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Characterization of the Sulfur-Saturated Melt Versions of the EMHQ LAW Glasses

M. C. Hsieh

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EXECUTIVE SUMMARY

This report provides the results from the chemical analyses of a series of sulfur-saturated melt versions of the EMHQ Low-Activity Waste study glasses, a series of simulated nuclear waste glasses designed and fabricated at Pacific Northwest National Laboratory. These data will be used in the development, validation, and implementation of enhanced property/composition models for waste glass vitrification at Hanford.

Chemical analyses were performed on a representative sample of each of the sulfur-saturated melt versions of the glasses to allow for comparisons with targeted compositions, as well as the measured compositions of the quenched glasses. The relative differences between the targeted and measured concentrations of B_2O_3, Na_2O, and SO_3 for several of the glasses and V_2O_5 and ZrO_2 in two individual glasses were greater than ±10%.

The wash solutions contained mainly sodium and sulfur.

TABLE OF CONTENTS

LIST OF TABLES viii
LIST OF ABBREVIATIONS ix
1.0 Introduction 1
2.0 Experimental Procedure 1
2.1 Quality Assurance 1
2.2 Glasses Selected for Study 1
2.3 Glass Composition Analysis 2
2.4 Wash Solution Analysis 3
3.0 Results and Discussion 4
3.1 Review and Evaluation of the SSM Glass Composition Measurements 4
3.1.1 Treatment of Detection Limits 4
3.1.2 Composition Measurements by Glass Identifier 4
3.1.3 Results for the LRM Standard Glass 5
3.1.4 Measured versus Target Compositions 5
3.2 Comparison of Measured Compositions of Baseline and SSM Glasses 5
3.3 Review and Evaluation of the Wash Solution Measurements 5
3.3.1 Treatment of Detection Limits 6
3.3.2 Composition Measurements by Wash Solution Identifier 6
3.3.3 Results for the Standard Solutions 6
3.3.4 Measured Compositions of the Wash Solutions 6
4.0 Summary 6
5.0 References 7
Appendix A . Tables and Exhibits Supporting the EMHQ LAW Glass Composition Measurements A-1
Appendix B . Tables and Exhibits Supporting the Wash Solution Composition Measurements B-1

LIST OF TABLES

Table 2-1. Identifiers for the EMHQ LAW SSM Study Glasses 2

Table 2-2. Identifiers for the EMHQ LAW SSM Wash Solutions 2

Table 2-3. Preparation and Measurement Methods Used in Reporting the Analyte Concentrations of the Study Glasses 3

Table 2-4. Measurement Methods Used in Reporting the Analyte Concentrations of the Wash Solutions . 4

LIST OF ABBREVIATIONS

BDL	below detection limit
DOE	Department of Energy
hp std	High Purity Standards ICP multi-element custom solution SM-744-063
IC	ion chromatography
ICP-OES	inductively coupled plasma – optical emission spectroscopy
ID	identifier
KH	potassium hydroxide fusion
LAW	low-activity waste
LM	lithium metaborate fusion
LRM	low-activity test reference material
ORP	Office of River Protection
PF	sodium peroxide fusion
PNNL	Pacific Northwest National Laboratory
seq	sequence
SRNL	Savannah River National Laboratory
SSM	sulfur-saturated melt
std	High Purity Standards ICP multi-element custom solution SM-744-013
TTQAP	Task Technical and Quality Assurance Plan
wt.%	weight percent
WTP	Hanford Waste Treatment and Immobilization Plant

1.0 Introduction

The U.S. Department of Energy (DOE) is responsible for building the Hanford Tank Waste Treatment and Immobilization Plant (WTP) at the Hanford site in Washington to remediate 55 million gallons of radioactive waste that is temporarily stored in 177 underground tanks. The Office of River Protection (ORP) has requested that the Savannah River National Laboratory (SRNL) contribute in areas of recognized capabilities and expertise for glass waste form development to support successful startup of the WTP.

Successful efforts have allowed for demonstration of greatly enhanced treatment efficiencies of those projected from the minimum requirements set forth in the WTP Contract[a]. Additional flexibility and expansion of the qualified glass forming region are the current focus.[1] SRNL support of this work is defined in the Task Technical and Quality Assurance Plan (TTQAP).[2]

This report provides results from the chemical analyses of the sulfur-saturated melt (SSM) versions of the Low-Activity Waste (LAW) composition boundary expansion study glasses, a series of simulated nuclear waste glasses designed and fabricated at Pacific Northwest National Laboratory (PNNL). The glasses were selected as part of a broader study of the influence of glass composition on chemical durability, sulfur retention, and other properties.[3] The resulting data will be used in the development, validation, and implementation of enhanced property/composition models for nuclear waste glasses.[1]

2.0 Experimental Procedure

2.1 Quality Assurance

Requirements for performing reviews of technical reports and the extent of review are established in Manual E7, Procedure 2.60.[4] SRNL documents the extent and type of review using the SRNL Technical Report Design Checklist contained in WSRC-IM-2002-00011.[5] Laboratory data for this study were recorded in the SRNL Electronic Laboratory Notebook system, experiment L6390-00441-04. The glasses provided by PNNL were designed and fabricated following a Task Plan.[1]

2.2 Glasses Selected for Study

The baseline (quenched) glass compositions in this study were designed and fabricated by PNNL. Characterization of the baseline glasses were reported earlier.[6] Samples of each of the SSM versions of the study glasses, along with samples of the wash solutions resulting from the preparation of each of the SSM glasses, were received at SRNL for chemical composition analysis. PNNL identifiers (IDs) for the glass samples and associated SRNL sample identifiers are listed in Table 2-1. The identifiers for the wash solutions are likewise listed in Table 2-2.

[a]Contract DE-AC27-01RV14136, as amended, U.S. Department of Energy, Richland, WA (2000).

Table 2-1. Identifiers for the EMHQ LAW SSM Study Glasses

PNNL Glass ID	Lab ID
EMHQ-LBE-01-SSM-S	S-13419
EMHQ-LBE-02-SSM-S	S-13420
EMHQ-LBE-03-SSM-S	S-13421
EMHQ-LBE-04-SSM-S	S-13422
EMHQ-LBE-05-SSM-S	S-13423
EMHQ-LBE-06-SSM-S	S-13424
EMHQ-LBE-07-SSM-S	S-13425
EMHQ-LBE-08-SSM-S	S-13426
EMHQ-LBE-09-SSM-S	S-13427
EMHQ-LBE-10-SSM-S	S-13428
EMHQ-LBE-SSM-S	S-13429

Table 2-2. Identifiers for the EMHQ LAW SSM Wash Solutions

PNNL Wash Solution ID	Lab ID
EMHQ-LBE-01-SSM-W	S-13430
EMHQ-LBE-02-SSM-W	S-13431
EMHQ-LBE-03-SSM-W	S-13432
EMHQ-LBE-04-SSM-W	S-13433
EMHQ-LBE-05-SSM-W	S-13434
EMHQ-LBE-06-SSM-W	S-13435
EMHQ-LBE-07-SSM-W	S-13436
EMHQ-LBE-08-SSM-W	S-13437
EMHQ-LBE-09-SSM-W	S-13438
EMHQ-LBE-10-SSM-W	S-13439
EMHQ-LBE-SSM-W	S-13440

2.3 Glass Composition Analysis

Chemical analyses were performed under the auspices of an analytical plan[7] on a representative sample of each of the glasses listed in Table 2-1 to allow for comparisons with the targeted compositions. Three dissolution techniques were used for preparing each of the glass samples, in duplicate, for analysis (potassium hydroxide fusion (KH), lithium metaborate fusion (LM), and sodium peroxide fusion (PF)).[8-10] Note that for some analytes, the analytical plan specified more than one preparation method for analysis. The results were reviewed and, in general, the method that provided better recovery of the analyte was selected for reporting.

Each of the duplicate samples was analyzed twice for each element of interest by inductively coupled plasma – optical emission spectroscopy (ICP-OES)[11] or ion chromatography (IC),[12] for a total of four measurements per element per glass. Glass standards were also intermittently measured to assess the performance of the ICP-OES and IC instruments over the course of these analyses. Specifically, several samples of the low-activity test reference material (LRM) were included as part of the analytical plans. The LRM composition reported as the "Consensus Average" is used as the reference composition of this glass.[13] The preparation and measurement methods used for each of the reported glass components are listed in Table 2-3.

Table 2-3. Preparation and Measurement Methods Used in Reporting the Analyte Concentrations of the Study Glasses

Analyte	Measurement Method	Preparation Method
Al	ICP-OES	PF
B	ICP-OES	PF
Ca	ICP-OES	PF
Cl	IC	KH
Cr	ICP-OES	LM
F	IC	KH
Fe	ICP-OES	LM
K	ICP-OES	LM
Li	ICP-OES	PF
Mg	ICP-OES	LM
Mn	ICP-OES	LM
Na	ICP-OES	LM
P	ICP-OES	LM
S	ICP-OES	LM
Si	ICP-OES	PF
Sn	ICP-OES	PF
Ti	ICP-OES	LM
V	ICP-OES	LM
Zr	ICP-OES	PF

2.4 Wash Solution Analysis

Chemical analyses were performed under the auspices of an analytical plan[7] on a representative sample of each of the wash solutions resulting from the preparation of the SSM versions of the glasses, as listed in Table 2-2. The samples were diluted at SRNL based on the expected concentrations of the species in solution in preparation for the analysis.

Each of the samples was analyzed in triplicate for each element of interest by ICP-OES[11] and IC[12]. Solution standards,[b] and blanks were also intermittently measured to assess the performance of the ICP-OES and IC instruments over the course of these analyses. The measurement methods used for each of the reported wash solution components are listed in Table 2-4.

[b] ICP multi-element custom solutions, product numbers SM-744-013 and SM-744-063, High Purity Standards, North Charleston, SC.

Table 2-4. Measurement Methods Used in Reporting the Analyte Concentrations of the Wash Solutions

Analyte	Measurement Method
Al	ICP-OES
B	ICP-OES
Ca	ICP-OES
Cl^-	IC
Cr	ICP-OES
F^-	IC
Fe	ICP-OES
K	ICP-OES
Li	ICP-OES
Mg	ICP-OES
Mn	ICP-OES
Na	ICP-OES
P	ICP-OES
PO_4^{3-}	IC
S	ICP-OES
SO_4^{2-}	IC
Si	ICP-OES
Sn	ICP-OES
Ti	ICP-OES
V	ICP-OES
Zr	ICP-OES

3.0 Results and Discussion

JMP® Version 16.0.0 (SAS Institute, Inc.)[14] was used to support these analyses.

3.1 Review and Evaluation of the SSM Glass Composition Measurements

Table A-1, Table A-2, and Table A-3 in Appendix A provide the elemental concentration measurements in weight percent (wt.%) from glasses prepared using KH, LM, and PF methods, respectively. Elemental measurements for samples of the LRM glass are also included in these tables of Appendix A.

3.1.1 Treatment of Detection Limits

The elemental concentrations in Table A-1, Table A-2, and Table A-3 in Appendix A were converted to oxide concentrations by multiplying the values of each element by the gravimetric factor for the corresponding oxide. A concentration measurement that was reported to be below the detection limit was set to the detection limit for the purposes of data review and calculating a sum of oxides for each glass in Table A-4. Concentration measurements that were below the detection limit (BDL) are denoted with a less than symbol (<).

3.1.2 Composition Measurements by Glass Identifier

Exhibit A-1 in Appendix A provides plots of the oxide concentration measurements by the PNNL Glass ID (including the LRM glasses) by Lab ID grouped by targeted concentration. 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 instrument calibrations for each glass. Plotting the data

in this format provides an opportunity to review the values for each individual glass as a function of the duplicate preparations and duplicate measurements. A review of the plots presented in these exhibits reveals the repeatability of the four individual values for each oxide for each glass. There were no indications of errors in preparation or measurement that had to be addressed in treatment of the data.

3.1.3 Results for the LRM Standard Glass

Exhibit A-2 in Appendix A provides a comparison of the LRM results to their acceptability limits utilized by SRNL.[11] The review is in the form of plots of the measurements arranged by element, framed by upper and lower acceptability limits for the concentration of each element of interest. The results show that all measurements of the LRM elements of interest were within the acceptability limits during the execution of these analyses.

3.1.4 Measured versus Target Compositions

All measurements for each oxide for each glass (Table A-1, Table A-2, and Table A-3 in Appendix A) were used in calculating oxide values, which were then averaged to determine a representative chemical composition for each glass. A sum of oxides was also computed for each glass based upon the averaged oxide values. Exhibit A-3 in Appendix A provides plots showing the result for each glass for each oxide to allow PNNL to draw comparisons between the measured and targeted values.

Table A-4 in Appendix A provides a summary of the average compositions, targeted compositions and some associated differences and relative differences. The measured sums of oxides for all glasses fall within the interval of 96.1 wt.% to 98.7 wt. %, indicating acceptable recovery of the glass components.[15] Entries in Table A-4 show the relative differences between the measured and targeted values for the analytes with measured and targeted values above 1 wt.%. The relative differences were shaded if they are 10% or more and are summarized below.

- B_2O_3 relative differences were 10% or greater for EMHQ-LBE-04-SSM-S, EMHQ-LBE-05-SSM-S, EMHQ-LBE-06-SSM-S, EMHQ-LBE-08-SSM-S, and EMHQ-LBE-10-SSM-S.
- Na_2O relative differences were 10% or greater for EMHQ-LBE-04-SSM-S, EMHQ-LBE-05-SSM-S, and EMHQ-LBE-06-SSM-S.
- The V_2O_5 relative difference was greater than 10% for EMHQ-LBE-05-SSM-S.
- The ZrO_2 relative difference was 10% for EMHQ-LBE-SSM-S.
- As expected, the measured SO_3 concentrations in the glasses were higher than targeted due to the use of the sulfur saturation method in fabricating these glasses.

3.2 Comparison of Measured Compositions of Baseline and SSM Glasses

Exhibit A-4 in Appendix A provides a comparison of the measured oxide concentrations among the baseline (quenched) and SSM versions of the study glasses. A review of Exhibit A-4 led to the following observation:

- The measured SO_3 concentrations were higher for SSM versions of the study glasses, as expected, due to the use of the sulfur saturation method in fabricating these glasses.

The discussion of the analyses of the wash solutions, provided in Section 3.3, may provide further insight into the measured compositions of the SSM glasses.

3.3 Review and Evaluation of the Wash Solution Measurements

Table B-1 in Appendix B provides the elemental concentration measurements in mg/L for the wash solutions as measured by ICP-OES. Table B-2 in Appendix B provides the anion concentration measurements in mg/L for the wash solutions as measured by IC. Elemental measurements of the blanks and standard solutions are included in these tables of Appendix B. These unprocessed data are provided so that the values are readily available should they be of interest for future reviews.

3.3.1 Treatment of Detection Limits

The elemental and anion concentrations in Table B-1 and Table B-2 of Appendix B include measurements that were reported to be below the detection limit. These values were set to the detection limit for the purposes of data review and of calculating an average composition for each wash solution.

3.3.2 Composition Measurements by Wash Solution Identifier

Exhibit B-1 in Appendix B provides plots of the elemental and anion concentration measurements grouped by the wash solution identifier (including the blanks and standard solutions). Different symbols and colors are used to represent the different solutions. Plotting the data in this format provides an opportunity to review the values for each individual solution as a function of the triplicate measurements. A review of the plots presented in these exhibits reveals the repeatability of the three individual values for each analyte for each solution. These observations were not considered to indicate an error in preparation or measurement that had to be addressed in treatment of the data. Therefore, the entire set of measurement data was used in determining representative, measured compositions for the wash solutions.

3.3.3 Results for the Standard Solutions

Table B-3 in Appendix B provides comparisons of the standard solution results to their reference values. The results in this table indicate no issues with the performance of the analyses.

3.3.4 Measured Compositions of the Wash Solutions

From the discussion of Section 3.3.2, all the measurements for each analyte for each wash solution (Table B-1 and Table B-2 of Appendix B) were averaged to determine a representative chemical composition for each solution. Table B-4 in Appendix B provides a summary of the average measured compositions of the wash solutions. The concentrations of PO_4^{3-} and SO_4^{2-} reported in these tables include the measured values from both ICP-OES and IC for comparison. The measured S and P concentrations from the ICP-OES analyses were converted to PO_4^{3-} and SO_4^{2-} concentrations by multiplying by the appropriate gravimetric factors to support these comparisons. A graphical representation of the average chemical composition data for each wash solution is provided in Exhibit B-2. The following observations are offered from the review of Table B-4 and Exhibit B-2:

- The wash solutions contained mainly Na (194-958 mg/L), S (124-567 mg/L), and SO_4^{2-} (386-1730 mg/L), which could be attributed to the excess sodium sulfate added as part of the SSM preparation process.
- The measured concentrations of B, Ca, Cr, K, Li, P, Si, and V in the wash solutions were generally below 100 mg/L.
- The measured concentrations of Al, Cl^-, F^-, Fe, Mg, Mn, PO_4^{3-}, Sn, Ti, and Zr in the wash solutions were near or below the detection limits.
- The ICP-OES measured concentrations of P were converted to PO_4^{3-} for comparison and were in the range of <3.07 to 16.4 mg/L. PO_4^{3-} values as measured by IC and were all <10.0.
- The ICP-OES measured concentrations of S were converted to SO_4^{2-} for comparison with IC values and were in the range of 370 to 1700 mg/L. SO_4^{2-} values as measured by IC were in the range of 386 to 1730 mg/L.

4.0 Summary

Chemical analyses were performed on a series of SSM versions of simulated nuclear waste glasses and resulting wash solutions with ICP-OES and IC. The glasses were designed and fabricated by PNNL as part of a broader study of the influence of glass composition on chemical durability, sulfur retention, and other properties.

The relative differences between the targeted and measured concentrations of B_2O_3 and Na_2O for several of the glasses and V_2O_5 and ZrO_2 for two individual glasses were greater than ±10%. As expected, the measured concentrations of SO_3 in most of the glasses were higher than targeted due to the use of the sulfur saturation method in fabricating these glasses.

The wash solutions contained mainly sodium and sulfur.

5.0 References

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Appendix A. Tables and Exhibits Supporting the EMHQ LAW Glass Composition Measurements

Table A-1. KH Measurements (wt.%) of the SSM Study Glasses

PNNL ID	Block	Sub – Block	Seq	Lab ID	Cl^-	F^-
LRM	1	1	1	LRMKH111	<0.0250	0.820
EMHQ-LBE-08-SSM-S	1	1	2	S-13426KH11	0.0286	0.0543
EMHQ-LBE-01-SSM-S	1	1	3	S-13419KH11	0.0463	0.0692
EMHQ-LBE-02-SSM-S	1	1	4	S-13420KH21	0.0484	0.0722
EMHQ-LBE-03-SSM-S	1	1	5	S-13421KH11	0.0455	0.0702
EMHQ-LBE-01-SSM-S	1	1	6	S-13419KH21	0.0497	0.0758
EMHQ-LBE-05-SSM-S	1	1	7	S-13423KH21	0.0298	0.0482
EMHQ-LBE-06-SSM-S	1	1	8	S-13424KH11	0.0309	0.0499
EMHQ-LBE-SSM-S	1	1	9	S-13429KH11	<0.0250	0.875
EMHQ-LBE-04-SSM-S	1	1	10	S-13422KH21	0.0323	0.0514
EMHQ-LBE-03-SSM-S	1	1	11	S-13421KH21	0.0429	0.0644
EMHQ-LBE-02-SSM-S	1	1	12	S-13420KH11	0.0465	0.0716
LRM	1	1	13	LRMKH112	<0.0250	0.853
EMHQ-LBE-08-SSM-S	1	1	14	S-13426KH21	0.0286	0.0557
EMHQ-LBE-07-SSM-S	1	1	15	S-13425KH11	0.0280	0.0543
EMHQ-LBE-10-SSM-S	1	1	16	S-13428KH11	0.0271	0.0573
EMHQ-LBE-09-SSM-S	1	1	17	S-13427KH11	0.0304	0.0606
EMHQ-LBE-05-SSM-S	1	1	18	S-13423KH11	0.0296	0.0488
EMHQ-LBE-04-SSM-S	1	1	19	S-13422KH11	0.0334	0.0514
EMHQ-LBE-SSM-S	1	1	20	S-13429KH21	<0.0250	0.856
EMHQ-LBE-09-SSM-S	1	1	21	S-13427KH21	0.0267	0.0579
EMHQ-LBE-07-SSM-S	1	1	22	S-13425KH21	0.0291	0.0541
EMHQ-LBE-06-SSM-S	1	1	23	S-13424KH21	0.0302	0.0496
EMHQ-LBE-10-SSM-S	1	1	24	S-13428KH21	0.0276	0.0564
LRM	1	1	25	LRMKH113	<0.0250	0.888
LRM	1	2	1	LRMKH121	<0.0250	0.807
EMHQ-LBE-02-SSM-S	1	2	2	S-13420KH12	0.0425	0.0700
EMHQ-LBE-09-SSM-S	1	2	3	S-13427KH22	<0.0250	0.0556
EMHQ-LBE-05-SSM-S	1	2	4	S-13423KH22	0.0265	0.0463
EMHQ-LBE-06-SSM-S	1	2	5	S-13424KH22	0.0285	0.0482
EMHQ-LBE-03-SSM-S	1	2	6	S-13421KH22	0.0392	0.0628
EMHQ-LBE-09-SSM-S	1	2	7	S-13427KH12	0.0274	0.0590
EMHQ-LBE-08-SSM-S	1	2	8	S-13426KH12	0.0253	0.0538
EMHQ-LBE-10-SSM-S	1	2	9	S-13428KH12	<0.0250	0.0560
EMHQ-LBE-07-SSM-S	1	2	10	S-13425KH12	0.0260	0.0521
EMHQ-LBE-SSM-S	1	2	11	S-13429KH12	<0.0250	0.858
EMHQ-LBE-01-SSM-S	1	2	12	S-13419KH12	0.0424	0.0677
LRM	1	2	13	LRMKH122	<0.0250	0.836
EMHQ-LBE-05-SSM-S	1	2	14	S-13423KH12	0.0276	0.0471
EMHQ-LBE-SSM-S	1	2	15	S-13429KH22	<0.0250	0.836
EMHQ-LBE-02-SSM-S	1	2	16	S-13420KH22	0.0443	0.0705
EMHQ-LBE-03-SSM-S	1	2	17	S-13421KH12	0.0422	0.0692
EMHQ-LBE-07-SSM-S	1	2	18	S-13425KH22	0.0256	0.0524
EMHQ-LBE-04-SSM-S	1	2	19	S-13422KH22	0.0293	0.0496
EMHQ-LBE-08-SSM-S	1	2	20	S-13426KH22	0.0253	0.0528
EMHQ-LBE-01-SSM-S	1	2	21	S-13419KH22	0.0452	0.0730

Table A-1. KH Measurements (wt.%) of the SSM Study Glasses (continued)

PNNL ID	Block	Sub – Block	Seq	Lab ID	Cl^-	F^-
EMHQ-LBE-06-SSM-S	1	2	22	S-13424KH12	0.0290	0.0470
EMHQ-LBE-10-SSM-S	1	2	23	S-13428KH22	<0.0250	0.0546
EMHQ-LBE-04-SSM-S	1	2	24	S-13422KH12	0.0303	0.0503
LRM	1	2	25	LRMKH123	<0.0250	0.882

Table A-2. LM Measurements (wt.%) of the SSM Study Glasses

PNNL ID	Block	Sub – Block	Seq	Lab ID	Cr	Fe	K	Mg	Mn	Na	P	S	Ti	V
LRM	1	1	1	LRMLM111	0.133	1.07	1.47	0.0678	0.0611	14.7	0.212	0.0905	0.0662	<0.100
EMHQ-LBE-03-SSM-S	1	1	2	S-13421LM21	0.0280	0.0936	0.0886	0.0982	0.422	14.3	0.118	0.865	0.0693	2.06
EMHQ-LBE-08-SSM-S	1	1	3	S-13426LM21	0.0507	0.0942	0.0469	0.0796	0.418	16.4	0.115	0.538	0.0803	<0.100
EMHQ-LBE-SSM-S	1	1	4	S-13429LM21	0.132	1.00	1.15	0.0671	0.0596	14.7	0.198	0.0867	0.0650	<0.100
EMHQ-LBE-04-SSM-S	1	1	5	S-13422LM11	0.0165	0.0884	0.0559	0.118	<0.0100	9.39	0.0649	1.02	0.0453	2.09
EMHQ-LBE-03-SSM-S	1	1	6	S-13421LM11	0.0572	0.0892	0.0847	0.0986	0.418	14.5	0.119	0.877	0.0695	2.09
EMHQ-LBE-05-SSM-S	1	1	7	S-13423LM11	0.0186	0.0924	0.0558	0.117	0.401	9.77	0.0621	1.01	0.0455	2.12
EMHQ-LBE-06-SSM-S	1	1	8	S-13424LM11	0.0369	0.0893	0.0489	0.116	0.405	9.70	0.0533	0.921	0.0453	2.10
EMHQ-LBE-07-SSM-S	1	1	9	S-13425LM11	0.110	0.0836	0.0477	0.0790	<0.0100	16.7	0.117	0.542	0.0805	<0.100
EMHQ-LBE-02-SSM-S	1	1	10	S-13420LM21	0.0261	0.0866	0.0886	0.0942	0.399	15.0	0.118	0.870	0.0673	2.08
EMHQ-LBE-06-SSM-S	1	1	11	S-13424LM21	0.0204	0.0889	0.0513	0.116	0.402	9.70	0.0612	0.958	0.0452	2.11
EMHQ-LBE-02-SSM-S	1	1	12	S-13420LM11	0.0267	0.0873	0.0819	0.0962	0.405	15.1	0.119	0.876	0.0683	2.13
LRM	1	1	13	LRMLM112	0.128	1.02	1.27	0.0653	0.0592	15.0	0.207	0.0900	0.0640	<0.100
EMHQ-LBE-09-SSM-S	1	1	14	S-13427LM21	0.0479	0.0790	0.0425	0.0767	0.412	16.3	0.115	0.507	0.0833	<0.100
EMHQ-LBE-07-SSM-S	1	1	15	S-13425LM21	0.0664	0.0809	0.0441	0.0782	<0.0100	16.5	0.116	0.533	0.0794	<0.100
EMHQ-LBE-SSM-S	1	1	16	S-13429LM11	0.130	0.992	1.15	0.0670	0.0590	14.8	0.196	0.0857	0.0653	<0.100
EMHQ-LBE-10-SSM-S	1	1	17	S-13428LM21	0.0526	0.0803	0.0462	0.0788	0.211	16.5	0.115	0.529	0.0853	<0.100
EMHQ-LBE-01-SSM-S	1	1	18	S-13419LM21	0.0303	0.0871	0.082	0.0972	<0.0100	14.5	0.119	0.864	0.0695	2.07
EMHQ-LBE-05-SSM-S	1	1	19	S-13423LM21	0.0175	0.0913	0.0527	0.116	0.398	9.64	0.0613	0.997	0.0456	2.09
EMHQ-LBE-10-SSM-S	1	1	20	S-13428LM11	0.0514	0.0767	0.0462	0.0767	0.206	16.5	0.114	0.528	0.0829	<0.100
EMHQ-LBE-09-SSM-S	1	1	21	S-13427LM11	0.0470	0.0799	0.0420	0.0762	0.410	16.1	0.114	0.502	0.0827	<0.100
EMHQ-LBE-01-SSM-S	1	1	22	S-13419LM11	0.0294	0.0832	0.0853	0.0922	<0.0100	14.4	0.107	0.829	0.0666	2.02
EMHQ-LBE-04-SSM-S	1	1	23	S-13422LM21	0.0161	0.0831	0.0534	0.112	<0.0100	9.38	0.0571	0.917	0.0444	2.07
EMHQ-LBE-08-SSM-S	1	1	24	S-13426LM11	0.0494	0.0930	0.0439	0.0779	0.406	16.2	0.113	0.519	0.0803	<0.100
LRM	1	1	25	LRMLM113	0.128	1.01	1.24	0.0657	0.0594	14.5	0.204	0.0889	0.0647	<0.100
LRM	1	2	1	LRMLM121	0.113	1.01	1.17	0.0581	0.0499	15.7	0.174	0.0732	0.0581	<0.100
EMHQ-LBE-07-SSM-S	1	2	2	S-13425LM12	0.108	0.0827	0.0401	0.0786	<0.0100	17.4	0.117	0.522	0.0821	<0.100
EMHQ-LBE-SSM-S	1	2	3	S-13429LM12	0.129	0.979	1.16	0.0667	0.0586	15.1	0.193	0.0787	0.0663	<0.100
EMHQ-LBE-09-SSM-S	1	2	4	S-13427LM12	0.0473	0.0802	0.0388	0.0767	0.408	16.9	0.115	0.495	0.0845	<0.100
EMHQ-LBE-03-SSM-S	1	2	5	S-13421LM22	0.0271	0.0895	0.0743	0.0952	0.405	14.9	0.113	0.826	0.0692	2.12
EMHQ-LBE-SSM-S	1	2	6	S-13429LM22	0.129	0.977	1.18	0.0663	0.0584	15.3	0.192	0.0812	0.0665	<0.100
EMHQ-LBE-10-SSM-S	1	2	7	S-13428LM22	0.0515	0.0789	0.0415	0.0772	0.206	17.2	0.112	0.517	0.0847	<0.100
EMHQ-LBE-07-SSM-S	1	2	8	S-13425LM22	0.0658	0.0803	0.0404	0.0778	<0.0100	17.2	0.114	0.520	0.0804	<0.100
EMHQ-LBE-05-SSM-S	1	2	9	S-13423LM12	0.0180	0.0905	0.0483	0.115	0.394	9.92	0.0599	0.972	0.0460	2.15
EMHQ-LBE-08-SSM-S	1	2	10	S-13426LM12	0.0498	0.0934	0.0414	0.0781	0.406	17.0	0.111	0.514	0.0813	<0.100
EMHQ-LBE-09-SSM-S	1	2	11	S-13427LM22	0.0476	0.0782	0.0394	0.0765	0.410	16.5	0.112	0.500	0.0844	<0.100
EMHQ-LBE-08-SSM-S	1	2	12	S-13426LM22	0.0493	0.0916	0.0411	0.0780	0.406	16.9	0.111	0.518	0.0811	<0.100
LRM	1	2	13	LRMLM122	0.131	1.02	1.20	0.0662	0.0591	15.2	0.210	0.0863	0.0634	<0.100
EMHQ-LBE-04-SSM-S	1	2	14	S-13422LM12	0.0165	0.0873	0.0482	0.118	<0.0100	9.70	0.0629	0.975	0.0468	2.17
EMHQ-LBE-01-SSM-S	1	2	15	S-13419LM22	0.0304	0.0868	0.0763	0.0970	<0.0100	15.0	0.119	0.853	0.0702	2.17
EMHQ-LBE-04-SSM-S	1	2	16	S-13422LM22	0.0162	0.0830	0.0511	0.111	<0.0100	9.83	0.0571	0.904	0.0448	2.18
EMHQ-LBE-01-SSM-S	1	2	17	S-13419LM12	0.0293	0.0825	0.0807	0.0912	<0.0100	14.9	0.107	0.816	0.0667	2.14
EMHQ-LBE-06-SSM-S	1	2	18	S-13424LM22	0.0203	0.0881	0.0456	0.115	0.398	9.65	0.0595	0.930	0.0459	2.16
EMHQ-LBE-10-SSM-S	1	2	19	S-13428LM12	0.0507	0.0760	0.0406	0.0760	0.203	16.2	0.109	0.508	0.0831	<0.100
EMHQ-LBE-02-SSM-S	1	2	20	S-13420LM12	0.0265	0.0868	0.0737	0.0959	0.401	14.4	0.117	0.849	0.0693	2.09
EMHQ-LBE-03-SSM-S	1	2	21	S-13421LM12	0.0557	0.0871	0.0728	0.0968	0.410	12.4	0.114	0.833	0.0701	1.97

Table A-2. LM Measurements (wt.%) of the SSM Study Glasses (continued)

PNNL ID	Block	Sub – Block	Seq	Lab ID	Cr	Fe	K	Mg	Mn	Na	P	S	Ti	V
EMHQ-LBE-02-SSM-S	1	2	22	S-13420LM22	0.0254	0.0852	0.0772	0.0931	0.393	12.8	0.113	0.833	0.0678	2.00
EMHQ-LBE-06-SSM-S	1	2	23	S-13424LM12	0.0363	0.0875	0.0422	0.114	0.395	8.08	0.0517	0.885	0.0455	1.97
EMHQ-LBE-05-SSM-S	1	2	24	S-13423LM22	0.0177	0.0912	0.0471	0.116	0.396	7.85	0.0607	0.981	0.0459	1.62
LRM	1	2	25	LRMLM123	0.129	1.01	1.15	0.0649	0.0581	14.7	0.205	0.0864	0.0611	<0.100

Table A-3. PF Measurements (wt.%) of the SSM Study Glasses

PNNL ID	Block	Sub – Block	Seq	Lab ID	Al	B	Ca	Li	Si	Sn	Zr
LRM	1	1	1	LRMPF111	5.36	2.34	0.480	<0.100	25.6	<0.100	0.735
EMHQ-LBE-06-SSM-S	1	1	2	S-13424PF11	1.80	3.75	8.38	0.829	22.1	<0.100	1.39
EMHQ-LBE-10-SSM-S	1	1	3	S-13428PF21	4.50	2.44	5.61	<0.100	18.2	3.37	4.20
EMHQ-LBE-02-SSM-S	1	1	4	S-13420PF21	2.84	3.68	7.01	<0.100	19.0	<0.100	2.77
EMHQ-LBE-SSM-S	1	1	5	S-13429PF11	5.25	2.31	0.611	<0.100	25.1	<0.100	0.750
EMHQ-LBE-01-SSM-S	1	1	6	S-13419PF21	2.89	3.74	7.13	<0.100	19.4	<0.100	2.78
EMHQ-LBE-09-SSM-S	1	1	7	S-13427PF11	4.68	2.49	5.79	<0.100	18.6	3.49	4.36
EMHQ-LBE-04-SSM-S	1	1	8	S-13422PF21	1.83	3.85	8.55	0.865	22.4	<0.100	1.42
EMHQ-LBE-07-SSM-S	1	1	9	S-13425PF11	4.58	2.51	5.72	<0.100	18.7	3.43	4.28
EMHQ-LBE-06-SSM-S	1	1	10	S-13424PF21	1.78	3.79	8.39	0.823	22.0	<0.100	1.40
EMHQ-LBE-08-SSM-S	1	1	11	S-13426PF11	4.56	2.49	5.73	<0.100	18.4	3.37	4.27
EMHQ-LBE-05-SSM-S	1	1	12	S-13423PF11	1.84	3.85	8.65	0.859	22.4	<0.100	1.43
LRM	1	1	13	LRMPF112	5.45	2.38	0.496	<0.100	26.0	<0.100	0.781
EMHQ-LBE-10-SSM-S	1	1	14	S-13428PF11	4.61	2.49	5.70	<0.100	18.5	3.39	4.26
EMHQ-LBE-08-SSM-S	1	1	15	S-13426PF21	4.66	2.49	5.80	<0.100	18.7	3.48	4.32
EMHQ-LBE-03-SSM-S	1	1	16	S-13421PF11	2.91	3.71	7.12	<0.100	19.2	<0.100	2.78
EMHQ-LBE-SSM-S	1	1	17	S-13429PF21	5.52	2.41	0.652	<0.100	26.3	<0.100	0.786
EMHQ-LBE-07-SSM-S	1	1	18	S-13425PF21	4.69	2.52	5.84	<0.100	18.9	3.46	4.38
EMHQ-LBE-03-SSM-S	1	1	19	S-13421PF21	2.87	3.72	7.12	<0.100	19.3	<0.100	2.76
EMHQ-LBE-09-SSM-S	1	1	20	S-13427PF21	4.66	2.51	5.75	<0.100	18.7	3.41	4.27
EMHQ-LBE-05-SSM-S	1	1	21	S-13423PF21	1.86	3.85	8.70	0.867	22.4	<0.100	1.46
EMHQ-LBE-02-SSM-S	1	1	22	S-13420PF11	2.92	3.76	7.09	<0.100	19.6	<0.100	2.81
EMHQ-LBE-01-SSM-S	1	1	23	S-13419PF11	2.99	3.79	7.29	<0.100	19.8	<0.100	2.89
EMHQ-LBE-04-SSM-S	1	1	24	S-13422PF11	1.88	3.91	8.71	0.845	22.7	<0.100	1.48
LRM	1	1	25	LRMPF113	5.50	2.40	0.507	<0.100	26.2	<0.100	0.784
LRM	1	2	1	LRMPF121	5.04	2.27	0.455	<0.100	24.3	<0.100	0.715
EMHQ-LBE-03-SSM-S	1	2	2	S-13421PF22	2.72	3.56	6.92	<0.100	18.2	<0.100	2.68
EMHQ-LBE-02-SSM-S	1	2	3	S-13420PF22	2.75	3.56	6.95	<0.100	18.3	<0.100	2.74
EMHQ-LBE-05-SSM-S	1	2	4	S-13423PF22	1.78	3.72	8.54	0.808	21.3	<0.100	1.43
EMHQ-LBE-10-SSM-S	1	2	5	S-13428PF22	4.35	2.39	5.61	<0.100	17.6	3.28	4.19
EMHQ-LBE-09-SSM-S	1	2	6	S-13427PF12	4.44	2.40	5.68	<0.100	17.8	3.31	4.26
EMHQ-LBE-05-SSM-S	1	2	7	S-13423PF12	1.76	3.68	8.49	0.803	21.3	<0.100	1.39
EMHQ-LBE-SSM-S	1	2	8	S-13429PF22	5.06	2.27	0.607	<0.100	24.5	<0.100	0.754
EMHQ-LBE-08-SSM-S	1	2	9	S-13426PF22	4.40	2.39	5.61	<0.100	17.7	3.32	4.18
EMHQ-LBE-07-SSM-S	1	2	10	S-13425PF22	4.38	2.40	5.65	<0.100	17.8	3.33	4.27
EMHQ-LBE-01-SSM-S	1	2	11	S-13419PF12	2.73	3.54	6.98	<0.100	18.4	<0.100	2.74
EMHQ-LBE-03-SSM-S	1	2	12	S-13421PF12	2.75	3.55	6.83	<0.100	18.2	<0.100	2.701
LRM	1	2	13	LRMPF122	5.03	2.24	0.459	<0.100	24.4	<0.100	0.737
EMHQ-LBE-06-SSM-S	1	2	14	S-13424PF12	1.70	3.57	8.15	0.755	20.8	<0.100	1.34
EMHQ-LBE-10-SSM-S	1	2	15	S-13428PF12	4.28	2.35	5.45	<0.100	17.3	3.18	4.09
EMHQ-LBE-07-SSM-S	1	2	16	S-13425PF12	4.23	2.36	5.46	<0.100	17.4	3.22	4.12
EMHQ-LBE-04-SSM-S	1	2	17	S-13422PF12	1.72	3.65	8.26	0.754	21.1	<0.100	1.40
EMHQ-LBE-09-SSM-S	1	2	18	S-13427PF22	4.34	2.36	5.52	<0.100	17.6	3.15	4.11
EMHQ-LBE-02-SSM-S	1	2	19	S-13420PF12	2.67	3.51	6.80	<0.100	18.2	<0.100	2.68
EMHQ-LBE-01-SSM-S	1	2	20	S-13419PF22	2.62	3.46	6.68	<0.100	17.9	<0.100	2.63
EMHQ-LBE-SSM-S	1	2	21	S-13429PF12	4.91	2.20	0.577	<0.100	23.7	<0.100	0.738

Table A-3. PF Measurements (wt.%) of the SSM Study Glasses (continued)

PNNL ID	Block	Sub – Block	Seq	Lab ID	Al	B	Ca	Li	Si	Sn	Zr
EMHQ-LBE-04-SSM-S	1	2	22	S-13422PF22	1.68	3.56	8.17	0.757	20.7	<0.100	1.34
EMHQ-LBE-08-SSM-S	1	2	23	S-13426PF12	4.22	2.33	5.49	<0.100	17.3	3.16	4.10
EMHQ-LBE-06-SSM-S	1	2	24	S-13424PF22	1.72	3.63	8.20	0.760	21.0	<0.100	1.37
LRM	1	2	25	LRMPF123	4.94	2.20	0.445	<0.100	24.1	<0.100	0.738

Table A-4. Comparison of Measured versus Target Compositions

PNNL ID	Oxide	Mean Measurement (wt.%)	Target (wt.%)	Difference of Measured versus Target	% Difference Measured versus Target
LRM	Al_2O_3	9.86	9.51	0.353	4%
LRM	B_2O_3	7.42	7.85	-0.428	-5%
LRM	CaO	0.663	0.540	0.123	
LRM	Cl^-	<0.0250	0	0.025	
LRM	Cr_2O_3	0.186	0.190	-0.004	
LRM	F^-	0.848	0.860	-0.012	
LRM	Fe_2O_3	1.46	1.38	0.083	6%
LRM	K_2O	1.51	1.48	0.026	2%
LRM	Li_2O	<0.215	0.110	0.105	
LRM	MgO	0.107	0.100	0.007	
LRM	MnO	0.0746	0.0800	-0.005	
LRM	Na_2O	20.2	20.0	0.145	1%
LRM	P_2O_5	0.463	0.540	-0.077	
LRM	SiO_2	53.7	54.2	-0.504	-1%
LRM	SnO_2	<0.127	0	0.127	
LRM	SO_3	0.214	0.300	-0.086	
LRM	TiO_2	0.105	0.100	0.005	
LRM	V_2O_5	<0.179	0	0.179	
LRM	ZrO_2	1.01	0.930	0.081	9%
LRM	**Sum of Oxides**	**98.3**	**98.2**	**0.142**	**0%**
EMHQ-LBE-01-SSM-S	Al_2O_3	5.30	5.35	-0.046	-1%
EMHQ-LBE-01-SSM-S	B_2O_3	11.7	12.9	-1.180	-9%
EMHQ-LBE-01-SSM-S	CaO	9.82	9.75	0.069	1%
EMHQ-LBE-01-SSM-S	Cl^-	0.0459	0.118	-0.072	
EMHQ-LBE-01-SSM-S	Cr_2O_3	0.0436	0.0540	-0.010	
EMHQ-LBE-01-SSM-S	F^-	0.0714	0.114	-0.043	
EMHQ-LBE-01-SSM-S	Fe_2O_3	0.121	0.132	-0.011	
EMHQ-LBE-01-SSM-S	K_2O	0.0977	0.126	-0.028	
EMHQ-LBE-01-SSM-S	Li_2O	<0.215	0	0.215	
EMHQ-LBE-01-SSM-S	MgO	0.157	0.144	0.013	
EMHQ-LBE-01-SSM-S	MnO	<0.0129	0.0100	0.003	
EMHQ-LBE-01-SSM-S	Na_2O	19.8	19.4	0.411	2%
EMHQ-LBE-01-SSM-S	P_2O_5	0.259	0.305	-0.046	
EMHQ-LBE-01-SSM-S	SiO_2	40.4	41.3	-0.913	-2%
EMHQ-LBE-01-SSM-S	SnO_2	<0.127	0	0.127	
EMHQ-LBE-01-SSM-S	SO_3	2.10	1.54	0.559	36%
EMHQ-LBE-01-SSM-S	TiO_2	0.114	0.126	-0.012	
EMHQ-LBE-01-SSM-S	V_2O_5	3.75	4.01	-0.258	-6%
EMHQ-LBE-01-SSM-S	ZrO_2	3.73	3.75	-0.017	0%
EMHQ-LBE-01-SSM-S	**Sum of Oxides**	**97.9**	**99.1**	**-1.240**	**-1%**
EMHQ-LBE-02-SSM-S	Al_2O_3	5.28	5.35	-0.070	-1%
EMHQ-LBE-02-SSM-S	B_2O_3	11.7	12.9	-1.200	-9%
EMHQ-LBE-02-SSM-S	CaO	9.74	9.75	-0.011	0%
EMHQ-LBE-02-SSM-S	Cl^-	0.0454	0.118	-0.073	
EMHQ-LBE-02-SSM-S	Cr_2O_3	0.0383	0.0540	-0.016	
EMHQ-LBE-02-SSM-S	F^-	0.0711	0.114	-0.043	

Table A-4. Comparison of Measured versus Target Compositions (continued)

PNNL ID	Oxide	Mean Measurement (wt.%)	Target (wt.%)	Difference of Measured versus Target	% Difference Measured versus Target
EMHQ-LBE-02-SSM-S	Fe_2O_3	0.124	0.132	-0.008	
EMHQ-LBE-02-SSM-S	K_2O	0.0968	0.126	-0.029	
EMHQ-LBE-02-SSM-S	Li_2O	<0.215	0	0.215	
EMHQ-LBE-02-SSM-S	MgO	0.157	0.144	0.013	
EMHQ-LBE-02-SSM-S	MnO	0.516	0.555	-0.039	
EMHQ-LBE-02-SSM-S	Na_2O	19.3	19.4	-0.095	0%
EMHQ-LBE-02-SSM-S	P_2O_5	0.268	0.305	-0.038	
EMHQ-LBE-02-SSM-S	SiO_2	40.2	41.3	-1.130	-3%
EMHQ-LBE-02-SSM-S	SnO_2	<0.127	0	0.127	
EMHQ-LBE-02-SSM-S	SO_3	2.14	1.54	0.600	39%
EMHQ-LBE-02-SSM-S	TiO_2	0.114	0.126	-0.012	
EMHQ-LBE-02-SSM-S	V_2O_5	3.70	4.01	-0.303	-8%
EMHQ-LBE-02-SSM-S	ZrO_2	3.71	3.75	-0.030	-1%
EMHQ-LBE-02-SSM-S	**Sum of Oxides**	**97.5**	**99.6**	**-2.130**	**-2%**
EMHQ-LBE-03-SSM-S	Al_2O_3	5.31	5.30	0.017	0%
EMHQ-LBE-03-SSM-S	B_2O_3	11.7	12.7	-1.040	-8%
EMHQ-LBE-03-SSM-S	CaO	9.79	9.56	0.235	2%
EMHQ-LBE-03-SSM-S	Cl^-	0.0425	0.117	-0.075	
EMHQ-LBE-03-SSM-S	Cr_2O_3	0.0614	0.054	0.007	
EMHQ-LBE-03-SSM-S	F^-	0.0667	0.113	-0.046	
EMHQ-LBE-03-SSM-S	Fe_2O_3	0.128	0.131	-0.003	
EMHQ-LBE-03-SSM-S	K_2O	0.0965	0.125	-0.029	
EMHQ-LBE-03-SSM-S	Li_2O	<0.215	0	0.215	
EMHQ-LBE-03-SSM-S	MgO	0.161	0.142	0.019	
EMHQ-LBE-03-SSM-S	MnO	0.534	0.555	-0.021	
EMHQ-LBE-03-SSM-S	Na_2O	18.9	19.2	-0.303	-2%
EMHQ-LBE-03-SSM-S	P_2O_5	0.266	0.301	-0.035	
EMHQ-LBE-03-SSM-S	SiO_2	40.1	40.9	-0.816	-2%
EMHQ-LBE-03-SSM-S	SnO_2	<0.127	0	0.127	
EMHQ-LBE-03-SSM-S	SO_3	2.12	1.53	0.598	39%
EMHQ-LBE-03-SSM-S	TiO_2	0.116	0.125	-0.009	
EMHQ-LBE-03-SSM-S	V_2O_5	3.68	3.97	-0.288	-7%
EMHQ-LBE-03-SSM-S	ZrO_2	3.69	3.71	-0.019	-1%
EMHQ-LBE-03-SSM-S	**Sum of Oxides**	**97.1**	**98.5**	**-1.470**	**-1%**
EMHQ-LBE-04-SSM-S	Al_2O_3	3.36	3.54	-0.179	-5%
EMHQ-LBE-04-SSM-S	B_2O_3	12.1	13.5	-1.490	-11%
EMHQ-LBE-04-SSM-S	CaO	11.8	12.2	-0.455	-4%
EMHQ-LBE-04-SSM-S	Cl^-	0.0313	0.0760	-0.045	
EMHQ-LBE-04-SSM-S	Cr_2O_3	0.0239	0.0250	-0.001	
EMHQ-LBE-04-SSM-S	F^-	0.0507	0.0950	-0.044	
EMHQ-LBE-04-SSM-S	Fe_2O_3	0.122	0.131	-0.009	
EMHQ-LBE-04-SSM-S	K_2O	0.0628	0.0870	-0.024	
EMHQ-LBE-04-SSM-S	Li_2O	1.73	1.67	0.069	4%
EMHQ-LBE-04-SSM-S	MgO	0.19	0.180	0.010	
EMHQ-LBE-04-SSM-S	MnO	<0.0129	0.0130	0.000	
EMHQ-LBE-04-SSM-S	Na_2O	12.9	9.81	3.100	32%
EMHQ-LBE-04-SSM-S	P_2O_5	0.139	0.158	-0.019	

Table A-4. Comparison of Measured versus Target Compositions (continued)

PNNL ID	Oxide	Mean Measurement (wt.%)	Target (wt.%)	Difference of Measured versus Target	% Difference Measured versus Target
EMHQ-LBE-04-SSM-S	SiO_2	46.5	49.6	-3.170	-6%
EMHQ-LBE-04-SSM-S	SnO_2	<0.127	0	0.127	
EMHQ-LBE-04-SSM-S	SO_3	2.38	1.69	0.697	41%
EMHQ-LBE-04-SSM-S	TiO_2	0.0756	0.0910	-0.015	
EMHQ-LBE-04-SSM-S	V_2O_5	3.80	4.03	-0.233	-6%
EMHQ-LBE-04-SSM-S	ZrO_2	1.90	2.00	-0.093	-5%
EMHQ-LBE-04-SSM-S	**Sum of Oxides**	**97.2**	**99.0**	**-1.780**	**-2%**
EMHQ-LBE-05-SSM-S	Al_2O_3	3.42	3.54	-0.118	-3%
EMHQ-LBE-05-SSM-S	B_2O_3	12.2	13.5	-1.380	-10%
EMHQ-LBE-05-SSM-S	CaO	12.0	12.2	-0.214	-2%
EMHQ-LBE-05-SSM-S	Cl^-	0.0284	0.0760	-0.048	
EMHQ-LBE-05-SSM-S	Cr_2O_3	0.0262	0.0250	0.001	
EMHQ-LBE-05-SSM-S	F^-	0.0476	0.0950	-0.047	
EMHQ-LBE-05-SSM-S	Fe_2O_3	0.131	0.131	0.000	
EMHQ-LBE-05-SSM-S	K_2O	0.0614	0.0870	-0.026	
EMHQ-LBE-05-SSM-S	Li_2O	1.80	1.67	0.131	8%
EMHQ-LBE-05-SSM-S	MgO	0.192	0.180	0.012	
EMHQ-LBE-05-SSM-S	MnO	0.513	0.558	-0.045	
EMHQ-LBE-05-SSM-S	Na_2O	12.5	9.81	2.720	28%
EMHQ-LBE-05-SSM-S	P_2O_5	0.140	0.158	-0.018	
EMHQ-LBE-05-SSM-S	SiO_2	46.7	49.6	-2.910	-6%
EMHQ-LBE-05-SSM-S	SnO_2	<0.127	0	0.127	
EMHQ-LBE-05-SSM-S	SO_3	2.47	1.69	0.787	47%
EMHQ-LBE-05-SSM-S	TiO_2	0.0763	0.0910	-0.015	
EMHQ-LBE-05-SSM-S	V_2O_5	3.56	4.03	-0.470	-12%
EMHQ-LBE-05-SSM-S	ZrO_2	1.93	2.00	-0.070	-3%
EMHQ-LBE-05-SSM-S	**Sum of Oxides**	**98.0**	**99.6**	**-1.580**	**-2%**
EMHQ-LBE-06-SSM-S	Al_2O_3	3.31	3.50	-0.196	-6%
EMHQ-LBE-06-SSM-S	B_2O_3	11.9	13.4	-1.540	-11%
EMHQ-LBE-06-SSM-S	CaO	11.6	12.1	-0.531	-4%
EMHQ-LBE-06-SSM-S	Cl^-	0.0297	0.0750	-0.045	
EMHQ-LBE-06-SSM-S	Cr_2O_3	0.0416	0.0250	0.017	
EMHQ-LBE-06-SSM-S	F^-	0.0487	0.0940	-0.045	
EMHQ-LBE-06-SSM-S	Fe_2O_3	0.126	0.129	-0.003	
EMHQ-LBE-06-SSM-S	K_2O	0.0566	0.0870	-0.030	
EMHQ-LBE-06-SSM-S	Li_2O	1.70	1.64	0.067	4%
EMHQ-LBE-06-SSM-S	MgO	0.191	0.179	0.012	
EMHQ-LBE-06-SSM-S	MnO	0.516	0.558	-0.042	
EMHQ-LBE-06-SSM-S	Na_2O	12.5	9.71	2.810	29%
EMHQ-LBE-06-SSM-S	P_2O_5	0.129	0.157	-0.028	
EMHQ-LBE-06-SSM-S	SiO_2	45.9	49.1	-3.210	-7%
EMHQ-LBE-06-SSM-S	SnO_2	<0.127	0	0.127	
EMHQ-LBE-06-SSM-S	SO_3	2.31	1.67	0.638	38%
EMHQ-LBE-06-SSM-S	TiO_2	0.0759	0.0900	-0.014	
EMHQ-LBE-06-SSM-S	V_2O_5	3.72	3.99	-0.268	-7%
EMHQ-LBE-06-SSM-S	ZrO_2	1.86	1.98	-0.121	-6%
EMHQ-LBE-06-SSM-S	**Sum of Oxides**	**96.1**	**98.5**	**-2.400**	**-2%**

Table A-4. Comparison of Measured versus Target Compositions (continued)

PNNL ID	Oxide	Mean Measurement (wt.%)	Target (wt.%)	Difference of Measured versus Target	% Difference Measured versus Target
EMHQ-LBE-07-SSM-S	Al_2O_3	8.45	8.69	-0.247	-3%
EMHQ-LBE-07-SSM-S	B_2O_3	7.88	8.64	-0.756	-9%
EMHQ-LBE-07-SSM-S	CaO	7.93	7.63	0.298	4%
EMHQ-LBE-07-SSM-S	Cl^-	0.0272	0.0770	-0.050	
EMHQ-LBE-07-SSM-S	Cr_2O_3	0.128	0.167	-0.039	
EMHQ-LBE-07-SSM-S	F^-	0.0532	0.0670	-0.014	
EMHQ-LBE-07-SSM-S	Fe_2O_3	0.117	0.124	-0.007	
EMHQ-LBE-07-SSM-S	K_2O	0.0519	0.0710	-0.019	
EMHQ-LBE-07-SSM-S	Li_2O	<0.215	0	0.215	
EMHQ-LBE-07-SSM-S	MgO	0.130	0.115	0.015	
EMHQ-LBE-07-SSM-S	MnO	<0.0129	0.00800	0.005	
EMHQ-LBE-07-SSM-S	Na_2O	22.8	23.2	-0.395	-2%
EMHQ-LBE-07-SSM-S	P_2O_5	0.266	0.310	-0.044	
EMHQ-LBE-07-SSM-S	SiO_2	38.9	39.4	-0.428	-1%
EMHQ-LBE-07-SSM-S	SnO_2	4.27	4.34	-0.071	-2%
EMHQ-LBE-07-SSM-S	SO_3	1.32	0.190	1.130	596%
EMHQ-LBE-07-SSM-S	TiO_2	0.134	0.139	-0.005	
EMHQ-LBE-07-SSM-S	V_2O_5	<0.179	0	0.179	
EMHQ-LBE-07-SSM-S	ZrO_2	5.76	5.82	-0.062	-1%
EMHQ-LBE-07-SSM-S	**Sum of Oxides**	**98.7**	**99.0**	**-0.294**	**0%**
EMHQ-LBE-08-SSM-S	Al_2O_3	8.43	8.69	-0.266	-3%
EMHQ-LBE-08-SSM-S	B_2O_3	7.81	8.64	-0.829	-10%
EMHQ-LBE-08-SSM-S	CaO	7.92	7.63	0.284	4%
EMHQ-LBE-08-SSM-S	Cl^-	0.0270	0.0770	-0.050	
EMHQ-LBE-08-SSM-S	Cr_2O_3	0.0728	0.167	-0.094	
EMHQ-LBE-08-SSM-S	F^-	0.0542	0.0670	-0.013	
EMHQ-LBE-08-SSM-S	Fe_2O_3	0.133	0.124	0.009	
EMHQ-LBE-08-SSM-S	K_2O	0.0522	0.0710	-0.019	
EMHQ-LBE-08-SSM-S	Li_2O	<0.215	0	0.215	
EMHQ-LBE-08-SSM-S	MgO	0.130	0.115	0.015	
EMHQ-LBE-08-SSM-S	MnO	0.528	0.553	-0.025	
EMHQ-LBE-08-SSM-S	Na_2O	22.4	23.2	-0.833	-4%
EMHQ-LBE-08-SSM-S	P_2O_5	0.258	0.310	-0.052	
EMHQ-LBE-08-SSM-S	SiO_2	38.6	39.4	-0.802	-2%
EMHQ-LBE-08-SSM-S	SnO_2	4.23	4.34	-0.106	-2%
EMHQ-LBE-08-SSM-S	SO_3	1.30	0.190	1.110	586%
EMHQ-LBE-08-SSM-S	TiO_2	0.135	0.139	-0.004	
EMHQ-LBE-08-SSM-S	V_2O_5	<0.179	0	0.179	
EMHQ-LBE-08-SSM-S	ZrO_2	5.70	5.82	-0.123	-2%
EMHQ-LBE-08-SSM-S	**Sum of Oxides**	**98.1**	**99.5**	**-1.400**	**-1%**
EMHQ-LBE-09-SSM-S	Al_2O_3	8.56	8.61	-0.046	-1%
EMHQ-LBE-09-SSM-S	B_2O_3	7.86	8.55	-0.693	-8%
EMHQ-LBE-09-SSM-S	CaO	7.95	7.56	0.399	5%
EMHQ-LBE-09-SSM-S	Cl^-	<0.0274	0.0760	-0.049	
EMHQ-LBE-09-SSM-S	Cr_2O_3	0.0694	0.165	-0.096	
EMHQ-LBE-09-SSM-S	F^-	0.0583	0.0660	-0.008	
EMHQ-LBE-09-SSM-S	Fe_2O_3	0.113	0.123	-0.010	

Table A-4. Comparison of Measured versus Target Compositions (continued)

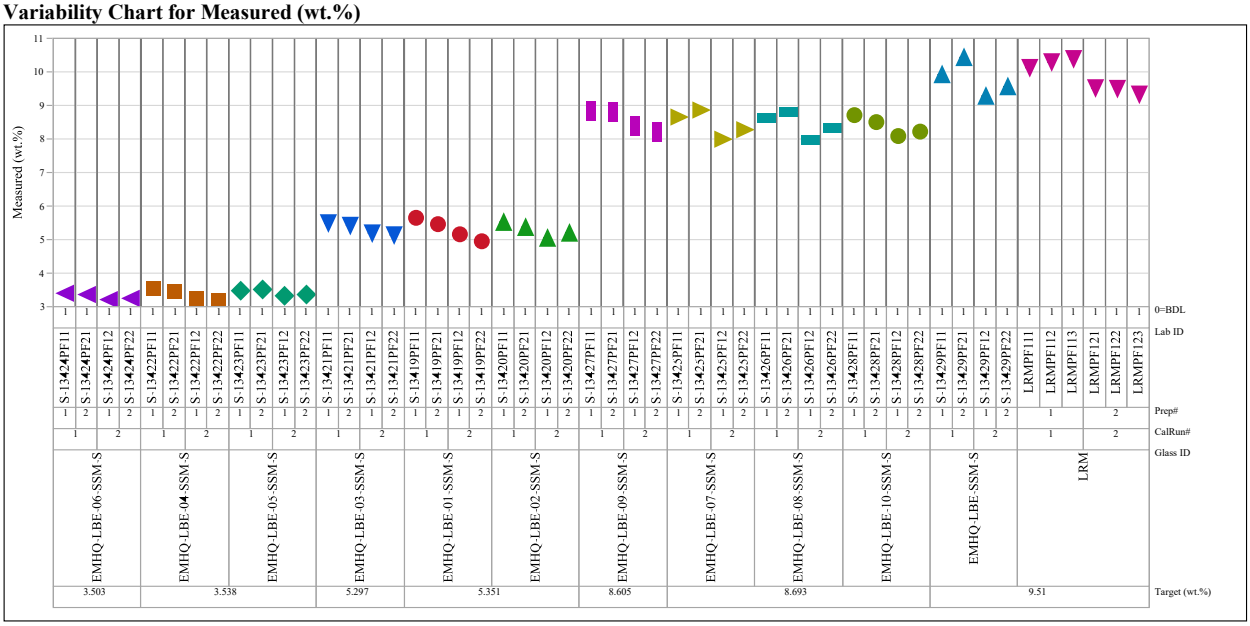
PNNL ID	Oxide	Mean Measurement (wt.%)	Target (wt.%)	Difference of Measured versus Target	% Difference Measured versus Target
EMHQ-LBE-09-SSM-S	K_2O	0.0490	0.0710	-0.022	
EMHQ-LBE-09-SSM-S	Li_2O	<0.215	0	0.215	
EMHQ-LBE-09-SSM-S	MgO	0.127	0.114	0.013	
EMHQ-LBE-09-SSM-S	MnO	0.529	0.553	-0.024	
EMHQ-LBE-09-SSM-S	Na_2O	22.2	23.0	-0.835	-4%
EMHQ-LBE-09-SSM-S	P_2O_5	0.261	0.307	-0.046	
EMHQ-LBE-09-SSM-S	SiO_2	38.9	39.0	-0.083	0%
EMHQ-LBE-09-SSM-S	SnO_2	4.24	4.29	-0.054	-1%
EMHQ-LBE-09-SSM-S	SO_3	1.25	0.188	1.060	565%
EMHQ-LBE-09-SSM-S	TiO_2	0.140	0.138	0.002	
EMHQ-LBE-09-SSM-S	V_2O_5	<0.179	0	0.179	
EMHQ-LBE-09-SSM-S	ZrO_2	5.74	5.76	-0.020	0%
EMHQ-LBE-09-SSM-S	**Sum of Oxides**	**98.4**	**98.5**	**-0.113**	**0%**
EMHQ-LBE-10-SSM-S	Al_2O_3	8.38	8.69	-0.313	-4%
EMHQ-LBE-10-SSM-S	B_2O_3	7.78	8.64	-0.853	-10%
EMHQ-LBE-10-SSM-S	CaO	7.83	7.63	0.193	3%
EMHQ-LBE-10-SSM-S	Cl^-	<0.0262	0.0770	-0.051	
EMHQ-LBE-10-SSM-S	Cr_2O_3	0.0753	0.167	-0.092	
EMHQ-LBE-10-SSM-S	F^-	0.0561	0.0670	-0.011	
EMHQ-LBE-10-SSM-S	Fe_2O_3	0.111	0.124	-0.013	
EMHQ-LBE-10-SSM-S	K_2O	0.0526	0.0710	-0.018	
EMHQ-LBE-10-SSM-S	Li_2O	<0.215	0	0.215	
EMHQ-LBE-10-SSM-S	MgO	0.128	0.115	0.013	
EMHQ-LBE-10-SSM-S	MnO	0.267	0.281	-0.014	
EMHQ-LBE-10-SSM-S	Na_2O	22.4	23.2	-0.867	-4%
EMHQ-LBE-10-SSM-S	P_2O_5	0.258	0.310	-0.052	
EMHQ-LBE-10-SSM-S	SiO_2	38.3	39.4	-1.070	-3%
EMHQ-LBE-10-SSM-S	SnO_2	4.20	4.34	-0.141	-3%
EMHQ-LBE-10-SSM-S	SO_3	1.30	0.190	1.110	584%
EMHQ-LBE-10-SSM-S	TiO_2	0.140	0.139	0.001	
EMHQ-LBE-10-SSM-S	V_2O_5	<0.179	0	0.179	
EMHQ-LBE-10-SSM-S	ZrO_2	5.65	5.82	-0.167	-3%
EMHQ-LBE-10-SSM-S	**Sum of Oxides**	**97.3**	**99.3**	**-1.950**	**-2%**
EMHQ-LBE-SSM-S	Al_2O_3	9.80	9.51	0.287	3%
EMHQ-LBE-SSM-S	B_2O_3	7.40	7.85	-0.452	-6%
EMHQ-LBE-SSM-S	CaO	0.856	0.540	0.316	
EMHQ-LBE-SSM-S	Cl^-	<0.0250	0	0.025	
EMHQ-LBE-SSM-S	Cr_2O_3	0.190	0.190	0.000	
EMHQ-LBE-SSM-S	F^-	0.856	0.860	-0.004	
EMHQ-LBE-SSM-S	Fe_2O_3	1.41	1.38	0.031	2%
EMHQ-LBE-SSM-S	K_2O	1.40	1.48	-0.083	-6%
EMHQ-LBE-SSM-S	Li_2O	<0.215	0.110	0.105	
EMHQ-LBE-SSM-S	MgO	0.111	0.100	0.011	
EMHQ-LBE-SSM-S	MnO	0.0761	0.0800	-0.004	
EMHQ-LBE-SSM-S	Na_2O	20.2	20.0	0.156	1%
EMHQ-LBE-SSM-S	P_2O_5	0.446	0.540	-0.094	
EMHQ-LBE-SSM-S	SiO_2	53.3	54.2	-0.931	-2%

Table A-4. Comparison of Measured versus Target Compositions (continued)

PNNL ID	Oxide	Mean Measurement (wt.%)	Target (wt.%)	Difference of Measured versus Target	% Difference Measured versus Target
EMHQ-LBE-SSM-S	SnO_2	<0.127	0	0.127	
EMHQ-LBE-SSM-S	SO_3	0.207	0.300	-0.093	
EMHQ-LBE-SSM-S	TiO_2	0.110	0.100	0.010	
EMHQ-LBE-SSM-S	V_2O_5	<0.179	0	0.179	
EMHQ-LBE-SSM-S	ZrO_2	1.02	0.930	0.093	10%
EMHQ-LBE-SSM-S	**Sum of Oxides**	**97.9**	**98.2**	**-0.321**	**0%**

Exhibit A-1. Plots of Oxide Measurements by Glass Identifier by Target Concentrations

Oxide=Al_2O_3 (wt%)
Variability Chart for Measured (wt.%)



Oxide=B_2O_3 (wt%)
Variability Chart for Measured (wt.%)

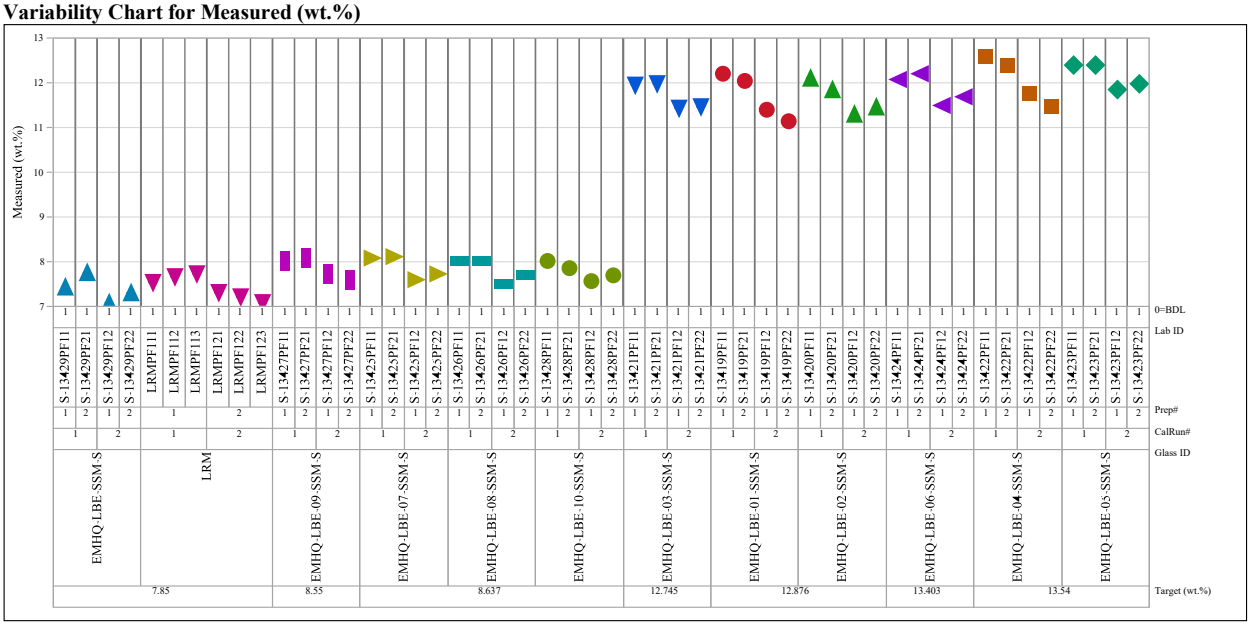
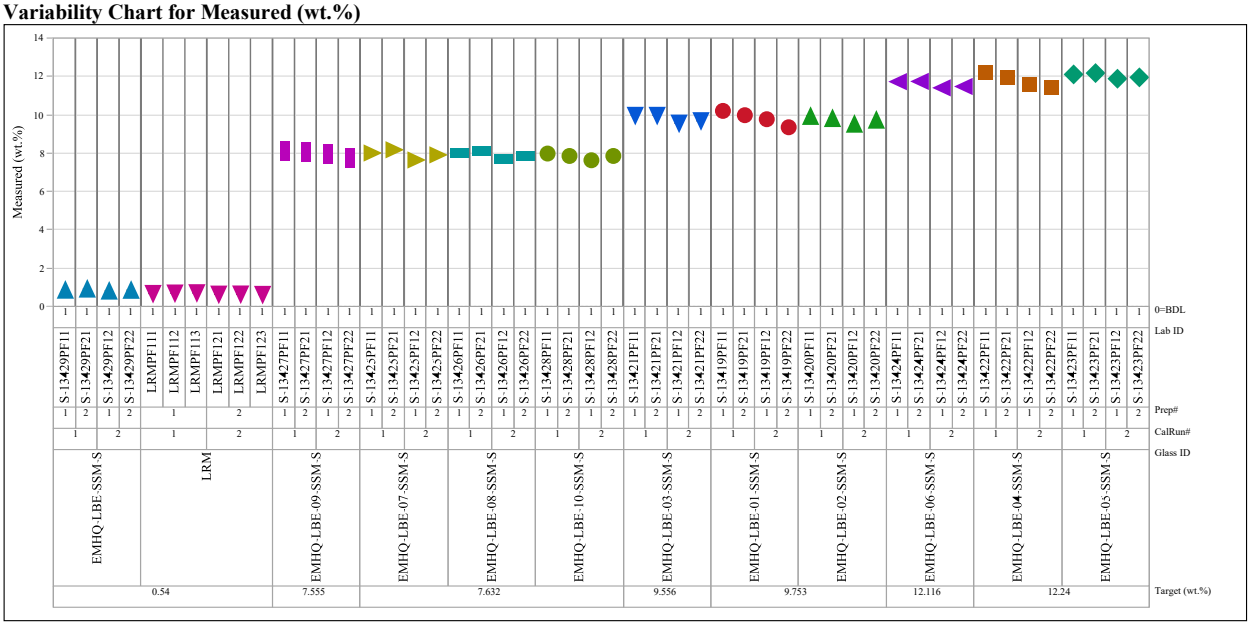


Exhibit A-1. Plots of Oxide Measurements by Glass Identifier by Target Concentrations (continued)

Oxide=CaO (wt%)
Variability Chart for Measured (wt.%)



Oxide=Cl^- (wt%)
Variability Chart for Measured (wt.%)

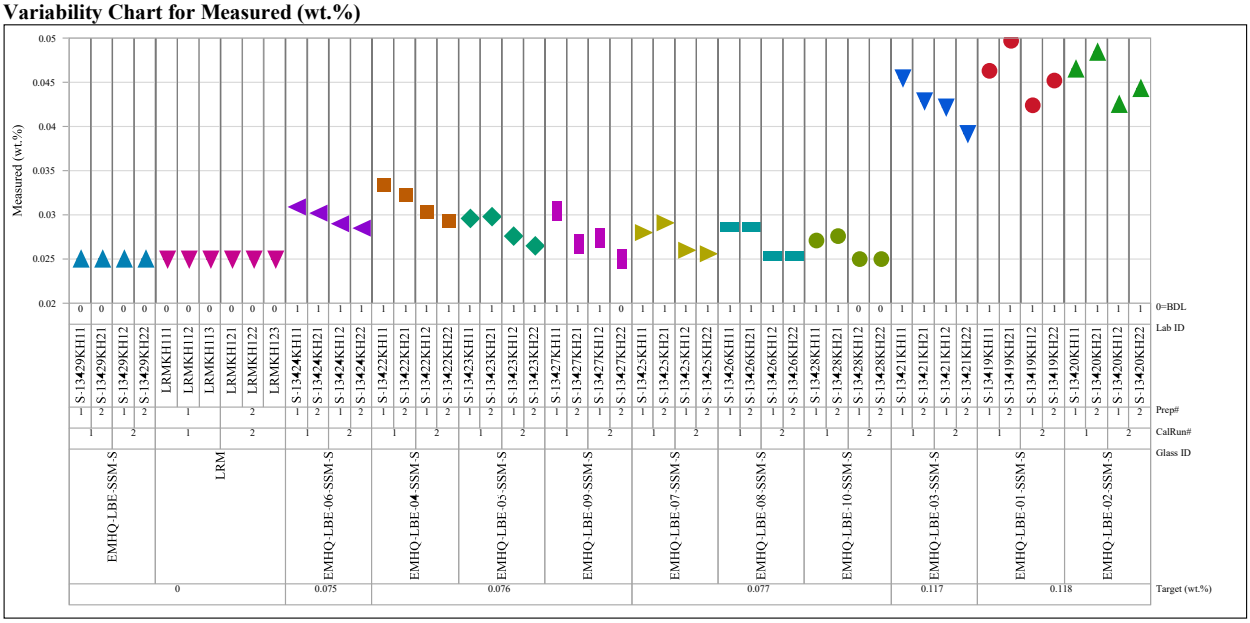
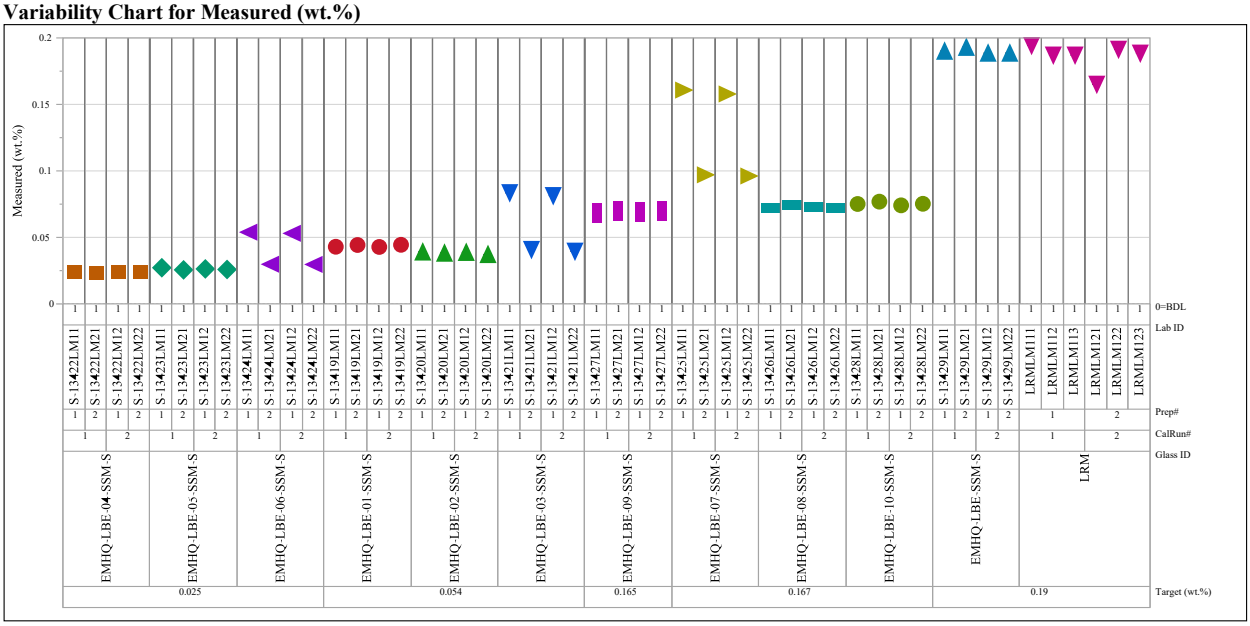


Exhibit A-1. Plots of Oxide Measurements by Glass Identifier by Target Concentrations (continued)

Oxide=Cr_2O_3 (wt%)
Variability Chart for Measured (wt.%)



Oxide=F^- (wt%)
Variability Chart for Measured (wt.%)

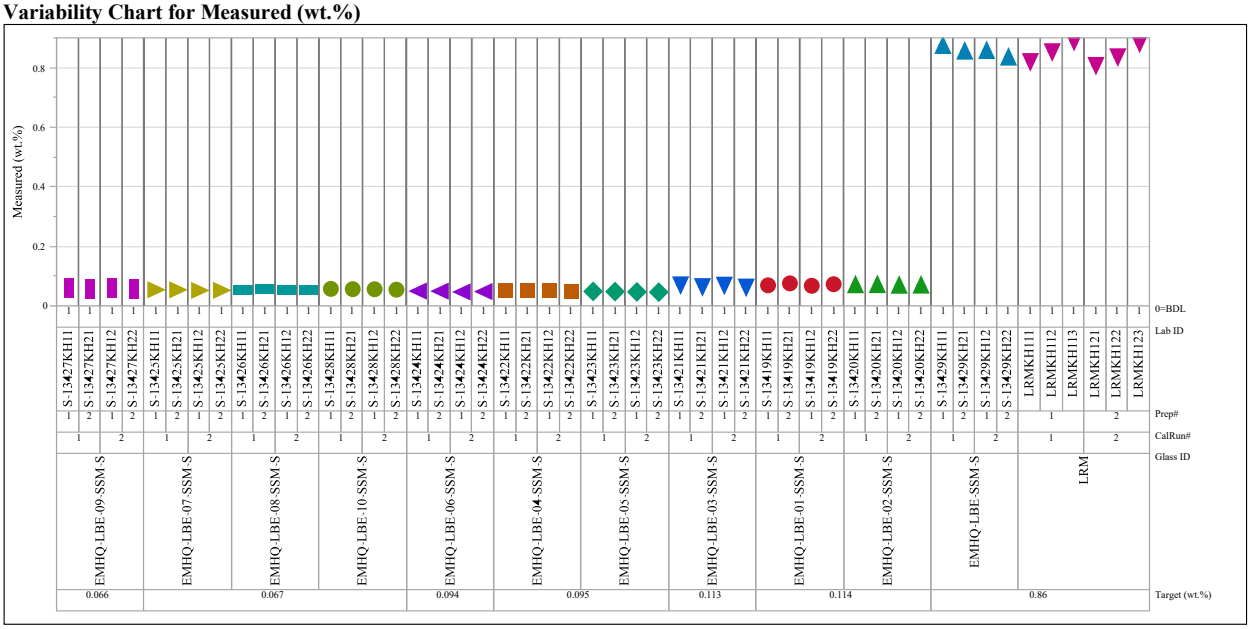
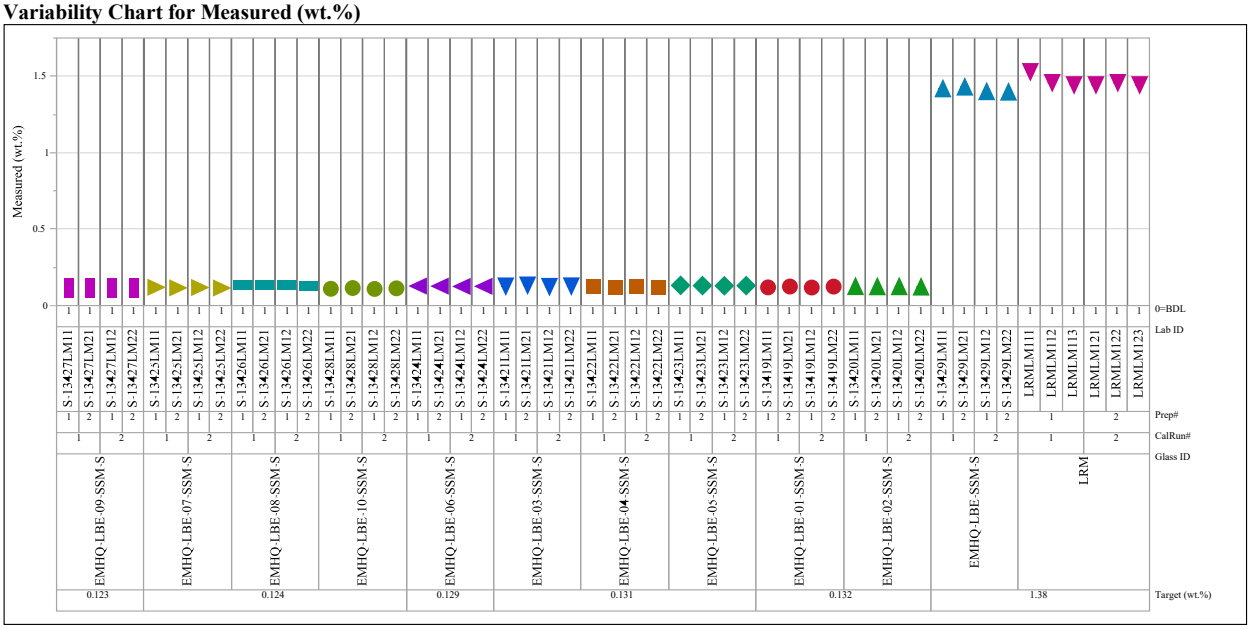


Exhibit A-1. Plots of Oxide Measurements by Glass Identifier by Target Concentrations (continued)

Oxide=Fe_2O_3 (wt%)
Variability Chart for Measured (wt.%)



Oxide=K_2O (wt%)
Variability Chart for Measured (wt.%)

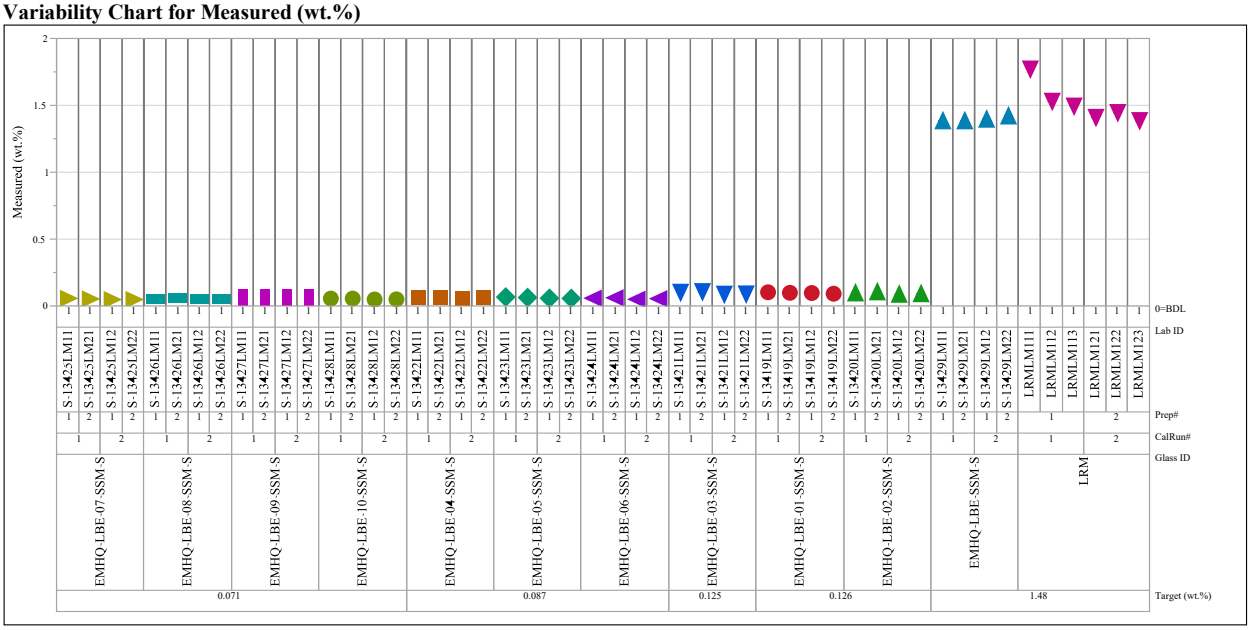
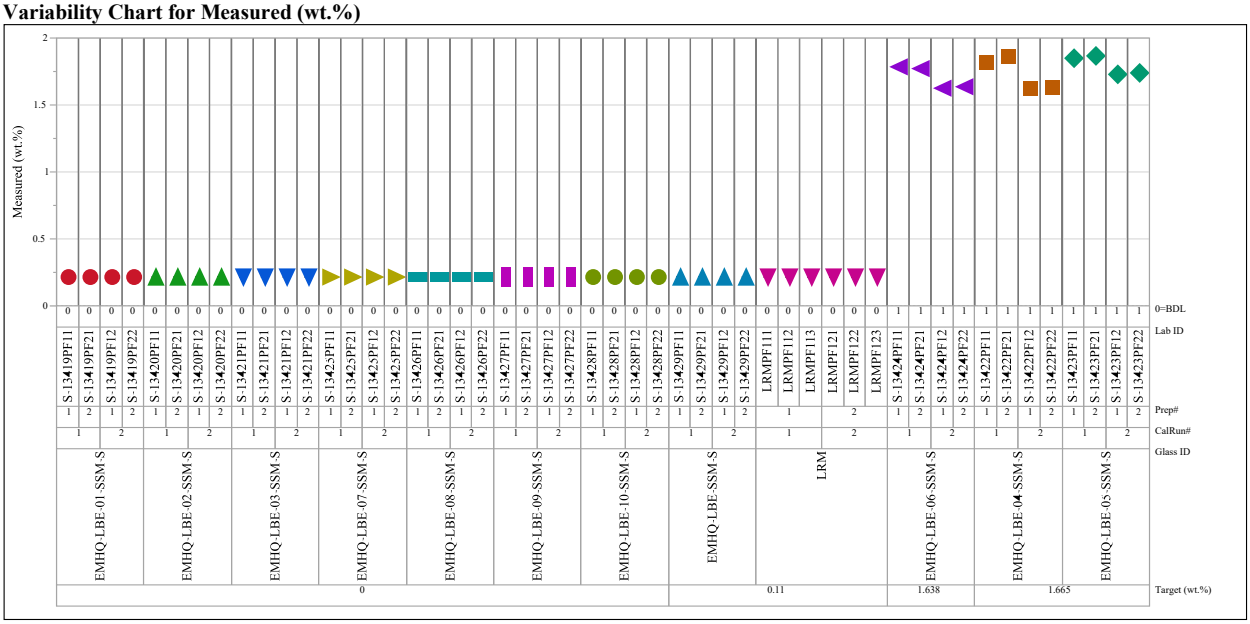


Exhibit A-1. Plots of Oxide Measurements by Glass Identifier by Target Concentrations (continued)

Oxide=Li_2O (wt%)
Variability Chart for Measured (wt.%)



Oxide=MgO (wt%)
Variability Chart for Measured (wt.%)

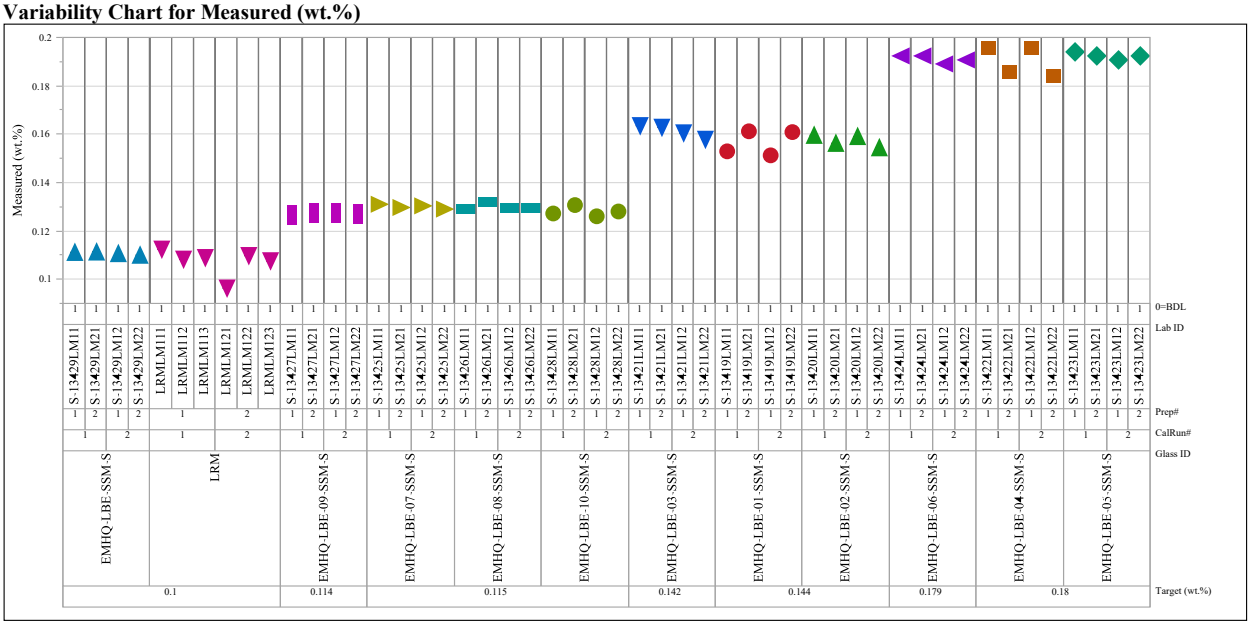
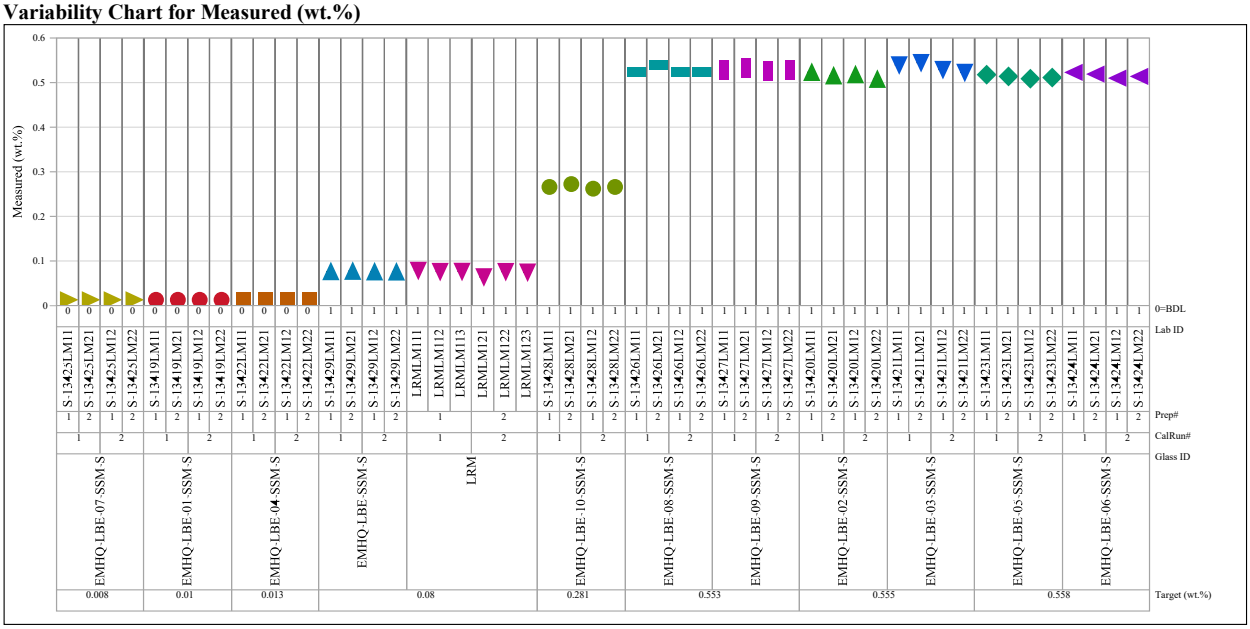


Exhibit A-1. Plots of Oxide Measurements by Glass Identifier by Target Concentrations (continued)

Oxide=MnO (wt%)
Variability Chart for Measured (wt.%)



Oxide=Na_2O (wt%)
Variability Chart for Measured (wt.%)

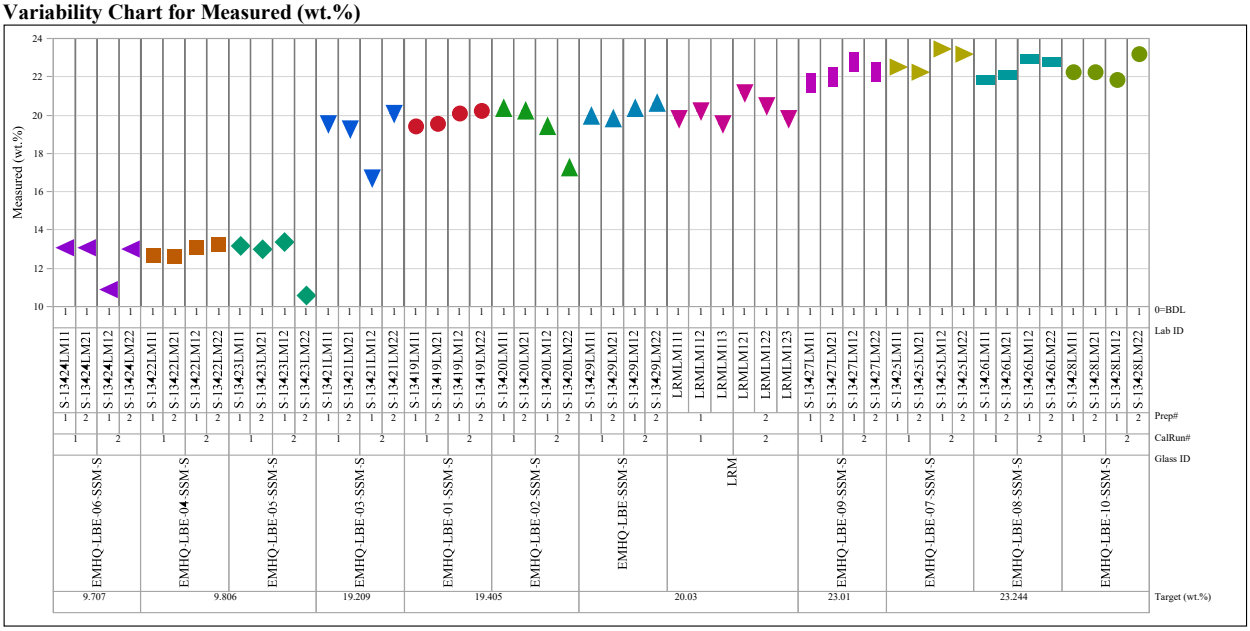
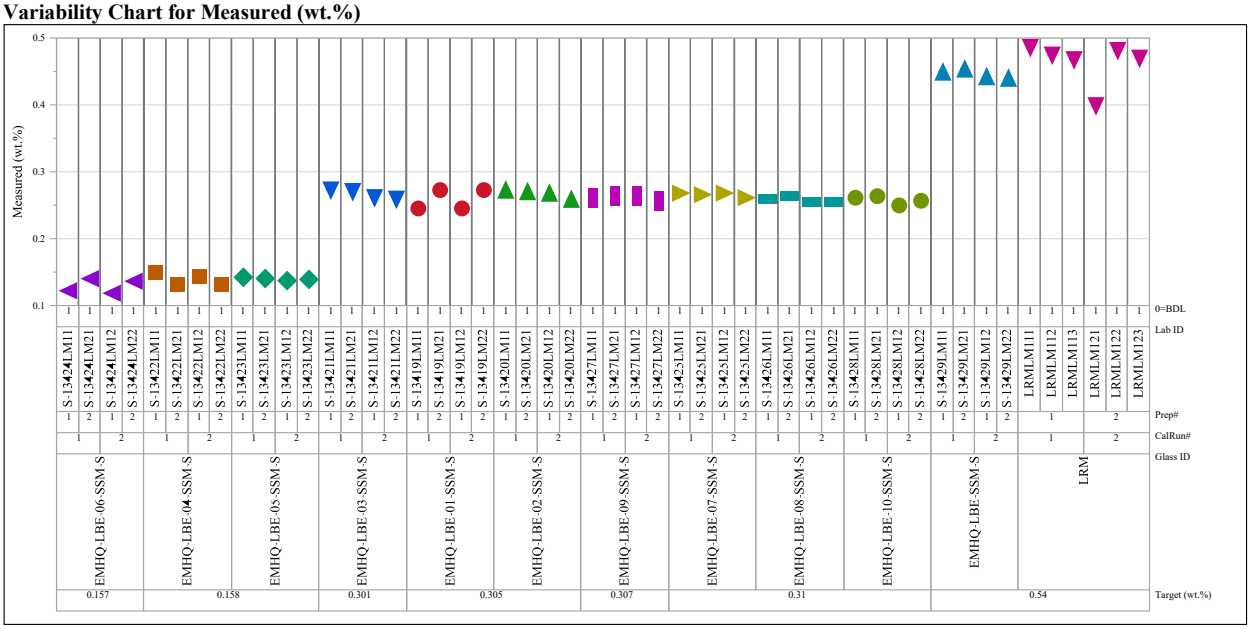


Exhibit A-1. Plots of Oxide Measurements by Glass Identifier by Target Concentrations (continued)

Oxide=P_2O_5 (wt%)
Variability Chart for Measured (wt.%)



Oxide=SiO_2 (wt%)
Variability Chart for Measured (wt.%)

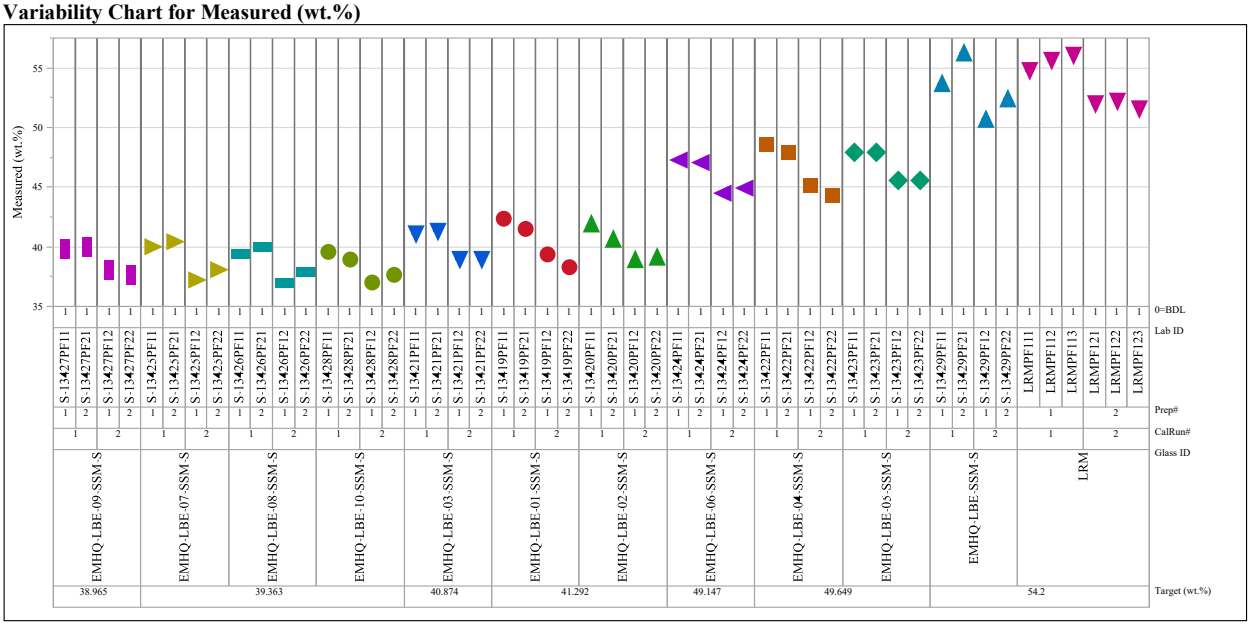
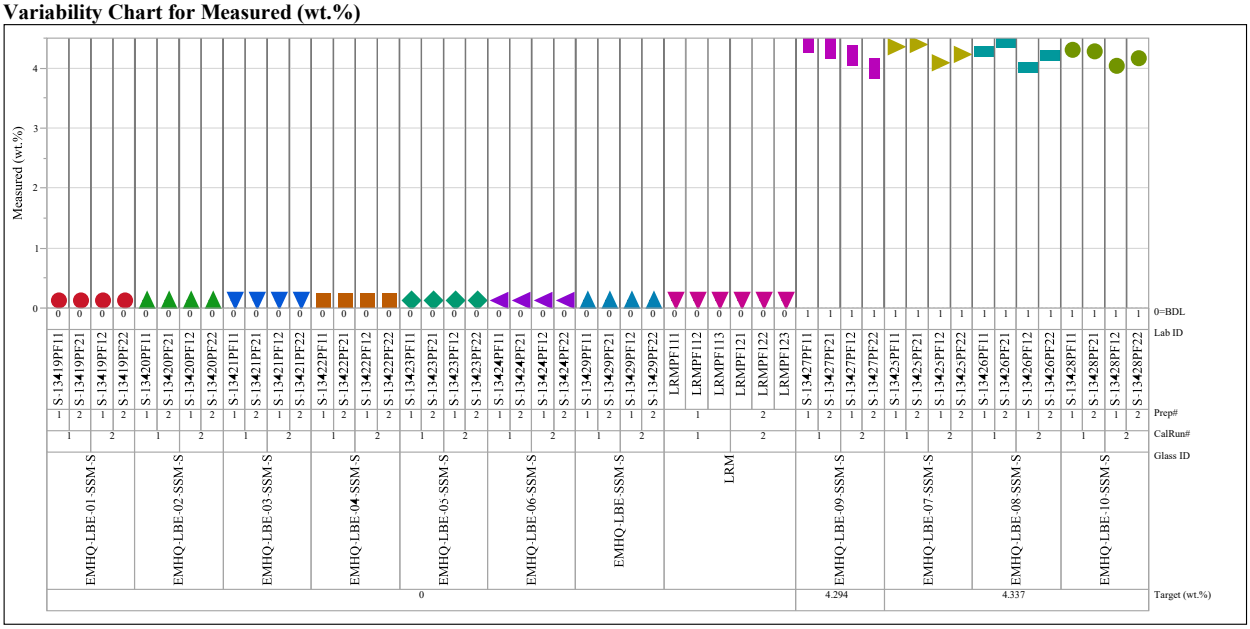


Exhibit A-1. Plots of Oxide Measurements by Glass Identifier by Target Concentrations (continued)

Oxide=SnO_2 (wt%)
Variability Chart for Measured (wt.%)



Oxide=SO_3 (wt%)
Variability Chart for Measured (wt.%)

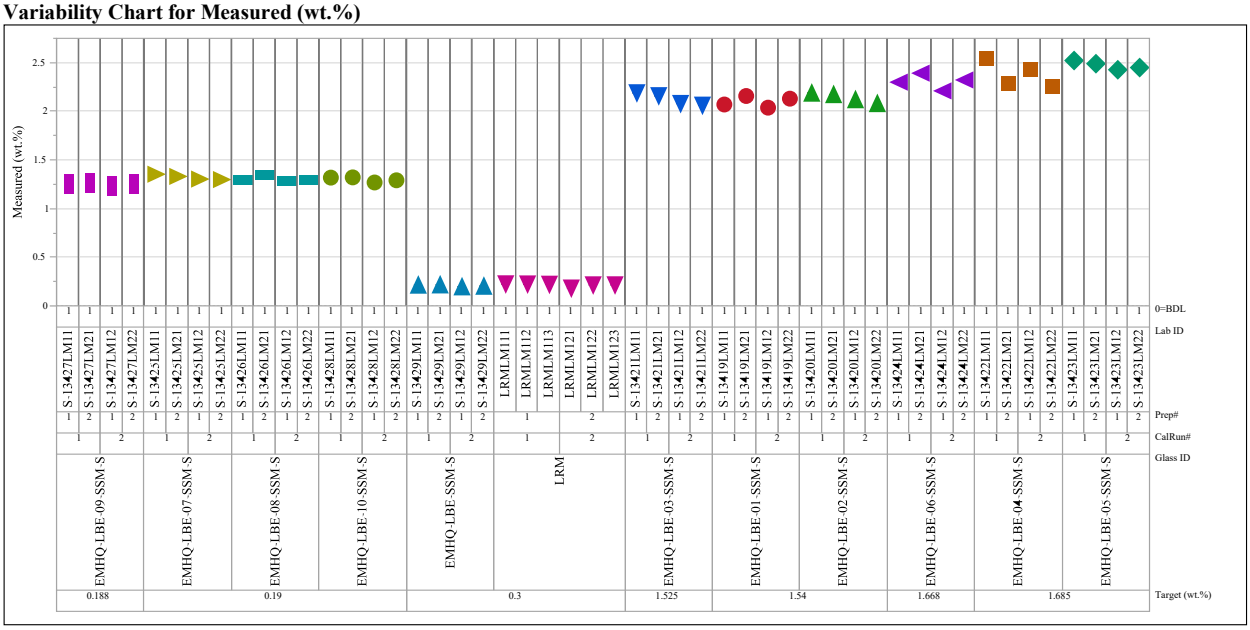
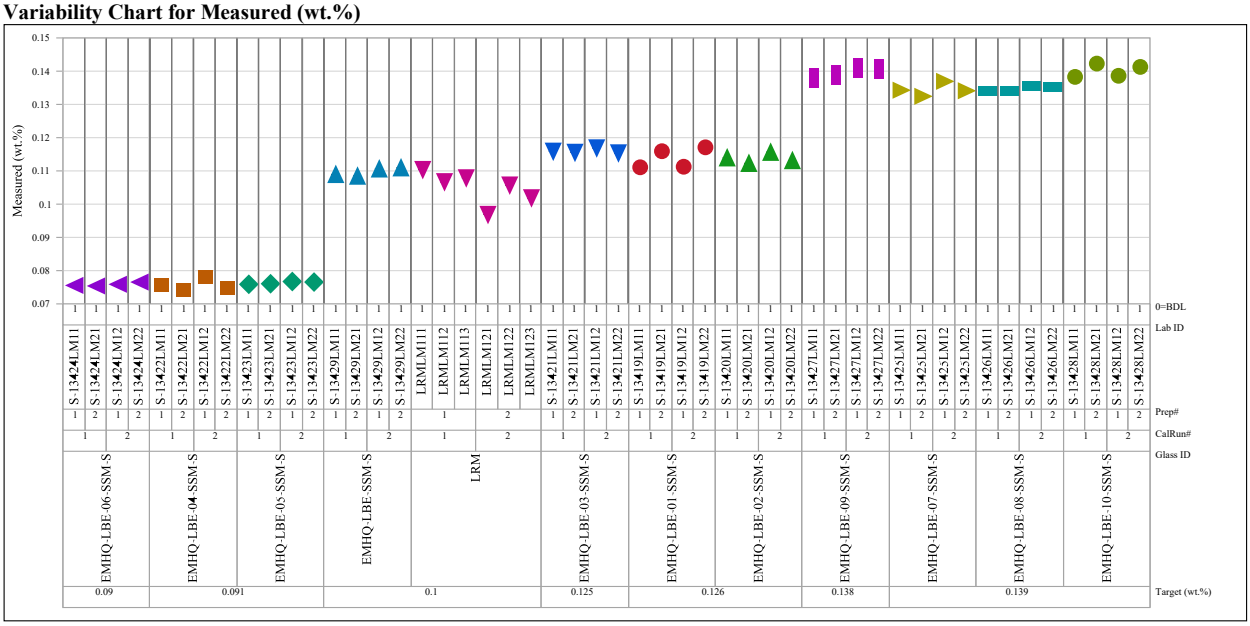


Exhibit A-1. Plots of Oxide Measurements by Glass Identifier by Target Concentrations (continued)

Oxide=TiO_2 (wt%)
Variability Chart for Measured (wt.%)



Oxide=V_2O_5 (wt%)
Variability Chart for Measured (wt.%)

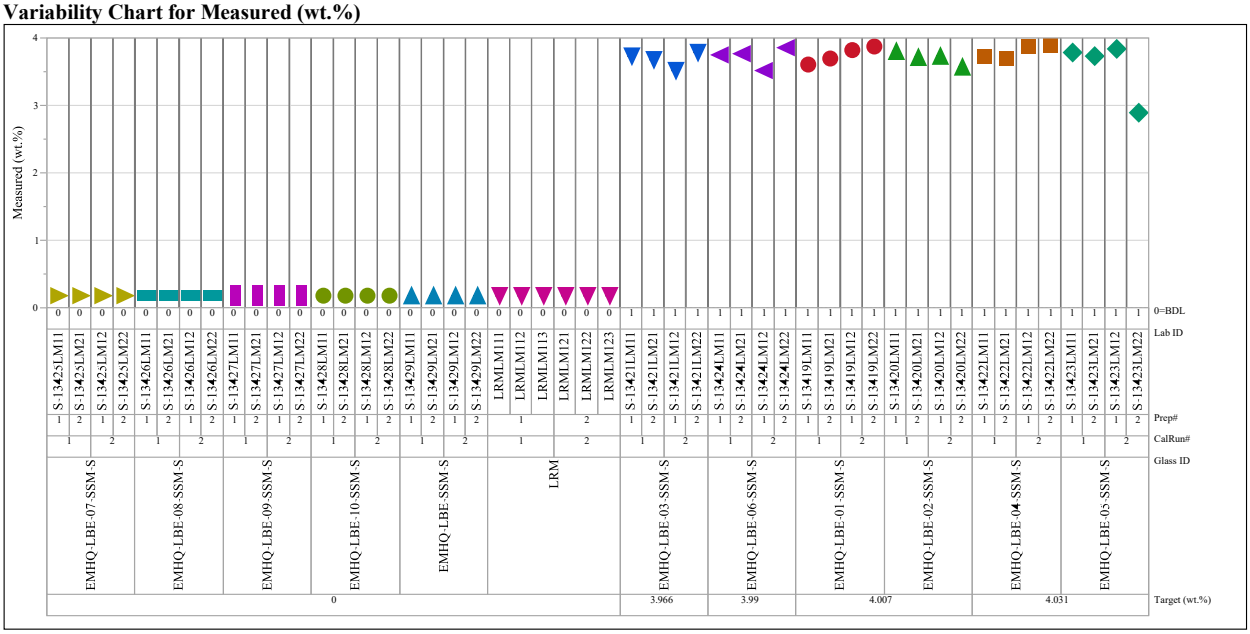


Exhibit A-1. Plots of Oxide Measurements by Glass Identifier by Target Concentrations (continued)

Oxide=ZrO_2 (wt%)
Variability Chart for Measured (wt.%)

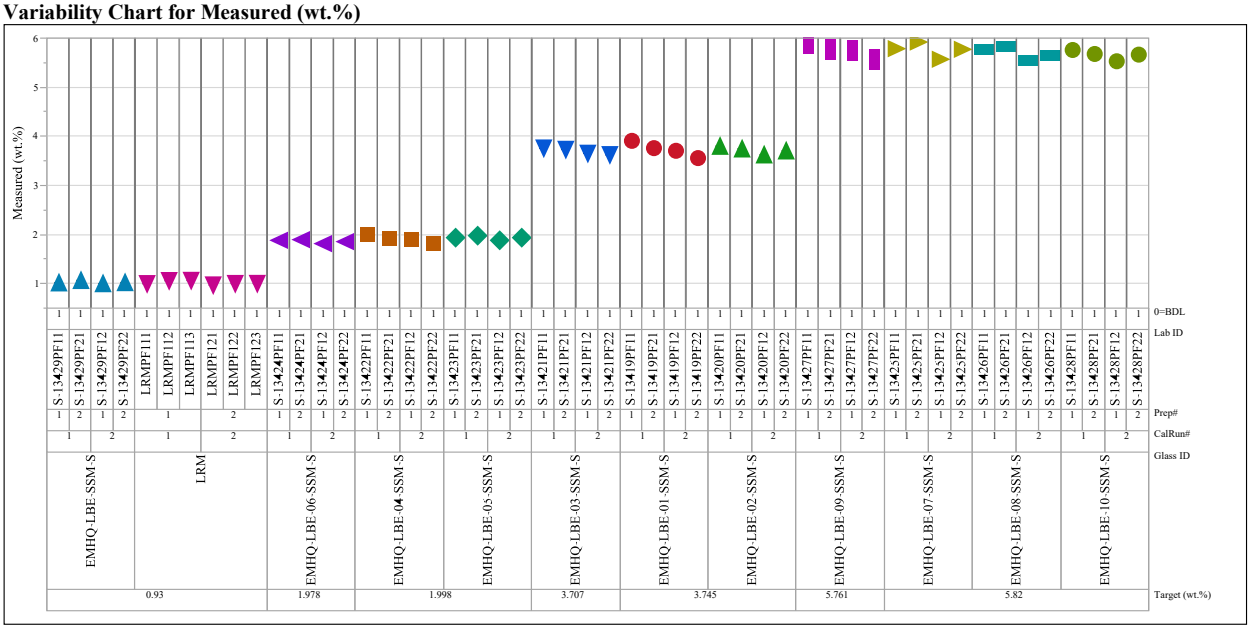
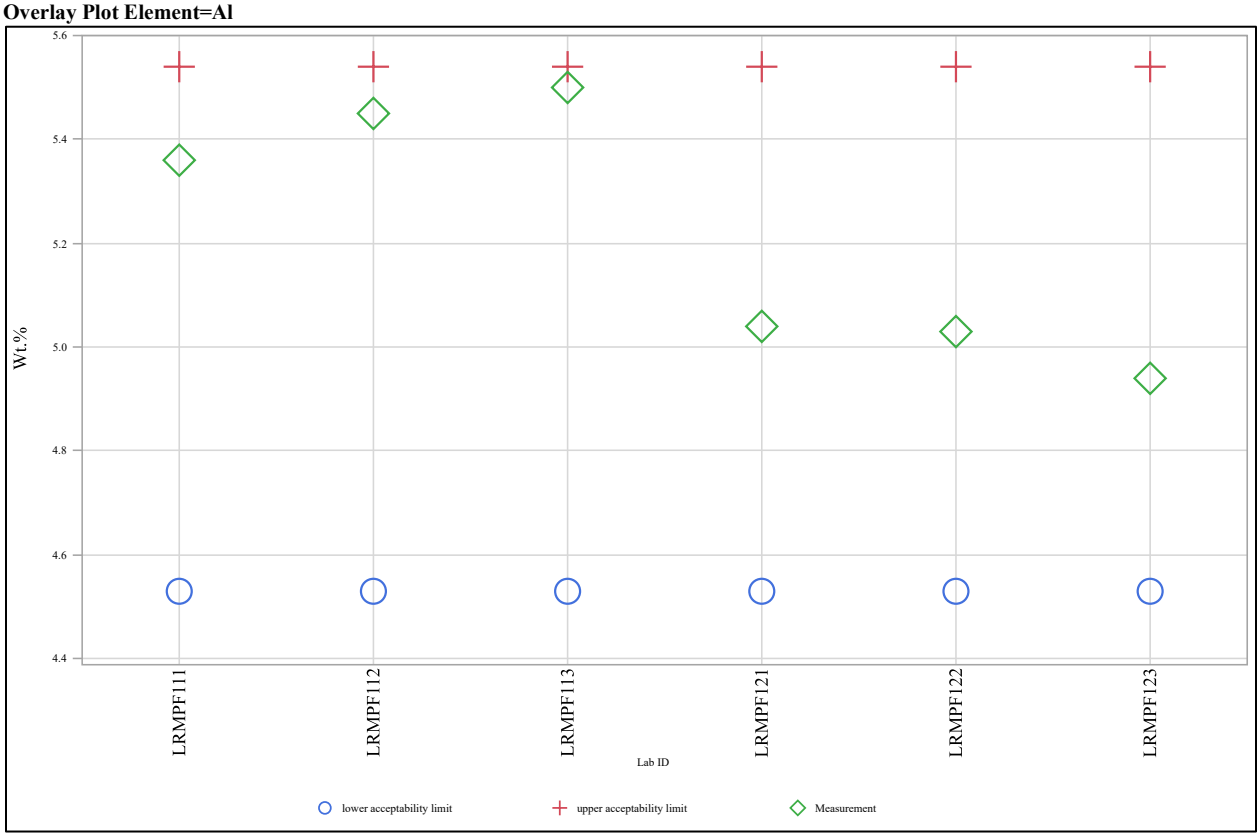


Exhibit A-2. Acceptability Evaluation for Measurements of the LRM Glass

Overlay Plot Element=Al



Overlay Plot Element=B

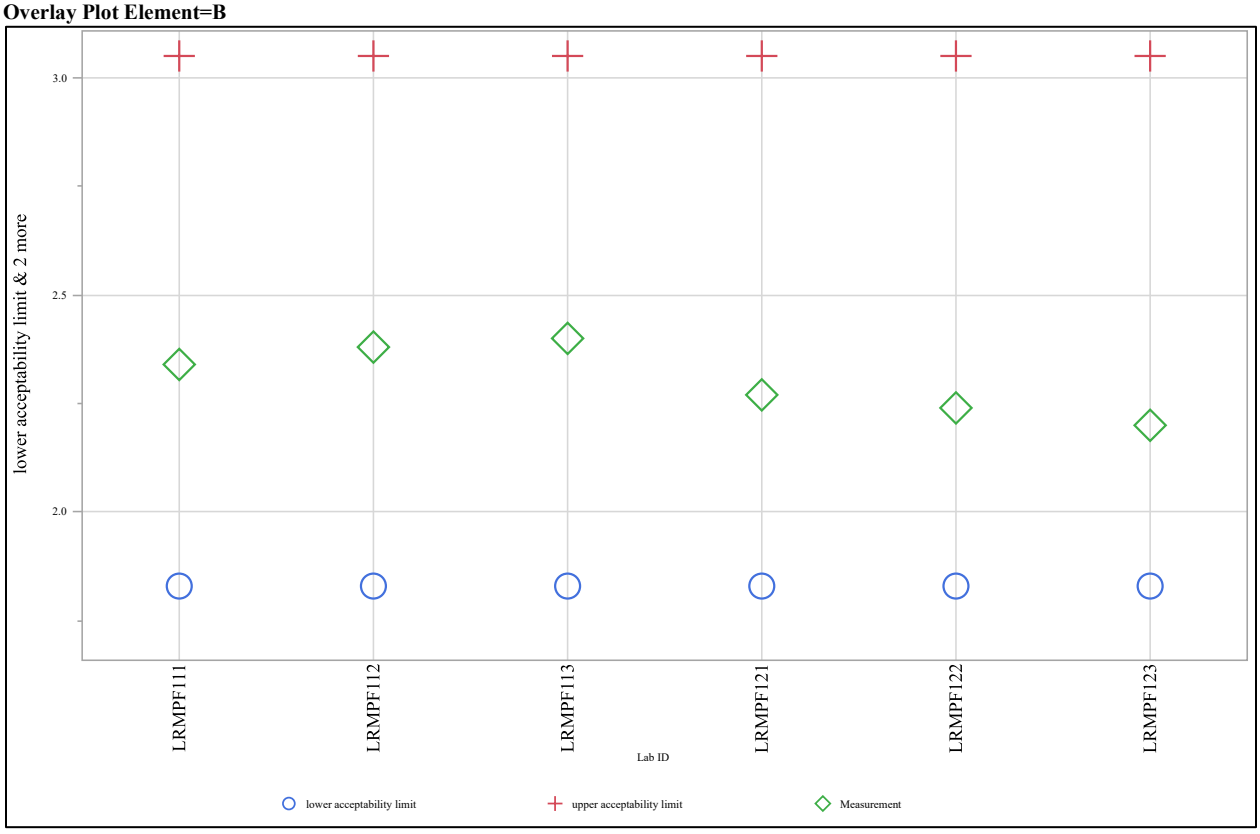
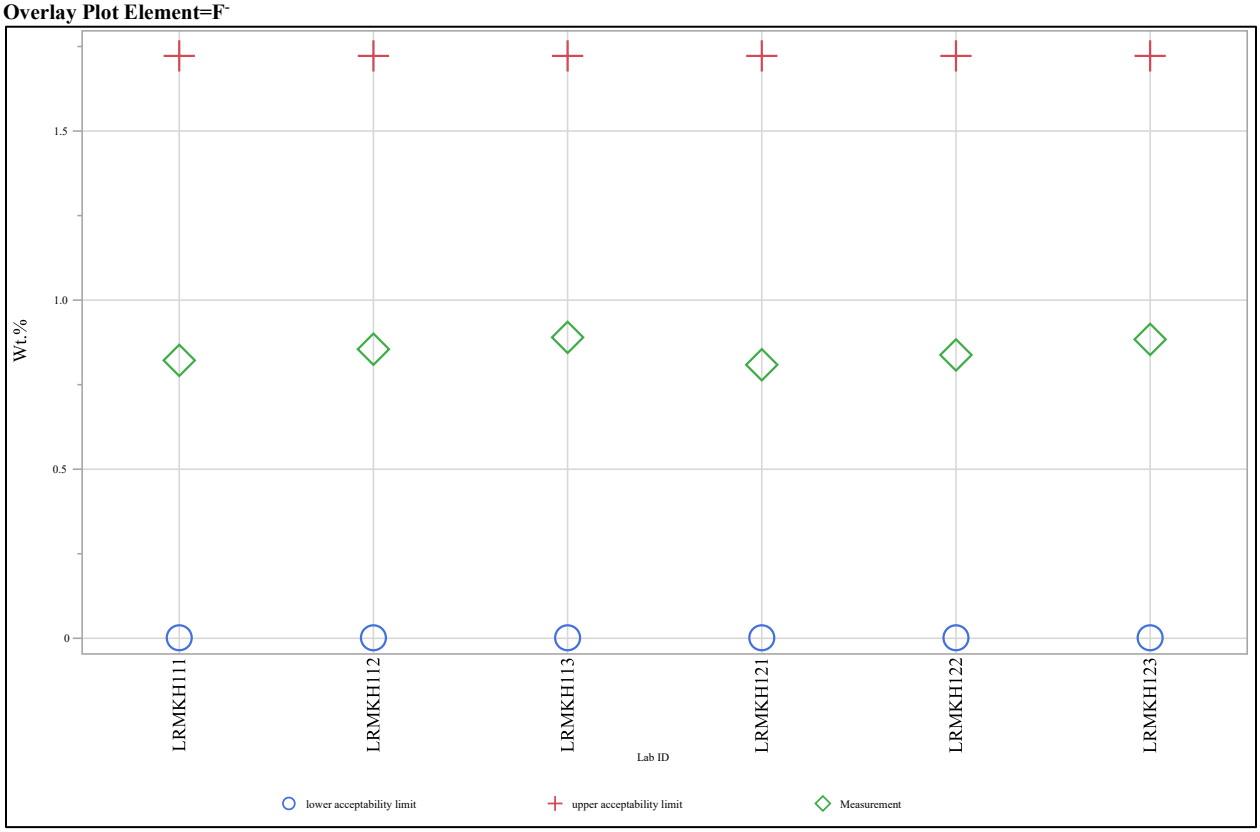


Exhibit A-2. Acceptability Evaluation for Measurements of the LRM Glass (continued)

Overlay Plot Element=F^-



Overlay Plot Element=Fe

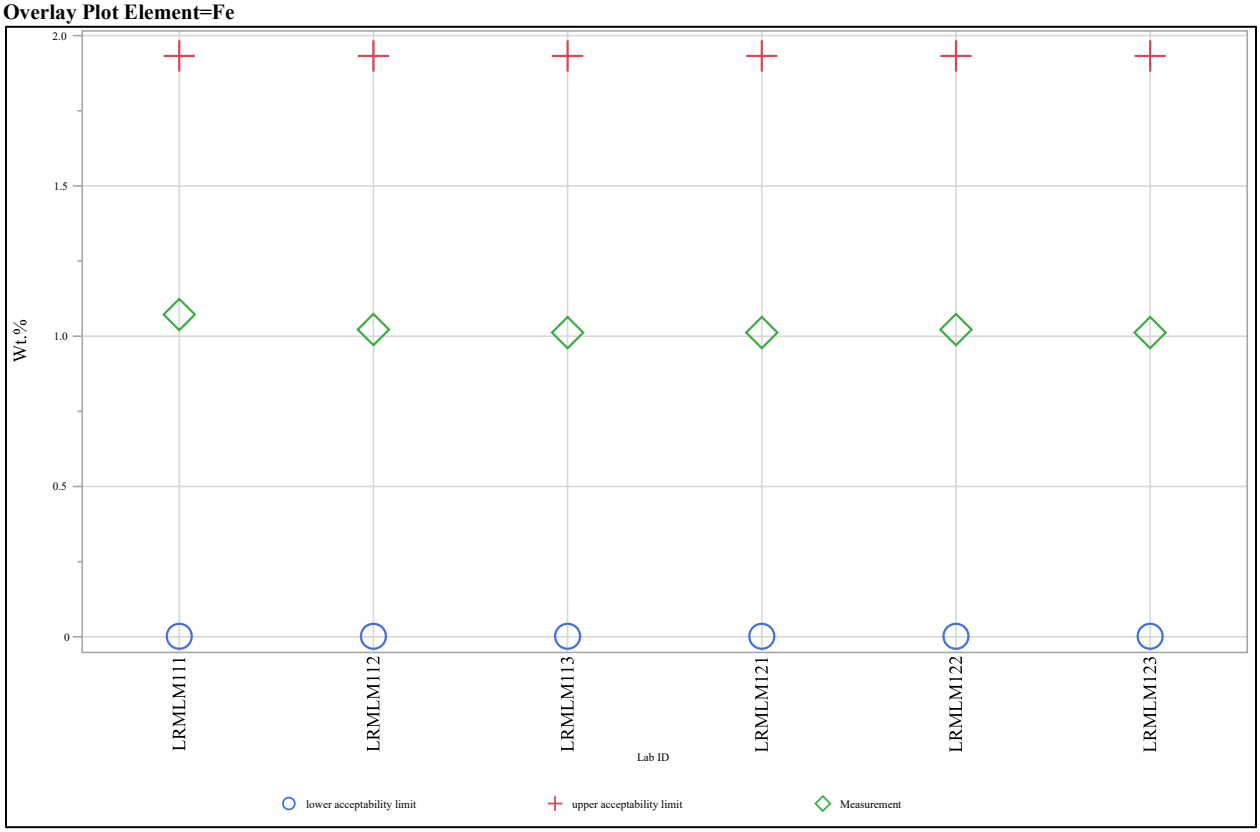
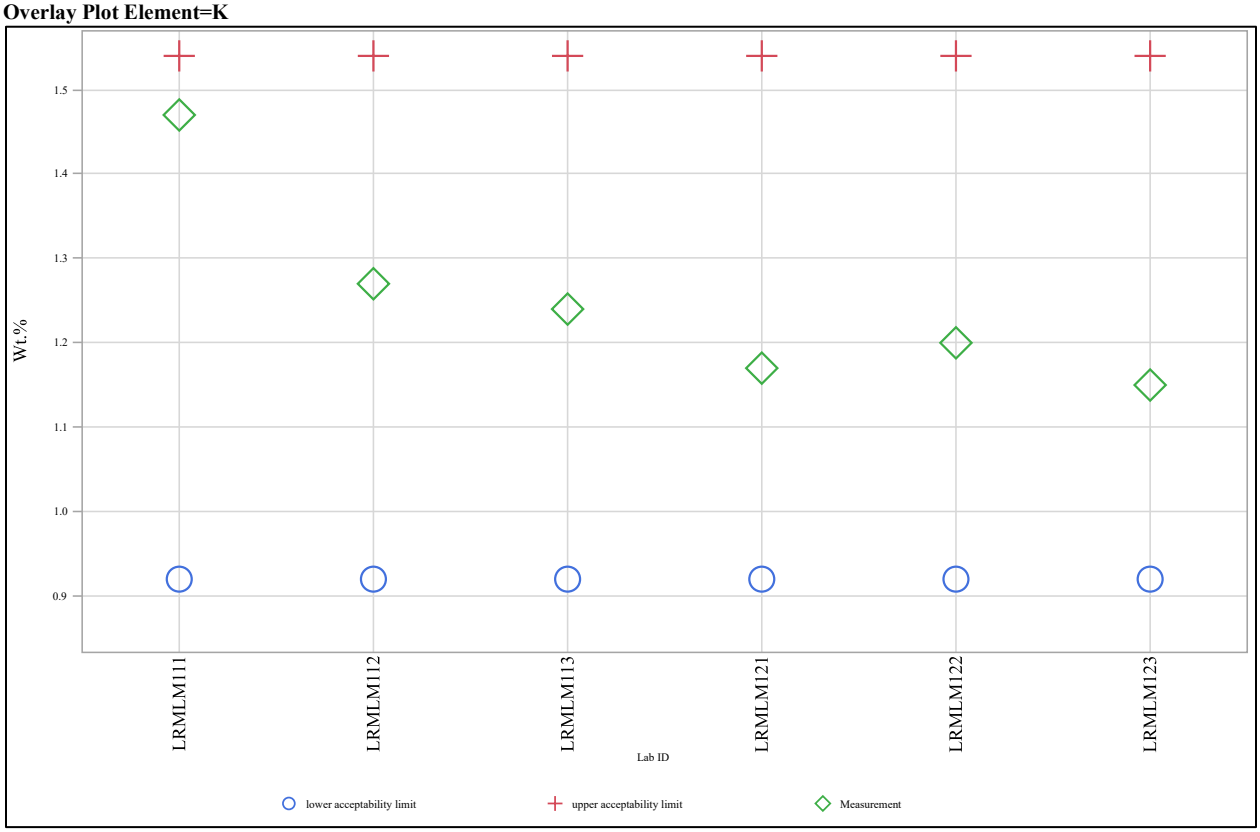


Exhibit A-2. Acceptability Evaluation for Measurements of the LRM Glass (continued)

Overlay Plot Element=K



Overlay Plot Element=Na

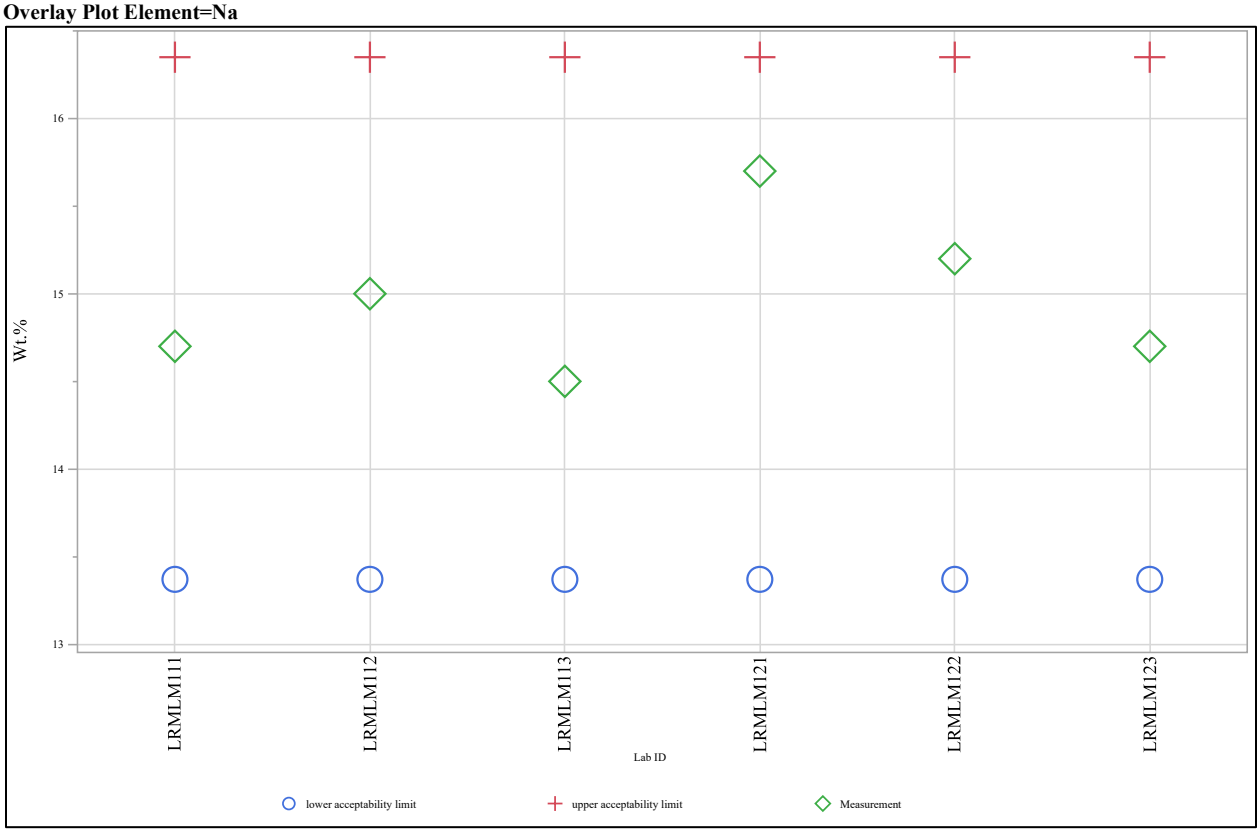
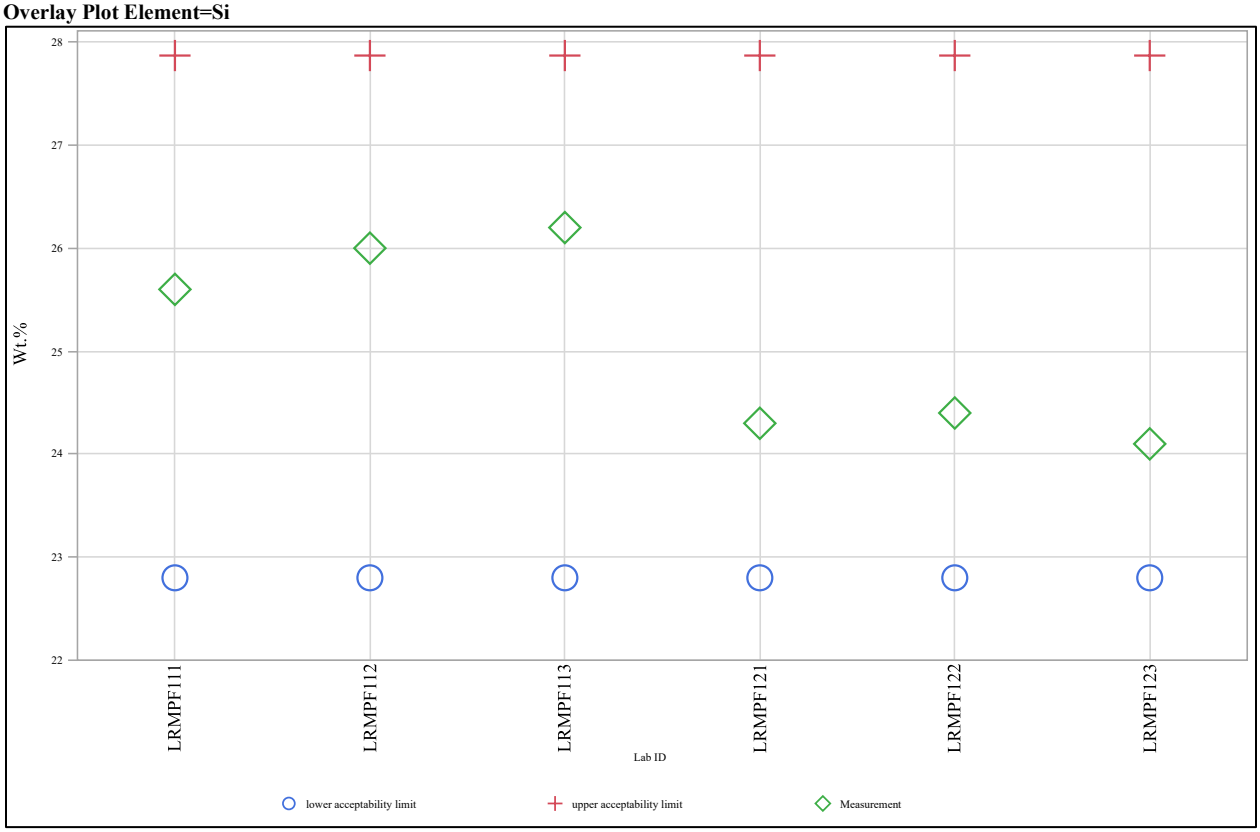


Exhibit A-2. Acceptability Evaluation for Measurements of the LRM Glass (continued)

Overlay Plot Element=Si



Overlay Plot Element=Zr

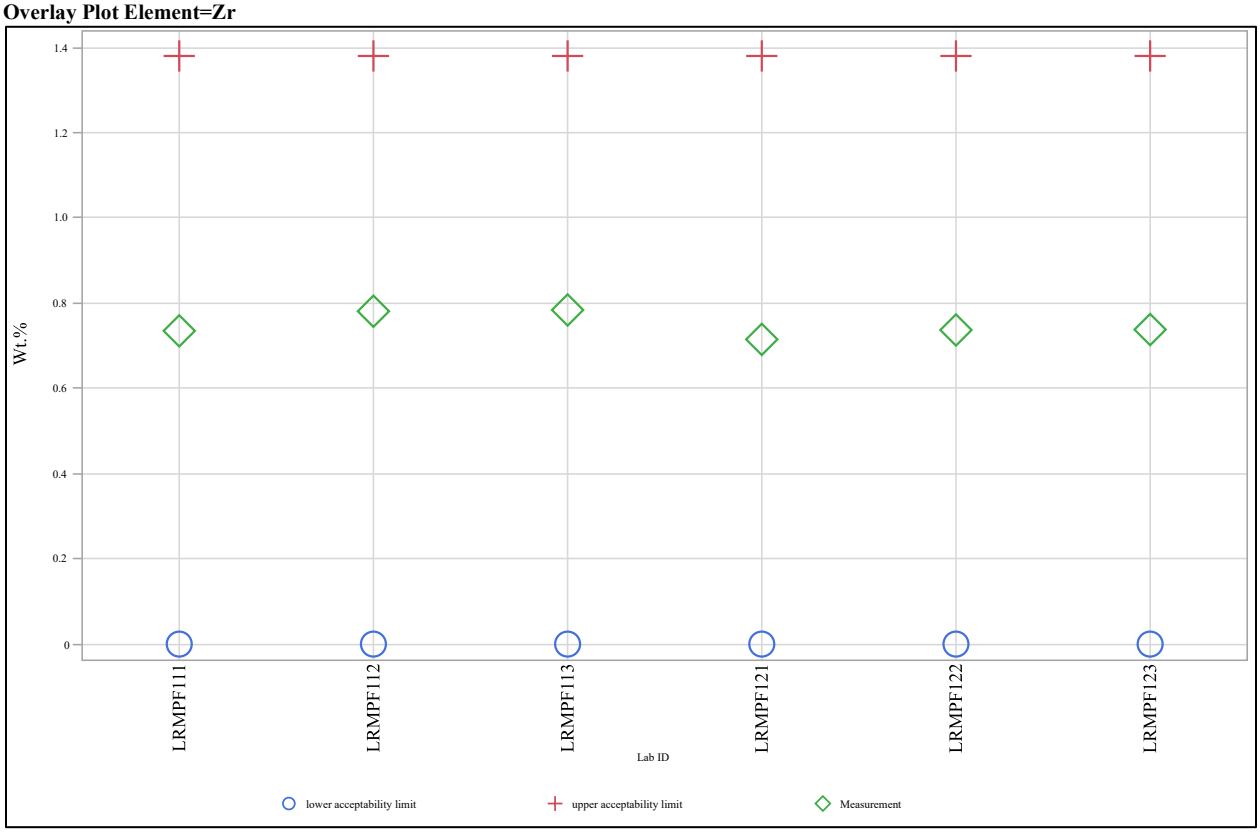
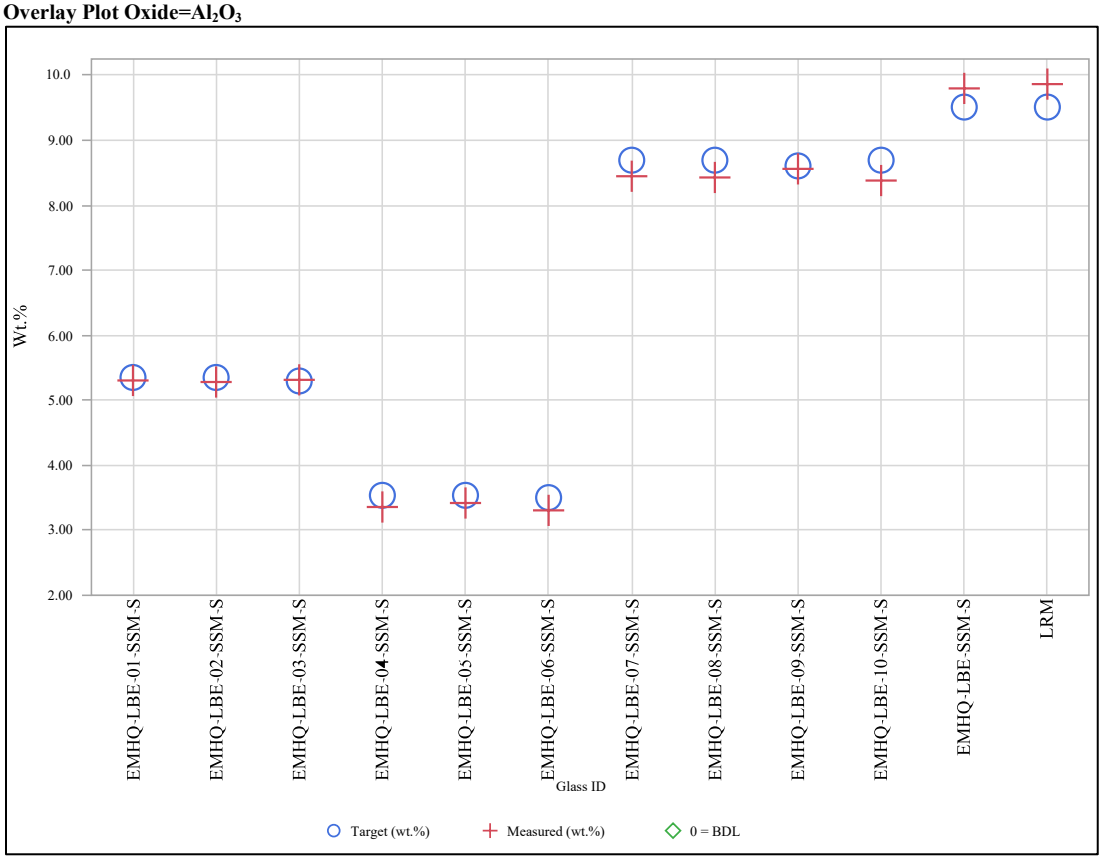


Exhibit A-3. Measured versus Target Concentrations by Glass ID by Oxide

Overlay Plot Oxide=Al_2O_3



Overlay Plot Oxide=B_2O_3

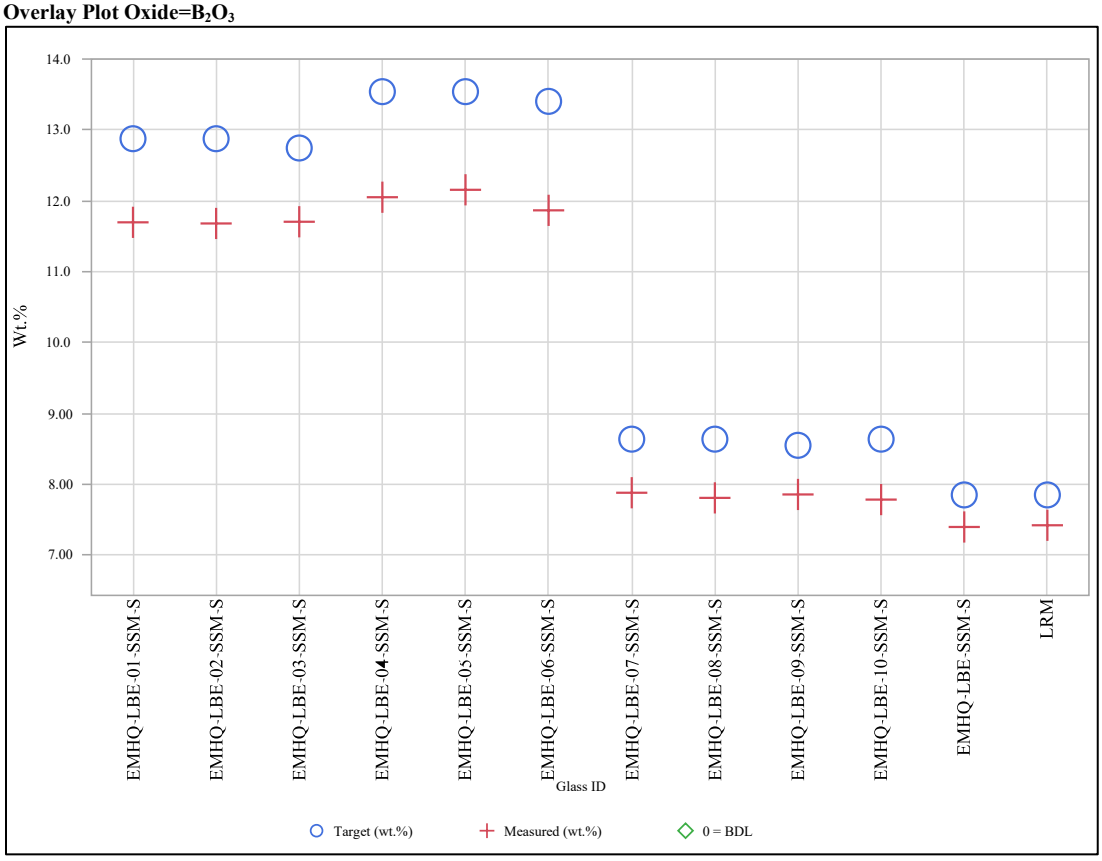
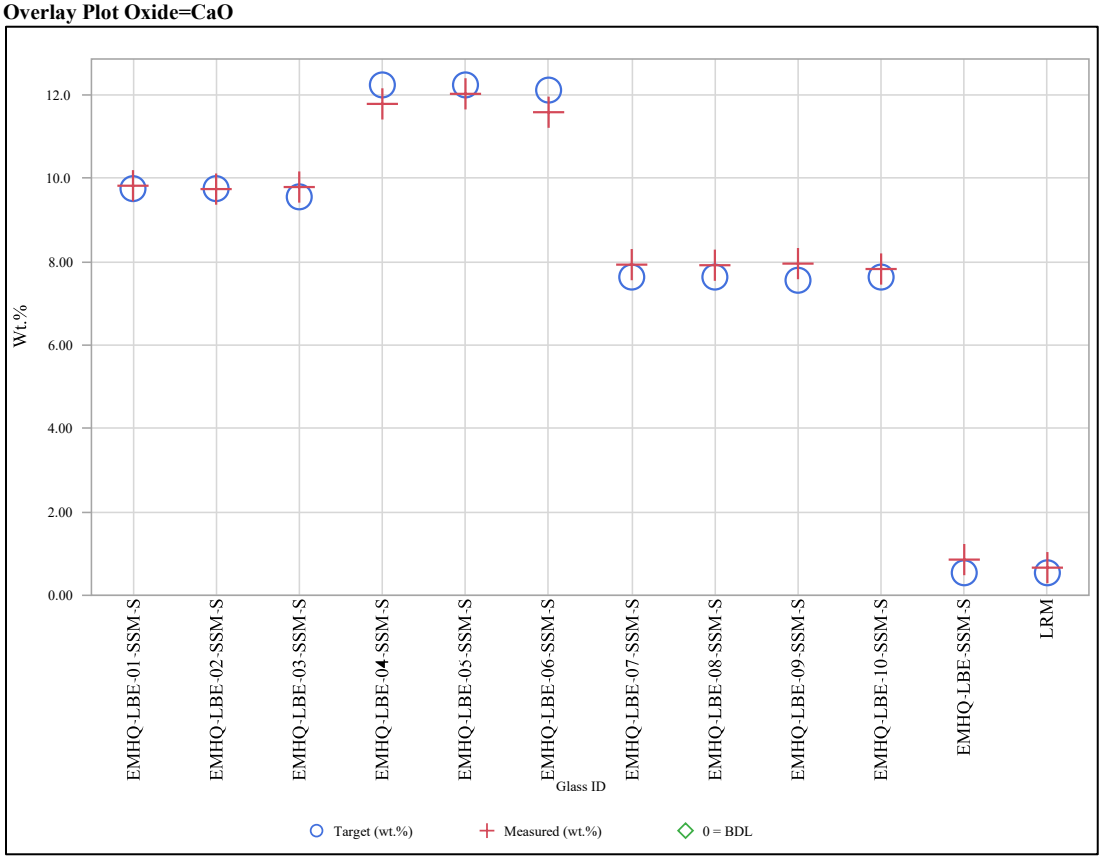


Exhibit A-3. Measured versus Target Concentrations by Glass ID by Oxide (continued)

Overlay Plot Oxide=CaO



Overlay Plot Oxide=Cl^-

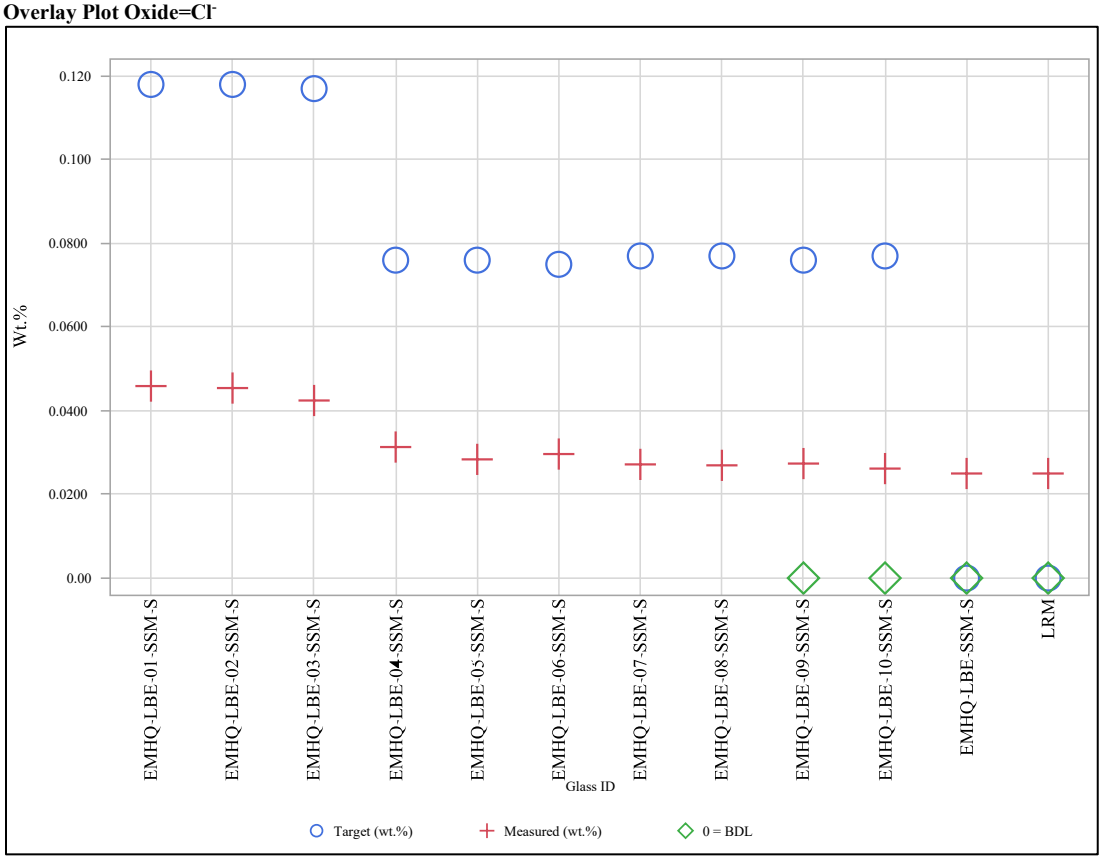
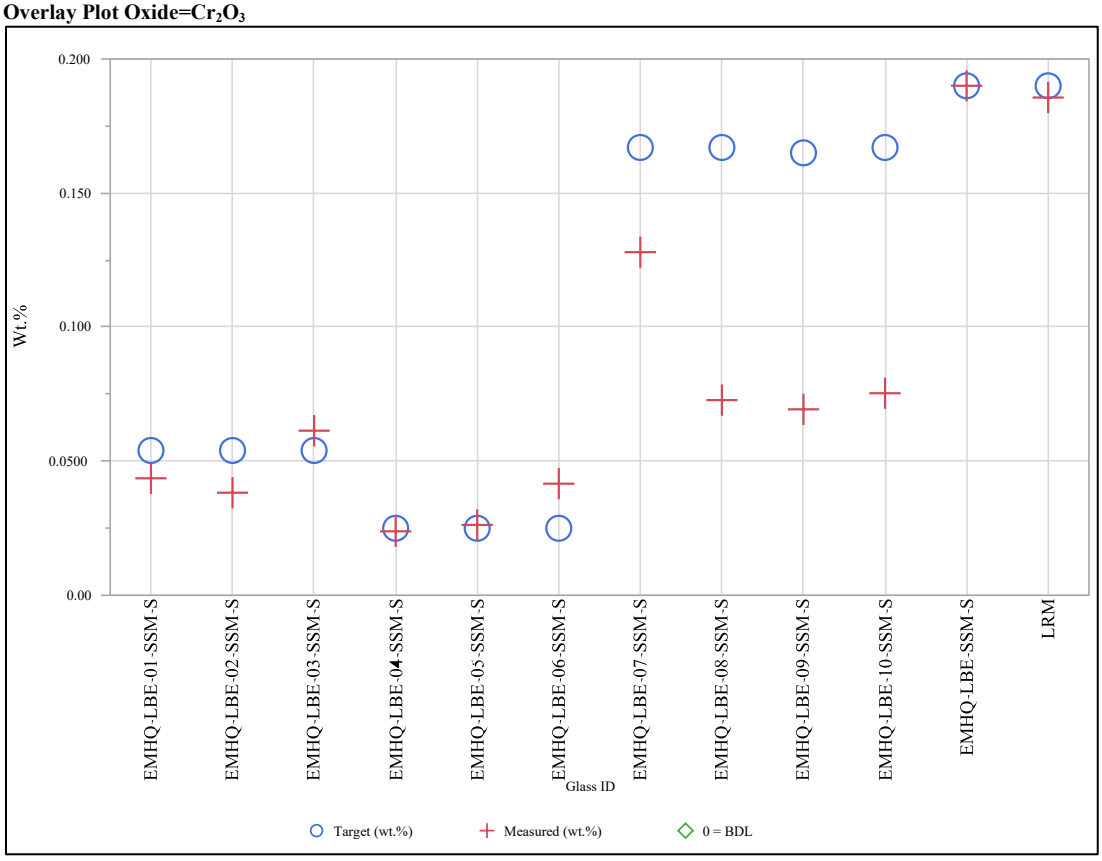


Exhibit A-3. Measured versus Target Concentrations by Glass ID by Oxide (continued)

Overlay Plot Oxide=Cr_2O_3



Overlay Plot Oxide=F^-

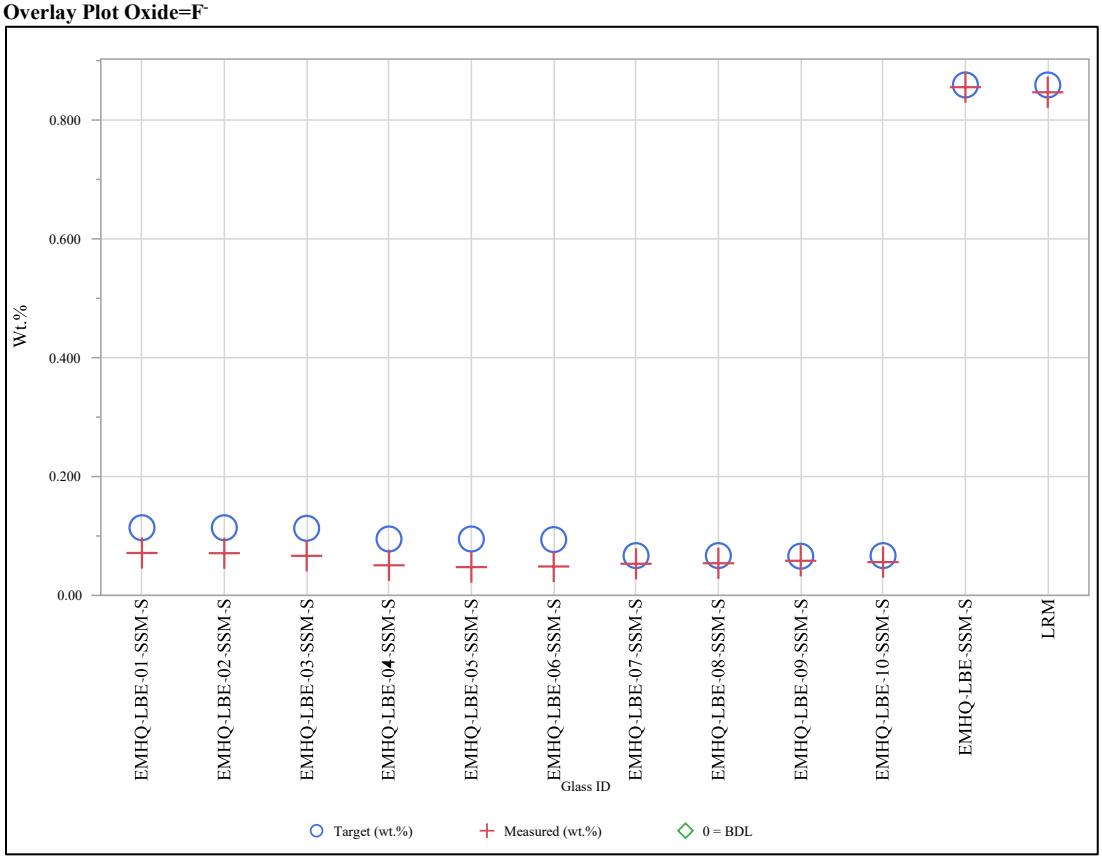
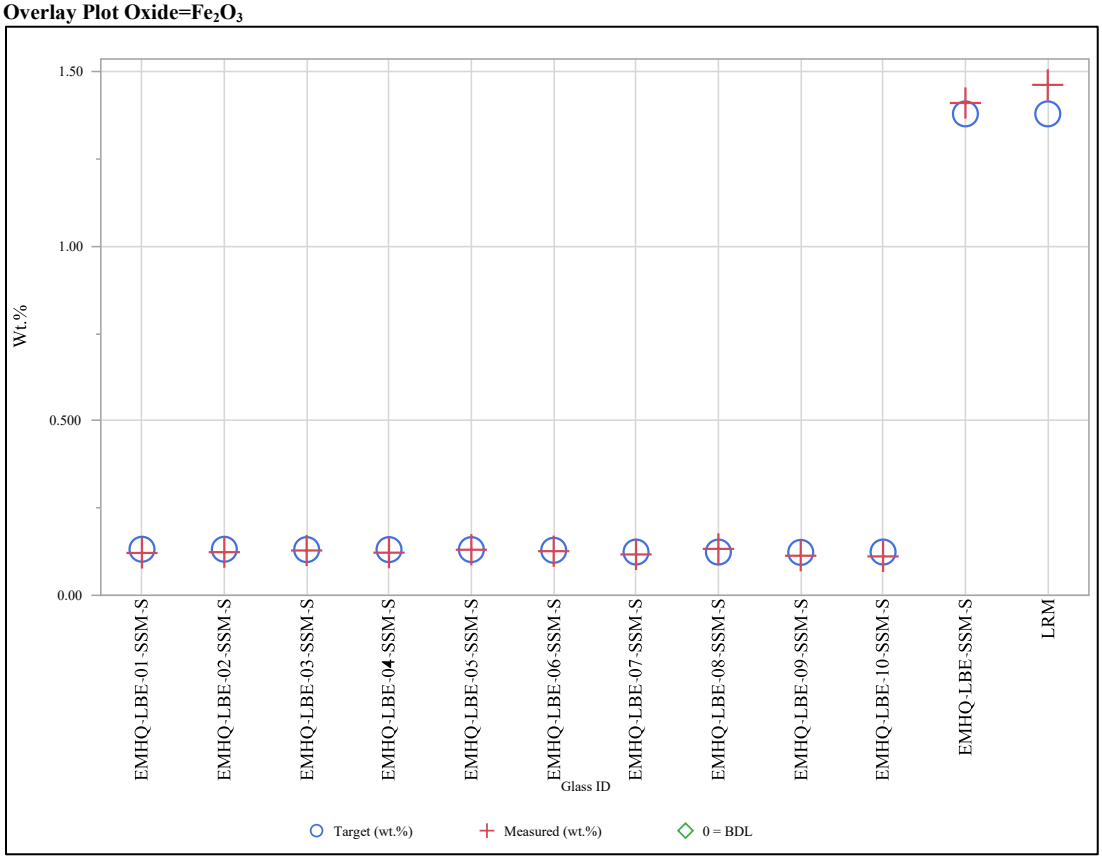


Exhibit A-3. Measured versus Target Concentrations by Glass ID by Oxide (continued)

Overlay Plot Oxide=Fe_2O_3



Overlay Plot Oxide=K_2O

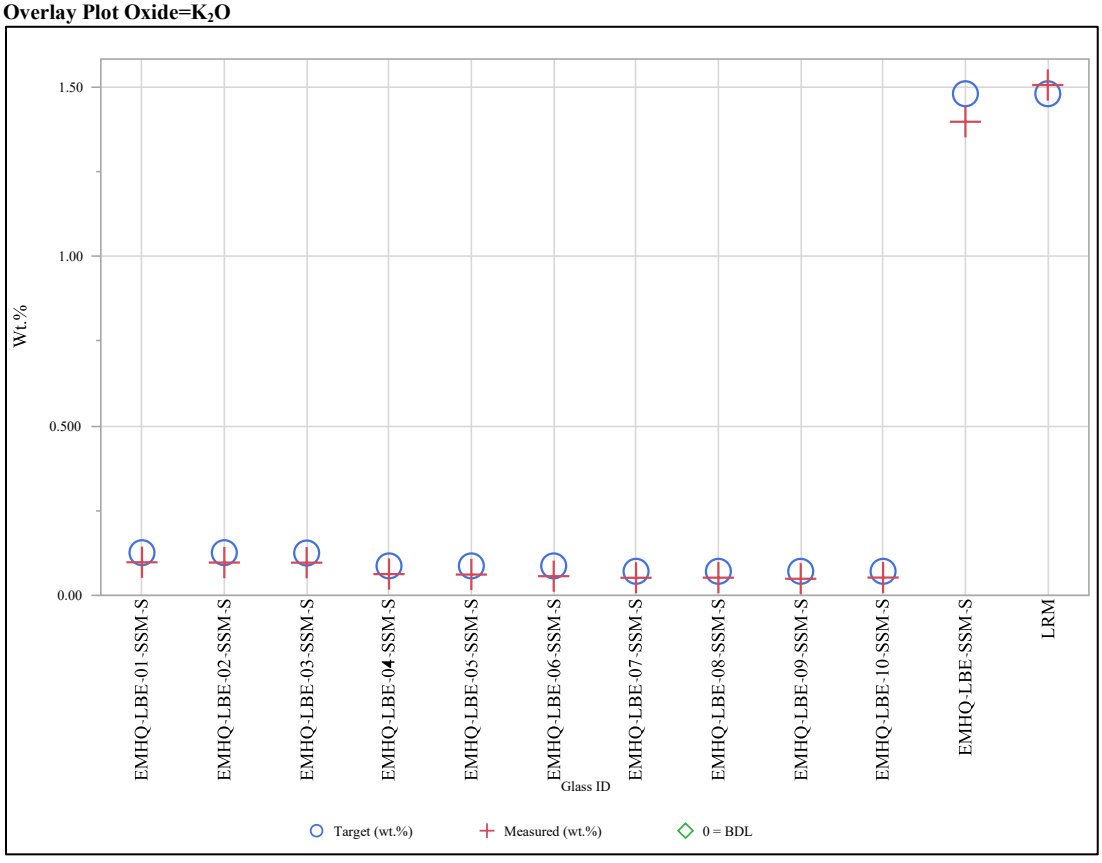
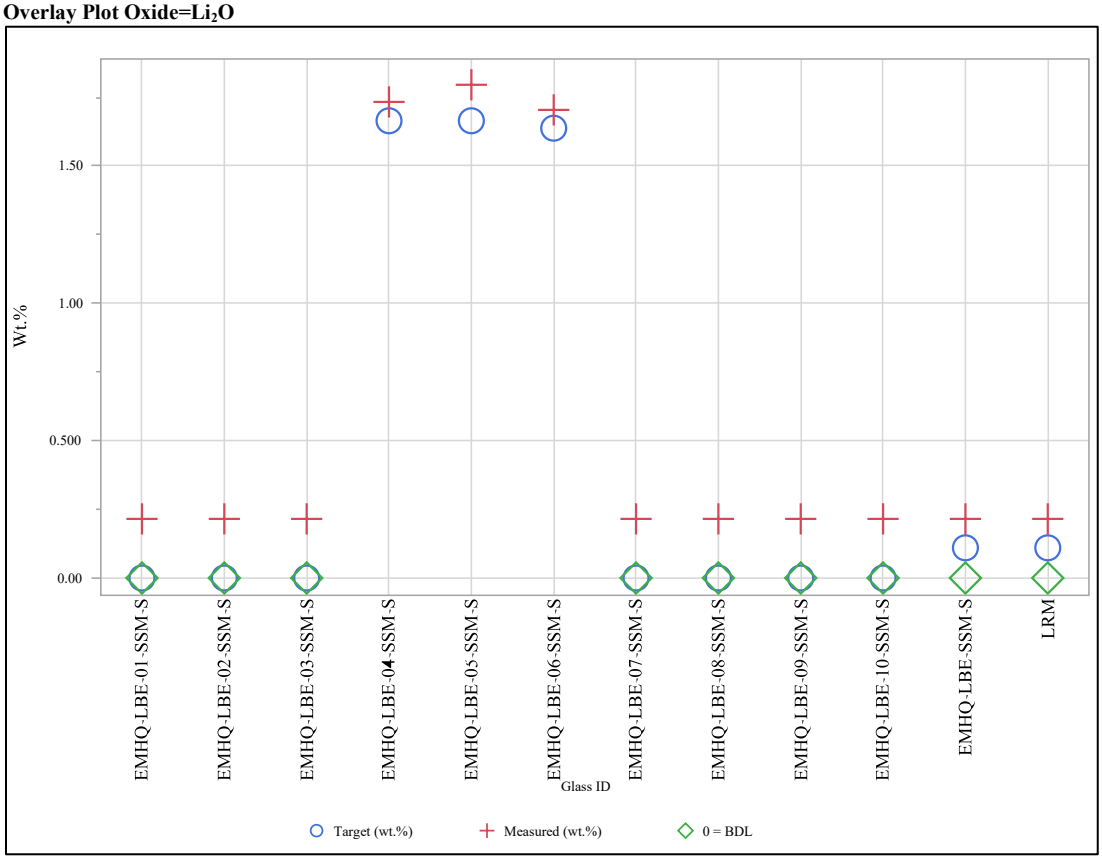


Exhibit A-3. Measured versus Target Concentrations by Glass ID by Oxide (continued)

Overlay Plot Oxide=Li_2O



Overlay Plot Oxide=MgO

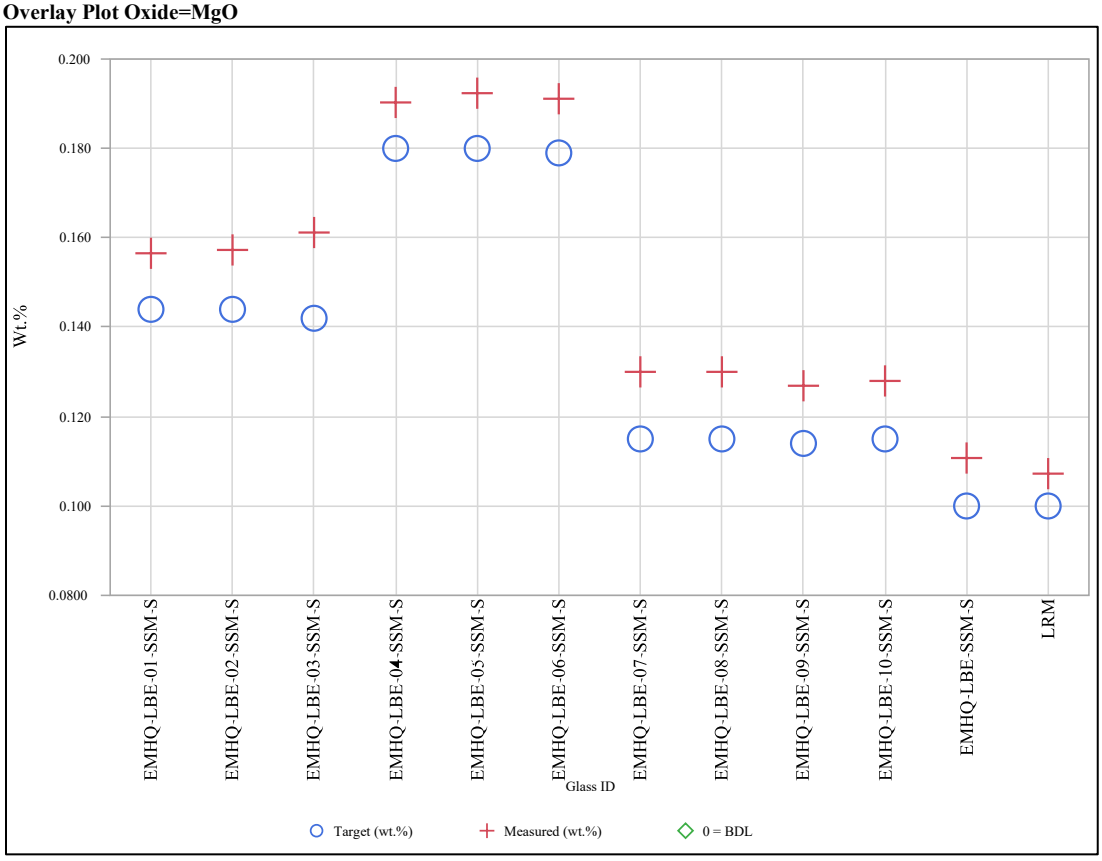
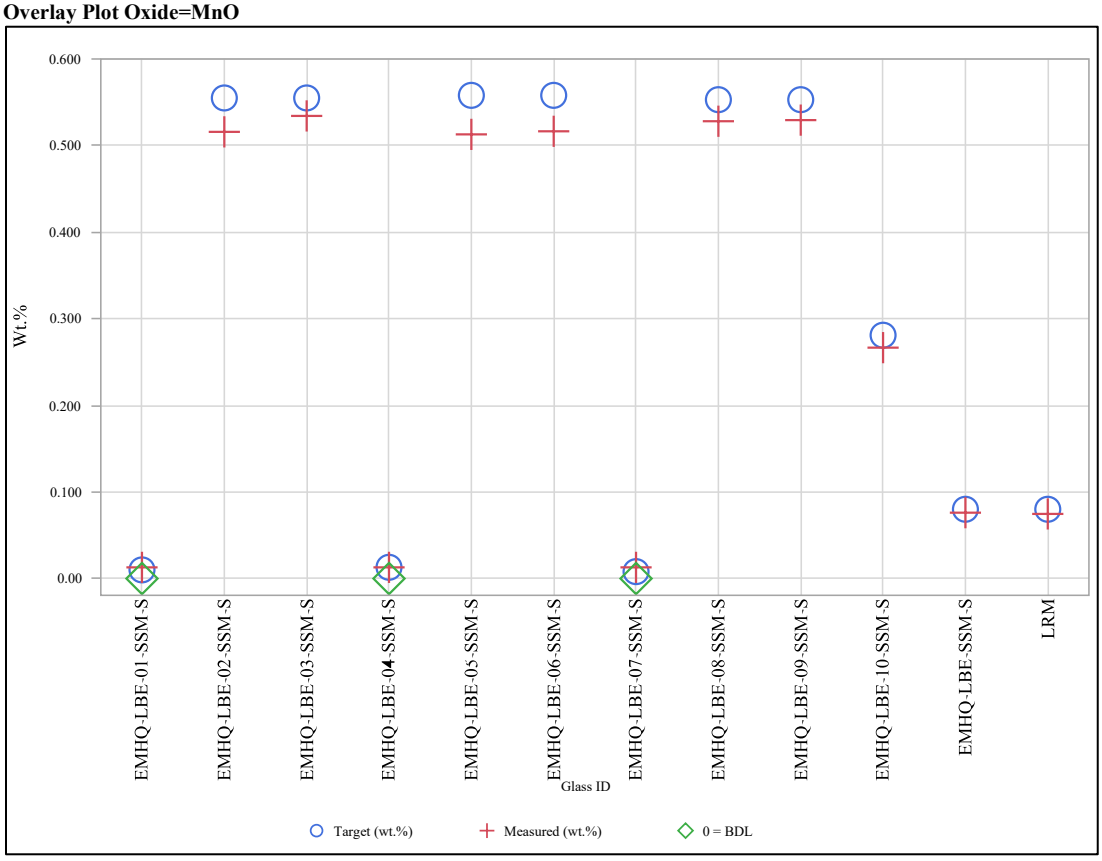


Exhibit A-3. Measured versus Target Concentrations by Glass ID by Oxide (continued)

Overlay Plot Oxide=MnO



Overlay Plot Oxide=Na_2O

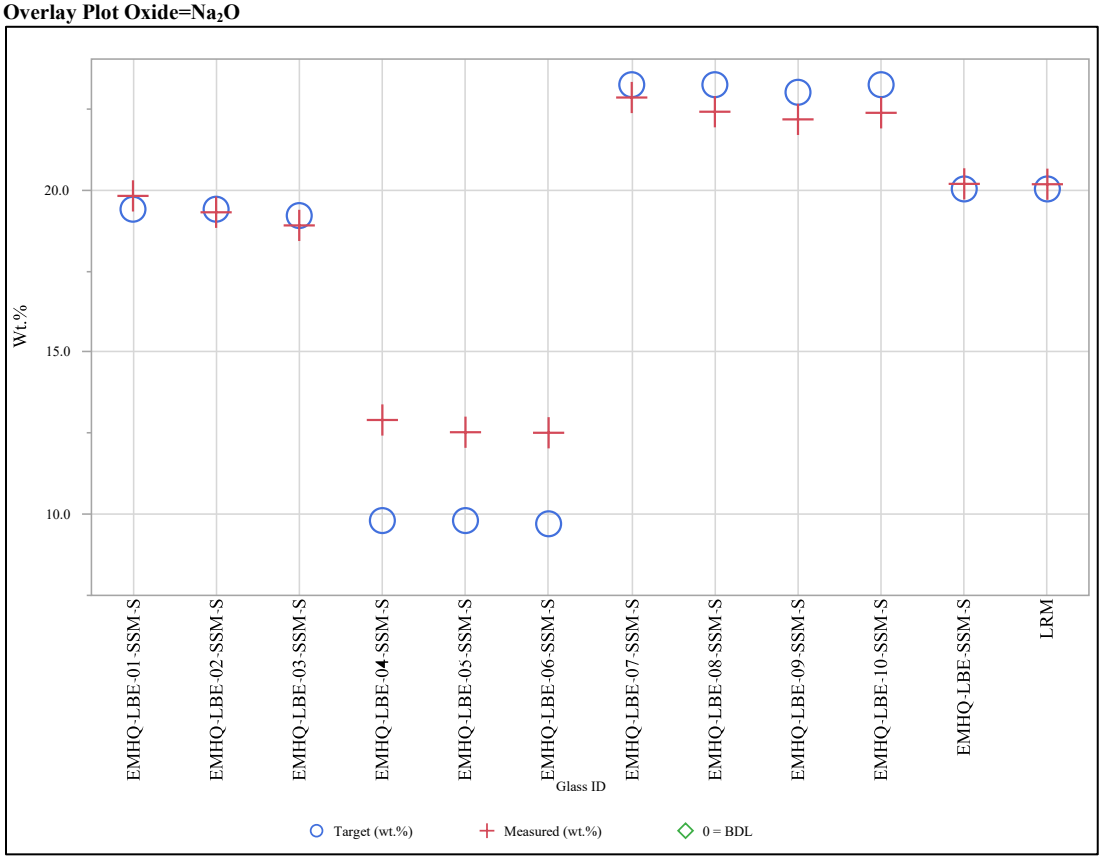
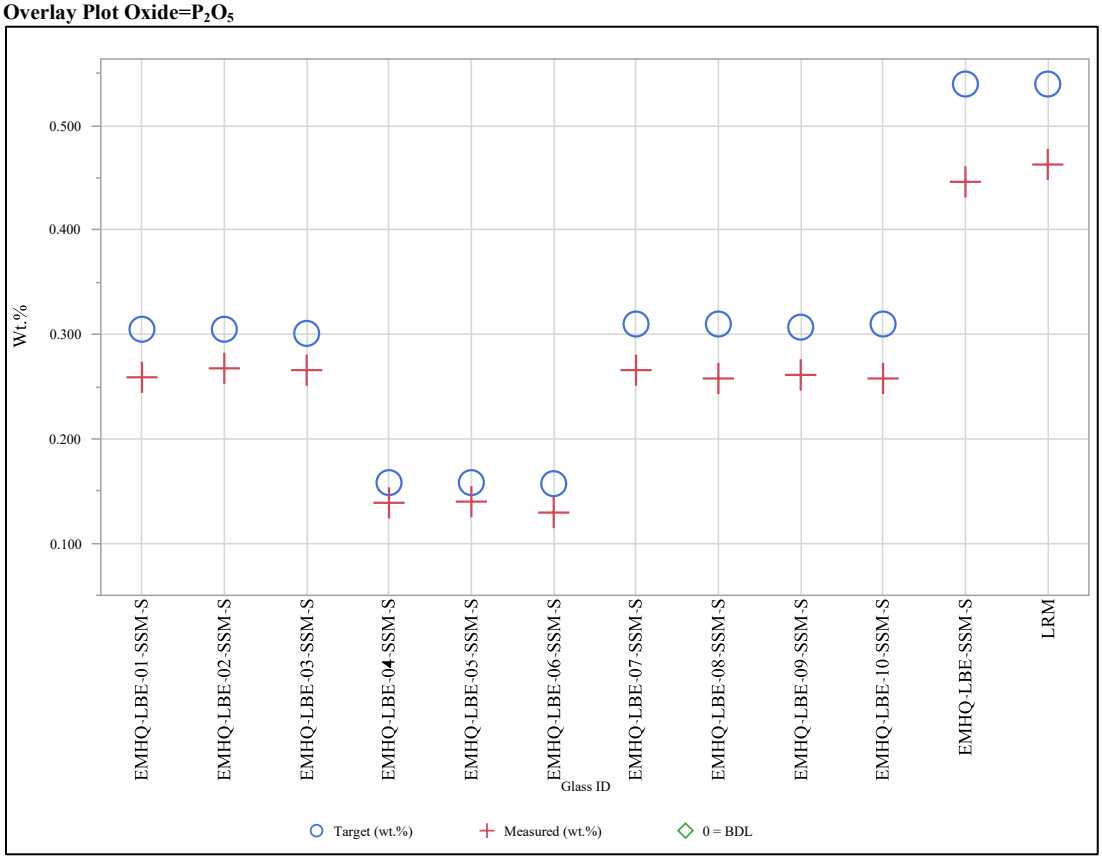


Exhibit A-3. Measured versus Target Concentrations by Glass ID by Oxide (continued)

Overlay Plot Oxide=P_2O_5



Overlay Plot Oxide=SiO_2

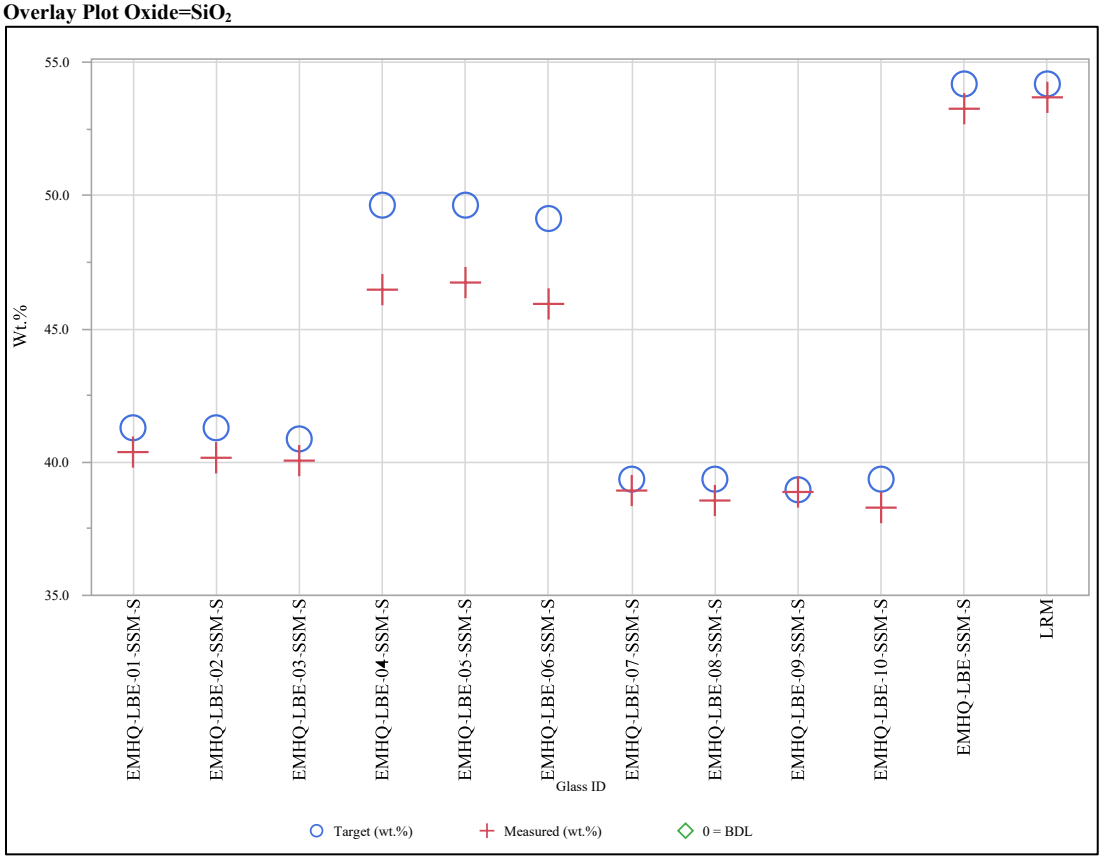
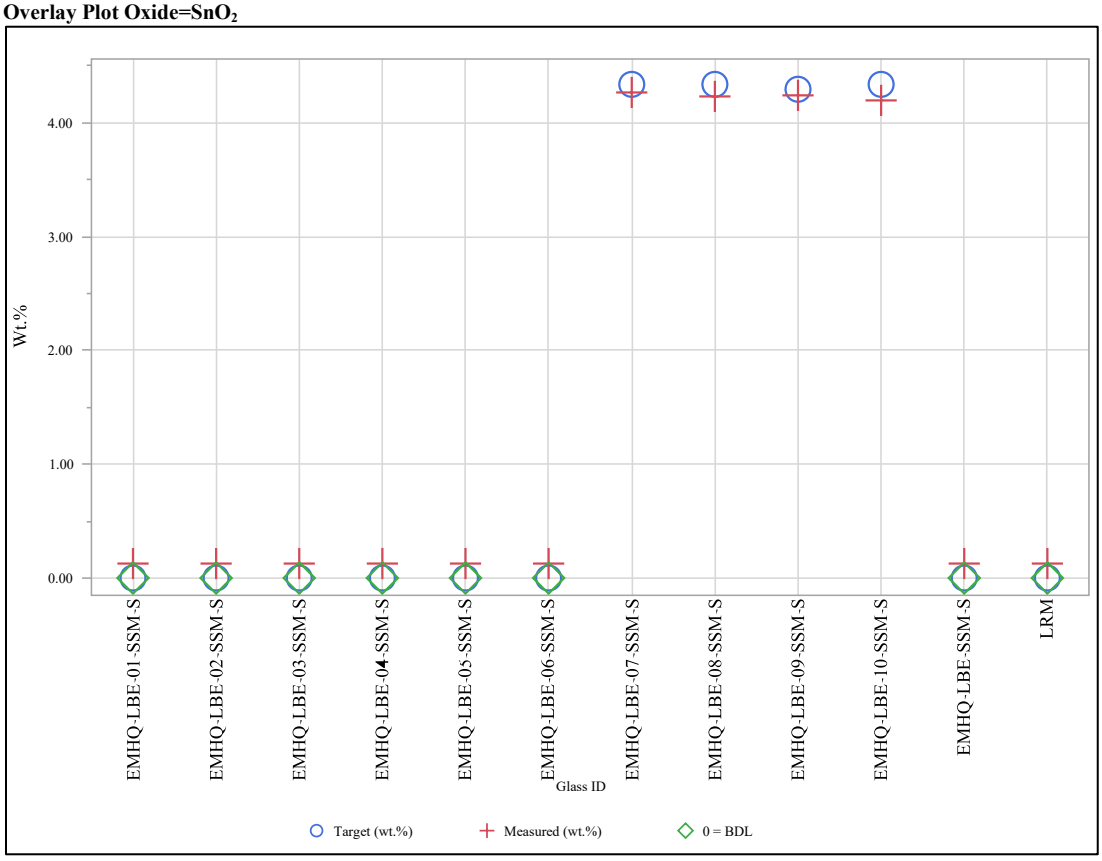


Exhibit A-3. Measured versus Target Concentrations by Glass ID by Oxide (continued)

Overlay Plot Oxide=SnO_2



Overlay Plot Oxide=SO_3

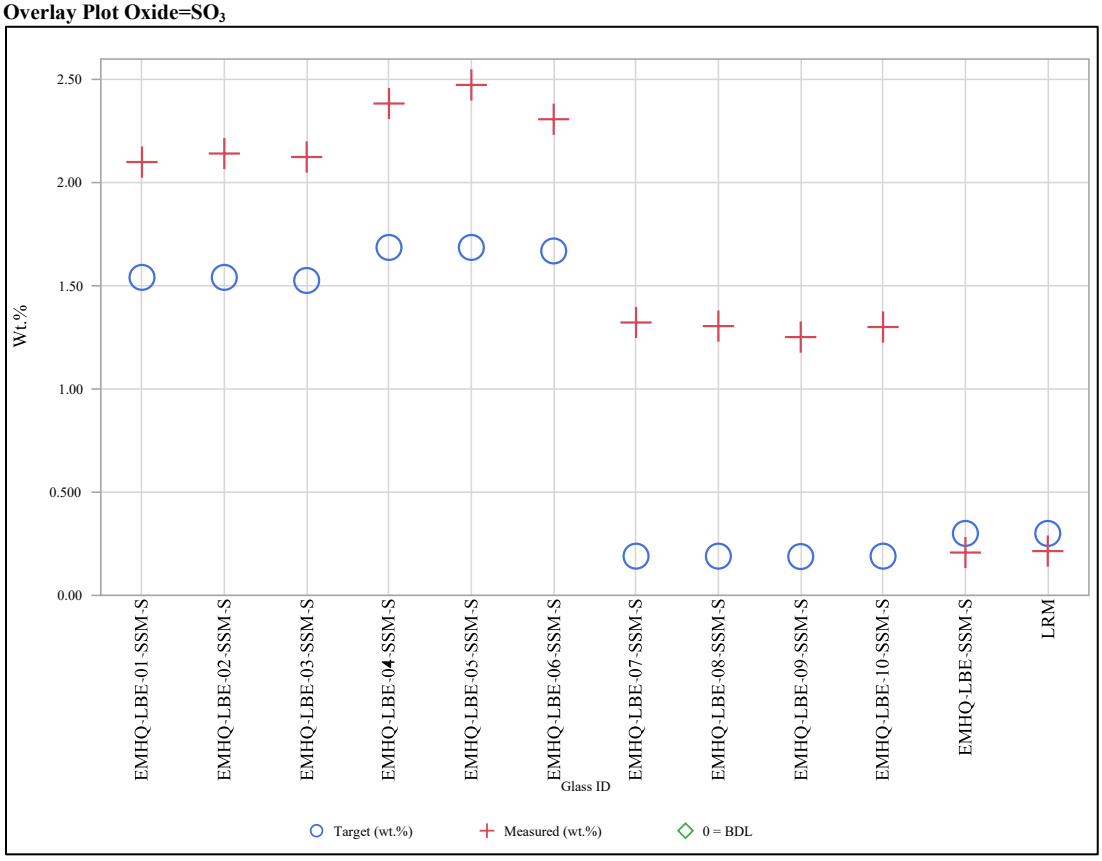
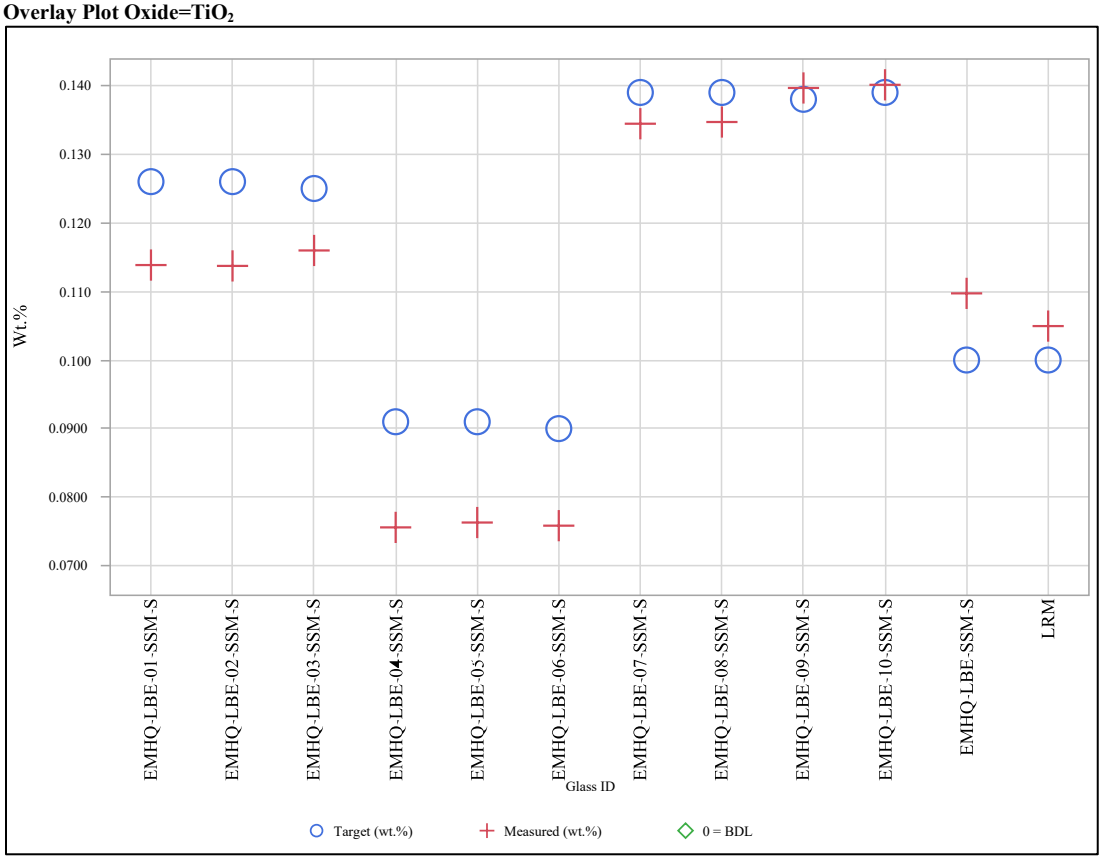


Exhibit A-3. Measured versus Target Concentrations by Glass ID by Oxide (continued)

Overlay Plot Oxide=TiO_2



Overlay Plot Oxide=V_2O_5

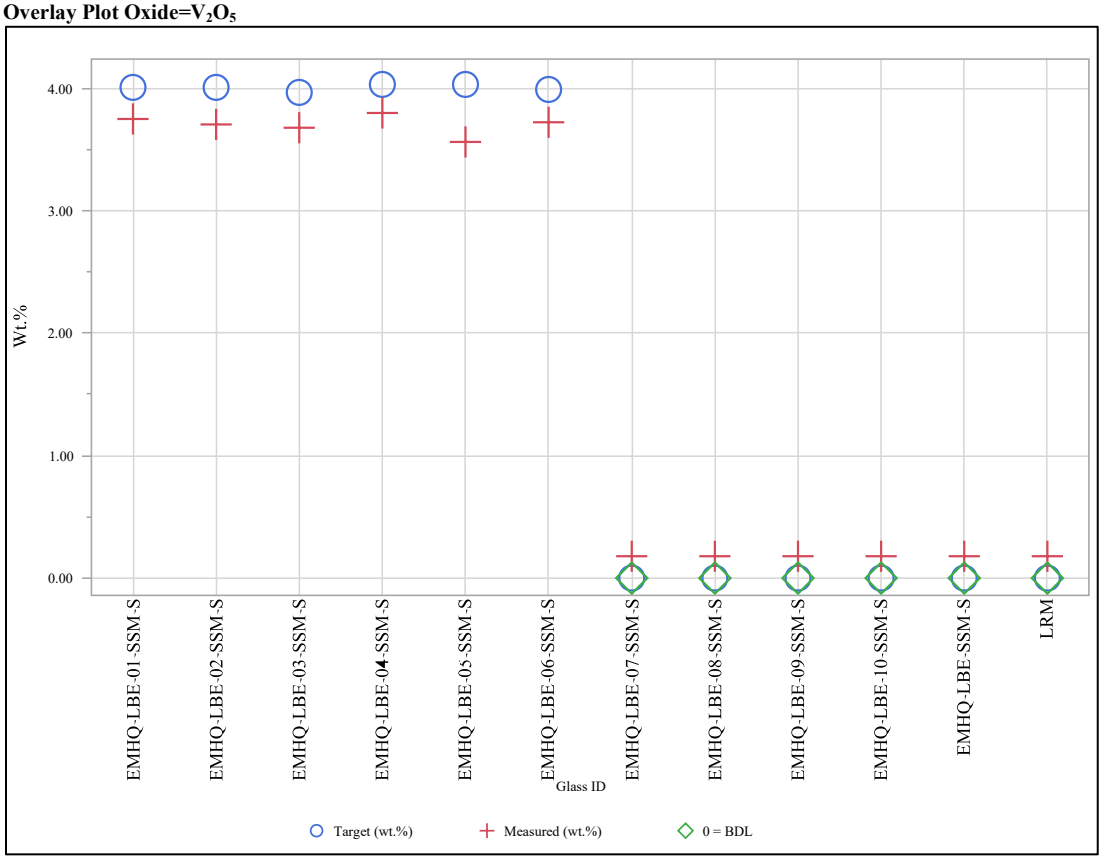
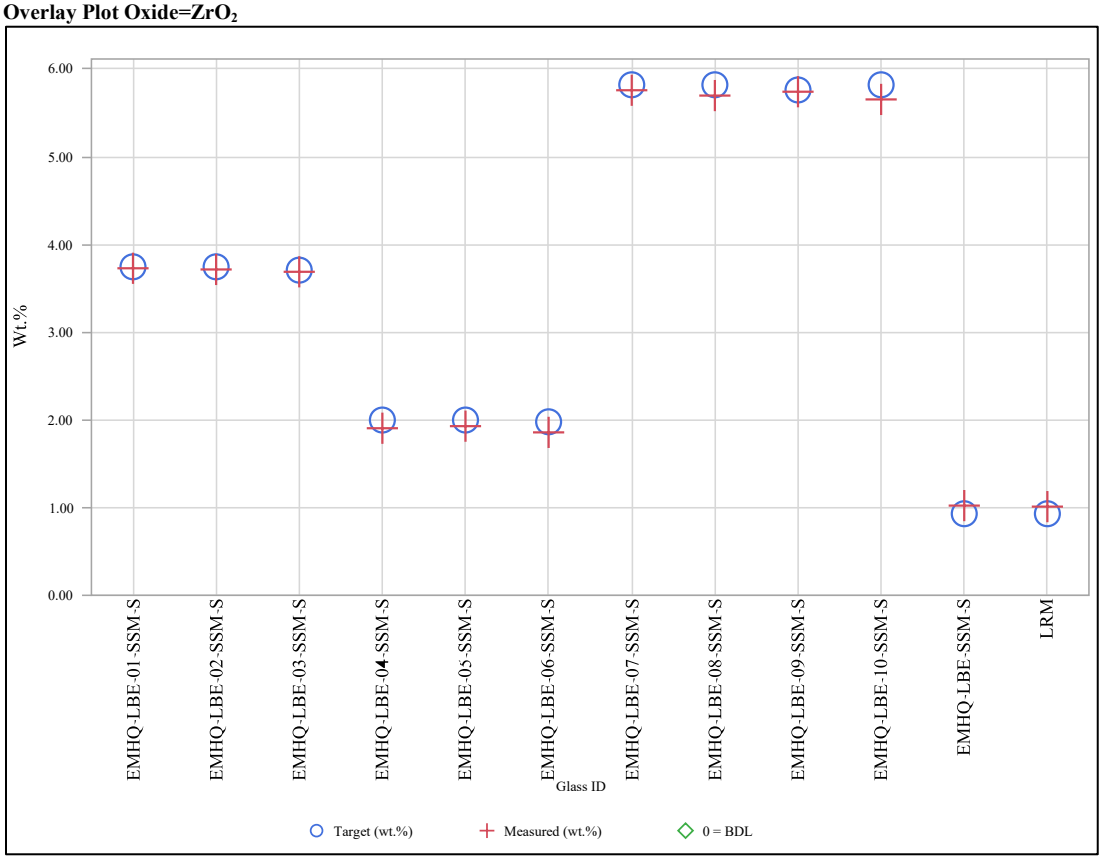


Exhibit A-3. Measured versus Target Concentrations by Glass ID by Oxide (continued)

Overlay Plot Oxide=ZrO_2



Overlay Plot Oxide=Sum of Oxides

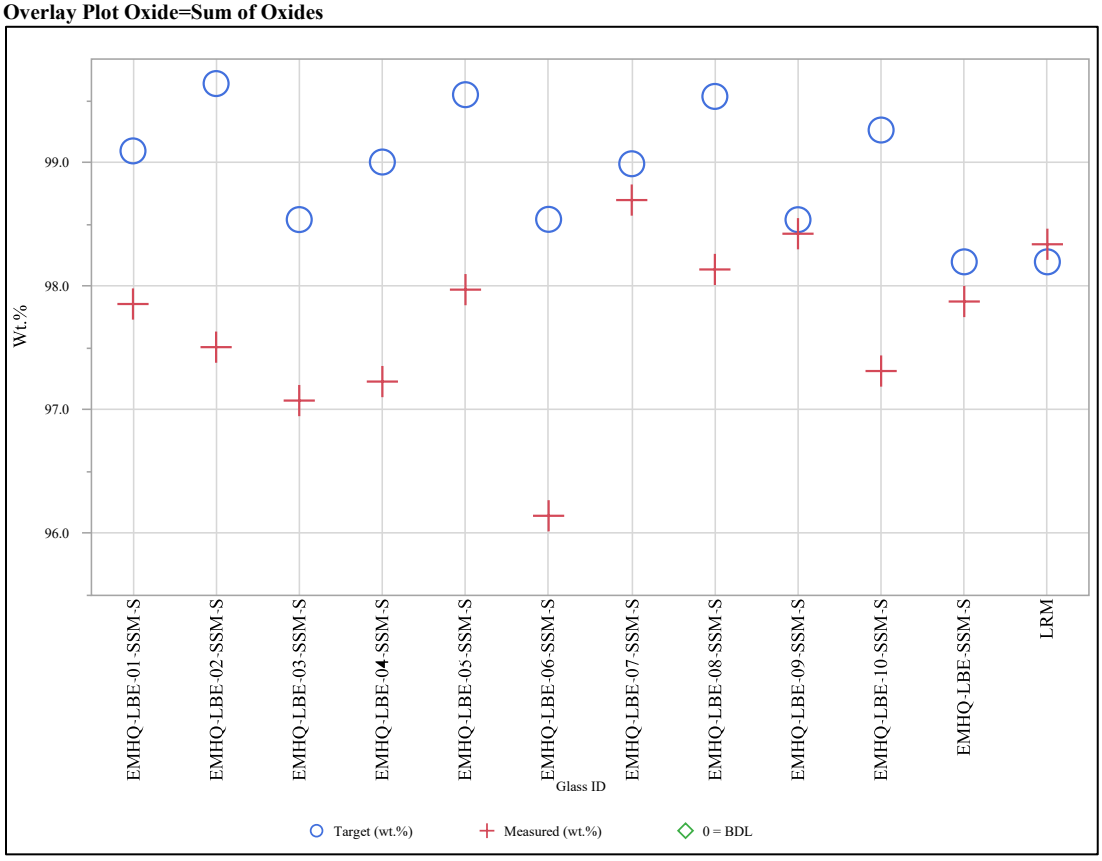
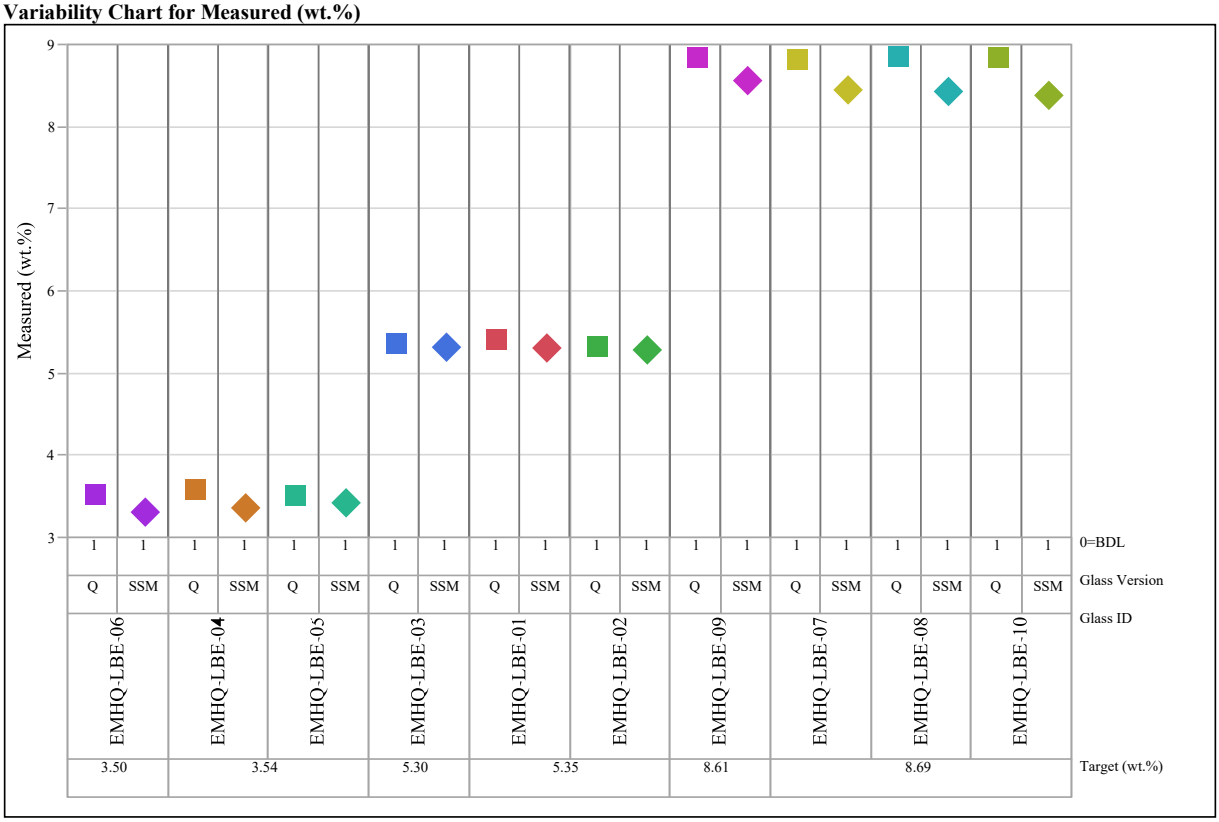


Exhibit A-4. Comparisons of the Measured Compositions of the Quenched and SSM Versions of the Study Glasses

Oxide=Al_2O_3
Variability Chart for Measured (wt.%)



Oxide=B_2O_3
Variability Chart for Measured (wt.%)

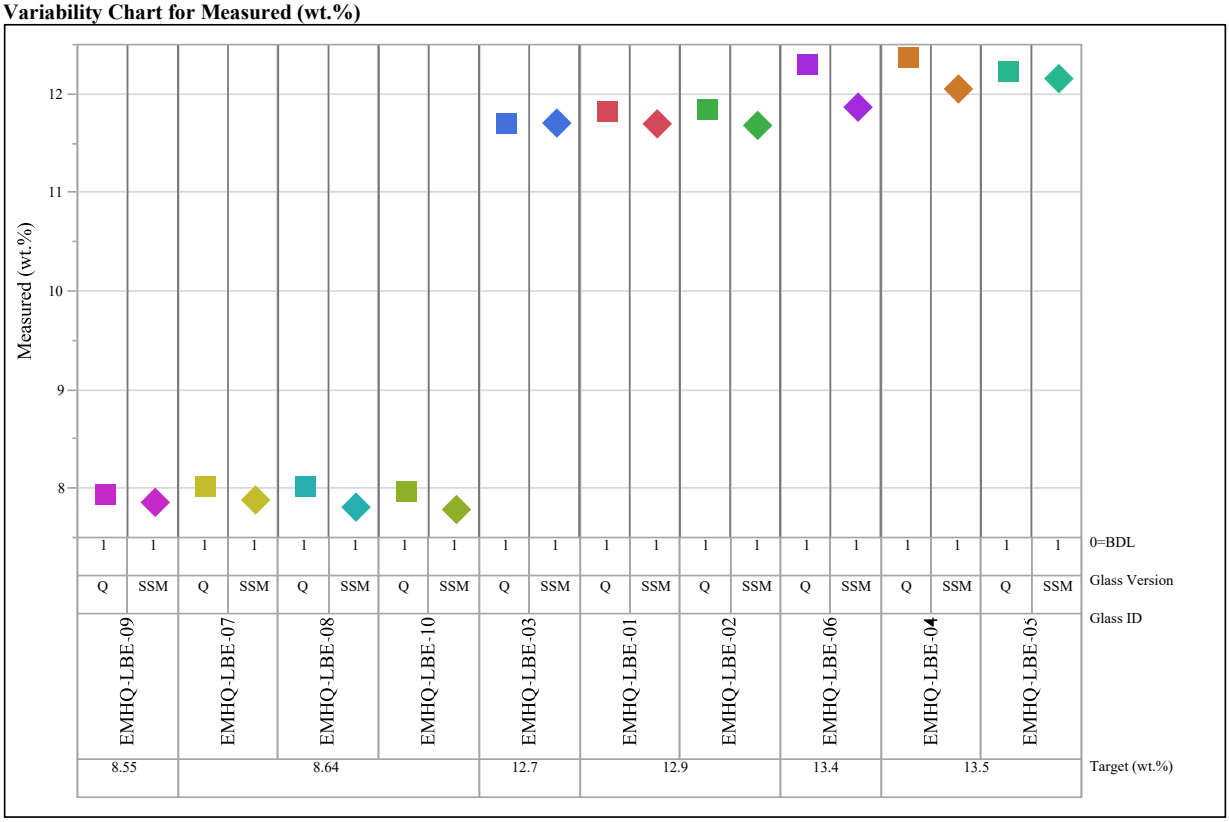
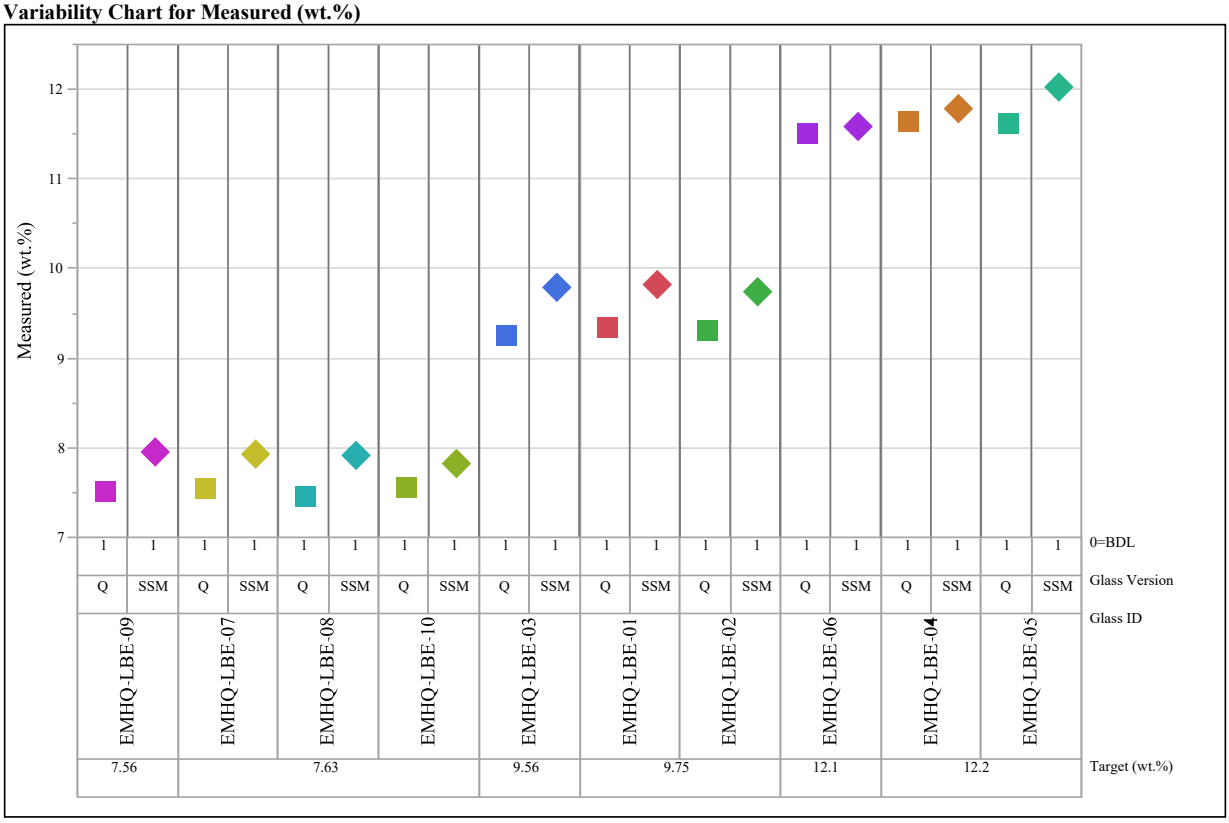


Exhibit A-4. Comparisons of the Measured Compositions of the Quenched and SSM Versions of the Study Glasses (continued)

Oxide=CaO
Variability Chart for Measured (wt.%)



Oxide=Cl^-
Variability Chart for Measured (wt.%)

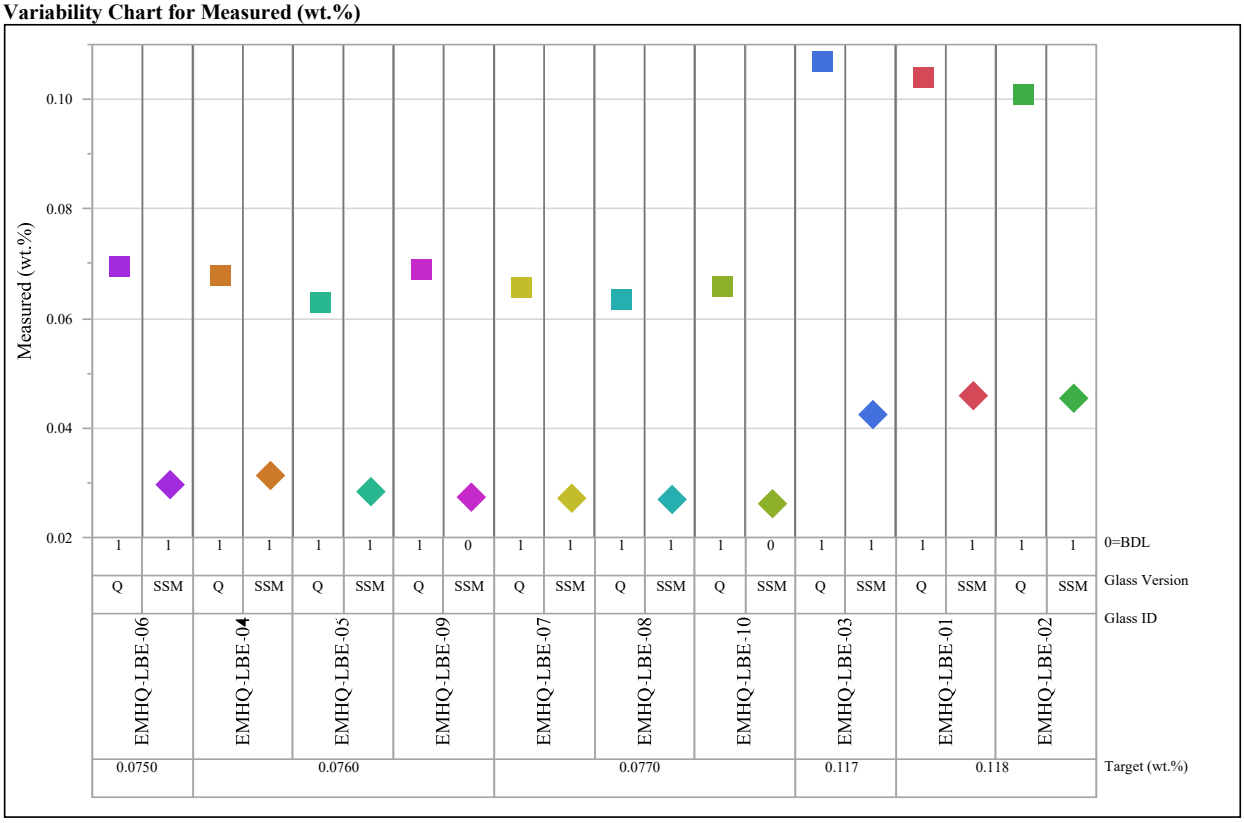
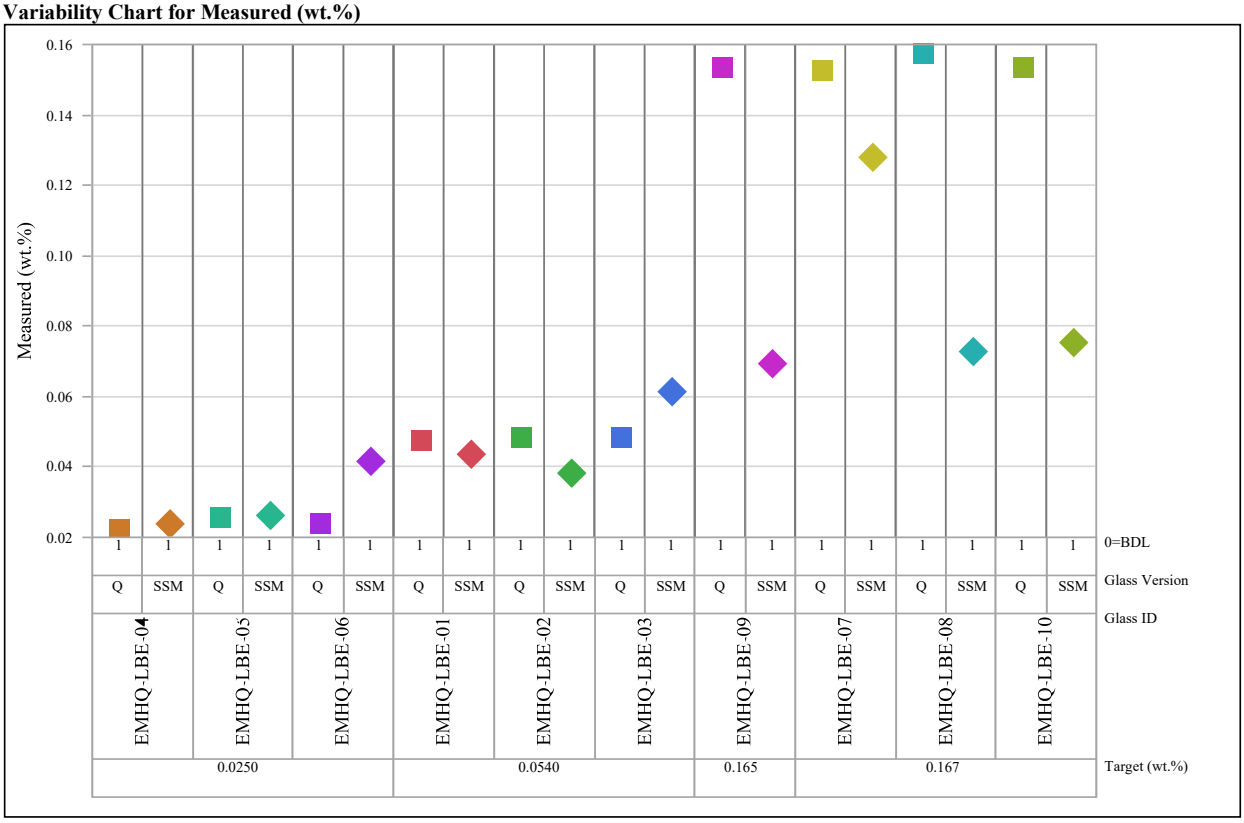


Exhibit A-4. Comparisons of the Measured Compositions of the Quenched and SSM Versions of the Study Glasses (continued)

Oxide=Cr_2O_3
Variability Chart for Measured (wt.%)



Oxide=F^-
Variability Chart for Measured (wt.%)

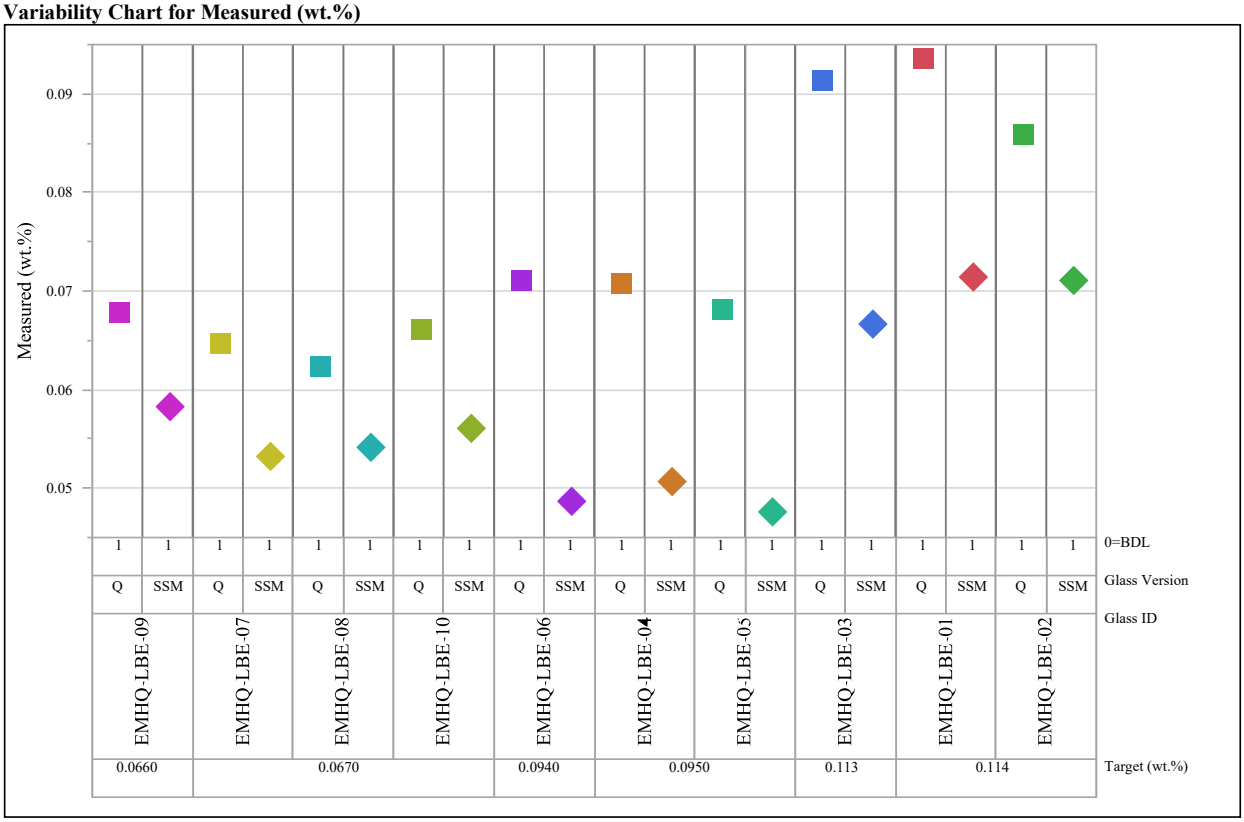
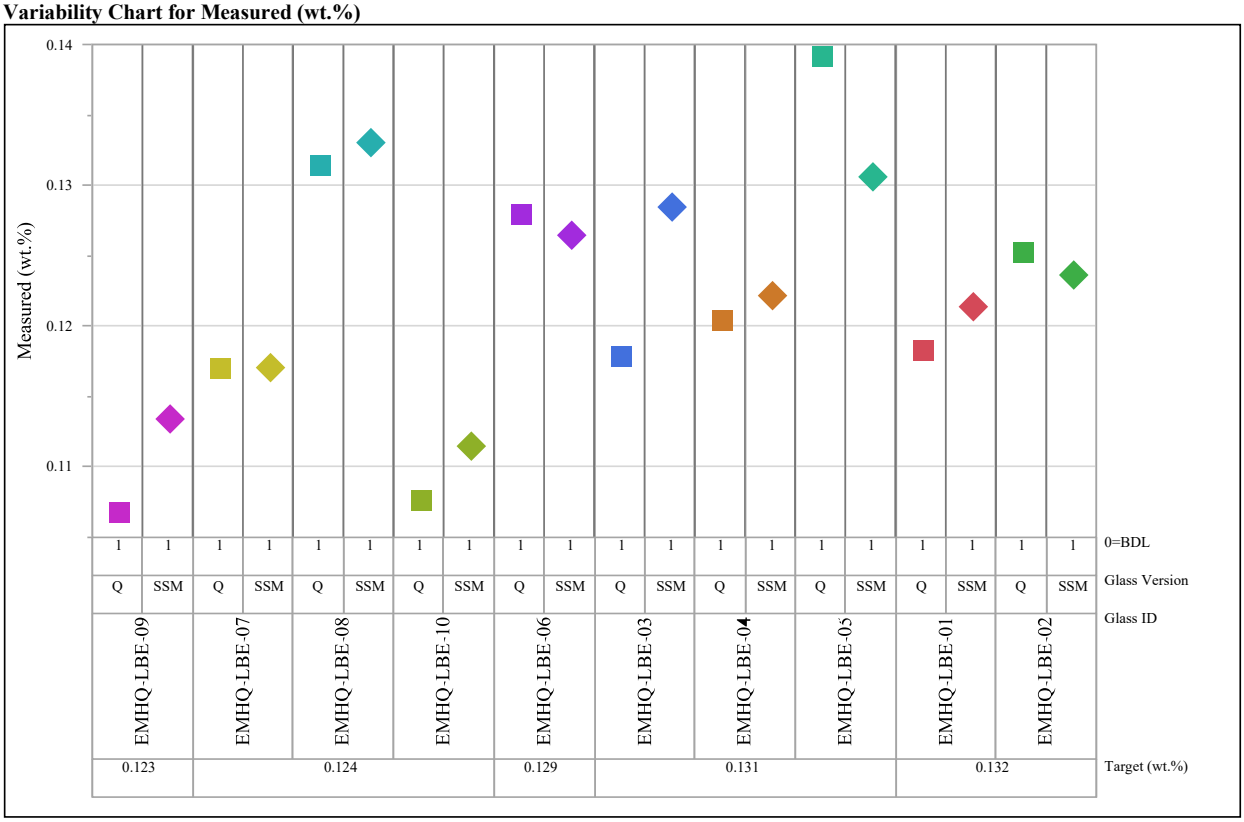


Exhibit A-4. Comparisons of the Measured Compositions of the Quenched and SSM Versions of the Study Glasses (continued)

Oxide=Fe_2O_3
Variability Chart for Measured (wt.%)



Oxide=K_2O
Variability Chart for Measured (wt.%)

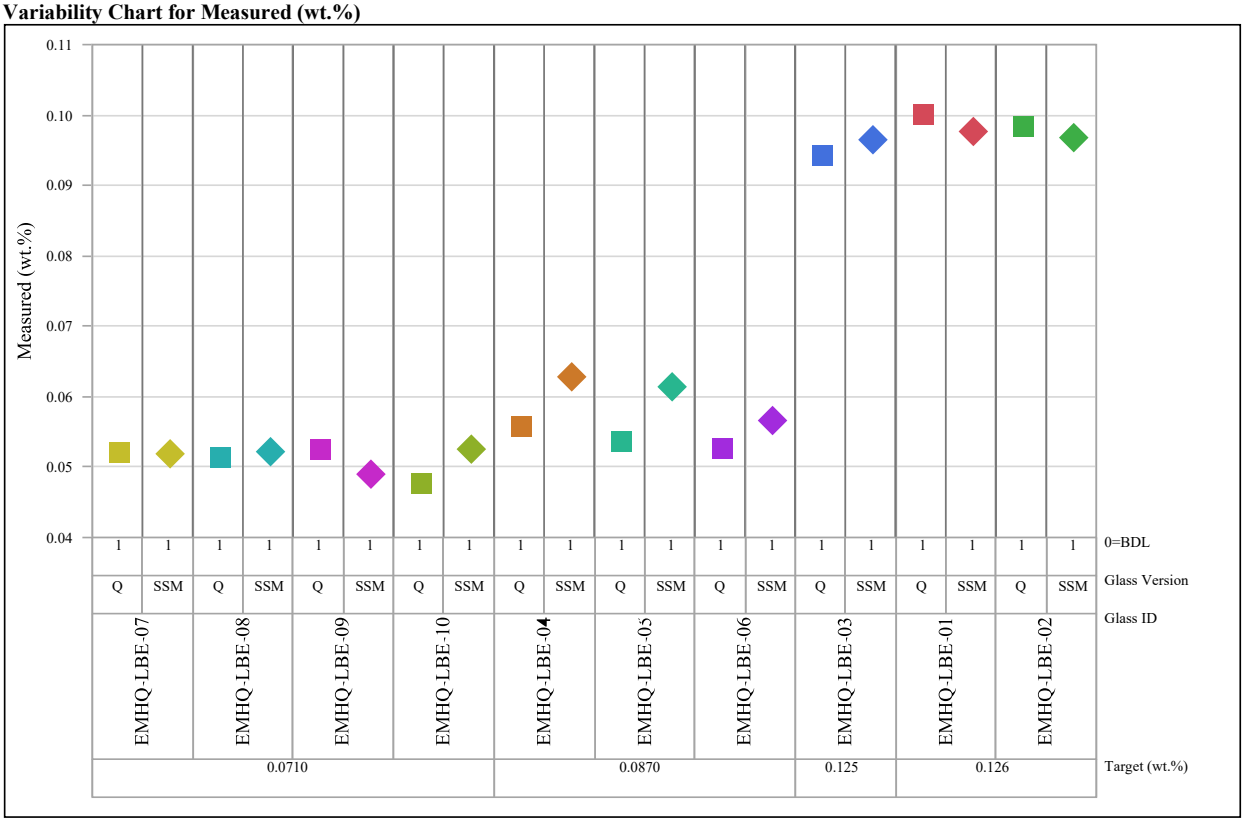
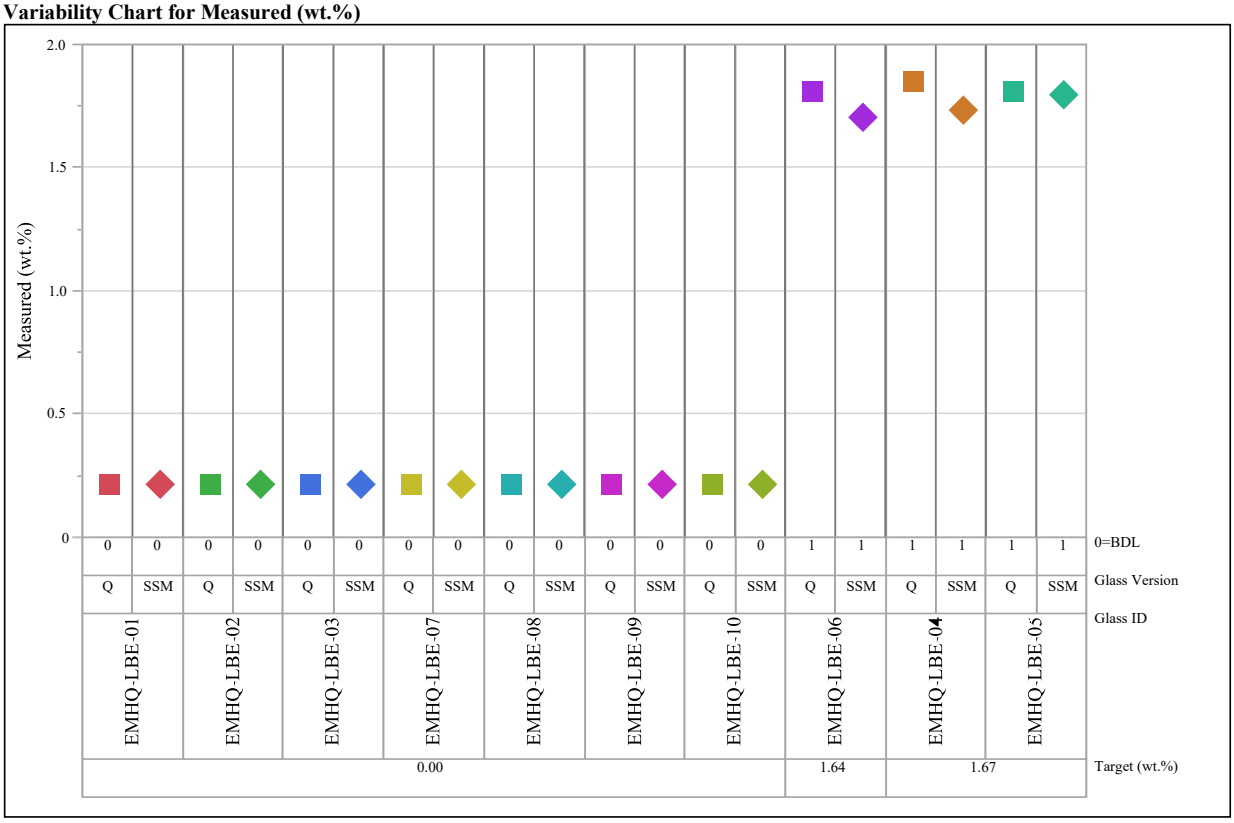


Exhibit A-4. Comparisons of the Measured Compositions of the Quenched and SSM Versions of the Study Glasses (continued)

Oxide=Li_2O
Variability Chart for Measured (wt.%)



Oxide=MgO
Variability Chart for Measured (wt.%)

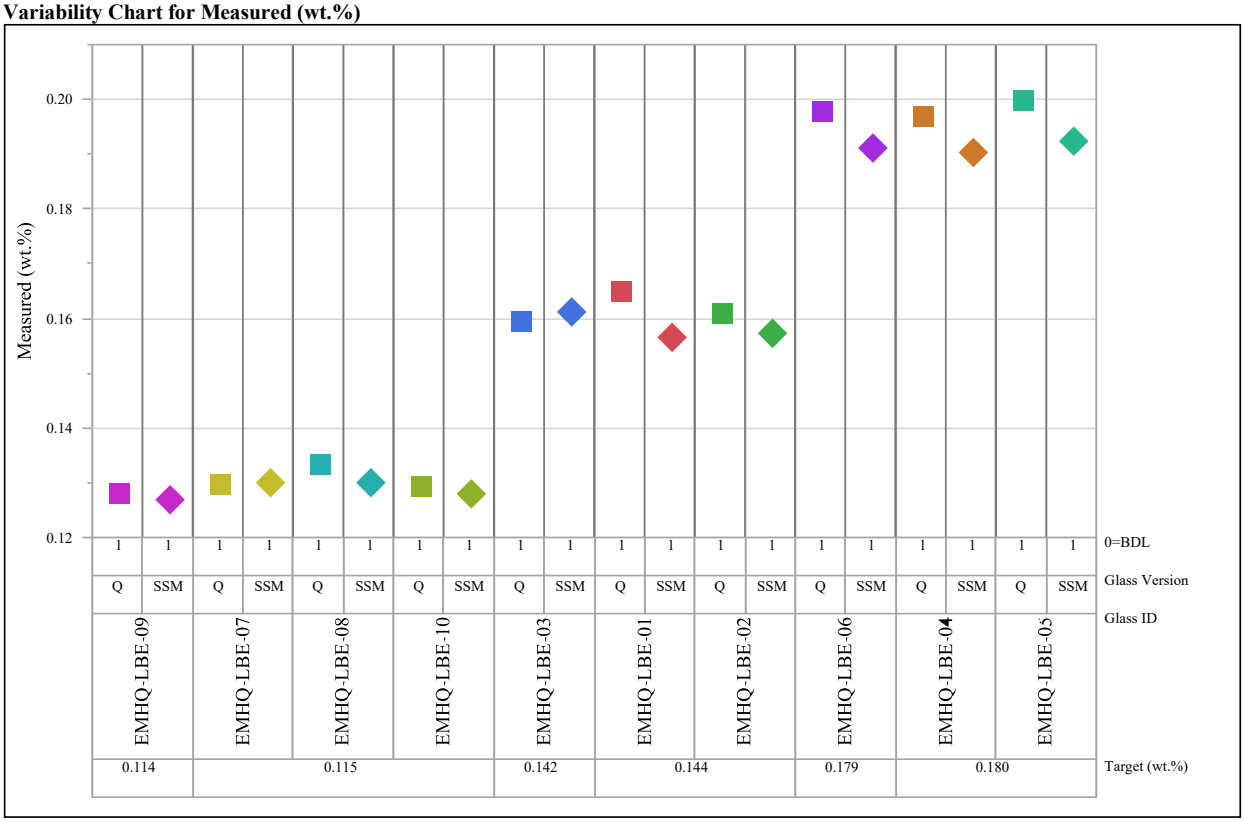
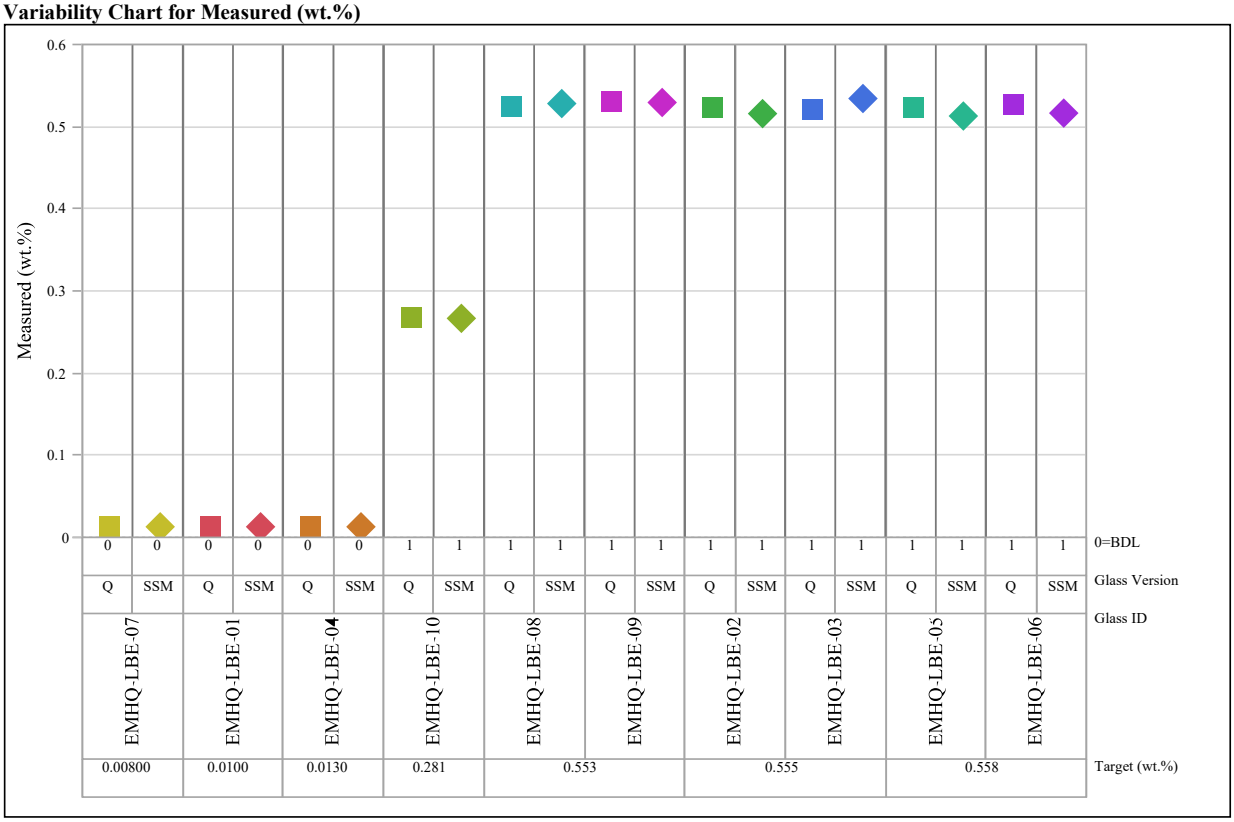


Exhibit A-4. Comparisons of the Measured Compositions of the Quenched and SSM Versions of the Study Glasses (continued)

Oxide=MnO
Variability Chart for Measured (wt.%)



Oxide=Na_2O
Variability Chart for Measured (wt.%)

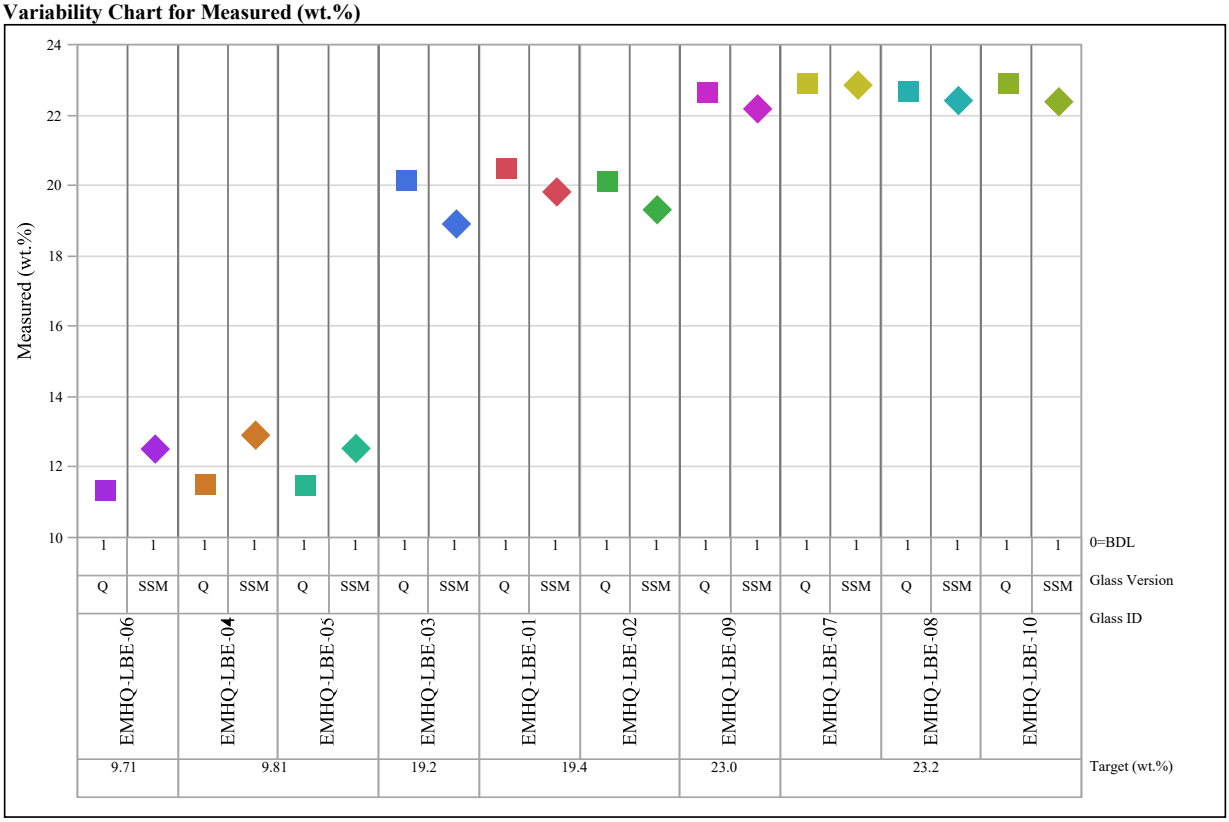
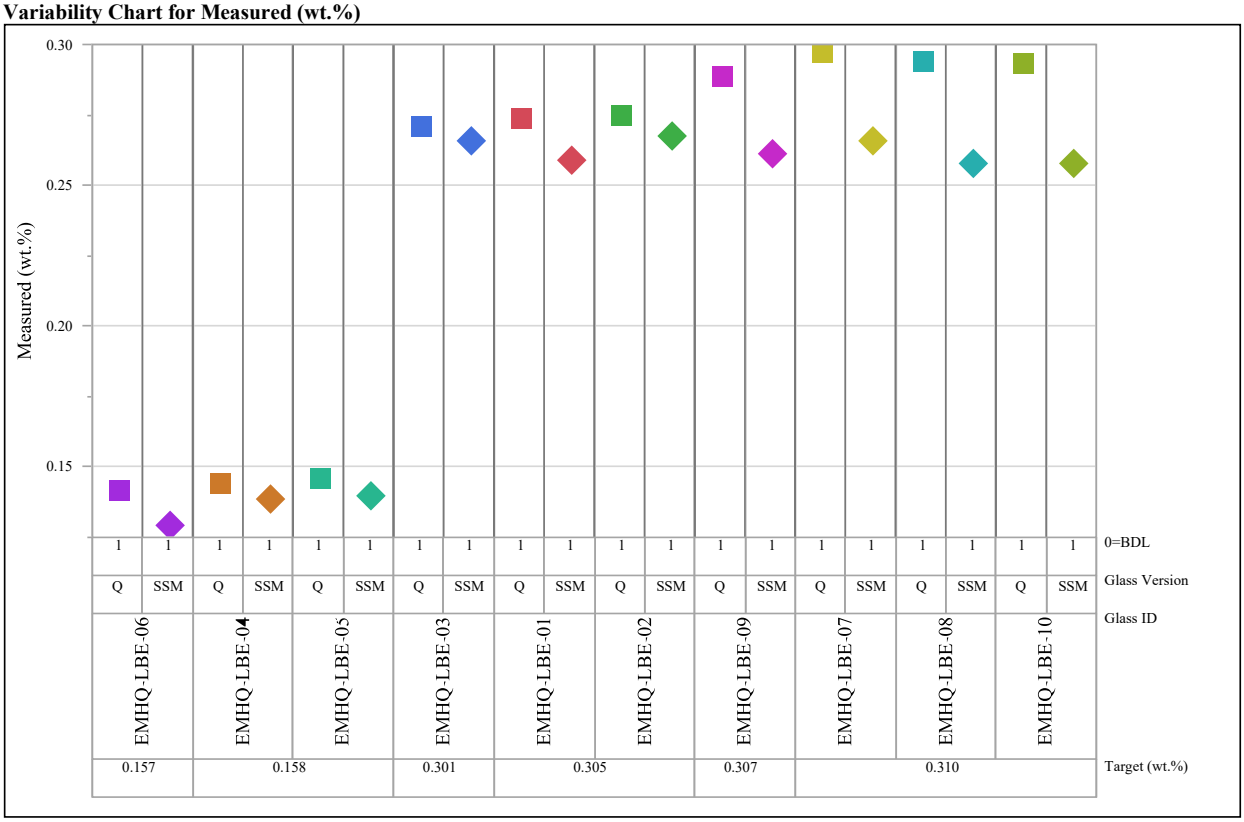


Exhibit A-4. Comparisons of the Measured Compositions of the Quenched and SSM Versions of the Study Glasses (continued)

Oxide=P_2O_5
Variability Chart for Measured (wt.%)



Oxide=SiO_2
Variability Chart for Measured (wt.%)

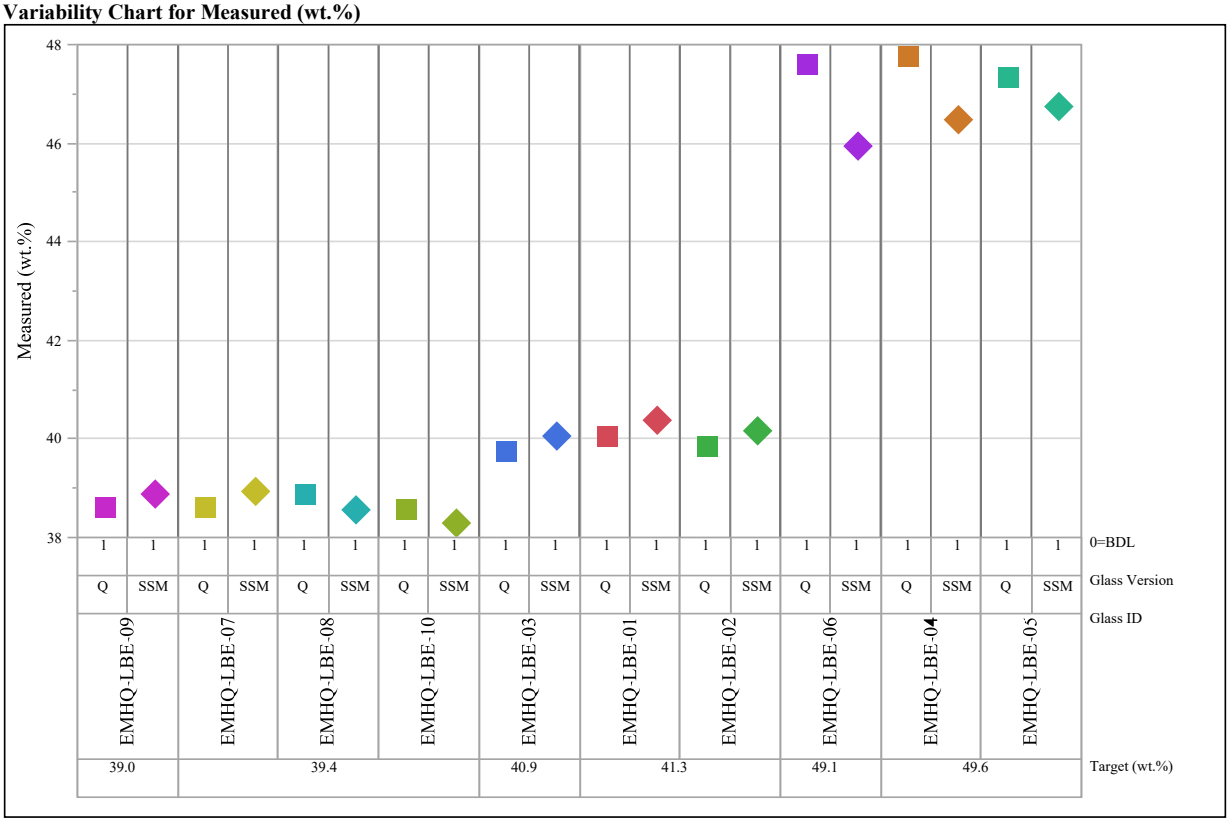
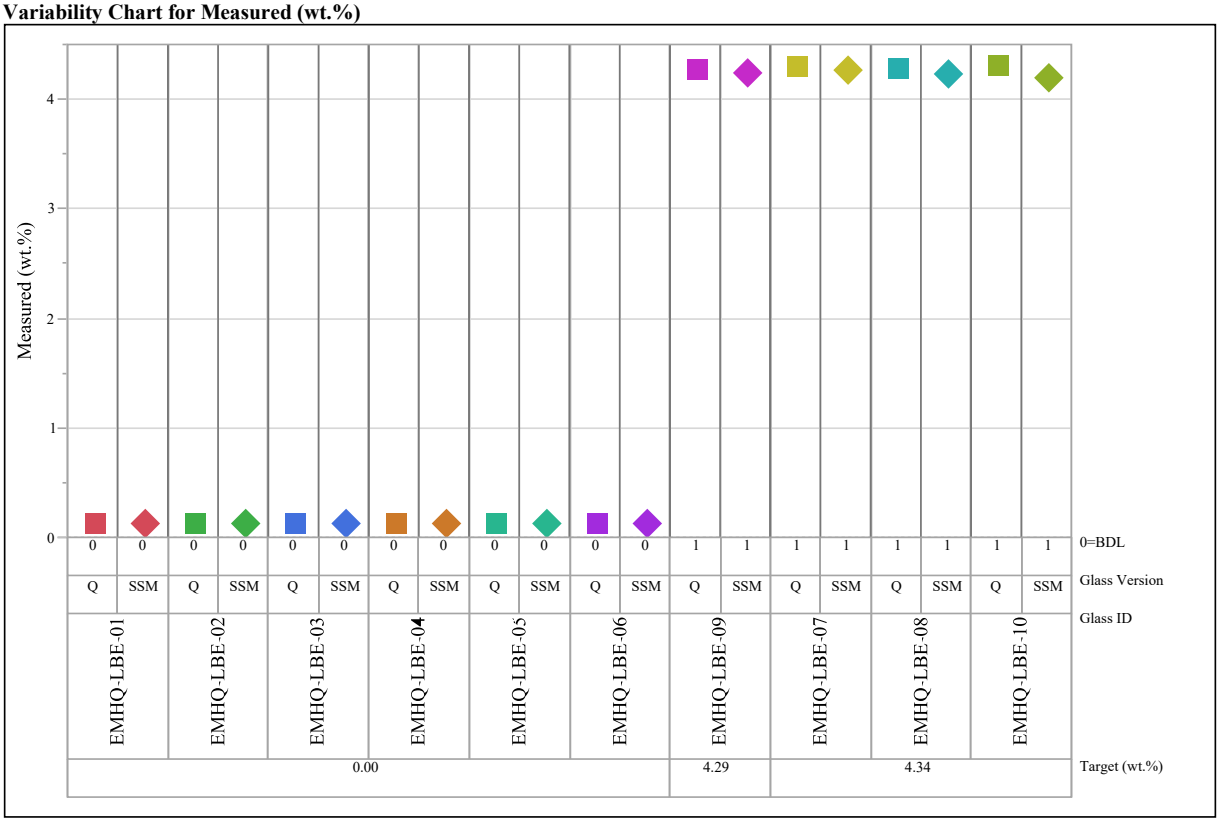


Exhibit A-4. Comparisons of the Measured Compositions of the Quenched and SSM Versions of the Study Glasses (continued)

Oxide=SnO_2
Variability Chart for Measured (wt.%)



Oxide=SO_3
Variability Chart for Measured (wt.%)

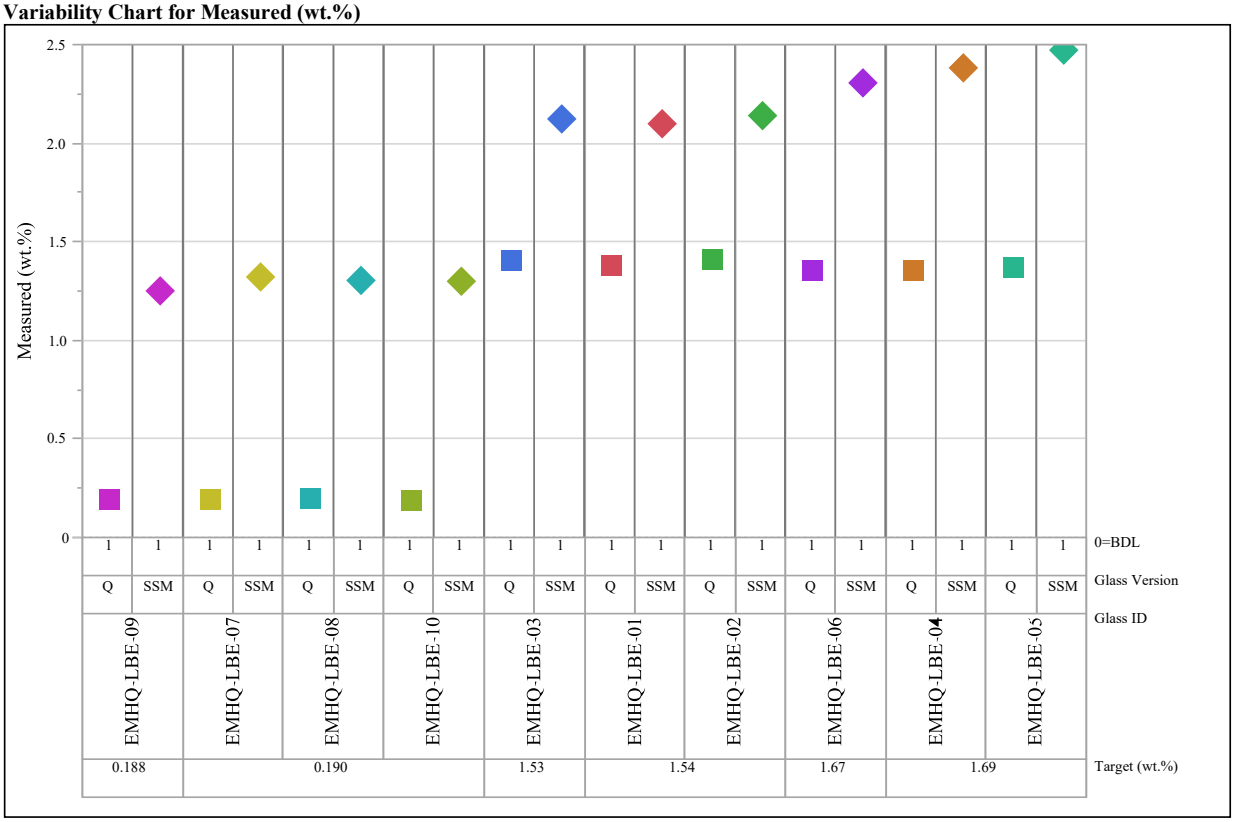
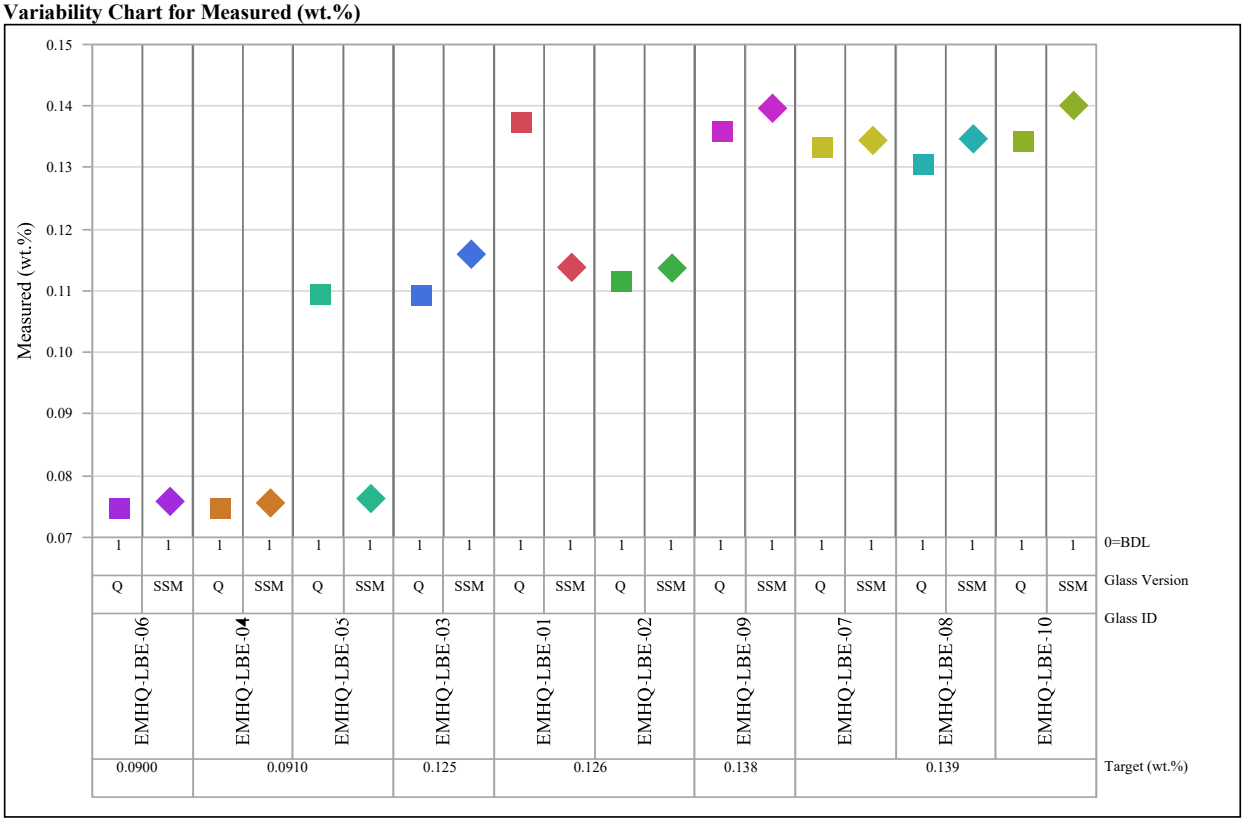


Exhibit A-4. Comparisons of the Measured Compositions of the Quenched and SSM Versions of the Study Glasses (continued)

Oxide=TiO_2
Variability Chart for Measured (wt.%)



Oxide=V_2O_5
Variability Chart for Measured (wt.%)

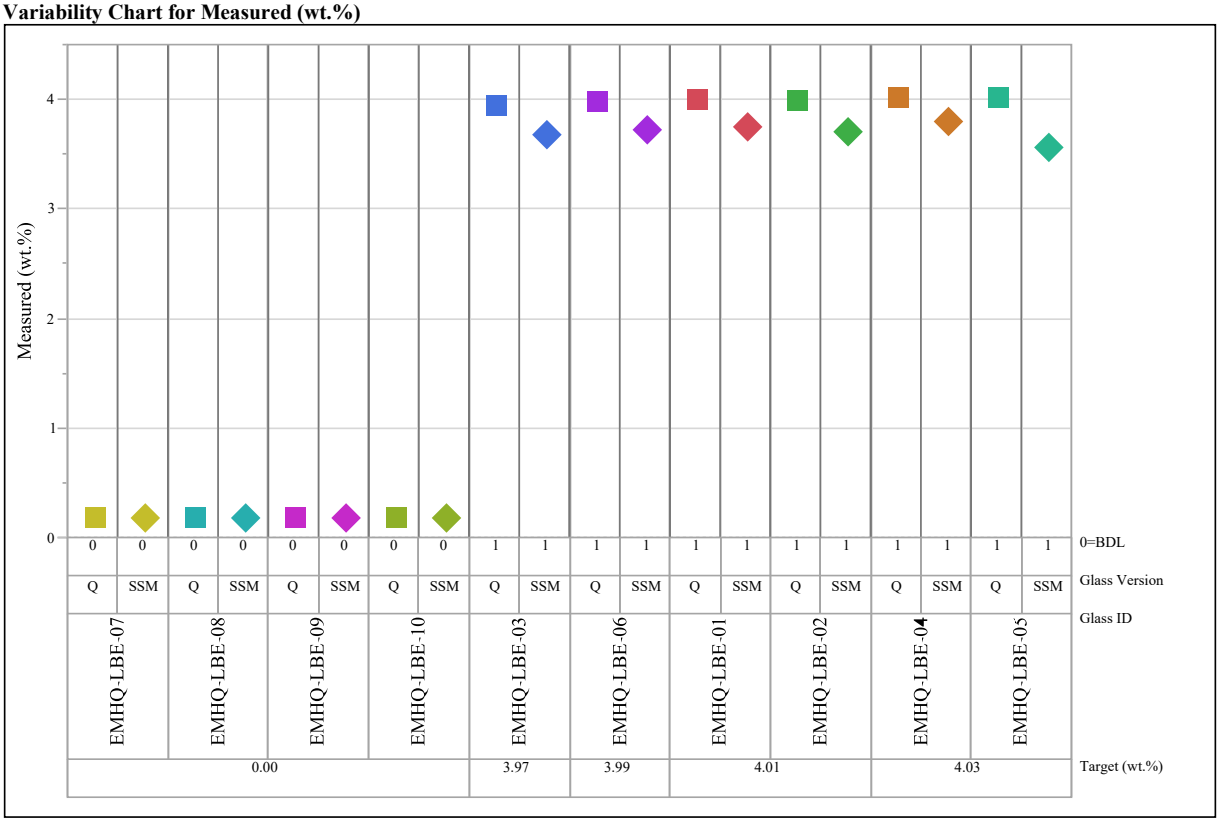
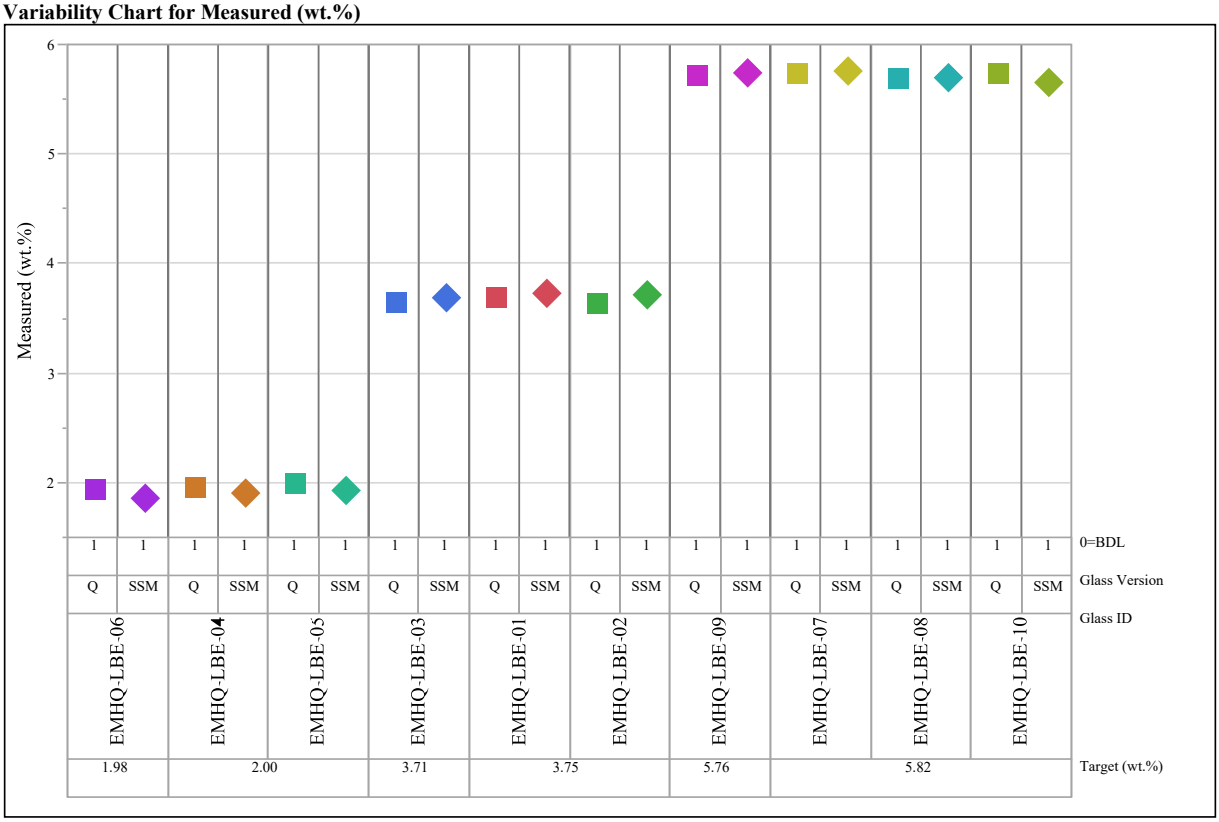
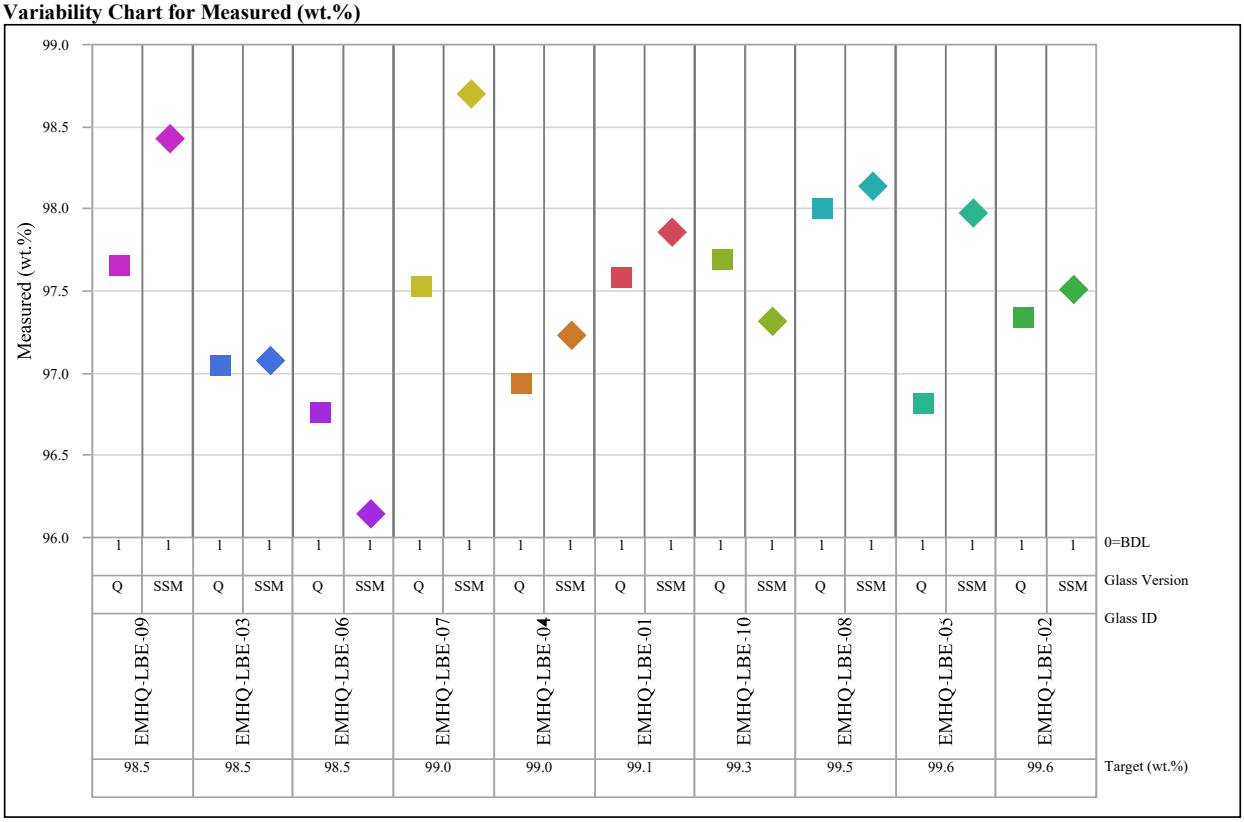


Exhibit A-4. Comparisons of the Measured Compositions of the Quenched and SSM Versions of the Study Glasses (continued)

Oxide=ZrO_2
Variability Chart for Measured (wt.%)



Oxide=Sum of Oxides
Variability Chart for Measured (wt.%)



Appendix B. Tables and Exhibits Supporting the Wash Solution Composition Measurements

Table B-1. Measurements (mg/L) of the SSM Wash Solutions Measured by ICP-OES

PNNL ID	Block	Seq.	Lab ID	Al	B	Ca	Cr	Fe	K	Li	Mg	Mn	Na	P	S	Si	Sn	Ti	V	Zr
soln std	1	1	soln std-11	4.00	19.0	<1.00	<1.00	4.10	10.4	10.7	<1.00	<1.00	81.7	<1.00	<1.00	51.9	<1.00	<1.00	<1.00	<1.00
EMHQ-LBE-01-SSM-W	1	2	S-13430-1	<1.00	33.4	28.5	2.59	<1.00	4.98	<1.00	<1.00	<1.00	915	<1.00	542	28.8	<1.00	<1.00	35.6	<1.00
EMHQ-LBE-03-SSM-W	1	3	S-13432-1	<1.00	31.5	28.2	4.98	<1.00	5.07	<1.00	<1.00	<1.00	953	<1.00	555	26.6	<1.00	<1.00	35.8	<1.00
EMHQ-LBE-07-SSM-W	1	4	S-13436-1	1.05	19.3	3.16	19.7	<1.00	3.32	<1.00	<1.00	<1.00	872	4.93	507	10.9	<1.00	<1.00	<1.00	<1.00
hpstd	1	5	hpstd-11	54.6	<1.00	<1.00	<1.00	49.5	<1.00	<1.00	<1.00	21.7	150	<1.00	9.90	<1.00	<1.00	<1.00	<1.00	<1.00
EMHQ-LBE-06-SSM-W	1	6	S-13435-1	<1.00	15.0	36.8	<1.00	<1.00	<1.00	6.92	<1.00	<1.00	205	<1.00	133	35.2	<1.00	<1.00	11.4	<1.00
EMHQ-LBE-05-SSM-W	1	7	S-13434-1	<1.00	15.9	36.5	<1.00	<1.00	1.00	6.84	<1.00	<1.00	197	<1.00	124	37.6	<1.00	<1.00	11.8	<1.00
ICP Blank	1	8	ICP Blank 1-1	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
EMHQ-LBE-SSM-W	1	9	S-13440-1	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	611	<1.00	425	<1.00	<1.00	<1.00	<1.00	<1.00
soln std	1	10	soln std-12	4.22	18.5	<1.00	<1.00	4.03	10.2	10.8	<1.00	<1.00	78.2	<1.00	<1.00	53.3	<1.00	<1.00	<1.00	<1.00
EMHQ-LBE-09-SSM-W	1	11	S-13438-1	1.14	18.0	3.28	28.2	<1.00	3.71	<1.00	<1.00	<1.00	842	4.59	500	9.66	<1.00	<1.00	<1.00	<1.00
ICP Blank	1	12	ICP Blank 1-2	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
EMHQ-LBE-02-SSM-W	1	13	S-13431-1	<1.00	28.4	28.2	4.41	<1.00	5.24	<1.00	<1.00	<1.00	893	<1.00	541	22.6	<1.00	<1.00	34.2	<1.00
hpstd	1	14	hpstd-12	54.2	<1.00	<1.00	<1.00	51.2	<1.00	<1.00	<1.00	21.4	145	<1.00	9.67	<1.00	<1.00	<1.00	<1.00	<1.00
EMHQ-LBE-10-SSM-W	1	15	S-13439-1	<1.00	17.0	4.21	25.7	<1.00	3.96	<1.00	<1.00	<1.00	857	5.24	512	6.79	<1.00	<1.00	<1.00	<1.00
EMHQ-LBE-08-SSM-W	1	16	S-13437-1	1.27	20.0	3.49	30.4	<1.00	3.19	<1.00	<1.00	<1.00	864	5.03	507	10.3	<1.00	<1.00	<1.00	<1.00
EMHQ-LBE-04-SSM-W	1	17	S-13433-1	<1.00	13.9	41.5	<1.00	<1.00	<1.00	7.81	<1.00	<1.00	235	<1.00	159	32.1	<1.00	<1.00	11.5	<1.00
soln std	1	18	soln std-13	4.08	19.2	<1.00	<1.00	4.18	10.1	10.8	<1.00	<1.00	79.9	<1.00	<1.00	51.8	<1.00	<1.00	<1.00	<1.00
soln std	2	1	soln std-21	3.91	19.6	<1.00	<1.00	4.13	9.33	9.91	<1.00	<1.00	78.7	<1.00	<1.00	49.3	<1.00	<1.00	<1.00	<1.00
EMHQ-LBE-05-SSM-W	2	2	S-13434-2	<1.00	16.4	37.1	<1.00	<1.00	<1.00	6.80	<1.00	<1.00	200	<1.00	127	38.6	<1.00	<1.00	12.0	<1.00
EMHQ-LBE-08-SSM-W	2	3	S-13437-2	1.24	19.3	3.49	28.1	<1.00	3.23	<1.00	<1.00	<1.00	845	5.03	507	10.4	<1.00	<1.00	<1.00	<1.00
EMHQ-LBE-04-SSM-W	2	4	S-13433-2	<1.00	14.6	42.1	<1.00	<1.00	<1.00	7.72	<1.00	<1.00	240	<1.00	160	33.3	<1.00	<1.00	11.7	<1.00
hpstd	2	5	hpstd-21	50.1	<1.00	<1.00	<1.00	50.6	<1.00	<1.00	<1.00	20.2	143	<1.00	9.69	<1.00	<1.00	<1.00	<1.00	<1.00
EMHQ-LBE-10-SSM-W	2	6	S-13439-2	<1.00	18.0	4.47	25.6	<1.00	3.71	<1.00	<1.00	<1.00	861	5.25	507	8.09	<1.00	<1.00	<1.00	<1.00
EMHQ-LBE-01-SSM-W	2	7	S-13430-2	<1.00	33.5	28.5	2.57	<1.00	5.08	<1.00	<1.00	<1.00	885	<1.00	528	28.9	<1.00	<1.00	35.4	<1.00
EMHQ-LBE-SSM-W	2	8	S-13440-2	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	611	<1.00	438	<1.00	<1.00	<1.00	<1.00	<1.00
EMHQ-LBE-09-SSM-W	2	9	S-13438-2	<1.00	18.6	2.96	27.3	<1.00	3.38	<1.00	<1.00	<1.00	843	4.45	503	8.78	<1.00	<1.00	<1.00	<1.00
soln std	2	10	soln std-22	3.87	18.4	<1.00	<1.00	4.05	9.40	9.83	<1.00	<1.00	79.4	<1.00	<1.00	49.1	<1.00	<1.00	<1.00	<1.00
ICP Blank	2	11	ICP Blank 2-1	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
EMHQ-LBE-03-SSM-W	2	12	S-13432-2	<1.00	31.4	28.2	4.59	<1.00	5.27	<1.00	<1.00	<1.00	921	<1.00	567	26.9	<1.00	<1.00	35.7	<1.00
EMHQ-LBE-06-SSM-W	2	13	S-13435-2	<1.00	14.8	36.5	<1.00	<1.00	<1.00	6.86	<1.00	<1.00	189	<1.00	120	35.2	<1.00	<1.00	11.4	<1.00
hpstd	2	14	hpstd-22	49.6	<1.00	<1.00	<1.00	49.5	<1.00	<1.00	<1.00	20.3	143	<1.00	9.82	<1.00	<1.00	<1.00	<1.00	<1.00
ICP Blank	2	15	ICP Blank 2-2	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
EMHQ-LBE-07-SSM-W	2	16	S-13436-2	1.18	19.2	3.23	19.3	<1.00	3.47	<1.00	<1.00	<1.00	858	4.87	508	11.1	<1.00	<1.00	<1.00	<1.00
EMHQ-LBE-02-SSM-W	2	17	S-13431-2	<1.00	28.1	28.9	4.36	<1.00	5.27	<1.00	<1.00	<1.00	899	<1.00	550	23.6	<1.00	<1.00	34.6	<1.00
soln std	2	18	soln std-23	3.89	18.3	<1.00	<1.00	4.09	9.43	9.77	<1.00	<1.00	78.4	<1.00	<1.00	48.8	<1.00	<1.00	<1.00	<1.00
soln std	3	1	soln std-31	3.90	18.5	<1.00	<1.00	4.00	9.01	9.84	<1.00	<1.00	80.8	<1.00	<1.00	48.9	<1.00	<1.00	<1.00	<1.00
EMHQ-LBE-05-SSM-W	3	2	S-13434-3	<1.00	15.8	37.0	<1.00	<1.00	<1.00	6.82	<1.00	<1.00	194	<1.00	126	38.3	<1.00	<1.00	11.9	<1.00
ICP Blank	3	3	ICP Blank 3-1	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
EMHQ-LBE-07-SSM-W	3	4	S-13436-3	1.01	19.6	3.07	20.2	<1.00	3.54	<1.00	<1.00	<1.00	877	5.07	529	10.6	<1.00	<1.00	<1.00	<1.00
hpstd	3	5	hpstd-31	54.5	<1.00	<1.00	<1.00	48.2	<1.00	<1.00	<1.00	21.3	145	<1.00	9.99	<1.00	<1.00	<1.00	<1.00	<1.00
EMHQ-LBE-08-SSM-W	3	6	S-13437-3	1.30	18.6	3.68	28.4	<1.00	3.42	<1.00	<1.00	<1.00	894	5.26	531	10.5	<1.00	<1.00	<1.00	<1.00
ICP Blank	3	7	ICP Blank 3-2	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
EMHQ-LBE-06-SSM-W	3	8	S-13435-3	<1.00	14.4	39.0	<1.00	<1.00	<1.00	7.35	<1.00	<1.00	187	<1.00	118	36.6	<1.00	<1.00	11.9	<1.00
EMHQ-LBE-01-SSM-W	3	9	S-13430-3	<1.00	31.0	30.8	2.48	<1.00	5.10	<1.00	<1.00	<1.00	924	<1.00	554	30.4	<1.00	<1.00	37.3	<1.00
soln std	3	10	soln std-32	4.19	19.0	<1.00	<1.00	4.13	9.26	10.5	<1.00	<1.00	80.7	<1.00	<1.00	51.4	<1.00	<1.00	<1.00	<1.00
EMHQ-LBE-SSM-W	3	11	S-13440-3	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	635	<1.00	461	<1.00	<1.00	<1.00	<1.00	<1.00
EMHQ-LBE-10-SSM-W	3	12	S-13439-3	<1.00	16.2	4.72	24.5	<1.00	3.71	<1.00	<1.00	<1.00	888	5.54	525	8.03	<1.00	<1.00	<1.00	<1.00
EMHQ-LBE-03-SSM-W	3	13	S-13432-3	<1.00	30.3	30.0	4.74	<1.00	5.50	<1.00	<1.00	<1.00	1000	<1.00	578	28.1	<1.00	<1.00	37.4	<1.00
hpstd	3	14	hpstd-32	53.8	<1.00	<1.00	<1.00	49.7	<1.00	<1.00	<1.00	21.2	145	<1.00	10.2	<1.00	<1.00	<1.00	<1.00	<1.00
EMHQ-LBE-04-SSM-W	3	15	S-13433-3	<1.00	13.4	44.6	<1.00	<1.00	<1.00	8.11	<1.00	<1.00	240	<1.00	170	34.5	<1.00	<1.00	12.2	<1.00
EMHQ-LBE-09-SSM-W	3	16	S-13438-3	<1.00	17.4	3.19	27.2	<1.00	3.21	<1.00	<1.00	<1.00	882	4.76	516	9.14	<1.00	<1.00	<1.00	<1.00
EMHQ-LBE-02-SSM-W	3	17	S-13431-3	<1.00	27.4	30.7	4.56	<1.00	4.99	<1.00	<1.00	<1.00	981	<1.00	573	24.4	<1.00	<1.00	36.0	<1.00
soln std	3	18	soln std-33	4.21	18.3	<1.00	<1.00	4.10	9.48	10.4	<1.00	<1.00	79.9	<1.00	<1.00	51.5	<1.00	<1.00	<1.00	<1.00

Table B-2. Measurements (mg/L) of the SSM Wash Solutions Measured by IC

PNNL ID	Block	Seq.	Lab ID	Cl^-	F^-	PO_4^{3-}	SO_4^{2-}
1ppm ckstd	1	1	1ppm ckstd	0.947	1.00	0.986	1.08
EMHQ-LBE-02-SSM-W	1	2	S-13431-1	6.08	<5.00	<10.0	1710
EMHQ-LBE-01-SSM-W	1	3	S-13430-1	6.19	<5.00	<10.0	1640
EMHQ-LBE-07-SSM-W	1	4	S-13436-1	<5.00	<5.00	<10.0	1600
EMHQ-LBE-06-SSM-W	1	5	S-13435-1	<5.00	<5.00	<10.0	402
EMHQ-LBE-09-SSM-W	1	6	S-13438-1	<5.00	<5.00	<10.0	1570
EMHQ-LBE-08-SSM-W	1	7	S-13437-1	<5.00	<5.00	<10.0	1590
IC BLANK	1	8	IC BLANK 1-1	<5.00	<5.00	<10.0	<10.0
EMHQ-LBE-10-SSM-W	1	9	S-13439-1	<5.00	<5.00	<10.0	1560
EMHQ-LBE-SSM-W	1	10	S-13440-1	<5.00	<5.00	<10.0	1340
IC BLANK	1	11	IC BLANK 1-2	<5.00	<5.00	<10.0	<10.0
EMHQ-LBE-03-SSM-W	1	12	S-13432-1	5.88	<5.00	<10.0	1720
EMHQ-LBE-05-SSM-W	1	13	S-13434-1	<5.00	<5.00	<10.0	387
EMHQ-LBE-04-SSM-W	1	14	S-13433-1	<5.00	<5.00	<10.0	501
1ppm ckstd	1	15	1ppm ckstd	0.950	1.00	0.948	0.950
1ppm ckstd	2	1	1ppm ckstd	0.954	1.00	0.958	1.00
EMHQ-LBE-05-SSM-W	2	2	S-13434-2	<5.00	<5.00	<10.0	385
IC BLANK	2	3	IC BLANK 2-1	<5.00	<5.00	<10.0	<10.0
EMHQ-LBE-10-SSM-W	2	4	S-13439-2	<5.00	<5.00	<10.0	1570
IC BLANK	2	5	IC BLANK 2-2	<5.00	<5.00	<10.0	<10.0
EMHQ-LBE-SSM-W	2	6	S-13440-2	<5.00	<5.00	<10.0	1350
EMHQ-LBE-03-SSM-W	2	7	S-13432-2	5.91	<5.00	<10.0	1730
EMHQ-LBE-08-SSM-W	2	8	S-13437-2	<5.00	<5.00	<10.0	1580
EMHQ-LBE-07-SSM-W	2	9	S-13436-2	<5.00	<5.00	<10.0	1620
EMHQ-LBE-04-SSM-W	2	10	S-13433-2	<5.00	<5.00	<10.0	501
EMHQ-LBE-01-SSM-W	2	11	S-13430-2	6.26	<5.00	<10.0	1660
EMHQ-LBE-09-SSM-W	2	12	S-13438-2	<5.00	<5.00	<10.0	1580
EMHQ-LBE-06-SSM-W	2	13	S-13435-2	<5.00	<5.00	<10.0	406
EMHQ-LBE-02-SSM-W	2	14	S-13431-2	6.04	<5.00	<10.0	1740
1ppm ckstd	2	15	1ppm ckstd	0.945	1.02	1.07	0.967
1ppm ckstd	3	1	1ppm ckstd	0.949	0.999	0.984	1.10
EMHQ-LBE-07-SSM-W	3	2	S-13436-3	<5.00	<5.00	<10.0	1630
EMHQ-LBE-01-SSM-W	3	3	S-13430-3	6.27	<5.00	<10.0	1670
EMHQ-LBE-02-SSM-W	3	4	S-13431-3	5.89	<5.00	<10.0	1700
EMHQ-LBE-10-SSM-W	3	5	S-13439-3	<5.00	<5.00	<10.0	1660
IC BLANK	3	6	IC BLANK 3-1	<5.00	<5.00	<10.0	<10.0
EMHQ-LBE-06-SSM-W	3	7	S-13435-3	<5.00	<5.00	<10.0	407
EMHQ-LBE-SSM-W	3	8	S-13440-3	<5.00	<5.00	<10.0	1350
EMHQ-LBE-08-SSM-W	3	9	S-13437-3	<5.00	<5.00	<10.0	1600
IC BLANK	3	10	IC BLANK 3-2	<5.00	<5.00	<10.0	<10.0
EMHQ-LBE-05-SSM-W	3	11	S-13434-3	<5.00	<5.00	<10.0	387
EMHQ-LBE-09-SSM-W	3	12	S-13438-3	<5.00	<5.00	<10.0	1570
EMHQ-LBE-04-SSM-W	3	13	S-13433-3	<5.00	<5.00	<10.0	503
EMHQ-LBE-03-SSM-W	3	14	S-13432-3	5.88	<5.00	<10.0	1730
1ppm ckstd	3	15	1ppm ckstd	0.963	1.01	0.968	1.07

Table B-3. Results for Standards and Blanks Utilized During the Measurement of the Wash Solutions

Solution ID	Instrument	Analyte	Reference Value (mg/L)	Mean Measurement (mg/L)
1ppm std	IC	Cl^-	1	0.951
1ppm std	IC	F^-	1	1.00
1ppm std	IC	PO_4^{3-}	1	0.986
1ppm std	IC	SO_4^{2-}	1	1.03
hp std	ICP-OES	Al	50	52.8
hp std	ICP-OES	B	0	<1.00
hp std	ICP-OES	Ca	0	<1.00
hp std	ICP-OES	Cr	0	<1.00
hp std	ICP-OES	Fe	50	49.8
hp std	ICP-OES	K	0	<1.00
hp std	ICP-OES	Li	0	<1.00
hp std	ICP-OES	Mg	0	<1.00
hp std	ICP-OES	Mn	20	21.0
hp std	ICP-OES	Na	150	145
hp std	ICP-OES	P	0	<1.00
hp std	ICP-OES	S	10	9.88
hp std	ICP-OES	Si	0	<1.00
hp std	ICP-OES	Sn	0	<1.00
hp std	ICP-OES	Ti	0	<1.00
hp std	ICP-OES	V	0	<1.00
hp std	ICP-OES	Zr	0	<1.00
std	ICP-OES	Al	4	4.03
std	ICP-OES	B	20	18.8
std	ICP-OES	Ca	0	<1.00
std	ICP-OES	Cr	0	<1.00
std	ICP-OES	Fe	4	4.09
std	ICP-OES	K	10	9.62
std	ICP-OES	Li	10	10.3
std	ICP-OES	Mg	0	<1.00
std	ICP-OES	Mn	0	<1.00
std	ICP-OES	Na	81	79.7
std	ICP-OES	P	0	<1.00
std	ICP-OES	S	0	<1.00
std	ICP-OES	Si	50	50.7
std	ICP-OES	Sn	0	<1.00
std	ICP-OES	Ti	0	<1.00
std	ICP-OES	V	0	<1.00
std	ICP-OES	Zr	0	<1.00

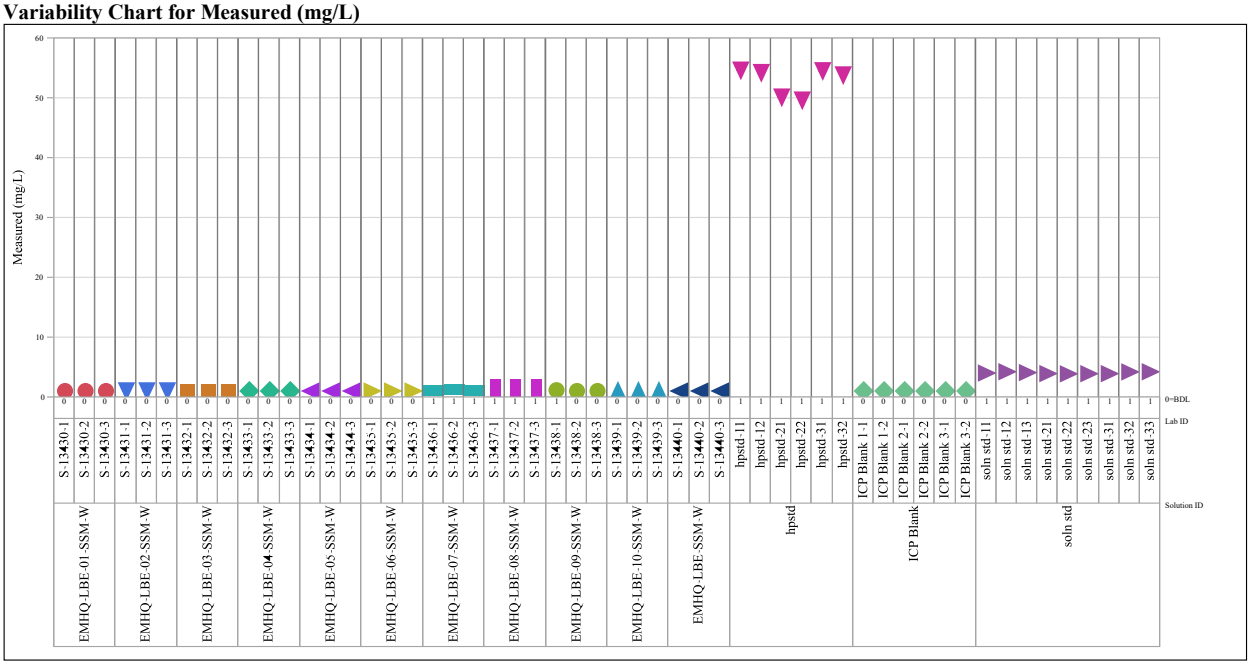
Table B-4. Average Measurements (mg/L) of the SSM Wash Solutions

		IC				ICP-OES																	
Lab ID	**PNNL ID**	**Cl^-**	**F^-**	**PO_4^{3-}**	**SO_4^{2-}**	**Al**	**B**	**Ca**	**Cr**	**Fe**	**K**	**Li**	**Mg**	**Mn**	**Na**	**P**	**PO_4^{3-*}**	**S**	**Si**	**Sn**	**SO_4^{2-*}**	**Ti**	**V**	**Zr**
S-13430	EMHQ-LBE-01-SSM-W	6.24	<5.00	<10.0	1660	<1.00	32.6	29.3	2.55	<1.00	5.05	<1.00	<1.00	<1.00	908	<1.00	<3.07	541	29.4	<1.00	1620	<1.00	36.1	<1.00
S-13431	EMHQ-LBE-02-SSM-W	6.00	<5.00	<10.0	1720	<1.00	28.0	29.3	4.44	<1.00	5.17	<1.00	<1.00	<1.00	924	<1.00	<3.07	555	23.5	<1.00	1660	<1.00	34.9	<1.00
S-13432	EMHQ-LBE-03-SSM-W	5.89	<5.00	<10.0	1730	<1.00	31.1	28.8	4.77	<1.00	5.28	<1.00	<1.00	<1.00	958	<1.00	<3.07	567	27.2	<1.00	1700	<1.00	36.3	<1.00
S-13433	EMHQ-LBE-04-SSM-W	<5.00	<5.00	<10.0	502	<1.00	14.0	42.7	<1.00	<1.00	<1.00	7.88	<1.00	<1.00	238	<1.00	<3.07	163	33.3	<1.00	488	<1.00	11.8	<1.00
S-13434	EMHQ-LBE-05-SSM-W	<5.00	<5.00	<10.0	386	<1.00	16.0	36.9	<1.00	<1.00	<1.00	6.82	<1.00	<1.00	197	<1.00	<3.07	126	38.2	<1.00	376	<1.00	11.9	<1.00
S-13435	EMHQ-LBE-06-SSM-W	<5.00	<5.00	<10.0	405	<1.00	14.7	37.4	<1.00	<1.00	<1.00	7.04	<1.00	<1.00	194	<1.00	<3.07	124	35.7	<1.00	370	<1.00	11.6	<1.00
S-13436	EMHQ-LBE-07-SSM-W	<5.00	<5.00	<10.0	1620	1.08	19.4	3.15	19.7	<1.00	3.44	<1.00	<1.00	<1.00	869	4.96	15.2	515	10.9	<1.00	1540	<1.00	<1.00	<1.00
S-13437	EMHQ-LBE-08-SSM-W	<5.00	<5.00	<10.0	1590	1.27	19.3	3.55	29.0	<1.00	3.28	<1.00	<1.00	<1.00	868	5.11	15.7	515	10.4	<1.00	1540	<1.00	<1.00	<1.00
S-13438	EMHQ-LBE-09-SSM-W	<5.00	<5.00	<10.0	1570	<1.05	18.0	3.14	27.6	<1.00	3.43	<1.00	<1.00	<1.00	856	4.60	14.1	506	9.19	<1.00	1520	<1.00	<1.00	<1.00
S-13439	EMHQ-LBE-10-SSM-W	<5.00	<5.00	<10.0	1600	<1.00	17.1	4.47	25.3	<1.00	3.79	<1.00	<1.00	<1.00	869	5.34	16.4	515	7.64	<1.00	1540	<1.00	<1.00	<1.00
S-13440	EMHQ-LBE-SSM-W	<5.00	<5.00	<10.0	1350	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	619	<1.00	<3.07	441	<1.00	<1.00	1320	<1.00	<1.00	<1.00

*ICP-OES PO_4^{3-} and SO_4^{2-} values were calculated from ICP-OES P and S values.

Exhibit B-1. Measurements of SSM Wash Solutions by Solution ID by Analyte

Analyte=Al, Analysis=ICP
Variability Chart for Measured (mg/L)



Analyte=B, Analysis=ICP
Variability Chart for Measured (mg/L)

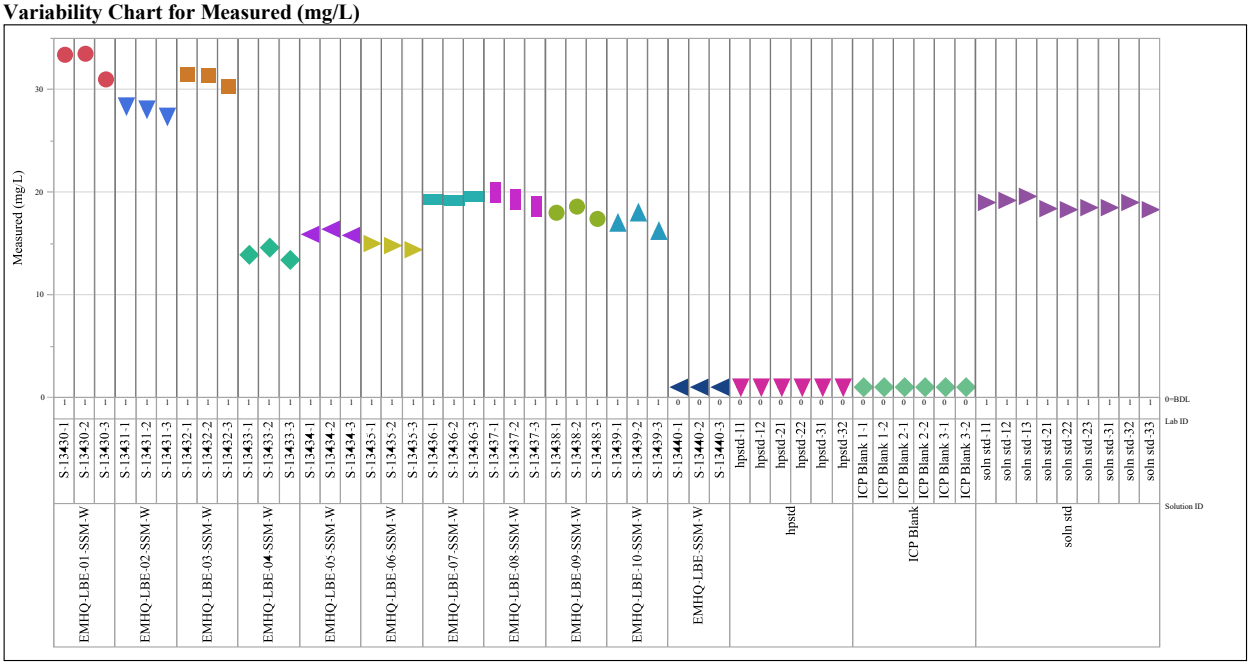
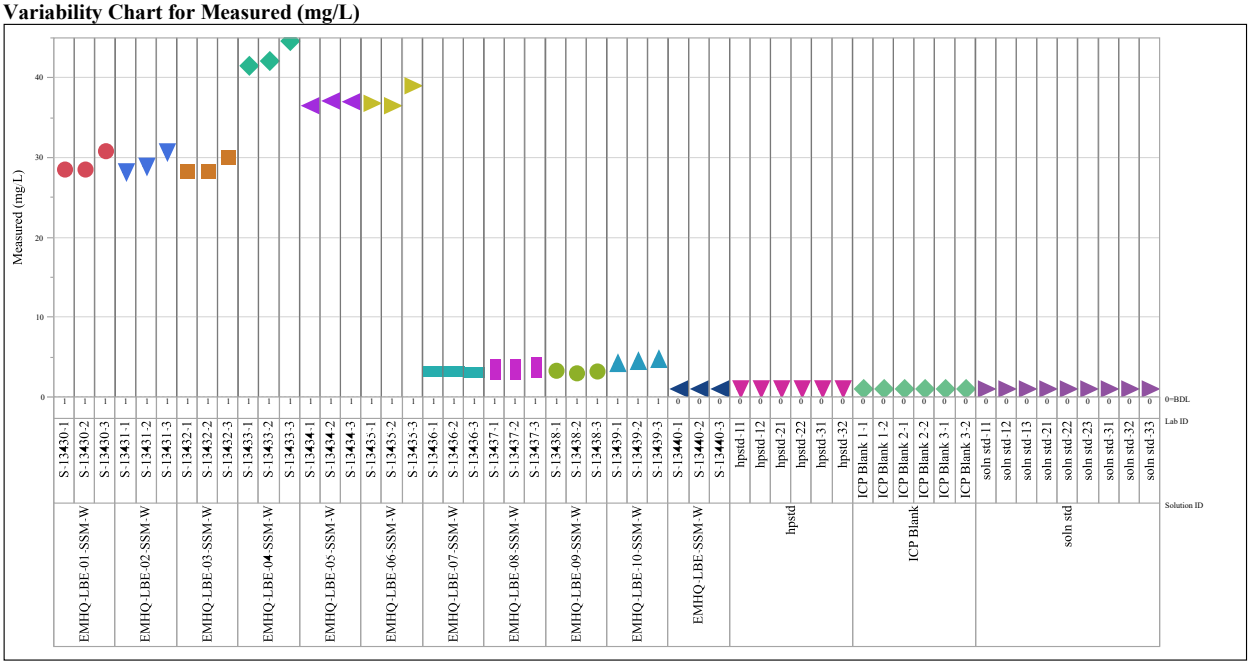


Exhibit B-1. Measurements of SSM Wash Solutions by Solution ID by Analyte (continued)

Analyte=Ca, Analysis=ICP
Variability Chart for Measured (mg/L)



Analyte=Cl^-, Analysis=IC
Variability Chart for Measured (mg/L)

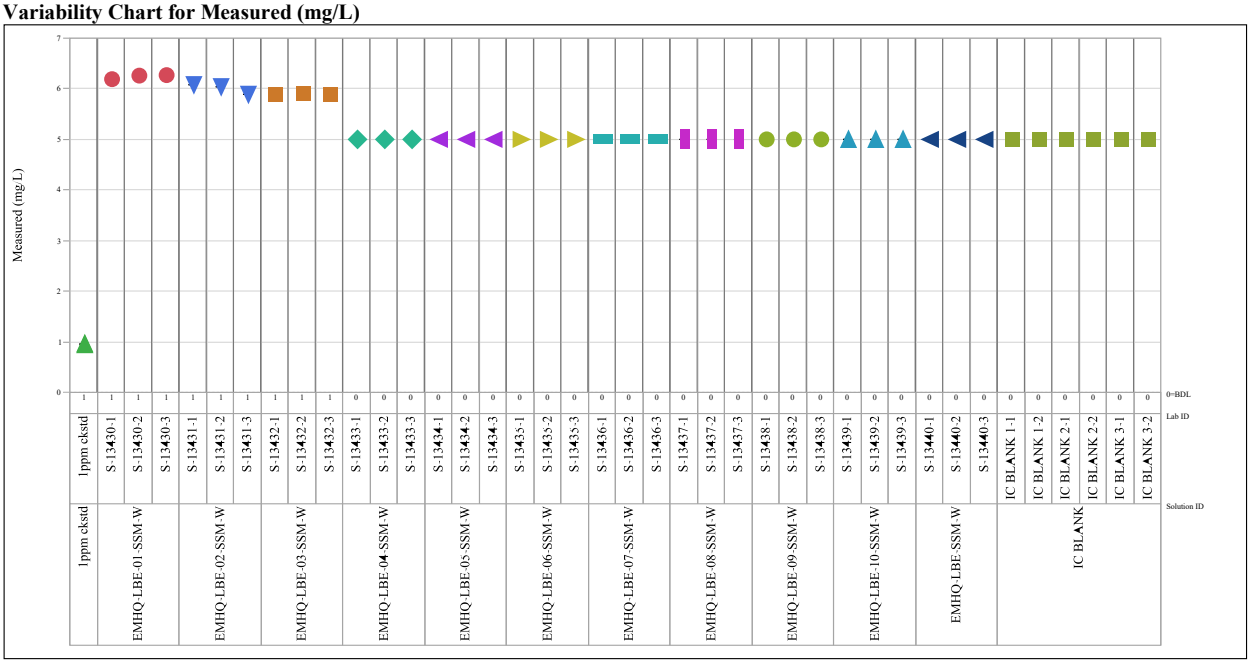
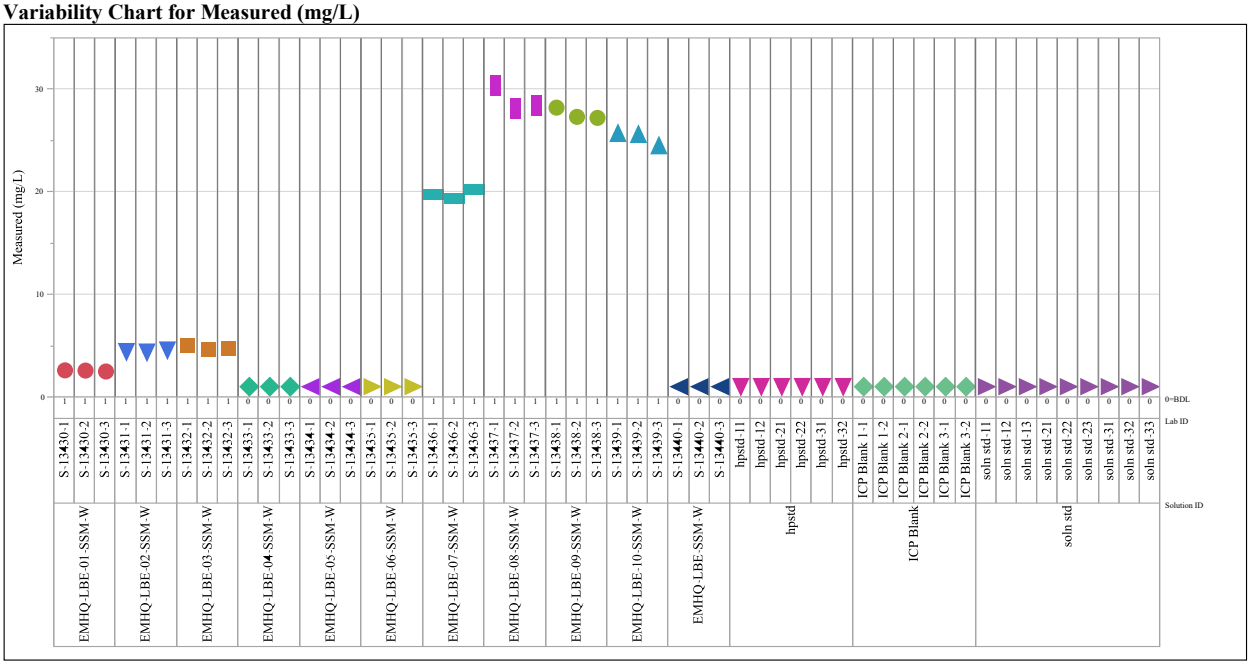


Exhibit B-1. Measurements of SSM Wash Solutions by Solution ID by Analyte (continued)

Analyte=Cr, Analysis=ICP
Variability Chart for Measured (mg/L)



Analyte=F⁻, Analysis=IC
Variability Chart for Measured (mg/L)

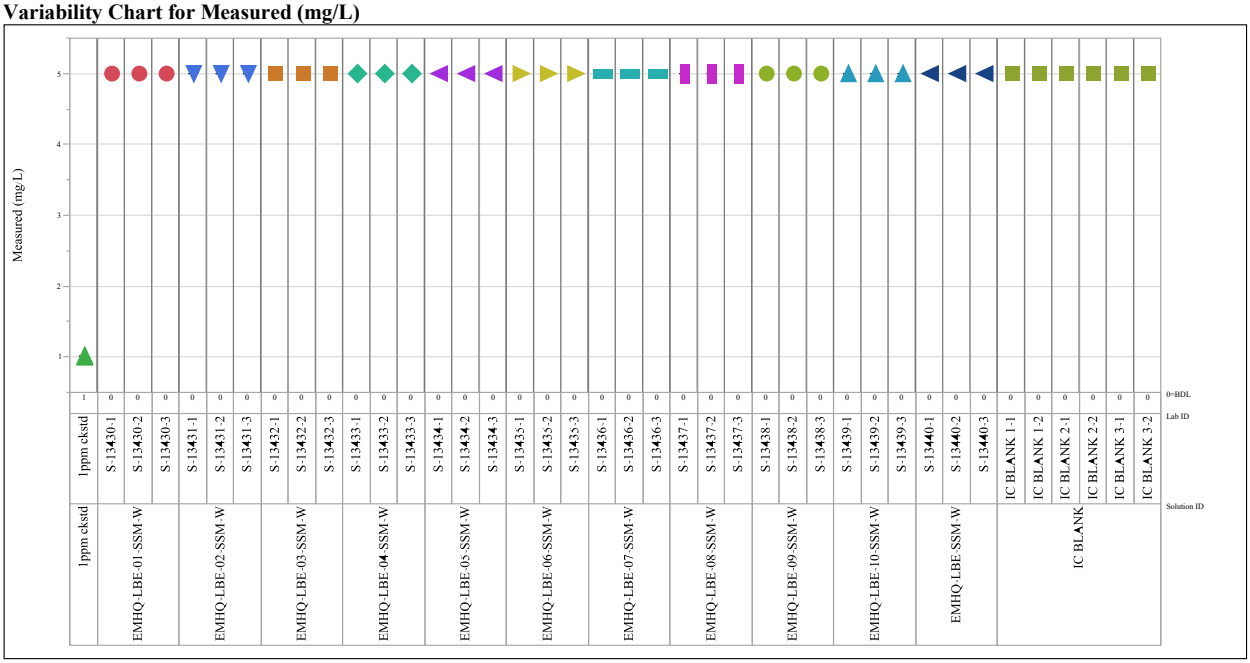
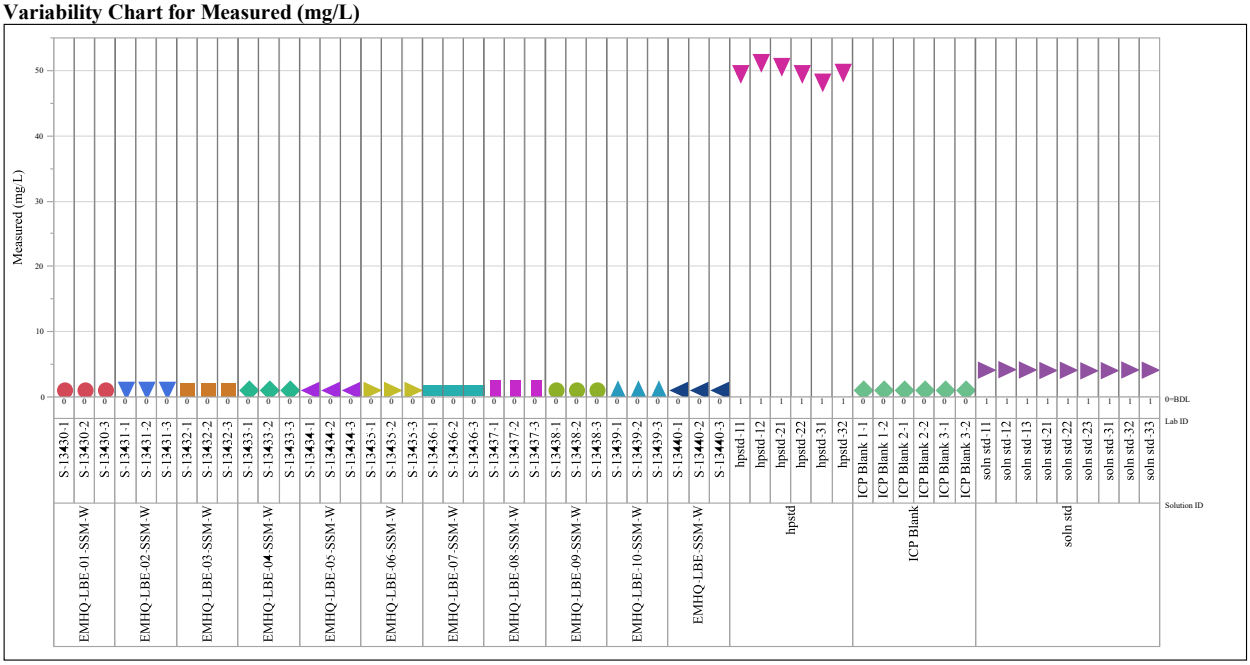


Exhibit B-1. Measurements of SSM Wash Solutions by Solution ID by Analyte (continued)

Analyte=Fe, Analysis=ICP
Variability Chart for Measured (mg/L)



Analyte=K, Analysis=ICP
Variability Chart for Measured (mg/L)

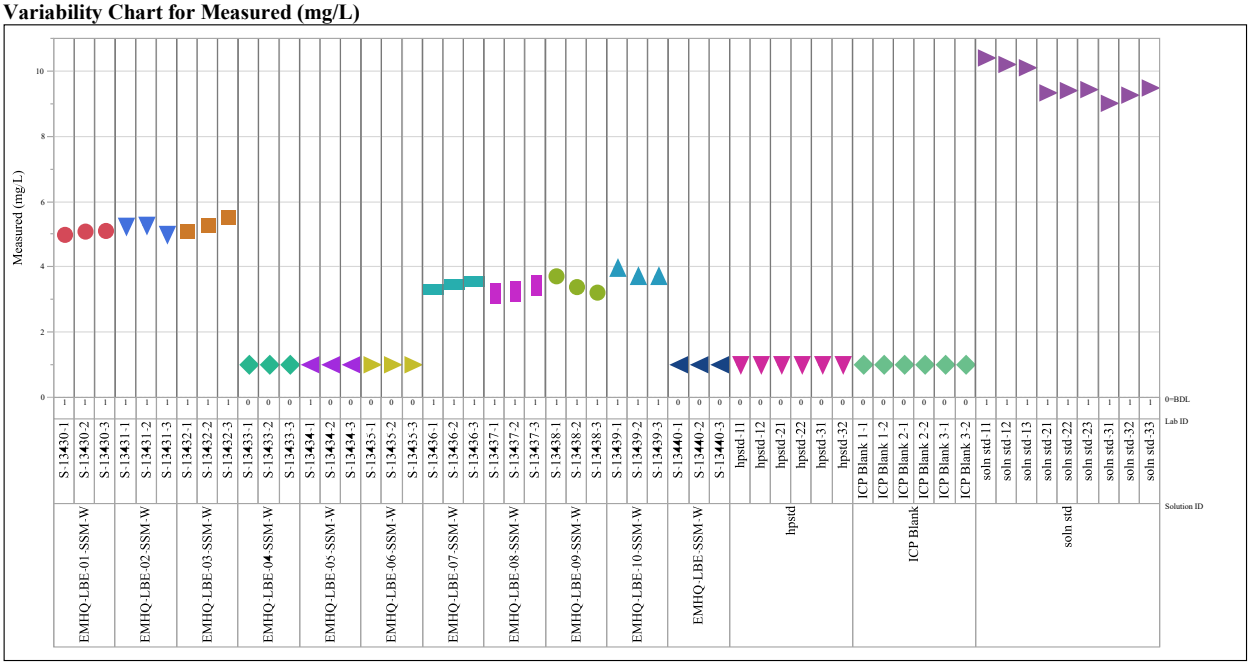
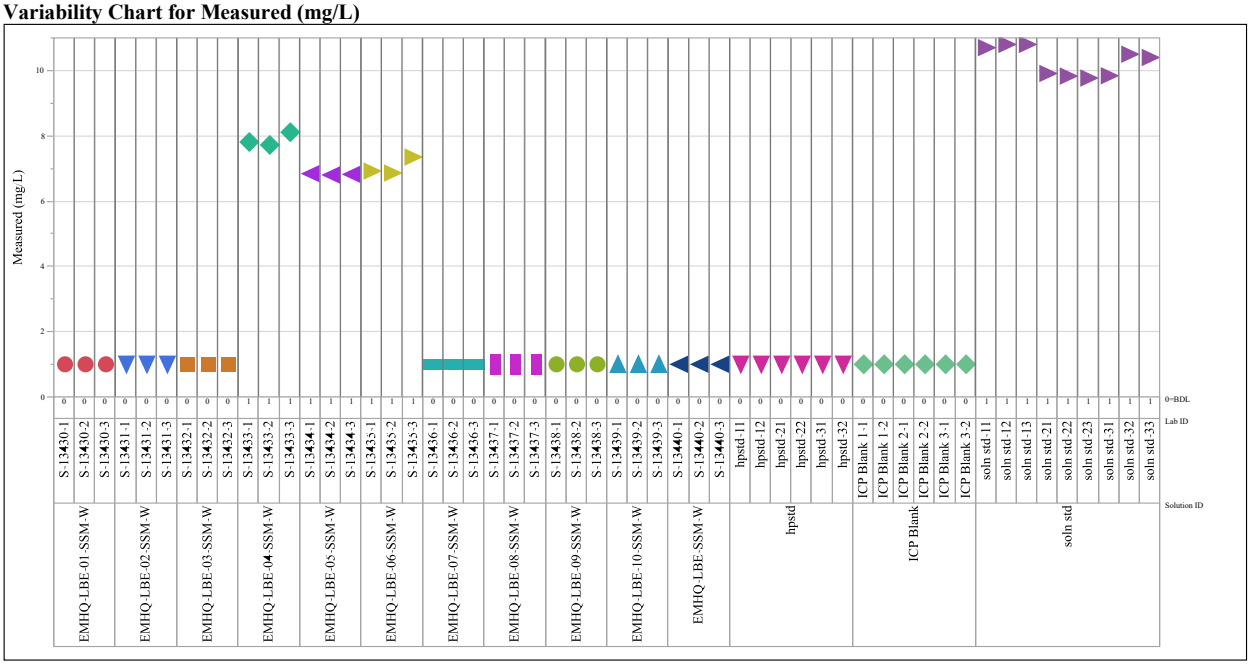


Exhibit B-1. Measurements of SSM Wash Solutions by Solution ID by Analyte (continued)

Analyte=Li, Analysis=ICP
Variability Chart for Measured (mg/L)



Analyte=Mg, Analysis=ICP
Variability Chart for Measured (mg/L)

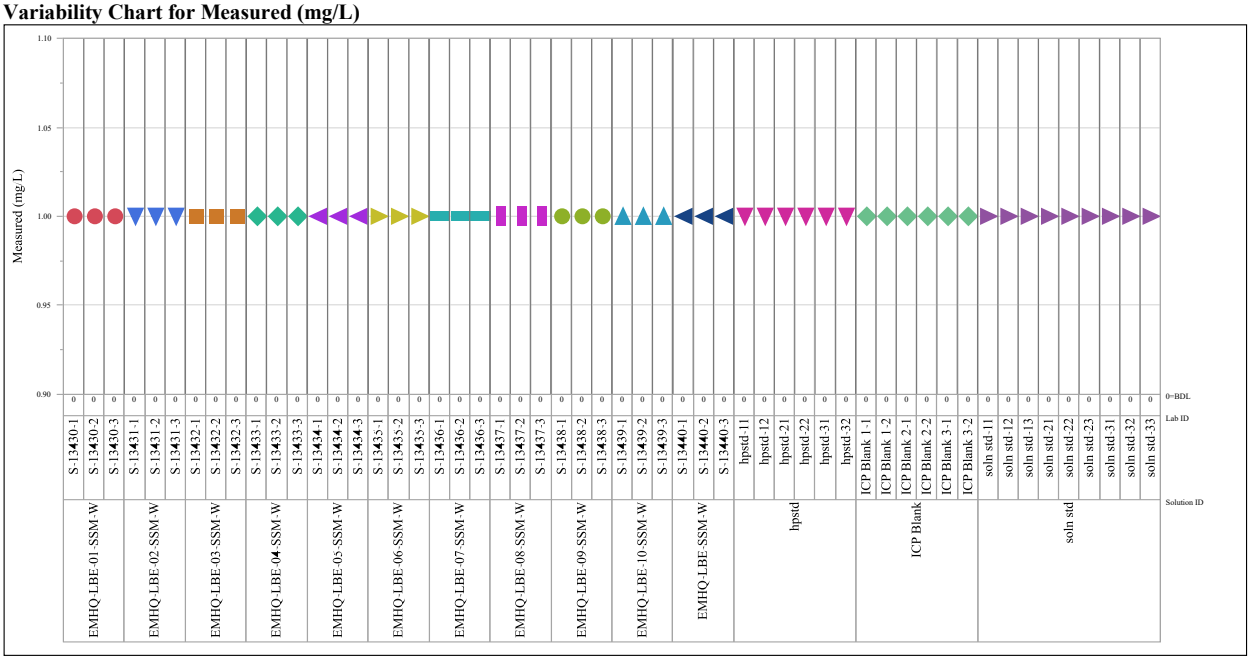
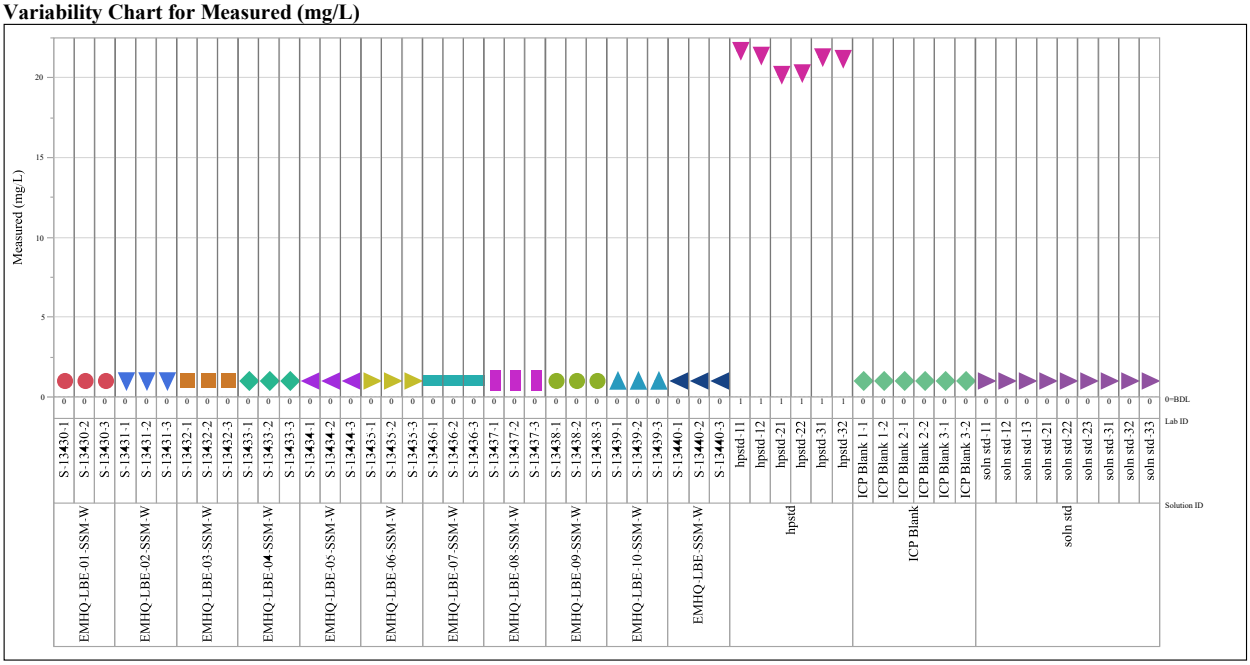


Exhibit B-1. Measurements of SSM Wash Solutions by Solution ID by Analyte (continued)

Analyte=Mn, Analysis=ICP
Variability Chart for Measured (mg/L)



Analyte=Na, Analysis=ICP
Variability Chart for Measured (mg/L)

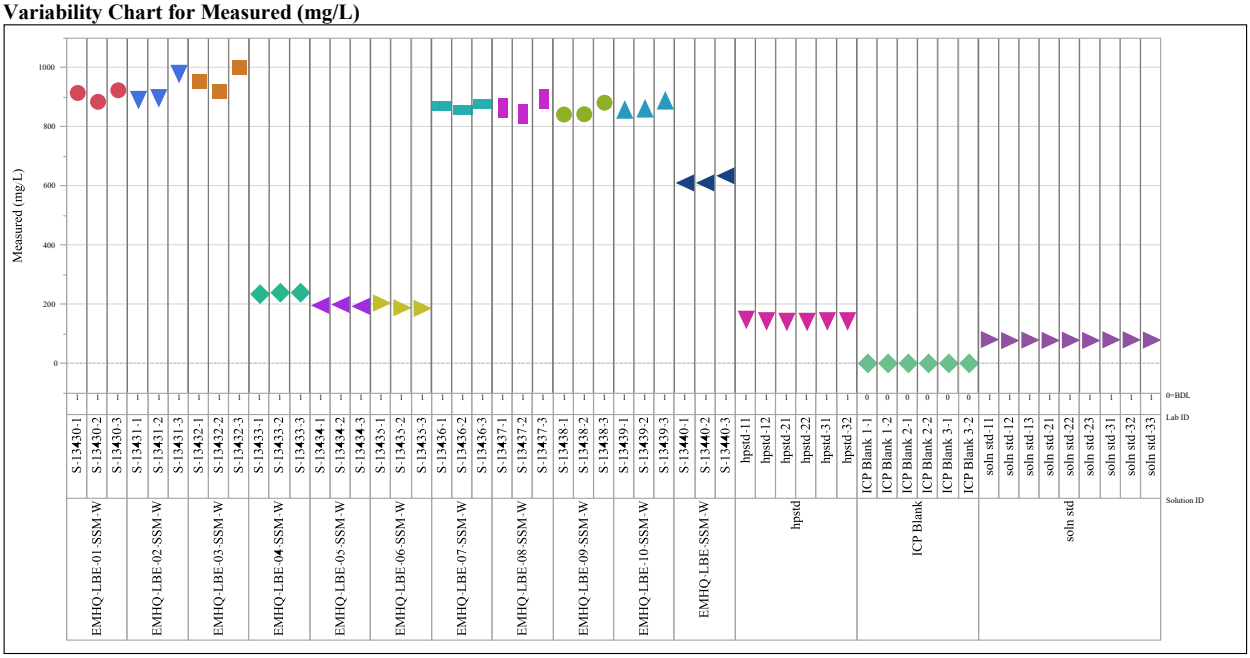
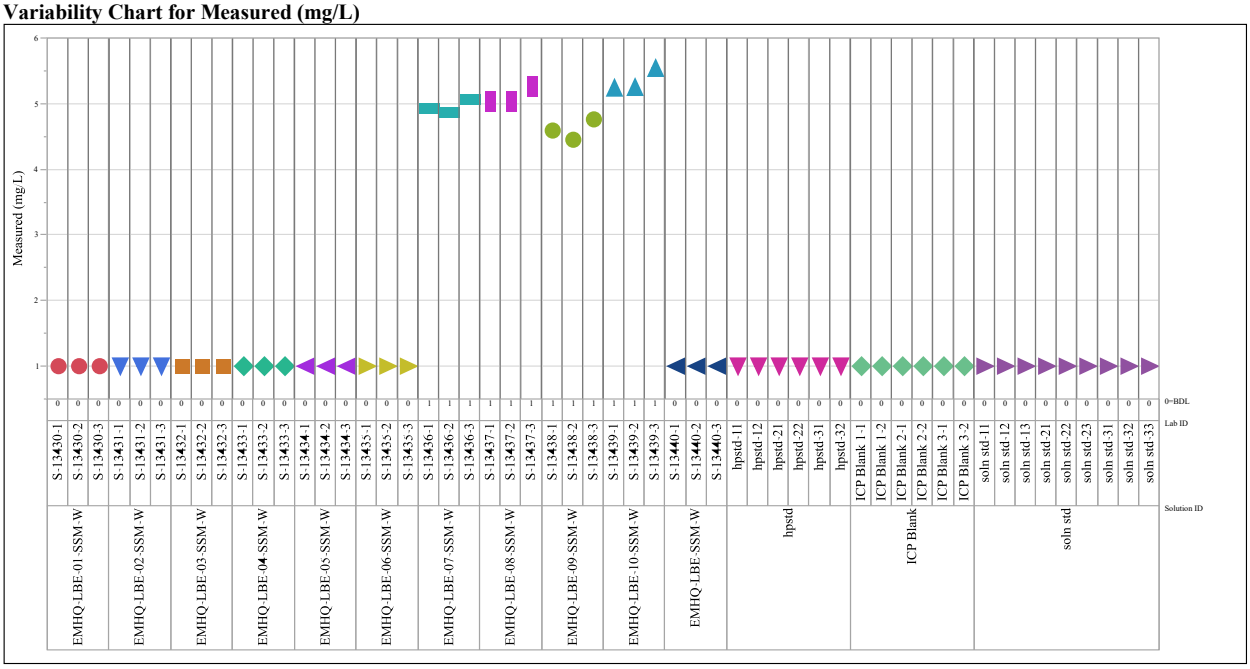


Exhibit B-1. Measurements of SSM Wash Solutions by Solution ID by Analyte (continued)

Analyte=P, Analysis=ICP
Variability Chart for Measured (mg/L)



Analyte=PO_4, Analysis=IC
Variability Chart for Measured (mg/L)

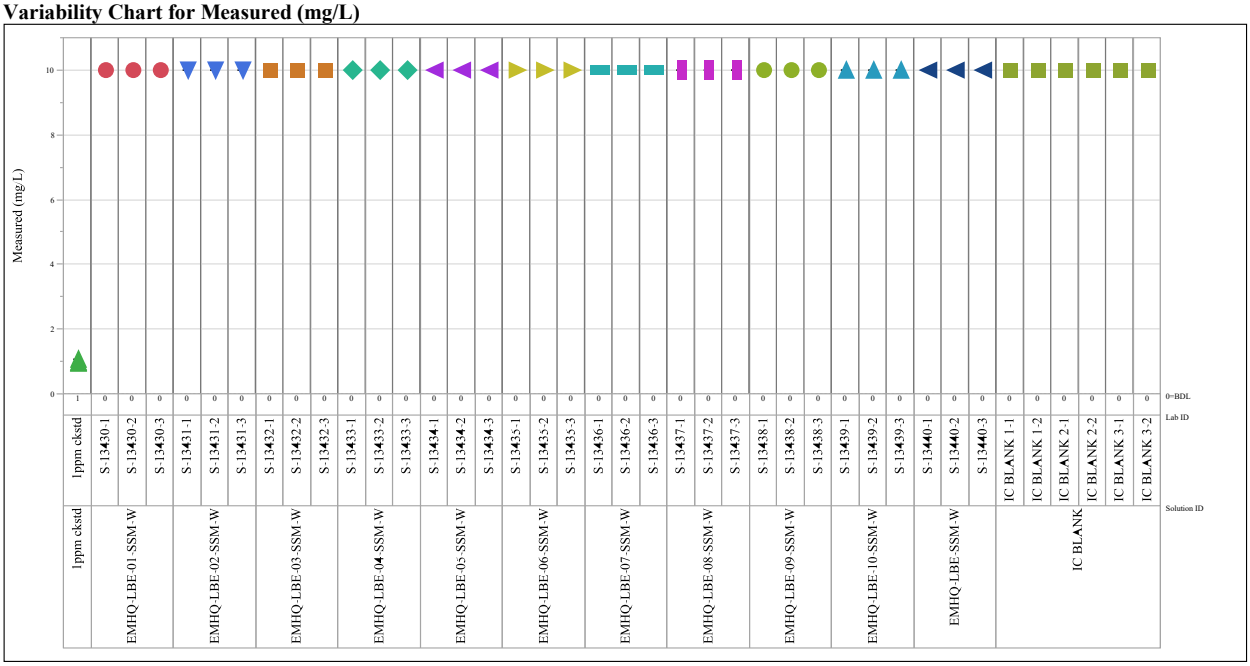
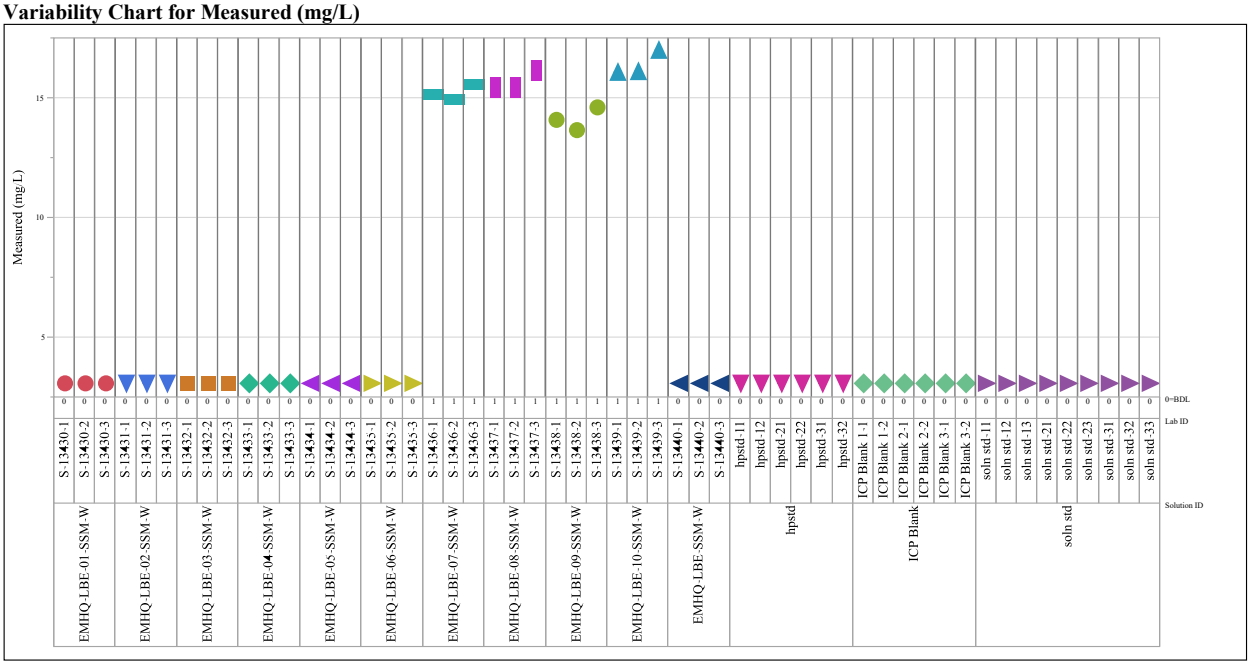


Exhibit B-1. Measurements of SSM Wash Solutions by Solution ID by Analyte (continued)

Analyte=PO_4, Analysis=ICP
Variability Chart for Measured (mg/L)



Analyte=S, Analysis=ICP
Variability Chart for Measured (mg/L)

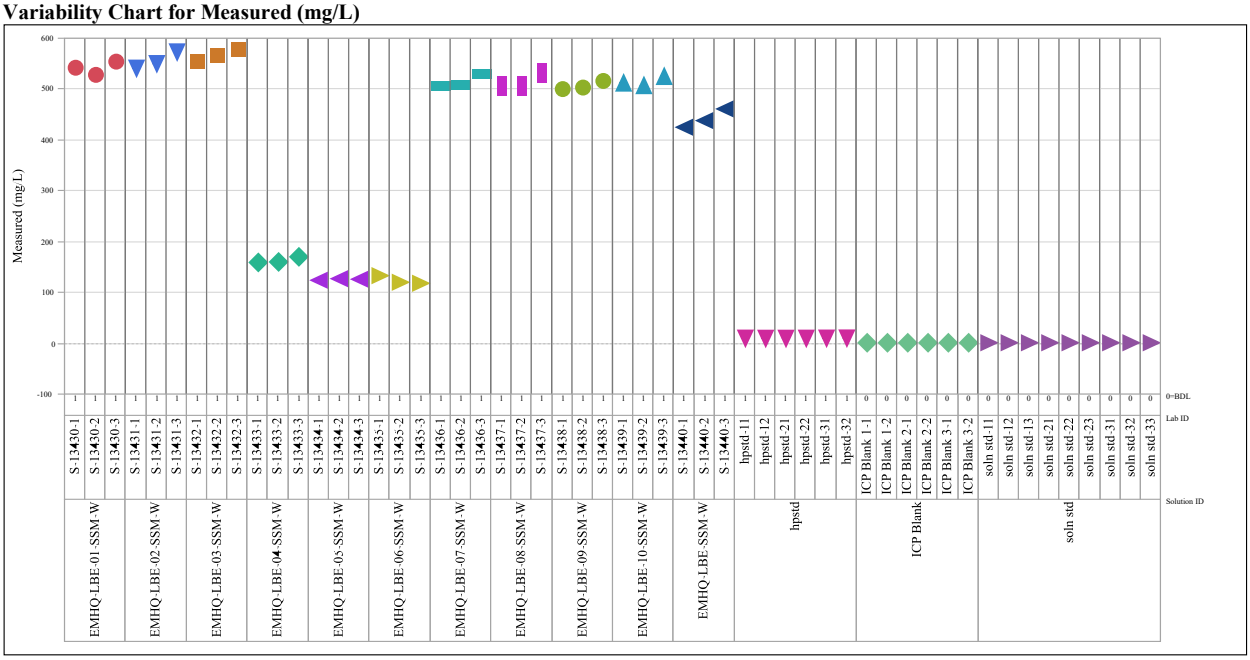
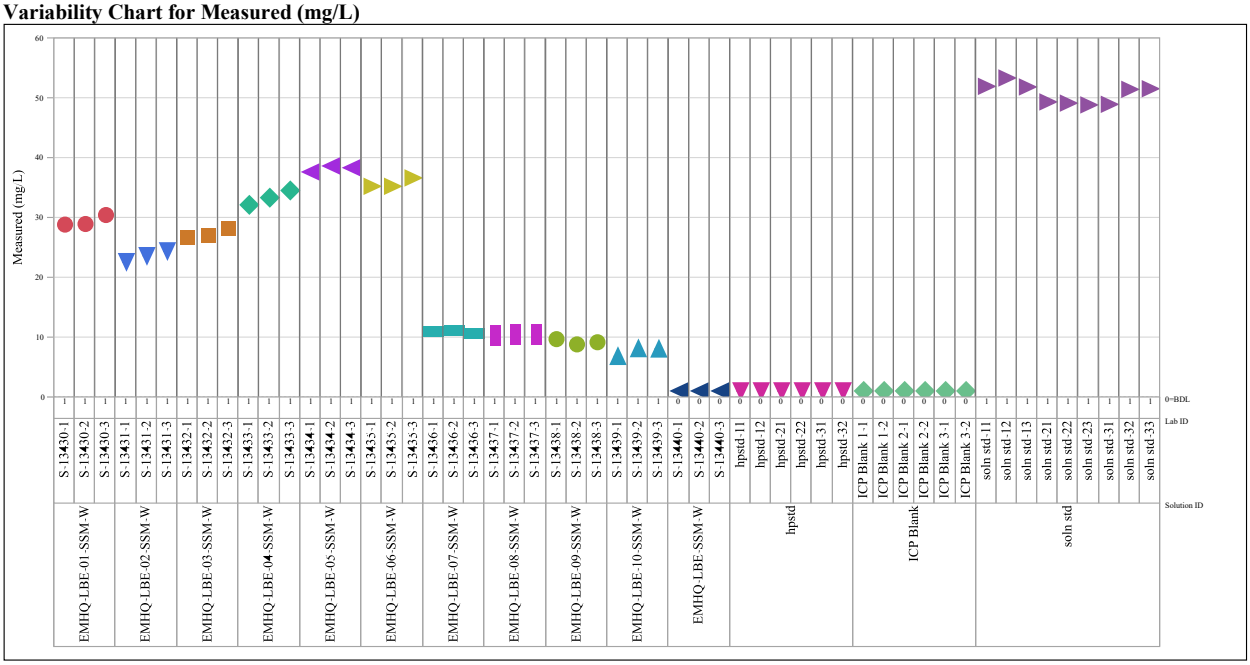


Exhibit B-1. Measurements of SSM Wash Solutions by Solution ID by Analyte (continued)

Analyte=Si, Analysis=ICP
Variability Chart for Measured (mg/L)



Analyte=Sn, Analysis=ICP
Variability Chart for Measured (mg/L)

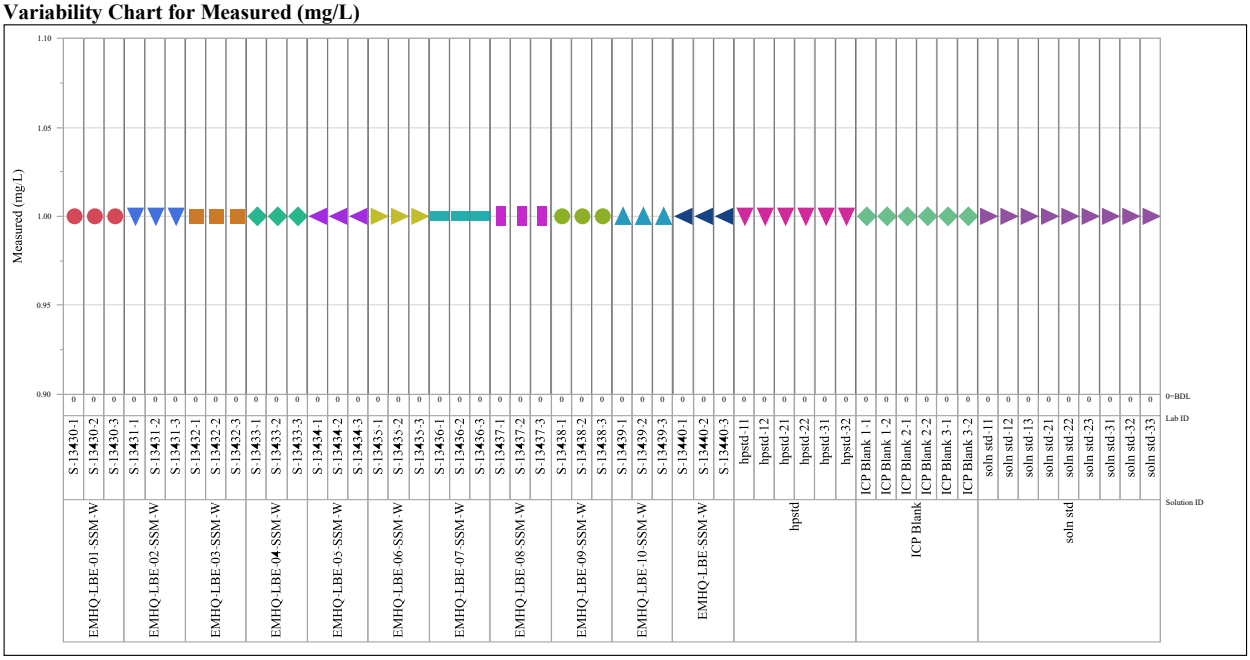
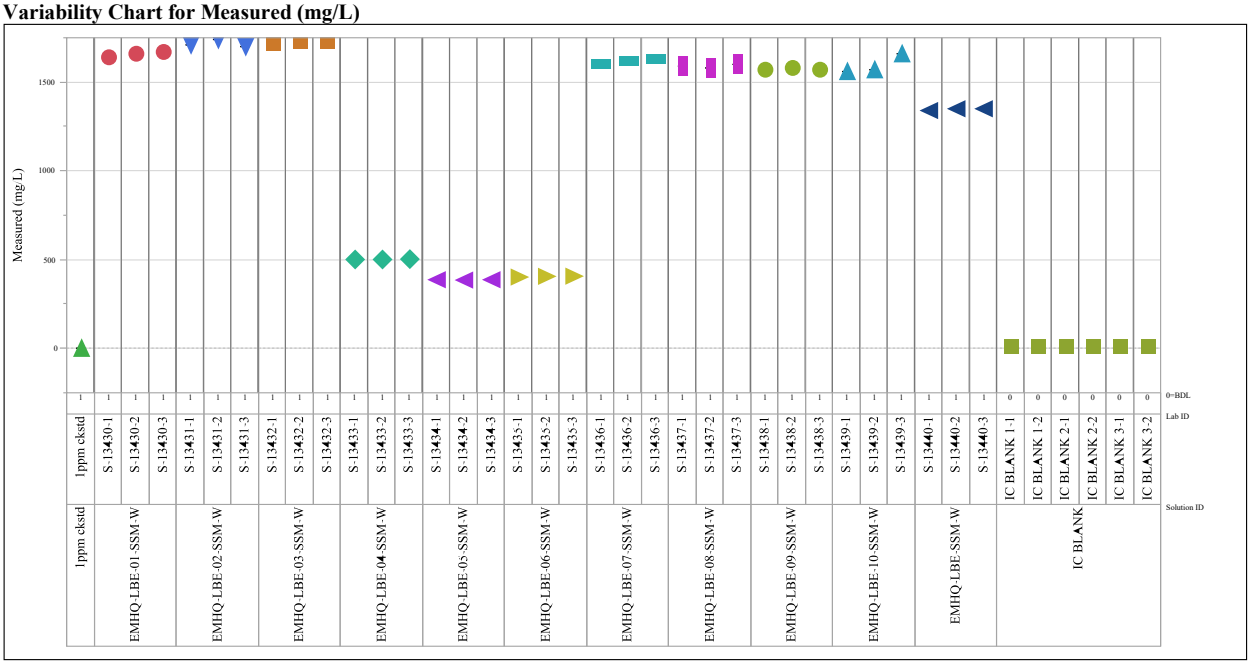


Exhibit B-1. Measurements of SSM Wash Solutions by Solution ID by Analyte (continued)

Analyte=SO_4, Analysis=IC
Variability Chart for Measured (mg/L)



Analyte=SO_4, Analysis=ICP
Variability Chart for Measured (mg/L)

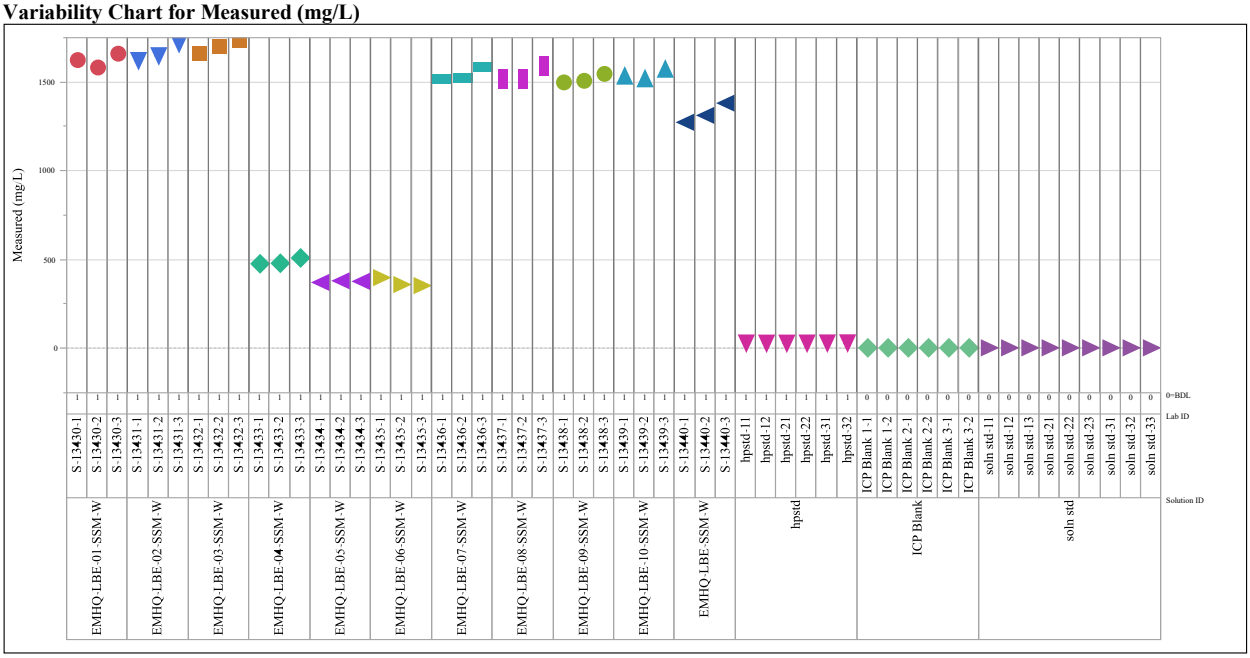
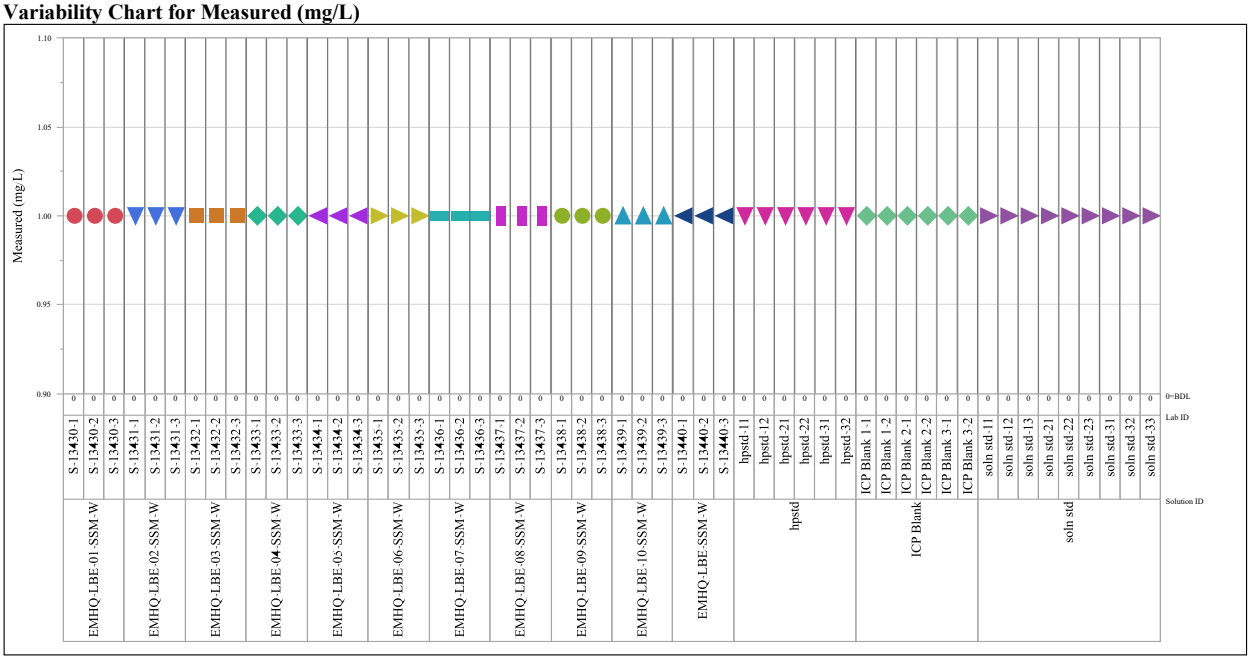


Exhibit B-1. Measurements of SSM Wash Solutions by Solution ID by Analyte (continued)

Analyte=Ti, Analysis=ICP
Variability Chart for Measured (mg/L)



Analyte=V, Analysis=ICP
Variability Chart for Measured (mg/L)

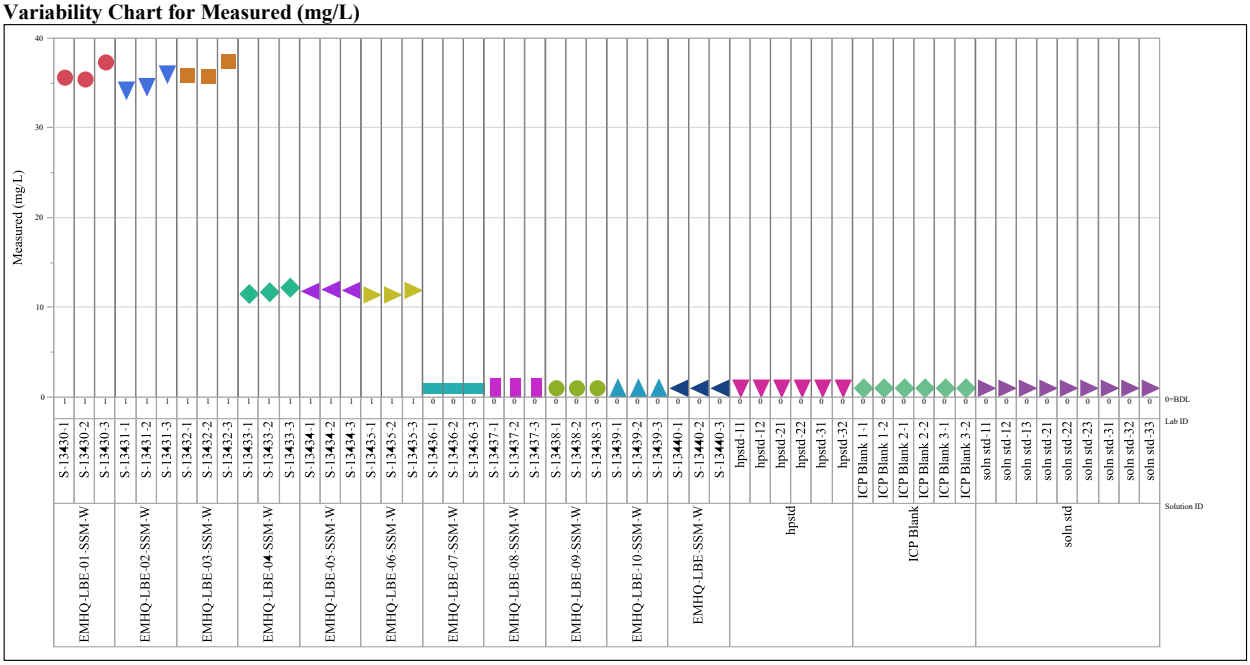


Exhibit B-1. Measurements of SSM Wash Solutions by Solution ID by Analyte (continued)

Analyte=Zr, Analysis=ICP
Variability Chart for Measured (mg/L)

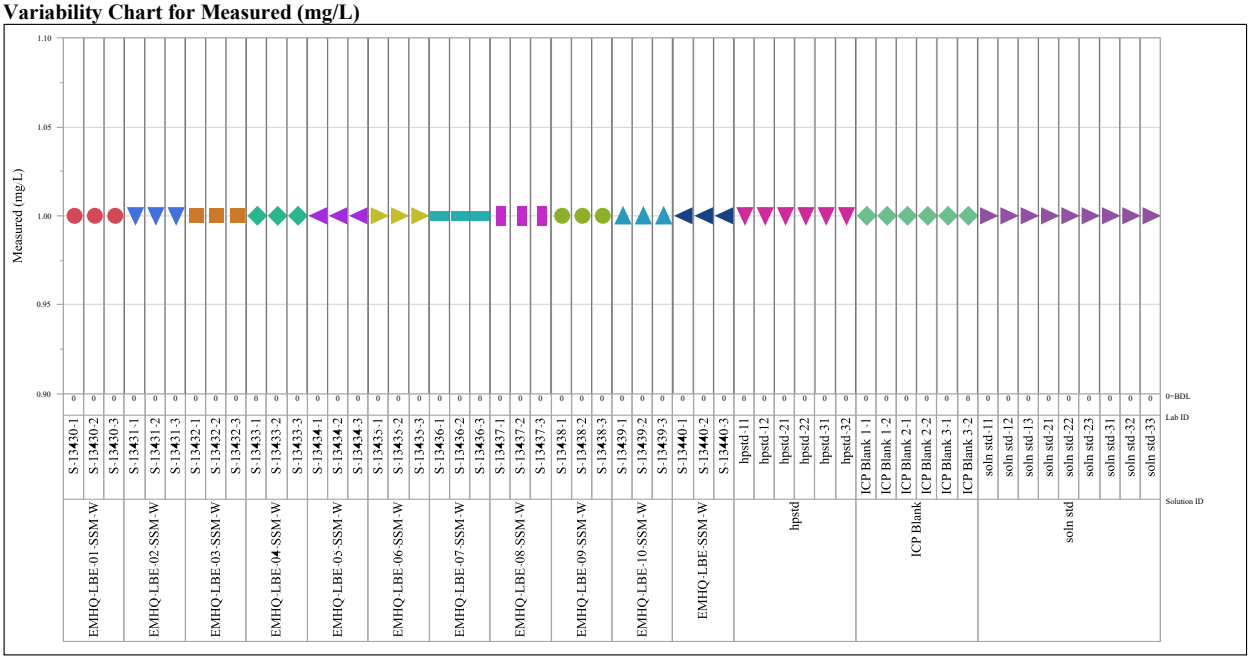
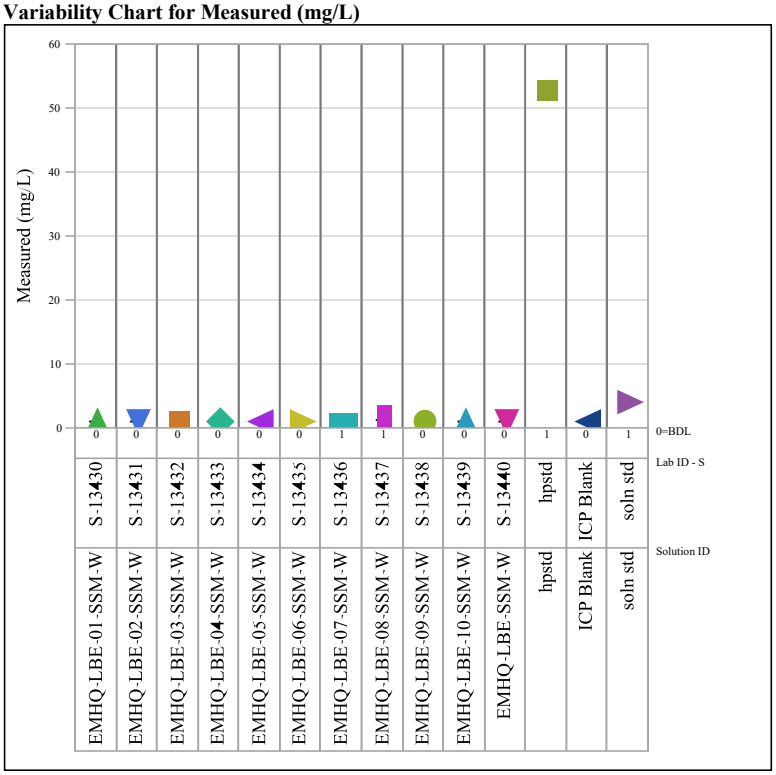


Exhibit B-2. Average Measurements of the SSM Wash Solutions

Analyte=Al, Analysis=ICP
Variability Chart for Measured (mg/L)



Analyte=B, Analysis=ICP
Variability Chart for Measured (mg/L)

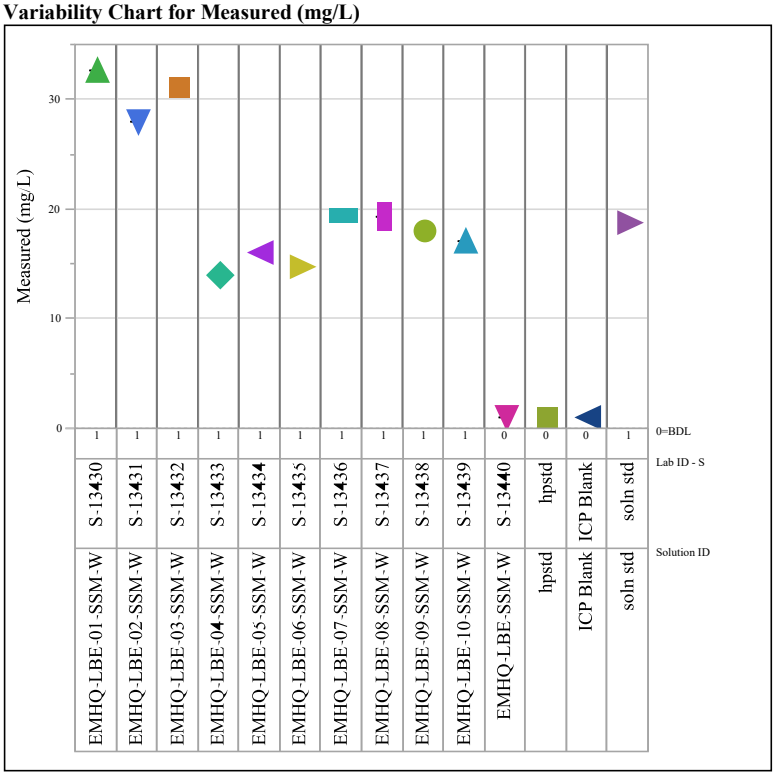
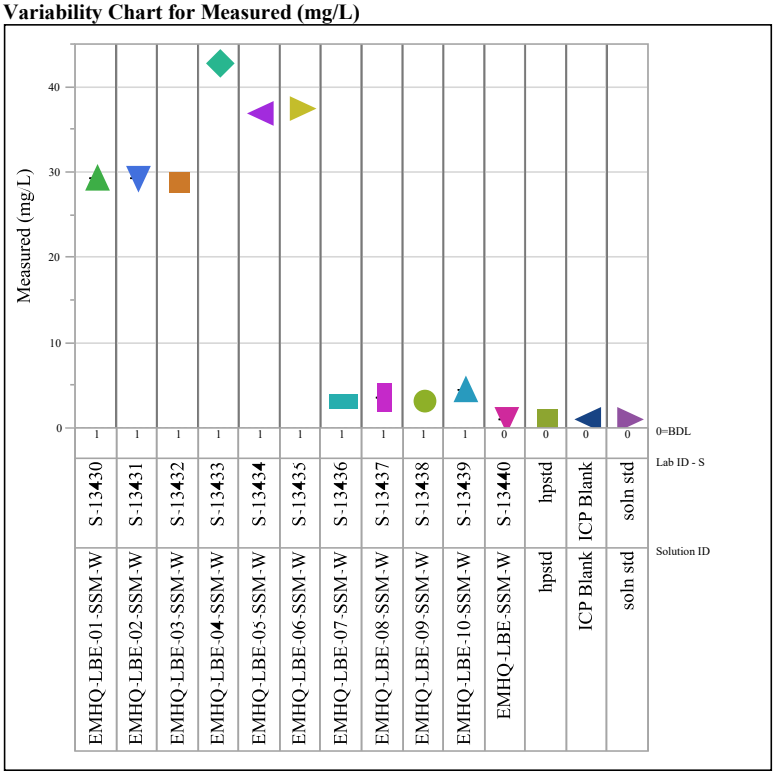


Exhibit B-2. Average Measurements of the SSM Wash Solutions (continued)

Analyte=Ca, Analysis=ICP
Variability Chart for Measured (mg/L)



Analyte=Cl^-, Analysis=IC
Variability Chart for Measured (mg/L)

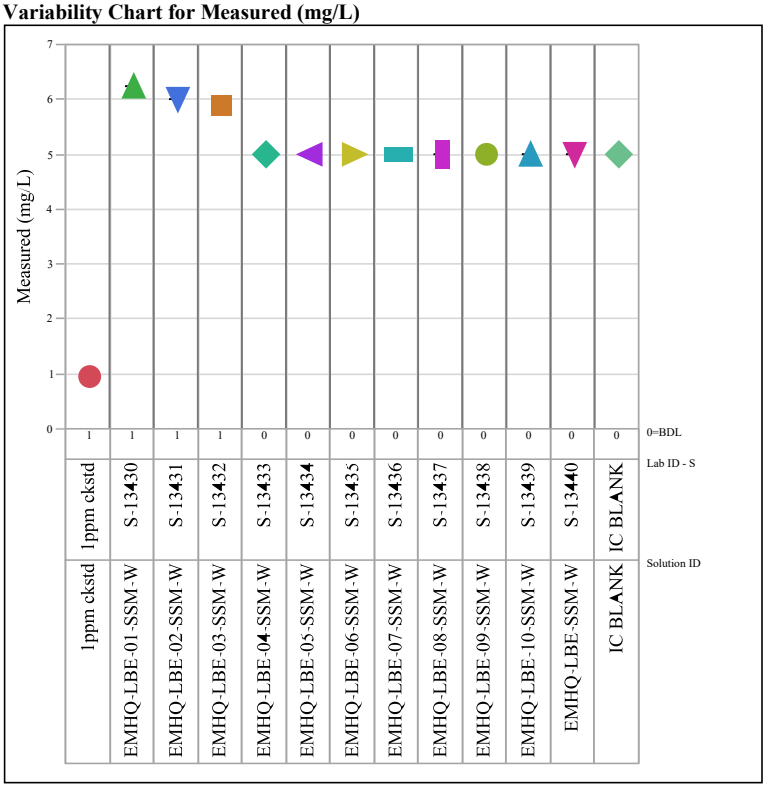
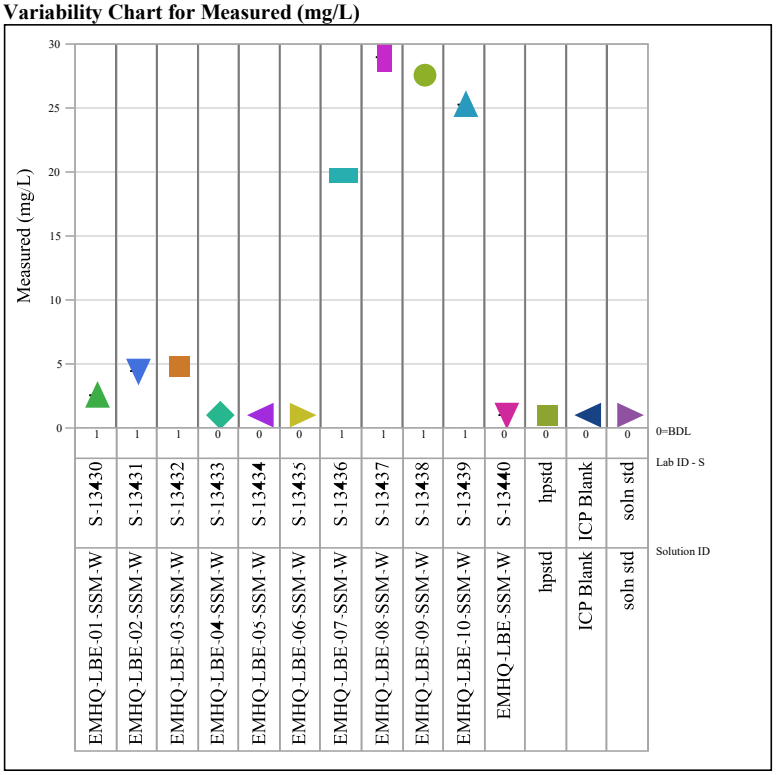


Exhibit B-2. Average Measurements of the SSM Wash Solutions (continued)

Analyte=Cr, Analysis=ICP
Variability Chart for Measured (mg/L)



Analyte=F⁻, Analysis=IC
Variability Chart for Measured (mg/L)

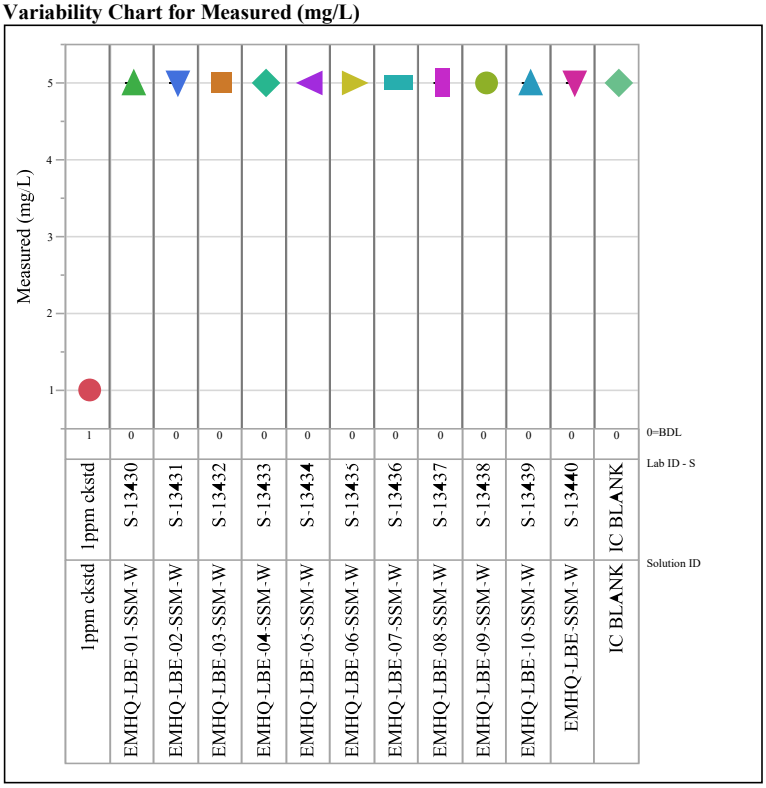
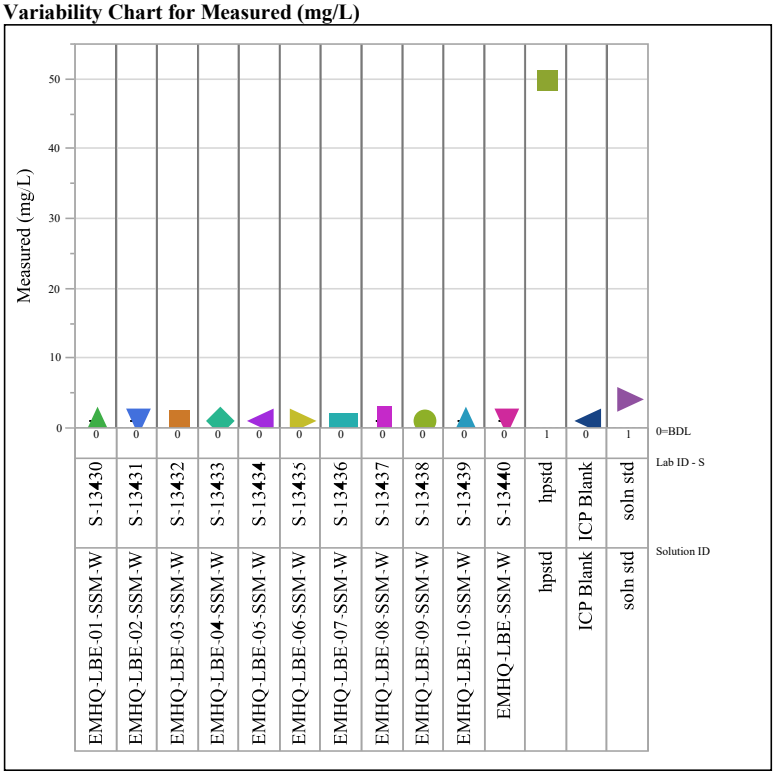


Exhibit B-2. Average Measurements of the SSM Wash Solutions (continued)

Analyte=Fe, Analysis=ICP
Variability Chart for Measured (mg/L)



Analyte=K, Analysis=ICP
Variability Chart for Measured (mg/L)

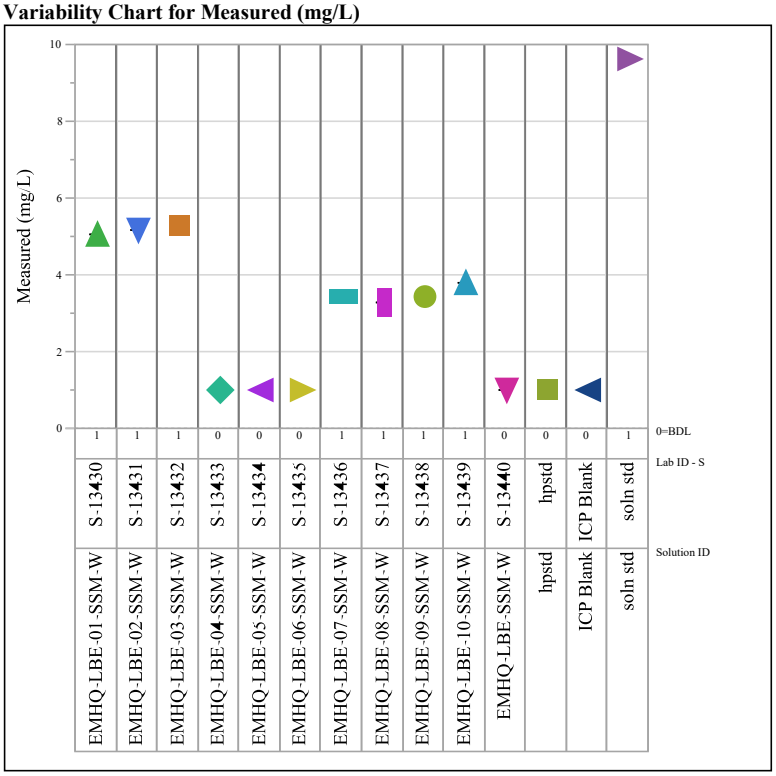
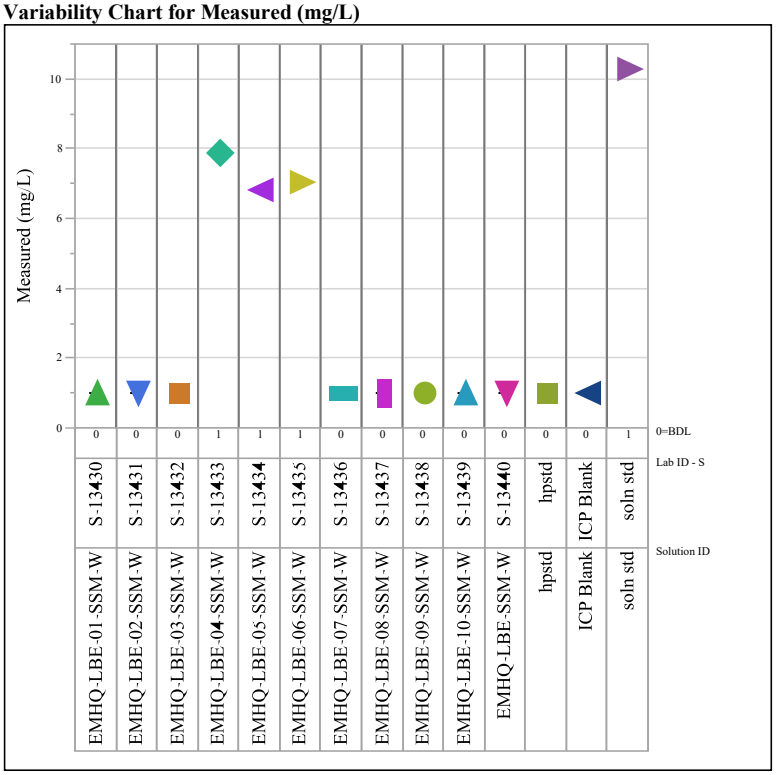


Exhibit B-2. Average Measurements of the SSM Wash Solutions (continued)

Analyte=Li, Analysis=ICP
Variability Chart for Measured (mg/L)



Analyte=Mg, Analysis=ICP
Variability Chart for Measured (mg/L)

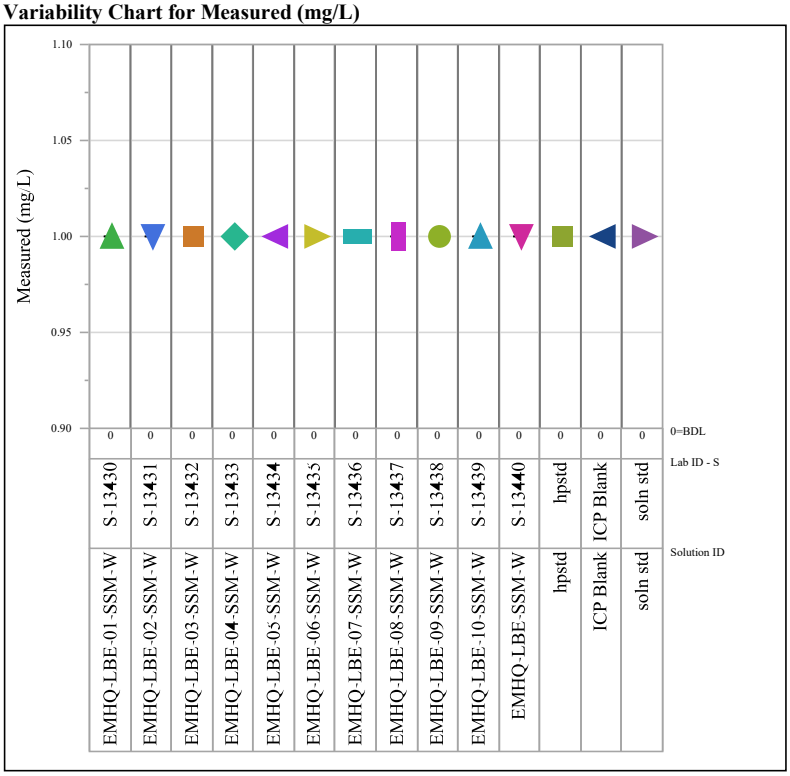
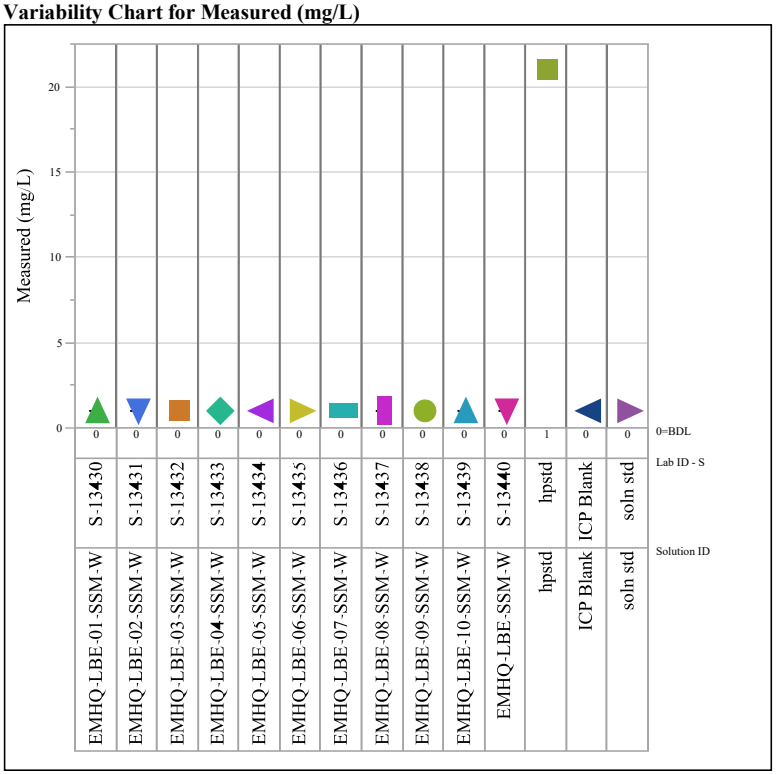


Exhibit B-2. Average Measurements of the SSM Wash Solutions (continued)

Analyte=Mn, Analysis=ICP
Variability Chart for Measured (mg/L)



Analyte=Na, Analysis=ICP
Variability Chart for Measured (mg/L)

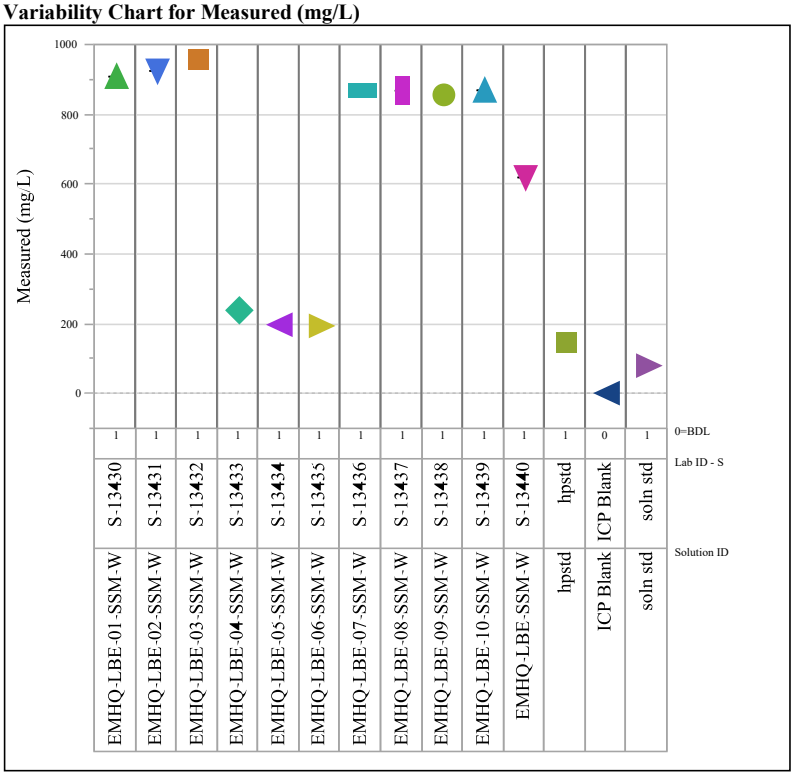
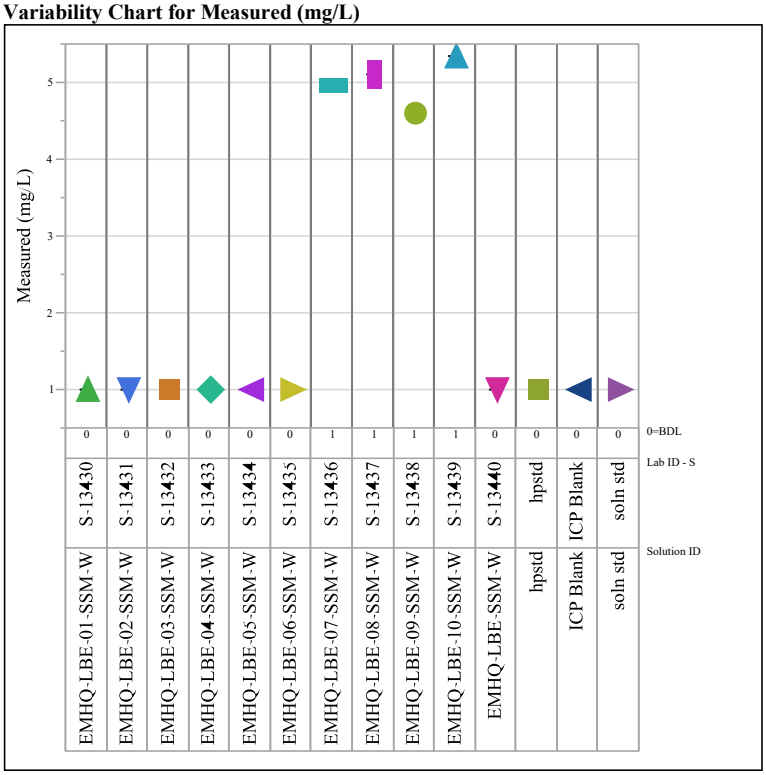


Exhibit B-2. Average Measurements of the SSM Wash Solutions (continued)

Analyte=P, Analysis=ICP
Variability Chart for Measured (mg/L)



Analyte=PO_4, Analysis=IC
Variability Chart for Measured (mg/L)

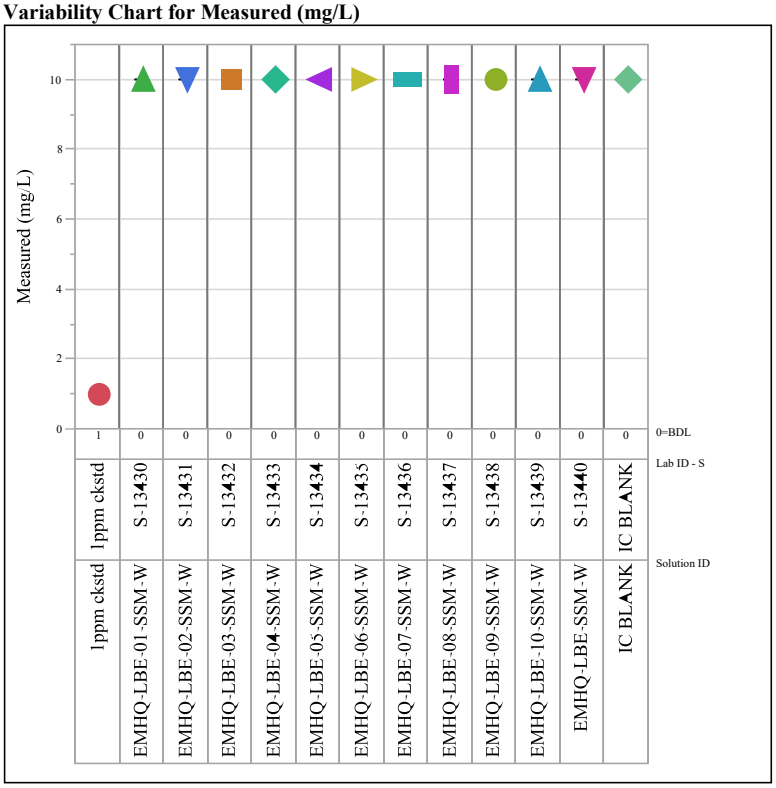
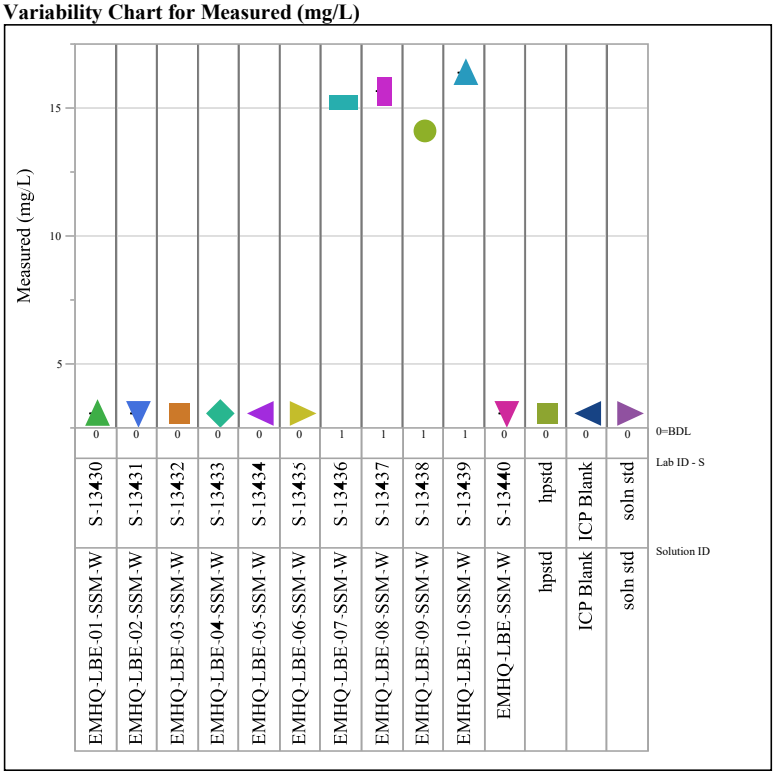


Exhibit B-2. Average Measurements of the SSM Wash Solutions (continued)

Analyte=PO_4, Analysis=ICP
Variability Chart for Measured (mg/L)



Analyte=S, Analysis=ICP
Variability Chart for Measured (mg/L)

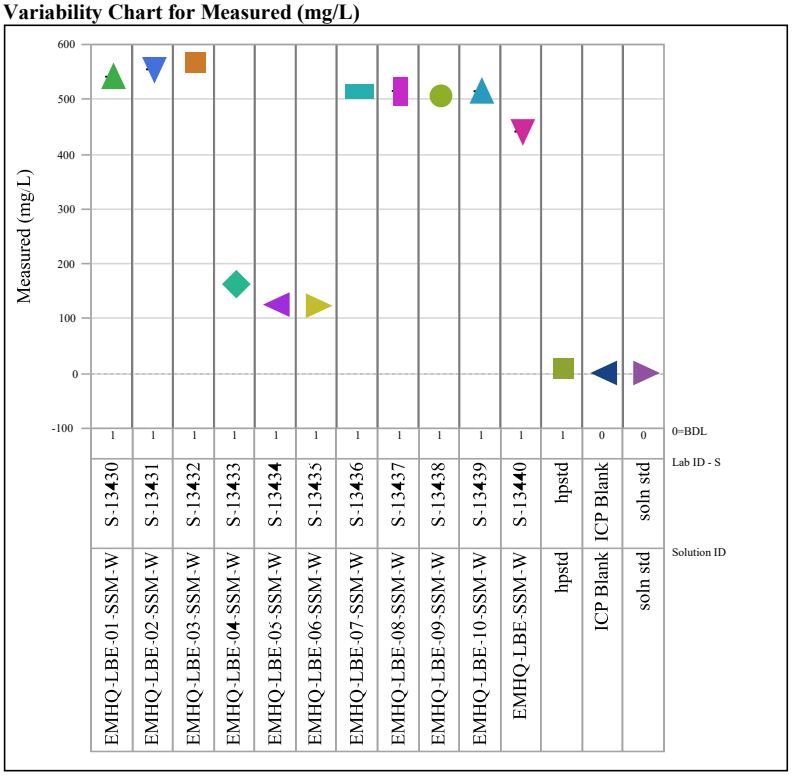
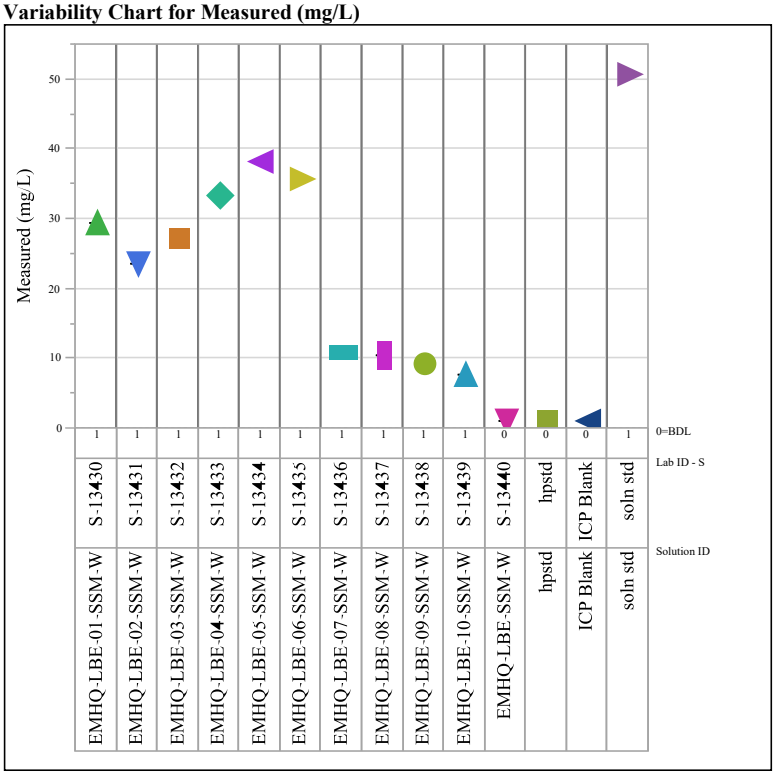


Exhibit B-2. Average Measurements of the SSM Wash Solutions (continued)

Analyte=Si, Analysis=ICP
Variability Chart for Measured (mg/L)



Analyte=Sn, Analysis=ICP
Variability Chart for Measured (mg/L)

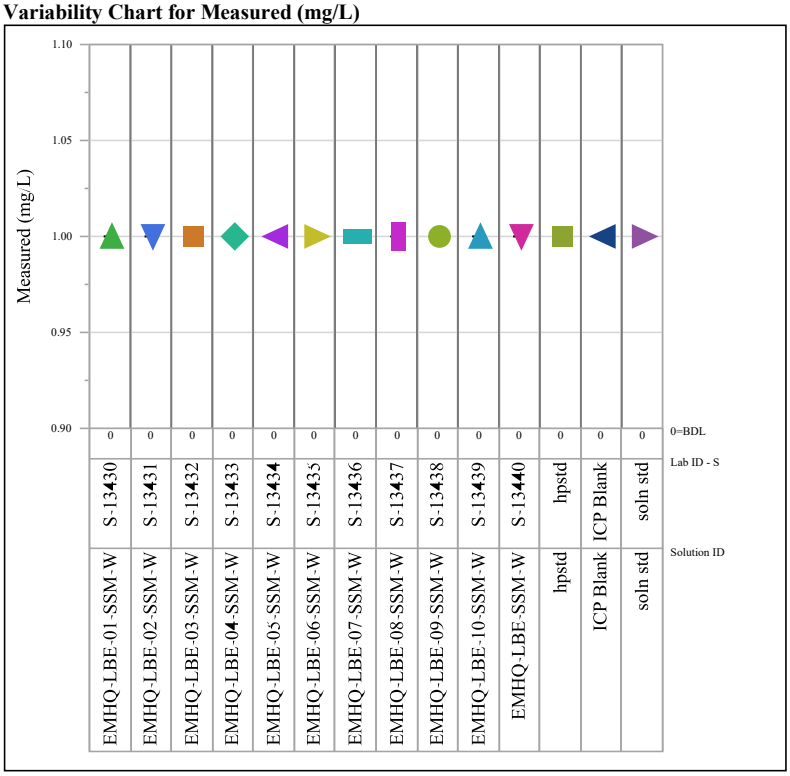
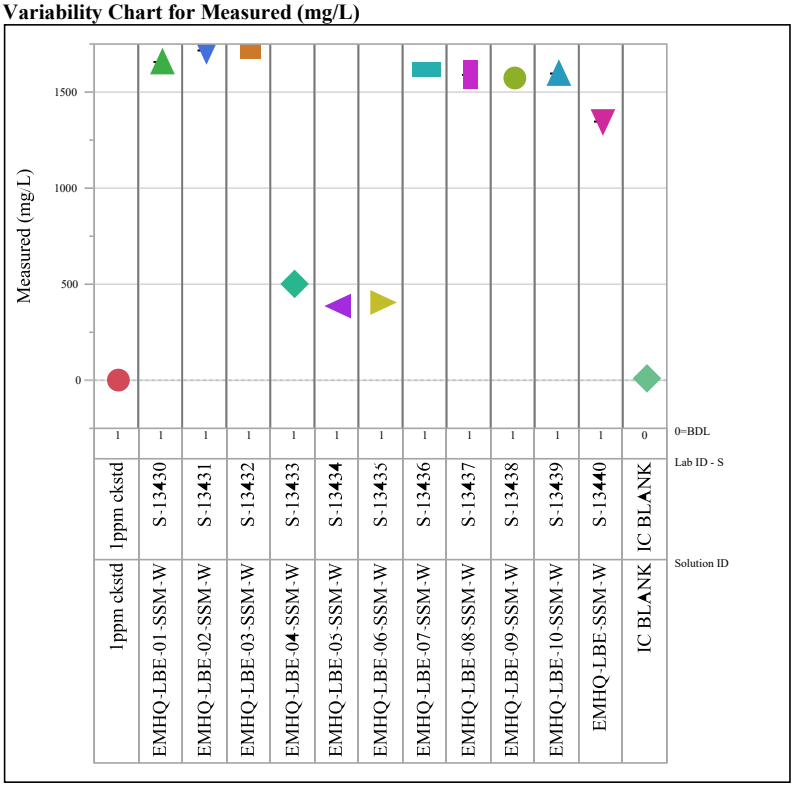


Exhibit B-2. Average Measurements of the SSM Wash Solutions (continued)

Analyte=SO_4, Analysis=IC
Variability Chart for Measured (mg/L)



Analyte=SO_4, Analysis=ICP
Variability Chart for Measured (mg/L)

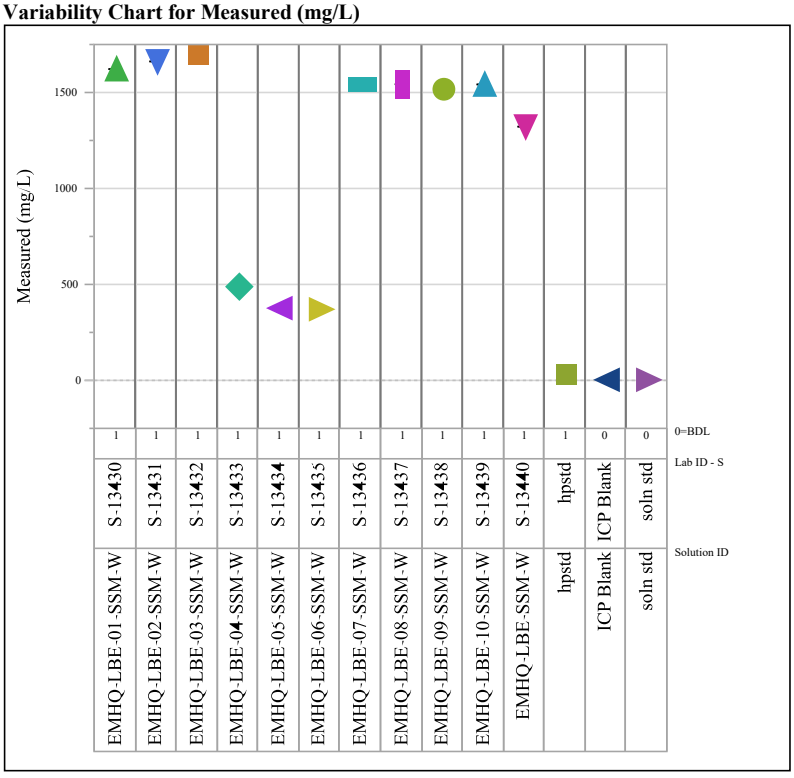
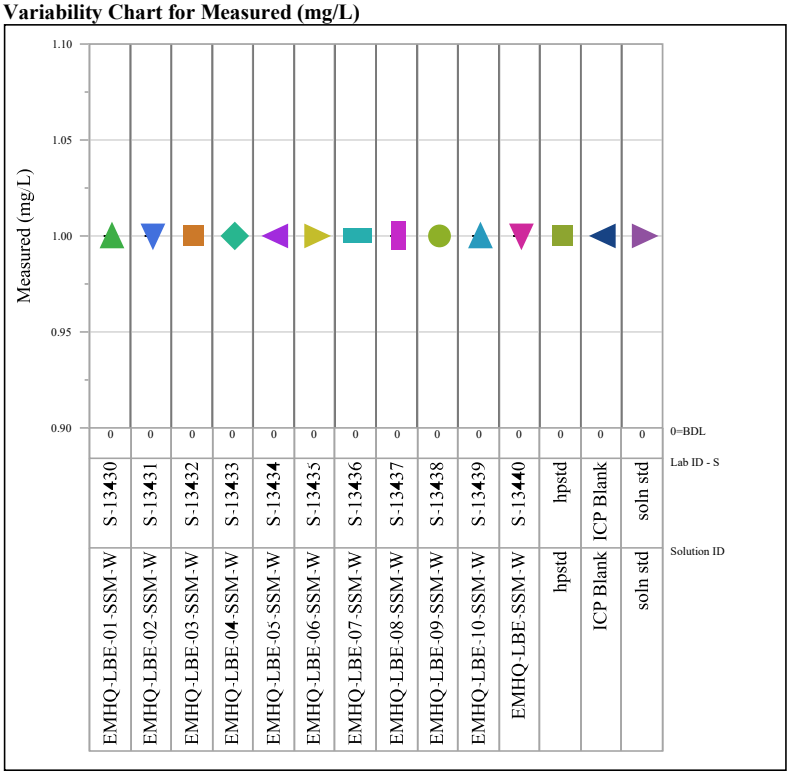


Exhibit B-2. Average Measurements of the SSM Wash Solutions (continued)

Analyte=Ti, Analysis=ICP
Variability Chart for Measured (mg/L)



Analyte=V, Analysis=ICP
Variability Chart for Measured (mg/L)

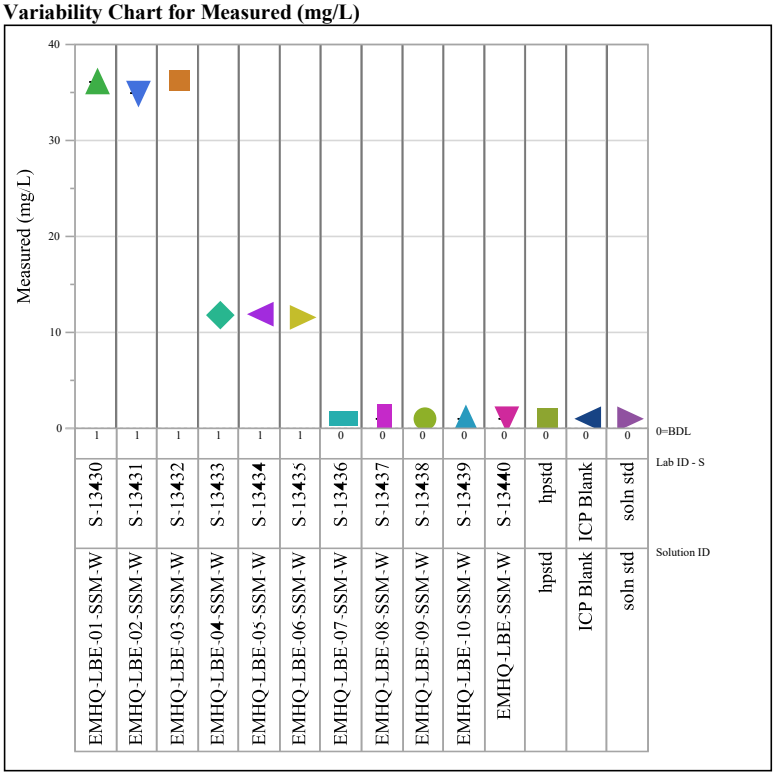
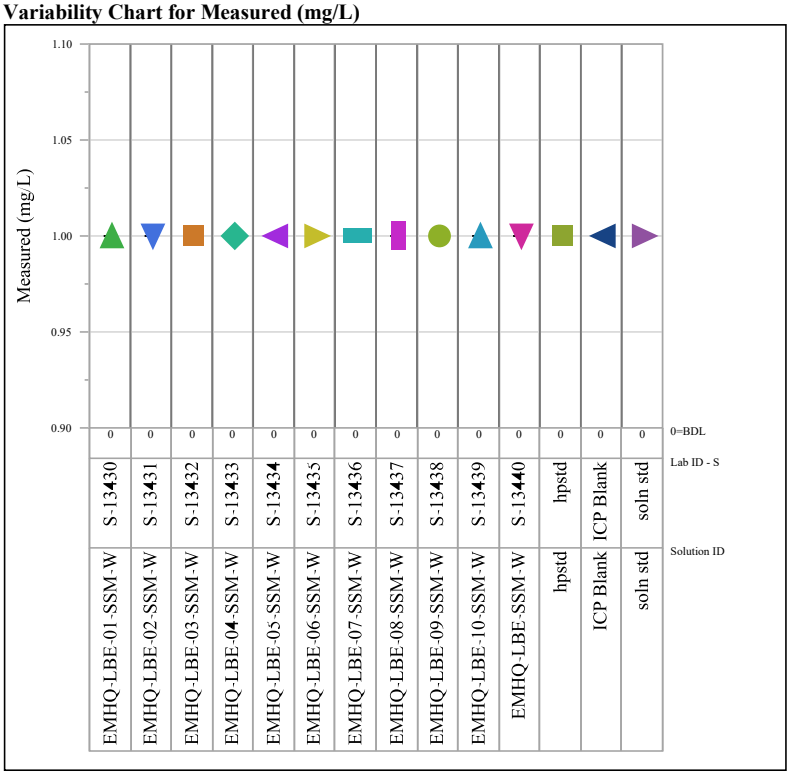


Exhibit B-2. Average Measurements of the SSM Wash Solutions (continued)

Analyte=Zr, Analysis=ICP
Variability Chart for Measured (mg/L)



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