	72.62	-8.083	222.67	74.57
U2-Decant #9	35	-	-	-	-	-	5.41	15.34	920.9	68.89	-8.169	224.50	73.82
U2-Decant #9	36	-	-	-	-	-	5.57	15.47	930.7	65.24	-8.254	226.34	73.07
U2-Decant #9	37	-	-	-	-	-	5.72	15.59	940.2	61.69	-8.340	228.17	72.32
U2-Decant #9	38	-	-	-	-	-	5.88	15.71	949.5	58.23	-8.425	230.00	71.57
U2-Decant #9	39	-	-	-	-	-	6.03	15.84	958.5	54.87	-8.510	231.84	70.83
U2-Decant #9	40	-	-	-	-	-	6.19	15.96	967.4	51.59	-8.596	233.67	70.08
U2-Decant #9	41	-	-	-	-	-	6.34	16.09	975.9	48.42	-8.681	235.50	69.33
U2-Decant #9	42	-	-	-	-	-	6.50	16.21	984.2	45.35	-8.766	237.33	68.58
U2-Decant #9	43	-	-	-	-	-	6.65	16.33	992.3	42.38	-8.852	239.17	67.83
U2-Decant #9	44	-	-	-	-	-	6.81	16.46	1000.2	39.51	-8.937	241.00	67.09
U2-Decant #9	45	-	-	-	-	-	6.96	16.58	1008.0	36.74	-9.022	242.83	66.34
U2-Decant #9	46	-	-	-	-	-	7.11	16.71	1015.4	34.08	-9.108	244.67	65.59
U2-Decant #9	47	-	NO	-	-	-	7.27	16.83	1022.8	31.53	-9.193	246.50	64.84
U2-Decant #9	48	-	NO	-	-	-	7.42	16.95	1029.9	29.08	-9.279	248.33	64.09
U2-Decant #9	49	-	NO	-	-	-	7.58	17.08	1036.9	26.75	-9.364	250.17	63.35
U2-Decant #9	50	-	NO	Low	-	-	7.73	17.20	1043.8	24.52	-9.450	252.00	62.60
U2-Decant #9	51	-	NO	Low	-	-	7.89	17.33	1050.4	22.40	-9.535	253.83	61.85
U2-Decant #9	52	-	NO	Low	-	-	8.04	17.45	1056.9	20.40	-9.620	255.67	61.10
U2-Decant #9	53	-	NO	Low	-	-	8.20	17.58	1063.2	18.50	-9.706	257.50	60.35
U2-Decant #9	54	-	NO	Low	-	-	8.35	17.70	1069.5	16.71	-9.791	259.33	59.61
U2-Decant #9	55	-	NO	Low	-	-	8.51	17.82	1075.5	15.03	-9.877	261.16	58.86
U2-Decant #9	56	-	NO	Low	-	-	8.66	17.95	1081.4	13.45	-9.962	263.00	58.11
U2-Decant #9	57	-	NO	Low	-	-	8.82	18.07	1087.2	11.98	-10.047	264.83	57.36
U2-Decant #9	58	-	NO	Low	-	-	8.97	18.20	1092.9	10.62	-10.133	266.66	56.61
U2-Decant #9	59	-	NO	Low	-	-	9.13	18.32	1098.5	9.36	-10.218	268.49	55.87
U2-Decant #9	60	-	NO	Low	-	-	9.28	18.44	1103.9	8.20	-10.304	270.33	55.12

Appendix C2

MAR Calculations for Various Frit/Washing Combinations

		MAR Assessment					Property Values						
Frit/Washing	% WL	Durability	T_L	Visc	Frit	Homog	Al_2O_3	alkali	T_L	Visc	ΔGp	Homog	Frit
202- Washing @ 0%	25	-	-	-	High	NO	3.29	18.61	715.9	73.29	-11.666	197.82	82.97
202- Washing @ 0%	26	-	-	-	High	NO	3.42	18.84	725.4	69.05	-11.848	199.45	82.37
202- Washing @ 0%	27	-	-	-	High	NO	3.55	19.06	734.5	64.96	-12.030	201.08	81.77
202- Washing @ 0%	28	-	-	-	-	NO	3.68	19.28	743.4	61.01	-12.213	202.71	81.17
202- Washing @ 0%	29	NO	-	-	-	NO	3.81	19.51	752.0	57.21	-12.395	204.33	80.56
202- Washing @ 0%	30	NO	-	-	-	NO	3.94	19.73	760.4	53.55	-12.578	205.96	79.96
202- Washing @ 0%	31	NO	-	-	-	NO	4.07	19.96	768.5	50.03	-12.760	207.59	79.36
202- Washing @ 0%	32	NO	-	-	-	NO	4.20	20.18	776.4	46.65	-12.942	209.22	78.76
202- Washing @ 0%	33	NO	-	-	-	NO	4.34	20.41	784.0	43.42	-13.125	210.84	78.16
202- Washing @ 0%	34	NO	-	-	-	-	4.47	20.63	791.4	40.32	-13.307	212.47	77.56
202- Washing @ 0%	35	NO	-	-	-	-	4.60	20.86	798.6	37.37	-13.490	214.10	76.96
202- Washing @ 0%	36	NO	-	-	-	-	4.73	21.08	805.7	34.55	-13.672	215.72	76.36
202- Washing @ 0%	37	NO	-	-	-	-	4.86	21.30	812.5	31.87	-13.854	217.35	75.75
202- Washing @ 0%	38	NO	-	-	-	-	4.99	21.53	819.1	29.32	-14.037	218.98	75.15
202- Washing @ 0%	39	NO	-	-	-	-	5.12	21.75	825.6	26.91	-14.219	220.61	74.55
202- Washing @ 0%	40	NO	-	-	-	-	5.26	21.98	831.9	24.63	-14.401	222.23	73.95
202- Washing @ 0%	41	NO	-	Low	-	-	5.39	22.20	838.0	22.48	-14.584	223.86	73.35
202- Washing @ 0%	42	NO	-	Low	-	-	5.52	22.43	844.0	20.46	-14.766	225.49	72.75
202- Washing @ 0%	43	NO	-	Low	-	-	5.65	22.65	849.8	18.56	-14.948	227.11	72.15
202- Washing @ 0%	44	NO	-	Low	-	-	5.78	22.88	855.5	16.78	-15.131	228.74	71.54
202- Washing @ 0%	45	NO	-	Low	-	-	5.91	23.10	861.0	15.12	-15.313	230.37	70.94
202- Washing @ 0%	46	NO	-	Low	-	-	6.04	23.32	866.4	13.57	-15.496	232.00	70.34
202- Washing @ 0%	47	NO	-	Low	-	-	6.18	23.55	871.7	12.14	-15.678	233.62	69.74
202- Washing @ 0%	48	NO	-	Low	-	-	6.31	23.77	876.9	10.81	-15.860	235.25	69.14
202- Washing @ 0%	49	NO	-	Low	-	-	6.44	24.00	881.9	9.59	-16.043	236.88	68.54
202- Washing @ 0%	50	NO	-	Low	-	-	6.57	24.22	886.8	8.47	-16.225	238.51	67.94
202- Washing @ 0%	51	NO	-	Low	-	-	6.70	24.45	891.6	7.44	-16.407	240.13	67.34
202- Washing @ 0%	52	NO	-	Low	-	-	6.83	24.67	896.3	6.50	-16.590	241.76	66.73
202- Washing @ 0%	53	NO	-	Low	-	-	6.96	24.90	900.9	5.66	-16.772	243.39	66.13
202- Washing @ 0%	54	NO	-	Low	-	-	7.10	25.12	905.4	4.89	-16.955	245.01	65.53
202- Washing @ 0%	55	NO	-	Low	-	-	7.23	25.34	909.8	4.20	-17.137	246.64	64.93
202- Washing @ 0%	56	NO	-	Low	-	-	7.36	25.57	914.1	3.59	-17.319	248.27	64.33
202- Washing @ 0%	57	NO	-	Low	-	-	7.49	25.79	918.3	3.05	-17.502	249.90	63.73
202- Washing @ 0%	58	NO	-	Low	-	-	7.62	26.02	922.5	2.56	-17.684	251.52	63.13
202- Washing @ 0%	59	NO	-	Low	-	-	7.75	26.24	926.5	2.14	-17.867	253.15	62.53
202- Washing @ 0%	60	NO	-	Low	-	-	7.88	26.47	930.5	1.78	-18.049	254.78	61.93
O- Washing @ 0%	25	-	-	High	High	NO	3.29	12.61	781.4	103.84	-7.809	200.23	84.47
O- Washing @ 0%	26	-	-	-	High	NO	3.42	12.92	790.7	97.66	-8.043	201.83	83.85
O- Washing @ 0%	27	-	-	-	High	NO	3.55	13.22	799.6	91.71	-8.277	203.42	83.23
O- Washing @ 0%	28	-	-	-	High	NO	3.68	13.52	808.1	85.98	-8.510	205.02	82.60
O- Washing @ 0%	29	-	-	-	High	NO	3.81	13.83	816.2	80.46	-8.744	206.61	81.98
O- Washing @ 0%	30	-	-	-	-	NO	3.94	14.13	824.0	75.17	-8.978	208.21	81.36
O- Washing @ 0%	31	-	-	-	-	NO	4.07	14.44	831.5	70.09	-9.212	209.80	80.74
O- Washing @ 0%	32	-	-	-	-	-	4.20	14.74	838.6	65.22	-9.446	211.40	80.12
O- Washing @ 0%	33	-	-	-	-	-	4.34	15.05	845.5	60.57	-9.680	212.99	79.50
O- Washing @ 0%	34	-	-	-	-	-	4.47	15.35	852.1	56.13	-9.913	214.59	78.88
O- Washing @ 0%	35	-	-	-	-	-	4.60	15.66	858.5	51.90	-10.147	216.18	78.26
O- Washing @ 0%	36	-	-	-	-	-	4.73	15.96	864.7	47.88	-10.381	217.78	77.64
O- Washing @ 0%	37	-	-	-	-	-	4.86	16.26	870.6	44.06	-10.615	219.37	77.01
O- Washing @ 0%	38	-	-	-	-	-	4.99	16.57	876.3	40.44	-10.849	220.97	76.39
O- Washing @ 0%	39	-	-	-	-	-	5.12	16.87	881.7	37.02	-11.082	222.56	75.77
O- Washing @ 0%	40	-	-	-	-	-	5.26	17.18	887.1	33.80	-11.316	224.16	75.15
O- Washing @ 0%	41	-	-	-	-	-	5.39	17.48	892.2	30.77	-11.550	225.75	74.53

		MAR Assessment					Property Values						
Frit/Washing	**% WL**	**Durability**	**T_L**	**Visc**	**Frit**	**Homog**	**Al_2O_3**	**alkali**	**T_L**	**Visc**	**ΔGp**	**Homog**	**Frit**
O- Washing @ 0%	42	-	-	-	-	-	5.52	17.79	897.2	27.92	-11.784	227.35	73.91
O- Washing @ 0%	43	-	-	-	-	-	5.65	18.09	902.0	25.26	-12.018	228.94	73.29
O- Washing @ 0%	44	-	-	Low	-	-	5.78	18.40	906.6	22.77	-12.251	230.54	72.67
O- Washing @ 0%	45	NO	-	Low	-	-	5.91	18.70	911.1	20.45	-12.485	232.13	72.04
O- Washing @ 0%	46	NO	-	Low	-	-	6.04	19.00	915.4	18.30	-12.719	233.73	71.42
O- Washing @ 0%	47	NO	-	Low	-	-	6.18	19.31	919.7	16.32	-12.953	235.32	70.80
O- Washing @ 0%	48	NO	-	Low	-	-	6.31	19.61	923.8	14.49	-13.186	236.92	70.18
O- Washing @ 0%	49	NO	-	Low	-	-	6.44	19.92	927.8	12.80	-13.420	238.52	69.56
O- Washing @ 0%	50	NO	-	Low	-	-	6.57	20.22	931.6	11.26	-13.654	240.11	68.94
O- Washing @ 0%	51	NO	-	Low	-	-	6.70	20.53	935.4	9.86	-13.888	241.71	68.32
O- Washing @ 0%	52	NO	-	Low	-	-	6.83	20.83	939.0	8.59	-14.122	243.30	67.70
O- Washing @ 0%	53	NO	-	Low	-	-	6.96	21.14	942.6	7.44	-14.356	244.89	67.07
O- Washing @ 0%	54	NO	-	Low	-	-	7.10	21.44	946.0	6.41	-14.589	246.49	66.45
O- Washing @ 0%	55	NO	-	Low	-	-	7.23	21.74	949.4	5.48	-14.823	248.09	65.83
O- Washing @ 0%	56	NO	-	Low	-	-	7.36	22.05	952.6	4.66	-15.057	249.68	65.21
O- Washing @ 0%	57	NO	-	Low	-	-	7.49	22.35	955.8	3.94	-15.291	251.28	64.59
O- Washing @ 0%	58	NO	-	Low	-	-	7.62	22.66	958.9	3.30	-15.525	252.87	63.97
O- Washing @ 0%	59	NO	-	Low	-	-	7.75	22.96	961.9	2.74	-15.758	254.47	63.35
O- Washing @ 0%	60	NO	-	Low	-	-	7.88	23.27	964.8	2.26	-15.992	256.06	62.72
P- Washing @ 0%	25	-	-	High	High	NO	3.29	12.61	775.1	150.10	-6.995	200.23	84.47
P- Washing @ 0%	26	-	-	High	High	NO	3.42	12.92	784.6	141.69	-7.239	201.83	83.85
P- Washing @ 0%	27	-	-	High	High	NO	3.55	13.22	793.5	133.54	-7.484	203.42	83.23
P- Washing @ 0%	28	-	-	High	High	NO	3.68	13.52	802.2	125.67	-7.728	205.01	82.60
P- Washing @ 0%	29	-	-	High	High	NO	3.81	13.83	810.4	118.06	-7.973	206.61	81.98
P- Washing @ 0%	30	-	-	High	-	NO	3.94	14.13	818.3	110.73	-8.218	208.21	81.36
P- Washing @ 0%	31	-	-	High	-	NO	4.07	14.44	826.0	103.67	-8.463	209.80	80.74
P- Washing @ 0%	32	-	-	-	-	-	4.20	14.74	833.2	96.87	-8.707	211.40	80.12
P- Washing @ 0%	33	-	-	-	-	-	4.34	15.05	840.3	90.35	-8.952	212.99	79.50
P- Washing @ 0%	34	-	-	-	-	-	4.47	15.35	847.0	84.10	-9.196	214.59	78.88
P- Washing @ 0%	35	-	-	-	-	-	4.60	15.66	853.5	78.12	-9.441	216.18	78.26
P- Washing @ 0%	36	-	-	-	-	-	4.73	15.96	859.8	72.40	-9.686	217.78	77.64
P- Washing @ 0%	37	-	-	-	-	-	4.86	16.26	865.8	66.95	-9.931	219.37	77.01
P- Washing @ 0%	38	-	-	-	-	-	4.99	16.57	871.6	61.75	-10.175	220.97	76.39
P- Washing @ 0%	39	-	-	-	-	-	5.12	16.87	877.2	56.82	-10.420	222.56	75.77
P- Washing @ 0%	40	-	-	-	-	-	5.26	17.18	882.7	52.15	-10.664	224.16	75.15
P- Washing @ 0%	41	-	-	-	-	-	5.39	17.48	887.9	47.72	-10.909	225.75	74.53
P- Washing @ 0%	42	-	-	-	-	-	5.52	17.79	893.0	43.55	-11.154	227.35	73.91
P- Washing @ 0%	43	-	-	-	-	-	5.65	18.09	897.9	39.62	-11.398	228.94	73.29
P- Washing @ 0%	44	-	-	-	-	-	5.78	18.40	902.6	35.93	-11.643	230.54	72.66
P- Washing @ 0%	45	-	-	-	-	-	5.91	18.70	907.3	32.47	-11.888	232.13	72.04
P- Washing @ 0%	46	-	-	-	-	-	6.04	19.00	911.7	29.24	-12.133	233.73	71.42
P- Washing @ 0%	47	NO	-	-	-	-	6.18	19.31	916.0	26.24	-12.377	235.32	70.80
P- Washing @ 0%	48	NO	-	Low	-	-	6.31	19.61	920.3	23.45	-12.622	236.92	70.18
P- Washing @ 0%	49	NO	-	Low	-	-	6.44	19.92	924.3	20.87	-12.866	238.52	69.56
P- Washing @ 0%	50	NO	-	Low	-	-	6.57	20.22	928.3	18.50	-13.111	240.11	68.94
P- Washing @ 0%	51	NO	-	Low	-	-	6.70	20.53	932.1	16.31	-13.356	241.71	68.32
P- Washing @ 0%	52	NO	-	Low	-	-	6.83	20.83	935.9	14.32	-13.600	243.30	67.70
P- Washing @ 0%	53	NO	-	Low	-	-	6.96	21.14	939.5	12.50	-13.845	244.89	67.07
P- Washing @ 0%	54	NO	-	Low	-	-	7.10	21.44	943.0	10.86	-14.090	246.49	66.45
P- Washing @ 0%	55	NO	-	Low	-	-	7.23	21.74	946.5	9.37	-14.335	248.09	65.83
P- Washing @ 0%	56	NO	-	Low	-	-	7.36	22.05	949.8	8.04	-14.579	249.68	65.21
P- Washing @ 0%	57	NO	-	Low	-	-	7.49	22.35	953.1	6.85	-14.824	251.28	64.59
P- Washing @ 0%	58	NO	-	Low	-	-	7.62	22.66	956.3	5.80	-15.068	252.87	63.97
P- Washing @ 0%	59	NO	-	Low	-	-	7.75	22.96	959.3	4.87	-15.313	254.47	63.35

		MAR Assessment					Property Values						
Frit/Washing	**% WL**	**Durability**	**T_L**	**Visc**	**Frit**	**Homog**	**Al_2O_3**	**alkali**	**T_L**	**Visc**	**ΔGp**	**Homog**	**Frit**
P- Washing @ 0%	60	NO	-	Low	-	-	7.88	23.27	962.4	4.06	-15.558	256.06	62.72
202-Washing @ 25%	25	-	-	-	High	NO	3.53	17.42	761.3	83.86	-10.556	200.76	81.83
202-Washing @ 25%	26	-	-	-	-	NO	3.67	17.60	772.0	79.59	-10.694	202.51	81.18
202-Washing @ 25%	27	-	-	-	-	NO	3.81	17.78	782.4	75.43	-10.832	204.25	80.53
202-Washing @ 25%	28	-	-	-	-	NO	3.95	17.96	792.5	71.39	-10.970	205.99	79.89
202-Washing @ 25%	29	-	-	-	-	NO	4.09	18.13	802.2	67.47	-11.108	207.74	79.24
202-Washing @ 25%	30	-	-	-	-	NO	4.23	18.31	811.7	63.66	-11.246	209.48	78.59
202-Washing @ 25%	31	-	-	-	-	-	4.37	18.49	820.9	59.97	-11.384	211.23	77.95
202-Washing @ 25%	32	-	-	-	-	-	4.52	18.66	829.9	56.40	-11.522	212.97	77.30
202-Washing @ 25%	33	-	-	-	-	-	4.66	18.84	838.6	52.96	-11.660	214.72	76.65
202-Washing @ 25%	34	-	-	-	-	-	4.80	19.02	847.0	49.63	-11.798	216.46	76.00
202-Washing @ 25%	35	-	-	-	-	-	4.94	19.19	855.3	46.42	-11.936	218.21	75.36
202-Washing @ 25%	36	-	-	-	-	-	5.08	19.37	863.2	43.34	-12.074	219.95	74.71
202-Washing @ 25%	37	-	-	-	-	-	5.22	19.55	871.0	40.37	-12.212	221.70	74.06
202-Washing @ 25%	38	-	-	-	-	-	5.36	19.73	878.7	37.53	-12.350	223.44	73.42
202-Washing @ 25%	39	NO	-	-	-	-	5.50	19.90	886.1	34.81	-12.488	225.19	72.77
202-Washing @ 25%	40	NO	-	-	-	-	5.64	20.08	893.2	32.21	-12.626	226.93	72.12
202-Washing @ 25%	41	NO	-	-	-	-	5.79	20.26	900.3	29.73	-12.764	228.68	71.48
202-Washing @ 25%	42	NO	-	-	-	-	5.93	20.43	907.1	27.37	-12.902	230.42	70.83
202-Washing @ 25%	43	NO	-	-	-	-	6.07	20.61	913.8	25.13	-13.040	232.17	70.18
202-Washing @ 25%	44	NO	-	Low	-	-	6.21	20.79	920.3	23.00	-13.178	233.91	69.54
202-Washing @ 25%	45	NO	-	Low	-	-	6.35	20.96	926.7	21.00	-13.316	235.66	68.89
202-Washing @ 25%	46	NO	-	Low	-	-	6.49	21.14	932.9	19.10	-13.454	237.40	68.24
202-Washing @ 25%	47	NO	-	Low	-	-	6.63	21.32	939.0	17.32	-13.592	239.14	67.59
202-Washing @ 25%	48	NO	-	Low	-	-	6.77	21.50	944.9	15.65	-13.730	240.89	66.95
202-Washing @ 25%	49	NO	-	Low	-	-	6.91	21.67	950.8	14.09	-13.868	242.63	66.30
202-Washing @ 25%	50	NO	-	Low	-	-	7.06	21.85	956.4	12.63	-14.006	244.38	65.65
202-Washing @ 25%	51	NO	-	Low	-	-	7.20	22.03	962.0	11.28	-14.144	246.12	65.01
202-Washing @ 25%	52	NO	-	Low	-	-	7.34	22.20	967.4	10.03	-14.282	247.87	64.36
202-Washing @ 25%	53	NO	-	Low	-	-	7.48	22.38	972.7	8.88	-14.420	249.61	63.71
202-Washing @ 25%	54	NO	-	Low	-	-	7.62	22.56	977.9	7.82	-14.558	251.36	63.07
202-Washing @ 25%	55	NO	-	Low	-	-	7.76	22.73	983.0	6.85	-14.696	253.10	62.42
202-Washing @ 25%	56	NO	-	Low	-	-	7.90	22.91	988.0	5.96	-14.834	254.85	61.77
202-Washing @ 25%	57	NO	-	Low	-	-	8.04	23.09	992.9	5.16	-14.972	256.59	61.13
202-Washing @ 25%	58	NO	-	Low	-	-	8.18	23.26	997.7	4.44	-15.110	258.34	60.48
202-Washing @ 25%	59	NO	-	Low	-	-	8.32	23.44	1002.3	3.80	-15.248	260.08	59.83
202-Washing @ 25%	60	NO	-	Low	-	-	8.47	23.62	1006.9	3.22	-15.386	261.83	59.18
O-Washing @ 25%	25	-	-	High	High	NO	3.53	11.42	837.3	119.20	-6.700	203.17	83.33
O-Washing @ 25%	26	-	-	High	High	NO	3.67	11.68	847.8	112.95	-6.889	204.88	82.66
O-Washing @ 25%	27	-	-	High	High	NO	3.81	11.94	857.8	106.88	-7.078	206.59	81.99
O-Washing @ 25%	28	-	-	High	-	NO	3.95	12.20	867.4	100.99	-7.268	208.30	81.33
O-Washing @ 25%	29	-	-	-	-	NO	4.09	12.45	876.6	95.27	-7.457	210.02	80.66
O-Washing @ 25%	30	-	-	-	-	-	4.23	12.71	885.4	89.74	-7.647	211.73	79.99
O-Washing @ 25%	31	-	-	-	-	-	4.37	12.97	893.9	84.39	-7.836	213.44	79.33
O-Washing @ 25%	32	-	-	-	-	-	4.52	13.22	902.0	79.22	-8.026	215.15	78.66
O-Washing @ 25%	33	-	-	-	-	-	4.66	13.48	909.9	74.23	-8.215	216.87	77.99
O-Washing @ 25%	34	-	-	-	-	-	4.80	13.74	917.4	69.43	-8.404	218.58	77.32
O-Washing @ 25%	35	-	-	-	-	-	4.94	13.99	924.7	64.82	-8.594	220.29	76.66
O-Washing @ 25%	36	-	-	-	-	-	5.08	14.25	931.6	60.39	-8.783	222.00	75.99
O-Washing @ 25%	37	-	-	-	-	-	5.22	14.51	938.4	56.14	-8.973	223.72	75.32
O-Washing @ 25%	38	-	-	-	-	-	5.36	14.77	944.9	52.07	-9.162	225.43	74.66
O-Washing @ 25%	39	-	-	-	-	-	5.50	15.02	951.2	48.19	-9.351	227.14	73.99
O-Washing @ 25%	40	-	-	-	-	-	5.64	15.28	957.3	44.48	-9.541	228.85	73.32
O-Washing @ 25%	41	-	-	-	-	-	5.79	15.54	963.1	40.96	-9.730	230.57	72.66

		MAR Assessment					Property Values						
Frit/Washing	**% WL**	**Durability**	**T_L**	**Visc**	**Frit**	**Homog**	**Al_2O_3**	**alkali**	**T_L**	**Visc**	**ΔGp**	**Homog**	**Frit**
O-Washing @ 25%	42	-	-	-	-	-	5.93	15.79	968.8	37.61	-9.920	232.28	71.99
O-Washing @ 25%	43	-	-	-	-	-	6.07	16.05	974.3	34.45	-10.109	233.99	71.32
O-Washing @ 25%	44	-	-	-	-	-	6.21	16.31	979.7	31.45	-10.299	235.70	70.66
O-Washing @ 25%	45	-	-	-	-	-	6.35	16.56	984.9	28.63	-10.488	237.42	69.99
O-Washing @ 25%	46	-	-	-	-	-	6.49	16.82	989.9	25.97	-10.677	239.13	69.32
O-Washing @ 25%	47	-	-	Low	-	-	6.63	17.08	994.7	23.48	-10.867	240.84	68.65
O-Washing @ 25%	48	-	-	Low	-	-	6.77	17.34	999.5	21.16	-11.056	242.56	67.99
O-Washing @ 25%	49	-	-	Low	-	-	6.91	17.59	1004.0	18.99	-11.246	244.27	67.32
O-Washing @ 25%	50	-	-	Low	-	-	7.06	17.85	1008.5	16.97	-11.435	245.98	66.65
O-Washing @ 25%	51	-	-	Low	-	-	7.20	18.11	1012.8	15.10	-11.625	247.69	65.99
O-Washing @ 25%	52	-	NO	Low	-	-	7.34	18.36	1017.0	13.38	-11.814	249.41	65.32
O-Washing @ 25%	53	-	NO	Low	-	-	7.48	18.62	1021.1	11.80	-12.003	251.12	64.65
O-Washing @ 25%	54	-	NO	Low	-	-	7.62	18.88	1025.1	10.35	-12.193	252.83	63.99
O-Washing @ 25%	55	NO	NO	Low	-	-	7.76	19.13	1029.0	9.03	-12.382	254.55	63.32
O-Washing @ 25%	56	NO	NO	Low	-	-	7.90	19.39	1032.8	7.84	-12.572	256.26	62.65
O-Washing @ 25%	57	NO	NO	Low	-	-	8.04	19.65	1036.4	6.76	-12.761	257.97	61.99
O-Washing @ 25%	58	NO	NO	Low	-	-	8.18	19.90	1040.0	5.79	-12.950	259.68	61.32
O-Washing @ 25%	59	NO	NO	Low	-	-	8.32	20.16	1043.5	4.93	-13.140	261.40	60.65
O-Washing @ 25%	60	NO	NO	Low	-	-	8.47	20.42	1046.9	4.16	-13.329	263.11	59.98
P-Washing @ 25%	25	-	-	High	High	NO	3.53	11.42	830.0	170.80	-5.885	203.17	83.33
P-Washing @ 25%	26	-	-	High	High	NO	3.67	11.68	840.6	162.35	-6.085	204.88	82.66
P-Washing @ 25%	27	-	-	High	High	NO	3.81	11.94	850.8	154.12	-6.286	206.59	81.99
P-Washing @ 25%	28	-	-	High	-	NO	3.95	12.20	860.5	146.10	-6.486	208.30	81.33
P-Washing @ 25%	29	-	-	High	-	NO	4.09	12.45	869.9	138.29	-6.686	210.02	80.66
P-Washing @ 25%	30	-	-	High	-	-	4.23	12.71	878.8	130.71	-6.886	211.73	79.99
P-Washing @ 25%	31	-	-	High	-	-	4.37	12.97	887.4	123.35	-7.087	213.44	79.33
P-Washing @ 25%	32	-	-	High	-	-	4.52	13.22	895.7	116.22	-7.287	215.15	78.66
P-Washing @ 25%	33	-	-	High	-	-	4.66	13.48	903.7	109.31	-7.487	216.87	77.99
P-Washing @ 25%	34	-	-	High	-	-	4.80	13.74	911.4	102.64	-7.688	218.58	77.32
P-Washing @ 25%	35	-	-	-	-	-	4.94	13.99	918.8	96.19	-7.888	220.29	76.66
P-Washing @ 25%	36	-	-	-	-	-	5.08	14.25	925.8	89.98	-8.088	222.00	75.99
P-Washing @ 25%	37	-	-	-	-	-	5.22	14.51	932.7	83.99	-8.288	223.72	75.32
P-Washing @ 25%	38	-	-	-	-	-	5.36	14.77	939.4	78.24	-8.489	225.43	74.66
P-Washing @ 25%	39	-	-	-	-	-	5.50	15.02	945.8	72.72	-8.689	227.14	73.99
P-Washing @ 25%	40	-	-	-	-	-	5.64	15.28	952.0	67.44	-8.889	228.86	73.32
P-Washing @ 25%	41	-	-	-	-	-	5.79	15.54	958.0	62.39	-9.090	230.57	72.66
P-Washing @ 25%	42	-	-	-	-	-	5.93	15.79	963.8	57.57	-9.290	232.28	71.99
P-Washing @ 25%	43	-	-	-	-	-	6.07	16.05	969.5	52.98	-9.490	233.99	71.32
P-Washing @ 25%	44	-	-	-	-	-	6.21	16.31	974.9	48.63	-9.690	235.70	70.66
P-Washing @ 25%	45	-	-	-	-	-	6.35	16.56	980.2	44.50	-9.891	237.42	69.99
P-Washing @ 25%	46	-	-	-	-	-	6.49	16.82	985.4	40.59	-10.091	239.13	69.32
P-Washing @ 25%	47	-	-	-	-	-	6.63	17.08	990.4	36.91	-10.291	240.84	68.65
P-Washing @ 25%	48	-	-	-	-	-	6.77	17.34	995.2	33.44	-10.492	242.56	67.99
P-Washing @ 25%	49	-	-	-	-	-	6.91	17.59	999.9	30.19	-10.692	244.27	67.32
P-Washing @ 25%	50	-	-	-	-	-	7.06	17.85	1004.5	27.16	-10.892	245.98	66.65
P-Washing @ 25%	51	-	-	Low	-	-	7.20	18.11	1008.9	24.32	-11.092	247.70	65.99
P-Washing @ 25%	52	-	-	Low	-	-	7.34	18.36	1013.2	21.70	-11.293	249.41	65.32
P-Washing @ 25%	53	-	NO	Low	-	-	7.48	18.62	1017.4	19.26	-11.493	251.12	64.65
P-Washing @ 25%	54	-	NO	Low	-	-	7.62	18.88	1021.5	17.02	-11.693	252.83	63.99
P-Washing @ 25%	55	-	NO	Low	-	-	7.76	19.13	1025.5	14.96	-11.893	254.55	63.32
P-Washing @ 25%	56	-	NO	Low	-	-	7.90	19.39	1029.4	13.08	-12.094	256.26	62.65
P-Washing @ 25%	57	-	NO	Low	-	-	8.04	19.65	1033.2	11.37	-12.294	257.97	61.99
P-Washing @ 25%	58	NO	NO	Low	-	-	8.18	19.90	1036.9	9.83	-12.494	259.68	61.32
P-Washing @ 25%	59	NO	NO	Low	-	-	8.32	20.16	1040.4	8.43	-12.695	261.40	60.65

		MAR Assessment					Property Values						
Frit/Washing	**% WL**	**Durability**	**T_L**	**Visc**	**Frit**	**Homog**	**Al_2O_3**	**alkali**	**T_L**	**Visc**	**DGp**	**Homog**	**Frit**
P-Washing @ 25%	60	NO	NO	Low	-	-	8.47	20.42	1043.9	7.19	-12.895	263.11	59.98
202-Washing @ 50%	25	-	-	-	-	NO	3.81	16.05	815.4	98.00	-9.272	204.16	80.50
202-Washing @ 50%	26	-	-	-	-	NO	3.96	16.17	827.7	93.78	-9.358	206.04	79.80
202-Washing @ 50%	27	-	-	-	-	NO	4.11	16.29	839.6	89.65	-9.445	207.92	79.10
202-Washing @ 50%	28	-	-	-	-	NO	4.26	16.41	851.1	85.60	-9.532	209.81	78.40
202-Washing @ 50%	29	-	-	-	-	-	4.42	16.54	862.3	81.63	-9.618	211.69	77.70
202-Washing @ 50%	30	-	-	-	-	-	4.57	16.66	873.2	77.75	-9.705	213.57	77.00
202-Washing @ 50%	31	-	-	-	-	-	4.72	16.78	883.8	73.95	-9.792	215.45	76.30
202-Washing @ 50%	32	-	-	-	-	-	4.87	16.90	894.1	70.24	-9.878	217.33	75.60
202-Washing @ 50%	33	-	-	-	-	-	5.03	17.02	904.1	66.61	-9.965	219.21	74.90
202-Washing @ 50%	34	-	-	-	-	-	5.18	17.15	913.9	63.08	-10.051	221.09	74.20
202-Washing @ 50%	35	-	-	-	-	-	5.33	17.27	923.4	59.64	-10.138	222.97	73.50
202-Washing @ 50%	36	-	-	-	-	-	5.48	17.39	932.6	56.30	-10.225	224.85	72.80
202-Washing @ 50%	37	-	-	-	-	-	5.64	17.51	941.7	53.05	-10.311	226.73	72.10
202-Washing @ 50%	38	-	-	-	-	-	5.79	17.63	950.5	49.90	-10.398	228.61	71.40
202-Washing @ 50%	39	-	-	-	-	-	5.94	17.76	959.1	46.85	-10.485	230.50	70.70
202-Washing @ 50%	40	-	-	-	-	-	6.09	17.88	967.5	43.89	-10.571	232.37	70.00
202-Washing @ 50%	41	-	-	-	-	-	6.24	18.00	975.6	41.04	-10.658	234.26	69.30
202-Washing @ 50%	42	-	-	-	-	-	6.40	18.12	983.6	38.29	-10.745	236.14	68.60
202-Washing @ 50%	43	-	-	-	-	-	6.55	18.24	991.4	35.64	-10.831	238.02	67.90
202-Washing @ 50%	44	-	-	-	-	-	6.70	18.37	999.0	33.10	-10.918	239.90	67.20
202-Washing @ 50%	45	-	-	-	-	-	6.85	18.49	1006.4	30.66	-11.004	241.78	66.50
202-Washing @ 50%	46	-	-	-	-	-	7.01	18.61	1013.7	28.33	-11.091	243.66	65.80
202-Washing @ 50%	47	-	NO	-	-	-	7.16	18.73	1020.8	26.10	-11.178	245.54	65.10
202-Washing @ 50%	48	-	NO	Low	-	-	7.31	18.85	1027.7	23.97	-11.264	247.42	64.40
202-Washing @ 50%	49	-	NO	Low	-	-	7.46	18.98	1034.5	21.95	-11.351	249.30	63.70
202-Washing @ 50%	50	-	NO	Low	-	-	7.62	19.10	1041.1	20.04	-11.438	251.18	63.00
202-Washing @ 50%	51	-	NO	Low	-	-	7.77	19.22	1047.6	18.22	-11.524	253.06	62.30
202-Washing @ 50%	52	-	NO	Low	-	-	7.92	19.34	1054.0	16.52	-11.611	254.95	61.60
202-Washing @ 50%	53	-	NO	Low	-	-	8.07	19.46	1060.3	14.91	-11.697	256.83	60.90
202-Washing @ 50%	54	-	NO	Low	-	-	8.22	19.58	1066.3	13.40	-11.784	258.71	60.20
202-Washing @ 50%	55	-	NO	Low	-	-	8.38	19.71	1072.3	12.00	-11.871	260.59	59.50
202-Washing @ 50%	56	-	NO	Low	-	-	8.53	19.83	1078.2	10.69	-11.957	262.47	58.80
202-Washing @ 50%	57	-	NO	Low	-	-	8.68	19.95	1083.9	9.48	-12.044	264.35	58.10
202-Washing @ 50%	58	-	NO	Low	-	-	8.83	20.07	1089.5	8.36	-12.131	266.23	57.40
202-Washing @ 50%	59	-	NO	Low	-	-	8.99	20.19	1095.0	7.33	-12.217	268.11	56.70
202-Washing @ 50%	60	-	NO	Low	-	-	9.14	20.32	1100.4	6.39	-12.304	269.99	56.00
G-Washing @ 50%	25	-	-	-	-	NO	4.56	19.05	733.5	77.68	-11.549	209.60	81.25
G-Washing @ 50%	26	-	-	-	-	-	4.70	19.13	746.6	74.22	-11.606	211.41	80.54
G-Washing @ 50%	27	-	-	-	-	-	4.84	19.21	759.3	70.83	-11.662	213.22	79.83
G-Washing @ 50%	28	-	-	-	-	-	4.98	19.29	771.8	67.52	-11.718	215.03	79.12
G-Washing @ 50%	29	-	-	-	-	-	5.13	19.38	783.9	64.28	-11.774	216.84	78.41
G-Washing @ 50%	30	-	-	-	-	-	5.27	19.46	795.7	61.12	-11.831	218.64	77.70
G-Washing @ 50%	31	-	-	-	-	-	5.41	19.54	807.2	58.02	-11.887	220.45	76.99
G-Washing @ 50%	32	-	-	-	-	-	5.55	19.62	818.6	55.01	-11.943	222.26	76.28
G-Washing @ 50%	33	-	-	-	-	-	5.70	19.70	829.6	52.07	-12.000	224.07	75.57
G-Washing @ 50%	34	-	-	-	-	-	5.84	19.79	840.4	49.21	-12.056	225.88	74.86
G-Washing @ 50%	35	-	-	-	-	-	5.98	19.87	850.9	46.44	-12.112	227.68	74.15
G-Washing @ 50%	36	-	-	-	-	-	6.12	19.95	861.2	43.74	-12.168	229.49	73.44
G-Washing @ 50%	37	-	-	-	-	-	6.27	20.03	871.3	41.13	-12.225	231.30	72.73
G-Washing @ 50%	38	-	-	-	-	-	6.41	20.11	881.3	38.61	-12.281	233.11	72.02
G-Washing @ 50%	39	-	-	-	-	-	6.55	20.20	890.9	36.16	-12.337	234.92	71.31
G-Washing @ 50%	40	NO	-	-	-	-	6.69	20.28	900.5	33.80	-12.393	236.73	70.60
G-Washing @ 50%	41	NO	-	-	-	-	6.83	20.36	909.8	31.53	-12.450	238.54	69.89

		MAR Assessment					Property Values						
Frit/Washing	**% WL**	**Durability**	**T_L**	**Visc**	**Frit**	**Homog**	**Al_2O_3**	**alkali**	**T_L**	**Visc**	**ΔGp**	**Homog**	**Frit**
G-Washing @ 50%	42	NO	-	-	-	-	6.98	20.44	918.9	29.35	-12.506	240.34	69.18
G-Washing @ 50%	43	NO	-	-	-	-	7.12	20.52	927.8	27.25	-12.562	242.15	68.47
G-Washing @ 50%	44	NO	-	-	-	-	7.26	20.61	936.6	25.24	-12.618	243.96	67.76
G-Washing @ 50%	45	NO	-	Low	-	-	7.40	20.69	945.2	23.31	-12.675	245.77	67.05
G-Washing @ 50%	46	NO	-	Low	-	-	7.55	20.77	953.6	21.48	-12.731	247.58	66.34
G-Washing @ 50%	47	NO	-	Low	-	-	7.69	20.85	961.9	19.73	-12.787	249.39	65.63
G-Washing @ 50%	48	NO	-	Low	-	-	7.83	20.93	970.0	18.07	-12.843	251.19	64.92
G-Washing @ 50%	49	NO	-	Low	-	-	7.97	21.02	978.0	16.50	-12.900	253.00	64.21
G-Washing @ 50%	50	NO	-	Low	-	-	8.12	21.10	985.8	15.01	-12.956	254.81	63.50
G-Washing @ 50%	51	NO	-	Low	-	-	8.26	21.18	993.5	13.61	-13.012	256.62	62.79
G-Washing @ 50%	52	NO	-	Low	-	-	8.40	21.26	1001.1	12.29	-13.068	258.43	62.08
G-Washing @ 50%	53	NO	-	Low	-	-	8.54	21.34	1008.5	11.06	-13.125	260.24	61.37
G-Washing @ 50%	54	NO	-	Low	-	-	8.68	21.42	1015.8	9.91	-13.181	262.04	60.66
G-Washing @ 50%	55	NO	NO	Low	-	-	8.83	21.51	1023.0	8.83	-13.237	263.85	59.95
G-Washing @ 50%	56	NO	NO	Low	-	-	8.97	21.59	1030.0	7.84	-13.293	265.66	59.24
G-Washing @ 50%	57	NO	NO	Low	-	-	9.11	21.67	1036.9	6.92	-13.350	267.47	58.53
G-Washing @ 50%	58	NO	NO	Low	-	-	9.25	21.75	1043.7	6.08	-13.406	269.28	57.82
G-Washing @ 50%	59	NO	NO	Low	-	-	9.40	21.83	1050.5	5.31	-13.462	271.09	57.11
G-Washing @ 50%	60	NO	NO	Low	-	-	9.54	21.92	1057.0	4.61	-13.519	272.89	56.40
320-75% Washed	25	-	-	-	-	NO	4.13	19.68	735.9	45.57	-12.230	210.56	80.45
320-75% Washed	26	-	-	-	-	-	4.30	19.67	751.7	43.97	-12.197	212.56	79.66
320-75% Washed	27	-	-	-	-	-	4.47	19.66	767.0	42.39	-12.163	214.57	78.88
320-75% Washed	28	-	-	-	-	-	4.63	19.65	782.2	40.82	-12.130	216.58	78.10
320-75% Washed	29	-	-	-	-	-	4.80	19.63	796.9	39.27	-12.097	218.59	77.32
320-75% Washed	30	-	-	-	-	-	4.96	19.62	811.3	37.75	-12.064	220.60	76.54
320-75% Washed	31	-	-	-	-	-	5.13	19.61	825.5	36.24	-12.030	222.61	75.75
320-75% Washed	32	-	-	-	-	-	5.29	19.60	839.4	34.75	-11.997	224.62	74.97
320-75% Washed	33	-	-	-	-	-	5.46	19.58	853.0	33.29	-11.964	226.62	74.19
320-75% Washed	34	-	-	-	-	-	5.62	19.57	866.3	31.85	-11.931	228.63	73.41
320-75% Washed	35	-	-	-	-	-	5.79	19.56	879.4	30.43	-11.897	230.64	72.63
320-75% Washed	36	-	-	-	-	-	5.95	19.55	892.3	29.03	-11.864	232.65	71.84
320-75% Washed	37	-	-	-	-	-	6.12	19.53	904.8	27.67	-11.831	234.66	71.06
320-75% Washed	38	-	-	-	-	-	6.29	19.52	917.2	26.32	-11.797	236.67	70.28
320-75% Washed	39	-	-	-	-	-	6.45	19.51	929.4	25.01	-11.764	238.67	69.50
320-75% Washed	40	-	-	Low	-	-	6.62	19.49	941.3	23.72	-11.731	240.68	68.71
320-75% Washed	41	-	-	Low	-	-	6.78	19.48	953.0	22.46	-11.698	242.69	67.93
320-75% Washed	42	-	-	Low	-	-	6.95	19.47	964.5	21.24	-11.664	244.70	67.15
320-75% Washed	43	-	-	Low	-	-	7.11	19.46	975.9	20.04	-11.631	246.71	66.37
320-75% Washed	44	-	-	Low	-	-	7.28	19.44	987.0	18.87	-11.598	248.72	65.59
320-75% Washed	45	-	-	Low	-	-	7.44	19.43	997.9	17.73	-11.565	250.72	64.80
320-75% Washed	46	-	-	Low	-	-	7.61	19.42	1008.6	16.63	-11.532	252.73	64.02
320-75% Washed	47	-	NO	Low	-	-	7.77	19.41	1019.2	15.56	-11.498	254.74	63.24
320-75% Washed	48	-	NO	Low	-	-	7.94	19.39	1029.6	14.53	-11.465	256.75	62.46
320-75% Washed	49	-	NO	Low	-	-	8.10	19.38	1039.8	13.53	-11.432	258.76	61.68
320-75% Washed	50	-	NO	Low	-	-	8.27	19.37	1049.8	12.57	-11.398	260.77	60.89
320-75% Washed	51	-	NO	Low	-	-	8.44	19.36	1059.7	11.64	-11.365	262.77	60.11
320-75% Washed	52	-	NO	Low	-	-	8.60	19.34	1069.4	10.75	-11.332	264.78	59.33
320-75% Washed	53	-	NO	Low	-	-	8.77	19.33	1079.1	9.90	-11.299	266.79	58.55
320-75% Washed	54	-	NO	Low	-	-	8.93	19.32	1088.5	9.08	-11.265	268.80	57.76
320-75% Washed	55	-	NO	Low	-	-	9.10	19.30	1097.7	8.31	-11.232	270.81	56.98
320-75% Washed	56	-	NO	Low	-	-	9.26	19.29	1106.9	7.57	-11.199	272.82	56.20

		MAR Assessment					Property Values						
Frit/Washing	**% WL**	**Durability**	**T_L**	**Visc**	**Frit**	**Homog**	**Al_2O_3**	**alkali**	**T_L**	**Visc**	**ΔGp**	**Homog**	**Frit**
320-75% Washed	57	-	NO	Low	-	-	9.43	19.28	1115.9	6.87	-11.165	274.82	55.42
320-75% Washed	58	-	NO	Low	-	-	9.59	19.27	1124.7	6.21	-11.132	276.83	54.64
320-75% Washed	59	-	NO	Low	-	-	9.76	19.25	1133.4	5.59	-11.099	278.84	53.85
320-75% Washed	60	-	NO	Low	-	-	9.92	19.24	1142.0	5.00	-11.066	280.85	53.07

Appendix D

Chemical Composition Analytical Plan

SRT-SCS-2002-00060

September 16, 2002

To: C. C. Herman, 773-43A
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cc: D. R. Best, 786-1A (wo)
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R. J. Workman, 999-1W

From: T. B. Edwards, 773-42A (5-5148)
Statistical Consulting Section

wo – without glass identifiers
es – executive summary only

S. P. Harris, Technical Reviewer — 9/18/02 Date

R. C. Tuckfield, Manager
Statistical Consulting Section — 9/18/02 Date

AN ANALYTICAL PLAN FOR MEASURING THE CHEMICAL COMPOSITIONS OF PHASE 1 GLASSES FROM THE SB3 VARIABILITY STUDY (U)

1.0 EXECUTIVE SUMMARY

A study is being conducted by the Savannah River Technology Center (SRTC) for the Defense Waste Processing Facility (DWPF) that involves investigating the glass region anticipated for the processing of sludge batch 3 (SB3). Forty-two (42) glass compositions were selected for batching and testing to support the first phase of this effort.

The chemical compositions of the 42 glasses from Phase 1 of this study are to be determined by the Savannah River Technology Center – Mobile Laboratory (SRTC-ML). This memorandum provides an analytical plan to direct and support these measurements at the SRTC-ML.

2.0 INTRODUCTION

A glass variability study for Sludge Batch 3 (SB3) is being conducted for the Defense Waste Processing Facility (DWPF) by the Savannah River Technology Center (SRTC) [1]. Forty-two (42) glass compositions were selected for batching and testing to support Phase 1 of this effort.

The chemical compositions of the 42 glasses from this study are to be determined by the Savannah River Technology Center – Mobile Laboratory (SRTC-ML). This memorandum provides an analytical plan in support of [2] to direct and support these measurements at the SRTC-ML.

3.0 ANALYTICAL PLAN

The analytical procedures used by the SRTC-ML to determine cation concentrations for a glass sample include steps for sample preparation and for instrument calibration. Each glass is to be prepared in duplicate by each of two dissolution methods: lithium metaborate (LM) and sodium peroxide fusion (PF).

The primary measurements of interest are to be acquired as follows: the samples prepared by lithium metaborate (LM) are to be measured for barium (Ba), calcium (Ca), cerium (Ce), chromium (Cr), copper (Cu), iron (Fe), potassium (K), lanthanum (La), magnesium (Mg), manganese (Mn), sodium (Na), nickel (Ni), lead (Pb), silicon (Si), thorium (Th), titanium (Ti), uranium (U), zinc (Zn), and zirconium (Zr) concentrations. Samples prepared by sodium peroxide (PF) are to be measured for aluminum (Al), boron (B) and lithium (Li). Samples dissolved by either of these two preparation methods are to be measured using Inductively Coupled Plasma – Atomic Emission Spectrometry (ICP-AES). It should be noted that some of these elements are minor components and may be below detection limits for most, if not all, of the study glasses.

Randomizing the preparation steps and blocking and randomizing the measurements for the ICP-AES are of primary concern in the development of this analytical plan. The sources of uncertainty for the analytical procedure used by the SRTC-ML to determine the cation concentrations for the submitted glass samples primarily involve the dissolution step in the preparation of the sample and the calibrations of the ICP-AES.

Samples of two standard glasses will be included in the analytical plan to provide an opportunity for checking the performance of the instrumentation over the course of the analyses and for potential bias correction. Specifically, several samples of Waste Compliance Plan (WCP) Batch 1 (BCH) [3] and a glass containing uranium (UST) are included in this analytical plan. The reference compositions of these glasses are provided in Table 1. These standards will be referred to using the short identifier provided in Table 1 in the remainder of this memo.

Table 1: Oxide Compositions of WCP Batch 1 (BCH) and Uranium Standard (UST) Glasses (wt%).

Oxide/ Anion	BCH (wt%)	UST (wt%)
Al_2O_3	4.877	4.1
B_2O_3	7.777	9.209
BaO	0.151	0.00
CaO	1.220	1.301
CdO	0.00	0.00
Cl	0.00	0.00
Cr_2O_3	0.107	0.00
Cs_2O	0.060	0.00
CuO	0.399	0.00
F	0.00	0.00
Fe_2O_3	12.839	13.196
K_2O	3.327	2.999
Li_2O	4.429	3.057
MgO	1.419	1.21
MnO	1.726	2.892
MoO_3	0.00	0.00
Na_2O	9.003	11.795
Nd_2O_3	0.147	0.00
NiO	0.751	1.12
P_2O_5	0.00	0.00
PbO	0.00	0.00
RuO_2	0.0214	0.00
SiO_2	50.22	45.353
SnO_2	0.00	0.00
SO_3	0.00	0.00
TiO_2	0.677	1.049
U_3O_8	0.00	2.406
ZrO_2	0.098	0.00

Each glass sample submitted to the SRTC-ML will be prepared in duplicate by the LM and PF dissolution methods. Each sample prepared using LM or PF will be read twice by ICP-AES, with the instrument being calibrated before each of these two sets of readings. This will lead to four measurements for each cation of interest for each submitted glass.

Table 2 presents identifying codes, k01 through k42, for the 42 glasses batched for Phase 1 of this variability study. The table provides a naming convention that is to be used in analyzing the glasses and reporting the measurements of their compositions.[23]

[23] Renaming these samples helps to ensure that they will be processed as blind samples within the SRTC-ML. Table 2 is not shown in its entirety in those copies going to the SRTC-ML.

Table 2: Identifiers to Establish Blind Samples for the SRTC-ML.

Glass ID	Sample ID	Glass ID	Sample ID	Glass ID	Sample ID
SB3-01	k41	SB3-15	k37	SB3-29	k11
SB3-02	k32	SB3-16	k27	SB3-30	k31
SB3-03	k13	SB3-17	k01	SB3-31	k08
SB3-04	k22	SB3-18	k04	SB3-32	k36
SB3-05	k35	SB3-19	k18	SB3-33	k16
SB3-06	k02	SB3-20	k42	SB3-34	k09
SB3-07	k38	SB3-21	k25	SB3-35	k07
SB3-08	k30	SB3-22	k12	SB3-36	k05
SB3-09	k24	SB3-23	k17	SB3-37	k10
SB3-10	k21	SB3-24	k23	SB3-38	k03
SB3-11	k28	SB3-25	k39	SB3-39	k26
SB3-12	k14	SB3-26	k40	SB3-40	k19
SB3-13	k33	SB3-27	k06	SB3-41	k15
SB3-14	k34	SB3-28	k29	SB3-42	k20

3.1 PREPARATION OF THE SAMPLES

Each of the 42 glasses included in this analytical plan is to be prepared in duplicate by the LM and PF dissolution method. Thus, the total number of prepared glass samples is determined by $42 \cdot 2 \cdot 2 = 168$, not including the samples of the BCH and UST glass standards that are to be prepared.

Tables 3a-3b provide blocking and (random) sequencing schema for conducting the preparation steps of the analytical procedures. Four blocks of preparation work are provided for each preparation method to facilitate the scheduling of activities by work shift. The identifier for each of the prepared samples indicates the sample identifier (ID), preparation method, and duplicate number.

Table 3a: LM (Lithium Metaborate) Preparation Blocks

1	2	3	4
k20LM1	k13LM1	k42LM1	k35LM1
k08LM1	k09LM1	k03LM1	k30LM1
k24LM1	k40LM1	k34LM1	k04LM1
k29LM1	k22LM1	k25LM1	k15LM1
k24LM2	k09LM2	k03LM2	k27LM1
k01LM1	k16LM1	k34LM2	k30LM2
k08LM2	k02LM1	k18LM1	k15LM2
k17LM1	k33LM1	k25LM2	k35LM2
k17LM2	k13LM2	k18LM2	k23LM1
k01LM2	k02LM2	k42LM2	k04LM2
k29LM2	k40LM2	k26LM1	k23LM2
k32LM1	k39LM1	k28LM1	k05LM1
k20LM2	k39LM2	k12LM1	k07LM1
k32LM2	k22LM2	k26LM2	k19LM1
k41LM1	k33LM2	k36LM1	k05LM2
k21LM1	k16LM2	k31LM1	k27LM2
k38LM1	k10LM1	k11LM1	k06LM1
k37LM1	k14LM1	k11LM2	k19LM2
k38LM2	k10LM2	k12LM2	k06LM2
k41LM2	k14LM2	k28LM2	k07LM2
k37LM2		k31LM2	
k21LM2		k36LM2	

Table 3b: PF (Peroxide Fusion)
Preparation Blocks

1	2	3	4
k35PF1	k27PF1	k12PF1	k07PF1
k28PF1	k04PF1	k23PF1	k15PF1
k21PF1	k14PF1	k29PF1	k05PF1
k41PF1	k27PF2	k29PF2	k26PF1
k41PF2	k14PF2	k11PF1	k09PF1
k13PF1	k18PF1	k12PF2	k19PF1
k28PF2	k04PF2	k08PF1	k03PF1
k13PF2	k34PF1	k39PF1	k10PF1
k22PF1	k37PF1	k11PF2	k16PF1
k35PF2	k01PF1	k23PF2	k07PF2
k22PF2	k33PF1	k36PF1	k16PF2
k38PF1	k37PF2	k06PF1	k19PF2
k02PF1	k01PF2	k40PF1	k09PF2
k21PF2	k42PF1	k39PF2	k05PF2
k24PF1	k42PF2	k08PF2	k26PF2
k32PF1	k25PF1	k31PF1	k15PF2
k02PF2	k34PF2	k17PF1	k20PF1
k24PF2	k18PF2	k36PF2	k03PF2
k38PF2	k33PF2	k31PF2	k10PF2
k30PF1	k25PF2	k06PF2	k20PF2
k32PF2		k40PF2	
k30PF2		k17PF2	

3.2 ICP-AES Calibration Blocks

The glass samples prepared by LM and PF dissolution methods are to be analyzed using ICP-AES instrumentation calibrated for the particular preparation method. After the initial set of cation concentration measurements, the ICP-AES instrumentation is to be recalibrated and a second set of concentration measurements for the cations determined.

Randomized plans for measuring cation concentrations in the LM-prepared and PF-prepared samples are provided in Tables 4 and 5, respectively. The cations to be measured are specified in the header of each of these tables. In these tables, the sample identifiers for the 42 study glasses have been modified by the addition of a suffix (a “1” or a “2”) to indicate whether the measurement was made during the first or second (respectively) ICP-AES calibration group. The identifiers for the BCH and UST samples have been modified to indicate that each of these prepared samples is to be read 3 times (mirrored in the corresponding suffix of 1, 2, or 3) per calibration block.

Table 4: ICP-AES Blocks and Calibration Groups for Samples Prepared Using LM (Used to Measure Elemental Ba, Ca, Ce, Cr, Cu, Fe, K, La, Mg, Mn, Na, Ni, Pb, Si, Th, Ti, U, Zn, and Zr)

ICP-AES Block 1		ICP-AES Block 2		ICP-AES Block 3		ICP-AES Block 4	
Calibration 1	**Calibration 2**	**Calibration 1**	**Calibration 2**	**Calibration 1**	**Calibration 2**	**Calibration 1**	**Calibration 2**
BCHLM111	BCHLM121	BCHLM211	BCHLM221	BCHLM311	BCHLM321	BCHLM411	BCHLM421
USTLM111	USTLM121	USTLM211	USTLM221	USTLM311	USTLM321	USTLM411	USTLM421
k09LM21	k25LM22	k33LM21	k37LM22	k29LM11	k04LM12	k10LM11	k34LM12
k16LM21	k09LM12	k42LM11	k22LM12	k29LM21	k36LM12	k12LM11	k24LM12
k14LM11	k16LM22	k40LM11	k07LM22	k11LM21	k36LM22	k32LM21	k06LM12
k35LM21	k18LM12	k02LM11	k22LM22	k36LM11	k04LM22	k31LM21	k31LM22
k35LM11	k17LM12	k02LM21	k02LM22	k30LM11	k41LM12	k23LM21	k13LM12
k18LM11	k38LM12	k22LM11	k27LM22	k30LM21	k11LM22	k34LM11	k12LM22
k18LM21	k38LM22	k15LM21	k27LM12	k41LM11	k29LM12	k31LM11	k10LM12
k28LM21	k09LM22	k37LM11	k33LM12	k01LM21	k41LM22	k34LM21	k10LM22
k08LM21	k25LM12	k05LM21	k42LM12	k41LM21	k03LM22	k32LM11	k24LM22
k08LM11	k35LM12	k07LM11	k42LM22	k01LM11	k20LM12	k10LM21	k21LM12
k14LM21	k18LM22	k19LM11	k15LM22	BCHLM312	BCHLM322	BCHLM412	BCHLM422
BCHLM112	BCHLM122	BCHLM212	BCHLM222	USTLM312	USTLM322	USTLM412	USTLM422
USTLM112	USTLM122	USTLM212	USTLM222	k39LM11	k39LM22	k24LM21	k13LM22
k16LM11	k26LM22	k15LM11	k05LM22	k39LM21	k20LM22	k24LM11	k34LM22
k25LM21	k14LM12	k22LM21	k33LM22	k03LM21	k03LM12	k21LM21	k32LM12
k25LM11	k28LM22	k27LM11	k02LM12	k11LM11	k11LM12	k12LM21	k06LM22
k09LM11	k14LM22	k37LM21	k19LM12	k03LM11	k01LM12	k23LM11	k32LM22
k38LM11	k08LM22	k42LM21	k40LM12	k20LM21	k30LM12	k13LM11	k23LM22
k28LM11	k35LM22	k27LM21	k40LM22	k04LM11	k01LM22	k06LM21	k12LM12
k38LM21	k08LM12	k19LM21	k07LM12	k20LM11	k39LM12	k06LM11	k23LM12
k17LM11	k16LM12	k40LM21	k37LM12	k36LM21	k30LM22	k21LM11	k21LM22
k26LM11	k28LM12	k05LM11	k05LM12	k04LM21	k29LM22	k13LM21	k31LM12
k17LM21	k26LM12	k07LM21	k15LM12	BCHLM313	BCHLM323	BCHLM413	BCHLM423
k26LM21	k17LM22	k33LM11	k19LM22	USTLM313	USTLM323	USTLM413	USTLM423
BCHLM113	BCHLM123	BCHLM213	BCHLM223				
USTLM113	USTLM123	USTLM213	USTLM223				

Table 5: ICP-AES Blocks and Calibration Groups for Samples Prepared Using PF (Used to Measure Elemental Al, B, and Li)

ICP-AES Block 1		ICP-AES Block 2		ICP-AES Block 3		ICP-AES Block 4	
Calibration 1	**Calibration 2**	**Calibration 1**	**Calibration 2**	**Calibration 1**	**Calibration 2**	**Calibration 1**	**Calibration 2**
BCHPF111	BCHPF121	BCHPF211	BCHPF221	BCHPF311	BCHPF321	BCHPF411	BCHPF421
USTPF111	USTPF121	USTPF211	USTPF221	USTPF311	USTPF321	USTPF411	USTPF421
k24PF21	k02PF12	k18PF21	k14PF22	k06PF11	k09PF22	k40PF11	k20PF22
k04PF21	k21PF22	k36PF21	k39PF22	k09PF21	k17PF22	k10PF21	k31PF12
k26PF21	k05PF22	k32PF21	k22PF22	k17PF21	k25PF22	k28PF11	k41PF22
k04PF11	k04PF22	k38PF11	k42PF12	k37PF11	k08PF22	k41PF11	k33PF22
k05PF11	k26PF22	k27PF11	k14PF12	k08PF11	k06PF22	k28PF21	k03PF22
k21PF11	k24PF22	k22PF11	k39PF12	k30PF21	k11PF12	k40PF21	k41PF12
k26PF11	k29PF22	k39PF21	k18PF22	k25PF21	k35PF22	k31PF11	k10PF22
k16PF21	k26PF12	k22PF21	k42PF22	k11PF11	k30PF12	k01PF11	k10PF12
k07PF11	k24PF12	k14PF11	k32PF12	k25PF11	k23PF12	k41PF21	k28PF22
k16PF11	k13PF12	k34PF11	k32PF22	k17PF11	k30PF22	k20PF21	k40PF12
k12PF11	k13PF22	k39PF11	k38PF12	BCHPF312	BCHPF322	BCHPF412	BCHPF422
BCHPF112	BCHPF122	BCHPF212	BCHPF222	USTPF312	USTPF322	USTPF412	USTPF422
USTPF112	USTPF122	USTPF212	USTPF222	k23PF21	k35PF12	k03PF21	k31PF22
k02PF11	k07PF22	k36PF11	k34PF22	k30PF11	k37PF12	k03PF11	k03PF12
k29PF11	k02PF22	k27PF21	k22PF12	k23PF11	k17PF12	k01PF21	k20PF12
k13PF21	k21PF12	k14PF21	k19PF22	k35PF11	k37PF22	k33PF21	k01PF12
k21PF21	k07PF12	k38PF21	k19PF12	k37PF21	k11PF22	k15PF11	k15PF22
k05PF21	k16PF12	k32PF11	k36PF12	k06PF21	k09PF12	k10PF11	k40PF22
k13PF11	k04PF12	k19PF11	k27PF12	k35PF21	k06PF12	k15PF21	k15PF12
k07PF21	k16PF22	k19PF21	k38PF22	k11PF21	k23PF22	k20PF11	k01PF22
k02PF21	k05PF12	k42PF11	k27PF22	k08PF21	k08PF12	k31PF21	k33PF12
k24PF11	k12PF12	k18PF11	k36PF22	k09PF11	k25PF12	k33PF11	k28PF12
k12PF21	k12PF22	k42PF21	k34PF12	BCHPF313	BCHPF323	BCHPF413	BCHPF423
k29PF21	k29PF12	k34PF21	k18PF12	USTPF313	USTPF323	USTPF413	USTPF423
BCHPF113	BCHPF123	BCHPF213	BCHPF223				
USTPF113	USTPF123	USTPF213	USTPF223				

4.0 CONCLUDING COMMENTS

In summary, this analytical plan identifies several ICP-AES calibration blocks in Tables 4 – 5 as well as eight preparation blocks in Tables 3a-3b for use by the SRTC-ML. The sequencing of the activities associated with each of the steps in the analytical procedures has been randomized. The size of each of the blocks was selected so that it could be completed in a single work shift.

If a problem is discovered while measuring samples in a calibration block, the instrument should be re-calibrated and the block of samples re-measured in its entirety. If for some reason the measurements are not conducted in the sequences presented in this report, a record should be made of the actual order used along with any explanative comments.

The analytical plan indicated in the preceding tables should be modified by the personnel of SRTC-ML to include any calibration check standards and/or other standards that are part of their routine operating procedures. It is also recommended that the solutions resulting from each of the prepared samples be archived for some period, considering the "shelf-life" of the solutions, in case questions arise during data analysis. This would allow for the solutions to be rerun without additional preparations, thus minimizing cost.

5.0 REFERENCES

[1] Herman, C. C., D. K. Peeler, and T. B. Edwards, “Task Technical/Quality Assurance Plan: Sludge Batch 3 Variability Studies with Simulants,” WSRC-RP-2002-00386, Revision 0, July 11, 2002.

[2] Peeler, D. K., C. C. Herman, and T. B. Edwards, “Analytical Study Plan: Sludge Batch 3 Variability Studies with Simulants,” WSRC-RP-2002-00394, Revision 0, July 11, 2002.

[3] Jantzen, C. M., J. B. Pickett, K. G. Brown, T. B. Edwards, and D. C. Beam, “Process/Product Models for the Defense Waste Processing Facility (DWPF): Part I. Predicting Glass Durability from Composition Using a Thermodynamic Hydration Energy Reaction Model (THERMO™) (U),” WSRC-TR-93-673, Rev. 1, Volume 2, Table B.1, pp. B.9, 1995.

Appendix E

PCT Analytical Plan for Set #1
SB3-1 through SB3-14

SRT-SCS-2002-00062

September 23, 2002

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From: T. B. Edwards, 773-42A (5-5148)
Statistical Consulting Section

wo – without glass identifiers
es – executive summary only

R. A. Baker, Technical Reviewer — 9/23/2002 Date

R. C. Tuckfield, Manager
Statistical Consulting Section — 9/24/02 Date

AN ANALYTICAL PLAN FOR MEASURING THE FIRST SET OF PCT SOLUTIONS FROM THE PHASE 1 GLASSES FOR THE SB3 VARIABILITY STUDY (U)

1.0 EXECUTIVE SUMMARY

A study is being conducted by the Savannah River Technology Center (SRTC) for the Defense Waste Processing Facility (DWPF) that involves investigating the glass region anticipated for the processing of Sludge Batch 3 (SB3). Forty-two (42) glass compositions were selected for batching and testing to support the first phase of this effort.

Fourteen (14) of the 42 study glasses are the focus of this analytical plan; they form the first set of glasses that are to be subjected to the Product Consistency Test, or PCT. The glasses were cooled both by quenching and centerline canister cooling, and the durabilities of the resulting twenty-eight glasses are to be measured in triplicate using the PCT, the requirements of which are described in ASTM C1285-97 (Method A).

The Savannah River Technology Center-Mobile Laboratory (SRTC-ML) is to be used to measure elemental concentrations of the resulting leachate solutions from the PCTs. This memorandum provides an analytical plan for the SRTC-ML to follow in measuring the compositions of the leachate solutions resulting from the PCT procedures for the glasses.

2.0 INTRODUCTION

A glass variability study for Sludge Batch 3 (SB3) is being conducted for the Defense Waste Processing Facility (DWPF) by the Savannah River Technology Center (SRTC) [1]. Forty-two (42) glass compositions were selected for batching and testing to support Phase 1 of this effort.

Fourteen (14) of the 42 study glasses are the focus of this analytical plan; they form the first set of glasses that are to be subjected to the Product Consistency Test, or PCT. The glasses were cooled both by quenching and by centerline canister cooling, and the durabilities of the resulting twenty-eight glasses are to be measured in triplicate using the PCT, the requirements of which are described in ASTM C1285-97 (Method A) [2].

The identifiers for the first set of study glasses are presented in Table 1. The centerline canister cooled glasses are denoted by a "ccc" suffix.

Table 1: Identifiers for the First Set of Study Glasses

Quenched	Centerline Canister Cooled	Quenched	Centerline Canister Cooled
SB3-01	SB3-01ccc	SB3-08	SB3-08ccc
SB3-02	SB3-02ccc	SB3-09	SB3-09ccc
SB3-03	SB3-03ccc	SB3-10	SB3-10ccc
SB3-04	SB3-04ccc	SB3-11	SB3-11ccc
SB3-05	SB3-05ccc	SB3-12	SB3-12ccc
SB3-06	SB3-06ccc	SB3-13	SB3-13ccc
SB3-07	SB3-07ccc	SB3-14	SB3-14ccc

This memorandum is in support of the Analytical Study Plan [3] and provides an analytical plan for the Savannah River Technology Center's Mobile Laboratory (SRTC-ML) to follow in measuring the compositions of the PCT leachate solutions for these glasses.

3.0 DISCUSSION

The quenched and centerline canister cooled versions of the study glasses are to be subjected to the PCT. The 2 different thermal histories for each of the 14 glasses lead to 28 glasses that are to be measured (in triplicate) using the PCT. In addition to those for the study glasses, triplicate PCTs are to be conducted on a sample of the Approved Reference Material (ARM) glass and a sample of the Environmental Assessment (EA) glass. Two reagent blank samples are also to be included in these tests. This results in 92 sample solutions being required to complete these PCTs.

The leachates from these tests will be diluted by adding 4 mL of 0.4 M HNO_3 to 6 mL of the leachate (a 6:10 volume to volume, v:v, dilution) before being submitted to the SRTC-ML. The EA leachates will be further diluted (1:10 v:v) with deionized water prior to submission to the SRTC-ML in order to prevent problems with the nebulizer.

Table 2 presents identifying codes, j01 through j92, for the individual solutions required for the PCTs of the study glasses and of the standards (EA, ARM, and blanks). This provides a naming

convention that is to be used by the SRTC-ML in analyzing the solutions and reporting the relevant concentration measurements.[24]

Table 2: Identifiers for the PCT Solutions

Original Sample	Solution Identifier	Original Sample	Solution Identifier	Original Sample	Solution Identifier	Original Sample	Solution Identifier
SB3-01	j61	SB3-05	j41	SB3-09	j90	SB3-13	j32
SB3-01	j18	SB3-05	j19	SB3-09	j92	SB3-13	j39
SB3-01	j30	SB3-05	j33	SB3-09	j02	SB3-13	j47
SB3-01ccc	j28	SB3-05ccc	j31	SB3-09ccc	j71	SB3-13ccc	j57
SB3-01ccc	j73	SB3-05ccc	j10	SB3-09ccc	j56	SB3-13ccc	j70
SB3-01ccc	j89	SB3-05ccc	j86	SB3-09ccc	j45	SB3-13ccc	j22
SB3-02	j05	SB3-06	j50	SB3-10	j37	SB3-14	j53
SB3-02	j03	SB3-06	j24	SB3-10	j65	SB3-14	j78
SB3-02	j64	SB3-06	j46	SB3-10	j29	SB3-14	j58
SB3-02ccc	j11	SB3-06ccc	j01	SB3-10ccc	j16	SB3-14ccc	j51
SB3-02ccc	j68	SB3-06ccc	j77	SB3-10ccc	j54	SB3-14ccc	j09
SB3-02ccc	j08	SB3-06ccc	j76	SB3-10ccc	j79	SB3-14ccc	j63
SB3-03	j88	SB3-07	j42	SB3-11	j62	ARM	j60
SB3-03	j34	SB3-07	j06	SB3-11	j40	ARM	j67
SB3-03	j04	SB3-07	j21	SB3-11	j38	ARM	j66
SB3-03ccc	j23	SB3-07ccc	j36	SB3-11ccc	j17	EA	j52
SB3-03ccc	j43	SB3-07ccc	j83	SB3-11ccc	j12	EA	j55
SB3-03ccc	j49	SB3-07ccc	j35	SB3-11ccc	j59	EA	j44
SB3-04	j75	SB3-08	j25	SB3-12	j74	blank	j80
SB3-04	j72	SB3-08	j85	SB3-12	j81	blank	j82
SB3-04	j69	SB3-08	j15	SB3-12	j07		
SB3-04ccc	j13	SB3-08ccc	j48	SB3-12ccc	j26		
SB3-04ccc	j87	SB3-08ccc	j14	SB3-12ccc	j91		
SB3-04ccc	j27	SB3-08ccc	j84	SB3-12ccc	j20		

4.0 ANALYTICAL PLAN

The analytical plan for the SRTC-ML is provided in this section. Each of the solution samples submitted to the SRTC-ML is to be analyzed only once for each of the following: aluminum, (Al), boron (B), iron (Fe), lithium (Li), sodium (Na), silicon (Si), and uranium (U). The measurements are to be made in parts per million (ppm). The analytical procedure used by the SRTC-ML to determine the concentrations utilizes an Inductively Coupled Plasma – Atomic Emission Spectrometer (ICP-AES). The PCT solutions (as identified in Table 2) are grouped in six ICP-AES blocks for processing by the SRTC-ML in Table 3. Each block requires a different calibration of the ICP-AES.

24 Renaming these samples ensures that they will be processed as blind samples by the SRTC-ML. This table does not contain the solution identifiers for those on the distribution list with a "wo" following their names.

Table 3: ICP-AES Calibration Blocks for Leachate Measurements.

Block 1	Block 2	Block 3	Block 4	Block 5	Block 6
std-b1-1	std-b2-1	std-b3-1	std-b4-1	std-b5-1	std-b6-1
j48	j65	j29	j01	j82	j20
j41	j78	j58	j60	j55	j66
j51	j85	j86	j05	j68	j44
j23	j34	j49	j50	j73	j21
j32	j87	j22	j52	j92	j35
j37	j14	j84	j36	j91	j64
j17	j70	j15	j42	j18	j89
j53	j10	j59	j28	j06	j08
std-b1-2	std-b2-2	std-b3-2	std-b4-2	std-b5-2	std-b6-2
j31	j39	j04	j74	j03	j07
j13	j43	j63	j90	j77	j76
j88	j54	j33	j80	j83	j46
j25	j40	j79	j26	j81	j30
j75	j09	j69	j61	j24	j02
j57	j12	j47	j71	j56	j45
j16	j72	j27	j11	j67	std-b6-3
j62	j19	j38	std-b4-3	std-b5-3	
std-b1-3	std-b2-3	std-b3-3			

A multi-element solution standard (denoted by "std-bi-j" where i=1 to 6 represents the block number and j=1, 2, and 3 represents the position in the block) was added at the beginning, middle, and end of each of the nine blocks. This standard may be useful in checking and correcting for bias in the concentration measurements arising from the ICP calibrations.

5.0 SUMMARY

In summary, this analytical plan provides identifiers for the PCT solutions in Table 2 and six ICP-AES calibration blocks in Table 3 for the SRTC-ML to use in conducting the aluminum, (Al), boron (B), iron (Fe), lithium (Li), sodium (Na), silicon (Si), and uranium (U) concentration measurements for this PCT study. The sequencing of the activities associated with each of the steps in the analytical procedure has been randomized. The size of the blocks was selected so that the block could be completed in a single work shift. If for some reason the measurements are not conducted in the sequence presented in this memorandum, the actual order should be recorded along with any explanative comments.

The analytical plan indicated in the preceding tables should be modified by the personnel of the SRTC-ML to include any calibration check standards and/or other standards that are part of their standard operating procedures.

6.0 REFERENCE

[1] Herman, C. C., D. K. Peeler, and T. B. Edwards, “Task Technical/Quality Assurance Plan: Sludge Batch 3 Variability Studies with Simulants,” WSRC-RP-2002-00386, Revision 0, July 11, 2002.

[2] ASTM C1285-97, “Standard Test Methods for Determining Chemical Durability of Nuclear Waste Glasses: The Product Consistency Test (PCT),” 1997.

[3] Peeler, D. K., C. C. Herman, and T. B. Edwards, “Analytical Study Plan: Sludge Batch 3 Variability Studies with Simulants,” WSRC-RP-2002-00394, Revision 0, July 11, 2002.

Appendix F

PCT Analytical Plan for Set #2
SB3-15 through SB3-28

Immobilization Technology Section
Savannah River Technology Center
Westinghouse Savannah River Company

WSRC-TR-2002-00549
Rev. 0

SRT-SCS-2002-00063

September 30, 2002

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wo – without glass identifiers
es – executive summary only

R. A. Baker, Technical Reviewer — 10/1/2002 Date

R. C. Tuckfield, Manager
Statistical Consulting Section — 10/1/2002 Date

AN ANALYTICAL PLAN FOR MEASURING THE SECOND SET OF PCT SOLUTIONS FROM THE PHASE 1 GLASSES FOR THE SB3 VARIABILITY STUDY (U)

1.0 EXECUTIVE SUMMARY

A study is being conducted by the Savannah River Technology Center (SRTC) for the Defense Waste Processing Facility (DWPF) that involves investigating the glass region anticipated for the processing of Sludge Batch 3 (SB3). Forty-two (42) glass compositions were selected for batching and testing to support the first phase of this effort.

Fourteen (14) of the 42 study glasses are the focus of this analytical plan; they form the second set of glasses that are to be subjected to the Product Consistency Test, or PCT. The glasses were cooled both by quenching and centerline canister cooling, and the durabilities of the resulting twenty-eight glasses are to be measured in triplicate using the PCT, the requirements of which are described in ASTM C1285-97 (Method A).

The Savannah River Technology Center-Mobile Laboratory (SRTC-ML) is to be used to measure elemental concentrations of the resulting leachate solutions from the PCTs. This memorandum provides an analytical plan for the SRTC-ML to follow in measuring the compositions of the leachate solutions resulting from the PCT procedures for the glasses.

2.0 INTRODUCTION

A glass variability study for Sludge Batch 3 (SB3) is being conducted for the Defense Waste Processing Facility (DWPF) by the Savannah River Technology Center (SRTC) [1]. Forty-two (42) glass compositions were selected for batching and testing to support Phase 1 of this effort.

Fourteen (14) of the 42 study glasses are the focus of this analytical plan; they form the second set of glasses that are to be subjected to the Product Consistency Test, or PCT. The glasses were cooled both by quenching and by centerline canister cooling, and the durabilities of the resulting twenty-eight glasses are to be measured in triplicate using the PCT, the requirements of which are described in ASTM C1285-97 (Method A) [2].

The identifiers for the second set of study glasses are presented in Table 1. The centerline canister cooled glasses are denoted by a "ccc" suffix.

Table 1: Identifiers for the Second Set of Study Glasses

Quenched	Centerline Canister Cooled	Quenched	Centerline Canister Cooled
SB3-15	SB3-15ccc	SB3-22	SB3-22ccc
SB3-16	SB3-16ccc	SB3-23	SB3-23ccc
SB3-17	SB3-17ccc	SB3-24	SB3-24ccc
SB3-18	SB3-18ccc	SB3-25	SB3-25ccc
SB3-19	SB3-19ccc	SB3-26	SB3-26ccc
SB3-20	SB3-20ccc	SB3-27	SB3-27ccc
SB3-21	SB3-21ccc	SB3-28	SB3-28ccc

This memorandum is in support of the Analytical Study Plan [3] and provides an analytical plan for the Savannah River Technology Center's Mobile Laboratory (SRTC-ML) to follow in measuring the compositions of the PCT leachate solutions for these glasses.

3.0 DISCUSSION

The quenched and centerline canister cooled versions of the study glasses are to be subjected to the PCT. The 2 different thermal histories for each of the 14 glasses lead to 28 glasses that are to be measured (in triplicate) using the PCT. In addition to those for the study glasses, triplicate PCTs are to be conducted on a sample of the Approved Reference Material (ARM) glass and a sample of the Environmental Assessment (EA) glass. Two reagent blank samples are also to be included in these tests. This results in 92 sample solutions being required to complete these PCTs.

The leachates from these tests will be diluted by adding 4 mL of 0.4 M HNO_3 to 6 mL of the leachate (a 6:10 volume to volume, v:v, dilution) before being submitted to the SRTC-ML. The EA leachates will be further diluted (1:10 v:v) with deionized water prior to submission to the SRTC-ML in order to prevent problems with the nebulizer.

Table 2 presents identifying codes, m01 through m92, for the individual solutions required for the PCTs of the study glasses and of the standards (EA, ARM, and blanks). This provides a naming

convention that is to be used by the SRTC-ML in analyzing the solutions and reporting the relevant concentration measurements.[25]

Table 2: Identifiers for the PCT Solutions

Original Sample	Solution Identifier	Original Sample	Solution Identifier	Original Sample	Solution Identifier	Original Sample	Solution Identifier
SB3-15	m52	SB3-19	m79	SB3-23	m03	SB3-27	m21
SB3-15	m13	SB3-19	m12	SB3-23	m31	SB3-27	m46
SB3-15	m51	SB3-19	m81	SB3-23	m92	SB3-27	m70
SB3-15ccc	m59	SB3-19ccc	m48	SB3-23ccc	m86	SB3-27ccc	m14
SB3-15ccc	m87	SB3-19ccc	m73	SB3-23ccc	m55	SB3-27ccc	m53
SB3-15ccc	m69	SB3-19ccc	m84	SB3-23ccc	m50	SB3-27ccc	m29
SB3-16	m77	SB3-20	m18	SB3-24	m44	SB3-28	m60
SB3-16	m58	SB3-20	m25	SB3-24	m01	SB3-28	m56
SB3-16	m64	SB3-20	m80	SB3-24	m57	SB3-28	m38
SB3-16ccc	m28	SB3-20ccc	m11	SB3-24ccc	m08	SB3-28ccc	m33
SB3-16ccc	m06	SB3-20ccc	m34	SB3-24ccc	m47	SB3-28ccc	m39
SB3-16ccc	m30	SB3-20ccc	m61	SB3-24ccc	m26	SB3-28ccc	m17
SB3-17	m75	SB3-21	m62	SB3-25	m05	ARM	m78
SB3-17	m02	SB3-21	m23	SB3-25	m32	ARM	m63
SB3-17	m45	SB3-21	m66	SB3-25	m20	ARM	m49
SB3-17ccc	m89	SB3-21ccc	m76	SB3-25ccc	m27	EA	m43
SB3-17ccc	m88	SB3-21ccc	m65	SB3-25ccc	m37	EA	m67
SB3-17ccc	m40	SB3-21ccc	m85	SB3-25ccc	m72	EA	m91
SB3-18	m24	SB3-22	m16	SB3-26	m36	blank	m35
SB3-18	m74	SB3-22	m71	SB3-26	m10	blank	m42
SB3-18	m54	SB3-22	m19	SB3-26	m82		
SB3-18ccc	m68	SB3-22ccc	m22	SB3-26ccc	m90		
SB3-18ccc	m41	SB3-22ccc	m07	SB3-26ccc	m15		
SB3-18ccc	m83	SB3-22ccc	m04	SB3-26ccc	m09		

4.0 ANALYTICAL PLAN

The analytical plan for the SRTC-ML is provided in this section. Each of the solution samples submitted to the SRTC-ML is to be analyzed only once for each of the following: aluminum (Al), boron (B), iron (Fe), lithium (Li), sodium (Na), silicon (Si), and uranium (U). The measurements are to be made in parts per million (ppm). The analytical procedure used by the SRTC-ML to determine the concentrations utilizes an Inductively Coupled Plasma – Atomic Emission Spectrometer (ICP-AES). The PCT solutions (as identified in Table 2) are grouped in six ICP-AES blocks for processing by the SRTC-ML in Table 3. Each block requires a different calibration of the ICP-AES.

[25] Renaming these samples ensures that they will be processed as blind samples by the SRTC-ML. This table does not contain the solution identifiers for those on the distribution list with a “wo” following their names.

Table 3: ICP-AES Calibration Blocks for Leachate Measurements.

Block 1	Block 2	Block 3	Block 4	Block 5	Block 6
std-b1-1	std-b2-1	std-b3-1	std-b4-1	std-b5-1	std-b6-1
m03	m01	m81	m43	m32	m40
m90	m87	m29	m76	m02	m20
m68	m58	m83	m18	m42	m66
m44	m12	m54	m60	m23	m80
m24	m10	m50	m22	m25	m19
m21	m15	m64	m75	m88	m17
m14	m06	m69	m89	m37	m91
m28	m74	m26	m27	m34	m45
std-b1-2	std-b2-2	std-b3-2	std-b4-2	std-b5-2	std-b6-2
m36	m55	m51	m16	m63	m04
m77	m53	m09	m05	m65	m61
m52	m31	m57	m33	m71	m38
m08	m13	m70	m62	m56	m85
m48	m73	m92	m11	m07	m72
m79	m47	m82	m35	m67	m49
m59	m41	m30	m78	m39	std-b6-3
m86	m46	m84	std-b4-3	std-b5-3	
std-b1-3	std-b2-3	std-b3-3			

A multi-element solution standard (denoted by "std-bi-j" where i=1 to 6 represents the block number and j=1, 2, and 3 represents the position in the block) was added at the beginning, middle, and end of each of the nine blocks. This standard may be useful in checking and correcting for bias in the concentration measurements arising from the ICP-AES calibrations.

5.0 SUMMARY

In summary, this analytical plan provides identifiers for the PCT solutions in Table 2 and six ICP-AES calibration blocks in Table 3 for the SRTC-ML to use in conducting the aluminum (Al), boron (B), iron (Fe), lithium (Li), sodium (Na), silicon (Si), and uranium (U) concentration measurements for this PCT study. The sequencing of the activities associated with each of the steps in the analytical procedure has been randomized. The size of the blocks was selected so that the block could be completed in a single work shift. If for some reason the measurements are not conducted in the sequence presented in this memorandum, the actual order should be recorded along with any explanative comments.

The analytical plan indicated in the preceding tables should be modified by the personnel of the SRTC-ML to include any calibration check standards and/or other standards that are part of their standard operating procedures.

6.0 REFERENCES

[1] Herman, C. C., D. K. Peeler, and T. B. Edwards, "Task Technical/Quality Assurance Plan: Sludge Batch 3 Variability Studies with Simulants," WSRC-RP-2002-00386, Revision 0, July 11, 2002.

[2] ASTM C1285-97, "Standard Test Methods for Determining Chemical Durability of Nuclear Waste Glasses: The Product Consistency Test (PCT)," 1997.

[3] Peeler, D. K., C. C. Herman, and T. B. Edwards, "Analytical Study Plan: Sludge Batch 3 Variability Studies with Simulants," WSRC-RP-2002-00394, Revision 0, July 11, 2002.

Appendix G

PCT Analytical Plan for Set #3
SB3-29 through SB3-42

Immobilization Technology Section
Savannah River Technology Center
Westinghouse Savannah River Company

WSRC-TR-2002-00549
Rev. 0

SRT-SCS-2002-00066

October 7, 2002

To:	C. C.	Herman, 773-43A		
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cc:	R. A.	Baker, 773-42A	I. A.	Reamer, 773-A
	D. R.	Best, 786-1A (wo)	P. A.	Toole, 786-1A (wo)
	S. L.	Marra, 999-W (es)	R. C.	Tuckfield, 773-42A
	D. J.	Pittman, 786-1A (wo)	R. J.	Workman, 999-1W

From: T. B. Edwards, 773-42A (5-5148)
Statistical Consulting Section

wo – without glass identifiers
es – executive summary only

R. A. Baker, Technical Reviewer — 10/8/2002 Date

R. C. Tuckfield, Manager
Statistical Consulting Section — 10/8/02 Date

AN ANALYTICAL PLAN FOR MEASURING THE THIRD SET OF PCT SOLUTIONS FROM THE PHASE 1 GLASSES FOR THE SB3 VARIABILITY STUDY (U)

1.0 EXECUTIVE SUMMARY

A study is being conducted by the Savannah River Technology Center (SRTC) for the Defense Waste Processing Facility (DWPF) that involves investigating the glass region anticipated for the processing of Sludge Batch 3 (SB3). Forty-two (42) glass compositions were selected for batching and testing to support the first phase of this effort.

Fourteen (14) of the 42 study glasses are the focus of this analytical plan; they form the third set of glasses that are to be subjected to the Product Consistency Test, or PCT. The glasses were cooled both by quenching and centerline canister cooling, and the durabilities of the resulting twenty-eight glasses are to be measured in triplicate using the PCT, the requirements of which are described in ASTM C1285-97 (Method A).

The Savannah River Technology Center-Mobile Laboratory (SRTC-ML) is to be used to measure elemental concentrations of the resulting leachate solutions from the PCTs. This memorandum provides an analytical plan for the SRTC-ML to follow in measuring the compositions of the leachate solutions resulting from the PCT procedures for the glasses.

2.0 INTRODUCTION

A glass variability study for Sludge Batch 3 (SB3) is being conducted for the Defense Waste Processing Facility (DWPF) by the Savannah River Technology Center (SRTC) [1]. Forty-two (42) glass compositions were selected for batching and testing to support Phase 1 of this effort.

Fourteen (14) of the 42 study glasses are the focus of this analytical plan; they form the third set of glasses that are to be subjected to the Product Consistency Test, or PCT. The glasses were cooled both by quenching and by centerline canister cooling, and the durabilities of the resulting twenty-eight glasses are to be measured in triplicate using the PCT, the requirements of which are described in ASTM C1285-97 (Method A) [2].

The identifiers for the third set of study glasses are presented in Table 1. The centerline canister cooled glasses are denoted by a "ccc" suffix.

Table 1: Identifiers for the Third Set of Study Glasses

Quenched	Centerline Canister Cooled	Quenched	Centerline Canister Cooled
SB3-29	SB3-29ccc	SB3-36	SB3-36ccc
SB3-30	SB3-30ccc	SB3-37	SB3-37ccc
SB3-31	SB3-31ccc	SB3-38	SB3-38ccc
SB3-32	SB3-32ccc	SB3-39	SB3-39ccc
SB3-33	SB3-33ccc	SB3-40	SB3-40ccc
SB3-34	SB3-34ccc	SB3-41	SB3-41ccc
SB3-35	SB3-35ccc	SB3-42	SB3-42ccc

This memorandum is in support of the Analytical Study Plan [3] and provides an analytical plan for the Savannah River Technology Center's Mobile Laboratory (SRTC-ML) to follow in measuring the compositions of the PCT leachate solutions for these glasses.

3.0 DISCUSSION

The quenched and centerline canister cooled versions of the study glasses are to be subjected to the PCT. The 2 different thermal histories for each of the 14 glasses lead to 28 glasses that are to be measured (in triplicate) using the PCT. In addition to those for the study glasses, triplicate PCTs are to be conducted on a sample of the Approved Reference Material (ARM) glass and a sample of the Environmental Assessment (EA) glass. Two reagent blank samples are also to be included in these tests. This results in 92 sample solutions being required to complete these PCTs.

The leachates from these tests will be diluted by adding 4 mL of 0.4 M HNO_3 to 6 mL of the leachate (a 6:10 volume to volume, v:v, dilution) before being submitted to the SRTC-ML. The EA leachates will be further diluted (1:10 v:v) with deionized water prior to submission to the SRTC-ML in order to prevent problems with the nebulizer.

Table 2 presents identifying codes, n01 through n92, for the individual solutions required for the PCTs of the study glasses and of the standards (EA, ARM, and blanks). This provides a naming

convention that is to be used by the SRTC-ML in analyzing the solutions and reporting the relevant concentration measurements.[26]

Table 2: Identifiers for the PCT Solutions

Original Sample	Solution Identifier	Original Sample	Solution Identifier	Original Sample	Solution Identifier	Original Sample	Solution Identifier
SB3-29	n47	SB3-33	n70	SB3-37	n35	SB3-41	n91
SB3-29	n62	SB3-33	n24	SB3-37	n30	SB3-41	n33
SB3-29	n72	SB3-33	n41	SB3-37	n22	SB3-41	n65
SB3-29ccc	n32	SB3-33ccc	n27	SB3-37ccc	n87	SB3-41ccc	n29
SB3-29ccc	n84	SB3-33ccc	n25	SB3-37ccc	n02	SB3-41ccc	n82
SB3-29ccc	n80	SB3-33ccc	n79	SB3-37ccc	n14	SB3-41ccc	n31
SB3-30	n58	SB3-34	n59	SB3-38	n07	SB3-42	n48
SB3-30	n54	SB3-34	n43	SB3-38	n15	SB3-42	n55
SB3-30	n52	SB3-34	n16	SB3-38	n56	SB3-42	n73
SB3-30ccc	n20	SB3-34ccc	n45	SB3-38ccc	n09	SB3-42ccc	n01
SB3-30ccc	n36	SB3-34ccc	n78	SB3-38ccc	n67	SB3-42ccc	n04
SB3-30ccc	n12	SB3-34ccc	n86	SB3-38ccc	n08	SB3-42ccc	n75
SB3-31	n63	SB3-35	n42	SB3-39	n03	ARM	n37
SB3-31	n34	SB3-35	n19	SB3-39	n74	ARM	n05
SB3-31	n40	SB3-35	n66	SB3-39	n49	ARM	n51
SB3-31ccc	n61	SB3-35ccc	n76	SB3-39ccc	n90	EA	n13
SB3-31ccc	n89	SB3-35ccc	n11	SB3-39ccc	n17	EA	n10
SB3-31ccc	n85	SB3-35ccc	n44	SB3-39ccc	n38	EA	n39
SB3-32	n53	SB3-36	n71	SB3-40	n23	blank	n50
SB3-32	n57	SB3-36	n83	SB3-40	n18	blank	n88
SB3-32	n46	SB3-36	n68	SB3-40	n64		
SB3-32ccc	n77	SB3-36ccc	n60	SB3-40ccc	n26		
SB3-32ccc	n69	SB3-36ccc	n28	SB3-40ccc	n21		
SB3-32ccc	n92	SB3-36ccc	n06	SB3-40ccc	n81		

4.0 ANALYTICAL PLAN

The analytical plan for the SRTC-ML is provided in this section. Each of the solution samples submitted to the SRTC-ML is to be analyzed only once for each of the following: aluminum (Al), boron (B), iron (Fe), lithium (Li), sodium (Na), silicon (Si), and uranium (U). The measurements are to be made in parts per million (ppm). The analytical procedure used by the SRTC-ML to determine the concentrations utilizes an Inductively Coupled Plasma – Atomic Emission Spectrometer (ICP-AES). The PCT solutions (as identified in Table 2) are grouped in six ICP-AES blocks for processing by the SRTC-ML in Table 3. Each block requires a different calibration of the ICP-AES.

26 Renaming these samples ensures that they will be processed as blind samples by the SRTC-ML. This table does not contain the solution identifiers for those on the distribution list with a "wo" following their names.

Table 3: ICP-AES Calibration Blocks for Leachate Measurements.

Block 1	Block 2	Block 3	Block 4	Block 5	Block 6
std-b1-1	std-b2-1	std-b3-1	std-b4-1	std-b5-1	std-b6-1
n87	n57	n80	n76	n55	n65
n61	n83	n16	n70	n15	n49
n45	n30	n64	n42	n67	n12
n47	n43	n92	n27	n17	n08
n59	n10	n06	n01	n54	n75
n26	n05	n86	n48	n36	n56
n63	n21	n46	n20	n25	n31
n60	n18	n40	n90	n88	n52
std-b1-2	std-b2-2	std-b3-2	std-b4-2	std-b5-2	std-b6-2
n53	n89	n39	n29	n04	n79
n77	n84	n68	n07	n24	n38
n13	n34	n85	n09	n11	n66
n32	n28	n72	n50	n33	n73
n37	n02	n81	n03	n82	n44
n35	n62	n22	n91	n19	n41
n71	n78	n14	n58	n74	std-b6-3
n23	n69	n51	std-b4-3	std-b5-3	
std-b1-3	std-b2-3	std-b3-3			

A multi-element solution standard (denoted by "std-bi-j" where i=1 to 6 represents the block number and j=1, 2, and 3 represents the position in the block) was added at the beginning, middle, and end of each of the nine blocks. This standard may be useful in checking and correcting for bias in the concentration measurements arising from the ICP-AES calibrations.

5.0 SUMMARY

In summary, this analytical plan provides identifiers for the PCT solutions in Table 2 and six ICP-AES calibration blocks in Table 3 for the SRTC-ML to use in conducting the aluminum (Al), boron (B), iron (Fe), lithium (Li), sodium (Na), silicon (Si), and uranium (U) concentration measurements for this PCT study. The sequencing of the activities associated with each of the steps in the analytical procedure has been randomized. The size of the blocks was selected so that the block could be completed in a single work shift. If for some reason the measurements are not conducted in the sequence presented in this memorandum, the actual order should be recorded along with any explanative comments.

The analytical plan indicated in the preceding tables should be modified by the personnel of the SRTC-ML to include any calibration check standards and/or other standards that are part of their standard operating procedures.

6.0 REFERENCES

[1] Herman, C. C., D. K. Peeler, and T. B. Edwards, "Task Technical/Quality Assurance Plan: Sludge Batch 3 Variability Studies with Simulants," WSRC-RP-2002-00386, Revision 0, July 11, 2002.

[2] ASTM C1285-97, "Standard Test Methods for Determining Chemical Durability of Nuclear Waste Glasses: The Product Consistency Test (PCT)," 1997.

[3] Peeler, D. K., C. C. Herman, and T. B. Edwards, "Analytical Study Plan: Sludge Batch 3 Variability Studies with Simulants," WSRC-RP-2002-00394, Revision 0, July 11, 2002.

Appendix H

Tables and Exhibits Supporting the
Statistical Analysis of the Measured Chemical Compositions of the
Study Glasses

Table H.1: Measured Elemental Concentrations (wt%) for the SB3 Phase 1 Glasses Prepared Using Lithium Metaborate

Glass ID	SRTC-ML ID	Block	Sub-Block	Analytical Sequence	Ba	Ca	Ce	Cr	Cu	Fe	K	La	Mg	Mn	Na	Ni	Pb	Th	Ti	U	Zn	Zr
Batch 1	BCHLM111	1	1	1	0.123	0.949	<0.010	0.068	0.297	8.47	3.05	<0.010	0.846	1.27	6.87	0.533	<0.010	<0.010	0.382	<0.100	<0.010	0.061
U std	USTLM111	1	1	2	<0.010	0.936	<0.010	0.160	0.002	8.52	2.51	<0.010	0.706	2.01	8.23	0.772	<0.010	0.060	0.548	1.95	<0.010	<0.010
SB3-34	k09LM21	1	1	3	0.079	1.119	0.118	0.086	0.063	10.4	0.151	0.063	0.021	2.06	11.0	0.397	0.086	0.151	0.642	3.31	0.121	0.197
SB3-33	k16LM21	1	1	4	0.052	0.737	0.079	0.054	0.051	7.54	0.060	0.041	0.007	1.52	9.28	0.330	0.069	0.102	0.442	2.32	0.082	0.139
SB3-12	k14LM11	1	1	5	0.076	1.070	0.116	0.084	0.060	10.1	0.128	0.053	0.674	2.01	10.9	0.404	0.099	0.149	<0.010	3.32	0.114	0.194
SB3-05	k35LM21	1	1	6	0.045	0.710	0.072	0.053	0.036	7.05	0.078	0.030	0.830	1.29	10.1	0.279	0.058	0.089	<0.010	2.06	0.067	0.123
SB3-05	k35LM11	1	1	7	0.045	0.657	0.070	0.052	0.036	6.85	0.049	0.030	0.856	1.32	9.91	0.288	0.061	0.090	<0.010	2.07	0.070	0.120
SB3-19	k18LM11	1	1	8	0.040	0.722	0.068	0.078	0.035	5.99	0.051	0.032	0.003	1.20	10.4	0.253	0.051	0.082	0.337	1.86	0.060	0.111
SB3-19	k18LM21	1	1	9	0.041	0.645	0.068	0.043	0.041	6.17	0.054	0.034	0.004	1.23	10.4	0.265	0.060	0.085	0.352	1.92	0.063	0.117
SB3-11	k28LM21	1	1	10	0.046	0.703	0.106	0.060	0.039	6.42	0.066	0.069	0.868	1.30	8.47	0.280	0.064	0.087	<0.010	1.99	0.070	0.131
SB3-31	k08LM21	1	1	11	0.061	0.818	0.090	0.057	0.046	7.79	0.088	0.045	0.011	1.63	9.28	0.350	0.077	0.117	0.479	2.73	0.089	0.151
SB3-31	k08LM11	1	1	12	0.060	0.834	0.090	0.057	0.046	8.24	0.096	0.043	0.010	1.61	9.71	0.341	0.073	0.114	0.476	2.67	0.091	0.151
SB3-12	k14LM21	1	1	13	0.081	1.079	0.117	0.091	0.061	10.4	0.129	0.055	0.714	2.13	10.8	0.439	0.102	0.153	<0.010	3.32	0.125	0.203
Batch 1	BCHLM112	1	1	14	0.128	0.926	<0.010	0.071	0.297	9.06	3.04	<0.010	0.874	1.31	6.76	0.543	<0.010	<0.010	0.387	<0.100	<0.010	0.061
U std	USTLM112	1	1	15	<0.010	0.953	<0.010	0.167	0.003	9.11	2.50	<0.010	0.743	2.11	8.30	0.801	<0.010	0.060	0.555	1.95	<0.010	<0.010
SB3-33	k16LM11	1	1	16	0.053	0.742	0.078	0.056	0.042	7.52	0.062	0.042	0.008	1.55	8.81	0.336	0.070	0.104	0.451	2.35	0.085	0.142
SB3-21	k25LM21	1	1	17	0.047	0.752	0.074	0.050	0.043	6.70	0.077	0.036	0.005	1.31	10.3	0.278	0.051	0.087	0.362	2.02	0.074	0.108
SB3-21	k25LM11	1	1	18	0.051	0.793	0.078	0.052	0.042	7.14	0.067	0.039	0.006	1.40	10.6	0.303	0.057	0.096	0.405	2.19	0.079	0.131
SB3-34	k09LM11	1	1	19	0.089	1.095	0.120	0.092	0.063	11.8	0.131	0.065	0.024	2.18	10.8	0.451	0.095	0.159	0.677	3.46	0.129	0.209
SB3-07	k38LM11	1	1	20	0.043	0.670	0.070	0.053	0.036	6.65	0.063	0.030	0.005	1.28	6.71	0.270	0.057	0.086	<0.010	2.00	0.066	0.119
SB3-11	k28LM11	1	1	21	0.047	0.680	0.070	0.066	0.037	6.74	0.053	0.032	0.890	1.36	8.30	0.296	0.062	0.090	<0.010	2.09	0.070	0.125
SB3-07	k38LM21	1	1	22	0.045	0.667	0.067	0.059	0.037	6.62	0.065	0.031	0.008	1.30	6.76	0.296	0.059	0.085	<0.010	2.00	0.078	0.116
SB3-23	k17LM11	1	1	23	0.049	0.718	0.072	0.043	0.042	7.04	0.066	0.038	0.004	1.41	9.92	0.303	0.054	0.096	0.411	2.17	0.081	0.126
SB3-39	k26LM11	1	1	24	0.046	0.665	0.068	0.175	0.045	7.21	0.055	0.037	0.003	1.33	6.22	0.330	0.056	0.090	0.387	2.06	0.076	0.194
SB3-23	k17LM21	1	1	25	0.050	0.724	0.072	0.044	0.041	7.19	0.069	0.038	0.005	1.43	9.98	0.308	0.054	0.098	0.416	2.20	0.082	0.131
SB3-39	k26LM21	1	1	26	0.047	0.683	0.066	0.080	0.043	7.21	0.060	0.037	0.002	1.32	6.51	0.278	0.057	0.088	0.385	2.03	0.078	0.124
Batch 1	BCHLM113	1	1	27	0.129	0.952	<0.010	0.072	0.305	9.53	3.09	<0.010	0.886	1.32	6.70	0.551	<0.010	<0.010	0.389	<0.100	<0.010	0.061
U std	USTLM113	1	1	28	<0.010	0.977	<0.010	0.167	0.004	9.18	2.53	<0.010	0.745	2.11	8.42	0.802	<0.010	0.061	0.563	1.99	<0.010	<0.010
Batch 1	BCHLM121	1	2	1	0.125	0.935	<0.010	0.069	0.300	8.79	3.08	<0.010	0.846	1.29	7.32	0.531	<0.010	<0.010	0.389	<0.100	<0.010	0.080
U std	USTLM121	1	2	2	<0.010	0.950	<0.010	0.163	0.008	9.92	2.52	<0.010	0.714	2.07	9.61	0.779	<0.010	0.061	0.551	1.96	<0.010	<0.010
SB3-21	k25LM22	1	2	3	0.050	0.735	0.075	0.052	0.043	6.52	0.074	0.041	0.006	1.36	10.8	0.281	0.060	0.089	0.372	2.05	0.069	0.119
SB3-34	k09LM12	1	2	4	0.086	1.087	0.123	0.095	0.068	11.4	0.132	0.071	0.027	2.26	11.4	0.454	0.104	0.158	0.684	3.52	0.138	0.217
SB3-33	k16LM22	1	2	5	0.055	0.736	0.082	0.057	0.054	7.80	0.062	0.047	0.009	1.59	9.62	0.336	0.079	0.105	0.453	2.38	0.084	0.152
SB3-19	k18LM12	1	2	6	0.043	0.663	0.067	0.080	0.038	6.25	0.052	0.037	0.005	1.26	10.8	0.260	0.061	0.085	0.348	1.92	0.062	0.126
SB3-23	k17LM12	1	2	7	0.050	0.712	0.076	0.044	0.043	6.84	0.066	0.041	0.005	1.43	10.5	0.301	0.061	0.097	0.411	2.20	0.081	0.136
SB3-07	k38LM12	1	2	8	0.045	0.671	0.070	0.055	0.038	6.36	0.064	0.034	0.007	1.32	7.18	0.276	0.065	0.088	0.001	2.03	0.067	0.131
SB3-07	k38LM22	1	2	9	0.045	0.661	0.070	0.059	0.038	6.41	0.068	0.035	0.009	1.32	7.16	0.293	0.066	0.087	0.001	2.03	0.075	0.129
SB3-34	k09LM22	1	2	10	0.086	1.113	0.121	0.088	0.065	10.5	0.152	0.069	0.024	2.15	11.4	0.404	0.099	0.154	0.653	3.37	0.123	0.213
SB3-21	k25LM12	1	2	11	0.054	0.756	0.078	0.055	0.045	6.95	0.068	0.044	0.009	1.47	11.4	0.308	0.066	0.097	0.414	2.25	0.082	0.142

Table H.1: Measured Elemental Concentrations (wt%) for the SB3 Phase 1 Glasses Prepared Using Lithium Metaborate *(continued)*

Glass ID	SRTC-ML ID	Block	Sub-Block	Analytical Sequence	Ba	Ca	Ce	Cr	Cu	Fe	K	La	Mg	Mn	Na	Ni	Pb	Th	Ti	U	Zn	Zr
SB3-05	k35LM12	1	2	12	0.048	0.671	0.073	0.055	0.039	6.85	0.052	0.034	0.869	1.38	10.5	0.293	0.071	0.094	<0.010	2.18	0.071	0.133
SB3-19	k18LM22	1	2	13	0.044	0.633	0.069	0.045	0.044	6.44	0.057	0.038	0.006	1.28	11.0	0.267	0.068	0.089	0.357	2.01	0.062	0.130
Batch 1	BCHLM122	1	2	14	0.124	0.960	<0.010	0.070	0.305	9.27	3.13	<0.010	0.831	1.29	6.99	0.526	<0.010	<0.010	0.382	<0.100	<0.010	0.072
U std	USTLM122	1	2	15	<0.010	0.964	<0.010	0.155	0.006	8.96	2.58	<0.010	0.667	1.97	8.58	0.745	<0.010	0.060	0.538	1.99	<0.010	<0.010
SB3-39	k26LM22	1	2	16	0.044	0.701	0.070	0.076	0.043	6.88	0.065	0.039	0.001	1.24	6.96	0.257	0.059	0.088	0.370	2.04	0.065	0.130
SB3-12	k14LM12	1	2	17	0.077	1.099	0.119	0.086	0.064	10.4	0.135	0.058	0.661	2.04	11.3	0.405	0.103	0.151	0.002	3.43	0.118	0.207
SB3-11	k28LM22	1	2	18	0.044	0.704	0.073	0.058	0.040	6.66	0.072	0.034	0.809	1.28	9.00	0.267	0.064	0.086	<0.010	2.05	0.057	0.130
SB3-12	k14LM22	1	2	19	0.076	1.098	0.122	0.087	0.063	10.4	0.137	0.057	0.655	2.03	11.5	0.412	0.101	0.150	<0.010	3.38	0.108	0.210
SB3-31	k08LM22	1	2	20	0.057	0.842	0.091	0.055	0.047	8.02	0.096	0.047	0.010	1.58	9.84	0.330	0.078	0.116	0.470	2.78	0.076	0.158
SB3-05	k35LM22	1	2	21	0.046	0.712	0.074	0.054	0.039	7.18	0.067	0.033	0.829	1.31	10.9	0.278	0.067	0.092	<0.010	2.11	0.067	0.134
SB3-31	k08LM12	1	2	22	0.059	0.856	0.091	0.057	0.049	8.25	0.103	0.047	0.011	1.59	10.3	0.331	0.079	0.114	0.467	2.72	0.084	0.158
SB3-33	k16LM12	1	2	23	0.054	0.750	0.083	0.056	0.044	7.43	0.065	0.046	0.009	1.57	9.43	0.334	0.076	0.104	0.450	2.36	0.083	0.152
SB3-11	k28LM12	1	2	24	0.047	0.673	0.072	0.066	0.038	6.56	0.054	0.035	0.868	1.35	8.94	0.288	0.070	0.090	<0.010	2.09	0.070	0.134
SB3-39	k26LM12	1	2	25	0.046	0.664	0.071	0.173	0.047	6.97	0.056	0.040	0.004	1.32	6.60	0.320	0.063	0.090	0.381	2.05	0.076	0.203
SB3-23	k17LM22	1	2	26	0.049	0.732	0.075	0.044	0.045	6.93	0.079	0.041	0.007	1.40	10.7	0.297	0.061	0.094	0.408	2.20	0.085	0.130
Batch 1	BCHLM123	1	2	27	0.122	0.941	<0.010	0.068	0.303	9.16	3.14	<0.010	0.822	1.27	7.06	0.524	<0.010	<0.010	0.381	<0.100	<0.010	0.071
U std	USTLM123	1	2	28	<0.010	0.957	<0.010	0.163	0.004	9.15	2.52	<0.010	0.706	2.06	8.86	0.772	<0.010	0.061	0.551	1.96	<0.010	<0.010
Batch 1	BCHLM211	2	1	1	0.120	0.940	<0.010	0.068	0.300	8.81	3.10	<0.010	0.806	1.22	7.03	0.513	<0.010	<0.010	0.371	<0.100	<0.010	0.070
U std	USTLM211	2	1	2	<0.010	0.960	<0.010	0.155	0.009	8.71	2.54	<0.010	0.673	1.94	8.62	0.744	<0.010	0.061	0.538	1.96	<0.010	<0.010
SB3-13	k33LM21	2	1	3	0.039	0.579	0.063	0.045	0.039	5.64	0.043	0.031	0.012	1.13	11.4	0.245	0.051	0.082	0.015	1.86	0.058	0.110
SB3-20	k42LM11	2	1	4	0.061	0.869	0.089	0.079	0.055	8.90	0.095	0.052	0.010	1.60	13.0	0.351	0.076	0.116	0.500	2.72	0.094	0.154
SB3-26	k40LM11	2	1	5	0.063	0.986	0.100	0.080	0.058	9.21	0.131	0.054	0.010	1.64	12.1	0.348	0.069	0.115	0.516	2.81	0.091	0.163
SB3-06	k02LM11	2	1	6	0.057	0.828	0.087	0.073	0.052	8.17	0.083	0.045	0.731	1.54	11.8	0.333	0.072	0.113	<0.010	2.57	0.085	0.149
SB3-06	k02LM21	2	1	7	0.057	0.852	0.087	0.071	0.050	8.17	0.090	0.044	0.721	1.50	11.7	0.327	0.074	0.111	<0.010	2.52	0.083	0.147
SB3-04	k22LM11	2	1	8	0.063	0.955	0.097	0.080	0.056	9.30	0.117	0.047	0.010	1.63	12.6	0.349	0.074	0.119	<0.010	2.70	0.095	0.159
SB3-41	k15LM21	2	1	9	0.044	0.664	0.071	0.054	0.040	6.64	0.060	0.034	0.001	1.21	10.9	0.264	0.056	0.087	0.001	2.01	0.063	0.123
SB3-15	k37LM11	2	1	10	0.046	0.717	0.073	0.058	0.044	6.77	0.072	0.039	0.761	1.27	10.9	0.273	0.059	0.090	0.386	2.11	0.072	0.123
SB3-36	k05LM21	2	1	11	0.072	1.037	0.109	0.088	0.061	10.1	0.130	0.060	0.015	1.85	13.1	0.393	0.087	0.136	0.581	3.09	0.099	0.181
SB3-35	k07LM11	2	1	12	0.039	0.604	0.066	0.045	0.035	5.64	0.057	0.033	0.001	1.09	11.8	0.228	0.050	0.080	0.305	1.76	0.057	0.101
SB3-40	k19LM11	2	1	13	0.076	1.079	0.114	0.084	0.063	10.5	0.138	0.065	0.018	1.96	9.72	0.404	0.093	0.148	0.629	3.26	0.111	0.194
Batch 1	BCHLM212	2	1	14	0.122	0.926	<0.010	0.069	0.298	9.06	3.10	<0.010	0.834	1.24	7.39	0.523	<0.010	<0.010	0.383	<0.100	<0.010	0.064
U std	USTLM212	2	1	15	<0.010	0.943	<0.010	0.158	0.006	9.40	2.52	<0.010	0.695	1.99	9.31	0.761	<0.010	0.062	0.541	1.93	<0.010	<0.010
SB3-41	k15LM11	2	1	16	0.046	0.668	0.071	0.062	0.041	6.62	0.057	0.034	0.002	1.24	10.6	0.264	0.057	0.085	0.000	1.99	0.067	0.122
SB3-04	k22LM21	2	1	17	0.069	0.935	0.099	0.082	0.057	9.35	0.113	0.050	0.014	1.75	12.7	0.368	0.081	0.125	<0.010	2.78	0.102	0.163
SB3-16	k27LM11	2	1	18	0.053	0.788	0.094	0.073	0.050	7.56	0.084	0.058	0.741	1.45	12.0	0.307	0.067	0.103	0.420	2.35	0.081	0.145
SB3-15	k37LM21	2	1	19	0.050	0.697	0.074	0.066	0.042	7.00	0.069	0.040	0.811	1.34	11.2	0.283	0.066	0.094	0.396	2.12	0.073	0.148
SB3-20	k42LM21	2	1	20	0.065	0.851	0.091	0.079	0.052	8.78	0.090	0.054	0.012	1.68	13.1	0.368	0.077	0.119	0.513	2.71	0.096	0.161
SB3-16	k27LM21	2	1	21	0.053	0.792	0.084	0.068	0.050	7.37	0.091	0.047	0.739	1.45	12.0	0.305	0.066	0.103	0.424	2.34	0.078	0.138
SB3-40	k19LM21	2	1	22	0.077	1.090	0.114	0.099	0.066	10.1	0.149	0.065	0.019	1.96	9.81	0.389	0.093	0.145	0.621	3.24	0.123	0.192

Table H.1: Measured Elemental Concentrations (wt%) for the SB3 Phase 1 Glasses Prepared Using Lithium Metaborate *(continued)*

Glass ID	SRTC-ML ID	Block	Sub-Block	Analytical Sequence	Ba	Ca	Ce	Cr	Cu	Fe	K	La	Mg	Mn	Na	Ni	Pb	Th	Ti	U	Zn	Zr
SB3-26	k40LM21	2	1	23	0.067	0.976	0.101	0.083	0.062	9.05	0.114	0.056	0.011	1.75	12.3	0.370	0.073	0.122	0.542	2.90	0.098	0.170
SB3-36	k05LM11	2	1	24	0.074	1.034	0.107	0.090	0.062	9.82	0.125	0.061	0.016	1.90	13.6	0.404	0.091	0.139	0.593	3.17	0.102	0.188
SB3-35	k07LM21	2	1	25	0.040	0.585	0.062	0.046	0.036	5.95	0.047	0.035	0.004	1.13	11.9	0.242	0.053	0.081	0.317	1.85	0.065	0.107
SB3-13	k33LM11	2	1	26	0.040	0.564	0.063	0.045	0.035	5.79	0.038	0.031	0.011	1.15	11.8	0.250	0.052	0.082	0.014	1.85	0.060	0.108
Batch 1	BCHLM213	2	1	27	0.118	0.949	<0.010	0.067	0.300	8.96	3.14	<0.010	0.788	1.20	7.09	0.509	<0.010	<0.010	0.371	<0.100	<0.010	0.063
U std	USTLM213	2	1	28	<0.010	0.958	<0.010	0.152	0.006	9.56	2.56	<0.010	0.658	1.90	9.18	0.733	<0.010	0.060	0.533	1.93	<0.010	0.003
Batch 1	BCHLM221	2	2	1	0.124	0.935	<0.010	0.070	0.301	9.10	3.07	<0.010	0.834	1.27	7.00	0.526	<0.010	<0.010	0.374	<0.100	<0.010	0.055
U std	USTLM221	2	2	2	<0.010	0.952	<0.010	0.162	0.008	8.97	2.51	<0.010	0.708	2.03	8.55	0.772	<0.010	0.060	0.546	1.96	<0.010	<0.010
SB3-15	k37LM22	2	2	3	0.049	0.706	0.072	0.066	0.040	6.87	0.072	0.039	0.803	1.34	11.0	0.279	0.061	0.092	0.391	2.15	0.067	0.140
SB3-04	k22LM12	2	2	4	0.069	0.927	0.098	0.085	0.056	9.32	0.115	0.048	0.011	1.75	12.1	0.366	0.077	0.123	<0.010	2.78	0.100	0.154
SB3-35	k07LM22	2	2	5	0.043	0.568	0.063	0.049	0.034	6.09	0.047	0.034	0.005	1.19	11.5	0.251	0.055	0.082	0.324	1.88	0.066	0.101
SB3-04	k22LM22	2	2	6	0.070	0.929	0.100	0.083	0.055	9.59	0.112	0.049	0.012	1.78	11.9	0.368	0.080	0.124	<0.010	2.82	0.097	0.157
SB3-06	k02LM22	2	2	7	0.062	0.819	0.090	0.076	0.048	8.30	0.085	0.045	0.780	1.63	11.4	0.347	0.079	0.113	<0.010	2.58	0.089	0.144
SB3-16	k27LM22	2	2	8	0.054	0.783	0.085	0.070	0.048	7.59	0.090	0.047	0.763	1.50	11.3	0.312	0.067	0.103	0.425	2.38	0.077	0.134
SB3-16	k27LM12	2	2	9	0.054	0.767	0.094	0.075	0.048	7.68	0.081	0.057	0.759	1.50	11.5	0.312	0.070	0.103	0.428	2.37	0.079	0.139
SB3-13	k33LM12	2	2	10	0.041	0.559	0.063	0.047	0.034	5.85	0.037	0.031	0.011	1.19	11.2	0.255	0.054	0.083	0.012	1.90	0.059	0.102
SB3-20	k42LM12	2	2	11	0.064	0.845	0.089	0.083	0.054	8.99	0.092	0.052	0.011	1.69	12.4	0.362	0.078	0.117	0.513	2.76	0.099	0.150
SB3-20	k42LM22	2	2	12	0.063	0.856	0.087	0.078	0.050	8.89	0.092	0.052	0.009	1.66	12.3	0.358	0.077	0.117	0.506	2.73	0.087	0.152
SB3-41	k15LM22	2	2	13	0.046	0.659	0.070	0.057	0.038	6.95	0.059	0.033	0.001	1.27	10.3	0.268	0.059	0.087	<0.010	2.06	0.062	0.116
Batch 1	BCHLM222	2	2	14	0.121	0.928	<0.010	0.069	0.298	9.21	3.05	<0.010	0.814	1.24	6.84	0.513	<0.010	<0.010	0.372	<0.100	<0.010	0.056
U std	USTLM222	2	2	15	<0.010	0.945	<0.010	0.155	0.004	9.37	2.51	<0.010	0.682	1.96	8.38	0.747	<0.010	0.059	0.536	1.96	<0.010	<0.010
SB3-36	k05LM22	2	2	16	0.074	1.041	0.105	0.091	0.060	10.7	0.131	0.060	0.014	1.90	12.6	0.397	0.090	0.136	0.593	3.17	0.098	0.175
SB3-13	k33LM22	2	2	17	0.039	0.572	0.060	0.045	0.036	6.00	0.044	0.029	0.011	1.15	11.2	0.244	0.050	0.079	0.013	1.84	0.053	0.102
SB3-06	k02LM12	2	2	18	0.059	0.804	0.084	0.074	0.050	8.72	0.083	0.044	0.753	1.57	11.5	0.341	0.076	0.111	<0.010	2.57	0.084	0.140
SB3-40	k19LM12	2	2	19	0.074	1.062	0.110	0.082	0.060	11.2	0.137	0.063	0.016	1.95	9.41	0.395	0.091	0.145	0.621	3.27	0.102	0.186
SB3-26	k40LM12	2	2	20	0.064	0.972	0.100	0.082	0.056	9.84	0.127	0.053	0.009	1.70	11.7	0.355	0.071	0.113	0.520	2.78	0.090	0.156
SB3-26	k40LM22	2	2	21	0.067	0.960	0.100	0.084	0.059	10.0	0.114	0.055	0.010	1.78	11.8	0.375	0.073	0.119	0.541	2.89	0.093	0.164
SB3-35	k07LM12	2	2	22	0.040	0.591	0.062	0.047	0.033	6.12	0.056	0.033	<0.001	1.14	11.4	0.233	0.049	0.078	0.310	1.78	0.054	0.095
SB3-15	k37LM12	2	2	23	0.050	0.694	0.070	0.061	0.042	7.34	0.070	0.039	0.820	1.35	10.8	0.286	0.062	0.091	0.399	2.13	0.074	0.118
SB3-36	k05LM12	2	2	24	0.077	1.027	0.106	0.094	0.060	10.8	0.125	0.061	0.016	1.97	13.3	0.418	0.095	0.140	0.603	3.17	0.104	0.182
SB3-41	k15LM12	2	2	25	0.046	0.658	0.068	0.062	0.039	7.10	0.058	0.033	0.001	1.26	10.4	0.264	0.057	0.085	<0.010	2.00	0.063	0.117
SB3-40	k19LM22	2	2	26	0.078	1.091	0.114	0.103	0.064	10.9	0.153	0.065	0.019	2.02	9.59	0.393	0.094	0.144	0.628	3.28	0.121	0.185
Batch 1	BCHLM223	2	2	27	0.126	0.915	<0.010	0.070	0.297	9.29	3.02	<0.010	0.846	1.27	7.27	0.528	<0.010	<0.010	0.379	<0.100	<0.010	0.055
U std	USTLM223	2	2	28	<0.010	0.929	<0.010	0.163	0.004	9.59	2.47	<0.010	0.710	2.04	8.90	0.771	<0.010	0.059	0.547	1.96	<0.010	<0.010
Batch 1	BCHLM311	3	1	1	0.119	0.951	<0.010	0.065	0.302	8.93	3.08	<0.010	0.833	1.27	7.00	0.533	<0.010	<0.010	0.384	<0.100	<0.010	0.054
U std	USTLM311	3	1	2	<0.010	0.956	<0.010	0.156	0.008	8.98	2.53	<0.010	0.689	2.01	8.53	0.761	<0.010	0.057	0.550	1.99	<0.010	<0.010
SB3-28	k29LM11	3	1	3	0.057	0.918	0.093	0.078	0.052	9.34	0.114	0.052	0.008	1.70	11.5	0.359	0.077	0.116	0.522	2.79	0.085	0.154
SB3-28	k29LM21	3	1	4	0.057	0.900	0.091	0.076	0.052	9.34	0.107	0.052	0.009	1.72	11.3	0.363	0.077	0.117	0.525	2.80	0.085	0.154
SB3-29	k11LM21	3	1	5	0.040	0.692	0.598	0.032	0.041	7.36	0.061	0.603	0.841	1.32	8.31	0.284	0.083	0.090	0.406	2.06	0.061	0.238

Table H.1: Measured Elemental Concentrations (wt%) for the SB3 Phase 1 Glasses Prepared Using Lithium Metaborate *(continued)*

Glass ID	SRTC-ML ID	Block	Sub-Block	Analytical Sequence	Ba	Ca	Ce	Cr	Cu	Fe	K	La	Mg	Mn	Na	Ni	Pb	Th	Ti	U	Zn	Zr
SB3-32	k36LM11	3	1	6	0.075	1.151	0.114	0.080	0.066	11.0	0.153	0.065	0.017	2.05	11.4	0.417	0.094	0.146	0.648	3.43	0.111	0.190
SB3-08	k30LM11	3	1	7	0.067	0.998	0.101	0.118	0.062	10.1	0.106	0.052	0.015	1.90	10.5	0.352	0.096	0.132	<0.010	3.16	0.107	0.168
SB3-08	k30LM21	3	1	8	0.065	0.991	0.099	0.134	0.058	10.3	0.116	0.051	0.013	1.88	10.6	0.383	0.090	0.129	<0.010	3.05	0.095	0.169
SB3-01	k41LM11	3	1	9	0.040	0.647	0.062	0.045	0.042	6.75	0.059	0.031	0.002	1.22	8.58	0.264	0.055	0.083	<0.010	2.03	0.062	0.108
SB3-17	k01LM21	3	1	10	0.031	0.640	0.061	0.046	0.038	7.02	0.060	0.035	<0.001	1.20	10.2	0.251	0.051	0.082	0.339	1.98	0.051	0.109
SB3-01	k41LM21	3	1	11	0.039	0.656	0.061	0.043	0.038	6.65	0.065	0.030	0.001	1.19	8.59	0.255	0.053	0.081	<0.010	1.97	0.056	0.100
SB3-17	k01LM11	3	1	12	0.035	0.635	0.060	0.045	0.036	6.67	0.061	0.033	<0.001	1.18	10.9	0.253	0.053	0.081	0.337	1.96	0.050	0.108
Batch 1	BCHLM312	3	1	13	0.107	0.963	<0.010	0.060	0.302	9.48	3.14	<0.010	0.761	1.17	6.88	0.493	<0.010	<0.010	0.362	<0.100	<0.010	0.048
U std	USTLM312	3	1	14	<0.010	0.963	<0.010	0.143	0.005	9.41	2.56	<0.010	0.632	1.87	8.52	0.721	<0.010	0.055	0.519	1.93	<0.010	<0.010
SB3-25	k39LM11	3	1	15	0.038	0.667	0.063	0.051	0.038	7.05	0.067	0.036	<0.001	1.19	9.07	0.264	0.054	0.082	0.369	2.01	0.050	0.109
SB3-25	k39LM21	3	1	16	0.036	0.659	0.064	0.051	0.040	6.92	0.066	0.035	<0.001	1.18	8.99	0.257	0.051	0.080	0.366	2.00	0.055	0.106
SB3-38	k03LM21	3	1	17	0.067	1.101	0.112	0.054	0.061	11.1	0.149	0.059	0.013	1.91	9.60	0.391	0.085	0.139	0.610	3.26	0.094	0.285
SB3-29	k11LM11	3	1	18	0.036	0.693	0.066	0.028	0.041	7.24	0.067	0.036	0.782	1.23	8.32	0.268	0.054	0.084	0.392	2.06	0.058	0.113
SB3-38	k03LM11	3	1	19	0.067	1.083	0.112	0.050	0.061	11.0	0.143	0.058	0.012	1.91	9.53	0.396	0.086	0.139	0.609	3.27	0.095	0.285
SB3-42	k20LM21	3	1	20	0.065	1.069	0.105	0.089	0.061	8.63	0.134	0.050	0.017	1.87	11.6	0.409	0.090	0.135	<0.010	3.20	0.096	0.174
SB3-18	k04LM11	3	1	21	0.052	0.919	0.090	0.078	0.052	9.29	0.113	0.047	0.008	1.59	13.0	0.339	0.073	0.112	0.496	2.68	0.081	0.150
SB3-42	k20LM11	3	1	22	0.061	1.070	0.105	0.090	0.065	9.01	0.135	0.051	0.018	1.90	11.4	0.410	0.091	0.133	<0.010	3.21	0.098	0.175
SB3-32	k36LM21	3	1	23	0.069	1.229	0.115	0.070	0.066	11.2	0.176	0.060	0.016	1.91	13.7	0.384	0.083	0.139	0.618	3.32	0.098	0.181
SB3-18	k04LM21	3	1	24	0.051	0.921	0.089	0.070	0.051	9.95	0.105	0.047	0.005	1.59	13.8	0.346	0.073	0.113	0.504	2.73	0.077	0.150
Batch 1	BCHLM313	3	1	25	0.107	0.942	<0.010	0.059	0.295	9.16	3.11	<0.010	0.764	1.17	7.08	0.495	<0.010	<0.010	0.366	<0.100	<0.010	0.051
U std	USTLM313	3	1	26	<0.010	0.953	<0.010	0.145	0.007	9.14	2.55	<0.010	0.650	1.89	8.67	0.732	<0.010	0.054	0.525	1.92	<0.010	<0.010
Batch 1	BCHLM321	3	2	1	0.121	0.933	<0.010	0.065	0.301	8.93	3.08	<0.010	0.830	1.27	6.76	0.524	<0.010	<0.010	0.378	<0.100	<0.010	0.061
U std	USTLM321	3	2	2	<0.010	0.963	<0.010	0.154	0.007	9.10	2.55	<0.010	0.683	2.01	8.39	0.754	<0.010	0.057	0.544	2.00	<0.010	<0.010
SB3-18	k04LM12	3	2	3	0.060	0.912	0.093	0.083	0.053	9.65	0.108	0.050	0.008	1.69	12.6	0.355	0.074	0.118	0.518	2.79	0.087	0.157
SB3-32	k36LM12	3	2	4	0.079	1.152	0.118	0.081	0.066	11.2	0.153	0.066	0.015	2.08	11.4	0.419	0.090	0.148	0.651	3.49	0.110	0.194
SB3-32	k36LM22	3	2	5	0.077	1.243	0.118	0.074	0.068	11.5	0.172	0.064	0.016	2.03	13.4	0.398	0.087	0.145	0.642	3.47	0.105	0.191
SB3-18	k04LM22	3	2	6	0.057	0.938	0.091	0.073	0.051	12.1	0.103	0.049	0.004	1.66	14.4	0.353	0.073	0.118	0.517	2.84	0.081	0.157
SB3-01	k41LM12	3	2	7	0.043	0.649	0.065	0.046	0.042	7.16	0.056	0.031	<0.001	1.22	8.25	0.260	0.053	0.083	<0.010	2.02	0.060	0.108
SB3-29	k11LM22	3	2	8	0.042	0.704	0.606	0.033	0.041	8.59	0.060	0.607	0.826	1.31	8.11	0.278	0.077	0.089	0.400	2.06	0.056	0.240
SB3-28	k29LM12	3	2	9	0.058	0.942	0.091	0.076	0.051	10.2	0.117	0.051	0.004	1.65	11.1	0.345	0.071	0.114	0.513	2.76	0.078	0.152
SB3-01	k41LM22	3	2	10	0.042	0.657	0.065	0.044	0.037	7.40	0.061	0.030	<0.001	1.19	8.21	0.253	0.049	0.080	<0.010	1.99	0.054	0.101
SB3-38	k03LM22	3	2	11	0.073	1.091	0.116	0.057	0.061	12.1	0.144	0.061	0.012	1.98	9.08	0.396	0.087	0.142	0.614	3.32	0.098	0.291
SB3-42	k20LM12	3	2	12	0.069	1.080	0.101	0.091	0.063	8.75	0.130	0.052	0.012	1.91	11.3	0.407	0.088	0.134	<0.010	3.25	0.095	0.177
Batch 1	BCHLM322	3	2	13	0.114	0.966	<0.010	0.062	0.299	9.47	3.12	<0.010	0.787	1.20	6.85	0.504	<0.010	<0.010	0.368	<0.100	<0.010	0.051
U std	USTLM322	3	2	14	<0.010	0.948	<0.010	0.148	0.005	9.76	2.53	<0.010	0.662	1.91	8.18	0.730	<0.010	0.055	0.529	1.94	<0.010	<0.010
SB3-25	k39LM22	3	2	15	0.042	0.662	0.067	0.054	0.040	7.70	0.061	0.036	<0.001	1.22	8.61	0.262	0.052	0.080	0.370	2.02	0.058	0.109
SB3-42	k20LM22	3	2	16	0.070	1.067	0.108	0.092	0.060	9.22	0.131	0.051	0.015	1.92	11.2	0.417	0.088	0.136	<0.010	3.24	0.099	0.176
SB3-38	k03LM12	3	2	17	0.071	1.090	0.116	0.051	0.061	11.6	0.140	0.059	0.010	1.94	9.24	0.396	0.086	0.142	0.608	3.28	0.095	0.288
SB3-29	k11LM12	3	2	18	0.040	0.679	0.071	0.029	0.040	8.21	0.062	0.036	0.800	1.26	8.19	0.268	0.051	0.086	0.394	2.08	0.059	0.115

Table H.1: Measured Elemental Concentrations (wt%) for the SB3 Phase 1 Glasses Prepared Using Lithium Metaborate *(continued)*

Glass ID	SRTC-ML ID	Block	Sub-Block	Analytical Sequence	Ba	Ca	Ce	Cr	Cu	Fe	K	La	Mg	Mn	Na	Ni	Pb	Th	Ti	U	Zn	Zr
SB3-17	k01LM12	3	2	19	0.038	0.627	0.066	0.045	0.035	7.34	0.057	0.033	<0.001	1.17	10.7	0.247	0.050	0.080	0.331	1.92	0.048	0.106
SB3-08	k30LM12	3	2	20	0.067	0.989	0.104	0.115	0.060	10.7	0.104	0.051	0.011	1.85	10.4	0.343	0.091	0.128	<0.010	3.08	0.102	0.164
SB3-17	k01LM22	3	2	21	0.030	0.645	0.061	0.047	0.040	7.31	0.058	0.037	<0.001	1.21	11.0	0.249	0.052	0.079	<0.010	1.90	0.049	0.106
SB3-25	k39LM12	3	2	22	0.041	0.654	0.068	0.052	0.038	7.17	0.062	0.036	<0.001	1.20	8.70	0.263	0.050	0.080	0.369	2.02	0.051	0.111
SB3-08	k30LM22	3	2	23	0.065	1.005	0.102	0.132	0.057	10.8	0.116	0.050	0.009	1.84	10.3	0.376	0.084	0.127	<0.010	3.02	0.090	0.166
SB3-28	k29LM22	3	2	24	0.055	0.912	0.092	0.071	0.051	9.92	0.112	0.049	0.003	1.60	11.2	0.341	0.069	0.112	0.502	2.74	0.073	0.149
Batch 1	BCHLM323	3	2	25	0.108	0.919	<0.010	0.059	0.292	9.66	3.09	<0.010	0.755	1.17	6.80	0.487	<0.010	<0.010	0.360	<0.100	<0.010	0.051
U std	USTLM323	3	2	26	<0.010	0.950	<0.010	0.143	0.005	9.49	2.55	<0.010	0.634	1.86	8.32	0.715	<0.010	0.053	0.516	1.92	<0.010	<0.010
Batch 1	BCHLM411	4	1	1	0.122	0.913	<0.010	0.067	0.304	8.22	3.08	<0.010	0.847	1.27	7.10	0.534	<0.010	<0.010	0.384	<0.100	<0.010	0.066
U std	USTLM411	4	1	2	<0.010	0.945	<0.010	0.162	<0.010	9.14	2.53	<0.010	0.721	2.01	8.81	0.785	<0.010	0.064	0.556	1.98	<0.010	<0.010
SB3-37	k10LM11	4	1	3	0.049	0.728	0.081	0.059	0.041	6.89	0.082	0.042	0.012	1.42	7.39	0.308	0.062	0.108	0.433	2.25	0.075	0.133
SB3-22	k12LM11	4	1	4	0.069	0.982	0.102	0.094	0.055	9.40	0.118	0.057	0.025	1.87	13.3	0.400	0.085	0.151	0.584	3.01	0.102	0.177
SB3-02	k32LM21	4	1	5	0.061	0.831	0.102	0.061	0.047	8.33	0.089	0.061	0.018	1.63	11.5	0.333	0.076	0.126	<0.010	2.53	0.093	0.150
SB3-30	k31LM21	4	1	6	0.077	1.02	0.107	0.085	0.061	10.6	0.118	0.065	0.712	2.06	10.8	0.430	0.099	0.162	0.638	3.33	0.114	0.197
SB3-24	k23LM21	4	1	7	0.072	0.985	0.104	0.084	0.056	9.64	0.118	0.059	0.024	1.92	13.8	0.414	0.091	0.154	0.596	3.11	0.103	0.181
SB3-14	k34LM11	4	1	8	0.064	0.886	0.092	0.089	0.051	8.47	0.115	0.046	0.021	1.75	13.4	0.380	0.079	0.137	<0.010	2.80	0.099	0.156
SB3-30	k31LM11	4	1	9	0.077	1.01	0.108	0.084	0.058	10.2	0.124	0.065	0.712	2.03	10.9	0.413	0.099	0.163	0.640	3.28	0.109	0.198
SB3-14	k34LM21	4	1	10	0.065	0.912	0.093	0.098	0.051	8.68	0.121	0.046	0.020	1.74	13.3	0.377	0.080	0.138	<0.010	2.80	0.095	0.176
SB3-02	k32LM11	4	1	11	0.065	0.859	0.089	0.066	0.050	8.54	0.095	0.046	0.019	1.70	12.2	0.368	0.076	0.130	<0.010	2.67	0.097	0.147
SB3-37	k10LM21	4	1	12	0.048	0.717	0.080	0.058	0.042	7.05	0.077	0.042	0.012	1.42	7.32	0.306	0.063	0.107	0.431	2.27	0.074	0.130
Batch 1	BCHLM412	4	1	13	0.120	0.933	<0.010	0.067	0.305	8.70	3.09	<0.010	0.834	1.25	7.27	0.530	<0.010	<0.010	0.381	<0.100	<0.010	0.057
U std	USTLM412	4	1	14	<0.010	0.921	<0.010	0.159	<0.010	8.45	2.55	<0.010	0.701	1.96	8.85	0.763	<0.010	0.065	0.542	1.96	<0.010	<0.010
SB3-09	k24LM21	4	1	15	0.051	0.741	0.083	0.071	0.046	6.68	0.080	0.038	0.011	1.44	8.46	0.318	0.066	0.115	0.002	2.35	0.074	0.135
SB3-09	k24LM11	4	1	16	0.053	0.738	0.175	0.060	0.042	6.78	0.086	0.145	0.010	1.40	8.46	0.309	0.068	0.115	0.001	2.29	0.073	0.155
SB3-10	k21LM21	4	1	17	0.075	1.04	0.116	0.092	0.060	9.74	0.146	0.054	0.678	2.00	12.1	0.421	0.094	0.161	<0.010	3.24	0.107	0.193
SB3-22	k12LM21	4	1	18	0.069	0.979	0.108	0.096	0.054	9.57	0.125	0.058	0.024	1.86	13.8	0.395	0.087	0.151	0.580	3.03	0.098	0.180
SB3-24	k23LM11	4	1	19	0.069	0.997	0.112	0.081	0.059	9.48	0.144	0.057	0.024	1.85	14.3	0.391	0.086	0.146	0.581	3.04	0.103	0.171
SB3-03	k13LM11	4	1	20	0.044	0.611	0.074	0.067	0.037	5.71	0.063	0.030	0.006	1.19	9.02	0.256	0.053	0.093	0.001	1.89	0.061	0.114
SB3-27	k06LM21	4	1	21	0.041	0.641	0.071	0.050	0.038	6.17	0.067	0.036	0.007	1.21	9.57	0.260	0.051	0.099	0.363	1.95	0.062	0.108
SB3-27	k06LM11	4	1	22	0.042	0.651	0.075	0.079	0.046	5.93	0.076	0.036	0.005	1.22	9.50	0.261	0.050	0.092	0.366	1.94	0.055	0.117
SB3-10	k21LM11	4	1	23	0.083	1.09	0.127	0.102	0.065	10.6	0.145	0.060	0.734	2.11	12.4	0.459	0.100	0.177	0.000	3.47	0.118	0.210
SB3-03	k13LM21	4	1	24	0.048	0.616	0.073	0.078	0.035	6.19	0.054	0.033	0.008	1.24	8.98	0.281	0.058	0.099	0.001	1.98	0.061	0.120
Batch 1	BCHLM413	4	1	25	0.122	0.912	<0.010	0.068	0.306	8.88	3.16	<0.010	0.845	1.80	7.28	0.533	<0.010	<0.010	0.381	<0.100	<0.010	0.059
U std	USTLM413	4	1	26	<0.010	0.927	<0.010	0.163	<0.010	8.74	2.58	<0.010	0.715	1.97	8.90	0.781	<0.010	0.066	0.551	1.97	<0.010	<0.010
Batch 1	BCHLM421	4	2	1	0.123	0.907	<0.010	0.068	0.300	9.10	3.08	<0.010	0.840	1.30	6.97	0.528	<0.010	<0.010	0.384	<0.100	<0.010	0.061
U std	USTLM421	4	2	2	<0.010	0.928	<0.010	0.161	<0.010	9.05	2.51	<0.010	0.707	2.06	8.69	0.771	<0.010	0.062	0.546	1.91	<0.010	<0.010
SB3-14	k34LM12	4	2	3	0.065	0.902	0.096	0.088	0.047	8.94	0.120	0.045	0.022	1.80	13.23	0.375	0.078	0.135	<0.010	2.76	0.101	0.157
SB3-09	k24LM12	4	2	4	0.052	0.739	0.087	0.059	0.039	7.16	0.090	0.040	0.014	1.47	8.28	0.309	0.066	0.111	0.000	2.24	0.078	0.130
SB3-27	k06LM12	4	2	5	0.045	0.660	0.070	0.078	0.043	6.43	0.080	0.036	0.009	1.27	9.19	0.260	0.050	0.090	0.366	1.89	0.066	0.113

Table H.1: Measured Elemental Concentrations (wt%) for the SB3 Phase 1 Glasses Prepared Using Lithium Metaborate *(continued)*

Glass ID	SRTC-ML ID	Block	Sub-Block	Analytical Sequence	Ba	Ca	Ce	Cr	Cu	Fe	K	La	Mg	Mn	Na	Ni	Pb	Th	Ti	U	Zn	Zr
SB3-30	k31LM22	4	2	6	0.080	1.01	0.114	0.086	0.058	11.0	0.120	0.066	0.720	2.16	10.7	0.432	0.099	0.164	0.649	3.21	0.122	0.194
SB3-03	k13LM12	4	2	7	0.047	0.611	0.071	0.068	0.032	6.20	0.065	0.030	0.009	1.28	8.73	0.261	0.053	0.090	0.001	1.84	0.065	0.110
SB3-22	k12LM22	4	2	8	0.073	0.988	0.106	0.097	0.051	10.1	0.125	0.058	0.028	1.97	13.7	0.400	0.089	0.151	0.585	2.93	0.110	0.177
SB3-37	k10LM12	4	2	9	0.050	0.727	0.082	0.059	0.039	7.48	0.086	0.042	0.015	1.48	7.35	0.303	0.063	0.107	0.433	2.17	0.081	0.128
SB3-37	k10LM22	4	2	10	0.050	0.715	0.078	0.058	0.039	7.32	0.080	0.042	0.015	1.49	7.30	0.306	0.065	0.107	0.433	2.18	0.079	0.128
SB3-09	k24LM22	4	2	11	0.052	0.722	0.083	0.070	0.043	7.23	0.082	0.038	0.014	1.52	8.44	0.312	0.066	0.112	0.001	2.24	0.079	0.130
SB3-10	k21LM12	4	2	12	0.084	1.09	0.124	0.101	0.062	11.1	0.147	0.059	0.733	2.19	12.0	0.457	0.102	0.172	0.000	3.31	0.125	0.206
Batch 1	BCHLM422	4	2	13	0.125	0.915	<0.010	0.069	0.300	9.06	3.03	<0.010	0.858	1.32	7.12	0.544	<0.010	<0.010	0.382	<0.100	<0.010	0.054
U std	USTLM422	4	2	14	<0.010	0.936	<0.010	0.163	<0.010	9.94	2.53	<0.010	0.714	2.10	9.02	0.783	<0.010	0.064	0.557	1.89	<0.010	<0.010
SB3-03	k13LM22	4	2	15	0.049	0.614	0.070	0.077	0.033	6.56	0.058	0.032	0.010	1.34	8.92	0.275	0.061	0.095	0.001	1.91	0.067	0.114
SB3-14	k34LM22	4	2	16	0.067	0.925	0.098	0.098	0.048	8.99	0.128	0.046	0.024	1.75	13.1	0.375	0.080	0.138	<0.010	2.67	0.102	0.175
SB3-02	k32LM12	4	2	17	0.067	0.849	0.094	0.067	0.048	8.92	0.100	0.047	0.023	1.68	12.1	0.371	0.080	0.128	<0.010	2.53	0.105	0.151
SB3-27	k06LM22	4	2	18	0.044	0.648	0.069	0.051	0.035	6.59	0.073	0.037	0.011	1.22	9.30	0.266	0.052	0.095	0.368	1.86	0.069	0.109
SB3-02	k32LM22	4	2	19	0.065	0.816	0.097	0.063	0.045	8.73	0.097	0.053	0.022	1.60	11.4	0.344	0.080	0.125	<0.010	2.42	0.101	0.147
SB3-24	k23LM22	4	2	20	0.076	0.995	0.107	0.087	0.054	10.3	0.127	0.061	0.028	1.95	13.6	0.422	0.093	0.154	0.609	2.95	0.114	0.183
SB3-22	k12LM12	4	2	21	0.072	0.983	0.105	0.095	0.052	10.1	0.126	0.058	0.028	1.92	13.3	0.401	0.091	0.150	0.585	2.89	0.109	0.177
SB3-24	k23LM12	4	2	22	0.073	1.02	0.109	0.083	0.056	10.2	0.144	0.059	0.028	1.98	14.0	0.399	0.089	0.148	0.590	2.90	0.111	0.175
SB3-10	k21LM22	4	2	23	0.078	1.05	0.118	0.094	0.057	10.5	0.148	0.054	0.676	2.15	11.7	0.423	0.094	0.161	<0.010	3.13	0.114	0.192
SB3-30	k31LM12	4	2	24	0.078	1.01	0.113	0.083	0.055	11.0	0.127	0.065	0.704	2.19	10.7	0.408	0.096	0.161	0.642	3.16	0.113	0.194
Batch 1	BCHLM423	4	2	25	0.131	0.910	<0.010	0.074	0.308	9.11	3.08	<0.010	0.899	1.40	7.12	0.577	<0.010	<0.010	0.406	<0.100	<0.010	0.058
U std	USTLM423	4	2	26	<0.010	0.917	<0.010	0.163	<0.010	9.52	2.50	<0.010	0.713	2.19	8.79	0.779	<0.010	0.064	0.553	1.91	<0.010	<0.010

**Table H.2: Measured Elemental Concentrations (wt%)
for the SB3 Phase 1 Glasses Prepared Using Peroxide Fusion**

Glass ID	SRTC-ML ID	Block	Sub-Block	Analytical Sequence	Al	B	Li	Si
Batch 1	BCHPF111	1	1	1	2.4524	2.6452	1.9939	22.031
U std	USTPF111	1	1	2	1.87	2.81	1.28	22.1
SB3-09	k24PF21	1	1	3	2.70	3.04	1.44	24.7
SB3-18	k04PF21	1	1	4	3.36	1.46	1.26	21.4
SB3-39	k26PF21	1	1	5	2.29	2.27	2.55	26.4
SB3-18	k04PF11	1	1	6	3.45	1.45	1.28	21.6
SB3-36	k05PF11	1	1	7	3.83	1.43	1.26	19.7
SB3-10	k21PF11	1	1	8	3.69	2.37	1.13	19.3
SB3-39	k26PF11	1	1	9	2.29	2.25	2.55	26.5
SB3-33	k16PF21	1	1	10	3.02	2.16	1.53	24.9
SB3-35	k07PF11	1	1	11	2.49	1.87	1.64	25.6
SB3-33	k16PF11	1	1	12	3.14	2.12	1.50	24.3
SB3-22	k12PF11	1	1	13	3.47	1.29	0.947	20.1
Batch 1	BCHPF112	1	1	14	2.51	2.46	1.98	22.2
U std	USTPF112	1	1	15	1.86	2.79	1.25	22.3
SB3-06	k02PF11	1	1	16	2.87	1.59	1.92	22.9
SB3-28	k29PF11	1	1	17	3.12	1.81	2.03	21.5
SB3-03	k13PF21	1	1	18	2.31	3.15	1.48	25.7
SB3-10	k21PF21	1	1	19	3.78	2.41	1.14	19.5
SB3-36	k05PF21	1	1	20	3.83	1.44	1.27	19.9
SB3-03	k13PF11	1	1	21	2.31	3.19	1.51	25.9
SB3-35	k07PF21	1	1	22	2.48	1.90	1.68	26.0
SB3-06	k02PF21	1	1	23	3.02	1.63	1.99	23.6
SB3-09	k24PF11	1	1	24	2.72	3.09	1.46	25.3
SB3-22	k12PF21	1	1	25	3.45	1.33	0.97	20.6
SB3-28	k29PF21	1	1	26	3.24	1.85	2.09	21.9
Batch 1	BCHPF113	1	1	27	2.54	2.52	2.01	22.0
U std	USTPF113	1	1	28	1.96	2.90	1.33	23.6
Batch 1	BCHPF121	1	2	1	2.51	2.50	1.98	21.5
U std	USTPF121	1	2	2	1.97	2.73	1.27	21.9
SB3-06	k02PF12	1	2	3	2.85	1.53	1.90	22.2
SB3-10	k21PF22	1	2	4	3.95	2.41	1.16	19.8
SB3-36	k05PF22	1	2	5	3.85	1.38	1.25	19.3
SB3-18	k04PF22	1	2	6	3.39	1.38	1.24	20.9
SB3-39	k26PF22	1	2	7	2.36	2.21	2.55	26.3
SB3-09	k24PF22	1	2	8	2.84	2.98	1.46	24.7
SB3-28	k29PF22	1	2	9	3.23	1.76	2.05	21.0
SB3-39	k26PF12	1	2	10	2.53	2.23	2.63	26.7
SB3-09	k24PF12	1	2	11	2.68	2.95	1.43	24.5
SB3-03	k13PF12	1	2	12	2.50	3.20	1.55	26.0
SB3-03	k13PF22	1	2	13	2.56	3.23	1.59	26.6
Batch 1	BCHPF122	1	2	14	2.94	2.43	1.96	21.5
U std	USTPF122	1	2	15	2.00	2.77	1.25	22.2
SB3-35	k07PF22	1	2	16	2.46	1.83	1.62	25.5
SB3-06	k02PF22	1	2	17	2.96	1.55	1.90	22.6
SB3-10	k21PF12	1	2	18	3.74	2.30	1.10	19.2
SB3-35	k07PF12	1	2	19	2.58	1.90	1.70	26.5
SB3-33	k16PF12	1	2	20	3.44	2.09	1.50	24.6
SB3-18	k04PF12	1	2	21	3.47	1.39	1.24	21.3
SB3-33	k16PF22	1	2	22	3.05	2.08	1.51	24.5
SB3-36	k05PF12	1	2	23	3.89	1.38	1.24	19.6
SB3-22	k12PF12	1	2	24	3.54	1.25	0.929	19.9
SB3-22	k12PF22	1	2	25	3.68	1.25	0.931	20.1
SB3-28	k29PF12	1	2	26	3.20	1.73	2.00	21.2
Batch 1	BCHPF123	1	2	27	2.54	2.42	1.95	21.9
U std	USTPF123	1	2	28	1.95	2.72	1.27	22.6
Batch 1	BCHPF211	2	1	1	2.49	2.52	1.98	21.8
U std	USTPF211	2	1	2	1.91	2.74	1.27	21.8
SB3-19	k18PF21	2	1	3	2.70	2.20	1.58	25.3
SB3-32	k36PF21	2	1	4	4.25	1.34	1.18	19.4
SB3-02	k32PF21	2	1	5	3.16	3.49	1.31	20.5
SB3-07	k38PF11	2	1	6	2.48	4.48	1.67	25.7

**Table H.2: Measured Elemental Concentrations (wt%)
for the SB3 Phase 1 Glasses Prepared Using Peroxide Fusion** ***(continued)***

Glass ID	SRTC-ML ID	Block	Sub-Block	Analytical Sequence	Al	B	Li	Si
SB3-16	k27PF11	2	1	7	2.80	1.59	1.99	22.7
SB3-04	k22PF11	2	1	8	4.21	2.83	1.65	23.2
SB3-25	k39PF21	2	1	9	2.45	1.77	2.59	26.5
SB3-04	k22PF21	2	1	10	3.29	2.53	1.23	20.9
SB3-12	k14PF11	2	1	11	3.82	1.35	1.72	20.1
SB3-14	k34PF11	2	1	12	3.57	1.51	1.39	21.7
SB3-25	k39PF11	2	1	13	2.43	1.73	2.56	26.6
Batch 1	BCHPF212	2	1	14	2.52	2.42	1.99	22.0
U std	USTPF212	2	1	15	2.01	2.78	1.28	22.1
SB3-32	k36PF11	2	1	16	4.64	1.39	1.25	20.3
SB3-16	k27PF21	2	1	17	2.80	1.56	1.97	22.5
SB3-12	k14PF21	2	1	18	3.76	1.30	1.63	19.6
SB3-07	k38PF21	2	1	19	2.40	4.35	1.61	25.2
SB3-02	k32PF11	2	1	20	3.10	3.61	1.32	20.9
SB3-40	k19PF11	2	1	21	4.04	1.76	2.04	20.9
SB3-40	k19PF21	2	1	22	3.92	1.73	2.00	20.7
SB3-20	k42PF11	2	1	23	3.56	1.92	1.40	22.5
SB3-19	k18PF11	2	1	24	2.75	2.23	1.63	25.9
SB3-20	k42PF21	2	1	25	3.35	1.82	1.33	21.0
SB3-14	k34PF21	2	1	26	3.75	1.59	1.45	22.6
Batch 1	BCHPF213	2	1	27	2.63	2.45	2.02	21.9
U std	USTPF213	2	1	28	1.94	2.70	1.26	22.3
Batch 1	BCHPF221	2	2	1	2.49	2.48	1.98	21.9
U std	USTPF221	2	2	2	1.92	2.70	1.24	21.5
SB3-12	k14PF22	2	2	3	3.62	1.29	1.56	18.7
SB3-25	k39PF22	2	2	4	2.28	1.68	2.40	25.4
SB3-04	k22PF22	2	2	5	3.17	2.47	1.18	20.3
SB3-20	k42PF12	2	2	6	3.32	1.80	1.30	20.8
SB3-12	k14PF12	2	2	7	3.69	1.32	1.65	19.2
SB3-25	k39PF12	2	2	8	2.32	1.68	2.44	25.5
SB3-19	k18PF22	2	2	9	2.58	2.10	1.51	24.4
SB3-20	k42PF22	2	2	10	3.28	1.80	1.30	20.5
SB3-02	k32PF12	2	2	11	2.98	3.47	1.28	20.0
SB3-02	k32PF22	2	2	12	3.22	3.43	1.29	20.0
SB3-07	k38PF12	2	2	13	2.33	4.24	1.57	24.3
Batch 1	BCHPF222	2	2	14	2.54	2.44	1.98	21.5
U std	USTPF222	2	2	15	2.00	2.78	1.27	21.9
SB3-14	k34PF22	2	2	16	3.51	1.54	1.36	21.2
SB3-04	k22PF12	2	2	17	4.01	2.71	1.53	22.5
SB3-40	k19PF22	2	2	18	3.75	1.69	1.92	20.0
SB3-40	k19PF12	2	2	19	3.75	1.65	1.89	19.7
SB3-32	k36PF12	2	2	20	4.48	1.31	1.19	19.4
SB3-16	k27PF12	2	2	21	2.71	1.52	1.93	22.1
SB3-07	k38PF22	2	2	22	2.31	4.21	1.54	24.3
SB3-16	k27PF22	2	2	23	2.72	1.56	1.92	22.2
SB3-32	k36PF22	2	2	24	4.25	1.32	1.18	19.4
SB3-14	k34PF12	2	2	25	3.50	1.50	1.36	21.2
SB3-19	k18PF12	2	2	26	2.64	2.15	1.57	24.8
Batch 1	BCHPF223	2	2	27	2.59	2.44	2.00	21.8
U std	USTPF223	2	2	28	1.93	2.71	1.27	22.2
Batch 1	BCHPF311	3	1	1	2.48	2.57	1.98	22.4
U std	USTPF311	3	1	2	2.04	2.80	1.27	22.2
SB3-27	k06PF11	3	1	3	2.34	2.16	2.43	25.1
SB3-34	k09PF21	3	1	4	4.14	1.70	1.18	19.2
SB3-23	k17PF21	3	1	5	2.55	1.68	1.48	25.5
SB3-15	k37PF11	3	1	6	2.40	1.64	2.05	23.3
SB3-31	k08PF11	3	1	7	3.30	1.63	1.44	23.9
SB3-08	k30PF21	3	1	8	3.30	3.30	1.18	18.9
SB3-21	k25PF21	3	1	9	2.48	1.64	1.17	24.6
SB3-29	k11PF11	3	1	10	2.34	1.76	2.18	25.0
SB3-21	k25PF11	3	1	11	2.47	1.62	1.18	24.2
SB3-23	k17PF11	3	1	12	2.45	1.64	1.45	25.0

Table H.2: Measured Elemental Concentrations (wt%) for the SB3 Phase 1 Glasses Prepared Using Peroxide Fusion *(continued)*

Glass ID	SRTC-ML ID	Block	Sub-Block	Analytical Sequence	Al	B	Li	Si
Batch 1	BCHPF312	3	1	13	2.46	2.44	1.96	21.5
U std	USTPF312	3	1	14	1.97	2.79	1.26	21.9
SB3-24	k23PF21	3	1	15	3.51	1.34	1.17	20.0
SB3-08	k30PF11	3	1	16	3.36	3.34	1.21	19.3
SB3-24	k23PF11	3	1	17	3.58	1.33	1.16	20.0
SB3-05	k35PF11	3	1	18	2.64	1.63	2.00	23.0
SB3-15	k37PF21	3	1	19	2.45	1.68	2.09	23.9
SB3-27	k06PF21	3	1	20	2.33	2.14	2.47	25.1
SB3-05	k35PF21	3	1	21	2.54	1.88	2.30	25.6
SB3-29	k11PF21	3	1	22	2.42	1.75	2.21	25.0
SB3-31	k08PF21	3	1	23	3.22	1.63	1.45	23.8
SB3-34	k09PF11	3	1	24	4.19	1.69	1.22	19.6
Batch 1	BCHPF313	3	1	25	2.45	2.51	2.00	23.0
U std	USTPF313	3	1	26	1.98	2.83	1.31	22.7
Batch 1	BCHPF321	3	2	1	2.42	2.45	1.97	22.6
U std	USTPF321	3	2	2	1.92	2.78	1.29	22.1
SB3-34	k09PF22	3	2	3	4.04	1.69	1.19	19.1
SB3-23	k17PF22	3	2	4	2.48	1.68	1.48	25.7
SB3-21	k25PF22	3	2	5	2.53	1.65	1.20	25.0
SB3-31	k08PF22	3	2	6	3.18	1.62	1.44	23.9
SB3-27	k06PF22	3	2	7	2.29	2.11	2.43	25.1
SB3-29	k11PF12	3	2	8	2.38	1.77	2.21	25.4
SB3-05	k35PF22	3	2	9	2.53	1.85	2.27	25.6
SB3-08	k30PF12	3	2	10	3.37	3.34	1.22	19.7
SB3-24	k23PF12	3	2	11	3.63	1.33	1.18	20.3
SB3-08	k30PF22	3	2	12	3.36	3.35	1.21	19.5
Batch 1	BCHPF322	3	2	13	2.47	2.48	1.99	22.8
U std	USTPF322	3	2	14	2.10	2.81	1.28	22.3
SB3-05	k35PF12	3	2	15	2.71	1.68	2.01	23.6
SB3-15	k37PF12	3	2	16	2.44	1.67	2.07	23.9
SB3-23	k17PF12	3	2	17	2.51	1.69	1.47	25.8
SB3-15	k37PF22	3	2	18	2.47	1.70	2.07	24.6
SB3-29	k11PF22	3	2	19	2.47	1.78	2.22	25.7
SB3-34	k09PF12	3	2	20	4.21	1.69	1.22	19.7
SB3-27	k06PF12	3	2	21	2.41	2.18	2.48	25.9
SB3-24	k23PF22	3	2	22	3.54	1.34	1.19	20.8
SB3-31	k08PF12	3	2	23	3.42	1.67	1.49	24.8
SB3-21	k25PF12	3	2	24	2.57	1.67	1.21	25.1
Batch 1	BCHPF323	3	2	25	2.53	2.49	2.01	22.4
U std	USTPF323	3	2	26	2.05	2.83	1.32	23.1
Batch 1	BCHPF411	4	1	1	2.47	2.53	1.97	22.5
U std	USTPF411	4	1	2	2.08	2.72	1.27	22.1
SB3-26	k40PF11	4	1	3	3.50	1.41	2.00	21.2
SB3-37	k10PF21	4	1	4	2.59	1.67	2.43	25.5
SB3-11	k28PF11	4	1	5	2.57	1.77	2.21	25.7
SB3-01	k41PF11	4	1	6	2.32	4.10	1.50	23.7
SB3-11	k28PF21	4	1	7	2.51	1.79	2.27	25.3
SB3-26	k40PF21	4	1	8	3.32	1.34	1.93	20.7
SB3-30	k31PF11	4	1	9	3.77	1.35	1.72	20.1
SB3-17	k01PF11	4	1	10	2.77	1.71	1.57	24.9
SB3-01	k41PF21	4	1	11	2.29	4.08	1.49	23.7
SB3-42	k20PF21	4	1	12	3.72	1.47	2.78	20.4
Batch 1	BCHPF412	4	1	13	2.49	2.42	1.98	22.6
U std	USTPF412	4	1	14	2.04	2.78	1.29	21.9
SB3-38	k03PF21	4	1	15	3.89	1.38	1.93	20.9
SB3-38	k03PF11	4	1	16	3.80	1.31	1.90	20.2
SB3-17	k01PF21	4	1	17	2.71	1.73	1.57	26.0
SB3-13	k33PF21	4	1	18	2.54	1.82	1.66	25.7
SB3-41	k15PF11	4	1	19	2.40	1.82	2.68	24.9
SB3-37	k10PF11	4	1	20	2.65	1.67	2.47	25.8
SB3-41	k15PF21	4	1	21	2.50	1.82	2.68	24.9
SB3-42	k20PF11	4	1	22	3.80	1.48	2.89	20.8

**Table H.2: Measured Elemental Concentrations (wt%)
for the SB3 Phase 1 Glasses Prepared Using Peroxide Fusion** ***(continued)***

Glass ID	SRTC-ML ID	Block	Sub-Block	Analytical Sequence	Al	B	Li	Si
SB3-30	k31PF21	4	1	23	4.36	1.36	1.76	20.2
SB3-13	k33PF11	4	1	24	2.54	1.81	1.68	26.0
Batch 1	BCHPF413	4	1	25	2.57	2.34	1.99	21.2
U std	USTPF413	4	1	26	1.94	2.62	1.27	21.6
Batch 1	BCHPF421	4	2	1	2.49	2.51	1.99	22.3
U std	USTPF421	4	2	2	1.96	2.73	1.29	22.1
SB3-42	k20PF22	4	2	3	3.71	1.49	2.80	20.4
SB3-30	k31PF12	4	2	4	3.70	1.34	1.72	19.8
SB3-01	k41PF22	4	2	5	2.31	4.09	1.51	23.7
SB3-13	k33PF22	4	2	6	2.50	1.82	1.66	25.5
SB3-38	k03PF22	4	2	7	3.86	1.34	1.97	20.7
SB3-01	k41PF12	4	2	8	2.30	4.05	1.52	23.8
SB3-37	k10PF22	4	2	9	2.60	1.66	2.47	25.8
SB3-37	k10PF12	4	2	10	2.62	1.65	2.44	25.7
SB3-11	k28PF22	4	2	11	2.51	1.76	2.28	25.5
SB3-26	k40PF12	4	2	12	3.47	1.36	2.01	21.3
Batch 1	BCHPF422	4	2	13	2.50	2.38	1.99	22.7
U std	USTPF422	4	2	14	1.99	2.75	1.29	22.3
SB3-30	k31PF22	4	2	15	4.28	1.39	1.74	20.5
SB3-38	k03PF12	4	2	16	3.77	1.29	1.91	20.5
SB3-42	k20PF12	4	2	17	3.71	1.47	2.84	21.0
SB3-17	k01PF12	4	2	18	2.81	1.71	1.60	25.3
SB3-41	k15PF22	4	2	19	2.52	1.82	2.69	25.4
SB3-26	k40PF22	4	2	20	3.36	1.34	1.96	21.2
SB3-41	k15PF12	4	2	21	2.41	1.81	2.68	25.2
SB3-17	k01PF22	4	2	22	2.71	1.72	1.57	26.2
SB3-13	k33PF12	4	2	23	2.53	1.81	1.67	26.3
SB3-11	k28PF12	4	2	24	2.63	1.77	2.26	26.3
Batch 1	BCHPF423	4	2	25	2.53	2.45	2.01	22.5
U std	USTPF423	4	2	26	2.05	2.76	1.33	22.9

Table H.3: Re-Measurements Generated by the SRTC-ML (wt%)

Glass	Element			Oxide
		Remeasured #1	Remeasured #2	Average
SB3-4	Al	3.29	3.29	6.22
SB3-8	Cr	0.134	0.154	0.21
SB3-9	Fe	7.19	7.34	10.39
SB3-10	Mg	0.797	0.751	1.28
SB3-14	Cr	0.095	0.095	0.139
SB3-17	Ti	0.367	0.348	0.60
SB3-18	Fe	8.06	8.24	11.65
SB3-21	Cr	0.055	0.051	0.08
SB3-21	Fe	7.02	6.57	9.72
SB3-23	Cr	0.050	0.051	0.07
SB3-29	La	0.040	0.041	0.047
SB3-29	Ce	0.071	0.071	0.09
SB3-29	Cr	0.037	0.037	0.054
SB3-30	Al	3.80	3.76	7.14
SB3-31	Cr	0.058	0.059	0.09
SB3-32	Al	4.39	4.25	8.16
SB3-32	Ca	1.15	1.13	1.60
SB3-32	Na	12.4	11.4	16.07
SB3-38	Zr	0.330	0.323	0.441
SB3-39	Cr	0.065	0.066	0.10
SB3-42	Fe	7.91	7.93	11.33
SB3-42	Li	2.80	2.84	6.06

Table H.4: Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by Glass Number
(Batch 1: 100; 101-U std)

Glass #	Glass ID	Oxide	Measured (wt%)	Measured Bias-Corrected (wt%)	Targeted (wt%)	Diff of Measured	Diff of Meas BC	% Diff of Measured	% Diff of Meas BC
1	SB3-01	Al2O3 (wt%)	4.3553	4.4817	4.2500	0.1053	0.2317	2.5%	5.5%
1	SB3-01	B2O3 (wt%)	13.1372	13.0133	13.6000	-0.4628	-0.5867	-3.4%	-4.3%
1	SB3-01	BaO (wt%)	0.0458	0.0549	0.0590	-0.0132	-0.0041	-22.4%	-6.9%
1	SB3-01	CaO (wt%)	0.9126	0.8415	0.8450	0.0676	-0.0035	8.0%	-0.4%
1	SB3-01	Ce2O3 (wt%)	0.0741	0.0741	0.0830	-0.0089	-0.0089	-10.7%	-10.7%
1	SB3-01	Cr2O3 (wt%)	0.0650	0.0772	0.0880	-0.0230	-0.0108	-26.1%	-12.3%
1	SB3-01	CuO (wt%)	0.0498	0.0531	0.0470	0.0028	0.0061	5.9%	13.0%
1	SB3-01	Fe2O3 (wt%)	9.9936	9.6767	9.4550	0.5386	0.2217	5.7%	2.3%
1	SB3-01	K2O (wt%)	0.0726	0.0646	0.1010	-0.0284	-0.0364	-28.1%	-36.1%
1	SB3-01	La2O3 (wt%)	0.0358	0.0358	0.0480	-0.0122	-0.0122	-25.5%	-25.5%
1	SB3-01	Li2O (wt%)	3.2401	3.3523	3.4010	-0.1609	-0.0487	-4.7%	-1.4%
1	SB3-01	MgO (wt%)	0.0017	0.0018	0.0440	-0.0423	-0.0422	-96.2%	-95.9%
1	SB3-01	MnO (wt%)	1.5559	1.7213	1.6850	-0.1291	0.0363	-7.7%	2.2%
1	SB3-01	Na2O (wt%)	11.3333	10.9768	11.3640	-0.0307	-0.3872	-0.3%	-3.4%
1	SB3-01	NiO (wt%)	0.3283	0.3829	0.3780	-0.0497	0.0049	-13.1%	1.3%
1	SB3-01	PbO (wt%)	0.0566	0.0566	0.0710	-0.0144	-0.0144	-20.3%	-20.3%
1	SB3-01	SiO2 (wt%)	50.7549	53.4329	51.7850	-1.0301	1.6479	-2.0%	3.2%
1	SB3-01	ThO2 (wt%)	0.0930	0.0930	0.0340	0.0590	0.0590	173.6%	173.6%
1	SB3-01	TiO2 (wt%)	0.0083	0.0092	0.0000	0.0083	0.0092		
1	SB3-01	U3O8 (wt%)	2.3613	2.4708	2.3920	-0.0307	0.0788	-1.3%	3.3%
1	SB3-01	ZnO (wt%)	0.0722	0.0722	0.0970	-0.0248	-0.0248	-25.6%	-25.6%
1	SB3-01	ZrO2 (wt%)	0.1408	0.1408	0.1740	-0.0332	-0.0332	-19.1%	-19.1%
1	SB3-01	Sum of Oxides	98.6882	101.0834	100.0010	-1.3128	1.0824	-1.3%	1.1%
2	SB3-02	Al2O3 (wt%)	5.8858	5.9732	5.7110	0.1748	0.2622	3.1%	4.6%
2	SB3-02	B2O3 (wt%)	11.2697	11.0721	11.4000	-0.1304	-0.3279	-1.1%	-2.9%
2	SB3-02	BaO (wt%)	0.0720	0.0786	0.0790	-0.0070	-0.0004	-8.8%	-0.4%
2	SB3-02	CaO (wt%)	1.1736	1.1183	1.1360	0.0376	-0.0177	3.3%	-1.6%
2	SB3-02	Ce2O3 (wt%)	0.1119	0.1119	0.1120	-0.0001	-0.0001	-0.1%	-0.1%
2	SB3-02	Cr2O3 (wt%)	0.0939	0.0999	0.1180	-0.0241	-0.0181	-20.4%	-15.3%
2	SB3-02	CuO (wt%)	0.0595	0.0624	0.0630	-0.0035	-0.0006	-5.6%	-1.0%
2	SB3-02	Fe2O3 (wt%)	12.3383	12.5287	12.7050	-0.3667	-0.1763	-2.9%	-1.4%
2	SB3-02	K2O (wt%)	0.1147	0.1027	0.1360	-0.0213	-0.0333	-15.6%	-24.5%
2	SB3-02	La2O3 (wt%)	0.0607	0.0607	0.0650	-0.0043	-0.0043	-6.6%	-6.6%
2	SB3-02	Li2O (wt%)	2.7988	2.8908	2.8510	-0.0522	0.0398	-1.8%	1.4%
2	SB3-02	MgO (wt%)	0.0340	0.0340	0.0600	-0.0260	-0.0260	-43.3%	-43.3%
2	SB3-02	MnO (wt%)	2.1337	2.0541	2.2640	-0.1303	-0.2099	-5.8%	-9.3%
2	SB3-02	Na2O (wt%)	15.9064	14.8729	15.2700	0.6364	-0.3971	4.2%	-2.6%
2	SB3-02	NiO (wt%)	0.4505	0.4915	0.5080	-0.0575	-0.0165	-11.3%	-3.3%
2	SB3-02	PbO (wt%)	0.0840	0.0840	0.0950	-0.0110	-0.0110	-11.6%	-11.6%
2	SB3-02	SiO2 (wt%)	43.5348	46.8415	43.8050	-0.2702	3.0365	-0.6%	6.9%
2	SB3-02	ThO2 (wt%)	0.1448	0.1448	0.0450	0.0998	0.0998	221.8%	221.8%
2	SB3-02	TiO2 (wt%)	0.0083	0.0088	0.0000	0.0083	0.0088		
2	SB3-02	U3O8 (wt%)	2.9922	3.1520	3.2140	-0.2218	-0.0620	-6.9%	-1.9%
2	SB3-02	ZnO (wt%)	0.1232	0.1232	0.1300	-0.0068	-0.0068	-5.2%	-5.2%
2	SB3-02	ZrO2 (wt%)	0.2009	0.2009	0.2340	-0.0331	-0.0331	-14.1%	-14.1%
2	SB3-02	Sum of Oxides	99.5916	102.1069	100.0010	-0.4094	2.1059	-0.4%	2.1%
3	SB3-03	Al2O3 (wt%)	4.5726	4.5689	4.2500	0.3226	0.3189	7.6%	7.5%
3	SB3-03	B2O3 (wt%)	10.2795	9.9523	10.2000	0.0795	-0.2477	0.8%	-2.4%
3	SB3-03	BaO (wt%)	0.0525	0.0573	0.0590	-0.0065	-0.0017	-11.1%	-2.9%
3	SB3-03	CaO (wt%)	0.8577	0.8174	0.8450	0.0127	-0.0276	1.5%	-3.3%
3	SB3-03	Ce2O3 (wt%)	0.0843	0.0843	0.0830	0.0013	0.0013	1.6%	1.6%
3	SB3-03	Cr2O3 (wt%)	0.1060	0.1128	0.0880	0.0180	0.0248	20.4%	28.1%
3	SB3-03	CuO (wt%)	0.0429	0.0450	0.0470	-0.0041	-0.0020	-8.8%	-4.3%

Table H.4: Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by Glass Number *(continued)*
(Batch 1: 100; 101-U std)

Glass #	Glass ID	Oxide	Measured (wt%)	Measured Bias-Corrected (wt%)	Targeted (wt%)	Diff of Measured	Diff of Meas BC	% Diff of Measured	% Diff of Meas BC
3	SB3-03	Fe2O3 (wt%)	8.8141	8.9471	9.4550	-0.6409	-0.5079	-6.8%	-5.4%
3	SB3-03	K2O (wt%)	0.0723	0.0647	0.1010	-0.0287	-0.0363	-28.4%	-36.0%
3	SB3-03	La2O3 (wt%)	0.0367	0.0367	0.0480	-0.0114	-0.0114	-23.6%	-23.6%
3	SB3-03	Li2O (wt%)	3.2993	3.4306	3.4010	-0.1017	0.0296	-3.0%	0.9%
3	SB3-03	MgO (wt%)	0.0137	0.0137	0.0440	-0.0303	-0.0303	-68.9%	-68.9%
3	SB3-03	MnO (wt%)	1.6301	1.5718	1.6850	-0.0549	-0.1132	-3.3%	-6.7%
3	SB3-03	Na2O (wt%)	12.0141	11.2328	11.3640	0.6500	-0.1312	5.7%	-1.2%
3	SB3-03	NiO (wt%)	0.3413	0.3725	0.3780	-0.0367	-0.0055	-9.7%	-1.5%
3	SB3-03	PbO (wt%)	0.0606	0.0606	0.0710	-0.0104	-0.0104	-14.7%	-14.7%
3	SB3-03	SiO2 (wt%)	55.7288	59.8711	55.1850	0.5438	4.6861	1.0%	8.5%
3	SB3-03	ThO2 (wt%)	0.1072	0.1072	0.0340	0.0732	0.0732	215.4%	215.4%
3	SB3-03	TiO2 (wt%)	0.0017	0.0018	0.0000	0.0017	0.0018		
3	SB3-03	U3O8 (wt%)	2.2464	2.3667	2.3920	-0.1456	-0.0253	-6.1%	-1.1%
3	SB3-03	ZnO (wt%)	0.0790	0.0790	0.0970	-0.0180	-0.0180	-18.5%	-18.5%
3	SB3-03	ZrO2 (wt%)	0.1547	0.1547	0.1740	-0.0193	-0.0193	-11.1%	-11.1%
3	SB3-03	Sum of Oxides	100.5954	103.9489	100.0010	0.5944	3.9479	0.6%	3.9%
4	SB3-04	Al2O3 (wt%)	6.9345	7.0373	6.1090	0.8255	0.9283	13.5%	15.2%
4	SB3-04	B2O3 (wt%)	8.4844	8.3356	8.1000	0.3844	0.2356	4.7%	2.9%
4	SB3-04	BaO (wt%)	0.0756	0.0840	0.0840	-0.0084	0.0000	-9.9%	-0.1%
4	SB3-04	CaO (wt%)	1.3104	1.2256	1.2150	0.0954	0.0106	7.8%	0.9%
4	SB3-04	Ce2O3 (wt%)	0.1154	0.1154	0.1200	-0.0046	-0.0046	-3.9%	-3.9%
4	SB3-04	Cr2O3 (wt%)	0.1206	0.1282	0.1260	-0.0054	0.0022	-4.3%	1.8%
4	SB3-04	CuO (wt%)	0.0701	0.0747	0.0670	0.0031	0.0077	4.6%	11.5%
4	SB3-04	Fe2O3 (wt%)	13.4249	13.2909	13.5910	-0.1661	-0.3001	-1.2%	-2.2%
4	SB3-04	K2O (wt%)	0.1376	0.1234	0.1450	-0.0074	-0.0216	-5.1%	-14.9%
4	SB3-04	La2O3 (wt%)	0.0569	0.0569	0.0690	-0.0121	-0.0121	-17.6%	-17.6%
4	SB3-04	Li2O (wt%)	3.0087	3.1075	2.7010	0.3077	0.4065	11.4%	15.0%
4	SB3-04	MgO (wt%)	0.0195	0.0203	0.0640	-0.0445	-0.0437	-69.6%	-68.2%
4	SB3-04	MnO (wt%)	2.2305	2.4044	2.4220	-0.1915	-0.0176	-7.9%	-0.7%
4	SB3-04	Na2O (wt%)	16.6141	15.6186	16.3350	0.2791	-0.7164	1.7%	-4.4%
4	SB3-04	NiO (wt%)	0.4616	0.5252	0.5440	-0.0824	-0.0188	-15.1%	-3.5%
4	SB3-04	PbO (wt%)	0.0840	0.0840	0.1020	-0.0180	-0.0180	-17.6%	-17.6%
4	SB3-04	SiO2 (wt%)	46.4763	50.0069	44.3280	2.1483	5.6789	4.8%	12.8%
4	SB3-04	ThO2 (wt%)	0.1397	0.1397	0.0480	0.0917	0.0917	191.0%	191.0%
4	SB3-04	TiO2 (wt%)	0.0083	0.0090	0.0000	0.0083	0.0090		
4	SB3-04	U3O8 (wt%)	3.2664	3.4177	3.4380	-0.1716	-0.0203	-5.0%	-0.6%
4	SB3-04	ZnO (wt%)	0.1226	0.1226	0.1390	-0.0164	-0.0164	-11.8%	-11.8%
4	SB3-04	ZrO2 (wt%)	0.2138	0.2138	0.2510	-0.0372	-0.0372	-14.8%	-14.8%
4	SB3-04	Sum of Oxides	103.3758	106.1417	99.9980	3.3778	6.1437	3.4%	6.1%
5	SB3-05	Al2O3 (wt%)	4.9221	5.1470	4.4240	0.4981	0.7230	11.3%	16.3%
5	SB3-05	B2O3 (wt%)	5.6670	5.4973	5.5200	0.1470	-0.0227	2.7%	-0.4%
5	SB3-05	BaO (wt%)	0.0514	0.0555	0.0610	-0.0096	-0.0055	-15.8%	-9.0%
5	SB3-05	CaO (wt%)	0.9620	0.8887	0.8800	0.0820	0.0087	9.3%	1.0%
5	SB3-05	Ce2O3 (wt%)	0.0846	0.0846	0.0870	-0.0024	-0.0024	-2.7%	-2.7%
5	SB3-05	Cr2O3 (wt%)	0.0782	0.0822	0.0910	-0.0128	-0.0088	-14.1%	-9.7%
5	SB3-05	CuO (wt%)	0.0469	0.0497	0.0480	-0.0011	0.0017	-2.2%	3.5%
5	SB3-05	Fe2O3 (wt%)	9.9829	9.9095	9.8410	0.1419	0.0685	1.4%	0.7%
5	SB3-05	K2O (wt%)	0.0741	0.0663	0.1050	-0.0309	-0.0387	-29.4%	-36.9%
5	SB3-05	La2O3 (wt%)	0.0372	0.0372	0.0500	-0.0128	-0.0128	-25.5%	-25.5%
5	SB3-05	Li2O (wt%)	4.6180	4.7861	4.8310	-0.2130	-0.0449	-4.4%	-0.9%
5	SB3-05	MgO (wt%)	1.4028	1.4117	1.4260	-0.0232	-0.0143	-1.6%	-1.0%
5	SB3-05	MnO (wt%)	1.7108	1.7708	1.7540	-0.0432	0.0168	-2.5%	1.0%
5	SB3-05	Na2O (wt%)	13.9552	13.4077	13.6610	0.2942	-0.2533	2.2%	-1.9%

Table H.4: Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by Glass Number *(continued)*
(Batch 1: 100; 101-U std)

Glass #	Glass ID	Oxide	Measured (wt%)	Measured Bias-Corrected (wt%)	Targeted (wt%)	Diff of Measured	Diff of Meas BC	% Diff of Measured	% Diff of Meas BC
5	SB3-05	NiO (wt%)	0.3620	0.3997	0.3940	-0.0320	0.0057	-8.1%	1.5%
5	SB3-05	PbO (wt%)	0.0692	0.0692	0.0740	-0.0048	-0.0048	-6.5%	-6.5%
5	SB3-05	SiO2 (wt%)	52.3059	54.6941	53.9470	-1.6411	0.7471	-3.0%	1.4%
5	SB3-05	ThO2 (wt%)	0.1038	0.1038	0.0350	0.0688	0.0688	196.7%	196.7%
5	SB3-05	TiO2 (wt%)	0.0083	0.0088	0.0000	0.0083	0.0088		
5	SB3-05	U3O8 (wt%)	2.4822	2.5752	2.4900	-0.0078	0.0852	-0.3%	3.4%
5	SB3-05	ZnO (wt%)	0.0856	0.0856	0.1000	-0.0144	-0.0144	-14.4%	-14.4%
5	SB3-05	ZrO2 (wt%)	0.1722	0.1722	0.1820	-0.0098	-0.0098	-5.4%	-5.4%
5	SB3-05	Sum of Oxides	99.1825	101.3029	100.0010	-0.8185	1.3019	-0.8%	1.3%
6	SB3-06	Al2O3 (wt%)	5.5268	5.5314	5.4230	0.1038	0.1084	1.9%	2.0%
6	SB3-06	B2O3 (wt%)	5.0713	4.9073	4.9600	0.1113	-0.0527	2.2%	-1.1%
6	SB3-06	BaO (wt%)	0.0656	0.0728	0.0750	-0.0094	-0.0022	-12.5%	-2.9%
6	SB3-06	CaO (wt%)	1.1554	1.0806	1.0780	0.0774	0.0026	7.2%	0.2%
6	SB3-06	Ce2O3 (wt%)	0.1019	0.1019	0.1060	-0.0041	-0.0041	-3.9%	-3.9%
6	SB3-06	Cr2O3 (wt%)	0.1074	0.1142	0.1120	-0.0046	0.0022	-4.1%	2.0%
6	SB3-06	CuO (wt%)	0.0626	0.0667	0.0590	0.0036	0.0077	6.1%	13.1%
6	SB3-06	Fe2O3 (wt%)	11.9237	11.8025	12.0630	-0.1393	-0.2605	-1.2%	-2.2%
6	SB3-06	K2O (wt%)	0.1027	0.0921	0.1290	-0.0263	-0.0369	-20.4%	-28.6%
6	SB3-06	La2O3 (wt%)	0.0522	0.0522	0.0620	-0.0098	-0.0098	-15.8%	-15.8%
6	SB3-06	Li2O (wt%)	4.1497	4.3136	4.3410	-0.1913	-0.0274	-4.4%	-0.6%
6	SB3-06	MgO (wt%)	1.2374	1.2906	1.2960	-0.0586	-0.0054	-4.5%	-0.4%
6	SB3-06	MnO (wt%)	2.0143	2.1711	2.1500	-0.1357	0.0211	-6.3%	1.0%
6	SB3-06	Na2O (wt%)	15.6368	14.7017	15.3900	0.2468	-0.6883	1.6%	-4.5%
6	SB3-06	NiO (wt%)	0.4288	0.4879	0.4830	-0.0542	0.0049	-11.2%	1.0%
6	SB3-06	PbO (wt%)	0.0811	0.0811	0.0910	-0.0099	-0.0099	-10.9%	-10.9%
6	SB3-06	SiO2 (wt%)	48.8295	52.4440	48.7420	0.0875	3.7020	0.2%	7.6%
6	SB3-06	ThO2 (wt%)	0.1274	0.1274	0.0430	0.0844	0.0844	196.4%	196.4%
6	SB3-06	TiO2 (wt%)	0.0083	0.0090	0.0000	0.0083	0.0090		
6	SB3-06	U3O8 (wt%)	3.0188	3.1586	3.0520	-0.0332	0.1066	-1.1%	3.5%
6	SB3-06	ZnO (wt%)	0.1061	0.1061	0.1230	-0.0169	-0.0169	-13.7%	-13.7%
6	SB3-06	ZrO2 (wt%)	0.1959	0.1959	0.2230	-0.0271	-0.0271	-12.2%	-12.2%
6	SB3-06	Sum of Oxides	100.0037	102.9088	100.0010	0.0027	2.9078	0.0%	2.9%
7	SB3-07	Al2O3 (wt%)	4.4970	4.5637	4.2810	0.2160	0.2827	5.0%	6.6%
7	SB3-07	B2O3 (wt%)	13.9100	13.6659	14.0000	-0.0900	-0.3341	-0.6%	-2.4%
7	SB3-07	BaO (wt%)	0.0497	0.0537	0.0590	-0.0093	-0.0053	-15.8%	-9.0%
7	SB3-07	CaO (wt%)	0.9336	0.8625	0.8510	0.0826	0.0115	9.7%	1.4%
7	SB3-07	Ce2O3 (wt%)	0.0811	0.0811	0.0840	-0.0029	-0.0029	-3.4%	-3.4%
7	SB3-07	Cr2O3 (wt%)	0.0826	0.0868	0.0880	-0.0054	-0.0012	-6.2%	-1.4%
7	SB3-07	CuO (wt%)	0.0466	0.0493	0.0470	-0.0004	0.0023	-0.8%	5.0%
7	SB3-07	Fe2O3 (wt%)	9.3073	9.2396	9.5230	-0.2157	-0.2834	-2.3%	-3.0%
7	SB3-07	K2O (wt%)	0.0783	0.0700	0.1020	-0.0237	-0.0320	-23.2%	-31.4%
7	SB3-07	La2O3 (wt%)	0.0381	0.0381	0.0490	-0.0109	-0.0109	-22.2%	-22.2%
7	SB3-07	Li2O (wt%)	3.4393	3.5523	3.5010	-0.0617	0.0513	-1.8%	1.5%
7	SB3-07	MgO (wt%)	0.0120	0.0121	0.0450	-0.0330	-0.0329	-73.3%	-73.1%
7	SB3-07	MnO (wt%)	1.6850	1.7440	1.6970	-0.0120	0.0470	-0.7%	2.8%
7	SB3-07	Na2O (wt%)	9.3720	9.0048	9.2130	0.1590	-0.2082	1.7%	-2.3%
7	SB3-07	NiO (wt%)	0.3611	0.3987	0.3810	-0.0199	0.0177	-5.2%	4.6%
7	SB3-07	PbO (wt%)	0.0665	0.0665	0.0720	-0.0055	-0.0055	-7.6%	-7.6%
7	SB3-07	SiO2 (wt%)	53.2151	57.2558	53.2910	-0.0759	3.9648	-0.1%	7.4%
7	SB3-07	ThO2 (wt%)	0.0984	0.0984	0.0340	0.0644	0.0644	189.5%	189.5%
7	SB3-07	TiO2 (wt%)	0.0050	0.0053	0.0000	0.0050	0.0053		
7	SB3-07	U3O8 (wt%)	2.3761	2.4651	2.4090	-0.0329	0.0561	-1.4%	2.3%
7	SB3-07	ZnO (wt%)	0.0890	0.0890	0.0970	-0.0080	-0.0080	-8.2%	-8.2%

Table H.4: Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by Glass Number *(continued)*
(Batch 1: 100; 101-U std)

Glass #	Glass ID	Oxide	Measured (wt%)	Measured Bias-Corrected (wt%)	Targeted (wt%)	Diff of Measured	Diff of Meas BC	% Diff of Measured	% Diff of Meas BC
7	SB3-07	ZrO2 (wt%)	0.1672	0.1672	0.1760	-0.0088	-0.0088	-5.0%	-5.0%
7	SB3-07	Sum of Oxides	99.9110	103.5698	100.0000	-0.0890	3.5698	-0.1%	3.6%
8	SB3-08	Al2O3 (wt%)	6.3251	6.6140	6.5640	-0.2389	0.0500	-3.6%	0.8%
8	SB3-08	B2O3 (wt%)	10.7303	10.4091	10.8000	-0.0697	-0.3909	-0.6%	-3.6%
8	SB3-08	BaO (wt%)	0.0737	0.0885	0.0910	-0.0173	-0.0025	-19.0%	-2.8%
8	SB3-08	CaO (wt%)	1.3933	1.2847	1.3050	0.0883	-0.0203	6.8%	-1.6%
8	SB3-08	Ce2O3 (wt%)	0.1189	0.1189	0.1290	-0.0101	-0.0101	-7.8%	-7.8%
8	SB3-08	Cr2O3 (wt%)	0.1823	0.2165	0.1360	0.0463	0.0805	34.1%	59.2%
8	SB3-08	CuO (wt%)	0.0742	0.0792	0.0720	0.0022	0.0072	3.0%	10.0%
8	SB3-08	Fe2O3 (wt%)	14.9761	14.5031	14.6030	0.3731	-0.0999	2.6%	-0.7%
8	SB3-08	K2O (wt%)	0.1331	0.1185	0.1560	-0.0229	-0.0375	-14.7%	-24.1%
8	SB3-08	La2O3 (wt%)	0.0598	0.0598	0.0750	-0.0152	-0.0152	-20.2%	-20.2%
8	SB3-08	Li2O (wt%)	2.5942	2.6886	2.7010	-0.1068	-0.0124	-4.0%	-0.5%
8	SB3-08	MgO (wt%)	0.0199	0.0216	0.0680	-0.0481	-0.0464	-70.7%	-68.2%
8	SB3-08	MnO (wt%)	2.4113	2.6677	2.6020	-0.1907	0.0657	-7.3%	2.5%
8	SB3-08	Na2O (wt%)	14.0866	13.6455	14.1270	-0.0404	-0.4815	-0.3%	-3.4%
8	SB3-08	NiO (wt%)	0.4626	0.5395	0.5840	-0.1214	-0.0445	-20.8%	-7.6%
8	SB3-08	PbO (wt%)	0.0972	0.0972	0.1100	-0.0128	-0.0128	-11.6%	-11.6%
8	SB3-08	SiO2 (wt%)	41.3955	43.2836	41.7120	-0.3165	1.5716	-0.8%	3.8%
8	SB3-08	ThO2 (wt%)	0.1468	0.1468	0.0520	0.0948	0.0948	182.3%	182.3%
8	SB3-08	TiO2 (wt%)	0.0083	0.0092	0.0000	0.0083	0.0092		
8	SB3-08	U3O8 (wt%)	3.6290	3.7972	3.6940	-0.0650	0.1032	-1.8%	2.8%
8	SB3-08	ZnO (wt%)	0.1226	0.1226	0.1490	-0.0264	-0.0264	-17.7%	-17.7%
8	SB3-08	ZrO2 (wt%)	0.2252	0.2252	0.2690	-0.0438	-0.0438	-16.3%	-16.3%
8	SB3-08	Sum of Oxides	99.2660	100.7370	99.9990	-0.7330	0.7380	-0.7%	0.7%
9	SB3-09	Al2O3 (wt%)	5.1678	5.1695	4.9940	0.1738	0.1755	3.5%	3.5%
9	SB3-09	B2O3 (wt%)	9.7080	9.3949	9.7500	-0.0420	-0.3551	-0.4%	-3.6%
9	SB3-09	BaO (wt%)	0.0581	0.0634	0.0690	-0.0109	-0.0056	-15.9%	-8.1%
9	SB3-09	CaO (wt%)	1.0284	0.9800	0.9930	0.0354	-0.0130	3.6%	-1.3%
9	SB3-09	Ce2O3 (wt%)	0.1253	0.1253	0.0980	0.0273	0.0273	27.9%	27.9%
9	SB3-09	Cr2O3 (wt%)	0.0950	0.1011	0.1030	-0.0080	-0.0019	-7.8%	-1.8%
9	SB3-09	CuO (wt%)	0.0532	0.0558	0.0550	-0.0018	0.0008	-3.3%	1.5%
9	SB3-09	Fe2O3 (wt%)	9.9543	10.1049	11.1110	-1.1567	-1.0061	-10.4%	-9.1%
9	SB3-09	K2O (wt%)	0.1018	0.0911	0.1190	-0.0172	-0.0279	-14.5%	-23.4%
9	SB3-09	La2O3 (wt%)	0.0765	0.0765	0.0570	0.0195	0.0195	34.3%	34.3%
9	SB3-09	Li2O (wt%)	3.1163	3.2397	3.2510	-0.1347	-0.0113	-4.1%	-0.3%
9	SB3-09	MgO (wt%)	0.0203	0.0203	0.0520	-0.0317	-0.0317	-60.9%	-60.9%
9	SB3-09	MnO (wt%)	1.8819	1.8138	1.9800	-0.0981	-0.1662	-5.0%	-8.4%
9	SB3-09	Na2O (wt%)	11.3367	10.5999	10.7490	0.5877	-0.1491	5.5%	-1.4%
9	SB3-09	NiO (wt%)	0.3970	0.4333	0.4450	-0.0480	-0.0117	-10.8%	-2.6%
9	SB3-09	PbO (wt%)	0.0716	0.0716	0.0830	-0.0114	-0.0114	-13.7%	-13.7%
9	SB3-09	SiO2 (wt%)	53.0546	56.9880	52.9220	0.1326	4.0660	0.3%	7.7%
9	SB3-09	ThO2 (wt%)	0.1289	0.1289	0.0390	0.0899	0.0899	230.4%	230.4%
9	SB3-09	TiO2 (wt%)	0.0017	0.0018	0.0000	0.0017	0.0018		
9	SB3-09	U3O8 (wt%)	2.6886	2.8325	2.8110	-0.1224	0.0215	-4.4%	0.8%
9	SB3-09	ZnO (wt%)	0.0946	0.0946	0.1130	-0.0184	-0.0184	-16.3%	-16.3%
9	SB3-09	ZrO2 (wt%)	0.1857	0.1857	0.2050	-0.0193	-0.0193	-9.4%	-9.4%
9	SB3-09	Sum of Oxides	99.3464	102.5727	99.9990	-0.6526	2.5737	-0.7%	2.6%
10	SB3-10	Al2O3 (wt%)	7.1612	7.1624	7.1350	0.0262	0.0274	0.4%	0.4%
10	SB3-10	B2O3 (wt%)	7.6392	7.3941	7.5000	0.1392	-0.1059	1.9%	-1.4%
10	SB3-10	BaO (wt%)	0.0893	0.0976	0.0990	-0.0097	-0.0014	-9.8%	-1.4%
10	SB3-10	CaO (wt%)	1.4936	1.4234	1.4190	0.0746	0.0044	5.3%	0.3%
10	SB3-10	Ce2O3 (wt%)	0.1420	0.1420	0.1400	0.0020	0.0020	1.4%	1.4%

Table H.4: Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by Glass Number *(continued)*
(Batch 1: 100; 101-U std)

Glass #	Glass ID	Oxide	Measured (wt%)	Measured Bias-Corrected (wt%)	Targeted (wt%)	Diff of Measured	Diff of Meas BC	% Diff of Measured	% Diff of Meas BC
10	SB3-10	Cr2O3 (wt%)	0.1421	0.1512	0.1470	-0.0049	0.0042	-3.3%	2.9%
10	SB3-10	CuO (wt%)	0.0764	0.0801	0.0780	-0.0016	0.0021	-2.1%	2.7%
10	SB3-10	Fe2O3 (wt%)	14.9904	15.2186	15.8720	-0.8816	-0.6534	-5.6%	-4.1%
10	SB3-10	K2O (wt%)	0.1765	0.1579	0.1700	0.0065	-0.0121	3.8%	-7.1%
10	SB3-10	La2O3 (wt%)	0.0666	0.0666	0.0810	-0.0144	-0.0144	-17.8%	-17.8%
10	SB3-10	Li2O (wt%)	2.4382	2.5347	2.5010	-0.0628	0.0337	-2.5%	1.3%
10	SB3-10	MgO (wt%)	1.1694	1.1723	0.0740	1.0954	1.0983	1480.2%	1484.2%
10	SB3-10	MnO (wt%)	2.7277	2.6291	2.8290	-0.1013	-0.1999	-3.6%	-7.1%
10	SB3-10	Na2O (wt%)	16.2434	15.1861	15.3560	0.8874	-0.1699	5.8%	-1.1%
10	SB3-10	NiO (wt%)	0.5599	0.6110	0.6350	-0.0751	-0.0240	-11.8%	-3.8%
10	SB3-10	PbO (wt%)	0.1050	0.1050	0.1190	-0.0140	-0.0140	-11.7%	-11.7%
10	SB3-10	SiO2 (wt%)	41.6094	44.6991	41.3180	0.2914	3.3811	0.7%	8.2%
10	SB3-10	ThO2 (wt%)	0.1909	0.1909	0.0560	0.1349	0.1349	240.9%	240.9%
10	SB3-10	TiO2 (wt%)	0.0042	0.0044	0.0000	0.0042	0.0044		
10	SB3-10	U3O8 (wt%)	3.8766	4.0840	4.0160	-0.1394	0.0680	-3.5%	1.7%
10	SB3-10	ZnO (wt%)	0.1444	0.1444	0.1620	-0.0176	-0.0176	-10.9%	-10.9%
10	SB3-10	ZrO2 (wt%)	0.2705	0.2705	0.2930	-0.0225	-0.0225	-7.7%	-7.7%
10	SB3-10	Sum of Oxides	101.3168	103.5251	100.0000	1.3168	3.5251	1.3%	3.5%
11	SB3-11	Al2O3 (wt%)	4.8277	4.9678	4.4710	0.3567	0.4968	8.0%	11.1%
11	SB3-11	B2O3 (wt%)	5.7073	5.6535	5.6800	0.0273	-0.0265	0.5%	-0.5%
11	SB3-11	BaO (wt%)	0.0514	0.0555	0.0620	-0.0106	-0.0065	-17.2%	-10.5%
11	SB3-11	CaO (wt%)	0.9654	0.8919	0.8890	0.0764	0.0029	8.6%	0.3%
11	SB3-11	Ce2O3 (wt%)	0.0940	0.0940	0.0880	0.0060	0.0060	6.8%	6.8%
11	SB3-11	Cr2O3 (wt%)	0.0914	0.0960	0.0920	-0.0006	0.0040	-0.7%	4.3%
11	SB3-11	CuO (wt%)	0.0482	0.0510	0.0490	-0.0008	0.0020	-1.6%	4.1%
11	SB3-11	Fe2O3 (wt%)	9.4289	9.3596	9.9460	-0.5171	-0.5864	-5.2%	-5.9%
11	SB3-11	K2O (wt%)	0.0738	0.0660	0.1060	-0.0322	-0.0400	-30.4%	-37.8%
11	SB3-11	La2O3 (wt%)	0.0498	0.0498	0.0510	-0.0012	-0.0012	-2.3%	-2.3%
11	SB3-11	Li2O (wt%)	4.8548	5.0229	4.9710	-0.1162	0.0519	-2.3%	1.0%
11	SB3-11	MgO (wt%)	1.4239	1.4321	1.4670	-0.0431	-0.0349	-2.9%	-2.4%
11	SB3-11	MnO (wt%)	1.7076	1.7672	1.7730	-0.0654	-0.0058	-3.7%	-0.3%
11	SB3-11	Na2O (wt%)	11.6973	11.2383	11.5500	0.1473	-0.3117	1.3%	-2.7%
11	SB3-11	NiO (wt%)	0.3598	0.3971	0.3980	-0.0382	-0.0009	-9.6%	-0.2%
11	SB3-11	PbO (wt%)	0.0700	0.0700	0.0750	-0.0050	-0.0050	-6.6%	-6.6%
11	SB3-11	SiO2 (wt%)	54.9800	57.8775	55.4960	-0.5160	2.3815	-0.9%	4.3%
11	SB3-11	ThO2 (wt%)	0.1004	0.1004	0.0350	0.0654	0.0654	186.9%	186.9%
11	SB3-11	TiO2 (wt%)	0.0083	0.0088	0.0000	0.0083	0.0088		
11	SB3-11	U3O8 (wt%)	2.4233	2.5140	2.5160	-0.0927	-0.0020	-3.7%	-0.1%
11	SB3-11	ZnO (wt%)	0.0831	0.0831	0.1020	-0.0189	-0.0189	-18.5%	-18.5%
11	SB3-11	ZrO2 (wt%)	0.1756	0.1756	0.1840	-0.0084	-0.0084	-4.6%	-4.6%
11	SB3-11	Sum of Oxides	99.2219	101.9723	100.0010	-0.7791	1.9713	-0.8%	2.0%
12	SB3-12	Al2O3 (wt%)	7.0337	7.1380	7.0920	-0.0583	0.0460	-0.8%	0.6%
12	SB3-12	B2O3 (wt%)	4.2342	4.1600	4.3200	-0.0858	-0.1600	-2.0%	-3.7%
12	SB3-12	BaO (wt%)	0.0865	0.0935	0.0980	-0.0115	-0.0045	-11.7%	-4.6%
12	SB3-12	CaO (wt%)	1.5202	1.4044	1.4100	0.1102	-0.0056	7.8%	-0.4%
12	SB3-12	Ce2O3 (wt%)	0.1388	0.1388	0.1390	-0.0002	-0.0002	-0.1%	-0.1%
12	SB3-12	Cr2O3 (wt%)	0.1272	0.1336	0.1470	-0.0198	-0.0134	-13.5%	-9.1%
12	SB3-12	CuO (wt%)	0.0776	0.0821	0.0780	-0.0004	0.0041	-0.5%	5.3%
12	SB3-12	Fe2O3 (wt%)	14.7617	14.6530	15.7770	-1.0153	-1.1240	-6.4%	-7.1%
12	SB3-12	K2O (wt%)	0.1593	0.1424	0.1690	-0.0097	-0.0266	-5.7%	-15.7%
12	SB3-12	La2O3 (wt%)	0.0654	0.0654	0.0810	-0.0156	-0.0156	-19.3%	-19.3%
12	SB3-12	Li2O (wt%)	3.5308	3.6468	3.7810	-0.2502	-0.1342	-6.6%	-3.5%
12	SB3-12	MgO (wt%)	1.1209	1.1273	1.1540	-0.0331	-0.0267	-2.9%	-2.3%

Table H.4: Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by Glass Number *(continued)*
(Batch 1: 100; 101-U std)

Glass #	Glass ID	Oxide	Measured (wt%)	Measured Bias-Corrected (wt%)	Targeted (wt%)	Diff of Measured	Diff of Meas BC	% Diff of Measured	% Diff of Meas BC
12	SB3-12	MnO (wt%)	2.6502	2.7426	2.8120	-0.1618	-0.0694	-5.8%	-2.5%
12	SB3-12	Na2O (wt%)	14.9965	14.4114	14.8040	0.1925	-0.3926	1.3%	-2.7%
12	SB3-12	NiO (wt%)	0.5281	0.5829	0.6310	-0.1029	-0.0481	-16.3%	-7.6%
12	SB3-12	PbO (wt%)	0.1091	0.1091	0.1180	-0.0089	-0.0089	-7.6%	-7.6%
12	SB3-12	SiO2 (wt%)	41.5024	44.6537	42.8900	-1.3876	1.7637	-3.2%	4.1%
12	SB3-12	ThO2 (wt%)	0.1715	0.1715	0.0560	0.1155	0.1155	206.3%	206.3%
12	SB3-12	TiO2 (wt%)	0.0071	0.0075	0.0000	0.0071	0.0075		
12	SB3-12	U3O8 (wt%)	3.9651	4.1136	3.9910	-0.0259	0.1226	-0.6%	3.1%
12	SB3-12	ZnO (wt%)	0.1447	0.1447	0.1610	-0.0163	-0.0163	-10.1%	-10.1%
12	SB3-12	ZrO2 (wt%)	0.2749	0.2749	0.2910	-0.0161	-0.0161	-5.5%	-5.5%
12	SB3-12	Sum of Oxides	97.2057	99.9972	100.0000	-2.7943	-0.0028	-2.8%	0.0%
13	SB3-13	Al2O3 (wt%)	4.7757	4.9143	4.6040	0.1717	0.3103	3.7%	6.7%
13	SB3-13	B2O3 (wt%)	5.8441	5.7890	6.0000	-0.1559	-0.2110	-2.6%	-3.5%
13	SB3-13	BaO (wt%)	0.0444	0.0493	0.0530	-0.0086	-0.0037	-16.3%	-7.0%
13	SB3-13	CaO (wt%)	0.7954	0.7440	0.7660	0.0294	-0.0220	3.8%	-2.9%
13	SB3-13	Ce2O3 (wt%)	0.0729	0.0729	0.0760	-0.0031	-0.0031	-4.1%	-4.1%
13	SB3-13	Cr2O3 (wt%)	0.0665	0.0707	0.0800	-0.0135	-0.0093	-16.9%	-11.6%
13	SB3-13	CuO (wt%)	0.0451	0.0480	0.0420	0.0031	0.0060	7.3%	14.4%
13	SB3-13	Fe2O3 (wt%)	8.3209	8.2365	8.5750	-0.2541	-0.3385	-3.0%	-3.9%
13	SB3-13	K2O (wt%)	0.0488	0.0438	0.0920	-0.0432	-0.0482	-47.0%	-52.4%
13	SB3-13	La2O3 (wt%)	0.0358	0.0358	0.0440	-0.0082	-0.0082	-18.7%	-18.7%
13	SB3-13	Li2O (wt%)	3.5900	3.7144	3.7510	-0.1610	-0.0366	-4.3%	-1.0%
13	SB3-13	MgO (wt%)	0.0187	0.0195	0.0400	-0.0213	-0.0205	-53.4%	-51.3%
13	SB3-13	MnO (wt%)	1.4913	1.6078	1.5280	-0.0367	0.0798	-2.4%	5.2%
13	SB3-13	Na2O (wt%)	15.3672	14.4476	15.2850	0.0822	-0.8374	0.5%	-5.5%
13	SB3-13	NiO (wt%)	0.3162	0.3598	0.3430	-0.0268	0.0168	-7.8%	4.9%
13	SB3-13	PbO (wt%)	0.0557	0.0557	0.0640	-0.0083	-0.0083	-12.9%	-12.9%
13	SB3-13	SiO2 (wt%)	55.3544	58.2751	56.2120	-0.8576	2.0631	-1.5%	3.7%
13	SB3-13	ThO2 (wt%)	0.0927	0.0927	0.0300	0.0627	0.0627	209.1%	209.1%
13	SB3-13	TiO2 (wt%)	0.0225	0.0244	0.0000	0.0225	0.0244		
13	SB3-13	U3O8 (wt%)	2.1963	2.2981	2.1690	0.0273	0.1291	1.3%	5.9%
13	SB3-13	ZnO (wt%)	0.0716	0.0716	0.0880	-0.0164	-0.0164	-18.7%	-18.7%
13	SB3-13	ZrO2 (wt%)	0.1425	0.1425	0.1580	-0.0155	-0.0155	-9.8%	-9.8%
13	SB3-13	Sum of Oxides	98.7686	101.1135	100.0000	-1.2314	1.1135	-1.2%	1.1%
14	SB3-14	Al2O3 (wt%)	6.7691	6.8695	6.6230	0.1461	0.2465	2.2%	3.7%
14	SB3-14	B2O3 (wt%)	4.9425	4.8559	4.8800	0.0625	-0.0241	1.3%	-0.5%
14	SB3-14	BaO (wt%)	0.0729	0.0796	0.0830	-0.0101	-0.0034	-12.2%	-4.1%
14	SB3-14	CaO (wt%)	1.2680	1.2084	1.1960	0.0720	0.0124	6.0%	1.0%
14	SB3-14	Ce2O3 (wt%)	0.1110	0.1110	0.1180	-0.0070	-0.0070	-5.9%	-5.9%
14	SB3-14	Cr2O3 (wt%)	0.1363	0.1450	0.1240	0.0123	0.0210	9.9%	17.0%
14	SB3-14	CuO (wt%)	0.0617	0.0647	0.0660	-0.0043	-0.0013	-6.6%	-2.0%
14	SB3-14	Fe2O3 (wt%)	12.5385	12.7321	13.3760	-0.8375	-0.6439	-6.3%	-4.8%
14	SB3-14	K2O (wt%)	0.1458	0.1305	0.1430	0.0028	-0.0125	1.9%	-8.8%
14	SB3-14	La2O3 (wt%)	0.0537	0.0537	0.0680	-0.0143	-0.0143	-21.1%	-21.1%
14	SB3-14	Li2O (wt%)	2.9925	3.0909	3.0510	-0.0585	0.0399	-1.9%	1.3%
14	SB3-14	MgO (wt%)	0.0361	0.0361	0.0630	-0.0269	-0.0269	-42.8%	-42.7%
14	SB3-14	MnO (wt%)	2.2725	2.1889	2.3840	-0.1115	-0.1951	-4.7%	-8.2%
14	SB3-14	Na2O (wt%)	17.8711	16.7095	17.1240	0.7471	-0.4145	4.4%	-2.4%
14	SB3-14	NiO (wt%)	0.4794	0.5232	0.5350	-0.0556	-0.0118	-10.4%	-2.2%
14	SB3-14	PbO (wt%)	0.0854	0.0854	0.1000	-0.0146	-0.0146	-14.6%	-14.6%
14	SB3-14	SiO2 (wt%)	46.3693	49.8904	46.2510	0.1183	3.6394	0.3%	7.9%
14	SB3-14	ThO2 (wt%)	0.1559	0.1559	0.0480	0.1079	0.1079	224.8%	224.8%
14	SB3-14	TiO2 (wt%)	0.0083	0.0088	0.0000	0.0083	0.0088		

Table H.4: Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by Glass Number *(continued)*
(Batch 1: 100; 101-U std)

Glass #	Glass ID	Oxide	Measured (wt%)	Measured Bias-Corrected (wt%)	Targeted (wt%)	Diff of Measured	Diff of Meas BC	% Diff of Measured	% Diff of Meas BC
14	SB3-14	U3O8 (wt%)	3.2516	3.4259	3.3840	-0.1324	0.0419	-3.9%	1.2%
14	SB3-14	ZnO (wt%)	0.1235	0.1235	0.1370	-0.0135	-0.0135	-9.8%	-9.8%
14	SB3-14	ZrO2 (wt%)	0.2242	0.2242	0.2470	-0.0228	-0.0228	-9.2%	-9.2%
14	SB3-14	Sum of Oxides	99.9693	102.7129	100.0010	-0.0317	2.7119	0.0%	2.7%
15	SB3-15	Al2O3 (wt%)	4.6104	4.8210	4.5860	0.0244	0.2350	0.5%	5.1%
15	SB3-15	B2O3 (wt%)	5.3853	5.2242	5.3600	0.0253	-0.1358	0.5%	-2.5%
15	SB3-15	BaO (wt%)	0.0544	0.0604	0.0630	-0.0086	-0.0026	-13.6%	-4.1%
15	SB3-15	CaO (wt%)	0.9843	0.9207	0.9120	0.0723	0.0087	7.9%	1.0%
15	SB3-15	Ce2O3 (wt%)	0.0846	0.0846	0.0880	-0.0034	-0.0034	-3.8%	-3.8%
15	SB3-15	Cr2O3 (wt%)	0.0917	0.0975	0.0940	-0.0023	0.0035	-2.4%	3.8%
15	SB3-15	CuO (wt%)	0.0526	0.0560	0.0500	0.0026	0.0060	5.2%	12.1%
15	SB3-15	Fe2O3 (wt%)	10.0008	9.8997	10.1970	-0.1962	-0.2973	-1.9%	-2.9%
15	SB3-15	K2O (wt%)	0.0852	0.0764	0.1090	-0.0238	-0.0326	-21.8%	-29.9%
15	SB3-15	La2O3 (wt%)	0.0460	0.0460	0.0580	-0.0120	-0.0120	-20.6%	-20.6%
15	SB3-15	Li2O (wt%)	4.4565	4.6187	4.6900	-0.2335	-0.0713	-5.0%	-1.5%
15	SB3-15	MgO (wt%)	1.3244	1.3816	1.3880	-0.0636	-0.0064	-4.6%	-0.5%
15	SB3-15	MnO (wt%)	1.7108	1.8443	1.8190	-0.1082	0.0253	-5.9%	1.4%
15	SB3-15	Na2O (wt%)	14.7943	13.9104	14.3570	0.4373	-0.4466	3.0%	-3.1%
15	SB3-15	NiO (wt%)	0.3566	0.4058	0.4080	-0.0514	-0.0022	-12.6%	-0.5%
15	SB3-15	PbO (wt%)	0.0668	0.0668	0.0760	-0.0092	-0.0092	-12.1%	-12.1%
15	SB3-15	SiO2 (wt%)	51.1828	53.5170	52.1210	-0.9382	1.3960	-1.8%	2.7%
15	SB3-15	ThO2 (wt%)	0.1044	0.1044	0.0360	0.0684	0.0684	190.0%	190.0%
15	SB3-15	TiO2 (wt%)	0.6555	0.7095	0.7140	-0.0585	-0.0045	-8.2%	-0.6%
15	SB3-15	U3O8 (wt%)	2.5087	2.6250	2.5810	-0.0723	0.0440	-2.8%	1.7%
15	SB3-15	ZnO (wt%)	0.0890	0.0890	0.1040	-0.0150	-0.0150	-14.4%	-14.4%
15	SB3-15	ZrO2 (wt%)	0.1786	0.1786	0.1880	-0.0094	-0.0094	-5.0%	-5.0%
15	SB3-15	Sum of Oxides	98.8239	100.7380	99.9990	-1.1751	0.7390	-1.2%	0.7%
16	SB3-16	Al2O3 (wt%)	5.2103	5.2876	5.1420	0.0683	0.1456	1.3%	2.8%
16	SB3-16	B2O3 (wt%)	5.0150	4.9271	5.0400	-0.0250	-0.1129	-0.5%	-2.2%
16	SB3-16	BaO (wt%)	0.0597	0.0663	0.0710	-0.0113	-0.0047	-15.9%	-6.6%
16	SB3-16	CaO (wt%)	1.0949	1.0241	1.0230	0.0719	0.0011	7.0%	0.1%
16	SB3-16	Ce2O3 (wt%)	0.1045	0.1045	0.0990	0.0055	0.0055	5.6%	5.6%
16	SB3-16	Cr2O3 (wt%)	0.1045	0.1111	0.1050	-0.0005	0.0061	-0.5%	5.9%
16	SB3-16	CuO (wt%)	0.0613	0.0654	0.0560	0.0053	0.0094	9.5%	16.8%
16	SB3-16	Fe2O3 (wt%)	10.7942	10.6859	11.4330	-0.6388	-0.7471	-5.6%	-6.5%
16	SB3-16	K2O (wt%)	0.1042	0.0934	0.1220	-0.0178	-0.0286	-14.6%	-23.4%
16	SB3-16	La2O3 (wt%)	0.0613	0.0613	0.0650	-0.0037	-0.0037	-5.7%	-5.7%
16	SB3-16	Li2O (wt%)	4.2035	4.3418	4.4100	-0.2065	-0.0682	-4.7%	-1.5%
16	SB3-16	MgO (wt%)	1.2444	1.2982	1.3140	-0.0696	-0.0158	-5.3%	-1.2%
16	SB3-16	MnO (wt%)	1.9045	2.0531	2.0390	-0.1345	0.0141	-6.6%	0.7%
16	SB3-16	Na2O (wt%)	15.7716	14.8267	15.3700	0.4016	-0.5433	2.6%	-3.5%
16	SB3-16	NiO (wt%)	0.3932	0.4474	0.4570	-0.0638	-0.0096	-14.0%	-2.1%
16	SB3-16	PbO (wt%)	0.0727	0.0727	0.0850	-0.0123	-0.0123	-14.5%	-14.5%
16	SB3-16	SiO2 (wt%)	47.8668	51.5040	49.1050	-1.2382	2.3990	-2.5%	4.9%
16	SB3-16	ThO2 (wt%)	0.1172	0.1172	0.0410	0.0762	0.0762	185.9%	185.9%
16	SB3-16	TiO2 (wt%)	0.7076	0.7659	0.8000	-0.0924	-0.0341	-11.5%	-4.3%
16	SB3-16	U3O8 (wt%)	2.7829	2.9119	2.8940	-0.1111	0.0179	-3.8%	0.6%
16	SB3-16	ZnO (wt%)	0.0980	0.0980	0.1170	-0.0190	-0.0190	-16.2%	-16.2%
16	SB3-16	ZrO2 (wt%)	0.1878	0.1878	0.2110	-0.0232	-0.0232	-11.0%	-11.0%
16	SB3-16	Sum of Oxides	97.9604	101.0514	99.9990	-2.0386	1.0524	-2.0%	1.1%
17	SB3-17	Al2O3 (wt%)	5.1961	5.3469	4.8690	0.3271	0.4779	6.7%	9.8%
17	SB3-17	B2O3 (wt%)	5.5302	5.4780	5.6000	-0.0698	-0.1220	-1.2%	-2.2%
17	SB3-17	BaO (wt%)	0.0374	0.0449	0.0580	-0.0206	-0.0131	-35.5%	-22.6%

Table H.4: Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by Glass Number *(continued)*
(Batch 1: 100; 101-U std)

Glass #	Glass ID	Oxide	Measured (wt%)	Measured Bias-Corrected (wt%)	Targeted (wt%)	Diff of Measured	Diff of Meas BC	% Diff of Measured	% Diff of Meas BC
17	SB3-17	CaO (wt%)	0.8909	0.8215	0.8290	0.0619	-0.0075	7.5%	-0.9%
17	SB3-17	Ce2O3 (wt%)	0.0726	0.0726	0.0800	-0.0074	-0.0074	-9.2%	-9.2%
17	SB3-17	Cr2O3 (wt%)	0.0669	0.0794	0.0850	-0.0181	-0.0056	-21.3%	-6.6%
17	SB3-17	CuO (wt%)	0.0466	0.0498	0.0460	0.0006	0.0038	1.4%	8.2%
17	SB3-17	Fe2O3 (wt%)	10.1294	9.8088	9.2700	0.8594	0.5388	9.3%	5.8%
17	SB3-17	K2O (wt%)	0.0711	0.0632	0.0990	-0.0279	-0.0358	-28.2%	-36.1%
17	SB3-17	La2O3 (wt%)	0.0405	0.0405	0.0530	-0.0125	-0.0125	-23.7%	-23.7%
17	SB3-17	Li2O (wt%)	3.3962	3.5139	3.5000	-0.1038	0.0139	-3.0%	0.4%
17	SB3-17	MgO (wt%)	0.0008	0.0009	0.0430	-0.0422	-0.0421	-98.1%	-97.9%
17	SB3-17	MnO (wt%)	1.5365	1.6998	1.6530	-0.1165	0.0468	-7.0%	2.8%
17	SB3-17	Na2O (wt%)	14.4236	13.9764	14.2970	0.1266	-0.3206	0.9%	-2.2%
17	SB3-17	NiO (wt%)	0.3181	0.3710	0.3710	-0.0529	0.0000	-14.3%	0.0%
17	SB3-17	PbO (wt%)	0.0555	0.0555	0.0690	-0.0135	-0.0135	-19.6%	-19.6%
17	SB3-17	SiO2 (wt%)	54.7661	57.6533	55.7830	-1.0169	1.8703	-1.8%	3.4%
17	SB3-17	ThO2 (wt%)	0.0916	0.0916	0.0330	0.0586	0.0586	177.6%	177.6%
17	SB3-17	TiO2 (wt%)	0.4220	0.4629	0.6490	-0.2270	-0.1861	-35.0%	-28.7%
17	SB3-17	U3O8 (wt%)	2.2876	2.3937	2.3460	-0.0584	0.0477	-2.5%	2.0%
17	SB3-17	ZnO (wt%)	0.0616	0.0616	0.0950	-0.0334	-0.0334	-35.1%	-35.1%
17	SB3-17	ZrO2 (wt%)	0.1449	0.1449	0.1710	-0.0261	-0.0261	-15.3%	-15.3%
17	SB3-17	Sum of Oxides	99.5863	102.2311	99.9990	-0.4127	2.2321	-0.4%	2.2%
18	SB3-18	Al2O3 (wt%)	6.4574	6.4606	6.5460	-0.0886	-0.0854	-1.4%	-1.3%
18	SB3-18	B2O3 (wt%)	4.5723	4.4241	4.5600	0.0123	-0.1359	0.3%	-3.0%
18	SB3-18	BaO (wt%)	0.0614	0.0737	0.0830	-0.0216	-0.0093	-26.0%	-11.3%
18	SB3-18	CaO (wt%)	1.2908	1.1902	1.1890	0.1018	0.0012	8.6%	0.1%
18	SB3-18	Ce2O3 (wt%)	0.1063	0.1063	0.1150	-0.0087	-0.0087	-7.6%	-7.6%
18	SB3-18	Cr2O3 (wt%)	0.1111	0.1319	0.1220	-0.0109	0.0099	-8.9%	8.1%
18	SB3-18	CuO (wt%)	0.0648	0.0692	0.0650	-0.0002	0.0042	-0.3%	6.4%
18	SB3-18	Fe2O3 (wt%)	14.6509	14.1837	13.2870	1.3639	0.8967	10.3%	6.7%
18	SB3-18	K2O (wt%)	0.1292	0.1150	0.1420	-0.0128	-0.0270	-9.0%	-19.0%
18	SB3-18	La2O3 (wt%)	0.0566	0.0566	0.0760	-0.0194	-0.0194	-25.5%	-25.5%
18	SB3-18	Li2O (wt%)	2.7019	2.8086	2.8500	-0.1481	-0.0414	-5.2%	-1.5%
18	SB3-18	MgO (wt%)	0.0104	0.0113	0.0620	-0.0516	-0.0507	-83.3%	-81.9%
18	SB3-18	MnO (wt%)	2.1079	2.3317	2.3700	-0.2621	-0.0383	-11.1%	-1.6%
18	SB3-18	Na2O (wt%)	18.1306	17.5660	17.4590	0.6716	0.1070	3.8%	0.6%
18	SB3-18	NiO (wt%)	0.4431	0.5169	0.5310	-0.0879	-0.0141	-16.5%	-2.7%
18	SB3-18	PbO (wt%)	0.0789	0.0789	0.0990	-0.0201	-0.0201	-20.3%	-20.3%
18	SB3-18	SiO2 (wt%)	45.5671	48.9447	45.7220	-0.1549	3.2227	-0.3%	7.0%
18	SB3-18	ThO2 (wt%)	0.1311	0.1311	0.0470	0.0841	0.0841	179.0%	179.0%
18	SB3-18	TiO2 (wt%)	0.8486	0.9318	0.9300	-0.0814	0.0018	-8.8%	0.2%
18	SB3-18	U3O8 (wt%)	3.2546	3.4053	3.3630	-0.1084	0.0423	-3.2%	1.3%
18	SB3-18	ZnO (wt%)	0.1015	0.1015	0.1360	-0.0345	-0.0345	-25.4%	-25.4%
18	SB3-18	ZrO2 (wt%)	0.2073	0.2073	0.2450	-0.0377	-0.0377	-15.4%	-15.4%
18	SB3-18	Sum of Oxides	101.0836	103.8463	99.9990	1.0846	3.8473	1.1%	3.8%
19	SB3-19	Al2O3 (wt%)	5.0402	5.1150	4.8690	0.1712	0.2460	3.5%	5.1%
19	SB3-19	B2O3 (wt%)	6.9872	6.8646	7.0000	-0.0128	-0.1354	-0.2%	-1.9%
19	SB3-19	BaO (wt%)	0.0469	0.0507	0.0580	-0.0111	-0.0073	-19.2%	-12.6%
19	SB3-19	CaO (wt%)	0.9315	0.8606	0.8290	0.1025	0.0316	12.4%	3.8%
19	SB3-19	Ce2O3 (wt%)	0.0796	0.0796	0.0800	-0.0004	-0.0004	-0.4%	-0.4%
19	SB3-19	Cr2O3 (wt%)	0.0899	0.0945	0.0850	0.0049	0.0095	5.8%	11.2%
19	SB3-19	CuO (wt%)	0.0494	0.0523	0.0460	0.0034	0.0063	7.5%	13.7%
19	SB3-19	Fe2O3 (wt%)	8.8820	8.8163	9.2700	-0.3880	-0.4537	-4.2%	-4.9%
19	SB3-19	K2O (wt%)	0.0644	0.0576	0.0990	-0.0346	-0.0414	-34.9%	-41.8%
19	SB3-19	La2O3 (wt%)	0.0413	0.0413	0.0530	-0.0117	-0.0117	-22.0%	-22.0%

Table H.4: Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by Glass Number *(continued)*
(Batch 1: 100; 101-U std)

Glass #	Glass ID	Oxide	Measured (wt%)	Measured Bias-Corrected (wt%)	Targeted (wt%)	Diff of Measured	Diff of Meas BC	% Diff of Measured	% Diff of Meas BC
19	SB3-19	Li2O (wt%)	3.3854	3.4967	3.5000	-0.1146	-0.0033	-3.3%	-0.1%
19	SB3-19	MgO (wt%)	0.0075	0.0075	0.0430	-0.0355	-0.0355	-82.6%	-82.5%
19	SB3-19	MnO (wt%)	1.6043	1.6606	1.6530	-0.0487	0.0076	-2.9%	0.5%
19	SB3-19	Na2O (wt%)	14.3562	13.7965	14.2970	0.0592	-0.5005	0.4%	-3.5%
19	SB3-19	NiO (wt%)	0.3324	0.3671	0.3710	-0.0386	-0.0039	-10.4%	-1.1%
19	SB3-19	PbO (wt%)	0.0646	0.0646	0.0690	-0.0044	-0.0044	-6.3%	-6.3%
19	SB3-19	SiO2 (wt%)	53.6964	57.7744	54.3830	-0.6866	3.3914	-1.3%	6.2%
19	SB3-19	ThO2 (wt%)	0.0970	0.0970	0.0330	0.0640	0.0640	194.0%	194.0%
19	SB3-19	TiO2 (wt%)	0.5813	0.6128	0.6490	-0.0677	-0.0362	-10.4%	-5.6%
19	SB3-19	U3O8 (wt%)	2.2729	2.3580	2.3460	-0.0731	0.0120	-3.1%	0.5%
19	SB3-19	ZnO (wt%)	0.0769	0.0769	0.0950	-0.0181	-0.0181	-19.1%	-19.1%
19	SB3-19	ZrO2 (wt%)	0.1634	0.1634	0.1710	-0.0076	-0.0076	-4.4%	-4.4%
19	SB3-19	Sum of Oxides	98.8511	102.5081	99.9990	-1.1479	2.5091	-1.1%	2.5%
20	SB3-20	Al2O3 (wt%)	6.3818	6.4764	6.2880	0.0938	0.1884	1.5%	3.0%
20	SB3-20	B2O3 (wt%)	5.9085	5.8049	5.9000	0.0085	-0.0951	0.1%	-1.6%
20	SB3-20	BaO (wt%)	0.0706	0.0784	0.0790	-0.0084	-0.0006	-10.6%	-0.8%
20	SB3-20	CaO (wt%)	1.1967	1.1193	1.1340	0.0627	-0.0147	5.5%	-1.3%
20	SB3-20	Ce2O3 (wt%)	0.1042	0.1042	0.1100	-0.0058	-0.0058	-5.2%	-5.2%
20	SB3-20	Cr2O3 (wt%)	0.1166	0.1240	0.1170	-0.0004	0.0070	-0.4%	6.0%
20	SB3-20	CuO (wt%)	0.0660	0.0704	0.0620	0.0040	0.0084	6.5%	13.5%
20	SB3-20	Fe2O3 (wt%)	12.7100	12.5834	12.6690	0.0410	-0.0856	0.3%	-0.7%
20	SB3-20	K2O (wt%)	0.1111	0.0997	0.1360	-0.0249	-0.0363	-18.3%	-26.7%
20	SB3-20	La2O3 (wt%)	0.0616	0.0616	0.0720	-0.0104	-0.0104	-14.5%	-14.5%
20	SB3-20	Li2O (wt%)	2.8687	2.9630	2.9500	-0.0813	0.0130	-2.8%	0.4%
20	SB3-20	MgO (wt%)	0.0174	0.0182	0.0590	-0.0416	-0.0408	-70.5%	-69.2%
20	SB3-20	MnO (wt%)	2.1402	2.3073	2.2600	-0.1198	0.0473	-5.3%	2.1%
20	SB3-20	Na2O (wt%)	17.1196	16.0937	16.9730	0.1466	-0.8793	0.9%	-5.2%
20	SB3-20	NiO (wt%)	0.4578	0.5209	0.5070	-0.0492	0.0139	-9.7%	2.7%
20	SB3-20	PbO (wt%)	0.0829	0.0829	0.0940	-0.0111	-0.0111	-11.8%	-11.8%
20	SB3-20	SiO2 (wt%)	45.3532	48.7964	46.0900	-0.7368	2.7064	-1.6%	5.9%
20	SB3-20	ThO2 (wt%)	0.1334	0.1334	0.0450	0.0884	0.0884	196.5%	196.5%
20	SB3-20	TiO2 (wt%)	0.8473	0.9171	0.8870	-0.0397	0.0301	-4.5%	3.4%
20	SB3-20	U3O8 (wt%)	3.2192	3.3684	3.2070	0.0122	0.1614	0.4%	5.0%
20	SB3-20	ZnO (wt%)	0.1170	0.1170	0.1290	-0.0120	-0.0120	-9.3%	-9.3%
20	SB3-20	ZrO2 (wt%)	0.2084	0.2084	0.2340	-0.0256	-0.0256	-11.0%	-11.0%
20	SB3-20	Sum of Oxides	99.2923	102.0489	100.0020	-0.7097	2.0469	-0.7%	2.0%
21	SB3-21	Al2O3 (wt%)	4.7474	4.9641	4.7250	0.0224	0.2391	0.5%	5.1%
21	SB3-21	B2O3 (wt%)	5.2967	5.1384	5.2800	0.0167	-0.1416	0.3%	-2.7%
21	SB3-21	BaO (wt%)	0.0564	0.0610	0.0650	-0.0086	-0.0040	-13.3%	-6.2%
21	SB3-21	CaO (wt%)	1.0620	0.9811	0.9400	0.1220	0.0411	13.0%	4.4%
21	SB3-21	Ce2O3 (wt%)	0.0893	0.0893	0.0910	-0.0017	-0.0017	-1.9%	-1.9%
21	SB3-21	Cr2O3 (wt%)	0.0764	0.0803	0.0970	-0.0206	-0.0167	-21.3%	-17.2%
21	SB3-21	CuO (wt%)	0.0541	0.0573	0.0520	0.0021	0.0053	4.1%	10.2%
21	SB3-21	Fe2O3 (wt%)	9.7613	9.6901	10.5060	-0.7447	-0.8159	-7.1%	-7.8%
21	SB3-21	K2O (wt%)	0.0861	0.0770	0.1120	-0.0259	-0.0350	-23.1%	-31.2%
21	SB3-21	La2O3 (wt%)	0.0469	0.0469	0.0600	-0.0131	-0.0131	-21.8%	-21.8%
21	SB3-21	Li2O (wt%)	2.5620	2.6551	2.6400	-0.0780	0.0151	-3.0%	0.6%
21	SB3-21	MgO (wt%)	0.0108	0.0109	0.0490	-0.0382	-0.0381	-78.0%	-77.8%
21	SB3-21	MnO (wt%)	1.7883	1.8511	1.8740	-0.0857	-0.0229	-4.6%	-1.2%
21	SB3-21	Na2O (wt%)	14.5247	13.9561	14.6100	-0.0853	-0.6539	-0.6%	-4.5%
21	SB3-21	NiO (wt%)	0.3722	0.4110	0.4200	-0.0478	-0.0090	-11.4%	-2.1%
21	SB3-21	PbO (wt%)	0.0630	0.0630	0.0780	-0.0150	-0.0150	-19.2%	-19.2%
21	SB3-21	SiO2 (wt%)	52.8942	55.3067	54.6670	-1.7728	0.6397	-3.2%	1.2%

Table H.4: Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by Glass Number *(continued)*
(Batch 1: 100; 101-U std)

Glass #	Glass ID	Oxide	Measured (wt%)	Measured Bias-Corrected (wt%)	Targeted (wt%)	Diff of Measured	Diff of Meas BC	% Diff of Measured	% Diff of Meas BC
21	SB3-21	ThO2 (wt%)	0.1050	0.1050	0.0370	0.0680	0.0680	183.7%	183.7%
21	SB3-21	TiO2 (wt%)	0.6476	0.6827	0.7350	-0.0874	-0.0523	-11.9%	-7.1%
21	SB3-21	U3O8 (wt%)	2.5087	2.6027	2.6590	-0.1503	-0.0563	-5.7%	-2.1%
21	SB3-21	ZnO (wt%)	0.0946	0.0946	0.1070	-0.0124	-0.0124	-11.6%	-11.6%
21	SB3-21	ZrO2 (wt%)	0.1689	0.1689	0.1940	-0.0252	-0.0252	-13.0%	-13.0%
21	SB3-21	Sum of Oxides	97.0165	99.0931	99.9980	-2.9815	-0.9049	-3.0%	-0.9%
22	SB3-22	Al2O3 (wt%)	6.6794	6.6791	6.6700	0.0094	0.0091	0.1%	0.1%
22	SB3-22	B2O3 (wt%)	4.1215	3.9880	4.1600	-0.0385	-0.1720	-0.9%	-4.1%
22	SB3-22	BaO (wt%)	0.0790	0.0863	0.0920	-0.0130	-0.0057	-14.1%	-6.2%
22	SB3-22	CaO (wt%)	1.3754	1.3107	1.3270	0.0484	-0.0163	3.6%	-1.2%
22	SB3-22	Ce2O3 (wt%)	0.1233	0.1233	0.1290	-0.0057	-0.0057	-4.4%	-4.4%
22	SB3-22	Cr2O3 (wt%)	0.1396	0.1485	0.1360	0.0036	0.0125	2.6%	9.2%
22	SB3-22	CuO (wt%)	0.0663	0.0696	0.0730	-0.0067	-0.0034	-9.1%	-4.7%
22	SB3-22	Fe2O3 (wt%)	14.0003	14.2129	14.8320	-0.8317	-0.6191	-5.6%	-4.2%
22	SB3-22	K2O (wt%)	0.1488	0.1331	0.1590	-0.0102	-0.0259	-6.4%	-16.3%
22	SB3-22	La2O3 (wt%)	0.0677	0.0677	0.0850	-0.0173	-0.0173	-20.3%	-20.3%
22	SB3-22	Li2O (wt%)	2.0329	2.1131	2.0800	-0.0471	0.0331	-2.3%	1.6%
22	SB3-22	MgO (wt%)	0.0435	0.0436	0.0700	-0.0265	-0.0264	-37.8%	-37.7%
22	SB3-22	MnO (wt%)	2.4597	2.3703	2.6450	-0.1853	-0.2747	-7.0%	-10.4%
22	SB3-22	Na2O (wt%)	18.2317	17.0475	18.1550	0.0767	-1.1075	0.4%	-6.1%
22	SB3-22	NiO (wt%)	0.5077	0.5540	0.5930	-0.0853	-0.0390	-14.4%	-6.6%
22	SB3-22	PbO (wt%)	0.0948	0.0948	0.1110	-0.0162	-0.0162	-14.6%	-14.6%
22	SB3-22	SiO2 (wt%)	43.1604	46.3599	43.4120	-0.2516	2.9479	-0.6%	6.8%
22	SB3-22	ThO2 (wt%)	0.1715	0.1715	0.0530	0.1185	0.1185	223.7%	223.7%
22	SB3-22	TiO2 (wt%)	0.9733	1.0226	1.0380	-0.0647	-0.0154	-6.2%	-1.5%
22	SB3-22	U3O8 (wt%)	3.4963	3.6835	3.7540	-0.2577	-0.0705	-6.9%	-1.9%
22	SB3-22	ZnO (wt%)	0.1304	0.1304	0.1520	-0.0216	-0.0216	-14.2%	-14.2%
22	SB3-22	ZrO2 (wt%)	0.2401	0.2401	0.2740	-0.0339	-0.0339	-12.4%	-12.4%
22	SB3-22	Sum of Oxides	98.3437	100.6506	100.0000	-1.6563	0.6506	-1.7%	0.7%
23	SB3-23	Al2O3 (wt%)	4.7190	4.9347	4.5860	0.1330	0.3487	2.9%	7.6%
23	SB3-23	B2O3 (wt%)	5.3853	5.2242	5.3600	0.0253	-0.1358	0.5%	-2.5%
23	SB3-23	BaO (wt%)	0.0553	0.0597	0.0630	-0.0077	-0.0033	-12.3%	-5.2%
23	SB3-23	CaO (wt%)	1.0095	0.9326	0.9120	0.0975	0.0206	10.7%	2.3%
23	SB3-23	Ce2O3 (wt%)	0.0864	0.0864	0.0880	-0.0016	-0.0016	-1.8%	-1.8%
23	SB3-23	Cr2O3 (wt%)	0.0639	0.0672	0.0940	-0.0301	-0.0268	-32.0%	-28.5%
23	SB3-23	CuO (wt%)	0.0535	0.0566	0.0500	0.0035	0.0066	7.0%	13.3%
23	SB3-23	Fe2O3 (wt%)	10.0079	9.9350	10.1970	-0.1891	-0.2620	-1.9%	-2.6%
23	SB3-23	K2O (wt%)	0.0843	0.0754	0.1090	-0.0247	-0.0336	-22.6%	-30.8%
23	SB3-23	La2O3 (wt%)	0.0463	0.0463	0.0580	-0.0117	-0.0117	-20.1%	-20.1%
23	SB3-23	Li2O (wt%)	3.1648	3.2799	3.3500	-0.1852	-0.0701	-5.5%	-2.1%
23	SB3-23	MgO (wt%)	0.0087	0.0088	0.0480	-0.0393	-0.0392	-81.9%	-81.7%
23	SB3-23	MnO (wt%)	1.8303	1.8942	1.8190	0.0113	0.0752	0.6%	4.1%
23	SB3-23	Na2O (wt%)	13.8507	13.3080	13.6870	0.1637	-0.3790	1.2%	-2.8%
23	SB3-23	NiO (wt%)	0.3846	0.4246	0.4080	-0.0234	0.0166	-5.7%	4.1%
23	SB3-23	PbO (wt%)	0.0619	0.0619	0.0760	-0.0141	-0.0141	-18.5%	-18.5%
23	SB3-23	SiO2 (wt%)	54.5522	57.0416	55.4710	-0.9188	1.5706	-1.7%	2.8%
23	SB3-23	ThO2 (wt%)	0.1095	0.1095	0.0360	0.0735	0.0735	204.2%	204.2%
23	SB3-23	TiO2 (wt%)	0.6864	0.7236	0.7140	-0.0276	0.0096	-3.9%	1.3%
23	SB3-23	U3O8 (wt%)	2.5854	2.6823	2.5810	0.0044	0.1013	0.2%	3.9%
23	SB3-23	ZnO (wt%)	0.1024	0.1024	0.1040	-0.0016	-0.0016	-1.6%	-1.6%
23	SB3-23	ZrO2 (wt%)	0.1766	0.1766	0.1880	-0.0114	-0.0114	-6.1%	-6.1%
23	SB3-23	Sum of Oxides	99.0249	101.2314	99.9990	-0.9741	1.2324	-1.0%	1.2%
24	SB3-24	Al2O3 (wt%)	6.7361	7.0438	6.6700	0.0661	0.3738	1.0%	5.6%

Table H.4: Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by Glass Number *(continued)*
(Batch 1: 100; 101-U std)

Glass #	Glass ID	Oxide	Measured (wt%)	Measured Bias-Corrected (wt%)	Targeted (wt%)	Diff of Measured	Diff of Meas BC	% Diff of Measured	% Diff of Meas BC
24	SB3-24	B2O3 (wt%)	4.2986	4.1698	4.1600	0.1386	0.0098	3.3%	0.2%
24	SB3-24	BaO (wt%)	0.0809	0.0884	0.0920	-0.0111	-0.0036	-12.0%	-3.9%
24	SB3-24	CaO (wt%)	1.3982	1.3324	1.3270	0.0712	0.0054	5.4%	0.4%
24	SB3-24	Ce2O3 (wt%)	0.1265	0.1265	0.1290	-0.0025	-0.0025	-1.9%	-1.9%
24	SB3-24	Cr2O3 (wt%)	0.1224	0.1302	0.1360	-0.0136	-0.0058	-10.0%	-4.3%
24	SB3-24	CuO (wt%)	0.0704	0.0739	0.0730	-0.0026	0.0009	-3.5%	1.2%
24	SB3-24	Fe2O3 (wt%)	14.1612	14.3748	14.8320	-0.6708	-0.4572	-4.5%	-3.1%
24	SB3-24	K2O (wt%)	0.1605	0.1437	0.1590	0.0015	-0.0153	1.0%	-9.7%
24	SB3-24	La2O3 (wt%)	0.0692	0.0692	0.0850	-0.0158	-0.0158	-18.6%	-18.6%
24	SB3-24	Li2O (wt%)	2.5297	2.6217	2.6000	-0.0703	0.0217	-2.7%	0.8%
24	SB3-24	MgO (wt%)	0.0431	0.0432	0.0700	-0.0269	-0.0268	-38.4%	-38.3%
24	SB3-24	MnO (wt%)	2.4856	2.3952	2.6450	-0.1594	-0.2498	-6.0%	-9.4%
24	SB3-24	Na2O (wt%)	18.7709	17.5504	17.6350	1.1359	-0.0846	6.4%	-0.5%
24	SB3-24	NiO (wt%)	0.5173	0.5643	0.5930	-0.0757	-0.0287	-12.8%	-4.8%
24	SB3-24	PbO (wt%)	0.0967	0.0967	0.1110	-0.0143	-0.0143	-12.9%	-12.9%
24	SB3-24	SiO2 (wt%)	43.3743	45.3525	43.4120	-0.0377	1.9405	-0.1%	4.5%
24	SB3-24	ThO2 (wt%)	0.1713	0.1713	0.0530	0.1183	0.1183	223.1%	223.1%
24	SB3-24	TiO2 (wt%)	0.9908	1.0409	1.0380	-0.0472	0.0029	-4.5%	0.3%
24	SB3-24	U3O8 (wt%)	3.5376	3.7265	3.7540	-0.2164	-0.0275	-5.8%	-0.7%
24	SB3-24	ZnO (wt%)	0.1341	0.1341	0.1520	-0.0179	-0.0179	-11.8%	-11.8%
24	SB3-24	ZrO2 (wt%)	0.2398	0.2398	0.2740	-0.0342	-0.0342	-12.5%	-12.5%
24	SB3-24	Sum of Oxides	100.1150	101.4892	100.0000	0.1150	1.4892	0.1%	1.5%
25	SB3-25	Al2O3 (wt%)	4.4781	4.5445	4.3080	0.1701	0.2365	3.9%	5.5%
25	SB3-25	B2O3 (wt%)	5.5221	5.4252	5.5200	0.0021	-0.0948	0.0%	-1.7%
25	SB3-25	BaO (wt%)	0.0438	0.0526	0.0600	-0.0162	-0.0074	-27.0%	-12.4%
25	SB3-25	CaO (wt%)	0.9242	0.8521	0.8570	0.0672	-0.0049	7.8%	-0.6%
25	SB3-25	Ce2O3 (wt%)	0.0767	0.0767	0.0830	-0.0063	-0.0063	-7.6%	-7.6%
25	SB3-25	Cr2O3 (wt%)	0.0760	0.0902	0.0880	-0.0120	0.0022	-13.6%	2.5%
25	SB3-25	CuO (wt%)	0.0488	0.0521	0.0470	0.0018	0.0051	3.9%	10.9%
25	SB3-25	Fe2O3 (wt%)	10.3081	9.9821	9.5790	0.7291	0.4031	7.6%	4.2%
25	SB3-25	K2O (wt%)	0.0771	0.0686	0.1030	-0.0259	-0.0344	-25.2%	-33.4%
25	SB3-25	La2O3 (wt%)	0.0419	0.0419	0.0550	-0.0131	-0.0131	-23.8%	-23.8%
25	SB3-25	Li2O (wt%)	5.3769	5.5535	5.5200	-0.1431	0.0335	-2.6%	0.6%
25	SB3-25	MgO (wt%)	0.0008	0.0009	0.0450	-0.0442	-0.0441	-98.2%	-98.0%
25	SB3-25	MnO (wt%)	1.5462	1.7105	1.7090	-0.1628	0.0015	-9.5%	0.1%
25	SB3-25	Na2O (wt%)	11.9197	11.5447	11.7800	0.1397	-0.2353	1.2%	-2.0%
25	SB3-25	NiO (wt%)	0.3328	0.3881	0.3830	-0.0502	0.0051	-13.1%	1.3%
25	SB3-25	PbO (wt%)	0.0557	0.0557	0.0710	-0.0153	-0.0153	-21.5%	-21.5%
25	SB3-25	SiO2 (wt%)	55.6218	59.8457	56.3890	-0.7672	3.4567	-1.4%	6.1%
25	SB3-25	ThO2 (wt%)	0.0916	0.0916	0.0340	0.0576	0.0576	169.4%	169.4%
25	SB3-25	TiO2 (wt%)	0.6147	0.6749	0.6700	-0.0553	0.0049	-8.3%	0.7%
25	SB3-25	U3O8 (wt%)	2.3731	2.4831	2.4250	-0.0519	0.0581	-2.1%	2.4%
25	SB3-25	ZnO (wt%)	0.0666	0.0666	0.0980	-0.0314	-0.0314	-32.0%	-32.0%
25	SB3-25	ZrO2 (wt%)	0.1469	0.1469	0.1770	-0.0301	-0.0301	-17.0%	-17.0%
25	SB3-25	Sum of Oxides	99.7437	103.7483	100.0010	-0.2573	3.7473	-0.3%	3.7%
26	SB3-26	Al2O3 (wt%)	6.4479	6.6350	6.2530	0.1949	0.3820	3.1%	6.1%
26	SB3-26	B2O3 (wt%)	4.3871	4.3458	4.4000	-0.0129	-0.0542	-0.3%	-1.2%
26	SB3-26	BaO (wt%)	0.0729	0.0809	0.0870	-0.0141	-0.0061	-16.3%	-7.0%
26	SB3-26	CaO (wt%)	1.3621	1.2741	1.2440	0.1181	0.0301	9.5%	2.4%
26	SB3-26	Ce2O3 (wt%)	0.1174	0.1174	0.1210	-0.0036	-0.0036	-3.0%	-3.0%
26	SB3-26	Cr2O3 (wt%)	0.1202	0.1279	0.1280	-0.0078	-0.0001	-6.1%	-0.1%
26	SB3-26	CuO (wt%)	0.0735	0.0784	0.0690	0.0045	0.0094	6.6%	13.6%
26	SB3-26	Fe2O3 (wt%)	13.6179	13.4754	13.9050	-0.2871	-0.4296	-2.1%	-3.1%

Table H.4: Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by Glass Number *(continued)*
(Batch 1: 100; 101-U std)

Glass #	Glass ID	Oxide	Measured (wt%)	Measured Bias-Corrected (wt%)	Targeted (wt%)	Diff of Measured	Diff of Meas BC	% Diff of Measured	% Diff of Meas BC
26	SB3-26	K2O (wt%)	0.1464	0.1312	0.1490	-0.0026	-0.0178	-1.8%	-11.9%
26	SB3-26	La2O3 (wt%)	0.0639	0.0639	0.0790	-0.0151	-0.0151	-19.1%	-19.1%
26	SB3-26	Li2O (wt%)	4.2520	4.3993	4.4000	-0.1480	-0.0007	-3.4%	0.0%
26	SB3-26	MgO (wt%)	0.0166	0.0173	0.0650	-0.0484	-0.0477	-74.5%	-73.4%
26	SB3-26	MnO (wt%)	2.2176	2.3908	2.4800	-0.2624	-0.0892	-10.6%	-3.6%
26	SB3-26	Na2O (wt%)	16.1423	15.1762	15.7450	0.3973	-0.5688	2.5%	-3.6%
26	SB3-26	NiO (wt%)	0.4606	0.5242	0.5560	-0.0954	-0.0318	-17.2%	-5.7%
26	SB3-26	PbO (wt%)	0.0770	0.0770	0.1040	-0.0270	-0.0270	-25.9%	-25.9%
26	SB3-26	SiO2 (wt%)	45.1392	47.5184	45.2740	-0.1348	2.2444	-0.3%	5.0%
26	SB3-26	ThO2 (wt%)	0.1334	0.1334	0.0490	0.0844	0.0844	172.3%	172.3%
26	SB3-26	TiO2 (wt%)	0.8836	0.9564	0.9730	-0.0894	-0.0166	-9.2%	-1.7%
26	SB3-26	U3O8 (wt%)	3.3548	3.5104	3.5190	-0.1642	-0.0086	-4.7%	-0.2%
26	SB3-26	ZnO (wt%)	0.1158	0.1158	0.1420	-0.0262	-0.0262	-18.5%	-18.5%
26	SB3-26	ZrO2 (wt%)	0.2205	0.2205	0.2570	-0.0365	-0.0365	-14.2%	-14.2%
26	SB3-26	Sum of Oxides	99.4229	101.3697	99.9990	-0.5761	1.3707	-0.6%	1.4%
27	SB3-27	Al2O3 (wt%)	4.4262	4.6284	4.3080	0.1182	0.3204	2.7%	7.4%
27	SB3-27	B2O3 (wt%)	6.9147	6.7075	6.9000	0.0147	-0.1925	0.2%	-2.8%
27	SB3-27	BaO (wt%)	0.0480	0.0524	0.0600	-0.0120	-0.0076	-20.0%	-12.6%
27	SB3-27	CaO (wt%)	0.9095	0.8667	0.8570	0.0525	0.0097	6.1%	1.1%
27	SB3-27	Ce2O3 (wt%)	0.0835	0.0835	0.0830	0.0005	0.0005	0.5%	0.5%
27	SB3-27	Cr2O3 (wt%)	0.0943	0.1003	0.0880	0.0063	0.0123	7.1%	14.0%
27	SB3-27	CuO (wt%)	0.0507	0.0532	0.0470	0.0037	0.0062	7.9%	13.1%
27	SB3-27	Fe2O3 (wt%)	8.9785	9.1135	9.5790	-0.6005	-0.4655	-6.3%	-4.9%
27	SB3-27	K2O (wt%)	0.0891	0.0798	0.1030	-0.0139	-0.0232	-13.5%	-22.5%
27	SB3-27	La2O3 (wt%)	0.0425	0.0425	0.0550	-0.0125	-0.0125	-22.7%	-22.7%
27	SB3-27	Li2O (wt%)	5.2800	5.4721	5.5200	-0.2400	-0.0479	-4.3%	-0.9%
27	SB3-27	MgO (wt%)	0.0133	0.0133	0.0450	-0.0317	-0.0317	-70.5%	-70.6%
27	SB3-27	MnO (wt%)	1.5882	1.5300	1.7090	-0.1208	-0.1790	-7.1%	-10.5%
27	SB3-27	Na2O (wt%)	12.6577	11.8339	11.7800	0.8777	0.0539	7.5%	0.5%
27	SB3-27	NiO (wt%)	0.3331	0.3634	0.3830	-0.0499	-0.0196	-13.0%	-5.1%
27	SB3-27	PbO (wt%)	0.0547	0.0547	0.0710	-0.0163	-0.0163	-23.0%	-23.0%
27	SB3-27	SiO2 (wt%)	54.1243	56.5949	55.0090	-0.8847	1.5859	-1.6%	2.9%
27	SB3-27	ThO2 (wt%)	0.1070	0.1070	0.0340	0.0730	0.0730	214.6%	214.6%
27	SB3-27	TiO2 (wt%)	0.6101	0.6410	0.6700	-0.0599	-0.0290	-8.9%	-4.3%
27	SB3-27	U3O8 (wt%)	2.2523	2.3728	2.4250	-0.1727	-0.0522	-7.1%	-2.2%
27	SB3-27	ZnO (wt%)	0.0784	0.0784	0.0980	-0.0196	-0.0196	-20.0%	-20.0%
27	SB3-27	ZrO2 (wt%)	0.1510	0.1510	0.1770	-0.0260	-0.0260	-14.7%	-14.7%
27	SB3-27	Sum of Oxides	98.8868	100.9402	100.0010	-1.1142	0.9392	-1.1%	0.9%
28	SB3-28	Al2O3 (wt%)	6.0417	6.0444	5.9760	0.0657	0.0684	1.1%	1.1%
28	SB3-28	B2O3 (wt%)	5.7556	5.5692	5.7000	0.0556	-0.1308	1.0%	-2.3%
28	SB3-28	BaO (wt%)	0.0634	0.0761	0.0830	-0.0196	-0.0069	-23.7%	-8.3%
28	SB3-28	CaO (wt%)	1.2845	1.1844	1.1890	0.0955	-0.0046	8.0%	-0.4%
28	SB3-28	Ce2O3 (wt%)	0.1075	0.1075	0.1150	-0.0075	-0.0075	-6.6%	-6.6%
28	SB3-28	Cr2O3 (wt%)	0.1100	0.1306	0.1220	-0.0120	0.0086	-9.8%	7.0%
28	SB3-28	CuO (wt%)	0.0645	0.0688	0.0650	-0.0005	0.0038	-0.8%	5.9%
28	SB3-28	Fe2O3 (wt%)	13.8681	13.4288	13.2870	0.5811	0.1418	4.4%	1.1%
28	SB3-28	K2O (wt%)	0.1355	0.1206	0.1420	-0.0065	-0.0214	-4.6%	-15.1%
28	SB3-28	La2O3 (wt%)	0.0598	0.0598	0.0760	-0.0162	-0.0162	-21.3%	-21.3%
28	SB3-28	Li2O (wt%)	4.3973	4.5711	4.5600	-0.1627	0.0111	-3.6%	0.2%
28	SB3-28	MgO (wt%)	0.0099	0.0108	0.0620	-0.0521	-0.0512	-84.0%	-82.6%
28	SB3-28	MnO (wt%)	2.1531	2.3822	2.3700	-0.2169	0.0122	-9.2%	0.5%
28	SB3-28	Na2O (wt%)	15.1987	14.7225	15.1790	0.0197	-0.4565	0.1%	-3.0%
28	SB3-28	NiO (wt%)	0.4479	0.5224	0.5310	-0.0831	-0.0086	-15.6%	-1.6%

Table H.4: Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by Glass Number *(continued)*
(Batch 1: 100; 101-U std)

Glass #	Glass ID	Oxide	Measured (wt%)	Measured Bias-Corrected (wt%)	Targeted (wt%)	Diff of Measured	Diff of Meas BC	% Diff of Measured	% Diff of Meas BC
28	SB3-28	PbO (wt%)	0.0792	0.0792	0.0990	-0.0198	-0.0198	-20.0%	-20.0%
28	SB3-28	SiO2 (wt%)	45.7810	49.1722	45.7220	0.0590	3.4502	0.1%	7.5%
28	SB3-28	ThO2 (wt%)	0.1306	0.1306	0.0470	0.0836	0.0836	177.8%	177.8%
28	SB3-28	TiO2 (wt%)	0.8599	0.9440	0.9300	-0.0701	0.0140	-7.5%	1.5%
28	SB3-28	U3O8 (wt%)	3.2693	3.4209	3.3630	-0.0937	0.0579	-2.8%	1.7%
28	SB3-28	ZnO (wt%)	0.0999	0.0999	0.1360	-0.0361	-0.0361	-26.5%	-26.5%
28	SB3-28	ZrO2 (wt%)	0.2057	0.2057	0.2450	-0.0393	-0.0393	-16.1%	-16.1%
28	SB3-28	Sum of Oxides	100.1229	103.0517	99.9990	0.1239	3.0527	0.1%	3.1%
29	SB3-29	Al2O3 (wt%)	4.5395	4.7469	4.5040	0.0355	0.2429	0.8%	5.4%
29	SB3-29	B2O3 (wt%)	5.6831	5.5131	5.6800	0.0031	-0.1669	0.1%	-2.9%
29	SB3-29	BaO (wt%)	0.0441	0.0529	0.0620	-0.0179	-0.0091	-28.9%	-14.6%
29	SB3-29	CaO (wt%)	0.9682	0.8928	0.8960	0.0722	-0.0032	8.1%	-0.4%
29	SB3-29	Ce2O3 (wt%)	0.3927	0.3927	0.0870	0.3057	0.3057	351.4%	351.4%
29	SB3-29	Cr2O3 (wt%)	0.0446	0.0529	0.0920	-0.0474	-0.0391	-51.5%	-42.5%
29	SB3-29	CuO (wt%)	0.0510	0.0545	0.0490	0.0020	0.0055	4.1%	11.2%
29	SB3-29	Fe2O3 (wt%)	11.2231	10.8645	10.0160	1.2071	0.8485	12.1%	8.5%
29	SB3-29	K2O (wt%)	0.0753	0.0670	0.1070	-0.0317	-0.0400	-29.6%	-37.4%
29	SB3-29	La2O3 (wt%)	0.3759	0.3759	0.0570	0.3189	0.3189	559.4%	559.4%
29	SB3-29	Li2O (wt%)	4.7471	4.9198	4.9700	-0.2229	-0.0502	-4.5%	-1.0%
29	SB3-29	MgO (wt%)	1.3468	1.4621	1.4670	-0.1202	-0.0049	-8.2%	-0.3%
29	SB3-29	MnO (wt%)	1.6527	1.8284	1.7860	-0.1333	0.0424	-7.5%	2.4%
29	SB3-29	Na2O (wt%)	11.0974	10.7499	11.0000	0.0974	-0.2501	0.9%	-2.3%
29	SB3-29	NiO (wt%)	0.3493	0.4074	0.4010	-0.0517	0.0064	-12.9%	1.6%
29	SB3-29	PbO (wt%)	0.0714	0.0714	0.0750	-0.0036	-0.0036	-4.8%	-4.8%
29	SB3-29	SiO2 (wt%)	54.0708	56.5378	55.1920	-1.1212	1.3458	-2.0%	2.4%
29	SB3-29	ThO2 (wt%)	0.0993	0.0993	0.0360	0.0633	0.0633	175.8%	175.8%
29	SB3-29	TiO2 (wt%)	0.6639	0.7289	0.7010	-0.0371	0.0279	-5.3%	4.0%
29	SB3-29	U3O8 (wt%)	2.4350	2.5479	2.5350	-0.1000	0.0129	-3.9%	0.5%
29	SB3-29	ZnO (wt%)	0.0728	0.0728	0.1020	-0.0292	-0.0292	-28.6%	-28.6%
29	SB3-29	ZrO2 (wt%)	0.2384	0.2384	0.1850	0.0534	0.0534	28.9%	28.9%
29	SB3-29	Sum of Oxides	100.2426	102.6771	100.0000	0.2426	2.6771	0.2%	2.7%
30	SB3-30	Al2O3 (wt%)	7.6100	7.8307	6.9900	0.6200	0.8407	8.9%	12.0%
30	SB3-30	B2O3 (wt%)	4.3791	4.3377	4.4000	-0.0209	-0.0623	-0.5%	-1.4%
30	SB3-30	BaO (wt%)	0.0871	0.0951	0.0970	-0.0099	-0.0019	-10.2%	-1.9%
30	SB3-30	CaO (wt%)	1.4167	1.3500	1.3910	0.0257	-0.0410	1.8%	-2.9%
30	SB3-30	Ce2O3 (wt%)	0.1294	0.1294	0.1350	-0.0056	-0.0056	-4.1%	-4.1%
30	SB3-30	Cr2O3 (wt%)	0.1235	0.1314	0.1430	-0.0195	-0.0116	-13.6%	-8.1%
30	SB3-30	CuO (wt%)	0.0726	0.0762	0.0770	-0.0044	-0.0008	-5.7%	-1.1%
30	SB3-30	Fe2O3 (wt%)	15.2978	15.5315	15.5420	-0.2442	-0.0105	-1.6%	-0.1%
30	SB3-30	K2O (wt%)	0.1473	0.1318	0.1660	-0.0187	-0.0342	-11.3%	-20.6%
30	SB3-30	La2O3 (wt%)	0.0765	0.0765	0.0890	-0.0125	-0.0125	-14.0%	-14.0%
30	SB3-30	Li2O (wt%)	3.7353	3.8648	3.8500	-0.1147	0.0148	-3.0%	0.4%
30	SB3-30	MgO (wt%)	1.1806	1.1835	1.1730	0.0076	0.0105	0.6%	0.9%
30	SB3-30	MnO (wt%)	2.7244	2.6263	2.7720	-0.0476	-0.1457	-1.7%	-5.3%
30	SB3-30	Na2O (wt%)	14.5247	13.5806	13.7580	0.7667	-0.1774	5.6%	-1.3%
30	SB3-30	NiO (wt%)	0.5354	0.5842	0.6210	-0.0856	-0.0368	-13.8%	-5.9%
30	SB3-30	PbO (wt%)	0.1058	0.1058	0.1160	-0.0102	-0.0102	-8.8%	-8.8%
30	SB3-30	SiO2 (wt%)	43.1069	45.3818	43.1590	-0.0521	2.2228	-0.1%	5.2%
30	SB3-30	ThO2 (wt%)	0.1849	0.1849	0.0550	0.1299	0.1299	236.2%	236.2%
30	SB3-30	TiO2 (wt%)	1.0713	1.1255	1.0880	-0.0167	0.0375	-1.5%	3.5%
30	SB3-30	U3O8 (wt%)	3.8265	4.0313	3.9340	-0.1075	0.0973	-2.7%	2.5%
30	SB3-30	ZnO (wt%)	0.1425	0.1425	0.1590	-0.0165	-0.0165	-10.4%	-10.4%
30	SB3-30	ZrO2 (wt%)	0.2644	0.2644	0.2870	-0.0226	-0.0226	-7.9%	-7.9%

Table H.4: Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by Glass Number *(continued)*
(Batch 1: 100; 101-U std)

Glass #	Glass ID	Oxide	Measured (wt%)	Measured Bias-Corrected (wt%)	Targeted (wt%)	Diff of Measured	Diff of Meas BC	% Diff of Measured	% Diff of Meas BC
30	SB3-30	Sum of Oxides	100.7427	102.7662	100.0020	0.7407	2.7642	0.7%	2.8%
31	SB3-31	Al2O3 (wt%)	6.1976	6.4807	6.0860	0.1116	0.3947	1.8%	6.5%
31	SB3-31	B2O3 (wt%)	5.2726	5.1148	5.2000	0.0726	-0.0852	1.4%	-1.6%
31	SB3-31	BaO (wt%)	0.0662	0.0715	0.0750	-0.0088	-0.0035	-11.8%	-4.7%
31	SB3-31	CaO (wt%)	1.1718	1.0825	1.0820	0.0898	0.0005	8.3%	0.0%
31	SB3-31	Ce2O3 (wt%)	0.1060	0.1060	0.1050	0.0010	0.0010	1.0%	1.0%
31	SB3-31	Cr2O3 (wt%)	0.0826	0.0868	0.1110	-0.0284	-0.0242	-25.6%	-21.8%
31	SB3-31	CuO (wt%)	0.0588	0.0623	0.0600	-0.0012	0.0023	-1.9%	3.8%
31	SB3-31	Fe2O3 (wt%)	11.5448	11.4599	12.0880	-0.5432	-0.6281	-4.5%	-5.2%
31	SB3-31	K2O (wt%)	0.1153	0.1031	0.1290	-0.0137	-0.0259	-10.6%	-20.1%
31	SB3-31	La2O3 (wt%)	0.0534	0.0534	0.0690	-0.0156	-0.0156	-22.7%	-22.7%
31	SB3-31	Li2O (wt%)	3.1325	3.2464	3.2500	-0.1175	-0.0036	-3.6%	-0.1%
31	SB3-31	MgO (wt%)	0.0174	0.0175	0.0570	-0.0396	-0.0395	-69.5%	-69.3%
31	SB3-31	MnO (wt%)	2.0691	2.1413	2.1560	-0.0869	-0.0147	-4.0%	-0.7%
31	SB3-31	Na2O (wt%)	13.1868	12.6708	12.6840	0.5028	-0.0132	4.0%	-0.1%
31	SB3-31	NiO (wt%)	0.4301	0.4747	0.4830	-0.0529	-0.0083	-11.0%	-1.7%
31	SB3-31	PbO (wt%)	0.0827	0.0827	0.0900	-0.0073	-0.0073	-8.1%	-8.1%
31	SB3-31	SiO2 (wt%)	51.5571	53.9097	51.9790	-0.4219	1.9307	-0.8%	3.7%
31	SB3-31	ThO2 (wt%)	0.1311	0.1311	0.0430	0.0881	0.0881	205.0%	205.0%
31	SB3-31	TiO2 (wt%)	0.7890	0.8317	0.8460	-0.0570	-0.0143	-6.7%	-1.7%
31	SB3-31	U3O8 (wt%)	3.2133	3.3337	3.0600	0.1533	0.2737	5.0%	8.9%
31	SB3-31	ZnO (wt%)	0.1058	0.1058	0.1240	-0.0182	-0.0182	-14.7%	-14.7%
31	SB3-31	ZrO2 (wt%)	0.2087	0.2087	0.2230	-0.0143	-0.0143	-6.4%	-6.4%
31	SB3-31	Sum of Oxides	99.5928	101.7750	100.0000	-0.4072	1.7750	-0.4%	1.8%
32	SB3-32	Al2O3 (wt%)	8.3232	8.4468	7.8300	0.4932	0.6168	6.3%	7.9%
32	SB3-32	B2O3 (wt%)	4.3147	4.2390	4.2400	0.0747	-0.0010	1.8%	0.0%
32	SB3-32	BaO (wt%)	0.0837	0.1005	0.1010	-0.0173	-0.0005	-17.1%	-0.5%
32	SB3-32	CaO (wt%)	1.6703	1.5401	1.4520	0.2183	0.0881	15.0%	6.1%
32	SB3-32	Ce2O3 (wt%)	0.1362	0.1362	0.1410	-0.0048	-0.0048	-3.4%	-3.4%
32	SB3-32	Cr2O3 (wt%)	0.1114	0.1323	0.1490	-0.0376	-0.0167	-25.2%	-11.2%
32	SB3-32	CuO (wt%)	0.0832	0.0889	0.0800	0.0032	0.0089	4.1%	11.1%
32	SB3-32	Fe2O3 (wt%)	16.0484	15.5436	16.2330	-0.1846	-0.6894	-1.1%	-4.2%
32	SB3-32	K2O (wt%)	0.1970	0.1753	0.1740	0.0230	0.0013	13.2%	0.7%
32	SB3-32	La2O3 (wt%)	0.0748	0.0748	0.0930	-0.0182	-0.0182	-19.6%	-19.6%
32	SB3-32	Li2O (wt%)	2.5835	2.6685	2.6500	-0.0665	0.0185	-2.5%	0.7%
32	SB3-32	MgO (wt%)	0.0265	0.0288	0.0760	-0.0495	-0.0472	-65.1%	-62.1%
32	SB3-32	MnO (wt%)	2.6050	2.8817	2.8950	-0.2900	-0.0133	-10.0%	-0.5%
32	SB3-32	Na2O (wt%)	16.8163	16.2905	14.6330	2.1833	1.6575	14.9%	11.3%
32	SB3-32	NiO (wt%)	0.5147	0.6004	0.6490	-0.1343	-0.0486	-20.7%	-7.5%
32	SB3-32	PbO (wt%)	0.0953	0.0953	0.1210	-0.0257	-0.0257	-21.2%	-21.2%
32	SB3-32	SiO2 (wt%)	41.9838	45.1737	42.7150	-0.7312	2.4587	-1.7%	5.8%
32	SB3-32	ThO2 (wt%)	0.1644	0.1644	0.0580	0.1064	0.1064	183.5%	183.5%
32	SB3-32	TiO2 (wt%)	1.0671	1.1717	1.1360	-0.0689	0.0357	-6.1%	3.1%
32	SB3-32	U3O8 (wt%)	4.0417	4.2289	4.1090	-0.0673	0.1199	-1.6%	2.9%
32	SB3-32	ZnO (wt%)	0.1319	0.1319	0.1660	-0.0341	-0.0341	-20.5%	-20.5%
32	SB3-32	ZrO2 (wt%)	0.2553	0.2553	0.3000	-0.0447	-0.0447	-14.9%	-14.9%
32	SB3-32	Sum of Oxides	101.3285	104.1684	100.0010	1.3275	4.1674	1.3%	4.2%
33	SB3-33	Al2O3 (wt%)	5.9755	5.9743	5.6500	0.3255	0.3243	5.8%	5.7%
33	SB3-33	B2O3 (wt%)	6.8020	6.5831	6.8000	0.0020	-0.2169	0.0%	-3.2%
33	SB3-33	BaO (wt%)	0.0597	0.0646	0.0690	-0.0093	-0.0044	-13.4%	-6.4%
33	SB3-33	CaO (wt%)	1.0372	0.9581	0.9890	0.0482	-0.0309	4.9%	-3.1%
33	SB3-33	Ce2O3 (wt%)	0.0943	0.0943	0.0960	-0.0017	-0.0017	-1.8%	-1.8%
33	SB3-33	Cr2O3 (wt%)	0.0815	0.0856	0.1020	-0.0205	-0.0164	-20.1%	-16.0%

Table H.4: Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by Glass Number *(continued)*
(Batch 1: 100; 101-U std)

Glass #	Glass ID	Oxide	Measured (wt%)	Measured Bias-Corrected (wt%)	Targeted (wt%)	Diff of Measured	Diff of Meas BC	% Diff of Measured	% Diff of Meas BC
33	SB3-33	CuO (wt%)	0.0598	0.0633	0.0540	0.0058	0.0093	10.7%	17.1%
33	SB3-33	Fe2O3 (wt%)	10.8264	10.7468	11.0520	-0.2256	-0.3052	-2.0%	-2.8%
33	SB3-33	K2O (wt%)	0.0750	0.0671	0.1180	-0.0430	-0.0509	-36.5%	-43.2%
33	SB3-33	La2O3 (wt%)	0.0516	0.0516	0.0630	-0.0114	-0.0114	-18.1%	-18.1%
33	SB3-33	Li2O (wt%)	3.2509	3.3795	3.4000	-0.1491	-0.0205	-4.4%	-0.6%
33	SB3-33	MgO (wt%)	0.0137	0.0138	0.0520	-0.0383	-0.0382	-73.7%	-73.5%
33	SB3-33	MnO (wt%)	2.0110	2.0815	1.9710	0.0400	0.1105	2.0%	5.6%
33	SB3-33	Na2O (wt%)	12.5162	12.0275	12.1970	0.3192	-0.1695	2.6%	-1.4%
33	SB3-33	NiO (wt%)	0.4250	0.4693	0.4420	-0.0170	0.0273	-3.8%	6.2%
33	SB3-33	PbO (wt%)	0.0792	0.0792	0.0820	-0.0028	-0.0028	-3.4%	-3.4%
33	SB3-33	SiO2 (wt%)	52.5733	56.4750	52.9360	-0.3627	3.5390	-0.7%	6.7%
33	SB3-33	ThO2 (wt%)	0.1181	0.1181	0.0390	0.0791	0.0791	202.7%	202.7%
33	SB3-33	TiO2 (wt%)	0.7489	0.7896	0.7730	-0.0241	0.0166	-3.1%	2.1%
33	SB3-33	U3O8 (wt%)	2.7741	2.8780	2.7970	-0.0229	0.0810	-0.8%	2.9%
33	SB3-33	ZnO (wt%)	0.1039	0.1039	0.1130	-0.0091	-0.0091	-8.0%	-8.0%
33	SB3-33	ZrO2 (wt%)	0.1976	0.1976	0.2040	-0.0064	-0.0064	-3.2%	-3.2%
33	SB3-33	Sum of Oxides	99.8748	103.3017	99.9990	-0.1242	3.3027	-0.1%	3.3%
34	SB3-34	Al2O3 (wt%)	7.8320	8.1899	7.8300	0.0020	0.3599	0.0%	4.6%
34	SB3-34	B2O3 (wt%)	5.4497	5.2864	5.3000	0.1497	-0.0136	2.8%	-0.3%
34	SB3-34	BaO (wt%)	0.0949	0.1026	0.1010	-0.0061	0.0016	-6.0%	1.6%
34	SB3-34	CaO (wt%)	1.5440	1.4264	1.4520	0.0920	-0.0256	6.3%	-1.8%
34	SB3-34	Ce2O3 (wt%)	0.1411	0.1411	0.1410	0.0001	0.0001	0.1%	0.1%
34	SB3-34	Cr2O3 (wt%)	0.1319	0.1386	0.1490	-0.0171	-0.0104	-11.5%	-6.9%
34	SB3-34	CuO (wt%)	0.0811	0.0858	0.0800	0.0011	0.0058	1.3%	7.2%
34	SB3-34	Fe2O3 (wt%)	15.7624	15.6471	16.2330	-0.4706	-0.5859	-2.9%	-3.6%
34	SB3-34	K2O (wt%)	0.1705	0.1524	0.1740	-0.0035	-0.0216	-2.0%	-12.4%
34	SB3-34	La2O3 (wt%)	0.0786	0.0786	0.0930	-0.0144	-0.0144	-15.5%	-15.5%
34	SB3-34	Li2O (wt%)	2.5889	2.6831	2.6500	-0.0611	0.0331	-2.3%	1.2%
34	SB3-34	MgO (wt%)	0.0398	0.0401	0.0760	-0.0362	-0.0359	-47.6%	-47.2%
34	SB3-34	MnO (wt%)	2.7922	2.8901	2.8950	-0.1028	-0.0049	-3.6%	-0.2%
34	SB3-34	Na2O (wt%)	15.0302	14.4446	14.6330	0.3972	-0.1884	2.7%	-1.3%
34	SB3-34	NiO (wt%)	0.5427	0.5992	0.6490	-0.1063	-0.0498	-16.4%	-7.7%
34	SB3-34	PbO (wt%)	0.1034	0.1034	0.1210	-0.0176	-0.0176	-14.5%	-14.5%
34	SB3-34	SiO2 (wt%)	41.5024	43.3992	41.6550	-0.1526	1.7442	-0.4%	4.2%
34	SB3-34	ThO2 (wt%)	0.1769	0.1769	0.0580	0.1189	0.1189	205.1%	205.1%
34	SB3-34	TiO2 (wt%)	1.1076	1.1676	1.1360	-0.0284	0.0316	-2.5%	2.8%
34	SB3-34	U3O8 (wt%)	4.0270	4.1778	4.1090	-0.0820	0.0688	-2.0%	1.7%
34	SB3-34	ZnO (wt%)	0.1590	0.1590	0.1660	-0.0070	-0.0070	-4.2%	-4.2%
34	SB3-34	ZrO2 (wt%)	0.2823	0.2823	0.3000	-0.0177	-0.0177	-5.9%	-5.9%
34	SB3-34	Sum of Oxides	99.6386	101.3724	100.0010	-0.3624	1.3714	-0.4%	1.4%
35	SB3-35	Al2O3 (wt%)	4.7285	4.7304	4.6330	0.0955	0.0974	2.1%	2.1%
35	SB3-35	B2O3 (wt%)	6.0373	5.8438	6.0000	0.0373	-0.1562	0.6%	-2.6%
35	SB3-35	BaO (wt%)	0.0452	0.0502	0.0540	-0.0088	-0.0038	-16.3%	-7.1%
35	SB3-35	CaO (wt%)	0.8213	0.7682	0.7730	0.0483	-0.0048	6.3%	-0.6%
35	SB3-35	Ce2O3 (wt%)	0.0741	0.0741	0.0750	-0.0009	-0.0009	-1.2%	-1.2%
35	SB3-35	Cr2O3 (wt%)	0.0683	0.0727	0.0790	-0.0107	-0.0063	-13.5%	-8.0%
35	SB3-35	CuO (wt%)	0.0432	0.0460	0.0430	0.0002	0.0030	0.4%	7.1%
35	SB3-35	Fe2O3 (wt%)	8.5067	8.4195	8.6340	-0.1273	-0.2145	-1.5%	-2.5%
35	SB3-35	K2O (wt%)	0.0623	0.0559	0.0920	-0.0297	-0.0361	-32.2%	-39.2%
35	SB3-35	La2O3 (wt%)	0.0396	0.0396	0.0490	-0.0094	-0.0094	-19.2%	-19.2%
35	SB3-35	Li2O (wt%)	3.5738	3.7153	3.7500	-0.1762	-0.0347	-4.7%	-0.9%
35	SB3-35	MgO (wt%)	0.0044	0.0045	0.0400	-0.0356	-0.0355	-89.1%	-88.7%
35	SB3-35	MnO (wt%)	1.4687	1.5831	1.5400	-0.0713	0.0431	-4.6%	2.8%

Table H.4: Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by Glass Number *(continued)*
(Batch 1: 100; 101-U std)

Glass #	Glass ID	Oxide	Measured (wt%)	Measured Bias-Corrected (wt%)	Targeted (wt%)	Diff of Measured	Diff of Meas BC	% Diff of Measured	% Diff of Meas BC
35	SB3-35	Na2O (wt%)	15.7042	14.7645	14.8100	0.8942	-0.0455	6.0%	-0.3%
35	SB3-35	NiO (wt%)	0.3035	0.3453	0.3450	-0.0415	0.0003	-12.0%	0.1%
35	SB3-35	PbO (wt%)	0.0557	0.0557	0.0640	-0.0083	-0.0083	-12.9%	-12.9%
35	SB3-35	SiO2 (wt%)	55.4079	59.5229	55.9500	-0.5421	3.5729	-1.0%	6.4%
35	SB3-35	ThO2 (wt%)	0.0913	0.0913	0.0310	0.0603	0.0603	194.6%	194.6%
35	SB3-35	TiO2 (wt%)	0.5238	0.5669	0.6040	-0.0802	-0.0371	-13.3%	-6.1%
35	SB3-35	U3O8 (wt%)	2.1432	2.2425	2.1850	-0.0418	0.0575	-1.9%	2.6%
35	SB3-35	ZnO (wt%)	0.0753	0.0753	0.0880	-0.0127	-0.0127	-14.4%	-14.4%
35	SB3-35	ZrO2 (wt%)	0.1364	0.1364	0.1590	-0.0226	-0.0226	-14.2%	-14.2%
35	SB3-35	Sum of Oxides	99.9148	103.2043	99.9980	-0.0832	3.2063	-0.1%	3.2%
36	SB3-36	Al2O3 (wt%)	7.2746	7.2779	7.5400	-0.2654	-0.2621	-3.5%	-3.5%
36	SB3-36	B2O3 (wt%)	4.5320	4.3856	4.4000	0.1320	-0.0144	3.0%	-0.3%
36	SB3-36	BaO (wt%)	0.0829	0.0920	0.0970	-0.0141	-0.0050	-14.5%	-5.1%
36	SB3-36	CaO (wt%)	1.4478	1.3543	1.3910	0.0568	-0.0367	4.1%	-2.6%
36	SB3-36	Ce2O3 (wt%)	0.1250	0.1250	0.1350	-0.0100	-0.0100	-7.4%	-7.4%
36	SB3-36	Cr2O3 (wt%)	0.1326	0.1411	0.1430	-0.0104	-0.0019	-7.2%	-1.4%
36	SB3-36	CuO (wt%)	0.0760	0.0811	0.0770	-0.0010	0.0041	-1.2%	5.3%
36	SB3-36	Fe2O3 (wt%)	14.8045	14.6503	15.5420	-0.7375	-0.8917	-4.7%	-5.7%
36	SB3-36	K2O (wt%)	0.1539	0.1380	0.1660	-0.0121	-0.0280	-7.3%	-16.9%
36	SB3-36	La2O3 (wt%)	0.0710	0.0710	0.0890	-0.0180	-0.0180	-20.3%	-20.3%
36	SB3-36	Li2O (wt%)	2.7019	2.8087	2.7500	-0.0481	0.0587	-1.7%	2.1%
36	SB3-36	MgO (wt%)	0.0253	0.0264	0.0730	-0.0477	-0.0466	-65.4%	-63.8%
36	SB3-36	MnO (wt%)	2.4597	2.6517	2.7720	-0.3123	-0.1203	-11.3%	-4.3%
36	SB3-36	Na2O (wt%)	17.7262	16.6658	17.0580	0.6682	-0.3922	3.9%	-2.3%
36	SB3-36	NiO (wt%)	0.5128	0.5835	0.6210	-0.1082	-0.0375	-17.4%	-6.0%
36	SB3-36	PbO (wt%)	0.0978	0.0978	0.1160	-0.0182	-0.0182	-15.7%	-15.7%
36	SB3-36	SiO2 (wt%)	41.9838	45.0960	41.5090	0.4748	3.5870	1.1%	8.6%
36	SB3-36	ThO2 (wt%)	0.1567	0.1567	0.0550	0.1017	0.1017	185.0%	185.0%
36	SB3-36	TiO2 (wt%)	0.9883	1.0697	1.0880	-0.0997	-0.0183	-9.2%	-1.7%
36	SB3-36	U3O8 (wt%)	3.7145	3.8866	3.9340	-0.2195	-0.0474	-5.6%	-1.2%
36	SB3-36	ZnO (wt%)	0.1254	0.1254	0.1590	-0.0336	-0.0336	-21.1%	-21.1%
36	SB3-36	ZrO2 (wt%)	0.2452	0.2452	0.2870	-0.0418	-0.0418	-14.6%	-14.6%
36	SB3-36	Sum of Oxides	99.4380	101.7297	100.0020	-0.5640	1.7277	-0.6%	1.7%
37	SB3-37	Al2O3 (wt%)	4.9410	5.0844	4.8150	0.1260	0.2694	2.6%	5.6%
37	SB3-37	B2O3 (wt%)	5.3531	5.3026	5.5200	-0.1669	-0.2174	-3.0%	-3.9%
37	SB3-37	BaO (wt%)	0.0550	0.0601	0.0670	-0.0120	-0.0069	-17.9%	-10.4%
37	SB3-37	CaO (wt%)	1.0099	0.9624	0.9580	0.0519	0.0044	5.4%	0.5%
37	SB3-37	Ce2O3 (wt%)	0.0940	0.0940	0.0930	0.0010	0.0010	1.1%	1.1%
37	SB3-37	Cr2O3 (wt%)	0.0855	0.0910	0.0980	-0.0125	-0.0070	-12.8%	-7.2%
37	SB3-37	CuO (wt%)	0.0504	0.0529	0.0530	-0.0026	-0.0001	-4.9%	-0.3%
37	SB3-37	Fe2O3 (wt%)	10.2724	10.4288	10.7070	-0.4346	-0.2782	-4.1%	-2.6%
37	SB3-37	K2O (wt%)	0.0979	0.0876	0.1150	-0.0171	-0.0274	-14.9%	-23.8%
37	SB3-37	La2O3 (wt%)	0.0493	0.0493	0.0610	-0.0117	-0.0117	-19.2%	-19.2%
37	SB3-37	Li2O (wt%)	5.2800	5.4630	5.5200	-0.2400	-0.0570	-4.3%	-1.0%
37	SB3-37	MgO (wt%)	0.0224	0.0224	0.0500	-0.0276	-0.0276	-55.2%	-55.2%
37	SB3-37	MnO (wt%)	1.8755	1.8074	1.9100	-0.0345	-0.1026	-1.8%	-5.4%
37	SB3-37	Na2O (wt%)	9.8943	9.2516	9.2740	0.6203	-0.0224	6.7%	-0.2%
37	SB3-37	NiO (wt%)	0.3891	0.4246	0.4280	-0.0389	-0.0034	-9.1%	-0.8%
37	SB3-37	PbO (wt%)	0.0681	0.0681	0.0800	-0.0119	-0.0119	-14.8%	-14.8%
37	SB3-37	SiO2 (wt%)	54.9800	57.8805	56.4480	-1.4680	1.4325	-2.6%	2.5%
37	SB3-37	ThO2 (wt%)	0.1220	0.1220	0.0380	0.0840	0.0840	221.2%	221.2%
37	SB3-37	TiO2 (wt%)	0.7214	0.7580	0.7490	-0.0276	0.0090	-3.7%	1.2%
37	SB3-37	U3O8 (wt%)	2.6149	2.7548	2.7100	-0.0951	0.0448	-3.5%	1.7%

Table H.4: Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by Glass Number *(continued)*
(Batch 1: 100; 101-U std)

Glass #	Glass ID	Oxide	Measured (wt%)	Measured Bias-Corrected (wt%)	Targeted (wt%)	Diff of Measured	Diff of Meas BC	% Diff of Measured	% Diff of Meas BC
37	SB3-37	ZnO (wt%)	0.0962	0.0962	0.1090	-0.0128	-0.0128	-11.8%	-11.8%
37	SB3-37	ZrO2 (wt%)	0.1753	0.1753	0.1980	-0.0227	-0.0227	-11.5%	-11.5%
37	SB3-37	Sum of Oxides	98.2475	101.0368	100.0010	-1.7535	1.0358	-1.8%	1.0%
38	SB3-38	Al2O3 (wt%)	7.2368	7.4467	7.1450	0.0918	0.3017	1.3%	4.2%
38	SB3-38	B2O3 (wt%)	4.2825	4.2422	4.3200	-0.0375	-0.0778	-0.9%	-1.8%
38	SB3-38	BaO (wt%)	0.0776	0.0931	0.0990	-0.0214	-0.0059	-21.6%	-5.9%
38	SB3-38	CaO (wt%)	1.5269	1.4079	1.4220	0.1049	-0.0141	7.4%	-1.0%
38	SB3-38	Ce2O3 (wt%)	0.1335	0.1335	0.1380	-0.0045	-0.0045	-3.2%	-3.2%
38	SB3-38	Cr2O3 (wt%)	0.0775	0.0920	0.1460	-0.0685	-0.0540	-46.9%	-37.0%
38	SB3-38	CuO (wt%)	0.0764	0.0815	0.0780	-0.0016	0.0035	-2.1%	4.5%
38	SB3-38	Fe2O3 (wt%)	16.3701	15.8518	15.8870	0.4831	-0.0352	3.0%	-0.2%
38	SB3-38	K2O (wt%)	0.1735	0.1544	0.1700	0.0035	-0.0156	2.0%	-9.2%
38	SB3-38	La2O3 (wt%)	0.0695	0.0695	0.0910	-0.0215	-0.0215	-23.6%	-23.6%
38	SB3-38	Li2O (wt%)	4.1497	4.2935	4.3200	-0.1703	-0.0265	-3.9%	-0.6%
38	SB3-38	MgO (wt%)	0.0195	0.0212	0.0740	-0.0545	-0.0528	-73.7%	-71.4%
38	SB3-38	MnO (wt%)	2.4985	2.7639	2.8340	-0.3355	-0.0701	-11.8%	-2.5%
38	SB3-38	Na2O (wt%)	12.6207	12.2235	12.3100	0.3106	-0.0865	2.5%	-0.7%
38	SB3-38	NiO (wt%)	0.5023	0.5859	0.6350	-0.1327	-0.0491	-20.9%	-7.7%
38	SB3-38	PbO (wt%)	0.0926	0.0926	0.1180	-0.0254	-0.0254	-21.5%	-21.5%
38	SB3-38	SiO2 (wt%)	44.0161	46.3385	44.5670	-0.5509	1.7715	-1.2%	4.0%
38	SB3-38	ThO2 (wt%)	0.1599	0.1599	0.0570	0.1029	0.1029	180.5%	180.5%
38	SB3-38	TiO2 (wt%)	1.0179	1.1176	1.1120	-0.0941	0.0056	-8.5%	0.5%
38	SB3-38	U3O8 (wt%)	3.8707	4.0501	4.0210	-0.1503	0.0291	-3.7%	0.7%
38	SB3-38	ZnO (wt%)	0.1189	0.1189	0.1620	-0.0431	-0.0431	-26.6%	-26.6%
38	SB3-38	ZrO2 (wt%)	0.3880	0.3880	0.2930	0.0950	0.0950	32.4%	32.4%
38	SB3-38	Sum of Oxides	99.4789	101.7261	99.9990	-0.5201	1.7271	-0.5%	1.7%
39	SB3-39	Al2O3 (wt%)	4.4734	4.4715	4.3490	0.1244	0.1225	2.9%	2.8%
39	SB3-39	B2O3 (wt%)	7.2126	6.9809	7.2000	0.0126	-0.2191	0.2%	-3.0%
39	SB3-39	BaO (wt%)	0.0511	0.0552	0.0600	-0.0089	-0.0048	-14.9%	-8.0%
39	SB3-39	CaO (wt%)	0.9490	0.8767	0.8650	0.0840	0.0117	9.7%	1.4%
39	SB3-39	Ce2O3 (wt%)	0.0805	0.0805	0.0840	-0.0035	-0.0035	-4.1%	-4.1%
39	SB3-39	Cr2O3 (wt%)	0.1842	0.1935	0.0890	0.0952	0.1045	106.9%	117.4%
39	SB3-39	CuO (wt%)	0.0557	0.0590	0.0480	0.0077	0.0110	16.1%	22.8%
39	SB3-39	Fe2O3 (wt%)	10.1044	10.0309	9.6710	0.4334	0.3599	4.5%	3.7%
39	SB3-39	K2O (wt%)	0.0711	0.0635	0.1030	-0.0319	-0.0395	-31.0%	-38.3%
39	SB3-39	La2O3 (wt%)	0.0449	0.0449	0.0550	-0.0101	-0.0101	-18.4%	-18.4%
39	SB3-39	Li2O (wt%)	5.5330	5.7524	5.7600	-0.2270	-0.0076	-3.9%	-0.1%
39	SB3-39	MgO (wt%)	0.0041	0.0042	0.0450	-0.0409	-0.0408	-90.8%	-90.7%
39	SB3-39	MnO (wt%)	1.6818	1.7404	1.7250	-0.0432	0.0154	-2.5%	0.9%
39	SB3-39	Na2O (wt%)	8.8597	8.5126	8.6670	0.1927	-0.1544	2.2%	-1.8%
39	SB3-39	NiO (wt%)	0.3770	0.4160	0.3870	-0.0100	0.0290	-2.6%	7.5%
39	SB3-39	PbO (wt%)	0.0633	0.0633	0.0720	-0.0087	-0.0087	-12.1%	-12.1%
39	SB3-39	SiO2 (wt%)	56.6380	60.8426	57.3840	-0.7460	3.4586	-1.3%	6.0%
39	SB3-39	ThO2 (wt%)	0.1013	0.1013	0.0340	0.0673	0.0673	197.9%	197.9%
39	SB3-39	TiO2 (wt%)	0.6351	0.6695	0.6770	-0.0419	-0.0075	-6.2%	-1.1%
39	SB3-39	U3O8 (wt%)	2.4115	2.5018	2.4480	-0.0365	0.0538	-1.5%	2.2%
39	SB3-39	ZnO (wt%)	0.0918	0.0918	0.0990	-0.0072	-0.0072	-7.3%	-7.3%
39	SB3-39	ZrO2 (wt%)	0.2198	0.2198	0.1790	0.0408	0.0408	22.8%	22.8%
39	SB3-39	Sum of Oxides	99.8431	103.7724	100.0010	-0.1579	3.7714	-0.2%	3.8%
40	SB3-40	Al2O3 (wt%)	7.3029	7.4111	7.1450	0.1579	0.2661	2.2%	3.7%
40	SB3-40	B2O3 (wt%)	5.4980	5.4015	5.4000	0.0980	0.0015	1.8%	0.0%
40	SB3-40	BaO (wt%)	0.0851	0.0945	0.0990	-0.0139	-0.0045	-14.0%	-4.5%
40	SB3-40	CaO (wt%)	1.5118	1.4142	1.4220	0.0898	-0.0078	6.3%	-0.6%

Table H.4: Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by Glass Number *(continued)*
(Batch 1: 100; 101-U std)

Glass #	Glass ID	Oxide	Measured (wt%)	Measured Bias-Corrected (wt%)	Targeted (wt%)	Diff of Measured	Diff of Meas BC	% Diff of Measured	% Diff of Meas BC
40	SB3-40	Ce2O3 (wt%)	0.1324	0.1324	0.1380	-0.0056	-0.0056	-4.1%	-4.1%
40	SB3-40	Cr2O3 (wt%)	0.1345	0.1430	0.1460	-0.0115	-0.0030	-7.9%	-2.0%
40	SB3-40	CuO (wt%)	0.0792	0.0844	0.0780	0.0012	0.0064	1.5%	8.2%
40	SB3-40	Fe2O3 (wt%)	15.2620	15.1037	15.8870	-0.6250	-0.7833	-3.9%	-4.9%
40	SB3-40	K2O (wt%)	0.1738	0.1558	0.1700	0.0038	-0.0142	2.2%	-8.3%
40	SB3-40	La2O3 (wt%)	0.0756	0.0756	0.0910	-0.0154	-0.0154	-16.9%	-16.9%
40	SB3-40	Li2O (wt%)	4.2251	4.3639	4.3200	-0.0949	0.0439	-2.2%	1.0%
40	SB3-40	MgO (wt%)	0.0298	0.0312	0.0740	-0.0442	-0.0428	-59.7%	-57.9%
40	SB3-40	MnO (wt%)	2.5469	2.7460	2.8340	-0.2871	-0.0880	-10.1%	-3.1%
40	SB3-40	Na2O (wt%)	12.9846	12.2080	12.3100	0.6746	-0.1020	5.5%	-0.8%
40	SB3-40	NiO (wt%)	0.5030	0.5723	0.6350	-0.1320	-0.0627	-20.8%	-9.9%
40	SB3-40	PbO (wt%)	0.0999	0.0999	0.1180	-0.0181	-0.0181	-15.3%	-15.3%
40	SB3-40	SiO2 (wt%)	43.4813	46.7828	43.4870	-0.0057	3.2958	0.0%	7.6%
40	SB3-40	ThO2 (wt%)	0.1656	0.1656	0.0570	0.1086	0.1086	190.5%	190.5%
40	SB3-40	TiO2 (wt%)	1.0421	1.1279	1.1120	-0.0699	0.0159	-6.3%	1.4%
40	SB3-40	U3O8 (wt%)	3.8471	4.0254	4.0210	-0.1739	0.0044	-4.3%	0.1%
40	SB3-40	ZnO (wt%)	0.1422	0.1422	0.1620	-0.0198	-0.0198	-12.2%	-12.2%
40	SB3-40	ZrO2 (wt%)	0.2556	0.2556	0.2930	-0.0374	-0.0374	-12.8%	-12.8%
40	SB3-40	Sum of Oxides	99.5785	102.5372	99.9990	-0.4205	2.5382	-0.4%	2.5%
41	SB3-41	Al2O3 (wt%)	4.6434	4.7782	4.3590	0.2844	0.4192	6.5%	9.6%
41	SB3-41	B2O3 (wt%)	5.8522	5.7970	5.9200	-0.0678	-0.1230	-1.1%	-2.1%
41	SB3-41	BaO (wt%)	0.0508	0.0564	0.0600	-0.0092	-0.0036	-15.3%	-6.0%
41	SB3-41	CaO (wt%)	0.9266	0.8667	0.8670	0.0596	-0.0003	6.9%	0.0%
41	SB3-41	Ce2O3 (wt%)	0.0820	0.0820	0.0860	-0.0040	-0.0040	-4.7%	-4.7%
41	SB3-41	Cr2O3 (wt%)	0.0859	0.0913	0.0900	-0.0041	0.0013	-4.6%	1.5%
41	SB3-41	CuO (wt%)	0.0494	0.0527	0.0480	0.0014	0.0047	3.0%	9.8%
41	SB3-41	Fe2O3 (wt%)	9.7613	9.6609	9.6970	0.0643	-0.0361	0.7%	-0.4%
41	SB3-41	K2O (wt%)	0.0705	0.0632	0.1040	-0.0335	-0.0408	-32.2%	-39.2%
41	SB3-41	La2O3 (wt%)	0.0393	0.0393	0.0490	-0.0097	-0.0097	-19.8%	-19.8%
41	SB3-41	Li2O (wt%)	5.7752	5.9753	5.9210	-0.1458	0.0543	-2.5%	0.9%
41	SB3-41	MgO (wt%)	0.0021	0.0022	0.0450	-0.0429	-0.0428	-95.4%	-95.2%
41	SB3-41	MnO (wt%)	1.6075	1.7330	1.7280	-0.1205	0.0050	-7.0%	0.3%
41	SB3-41	Na2O (wt%)	14.2214	13.3702	13.7140	0.5074	-0.3438	3.7%	-2.5%
41	SB3-41	NiO (wt%)	0.3372	0.3837	0.3880	-0.0508	-0.0043	-13.1%	-1.1%
41	SB3-41	PbO (wt%)	0.0617	0.0617	0.0730	-0.0113	-0.0113	-15.5%	-15.5%
41	SB3-41	SiO2 (wt%)	53.6964	56.5261	54.0850	-0.3886	2.4411	-0.7%	4.5%
41	SB3-41	ThO2 (wt%)	0.0979	0.0979	0.0340	0.0639	0.0639	187.8%	187.8%
41	SB3-41	TiO2 (wt%)	0.0046	0.0050	0.0000	0.0046	0.0050		
41	SB3-41	U3O8 (wt%)	2.3761	2.4862	2.4530	-0.0769	0.0332	-3.1%	1.4%
41	SB3-41	ZnO (wt%)	0.0794	0.0794	0.0990	-0.0196	-0.0196	-19.8%	-19.8%
41	SB3-41	ZrO2 (wt%)	0.1614	0.1614	0.1790	-0.0176	-0.0176	-9.8%	-9.8%
41	SB3-41	Sum of Oxides	99.9822	102.3696	99.9990	-0.0168	2.3706	0.0%	2.4%
42	SB3-42	Al2O3 (wt%)	7.0573	7.2620	6.8740	0.1833	0.3880	2.7%	5.6%
42	SB3-42	B2O3 (wt%)	4.7574	4.7125	4.7200	0.0374	-0.0075	0.8%	-0.2%
42	SB3-42	BaO (wt%)	0.0740	0.0887	0.0950	-0.0210	-0.0063	-22.1%	-6.6%
42	SB3-42	CaO (wt%)	1.4992	1.3824	1.3670	0.1322	0.0154	9.7%	1.1%
42	SB3-42	Ce2O3 (wt%)	0.1227	0.1227	0.1350	-0.0123	-0.0123	-9.1%	-9.1%
42	SB3-42	Cr2O3 (wt%)	0.1323	0.1570	0.1420	-0.0097	0.0150	-6.8%	10.6%
42	SB3-42	CuO (wt%)	0.0779	0.0832	0.0750	0.0029	0.0082	3.9%	10.9%
42	SB3-42	Fe2O3 (wt%)	12.7279	12.3277	15.2920	-2.5641	-2.9643	-16.8%	-19.4%
42	SB3-42	K2O (wt%)	0.1596	0.1420	0.1630	-0.0034	-0.0210	-2.1%	-12.9%
42	SB3-42	La2O3 (wt%)	0.0598	0.0598	0.0780	-0.0182	-0.0182	-23.3%	-23.3%
42	SB3-42	Li2O (wt%)	6.0873	6.2984	4.7210	1.3663	1.5774	28.9%	33.4%

Table H.4: Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by Glass Number *(continued)*
(Batch 1: 100; 101-U std)

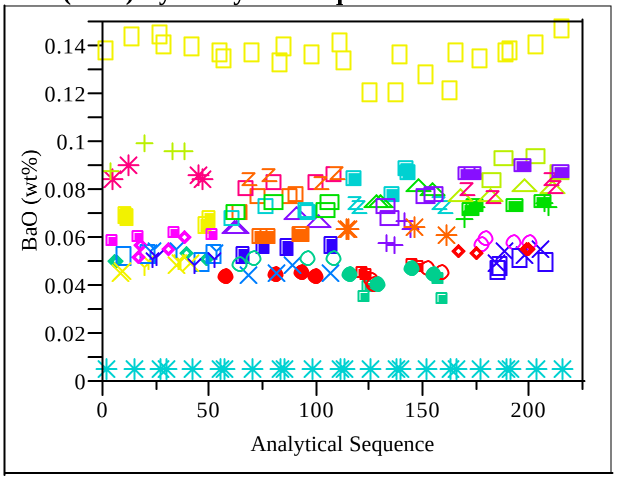
Glass #	Glass ID	Oxide	Measured (wt%)	Measured Bias-Corrected (wt%)	Targeted (wt%)	Diff of Measured	Diff of Meas BC	% Diff of Measured	% Diff of Meas BC
42	SB3-42	MgO (wt%)	0.0257	0.0279	0.0720	-0.0463	-0.0441	-64.3%	-61.2%
42	SB3-42	MnO (wt%)	2.4533	2.7139	2.7250	-0.2717	-0.0111	-10.0%	-0.4%
42	SB3-42	Na2O (wt%)	15.3335	14.8531	14.7020	0.6315	0.1511	4.3%	1.0%
42	SB3-42	NiO (wt%)	0.5227	0.6096	0.6120	-0.0893	-0.0024	-14.6%	-0.4%
42	SB3-42	PbO (wt%)	0.0961	0.0961	0.1150	-0.0189	-0.0189	-16.4%	-16.4%
42	SB3-42	SiO2 (wt%)	44.1765	46.5069	43.7500	0.4265	2.7569	1.0%	6.3%
42	SB3-42	ThO2 (wt%)	0.1530	0.1530	0.0540	0.0990	0.0990	183.4%	183.4%
42	SB3-42	TiO2 (wt%)	0.0083	0.0092	0.0000	0.0083	0.0092		
42	SB3-42	U3O8 (wt%)	3.8029	3.9791	3.8690	-0.0661	0.1101	-1.7%	2.8%
42	SB3-42	ZnO (wt%)	0.1207	0.1207	0.1560	-0.0353	-0.0353	-22.6%	-22.6%
42	SB3-42	ZrO2 (wt%)	0.2371	0.2371	0.2820	-0.0449	-0.0449	-15.9%	-15.9%
42	SB3-42	Sum of Oxides	99.6854	101.9434	99.9990	-0.3136	1.9444	-0.3%	1.9%
100	Batch 1	Al2O3 (wt%)	4.7720	4.8770	4.8770	-0.1050	0.0000	-2.2%	0.0%
100	Batch 1	B2O3 (wt%)	7.9552	7.7770	7.7770	0.1782	0.0000	2.3%	0.0%
100	Batch 1	BaO (wt%)	0.1350	0.1510	0.1510	-0.0160	0.0000	-10.6%	0.0%
100	Batch 1	CaO (wt%)	1.3071	1.2200	1.2200	0.0871	0.0000	7.1%	0.0%
100	Batch 1	Ce2O3 (wt%)	0.0059	0.0059	0.0000	0.0059	0.0059		
100	Batch 1	Cr2O3 (wt%)	0.0983	0.1070	0.1070	-0.0087	0.0000	-8.1%	0.0%
100	Batch 1	CuO (wt%)	0.3763	0.3990	0.3990	-0.0227	0.0000	-5.7%	0.0%
100	Batch 1	Fe2O3 (wt%)	12.9513	12.8390	12.8390	0.1123	0.0000	0.9%	0.0%
100	Batch 1	K2O (wt%)	3.7217	3.3270	3.3270	0.3947	0.0000	11.9%	0.0%
100	Batch 1	La2O3 (wt%)	0.0059	0.0059	0.0000	0.0059	0.0059		
100	Batch 1	Li2O (wt%)	4.2757	4.4290	4.4290	-0.1533	0.0000	-3.5%	0.0%
100	Batch 1	MgO (wt%)	1.3735	1.4190	1.4190	-0.0455	0.0000	-3.2%	0.0%
100	Batch 1	MnO (wt%)	1.6560	1.7260	1.7260	-0.0700	0.0000	-4.1%	0.0%
100	Batch 1	Na2O (wt%)	9.4669	9.0030	9.0030	0.4639	0.0000	5.2%	0.0%
100	Batch 1	NiO (wt%)	0.6682	0.7510	0.7510	-0.0828	0.0000	-11.0%	0.0%
100	Batch 1	PbO (wt%)	0.0054	0.0054	0.0000	0.0054	0.0054		
100	Batch 1	SiO2 (wt%)	47.2902	50.2200	50.2200	-2.9298	0.0000	-5.8%	0.0%
100	Batch 1	ThO2 (wt%)	0.0057	0.0057	0.0000	0.0057	0.0057		
100	Batch 1	TiO2 (wt%)	0.6322	0.6770	0.6770	-0.0448	0.0000	-6.6%	0.0%
100	Batch 1	U3O8 (wt%)	0.0590	0.0617	0.0000	0.0590	0.0617		
100	Batch 1	ZnO (wt%)	0.0062	0.0062	0.0000	0.0062	0.0062		
100	Batch 1	ZrO2 (wt%)	0.0810	0.0810	0.0980	-0.0170	-0.0170	-17.3%	-17.3%
100	Batch 1	Sum of Oxides	96.8484	99.0937	99.0200	-2.1716	0.0737	-2.2%	0.1%
101	U std	Al2O3 (wt%)	3.7349	3.8195	4.1000	-0.3651	-0.2805	-8.9%	-6.8%
101	U std	B2O3 (wt%)	8.8990	8.6996	9.2090	-0.3100	-0.5094	-3.4%	-5.5%
101	U std	BaO (wt%)	0.0056	0.0063	0.0000	0.0056	0.0063		
101	U std	CaO (wt%)	1.3252	1.2370	1.3010	0.0242	-0.0640	1.9%	-4.9%
101	U std	Ce2O3 (wt%)	0.0059	0.0059	0.0000	0.0059	0.0059		
101	U std	Cr2O3 (wt%)	0.2302	0.2508	0.0000	0.2302	0.2508		
101	U std	CuO (wt%)	0.0068	0.0072	0.0000	0.0068	0.0072		
101	U std	Fe2O3 (wt%)	13.1747	13.0616	13.1960	-0.0213	-0.1344	-0.2%	-1.0%
101	U std	K2O (wt%)	3.0486	2.7253	2.9990	0.0496	-0.2737	1.7%	-9.1%
101	U std	La2O3 (wt%)	0.0059	0.0059	0.0000	0.0059	0.0059		
101	U std	Li2O (wt%)	2.7548	2.8536	3.0570	-0.3022	-0.2034	-9.9%	-6.7%
101	U std	MgO (wt%)	1.1488	1.1869	1.2100	-0.0612	-0.0231	-5.1%	-1.9%
101	U std	MnO (wt%)	2.5840	2.6992	2.8920	-0.3080	-0.1928	-10.6%	-6.7%
101	U std	Na2O (wt%)	11.7169	11.1410	11.7950	-0.0781	-0.6540	-0.7%	-5.5%
101	U std	NiO (wt%)	0.9689	1.0892	1.1200	-0.1511	-0.0308	-13.5%	-2.8%
101	U std	PbO (wt%)	0.0054	0.0054	0.0000	0.0054	0.0054		
101	U std	SiO2 (wt%)	47.5727	50.5260	45.3530	2.2197	5.1730	4.9%	11.4%
101	U std	ThO2 (wt%)	0.0683	0.0683	0.0000	0.0683	0.0683		

Table H.4: Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by Glass Number *(continued)*
(Batch 1: 100; 101-U std)

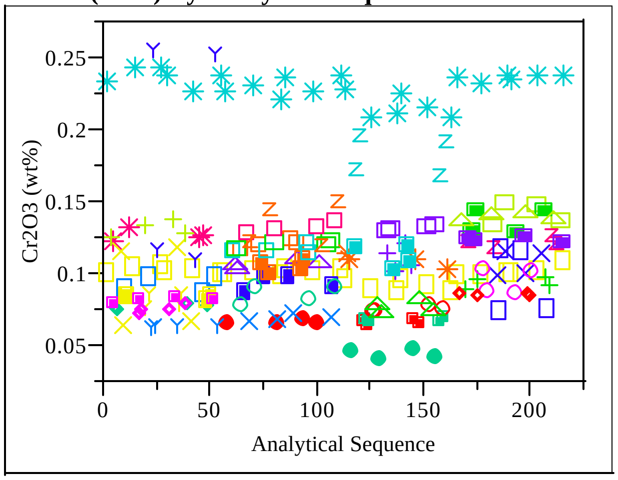
Glass #	Glass ID	Oxide	Measured (wt%)	Measured Bias-Corrected (wt%)	Targeted (wt%)	Diff of Measured	Diff of Meas BC	% Diff of Measured	% Diff of Meas BC
101	U std	TiO2 (wt%)	0.9059	0.9702	1.0490	-0.1431	-0.0788	-13.6%	-7.5%
101	U std	U3O8 (wt%)	2.3004	2.4060	2.4060	-0.1056	0.0000	-4.4%	0.0%
101	U std	ZnO (wt%)	0.0062	0.0062	0.0000	0.0062	0.0062		
101	U std	ZrO2 (wt%)	0.0066	0.0066	0.0000	0.0066	0.0066		
101	U std	Sum of Oxides	100.4758	102.7777	99.6870	0.7888	3.0907	0.8%	3.1%

Exhibit H.1: SRTC-ML Measurements in Analytical Sequence for Samples Prepared Using the LM Method

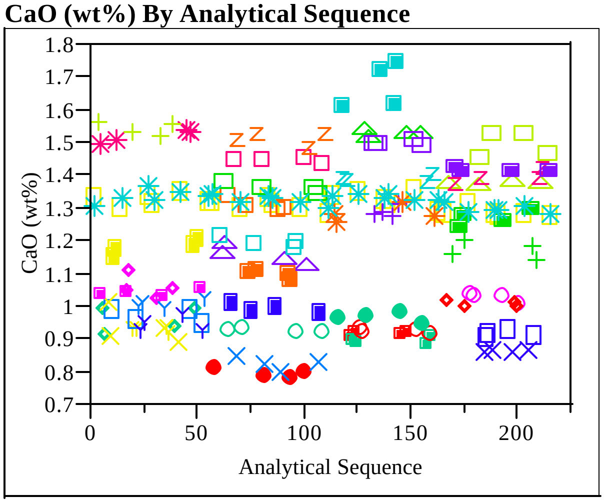
BaO (wt%) By Analytical Sequence



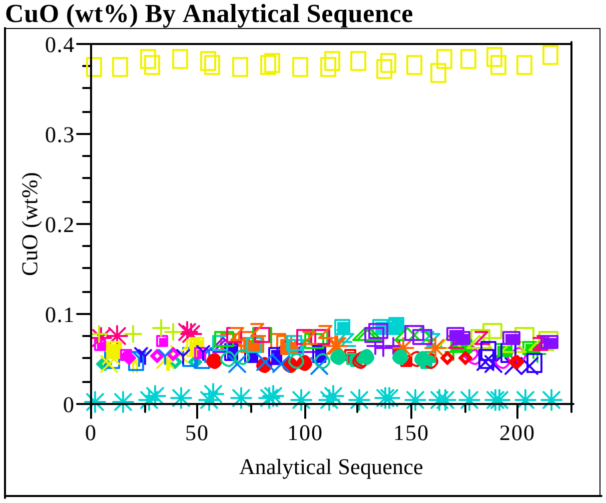
Cr2O3 (wt%) By Analytical Sequence



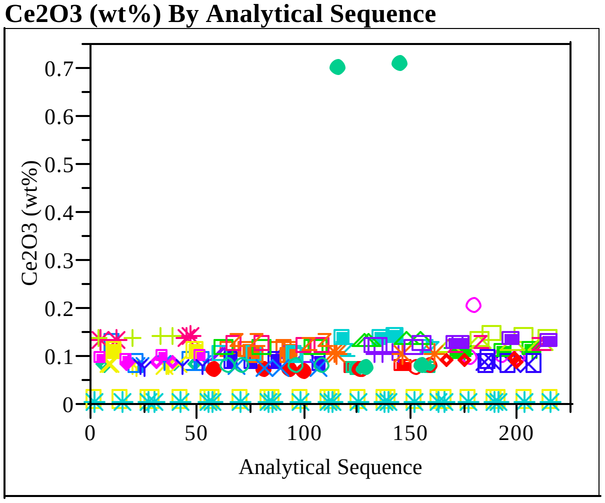
CaO (wt%) By Analytical Sequence



CuO (wt%) By Analytical Sequence



Ce2O3 (wt%) By Analytical Sequence



Fe2O3 (wt%) By Analytical Sequence

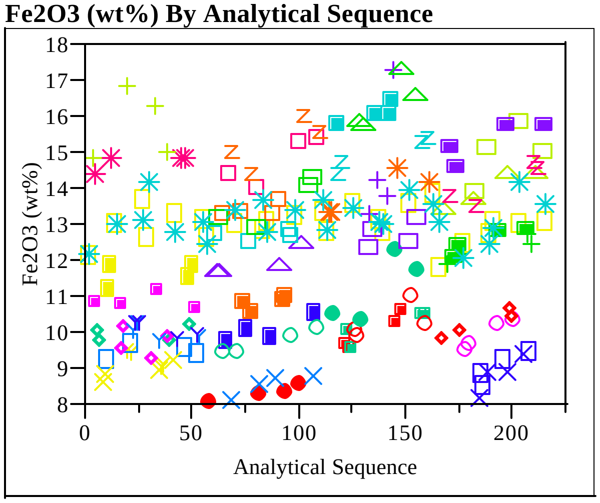
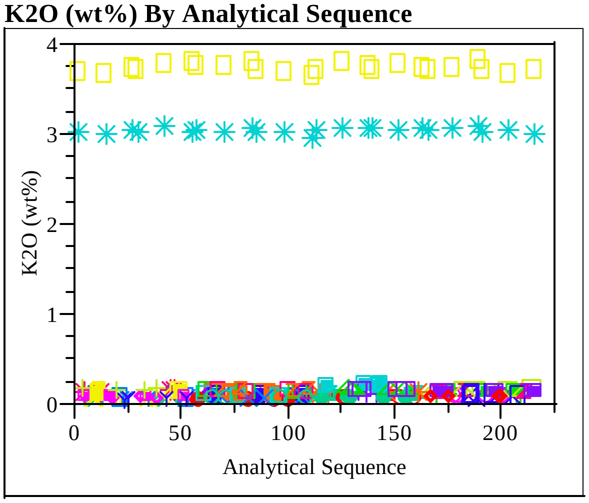
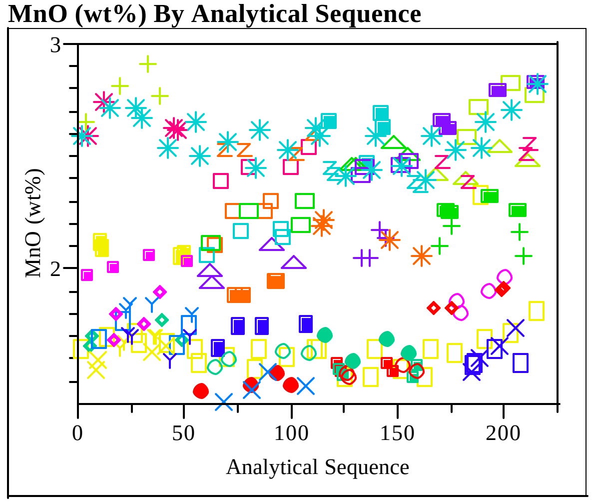


Exhibit H.1: SRTC-ML Measurements in Analytical Sequence for Samples Prepared Using the LM Method *(continued)*

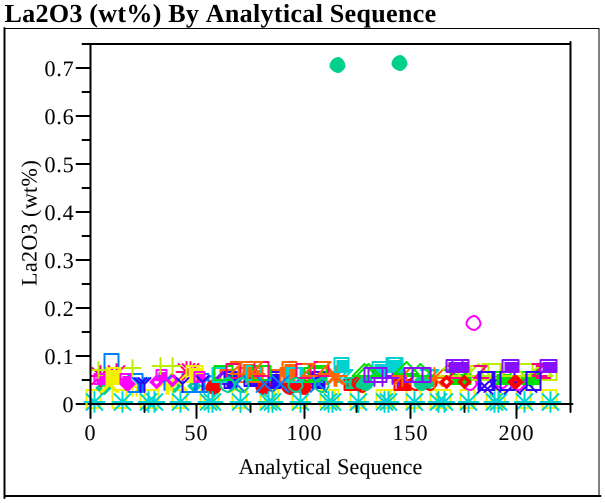
K2O (wt%) By Analytical Sequence



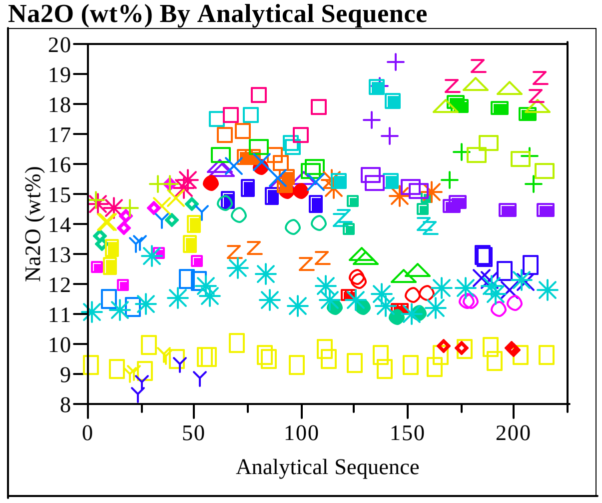
MnO (wt%) By Analytical Sequence



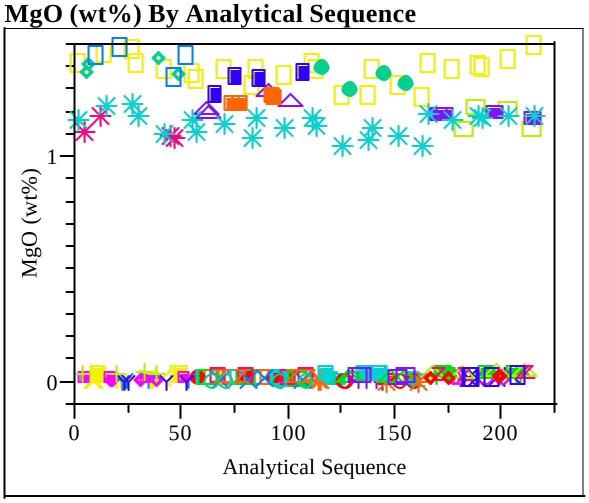
La2O3 (wt%) By Analytical Sequence



Na2O (wt%) By Analytical Sequence



MgO (wt%) By Analytical Sequence



NiO (wt%) By Analytical Sequence

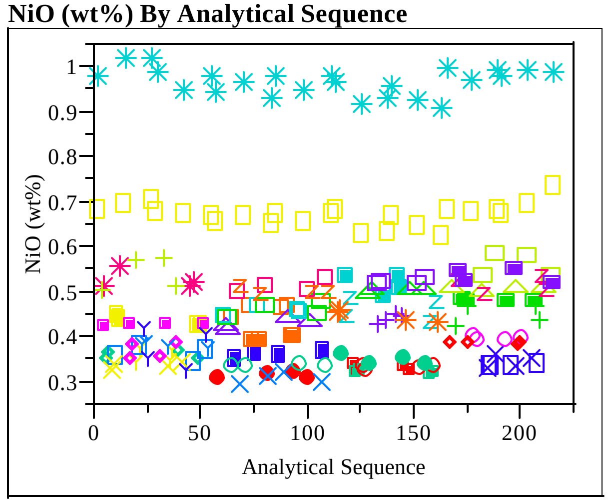
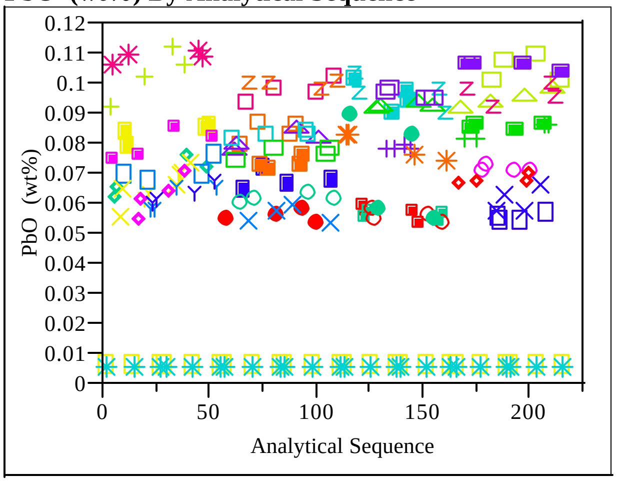
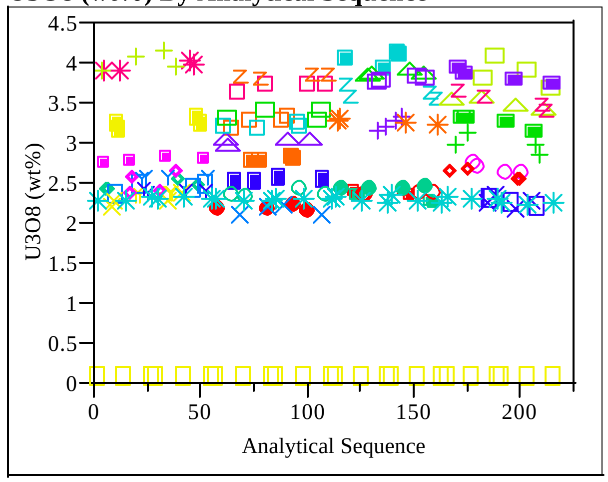


Exhibit H.1: SRTC-ML Measurements in Analytical Sequence for Samples Prepared Using the LM Method *(continued)*

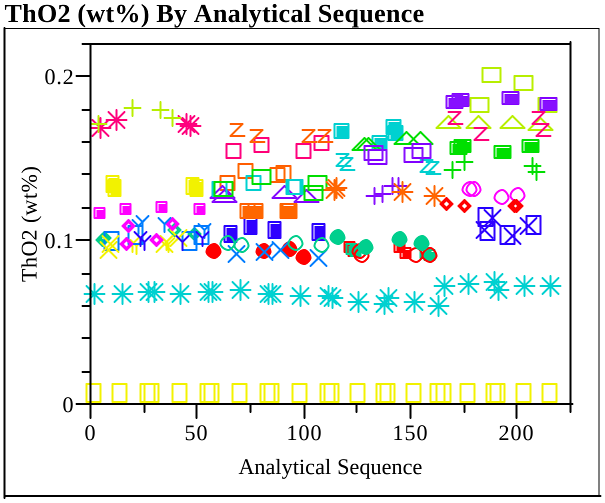
PbO (wt%) By Analytical Sequence



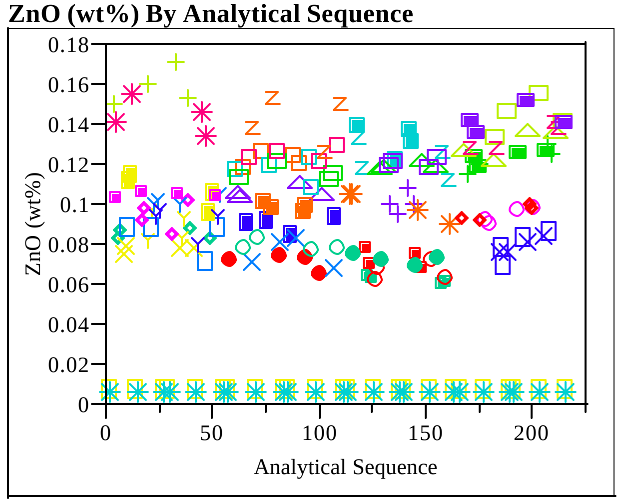
U3O8 (wt%) By Analytical Sequence



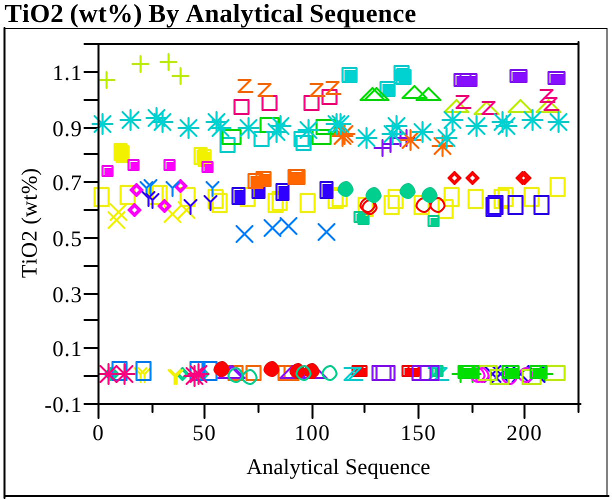
ThO2 (wt%) By Analytical Sequence



ZnO (wt%) By Analytical Sequence



TiO2 (wt%) By Analytical Sequence



ZrO2 (wt%) By Analytical Sequence

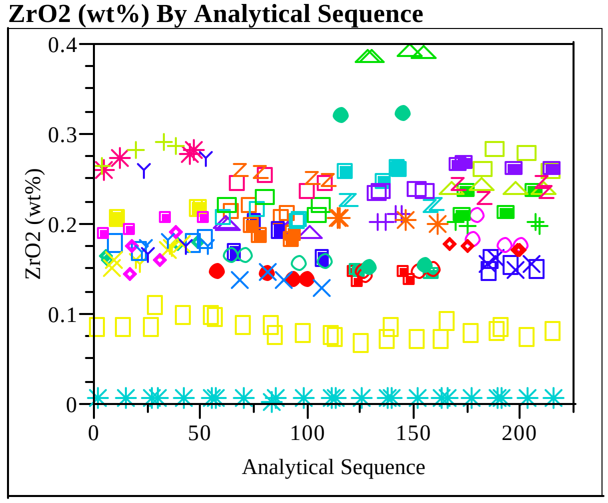
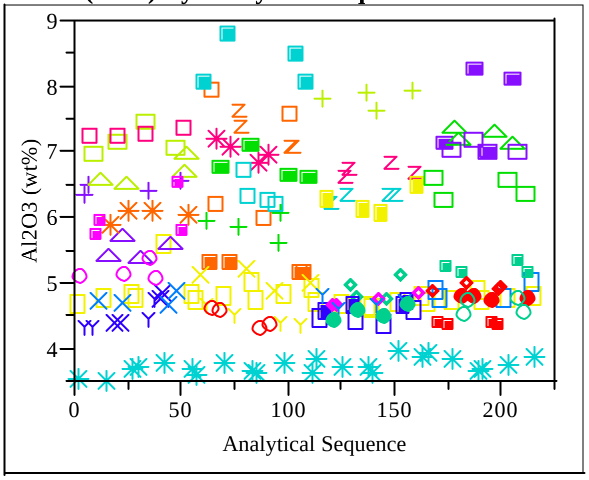
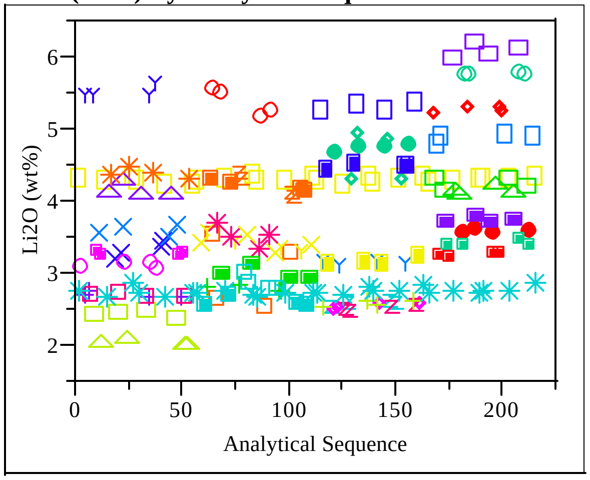


Exhibit H.2: SRTC-ML Measurements in Analytical Sequence for Samples Prepared Using the PF Method

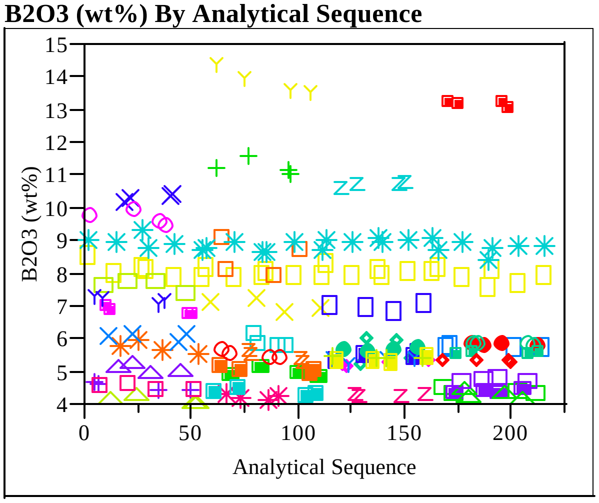
Al2O3 (wt%) By Analytical Sequence



Li2O (wt%) By Analytical Sequence



B2O3 (wt%) By Analytical Sequence



SiO2 (wt%) By Analytical Sequence

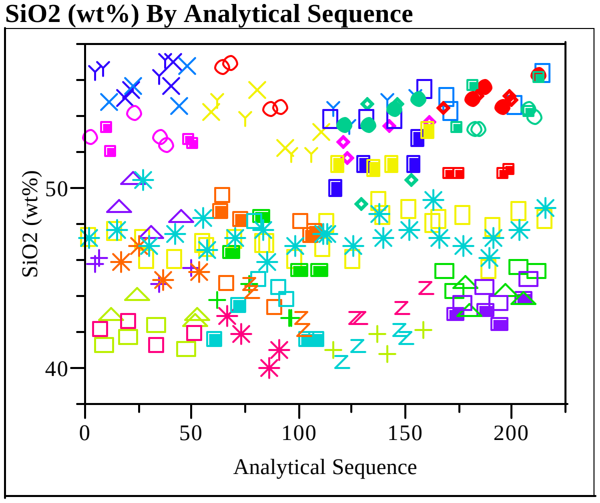
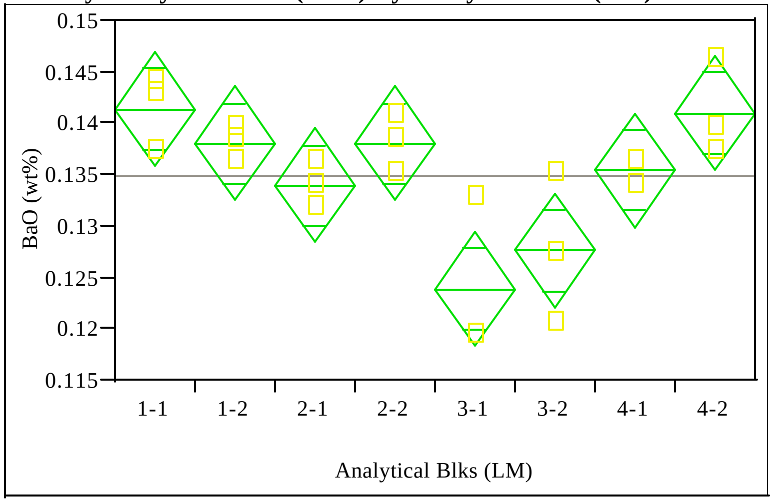


Exhibit H.4: Statistical Analysis by Analytical Block of Measurements of Standard Glasses Prepared Using the PF Method

SB3 Glass #=100; Reference Value for BaO is 0.151 wt%
Oneway Analysis of BaO (wt%) By Analytical Blks (LM)



Oneway Anova

Rsquare	0.714479
Root Mean Square Error	0.004535
Mean of Response	0.134957
Observations (or Sum Wgts)	24

Analysis of Variance

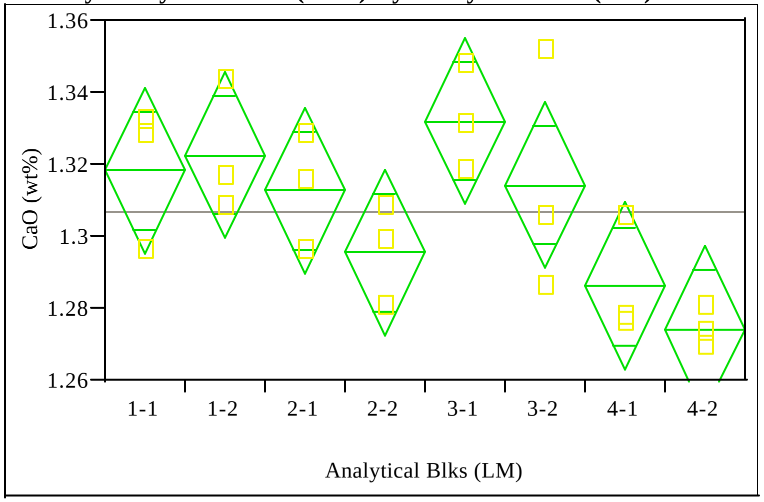
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Analytical Blks (LM)	7	0.00082352	0.000118	5.7197	0.0019
Error	16	0.00032910	0.000021		
C. Total	23	0.00115261			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1	3	0.141423	0.00262	0.13587	0.14697
1-2	3	0.138074	0.00262	0.13252	0.14362
2-1	3	0.133980	0.00262	0.12843	0.13953
2-2	3	0.138074	0.00262	0.13252	0.14362
3-1	3	0.123932	0.00262	0.11838	0.12948
3-2	3	0.127653	0.00262	0.12210	0.13320
4-1	3	0.135469	0.00262	0.12992	0.14102
4-2	3	0.141051	0.00262	0.13550	0.14660

Std Error uses a pooled estimate of error variance

SB3 Glass #=100; Reference Value for CaO is 1.22 wt%
Oneway Analysis of CaO (wt%) By Analytical Blks (LM)



Oneway Anova

Rsquare	0.588578
Root Mean Square Error	0.018902
Mean of Response	1.307086
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Analytical Blks (LM)	7	0.00817822	0.001168	3.2699	0.0235
Error	16	0.00571666	0.000357		
C. Total	23	0.01389488			

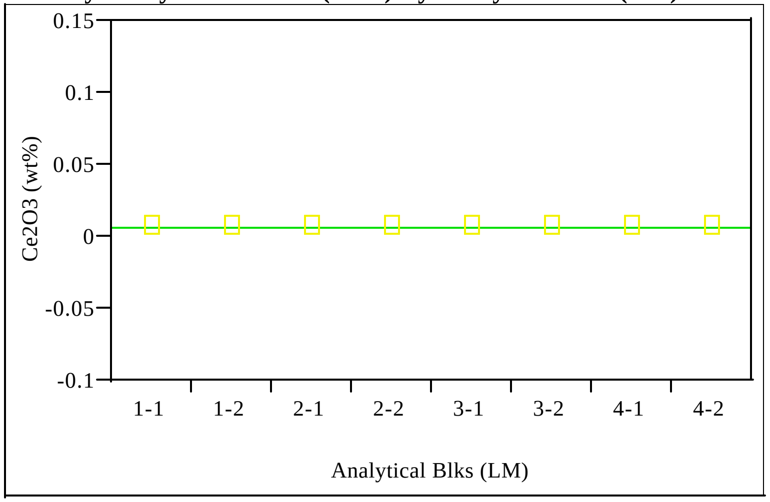
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1	3	1.31851	0.01091	1.2954	1.3416
1-2	3	1.32271	0.01091	1.2996	1.3458
2-1	3	1.31292	0.01091	1.2898	1.3361
2-2	3	1.29566	0.01091	1.2725	1.3188
3-1	3	1.33204	0.01091	1.3089	1.3552
3-2	3	1.31432	0.01091	1.2912	1.3375
4-1	3	1.28633	0.01091	1.2632	1.3095
4-2	3	1.27420	0.01091	1.2511	1.2973

Std Error uses a pooled estimate of error variance

Exhibit H.4: Statistical Analysis by Analytical Block of Measurements of Standard Glasses Prepared Using the PF Method *(continued)*

SB3 Glass #=100; Reference Value for Ce2O3 is 0 wt%
Oneway Analysis of Ce2O3 (wt%) By Analytical Blks (LM)



Oneway Anova

Rsquare	.
Root Mean Square Error	0
Mean of Response	0.005857
Observations (or Sum Wgts)	24

Analysis of Variance

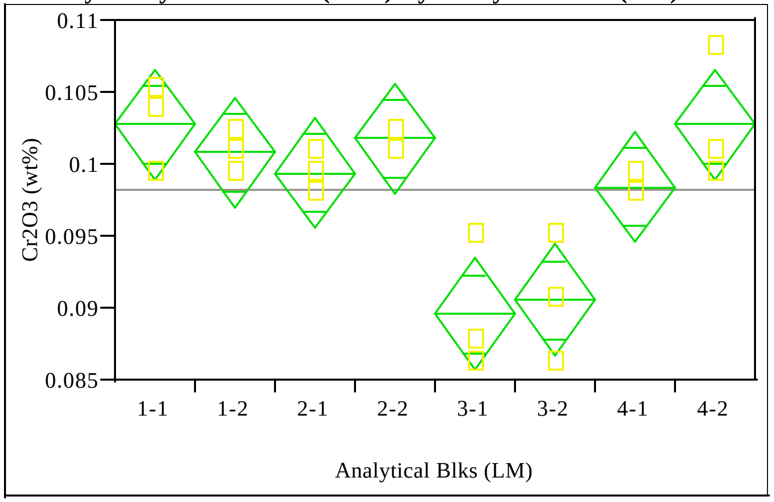
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Analytical Blks (LM)	7	0	0	.	.
Error	16	0	0		
C. Total	23	0			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1	3	0.005857	0	0.00586	0.00586
1-2	3	0.005857	0	0.00586	0.00586
2-1	3	0.005857	0	0.00586	0.00586
2-2	3	0.005857	0	0.00586	0.00586
3-1	3	0.005857	0	0.00586	0.00586
3-2	3	0.005857	0	0.00586	0.00586
4-1	3	0.005857	0	0.00586	0.00586
4-2	3	0.005857	0	0.00586	0.00586

Std Error uses a pooled estimate of error variance

SB3 Glass #=100; Reference Value for Cr2O3 is 0.107 wt%
Oneway Analysis of Cr2O3 (wt%) By Analytical Blks (LM)



Oneway Anova

Rsquare	0.78836
Root Mean Square Error	0.003129
Mean of Response	0.098293
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Analytical Blks (LM)	7	0.00058356	0.000083	8.5143	0.0002
Error	16	0.00015666	0.000010		
C. Total	23	0.00074022			

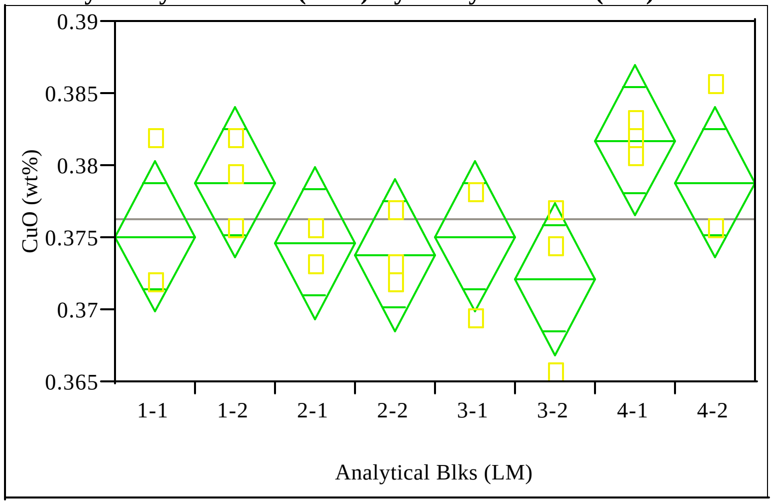
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1	3	0.102799	0.00181	0.09897	0.10663
1-2	3	0.100850	0.00181	0.09702	0.10468
2-1	3	0.099389	0.00181	0.09556	0.10322
2-2	3	0.101825	0.00181	0.09800	0.10565
3-1	3	0.089645	0.00181	0.08582	0.09347
3-2	3	0.090619	0.00181	0.08679	0.09445
4-1	3	0.098414	0.00181	0.09458	0.10224
4-2	3	0.102799	0.00181	0.09897	0.10663

Std Error uses a pooled estimate of error variance

Exhibit H.4: Statistical Analysis by Analytical Block of Measurements of Standard Glasses Prepared Using the PF Method *(continued)*

SB3 Glass #=100; Reference Value for CuO is 0.399 wt%
Oneway Analysis of CuO (wt%) By Analytical Blks (LM)



Oneway Anova

Rsquare	0.420601
Root Mean Square Error	0.004299
Mean of Response	0.376322
Observations (or Sum Wgts)	24

Analysis of Variance

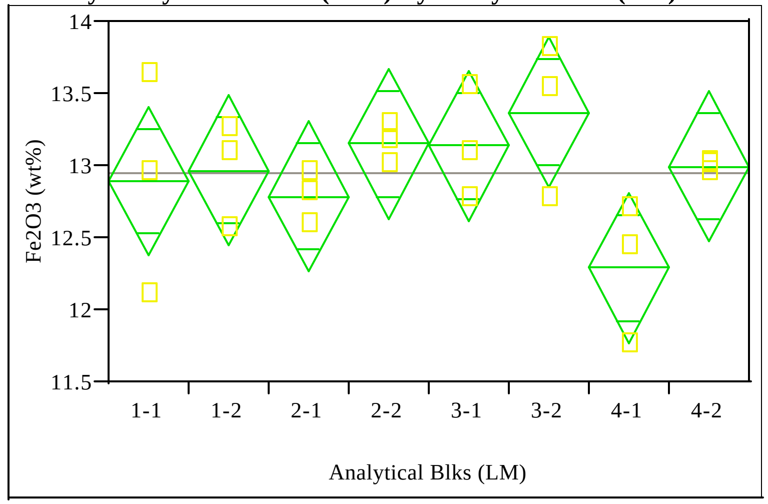
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Analytical Blks (LM)	7	0.00021461	0.000031	1.6593	0.1898
Error	16	0.00029564	0.000018		
C. Total	23	0.00051026			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1	3	0.375123	0.00248	0.36986	0.38038
1-2	3	0.378878	0.00248	0.37362	0.38414
2-1	3	0.374705	0.00248	0.36944	0.37997
2-2	3	0.373871	0.00248	0.36861	0.37913
3-1	3	0.375123	0.00248	0.36986	0.38038
3-2	3	0.372202	0.00248	0.36694	0.37746
4-1	3	0.381799	0.00248	0.37654	0.38706
4-2	3	0.378878	0.00248	0.37362	0.38414

Std Error uses a pooled estimate of error variance

SB3 Glass #=100; Reference Value for Fe2O3 is 12.839 wt%
Oneway Analysis of Fe2O3 (wt%) By Analytical Blks (LM)



Oneway Anova

Rsquare	0.426396
Root Mean Square Error	0.42505
Mean of Response	12.95129
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Analytical Blks (LM)	7	2.1488248	0.306975	1.6991	0.1796
Error	16	2.8906843	0.180668		
C. Total	23	5.0395091			

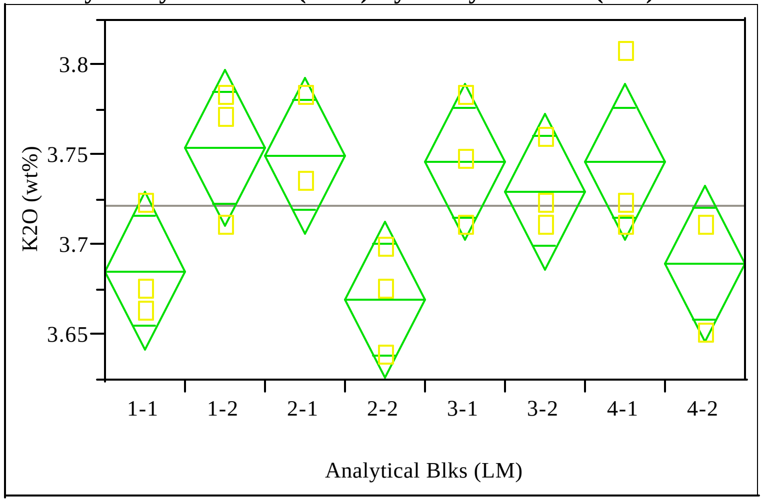
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1	3	12.8959	0.24540	12.376	13.416
1-2	3	12.9721	0.24540	12.452	13.492
2-1	3	12.7863	0.24540	12.266	13.307
2-2	3	13.1532	0.24540	12.633	13.673
3-1	3	13.1389	0.24540	12.619	13.659
3-2	3	13.3725	0.24540	12.852	13.893
4-1	3	12.2954	0.24540	11.775	12.816
4-2	3	12.9960	0.24540	12.476	13.516

Std Error uses a pooled estimate of error variance

Exhibit H.4: Statistical Analysis by Analytical Block of Measurements of Standard Glasses Prepared Using the PF Method *(continued)*

SB3 Glass #=100; Reference Value for K2) is 3.327 wt%
Oneway Analysis of K2O (wt%) By Analytical Blks (LM)



Oneway Anova

Rsquare	0.546084
Root Mean Square Error	0.035548
Mean of Response	3.721712
Observations (or Sum Wgts)	24

Analysis of Variance

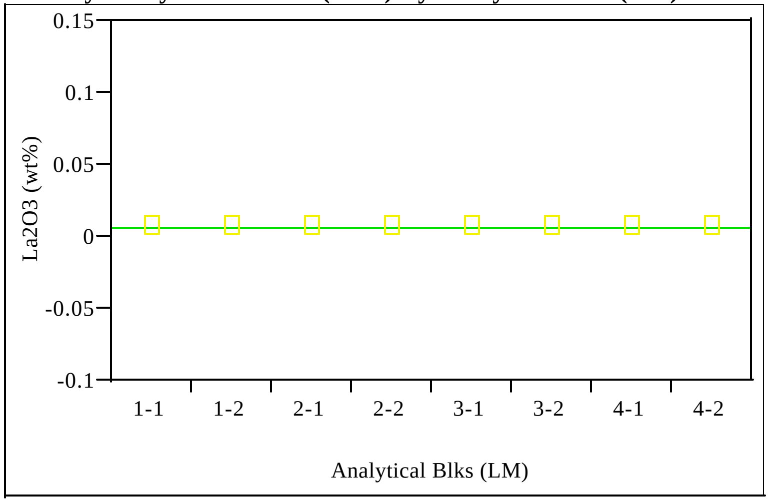
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Analytical Blks (LM)	7	0.02432341	0.003475	2.7498	0.0445
Error	16	0.02021812	0.001264		
C. Total	23	0.04454153			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1	3	3.68608	0.02052	3.6426	3.7296
1-2	3	3.75434	0.02052	3.7108	3.7978
2-1	3	3.75032	0.02052	3.7068	3.7938
2-2	3	3.67001	0.02052	3.6265	3.7135
3-1	3	3.74631	0.02052	3.7028	3.7898
3-2	3	3.73024	0.02052	3.6867	3.7738
4-1	3	3.74631	0.02052	3.7028	3.7898
4-2	3	3.69009	0.02052	3.6466	3.7336

Std Error uses a pooled estimate of error variance

SB3 Glass #=100; Reference Value for La2O3 is 0 wt%
Oneway Analysis of La2O3 (wt%) By Analytical Blks (LM)



Oneway Anova

Rsquare	.
Root Mean Square Error	0
Mean of Response	0.005864
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Analytical Blks (LM)	7	0	0	.	.
Error	16	0	0		
C. Total	23	0			

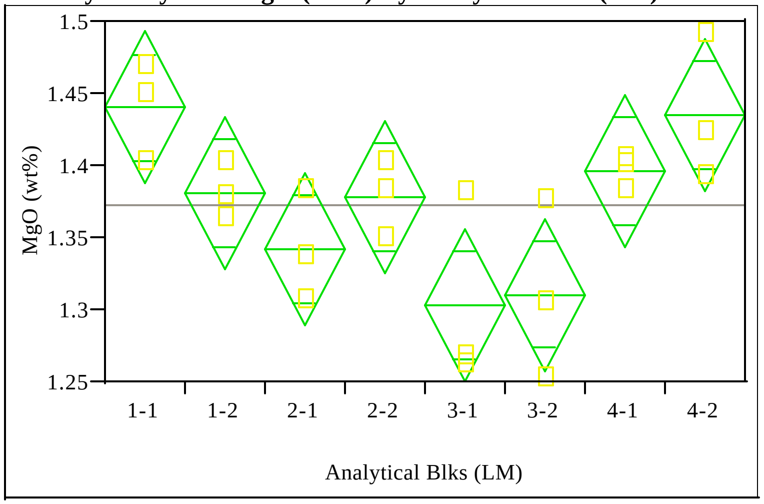
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1	3	0.005864	0	0.00586	0.00586
1-2	3	0.005864	0	0.00586	0.00586
2-1	3	0.005864	0	0.00586	0.00586
2-2	3	0.005864	0	0.00586	0.00586
3-1	3	0.005864	0	0.00586	0.00586
3-2	3	0.005864	0	0.00586	0.00586
4-1	3	0.005864	0	0.00586	0.00586
4-2	3	0.005864	0	0.00586	0.00586

Std Error uses a pooled estimate of error variance

Exhibit H.4: Statistical Analysis by Analytical Block of Measurements of Standard Glasses Prepared Using the PF Method *(continued)*

SB3 Glass #=100; Reference Value for MgO is 1.419 wt%
Oneway Analysis of MgO (wt%) By Analytical Blks (LM)



Oneway Anova

Rsquare	0.653941
Root Mean Square Error	0.043101
Mean of Response	1.373459
Observations (or Sum Wgts)	24

Analysis of Variance

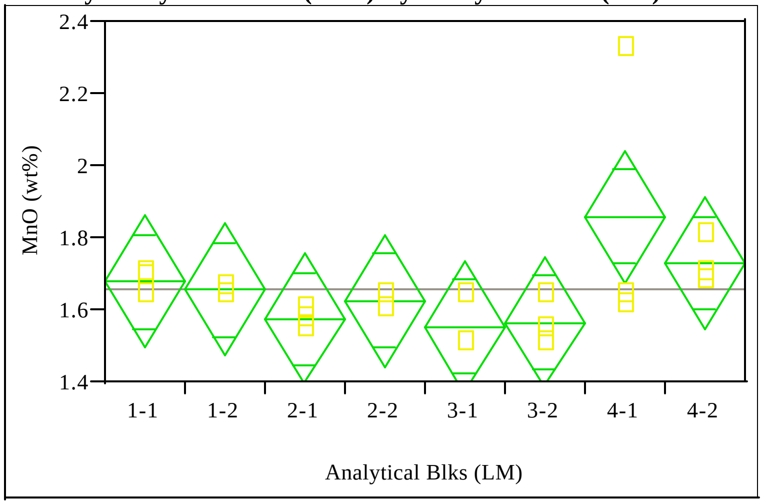
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Analytical Blks (LM)	7	0.05616811	0.008024	4.3193	0.0073
Error	16	0.02972355	0.001858		
C. Total	23	0.08589166			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1	3	1.44034	0.02488	1.3876	1.4931
1-2	3	1.38120	0.02488	1.3284	1.4340
2-1	3	1.34196	0.02488	1.2892	1.3947
2-2	3	1.37843	0.02488	1.3257	1.4312
3-1	3	1.30327	0.02488	1.2505	1.3560
3-2	3	1.31100	0.02488	1.2583	1.3638
4-1	3	1.39612	0.02488	1.3434	1.4489
4-2	3	1.43536	0.02488	1.3826	1.4881

Std Error uses a pooled estimate of error variance

SB3 Glass #=100; Reference Value for MnO is 1.726 wt%
Oneway Analysis of MnO (wt%) By Analytical Blks (LM)



Oneway Anova

Rsquare	0.379559
Root Mean Square Error	0.149746
Mean of Response	1.655964
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Analytical Blks (LM)	7	0.21948654	0.031355	1.3983	0.2723
Error	16	0.35878089	0.022424		
C. Total	23	0.57826743			

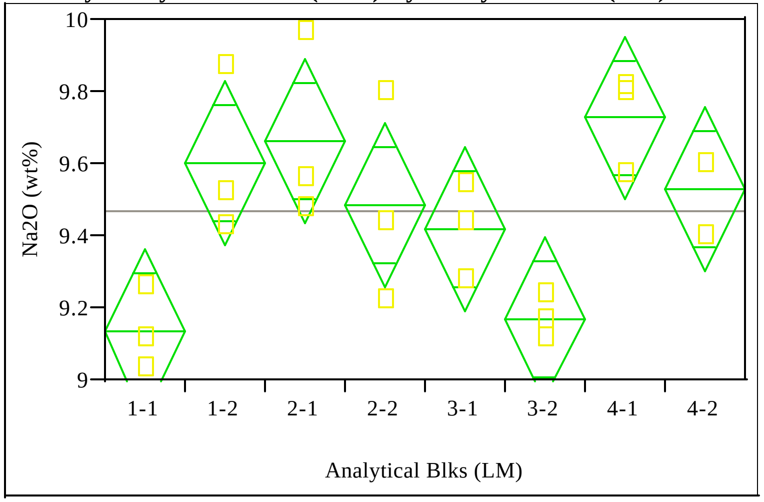
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1	3	1.67856	0.08646	1.4953	1.8618
1-2	3	1.65704	0.08646	1.4738	1.8403
2-1	3	1.57526	0.08646	1.3920	1.7585
2-2	3	1.62691	0.08646	1.4436	1.8102
3-1	3	1.55374	0.08646	1.3705	1.7370
3-2	3	1.56666	0.08646	1.3834	1.7499
4-1	3	1.85933	0.08646	1.6760	2.0426
4-2	3	1.73021	0.08646	1.5469	1.9135

Std Error uses a pooled estimate of error variance

Exhibit H.4: Statistical Analysis by Analytical Block of Measurements of Standard Glasses Prepared Using the PF Method *(continued)*

SB3 Glass #=100; Reference Value for Na2O is 9.003 wt%
Oneway Analysis of Na2O (wt%) By Analytical Blks (LM)



Oneway Anova

Rsquare	0.642141
Root Mean Square Error	0.185809
Mean of Response	9.466892
Observations (or Sum Wgts)	24

Analysis of Variance

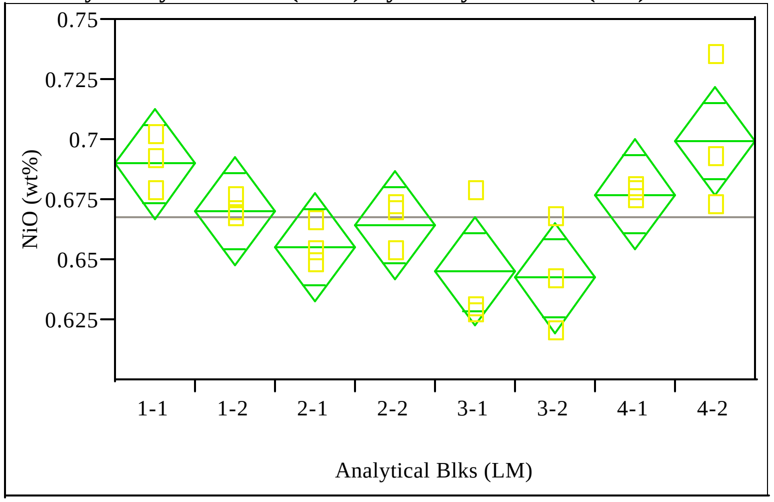
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Analytical Blks (LM)	7	0.9912227	0.141603	4.1015	0.0092
Error	16	0.5523996	0.034525		
C. Total	23	1.5436223			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1	3	9.13495	0.10728	8.9075	9.3624
1-2	3	9.60225	0.10728	9.3748	9.8297
2-1	3	9.66516	0.10728	9.4377	9.8926
2-2	3	9.48543	0.10728	9.2580	9.7128
3-1	3	9.41803	0.10728	9.1906	9.6454
3-2	3	9.17089	0.10728	8.9435	9.3983
4-1	3	9.72807	0.10728	9.5006	9.9555
4-2	3	9.53036	0.10728	9.3029	9.7578

Std Error uses a pooled estimate of error variance

SB3 Glass #=100; Reference Value for NiO is 0.751 wt%
Oneway Analysis of NiO (wt%) By Analytical Blks (LM)



Oneway Anova

Rsquare	0.614408
Root Mean Square Error	0.018508
Mean of Response	0.668169
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Analytical Blks (LM)	7	0.00873292	0.001248	3.6421	0.0153
Error	16	0.00548064	0.000343		
C. Total	23	0.01421356			

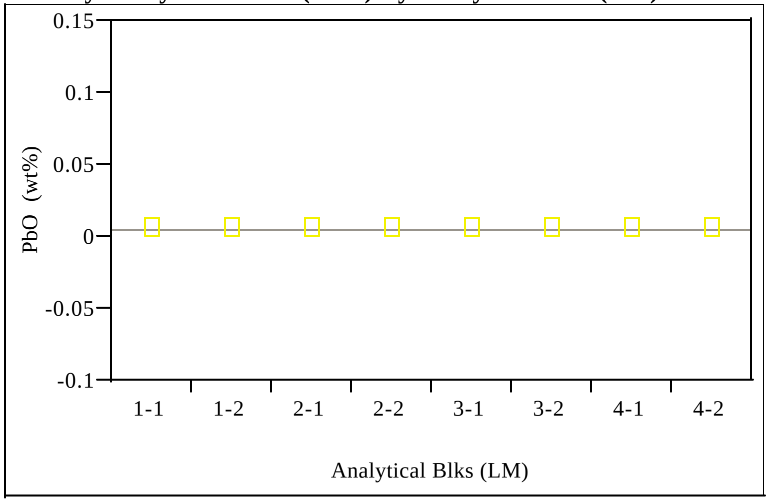
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1	3	0.690119	0.01069	0.66747	0.71277
1-2	3	0.670608	0.01069	0.64796	0.69326
2-1	3	0.655337	0.01069	0.63269	0.67799
2-2	3	0.664669	0.01069	0.64202	0.68732
3-1	3	0.645157	0.01069	0.62251	0.66781
3-2	3	0.642612	0.01069	0.61996	0.66526
4-1	3	0.677394	0.01069	0.65474	0.70005
4-2	3	0.699451	0.01069	0.67680	0.72210

Std Error uses a pooled estimate of error variance

Exhibit H.4: Statistical Analysis by Analytical Block of Measurements of Standard Glasses Prepared Using the PF Method *(continued)*

SB3 Glass #=100; Reference Value for PbO is 0 wt%
Oneway Analysis of PbO (wt%) By Analytical Blks (LM)



Oneway Anova

Rsquare	4
Root Mean Square Error	.
Mean of Response	0.005386
Observations (or Sum Wgts)	24

Analysis of Variance

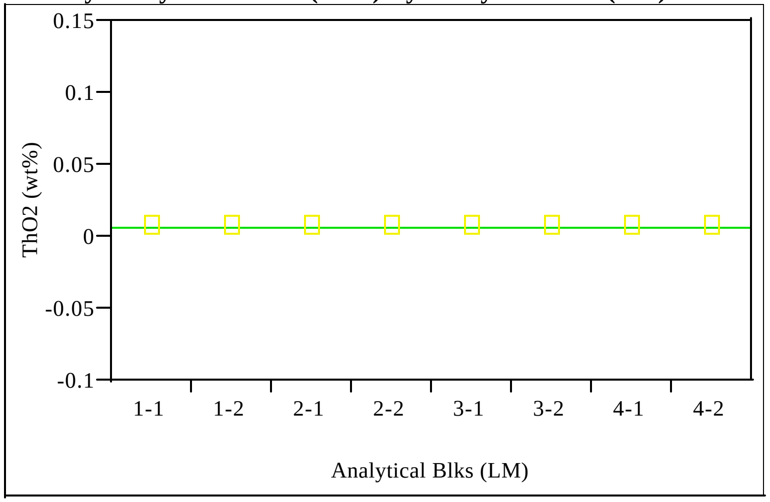
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Analytical Blks (LM)	7	7.2222e-35	1.032e-35	-3.0476	-1.0000
Error	16	-5.417e-35	-3.39e-36		
C. Total	23	1.8056e-35			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1	3	0.005386	.	.	.
1-2	3	0.005386	.	.	.
2-1	3	0.005386	.	.	.
2-2	3	0.005386	.	.	.
3-1	3	0.005386	.	.	.
3-2	3	0.005386	.	.	.
4-1	3	0.005386	.	.	.
4-2	3	0.005386	.	.	.

Std Error uses a pooled estimate of error variance

SB3 Glass #=100; Reference Value for ThO2 is 0 wt%
Oneway Analysis of ThO2 (wt%) By Analytical Blks (LM)



Oneway Anova

Rsquare	.
Root Mean Square Error	0
Mean of Response	0.005689
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Analytical Blks (LM)	7	0	0	.	.
Error	16	0	0		
C. Total	23	0			

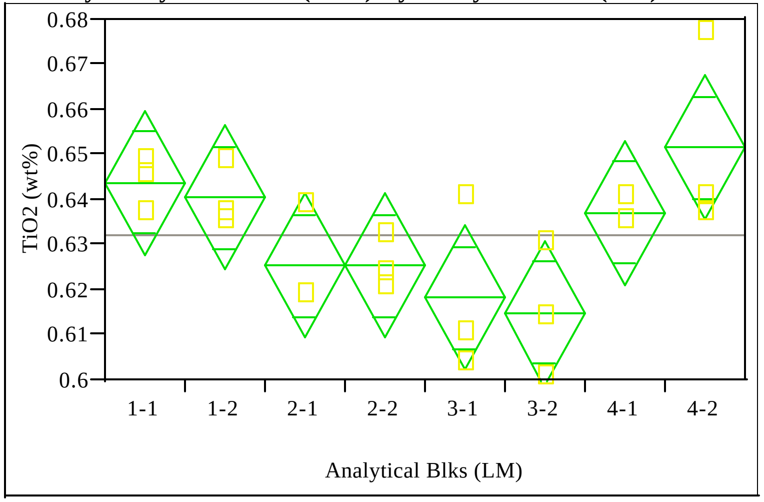
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1	3	0.005689	0	0.00569	0.00569
1-2	3	0.005689	0	0.00569	0.00569
2-1	3	0.005689	0	0.00569	0.00569
2-2	3	0.005689	0	0.00569	0.00569
3-1	3	0.005689	0	0.00569	0.00569
3-2	3	0.005689	0	0.00569	0.00569
4-1	3	0.005689	0	0.00569	0.00569
4-2	3	0.005689	0	0.00569	0.00569

Std Error uses a pooled estimate of error variance

Exhibit H.4: Statistical Analysis by Analytical Block of Measurements of Standard Glasses Prepared Using the PF Method *(continued)*

SB3 Glass #=100; Reference Value for TiO2 is 0.677 wt%
Oneway Analysis of TiO2 (wt%) By Analytical Blks (LM)



Oneway Anova

Rsquare	0.565755
Root Mean Square Error	0.013081
Mean of Response	0.632172
Observations (or Sum Wgts)	24

Analysis of Variance

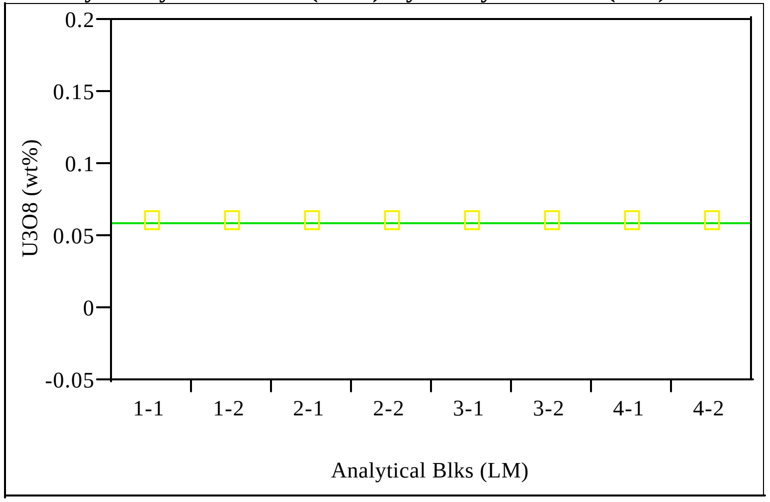
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Analytical Blks (LM)	7	0.00356681	0.000510	2.9779	0.0335
Error	16	0.00273771	0.000171		
C. Total	23	0.00630452			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1	3	0.643848	0.00755	0.62784	0.65986
1-2	3	0.640512	0.00755	0.62450	0.65652
2-1	3	0.625500	0.00755	0.60949	0.64151
2-2	3	0.625500	0.00755	0.60949	0.64151
3-1	3	0.618272	0.00755	0.60226	0.63428
3-2	3	0.614936	0.00755	0.59893	0.63095
4-1	3	0.637176	0.00755	0.62117	0.65319
4-2	3	0.651632	0.00755	0.63562	0.66764

Std Error uses a pooled estimate of error variance

SB3 Glass #=100; Reference Value for U3O8 is 0 wt%
Oneway Analysis of U3O8 (wt%) By Analytical Blks (LM)



Oneway Anova

Rsquare	1
Root Mean Square Error	0
Mean of Response	0.05896
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Analytical Blks (LM)	7	4.6222e-33	6.603e-34	.	.
Error	16	0	0		
C. Total	23	4.6222e-33			

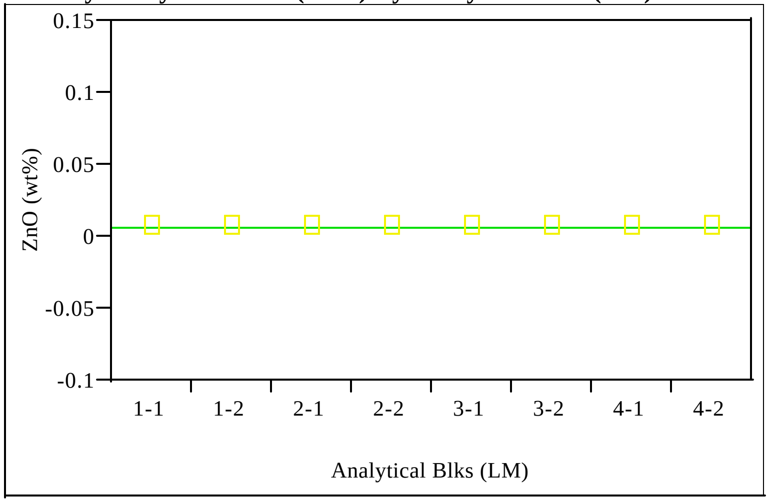
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1	3	0.058960	0	0.05896	0.05896
1-2	3	0.058960	0	0.05896	0.05896
2-1	3	0.058960	0	0.05896	0.05896
2-2	3	0.058960	0	0.05896	0.05896
3-1	3	0.058960	0	0.05896	0.05896
3-2	3	0.058960	0	0.05896	0.05896
4-1	3	0.058960	0	0.05896	0.05896
4-2	3	0.058960	0	0.05896	0.05896

Std Error uses a pooled estimate of error variance

Exhibit H.4: Statistical Analysis by Analytical Block of Measurements of Standard Glasses Prepared Using the PF Method *(continued)*

SB3 Glass #=100; Reference Value for ZnO is 0 wt%
Oneway Analysis of ZnO (wt%) By Analytical Blks (LM)



Oneway Anova

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

Analysis of Variance

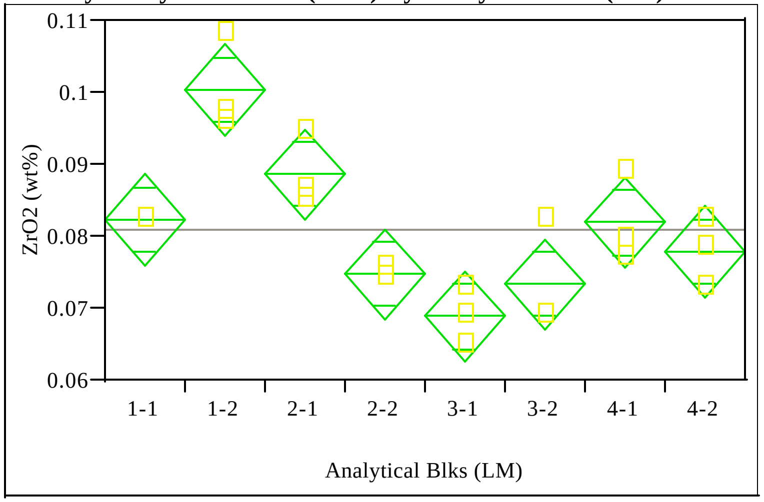
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Analytical Blks (LM)	7	0	0	.	.
Error	16	0	0		
C. Total	23	0			

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	3	0.006224	0	0.00622	0.00622
3-2	3	0.006224	0	0.00622	0.00622
4-1	3	0.006224	0	0.00622	0.00622
4-2	3	0.006224	0	0.00622	0.00622

Std Error uses a pooled estimate of error variance

SB3 Glass #=100; Reference Value for ZrO2 is 0.098 wt%
Oneway Analysis of ZrO2 (wt%) By Analytical Blks (LM)



Oneway Anova

Rsquare	0.830657
Root Mean Square Error	0.005144
Mean of Response	0.081048
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Analytical Blks (LM)	7	0.00207646	0.000297	11.2118	<.0001
Error	16	0.00042332	0.000026		
C. Total	23	0.00249979			

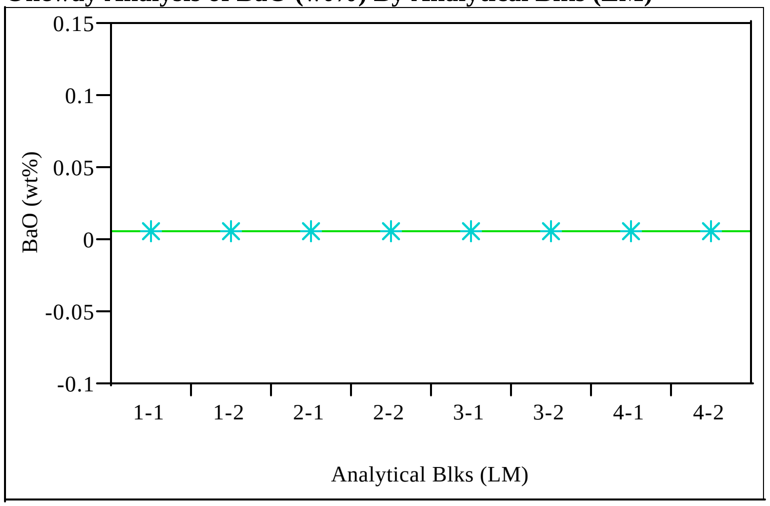
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1	3	0.082399	0.00297	0.07610	0.08869
1-2	3	0.100409	0.00297	0.09411	0.10670
2-1	3	0.088703	0.00297	0.08241	0.09500
2-2	3	0.074744	0.00297	0.06845	0.08104
3-1	3	0.068891	0.00297	0.06260	0.07519
3-2	3	0.073393	0.00297	0.06710	0.07969
4-1	3	0.081949	0.00297	0.07565	0.08824
4-2	3	0.077896	0.00297	0.07160	0.08419

Std Error uses a pooled estimate of error variance

Exhibit H.4: Statistical Analysis by Analytical Block of Measurements of Standard Glasses Prepared Using the PF Method *(continued)*

SB3 Glass #=101; Reference Value for BaO is 0 wt%
Oneway Analysis of BaO (wt%) By Analytical Blks (LM)



Oneway Anova

Rsquare	.
Root Mean Square Error	0
Mean of Response	0.005583
Observations (or Sum Wgts)	24

Analysis of Variance

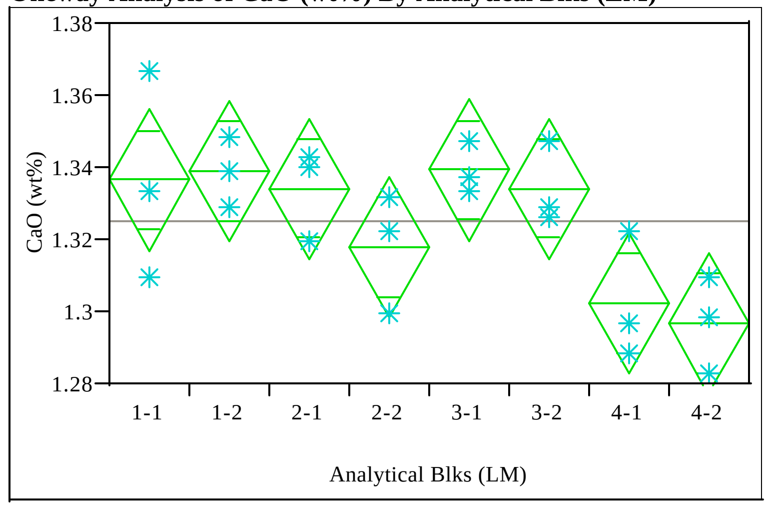
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Analytical Blks (LM)	7	0	0	.	.
Error	16	0	0		
C. Total	23	0			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1	3	0.005583	0	0.00558	0.00558
1-2	3	0.005583	0	0.00558	0.00558
2-1	3	0.005583	0	0.00558	0.00558
2-2	3	0.005583	0	0.00558	0.00558
3-1	3	0.005583	0	0.00558	0.00558
3-2	3	0.005583	0	0.00558	0.00558
4-1	3	0.005583	0	0.00558	0.00558
4-2	3	0.005583	0	0.00558	0.00558

Std Error uses a pooled estimate of error variance

SB3 Glass #=101; Reference Value for CaO is 1.301 wt%
Oneway Analysis of CaO (wt%) By Analytical Blks (LM)



Oneway Anova

Rsquare	0.601761
Root Mean Square Error	0.015941
Mean of Response	1.325217
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Analytical Blks (LM)	7	0.00614337	0.000878	3.4538	0.0190
Error	16	0.00406562	0.000254		
C. Total	23	0.01020899			

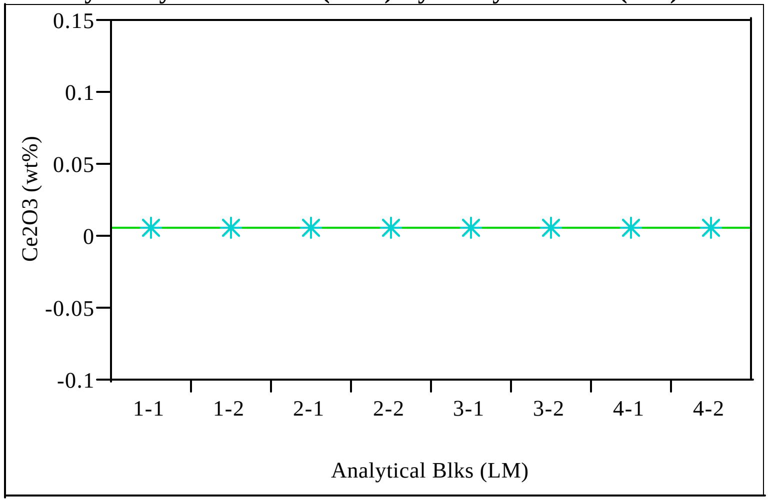
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1	3	1.33670	0.00920	1.3172	1.3562
1-2	3	1.33903	0.00920	1.3195	1.3585
2-1	3	1.33437	0.00920	1.3149	1.3539
2-2	3	1.31805	0.00920	1.2985	1.3376
3-1	3	1.33950	0.00920	1.3200	1.3590
3-2	3	1.33437	0.00920	1.3149	1.3539
4-1	3	1.30266	0.00920	1.2831	1.3222
4-2	3	1.29706	0.00920	1.2775	1.3166

Std Error uses a pooled estimate of error variance

Exhibit H.4: Statistical Analysis by Analytical Block of Measurements of Standard Glasses Prepared Using the PF Method *(continued)*

SB3 Glass #=101; Reference Value for Ce2O3 is 0 wt%
Oneway Analysis of Ce2O3 (wt%) By Analytical Blks (LM)



Oneway Anova

Rsquare	.
Root Mean Square Error	0
Mean of Response	0.005857
Observations (or Sum Wgts)	24

Analysis of Variance

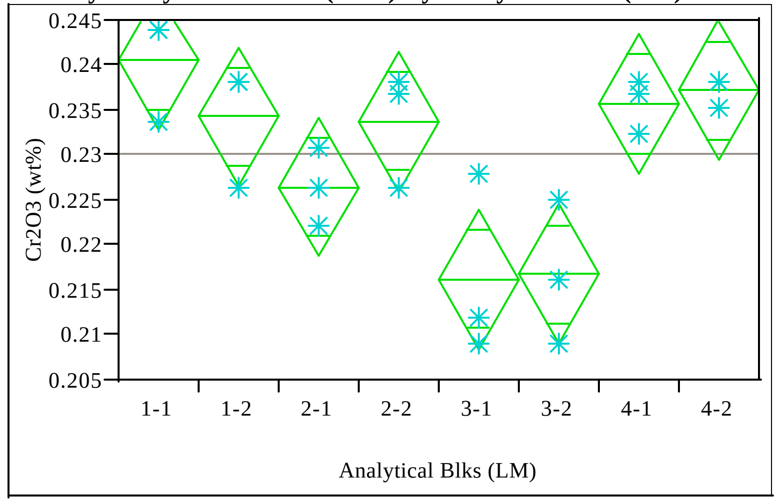
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Analytical Blks (LM)	7	0	0	.	.
Error	16	0	0		
C. Total	23	0			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1	3	0.005857	0	0.00586	0.00586
1-2	3	0.005857	0	0.00586	0.00586
2-1	3	0.005857	0	0.00586	0.00586
2-2	3	0.005857	0	0.00586	0.00586
3-1	3	0.005857	0	0.00586	0.00586
3-2	3	0.005857	0	0.00586	0.00586
4-1	3	0.005857	0	0.00586	0.00586
4-2	3	0.005857	0	0.00586	0.00586

Std Error uses a pooled estimate of error variance

SB3 Glass #=101; Reference Value for Cr2O3 is 0 wt%
Oneway Analysis of Cr2O3 (wt%) By Analytical Blks (LM)



Oneway Anova

Rsquare	0.738879
Root Mean Square Error	0.006343
Mean of Response	0.230202
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Analytical Blks (LM)	7	0.00182153	0.000260	6.4678	0.0010
Error	16	0.00064373	0.000040		
C. Total	23	0.00246526			

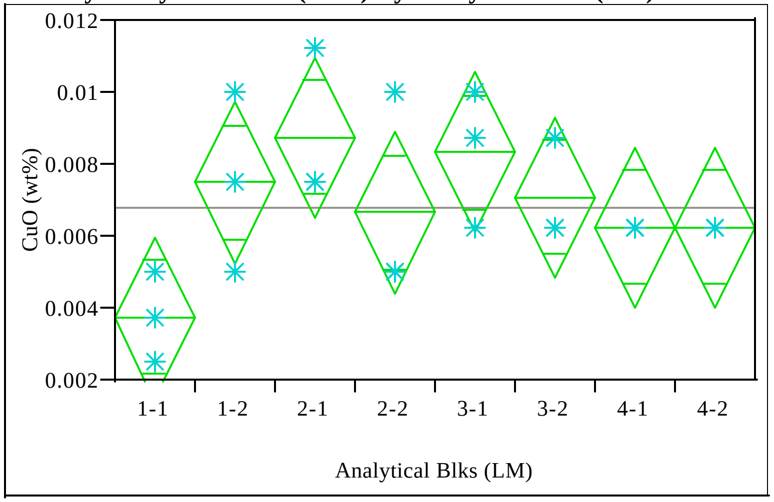
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1	3	0.240677	0.00366	0.23291	0.24844
1-2	3	0.234343	0.00366	0.22658	0.24211
2-1	3	0.226548	0.00366	0.21878	0.23431
2-2	3	0.233856	0.00366	0.22609	0.24162
3-1	3	0.216317	0.00366	0.20855	0.22408
3-2	3	0.216804	0.00366	0.20904	0.22457
4-1	3	0.235805	0.00366	0.22804	0.24357
4-2	3	0.237266	0.00366	0.22950	0.24503

Std Error uses a pooled estimate of error variance

Exhibit H.4: Statistical Analysis by Analytical Block of Measurements of Standard Glasses Prepared Using the PF Method *(continued)*

SB3 Glass #=101; Reference Value for CuO is 0 wt%
Oneway Analysis of CuO (wt%) By Analytical Blks (LM)



Oneway Anova

Rsquare	0.484523
Root Mean Square Error	0.001825
Mean of Response	0.006833
Observations (or Sum Wgts)	24

Analysis of Variance

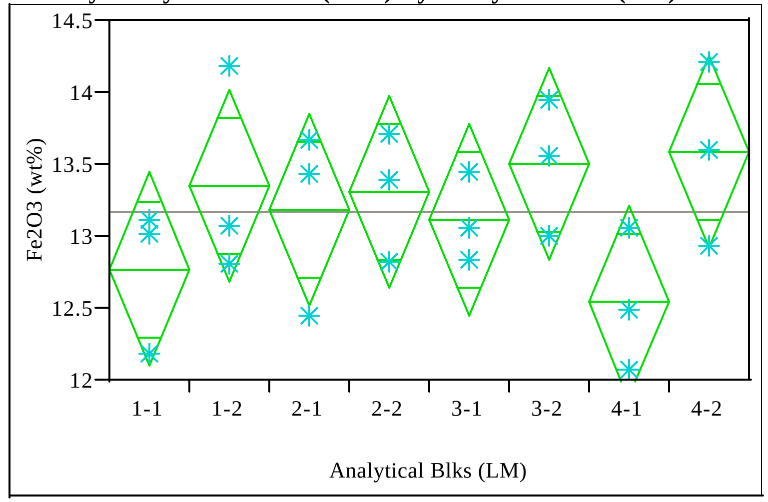
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Analytical Blks (LM)	7	0.00005008	0.0000072	2.1485	0.0973
Error	16	0.00005328	0.0000033		
C. Total	23	0.00010336			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1	3	0.003755	0.00105	0.00152	0.00599
1-2	3	0.007511	0.00105	0.00528	0.00974
2-1	3	0.008763	0.00105	0.00653	0.01100
2-2	3	0.006676	0.00105	0.00444	0.00891
3-1	3	0.008345	0.00105	0.00611	0.01058
3-2	3	0.007094	0.00105	0.00486	0.00933
4-1	3	0.006259	0.00105	0.00403	0.00849
4-2	3	0.006259	0.00105	0.00403	0.00849

Std Error uses a pooled estimate of error variance

SB3 Glass #=101; Reference Value for Fe2O3 is 13.196 wt%
Oneway Analysis of Fe2O3 (wt%) By Analytical Blks (LM)



Oneway Anova

Rsquare	0.358359
Root Mean Square Error	0.546358
Mean of Response	13.17469
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Analytical Blks (LM)	7	2.6674749	0.381068	1.2766	0.3219
Error	16	4.7761087	0.298507		
C. Total	23	7.4435837			

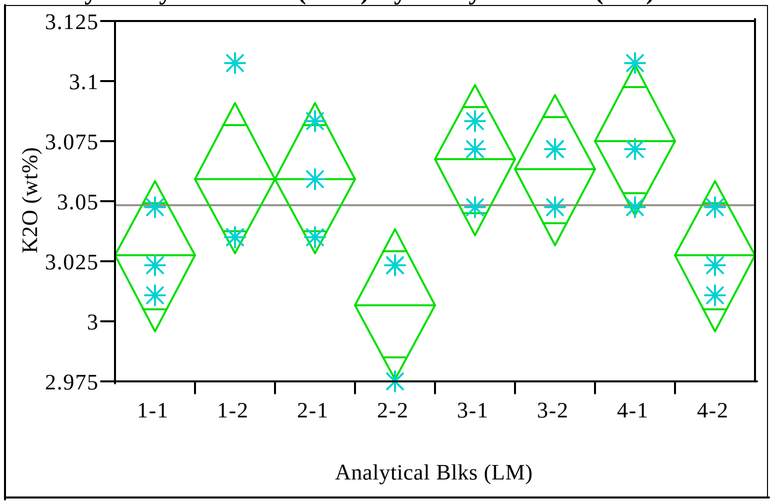
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1	3	12.7768	0.31544	12.108	13.445
1-2	3	13.3582	0.31544	12.689	14.027
2-1	3	13.1866	0.31544	12.518	13.855
2-2	3	13.3105	0.31544	12.642	13.979
3-1	3	13.1199	0.31544	12.451	13.789
3-2	3	13.5107	0.31544	12.842	14.179
4-1	3	12.5480	0.31544	11.879	13.217
4-2	3	13.5869	0.31544	12.918	14.256

Std Error uses a pooled estimate of error variance

Exhibit H.4: Statistical Analysis by Analytical Block of Measurements of Standard Glasses Prepared Using the PF Method *(continued)*

SB3 Glass #=101; Reference Value for K2O is 2.999 wt%
Oneway Analysis of K2O (wt%) By Analytical Blks (LM)



Oneway Anova

Rsquare	0.543823
Root Mean Square Error	0.025553
Mean of Response	3.048642
Observations (or Sum Wgts)	24

Analysis of Variance

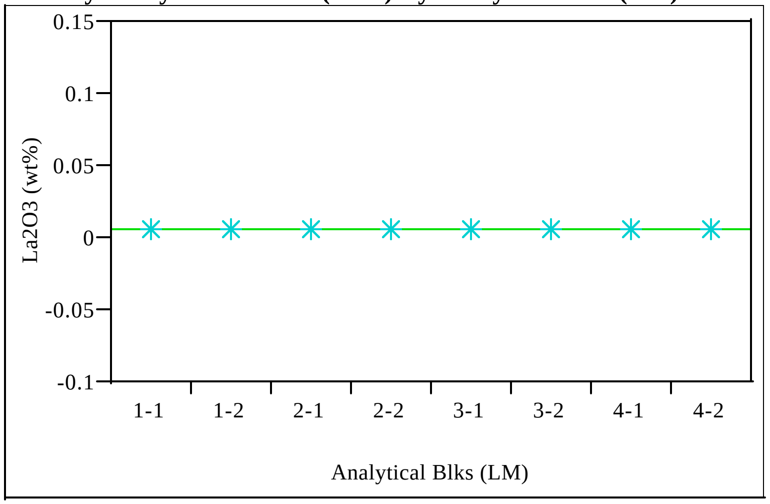
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Analytical Blks (LM)	7	0.01245494	0.001779	2.7249	0.0459
Error	16	0.01044764	0.000653		
C. Total	23	0.02290258			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1	3	3.02756	0.01475	2.9963	3.0588
1-2	3	3.05968	0.01475	3.0284	3.0910
2-1	3	3.05968	0.01475	3.0284	3.0910
2-2	3	3.00748	0.01475	2.9762	3.0388
3-1	3	3.06771	0.01475	3.0364	3.0990
3-2	3	3.06370	0.01475	3.0324	3.0950
4-1	3	3.07575	0.01475	3.0445	3.1070
4-2	3	3.02756	0.01475	2.9963	3.0588

Std Error uses a pooled estimate of error variance

SB3 Glass #=101; Reference Value for La2O3 is 0 wt%
Oneway Analysis of La2O3 (wt%) By Analytical Blks (LM)



Oneway Anova

Rsquare	.
Root Mean Square Error	0
Mean of Response	0.005864
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Analytical Blks (LM)	7	0	0	.	.
Error	16	0	0		
C. Total	23	0			

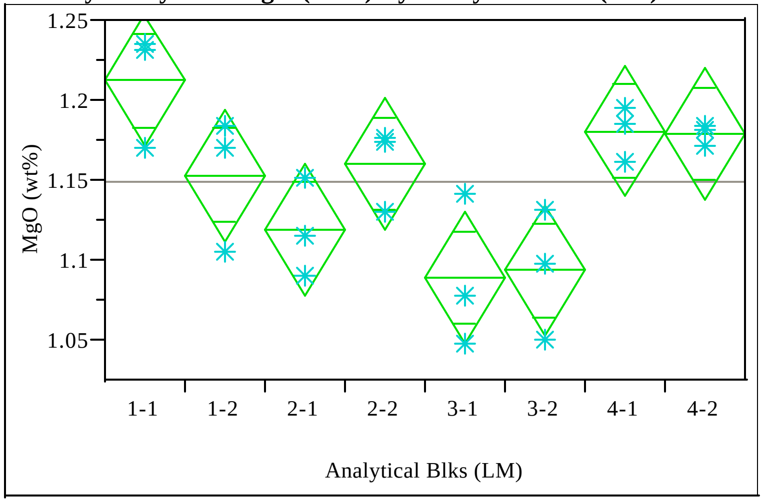
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1	3	0.005864	0	0.00586	0.00586
1-2	3	0.005864	0	0.00586	0.00586
2-1	3	0.005864	0	0.00586	0.00586
2-2	3	0.005864	0	0.00586	0.00586
3-1	3	0.005864	0	0.00586	0.00586
3-2	3	0.005864	0	0.00586	0.00586
4-1	3	0.005864	0	0.00586	0.00586
4-2	3	0.005864	0	0.00586	0.00586

Std Error uses a pooled estimate of error variance

Exhibit H.4: Statistical Analysis by Analytical Block of Measurements of Standard Glasses Prepared Using the PF Method *(continued)*

SB3 Glass #=101; Reference Value for MgO is 1.21 wt%
Oneway Analysis of MgO (wt%) By Analytical Blks (LM)



Oneway Anova

Rsquare	0.693921
Root Mean Square Error	0.033564
Mean of Response	1.148787
Observations (or Sum Wgts)	24

Analysis of Variance

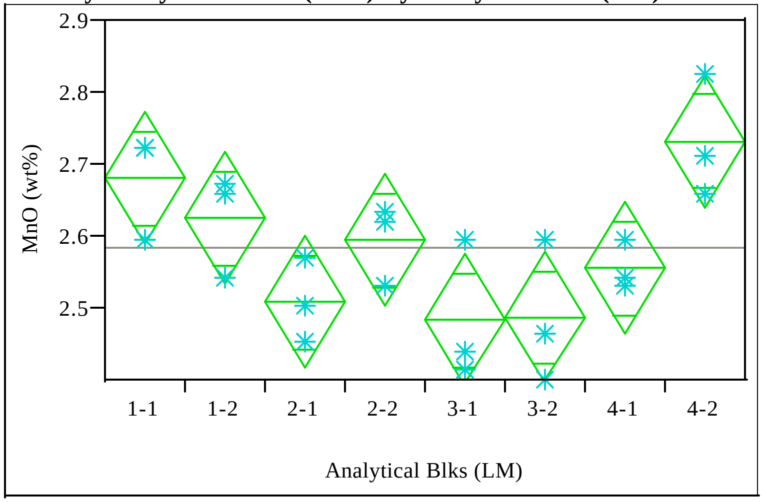
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Analytical Blks (LM)	7	0.04086370	0.005838	5.1820	0.0031
Error	16	0.01802438	0.001127		
C. Total	23	0.05888808			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1	3	1.21262	0.01938	1.1715	1.2537
1-2	3	1.15348	0.01938	1.1124	1.1946
2-1	3	1.11977	0.01938	1.0787	1.1608
2-2	3	1.16067	0.01938	1.1196	1.2017
3-1	3	1.08937	0.01938	1.0483	1.1305
3-2	3	1.09379	0.01938	1.0527	1.1349
4-1	3	1.18112	0.01938	1.1400	1.2222
4-2	3	1.17946	0.01938	1.1384	1.2205

Std Error uses a pooled estimate of error variance

SB3 Glass #=101; Reference Value for MnO is 2.892 wt%
Oneway Analysis of MnO (wt%) By Analytical Blks (LM)



Oneway Anova

Rsquare	0.663892
Root Mean Square Error	0.075012
Mean of Response	2.584014
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Analytical Blks (LM)	7	0.17782745	0.025404	4.5148	0.0060
Error	16	0.09002866	0.005627		
C. Total	23	0.26785611			

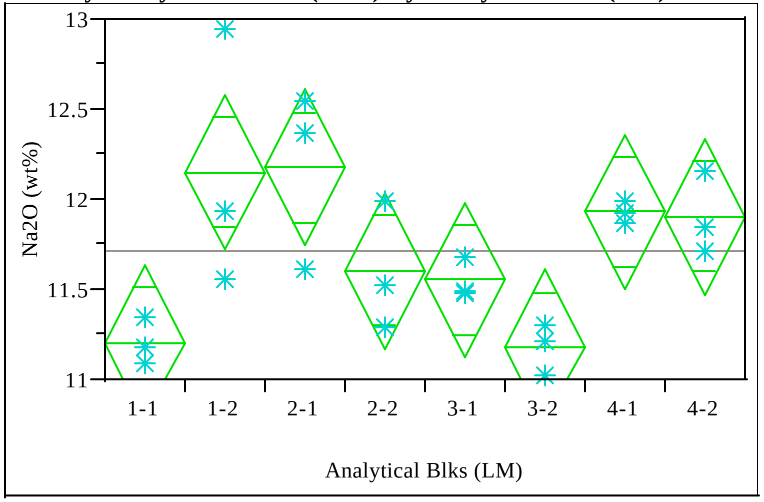
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1	3	2.68139	0.04331	2.5896	2.7732
1-2	3	2.62544	0.04331	2.5336	2.7172
2-1	3	2.50923	0.04331	2.4174	2.6010
2-2	3	2.59531	0.04331	2.5035	2.6871
3-1	3	2.48341	0.04331	2.3916	2.5752
3-2	3	2.48771	0.04331	2.3959	2.5795
4-1	3	2.55658	0.04331	2.4648	2.6484
4-2	3	2.73304	0.04331	2.6412	2.8248

Std Error uses a pooled estimate of error variance

Exhibit H.4: Statistical Analysis by Analytical Block of Measurements of Standard Glasses Prepared Using the PF Method *(continued)*

SB3 Glass #=101; Reference Value for Na2O is 11.795 wt%
Oneway Analysis of Na2O (wt%) By Analytical Blks (LM)



Oneway Anova

Rsquare	0.617401
Root Mean Square Error	0.352397
Mean of Response	11.71693
Observations (or Sum Wgts)	24

Analysis of Variance

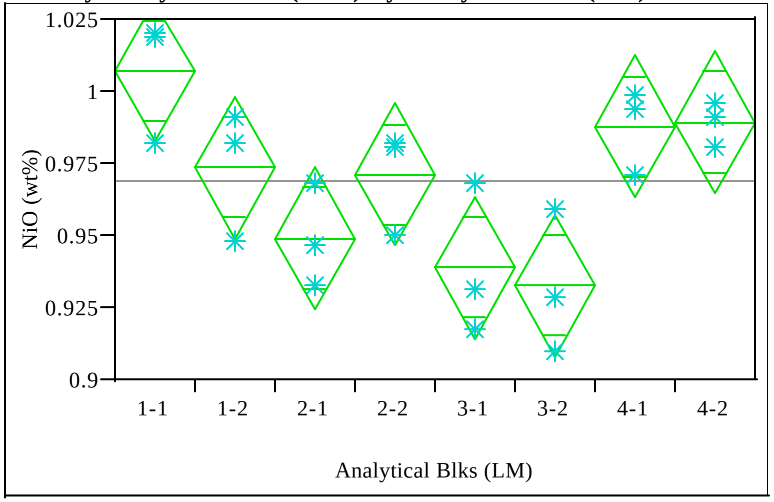
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Analytical Blks (LM)	7	3.2063330	0.458048	3.6885	0.0145
Error	16	1.9869427	0.124184		
C. Total	23	5.1932757			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1	3	11.2109	0.20346	10.780	11.642
1-2	3	12.1545	0.20346	11.723	12.586
2-1	3	12.1814	0.20346	11.750	12.613
2-2	3	11.6063	0.20346	11.175	12.038
3-1	3	11.5569	0.20346	11.126	11.988
3-2	3	11.1839	0.20346	10.753	11.615
4-1	3	11.9343	0.20346	11.503	12.366
4-2	3	11.9073	0.20346	11.476	12.339

Std Error uses a pooled estimate of error variance

SB3 Glass #=101; Reference Value for NiO is 1.12 wt%
Oneway Analysis of NiO (wt%) By Analytical Blks (LM)



Oneway Anova

Rsquare	0.693239
Root Mean Square Error	0.020123
Mean of Response	0.968903
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Analytical Blks (LM)	7	0.01464212	0.002092	5.1654	0.0032
Error	16	0.00647918	0.000405		
C. Total	23	0.02112131			

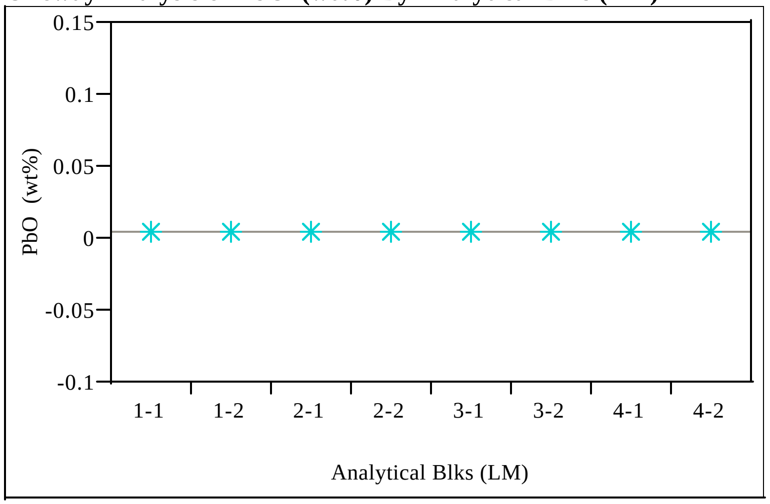
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1	3	1.00740	0.01162	0.98277	1.0320
1-2	3	0.97389	0.01162	0.94926	0.9985
2-1	3	0.94928	0.01162	0.92466	0.9739
2-2	3	0.97134	0.01162	0.94671	0.9960
3-1	3	0.93910	0.01162	0.91448	0.9637
3-2	3	0.93274	0.01162	0.90811	0.9574
4-1	3	0.98788	0.01162	0.96325	1.0125
4-2	3	0.98958	0.01162	0.96495	1.0142

Std Error uses a pooled estimate of error variance

Exhibit H.4: Statistical Analysis by Analytical Block of Measurements of Standard Glasses Prepared Using the PF Method *(continued)*

SB3 Glass #=101; Reference Value for PbO is 0 wt%
Oneway Analysis of PbO (wt%) By Analytical Blks (LM)



Oneway Anova

Rsquare	4
Root Mean Square Error	.
Mean of Response	0.005386
Observations (or Sum Wgts)	24

Analysis of Variance

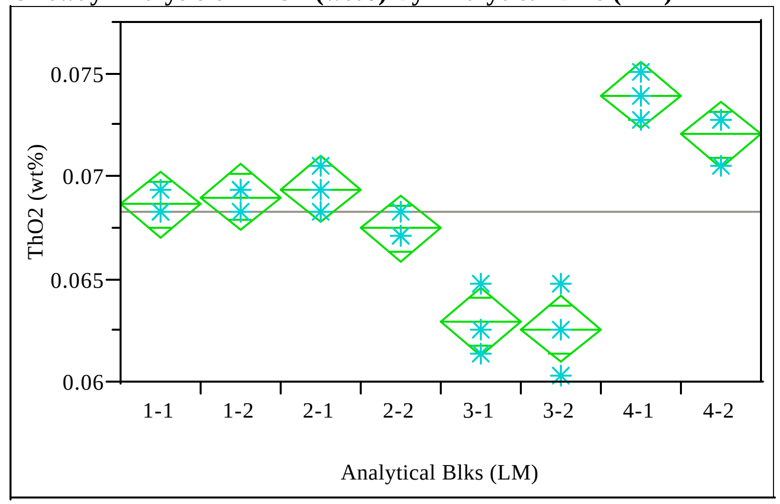
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Analytical Blks (LM)	7	7.2222e-35	1.032e-35	-3.0476	-1.0000
Error	16	-5.417e-35	-3.39e-36		
C. Total	23	1.8056e-35			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1	3	0.005386	.	.	.
1-2	3	0.005386	.	.	.
2-1	3	0.005386	.	.	.
2-2	3	0.005386	.	.	.
3-1	3	0.005386	.	.	.
3-2	3	0.005386	.	.	.
4-1	3	0.005386	.	.	.
4-2	3	0.005386		.	.

Std Error uses a pooled estimate of error variance

SB3 Glass #=101; Reference Value for ThO2 is 0 wt%
Oneway Analysis of ThO2 (wt%) By Analytical Blks (LM)



Oneway Anova

Rsquare	0.922705
Root Mean Square Error	0.001314
Mean of Response	0.068274
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Analytical Blks (LM)	7	0.00032975	0.000047	27.2857	<.0001
Error	16	0.00002762	0.000002		
C. Total	23	0.00035737			

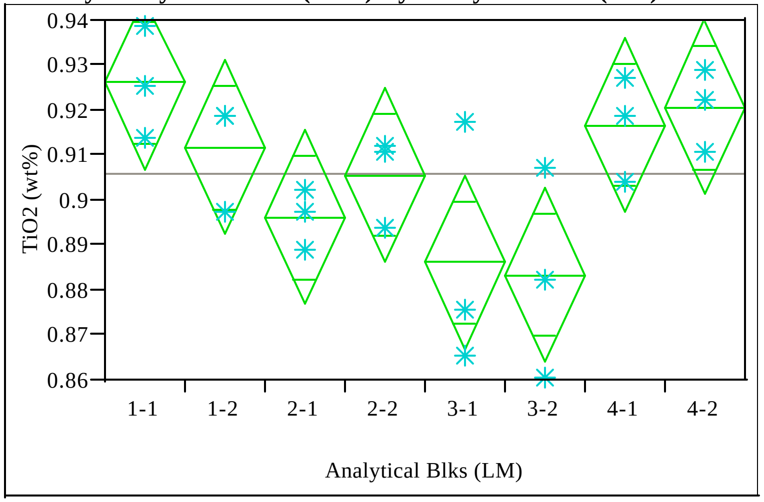
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1	3	0.068653	0.00076	0.06705	0.07026
1-2	3	0.069033	0.00076	0.06742	0.07064
2-1	3	0.069412	0.00076	0.06780	0.07102
2-2	3	0.067515	0.00076	0.06591	0.06912
3-1	3	0.062964	0.00076	0.06136	0.06457
3-2	3	0.062585	0.00076	0.06098	0.06419
4-1	3	0.073964	0.00076	0.07236	0.07557
4-2 .	3	0.072067	0.00076	0.07046	0.07368

Std Error uses a pooled estimate of error variance

Exhibit H.4: Statistical Analysis by Analytical Block of Measurements of Standard Glasses Prepared Using the PF Method *(continued)*

SB3 Glass #=101; Reference Value for TiO2 is 1.049 wt%
Oneway Analysis of TiO2 (wt%) By Analytical Blks (LM)



Oneway Anova

Rsquare	0.572279
Root Mean Square Error	0.015758
Mean of Response	0.905933
Observations (or Sum Wgts)	24

Analysis of Variance

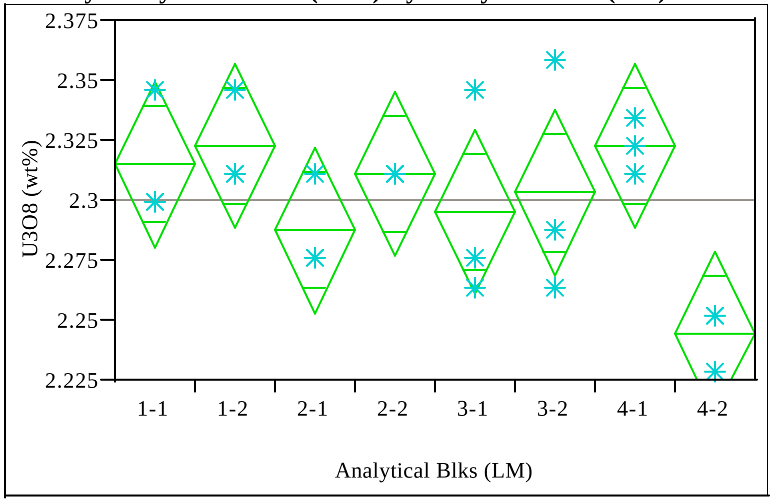
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Analytical Blks (LM)	7	0.00531579	0.000759	3.0582	0.0304
Error	16	0.00397302	0.000248		
C. Total	23	0.00928880			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1	3	0.926296	0.00910	0.90701	0.94558
1-2	3	0.911840	0.00910	0.89255	0.93113
2-1	3	0.896272	0.00910	0.87699	0.91556
2-2	3	0.905724	0.00910	0.88644	0.92501
3-1	3	0.886264	0.00910	0.86698	0.90555
3-2	3	0.883484	0.00910	0.86420	0.90277
4-1	3	0.916844	0.00910	0.89756	0.93613
4-2	3	0.920736	0.00910	0.90145	0.94002

Std Error uses a pooled estimate of error variance

SB3 Glass #=101; Reference Value for U3O8 is 2.406 wt%
Oneway Analysis of U3O8 (wt%) By Analytical Blks (LM)



Oneway Anova

Rsquare	0.527368
Root Mean Square Error	0.028071
Mean of Response	2.300423
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Analytical Blks (LM)	7	0.01406735	0.002010	2.5504	0.0573
Error	16	0.01260731	0.000788		
C. Total	23	0.02667467			

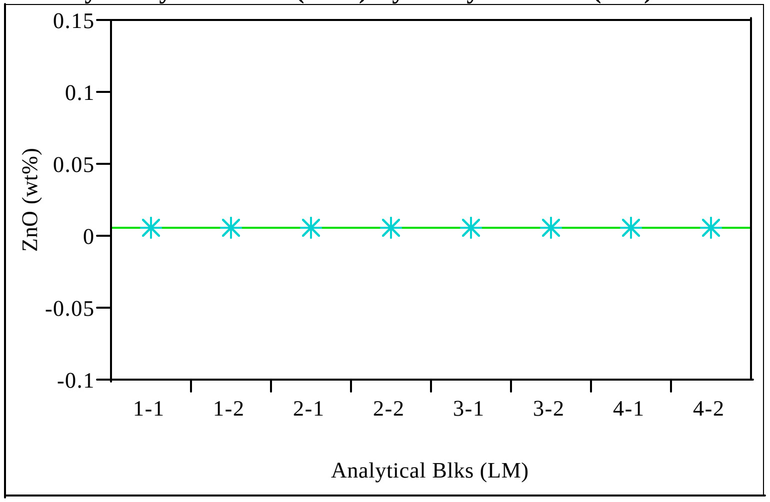
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1	3	2.31516	0.01621	2.2808	2.3495
1-2	3	2.32302	0.01621	2.2887	2.3574
2-1	3	2.28765	0.01621	2.2533	2.3220
2-2	3	2.31123	0.01621	2.2769	2.3456
3-1	3	2.29551	0.01621	2.2612	2.3299
3-2	3	2.30337	0.01621	2.2690	2.3377
4-1	3	2.32302	0.01621	2.2887	2.3574
4-2	3	2.24441	0.01621	2.2101	2.2788

Std Error uses a pooled estimate of error variance

Exhibit H.4: Statistical Analysis by Analytical Block of Measurements of Standard Glasses Prepared Using the PF Method *(continued)*

SB3 Glass #=101; Reference Value for ZnO is 0 wt%
Oneway Analysis of ZnO (wt%) By Analytical Blks (LM)



Oneway Anova

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

Analysis of Variance

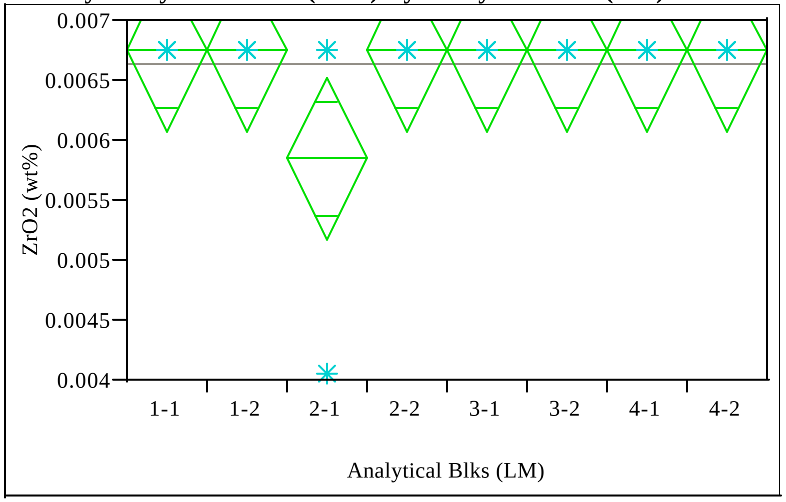
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Analytical Blks (LM)	7	0	0	.	.
Error	16	0	0		
C. Total	23	0			

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	3	0.006224	0	0.00622	0.00622
3-2	3	0.006224	0	0.00622	0.00622
4-1	3	0.006224	0	0.00622	0.00622
4-2	3	0.006224	0	0.00622	0.00622

Std Error uses a pooled estimate of error variance

SB3 Glass #=101; Reference Value for ZrO2 is 0 wt%
Oneway Analysis of ZrO2 (wt%) By Analytical Blks (LM)



Oneway Anova

Rsquare	0.304348
Root Mean Square Error	0.000551
Mean of Response	0.006641
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Analytical Blks (LM)	7	0.00000213	3.0411e-7	1.0000	0.4663
Error	16	0.00000487	3.0411e-7		
C. Total	23	0.00000699			

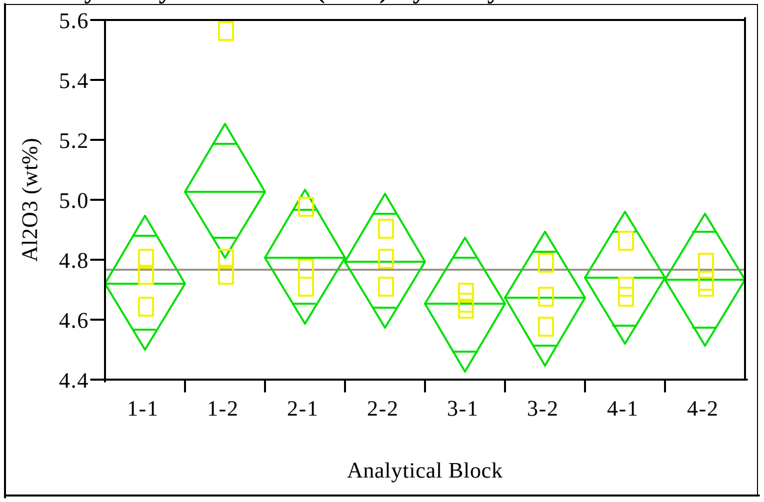
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1	3	0.006754	0.00032	0.00608	0.00743
1-2	3	0.006754	0.00032	0.00608	0.00743
2-1	3	0.005853	0.00032	0.00518	0.00653
2-2	3	0.006754	0.00032	0.00608	0.00743
3-1	3	0.006754	0.00032	0.00608	0.00743
3-2	3	0.006754	0.00032	0.00608	0.00743
4-1	3	0.006754	0.00032	0.00608	0.00743
4-2	3	0.006754	0.00032	0.00608	0.00743

Std Error uses a pooled estimate of error variance

Exhibit H.4: Statistical Analysis by Analytical Block of Measurements of Standard Glasses Prepared Using the PF Method *(continued)*

SB3 Glass #=100; Reference Value for Al2O3 is 4.877 wt%
Oneway Analysis of Al2O3 (wt%) By Analytical Block



Oneway Anova

Rsquare	0.357327
Root Mean Square Error	0.181786
Mean of Response	4.771964
Observations (or Sum Wgts)	24

Analysis of Variance

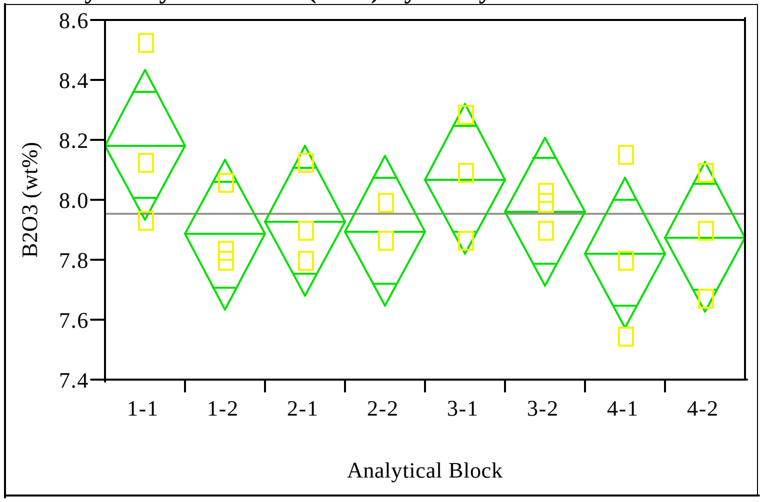
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Analytical Block	7	0.29397890	0.041997	1.2709	0.3244
Error	16	0.52873805	0.033046		
C. Total	23	0.82271694			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1	3	4.72526	0.10495	4.5028	4.9478
1-2	3	5.03237	0.10495	4.8099	5.2549
2-1	3	4.81193	0.10495	4.5894	5.0344
2-2	3	4.79933	0.10495	4.5768	5.0218
3-1	3	4.65447	0.10495	4.4320	4.8770
3-2	3	4.67336	0.10495	4.4509	4.8959
4-1	3	4.74264	0.10495	4.5202	4.9651
4-2	3	4.73635	0.10495	4.5139	4.9588

Std Error uses a pooled estimate of error variance

SB3 Glass #=100; Reference Value for B2O3 is 7.777 wt%
Oneway Analysis of B2O3 (wt%) By Analytical Block



Oneway Anova

Rsquare	0.305087
Root Mean Square Error	0.203631
Mean of Response	7.955192
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Analytical Block	7	0.29127229	0.041610	1.0035	0.4642
Error	16	0.66344681	0.041465		
C. Total	23	0.95471910			

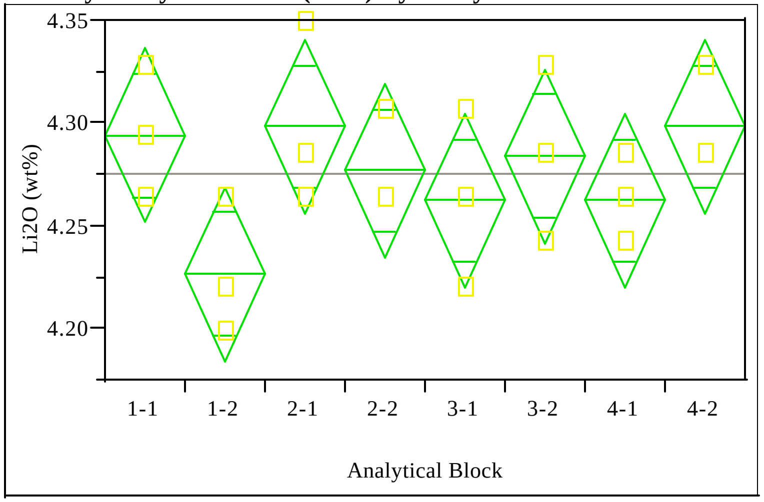
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1	3	8.18413	0.11757	7.9349	8.4334
1-2	3	7.88875	0.11757	7.6395	8.1380
2-1	3	7.93169	0.11757	7.6825	8.1809
2-2	3	7.89949	0.11757	7.6503	8.1487
3-1	3	8.07122	0.11757	7.8220	8.3204
3-2	3	7.96389	0.11757	7.7147	8.2131
4-1	3	7.82436	0.11757	7.5751	8.0736
4-2	3	7.87802	0.11757	7.6288	8.1273

Std Error uses a pooled estimate of error variance

Exhibit H.4: Statistical Analysis by Analytical Block of Measurements of Standard Glasses Prepared Using the PF Method *(continued)*

SB3 Glass #=100; Reference Value for Li2O is 4.429 wt%
Oneway Analysis of Li2O (wt%) By Analytical Block



Oneway Anova

Rsquare	0.397185
Root Mean Square Error	0.034537
Mean of Response	4.27565
Observations (or Sum Wgts)	24

Analysis of Variance

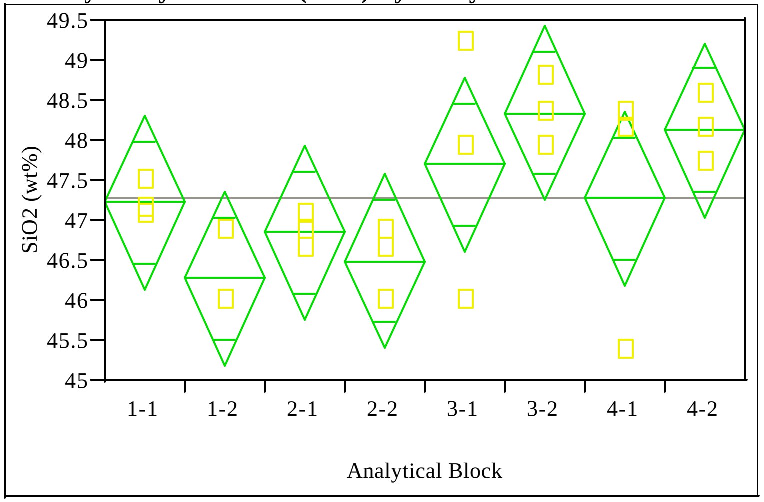
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Analytical Block	7	0.01257440	0.001796	1.5060	0.2346
Error	16	0.01908440	0.001193		
C. Total	23	0.03165880			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1	3	4.29425	0.01994	4.2520	4.3365
1-2	3	4.22686	0.01994	4.1846	4.2691
2-1	3	4.29862	0.01994	4.2564	4.3409
2-2	3	4.27709	0.01994	4.2348	4.3194
3-1	3	4.26274	0.01994	4.2205	4.3050
3-2	3	4.28427	0.01994	4.2420	4.3265
4-1	3	4.26274	0.01994	4.2205	4.3050
4-2	3	4.29862	0.01994	4.2564	4.3409

Std Error uses a pooled estimate of error variance

SB3 Glass #=100; Reference Value for SiO2 is 50.22 wt%
Oneway Analysis of SiO2 (wt%) By Analytical Block



Oneway Anova

Rsquare	0.478334
Root Mean Square Error	0.887956
Mean of Response	47.29021
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Analytical Block	7	11.567545	1.65251	2.0959	0.1044
Error	16	12.615444	0.78847		
C. Total	23	24.182988			

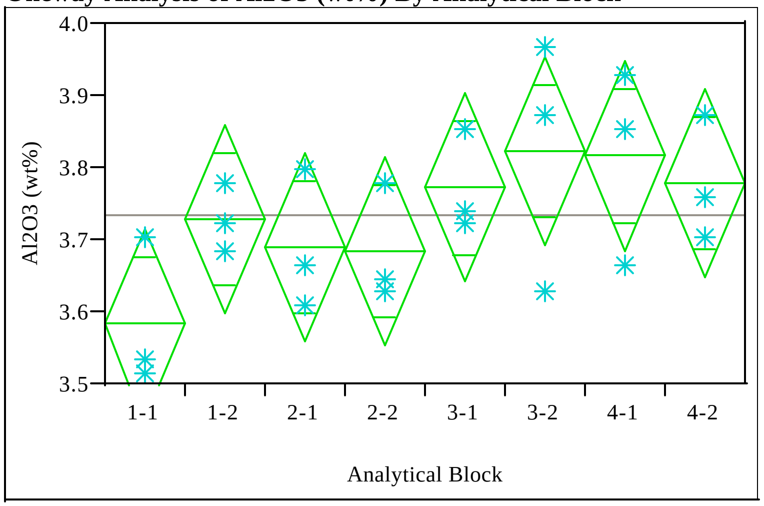
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1	3	47.2293	0.51266	46.143	48.316
1-2	3	46.2802	0.51266	45.193	47.367
2-1	3	46.8507	0.51266	45.764	47.937
2-2	3	46.4941	0.51266	45.407	47.581
3-1	3	47.7064	0.51266	46.620	48.793
3-2	3	48.3482	0.51266	47.261	49.435
4-1	3	47.2785	0.51266	46.192	48.365
4-2	3	48.1343	0.51266	47.047	49.221

Std Error uses a pooled estimate of error variance

Exhibit H.4: Statistical Analysis by Analytical Block of Measurements of Standard Glasses Prepared Using the PF Method *(continued)*

SB3 Glass #=101; Reference Value for Al2O3 is 4.1 wt%
Oneway Analysis of Al2O3 (wt%) By Analytical Block



Oneway Anova

Rsquare	0.426328
Root Mean Square Error	0.106817
Mean of Response	3.734912
Observations (or Sum Wgts)	24

Analysis of Variance

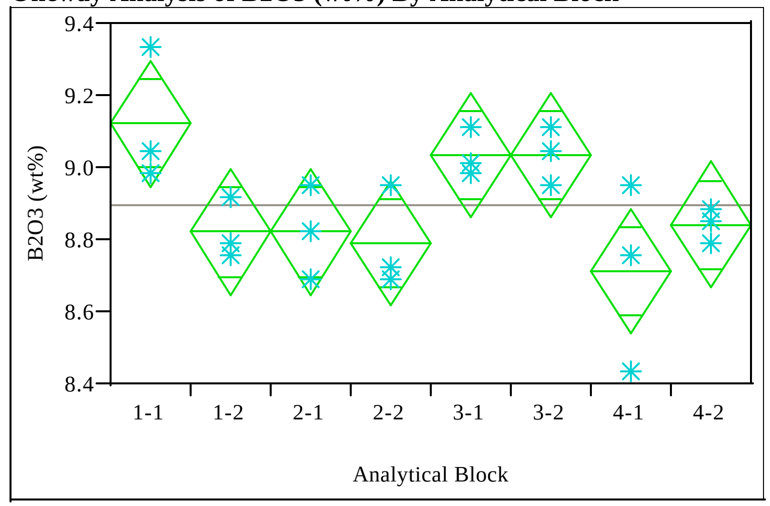
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Analytical Block	7	0.13566799	0.019381	1.6986	0.1797
Error	16	0.18255675	0.011410		
C. Total	23	0.31822474			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1	3	3.58375	0.06167	3.4530	3.7145
1-2	3	3.72861	0.06167	3.5979	3.8593
2-1	3	3.69082	0.06167	3.5601	3.8216
2-2	3	3.68452	0.06167	3.5538	3.8153
3-1	3	3.77270	0.06167	3.6420	3.9034
3-2	3	3.82309	0.06167	3.6924	3.9538
4-1	3	3.81679	0.06167	3.6861	3.9475
4-2	3	3.77900	0.06167	3.6483	3.9097

Std Error uses a pooled estimate of error variance

SB3 Glass #=101; Reference Value for B2O3 is 9.209 wt%
Oneway Analysis of B2O3 (wt%) By Analytical Block



Oneway Anova

Rsquare	0.58177
Root Mean Square Error	0.141578
Mean of Response	8.898999
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Analytical Block	7	0.44611590	0.063731	3.1795	0.0262
Error	16	0.32070925	0.020044		
C. Total	23	0.76682515			

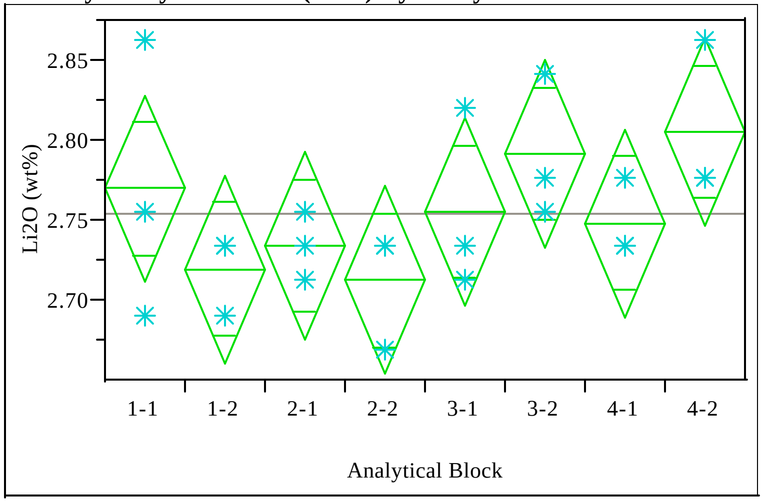
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1	3	9.12305	0.08174	8.9498	9.2963
1-2	3	8.82253	0.08174	8.6492	8.9958
2-1	3	8.82253	0.08174	8.6492	8.9958
2-2	3	8.79033	0.08174	8.6170	8.9636
3-1	3	9.03719	0.08174	8.8639	9.2105
3-2	3	9.03719	0.08174	8.8639	9.2105
4-1	3	8.71520	0.08174	8.5419	8.8885
4-2	3	8.84399	0.08174	8.6707	9.0173

Std Error uses a pooled estimate of error variance

Exhibit H.4: Statistical Analysis by Analytical Block of Measurements of Standard Glasses Prepared Using the PF Method *(continued)*

SB3 Glass #=101; Reference Value for Li2O is 3.057 wt%
Oneway Analysis of Li2O (wt%) By Analytical Block



Oneway Anova

Rsquare	0.384814
Root Mean Square Error	0.047939
Mean of Response	2.754815
Observations (or Sum Wgts)	24

Analysis of Variance

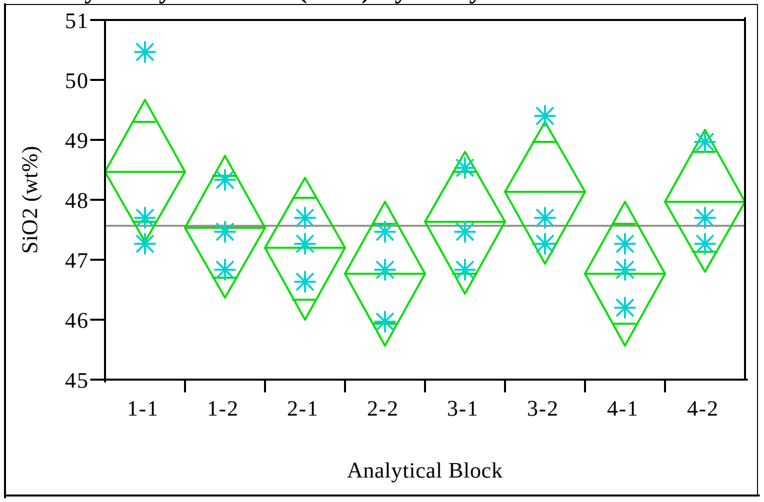
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Analytical Block	7	0.02300108	0.003286	1.4298	0.2607
Error	16	0.03677083	0.002298		
C. Total	23	0.05977191			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1	3	2.77006	0.02768	2.7114	2.8287
1-2	3	2.71983	0.02768	2.6612	2.7785
2-1	3	2.73418	0.02768	2.6755	2.7929
2-2	3	2.71265	0.02768	2.6540	2.7713
3-1	3	2.75571	0.02768	2.6970	2.8144
3-2	3	2.79159	0.02768	2.7329	2.8503
4-1	3	2.74854	0.02768	2.6899	2.8072
4-2	3	2.80595	0.02768	2.7473	2.8646

Std Error uses a pooled estimate of error variance

SB3 Glass #=101; Reference Value for SiO2 is 45.353 wt%
Oneway Analysis of SiO2 (wt%) By Analytical Block



Oneway Anova

Rsquare	0.351157
Root Mean Square Error	0.972539
Mean of Response	47.57268
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Analytical Block	7	8.190215	1.17003	1.2370	0.3397
Error	16	15.133306	0.94583		
C. Total	23	23.323521			

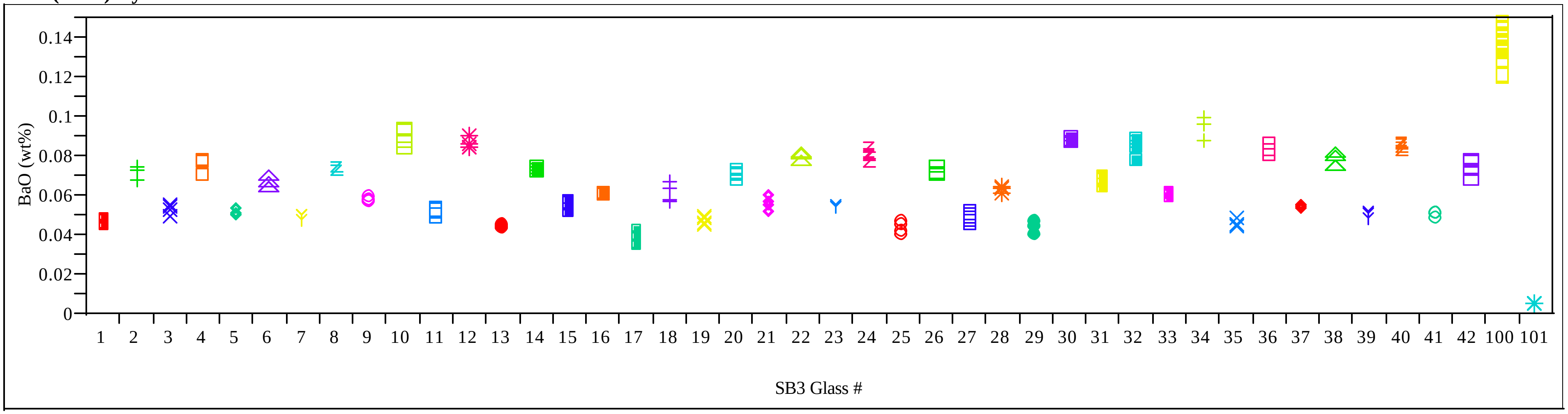
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1	3	48.4908	0.56150	47.300	49.681
1-2	3	47.5638	0.56150	46.373	48.754
2-1	3	47.2072	0.56150	46.017	48.398
2-2	3	46.7794	0.56150	45.589	47.970
3-1	3	47.6351	0.56150	46.445	48.825
3-2	3	48.1343	0.56150	46.944	49.325
4-1	3	46.7794	0.56150	45.589	47.970
4-2	3	47.9916	0.56150	46.801	49.182

Std Error uses a pooled estimate of error variance

Exhibit H.5: LM Measurements by SB3 Glass ID Number by Oxide
(Batch 1 – 100 and Ustd – 101)

BaO (wt%) By SB3 Glass #



BaO bc (wt%) By SB3 Glass #

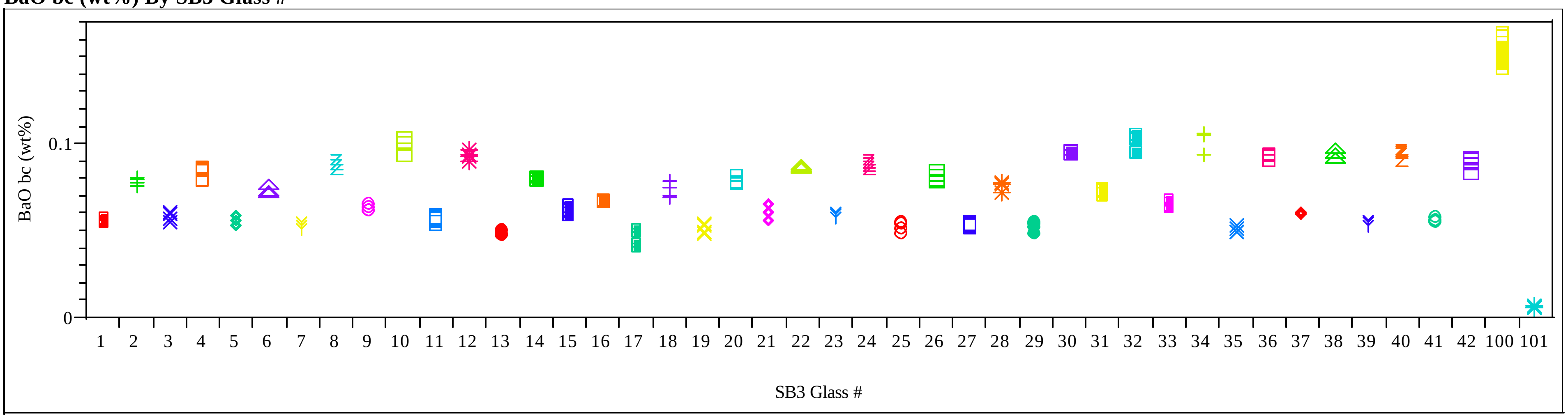
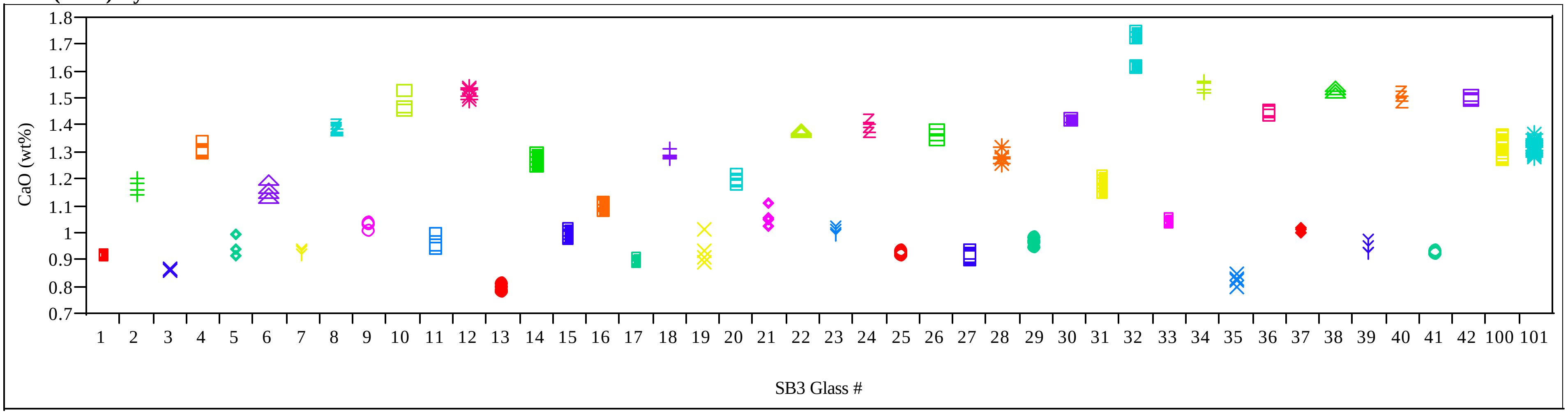


Exhibit H.5: LM Measurements by SB3 Glass ID Number by Oxide *(continued)*
(Batch 1 – 100 and Ustd – 101)

CaO (wt%) By SB3 Glass #



CaO bc (wt%) By SB3 Glass #

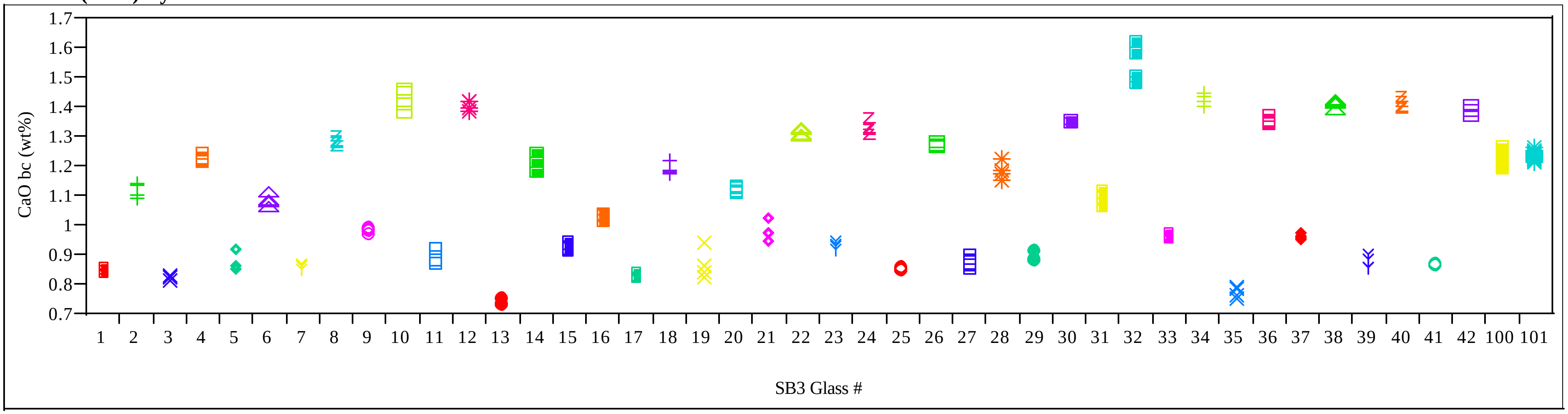
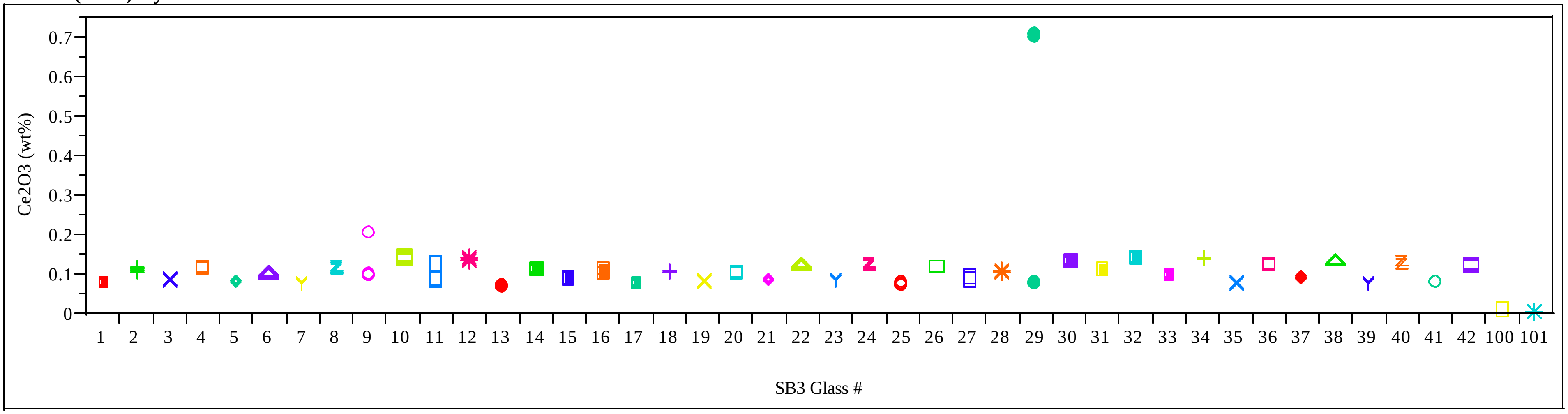


Exhibit H.5: LM Measurements by SB3 Glass ID Number by Oxide ***(continued)***
(Batch 1 – 100 and Ustd – 101)

Ce2O3 (wt%) By SB3 Glass #



Ce2O3 bc (wt%) By SB3 Glass #

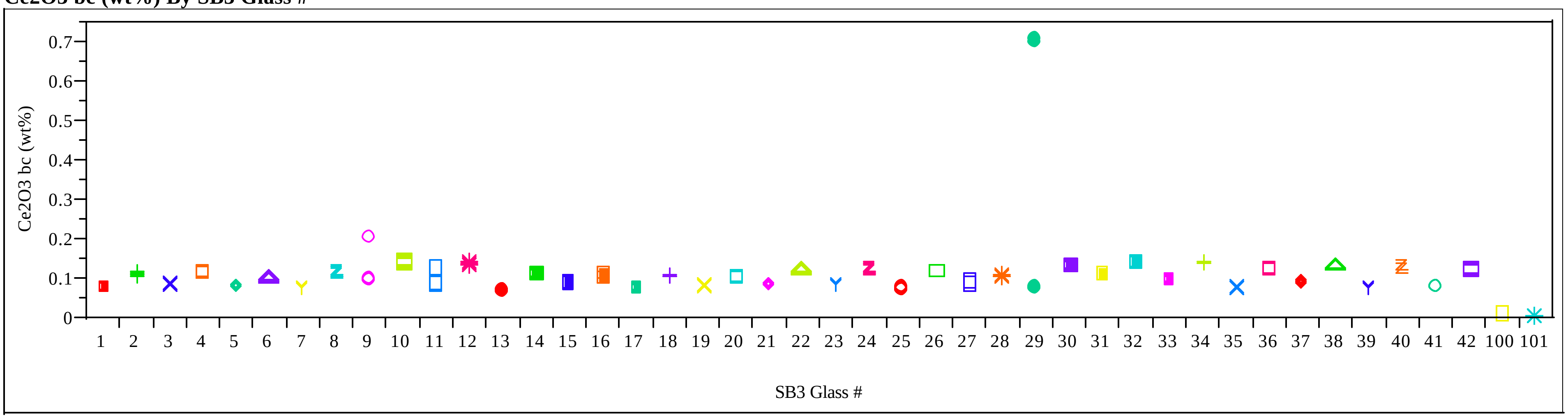
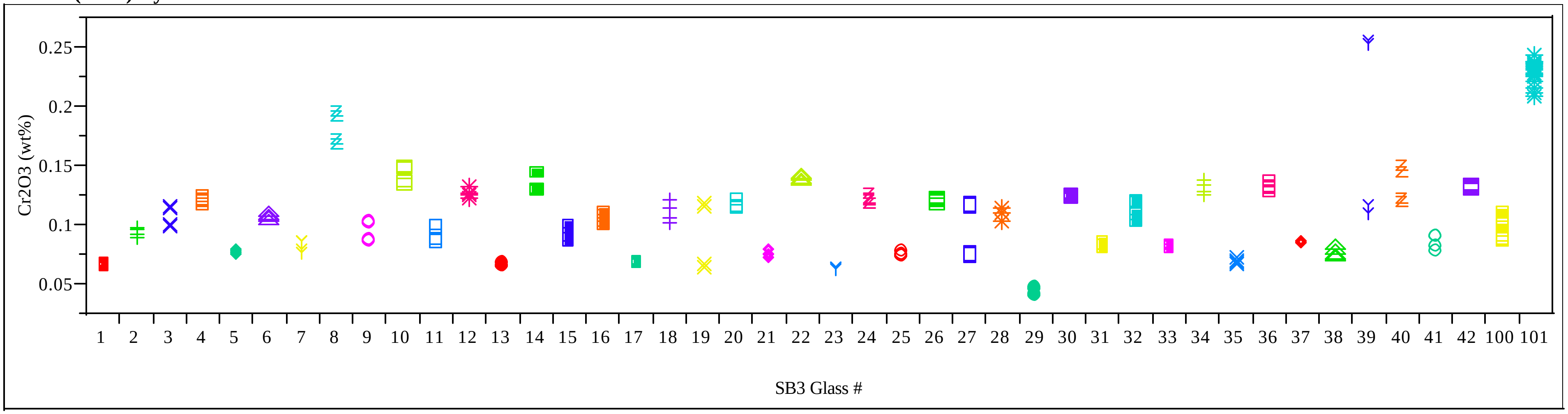


Exhibit H.5: LM Measurements by SB3 Glass ID Number by Oxide *(continued)*

(Batch 1 – 100 and Ustd – 101)

Cr2O3 (wt%) By SB3 Glass #



Cr2O3 bc (wt%) By SB3 Glass #

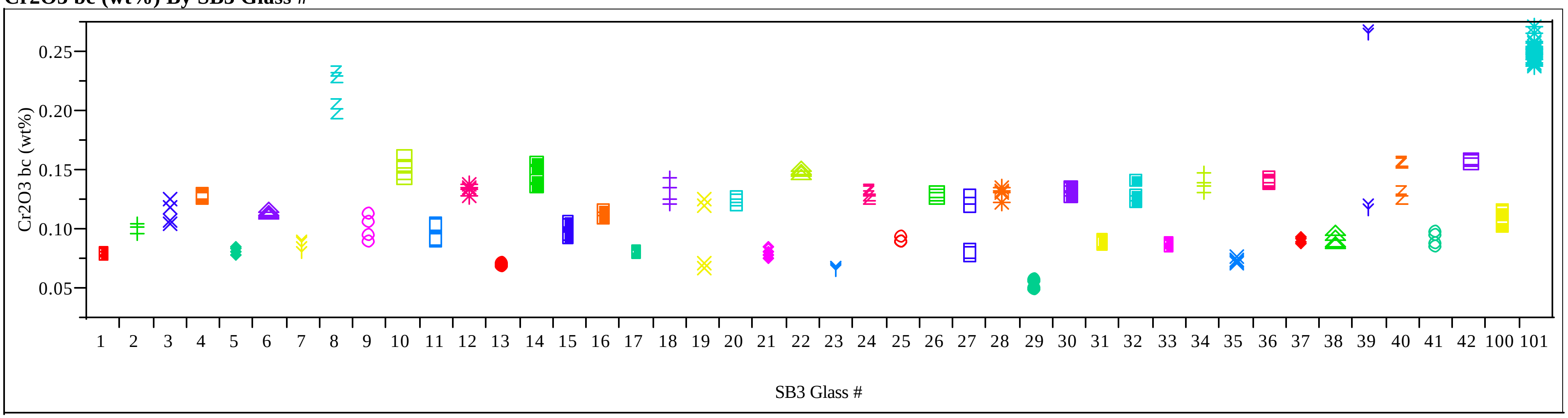
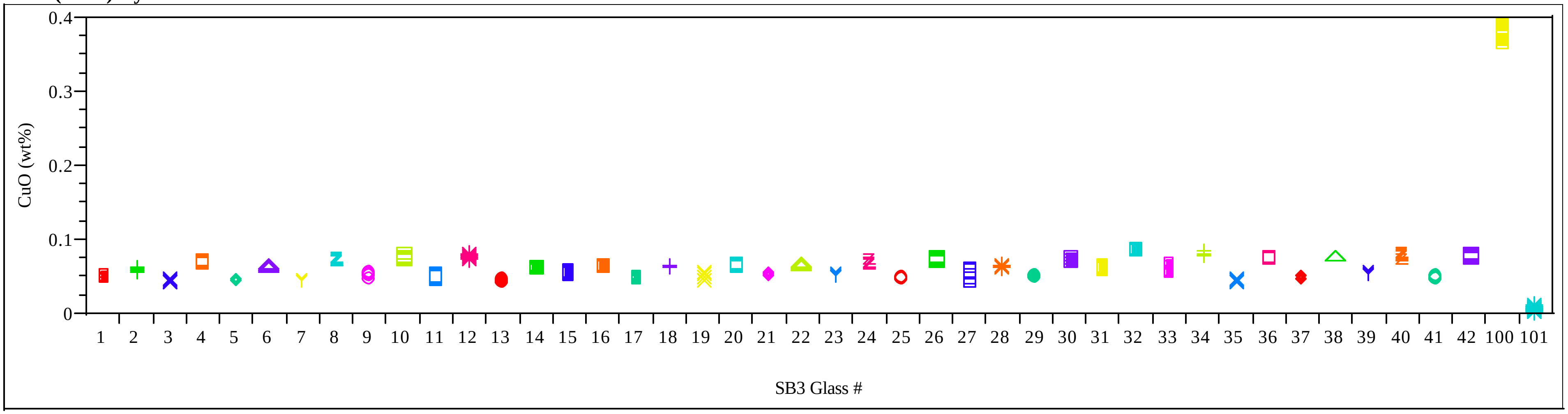


Exhibit H.5: LM Measurements by SB3 Glass ID Number by Oxide *(continued)*

(Batch 1 – 100 and Ustd – 101)

CuO (wt%) By SB3 Glass #



CuO bc (wt%) By SB3 Glass #

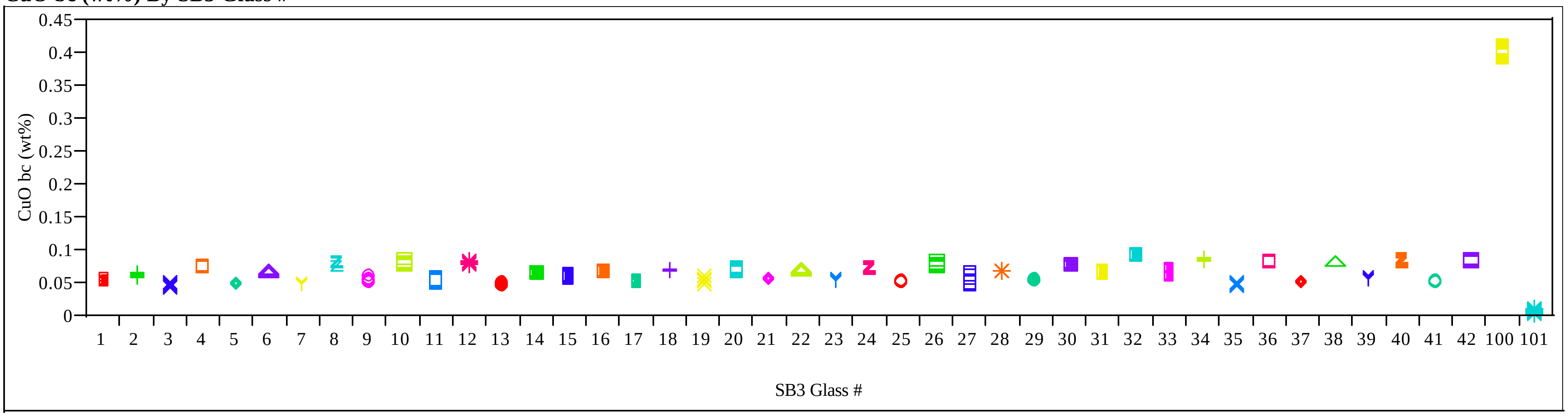
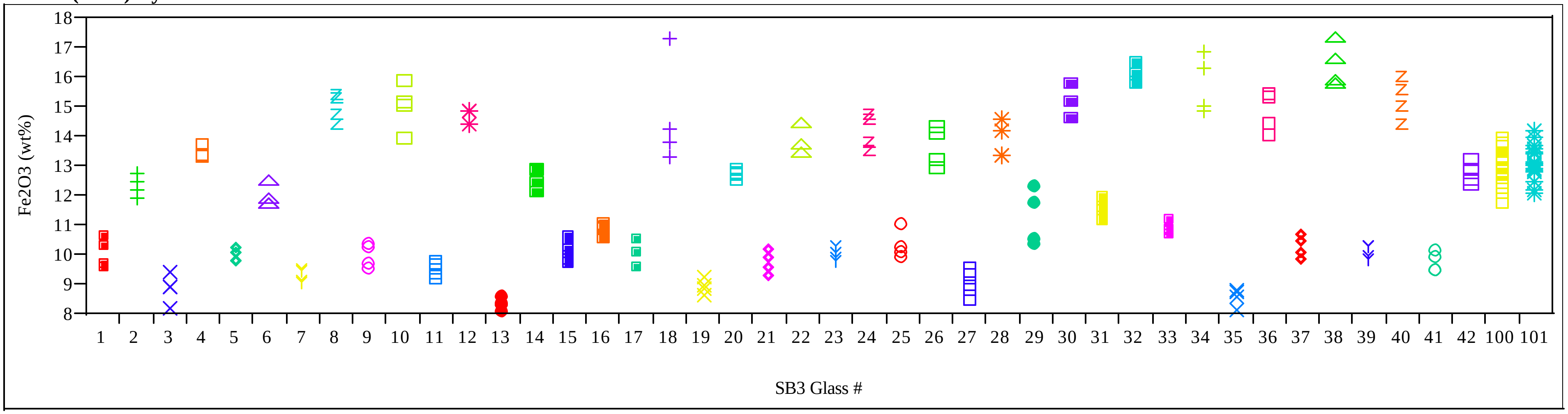


Exhibit H.5: LM Measurements by SB3 Glass ID Number by Oxide *(continued)*
(Batch 1 – 100 and Ustd – 101)

Fe2O3 (wt%) By SB3 Glass #



Fe2O3 bc (wt%) By SB3 Glass #

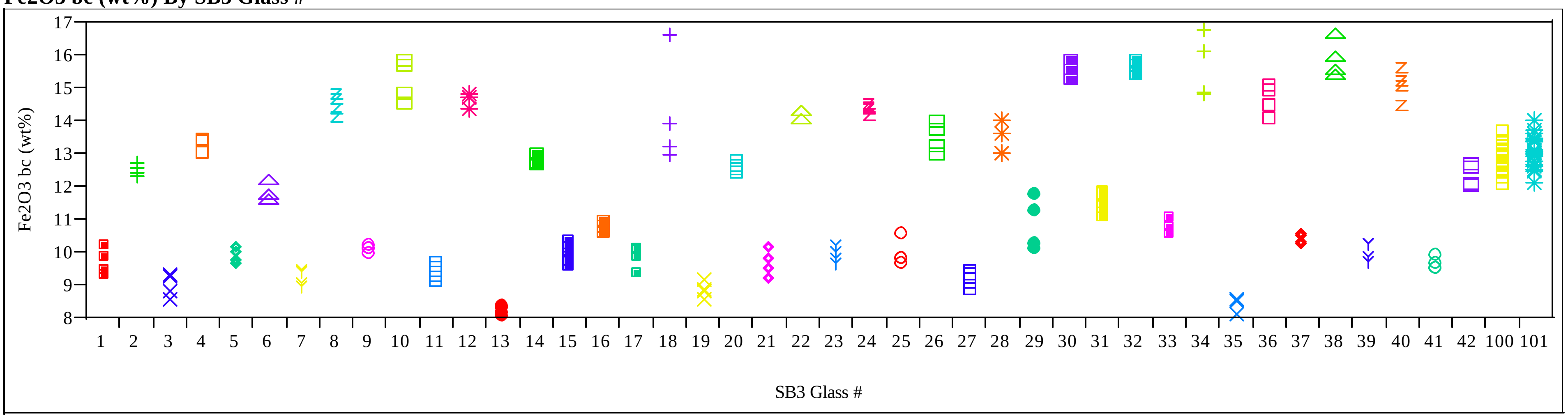
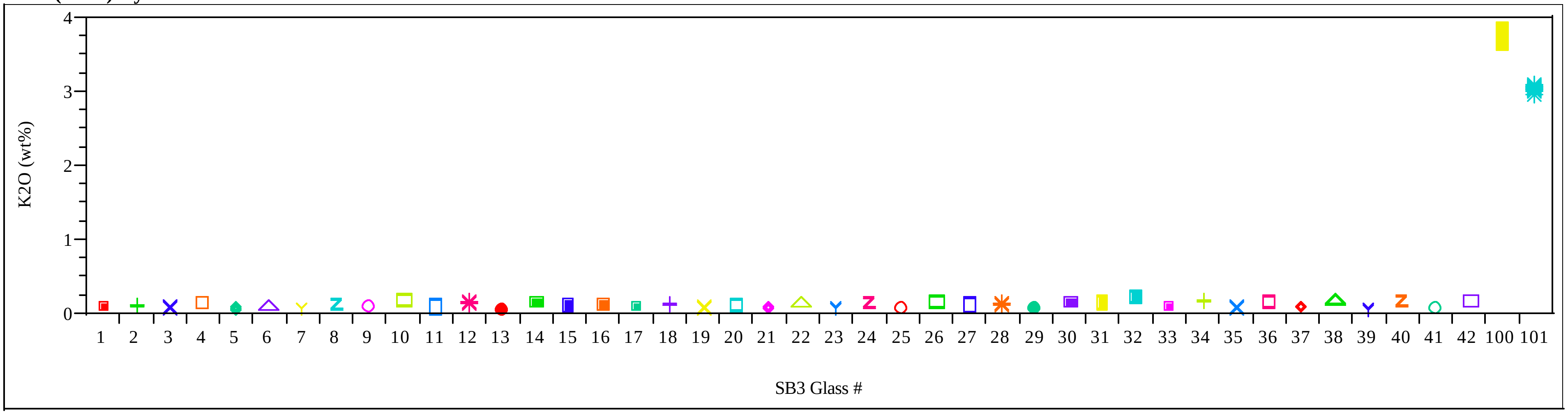


Exhibit H.5: LM Measurements by SB3 Glass ID Number by Oxide ***(continued)***

(Batch 1 – 100 and Ustd – 101)

K2O (wt%) By SB3 Glass #



K2O bc (wt%) By SB3 Glass #

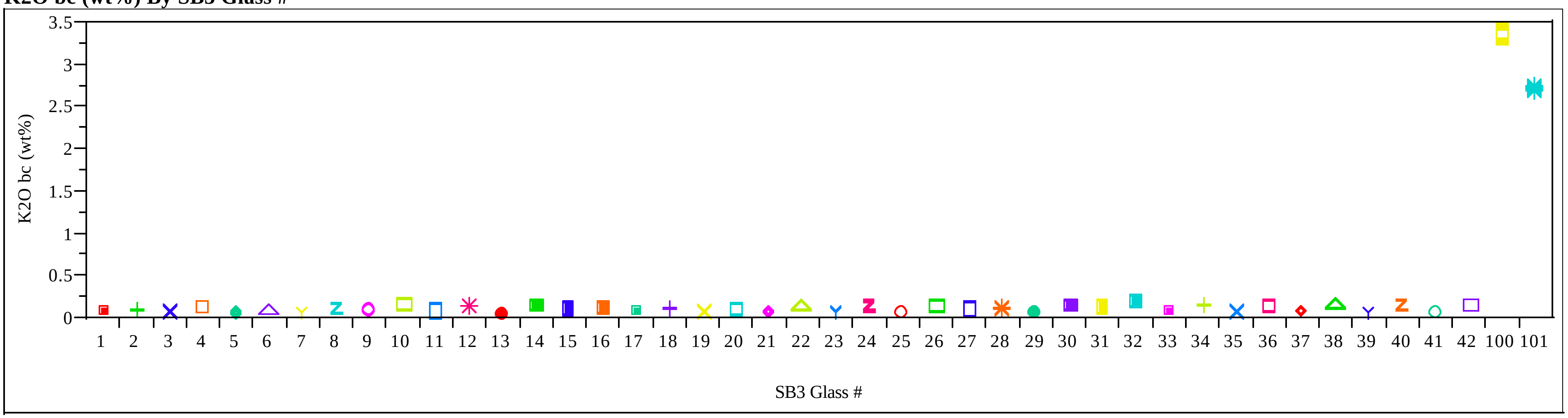
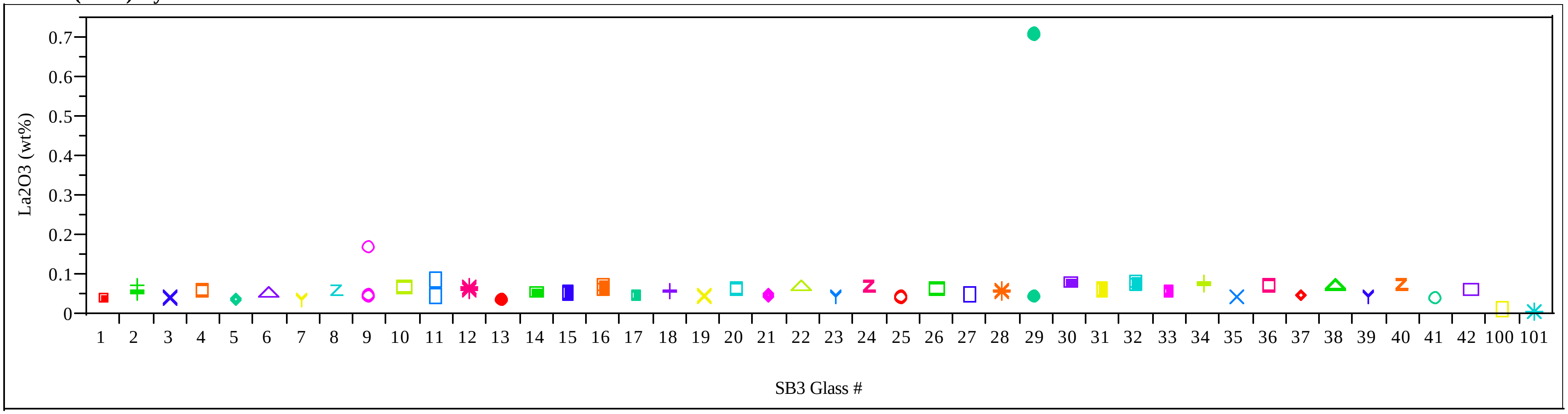


Exhibit H.5: LM Measurements by SB3 Glass ID Number by Oxide *(continued)*
(Batch 1 – 100 and Ustd – 101)

La2O3 (wt%) By SB3 Glass #



La2O3 bc (wt%) By SB3 Glass #

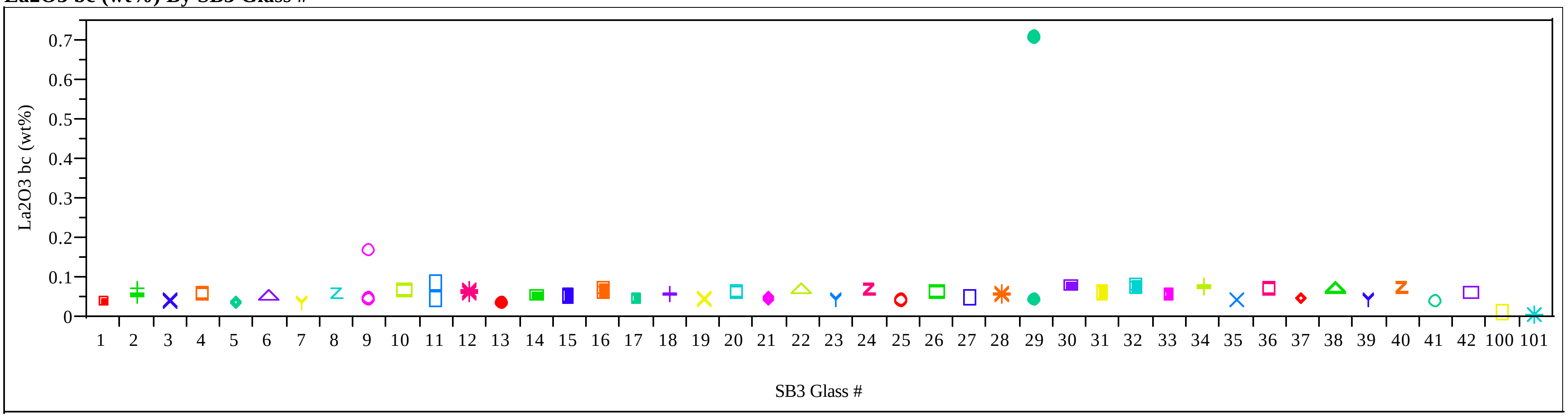
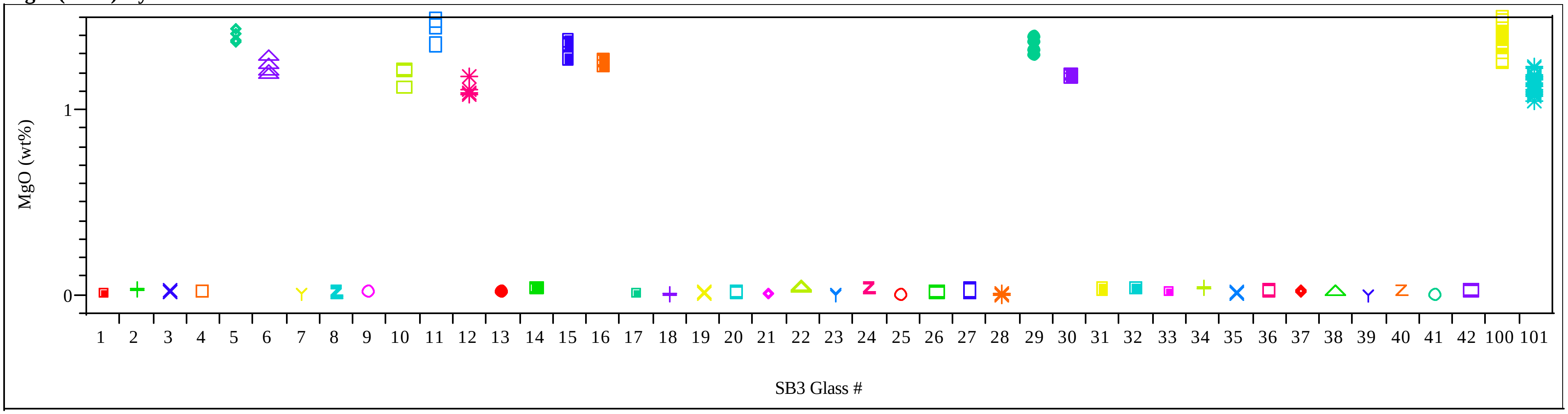


Exhibit H.5: LM Measurements by SB3 Glass ID Number by Oxide *(continued)*
(Batch 1 – 100 and Ustd – 101)

MgO (wt%) By SB3 Glass #



MgO bc (wt%) By SB3 Glass #

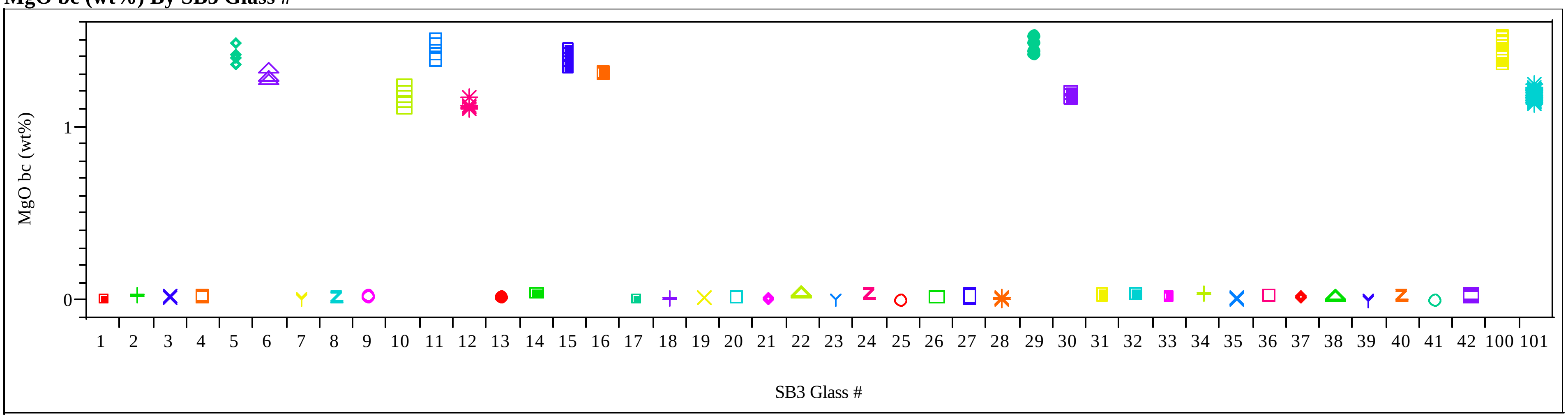
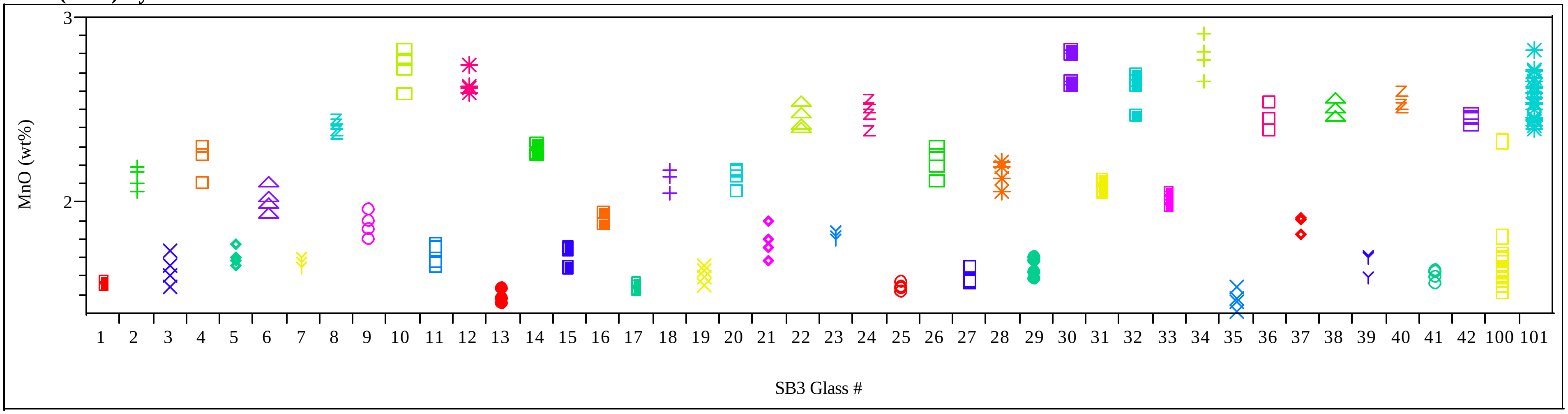


Exhibit H.5: LM Measurements by SB3 Glass ID Number by Oxide *(continued)*
(Batch 1 – 100 and Ustd – 101)

MnO (wt%) By SB3 Glass #



MnO bc (wt%) By SB3 Glass #

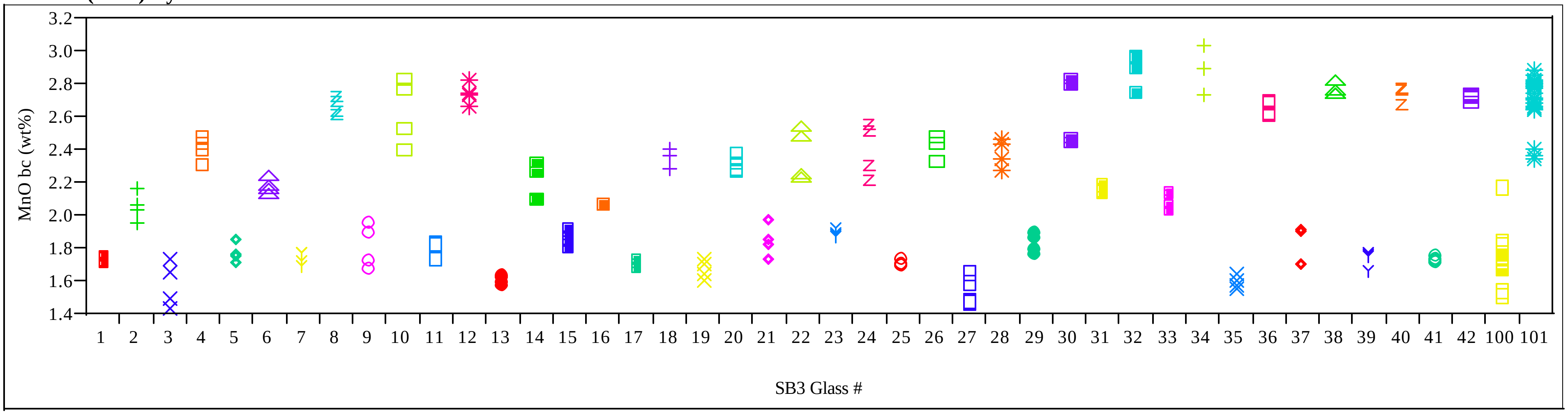
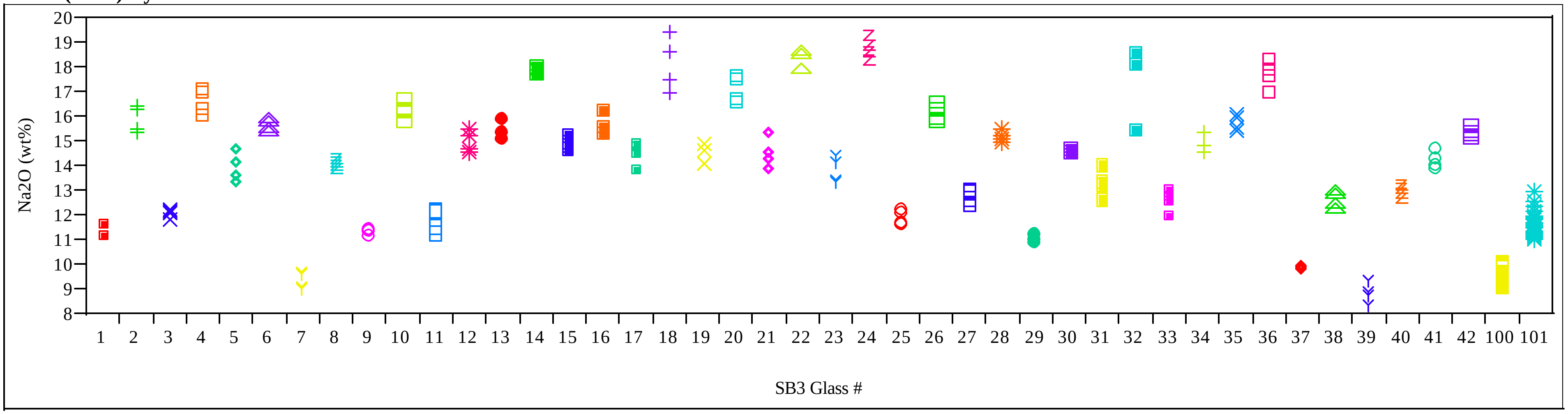


Exhibit H.5: LM Measurements by SB3 Glass ID Number by Oxide ***(continued)***

(Batch 1 – 100 and Ustd – 101)

Na2O (wt%) By SB3 Glass #



Na2O bc (wt%) By SB3 Glass #

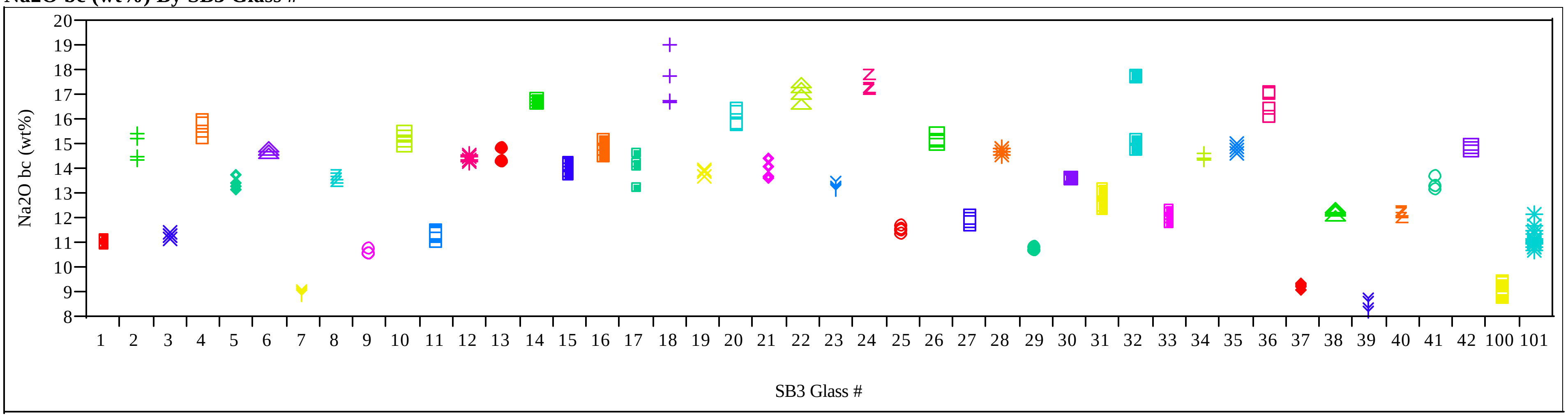
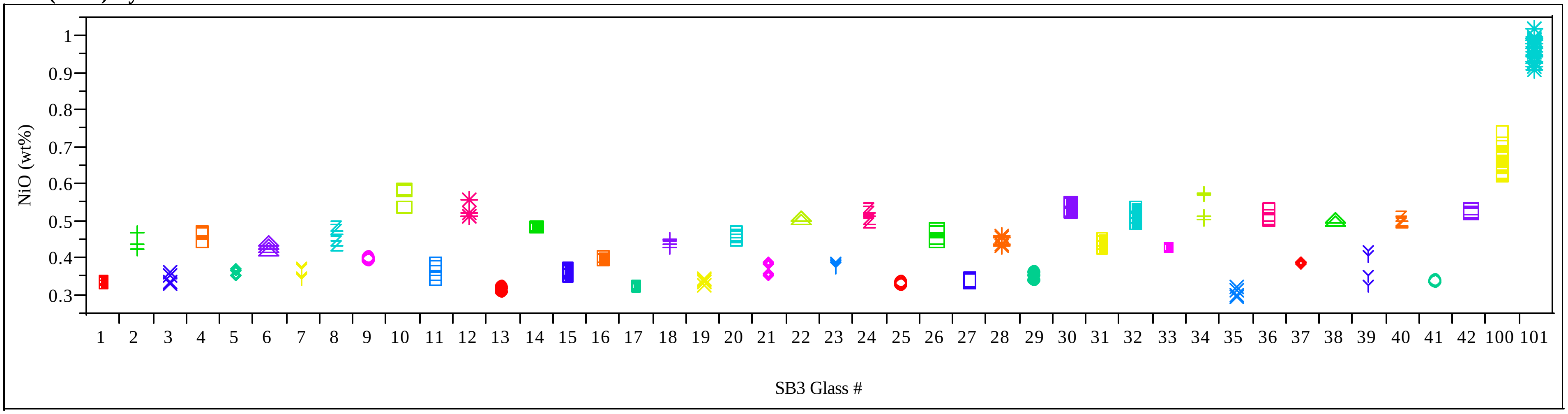


Exhibit H.5: LM Measurements by SB3 Glass ID Number by Oxide *(continued)*
(Batch 1 – 100 and Ustd – 101)

NiO (wt%) By SB3 Glass #



NiO bc (wt%) By SB3 Glass #

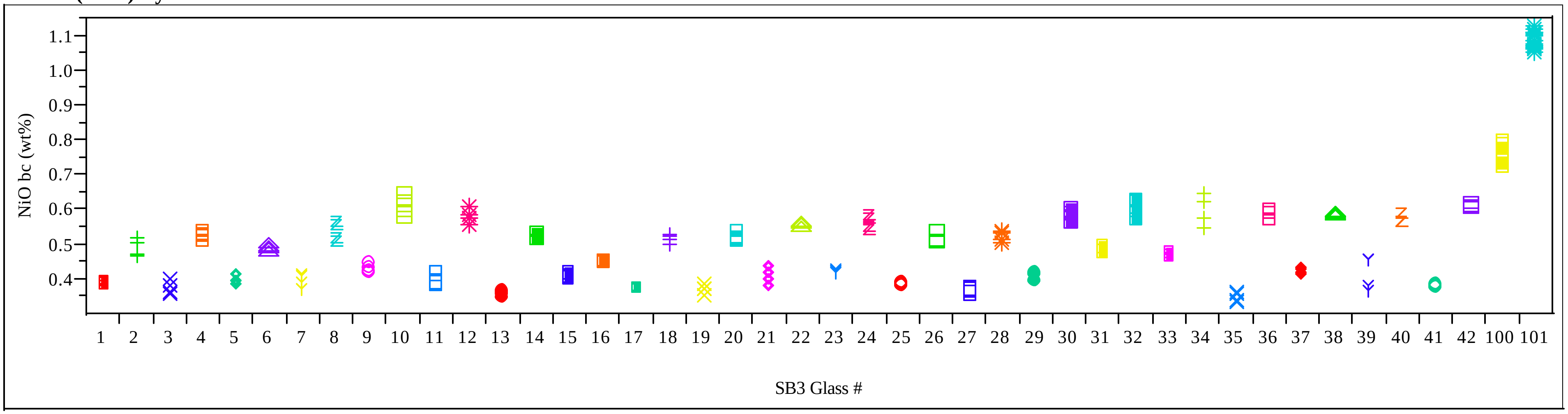
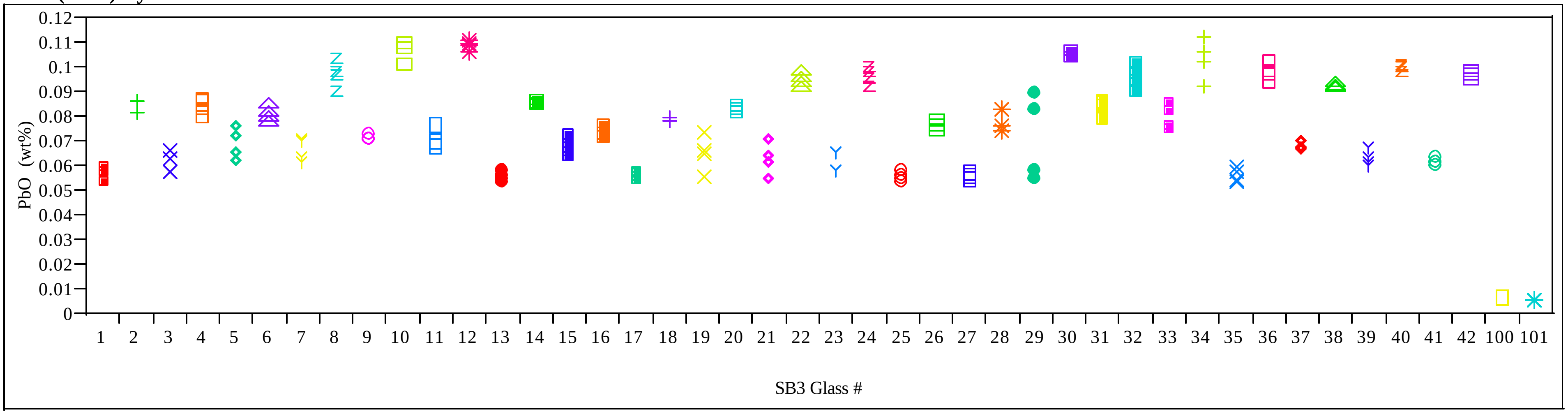


Exhibit H.5: LM Measurements by SB3 Glass ID Number by Oxide ***(continued)***

(Batch 1 – 100 and Ustd – 101)

PbO (wt%) By SB3 Glass #



PbO bc (wt%) By SB3 Glass #

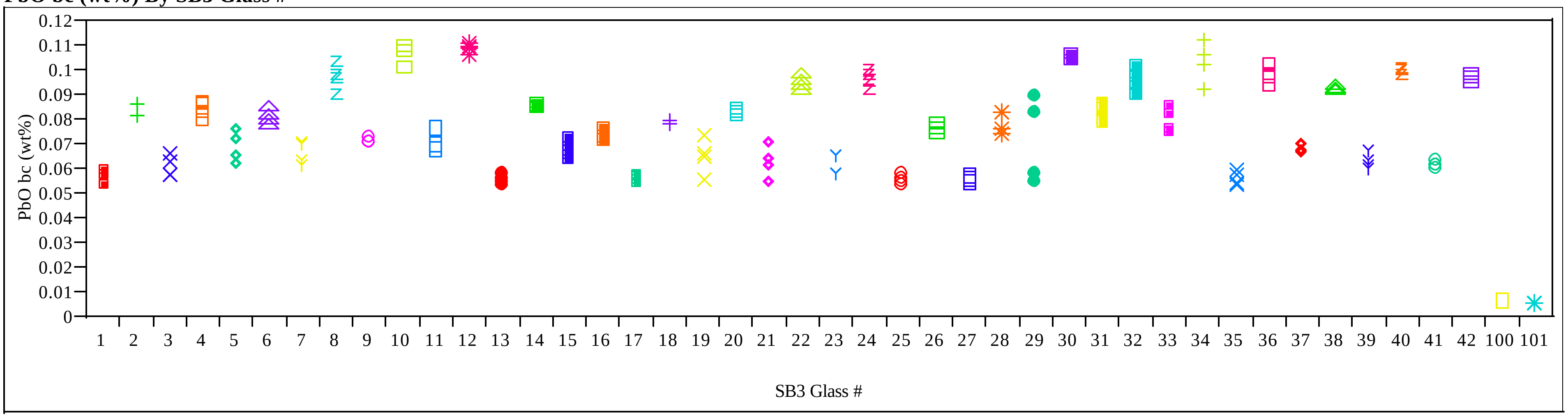
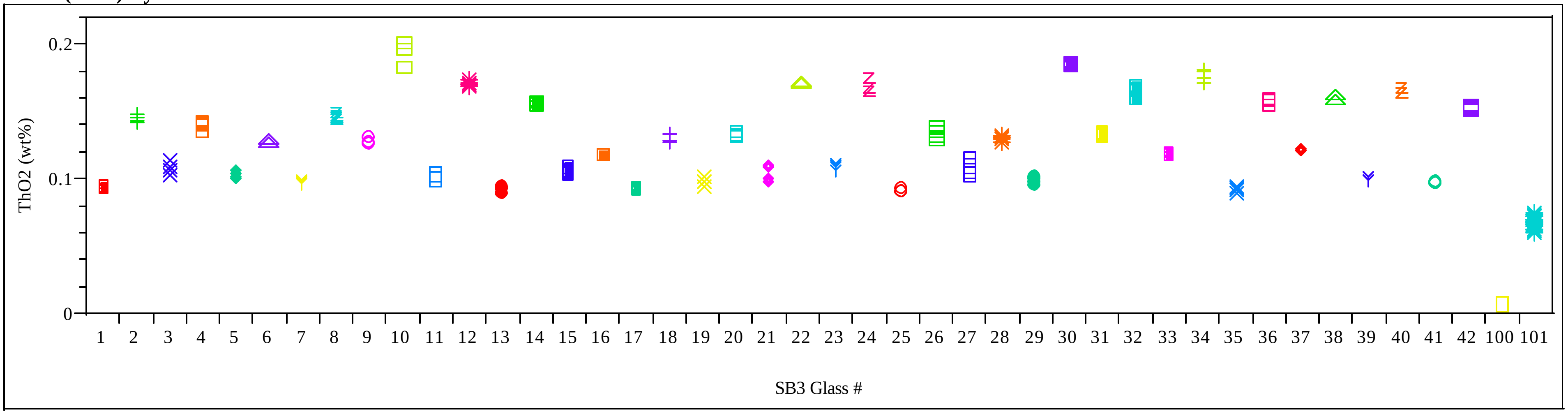


Exhibit H.5: LM Measurements by SB3 Glass ID Number by Oxide *(continued)*

(Batch 1 – 100 and Ustd – 101)

ThO2 (wt%) By SB3 Glass #



ThO2 bc (wt%) By SB3 Glass #

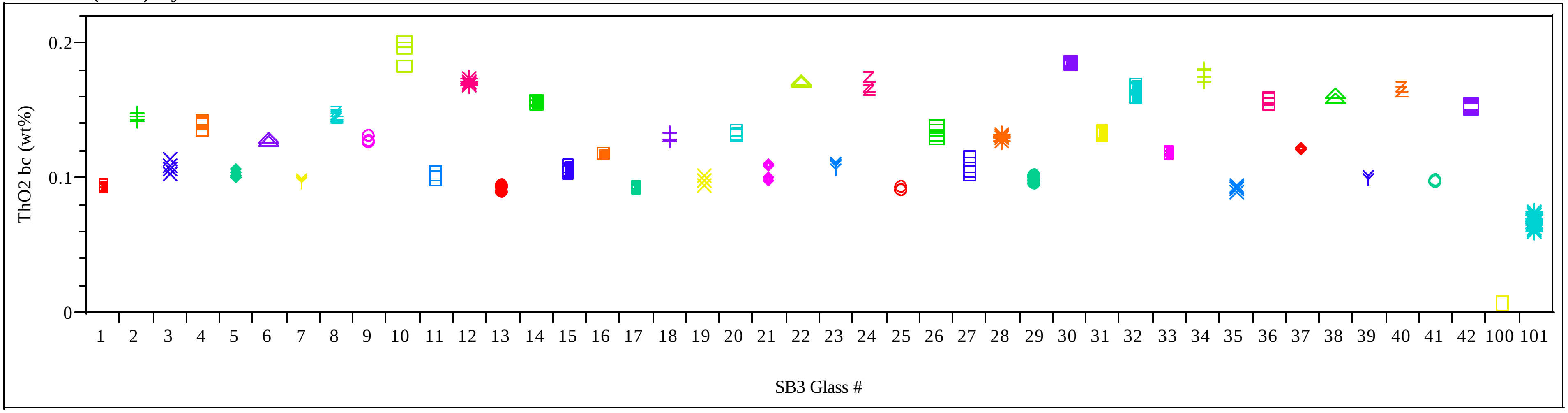
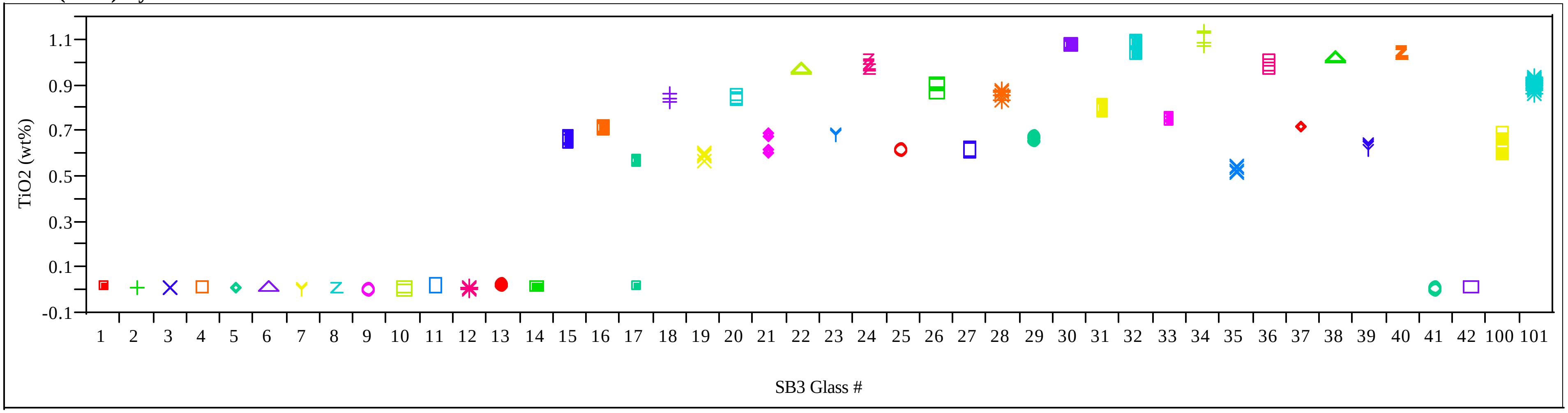


Exhibit H.5: LM Measurements by SB3 Glass ID Number by Oxide *(continued)*

(Batch 1 – 100 and Ustd – 101)

TiO2 (wt%) By SB3 Glass #



TiO2 bc (wt%) By SB3 Glass #

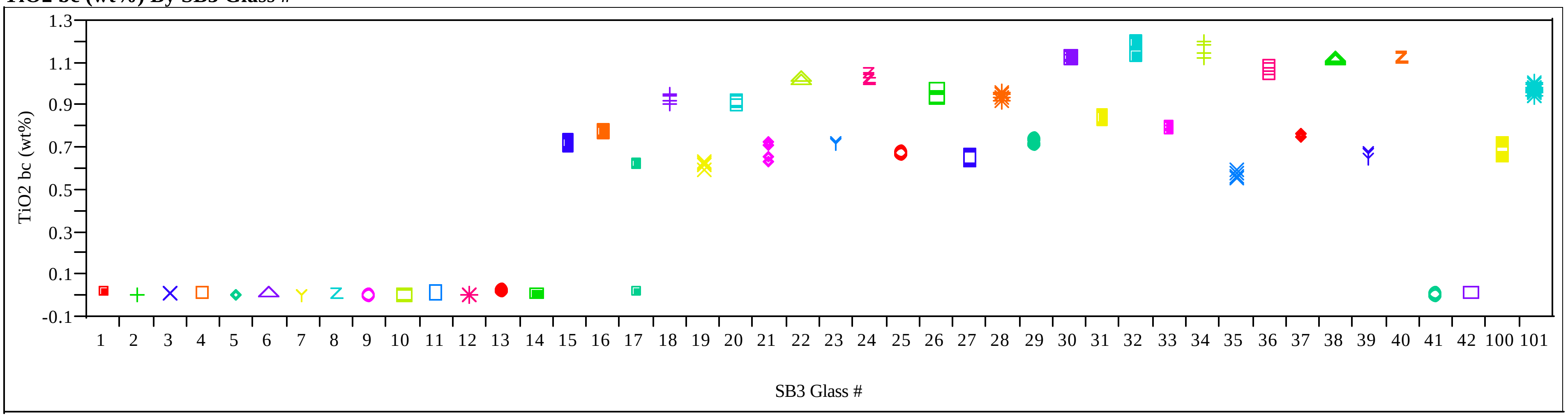
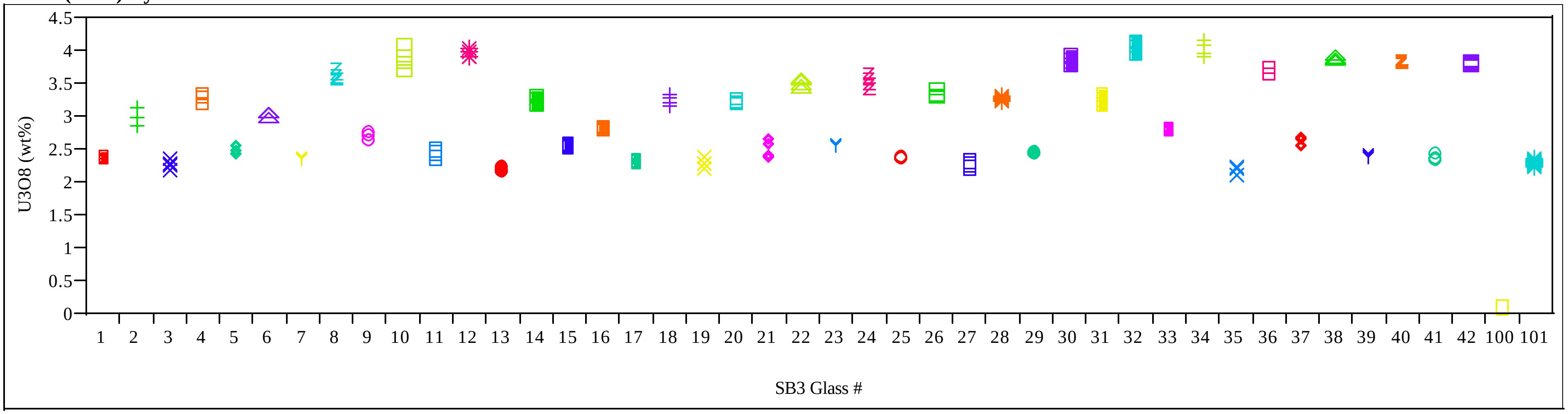


Exhibit H.5: LM Measurements by SB3 Glass ID Number by Oxide *(continued)*

(Batch 1 – 100 and Ustd – 101)

U3O8 (wt%) By SB3 Glass #



U3O8 bc (wt%) By SB3 Glass #

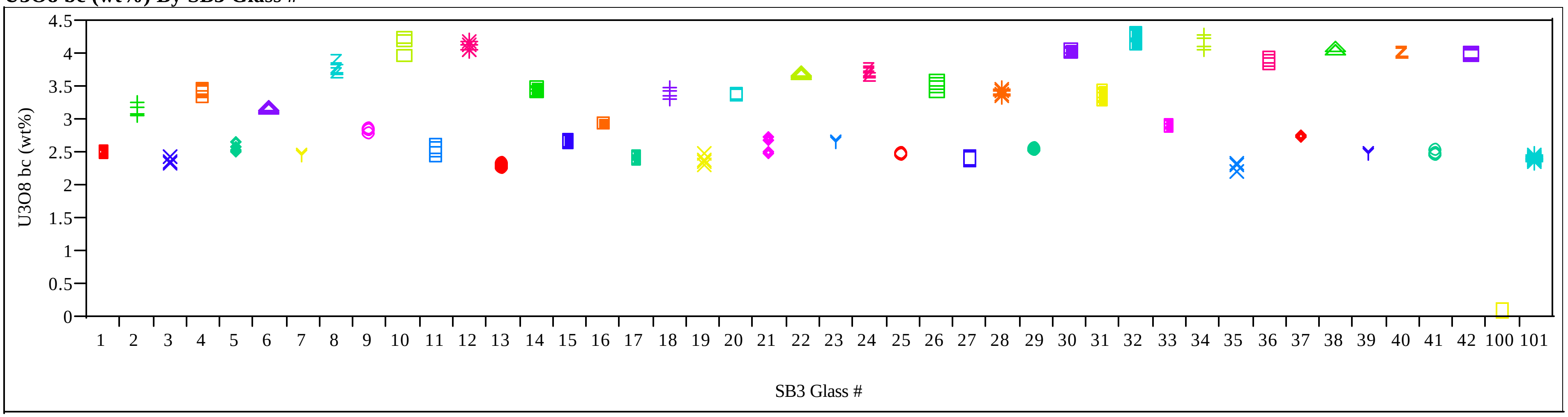
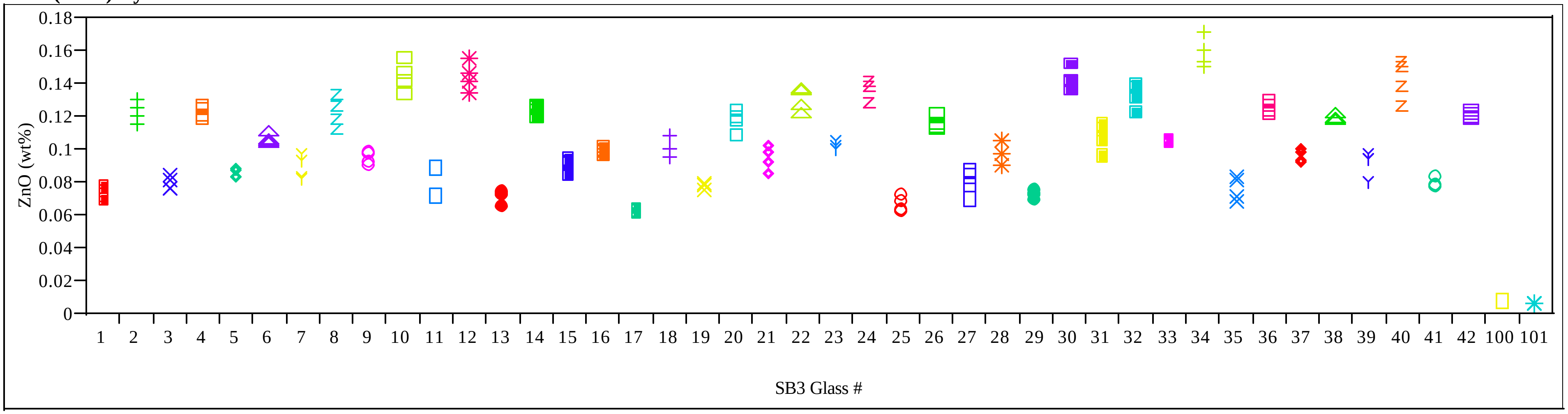


Exhibit H.5: LM Measurements by SB3 Glass ID Number by Oxide ***(continued)***

(Batch 1 – 100 and Ustd – 101)

ZnO (wt%) By SB3 Glass #



ZnO bc (wt%) By SB3 Glass #

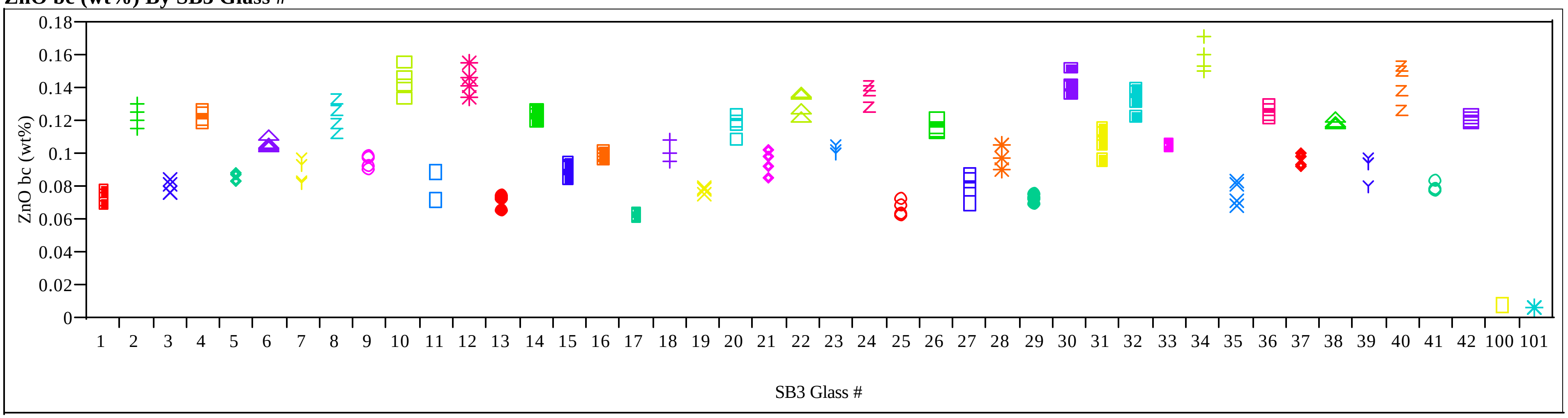
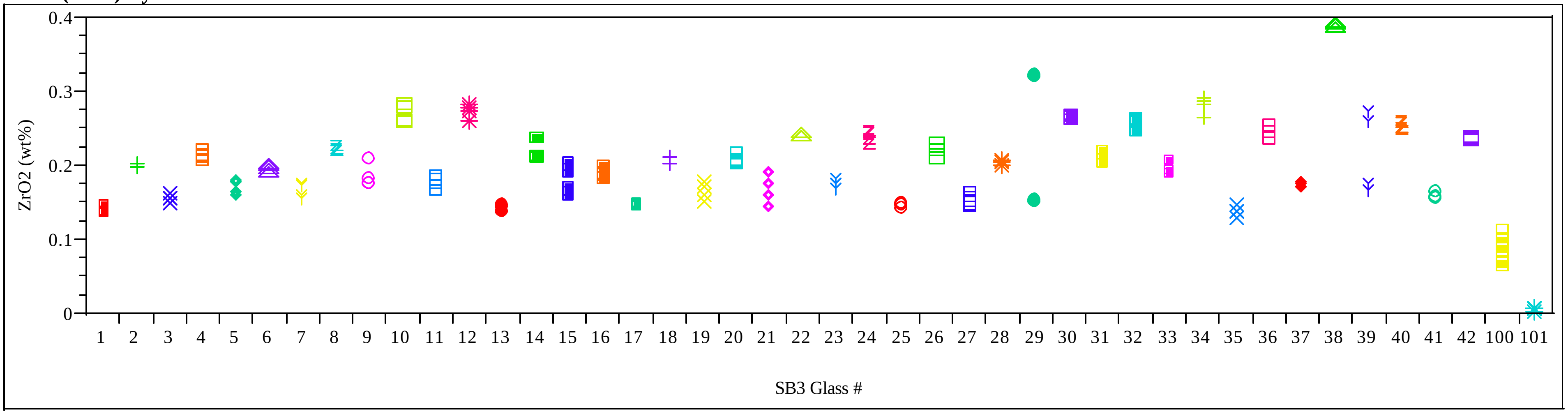


Exhibit H.5: LM Measurements by SB3 Glass ID Number by Oxide *(continued)*

(Batch 1 – 100 and Ustd – 101)

ZrO2 (wt%) By SB3 Glass #



ZrO2 bc (wt%) By SB3 Glass #

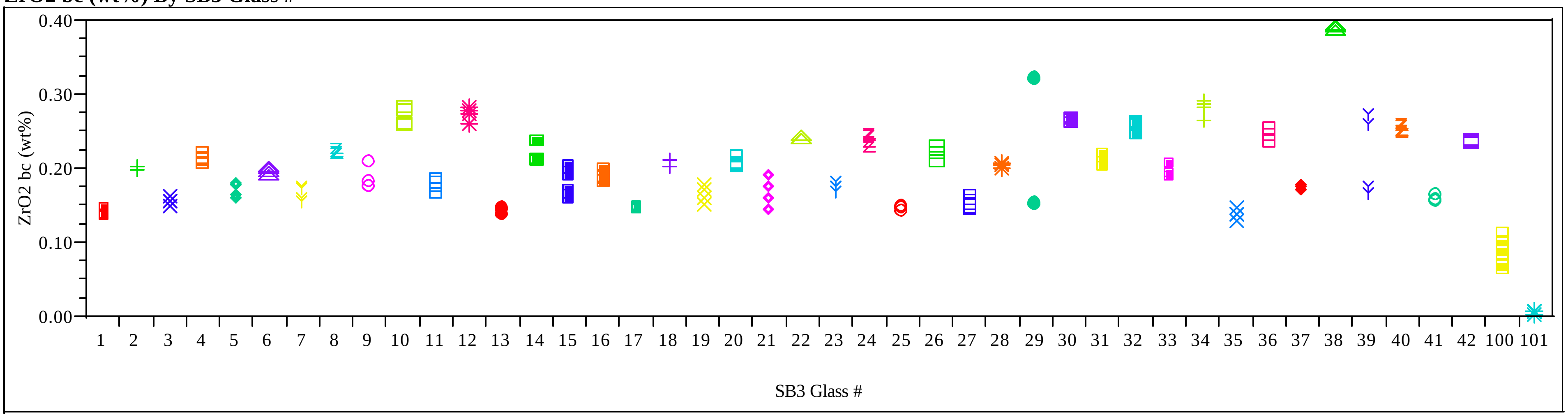
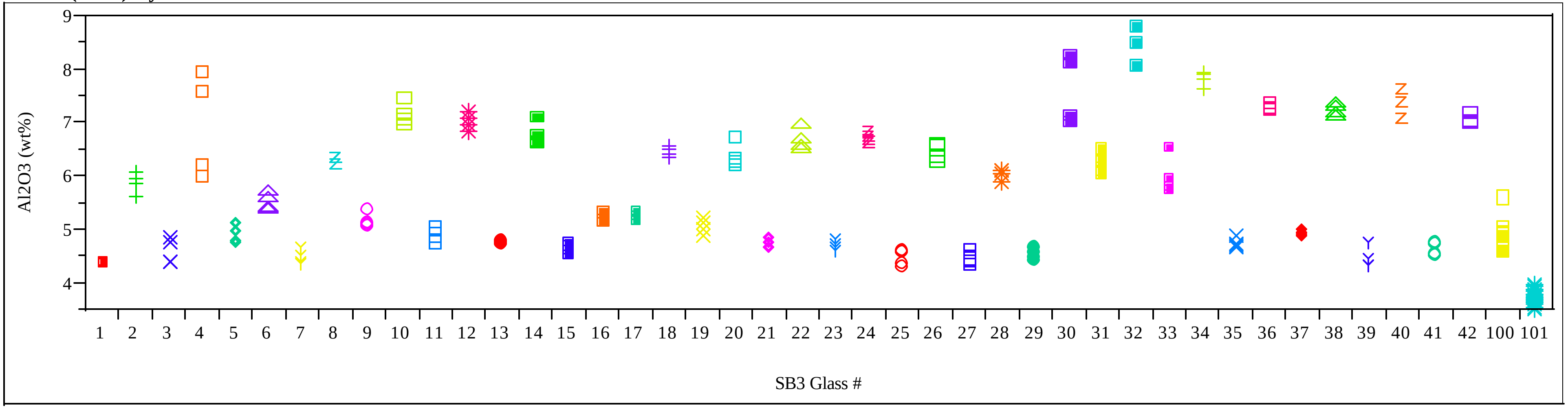


Exhibit H.6: PF Measurements by SB3 Glass ID Number by Oxide ***(continued)***

(Batch 1 – 100 and Ustd – 101)

Al2O3 (wt%) By SB3 Glass #



Al2O3 bc (wt%) By SB3 Glass #

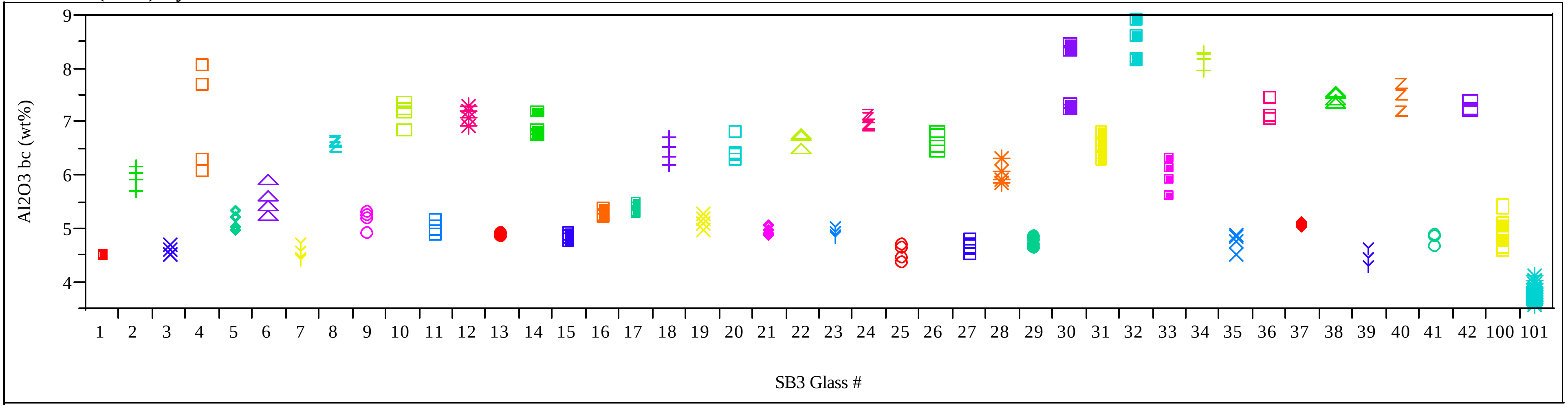
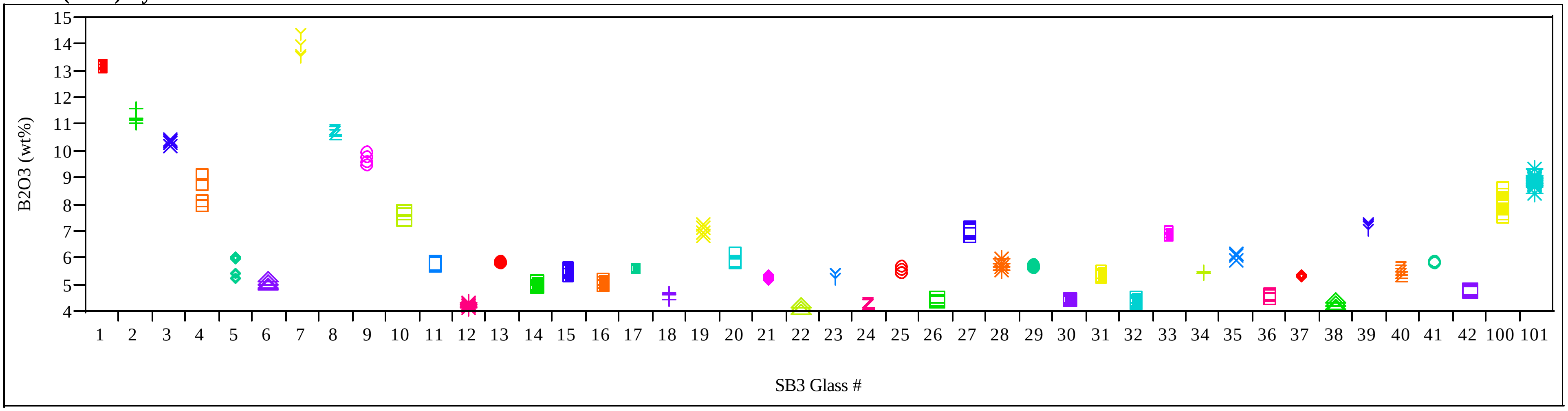


Exhibit H.6: PF Measurements by SB3 Glass ID Number by Oxide ***(continued)***

(Batch 1 – 100 and Ustd – 101)

B2O3 (wt%) By SB3 Glass #



B2O3 bc (wt%) By SB3 Glass #

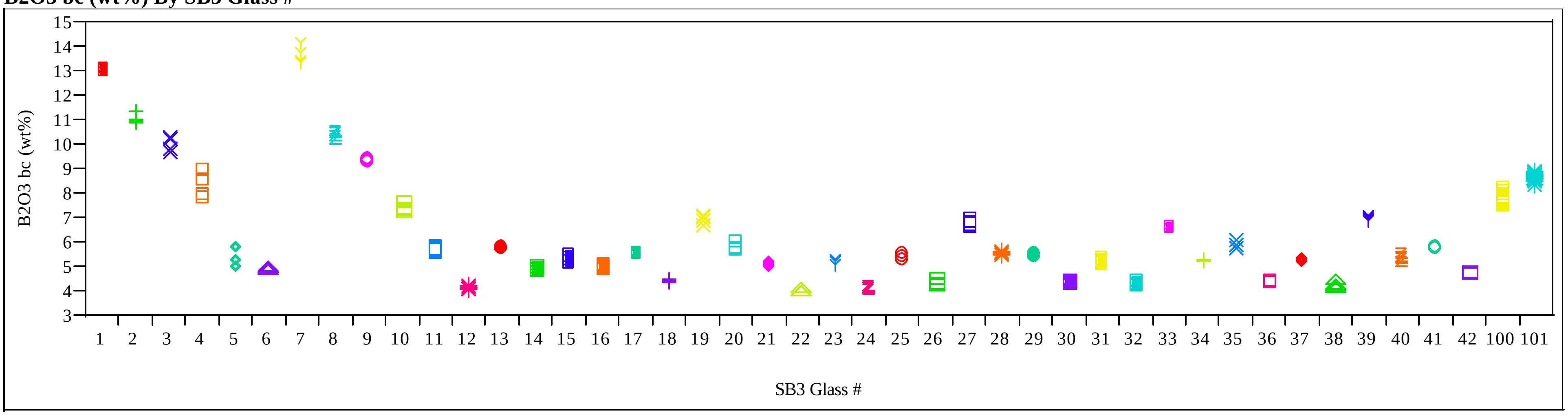
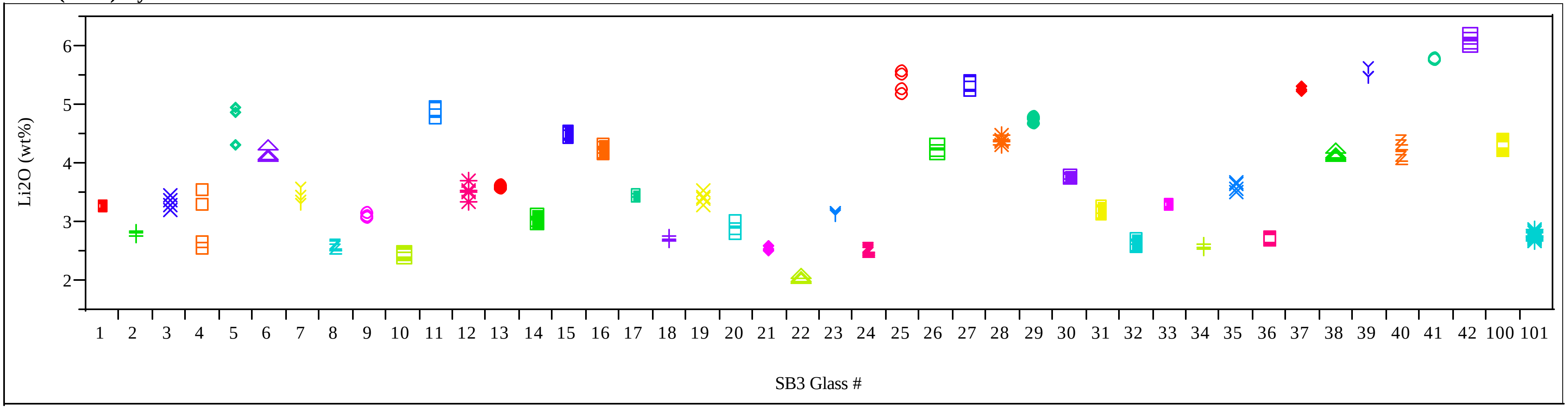


Exhibit H.6: PF Measurements by SB3 Glass ID Number by Oxide ***(continued)***

(Batch 1 – 100 and Ustd – 101)

Li2O (wt%) By SB3 Glass #



Li2O bc (wt%) By SB3 Glass #

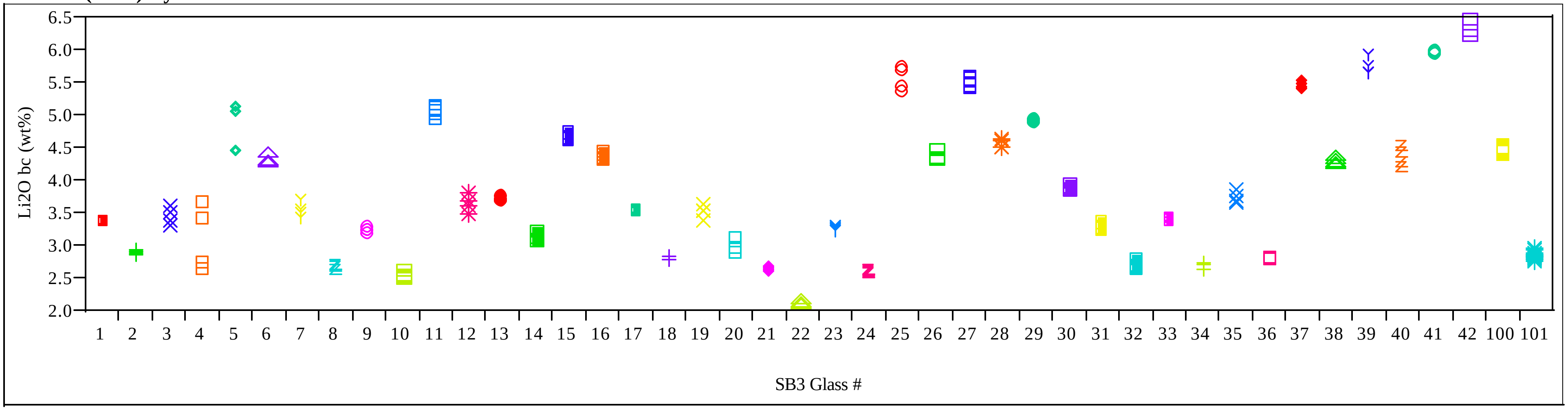
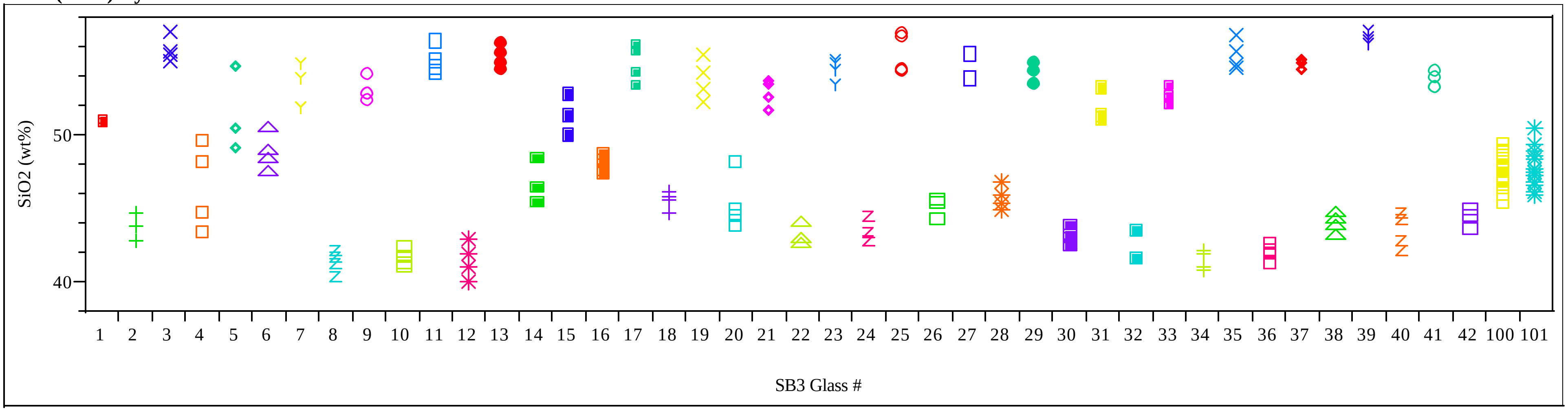


Exhibit H.6: PF Measurements by SB3 Glass ID Number by Oxide ***(continued)***
(Batch 1 – 100 and Ustd – 101)

SiO2 (wt%) By SB3 Glass #



SiO2 bc (wt%) By SB3 Glass #

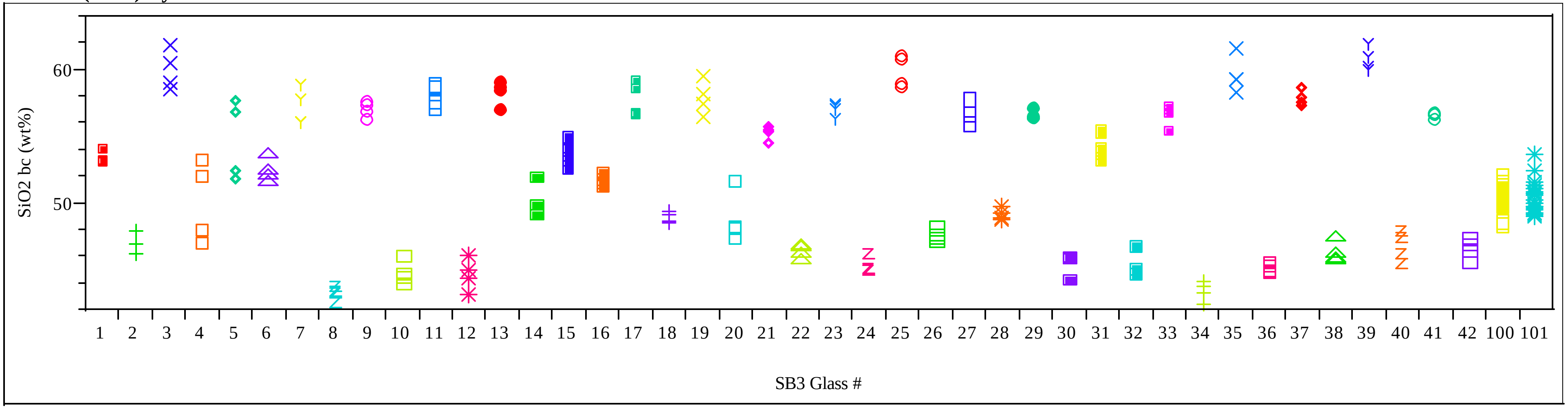
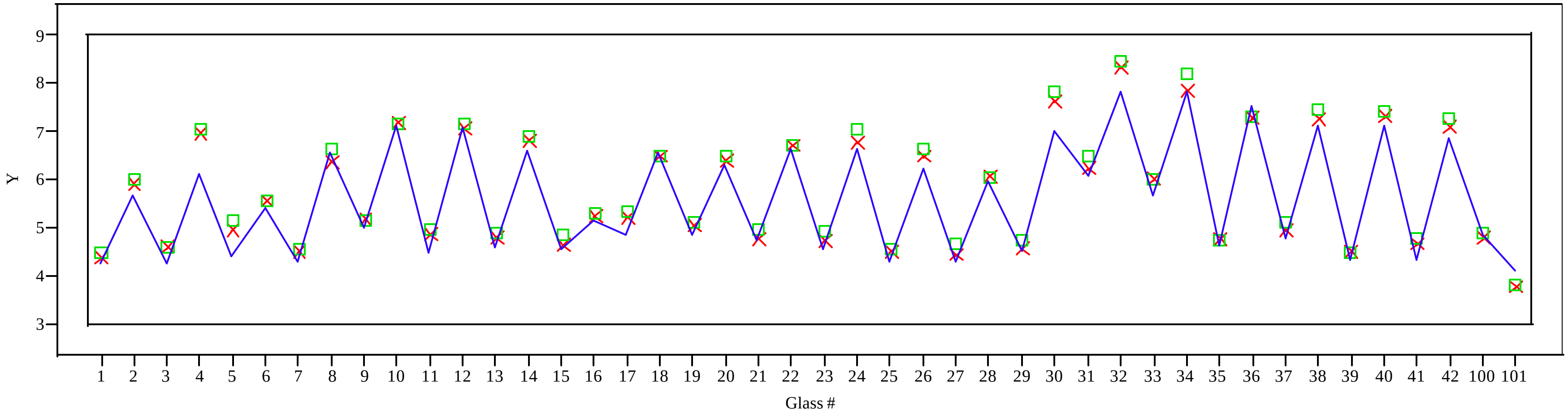


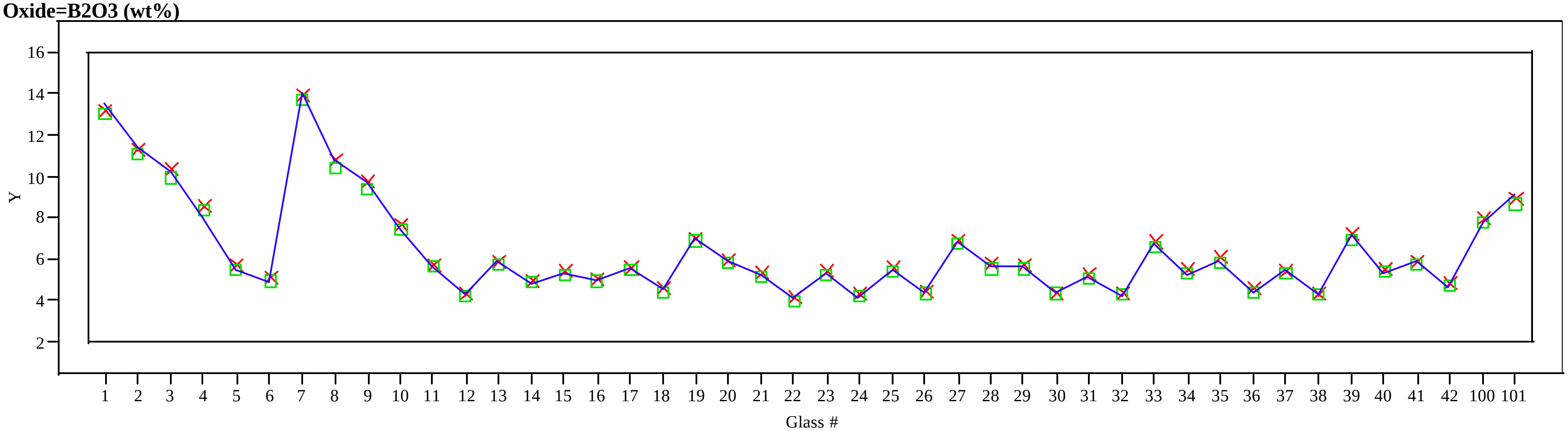
Exhibit H.7: Measured, Measured Bias-Corrected, and Targeted Compositions for the SB3 Glasses by Oxide ***(continued)***

(Batch 1 – 100 and Ustd – 101)

Oxide=Al2O3 (wt%)



Oxide=B2O3 (wt%)

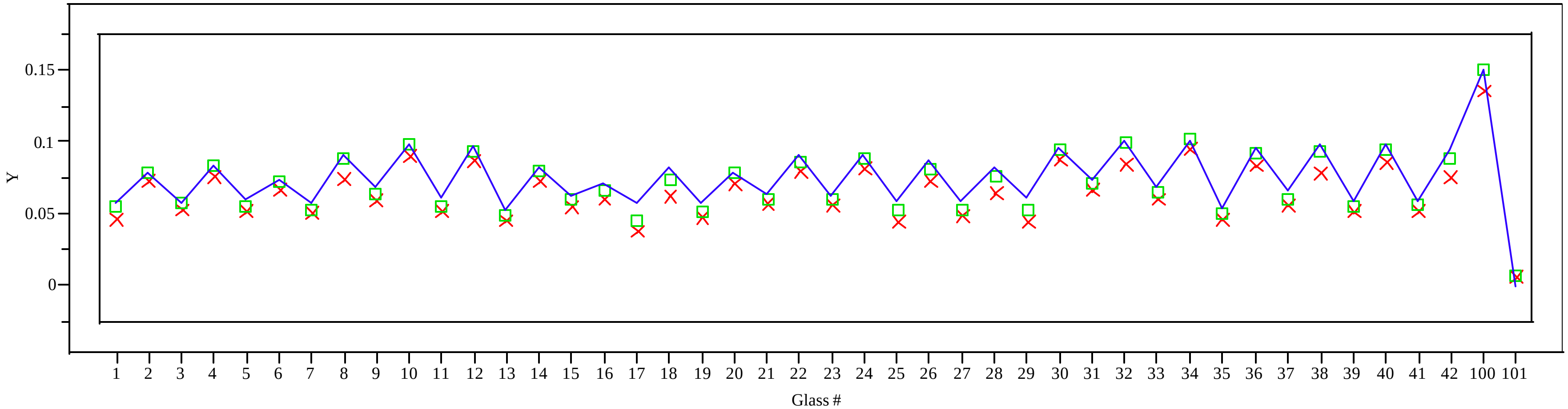


Y Measured Measured bc Targeted

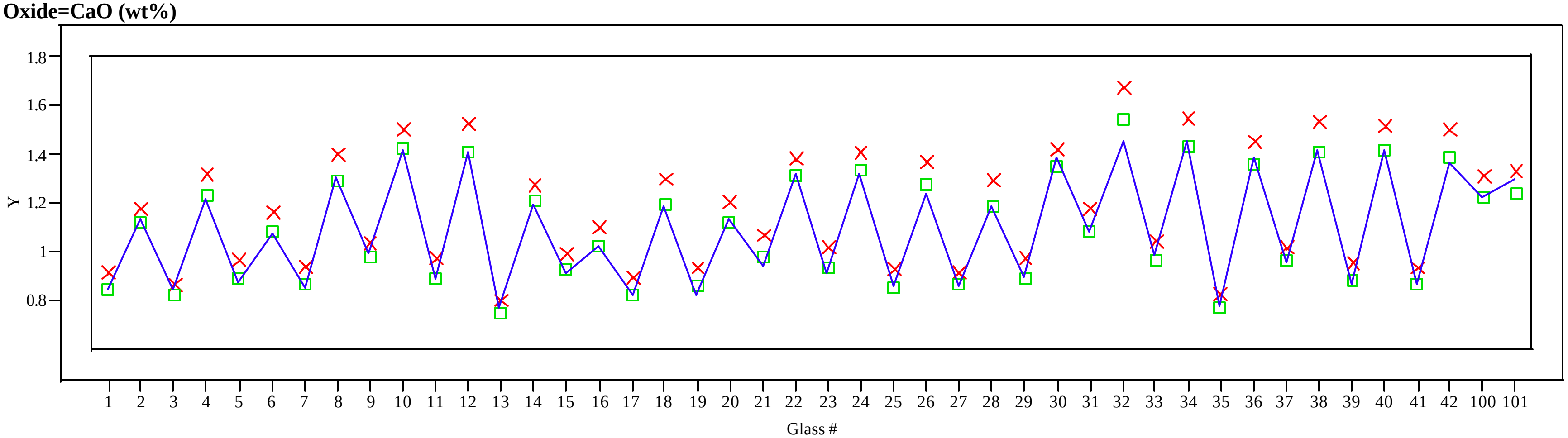
Exhibit H.7: Measured, Measured Bias-Corrected, and Targeted Compositions for the SB3 Glasses by Oxide *(continued)*

(Batch 1 – 100 and Ustd – 101)

Oxide=BaO (wt%)



Oxide=CaO (wt%)

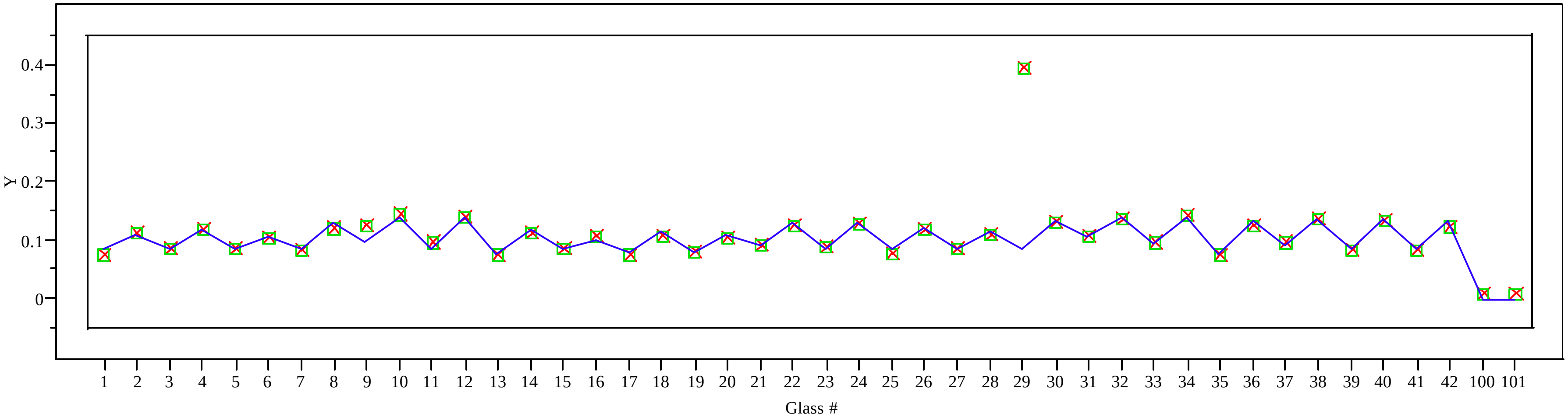


Y Measured Measured bc Targeted

Exhibit H.7: Measured, Measured Bias-Corrected, and Targeted Compositions for the SB3 Glasses by Oxide ***(continued)***

(Batch 1 – 100 and Ustd – 101)

Oxide=Ce2O3 (wt%)



Oxide=Cr2O3 (wt%)

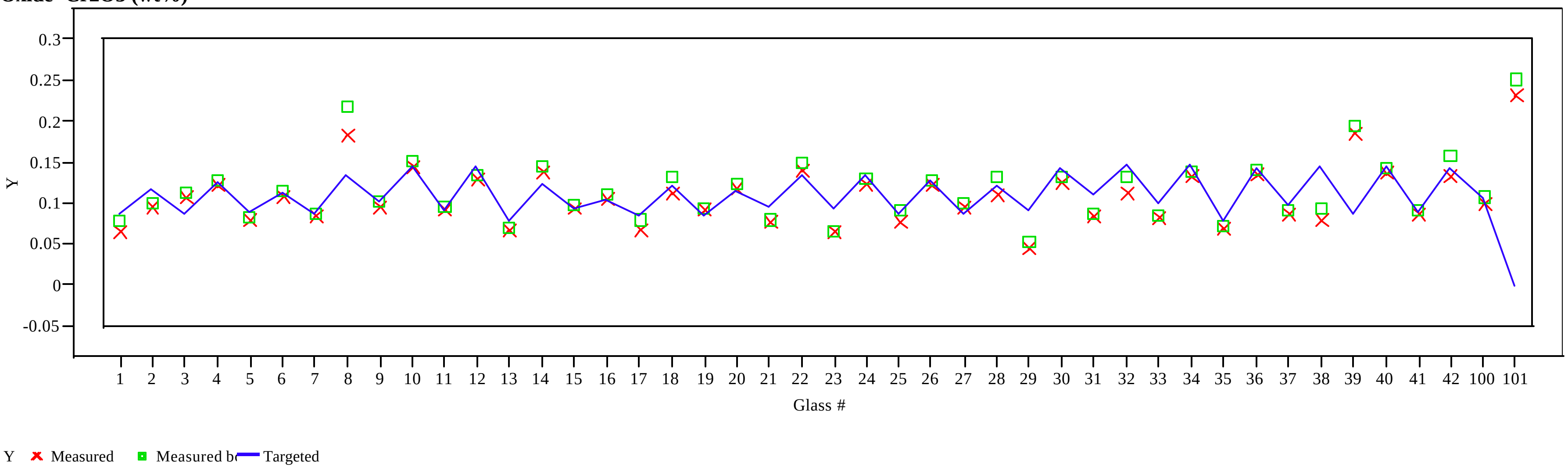
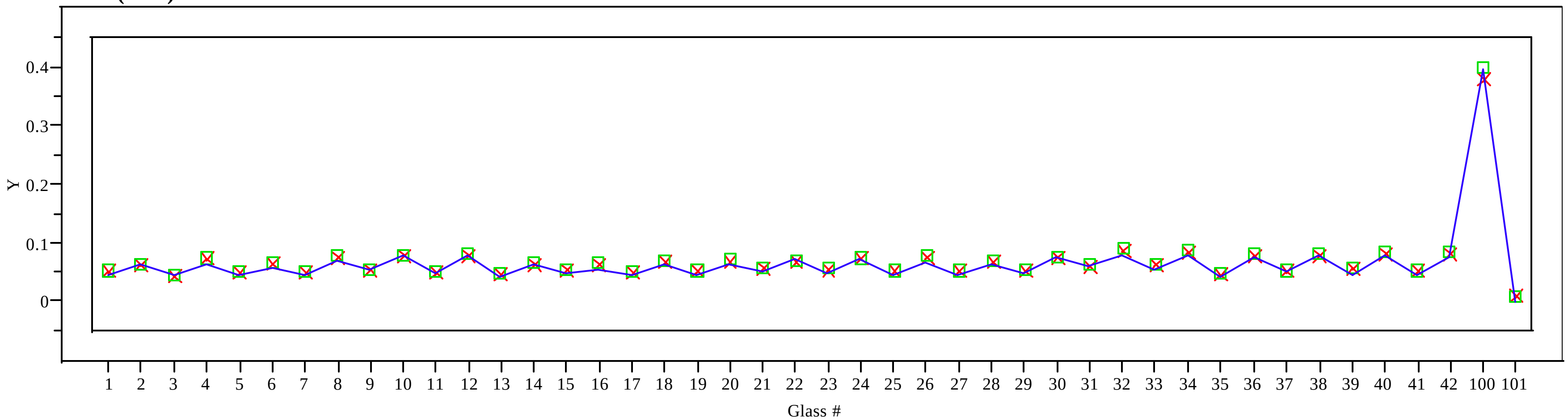


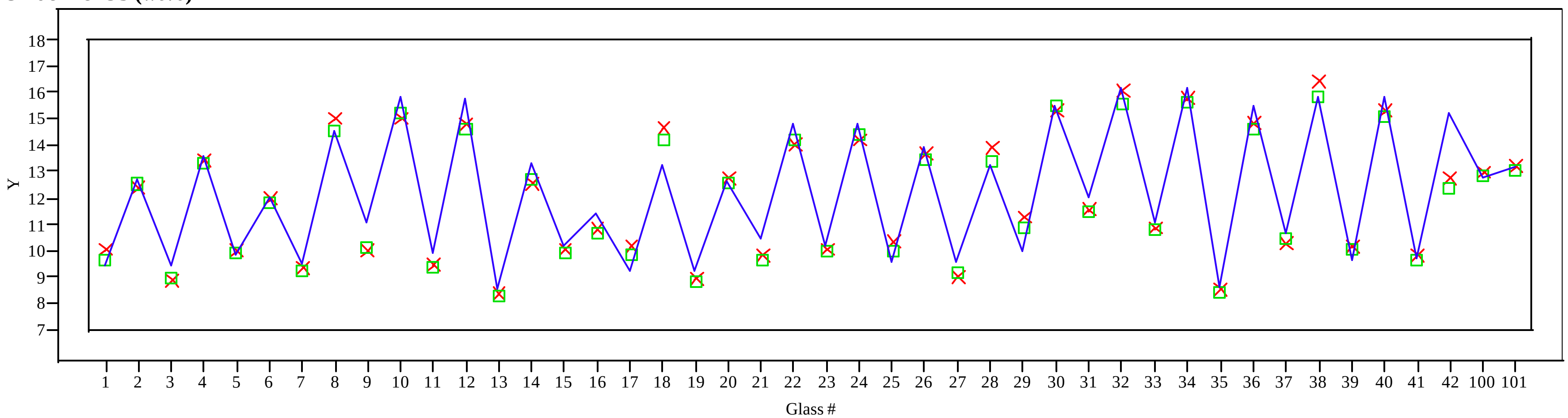
Exhibit H.7: Measured, Measured Bias-Corrected, and Targeted Compositions for the SB3 Glasses by Oxide *(continued)*

(Batch 1 – 100 and Ustd – 101)

Oxide=CuO (wt%)



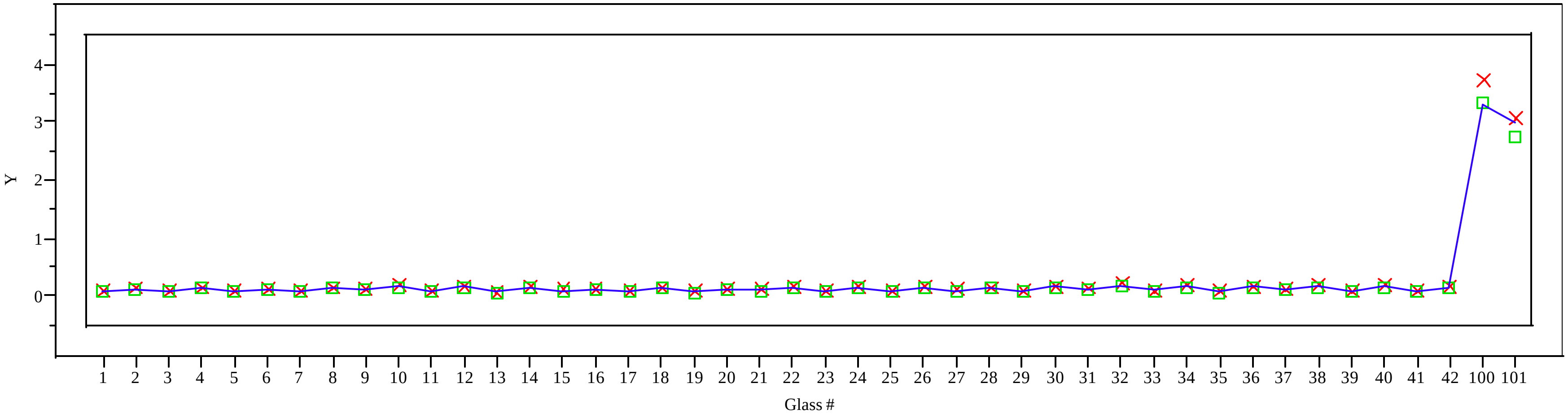
Oxide=Fe2O3 (wt%)



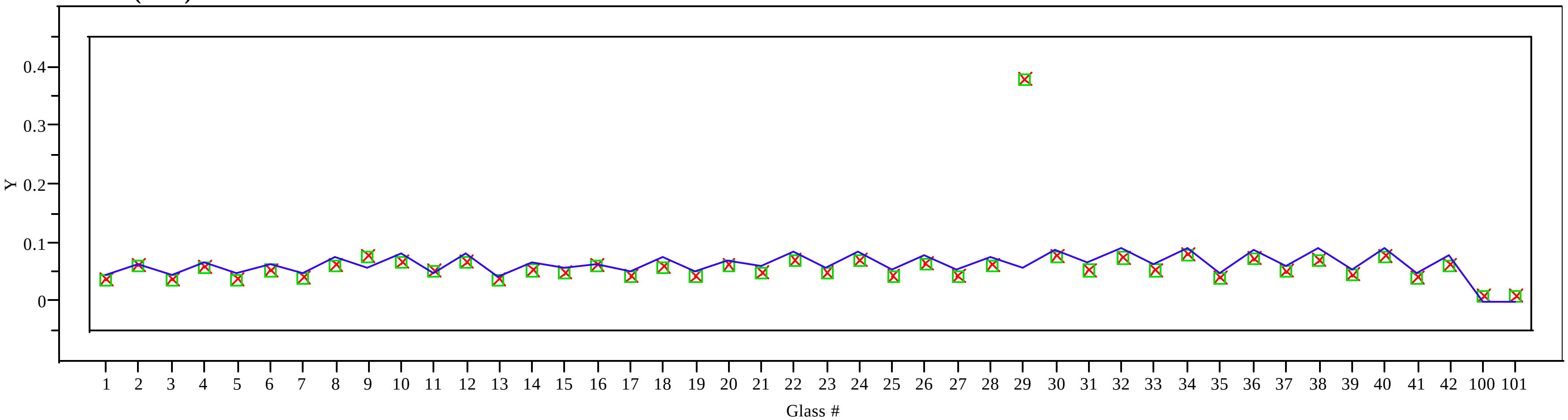
Y Measured Measured bc Targeted

Exhibit H.7: Measured, Measured Bias-Corrected, and Targeted Compositions for the SB3 Glasses by Oxide *(continued)*
(Batch 1 – 100 and Ustd – 101)

Oxide=K2O (wt%)



Oxide=La2O3 (wt%)

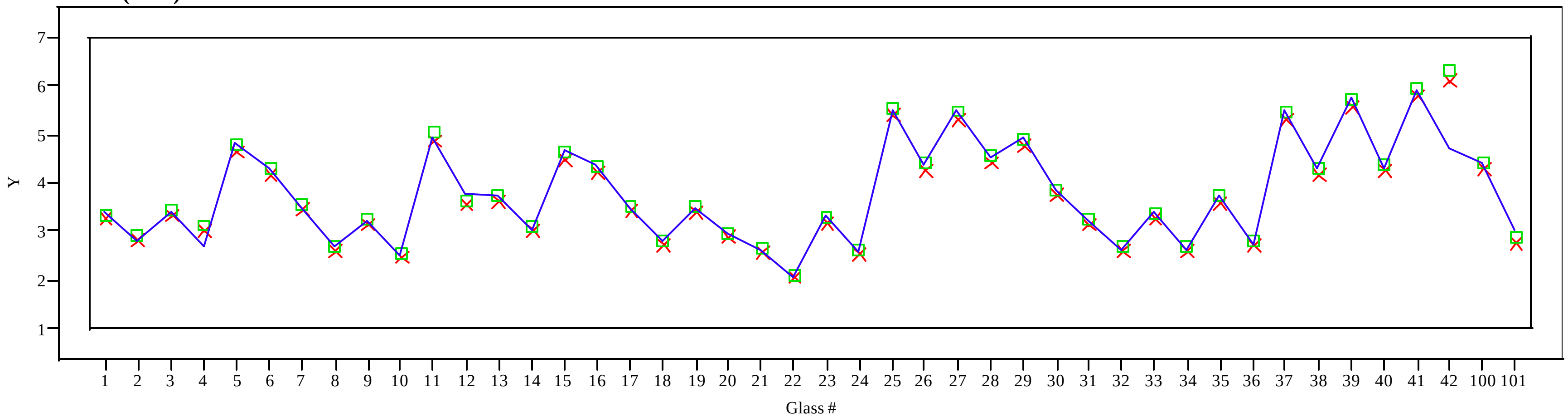


Y Measured Measured bc Targeted

Exhibit H.7: Measured, Measured Bias-Corrected, and Targeted Compositions for the SB3 Glasses by Oxide ***(continued)***

(Batch 1 – 100 and Ustd – 101)

Oxide=Li2O (wt%)



Oxide=MgO (wt%)

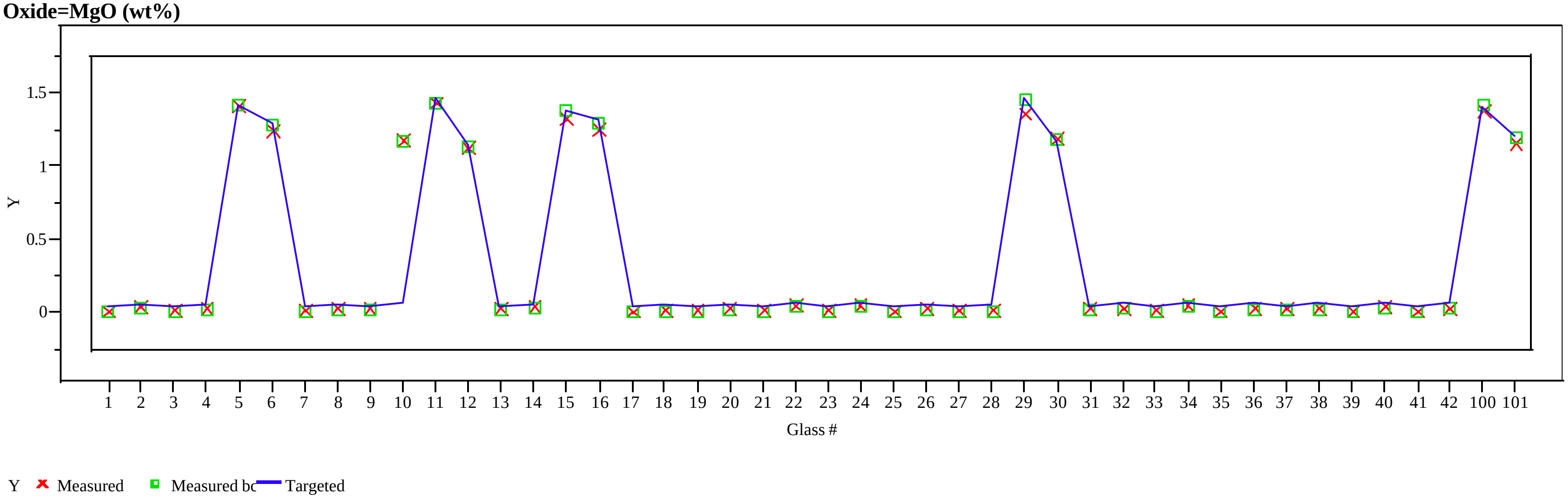
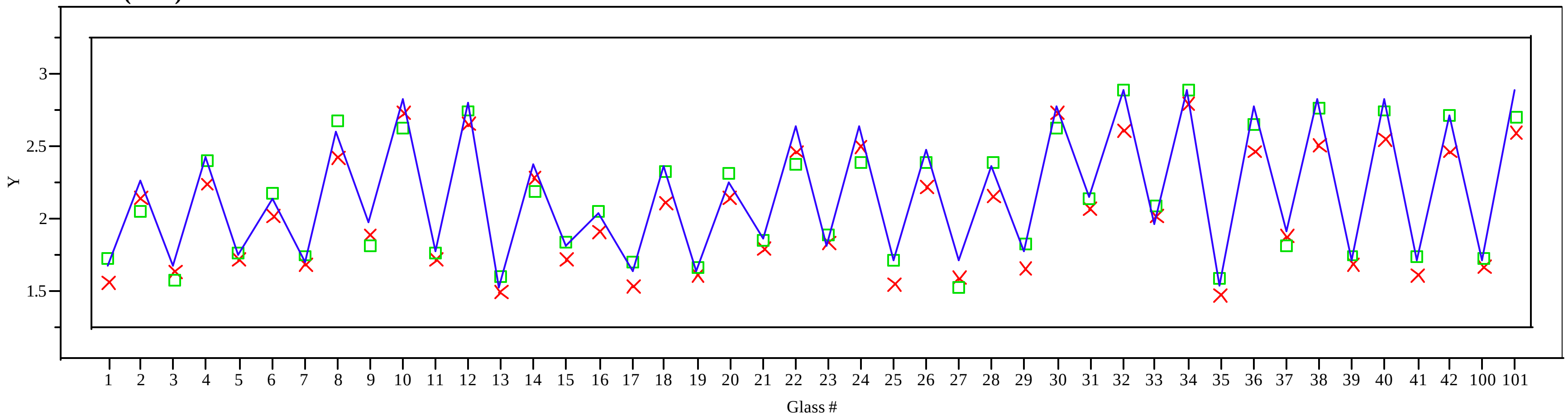


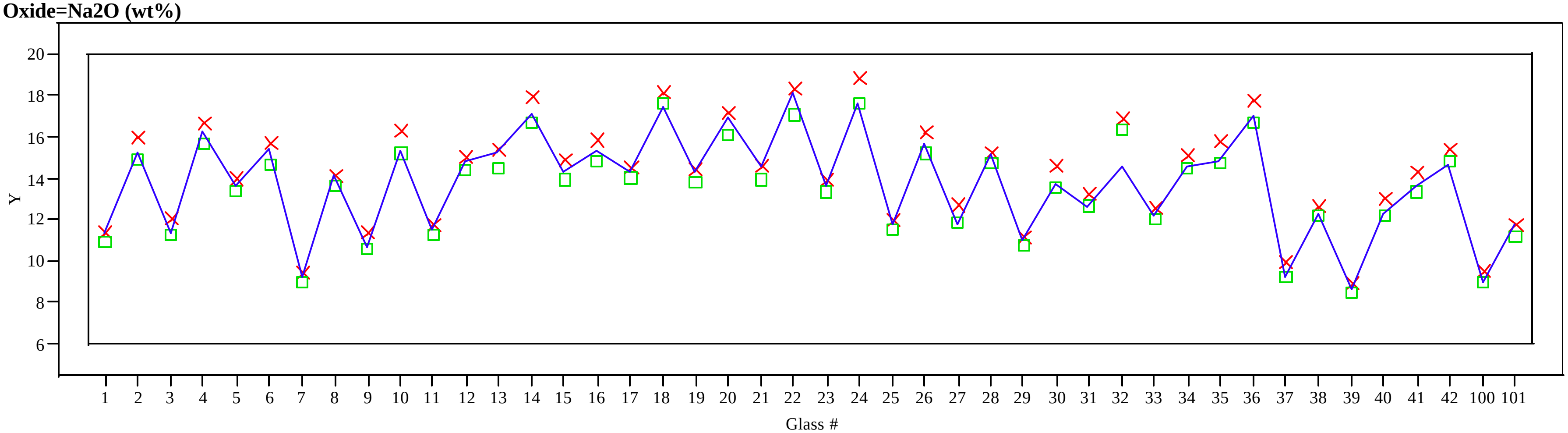
Exhibit H.7: Measured, Measured Bias-Corrected, and Targeted Compositions for the SB3 Glasses by Oxide *(continued)*

(Batch 1 – 100 and Ustd – 101)

Oxide=MnO (wt%)



Oxide=Na2O (wt%)

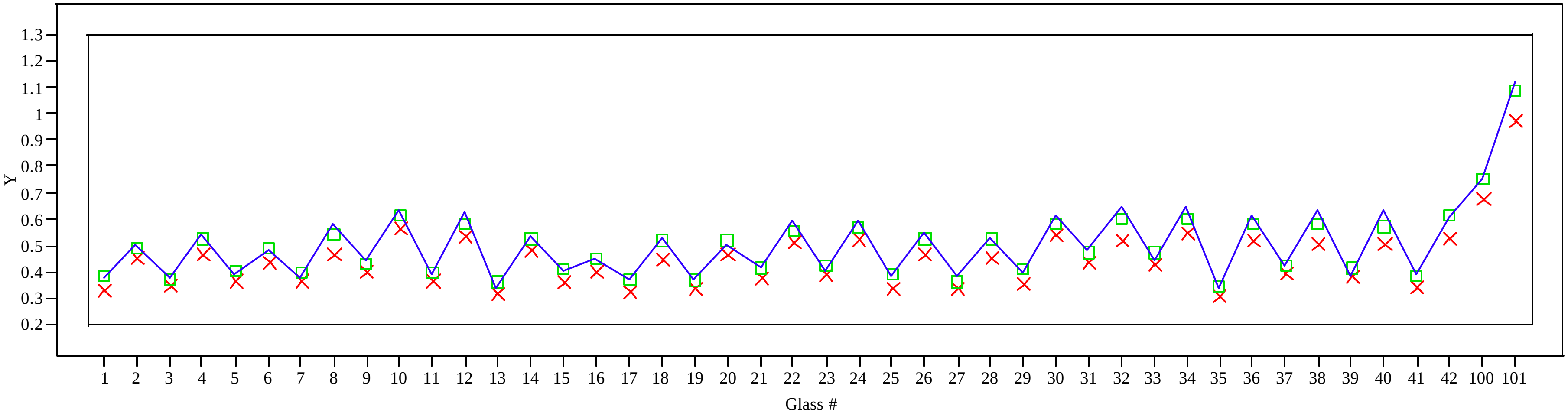


Y Measured Measured bc Targeted

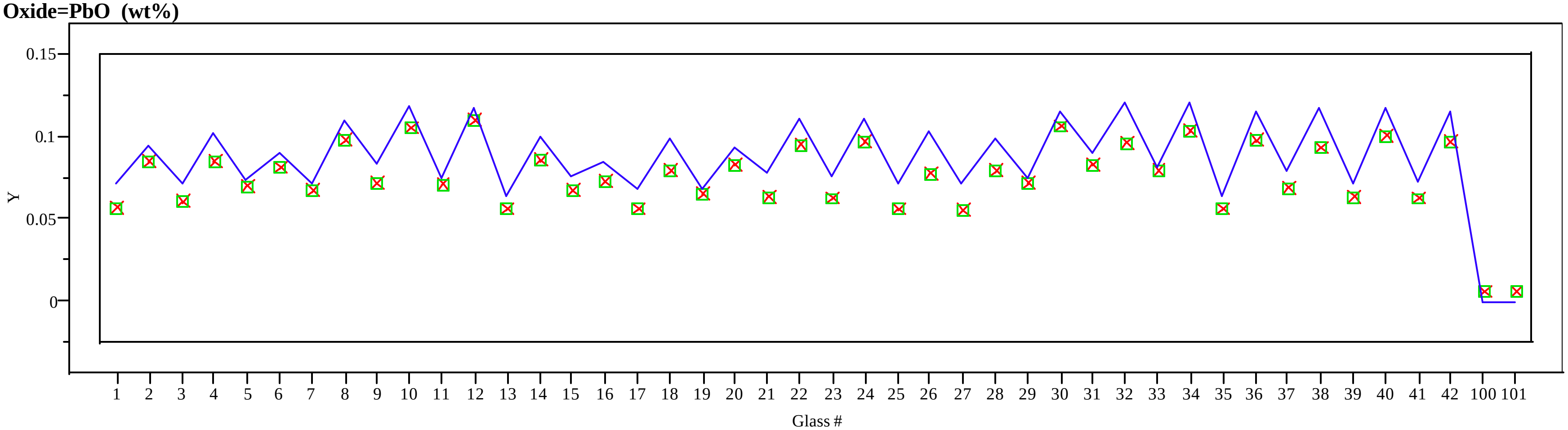
Exhibit H.7: Measured, Measured Bias-Corrected, and Targeted Compositions for the SB3 Glasses by Oxide ***(continued)***

(Batch 1 – 100 and Ustd – 101)

Oxide=NiO (wt%)



Oxide=PbO (wt%)

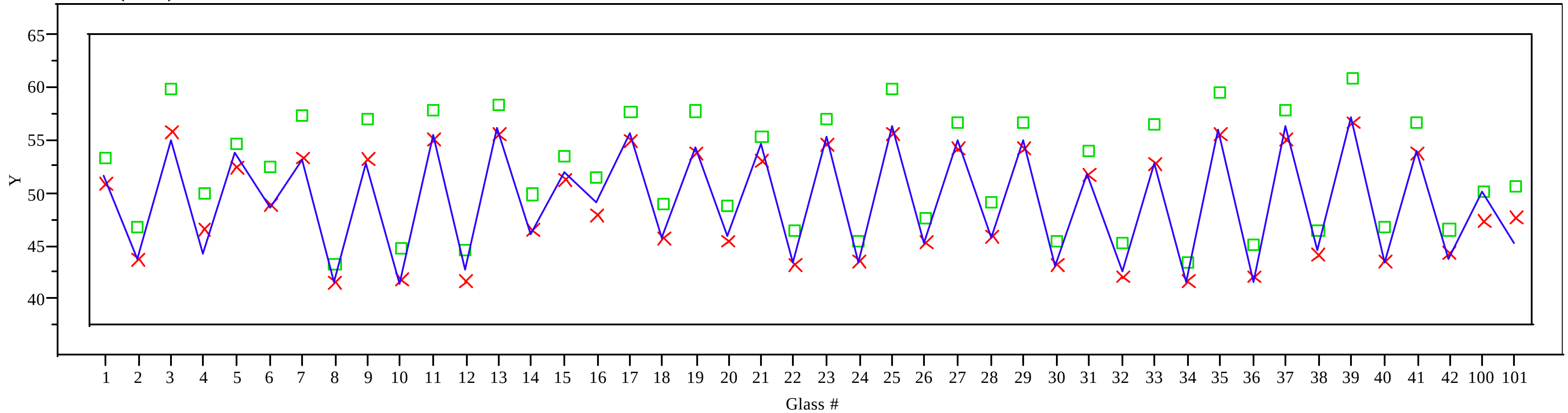


Y Measured Measured bc Targeted

Exhibit H.7: Measured, Measured Bias-Corrected, and Targeted Compositions for the SB3 Glasses by Oxide *(continued)*

(Batch 1 – 100 and Ustd – 101)

Oxide=SiO2 (wt%)



Oxide=ThO2 (wt%)

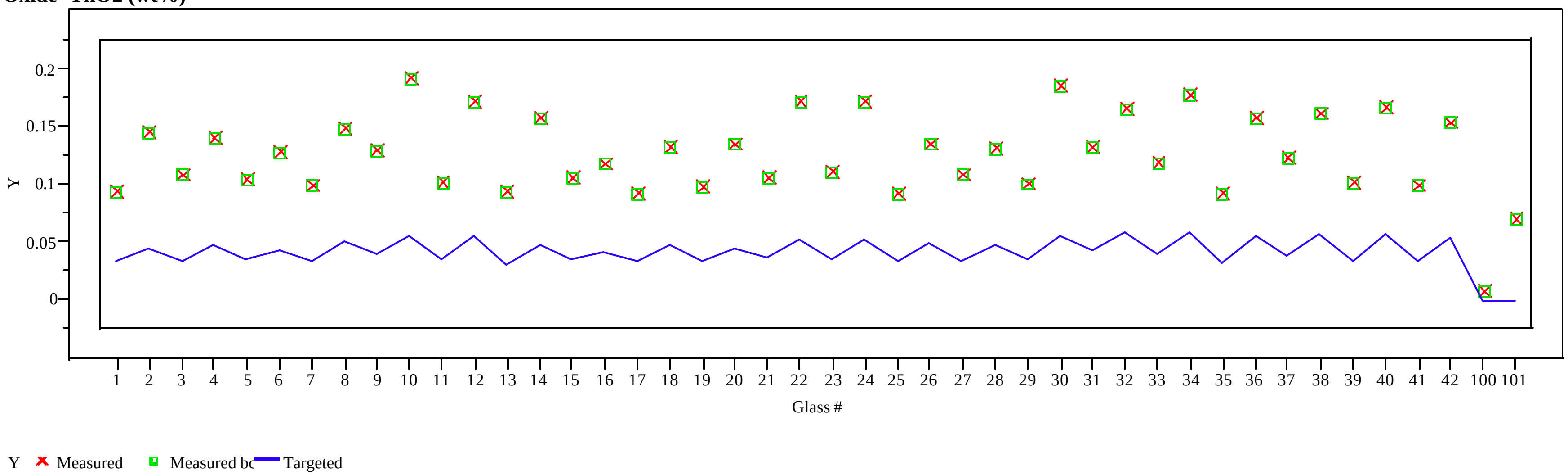
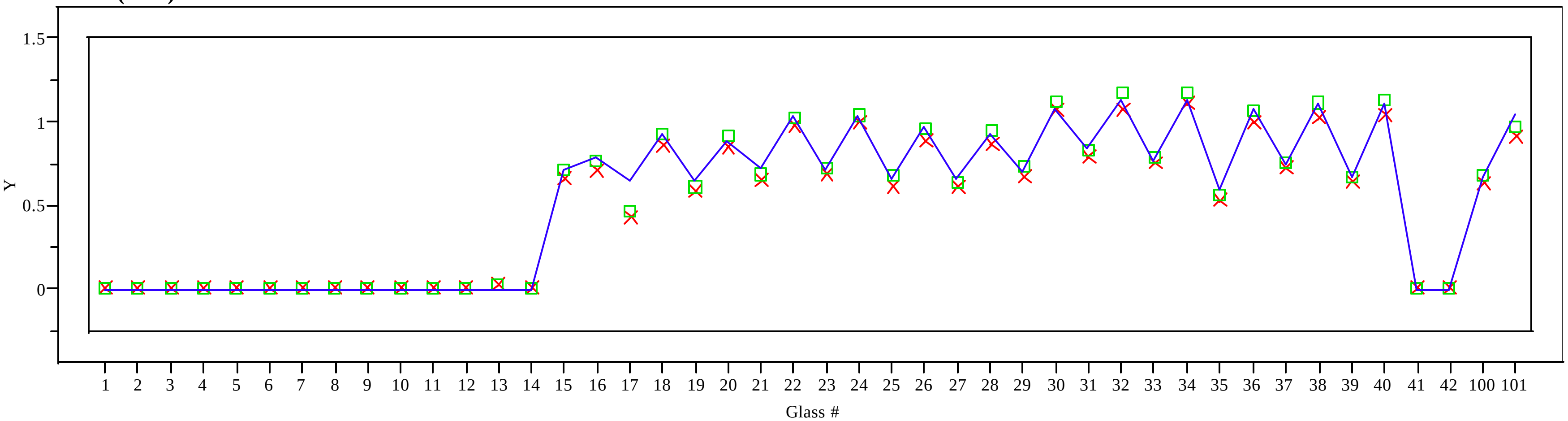


Exhibit H.7: Measured, Measured Bias-Corrected, and Targeted Compositions for the SB3 Glasses by Oxide *(continued)*

(Batch 1 – 100 and Ustd – 101)

Oxide=TiO2 (wt%)



Oxide=U3O8 (wt%)

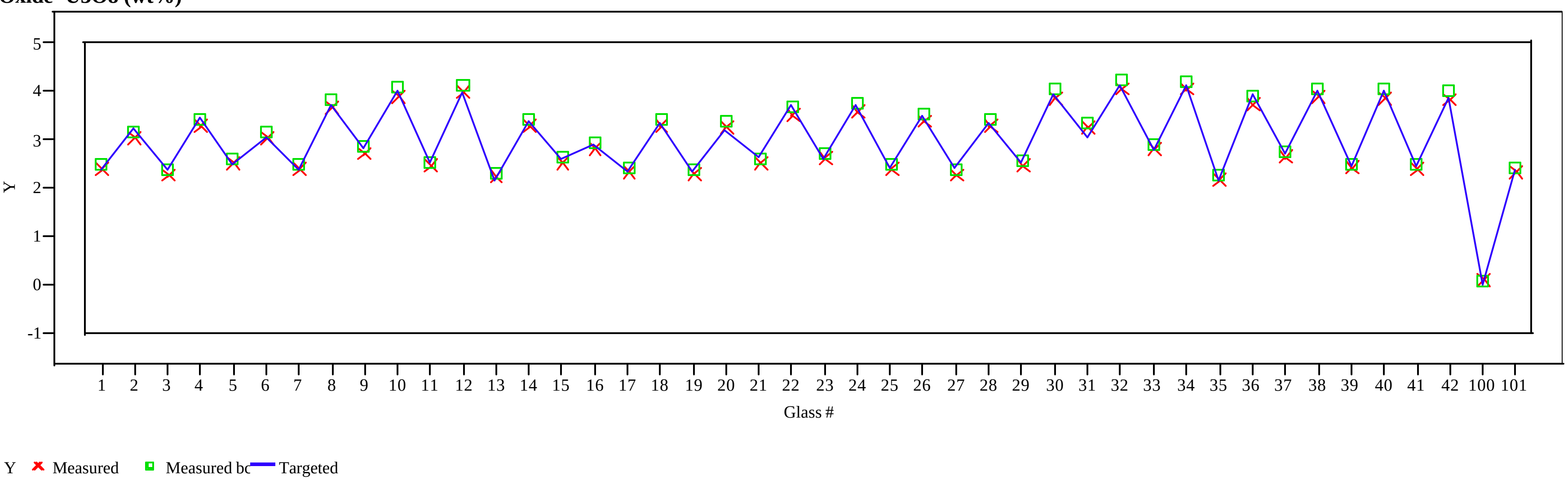
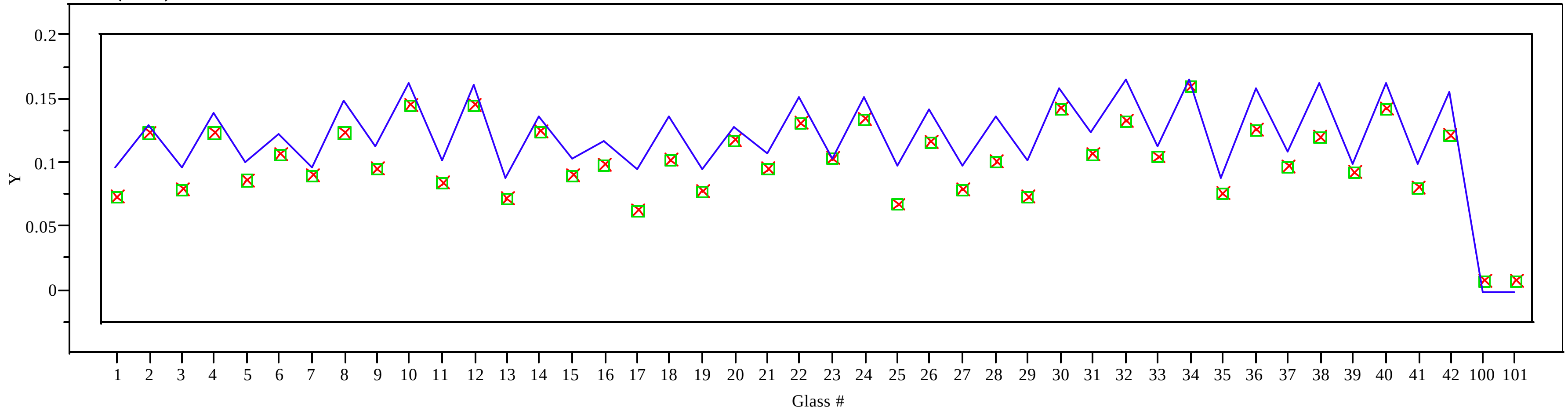
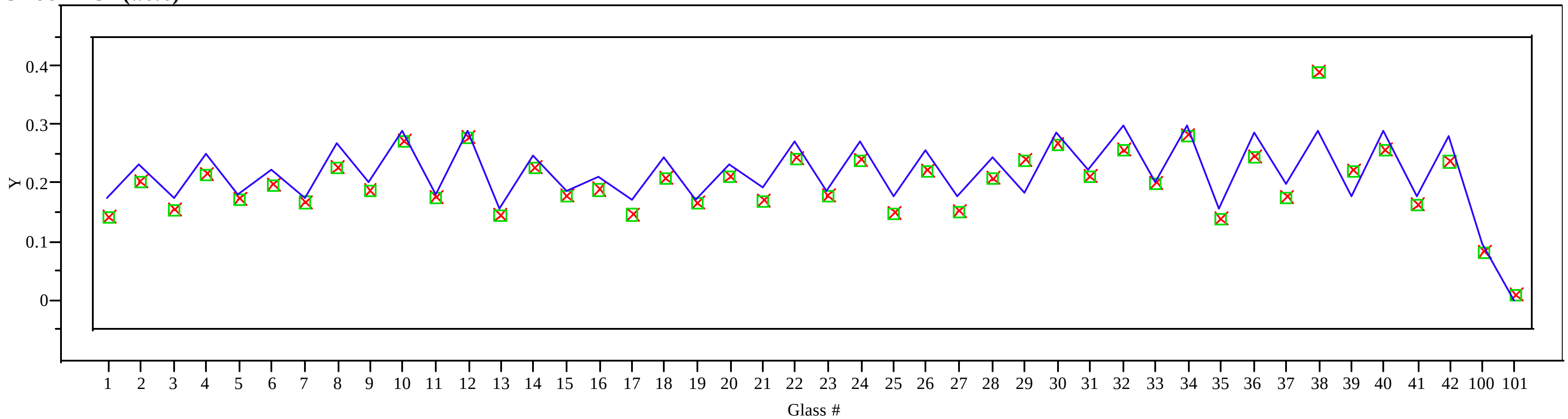


Exhibit H.7: Measured, Measured Bias-Corrected, and Targeted Compositions for the SB3 Glasses by Oxide *(continued)*
(Batch 1 – 100 and Ustd – 101)

Oxide=ZnO (wt%)



Oxide=ZrO2 (wt%)

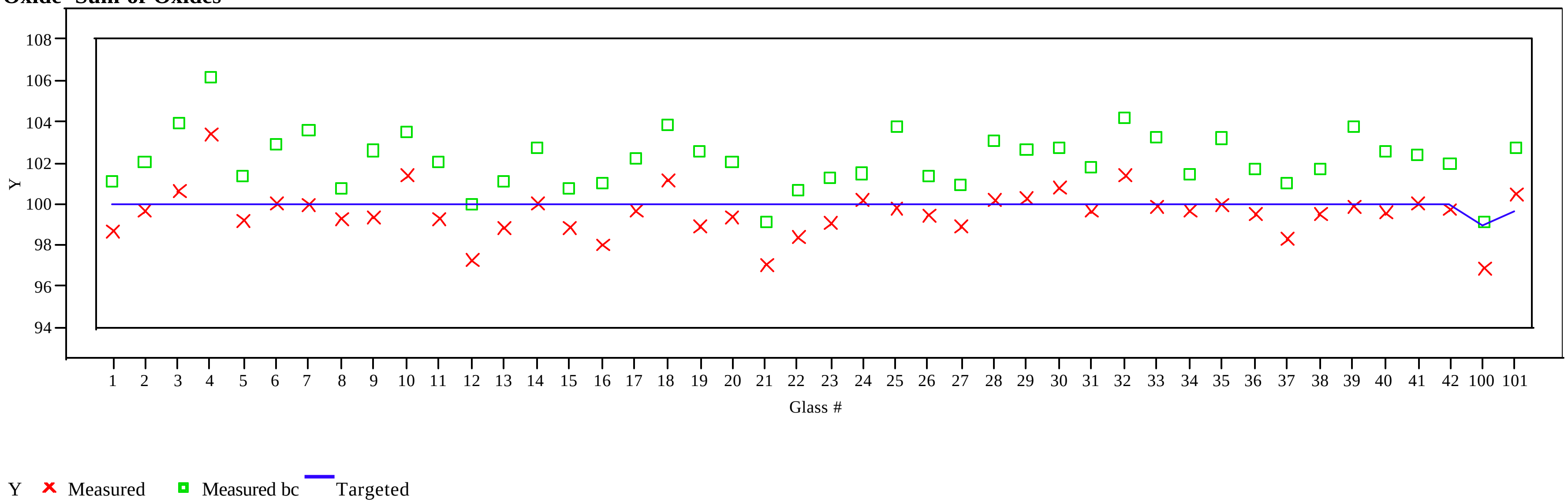


Y Measured Measured bc Targeted

Exhibit H.7: Measured, Measured Bias-Corrected, and Targeted Compositions for the SB3 Glasses by Oxide *(continued)*

(Batch 1 – 100 and Ustd – 101)

Oxide=Sum of Oxides



Appendix I

Tables and Exhibits Supporting the
Statistical Analysis of the Measured PCTs of the
Study Glasses

Table I.1. SRTC-ML Mesaurements of PCT Leachate Solutions for SB3 Phase 1 glasses

Analytical	Glass	SRTC-ML	Heat		Seq	As Reported (in ppm) by SRTC-ML							Values (in ppm) after Adjusting for Dilution Effects						
Plan	ID	ID	Treatment	Block	#	Al	B	Fe	Li	Na	Si	U	Al	B	Fe	Li	Na	Si	U
SRT-SCS-2002-00062	soln std	stdb1-1		1	1	3.65	20.3	3.75	9.08	81.8	47.5	<1.00	3.65	20.30	3.75	9.08	81.80	47.50	0.50
SRT-SCS-2002-00062	SB3-08ccc	J48	ccc	1	2	7.05	15.5	0.976	5.47	44.8	45.9	2.13	11.75	25.83	1.63	9.12	74.67	76.50	3.55
SRT-SCS-2002-00062	SB3-05	J41	quenched	1	3	5.72	9.81	3.45	12.5	61.9	90.4	2.33	9.53	16.35	5.75	20.83	103.17	150.67	3.88
SRT-SCS-2002-00062	SB3-14ccc	J51	ccc	1	4	12.1	7.98	5.81	7.26	78.9	77.4	2.36	20.17	13.30	9.68	12.10	131.50	129.00	3.93
SRT-SCS-2002-00062	SB3-03ccc	J23	ccc	1	5	5.18	10.3	3.88	5.51	24.4	58.7	2.67	8.63	17.17	6.47	9.18	40.67	97.84	4.45
SRT-SCS-2002-00062	SB3-13	J32	quenched	1	6	7.77	8.86	13.4	8.48	66	93.3	5.05	12.95	14.77	22.33	14.13	110.00	155.50	8.42
SRT-SCS-2002-00062	SB3-10	J37	quenched	1	7	12.6	12.1	2.47	5.3	58.1	54.8	1.78	21.00	20.17	4.12	8.83	96.84	91.34	2.97
SRT-SCS-2002-00062	SB3-11ccc	J17	ccc	1	8	7.09	8.38	2.65	11	38.2	81.8	3.62	11.82	13.97	4.42	18.33	63.67	136.34	6.03
SRT-SCS-2002-00062	SB3-14	J53	quenched	1	9	12.8	8.3	7.48	7.07	85.7	82.8	2.3	21.33	13.83	12.47	11.78	142.84	138.00	3.83
SRT-SCS-2002-00062	soln std	std-b-1-2		1	10	3.9	21.1	3.8	9.32	79.5	50.9	<1.00	3.90	21.10	3.80	9.32	79.50	50.90	0.50
SRT-SCS-2002-00062	SB3-05ccc	J31	ccc	1	11	5.43	9.32	3.45	11.6	51.4	89.5	2.47	9.05	15.53	5.75	19.33	85.67	149.17	4.12
SRT-SCS-2002-00062	SB3-04ccc	J13	ccc	1	12	8.55	11.7	3.23	5.37	54.9	60.2	2.26	14.25	19.50	5.38	8.95	91.50	100.34	3.77
SRT-SCS-2002-00062	SB3-03	J88	quenched	1	13	4.32	11.7	4.55	6.27	25.1	63.7	2.78	7.20	19.50	7.58	10.45	41.83	106.17	4.63
SRT-SCS-2002-00062	SB3-08	J25	quenched	1	14	8.03	17.1	1.25	5.59	44.1	49.5	2.2	13.38	28.50	2.08	9.32	73.50	82.50	3.67
SRT-SCS-2002-00062	SB3-04	J75	quenched	1	15	9.16	12.3	2.78	5.19	59.2	62.7	2.41	15.27	20.50	4.63	8.65	98.67	104.50	4.02
SRT-SCS-2002-00062	SB3-13ccc	J57	ccc	1	16	7.87	7.98	14.3	7.87	54.5	88	4.72	13.12	13.30	23.83	13.12	90.84	146.67	7.87
SRT-SCS-2002-00062	SB3-10ccc	J16	ccc	1	17	12.6	12.4	2.65	5.66	55.7	58.3	2.08	21.00	20.67	4.42	9.43	92.84	97.17	3.47
SRT-SCS-2002-00062	SB3-11	J62	quenched	1	18	7.14	8.9	3.14	11.7	39.6	87.7	3.2	11.90	14.83	5.23	19.50	66.00	146.17	5.33
SRT-SCS-2002-00062	soln std	std-b1-3		1	19	4.16	20.7	4.07	9.05	76.8	50.7	<1.00	4.16	20.70	4.07	9.05	76.80	50.70	0.50
SRT-SCS-2002-00062	soln std	std-b2-1		2	1	4.07	20.3	3.88	9.39	84.1	49.9	<1.00	4.07	20.30	3.88	9.39	84.10	49.90	0.50
SRT-SCS-2002-00062	SB3-10	J65	quenched	2	2	13.7	12.1	4.1	5.67	62.3	55.6	2.13	22.83	20.17	6.83	9.45	103.84	92.67	3.55
SRT-SCS-2002-00062	SB3-14	J78	quenched	2	3	12.8	8.15	6.97	7.24	91.9	79.9	2.62	21.33	13.58	11.62	12.07	153.17	133.17	4.37
SRT-SCS-2002-00062	SB3-08	J85	quenched	2	4	8.31	16.3	2.24	5.77	48.3	47.4	2.43	13.85	27.17	3.73	9.62	80.50	79.00	4.05
SRT-SCS-2002-00062	SB3-03	J34	quenched	2	5	5.55	11.3	3.97	6.35	27.3	60.5	2.91	9.25	18.83	6.62	10.58	45.50	100.84	4.85
SRT-SCS-2002-00062	SB3-04ccc	J87	ccc	2	6	8.06	11.1	2.48	5.36	57.4	57.2	2.24	13.43	18.50	4.13	8.93	95.67	95.34	3.73
SRT-SCS-2002-00062	SB3-08ccc	J14	ccc	2	7	7.81	15	1.35	5.58	44.6	46.6	2.39	13.02	25.00	2.25	9.30	74.33	77.67	3.98
SRT-SCS-2002-00062	SB3-13ccc	J70	ccc	2	8	8.82	7.81	15	8.32	61.3	87.9	5.19	14.70	13.02	25.00	13.87	102.17	146.50	8.65
SRT-SCS-2002-00062	SB3-05ccc	J10	ccc	2	9	6.35	8.88	4.16	11.8	55.9	87.6	2.68	10.58	14.80	6.93	19.67	93.17	146.00	4.47
SRT-SCS-2002-00062	soln std	std-b-2-2		2	10	4.38	21.2	4.13	9.51	85.7	51.1	<1.00	4.38	21.20	4.13	9.51	85.70	51.10	0.50
SRT-SCS-2002-00062	SB3-13	J39	quenched	2	11	8.53	8.89	14.7	8.6	68.9	94.3	5.34	14.22	14.82	24.50	14.33	114.84	157.17	8.90
SRT-SCS-2002-00062	SB3-03ccc	J43	ccc	2	12	5.75	10.7	5.34	5.86	26.3	61.8	2.9	9.58	17.83	8.90	9.77	43.83	103.00	4.83
SRT-SCS-2002-00062	SB3-10ccc	J54	ccc	2	13	12.5	11.7	2.36	5.56	58.5	55.9	2.36	20.83	19.50	3.93	9.27	97.50	93.17	3.93
SRT-SCS-2002-00062	SB3-11	J40	quenched	2	14	7.36	8.25	3.2	11.3	41.3	83.2	3.68	12.27	13.75	5.33	18.83	68.83	138.67	6.13
SRT-SCS-2002-00062	SB3-14ccc	J09	ccc	2	15	12.7	7.12	6.67	6.9	75.6	74.1	2.97	21.17	11.87	11.12	11.50	126.00	123.50	4.95
SRT-SCS-2002-00062	SB3-11ccc	J12	ccc	2	16	10.1	8.03	2.91	10.8	39.1	80.2	3.88	16.83	13.38	4.85	18.00	65.17	133.67	6.47
SRT-SCS-2002-00062	SB3-04	J72	quenched	2	17	13.6	11.7	2.74	5.18	63.3	60.8	2.78	22.67	19.50	4.57	8.63	105.50	101.34	4.63
SRT-SCS-2002-00062	SB3-05	J19	quenched	2	18	5.55	9.3	4.3	12.1	61.2	92.5	2.68	9.25	15.50	7.17	20.17	102.00	154.17	4.47
SRT-SCS-2002-00062	soln std	std-bl-2-3		2	19	4.12	20.7	4.15	9.24	83.3	51	<1.00	4.12	20.70	4.15	9.24	83.30	51.00	0.50
SRT-SCS-2002-00062	soln std	std-b3-1		3	1	4.06	21.2	3.88	9.65	87	50	<1.00	4.06	21.20	3.88	9.65	87.00	50.00	0.50
SRT-SCS-2002-00062	SB3-10	J29	quenched	3	2	12.5	12	2.2	5.49	62.9	54	2.16	20.83	20.00	3.67	9.15	104.84	90.00	3.60
SRT-SCS-2002-00062	SB3-14	J58	quenched	3	3	12.5	8.16	7.47	7.24	91.3	79.2	2.56	20.83	13.60	12.45	12.07	152.17	132.00	4.27
SRT-SCS-2002-00062	SB3-05ccc	J86	ccc	3	4	5.6	9.14	3.93	12	56.2	87.9	2.87	9.33	15.23	6.55	20.00	93.67	146.50	4.78

Table I.1. SRTC-ML Mesaurements of PCT Leachate Solutions for SB3 Phase 1 glasses

Analytical	Glass	SRTC-ML	Heat		Seq	As Reported (in ppm) by SRTC-ML							Values (in ppm) after Adjusting for Dilution Effects						
Plan	ID	ID	Treatment	Block	#	Al	B	Fe	Li	Na	Si	U	Al	B	Fe	Li	Na	Si	U
SRT-SCS-2002-00062	SB3-03ccc	J49	ccc	3	5	17.6	10.3	4.08	5.81	25.8	59.1	3.03	29.33	17.17	6.80	9.68	43.00	98.50	5.05
SRT-SCS-2002-00062	SB3-13ccc	J22	ccc	3	6	11.5	8.84	16.3	8.77	63.6	90.3	4.79	19.17	14.73	27.17	14.62	106.00	150.50	7.98
SRT-SCS-2002-00062	SB3-08ccc	J84	ccc	3	7	7.57	16	1.2	5.84	46.5	47.6	2.6	12.62	26.67	2.00	9.73	77.50	79.33	4.33
SRT-SCS-2002-00062	SB3-08	J15	quenched	3	8	8.12	16.8	1.21	5.93	50.3	48	2.63	13.53	28.00	2.02	9.88	83.84	80.00	4.38
SRT-SCS-2002-00062	SB3-11ccc	J59	ccc	3	9	7.16	8.33	2.53	11.3	41	80.8	4.19	11.93	13.88	4.22	18.83	68.33	134.67	6.98
SRT-SCS-2002-00062	soln std	std-b3-2		3	10	3.97	21.2	4.02	9.66	85.8	50.4	<1.00	3.97	21.20	4.02	9.66	85.80	50.40	0.50
SRT-SCS-2002-00062	SB3-03	J04	quenched	3	11	4.55	11.9	4.28	6.54	28	62.7	3.22	7.58	19.83	7.13	10.90	46.67	104.50	5.37
SRT-SCS-2002-00062	SB3-14ccc	J63	ccc	3	12	13.7	7.79	7.01	7.65	81.3	77.7	3.24	22.83	12.98	11.68	12.75	135.50	129.50	5.40
SRT-SCS-2002-00062	SB3-05	J33	quenched	3	13	6.47	9.75	4.78	12.6	63.9	92.6	2.87	10.78	16.25	7.97	21.00	106.50	154.34	4.78
SRT-SCS-2002-00062	SB3-10ccc	J79	ccc	3	14	13.4	12	3.86	5.86	60.1	56.3	2.69	22.33	20.00	6.43	9.77	100.17	93.84	4.48
SRT-SCS-2002-00062	SB3-04	J69	quenched	3	15	9.94	12	4.78	5.39	66.3	60.5	2.81	16.57	20.00	7.97	8.98	110.50	100.84	4.68
SRT-SCS-2002-00062	SB3-13	J47	quenched	3	16	8.72	9.02	14.5	8.98	72.3	94.3	5.7	14.53	15.03	24.17	14.97	120.50	157.17	9.50
SRT-SCS-2002-00062	SB3-04ccc	J27	ccc	3	17	9.16	11.9	3.26	5.81	63.8	61	2.49	15.27	19.83	5.43	9.68	106.34	101.67	4.15
SRT-SCS-2002-00062	SB3-11	J38	quenched	3	18	7.96	8.72	3.23	12	43.3	84.8	3.63	13.27	14.53	5.38	20.00	72.17	141.34	6.05
SRT-SCS-2002-00062	soln std	std-b3-3		3	19	4.21	21.4	4.03	9.87	88.7	51.6	<1.00	4.21	21.40	4.03	9.87	88.70	51.60	0.50
SRT-SCS-2002-00062	soln std	std-b4-1		4	1	3.84	21.2	3.58	9.42	85.9	49.7	<1.00	3.84	21.20	3.58	9.42	85.90	49.70	0.50
SRT-SCS-2002-00062	SB3-06ccc	J01	ccc	4	2	7.5	9.5	6.68	11.2	74	86.9	2.66	12.50	15.83	11.13	18.67	123.34	144.84	4.43
SRT-SCS-2002-00062	ARM	J60		4	3	2.49	12.4	<0.040	8.61	24.2	38	<1.00	4.15	20.67	0.03	14.35	40.33	63.33	0.83
SRT-SCS-2002-00062	SB3-02	J05	quenched	4	4	6.52	18.9	1.5	6	56.3	50.5	2.55	10.87	31.50	2.50	10.00	93.84	84.17	4.25
SRT-SCS-2002-00062	SB3-06	J50	quenched	4	5	8.33	10.4	6.08	12.2	87.5	94.6	2.12	13.88	17.33	10.13	20.33	145.84	157.67	3.53
SRT-SCS-2002-00062	EA	J52		4	6	<0.090	38.7	<0.040	10.9	100	52.6	<1.00	0.75	645.00	0.33	181.67	1666.67	876.67	8.33
SRT-SCS-2002-00062	SB3-07ccc	J36	ccc	4	7	2.9	18	1.6	7.08	20.9	53.6	2.39	4.83	30.00	2.67	11.80	34.83	89.34	3.98
SRT-SCS-2002-00062	SB3-07	J42	quenched	4	8	4.43	19.1	2.78	7.98	21	55.8	2.77	7.38	31.83	4.63	13.30	35.00	93.00	4.62
SRT-SCS-2002-00062	SB3-01ccc	J28	ccc	4	9	3.89	29.2	1.4	10.2	44.4	67.3	2.8	6.48	48.67	2.33	17.00	74.00	112.17	4.67
SRT-SCS-2002-00062	soln std	std-b4-2		4	10	3.99	20.8	3.54	9.4	85	49.7	<1.00	3.99	20.80	3.54	9.40	85.00	49.70	0.50
SRT-SCS-2002-00062	SB3-12	J74	quenched	4	11	13.8	9.74	6.12	10.2	80.3	75.9	2.04	23.00	16.23	10.20	17.00	133.84	126.50	3.40
SRT-SCS-2002-00062	SB3-09	J90	quenched	4	12	5.01	8.99	3.17	5.42	21.8	52.8	2.69	8.35	14.98	5.28	9.03	36.33	88.00	4.48
SRT-SCS-2002-00062	blank	J80		4	13	<0.090	<0.150	<0.040	<0.500	<0.100	<0.790	<1.00	0.08	0.13	0.03	0.42	0.08	0.66	0.83
SRT-SCS-2002-00062	SB3-12ccc	J26	ccc	4	14	13.9	9.42	4.96	11	78.2	76.9	2.18	23.17	15.70	8.27	18.33	130.34	128.17	3.63
SRT-SCS-2002-00062	SB3-01	J61	quenched	4	15	2.28	30	3.05	10.8	45.8	65.4	2.98	3.80	50.00	5.08	18.00	76.33	109.00	4.97
SRT-SCS-2002-00062	SB3-09ccc	J71	ccc	4	16	4.87	9.02	3.04	5.18	21.9	53.3	2.7	8.12	15.03	5.07	8.63	36.50	88.84	4.50
SRT-SCS-2002-00062	SB3-02ccc	J11	ccc	4	17	6.97	17.6	3.15	6.02	54.4	51.9	2.82	11.62	29.33	5.25	10.03	90.67	86.50	4.70
SRT-SCS-2002-00062	soln std	std4-3		4	18	3.7	20.7	3.7	9.48	86.3	49.7	<1.00	3.70	20.70	3.70	9.48	86.30	49.70	0.50
SRT-SCS-2002-00062	soln std	std-b5-1		5	1	4.06	21.2	3.81	9.6	86.2	49.9	<1.00	4.06	21.20	3.81	9.60	86.20	49.90	0.50
SRT-SCS-2002-00062	blank	J82		5	2	<0.090	0.374	<0.040	<0.500	0.829	<0.790	0.04	0.08	0.62	0.03	0.42	1.38	0.66	0.07
SRT-SCS-2002-00062	EA	J55		5	3	0.559	38.3	0.065	11.1	99.3	53	<1.00	9.32	638.33	1.08	185.00	1655.00	883.34	8.33
SRT-SCS-2002-00062	SB3-02ccc	J68	ccc	5	4	6.97	17.6	2.22	5.97	51.9	50.6	2.5	11.62	29.33	3.70	9.95	86.50	84.34	4.17
SRT-SCS-2002-00062	SB3-01ccc	J73	ccc	5	5	4.84	30.4	2.93	10.7	45.7	68.4	2.83	8.07	50.67	4.88	17.83	76.17	114.00	4.72
SRT-SCS-2002-00062	SB3-09	J92	quenched	5	6	5.55	9.34	2.81	5.72	22.2	54.2	2.78	9.25	15.57	4.68	9.53	37.00	90.34	4.63
SRT-SCS-2002-00062	SB3-12ccc	J91	ccc	5	7	14.2	9.76	5.45	11.1	77.5	77.6	2.14	23.67	16.27	9.08	18.50	129.17	129.34	3.57
SRT-SCS-2002-00062	SB3-01	J18	quenched	5	8	2.44	30.1	2	10.8	44.4	66.2	2.86	4.07	50.17	3.33	18.00	74.00	110.34	4.77
SRT-SCS-2002-00062	SB3-07	J06	quenched	5	9	9.83	19.1	2.85	8.12	21.4	57.4	2.52	16.38	31.83	4.75	13.53	35.67	95.67	4.20

Table I.1. SRTC-ML Mesaurements of PCT Leachate Solutions for SB3 Phase 1 glasses

Analytical Plan	Glass ID	SRTC-ML ID	Heat Treatment	Block	Seq #	As Reported (in ppm) by SRTC-ML Al	B	Fe	Li	Na	Si	U	Values (in ppm) after Adjusting for Dilution Effects Al	B	Fe	Li	Na	Si	U
SRT-SCS-2002-00062	soln std	std-b4-2		5	10	3.96	20.9	3.7	9.54	84.7	49.8	<1.00	3.96	20.90	3.70	9.54	84.70	49.80	0.50
SRT-SCS-2002-00062	SB3-02	J03	quenched	5	11	6.83	20	1.65	6.3	58.5	52.2	2.62	11.38	33.33	2.75	10.50	97.50	87.00	4.37
SRT-SCS-2002-00062	SB3-06ccc	J77	ccc	5	12	7.78	9.4	6.49	11.4	74.7	86.6	2.65	12.97	15.67	10.82	19.00	124.50	144.34	4.42
SRT-SCS-2002-00062	SB3-07ccc	J83	ccc	5	13	3.67	18	2.72	7.28	21.1	55.1	2.46	6.12	30.00	4.53	12.13	35.17	91.84	4.10
SRT-SCS-2002-00062	SB3-12	J81	quenched	5	14	14.5	10.1	4.95	10.7	83.3	78.9	1.95	24.17	16.83	8.25	17.83	138.84	131.50	3.25
SRT-SCS-2002-00062	SB3-06	J24	quenched	5	15	7.97	10.1	5.4	11.9	83.9	92.8	2	13.28	16.83	9.00	19.83	139.84	154.67	3.33
SRT-SCS-2002-00062	SB3-09ccc	J56	ccc	5	16	11	9.08	2.9	5.43	21.9	55.4	2.82	18.33	15.13	4.83	9.05	36.50	92.34	4.70
SRT-SCS-2002-00062	ARM	J67		5	17	3.02	11.7	<0.040	8.42	23	37.6	<1.00	5.03	19.50	0.03	14.03	38.33	62.67	0.83
SRT-SCS-2002-00062	soln std	std-b5-3		5	18	4.15	20.7	4.03	9.47	84.8	49.9	<1.00	4.15	20.70	4.03	9.47	84.80	49.90	0.50
SRT-SCS-2002-00062	soln std	std-b6-1		6	1	3.94	21.5	3.8	9.46	85.3	50.4	<1.00	3.94	21.50	3.80	9.46	85.30	50.40	0.50
SRT-SCS-2002-00062	SB3-12ccc	J20	ccc	6	2	14.2	10.1	5.67	11.1	75.6	79.4	1.86	23.67	16.83	9.45	18.50	126.00	132.34	3.10
SRT-SCS-2002-00062	ARM	J66		6	3	2.83	11.6	<0.040	8.12	22.2	37.7	<1.00	4.72	19.33	0.03	13.53	37.00	62.83	0.83
SRT-SCS-2002-00062	EA	J44		6	4	0.565	39.4	1.75	11	96.8	54.7	<1.00	9.42	656.67	29.17	183.33	1613.34	911.67	8.33
SRT-SCS-2002-00062	SB3-07	J21	quenched	6	5	4.19	19.4	3.62	7.97	21.1	57.5	2.31	6.98	32.33	6.03	13.28	35.17	95.84	3.85
SRT-SCS-2002-00062	SB3-07ccc	J35	ccc	6	6	3.77	19.5	3.16	7.75	23.3	57.9	2.32	6.28	32.50	5.27	12.92	38.83	96.50	3.87
SRT-SCS-2002-00062	SB3-02	J64	quenched	6	7	6.41	18.9	1.48	5.83	53.8	50.3	2.18	10.68	31.50	2.47	9.72	89.67	83.84	3.63
SRT-SCS-2002-00062	SB3-01ccc	J89	ccc	6	8	2.46	31.4	2.85	10.9	45	70.5	2.57	4.10	52.33	4.75	18.17	75.00	117.50	4.28
SRT-SCS-2002-00062	SB3-02ccc	J08	ccc	6	9	7.1	19	3.01	6.34	53.8	53.6	2.32	11.83	31.67	5.02	10.57	89.67	89.34	3.87
SRT-SCS-2002-00062	soln std	std-b6-2		6	10	4.14	21.7	4.17	9.73	84.1	51.7	<1.00	4.14	21.70	4.17	9.73	84.10	51.70	0.50
SRT-SCS-2002-00062	SB3-12	J07	quenched	6	11	14	10.5	5.25	10.7	79.3	80.9	1.65	23.33	17.50	8.75	17.83	132.17	134.84	2.75
SRT-SCS-2002-00062	SB3-06ccc	J76	ccc	6	12	8.86	10.4	7.36	12.3	75.9	93.2	1.86	14.77	17.33	12.27	20.50	126.50	155.34	3.10
SRT-SCS-2002-00062	SB3-06	J46	quenched	6	13	8.39	10.8	5.34	12.5	84.5	97.8	1.84	13.98	18.00	8.90	20.83	140.84	163.00	3.07
SRT-SCS-2002-00062	SB3-01	J30	quenched	6	14	7.77	33.1	2.83	11.8	43.8	70.4	2.76	12.95	55.17	4.72	19.67	73.00	117.34	4.60
SRT-SCS-2002-00062	SB3-09	J02	quenched	6	15	5.77	9.92	4.29	6.07	22.9	57.8	2.52	9.62	16.53	7.15	10.12	38.17	96.34	4.20
SRT-SCS-2002-00062	SB3-09ccc	J45	ccc	6	16	7.74	9.43	2.58	5.45	21.6	57.5	2.41	12.90	15.72	4.30	9.08	36.00	95.84	4.02
SRT-SCS-2002-00062	soln std	std-b6-3		6	17	4.39	21.6	4.97	9.73	84	52.2	<1.00	4.39	21.60	4.97	9.73	84.00	52.20	0.50
SRT-SCS-2002-00063	soln std	std-b1-1		1	1	4.04	21.3	3.99	9.61	85.7	50.1	<1.00	4.04	21.30	3.99	9.61	85.70	50.10	0.50
SRT-SCS-2002-00063	SB3-23	m03	quenched	1	2	6.14	5.61	7.45	6.1	43.3	67.4	2.98	10.23	9.35	12.42	10.17	72.17	112.34	4.97
SRT-SCS-2002-00063	SB3-26ccc	m90	ccc	1	3	11.7	8.8	6.25	13	82.5	87.4	1.97	19.50	14.67	10.42	21.67	137.50	145.67	3.28
SRT-SCS-2002-00063	SB3-18ccc	m68	ccc	1	4	10.9	7.02	5.06	6.49	75.6	72.8	1.71	18.17	11.70	8.43	10.82	126.00	121.34	2.85
SRT-SCS-2002-00063	SB3-24	m44	quenched	1	5	12.2	7.59	5.24	6.16	93.6	76.6	1.51	20.33	12.65	8.73	10.27	156.00	127.67	2.52
SRT-SCS-2002-00063	SB3-18	m24	quenched	1	6	11.6	7.5	5.61	6.49	88.9	78.5	1.67	19.33	12.50	9.35	10.82	148.17	130.84	2.78
SRT-SCS-2002-00063	SB3-27	m21	quenched	1	7	6.73	9.87	9.12	13.1	41.9	88.3	3.62	11.22	16.45	15.20	21.83	69.83	147.17	6.03
SRT-SCS-2002-00063	SB3-27ccc	m14	ccc	1	8	6.51	9.34	7.72	12.6	39.1	84.3	3.42	10.85	15.57	12.87	21.00	65.17	140.50	5.70
SRT-SCS-2002-00063	SB3-16ccc	m28	ccc	1	9	7.28	10.1	4.29	12.2	75.3	92.2	2.57	12.13	16.83	7.15	20.33	125.50	153.67	4.28
SRT-SCS-2002-00063	soln std	std-b1-2		1	10	4.02	21.4	4.24	9.47	82.1	51	<1.00	4.02	21.40	4.24	9.47	82.10	51.00	0.50
SRT-SCS-2002-00063	SB3-26	m36	quenched	1	11	12.2	9.23	6.76	12.5	88.9	92.1	1.95	20.33	15.38	11.27	20.83	148.17	153.50	3.25
SRT-SCS-2002-00063	SB3-16	m77	quenched	1	12	7.49	10.4	5.17	11.9	78.9	96.1	2.66	12.48	17.33	8.62	19.83	131.50	160.17	4.43
SRT-SCS-2002-00063	SB3-15	m52	quenched	1	13	6.12	9.95	4.45	12.1	67.7	94.7	3.05	10.20	16.58	7.42	20.17	112.84	157.84	5.08
SRT-SCS-2002-00063	SB3-24ccc	m08	ccc	1	14	11.9	7.73	4.44	6.67	86.9	76.5	1.48	19.83	12.88	7.40	11.12	144.84	127.50	2.47
SRT-SCS-2002-00063	SB3-19ccc	m48	ccc	1	15	6.51	7.55	8.23	6.13	41.4	68.7	2.99	10.85	12.58	13.72	10.22	69.00	114.50	4.98
SRT-SCS-2002-00063	SB3-19	m79	quenched	1	16	6.5	8.06	8.84	6.33	44.1	71.2	3.13	10.83	13.43	14.73	10.55	73.50	118.67	5.22

Table I.1. SRTC-ML Mesaurements of PCT Leachate Solutions for SB3 Phase 1 glasses

Analytical	Glass	SRTC-ML	Heat		Seq	As Reported (in ppm) by SRTC-ML							Values (in ppm) after Adjusting for Dilution Effects						
Plan	ID	ID	Treatment	Block	#	Al	B	Fe	Li	Na	Si	U	Al	B	Fe	Li	Na	Si	U
SRT-SCS-2002-00063	SB3-15ccc	m59	ccc	1	17	5.91	9.94	4.28	12.3	62.9	93.7	2.78	9.85	16.57	7.13	20.50	104.84	156.17	4.63
SRT-SCS-2002-00063	SB3-23ccc	m86	ccc	1	18	6.43	5.78	7.54	6.14	39.5	72	2.88	10.72	9.63	12.57	10.23	65.83	120.00	4.80
SRT-SCS-2002-00063	soln std	std-b1-3		1	19	4.12	21.5	4.4	9.56	82.8	52.1	<1.00	4.12	21.50	4.40	9.56	82.80	52.10	0.50
SRT-SCS-2002-00063	soln std	std-b2-1		2	1	4.1	21.3	4.2	9.59	85.9	50.5	<1.00	4.10	21.30	4.20	9.59	85.90	50.50	0.50
SRT-SCS-2002-00063	SB3-24	m01	quenched	2	2	13.1	7.95	5.35	6.38	99.2	77.8	1.6	21.83	13.25	8.92	10.63	165.34	129.67	2.67
SRT-SCS-2002-00063	SB3-15ccc	m87	ccc	2	3	6.11	9.61	4.2	12.27	65.3	89.8	2.85	10.18	16.02	7.00	20.45	108.84	149.67	4.75
SRT-SCS-2002-00063	SB3-16	m58	quenched	2	4	8.45	9.93	7.88	11.77	83.9	92.5	2.71	14.08	16.55	13.13	19.62	139.84	154.17	4.52
SRT-SCS-2002-00063	SB3-19	m12	quenched	2	5	7.08	7.55	9.15	6.29	46.4	68.5	3.22	11.80	12.58	15.25	10.48	77.33	114.17	5.37
SRT-SCS-2002-00063	SB3-26	m10	quenched	2	6	12.1	8.74	6.68	12.3	91.5	89.3	1.82	20.17	14.57	11.13	20.50	152.50	148.84	3.03
SRT-SCS-2002-00063	SB3-26ccc	m15	ccc	2	7	12.1	8.68	6.85	13.4	84.9	88.7	1.99	20.17	14.47	11.42	22.33	141.50	147.84	3.32
SRT-SCS-2002-00063	SB3-16ccc	m06	ccc	2	8	7.66	10	4.65	12.3	76.7	93.1	2.61	12.77	16.67	7.75	20.50	127.84	155.17	4.35
SRT-SCS-2002-00063	SB3-18	m74	quenched	2	9	11.7	7.15	6.48	6.33	88.4	76.9	1.64	19.50	11.92	10.80	10.55	147.34	128.17	2.73
SRT-SCS-2002-00063	soln std	std-b2-2		2	10	4.33	21.2	4.6	9.55	86.1	50.7	<1.00	4.33	21.20	4.60	9.55	86.10	50.70	0.50
SRT-SCS-2002-00063	SB3-23ccc	m55	ccc	2	11	6.6	5.71	7.83	6.23	40.7	70.1	2.9	11.00	9.52	13.05	10.38	67.83	116.84	4.83
SRT-SCS-2002-00063	SB3-27ccc	m53	ccc	2	12	6.66	9.01	7.95	12.3	39.4	83.1	3.49	11.10	15.02	13.25	20.50	65.67	138.50	5.82
SRT-SCS-2002-00063	SB3-23	m31	quenched	2	13	6.8	5.62	8.98	6.28	44.5	71.8	3.07	11.33	9.37	14.97	10.47	74.17	119.67	5.12
SRT-SCS-2002-00063	SB3-15	m13	quenched	2	14	7.12	9.67	5.52	12.2	70.6	94.7	3.03	11.87	16.12	9.20	20.33	117.67	157.84	5.05
SRT-SCS-2002-00063	SB3-19ccc	m73	ccc	2	15	6.59	7.33	9.02	6.09	41	68.8	3	10.98	12.22	15.03	10.15	68.33	114.67	5.00
SRT-SCS-2002-00063	SB3-24ccc	m47	ccc	2	16	12.1	7.33	4.93	6.67	89.9	75.6	1.55	20.17	12.22	8.22	11.12	149.84	126.00	2.58
SRT-SCS-2002-00063	SB3-18ccc	m41	ccc	2	17	11.35	6.89	5.95	6.56	79.5	73.8	1.75	18.92	11.48	9.92	10.93	132.50	123.00	2.92
SRT-SCS-2002-00063	SB3-27	m46	quenched	2	18	6.59	9.17	9.2	12.4	41	84.5	3.53	10.98	15.28	15.33	20.67	68.33	140.84	5.88
SRT-SCS-2002-00063	soln std	std-b2-3		2	19	4.1	20.8	4.34	9.41	84.8	50.6	<1.00	4.10	20.80	4.34	9.41	84.80	50.60	0.50
SRT-SCS-2002-00063	soln std	std-b3-1		3	1	4.12	21	3.96	9.47	87.2	49.7	<1.00	4.12	21.00	3.96	9.47	87.20	49.70	0.50
SRT-SCS-2002-00063	SB3-19	m81	quenched	3	2	6.93	7.77	8.95	6.27	46.3	69.4	3.14	11.55	12.95	14.92	10.45	77.17	115.67	5.23
SRT-SCS-2002-00063	SB3-27ccc	m29	ccc	3	3	7.29	9.36	9.01	12.9	42.4	86	3.5	12.15	15.60	15.02	21.50	70.67	143.34	5.83
SRT-SCS-2002-00063	SB3-18ccc	m83	ccc	3	4	11.4	6.95	5.11	6.63	83.6	74.6	1.66	19.00	11.58	8.52	11.05	139.34	124.34	2.77
SRT-SCS-2002-00063	SB3-18	m54	quenched	3	5	11.3	6.79	5.52	5.99	87.3	73.8	1.68	18.83	11.32	9.20	9.98	145.50	123.00	2.80
SRT-SCS-2002-00063	SB3-23ccc	m50	ccc	3	6	6.49	5.31	7.35	6.03	41.8	69.7	2.96	10.82	8.85	12.25	10.05	69.67	116.17	4.93
SRT-SCS-2002-00063	SB3-16	m64	quenched	3	7	8.12	9.61	6.45	11.5	83.2	90.7	2.56	13.53	16.02	10.75	19.17	138.67	151.17	4.27
SRT-SCS-2002-00063	SB3-15ccc	m69	ccc	3	8	6.4	9.38	5.28	12.2	65.9	91.2	2.89	10.67	15.63	8.80	20.33	109.84	152.00	4.82
SRT-SCS-2002-00063	SB3-24ccc	m26	ccc	3	9	12.6	7.14	5.07	6.59	91.8	74.6	1.42	21.00	11.90	8.45	10.98	153.00	124.34	2.37
SRT-SCS-2002-00063	soln std	std-b3-2		3	10	4.04	20.9	3.95	9.41	86.6	49.9	<1.00	4.04	20.90	3.95	9.41	86.60	49.90	0.50
SRT-SCS-2002-00063	SB3-15	m51	quenched	3	11	6.32	9.12	5.7	11.4	67.6	89.6	2.64	10.53	15.20	9.50	19.00	112.67	149.34	4.40
SRT-SCS-2002-00063	SB3-26ccc	m09	ccc	3	12	12.4	8.76	7.02	13.5	85.3	90	2	20.67	14.60	11.70	22.50	142.17	150.00	3.33
SRT-SCS-2002-00063	SB3-24	m57	quenched	3	13	12.5	7.39	4.82	6.1	98	77.2	1.42	20.83	12.32	8.03	10.17	163.34	128.67	2.37
SRT-SCS-2002-00063	SB3-27	m70	quenched	3	14	6.67	9.49	8.52	13	42.7	87	3.54	11.12	15.82	14.20	21.67	71.17	145.00	5.90
SRT-SCS-2002-00063	SB3-23	m92	quenched	3	15	6.84	5.55	8.85	6.35	45.2	73	3.04	11.40	9.25	14.75	10.58	75.33	121.67	5.07
SRT-SCS-2002-00063	SB3-26	m82	quenched	3	16	12.2	8.79	6.73	12.5	93.7	92	1.77	20.33	14.65	11.22	20.83	156.17	153.34	2.95
SRT-SCS-2002-00063	SB3-16ccc	m30	ccc	3	17	7.67	9.75	5.32	12	76.6	92.2	2.47	12.78	16.25	8.87	20.00	127.67	153.67	4.12
SRT-SCS-2002-00063	SB3-19ccc	m84	ccc	3	18	6.81	7.09	8.13	5.99	42.6	67.5	2.84	11.35	11.82	13.55	9.98	71.00	112.50	4.73
SRT-SCS-2002-00063	soln std	std-b3-3		3	19	4.02	20.6	3.97	9.35	85.6	50.4	<1.00	4.02	20.60	3.97	9.35	85.60	50.40	0.50
SRT-SCS-2002-00063	soln std	std-b4-1		4	1	4.2	21	4	9.44	85.3	48.9	<1.00	4.20	21.00	4.00	9.44	85.30	48.90	0.50

Table I.1. SRTC-ML Mesaurements of PCT Leachate Solutions for SB3 Phase 1 glasses

Analytical	Glass	SRTC-ML	Heat		Seq	As Reported (in ppm) by SRTC-ML							Values (in ppm) after Adjusting for Dilution Effects						
Plan	ID	ID	Treatment	Block	#	Al	B	Fe	Li	Na	Si	U	Al	B	Fe	Li	Na	Si	U
SRT-SCS-2002-00063	EA	m43		4	2	0.841	38.4	0.319	10.8	98.1	52.1	<1.00	14.02	640.00	5.32	180.00	1635.00	868.34	8.33
SRT-SCS-2002-00063	SB3-21ccc	m76	ccc	4	3	6.82	5.53	6.55	4.56	43.1	63.9	2.57	11.37	9.22	10.92	7.60	71.83	106.50	4.28
SRT-SCS-2002-00063	SB3-20	m18	quenched	4	4	10.5	8.76	4.76	6.15	78.2	69.5	1.77	17.50	14.60	7.93	10.25	130.34	115.84	2.95
SRT-SCS-2002-00063	SB3-28	m60	quenched	4	5	11	11	6.04	12.5	82.7	85.5	1.97	18.33	18.33	10.07	20.83	137.84	142.50	3.28
SRT-SCS-2002-00063	SB3-22ccc	m22	ccc	4	6	12.1	6.88	6.37	4.94	88.9	69.3	1.6	20.17	11.47	10.62	8.23	148.17	115.50	2.67
SRT-SCS-2002-00063	SB3-17	m75	quenched	4	7	7.59	5.99	11.5	6.67	48.8	74.3	3.85	12.65	9.98	19.17	11.12	81.33	123.84	6.42
SRT-SCS-2002-00063	SB3-17ccc	m89	ccc	4	8	7.36	5.76	11.1	6.4	44.2	70.6	3.49	12.27	9.60	18.50	10.67	73.67	117.67	5.82
SRT-SCS-2002-00063	SB3-25ccc	m27	ccc	4	9	7.63	7.01	11.6	12.7	40.9	87.2	3.86	12.72	11.68	19.33	21.17	68.17	145.34	6.43
SRT-SCS-2002-00063	soln std	std-b4-2		4	10	4.13	20.4	4.11	9.3	83.4	49.1	<1.00	4.13	20.40	4.11	9.30	83.40	49.10	0.50
SRT-SCS-2002-00063	SB3-22	m16	quenched	4	11	13	7.35	4.99	4.67	97.5	72.1	1.6	21.67	12.25	8.32	7.78	162.50	120.17	2.67
SRT-SCS-2002-00063	SB3-25	m05	quenched	4	12	7.76	7.24	12.9	13.1	42.5	89.5	4.13	12.93	12.07	21.50	21.83	70.83	149.17	6.88
SRT-SCS-2002-00063	SB3-28ccc	m33	ccc	4	13	10.7	10.4	5.85	12.4	72.9	82.5	2.02	17.83	17.33	9.75	20.67	121.50	137.50	3.37
SRT-SCS-2002-00063	SB3-21	m62	quenched	4	14	6.96	5.55	9.57	4.72	47.4	68.8	2.73	11.60	9.25	15.95	7.87	79.00	114.67	4.55
SRT-SCS-2002-00063	SB3-20ccc	m11	ccc	4	15	9.42	7.88	4.3	5.83	65.5	63.5	1.72	15.70	13.13	7.17	9.72	109.17	105.84	2.87
SRT-SCS-2002-00063	blank	m35		4	16	0.731	<0.150	0.786	<0.500	<0.100	<0.790	<1.00	1.22	0.13	1.31	0.42	0.08	0.66	0.83
SRT-SCS-2002-00063	ARM	m78		4	17	3.67	10.7	0.761	7.84	22.1	36.1	<1.00	6.12	17.83	1.27	13.07	36.83	60.17	0.83
SRT-SCS-2002-00063	soln std	std-b4-3		4	18	4.15	20.4	4.06	9.36	84.9	49.4	<1.00	4.15	20.40	4.06	9.36	84.90	49.40	0.50
SRT-SCS-2002-00063	soln std	std-b5-1		5	1	4.21	20.8	3.91	9.35	86	49.2	<1.00	4.21	20.80	3.91	9.35	86.00	49.20	0.50
SRT-SCS-2002-00063	SB3-25	m32	quenched	5	2	7.39	7.27	11.2	12.8	42.5	87.6	4.22	12.32	12.12	18.67	21.33	70.83	146.00	7.03
SRT-SCS-2002-00063	SB3-17	m02	quenched	5	3	7.15	5.84	10.6	6.39	48.7	72.5	3.85	11.92	9.73	17.67	10.65	81.17	120.84	6.42
SRT-SCS-2002-00063	blank	m42		5	4	2.05	0.432	0.621	<0.500	2.1	1.11	<1.00	3.42	0.72	1.04	0.42	3.50	1.85	0.83
SRT-SCS-2002-00063	SB3-21	m23	quenched	5	5	6.49	5.32	6.47	4.59	48.2	68	2.65	10.82	8.87	10.78	7.65	80.33	113.34	4.42
SRT-SCS-2002-00063	SB3-20	m25	quenched	5	6	10.2	8.35	4.8	5.95	78	69.3	1.84	17.00	13.92	8.00	9.92	130.00	115.50	3.07
SRT-SCS-2002-00063	SB3-17ccc	m88	ccc	5	7	7.55	5.56	10.9	6.26	44	69.9	3.46	12.58	9.27	18.17	10.43	73.33	116.50	5.77
SRT-SCS-2002-00063	SB3-25ccc	m37	ccc	5	8	7.47	6.88	11.6	12.6	41.6	87.5	3.96	12.45	11.47	19.33	21.00	69.33	145.84	6.60
SRT-SCS-2002-00063	SB3-20ccc	m34	ccc	5	9	9.59	7.71	4.11	5.87	67.4	63.5	1.76	15.98	12.85	6.85	9.78	112.34	105.84	2.93
SRT-SCS-2002-00063	soln std	std-b5-2		5	10	4.14	20.4	3.95	9.33	86.6	49.4	<1.00	4.14	20.40	3.95	9.33	86.60	49.40	0.50
SRT-SCS-2002-00063	ARM	m63		5	11	3.37	10.7	<0.040	7.81	22.2	35.9	<1.00	5.62	17.83	0.03	13.02	37.00	59.83	0.83
SRT-SCS-2002-00063	SB3-21ccc	m65	ccc	5	12	6.7	5.17	6.98	4.51	42.6	64.7	2.64	11.17	8.62	11.63	7.52	71.00	107.84	4.40
SRT-SCS-2002-00063	SB3-22	m71	quenched	5	13	11.9	6.74	3.95	4.37	95.3	69.9	1.69	19.83	11.23	6.58	7.28	158.84	116.50	2.82
SRT-SCS-2002-00063	SB3-28	m56	quenched	5	14	11	10.73	6.06	12.4	90	86.2	2.06	18.33	17.88	10.10	20.67	150.00	143.67	3.43
SRT-SCS-2002-00063	SB3-22ccc	m07	ccc	5	15	11.7	6.71	4.07	4.85	92	69.9	1.75	19.50	11.18	6.78	8.08	153.34	116.50	2.92
SRT-SCS-2002-00063	EA	m67		5	16	0.804	36.1	0.864	10.3	95	50.6	<1.00	13.40	601.67	14.40	171.67	1583.34	843.34	8.33
SRT-SCS-2002-00063	SB3-28ccc	m39	ccc	5	17	10.7	9.56	5.51	11.6	69.7	76.3	2.24	17.83	15.93	9.18	19.33	116.17	127.17	3.73
SRT-SCS-2002-00063	soln std	std-b5-3		5	18	4.07	20.1	3.93	9.25	84.9	49.3	<1.00	4.07	20.10	3.93	9.25	84.90	49.30	0.50
SRT-SCS-2002-00063	soln std	std-b6-1		6	1	4.07	20.7	3.88	9.31	83.7	49.1	<1.00	4.07	20.70	3.88	9.31	83.70	49.10	0.50
SRT-SCS-2002-00063	SB3-17ccc	m40	ccc	6	2	7.36	5.73	10.8	6.26	43.3	69.4	3.3	12.27	9.55	18.00	10.43	72.17	115.67	5.50
SRT-SCS-2002-00063	SB3-25	m20	quenched	6	3	7.45	7.21	11.6	13.3	43.9	89.7	4.1	12.42	12.02	19.33	22.17	73.17	149.50	6.83
SRT-SCS-2002-00063	SB3-21	m66	quenched	6	4	6.33	5.11	6.61	4.48	46.3	65.7	2.6	10.55	8.52	11.02	7.47	77.17	109.50	4.33
SRT-SCS-2002-00063	SB3-20	m80	quenched	6	5	10.2	8.43	4.44	6.1	77.5	69.8	1.77	17.00	14.05	7.40	10.17	129.17	116.34	2.95
SRT-SCS-2002-00063	SB3-22	m19	quenched	6	6	14.6	6.9	4.5	4.61	96.2	72.4	1.53	24.33	11.50	7.50	7.68	160.34	120.67	2.55
SRT-SCS-2002-00063	SB3-28ccc	m17	ccc	6	7	10.7	9.64	7.11	12	69.2	78.4	2.23	17.83	16.07	11.85	20.00	115.34	130.67	3.72

Table I.1. SRTC-ML Mesaurements of PCT Leachate Solutions for SB3 Phase 1 glasses

Analytical	Glass	SRTC-ML	Heat		Seq	As Reported (in ppm) by SRTC-ML							Values (in ppm) after Adjusting for Dilution Effects						
Plan	ID	ID	Treatment	Block	#	Al	B	Fe	Li	Na	Si	U	Al	B	Fe	Li	Na	Si	U
SRT-SCS-2002-00063	EA	m91		6	8	0.741	36.8	1.36	10.4	93.8	51.5	<1.00	12.35	613.33	22.67	173.33	1563.34	858.34	8.33
SRT-SCS-2002-00063	SB3-17	m45	quenched	6	9	8.08	5.92	13.8	6.58	47.8	74.2	3.77	13.47	9.87	23.00	10.97	79.67	123.67	6.28
SRT-SCS-2002-00063	soln std	std-b6-2		6	10	4.24	20.8	4.23	9.43	84.9	49.6	<1.00	4.24	20.80	4.23	9.43	84.90	49.60	0.50
SRT-SCS-2002-00063	SB3-22ccc	m04	ccc	6	11	13	7.07	4.81	5	90.2	72.9	1.55	21.67	11.78	8.02	8.33	150.34	121.50	2.58
SRT-SCS-2002-00063	SB3-20ccc	m61	ccc	6	12	10.4	8.32	4.18	6.33	70.9	68.7	1.69	17.33	13.87	6.97	10.55	118.17	114.50	2.82
SRT-SCS-2002-00063	SB3-28	m38	quenched	6	13	11.1	10.6	6.01	12.2	81.5	85.6	1.93	18.50	17.67	10.02	20.33	135.84	142.67	3.22
SRT-SCS-2002-00063	SB3-21ccc	m85	ccc	6	14	6.22	5.01	6.23	4.46	42.1	64.9	2.57	10.37	8.35	10.38	7.43	70.17	108.17	4.28
SRT-SCS-2002-00063	SB3-25ccc	m72	ccc	6	15	8.35	6.9	10.6	12.6	40.7	88.9	3.97	13.92	11.50	17.67	21.00	67.83	148.17	6.62
SRT-SCS-2002-00063	ARM	m49		6	16	3.31	11.3	<0.040	8.05	22.8	37	<1.00	5.52	18.83	0.03	13.42	38.00	61.67	0.83
SRT-SCS-2002-00063	soln std	std-b6-3		6	17	4.16	20.7	4	9.42	86.1	50.2	<1.00	4.16	20.70	4.00	9.42	86.10	50.20	0.50
SRT-SCS-2002-00066	soln std	std-b1-1		1	1	3.85	21	3.8	9.54	86.1	49.1	<1.00	3.85	21.00	3.80	9.54	86.10	49.10	0.50
SRT-SCS-2002-00066	SB3-37ccc	n87	ccc	1	2	6.6	6.12	6.75	10.9	22.1	73.4	3.02	11.00	10.20	11.25	18.17	36.83	122.34	5.03
SRT-SCS-2002-00066	SB3-31ccc	n61	ccc	1	3	7.33	5.14	3.88	5.62	33.1	57.3	1.63	12.22	8.57	6.47	9.37	55.17	95.50	2.72
SRT-SCS-2002-00066	SB3-34ccc	n45	ccc	1	4	10.8	6.54	2.98	5.27	48.9	50.6	1.29	18.00	10.90	4.97	8.78	81.50	84.34	2.15
SRT-SCS-2002-00066	SB3-29	n47	quenched	1	5	4.88	7.78	2.81	10.8	35.8	76.4	2.19	8.13	12.97	4.68	18.00	59.67	127.34	3.65
SRT-SCS-2002-00066	SB3-34	n59	quenched	1	6	10.9	7.46	1.37	5.32	53.5	51.5	1.04	18.17	12.43	2.28	8.87	89.17	85.84	1.73
SRT-SCS-2002-00066	SB3-40ccc	n26	ccc	1	7	11.5	7.55	3.69	10.2	44.9	61.7	1.9	19.17	12.58	6.15	17.00	74.83	102.84	3.17
SRT-SCS-2002-00066	SB3-31	n63	quenched	1	8	7.4	5.12	4.14	5.76	34.7	57.9	1.72	12.33	8.53	6.90	9.60	57.83	96.50	2.87
SRT-SCS-2002-00066	SB3-36ccc	n60	ccc	1	9	13.4	7.08	4.21	6.6	79.1	64.8	1.49	22.33	11.80	7.02	11.00	131.84	108.00	2.48
SRT-SCS-2002-00066	soln std	std-b1-2		1	10	3.73	20.9	3.96	9.5	83.5	49.9	<1.00	3.73	20.90	3.96	9.50	83.50	49.90	0.50
SRT-SCS-2002-00066	SB3-32	n53	quenched	1	11	11.5	6.24	1.92	5.46	56.1	55.2	<1.00	19.17	10.40	3.20	9.10	93.50	92.00	0.83
SRT-SCS-2002-00066	SB3-32ccc	n77	ccc	1	12	11.6	5.42	2.91	5.49	51.8	54.5	1.17	19.33	9.03	4.85	9.15	86.34	90.84	1.95
SRT-SCS-2002-00066	EA	n13		1	13	0.103	38.9	<0.040	10.8	98.6	52.8	<1.00	1.72	648.33	0.33	180.00	1643.34	880.00	8.33
SRT-SCS-2002-00066	SB3-29ccc	n32	ccc	1	14	4.9	7.89	2.72	10.5	34.9	75.1	2.14	8.17	13.15	4.53	17.50	58.17	125.17	3.57
SRT-SCS-2002-00066	ARM	n37		1	15	2.87	11.33	0.188	8.04	22.3	36.2	<1.00	4.78	18.88	0.31	13.40	37.17	60.33	0.83
SRT-SCS-2002-00066	SB3-37	n35	quenched	1	16	6.47	5.82	7.33	10.7	20.4	71.8	3.12	10.78	9.70	12.22	17.83	34.00	119.67	5.20
SRT-SCS-2002-00066	SB3-36	n71	quenched	1	17	12.8	7.75	3.48	6.18	84.2	66.9	1.32	21.33	12.92	5.80	10.30	140.34	111.50	2.20
SRT-SCS-2002-00066	SB3-40	n23	quenched	1	18	10.8	8.51	2.99	10.2	46.4	62.1	1.29	18.00	14.18	4.98	17.00	77.33	103.50	2.15
SRT-SCS-2002-00066	soln std	std-b1-3		1	19	3.88	20.7	3.97	9.46	84.9	49.8	<1.00	3.88	20.70	3.97	9.46	84.90	49.80	0.50
SRT-SCS-2002-00066	soln std	std-b2-1		2	1	4.2	21.1	4.24	9.6	86.2	50	<1.00	4.20	21.10	4.24	9.60	86.20	50.00	0.50
SRT-SCS-2002-00066	SB3-32	n57	quenched	2	2	12.1	6.31	2.11	5.6	58.3	55.5	1.21	20.17	10.52	3.52	9.33	97.17	92.50	2.02
SRT-SCS-2002-00066	SB3-36	n83	quenched	2	3	13	7.51	3.32	6.17	84.9	64.3	1.57	21.67	12.52	5.53	10.28	141.50	107.17	2.62
SRT-SCS-2002-00066	SB3-37	n30	quenched	2	4	7.15	5.91	7.82	11.2	21.9	73.1	3.39	11.92	9.85	13.03	18.67	36.50	121.84	5.65
SRT-SCS-2002-00066	SB3-34	n43	quenched	2	5	11.2	7.4	1.7	5.44	55.2	51.8	1.2	18.67	12.33	2.83	9.07	92.00	86.34	2.00
SRT-SCS-2002-00066	EA	n10		2	6	0.632	37.9	0.411	10.9	97.2	52.4	<1.00	10.53	631.67	6.85	181.67	1620.00	873.34	8.33
SRT-SCS-2002-00066	ARM	n05		2	7	3.31	10.9	0.183	7.91	22.1	35.8	<1.00	5.52	18.17	0.31	13.18	36.83	59.67	0.83
SRT-SCS-2002-00066	SB3-40ccc	n21	ccc	2	8	11.6	7.48	4.57	10.1	44.5	62	2.09	19.33	12.47	7.62	16.83	74.17	103.34	3.48
SRT-SCS-2002-00066	SB3-40	n18	quenched	2	9	11.1	8.47	2.93	10.2	47.1	62.5	1.46	18.50	14.12	4.88	17.00	78.50	104.17	2.43
SRT-SCS-2002-00066	soln std	std-b2-2		2	10	4.2	20.8	4.15	9.45	85.8	49.5	<1.00	4.20	20.80	4.15	9.45	85.80	49.50	0.50
SRT-SCS-2002-00066	SB3-31ccc	n89	ccc	2	11	7.98	5.11	4.18	5.58	32.6	57.3	1.82	13.30	8.52	6.97	9.30	54.33	95.50	3.03
SRT-SCS-2002-00066	SB3-29ccc	n84	ccc	2	12	5.44	7.64	2.96	10.5	34.9	76.7	2.33	9.07	12.73	4.93	17.50	58.17	127.84	3.88
SRT-SCS-2002-00066	SB3-31	n34	quenched	2	13	7.76	5.09	4.4	5.81	34.8	58.8	1.9	12.93	8.48	7.33	9.68	58.00	98.00	3.17

Table I.1. SRTC-ML Mesaurements of PCT Leachate Solutions for SB3 Phase 1 glasses

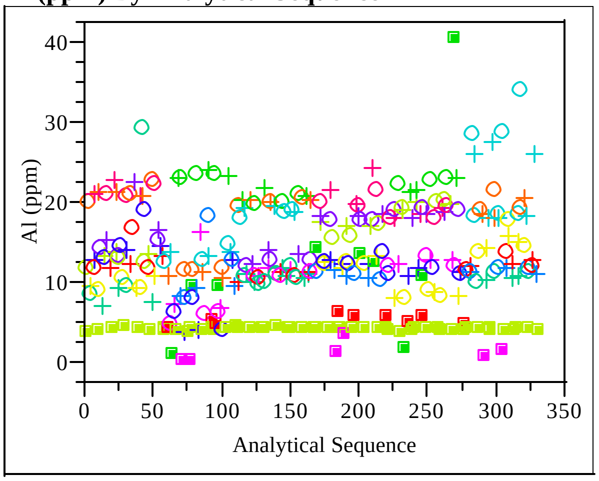
Analytical	Glass	SRTC-ML	Heat		Seq		As Reported (in ppm) by SRTC-ML							Values (in ppm) after Adjusting for Dilution Effects					
Plan	ID	ID	Treatment	Block	#	Al	B	Fe	Li	Na	Si	U	Al	B	Fe	Li	Na	Si	U
SRT-SCS-2002-00066	SB3-36ccc	n28	ccc	2	14	13.7	7.14	4.52	6.72	81.5	66.3	1.71	22.83	11.90	7.53	11.20	135.84	110.50	2.85
SRT-SCS-2002-00066	SB3-37ccc	n02	ccc	2	15	7.16	5.93	6.95	11	22.7	73.4	3.27	11.93	9.88	11.58	18.33	37.83	122.34	5.45
SRT-SCS-2002-00066	SB3-29	n62	quenched	2	16	5.25	7.59	3.1	10.5	35.9	75.4	2.42	8.75	12.65	5.17	17.50	59.83	125.67	4.03
SRT-SCS-2002-00066	SB3-34ccc	n78	ccc	2	17	10.9	6.34	2.9	5.24	48.8	50	1.43	18.17	10.57	4.83	8.73	81.33	83.34	2.38
SRT-SCS-2002-00066	SB3-32ccc	n69	ccc	2	18	12.1	5.38	2.86	5.62	53.9	55.6	1.41	20.17	8.97	4.77	9.37	89.84	92.67	2.35
SRT-SCS-2002-00066	soln std	std-b2-3		2	19	4.19	20.6	4.25	9.52	86.5	50.3	<1.00	4.19	20.60	4.25	9.52	86.50	50.30	0.50
SRT-SCS-2002-00066	soln std	std-b3-1		3	1	3.85	20.5	3.48	9.37	85.1	48.9	<1.00	3.85	20.50	3.48	9.37	85.10	48.90	0.50
SRT-SCS-2002-00066	SB3-29ccc	n80	ccc	3	2	4.98	7.65	2.73	10.7	35.6	75.9	2.25	8.30	12.75	4.55	17.83	59.33	126.50	3.75
SRT-SCS-2002-00066	SB3-34	n16	quenched	3	3	11.6	7.55	1.24	5.57	56.8	53.8	1.13	19.33	12.58	2.07	9.28	94.67	89.67	1.88
SRT-SCS-2002-00066	SB3-40	n64	quenched	3	4	11.3	8.36	2.5	10.4	48	63.2	1.35	18.83	13.93	4.17	17.33	80.00	105.34	2.25
SRT-SCS-2002-00066	SB3-32ccc	n92	ccc	3	5	12.2	5.22	2.5	5.69	55	56	1.26	20.33	8.70	4.17	9.48	91.67	93.34	2.10
SRT-SCS-2002-00066	SB3-36ccc	n06	ccc	3	6	13.8	7.08	3.81	6.86	83	67.7	1.54	23.00	11.80	6.35	11.43	138.34	112.84	2.57
SRT-SCS-2002-00066	SB3-34ccc	n86	ccc	3	7	11.8	6.42	2.35	5.46	51.5	53.1	1.29	19.67	10.70	3.92	9.10	85.84	88.50	2.15
SRT-SCS-2002-00066	SB3-32	n46	quenched	3	8	11.9	5.84	1.71	5.52	58.2	56.2	1.03	19.83	9.73	2.85	9.20	97.00	93.67	1.72
SRT-SCS-2002-00066	SB3-31	n40	quenched	3	9	7.65	4.84	3.96	5.82	35.3	59.8	1.75	12.75	8.07	6.60	9.70	58.83	99.67	2.92
SRT-SCS-2002-00066	soln std	std-b3-2		3	10	4	20.7	3.75	9.42	85.3	50.2	<1.00	4.00	20.70	3.75	9.42	85.30	50.20	0.50
SRT-SCS-2002-00066	EA	n39		3	11	2.42	38.3	0.496	10.7	97.8	53.1	<1.00	40.33	638.33	8.27	178.33	1630.00	885.00	8.33
SRT-SCS-2002-00066	SB3-36	n68	quenched	3	12	13.8	7.83	3.41	6.38	87.7	68.6	1.38	23.00	13.05	5.68	10.63	146.17	114.34	2.30
SRT-SCS-2002-00066	SB3-31ccc	n85	ccc	3	13	7.3	4.81	3.63	5.54	32.7	58.2	1.63	12.17	8.02	6.05	9.23	54.50	97.00	2.72
SRT-SCS-2002-00066	SB3-29	n72	quenched	3	14	4.95	7.49	2.85	10.6	36	77.3	2.18	8.25	12.48	4.75	17.67	60.00	128.84	3.63
SRT-SCS-2002-00066	SB3-40ccc	n81	ccc	3	15	11.5	7.3	3.74	10.2	45.2	63.4	1.99	19.17	12.17	6.23	17.00	75.33	105.67	3.32
SRT-SCS-2002-00066	SB3-37	n22	quenched	3	16	6.8	5.65	7.53	11.3	21.8	74.7	3.24	11.33	9.42	12.55	18.83	36.33	124.50	5.40
SRT-SCS-2002-00066	SB3-37ccc	n14	ccc	3	17	6.61	5.64	6.42	10.8	21.9	74	2.93	11.02	9.40	10.70	18.00	36.50	123.34	4.88
SRT-SCS-2002-00066	ARM	n51		3	18	2.84	10.4	<0.040	7.79	21.4	36	<1.00	4.73	17.33	0.03	12.98	35.67	60.00	0.83
SRT-SCS-2002-00066	soln std	std-b3-3		3	19	3.76	20.6	3.7	9.45	85.6	50.2	<1.00	3.76	20.60	3.70	9.45	85.60	50.20	0.50
SRT-SCS-2002-00066	soln std	std-b4-1		4	1	4.23	21.2	4.06	9.61	88.3	49.4	<1.00	4.23	21.20	4.06	9.61	88.30	49.40	0.50
SRT-SCS-2002-00066	SB3-35ccc	n76	ccc	4	2	6.99	6.95	11.2	7.31	52.3	74	4.03	11.65	11.58	18.67	12.18	87.17	123.34	6.72
SRT-SCS-2002-00066	SB3-33	n70	quenched	4	3	6.85	6.43	4.56	5.8	30.9	57.7	2.03	11.42	10.72	7.60	9.67	51.50	96.17	3.38
SRT-SCS-2002-00066	SB3-35	n42	quenched	4	4	7.34	7.34	12.5	7.64	58.8	80.7	4.2	12.23	12.23	20.83	12.73	98.00	134.50	7.00
SRT-SCS-2002-00066	SB3-33ccc	n27	ccc	4	5	6.85	6.36	4.41	5.68	30	58.1	1.93	11.42	10.60	7.35	9.47	50.00	96.84	3.22
SRT-SCS-2002-00066	SB3-42ccc	n01	ccc	4	6	17.1	14.5	14.3	38.9	114	140	3.66	28.50	24.17	23.83	64.83	190.00	233.34	6.10
SRT-SCS-2002-00066	SB3-42	n48	quenched	4	7	15.6	12.2	8.58	23.7	110	106	2.87	26.00	20.33	14.30	39.50	183.34	176.67	4.78
SRT-SCS-2002-00066	SB3-30ccc	n20	ccc	4	8	11	7.5	4.09	9.25	59.5	67.8	1.33	18.33	12.50	6.82	15.42	99.17	113.00	2.22
SRT-SCS-2002-00066	SB3-39ccc	n90	ccc	4	9	6.1	7.73	7.38	11.2	19.5	74.5	3.26	10.17	12.88	12.30	18.67	32.50	124.17	5.43
SRT-SCS-2002-00066	soln std	std-b4-2		4	10	4.12	20.9	4.14	9.49	86.5	49.9	<1.00	4.12	20.90	4.14	9.49	86.50	49.90	0.50
SRT-SCS-2002-00066	SB3-41ccc	n29	ccc	4	11	8.3	10.9	12.5	19.4	70.4	111	4.07	13.83	18.17	20.83	32.33	117.34	185.00	6.78
SRT-SCS-2002-00066	SB3-38	n07	quenched	4	12	11.1	6.29	2.77	9.65	45.7	61.2	1.74	18.50	10.48	4.62	16.08	76.17	102.00	2.90
SRT-SCS-2002-00066	SB3-38ccc	n09	ccc	4	13	11.4	5.72	4.04	9.72	43.6	62	2.09	19.00	9.53	6.73	16.20	72.67	103.34	3.48
SRT-SCS-2002-00066	blank	n50		4	14	0.38	<0.150	<0.040	<0.500	<0.100	<0.790	<1.00	0.63	0.13	0.03	0.42	0.08	0.66	0.83
SRT-SCS-2002-00066	SB3-39	n03	quenched	4	15	6.26	7.53	7.79	11.4	18.6	73.2	3.5	10.43	12.55	12.98	19.00	31.00	122.00	5.83
SRT-SCS-2002-00066	SB3-41	n91	quenched	4	16	8.59	10.8	13.8	18	75.7	108	4.13	14.32	18.00	23.00	30.00	126.17	180.00	6.88
SRT-SCS-2002-00066	SB3-30	n58	quenched	4	17	10.8	8.51	3.55	9.64	65.1	68.3	1.67	18.00	14.18	5.92	16.07	108.50	113.84	2.78

Table I.1. SRTC-ML Mesaurements of PCT Leachate Solutions for SB3 Phase 1 glasses

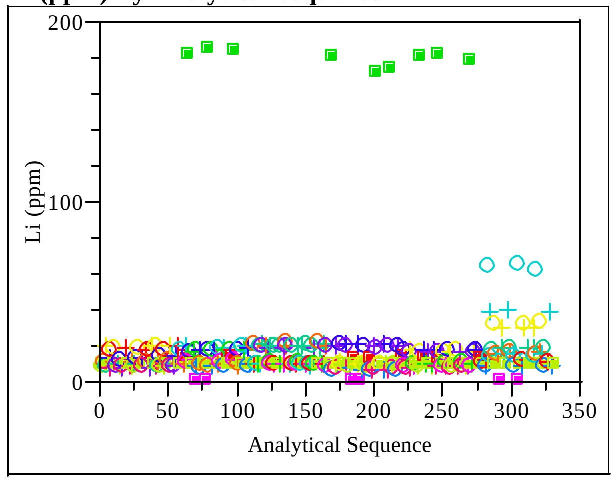
Analytical	Glass	SRTC-ML	Heat		Seq	As Reported (in ppm) by SRTC-ML							Values (in ppm) after Adjusting for Dilution Effects						
Plan	ID	ID	Treatment	Block	#	Al	B	Fe	Li	Na	Si	U	Al	B	Fe	Li	Na	Si	U
SRT-SCS-2002-00066	soln std	std-b4-3		4	18	4.08	20.2	4.03	9.34	85.4	48.9	<1.00	4.08	20.20	4.03	9.34	85.40	48.90	0.50
SRT-SCS-2002-00066	soln std	std-b5-1		5	1	3.97	21	3.71	9.44	86	49.8	<1.00	3.97	21.00	3.71	9.44	86.00	49.80	0.50
SRT-SCS-2002-00066	SB3-42	n55	quenched	5	2	16.6	12.7	9.08	24.5	113	111	3.23	27.67	21.17	15.13	40.83	188.34	185.00	5.38
SRT-SCS-2002-00066	SB3-38	n15	quenched	5	3	10.9	6.22	2.4	9.64	45.4	62.2	1.61	18.17	10.37	4.00	16.07	75.67	103.67	2.68
SRT-SCS-2002-00066	SB3-38ccc	n67	ccc	5	4	12.9	6.02	6.49	10.3	46.4	66.5	2	21.50	10.03	10.82	17.17	77.33	110.84	3.33
SRT-SCS-2002-00066	SB3-39ccc	n17	ccc	5	5	6.82	7.89	7.98	11.5	21.5	77.5	3.21	11.37	13.15	13.30	19.17	35.83	129.17	5.35
SRT-SCS-2002-00066	SB3-30	n54	quenched	5	6	10.8	8.64	3.42	9.82	66.1	70	1.64	18.00	14.40	5.70	16.37	110.17	116.67	2.73
SRT-SCS-2002-00066	SB3-30ccc	n36	ccc	5	7	11.2	7.26	4.19	9.21	59.2	67.9	1.32	18.67	12.10	6.98	15.35	98.67	113.17	2.20
SRT-SCS-2002-00066	SB3-33ccc	n25	ccc	5	8	7.15	6.12	3.93	5.62	29.6	58.1	1.81	11.92	10.20	6.55	9.37	49.33	96.84	3.02
SRT-SCS-2002-00066	blank	n88		5	9	0.786	<0.150	<0.040	<0.500	<0.100	<0.790	<1.00	1.31	0.13	0.03	0.42	0.08	0.66	0.83
SRT-SCS-2002-00066	soln std	std-b5-2		5	10	3.97	20.7	3.76	9.36	85.5	49.9	<1.00	3.97	20.70	3.76	9.36	85.50	49.90	0.50
SRT-SCS-2002-00066	SB3-42ccc	n04	ccc	5	11	17.3	14.1	14.9	39.4	112	141	3.81	28.83	23.50	24.83	65.67	186.67	235.00	6.35
SRT-SCS-2002-00066	SB3-33	n24	quenched	5	12	7.19	6.31	4.81	5.82	31.2	59.4	1.92	11.98	10.52	8.02	9.70	52.00	99.00	3.20
SRT-SCS-2002-00066	SB3-35ccc	n11	ccc	5	13	8.26	6.71	13.4	7.42	52.4	79	4.02	13.77	11.18	22.33	12.37	87.34	131.67	6.70
SRT-SCS-2002-00066	SB3-41	n33	quenched	5	14	9.53	10.9	16.1	18.2	75.6	111	4.58	15.88	18.17	26.83	30.33	126.00	185.00	7.63
SRT-SCS-2002-00066	SB3-41ccc	n82	ccc	5	15	10.7	10.9	12.7	19.7	71.8	115	3.81	17.83	18.17	21.17	32.83	119.67	191.67	6.35
SRT-SCS-2002-00066	SB3-35	n19	quenched	5	16	7.37	7.18	11.6	7.66	59.2	82	4.02	12.28	11.97	19.33	12.77	98.67	136.67	6.70
SRT-SCS-2002-00066	SB3-39	n74	quenched	5	17	6.42	7.49	8.38	11.6	19.4	77	3.4	10.70	12.48	13.97	19.33	32.33	128.34	5.67
SRT-SCS-2002-00066	soln std	std-b5-3		5	18	3.96	20.6	3.81	9.36	86.8	50.1	<1.00	3.96	20.60	3.81	9.36	86.80	50.10	0.50
SRT-SCS-2002-00066	soln std	std-b6-1		6	1	4.05	20.8	4.13	9.4	84.2	49.1	<1.00	4.05	20.80	4.13	9.40	84.20	49.10	0.50
SRT-SCS-2002-00066	SB3-41	n65	quenched	6	2	9.1	11.4	14.7	18.5	76	113	4.64	15.17	19.00	24.50	30.83	126.67	188.34	7.73
SRT-SCS-2002-00066	SB3-39	n49	quenched	6	3	6.51	8.02	8.45	11.8	18.6	75.9	3.47	10.85	13.37	14.08	19.67	31.00	126.50	5.78
SRT-SCS-2002-00066	SB3-30ccc	n12	ccc	6	4	11.2	7.5	4.29	9.17	58.4	66.4	1.37	18.67	12.50	7.15	15.28	97.34	110.67	2.28
SRT-SCS-2002-00066	SB3-38ccc	n08	ccc	6	5	11.6	5.81	3.98	9.74	42.9	62	2.04	19.33	9.68	6.63	16.23	71.50	103.34	3.40
SRT-SCS-2002-00066	SB3-42ccc	n75	ccc	6	6	20.5	13.4	23	37.7	105	139	4.83	34.17	22.33	38.33	62.83	175.00	231.67	8.05
SRT-SCS-2002-00066	SB3-38	n56	quenched	6	7	12.38	6.85	5.45	10.3	47.5	65.9	1.7	20.63	11.42	9.08	17.17	79.17	109.84	2.83
SRT-SCS-2002-00066	SB3-41ccc	n31	ccc	6	8	8.7	11.2	13.5	20.1	72.1	115	3.9	14.50	18.67	22.50	33.50	120.17	191.67	6.50
SRT-SCS-2002-00066	SB3-30	n52	quenched	6	9	11	8.53	4.76	9.4	62.9	67.1	1.62	18.33	14.22	7.93	15.67	104.84	111.84	2.70
SRT-SCS-2002-00066	soln std	std-b6-2		6	10	4.08	20.6	4.14	9.32	84.3	48.9	<1.00	4.08	20.60	4.14	9.32	84.30	48.90	0.50
SRT-SCS-2002-00066	SB3-33ccc	n79	ccc	6	11	7.13	6.67	4.67	5.79	29.8	58.9	1.9	11.88	11.12	7.78	9.65	49.67	98.17	3.17
SRT-SCS-2002-00066	SB3-39ccc	n38	ccc	6	12	6.85	7.9	8.29	11.4	19.7	75.9	3.39	11.42	13.17	13.82	19.00	32.83	126.50	5.65
SRT-SCS-2002-00066	SB3-35	n66	quenched	6	13	7.73	6.88	12	7.09	54.7	77.3	3.59	12.88	11.47	20.00	11.82	91.17	128.84	5.98
SRT-SCS-2002-00066	SB3-42	n73	quenched	6	14	15.7	12.1	8.24	23.5	108	106	3.17	26.17	20.17	13.73	39.17	180.00	176.67	5.28
SRT-SCS-2002-00066	SB3-35ccc	n44	ccc	6	15	7.25	6.86	12.7	7.28	50.4	77.7	3.99	12.08	11.43	21.17	12.13	84.00	129.50	6.65
SRT-SCS-2002-00066	SB3-33	n41	quenched	6	16	6.72	6.23	5	5.59	29.1	57.1	1.9	11.20	10.38	8.33	9.32	48.50	95.17	3.17
SRT-SCS-2002-00066	soln std	std-b6-3		6	17	3.96	20.1	4.26	9.18	82	49.1	<1.00	3.96	20.10	4.26	9.18	82.00	49.10	0.50

Exhibit I.1. SRTC-ML Mesaurements of PCT Leachate Solutions for SB3 Phase 1 glasses In Analytical Sequence Over All Three Groups

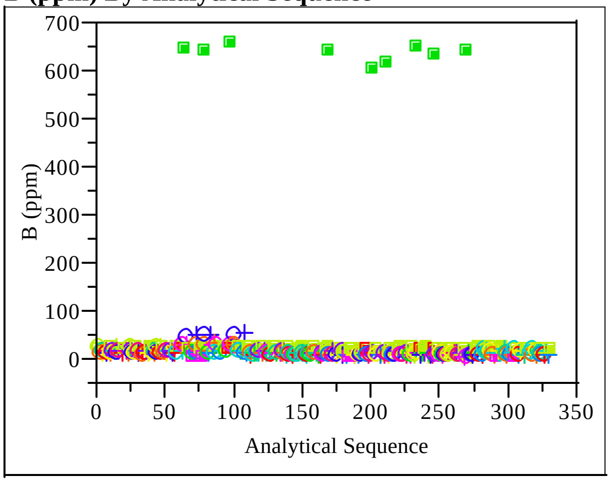
Al (ppm) By Analytical Sequence



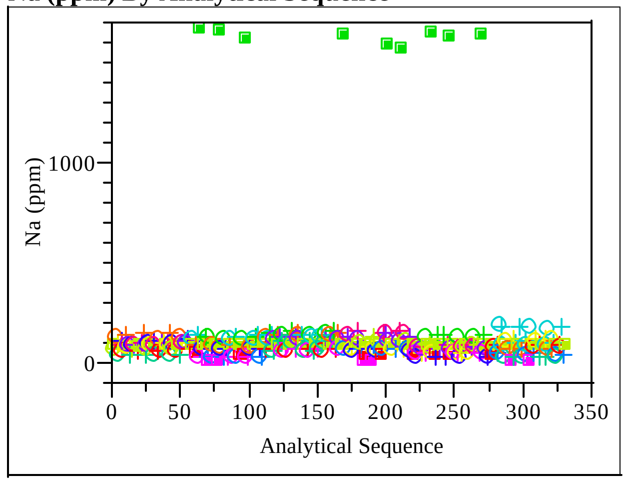
Li (ppm) By Analytical Sequence



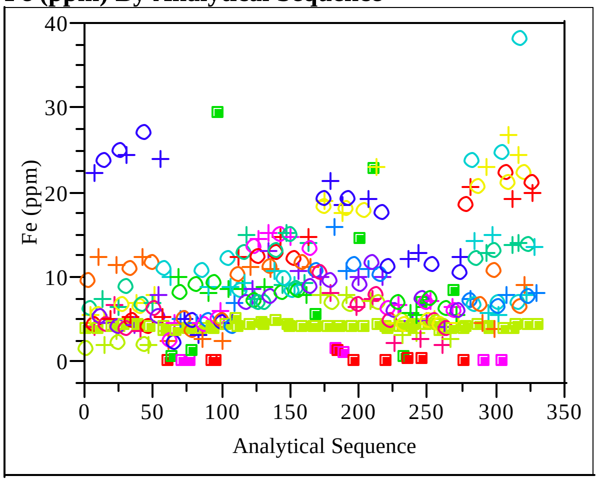
B (ppm) By Analytical Sequence



Na (ppm) By Analytical Sequence



Fe (ppm) By Analytical Sequence



Si (ppm) By Analytical Sequence

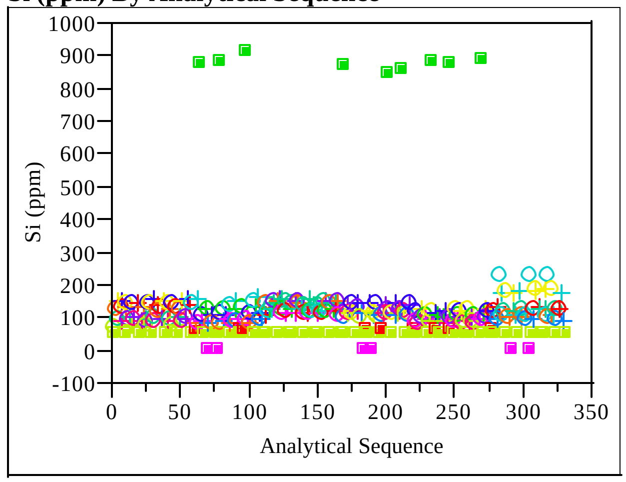


Exhibit I.1. SRTC-ML Mesaurements of PCT Leachate Solutions for SB3 Phase 1 glasses In Analytical Sequence Over All Three Groups

U (ppm) By Analytical Sequence

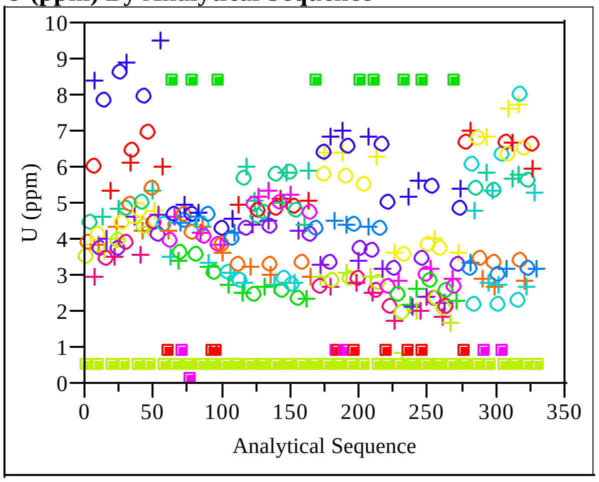
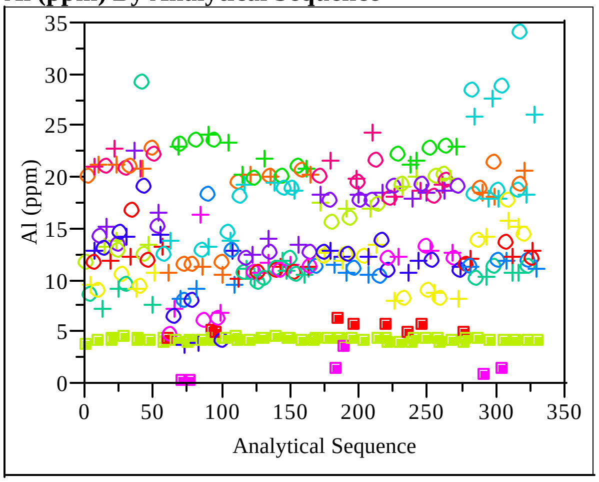
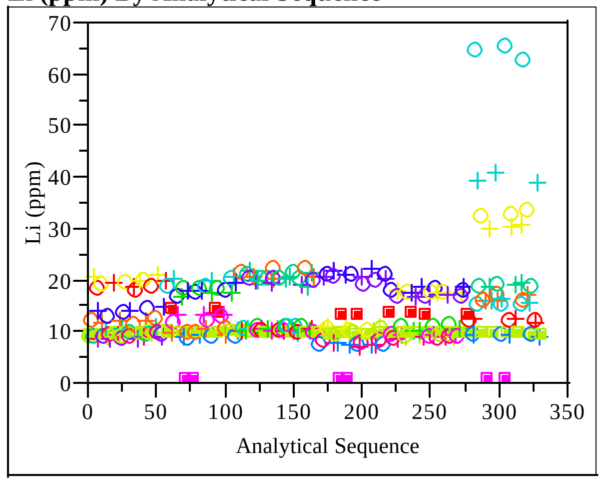


Exhibit I.2. SRTC-ML Mesaurements of PCT Leachate Solutions for SB3 Phase 1 glasses In Analytical Sequence Over All Three Groups Excluding the EA Glass

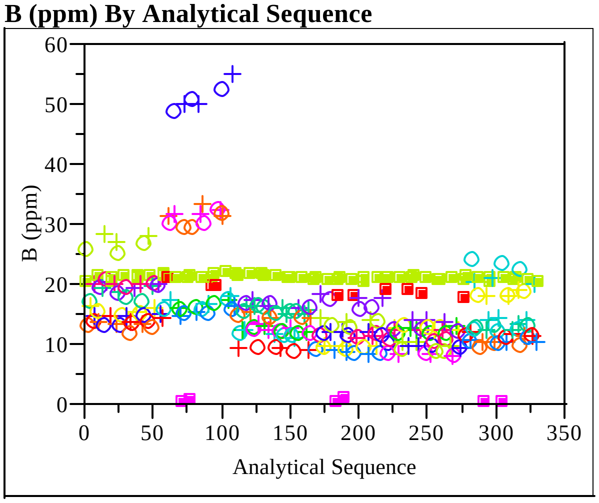
Al (ppm) By Analytical Sequence



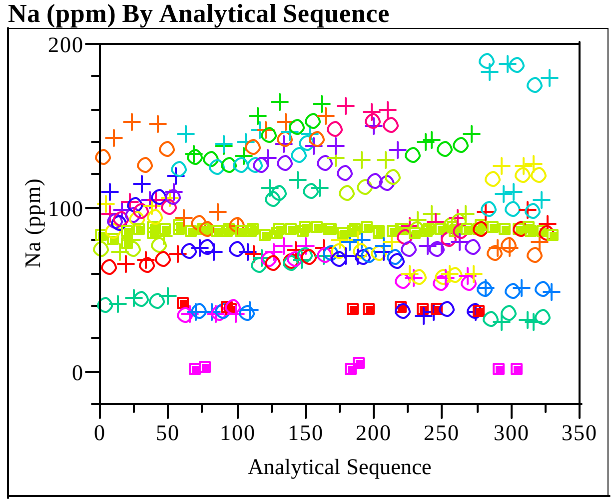
Li (ppm) By Analytical Sequence



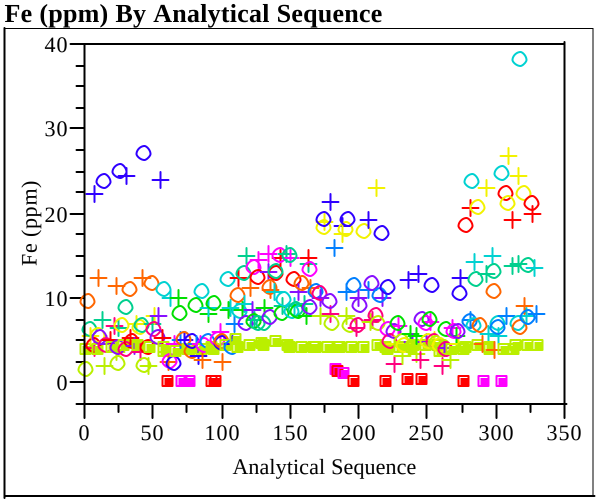
B (ppm) By Analytical Sequence



Na (ppm) By Analytical Sequence



Fe (ppm) By Analytical Sequence



Si (ppm) By Analytical Sequence

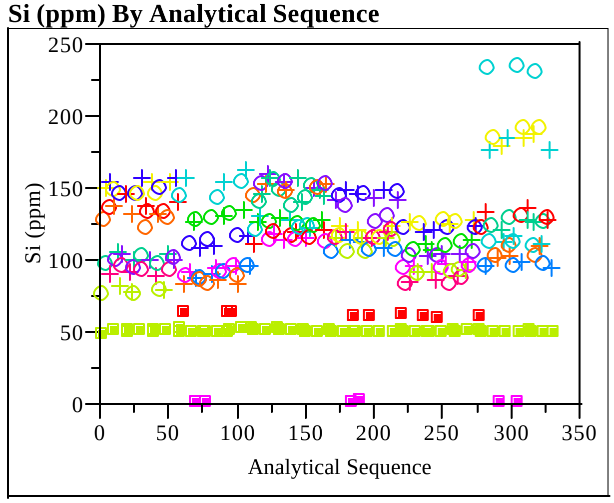


Exhibit I.2. SRTC-ML Mesaurements of PCT Leachate Solutions for SB3 Phase 1 glasses In Analytical Sequence Over All Three Groups Excluding the EA Glass

U (ppm) By Analytical Sequence

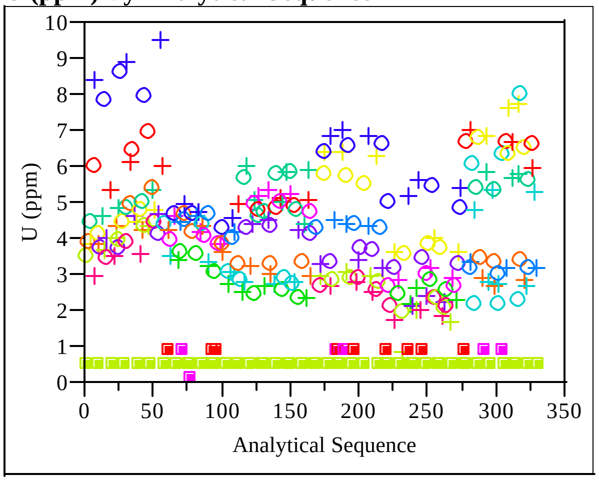
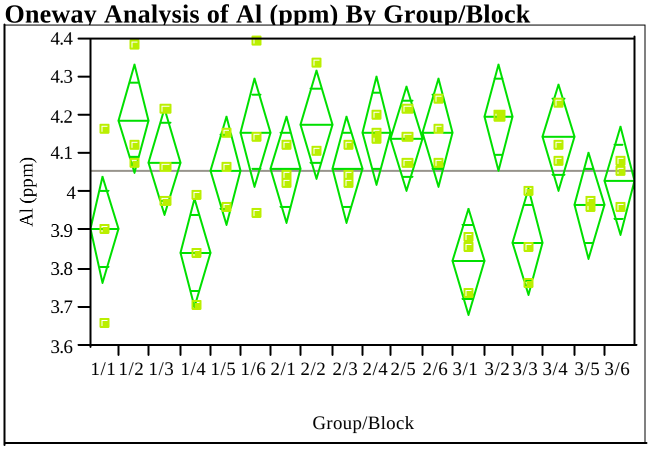


Exhibit I.3. SRTC-ML Mesaurements of PCT Leachate Solutions by SB3 Phase 1 Glass ID

(Plus – Quenched; Circle – Centerline Canister Cooled (ccc))

Oneway Analysis of Al (ppm) By Group/Block



Oneway Anova

Summary of Fit

Rsquare	0.609304
Adj Rsquare	0.424809
Root Mean Square Error	0.119257
Mean of Response	4.056111
Observations (or Sum Wgts)	54

Analysis of Variance

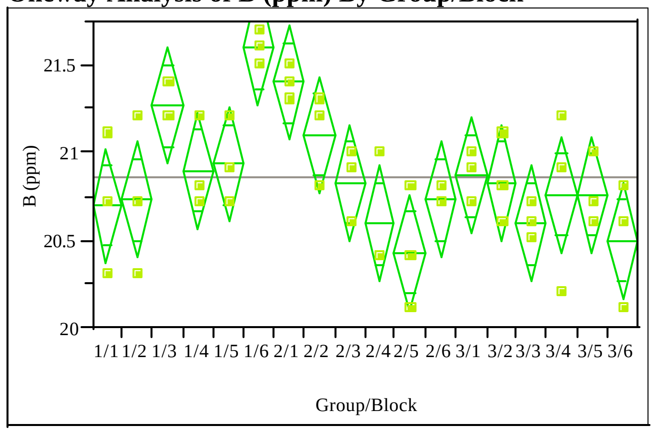
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Group/Block	17	0.7984833	0.046970	3.3026	0.0013
Error	36	0.5120000	0.014222		
C. Total	53	1.3104833			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1	3	3.90333	0.06885	3.7637	4.0430
1/2	3	4.19000	0.06885	4.0504	4.3296
1/3	3	4.08000	0.06885	3.9404	4.2196
1/4	3	3.84333	0.06885	3.7037	3.9830
1/5	3	4.05667	0.06885	3.9170	4.1963
1/6	3	4.15667	0.06885	4.0170	4.2963
2/1	3	4.06000	0.06885	3.9204	4.1996
2/2	3	4.17667	0.06885	4.0370	4.3163
2/3	3	4.06000	0.06885	3.9204	4.1996
2/4	3	4.16000	0.06885	4.0204	4.2996
2/5	3	4.14000	0.06885	4.0004	4.2796
2/6	3	4.15667	0.06885	4.0170	4.2963
3/1	3	3.82000	0.06885	3.6804	3.9596
3/2	3	4.19667	0.06885	4.0570	4.3363
3/3	3	3.87000	0.06885	3.7304	4.0096
3/4	3	4.14333	0.06885	4.0037	4.2830
3/5	3	3.96667	0.06885	3.8270	4.1063
3/6	3	4.03000	0.06885	3.8904	4.1696

Std Error uses a pooled estimate of error variance

Oneway Analysis of B (ppm) By Group/Block



Oneway Anova

Summary of Fit

Rsquare	0.626576
Adj Rsquare	0.450237
Root Mean Square Error	0.281201
Mean of Response	20.86481
Observations (or Sum Wgts)	54

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Group/Block	17	4.7764815	0.280969	3.5532	0.0007
Error	36	2.8466667	0.079074		
C. Total	53	7.6231481			

Means for Oneway Anova

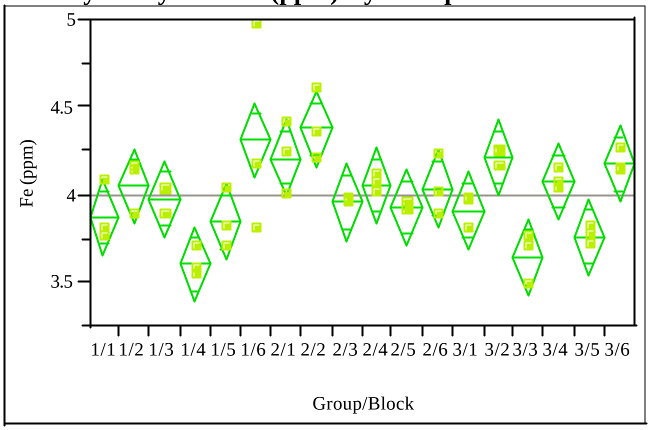
Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1	3	20.7000	0.16235	20.371	21.029
1/2	3	20.7333	0.16235	20.404	21.063
1/3	3	21.2667	0.16235	20.937	21.596
1/4	3	20.9000	0.16235	20.571	21.229
1/5	3	20.9333	0.16235	20.604	21.263
1/6	3	21.6000	0.16235	21.271	21.929
2/1	3	21.4000	0.16235	21.071	21.729
2/2	3	21.1000	0.16235	20.771	21.429
2/3	3	20.8333	0.16235	20.504	21.163
2/4	3	20.6000	0.16235	20.271	20.929
2/5	3	20.4333	0.16235	20.104	20.763
2/6	3	20.7333	0.16235	20.404	21.063
3/1	3	20.8667	0.16235	20.537	21.196
3/2	3	20.8333	0.16235	20.504	21.163
3/3	3	20.6000	0.16235	20.271	20.929
3/4	3	20.7667	0.16235	20.437	21.096
3/5	3	20.7667	0.16235	20.437	21.096
3/6	3	20.5000	0.16235	20.171	20.829

Std Error uses a pooled estimate of error variance

Exhibit I.3. SRTC-ML Mesaurements of PCT Leachate Solutions by SB3 Phase 1 Glass ID

(Plus – Quenched; Circle – Centerline Canister Cooled (ccc))

Oneway Analysis of Fe (ppm) By Group/Block



Oneway Anova

Summary of Fit

Rsquare	0.652835
Adj Rsquare	0.488896
Root Mean Square Error	0.184827
Mean of Response	4.001296
Observations (or Sum Wgts)	54

Analysis of Variance

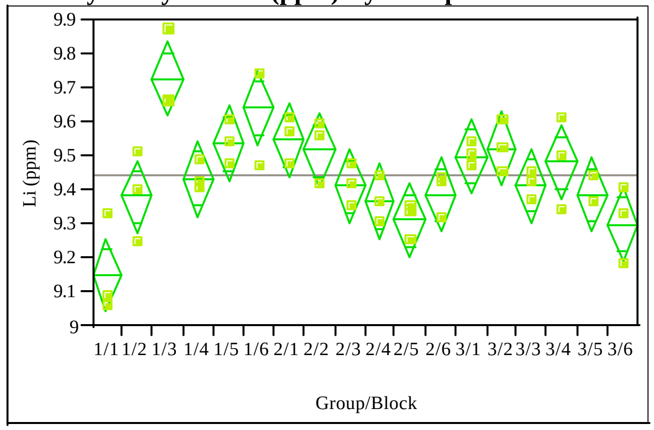
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Group/Block	17	2.3126093	0.136036	3.9822	0.0002
Error	36	1.2298000	0.034161		
C. Total	53	3.5424093			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1	3	3.87333	0.10671	3.6569	4.0898
1/2	3	4.05333	0.10671	3.8369	4.2698
1/3	3	3.97667	0.10671	3.7602	4.1931
1/4	3	3.60667	0.10671	3.3902	3.8231
1/5	3	3.84667	0.10671	3.6302	4.0631
1/6	3	4.31333	0.10671	4.0969	4.5298
2/1	3	4.21000	0.10671	3.9936	4.4264
2/2	3	4.38000	0.10671	4.1636	4.5964
2/3	3	3.96000	0.10671	3.7436	4.1764
2/4	3	4.05667	0.10671	3.8402	4.2731
2/5	3	3.93000	0.10671	3.7136	4.1464
2/6	3	4.03667	0.10671	3.8202	4.2531
3/1	3	3.91000	0.10671	3.6936	4.1264
3/2	3	4.21333	0.10671	3.9969	4.4298
3/3	3	3.64333	0.10671	3.4269	3.8598
3/4	3	4.07667	0.10671	3.8602	4.2931
3/5	3	3.76000	0.10671	3.5436	3.9764
3/6	3	4.17667	0.10671	3.9602	4.3931

Std Error uses a pooled estimate of error variance

Oneway Analysis of Li (ppm) By Group/Block



Oneway Anova

Summary of Fit

Rsquare	0.739287
Adj Rsquare	0.616173
Root Mean Square Error	0.093492
Mean of Response	9.444815
Observations (or Sum Wgts)	54

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Group/Block	17	0.8922815	0.052487	6.0049	<.0001
Error	36	0.3146667	0.008741		
C. Total	53	1.2069481			

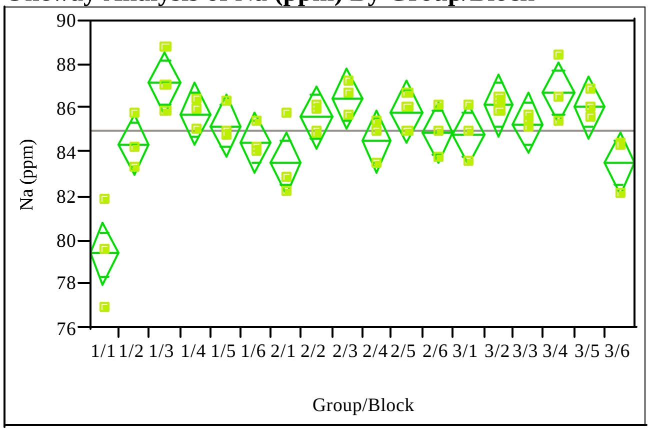
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1	3	9.15000	0.05398	9.0405	9.2595
1/2	3	9.38000	0.05398	9.2705	9.4895
1/3	3	9.72667	0.05398	9.6172	9.8361
1/4	3	9.43333	0.05398	9.3239	9.5428
1/5	3	9.53667	0.05398	9.4272	9.6461
1/6	3	9.64000	0.05398	9.5305	9.7495
2/1	3	9.54667	0.05398	9.4372	9.6561
2/2	3	9.51667	0.05398	9.4072	9.6261
2/3	3	9.41000	0.05398	9.3005	9.5195
2/4	3	9.36667	0.05398	9.2572	9.4761
2/5	3	9.31000	0.05398	9.2005	9.4195
2/6	3	9.38667	0.05398	9.2772	9.4961
3/1	3	9.50000	0.05398	9.3905	9.6095
3/2	3	9.52333	0.05398	9.4139	9.6328
3/3	3	9.41333	0.05398	9.3039	9.5228
3/4	3	9.48000	0.05398	9.3705	9.5895
3/5	3	9.38667	0.05398	9.2772	9.4961
3/6	3	9.30000	0.05398	9.1905	9.4095

Std Error uses a pooled estimate of error variance

Exhibit I.3. SRTC-ML Mesaurements of PCT Leachate Solutions by SB3 Phase 1 Glass ID
(Plus – Quenched; Circle – Centerline Canister Cooled (ccc))

Oneway Analysis of Na (ppm) By Group/Block



Oneway Anova
Summary of Fit

Rsquare	0.749712
Adj Rsquare	0.63152
Root Mean Square Error	1.194121
Mean of Response	84.99259
Observations (or Sum Wgts)	54

Analysis of Variance

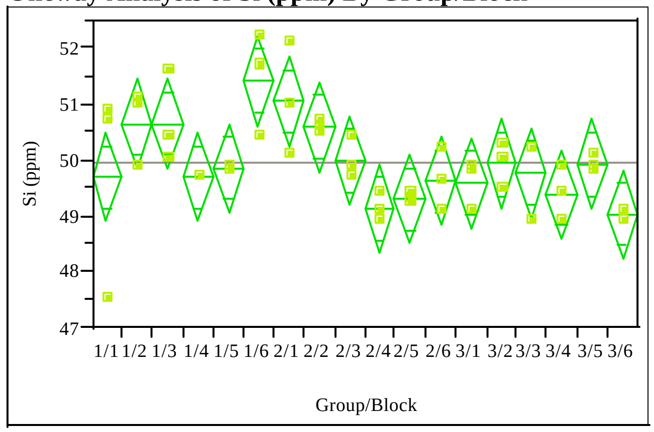
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Group/Block	17	153.76370	9.04492	6.3432	<.0001
Error	36	51.33333	1.42593		
C. Total	53	205.09704			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1	3	79.3667	0.68943	77.968	80.765
1/2	3	84.3667	0.68943	82.968	85.765
1/3	3	87.1667	0.68943	85.768	88.565
1/4	3	85.7333	0.68943	84.335	87.132
1/5	3	85.2333	0.68943	83.835	86.632
1/6	3	84.4667	0.68943	83.068	85.865
2/1	3	83.5333	0.68943	82.135	84.932
2/2	3	85.6000	0.68943	84.202	86.998
2/3	3	86.4667	0.68943	85.068	87.865
2/4	3	84.5333	0.68943	83.135	85.932
2/5	3	85.8333	0.68943	84.435	87.232
2/6	3	84.9000	0.68943	83.502	86.298
3/1	3	84.8333	0.68943	83.435	86.232
3/2	3	86.1667	0.68943	84.768	87.565
3/3	3	85.3333	0.68943	83.935	86.732
3/4	3	86.7333	0.68943	85.335	88.132
3/5	3	86.1000	0.68943	84.702	87.498
3/6	3	83.5000	0.68943	82.102	84.898

Std Error uses a pooled estimate of error variance

Oneway Analysis of Si (ppm) By Group/Block



Oneway Anova
Summary of Fit

Rsquare	0.57396
Adj Rsquare	0.372775
Root Mean Square Error	0.681773
Mean of Response	49.96852
Observations (or Sum Wgts)	54

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Group/Block	17	22.543148	1.32607	2.8529	0.0040
Error	36	16.733333	0.46481		
C. Total	53	39.276481			

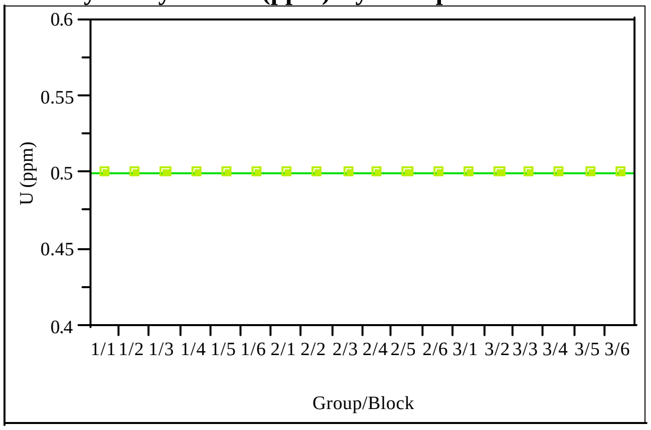
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1	3	49.7000	0.39362	48.902	50.498
1/2	3	50.6667	0.39362	49.868	51.465
1/3	3	50.6667	0.39362	49.868	51.465
1/4	3	49.7000	0.39362	48.902	50.498
1/5	3	49.8667	0.39362	49.068	50.665
1/6	3	51.4333	0.39362	50.635	52.232
2/1	3	51.0667	0.39362	50.268	51.865
2/2	3	50.6000	0.39362	49.802	51.398
2/3	3	50.0000	0.39362	49.202	50.798
2/4	3	49.1333	0.39362	48.335	49.932
2/5	3	49.3000	0.39362	48.502	50.098
2/6	3	49.6333	0.39362	48.835	50.432
3/1	3	49.6000	0.39362	48.802	50.398
3/2	3	49.9333	0.39362	49.135	50.732
3/3	3	49.7667	0.39362	48.968	50.565
3/4	3	49.4000	0.39362	48.602	50.198
3/5	3	49.9333	0.39362	49.135	50.732
3/6	3	49.0333	0.39362	48.235	49.832

Std Error uses a pooled estimate of error variance

Exhibit I.3. SRTC-ML Mesaurements of PCT Leachate Solutions by SB3 Phase 1 Glass ID
(Plus – Quenched; Circle – Centerline Canister Cooled (ccc))

Oneway Analysis of U (ppm) By Group/Block



Oneway Anova
Summary of Fit

Rsquare	.
Adj Rsquare	.
Root Mean Square Error	0
Mean of Response	0.5
Observations (or Sum Wgts)	54

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Group/Block	17	0	0	.	.
Error	36	0	0		
C. Total	53	0			

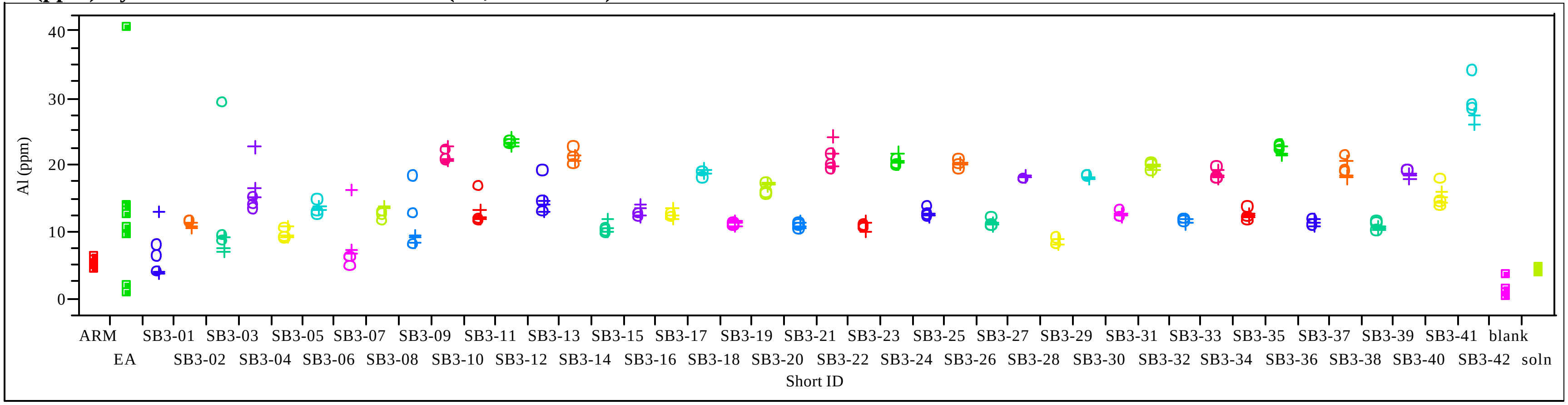
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1	3	0.500000	0	0.50000	0.50000
1/2	3	0.500000	0	0.50000	0.50000
1/3	3	0.500000	0	0.50000	0.50000
1/4	3	0.500000	0	0.50000	0.50000
1/5	3	0.500000	0	0.50000	0.50000
1/6	3	0.500000	0	0.50000	0.50000
2/1	3	0.500000	0	0.50000	0.50000
2/2	3	0.500000	0	0.50000	0.50000
2/3	3	0.500000	0	0.50000	0.50000
2/4	3	0.500000	0	0.50000	0.50000
2/5	3	0.500000	0	0.50000	0.50000
2/6	3	0.500000	0	0.50000	0.50000
3/1	3	0.500000	0	0.50000	0.50000
3/2	3	0.500000	0	0.50000	0.50000
3/3	3	0.500000	0	0.50000	0.50000
3/4	3	0.500000	0	0.50000	0.50000
3/5	3	0.500000	0	0.50000	0.50000
3/6	3	0.500000	0	0.50000	0.50000

Std Error uses a pooled estimate of error variance

Exhibit I.4. SRTC-ML Mesaurements of PCT Leachate Solutions by SB3 Phase 1 Glass ID
(Plus – Quenched; Circle – Centerline Canister Cooled (ccc))

Al (ppm) By Glass ID w/o Heat Treatment (i.e., a Short ID)



B (ppm) By Glass ID w/o Heat Treatment (i.e., a Short ID)

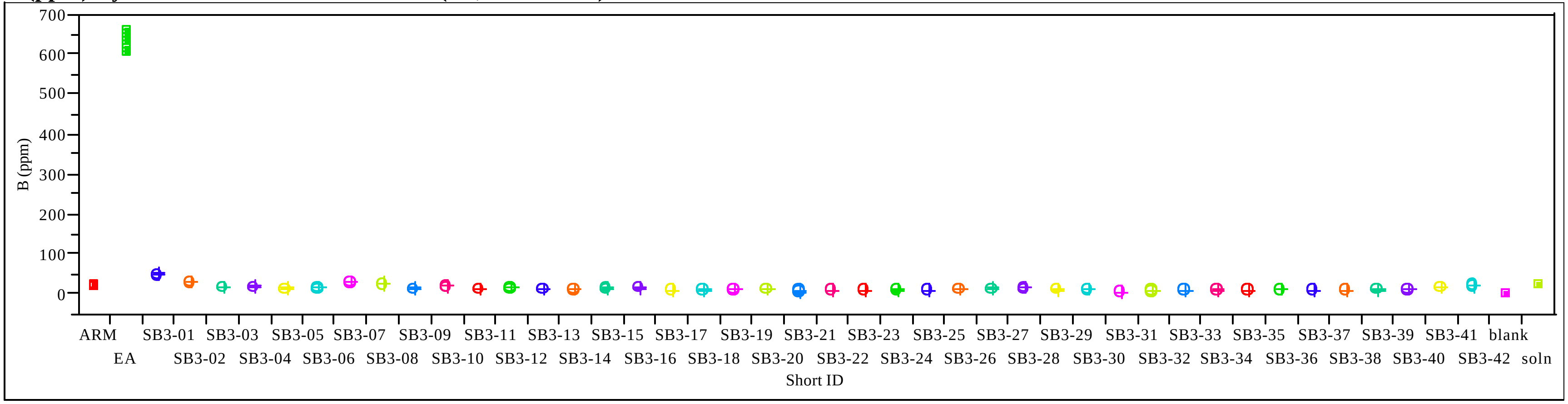
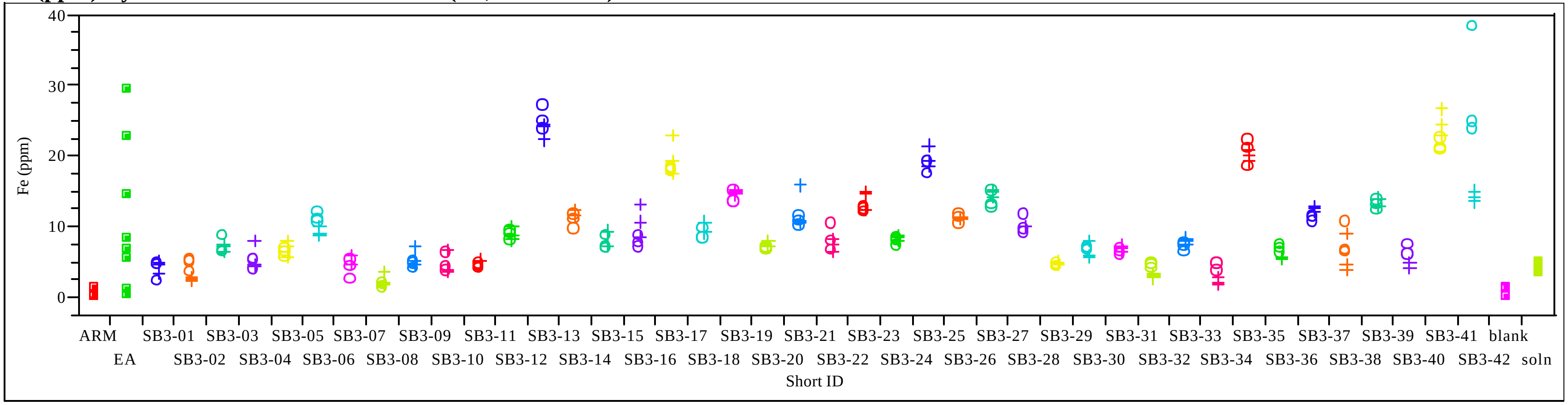


Exhibit I.4. SRTC-ML Mesaurements of PCT Leachate Solutions by SB3 Phase 1 Glass ID
(Plus – Quenched; Circle – Centerline Canister Cooled (ccc))

Fe (ppm) By Glass ID w/o Heat Treatment (i.e., a Short ID)



Li (ppm) By Glass ID w/o Heat Treatment (i.e., a Short ID)

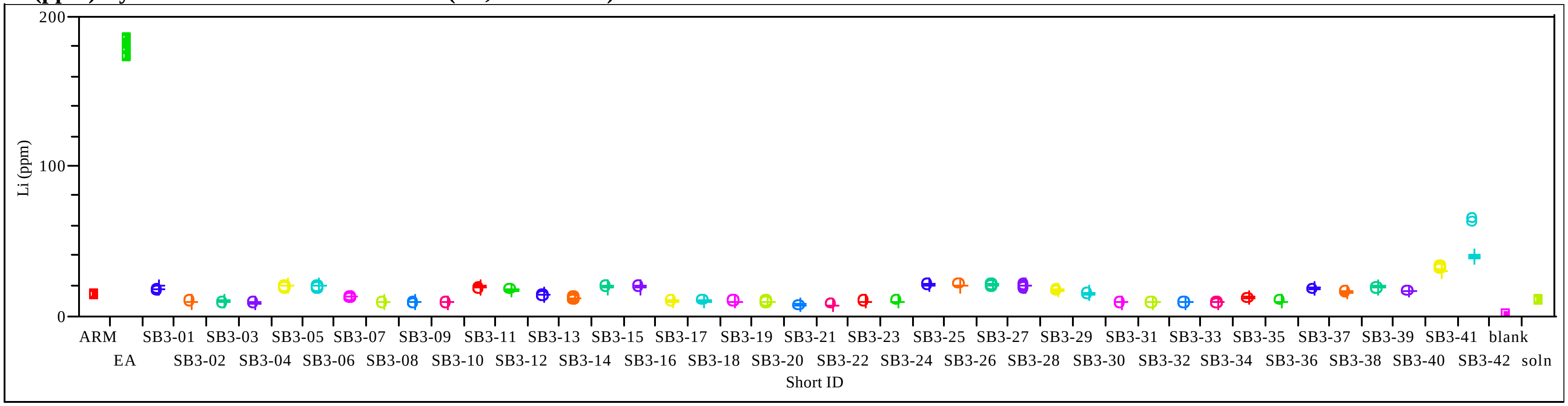
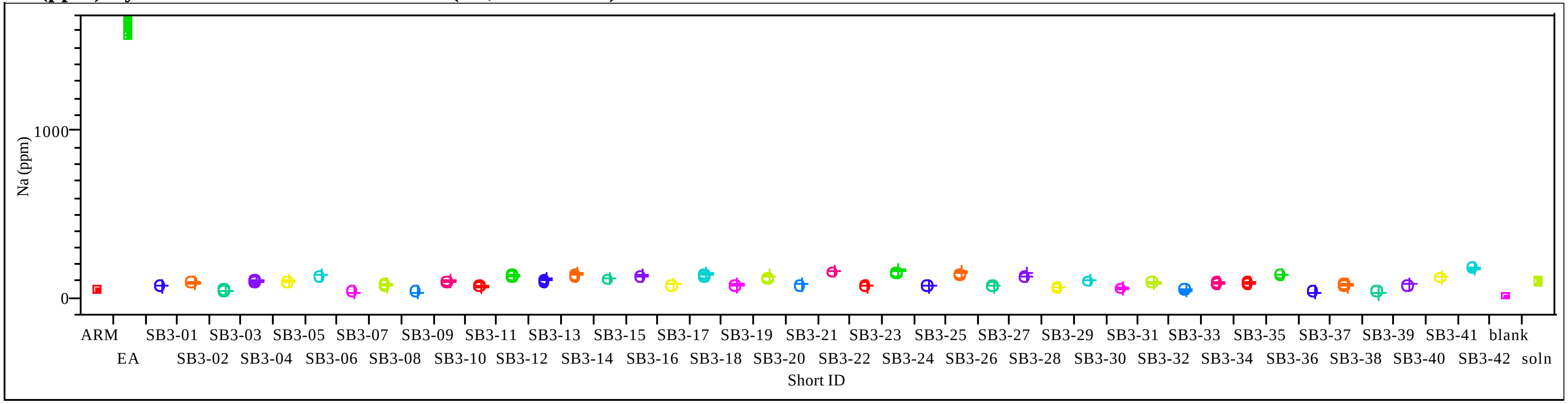


Exhibit I.4. SRTC-ML Mesaurements of PCT Leachate Solutions by SB3 Phase 1 Glass ID
(Plus – Quenched; Circle – Centerline Canister Cooled (ccc))

Na (ppm) By Glass ID w/o Heat Treatment (i.e., a Short ID)



Si (ppm) By Glass ID w/o Heat Treatment (i.e., a Short ID)

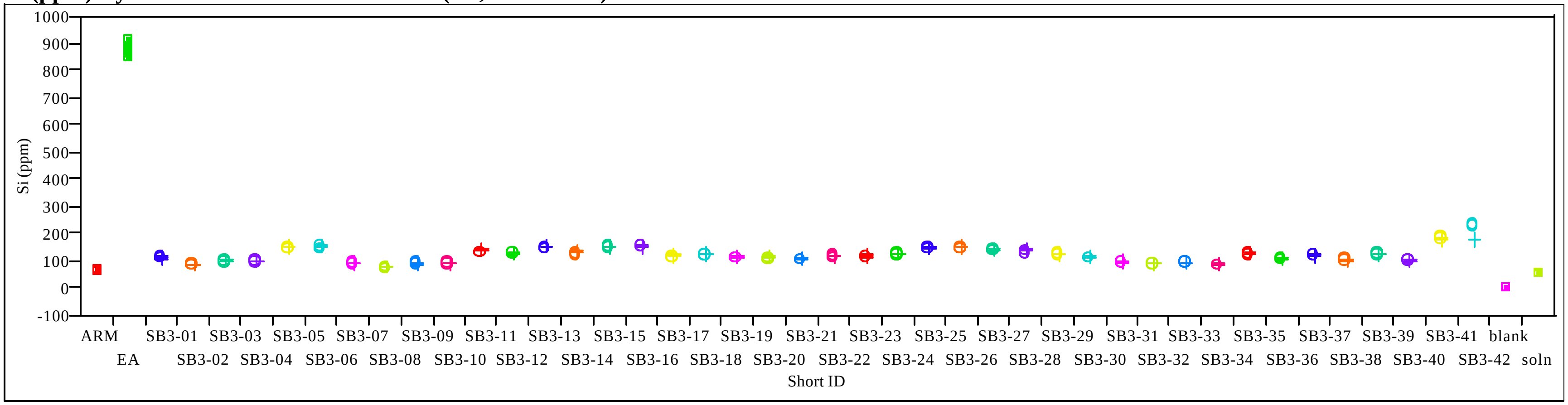


Exhibit I.4. SRTC-ML Mesaurements of PCT Leachate Solutions by SB3 Phase 1 Glass ID
(Plus – Quenched; Circle – Centerline Canister Cooled (ccc))

U (ppm) By Glass ID w/o Heat Treatment (i.e., a Short ID)

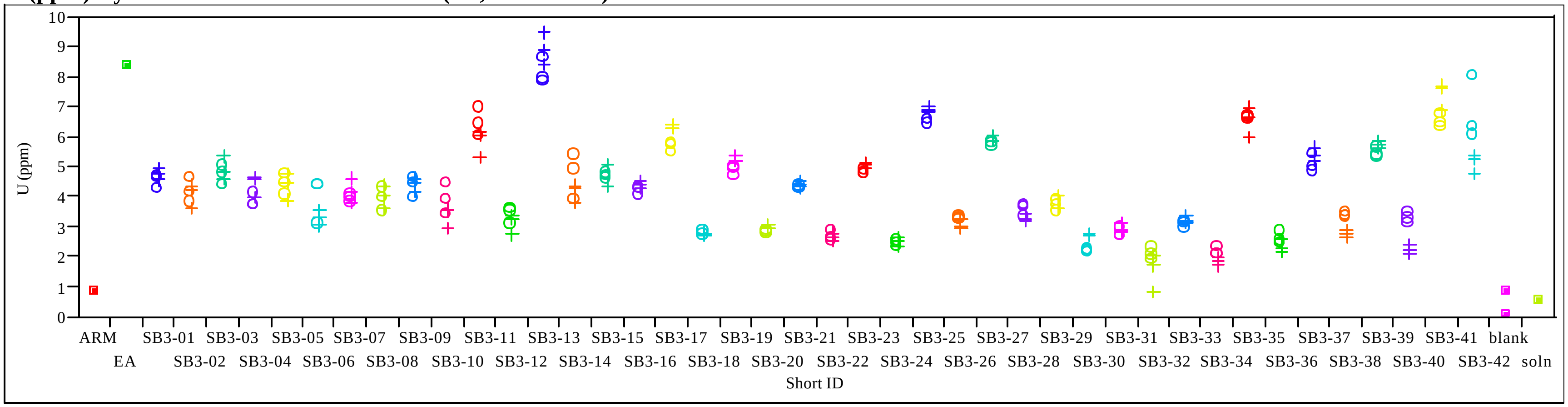
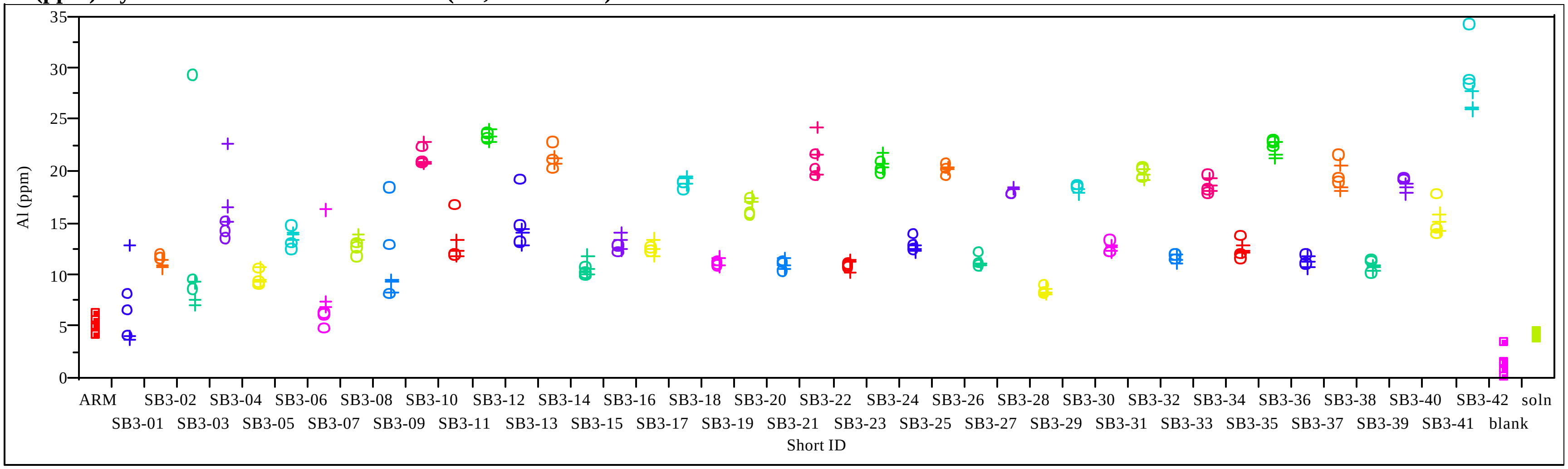


Exhibit I.5. SRTC-ML Mesaurements of PCT Leachate Solutions by SB3 Phase 1 Glass ID without EA

(Plus – Quenched; Circle – Centerline Canister Cooled (ccc))

Al (ppm) By Glass ID w/o Heat Treatment (i.e., a Short ID)



B (ppm) By Glass ID w/o Heat Treatment (i.e., a Short ID)

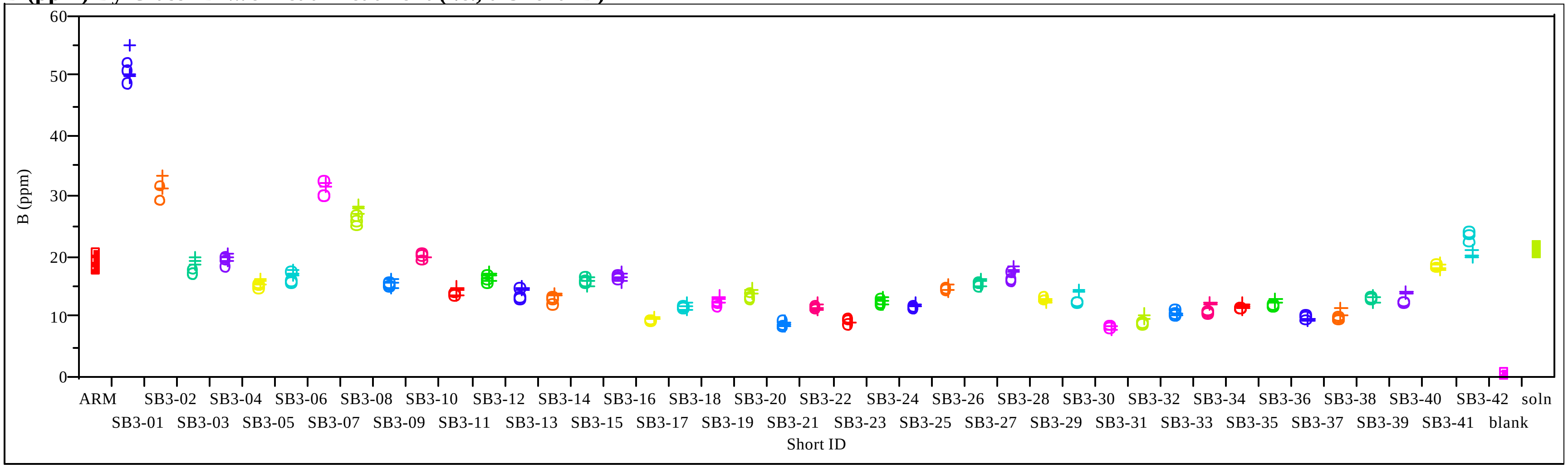
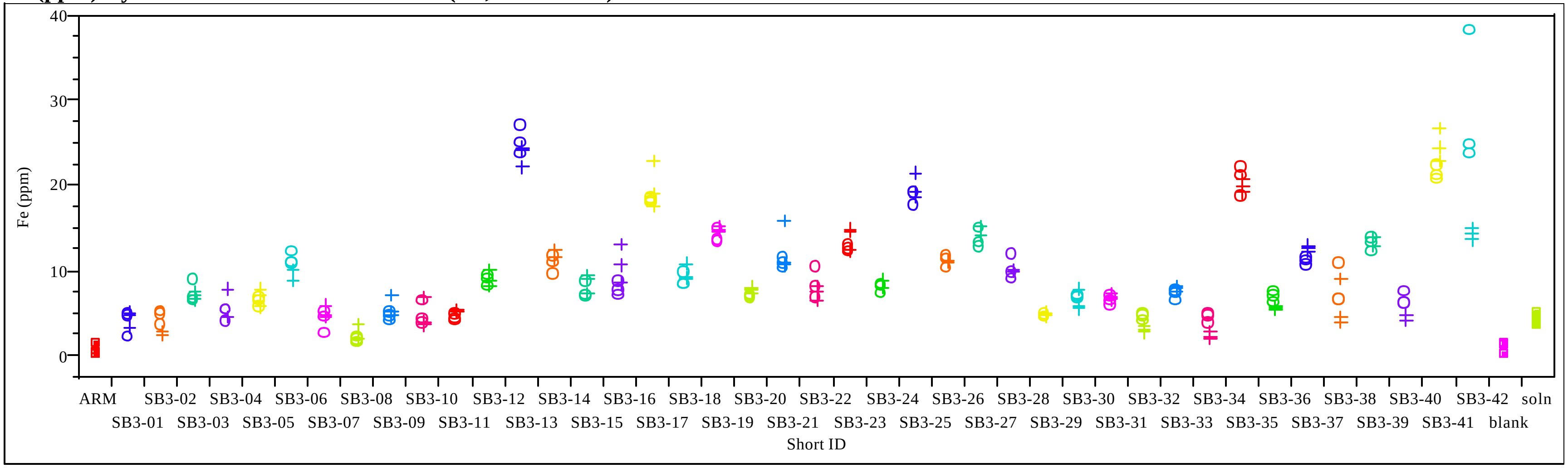


Exhibit I.5. SRTC-ML Mesaurements of PCT Leachate Solutions by SB3 Phase 1 Glass ID without EA

(Plus – Quenched; Circle – Centerline Canister Cooled (ccc))

Fe (ppm) By Glass ID w/o Heat Treatment (i.e., a Short ID)



Li (ppm) By Glass ID w/o Heat Treatment (i.e., a Short ID)

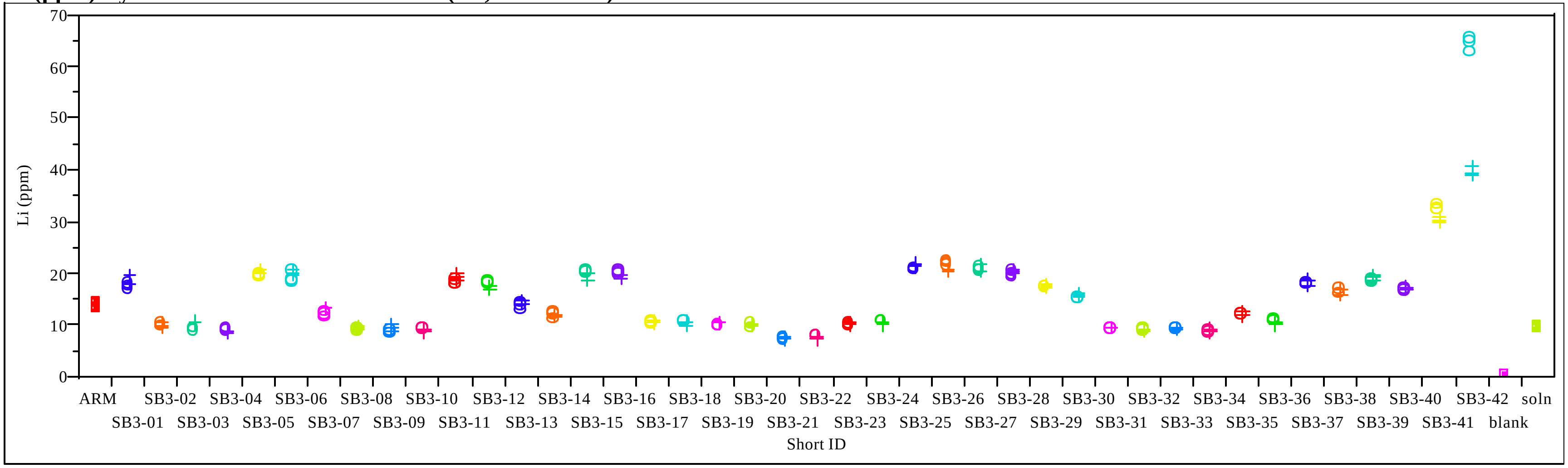
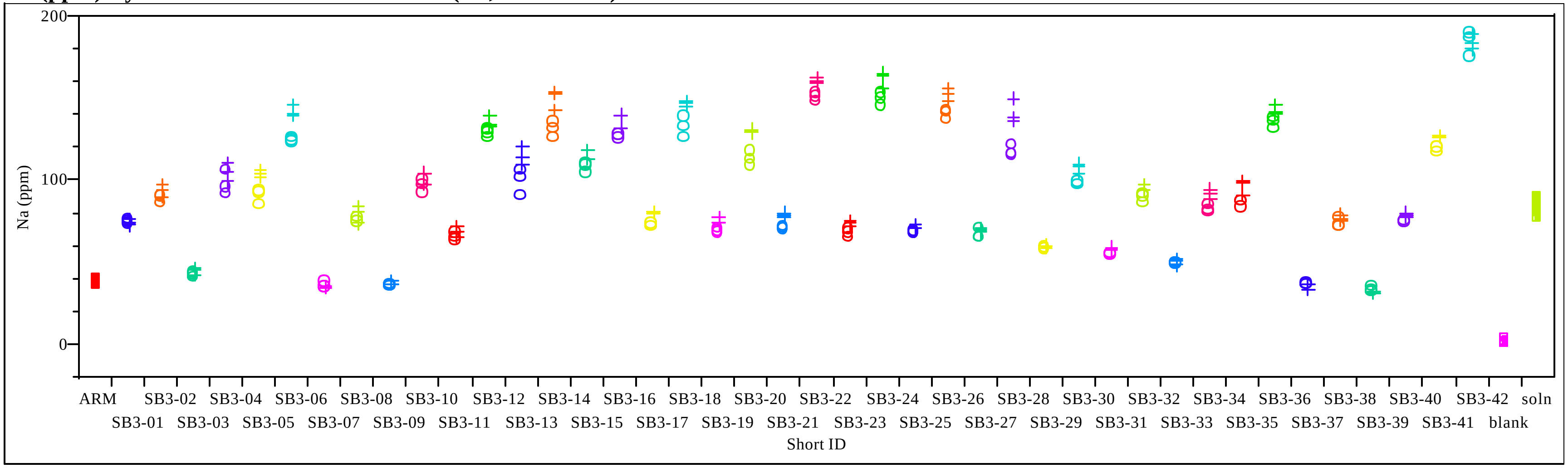


Exhibit I.5. SRTC-ML Mesaurements of PCT Leachate Solutions by SB3 Phase 1 Glass ID without EA

(Plus – Quenched; Circle – Centerline Canister Cooled (ccc))

Na (ppm) By Glass ID w/o Heat Treatment (i.e., a Short ID)



Si (ppm) By Glass ID w/o Heat Treatment (i.e., a Short ID)

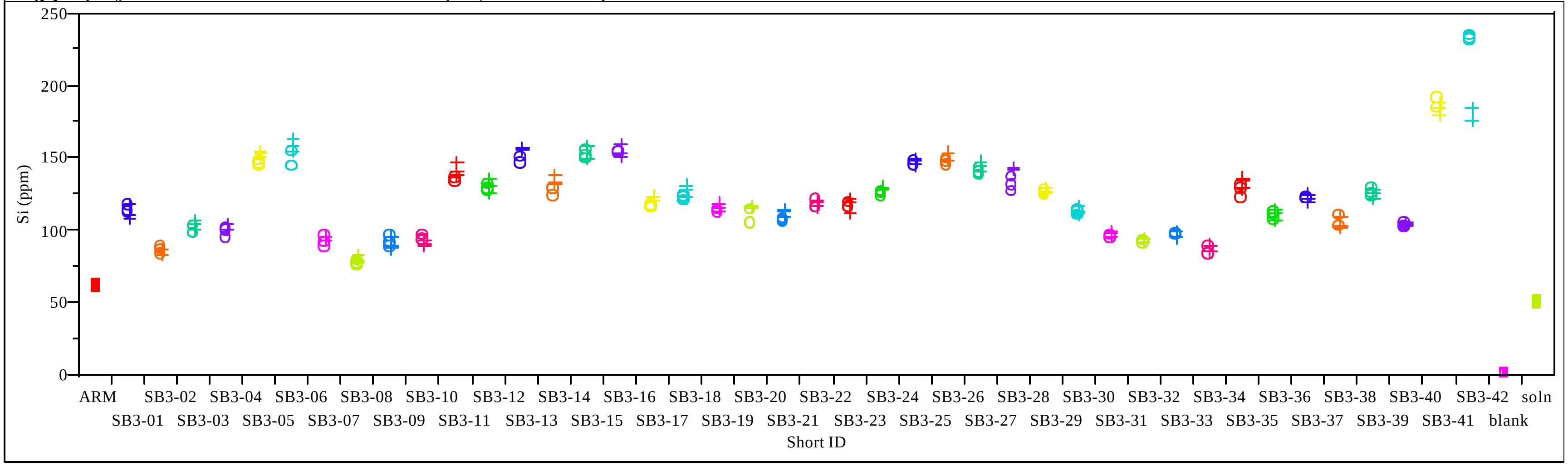


Exhibit I.5. SRTC-ML Mesaurements of PCT Leachate Solutions by SB3 Phase 1 Glass ID without EA
(Plus – Quenched; Circle – Centerline Canister Cooled (ccc))

U (ppm) By Glass ID w/o Heat Treatment (i.e., a Short ID)

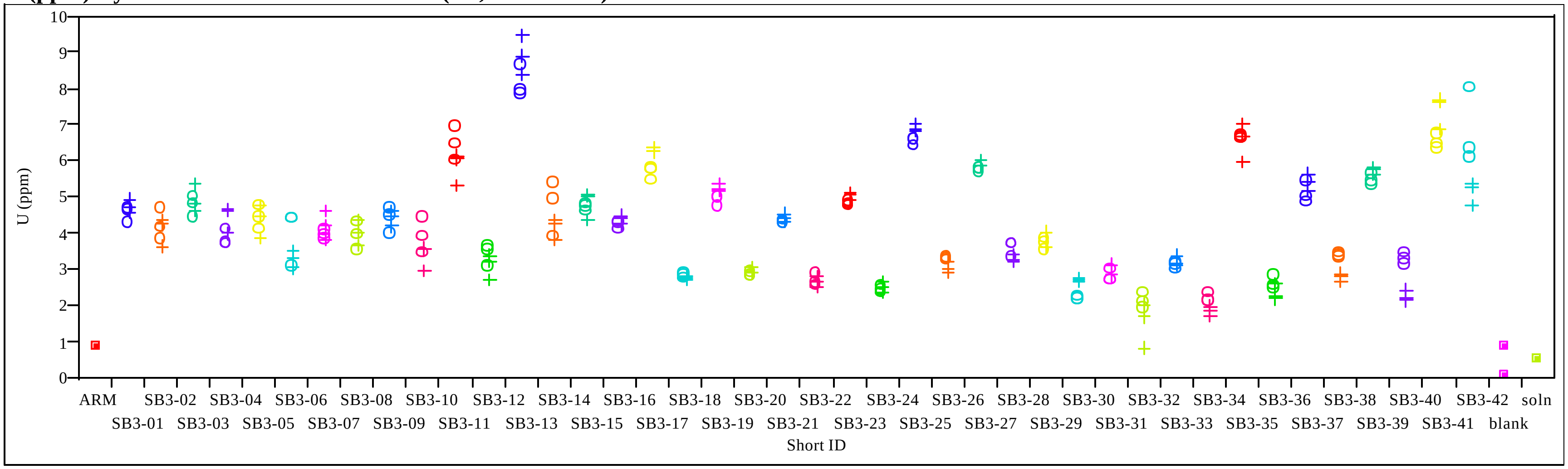
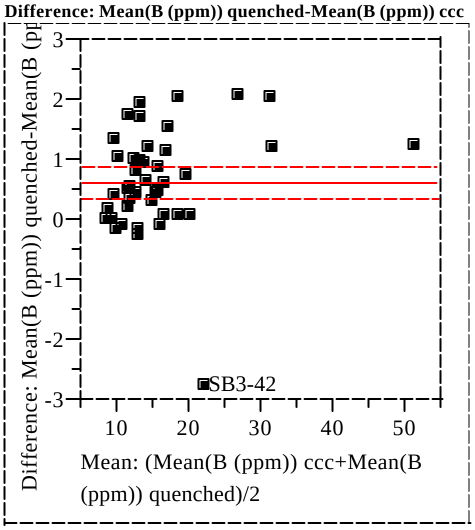


Exhibit I.5. SRTC-ML Mesaurements of PCT Leachate Solutions by SB3 Phase 1 Glass ID without EA

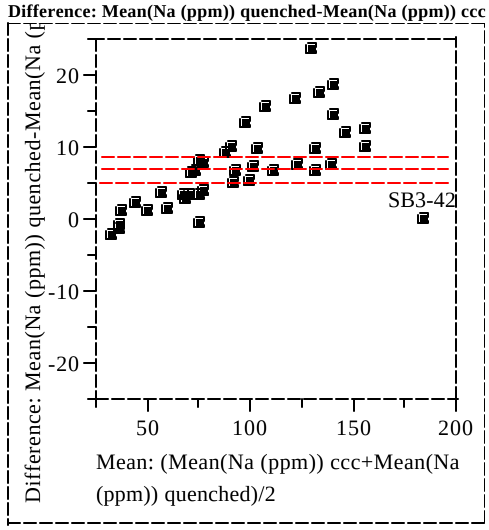
(Plus – Quenched; Circle – Centerline Canister Cooled (ccc))

Difference: Mean(B (ppm)) quenched-Mean(B (ppm)) ccc



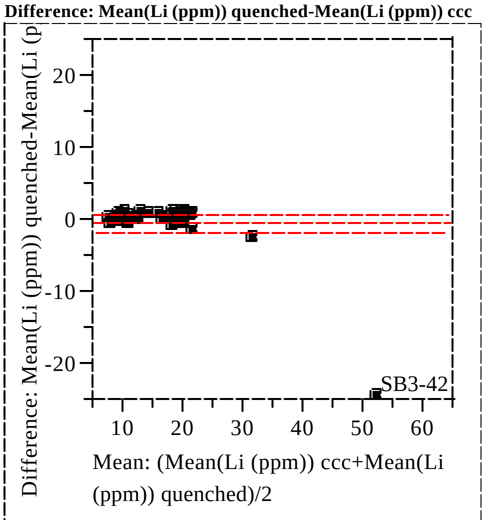
Mean(B (ppm)) quenched	16.1085	t-Ratio	4.760958
Mean(B (ppm)) ccc	15.4787	DF	41
Mean Difference	0.62977	Prob > |t|	<.0001
Std Error	0.13228	Prob > t	<.0001
Upper95%	0.89692	Prob < t	1.0000
Lower95%	0.36263		
N	42		
Correlation	0.99409		

Difference: Mean(Na (ppm)) quenched-Mean(Na (ppm)) ccc



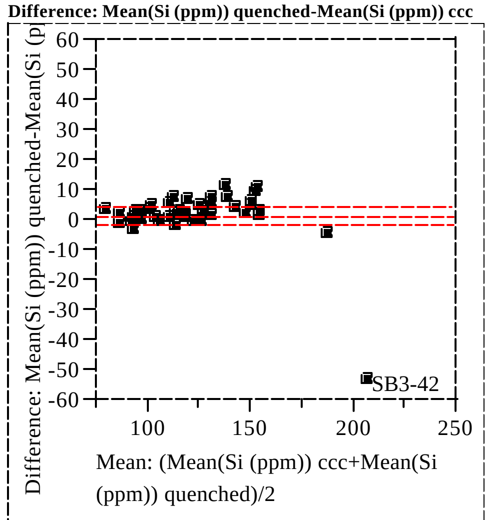
Mean(Na (ppm)) quenched	97.9993	t-Ratio	7.697725
Mean(Na (ppm)) ccc	91.0137	DF	41
Mean Difference	6.98559	Prob > |t|	<.0001
Std Error	0.90749	Prob > t	<.0001
Upper95%	8.8183	Prob < t	1.0000
Lower95%	5.15288		
N	42		
Correlation	0.99283		

Difference: Mean(Li (ppm)) quenched-Mean(Li (ppm)) ccc



Mean(Li (ppm)) quenched	15.0399	t-Ratio	-0.86492
Mean(Li (ppm)) ccc	15.5572	DF	41
Mean Difference	-0.5173	Prob > |t|	0.3921
Std Error	0.59813	Prob > t	0.8039
Upper95%	0.69062	Prob < t	0.1961
Lower95%	-1.7253		
N	42		
Correlation	0.94519		

Difference: Mean(Si (ppm)) quenched-Mean(Si (ppm)) ccc

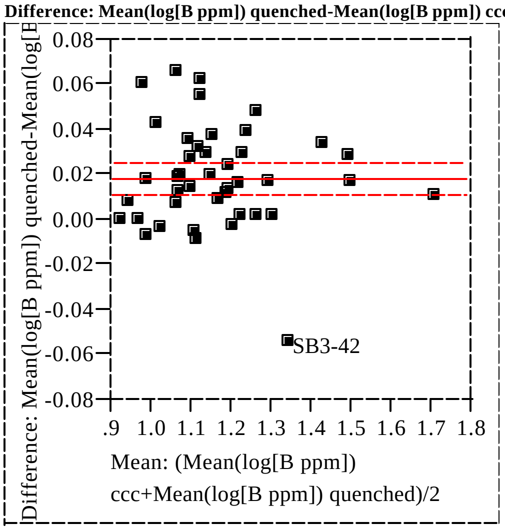


Mean(Si (ppm)) quenched	123.251	t-Ratio	0.799233
Mean(Si (ppm)) ccc	122.095	DF	41
Mean Difference	1.15611	Prob > |t|	0.4288
Std Error	1.44652	Prob > t	0.2144
Upper95%	4.07742	Prob < t	0.7856
Lower95%	-1.7652		
N	42		
Correlation	0.94874		

Exhibit I.5. SRTC-ML Mesaurements of PCT Leachate Solutions by SB3 Phase 1 Glass ID without EA

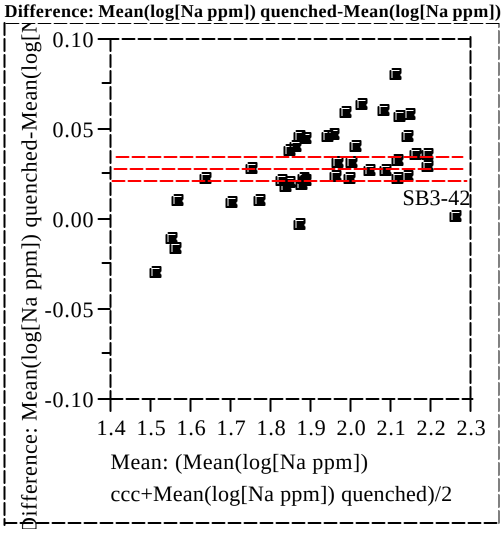
(Plus – Quenched; Circle – Centerline Canister Cooled (ccc))

Difference: Mean(log[B ppm]) quenched-Mean(log[B ppm]) ccc



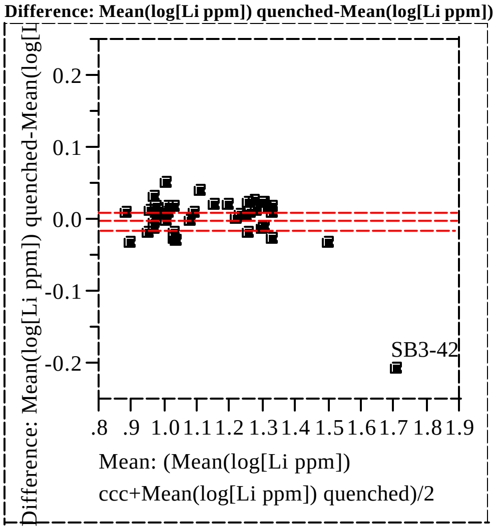
Mean(log[B ppm]) quenched	1.17356	t-Ratio	5.232583
Mean(log[B ppm]) ccc	1.15533	DF	41
Mean Difference	0.01823	Prob > |t|	<.0001
Std Error	0.00348	Prob > t	<.0001
Upper95%	0.02526	Prob < t	1.0000
Lower95%	0.01119		
N	42		
Correlation	0.99016		

Difference: Mean(log[Na ppm]) quenched-Mean(log[Na ppm]) ccc



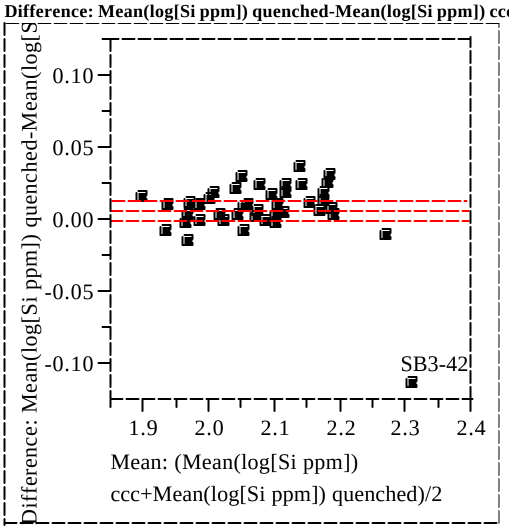
Mean(log[Na ppm]) quenched	1.95091	t-Ratio	8.264532
Mean(log[Na ppm]) ccc	1.92286	DF	41
Mean Difference	0.02805	Prob > |t|	<.0001
Std Error	0.00339	Prob > t	<.0001
Upper95%	0.03491	Prob < t	1.0000
Lower95%	0.0212		
N	42		
Correlation	0.99572		

Difference: Mean(log[Li ppm]) quenched-Mean(log[Li ppm]) ccc



Mean(log[Li ppm]) quenched	1.14254	t-Ratio	-0.39455
Mean(log[Li ppm]) ccc	1.14486	DF	41
Mean Difference	-0.0023	Prob > |t|	0.6952
Std Error	0.00588	Prob > t	0.6524
Upper95%	0.00956	Prob < t	0.3476
Lower95%	-0.0142		
N	42		
Correlation	0.98158		

Difference: Mean(log[Si ppm]) quenched-Mean(log[Si ppm]) ccc

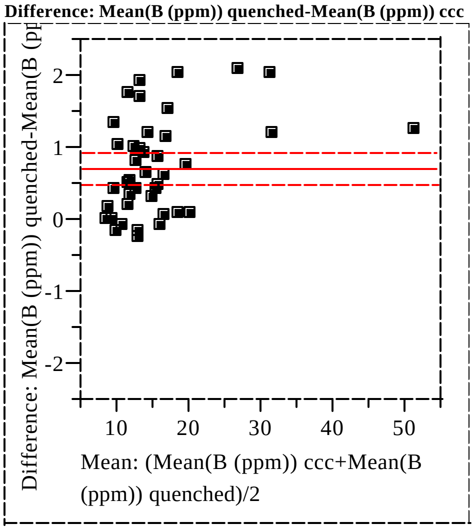


Mean(log[Si ppm]) quenched	2.0816	t-Ratio	1.635174
Mean(log[Si ppm]) ccc	2.07601	DF	41
Mean Difference	0.0056	Prob > |t|	0.1097
Std Error	0.00342	Prob > t	0.0548
Upper95%	0.01251	Prob < t	0.9452
Lower95%	-0.0013		
N	42		
Correlation	0.97274		

Exhibit I.5. SRTC-ML Mesaurements of PCT Leachate Solutions by SB3 Phase 1 Glass ID without EA

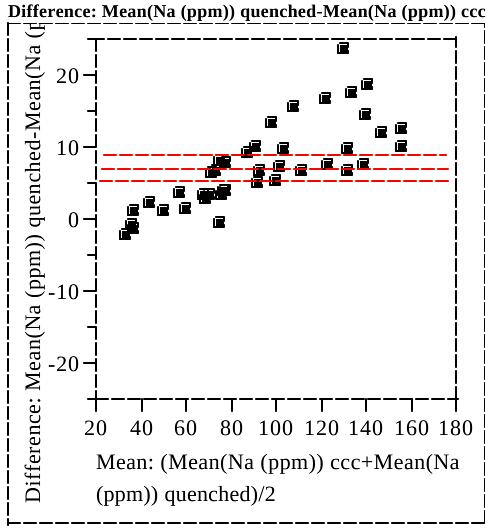
(Plus – Quenched; Circle – Centerline Canister Cooled (ccc))

Difference: Mean(B (ppm)) quenched-Mean(B (ppm)) ccc



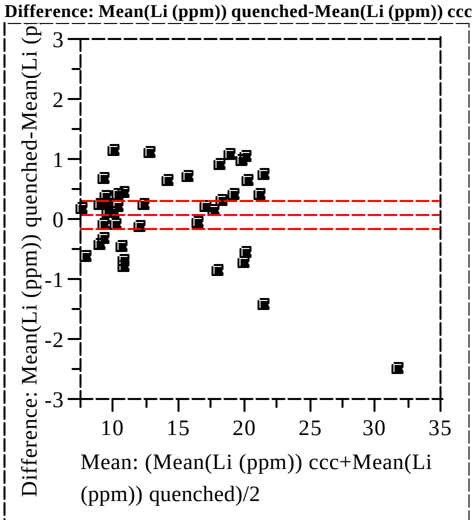
Mean(B (ppm)) quenched	16	t-Ratio	6.760471
Mean(B (ppm)) ccc	15.2872	DF	40
Mean Difference	0.71289	Prob > |t|	<.0001
Std Error	0.10545	Prob > t	<.0001
Upper95%	0.92601	Prob < t	1.0000
Lower95%	0.49977		
N	41		
Correlation	0.99674		

Difference: Mean(Na (ppm)) quenched-Mean(Na (ppm)) ccc



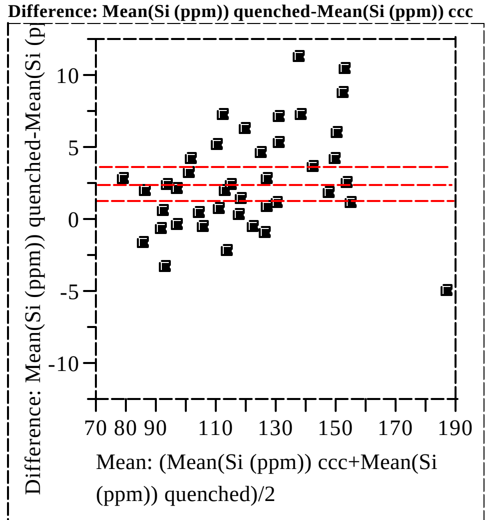
Mean(Na (ppm)) quenched	95.9044	t-Ratio	7.834761
Mean(Na (ppm)) ccc	88.7484	DF	40
Mean Difference	7.15597	Prob > |t|	<.0001
Std Error	0.91336	Prob > t	<.0001
Upper95%	9.00194	Prob < t	1.0000
Lower95%	5.31		
N	41		
Correlation	0.99465		

Difference: Mean(Li (ppm)) quenched-Mean(Li (ppm)) ccc



Mean(Li (ppm)) quenched	14.4351	t-Ratio	0.616012
Mean(Li (ppm)) ccc	14.3648	DF	40
Mean Difference	0.07033	Prob > |t|	0.5414
Std Error	0.11416	Prob > t	0.2707
Upper95%	0.30106	Prob < t	0.7293
Lower95%	-0.1604		
N	41		
Correlation	0.99124		

Difference: Mean(Si (ppm)) quenched-Mean(Si (ppm)) ccc

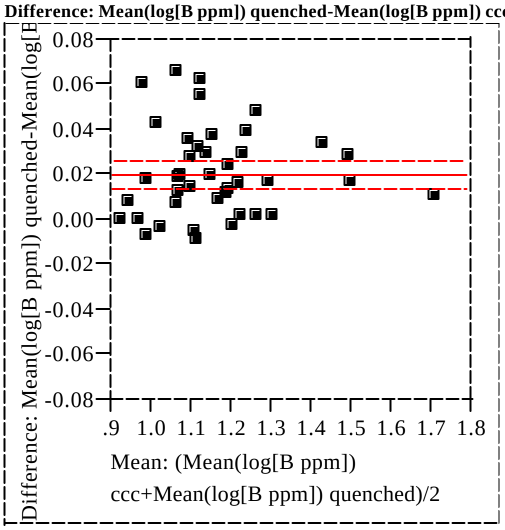


Mean(Si (ppm)) quenched	121.88	t-Ratio	4.529057
Mean(Si (ppm)) ccc	119.382	DF	40
Mean Difference	2.49869	Prob > |t|	<.0001
Std Error	0.5517	Prob > t	<.0001
Upper95%	3.61373	Prob < t	1.0000
Lower95%	1.38366		
N	41		
Correlation	0.98985		

Exhibit I.5. SRTC-ML Mesaurements of PCT Leachate Solutions by SB3 Phase 1 Glass ID without EA

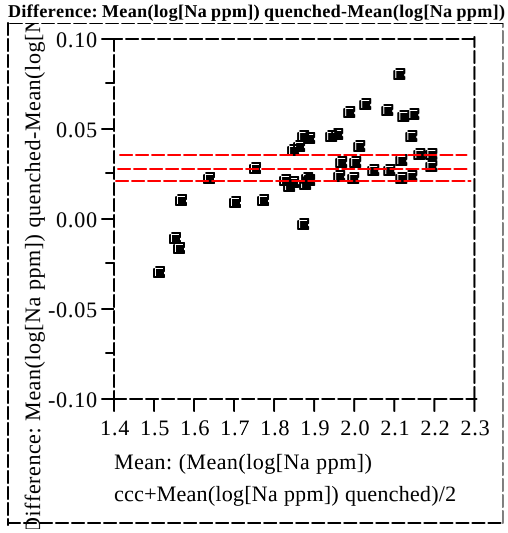
(Plus – Quenched; Circle – Centerline Canister Cooled (ccc))

Difference: Mean(log[B ppm]) quenched-Mean(log[B ppm]) ccc



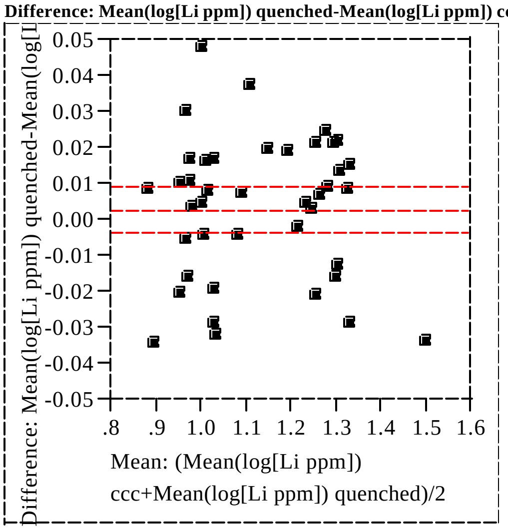
Mean(log[B ppm]) quenched	1.17016	t-Ratio	6.527129
Mean(log[B ppm]) ccc	1.15015	DF	40
Mean Difference	0.02001	Prob > |t|	<.0001
Std Error	0.00307	Prob > t	<.0001
Upper95%	0.02621	Prob < t	1.0000
Lower95%	0.01382		
N	41		
Correlation	0.99246		

Difference: Mean(log[Na ppm]) quenched-Mean(log[Na ppm]) ccc



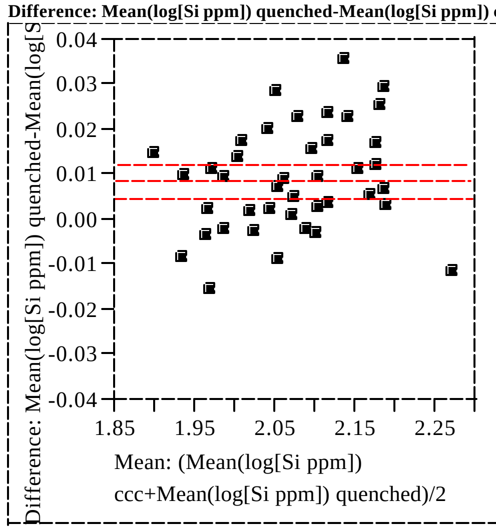
Mean(log[Na ppm]) quenched	1.94326	t-Ratio	8.431366
Mean(log[Na ppm]) ccc	1.91453	DF	40
Mean Difference	0.02873	Prob > |t|	<.0001
Std Error	0.00341	Prob > t	<.0001
Upper95%	0.03562	Prob < t	1.0000
Lower95%	0.02184		
N	41		
Correlation	0.99636		

Difference: Mean(log[Li ppm]) quenched-Mean(log[Li ppm]) ccc



Mean(log[Li ppm]) quenched	1.13138	t-Ratio	0.87388
Mean(log[Li ppm]) ccc	1.12866	DF	40
Mean Difference	0.00272	Prob > |t|	0.3874
Std Error	0.00311	Prob > t	0.1937
Upper95%	0.009	Prob < t	0.8063
Lower95%	-0.0036		
N	41		
Correlation	0.99196		

Difference: Mean(log[Si ppm]) quenched-Mean(log[Si ppm]) ccc



Mean(log[Si ppm]) quenched	2.0774	t-Ratio	4.660801
Mean(log[Si ppm]) ccc	2.06888	DF	40
Mean Difference	0.00852	Prob > |t|	<.0001
Std Error	0.00183	Prob > t	<.0001
Upper95%	0.01221	Prob < t	1.0000
Lower95%	0.00482		
N	41		
Correlation	0.99118		

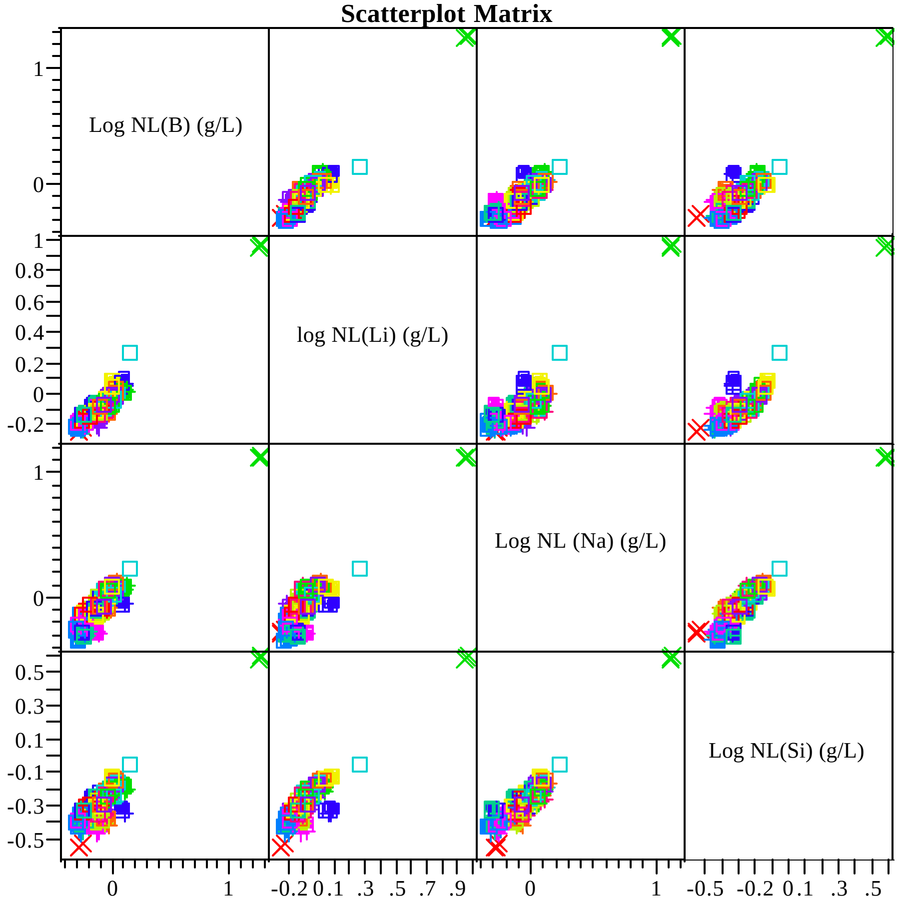
Exhibit I.8 Correlations and Scatterplots of Normalized PCTs Over All Compositional Views and Heat Treatments

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	0.9653	0.9281	0.8894
log NL(Li) (g/L)	0.9653	1.0000	0.8880	0.9182
Log NL (Na) (g/L)	0.9281	0.8880	1.0000	0.9315
Log NL(Si) (g/L)	0.8894	0.9182	0.9315	1.0000

5 rows not used due to missing values.

Scatterplot Matrix



Appendix J

ΔG_P Delta as a Function Fe Concentration and Redox

Table J.1. Predicted ΔG_P Delta as a Function of Fe Concentration in Glass and Redox.

	Fe Concentration (wt%) in Glass														
Redox (f)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
0.01	-0.0051	-0.0102	-0.0154	-0.0205	-0.0256	-0.0307	-0.0359	-0.0410	-0.0461	-0.0512	-0.0564	-0.0615	-0.0666	-0.0717	-0.0768
0.02	-0.0102	-0.0205	-0.0307	-0.0410	-0.0512	-0.0615	-0.0717	-0.0820	-0.0922	-0.1025	-0.1127	-0.1230	-0.1332	-0.1434	-0.1537
0.03	-0.0154	-0.0307	-0.0461	-0.0615	-0.0768	-0.0922	-0.1076	-0.1230	-0.1383	-0.1537	-0.1691	-0.1844	-0.1998	-0.2152	-0.2305
0.04	-0.0205	-0.0410	-0.0615	-0.0820	-0.1025	-0.1230	-0.1434	-0.1639	-0.1844	-0.2049	-0.2254	-0.2459	-0.2664	-0.2869	-0.3074
0.05	-0.0256	-0.0512	-0.0768	-0.1025	-0.1281	-0.1537	-0.1793	-0.2049	-0.2305	-0.2561	-0.2818	-0.3074	-0.3330	-0.3586	-0.3842
0.06	-0.0307	-0.0615	-0.0922	-0.1230	-0.1537	-0.1844	-0.2152	-0.2459	-0.2766	-0.3074	-0.3381	-0.3689	-0.3996	-0.4303	-0.4611
0.07	-0.0359	-0.0717	-0.1076	-0.1434	-0.1793	-0.2152	-0.2510	-0.2869	-0.3227	-0.3586	-0.3945	-0.4303	-0.4662	-0.5020	-0.5379
0.08	-0.0410	-0.0820	-0.1230	-0.1639	-0.2049	-0.2459	-0.2869	-0.3279	-0.3689	-0.4098	-0.4508	-0.4918	-0.5328	-0.5738	-0.6148
0.09	-0.0461	-0.0922	-0.1383	-0.1844	-0.2305	-0.2766	-0.3227	-0.3689	-0.4150	-0.4611	-0.5072	-0.5533	-0.5994	-0.6455	-0.6916
0.10	-0.0512	-0.1025	-0.1537	-0.2049	-0.2561	-0.3074	-0.3586	-0.4098	-0.4611	-0.5123	-0.5635	-0.6148	-0.6660	-0.7172	-0.7684
0.11	-0.0564	-0.1127	-0.1691	-0.2254	-0.2818	-0.3381	-0.3945	-0.4508	-0.5072	-0.5635	-0.6199	-0.6762	-0.7326	-0.7889	-0.8453
0.12	-0.0615	-0.1230	-0.1844	-0.2459	-0.3074	-0.3689	-0.4303	-0.4918	-0.5533	-0.6148	-0.6762	-0.7377	-0.7992	-0.8607	-0.9221
0.13	-0.0666	-0.1332	-0.1998	-0.2664	-0.3330	-0.3996	-0.4662	-0.5328	-0.5994	-0.6660	-0.7326	-0.7992	-0.8658	-0.9324	-0.9990
0.14	-0.0717	-0.1434	-0.2152	-0.2869	-0.3586	-0.4303	-0.5020	-0.5738	-0.6455	-0.7172	-0.7889	-0.8607	-0.9324	-1.0041	-1.0758
0.15	-0.0768	-0.1537	-0.2305	-0.3074	-0.3842	-0.4611	-0.5379	-0.6148	-0.6916	-0.7684	-0.8453	-0.9221	-0.9990	-1.0758	-1.1527
0.16	-0.0820	-0.1639	-0.2459	-0.3279	-0.4098	-0.4918	-0.5738	-0.6557	-0.7377	-0.8197	-0.9016	-0.9836	-1.0656	-1.1475	-1.2295
0.17	-0.0871	-0.1742	-0.2613	-0.3484	-0.4354	-0.5225	-0.6096	-0.6967	-0.7838	-0.8709	-0.9580	-1.0451	-1.1322	-1.2193	-1.3063
0.18	-0.0922	-0.1844	-0.2766	-0.3689	-0.4611	-0.5533	-0.6455	-0.7377	-0.8299	-0.9221	-1.0143	-1.1066	-1.1988	-1.2910	-1.3832
0.19	-0.0973	-0.1947	-0.2920	-0.3893	-0.4867	-0.5840	-0.6814	-0.7787	-0.8760	-0.9734	-1.0707	-1.1680	-1.2654	-1.3627	-1.4600
0.20	-0.1025	-0.2049	-0.3074	-0.4098	-0.5123	-0.6148	-0.7172	-0.8197	-0.9221	-1.0246	-1.1270	-1.2295	-1.3320	-1.4344	-1.5369
0.21	-0.1076	-0.2152	-0.3227	-0.4303	-0.5379	-0.6455	-0.7531	-0.8607	-0.9682	-1.0758	-1.1834	-1.2910	-1.3986	-1.5061	-1.6137
0.22	-0.1127	-0.2254	-0.3381	-0.4508	-0.5635	-0.6762	-0.7889	-0.9016	-1.0143	-1.1270	-1.2398	-1.3525	-1.4652	-1.5779	-1.6906
0.23	-0.1178	-0.2357	-0.3535	-0.4713	-0.5891	-0.7070	-0.8248	-0.9426	-1.0604	-1.1783	-1.2961	-1.4139	-1.5318	-1.6496	-1.7674
0.24	-0.1230	-0.2459	-0.3689	-0.4918	-0.6148	-0.7377	-0.8607	-0.9836	-1.1066	-1.2295	-1.3525	-1.4754	-1.5984	-1.7213	-1.8443
0.25	-0.1281	-0.2561	-0.3842	-0.5123	-0.6404	-0.7684	-0.8965	-1.0246	-1.1527	-1.2807	-1.4088	-1.5369	-1.6650	-1.7930	-1.9211
0.26	-0.1332	-0.2664	-0.3996	-0.5328	-0.6660	-0.7992	-0.9324	-1.0656	-1.1988	-1.3320	-1.4652	-1.5984	-1.7316	-1.8647	-1.9979
0.27	-0.1383	-0.2766	-0.4150	-0.5533	-0.6916	-0.8299	-0.9682	-1.1066	-1.2449	-1.3832	-1.5215	-1.6598	-1.7982	-1.9365	-2.0748
0.28	-0.1434	-0.2869	-0.4303	-0.5738	-0.7172	-0.8607	-1.0041	-1.1475	-1.2910	-1.4344	-1.5779	-1.7213	-1.8647	-2.0082	-2.1516
0.29	-0.1486	-0.2971	-0.4457	-0.5943	-0.7428	-0.8914	-1.0400	-1.1885	-1.3371	-1.4857	-1.6342	-1.7828	-1.9313	-2.0799	-2.2285
0.30	-0.1537	-0.3074	-0.4611	-0.6148	-0.7684	-0.9221	-1.0758	-1.2295	-1.3832	-1.5369	-1.6906	-1.8443	-1.9979	-2.1516	-2.3053
0.31	-0.1588	-0.3176	-0.4764	-0.6352	-0.7941	-0.9529	-1.1117	-1.2705	-1.4293	-1.5881	-1.7469	-1.9057	-2.0645	-2.2234	-2.3822
0.32	-0.1639	-0.3279	-0.4918	-0.6557	-0.8197	-0.9836	-1.1475	-1.3115	-1.4754	-1.6393	-1.8033	-1.9672	-2.1311	-2.2951	-2.4590
0.33	-0.1691	-0.3381	-0.5072	-0.6762	-0.8453	-1.0143	-1.1834	-1.3525	-1.5215	-1.6906	-1.8596	-2.0287	-2.1977	-2.3668	-2.5359