



facility 439136

project 10243

Gross Alpha/Beta Case Narrative

COGCC

PW NORM 2017 – 10048

Work Order Number: 1705202

1. This report consists of the analytical results and supporting documentation for one water sample received by ALS on 05/09/2017.
2. This sample was prepared according to the current revision of SOP 702.
3. The sample was analyzed for gross alpha and beta activity by gas flow proportional counting according to the current revision of SOP 724. The analysis was completed on 05/12/2017. Gross alpha results are referenced to ^{241}Am . Gross beta results are referenced to ^{137}Cs .
4. The analysis results for this sample are reported in units of pCi/L. The sample was not filtered prior to analysis.
5. Sample volume was insufficient to allow preparation of a duplicate. A laboratory control sample duplicate (LCSD) was prepared in lieu of a client sample duplicate for batch GA170511-1.
6. The requested MDC for gross alpha/beta for sample 1705202-1 was not achieved. The reported activity for this sample exceeds the achieved MDC. The results are flagged with an "M3" qualifier on the final reports.
7. No further anomalous situations were encountered during the preparation or analysis of this sample. All remaining quality control criteria were met.



The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, ALS certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.

Jean Anderson
Jean Anderson
Radiochemistry Primary Data Reviewer

5/26/17
Date

Shirley Loney
Radiochemistry Final Data Reviewer

5/26/17
Date

Section 1

CHAIN OF CUSTODY

ALS -- Fort Collins

Sample Number(s) Cross-Reference Table

OrderNum: 1705202

Client Name: COGCC

Client Project Name: PW NORM 2017

Client Project Number: 10048

Client PO Number: CT 2017-3066

Client Sample Number	Lab Sample Number	COC Number	Matrix	Date Collected	Time Collected
439136	1705202-1		WATER	09-May-17	12:50
439136	1705202-2		WATER	09-May-17	12:50



MTF: (800) 443-1511 PH: (970) 490-1511 FX: (970) 490-1522

Chain-of-Custody

Turnaround time for samples received Saturday will be calculated beginning from the next business day.

ALS WORKORDER #

1705202

[illegible]



225 Commerce Drive, Fort Collins, Colorado 80524
TF: (800) 443-1511 PH: (970) 490-1511 FX: (970) 490-1522

Chain-of-Custody

Turnaround time for samples received after 2 p.m. will be calculated beginning from the next business day.

ALS WORKORDER #

1705202

[illegible]



ALS Environmental - Fort Collins
CONDITION OF SAMPLE UPON RECEIPT FORM

Client: COGCC
Project Manager: SS

Workorder No: 1705202
Initials: CAT Date: 5-10-17

1. Does this project require any special handling in addition to standard ALS procedures?		YES	<u>NO</u>
2. Are custody seals on shipping containers intact?	<u>NONE</u>	YES	NO
3. Are Custody seals on sample containers intact?	<u>NONE</u>	YES	NO
4. Is there a COC (Chain-of-Custody) present or other representative documents?		<u>YES</u>	NO
5. Are the COC and bottle labels complete and legible?		<u>YES</u>	NO
6. Is the COC in agreement with samples received? (IDs, dates, times, no. of samples, no. of containers, matrix, requested analyses, etc.)		<u>YES</u>	NO
7. Were airbills / shipping documents present and/or removable?	<u>DROP OFF</u>	YES	NO
8. Are all aqueous samples requiring preservation preserved correctly? (excluding volatiles)	N/A	YES	<u>NO</u>
9. Are all aqueous non-preserved samples pH 4-9?	N/A	<u>YES</u>	NO
10. Is there sufficient sample for the requested analyses?		<u>YES</u>	NO
11. Were all samples placed in the proper containers for the requested analyses?		<u>YES</u>	NO
12. Are all samples within holding times for the requested analyses?		<u>YES</u>	NO
13. Were all sample containers received intact? (not broken or leaking, etc.)		<u>YES</u>	NO
14. Are all samples requiring no headspace (VOC, GRO, RSK/MEE, Rx CN/S, radon) headspace free? Size of bubble: ____ < green pea ____ > green pea	N/A	<u>YES</u>	NO
15. Do any water samples contain sediment? Amount Amount of sediment: ____ dusting ____ moderate ____ heavy	N/A	YES	<u>NO</u>
16. Were the samples shipped on ice?		<u>YES</u>	<u>NO</u>
17. Were cooler temperatures measured at 0.1-6.0°C? IR gun used*: <u>#2</u> #4		<u>YES</u>	<u>NO</u>
Cooler #: <u>1</u> <u>2</u>			
Temperature (°C): <u>6.0</u> <u>Amb</u>			
No. of custody seals on cooler: <u>0</u> <u>0</u>			
External µR/hr reading: <u>NA</u> <u>NA</u>			
Background µR/hr reading: <u>NA</u>			
Were external µR/hr readings ≤ two times background and within DOT acceptance criteria? YES / NO / <u>NA</u> (If no, see Form 008.)			

Additional Information: PROVIDE DETAILS BELOW FOR A NO RESPONSE TO ANY QUESTION ABOVE, EXCEPT #1 AND #16.

All RAD samples in the Amb cooler.

Added 3.5ml HNO₃ to EA. RAD and TOTAL metals bottle. Final pH < 2. HNO₃ lot no. 152495.

If applicable, was the client contacted? YES / NO / NA Contact: [Signature] Date/Time: _____

Project Manager Signature / Date: [Signature]

Section 2



SAMPLE RESULTS SUMMARY

Gross Beta by GFPC Sample Results Summary

Client Name: COGCC
Client Project Name: PW NORM 2017
Client Project Number: 10048
Laboratory Name: ALS – Fort Collins
PAI Work Order: 1705202

Page: 1 of 1
Reported on: Thursday, May 25, 2017
12:11:29 PM

Lab Sample ID	Client Sample ID	Sample Type	Nuclide	Result +/- 2 s TPU	MDC	DL	Units	Matrix	Prep Batch	Date Analyzed	Flags
1705202-1	439136	Sample	GROSS BETA	9.6E+01 +/- 2.3E+01	2.5E+01	NA	pCi/l	WATER	AB170511-1	5/12/2017	M3

Comments:

Data Package ID: AB1705202-1

Qualifiers/Flags:

- U - Result is less than the sample specific MDC.
- LT - Result is less than Requested MDC, greater than sample specific MDC.
- Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
- Y2 - Chemical Yield outside default limits.
- M - The requested MDC was not met.
- M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

Abbreviations:

- TPU - Total Propagated Uncertainty
- MDC - Sample specific Minimum Detectable Concentration
- BDL - Below Detection Limit

Gross Alpha(Co-Precipitation) Analysis by GFPC Sample Results Summary

Client Name: COGCC
Client Project Name: PW NORM 2017
Client Project Number: 10048
Laboratory Name: ALS – Fort Collins
PAI Work Order: 1705202

Page: 1 of 1
Reported on: Friday, May 26, 2017
5:33:04 AM

Lab Sample ID	Client Sample ID	Sample Type	Nuclide	Result +/- 2 s TPU	MDC	DL	Units	Matrix	Prep Batch	Date Analyzed	Flags
1705202-1	439136	Sample	GROSS ALPHA	2.71E+02 +/- 4.4E+01	3E+00	NA	pCi/l	WATER	GA170511-1	5/12/2017	M3

Comments:

Data Package ID: GA1705202-2

Qualifiers/Flags:

- U - Result is less than the sample specific MDC.
- LT - Result is less than Requested MDC, greater than sample specific MDC.
- Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
- Y2 - Chemical Yield outside default limits.
- M - The requested MDC was not met.
- M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

Abbreviations:

- TPU - Total Propagated Uncertainty
- MDC - Sample specific Minimum Detectable Concentration
- BDL - Below Detection Limit

Section 3

QC RESULTS SUMMARY

3

Gross Alpha(Co-Precipitation) Analysis by GFPC

PAI 724 Rev 12

Method Blank Results

Lab Name: ALS -- Fort Collins

Work Order Number: 1705202

Client Name: COGCC

ClientProject ID: PW NORM 2017 10048

Lab ID: GA170511-1MB

Sample Matrix: WATER

Prep SOP: PAI 786 Rev 7

Date Collected: 11-May-17

Date Prepared: 11-May-17

Date Analyzed: 12-May-17

Prep Batch: GA170511-1

QCBatchID: GA170511-1-1

Run ID: GA170511-1A

Count Time: 1000 minutes

Final Aliquot: 500 ml

Result Units: pCi/l

File Name: aba0512

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
12587-46-1	GROSS ALPHA	2.6E-01 +/- 2.4E-01	3.9E-01	3E+00	NA	U

Comments: This sample was filtered prior to analysis.

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

M - Requested MDC not met.

B - Analyte concentration greater than MDC.

B3 - Analyte concentration greater than MDC but less than Requested MDC.

DL - Decision Level

Data Package ID: GA1705202-2

Date Printed: Friday, May 26, 2017

ALS -- Fort Collins

LIMS Version: 6.842

Page 1 of 1

12 of 329

Gross Beta by GFPC

PAI 724 Rev 12

Method Blank Results

Lab Name: ALS -- Fort Collins

Work Order Number: 1705202

Client Name: COGCC

ClientProject ID: PW NORM 2017 10048

Lab ID: AB170511-1MB

Sample Matrix: WATER

Prep SOP: PAI 702 Rev 20

Date Collected: 11-May-17

Date Prepared: 11-May-17

Date Analyzed: 12-May-17

Prep Batch: AB170511-1

QCBatchID: AB170511-1-1

Run ID: AB170511-1A

Count Time: 1000 minutes

Final Aliquot: 200 ml

Result Units: pCi/l

File Name: abc0512b

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
12587-47-2	GROSS BETA	-2.4E-01 +/- 6.3E-01	1.06E+00	4E+00	NA	U

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

M - Requested MDC not met.

B - Analyte concentration greater than MDC.

B3 - Analyte concentration greater than MDC but less than Requested MDC.

DL - Decision Level

Data Package ID: AB1705202-1

Gross Alpha(Co-Precipitation) Analysis by GFPC

PAI 724 Rev 12

Laboratory Control Sample(s)

Lab Name: ALS -- Fort Collins

Work Order Number: 1705202

Client Name: COGCC

ClientProject ID: PW NORM 2017 10048

Lab ID: GA170511-1LCS

Sample Matrix: WATER

Prep SOP: PAI 786 Rev 7

Date Collected: 11-May-17

Date Prepared: 11-May-17

Date Analyzed: 12-May-17

Prep Batch: GA170511-1

QCBatchID: GA170511-1-1

Run ID: GA170511-1A

Count Time: 30 minutes

Final Aliquot: 500 ml

Result Units: pCi/l

File Name: aba0512a

CASNO	Target Nuclide	Results +/- 2s TPU	MDC	Spike Added	% Rec	Control Limits	Lab Qualifier
12587-46-1	GROSS ALPHA	1E+02 +/- 1.8E+01	2E+00	8.920E+01	112	75 - 125	P

Comments: This sample was filtered prior to analysis.

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

LT - Result is less than Requested MDC, greater than sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

L - LCS Recovery below lower control limit.

H - LCS Recovery above upper control limit.

P - LCS Recovery within control limits.

M - The requested MDC was not met.

M3 - The requested MDC was not met, but thereported activity is greater than the reported MDC.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Minimum Detectable Concentration

Data Package ID: GA1705202-2

Date Printed: Friday, May 26, 2017

ALS -- Fort Collins

LIMS Version: 6.842

Page 1 of 2

Gross Beta by GFPC

PAI 724 Rev 12

Laboratory Control Sample(s)

Lab Name: ALS -- Fort Collins

Work Order Number: 1705202

Client Name: COGCC

ClientProject ID: PW NORM 2017 10048

Lab ID: AB170511-1LCS

Sample Matrix: WATER

Prep SOP: PAI 702 Rev 20

Date Collected: 11-May-17

Date Prepared: 11-May-17

Date Analyzed: 12-May-17

Prep Batch: AB170511-1

QCBatchID: AB170511-1-1

Run ID: AB170511-1A

Count Time: 30 minutes

Final Aliquot: 200 ml

Result Units: pCi/l

File Name: abc0512c

CASNO	Target Nuclide	Results +/- 2s TPU	MDC	Spike Added	% Rec	Control Limits	Lab Qualifier
12587-47-2	GROSS BETA	2E+02 +/- 3.5E+01	1.2E+01	2.270E+02	88.0	75 - 125	P,M3

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

LT - Result is less than Requested MDC, greater than sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

L - LCS Recovery below lower control limit.

H - LCS Recovery above upper control limit.

P - LCS Recovery within control limits.

M - The requested MDC was not met.

M3 - The requested MDC was not met, but thereported activity is greater than the reported MDC.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Minimum Detectable Concentration

Data Package ID: AB1705202-1

Gross Alpha(Co-Precipitation) Analysis by GFPC

PAI 724 Rev 12

Laboratory Control Sample(s)

Lab Name: ALS -- Fort Collins

Work Order Number: 1705202

Client Name: COGCC

ClientProject ID: PW NORM 2017 10048

Lab ID: GA170511-1LCSD

Sample Matrix: WATER

Prep SOP: PAI 786 Rev 7

Date Collected: 11-May-17

Date Prepared: 11-May-17

Date Analyzed: 12-May-17

Prep Batch: GA170511-1

QCBatchID: GA170511-1-1

Run ID: GA170511-1A

Count Time: 30 minutes

Final Aliquot: 500 ml

Result Units: pCi/l

File Name: aba0512a

CASNO	Target Nuclide	Results +/- 2s TPU	MDC	Spike Added	% Rec	Control Limits	Lab Qualifier
12587-46-1	GROSS ALPHA	1.04E+02 +/- 1.9E+01	2E+00	8.920E+01	117	75 - 125	P

Comments: This sample was filtered prior to analysis.

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

LT - Result is less than Requested MDC, greater than sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

L - LCS Recovery below lower control limit.

H - LCS Recovery above upper control limit.

P - LCS Recovery within control limits.

M - The requested MDC was not met.

M3 - The requested MDC was not met, but thereported activity is greater than the reported MDC.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Minimum Detectable Concentration

Data Package ID: GA1705202-2

Date Printed: Friday, May 26, 2017

ALS -- Fort Collins

LIMS Version: 6.842

Page 2 of 2

16 of 329

Gross Alpha(Co-Precipitation) Analysis by GFPC

PAI 724 Rev 12

Duplicate Sample Results (DER)

Lab Name: ALS -- Fort Collins

Work Order Number: 1705202

Client Name: COGCC

ClientProject ID: PW NORM 2017 10048

Field ID:	
Lab ID:	GA170511-1LCSD

Sample Matrix: WATER

Prep SOP: PAI 786 Rev 7

Date Collected: 11-May-17

Date Prepared: 11-May-17

Date Analyzed: 12-May-17

Prep Batch: GA170511-1

QCBatchID: GA170511-1-1

Run ID: GA170511-1A

Count Time: 30 minutes

Final Aliquot: 500 ml

Prep Basis: Filtered

Moisture(%): NA

Result Units: pCi/l

File Name: aba0512a

CASNO	Analyte	Sample				Duplicate				DER	DER Lim
		Result +/-	2 s TPU	MDC	Flags	Result +/-	2 s TPU	MDC	Flags		
12587-46-1	GROSS ALPHA	1E+02 +/-	1.8E+01	2E+00	P	1.04E+02 +/-	1.9E+01	2E+00	P	0.167	2

Comments: This sample was filtered prior to analysis.

Duplicate Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.

Y2 - Chemical Yield outside default limits.

W - DER is greater than Warning Limit of 1.42

D - DER is greater than Control Limit of 2

LT - Result is less than Request MDC, greater than sample specific MDC

M - Requested MDC not met.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

L - LCS Recovery below lower control limit.

H - LCS Recovery above upper control limit.

P - LCS, Matrix Spike Recovery within control limits.

N - Matrix Spike Recovery outside control limits

Abbreviations:

TPU - Total Propagated Uncertainty

DER - Duplicate Error Ratio

BDL - Below Detection Limit

NR - Not Reported

Data Package ID: GA1705202-2

Section 4

INDIVIDUAL SAMPLE RESULTS



Gross Alpha(Co-Precipitation) Analysis by GFPC

PAI 724 Rev 12

Sample Results

Lab Name: ALS -- Fort Collins

Work Order Number: 1705202

Client Name: COGCC

ClientProject ID: PW NORM 2017 10048

Field ID: 439136

Lab ID: 1705202-1

Sample Matrix: WATER

Prep SOP: PAI 786 Rev 7

Date Collected: 09-May-17

Date Prepared: 11-May-17

Date Analyzed: 12-May-17

Prep Batch: GA170511-1

QCBatchID: GA170511-1-1

Run ID: GA170511-1A

Count Time: 1000 minutes

Report Basis: Filtered

Final Aliquot: 50.0 ml

Prep Basis: Filtered

Moisture(%): NA

Result Units: pCi/l

File Name: aba0512

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
12587-46-1	GROSS ALPHA	2.71E+02 +/- 4.4E+01	3E+00	3E+00	NA	M3

Comments: This sample was filtered prior to analysis.

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

Data Package ID: GA1705202-2

Gross Beta by GFPC

PAI 724 Rev 12

Sample Results

Lab Name: ALS -- Fort Collins

Work Order Number: 1705202

Client Name: COGCC

ClientProject ID: PW NORM 2017 10048

Field ID: 439136

Lab ID: 1705202-1

Sample Matrix: WATER

Prep SOP: PAI 702 Rev 20

Date Collected: 09-May-17

Date Prepared: 11-May-17

Date Analyzed: 12-May-17

Prep Batch: AB170511-1

QCBatchID: AB170511-1-1

Run ID: AB170511-1A

Count Time: 1000 minutes

Report Basis: Unfiltered

Final Aliquot: 10.0 ml

Prep Basis: Unfiltered

Moisture(%): NA

Result Units: pCi/l

File Name: abc0512b

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
12587-47-2	GROSS BETA	9.6E+01 +/- 2.3E+01	2.5E+01	4E+00	NA	M3

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

Data Package ID: AB1705202-1

Section 5

RAW DATA

5

Gross Beta by GFPC Raw Data Report

Laboratory Name: ALS -- Fort Collins

Prep SOP: PAI 702

Reported on: Wednesday, May 24, 2017

PAI Work Order: 1705202

Analytical SOP: PAI 724

3:46:08 PM

Sample ID QC Type	Nuclide Type	Sample Date/Time	Prep Batch QC Batch ID	Ingrowth Date /Time	Decay Date/Time	Matrix %Moist.	Samp Aliq Analy Aliq	Inst ID Det ID	AnRunID File Name	Count Date/Time	GrossCPM BkgCPM	BaseEff ProgEff	CntDur(min) Yield	Activity +/- 2 s TPU	MDC DeclEv	ReportUnits ReportBasis	DER RPD	%Spk. Recov Flags
1705202-1	GROSS BETA	5/9/2017	AB170511-1	NA	NA	WATER	10 ml	LB4100-c	AB170511-1A	5/12/2017	2,254	41.19%	1000	9.6E+01	2.5E+01	pCi/l	NA	M3
	SNMP	12:50:00 PM	AB170511-1-1	NA	NA	NA	10 ml	A1	abc0512b	2:05 PM	1,446	NA	NA	2.3E+01		Unfiltered	NA	M3
AB170511-1	GROSS BETA	5/11/2017	AB170511-1	NA	NA	WATER	200 ml	LB4100-c	AB170511-1A	5/12/2017	1,454	40.88%	1000	-2.4E-01	1.08E+00	pCi/l	NA	U
MB	Trg. Analyte	7:15:30 AM	AB170511-1-1	NA	NA	NA	200 ml	A4	abc0512b	2:05 PM	1,495	NA	NA	6.3E-01		Unfiltered	NA	U
AB170511-1	GROSS BETA	5/11/2017	AB170511-1	NA	NA	WATER	200 ml	LB4100-c	AB170511-1A	5/12/2017	39,400	40.49%	30	2E+02	1.2E+01	pCi/l	NA	88.0
LCS	Trg. Analyte	7:15:30 AM	AB170511-1-1	NA	NA	NA	200 ml	B1	abc0512c	1:56 PM	1,589	NA	NA	3.5E+01		Unfiltered	NA	P,M3

Comments:

Data Package ID: AB1705202-1

Qualifiers/Flags:

U - Result is less than the sample specific MDC.
Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.
Y2 - Chemical Yield outside default limits.
W - DER is greater than Warning Limit of 1.42
D - DER is greater than Control Limit of 2
+ - Duplicate RPD not within limits.
LT - Result is less than Request MDC, greater than sample specific MDC
* - Aliquot Basis is 'As Received' while the Report Basis is 'Dry Weight'.
- Aliquot Basis is 'Dry Weight' while the Report Basis is 'As Received'.

M - Requested MDC not met.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

L - LCS Recovery below lower control limit.

H - LCS Recovery above upper control limit.

P - LCS, Matrix Spike Recovery within control limits.

N - Matrix Spike Recovery outside control limits

NC - Not Calculated for duplicate results less than 5 times MDC

B - Analyte concentration greater than MDC.

B3 - Analyte concentration greater than MDC but less than Requested MDC.

Notes:

1) The Tracer results are not yield corrected (i.e. activity measured not activity added).
2) Where sample time is not available, 12:00 PM (Mountain) is used for decay correction.

Abbreviations:

TR- Tracer TA - Target Analyte

TPU - Total Propagated Uncertainty

MDC - Minimum Detectable Concentration

DER - Duplicate Error Ratio

BDL - Below Detection Limit

Date Printed: Thursday, May 25, 2017

ALS -- Fort Collins

LIMS Version: 6.842

Page 1 of 1

Gross Alpha(Co-Precipitation) Analysis by GFPC Raw Data Report

Laboratory Name: ALS -- Fort Collins

Prep SOP: PAI 786

Reported on: Thursday, May 25, 2017

PAI Work Order: 1705202

Analytical SOP: PAI 724

9:25:00 AM

Sample ID QC Type	Nuclide Type	Sample Date/Time	Prep Batch QC Batch ID	Ingrowth Date /Time	Decay Date/Time	Matrix %Moist.	Samp Aliq Analy Aliq	Inst ID Det ID	AnlRunID File Name	Count Date/Time	GrossCPM BkgCPM	BaseEff ProgEff	CntDur(min) Yield	Activity +/- 2 s TPU	MDC DeclEv	ReportUnits ReportBasis	DER RPD	%Spk. Recov Flags
1705202-1	GROSS ALPHA	5/9/2017	GA170511-1	NA	NA	WATER	50 ml	LB4100-a	GA170511-1A	5/12/2017	4.286	23.77%	1000	2.71E+02	3E+00	pCi/l	NA	M3
	SNMP	12:50:00 PM	GA170511-1-1	NA	NA	NA	50 ml	B1	aba0512	2:05 PM	0.106	NA	NA	4.4E+01		Filtered	NA	M3
GA170511-1	GROSS ALPHA	5/11/2017	GA170511-1	NA	NA	WATER	500 ml	LB4100-a	GA170511-1A	5/12/2017	0.216	22.45%	1000	2.6E-01	3.9E-01	pCi/l	NA	U
	MB	8:01:00 AM	GA170511-1-1	NA	NA	NA	500 ml	B4	aba0512	2:05 PM	0.173	NA	NA	2.4E-01		Filtered	NA	U
GA170511-1	GROSS ALPHA	5/11/2017	GA170511-1	NA	NA	WATER	500 ml	LB4100-a	GA170511-1A	5/12/2017	16.633	22.69%	30	1E+02	2E+00	pCi/l	NA	112
	LCS	8:01:00 AM	GA170511-1-1	NA	NA	NA	500 ml	C1	aba0512a	1:56 PM	0.128	NA	NA	1.8E+01		Filtered	NA	P
GA170511-1	GROSS ALPHA	5/11/2017	GA170511-1	NA	NA	WATER	500 ml	LB4100-a	GA170511-1A	5/12/2017	17.900	23.49%	30	1.04E+02	2E+00	pCi/l	0.17	117
	LCSD	8:01:00 AM	GA170511-1-1	NA	NA	NA	500 ml	C3	aba0512a	1:56 PM	0.103	NA	NA	1.9E+01		Filtered	NA	P

Comments:

Data Package ID: GA1705202-2

Qualifiers/Flags:

U - Result is less than the sample specific MDC.
Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.
Y2 - Chemical Yield outside default limits.
W - DER is greater than Warning Limit of 1.42
D - DER is greater than Control Limit of 2
+ - Duplicate RPD not within limits.
LT - Result is less than Request MDC, greater than sample specific MDC
* - Aliquot Basis is 'As Received' while the Report Basis is 'Dry Weight'.
- Aliquot Basis is 'Dry Weight' while the Report Basis is 'As Received'.

M - Requested MDC not met.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

L - LCS Recovery below lower control limit.

H - LCS Recovery above upper control limit.

P - LCS, Matrix Spike Recovery within control limits.

N - Matrix Spike Recovery outside control limits

NC - Not Calculated for duplicate results less than 5 times MDC

B - Analyte concentration greater than MDC.

B3 - Analyte concentration greater than MDC but less than Requested MDC.

Notes:

1) The Tracer results are not yield corrected (i.e. activity measured not activity added).
2) Where sample time is not available, 12:00 PM (Mountain) is used for decay correction.

Abbreviations:

TR- Tracer TA - Target Analyte

TPU - Total Propagated Uncertainty

MDC - Minimum Detectable Concentration

DER - Duplicate Error Ratio

BDL - Below Detection Limit

Date Printed: Friday, May 26, 2017

ALS -- Fort Collins

LIMS Version: 6.842

Page 1 of 1

PAI - Gas Flow Proportional Sample Analysis LB4100-A

Unit Type: LB4100-A/W
 Counting Unit ID: Orange
 High Voltage Mode: Simultaneous
 Application Revision: C
 Application Version: PA
 Rev: 05/08/13 JP

Data File Name: ABA0512
 Batch ID: GA170511-1
 Count Preset (m): 1000
 Batch Endet: 5/13/17 6:38

Background logfile: BKGABW
 Date of Bkg. Cal: 5/10/17
 Alpha efficiency logfile: Tlb-230-12/16
 Alpha attenuation calibration: ACP0415
 Beta efficiency logfile: CS137-12/16
 Beta attenuation calibration: ACS207

Alpha prog. logfile: n/a
 Alpha prog. attenuation: n/a
 Beta prog. logfile: n/a
 Beta prog. attenuation: n/a

Alpha Attenuation Calibration $y = b'm' (a'/(mass-x'))$		Beta Attenuation Calibration $y = b'm' (a'/(mass-x'))$	
Alpha b=	0.98100	Beta b=	0.9455
m=	0.98590	m=	0.9886
a=	0.8971	a=	1.0026
x0=	0.0000	x0=	0.0008
Alpha to Beta X-talk		Beta to Alpha X-talk	
a → b xtalk m=	0.2333	b → a xtalk m=	1.618E-06
a → b xtalk m=	0.9968	b → a xtalk m=	0.0027

Det. ID	Sample ID	Count		Resid.	Alpha Activity										Beta Activity									
		Date & Time	Dur. (min)		Gross CPM	Bkg. CPM	b>a xtlk CPM	Base Eff	Cor.Fact.	Progeny Eff	Progeny Cor.Fact.	Gross CPM	Bkg. CPM	a>b xtlk CPM	Base Eff	Cor.Fact.	Progeny Eff	Progeny Cor.Fact.						
B1	1705202-1	5/13/17 6:38	1000.00	43.9	4.285	0.106	0.013	0.2377	0.584	n/a	n/a	5.563	2.033	1.1254	0.4271	0.889	n/a	n/a						
B3	1705203-1	5/13/17 6:38	1000.00	38.0	1.854	0.129	0.005	0.2320	0.626	n/a	n/a	3.426	2.000	0.4557	0.4171	0.896	n/a	n/a						
B4	GA170511-1MB	5/13/17 6:36	1000.00	33.4	0.216	0.173	0.000	0.2245	0.661	n/a	n/a	1.905	1.911	0.0112	0.3964	0.902	n/a	n/a						

TS/25/17
 TS/25/17

PAI - Gas Flow Proportional Sample Analysis LB4100-A

Unit Type: LB4100-4W
 Counting Unit ID: Orange
 High Voltage Mode: Simultaneous
 Application Revision: C
 Rev:05/09/13 JP

Data file name: ABA0512A
 Batch ID: GA170511-1
 Count Preset (m): 30
 Batch Ended: 5/12/17 14:24

Background logfile: BKGABW
 Date of Bkg. Cal: 5/10/17
 Alpha efficiency logfile: 1b-230-12/16
 Alpha attenuation calibration: AC-P0415
 Beta efficiency logfile: C-137-12/16
 Beta attenuation calibration: AC-57207

Alpha Attenuation Calibration		Beta Attenuation Calibration	
$y = b'm^a \cdot e^{(mass \cdot x)}$		$y = b'm^a \cdot e^{(mass \cdot x)}$	
Alpha b=	0.98100	Beta b=	0.9415
m=	0.98690	m=	0.9986
a=	0.8971	a=	1.0026
x0=	0.0000	x0=	0.0000
Alpha to Beta Xtalk		Beta to Alpha Xtalk	
$y = b'm^a \cdot x$		$y = b'm^a \cdot x$	
a -> b xtalk=	0.2339	b -> a xtalk=	1.618E-06
a -> b xtalk m=	0.99168	b -> a xtalk m=	0.0037

Det. ID	Sample ID	Count End	Date & Time	Dur. (min)	Resid. Mass (mg)	Alpha Activity						Beta Activity					
						Gross CPM	Bkg. CPM	b>a xtlk CPM	Base Eff	Base Cor.Fact.	Progeny Eff	Progeny Cor.Fact.	Gross CPM	Bkg. CPM	a>b xtlk CPM	Base Eff	Base Cor.Fact.
C1	GA170511-1LCS	5/12/17 14:24	30.00	33.9	34.1	16833	0.128	0.017	0.2269	0.857	n/a	n/a	6509	1.891	4.3037	0.3974	0.902
C3	GA170511-1LCSD	5/12/17 14:24	30.00	34.1	34.1	17900	0.103	0.017	0.2349	0.655	n/a	n/a	6200	1.794	4.6435	0.4191	0.901

7/15/25/17
 7/15/25/17

Date 5/12/17SOP 724r 12

ALS
Low Background Gas Flow Proportional Counter Log
Instrument: LB4100/A JICS 5/12/17

Instrument Daily Response and Background Checks

Det.	Daily Response Check				Background Check				Det. Status
	Start 1	Status	Start 2	Status	Start 1	Status	Start 2	Status	
1	JICS	P			JICS	P			P
2	↓				↓				↓
3									
4									
5									↓
6									OL
7		H2	JCS	P					P
8		P							↓
9									↓
10									OL
11									P
12	↓	↓			↓	↓			OL
13	OL				OL				↓
14	↓				↓				↓
15									
16	↓				↓				↓

Det = Detector; α = Alpha; β = Beta; P = Pass; H = High; L = Low; OL = Offline; R = Recount; W = Weekly; NP = Not Processed

Weekly Background Calibration

	Current Calib. File ID	Weekly Calib. Started	Status	File ID
Dr A	BKPA0509W			
Dr B	↓			
Dr C				
Dr D	OL			

Dr = Drawer

Gas Supply

	P-10 Supply		P-10 Flow
Tank 1	1700	Dr A	10
	↓	Dr B	
Tank 2	2000	Dr C	
	↓	Dr D	

Comments:

Date 5/12/17SOP 724r 12

ALS

Low Background Gas Flow Proportional Counter Log

Instrument: LB4100A

Det.	Sample ID	Batch	Test	Count Dur. (min)	Start Time	Analyst Initials	File ID	Output Initials
1-12	Daily Eff	—	—	30	705	JCB	EFA0512	JCB
9	daily eff	—	—	30	727	J	EFA0512A	J
1-12	Daily Bkgd	—	—	60	749	JCB	BKA0512	J
1-57	17162006-1-19	TR170420-1	Total/24h	30	9.11	JN	ATRO512, A	
8, 9, 11	↓	↓	Mass/Attn	↓	↓	↓	↓	↓
5	1705202-1	GA170511-1	2	1000	1352	JCB	ABA0512	JCB
7	1705203-1	↓	↓	↓	↓	↓	↓	↓
8	GA170511-1MB	↓	↓	↓	↓	↓	↓	↓
9	↓ LUS	↓	↓	30	1354	↓	ABA0512A	↓
11	↓ LUS	↓	↓	↓	↓	↓	↓	↓
1	1704600-1	GA1704303	2	60	1406	↓	ABA0512B	↓
2	↓ 2	↓	↓	↓	↓	↓	↓	↓
3	↓ 3	↓	↓	↓	↓	↓	↓	↓
4	↓ 4	↓	↓	↓	↓	↓	↓	↓
9	↓ 5	↓	↓	↓	↓	↓	ABA0512C	↓
11	↓ 6	↓	↓	↓	↓	↓	↓	↓
<div>5/13/17</div>								

Comments:

Page No.: 472219 **B**
(cont. from page NA B)

Form 780r8.doc (6/23/06)

Reviewed By / Date JCB 5/13/17

27 of 329

PAI - Gas Flow Proportional Sample Analysis LB4100-C

Unit Type: LB4100 -C
 Counting Unit ID: Magenta
 High Voltage Mode: Simultaneous
 Application Revision:
 Application Version: Standard
 Rev.12/01/08 JCP

Data file name: ABC05128
 Batch ID: AB170511-1
 Count Preset (m): 1000
 Batch Ended: 5/13/2017 6:39

Background logfile: BKGABW
 Date of Bkg. Cal: 5/10/2017
 Alpha efficiency logfile: TH230-06/15
 Alpha attenuation calibration: ATH0609_0610A
 Beta efficiency logfile: Cs-137-06/15
 Beta attenuation calibration: ACS0608_0608A

Alpha prog. logfile: n/a
 Alpha prog. attenuation: n/a
 Beta prog. logfile: n/a
 Beta prog. attenuation: n/a

Det. ID	Sample ID	Count Date & Time	Count Dur. (min)	Resid. Mass (mg)	Alpha Activity				Beta Activity			
					Gross CPM	Bkg. CPM	b>a xtlk CPM	Base Eff	Progeny Eff	Base Cor.Fact	Progeny Cor.Fact	Progeny Eff
A1	1705202-1	5/13/2017 6:39	1000.00	162.6	0.369	0.090	0.000	0.2345	0.198	0.4119	0.807	n/a
A2	1705203-1	5/13/2017 6:39	1000.00	145.6	0.162	0.113	0.000	0.2280	0.230	0.4183	0.823	n/a
A3	1705203-1D	5/13/2017 6:39	1000.00	142.4	0.166	0.096	0.000	0.2309	0.236	0.4102	0.826	n/a
A4	AB170511-1MB	5/13/2017 6:39	1000.00	25.7	0.074	0.092	0.000	0.2370	0.652	0.4088	0.947	n/a

Alpha Attenuation Calibration				Beta Attenuation Calibration			
$y = b \cdot m^{-1} (e^{-1}(\text{mass} \cdot x))$				$y = b \cdot m^{-1} (e^{-1}(\text{mass} \cdot x))$			
Alpha b=				Beta b=			
m=				m=			
a=				a=			
x0=				x0=			
Alpha to Beta X-talk				Beta to Alpha X-talk			
$y = b \cdot m^{-1} \cdot \text{mass}$				$y = b \cdot m^{-1} \cdot \text{mass}$			
a->b xtlk b=				b->a xtlk b=			
a->b xtlk m=				b->a xtlk m=			

05/25/17
 7/5/17-1/17

PAI - Gas Flow Proportional Sample Analysis LB4100-C

Unit Type: LB4100 -C
Counting Unit ID: Magenta
High Voltage Mode: Simultaneous
Application Revision: Standard
Rev.12/01/08 JCP

Data file name: ABC0512C
Batch ID: AB170511-1
Count Preset (m): 30
Batch Ended: 5/12/2017 14:27

Background logfile: BKGABW
Date of Bkg. Cal: 5/10/2017
Alpha efficiency logfile: TH230-06/15
Alpha attenuation calibration: ATH0609_0610
Beta efficiency logfile: Cs-137-06/15
Beta attenuation calibration: ACS0606_0608

Alpha prog. logfile: n/a
Alpha prog. attenuation: n/a
Beta prog. logfile: n/a
Beta prog. attenuation: n/a

Alpha Attenuation Calibration	Beta Attenuation Calibration
$y = b'm^a(e^{(mass \cdot x)})$	$y = b'm^a(e^{(mass \cdot x)})$
Alpha b= 0.81480	Beta b= 0.5764
m= 0.99020	m= 0.9988
a= 0.8822	a= 0.9758
x0= 0.0000	x0= 0.0000
Alpha to Beta X-talk $y = b'm^a \cdot mass$	Beta to Alpha X-talk $y = b'm^a \cdot m$
a->b xtalk b= 0.2652	b->a xtalk b= -1.07E-07
a->b xtalk m= 0.9981	b->a xtalk m= 0.0004

Det. ID	Sample ID	Count End Date & Time	Count Dur. (min)	Resid. Mass (mg)	Alpha Activity						Beta Activity					
					Gross CPM	Bkg. CPM	b>a xtalk CPM	Base Eff	Progeny Eff	Base Cor.Fact.	Gross CPM	Bkg. CPM	a>b xtalk CPM	Base Eff	Progeny Eff	Base Cor.Fact.
B1	AB170511-1LCS	5/12/2017 14:27	30.00	28.9	14.067	0.095	0.015	0.2254	0.634	n/a	39.400	1.589	3.9146	0.4049	n/a	n/a

JS 5/25/17
JS 5/25/17
JS 5/25/17

Date 5/12/17

SOP 724L.12

ALS
Low Background Gas Flow Proportional Counter Log
Instrument: LB4100C

Instrument Daily Response and Background Checks

Det.	Daily Response Check				Background Check				Det. Status
	Start 1	Status	Start 2	Status	Start 1	Status	Start 2	Status	
1	7/17	P			7/17	P			P
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									

Det = Detector; α = Alpha; β = Beta; P = Pass; H = High; L = Low; OL = Offline; R = Recount; W = Weekly; NP = Not Processed

Weekly Background Calibration

	Current Calib. File ID	Weekly Calib. Started	Status	File ID
Dr A	BK0509 W			
Dr B				
Dr C				
Dr D				

Dr = Drawer

Gas Supply

P-10 Supply		P-10 Flow	
Tank 1	1200	Dr A	10
	↓	Dr B	↓
Tank 2	2000	Dr C	
	↓	Dr D	↓

Comments:

Date 5/12/17

SOP 724r 12

ALS
Low Background Gas Flow Proportional Counter Log
Instrument: LB4100C

Det.	Sample ID	Batch	Test	Count Dur. (min)	Start Time	Analyst Initials	File ID	Output Initials
-1b	Daily Eff	—	—	30	7:30	JCB	EFCOS12	JCB
-1b	Daily Bkgd	—	—	60	7:42	JCB	BK120512	JCB
1	1705549-1	RA170545	RA225	90	9:18		RACOS12	JCB
2	↓ 2							
3	↓ 3							
4	1704551-1							
5	↓ 2							
6	↓ 3							
7	1704553-1							
8	↓ 2							
9	↓ 3							
10	1704554-1							
11	↓ 2							
13	↓ 3							
14	RA170545 MB							
15	↓ 125							
16	↓ 125							
1	1705153-8	MB170510-12	MB	30	11:59	JCB	MB COS12	
2	↓ -9							
4	↓ -80							
1	1705202-1	MB170511-1		1000	13:54		MB COS12 A	JCB
2	1705203-1						MB COS12 B	
3	↓ -10							
4	MB170511-1 MB							
5	↓ 125			30	13:57		MB COS12 C	

JCB/RFH

Comments:

Page No.: 471456

B

(cont. from page 471455)

B)

Form 780r8.doc (6/23/06)

Reviewed By / Date

JCB 5/13/17

31 of 329

Section 6

QUALITY ASSURANCE SUMMARY REPORTS

6

No *NON-CONFORMANCE REPORTS* or *QUALITY ASSURANCE SUMMARY SHEETS* are included in this data package.

Section 7

LABORATORY BENCH SHEETS



Radiochemistry Instrument Worksheet

ALS -- Fort Collins

Prep Batch: AB170511-1

Prep Procedure: GROSS_BETA

1000~in

Analytical QASS / NCR? Y / NA

Prep Num	LabID	QC Type	Init Aliq	Fin Aliq	Units	Report Units	Residual Mass (mg)	Cnt 1 File	Cnt 1 Inst/Det	Cnt 1 Pos Chk By	Cnt 2 File	Cnt 2 Inst/Det	Cnt 2 Pos Chk By	Cnt 3 File	Cnt 3 Inst/Det	Cnt 3 Pos Chk By	Notes
1	1705202-1	SMP	10	10	ml	pCi/l	162.6	AB170511-1	7up								
1	1705203-1	SMP	10	10	ml	pCi/l	145.6	2									
1	1705203-1	DUP	10	10	ml	pCi/l	142.4	3									
1	AB170511-1	MB	200	200	ml	pCi/l	25.7	4									
1	AB170511-1	LCS	200	200	ml	pCi/l	28.9	MB170511-1	7up								

Spike Solution Information

Soln #	Nuclide	SolnID	Exp Date	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	Cs-137	1013.4095.77	12/29/17	100.828	DPM/ml	05/11/17	1	ml	RS-033
S2	Th-230	760.4243.03	4/23/18	98.994	DPM/ml	05/11/17	1	ml	RS-033

Sample Barcodes

1705202-1 AB170511-1PS1		1705203-1 AB170511-1PS2	
AB170511-1MB AB170511-1PS4		AB170511-1LCS AB170511-1PS5	

Reporting Units

LabID	TstGrpName	RptUnits
1705203-1	GrossB_96h_COGCC Co-pre	pCi/l
1705202-1	GrossB_96h_COGCC Co-pre	pCi/l

Radiochemistry Prep Worksheet

ALS -- Fort Collins

Prep Batch: AB170511-1

Prep Procedure: GROSS_BETA

Reviewed By: rim *rw* Review Date: 5/11/2017

Non-Routine Pre-Treatment? ☒ Batch: *NA* Re-Prep? ☒ Batch: *NA* Prep QASS / NCR? ☒ Y / *NA*

Prep SOP: PAI 702 Rev: 20

Prep SOP: NONE

Matrix Class: liquid

Prep Analyst: Rebecca L. Merola

Prep Date: 5/11/2017

Prep Dept: RS

Balance: 13

Balance: na

Samp Num	Prep Num	LabID	QC Type	Dish No.	Init Alq ml	Fin Alq ml	Prep Basis	Standards	Prep Notes
1	1	1705202-1	SMP		10	10	Unfiltered		
2	1	1705203-1	SMP		10	10	Unfiltered		
3	1	1705203-1	DUP		10	10	Unfiltered		
4	1	AB170511-1	MB		200	200	Unfiltered		
5	1	AB170511-1	LCS		200	200	Unfiltered	S1, S2	

Comments

COGCC

Spiked By: Rebecca L. Merola Date: 5/11/2017

Witnessed By: Hunter C. Jordan Date: 5/11/2017

Spike Solution Information									
Soln #	Nuclide	SolnID	Exp Date	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	Cs-137	1013.4095.77		100.828	DPM/ml	05/11/17	1	ml	RS-033
S2	Th-230	760.4243.03		98.994	DPM/ml	05/11/17	1	ml	RS-033

Radiochemistry Prep Worksheet

ALS -- Fort Collins

Prep Batch: AB170511-1

Prep Procedure: GROSS_BETA

Prep Batch Not Validated!!!

Reviewed By:

Review Date:

Non-Routine Pre-Treatment? Y / N Batch: Re-Prep? Y / N Prep QASS / NCR? Y / N

Prep SOP: PAI 702 Rev: 20

Prep Analyst: Rebecca L. Merola

Balance: 13

Prep Date: 5/11/2017

Balance: na

Matrix Class: liquid

Prep Dept: RS

Samp Num	Prep Num	LabID	QC Type	Dish No.	Init Aliq ml	Fin Aliq ml	Prep Basis	Standards	Prep Notes
1	1	1705202-1	SMP	0	0	0	Unfiltered		
2	1	1705203-1	SMP	0	0	0	Unfiltered		
3	1	1705203-1	DUP	0	0	0	Unfiltered		
4	1	AB170511-1	MB	0	0	0	Unfiltered		
5	1	AB170511-1	LCS	0	0	0	Unfiltered	S1,S2	

Comments

COGCC

Spiked By: m Date: 5/11/17

Witnessed By: HCS Date: 5-11-17

Spike Solution Information									
Soln #	Nuclide	SolnID	Exp Date	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	Cs-137	1013.4095.77	12-29-17	100.828	DPM/ml	05/11/17	1	ml	RS-033
S2	Th-230	760.4243.03	4-27-18	98.994	DPM/ml	05/11/17	1	ml	RS-033

Radiochemistry Gravimetric Worksheet

ALS -- Fort Collins

Prep Batch: AB170511-1

Prep Procedure: GROSS_BETA

Reviewed By: rlm Review Date: 5/11/2017

Prep Num	Planc. Num	LabID	QC Type	Test Alq (ml)	Tare Mass (g)	Initial Gross Mass (g)	Initial Net Mass (mg)	Suggested Alq (ml)	Samp Vol Available (ml)	Samp Vol Taken (ml)	Fin Gross Mass (g)	Final Net Mass (mg)	Salt Sol. Added (ml)	Flag
1	1	1705202-1	SMP	10	9.3908	9.5534	162.6	5	200	10	9.5534	162.6	0	
1	2	1705203-1	SMP	10	9.4280	9.5736	145.6	5	200	10	9.5736	145.6	0	
1	3	1705203-1	DUP	10	9.3631	9.5055	142.4	5	200	10	9.5055	142.4	0	
1	4	AB170511-1	MB	0	9.4136	9.4137	0.1	0	200	200	9.4393	25.7	0.5	
1	5	AB170511-1	LCS	0	9.3997	9.3998	0.1	0	200	200	9.4286	28.9	0.5	

Sample Condition Form (Liquid)

Analyst: *lv*

Analysis Date: 5/11/17

Method: Prep

	Sample Condition (Visual Appearance of Analysis Aliquot at Time of Prep)
--	--

Work Order	Sample ID	pH	Color	Remarks
1705202	1	12.0	colorless	bleach precip
1705203	1	↓	↓	oily
<div style="transform: rotate(-45deg);"> RM 5/11/17 </div>				

Radiochemistry Instrument Worksheet

ALS -- Fort Collins

Prep Batch: GA170511-1

Prep Procedure: GR_ALPH_CO

1000 min

Analytical QASS / NCR? Y / NA

Prep Num	LabID	QC Type	Init Aliq	Fin Aliq	Units	Report Units	Residual Mass (mg)	Cnt 1 File	Cnt 1 Inst/Det	Cnt 1 Pos Chk By	Cnt 2 File	Cnt 2 Inst/Det	Cnt 2 Pos Chk By	Cnt 3 File	Cnt 3 Inst/Det	Cnt 3 Pos Chk By	Notes
1	1705202-1	SMP	50	50	ml	pCi/l	43.9	AB170511-1	5	705							
1	1705203-1	SMP	50	50	ml	pCi/l	38		7								
1	GA170511-1	MB	500	500	ml	pCi/l	33.4		8								
1	GA170511-1	LCS	500	500	ml	pCi/l	33.9	AB170511-1	9	705							
1	GA170511-1	LCSD	500	500	ml	pCi/l	34.1		11								

Spike Solution Information									
Soln #	Nuclide	SolnID	Exp Date	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	Th-230	760.4243.03	4/23/18	98.994	DPK/ml	05/11/17	1	ml	RS-033

Sample Barcodes

1705202-1 GA170511-1PS1		1705203-1 GA170511-1PS2		GA170511-1MB GA170511-1PS3	
GA170511-1LCS GA170511-1PS4		GA170511-1LCSD GA170511-1PS5			

Reporting Units

LabID	TstGrpName	RptUnits
1705203-1	GrossA_96h_COGCC Co-pre	pCi/l
1705202-1	GrossA_96h_COGCC Co-pre	pCi/l

Radiochemistry Prep Worksheet

ALS -- Fort Collins

Prep Batch: GA170511-1

Prep Procedure: GR_ALPHA_CO

Reviewed By: rim

Review Date: 5/11/2017

Non-Routine Pre-Treatment? Y ☒ Batch: NA Re-Prep? Y ☒ Prep QASS / NCR? Y ☒ NA

Prep SOP: PAI 786 Rev: 7

Prep SOP: NONE

Matrix Class: liquid

Prep Analyst: Rebecca L. Merola

Prep Date: 5/11/2017

Prep Dept: RS

Balance: 13

Balance: na

Samp Num	Prep Num	LabID	QC Type	Dish No.	Init Aliq ml	Fin Aliq ml	Prep Basis	Standards	Prep Notes
1	1	1705202-1	SMP		50	50	Filtered		
2	1	1705203-1	SMP		50	50	Filtered		
3	1	GA170511-1	MB		500	500	Filtered		
4	1	GA170511-1	LCS		500	500	Filtered	S1	
5	1	GA170511-1	LCS		500	500	Filtered	S1	

Comments

COGCC

Spiked By: Rebecca L. Merola Date: 5/11/2017

Witnessed By: Hunter C. Jordan Date: 5/11/2017

Spike Solution Information						
Soln #	Nuclide	SolnID	Exp Date	Prep Conc	Units	Pipet ID
S1	Th-230	760.4243.03	4/23/18	98.994	DPM/ml	05/11/17
					1	mi
						RS-033

Radiochemistry Prep Worksheet

ALS -- Fort Collins

Prep Batch: GA170511-1

Prep Procedure: GR_ALPH_CO

Prep Batch Not Validated!!!

Reviewed By:

Review Date:

Non-Routine Pre-Treatment? Y / N Batch: Re-Prep? Y / N Batch: Prep QASS / NCR? Y / N

Prep SOP: PAI 786 Rev: 7

Prep Analyst: Rebecca L. Merola

Balance:

Prep Date: 5/11/2017

Balance:

Matrix Class: liquid

Prep Dept: RS

Sample Num	Prep Num	LabID	QC Type	Dish No.	Init Alq ml	Fin Alq ml	Prep Basis	Standards	Prep Notes
1	1	1705202-1	SMP		50	500	Filtered		
2	1	1705203-1	SMP		50	500	Filtered		
3	1	GA170511-1	MB		50	500	Filtered		
4	1	GA170511-1	LCS		50	500	Filtered	S1	
5	1	GA170511-1	LCSD		50	500	Filtered	S1	

Comments

COGCC

Spiked By: RL Date: 5/11/17

Witnessed By: HCO Date: 5-11-17

Spike Solution Information						
Soln #	Nuclide	SolnID	Exp Date	Prep Conc	Units	Pipet ID
S1	Th-230	760.4243.03	4-23-18	98.994	DPM/ml	05/11/17
					1	ml
						RS-033

Radiochemistry Gravimetric Worksheet

ALS -- Fort Collins

Prep Batch: GA170511-1

Prep Procedure: GR_ALPH_CO

Reviewed By: rlm *rlm* Review Date: 5/11/2017

Prep Num	Planc. Num	LabID	QC Type	Test Alq (ml)	Tare Mass (g)	Initial Gross Mass (g)	Initial Net Mass (mg)	Suggested Alq (ml)	Samp Vol Available (ml)	Samp Vol Taken (ml)	Fin Gross Mass (g)	Final Net Mass (mg)	Salt Sol. Added (ml)	Flag
1	1	1705202-1	SMP	0	9.3578	0.0000	0	0	50	50	9.4017	43.9	0	
1	2	1705203-1	SMP	0	9.3078	0.0000	0	0	50	50	9.3458	38	0	
1	3	GA170511-1	MB	0	9.3783	0.0000	0	0	500	500	9.4117	33.4	0	
1	4	GA170511-1	LCS	0	9.4095	0.0000	0	0	500	500	9.4434	33.9	0	
1	5	GA170511-1	LCSD	0	9.3533	0.0000	0	0	500	500	9.3874	34.1	0	

Sample Condition Form (Liquid)					
Analyst: <i>R</i>					
Analysis Date: <i>5/11/17</i>			Method: <i>Prep</i>		
		Sample Condition (Visual Appearance of Analysis Aliquot at Time of Prep)			
Work Order	Sample ID	pH	Color	Remarks	
<i>1705202</i>	<i>1</i>	<i>~2.0</i>	<i>colorless</i>	<i>black precip. filtered</i>	
<i>1705203</i>	<i>1</i>	<i>↓</i>	<i>↓</i>	<i>oily filtered</i>	
<i>R 5/11/17</i>					

Section 8

STANDARDS TRACEABILITY DOCUMENTS



Prepare a working dilution of 760.3020.08

1. Density of 0.5 M HNO₃ lot # 0000127617
Mass of 100mL vol. flask: 68.2961 g Balance # 12
Mass of flask & 100mL acid: 169.4362 g Balance # 12
Net Mass: 101.1401 g
Density: 1.0114 g/mL

2. Mass of 760.3020.08 transferred:
Mass of open empty nalgene: 74.6548 g Balance # 12
Mass of nalgene & standard: 77.6893 g Balance # 12
Net mass of standard transferred: 3.0345 g

3. Dilute to final volume:
Mass of nalgene, standard, & diluent: 897.2 g Balance # 26
Mass of empty nalgene (from above): 74.6548 g Balance # 12
Net mass of new dilution: 822.5452 g

4. Final activity calculation:

$$26,534.43 \text{ dpm/g} \times 1.0114 \text{ g/mL} \times \frac{3.0345 \text{ g}}{822.5452 \text{ g}} = 99.01 \text{ dpm/mL}$$

Std ID: 760.4243.03

Description: Th-230
Expiration: 5/5/2017
Activity: 99.01 dpm/ml

2s Uncertainty: 3.27 dpm/ml

Ref. Date: 7/13/2004

Ref Time: N/A

Prep Date: 4/7/2016 Prep by: TE

Matrix/Comp. 0.5 M HNO₃

Half Life (y): 7.54E+04

Reverification Log		
Analysis Date	Initials	Expiration Date
04/23/17	JP	04/23/2018

Signed

Date

Signed

Date

Continued on Page _____

Prepare a primary dilution of R50 #760 (Analytical # 68750-307) in 0.5 M HNO_3 to a concentration of approx 30,000 dpm/mL.

1) Prepare 0.5 M HNO_3 by diluting 31 mL of conc. (16M) HNO_3 (EMD lot # 44287) to a final volume of 1000 mL.

2) Determine density of 0.5 M HNO_3

Mass of 100 mL volumetric flask = 66.4289 g (Bal 12)

Mass of flask + 0.5 M HNO_3 = 167.5792 g

Net mass of solution = 101.1503 g ^{11/24/06}

$\div 100 \text{ mL} = \text{density} = 1.0115 \text{ g/mL}$

3) Transfer # 760 to a 40 mL VOA vial.

Mass of bottle w/out lid = 21.5801 g (Bal 12)

Mass of std + bottle

26.5278 g

Net mass of std transferred

4.9477 g

4) Dilute to volume w/ 0.5 M HNO_3

Mass of bottle + std + soln = 61.8912 g (Bal 12)

Mass of bottle (from above)

21.5801 g

Net mass of std.

40.3111 g

5) Final activity calc.

$$\frac{(1.832 \times 10^4 \text{ d/sec}) \left(\frac{1600 \text{ sec}}{1 \text{ min}} \right) (4.9477 \text{ g}) \left(\frac{1}{1.0115 \text{ g/mL}} \right)}{(5.08447) (40.3111 \text{ g})} = 26,534.43 \text{ d/g}$$

Continued on Page

Read and Understood By

Deborah Baker

Signed

1/24/06

Date

[Signature]

Signed

1/27/06

Date



ANALYTICS

RSO# 760 Rec'd 7/14/04 JCB

1380 Seaboard Industrial Blvd.
Atlanta, Georgia 30318 - U.S.A.

Phone (404) 352-8577
Fax (404) 352-2837

CERTIFICATE OF CALIBRATION

Standard Radionuclide Source

68750-307

Th-230 5 mL Liquid in Flame Sealed Vial

This standard radionuclide source was prepared gravimetrically from a calibrated master solution. The master solution was calibrated by liquid scintillation counting.

Radionuclide purity and calibration were checked by germanium gamma-ray spectrometry and liquid scintillation counting. The nuclear decay rate and assay date for this source are given below.

ANALYTICS maintains traceability to the National Institute of Standards and Technology through Measurements Assurance Programs as described in USNRC Reg. Guide 4.15, Revision 1.

ISOTOPE:	Th-230
ACTIVITY (dps):	1.832 Bq
HALF-LIFE:	7.538 Bq years
CALIBRATION DATE:	July 13, 2004 12:00 EST
RELATIVE EXPANDED UNCERTAINTY (k=2):	3.3%

Impurities: γ -impurities <0.1%, α -impurities <0.01%

5.08447 grams 0.5M HNO₃ solution.

P O NUMBER 70635, Item 1

SOURCE PREPARED BY:

M. D. Currie
M. D. Currie, Radiochemist

Q A APPROVED:

A. Currie 7/13/04

Prepare a working dilution of 1013.4095.76

1. Density of 4% HCl, lot # 0000094396
Mass of 100mL vol. flask: 68.5652g
Mass of flask & 100mL acid: 169.0154g
Net Mass: 100.4502g
Density: 1.0045g/mL

Balance # 12
Balance# 12

2. Mass of 1013.4095.76 transferred:
Mass of empty nalgene: 74.1532g
Mass of nalgene & standard 75.4532g
Net mass of standard transferred: 1.3000g

Balance# 12
Balance# 12

3. Dilute to final volume:

Mass of nalgene, standard, & diluent: 1069.7g
Mass of empty nalgene: 74.1532g
Net mass of new dilution: 995.5468g

Balance# 26
Balance# 12

4. Final activity calculation:

$$100,443.61 \text{ dpm/g} (1.0045 \text{ g/mL}) \left(\frac{1.3000 \text{ g}}{995.5468 \text{ g}} \right) = 131.75 \text{ dpm/mL}$$

Std ID: 1013.4095.77

Description: Cs-137
Expiration: 1/20/2016
Activity: 131.75 dpm/mL

2s Uncertainty: 0.92 dpm/mL

Ref. Date: 9/30/2005

Ref Time: N/A

Prep Date: 1/16/2015 Prep by: TE

Matrix/Comp. 4% HCl

Half Life (y): 3.01E+01

Reverification Log		
Analysis Date	Initials	Expiration Date
12/29/16	JP	12/29/2017

Continued on Page _____

Signed

Date

Read and Understood by

Signed

Date

10/16/15
Prepare an intermediate dilution of RSO# 1013

1. Density of 4% HCl, lot # 0000094396

Mass of 100mL vol. flask:

68.5652g

Balance # 12

Mass of flask & 100mL acid:

169.0154g

Balance # 12

Net Mass:

100.4502g

Density:

1.0045 g/mL

2. Mass of RSO# 1013 transferred:

Mass of open empty bottle:

398.34g

Balance # 26

Mass of bottle and standard:

403.33g

Balance # 26

Net mass of standard transferred:

4.99g

3. Dilute to final volume:

Mass of open empty bottle:

398.34g

Balance # 26

Mass of bottle, standard, & diluent:

1288.4g

Balance # 26

Net mass of new dilution:

890.06g

4. Final activity calculation:

10/16/15

$$298.6 \text{ kBq/g} \left(\frac{1000 \text{ Bq}}{1 \text{ kBq}} \right) \left(\frac{60 \text{ dpm}}{1 \text{ Bq}} \right) \left(\frac{4.99 \text{ g}}{890.06 \text{ g}} \right) = 100,443.61 \text{ dpm/g}$$

10/16/15

Continued on Page

10/16/15
Signed

10/16/15
Date

Read and Understood By

Signed

10/16/15
Date



National Institute of Standards & Technology Certificate

Standard Reference Material 4233E Cesium-137 Radioactivity Standard

This Standard Reference Material (SRM) consists of radioactive cesium-137 chloride, non-radioactive cesium chloride, and hydrochloric acid dissolved in 5 mL of distilled water. The solution is contained in a flame-sealed NIST borosilicate-glass ampoule. The SRM is intended for the calibration of ionization chambers and solid-state gamma-ray spectrometry systems.

Radiological Hazard: The SRM ampoule contains cesium-137 with a total activity of approximately 1.5MBq. Cesium-137 decays by beta-particle emission to barium-137m, which decays by internal conversion. During the decay process X-rays and gamma rays with energies from approximately 3 keV to 662 keV are emitted. Most of these photons escape from the SRM ampoule and can represent a radiation hazard. Approximate unshielded dose rates at several distances (as of the reference time) are given in note [a]*. Appropriate shielding and/or distance should be used to minimize personnel exposure. The SRM should be used only by persons qualified to handle radioactive material.

Chemical Hazard: The SRM ampoule contains hydrochloric acid with a concentration of 1 mole per liter of water. The solution is corrosive and represents a health hazard if it comes in contact with eyes or skin. If the ampoule is to be opened to transfer the solution, the recommended procedure is given on page 2. The ampoule should be opened only by persons qualified to handle both radioactive material and strong acid solution.

Storage and Handling: The SRM should be stored and used at a temperature between 5 and 65 °C. The solution in an unopened ampoule should remain stable and homogeneous until at least September 2015. The ampoule (or any subsequent container) should always be clearly marked as containing radioactive material. If the ampoule is transported, it should be packed, marked, labeled, and shipped in accordance with the applicable national, international, and carrier regulations. The solution in the ampoule is a dangerous good (hazardous material) because of both the radioactivity and the strong acid.

Preparation: This Standard Reference Material was prepared in the Physics Laboratory, Ionizing Radiation Division, Radioactivity Group, M.P. Unterweger, Acting Group Leader. The overall technical direction and physical measurements leading to certification were provided by L.L. Lucas, R. Collé and L. Laureano-Pérez of the Radioactivity Group. The support aspects involved in the preparation, certification, and issuance of this SRM were coordinated through the Standard Reference Materials Program.

Lisa R. Karam, Deputy Chief
Ionizing Radiation Division

Gaithersburg, Maryland 20899
October 2005

Robert L. Watters, Jr., Chief
Measurement Services Division

Recommended Procedure for Opening the SRM Ampoule

- 1) If the SRM solution is to be diluted, it is recommended that the diluting solution have a composition comparable to that of the SRM solution.
- 2) Wear eye protection, gloves, and protective clothing and work over a tray with absorbent paper in it. Work in a fume hood. In addition to the radioactive material, the solution contains strong acid and is corrosive.
- 3) Shake the ampoule to wet all of the inside surface of the ampoule. Return the ampoule to the upright position.
- 4) Check that all of the liquid has drained out of the neck of the ampoule. If necessary, gently tap the neck to speed the process.
- 5) Holding the ampoule upright, score the narrowest part of the neck with a scribe or diamond pencil.
- 6) Lightly wet the scored line. This reduces the crack propagation velocity and makes for a cleaner break.
- 7) Hold the ampoule upright with a paper towel, a wiper, or a support jig. Position the scored line away from you. Using a paper towel or wiper to avoid contamination, snap off the top of the ampoule by pressing the narrowest part of the neck away from you while pulling the tip of the ampoule towards you.
- 8) Transfer the solution from the ampoule using a pycnometer or a pipet with dispenser handle. NEVER PIPETTE BY MOUTH.
- 9) Seal any unused SRM solution in a flame-sealed glass ampoule, if possible, to minimize the evaporation loss.

See also reference [4]*.

PROPERTIES OF SRM 4233E

Certified values

Radionuclide	Cesium-137
Reference time	1200 EST, 30 September 2005
Massic activity of the solution [c]*	298.6 kBq·g ⁻¹
Relative expanded uncertainty (k=2)	0.70% [d] [e]
Solution mass	(5.0668 ± 0.0009) g [b]
Solution density	(1.015 ± 0.002) g·mL ⁻¹ at 20 °C [b]

Uncertified values

Physical Properties:			
Source description	Liquid in flame-sealed NIST borosilicate-glass ampoule		
Ampoule specifications	Body outside diameter	(16.5 ± 0.5) mm	
	Wall thickness	(0.60 ± 0.04) mm	
	Barium content	Less than 2.5%	
	Lead-oxide content	Less than 0.02%	
	Other heavy elements	Trace quantities	
Chemical Properties:			
Solution composition	Chemical Formula	Concentration (mol·L ⁻¹)	Mass Fraction (g·g ⁻¹)
	H ₂ O	54	0.96
	HCl	1.0	0.04
	CsCl	1.6 × 10 ⁻⁴	2.7 × 10 ⁻⁵
	¹³⁷ CsCl	6.9 × 10 ⁻⁷	1.2 × 10 ⁻⁷
Radiological Properties:			
Photon-emitting impurities	None detected [f]		
Half lives used	Cesium-137: (10983 ± 11) d [g] [5] Radium-226: (1600 ± 7) a [g] [5]		
Calibration method and measuring instrument(s)	Pressurized "4π"γ ionization chamber A calibrated using an cesium-137 solution whose activity was determined by the 4π(e+X)-γ-coincidence efficiency-extrapolation technique.		

EVALUATION OF THE UNCERTAINTY OF THE MASSIC ACTIVITY [d]*

Input Quantity x_i , the source of uncertainty (and individual uncertainty components where appropriate)	Method Used To Evaluate $u(x_i)$, the standard uncertainty of x_i (A) denotes evaluation by statistical methods (B) denotes evaluation by other methods	Relative Uncertainty Of Input Quantity, $u(x_i)/x_i$, (%) [h]	Relative Sensitivity Factor, $ \partial y/\partial x_i \cdot$ (x_i/y) [i]	Relative Uncertainty Of Output Quantity, $u(y)/y$, (%) [j]
PIC A net response per gram of SRM 4233E, measured relative to RRS20 [k]	Standard deviation of the mean (within-measurement precision) for 20 to 100 repeated measurements (A)	0.02	1.0	0.02
	Standard deviation (between- measurement precision) for 4 sets of measurement (A)	0.13	1.0	0.13
PIC A net response per Bq of cesium-137 in solution, measured relative to RRS20.	Standard deviation of the mean (for both between- and within- measurement precision) for >100 repeated measurements (A)	0.01	1.0	0.01
Activity used to calibrate PIC A net response per Bq of cesium-137 in solution	Standard uncertainty of the activity determined by the $4\pi(e+X)$ - γ -coincidence efficiency-extrapolation technique. (B)	0.31	1.0	0.31
Half life of cesium-137 Half life of radium-226	Standard uncertainty of the half life (A)	0.10 [m] 0.44 [m]	0.0001 [n] 0.010 [n]	0.00001 0.004
Gravimetric measurements	Estimated (B)	0.03	1.0	0.03
PIC A charge collection	Estimated (B)	0.05	1.0	0.05
Charge collection measurement time [p]	Estimated (B)	0.05	1.0	0.05
Long-term RRS positioning	Estimated (B)	0.05	1.0	0.05
Photon-emitting impurities	Limit of detection (B) [q]	100.	0.0001	0.01
Relative Combined Standard Uncertainty of the Output Quantity, $u_c(y)/y$, (%)				0.35
Coverage Factor, k				<u>x 2</u>
Relative Expanded Uncertainty of the Output Quantity, U/y , (%)				0.70

NOTES

- [a] The Sievert is the SI unit for dose equivalent. See reference [1]. One μSv is equal to 0.1 mrem.
 Distance from Ampoule (cm): 1 30 100
 Approximate Dose Rate ($\mu\text{Sv/h}$): 300 4 0.3
- [b] The stated uncertainty is two times the standard uncertainty.
- [c] **Massic activity** is the preferred name for the quantity activity divided by the total mass of the sample. See reference [1].
- [d] The reported value, y , of massic activity (activity per unit mass) at the reference time was not measured directly but was derived from measurements and calculations of other quantities. This can be expressed as $y = f(x_1, x_2, x_3, \dots, x_n)$, where f is a mathematical function derived from the assumed model of the measurement process. The value, x_i , used for each input quantity i has a **standard uncertainty**, $u(x_i)$, that generates a corresponding uncertainty in y , $u_i(y) \equiv |\partial y / \partial x_i| \cdot u(x_i)$, called a **component of combined standard uncertainty** of y . The **combined standard uncertainty** of y , $u_c(y)$, is the positive square root of the sum of the squares of the components of combined standard uncertainty. The combined standard uncertainty is multiplied by a **coverage factor** of $k = 2$ to obtain U , the **expanded uncertainty** of y .
- Since it can be assumed that the possible estimated values of the massic activity are approximately normally distributed with approximate standard deviation $u_c(y)$, the unknown value of the massic activity is believed to lie in the interval $y \pm U$ with a level of confidence of approximately 95 percent.
- For further information on the expression of uncertainties, see references [2] and [3].
- [e] The value of each component of combined standard uncertainty, and hence the value of the expanded uncertainty itself, is a best estimate based upon all available information, but is only approximately known. That is to say, the "uncertainty of the uncertainty" is large and not well known. This is true for uncertainties evaluated by statistical methods (e.g., the relative standard deviation of the standard deviation of the mean for the massic response is approximately 50%) and for uncertainties evaluated by other methods (which could easily be over estimated or under estimated by substantial amounts). The unknown value of the expanded uncertainty is believed to lie in the interval $U/2$ to $2U$ (i.e., within a factor of 2 of the estimated value).
- [f] Estimated limits of detection for photon-emitting impurities, as of 3 October 2005 (3 days after the reference time), expressed as massic photon emission rates, are:
 $< 40 \gamma \cdot \text{s}^{-1} \cdot \text{g}^{-1}$ for energies between 40 keV and 1350 keV, and
 $< 4 \gamma \cdot \text{s}^{-1} \cdot \text{g}^{-1}$ for energies between 1350 keV and 3600 keV,
- [g] The stated uncertainty is the standard uncertainty.
- [h] Relative standard uncertainty of the input quantity x_i .
- [i] The relative change in the output quantity y divided by the relative change in the input quantity x_i . If $|\partial y / \partial x_i| \cdot (x_i / y) = 1.0$, then a 1% change in x_i results in a 1% change in y . If $|\partial y / \partial x_i| \cdot (x_i / y) = 0.05$, then a 1% change in x_i results in a 0.05% change in y .

- [j] Relative component of combined standard uncertainty of output quantity y , rounded to two significant figures or less. The relative component of combined standard uncertainty of y is given by $u_i(y)/y \approx |\partial y/\partial x_i| \cdot u(x_i)/y = |\partial y/\partial x_i| \cdot (x_i/y) \cdot u(x_i)/x_i$. The numerical values of $u(x_i)/x_i$, $|\partial y/\partial x_i| \cdot (x_i/y)$, and $u_i(y)/y$, all dimensionless quantities, are listed in columns 3, 4, and 5, respectively. Thus, the value in column 5 is equal to the value in column 4 multiplied by the value in column 3. The input quantities are independent, or very nearly so. Hence the covariances are zero or negligible.
- [k] The response of pressurized ionization chamber A (PIC A) is determined from measurement of the time required to collect a given amount of charge on a stable fixed capacitor. All of the response measurements in the NIST pressurized ionization chambers are made relative to the response of one or more artifact standards. These artifact standards consist of microgram quantities of aged radium-226 in small welded stainless-steel capsules. These capsules are encapsulated in plastic rods whose dimensions are similar to those of the standard NIST ampoule. The artifact standards are called **Radium Reference Sources** and are designated as RRSx, where x is the nominal mass (in micrograms) of radium-226 in the capsule.
- [m] The relative standard uncertainty of $\lambda \cdot t$ is determined by the relative standard uncertainty of λ (i.e., of the half life). The relative standard uncertainty of t is negligible.
- [n] $|\partial y/\partial x_i| \cdot (x_i/y) = |\lambda \cdot t|$
- [p] The charge collection measurement time is determined by counting the pulses from a gated crystal-controlled oscillator.
- [q] The standard uncertainty for each undetected impurity that might reasonably be expected to be present is estimated to be equal to the estimated limit of detection for that impurity, i.e. $u(x_i)/x_i = 100\%$. $|\partial y/\partial x_i| \cdot (x_i/y) = \{(\text{response per Bq of impurity})/(\text{response per Bq of cesium-137})\} \cdot \{(\text{Bq of impurity})/(\text{Bq of cesium-137})\}$. Thus $u_i(y)/y$ is the relative change in y if the impurity were present with a massic activity equal to the estimated limit of detection.

REFERENCES

- [1] International Organization for Standardization (ISO), *ISO Standards Handbook - Quantities and Units*, 1993. Available from Global Engineering Documents, 12 Inverness Way East, Englewood, CO 80112, U.S.A. Telephone 1-800-854-7179.
- [2] International Organization for Standardization (ISO), *Guide to the Expression of Uncertainty in Measurement*, 1993 (corrected and reprinted, 1995). Available from Global Engineering Documents, 12 Inverness Way East, Englewood, CO 80112, U.S.A. Telephone 1-800-854-7179.
- [3] B. N. Taylor and C. E. Kuyatt, *Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results*, NIST Technical Note 1297, 1994. Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20407, U.S.A.
- [4] National Council on Radiation Protection and Measurements Report No. 58, *A Handbook of Radioactivity Measurements Procedures*, Second Edition, 1985. Available from the National Council on Radiation Protection and Measurements, 7910 Woodmont Avenue, Bethesda, MD 20814 U.S.A.
- [5] Evaluated Nuclear Structure Data File (ENSDF), September 2005.

Section 9

ADDITIONAL SUPPORTING DOCUMENTATION

Gas Proportional Counter

Instrument Calibration

Background Calibration

**LB4100-A Long Background Instrument Calibration
Background Determinations**

Detector ID	Alpha			Beta			Flag	Detector ID
	CPM	LCL	UCL	CPM	LCL	UCL		
A1 (01)	0.121	0.0808	0.1920	2.064	1.833	2.488	PASS	A1 (01)
A2 (02)	0.115	0.0778	0.2056	1.931	1.814	2.358	PASS	A2 (02)
A3 (03)	0.121	0.0423	0.1841	2.330	1.882	2.627	PASS	A3 (03)
A4 (04)	0.109	0.0660	0.1534	2.234	1.910	2.350	PASS	A4 (04)
B1 (05)	0.106	0.0565	0.1769	2.033	1.625	2.614	PASS	B1 (05)
B2 (06)	0.128	0.0530	0.1824	1.824	1.673	2.157	PASS	B2 (06)
B3 (07)	0.129	0.0777	0.2003	2.000	1.540	2.483	PASS	B3 (07)
B4 (08)	0.173	0.1055	0.2263	1.911	1.613	2.011	PASS	B4 (08)
C1 (09)	0.128	0.0158	0.2074	1.991	1.267	2.743	PASS	C1 (09)
C2 (10)	0.159	0.1259	0.2317	1.851	1.612	1.987	PASS	C2 (10)
C3 (11)	0.103	0.0310	0.1808	1.794	1.289	2.177	PASS	C3 (11)
C4 (12)	0.136	0.1023	0.2329	1.995	1.719	2.289	PASS	C4 (12)
D1 (13)	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	D1 (13)
D2 (14)	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	D2 (14)
D3 (15)	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	D3 (15)
D4 (16)	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	D4 (16)

Reviewed by: _____

Date: _____

JP *5/10/17*

Historical Control Limits set to AVE 10 POINTS +- 3 Std Dev JP 04/10/2017

LB4100-C
Long Instrument Background Calibration
Background Determination

Detector ID	Alpha				Beta				Detector ID
	CPM	LCL	UCL	Flag	CPM	LCL	UCL	Flag	
A1 (01)	0.090	0.0012	0.2468	PASS	1.446	1.075	2.150	PASS	A1 (01)
A2 (02)	0.113	0.0016	0.3124	PASS	1.433	1.211	2.423	PASS	A2 (02)
A3 (03)	0.096	0.0011	0.2229	PASS	1.581	1.123	2.246	PASS	A3 (03)
A4 (04)	0.092	0.0011	0.2189	PASS	1.495	1.157	2.313	PASS	A4 (04)
B1 (05)	0.095	0.0011	0.2269	PASS	1.589	1.217	2.433	PASS	B1 (05)
B2 (06)	0.097	0.0012	0.2428	PASS	1.646	1.202	2.405	PASS	B2 (06)
B3 (07)	0.110	0.0013	0.2667	PASS	1.589	1.236	2.472	PASS	B3 (07)
B4 (08)	0.116	0.0015	0.2886	PASS	1.621	1.220	2.441	PASS	B4 (08)
C1 (09)	0.121	0.0010	0.2030	PASS	1.590	1.136	2.273	PASS	C1 (09)
C2 (10)	0.124	0.0011	0.2229	PASS	1.701	1.160	2.319	PASS	C2 (10)
C3 (11)	0.103	0.0011	0.2149	PASS	1.722	1.234	2.468	PASS	C3 (11)
C4 (12)	0.123	0.0012	0.2368	PASS	3.340	1.395	4.184	PASS	C4 (12)
D1 (13)	0.094	0.0010	0.1930	PASS	1.687	1.247	2.495	PASS	D1 (13)
D2 (14)	0.093	0.0009	0.1851	PASS	1.682	1.178	2.357	PASS	D2 (14)
D3 (15)	0.104	0.0009	0.1791	PASS	1.801	1.173	2.346	PASS	D3 (15)
D4 (16)	0.089	0.0009	0.1731	PASS	1.716	1.210	2.420	PASS	D4 (16)

Reviewed by: _____

Date: 5/10/17

Historical limits for alpha/beta set to be +/- 3 Std Deviations
JP 09/30/2016

Gas Proportional Counter

Quality Control Data

Daily Instrument Performance Checks

LB4100-A Daily Instrument Performance Check
Efficiency Determinations

Detector ID		Alpha			Beta			Detector ID	
	Eff.	LCL	UCL	Flag	Eff.	LCL	UCL	Flag	
A1 (01)	0.2186	0.1979	0.2300	PASS	0.2283	0.2088	0.2426	PASS	A1 (01)
A2 (02)	0.2093	0.1918	0.2229	PASS	0.2275	0.2077	0.2414	PASS	A2 (02)
A3 (03)	0.2227	0.2064	0.2399	PASS	0.2323	0.2145	0.2492	PASS	A3 (03)
A4 (04)	0.2234	0.2084	0.2421	PASS	0.2272	0.2166	0.2518	PASS	A4 (04)
B1 (05)	0.2241	0.2064	0.2399	PASS	0.2415	0.2220	0.2580	PASS	B1 (05)
B2 (06)	0.2260	0.2124	0.2468	PASS	0.2442	0.2291	0.2663	PASS	B2 (06)
B3 (07)	0.2386	0.1937	0.2352	FLAG-HIGH	0.2362	0.2051	0.2387	PASS	B3 (07)
B4 (08)	0.2273	0.2003	0.2328	PASS	0.2161	0.1998	0.2322	PASS	B4 (08)
C1 (09)	0.2150	0.1911	0.2221	PASS	0.2423	0.2198	0.2554	PASS	C1 (09)
C2 (10)	0.2189	0.1997	0.2320	PASS	0.2416	0.2225	0.2586	PASS	C2 (10)
C3 (11)	0.2243	0.2004	0.2329	PASS	0.2313	0.2144	0.2492	PASS	C3 (11)
C4 (12)	0.2052	0.1908	0.2217	PASS	0.2625	0.2325	0.2702	PASS	C4 (12)
D1 (13)	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	D1 (13)
D2 (14)	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	D2 (14)
D3 (15)	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	D3 (15)
D4 (16)	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	D4 (16)

recounted in
EFA0512 A

Reviewed by: JCB

Date: 5/12/17

Historical Control Limits -- +/- 7.5% of Average of 30 Data Points. JP 02/10/17

LB4100-A Daily Instrument Performance Check
Efficiency Determinations

Detector ID	Alpha				Beta				Detector ID
	Eff.	LCL	UCL	Flag	Eff.	LCL	UCL	Flag	
A1 (01)	#VALUE!	0.1979	0.2300	#VALUE!	#VALUE!	0.2088	0.2426	#VALUE!	A1 (01)
A2 (02)	#VALUE!	0.1918	0.2229	#VALUE!	#VALUE!	0.2077	0.2414	#VALUE!	A2 (02)
A3 (03)	#VALUE!	0.2064	0.2399	#VALUE!	#VALUE!	0.2145	0.2492	#VALUE!	A3 (03)
A4 (04)	#VALUE!	0.2084	0.2421	#VALUE!	#VALUE!	0.2166	0.2518	#VALUE!	A4 (04)
B1 (05)	#VALUE!	0.2064	0.2399	#VALUE!	#VALUE!	0.2220	0.2580	#VALUE!	B1 (05)
B2 (06)	#VALUE!	0.2124	0.2468	#VALUE!	#VALUE!	0.2291	0.2663	#VALUE!	B2 (06)
B3 (07)	0.2297	0.1937	0.2352	PASS	0.2309	0.2051	0.2387	PASS	B3 (07)
B4 (08)	#VALUE!	0.2003	0.2328	#VALUE!	#VALUE!	0.1998	0.2322	#VALUE!	B4 (08)
C1 (09)	#VALUE!	0.1911	0.2221	#VALUE!	#VALUE!	0.2198	0.2554	#VALUE!	C1 (09)
C2 (10)	#VALUE!	0.1997	0.2320	#VALUE!	#VALUE!	0.2225	0.2586	#VALUE!	C2 (10)
C3 (11)	#VALUE!	0.2004	0.2329	#VALUE!	#VALUE!	0.2144	0.2492	#VALUE!	C3 (11)
C4 (12)	#VALUE!	0.1908	0.2217	#VALUE!	#VALUE!	0.2325	0.2702	#VALUE!	C4 (12)
D1 (13)	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	D1 (13)
D2 (14)	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	D2 (14)
D3 (15)	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	D3 (15)
D4 (16)	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	D4 (16)

Reviewed by: 765

Date: 5/12/17

Historical Control Limits -- +/-7.5% of Average of 30 Data Points. JP 02/10/17

LB4100-A Daily Instrument Calibration and Check
Background Determinations

Detector ID	Alpha				Beta				Detector ID
	CPM	LCL	UCL	Flag	CPM	LCL	UCL	Flag	
A1 (01)	0.167	-0.0137	0.2557	PASS	2.267	1.508	2.620	PASS	A1 (01)
A2 (02)	0.133	-0.0163	0.2463	PASS	2.183	1.393	2.469	PASS	A2 (02)
A3 (03)	0.117	-0.0137	0.2557	PASS	2.100	1.739	2.921	PASS	A3 (03)
A4 (04)	0.133	-0.0189	0.2369	PASS	2.400	1.655	2.813	PASS	A4 (04)
B1 (05)	0.067	-0.0201	0.2321	PASS	1.750	1.481	2.585	PASS	B1 (05)
B2 (06)	0.217	-0.0106	0.2666	PASS	1.633	1.301	2.347	PASS	B2 (06)
B3 (07)	0.267	-0.0101	0.2681	PASS	2.200	1.452	2.548	PASS	B3 (07)
B4 (08)	0.217	0.0119	0.3341	PASS	1.600	1.376	2.446	PASS	B4 (08)
C1 (09)	0.133	-0.0106	0.2666	PASS	1.933	1.445	2.537	PASS	C1 (09)
C2 (10)	0.150	0.0046	0.3134	PASS	2.100	1.324	2.378	PASS	C2 (10)
C3 (11)	0.083	-0.0213	0.2273	PASS	1.700	1.275	2.313	PASS	C3 (11)
C4 (12)	0.200	-0.0068	0.2788	PASS	1.733	1.448	2.542	PASS	C4 (12)
D1 (13)	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	D1 (13)
D2 (14)	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	D2 (14)
D3 (15)	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	D3 (15)
D4 (16)	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	D4 (16)

Reviewed by: JCS Date: 5/12/17

Control Limits established from previous weekly background determinations
Weekly Bkg File: BKA0509W Date: 5/9/17 Analyst: JP
0 1/0/00 0

LB4100-A Daily Instrument Performance Check
Efficiency Determinations

Detector ID		Alpha			Beta			Detector ID	
	Eff.	LCL	UCL	Flag	Eff.	LCL	UCL	Flag	
A1 (01)	0.2162	0.1979	0.2300	PASS	0.2276	0.2088	0.2426	PASS	A1 (01)
A2 (02)	0.2082	0.1918	0.2229	PASS	0.2233	0.2077	0.2414	PASS	A2 (02)
A3 (03)	0.2230	0.2064	0.2399	PASS	0.2274	0.2145	0.2492	PASS	A3 (03)
A4 (04)	0.2209	0.2084	0.2421	PASS	0.2257	0.2166	0.2518	PASS	A4 (04)
B1 (05)	0.2219	0.2064	0.2399	PASS	0.2387	0.2220	0.2580	PASS	B1 (05)
B2 (06)	0.2285	0.2124	0.2468	PASS	0.2472	0.2291	0.2663	PASS	B2 (06)
B3 (07)	0.2351	0.1937	0.2352	PASS	0.2362	0.2051	0.2387	PASS	B3 (07)
B4 (08)	0.2253	0.2003	0.2328	PASS	0.2197	0.1998	0.2322	PASS	B4 (08)
C1 (09)	0.2186	0.1911	0.2221	PASS	0.2405	0.2198	0.2554	PASS	C1 (09)
C2 (10)	0.2158	0.1997	0.2320	PASS	0.2441	0.2225	0.2586	PASS	C2 (10)
C3 (11)	0.2263	0.2004	0.2329	PASS	0.2323	0.2144	0.2492	PASS	C3 (11)
C4 (12)	0.2096	0.1908	0.2217	PASS	0.2759	0.2325	0.2702	FLAG-HIGH	C4 (12)
D1 (13)	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	D1 (13)
D2 (14)	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	D2 (14)
D3 (15)	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	D3 (15)
D4 (16)	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	D4 (16)

*Set-offline

Reviewed by: 2007 Date: 5/13/17

Historical Control Limits -- +/-7.5% of Average of 30 Data Points. JP 02/10/17

[illegible]

50

7/13/15

Weekly Bkg File: BKA0509W

5/9/17

Analyst:

0 JP

LB4100-C
Daily Instrument Performance Check-Efficiency Determination

Detector ID	Alpha				Eff.	Beta			Flag	Detector ID
	Eff.	LCL	UCL	Flag		LCL	UCL	Flag		
A1 (01)	0.2015	0.1859	0.2160	PASS	0.3873	0.3641	0.4232	PASS	A1 (01)	
A2 (02)	0.2040	0.1952	0.2268	PASS	0.3941	0.3753	0.4362	PASS	A2 (02)	
A3 (03)	0.2144	0.2000	0.2324	PASS	0.3968	0.3769	0.4381	PASS	A3 (03)	
A4 (04)	0.2085	0.1960	0.2278	PASS	0.3985	0.3791	0.4406	PASS	A4 (04)	
B1 (05)	0.2267	0.2151	0.2500	PASS	0.4103	0.3905	0.4538	PASS	B1 (05)	
B2 (06)	0.1984	0.1877	0.2182	PASS	0.3666	0.3547	0.4122	PASS	B2 (06)	
B3 (07)	0.2155	0.2045	0.2376	PASS	0.4078	0.3736	0.4341	PASS	B3 (07)	
B4 (08)	0.2103	0.2022	0.2349	PASS	0.4028	0.3756	0.4365	PASS	B4 (08)	
C1 (09)	0.2095	0.1945	0.2261	PASS	0.4053	0.3758	0.4367	PASS	C1 (09)	
C2 (10)	0.2235	0.2041	0.2372	PASS	0.4058	0.3833	0.4454	PASS	C2 (10)	
C3 (11)	0.2109	0.1952	0.2269	PASS	0.3910	0.3726	0.4330	PASS	C3 (11)	
C4 (12)	0.2280	0.2057	0.2390	PASS	0.4217	0.3878	0.4507	PASS	C4 (12)	
D1 (13)	0.2074	0.1992	0.2316	PASS	0.3983	0.3737	0.4342	PASS	D1 (13)	
D2 (14)	0.2131	0.1979	0.2300	PASS	0.4139	0.3729	0.4333	PASS	D2 (14)	
D3 (15)	0.2101	0.2015	0.2342	PASS	0.4091	0.3809	0.4427	PASS	D3 (15)	
D4 (16)	0.2159	0.2062	0.2396	PASS	0.4176	0.3833	0.4455	PASS	D4 (16)	

Reviewed by: _____

JCB

Date: _____

5/12/17

Historical Control Limits -- $\pm 7.5\%$ of average from last 30 data points
 Established: 01/24/17 JP

LB4100-C

Reviewed by:

Date:

7/12/15

Control Limits established from previous weekly background determinations.
Weekly Background File: BKC0509W Date: 5/9/2017 Analyst: JP

Weekly Background File: BKC0509W

Date: 5/9/2017

Analyst: JP

1/0/1900



1/0/1900

Q

LB4100-C
Daily Instrument Performance Check-Efficiency Determination

Detector ID	Alpha				Beta				Detector ID
	Eff.	LCL	UCL	Flag	Eff.	LCL	UCL	Flag	
A1 (01)	0.1993	0.1859	0.2160	PASS	0.3830	0.3641	0.4232	PASS	A1 (01)
A2 (02)	0.2062	0.1952	0.2268	PASS	0.3897	0.3753	0.4362	PASS	A2 (02)
A3 (03)	0.2148	0.2000	0.2324	PASS	0.3919	0.3769	0.4381	PASS	A3 (03)
A4 (04)	0.2097	0.1960	0.2278	PASS	0.3919	0.3791	0.4406	PASS	A4 (04)
B1 (05)	0.2324	0.2151	0.2500	PASS	0.4098	0.3905	0.4538	PASS	B1 (05)
B2 (06)	0.2008	0.1877	0.2182	PASS	0.3800	0.3547	0.4122	PASS	B2 (06)
B3 (07)	0.2162	0.2045	0.2376	PASS	0.4096	0.3736	0.4341	PASS	B3 (07)
B4 (08)	0.2138	0.2022	0.2349	PASS	0.4021	0.3756	0.4365	PASS	B4 (08)
C1 (09)	0.2081	0.1945	0.2261	PASS	0.4012	0.3758	0.4367	PASS	C1 (09)
C2 (10)	0.2198	0.2041	0.2372	PASS	0.4098	0.3833	0.4454	PASS	C2 (10)
C3 (11)	0.2124	0.1952	0.2269	PASS	0.3971	0.3726	0.4330	PASS	C3 (11)
C4 (12)	0.2248	0.2057	0.2390	PASS	0.4210	0.3878	0.4507	PASS	C4 (12)
D1 (13)	0.2161	0.1992	0.2316	PASS	0.4004	0.3737	0.4342	PASS	D1 (13)
D2 (14)	0.2093	0.1979	0.2300	PASS	0.4009	0.3729	0.4333	PASS	D2 (14)
D3 (15)	0.2182	0.2015	0.2342	PASS	0.4156	0.3809	0.4427	PASS	D3 (15)
D4 (16)	0.2197	0.2062	0.2396	PASS	0.4172	0.3833	0.4455	PASS	D4 (16)

Reviewed by: _____

JS

Date: 5/13/17

Historical Control Limits -- +/-7.5% of average from last 30 data points
 Established: 01/24/17 JP

LB4100-C
Daily Instrument Performance Checks
Background Checks

Detector ID	Alpha				Beta				Detector ID
	CPM	LCL	UCL	Flag	CPM	LCL	UCL	Flag	
A1 (01)	0.117	-0.026	0.206	PASS	1.583	0.980	1.912	PASS	A1 (01)
A2 (02)	0.117	-0.017	0.243	PASS	1.583	0.969	1.897	PASS	A2 (02)
A3 (03)	0.067	-0.024	0.216	PASS	1.417	1.094	2.068	PASS	A3 (03)
A4 (04)	0.167	-0.025	0.209	PASS	1.233	1.021	1.969	PASS	A4 (04)
B1 (05)	0.133	-0.024	0.214	PASS	1.600	1.101	2.077	PASS	B1 (05)
B2 (06)	0.100	-0.024	0.218	PASS	1.583	1.149	2.143	PASS	B2 (06)
B3 (07)	0.067	-0.018	0.238	PASS	1.883	1.101	2.077	PASS	B3 (07)
B4 (08)	0.100	-0.016	0.248	PASS	2.150	1.128	2.114	FLAG-HIGH	B4 (08)
C1 (09)	0.183	-0.014	0.256	PASS	1.817	1.102	2.078	PASS	C1 (09)
C2 (10)	0.150	-0.012	0.260	PASS	1.733	1.196	2.206	PASS	C2 (10)
C3 (11)	0.117	-0.021	0.227	PASS	1.450	1.214	2.230	PASS	C3 (11)
C4 (12)	0.150	-0.013	0.259	PASS	3.117	2.632	4.048	PASS	C4 (12)
D1 (13)	0.200	-0.025	0.213	PASS	1.383	1.184	2.190	PASS	D1 (13)
D2 (14)	0.167	-0.025	0.211	PASS	1.583	1.180	2.184	PASS	D2 (14)
D3 (15)	0.067	-0.021	0.229	PASS	1.650	1.281	2.321	PASS	D3 (15)
D4 (16)	0.083	-0.027	0.205	PASS	1.983	1.209	2.223	PASS	D4 (16)

* recounted in
BKC0513A

Reviewed by: 767 Date: 5/13/17

Control Limits established from previous weekly background determinations.
Weekly Background File: BKC0509W Date: 5/9/2017 Analyst: JP
0 1/0/1900 0
0 1/0/1900 0

Daily Instrument Performance Checks

7/13/17

Date:

○

Printed 5/13/2017 11:04 AM

Gas Proportional Counter

Instrument Calibration

**Initial Efficiency Calibration
Standards Traceability**

Instrument: LB4100-A

Calibration: Gross Alpha (Th-230) -- ringed planchet
Gross Beta (Cs-137) -- ringed planchet
Drinking Water EPA Method 900.0 Compliant

Date of Calibration: Gross Alpha 12/07/16
Gross Beta 12/07/16

Efficiency Log Files: **Th230-12/16**
Cs-137-12/16

Efficiency Instrument Files: ETH1207A-C
ECS1207A-C

Source ID's: (Th-230 853.3020.89)
(Cs-137 1019.4095.83)

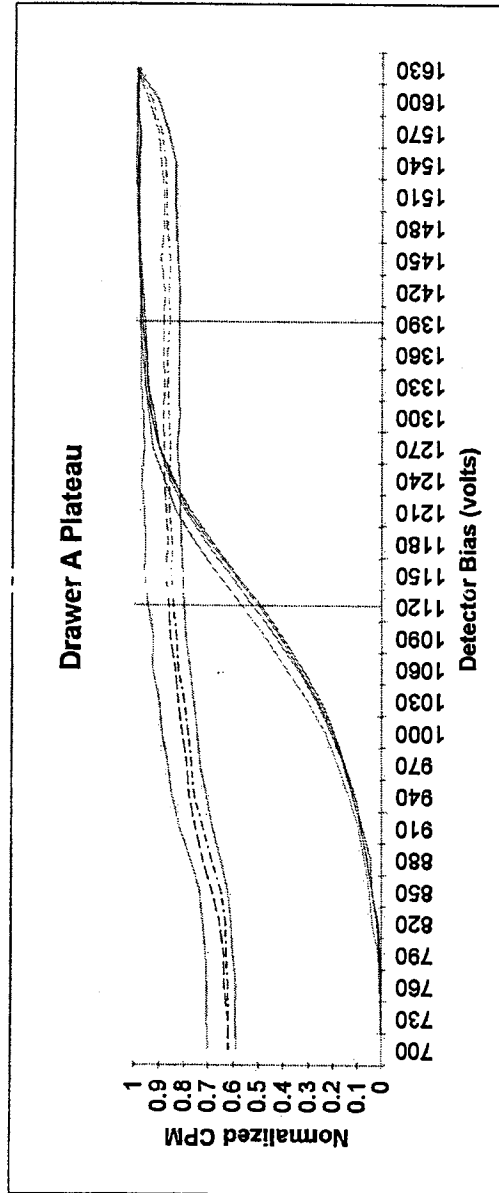
OK JP 2/15/2017

Expires 11/03/2017

Instrument Plateaus

Unit Type: LB4100/W
 Date Performed: 11/3/16 13:18
 FileName: PTA1103
 Batch ID: PLATEAU CHECK

Unit Id: Orange
 Application Revision: B
 Application Version: Standard



Optimum alpha beta simultaneous operating voltage: **1402.5**

Optimum alpha only operating voltage: **1120**

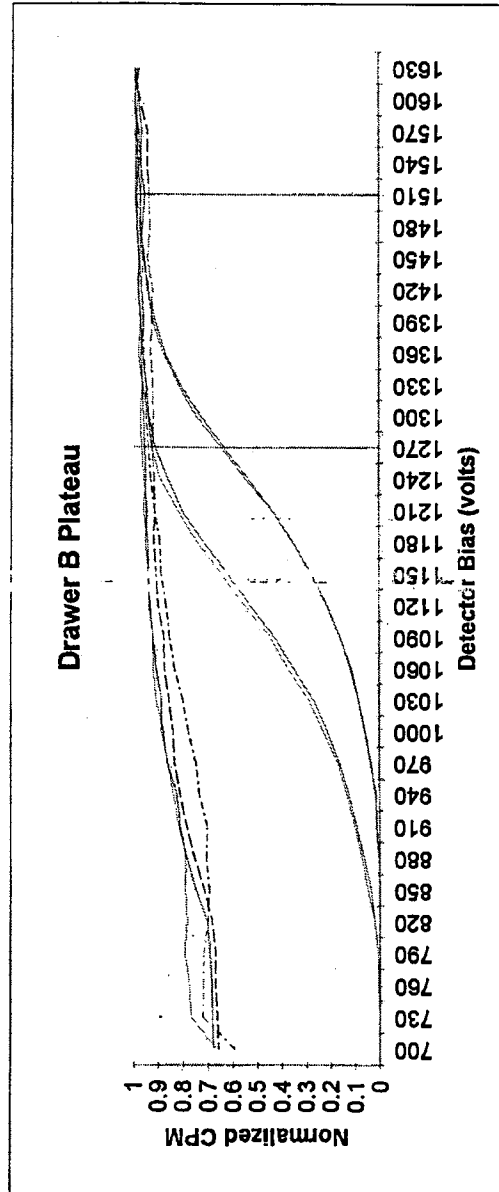
	A1	A2	A3	A4
Beta slope at beta voltage	2.48%	2.17%	3.46%	2.60%
Alpha slope at beta voltage	0.69%	1.09%	0.53%	-0.62%
Alpha slope at alpha voltage	3.21%	3.26%	3.49%	2.70%

OK 11/7/16

Printed 11/4/16 7:03 AM

Unit Type: LB4100W
 Date Performed: 11/3/16 13:18
 FileName: PTA1103
 Batch ID: PLATEAU CHECK

Unit Id: Orange
 Application Revision: B
 Application Version: Standard

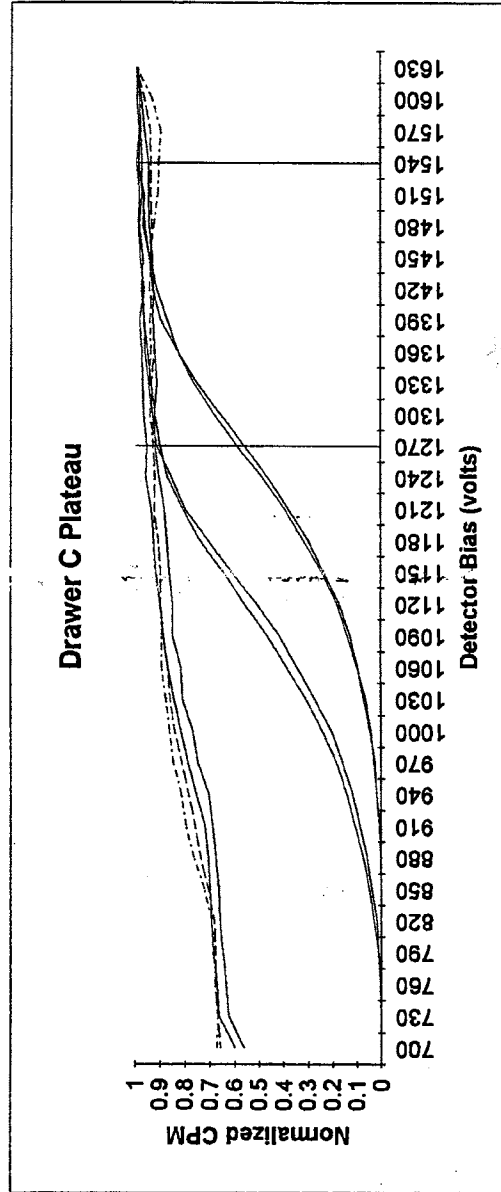


	B1	B2	B3	B4
Beta slope at beta voltage	1.06%	0.81%	1.70%	2.57%
Alpha slope at beta voltage	0.00%	0.72%	1.22%	1.58%
Alpha slope at alpha voltage	0.84%	0.83%	1.99%	3.07%

OK 11/7/16

Unit Type: LB4100/W
 Date Performed: 11/4/16 07:00
 FileName: PTA1104C
 Batch ID: DRAWER C PLATEAU

Unit Id: Orange
 Application Revision: B
 Application Version: Standard



Optimum alpha beta simultaneous operating voltage: **1530**

Optimum alpha only operating voltage: **1270**

	C1	C2	C3	C4
Beta slope at beta voltage	2.80%	0.60%	1.61%	0.38%
Alpha slope at beta voltage	2.88%	2.32%	-0.15%	-0.03%
Alpha slope at alpha voltage	2.92%	1.27%	2.92%	1.94%

OK 11/17/16

Printed 11/4/16 1:22 PM

11-4-15

Plateau checks performed for Drawers A-C

2 sources

Source	Detector	Count	Rate	PTA1104A
410 Am-241	A1 B1 C1	406	51.90/4.90	
411 17800dpm	A2 B2 C2	407	29600dpm	B
412 2-16-95	A3 B3 C3	408	9-15-92	C
413	A4 B4 C4	409		

Parameters

Starting voltage 700	Ct. preset 40,000
Ending voltage 1650	weak check time 0.1
Volts/step 30	weak ct. limit 35
Ct. time/step 5	
Time between steps 0.1	

3-24-16

Power outage. Instrument was turned off. ^{Turned} back on when power was restored. Daily checks were performed.

All in control. Instrument on-line.

3-30-16

memory loss caused computer to crash and files to be lost. All instrument calibration files were restored from last back-up. As of 4-1-16 instrument was on-line and resumed as normal.

11-3-16 & 11-4-16

Plateau checks performed for Drawers A-C

Source	Detectors	3 sources
410 Am-241	A1 B1 C1	406 51.90/4.90
411 17800dpm	A2 B2 C2	407 29600dpm
412 2-16-95	A3 B3 C3	408 9-15-92
413	A4 B4 C4	409

Parameters

Starting voltage 700	Time between steps 0.1
Ending voltage 1650	Ct. preset 40,000
Volts/step 30	weak check time 0.1
Ct. time/step 5	weak ct. limit 35

Continued on Page _____

M. J. In

Signed

11-7-16

Date

Read and Understood By

[Signature]

Signed

11/7/16

Date

Date 11/3/16 / 11/4/16

SOP 724r **U**

ALS

Low Background Gas Flow Proportional Counter Log

Instrument: LB4100A

Det.	Sample ID	Batch	Test	Count Dur. (min)	Start Time	Analyst Initials	File ID	Output Initials
1-4	Alpha/Beta	Drynet Plat	Plat	5/Min/Stop	13:18	MH	PTA1103	JP
5-6	Beta/Alpha	B						
9-12	Alpha/Beta	C			0:55	JP	PTA11034C	
1-12	Daily Eff.	—	—	30	14:05	UW	EFA1104	UW
		—	—		14:20		A	
		—	—		14:31		B	
		—	—		14:44		C	
		—	—		14:54		D	
1-12	Weekly bkgd	—	—	1000	15:17	UW	EFA1104W	UW

JP 11/5/16

Comments:

Page No.: 468536 **B**
(cont. from page Mr **B**)

Form 780r8.doc (6/23/06)

Reviewed By / Date

JP 11/5/16

Instrument ROIs

LB4100-AW Sample Counting Parameters for LIMS

Certainty requirement for MDA and flags	95%
Maximum count time (min)	120.00
Typical Residual Mass (mg)	80.00
Typical Sample Volume (l)	1.00

Action level for flags (pCi/l)	$1.000\text{E}+00$	$8.000\text{E}+00$
Activity Multiplier	$1.000\text{E}+00$	$1.000\text{E}+00$
Mass Error (%)	1.00%	
Volume Error (%)	1.00%	

	Alpha		Beta	
	eff.	bkg.	eff.	MDA (pCi/l)
A1	16.35%	0.142	34.64%	$3.958\text{E}-01$
A2	21.07%	0.125	37.63%	$3.055\text{E}-01$
A3	22.60%	0.1	36.33%	$2.635\text{E}-01$
A4	19.36%	0.141	35.10%	$3.464\text{E}-01$
				$6.404\text{E}-01$
				$5.775\text{E}-01$
				$6.140\text{E}-01$
				$6.206\text{E}-01$

Batch Specific:

Orange	Event	Recycle
	1	0

Drawer Specific:

	Date/Time	Official	Blas	Step
A	11/3/16 13:18	TRUE	1402.5	0
B	11/3/16 13:18	TRUE	1500	0
C	11/4/16 7:00	TRUE	1530	0
D	8/5/08 11:19	TRUE	1500	0

Detector Specific:

	Date/Time	Official	Threshold	bLL	bUL	aLL	aUL	Time
A1	11/4/16 0:00	TRUE	0.1	0	21.51	41.83	100	120
A2	11/4/16 0:00	TRUE	0.1	0	24.68	47.05	100	120
A3	11/4/16 0:00	TRUE	0.1	0	20.53	39.21	100	120
A4	11/4/16 0:00	TRUE	0.1	0	21.8	40.51	100	120
B1	11/4/16 0:00	TRUE	0.1	0	47.74	94.77	100	120
B2	11/4/16 0:00	TRUE	0.1	0	53.65	100	100	120
B3	11/4/16 0:00	TRUE	0.1	0	13.94	32.01	100	120
B4	11/4/16 0:00	TRUE	0.1	0	11.52	27.44	100	120
C1	11/4/16 0:00	TRUE	0.1	0	21.44	47.05	100	120
C2	11/4/16 0:00	TRUE	0.1	0	67.57	100	100	120
C3	11/4/16 0:00	TRUE	0.1	0	23.27	50.98	100	120
C4	11/4/16 0:00	TRUE	0.1	0	88.44	100	100	120
D1	5/2/13 0:00	TRUE	0.1	0	60.52	100	100	120
D2	5/2/13 0:00	TRUE	0.1	0	60.52	100	100	120
D3	5/2/13 0:00	TRUE	0.1	0	60.52	100	100	120
D4	5/2/13 0:00	TRUE	0.1	0	60.52	100	100	120

Calibration Efficiencies

SOURCES.XLS

628	Th-230	Alpha	28124250	5831.9	116.64	6-Nov-07	ALS	Th-230-12/16
629	Cs-137	Beta	10994	3937.1	70.87	9-Feb-15	ALS	Cs137-12/16

Th-230 Ringed Planchet Efficiency Calibration
LB4100-A

Date: 12/7/2016

Source ID: 628

Det ID	A1	A2	A3	A4	B1	B2	B3	B4
File Name	ETH1207A	ETH1207A	ETH1207A	ETH1207A	ETH1207B	NA	ETH1207B	ETH1207B
Cnt Time	7.52	7.75	7.35	7.5	7.22	NA	7.39	7.64
Tot Cnts	10008	10009	10011	10011	10010	NA	10000	10001
Bkg CPM	0.122	0.156	0.124	0.095	0.105	NA	0.134	0.158
CPM	1330.7291	1291.3279	1361.9168	1334.705	1386.3216	NA	1353.046	1308.8734
Alpha EFF	0.2281997	0.221443	0.2335479	0.22888153	0.237733	NA	0.2320267	0.2244518
Beta EFF	0.0643288	0.0666528	0.0680612	0.06615498	0.0771242	NA	0.0679839	0.0654528
Efficiency	0.2282	0.2214	0.2335	0.2289	0.2377	NA	0.2320	0.2245

Det ID	C1	C3	C2	C4	D1	D2	D3	D4
File Name	ETH1207C	ETH1207C	NA	NA	NA	NA	NA	NA
Cnt Time	7.56	7.31	NA	NA	NA	NA	NA	NA
Tot Cnts	10005	10016	NA	NA	NA	NA	NA	NA
Bkg CPM	0.124	0.115	NA	NA	NA	NA	NA	NA
CPM	1323.2887	1370.0628	NA	NA	NA	NA	NA	NA
Alpha EFF	0.2269238	0.2349449	NA	NA	NA	NA	NA	NA
Beta EFF	0.071381	0.071137	NA	NA	NA	NA	NA	NA
Efficiency	0.2269	0.2349	NA	NA	NA	NA	NA	NA

	A1	A2	A3	A4	B1	B3	B4	C1	C3
		0	1	2	3	4	6	7	8
offset		0	1	2	3	0	1	2	0
NumRecs		1	1	1	1	1	1	1	1
total time	7.52	7.75	7.75	7.35	7.5	7.22	7.39	7.64	7.56
total counts	10008	10009	10011	10011	10011	10010	10000	10001	10005
reduced chi	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
chi-square	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
CPM	1330.729	1291.328	1361.917	1334.705	1386.322	1353.046	1308.873	1323.289	1370.063
CPM var	354.0915	333.4363	370.8273	356.1425	384.2438	366.2193	342.6957	350.1968	375.1777
Efficiency	0.2282	0.221443	0.233548	0.228882	0.237733	0.232027	0.224452	0.226924	0.234945
archived ST	0.00559	0.005424	0.00572	0.005606	0.005823	0.005684	0.005498	0.005558	0.005754
predicted S	0.002281	0.002214	0.002334	0.002288	0.002376	0.00232	0.002245	0.002269	0.002348
actual STD	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
total counts	2837	3028	2934	2909	3261	2946	2930	3162	3045
reduced chi	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
chi-square	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
CPM	375.1286	388.6807	396.8937	385.7777	449.744	396.4428	381.6829	416.253	414.8297
CPM var	64.40233	65.68159	70.24775	66.7617	82.95885	69.83822	64.90702	72.82024	74.33728
Efficiency	0.064329	0.066653	0.068061	0.066155	0.077124	0.067984	0.065453	0.071381	0.071137
archived ST	0.001884	0.001926	0.00198	0.001927	0.002195	0.001975	0.001903	0.002044	0.002052
predicted S	0.001211	0.001214	0.00126	0.00123	0.001353	0.001256	0.001212	0.001272	0.001292
actual STD	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Cs-137 Ringed Planchet Efficiency Calibration
LB4100-A

Date: 12/7/2016

629

Source ID:

Det ID File Name	A1 ECS1207A	A2 ECS1207A	A3 ECS1207A	A4 ECS1207A	B1 ECS1207B	B2 NA	B3 ECS1207B	B4 ECS1207B
Cnt Time	6.72	6.67	6.56	6.75	6.2	NA	6.35	6.69
Tot Cnts	10015	10015	10019	10006	10008	NA	10011	10022
Bkg CPM	2.132	2.029	2.290	2.089	1.918	NA	2.204	1.825
CPM	1488.195381	1499.47025	1524.9966	1480.28137	1612.27555	NA	1574.33143	1496.2318
Alpha EFF	0.001071469	0.000832437	0.0005325	0.00056352	0.00155309	NA	0.00014488	0.0002741
Beta EFF	0.394236559	0.397223375	0.4039855	0.39214006	0.42710674	NA	0.41705499	0.3963657
Efficiency	0.3942	0.3972	0.4040	0.3921	0.4271	NA	0.4171	0.3964

Det ID File Name	C1 ECS1207C	C3 ECS1207C	C2 NA	C4 NA	D1 N.A.	D2 N.A.	D3 N.A.	D4 N.A.
Cnt Time	6.66	6.32	NA	NA	N.A.	N.A.	N.A.	N.A.
Tot Cnts	10003	10010	NA	NA	N.A.	N.A.	N.A.	N.A.
Bkg CPM	2.001	1.723	NA	NA	N.A.	N.A.	N.A.	N.A.
CPM	1499.950952	1582.137759	NA	NA	N.A.	N.A.	N.A.	N.A.
Alpha EFF	0.001200211	0.000682107	NA	NA	N.A.	N.A.	N.A.	N.A.
Beta EFF	0.397350495	0.419122519	NA	NA	N.A.	N.A.	N.A.	N.A.
Efficiency	0.3974	0.4191	NA	NA	N.A.	N.A.	N.A.	N.A.

	A1	A2	A3	A4	B1	B3	B4	C1	C3
		0	1	2	3	4	6	7	8
offset		0	1	2	3	0	1	2	0
NumRecs	1	1	1	1	1	1	1	1	1
total time	6.72	6.67	6.67	6.56	6.75	6.2	6.35	6.69	6.32
total counts	28	22	22	14	15	37	12	47	31
reduced chi	#DIV/O!	#DIV/O!	#DIV/O!	#DIV/O!	#DIV/O!	#DIV/O!	#DIV/O!	#DIV/O!	#DIV/O!
chi-square	#DIV/O!	#DIV/O!	#DIV/O!	#DIV/O!	#DIV/O!	#DIV/O!	#DIV/O!	#DIV/O!	#DIV/O!
CPM	4.044667	3.142351	2.010146	2.127222	5.862742	1.755764	6.867411	4.530655	2.574873
CPM var	0.621898	0.495749	0.325907	0.329807	0.966205	0.298092	1.05523	0.701188	0.426451
Efficiency	0.001071	0.000832	0.000533	0.000564	0.001553	0.000465	0.001819	0.0012	0.000682
archived ST	0.00021	0.000187	0.000152	0.000152	0.000262	0.000145	0.000274	0.000223	0.000173
predicted S	0.000206	0.000182	0.000147	0.000149	0.000258	0.000139	0.000268	0.000218	0.000169
actual STD	#DIV/O!	#DIV/O!	#DIV/O!	#DIV/O!	#DIV/O!	#DIV/O!	#DIV/O!	#DIV/O!	#DIV/O!
total counts	10015	10015	10015	10019	10006	10008	10011	10022	10010
reduced chi	#DIV/O!	#DIV/O!	#DIV/O!	#DIV/O!	#DIV/O!	#DIV/O!	#DIV/O!	#DIV/O!	#DIV/O!
chi-square	#DIV/O!	#DIV/O!	#DIV/O!	#DIV/O!	#DIV/O!	#DIV/O!	#DIV/O!	#DIV/O!	#DIV/O!
CPM	1488.195	1499.47	1524.997	1480.281	1612.276	1574.331	1496.232	1499.951	1582.138
CPM var	443.8846	450.5644	466.0808	439.3547	520.9178	496.8219	448.344	451.1063	501.4741
Efficiency	0.394237	0.397223	0.403986	0.39214	0.427107	0.417055	0.396366	0.39735	0.419123
archived ST	0.009028	0.009096	0.009251	0.008981	0.009781	0.009551	0.009076	0.0091	0.009597
predicted S	0.003942	0.003972	0.004039	0.003923	0.004272	0.004171	0.003962	0.003976	0.004191
actual STD	#DIV/O!	#DIV/O!	#DIV/O!	#DIV/O!	#DIV/O!	#DIV/O!	#DIV/O!	#DIV/O!	#DIV/O!

Date 12/2/16SOP 724r 11

ALS
Low Background Gas Flow Proportional Counter Log
Instrument: LB4100A

Instrument Daily Response and Background Checks

Det.	Daily Response Check				Background Check				Det. Status
	Start 1	Status	Start 2	Status	Start 1	Status	Start 2	Status	
1	JP	P			JP	P			P
2									
3									
4									
5									
6									OL
7									P
8									
9									
10									OL
11									P
12									OL
13	OL				OL				
14									
15									
16									

Det = Detector; α = Alpha; β = Beta; P = Pass; H = High; L = Low; OL = Offline; R = Recount; W = Weekly; NP = Not Processed

Weekly Background Calibration

	Current Calib. File ID	Weekly Calib. Started	Status	File ID
Dr A	BKA201W			
Dr B				
Dr C				
Dr D	OL			

Dr = Drawer

Gas Supply

P-10 Supply		P-10 Flow	
Tank 1	0	Dr A	10
		Dr B	
Tank 2	2050	Dr C	
		Dr D	

Comments:

Date

12/7/16

SOP 724r 11

ALS

Low Background Gas Flow Proportional Counter Log

Instrument: LB4100A

Det.	Sample ID	Batch	Test	Count Dur. (min)	Start Time	Analyst Initials	File ID	Output Initials
1-12	Daily EQ	—	—	30	7:08	JP	EFA1207	JP
1-12	Daily BK	—	—	60	7:20	JP	BKA1207	JP
1-4	G28	AB150603-5	Th230	30	8:27	JP	ETH1207A	JP
5.7.8			Eff		8:40	JP	B	
9.11					8:51	JP	C	
9.11	G29	AB150310-2	G137		8:28	JP	ECS1207C	
1-4			Eff		8:40	JP	A	
5.7.8					8:52	JP	B	
1-4	1617003-1-18	AB160510-2	G137Hn	30	9:04	JP	ACS1207	
7.9.11								
<div style="position: absolute; bottom: 20px; right: 20px;">JP 12/8/16</div>								

Comments:

 Page No.: 468567 **B**
 (cont. from page 11 **B**)

Form 780r8.doc (6/23/06)

Reviewed By / Date

JP 12/8/16

Date 12/8/16SOP 724r 11

ALS
Low Background Gas Flow Proportional Counter Log
Instrument: LB4100A

Instrument Daily Response and Background Checks

Det.	Daily Response Check				Background Check				Det. Status
	Start 1	Status	Start 2	Status	Start 1	Status	Start 2	Status	
1	JP	P			JP	P			P
2									
3									
4									
5									
6									α
7									P
8									
9									
10									α
11									P
12									OL
13	OL				OL				
14									
15									
16									

Det = Detector; α = Alpha; β = Beta; P = Pass; H = High; L = Low; OL = Offline; R = Recount; W = Weekly; NP = Not Processed

Weekly Background Calibration

	Current Calib: File ID	Weekly Calib. Started	Status	File ID
Dr A	BKA7201W			
Dr B				
Dr C				
Dr D	OL			

Dr = Drawer

Gas Supply

P-10 Supply		P-10 Flow	
Tank 1	0	Dr A	10
		Dr B	
Tank 2	1600	Dr C	
		Dr D	

Comments:

Continued from Page

8:01 12/16/16

Am 241 Mass Attn Curve

Filename: AAM1206

Benchsheet: AB121109-1 Source: 1223001-1-4, 714, 16-19

6, 8-14 JP 12/16/16

JP 12/16/16

JP 12/16/16

Def	8:23	8:52	9:20	9:50	10:21	10:54	11:26	11:57	12:26	12:55	13:23	13:49	14:15	14:39	14:57		
A1	1	19	18	17	16	14	13	12	11	10	9	8	7	4	3	2	
A2	2	1	19	18	17	16	14	13	12	11	10	9	8	7	6	4	3
A3	3	2	1	19	18	17	16	14	13	12	11	10	9	8	7	6	4
A4	4	3	2	1	19	18	17	16	14	13	12	11	10	9	8	7	6
B1	7	6	4	3	2	1	19	18	17	16	14	13	12	11	10	9	8
B3	8	7	6	4	3	2	1	19	18	17	16	14	13	12	11	10	9
B4	9	8	7	6	4	3	2	1	19	18	17	16	14	13	12	11	10
C1	10	9	8	7	6	4	3	2	1	19	18	17	16	14	13	12	11
C2	11	10	9	8	7	6	4	3	2	1	19	18	17	16	14	13	12
C3																	

JP 12/16/16

12/7/16

Gross Alpha (Th-230) EFF Calibration

Benchsheet: AB150603-5 Source ID: 628

Logfile: Th-230-12/16

Sources	Detectors	Filename
1518003-1	A1 B1 C1	ETH1207A
-2	A2 B3 C3	B
-3	A3 B4	C
-4	A4	

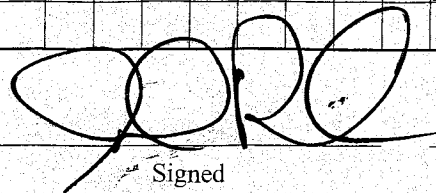
Gross Beta (Cs-137) EFF Calibration

Benchsheet: AB150310-2 Source ID: 629

Logfile: Cs137-12/16

Sources	Detectors	Filename
1515003-1	A1 B1 C1	ECS1207A
-3	A2 B3 C3	B
-4	A3 B4	C
-5	A4	

Continued on Page

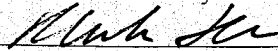


Signed

12/8/16

Date

Read and Understood By



Signed

12-12-16

91 of 329

Date

Radiochemistry Instrument Worksheet

ALS Environmental -- FC

Prep Batch: AB150603-5

Prep Procedure: GROSS_ALPHA

Base Efficiency

Analytical QASS / NCR? Y NA

Prep Num	LabID	QC Type	Init Aliq	Fin Aliq	Report Units	Residual Mass (mg)	Cnt 1 File	Cnt 1 Inst/Det	Cnt 1 Pos Chk By	Cnt 2 File	Cnt 2 Inst/Det	Cnt 2 Pos Chk By	Cnt 3 File	Cnt 3 Inst/Det	Cnt 3 Pos Chk By	Notes
1	1518003-1	SMP	200	200	ml	pCi/l										
1	1518003-2	SMP	200	200	ml	pCi/l										
1	1518003-3	SMP	200	200	ml	pCi/l										
1	1518003-4	SMP	200	200	ml	pCi/l										
1	1518003-5	SMP	200	200	ml	pCi/l										

See Maintenance Log #3974 pg 38

Przlish

Other

Spike Solution Information

Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	Th-230	853.3020.89	1,166.300	DPM/ml	06/03/15	5	ml	RS-027

Sample Barcodes

1518003-1 AB150603-SPS1		1518003-2 AB150603-SPS2		1518003-3 AB150603-SPS3	
1518003-4 AB150603-SPS4		1518003-5 AB150603-SPS5			

Reporting Units

LabID:	TstGrpName:	RptUnits:
1518003-1	GrossAlpha_DW	pCi/l
1518003-2	GrossAlpha_DW	pCi/l
1518003-3	GrossAlpha_DW	pCi/l
1518003-4	GrossAlpha_DW	pCi/l
1518003-5	GrossAlpha_DW	pCi/l

Radiochemistry Prep Worksheet

ALS Environmental -- FC

Prep Batch: AB150603-5

Prep Procedure: GROSS_ALPHA

Reviewed By: jkb *jkb* Review Date: 6/8/2015

Prep QASS / NCR? Y *(N)* NA

Batch: NA

Re-Prep? Y *(N)*

Prep Analyst: Jennie Kill-Bowden

Prep Date: 6/3/2015

Prep Dept: RS

Prep SOP: PAI 702 Rev: 20

Prep SOP: NONE

Matrix Class: liquid

Batch: NA

Y *(N)*

Prep Notes

Standards

Prep Basis

Fin Alq
ml

Init Alq
ml

Dish
No.

QC
Type

LabID

Samp
Num

not 6/8/15

S1

S1

S1

S1

S1

S1

S1

S1

S1

S1

S1

S1

S1

S1

S1

S1

S1

S1

S1

S1

S1

Comments

Zero Mass Efficiency for Th-230 USGS method

Spiked By: Jennie Kill-Bowden Date: 6/4/2015

Witnessed By: Dayna K. Lewis Date: 6/4/2015

Spike Solution Information

Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	Th-230	853.3020.89	1,166.300	DPM/ml	06/03/15	5	ml	RS-027

Radiochemistry Prep Worksheet

ALS Environmental -- FC

Prep Batch: AB150603-5

Prep Procedure: GROSS_ALPHA

Prep Batch Not Validated!!!

Reviewed By:

Review Date:

Non-Routine Pre-Treatment? Y / N Batch:

Re-Prep? Y / N Batch:

Prep QASS / NCR? Y / N

Prep SOP: PAI 702 Rev: 20

Prep SOP: NONE

Matrix Class: liquid

Prep Analyst: Jennie Kill-Bowden *JKB*

Prep Date: 6/3/2015

Prep Dept: RS

Balance:

Balance:

Samp Num	Prep Num	LabID	QC Type	Dish No.	Init Alq ml	Fin Alq ml	Prep Basis	Standards	Prep Notes
1	1	1518003-1	SMP	200	200	200	Unfiltered	S1	
2	1	1518003-2	SMP	200	200	200	Unfiltered	S1	
3	1	1518003-3	SMP	200	200	200	Unfiltered	S1	
4	1	1518003-4	SMP	200	200	200	Unfiltered	S1	
5	1	1518003-5	SMP	200	200	200	Unfiltered	S1	

Comments

Zero Mass Efficiency for Th-230 USGS method

Spiked By: *JKB* Date: *6/4/15*

Witnessed By: *[Signature]* Date: *6/4/15*

Spike Solution Information					
Soln #	Nuclide	SolnID	Prep Conc	Units	Pipet ID
S1	Th-230	853.3020.89	1,166.300	DPM/ml	06/03/15
				5	ml
					RS-027

ra/13/15

Radiochemistry Instrument Worksheet

Prep Batch: AB150603-5

ALS Environmental -- FC

Prep Procedure: GROSS_ALPHA

Analytical QASS / NCR? Y *NA*

Prep Num	LabID	QC Type	Init Aliq	Fin Aliq	Units	Report Units	Residual Mass (mg)	Cnt 1 File	Cnt 1 Ins/Dat	Cnt 1 Pos Chk By	Cnt 2 File	Cnt 2 Ins/Dat	Cnt 2 Pos Chk By	Cnt 3 File	Cnt 3 Ins/Dat	Cnt 3 Pos Chk By	Notes
1	1518003-1	SMP	200	200	ml	pCi/l		AB00609									
1	1518003-2	SMP	200	200	ml	pCi/l		A									
1	1518003-3	SMP	200	200	ml	pCi/l		B									
1	1518003-4	SMP	200	200	ml	pCi/l		C									
1	1518003-5	SMP	200	200	ml	pCi/l		D									

pp 6/6/15

Other

Scan #	Nuclide	Soln ID	Prep Conc	Units	Prep Date	Aliquot Units	Pipet ID
S1	Th-230	853.3020.89	1,166.300	DPW/ml	06/03/15	5 ml	RS-027

Sample Barcodes

1518003-1 AB150603-SPS1	1518003-2 AB150603-SPS2	1518003-3 AB150603-SPS3
1518003-4 AB150603-SPS4	1518003-5 AB150603-SPS5	

Reporting Units

LabID	TestName	RptUnits
1518003-1	GrossAlpha_DW	pCi/l
1518003-2	GrossAlpha_DW	pCi/l
1518003-3	GrossAlpha_DW	pCi/l
1518003-4	GrossAlpha_DW	pCi/l
1518003-5	GrossAlpha_DW	pCi/l

Radiochemistry Prep Worksheet

Prep Batch: AB150603-5

ALS Environmental -- FC

Reviewed By: jkb 3/6/15 Review Date: 6/8/2015

Prep Procedure: GROSS_ALPHA

Non-Routine Pre-Treatment? Y (N) Batch: NA Re-Prep? Y (N) Prep QASS / NCR? Y (N) NA

Prep SOP: PAI 702 Rev: 20
Prep SOP: NONE
Matrix Class: liquid

Prep Analyst: Jennie Kil-Bowden
Prep Date: 6/3/2015
Prep Dept: RS

Balance:
Balance:

Sample Num	Prep Num	LabID	QC Type	Dish No.	Inu Aliq ml	Fin Aliq ml	Prep Basis	Standards	Prep Notes
1	1	1518003-1	SMP		200	200	Unfiltered	S1	
2	1	1518003-2	SMP		200	200	Unfiltered	S1	
3	1	1518003-3	SMP		200	200	Unfiltered	S1	
4	1	1518003-4	SMP		200	200	Unfiltered	S1	
5	1	1518003-5	SMP		200	200	Unfiltered	S1	

Comments

Zero Mass Efficiency for Th-230 USGS method

Spiked By: Jennie Kil-Bowden Date: 6/4/2015

Witnessed By: Dayna K. Lewis Date: 6/4/2015

Spike Solution Information					
Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date
S1	Th-230	853 3020.89	1,166,300	DPM/ml	06/03/15
				5 ml	RS-027

ALS Environmental -- FC

Supersedes: 6/4/15 842

Page 1 of 1 GROSS_ALPHA Bench Sheet

Date Printed: 6/8/2015 17:16

Radiochemistry Prep Worksheet

Prep Batch: AB150603-5

ALS Environmental -- FC

Prep Procedure: GROSS_ALPHA

Prep Batch Not Validated!!!

Reviewed By:

Review Date:

Non-Routine Pre-Treatment? Y / N Batch:

Prep QASS / NCR? Y / N

Re-Prep? Y / N Batch:

Prep SOP: PAI 702 Rev: 20

Prep SOP: NONE

Matrix Class: liquid

Prep Analyst: Jennie Kill-Bowden *JKB*

Prep Date: 6/3/2015

Prep Dept: RS

Balance:

Balance:

Sample Num	Prep Num	LabID	QC Type	Dish No.	Init Aliq ml	Fin Aliq ml	Prep Basis	Standards	Prep Notes
1	1	1518003-1	SMP		200	200	Unfiltered	S1	
2	1	1518003-2	SMP		200	200	Unfiltered	S1	
3	1	1518003-3	SMP		200	200	Unfiltered	S1	
4	1	1518003-4	SMP		200	200	Unfiltered	S1	
5	1	1518003-5	SMP		200	200	Unfiltered	S1	

Comments

Zero Mass Efficiency for Th-230 USGS method

Spiked By: *JKB*

Date: *6/4/15*

Witnessed By: *JKB*

Date: *6/4/15*

Spike Solution Information					
Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date
S1	Th-230	853.3020.89	1.166	300 DPM/ml	06/03/15
				5 ml	RS-027

ra/13/15

PAJ - Gas Flow Proportional Sample Analysis LB4100-C

Unit Type: LB4100-C
 Counting Unit ID: Magerita
 High Voltage Mode: Simultaneous
 Application Revision: Standard
 Rev.120100a JCF

Background logfiles: BKCADW
 Date of Bkg. Cal: 08/20/15
 Alpha activity logfiles: TH230-06/15
 Alpha attenuation calibration: AT18019, 06/20
 Beta efficiency logfiles: Ca-137-03/15
 Beta attenuation calibration: ACS0312

Data file name: ABC0609
 Batch ID: TH230 OUTLIER
 Count Preset (nq): 10
 Batch Ended: 09/20/15 8:58

2

Det. ID	Sample ID	Count End Date & Time	Count Dur. (min)	Resid. Mass (mg)	Alpha Activity				Beta Activity				Alpha Attenuation Calibration				Beta Attenuation Calibration			
					Gross CPM	Bkg. CPM	a>b x10k CPM	Base EIR	Cor.Factl	Base EIR	Cor.Factl	Base EIR	Base EIR	Base EIR	Cor.Factl	Base EIR	Base EIR	Cor.Factl	Base EIR	Cor.Factl
A1	1518003-1	09/20/15 8:58	10.00	0.0	1379.300	0.124	1.223	0.2386	0.937	0.4155	0.0449	0.4155	0.4155	0.0449	0.0449	0.4155	0.4155	0.0449	0.4155	0.0449

JP 6/9/15

PAI - Gas Flow Proportional Sample Analysis LB4100-C

Unit Type: LB4100-C
Counting Unit ID: Magenta
High Voltage Mode: Simultaneous
Application Revision: Standard
Rev: 12/01/04 JCP
Data file name: ASC0809A
Batch ID: TH230 OUTLIER
Count Preset Int: 10
Batch Ended: 6/5/2015 9:10
2

Background Logfile: BKGABW
Data of Bkg. Cal: 6/5/2015
Alpha efficiency logfile: TH230-06/13
Alpha prop. logfile: n/a
Alpha attenuation logfile: AT165-10_0620
Alpha prop. attenuation: n/a
Beta efficiency logfile: C1-137-05/16
Beta prop. attenuation: n/a
Beta attenuation calibration: ACS0312

Alpha Attenuation Calibration		Beta Attenuation Calibration	
$y = b \cdot m^a$ (a: mass, b: eff)		$y = b \cdot m^a$ (a: mass, b: eff)	
Alpha B=	0.93740	Beta B=	0.9494
n=	0.99990	n=	0.9913
a=	0.5206	a=	1.0468
std=	0.0080	std=	0.0008
Alpha to Beta Ratio		Beta to Alpha Ratio	
$y = b \cdot m^a$ (a: mass, b: eff)		$y = b \cdot m^a$ (a: mass, b: eff)	
Alpha to Beta B=	0.2527	Beta to Alpha B=	0.3456
Alpha to Beta n=	0.9973	Beta to Alpha n=	0.9822

Det. ID	Sample ID	Count End Date & Time	Count Dur. (min)	Resid. Mass (mg)	Alpha Activity						Beta Activity					
					Gross CPM	Bkg. CPM	b+a xlik CPM	Base EN	Base Cor.Fact.	Progeny Eff	Progeny Cor.Fact.	Gross CPM	Bkg. CPM	a+b xlik CPM	Base EN	Base Cor.Fact.
A1	151803-2	6/5/2015 9:10	10.00	0.0	1319.700	0.124	1.210	0.2386	0.937	NA	NA	376.700	1.476	333.058	0.4155	0.949

TH 6/9/15

PAI - Gas Flow Proportional Sample Analysis LB4100-C

Unit Type: LB4100-C
Counting Unit ID: Magenta
High Voltage Mode: Simultaneous
Application Revision: Standard
Rev: 120100 JCP

Data file name: ABC0609B
Batch ID: TH230 OUTLIER
Count Preset (m): 10
Batch Endset: 9/2/2015 9:24

Background logfiles: BKDABW
Date of Bkg. Cal: 6/2/2015
Alpha efficiency logfiles: TH230-06/13
Alpha attenuation calibration: ATH0819_0820
Alpha prog. logfiles: n/a
Alpha attenuation calibration: Ca-137-03/15
Alpha prog. attenuation: n/a
Beta efficiency logfiles: ACS0312
Beta attenuation calibration: n/a
Beta prog. attenuation: n/a

Alpha Attenuation Calibration		Beta Attenuation Calibration	
$y = b \cdot m^a$ (mass- α)		$y = b \cdot m^a$ (mass- β)	
Alpha b	0.33740	Beta b	0.2434
m	0.99030	m	0.9993
a	0.8208	a	1.0489
adj	0.0095	adj	0.0090
Alpha to Beta X-40K		Beta to Alpha X-40K	
$y = b \cdot x^a$ mass	0.2527	$y = b \cdot x^a$ mass	3.242-06
$b \rightarrow a$ stat	0.9978	$b \rightarrow a$ stat	0.0032

Det. ID	Sample ID	Count End Date & Time	Count Dur. (min)	Resid. Mass (mg)	Alpha Activity						Beta Activity					
					Gross CPM	Bkg. CPM	b-a xlik CPM	Base Eff	Cor.Fact.	Progeny Eff	Progeny Cor.Fact.	Gross CPM	Bkg. CPM	a-b xlik CPM	Base Eff	Cor.Fact.
A1	1318003-3	9/2/2015 8:24	10.00	0.0	1333.000	0.124	1.243	0.2368	0.837	n/a	n/a	382.500	1.476	336.0178	0.4155	0.948

JPG 6/9/15

PAI - Gas Flow Proportional Sample Analysis LB4100-C

Unit Type: LB4100-C
 Counting Unit ID: Magenta
 High Voltage Mode: Simultaneous
 Application Revision: Standard
 Rev: 1207188 ICP

Data file name: ABC0605C
 Batch ID: TH230 OUTLIER
 Count Preset (nt): 10
 2 Batch Ended: 6/6/2015 9:47

Background log file: BKGABW
 Date of Bkg. Cal: 6/6/2015
 Alpha efficiency log file: TH230-06/13
 Alpha attenuation calibration: A1H0619_0630
 Beta efficiency log file: Ca-137-03/15
 Beta attenuation calibration: ACS06112

Alpha Attenuation Calibration		Beta Attenuation Calibration	
$y = b \cdot \ln(x) / (\ln(10) \cdot \ln(2))$		$y = b \cdot \ln(x) / (\ln(10) \cdot \ln(2))$	
Alpha b=	0.93740	Beta b=	0.9494
m=	0.99590	m=	0.9983
a=	0.9364	a=	1.0483
sd=	0.0080	sd=	0.0003
Alpha to Beta X-44k		Beta to Alpha X-44k	
$y = b \cdot \ln(x) / (\ln(10) \cdot \ln(2))$	0.2557	$y = b \cdot \ln(x) / (\ln(10) \cdot \ln(2))$	-1.56246
a -> b x44k m=	0.9378	b -> a x44k m=	2.6032

Det. ID	Sample ID	Count End Date & Time	Count Dur. (min)	Resid. Mass (mg)	Alpha Activity						Beta Activity					
					Gross CPM	Bkg. CPM	B>A x44k CPM	Base EH	Base Cor.Fact.	Progeny Eff	Progeny Cor.Fact.	Gross CPM	Bkg. CPM	B>A x44k CPM	Base EH	Base Cor.Fact.
A1	1518003.4	6/6/2015 9:47	10.00	0.0	1348.500	0.124	1.276	0.2386	0.037	na	na	401.100	1.476	340.7348	0.4155	0.948
										na	na					na

TH230

PAI - Gas Flow Proportional Sample Analysis LB4100-C

Unit Type: LB4100-C
 Counting Unit ID: M-gentia
 High Voltage Mode: Simultaneous
 Application Revision: Standard
 Rev.12/01/04 JCP

Data file name: AEC0609D
 Batch ID: T1230 OUTLIER
 Count Preset (mg): 10
 Batch Ends at: 09/20/15 10:01

Background logfiles: BKGADBW
 Date of Bkg. Cal: 08/22/15
 Alpha efficiency logfile: T1230-09/15
 Alpha attenuation calibration: ATH0019.DC20
 Beta efficiency logfile: C-137-02/15
 Beta attenuation calibration: ACS0012

Alpha Attenuation Calibration		Beta Attenuation Calibration	
$y = b \cdot m^a$ (a: mass < c)		$y = b \cdot m^a$ (a: mass < c)	
Alpha B=	0.31740	Beta B=	0.3434
m=	0.96090	m=	0.9993
a=	0.9208	a=	1.0168
sd=	0.0000	sd=	0.0000
Alpha to Beta Ratio		Beta to Alpha Ratio	
$y = b \cdot m^a$ (a: mass < c)		$y = b \cdot m^a$ (a: mass < c)	
b -> b ratio B=		b -> b ratio B=	
b -> b ratio C=		b -> b ratio C=	
0.9878		0.9878	

Det. ID	Sample ID	Count End Date & Time	Count Dur. (min)	Resid. Mass (mg)	Alpha Activity				Beta Activity				Progeny			
					Gross CPM	Bkg. CPM	Net CPM	Eff	Gross CPM	Bkg. CPM	Net CPM	Eff	Gross CPM	Bkg. CPM	Net CPM	Eff
A1	1818003-5	6/20/2015 10:01	10.00	0.0	1268.800	0.124	1.184	0.2366	0.837	0.037	0.037	0.037	374.500	1.476	320.1143	0.4155

MC/9/15

Date 6/9/15

SOP 724r 11

ALS
Low Background Gas Flow Proportional Counter Log
Instrument: LB4100C

Instrument Daily Response and Background Checks

Det.	Daily Response Check				Background Check				Det. Status
	Start 1	Status	Start 2	Status	Start 1	Status	Start 2	Status	
1	JP	P			JP	P			P
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									

Det = Detector; α = Alpha; β = Beta; P = Pass; H = High; L = Low; OL = Offline; R = Recount; W = Weekly; NP = Not Processed

Weekly Background Calibration

	Current Calib. File ID	Weekly Calib. Started	Status	File ID
Dr A	BK00605W			
Dr B				
Dr C				
Dr D				

Dr = Drawer

Gas Supply

	P-10 Supply		P-10 Flow
Tank 1	1850	Dr A	0.1
		Dr B	
Tank 2	1200	Dr C	
		Dr D	

Comments:

Page No.: 455204 A

Form 780r8.doc (6/23/06)

Reviewed By / Date J 6/9/15

Date

6/9/15

SOP 724r/11

ALS

Low Background Gas Flow Proportional Counter Log

Instrument: LB4100C

Det.	Sample ID	Batch	Test	Count Dur. (min)	Start Time	Analyst Initials	File ID	Output Initials
1-16	Daily EFP	==	==	30	7:13	JP	EFC0609	JP
1-16	Daily Bkg	==	==	60	7:22	JP	BK0609	JP
1	1518003-1	AB1506035	Th230	10	8:47	JP	AB0609	JP
1	-2		Outlier		9:00	JP	A	
1	-3				9:13	JP	B	
1	-4				9:37	JP	C	
1	-5				9:51	JP	D	
1-4	1067	AB1506035	Th230	30	10:15	JP	ETH0609	JP
5-8			Eff		10:23		B	
9-12			Cal		10:37		C	
13-16			Mass Ath		10:51		D	
1-16	1518004-1-16	AB1506036	Th230	30	11:01	JP	ATH0609	JP
1	1505092-1	SR1506051	SR90	180	16:03	JP	SR0609	JP
2	-3							
3	-3D							
4	1505234-1							
5	-3							
6	-5							
7	-7							
8	-9							
9	-11							
10	-13							
11	-13D							
12	1505235-1							
14	-3							
15	-3D							
16	1505249-1							
1	-2	SR1506051	SR90	180	22:12	JP	SR0609	
2	1505344-1							
3	427-1							
4	-3							
5	SR1506051MB							
6	101							
7	1505379-8	AB1506051	917	120	22:13	JP	AB0609	
8	-8D							
9	-1D							
10	AB1506051-16							
11	1505341-1	AB1506052		480	22:15		AB0609	
12	-1D							
14	1505448-1							
15	-4							
JP 6/10/15								

Comments:

 Page No.: 455204 B
 (cont. from page 111 B)

Form 780r8.doc (6/23/06)

Reviewed By / Date

JP 6/10/15

Date

6/10/15

SOP 724r

11

ALS
Low Background Gas Flow Proportional Counter Log
Instrument: LB4100C

Instrument Daily Response and Background Checks

Det.	Daily Response Check				Background Check				Det. Status
	Start 1	Status	Start 2	Status	Start 1	Status	Start 2	Status	
1	P	P			P	P			P
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									

Det = Detector; α = Alpha; β = Beta; P = Pass; H = High; L = Low; OL = Offline; R = Recount; W = Weekly; NP = Not Processed

Weekly Background Calibration

	Current Calib. File ID	Weekly Calib. Started	Status	File ID
Dr A	BKC 010512			
Dr B				
Dr C				
Dr D				

Dr = Drawer

Gas Supply

	P-10 Supply		P-10 Flow
Tank 1	1500	Dr A	0.1
		Dr B	
Tank 2	1200	Dr C	
		Dr D	

Comments:

Page No.: 455205 A

Form 780r8.doc (6/23/06)

Reviewed By / Date

JPC/10/15

Prepare an Intermediate dilution of Th-230 P50 # 853
of approximately 1200 dpm/ml

1) Prepare 0.5M HNO_3 , 31 ml HNO_3 and 969 ml DI water,
lot # 073602

2) Determine density of 0.5M HNO_3

Mass of 100 ml vol. flask:

Cal. 12

68.2999g

Mass of flask + 100 ml 0.5M HNO_3 :

107.4529g

Net mass of 0.5M HNO_3 :

101.153g

$$\rho = 1.015 \text{ g/ml}$$

3) Transfer contents of vial to 1000 ml Nalgene

Cal. 14

Mass of full standard vial:

81.2827

Mass of empty standard vial:

3.2327

Net mass of standard transferred:

5.05g

4) Dilute with 0.5M HNO_3

Mass of Nalgene w/ lid (empty):

73.66g

73.73g

Mass of Nalgene with standard:

78.71g

Mass of Nalgene, standard, and diluent:

1085.2

Net mass of standard:

1011.54g

5) Final activity calculation

$$(1.983 \times 10^4 \text{ Bq}) / (5.1519 \text{ g}) = 3849.60 \text{ Bq/g} \times (60 \text{ s/min}) = 230,976.755 \text{ dpm}$$

$$(3849.60 \text{ Bq/g}) \cdot (5.05 \text{ g}) \cdot (1.015 \text{ g/ml}) = 1981.22 \text{ dpm/ml}$$

Std ID: 853.3020.89

Description: Th-230

Expiration: 2/5/2009

Activity: 1166.38 dpm/mL

2s Uncertainty: 23.33 dpm/mL

Ref. Date: 11/6/2007

Ref Time: N/A

Prep Date: 12/12/2007 Prep by: DC

Matrix/Comp. 0.5 M HNO_3

Half Life (y): 7.70E+04

Reverification Log

Analysis Date	Initials	Expiration Date
5/5/09	RG	5/5/2010
11/19/10	RG	11/19/2011
12/13/14	JP	12/13/2015

Continued on Page

Signature:

12/12/07

DC:

Read and Understood By

Signature:

Signature

2/13/08



Eckert & Ziegler

Analytics

1380 Seaboard Industrial Blvd.
Atlanta, Georgia 30318
Tel 404-352-8677
Fax 404-352-2837
www.analyticsinc.com

CERTIFICATE OF CALIBRATION
Standard Radionuclide Source

76253-307

Th-230 5 mL Liquid in Flame Sealed Vial

Customer: Paragon Analytics / Fort Collins, CO
P.O. No.: 72809-REL 10-30-07, Item 1

This standard radionuclide source was prepared gravimetrically from a calibrated master solution. The master solution was calibrated by liquid scintillation counting.

Radionuclide purity and calibration were checked by germanium gamma-ray spectrometry and liquid scintillation counting. The nuclear decay rate and assay date for this source are given below.

ANALYTICS maintains traceability to the National Institute of Standards and Technology through Measurements Assurance Programs as described in USNRC Reg. Guide 4.18, Revision 1.

Isotope:	Th-230
Activity (Bq):	1.983 E4
Half-Life:	7.538 E4 years
Calibration Date:	November 8, 2007 12:00 EST
Relative Expanded Uncertainty (k=2):	2.0%

Comments:

Impurities: γ -impurities <0.1%, α -impurities <0.01%,
5.16119 grams 0.5M HNO₃ solution.

Source Prepared By: N. E. Klesman
N. E. Klesman, Radiochemist

QA Approved: D. M. Montgomery
D. M. Montgomery, QA Manager

Date: 11-19-07

End of Certificate

Corporate Office
24937 Avenue Tibbitts Valencia, California 91355

Laboratory
1380 Seaboard Industrial Blvd. Atlanta, Georgia, 30318

Radiochemistry Instrument Worksheet

Prep Batch: AB150310-2

ALS Environmental -- FC W 3/10/15

Prep Procedure: GROSS ~~ALPHA~~ BETA BASE EFFICIENCY

Analytical QASS / NCR? Y N

rep num	LabID	QC Type	Init Aliq	Fin Aliq	Units	Report Units	Residual Mass (mg)	Cnt 1 File	Cnt 1 Inst/Det	Cnt 1 Pos Chk By	Cnt 2 File	Cnt 2 Inst/Det	Cnt 2 Pos Chk By	Cnt 3 File	Cnt 3 Inst/Det	Cnt 3 Pos Chk By	Notes
1	1515003-1	SMP	200	200	ml	pCi/l	0										
1	1515003-2	SMP	200	200	ml	pCi/l	0										
1	1515003-3	SMP	200	200	ml	pCi/l	0										
1	1515003-4	SMP	200	200	ml	pCi/l	0										
1	1515003-5	SMP	200	200	ml	pCi/l	0										

Sec Maintenance Log 3974 pg 38

Outline

2/15/17

Sec Narehena Log 3974 pg 38

Outlier

M 2/15/17

Spike Solution Information						
Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Pipet ID
S1	Cs-137	1019.4095.83	3.929.815	DPM/ml	03/10/15	1 ml RS-005

Sample Barcodes

1515003-1 AB150310-2PS1		1515003-2 AB150310-2PS2		1515003-3 AB150310-2PS3	
1515003-4 AB150310-2PS4		1515003-5 AB150310-2PS5			

Reporting Units

LabID	TstGrpName	RptUnits
1515003-1	GrossAlpha_DW	pCi/l
1515003-2	GrossAlpha_DW	pCi/l
1515003-3	GrossAlpha_DW	pCi/l
1515003-4	GrossAlpha_DW	pCi/l
1515003-5	GrossAlpha_DW	pCi/l

Radiochemistry Prep Worksheet

ALS Environmental -- FC

Prep Batch: AB150310-2

Prep Procedure: GROSS_ALPHA

Reviewed By: jkb

Review Date: 3/10/2015

Non-Routine Pre-Treatment? Y ☒ Batch: AA

Re-Prep? Y ☒ Prep QASS / NCR? Y ☒ NA

Prep SOP: PAI 702 Rev: 20

Prep Analyst: Jennie Kill-Bowden

Prep Date: 3/10/2015

Balance:

Prep SOP: NONE

Prep Dept: RS

Balance:

Matrix Class: liquid

Samp Num	Prep Num	LabID	QC Type	Dish No.	Init Aliq ml	Fin Aliq ml	Prep Basis	Standards	Prep Notes
1	1	1515003-1	SMP		200	200	As Received	S1	
2	1	1515003-2	SMP		200	200	As Received	S1	
3	1	1515003-3	SMP		200	200	As Received	S1	
4	1	1515003-4	SMP		200	200	As Received	S1	
5	1	1515003-5	SMP		200	200	As Received	S1	

Comments

Cs-137 efficiencies

Spiked By: Jennie Kill-Bowden Date: 3/10/2015

Witnessed By: Dayna K. Lewis Date: 3/10/2015

Spike Solution Information					
Soln #	Nuclide	SolnID	Prep Conc	Units	Pipet ID
S1	Cs-137	1019.4095.83	3,929.815	DPM/ml	03/10/15
				1	ml
					RS-005

Radiochemistry Prep Worksheet

ALS Environmental -- FC

Prep Batch: AB150310-2

Prep Procedure: GROSS_ALPHA

Prep Batch Not Validated!!!

Reviewed By:

Review Date:

Non-Routine Pre-Treatment? Y / N Batch: Re-Prep? Y / N Batch: Prep QASS / NCR? Y / N

Prep SOP: PAI 702 Rev: 20

Prep Analyst: Jennie Kill-Bowden

Balance:

Prep SOP: NONE

Prep Date: 3/10/2015

Balance:

Matrix Class: liquid

Prep Dept: RS

Samp Num	Prep Num	LabID	QC Type	Dish No.	Init Alq ml	Fin Alq ml	Prep Basis	Standards	Prep Notes
1	1	1515003-1	SMP	200	200	200	As Received	S1	
2	1	1515003-2	SMP	200	200	200	As Received	S1	
3	1	1515003-3	SMP	200	200	200	As Received	S1	
4	1	1515003-4	SMP	200	200	200	As Received	S1	
5	1	1515003-5	SMP	200	200	200	As Received	S1	

Comments

Cs-137 efficiencies

Spiked By: SKS Date: 3/10/15

Witnessed By: B Date: 3/10/15

Spike Solution Information					
Soln #	Nuclide	SolnID	Prep Conc	Units	Pipet ID
S1	Cs-137	1019.4095.83	3.929.815	DPM/ml	03/10/15
				ml	RS-005

exp. 3/5/16

Radiochemistry Instrument Worksheet

ALS Environmental -- FC JP 3/15

Prep Batch: AB150310-2

Prep Procedure: GROSS ALPHA BETA

BASE EFFICIENCY

OUTLIER

Analytical QASS / NCR? Y NA

Prep Num	LabID	QC Type	Init Aliq	Fin Aliq	Units	Report Units	Residual Mass (mg)	Cat 1 File	Cat 1 InsIDet	Cat 1 Pos Chk By	Cat 2 File	Cat 2 InsIDet	Cat 2 Pos Chk By	Cat 3 File	Cat 3 InsIDet	Cat 3 Pos Chk By	Notes
1	1515003-1	SMP	200	200	ml	pCi/l	0	ABC031Z			JP						
1	1515003-2	SMP	200	200	ml	pCi/l	0				A						OUTLIER
1	1515003-3	SMP	200	200	ml	pCi/l	0				B						
1	1515003-4	SMP	200	200	ml	pCi/l	0				C						
1	1515003-5	SMP	200	200	ml	pCi/l	0				D						

JP 4/2/10

Spill Solution Information

Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	Cs-137	1019.4095.83	3.929.815	DPM/ml	03/10/15	1	ml	RS-005

Sample Barcodes

1515003-1 AB150310-2PS1	1515003-2 AB150310-2PS2	1515003-3 AB150310-2PS3
1515003-4 AB150310-2PS4	1515003-5 AB150310-2PS5	

Reporting Units

Sample	Reporting Units
1515003-1 GrossAlpha_DW	pCi/l
1515003-2 GrossAlpha_DW	pCi/l
1515003-3 GrossAlpha_DW	pCi/l
1515003-4 GrossAlpha_DW	pCi/l
1515003-5 GrossAlpha_DW	pCi/l

Radiochemistry Prep Worksheet

ALS Environmental - FC

Prep Batch: AB150310-2

Prep Procedure: GROSS_ALPHA

Reviewed By: jkb Review Date: 3/10/2015

Non-Routine Pre-Treatment? Y ☒ Batch: AA Re-Prep? Y ☒ Batch: AA Prep QASS / NCR? Y ☒ NA

Prep SOP: PAI 702 Rev: 20

Prep SOP: NONE

Matrix Class: liquid

Prep Analyst: Jennie Kill-Bowden

Prep Date: 3/10/2015

Prep Dept: RS

Balance:

Balance:

Sample Num	Prep Num	LabID	QC Type	Dish No.	Init Aliq ml	Fin Aliq ml	Prep Basis	Standards	Prep Notes
1	1	1515003-1	SMP		200	200	As Received	S1	
2	1	1515003-2	SMP		200	200	As Received	S1	
3	1	1515003-3	SMP		200	200	As Received	S1	
4	1	1515003-4	SMP		200	200	As Received	S1	
5	1	1515003-5	SMP		200	200	As Received	S1	

Comments

Cs-137 efficiencies

Spiked By: Jennie Kill-Bowden Date: 3/10/2015

Witnessed By: Dayna K. Lewis Date: 3/10/2015

Spike Solution Information					
Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date
S1	Cs-137	1019.4095.83	3.929.815	DPM/ml	03/10/15
				1	ml
					RS-005

Radiochemistry Prep Worksheet

ALS Environmental -- FC

Prep Batch: AB150310-2

Prep Procedure: GROSS_ALPH

Prep Batch Not Validated!!!

Reviewed By: _____ Review Date: _____

Non-Routine Pre-Treatment? Y / N Batch: _____

Prep QASS / NCR? Y / N

Prep SOP: PAI 702 Rev: 20

Prep SOP: NONE

Matrix Class: liquid

Prep Analyst: Jennie Kill-Bowden

Prep Date: 3/10/2015

Prep Dept: RS

Balance:

Balance:

Sample Num	Prep Num	LabID	QC Type	Dish No.	Init Aliq ml	Fin Aliq ml	Prep Basis	Standards	Prep Notes
1	1	1515003-1	SMP		200	200	As Received	S1	
2	1	1515003-2	SMP		200	200	As Received	S1	
3	1	1515003-3	SMP		200	200	As Received	S1	
4	1	1515003-4	SMP		200	200	As Received	S1	
5	1	1515003-5	SMP		200	200	As Received	S1	

Comments

Cs-137 efficiencies

Spiked By: SKS

Date: 3/10/15

Witnessed By: SKS

Date: 3/10/15

Spike Solution Information					
Soln #	Nuclide	SolnID	Prep Conc	Units	Pipet ID
S1	Cs-137	1019.4095.83	3.929.815	DPM/ml	03/10/15
				1	ml
					RS-005

exp: 3/5/16

OUTLIER TEST

FILE	DET	SAMPLE ID	Beta CPM	Relative % diff. from mean	Within acceptability range	Outlier?
ABC0312	A1(1)	1515003-1	1620.1	0.64%	YES	NO
ABC0312A	A1(1)	1515003-2	1587.29	1.41%	YES	OUTLIER!
ABC0312B	A1(1)	1515003-3	1625.29	0.95%	YES	NO
ABC0312C	A1(1)	1515003-4	1622.57	0.79%	YES	NO
ABC0312D	A1(1)	1515003-5	1594.29	0.97%	YES	NO

Mean of all five planchets:

Average= 1609.91

Std dev= 17.7299

2 Std Dev= 35.46

Acceptability range

1645.37

1574.45

Relative range

+/- 1.49%

2.20%**Sample 1515003-2 rejected as outlier.**

Criteria: Potential outliers fall outside acceptability range; which is the mean of all five measurements +/- 2 std dev per the Grubbs statistical test.

PAI - Gas Flow Proportional Sample Analysis LB4100-C

Unit Type: LB4100-C
 Counting Unit ID: Magenta
 High Voltage Mode: Simultaneous
 Application Revision: Standard
 Rev.12/01/08 JCP

Data file name: ABC0312
 Batch ID: AB150310-2 OUTLIER
 Count Preset (m): 7
 Batch Ended: 3/12/2015 7:20

Background logfile: BKGABW
 Date of Bkg. Cal: 3/12/2015
 Alpha efficiency logfile: Am241R-06/13
 Alpha attenuation calibration: AAM0610, 0611
 Beta efficiency logfile: SR0R-06/13
 Beta attenuation calibration: ASR0611

Alpha prog. logfile: n/a
 Alpha prog. attenuation: n/a
 Beta prog. logfile: n/a
 Beta prog. attenuation: n/a

Alpha Attenuation Calibration		Beta Attenuation Calibration	
$y = b'm^a(a'(mass \cdot x0))$		$y = b'm^a(a'(mass \cdot x0))$	
Alpha b=	0.90570	Beta b=	0.9782
m=	0.99140	m=	0.9993
a=	0.8487	a=	1.0249
x0=	21.4875	x0=	0.0000
Alpha to Beta X-talk		Beta to Alpha X-talk	
$y = b'm^a \cdot mass$		$y = b'm^a \cdot mass$	
a -> b xtalk b=	0.2510	b -> a xtalk b=	-1.82E-05
a -> b xtalk m=	0.9987	b -> a xtalk m=	0.0032

Det. ID	Sample ID	Count End Date & Time	Count Dur. (min)	Resid. Mass (mg)	Alpha Activity				Beta Activity			
					Gross CPM	Bkg. CPM	a>b xtlk CPM	Base Cor.Fact.	Alpha Eff	Base Cor.Fact.	Beta Eff	Progeny Cor.Fact.
A1	1515003-1	3/12/2015 7:20	7.00	0.0	3.000	0.109	5.180	0.2102	1.060	0.4355	0.978	n/a
							0.7256		n/a		n/a	n/a
							1.399		n/a		n/a	n/a
							1620.143		n/a		n/a	n/a

JP 3/12/15

PAI - Gas Flow Proportional Sample Analysis LB4100-C

Alpha Attenuation Calibration		Beta Attenuation Calibration	
$y = b'm^*(a'(m_{\text{mass}} - x_0))$		$y = b'm^*(a'(m_{\text{mass}} - x_0))$	
Alpha b=	0.90570	Beta b=	0.9782
m=	0.99140	m=	0.9993
a=	0.8487	a=	1.0249
x0=	21.4875	x0=	0.0000
Alpha to Beta X-talk		Beta to Alpha X-talk	
$y = b'm^*(m_{\text{mass}} - x_0)$		$y = b'm^*(m_{\text{mass}} - x_0)$	
a -> b xtalk b=	0.2510	b -> a xtalk b=	-1.82E-05
a -> b xtalk m=	0.9987	b -> a xtalk m=	0.0032

Background logfile: BKGABW
Date of Bkg Cal: 3/12/2015
Alpha efficiency logfile: Am241R-06/13
Alpha attenuation calibration: AAM0610_0611
Beta efficiency logfile: SR0R-06/13
Beta attenuation calibration: ASR0611

Alpha prog. logfile: n/a
Alpha prog. attenuation: n/a
Beta prog. logfile: n/a
Beta prog. attenuation: n/a

Unit Type: LB4100 -C
Counting Unit ID: Magenta
High Voltage Mode: Simultaneous
Application Revision: Standard
Rev:12/01/08 JCP

Data file name: ABC0312A
Batch ID: AB150310-2 OUTLIER
Count Preset (m): 7
Batch Ended: 3/12/2015 7:33

Det. ID	Sample ID	Count End Date & Time	Count Dur. (min)	Resid. Mass (mg)	Alpha Activity				Beta Activity				Alpha Attenuation Calibration				Beta Attenuation Calibration			
					Gross CPM	Bkg. CPM	a>b xtalk CPM	Base Cor.Fact. Eff	Progeny Cor.Fact. Eff	Gross CPM	Bkg. CPM	a>b xtalk CPM	Base Cor.Fact. Eff	Progeny Cor.Fact. Eff	Progeny Cor.Fact. Eff	Progeny Cor.Fact. Eff	Base Cor.Fact. Eff	Progeny Cor.Fact. Eff	Progeny Cor.Fact. Eff	Progeny Cor.Fact. Eff
A1	1515003-2	3/12/2015 7:33	7.00	0.0	2.286	0.109	5.075	0.2102	1.060	n/a	n/a	0.5464	0.4355	0.978	n/a	n/a	0.978	n/a	n/a	n/a

JP 3/12/15

PAI - Gas Flow Proportional Sample Analysis LB4100-C

Alpha Attenuation Calibration		Beta Attenuation Calibration	
$y = b \cdot m^a (a'(\text{mass} \rightarrow 0))$		$y = b \cdot m^a (a'(\text{mass} \rightarrow 0))$	
Alpha b=	0.90570	Beta b=	0.9782
m=	0.99140	m=	0.9993
a=	0.8487	a=	1.0249
x0=	21.4875	x0=	0.0000
Alpha to Beta X-talk		Beta to Alpha X-talk	
$y = b \cdot m^a \cdot \text{mass}$		$y = b \cdot m^a \cdot \text{mass}$	
a \rightarrow b xtalk b=	0.2510	b \rightarrow a xtalk b=	-1.82E-05
a \rightarrow b xtalk m=	0.9987	b \rightarrow a xtalk m=	0.0032

Background logfile: BKGABW
Data of Bkg. Cal: 3/12/2015
Alpha efficiency logfile: Am241R-06/13
Alpha attenuation calibration: AAM0510_0611
Beta efficiency logfile: S90R-06/13
Beta attenuation calibration: ASR0611

Alpha prog. logfile: n/a
Alpha prog. attenuation: n/a
Beta prog. logfile: n/a
Beta prog. attenuation: n/a

Unit Type: LB4100-C
Counting Unit ID: Magenta
High Voltage Mode: Simultaneous
Application Revision: Standard
Rev.12/01/08 JCP

Data file name: ABC0312B
Batch ID: AB150310-2 OUTLIER
Count Preset (mj): 7
Batch Ended: 3/12/2015 7:41

Det. ID

Det. ID	Sample ID	Count End Date & Time	Count Dur. (min)	Resid. Mass (mg)	Alpha Activity				Beta Activity			
					Gross CPM	Bkg. CPM	b>a xtlk CPM	Base Eff	Progeny Eff	Base Cor.Fact.	Progeny Cor.Fact.	Progeny Eff
A1	1515003-3	3/12/2015 7:41	7.00	0.0	4.286	0.109	5.196	0.2102	1.060	0.4355	0.978	n/a

a>b xtlk CPM	1.0484
Gross CPM	1625.286
Bkg. CPM	1.399
Progeny Cor.Fact.	n/a
Progeny Eff	n/a
Base Cor.Fact.	0.978
Progeny Cor.Fact.	n/a

JP 3/12/15

PAI - Gas Flow Proportional Sample Analysis LB4100-C

Unit Type: LB4100 -C
Counting Unit ID: Magenta
High Voltage Mode: Simultaneous
Application Revision: Standard
Rev.12/01/08 JCP

Data file name: ABC0312C
Batch ID: AB150310-2 OUTLIER
Count Preset (m): 7
Batch Ended: 3/12/2015 7:51

Background logfile: BKGABW
Date of Bkg. Cal: 3/12/2015
Alpha efficiency logfile: Am241R-06/13
Alpha attenuation calibration: AAM0610, 0611
Beta efficiency logfile: S90R-06/13
Beta attenuation calibration: ASR0611

Alpha prog. logfile: n/a
Alpha prog. attenuation: n/a
Beta prog. logfile: n/a
Beta prog. attenuation: n/a

Alpha Attenuation Calibration	Beta Attenuation Calibration
$y = b \cdot m^a (a'(\text{mass} \cdot x_0))$	$y = b \cdot m^a (a'(\text{mass} \cdot x_0))$
Alpha b = 0.90570	Beta b = 0.9782
n = 0.99140	n = 0.9993
a = 0.8487	a = 1.0249
x0 = 21.4875	x0 = 0.0000
Alpha to Beta X-talk	Beta to Alpha X-talk
$y = b \cdot m^a \cdot \text{mass}$	$y = b \cdot m^a \cdot \text{mass} \cdot m$
a -> b xtalk b = 0.2510	b -> a xtalk b = -1.82E-05
a -> b xtalk n = 0.9987	b -> a xtalk n = 0.0032

Det. ID	Sample ID	Count End Date & Time	Count Dur. (min)	Resid. Mass (mg)	Alpha Activity				Beta Activity			
					Gross CPM	Bkg. CPM	b-a xtlk CPM	Base Eff	Progeny Eff	Base Cor.Fact.	Progeny Eff	Progeny Cor.Fact.
A1	1515003-4	3/12/2015 7:51	7.00	0.0	3.571	0.109	5.188	0.2102	1.060	n/a	n/a	n/a
										0.8681	0.4355	0.978
										1622.571	1.389	

JP 3/12/15

PAI - Gas Flow Proportional Sample Analysis LB4100-C

Unit Type: LB4100 -C
Counting Unit ID: Magenta
High Voltage Mode: Simultaneous
Application Revision: Standard
Rev.12/01/08 JCP

Data file name: ABC0312D
Batch ID: AB150310-2 OUTLIER
Count Preset (m): 7
Batch Ended: 3/12/2015 8:06

Background logfile: BKGABW
Date of Bkg. Cal: 3/12/2015
Alpha efficiency logfile: AM241R-06/13
Alpha attenuation calibration: AAM0610_0611
Beta efficiency logfile: SR09R-06/13
Beta attenuation calibration: ASR0611

Alpha prog. logfile: n/a
Alpha prog. attenuation: n/a
Beta prog. logfile: n/a
Beta prog. attenuation: n/a

Det. ID	Sample ID	Count End Date & Time	Count Dur. (min)	Resid. Mass (mg)	Alpha Activity				Beta Activity				Alpha Attenuation Calibration				Beta Attenuation Calibration			
					Gross CPM	Bkg. CPM	b>a xtlk CPM	Base Eff	Progeny Eff	Progeny Cor.Fact.	Gross CPM	Bkg. CPM	a>b xtlk CPM	Base Eff	Progeny Eff	Progeny Cor.Fact.	y = b'm*(a*(mass-x0))	Beta b=	m=	a=
A1	1515003-5	3/12/2015 8:06	7.00	0.0	3.571	0.109	5.097	0.2102	1.060	n/a	1594.286	1.399	0.8691	0.4355	0.978	n/a	y = b'm*(a*(mass-x0))	0.90570	0.99140	0.8487
					Alpha to Beta X-talk				Beta to Alpha X-talk											
					y = b'm*mass				y = b'm*mass											
					a -> b xtalk b=				b -> a xtalk b=											
					0.2510				0.2510											
					0.9987				0.9987											
					n/a				n/a											

DP 3/12/15

Date 3/12/15SOP 724r 11

ALS
Low Background Gas Flow Proportional Counter Log
Instrument: LB4100C

Instrument Daily Response and Background Checks

Det.	Daily Response Check				Background Check				Det. Status
	Start 1	Status	Start 2	Status	Start 1	Status	Start 2	Status	
1	JP	P			*				P
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									

Det = Detector; α = Alpha; β = Beta; P = Pass; H = High; L = Low; OL = Offline; R = Recount; W = Weekly; NP = Not Processed

Weekly Background Calibration

	Current Calib. File ID	Weekly Calib. Started	Status	File ID
Dr A	BK0311W			
Dr B				
Dr C				
Dr D				

Dr = Drawer

Gas Supply

	P-10 Supply		P-10 Flow
Tank 1	2100	Dr A	0.1
		Dr B	
Tank 2	1900	Dr C	
		Dr D	

Comments: * It is not necessary to run daily background checks on the morning following a weekly background calibration.

Page No.: 450690 **A**

Form 780r8.doc (6/23/06)

Reviewed By / Date

JP 3/12/15

Date 3/12/15SOP 724r 11ALS
Low Background Gas Flow Proportional Counter Log
Instrument: LB4100C

Det.	Sample ID	Batch	Test	Count Dur. (min)	Start Time	Analyst Initials	File ID	Output Initials
1-16	Dark Eff			30	6:52	JP	EFC0312	JP
1	1515003-1	AB150310-2	B-Q/H	7	7:13	JP	ABC0312	JP
1	-2				7:26	JP	A	JP
1	-3				7:34	JP	B	JP
1	-4				7:44	JP	C	JP
1	-5				7:59	JP	D	JP
1-4	1061		(S) 17 Eff	30	8:20	JP	ECS0312A	JP
5-8			Cal		8:28	JP	B	
9-12					8:36	JP	C	
13-16					8:43	JP	D	
1-16	1515002-1-24	AB150310-1	ATTN (C) 17	30	8:53	JP	ACS0312	JP
1	1503144-1	AB150311-1	α 1B	240	15:15:42	JP	ABC0312E	JP
2	-10							
3	AB150311-1MB							
4	(C)							
5	1503192-1	AB150312-4		300	15:43	JP	ABC03124F	
6	-10							
7	-2							
8	AB150312-4MB							
9	(C)							
10	1503160-1	AB150311-3		1006	15:44	JP	ABC0312G	
11	-7							
12	-2D							
13	-7			120	15:45		H	
14	AB150311-3MB			1006	15:44		G	
15	(C)			120	15:45		H	

JP 3/12/15

JP 3/12/15

JP 3/13/15

Comments:

Page No.: 450690 **B**
(cont. from page NA **B**)

Form 780r8.doc (6/23/06)

Reviewed By / Date JP 3/13/15

Date 3/13/15SOP 724r 11

ALS
Low Background Gas Flow Proportional Counter Log
Instrument: LB4100C

Instrument Daily Response and Background Checks

Det.	Daily Response Check				Background Check				Det. Status
	Start 1	Status	Start 2	Status	Start 1	Status	Start 2	Status	
1	JP	P			JP	P			P
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									

Det = Detector; α = Alpha; β = Beta; P = Pass; H = High; L = Low; OL = Offline; R = Recount; W = Weekly; NP = Not Processed*Weekly Background Calibration*

	Current Calib. File ID	Weekly Calib. Started	Status	File ID
Dr A	1360311W			
Dr B				
Dr C				
Dr D				

Dr = Drawer

Gas Supply

P-10 Supply		P-10 Flow	
Tank 1	1850	Dr A	0.1
		Dr B	
Tank 2	1900	Dr C	
		Dr D	

Comments:Page No.: 450691 A

Form 780r8.doc (6/23/06)

Reviewed By / Date JP 3/13/15

Prepare an intermediate dilution of Th-230 RSO# 853 of approximately 1200 dpm/ml

1) Prepare 0.5 M HNO_3 . 31 ml HNO_3 and 969 ml DI water.
bottle # 073602

2) Determine density of 0.5 M HNO_3 .

Mass of 100 ml vol. flask:

Mass of flask + 100 ml 0.5 M HNO_3 :

Net mass of 0.5 M HNO_3 :

Bal. 12

68.2999 g

169.4529 g

101.153 g

$$\rho = 1.015 \text{ g/ml}$$

3) Transfer contents of vial to 1000 ml Nalgene.

Mass of full standard vial:

Mass of empty standard vial:

Net mass of standard transferred:

81.2827

3.2327

5.05 g

4) Dilute with 0.5 M HNO_3

Mass of Nalgene w/o lid (empty):

Mass of Nalgene with standard:

Mass of Nalgene, standard, and diluent:

Net mass of standard:

73.66 g

73.70 g

78.71 g

1085.2

1011.54 g

5) Final activity calculation

$$(1.983 \times 10^4 \text{ Bq}) (5.13119 \text{ g}) = 3849.60 \text{ Bq/g} \times \left(\frac{60 \text{ s}}{1 \text{ min}} \right) = 230,975.755 \text{ dpm}$$

$$(3849.60 \text{ Bq/g}) \cdot \left(\frac{5.05 \text{ g}}{1011.54 \text{ g}} \right) \cdot (1.015 \text{ g/ml}) = 1166.38 \text{ dpm/ml}$$

Std ID: 853.3020.89

Description: Th-230

Expiration: 2/5/2009

Activity: 1166.38 dpm/mL

2s Uncertainty: 23.33 dpm/mL

Ref. Date: 11/6/2007

Ref Time: N/A

Prep Date: 12/12/2007 Prep by: DC

Matrix/Comp. 0.5 M HNO_3

Half Life (y): 7.70E+04

Reverification Log

Analysis Date	Initials	Expiration Date
5/5/09	RG	5/5/2010
11/19/10	RG	11/19/2011
12/13/14	JP	12/13/2015

Continued on Page

Sign:

Date: 12/12/07

DC

Read and Understood By

Sign:

DC

Date: 7/13/08



Eckert & Ziegler

Analytics

1380 Seaboard Industrial Blvd.
Atlanta, Georgia 30318
Tel 404-352-8677
Fax 404-352-2837
www.analyticsinc.com

CERTIFICATE OF CALIBRATION
Standard Radionuclide Source

76253-307

Th-230 5 mL Liquid in Flame Sealed Vial

Customer: Paragon Analytics / Fort Collins, CO
P.O. No.: 72905-REL 10-30-07, Item 1

This standard radionuclide source was prepared gravimetrically from a calibrated master solution. The master solution was calibrated by liquid scintillation counting.

Radionuclide purity and calibration were checked by germanium gamma-ray spectrometry and liquid scintillation counting. The nuclear decay rate and assay date for this source are given below.

ANALYTICS maintains traceability to the National Institute of Standards and Technology through Measurements Assurance Programs as described in USNRC Reg. Guide 4.18, Revision 1.

Isotope:	Th-230
Activity (Bq):	1.983 E4
Half-Life:	7.538 E4 years
Calibration Date:	November 8, 2007 12:00 EST
Relative Expanded Uncertainty (k=2):	2.0%

Comments:

Impurities: γ -impurities <0.1%, α -impurities <0.01%.
5.15119 grams 0.5M HNO₃ solution.

Source Prepared By: N. E. Kiesman
N. E. Kiesman, Radiochemist

QA Approved: D. M. Montgomery
D. M. Montgomery, QA Manager

Date: 11-19-07

End of Certificate

Corporate Office
24937 Avenue Tibbitts Valencia, California 91355

Laboratory
1380 Seaboard Industrial Blvd. Atlanta, Georgia, 30318

Prepare a working dilution of R50*1019

12/3/15

1. Density of 0.1M HCl, lot # 0000094396

Mass of 100mL vol. flask:

56.4421g

Balance # 12

Mass of flask & 100mL acid:

156.2152g

Balance# 12

Net Mass:

99.7731g

Density:

0.9977g/mL

2. Mass of R50*1019 transferred:

Mass of empty nalgene:

74.1899g

Balance# 12

Mass of nalgene & standard

79.0859g

Balance# 12

Net mass of standard transferred:

4.8960g

3. Dilute to final volume:

Mass of nalgene, standard, & diluent:

629.3g

Balance# 26

Mass of empty nalgene:

74.1899g

Balance# 12

Net mass of new dilution:

555.1101g

4. Final activity calculation:

$$\frac{37270 \text{ Bq}}{(1 \text{ Bq})} \times \frac{(60 \text{ dpm})}{(4.99800 \text{ g})} \times \frac{(0.9977 \text{ g/mL})}{(555.1101 \text{ g})} = 3937.10 \text{ dpm/mL}$$

Std ID: 1019.4095.83

Description: Cs-137

Expiration: 3/6/2016

Activity: 3937.10 dpm/mL

2s Uncertainty: 70.87 dpm/mL

Ref. Date: 2/9/2015

Ref Time: N/A

Prep Date: 3/5/2015 Prep by: TE

Matrix/Comp. 0.1 MHC

Half Life (y): 3.01E+01

Reverification Log

Analysis Date Initials Expiration Date

Continued on Page

Signed

Date

Read and Understood By

Signed

Date



Eckert & Ziegler

Analytics

RSO#
1019

1380 Seaboard Industrial Blvd.
Atlanta, Georgia 30318
Tel 404-352-8677
Fax 404-352-2837
www.ezag.com

CERTIFICATE OF CALIBRATION

Standard Reference Source

99576

Cs-137 5 mL Liquid in Flame Sealed Vial

Customer: ALS Laboratory Group
P.O. No.: FC000610, Item 3 Product Code: 8137

This standard radionuclide source was prepared gravimetrically from a master solution calibrated with an ionization chamber. The ionization chamber was calibrated by the National Physical Laboratory, Teddington, U.K., and is traceable to national standards. Radionuclide calibration and purity were checked by germanium gamma-ray spectrometry, liquid scintillation counting, and/or alpha spectrometry, as applicable. The nuclear decay rate and reference date for this source are given below. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST."

Isotope	Half-Life, Days	Activity (Bq)	Uncertainty*, %			Reference Date (12:00 PM EST)
			u _A	u _B	U	
Cs-137	1.099E+04	3.727E+04	0.1	0.9	1.8	02/09/2015

*Uncertainty: U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results."

Comments:

Impurities: γ -impurities < 0.1%.

4.99800 g 0.1M HCl solution with approximately 30 μ g/g Cs carrier.

Source Prepared by:

K. Eardley
K. Eardley, Radiochemist

QC Approved:

A. Chen
A. Chen, Spectroscopist

Date: 7 Feb 15

Mass Attenuation Curves

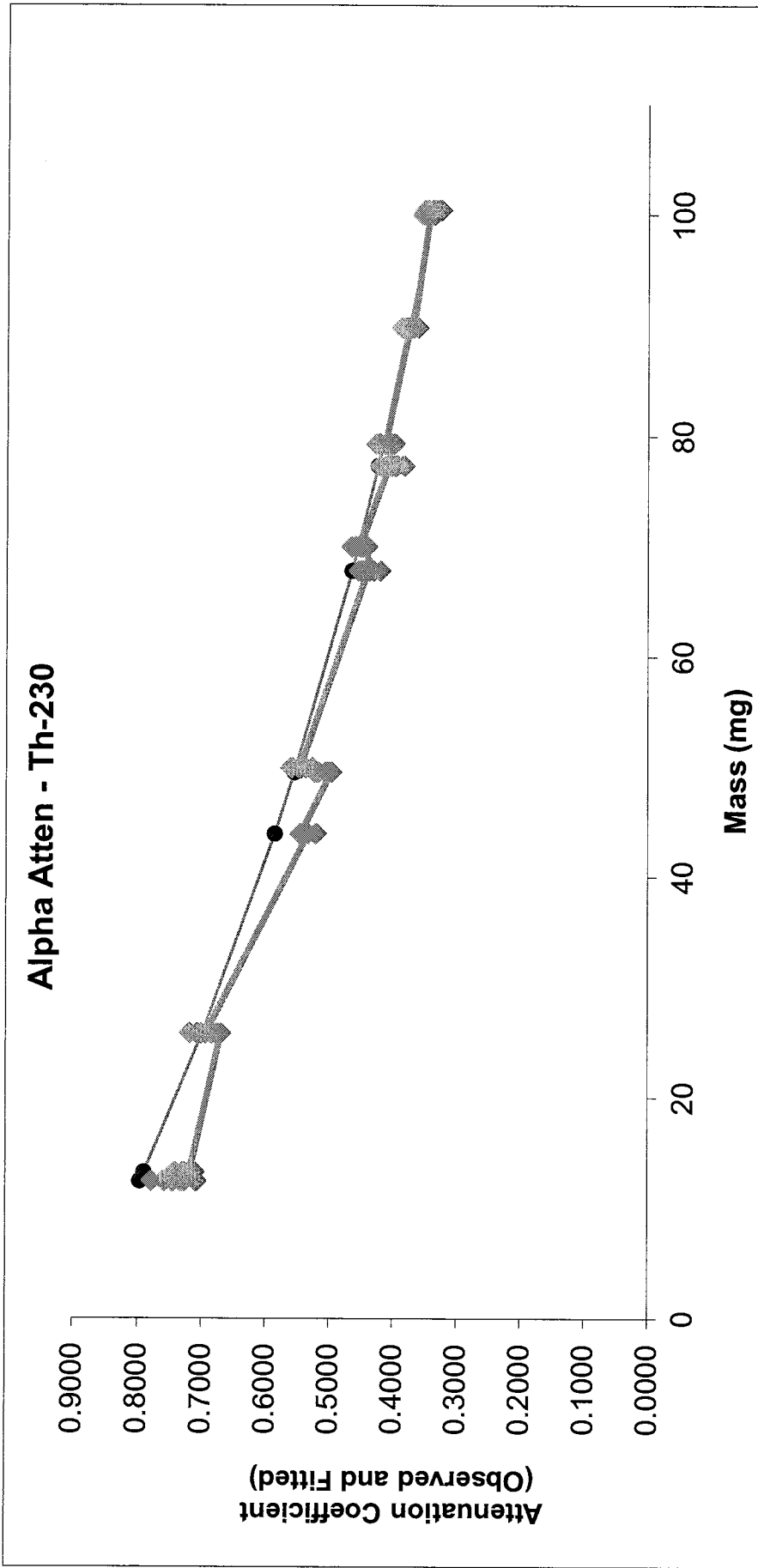
[illegible]

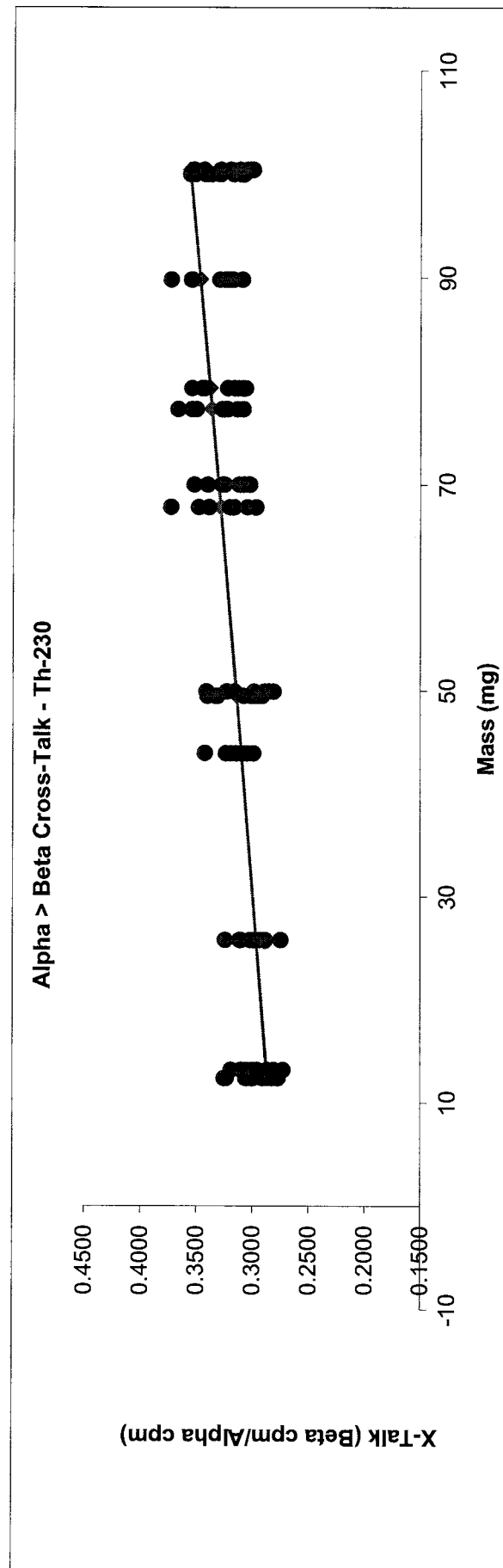
LB4100A Alpha Attenuation Curve -- Th-230

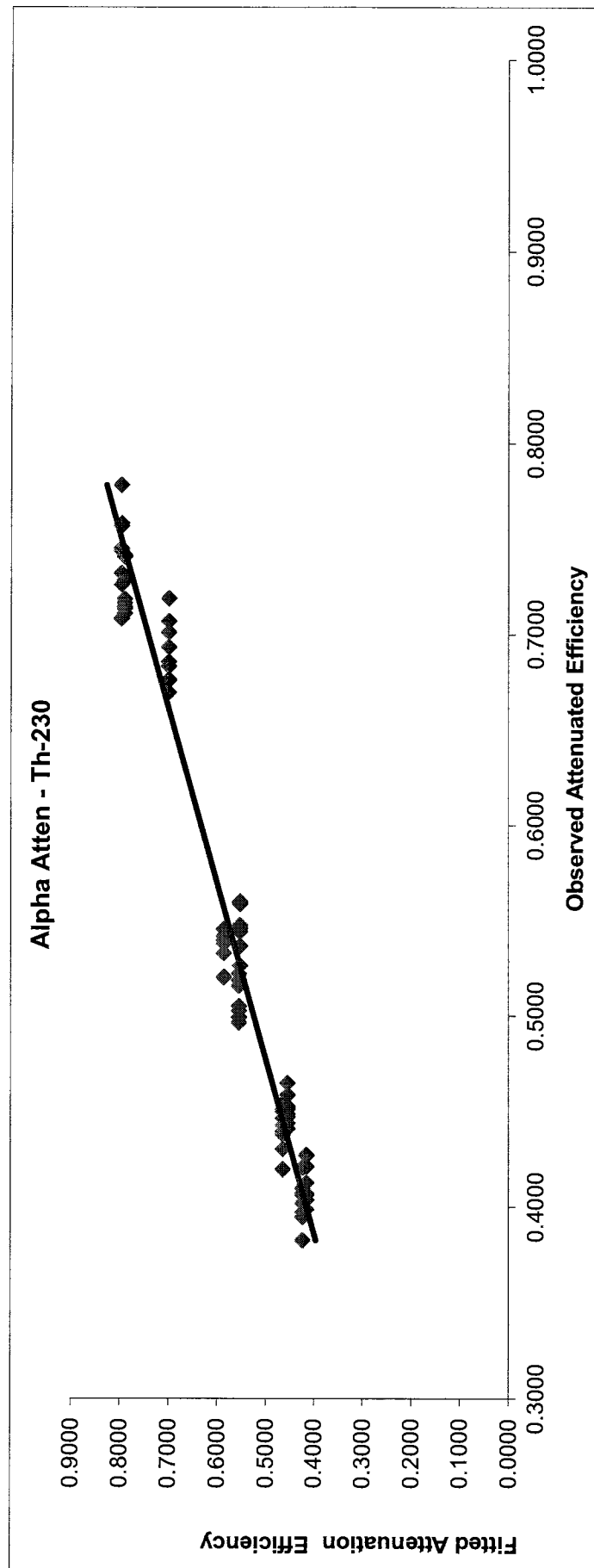
WO # 1518004				Spike Information				Attenuation Equation: $y=b \cdot m^a \cdot x^{-x}$				Cross-Talk Equation									
File ID	Detector ID	Sample ID	Mass (mg)	Count	Date	Alpha Counts	Beta Counts	Time	Alpha CPM	Beta CPM	Base Alpha Eff.	Decay Cor. Act. added dpm/L	Alpha Eff. Fitted	Alpha Att. Fitted	Actual/Fit Ratio	Obs. Atten Fact.	Fitted Atten Fact.	% Diff.	% Diff.	$\alpha > \beta \times \text{TH} \alpha \cdot \beta \times \text{TH}$	% Diff.
ATH1208 A1	1518004-10	70	12/8/2016 12:36	10003	10003	3065	16.8	585.234667	180.3065	0.2282	5831.41	0.1021	0.1037	1.0162	0.4473	0.4546	-1.6%	-9.2%	0.3308	-9.2%	
ATH1208 A2	1518004-10	70	12/8/2016 13:03	10003	3161	16.66	16.66	600.264168	187.7059	0.2214	5831.41	0.1029	0.1006	0.9777	0.4649	0.4546	2.2%	-5.8%	0.3308	-5.8%	
ATH1208 A3	1518004-10	70	12/8/2016 13:31	10006	3083	16.66	16.66	600.264168	187.7059	0.2214	5831.41	0.1029	0.1006	0.9777	0.4649	0.4546	2.2%	-5.8%	0.3308	-5.8%	
ATH1208 A4	1518004-10	70	12/8/2016 13:59	10007	3115	16.71	16.71	598.767956	184.3263	0.2289	5831.41	0.1041	0.1034	1.0134	0.4486	0.4546	-1.3%	-7.4%	0.3308	-7.4%	
ATH1208 B1	1518004-10	70	12/8/2016 14:23	10008	3117	15.74	15.74	635.727274	196.1125	0.2377	5831.41	0.1090	0.1081	0.9912	0.4586	0.4546	0.9%	-0.9%	0.3308	-0.9%	
ATH1208 B3	1518004-10	70	12/8/2016 14:45	9999	3439	16.38	16.38	610.30556	207.7472	0.2320	5831.41	0.1047	0.1055	1.0077	0.4511	0.4546	-0.8%	0.304	0.3308	2.8%	
ATH1208 B4	1518004-10	70	12/8/2016 15:07	10000	3308	16.87	16.87	592.610028	197.7472	0.2320	5831.41	0.1016	0.1021	1.0042	0.4529	0.4546	-0.4%	0.3278	0.3308	-0.9%	
ATH1208 C1	1518004-10	70	12/8/2016 15:28	9999	3557	17.02	17.02	587.361311	206.9884	0.2289	5831.41	0.1007	0.1031	1.0240	0.4437	0.4546	-2.4%	0.3524	0.3308	6.1%	
ATH1208 C3	1518004-10	70	12/8/2016 15:47	10004	3293	16.16	16.16	618.944408	201.9329	0.2349	5831.41	0.1081	0.1068	1.0061	0.4519	0.4546	-0.6%	0.3524	0.3308	6.1%	
ATH1208 A1	1518004-12	77.3	12/8/2016 11:48	10006	3132	18.47	18.47	541.621368	167.4403	0.2282	5831.41	0.0929	0.0966	1.0463	0.4070	0.4234	-4.0%	0.3091	0.3368	-8.9%	
ATH1208 A2	1518004-12	77.3	12/8/2016 12:13	10000	3180	18.41	18.41	543.027053	170.7032	0.2214	5831.41	0.0931	0.0937	1.0067	0.4206	0.4234	-0.7%	0.3144	0.3368	-7.1%	
ATH1208 A3	1518004-12	77.3	12/8/2016 12:38	10001	3296	18.6	18.6	537.564172	174.9143	0.2335	5831.41	0.0922	0.0889	1.0725	0.3948	0.4234	-7.3%	0.3254	0.3368	-3.5%	
ATH1208 A4	1518004-12	77.3	12/8/2016 13:05	10001	3301	18.65	18.65	530.408979	173.0304	0.2289	5831.41	0.0910	0.0969	1.0656	0.3974	0.4234	-6.6%	0.3262	0.3368	-3.2%	
ATH1208 B1	1518004-12	77.3	12/8/2016 13:31	10003	3311	17.59	17.59	568.570384	186.3139	0.2377	5831.41	0.0975	0.1006	1.0323	0.4102	0.4234	-3.2%	0.3277	0.3368	-2.8%	
ATH1208 B3	1518004-12	77.3	12/8/2016 14:00	10007	3589	18.38	18.38	544.020432	192.9564	0.2320	5831.41	0.0923	0.0982	1.0530	0.4021	0.4234	-5.3%	0.3547	0.3368	5.1%	
ATH1208 B4	1518004-12	77.3	12/8/2016 14:26	10004	3262	18.65	18.65	536.249507	173.0812	0.2245	5831.41	0.0920	0.0951	1.0337	0.4096	0.4234	-3.4%	0.3228	0.3368	-4.3%	
ATH1208 C1	1518004-12	77.3	12/8/2016 14:48	10002	3708	19.75	19.75	506.30638	185.7458	0.2289	5831.41	0.0868	0.0961	1.1066	0.3827	0.4234	-10.7%	0.3668	0.3368	8.2%	
ATH1208 C3	1518004-12	77.3	12/8/2016 15:09	10005	3537	17.98	17.98	556.336613	194.9956	0.2349	5831.41	0.0954	0.0995	1.0426	0.4061	0.4234	-4.3%	0.3505	0.3368	3.9%	
ATH1208 A1	1518004-11	79.3	12/8/2016 12:37	10011	3136	18.5	18.5	540.634757	165.9221	0.2282	5831.41	0.0927	0.0948	1.0222	0.4063	0.4153	-2.2%	0.3069	0.3384	-10.3%	
ATH1208 A2	1518004-11	79.3	12/8/2016 12:37	10011	3136	18.17	18.17	550.807126	170.3632	0.2214	5831.41	0.0945	0.0919	0.9734	0.4266	0.4153	2.7%	0.3097	0.3384	-9.3%	
ATH1208 A3	1518004-11	79.3	12/8/2016 13:05	10006	3128	18.43	18.43	542.795154	167.4333	0.2335	5831.41	0.0931	0.0970	1.0417	0.3966	0.4153	-4.2%	0.3085	0.3384	-9.7%	
ATH1208 A4	1518004-11	79.3	12/8/2016 13:32	10010	3268	18.56	18.56	538.859741	175.9886	0.2289	5831.41	0.0924	0.0951	1.0287	0.4037	0.4153	-2.9%	0.3279	0.3384	-4.8%	
ATH1208 B1	1518004-11	79.3	12/8/2016 13:59	10010	3175	16.9	16.9	592.202692	185.9518	0.2377	5831.41	0.1016	0.0987	0.9720	0.4272	0.4153	2.8%	0.3140	0.3384	-7.8%	
ATH1208 B3	1518004-11	79.3	12/8/2016 14:25	10009	3496	18.18	18.18	550.416055	190.9552	0.2320	5831.41	0.0944	0.0963	1.0207	0.4068	0.4153	-2.1%	0.3454	0.3384	2.0%	
ATH1208 B4	1518004-11	79.3	12/8/2016 14:47	9999	3198	18.13	18.13	551.398823	174.5777	0.2245	5831.41	0.0945	0.0932	0.9860	0.4212	0.4153	1.4%	0.3166	0.3384	-6.9%	
ATH1208 C1	1518004-11	79.3	12/8/2016 15:10	10002	3584	18.96	18.96	527.407646	177.5085	0.2289	5831.41	0.0904	0.0942	1.0418	0.3986	0.4153	-4.2%	0.3546	0.3384	4.8%	
ATH1208 C3	1518004-11	79.3	12/8/2016 15:29	10008	3455	17.7	17.7	565.308729	194.0397	0.2349	5831.41	0.0889	0.0975	1.0063	0.4127	0.4153	-0.6%	0.3432	0.3384	1.4%	
ATH1208 A1	1518004-14	89.8	12/8/2016 10:56	10004	3143	20.07	20.07	486.333406	154.4689	0.2282	5831.41	0.0855	0.0856	1.0013	0.3745	0.3750	-0.1%	0.3100	0.3473	-12.0%	
ATH1208 A2	1518004-14	89.8	12/8/2016 11:21	10000	3254	20.14	20.14	496.36833	159.54	0.2214	5831.41	0.0851	0.0851	0.9953	0.3845	0.3750	2.5%	0.3214	0.3473	-8.0%	
ATH1208 A3	1518004-14	89.8	12/8/2016 11:49	10003	3223	20.14	20.14	516.29314	164.1013	0.2335	5831.41	0.0851	0.0851	0.9953	0.3792	0.3750	1.1%	0.3178	0.3473	-9.9%	
ATH1208 A4	1518004-14	89.8	12/8/2016 12:15	10001	3344	20.12	20.12	496.972594	164.1138	0.2289	5831.41	0.0852	0.0858	1.0071	0.3723	0.3750	-0.7%	0.3302	0.3473	-5.2%	
ATH1208 B1	1518004-15	89.8	12/8/2016 12:38	10002	3285	18.67	18.67	535.620763	174.0327	0.2377	5831.41	0.0919	0.0881	0.9704	0.3864	0.3750	3.0%	0.3249	0.3473	-6.9%	
ATH1208 B3	1518004-14	89.8	12/8/2016 13:06	10000	3590	19.72	19.72	506.965391	178.8447	0.2320	5831.41	0.0869	0.0870	1.0006	0.3747	0.3750	-0.1%	0.3547	0.3473	2.1%	
ATH1208 B4	1518004-14	89.8	12/8/2016 13:34	10000	3264	20.15	20.15	496.119916	160.1601	0.2245	5831.41	0.0851	0.0842	0.9894	0.3790	0.3750	1.1%	0.3228	0.3473	-7.6%	
ATH1208 C1	1518004-14	89.8	12/8/2016 14:03	10002	3773	20.9	20.9	478.440593	178.5253	0.2269	5831.41	0.0820	0.0851	1.0370	0.3616	0.3750	-3.7%	0.3731	0.3473	6.9%	
ATH1208 C3	1518004-14	89.8	12/8/2016 14:27	10002	3585	19.77	19.77	505.803058	178.6124	0.2349	5831.41	0.0867	0.0881	1.0155	0.3693	0.3750	-1.5%	0.3551	0.3473	2.2%	
ATH1208 A1	1518004-16	100	12/8/2016 10:09	10002	3133	21.9	21.9	456.580329	140.9274	0.2282	5831.41	0.0783	0.0775	0.9966	0.3431	0.3396	1.0%	0.3087	0.3561	-15.4%	
ATH1208 A2	1518004-16	100	12/8/2016 10:33	10006	3423	22.06	22.06	453.425142	153.1387	0.2214	5831.41	0.0778	0.0752	0.9668	0.3512	0.3396	3.3%	0.3377	0.3561	-5.4%	
ATH1208 A3	1518004-16	100	12/8/2016 10:57	9999	3226	21.31	21.31	469.092323	149.0943	0.2335	5831.41	0.0804	0.0793	0.9856	0.3445	0.3396	1.4%	0.3178	0.3561	-12.0%	
ATH1208 A4	1518004-16	100	12/8/2016 11:23	10000	3339	21.7	21.7	460.734493	151.782	0.2289	5831.41	0.0790	0.0777	0.9837	0.3452	0.3396	1.6%	0.3294	0.3561	-8.1%	
ATH1208 B1	1518004-16	100	12/8/2016 11:50	10002	3340	20.36	20.36	491.152487	162.1292	0.2377	5831.41	0.0842	0.0807	0.9583	0.3543	0.3396	4.2%	0.3301	0.3561	-7.9%	
ATH1208 B3	1518004-16	100	12/8/2016 12:16	10004	3478	21.08	21.08	474.439055	162.7865	0.2320	5831.41	0.0814	0.0788	0.9632	0.3507	0.3396	3.2%	0.3431	0.3561	-3.8%	
ATH1208 B4	1518004-16	100	12/8/2016 12:41	10001	3149	21.81	21.81	462.637092	143.8946	0.2245	5831.41	0.0793	0.0762	0.9608	0.3534	0.3396	3.8%	0.3110	0.3561	-14.5%	
ATH1208 C1	1518004-16	100	12/8/2016 13:09	10003	3605	22.45	22.45	445.443929	158.5781	0.2269	5831.41	0.0764	0.0770	1.0066	0.3367	0.3396	-0.9%	0.3560	0.3561	0.0%	
ATH1208 C3	1518004-16	100	12/8/2016 13:35	10007	3558	20.99	20.99	476.635934	167.7863	0.2349	5831.41	0.0749	0.0779	0.9758	0.3460	0.3396	2.4%	0.3520	0.3561	-1.2%	
ATH1208 A1	1518004-15	100.4	12/8/2016 10:34	10002	3053	22.88	22.88	437.02835	131.3033	0.2282	5831.41	0.0749	0.0772	1.0299	0.3284	0.3382	-3.0%	0.3004	0.3565	-18.6%	
ATH1208 A2	1518004-15	100.4	12/8/2016 10:58	10003	3103	22.07	22.07	453.063692	138.4775	0.2214	5831.41	0.0749	0.0749	0.9638	0.3509	0.3382	3.6%	0.3066	0.3565	-16.6%	
ATH1208 A3	1518004-15	100.4	12/8/2016 11:24	10000	3342	22.57	22.57	442.942017	145.8272	0.2335	5831.41	0.0760	0.0790	1.0397	0.3253	0.3382	-4.0%	0.3291	0.3565	-8.3%	
ATH1208 A4	1518004-15	100.4	12/8/2016 11:52	10001	3167	22.22	22.22	449.950509	140.4403	0.2289	5831.41	0.0772	0.0774	1.0033	0.3371	0.33					

LB4100A Alpha Attenuation Curve -- Th-230

WO #		1518004		Spike Information										Attenuation Equation: $y=b \cdot m^x$										Cross-Talk Equation: $y=b \cdot m^x$																																																																									
Mass Range		Low	12.4 mg	Ref. Date	863.3020.89	Std. ID	11/6/2007	Activity	75380	Vol.	1166.38	Act. Added	5831.90	Alpha Counts	10006	Beta Counts	3050	Count Time	17.18	Alpha CPM	175.4	Base Alpha Eff.	2282	Decay Corr. Act. added dpm/mL	5831.41	Alpha EFF Actual	0.0999	Alpha ATT Fitted	0.0910	Actual/Fit Ratio	Obs. Atten Fact.	% Diff.	% Diff.	$\alpha > \beta$ X Tlk	Actual	Fitted	% Diff.																																																												
File ID	Detector ID	Sample ID	Mass (mg)	Count Date	Alpha Counts	Beta Counts	Count Time	Alpha CPM	Beta CPM	Base Alpha Eff.	Decay Corr. Act. added dpm/mL	Alpha EFF Actual	Alpha ATT Fitted	0.0999	0.0910	0.9110	0.4376	0.3987	8.9%	0.3012	0.3419	-13.5%	0.3012	0.3419	-12.8%	0.3010	0.3419	-13.6%	0.3100	0.3419	-7.7%	0.3174	0.3419	-7.9%	0.3371	0.3419	-1.4%	0.3168	0.3419	-7.9%	0.3517	0.3419	2.8%	0.3348	0.3419	-2.1%	0.3042	0.2984	1.9%	0.3015	0.2984	1.0%	0.3033	0.2984	1.6%	0.3157	0.2984	4.5%	0.3135	0.2984	4.8%	0.3198	0.2984	6.7%	0.2860	0.2984	-4.3%	0.3359	0.2984	11.2%	0.3370	0.2984	11.5%	0.3193	0.3048	4.5%	0.3326	0.3048	8.3%	0.3142	0.3048	3.0%	0.3290	0.3048	7.4%	0.3402	0.3048	10.4%	0.3202	0.3048	4.8%	0.3774	0.3048	19.2%	0.3468	0.3048	12.1%
OUTLIERS																																																																																																	
ATH1208	A1	1518004-13	83.5	12/8/2016 11:18	10006	3050	17.18	582.29942	175.4	0.2282	5831.41	0.0999	0.0999	0.9110	0.4376	0.3987	8.9%	0.3012	0.3419	-13.5%																																																																													
ATH1208	A2	1518004-13	83.5	12/8/2016 11:47	10005	3067	17.21	591.192053	176.1813	0.2214	5831.41	0.0987	0.0987	0.8856	0.4502	0.3987	11.4%	0.3031	0.3419	-12.8%																																																																													
ATH1208	A3	1518004-13	83.5	12/8/2016 12:12	10007	3050	16.9	592.006178	178.1834	0.2335	5831.41	0.1015	0.1015	0.9169	0.4348	0.3987	8.3%	0.3010	0.3419	-13.6%																																																																													
ATH1208	A4	1518004-13	83.5	12/8/2016 12:36	10008	3138	17.38	575.739292	178.4634	0.2289	5831.41	0.0987	0.0987	0.9243	0.4313	0.3987	7.6%	0.3100	0.3419	-10.3%																																																																													
ATH1208	B1	1518004-13	83.5	12/8/2016 13:03	10001	3205	16.53	604.916174	191.9719	0.2377	5831.41	0.1037	0.1037	0.9135	0.4384	0.3987	8.7%	0.3174	0.3419	-7.7%																																																																													
ATH1208	B3	1518004-13	83.5	12/8/2016 13:31	10002	3408	16.91	591.350239	199.3336	0.2320	5831.41	0.1014	0.1014	0.9120	0.4371	0.3987	8.8%	0.3371	0.3419	-1.4%																																																																													
ATH1208	B4	1518004-13	83.5	12/8/2016 13:59	10006	3201	17.5	571.673429	181.0883	0.2245	5831.41	0.0980	0.0980	0.9130	0.4366	0.3987	8.7%	0.3168	0.3419	-7.9%																																																																													
ATH1208	C1	1518004-13	83.5	12/8/2016 14:25	10000	3552	18.04	554.199725	194.8948	0.2269	5831.41	0.0950	0.0950	0.9518	0.4188	0.3987	4.8%	0.3517	0.3419	2.8%																																																																													
ATH1208	C3	1518004-13	83.5	12/8/2016 14:45	10000	3377	17.06	586.051471	196.2254	0.2349	5831.41	0.1005	0.1005	0.9318	0.4278	0.3987	6.8%	0.3348	0.3419	-2.1%																																																																													
ATH1208	A1	1518004-4	28.1	12/8/2016 15:04	10008	3073	13.74	728.282279	221.5276	0.2282	5831.41	0.1249	0.1249	1.2485	0.5473	0.6833	-24.9%	0.3042	0.2984	1.9%																																																																													
ATH1208	A2	1518004-4	28.1	12/8/2016 15:25	10007	3044	13.54	738.913424	222.7864	0.2214	5831.41	0.1267	0.1267	1.1938	0.5723	0.6833	-19.4%	0.3015	0.2984	1.0%																																																																													
ATH1208	A3	1518004-4	28.1	12/8/2016 15:44	10002	3064	13.49	741.314102	224.8412	0.2335	5831.41	0.1271	0.1271	1.1595	0.5444	0.6833	-25.5%	0.3033	0.2984	1.6%																																																																													
ATH1208	A4	1518004-4	28.1	12/8/2016 15:41	10001	3185	13.35	749.043577	236.4878	0.2289	5831.41	0.1284	0.1284	1.1564	0.5612	0.6833	-21.8%	0.3157	0.2984	5.5%																																																																													
ATH1208	B1	1518004-4	28.1	12/8/2016 16:00	10010	3162	12.56	796.869522	249.8336	0.2377	5831.41	0.1367	0.1367	1.1885	0.5749	0.6833	-18.9%	0.3135	0.2984	4.8%																																																																													
ATH1208	B3	1518004-4	28.1	12/8/2016 16:24	10001	3226	12.76	783.643429	250.8173	0.2320	5831.41	0.1344	0.1344	1.1585	0.5792	0.6833	-18.0%	0.3198	0.2984	6.7%																																																																													
ATH1208	B4	1518004-4	28.1	12/8/2016 16:49	10003	2884	13.03	767.531946	219.5104	0.2245	5831.41	0.1316	0.1316	1.1654	0.5863	0.6833	-16.5%	0.2860	0.2984	-4.3%																																																																													
ATH1208	C1	1518004-4	28.1	12/8/2016 11:15	10002	3396	13.5	740.764889	248.8138	0.2269	5831.41	0.1270	0.1270	1.1550	0.5599	0.6833	-22.0%	0.3359	0.2984	11.2%																																																																													
ATH1208	C3	1518004-4	28.1	12/8/2016 11:42	10008	3394	12.82	792.911941	267.2152	0.2349	5831.41	0.1360	0.1360	1.1605	0.5789	0.6833	-18.0%	0.3370	0.2984	11.5%																																																																													
ATH1208	A1	1518004-6	36.8	12/8/2016 14:21	10006	3225	14.36	696.674657	222.4502	0.2282	5831.41	0.1195	0.1195	1.1433	0.5235	0.6278	-19.9%	0.3193	0.3048	4.5%																																																																													
ATH1208	A2	1518004-6	36.8	12/8/2016 14:43	10013	3359	14.66	682.859007	227.0979	0.2214	5831.41	0.1171	0.1171	1.1390	0.5235	0.6278	-18.7%	0.3326	0.3048	8.3%																																																																													
ATH1208	A3	1518004-6	36.8	12/8/2016 15:05	10005	3175	14.05	711.975644	223.8886	0.2335	5831.41	0.1221	0.1221	1.1466	0.5229	0.6278	-20.1%	0.3142	0.3048	3.0%																																																																													
ATH1208	A4	1518004-6	36.8	12/8/2016 15:25	10004	3272	13.94	717.552059	232.6312	0.2289	5831.41	0.1230	0.1230	1.1437	0.5376	0.6278	-16.8%	0.3290	0.3048	6.0%																																																																													
ATH1208	B1	1518004-6	36.8	12/8/2016 15:44	10006	3318	13.59	736.171674	242.3321	0.2377	5831.41	0.1262	0.1262	1.1492	0.5311	0.6278	-18.2%	0.3402	0.3048	10.4%																																																																													
ATH1208	B3	1518004-6	36.8	12/8/2016 16:02	10003	3433	14.1	709.298624	241.2712	0.2320	5831.41	0.1216	0.1216	1.1457	0.5243	0.6278	-19.8%	0.3202	0.3048	4.8%																																																																													
ATH1208	B4	1518004-6	36.8	12/8/2016 16:26	10009	3230	14.21	704.205125	225.4797	0.2245	5831.41	0.1208	0.1208	1.1409	0.5379	0.6278	-16.7%	0.3774	0.3048	19.2%																																																																													
ATH1208	C1	1518004-6	36.8	12/8/2016 16:26	10000	3803	14.9	671.07684	253.2339	0.2269	5831.41	0.1151	0.1151	1.2425	0.5071	0.6278	-23.8%	0.3468	0.3048	12.1%																																																																													
ATH1208	C3	1518004-6	36.8	12/8/2016 16:50	10000	3491	13.95	716.730878	248.5279	0.2349	5831.41	0.1229	0.1229	1.1475	0.5232	0.6278	-20.0%	0.3468	0.3048	12.1%																																																																													







										Alpha	Beta
									Mass	CPM	CPM
Detector ID	Sample ID	Alpha	Beta	Guard	Count Time	Event	Voltage	TOD	#VALUE!	#VALUE!	#VALUE!
A1	12.4	10019	2856	7306	10.36	0	1402.5	12/8/16 15:41	12.4	966.9629	273.5437
A1	13.2	10014	2926	7778	10.93	0	1402.5	12/8/16 9:39	13.2	916.072	265.5716
A1	25.8	10005	2774	8193	11.23	0	1402.5	12/8/16 15:22	25.8	890.7952	244.8849
A1	28.1	10008	3073	10279	13.74	0	1402.5	12/8/16 15:04	28.1	728.2623	221.5216
A1	36.8	10006	3225	11053	14.36	0	1402.5	12/8/16 14:21	36.8	696.6747	222.4502
A1	43.9	10010	3131	10036	14.11	0	1402.5	12/8/16 14:42	43.9	709.3039	219.7674
A1	49.5	10012	2954	11713	15.15	0	1402.5	12/8/16 13:29	49.5	660.7361	192.8515
A1	49.9	10009	2846	10445	13.82	0	1402.5	12/8/16 13:56	49.9	724.1182	203.8014
A1	67.8	10005	3010	12382	17.11	0	1402.5	12/8/16 13:04	67.8	584.6238	173.7885
A1	70	10003	3065	11977	16.8	0	1402.5	12/8/16 12:36	70	595.2947	180.3085
A1	77.3	10006	3132	13538	18.47	0	1402.5	12/8/16 11:48	77.3	541.6214	167.4403
A1	79.3	10004	3109	13825	18.5	0	1402.5	12/8/16 12:13	79.3	540.6348	165.9221
A1	83.5	10006	3050	12202	17.18	0	1402.5	12/8/16 11:18	83.5	582.2994	175.4
A1	89.8	10004	3143	14423	20.07	0	1402.5	12/8/16 10:56	89.8	498.3334	154.4699
A1	100	10002	3133	15055	21.9	0	1402.5	12/8/16 10:09	100	456.5903	140.9274
A1	100.4	10002	3053	16182	22.88	0	1402.5	12/8/16 10:34	100.4	437.0283	131.3033
A2	12.4	10006	3030	7330	10.24	0	1402.5	12/8/16 9:38	12.4	976.9924	293.8694
A2	13.2	10004	2891	7100	10.45	0	1402.5	12/8/16 9:58	13.2	957.1646	274.6217
A2	25.8	10003	2921	7601	10.78	0	1402.5	12/8/16 15:41	25.8	927.7661	268.9357
A2	28.1	10007	3044	10009	13.54	0	1402.5	12/8/16 15:25	28.1	738.9134	222.7864
A2	36.8	10013	3359	10439	14.66	0	1402.5	12/8/16 14:43	36.8	682.859	227.0979
A2	43.9	10006	3137	10659	14.36	0	1402.5	12/8/16 15:05	43.9	696.6407	216.425
A2	49.5	10012	3115	11299	15.03	0	1402.5	12/8/16 13:57	49.5	665.9784	205.2232
A2	49.9	10002	2893	10660	13.83	0	1402.5	12/8/16 14:21	49.9	723.0544	207.1539
A2	67.8	10008	3242	13371	17.36	0	1402.5	12/8/16 13:31	67.8	576.3417	184.7222
A2	70	10003	3161	12054	16.66	0	1402.5	12/8/16 13:03	70	600.2642	187.7069
A2	77.3	10000	3180	13761	18.41	0	1402.5	12/8/16 12:13	77.3	543.0271	170.7032
A2	79.3	10011	3136	12925	18.17	0	1402.5	12/8/16 12:37	79.3	550.8071	170.5632
A2	83.5	10005	3067	12553	17.21	0	1402.5	12/8/16 11:47	83.5	581.1921	176.1813
A2	89.8	10000	3254	14330	20.14	0	1402.5	12/8/16 11:21	89.8	496.3683	159.54
A2	100	10006	3423	15624	22.06	0	1402.5	12/8/16 10:33	100	453.4251	153.1387
A2	100.4	10003	3101	15870	22.07	0	1402.5	12/8/16 10:58	100.4	453.0837	138.4785
A3	12.4	10004	2937	6720	9.88	0	1402.5	12/8/16 9:57	12.4	1012.427	294.9772
A3	13.2	10018	2840	7430	10.27	0	1402.5	12/8/16 10:22	13.2	975.3385	274.2436
A3	25.8	10009	2962	7665	10.76	0	1402.5	12/8/16 9:38	25.8	930.0805	272.9888
A3	28.1	10002	3064	9508	13.49	0	1402.5	12/8/16 15:44	28.1	741.3141	224.8412
A3	36.8	10005	3175	10441	14.05	0	1402.5	12/8/16 15:05	36.8	711.9756	223.6886
A3	43.9	10004	3027	10120	13.66	0	1402.5	12/8/16 15:25	43.9	732.2332	219.3059
A3	49.5	10005	2978	11339	14.72	0	1402.5	12/8/16 14:22	49.5	679.5635	200.0198
A3	49.9	10000	2918	9510	13.41	0	1402.5	12/8/16 14:42	49.9	745.5882	215.3088
A3	67.8	10002	3207	12589	16.77	0	1402.5	12/8/16 13:59	67.8	596.2982	188.9443
A3	70	10006	3083	12850	16.66	0	1402.5	12/8/16 13:31	70	600.4762	182.764
A3	77.3	10001	3296	13235	18.6	0	1402.5	12/8/16 12:38	77.3	537.5642	174.9143
A3	79.3	10006	3128	13291	18.43	0	1402.5	12/8/16 13:05	79.3	542.7952	167.4333
A3	83.5	10007	3050	12526	16.9	0	1402.5	12/8/16 12:12	83.5	592.0062	178.1834
A3	89.8	10003	3223	14176	19.37	0	1402.5	12/8/16 11:49	89.8	516.2931	164.1013
A3	100	9999	3226	15342	21.31	0	1402.5	12/8/16 10:57	100	469.0923	149.0943
A3	100.4	10000	3342	16058	22.57	0	1402.5	12/8/16 11:24	100.4	442.942	145.7827
A4	12.4	10003	3073	7643	10.58	0	1402.5	12/8/16 10:22	12.4	945.3681	288.3647
A4	13.2	10010	2987	7725	10.51	0	1402.5	12/8/16 10:47	13.2	952.3313	282.1165
A4	25.8	10002	3011	7508	11.08	0	1402.5	12/8/16 9:59	25.8	902.6126	269.6619
A4	28.1	10001	3185	9356	13.35	0	1402.5	12/8/16 9:41	28.1	749.0436	236.4878
A4	36.8	10004	3272	10342	13.94	0	1402.5	12/8/16 15:25	36.8	717.5521	232.6312
A4	43.9	10001	3171	10137	14.39	0	1402.5	12/8/16 15:45	43.9	694.9015	218.2724
A4	49.5	9999	3035	10607	14.9	0	1402.5	12/8/16 14:43	49.5	670.9788	201.6023
A4	49.9	10007	3021	10395	13.97	0	1402.5	12/8/16 15:04	49.9	716.2257	214.1601
A4	67.8	10008	3088	12624	16.51	0	1402.5	12/8/16 14:24	67.8	606.0831	184.9492
A4	70	10007	3115	12540	16.71	0	1402.5	12/8/16 13:59	70	598.768	184.3263
A4	77.3	10000	3301	13587	18.85	0	1402.5	12/8/16 13:05	77.3	530.409	173.0304
A4	79.3	10003	3268	14207	18.56	0	1402.5	12/8/16 13:32	79.3	538.8597	173.9886
A4	83.5	10008	3138	12398	17.38	0	1402.5	12/8/16 12:36	83.5	575.7393	178.4634
A4	89.8	10001	3344	15131	20.12	0	1402.5	12/8/16 12:15	89.8	496.9726	164.1138
A4	100	10000	3339	15446	21.7	0	1402.5	12/8/16 11:23	100	460.7345	151.782
A4	100.4	10001	3167	16129	22.22	0	1402.5	12/8/16 11:52	100.4	449.995	140.4403
B1	12.4	10003	3257	7078	9.86	0	1500	12/8/16 10:46	12.4	1014.398	328.4065
B1	13.2	10009	3082	6835	9.91	0	1500	12/8/16 11:11	13.2	1009.885	309.081
B1	25.8	10009	3045	7138	10.3	0	1500	12/8/16 10:22	25.8	971.6426	293.7131

B1	28.1	10010	3162	8675	12.56	0	1500	12/8/16 10:00	28.1	796.8695	249.8336
B1	36.8	10006	3318	9590	13.59	0	1500	12/8/16 15:44	36.8	736.1717	242.2321
B1	43.9	10008	3177	9354	13.38	0	1500	12/8/16 9:41	43.9	747.8771	235.5259
B1	49.5	10002	3046	9681	13.82	0	1500	12/8/16 15:04	49.5	723.6287	218.4872
B1	49.9	10003	2846	9222	12.9	0	1500	12/8/16 15:24	49.9	775.3214	218.7022
B1	67.8	10008	3214	11405	16.01	0	1500	12/8/16 14:44	67.8	625.0043	198.8315
B1	70	10008	3117	11226	15.74	0	1500	12/8/16 14:23	70	635.7273	196.1125
B1	77.3	10003	3311	12243	17.59	0	1500	12/8/16 13:31	77.3	568.5704	186.3139
B1	79.3	10010	3175	12120	16.9	0	1500	12/8/16 13:59	79.3	592.2027	185.9518
B1	83.5	10001	3205	11680	16.53	0	1500	12/8/16 13:03	83.5	604.9162	191.9719
B1	100	10002	3340	14276	20.36	0	1500	12/8/16 11:50	100	491.1524	162.1292
B1	100.4	10005	3245	14470	20.91	0	1500	12/8/16 12:16	100.4	478.3742	153.2709
B1	8938	10002	3285	13093	18.67	0	1500	12/8/16 12:38	8938	535.6208	174.0327
B3	12.4	10009	3087	6848	9.93	0	1500	12/8/16 11:11	12.4	1007.822	308.6721
B3	13.2	10007	3030	7146	10.16	0	1500	12/8/16 11:40	13.2	984.8069	296.0243
B3	25.8	10017	3147	7762	10.8	0	1500	12/8/16 10:47	25.8	927.366	289.1849
B3	28.1	10001	3226	8920	12.76	0	1500	12/8/16 10:24	28.1	783.6434	250.6173
B3	36.8	10003	3433	9858	14.1	0	1500	12/8/16 9:42	36.8	709.2986	241.2712
B3	43.9	10011	3234	9376	13.57	0	1500	12/8/16 10:01	43.9	737.5963	236.1158
B3	49.5	10001	3350	10634	14.8	0	1500	12/8/16 15:26	49.5	675.6092	224.1474
B3	49.9	10010	3199	9589	13.59	0	1500	12/8/16 15:44	49.9	736.437	233.1897
B3	67.8	10003	3431	11573	16.42	0	1500	12/8/16 15:07	67.8	609.0621	206.7485
B3	70	9999	3439	11676	16.38	0	1500	12/8/16 14:45	70	610.3056	207.7472
B3	77.3	10007	3589	13187	18.39	0	1500	12/8/16 14:00	77.3	544.0204	192.9564
B3	79.3	10009	3496	12967	18.18	0	1500	12/8/16 14:25	79.3	550.4161	190.0952
B3	83.5	10002	3408	11810	16.91	0	1500	12/8/16 13:31	83.5	591.3503	199.3336
B3	89.8	10000	3590	13920	19.72	0	1500	12/8/16 13:06	89.8	506.9654	179.8447
B3	100	10004	3478	14579	21.08	0	1500	12/8/16 12:16	100	474.4391	162.7865
B3	100.4	10004	3491	15409	21.94	0	1500	12/8/16 12:41	100.4	455.8368	156.9118
B4	12.4	10003	2794	6924	9.82	0	1500	12/8/16 11:39	12.4	1018.477	282.6964
B4	13.2	10006	2748	7180	10.32	0	1500	12/8/16 12:05	13.2	969.4156	264.4541
B4	25.8	10005	2910	7465	10.81	0	1500	12/8/16 11:12	25.8	925.3739	267.3702
B4	28.1	10003	2884	9261	13.03	0	1500	12/8/16 10:49	28.1	767.5319	219.5104
B4	36.8	10009	3230	9829	14.21	0	1500	12/8/16 10:02	36.8	704.2051	225.4797
B4	43.9	10012	3080	9852	14.12	0	1500	12/8/16 10:26	43.9	708.9072	216.3053
B4	49.5	10004	2994	10347	14.73	0	1500	12/8/16 15:45	49.5	679.0002	201.4337
B4	49.9	10000	2920	9561	13.67	0	1500	12/8/16 9:41	49.9	731.3709	211.7814
B4	67.8	10004	3208	12383	17.26	0	1500	12/8/16 15:28	67.8	579.448	184.0383
B4	70	10000	3308	11882	16.87	0	1500	12/8/16 15:07	70	592.6102	194.2627
B4	77.3	10004	3262	13296	18.65	0	1500	12/8/16 14:26	77.3	536.2495	173.0812
B4	79.3	9999	3198	12847	18.13	0	1500	12/8/16 14:47	79.3	551.3588	174.5677
B4	83.5	10006	3201	12550	17.5	0	1500	12/8/16 13:59	83.5	571.6134	181.0893
B4	89.8	10000	3264	14008	20.15	0	1500	12/8/16 13:34	89.8	496.1199	160.1601
B4	100	10001	3149	15163	21.61	0	1500	12/8/16 12:41	100	462.637	143.8946
B4	100.4	10000	3066	15882	22.54	0	1500	12/8/16 13:09	100.4	443.4977	134.1998
C1	12.4	10010	3280	7534	10.42	0	1530	12/8/16 12:05	12.4	960.5286	312.7783
C1	13.2	10000	3215	7607	10.58	0	1530	12/8/16 12:30	13.2	945.0556	301.8742
C1	25.8	10005	3270	7977	11.19	0	1530	12/8/16 11:41	25.8	893.9779	290.2242
C1	28.1	10002	3386	9616	13.5	0	1530	12/8/16 11:15	28.1	740.7649	248.8138
C1	36.8	10000	3803	10632	14.9	0	1530	12/8/16 10:26	36.8	671.0169	253.2339
C1	43.9	10003	3452	10587	14.53	0	1530	12/8/16 10:51	43.9	688.3137	235.5764
C1	49.5	10003	3543	10988	15.61	0	1530	12/8/16 9:43	49.5	640.6832	224.9689
C1	49.9	10003	3444	10206	14.36	0	1530	12/8/16 10:02	49.9	696.4637	237.8319
C1	67.8	10003	3768	12722	18.01	0	1530	12/8/16 15:49	67.8	555.2897	207.2161
C1	70	9999	3557	12476	17.02	0	1530	12/8/16 15:28	70	587.3613	206.9884
C1	77.3	10002	3708	14315	19.75	0	1530	12/8/16 14:48	77.3	506.3064	185.7458
C1	79.3	10002	3584	13588	18.96	0	1530	12/8/16 15:10	79.3	527.4076	187.0285
C1	83.5	10000	3552	12929	18.04	0	1530	12/8/16 14:25	83.5	554.1997	194.8948
C1	89.8	10002	3773	15136	20.9	0	1530	12/8/16 14:03	89.8	478.4406	178.5253
C1	100	10003	3605	16202	22.45	0	1530	12/8/16 13:09	100	445.4439	158.5781
C1	100.4	10002	3576	16314	23.18	0	1530	12/8/16 13:37	100.4	431.3687	152.2699
C3	12.4	10012	3018	6950	9.64	0	1530	12/8/16 12:29	12.4	1038.474	311.3475
C3	13.2	10001	3122	7346	10.16	0	1530	12/8/16 12:57	13.2	984.2354	305.5605
C3	25.8	10000	3123	7635	10.53	0	1530	12/8/16 12:05	25.8	949.5526	294.8582
C3	28.1	10008	3394	8954	12.62	0	1530	12/8/16 11:42	28.1	792.9119	267.2152
C3	36.8	10000	3491	10188	13.95	0	1530	12/8/16 10:50	36.8	716.7309	248.5279
C3	43.9	10006	3264	9541	13.39	0	1530	12/8/16 11:14	43.9	747.1591	242.041
C3	49.5	10008	3358	10281	14.46	0	1530	12/8/16 10:02	49.5	692.0012	230.5038
C3	49.9	10000	3255	9553	13.37	0	1530	12/8/16 10:25	49.9	747.8282	241.7325
C3	67.8	10005	3516	11890	16.97	0	1530	12/8/16 9:45	67.8	589.4548	205.4662

C3	70	10004	3283	11410	16.16	0	1530	12/8/16 15:47	70	618.9444	201.4329
C3	77.3	10005	3537	12845	17.98	0	1530	12/8/16 15:09	77.3	556.3366	194.9956
C3	79.3	10008	3465	12958	17.7	0	1530	12/8/16 15:29	79.3	565.3087	194.0397
C3	83.5	10000	3377	12433	17.06	0	1530	12/8/16 14:45	83.5	586.0515	196.2254
C3	89.8	10002	3585	14178	19.77	0	1530	12/8/16 14:27	89.8	505.8031	179.6124
C3	100	10007	3558	14798	20.99	0	1530	12/8/16 13:35	100	476.6358	167.7863
C3	100.4	9999	3573	15806	21.87	0	1530	12/8/16 14:04	100.4	457.0866	161.6515

LB4100A Beta Attenuation Curve -- Cs-137

WO #: 1617003				Calibrated Mass Range				Attenuation Equation				Cross-Talk Equation					
Nuclide: Cs-137				Low				y=b*x ^m (a ^x)				b = 0.9455					
Std. ID: 1019.4095.83				0.0				m = 0.9986				m = 0.0037					
Ref. Date: 02/09/15				High				a = 1.0026				% Diff Max. = 86.7%					
Half-life: 30.1 yrs				mg				% Diff Max. = 10.9%									
Activity: 3937.1 dpm/mL				mg													
Vol.: 1																	
File ID	Detector ID	Sample ID	Mass (mg)	Count Date	Alpha Counts	Beta Counts	Count Time	Base Beta Eff.	Alpha CPM	Beta CPM	Decay Corr. added dpm/mL	Beta Obs. Atten. Eff.	Obs. Atten Fact.	Fitted Atten Fact.	% Diff.	β > α XTLK β > α XTLK	% Diff.
ACSI207	A1	1617003-1	0	12/17/2016 9:11	23	10011	6.74	0.3942	3.290463	1483.18	3774.88	0.3929	0.9967	0.9455	5.4%	0.0022	0.0037
ACSI207	A2	1617003-1	0	12/17/2016 9:25	20	10008	6.73	0.3972	2.815768	1485.04	3774.87	0.3934	0.9904	0.9455	4.8%	0.0019	0.0037
ACSI207	A3	1617003-1	0	12/17/2016 9:39	17	10017	6.53	0.4040	2.479369	1531.707	3774.87	0.4058	1.0044	0.9455	6.2%	0.0016	0.0037
ACSI207	A4	1617003-1	0	12/17/2016 9:52	23	10003	6.55	0.3921	3.41645	1525.087	3774.87	0.4040	1.0304	0.9455	9.0%	0.0022	0.0037
ACSI207	B1	1617003-1	0	12/17/2016 10:06	40	10011	6.4	0.4271	6.145	1562.301	3774.87	0.4139	0.9690	0.9455	2.5%	0.0039	0.0037
ACSI207	B3	1617003-1	0	12/17/2016 10:19	11	10008	6.41	0.4171	1.582069	1559.106	3774.86	0.4130	0.9602	0.9455	4.7%	0.0010	0.0037
ACSI207	B4	1617003-1	0	12/17/2016 10:35	64	10009	6.86	0.3964	9.171446	1457.213	3774.86	0.3860	0.9738	0.9455	3.0%	0.0063	0.0037
ACSI207	C1	1617003-1	0	12/17/2016 10:46	27	10019	6.64	0.3974	3.942265	1506.885	3774.86	0.3992	1.0045	0.9455	6.2%	0.0026	0.0037
ACSI207	C3	1617003-1	0	12/17/2016 11:07	19	10002	6.31	0.4191	2.896094	1583.38	3774.86	0.4195	1.0008	0.9455	5.9%	0.0018	0.0037
ACSI207	A1	1617003-2	16.3	12/17/2016 13:19	31	10008	6.99	0.3942	4.312907	1429.628	3774.83	0.3787	0.9607	0.9241	4.9%	0.0030	0.0037
ACSI207	A2	1617003-2	16.3	12/17/2016 9:11	24	10012	6.96	0.3972	3.292276	1436.477	3774.88	0.3805	0.9580	0.9241	3.7%	0.0023	0.0037
ACSI207	A3	1617003-2	16.3	12/17/2016 9:25	13	10011	6.74	0.4040	1.804783	1483.022	3774.87	0.3929	0.9724	0.9241	5.2%	0.0012	0.0037
ACSI207	A4	1617003-2	16.3	12/17/2016 9:40	27	10016	7.08	0.3921	3.718559	1412.6	3774.87	0.3742	0.9544	0.9241	3.3%	0.0026	0.0037
ACSI207	B1	1617003-2	16.3	12/17/2016 9:52	29	10009	6.78	0.4271	4.172286	1474.336	3774.87	0.3906	0.9145	0.9241	-1.0%	0.0028	0.0037
ACSI207	B3	1617003-2	16.3	12/17/2016 10:06	13	10022	6.82	0.4171	1.772158	1467.297	3774.87	0.3887	0.9319	0.9241	1.8%	0.0012	0.0037
ACSI207	B4	1617003-2	16.3	12/17/2016 10:20	55	10003	7.1	0.3964	7.586479	1407.048	3774.86	0.3727	0.9403	0.9241	1.8%	0.0054	0.0037
ACSI207	C1	1617003-2	16.3	12/17/2016 10:35	27	10007	6.89	0.3974	3.794723	1450.394	3774.86	0.3842	0.9668	0.9241	4.8%	0.0026	0.0037
ACSI207	C3	1617003-2	16.3	12/17/2016 10:46	20	10014	6.74	0.4191	2.852359	1484.034	3774.86	0.3931	0.9393	0.9241	1.5%	0.0019	0.0037
ACSI207	A1	1617003-3	30.4	12/17/2016 13:05	21	10006	7.02	0.3942	2.869453	1423.224	3774.84	0.3770	0.9564	0.9060	5.6%	0.0020	0.0037
ACSI207	A2	1617003-3	30.4	12/17/2016 13:19	27	10021	6.88	0.3972	3.768419	1454.512	3774.83	0.3853	0.9701	0.9060	7.1%	0.0026	0.0037
ACSI207	A3	1617003-3	30.4	12/17/2016 13:31	16	10013	6.7	0.4040	2.264006	1492.188	3774.88	0.3953	0.9785	0.9060	8.0%	0.0015	0.0037
ACSI207	A4	1617003-3	30.4	12/17/2016 9:25	14	10022	6.94	0.3921	1.922291	1442.003	3774.87	0.3820	0.9742	0.9060	7.5%	0.0013	0.0037
ACSI207	B1	1617003-3	30.4	12/17/2016 9:39	29	10015	6.52	0.4271	4.342853	1534.125	3774.87	0.4064	0.9515	0.9060	5.0%	0.0028	0.0037
ACSI207	B3	1617003-3	30.4	12/17/2016 9:52	12	10003	6.73	0.4171	1.649061	1484.126	3774.87	0.3932	0.9426	0.9060	4.0%	0.0011	0.0037
ACSI207	B4	1617003-3	30.4	12/17/2016 10:06	40	10001	6.96	0.3964	5.589126	1435.1	3774.87	0.3802	0.9591	0.9060	5.9%	0.0039	0.0037
ACSI207	C1	1617003-3	30.4	12/17/2016 10:19	33	10010	6.75	0.3974	4.764889	1480.962	3774.86	0.3923	0.9872	0.9060	9.0%	0.0032	0.0037
ACSI207	C3	1617003-3	30.4	12/17/2016 10:34	33	10019	6.59	0.4191	4.892587	1518.611	3774.86	0.4023	0.9599	0.9060	5.9%	0.0032	0.0037
ACSI207	A1	1617003-4	49.6	12/17/2016 12:51	15	10008	8.41	0.3942	1.661591	1187.88	3774.84	0.3147	0.7983	0.8819	-9.5%	0.0014	0.0038
ACSI207	A2	1617003-4	49.6	12/17/2016 13:06	28	10012	8.19	0.3972	3.262803	1220.437	3774.84	0.3233	0.8140	0.8819	-7.7%	0.0027	0.0038
ACSI207	A3	1617003-4	49.6	12/17/2016 13:20	9	10010	8.28	0.4040	0.962957	1206.647	3774.83	0.3197	0.7912	0.8819	-10.3%	0.0008	0.0038
ACSI207	A4	1617003-4	49.6	12/17/2016 9:13	9	10006	8.04	0.3921	1.024403	1242.438	3774.88	0.3291	0.8394	0.8819	-4.8%	0.0008	0.0038
ACSI207	B1	1617003-4	49.6	12/17/2016 9:26	44	10014	7.59	0.4271	5.692101	1317.45	3774.87	0.3490	0.8172	0.8819	-7.3%	0.0043	0.0038
ACSI207	B3	1617003-4	49.6	12/17/2016 9:40	11	10010	7.89	0.4171	1.26017	1266.491	3774.87	0.3355	0.8044	0.8819	-8.8%	0.0010	0.0038
ACSI207	B4	1617003-4	49.6	12/17/2016 9:54	66	10019	8.25	0.3964	7.842	1212.599	3774.87	0.3212	0.8104	0.8819	-8.1%	0.0065	0.0038
ACSI207	C1	1617003-4	49.6	12/17/2016 10:07	29	10013	7.82	0.3974	3.58444	1278.434	3774.87	0.3387	0.8522	0.8819	-3.4%	0.0028	0.0038
ACSI207	C3	1617003-4	49.6	12/17/2016 10:20	17	10011	7.63	0.4191	2.113047	1310.335	3774.86	0.3471	0.8283	0.8819	-6.1%	0.0016	0.0038
ACSI207	A1	1617003-5	63.4	12/17/2016 12:35	21	10012	8.31	0.3942	2.405076	1202.681	3774.84	0.3186	0.8082	0.8650	-6.6%	0.0020	0.0038
ACSI207	A2	1617003-5	63.4	12/17/2016 12:51	28	10001	8.64	0.3972	3.084741	1155.494	3774.84	0.3061	0.7707	0.8650	-10.9%	0.0027	0.0038
ACSI207	A3	1617003-5	63.4	12/17/2016 13:06	6	10014	7.94	0.4040	0.631668	1258.919	3774.84	0.3335	0.8255	0.8650	-4.6%	0.0005	0.0038
ACSI207	A4	1617003-5	63.4	12/17/2016 13:20	21	10011	8.2	0.3921	2.465976	1218.765	3774.83	0.3229	0.8234	0.8650	-4.8%	0.0020	0.0038
ACSI207	B1	1617003-5	63.4	12/17/2016 9:12	35	10011	7.82	0.4271	4.370703	1276.261	3774.88	0.3386	0.7928	0.8650	-8.3%	0.0034	0.0038
ACSI207	B3	1617003-5	63.4	12/17/2016 9:26	19	10003	8.05	0.4171	2.226248	1240.405	3774.87	0.3286	0.7878	0.8650	-8.9%	0.0018	0.0038
ACSI207	B4	1617003-5	63.4	12/17/2016 9:41	61	10011	8.16	0.3964	7.31749	1225.013	3774.87	0.3245	0.8187	0.8650	-5.4%	0.0060	0.0038
ACSI207	C1	1617003-5	63.4	12/17/2016 9:54	25	10009	8.12	0.3974	2.954818	1230.634	3774.87	0.3260	0.8204	0.8650	-5.2%	0.0024	0.0038
ACSI207	C3	1617003-5	63.4	12/17/2016 10:07	15	10011	7.81	0.4191	1.805615	1280.095	3774.87	0.3391	0.8091	0.8650	-6.5%	0.0014	0.0038

LB4100A Beta Attenuation Curve -- Cs-137

WO #:		1617003		Calibrated Mass Range		Attenuation Equation		Cross-Talk Equation									
Nuclide:		Cs-137		Low		y=b*m*(a^x)		b =									
Std. ID:		1019.4095.83		0.0		b = 0.9455		m =									
Ref. Date:		02/09/15		High		a = 1.0026		% Diff Max. =									
Half-life:		30.1		mg		%											
Activity:		3937.1		mg		%											
Vol.:		1		mL		%											
File ID	Detector ID	Sample ID	Mass (mg)	Count Date	Alpha Counts	Beta Counts	Count Time	Base Beta Eff.	Alpha CPM	Beta CPM	Decay Corr. added dpm/mL	Beta Obs. Atten. Eff.	Obs. Atten. Fact.	Fitted Atten. Fact.	% Diff.	$\beta > \alpha \times \text{XTLK}$	$\beta > \alpha \times \text{XTLK}$
ACS1207	A1	1617003-6	75.3	12/17/2016 12:21	29	10003	7.93	0.3942	3.534999	1259.28	3774.84	0.3336	0.8463	0.8507	-0.5%	0.0028	0.0038
ACS1207	A2	1617003-6	75.3	12/17/2016 12:35	24	10016	7.95	0.3972	2.862868	1257.845	3774.84	0.3332	0.8389	0.8507	-1.4%	0.0023	0.0038
ACS1207	A3	1617003-6	75.3	12/17/2016 12:50	11	10017	7.87	0.4040	1.273713	1270.518	3774.84	0.3366	0.8331	0.8507	-2.1%	0.0010	0.0038
ACS1207	B1	1617003-6	75.3	12/17/2016 13:06	13	10019	7.87	0.3921	1.566842	1270.973	3774.84	0.3367	0.8587	0.8507	0.9%	0.0012	0.0038
ACS1207	B3	1617003-6	75.3	12/17/2016 13:19	26	10012	7.61	0.4271	3.311557	1313.719	3774.83	0.3480	0.8148	0.8507	-4.2%	0.0025	0.0038
ACS1207	B4	1617003-6	75.3	12/17/2016 9:12	14	10002	7.55	0.4171	1.720305	1322.564	3774.88	0.3504	0.8400	0.8507	-1.3%	0.0013	0.0038
ACS1207	C1	1617003-6	75.3	12/17/2016 9:26	41	10014	8.11	0.3964	4.897487	1322.947	3774.87	0.3266	0.8240	0.8507	-3.1%	0.0040	0.0038
ACS1207	C3	1617003-6	75.3	12/17/2016 9:40	35	10006	7.95	0.3974	4.278516	1256.615	3774.87	0.3329	0.8377	0.8507	-1.5%	0.0034	0.0038
ACS1207	A1	1617003-7	95.8	12/17/2016 12:09	14	10019	7.46	0.4191	1.761676	1341.306	3774.87	0.3553	0.8478	0.8507	-0.3%	0.0013	0.0038
ACS1207	A2	1617003-7	95.8	12/17/2016 12:21	23	10010	8.08	0.3942	2.724535	1236.729	3774.85	0.3276	0.8311	0.8266	0.5%	0.0022	0.0038
ACS1207	A3	1617003-7	95.8	12/17/2016 12:35	25	10010	8.21	0.3972	2.889067	1217.216	3774.84	0.3225	0.8118	0.8266	-1.8%	0.0024	0.0038
ACS1207	A4	1617003-7	95.8	12/17/2016 12:51	16	10013	7.94	0.4040	1.891113	1258.793	3774.84	0.3335	0.8254	0.8266	-0.1%	0.0015	0.0038
ACS1207	B1	1617003-7	95.8	12/17/2016 13:06	37	10007	7.92	0.4271	1.494242	1221.994	3774.84	0.3237	0.8256	0.8266	-0.1%	0.0012	0.0038
ACS1207	B3	1617003-7	95.8	12/17/2016 13:20	9	10005	7.97	0.4171	0.566717	1261.592	3774.84	0.3342	0.7825	0.8266	-5.3%	0.0036	0.0038
ACS1207	B4	1617003-7	95.8	12/17/2016 9:13	49	10009	8.21	0.3964	0.956235	1253.128	3774.83	0.3320	0.7959	0.8266	-3.7%	0.0008	0.0038
ACS1207	C1	1617003-7	95.8	12/17/2016 9:26	27	10009	8.01	0.3974	5.810331	1217.298	3774.88	0.3225	0.8135	0.8266	-1.6%	0.0048	0.0038
ACS1207	C3	1617003-7	95.8	12/17/2016 9:40	18	10013	7.76	0.4191	3.246787	1247.562	3774.87	0.3305	0.8316	0.8266	0.6%	0.0026	0.0038
ACS1207	A1	1617003-8	102.6	12/17/2016 11:51	16	10010	8.75	0.3942	2.045588	1288.612	3774.87	0.3414	0.8145	0.8266	-1.5%	0.0017	0.0038
ACS1207	A2	1617003-8	102.6	12/17/2016 12:09	29	10009	8.4	0.3972	1.706571	1141.868	3774.85	0.3025	0.7674	0.8188	-6.3%	0.0015	0.0038
ACS1207	A3	1617003-8	102.6	12/17/2016 12:21	13	10012	8.38	0.4040	3.296381	1189.519	3774.85	0.3151	0.7933	0.8188	-3.1%	0.0028	0.0038
ACS1207	A4	1617003-8	102.6	12/17/2016 12:35	13	10011	8.56	0.3921	1.427313	1192.459	3774.84	0.3159	0.7819	0.8188	-4.5%	0.0012	0.0038
ACS1207	B1	1617003-8	102.6	12/17/2016 12:51	32	10002	8.43	0.4271	1.423692	1167.42	3774.84	0.3093	0.7887	0.8188	-3.7%	0.0012	0.0038
ACS1207	B3	1617003-8	102.6	12/17/2016 13:07	12	10004	8.43	0.4171	3.690967	1184.559	3774.84	0.3138	0.7347	0.8188	-10.3%	0.0031	0.0038
ACS1207	B4	1617003-8	102.6	12/17/2016 13:21	47	10000	8.81	0.3964	1.289488	1184.51	3774.84	0.3138	0.7523	0.8188	-8.1%	0.0011	0.0038
ACS1207	C1	1617003-8	102.6	12/17/2016 13:21	19	10000	8.41	0.3974	5.176847	1133.249	3774.83	0.3002	0.7573	0.8188	-7.5%	0.0046	0.0038
ACS1207	C3	1617003-8	102.6	12/17/2016 9:26	16	10004	8.2	0.4191	2.135215	1187.06	3774.88	0.3145	0.7913	0.8188	-3.4%	0.0018	0.0038
ACS1207	A1	1617003-9	129.6	12/17/2016 11:38	25	10007	8.4	0.3942	1.836222	1218.277	3774.87	0.3227	0.7701	0.8188	-5.9%	0.0015	0.0038
ACS1207	A2	1617003-9	129.6	12/17/2016 11:51	27	10011	8.51	0.3972	2.85419	1189.178	3774.85	0.3150	0.7992	0.7883	1.4%	0.0024	0.0039
ACS1207	A3	1617003-9	129.6	12/17/2016 12:09	10	10014	8.19	0.4040	1.861664	1174.352	3774.85	0.3111	0.7832	0.7883	-0.6%	0.0026	0.0039
ACS1207	A4	1617003-9	129.6	12/17/2016 12:21	28	10003	8.38	0.3921	3.016738	1220.421	3774.85	0.3233	0.8003	0.7883	1.5%	0.0009	0.0039
ACS1207	B1	1617003-9	129.6	12/17/2016 12:35	44	10007	8.08	0.4271	1.097001	1220.421	3774.85	0.3233	0.8003	0.7883	1.5%	0.0009	0.0039
ACS1207	B3	1617003-9	129.6	12/17/2016 12:51	19	10009	8.3	0.4171	3.246289	1191.586	3774.84	0.3157	0.8051	0.7883	2.1%	0.0027	0.0039
ACS1207	B4	1617003-9	129.6	12/17/2016 13:07	38	10012	8.52	0.3964	1.5340545	1236.572	3774.84	0.3276	0.7670	0.7883	-2.7%	0.0043	0.0039
ACS1207	C1	1617003-9	129.6	12/17/2016 13:20	24	10006	8.44	0.3974	2.155157	1203.7	3774.84	0.3189	0.7645	0.7883	-3.0%	0.0018	0.0039
ACS1207	C3	1617003-9	129.6	12/17/2016 9:13	17	9999	8.09	0.4191	4.302094	1173.292	3774.84	0.3108	0.7841	0.7883	-0.5%	0.0037	0.0039
ACS1207	A1	1617003-10	139	12/17/2016 11:23	17	10004	8.57	0.3942	2.719602	1183.544	3774.83	0.3135	0.7890	0.7883	0.1%	0.0023	0.0039
ACS1207	A2	1617003-10	139	12/17/2016 11:38	25	10015	8.56	0.3972	1.96636	1234.247	3774.88	0.3270	0.7802	0.7883	-1.0%	0.0016	0.0039
ACS1207	A3	1617003-10	139	12/17/2016 11:51	7	9999	8.47	0.4040	1.861664	1165.196	3774.85	0.3087	0.7830	0.7883	0.6%	0.0016	0.0039
ACS1207	A4	1617003-10	139	12/17/2016 12:09	20	10001	8.43	0.3921	3.016738	1174.352	3774.85	0.3111	0.7832	0.7883	-0.6%	0.0024	0.0039
ACS1207	B1	1617003-10	139	12/17/2016 12:21	32	10008	7.96	0.4271	0.702446	1178.229	3774.85	0.3121	0.7726	0.7883	-0.7%	0.0006	0.0039
ACS1207	B3	1617003-10	139	12/17/2016 12:35	8	10006	8.11	0.4171	2.27479	1184.269	3774.85	0.3137	0.8001	0.7883	2.8%	0.0019	0.0039
ACS1207	B4	1617003-10	139	12/17/2016 12:51	42	10004	8.62	0.3964	2.27479	1184.269	3774.85	0.3137	0.8001	0.7883	2.8%	0.0019	0.0039
ACS1207	C1	1617003-10	139	12/17/2016 13:06	35	10010	8.21	0.3974	3.915101	1255.368	3774.84	0.3326	0.7787	0.7883	0.1%	0.0031	0.0039
ACS1207	C3	1617003-10	139	12/17/2016 13:20	20	10004	8.12	0.4191	0.852436	1231.581	3774.84	0.3263	0.7822	0.7883	0.5%	0.0007	0.0039
ACS1207	A1	1617003-10	139	12/17/2016 13:20	35	10010	8.21	0.3974	4.714339	1158.732	3774.84	0.3070	0.7744	0.7883	-0.5%	0.0041	0.0039
ACS1207	A2	1617003-10	139	12/17/2016 13:20	20	10004	8.12	0.4191	4.139094	1217.244	3774.84	0.3225	0.8114	0.7883	4.3%	0.0034	0.0039
ACS1207	A3	1617003-10	139	12/17/2016 13:20	20	10004	8.12	0.4191	2.348054	1230.297	3774.83	0.3259	0.7777	0.7883	0.0%	0.0019	0.0039

LB4100A Beta Attenuation Curve -- Cs-137

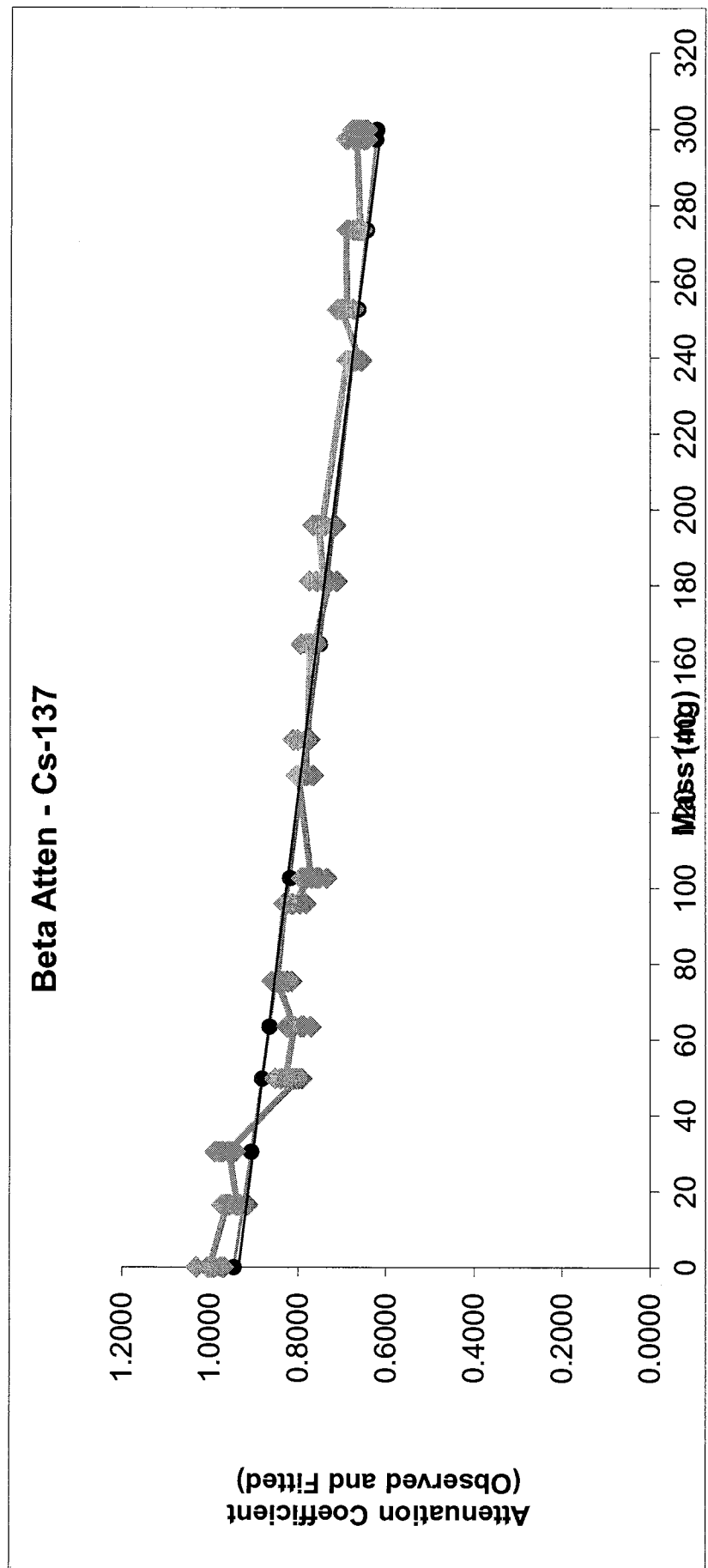
WO #:		1617003		Calibrated Mass Range		Attenuation Equation		Cross-Talk Equation		
Nucide:		Cs-137		Low High	0.0 mg 299.7 mg	b = 0.9455 m = 0.9986 a = 1.0026 % Diff Max. = 10.9%		b = 1.6183E-06 m = 0.0037 % Diff Max. = 86.7%		
Ref. Date:		02/09/15								
Half-life:		30.1		yrs						
Activity:		3937.1		dpm/mL						
Vol.:		1		mL						

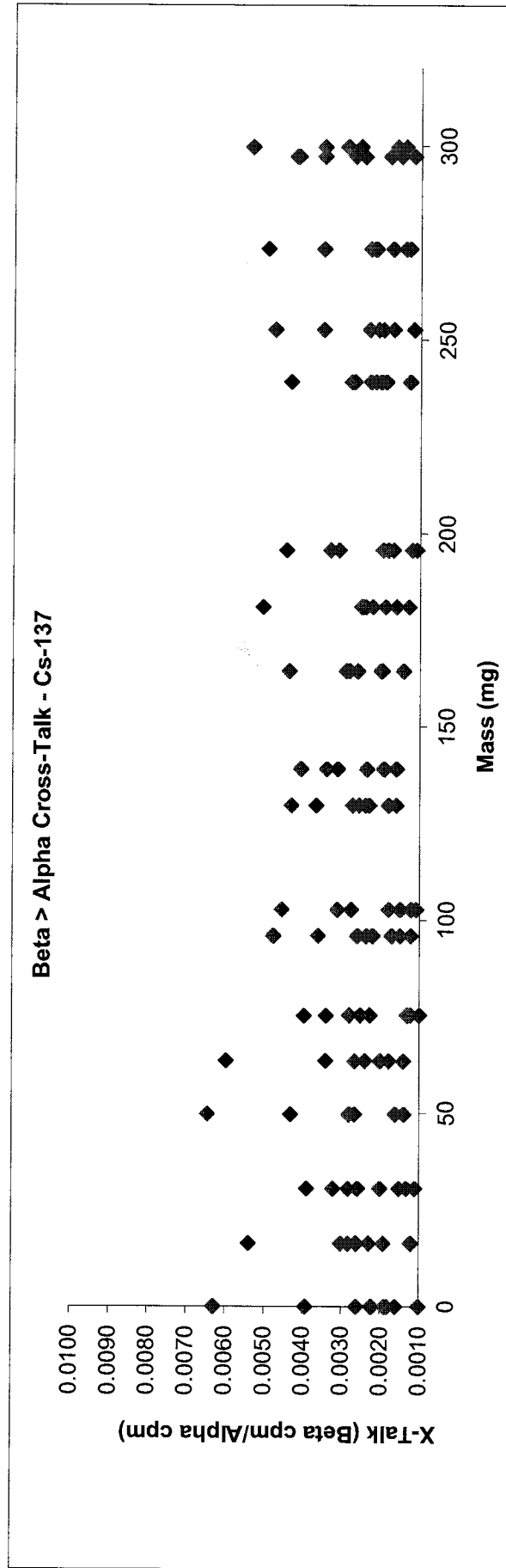
File ID	Detector ID	Sample ID	Mass (mg)	Count Date	Alpha Counts	Beta Counts	Count Time	Base Beta Eff	Alpha CPM	Beta CPM	Decay Corr. added dpm/mL	Beta Obs. Atten. Eff.	Obs. Atten. Fact.	Fitted Atten. Fact.	% Diff.	$\beta > \alpha$ XTLLK Observed	$\beta > \alpha$ XTLLK Fitted	% Diff.
ACSI207	A1	1617003-11	164.4	12/17/2016 11:10	21	10015	8.69	0.3942	2.294571	1150.342	3774.86	0.3047	0.7731	0.7508	3.0%	0.0020	0.0039	-49.4%
ACSI207	A2	1617003-11	164.4	12/17/2016 11:23	21	10011	8.57	0.3972	2.294408	1166.116	3774.85	0.3089	0.7777	0.7508	3.6%	0.0020	0.0039	-50.1%
ACSI207	A3	1617003-11	164.4	12/17/2016 11:38	11	10017	8.27	0.4040	1.206109	1208.955	3774.85	0.3203	0.7927	0.7508	5.6%	0.0010	0.0039	-74.7%
ACSI207	A4	1617003-11	164.4	12/17/2016 11:51	15	10004	8.64	0.3921	1.641111	1155.781	3774.85	0.3062	0.7809	0.7508	4.0%	0.0014	0.0039	-64.0%
ACSI207	B1	1617003-11	164.4	12/17/2016 12:09	29	10014	8.1	0.4271	3.475247	1234.378	3774.85	0.3270	0.7656	0.7508	2.0%	0.0028	0.0039	-28.6%
ACSI207	B3	1617003-11	164.4	12/17/2016 12:21	11	10012	8.4	0.4171	1.175524	1189.701	3774.84	0.3152	0.7556	0.7508	0.6%	0.0010	0.0039	-74.9%
ACSI207	B4	1617003-11	164.4	12/17/2016 12:35	45	10003	8.65	0.3964	5.043312	1154.591	3774.84	0.3059	0.7716	0.7508	2.8%	0.0044	0.0039	10.8%
ACSI207	C1	1617003-11	164.4	12/17/2016 12:51	30	10007	8.52	0.3974	3.397127	1172.53	3774.84	0.3106	0.7816	0.7508	4.1%	0.0029	0.0039	-26.5%
ACSI207	C3	1617003-11	164.4	12/17/2016 13:07	27	10006	8.29	0.4191	3.141936	1205.273	3774.84	0.3193	0.7619	0.7508	1.5%	0.0026	0.0039	-33.9%
ACSI207	A1	1617003-12	181	12/17/2016 10:49	25	10015	9.21	0.3942	2.592441	1085.273	3774.86	0.2875	0.7293	0.7335	-0.6%	0.0024	0.0040	-39.8%
ACSI207	A2	1617003-12	181	12/17/2016 11:10	26	10022	8.81	0.3972	2.795192	1135.542	3774.86	0.3008	0.7573	0.7335	3.2%	0.0025	0.0040	-38.0%
ACSI207	A3	1617003-12	181	12/17/2016 11:23	14	10015	8.98	0.4040	1.43502	1112.966	3774.85	0.2948	0.7298	0.7335	-0.5%	0.0013	0.0040	-67.5%
ACSI207	A4	1617003-12	181	12/17/2016 11:38	23	10014	8.71	0.3921	2.545643	1147.624	3774.85	0.3040	0.7754	0.7335	5.7%	0.0022	0.0040	-44.1%
ACSI207	B1	1617003-12	181	12/17/2016 11:51	26	10011	8.55	0.4271	2.935936	1168.959	3774.85	0.3097	0.7251	0.7335	-1.2%	0.0025	0.0040	-36.7%
ACSI207	B3	1617003-12	181	12/17/2016 12:10	11	10013	8.91	0.4171	1.100568	1121.589	3774.85	0.2971	0.7124	0.7335	-2.9%	0.0010	0.0040	-75.3%
ACSI207	B4	1617003-12	181	12/17/2016 12:22	52	10008	9.07	0.3964	5.575186	1101.593	3774.84	0.2918	0.7362	0.7335	0.4%	0.0051	0.0040	27.5%
ACSI207	C1	1617003-12	181	12/17/2016 12:36	20	10001	8.93	0.3974	2.115642	1117.932	3774.84	0.2962	0.7452	0.7335	1.6%	0.0019	0.0040	-52.3%
ACSI207	C3	1617003-12	181	12/17/2016 12:51	17	10001	8.51	0.4191	1.892855	1173.483	3774.84	0.3109	0.7418	0.7335	1.1%	0.0016	0.0040	-59.6%
ACSI207	A1	1617003-13	195.7	12/17/2016 10:37	18	10008	8.92	0.3942	1.895937	1119.841	3774.86	0.2967	0.7526	0.7186	4.7%	0.0017	0.0040	-57.6%
ACSI207	A2	1617003-13	195.7	12/17/2016 10:48	21	10011	8.81	0.3972	2.227655	1134.293	3774.86	0.3005	0.7565	0.7186	5.3%	0.0020	0.0040	-50.8%
ACSI207	A3	1617003-13	195.7	12/17/2016 11:10	9	10008	8.83	0.4040	0.895253	1131.119	3774.86	0.2996	0.7417	0.7186	3.2%	0.0008	0.0040	-80.2%
ACSI207	A4	1617003-13	195.7	12/17/2016 11:23	19	10010	8.81	0.3921	2.06164	1134.12	3774.85	0.3004	0.7662	0.7186	6.6%	0.0018	0.0040	-54.5%
ACSI207	B1	1617003-13	195.7	12/17/2016 11:38	34	10007	8.64	0.4271	3.830185	1156.3	3774.85	0.3063	0.7172	0.7186	-0.2%	0.0033	0.0040	-17.0%
ACSI207	B3	1617003-13	195.7	12/17/2016 11:51	12	10002	8.87	0.4171	1.218875	1125.417	3774.85	0.2981	0.7148	0.7186	-0.5%	0.0011	0.0040	-72.9%
ACSI207	B4	1617003-13	195.7	12/17/2016 12:10	46	10011	9.04	0.3964	4.930496	1105.587	3774.85	0.2929	0.7389	0.7186	2.8%	0.0045	0.0040	11.7%
ACSI207	C1	1617003-13	195.7	12/17/2016 12:22	32	10006	8.77	0.3974	3.524803	1138.934	3774.84	0.3017	0.7592	0.7186	5.7%	0.0031	0.0040	-22.5%
ACSI207	C3	1617003-13	195.7	12/17/2016 12:35	13	10008	8.47	0.4191	1.419829	1179.859	3774.84	0.3126	0.7458	0.7186	3.8%	0.0012	0.0040	-69.9%
ACSI207	A1	1617003-14	239.1	12/17/2016 10:22	24	10000	9.73	0.3942	2.344598	1025.617	3774.86	0.2717	0.6892	0.6761	1.9%	0.0023	0.0041	-43.7%
ACSI207	A2	1617003-14	239.1	12/17/2016 10:38	23	10002	9.87	0.3972	2.174294	1011.345	3774.86	0.2679	0.6745	0.6761	-0.2%	0.0021	0.0041	-47.1%
ACSI207	A3	1617003-14	239.1	12/17/2016 10:49	11	10017	9.64	0.4040	1.017079	1036.818	3774.86	0.2747	0.6799	0.6761	0.6%	0.0010	0.0041	-75.9%
ACSI207	A4	1617003-14	239.1	12/17/2016 11:11	21	10003	9.8	0.3921	2.047857	1018.625	3774.86	0.2698	0.6882	0.6761	1.8%	0.0020	0.0041	-50.5%
ACSI207	B1	1617003-14	239.1	12/17/2016 11:24	28	10011	9.43	0.4271	2.864247	1059.694	3774.85	0.2807	0.6573	0.6761	-2.8%	0.0027	0.0041	-33.5%
ACSI207	B3	1617003-14	239.1	12/17/2016 11:39	14	10006	9.61	0.4171	1.322816	1039.003	3774.85	0.2752	0.6599	0.6761	-2.4%	0.0013	0.0041	-68.7%
ACSI207	B4	1617003-14	239.1	12/17/2016 11:52	45	10009	10.18	0.3964	4.262432	981.3774	3774.85	0.2600	0.6558	0.6761	-3.0%	0.0043	0.0041	6.9%
ACSI207	C1	1617003-14	239.1	12/17/2016 12:11	29	10004	9.94	0.3974	2.793505	1004.438	3774.85	0.2661	0.6696	0.6761	-1.0%	0.0028	0.0041	-31.5%
ACSI207	C3	1617003-14	239.1	12/17/2016 12:22	20	10003	9.57	0.4191	1.974864	1043.523	3774.84	0.2764	0.6596	0.6761	-2.4%	0.0019	0.0041	-53.4%
ACSI207	A1	1617003-15	252.6	12/17/2016 10:09	22	10015	9.57	0.3942	2.176851	1044.367	3774.87	0.2767	0.7018	0.6635	5.8%	0.0021	0.0041	-49.0%
ACSI207	A2	1617003-15	252.6	12/17/2016 10:22	21	10008	9.39	0.3972	2.080422	1063.786	3774.86	0.2818	0.6785	0.6635	6.9%	0.0020	0.0041	-52.1%
ACSI207	A3	1617003-15	252.6	12/17/2016 10:37	11	10012	9.21	0.4040	1.070354	1084.789	3774.86	0.2874	0.7113	0.6635	7.2%	0.0010	0.0041	-75.8%
ACSI207	A4	1617003-15	252.6	12/17/2016 10:49	24	10007	9.65	0.3921	2.392047	1034.906	3774.86	0.2742	0.6992	0.6635	5.4%	0.0023	0.0041	-43.4%
ACSI207	B1	1617003-15	252.6	12/17/2016 11:10	36	10009	9.2	0.4271	3.808043	1086.017	3774.86	0.2877	0.6736	0.6635	1.5%	0.0035	0.0041	-14.2%
ACSI207	B3	1617003-15	252.6	12/17/2016 11:24	13	10003	9.39	0.4171	1.250452	1063.078	3774.85	0.2816	0.6752	0.6635	1.8%	0.0012	0.0041	-71.2%
ACSI207	B4	1617003-15	252.6	12/17/2016 11:39	49	10002	9.59	0.3964	4.951489	1041.136	3774.85	0.2758	0.6958	0.6635	4.9%	0.0048	0.0041	16.4%
ACSI207	C1	1617003-15	252.6	12/17/2016 11:52	22	10005	9.39	0.3974	2.218918	1063.494	3774.85	0.2817	0.7089	0.6635	6.9%	0.0021	0.0041	-48.9%
ACSI207	C3	1617003-15	252.6	12/17/2016 12:10	18	10005	9.15	0.4191	1.852213	1091.72	3774.85	0.2892	0.6901	0.6635	4.0%	0.0017	0.0041	-58.5%

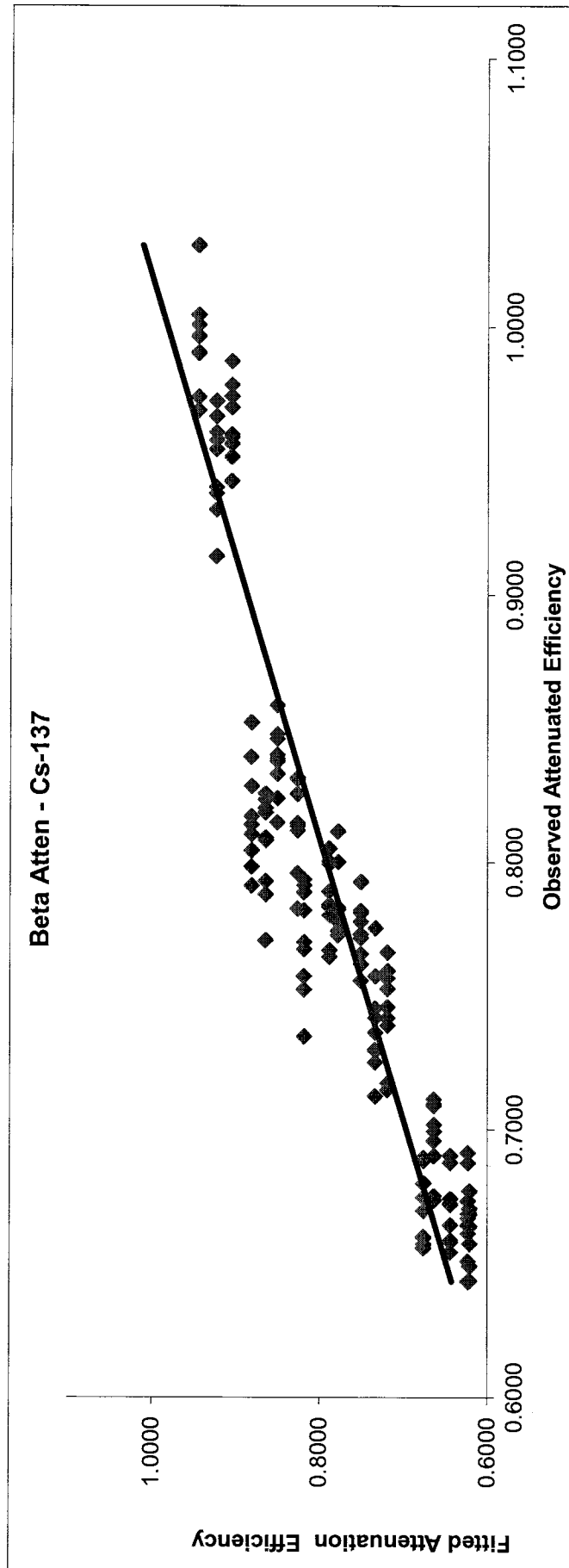
LB4100A Beta Attenuation Curve -- Cs-137

WO #: 1617003		Calibrated Mass Range		Attenuation Equation		Cross-Talk Equation	
Nuclide:	Cs-137	Low	0.0	b = 0.9455 m = 0.9986 a = 1.0026 % Diff Max. = 10.9%	y=b*m*(a*x)	b = 1.6183E-06 m = 0.0037 % Diff Max. = 86.7%	y=b*x+m
Std. ID:	1019.4095.83	High	299.7				
Ref. Date:	02/09/15						
Half-life:	30.1 yrs						
Activity:	3937.1 dpm/mL						
Vol.:	1 mL						

File ID	Detector ID	Sample ID	Mass (mg)	Count Date	Alpha Counts	Beta Counts	Count Time	Base Beta Eff.	Alpha CPM	Beta CPM	Decay Corr. added dpm/mL	Beta Obs. Atten. Eff.	Obs. Atten. Fact.	Fitted Atten. Fact.	% Diff.	$\beta > \alpha$ XTLLK Observed	$\beta > \alpha$ XTLLK Fitted	% Diff.
ACSI1207	A1	1617003-16	273.4	12/7/2016 9:55	24	10004	9.72	0.3942	2.347136	1027.086	3774.87	0.2721	0.6902	0.6444	7.1%	0.0023	0.0041	-44.5%
ACSI1207	A2	1617003-16	273.4	12/7/2016 10:09	23	10013	9.92	0.3972	2.162548	1007.346	3774.87	0.2669	0.6718	0.6444	4.3%	0.0021	0.0041	-47.9%
ACSI1207	A3	1617003-16	273.4	12/7/2016 10:22	14	10001	9.85	0.4040	1.29732	1013.04	3774.86	0.2684	0.6643	0.6444	3.1%	0.0013	0.0041	-68.9%
ACSI1207	A4	1617003-16	273.4	12/7/2016 10:37	18	10005	9.81	0.3921	1.739862	1017.789	3774.86	0.2696	0.6876	0.6444	6.7%	0.0017	0.0041	-58.5%
ACSI1207	B1	1617003-16	273.4	12/7/2016 10:49	36	10008	9.47	0.4271	3.696478	1054.993	3774.86	0.2795	0.6543	0.6444	1.5%	0.0035	0.0041	-14.9%
ACSI1207	B3	1617003-16	273.4	12/7/2016 11:10	15	10005	9.43	0.4171	1.456668	1058.772	3774.86	0.2805	0.6725	0.6444	4.4%	0.0014	0.0041	-66.6%
ACSI1207	B4	1617003-16	273.4	12/7/2016 11:25	51	10004	10.14	0.3964	4.871586	984.7628	3774.85	0.2609	0.6581	0.6444	2.1%	0.0049	0.0041	20.1%
ACSI1207	C1	1617003-16	273.4	12/7/2016 11:39	23	10001	9.87	0.3974	2.206294	1011.272	3774.85	0.2679	0.6741	0.6444	4.6%	0.0022	0.0041	-47.0%
ACSI1207	C3	1617003-16	273.4	12/7/2016 11:52	14	10009	9.59	0.4191	1.344854	1041.968	3774.85	0.2760	0.6586	0.6444	2.2%	0.0013	0.0041	-67.7%
ACSI1207	A1	1617003-17	297.2	12/7/2016 9:43	19	10004	10.06	0.3942	1.766668	992.3014	3774.87	0.2629	0.6668	0.6232	7.0%	0.0018	0.0042	-57.2%
ACSI1207	A2	1617003-17	297.2	12/7/2016 9:56	26	10011	10.03	0.3972	2.436223	996.0767	3774.87	0.2639	0.6643	0.6232	6.6%	0.0024	0.0042	-41.2%
ACSI1207	A3	1617003-17	297.2	12/7/2016 10:09	13	10016	9.91	0.4040	1.187806	1008.406	3774.87	0.2671	0.6612	0.6232	6.1%	0.0012	0.0042	-71.7%
ACSI1207	A4	1617003-17	297.2	12/7/2016 10:22	16	10006	9.76	0.3921	1.544344	1023.116	3774.86	0.2710	0.6912	0.6232	10.9%	0.0015	0.0042	-63.7%
ACSI1207	B1	1617003-17	297.2	12/7/2016 10:37	43	10006	9.52	0.4271	4.411807	1049.132	3774.86	0.2779	0.6507	0.6232	4.4%	0.0042	0.0042	1.2%
ACSI1207	B3	1617003-17	297.2	12/7/2016 10:49	11	10009	9.86	0.4171	0.981619	1012.908	3774.86	0.2683	0.6433	0.6232	3.2%	0.0010	0.0042	-76.7%
ACSI1207	B4	1617003-17	297.2	12/7/2016 11:11	43	10003	9.91	0.3964	4.181051	1007.559	3774.86	0.2669	0.6733	0.6232	8.0%	0.0041	0.0042	-0.2%
ACSI1207	C1	1617003-17	297.2	12/7/2016 11:24	36	10003	9.68	0.3974	3.595008	1031.367	3774.85	0.2732	0.6875	0.6232	10.3%	0.0035	0.0042	-16.1%
ACSI1207	C3	1617003-17	297.2	12/7/2016 11:39	28	10012	9.45	0.4191	2.847963	1057.748	3774.85	0.2802	0.6686	0.6232	7.3%	0.0027	0.0042	-35.2%
ACSI1207	A1	1617003-18	299.7	12/7/2016 9:28	36	10006	10.01	0.3942	3.474404	997.4684	3774.87	0.2642	0.6703	0.6211	7.9%	0.0035	0.0042	-16.3%
ACSI1207	A2	1617003-18	299.7	12/7/2016 9:42	27	10002	9.96	0.3972	2.554843	1002.188	3774.87	0.2655	0.6684	0.6211	7.6%	0.0025	0.0042	-38.7%
ACSI1207	A3	1617003-18	299.7	12/7/2016 9:55	10	10004	9.79	0.4040	0.89745	1019.569	3774.87	0.2701	0.6685	0.6211	7.6%	0.0009	0.0042	-78.8%
ACSI1207	A4	1617003-18	299.7	12/7/2016 10:09	17	10000	9.96	0.3921	1.611827	1001.927	3774.87	0.2654	0.6769	0.6211	9.0%	0.0016	0.0042	-61.3%
ACSI1207	B1	1617003-18	299.7	12/7/2016 10:22	30	10002	9.42	0.4271	3.079713	1059.865	3774.86	0.2808	0.6574	0.6211	5.8%	0.0029	0.0042	-30.2%
ACSI1207	B3	1617003-18	299.7	12/7/2016 10:38	9	10002	9.85	0.4171	0.779706	1013.227	3774.86	0.2884	0.6435	0.6211	3.6%	0.0008	0.0042	-81.5%
ACSI1207	B4	1617003-18	299.7	12/7/2016 10:50	55	10001	10.05	0.3964	5.314637	993.2994	3774.86	0.2631	0.6638	0.6211	6.9%	0.0054	0.0042	28.6%
ACSI1207	C1	1617003-18	299.7	12/7/2016 11:11	30	10007	9.93	0.3974	2.897148	1005.753	3774.86	0.2664	0.6704	0.6211	8.0%	0.0029	0.0042	-30.8%
ACSI1207	C3	1617003-18	299.7	12/7/2016 11:24	15	10007	9.73	0.4191	1.426624	1026.746	3774.85	0.2720	0.6490	0.6211	4.5%	0.0014	0.0042	-66.6%







Detector ID	Sample ID	Alpha	Beta	Guard	Count Time	Event	Voltage	TOD	ALPHA CPM	BETA CPM
A1	0	23	10011	4809	6.74	0	1402.5	12/7/16 9:11	3.290463	1483.18
A1	16.3	31	10008	5380	6.99	0	1402.5	12/7/16 13:19	4.312907	1429.628
A1	30.4	21	10006	5335	7.02	0	1402.5	12/7/16 13:05	2.869453	1423.224
A1	49.6	15	10008	6267	8.41	0	1402.5	12/7/16 12:51	1.661591	1187.88
A1	63.4	21	10012	6197	8.31	0	1402.5	12/7/16 12:35	2.405076	1202.681
A1	75.3	29	10003	5699	7.93	0	1402.5	12/7/16 12:21	3.534999	1259.28
A1	95.8	23	10010	5873	8.08	0	1402.5	12/7/16 12:09	2.724535	1236.729
A1	102.6	16	10010	6748	8.75	0	1402.5	12/7/16 11:51	1.706571	1141.868
A1	129.6	25	10007	6195	8.4	0	1402.5	12/7/16 11:38	2.85419	1189.178
A1	139	17	10004	6324	8.57	0	1402.5	12/7/16 11:23	1.861664	1165.196
A1	164.4	21	10015	6711	8.69	0	1402.5	12/7/16 11:10	2.294571	1150.342
A1	181	25	10015	7089	9.21	0	1402.5	12/7/16 10:49	2.592441	1085.273
A1	195.7	18	10008	6761	8.92	0	1402.5	12/7/16 10:37	1.895937	1119.841
A1	239.1	24	10000	7379	9.73	0	1402.5	12/7/16 10:22	2.344598	1025.617
A1	252.6	22	10015	7071	9.57	0	1402.5	12/7/16 10:09	2.176851	1044.367
A1	273.4	24	10004	7730	9.72	0	1402.5	12/7/16 9:55	2.347136	1027.086
A1	297.2	19	10004	7621	10.06	0	1402.5	12/7/16 9:43	1.766668	992.3014
A1	299.7	36	10006	7341	10.01	0	1402.5	12/7/16 9:28	3.474404	997.4684
A2	0	20	10008	4929	6.73	0	1402.5	12/7/16 9:25	2.815768	1485.044
A2	16.3	24	10012	4958	6.96	0	1402.5	12/7/16 9:11	3.292276	1436.477
A2	30.4	27	10021	5290	6.88	0	1402.5	12/7/16 13:19	3.768419	1454.512
A2	49.6	28	10012	6181	8.19	0	1402.5	12/7/16 13:06	3.262803	1220.437
A2	63.4	28	10001	6420	8.64	0	1402.5	12/7/16 12:51	3.084741	1155.494
A2	75.3	24	10016	5936	7.95	0	1402.5	12/7/16 12:35	2.862868	1257.845
A2	95.8	25	10010	5922	8.21	0	1402.5	12/7/16 12:21	2.889067	1217.216
A2	102.6	29	10009	6120	8.4	0	1402.5	12/7/16 12:09	3.296381	1189.519
A2	129.6	27	10011	6561	8.51	0	1402.5	12/7/16 11:51	3.016738	1174.352
A2	139	25	10015	6299	8.56	0	1402.5	12/7/16 11:38	2.764561	1167.948
A2	164.4	21	10011	6322	8.57	0	1402.5	12/7/16 11:23	2.294408	1166.116
A2	181	26	10022	6801	8.81	0	1402.5	12/7/16 11:10	2.795192	1135.542
A2	195.7	21	10011	6793	8.81	0	1402.5	12/7/16 10:48	2.227655	1134.293
A2	239.1	23	10002	7536	9.87	0	1402.5	12/7/16 10:38	2.174294	1011.345
A2	252.6	21	10008	7143	9.39	0	1402.5	12/7/16 10:22	2.080422	1063.786
A2	273.4	23	10013	7353	9.92	0	1402.5	12/7/16 10:09	2.162548	1007.346
A2	297.2	26	10011	7981	10.03	0	1402.5	12/7/16 9:56	2.436223	996.0767
A2	299.7	27	10002	7555	9.96	0	1402.5	12/7/16 9:42	2.554843	1002.188
A3	0	17	10017	4978	6.53	0	1402.5	12/7/16 9:39	2.479369	1531.707
A3	16.3	13	10011	4936	6.74	0	1402.5	12/7/16 9:25	1.804783	1483.022
A3	30.4	16	10013	4783	6.7	0	1402.5	12/7/16 9:11	2.26406	1492.188
A3	49.6	9	10010	6333	8.28	0	1402.5	12/7/16 13:20	0.962957	1206.647
A3	63.4	6	10014	5996	7.94	0	1402.5	12/7/16 13:06	0.631668	1258.919
A3	75.3	11	10017	5875	7.87	0	1402.5	12/7/16 12:50	1.273713	1270.518
A3	95.8	16	10013	5926	7.94	0	1402.5	12/7/16 12:35	1.891113	1258.793
A3	102.6	13	10012	6046	8.38	0	1402.5	12/7/16 12:21	1.427313	1192.459
A3	129.6	10	10014	5954	8.19	0	1402.5	12/7/16 12:09	1.097001	1220.421
A3	139	7	9999	6535	8.47	0	1402.5	12/7/16 11:51	0.702446	1178.229
A3	164.4	11	10017	6090	8.27	0	1402.5	12/7/16 11:38	1.206109	1208.955
A3	181	14	10015	6601	8.98	0	1402.5	12/7/16 11:23	1.43502	1112.966
A3	195.7	9	10008	6813	8.83	0	1402.5	12/7/16 11:10	0.895253	1131.119
A3	239.1	11	10017	7425	9.64	0	1402.5	12/7/16 10:49	1.017079	1036.818
A3	252.6	11	10012	6989	9.21	0	1402.5	12/7/16 10:37	1.070354	1084.789
A3	273.4	14	10001	7476	9.85	0	1402.5	12/7/16 10:22	1.29732	1013.04
A3	297.2	13	10016	7344	9.91	0	1402.5	12/7/16 10:09	1.187806	1008.406
A3	299.7	10	10004	7789	9.79	0	1402.5	12/7/16 9:55	0.89745	1019.569
A4	0	23	10003	5337	6.55	0	1402.5	12/7/16 9:52	3.41645	1525.087
A4	16.3	27	10016	5371	7.08	0	1402.5	12/7/16 9:40	3.718559	1412.6
A4	30.4	14	10022	5089	6.94	0	1402.5	12/7/16 9:25	1.922291	1442.003
A4	49.6	9	10006	5712	8.04	0	1402.5	12/7/16 9:13	1.024403	1242.438
A4	63.4	21	10011	6264	8.2	0	1402.5	12/7/16 13:20	2.465976	1218.765
A4	75.3	13	10019	5950	7.87	0	1402.5	12/7/16 13:06	1.556842	1270.973
A4	95.8	13	10013	6096	8.18	0	1402.5	12/7/16 12:51	1.494242	1221.994
A4	102.6	13	10011	6371	8.56	0	1402.5	12/7/16 12:35	1.423692	1167.42
A4	129.6	28	10003	6046	8.38	0	1402.5	12/7/16 12:21	3.246289	1191.586

A4	139	20	10001	6133	8.43	0	1402.5	12/7/16 12:09	2.277479	1184.269
A4	164.4	15	10004	6672	8.64	0	1402.5	12/7/16 11:51	1.641111	1155.781
A4	181	23	10014	6415	8.71	0	1402.5	12/7/16 11:38	2.545643	1147.624
A4	195.7	19	10010	6481	8.81	0	1402.5	12/7/16 11:23	2.06164	1134.12
A4	239.1	21	10003	7554	9.8	0	1402.5	12/7/16 11:11	2.047857	1018.625
A4	252.6	24	10007	7435	9.65	0	1402.5	12/7/16 10:49	2.392047	1034.906
A4	273.4	18	10005	7489	9.81	0	1402.5	12/7/16 10:37	1.739862	1017.789
A4	297.2	16	10006	7398	9.76	0	1402.5	12/7/16 10:22	1.544344	1023.116
A4	299.7	17	10000	7388	9.96	0	1402.5	12/7/16 10:09	1.611827	1001.927
B1	0	40	10011	4660	6.4	0	1500	12/7/16 10:06	6.145	1562.301
B1	16.3	29	10009	4985	6.78	0	1500	12/7/16 9:52	4.172286	1474.336
B1	30.4	29	10015	4810	6.52	0	1500	12/7/16 9:39	4.342853	1534.125
B1	49.6	44	10014	5517	7.59	0	1500	12/7/16 9:26	5.692101	1317.45
B1	63.4	35	10011	5729	7.82	0	1500	12/7/16 9:12	4.370703	1278.261
B1	75.3	26	10012	5555	7.61	0	1500	12/7/16 13:19	3.311557	1313.719
B1	95.8	37	10007	5615	7.92	0	1500	12/7/16 13:06	4.566717	1261.592
B1	102.6	32	10002	6293	8.43	0	1500	12/7/16 12:51	3.690967	1184.559
B1	129.6	44	10007	5953	8.08	0	1500	12/7/16 12:35	5.340545	1236.572
B1	139	32	10008	5814	7.96	0	1500	12/7/16 12:21	3.915101	1255.368
B1	164.4	29	10014	5919	8.1	0	1500	12/7/16 12:09	3.475247	1234.378
B1	181	26	10011	6234	8.55	0	1500	12/7/16 11:51	2.935936	1168.959
B1	195.7	34	10007	6474	8.64	0	1500	12/7/16 11:38	3.830185	1156.3
B1	239.1	28	10011	6973	9.43	0	1500	12/7/16 11:24	2.864247	1059.694
B1	252.6	36	10009	6720	9.2	0	1500	12/7/16 11:10	3.808043	1086.017
B1	273.4	36	10008	6961	9.47	0	1500	12/7/16 10:49	3.696478	1054.893
B1	297.2	43	10006	6984	9.52	0	1500	12/7/16 10:37	4.411807	1049.132
B1	299.7	30	10002	6836	9.42	0	1500	12/7/16 10:22	3.079713	1059.865
B3	0	11	10008	4622	6.41	0	1500	12/7/16 10:19	1.582069	1559.106
B3	16.3	13	10022	4957	6.82	0	1500	12/7/16 10:06	1.772158	1467.297
B3	30.4	12	10003	4948	6.73	0	1500	12/7/16 9:52	1.649061	1484.126
B3	49.6	11	10010	5803	7.89	0	1500	12/7/16 9:40	1.26017	1266.491
B3	63.4	19	10003	5839	8.05	0	1500	12/7/16 9:26	2.226248	1240.405
B3	75.3	14	10002	5532	7.55	0	1500	12/7/16 9:12	1.720305	1322.564
B3	95.8	9	10005	5805	7.97	0	1500	12/7/16 13:20	0.995235	1253.128
B3	102.6	12	10004	5948	8.43	0	1500	12/7/16 13:07	1.289488	1184.51
B3	129.6	19	10009	6198	8.3	0	1500	12/7/16 12:51	2.155157	1203.7
B3	139	8	10006	5976	8.11	0	1500	12/7/16 12:35	0.852436	1231.581
B3	164.4	11	10012	6154	8.4	0	1500	12/7/16 12:21	1.175524	1189.701
B3	181	11	10013	6499	8.91	0	1500	12/7/16 12:10	1.100568	1121.589
B3	195.7	12	10002	6476	8.87	0	1500	12/7/16 11:51	1.218875	1125.417
B3	239.1	14	10006	7210	9.61	0	1500	12/7/16 11:39	1.322816	1039.003
B3	252.6	13	10003	6950	9.39	0	1500	12/7/16 11:24	1.250452	1063.078
B3	273.4	15	10005	6884	9.43	0	1500	12/7/16 11:10	1.456668	1058.772
B3	297.2	11	10009	7257	9.86	0	1500	12/7/16 10:49	0.981619	1012.908
B3	299.7	9	10002	7236	9.85	0	1500	12/7/16 10:38	0.779706	1013.227
B4	0	64	10009	5023	6.86	0	1500	12/7/16 10:35	9.171446	1457.213
B4	16.3	55	10003	5131	7.1	0	1500	12/7/16 10:20	7.588479	1407.048
B4	30.4	40	10001	5058	6.96	0	1500	12/7/16 10:06	5.589126	1435.1
B4	49.6	66	10019	6053	8.25	0	1500	12/7/16 9:54	7.842	1212.599
B4	63.4	61	10011	5994	8.16	0	1500	12/7/16 9:41	7.31749	1225.013
B4	75.3	41	10014	5881	8.11	0	1500	12/7/16 9:26	4.897487	1232.947
B4	95.8	49	10009	6004	8.21	0	1500	12/7/16 9:13	5.810331	1217.298
B4	102.6	47	10000	6439	8.81	0	1500	12/7/16 13:21	5.176847	1133.249
B4	129.6	38	10012	6016	8.52	0	1500	12/7/16 13:07	4.302094	1173.292
B4	139	42	10004	6432	8.62	0	1500	12/7/16 12:51	4.71439	1158.732
B4	164.4	45	10003	6396	8.65	0	1500	12/7/16 12:35	5.044312	1154.591
B4	181	52	10008	6637	9.07	0	1500	12/7/16 12:22	5.575186	1101.593
B4	195.7	46	10011	6610	9.04	0	1500	12/7/16 12:10	4.930496	1105.587
B4	239.1	45	10009	7399	10.18	0	1500	12/7/16 11:52	4.262432	981.3774
B4	252.6	49	10002	7200	9.59	0	1500	12/7/16 11:39	4.951489	1041.136
B4	273.4	51	10004	7507	10.14	0	1500	12/7/16 11:25	4.871586	984.7628
B4	297.2	43	10003	7240	9.91	0	1500	12/7/16 11:11	4.181051	1007.559
B4	299.7	55	10001	7394	10.05	0	1500	12/7/16 10:50	5.314637	993.2994
C1	0	27	10019	4903	6.64	0	1530	12/7/16 10:46	3.942265	1506.885
C1	16.3	27	10007	5049	6.89	0	1530	12/7/16 10:35	3.794723	1450.394

C1	30.4	33	10010	4919	6.75	0	1530	12/7/16 10:19	4.764889	1480.962
C1	49.6	29	10013	5686	7.82	0	1530	12/7/16 10:07	3.58444	1278.434
C1	63.4	25	10009	5974	8.12	0	1530	12/7/16 9:54	2.954818	1230.634
C1	75.3	35	10006	5832	7.95	0	1530	12/7/16 9:40	4.278516	1256.615
C1	95.8	27	10009	5867	8.01	0	1530	12/7/16 9:26	3.246787	1247.562
C1	102.6	19	10000	6112	8.41	0	1530	12/7/16 9:13	2.135215	1187.06
C1	129.6	24	10006	6243	8.44	0	1530	12/7/16 13:20	2.719602	1183.544
C1	139	35	10010	5891	8.21	0	1530	12/7/16 13:06	4.139094	1217.244
C1	164.4	30	10007	6371	8.52	0	1530	12/7/16 12:51	3.397127	1172.53
C1	181	20	10001	6658	8.93	0	1530	12/7/16 12:36	2.115642	1117.932
C1	195.7	32	10006	6381	8.77	0	1530	12/7/16 12:22	3.524803	1138.934
C1	239.1	29	10004	7391	9.94	0	1530	12/7/16 12:11	2.793505	1004.438
C1	252.6	22	10005	6858	9.39	0	1530	12/7/16 11:52	2.218918	1063.494
C1	273.4	23	10001	7317	9.87	0	1530	12/7/16 11:39	2.206294	1011.272
C1	297.2	36	10003	7128	9.68	0	1530	12/7/16 11:24	3.595008	1031.367
C1	299.7	30	10007	7298	9.93	0	1530	12/7/16 11:11	2.897148	1005.753
C3	0	19	10002	4665	6.31	0	1530	12/7/16 11:07	2.896094	1583.38
C3	16.3	20	10014	4970	6.74	0	1530	12/7/16 10:46	2.852359	1484.034
C3	30.4	33	10019	4836	6.59	0	1530	12/7/16 10:34	4.892587	1518.611
C3	49.6	17	10011	5590	7.63	0	1530	12/7/16 10:20	2.113047	1310.335
C3	63.4	15	10011	5674	7.81	0	1530	12/7/16 10:07	1.805615	1280.095
C3	75.3	14	10019	5450	7.46	0	1530	12/7/16 9:53	1.761676	1341.306
C3	95.8	18	10013	5689	7.76	0	1530	12/7/16 9:40	2.204588	1288.612
C3	102.6	16	10004	6002	8.2	0	1530	12/7/16 9:26	1.83622	1218.277
C3	129.6	17	9999	5885	8.09	0	1530	12/7/16 9:13	1.98636	1234.247
C3	139	20	10004	6004	8.12	0	1530	12/7/16 13:20	2.348054	1230.297
C3	164.4	27	10006	5943	8.29	0	1530	12/7/16 13:07	3.141936	1205.273
C3	181	17	10001	6360	8.51	0	1530	12/7/16 12:51	1.88265	1173.483
C3	195.7	13	10008	6277	8.47	0	1530	12/7/16 12:35	1.419829	1179.859
C3	239.1	20	10003	6957	9.57	0	1530	12/7/16 12:22	1.974864	1043.523
C3	252.6	18	10005	6790	9.15	0	1530	12/7/16 12:10	1.852213	1091.72
C3	273.4	14	10009	7016	9.59	0	1530	12/7/16 11:52	1.344854	1041.968
C3	297.2	28	10012	7017	9.45	0	1530	12/7/16 11:39	2.847963	1057.748
C3	299.7	15	10007	7158	9.73	0	1530	12/7/16 11:24	1.426624	1026.746

Date

12/2/16

SOP 724r

11

ALS

Low Background Gas Flow Proportional Counter Log

Instrument: LB4100A

Instrument Daily Response and Background Checks

Det.	Daily Response Check				Background Check				Det. Status
	Start 1	Status	Start 2	Status	Start 1	Status	Start 2	Status	
1	JP	P			JP	P			P
2									
3									
4									
5									
6									OL
7									P
8									
9									
10									OL
11									P
12									OL
13	OL				OL				
14									
15									
16									

Det = Detector; α = Alpha; β = Beta; P = Pass; H = High; L = Low; OL = Offline; R = Recount; W = Weekly; NP = Not Processed

Weekly Background Calibration

	Current Calib. File ID	Weekly Calib. Started	Status	File ID
Dr A	BK41201W			
Dr B				
Dr C				
Dr D	OL			

Dr = Drawer

Gas Supply

P-10 Supply		P-10 Flow	
Tank 1	9	Dr A	10
		Dr B	
Tank 2	2050	Dr C	
		Dr D	

Comments:

Date 12/7/16

SOP 724r 11

ALS

Low Background Gas Flow Proportional Counter Log

Instrument: LB4100A[illegible]Comments:

Page No.: 468567 **B**
(cont. from page 11 **B**)

Form 780r8.doc (6/23/06)

Reviewed By / Date

JP 12/8/16

Date 12/8/16SOP 724r 11

ALS
Low Background Gas Flow Proportional Counter Log
Instrument: LB4100A

Instrument Daily Response and Background Checks

Det.	Daily Response Check				Background Check				Det. Status
	Start 1	Status	Start 2	Status	Start 1	Status	Start 2	Status	
1	JP	P			JP	P			P
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13	OL				OL				
14									
15									
16									

Det = Detector; α = Alpha; β = Beta; P = Pass; H = High; L = Low; OL = Offline; R = Recount; W = Weekly; NP = Not Processed

Weekly Background Calibration

	Current Calib. File ID	Weekly Calib. Started	Status	File ID
Dr A	BKA1201W			
Dr B				
Dr C				
Dr D	OL			

Dr = Drawer

Gas Supply

P-10 Supply		P-10 Flow	
Tank 1	0	Dr A	LO
		Dr B	
Tank 2	16/16	Dr C	
		Dr D	

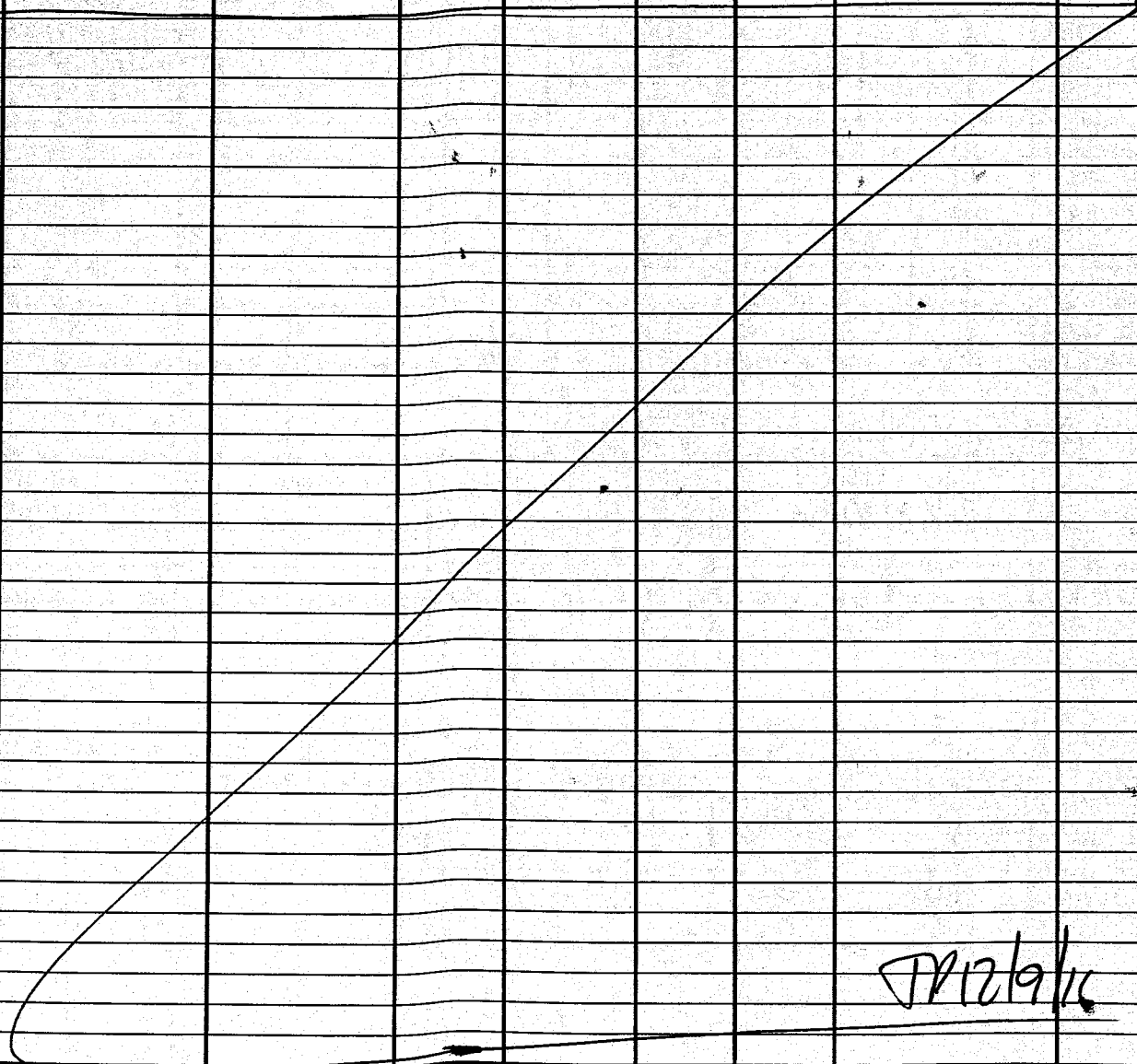
Comments:

Date 12/8/16SOP 724r 11

ALS

Low Background Gas Flow Proportional Counter Log

Instrument: **LB4100A**

Det.	Sample ID	Batch	Test	Count Dur. (min)	Start Time	Analyst Initials	File ID	Output Initials
1-12	Daily EFF	---	---	30	7:09	JP	FFA1208	JP
1-12	Daily BKGs	---	---	60	7:22	JP	BKA1208	JP
1	1611044-6	RA161205-1	RA224	90	9:04	SKB	RAA1208	7
2	1611061-6	↓	↓	↓	↓	↓	↓	
3	-7							
4	1611085-3							
5	1611141-2							
7	RA161205-1 MB							
9	LCS							
11	LSSD							
1-5,7,9,11	1518004-1-16	AB150603-6	RA2307H	30	9:27	JP	ATG1208	JP
								

JP 12/9/16

Comments:

Page No.: 468568 **B**
(cont. from page VA B)

Form 780r8.doc (6/23/06)

Reviewed By / Date

JP 12/9/16

150 of 329

Date 12/9/16SOP 724r 11

ALS
Low Background Gas Flow Proportional Counter Log
Instrument: LB4100A

Instrument Daily Response and Background Checks

Det.	Daily Response Check				Background Check				Det. Status
	Start 1	Status	Start 2	Status	Start 1	Status	Start 2	Status	
1	JP	P			JP	HB	JPB	OL	OL
2						HL	↓	P	P
3									
4									
5						HB	JPB	HB	OL
6									
7									
8									
9						HB	JPB	HB	OL
10									
11									
12									
13	OL				OL				OL
14									
15									
16									

Det = Detector; α = Alpha; β = Beta; P = Pass; H = High; L = Low; OL = Offline; R = Recount; W = Weekly; NP = Not Processed

Weekly Background Calibration

	Current Calib. File ID	Weekly Calib. Started*	Status	File ID
Dr A	BKA1201W			
Dr B				
Dr C				
Dr D	u			

Dr = Drawer

Gas Supply

	P-10 Supply	P-10 Flow	
Tank 1	0	Dr A	10
		Dr B	
Tank 2	1500	Dr C	
		Dr D	

Comments:

12/7/16

CS137 Mass Attenuation Curve Filename: ACS1207
Benchsheet: AB160510-2 Sources: 1617003-1-18

Det	9:04	9:18	9:32	9:45	9:59	10:12	10:27	10:39	11:00	11:14	11:29	11:42	12:00	12:13	12:26	12:42	12:58	13:11
A1	1	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2
A2	2	1	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3
A3	3	2	1	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4
A4	4	3	2	1	18	17	16	15	14	13	12	11	10	9	8	7	6	5
B1	5	4	3	2	1	18	17	16	15	14	13	12	11	10	9	8	7	6
B3	6	5	4	3	2	1	18	17	16	15	14	13	12	11	10	9	8	7
B4	7	6	5	4	3	2	1	18	17	16	15	14	13	12	11	10	9	8
C1	8	7	6	5	4	3	2	1	18	17	16	15	14	13	12	11	10	9
C3	9	8	7	6	5	4	3	2	1	18	17	16	15	14	13	12	11	10

12/8/16

Th230 Mass Attenuation Curve Filename: ATH1208
Benchsheet: ~~AB160510-2~~ AB150603-6 Sources: 1518004-1-16 JP12/kk

Det	9:27	9:47	10:11	10:36	11:01	11:29	11:54	12:19	12:46	13:13	13:41	14:06	14:28	14:50	15:11	15:30
A1	1	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2
A2	2	1	16	15	14	13	12	11	10	9	8	7	6	5	4	3
A3	3	2	1	16	15	14	13	12	11	10	9	8	7	6	5	4
A4	4	3	2	1	16	15	14	13	12	11	10	9	8	7	6	5
B1	5	4	3	2	1	16	15	14	13	12	11	10	9	8	7	6
B3	6	5	4	3	2	1	16	15	14	13	12	11	10	9	8	7
B4	7	6	5	4	3	2	1	16	15	14	13	12	11	10	9	8
C1	8	7	6	5	4	3	2	1	16	15	14	13	12	11	10	9
C3	9	8	7	6	5	4	3	2	1	16	15	14	13	12	11	10

Continued on Page

Signed

Date

Read and Understood By

Signed

Date

12-12-16 of 329

Radiochemistry Instrument Worksheet

ALS Environmental -- FC

Prep Batch: AB150603-6

Prep Procedure: GROSS_ALPHA

Analytical QASS / NCR? *Y*

Mass Attenuation Curve

Prep Num	LabID	QC Type	Init Alq	Fin Alq	Units	Report Units	Residual Mass (mg)	Cnt 1 File	Cnt 1 Inst/Det	Cnt 1 Pos Chk By	Cnt 2 File	Cnt 2 Inst/Det	Cnt 2 Pos Chk By	Cnt 3 File	Cnt 3 Inst/Det	Cnt 3 Pos Chk By	Notes
1	1518004-1	SMP	200	200	ml	pCi/l	13.2	<i>See Maintenance Log # 3974 pg 39</i>									
1	1518004-2	SMP	200	200	ml	pCi/l	12.4										
1	1518004-3	SMP	200	200	ml	pCi/l	25.8										
1	1518004-4	SMP	200	200	ml	pCi/l	28.1										
1	1518004-5	SMP	200	200	ml	pCi/l	43.9										
1	1518004-6	SMP	200	200	ml	pCi/l	36.8										
1	1518004-7	SMP	200	200	ml	pCi/l	49.9										
1	1518004-8	SMP	200	200	ml	pCi/l	49.5										
1	1518004-9	SMP	200	200	ml	pCi/l	67.8										
1	1518004-10	SMP	200	200	ml	pCi/l	70										
1	1518004-11	SMP	200	200	ml	pCi/l	79.3										
1	1518004-12	SMP	200	200	ml	pCi/l	77.3										
1	1518004-13	SMP	200	200	ml	pCi/l	83.5										
1	1518004-14	SMP	200	200	ml	pCi/l	89.8										
1	1518004-15	SMP	200	200	ml	pCi/l	100.4										
1	1518004-16	SMP	200	200	ml	pCi/l	100										

Handwritten signature

Spike Solution Information

Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	Th-230	853.3020.89	1,166.300	DPM/ml	06/03/15	5	ml	RS-027

Sample Barcodes

1518004-1 AB150603-6PS1		1518004-2 AB150603-6PS2		1518004-3 AB150603-6PS3	
1518004-4 AB150603-6PS4		1518004-5 AB150603-6PS5		1518004-6 AB150603-6PS6	
1518004-7 AB150603-6PS7		1518004-8 AB150603-6PS8		1518004-9 AB150603-6PS9	
1518004-10 AB150603-6PS10		1518004-11 AB150603-6PS11		1518004-12 AB150603-6PS12	

Radiochemistry Instrument Worksheet

ALS Environmental -- FC

Prep Batch: AB150603-6

Prep Procedure: GROSS_ALPH

Analytical QASS / NCR? Y (N) *NA*

Prep Num	LabID	QC Type	Init Alq	Fin Alq	Units	Report Units	Residual Mass (mg)	Cnt 1 File	Cnt 1 Inst/Det	Cnt 1 Pos Chk By	Cnt 2 File	Cnt 2 Inst/Det	Cnt 2 Pos Chk By	Cnt 3 File	Cnt 3 Inst/Det	Cnt 3 Pos Chk By	Notes	
1518004-13	AB150603-6PS13							1518004-14 AB150603-6PS14							1518004-15 AB150603-6PS15			
1518004-16	AB150603-6PS16																	

Reporting Units

LabID:	TstGrpName:	RptUnits:
1518004-1	GrossAlpha_DW	pCi/l
1518004-2	GrossAlpha_DW	pCi/l
1518004-3	GrossAlpha_DW	pCi/l
1518004-4	GrossAlpha_DW	pCi/l
1518004-5	GrossAlpha_DW	pCi/l
1518004-6	GrossAlpha_DW	pCi/l
1518004-7	GrossAlpha_DW	pCi/l
1518004-8	GrossAlpha_DW	pCi/l
1518004-9	GrossAlpha_DW	pCi/l
1518004-10	GrossAlpha_DW	pCi/l
1518004-11	GrossAlpha_DW	pCi/l
1518004-12	GrossAlpha_DW	pCi/l
1518004-13	GrossAlpha_DW	pCi/l
1518004-14	GrossAlpha_DW	pCi/l
1518004-15	GrossAlpha_DW	pCi/l
1518004-16	GrossAlpha_DW	pCi/l

Radiochemistry Prep Worksheet

ALS Environmental -- FC

Prep Batch: AB150603-6

Prep Procedure: GROSS_ALPHA

Reviewed By: jkb *jk* Review Date: 6/8/2015

Non-Routine Pre-Treatment? Y / ☒ Batch: *NA*

Prep QASS / NCR? Y / ☒

Prep SOP: PAI 702 Rev: 20

Prep SOP: NONE

Matrix Class: liquid

Prep Analyst: Jennie Kill-Bowden

Prep Date: 6/3/2015

Prep Dept: RS

Balance:

Balance:

Samp Num	Prep Num	LabID	QC Type	Dish No.	Init Alq ml	Fin Alq ml	Prep Basis	Standards	Prep Notes
1	1	1518004-1	SMP		200	200		S1	Salt added based on 51mg/mL -->0.23ml
2	1	1518004-2	SMP		200	200		S1	0.23 mL salt
3	1	1518004-3	SMP		200	200		S1	0.5 mL salt
4	1	1518004-4	SMP		200	200		S1	0.5 mL salt
5	1	1518004-5	SMP		200	200		S1	0.78 mL salt
6	1	1518004-6	SMP		200	200		S1	0.78 mL salt
7	1	1518004-7	SMP		200	200		S1	1.08 mL salt
8	1	1518004-8	SMP		200	200		S1	1.08 mL salt
9	1	1518004-9	SMP		200	200		S1	1.37 mL salt
10	1	1518004-10	SMP		200	200		S1	1.37 mL salt
11	1	1518004-11	SMP		200	200		S1	1.57 mL salt
12	1	1518004-12	SMP		200	200		S1	1.57 mL salt
13	1	1518004-13	SMP		200	200		S1	1.76 mL salt
14	1	1518004-14	SMP		200	200		S1	1.76 mL salt
15	1	1518004-15	SMP		200	200		S1	2.02 mL salt
16	1	1518004-16	SMP		200	200		S1	2.02 mL salt

Comments

Th-230 mass attenuation curve USGS method (approximately 200 mL DI H2O + 20 mL conc HNO3 cooked down in a glass beaker and transferred to a planchet) Salt added based on weight per mL of salt solution, additional salt added as needed.

Spiked By: Jennie Kill-Bowden Date: 6/3/2015

Witnessed By: Peter Workman Date: 6/3/2015

Spike Solution Information					
Soln #	Nuclide	SolnID	Prep Conc	Units	Pipet ID
S1	Th-230	853.3020.89	1,166.300	DPW/ml	06/03/15
				5	ml
					RS-027

Radiochemistry Prep Worksheet

ALS Environmental -- FC

Prep Batch: AB150603-6

Prep Batch Not Validated!!!

Prep Procedure: GROSS_ALPHA

Reviewed By:

Review Date:

Non-Routine Pre-Treatment? Y / N Batch: Prep QASS / NCR? Y / N

Prep SOP: PAI 702 Rev: 20

Prep SOP: NONE

Matrix Class: liquid

Prep Analyst: Jennie Kill-Bowden

Prep Date: 6/3/2015

Prep Dept: RS

Balance:

Balance:

Samp Num	Prep Num	LabID	QC Type	Dish No.	Init Aliq ml	Fin Aliq ml	Prep Basis	Standards	Prep Notes
1	1	1518004-1	SMP	200	200	200		S1	
2	1	1518004-2	SMP	200	200	200		S1	
3	1	1518004-3	SMP	200	200	200		S1	
4	1	1518004-4	SMP	200	200	200		S1	
5	1	1518004-5	SMP	200	200	200		S1	
6	1	1518004-6	SMP	200	200	200		S1	
7	1	1518004-7	SMP	200	200	200		S1	
8	1	1518004-8	SMP	200	200	200		S1	
9	1	1518004-9	SMP	200	200	200		S1	
10	1	1518004-10	SMP	200	200	200		S1	
11	1	1518004-11	SMP	200	200	200		S1	
12	1	1518004-12	SMP	200	200	200		S1	
13	1	1518004-13	SMP	200	200	200		S1	
14	1	1518004-14	SMP	200	200	200		S1	
15	1	1518004-15	SMP	200	200	200		S1	
16	1	1518004-16	SMP	200	200	200		S1	

Comments

Th-230 mass attenuation curve USGS method

Spiked By: JKB Date: 6/3/15
 Witnessed By: RL Date: 6/3/15

Spike Solution Information					
Soln #	Nuclide	SolnID	Prep Conc	Units	Pipet ID
S1	Th-230	853.3020.89	1,166.300	DPM/ml	06/03/15
				5	ml
					RS-027

Radiochemistry Gravimetric Worksheet

ALS Environmental -- FC

Prep Batch: AB150603-6

Prep Procedure: GROSS ALPH

Reviewed By: jkb *jk* Review Date: 6/8/2015

Prep Num	Planc. Num	LabID	QC Type	Test Alq (ml)	Tare Mass (g)	Initial Gross Mass (g)	Initial Net Mass (mg)	Suggested Alq (ml)	Samp Vol Available (ml)	Samp Vol Taken (ml)	Fin Gross Mass (g)	Final Net Mass (mg)	Salt Sol. Added (ml)	Flag
1	1	1518004-1	SMP	10	9.1569	0.0000	0	0	0	200	9.1701	13.2	0.23	
1	2	1518004-2	SMP	10	9.1115	0.0000	0	0	0	200	9.1239	12.4	0.23	
1	3	1518004-3	SMP	10	9.1509	0.0000	0	0	0	200	9.1767	25.8	0.5	
1	4	1518004-4	SMP	10	9.1834	0.0000	0	0	0	200	9.2115	28.1	0.5	
1	5	1518004-5	SMP	10	9.1505	0.0000	0	0	0	200	9.1944	43.9	0.78	
1	6	1518004-6	SMP	10	9.1176	0.0000	0	0	0	200	9.1544	36.8	0.78	
1	7	1518004-7	SMP	10	9.1596	0.0000	0	0	0	200	9.2095	49.9	1.08	
1	8	1518004-8	SMP	10	9.1459	0.0000	0	0	0	200	9.1954	49.5	1.08	
1	9	1518004-9	SMP	10	9.1503	0.0000	0	0	0	200	9.2181	67.8	1.37	
1	10	1518004-10	SMP	10	9.0442	0.0000	0	0	0	200	9.1142	70	1.37	
1	11	1518004-11	SMP	10	9.0531	0.0000	0	0	0	200	9.1324	79.3	1.57	
1	12	1518004-12	SMP	10	9.0094	0.0000	0	0	0	200	9.0867	77.3	1.57	
1	13	1518004-13	SMP	10	9.0334	0.0000	0	0	0	200	9.1169	83.5	1.76	
1	14	1518004-14	SMP	10	9.4305	0.0000	0	0	0	200	9.5203	89.8	1.76	
1	15	1518004-15	SMP	10	9.3886	0.0000	0	0	0	200	9.4890	100.4	2.02	
1	16	1518004-16	SMP	10	9.3856	0.0000	0	0	0	200	9.4856	100	2.02	

Prepare an Intermediate dilution of Th-230 P50# 853 of approximately 1200 dpm/ml

1) Prepare 0.5 M HNO_3 , 31 ml HNO_3 and 969 ml DI water, lot # 073602

2) Determine density of 0.5 M HNO_3 .

Mass of 100 ml vol. flask:

Mass of flask + 100 ml 0.5 M HNO_3 :

Net mass of 0.5 M HNO_3 :

Bal. 12

68.2999 g

169.4539 g

101.1539 g

$$\rho = 1.015 \text{ g/ml}$$

3) Transfer contents of vial to 1000 ml Nalgene.

Mass of full standard vial:

Mass of empty standard vial:

Net mass of standard transferred:

8.2827

3.2327

5.05 g

4) Dilute with 0.5 M HNO_3

Mass of Nalgene w/ lid (empty):

Mass of Nalgene with standard:

Mass of Nalgene, standard, and diluent:

Net mass of standard:

73.66 g

73.70 g

78.71 g

108.52

101.54 g

5) Final activity calculation

$$(1.983 \times 10^4 \text{ Bq}) / (5.15119 \text{ g}) = 3849.60 \text{ Bq/g} \times (60 \text{ s} / 1 \text{ min}) = 230,975.755 \text{ dpm}$$

$$(3849.60 \text{ Bq/g}) \cdot (5.05 \text{ g}) \cdot (1.015 \text{ g/ml}) = 1985.22 \text{ dpm/ml}$$

Std ID: 853.3020.89

Description: Th-230

Expiration: 2/5/2009

Activity: 1166.38 dpm/mL

2s Uncertainty: 23.33 dpm/mL

Ref. Date: 11/6/2007

Ref Time: N/A

Prep Date: 12/12/2007 Prep by: DC

Matrix/Comp. 0.5 M HNO_3

Half Life (y): 7.70E+04

Reverification Log

Analysis Date	Initials	Expiration Date
5/5/09	RG	5/5/2010
11/19/10	RG	11/19/2011
12/13/14	JP	12/13/2015

Continued on Page

Signature:

Date: 12/12/07

Read and Understood By

Signature:

Date: 2/13/08



1380 Seaboard Industrial Blvd.
Atlanta, Georgia 30318
Tel 404-352-8677
Fax 404-352-2837
www.analytiscinc.com

CERTIFICATE OF CALIBRATION

Standard Radionuclide Source

76253-307

Th-230 5 mL Liquid in-Flame Sealed Vial

Customer: Paragon Analytics / Fort Collins, CO
P.O. No.: 72908-REL 10-30-07, Item 1

This standard radionuclide source was prepared gravimetrically from a calibrated master solution. The master solution was calibrated by liquid scintillation counting.

Radionuclide purity and calibration were checked by germanium gamma-ray spectrometry and liquid scintillation counting. The nuclear decay rate and assay date for this source are given below.

ANALYTICS maintains traceability to the National Institute of Standards and Technology through Measurements Assurance Programs as described in USNRC Reg. Guide 4.15, Revision 1.

Isotope:	Th-230
Activity (Bq):	1.983 E4
Half-Life:	7.538 E4 years
Calibration Date:	November 8, 2007 12:00 EST
Relative Expanded Uncertainty (k=2):	2.0%

Comments:

Impurities: γ -impurities <0.1%, α -impurities <0.01%,
5.15119 grams 0.5M HNO₃ solution.

Source Prepared By:

N. E. Kiesman
N. E. Kiesman, Radiochemist

QA Approved:

D. M. Montgomery
D. M. Montgomery, QA Manager

Date: 11-19-07

End of Certificate

Corporate Office
24937 Avenue Tibbitts Valencia, California 91355

Laboratory
1380 Seaboard Industrial Blvd. Atlanta, Georgia, 30318

Radiochemistry Instrument Worksheet

ALS Environmental -- FC

Prep Batch: AB160510-2

Prep Procedure: GAB

Gross Beta (Cs137) Attenuation

Analytical QASS / NCR? Y *NA*

Prep Num	LabID	QC Type	Init Aliq	Fin Aliq	Units	Report Units	Residual Mass (mg)	Cnt 1 File	Cnt 1 Inst/Det	Cnt 1 Pos Chk By	Cnt 2 File	Cnt 2 Inst/Det	Cnt 2 Pos Chk By	Cnt 3 File	Cnt 3 Inst/Det	Cnt 3 Pos Chk By	Notes
1	1617003-1	SMP	200	200	ml	pCi/l	0										
1	1617003-2	SMP	200	200	ml	pCi/l	16.3										
1	1617003-3	SMP	200	200	ml	pCi/l	30.4										
1	1617003-4	SMP	200	200	ml	pCi/l	49.6										
1	1617003-5	SMP	200	200	ml	pCi/l	63.4										
1	1617003-6	SMP	200	200	ml	pCi/l	75.3										
1	1617003-7	SMP	200	200	ml	pCi/l	95.8										
1	1617003-8	SMP	200	200	ml	pCi/l	102.6										
1	1617003-9	SMP	200	200	ml	pCi/l	129.6										
1	1617003-10	SMP	200	200	ml	pCi/l	139										
1	1617003-11	SMP	200	200	ml	pCi/l	164.4										
1	1617003-12	SMP	200	200	ml	pCi/l	181										
1	1617003-13	SMP	200	200	ml	pCi/l	195.7										
1	1617003-14	SMP	200	200	ml	pCi/l	239.1										
1	1617003-15	SMP	200	200	ml	pCi/l	252.6										
1	1617003-16	SMP	200	200	ml	pCi/l	273.4										
1	1617003-17	SMP	200	200	ml	pCi/l	297.2										
1	1617003-18	SMP	200	200	ml	pCi/l	299.7										

See Mantec Log # 3974 pg 39

JPZ/zh

Spike Solution Information

Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	Cs-137	1019.4095.83	3.825.389	DPM/ml	05/10/16	1	ml	RS-019

Sample Barcodes

1617003-1 AB160510-2PS1		1617003-2 AB160510-2PS2		1617003-3 AB160510-2PS3	
1617003-4 AB160510-2PS4		1617003-5 AB160510-2PS5		1617003-6 AB160510-2PS6	
1617003-7 AB160510-2PS7		1617003-8 AB160510-2PS8		1617003-9 AB160510-2PS9	

Radiochemistry Instrument Worksheet

ALS Environmental -- FC

Prep Batch: AB160510-2

Prep Procedure: GAB

Analytical QASS / NCR? Y / N

WA

Prep Num	LabID	QC Type	Init Aliq	Fin Aliq	Units	Report Units	Residual Mass (mg)	Cnt 1 File	Cnt 1 Inst/Det	Cnt 1 Pos Chk By	Cnt 2 File	Cnt 2 Inst/Det	Cnt 2 Pos Chk By	Cnt 3 File	Cnt 3 Inst/Det	Cnt 3 Pos Chk By	Notes
1617003-10	AB160510-2PS10							1617003-11 AB160510-2PS11							1617003-12 AB160510-2PS12		
1617003-13	AB160510-2PS13							1617003-14 AB160510-2PS14							1617003-15 AB160510-2PS15		
1617003-16	AB160510-2PS16							1617003-17 AB160510-2PS17							1617003-18 AB160510-2PS18		

Reporting Units

LabID:	TstGrpName:	RptUnits:
1617003-1	GrossAlpha/Beta_DW	pCi/l
1617003-2	GrossAlpha/Beta_DW	pCi/l
1617003-3	GrossAlpha/Beta_DW	pCi/l
1617003-4	GrossAlpha/Beta_DW	pCi/l
1617003-5	GrossAlpha/Beta_DW	pCi/l
1617003-6	GrossAlpha/Beta_DW	pCi/l
1617003-7	GrossAlpha/Beta_DW	pCi/l
1617003-8	GrossAlpha/Beta_DW	pCi/l
1617003-9	GrossAlpha/Beta_DW	pCi/l
1617003-10	GrossAlpha/Beta_DW	pCi/l
1617003-11	GrossAlpha/Beta_DW	pCi/l
1617003-12	GrossAlpha/Beta_DW	pCi/l
1617003-13	GrossAlpha/Beta_DW	pCi/l
1617003-14	GrossAlpha/Beta_DW	pCi/l
1617003-15	GrossAlpha/Beta_DW	pCi/l
1617003-16	GrossAlpha/Beta_DW	pCi/l
1617003-17	GrossAlpha/Beta_DW	pCi/l
1617003-18	GrossAlpha/Beta_DW	pCi/l

WA

Radiochemistry Prep Worksheet

ALS Environmental -- FC

Prep Batch: AB160510-2

Prep Procedure: GAB

Reviewed By: jkb

Review Date: 5/18/2016

Non-Routine Pre-Treatment? Y / N Batch: Re-Prep? Y / N Batch: Prep QASS / NCR? Y / N

Prep SOP: PAI 702 Rev: 20

Prep SOP: NONE

Matrix Class: liquid

Prep Analyst: Jennie Kill-Bowden

Prep Date: 5/10/2016

Prep Dept: RS

Balance: 13

Balance:

Samp Num	Prep Num	LabID	QC Type	Dish No.	Init Alq ml	Fin Alq ml	Prep Basis	Standards	Prep Notes
1	1	1617003-1	SMP		200	200	Unfiltered	S1	
2	1	1617003-2	SMP		200	200	Unfiltered	S1	
3	1	1617003-3	SMP		200	200	Unfiltered	S1	
4	1	1617003-4	SMP		200	200	Unfiltered	S1	
5	1	1617003-5	SMP		200	200	Unfiltered	S1	
6	1	1617003-6	SMP		200	200	Unfiltered	S1	
7	1	1617003-7	SMP		200	200	Unfiltered	S1	
8	1	1617003-8	SMP		200	200	Unfiltered	S1	
9	1	1617003-9	SMP		200	200	Unfiltered	S1	
10	1	1617003-10	SMP		200	200	Unfiltered	S1	
11	1	1617003-11	SMP		200	200	Unfiltered	S1	
12	1	1617003-12	SMP		200	200	Unfiltered	S1	
13	1	1617003-13	SMP		200	200	Unfiltered	S1	
14	1	1617003-14	SMP		200	200	Unfiltered	S1	
15	1	1617003-15	SMP		200	200	Unfiltered	S1	
16	1	1617003-16	SMP		200	200	Unfiltered	S1	
17	1	1617003-17	SMP		200	200	Unfiltered	S1	
18	1	1617003-18	SMP		200	200	Unfiltered	S1	

Comments

Cs-137 calibration planchets

Spiked By: Jennie Kill-Bowden Date: 5/17/2016

Witnessed By: Clayton D. Jacobs Date: 5/14/2016

Spike Solution Information					
Soln #	Nuclide	SolnID	Prep Conc	Units	Pipet ID
S1	Cs-137	1019.4095.83	3.825.389	DPM/ml	05/10/16
				1	ml
					RS-019

Radiochemistry Prep Worksheet

ALS Environmental -- FC

Prep Batch: AB160510-2

Prep Procedure: GAB

Prep Batch Not Validated!!!

Reviewed By: Review Date:

Non-Routine Pre-Treatment? Y / N Batch: Re-Prep? Y / N Batch: Prep QASS / NCR? Y / N

Prep SOP: PAI 702 Rev: 20

Prep SOP: NONE

Matrix Class: liquid

Prep Analyst: Jennie Kill-Bowden

Prep Date: 5/10/2016

Prep Dept: RS

Balance:

Balance:

Samp Num	Prep Num	LabID	QC Type	Dish No.	Init Alq ml	Fin Alq ml	Prep Basis	Standards	Prep Notes
1	1	1617003-1	SMP	200	200	200	Unfiltered	S1	
2	1	1617003-2	SMP	200	200	200	Unfiltered	S1	
3	1	1617003-3	SMP	200	200	200	Unfiltered	S1	
4	1	1617003-4	SMP	200	200	200	Unfiltered	S1	
5	1	1617003-5	SMP	200	200	200	Unfiltered	S1	
6	1	1617003-6	SMP	200	200	200	Unfiltered	S1	
7	1	1617003-7	SMP	200	200	200	Unfiltered	S1	
8	1	1617003-8	SMP	200	200	200	Unfiltered	S1	
9	1	1617003-9	SMP	200	200	200	Unfiltered	S1	
10	1	1617003-10	SMP	200	200	200	Unfiltered	S1	
11	1	1617003-11	SMP	200	200	200	Unfiltered	S1	
12	1	1617003-12	SMP	200	200	200	Unfiltered	S1	
13	1	1617003-13	SMP	200	200	200	Unfiltered	S1	
14	1	1617003-14	SMP	200	200	200	Unfiltered	S1	
15	1	1617003-15	SMP	200	200	200	Unfiltered	S1	
16	1	1617003-16	SMP	200	200	200	Unfiltered	S1	
17	1	1617003-17	SMP	200	200	200	Unfiltered	S1	
18	1	1617003-18	SMP	200	200	200	Unfiltered	S1	

Comments

Spiked By: 763 Date: 5/17/16
 Witnessed By: CDS Date: 5/12/2016

Spike Solution Information					
Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date
S1	Cs-137	1019.4095.83	3.825.389	DPM/ml	05/10/16
				ml	RS-019

4/11/2017

Radiochemistry Gravimetric Worksheet

ALS Environmental -- FC

Prep Batch: AB160510-2

Prep Procedure: GAB

Reviewed By: jkb jk

Review Date: 5/18/2016

Prep Num	Planc. Num	LabID	QC Type	Test Alq (ml)	Tare Mass (g)	Initial Gross Mass (g)	Initial Net Mass (mg)	Suggested Alq (ml)	Samp Vol Available (ml)	Samp Vol Taken (ml)	Fin Gross Mass (g)	Final Net Mass (mg)	Salt Sol. Added (ml)	Flag
1	1	1617003-1	SMP	10	9.4100	0.0000	0	0	0	0	0.0000	0	0	0
1	2	1617003-2	SMP	10	9.4242	9.4391	14.9	0	0	0	9.4405	16.3	0	0
1	3	1617003-3	SMP	10	9.4391	9.4711	32	0	0	0	9.4695	30.4	0	0
1	4	1617003-4	SMP	10	9.3826	9.4298	47.2	0	0	0	9.4322	49.6	0	0
1	5	1617003-5	SMP	10	9.3332	9.3942	61	0	0	0	9.3966	63.4	0	0
1	6	1617003-6	SMP	10	9.3931	9.4638	70.7	0	0	0	9.4684	75.3	0	0
1	7	1617003-7	SMP	10	9.4174	9.5130	95.6	0	0	0	9.5132	95.8	0	0
1	8	1617003-8	SMP	10	9.4186	9.5263	107.7	0	0	0	9.5212	102.6	0	0
1	9	1617003-9	SMP	10	9.4485	9.5765	128	0	0	0	9.5781	129.6	0	0
1	10	1617003-10	SMP	10	9.4189	9.5572	138.3	0	0	0	9.5579	139	0	0
1	11	1617003-11	SMP	10	9.4339	9.5938	159.9	0	0	0	9.5983	164.4	0	0
1	12	1617003-12	SMP	10	9.4347	9.6170	182.3	0	0	0	9.6157	181	0	0
1	13	1617003-13	SMP	10	9.4474	9.6500	202.6	0	0	0	9.6431	195.7	0	0
1	14	1617003-14	SMP	10	9.4350	9.6593	224.3	0	0	0	9.6741	239.1	0	0
1	15	1617003-15	SMP	10	9.4210	9.6725	251.5	0	0	0	9.6736	252.6	0	0
1	16	1617003-16	SMP	10	9.3651	9.6307	265.6	0	0	0	9.6385	273.4	0	0
1	17	1617003-17	SMP	10	9.3731	9.6609	287.8	0	0	0	9.6703	297.2	0	0
1	18	1617003-18	SMP	10	9.3909	9.6913	300.4	0	0	0	9.6906	299.7	0	0

Prepare an Intermediate dilution of Th-230 P50# 853 of approximately 1200 dpm/ml

1) Prepare 0.5M HNO₃. 31 ml HNO₃ and 969 ml DI water.
bottle # 073602

2) Determine density of 0.5M HNO₃.

Mass of 100 ml vol. flask:

Bal. 12

68.2999 g

Mass of flask + 100 ml 0.5M HNO₃:

169.4539 g

Net mass of 0.5M HNO₃:

101.1539 g

$$\rho = 1.0115 \text{ g/ml}$$

3) Transfer contents of vial to 1000 ml Nalgene.

Bal. 12

Mass of full standard vial:

8.2827

Mass of empty standard vial:

3.2327

Net mass of standard transferred:

5.05 g

4) Dilute with 0.5 M HNO₃

P50# 853

Bal. 26

Mass of Nalgene w/o lid (empty):

73.66 g

73.70 g

Mass of Nalgene with standard:

78.71 g

Mass of Nalgene, standard, and diluent:

1085.2

Net mass of standard:

1011.54 g

5) Final activity calculation

$$(1.983 \times 10^4 \text{ Bq}) / (5.15119 \text{ g}) = 3849.60 \text{ Bq/g} \times \left(\frac{60 \text{ s}}{1 \text{ min}} \right) = 230,975.755 \text{ dpm}$$

$$(3849.60 \text{ Bq/g}) \cdot \left(\frac{5.05 \text{ g}}{1011.54 \text{ g}} \right) \cdot (1.0115 \text{ g/ml}) = 1166.38 \text{ dpm/ml}$$

Std ID: 853.3020.89

Description: Th-230

Expiration: 2/5/2009

Activity: 1166.38 dpm/mL

2s Uncertainty: 23.33 dpm/mL

Ref. Date: 11/6/2007

Ref Time: N/A

Prep Date: 12/12/2007 Prep by: DC

Matrix/Comp. 0.5 M HNO₃

Half Life (y): 7.70E+04

Reverification Log

Analysis Date	Initials	Expiration Date
5/5/09	RG	5/5/2010
11/19/10	RG	11/19/2011
12/13/14	JP	12/13/2015

Continued on Page

Read and Understood By

Signature

Date

Signature

2/13/08



Eckert & Ziegler

Analytics

1380 Seaboard Industrial Blvd.
Atlanta, Georgia 30318
Tel 404-352-8677
Fax 404-352-2837
www.analyticsinc.com

CERTIFICATE OF CALIBRATION
Standard Radionuclide Source

76253-307

Th-230 5 mL Liquid in Flame Sealed Vial

Customer: Paragon Analytics / Fort Collins, CO
P.O. No.: 72905-REL 10-30-07, Item 1

This standard radionuclide source was prepared gravimetrically from a calibrated master solution. The master solution was calibrated by liquid scintillation counting.

Radionuclide purity and calibration were checked by germanium gamma-ray spectrometry and liquid scintillation counting. The nuclear decay rate and assay date for this source are given below.

ANALYTICS maintains traceability to the National Institute of Standards and Technology through Measurements Assurance Programs as described in USNRC Reg. Guide 4.15, Revision 1.

Isotope:	Th-230
Activity (Bq):	1.989 E4
Half-Life:	7.538 E4 years
Calibration Date:	November 8, 2007 12:00 EST
Relative Expanded Uncertainty (k=2):	2.0%

Comments:

Impurities: γ -impurities <0.1%, α -impurities <0.01%,
5.15119 grams 0.5M HNO₃ solution.

Source Prepared By: N. E. Kiesman
N. E. Kiesman, Radiochemist

QA Approved: D. M. Montgomery
D. M. Montgomery, QA Manager

Date: 11-19-07

End of Certificate

Corporate Office
24937 Avenue Tibbitts Valencia, California 91355

Laboratory
1380 Seaboard Industrial Blvd. Atlanta, Georgia, 30318

Prepare a working dilution of RSO*1019

12/3/15

1. Density of 0.1M HCl, lot # 0000094396

Mass of 100mL vol. flask:

56.4421 g

Balance # 12

Mass of flask & 100mL acid:

156.2152 g

Balance# 12

Net Mass:

99.7731 g

Density:

0.9977 g/mL

2. Mass of RSO*1019 transferred:

Mass of empty nalgene:

74.1899 g

Balance# 12

Mass of nalgene & standard

79.0859 g

Balance# 12

Net mass of standard transferred:

4.8960 g

3. Dilute to final volume:

Mass of nalgene, standard, & diluent:

629.3 g

Balance# 26

Mass of empty nalgene:

74.1899 g

Balance# 12

Net mass of new dilution:

555.1101 g

4. Final activity calculation:

$$\frac{37270 \text{ Bq}}{(1 \text{ Bq})} \times \frac{(60 \text{ dpm})}{(4.99800 \text{ g})} \times \frac{(4.8960 \text{ g})}{(0.9977 \text{ g/mL})} \times \frac{(555.1101 \text{ g})}{(555.1101 \text{ g})} = 3937.10 \text{ dpm/mL}$$

Std ID: 1019.4095.83

Description: Cs-137

Expiration: 3/6/2016

Activity: 3937.10 dpm/mL

2s Uncertainty: 70.87 dpm/mL

Ref. Date: 2/9/2015

Ref Time: N/A

Prep Date: 3/5/2015 Prep by: TE

Matrix/Comp. 0.1 MHCl

Half Life (y): 3.01E+01

Reverification Log		
Analysis Date	Initials	Expiration Date
04/01/16	JP	04/01/2017

JP 4/2/15
JP 4/2/15

Continued on Page

Signed

Date

Read and Understood By

Signed

Date



Eckert & Ziegler

Analytics

RSO#
1019

1380 Seaboard Industrial Blvd.
Atlanta, Georgia 30318
Tel 404-352-8677
Fax 404-352-2837
www.ezag.com

CERTIFICATE OF CALIBRATION

Standard Reference Source

99575

Cs-137 5 mL Liquid in Flame Sealed Vial

Customer: ALS Laboratory Group
P.O. No.: FC000610, Item 3 Product Code: 8137

This standard radionuclide source was prepared gravimetrically from a master solution calibrated with an ionization chamber. The ionization chamber was calibrated by the National Physical Laboratory, Teddington, U.K., and is traceable to national standards. Radionuclide calibration and purity were checked by germanium gamma-ray spectrometry, liquid scintillation counting, and/or alpha spectrometry, as applicable. The nuclear decay rate and reference date for this source are given below. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST."

Isotope	Half-Life, Days	Activity (Bq)	Uncertainty*, %			Reference Date (12:00 PM EST)
			u_A	u_B	U	
Cs-137	1.099E+04	3.727E+04	0.1	0.9	1.8	02/09/2015

*Uncertainty: U - Relative expanded uncertainty, $k = 2$. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results."

Comments:

Impurities: γ -impurities < 0.1%.

4.99800 g 0.1M HCl solution with approximately 30 μ g/g Cs carrier.

Source Prepared by:

K. Eardley, Radiochemist

QC Approved:

A. Chen, Spectroscopist

Date: 7 Feb 15

Internal Calculation Verifications

ICBs

&

ICVs

PAI - Gas Flow Proportional Sample Analysis LB4100-A

Unit Type: LB4100-AW
Counting Unit ID: Orange
High Voltage Mode: Simultaneous
Application Revision: C
Rev: 05/09/13 JP

Data file name: ABA0214A
Batch ID: AB161208-2
Count Preset (m): 300
Batch Ended: 2/14/17 19:59

Background logfile: BKGBW
Date of Bkg. Cal: 2/2/17
Alpha efficiency logfile: TH-230-12/16
Alpha attenuation calibration: ATH1208
Beta efficiency logfile: CS137-12/16
Beta attenuation calibration: ACS1207

Alpha Attenuation Calibration		Beta Attenuation Calibration	
$y = b \cdot m^a (x^{(mass \cdot x)})$		$y = b \cdot m^a (x^{(mass \cdot x)})$	
Alpha b=	0.89800	Beta b=	0.9455
m=	0.99910	m=	0.9986
a=	0.9775	a=	1.0026
x0=	0.0000	x0=	0.0000
Alpha to Beta X-talk		Beta to Alpha X-talk	
$y = b \cdot m^a \cdot x$		$y = b \cdot m^a \cdot x$	
a -> b xtalk m=	0.2784	b -> a xtalk m=	1.818E-06
a -> b xtalk m=	0.9975	b -> a xtalk m=	0.0037

Det. ID	Sample	Count		Resid. Mass (mg)	Alpha Activity										Beta Activity									
		Date & Time	Dur. (min)		Gross CPM	Bkg. CPM	b>a xtlk CPM	Base Eff	Base Cor.Fact.	Progeny Eff	Progeny Cor.Fact.	Gross CPM	Bkg. CPM	a>b xtlk CPM	Base Eff	Base Cor.Fact.	Progeny Eff	Progeny Cor.Fact.						
C1	1624002-3	2/14/17 19:58	300.00	51.7	13.913	0.115	0.169	0.2289	0.543	n/a	n/a	46.530	1.981	4.3722	0.3974	0.879	n/a	n/a						
A3	AB161208-2CMB	2/14/17 19:58	300.00	50.7	0.113	0.090	0.001	0.2349	0.548	n/a	n/a	1.823	1.619	0.0074	0.4191	0.881	n/a	n/a						
A1	16124002-1	2/14/17 19:58	300.00	52.1	14.157	0.129	0.163	0.2282	0.541	n/a	n/a	45.113	2.032	4.4493	0.3942	0.879	n/a	n/a						
A2	AB161208-2AMB	2/14/17 19:58	300.00	51.2	0.143	0.120	0.000	0.2214	0.546	n/a	n/a	2.017	2.181	0.0074	0.3972	0.880	n/a	n/a						
A3	1624002-4	2/14/17 19:58	300.00	52.1	11.470	0.127	0.156	0.2335	0.541	n/a	n/a	43.657	2.343	3.5978	0.4040	0.879	n/a	n/a						
A4	AB161208-2EMB	2/14/17 19:58	300.00	50.4	0.097	0.113	0.000	0.2289	0.550	n/a	n/a	2.120	2.100	0.0000	0.3921	0.881	n/a	n/a						
B1	1624002-2	2/14/17 19:59	300.00	51.2	14.323	0.157	0.163	0.2377	0.546	n/a	n/a	45.283	2.215	4.4832	0.4271	0.880	n/a	n/a						
B3	AB161208-2BMB	2/14/17 19:59	300.00	49.7	0.087	0.127	0.000	0.2320	0.554	n/a	n/a	1.590	1.920	0.0000	0.4171	0.882	n/a	n/a						

JP 2/15/17

Date

2/14/17

SOP 724r

11

ALS

Low Background Gas Flow Proportional Counter Log

Instrument: LB4100A

Instrument Daily Response and Background Checks

Det.	Daily Response Check				Background Check				Det. Status
	Start 1	Status	Start 2	Status	Start 1	Status	Start 2	Status	
1	JP	P			JP	P			P
2									
3									
4									
5									
6						(Hα)			OL
7						P			P
8									
9									
10									OL
11									P
12									OL
13	OL				OL				
14									
15									
16									

Det = Detector; α = Alpha; β = Beta; P = Pass; H = High; L = Low; OL = Offline; R = Recount; W = Weekly; NP = Not Processed

Weekly Background Calibration

	Current Calib. File ID	Weekly Calib. Started	Status	File ID
Dr A	BK10201W			
Dr B				
Dr C				
Dr D	OL			

Dr = Drawer

Gas Supply

P-10 Supply		P-10 Flow	
Tank 1	2300	Dr A	10
		Dr B	
Tank 2	850	Dr C	
		Dr D	

Comments:

Page No.:

470429

A

Form 780r8.doc (6/23/06)

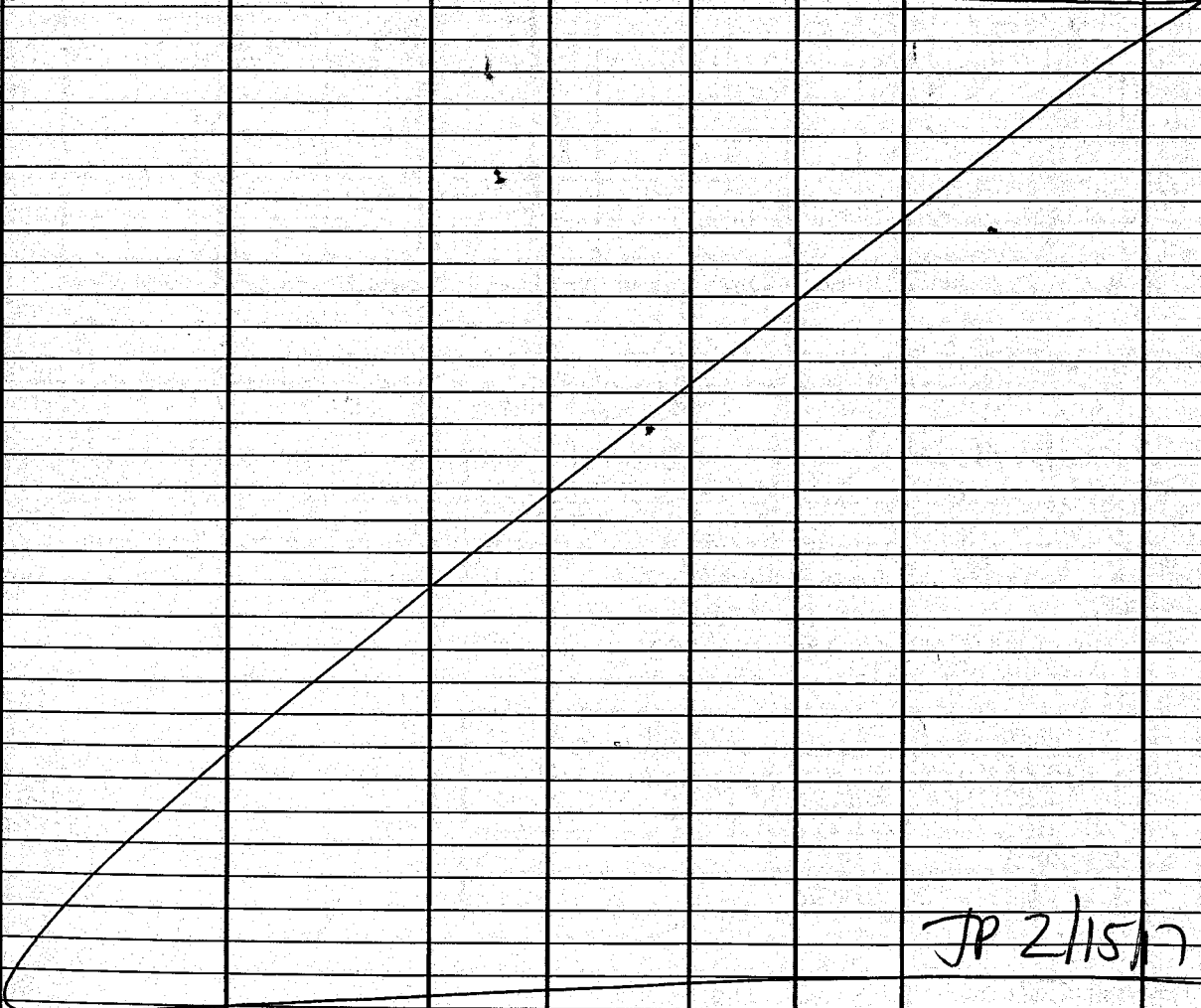
Reviewed By / Date

JP 2/14/17

172 of 329

Date 2/14/17SOP 724r H

ALS
Low Background Gas Flow Proportional Counter Log
Instrument: LB4100A

Det.	Sample ID	Batch	Test	Count Dur. (min) -	Start Time	Analyst Initials	File ID	Output Initials
1-12	Daily Eff	—	—	30	7:16	JP	EFA0214	JP
1-12	Daily Bkg	—	—	60	7:29	JP	BKA0214	JP
1	1701228-1	AB170208-1	a-b	240	1036	JP	AB170214	JP
2	-1D	↓	↓	↓	↓	↓	↓	↓
3	-2MS	↓	↓	↓	↓	↓	↓	↓
4	-2MSD	↓	↓	↓	↓	↓	↓	↓
1	1701228-1	AB170208-2	a-b	300	1452	JP	AB170214	JP
5	-2	↓	↓	↓	↓	↓	↓	↓
9	-3	↓	↓	↓	↓	↓	↓	↓
3	-4	↓	↓	↓	↓	↓	↓	↓
2	AB170208-2MSD	↓	↓	↓	↓	↓	↓	↓
7	B	↓	↓	↓	↓	↓	↓	↓
11	C	↓	↓	↓	↓	↓	↓	↓
4	E	↓	↓	↓	↓	↓	↓	↓
								

Comments:

Page No.: 470429 **B**
(cont. from page NA B)

Form 780r8.doc (6/23/06)

Reviewed By / Date

JP 2/15/17

173 of 329

Date

2/15/17

SOP 724r

11

ALS

Low Background Gas Flow Proportional Counter Log

Instrument: LB4100A

Instrument Daily Response and Background Checks

Det.	Daily Response Check				Background Check				Det. Status
	Start 1	Status	Start 2	Status	Start 1	Status	Start 2	Status	
1	JP	P			JP	P			P
2									
3						H α	JKB	P	
4						P			
5									
6									OL
7		(L α)	JP	P					P
8		P							
9						L β	JKB	P	
10						P			OL
11						H β	JKB	P	P
12						P			OL
13	OL				OL				
14									
15									
16									

Det = Detector; α = Alpha; β = Beta; P = Pass; H = High; L = Low; OL = Offline; R = Recount; W = Weekly; NP = Not Processed

Weekly Background Calibration

	Current Calib. File ID	Weekly Calib. Started	Status	File ID
Dr A	BKADZ01W	JKB	P	BKADZ013W
Dr B				
Dr C				
Dr D	OL	OL		

Dr = Drawer

Gas Supply

P-10 Supply		P-10 Flow	
Tank 1	1900	Dr A	10
		Dr B	
Tank 2	800	Dr C	
		Dr D	

Comments:

Radiochemistry Instrument Worksheet

ALS -- Fort Collins

Prep Batch: AB161208-2

Prep Procedure: GAB

ICVs / ICBs

Analytical QASS / NCR? Y

N

Notes

Prep Num	QC Type	Init Alq	Fin Alq	Units	Report Units	Residual Mass (mg)	Cnt 1 Inst/Det	Cnt 1 Pos Chk By	Cnt 2 File	Cnt 2 Inst/Det	Cnt 2 Pos Chk By	Cnt 3 File	Cnt 3 Inst/Det	Cnt 3 Pos Chk By
1	1624002-1	SMP	200	200	ml	pCi/l	52.1							
1	1624002-2	SMP	200	200	ml	pCi/l	51.2							
1	1624002-3	SMP	200	200	ml	pCi/l	51.7							
1	1624002-4	SMP	200	200	ml	pCi/l	52.1							
1	AB161208-2a	MB	200	200	ml	pCi/l	51.2							
1	AB161208-2b	MB	200	200	ml	pCi/l	49.7							
1	AB161208-2c	MB	200	200	ml	pCi/l	50.7							
1	AB161208-2e	MB	200	200	ml	pCi/l	50.4							

115/17

Spike Solution Information

Soln #	Nuclide	SolnID	Exp Date	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	Cs-137	1013.4095.77		101.810	DPM/ml	12/08/16	1	ml	RS-033
S2	Th-230	760.4095.67		96.653	DPM/ml	12/08/16	1	ml	RS-033

Sample Barcodes

1624002-1 AB161208-2PS1		1624002-2 AB161208-2PS2	
1624002-4 AB161208-2PS4		AB161208-2eMB AB161208-2PS5	
AB161208-2cMB AB161208-2PS7		AB161208-2eMB AB161208-2PS8	

Reporting Units

LabID:	TstGrpName:	RptUnits:
1624002-1	GrossAlpha/Beta_DW	pCi/l
1624002-2	GrossAlpha/Beta_DW	pCi/l
1624002-3	GrossAlpha/Beta_DW	pCi/l
1624002-4	GrossAlpha/Beta_DW	pCi/l

Radiochemistry Prep Worksheet

ALS -- Fort Collins

Prep Batch: AB161208-2

Prep Procedure: GAB

Reviewed By: bat BAT

Review Date: 12/12/2016

Non-Routine Pre-Treatment? Y / ☒ Batch: MA Prep QASS / NCR? Y / ☒ MA

Prep SOP: PAI 702 Rev: 20

Prep SOP: NONE

Matrix Class: liquid

Prep Analyst: Bryan A. Terry BAT

Prep Date: 12/8/2016

Prep Dept: RS

Batch: MA

Re-Prep? Y / ☒

Balance: 13

Balance: N/A

Prep Notes

Standards

Prep Basis

Fin Alq

ml

Init Alq

ml

Dish

QC

Type

LabID

Samp

Num

1

1

1624002-1

SMP

MA

200

200

Unfiltered

S1,S2

2

1

1624002-2

SMP

200

200

Unfiltered

S1,S2

3

1

1624002-3

SMP

200

200

Unfiltered

S1,S2

4

1

1624002-4

SMP

200

200

Unfiltered

S1,S2

5

1

AB161208-2a

MB

200

200

Unfiltered

MA

6

1

AB161208-2b

MB

200

200

Unfiltered

7

1

AB161208-2c

MB

200

200

Unfiltered

8

1

AB161208-2e

MB

200

200

Unfiltered

Comments

Spiked By: Bryan A. Terry Date: 12/8/2016

Witnessed By: Andrew R. Steger Date: 12/8/2016

Spiked Solution Information

Soln #	Nuclide	SolnID	Exp Date	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	Cs-137	1013.4095.77		101.810	DPM/ml	12/08/16	1	ml	RS-033
S2	Th-230	760.4095.67		96.653	DPM/ml	12/08/16	1	ml	RS-033

Reagent Solution IDs*

0000046694

*Except where otherwise noted, all reagents were applied in accordance with the specifications of the preparation methods associated with this batch.

Radiochemistry Prep Worksheet

ALS -- Fort Collins

Prep Batch: AB161208-2

Prep Procedure: GAB

Prep Batch Not Validated!!!

Reviewed By:

Review Date:

Non-Routine Pre-Treatment? Y / N Batch: Re-Prep? Y / N Batch: Prep QASS / NCR? Y / N

Prep SOP: PAI 702 Rev: 20

Prep Analyst: Bryan A. Terry

Balance: 13

Prep SOP: NONE

Prep Date: 12/8/2016

Balance: N/A

Matrix Class: liquid

Prep Dept: RS

Samp Num	Prep Num	LabID	QC Type	Dish No.	Init Alq ml	Fin Alq ml	Prep Basis	Standards	Prep Notes
1	1	1624002-1	SMP	0	0	0		S1,S2	
2	1	1624002-2	SMP	0	0	0		S1,S2	
3	1	1624002-3	SMP	0	0	0		S1,S2	
4	1	1624002-4	SMP	0	0	0		S1,S2	
5	1	AB161208-2a	MB	0	0	0			
6	1	AB161208-2b	MB	0	0	0			
7	1	AB161208-2c	MB	0	0	0			
8	1	AB161208-2e	MB	0	0	0			

Comments

Spiked By: BA Date: 12/8/2016

Witnessed By: ALC R. R. R. Date: 12/8/16

Spike Solution Information						
Soln #	Nuclide	SolnID	Exp Date	Prep Conc	Units	Pipet ID
S1	Cs-137	1013.4095.77	1/7/17	101.810	DPM/ml	RS-033
S2	Th-230	760.4095.67	4/7/17	96.653	DPM/ml	RS-033

Reagent Solution IDs*

0000046694

*Except where otherwise noted, all reagents were applied in accordance with the specifications of the preparation methods associated with this batch.

Radiochemistry Gravimetric Worksheet

ALS -- Fort Collins

Prep Batch: AB161208-2

Prep Procedure: GAB

Reviewed By: bat

Review Date: 12/12/2016

Prep Num	Planc. Num	LabID	QC Type	Test Alq (ml)	Tare Mass (g)	Initial Gross Mass (g)	Initial Net Mass (mg)	Suggested Alq (ml)	Samp Vol Available (ml)	Samp Vol Taken (ml)	Fin Gross Mass (g)	Final Net Mass (mg)	Salt Sol. Added (ml)	Flag
1	1	1624002-1	SMP	10	9.3802	9.4323	52.1	14	200	200	9.4323	52.1	1	
1	2	1624002-2	SMP	10	9.4308	9.4820	51.2	15	200	200	9.4820	51.2	1	
1	3	1624002-3	SMP	10	9.4130	9.4647	51.7	15	200	200	9.4647	51.7	1	
1	4	1624002-4	SMP	10	9.4013	9.4534	52.1	14	200	200	9.4534	52.1	1	
1	5	AB161208-2a	MB	10	9.4458	9.4970	51.2	15	200	200	9.4970	51.2	1	
1	6	AB161208-2b	MB	10	9.3486	9.3983	49.7	15	200	200	9.3983	49.7	1	
1	7	AB161208-2c	MB	10	9.3869	9.4376	50.7	15	200	200	9.4376	50.7	1	
1	8	AB161208-2e	MB	10	9.4117	9.4621	50.4	15	200	200	9.4621	50.4	1	

Sample Condition Form (Liquid)

Analyst: BAT

Analysis Date: 12/8/2016 Method: Preo

Analysis Date: 12/8/2016 Method: Preo

		Sample Condition (Visual Appearance of Analysis Aliquot at Time of Prep)					
Work	Sample						

[illegible]

Prepare a working dilution of 760.3020.08

1. Density of 0.5M HNO₃ lot # 0000084176
 Mass of 100mL vol. flask: 68.5632g Balance # 12
 Mass of flask & 100mL acid: 169.6732g Balance # 12
 Net Mass: 101.1100g
 Density: 1.011g/mL

2. Mass of 760.3020.08 transferred:
 Mass of open empty nalgene: 74.1983g Balance # 12
 Mass of nalgene & standard: 77.2060g Balance # 12
 Net mass of standard transferred: 3.0077g Balance # NA

3. Dilute to final volume:
 Mass of nalgene, standard, & diluent: 908.9g Balance # 26
 Mass of empty nalgene (from above): 74.1983g Balance # 12
 Net mass of new dilution: 834.7017g Balance # NA

4. Final activity calculation:

$$26,534.43 \text{ dpm/g} (1.011 \text{ g/mL}) \left(\frac{3.0077 \text{ g}}{834.7017 \text{ g}} \right) = 96.66 \text{ dpm/mL}$$

Std ID: 760.4095.67

Description: Th-230

Expiration: 4/12/2016

Activity: 96.66 dpm/mL

2s Uncertainty: 3.19 dpm/mL

Ref. Date: 7/13/2004

Ref Time: N/A

Prep Date: 12/8/2014 Prep by: TE

Matrix/Comp. 0.5 M HNO₃

Half Life (y): 7.54E+04

Reverification Log

Analysis Date	Initials	Expiration Date
4/07/16	JP	04/07/2017

Continued on Page

Signed

Date

Read and Understood By

Signed

Date

Prepare a primary dilution of R50 #760 (Analytical # 68750-307) to a concentration of approx 30,000 dpm/ml.

1) Prepare 0.5M HNO₃ by diluting 5 ml of conc. (16M) HNO₃ (EMD lot # 4435) to a final volume of 1000 mL.

2) Determine density of 0.5M HNO₃

Mass of 100ml volumetric flask =	66.4289 g (Bal 12)
Mass of flask + 0.5M HNO ₃ =	167.5792 g
Net mass of solution =	101.1503 g
÷ 100 ml = density =	1.0115 g/ml

3) Transfer # 760 to a 40 ml VOA vial.

Mass of bottle without lid =	21.5801 g (Bal 12)
Mass of std + bottle	26.5278 g
Net mass of std transferred	4.9477 g

4) Dilute to volume w/ 0.5M HNO₃

Mass of bottle + std + soln =	61.8912 g (Bal 12)
Mass of bottle (from above)	21.5801 g
Net mass of std	40.3111 g

5) Final activity calc.

$$\frac{(1.852 \times 10^4 \text{ dpm/g}) (4.9477 \text{ g})}{(5.0847) (40.3111 \text{ g})} \left(\frac{1.0115 \text{ g/ml}}{1.0115 \text{ g/ml}} \right) = 26,534.83 \text{ dpm/g}$$

Continued on Page _____

Read and Understood By

Alister Baker

Signed

1/24/06

Date

[Signature]

Signed

1/27/06

Date



ANALYTICS

RSO# 760 Rec'd 7/14/04 JCB

1380 Seaboard Industrial Blvd.
Atlanta, Georgia 30318 - U.S.A.

Phone (404) 352-8577
Fax (404) 352-2837

CERTIFICATE OF CALIBRATION

Standard Radionuclide Source

68750-307

Th-230 5 mL Liquid in Flame Sealed Vial

This standard radionuclide source was prepared gravimetrically from a calibrated master solution. The master solution was calibrated by liquid scintillation counting.

Radionuclide purity and calibration were checked by germanium gamma-ray spectrometry and liquid scintillation counting. The nuclear decay rate and assay date for this source are given below.

ANALYTICS maintains traceability to the National Institute of Standards and Technology through Measurements Assurance Programs as described in USNRC Reg. Guide 4.15, Revision 1.

ISOTOPE:	Th-230
ACTIVITY (dps):	1.832 Bq
HALF-LIFE:	7.538 Bq years
CALIBRATION DATE:	July 13, 2004 12:00 EST
RELATIVE EXPANDED UNCERTAINTY (k=2):	3.3%

Impurities: γ -impurities <0.1%, α -impurities <0.01%

5.08447 grams 0.5M HNO₃ solution.

P O NUMBER 70635, Item 1

SOURCE PREPARED BY:

M. D. Currie
M. D. Currie, Radiochemist

Q A APPROVED:

A. Currie 7/13/04

Project CS-137 working standard 1013.4095.77
Continued from Page _____

Prepare a working dilution of 1013.4095.76

1. Density of 4% HCl, lot # 0000094396
Mass of 100mL vol. flask: 68.5652g
Mass of flask & 100mL acid: 169.0154g
Net Mass: 100.4502g
Density: 1.0045g/mL

Balance # 12
Balance# 12

2. Mass of 1013.4095.76 transferred:
Mass of empty nalgene: 74.1532g
Mass of nalgene & standard: 75.4532g
Net mass of standard transferred: 1.3000g

Balance# 12
Balance# 12

3. Dilute to final volume:

Mass of nalgene, standard, & diluent: 1069.7g
Mass of empty nalgene: 74.1532g
Net mass of new dilution: 995.5468g

Balance# 26
Balance# 12

4. Final activity calculation:

$$100,443.6 \text{ dpm/g} (1.0045 \text{ g/mL}) \left(\frac{1.3000 \text{ g}}{995.5468 \text{ g}} \right) = 131.75 \text{ dpm/mL}$$

Std ID: 1013.4095.77

Description: Cs-137
Expiration: 1/20/2018
Activity: 131.75 dpm/mL

2s Uncertainty: 0.92 dpm/mL

Ref. Date: 9/30/2005

Ref Time: N/A

Prep Date: 1/16/2015 Prep by: TE

Matrix/Comp. 4% HCl

Half Life (y): 3.01E+01

Reverification Log		
Analysis Date	Initials	Expiration Date
1/7/2016	JK	1/07/2017

Continued on Page _____

Signed

Date

Signed

Date

Prepare an intermediate dilution of RSO# 10131. Density of 4% HCl, lot # 0000094396Mass of 100mL vol. flask: 68.5652gBalance # 12Mass of flask & 100mL acid: 169.0154gBalance # 12Net Mass: 100.4502gDensity: 1.0045g/mL2. Mass of RSO# 1013 -transferred:Mass of open empty bottle: 398.34gBalance# 26Mass of bottle and standard: 403.33gBalance# 26Net mass of standard transferred: 4.99g

3. Dilute to final volume:

Mass of open empty bottle: 398.34gBalance# 26Mass of bottle, standard, & diluent: 1288.4gBalance# 26Net mass of new dilution: 890.06g

4. Final activity calculation:

$$298.6 \text{ kBq/g} \left(\frac{1000 \text{ Bq}}{1 \text{ kBq}} \right) \left(\frac{60 \text{ dpm}}{1 \text{ Bq}} \right) \left(\frac{4.99 \text{ g}}{890.06 \text{ g}} \right) = 100,443.61 \text{ dpm/g}$$

Continued on Page

1/16/15
Signed

1/16/15
Date

Read and Understood By
[Signature]
Signed

1-16-15
Date

RSO²
1013



National Institute of Standards & Technology Certificate

Standard Reference Material 4233E Cesium-137 Radioactivity Standard

This Standard Reference Material (SRM) consists of radioactive cesium-137 chloride, non-radioactive cesium chloride, and hydrochloric acid dissolved in 5 mL of distilled water. The solution is contained in a flame-sealed NIST borosilicate-glass ampoule. The SRM is intended for the calibration of ionization chambers and solid-state gamma-ray spectrometry systems.

Radiological Hazard: The SRM ampoule contains cesium-137 with a total activity of approximately 1.5MBq. Cesium-137 decays by beta-particle emission to barium-137m, which decays by internal conversion. During the decay process X-rays and gamma rays with energies from approximately 3 keV to 662 keV are emitted. Most of these photons escape from the SRM ampoule and can represent a radiation hazard. Approximate unshielded dose rates at several distances (as of the reference time) are given in note [a]*. Appropriate shielding and/or distance should be used to minimize personnel exposure. The SRM should be used only by persons qualified to handle radioactive material.

Chemical Hazard: The SRM ampoule contains hydrochloric acid with a concentration of 1 mole per liter of water. The solution is corrosive and represents a health hazard if it comes in contact with eyes or skin. If the ampoule is to be opened to transfer the solution, the recommended procedure is given on page 2. The ampoule should be opened only by persons qualified to handle both radioactive material and strong acid solution.

Storage and Handling: The SRM should be stored and used at a temperature between 5 and 65 °C. The solution in an unopened ampoule should remain stable and homogeneous until at least September 2015. The ampoule (or any subsequent container) should always be clearly marked as containing radioactive material. If the ampoule is transported, it should be packed, marked, labeled, and shipped in accordance with the applicable national, international, and carrier regulations. The solution in the ampoule is a dangerous good (hazardous material) because of both the radioactivity and the strong acid.

Preparation: This Standard Reference Material was prepared in the Physics Laboratory, Ionizing Radiation Division, Radioactivity Group, M.P. Unterwieser, Acting Group Leader. The overall technical direction and physical measurements leading to certification were provided by L.L. Lucas, R. Collé and L. Laureano-Pérez of the Radioactivity Group. The support aspects involved in the preparation, certification, and issuance of this SRM were coordinated through the Standard Reference Materials Program.

Lisa R. Karam, Deputy Chief
Ionizing Radiation Division

Gaithersburg, Maryland 20899
October 2005

Robert L. Watters, Jr., Chief
Measurement Services Division

Recommended Procedure for Opening the SRM Ampoule

- 1) If the SRM solution is to be diluted, it is recommended that the diluting solution have a composition comparable to that of the SRM solution.
- 2) Wear eye protection, gloves, and protective clothing and work over a tray with absorbent paper in it. Work in a fume hood. In addition to the radioactive material, the solution contains strong acid and is corrosive.
- 3) Shake the ampoule to wet all of the inside surface of the ampoule. Return the ampoule to the upright position.
- 4) Check that all of the liquid has drained out of the neck of the ampoule. If necessary, gently tap the neck to speed the process.
- 5) Holding the ampoule upright, score the narrowest part of the neck with a scribe or diamond pencil.
- 6) Lightly wet the scored line. This reduces the crack propagation velocity and makes for a cleaner break.
- 7) Hold the ampoule upright with a paper towel, a wiper, or a support jig. Position the scored line away from you. Using a paper towel or wiper to avoid contamination, snap off the top of the ampoule by pressing the narrowest part of the neck away from you while pulling the tip of the ampoule towards you.
- 8) Transfer the solution from the ampoule using a pycnometer or a pipet with dispenser handle. NEVER PIPETTE BY MOUTH.
- 9) Seal any unused SRM solution in a flame-sealed glass ampoule, if possible, to minimize the evaporation loss.

See also reference [4]*.

PROPERTIES OF SRM 4233E

Certified values

Radionuclide	Cesium-137
Reference time	1200 EST, 30 September 2005
Massic activity of the solution [c]*	298.6 kBq·g ⁻¹
Relative expanded uncertainty (k=2)	0.70% [d] [e]
Solution mass	(5.0668 ± 0.0009) g [b]
Solution density	(1.015 ± 0.002) g·mL ⁻¹ at 20 °C [b]

Uncertified values

Physical Properties:			
Source description	Liquid in flame-sealed NIST borosilicate-glass ampoule		
Ampoule specifications	Body outside diameter	(16.5 ± 0.5) mm	
	Wall thickness	(0.60 ± 0.04) mm	
	Barium content	Less than 2.5%	
	Lead-oxide content	Less than 0.02%	
	Other heavy elements	Trace quantities	
Chemical Properties:			
Solution composition	Chemical Formula	Concentration (mol·L ⁻¹)	Mass Fraction (g·g ⁻¹)
	H ₂ O	54	0.96
	HCl	1.0	0.04
	CsCl	1.6 × 10 ⁻⁴	2.7 × 10 ⁻⁵
	¹³⁷ CsCl	6.9 × 10 ⁻⁷	1.2 × 10 ⁻⁷
Radiological Properties:			
Photon-emitting impurities	None detected [f]		
Half lives used	Cesium-137: (10983 ± 11) d [g] [5] Radium-226: (1600 ± 7) a [g] [5]		
Calibration method and measuring instrument(s)	Pressurized "4π"γ ionization chamber A calibrated using an cesium-137 solution whose activity was determined by the 4π(e+X)-γ-coincidence efficiency-extrapolation technique.		

EVALUATION OF THE UNCERTAINTY OF THE MASSIC ACTIVITY [d]*

Input Quantity x_i , the source of uncertainty (and individual uncertainty components where appropriate)	Method Used To Evaluate $u(x_i)$, the standard uncertainty of x_i (A) denotes evaluation by statistical methods (B) denotes evaluation by other methods	Relative Uncertainty Of Input Quantity, $u(x_i)/x_i$, (%) [h]	Relative Sensitivity Factor, $ \partial y/\partial x_i \cdot$ (x_i/y) [i]	Relative Uncertainty Of Output Quantity, $u(y)/y$, (%) [j]
PIC A net response per gram of SRM 4233E, measured relative to RRS20 [k]	Standard deviation of the mean (within-measurement precision) for 20 to 100 repeated measurements (A)	0.02	1.0	0.02
	Standard deviation (between- measurement precision) for 4 sets of measurement (A)	0.13	1.0	0.13
PIC A net response per Bq of cesium-137 in solution, measured relative to RRS20.	Standard deviation of the mean (for both between- and within- measurement precision) for >100 repeated measurements (A)	0.01	1.0	0.01
Activity used to calibrate PIC A net response per Bq of cesium-137 in solution	Standard uncertainty of the activity determined by the $4\pi(e+X)$ - γ -coincidence efficiency-extrapolation technique. (B)	0.31	1.0	0.31
Half life of cesium-137 Half life of radium-226	Standard uncertainty of the half life (A)	0.10 [m] 0.44 [m]	0.0001 [n] 0.010 [n]	0.00001 0.004
Gravimetric measurements	Estimated (B)	0.03	1.0	0.03
PIC A charge collection	Estimated (B)	0.05	1.0	0.05
Charge collection measurement time [p]	Estimated (B)	0.05	1.0	0.05
Long-term RRS positioning	Estimated (B)	0.05	1.0	0.05
Photon-emitting impurities	Limit of detection (B) [q]	100.	0.0001	0.01
Relative Combined Standard Uncertainty of the Output Quantity, $u_c(y)/y$, (%)				0.35
Coverage Factor, k				<u>x 2</u>
Relative Expanded Uncertainty of the Output Quantity, U/y , (%)				0.70

NOTES

- [a] The Sievert is the SI unit for dose equivalent. See reference [1]. One μSv is equal to 0.1 mrem.
 Distance from Ampoule (cm): 1 30 100
 Approximate Dose Rate ($\mu\text{Sv/h}$): 300 4 0.3
- [b] The stated uncertainty is two times the standard uncertainty.
- [c] **Massic activity** is the preferred name for the quantity activity divided by the total mass of the sample. See reference [1].
- [d] The reported value, y , of massic activity (activity per unit mass) at the reference time was not measured directly but was derived from measurements and calculations of other quantities. This can be expressed as $y = f(x_1, x_2, x_3, \dots, x_n)$, where f is a mathematical function derived from the assumed model of the measurement process. The value, x_i , used for each input quantity i has a **standard uncertainty**, $u(x_i)$, that generates a corresponding uncertainty in y , $u_i(y) = |\partial y / \partial x_i| \cdot u(x_i)$, called a **component of combined standard uncertainty** of y . The **combined standard uncertainty** of y , $u_c(y)$, is the positive square root of the sum of the squares of the components of combined standard uncertainty. The combined standard uncertainty is multiplied by a **coverage factor** of $k = 2$ to obtain U , the **expanded uncertainty** of y .
- Since it can be assumed that the possible estimated values of the massic activity are approximately normally distributed with approximate standard deviation $u_c(y)$, the unknown value of the massic activity is believed to lie in the interval $y \pm U$ with a level of confidence of approximately 95 percent.
- For further information on the expression of uncertainties, see references [2] and [3].
- [e] The value of each component of combined standard uncertainty, and hence the value of the expanded uncertainty itself, is a best estimate based upon all available information, but is only approximately known. That is to say, the "uncertainty of the uncertainty" is large and not well known. This is true for uncertainties evaluated by statistical methods (e.g., the relative standard deviation of the standard deviation of the mean for the massic response is approximately 50%) and for uncertainties evaluated by other methods (which could easily be over estimated or under estimated by substantial amounts). The unknown value of the expanded uncertainty is believed to lie in the interval $U/2$ to $2U$ (i.e., within a factor of 2 of the estimated value).
- [f] Estimated limits of detection for photon-emitting impurities, as of 3 October 2005 (3 days after the reference time), expressed as massic photon emission rates, are:
 $< 40 \gamma \cdot \text{s}^{-1} \cdot \text{g}^{-1}$ for energies between 40 keV and 1350 keV, and
 $< 4 \gamma \cdot \text{s}^{-1} \cdot \text{g}^{-1}$ for energies between 1350 keV and 3600 keV,
- [g] The stated uncertainty is the standard uncertainty.
- [h] Relative standard uncertainty of the input quantity x_i .
- [i] The relative change in the output quantity y divided by the relative change in the input quantity x_i . If $|\partial y / \partial x_i| \cdot (x_i / y) = 1.0$, then a 1% change in x_i results in a 1% change in y . If $|\partial y / \partial x_i| \cdot (x_i / y) = 0.05$, then a 1% change in x_i results in a 0.05% change in y .

- [j] Relative component of combined standard uncertainty of output quantity y , rounded to two significant figures or less. The relative component of combined standard uncertainty of y is given by $u_i(y)/y = |\partial y/\partial x_i| \cdot u(x_i)/y = |\partial y/\partial x_i| \cdot (x_i/y) \cdot u(x_i)/x_i$. The numerical values of $u(x_i)/x_i$, $|\partial y/\partial x_i| \cdot (x_i/y)$, and $u_i(y)/y$, all dimensionless quantities, are listed in columns 3, 4, and 5, respectively. Thus, the value in column 5 is equal to the value in column 4 multiplied by the value in column 3. The input quantities are independent, or very nearly so. Hence the covariances are zero or negligible.
- [k] The response of pressurized ionization chamber A (PIC A) is determined from measurement of the time required to collect a given amount of charge on a stable fixed capacitor. All of the response measurements in the NIST pressurized ionization chambers are made relative to the response of one or more artifact standards. These artifact standards consist of microgram quantities of aged radium-226 in small welded stainless-steel capsules. These capsules are encapsulated in plastic rods whose dimensions are similar to those of the standard NIST ampoule. The artifact standards are called **Radium Reference Sources** and are designated as RRSx, where x is the nominal mass (in micrograms) of radium-226 in the capsule.
- [m] The relative standard uncertainty of $\lambda \cdot t$ is determined by the relative standard uncertainty of λ (i.e., of the half life). The relative standard uncertainty of t is negligible.
- [n] $|\partial y/\partial x_i| \cdot (x_i/y) = |\lambda \cdot t|$
- [p] The charge collection measurement time is determined by counting the pulses from a gated crystal-controlled oscillator.
- [q] The standard uncertainty for each undetected impurity that might reasonably be expected to be present is estimated to be equal to the estimated limit of detection for that impurity, i.e. $u(x_i)/x_i = 100\%$. $|\partial y/\partial x_i| \cdot (x_i/y) = \{(\text{response per Bq of impurity})/(\text{response per Bq of cesium-137})\} \cdot \{(\text{Bq of impurity})/(\text{Bq of cesium-137})\}$. Thus $u_i(y)/y$ is the relative change in y if the impurity were present with a massic activity equal to the estimated limit of detection.

REFERENCES

- [1] International Organization for Standardization (ISO), *ISO Standards Handbook - Quantities and Units*, 1993. Available from Global Engineering Documents, 12 Inverness Way East, Englewood, CO 80112, U.S.A. Telephone 1-800-854-7179.
- [2] International Organization for Standardization (ISO), *Guide to the Expression of Uncertainty in Measurement*, 1993 (corrected and reprinted, 1995). Available from Global Engineering Documents, 12 Inverness Way East, Englewood, CO 80112, U.S.A. Telephone 1-800-854-7179.
- [3] B. N. Taylor and C. E. Kuyatt, *Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results*, NIST Technical Note 1297, 1994. Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20407, U.S.A.
- [4] National Council on Radiation Protection and Measurements Report No. 58, *A Handbook of Radioactivity Measurements Procedures*, Second Edition, 1985. Available from the National Council on Radiation Protection and Measurements, 7910 Woodmont Avenue, Bethesda, MD 20814 U.S.A.
- [5] Evaluated Nuclear Structure Data File (ENSDF), September 2005.

Instrument: LB4100-C

Calibration: Gross Alpha (Am-241) - ringed planchet
Gross Beta (Sr-90/Y-90) - ringed planchet

Date of Calibration: Gross Alpha 06/06/2015
Gross Beta 06/06/2015

Efficiency Log Files: **Am241R-06/15**
Sr90R-06/15

Efficiency Instrument Files: EAM0606A-D
ESR0606A-D

Source ID's: (Am-241 955.4095.10)
(Sr-90/Y-90 777.3020.11)

NOTE: Calibration Re-Verified 06/03/16.
(See Supporting Documentation in Package)

OK
Expired 6/2/2017
JP 6/3/16

QUALITY ASSURANCE SUMMARY SHEET

ALS W.O. # / BATCH Inst. C Calibration
TEST All tests
METHOD GFPC
SOP/REV (PREP) -
SOP/REV (ANAL) 724

Briefly document any QA or other problems or deviations associated with the analysis of samples. Problems could result from: log-in, color, odor, dilution, consistency, scheduling, equipment, or instrumentation, or may include documentation of minor deviations necessary due to unique DQO's or sample characteristics.

6-3-16
ALS Fort Collins SOP 724 requires an efficiency calibration for each Gas Flow test to be performed annually for each instrument. Per Technical Manager, the efficiency calibrations performed in 2015 for Instrument C will be acceptable for another year providing the following acceptance criteria was met: 1) Plateau checks were performed and were within acceptance criteria (The beta slope at the beta voltage and the alpha slope at the beta voltage had a slope of less than 3.5%). 2) CCV's and CCB's were performed for each calibration and were within the acceptance criteria. These results for the plateau checks and the CCV's/CCB's can be found in the "Addendum" section in the back of the calibration. *6-3-16*

The instrument will be monitored with daily efficiency checks, daily background checks, and weekly background checks, as well as quarterly plateau checks as required per SOP 724. If any detectors fail any of these checks, the specific detector will be taken offline for the day and not be used to count client samples. If a detector fails its quarterly plateau check, the detector will be taken off-line until the instrument is re-calibrated for Voltage Plateaus, ROI's, and efficiency calibrations.

TECHNICIAN/ANALYST

DATE 6-3-16

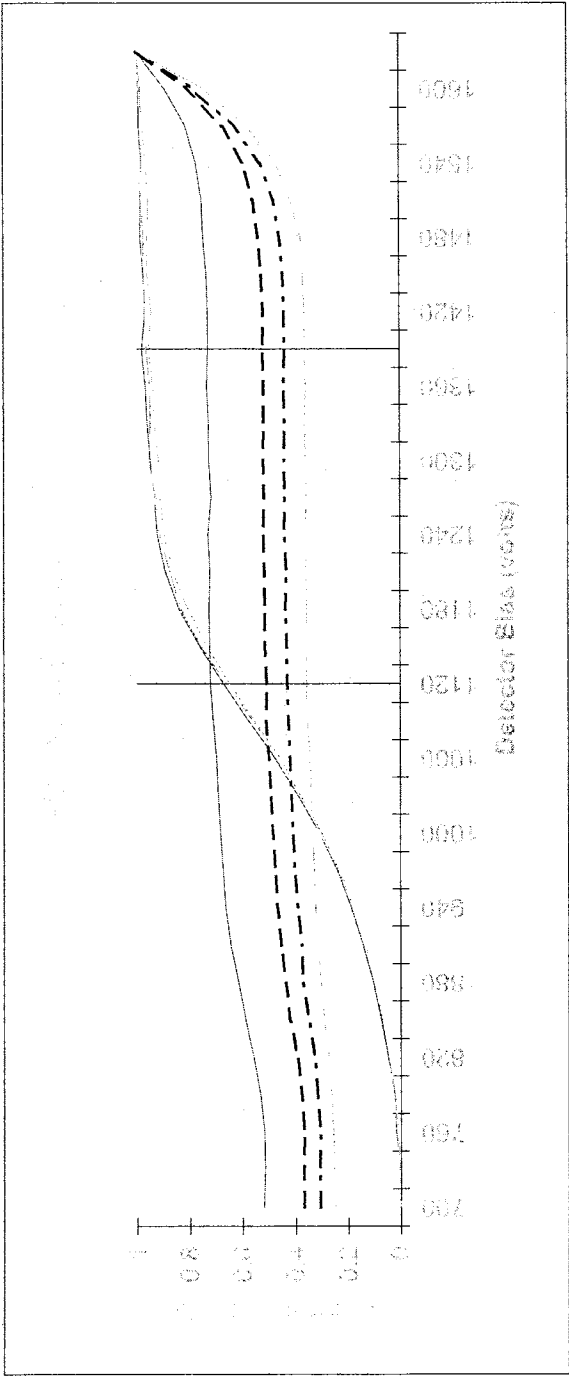
DEPARTMENT MANAGER

DATE 06/03/16

Instrument Plateaus

Unit Type: LB4100/W
Date Performed: 6/4/15 07:19
FileName: PTC0604A
Batch ID: DRAWER A PLATEAU

Unit Id: Magenta
Application Revision: 2
Application Version: Standard



Optimum alpha beta simultaneous operating voltage: 1402.5

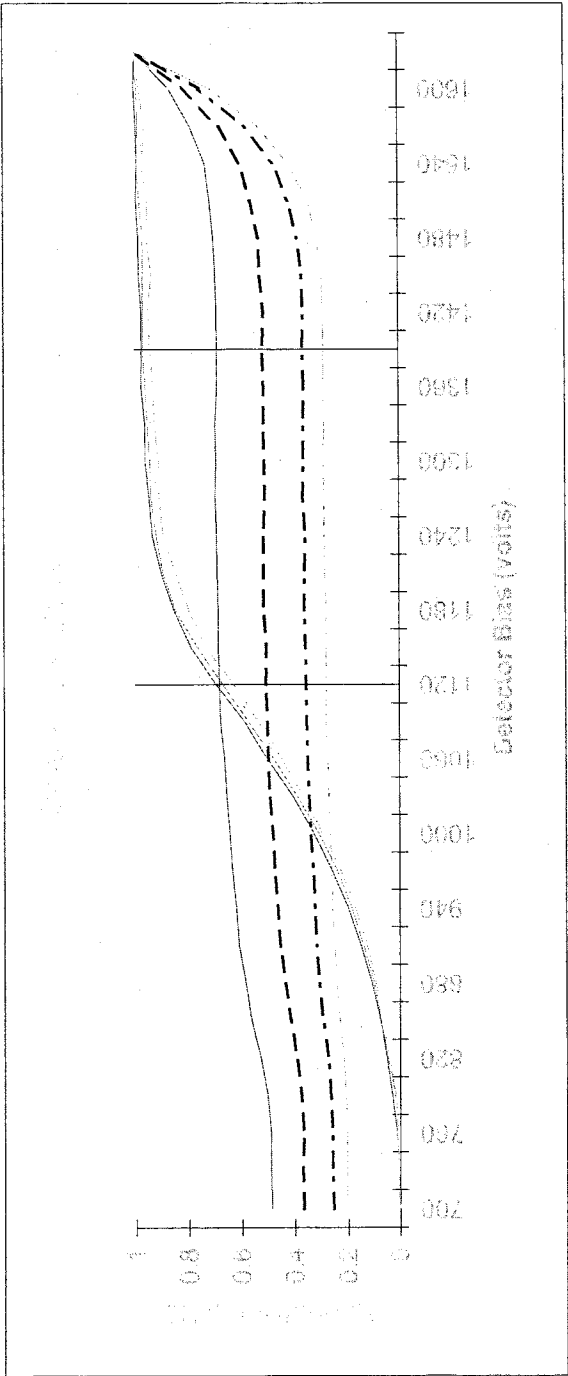
Optimum alpha only operating voltage: 1117.5

	A1	A2	A3	A4
Beta slope at beta voltage	0.98%	2.32%	2.15%	2.01%
Alpha slope at beta voltage	0.45%	0.91%	1.62%	0.57%
Alpha slope at alpha voltage	3.19%	2.18%	2.42%	3.19%

OK 8/6/15

Unit Type: LB4100/W
Date Performed: 6/4/15 07:19
FileName: PTC0604B
Batch ID: DRAWER B PLATEAU

Unit Id: Magenta
Application Revision: 2
Application Version: Standard



Optimum alpha beta simultaneous operating voltage: 1402.5

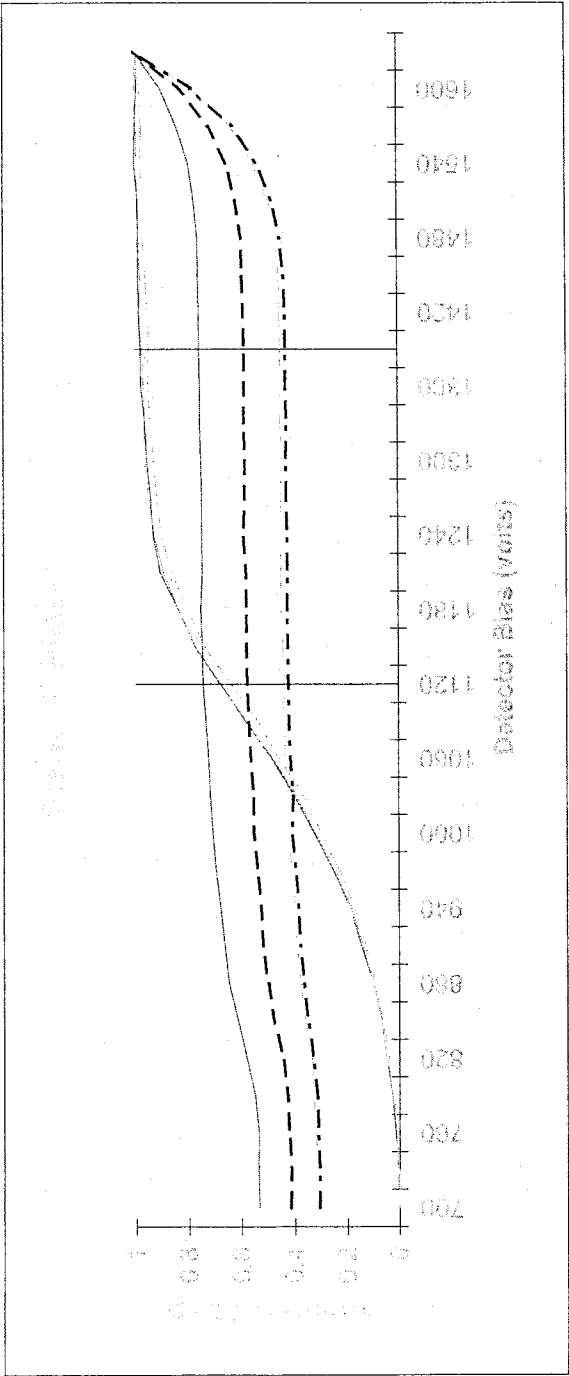
Optimum alpha only operating voltage: 1120

	B1	B2	B3	B4
Beta slope at beta voltage	1.40%	1.36%	1.60%	1.37%
Alpha slope at beta voltage	-0.18%	1.56%	1.68%	0.87%
Alpha slope at alpha voltage	2.53%	2.15%	1.16%	2.36%

OK 6/5/15
6/5/15

Unit Type: LB4100/W
Date Performed: 6/4/15 13:32
File Name: PTC0604C
Batch ID: DRAWER C PLATEAU

Unit Id: Magenta
Application Revision: 2
Application Version: Standard



Optimum alpha beta simultaneous operating voltage: 1402.5

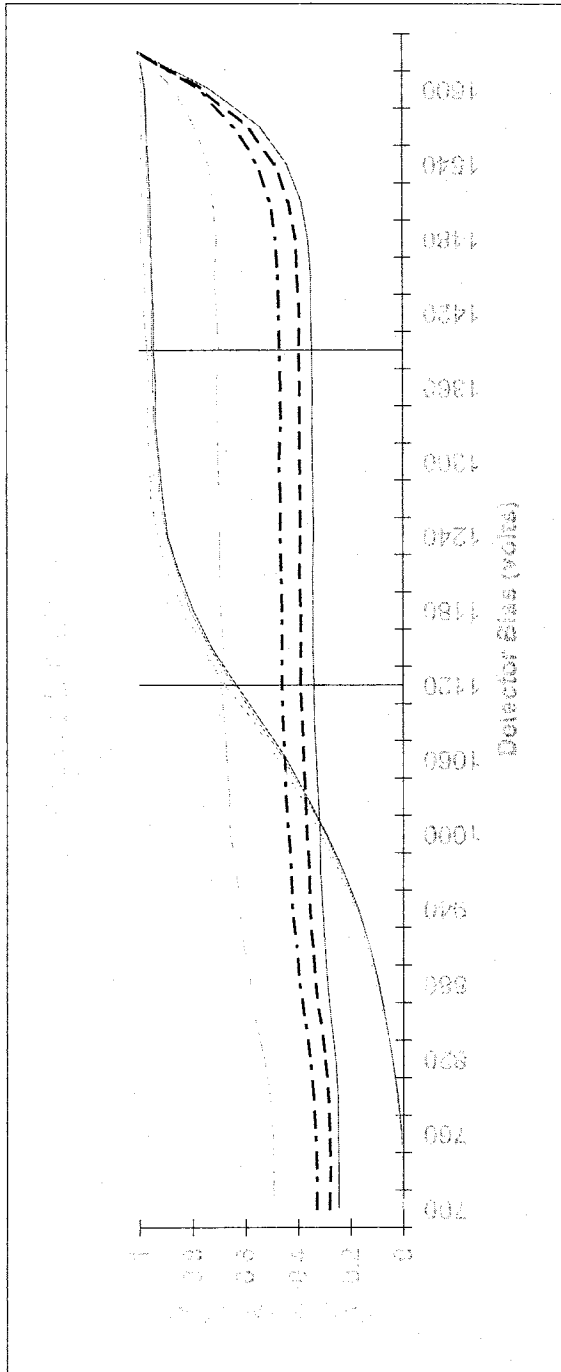
Optimum alpha only operating voltage: 1120

	C1	C2	C3	C4
Beta slope at beta voltage	1.94%	1.64%	1.29%	1.87%
Alpha slope at beta voltage	0.69%	0.89%	0.80%	1.37%
Alpha slope at alpha voltage	3.36%	2.27%	2.34%	1.89%

OK 6/6/15

Unit Type: LB4100/W
 Date Performed: 6/4/15 13:33
 FileName: PTC0604D
 Batch ID: DRAWER D PLATEAU

Unit Id: Magenta
 Application Revision: 2
 Application Version: Standard



Optimum alpha beta simultaneous operating voltage: **1402.5**

Optimum alpha only operating voltage: **1120**

	D1	D2	D3	D4
Beta slope at beta voltage	1.37%	0.31%	1.04%	2.34%
Alpha slope at beta voltage	1.21%	1.40%	0.81%	1.80%
Alpha slope at alpha voltage	2.81%	2.19%	2.37%	1.86%

OK TPC/5/15

3/12/15

Cs-137 / Gross Beta Mass Attenuation

Benchsheet: AB150310-1

Sources: 1515002-1 → 24 File Name ACS0312

Det	8:53	9:03	9:21	9:38	9:50	10:00	10:12	10:22	10:36	10:49	11:04	11:16	11:26	11:38	11:48	12:00	12:10	12:22	12:33	12:43	12:59	13:11	13:21	13:31
A1	1	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2
A2	2	1	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3
A3	3	2	1	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4
A4	4	3	2	1	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5
B1	5	4	3	2	1	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6
B2	6	5	4	3	2	1	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7
B3	7	6	5	4	3	2	1	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8
B4	8	7	6	5	4	3	2	1	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9
C1	9	8	7	6	5	4	3	2	1	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10
C2	10	9	8	7	6	5	4	3	2	1	24	23	22	21	20	19	18	17	16	15	14	13	12	11
C3	11	10	9	8	7	6	5	4	3	2	1	24	23	22	21	20	19	18	17	16	15	14	13	12
C4	12	11	10	9	8	7	6	5	4	3	2	1	24	23	22	21	20	19	18	17	16	15	14	13
D1	13	12	11	10	9	8	7	6	5	4	3	2	1	24	23	22	21	20	19	18	17	16	15	14
D2	14	13	12	11	10	9	8	7	6	5	4	3	2	1	24	23	22	21	20	19	18	17	16	15
D3	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	24	23	22	21	20	19	18	17	16
D4	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	24	23	22	21	20	19	18	17

6/04/2015

Plateau for Drawers A-D

A Source Used	Detectors	B Source Used
410 Am-241	A1 B1 C1 D1	406 Sr-90/490
411 17,800 DPM	H2 B2 C2 D2	407 29,600 dpm
412 2-16.95	A3 B3 C3 D3	408 9-15-92
413	A4 B4 C4 D4	409

Parameters

Starting Voltage 700

End Voltage 1650

30V / Step

5 min / Step

Count Preset 40,000

Time Between Steps 0.1

Weak Check Times 0.1

Weak Check Limits 20

File Names

PTC0604A-D

Continued on Page

Read and Understood By

03/13/15

Signed

Date

Signed

Page 8 of 329

Date 6/4/15SOP 724r 11

ALS
Low Background Gas Flow Proportional Counter Log
Instrument: LB4100C

Instrument Daily Response and Background Checks

Det.	Daily Response Check				Background Check				Det. Status
	Start 1	Status	Start 2	Status	Start 1	Status	Start 2	Status	
1	JP	P			JP	P			P
2	↓	↓			↓	↓			↓
3									
4									
5									
6									
7									
8									
9									
10									
11									
12						(LB)			OLB
13						P			P
14						↓			↓
15									
16	↓	↓			↓				↓

Det = Detector; α = Alpha; β = Beta; P = Pass; H = High; L = Low; OL = Offline; R = Recount; W = Weekly; NP = Not Processed

Weekly Background Calibration

	Current Calib. File ID	Weekly Calib. Started	Status	File ID
Dr A	BKC0520W			
Dr B	↓			
Dr C				
Dr D	↓			

Dr = Drawer

Gas Supply

P-10 Supply		P-10 Flow	
Tank 1	500	Dr A	0.1
	↓	Dr B	↓
Tank 2	350	Dr C	
	↓	Dr D	↓

Comments:

JP 6/4/15

Date 6/4/15SOP 724r 11

ALS

Low Background Gas Flow Proportional Counter Log

Instrument: LB4100C

Det.	Sample ID	Batch	Test	Count Dur. (min)	Start Time	Analyst Initials	File ID	Output Initials
F-16	Daily EFF	—	—	30	6:02	JP	EFF0604	JP
F-16	Daily Bkg	—	—	60	6:10	JP	BK0604	JP
1-4	Alpha Beta	Drawer A Plateau	Plateau	5 Min/step	7:19	JP	PTC0604A	JP
5-8	Beta Alpha	Drawer B Plateau					B	
9-12	Alpha Beta				13:33	JP	C	
13-16	Beta Alpha						D	
JP 6/5/15								

Comments:

Page No.: 453998 **B**
(cont. from page IVA **B**)

Form 780r8.doc (6/23/06)

Reviewed By / Date JP 6/5/15

Instrument ROIs

Batch Specific:

Magenta	Event	Recycle
1	1	0.01

Drawer Specific:

	Date/Time	Official	Bias	Step
A	6-4-15 7:19	TRUE	1402.5	0
B	6-4-15 7:19	TRUE	1402.5	0
C	6-4-15 13:32	TRUE	1402.5	0
D	6-4-15 13:33	TRUE	1402.5	0

Detector Specific:

	Date/Time	Official	Thres	bLL	bUL	aLL	aUL	Time	bCntPst	bPsiTm	aCntPst	aPsiTm	bWkCnt	bWkTm	aWkCnt
A1	6-5-15 0:00	TRUE	0.1	0	43.71	80.56	100	35	10000	0	10000	0	0	0	0
A2	6-5-15 0:00	TRUE	0.1	0	42.85	80.21	100	35	10000	0	10000	0	0	0	0
A3	6-5-15 0:00	TRUE	0.1	0	41.58	79.82	100	35	10000	0	10000	0	0	0	0
A4	6-5-15 0:00	TRUE	0.1	0	42	76.8	100	35	10000	0	10000	0	0	0	0
B1	6-5-15 0:00	TRUE	0.1	0	44.51	86.44	100	35	10000	0	10000	0	0	0	0
B2	6-5-15 0:00	TRUE	0.1	0	42.53	77.46	100	35	10000	0	10000	0	0	0	0
B3	6-5-15 0:00	TRUE	0.1	0	41.48	76.5	100	35	10000	0	10000	0	0	0	0
B4	6-5-15 0:00	TRUE	0.1	0	41.44	77.5	100	35	10000	0	10000	0	0	0	0
C1	6-5-15 0:00	TRUE	0.1	0	40.92	77.99	100	35	10000	0	10000	0	0	0	0
C2	6-5-15 0:00	TRUE	0.1	0	41.36	77.09	100	35	10000	0	10000	0	0	0	0
C3	6-5-15 0:00	TRUE	0.1	0	37.28	71.47	100	35	10000	0	10000	0	0	0	0
C4	6-5-15 0:00	TRUE	0.1	0	42.34	78.09	100	35	10000	0	10000	0	0	0	0
D1	6-5-15 0:00	TRUE	0.1	0	38.19	71.47	100	35	10000	0	10000	0	0	0	0
D2	6-5-15 0:00	TRUE	0.1	0	39.56	73.84	100	35	10000	0	10000	0	0	0	0
D3	6-5-15 0:00	TRUE	0.1	0	38.24	72.82	100	35	10000	0	10000	0	0	0	0
D4	6-5-15 0:00	TRUE	0.1	0	40.92	77.82	100	35	10000	0	10000	0	0	0	0

ROI's

OK JP 6/5/15

6/5/2015

ROI's Set for All Drawers using Sr/Y-90 sources

Sources \rightarrow 406, 407, 408, 409: Over 50,000 counts achieved for each detector α Lower Limit + β Upper limit set to 50% to startBoth α lower limit + β upper limit moved to achieve β \rightarrow α talk of ~~2.50%~~ ^{2.50%} ~~2.50%~~ ^{2.50%} α lower limit moved to achieve α \rightarrow β X Talk of 0.10%.

All ROI's Archived

6/5/15

After ROI's set, Interim Daily Efficiency control limits established for All 16 Detectors based on 5 individual counts

Files EFC0605A \rightarrow E. Interim limits for alpha + beta set at $\pm 10\%$ of the mean of the 5 individual counts.

Historical control limits will be established upon acquisition of 30 Data Points.

6/5/151000 minute background count run. Interim long background calibration limits set to $\pm 99\%$ for alpha, $\pm 25\%$ for beta based on 6/5/15 1000 minute count.

Historical limits will be established following the acquisition of 10 data points.

6/6/15

Gross Alpha

Am241 Eff Calibration

Benchmark: ABIZ1109-1 Source ID \rightarrow ~~1050~~ 106Z JP60606ALog File: Am241R \rightarrow 06/15

Sources

Detection

File names

1223001-20

A1 B1 C1 D1

EAM0606A

-22

A2 B2 C2 D2

B

-23

A3 B3 C3 D3

C

-24

A4 B4 C4 D4

D

Continued on Page

Read and Understood By

6/5/15

Signed

Date

Signed

203 of 329

Calibration Efficiencies

Source Database for OSUM

Number of sources in table: 127

Application Revision:

Control ID	Isotope	Type	Half-Life	DPM	Std dev	Date	Status	Alpha/Beta Archive File
1062	Am-241	Alpha	158153.25	5516.133	99.29	40841	ALS	Am241R-06/15
1063	Sr-90	Beta	10519.2	9993.46	199.86	38323	ALS	Sr90R-06/15

Am-241 Ringed Planchet Efficiency Calibration
LB4100-C

Date: 6/6/2015

Source ID: 1062

Det ID	A1	A2	A3	A4	B1	B2	B3	B4
File Name	EAM0606A	EAM0606A	EAM0606A	EAM0606A	EAM0606B	EAM0606B	EAM0606B	EAM0606B
Cnt Time	8.53	8.06	8.31	8.33	8.9	8.34	8.74	9
Tot Cnts	10003	10006	10010	10005	10012	10015	10010	10005
Bkg CPM	0.124	0.157	0.112	0.110	0.114	0.122	0.134	0.145
CPM	1172.561	1241.282	1204.461	1200.970	1124.830	1200.717	1145.175	1111.522
Alpha Efficiency	0.213803	0.226334	0.219620	0.218983	0.205100	0.218937	0.208810	0.202673
Beta Efficiency	0.059071	0.065158	0.063385	0.065506	0.056844	0.059034	0.058206	0.058478
Efficiency	0.2138	0.2263	0.2196	0.2190	0.2051	0.2189	0.2088	0.2027

Det ID	C1	C2	C3	C4	D1	D2	D3	D4
File Name	EAM0606C	EAM0606C	EAM0606C	EAM0606C	EAM0606D	EAM0606D	EAM0606D	EAM0606D
Cnt Time	8.82	8.01	8.55	8.73	8.83	8.14	8.21	8.45
Tot Cnts	10011	10013	10012	10005	10008	10001	10005	10009
Bkg CPM	0.102	0.112	0.108	0.119	0.097	0.093	0.090	0.087
CPM	1134.932	1249.950	1170.886	1145.929	1133.312	1228.531	1218.546	1184.410
Alpha Efficiency	0.206942	0.227914	0.213498	0.208947	0.206646	0.224009	0.222188	0.215964
Beta Efficiency	0.057852	0.064358	0.059487	0.059595	0.057858	0.063384	0.062627	0.061469
Efficiency	0.2069	0.2279	0.2135	0.2089	0.2066	0.2240	0.2222	0.2160

[illegible]

Sr-90 Ringed Planchet Efficiency Calibration
LB4100-C

Date: 6/6/2015

Source ID: 1063

Det ID	A1	A2	A3	A4	B1	B2	B3	B4
File Name	ESR0606A	ESR0606A	ESR0606A	ESR0606A	ESR0606B	ESR0606B	ESR0606B	ESR0606B
Cnt Time	3.01	2.91	2.87	2.85	2.97	3.02	2.97	3.02
Tot Cnts	10042	10036	10045	10051	10023	10017	10011	10030
Bkg CPM	1.476	1.588	1.595	1.612	1.623	1.657	1.833	1.732
CPM	3334.737	3447.209	3498.405	3525.055	3373.124	3315.230	3368.874	3319.460
Alpha Efficiency	0.000797	0.000157	0.000479	0.000619	0.000463	0.000539	0.000417	0.000408
Beta Efficiency	0.429723	0.444217	0.450814	0.454248	0.434670	0.427210	0.434123	0.427755
Efficiency	0.4297	0.4442	0.4508	0.4542	0.4347	0.4272	0.4341	0.4278

Det ID	C1	C2	C3	C4	D1	D2	D3	D4
File Name	ESR0606C	ESR0606C	ESR0606C	ESR0606C	ESR0606D	ESR0606D	ESR0606D	ESR0606D
Cnt Time	2.99	2.98	2.93	2.98	3.01	2.99	2.89	2.89
Tot Cnts	10015	10027	10060	10043	10030	10026	10040	10016
Bkg CPM	1.884	1.850	2.060	1.917	2.846	1.646	1.600	1.704
CPM	3347.614	3362.915	3431.387	3368.217	3329.380	3351.531	3472.448	3464.040
Alpha Efficiency	0.000202	0.000591	0.000206	0.000720	0.000972	0.000591	0.000702	0.000568
Beta Efficiency	0.431383	0.433355	0.442178	0.434038	0.429034	0.431888	0.447470	0.446386
Efficiency	0.4314	0.4334	0.4422	0.4340	0.4290	0.4319	0.4475	0.4464

	A1	A2	A3	A4	B1	B2	B3	B4	C1	C2	C3	C4	D1	D2	D3	D4
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
offset		0	1	2	3	0	1	2	3	0	1	2	3	0	1	2
NumRecs		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
total time	3.01	2.91	2.87	2.85	2.97	2.97	3.02	2.97	3.02	2.99	2.98	2.93	2.98	3.01	2.99	2.89
total count	19	4	4	11	14	11	13	10	10	5	14	5	17	23	14	16
reduced cf	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
chi-square	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
CPM	6.188292	1.21757	3.720753	4.802281	3.589704	4.182636	3.233003	3.166258	1.570241	4.585987	1.598485	5.585698	7.544196	4.589274	5.446332	4.41127
CPM var	2.101216	0.472707	1.337035	1.72613	1.248524	1.427351	1.134939	1.097685	0.559659	1.578825	0.582817	1.917702	2.544539	1.568263	1.918841	1.558605
Efficiency	0.000797	0.000157	0.000479	0.000619	0.000463	0.000539	0.000417	0.000408	0.000202	0.000591	0.000206	0.00072	0.000972	0.000591	0.000702	0.000568
archived S	0.000187	8.87E-05	0.000149	0.00017	0.000144	0.000154	0.000138	0.000135	9.65E-05	0.000162	9.85E-05	0.000179	0.000206	0.000162	0.000179	0.000161
predicted S	0.000185	8.34E-05	0.000147	0.000167	0.000142	0.000152	0.000134	0.000132	9.34E-05	0.00016	9.52E-05	0.000176	0.000204	0.00016	0.000177	0.000159
actual STL	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
total count	10042	10036	10045	10051	10023	10017	10011	10030	10015	10027	10060	10043	10030	10026	10040	10016
reduced cf	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
chi-square	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
CPM	3334.737	3447.209	3498.405	3525.055	3373.124	3315.23	3368.874	3319.46	3347.614	3362.915	3431.387	3368.217	3329.38	3351.531	3472.448	3464.04
CPM var	2221.409	2374.578	2444.514	2481.166	2275.172	2198.483	2271.087	2202.766	2242.149	2261.282	2350.683	2266.7	2217.428	2245.845	2408.996	2400.359
Efficiency	0.429723	0.444217	0.450814	0.454248	0.43467	0.42721	0.434123	0.427755	0.431383	0.433355	0.442178	0.434038	0.429034	0.431888	0.44747	0.446386
archived S	0.010524	0.010879	0.01104	0.011123	0.010647	0.010464	0.010634	0.010477	0.010567	0.010614	0.010828	0.01063	0.010509	0.010578	0.010958	0.010934
predicted S	0.004289	0.004435	0.004499	0.004532	0.004343	0.00427	0.00434	0.004272	0.004312	0.004329	0.00441	0.004332	0.004286	0.004314	0.004467	0.004461
actual STL	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Radiochemistry Instrument Worksheet

ALS Environmental -- FC

Gross Alpha!!

Prep Batch: AB121109-1

Prep Procedure: GAB

EA & ATN calibration

Analytical QASS / NCR? Y *NM*

Prep Num	LabID	QC Type	Init Aliq	Fin Aliq	Units	Report Units	Residual Mass (mg)	Cnt 1 File	Cnt 1 Ins/Det	Cnt 1 Pos Chk By	Cnt 2 File	Cnt 2 Ins/Det	Cnt 2 Pos Chk By	Cnt 3 File	Cnt 3 Ins/Det	Cnt 3 Pos Chk By	Notes
1	1223001-1	SMP	200	200	ml	PC/L	23.3										
1	1223001-2	SMP	200	200	ml	PC/L	22.1										
1	1223001-3	SMP	200	200	ml	PC/L	21										
1	1223001-4	SMP	200	200	ml	PC/L	22.8										
1	1223001-5	SMP	200	200	ml	PC/L	22.7										
1	1223001-6	SMP	200	200	ml	PC/L	48.5										
1	1223001-7	SMP	200	200	ml	PC/L	47.5										
1	1223001-8	SMP	200	200	ml	PC/L	43.7										
1	1223001-9	SMP	200	200	ml	PC/L	46.1										
1	1223001-10	SMP	200	200	ml	PC/L	63.5										
1	1223001-11	SMP	200	200	ml	PC/L	81.1										
1	1223001-12	SMP	200	200	ml	PC/L	93.6										
1	1223001-13	SMP	200	200	ml	PC/L	95.2										
1	1223001-14	SMP	200	200	ml	PC/L	116.1										
1	1223001-15	SMP	200	200	ml	PC/L	90.7										
1	1223001-16	SMP	200	200	ml	PC/L	134.2										
1	1223001-17	SMP	200	200	ml	PC/L	134.2										
1	1223001-18	SMP	200	200	ml	PC/L	151.6										
1	1223001-19	SMP	200	200	ml	PC/L	156										
1	1223001-20	SMP	200	200	ml	PC/L	21.3										
1	1223001-21	SMP	200	200	ml	PC/L	21.8										
1	1223001-22	SMP	200	200	ml	PC/L	19.7										
1	1223001-23	SMP	200	200	ml	PC/L	20.5										
1	1223001-24	SMP	200	200	ml	PC/L	21.2										
1	1223001-25	SMP	200	200	ml	PC/L	21.1										
1	1223001-26	SMP	200	200	ml	PC/L	21.5										
1	1223001-27	SMP	200	200	ml	PC/L	20.7										

See Runlog 3710 ps 70

OUTLIER don't use

OUTLIER

OUTLIER

OUTLIER

OUTLIER

OUTLIER

OUTLIER

OUTLIER

OUTLIER

ALS Environmental -- FC

Supersedes: *NM*

Page 1 of 3 GAB Instrument Sheet

Date Printed: 11/15/2012 14:00

LIMS Version: 6.621

Radiochemistry Instrument Worksheet

ALS Environmental -- FC

Prep Batch: AB121109-1

Prep Procedure: GAB

Analytical QASS / NCR? Y *N*

Prep Num	LabID	QC Type	Init Aliq	Fin Aliq	Units	Report Units	Residual Mass (mg)	Cnt 1 File	Cnt 1 Ins/Det	Cnt 1 Pos Chk By	Cnt 2 File	Cnt 2 Ins/Det	Cnt 2 Pos Chk By	Cnt 3 File	Cnt 3 Ins/Det	Cnt 3 Pos Chk By	Notes
----------	-------	---------	-----------	----------	-------	--------------	--------------------	------------	---------------	------------------	------------	---------------	------------------	------------	---------------	------------------	-------

Spike Solution Information

Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	Am-241	955.4095.10	55,069.251	DPM/ml	11/08/12	0.1	ml	RS-008

Sample Barcodes

1223001-1 AB121109-1PS1		1223001-2 AB121109-1PS2		1223001-3 AB121109-1PS3	
1223001-4 AB121109-1PS4		1223001-5 AB121109-1PS5		1223001-6 AB121109-1PS6	
1223001-7 AB121109-1PS7		1223001-8 AB121109-1PS8		1223001-9 AB121109-1PS9	
1223001-10 AB121109-1PS10		1223001-11 AB121109-1PS11		1223001-12 AB121109-1PS12	
1223001-13 AB121109-1PS13		1223001-14 AB121109-1PS14		1223001-15 AB121109-1PS15	
1223001-16 AB121109-1PS16		1223001-17 AB121109-1PS17		1223001-18 AB121109-1PS18	
1223001-19 AB121109-1PS19		1223001-20 AB121109-1PS20		1223001-21 AB121109-1PS21	
1223001-22 AB121109-1PS22		1223001-23 AB121109-1PS23		1223001-24 AB121109-1PS24	
1223001-25 AB121109-1PS25		1223001-26 AB121109-1PS26		1223001-27 AB121109-1PS27	

Radiochemistry Instrument Worksheet

Prep Batch: AB121109-1

ALS Environmental -- FC

Reporting Units

LabID:	TstGrpName:	RptUnits:
1223001-1	GrossAlpha/Beta	PCI/L
1223001-2	GrossAlpha/Beta	PCI/L
1223001-3	GrossAlpha/Beta	PCI/L
1223001-4	GrossAlpha/Beta	PCI/L
1223001-5	GrossAlpha/Beta	PCI/L
1223001-6	GrossAlpha/Beta	PCI/L
1223001-7	GrossAlpha/Beta	PCI/L
1223001-8	GrossAlpha/Beta	PCI/L
1223001-9	GrossAlpha/Beta	PCI/L
1223001-10	GrossAlpha/Beta	PCI/L
1223001-11	GrossAlpha/Beta	PCI/L
1223001-12	GrossAlpha/Beta	PCI/L
1223001-13	GrossAlpha/Beta	PCI/L
1223001-14	GrossAlpha/Beta	PCI/L
1223001-15	GrossAlpha/Beta	PCI/L
1223001-16	GrossAlpha/Beta	PCI/L
1223001-17	GrossAlpha/Beta	PCI/L
1223001-18	GrossAlpha/Beta	PCI/L
1223001-19	GrossAlpha/Beta	PCI/L
1223001-20	GrossAlpha/Beta	PCI/L
1223001-21	GrossAlpha/Beta	PCI/L
1223001-22	GrossAlpha/Beta	PCI/L
1223001-23	GrossAlpha/Beta	PCI/L
1223001-24	GrossAlpha/Beta	PCI/L
1223001-25	GrossAlpha/Beta	PCI/L
1223001-26	GrossAlpha/Beta	PCI/L
1223001-27	GrossAlpha/Beta	PCI/L

Radiochemistry Prep Worksheet

ALS Environmental -- FC

Prep Batch: AB121109-1

Prep Procedure: GAB

Reviewed By: jll *SN* Review Date: 11/15/2012

Non-Routine Pre-Treatment? Y *(N)* Batch: *N/A*

Re-Prep? Y *(N)* Batch: *N/A*

Prep QASS / NCR? Y *(N)* *N/A*

Prep SOP: PAI 702 Rev: 20

Prep Analyst: Steve Workman

Balance: 10

Prep SOP: NONE

Prep Date: 11/8/2012

Balance: 13

Matrix Class: liquid

Prep Dept: RS

Samp Num	Prep Num	LabID	QC Type	Dish No.	Init Aliq ml	Fin Aliq ml	Prep Basis	Standards	Prep Notes
1	1	1223001-1	SMP	200	200	200	Unfiltered	S1	
2	1	1223001-2	SMP	200	200	200	Unfiltered	S1	
3	1	1223001-3	SMP	200	200	200	Unfiltered	S1	
4	1	1223001-4	SMP	200	200	200	Unfiltered	S1	
5	1	1223001-5	SMP	200	200	200	Unfiltered	S1	
6	1	1223001-6	SMP	200	200	200	Unfiltered	S1	
7	1	1223001-7	SMP	200	200	200	Unfiltered	S1	
8	1	1223001-8	SMP	200	200	200	Unfiltered	S1	
9	1	1223001-9	SMP	200	200	200	Unfiltered	S1	
10	1	1223001-10	SMP	200	200	200	Unfiltered	S1	
11	1	1223001-11	SMP	200	200	200	Unfiltered	S1	
12	1	1223001-12	SMP	200	200	200	Unfiltered	S1	
13	1	1223001-13	SMP	200	200	200	Unfiltered	S1	
14	1	1223001-14	SMP	200	200	200	Unfiltered	S1	
15	1	1223001-15	SMP	200	200	200	Unfiltered	S1	
16	1	1223001-16	SMP	200	200	200	Unfiltered	S1	
17	1	1223001-17	SMP	200	200	200	Unfiltered	S1	
18	1	1223001-18	SMP	200	200	200	Unfiltered	S1	
19	1	1223001-19	SMP	200	200	200	Unfiltered	S1	
20	1	1223001-20	SMP	200	200	200	Unfiltered	S1	Spiked on 11/14 by SW
21	1	1223001-21	SMP	200	200	200	Unfiltered	S1	Spiked on 11/14 by SW
22	1	1223001-22	SMP	200	200	200	Unfiltered	S1	Spiked on 11/14 by SW
23	1	1223001-23	SMP	200	200	200	Unfiltered	S1	Spiked on 11/14 by SW
24	1	1223001-24	SMP	200	200	200	Unfiltered	S1	Spiked on 11/14 by SW
25	1	1223001-25	SMP	200	200	200	Unfiltered	S1	0.05 mL of 10 mg/mL natural Uranium
26	1	1223001-26	SMP	200	200	200	Unfiltered	S1	0.05 mL of 10 mg/mL natural Uranium
27	1	1223001-27	SMP	200	200	200	Unfiltered	S1	0.05 mL of 10 mg/mL natural Uranium

Radiochemistry Prep Worksheet

ALS Environmental -- FC

Prep Batch: AB121109-1

Prep Procedure: GAB

Reviewed By: jtl

Review Date: 11/15/2012

Non-Routine Pre-Treatment? Y / N Batch:

Prep QASS / NCR? Y / N

Prep SOP: PAI 702 Rev: 20

Prep Analyst: Steve Workman

Balance: 10

Prep SOP: NONE

Prep Date: 11/8/2012

Balance: 13

Matrix Class: liquid

Prep Dept: RS

Prep Notes

Sample Num	Prep Num	LabID	QC Type	Dish No.	Init Alq ml	Fin Alq ml	Prep Basis	Standards
------------	----------	-------	---------	----------	-------------	------------	------------	-----------

Comments

Calibration planchets and mass attenuation curve.

Spiked By: Steve Workman Date: 11/8/2012

Witnessed By: N/A Date: N/A

Spike Solution Information

Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	Am-241	955.4095.10	55,069.251	DPM/ml	11/08/12	0.1	ml	RS-008

Reagent Solution IDs

J12036

Except where otherwise noted, all reagents were applied in accordance with the specifications of the preparation methods associated with this batch.

Radiochemistry Gravimetric Worksheet

ALS Environmental -- FC

Prep Batch: AB121109-1

Review Date: 11/15/2012

Reviewed By: jtl *SM*

Prep Procedure: GAB

Prep Num	Planc. Num	LabID	QC Type	Test Alq (ml)	Tare Mass (g)	Initial Gross Mass (g)	Initial Net Mass (mg)	Suggested Alq (ml)	Samp Vol Available (ml)	Samp Vol Taken (ml)	Fin Gross Mass (g)	Final Net Mass (mg)	Salt Sol. Added (ml)	Flag
1	1	1223001-1	SMP	10	9.1050	0.0000	0	200	200	200	9.1283	23.3	0.5	
1	2	1223001-2	SMP	10	9.0995	0.0000	0	200	200	200	9.1216	22.1	0.5	
1	3	1223001-3	SMP	10	9.0872	0.0000	0	200	200	200	9.1082	21	0.5	
1	4	1223001-4	SMP	10	9.1198	0.0000	0	200	200	200	9.1426	22.8	0.5	
1	5	1223001-5	SMP	10	9.1442	0.0000	0	200	200	200	9.1669	22.7	0.5	
1	6	1223001-6	SMP	10	9.1142	0.0000	0	200	200	200	9.1627	48.5	1	
1	7	1223001-7	SMP	10	9.1346	0.0000	0	200	200	200	9.1821	47.5	1	
1	8	1223001-8	SMP	10	9.0877	0.0000	0	200	200	200	9.1314	43.7	1.5	
1	9	1223001-9	SMP	10	9.0922	0.0000	0	200	200	200	9.1383	46.1	1.5	
1	10	1223001-10	SMP	10	9.0712	0.0000	0	200	200	200	9.1347	63.5	2	
1	11	1223001-11	SMP	10	9.1302	0.0000	0	200	200	200	9.2113	81.1	2	
1	12	1223001-12	SMP	10	9.1044	0.0000	0	200	200	200	9.1980	93.6	2.5	
1	13	1223001-13	SMP	10	9.1418	0.0000	0	200	200	200	9.2370	95.2	2.5	
1	14	1223001-14	SMP	10	9.1031	0.0000	0	200	200	200	9.2192	116.1	3	
1	15	1223001-15	SMP	10	9.1182	0.0000	0	200	200	200	9.2089	90.7	3	
1	16	1223001-16	SMP	10	9.1173	0.0000	0	200	200	200	9.2515	134.2	3.5	
1	17	1223001-17	SMP	10	9.0956	0.0000	0	200	200	200	9.2298	134.2	3.5	
1	18	1223001-18	SMP	10	9.1276	0.0000	0	200	200	200	9.2792	151.6	4	
1	19	1223001-19	SMP	10	9.1131	0.0000	0	200	200	200	9.2691	156	4	
1	20	1223001-20	SMP	10	9.0751	0.0000	0	200	200	200	9.0964	21.3	0.5	
1	21	1223001-21	SMP	10	9.1113	0.0000	0	200	200	200	9.1331	21.8	0.5	
1	22	1223001-22	SMP	10	9.0713	0.0000	0	200	200	200	9.0910	19.7	0.5	
1	23	1223001-23	SMP	10	9.1326	0.0000	0	200	200	200	9.1531	20.5	0.5	
1	24	1223001-24	SMP	10	9.1320	0.0000	0	200	200	200	9.1532	21.2	0.5	
1	25	1223001-25	SMP	10	9.1188	0.0000	0	200	200	200	9.1399	21.1	0.5	
1	26	1223001-26	SMP	10	9.0872	0.0000	0	200	200	200	9.1087	21.5	0.5	
1	27	1223001-27	SMP	10	9.1133	0.0000	0	200	200	200	9.1340	20.7	0.5	

Gross α standards

mg mass	Std					
			0.5ml salt,	0.1ml	955.4095.10	
21.3	1	20mg R1				.0751 .0964
1.8	2	R2				.1113 .1331
9.7	3	R3				.0713 .0910
20.5	4	R4				.1326 .1531
21.2	5	R5				.1320 .1532
					0.05ml of 10mg/ml nat. U	
21.1	6	20mg + U				.1188 .1399
21.5	7					.0872 .1087
20.7	8					.1133 .134

OUTLIER TEST

FILE	DET	SAMPLE ID	Alpha CPM	Relative % diff. from mean	Within acceptability range	Outlier?
ABA1118	A1(1)	1223001-20	1163.818	0.71%	YES	NO
ABA1118A	A1(1)	1223001-21	1074.100	8.36%	YES	OUTLIER!
ABA1118B	A1(1)	1223001-22	1248.300	6.50%	YES	NO
ABA1118C	A1(1)	1223001-23	1203.900	2.71%	YES	NO
ABA1119	A1(1)	1223001-24	1170.500	0.14%	YES	NO

Mean of all five plachets:

Average= 1172.12 Upper
 Std dev= 64.21220433 Lower
 2 Std Dev= 128.42

Acceptability range
 1300.55
 1043.70
 relative range
 +/- 10.96%
10.96%

Sample 1223001-21 rejected as outlier.

Criteria: Potential outliers fall outside acceptability range; which is the mean of all five measurements +/- 2 std dev per the Grubbs statistical test.

PAI - Gas Flow Proportional Sample Analysis LB4100-A

Unit Type: LB4100-AW
Counting Unit ID: Orange
High Voltage Mode: Simultaneous
Application Revision: C
Application Version: PA
Rev. 12/23/03 JE

Data file name: ABA1118
Batch ID: OUTLIER TEST
Count Preset (m): 11
Batch Ended: 11/18/12 16:44

Background logfile: BKGAB
Date of Bkg. Cal: 11/14/12
Alpha efficiency logfile: Am241R-12/11
Alpha attenuation calibration: AAM0108
Beta efficiency logfile: S-90F-10/12
Beta attenuation calibration: ASR1173

Alpha Attenuation Calibration		Beta Attenuation Calibration	
$y = b \cdot m^{1/2} (mass \cdot x^{0.5})$		$y = b \cdot m^{1/2} (x^{0.5} \cdot mass)$	
Alpha b2	1.02810	Beta b2	1.0002
m2	0.89320	m2	0.8995
a2	0.9951	a2	0.7885
x02	0.0080	x02	0.0080
Alpha to Beta X-talk		Beta to Alpha X-talk	
$y = b \cdot m^{1/2} \cdot x$		$y = b \cdot mass \cdot x$	
a -> b xtalk b2	0.7560	b -> a xtalk b2	-5.009E-08
a -> b xtalk m2	1.0002	b -> a xtalk m2	0.0002

Det. ID	Sample ID	Count End Date & Time	Count Dur. (min)	Resid. Mass (mg)	Alpha Activity				Beta Activity			
					Gross CPM	Bkg. CPM	a>b xtalk CPM	Base Eff	Gross CPM	Bkg. CPM	a>b xtalk CPM	Base Eff
A1	1223001-20	11/18/12 16:44	11:00	21.3	1183.818	0.114	0.060	0.2633	300.818	1.998	296.8420	0.3879
								0.890				0.992
								n/a				n/a
								n/a				n/a
								n/a				n/a

PAI - Gas Flow Proportional Sample Analysis LB4100-A

Alpha Attenuation Calibration $y = b \cdot m^2 \cdot (x \cdot \text{mass} \cdot x0)$	Beta Attenuation Calibration $y = b \cdot m^2 \cdot (x \cdot \text{mass} \cdot x0)$
Alpha b= 1.02810 m= 0.99370 a= 0.8951 x0= 0.0000	Beta b= 1.0002 m= 0.9995 a= 0.7685 x0= 0.0000
Alpha to Beta X-talk $y = b \cdot m^2 \cdot x$	Beta to Alpha X-talk $y = b \cdot \text{mass} \cdot m$
a -> b xtalk b= 0.2560 a -> b xtalk m= 1.0002	b -> a xtalk b= -5.980E-09 b -> a xtalk m= 0.0002

Background logfile: BKGAB
Date of Bkg. Cal: 11/10/12
Alpha efficiency logfile: Am241R-12/11
Alpha attenuation calibration: AAM0108
Beta efficiency logfile: SR0F-10/12
Beta attenuation calibration: ASR1123

Alpha prog. logfile: n/a
Alpha prog. attenuation: n/a
Beta prog. logfile: n/a
Beta prog. attenuation: n/a

Unit Type: LB4100-AW
Counting Unit ID: Orange
High Voltage Mode: Simultaneous
Application Revision: C
Application Version: PA
Rev.12/29/03 JE

Data file name: ABA1118A
Batch ID: OUTLIER TEST
Count Preset (m): 10
Batch Ended: 11/18/12 17:02

Det. ID	Sample ID	Count End Date & Time	Count Dur. (min)	Resid. Mass (mg)	Alpha Activity						Beta Activity							
					Gross CPM	Bkg. CPM	b>a xtlk CPM	Base Eff	Base Cor.Fact.	Progeny Eff	Progeny Cor.Fact.	Gross CPM	Bkg. CPM	a>b xtlk CPM	Base Eff	Base Cor.Fact.	Progeny Eff	Progeny Cor.Fact.
AT	1223001-21	11/18/12 17:02	10:00	21.8	1074.700	0.114	0.056	0.2633	0.887	n/a	n/a	280.700	1.998	273.7444	0.3879	0.992	n/a	n/a

PAI - Gas Flow Proportional Sample Analysis LB4100-A

Unit Type: LB4100-A/W
Counting Unit ID: Orange
High Voltage Mode: Simultaneous
Application Revision: C
Application Version: PA
Rev.12/29/03 JE

Data file name: ABA1118B
Batch ID: OUTLIER TEST
Count Present (m): 10
Batch Ended: 11/18/12 17:13

Background logfile: BKGAB
Date of Bkg. Cal: 11/14/12
Alpha efficiency logfile: An241R-1211
Alpha attenuation calibration: AAM0108
Beta efficiency logfile: SR90-10/12
Beta attenuation calibration: ASR1123

Alpha prog. logfile: n/a
Alpha prog. attenuation: n/a
Beta prog. logfile: n/a
Beta prog. attenuation: n/a

Alpha Attenuation Calibration	Beta Attenuation Calibration
$y = b'm^2/g'(mass \cdot x0)$	$y = b'm^2/g'(mass \cdot x0)$
Alpha b= 1.07810	Beta b= 1.0002
m= 0.99220	m= 0.9945
a= 0.9951	a= 0.7685
x0= 0.0000	x0= 0.0000
Alpha to Beta X-talk	Beta to Alpha X-talk
$y = b'm^2 \cdot x$	$y = b'mass \cdot m$
a->b xtalk b= 0.2560	b->a xtalk b= -5.800E-09
a->b xtalk m= 1.0002	b->a xtalk m= 0.0002

Det. ID	Sample ID	Count End Date & Time	Count Dur. (min)	Resid. Mass (mg)	Alpha Activity						Beta Activity					
					Gross CPM	Bkg. CPM	b>a xtlk CPM	Base Eff	Cor.Fact.	Progeny Eff	Progeny Cor.Fact.	Gross CPM	Bkg. CPM	a>b xtlk CPM	Base Eff	Progeny Cor.Fact.
A1	1223001-22	11/18/12 17:13	10.00	19.7	1248.300	0.114	0.070	0.2833	0.889	n/a	n/a	350.400	1.988	318.2792	0.3879	0.993
															n/a	n/a

PAI - Gas Flow Proportional Sample Analysis LB4100-A

Unit Type: LB4100-AQW
Counting Unit ID: Orange
High Voltage Mode: Simultaneous
Application Revision: C
Application Version: PA
Rev.12/29/03 JE

Data file name: ABA1118C
Batch ID: OUTLIER TEST
Count Preset (m): 10
Batch Ended: 11/18/12 17:37

Background logfile: BKGAB
Date of Bkg. Cal: 11/14/12
Alpha efficiency logfile: Am214R-12/11
Alpha attenuation calibration: AAM0108
Beta efficiency logfile: S40F-10/12
Beta attenuation calibration: ASR1123

Alpha prog. logfile: n/a
Alpha prog. attenuation: n/a
Beta prog. logfile: n/a
Beta prog. attenuation: n/a

Alpha Attenuation Calibration $y = b \cdot m^2 / a^2 \cdot (\text{mass} \cdot x^0)$		Beta Attenuation Calibration $y = b \cdot m^2 / a^2 \cdot (\text{mass} \cdot x^0)$	
Alpha b=	1.02810	Beta b=	1.0002
m=	0.99220	m=	0.9995
a=	0.9951	a=	0.7885
x0=	0.0000	x0=	0.0009
Alpha to Beta X-talk $y = b \cdot m^2 \cdot x$		Beta to Alpha X-talk $y = b \cdot \text{mass} \cdot m$	
a -> b xtalk b=	0.2560	b -> a xtalk b=	-3.900E-09
a -> b xtalk m=	1.0002	b -> a xtalk m=	0.0002

Det. ID	Sample ID	Count End Date & Time	Count Dur. (min)	Resid. Mass (mg)	Alpha Activity						Beta Activity					
					Gross CPM	Bkg. CPM	b>a xtlk CPM	Base Eff	Cor.Fact.	Progeny Eff	Progeny Cor.Fact.	Gross CPM	Bkg. CPM	a>b xtlk CPM	Base Eff	Cor.Fact.
A1	1223001-23	11/18/12 17:37	10.00	20.5	1203.900	0.114	0.066	0.2633	0.895	n/a	n/a	332.000	1.998	306.9084	0.3879	0.992
															n/a	n/a

PAI - Gas Flow Proportional Sample Analysis LB4100-A

Alpha Attenuation Calibration $y = b \cdot m \cdot [x] \cdot (\text{mass} - x_0)$	Beta Attenuation Calibration $y = b \cdot m \cdot [x] \cdot (\text{mass} - x_0)$
Alpha b = 1.82810 m = 0.99320 x0 = 0.9951 a = 0.7685 x0 = 0.0090	Beta b = 1.0002 m = 0.9995 a = 0.7685 x0 = 0.0090
Alpha to Beta X-talk $y = b \cdot m \cdot x$	Beta to Alpha X-talk $y = b \cdot m \cdot x$
a -> b xtalk = 0.2560 a -> b xtalk m = 1.0002	b -> a xtalk = -5.900E-09 b -> a xtalk m = 0.0002

Background logfile: BKGAB
Date of Bkg. Cal: 11/14/12
Alpha efficiency logfile: Am241R-12/11
Alpha attenuation calibration: AAM0108
Beta efficiency logfile: SH09F-10/12
Beta attenuation calibration: ASR1123

Alpha prog. logfile: n/a
Alpha prog. attenuation: n/a
Beta prog. logfile: n/a
Beta prog. attenuation: n/a

Unit Type: LB4100-AW
Counting Unit ID: Orange
High Voltage Mode: Simultaneous
Application Revision: C
Application Version: PA
Rev.12/29/03 JE

Data file name: ABA1119
Batch ID: OUTLIER TEST
Count Preset (m): 10
Batch Ended: 11/19/12 9:42

Det. ID	Sample ID	Count End Date & Time	Count Dur. (min)	Resid. Mass (mg)	Alpha Activity						Beta Activity					
					Gross CPM	Bkg. CPM	b>a xtlk CPM	Base Eff	Cor.Fact.	Progeny Eff	Progeny Cor.Fact.	Gross CPM	Bkg. CPM	a>b xtlk CPM	Base Eff	Cor.Fact.
AT	1223001-24	11/19/12 9:42	10:00	21.2	1170.500	0.114	0.066	0.2633	0.890	n/a	n/a	331.800	1.398	298.3512	0.3879	0.992
																n/a

Radiochemistry Instrument Worksheet

ALS Environmental -- FC

Prep Batch: AB110616-3

Prep Procedure: GAB

EFF CAL SET Drinking H₂O / 5.90

Analytical QASS / NCR? Y NA

Prep Num	LabID	QC Type	Init Aliq	Fin Aliq	Units	Report Units	Residual Mass (mg)	Cnt 1 Inst/Det	Cnt 1 Pos Chk By	Cnt 2 File	Cnt 2 Inst/Det	Cnt 2 Pos Chk By	Cnt 3 File	Cnt 3 Inst/Det	Cnt 3 Pos Chk By	Notes
1	1118005-1	SMP	200	200	ml	PC/L										OUTLIER
1	1118005-2	SMP	200	200	ml	PC/L										
1	1118005-3	SMP	200	200	ml	PC/L										
1	1118005-4	SMP	200	200	ml	PC/L										
1	1118005-5	SMP	200	200	ml	PC/L										
1	1118005-6	SMP	200	200	ml	PC/L										
1	1118005-7	SMP	200	200	ml	PC/L										
1	1118005-8	SMP	200	200	ml	PC/L										
1	1118005-9	SMP	200	200	ml	PC/L										
1	1118005-10	SMP	200	200	ml	PC/L										

See Run Log 3710 pg 71

Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	Sr-90	777.3020.11	4,268.831	DPM/ml	06/16/11	1	ml	RS-005
S2	Th-230	853.3020.89	1,166.342	DPM/ml	06/16/11	5	ml	RS-009

Sample Barcodes

1118005-1 AB110616-3PS1		1118005-2 AB110616-3PS2		1118005-3 AB110616-3PS3	
1118005-4 AB110616-3PS4		1118005-5 AB110616-3PS5		1118005-6 AB110616-3PS6	
1118005-7 AB110616-3PS7		1118005-8 AB110616-3PS8		1118005-9 AB110616-3PS9	
1118005-10 AB110616-3PS10					

Radiochemistry Instrument Worksheet

ALS Environmental -- FC

Prep Batch: AB110616-3

Reporting Units

LabID:	TstGrpName:	RptUnits:
1118005-1	GrossAlpha/Beta	PCI/L
1118005-2	GrossAlpha/Beta	PCI/L
1118005-3	GrossAlpha/Beta	PCI/L
1118005-4	GrossAlpha/Beta	PCI/L
1118005-5	GrossAlpha/Beta	PCI/L
1118005-6	GrossAlpha/Beta	PCI/L
1118005-7	GrossAlpha/Beta	PCI/L
1118005-8	GrossAlpha/Beta	PCI/L
1118005-9	GrossAlpha/Beta	PCI/L
1118005-10	GrossAlpha/Beta	PCI/L

Radiochemistry Instrument Worksheet

ALS Environmental -- FC

Prep Batch# AB110616-8

Prep Procedure: GAB

Calib. SET ^{gross} ~~gross~~ _{net} OUTLIER TEST

Analytical QASS / NCR? Y / N

Prep Num	LabID	QC Type	Init Aliq	Fin Aliq	Units	Report Units	Residual Mass (mg)	Cnt 1 Inst/Det	Cnt 1 Pos Chk By	Cnt 2 File	Cnt 2 Inst/Det	Cnt 2 Pos Chk By	Cnt 3 File	Cnt 3 Inst/Det	Cnt 3 Pos Chk By	Notes
1	1118005-1	SMP	200	200	ml	PCUL	X	AB0621	F 11 5	X						OUTLIER
1	1118005-2	SMP	200	200	ml	PCUL		G 11 2								
1	1118005-3	SMP	200	200	ml	PCUL		H 11 2								
1	1118005-4	SMP	200	200	ml	PCUL		I 11 2								
1	1118005-5	SMP	200	200	ml	PCUL		J 11 2								
1	1118005-6	SMP	200	200	ml	PCUL		AB0621A 70 8								
1	1118005-7	SMP	200	200	ml	PCUL	X	B 6 2	X							OUTLIER
1	1118005-8	SMP	200	200	ml	PCUL		C 6 2								
1	1118005-9	SMP	200	200	ml	PCUL		D 4 2								
1	1118005-10	SMP	200	200	ml	PCUL		E 6 2								

X Rejected as OUTLIER
8/6/11

Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	Sr-90	777.3020.11	4,268.831	DPM/ml	06/16/11	1	ml	RS-005
S2	Th-230	853.3020.89	1,166.342	DPM/ml	06/16/11	5	ml	RS-009

Sample Barcodes

1118005-1 AB110616-3PS1	1118005-2 AB110616-3PS2	1118005-3 AB110616-3PS3
1118005-4 AB110616-3PS4	1118005-5 AB110616-3PS5	1118005-6 AB110616-3PS6
1118005-7 AB110616-3PS7	1118005-8 AB110616-3PS8	1118005-9 AB110616-3PS9
1118005-10 AB110616-3PS10		

Radiochemistry Instrument Worksheet

ALS Environmental -- FC

Prep Batch: AB110616-3

Reporting Units

LabID:	TstGrpName:	RptUnits:
1118005-1	GrossAlpha/Beta	PCI/L
1118005-2	GrossAlpha/Beta	PCI/L
1118005-3	GrossAlpha/Beta	PCI/L
1118005-4	GrossAlpha/Beta	PCI/L
1118005-5	GrossAlpha/Beta	PCI/L
1118005-6	GrossAlpha/Beta	PCI/L
1118005-7	GrossAlpha/Beta	PCI/L
1118005-8	GrossAlpha/Beta	PCI/L
1118005-9	GrossAlpha/Beta	PCI/L
1118005-10	GrossAlpha/Beta	PCI/L

Radiochemistry Prep Worksheet

ALS Environmental -- FC

Prep Batch: AB110616-3

Prep Procedure: GAB

Reviewed By: gdw Review Date: 6/20/2011

Non-Routine Pre-Treatment? Y ☒ N

Batch: Y/N Re-Prep? Y ☒ N

Prep QASS / NCR? Y ☒ N

Prep SOP: PAI 702 Rev: 20

Prep SOP: NONE

Matrix Class: liquid

Prep Analyst: Gabriel D. Wagner

Prep Date: 6/16/2011

Prep Dept: RS

Balance:

Balance:

Sample Num	Prep Num	LabID	QC Type	Dish No.	Init Aliq ml	Fin Aliq ml	Prep Basis	Standards	Prep Notes
1	1	1118005-1	SMP		200	200	Unfiltered	S1	
2	1	1118005-2	SMP		200	200	Unfiltered	S1	
3	1	1118005-3	SMP		200	200	Unfiltered	S1	
4	1	1118005-4	SMP		200	200	Unfiltered	S1	
5	1	1118005-5	SMP		200	200	Unfiltered	S1	
6	1	1118005-6	SMP		200	200	Unfiltered	S2	
7	1	1118005-7	SMP		200	200	Unfiltered	S2	
8	1	1118005-8	SMP		200	200	Unfiltered	S2	
9	1	1118005-9	SMP		200	200	Unfiltered	S2	
10	1	1118005-10	SMP		200	200	Unfiltered	S2	

Comments

Gross alpha and beta zero mass efficiency. Direct spike onto planchet along with concentrated HNO₃. (Into desiccator on 6/20/11 @ 13:00 gdw 6/20/11)

Spiked By: Gabriel D. Wagner

Date: 6/20/2011

Witnessed By: Justin D. Anderson

Date: 6/20/2011

Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	Si-90	777.3020.11	4,268.831	DPM/ml	06/16/11	1	ml	RS-005
S2	Th-230	853.3020.89	1,166.342	DPM/ml	06/16/11	5	ml	RS-009

J12036

Except where otherwise noted, all reagents were applied in accordance with the specifications of the preparation methods associated with this batch.

Radiochemistry Prep Worksheet

ALS Environmental -- FC

Prep Batch: AB110616-3

Prep Batch Not Validated!!!

Prep Procedure: GAB

Reviewed By: _____ Review Date: _____

Non-Routine Pre-Treatment? Y / N

Prep QASS / NCR? Y / N

Re-Prep? Y / N

Batch: _____

Prep SOP: PAI 702 Rev: 20
Prep SOP: NONE
Matrix Class: liquid

Prep Analyst: Gabriel D. Wagner *GDW*
Prep Date: 6/16/2011
Prep Dept: RS

Balance:
Balance:

Sampl Num	Prep Num	LabID	QC Type	Dish No.	Init Aliq ml	Fin Aliq ml	Prep Basis	Standards	Prep Notes
1	1	1118005-1	SMP		200	200	Unfiltered	S1	
2	1	1118005-2	SMP		200	200	Unfiltered	S1	
3	1	1118005-3	SMP		200	200	Unfiltered	S1	
4	1	1118005-4	SMP		200	200	Unfiltered	S1	
5	1	1118005-5	SMP		200	200	Unfiltered	S1	
6	1	1118005-6	SMP		200	200	Unfiltered	S2	
7	1	1118005-7	SMP		200	200	Unfiltered	S2	
8	1	1118005-8	SMP		200	200	Unfiltered	S2	
9	1	1118005-9	SMP		200	200	Unfiltered	S2	
10	1	1118005-10	SMP		200	200	Unfiltered	S2	

Comments

Gross alpha and beta zero mass efficiency.

TR4443
Direct spike onto planchet along with concentrated HNO₃.

Spiked By: *GDW* Date: *6/16/11*

Witnessed By: *MA* Date: *6/22/11*

Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	Sr-90	777.3020.11	4,268.831	DPW/ml	06/16/11	1	ml	RS-005
S2	Th-230	853.3020.89	1,166.342	DPW/ml	06/16/11	5	ml	RS-009

ex. 4/1/12
ex. 11/19/11

J12036

Except where otherwise noted, all reagents were applied in accordance with the specifications of the preparation methods associated with this batch.

OUTLIER TEST

FILE	DET	SAMPLE ID	Beta CPM	Relative % diff. from mean	Within acceptability range	Outlier?
ABC0621F	C3(11)	1118005-1	3650.0	1.94%	YES	OUTLIER!
ABC0621G	C3(11)	1118005-2	3736	0.37%	YES	NO
ABC0621H	C3(11)	1118005-3	3676.67	1.22%	YES	NO
ABC0621I	C3(11)	1118005-4	3757.67	0.95%	YES	NO
ABC0621J	C3(11)	1118005-5	3790.67	1.84%	YES	NO

Mean of all five plachets:

Average= 3722.20

Std dev= 57.927

2 Std Dev= 115.85

Acceptability range

Upper 3838.05

Lower 3606.35

Relative range
+/- 3.11%**3.11%****Sample 1118005-1 rejected as outlier.**

Criteria: Potential outliers fall outside acceptability range; which is the mean of all five measurements +/- 2 std dev per the Grubbs statistical test.

PAI - Gas Flow Proportional Sample Analysis LB4100-C

Unit Type: LB4100-C
 Counting Unit ID: Magenta
 High Voltage Mode: Simultaneous
 Application Revision: Standard
 Rev.12/01/08 JCP

Data file name: ABC0621F
 Batch ID: SR90 OUTLIER TEST
 Count Preset (m): 3
 Batch Ended: 6/21/2011 9:59

Background logfile: BKGABW
 Date of Bkg. Cal: 6/16/2011
 Alpha efficiency logfile: n/a
 Alpha attenuation calibration: AAM0611/12/14
 Beta efficiency logfile: Sr-89-06/11
 Beta attenuation calibration: ASR0610/06/11

Alpha Attenuation Calibration	Beta Attenuation Calibration
$y = b \cdot m \cdot (e^{(mass-x)})$	$y = b \cdot m \cdot (e^{(mass-x)})$
Alpha b= 1.14100	Beta b= 1.0680
m= 0.99380	m= 0.9990
a= 0.9950	a= 0.9920
x0= 0.0000	x0= 0.0000
Alpha to Beta X-talk	Beta to Alpha X-talk
$y = b \cdot m \cdot mass$	$y = b \cdot m \cdot mass + m$
a->b stalk b= 0.2779	b->a stalk b= -1.05E-05
a->b stalk m= 1.0004	b->a stalk m= 0.0023

Det. ID	Sample ID	Count End Date & Time	Count Dur. (min)	Resid. Mass (mg)	Alpha Activity						Beta Activity					
					Gross CPM	Bkg. CPM	b>a xlik CPM	Base Eff	Base Cor.Fact.	Progeny Eff	Progeny Cor.Fact.	Gross CPM	Bkg. CPM	a>b xlik CPM	Base Eff	Base Cor.Fact.
C3	1118005-1	6/21/2011 9:59	3.00	0.0	2.687	0.084	8.391	0.2180	1.141	n/a	n/a	3650.000	1.727	0.7233	0.4712	1.068
															n/a	n/a

6/27/11

Alaska Annotations Collection

Background logfile: BKGABW	Alpha prog. logfile: n/a
Date of Bkg. Cal: 5/15/2011	Alpha prog. attenuation: n/a
Alpha efficiency logfile: Am-241R-06/10	Alpha prog. logfile: n/a
Alpha attenuation calibration: AAM0611/12/14	Beta prog. attenuation: n/a
Beta efficiency logfile: Sg-90-06/11	Beta prog. logfile: n/a
Beta attenuation calibration: ASR0610/06/11	Beta prog. attenuation: n/a

Det. ID	Sample ID	Count End Date & Time	Count Dur. (min)	Resid. Mass (mg)	Alpha Activity												Beta Activity											
					Gross			b-a xtlk			Base			Progeny			Gross			b-a xtlk			Base			Progeny		
					CPM	Eff	Cor.Fact.	CPM	Eff	Cor.Fact.	CPM	Eff	Cor.Fact.	CPM	Eff	Cor.Fact.	CPM	Eff	Cor.Fact.	CPM	Eff	Cor.Fact.	CPM	Eff	Cor.Fact.	CPM	Eff	Cor.Fact.
C3	1118005-2	6/21/2011 10:03	3.00	0.0	4.333	0.064	8.589	0.2180	1.141	n/a	n/a	n/a	3738.000	1.727	1.864	0.4712	1.068	n/a	n/a									

Page 1 of 1

PAI - Gas Flow Proportional Sample Analysis LB4100-C

Unit Type: LB4100-C
Counting Unit ID: Magenta
High Voltage Mode: Simultaneous
Application Revision: Standard
Rev. 12/01/08 JCP

Data file name: ABC0621H
Batch ID: SR80 OUTLIER TEST
Count Preset (m): 3
Batch Ended: 6/21/2011 10:07

Background logfile: BKGABW
Date of Bkg. Cal: 6/16/2011
Alpha efficiency logfile: Am-241R-06/10
Alpha attenuation calibration: AAM0611/12/14
Alpha prog. logfile: n/a
Beta efficiency logfile: Sr-89-06/11
Beta attenuation calibration: ASR0610/06/11
Beta prog. logfile: n/a
Beta attenuation: n/a

Alpha Attenuation Calibration	Beta Attenuation Calibration
$y = b \cdot m^a (e^{(mass-x)})$	$y = b \cdot m^a (e^{(mass-x)})$
Alpha b= 1.14100	Beta b= 1.0680
m= 0.99380	m= 0.9990
a= 0.9950	a= 0.9920
x0= 0.0000	x0= 0.0000
Alpha to Beta X-talk	Beta to Alpha X-talk
$y = b \cdot m^a \cdot mass$	$y = b \cdot m^a \cdot m$
a -> b xtalk b= 0.2779	b -> a xtalk b= -1.05E-05
a -> b xtalk m= 1.0004	b -> a xtalk m= 0.0023

Det. ID	Sample ID	Count End Date & Time	Count Dur. (min)	Resid. Mass (mg)	Alpha Activity						Beta Activity							
					Gross CPM	Bkg. CPM	b>a xtlk CPM	Base Eff	Base Cor.Fact.	Progeny Eff	Progeny Cor.Fact.	Gross CPM	Bkg. CPM	a>b xtlk CPM	Base Eff	Base Cor.Fact.	Progeny Eff	Progeny Cor.Fact.
C3	1118005-3	6/21/2011 10:07	3.00	0.0	2.667	0.064	8.452	0.2180	1.141	n/a	n/a	3676.867	1.727	0.7233	0.4712	1.068	n/a	n/a

6/27/11

PAI - Gas Flow Proportional Sample Analysis LB4100-C

Unit Type: LB4100-C
Counting Unit ID: Magenta
High Voltage Mode: Simultaneous
Application Revision: Standard
Rev.12/01/05 JCP

Data file name: ABC06211
Batch ID: SR90 OUTLIER TEST
Count Preset (m): 3
Batch Ended: 6/21/2011 10:11
2

Background logfile: BKGABW
Date of Bkg. Cal: 6/16/2011
Alpha efficiency logfile: Am-241R-06/10
Alpha attenuation calibration: AAM0611/12/14
Alpha prog. logfile: n/a
Beta efficiency logfile: Sr-89-06/11
Beta attenuation calibration: ASP0610/0611
Beta prog. logfile: n/a
Beta prog. attenuation: n/a

Alpha Attenuation Calibration	Beta Attenuation Calibration
$y = b \cdot m^a \cdot (e^{(mass-x0)})$	$y = b \cdot m^a \cdot (e^{(mass-x0)})$
Alpha b= 1.14100	Beta b= 1.0680
m= 0.99360	m= 0.9990
a= 0.9950	a= 0.9920
x0= 0.0000	x0= 0.0000
Alpha to Beta X-talk	Beta to Alpha X-talk
$y = b \cdot m^a \cdot mass$	$y = b \cdot m^a \cdot mass + m$
a -> b xtalk b= 0.2779	b -> a xtalk b= -1.05E-05
a -> b xtalk m= 1.0004	b -> a xtalk m= 0.0023

Det. ID	Sample ID	Count End Date & Time	Count Dur. (min)	Resid. Mass (mg)	Alpha Activity						Beta Activity					
					Gross CPM	Bkg. CPM	b>a xtlk CPM	a>b xtlk CPM	Base Eff	Progeny Eff	Gross CPM	Bkg. CPM	Base Cor.Fact.	Progeny Cor.Fact.	Base Eff	Progeny Eff
C3	1118005-4	6/21/2011 10:11	3.00	0.0	2.000	0.064	8.639	0.2180	1.141	n/a	3757.687	1.727	0.5380	0.4712	1.068	n/a

6/27/11

11/12/19
6

Background logfile: BKGABW	Alpha prog. logfile: n/a
Date of Bkg. Cal: 8/16/2011	Alpha prog. attenuation: n/a
Alpha efficiency logfile: Am-241R-06/10	Beta prog. logfile: n/a
Alpha attenuation calibration: AAM0611/12/14	Beta prog. attenuation: n/a
Beta efficiency logfile: S-49-06/11	
Beta attenuation calibration: ASR0610/06/11	

Det. ID	Sample ID	Count End Date & Time	Count Dur. (min)	Resid. Mass (mg)	Alpha Activity									Beta Activity														
					Gross			Bkg. b-a xlik			Base			Progeny			Gross			Bkg. a>b xlik			Base			Progeny		
					CPM	Eff	Cor.Fact.	CPM	Eff	Cor.Fact.	CPM	Eff	Cor.Fact.	CPM	Eff	Cor.Fact.	CPM	Eff	Cor.Fact.	CPM	Eff	Cor.Fact.	CPM	Eff	Cor.Fact.	CPM	Eff	Cor.Fact.
C3	1118005-5	6/21/2011 10:15	3.00	0.0	2.687	0.064	8.715	0.2190	1.141	n/a	n/a	n/a	3790.667	1.727	0.7233	0.4712	1.068	n/a	n/a	n/a								

Prepare a primary dilution of RSO #777 (Analytics #69573-307) in 0.1M HCl to a final volume of approx. 500 mL

1) Prepare 0.1M HCl by diluting 8.3 mL HCl (12M) (Fisher Scientific Lot # 055784) to a final volume of 1L.

2) Determine the density of 0.1M HCl

Weight of empty volumetric flask (100mL) 68.54g
Mass of flask + 100mL 0.1M HCl 168.31g
Mass of 100mL of 0.1M HCl 99.77g
÷ 100mL = density = 0.9977

3) Transfer #777 to a 500mL

Mass of bottle 47.9687g
Mass of bottle + std. 52.9160g
Mass of std. 4.9473g

4) Dilute to volume w/ 0.1M HCl

Mass of bottle + std. + soln 494.52g
Mass of bottle (from above) 47.9687g
Mass of soln 446.55g

5) Final activity (dpm/mL)

$$\frac{(3.812 \times 10^4 \text{ dpm}) (60 \text{ sec/min}) (4.9473 \text{ g})}{(5.05960 \text{ g}) (446.55 \text{ g})} = 5040.94 \text{ dpm}$$

$$5040.94 \text{ dpm} \times 0.9977 \text{ g/mL} = 4999.42 \text{ dpm}$$

$$5008.25 \text{ g} = 4996.73 \text{ mL}$$

Description: Sr-90
Expiration: 2/27/07
Activity: 4996.73 dpm/mL

2s Uncertainty: 99.93 dpm/mL
Ref. Date: 12/2/04
Ref Time: N/A
Prep Date: 2/8/06
Matrix/Comp. 0.1 M HCl
Half Life (y): 2.88E+01

rep by: HB

NEW EXP. DATE 10/6/07

Read and Understood

Reverification Log		
Analysis Date	Initials	Expiration Date
11/8/06	RG	11/8/07
5/3/07	RG	5/3/08
2/28/08	MBC	2/25/09
1/30/09	RG	1/30/2010
7/17/09	RG	7/17/2010

Antonia Barker

2/8/06

2/8/06

Signed

Date

Signed

Date

ANALYTICS

1380 Seaboard Industrial Blvd.
Atlanta, Georgia 30318 - U.S.A.

Phone (404) 352-8677
Fax (404) 352-2837

CERTIFICATE OF CALIBRATION
Standard Radionuclide Source

69573-307

Sr-90 5 mL Liquid in Flame Sealed Vial

This standard radionuclide source was prepared gravimetrically from a calibrated master solution. The master solution was calibrated by liquid scintillation counting.

Radionuclide purity and calibration were checked by germanium gamma-ray spectrometry and liquid scintillation counting. The nuclear decay rate and assay date for this source are given below.

ANALYTICS maintains traceability to the National Institute of Standards and Technology through Measurements Assurance Programs as described in USNRC Reg. Guide 4.15, Revision 1.

ISOTOPE:	Sr-90
ACTIVITY (dps):	3.812 E4
HALF-LIFE:	28.79 years
CALIBRATION DATE:	December 2, 2004 12:00 EST
RELATIVE EXPANDED UNCERTAINTY (k=2):	2.0%

Impurities: γ -impurities <0.1%

5.05960 grams in 0.1M HCl solution with 30 μ g/g Sr carrier.

This source also contains Y-90 in secular equilibrium with Sr-90. The Y-90 activity is equal to the Sr-90 activity. Since Sr-90 and Y-90 both decay 100% by beta emission, the total beta emission rate for the source is twice the certified Sr-90 activity. The half-life for Y-90 is 64.08 hours.

P O NUMBER 71069, Item 1

SOURCE PREPARED BY:

M. Dimitrova
M. Dimitrova, Radiochemist

Q A APPROVED:

MMT 12-6-04

6/5/2015

ROI's Set For All Drawers Using Sr/Y-90 sources

Sources \rightarrow 406, 407, 408, 409. Over 50,000 counts achieved for each detector
 α Lower Limit + β Upper limit set to 50% to startBoth α lower limit + β upper limit moved to achieve β α Talk of 2.50%
 α lower limit moved to achieve α β Talk of 0.10%.

All ROI's Archived

6/5/15

After ROI's set, Interim Daily Efficiency control limits established for All 16 Detectors based on 5 individual counts

Files EFC0605A \rightarrow E. Interim limits for alpha + beta set at $\pm 10\%$ of the mean of the 5 individual counts.

Historical control limits will be established upon acquisition of 30 Data Points.

6/5/151000 minute background count run. Interim long background calibration limits set to $\pm 99\%$ for alpha, $\pm 25\%$ for beta based on 6/5/15 1000 minute count.

Historical limits will be established following the acquisition of 10 data points.

6/6/15

Gross Alpha

Am241 Eff Calibration

Benchmark: AB121109-1 Source ID \rightarrow ~~1050~~ 106Z JPC6/6/15Logfile: Am241R \rightarrow 06/6/15

Sources	Detectors	File names
1223001-20	A1 B1 C1 D1	EAM0606A
-22	A2 B2 C2 D2	B
-23	A3 B3 C3 D3	C
-24	A4 B4 C4 D4	D

Continued on Page

Read and Understood By

Signed

6/5/15

Date

Signed

Date

6/6/15

Sr90 Ring Eff Calibration (Gross Beta)

Benchsheet: AB110616-3

Source ID: ~~1051~~

1063

JP G/uh

Logfile: Sr90R-06/15

Sources	Detector
1118005-2	A1 B1 C1 D1
-3	A2 B2 C2 D2
-4	A3 B3 C3 D3
-5	A4 B4 C4 D4

File names	JP G/uh
ESR0606A	
ESR0606B	
C	
D	

6/6/15

Cs137 Eff Calibration (Gross Beta)

Benchsheet: AB150310-2

Source ID: ~~1063~~

1064

JP G/uh

Logfile: Cs137-06/15

Sources	Detector
1515003-1	A1 B1 C1 D1
-3	A2 B2 C2 D2
-4	A3 B3 C3 D3
-5	A4 B4 C4 D4

File names	JP G/uh
ECS0606A	
B	
C	
D	

~~6/6/15~~6/8/2015

Ra228 Efficiency Calibration

Benchsheet: RA150603-1

Source ID: 1065

Logfile: Ra228-06/15

Sources	Detector
1518001-1	A1 B1 C1 D1
-2	A2 B2 C2 D2
-3	A3 B3 C3 D3
-5	A4 B4 C4 D4

File names
ERA0608A
B
C
D

Continued on Page

Read and Understood By

Signed

6/6/15

Signed

Date 6/6/15SOP 724r 11

ALS
Low Background Gas Flow Proportional Counter Log
Instrument: LB4100C

Instrument Daily Response and Background Checks

Det.	Daily Response Check				Background Check				Det. Status
	Start 1	Status	Start 2	Status	Start 1	Status	Start 2	Status	
1	JP	P			*				P
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16	✓	✓			✓				✓

Det = Detector; α = Alpha; β = Beta; P = Pass; H = High; L = Low; OL = Offline; R = Recount; W = Weekly; NP = Not Processed

Weekly Background Calibration

	Current Calib. File ID	Weekly Calib. Started	Status	File ID
Dr A	BKC0605W			
Dr B				
Dr C				
Dr D				

Dr = Drawer

Gas Supply

P-10 Supply		P-10 Flow	
Tank 1	400	Dr A	0.1
		Dr B	
Tank 2	1800	Dr C	
		Dr D	✓

Comments: * Not necessary to run daily background checks following a 1000 Minute Background Calibration JP 6/6/15

Date

6/6/15

ALS

SOP 724r 11

Low Background Gas Flow Proportional Counter Log
Instrument: LB4100C

Det.	Sample ID	Batch	Test	Count Dur. (min)	Start Time	Analyst Initials	File ID	Output Initials
1-16	Daily Eff							
1-4	1050	AB121109-1	Gross/Am (Am 241)	30	7:12	JP	EFC0606	JP
5-8			Eff	30	7:38	JP	EAM0606A	
9-12			Cal		7:47			
13-16					7:58			
1-4	1051	AB110616-3	Gross	30	8:07	JP	ESR0606A	JP
5-8			Beta		8:18			
9-12			(Sr 90)		8:22			
13-16			Cal		8:27			
1-4	1061	AB150310-2	Gross	30	8:08	JP	ECS0606A	JP
5-8			Beta		8:17			
9-12			Cs 137		8:25			
13-16			Cal					
1-16	1223001-1-3,6-14,16-19	AB121109-1	Am 241 Mass Attn/Line	30		JP	AAM0606	
1-4	1062	AB121109-1	A Eff	30	8:34	JP	EAM0606A	JP
5-8			Cal (Am 241)		8:43	JP		
9-12					8:53	JP		
13-16					9:03			
1-4	1063	AB110616-3	B Eff	30	9:04		ESR0606A	JP
5-8			Cal (Sr 90)		9:14			
9-12					9:24			
13-16					9:34			
1-4	1064	AB150310-2	B Eff	30	9:07		ECS0606A	JP
5-8			Cal		9:12			
9-12			Cs 137		9:29			
13-16					9:36			
1-16	1223001-1-3,6-14,16-19	AB121109-1	Am 241 Mass/Attn	30	9:56	JP	AAM0606	JP

Comments:

Page No.: 455201 B
(cont. from page Nn B)

Form 780r8.doc (6/23/06)

Reviewed By / Date

JP 6/7/15

240 of 329

Project

Continued from Page

955.4095.10 Am-241

Working
Intermediate Standard
MEL 11/8/11

Prepare a working dilution of 955, Am-241

1. Density of 1M HCl, lot # K22032

Mass of 100mL vol. flask:

Mass of flask & 100mL acid:

Net Mass:

Density:

66.4295g
167.9701g
101.5406g
1.0154 g/mL

Balance # 12

Balance# 12

2. Mass of 955 transferred:

Mass of empty vial:

Mass of vial & standard:

Net mass of standard transferred:

21.3568g
26.4318g
5.0750g

Balance# 12

Balance# 12

3. Dilute to final volume:

Mass of vial, standard, & diluent:

Mass of empty vial:

Net mass of new dilution:

42.8085g
21.3568g
21.4517g

Balance# 12

Balance# 12

4. Final activity calculation:

$$(1.965 \times 10^4 \text{ Bq}) \left(\frac{60 \text{ dpm}}{1 \text{ Bq}} \right) \left(\frac{5.0750 \text{ g}}{5.1344 \text{ g}} \right) \left(\frac{1.0154 \text{ g/mL}}{21.4517 \text{ g}} \right) = 55,161.32 \text{ dpm/mL}$$

Std ID: 955.4095.10

Description: Am-241

Expiration: 11/11/2012

Activity: 55161.33 dpm/mL

2s Uncertainty: 992.90 dpm/mL

Ref. Date: 10/25/2011

Ref Time: N/A

Prep Date: 11/8/2011 Prep by: MEL

Matrix/Comp. 3M HCl

Half Life (y): 4.33E+02

Reverification Log

Analysis Date Initials Expiration Date

Continued on Page

Megan Lane
Signed11/8/11
DateRead and Understood By
Kane Polleg
Signed11/29/11
241 of 329



Eckert & Ziegler
Analytics

R# 955
Rec 10-31-11

1380 Seaboard Industrial Blvd.
Atlanta, Georgia 30318
Tel 404-352-8677
Fax 404-352-2837
www.analytisc.com

CERTIFICATE OF CALIBRATION

Standard Radionuclide Source

85983-307

Am-241 5 mL Liquid in Flame Sealed Vial

Customer: ALS Laboratory Group / Fort Collins
P.O. No.: 73625, Item 1

This standard radionuclide source was prepared gravimetrically from a master solution, calibrated by Eckert & Ziegler Analytics. The master solution was calibrated by liquid scintillation counting. Radionuclide purity and calibration were checked by germanium gamma-ray spectrometry and liquid scintillation counting. The nuclear decay rate and reference date for this source are given below. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 1, February, 1979, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST." EZA is accredited by the Health Physics Society (HPS) for the production of NIST-traceable sources, and this source was produced in accordance with the HPS accreditation requirements. Customers may report any concerns with the accreditation program to the HPS Secretariat, 1313 Dolley Madison Blvd., Ste. 402, McLean, VA 22101.

Isotope	Half-Life, Days	Activity (Bq)	Uncertainty*, %			Reference Date (12:00 PM EST)
			u _A	u _B	U	
Am-241	1.580E+05	1.965E+04	0.1	0.9	1.8	10/25/2011

*Uncertainty: U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results."

Comments:

Impurities: γ -impurities < 0.1 %, α -impurities < 0.1 %. 5.13441 g 1M HCl solution, carrier free.

Source Prepared by:

M. I. Taskaeva
M. I. Taskaeva, Radiochemist

QA Approved:

J. D. McCorvey
J. D. McCorvey, QA Manager Alternate

Date: 26 Oct 11



Prepare a primary dilution of RSO #777 (Analytics #69573-307) in 0.1M HCl to a final volume of approx. 500 mL.

1) Prepare 0.1M HCl by diluting 8.3 mL HCl (12M) (Fisher Scientific Lot #055784) to a final volume of 1L.

2) Determine the density of 0.1M HCl

Weight of empty volumetric flask (100mL) 68.54g
 Mass of flask + 100mL 0.1M HCl 168.31g
 Mass of 100mL of 0.1M HCl 99.77g
 $\div 100\text{mL} = \text{density} = 0.9977$

3) Transfer #777 to a 500mL

Mass of bottle 47.9687g
 Mass of bottle + std. 52.9160g
 Mass of std. 4.9473g

4) Dilute to volume w/ 0.1M HCl
 Mass of bottle + std. + soln 94.52g
 Mass of bottle (from above) 47.9687g
 Mass of soln 46.55g

5) Final activity (dpm/mL)

$$\frac{(3.812 \times 10^4 \text{ dps}) (60 \text{ sec/min}) (4.9473 \text{ g})}{(5.05960 \text{ g}) (446.31 \text{ g})} = 5010.94 \text{ dpm}$$

$$\frac{5010.94 \text{ dpm}}{5008.25 \text{ g}} = 9.9942 \text{ dpm/g}$$

Reverification Log	Analysis Date	Initials	Expiration Date
	7/7/10	RG	7/7/11
	4/1/11	RG	4/1/12

Std ID: 777.3020.11

Description: Sr-90
 Expiration: 2/27/07
 Activity: 4996.73

2s Uncertainty: 99.93
 Ref. Date: 12/2/04
 Ref Time: N/A
 Prep Date: 2/8/06
 Matrix/Comp. 0.1 M HCl
 Half Life (y): 2.88E+01

dpm/mL
 dpm/mL
 rep by: HB

ANALYSIS DATE = 06/10/11

NEW EXP. DATE = 06/07/11

Reverification Log	Analysis Date	Initials	Expiration Date
	11/3/06	RG	11/8/07
	8/3/07	JCB	8/3/08
	2/28/08	MBC	2/25/09
	1/30/09	RG	1/30/2010
	7/17/09	RG	7/17/2010

Heather Barker

2/8/06

2/8/06

Signed

Date

Signed

Date

ANALYTICS

RSO #777
Rec'd 12/9/04
JCS

1980 Seaboard Industrial Blvd.
Atlanta, Georgia 30318 - U.S.A.

Phone (404) 352-8677
Fax (404) 352-2837

CERTIFICATE OF CALIBRATION
Standard Radionuclide Source

69573-307

Sr-90 5 mL Liquid in Flame Sealed Vial

This standard radionuclide source was prepared gravimetrically from a calibrated master solution. The master solution was calibrated by liquid scintillation counting.

Radionuclide purity and calibration were checked by germanium gamma-ray spectrometry and liquid scintillation counting. The nuclear decay rate and assay date for this source are given below.

ANALYTICS maintains traceability to the National Institute of Standards and Technology through Measurements Assurance Programs as described in USNRC Reg. Guide 4.15, Revision 1.

ISOTOPE: Sr-90
ACTIVITY (dps): 3.812 E4
HALF-LIFE: 28.79 years
CALIBRATION DATE: December 2, 2004 12:00 EST
RELATIVE EXPANDED
UNCERTAINTY (k=2): 2.0%

Impurities: γ -impurities <0.1%

5.05960 grams in 0.1M HCl solution with 30 μ g/g Sr carrier.

This source also contains Y-90 in secular equilibrium with Sr-90. The Y-90 activity is equal to the Sr-90 activity. Since Sr-90 and Y-90 both decay 100% by beta emission, the total beta emission rate for the source is twice the certified Sr-90 activity. The half-life for Y-90 is 64.08 hours.

P O NUMBER 71069, Item 1

SOURCE PREPARED BY:

M. Dimitrova
M. Dimitrova, Radiochemist

Q A APPROVED:

LM Mty 12-6-04

Mass Attenuation Curves

LB4100C Alpha Attenuation Curve -- Am-241

WO #	1223001
Mass Range	965.4065.10
Low	10/25/2011
High	433
Activity	55161.33 dpm/mL
Vol.	0.1 mL
Act. Added	5516.13 dpm

Spike Information	
Std. ID	965.4065.10
Ref. Date	10/25/2011
Half-life	433
Activity	55161.33 dpm/mL
Vol.	0.1 mL
Act. Added	5516.13 dpm

Attenuation Equation	$y = b \cdot m^a \cdot x^c$
b =	0.9030
m =	0.9911
a =	0.8270
c =	21.4875
% Diff Max.	11.5%

Cross-Talk Equation	$y = b \cdot m^a \cdot x^c$
b =	0.2511
m =	0.9984
a =	
c =	
% Diff Max.	17.2%

File ID	Detector	Sample ID	Mass (mg)	Count Date	Alpha Counts	Beta Counts	Count Time	Alpha CPM	Beta CPM	Base Alpha Eff.	Decay Corr. Act. added (dpm/mL)	Alpha EFF Actual	Alpha EFF Fitted	Ratio Actual/Fitted	Obs. Attenu Fact.	Fitted Attenu Fact.	% Diff.	% Diff. $\alpha > 8 \times \text{Thd} > 8 \times \text{Thd}$	% Diff. Fitted
AA0607	A1	1223001-3	21	6/7/2015 9:42	10016	2835	8.29	1188.0787	340.5023	0.2138	5484.28	0.2166	0.1938	0.9063	1.0133	0.9063	10.6%	0.2866	0.2564
AA0607	A2	1223001-3	21	6/7/2015 10:04	10014	2861	8.18	1224.0984	348.1675	0.2263	5484.28	0.2232	0.2051	0.9189	0.9863	0.9063	8.1%	0.2844	0.2564
AA0606	A3	1223001-3	21	6/6/2015 10:09	10005	2859	8.28	1211.1471	344.5308	0.2106	5484.30	0.2206	0.1930	0.9012	1.0056	0.9063	8.9%	0.2845	0.2564
AA0606	A4	1223001-3	21	6/6/2015 10:30	10006	2864	8.19	1221.6238	362.7348	0.2190	5484.30	0.2227	0.1885	0.8810	1.0171	0.9063	10.9%	0.2869	0.2564
AA0606	B1	1223001-3	21	6/6/2015 10:37	10002	2866	8.50	1136.5919	335.3535	0.2051	5484.30	0.2072	0.1859	0.8669	1.0105	0.9063	10.3%	0.2852	0.2564
AA0606	B2	1223001-3	21	6/6/2015 11:23	10002	2722	8.53	1172.4454	317.4620	0.2189	5484.30	0.2139	0.1862	0.8848	0.9766	0.9063	7.2%	0.2708	0.2564
AA0606	B3	1223001-3	21	6/6/2015 11:49	10006	2764	8.53	1173.9023	322.1998	0.2088	5484.30	0.2106	0.1857	0.8848	0.9623	0.9063	11.5%	0.2747	0.2564
AA0606	B4	1223001-3	21	6/6/2015 12:14	10010	3016	8.68	1103.9808	345.7334	0.2027	5484.30	0.2106	0.1857	0.9133	0.9623	0.9063	8.7%	0.3134	0.2564
AA0606	C1	1223001-3	21	6/6/2015 12:43	10003	2841	8.23	1155.2078	343.3165	0.2069	5484.30	0.2106	0.1875	0.8902	1.0181	0.9063	11.0%	0.2972	0.2564
AA0606	C2	1223001-3	21	6/6/2015 13:10	10003	2857	8.32	1202.1717	341.5394	0.2279	5484.30	0.2123	0.1935	0.9031	0.9618	0.9063	5.8%	0.2941	0.2564
AA0606	C3	1223001-3	21	6/6/2015 13:37	10014	2972	8.60	1164.3106	343.5214	0.2135	5484.30	0.2123	0.1935	0.9031	0.9944	0.9063	8.9%	0.2950	0.2564
AA0606	C4	1223001-3	21	6/6/2015 14:07	10017	2968	8.28	1149.6536	344.4598	0.2089	5484.30	0.2096	0.1883	0.9114	1.0035	0.9063	9.7%	0.2996	0.2564
AA0606	D1	1223001-3	21	6/6/2015 21:23	10003	2914	8.41	1108.3204	343.6463	0.2066	5484.28	0.2023	0.1872	0.9257	0.9622	0.9063	7.4%	0.3088	0.2564
AA0607	D2	1223001-3	21	6/7/15 8:22 AM	10013	2914	8.47	1182.0794	337.6692	0.2240	5484.28	0.2155	0.2030	0.9418	0.9622	0.9063	5.8%	0.2857	0.2564
AA0607	D3	1223001-3	21	6/7/15 8:49 AM	10024	2778	8.1	1237.4409	341.363	0.2222	5484.28	0.2256	0.2014	0.8925	1.0155	0.9063	10.8%	0.2759	0.2564
AA0607	D4	1223001-3	21	6/7/15 9:16 AM	10004	2880	8.29	1206.6681	357.7652	0.2160	5484.28	0.2200	0.1958	0.8897	1.0186	0.9063	11.0%	0.2965	0.2564
AA0607	A1	1223001-2	22.1	6/7/2015 10:10	10011	2898	8.7	1150.5557	308.6389	0.2138	5484.28	0.2098	0.1922	0.9161	0.9813	0.8990	8.4%	0.2682	0.2598
AA0606	A2	1223001-2	22.1	6/6/2015 10:05	10007	2801	8.68	1152.7232	321.1079	0.2263	5484.30	0.2102	0.2034	0.9678	0.9288	0.8990	3.2%	0.2786	0.2598
AA0606	A3	1223001-2	22.1	6/6/2015 10:31	10007	2801	8.78	1139.6374	317.4255	0.2196	5484.30	0.2078	0.1914	0.9500	0.9463	0.8990	5.0%	0.2785	0.2598
AA0606	A4	1223001-2	22.1	6/6/2015 10:57	10006	2809	8.57	1167.4513	326.1593	0.2190	5484.30	0.2129	0.1969	0.9248	0.9720	0.8990	7.5%	0.2794	0.2598
AA0606	B1	1223001-2	22.1	6/6/2015 11:23	10002	2686	8.9	1125.9634	300.1748	0.2051	5484.30	0.2053	0.1844	0.8981	1.0010	0.8990	10.2%	0.2666	0.2598
AA0606	B2	1223001-2	22.1	6/6/2015 11:49	10004	2753	9.07	1102.8548	301.8711	0.2189	5484.30	0.2011	0.1968	0.9786	0.9187	0.8990	2.1%	0.2737	0.2598
AA0606	B3	1223001-2	22.1	6/6/2015 12:15	10012	2731	8.96	1117.2767	302.9681	0.2088	5484.30	0.2037	0.1877	0.9214	0.9757	0.8990	7.9%	0.2712	0.2598
AA0606	B4	1223001-2	22.1	6/6/2015 12:44	10021	2835	9.08	1103.4684	310.4927	0.2027	5484.30	0.2012	0.1822	0.9056	0.9626	0.8990	9.4%	0.2814	0.2598
AA0606	C1	1223001-2	22.1	6/6/2015 13:10	10011	2822	8.73	1146.6334	321.3692	0.2069	5484.30	0.2091	0.1860	0.8986	1.0105	0.8990	11.0%	0.2803	0.2598
AA0606	C2	1223001-2	22.1	6/6/2015 13:37	10014	2852	8.73	1141.7352	323.3465	0.2279	5484.30	0.2082	0.2049	0.8841	0.9135	0.8990	1.6%	0.2832	0.2598
AA0606	C3	1223001-2	22.1	6/6/2015 14:08	10005	2817	8.97	1135.2766	311.9868	0.2135	5484.30	0.2034	0.1919	0.9438	0.9525	0.8990	5.6%	0.2797	0.2598
AA0606	C4	1223001-2	22.1	6/6/2015 21:24	10015	2749	8.80	1091.3970	304.8966	0.2089	5484.29	0.2075	0.1878	0.9051	0.9833	0.8990	9.5%	0.2728	0.2598
AA0607	D1	1223001-2	22.1	6/7/2015 8:23 AM	10009	2822	9.17	1137.9492	314.4694	0.2066	5484.28	0.1990	0.1857	0.9333	0.9632	0.8990	6.7%	0.2784	0.2598
AA0607	D2	1223001-2	22.1	6/7/15 8:50 AM	10019	2817	8.98	1115.6986	312.0511	0.2240	5484.28	0.2034	0.2014	0.9869	0.9091	0.8990	1.0%	0.2797	0.2598
AA0607	D3	1223001-2	22.1	6/7/15 9:17 AM	10003	2809	8.74	1144.418	319.7959	0.2222	5484.28	0.2087	0.1907	0.9572	0.9391	0.8990	4.3%	0.2784	0.2598
AA0607	D4	1223001-2	22.1	6/7/15 9:42 AM	10014	2835	8.58	1167.0459	340.3706	0.2160	5484.28	0.2128	0.1942	0.9125	0.9852	0.8990	8.8%	0.2937	0.2598
AA0606	A1	1223001-1	23.3	6/6/2015 10:06	10004	2794	10.12	986.4735	274.6110	0.2138	5484.30	0.1802	0.1905	1.0570	0.8430	0.8910	-3.7%	0.2778	0.2604
AA0606	A2	1223001-1	23.3	6/6/2015 10:32	10009	2803	10.07	1023.7654	276.7635	0.2263	5484.30	0.1867	0.2016	1.0802	0.8249	0.8910	-8.0%	0.2703	0.2604
AA0606	A3	1223001-1	23.3	6/6/2015 10:58	10006	2806	10.03	997.4952	278.1657	0.2196	5484.30	0.1819	0.1957	1.0755	0.8282	0.8910	-7.6%	0.2789	0.2604
AA0606	A4	1223001-1	23.3	6/6/2015 11:24	10009	2922	10.04	996.8024	289.4239	0.2190	5484.30	0.1818	0.1951	1.0736	0.8299	0.8910	-7.4%	0.2904	0.2604
AA0606	B1	1223001-1	23.3	6/6/2015 11:50	10004	2791	10.08	992.3463	275.2619	0.2051	5484.30	0.1809	0.1828	1.0100	0.8822	0.8910	-1.0%	0.2774	0.2604
AA0606	B2	1223001-1	23.3	6/6/2015 12:16	10025	2743	10.23	979.9389	266.4759	0.2189	5484.30	0.1767	0.1951	1.0917	0.8162	0.8910	-8.2%	0.2720	0.2604
AA0606	B3	1223001-1	23.3	6/6/2015 12:45	10019	2814	10.34	968.8215	270.3140	0.2088	5484.30	0.1767	0.1861	1.0532	0.8460	0.8910	-5.3%	0.2790	0.2604
AA0606	B4	1223001-1	23.3	6/6/2015 13:12	10019	2912	10.40	963.2204	278.2680	0.2027	5484.30	0.1756	0.1806	1.0284	0.8665	0.8910	-2.8%	0.2889	0.2604
AA0606	C1	1223001-1	23.3	6/6/2015 13:38	10005	2895	9.99	1001.3995	280.5985	0.2069	5484.30	0.1826	0.1844	1.0087	0.8825	0.8910	-1.0%	0.2802	0.2604
AA0606	C2	1223001-1	23.3	6/6/2015 14:08	10019	2895	10.08	1023.8364	285.3524	0.2279	5484.30	0.1867	0.2031	1.0878	0.8192	0.8910	-8.8%	0.2787	0.2604
AA0606	C3	1223001-1	23.3	6/6/2015 21:25	10020	2873	10.09	992.9544	282.6774	0.2135	5484.29	0.1811	0.1902	1.0507	0.8480	0.8910	-5.1%	0.2847	0.2604
AA0606	C4	1223001-1	23.3	6/7/2015 8:24 AM	10001	2824	10.14	986.1729	286.4459	0.2089	5484.28	0.1798	0.1861	1.0352	0.8608	0.8910	-3.6%	0.2905	0.2604
AA0607	D1	1223001-1	23.3	6/7/2015 8:51 AM	10001	2815	10.29	971.7203	270.7206	0.2066	5484.28	0.1772	0.1841	1.0390	0.8576	0.8910	-3.9%	0.2786	0.2604
AA0607	D2	1223001-1	23.3	6/7/15 9:18 AM	10008	2835	10.15	1015.9169	277.9643	0.2240	5484.28	0.1852	0.1986	1.0775	0.8270	0.8910	-7.7%	0.2733	0.2604
AA0607	D3	1223001-1	23.3	6/7/15 9:44 AM	10005	2839	10.09	991.48582	279.7677	0.2222	5484.28	0.1808	0.1980	1.0952	0.8136	0.8910	-9.5%	0.2822	0.2604
AA0607	D4	1223001-1	23.3	6/7/15 10:11 AM	10012	2899	10.20	981.48163	282.5117	0.2160	5484.28	0.1790	0.1925	1.0755	0.8285	0.8910	-7.5%	0.2878	0.2604

Attenuation Equation= $y=b^x \cdot m^{\alpha(x)}$	Cross-Talk Equation	$y=b^x \cdot m^{\alpha(x)}$
b = 0.9030	b = 0.2511	
m = 0.9911		
a = 0.8270	m = 0.9984	
x0 = 21.4875		
% Diff Max. = 11.5%	% Diff Max. = 17.2%	

File ID	Detector	Sample ID	Mass (mg)	Count Date	Alpha Counts	Count Time	Alpha CPM	Base Alpha CPM	Decay Corr. Act. and/or Semil.	Alpha EFF Fitted	Alpha Att. Fitted	Ratio Actual/Fit	Obs. Atten Fact.	Fitted Atten Fact.	% Diff.	$\alpha - \beta$ X THU > 0	Fitted	% Diff.
AA00607	A1	1223001-8	43.7	6/7/2015 8:26	10002	11.97	836.4650	223.3360	0.2138	0.1539	0.1062	0.1639	0.7125	0.7688	-7.6%	0.2673	0.2688	-0.5%
AA00607	A2	1223001-8	43.7	6/7/2015 8:53	10009	12.03	901.8463	240.6398	0.2263	0.1644	0.1052	0.1735	0.7267	0.7668	-6.5%	0.2668	0.2688	-0.7%
AA00607	A3	1223001-8	43.7	6/7/2015 9:20	10004	12.00	833.5547	228.6550	0.2196	0.1520	0.1079	0.1679	0.6921	0.7668	-10.8%	0.2743	0.2688	2.0%
AA00607	B1	1223001-8	43.7	6/7/2015 9:43	10010	11.78	849.6533	233.8719	0.2190	0.1549	0.1039	0.1679	0.7024	0.7668	-8.4%	0.2753	0.2688	2.8%
AA00606	B2	1223001-8	43.7	6/7/2015 10:15	10007	12.10	812.8023	234.7702	0.2051	0.1482	0.1011	0.1611	0.7228	0.7668	-4.1%	0.2888	0.2688	6.8%
AA00606	B3	1223001-8	43.7	6/6/2015 10:09	10006	12.44	884.2188	221.8157	0.2188	0.1492	0.1011	0.1679	0.7365	0.7668	-4.1%	0.2509	0.2688	-7.1%
AA00606	B4	1223001-8	43.7	6/6/2015 10:35	10011	12.45	893.9624	222.5847	0.2088	0.1466	0.1022	0.1679	0.7021	0.7668	-8.2%	0.2769	0.2688	2.9%
AA00606	C1	1223001-8	43.7	6/6/2015 11:07	10012	12.54	798.2601	234.9606	0.2027	0.1456	0.1022	0.1679	0.7181	0.7668	-8.8%	0.2943	0.2688	8.7%
AA00606	C2	1223001-8	43.7	6/6/2015 11:21	10002	12.92	819.0626	226.7810	0.2069	0.1493	0.1063	0.1566	0.7218	0.7668	-6.2%	0.2769	0.2688	2.9%
AA00606	C3	1223001-8	43.7	6/6/2015 11:52	10005	12.86	866.7475	234.6789	0.2279	0.1580	0.1063	0.1566	0.7148	0.7668	-10.8%	0.2708	0.2688	3.0%
AA00606	C4	1223001-8	43.7	6/6/2015 12:18	10004	12.18	802.2385	227.4967	0.2135	0.1497	0.1033	0.1566	0.7014	0.7668	-8.3%	0.2770	0.2688	3.0%
AA00606	D1	1223001-8	43.7	6/6/2015 12:47	10006	12.29	814.0389	231.2807	0.2069	0.1484	0.1062	0.1584	0.7050	0.7668	-7.9%	0.2841	0.2688	5.4%
AA00606	D2	1223001-8	43.7	6/6/2015 13:10	10004	12.47	802.1484	230.5141	0.2066	0.1463	0.1031	0.1584	0.7080	0.7668	-8.3%	0.2874	0.2688	6.5%
AA00606	D3	1223001-8	43.7	6/6/2015 13:40	10007	12.10	876.9318	227.6928	0.2240	0.1596	0.1042	0.1584	0.7138	0.7668	-7.4%	0.2596	0.2688	-3.5%
AA00606	D4	1223001-8	43.7	6/6/2015 14:13	10004	11.8	847.7066	237.1288	0.2222	0.1546	0.1074	0.1584	0.7102	0.7668	-10.2%	0.2797	0.2688	3.9%
AA00606	A1	1223001-9	48.1	6/6/2015 21:27	10002	11.89	841.1241	240.8243	0.2168	0.1556	0.1099	0.1656	0.7100	0.7668	-4.6%	0.2688	0.2688	6.1%
AA00606	A2	1223001-9	48.1	6/6/2015 21:26	10006	10.81	925.5004	242.8673	0.2138	0.1688	0.0945	0.1611	0.7693	0.7534	18.0%	0.2625	0.2688	-2.8%
AA00607	A3	1223001-9	48.1	6/7/2015 8:25	10002	10.88	915.1445	255.3034	0.2263	0.1676	0.1052	0.1705	0.7406	0.7534	-1.7%	0.2779	0.2688	2.9%
AA00607	A4	1223001-9	48.1	6/7/2015 8:52	10009	10.98	911.4545	253.3202	0.2196	0.1682	0.1052	0.1654	0.7534	0.7534	0.5%	0.2779	0.2688	2.9%
AA00607	B1	1223001-9	48.1	6/7/2015 9:45	10008	10.66	938.0448	256.2670	0.2190	0.1712	0.1050	0.1650	0.7534	0.7534	3.6%	0.2730	0.2688	1.2%
AA00607	B2	1223001-9	48.1	6/7/2015 9:45	10002	11.05	905.0644	245.6168	0.2051	0.1580	0.1039	0.1650	0.7534	0.7534	6.4%	0.2730	0.2688	1.2%
AA00607	B3	1223001-9	48.1	6/7/2015 10:12	10013	11.42	876.6731	241.9831	0.2189	0.1598	0.1031	0.1649	0.7303	0.7534	-3.2%	0.2759	0.2688	2.2%
AA00606	B4	1223001-9	48.1	6/6/2015 10:08	10002	11.33	892.6551	232.3006	0.2098	0.1609	0.1031	0.1573	0.7303	0.7534	-3.2%	0.2634	0.2688	-2.4%
AA00606	C1	1223001-9	48.1	6/6/2015 10:34	10001	11.47	874.0683	250.3407	0.2027	0.1594	0.1027	0.1527	0.7663	0.7534	4.2%	0.2966	0.2688	5.9%
AA00606	C2	1223001-9	46.1	6/6/2015 10:59	10008	11.17	896.8694	253.0647	0.2209	0.1634	0.1059	0.1559	0.7534	0.7534	4.6%	0.2820	0.2688	4.5%
AA00606	C3	1223001-9	46.1	6/6/2015 11:25	10011	11.47	914.1346	256.0435	0.2279	0.1667	0.1077	0.1608	0.8886	0.7621	1.1%	0.2758	0.2688	2.2%
AA00606	C4	1223001-9	48.1	6/6/2015 12:17	10022	11.23	902.3074	246.0145	0.2135	0.1629	0.1054	0.1574	0.7534	0.7534	4.6%	0.2721	0.2688	0.8%
AA00606	D1	1223001-9	48.1	6/6/2015 12:51	10002	11.34	882.5309	245.8312	0.2068	0.1609	0.1056	0.1556	0.7769	0.7534	-3.2%	0.2786	0.2688	3.1%
AA00606	D2	1223001-9	48.1	6/6/2015 13:16	10008	11.27	887.9293	238.5492	0.2240	0.1619	0.1088	0.1688	0.7534	0.7534	-4.2%	0.2687	0.2688	0.4%
AA00606	D3	1223001-9	48.1	6/6/2015 13:39	10006	10.82	924.6787	251.7272	0.2222	0.1686	0.1074	0.1692	0.7534	0.7534	0.7%	0.2722	0.2688	4.5%
AA00606	D4	1223001-9	48.1	6/6/2015 14:14	10004	10.96	912.6867	257.9675	0.2160	0.1654	0.1077	0.1677	0.7705	0.7534	2.2%	0.2826	0.2688	4.8%
AA00606	A1	1223001-10	63.5	6/6/2015 14:11	10002	12.52	798.1202	216.4010	0.2138	0.1455	0.1017	0.1417	0.9737	0.6907	0.6907	0.2771	0.2772	-2.2%
AA00606	A2	1223001-10	63.5	6/6/2015 14:27	10007	12.43	805.5596	225.6262	0.2263	0.1469	0.1021	0.1500	0.9628	0.6907	2.6%	0.2781	0.2772	1.0%
AA00607	A3	1223001-10	63.5	6/7/2015 8:26	10009	12.65	826.3950	226.7287	0.2196	0.1507	0.1045	0.1455	0.9569	0.6907	3.4%	0.2744	0.2772	-1.0%
AA00607	A4	1223001-10	63.5	6/7/2015 8:53	10013	12.06	830.1553	235.2868	0.2190	0.1548	0.1045	0.1451	0.9569	0.6912	0.6912	0.2834	0.2772	2.2%
AA00607	B1	1223001-10	63.5	6/7/2015 9:46	10004	12.87	793.4746	225.2368	0.2051	0.1428	0.1039	0.1359	0.9518	0.6918	0.6928	0.2876	0.2772	3.6%
AA00607	B2	1223001-10	63.5	6/7/2015 9:46	10004	12.59	784.2969	220.6361	0.2189	0.1498	0.1045	0.1451	0.9518	0.6928	0.6928	0.2813	0.2772	-6.1%
AA00607	B3	1223001-10	63.5	6/7/2015 10:14	10005	12.81	787.6613	205.3324	0.2088	0.1436	0.1034	0.1384	0.9636	0.6918	0.6928	0.2807	0.2772	-6.3%
AA00607	B4	1223001-10	63.5	6/6/2015 10:09	9999	12.70	795.9392	221.6711	0.2027	0.1462	0.1034	0.1343	0.9375	0.7070	0.7070	0.2920	0.2772	1.3%
AA00606	C1	1223001-10	63.5	6/6/2015 10:35	10008	12.48	801.8211	224.9589	0.2069	0.1469	0.1027	0.1462	0.9379	0.7068	0.7068	0.2906	0.2772	1.2%
AA00606	C2	1223001-10	63.5	6/6/2015 11:01	10005	12.31	805.4436	233.3352	0.2279	0.1478	0.1025	0.1478	0.9805	0.6928	0.6928	0.2897	0.2772	4.3%
AA00606	C3	1223001-10	63.5	6/6/2015 11:27	10006	12.64	791.5059	220.9830	0.2135	0.1485	0.1043	0.1485	0.9324	0.7108	0.7108	0.2942	0.2772	-3.3%
AA00606	C4	1223001-11	63.5	6/6/2015 11:52	10008	12.08	814.3761	218.6042	0.2089	0.1485	0.1036	0.1485	0.9628	0.6928	0.6928	0.2884	0.2772	2.4%
AA00606	D1	1223001-10	63.5	6/6/2015 12:17	10006	12.68	799.0197	224.0445	0.2066	0.1439	0.1036	0.1439	0.9518	0.6928	0.6928	0.2815	0.2772	1.5%
AA00606	D2	1223001-10	63.5	6/6/2015 12:48	10000	12.57	786.4519	223.8910	0.2240	0.1450	0.1036	0.1450	0.9628	0.6928	0.6928	0.2842	0.2772	2.4%
AA00606	D3	1223001-10	63.5	6/6/2015 13:14	10003	11.98	834.8850	221.9392	0.2222	0.1522	0.1036	0.1473	0.9574	0.6928	0.6928	0.2851	0.2772	1.3%
AA00606	D4	1223001-10	63.5	6/6/2015 13:41	10008	12.43	804.9006	225.8101	0.2160	0.1468	0.1036	0.1468	0.9745	0.6905	0.6905	0.2865	0.2772	1.3%

LB4100C Alpha Attenuation Curve -- Am-241

Spike Information				Attenuation Equation: $y = b \cdot m^a \cdot x^c$				Cross-Talk Equation: $y = b \cdot m^a \cdot x^c$			
WO #	1230001	Std. ID	965.4065.10	b	0.9030	Diff Max	11.5%	b	0.9030	Diff	17.2%
Mass Range	20.5 mg	Ref. Date	10/25/2011	m	0.9911			m	0.9911		
Low	156.0 mg	Half-life	433 yrs	a	0.9270						
High		Activity	55161.33 dpm/mL	c	0.214875						
		Vol.	0.1 mL								
		Act. Added	5516.13 dpm								

File ID	Detector ID	Sample ID	Mass (mg)	Count Date	Alpha Counts	Beta Counts	Count Time	Alpha CPM	Beta CPM	Base Alpha Eff. (dpm/g)	Decay Corr. Act. added (dpm/g)	Alpha Att. Fitted EFF	Alpha Att. Fitted Ratio	Obs. Att. Fitted	% Diff.	$\alpha > \beta \times T_{1/2} > \beta \times T_{1/2}$	% Diff.
AA0606	A1	1233001-12	93.6	6/6/2015 13:17	10009	2633	15.19	658.7963	171.9617	0.2138	5484.30	0.1201	0.9452	0.5819	5.5%	0.2609	-11.4%
AA0606	A2	1233001-12	93.6	6/6/2015 13:44	10000	2637	15.26	655.1510	171.2167	0.2263	5484.30	0.1196	1.0036	0.5279	-0.6%	0.2613	-11.2%
AA0606	A3	1233001-12	93.6	6/6/2015 14:14	10000	2665	15.22	656.9182	173.5036	0.2196	5484.30	0.1198	0.9730	0.5455	2.6%	0.2641	-10.0%
AA0606	B1	1233001-12	93.6	6/6/2015 21:29	10008	2619	14.55	687.7938	178.3880	0.2190	5484.28	0.1254	0.9273	0.5727	7.3%	0.2594	-12.0%
AA0607	B2	1233001-12	93.6	6/7/2015 8:29	10006	2504	15.06	684.2660	164.6453	0.2051	5484.28	0.1211	0.1089	0.8982	10.1%	0.2478	-17.2%
AA0607	B3	1233001-12	93.6	6/7/2015 8:57	10008	2585	15.70	637.2028	162.9927	0.2189	5484.28	0.1162	1.0065	0.5308	4.0%	0.2558	-13.6%
AA0607	B4	1233001-12	93.6	6/7/2015 9:24	10008	2612	15.79	633.6949	163.5882	0.2088	5484.28	0.1155	0.9966	0.5534	0.0%	0.2582	-12.5%
AA0607	C1	1233001-12	93.6	6/7/2015 9:49	10007	2574	15.77	634.4143	161.4893	0.2027	5484.28	0.1157	0.9174	0.5707	6.9%	0.2545	-14.1%
AA0606	C2	1233001-12	93.6	6/7/2015 10:16	10005	2671	15.23	650.8251	170.6045	0.2069	5484.30	0.1186	0.9174	0.5789	8.3%	0.2597	-11.9%
AA0606	C3	1233001-12	93.6	6/6/2015 10:32	10003	2589	15.38	650.2781	166.4855	0.2279	5484.30	0.1186	1.0207	0.5203	-2.1%	0.2560	-13.5%
AA0606	C4	1233001-12	93.6	6/6/2015 10:38	10005	2632	15.58	642.0614	166.8745	0.2135	5484.30	0.1171	0.9684	0.5483	3.2%	0.2589	-11.8%
AA0606	D1	1233001-12	93.6	6/6/2015 11:04	10001	2723	15.49	645.5233	173.8738	0.2089	5484.30	0.1177	0.1109	0.9425	5.8%	0.2684	-7.8%
AA0606	D2	1233001-12	93.6	6/6/2015 11:30	10000	2711	15.69	637.2516	169.9392	0.2066	5484.30	0.1162	0.9442	0.5624	3.6%	0.2607	-8.9%
AA0606	D3	1233001-12	93.6	6/6/2015 11:56	10004	2599	15.63	639.9562	164.6368	0.2240	5484.30	0.1167	1.0184	0.5209	-1.9%	0.2573	-12.9%
AA0606	D4	1233001-12	93.6	6/6/2015 12:21	10000	2568	14.98	667.4667	169.8286	0.2222	5484.30	0.1217	1.0184	0.5477	3.0%	0.2544	-14.2%
AA0606	A1	1233001-13	95.2	6/6/2015 12:51	10004	2671	16.21	617.0259	163.2988	0.2138	5484.30	0.1125	0.9973	0.5262	0.3%	0.2647	-10.1%
AA0606	A2	1233001-13	95.2	6/6/2015 13:18	10004	2809	16.22	616.6124	171.5933	0.2263	5484.30	0.1124	1.0563	0.4968	-5.6%	0.2783	-29.1%
AA0606	A3	1233001-13	95.2	6/6/2015 13:45	10001	2803	16.35	611.5700	169.8423	0.2196	5484.30	0.1115	1.0335	0.5078	-3.4%	0.2777	-29.1%
AA0606	A4	1233001-13	95.2	6/6/2015 14:14	9999	2766	15.76	634.3443	173.8656	0.2160	5484.30	0.1157	0.9937	0.5248	0.6%	0.2741	-6.2%
AA0607	B1	1233001-13	95.2	6/6/2015 21:31	10004	2746	16.46	607.6624	165.2057	0.2051	5484.29	0.1108	0.9715	0.5402	2.9%	0.2719	-29.1%
AA0607	B2	1233001-13	95.2	6/7/2015 8:31	10000	2799	18.72	597.9641	165.7473	0.2189	5484.28	0.1060	1.0637	0.4981	-5.4%	0.2772	-29.1%
AA0607	B3	1233001-13	95.2	6/7/2015 8:58	10001	2751	17.24	579.9704	157.7378	0.2088	5484.28	0.1068	1.0382	0.5085	-3.6%	0.2720	-29.1%
AA0607	B4	1233001-13	95.2	6/7/2015 9:24	10003	2844	16.7	598.8370	168.5674	0.2027	5484.28	0.1062	0.9743	0.5387	0.2%	0.2815	-29.1%
AA0607	C1	1233001-13	95.2	6/7/2015 9:50	10005	2709	15.95	627.1707	167.9593	0.2069	5484.28	0.1144	0.1086	0.5527	5.0%	0.2678	-29.1%
AA0607	C2	1233001-13	95.2	6/7/2015 10:17	10003	2663	15.85	630.9921	166.1628	0.2278	5484.28	0.1151	1.0396	0.5048	-4.0%	0.2633	-29.1%
AA0606	C3	1233001-14	95.2	6/6/2015 10:38	10002	2820	16.57	603.5130	168.1271	0.2135	5484.30	0.1100	1.0182	0.5154	-1.8%	0.2786	-29.1%
AA0606	C4	1233001-14	95.2	6/6/2015 11:05	9999	2635	16.11	621.3583	161.6460	0.2089	5484.30	0.1133	0.9951	0.5248	3.2%	0.2601	-29.1%
AA0606	D1	1233001-13	95.2	6/6/2015 11:31	10007	2768	16.73	597.5719	167.5007	0.2066	5484.30	0.1090	1.0581	0.4969	-5.6%	0.2803	-29.1%
AA0606	D2	1233001-13	95.2	6/6/2015 11:56	10002	2711	15.84	631.3494	169.5490	0.2222	5484.30	0.1113	1.0766	0.4969	-1.3%	0.2740	-29.1%
AA0606	D3	1233001-13	95.2	6/6/2015 12:21	9999	2743	15.73	635.5773	172.6762	0.2160	5484.30	0.1159	1.0342	0.5365	2.2%	0.2717	-29.1%
AA0606	A1	1233001-14	118.1	6/6/2015 12:52	10004	2762	17.95	557.2019	152.3959	0.2138	5484.30	0.1016	0.9682	0.4752	5.3%	0.2735	-30.0%
AA0606	A2	1233001-14	118.1	6/6/2015 12:52	10003	2856	17.88	565.6235	159.9505	0.2263	5484.30	0.1031	1.0473	0.4557	1.3%	0.2828	-30.0%
AA0606	A3	1233001-14	118.1	6/6/2015 13:19	10004	2738	17.81	561.5949	152.1389	0.2196	5484.30	0.1024	0.9890	0.4665	3.5%	0.2709	-30.0%
AA0606	A4	1233001-14	118.1	6/6/2015 13:45	10002	2726	16.79	595.6917	160.7485	0.2106	5484.30	0.1086	0.9650	0.4859	8.3%	0.2699	-30.0%
AA0606	B1	1233001-14	118.1	6/6/2015 14:17	10002	2752	17.85	569.7824	152.5807	0.2051	5484.30	0.1023	0.9926	0.4865	9.7%	0.2720	-30.0%
AA0606	B2	1233001-14	118.1	6/6/2015 21:33	10001	2677	18.69	552.7249	146.3263	0.2189	5484.29	0.1008	0.9873	0.4604	2.3%	0.2647	-30.0%
AA0607	B3	1233001-14	118.1	6/7/2015 8:32	10004	2831	18.39	542.8573	153.1515	0.2088	5484.28	0.0992	0.9474	0.4749	4.5%	0.2797	-30.0%
AA0607	B4	1233001-14	118.1	6/7/2015 8:59	10004	2791	18.02	555.0159	153.1515	0.2027	5484.28	0.1012	0.9013	0.4693	8.9%	0.2759	-30.0%
AA0607	C1	1233001-14	118.1	6/7/2015 9:26	10006	2639	17.82	591.4019	157.4314	0.2069	5484.28	0.1046	0.9931	0.4646	9.1%	0.2804	-30.0%
AA0607	C2	1233001-14	118.1	6/7/2015 9:51	10005	2726	17.43	573.8963	154.5470	0.2279	5484.28	0.1046	1.0095	0.4592	2.0%	0.2693	-30.0%
AA0607	C3	1233001-16	118.1	6/7/2015 10:19	9999	2773	17.92	573.8963	154.5470	0.2135	5484.28	0.1017	0.9641	0.4794	5.6%	0.2737	-30.0%
AA0606	C4	1233001-14	118.1	6/6/2015 10:14	10007	2841	18.15	551.2309	160.1216	0.2089	5484.30	0.1005	0.9352	0.4811	6.5%	0.2805	-30.0%
AA0606	D1	1233001-14	118.1	6/6/2015 10:40	10003	2862	18.20	549.5184	154.4067	0.2066	5484.30	0.1002	0.9038	0.4880	7.2%	0.2810	-30.0%
AA0606	D2	1233001-14	118.1	6/6/2015 11:06	10004	2786	18.17	550.4849	151.6837	0.2240	5484.30	0.1004	1.0048	0.4481	-0.4%	0.2755	-30.0%
AA0606	D3	1233001-14	118.1	6/6/2015 11:32	10001	2629	17.16	582.7189	151.6051	0.2222	5484.30	0.1063	1.0040	0.4782	5.0%	0.2602	-30.0%
AA0606	D4	1233001-14	118.1	6/6/2015 11:57	10006	2867	17.34	576.9603	163.6963	0.2160	5484.30	0.1052	0.9972	0.4870	7.6%	0.2636	-30.0%
AA0606	A1	1233001-16	134.2	6/6/2015 11:34	10000	2945	19.57	510.8622	149.0004	0.2138	5484.30	0.0931	0.9842	0.4939	9.8%	0.2917	-6.1%
AA0606	A2	1233001-17	134.2	6/6/2015 12:02	10002	3071	22.09	462.6601	137.5462	0.2138	5484.30	0.0825	1.0202	0.3968	-2.0%	0.3039	-1.9%
AA0606	A3	1233001-16	134.2	6/6/2015 12:00	10004	3056	20.30	492.6509	148.9539	0.2263	5484.30	0.0898	0.9891	0.3968	0.8%	0.3024	-30.0%
AA0606	A4	1233001-17	134.2	6/6/2015 12:28	10002	3108	22.57	442.9976	136.1168	0.2263	5484.30	0.0808	1.1034	0.3569	-10.3%	0.3073	-30.0%
AA0606	B1	1233001-16	134.2	6/6/2015 12:25	10006	3007	19.63	509.6180	151.5889	0.2196	5484.30	0.0929	0.9865	0.4937	6.9%	0.2975	-30.0%
AA0606	B2	1233001-17	134.2	6/6/2015 12:57	10003	3084	22.12	452.1032	137.8263	0.2196	5484.30	0.0824	1.0491	0.3754	-3.9%	0.3049	-1.5%
AA0606	B3	1233001-16	134.2	6/6/2015 12:54	10004	3039	19.48	513.4424	154.3942	0.2190	5484.30	0.0936	0.9862	0.4923	7.9%	0.3007	-30.0%
AA0606	B4	1233001-17	134.2	6/6/2015 13:23	10005	3066	21.85	464.2135	140.0046	0.2190	5484.30	0.0842	1.0238	0.3947	-2.4%	0.3030	-2.9%
AA0606	B1	1233001-16	134.2	6/6/2015 13:22	10001	30											

LB4100C Alpha Attenuation Curve -- Am-241

WO #		Spike Information	
1223001		Std. ID	955.4095.10
Mass Range		Ref. Date	10/25/2011
Low	20.5 mg	Half-life	433 yrs
High	156.0 mg	Activity	55161.33 dpm/mL
		Vol.	0.1 mL
		Act. Added	5516.13 dpm

Attenuation Equation: $e^{-b(x-a)}$	
b =	0.9030
m =	0.9911
a =	0.8270
x0	21.4875
% Diff Max.	= 11.5%

Cross-Talk Equation	
b =	0.2511
m =	0.9984
% Diff Max.	= 17.2%

File ID	Detector ID	Sample ID	Mass (mg)	Count Date	Alpha Counts	Beta Counts	Count Time	Alpha CPM	Beta CPM	Base Alpha Eff.	Decay Corr. Act. added dpm/mL	Alpha Att. Fitted EFF	Alpha Att. Actual	Actual/Fit Ratio	Obs. Attenu Fact.	% Diff.	Fitted	Actual	$\alpha > \beta \times \text{TL}(\alpha > \beta \times \text{TL})$	% Diff.
AA00606	B4	1223001-16	134.2	6/6/2015 21:35	9999	3063	20.49	487.8491	148.7316	0.2027	5484.29	0.0798	0.0890	0.0798	0.4398	10.3%	0.3049	0.3095	0.3049	-1.5%
AA00607	B4	1223001-17	134.2	6/7/2015 8:37	10002	3209	23.15	471.9068	136.6857	0.2027	5484.28	0.0788	0.0863	0.0788	0.3885	-1.4%	0.3049	0.3095	0.3049	2.3%
AA00607	C1	1223001-16	134.2	6/7/2015 8:34	10006	2917	19.70	467.8168	146.1871	0.2069	5484.28	0.0853	0.0815	0.0853	0.4123	4.5%	0.3049	0.3095	0.3049	0.0%
AA00607	C2	1223001-17	134.2	6/7/2015 9:03	10000	3090	22.08	452.7966	138.0617	0.2069	5484.28	0.0815	0.0869	0.0815	0.3990	1.3%	0.3049	0.3095	0.3049	-1.5%
AA00607	C2	1223001-16	134.2	6/7/2015 9:03	10006	2981	18.64	509.3585	149.9321	0.2279	5484.28	0.0628	0.0698	0.0628	0.4075	3.4%	0.3049	0.3095	0.3049	-5.2%
AA00607	C2	1223001-17	134.2	6/7/2015 9:29	10000	3040	21.75	459.6581	137.9201	0.2279	5484.28	0.0638	0.0698	0.0638	0.3678	-7.1%	0.3049	0.3095	0.3049	-3.2%
AA00607	C3	1223001-17	134.2	6/7/2015 9:28	9999	2824	16.99	500.0621	139.2106	0.2135	5484.28	0.0612	0.0641	0.0612	0.4271	7.8%	0.3049	0.3095	0.3049	-11.2%
AA00607	C3	1223001-16	134.2	6/7/2015 9:56	10001	3127	22.45	445.3708	137.2273	0.2135	5484.28	0.0612	0.0641	0.0612	0.3804	-3.5%	0.3049	0.3095	0.3049	-0.5%
AA00607	C4	1223001-16	134.2	6/7/2015 10:24	9999	3063	20.12	497.1971	153.3017	0.2089	5484.28	0.0823	0.0808	0.0823	0.4340	9.3%	0.3049	0.3095	0.3049	-0.4%
AA00607	D1	1223001-16	134.2	6/7/2015 10:24	10000	3341	22.76	442.9027	135.1233	0.2089	5484.28	0.0808	0.0814	0.0808	0.3966	-1.9%	0.3049	0.3095	0.3049	-1.5%
AA00607	D1	1223001-17	134.2	6/6/2015 10:19	10000	3063	22.76	483.9378	143.9466	0.2089	5484.28	0.0808	0.0814	0.0808	0.3977	-1.6%	0.3049	0.3095	0.3049	5.5%
AA00607	D2	1223001-16	134.2	6/7/2015 10:22	10004	3001	20.37	491.0214	145.6785	0.2266	5484.28	0.0895	0.0882	0.0895	0.3907	7.8%	0.3049	0.3095	0.3049	-4.8%
AA00607	D2	1223001-17	134.2	6/6/2015 10:45	10001	3140	22.54	443.6071	137.8819	0.2240	5484.30	0.0895	0.0895	0.0895	0.3611	-9.1%	0.3049	0.3095	0.3049	-4.3%
AA00607	D3	1223001-16	134.2	6/6/2015 10:42	10002	3010	19.51	512.5702	152.6399	0.2222	5484.30	0.0935	0.0935	0.0935	0.4306	6.4%	0.3049	0.3095	0.3049	-3.9%
AA00607	D3	1223001-17	134.2	6/6/2015 11:10	10004	3039	21.99	454.8441	136.9582	0.2222	5484.30	0.0823	0.0823	0.0823	0.3732	-5.5%	0.3049	0.3095	0.3049	-3.1%
AA00607	D4	1223001-16	134.2	6/6/2015 11:08	10001	3160	19.75	506.2827	158.2360	0.2160	5484.30	0.0815	0.0815	0.0815	0.4274	7.9%	0.3049	0.3095	0.3049	1.0%
AA00607	D4	1223001-17	134.2	6/6/2015 11:37	10001	3118	22.35	447.3550	137.6038	0.2160	5484.30	0.0815	0.0815	0.0815	0.3777	-4.3%	0.3049	0.3095	0.3049	-0.5%
AA00607	A1	1223001-19	156	6/6/2015 10:46	10002	3057	23.89	418.5449	126.4885	0.2138	5484.30	0.0763	0.0763	0.0763	0.3570	6.0%	0.3049	0.3095	0.3049	-6.0%
AA00607	A2	1223001-19	156	6/6/2015 11:12	10002	3180	23.73	421.3348	132.4196	0.2263	5484.30	0.0768	0.0768	0.0768	0.3365	1.2%	0.3049	0.3095	0.3049	-1.0%
AA00607	A3	1223001-19	156	6/6/2015 11:38	10001	3058	23.67	422.4060	127.5961	0.2196	5484.30	0.0770	0.0770	0.0770	0.3507	4.4%	0.3049	0.3095	0.3049	-6.0%
AA00607	A4	1223001-19	156	6/6/2015 12:03	10000	3168	23.09	432.9779	135.5903	0.2196	5484.30	0.0768	0.0768	0.0768	0.3605	7.0%	0.3049	0.3095	0.3049	-2.3%
AA00607	B1	1223001-19	156	6/6/2015 12:30	10000	3275	24.30	411.4066	133.1507	0.2051	5484.30	0.0750	0.0750	0.0750	0.3658	8.3%	0.3049	0.3095	0.3049	1.1%
AA00607	B2	1223001-19	156	6/6/2015 12:59	9999	3162	24.89	401.6056	125.3820	0.2189	5484.30	0.0732	0.0732	0.0732	0.3345	-3.3%	0.3049	0.3095	0.3049	-2.6%
AA00607	B3	1223001-19	156	6/6/2015 13:26	10003	3166	24.63	405.9987	126.7084	0.2088	5484.30	0.0740	0.0740	0.0740	0.3545	5.4%	0.3049	0.3095	0.3049	-2.6%
AA00607	B4	1223001-19	156	6/6/2015 13:53	10001	3078	24.29	411.5882	124.9868	0.2027	5484.30	0.0750	0.0750	0.0750	0.3702	9.4%	0.3049	0.3095	0.3049	-5.5%
AA00607	C1	1223001-19	156	6/6/2015 14:22	10004	2890	23.19	401.2908	122.7387	0.2069	5484.30	0.0732	0.0732	0.0732	0.3537	5.2%	0.3049	0.3095	0.3049	-4.7%
AA00607	C2	1223001-19	156	6/6/2015 21:39	10001	3015	23.95	417.4663	124.0373	0.2079	5484.29	0.0761	0.0761	0.0761	0.3440	-0.4%	0.3049	0.3095	0.3049	-7.8%
AA00607	C3	1223001-19	156	6/7/2015 8:38	10001	3206	24.50	408.0961	128.7971	0.2135	5484.28	0.0744	0.0744	0.0744	0.3686	3.8%	0.3049	0.3095	0.3049	-1.5%
AA00607	C4	1223001-19	156	6/7/2015 9:05	10002	3103	23.68	422.2628	129.1219	0.2089	5484.28	0.0770	0.0770	0.0770	0.3901	9.0%	0.3049	0.3095	0.3049	-4.7%
AA00607	D1	1223001-19	156	6/7/15 9:32 AM	10001	3047	23.8	420.1108	125.1792	0.2066	5484.28	0.0768	0.0768	0.0768	0.3703	9.5%	0.3049	0.3095	0.3049	-7.5%
AA00607	D2	1223001-19	156	6/7/15 9:59 AM	10000	3145	24.13	414.3288	128.6887	0.2240	5484.28	0.0751	0.0751	0.0751	0.3773	0.5%	0.3049	0.3095	0.3049	-3.1%
AA00607	D3	1223001-19	156	6/7/15 10:24 AM	10005	3072	23.45	426.56245	129.4021	0.2222	5484.28	0.0778	0.0778	0.0778	0.3500	4.2%	0.3049	0.3095	0.3049	-5.6%
AA00607	D4	1223001-19	156	6/6/2015 10:20	10003	3201	23.74	421.2694	133.1317	0.2160	5484.28	0.0768	0.0768	0.0768	0.3556	5.7%	0.3049	0.3095	0.3049	-1.9%

OUTLIERS

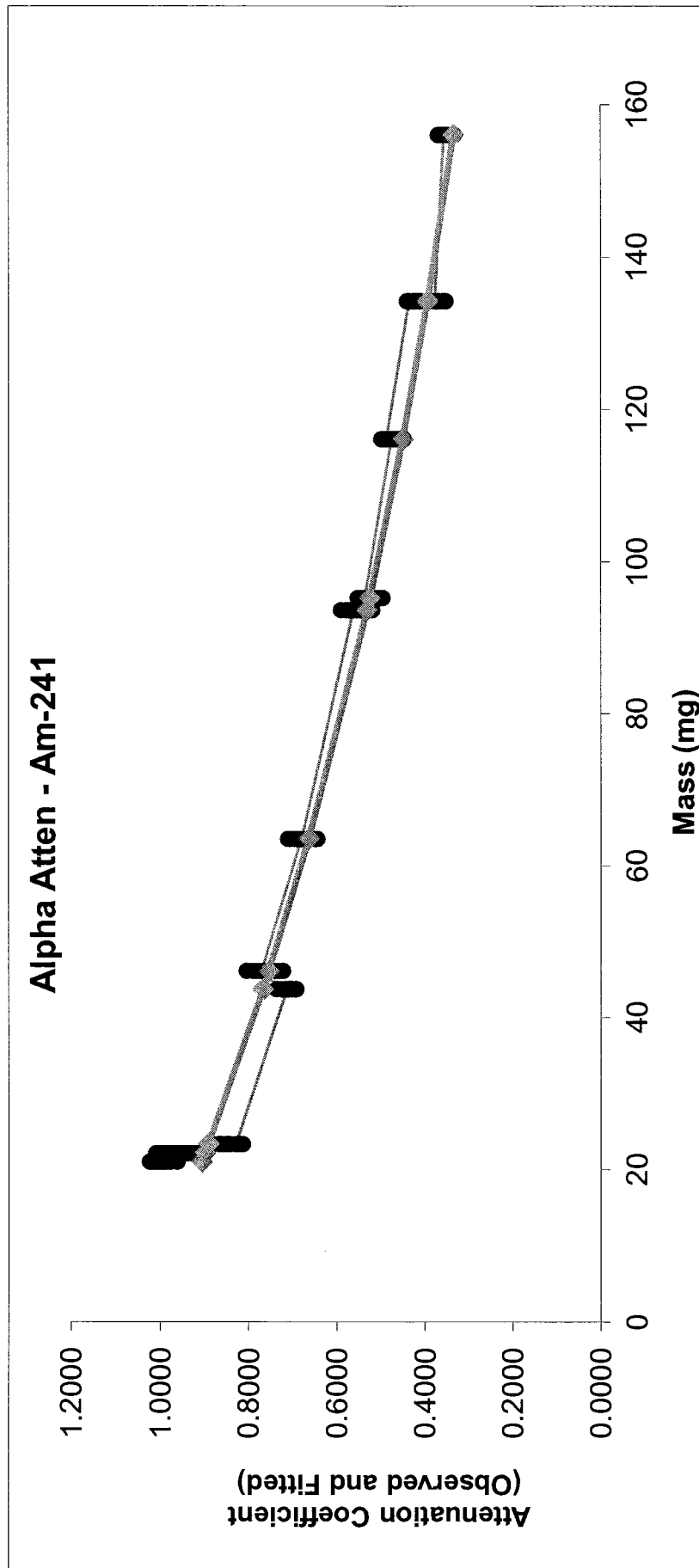
AA\0607	A1	1223001-7	47.5	6/7/2015 8:59	10001	2967	17.7	564.9042	166.1511	0.2138	5484.28	0.1030	0.1594	1.5477	0.4818	0.7456	-54.8%	0.2941	0.2704	0.2941	8.1%
AA\0607	A2	1223001-7	47.5	6/7/2015 9:25	10000	2968	17.64	566.7364	166.6660	0.2263	5484.28	0.1033	0.1637	1.6329	0.4742	0.7456	-63.3%	0.2941	0.2704	0.2941	8.1%
AA\0607	A3	1223001-7	47.5	6/7/2015 9:51	10002	2962	17.51	571.1044	167.5665	0.2196	5484.28	0.1041	0.1837	1.5724	0.4566	0.7456	-57.2%	0.2934	0.2704	0.2934	7.8%
AA\0607	A4	1223001-7	47.5	6/7/2015 10:18	10001	2941	17.26	570.3222	168.7820	0.2190	5484.28	0.1056	0.1933	1.5459	0.4823	0.7456	-54.6%	0.2913	0.2704	0.2913	7.2%
AA\0606	B1	1223001-7	47.5	6/6/2015 10:15	10002	3022	18.33	545.5488	163.2433	0.2051	5484.30	0.0995	0.1529	1.5374	0.4850	0.7456	-53.7%	0.2992	0.2704	0.2992	9.6%
AA\0606	B2	1223001-7	47.5	6/6/2015 10:41	10002	2942	18.56	538.7789	156.8559	0.2189	5484.30	0.0982	0.1632	1.6814	0.4468	0.7456	-66.1%	0.2911	0.2704	0.2911	7.1%
AA\0606	B3	1223001-7	47.5	6/6/2015 11:07	10000	2895	18.34	545.1223	156.0187	0.2088	5484.30	0.0984	0.1557	1.5863	0.4760	0.7456	-56.6%	0.2862	0.2704	0.2862	5.5%
AA\0606	B4	1223001-7	47.5	6/6/2015 11:33	10005	3041	18.20	549.5803	165.3559	0.2027	5484.30	0.1002	0.1511	1.5082	0.4944	0.7456	-50.8%	0.3009	0.2704	0.3009	10.1%
AA\0606	C1	1223001-7	47.5	6/6/2015 11:58	10001	2925	17.67	565.8855	163.6508	0.2069	5484.30	0.1032	0.1543	1.4851	0.4987	0.7456	-49.5%	0.2892	0.2704	0.2892	6.5%
AA\0606	C2	1223001-7	47.5	6/6/2015 12:23	10008	2963	17.26	578.7258	169.2382	0.2279	5484.30	0.1067	0.1699	1.6076	0.4638	0.7456	-60.5%	0.2819	0.2704	0.2819	7.4%
AA\0606	C3	1223001-6	47.5	6/6/2015 12:52	10002	2997	17.89	558.9753	165.4638	0.2135	5484.30	0.1019	0.1592	1.5819	0.4744	0.7456	-58.2%	0.2960	0.2704	0.2960	7.4%
AA\0606	C4	1223001-7	47.5	6/6/2015 13:18	10003	2941	17.57	569.2037	165.4706	0.2089	5484.30	0.1038	0.1558	1.5008	0.4968	0.7456	-50.1%	0.2907	0.2704	0.2907	7.0%
AA\0606	D1	1223001-7	47.5	6/6/2015 13:47	10005	3077	18.15	551.1427	166.8857	0.2066	5484.30	0.1005	0.1540	1.5329	0.4545	0.7456	-53.3%	0.3024	0.2704	0.3024	10.6%
AA\0606	D2	1223001-7	47.5	6/6/2015 14:17	10001	2925	17.91	558.3101	161.6706	0.2240	5484.30	0.1018	0.1670	1.6407	0.4545	0.7456	-64.1%	0.2896	0.2704	0.2896	8.6%
AA\0606	D3	1223001-7	47.5	6/6/2015 21:32	10001	2892	17.47	572.3771	163.9409	0.2222	5484.28	0.1044	0.1657	1.5875	0.4697	0.7456	-58.7%	0.2864	0.2704	0.2864	5.6%
AA\0607	D4	1223001-7	47.5	6/7/15 8:31 AM	10000	3040	17.55	569.71567	171.5154	0.2160	5484.28	0.1038	0.1811	1.5504	0.4809	0.7456	-55.0%	0.3011	0.2704	0.3011	10.2%

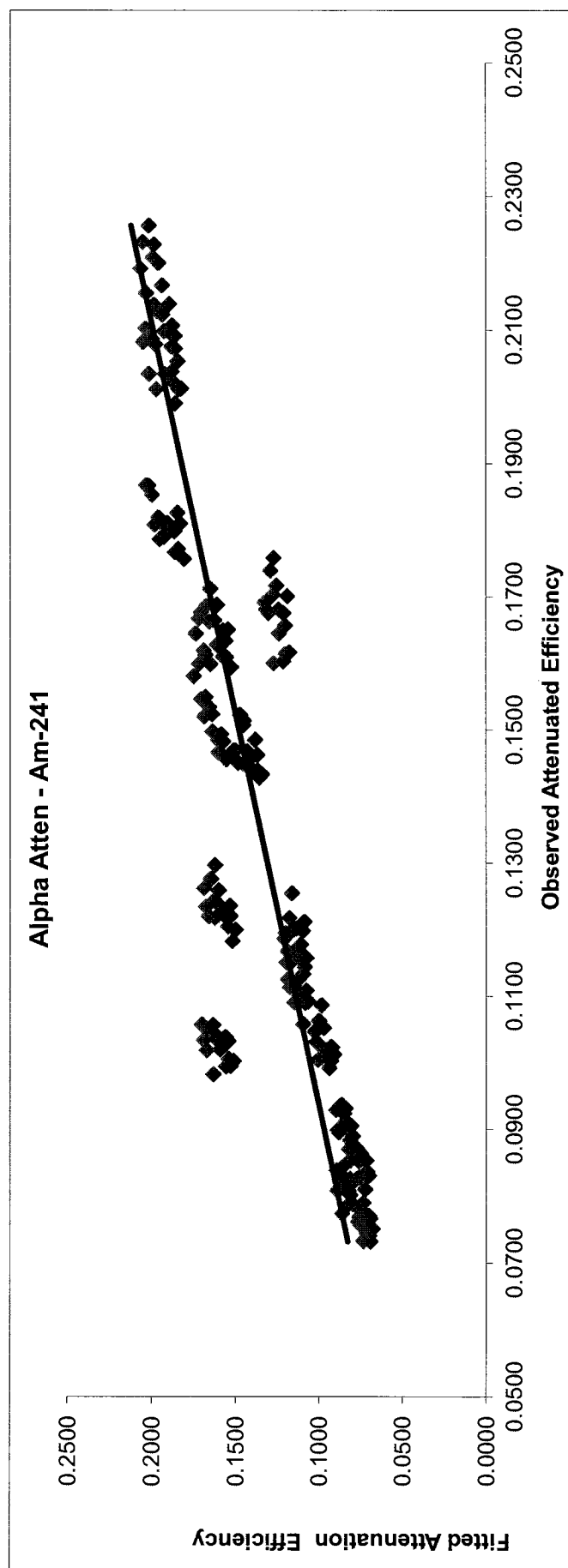
LB4100C Alpha Attenuation Curve -- Am-241

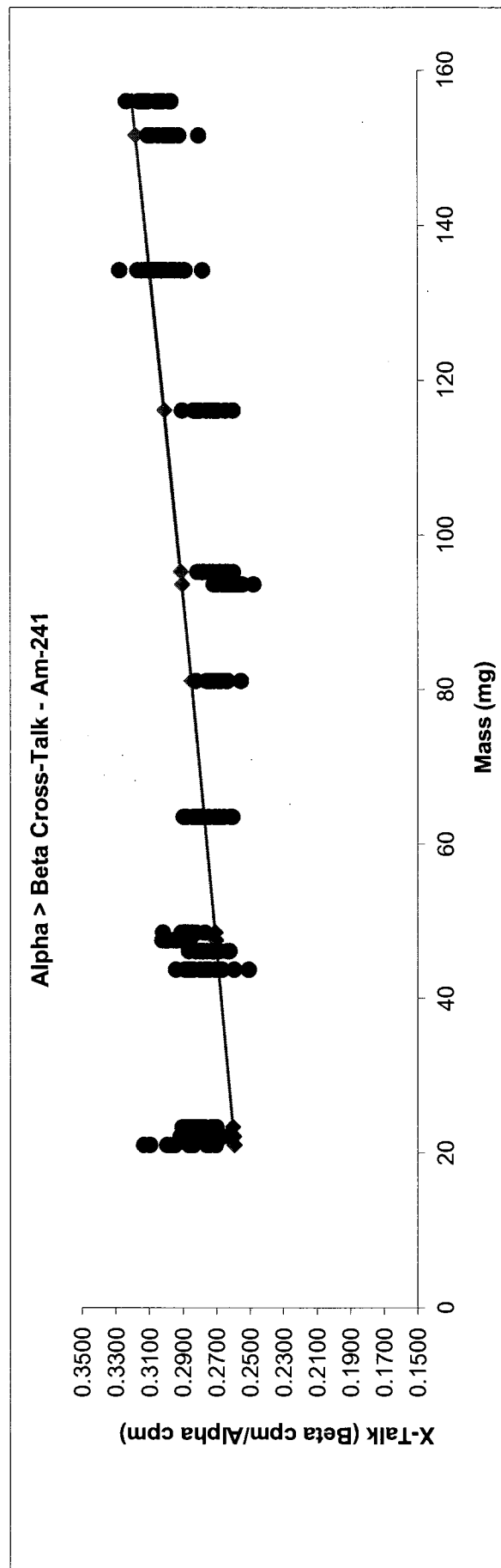
WD #		1223001		Spike Information		955.4065.10		10/25/2011		yrs	
File ID	Detector ID	Sample ID	Mass (mg)	Count	Count Date	Alpha Counts	Beta Counts	Time	Count	Alpha CPM	Beta CPM
AA06007	A1	1223001-6	48.5	2900	67/2015 9:22	10007	2900	14.8	676.0246	194.4669	194.4669
AA06007	A2	1223001-6	48.5	2926	67/2015 9:48	10005	2926	14.78	677.7173	196.3822	196.3822
AA06007	A3	1223001-6	48.5	2910	67/2015 10:16	10002	2910	14.66	682.1527	196.9043	196.9043
AA06006	A4	1223001-6	48.5	2845	66/2015 10:10	10000	2845	14.06	711.1276	188.7201	188.7201
AA06006	B1	1223001-6	48.5	2937	66/2015 10:38	10009	2937	15.43	648.5574	198.7355	198.7355
AA06006	B2	1223001-6	48.5	2859	66/2015 11:03	10001	2859	14.98	667.5015	189.1975	189.1975
AA06006	B3	1223001-6	48.5	2852	66/2015 11:30	10005	2852	15.15	660.2620	186.4178	186.4178
AA06006	B4	1223001-6	48.5	2968	66/2015 11:55	10006	2968	15.71	657.7117	182.2259	182.2259
AA06006	C1	1223001-6	48.5	2926	66/2015 12:20	10010	2926	14.77	677.6231	196.2203	196.2203
AA06006	C2	1223001-6	48.5	2969	66/2015 12:49	10001	2969	14.45	691.9987	196.6967	196.6967
AA06006	C3	1223001-10	48.5	2927	66/2015 13:16	10000	2927	14.86	672.8395	194.9117	194.9117
AA06006	C4	1223001-6	48.5	2924	66/2015 13:43	10006	2924	14.95	686.9477	193.1487	193.1487
AA06006	D1	1223001-6	48.5	2924	66/2015 14:14	10003	2924	14.96	689.0040	190.8283	190.8283
AA06006	D2	1223001-6	48.5	2879	66/2015 21:30	10003	2879	14.95	689.84002	190.8283	190.8283
AA06007	D3	1223001-6	48.5	2917	67/15 8:26 AM	10002	2917	14.29	690.2516	202.5268	202.5268
AA06007	D4	1223001-6	48.5	3046	67/15 8:55 AM	10003	3046	14.49	690.2516	208.5089	208.5089
AA06006	A1	1223001-11	81.1	2570	66/2015 13:39	10000	2570	10.85	921.5350	235.3904	235.3904
AA06006	A2	1223001-11	81.1	2642	66/2015 14:09	10002	2642	10.85	921.6963	260.3475	260.3475
AA06006	A3	1223001-11	81.1	2707	66/2015 21:25	10011	2707	10.72	933.7499	250.9237	250.9237
AA06007	A4	1223001-11	81.1	2695	67/2015 8:24	10009	2695	10.38	964.1482	258.0219	258.0219
AA06007	B1	1223001-11	81.1	2696	67/2015 8:52	10008	2696	10.73	932.5980	249.5420	249.5420
AA06007	B2	1223001-11	81.1	2698	67/2015 9:19	10010	2698	11.41	877.1786	234.8022	234.8022
AA06007	B3	1223001-11	81.1	2784	67/2015 9:45	10015	2784	11.39	879.1481	242.5919	242.5919
AA06007	B4	1223001-11	81.1	2753	67/2015 10:12	10007	2753	11.29	886.2146	242.1121	242.1121
AA06006	C1	1223001-11	81.1	2704	66/2015 10:07	10011	2704	11.02	908.3372	243.4881	243.4881
AA06006	C2	1223001-11	81.1	2656	66/2015 10:33	10006	2656	10.79	927.2281	244.3038	244.3038
AA06006	C3	1223001-12	81.1	2740	66/2015 10:59	10002	2740	11.09	901.7656	245.0064	245.0064
AA06006	C4	1223001-11	81.1	2716	66/2015 11:25	10007	2716	10.89	918.7974	247.4861	247.4861
AA06006	D1	1223001-11	81.1	2721	66/2015 11:51	10011	2721	11.31	885.0489	237.7376	237.7376
AA06006	D2	1223001-11	81.1	2709	66/2015 12:17	10016	2709	10.9	918.8061	246.8861	246.8861
AA06006	D3	1223001-11	81.1	2665	66/2015 12:45	10013	2665	10.5	953.5290	252.2095	252.2095
AA06006	D4	1223001-11	81.1	2757	66/2015 13:12	10007	2757	10.63	941.3053	257.6563	257.6563
AA06006	A1	1223001-18	151.6	3016	66/2015 11:10	10002	3016	21.27	470.1158	140.3200	140.3200
AA06006	A2	1223001-18	151.6	3015	66/2015 11:36	10000	3015	21.26	470.2098	140.2276	140.2276
AA06006	A3	1223001-18	151.6	3143	66/2015 12:02	10003	3143	21.42	466.8815	145.1370	145.1370
AA06006	A4	1223001-18	151.6	3119	66/2015 12:27	10004	3119	21.06	474.9137	146.8887	146.8887
AA06006	B1	1223001-18	151.6	3036	66/2015 12:56	10002	3036	21.6	468.6853	137.6431	137.6431
AA06006	B2	1223001-18	151.6	3088	66/2015 13:24	10001	3088	22.02	444.1574	135.3505	135.3505
AA06006	B3	1223001-18	151.6	3052	66/2015 13:51	10001	3052	21.97	465.1577	136.4109	136.4109
AA06006	B4	1223001-18	151.6	3088	66/2015 14:21	10001	3088	22.51	467.6716	140.8662	140.8662
AA06006	C1	1223001-18	151.6	3052	66/2015 14:35	10001	3052	21.98	474.4136	140.3227	140.3227
AA06007	C2	1223001-18	151.6	2997	67/2015 8:35	10003	2997	21.08	470.1788	131.9315	131.9315
AA06007	C3	1223001-19	151.6	2850	67/2015 9:02	10003	2850	21.27	468.5461	138.6919	138.6919
AA06007	C4	1223001-18	151.6	3002	67/2015 9:29	10006	3002	21.35	468.5461	138.6919	138.6919
AA06007	D1	1223001-18	151.6	3061	67/2015 9:56	10001	3061	21.92	456.1530	136.7882	136.7882
AA06007	D2	1223001-18	151.6	2997	67/15 10:23 AM	10002	2997	22.09	452.69107	134.0262	134.0262
AA06006	D3	1223001-18	151.6	2959	66/2015 10:17	10004	2959	20.96	477.2001	139.5737	139.5737
AA06006	D4	1223001-18	151.6	3081	66/2015 10:43	10001	3081	21.14	492.9872	144.0387	144.0387

Attenuation Equation: $y = b \cdot m^a$		b = 0.6030		m = 0.9911		a = 0.8270		x0 = 21.4875		% Diff Max = 11.5%	
File ID	Detector ID	Sample ID	Mass (mg)	Count	Count Date	Alpha Counts	Beta Counts	Time	Count	Alpha CPM	Beta CPM
AA06007	A1	1223001-6	48.5	2900	67/2015 9:22	10007	2900	14.8	676.0246	194.4669	194.4669
AA06007	A2	1223001-6	48.5	2926	67/2015 9:48	10005	2926	14.78	677.7173	196.3822	196.3822
AA06007	A3	1223001-6	48.5	2910	67/2015 10:16	10002	2910	14.66	682.1527	196.9043	196.9043
AA06006	A4	1223001-6	48.5	2845	66/2015 10:10	10000	2845	14.06	711.1276	188.7201	188.7201
AA06006	B1	1223001-6	48.5	2937	66/2015 10:38	10009	2937	15.43	648.5574	198.7355	198.7355
AA06006	B2	1223001-6	48.5	2859	66/2015 11:03	10001	2859	14.98	667.5015	189.1975	189.1975
AA06006	B3	1223001-6	48.5	2852	66/2015 11:30	10005	2852	15.15	660.2620	186.4178	186.4178
AA06006	B4	1223001-6	48.5	2968	66/2015 11:55	10006	2968	15.71	657.7117	182.2259	182.2259
AA06006	C1	1223001-6	48.5	2926	66/2015 12:20	10010	2926	14.77	677.6231	196.2203	196.2203
AA06006	C2	1223001-6	48.5	2969	66/2015 12:49	10001	2969	14.45	691.9987	196.6967	196.6967
AA06006	C3	1223001-10	48.5	2927	66/2015 13:16	10000	2927	14.86	672.8395	194.9117	194.9117
AA06006	C4	1223001-6	48.5	2924	66/2015 13:43	10006	2924	14.95	686.9477	193.1487	193.1487
AA06006	D1	1223001-6	48.5	2924	66/2015 14:14	10003	2924	14.96	689.0040	190.8283	190.8283
AA06006	D2	1223001-6	48.5	2879	66/2015 21:30	10003	2879	14.95	689.84002	190.8283	190.8283
AA06007	D3	1223001-6	48.5	2917	67/15 8:26 AM	10002	2917	14.29	690.2516	202.5268	202.5268
AA06007	D4	1223001-6	48.5	3046	67/15 8:55 AM	10003	3046	14.49	690.2516	208.5089	208.5089

Cross-Talk Equation		b = 0.2511		m = 0.9684		a = 0.8270		x0 = 21.4875		% Diff Max = 17.2%	
File ID	Detector ID	Sample ID	Mass (mg)	Count	Count Date	Alpha Counts	Beta Counts	Time	Count	Alpha CPM	Beta CPM
AA06007	A1	1223001-6	48.5	2900	67/2015 9:22	10007	2900	14.8	676.0246	194.4669	194.4669
AA06007	A2	1223001-6	48.5	2926	67/2015 9:48	10005	2926	14.78	677.7173	196.3822	196.3822
AA06007	A3	1223001-6	48.5	2910	67/2015 10:16	10002	2910	14.66	682.1527	196.9043	196.9043
AA06006	A4	1223001-6	48.5	2845	66/2015 10:10	10000	2845	14.06	711.1276	188.7201	188.7201
AA06006	B1	1223001-6	48.5	2937	66/2015 10:38	10009	2937	15.43	648.5574	198.7355	198.7355
AA06006	B2	1223001-6	48.5	2859	66/2015 11:03	10001	2859	14.98	667.5015	189.1975	189.1975
AA06006	B3	1223001-6	48.5	2852	66/2015 11:30	10005	2852	15.15	660.2620	186.4178	186.4178
AA06006	B4	1223001-6	48.5	2968	66/2015 11:55	10006	2968	15.71	657.7117	182.2259	182.2259
AA06006	C1	1223001-6	48.5	2926	66/2015 12:20	10010	2926	14.77	677.6231	196.2203	196.2203
AA06006	C2	1223001-6	48.5	2969	66/2015 12:49	10001	2969	14.45	691.9987	196.6967	196.6967
AA06006	C3	1223001-10	48.5	2927	66/2015 13:16	10000	2927	14.86	672.8395	194.9117	194.9117
AA06006	C4	1223001-6	48.5	2924	66/2015 13:43	10006	2924	14.95	686.9477	193.1487	193.1487
AA06006	D1	1223001-6	48.5	2924	66/2015 14:14	10003	2924	14.96	689.0040	190.8283	190.8283
AA06006	D2	1223001-6	48.5	2879	66/2015 21:30	10003	2879	14.95	689.84002	190.8283	190.8283
AA06007	D3	1223001-6	48.5	2917	67/15 8:26 AM	10002	2917	14.29	690.2516	202.5268	202.5268
AA06007	D4	1223001-6	48.5	3046	67/15 8:55 AM	10003	3046	14.49	690.2516	208.5089	208.5089







LB4100C Beta Attenuation Curve -- Sr-90

WO #: 1118007		Calibrated Mass Range		Attenuation Equation		Cross-Talk Equation	
Nuclide: Sr-90		Low 7.7 mg		b = 0.9681		b = -1.6873E-05	
Std. ID: 777.3020.11		High 158.6 mg		m = 0.9996		m = 0.0036	
Ref. Date: 02/08/06				a = 0.9174		% Diff Max. = 85.5%	
Half-life: 28.5 yrs				% Diff Max. = 5.0%			
Activity: 4996.73 dpm/mL							
Vol.: 2 mL							

File ID	Detector	Sample ID	Mass (mg)	Count Date	Alpha Counts	Beta Counts	Count Time	Base Beta Eff.	Alpha CPM	Beta CPM	Decay Corr. added dpm/mL	Beta Obs. Attenu. Eff.	Obs. Attenu. Fact.	Fitted Attenu. Fact.	% Diff.	$\beta > \alpha$ XTLLK Observed	$\beta > \alpha$ XTLLK Fitted	% Diff.
ASR0607	A1	1118007-2	7.7	6/7/2015 11:58	10	10043	2.9	0.4297	3.32	3461.63	7965.36	0.4346	1.0114	0.9652	4.8%	0.0010	0.0035	-72.3%
ASR0607	A2	1118007-2	7.7	6/7/2015 10:38	12	10049	2.94	0.4442	3.92	3416.44	7965.39	0.4289	0.9656	0.9652	0.0%	0.0011	0.0035	-66.9%
ASR0607	A3	1118007-2	7.7	6/7/2015 10:44	12	10032	2.93	0.4508	3.92	3422.30	7965.38	0.4296	0.9531	0.9652	-1.3%	0.0012	0.0035	-66.5%
ASR0607	A4	1118007-2	7.7	6/7/2015 10:49	10	10028	2.88	0.4542	3.36	3480.33	7965.38	0.4369	0.9620	0.9652	-0.3%	0.0010	0.0035	-72.2%
ASR0607	B1	1118007-2	7.7	6/7/2015 10:55	7	10025	2.94	0.4347	2.27	3408.24	7965.38	0.4279	0.9843	0.9652	2.0%	0.0007	0.0035	-80.8%
ASR0607	B2	1118007-2	7.7	6/7/2015 11:00	14	10049	3	0.4272	4.54	3348.01	7965.38	0.4203	0.9839	0.9652	1.9%	0.0014	0.0035	-60.9%
ASR0607	B3	1118007-2	7.7	6/7/2015 11:05	12	10025	2.98	0.4341	3.89	3362.26	7965.38	0.4221	0.9724	0.9652	0.7%	0.0012	0.0035	-66.7%
ASR0607	B4	1118007-2	7.7	6/7/2015 11:11	13	10039	3	0.4278	4.19	3344.60	7965.38	0.4199	0.9815	0.9652	1.7%	0.0013	0.0035	-63.9%
ASR0607	C1	1118007-2	7.7	6/7/2015 11:16	14	10035	2.91	0.4314	4.71	3446.57	7965.37	0.4327	1.0030	0.9652	3.9%	0.0014	0.0035	-60.6%
ASR0607	C2	1118007-2	7.7	6/7/2015 11:21	9	10042	2.87	0.4334	3.02	3497.10	7965.37	0.4390	1.0130	0.9652	5.0%	0.0009	0.0035	-75.1%
ASR0607	C3	1118007-2	7.7	6/7/2015 11:26	22	10059	2.9	0.4422	7.48	3466.56	7965.37	0.4352	0.9842	0.9652	2.0%	0.0022	0.0035	-37.9%
ASR0607	C4	1118007-2	7.7	6/7/2015 11:32	10	10032	2.89	0.434	3.34	3469.36	7965.37	0.4356	1.0036	0.9652	4.0%	0.0010	0.0035	-72.3%
ASR0607	D1	1118007-2	7.7	6/7/2015 11:37	22	10025	3.01	0.4290	7.21	3327.72	7965.37	0.4178	0.9738	0.9652	0.9%	0.0022	0.0035	-37.6%
ASR0607	D2	1118007-2	7.7	6/7/2015 11:42	15	10004	2.93	0.4319	5.03	3412.69	7965.36	0.4284	0.9920	0.9652	2.8%	0.0015	0.0035	-57.6%
ASR0607	D3	1118007-2	7.7	6/7/2015 11:47	11	10056	2.92	0.4475	3.68	3442.24	7965.36	0.4322	0.9657	0.9652	0.1%	0.0011	0.0035	-69.2%
ASR0607	D4	1118007-2	7.7	6/7/2015 11:53	11	10045	2.91	0.4464	3.69	3450.19	7965.36	0.4331	0.9703	0.9652	0.5%	0.0011	0.0035	-69.2%
ASR0607	A1	1118007-1	8.1	6/7/2015 10:38	13	10055	2.96	0.4297	4.27	3395.48	7965.39	0.4263	0.9920	0.9650	2.8%	0.0013	0.0035	-63.7%
ASR0607	A2	1118007-1	8.1	6/7/2015 10:44	11	10023	2.88	0.4442	3.66	3478.62	7965.38	0.4367	0.9832	0.9650	1.9%	0.0011	0.0035	-69.6%
ASR0607	A3	1118007-1	8.1	6/7/2015 10:49	8	10025	2.94	0.4508	2.61	3408.27	7965.38	0.4279	0.9492	0.9650	-1.6%	0.0008	0.0035	-77.9%
ASR0607	A4	1118007-1	8.1	6/7/2015 10:55	15	10022	2.82	0.4542	5.21	3552.29	7965.38	0.4460	0.9819	0.9650	1.7%	0.0015	0.0035	-57.9%
ASR0607	B1	1118007-1	8.1	6/7/2015 11:00	12	10022	2.97	0.4347	3.93	3372.79	7965.38	0.4234	0.9741	0.9650	0.9%	0.0012	0.0035	-66.4%
ASR0607	B2	1118007-1	8.1	6/7/2015 11:05	15	10030	3.01	0.4272	4.86	3330.57	7965.38	0.4181	0.9788	0.9650	1.4%	0.0015	0.0035	-57.9%
ASR0607	B3	1118007-1	8.1	6/7/2015 11:11	19	10053	2.95	0.4341	6.31	3405.96	7965.38	0.4276	0.9850	0.9650	2.1%	0.0019	0.0035	-46.6%
ASR0607	B4	1118007-1	8.1	6/7/2015 11:16	16	10019	2.98	0.4278	5.22	3360.35	7965.37	0.4219	0.9861	0.9650	2.2%	0.0016	0.0035	-55.1%
ASR0607	C1	1118007-1	8.1	6/7/2015 11:21	13	10022	2.95	0.4314	4.30	3395.40	7965.37	0.4263	0.9881	0.9650	2.4%	0.0013	0.0035	-63.4%
ASR0607	C2	1118007-1	8.1	6/7/2015 11:26	10	10060	2.92	0.4334	3.31	3443.36	7965.37	0.4323	0.9974	0.9650	3.4%	0.0010	0.0035	-72.2%
ASR0607	C3	1118007-1	8.1	6/7/2015 11:32	14	10069	2.92	0.4422	4.69	3446.23	7965.37	0.4327	0.9784	0.9650	1.4%	0.0014	0.0035	-60.8%
ASR0607	C4	1118007-1	8.1	6/7/2015 11:37	18	10047	2.93	0.4340	6.02	3427.09	7965.37	0.4302	0.9914	0.9650	2.7%	0.0018	0.0035	-49.3%
ASR0607	D1	1118007-1	8.1	6/7/2015 11:42	21	10034	3	0.4290	6.90	3341.82	7965.36	0.4195	0.9780	0.9650	1.3%	0.0021	0.0035	-40.4%
ASR0607	D2	1118007-1	8.1	6/7/2015 11:47	20	10038	2.9	0.4319	6.80	3459.73	7965.36	0.4343	1.0057	0.9650	4.2%	0.0020	0.0035	-43.3%
ASR0607	D3	1118007-1	8.1	6/7/2015 11:53	17	10059	2.89	0.4475	5.79	3479.02	7965.36	0.4368	0.9760	0.9650	1.1%	0.0017	0.0035	-52.0%
ASR0607	D4	1118007-1	8.1	6/7/2015 11:58	7	10031	2.87	0.4464	2.35	3493.42	7965.36	0.4386	0.9825	0.9650	1.8%	0.0007	0.0035	-80.8%
ASR0607	A1	1118007-4	19	6/7/2015 11:48	21	10039	2.98	0.4297	6.92	3367.32	7965.36	0.4227	0.9838	0.9609	2.4%	0.0021	0.0033	-37.3%
ASR0607	A2	1118007-4	19	6/7/2015 11:53	9	10057	2.95	0.4442	2.89	3407.56	7965.36	0.4278	0.9631	0.9609	0.2%	0.0008	0.0033	-74.1%
ASR0607	A3	1118007-4	19	6/7/2015 11:58	10	10020	2.94	0.4508	3.29	3406.57	7965.36	0.4277	0.9487	0.9609	-1.3%	0.0010	0.0033	-70.6%
ASR0607	A4	1118007-4	19	6/7/2015 10:38	14	10033	2.81	0.4542	4.87	3588.85	7965.39	0.4480	0.9864	0.9609	2.7%	0.0014	0.0033	-58.4%
ASR0607	B1	1118007-4	19	6/7/2015 10:44	17	10040	2.97	0.4347	5.61	3378.85	7965.38	0.4242	0.9758	0.9609	1.5%	0.0017	0.0033	-49.4%
ASR0607	B2	1118007-4	19	6/7/2015 10:49	21	10005	2.98	0.4272	6.92	3355.73	7965.38	0.4213	0.9862	0.9609	2.6%	0.0021	0.0033	-37.1%
ASR0607	B3	1118007-4	19	6/7/2015 10:55	14	10026	3	0.4341	4.53	3340.17	7965.38	0.4193	0.9660	0.9609	0.5%	0.0014	0.0033	-58.6%
ASR0607	B4	1118007-4	19	6/7/2015 11:00	16	10058	2.97	0.4278	5.24	3384.80	7965.38	0.4249	0.9833	0.9609	3.4%	0.0015	0.0033	-52.8%
ASR0607	C1	1118007-4	19	6/7/2015 11:05	8	10019	2.96	0.4314	2.60	3382.91	7965.38	0.4247	0.9845	0.9609	2.4%	0.0008	0.0033	-76.6%
ASR0607	C2	1118007-4	19	6/7/2015 11:11	14	10035	2.94	0.4334	4.65	3411.42	7965.38	0.4283	0.9882	0.9609	2.8%	0.0014	0.0033	-58.5%
ASR0607	C3	1118007-4	19	6/7/2015 11:16	14	10062	2.9	0.4422	4.72	3467.60	7965.37	0.4353	0.9845	0.9609	2.4%	0.0014	0.0033	-58.5%
ASR0607	C4	1118007-4	19	6/7/2015 11:21	19	10044	2.91	0.4340	6.41	3449.63	7965.37	0.4331	0.9979	0.9609	3.8%	0.0019	0.0033	-43.4%
ASR0607	D1	1118007-4	19	6/7/2015 11:27	13	10022	3.02	0.4290	4.21	3315.70	7965.37	0.4163	0.9703	0.9609	1.0%	0.0013	0.0033	-61.3%
ASR0607	D2	1118007-4	19	6/7/2015 11:32	22	10026	2.94	0.4319	7.39	3408.56	7965.37	0.4279	0.9908	0.9609	3.1%	0.0022	0.0033	-33.9%
ASR0607	D3	1118007-4	19	6/7/2015 11:37	16	10032	2.91	0.4475	5.41	3445.82	7965.37	0.4326	0.9667	0.9609	0.6%	0.0016	0.0033	-52.2%
ASR0607	D4	1118007-4	19	6/7/2015 11:42	17	10029	2.94	0.4464	5.70	3409.52	7965.36	0.4280	0.9589	0.9609	-0.2%	0.0017	0.0033	-49.1%

LB4100C Beta Attenuation Curve -- Sr-90

WO #.		1118007		Calibrated Mass Range										Cross-Talk Equation									
				Low		High		7.7 mg		mg													

Nuclide: Sr-90		Std. ID: 777 3020.11		Ref. Date: 02/08/06		Half-life: 28.5 yrs		Activity: 4996.73 dpm/mL		Vol.: 2 mL		Attenuation Equation										Cross-Talk Equation																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								</	

Cross-Talk Equation		y=b*x+m	
		b = -1.6873E-05	
		m = 0.0036	
		% Diff Max = 85.5%	

Attenuation Equation		y=b*t^n*(a*x)	
		b = 0.9681	
		m = 0.9996	
		a = 0.9174	
		% Diff Max = 5.0%	

LB4100C Beta Attenuation Curve -- Sr-90

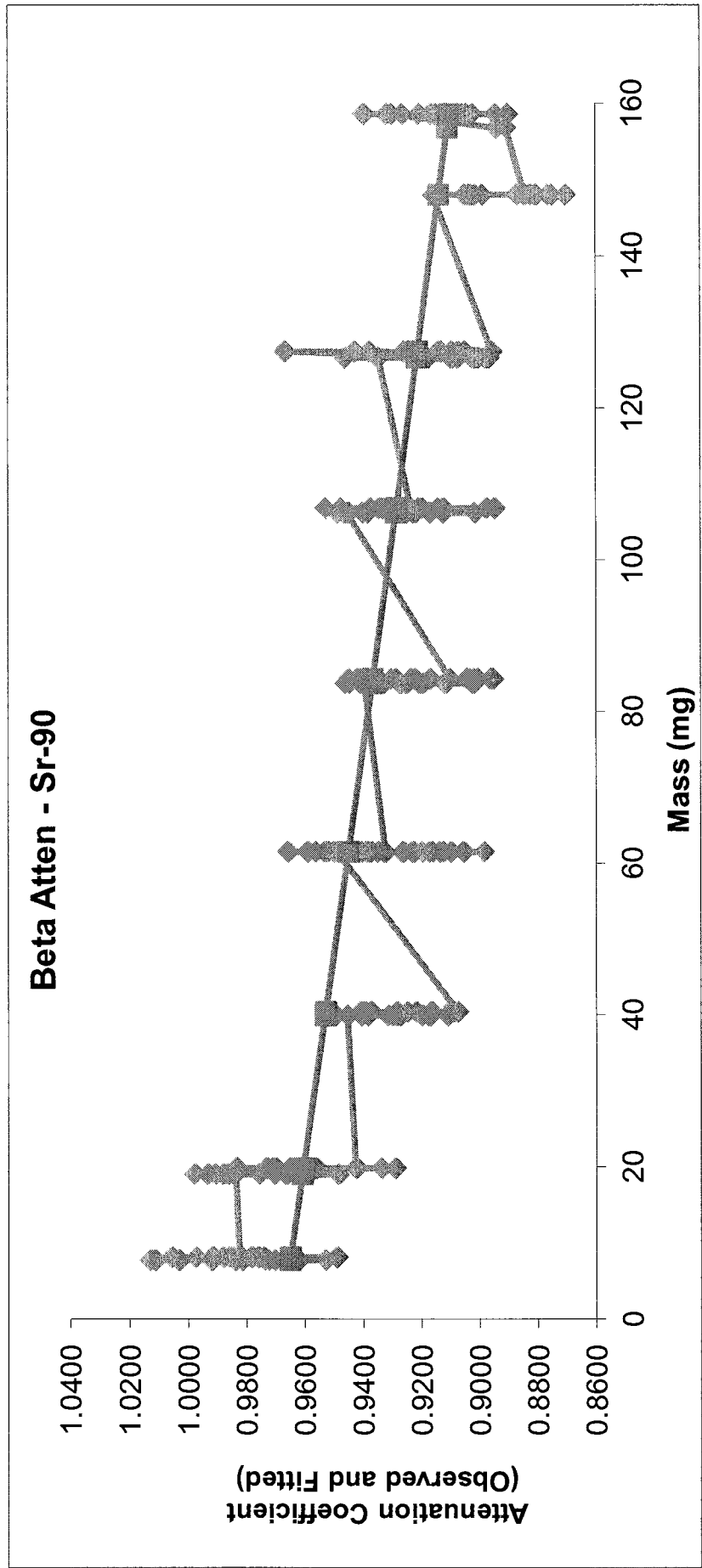
WO #: 1118007		Calibrated Mass Range				Attenuation Equation										Cross-Talk Equation			
		Low		High		y=b*m ^a (a,x)										y=b*x ^m			
		7.7 mg		158.6 mg		b = 0.9681 m = 0.9996 a = 0.9174										b = -1.6873E-05 m = 0.0036			
						% Diff Max. = 5.0%										% Diff Max. = 85.5%			
Nuclide:	Sr-90	61.5	67/2015 11:27	10	10010	3.08	0.4297	3.12	3248.52	7965.37	0.4078	0.9491	0.9452	0.0010	0.0026	-62.5%			
Std. ID:	777.3020.11	61.5	67/2015 11:32	16	10021	3.06 <td>0.4297</td> <td>5.10</td> <td>3273.36</td> <td>7965.37</td> <th>0.4109</th> <th>0.9564</th> <th>0.9452</th> <th>0.0016</th> <th>0.0026</th> <th>-39.2%</th>	0.4297	5.10	3273.36	7965.37	0.4109	0.9564	0.9452	0.0016	0.0026	-39.2%			
Ref. Date:	02/08/06	61.5	67/2015 11:32	17	10033	3.06 <td>0.4442</td> <td>5.40</td> <td>3277.17</td> <td>7965.37</td> <th>0.4114</th> <th>0.9262</th> <th>0.9452</th> <th>0.0016</th> <th>0.0026</th> <th>-35.8%</th>	0.4442	5.40	3277.17	7965.37	0.4114	0.9262	0.9452	0.0016	0.0026	-35.8%			
Half-life:	28.5 yrs	61.5	67/2015 11:37	7	10022	3.01 <td>0.4442</td> <td>2.17</td> <td>3327.98</td> <td>7965.37</td> <th>0.4178</th> <th>0.9406</th> <th>0.9452</th> <th>0.0007</th> <th>0.0026</th> <th>-74.6%</th>	0.4442	2.17	3327.98	7965.37	0.4178	0.9406	0.9452	0.0007	0.0026	-74.6%			
Activity:	4996.73 dpm/mL	61.5	67/2015 11:37	12	10034	3.07 <td>0.4508</td> <td>3.80</td> <td>3266.81</td> <td>7965.37</td> <th>0.4101</th> <th>0.9098</th> <th>0.9452</th> <th>0.0012</th> <th>0.0026</th> <th>-54.7%</th>	0.4508	3.80	3266.81	7965.37	0.4101	0.9098	0.9452	0.0012	0.0026	-54.7%			
Vol.:	2	61.5	67/2015 11:43	7	10011	3.05	0.4508	2.18	3280.70	7965.36	0.4119	0.9136	0.9452	0.0007	0.0026	-74.1%			
		61.5	67/2015 11:43	10	10054	3.02	0.4542	3.20	3327.53	7965.36	0.4177	0.9197	0.9452	0.0010	0.0026	-62.5%			
		61.5	67/2015 11:48	17	10042	2.94	0.4542	5.67	3414.03	7965.36	0.4286	0.9437	0.9452	0.0017	0.0026	-35.2%			
		61.5	67/2015 11:48	13	10011	3.13	0.4347	4.04	3196.78	7965.36	0.4013 <th>0.9232</th> <th>0.9452</th> <th>0.0013</th> <th>0.0026</th> <th>-50.7%</th>	0.9232	0.9452	0.0013	0.0026	-50.7%			
		61.5	67/2015 11:53	6	10041	3.04	0.4347	1.86	3301.34	7965.36	0.4145	0.9534	0.9452	0.0006	0.0026	-78.0%			
		61.5	67/2015 11:53	13	10008	3.1	0.4272	4.07	3226.73	7965.36	0.4051	0.9463	0.9452	0.0013	0.0026	-50.8%			
		61.5	67/2015 11:58	12	10028	3.15	0.4272	3.69	3181.84	7965.36	0.3995	0.9351	0.9452	0.0012	0.0026	-54.8%			
		61.5	67/2015 10:38	13	10007	3.17	0.4341	3.97	3154.95	7965.39	0.3961	0.9124	0.9452	0.0013	0.0026	-61.0%			
		61.5	67/2015 11:58	14	10016	3.16	0.4341	4.30	3167.79	7965.36	0.3977	0.9161	0.9452	0.0014	0.0026	-47.1%			
		61.5	67/2015 10:38	7	10020	3.15	0.4278	2.08	3179.22	7965.39	0.3991	0.9330	0.9452	0.0007	0.0026	-74.5%			
		61.5	67/2015 10:44	13	10009	3.09	0.4278	4.06	3237.43	7965.38	0.4064	0.9501	0.9452	0.0013	0.0026	-51.1%			
		61.5	67/2015 10:44	14	10033	3.11	0.4314	4.40	3224.16	7965.38	0.4048	0.9363	0.9452	0.0014	0.0026	-46.8%			
		61.5	67/2015 10:49	12	10056	3.07	0.4314	3.81	3273.69	7965.38	0.4110	0.9527	0.9452	0.0012	0.0026	-54.7%			
		61.5	67/2015 10:49	21	10049	3.09	0.4334	6.68	3250.25	7965.38	0.4080	0.9415	0.9452	0.0021	0.0026	-19.8%			
		61.5	67/2015 10:55	17	10047	3.07	0.4334	5.43	3270.79	7965.38	0.4106	0.9475	0.9452	0.0017	0.0026	-35.3%			
		61.5	67/2015 10:55	8	10037	3.17	0.4422	2.42	3164.19	7965.38	0.3972	0.8963	0.9452	0.0008	0.0026	-70.2%			
		61.5	67/2015 11:00	10	10042	3.04	0.4422	3.18	3301.23	7965.38	0.4144	0.9372	0.9452	0.0010	0.0026	-62.4%			
		61.5	67/2015 11:00	9	10010	3.04	0.4340	2.84	3290.85	7965.38	0.4131	0.9519	0.9452	0.0009	0.0026	-66.3%			
		61.5	67/2015 11:05	9	10018	3.02	0.4340	2.86	3315.30	7965.38	0.4162	0.9590	0.9452	0.0009	0.0026	-66.3%			
		61.5	67/2015 11:05	13	10016	3.16	0.4290	4.02	3166.77	7965.38	0.3976	0.9267	0.9452	0.0013	0.0026	-50.5%			
		61.5	67/2015 11:11	11	10020	3.12	0.4290	3.43	3208.69	7965.38	0.4028	0.9390	0.9452	0.0011	0.0026	-58.3%			
		61.5	67/2015 11:11	12	10035	3.16	0.4319	3.70	3173.99	7965.37	0.3985	0.9226	0.9452	0.0012	0.0026	-54.5%			
		61.5	67/2015 11:16	14	10039	3.02	0.4319	4.54	3322.53	7965.37	0.4171	0.9658	0.9452	0.0014	0.0026	-46.7%			
		61.5	67/2015 11:16	4	10010	3	0.4475	1.20	3227.43	7965.37	0.4052	0.9054	0.9452	0.0004	0.0026	-85.5%			
		61.5	67/2015 11:21	5	10038	3.1	0.4475	1.58	3344.40	7965.37	0.4199	0.9363	0.9452	0.0005	0.0026	-81.6%			
		61.5	67/2015 11:21	12	10018	3.07	0.4464	3.82	3261.49	7965.37	0.4095	0.9172	0.9452	0.0012	0.0026	-54.3%			
		61.5	67/2015 11:27	9	10018	3.02	0.4464	2.89	3315.51	7965.37	0.4162	0.9324	0.9452	0.0009	0.0026	-66.0%			
		83.7	67/2015 11:21	6	10007	3.11	0.4297	1.81	3216.21	7965.37	0.4038	0.9397	0.9370	0.0006	0.0022	-74.4%			
		83.7	67/2015 11:32	5	10037	3.08	0.4442	1.47	3257.18	7965.37	0.4089	0.9206	0.9370	0.0005	0.0022	-79.4%			
		83.7	67/2015 11:32	12	10055	3.07	0.4508	3.80	3273.65	7965.37	0.4110	0.9117 <th>0.9370</th> <th>0.0012</th> <th>0.0022</th> <th>-47.0%</th>	0.9370	0.0012	0.0022	-47.0%			
		83.7	67/2015 11:37	12	10029	3.01	0.4542	3.88	3330.28	7965.37	0.4181	0.9205	0.9370	0.0012	0.0022	-46.8%			
		83.7	67/2015 11:43	4	10023	3.12	0.4347	1.17	3210.88	7965.36	0.4031	0.9273 <th>0.9370</th> <th>0.0004</th> <th>0.0022</th> <th>-83.4%</th>	0.9370	0.0004	0.0022	-83.4%			
		83.7	67/2015 11:48	14	10036	3.12	0.4272	4.37	3215.01	7965.36	0.4036	0.9448	0.9370	0.0014	0.0022	-38.0%			
		83.7	67/2015 11:53	15	10004	3.17	0.4341	4.60	3154.00	7965.36	0.3960 <th>0.9122<th>0.9370</th><th>0.0015</th><th>0.0022</th><th>-33.4%</th></th>	0.9122 <th>0.9370</th> <th>0.0015</th> <th>0.0022</th> <th>-33.4%</th>	0.9370	0.0015	0.0022	-33.4%			
		83.7	67/2015 11:58	16	10040	3.13	0.4278	4.97	3205.94	7965.36	0.4025	0.9408	0.9370	0.0015	0.0022	-29.2%			
		83.7	67/2015 10:38	12	10020	3.17	0.4314	3.68	3159.00	7965.39	0.3966	0.9193 <th>0.9370</th> <th>0.0012</th> <th>0.0022</th> <th>-46.7%</th>	0.9370	0.0012	0.0022	-46.7%			
		83.7	67/2015 10:44	11	10034	3.07	0.4334	3.47	3266.55	7965.38	0.4101	0.9462	0.9370	0.0011	0.0022	-51.5%			
		83.7	67/2015 10:49	10	10031	3.05	0.4422	3.17	3286.79	7965.38	0.4126	0.9331 <th>0.9370</th> <th>0.0010</th> <th>0.0022</th> <th>-55.9%</th>	0.9370	0.0010	0.0022	-55.9%			
		83.7	67/2015 10:55	12	10039	3.13	0.4340	3.71	3205.43	7965.38	0.4024	0.9272 <th>0.9370</th> <th>0.0012</th> <th>0.0022</th> <th>-47.1%</th>	0.9370	0.0012	0.0022	-47.1%			
		83.7	67/2015 11:00	19	10023	3.14	0.4290	5.95	3189.19	7965.38	0.4004	0.9333 <th>0.9370</th> <th>0.0019</th> <th>0.0022</th> <th>-14.7%</th>	0.9370	0.0019	0.0022	-14.7%			
		83.7	67/2015 11:05	12	10034	3.11	0.4319	3.77	3224.72	7965.38	0.4048	0.9374 <th>0.9370</th> <th>0.0012</th> <th>0.0022</th> <th>-46.7%</th>	0.9370	0.0012	0.0022	-46.7%			
		83.7	67/2015 11:11	21	10005	3.11	0.4475	6.66	3215.44	7965.38	0.4037	0.9021 <th>0.9370</th> <th>0.0021</th> <th>0.0022</th> <th>-5.4%</th>	0.9370	0.0021	0.0022	-5.4%			
		83.7	67/2015 11:16	10	10006	3.04	0.4464	3.20	3289.74	7965.37	0.4130	0.9252 <th>0.9370</th> <th>0.0010</th> <th>0.0022</th> <th>-55.5%</th>	0.9370	0.0010	0.0022	-55.5%			

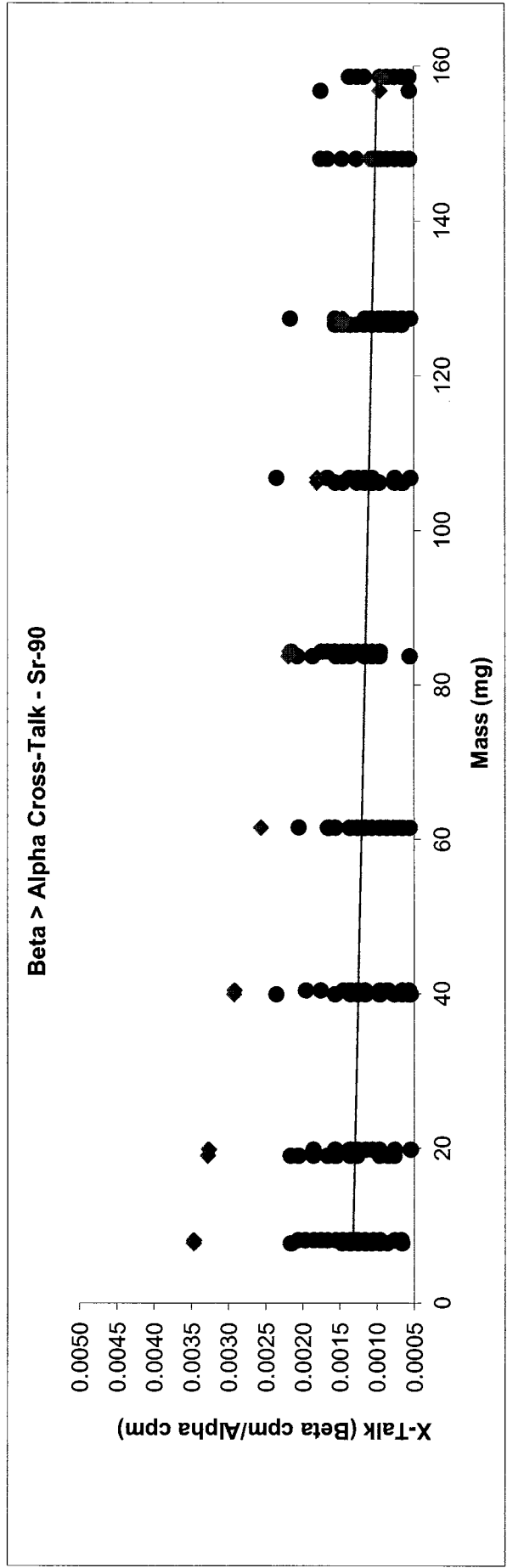
LB4100C Beta Attenuation Curve -- Sr-90

WO #.		1118007		Calibrated Mass Range		Low 7.7 mg		High 158.6 mg		Attenuation Equation		y=b·m ^a (a·x)		Cross-Talk Equation		b = -1.6873E-05 m = 0.0036 % Diff Max = 85.5%	

LB4100C Beta Attenuation Curve -- Sr-90

WO #:		1118007		Calibrated Mass Range		Low		7.7 mg		High		158.6 mg		Attenuation Equation		y=b*m^(a*x)		Cross-Talk Equation		y=b*x+m	
Nuclide:		Sr-90														b = 0.9681		b = -1.6873E-05		b = -1.6873E-05	
Std. ID:		777 3020.11														m = 0.9996		m = 0.9996		m = 0.0036	
Ref. Date:		02/08/06														a = 0.9174				% Diff Max. = 85.5%	
Half-life:		28.5 yrs																			
Activity:		4996.73 dpm/mL																			
Vol.:		2																			
ASR0607	C1	1118007-13	126.6	6/7/2015 11:43	14	10010	3.2	0.4314	4.27	3126.24	7965.36	0.3925	0.9098	0.9215	0.0014	0.0015	-1.3%	0.0014	0.0015	-6.8%	
ASR0607	C2	1118007-13	126.6	6/7/2015 11:48	16	10031	3.16	0.4334	4.95	3172.52	7965.36	0.3983	0.9190	0.9215	0.0016	0.0015	-0.3%	0.0016	0.0015	6.5%	
ASR0607	C3	1118007-13	126.6	6/7/2015 11:53	11	10025	3.16	0.4422	3.37	3170.41	7965.36	0.3980	0.9001	0.9215	0.0011	0.0015	-2.3%	0.0011	0.0015	-27.4%	
ASR0607	C4	1118007-13	126.6	6/7/2015 11:58	11	10049	3.03	0.4340	3.46	3271.37	7965.36	0.4107	0.9463	0.9215	0.0011	0.0015	2.7%	0.0011	0.0015	-27.2%	
ASR0607	D1	1118007-13	126.6	6/7/2015 10:38	11	10030	3.19	0.4290	3.35	3141.35	7965.39	0.3944	0.9193	0.9215	0.0011	0.0015	-0.2%	0.0011	0.0015	-27.8%	
ASR0607	D2	1118007-13	126.6	6/7/2015 10:44	12	10017	3.2	0.4319	3.66	3128.67	7965.38	0.3928	0.9094	0.9215	0.0012	0.0015	-1.3%	0.0012	0.0015	-20.3%	
ASR0607	D3	1118007-13	126.6	6/7/2015 10:50	13	10022	3.13	0.4475	4.06	3200.32	7965.38	0.4018	0.8978	0.9215	0.0013	0.0015	-2.6%	0.0013	0.0015	-13.4%	
ASR0607	D4	1118007-13	126.6	6/7/2015 10:55	8	10038	3.13	0.4464	2.47	3205.32	7965.38	0.4024	0.9014	0.9215	0.0008	0.0015	-2.2%	0.0008	0.0015	-47.5%	
ASR0607	A1	1118007-14	127.4	6/7/2015 10:55	12	10030	3.03	0.4297	3.84	3308.76	7965.38	0.4154	0.9667	0.9212	0.0012	0.0015	4.9%	0.0012	0.0015	-20.2%	
ASR0607	A2	1118007-14	127.4	6/7/2015 11:00	6	10013	3.11	0.4442	1.77	3218.03	7965.38	0.4040	0.9095	0.9212	0.0006	0.0015	-1.3%	0.0006	0.0015	-62.1%	
ASR0607	A3	1118007-14	127.4	6/7/2015 11:05	9	10046	3.09	0.4508	2.80	3249.54	7965.38	0.4080	0.9050	0.9212	0.0009	0.0015	-1.8%	0.0009	0.0015	-40.7%	
ASR0607	B1	1118007-14	127.4	6/7/2015 11:11	5	10026	3.03	0.4542	1.54	3307.30	7965.38	0.4152	0.9142	0.9212	0.0005	0.0015	-0.8%	0.0005	0.0015	-67.9%	
ASR0607	B2	1118007-14	127.4	6/7/2015 11:16	7	10032	3.17	0.4347	2.09	3163.05	7965.37	0.3971	0.9135	0.9212	0.0007	0.0015	-0.8%	0.0007	0.0015	-54.4%	
ASR0607	B3	1118007-14	127.4	6/7/2015 11:21	16	10024	3.18	0.4272	4.91	3150.54	7965.37	0.3955	0.9259	0.9212	0.0016	0.0015	0.5%	0.0016	0.0015	7.3%	
ASR0607	B4	1118007-14	127.4	6/7/2015 11:27	10	10014	3.17	0.4341	3.02	3157.16	7965.37	0.3964	0.9131	0.9212	0.0010	0.0015	-0.9%	0.0010	0.0015	-34.1%	
ASR0607	C1	1118007-14	127.4	6/7/2015 11:32	9	10029	3.12	0.4278	2.74	3212.69	7965.37	0.4033	0.9428	0.9212	0.0009	0.0015	2.3%	0.0009	0.0015	-41.3%	
ASR0607	C2	1118007-14	127.4	6/7/2015 11:37	7	10030	3.11	0.4314	2.15	3223.20	7965.37	0.4047	0.9380	0.9212	0.0007	0.0015	1.8%	0.0007	0.0015	-54.1%	
ASR0607	C3	1118007-14	127.4	6/7/2015 11:43	8	10013	3.14	0.4334	2.44	3187.00	7965.36	0.4001	0.9232	0.9212	0.0008	0.0015	0.2%	0.0008	0.0015	-47.4%	
ASR0607	C4	1118007-14	127.4	6/7/2015 11:48	8	10040	3.18	0.4422	2.41	3155.17	7965.36	0.3961	0.8958	0.9212	0.0008	0.0015	-2.8%	0.0008	0.0015	-47.5%	
ASR0607	D1	1118007-14	127.4	6/7/2015 11:53	10	10040	3.15	0.4340	3.06	3185.38	7965.36	0.3999	0.9214	0.9212	0.0010	0.0015	0.0%	0.0010	0.0015	-34.0%	
ASR0607	D2	1118007-14	127.4	6/7/2015 11:58	22	10021	3.23	0.4290	6.71	3099.63	7965.36	0.3891	0.9071	0.9212	0.0022	0.0015	-1.5%	0.0022	0.0015	-49.1%	
ASR0607	D3	1118007-14	127.4	6/7/2015 10:38	10	10050	3.16	0.4319	3.07	3178.73	7965.39	0.3991	0.9240	0.9212	0.0010	0.0015	0.3%	0.0010	0.0015	-33.5%	
ASR0607	D4	1118007-14	127.4	6/7/2015 10:44	11	10008	3.07	0.4475	3.49	3258.33	7965.38	0.4091	0.9141	0.9212	0.0011	0.0015	-0.8%	0.0011	0.0015	-26.2%	
ASR0607	A1	1118007-16	148	6/7/2015 10:44	18	10035	3.2	0.4297	5.50	3134.43	7965.38	0.3935	0.9158	0.9139	0.0018	0.0011	0.2%	0.0018	0.0011	58.9%	
ASR0607	A2	1118007-16	148	6/7/2015 10:49	10	10008	3.21	0.4442	2.96	3116.17	7965.38	0.3912	0.8807	0.9139	0.0009	0.0011	-3.6%	0.0009	0.0011	-14.1%	
ASR0607	A3	1118007-16	148	6/7/2015 10:55	6	10036	3.21	0.4508	1.76	3124.88	7965.38	0.3923	0.8702	0.9139	0.0006	0.0011	-4.8%	0.0006	0.0011	-49.1%	
ASR0607	B1	1118007-16	148	6/7/2015 11:00	9	10008	3.16	0.4542	2.74	3165.48	7965.38	0.3974	0.8750	0.9139	0.0009	0.0011	-4.3%	0.0009	0.0011	-21.7%	
ASR0607	B2	1118007-16	148	6/7/2015 11:05	11	10033	3.29	0.4347	3.23	3047.92	7965.37	0.3826	0.8803	0.9139	0.0011	0.0011	-3.7%	0.0011	0.0011	-4.1%	
ASR0607	B3	1118007-16	148	6/7/2015 11:11	8	10033	3.34	0.4272	2.27	3002.24	7965.37	0.3769	0.8823	0.9139	0.0008	0.0011	-3.5%	0.0008	0.0011	-31.5%	
ASR0607	B4	1118007-16	148	6/7/2015 11:16	7	10035	3.21	0.4341	2.05	3124.34	7965.37	0.3922	0.9036	0.9139	0.0007	0.0011	-1.1%	0.0007	0.0011	-40.7%	
ASR0607	C1	1118007-16	148	6/7/2015 11:22	5	10000	3.25	0.4278	1.39	3075.19	7965.37	0.3861	0.9025	0.9139	0.0005	0.0011	-1.3%	0.0005	0.0011	-59.0%	
ASR0607	C2	1118007-16	148	6/7/2015 11:27	10	10012	3.24	0.4314	2.98	3088.24	7965.37	0.3877	0.8987	0.9139	0.0009	0.0011	-1.7%	0.0009	0.0011	-12.5%	
ASR0607	C3	1118007-16	148	6/7/2015 11:32	11	10016	3.21	0.4334	3.31	3118.40	7965.37	0.3915	0.9033	0.9139	0.0011	0.0011	-1.2%	0.0011	0.0011	-3.8%	
ASR0607	C4	1118007-16	148	6/7/2015 11:37	9	10031	3.21	0.4422	2.70	3122.86	7965.37	0.3921	0.8866	0.9139	0.0009	0.0011	-3.0%	0.0009	0.0011	-21.9%	
ASR0607	D1	1118007-16	148	6/7/2015 11:43	17	10016	3.2	0.4340	5.19	3128.08	7965.36	0.3927	0.9049	0.9139	0.0017	0.0011	1.0%	0.0017	0.0011	50.3%	
ASR0607	D2	1118007-16	148	6/7/2015 11:48	15	10011	3.3	0.4290	4.45	3030.79	7965.36	0.3805	0.8869	0.9139	0.0015	0.0011	-2.9%	0.0015	0.0011	32.9%	
ASR0607	D3	1118007-16	148	6/7/2015 11:53	9	10022	3.23	0.4319	2.69	3101.14	7965.36	0.3893	0.9014	0.9139	0.0009	0.0011	-1.4%	0.0009	0.0011	-21.4%	
ASR0607	D4	1118007-16	148	6/7/2015 11:58	6	10033	3.21	0.4475	1.78	3123.95	7965.36	0.3922	0.8764	0.9139	0.0006	0.0011	-4.1%	0.0006	0.0011	-48.5%	
ASR0607	A3	1118007-15	158.6	6/7/2015 11:00	6	10014	3.13	0.4508	1.80	3197.77	7965.38	0.3947	0.8843	0.9139	0.0013	0.0011	-3.2%	0.0013	0.0011	15.2%	
ASR0607	B3	1118007-15	158.6	6/7/2015 11:21	18	10022	3.24	0.4341	5.42	3091.38	7965.37	0.3881	0.8940	0.9108	0.0010	0.0010	-2.2%	0.0010	0.0010	-41.0%	
ASR0607	A2	1118007-15	158.6	6/7/2015 10:49	13	10034	3.15	0.4297	4.00	3183.92	7965.38	0.3997	0.9302	0.9101	0.0013	0.0009	-1.8%	0.0013	0.0009	83.4%	
ASR0607	A1	1118007-15	158.6	6/7/2015 10:55	10	10018	3.13	0.4442	3.04	3199.05	7965.38	0.4016	0.9041	0.9101	0.0009	0.0009	0.2%	0.0009	0.0009	2.6%	
ASR0607	B1	1118007-15	158.6	6/7/2015 11:05	5	10019	3.11	0.4542	1.50	3219.93	7965.38	0.4042	0.8900	0.9101	0.0005	0.0009	-2.2%	0.0005	0.0009	-49.8%	
ASR0607	B2	1118007-15	158.6	6/7/2015 11:11	8	10017	3.16	0.4347	2.42	3168.31	7965.37	0.3978	0.9150	0.9101	0.0008	0.0009	0.5%	0.0008	0.0009		





Detector	Sample			Count		CPM	CPM
ID	ID	Alpha	Beta	Time	TOD	#VALUE!	#VALUE!
A1	23.3	10004	2794	10.12	6/6/15 10:06 AM	988.4135	274.611
A1	46.1	10006	2642	10.81	6/6/15 9:26 PM	925.5004	242.9273
A1	63.5	10002	2730	12.53	6/6/15 2:11 PM	798.1202	216.4011
A1	81.1	10000	2570	10.85	6/6/15 1:39 PM	921.535	235.3904
A1	93.6	10009	2633	15.19	6/6/15 1:17 PM	658.7963	171.8617
A1	95.2	10004	2671	16.21	6/6/15 12:51 PM	617.0259	163.2988
A1	116.1	10004	2762	17.95	6/6/15 12:24 PM	557.2019	152.3959
A1	134.2	10000	2945	19.57	6/6/15 11:34 AM	510.8622	149.0094
A1	134.2	10002	3071	22.09	6/6/15 12:02 PM	452.6601	137.5462
A1	151.6	10002	3016	21.27	6/6/15 11:10 AM	470.1158	140.32
A1	156	10002	3057	23.89	6/6/15 10:46 AM	418.5449	126.4855
A2	22.1	10007	2801	8.68	6/6/15 10:05 AM	1152.723	321.1079
A2	23.3	10009	2803	10.07	6/6/15 10:32 AM	993.7854	276.7635
A2	63.5	10007	2822	12.42	6/6/15 9:27 PM	805.5596	225.6262
A2	81.1	10002	2842	10.85	6/6/15 2:09 PM	921.6863	260.3475
A2	93.6	10000	2637	15.26	6/6/15 1:44 PM	655.151	171.2167
A2	95.2	10004	2809	16.22	6/6/15 1:18 PM	616.6124	171.5933
A2	116.1	10003	2856	17.68	6/6/15 12:52 PM	565.6235	159.9505
A2	134.2	10004	3056	20.3	6/6/15 12:00 PM	492.6509	148.9539
A2	134.2	10002	3108	22.57	6/6/15 12:28 PM	442.9976	136.1169
A2	151.6	10000	3015	21.26	6/6/15 11:36 AM	470.2099	140.2276
A2	156	10002	3180	23.73	6/6/15 11:12 AM	421.3348	132.4196
A3	21	10005	2859	8.26	6/6/15 10:04 AM	1211.147	344.5309
A3	22.1	10007	2801	8.78	6/6/15 10:31 AM	1139.637	317.4255
A3	23.3	10006	2806	10.03	6/6/15 10:58 AM	997.4952	278.1657
A3	81.1	10011	2707	10.72	6/6/15 9:25 PM	933.7499	250.9237
A3	93.6	10000	2665	15.22	6/6/15 2:14 PM	656.9182	173.5036
A3	95.2	10001	2803	16.35	6/6/15 1:45 PM	611.57	169.8423
A3	116.1	10004	2738	17.81	6/6/15 1:19 PM	561.5949	152.1389
A3	134.2	10006	3007	19.63	6/6/15 12:25 PM	509.618	151.5889
A3	134.2	10003	3084	22.12	6/6/15 12:57 PM	452.1032	137.8263
A3	151.6	10003	3143	21.42	6/6/15 12:02 PM	466.8815	145.137
A3	156	10001	3058	23.67	6/6/15 11:38 AM	422.406	127.5981
A4	21	10006	2984	8.19	6/6/15 10:30 AM	1221.624	362.7348
A4	22.1	10006	2809	8.57	6/6/15 10:57 AM	1167.451	326.1593
A4	23.3	10009	2922	10.04	6/6/15 11:24 AM	996.8024	289.4239
A4	48.5	10000	2845	14.06	6/6/15 10:10 AM	711.1276	200.7351
A4	93.6	10009	2619	14.55	6/6/15 9:29 PM	687.7938	178.388
A4	95.2	9999	2766	15.76	6/6/15 2:14 PM	634.3443	173.8956
A4	116.1	10002	2726	16.79	6/6/15 1:45 PM	595.6017	160.7465
A4	134.2	10004	3039	19.48	6/6/15 12:54 PM	513.4424	154.3942
A4	134.2	10005	3066	21.65	6/6/15 1:23 PM	462.0147	140.0046
A4	151.6	10004	3119	21.06	6/6/15 12:27 PM	474.9137	146.4887
A4	156	10000	3168	23.09	6/6/15 12:03 PM	432.9779	135.5903
B1	21	10002	2866	8.5	6/6/15 10:57 AM	1176.592	335.5535
B1	22.1	10022	2686	8.9	6/6/15 11:23 AM	1125.953	300.1748
B1	23.3	10004	2791	10.08	6/6/15 11:50 AM	992.3463	275.2619
B1	47.5	10002	3022	18.33	6/6/15 10:15 AM	545.5488	163.2433
B1	48.5	10009	2937	15.43	6/6/15 10:38 AM	648.5574	188.7205
B1	95.2	10004	2746	16.46	6/6/15 9:31 PM	607.6624	165.2057
B1	116.1	10012	2752	17.85	6/6/15 2:17 PM	560.7824	152.5507
B1	134.2	10001	3039	20.15	6/6/15 1:22 PM	496.2135	149.1959
B1	134.2	10000	2923	22.29	6/6/15 1:51 PM	448.5177	129.512
B1	151.6	10002	3036	21.8	6/6/15 12:56 PM	458.6933	137.6431
B1	156	10000	3275	24.3	6/6/15 12:30 PM	411.4086	133.1507
B2	21	10002	2722	8.53	6/6/15 11:23 AM	1172.445	317.452
B2	22.1	10004	2753	9.07	6/6/15 11:49 AM	1102.855	301.8711
B2	23.3	10025	2743	10.23	6/6/15 12:16 PM	979.8389	266.4759
B2	43.7	10006	2780	12.44	6/6/15 10:09 AM	804.2188	221.8157
B2	47.5	10002	2942	18.56	6/6/15 10:41 AM	538.7789	156.8559
B2	48.5	10001	2859	14.98	6/6/15 11:03 AM	667.5015	189.1975
B2	116.1	10001	2677	18.09	6/6/15 9:33 PM	552.7249	146.3253
B2	134.2	9999	2928	20.22	6/6/15 1:49 PM	494.3884	143.1501

B2	134.2	10000	3183	23.58	6/6/15 2:22 PM	423.9662	133.3303
B2	151.6	10001	3009	22.02	6/6/15 1:24 PM	454.056	134.9915
B2	156	9999	3162	24.89	6/6/15 12:59 PM	401.6056	125.382
B3	21	10006	2764	8.53	6/6/15 11:49 AM	1172.902	322.1998
B3	22.1	10012	2731	8.96	6/6/15 12:15 PM	1117.277	302.9661
B3	23.3	10019	2814	10.34	6/6/15 12:45 PM	968.8215	270.314
B3	43.7	10011	2794	12.45	6/6/15 10:35 AM	803.9624	222.5847
B3	46.1	10002	2655	11.33	6/6/15 10:08 AM	882.6551	232.5006
B3	47.5	10000	2895	18.34	6/6/15 11:07 AM	545.1223	156.0187
B3	48.5	10005	2852	15.15	6/6/15 11:30 AM	660.262	186.4178
B3	134.2	10001	3013	20.95	6/6/15 2:20 PM	477.2407	141.9856
B3	134.2	10000	3108	23.14	6/6/15 9:38 PM	432.0181	132.4799
B3	151.6	10001	3088	22.51	6/6/15 1:51 PM	444.1574	135.3505
B3	156	10003	3166	24.63	6/6/15 1:26 PM	405.9967	126.7094
B4	21	10010	3016	8.68	6/6/15 12:14 PM	1153.081	345.7334
B4	22.1	10021	2835	9.08	6/6/15 12:44 PM	1103.489	310.4927
B4	23.3	10019	2912	10.4	6/6/15 1:12 PM	963.2204	278.268
B4	43.7	10012	2968	12.54	6/6/15 11:01 AM	798.2601	234.9506
B4	46.1	10001	2886	11.44	6/6/15 10:34 AM	874.0683	250.5407
B4	47.5	10005	3041	18.2	6/6/15 11:33 AM	549.5803	165.3559
B4	48.5	10006	2798	15.21	6/6/15 11:55 AM	657.7117	182.2259
B4	63.5	9999	2841	12.72	6/6/15 10:09 AM	785.9399	221.6171
B4	134.2	9999	3083	20.49	6/6/15 9:35 PM	487.8491	148.7316
B4	151.6	10003	3035	21.97	6/6/15 2:21 PM	455.1577	136.4109
B4	156	10001	3078	24.29	6/6/15 1:53 PM	411.5882	124.9868
C1	21	10002	2841	8.23	6/6/15 12:43 PM	1215.208	343.3165
C1	22.1	10011	2822	8.73	6/6/15 1:10 PM	1146.633	321.3692
C1	23.3	10005	2822	9.99	6/6/15 1:38 PM	1001.4	280.5985
C1	43.7	10002	2792	12.21	6/6/15 11:27 AM	819.0626	226.781
C1	46.1	10008	2848	11.17	6/6/15 10:59 AM	895.8694	253.0847
C1	47.5	10001	2925	17.67	6/6/15 11:58 AM	565.8855	163.6508
C1	48.5	10010	2926	14.77	6/6/15 12:20 PM	677.6231	196.2203
C1	63.5	10008	2831	12.48	6/6/15 10:35 AM	801.8211	224.9589
C1	81.1	10011	2704	11.02	6/6/15 10:07 AM	908.3372	243.4881
C1	151.6	10001	3052	21.38	6/6/15 9:36 PM	467.6716	140.8662
C1	156	10004	2890	23.19	6/6/15 2:22 PM	431.2908	122.7387
C2	21	10003	2857	8.32	6/6/15 1:10 PM	1202.172	341.5394
C2	22.1	10014	2852	8.77	6/6/15 1:37 PM	1141.735	323.3495
C2	43.7	10005	2862	12.1	6/6/15 11:52 AM	826.7475	234.6789
C2	46.1	10011	2824	10.95	6/6/15 11:25 AM	914.1346	256.0495
C2	47.5	10008	2953	17.26	6/6/15 12:23 PM	579.7258	169.2392
C2	48.5	10001	2869	14.45	6/6/15 12:49 PM	691.9987	196.6967
C2	63.5	10005	2921	12.42	6/6/15 11:01 AM	805.4436	233.3352
C2	81.1	10006	2656	10.79	6/6/15 10:33 AM	927.2281	244.3038
C2	93.6	10003	2589	15.38	6/6/15 10:12 AM	650.2781	166.4855
C2	156	10001	3015	23.95	6/6/15 9:39 PM	417.4663	124.0373
C2	23.3	10019	2895	10.08	6/6/15 2:09 PM	993.8364	285.3524
C3	21	10014	2972	8.6	6/6/15 1:37 PM	1164.311	343.5214
C3	23.3	10020	2873	10.09	6/6/15 9:25 PM	992.9544	282.6774
C3	43.7	10004	2796	12.18	6/6/15 12:18 PM	821.2385	227.4967
C3	46.1	10022	2787	11.23	6/6/15 11:51 AM	892.323	246.1145
C3	47.5	10002	2997	17.89	6/6/15 12:52 PM	558.9753	165.4638
C3	48.5	10000	2927	14.86	6/6/15 1:16 PM	672.8395	194.9117
C3	63.5	10006	2818	12.64	6/6/15 11:27 AM	791.5059	220.883
C3	81.1	10002	2740	11.09	6/6/15 10:59 AM	901.7856	245.0094
C3	93.6	10005	2632	15.58	6/6/15 10:38 AM	642.0614	166.8745
C3	95.2	10002	2820	16.57	6/6/15 10:13 AM	603.513	168.1271
C3	22.1	10005	2817	8.97	6/6/15 2:08 PM	1115.277	311.9868
C4	22.1	10015	2749	8.8	6/6/15 9:24 PM	1137.949	310.4694
C4	43.7	10006	2866	12.29	6/6/15 12:47 PM	814.0389	231.2807
C4	46.1	10012	2745	11.07	6/6/15 12:17 PM	904.3074	246.0505
C4	47.5	10003	2941	17.57	6/6/15 1:19 PM	569.2037	165.4706
C4	48.5	10006	2926	15	6/6/15 1:43 PM	666.9477	193.1497
C4	63.5	10002	2708	12.28	6/6/15 11:52 AM	814.3761	218.6042
C4	81.1	10007	2716	10.89	6/6/15 11:25 AM	918.7974	247.4861

C4	93.6	10001	2723	15.49	6/6/15 11:04 AM	645.5233	173.8738
C4	95.2	10012	2635	16.11	6/6/15 10:38 AM	621.3583	161.646
C4	116.1	10007	2941	18.15	6/6/15 10:14 AM	551.2309	160.1216
C4	21	10017	2868	8.28	6/6/15 2:07 PM	1209.664	344.4598
D1	21	10003	2914	8.41	6/6/15 9:23 PM	1189.32	343.6463
D1	43.7	10004	2910	12.47	6/6/15 1:14 PM	802.1484	230.5141
D1	46.1	10009	2820	11.34	6/6/15 12:46 PM	882.5309	245.8312
D1	47.5	10005	3077	18.15	6/6/15 1:47 PM	551.1427	166.6857
D1	63.5	10006	2879	12.68	6/6/15 12:18 PM	789.0197	224.2045
D1	81.1	10011	2721	11.31	6/6/15 11:51 AM	885.0489	237.7376
D1	93.6	10000	2711	15.69	6/6/15 11:30 AM	637.2516	169.9392
D1	95.2	9999	2850	16.73	6/6/15 11:05 AM	597.5719	167.5067
D1	116.1	10003	2862	18.2	6/6/15 10:40 AM	549.5184	154.4067
D1	134.2	10000	3341	22.76	6/6/15 10:19 AM	439.2703	143.9466
D1	48.5	10003	2924	14.95	6/6/15 2:14 PM	669	192.7393
D2	43.7	10007	2775	12.1	6/6/15 1:40 PM	826.9318	227.6928
D2	46.1	10008	2707	11.27	6/6/15 1:13 PM	887.9283	238.5492
D2	48.5	10003	2879	14.95	6/6/15 9:30 PM	669.004	190.9293
D2	63.5	10000	2835	12.57	6/6/15 12:47 PM	795.4519	223.891
D2	81.1	10016	2709	10.9	6/6/15 12:17 PM	918.8061	246.8861
D2	93.6	10004	2599	15.63	6/6/15 11:56 AM	639.9582	164.6368
D2	95.2	10007	2768	16.39	6/6/15 11:31 AM	610.4622	167.2375
D2	116.1	10004	2786	18.17	6/6/15 11:06 AM	550.4849	151.6837
D2	134.2	10004	3001	20.37	6/6/15 10:17 AM	491.0214	145.6785
D2	134.2	10001	3140	22.54	6/6/15 10:45 AM	443.6071	137.6619
D2	47.5	10001	2925	17.91	6/6/15 2:17 PM	558.3101	161.6706
D3	46.1	10006	2741	10.82	6/6/15 1:39 PM	924.6789	251.7272
D3	47.5	10001	2892	17.47	6/6/15 9:32 PM	572.3771	163.9409
D3	63.5	10003	2678	11.98	6/6/15 1:14 PM	834.885	221.9392
D3	81.1	10013	2665	10.5	6/6/15 12:45 PM	953.529	252.2095
D3	93.6	10000	2568	14.98	6/6/15 12:21 PM	667.4667	169.8286
D3	95.2	10002	2711	15.84	6/6/15 11:56 AM	631.3494	169.549
D3	116.1	10001	2629	17.16	6/6/15 11:32 AM	582.7189	151.6051
D3	134.2	10002	3010	19.51	6/6/15 10:42 AM	512.5702	152.6799
D3	134.2	10004	3039	21.99	6/6/15 11:10 AM	454.8441	136.5992
D3	151.6	10004	2959	20.96	6/6/15 10:17 AM	477.2001	139.5737
D3	43.7	10004	2817	11.8	6/6/15 2:10 PM	847.7066	237.1288
D4	43.7	10002	2882	11.89	6/6/15 9:27 PM	841.1241	240.6846
D4	63.5	10006	2828	12.43	6/6/15 1:41 PM	804.9009	225.8101
D4	81.1	10007	2757	10.63	6/6/15 1:12 PM	941.3053	257.6563
D4	93.6	10003	2744	15.19	6/6/15 12:50 PM	658.4383	178.9412
D4	95.2	9999	2743	15.73	6/6/15 12:21 PM	635.5773	172.6762
D4	116.1	10006	2867	17.34	6/6/15 11:57 AM	576.9603	163.6363
D4	134.2	10001	3160	19.75	6/6/15 11:08 AM	506.2927	158.296
D4	134.2	10001	3118	22.35	6/6/15 11:37 AM	447.385	137.8038
D4	151.6	10001	3081	21.14	6/6/15 10:43 AM	472.9972	144.0387
D4	156	10003	3201	23.74	6/6/15 10:20 AM	421.2694	133.1317
D4	46.1	10004	2846	10.96	6/6/15 2:10 PM	912.6867	257.9675
A1	21	10016	2835	8.29	6/7/15 9:42 AM	1208.079	340.5023
A1	22.1	10011	2698	8.7	6/7/15 10:10 AM	1150.566	308.6389
A1	43.7	10002	2691	11.97	6/7/15 8:26 AM	835.465	223.336
A1	47.5	10001	2967	17.7	6/7/15 8:59 AM	564.9042	166.1511
A1	48.5	10007	2900	14.8	6/7/15 9:22 AM	676.0246	194.4699
A2	21	10014	2861	8.18	6/7/15 10:09 AM	1224.048	348.1675
A2	43.7	10009	2914	12.03	6/7/15 8:53 AM	831.8463	240.6398
A2	46.1	10002	2795	10.88	6/7/15 8:25 AM	919.1445	255.3054
A2	47.5	10000	2968	17.64	6/7/15 9:25 AM	566.7364	166.666
A2	48.5	10005	2926	14.78	6/7/15 9:48 AM	676.7713	196.3822
A3	43.7	10004	2763	12	6/7/15 9:20 AM	833.5547	228.655
A3	46.1	10009	2799	10.98	6/7/15 8:52 AM	911.4545	253.323
A3	47.5	10002	2962	17.51	6/7/15 9:51 AM	571.1044	167.5655
A3	48.5	10002	2910	14.66	6/7/15 10:16 AM	682.1527	196.9043
A3	63.5	10009	2765	12.11	6/7/15 8:26 AM	826.395	226.7287
A4	43.7	10010	2774	11.78	6/7/15 9:45 AM	849.6353	233.8719
A4	46.1	10008	2749	10.66	6/7/15 9:18 AM	938.7268	256.2679

A4	47.5	10001	2941	17.26	6/7/15 10:18 AM	579.3222	168.782
A4	63.5	10013	2857	12.06	6/7/15 8:53 AM	830.1553	235.2868
A4	81.1	10009	2695	10.38	6/7/15 8:24 AM	964.1482	258.0219
B1	43.7	10007	2910	12.31	6/7/15 10:13 AM	812.8023	234.7702
B1	46.1	10002	2732	11.05	6/7/15 9:45 AM	905.0444	245.6168
B1	63.5	10004	2897	12.77	6/7/15 9:20 AM	783.2846	225.2368
B1	81.1	10008	2695	10.73	6/7/15 8:52 AM	932.598	249.542
B1	93.6	10006	2504	15.06	6/7/15 8:29 AM	664.295	164.6453
B2	46.1	10013	2781	11.42	6/7/15 10:12 AM	876.6731	241.8631
B2	63.5	10004	2635	12.59	6/7/15 9:46 AM	794.4769	207.6361
B2	81.1	10010	2698	11.41	6/7/15 9:19 AM	877.1786	234.8022
B2	93.6	10006	2585	15.7	6/7/15 8:57 AM	637.2028	162.9927
B2	95.2	10000	2799	16.72	6/7/15 8:31 AM	597.9641	165.7473
B3	63.5	10005	2631	12.7	6/7/15 10:14 AM	787.6613	205.3324
B3	81.1	10015	2784	11.39	6/7/15 9:45 AM	879.1461	242.5919
B3	93.6	10008	2612	15.79	6/7/15 9:24 AM	633.6849	163.5882
B3	95.2	10001	2751	17.24	6/7/15 8:58 AM	579.9704	157.7378
B3	116.1	10004	2831	18.39	6/7/15 8:32 AM	543.8573	152.1094
B4	81.1	10007	2753	11.29	6/7/15 10:12 AM	886.2146	242.1121
B4	93.6	10007	2574	15.77	6/7/15 9:49 AM	634.4143	161.4893
B4	95.2	10003	2844	16.7	6/7/15 9:24 AM	598.837	168.5674
B4	116.1	10004	2791	18.02	6/7/15 8:59 AM	555.0159	153.1515
B4	134.2	10002	3209	23.15	6/7/15 8:37 AM	431.9068	136.8857
C1	93.6	10005	2627	15.23	6/7/15 10:16 AM	656.8251	170.6045
C1	95.2	10005	2709	15.95	6/7/15 9:50 AM	627.1707	167.9593
C1	116.1	10006	2839	17.82	6/7/15 9:26 AM	561.4019	157.4314
C1	134.2	10006	2917	19.7	6/7/15 8:34 AM	507.8168	146.1871
C1	134.2	10000	3090	22.08	6/7/15 9:03 AM	452.7966	138.0617
C2	95.2	10003	2663	15.85	6/7/15 10:17 AM	630.9921	166.1626
C2	116.1	10005	2726	17.43	6/7/15 9:51 AM	573.8983	154.547
C2	134.2	10006	2981	19.64	6/7/15 9:01 AM	509.3585	149.9321
C2	134.2	10000	3040	21.75	6/7/15 9:29 AM	459.6581	137.9201
C2	151.6	10003	2997	21.08	6/7/15 8:35 AM	474.4136	140.3227
C3	116.1	9999	2773	17.92	6/7/15 10:19 AM	557.8719	152.6833
C3	134.2	9999	2824	19.99	6/7/15 9:28 AM	500.0921	139.2106
C3	134.2	10001	3127	22.45	6/7/15 9:56 AM	445.3708	137.2273
C3	151.6	10003	2850	21.27	6/7/15 9:02 AM	470.1788	131.9315
C3	156	10001	3206	24.5	6/7/15 8:38 AM	408.0961	128.7971
C4	23.3	10001	2924	10.14	6/7/15 8:24 AM	986.1729	286.4459
C4	134.2	10006	3123	20.12	6/7/15 9:54 AM	497.1971	153.3017
C4	134.2	9999	3093	22.57	6/7/15 10:24 AM	442.9027	135.1233
C4	151.6	10006	3002	21.35	6/7/15 9:29 AM	468.5461	138.6919
C4	156	10002	3103	23.68	6/7/15 9:05 AM	422.2628	129.1219
D1	22.1	10009	2822	9.17	6/7/15 8:23 AM	1091.397	304.8966
D1	23.3	10000	2815	10.29	6/7/15 8:51 AM	971.7203	270.7206
D1	134.2	10005	3014	20.67	6/7/15 10:22 AM	483.9378	142.9692
D1	151.6	10001	3061	21.92	6/7/15 9:56 AM	456.153	136.7982
D1	156	10001	3047	23.8	6/7/15 9:32 AM	420.1131	125.1792
D2	21	10013	2874	8.47	6/7/15 8:22 AM	1182.079	337.6692
D2	22.1	10019	2817	8.98	6/7/15 8:50 AM	1115.609	312.0511
D2	23.3	10008	2835	10.15	6/7/15 9:18 AM	985.9169	277.6643
D2	151.6	10002	2997	22.09	6/7/15 10:23 AM	452.6911	134.0262
D2	156	10000	3145	24.13	6/7/15 9:58 AM	414.3289	128.6897
D3	21	10024	2778	8.1	6/7/15 8:49 AM	1237.441	341.363
D3	22.1	10003	2809	8.74	6/7/15 9:17 AM	1144.418	319.7959
D3	23.3	10005	2839	10.09	6/7/15 9:44 AM	991.4858	279.7677
D3	48.5	10002	2917	14.29	6/7/15 8:28 AM	699.84	202.5288
D3	156	10005	3072	23.45	6/7/15 10:24 AM	426.5625	129.4021
D4	21	10004	2980	8.29	6/7/15 9:16 AM	1206.668	357.7652
D4	22.1	10014	2935	8.58	6/7/15 9:42 AM	1167.046	340.3706
D4	23.3	10012	2899	10.2	6/7/15 10:11 AM	981.4816	282.5117
D4	47.5	10000	3040	17.55	6/7/15 8:31 AM	569.7136	171.5154
D4	48.5	10003	3046	14.49	6/7/15 8:55 AM	690.2512	208.5099

Detector	Sample			Count	Alpha CPM	Beta CPM		
ID	ID	Alpha	Beta	Time	#VALUE!	#VALUE!	Voltage	TOD
A1	7.7	10	10043	2.9	3.324276	3461.627	1402.5	6/7/15 11:58 AM
A1	8.1	13	10055	2.96	4.267892	3395.483	1402.5	6/7/15 10:38 AM
A1	19	21	10039	2.98	6.92298	3367.316	1402.5	6/7/15 11:48 AM
A1	19.8	14	10012	3.01	4.527163	3324.77	1402.5	6/7/15 11:53 AM
A1	39.9	14	10037	3.1	4.392129	3236.266	1402.5	6/7/15 11:43 AM
A1	40.4	18	10017	3.11	5.663781	3219.424	1402.5	6/7/15 11:37 AM
A1	61.5	10	10010	3.08	3.122753	3248.524	1402.5	6/7/15 11:27 AM
A1	61.5	16	10021	3.06	5.104758	3273.361	1402.5	6/7/15 11:32 AM
A1	83.7	6	10007	3.11	1.80526	3216.209	1402.5	6/7/15 11:21 AM
A1	84.3	12	10027	3.17	3.661489	3161.615	1402.5	6/7/15 11:16 AM
A1	106.2	16	10038	3.1	5.03729	3236.589	1402.5	6/7/15 11:11 AM
A1	106.8	12	10036	3.14	3.697656	3194.702	1402.5	6/7/15 11:05 AM
A1	126.6	14	10019	3.13	4.348843	3199.482	1402.5	6/7/15 11:00 AM
A1	127.4	12	10030	3.03	3.836396	3308.755	1402.5	6/7/15 10:55 AM
A1	148	18	10035	3.2	5.501	3134.462	1402.5	6/7/15 10:44 AM
A1	158.6	13	10034	3.15	4.002984	3183.921	1402.5	6/7/15 10:49 AM
A2	7.7	12	10049	2.94	3.924633	3416.439	1402.5	6/7/15 10:38 AM
A2	8.1	11	10023	2.88	3.662444	3478.62	1402.5	6/7/15 10:44 AM
A2	19	9	10057	2.95	2.893847	3407.565	1402.5	6/7/15 11:53 AM
A2	19.8	6	10052	2.97	1.863202	3382.924	1402.5	6/7/15 11:58 AM
A2	39.9	6	10029	3.11	1.77226	3223.171	1402.5	6/7/15 11:48 AM
A2	40.4	9	10024	3.11	2.736891	3221.563	1402.5	6/7/15 11:43 AM
A2	61.5	17	10033	3.06	5.398556	3277.17	1402.5	6/7/15 11:32 AM
A2	61.5	7	10022	3.01	2.168581	3327.98	1402.5	6/7/15 11:37 AM
A2	83.7	5	10037	3.08	1.466377	3257.178	1402.5	6/7/15 11:27 AM
A2	84.3	18	10019	3.13	5.593799	3199.37	1402.5	6/7/15 11:21 AM
A2	106.2	7	10064	3.06	2.130582	3287.301	1402.5	6/7/15 11:16 AM
A2	106.8	6	10039	3.08	1.791052	3257.828	1402.5	6/7/15 11:11 AM
A2	126.6	9	10036	3.09	2.755621	3246.308	1402.5	6/7/15 11:05 AM
A2	127.4	6	10013	3.11	1.77226	3218.026	1402.5	6/7/15 11:00 AM
A2	148	10	10008	3.21	2.958265	3116.169	1402.5	6/7/15 10:49 AM
A2	158.6	10	10018	3.13	3.037888	3199.051	1402.5	6/7/15 10:55 AM
A3	7.7	12	10032	2.93	3.983563	3422.296	1402.5	6/7/15 10:44 AM
A3	8.1	8	10025	2.94	2.609088	3408.269	1402.5	6/7/15 10:49 AM
A3	19	10	10020	2.94	3.289361	3406.568	1402.5	6/7/15 11:58 AM
A3	19.8	11	10020	2.96	3.604216	3383.54	1402.5	6/7/15 10:38 AM
A3	39.9	7	10040	3.01	2.213581	3333.953	1402.5	6/7/15 11:53 AM
A3	40.4	13	10040	3.01	4.206937	3333.953	1402.5	6/7/15 11:48 AM
A3	61.5	12	10034	3.07	3.796795	3266.809	1402.5	6/7/15 11:37 AM
A3	61.5	7	10011	3.05	2.183082	3280.7	1402.5	6/7/15 11:43 AM
A3	83.7	12	10055	3.07	3.796795	3273.649	1402.5	6/7/15 11:32 AM
A3	84.3	11	10002	3.11	3.424977	3214.482	1402.5	6/7/15 11:27 AM
A3	106.2	7	10044	3.05	2.183082	3291.52	1402.5	6/7/15 11:21 AM
A3	106.8	11	10027	3.03	3.518363	3307.646	1402.5	6/7/15 11:16 AM
A3	126.6	7	10033	3.1	2.146065	3234.857	1402.5	6/7/15 11:11 AM
A3	127.4	9	10046	3.09	2.800621	3249.538	1402.5	6/7/15 11:05 AM
A3	148	6	10036	3.21	1.757159	3124.885	1402.5	6/7/15 10:55 AM
A3	156.8	6	10014	3.13	1.804933	3197.766	1402.5	6/7/15 11:00 AM
A4	7.7	10	10028	2.88	3.362222	3480.332	1402.5	6/7/15 10:49 AM
A4	8.1	15	10022	2.82	5.209149	3552.289	1402.5	6/7/15 10:55 AM
A4	19	14	10033	2.81	4.872206	3568.851	1402.5	6/7/15 10:38 AM
A4	19.8	16	10040	2.97	5.277205	3378.859	1402.5	6/7/15 10:44 AM
A4	39.9	12	10048	2.98	3.916846	3370.2	1402.5	6/7/15 11:58 AM
A4	40.4	18	10052	3.03	5.830594	3315.88	1402.5	6/7/15 11:53 AM
A4	61.5	10	10054	3.02	3.201258	3327.527	1402.5	6/7/15 11:43 AM
A4	61.5	17	10042	2.94	5.672313	3414.034	1402.5	6/7/15 11:48 AM
A4	83.7	12	10029	3.01	3.876711	3330.282	1402.5	6/7/15 11:37 AM
A4	84.3	16	10037	3.07	5.101726	3267.769	1402.5	6/7/15 11:32 AM
A4	106.2	4	10059	3.03	1.210132	3318.19	1402.5	6/7/15 11:27 AM
A4	106.8	14	10053	2.98	4.587987	3371.878	1402.5	6/7/15 11:21 AM
A4	126.6	10	10059	3.1	3.115806	3243.227	1402.5	6/7/15 11:16 AM
A4	127.4	5	10026	3.03	1.540165	3307.299	1402.5	6/7/15 11:11 AM

A4	148	9	10008	3.16	2.738101	3165.477	1402.5	6/7/15 11:00 AM
A4	158.6	5	10019	3.11	1.497717	3219.931	1402.5	6/7/15 11:05 AM
B1	7.7	7	10025	2.94	2.266952	3408.241	1402.5	6/7/15 10:55 AM
B1	8.1	12	10022	2.97	3.926404	3372.788	1402.5	6/7/15 11:00 AM
B1	19	17	10040	2.97	5.609906	3378.848	1402.5	6/7/15 10:44 AM
B1	19.8	13	10013	3.01	4.204937	3324.955	1402.5	6/7/15 10:49 AM
B1	39.9	13	10037	3.15	4.012984	3184.726	1402.5	6/7/15 10:38 AM
B1	40.4	12	10029	3.13	3.719866	3202.53	1402.5	6/7/15 11:58 AM
B1	61.5	13	10011	3.13	4.039355	3196.78	1402.5	6/7/15 11:48 AM
B1	61.5	6	10041	3.04	1.859684	3301.338	1402.5	6/7/15 11:53 AM
B1	83.7	4	10023	3.12	1.168051	3210.877	1402.5	6/7/15 11:43 AM
B1	84.3	10	10014	3.21	3.001265	3118.003	1402.5	6/7/15 11:38 AM
B1	106.2	8	10039	3.14	2.433771	3195.511	1402.5	6/7/15 11:32 AM
B1	106.8	12	10037	3.09	3.769495	3246.597	1402.5	6/7/15 11:27 AM
B1	126.6	16	10014	3.18	4.917447	3147.434	1402.5	6/7/15 11:21 AM
B1	127.4	7	10032	3.17	2.094202	3163.046	1402.5	6/7/15 11:16 AM
B1	148	11	10033	3.29	3.229465	3047.921	1402.5	6/7/15 11:05 AM
B1	158.6	8	10017	3.16	2.417646	3168.314	1402.5	6/7/15 11:11 AM
B2	7.7	14	10049	3	4.544667	3348.01	1402.5	6/7/15 11:00 AM
B2	8.1	15	10030	3.01	4.861389	3330.569	1402.5	6/7/15 11:05 AM
B2	19	21	10005	2.98	6.92498	3355.726	1402.5	6/7/15 10:49 AM
B2	19.8	19	10026	3.06	6.08715	3274.814	1402.5	6/7/15 10:55 AM
B2	39.9	24	10026	3.13	7.545732	3201.538	1402.5	6/7/15 10:44 AM
B2	40.4	20	10023	3.14	6.247427	3190.381	1402.5	6/7/15 10:38 AM
B2	61.5	13	10008	3.1	4.071548	3226.73	1402.5	6/7/15 11:53 AM
B2	61.5	12	10028	3.15	3.687524	3181.835	1402.5	6/7/15 11:58 AM
B2	83.7	14	10036	3.12	4.365179	3215.01	1402.5	6/7/15 11:48 AM
B2	84.3	13	10012	3.16	3.991924	3166.697	1402.5	6/7/15 11:43 AM
B2	106.2	12	10035	3.14	3.699656	3194.203	1402.5	6/7/15 11:37 AM
B2	106.8	24	10033	3.23	7.308341	3104.535	1402.5	6/7/15 11:32 AM
B2	126.6	15	10014	3.26	4.479227	3070.122	1402.5	6/7/15 11:27 AM
B2	127.4	16	10024	3.18	4.909447	3150.544	1402.5	6/7/15 11:21 AM
B2	148	8	10033	3.34	2.27321	3002.235	1402.5	6/7/15 11:11 AM
B2	158.6	9	10020	3.25	2.647231	3081.42	1402.5	6/7/15 11:16 AM
B3	7.7	12	10025	2.98	3.892846	3362.261	1402.5	6/7/15 11:05 AM
B3	8.1	19	10053	2.95	6.306678	3405.964	1402.5	6/7/15 11:11 AM
B3	19	14	10026	3	4.532667	3340.167	1402.5	6/7/15 10:55 AM
B3	19.8	14	10037	3.02	4.501762	3321.677	1402.5	6/7/15 11:00 AM
B3	39.9	10	10009	3.12	3.071128	3206.18	1402.5	6/7/15 10:49 AM
B3	40.4	14	10015	3.14	4.324599	3187.657	1402.5	6/7/15 10:44 AM
B3	61.5	13	10007	3.17	3.966946	3154.949	1402.5	6/7/15 10:38 AM
B3	61.5	14	10016	3.16	4.29638	3167.787	1402.5	6/7/15 11:58 AM
B3	83.7	15	10004	3.17	4.597861	3154.003	1402.5	6/7/15 11:53 AM
B3	84.3	22	10013	3.23	6.677146	3098.167	1402.5	6/7/15 11:48 AM
B3	106.2	15	10014	3.14	4.64307	3187.339	1402.5	6/7/15 11:43 AM
B3	106.8	8	10029	3.23	2.34278	3103.121	1402.5	6/7/15 11:38 AM
B3	126.6	16	10024	3.23	4.81956	3101.573	1402.5	6/7/15 11:32 AM
B3	127.4	10	10014	3.17	3.020574	3157.158	1402.5	6/7/15 11:27 AM
B3	148	7	10035	3.21	2.046685	3124.335	1402.5	6/7/15 11:16 AM
B3	156.8	18	10022	3.24	5.421556	3091.377	1402.5	6/7/15 11:21 AM
B4	7.7	13	10039	3	4.188333	3344.601	1402.5	6/7/15 11:11 AM
B4	8.1	16	10019	2.98	5.224128	3360.349	1402.5	6/7/15 11:16 AM
B4	19	16	10058	2.97	5.242205	3384.8	1402.5	6/7/15 11:00 AM
B4	19.8	12	10019	3.02	3.82851	3315.818	1402.5	6/7/15 11:05 AM
B4	39.9	12	10015	3.13	3.688866	3197.949	1402.5	6/7/15 10:55 AM
B4	40.4	15	10006	3.12	4.662692	3205.319	1402.5	6/7/15 10:49 AM
B4	61.5	7	10020	3.15	2.077222	3179.22	1402.5	6/7/15 10:38 AM
B4	61.5	13	10009	3.09	4.06212	3237.427	1402.5	6/7/15 10:44 AM
B4	83.7	16	10040	3.13	4.966821	3205.936	1402.5	6/7/15 11:58 AM
B4	84.3	15	10008	3.16	4.601835	3165.357	1402.5	6/7/15 11:53 AM
B4	106.2	11	10030	3.11	3.391977	3223.348	1402.5	6/7/15 11:48 AM
B4	106.8	13	10007	3.21	3.904844	3115.713	1402.5	6/7/15 11:43 AM
B4	126.6	9	10023	3.24	2.632778	3091.787	1402.5	6/7/15 11:38 AM
B4	127.4	9	10029	3.12	2.739615	3212.691	1402.5	6/7/15 11:32 AM
B4	148	5	10000	3.25	1.393462	3075.191	1402.5	6/7/15 11:22 AM

B4	158.6	14	10013	3.17	4.271404	3156.943	1402.5	6/7/15 11:27 AM
C1	7.7	14	10035	2.91	4.708997	3446.57	1402.5	6/7/15 11:16 AM
C1	8.1	13	10022	2.95	4.30478	3395.404	1402.5	6/7/15 11:21 AM
C1	19	8	10019	2.96	2.600703	3382.913	1402.5	6/7/15 11:05 AM
C1	19.8	13	10036	3.01	4.216937	3332.335	1402.5	6/7/15 11:11 AM
C1	39.9	10	10048	3.07	3.155329	3271.08	1402.5	6/7/15 11:00 AM
C1	40.4	9	10057	3.15	2.755143	3190.814	1402.5	6/7/15 10:55 AM
C1	61.5	14	10033	3.11	4.399608	3224.161	1402.5	6/7/15 10:44 AM
C1	61.5	12	10056	3.07	3.806795	3273.686	1402.5	6/7/15 10:49 AM
C1	83.7	12	10020	3.17	3.683489	3158.999	1402.5	6/7/15 10:38 AM
C1	84.3	14	10031	3.1	4.414129	3233.922	1402.5	6/7/15 11:58 AM
C1	106.2	13	10025	3.08	4.118779	3252.986	1402.5	6/7/15 11:53 AM
C1	106.8	12	10026	3.12	3.744154	3211.578	1402.5	6/7/15 11:48 AM
C1	126.6	14	10010	3.2	4.273	3126.241	1402.5	6/7/15 11:43 AM
C1	127.4	7	10030	3.11	2.148804	3223.196	1402.5	6/7/15 11:37 AM
C1	148	10	10012	3.24	2.98442	3088.239	1402.5	6/7/15 11:27 AM
C1	158.6	14	10016	3.1	4.414129	3229.084	1402.5	6/7/15 11:32 AM
C2	7.7	9	10042	2.87	3.023889	3497.105	1402.5	6/7/15 11:21 AM
C2	8.1	10	10060	2.92	3.312658	3443.355	1402.5	6/7/15 11:26 AM
C2	19	14	10035	2.94	4.649905	3411.415	1402.5	6/7/15 11:11 AM
C2	19.8	11	10021	2.95	3.616814	3395.099	1402.5	6/7/15 11:16 AM
C2	39.9	16	10037	3.06	5.116758	3278.215	1402.5	6/7/15 11:05 AM
C2	40.4	10	10024	3.09	3.124246	3242.163	1402.5	6/7/15 11:00 AM
C2	61.5	21	10049	3.09	6.684117	3250.254	1402.5	6/7/15 10:49 AM
C2	61.5	17	10047	3.07	5.425459	3270.788	1402.5	6/7/15 10:55 AM
C2	83.7	11	10034	3.07	3.471062	3266.554	1402.5	6/7/15 10:44 AM
C2	84.3	10	10054	3.11	3.103434	3230.947	1402.5	6/7/15 10:38 AM
C2	106.2	16	10027	3.06	5.116758	3274.947	1402.5	6/7/15 11:58 AM
C2	106.8	14	10039	3.05	4.478164	3289.625	1402.5	6/7/15 11:53 AM
C2	126.6	16	10031	3.16	4.951291	3172.517	1402.5	6/7/15 11:48 AM
C2	127.4	8	10013	3.14	2.435771	3187.004	1402.5	6/7/15 11:43 AM
C2	148	11	10016	3.21	3.314791	3118.399	1402.5	6/7/15 11:32 AM
C2	158.6	7	10043	3.12	2.13159	3217.06	1402.5	6/7/15 11:37 AM
C3	7.7	22	10059	2.9	7.478207	3466.561	1402.5	6/7/15 11:26 AM
C3	8.1	14	10069	2.92	4.686521	3446.228	1402.5	6/7/15 11:32 AM
C3	19	14	10062	2.9	4.719586	3467.595	1402.5	6/7/15 11:16 AM
C3	19.8	13	10021	3.06	4.140366	3272.777	1402.5	6/7/15 11:21 AM
C3	39.9	10	10025	3.1	3.117806	3231.811	1402.5	6/7/15 11:11 AM
C3	40.4	10	10047	3.04	3.181474	3302.874	1402.5	6/7/15 11:05 AM
C3	61.5	8	10037	3.17	2.415659	3164.186	1402.5	6/7/15 10:55 AM
C3	61.5	10	10042	3.04	3.181474	3301.229	1402.5	6/7/15 11:00 AM
C3	83.7	10	10031	3.05	3.170689	3286.792	1402.5	6/7/15 10:49 AM
C3	84.3	12	10012	3.15	3.701524	3176.353	1402.5	6/7/15 10:44 AM
C3	106.2	10	10009	3.15	3.066603	3175.4	1402.5	6/7/15 10:38 AM
C3	106.8	17	10027	3.18	5.237912	3151.085	1402.5	6/7/15 11:58 AM
C3	126.6	11	10025	3.16	3.373013	3170.408	1402.5	6/7/15 11:53 AM
C3	127.4	8	10040	3.18	2.407723	3155.173	1402.5	6/7/15 11:48 AM
C3	148	9	10031	3.21	2.695738	3122.862	1402.5	6/7/15 11:37 AM
C3	158.6	5	10021	3.13	1.489444	3199.537	1402.5	6/7/15 11:43 AM
C4	7.7	10	10032	2.89	3.341208	3469.363	1402.5	6/7/15 11:32 AM
C4	8.1	18	10047	2.93	6.024345	3427.093	1402.5	6/7/15 11:37 AM
C4	19	19	10044	2.91	6.41021	3449.629	1402.5	6/7/15 11:21 AM
C4	19.8	8	10032	2.98	2.565564	3364.526	1402.5	6/7/15 11:26 AM
C4	39.9	14	10040	3.13	4.353843	3205.751	1402.5	6/7/15 11:16 AM
C4	40.4	7	10019	3.09	2.146372	3240.478	1402.5	6/7/15 11:11 AM
C4	61.5	9	10010	3.04	2.841526	3290.846	1402.5	6/7/15 11:00 AM
C4	61.5	9	10018	3.02	2.861132	3315.302	1402.5	6/7/15 11:05 AM
C4	83.7	12	10039	3.13	3.714866	3205.431	1402.5	6/7/15 10:55 AM
C4	84.3	17	10036	3.08	5.400481	3256.525	1402.5	6/7/15 10:49 AM
C4	106.2	12	10004	3.06	3.802569	3267.364	1402.5	6/7/15 10:44 AM
C4	106.8	8	10047	3.12	2.445103	3218.275	1402.5	6/7/15 10:38 AM
C4	126.6	11	10049	3.07	3.464062	3271.373	1402.5	6/7/15 11:58 AM
C4	127.4	10	10040	3.15	3.055603	3185.385	1402.5	6/7/15 11:53 AM
C4	148	17	10016	3.2	5.1935	3128.083	1402.5	6/7/15 11:43 AM
C4	158.6	13	10032	3.15	4.007984	3182.845	1402.5	6/7/15 11:48 AM

D1	7.7	22	10025	3.01	7.21197	3327.719	1402.5	6/7/15 11:37 AM
D1	8.1	21	10034	3	6.903	3341.821	1402.5	6/7/15 11:42 AM
D1	19	13	10022	3.02	4.207636	3315.697	1402.5	6/7/15 11:27 AM
D1	19.8	14	10028	3.02	4.538762	3317.684	1402.5	6/7/15 11:32 AM
D1	39.9	16	10019	3.15	4.982365	3177.789	1402.5	6/7/15 11:21 AM
D1	40.4	13	10009	3.11	4.083064	3215.482	1402.5	6/7/15 11:16 AM
D1	61.5	13	10016	3.16	4.016924	3166.774	1402.5	6/7/15 11:05 AM
D1	61.5	11	10020	3.12	3.428641	3208.692	1402.5	6/7/15 11:11 AM
D1	83.7	19	10023	3.14	5.953955	3189.192	1402.5	6/7/15 11:00 AM
D1	84.3	17	10031	3.18	5.248912	3151.557	1402.5	6/7/15 10:55 AM
D1	106.2	7	10018	3.1	2.161065	3228.767	1402.5	6/7/15 10:49 AM
D1	106.8	17	10017	3.09	5.404618	3238.902	1402.5	6/7/15 10:44 AM
D1	126.6	11	10030	3.19	3.351276	3141.355	1402.5	6/7/15 10:38 AM
D1	127.4	22	10021	3.23	6.714146	3099.631	1402.5	6/7/15 11:58 AM
D1	148	15	10011	3.3	4.448455	3030.79	1402.5	6/7/15 11:48 AM
D1	158.6	12	10031	3.2	3.653	3131.842	1402.5	6/7/15 11:53 AM
D2	7.7	15	10004	2.93	5.026454	3412.688	1402.5	6/7/15 11:42 AM
D2	8.1	20	10038	2.9	6.803552	3459.733	1402.5	6/7/15 11:47 AM
D2	19	22	10026	2.94	7.389993	3408.558	1402.5	6/7/15 11:32 AM
D2	19.8	16	10023	3.09	5.084994	3242.043	1402.5	6/7/15 11:37 AM
D2	39.9	8	10027	3.06	2.521379	3275.151	1402.5	6/7/15 11:27 AM
D2	40.4	12	10028	3.1	3.777968	3233.193	1402.5	6/7/15 11:21 AM
D2	61.5	12	10035	3.16	3.704468	3173.987	1402.5	6/7/15 11:11 AM
D2	61.5	14	10039	3.02	4.542762	3322.526	1402.5	6/7/15 11:16 AM
D2	83.7	12	10034	3.11	3.765521	3224.721	1402.5	6/7/15 11:05 AM
D2	84.3	10	10018	3.08	3.153753	3250.951	1402.5	6/7/15 11:00 AM
D2	106.2	11	10001	3.09	3.466871	3234.924	1402.5	6/7/15 10:55 AM
D2	106.8	12	10025	3.12	3.753154	3211.495	1402.5	6/7/15 10:49 AM
D2	126.6	12	10017	3.2	3.657	3128.667	1402.5	6/7/15 10:44 AM
D2	127.4	10	10050	3.16	3.071557	3178.734	1402.5	6/7/15 10:38 AM
D2	148	9	10022	3.23	2.693378	3101.14	1402.5	6/7/15 11:53 AM
D2	158.6	12	10004	3.2	3.657	3124.604	1402.5	6/7/15 11:58 AM
D3	7.7	11	10056	2.92	3.677123	3442.236	1402.5	6/7/15 11:47 AM
D3	8.1	17	10059	2.89	5.792353	3479.023	1402.5	6/7/15 11:53 AM
D3	19	16	10032	2.91	5.408282	3445.823	1402.5	6/7/15 11:37 AM
D3	19.8	10	10049	2.92	3.334658	3439.838	1402.5	6/7/15 11:42 AM
D3	39.9	10	10016	3.06	3.177974	3271.603	1402.5	6/7/15 11:32 AM
D3	40.4	14	10015	3.09	4.440744	3239.5	1402.5	6/7/15 11:27 AM
D3	61.5	4	10010	3.1	1.200323	3227.432	1402.5	6/7/15 11:16 AM
D3	61.5	5	10038	3	1.576667	3344.4	1402.5	6/7/15 11:21 AM
D3	83.7	21	10005	3.11	6.662412	3215.442	1402.5	6/7/15 11:11 AM
D3	84.3	16	10006	3.06	5.138758	3268.335	1402.5	6/7/15 11:05 AM
D3	106.2	10	10060	3.05	3.188689	3296.761	1402.5	6/7/15 11:00 AM
D3	106.8	14	10037	3.06	4.485163	3278.465	1402.5	6/7/15 10:55 AM
D3	126.6	13	10022	3.13	4.063355	3200.317	1402.5	6/7/15 10:50 AM
D3	127.4	11	10008	3.07	3.493062	3258.335	1402.5	6/7/15 10:44 AM
D3	148	6	10033	3.21	1.779159	3123.945	1402.5	6/7/15 11:58 AM
D3	158.6	6	10046	3.15	1.814762	3187.606	1402.5	6/7/15 10:38 AM
D4	7.7	11	10045	2.91	3.693069	3450.186	1402.5	6/7/15 11:53 AM
D4	8.1	7	10031	2.87	2.352024	3493.418	1402.5	6/7/15 11:58 AM
D4	19	17	10029	2.94	5.695313	3409.52	1402.5	6/7/15 11:42 AM
D4	19.8	13	10028	2.99	4.260826	3352.142	1402.5	6/7/15 11:48 AM
D4	39.9	6	10016	3.07	1.867397	3260.837	1402.5	6/7/15 11:37 AM
D4	40.4	6	10040	3.11	1.84226	3226.592	1402.5	6/7/15 11:32 AM
D4	61.5	12	10018	3.07	3.821795	3261.488	1402.5	6/7/15 11:21 AM
D4	61.5	9	10018	3.02	2.893132	3315.515	1402.5	6/7/15 11:27 AM
D4	83.7	10	10006	3.04	3.202474	3289.743	1402.5	6/7/15 11:16 AM
D4	84.3	10	10037	3.1	3.138806	3236.038	1402.5	6/7/15 11:11 AM
D4	106.2	12	10031	3.09	3.796495	3244.574	1402.5	6/7/15 11:05 AM
D4	106.8	11	10022	3.05	3.519557	3284.198	1402.5	6/7/15 11:00 AM
D4	126.6	8	10038	3.13	2.468911	3205.325	1402.5	6/7/15 10:55 AM
D4	127.4	9	10036	3.15	2.770143	3184.328	1402.5	6/7/15 10:50 AM
D4	148	13	10004	3.18	4.00105	3144.208	1402.5	6/7/15 10:38 AM
D4	158.6	7	10047	3.13	2.149422	3208.2	1402.5	6/7/15 10:44 AM

Prep Num	LabID	QC Type	Init Aliq	Fin Aliq	Units	Report Units	Residual Mass (mg)	Cnt 1 File	Cnt 1 Ins/Det	Cnt 1 Pos Chk By	Cnt 2 File	Cnt 2 Ins/Det	Cnt 2 Pos Chk By	Cnt 3 File	Cnt 3 Ins/Det	Cnt 3 Pos Chk By	Notes
1	1223001-1	SMP	200	200	ml	PC/L	23.3										
1	1223001-2	SMP	200	200	ml	PC/L	22.1										
1	1223001-3	SMP	200	200	ml	PC/L	21										
1	1223001-4	SMP	200	200	ml	PC/L	22.8										
1	1223001-5	SMP	200	200	ml	PC/L	22.7										
1	1223001-6	SMP	200	200	ml	PC/L	48.5										
1	1223001-7	SMP	200	200	ml	PC/L	47.5										
1	1223001-8	SMP	200	200	ml	PC/L	43.7										
1	1223001-9	SMP	200	200	ml	PC/L	46.1										
1	1223001-10	SMP	200	200	ml	PC/L	63.5										
1	1223001-11	SMP	200	200	ml	PC/L	81.1										
1	1223001-12	SMP	200	200	ml	PC/L	93.6										
1	1223001-13	SMP	200	200	ml	PC/L	95.2										
1	1223001-14	SMP	200	200	ml	PC/L	118.1										
1	1223001-15	SMP	200	200	ml	PC/L	90.7										
1	1223001-16	SMP	200	200	ml	PC/L	134.2										
1	1223001-17	SMP	200	200	ml	PC/L	134.2										
1	1223001-18	SMP	200	200	ml	PC/L	151.5										
1	1223001-19	SMP	200	200	ml	PC/L	156										
1	1223001-20	SMP	200	200	ml	PC/L	21.3										
1	1223001-21	SMP	200	200	ml	PC/L	21.8										
1	1223001-22	SMP	200	200	ml	PC/L	19.7										
1	1223001-23	SMP	200	200	ml	PC/L	20.5										
1	1223001-24	SMP	200	200	ml	PC/L	21.2										
1	1223001-25	SMP	200	200	ml	PC/L	21.1										
1	1223001-26	SMP	200	200	ml	PC/L	21.5										
1	1223001-27	SMP	200	200	ml	PC/L	20.7										

See RunLog 3710 pg 72

outlier -> do not use

outlier - don't use

outlier -> do not use

outlier don't use

ABAH110 | NK

A |

Radiochemistry Instrument Worksheet

ALS Environmental -- FC

Prep Batch: AB121109-1

Prep Procedure: GAB

Analytical QASS / NCR? Y

Notes

Prep Num	LabID	OC Type	Init Aliq	Fin Aliq	Units	Report Units	Residual Mass (mg)	Cnt 1 File	Cnt 1 Ins/Det	Cnt 1 Pos Chk By	Cnt 2 File	Cnt 2 Ins/Det	Cnt 2 Pos Chk By	Cnt 3 File	Cnt 3 Ins/Det	Cnt 3 Pos Chk By	Notes
----------	-------	---------	-----------	----------	-------	--------------	--------------------	------------	---------------	------------------	------------	---------------	------------------	------------	---------------	------------------	-------

Spike Solution Information

Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	Am-241	955.4095.10	55,069.251	DPM/ml	11/08/12	0.1	ml	RS-008

Sample Barcodes

1223001-1 AB121109-1PS1		1223001-2 AB121109-1PS2		1223001-3 AB121109-1PS3	
1223001-4 AB121109-1PS4		1223001-5 AB121109-1PS5		1223001-6 AB121109-1PS6	
1223001-7 AB121109-1PS7		1223001-8 AB121109-1PS8		1223001-9 AB121109-1PS9	
1223001-10 AB121109-1PS10		1223001-11 AB121109-1PS11		1223001-12 AB121109-1PS12	
1223001-13 AB121109-1PS13		1223001-14 AB121109-1PS14		1223001-15 AB121109-1PS15	
1223001-16 AB121109-1PS16		1223001-17 AB121109-1PS17		1223001-18 AB121109-1PS18	
1223001-19 AB121109-1PS19		1223001-20 AB121109-1PS20		1223001-21 AB121109-1PS21	
1223001-22 AB121109-1PS22		1223001-23 AB121109-1PS23		1223001-24 AB121109-1PS24	
1223001-25 AB121109-1PS25		1223001-26 AB121109-1PS26		1223001-27 AB121109-1PS27	

Mr

Radiochemistry Instrument Worksheet

Prep Batch: AB121109-1

ALS Environmental -- FC

Reporting Units

LabID:	TstGrpName:	RptUnits:
1223001-1	GrossAlpha/Beta	PCI/L
1223001-2	GrossAlpha/Beta	PCI/L
1223001-3	GrossAlpha/Beta	PCI/L
1223001-4	GrossAlpha/Beta	PCI/L
1223001-5	GrossAlpha/Beta	PCI/L
1223001-6	GrossAlpha/Beta	PCI/L
1223001-7	GrossAlpha/Beta	PCI/L
1223001-8	GrossAlpha/Beta	PCI/L
1223001-9	GrossAlpha/Beta	PCI/L
1223001-10	GrossAlpha/Beta	PCI/L
1223001-11	GrossAlpha/Beta	PCI/L
1223001-12	GrossAlpha/Beta	PCI/L
1223001-13	GrossAlpha/Beta	PCI/L
1223001-14	GrossAlpha/Beta	PCI/L
1223001-15	GrossAlpha/Beta	PCI/L
1223001-16	GrossAlpha/Beta	PCI/L
1223001-17	GrossAlpha/Beta	PCI/L
1223001-18	GrossAlpha/Beta	PCI/L
1223001-19	GrossAlpha/Beta	PCI/L
1223001-20	GrossAlpha/Beta	PCI/L
1223001-21	GrossAlpha/Beta	PCI/L
1223001-22	GrossAlpha/Beta	PCI/L
1223001-23	GrossAlpha/Beta	PCI/L
1223001-24	GrossAlpha/Beta	PCI/L
1223001-25	GrossAlpha/Beta	PCI/L
1223001-26	GrossAlpha/Beta	PCI/L
1223001-27	GrossAlpha/Beta	PCI/L

Radiochemistry Prep Worksheet

ALS Environmental -- FC

Prep Batch: AB121109-1

Prep Procedure: GAB

Reviewed By: jll *SN* Review Date: 11/15/2012

Non-Routine Pre-Treatment? Y *(N)* Batch: *N/A* Re-Prep? Y *(N)* Batch: *N/A* Prep QASS / NCR? Y *(N)* *N/A*

Prep SOP: PAI 702 Rev: 20
Prep SOP: NONE
Matrix Class: liquid
Prep Analyst: Steve Workman
Prep Date: 11/8/2012
Prep Dept: RS
Balance: 10
Balance: 13

Samp Num	Prep Num	LabID	QC Type	Dish No.	Init Aliq ml	Fin Aliq ml	Prep Basis	Standards	Prep Notes
1	1	1223001-1	SMP		200	200	Unfiltered	S1	<i>SA 11/15/12</i>
2	1	1223001-2	SMP		200	200	Unfiltered	S1	
3	1	1223001-3	SMP		200	200	Unfiltered	S1	
4	1	1223001-4	SMP		200	200	Unfiltered	S1	
5	1	1223001-5	SMP		200	200	Unfiltered	S1	
6	1	1223001-6	SMP		200	200	Unfiltered	S1	
7	1	1223001-7	SMP		200	200	Unfiltered	S1	
8	1	1223001-8	SMP		200	200	Unfiltered	S1	
9	1	1223001-9	SMP		200	200	Unfiltered	S1	
10	1	1223001-10	SMP		200	200	Unfiltered	S1	
11	1	1223001-11	SMP		200	200	Unfiltered	S1	
12	1	1223001-12	SMP		200	200	Unfiltered	S1	
13	1	1223001-13	SMP		200	200	Unfiltered	S1	
14	1	1223001-14	SMP		200	200	Unfiltered	S1	
15	1	1223001-15	SMP		200	200	Unfiltered	S1	
16	1	1223001-16	SMP		200	200	Unfiltered	S1	
17	1	1223001-17	SMP		200	200	Unfiltered	S1	
18	1	1223001-18	SMP		200	200	Unfiltered	S1	
19	1	1223001-19	SMP		200	200	Unfiltered	S1	
20	1	1223001-20	SMP		200	200	Unfiltered	S1	
21	1	1223001-21	SMP		200	200	Unfiltered	S1	
22	1	1223001-22	SMP		200	200	Unfiltered	S1	
23	1	1223001-23	SMP		200	200	Unfiltered	S1	
24	1	1223001-24	SMP		200	200	Unfiltered	S1	
25	1	1223001-25	SMP		200	200	Unfiltered	S1	
26	1	1223001-26	SMP		200	200	Unfiltered	S1	
27	1	1223001-27	SMP		200	200	Unfiltered	S1	

Spiked on 11/14 by SW
Spiked on 11/14 by SW
Spiked on 11/14 by SW
Spiked on 11/14 by SW
Spiked on 11/14 by SW

0.05 mL of 10 mg/mL natural Uranium
0.05 mL of 10 mg/mL natural Uranium
0.05 mL of 10 mg/mL natural Uranium

Radiochemistry Prep Worksheet

ALS Environmental -- FC

Prep Batch: AB121109-1

Prep Procedure: GAB

Reviewed By: jtl

Review Date: 11/15/2012

Non-Routine Pre-Treatment? Y / N Batch: Re-Prep? Y / N Batch: Prep QASS / NCR? Y / N

Prep SOP: PAI 702 Rev: 20

Prep Analyst: Steve Workman

Balance: 10

Prep SOP: NONE

Prep Date: 11/8/2012

Balance: 13

Matrix Class: liquid

Prep Dept: RS

Prep Notes

Samp Num	Prep Num	LabID	QC Type	Dish No.	Init Aliq ml	Fin Aliq ml	Prep Basis	Standards
----------	----------	-------	---------	----------	--------------	-------------	------------	-----------

Comments

Calibration planchets and mass attenuation curve.

Spiked By: Steve Workman Date: 11/8/2012

Witnessed By: N/A Date: N/A

Spike Solution Information

Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	Am-241	955.4095.10	55,069,251	DPM/ml	11/08/12	0.1	ml	RS-008

Reagent Solution IDs*

J12036

*Except where otherwise noted, all reagents were applied in accordance with the specifications of the preparation methods associated with this batch.

Radiochemistry Gravimetric Worksheet

ALS Environmental -- FC

Prep Batch: AB121109-1

Review Date: 11/15/2012

Reviewed By: jtl *SN*

Prep Procedure: GAB

Prep Num	Planc. Num	LabID	QC Type	Test Aliq (ml)	Tare Mass (g)	Initial Gross Mass (g)	Initial Net Mass (mg)	Suggested Aliq (ml)	Samp Vol Available (ml)	Samp Vol Taken (ml)	Fin Gross Mass (g)	Final Net Mass (mg)	Salt Sol. Added (ml)	Flag
1	1	1223001-1	SMP	10	9.1050	0.0000	0	200	200	200	9.1283	23.3	0.5	
1	2	1223001-2	SMP	10	9.0995	0.0000	0	200	200	200	9.1216	22.1	0.5	
1	3	1223001-3	SMP	10	9.0872	0.0000	0	200	200	200	9.1082	21	0.5	
1	4	1223001-4	SMP	10	9.1198	0.0000	0	200	200	200	9.1426	22.8	0.5	
1	5	1223001-5	SMP	10	9.1442	0.0000	0	200	200	200	9.1669	22.7	0.5	
1	6	1223001-6	SMP	10	9.1142	0.0000	0	200	200	200	9.1627	48.5	1	
1	7	1223001-7	SMP	10	9.1346	0.0000	0	200	200	200	9.1821	47.5	1	
1	8	1223001-8	SMP	10	9.0877	0.0000	0	200	200	200	9.1314	43.7	1.5	
1	9	1223001-9	SMP	10	9.0922	0.0000	0	200	200	200	9.1383	46.1	1.5	
1	10	1223001-10	SMP	10	9.0712	0.0000	0	200	200	200	9.1347	63.5	2	
1	11	1223001-11	SMP	10	9.1302	0.0000	0	200	200	200	9.2113	81.1	2	
1	12	1223001-12	SMP	10	9.1044	0.0000	0	200	200	200	9.1980	93.6	2.5	
1	13	1223001-13	SMP	10	9.1418	0.0000	0	200	200	200	9.2370	95.2	2.5	
1	14	1223001-14	SMP	10	9.1031	0.0000	0	200	200	200	9.2192	116.1	3	
1	15	1223001-15	SMP	10	9.1182	0.0000	0	200	200	200	9.2089	90.7	3	
1	16	1223001-16	SMP	10	9.1173	0.0000	0	200	200	200	9.2515	134.2	3.5	
1	17	1223001-17	SMP	10	9.0956	0.0000	0	200	200	200	9.2298	134.2	3.5	
1	18	1223001-18	SMP	10	9.1276	0.0000	0	200	200	200	9.2792	151.6	4	
1	19	1223001-19	SMP	10	9.1131	0.0000	0	200	200	200	9.2691	156	4	
1	20	1223001-20	SMP	10	9.0751	0.0000	0	200	200	200	9.0964	21.3	0.5	
1	21	1223001-21	SMP	10	9.1113	0.0000	0	200	200	200	9.1331	21.8	0.5	
1	22	1223001-22	SMP	10	9.0713	0.0000	0	200	200	200	9.0910	19.7	0.5	
1	23	1223001-23	SMP	10	9.1326	0.0000	0	200	200	200	9.1531	20.5	0.5	
1	24	1223001-24	SMP	10	9.1320	0.0000	0	200	200	200	9.1532	21.2	0.5	
1	25	1223001-25	SMP	10	9.1188	0.0000	0	200	200	200	9.1399	21.1	0.5	
1	26	1223001-26	SMP	10	9.0872	0.0000	0	200	200	200	9.1087	21.5	0.5	
1	27	1223001-27	SMP	10	9.1133	0.0000	0	200	200	200	9.1340	20.7	0.5	

Radiochemistry Instrument Worksheet

ALS Environmental -- FC

Prep Batch: AB110619-4

Prep Procedure: GROSS_BETA

MASS

ATTEN

CALIB

Analytical QASS / NCR? Y *NM*

Prep Num	LabID	QC Type	Init Alq	Fin Alq	Report Units	Residual Mass (mg)	Cnt 1 File	Cnt 1 Inst/Det	Cnt 1 Pos Chk By	Cnt 2 File	Cnt 2 Inst/Det	Cnt 2 Pos Chk By	Cnt 3 File	Cnt 3 Inst/Det	Cnt 3 Pos Chk By	Notes
1	1118007-1	SMP	200	200	ml	pCi/l	8.1									
1	1118007-2	SMP	200	200	ml	pCi/l	7.7									
1	1118007-3	SMP	200	200	ml	pCi/l	19.8									
1	1118007-4	SMP	200	200	ml	pCi/l	19									
1	1118007-5	SMP	200	200	ml	pCi/l	39.9									
1	1118007-6	SMP	200	200	ml	pCi/l	40.4									
1	1118007-7	SMP	200	200	ml	pCi/l	61.5									
1	1118007-8	SMP	200	200	ml	pCi/l	61.5									
1	1118007-9	SMP	200	200	ml	pCi/l	83.7									
1	1118007-10	SMP	200	200	ml	pCi/l	84.3									
1	1118007-11	SMP	200	200	ml	pCi/l	106.2									
1	1118007-12	SMP	200	200	ml	pCi/l	106.8									
1	1118007-13	SMP	200	200	ml	pCi/l	126.6									
1	1118007-14	SMP	200	200	ml	pCi/l	127.4									
1	1118007-15	SMP	200	200	ml	pCi/l	158.6									
1	1118007-16	SMP	200	200	ml	pCi/l	148									

See Run Log 370 p573

JP 6/19/11

Spike Solution Information						
Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Pipet ID
S1	Sr-90	777.3020.11	4,268.018	DPW/ml	06/19/11	RS-005

Sample Barcodes

1118007-1 AB110619-4PS1		1118007-2 AB110619-4PS2		1118007-3 AB110619-4PS3	
1118007-4 AB110619-4PS4		1118007-5 AB110619-4PS5		1118007-6 AB110619-4PS6	
1118007-7 AB110619-4PS7		1118007-8 AB110619-4PS8		1118007-9 AB110619-4PS9	
1118007-10 AB110619-4PS10		1118007-11 AB110619-4PS11		1118007-12 AB110619-4PS12	

Radiochemistry Instrument Worksheet

ALS Environmental -- FC

Prep Batch: AB110619-4

Prep Procedure: GROSS_BETA

Analytical QASS / NCR? Y / N

Prep Num	LabID	QC Type	Init Alq	Fin Alq	Units	Report Units	Residual Mass (mg)	Cnt 1 Inst/Det	Cnt 1 Pos Chk By	Cnt 2 File	Cnt 2 Inst/Det	Cnt 2 Pos Chk By	Cnt 3 File	Cnt 3 Inst/Det	Cnt 3 Pos Chk By	Notes	
1118007-13	AB110619-4PS13							1118007-14 AB110619-4PS14						1118007-15 AB110619-4PS15			

1118007-16
AB110619-4PS16

Reporting Units

LabID:	TstGrpName:	RptUnits:
1118007-1	GrossBeta	pCi/l
1118007-2	GrossBeta	pCi/l
1118007-3	GrossBeta	pCi/l
1118007-4	GrossBeta	pCi/l
1118007-5	GrossBeta	pCi/l
1118007-6	GrossBeta	pCi/l
1118007-7	GrossBeta	pCi/l
1118007-8	GrossBeta	pCi/l
1118007-9	GrossBeta	pCi/l
1118007-10	GrossBeta	pCi/l
1118007-11	GrossBeta	pCi/l
1118007-12	GrossBeta	pCi/l
1118007-13	GrossBeta	pCi/l
1118007-14	GrossBeta	pCi/l
1118007-15	GrossBeta	pCi/l
1118007-16	GrossBeta	pCi/l

Radiochemistry Prep Worksheet

ALS Environmental -- FC

Prep Batch: AB110619-4

Prep Procedure: GROSS_BETA

Reviewed By: gdw Review Date: 6/20/2011

Non-Routine Pre-Treatment? Y/N Batch: N/A Re-Prep? Y/N Batch: N/A Prep QASS / NCR? Y/N

Prep SOP: PAI 702 Rev: 20

Prep SOP: NONE

Matrix Class: liquid

Prep Analyst: Gabriel D. Wagner gdw

Prep Date: 6/19/2011

Prep Dept: RS

Balance: 13

Balance:

Samp Num	Prep Num	LabID	QC Type	Dish No.	Init Aliq ml	Fin Aliq ml	Prep Basis	Standards	Prep Notes
1	1	1118007-1	SMP		200	200	Unfiltered	S1	
2	1	1118007-2	SMP		200	200	Unfiltered	S1	
3	1	1118007-3	SMP		200	200	Unfiltered	S1	
4	1	1118007-4	SMP		200	200	Unfiltered	S1	
5	1	1118007-5	SMP		200	200	Unfiltered	S1	
6	1	1118007-6	SMP		200	200	Unfiltered	S1	
7	1	1118007-7	SMP		200	200	Unfiltered	S1	
8	1	1118007-8	SMP		200	200	Unfiltered	S1	
9	1	1118007-9	SMP		200	200	Unfiltered	S1	
10	1	1118007-10	SMP		200	200	Unfiltered	S1	
11	1	1118007-11	SMP		200	200	Unfiltered	S1	
12	1	1118007-12	SMP		200	200	Unfiltered	S1	
13	1	1118007-13	SMP		200	200	Unfiltered	S1	
14	1	1118007-14	SMP		200	200	Unfiltered	S1	
15	1	1118007-15	SMP		200	200	Unfiltered	S1	
16	1	1118007-16	SMP		200	200	Unfiltered	S1	

Comments

(Gross beta mass attenuation curve. All samples desiccated on 06/19/2011 @ 14:48.

Spiked By: Gabriel D. Wagner gdw Date: 6/19/2011

Witnessed By: Justin D. Anderson Date: 6/19/2011

Spike Solution Information						
Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Pipet ID
S1	Sr-90	777.3020.11	4,268.018	DPM/ml	06/19/11	RS-005

Radiochemistry Prep Worksheet

ALS Environmental -- FC

Prep Batch: AB110619-4

Prep Batch Not Validated!!!

Prep Procedure: GROSS_BETA

Reviewed By: Review Date:

Non-Routine Pre-Treatment? Y / N Batch: _____

Prep QASS / NCR? Y / N _____

Prep SOP: PAI 702 Rev: 20

Balance: 13

Prep SOP: NONE

Prep Analyst: Gabriel D. Wagner *GDW*

Balance:

Matrix Class: liquid

Prep Date: 6/19/2011

Prep Dept: RS

Samp Num	Prep Num	LabID	QC Type	Dish No.	Init Aliq ml	Fin Aliq ml	Prep Basis	Standards	Prep Notes
1	1	1118007-1	SMP	0	0	0	Unfiltered	S1	
2	1	1118007-2	SMP	0	0	0	Unfiltered	S1	
3	1	1118007-3	SMP	0	0	0	Unfiltered	S1	
4	1	1118007-4	SMP	0	0	0	Unfiltered	S1	
5	1	1118007-5	SMP	0	0	0	Unfiltered	S1	
6	1	1118007-6	SMP	0	0	0	Unfiltered	S1	
7	1	1118007-7	SMP	0	0	0	Unfiltered	S1	
8	1	1118007-8	SMP	0	0	0	Unfiltered	S1	
9	1	1118007-9	SMP	0	0	0	Unfiltered	S1	
10	1	1118007-10	SMP	0	0	0	Unfiltered	S1	
11	1	1118007-11	SMP	0	0	0	Unfiltered	S1	
12	1	1118007-12	SMP	0	0	0	Unfiltered	S1	
13	1	1118007-13	SMP	0	0	0	Unfiltered	S1	
14	1	1118007-14	SMP	0	0	0	Unfiltered	S1	
15	1	1118007-15	SMP	0	0	0	Unfiltered	S1	
16	1	1118007-16	SMP	0	0	0	Unfiltered	S1	

Comments

Gross beta mass attenuation curve. All samples desiccated on 06/19/11 @ 14:48.

TRAY#3

Spiked By: Gabriel D. Wagner *GDW* Date: 06/19/11

Witnessed By: *WJA* Date: 06/19/11

Spike Solution Information					
Soln #	Nuclide	SolnID	Prep Conc	Units	Pipet ID
S1	Si-90	777.3020.11	4,268.018	DPM/ml	06/19/11
				1 ml	RS-005

Exp: 4/1/12

Radiochemistry Gravimetric Worksheet

ALS Environmental -- FC

Prep Batch: AB110619-4

Prep Procedure: GROSS BETA

Reviewed By: gdw *gdw* Review Date: 6/20/2011

Prep Num	Planc. Num	LabID	QC Type	Test Alq (ml)	Tare Mass (g)	Initial Gross Mass (g)	Initial Net Mass (mg)	Suggested Alq (ml)	Samp Vol Available (ml)	Samp Vol Taken (ml)	Fin Gross Mass (g)	Final Net Mass (mg)	Salt Sol. Added (ml)	Flag
1	1	1118007-1	SMP	10	9.1792	0.0000	0	200	200	200	9.1873	8.1	0.25	
1	2	1118007-2	SMP	10	9.1459	0.0000	0	200	200	200	9.1536	7.7	0.25	
1	3	1118007-3	SMP	10	9.1322	0.0000	0	200	200	200	9.1520	19.8	0.5	
1	4	1118007-4	SMP	10	9.1795	0.0000	0	200	200	200	9.1985	19	0.5	
1	5	1118007-5	SMP	10	9.1387	0.0000	0	200	200	200	9.1786	39.9	1	
1	6	1118007-6	SMP	10	9.1305	0.0000	0	200	200	200	9.1709	40.4	1	
1	7	1118007-7	SMP	10	9.1189	0.0000	0	200	200	200	9.1804	61.5	1.5	
1	8	1118007-8	SMP	10	9.1427	0.0000	0	200	200	200	9.2042	61.5	1.5	
1	9	1118007-9	SMP	10	9.1715	0.0000	0	200	200	200	9.2552	83.7	2	
1	10	1118007-10	SMP	10	9.1351	0.0000	0	200	200	200	9.2194	84.3	2	
1	11	1118007-11	SMP	10	9.1447	0.0000	0	200	200	200	9.2509	106.2	2.5	
1	12	1118007-12	SMP	10	9.1506	0.0000	0	200	200	200	9.2574	106.8	2.5	
1	13	1118007-13	SMP	10	9.1339	0.0000	0	200	200	200	9.2605	126.6	3	
1	14	1118007-14	SMP	10	9.1621	0.0000	0	200	200	200	9.2895	127.4	3	
1	15	1118007-15	SMP	10	9.0634	0.0000	0	200	200	200	9.2220	158.6	3.5	
1	16	1118007-16	SMP	10	9.2095	0.0000	0	200	200	200	9.3575	148	3.5	

6/6/2015

Am 241 (Gross Alpha) Mass Attenuation Curve

Benchsheet: AB1Z1109-1

Sources: 1Z23001-1→3, 6-14, 16-19

Calibration Curve Range: 21 mg → 156 mg

File names

AAM0606

AAM0607

Det	9:56	10:22	10:48	11:14	11:40	12:05	12:34	13:01	13:28	13:58	2:14	9:13	9:40	9:57	9:33	10:01
A1	1	19	18	17	16	14	13	12	11	10	9	8	7	6	3	2
A2	2	1	19	18	17	16	14	13	12	11	10	9	8	7	6	3
A3	3	2	1	19	18	17	16	14	13	12	11	10	9	8	7	6
A4	6	3	2	1	19	18	17	16	14	13	12	11	10	9	8	7
B1	7	6	3	2	1	19	18	17	16	14	13	12	11	10	9	8
B2	8	7	6	3	2	1	19	18	17	16	14	13	12	11	10	9
B3	9	8	7	6	3	2	1	19	18	17	16	14	13	12	11	10
B4	10	9	8	7	6	3	2	1	19	18	17	16	14	13	12	11
C1	11	10	9	8	7	6	3	2	1	19	18	17	16	14	13	12
C2	12	11	10	9	8	7	6	3	2	1	19	18	17	16	14	13
C3	13	12	11	10	9	8	7	6	3	2	1	19	18	17	16	14
C4	14	13	12	11	10	9	8	7	6	3	2	1	19	18	17	16
D1	16	14	13	12	11	10	9	8	7	6	3	2	1	19	18	17
D2	17	16	14	13	12	11	10	9	8	7	6	3	2	1	19	18
D3	18	17	16	14	13	12	11	10	9	8	7	6	3	2	1	19
D4	19	18	17	16	14	13	12	11	10	9	8	7	6	3	2	1

JP 6/7/15

Continued on Page

Signed

Read and Understood By

6/7/2015

Date

Signed

6/7/2015

Filename:
ASR0607Sr 90 Ring (Gross Beta) Mass Attenuation Curve
Benchsheet: AB110619-4 Sources: 1118007-1 → 16

Calibration Curve Range: 7.7mg → 158.6

Det	10:25	10:41	10:46	10:51	10:57	11:02	11:07	11:13	11:18	11:23	11:29	11:34	11:39	11:44	11:49	11:55
A1	1	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2
A2	2	1	16	15	14	13	12	11	10	9	8	7	6	5	4	3
A3	3	2	1	16	15	14	13	12	11	10	9	8	7	6	5	4
A4	4	3	2	1	16	15	14	13	12	11	10	9	8	7	6	5
B1	5	4	3	2	1	16	15	14	13	12	11	10	9	8	7	6
B2	6	5	4	3	2	1	16	15	14	13	12	11	10	9	8	7
B3	7	6	5	4	3	2	1	16	15	14	13	12	11	10	9	8
B4	8	7	6	5	4	3	2	1	16	15	14	13	12	11	10	9
C1	9	8	7	6	5	4	3	2	1	16	15	14	13	12	11	10
C2	10	9	8	7	6	5	4	3	2	1	16	15	14	13	12	11
C3	11	10	9	8	7	6	5	4	3	2	1	16	15	14	13	12
C4	12	11	10	9	8	7	6	5	4	3	2	1	16	15	14	13
D1	13	12	11	10	9	8	7	6	5	4	3	2	1	16	15	14
D2	14	13	12	11	10	9	8	7	6	5	4	3	2	1	16	15
D3	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	16
D4	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

JP 6/8/15

Continued on Page

Read and Understood By

J. P. R.

6/7/2015

Signed

Date

Signed

281 of 329

Date 6/6/15SOP 724r 11

ALS
Low Background Gas Flow Proportional Counter Log
Instrument: LB4100C

Instrument Daily Response and Background Checks

Det.	Daily Response Check				Background Check				Det. Status
	Start 1	Status	Start 2	Status	Start 1	Status	Start 2	Status	
1	JP	P			*				P
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16	✓	✓			✓				✓

Det = Detector; α = Alpha; β = Beta; P = Pass; H = High; L = Low; OL = Offline; R = Recount; W = Weekly; NP = Not Processed*Weekly Background Calibration*

	Current Calib. File ID	Weekly Calib. Started	Status	File ID
Dr A	BKC0605W			
Dr B				
Dr C				
Dr D				

Dr = Drawer

Gas Supply

P-10 Supply		P-10 Flow	
Tank 1	400	Dr A	0.1
		Dr B	
Tank 2	1800	Dr C	
		Dr D	✓

Comments: * Not necessary to run daily background checks following a 1000 Minute Background Calibration JP 6/6/15

Date 6/6/15

SOP 724r 11

ALS
Low Background Gas Flow Proportional Counter Log
Instrument: LB4100C

Det.	Sample ID	Batch	Test	Count Dur. (min)	Start Time	Analyst Initials	File ID	Output Initials
1-16	1050	AB121109-1	Gross/Am 241	30	7:12	JP	EFC0606	JP
5-8			(Am 241)	30	7:38	JP	EAM0606A	
9-12			Cal		7:47			
13-16					7:58			
1-4	1051	AB110616-3	Gross	30	8:07	JP	ESR0606A	JP
5-8			Beta		8:18			
9-12			(Sr 90)		8:18			
13-16			Cal		8:18			
1-4	1061	AB150310-2	Gross	30	8:22	JP	ECS0606A	JP
5-8			Beta		8:08			
9-12			Cs 137		8:17			
13-16			Cal		8:25			
1-16	1223001-13,6-14,16-19	AB121109-1	Am 241	30		JP	AAM0606	
			Mass Attenuation					
1-4	1062	AB121109-1	A EFF	30	8:34	JP	EAM0606A	JP
5-8			(Cal) (Am 241)		8:43	JP		
9-12					8:53	JP		
13-16					9:03			
1-4	1063	AB110616-3	B EFF	30	9:03		ESR0606A	JP
5-8			(Cal) (Sr 90)		9:44			
9-12					9:54			
13-16					9:04			
1-4	1064	AB150310-2	B EFF	30	9:07		ECS0606A	JP
5-8			Cal		9:22			
9-12			Cs 137		9:29			
13-16					9:36			
1-16	1223001-13,6-14,16-19	AB121109-1	Am 241	30	9:43	JP	AAM0606	JP
			Mass Attenuation		9:56			

JP 6/6/15

JP 8/6/15

JP 6/6/15

Comments:

Date 6/7/15SOP 724r 11

ALS
Low Background Gas Flow Proportional Counter Log
Instrument: LB4100C

Instrument Daily Response and Background Checks

Det. #	Daily Response Check				Background Check				Det. Status
	Start 1	Status	Start 2	Status	Start 1	Status	Start 2	Status	
1	JP	P			JP	P			P
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									

Det = Detector; α = Alpha; β = Beta; P = Pass; H = High; L = Low; OL = Offline; R = Recount; W = Weekly; NP = Not Processed*Weekly Background Calibration*

	Current Calib. File ID	Weekly Calib. Started	Status	File ID
Dr A	BKCOL05W			
Dr B				
Dr C				
Dr D				

Dr = Drawer

Gas Supply

P-10 Supply		P-10 Flow	
Tank 1	350	Dr A	0.1
		Dr B	
Tank 2	1450	Dr C	
		Dr D	

Comments:

Date 6/17/15SOP 724r 11ALS
Low Background Gas Flow Proportional Counter Log
Instrument: LB4100C

Det.	Sample ID	Batch	Test	Count Dur. (min)	Start Time	Analyst Initials	File ID	Output Initials
1-16	Dash EFF	—	—	30	7:01	JP	EFC0607	JP
1-16	Dash Bk	—	—	60	7:08	JP	BKC0607	JP
1-16	1223001-1-14, 16-19	AB121109-1	Mass Attr	30	8:13	JP	AAM0607	JP
1-16	1118007-1-16	AB110619-4	BMass Attr	30	10:28	JP	ASR0607	JP
2	1224001-1	AB121206-3	α LB	180	12:01	JP	ABC0607	JP
6	-2		+CVS/					
10	-3		ICB					
14	-4							
3	AB121206-3AMB							
7	BMB							
11	CMB							
15	EMB							

JP 6/18/15

Comments:

Page No.: 455202 **B**
(cont. from page NA B)

Form 780r8.doc (6/23/06)

Reviewed By / Date

JP 6/17/15

Project

Continued from Page

955.4095.10

Am-241

Working
Intermediate Standard
MEL 11/8/11

MEL 11/8/11

Prepare a working dilution of 955, Am-2411. Density of 1M HCl, lot # K22032

Mass of 100mL vol. flask:

66.4295gBalance # 12

Mass of flask & 100mL acid:

167.9701gBalance# 12

Net Mass:

101.5406g

Density:

1.0154g/mL2. Mass of 955 transferred:

Mass of empty vial:

21.3568gBalance# 12

Mass of vial & standard:

26.4318gBalance# 12

Net mass of standard transferred:

5.0750g

MEL 11/8/11

3. Dilute to final volume:

Mass of vial, standard, & diluent:

42.8085gBalance# 12

Mass of empty vial:

21.3568gBalance# 12

Net mass of new dilution:

21.4517g

4. Final activity calculation:

$$(1.965 \times 10^4 \text{ Bq}) \left(\frac{60 \text{ dpm}}{1 \text{ Bq}} \right) \left(\frac{5.0750 \text{ g}}{5.1344 \text{ g}} \right) \left(\frac{1.0154 \text{ g/mL}}{21.4517 \text{ g}} \right) = 55,161.32 \text{ dpm/mL}$$

MEL 11/8/11
MEL 11/8/11

MEL 11/8/11

Std ID: 955.4095.10

RG 11/29/11

RG 11/29/11

Description: Am-241

Expiration: 11/11/2012

Activity: 55161.33 dpm/mL

2s Uncertainty: 992.90 dpm/mL

Ref. Date: 10/25/2011

Ref Time: N/A

Prep Date: 11/8/2011 Prep by: MEL

Matrix/Comp. 3M HCl

Half Life (y): 4.33E+02

Reverification Log		
Analysis Date	Initials	Expiration Date

RG 11/29/11

Continued on Page

Megan Jones
Signed

11/8/11
Date

Read and Understood By
Kane Hollis
Signed

11/29/11
286 of 329



Eckert & Ziegler
Analytics

RS# 955
Rec 10-31-11

1380 Seaboard Industrial Blvd.
Atlanta, Georgia 30318
Tel 404-352-8677
Fax 404-352-2837
www.analyticsinc.com

CERTIFICATE OF CALIBRATION

Standard Radionuclide Source

85983-307

Am-241 5 mL Liquid in Flame Sealed Vial

Customer: ALS Laboratory Group / Fort Collins
P.O. No.: 73625, Item 1

This standard radionuclide source was prepared gravimetrically from a master solution, calibrated by Eckert & Ziegler Analytics. The master solution was calibrated by liquid scintillation counting. Radionuclide purity and calibration were checked by germanium gamma-ray spectrometry and liquid scintillation counting. The nuclear decay rate and reference date for this source are given below. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 1, February, 1979, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST." EZA is accredited by the Health Physics Society (HPS) for the production of NIST-traceable sources, and this source was produced in accordance with the HPS accreditation requirements. Customers may report any concerns with the accreditation program to the HPS Secretariat, 1313 Dolley Madison Blvd., Ste. 402, McLean, VA 22101.

Isotope	Half-Life, Days	Activity (Bq)	Uncertainty*, %			Reference Date (12:00 PM EST)
			Type u_A	u_B	U	
Am-241	1.580E+05	1.965E+04	0.1	0.9	1.8	10/25/2011

***Uncertainty:** U - Relative expanded uncertainty, $k = 2$. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results."

Comments:

Impurities: γ -impurities < 0.1 %, α -impurities < 0.1 %. 5.13441 g 1M HCl solution, carrier free.

Source Prepared by:

M. I. Taskaeva
M. I. Taskaeva, Radiochemist

QA Approved:

J. D. McCorvey
J. D. McCorvey, QA Manager Alternate

Date: 26 Oct 11



Prepare a primary dilution of RSO #777 (Analytics #69573-307) in 0.1M HCl to a final volume of approx. 500 mL.

1) Prepare 0.1M HCl by diluting 8.3 mL HCl (12M) (Fisher Scientific Lot #055784) to a final volume of 1L.

2) Determine the density of 0.1M HCl

Weight of empty volumetric flask (100mL) 68.54g
Mass of flask + 100mL 0.1M HCl 168.31g
Mass of 100mL of 0.1M HCl 99.77g
÷ 100mL = density = 0.9977

3) Transfer #777 to a 500mL

Mass of bottle 47.9687g
Mass of bottle + std. 52.9160g
Mass of std. 4.9473g

4) Dilute to volume w/ 0.1M HCl

Mass of bottle + std. + soln 494.52g
Mass of bottle (from above) 47.9687g
Mass of soln 446.55g

5) Final activity (dpm/mL)

$$\frac{(3.812 \times 10^4 \text{ dps}) (60 \text{ sec/min}) (4.9473 \text{ g})}{(5.05960 \text{ g}) (446.55 \text{ g})} = \frac{5010.94 \text{ dpm}}{5008.25 \text{ g}}$$

Std ID: 777.3020.11

Description: Sr-90
Expiration: 2/27/07
Activity: 4996.73

2s Uncertainty: 99.93
Ref. Date: 12/2/04
Ref Time: N/A
Prep Date: 2/8/06
Matrix/Comp: 0.1 M HCl
Half Life (y): 2.88E+01

dpm/mL

dpm/mL

rep by: HB

ANALYSIS DATE = 06/10/06

NEW EXP. DATE = 06/07/11

Read and Understate:

Reverification Log		
Analysis Date	Initials	Expiration Date
11/3/06	RG	11/8/07
8/3/07	JCB	8/3/08
2/28/08	MBC	2/25/09
1/30/09	RG	1/30/2010
7/17/09	RG	7/17/2010

Deanne Barker

2/8/06

2/8/06

Signed

Date

Signed

Date 288 of 329

ANALYTICS

RSO #777
Rec'd 12/9/04
JCS

1980 Seaboard Industrial Blvd.
Atlanta, Georgia 30318 - U.S.A.

Phone (404) 352-8677
Fax (404) 352-2837

CERTIFICATE OF CALIBRATION
Standard Radionuclide Source

69573-307

Sr-90 5 mL Liquid in Flame Sealed Vial

This standard radionuclide source was prepared gravimetrically from a calibrated master solution. The master solution was calibrated by liquid scintillation counting.

Radionuclide purity and calibration were checked by germanium gamma-ray spectrometry and liquid scintillation counting. The nuclear decay rate and assay date for this source are given below.

ANALYTICS maintains traceability to the National Institute of Standards and Technology through Measurements Assurance Programs as described in USNRC Reg. Guide 4.15, Revision 1.

ISOTOPE: Sr-90
ACTIVITY (dps): 3.812 E4
HALF-LIFE: 28.79 years
CALIBRATION DATE: December 2, 2004 12:00 EST
RELATIVE EXPANDED
UNCERTAINTY (k=2): 2.0%

Impurities: γ -impurities <0.1%

5.05960 grams in 0.1M HCl solution with 30 μ g/g Sr carrier.

This source also contains Y-90 in secular equilibrium with Sr-90. The Y-90 activity is equal to the Sr-90 activity. Since Sr-90 and Y-90 both decay 100% by beta emission, the total beta emission rate for the source is twice the certified Sr-90 activity. The half-life for Y-90 is 64.08 hours.

P O NUMBER 71069, Item 1

SOURCE PREPARED BY:

M. Dimitrova
M. Dimitrova, Radiochemist

Q A APPROVED:

LM Mtg 12-6-04

Internal Calculation Verifications

ICBs

&

ICVs

OK 07/6/91

Atten. Constants	b	m	a	x0
Alpha	0.9030	0.9911	0.8270	21.4875
Beta	0.9681	0.9996	0.9174	0.0

Detector	Sample ID	Initial Aliquot	Final Sam. Size	Count Date	Count Dur.	Alpha				Beta								
						Residual Mass (mg)	Gross CPM	Bkg CPM	$\beta > \alpha$ X-Talk	Net CPM	Atten.	Efficiency	Gross CPM	Bkg CPM	$\alpha > \beta$ X-Talk	Net CPM	Atten.	Efficiency
A2	1224001-1	0.200	0.200	6/7/2015	180	21.4	17.094	0.157	0.145	16.792	0.904	0.2263	46.472	1.588	4.4011	40.4829	0.8605	0.4442
B2	1224001-2	0.200	0.200	6/7/2015	180	43.8	16.006	0.122	0.123	15.761	0.786	0.2189	44.817	1.657	4.2783	38.8817	0.9527	0.4272
C2	1224001-3	0.200	0.200	6/7/2015	180	64.0	14.361	0.112	0.099	14.240	0.659	0.2279	46.659	1.850	3.9640	38.8080	0.9456	0.4334
D2	1224001-4	0.200	0.200	6/7/2015	180	91.2	13.472	0.093	0.084	13.295	0.539	0.2240	42.594	1.646	3.8877	37.0603	0.9362	0.4319
A3	AB121206-3AMB	0.200	0.200	6/7/2015	180	22.4	0.144	0.112	0.001	0.031	0.897	0.2196	1.778	1.595	0.0083	0.1747	0.9602	0.4508
B3	AB121206-3BMB	0.200	0.200	6/7/2015	180	46.4	0.217	0.134	0.000	0.083	0.751	0.2088	1.850	1.833	0.0224	-0.0054	0.9518	0.4341
C3	AB121206-3CMB	0.200	0.200	6/7/2015	180	69.8	0.117	0.108	0.000	0.042	0.632	0.2135	2.128	2.060	0.0025	0.0655	0.9436	0.4422
D3	AB121206-3EMB	0.200	0.200	6/7/2015	180	96.0	0.133	0.090	0.001	0.042	0.521	0.2222	1.861	1.600	0.0126	0.0462	0.9346	0.4475

Spike Information				Decay Corr.	
Beta	Std	Ref.	Act	Spike	
ID		Date	(dpm/ml)	Vol (mL)	Act. Added
931.4095.33		4/11/2011	51.950	1.0	47.005

Acceptance criteria for LCS's --> 70-130%

Sample ID	Alpha				Beta				
	Act (pCi/L)	TPU (2 sig)	MDC	% Recov.	Act<MDCa	TPU (2 sig)	MDC	% Recov.	
1224001-1	184.95	30.2	2.26	83.9%	NA	213.70	34.5	4.56	100.9%
1224001-2	211.79	34.7	2.51	96.0%	NA	215.18	34.8	4.76	101.6%
1224001-3	213.40	35.0	2.03	96.8%	NA	213.27	34.4	4.68	100.7%
1224001-4	247.85	40.8	3.00	112.4%	NA	206.42	33.4	4.63	97.5%
AB121206-3AMB	0.36	0.7	1.50	0.2%	PASS	0.91	1.1	2.36	NA
AB121206-3EMB	1.19	1.1	2.04	0.5%	PASS	-0.03	1.2	2.66	NA
AB121206-3CMB	0.45	0.0	2.15	0.1%	PASS	0.35	0.0	2.77	NA
AB121206-3EMB	0.83	0.0	2.32	0.4%	PASS	1.34	0.0	2.45	NA

Alpha CU	Alpha TPU	Beta CU	Beta TPU
(1 sig)	(1 sig)	(1 sig)	(1 sig)
3.4115	15.1159	2.8142	17.2460
4.0253	17.3363	2.8990	17.3760
4.2372	17.5115	2.8649	17.2207
5.1194	20.3875	2.8395	16.6791
0.3459	0.3471	0.5585	0.5631
0.6957	0.5342	0.6030	0.6030

PAI - Gas Flow Proportional Sample Analysis LB4100-C

Alpha Attenuation Calibration	Beta Attenuation Calibration
y = b'm*(a*(mass-x0)) Alpha b= m= a= x0=	y = b'm*(a*(mass-x0)) Beta b= m= a= x0=
Alpha to Beta X-talk y = b'm*(a-mass) a->b xtalk b= a->b xtalk m=	Beta to Alpha X-talk y = b'm*(a-mass) b->a xtalk b= b->a xtalk m=

Unit Type: LB4100-C
Counting Unit ID: Magenta
High Voltage Mode: Simultaneous
Application Revision: Standard
Rev:12/01/08 JCP

Data file name: ABC0607
Batch ID: AB121206-3 JCVS/ICB'S
Count Preset (m): 180
Batch Ended: 6/7/2015 15:02

Background logfile: BKGABW
Date of Bkg. Cal: 6/6/2015
Alpha efficiency logfile: An241R-06/15
Alpha attenuation calibration: AAM0606_0607
Beta efficiency logfile: SR0R-06/15
Beta attenuation calibration: ASR0607

Alpha prog. logfile: n/a
Alpha prog. attenuation: n/a
Beta prog. logfile: n/a
Beta prog. attenuation: n/a

Det. ID	Sample ID	Count End Date & Time	Count Dur. (min)	Resid. Mass (mg)	Alpha Activity					Beta Activity				
					Gross CPM	Bkg. CPM	b>a xtlk CPM	Base Eff	Progeny Cor.Fact.	Gross CPM	Bkg. CPM	a>b xtlk CPM	Base Eff	Progeny Cor.Fact.
A2	1224001-1	6/7/2015 15:02	180.00	21.4	17.084	0.157	0.145	0.2263	0.804	46.472	1.588	4.4013	0.4442	0.961
A3	AB121206-3AMB	6/7/2015 15:02	180.00	22.4	0.144	0.112	0.001	0.2196	0.897	1.778	1.595	0.0084	0.4508	0.960
C2	1224001-3	6/7/2015 15:02	180.00	64.0	14.361	0.112	0.108	0.2279	0.659	44.622	1.850	3.9641	0.4334	0.946
C3	AB121206-3CMB	6/7/2015 15:02	180.00	69.8	0.117	0.108	0.000	0.2135	0.632	2.128	2.060	0.0024	0.4422	0.944
B2	1224001-2	6/7/2015 15:02	180.00	43.8	16.006	0.122	0.123	0.2189	0.766	44.817	1.657	4.2781	0.4272	0.953
B3	AB121206-3BMB	6/7/2015 15:02	180.00	46.4	0.217	0.134	0.000	0.2088	0.751	1.850	1.833	0.0224	0.4341	0.952
D2	1224001-4	6/7/2015 15:02	180.00	91.2	13.472	0.093	0.084	0.2240	0.539	42.594	1.646	3.8878	0.4319	0.936
D3	AB121206-3EMB	6/7/2015 15:02	180.00	96.0	0.133	0.090	0.001	0.2222	0.521	1.881	1.600	0.0127	0.4475	0.935

McGlad

Date 6/7/15SOP 724r 11

ALS
Low Background Gas Flow Proportional Counter Log
Instrument: LB4100C

Instrument Daily Response and Background Checks

Det.	Daily Response Check				Background Check				Det. Status
	Start 1	Status	Start 2	Status	Start 1	Status	Start 2	Status	
1	JP	P			JP	P			P
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									

Det = Detector; α = Alpha; β = Beta; P = Pass; H = High; L = Low; OL = Offline; R = Recount; W = Weekly; NP = Not Processed

Weekly Background Calibration

	Current Calib. File ID	Weekly Calib. Started	Status	File ID
Dr A	BKCO60SW			
Dr B				
Dr C				
Dr D				

Dr = Drawer

Gas Supply

P-10 Supply		P-10 Flow	
Tank 1	350	Dr A	0.1
		Dr B	
Tank 2	1450	Dr C	
		Dr D	

Comments:

Date 6/7/15
JP 6/7/15

SOP 724r 11

ALS

Low Background Gas Flow Proportional Counter Log
 Instrument: LB4100C

Det.	Sample ID	Batch	Test	Count Dur. (min)	Start Time	Analyst Initials	File ID	Output Initials
1-16	Darb EFF	—	—	30	7:01	JP	EFC0607	JP
1-16	Darb Bkg	—	—	60	7:08	JP	BKCO607	JP
1-16	1223001-13614, 1619	AB121109-1	Mass Attn	30	8:13	JP	AAM0607	JP
1-16	1118007-1-16	AB110619-4	BMass Attn	30	10:28	JP	ASRO607	JP
2	1224001-1	AB121206-3	α LB	180	12:01	JP	ABC0607	JP
6	-2		TCVS/ ICB					
10	-3							
14	-4							
3	AB121206-3AMB							
7	BMB							
11	CMB							
15	EMB							

JP 6/8/15

Comments:

Page No.: 455202 **B**
 (cont. from page NA) **B)**

Form 780r8.doc (6/23/06)

Reviewed By / Date JP 6/7/15

Date 6/8/15

SOP 724r 11

ALS
Low Background Gas Flow Proportional Counter Log
Instrument: LB4100C

Instrument Daily Response and Background Checks

Det.	Daily Response Check				Background Check				Det. Status
	Start 1	Status	Start 2	Status	Start 1	Status	Start 2	Status	
1	JP	P			JP	P			P
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									

Det = Detector; α = Alpha; β = Beta; P = Pass; H = High; L = Low; OL = Offline; R = Recount; W = Weekly; NP = Not Processed

Weekly Background Calibration

	Current Calib. File ID	Weekly Calib. Started	Status	File ID
Dr A	BKCOUWSCW			
Dr B				
Dr C				
Dr D				

Dr = Drawer

Gas Supply

P-10 Supply		P-10 Flow	
Tank 1	2200	Dr A	0.1
		Dr B	
Tank 2	1200	Dr C	
		Dr D	

Comments:

Radiochemistry Instrument Worksheet

ALS Environmental -- FC

Prep Batch: AB121206-3

Prep Procedure: GAB ICBs, ICB's

Analytical QASS/NCR? Y *CM*

Prep Num	LabID	QC Type	Init Aliq	Fin Aliq	Units	Report Units	Residual Mass (mg)	Cnt 1 File	Cnt 1 Inst/Det	Cnt 1 Pos Chk By	Cnt 2 File	Cnt 2 Inst/Det	Cnt 2 Pos Chk By	Cnt 3 File	Cnt 3 Inst/Det	Cnt 3 Pos Chk By	Notes
1	1224001-1	SMP	200	200	200	ml	21.4	AB0007 2	2	✓							
1	1224001-2	SMP	200	200	200	ml	43.8	6									
1	1224001-3	SMP	200	200	200	ml	64	10									
1	1224001-4	SMP	200	200	200	ml	91.2	14									
1	AB121206-3A	MB	200	200	200	ml	22.4	3									
1	AB121206-3B	MB	200	200	200	ml	46.4	7									
1	AB121206-3C	MB	200	200	200	ml	69.8	11									
1	AB121206-3E	MB	200	200	200	ml	96	15									

Spike Solution Information

Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	AM-241	616.4095.13	98.308	DPM/ml	12/06/12	1	ml	RS-016
S2	Sr-90	931.4095.33	49.916	DPM/ml	12/06/12	1	ml	RS-016

Sample Barcodes

1224001-1 AB121206-3PS1		1224001-2 AB121206-3PS2		1224001-3 AB121206-3PS3	
1224001-4 AB121206-3PS4		AB121206-3AMB AB121206-3PS5		AB121206-3BMB AB121206-3PS6	
AB121206-3CMB AB121206-3PS7		AB121206-3EMB AB121206-3PS8			

Reporting Units

LabID:	TstGrpName:	RptUnits:
1224001-1	GrossAlpha/Beta	PCI/L
1224001-2	GrossAlpha/Beta	PCI/L
1224001-3	GrossAlpha/Beta	PCI/L
1224001-4	GrossAlpha/Beta	PCI/L

Radiochemistry Prep Worksheet

Prep Batch: AB1212063

ALS Environmental -- FC

Reviewed By: JL Review Date: 12/6/2012

Prep Procedure: GAB

Non-Routine Pre-Treatment? Y N Batch: NA Re-Prep? Y N Prep QASS / NCR? Y N NA
 Prep Analyst: Jeffrey T. Lee Balance: 13
 Prep Date: 12/6/2012 Balance:
 Prep Dept: RS Matrix Class: liquid

Sample Num	Prep Num	LabID	QC Type	Dish No.	Init Alq ml	Fin Alq ml	Prep Basis	Standards	Prep Notes
1	1	1224001-1	SMP		200	200	Unfiltered	S1, S2	
2	1	1224001-2	SMP		200	200	Unfiltered	S1, S2	
3	1	1224001-3	SMP		200	200	Unfiltered	S1, S2	
4	1	1224001-4	SMP		200	200	Unfiltered	S1, S2	
5	1	AB121206-3A	MB		200	200	Unfiltered		
6	1	AB121206-3B	MB		200	200	Unfiltered		
7	1	AB121206-3C	MB		200	200	Unfiltered		
8	1	AB121206-3E	MB		200	200	Unfiltered		

Comments

ICV/ICBS. Samples desiccated on 12/6/12 @ 17:15.

Spiked By: Jeffrey T. Lee Date: 12/6/2012
 Witnessed By: Eric K. Gobel Date: 12/6/2012

Spike Solution Information					
Soln #	Nuclide	SolnID	Prep Conc	Units	Pipet ID
S1	AM-241	616.4095.13	98.308	DPM/ml	12/06/12 1 ml RS-016
S2	Sc-80	931.4095.33	49.816	DPM/ml	12/06/12 1 ml RS-016

Reference Solutions

J12036

Except where otherwise noted, all reagents were applied in accordance with the specifications of the preparation methods associated with this batch.

Page 1 of 1 GAB Bench Sheet
 Date Printed: 12/6/2012 17:34

ALS Environmental -- FC
 LIMS Version: 6.025

Supersedes: 12/6/12 17:00

Radiochemistry Prep Worksheet

ALS Environmental -- FC

Prep Batch: AB121206-8

Prep Batch Not Validated!!!

Prep Procedure: GAB

Review Date:

Reviewed By:

Non-Routine Pre-Treatment? Y / N Batch: Re-Prep? Y / N Batch: Prep QASS / NCR? Y / N

Prep SOP: PAI 702 Rev: 20

Prep SOP: NONE

Matrix Class: liquid

Prep Analyst: Jeffrey T. Lee

Prep Date: 12/6/2012

Prep Dept: RS

Balance: 13

Balance:

Sample Num	LabID	QC Type	Dish No.	Init Aliq ml	Fin Aliq ml	Prep Basis	Standards	Prep Notes
1	1224001-1	SMP		200	200	Unfiltered	S1, S2	
2	1224001-2	SMP		200	200	Unfiltered	S1, S2	
3	1224001-3	SMP		200	200	Unfiltered	S1, S2	
4	1224001-4	SMP		200	200	Unfiltered	S1, S2	
5	AB121206-3A	MB		200	200	Unfiltered		
6	AB121206-3B	MB		200	200	Unfiltered		
7	AB121206-3C	MB		200	200	Unfiltered		
8	AB121206-3E	MB		200	200	Unfiltered		

Comments

Spiked By: ML Date: 12/6/12
 Witnessed By: ERG Date: 12/6/12

Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot Units	Pipet ID
S1	AM-241	616.4095.13	98.308	DPM/ml	12/06/12	1 ml	RS-016
S2	Sr-90	931.4095.33	49.916	DPM/ml	12/06/12	1 ml	RS-016

S1: 4/24/13
 S2: 9/18/13

J12036

*Except where otherwise noted, all reagents were applied in accordance with the specifications of the preparation methods associated with this batch.

Radiochemistry Gravimetric Worksheet

ALS Environmental – FC

Prep Batch: AB121206-3

Prep Procedure: **GAB**

Reviewed By: jtl *jl*

Review Date: 12/6/2012

Prep Num	Planc. Num	LabID	QC Type	Test Alq (ml)	Tare Mass (g)	Initial Gross Mass (g)	Initial Net Mass (mg)	Suggested Alq (ml)	Samp Vol Available (ml)	Samp Vol Taken (ml)	Fin Gross Mass (g)	Final Net Mass (mg)	Salt Sol. Added (ml)	Flag
1	1	1224001-1	SMP	10	9.1723	0.0000	0	200	200	200	9.1937	21.4	0.5	
1	2	1224001-2	SMP	10	9.1914	0.0000	0	200	200	200	9.2352	43.8	1	
1	3	1224001-3	SMP	10	9.2220	0.0000	0	200	200	200	9.2860	64	1.5	
1	4	1224001-4	SMP	10	9.1331	0.0000	0	200	200	200	9.2243	91.2	2	
1	5	AB121206-3A	MB	10	9.1271	0.0000	0	200	200	200	9.1495	22.4	0.5	
1	6	AB121206-3B	MB	10	9.2092	0.0000	0	200	200	200	9.2556	46.4	1	
1	7	AB121206-3C	MB	10	9.1743	0.0000	0	200	200	200	9.2441	69.8	1.5	
1	8	AB121206-3E	MB	10	9.2158	0.0000	0	200	200	200	9.3118	96	2	

MEL 1/6/12

Prepare a working dilution of 616.2382.91

1. Density of 1M HCl, lot # K43J20

Mass of 100mL vol. flask: 56.4421g
Mass of flask & 100mL acid: 157.7445g
Net Mass: 101.3024g
Density: 1.0130g/mL

Balance # 12
Balance# 12

2. Mass of 616.2382.91 transferred:

Mass of open empty nalgene: 74.7685g
Mass of nalgene & standard: 78.4340g
Net mass of standard transferred: 3.6655g

Balance# 12
Balance# 12
Balance# NA

3. Dilute to final volume:

Mass of nalgene, standard, & diluent: 1084.8g
Mass of empty nalgene (from above): 74.7685g
Net mass of new dilution: 1010.0315g

Balance# 26
Balance# 12
Balance# NA

4. Final activity calculation:

$$27,201.49 \text{ dpm/g} \left(\frac{3.6655\text{g}}{1010.0315\text{g}} \right) (1.0130\text{g/mL}) = 100.00 \text{ dpm/mL}$$

MEL 1/6/12

JP 5/1/12

Std ID: 616.4095.13

Description: Am-241

Expiration: 4/21/2013

Activity: 100.00 dpm/mL

2s Uncertainty: 3.30 dpm/mL

Ref. Date: 4/18/2002

Ref Time: N/A

Prep Date: 4/21/2012 Prep by: TE

Matrix/Comp. 1M HCl

Half Life (y): 4.32E+02

Reverification Log		
Analysis Date	Initials	Expiration Date

JP 5/1/12

Continued on Page _____

Megm L...

Signed

1/6/12

Date

Read and Understood By

[Signature]

Signed

05/01/12

Date

Am-241 intermediary dilution

Prepare an intermediate dilution of 616.2382.38 by diluting with 1M HCL (lot 43015)

(1) Determine the density of 1M HCL

mass of 100 ml class A volumetric flask

167.5757 g (621)

mass of flask and 1M HCL

168.8580 g

net mass of 1M HCL

101.2823

 $\rho = 1.0128 \text{ g/ml}$

(2) Transfer Am-241 (616.2382.38) to a 40 ml NOA vial

mass of empty NOA vial with out lid & 50 ml beaker

54.0248 g (621)

mass of standard, transfer pipet & 50 ml beaker (initial)

95.0640 g

mass of standard, transfer pipet & 50 ml beaker after transfer

75.0076 g

net mass of standard transferred

20.0564 g

(3) Dilute to final volume with 1M HCL

mass of empty NOA vial w/o lid & 50 ml beaker (from above)

54.0248 g (621)

mass of standard, 1M HCL NOA vial & 50 ml beaker

92.4609 g

net mass of standard

38.4361 g

(4) final activity calculation

$$\frac{52.12896}{38.4361 \text{ g}} \times (20.0564 \text{ g}) = \frac{27,201.49}{27,201.49} \text{ dpm/g}$$

Continued on Page _____

Read and Understood By

C Moncarlage

Signed

4/25/03

Date

Renee Haller

Signed

5/5/03

Date

Am-241 primary dilution

prepare a primary dilution of

of RSN 1010 (NIST: ~~SR5~~ ^{SR5} 13651-307) by diluting w/ 1M HCl

SRS 10/14/02

1) Determine the density of 1M HCl (lot # 42223 + lot # 42216)

mass of 100ml vol flask 62.4712 g (bal 12)

mass of flask + 1M HCl 163.802 g

Net mass of 1M HCl 101.33090 g

2) Transfer contents of ampule to 40 ml vol vial

mass of vial w/o lid 22.3577 g (bal 12)

mass of opened amp + mass of vial + 50 ml beaker 37.9238 g

mass of beaker + empty ampule 32.9862 g

Net mass of std transferred 4.9376 g

3) Dilute std to final vol w/ 1M HCl

mass of vial w/o lid (from above) 22.3577 g (bal 12)

mass of std + vial + 1M HCl 63.7403 g

Net mass of diluted std 41.3826 g

4) Final Activity Calc

$$\left(\frac{3.728 \times 10^4 \text{ dps}}{5.11972 \text{ g}} \right) \left(\frac{60 \text{ dpm}}{\text{dps}} \right) \left(4.9376 \text{ g} \right)$$

41.3826 g

$$= \frac{52,066 \text{ dpm/g}}{52,128.96 \text{ dpm/g}}$$

ANALYTICS

1380 Seaboard Ind Blvd, Atlanta, GA 30318, USA 404-352-8677

Am-241

SRS 63651-307 Amount 1.008 UCI QA

Date 4/18/02 12:00 EST

Exp

PO # EW040502, Item 3

5.11972 g 1M HCl solution



CAUTION RADIOACTIVE MATERIAL

Continued on Page

Read and Understood By

Signed OM/RS Date 10-14-02

Signed R. Keller

Date 2/4/03



ANALYTICS

1380 Seaboard Industrial Blvd.
Atlanta, Georgia 30318 U.S.A.

Phone (404) 362-8677
Fax (404) 362-2837

PAID 00616
REC'D 4-22-02
CERTIFICATE OF CALIBRATION
Standard Radionuclide Source

63651-307

Am-241 5 mL Liquid in Flame Sealed Vial

This standard radionuclide source was prepared gravimetrically from a calibrated master solution. The master solution was calibrated by liquid scintillation counting.

Radionuclide purity and calibration were checked by germanium gamma-ray spectrometry and liquid scintillation counting. The nuclear decay rate and assay date for this source are given below.

ANALYTICS maintains traceability to the National Institute of Standards and Technology through Measurements Assurance Programs as described in USNRC Reg. Guide 4.15, Revision 1.

ISOTOPE:	Am-241
ACTIVITY (dps):	3.728 E4
HALF-LIFE:	4.322 E2 years
CALIBRATION DATE:	April 18, 2002 12:00 EST
TOTAL UNCERTAINTY*:	3.3%
SYSTEMATIC:	3.0%
RANDOM:	0.3%

*99% confidence level.

Impurities: γ -impurities <0.1%

5.11972 grams 1M HCl solution.

P O NUMBER BW040502, Item 3

SOURCE PREPARED BY: M. Taskaeva
M. Taskaeva, Radiochemist

Q A APPROVED: M. R. 4-19-02

Prepare a working dilution of 931.4095.11

1. Density of 0.1 M HCl lot # LO9031

Mass of 100mL vol. flask: 68.5649g

Balance # 12

Mass of flask & 100mL acid: 168.4557g

Balance# 12

Net Mass: 99.8908g

Density: 0.9989g/mL

2. Mass of 931.4095.11 transferred:

Mass of open empty nalgene: 75.0081g

Balance# 12

Mass of nalgene & standard: 76.5548g

Balance# 12

Net mass of standard transferred: 1.5467g

Balance# NA

3. Dilute to final volume:

Mass of nalgene, standard, & diluent: 1085.2g

Balance# 26

Mass of empty nalgene (from above): 75.0081g

Balance# 12

Net mass of new dilution: 1010.1919g

Balance# NA

4. Final activity calculation:

$$33,966.93 \text{ dpm/g} (0.9989 \text{ g/mL}) \left(\frac{1.5467 \text{ g}}{1010.1919 \text{ g}} \right) = 51.95 \text{ dpm/mL}$$

MC
10/17/2012

Std ID: 931.4095.33

Description: Sr-90

Expiration: 9/8/2013

Activity: 51.95 dpm/mL

2s Uncertainty: 93.51 dpm/mL

Ref. Date: 4/11/2011

Ref Time: N/A

Prep Date: 9/8/2012 Prep by: TE

Matrix/Comp. 0.1 M HCl

Half Life (y): 2.88E+01

Reverification Log		
Analysis Date	Initials	Expiration Date

MC
10/17/2012

MC
10/17/2012

MC
10/17/2012

Continued on Page _____

TE

Signed

9/8/12

Date

Read and Understood By

[Signature]

Signed

9/8/12

Date

MEL 12/14/11

Prepare an intermediate dilution of 931 Sr-90

1. Density of 0.1 M HCl, lot # K30039

Mass of 100mL vol. flask: 66.4305 g

Balance # 12

Mass of flask & 100mL acid: 166.2718 g

Balance# 12

Net Mass: 99.8413 g

Density: 0.9984 g/mL

2. Mass of 931 transferred:

Mass of open empty 40mL Voa vial: 21.7293 g

Balance# 12

Mass of Voa vial and standard: 27.0645 g

Balance# 12

Net mass of standard transferred: 5.3352 g

3. Dilute to final volume:

Mass of open empty 40mL Voa vial: 21.7293 g

Balance# 12

Mass of vial, standard, & diluent: 56.1105 g

Balance# 12

Net mass of new dilution: 34.3812 g

4. Final activity calculation:

$$1.967 \times 10^4 \text{ Bq} \left(\frac{5.3352 \text{ g}}{5.39174 \text{ g}} \right) \left(\frac{60 \text{ dpm}}{1 \text{ Bq}} \right) \left(\frac{0.9984 \text{ g/mL}}{34.3812 \text{ g}} \right) = 33,912.59 \text{ dpm/mL}$$

JP 6/20/12

MEL 12/14/11

JP 6/20/12

Std ID: 931.4095.11

Description: Sr-90

Expiration: 1/19/2013

Activity: 33912.59 dpm/mL

2s Uncertainty: 610.43 dpm/mL

Ref. Date: 4/11/2011

Ref Time: N/A

Prep Date: 12/14/2011 Prep by: ML

Matrix/Comp. 0.1 M HCl

Half Life (y): 2.88E+01

Reverification Log		
Analysis Date	Initials	Expiration Date

JP 6/20/12

Continued on Page _____

Megan Lane
Signed

12/14/11
Date

Read and Understood By

T. Elch
Signed

12/14/11
Date



Eckert & Ziegler
Analytics

*rec
4-5-11 RSO# 931*

1380 Seaboard Industrial Blvd.
Atlanta, Georgia 30318
Tel 404-352-8677
Fax 404-352-2837
www.analyticsinc.com

CERTIFICATE OF CALIBRATION

Standard Radionuclide Source

84379-307

5 mL Liquid in Flame Sealed Vial

Customer: ALS Laboratory Group/Fort Collins, CO
P.O. No.: 73628, Item 1

This standard radionuclide source was prepared gravimetrically from a master solution, calibrated by Eckert & Ziegler Analytics. The master solution was calibrated by liquid scintillation counting. Radionuclide purity and calibration were checked by germanium gamma-ray spectrometry and liquid scintillation counting. The nuclear decay rate and reference date for this source are given below. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 1, February, 1979, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST." EZA is accredited by the Health Physics Society (HPS) for the production of NIST-traceable sources, and this source was produced in accordance with the HPS accreditation requirements. Customers may report any concerns with the accreditation program to the HPS Secretariat, 1313 Dolley Madison Blvd., Ste. 402, McLean, VA 22101.

Isotope	Half-Life, Days	Activity (Bq)	Uncertainty*, %			Reference Date (12:00 PM EST)
			u_A	u_B	U	
Sr-90	1.052E+04	1.967E+04	0.1	0.9	1.8	04/11/2011

*Uncertainty: U - Relative expanded uncertainty, $k = 2$. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results."

Comments:

Impurities: γ -impurities < 0.1 %. 5.39174 grams 0.1M HCl solution with approximately 30 $\mu\text{g/g}$ each of Sr and Y carriers.

NOTE: This source also contains Y-90 in secular equilibrium with Sr-90. The Y-90 activity is equal to the Sr-90 activity. Since Sr-90 and Y-90 both decay 100% by beta emission, the total beta emission rate for the source is twice the certified Sr-90 activity. The half-life for Y-90 is 64.08 hours.

Source Prepared by: W. Mao
W. Mao, Radiochemist

QA Approved: J. D. McCorvey
J. D. McCorvey, QA Manager Alternate

Date: 3/31/11



Single Isotope Certificate, Rev 1 9/28/2009

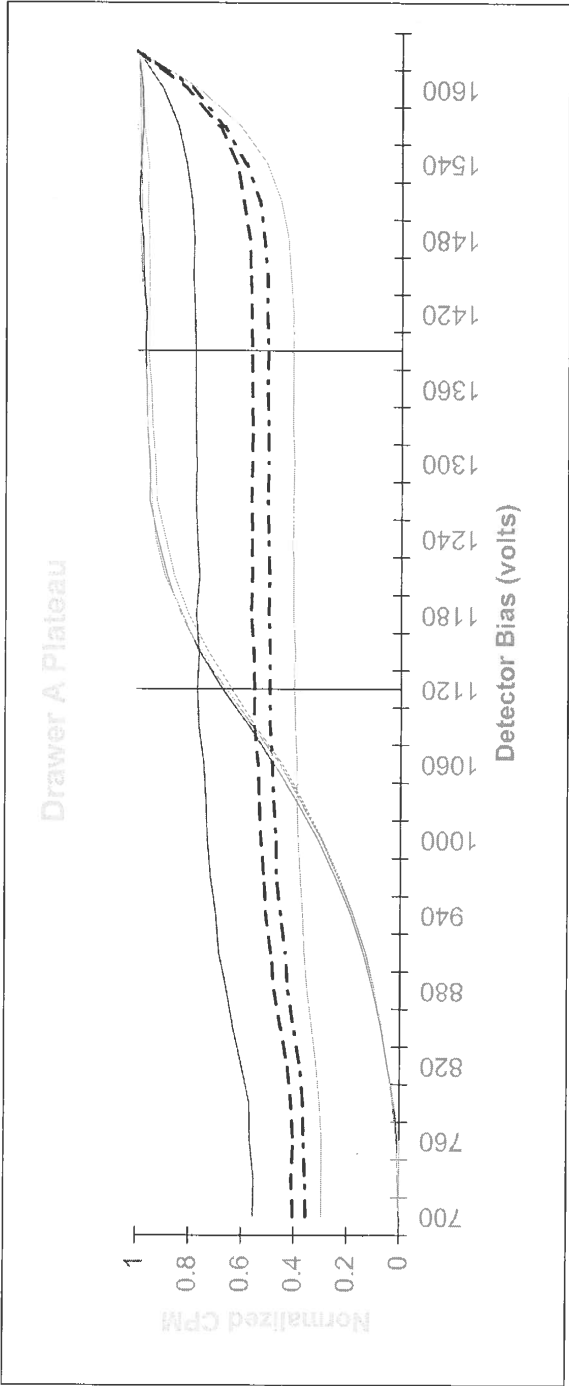
Corporate Office
24937 Avenue Tibbitts Valencia, California 91355

Laboratory
1380 Seaboard Industrial Blvd. Atlanta, Georgia, 30318

Addendum

Unit Type: LB4100/W
Date Performed: 6/2/16 09:00
FileName: PTA0602
Batch ID: DRAWER A PLAT CHECK

Unit Id: Magenta
Application Revision: 2
Application Version: Standard



Optimum alpha beta simultaneous operating voltage: 1402.5

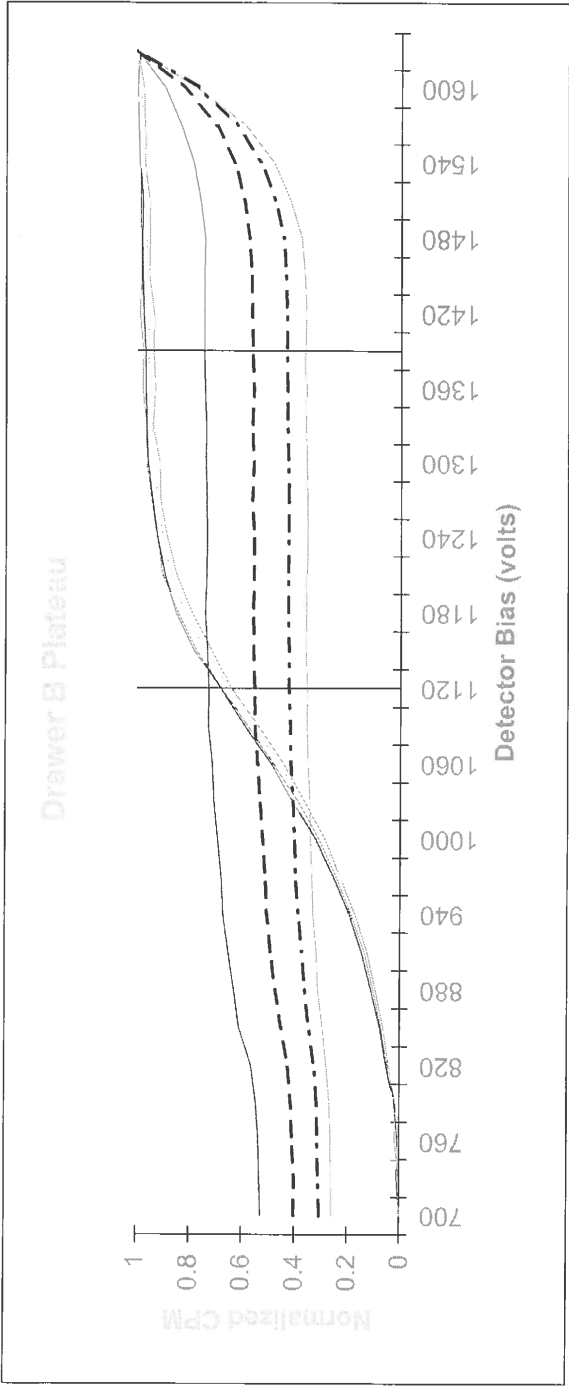
Optimum alpha only operating voltage: 1120

	A1	A2	A3	A4
Beta slope at beta voltage	1.18%	1.57%	1.58%	2.52%
Alpha slope at beta voltage	0.99%	1.20%	0.76%	0.72%
Alpha slope at alpha voltage	2.63%	3.48%	2.64%	2.19%

OK 6/3/16

Unit Type: LB4100/W
Date Performed: 6/2/16 09:00
FileName: PTB0602
Batch ID: DRAWER B PLAT CHECK

Unit Id: Magenta
Application Revision: 2
Application Version: Standard



Optimum alpha beta simultaneous operating voltage: 1402.5

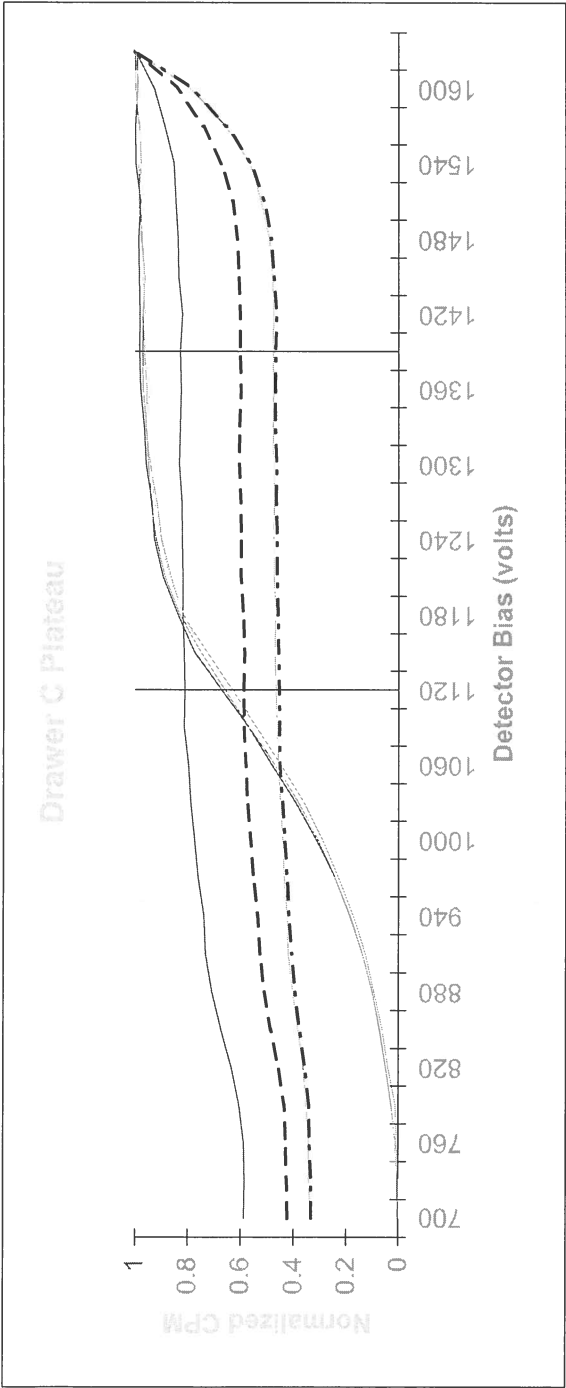
Optimum alpha only operating voltage: 1120

	B1	B2	B3	B4
Beta slope at beta voltage	1.44%	1.61%	1.23%	1.72%
Alpha slope at beta voltage	0.76%	0.74%	0.97%	1.24%
Alpha slope at alpha voltage	2.82%	2.66%	2.19%	2.27%

OK 6/3/16

Unit Type: LB4100/W
Date Performed: 6/2/16 14:38
File Name: PTC0602
Batch ID: DRAWER C PLAT CHECK

Unit Id: Magenta
Application Revision: 2
Application Version: Standard



Optimum alpha beta simultaneous operating voltage: 1402.5

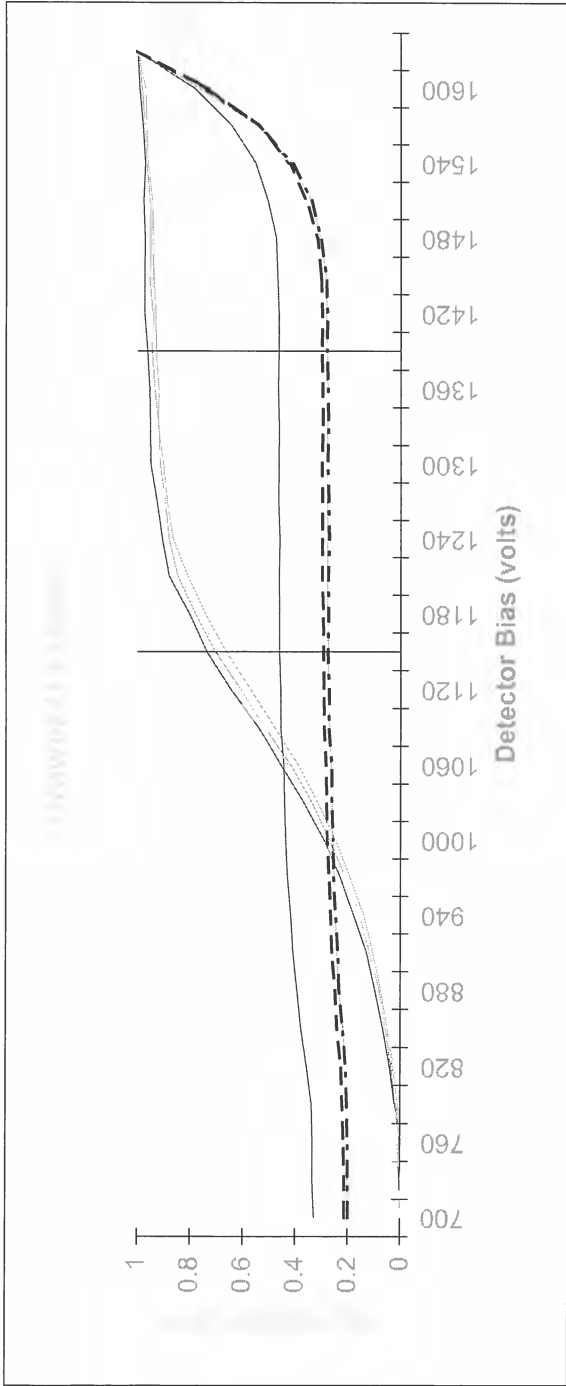
Optimum alpha only operating voltage: 1120

	C1	C2	C3	C4
Beta slope at beta voltage	1.41%	0.80%	1.18%	1.89%
Alpha slope at beta voltage	0.30%	0.41%	0.45%	0.26%
Alpha slope at alpha voltage	1.84%	1.03%	2.10%	1.37%

OK JP 6/3/13

Unit Type: LB4100/W
Date Performed: 6/2/16 14:38
FileName: PTD0602
Batch ID: DRAWER D PLAT CHECK

Unit Id: Magenta
Application Revision: 2
Application Version: Standard



Optimum alpha beta simultaneous operating voltage: 1402.5

Optimum alpha only operating voltage: 1150

	D1	D2	D3	D4
Beta slope at beta voltage	2.11%	2.90%	1.74%	0.82%
Alpha slope at beta voltage	0.97%	1.51%	2.02%	2.23%
Alpha slope at alpha voltage	1.28%	1.73%	2.15%	0.89%

OK JP GT JPL316
6/3/16

4/11/16 Drawn C+D removed from Instrument and sent back to Canberra in order to fix guard detector / detector slide tray connection so the 3 guard pins holding the two detectors together stop moving around and popping out when the drawers are opened & closed, resulting in $\uparrow \uparrow$ beta cpm, \downarrow gamma cpm

5-24-16 Power outage. Instrument was turned off. Turned back on when power was restored. Daily checks were performed. All in control. Instrument on-line, resumed to normal.

6-2-16

Plateau check run for drawers A-D on 6-2-16.

α Sources used	Detectors	β Sources used
410 Am241	A1 B1 C1 D1	406 Sr90/Y90
411 17800 dpm	A2 B2 C2 D2	407 29600 dpm
412 2-16-95	A3 B3 C3 D3	408 9-15-95
413	A4 B4 C4 D4	409

Parameters:

Starting voltage 700

Ending voltage 1650

30V/step

5min/step

Count preset 40,000

Time between steps 0.1

Weak check times 0.1

Weak check limits 20

File names:

PTA0602

PTB0602

PTC0602

PTD0602

Continued on Page

[Signature]

Signed

6-3-16

Date

Read and Understood By

[Signature]

Signed

6/3/16

Date

Date 6/2/16SOP 724r 11

ALS
Low Background Gas Flow Proportional Counter Log
Instrument: LB4100C

Instrument Daily Response and Background Checks

Det.	Daily Response Check				Background Check				Det. Status
	Start 1	Status	Start 2	Status	Start 1	Status	Start 2	Status	
1	JP	P			JP	P			P
2									
3									
4									
5									
6									
7									
8									
9									OLB
10									P
11									
12									
13									
14									
15									
16									

Det = Detector; α = Alpha; β = Beta; P = Pass; H = High; L = Low; OL = Offline; R = Recount; W = Weekly; NP = Not Processed

Weekly Background Calibration

	Current Calib. File ID	Weekly Calib. Started	Status	File ID
Dr A	BK0531W			
Dr B				
Dr C	BK0601W			
Dr D				

Dr = Drawer

Gas Supply

P-10 Supply		P-10 Flow	
Tank 1	1950	Dr A	10.0
		Dr B	
Tank 2	350	Dr C	
		Dr D	

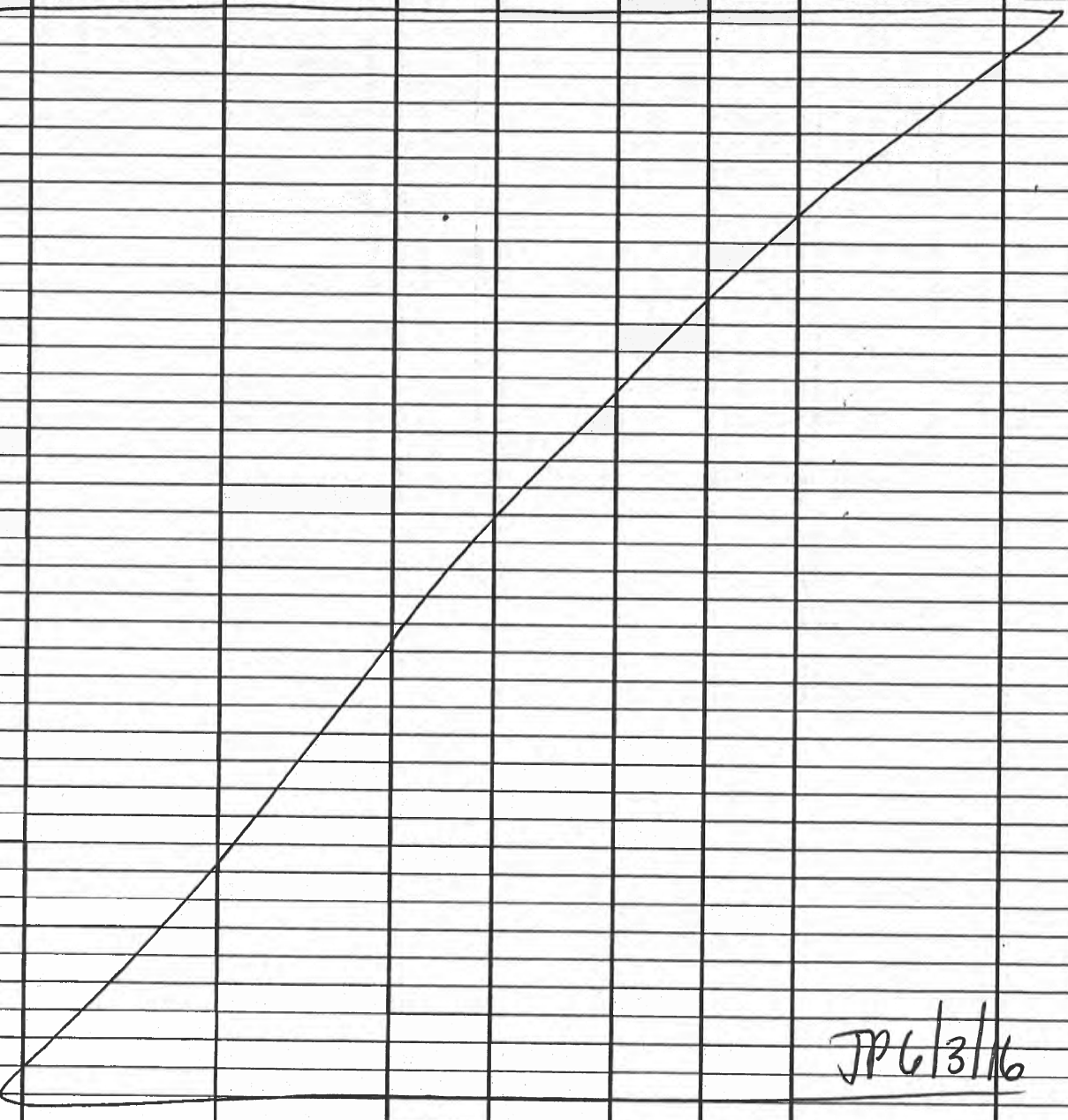
Comments:

Date 6/2/16SOP 724r 11

ALS

Low Background Gas Flow Proportional Counter Log

Instrument: LB4100C

Det.	Sample ID	Batch	Test	Count Dur. (min)	Start Time	Analyst Initials	File ID	Output Initials
1-16	Daily EQ	—	—	30	7:33	JP	EFC0602	JP
1-16	Daily Bkg	—	—	60	7:42	JP	BKC0602	JP
1-4	Alpha/Beta	Drawer A Plat Check	Plat Check	5 min/STEP	9:00	JP	PTA0602	JP
5-8	Beta/Alpha	Drawer B Plat Check	↓	↓	↓	↓	PTB0602	↓
9-12	Alpha/Beta	Drawer C Plat Check	↓	↓	14:38	JP	PTC0602	↓
13-16	Beta/Alpha	Drawer D Plat Check	↓	↓	↓	↓	PTD0602	↓
								
							JP 6/3/16	

Comments:

Page No.: 465424 **B**(cont. from page ms **B**)

Form 780r8.doc (6/23/06)

Reviewed By / Date

JP 6/3/16

Gross Alpha/Beta LB4100C ICV's/ICB's AM241/SR90

Atten. Constants		b	m	a	x0
Alpha		0.9030	0.9911	0.8270	21.4875
Beta		0.9681	0.9996	0.9174	0.0

X-Talk Constants		m	b
$\alpha > \beta$		0.9984	0.2511
$\beta > \alpha$		0.0036	-1.690E-05

Detector	Sample ID	Alpha					Beta											
		Initial Aliquot	Final Sam. Size	Count Date	Count Dur.	Residual Mass (mg)	Gross CPM	Bkg CPM	$\beta > \alpha$ X-Talk	Net CPM	Atten.	Efficiency	Gross CPM	Bkg CPM	$\alpha > \beta$ X-Talk	Net CPM	Atten.	Efficiency
A1	1224001-1	0.200	0.200	6/3/2016	180	21.4	16.739	0.096	0.138	16.505	0.904	0.2138	44.317	1.747	4.3247	38.2453	0.9605	0.4297
B1	1224001-2	0.200	0.200	6/3/2016	180	43.8	15.578	0.101	0.121	15.356	0.766	0.2051	44.583	2.201	4.1686	38.2134	0.9527	0.4347
C2	1224001-3	0.200	0.200	6/3/2016	180	64.0	13.578	0.116	0.009	13.453	0.659	0.2279	43.378	1.610	3.7451	38.0229	0.9456	0.4334
D1	1224001-4	0.200	0.200	6/3/2016	180	91.2	12.028	0.096	0.084	11.848	0.539	0.2066	42.550	1.606	3.4672	37.4768	0.9362	0.4290
AB121206-3AMB	A2	0.200	0.200	6/3/2016	180	22.4	0.100	0.124	0.000	-0.024	0.897	0.2263	1.511	1.557	-0.0062	-0.0398	0.9602	0.4442
	B2	0.200	0.200	6/3/2016	180	46.4	0.111	0.113	0.000	-0.002	0.751	0.2189	1.594	1.632	-0.0005	-0.0375	0.9518	0.4272
C3	AB121206-3CMB	0.200	0.200	6/3/2016	180	69.8	0.094	0.108	0.001	-0.015	0.632	0.2135	1.800	1.564	-0.0039	0.2399	0.9436	0.4422
D2	AB121206-3EMB	0.200	0.200	6/3/2016	180	96.0	0.133	0.119	-0.001	0.015	0.521	0.2240	1.511	2.168	0.0041	-0.6611	0.9346	0.4319

Spike Information					Decay Corr.		
Alpha Std ID	Ref. Date	Act (dpm/ml)	Spike Vol (mL)	Act. Added	Beta Std ID	Ref. Date	Decay Corr. Spike Vol (mL)
616-4095.13	4/18/2002	100.000	1.0	97.759	831-4095.33	4/11/2011	51.950 1.0 45.897

Spike Information					Decay Corr.		
Alpha Std ID	Ref. Date	Act (dpm/ml)	Spike Vol (mL)	Act. Added	Beta Std ID	Ref. Date	Decay Corr. Spike Vol (mL)
831-4095.33	4/11/2011	51.950	1.0	45.897			

Acceptance criteria for LCS's --> 70-130%

Sample ID	Alpha				Beta			
	Act (pCi/L)	TPU (2 sig)	MDC	% Recov.	Act (pCi/L)	TPU (2 sig)	MDC	% Recov.
1224001-1	192.42	31.5	2.13	87.4%	208.70	33.7	4.74	100.9%
1224001-2	220.23	36.1	2.56	100.0%	207.83	33.6	4.84	100.5%
1224001-3	201.61	33.1	2.06	91.6%	208.96	33.7	4.49	101.1%
1224001-4	239.48	39.6	3.28	108.8%	210.15	33.9	4.46	101.6%
AB121206-3AMB	-0.26	0.6	1.52	-0.1%	-0.21	1.1	2.36	NA
AB121206-3MB	-0.03	0.7	1.80	0.0%	-0.21	1.1	2.54	NA
AB121206-3CMB	-0.24	0.0	2.16	-0.1%	1.30	0.0	2.42	NA
AB121206-3EMB	0.30	0.0	2.59	0.1%	-3.89	0.0	2.93	NA

Alpha CU	Alpha TPU	Beta CU	Beta TPU
(1 sig)	(1 sig)	(1 sig)	(1 sig)
3.5717	15.7318	2.8458	16.8587
4.2380	18.0398	2.8419	16.7897
4.1205	16.5725	2.8205	16.8746
5.2471	19.7764	2.8442	16.9727
0.2891	0.2899	0.5259	0.5261
0.3699	0.3699	0.5672	0.5674

PAI - Gas Flow Proportional Sample Analysis LB4100-C

Alpha Attenuation $y = b^*m^a(a^*mass-x0)$	Beta Attenuation Calibration $y = b^*m^a(a^*mass-x0)$
Alpha b= 0.93030 m= 0.99110 a= 0.8270 x0= 21.4875	Beta b= 0.9561 m= 0.9996 a= 0.9174 x0= 0.0000
Alpha to Beta X-talk $y = b^*m^a*mass$ a->b xtalk b= 0.2511 a->b xtalk m= 0.9984	Beta to Alpha X-talk $y = b^*mass * m$ b->a xtalk b= -1.69E-05 b->a xtalk m= 0.0036

Background logfile: BKGABW	Alpha prog. logfile: n/a
Date of Bkg. Cal: 8/1/2016	Alpha prog. attenuation: n/a
Alpha efficiency logfile: An241F-Q6/15	Beta prog. logfile: n/a
Alpha attenuation calibration: AAM0606, 0607	Beta prog. attenuation: n/a
Beta efficiency logfile: SR09-06/15	
Beta attenuation calibration: ASR0607	

Unit Type: LB4100-C
Counting Unit ID: Magenta
High Voltage Mode: Simultaneous
Application Revision: 2
Application Version: Standard
Rev:12/01/08 JCP

Det. ID	Sample ID	Count End Date & Time	Count Dur. (min)	Resid. Mass (mg)	Alpha Activity						Beta Activity											
					b>a xtlk			Base			Progeny			a>b xtlk			Base			Progeny		
					Gross CPM	Bkg. CPM	Eff	Gross CPM	Bkg. CPM	Cor.Fact.	Gross CPM	Bkg. CPM	Cor.Fact.	Gross CPM	Bkg. CPM	Cor.Fact.	Gross CPM	Bkg. CPM	Cor.Fact.			
A1	1224001-1	6/3/2016 12:36	180.00	21.4	16.739	0.096	0.138	0.2138	0.904	n/a	n/a	44.317	1.747	4.3247	0.4297	0.981	n/a					
A2	AB121206-3AMB	6/3/2016 12:36	180.00	22.4	0.100	0.124	0.000	0.2263	0.897	n/a	n/a	1.511	1.557	0.0000	0.4442	0.960	n/a					
C2	1224001-3	6/3/2016 12:36	180.00	64.0	13.578	0.116	0.105	0.2279	0.659	n/a	n/a	43.378	1.610	3.7450	0.4334	0.946	n/a					
C3	AB121206-3CMB	6/3/2016 12:36	180.00	68.8	0.094	0.108	0.001	0.2135	0.632	n/a	n/a	1.800	1.564	0.0000	0.4422	0.944	n/a					
B1	1224001-2	6/3/2016 12:36	180.00	43.8	15.578	0.101	0.121	0.2051	0.766	n/a	n/a	44.583	2.201	4.1686	0.4347	0.952	n/a					
B2	AB121206-3BMB	6/3/2016 12:36	180.00	46.4	0.111	0.113	0.000	0.2189	0.751	n/a	n/a	1.594	1.632	0.0000	0.4272	0.952	n/a					
D1	1224001-4	6/3/2016 12:36	180.00	91.2	12.028	0.096	0.084	0.2066	0.539	n/a	n/a	42.550	2.608	3.4672	0.4290	0.936	n/a					
D2	AB121206-3EMB	6/3/2016 12:36	180.00	96.0	0.133	0.119	0.000	0.2240	0.521	n/a	n/a	1.511	1.268	0.0042	0.4319	0.935	n/a					

91-3-16

Date 6/3/16SOP 724r 11

ALS
Low Background Gas Flow Proportional Counter Log
Instrument: LB4100C

Instrument Daily Response and Background Checks

Det.	Daily Response Check				Background Check				Det. Status
	Start 1	Status	Start 2	Status	Start 1	Status	Start 2	Status	
1	JP	P			JP	P			P
2									
3									
4									
5									
6									
7									
8									
9						(LB)			OLB
10						P			P
11									
12									
13									
14									
15									
16									

Det = Detector; α = Alpha; β = Beta; P = Pass; H = High; L = Low; OL = Offline; R = Recount; W = Weekly; NP = Not Processed

Weekly Background Calibration

	Current Calib. File ID	Weekly Calib. Started	Status	File ID
Dr A	BKCP531W			
Dr B				
Dr C	BKCP601W			
Dr D				

Dr = Drawer

Gas Supply

P-10 Supply		P-10 Flow	
Tank 1	1600	Dr A	10
		Dr B	
Tank 2	350	Dr C	
		Dr D	

Comments:

Date 6/3/16SOP 724r 11

ALS

Low Background Gas Flow Proportional Counter Log

Instrument: LB4100C

Det.	Sample ID	Batch	Test	Count Dur. (min)	Start Time	Analyst Initials	File ID	Output Initials
F-16	Daily EFP	==	==	30	7:17	JP	EFC0603	JP
I-16	Daily Bkg			60	7:28	JP	BKC0603	JP
1	1224001-1	AB121206-3	αIP	180	9:36	ML	ABC0603	ML
5	↓ -2	↓	↓	↓	↓	↓	↓	↓
10	↓ -3	↓	↓	↓	↓	↓	↓	↓
13	↓ -4	↓	↓	↓	↓	↓	↓	↓
2	AB121206-3AMB	↓	↓	↓	↓	↓	↓	↓
6	AB121206-3BMB	↓	↓	↓	↓	↓	↓	↓
11	↓ C	↓	↓	↓	↓	↓	↓	↓
14	↓ E ↓	↓	↓	↓	↓	↓	↓	↓
1	1029	GAB Wipe ICV	α, β	10	12:48	ML	ABC0603A	ML
2	729	↓	β	↓	↓	↓	↓	↓
5	1029	↓	α	↓	12:59	↓	ABC0603B	↓
6	729	↓	β	↓	↓	↓	↓	↓
10	1029	↓	α	↓	13:11	↓	ABC0603C	↓
11	729	↓	β	↓	↓	↓	↓	↓
<hr/>								
<div>ML 6-3-16</div>								

Radiochemistry Instrument Worksheet

ALS Environmental -- FC

Prep Batch: AB121206-3

Prep Procedure: GAB ICBs, ICBs

Analytical QASS / NCR? Y / *NA*

Prep Num	LabID	QC Type	Init Alq	Fin Alq	Units	Report Units	Residual Mass (mg)	Cnt 1 File	Cnt 1 Inst/Det	Cnt 1 Pos Chk By	Cnt 2 File	Cnt 2 Inst/Det	Cnt 2 Pos Chk By	Cnt 3 File	Cnt 3 Inst/Det	Cnt 3 Pos Chk By	Notes
----------	-------	---------	----------	---------	-------	--------------	--------------------	------------	----------------	------------------	------------	----------------	------------------	------------	----------------	------------------	-------

1	1224001-1	SMP	200	200	ml	PCI/L	21.4										
1	1224001-2	SMP	200	200	ml	PCI/L	43.8										
1	1224001-3	SMP	200	200	ml	PCI/L	64										
1	1224001-4	SMP	200	200	ml	PCI/L	91.2										
1	AB121206-3A	MB	200	200	ml	PCI/L	22.4										
1	AB121206-3B	MB	200	200	ml	PCI/L	46.4										
1	AB121206-3C	MB	200	200	ml	PCI/L	69.8										
1	AB121206-3E	MB	200	200	ml	PCI/L	96										

Spike Solution Information							
Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot Units	Pipet ID
S1	AM-241	616.4095.13	98.308	DPM/ml	12/06/12	1 ml	RS-016
S2	Sr-90	931.4095.33	49.916	DPM/ml	12/06/12	1 ml	RS-016

Sample Barcodes

1224001-1 AB121206-3PS1		1224001-2 AB121206-3PS2		1224001-3 AB121206-3PS3	
1224001-4 AB121206-3PS4		AB121206-3AMB AB121206-3PS5		AB121206-3BMB AB121206-3PS6	
AB121206-3CMB AB121206-3PS7		AB121206-3EMB AB121206-3PS8			

Reporting Units

LabID:	TstGrpName:	RptUnits:
1224001-1	GrossAlpha/Beta	PCI/L
1224001-2	GrossAlpha/Beta	PCI/L
1224001-3	GrossAlpha/Beta	PCI/L
1224001-4	GrossAlpha/Beta	PCI/L

Radiochemistry Prep Worksheet

ALS Environmental -- FC

Prep Batch: AB1212063

Prep Procedure: GAB

Reviewed By: JH JK Review Date: 12/6/2012

Non-Routine Pre-Treatment? Y ☒ N ☐ Batch: NA Re-Prep? Y ☐ N ☒ Prep QASS / NCR? Y ☐ N ☒ Balance: 13 Balance: NA

Prep Analyst: Jeffrey T. Lee
Prep Date: 12/6/2012
Prep Dept: RS

Samp Num	Prep Num	LabID	QC Type	Dish No.	Init Alq ml	Fin Alq ml	Prep Basis	Standards	Prep Notes
1	1	1224001-1	SMP		200	200	Unfiltered	S1,S2	
2	1	1224001-2	SMP		200	200	Unfiltered	S1,S2	
3	1	1224001-3	SMP		200	200	Unfiltered	S1,S2	
4	1	1224001-4	SMP		200	200	Unfiltered	S1,S2	
5	1	AB121206-3A	MB		200	200	Unfiltered		
6	1	AB121206-3B	MB		200	200	Unfiltered		
7	1	AB121206-3C	MB		200	200	Unfiltered		
8	1	AB121206-3E	MB		200	200	Unfiltered		

Comments

ICV/ICBS. Samples desiccated on 12/6/12 @ 17:15.

Spiked By: Jeffrey T. Lee Date: 12/6/2012

Witnessed By: Eric K. Gobel Date: 12/6/2012

Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	AM-241	616.4095.13	98.308	DPM/ml	12/06/12	1	ml	RS-016
S2	Sr-90	931.4095.33	49.916	DPM/ml	12/06/12	1	ml	RS-016

J12036

*Except where otherwise noted, all reagents were applied in accordance with the specifications of the preparation methods associated with this batch.

Radiochemistry Prep Worksheet

ALS Environmental -- FC

Prep Batch: A151212068

Prep Procedure: GAB

Prep Batch Not Validated!!!

Reviewed By: Review Date:

Non-Routine Pre-Treatment? Y / N Batch: Re-Prep? Y / N Batch: Prep QASS / NCR? Y / N

Prep SOP: PAI 702 Rev: 20

Prep SOP: NONE

Matrix Class: liquid

Prep Analyst: Jeffrey T. Lee

Prep Date: 12/6/2012

Prep Dept: RS

Balance: 13

Balance:

Sample Num	Prep Num	LabID	QC Type	Dish No.	Init Aliq ml	Fin Aliq ml	Prep Basis	Standards	Prep Notes
1	1	1224001-1	SMP	200	200	200	Unfiltered	S1,S2	
2	1	1224001-2	SMP	200	200	200	Unfiltered	S1,S2	
3	1	1224001-3	SMP	200	200	200	Unfiltered	S1,S2	
4	1	1224001-4	SMP	200	200	200	Unfiltered	S1,S2	
5	1	AB121206-3A	MB	200	200	200	Unfiltered		
6	1	AB121206-3B	MB	200	200	200	Unfiltered		
7	1	AB121206-3C	MB	200	200	200	Unfiltered		
8	1	AB121206-3E	MB	200	200	200	Unfiltered		

Comments

Spiked By: TL Date: 12/6/12
Witnessed By: ERG Date: 12/6/12

S1: 4/24/13
S2: 9/8/13

Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	AM-241	616.4095.13	98.308	DPM/ml	12/06/12	1	ml	RS-016
S2	Sr-90	931.4095.33	49.916	DPM/ml	12/06/12	1	ml	RS-016

Recent Solution IDs

J12036

*Except where otherwise noted, all reagents were applied in accordance with the specifications of the preparation methods associated with this batch.

Page 1 of 1 GAB Bench Sheet
Date Printed: 12/6/2012 12:00

ALS Environmental -- FC
LIMS Version: 6.625

Supersedes: NA

Radiochemistry Gravimetric Worksheet

ALS Environmental -- FC

Prep Batch: AB121206-3

Prep Procedure: GAB

Reviewed By: jtl *jm* Review Date: 12/6/2012

Prep Num	Planc. Num	LabID	QC Type	Test Alq (ml)	Tare Mass (g)	Initial Gross Mass (g)	Initial Net Mass (mg)	Suggested Alq (ml)	Samp Vol Available (ml)	Samp Vol Taken (ml)	Fin Gross Mass (g)	Final Net Mass (mg)	Salt Sol. Added (ml)	Flag
1	1	1224001-1	SMP	10	9.1723	0.0000	0	200	200	200	9.1937	21.4	0.5	
1	2	1224001-2	SMP	10	9.1914	0.0000	0	200	200	200	9.2352	43.8	1	
1	3	1224001-3	SMP	10	9.2220	0.0000	0	200	200	200	9.2860	64	1.5	
1	4	1224001-4	SMP	10	9.1331	0.0000	0	200	200	200	9.2243	91.2	2	
1	5	AB121206-3A	MB	10	9.1271	0.0000	0	200	200	200	9.1495	22.4	0.5	
1	6	AB121206-3B	MB	10	9.2092	0.0000	0	200	200	200	9.2556	48.4	1	
1	7	AB121206-3C	MB	10	9.1743	0.0000	0	200	200	200	9.2441	69.8	1.5	
1	8	AB121206-3E	MB	10	9.2158	0.0000	0	200	200	200	9.3118	96	2	

MEL 1/6/12

Prepare a working dilution of 616.2382.91

1. Density of 1M HCl, lot # K43J20
Mass of 100mL vol. flask: 56.4421g Balance # 12
Mass of flask & 100mL acid: 157.7445g Balance# 12
Net Mass: 101.3024g
Density: 1.0130g/mL

2. Mass of 616.2382.91 transferred:
Mass of open empty nalgene: 74.7685g Balance# 12
Mass of nalgene & standard: 78.4340g Balance# 12
Net mass of standard transferred: 3.6655g Balance# NA

3. Dilute to final volume:
Mass of nalgene, standard, & diluent: 1084.8g Balance# 26
Mass of empty nalgene (from above): 74.7685g Balance# 12
Net mass of new dilution: 1010.0315g Balance# NA

4. Final activity calculation:

$$27,201.49 \text{ dpm/g} \left(\frac{3.6655\text{g}}{1010.0315\text{g}} \right) (1.0130\text{g/mL}) = 100.00 \text{ dpm/mL}$$

MEL 1/6/12

JP 5/1/12

Std ID: 616.4095.13

Description: Am-241

Expiration: 4/21/2013

Activity: 100.00 dpm/mL

2s Uncertainty: 3.30 dpm/mL

Ref. Date: 4/18/2002

Ref Time: N/A

Prep Date: 4/21/2012 Prep by: TE

Matrix/Comp. 1M HCl

Half Life (y): 4.32E+02

Reverification Log		
Analysis Date	Initials	Expiration Date

JP 5/1/12

Continued on Page _____

Signed _____

Date 1/6/12

Read and Understood By _____

Signed _____

Date 05/01/12

Am-241 intermediary dilution

Prepare an intermediate dilution of 616.2382.38 by diluting with 1M HCl (lot 43015)

(1) Determine the density of 1M HCl

mass of 100 mL class A volumetric flask

127.5757g (6012)

mass of flask and 1M HCl

168.8580g

net mass of 1M HCl

101.2823

$$\rho = 1.0128 \text{ g/mL}$$

(2) Transfer Am-241 (616.2382.38) to a 40 mL VOA vial

mass of empty VOA vial without lid & 50 mL beaker

54.0248g (601)

mass of standard, transfer pipet & 50 mL beaker (initial)

95.0640g

mass of standard, transfer pipet & 50 mL beaker after transfer

74.7500g

net mass of standard transferred

20.0564g

(3) Dilute to final volume with 1M HCl

mass of empty VOA vial w/o lid & 50 mL beaker (from above)

54.0248g (601)

mass of standard, 1M HCl, VOA vial & 50 mL beaker

92.4609g

net mass of standard

38.4361g

(4) final activity calculation

$$\frac{52.2896}{38.4361 \text{ g}} \times (20.0564 \text{ g}) = 27.2014 \text{ dpm/g}$$

$$\frac{MC}{11/1/07} = \frac{27.2014 \text{ dpm/g}}{27.2014 \text{ g}}$$

Continued on Page

Read and Understood By

C Moncarage

4/25/03

Renee Haller

5/5/03

Signed

Date

Signed

Date

Am-241 primary dilution

prepare a primary dilution of RSN 1010 (NIST: ²⁴¹Am SR5 1.3(251-307) by diluting w/ 1M HCl

1) Determine the density of 1M HCl (Lot # 42273 Lot # 42216)

mass of 100 ml vol flask	62.4712 g (Cal 12)
mass of flask + 1M HCl	113.802 g
Net mass of 1M HCl	51.3308 g

2) Transfer contents of ampule to 40 ml vol Vial

mass of vol vial w/o lid	22.3577 g (Cal 12)
mass of vol vial + 50 ml beaker	37.9238 g
mass of beaker + empty ampule	32.9862 g
Net mass of std transferred	4.9376 g

3) Dilute std to final vol w/ 1M HCl

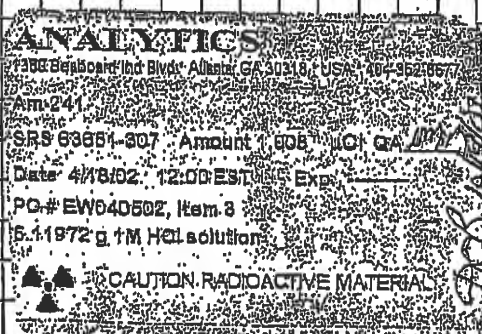
mass of vol vial w/o lid (from above)	22.3577 g (Cal 12)
mass of std + vol vial + 1M HCl	103.7403 g
Net mass of diluted std	41.3826 g

4) Final Activity Calc

$$\left(\frac{3.728 \times 10^4 \text{ dps}}{5.11972 \text{ g}} \right) \left(\frac{100 \text{ dpm}}{\text{dps}} \right) (4.9376 \text{ g})$$

$$41.382 \text{ g}$$

$$= \frac{52,128.96 \text{ dpm/g}}{52,128.96 \text{ dpm/g}}$$



Continued on Page

Read and Understood By

BM/RS

Signed

10-14-02

Date

R. Bell

Signed

2/4/03

Date



ANALYTICS

1380 Seaboard Industrial Blvd.
Atlanta, Georgia 30318 • U.S.A.

Phone (404) 852-8577
Fax (404) 852-2837

PAI FO 0616
rec'd 4-12-02
CERTIFICATE OF CALIBRATION

Standard Radionuclide Source

63651-307

Am-241 5 mL Liquid in Flame Sealed Vial

This standard radionuclide source was prepared gravimetrically from a calibrated master solution. The master solution was calibrated by liquid scintillation counting.

Radionuclide purity and calibration were checked by germanium gamma-ray spectrometry and liquid scintillation counting. The nuclear decay rate and assay date for this source are given below.

ANALYTICS maintains traceability to the National Institute of Standards and Technology through Measurements Assurance Programs as described in USNRC Reg. Guide 4.15, Revision 1.

ISOTOPE:	Am-241
ACTIVITY (dps):	3.728 E4
HALF-LIFE:	4.322 E2 years
CALIBRATION DATE:	April 18, 2002 12:00 EST
TOTAL UNCERTAINTY*:	3.3%
SYSTEMATIC:	3.0%
RANDOM:	0.3%

*99% confidence level.

Impurities: γ -impurities <0.1%

5.11972 grams in HCl solution.

P O NUMBER: BW940502, Item 3

SOURCE PREPARED BY: *M. Taskasva*
M. Taskasva, Radiochemist

Q & A APPROVED: *M. Ruty* *4-19-02*

Prepare a working dilution of 931.4095.11

1. Density of 0.1 M HCl lot # 109031
 Mass of 100mL vol. flask: 68.5649g Balance # 12
 Mass of flask & 100mL acid: 168.4557g Balance # 12
 Net Mass: 99.8908g
 Density: 0.9989g/mL

2. Mass of 931.4095.11 transferred:
 Mass of open empty nalgene: 75.0081g Balance # 12
 Mass of nalgene & standard: 76.5548g Balance # 12
 Net mass of standard transferred: 1.5467g Balance # NA

3. Dilute to final volume:
 Mass of nalgene, standard, & diluent: 1085.2g Balance # 26
 Mass of empty nalgene (from above): 75.0081g Balance # 12
 Net mass of new dilution: 1010.1919g Balance # NA

4. Final activity calculation:

$$33,966.93 \text{ dpm/g} (0.9989 \text{ g/mL}) \left(\frac{1.5467 \text{ g}}{1010.1919 \text{ g}} \right) = 51.95 \text{ dpm/mL}$$

MC
10/17/2012

Std ID: 931.4095.33

Description: Sr-90

Expiration: 9/8/2013

Activity: 51.95 dpm/mL

2s Uncertainty: 93.51 dpm/mL

Ref. Date: 4/11/2011

Ref Time: N/A

Prep Date: 9/8/2012 Prep by: TE

Matrix/Comp. 0.1 M HCl

Half Life (y): 2.88E+01

Reverification Log		
Analysis Date	Initials	Expiration Date

MC
10/17/2012

MC
10/17/2012

Continued on Page _____

TE
Signed

9/8/12
Date

[Signature]
Signed

9/8/12
Date

Prepare an intermediate dilution of 931 Sr-90

1. Density of 0.1 M HCl, lot # K30039
Mass of 100mL vol. flask: 66.4305g Balance # 12
Mass of flask & 100mL acid: 166.2718g Balance# 12
Net Mass: 99.8413g
Density: 0.9984g/mL

2. Mass of 931 transferred:
Mass of open empty 40mL Voa vial: 21.7293g Balance# 12
Mass of Voa vial and standard: 27.0645g Balance# 12
Net mass of standard transferred: 5.3352g

3. Dilute to final volume:
Mass of open empty 40mL Voa vial: 21.7293g Balance# 12
Mass of vial, standard, & diluent: 56.1105g Balance# 12
Net mass of new dilution: 34.3812g

4. Final activity calculation:

$$1.967 \times 10^4 \text{ Bq} \left(\frac{5.3352 \text{ g}}{5.39174 \text{ g}} \right) \left(\frac{60 \text{ dpm}}{1 \text{ Bq}} \right) \left(\frac{0.9984 \text{ g/mL}}{34.3812 \text{ g}} \right) = 33,966.93 \text{ dpm/g}$$

JP 6/20/12
33,912.59 dpm/mL

Std ID: 931.4095.11

Description: Sr-90

Expiration: 1/19/2013

Activity: 33912.59 dpm/mL

2s Uncertainty: 610.43 dpm/mL

Ref. Date: 4/11/2011

Ref Time: N/A

Prep Date: 12/14/2011 Prep by: ML

Matrix/Comp. 0.1 M HCl

Half Life (y): 2.88E+01

Reverification Log		
Analysis Date	Initials	Expiration Date

Continued on Page _____

Meyn L...
Signed

12/14/11
Date

Read and Understood By

JP 6/20/12
Signed

12/14/11
Date



Eckert & Ziegler

Analytics

rec
4-5-11 RSO# 931

1380 Seaboard Industrial Blvd.
Atlanta, Georgia 30318
Tel 404-352-8677
Fax 404-352-2837
www.analyticinc.com

CERTIFICATE OF CALIBRATION

Standard Radionuclide Source

84379-307

5 mL Liquid in Flame Sealed Vial

Customer: AIS Laboratory Group/Fort Collins, CO
P.O. No.: 73625, Item 1

This standard radionuclide source was prepared gravimetrically from a master solution, calibrated by Eckert & Ziegler Analytics. The master solution was calibrated by liquid scintillation counting. Radionuclide purity and calibration were checked by germanium gamma-ray spectrometry and liquid scintillation counting. The nuclear decay rate and reference date for this source are given below. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 1, February, 1979, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST." EZA is accredited by the Health Physics Society (HPS) for the production of NIST-traceable sources, and this source was produced in accordance with the HPS accreditation requirements. Customers may report any concerns with the accreditation program to the HPS Secretariat, 1813 Dolley Madison Blvd., Ste. 402, McLean, VA 22101.

Isotope	Half-Life, Days	Activity (Bq)	Uncertainty*, %			Reference Date (12:00 PM EST)
			u_k	u_a	U	
Sr-90	1.052E+04	1.967E+04	0.1	0.9	1.8	04/11/2011

*Uncertainty: U - Relative expanded uncertainty, $k = 2$. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results."

Comments:

Impurities: γ -impurities < 0.1 %. 8.39174 grams 0.1M HCl solution with approximately 30 $\mu\text{g/g}$ each of Sr and Y carriers.

NOTE: This source also contains Y-90 in secular equilibrium with Sr-90. The Y-90 activity is equal to the Sr-90 activity. Since Sr-90 and Y-90 both decay 100% by beta emission, the total beta emission rate for the source is twice the certified Sr-90 activity. The half-life for Y-90 is 64.08 hours.

Source Prepared by: W. Mac
W. Mac, Radiochemist

QA Approved:

J. D. McCorvey, QA Manager Alternate

Date: 3/31/11



Single Isotope Certificate, Rev 1 9/28/2009

Corporate Office
24937 Avenue Tibbitts Valencia, California 91355

Laboratory
1380 Seaboard Industrial Blvd. Atlanta, Georgia, 30318