General Narrative
for
BRC
Eastside North Addtional Samples
SDG: 256152

July 09, 2010

Laboratory Identification:

GEL Laboratories LLC
2040 Savage Road
Charleston, South Carolina 29407
(843) 556-8171

Summary

Sample receipt

The sample(s) arrived at GEL Laboratories, LLC, Charleston, South Carolina on July 09, 2010, for analysis. The samples were delivered with proper chain of custody documentation and signatures. Sample was received broken. Please see attached e-mail for details. *256152005(BEC-9)*. There are no additional comments concerning sample receipt.

Sample Identification
The laboratory received the following samples:

Laboratory Identification	Sample Description
256152001	AA-10
256152002	AA-8
256152003	PC-56
256152004	DBMW-5
256152005	BEC-9

Case Narrative

Sample analyses were conducted using methodology as outlined in GEL Laboratories, LLC (GEL) Standard Operating Procedures. Any technical or administrative problems during analysis, data review, and reduction are contained in the analytical case narratives in the enclosed data package.

Data Package

The enclosed data package contains the following sections: General Narrative, Chain of Custody and Supporting Documentation, and data from the following fractions: Radiochemistry. This package, to the best of my knowledge, is in compliance with technical and administrative requirements.

GEL Laboratories, LLC appreciates this opportunity to provide you with analytical results and trusts that you will find everything in order and to your satisfaction. If you have any questions, please do not hesitate in contacting me at (843) 556-8171.

Ann Skradski
Project Manager

Chain of Custody

CONVERSE CONSULTANTS
Matt Schmidt
731 Pilot Road, Suite H
Las Vegas, Nevada 89119
(702) 269-8336 • Fax (702) 269-8353

250152

CHAIN OF CUSTODY FORM

GEL LABORATORIES, LLC
Contact: Amanda Raslo
2040 Savage Road
Charleston, SC 29407
(843) 556-8171

Client Name/Address: BRC - GW Sampling

Project/PO Number: 06-43226-06

Project Name: BMI Commons Area (Eastside)

Sampler(s): Carlos Cobos

Analysis Required

Sample Description	Sample Matrix	# of Cont.	Date	Time	Preservatives	~~PERCHLORATE~~	~~RADIOCHEM~~	~~TRACER ANALYSIS~~	RADON
AA-10	AQ	2	7-8-10	0715	4°C				X
AA-8	AQ	2	7-8-10	0830	4°C				X
PC-56	AQ	2	7-8-10	0945	4°C				X
DBMW-5	AQ	2	7-8-10	1050	4°C				X
BEC-9	AQ	2	7-8-10	1210	4°C				X
TB-20100708	AQ	2	7-8-10	0630	HCL				
EB-20100708	AQ	2	7-8-10	1300	HCL				

Comments/Instructions: TB-20100708 = TRIPBLANK
EB-20100708 = EQUIPMENT BLANK

Fed-Ex # 8659 4851 4112

Relinquished By:	Date/Time:	Received By:	Date/Time:
[signature]	7-8-10 1600	[signature]	7/9/10 @ 850
Relinquished By:	Date/Time:	Received By:	Date/Time:
Relinquished By:	Date/Time:	Received By:	Date/Time:

Turnaround Time: (Check)
- ☐ Same Day
- ☐ 24 Hours
- ☐ 48 Hours
- ☐ 72 Hours
- ☐ 5 Days
- ☒ Normal

Sample Integrity: (Check)
- ☐ Intact
- ☐ On Ice

Note: By relinquishing samples to Converse Consultants, client agrees to pay for the services requested on this chain of custody form and any additional analysis performed on this project. Payment for services is due within 30 days from the date of invoice. Sample(s) will be disposed of after 30 days.

GEL Laboratories LLC

SAMPLE RECEIPT & REVIEW FORM

Client: BRCM	**SDG/AR/COC/Work Order:** 2560152
Received By: H. Taylor	**Date Received:** 9JUL10

Suspected Hazard Information	**Yes**	**No**	*If Counts > x2 area background on samples not marked "radioactive", contact the Radiation Safety Group of further investigation.
COC/Samples marked as radioactive?		✓	Maximum Counts Observed*:
Classified Radioactive II or III by RSO?		✓	
COC/Samples marked containing PCBs?		✓	
Shipped as a DOT Hazardous?		✓	Hazard Class Shipped: UN#:
Samples identified as Foreign Soil?		✓	

	Sample Receipt Criteria	**Yes**	**NA**	**No**	**Comments/Qualifiers (Required for Non-Conforming Items)**
1	Shipping containers received intact and sealed?	✓			Circle Applicable: Seals broken Damaged container Leaking container Other (describe)
2	Samples requiring cold preservation within (0 ≤ 6 deg. C)?	✓			Preservation Method: 4 Ice bags Blue ice Dry ice None Other (describe)
2a	Daily check performed and passed on IR temperature gun?	✓			Temperature Device Serial #: 51049919 Secondary Temperature Device Serial # (If Applicable):
3	Chain of custody documents included with shipment?	✓			
4	Sample containers intact and sealed?			✓	Circle Applicable: Seals broken Damaged container Leaking container Other (describe) Received 1 of 2 containers broken for ID BEG9
5	Samples requiring chemical preservation at proper pH?		✓		Sample ID's, containers affected and observed pH: If Preservation added, Lot#:
6	VOA vials free of headspace (defined as < 6mm bubble)?	✓			Sample ID's and containers affected:
7	Are Encore containers present?		✓		(If yes, immediately deliver to Volatiles laboratory)
8	Samples received within holding time?	✓			ID's and tests affected:
9	Sample ID's on COC match ID's on bottles?	✓			Sample ID's and containers affected:
10	Date & time on COC match date & time on bottles?	✓			Sample ID's affected:
11	Number of containers received match number indicated on COC?	✓			Sample ID's affected:
12	COC form is properly signed in relinquished/received sections?	✓			
13	Carrier and tracking number.	✓			Circle Applicable: FedEx Air FedEx Ground UPS Field Services Courier Other 8659 4851 4112

Comments (Use Continuation Form if needed):

PM (or PMA) review: Initials AMB Date 7/9/10 Page 1 of 1

From: "Ashley Earl" <ash01394@gel.com>
Subject: Sample Received broken
Date: Fri, 09 Jul 2010 11:06:11 -0400
To: sahuron@earthlink.net
Cc: ann.skradski@gel.com

Ron,

We received a shipment of samples from you today. One of the samples labeled BEC-9 sampled 07/08/10 @ 1210 for PO number 06-43226-06 was received broken. Since two samples were shipped we have plenty to proceed with analysis.

Thank you,
Ashley Earl

Laboratory Certifications

List of current GEL Certifications as of 09 July 2010

State	Certification
Arizona	AZ0668
Arkansas	88–0651
CLIA	42D0904046
California – NELAP	01151CA
Colorado	GEL
Connecticut	PH–0169
Dept. of Navy	NFESC 413
EPA Region 5	WG–15J
Florida – NELAP	E87156
Georgia	E87156 (FL/NELAP)
Georgia DW	967
Hawaii	N/A
ISO 17025	2567.01
Idaho	SC00012
Illinois – NELAP	200029
Indiana	C–SC–01
Kansas – NELAP	E–10332
Kentucky	90129
Louisiana – NELAP	03046
Maryland	270
Massachusetts	M–SC012
Nevada	SC00012
New Jersey – NELAP	SC002
New Mexico	FL NELAP E87156
New York – NELAP	11501
North Carolina	233
North Carolina DW	45709
Oklahoma	9904
Pennsylvania – NELAP	68–00485
South Carolina	10120001/10120002
Tennessee	TN 02934
Texas – NELAP	T104704235–07B–TX
U.S. Dept. of Agriculture	S–52597
Utah – NELAP	GEL
Vermont	VT87156
Virginia	00151
Washington	C1641

Radiological Analysis

Radiochemistry Case Narrative
BRC (BRCM)
SDG 256152

Method/Analysis Information

Product:	**Liquid Scint Rn222, Liquid**
Analytical Method:	SM 7500 Rn B
Analytical Batch Number:	1001621

Sample ID	Client ID
256152001	AA-10
256152002	AA-8
256152003	PC-56
256152004	DBMW-5
256152005	BEC-9
1202159127	Method Blank (MB)
1202159128	256152001(AA-10) Sample Duplicate (DUP)
1202159129	256152001(AA-10) Matrix Spike (MS)
1202159130	Laboratory Control Sample (LCS)

The samples in this SDG were analyzed on an "as received" basis.

SOP Reference
Procedure for preparation, analysis and reporting of analytical data are controlled by GEL Laboratories LLC as Standard Operating Procedure (SOP). The data discussed in this narrative has been analyzed in accordance with GL-RAD-A-007 REV# 11.

Calibration Information:

Calibration Information
All initial and continuing calibration requirements have been met.

Standards Information
Standard solutions for these analysis are NIST traceable or verified with a NIST traceable standard and used before the expiration dates.

Sample Geometry
All counting sources were prepared in the same geometry as the calibration standards.

Quality Control (QC) Information:

Blank Information
The blank volume is representative of the sample volume in this batch.

Designated QC
The following sample was used for QC: 256152001 (AA-10).

QC Information
All of the QC samples met the required acceptance limits.

Technical Information:

Holding Time
All sample procedures for this sample set were performed within the required holding time.

Sample Re-prep/Re-analysis
None of the samples in this sample set required reprep or reanalysis.

Miscellaneous Information:

Data Exception (DER) Documentation
Data exception reports are generated to document any procedural anomalies that may deviate from referenced SOP or contractual documents. A data exception report (DER) was not generated for this SDG.

Additional Comments
Additional comments were not required for this sample set.

Qualifier Information

Manual qualifiers were not required.

Certification Statement

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless otherwise noted in the analytical case narrative.

GEL LABORATORIES LLC

2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Qualifier Definition Report
for

BRCM001 BRC

Client SDG: 256152 GEL Work Order: 256152

The Qualifiers in this report are defined as follows:

* A quality control analyte recovery is outside of specified acceptance criteria

** Analyte is a surrogate compound

U Analyte was analyzed for, but not detected above the MDL, MDA, or LOD.

Review/Validation

GEL requires all analytical data to be verified by a qualified data reviewer. In addition, all CLP-like deliverables receive a third level review of the fractional data package.

The following data validator verified the information presented in this case narrative:

Signature: **Name: Tamiko Williams**

Date: 14 JUL 2010 **Title: Analyst I**

Sample Data Summary

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Company : BRC
Address : 875 W. Warm Springs Road
Henderson, Nevada 89011

Report Date: July 14, 2010

Contact: Mr. Ron Sahu
Project: **Eastside North Addtional Samples**

Client Sample ID:	AA-10	Project:	BRCM00140
Sample ID:	256152001	Client ID:	BRCM001
Matrix:	Water		
Collect Date:	08-JUL-10 07:15		
Receive Date:	09-JUL-10		
Collector:	Client		

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Rad Liquid Scintillation Analysis											
Liquid Scint Rn222, Liquid "As Received"											
Radon-222		1180	+/-82.1	70.3	200	pCi/L		KXK2 07/09/10	2047	1001621	1

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SM 7500 Rn B	

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2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Company : BRC
Address : 875 W. Warm Springs Road
Henderson, Nevada 89011

Report Date: July 14, 2010

Contact: Mr. Ron Sahu
Project: **Eastside North Addtional Samples**

Client Sample ID:	AA-8	Project:	BRCM00140
Sample ID:	256152002	Client ID:	BRCM001
Matrix:	Water		
Collect Date:	08-JUL-10 08:30		
Receive Date:	09-JUL-10		
Collector:	Client		

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Rad Liquid Scintillation Analysis											
Liquid Scint Rn222, Liquid "As Received"											
Radon-222		563	+/-63.2	69.8	200	pCi/L		KXK2 07/09/10	2103	1001621	1

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SM 7500 Rn B	

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Company : BRC
Address : 875 W. Warm Springs Road
Henderson, Nevada 89011

Report Date: July 14, 2010

Contact: Mr. Ron Sahu
Project: **Eastside North Addtional Samples**

Client Sample ID:	PC-56	Project:	BRCM00140
Sample ID:	256152003	Client ID:	BRCM001
Matrix:	Water		
Collect Date:	08-JUL-10 09:45		
Receive Date:	09-JUL-10		
Collector:	Client		

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Rad Liquid Scintillation Analysis											
Liquid Scint Rn222, Liquid "As Received"											
Radon-222		363	+/-55.7	69.3	200	pCi/L		KXK2 07/09/10	2119	1001621	1

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SM 7500 Rn B	

GEL LABORATORIES LLC
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Certificate of Analysis

Company : BRC
Address : 875 W. Warm Springs Road
Henderson, Nevada 89011

Report Date: July 14, 2010

Contact: Mr. Ron Sahu
Project: **Eastside North Addtional Samples**

Client Sample ID:	DBMW-5	Project:	BRCM00140
Sample ID:	256152004	Client ID:	BRCM001
Matrix:	Water		
Collect Date:	08-JUL-10 10:50		
Receive Date:	09-JUL-10		
Collector:	Client		

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Rad Liquid Scintillation Analysis											
Liquid Scint Rn222, Liquid "As Received"											
Radon-222		320	+/-53.7	68.8	200	pCi/L		KXK2 07/09/10	2135	1001621	1

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SM 7500 Rn B	

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Company : BRC
Address : 875 W. Warm Springs Road
Henderson, Nevada 89011

Report Date: July 14, 2010

Contact: Mr. Ron Sahu
Project: **Eastside North Addtional Samples**

Client Sample ID:	BEC-9	Project:	BRCM00140
Sample ID:	256152005	Client ID:	BRCM001
Matrix:	Water		
Collect Date:	08-JUL-10 12:10		
Receive Date:	09-JUL-10		
Collector:	Client		

Parameter	Qualifier	Result	Uncertainty	DL	RL	Units	DF	AnalystDate	Time	Batch	Method
Rad Liquid Scintillation Analysis											
Liquid Scint Rn222, Liquid "As Received"											
Radon-222		266	+/-51.2	68.3	200	pCi/L		KXK2 07/09/10	2151	1001621	1

The following Analytical Methods were performed

Method	Description	Analyst Comments
1	SM 7500 Rn B	

Quality Control Data

QC Summary

Report Date: July 14, 2010

BRC
875 W. Warm Springs Road
Henderson, Nevada

Contact: **Mr. Ron Sahu**

Workorder: **256152**

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Rad Liquid Scintillation										
Batch 1001621										
QC1202159128 256152001 DUP										
Radon-222		1180		1040	pCi/L	13.1		(0% - 20%)	KXK2	07/09/10 22:24
	Uncertainty	+/-82.1		+/-78.7						
QC1202159130 LCS										
Radon-222	10900			11200	pCi/L		103	(75%-125%)		07/12/10 08:47
	Uncertainty			+/-313						
QC1202159127 MB										
Radon-222			U	13.2	pCi/L					07/09/10 22:07
	Uncertainty			+/-36.2						
QC1202159129 256152001 MS										
Radon-222	10900	1180		12500	pCi/L		102	(75%-125%)		07/12/10 08:30
	Uncertainty	+/-82.1		+/-331						

Notes:
The Qualifiers in this report are defined as follows:

**	Analyte is a surrogate compound
<	Result is less than value reported
>	Result is greater than value reported
A	The TIC is a suspected aldol-condensation product
B	For General Chemistry and Organic analysis the target analyte was detected in the associated blank.
BD	Results are either below the MDC or tracer recovery is low
C	Analyte has been confirmed by GC/MS analysis
D	Results are reported from a diluted aliquot of the sample
F	Estimated Value
H	Analytical holding time was exceeded
J	Value is estimated
M	M if above MDC and less than LLD
M	Matrix Related Failure
N/A	RPD or %Recovery limits do not apply.
ND	Analyte concentration is not detected above the detection limit
NJ	Consult Case Narrative, Data Summary package, or Project Manager concerning this qualifier
R	Sample results are rejected
U	Analyte was analyzed for, but not detected above the MDL, MDA, or LOD.
UI	Gamma Spectroscopy--Uncertain identification
UJ	Gamma Spectroscopy--Uncertain identification

QC Summary

Workorder: **256152**

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date	Time

X Consult Case Narrative, Data Summary package, or Project Manager concerning this qualifier

Y QC Samples were not spiked with this compound

^ RPD of sample and duplicate evaluated using +/-RL. Concentrations are <5X the RL. Qualifier Not Applicable for Radiochemistry.

h Preparation or preservation holding time was exceeded

N/A indicates that spike recovery limits do not apply when sample concentration exceeds spike conc. by a factor of 4 or more.
^ The Relative Percent Difference (RPD) obtained from the sample duplicate (DUP) is evaluated against the acceptance criteria when the sample is greater than five times (5X) the contract required detection limit (RL). In cases where either the sample or duplicate value is less than 5X the RL, a control limit of +/- the RL is used to evaluate the DUP result.
* Indicates that a Quality Control parameter was not within specifications.
For PS, PSD, and SDILT results, the values listed are the measured amounts, not final concentrations.

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless qualified on the QC Summary.

Liquid Scintillation Raw Data

Batch# 1001621 Product: RN-222 Date: 7/13/10

Criteria:	Yes	No	Comments
Sample Solids are less than or equal to 100 mg for GAB.			NA
Samples have been blank corrected (if required). Blank correction reported included (if required).			NA
If activity less than 10x MDA/MDC, error is less than or equal to 150% of sample activity. If greater than 10* MDA/ MDC, error is 40% or less. If below the MDA/ MDC, error is okay.	✓		
Instrument source check is within limits. Instrument bkg check is within limits.	✓		
Method RDL/ LLD has been met.	✓		
If duplicate activities are: Less than 5* MDA/ MDC, then RPD is 100% or less, If greater 5* MDA/ MDC, then RPD 20% or less, If below the MDA/ MDC, the RPD is 0%, Or meets the client's required RER acceptance criteria.	✓		
Tracer yield is 15-125% . Carrier yield 25-125%. (Or meets the client's contract acceptance criteria).			NA
Method blank is less than the RDL/ LLD. (If rad samples, < 5% of lowest activity)	✓		
Sample was run within hold time.	✓		
Sample was correctly preserved if required.	✓		
Smears Taken for Radioactive batches.			NA
Method Spike and LCS are within 75-125% (or meets the client's contract acceptance criteria).	✓		
No blank spaces on data forms. All line outs initialed and dated. No transcription errors are apparent.	✓		
Aux data is correct.			NA
Client Special requirements page has been checked.	✓		
Raw Data and/ or spectrum are included and properly statused.	✓		
MS, LCS, and Duplicate RPD/RER values uploaded to LIMS and values verified	✓		
Hit notification complete (if necessary)			NA
Batch entered into Case Narrative.	✓		
Batch Data Exception Reports (DER) completed, if applicable.			NA
Batch Data Exception Reports (DER) second reviewed. Disposition verified to be completed.			NA
Aliquot Correction completed if required.			NA
Review sample historical results if available (If REMP, results above MDC have been verified by historical results, recount or re-analysis.)	✓		

Primary Review Performed By: [signature] BRCM 7/30/10

Secondary Review Performed By: [signature] 7/14/10

Radon 222 Que Sheet

15

07/09/2010

Batch #:1001621 Analyst:KXK2 First Client Due Date07/30/2010 Internal Due Date07/20/2010

Spike Isotope: Radium-226 Spike Code: 0638-E Expiration Date: 4/8/11 Vol: 0.1 Nom Conc: 10851.5826 pCi/L

LCS Isotope: Radium-226 LCS Code: 0638-E Expiration Date: 4/8/11 Vol: 0.1 Nom Conc: 10851.5826 pCi/L

Comments

Prep Date: 7/9/10 Pipet ID: 2970968 Initials: KKJ Witness: DJM 7-9-10

Sample ID	Client Description	Type	Hazard Code	Min CRDL	Matrix	Client	Collection Date	Pos. #	Wet/Dry Sample Mass (g/mL)	LSC Rack #	Time Spike Added
256152001-1	AA-10	SAMPLE		.2 pCi/mL	WATER	BRCM001	08-JUL-10 07:15 AM	1	10	62-2	KKJ 7/9/10
256152002-1	AA-8	SAMPLE		.2 pCi/mL	WATER	BRCM001	08-JUL-10 08:30 AM	2	10	62-3	
256152003-1	PC-56	SAMPLE		.2 pCi/mL	WATER	BRCM001	08-JUL-10 09:45 AM	3	10	62-4	
256152004-1	DBMW-5	SAMPLE		.2 pCi/mL	WATER	BRCM001	08-JUL-10 10:50 AM	4	10	62-5	
256152005-1	BEC-9	SAMPLE		.2 pCi/mL	WATER	BRCM001	08-JUL-10 12:10 PM	5	10	62-6	
1202159127-1	MB for batch 1001621	MB		.2 pCi/mL	WATER	QC ACCOUNT		6	10	62-7	
1202159128-1	AA-10(256152001DUP)	DUP		.2 pCi/mL	WATER	QC ACCOUNT	08-JUL-10 07:15 AM	7	10	62-8	
1202159129-1	AA-10(256152001MS)	MS		.2 pCi/mL	WATER	QC ACCOUNT	08-JUL-10 07:15 AM	8	10	29-2	15:05
1202159130-1	LCS for batch 1001621	LCS		.2 pCi/mL	WATER	QC ACCOUNT		9	10	29-3	15:05

Bkg Rack #: 62-1 / 29-1

Comments:

Data Reviewed By: Lynnette Rowe 7/13/10

Instrument Used: LS6000 (Red) 7065155, LS6500 (Black) 7069123, LS6500 (Blue) 7067083, LS6500 (Green) 7067404 Wallac (Yellow) 4140127, Wallac (Pink) 2200082, Purple 7069123, Silver 7060656, Orange DG06095168

GEL Laboratories LLC, Radiochemistry Division

Radon-222 Liquid

Filename : RN222.XLS
File type : Excel
Version # : 1.2.7

Batch : 1001621
Analyst : KXK2
Prep Date : 7/9/2010

Rn-222 Abundance : 1
Rn-222 Method Uncertainty : 0.1111
Geometry : 10ML MINERAL OIL/10ML SAMPLE

Spike S/N : 0638-E
Spike Exp Date : 4/8/2011
Spike Activity (dpm/ml): 2409.05
Spike Volume Added: 0.10
Spike Date/Time: 7/9/2010 15:05

Pipet, 0.1 ml Stdev : +/- 0.000701 ml
Pipet, 0.5 ml Stdev : +/- 0.002564 ml

LCS S/N : 0638-E
LCS Exp Date : 4/8/2011
LCS Activity (dpm/ml): 2409.05
LCS Volume Added: 0.10

Procedure Code : LSC22RNL
Parmname : Radon-222
Required MDA : 200 pCi/L
Halflife of Radon-222 : 3.8235 days

Sample Characteristics					Count raw Data				Background			
Pos.	Sample ID	Sample Aliquot L	Sample Aliquot StDev. L	Sample Date/Time	Rack Position #	Counting Time (min.)	Quench#	Gross cpm	cpm	Count Time (min.)	Count Start Date/Time	Sample Decay
1	256152001.1	0.0100	4.2391E-06	7/8/2010 7:15	62-2	15	51	80.27	10.73	15	7/9/2010 20:47	0.752
2	256152002.1	0.0100	4.2391E-06	7/8/2010 8:30	62-3	15	54.6	44.07	10.73	15	7/9/2010 21:03	0.758
3	256152003.1	0.0100	4.2391E-06	7/8/2010 9:45	62-4	15	52.1	32.4	10.73	15	7/9/2010 21:19	0.764
4	256152004.1	0.0100	4.2391E-06	7/8/2010 10:50	62-5	15	69.7	29.93	10.73	15	7/9/2010 21:35	0.768
5	256152005.1	0.0100	4.2391E-06	7/8/2010 12:10	62-6	15	57.5	26.87	10.73	15	7/9/2010 21:51	0.775
6	1202159127.1	0.0100	4.2391E-06	7/9/2010 0:00	62-7	15	48.6	11.6	10.73	15	7/9/2010 22:07	0.845
7	1202159128.1	0.0100	4.2391E-06	7/8/2010 7:15	62-8	15	54.4	71	10.73	15	7/9/2010 22:24	0.743
8	1202159129.1	0.0100	4.2391E-06	7/8/2010 7:15	29-2	15	50.9	397.93	10.47	15	7/12/2010 8:30	0.479
9	1202159130.1	0.0100	4.2391E-06	7/9/2010 0:00	29-3	15	48.5	356.73	10.47	15	7/12/2010 8:47	0.543

Analytical SOP: GL-RAD-A-007
Instrument SOP: GL-RAD-I-004

Calibration Data						Backgrounds		Correction Factors			
Pos.	Counted on	Calibration Date	Calibration Due Date	Detector Efficiency (cpm/dpm)	Detector Efficiency Error (cpm/dpm)	Rack Position #	Count Start Date/Time	Spike Date/Time	Rn-222 Ingrowth	Rn-222 Count Correction	Net Sample Activity for MS pCi/L
1	LSCGREEN	10/10/2009	10/31/2010	3.5222	0.00792	62-1	7/9/2010 20:30	NA	NA	0.752	
2	LSCGREEN	10/10/2009	10/31/2010	3.5222	0.00792	62-1	7/9/2010 20:30	NA	NA	0.758	
3	LSCGREEN	10/10/2009	10/31/2010	3.5222	0.00792	62-1	7/9/2010 20:30	NA	NA	0.764	
4	LSCGREEN	10/10/2009	10/31/2010	3.5222	0.00792	62-1	7/9/2010 20:30	NA	NA	0.768	
5	LSCGREEN	10/10/2009	10/31/2010	3.5222	0.00792	62-1	7/9/2010 20:30	NA	NA	0.775	
6	LSCGREEN	10/10/2009	10/31/2010	3.5222	0.00792	62-1	7/9/2010 20:30	NA	NA	0.845	
7	LSCGREEN	10/10/2009	10/31/2010	3.5222	0.00792	62-1	7/9/2010 20:30	NA	NA	0.743	
8	LSCRED	7/28/2009	7/31/2010	3.5654	0.00792	29-1	7/12/2010 8:14	7/9/2010 15:05	0.391	0.391	1432.671
9	LSCRED	7/28/2009	7/31/2010	3.5654	0.00792	29-1	7/12/2010 8:14	7/9/2010 15:05	0.392	0.392	

Notes:
1 - Results are decay corrected to Sample Date/Time
2 - Reference date for Spike Activity (dpm/ml) is the batch Prep Date
3 - Spike Nominals are decay corrected to Sample Date/Time

Results

Pos.	Decision Level pCi/L	Critical Level pCi/L	Required MDA pCi/L	MDA pCi/L	Sample Act. Conc. pCi/L	Sample Act. Error pCi/L	Net Count Rate CPM	Net Count Rate Error CPM	**2 SIGMA** Counting Uncertainty pCi/L	**2 SIGMA** Total Prop. Uncertainty pCi/L	Sample QC	Sample Type	RPD	RER	Nominal pCi/L	Recovery
1	47.3703	33.4438	200	70.2871	**1181.9950**	0.0363	69.5400	2.4631	82.0563	270.7742		SAMPLE				
2	47.0209	33.1972	200	69.7688	**562.5118**	0.0579	33.3400	1.9114	63.2072	138.1141		SAMPLE				
3	46.6734	32.9518	200	69.2530	**362.9132**	0.0787	21.6700	1.6957	55.6601	96.8249		SAMPLE				
4	46.3875	32.7500	200	68.8289	**319.5781**	0.0861	19.2000	1.6464	53.7118	88.0478		SAMPLE				
5	46.0162	32.4878	200	68.2780	**266.4951**	0.0984	16.1400	1.5832	51.2378	77.5246		SAMPLE				
6	42.1674	29.7705	200	62.5672	**13.1635**	1.4024	0.8700	1.2201	36.1831	36.2971		MB				
7	47.9523	33.8547	200	71.1507	**1037.0163**	0.0395	60.2700	2.3342	78.7201	239.6870	256152001.1	DUP	13.1%			
8	89.0549	62.8735	200	132.2169	**12533.8985**	0.0156	387.4600	5.2179	330.8359	2756.2053	256152001.1	MS			10851.5826	102.3%
9	88.7744	62.6755	200	131.8004	**11165.8435**	0.0163	346.2600	4.9477	312.7166	2457.5943		LCS			10851.5826	102.9%

ID:RN 2222 9 JUL 2010 20:31

USER:18 COMMENT:GREEN

PRESET TIME : 15.00

DATA CALC :	CPM	H#	:YES	SAMPLE REPEATS:	1	PRINTER	:EDIT
COUNT BLANK :	NO	IC#	: NO	REPLICATES :	1	RS232	:EDIT
TWO PHASE :	NO	AQC	: NO	CYCLE REPEATS :	1	DISK	: OFF
SCINTILLATOR:	LIQUID	LUMEX	: NO	LOW SAMPLE REJ:	0	RWM LIST	: OFF
LOW LEVEL :	YES	HALF LIFE CORRECTION DATE:				none	

CHAN: 600.0 - 875.0 %ERROR: 2.00 FACTOR: 1.000000 BKG. SUB: 0
CHAN: 300.0 - 900.0 %ERROR: 2.00 FACTOR: 1.000000 BKG. SUB: 0

ALPHA-BETA DISCRIMINATION: NO

SAM NO	POS	TIME MIN	H#	WIND1 CPM	WIND1 %ERROR	WIND2 CPM	WIND2 %ERROR	LUMEX %	ELAPSED TIME
1	62-1	15.00	52.4	10.73	15.76	22.47	10.89	0.48	15.62
2	62-2	15.00	51.0	80.27	5.76	99.40	5.18	0.09	31.81
3	62-3	15.00	54.6	44.07	7.78	58.87	6.73	0.17	48.02
4	62-4	15.00	52.1	32.40	9.07	45.67	7.64	0.20	64.08
5	62-5	15.00	69.7	29.93	9.44	43.67	7.81	0.20	80.28
6	62-6	15.00	57.5	26.87	9.96	39.67	8.20	0.25	96.45
7	62-7	15.00	48.6	11.60	15.16	22.27	10.94	0.39	112.63
8	62-8	15.00	54.4	71.00	6.13	90.00	5.44	0.11	128.82

Sample Count Start Time:	9 Jul 2010 20:30:54		
Data Capture Date	09 Jul 2010 20:46:00		
User Filename	S18070962-1A.XLS		
	U18070962-1A.XLS		
Spectrum Type	Log Counts		
User Number	18		
User Id	RN 222		
User Comment	GREEN		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	1	62-1	15.00
H#, Total Counts:	52.4	465	
Win1: - Start, End, Counts:	0	990	465
Win2: - Start, End, Counts:	0	990	465

Sample Count Start Time:	9 Jul 2010 20:47:06		
Data Capture Date	09 Jul 2010 21:02:12		
User Filename	S18070962-2A.XLS		
	U18070962-1A.XLS		
Spectrum Type	Log Counts		
User Number	18		
User Id	RN 222		
User Comment	GREEN		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	2	62-2	15.00
H#, Total Counts:	51.0	1625	
Win1: - Start, End, Counts:	0	990	1625
Win2: - Start, End, Counts:	0	990	1625

Sample Count Start Time:	9 Jul 2010 21:03:18		
Data Capture Date	09 Jul 2010 21:18:24		
User Filename	S18070962-3A.XLS		
	U18070962-1A.XLS		
Spectrum Type	Log Counts		
User Number	18		
User Id	RN 222		
User Comment	GREEN		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	3	62-3	15.00
H#, Total Counts:	54.6	1026	
Win1: - Start, End, Counts:	0	990	1026
Win2: - Start, End, Counts:	0	990	1026

Sample Count Start Time:	9 Jul 2010 21:19:22		
Data Capture Date	09 Jul 2010 21:34:28		
User Filename	S18070962-4A.XLS		
	U18070962-1A.XLS		
Spectrum Type	Log Counts		
User Number	18		
User Id	RN 222		
User Comment	GREEN		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	4	62-4	15.00
H#, Total Counts:	52.1	787	
Win1: - Start, End, Counts:	0	990	787
Win2: - Start, End, Counts:	0	990	787

Sample Count Start Time:	9 Jul 2010 21:35:34		
Data Capture Date	09 Jul 2010 21:50:40		
User Filename	S18070962-5A.XLS		
	U18070962-1A.XLS		
Spectrum Type	Log Counts		
User Number	18		
User Id	RN 222		
User Comment	GREEN		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	5	62-5	15.00
H#, Total Counts:	69.7	760	
Win1: - Start, End, Counts:	0	990	760
Win2: - Start, End, Counts:	0	990	760

Sample Count Start Time:	9 Jul 2010 21:51:44		
Data Capture Date	09 Jul 2010 22:06:50		
User Filename	S18070962-6A.XLS		
	U18070962-1A.XLS		
Spectrum Type	Log Counts		
User Number	18		
User Id	RN 222		
User Comment	GREEN		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	6	62-6	15.00
H#, Total Counts:	57.5	718	
Win1: - Start, End, Counts:	0	990	718
Win2: - Start, End, Counts:	0	990	718

Sample Count Start Time:	9 Jul 2010 22:07:55		
Data Capture Date	09 Jul 2010 22:23:01		
User Filename	S18070962-7A.XLS		
	U18070962-1A.XLS		
Spectrum Type	Log Counts		
User Number	18		
User Id	RN 222		
User Comment	GREEN		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	7	62-7	15.00
H#, Total Counts:	48.6	450	
Win1: - Start, End, Counts:	0	990	450
Win2: - Start, End, Counts:	0	990	450

Sample Count Start Time:	9 Jul 2010 22:24:06		
Data Capture Date	09 Jul 2010 22:39:15		
User Filename	S18070962-8A.XLS		
	U18070962-1A.XLS		
Spectrum Type	Log Counts		
User Number	18		
User Id	RN 222		
User Comment	GREEN		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	8	62-8	15.00
H#, Total Counts:	54.4	1473	
Win1: - Start, End, Counts:	0	990	1473
Win2: - Start, End, Counts:	0	990	1473

ID = RN-222 12 JUL 2010 08:22
USER:12 COMMENT:RED
PRESET TIME : 15.00
DATA CALC : CPM H# :YES SAMPLE REPEATS: 1 PRINTER :EDIT
COUNT BLANK : NO IC# : NO REPLICATES : 1 RS232 :EDIT
TWO PHASE : NO ADC : NO CYCLE REPEATS : 1 DISK : OFF
SCINTILLATOR: LIQUID LUMEX: NO LOW SAMPLE REJ: 0
LOW LEVEL : YES HALF LIFE CORRECTION DATE: none

CHAN: 600.0 - 875.0 %ERROR: 2.00 FACTOR: 1.000000 BKG. SUB: 0
CHAN: 0.0 - 900.0 %ERROR: 2.00 FACTOR: 1.000000 BKG. SUB: 0

ALPHA-BETA DISCRIMINATION: NO

SAM NO	POS	TIME MIN	H#	WIND1 RAW CPM	WIND2 RAW CPM	WIND1 CPM	WIND1 %ERROR	WIND2 CPM	WIND2 %ERROR	LUMEX %	ELAPSED TIME
1	29-1	15.00	49.3	10.47	30.27	10.47	15.96	30.27	9.39	1.00	15.62
2	29-2	15.00	50.9	397.93	501.93	397.93	2.59	501.93	2.30	0.05	31.95
3	29-3	15.00	48.5	356.73	453.07	356.73	2.73	453.07	2.43	0.06	47.95

Sample Count Start Time:	12 Jul 2010 08:14:45		
Data Capture Date	12 Jul 2010 08:29:57		
User Filename	S12071229-1A.XLS		
	U12071229-1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN-222		
User Comment	RED		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	1	29-1	15.00
H#, Total Counts:	48.3	463	
Win1: Rn-222 - Start, End, Counts:	600	875	155
Win2: - Start, End, Counts:	0	990	463

Sample Count Start Time:	12 Jul 2010 08:30:59		
Data Capture Date	12 Jul 2010 08:46:11		
User Filename	S12071229-2A.XLS		
	U12071229-1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN-222		
User Comment	RED		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	2	29-2	15.00
H#, Total Counts:	50.9	7555	
Win1: Rn-222 - Start, End, Counts:	600	875	5967
Win2: - Start, End, Counts:	0	990	7555

Sample Count Start Time:	12 Jul 2010 08:47:05		
Data Capture Date	12 Jul 2010 09:02:18		
User Filename	S12071229-3A.XLS		
	U12071229-1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN-222		
User Comment	RED		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	3	29-3	15.00
H#, Total Counts:	48.5	6823	
Win1: Rn-222 - Start, End, Counts:	600	875	5349
Win2: - Start, End, Counts:	0	990	6823

Method Calibrations Data

GEL Laboratories

2040 Savage Road, Charleston, SC 29407

(843)556-8171

Liquid Scintillation Counter Calibration Package

Method: Rn 222

Instrument Color Code: Red

	Included/ Acceptable	Comments
Part 1: Efficiency determination		
1 Efficiency spreadsheet (eff pts, graph, trendline equation)	✓	
2 Verification Spreadsheet (recoveries 90%-110%)	✓	
3 Applicable portion of Machines.XLS	✓	
4 Raw Data and spectra	✓	
5 Window, Low Level and Lumex settings	✓	
Part 2. Documentation for Calibration Source		
1 Vendor Certificate	✓	
2 Standard Traceability Log (from LIMS)	✓	
3 Verification of Source	✓	
4 Source preparation sheet	✓	
5 Efficiency standard precision check	NA	
Part 3. Documentation for Verification Source		
1 Vendor Certificate	✓	
2 Standard Traceability Log (from LIMS)	✓	
3 Verification of Source	✓	
4 Source preparation sheet	✓	
5 Efficiency standard precision check	NA	
Part 4. Enter into LIMS		
1 Alpha LIMS instrument calibration updated	✓	

Primary Review of Package L Cinch 8/4/09

Secondary Review of Package 8/5/09

Effective Date: 7/28/09

Rev 7 SSC 8/3/09

Radon 222 Calibration

Instrument	Red

Standard Information from prep sheet	
Isotope	Ra-226
Serial Number	0024-A
Isotope Halflife (days)	584400
Reference Date	9/10/1997
Ref. Act. (DPM/mL)	131439.80
Amount of Std. (mL)	0.1

Std #	Start Count Time	Quench Number	RAW CPM	BKG	RAW CPM-BKG	Nominal DPM	EFF.
1	7/28/09 8:40	50.00	46572.00	8.73	46563.27	13076.50356	3.56083
2	7/28/09 8:42	49.30	47740.00	8.73	47731.27	13076.50355	3.65016
3	7/28/09 8:43	50.30	45272.00	8.73	45263.27	13076.50354	3.46142
4	7/28/09 8:44	49.40	47800.00	8.73	47791.27	13076.50352	3.65474
5	7/28/09 8:45	50.80	46324.00	8.73	46315.27	13076.50351	3.54187
6	7/28/09 8:47	50.70	44828.00	8.73	44819.27	13076.5035	3.42747
7	7/28/09 8:48	50.20	47660.00	8.73	47651.27	13076.50348	3.64404
8	7/28/09 8:49	50.30	45392.00	8.73	45383.27	13076.50347	3.47060
9	7/28/09 8:51	50.20	47560.00	8.73	47551.27	13076.50345	3.63639
10	7/28/09 8:52	50.00	46604.00	8.73	46595.27	13076.50344	3.56328
11	7/28/09 8:53	50.80	47200.00	8.73	47191.27	13076.50343	3.60886

Copy into Machines.xls	
Cal Date	07/28/09
Min H#	0.0
Max H#	0.0
A0	3.56542328E+00
A1	0.00000000E+00
A2	0.00000000E+00
A3	0.00000000E+00
A4	0
A5	0
Geometry	MINERAL OIL/10ML SAMPLE
Exp Date	07/31/10
Low Level	y
Eff Error	0.007920
Window1 LL	600
Window1 UL	875
Window2 LL	0
Window2 UL	900

8/4/09

Radon 222 Verification

Standard Information from prep sheet	
Isotope	Ra-226
Serial Number	0299-G
Isotope Halflife (days)	584400
Reference Date	12/15/1999
Ref. Act. (DPM/mL)	2446.35
Amount of Std. (mL)	0.1

Std #	Start Count Time	Quench Number	Raw CPM	BKG	BKG Corrected CPM	Calculated EFF.	Standard DPM	Measured DPM	Recovery %
1	7/28/09 9:12	51.50	952.89	8.73	944.16	3.5654	243.62	264.81	108.70%
2	7/28/09 9:23	49.90	942.35	8.73	933.62	3.5654	243.62	261.85	107.49%
3	7/28/09 9:35	50.80	924.06	8.73	915.33	3.5654	243.62	256.72	105.38%
4	7/28/09 9:47	49.60	926.48	8.73	917.75	3.5654	243.62	257.40	105.66%
5	7/28/09 9:59	50.30	944.06	8.73	935.33	3.5654	243.62	262.33	107.68%
6	7/28/09 10:10	49.20	958.47	8.73	949.74	3.5654	243.62	266.38	109.34%
7	7/28/09 10:22	51.00	928.15	8.73	919.42	3.5654	243.62	257.87	105.85%
8	7/28/09 10:34	50.90	959.33	8.73	950.60	3.5654	243.62	266.62	109.44%
9	7/28/09 10:46	51.40	937.29	8.73	928.56	3.5654	243.62	260.43	106.90%
10	7/28/09 10:57	52.80	924.42	8.73	915.69	3.5654	243.62	256.83	105.42%

	Calibration Coeffs
a0	3.56542328E+00
a1	0.00000000E+00
a2	0.00000000E+00
a3	0.00000000E+00

8/4/09

Red	**Rn-222**
Cal Date	07/28/2009
Min H#	0.00
Max H#	0.00
A0	3.56542328129873E+00
A1	0.00000000000000E+00
A2	0.00000000000000E+00
A3	0.00000000000000E+00
A4	0.00000000000000E+00
A5	0.00000000000000E+00
Geometry	10ML MINERAL OIL/10ML SAMPLE
Exp Date	07/31/2010
Low Level	y
Eff Error	0.007920
Window1 LL	600
Window1 UL	875
Window2 LL	0
Window2 UL	900

8/4/09

ID:RN222 DONT USE 28 JUL 2009 08:57

USER:12 COMMENT:RED

PRESET TIME : 15.00

DATA CALC :	CPM	H# :YES	SAMPLE REPEATS:	1	PRINTER	:EDIT
COUNT BLANK :	NO	IC# : NO	REPLICATES :	1	RS232	:EDIT
TWO PHASE :	NO	AQC : NO	CYCLE REPEATS :	1	DISK	: OFF
SCINTILLATOR:	LIQUID	LUMEX: NO	LOW SAMPLE REJ:	0		
LOW LEVEL :	YES	HALF LIFE CORRECTION DATE:			none	

CHAN: 600.0 - 875.0 %ERROR: 2.00 FACTOR: 1.000000 BKG. SUB: 0

CHAN: 0.0 - 900.0 %ERROR: 2.00 FACTOR: 1.000000 BKG. SUB: 0

ALPHA-BETA DISCRIMINATION: NO

SAM NO	POS	TIME MIN	H#	WIND1 RAW CPM	WIND2 RAW CPM	WIND1 CPM	WIND1 %ERROR	WIND2 CPM	WIND2 %ERROR	LUMEX %	ELAPSED TIME
1	**-1	0.25	50.0	46572.00	52956.00	46572.00	1.85	52956.00	1.74	0.00	0.73
2	**-2	0.25	49.3	47740.00	54180.00	47740.00	1.83	54180.00	1.72	0.00	1.97
3	**-3	0.25	50.3	45272.00	51812.00	45272.00	1.88	51812.00	1.76	0.00	3.18
4	**-4	0.25	49.4	47800.00	54724.00	47800.00	1.83	54724.00	1.71	0.00	4.55
5	**-5	0.25	50.8	46324.00	53004.00	46324.00	1.86	53004.00	1.74	0.00	5.78
6	**-6	0.25	50.7	44828.00	51016.00	44828.00	1.89	51016.00	1.77	0.00	7.00
7	**-7	0.25	50.2	47660.00	54128.00	47660.00	1.83	54128.00	1.72	0.00	8.37
8	**-8	0.25	50.3	45392.00	51364.00	45392.00	1.88	51364.00	1.76	0.00	9.60
9	**-9	0.25	50.2	47560.00	54088.00	47560.00	1.83	54088.00	1.72	0.00	10.96
10	**-10	0.25	50.0	46604.00	53176.00	46604.00	1.85	53176.00	1.73	0.00	12.20
11	**-11	0.25	50.8	47200.00	53668.00	47200.00	1.84	53668.00	1.73	0.00	13.56
12	**-12	15.00	50.1	8.73	31.13	8.73	17.47	31.13	9.25	0.84	29.68

 8/4/09

ID:RN222 DONT USE 28 JUL 2009 09:27

USER:12 COMMENT:RED

PRESET TIME : 15.00

DATA CALC :	CPM	H#	:YES	SAMPLE REPEATS:	1	PRINTER	:EDIT
COUNT BLANK :	NO	IC#	: NO	REPLICATES :	1	RS232	:EDIT
TWO PHASE :	NO	AQC	: NO	CYCLE REPEATS :	1	DISK	: OFF
SCINTILLATOR:	LIQUID	LUMEX:	NO	LOW SAMPLE REJ:	0		
LOW LEVEL :	YES	HALF LIFE CORRECTION DATE:				none	

CHAN: 600.0 - 875.0 %ERROR: 2.00 FACTOR: 1.000000 BKG. SUB: 0

CHAN: 0.0 - 900.0 %ERROR: 2.00 FACTOR: 1.000000 BKG. SUB: 0

ALPHA-BETA DISCRIMINATION: NO

SAM NO	POS	TIME MIN	H#	WIND1 RAW CPM	WIND2 RAW CPM	WIND1 CPM	WIND1 %ERROR	WIND2 CPM	WIND2 %ERROR	LUMEX %	ELAPSED TIME
1	57-1	10.55	51.5	952.89	1099.34	952.89	1.99	1099.34	1.86	0.03	11.15
2	57-2	10.65	49.9	942.35	1095.12	942.35	2.00	1095.12	1.85	0.02	22.86
3	57-3	10.85	50.8	924.06	1074.93	924.06	2.00	1074.93	1.85	0.02	34.78
4	57-4	10.80	49.6	926.48	1076.39	926.48	2.00	1076.39	1.85	0.02	46.78
5	57-5	10.60	50.3	944.06	1096.42	944.06	2.00	1096.42	1.86	0.02	58.44
6	57-6	10.45	49.2	958.47	1105.74	958.47	2.00	1105.74	1.86	0.02	69.98
7	57-7	10.80	51.0	928.15	1077.22	928.15	2.00	1077.22	1.85	0.02	81.97
8	57-8	10.45	50.9	959.33	1111.96	959.33	2.00	1111.96	1.86	0.02	93.50
9	57-9	10.70	51.4	937.29	1090.65	937.29	2.00	1090.65	1.85	0.03	105.29
10	57-10	10.85	52.8	924.42	1081.84	924.42	2.00	1081.84	1.85	0.02	117.34

Filename: 10:43 AMab

Instrument Type	LS 6000
Data Capture Date	28 Jul 2009 08:40:27
User Filename	C:\LSCCAPTURE\BROWN\USER12\UN072801.BSF

User Number	12
User Id	RN222
User Comments	RED

Scintillator Choice:	LIQUID

Sam	Rack	Time	H#	Raw CPM1	Raw CPM2	CPM Iso1	%Err1	CPM Iso2	%Err2	LumEx
1	**-1	0.25	50.0	46572.00	52956.00	46572.00	1.85	52956.00	1.74	0.00
2	**-2	0.25	49.3	47740.00	54180.00	47740.00	1.83	54180.00	1.72	0.00
3	**-3	0.25	50.3	45272.00	51812.00	45272.00	1.88	51812.00	1.76	0.00
4	**-4	0.25	49.4	47800.00	54724.00	47800.00	1.83	54724.00	1.71	0.00
5	**-5	0.25	50.8	46324.00	53004.00	46324.00	1.86	53004.00	1.74	0.00
6	**-6	0.25	50.7	44828.00	51016.00	44828.00	1.89	51016.00	1.77	0.00
7	**-7	0.25	50.2	47660.00	54128.00	47660.00	1.83	54128.00	1.72	0.00
8	**-8	0.25	50.3	45392.00	51364.00	45392.00	1.88	51364.00	1.76	0.00
9	**-9	0.25	50.2	47560.00	54088.00	47560.00	1.83	54088.00	1.72	0.00
10	**-10	0.25	50.0	46604.00	53176.00	46604.00	1.85	53176.00	1.73	0.00
11	**-11	0.25	50.8	47200.00	53668.00	47200.00	1.84	53668.00	1.73	0.00
12	**-12	15.00	50.1	8.73	31.13	8.73	17.47	31.13	9.25	0.84

Sample Count Start Time:	28 Jul 2009 08:40:56		
Data Capture Date	28 Jul 2009 08:41:35		
User Filename	S120728---1A.XLS		
	U120728---1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN222 DONT USE		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	1	**-1	0.25
H#, Total Counts:	50.0	13302	
Start, End, X-Axis:	0	990	Channel Number

 8/4/09

Sample Count Start Time:	28 Jul 2009 08:42:10		
Data Capture Date	28 Jul 2009 08:42:58		
User Filename	S120728---2A.XLS		
	U120728---1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN222 DONT USE		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	2	**-2	0.25
H#, Total Counts:	49.3	13619	
Start, End, X-Axis:	0	990	Channel Number

 8/9/09

Sample Count Start Time:	28 Jul 2009 08:43:23		
Data Capture Date	28 Jul 2009 08:44:11		
User Filename	S120728---3A.XLS		
	U120728---1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN222 DONT USE		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	3	**-3	0.25
H#, Total Counts:	50.3	13010	
Start, End, X-Axis:	0	990	Channel Number

Sample Count Start Time:	28 Jul 2009 08:44:45		
Data Capture Date	28 Jul 2009 08:45:25		
User Filename	S120728---4A.XLS		
	U120728---1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN222 DONT USE		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	4	**-4	0.25
H#, Total Counts:	49.4	13752	
Start, End, X-Axis:	0	990	Channel Number

10/4/09

Sample Count Start Time:	28 Jul 2009 08:45:59		
Data Capture Date	28 Jul 2009 08:46:42		
User Filename	S120728---5A.XLS		
	U120728---1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN222 DONT USE		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	5	**-5	0.25
H#, Total Counts:	50.8	13312	
Start, End, X-Axis:	0	990	Channel Number

8/4/09

Sample Count Start Time:	28 Jul 2009 08:47:12		
Data Capture Date	28 Jul 2009 08:47:56		
User Filename	S120728---6A.XLS		
	U120728---1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN222 DONT USE		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	6	**-6	0.25
H#, Total Counts:	50.7	12813	
Start, End, X-Axis:	0	990	Channel Number

Sample Count Start Time:	28 Jul 2009 08:48:34		
Data Capture Date	28 Jul 2009 08:49:13		
User Filename	S120728---7A.XLS		
	U120728---1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN222 DONT USE		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	7	**-7	0.25
H#, Total Counts:	50.2	13592	
Start, End, X-Axis:	0	990	Channel Number

 8/4/09

Sample Count Start Time:	28 Jul 2009 08:49:48		
Data Capture Date	28 Jul 2009 08:50:27		
User Filename	S120728---8A.XLS		
	U120728---1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN222 DONT USE		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	8	**-8	0.25
H#, Total Counts:	50.3	12904	
Start, End, X-Axis:	0	990	Channel Number

8/4/09

Sample Count Start Time:	28 Jul 2009 08:51:10		
Data Capture Date	28 Jul 2009 08:51:49		
User Filename	S120728---9A.XLS		
	U120728---1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN222 DONT USE		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	9	**-9	0.25
H#, Total Counts:	50.2	13586	
Start, End, X-Axis:	0	990	Channel Number

Sample Count Start Time:	28 Jul 2009 08:52:24		
Data Capture Date	28 Jul 2009 08:53:18		
User Filename	S120728---10A.XLS		
	U120728---1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN222 DONT USE		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	10	**-10	0.25
H#, Total Counts:	50.0	13354	
Start, End, X-Axis:	0	990	Channel Number

8/4/09

Sample Count Start Time:	28 Jul 2009 08:53:46		
Data Capture Date	28 Jul 2009 08:54:31		
User Filename	S120728---11A.XLS		
	U120728---1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN222 DONT USE		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	11	**-11	0.25
H#, Total Counts:	50.8	13477	
Start, End, X-Axis:	0	990	Channel Number

 8/4/09

Sample Count Start Time:	28 Jul 2009 08:55:08		
Data Capture Date	28 Jul 2009 09:10:30		
User Filename	S120728---12A.XLS		
	U120728---1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN222 DONT USE		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	12	**-12	15.00
H#, Total Counts:	50.1	474	
Start, End, X-Axis:	0	990	Channel Number

Filename: 10:43 AMab

Instrument Type	LS 6000
Data Capture Date	28 Jul 2009 09:11:25
User Filename	C:\LSCCAPTURE\BROWN\USER12\UN072801.BSF

User Number	12
User Id	RN222
User Comments	RED

Scintillator Choice:	LIQUID

Sam	Rack	Time	H#	Raw CPM1	Raw CPM2	CPM Iso1	%Err1	CPM Iso2	%Err2	LumEx
1	57-1	10.55	51.5	952.89	1099.34	952.89	1.99	1099.34	1.86	0.03
2	57-2	10.65	49.9	942.35	1095.12	942.35	2.00	1095.12	1.85	0.02
3	57-3	10.85	50.8	924.06	1074.93	924.06	2.00	1074.93	1.85	0.02
4	57-4	10.80	49.6	926.48	1076.39	926.48	2.00	1076.39	1.85	0.02
5	57-5	10.60	50.3	944.06	1096.42	944.06	2.00	1096.42	1.86	0.02
6	57-6	10.45	49.2	958.47	1105.74	958.47	2.00	1105.74	1.86	0.02
7	57-7	10.80	51.0	928.15	1077.22	928.15	2.00	1077.22	1.85	0.02
8	57-8	10.45	50.9	959.33	1111.96	959.33	2.00	1111.96	1.86	0.02
9	57-9	10.70	51.4	937.29	1090.65	937.29	2.00	1090.65	1.85	0.03
10	57-10	10.85	52.8	924.42	1081.84	924.42	2.00	1081.84	1.85	0.02

Sample Count Start Time:	28 Jul 2009 09:12:01		
Data Capture Date	28 Jul 2009 09:22:17		
User Filename	S12072857-1A.XLS		
	U12072857-1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN222 DONT USE		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	1	57-1	10.55
H#, Total Counts:	51.5	11646	
Start, End, X-Axis:	0	990	Channel Number

Sample Count Start Time:	28 Jul 2009 09:23:38		
Data Capture Date	28 Jul 2009 09:34:01		
User Filename	S12072857-2A.XLS		
	U12072857-1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN222 DONT USE		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	2	57-2	10.65
H#, Total Counts:	49.9	11708	
Start, End, X-Axis:	0	990	Channel Number

 8/4/09

Sample Count Start Time:	28 Jul 2009 09:35:21		
Data Capture Date	28 Jul 2009 09:46:26		
User Filename	S12072857-3A.XLS		
	U12072857-1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN222 DONT USE		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	3	57-3	10.85
H#, Total Counts:	50.8	11720	
Start, End, X-Axis:	0	990	Channel Number

 8/9/09

Sample Count Start Time:	28 Jul 2009 09:47:24		
Data Capture Date	28 Jul 2009 09:57:56		
User Filename	S12072857-4A.XLS		
	U12072857-1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN222 DONT USE		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	4	57-4	10.80
H#, Total Counts:	49.6	11690	
Start, End, X-Axis:	0	990	Channel Number

 8/4/09

Sample Count Start Time:	28 Jul 2009 09:59:15		
Data Capture Date	28 Jul 2009 10:09:36		
User Filename	S12072857-5A.XLS		
	U12072857-1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN222 DONT USE		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	5	57-5	10.60
H#, Total Counts:	50.3	11687	
Start, End, X-Axis:	0	990	Channel Number

 9/4/09

Sample Count Start Time:	28 Jul 2009 10:10:57		
Data Capture Date	28 Jul 2009 10:21:07		
User Filename	S12072857-6A.XLS		
	U12072857-1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN222 DONT USE		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	6	57-6	10.45
H#, Total Counts:	49.2	11606	
Start, End, X-Axis:	0	990	Channel Number

 8/4/09

Sample Count Start Time:	28 Jul 2009 10:22:35		
Data Capture Date	28 Jul 2009 10:33:08		
User Filename	S12072857-7A.XLS		
	U12072857-1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN222 DONT USE		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	7	57-7	10.80
H#, Total Counts:	51.0	11700	
Start, End, X-Axis:	0	990	Channel Number

 8/4/09

Sample Count Start Time:	28 Jul 2009 10:34:28		
Data Capture Date	28 Jul 2009 10:44:39		
User Filename	S12072857-8A.XLS		
	U12072857-1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN222 DONT USE		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	8	57-8	10.45
H#, Total Counts:	50.9	11680	
Start, End, X-Axis:	0	990	Channel Number

 8/4/09

Sample Count Start Time:	28 Jul 2009 10:46:00		
Data Capture Date	28 Jul 2009 10:56:26		
User Filename	S12072857-9A.XLS		
	U12072857-1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN222 DONT USE		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	9	57-9	10.70
H#, Total Counts:	51.4	11732	
Start, End, X-Axis:	0	990	Channel Number

 7/4/09

Sample Count Start Time:	28 Jul 2009 10:57:54		
Data Capture Date	28 Jul 2009 11:08:32		
User Filename	S12072857-10A.XLS		
	U12072857-1A.XLS		
Spectrum Type	Log Counts		
User Number	12		
User Id	RN222 DONT USE		
User Comment	RED		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	10	57-10	10.85
H#, Total Counts:	52.8	11797	
Start, End, X-Axis:	0	990	Channel Number

 8/4/09

Amersham International plc
Amersham Laboratories

0024

NAMAS
CALIBRATION
No. 0146

[redacted]

Description	Principal radionuclide:	Radium-226	Product code: RAY.44
			Solution number: R4/131/58
Measurement	Reference time:		1200 GMT on 10 September 1997
	Radioactive concentration of radium-226:		43.85 kilobecquerels per gram of solution
	which is equivalent to:		1.185 microcuries per gram of solution
	Mass of solution:		5.0357 grams
	Total activity of radium-226:		220.8 kilobecquerels
	which is equivalent to:		5.968 microcuries
	Recommended half life:		1600.00 years

Method of measurement:
The activity of the solution was measured in a high pressure re-entrant ionisation chamber calibrated with a large number of absolutely standardised solutions.

Accuracy

Overall uncertainty in the radioactive concentration quoted above: ± 3.7 %

Random uncertainty: ± 0.7 % Systematic uncertainty: ± 3.0 %

The limits of overall uncertainty were taken as the arithmetic sum of the uncertainty due to random variations, calculated at the 99.7% confidence level, and the estimated systematic uncertainties in the measurement.

Radionuclidic Purity

The estimated activities of any radioactive impurities found by high-resolution gamma ray spectrometry, or in any other examination of the solution, are listed below expressed as percentages of the activity of the principal radionuclide at the reference time.

Chemical Composition.

Carrier free in 0.5M HCl

Remarks

At the reference date radium-226 was shown to be in radioactive equilibrium with its daughter nuclides down the decay chain to polonium-214 and thallium-210, the precursors of lead-210. The ionisation chamber was calibrated using a standard supplied by the National Institute of Standards and Technology, Washington DC, USA.

This product meets the quality assurance requirements of the NRC Regulatory Guide 4.15 for achieving implicit NIST traceability as defined in NCRP 58 (1985).

Approved Signatory

RC-5-021-097

 8/4/09

Standard Traceability Log Rad

Source Material Info	
Parent Code:	0024
Prepared By:	Richard Kinney
Carrier Conc:	0.5 M HCL
Reference Date:	09/10/1997
Ampoule Mass (g):	5.0357 g
Uncertainty:	+/- 3.7 %
LogBook No:	RC S 021 097

A Solution Material Info	
Isotope:	Radium-226
Prepared By:	Angela Johnson
Prep Date:	01/22/1999
Verification Date:	01/23/2008
Expiration Date:	04/09/2010
Primary Code:	0024-A
Dilution(mL):	100 mL
Mass of Parent(g):	4.9958 g
Density(g/mL):	1.0044
Balance ID:	38080204

Calculations Converting parent activity to dpm/mL|dpm/g

(Mass of parent(g)) * (Parm Activity (kBq/g)) * (conversion dpm to kBq) / (Dilution Vol) = Parent Activity (dpm/mL)

(Mass of parent(g)) * (Parm Activity (kBq/g)) * (conversion dpm to kBq) / Density (g/mL)/ (Dilution Vol) = Parent Activity (dpm/g)

(4.9958 g) * (43.85 kBq/g) * (60000 dpm/kBq) / (100 mL) = 131439.4980 dpm/mL

(4.9958 g) * (43.85 kBq/g) * (60000 dpm/kBq) / (1.0044 g/mL) / (100 mL) = 130865.9326 dpm/g

Secondary Standards

Prep Date	Preparer	Mass Primary	Dilution (mL)	Code	Conc dpm/mL	Verification Date	Expiration Date
03/02/2000	Angela Johnson	10.5724	100	0024-D	13834.1 dpm/mL	02/10/2005	02/10/2006
08/23/2002	Angela Johnson	8.0371	100	0024-G	10516.626 dpm/mL	02/10/2004	02/10/2005

GEL Laboratories LLC
Version 1.0 9/18/2000

Verification for Ra-226 Standard 0024-A 09

M. Aders	Isotope	Value	Uncertainty
4/13/2009	0024-A	5930.765	106.9965
	0024-A	5563.022	98.7976
	0024-A	5699.674	104.7832

Mean Value (Counting) =	5731.153	97.29	**Pass**
Stdev =	185.8813485		**Rule 3 (Pass/Fail)**

Target =	5891.04
Lower Limit =	5359.390736
Upper Limit =	6102.91613
Rule 1 Pass/Fail	**Pass**
Two sigma =	371.762697
10 % of Mean =	573.1153433
Rule 2 (Pass/Fail)	**Pass**

Rule 1 = The certificate value (NOT including any uncertainty) shall lie within the 95% confidence interval determined from the mean and two sigma standard deviation of the three measurements
Rule 2 = The two sigma value used for the 95% confidence interval shall not exceed 10% of the mean value of the three verification measurements.
Rule 3 = The determined mean value shall be within 5% of the certificate value.

The analyst prepared three standard verification sources for Ra-226 source 0024-A by transferring portions of the degassed standard into tared glass liquid scintillation vials. Ten mL of DI Water and 10 mL mineral oil was added to each vial and the vials were shaken to mix. A Blank vial was prepared in a similar fashion using 10 mL of DI water and 10 mL of mineral oil. The standard verification vials and Background source were dark adapted for two hours and counted on LSC Green using source standard verification. Each verification source calculation was performed as follows:

Source dpm/g = (A - B)/(C)(D)
where:
A = Ver. source cpm,
B = BKG cpm,
C = System efficiency, (cpm/dpm), and
D = mass used for standard verification.

Reference RAD SOP M-001

4/14/09

Radon-222 Liquid

Filename : RN222.XLS
File type : Excel
Version # : 1.2.3

Batch : 856389
Analyst : AF1
Prep Date : 4/9/2009

Rn-222 Abundance : 1
Rn-222 Method Uncertainty : 0.1111
Geometry : 10ML MINERAL OIL/10ML SAMPLE

Spike S/N : N/A
Spike Exp Date : N/A
Spike Activity (dpm/ml): N/A
Spike Volume Added: N/A
Spike Date/Time: 4/9/2009 14:45

Pipet, 0.1 ml Stdev : +/- 0.000701 ml
Pipet, 0.5 ml Stdev : +/- 0.002564 ml

LCS S/N : 0024-A
LCS Exp Date : 7/23/2009
LCS Activity (dpm/ml): 130781.16
LCS Volume Added: 0.10

Procedure Code : LSC22RNL
Parmname : Radon-222
Required MDA : 200 pCi/L
Halflife of Radon-222 : 3.823 days

Sample Characteristics				Count raw Data				Background			
Sample ID	Sample Aliquot L	Sample Aliquot StDev. L	Sample Date/Time	Rack Position #	Counting Time (min.)	Quench#	Gross cpm	cpm	Count Time (min.)	Count Start Date/Time	Sample Decay
1201812586.1	1.0000	2.0399E-05	4/9/2009 14:45	29-2	0.5	51.1	23650	21.60	15	4/13/2009 16:30	0.478
1201812587.1	1.0000	2.0399E-05	4/9/2009 14:45	29-3	0.55	48.9	22189.09	21.60	15	4/13/2009 16:32	0.478
1201812588.1	1.0000	2.0399E-05	4/9/2009 14:45	29-4	0.5	50.2	22738	21.60	15	4/13/2009 16:34	0.478
1201812589.1	1.0000	2.0399E-05	4/9/2009 14:45	29-5	4.3	50.2	2636.28	21.60	15	4/13/2009 16:35	0.477
1201812590.1	1.0000	2.0399E-05	4/9/2009 14:45	29-6	4.45	49.7	2562.25	21.60	15	4/13/2009 16:41	0.477
1201812591.1	1.0000	2.0399E-05	4/9/2009 14:45	29-7	4.55	49.3	2521.76	21.60	15	4/13/2009 16:46	0.477
1201812592.1	1.0000	2.0399E-05	4/9/2009 14:45	29-8	15	49.6	477.4	21.60	15	4/13/2009 16:52	0.476
1201812593.1	1.0000	2.0399E-05	4/9/2009 14:45	29-9	15	50.3	486.73	21.60	15	4/13/2009 17:09	0.475
1201812594.1	1.0000	2.0399E-05	4/9/2009 14:45	29-10	15	48.5	501.67	21.60	15	4/13/2009 17:25	0.474

Calibration Data					Backgrounds		Correction Factors			
Counted on	Calibration Date	Calibration Due Date	Detector Efficiency (cpm/dpm)	Detector Efficiency Error (cpm/dpm)	Rack Position #	Count Start Date/Time	Spike Date/Time	Rn-222 Ingrowth	Rn-222 Count Correction	Net Sample Activity for MS pCi/L
LSCGREEN	3/25/2009	3/31/2010	3.4365	0.00792	29-1	4/13/2009 16:14	4/9/2009 14:45	0.522	0.522	
LSCGREEN	3/25/2009	3/31/2010	3.4365	0.00792	29-1	4/13/2009 16:14	4/9/2009 14:45	0.522	0.522	
LSCGREEN	3/25/2009	3/31/2010	3.4365	0.00792	29-1	4/13/2009 16:14	4/9/2009 14:45	0.522	0.522	
LSCGREEN	3/25/2009	3/31/2010	3.4365	0.00792	29-1	4/13/2009 16:14	4/9/2009 14:45	0.523	0.523	
LSCGREEN	3/25/2009	3/31/2010	3.4365	0.00792	29-1	4/13/2009 16:14	4/9/2009 14:45	0.523	0.523	
LSCGREEN	3/25/2009	3/31/2010	3.4365	0.00792	29-1	4/13/2009 16:14	4/9/2009 14:45	0.523	0.523	
LSCGREEN	3/25/2009	3/31/2010	3.4365	0.00792	29-1	4/13/2009 16:14	4/9/2009 14:45	0.524	0.524	
LSCGREEN	3/25/2009	3/31/2010	3.4365	0.00792	29-1	4/13/2009 16:14	4/9/2009 14:45	0.525	0.525	
LSCGREEN	3/25/2009	3/31/2010	3.4365	0.00792	29-1	4/13/2009 16:14	4/9/2009 14:45	0.526	0.526	

4/14/09

Notes:
1 - Results are decay corrected to Sample Date/Time
2 - Reference date for Spike Activity (dpm/ml) is the batch Prep Date
3 - Spike Nominals are decay corrected to Sample Date/Time

Results Decision Level pCi/L	Critical Level pCi/L	MDA pCi/L	Sample Act. Conc. pCi/L	Sample Act. Error pCi/L	Net Count Rate CPM	Net Count Rate Error CPM	2 SIGMA Counting Uncertainty pCi/L	2 SIGMA Total Prop. Uncertainty pCi/L	Sample QC	Sample Type	RPD	RER	Nominal pCi/L	Recovery
3.9075	2.7587	7.0234	**5930.7645**	0.0121	23628.4000	217.4889	106.9965	1299.1505		LCS			5891.0434	100.7%
3.7309	2.6341	6.6370	**5563.0219**	0.0120	22167.4900	200.8612	98.7976	1218.4676		LCS			5891.0434	94.4%
3.9060	2.7576	7.0207	**5699.6739**	0.0123	22716.4000	213.2544	104.8732	1248.6996		LCS			5891.0434	96.8%
1.4856	1.0489	2.2727	**655.7702**	0.0124	2614.6800	24.7897	12.1860	143.6780		LCS			612.8784	107.0%
1.4651	1.0344	2.2377	**636.7951**	0.0123	2540.6500	24.0255	11.8028	139.5180		LCS			612.8784	103.9%
1.4517	1.0249	2.2150	**626.2343**	0.0123	2500.1600	23.5727	11.5727	137.2013		LCS			612.8784	102.2%
0.9892	0.6984	1.4467	**114.0215**	0.0149	455.8000	5.7677	2.8280	25.0520		LCS			108.5740	105.0%
0.9873	0.6970	1.4440	**116.1380**	0.0148	465.1300	5.8214	2.8489	25.5135		LCS			108.5740	107.0%
0.9855	0.6957	1.4413	**119.6448**	0.0146	480.0700	5.9063	2.8851	26.2784		LCS			108.5740	110.2%

ECL 6/14/09

SAM NO	PUS	TIME MIN	HH	WIND1 CPM	WIND1 %ERROR	WIND2 CPM	WIND2 %ERROR	LUMEX %	ELAPSED TIME
[illegible]	[illegible]	[illegible]	[illegible]	10.33	[illegible]	21.60	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	21172.00	[illegible]	23650.00	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	19761.32	[illegible]	22189.09	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	20378.00	[illegible]	22738.00	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	2350.47		2635.28	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	2261.57	[illegible]	2562.25	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	2220.22	[illegible]	2521.76	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	410.33	[illegible]	477.40	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	424.07	[illegible]	436.73	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	438.53	[illegible]	501.67	[illegible]	[illegible]	[illegible]

Q025-A Q024-A

Q025-E

8/4/09

4/14/09

Sample Count Start Time:	13 Apr 2009 16:14:45		
Data Capture Date:	13 Apr 2009 16:30:02		
User Filename:	S16041329-1A.WK1		
	U16041329-1A.WK1		
Spectrum Type	Log Counts		
User Number:	16		
User Id:	RN-222		
User Comment:	GREEN		
Isotope Name:	14C		
Scintillator:	LIQUID		
Sample, Rack-Pos, Time:	1	29-1	15.00
H#, Total Counts:	48.1	450	
Start, End, X-Axis:	0	990	Channel Number

Sample Count Start Time:	13 Apr 2009 16:30:50		
Data Capture Date:	13 Apr 2009 16:31:39		
User Filename:	S16041329-2A.WK1		
	U16041329-1A.WK1		
Spectrum Type	Log Counts		
User Number:	16		
User Id:	RN-222		
User Comment:	GREEN		
Isotope Name:	14C		
Scintillator:	LIQUID		
Sample, Rack-Pos, Time:	2	29-2	0.50
H#, Total Counts:	51.1	12433	
Start, End, X-Axis:	0	990	Channel Number

 8/4/09

Sample Count Start Time:	13 Apr 2009 16:32:27		
Data Capture Date:	13 Apr 2009 16:33:19		
User Filename:	S16041329-3A.WK1		
	U16041329-1A.WK1		
Spectrum Type	Log Counts		
User Number:	16		
User Id:	RN-222		
User Comment:	GREEN		
Isotope Name:	14C		
Scintillator:	LIQUID		
Sample, Rack-Pos, Time:	3	29-3	0.55
H#, Total Counts:	48.9	12867	
Start, End, X-Axis:	0	990	Channel Number

 LL 8/4/09

Sample Count Start Time:	13 Apr 2009 16:34:09		
Data Capture Date:	13 Apr 2009 16:34:57		
User Filename:	S16041329-4A.WK1		
	U16041329-1A.WK1		
Spectrum Type	Log Counts		
User Number:	16		
User Id:	RN-222		
User Comment:	GREEN		
Isotope Name:	14C		
Scintillator:	LIQUID		
Sample, Rack-Pos, Time:	4	29-4	0.50
H#, Total Counts:	50.2	11972	
Start, End, X-Axis:	0	990	Channel Number

 8/4/09

General Engineering Laboratories
Calibration Source Preparation Sheet

Applicable SOP Number: GL-RAD-A-007

Isotope: Rn-222

Date Standards Prepared: 2/22/06

Cocktail Type Used: Mineral Oil Scintillato

Standard ID: 0024-A

Matrix of Vial/Planchett: 10 mL DI water
10 mL Mineral Oil

Amount Used (g or mL): 0.1

Standard Activity (DPM/g or mL): 131439.4980

Type of Scintillation Vial: glass

Reference Date: 9/10/97

Pipette ID Used: 1429303

Expiration Date: 12/15/06

Balance ID Used: N/A

Residue/Carrier Agent: N/A

Quenching Agent: N/A

	Standard Number	Quenching Vol (uL)/ Residue Volume(mL)	Initial Wt. (g)	Final Wt. (g)	Net Wt. (mg)
	c1				
	c2				
	c3				
	c4				
	c5				
	c6				
	c7				
	c8				
	c9				
	c10				
	c11				

Prepared By: Amanda L. Fehr Date: 2/22/06

Reviewed By: [illegible] Date: 3/30/06

Rev 1 RLM 9/10/97

 8/4/09

Rec'd 8-21-00

Nycomed Amersham plc
Amersham Laboratories

0299

NAMAS
CALIBRATION
No. 0146

[redacted]

ISSUED	Nycomed Amersham plc Radiation & Radioactivity Calibration Laboratory Amersham Laboratories White Lion Road Amersham Buckinghamshire HP7 9LL	ISSUED FOR:	AEA Technology plc Isotrak Amersham Laboratories White Lion Road Amersham Buckinghamshire HP7 9LL

Description Principal radionuclide: Radium-226

Product code: RAY44
Solution number: R4/131/89

Measurement Reference time: 1200 GMT on 15 December 1999

Nuclear data Nuclear data quoted on this certificate are taken from the Joint European File, Version 2.2.

Expression of uncertainties The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k = 2.00, which for a *t*-distribution with $\nu_{eff} = \infty$ effective degrees of freedom corresponds to a coverage probability of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

Unless indicated, all other uncertainties are expressed at the confidence level associated with one standard uncertainty.

The format used for the uncertainties in the values of radionuclidic purity is illustrated in the following examples;

6.5(21)	=	6.5 ± 2.1
6.54(21)	=	6.54 ± 0.21
6.543(21)	=	6.543 ± 0.021

Approved Signatory

Date of issue 17th December 1999

Nycomed Amersham

Standard Traceability Log Rad

Source Material Info	
Parent Code:	0299
Prepared By:	Angela Johnson
Carrier Conc:	0.5 M HCL
Reference Date:	12/15/1999
Ampoule Mass (g):	5.0368 g
Uncertainty:	+/- 2.5 %
LogBook No:	RC S 027 128

A Solution Material Info	
Isotope:	Radium-226
Prepared By:	Angela Johnson
Prep Date:	09/15/2000
Verification Date:	01/23/2008
Expiration Date:	01/23/2009
Primary Code:	0299-A
Dilution(mL):	100 mL
Mass of Parent(g):	4.6634 g
Density(g/mL):	1.0012
Balance ID:	

Calculations Converting parent activity to dpm/mL|dpm/g

(Mass of parent(g)) * (Parm Activity (kBq/g)) * (conversion dpm to kBq) / (Dilution Vol) = Parent Activity (dpm/mL)

(Mass of parent(g)) * (Parm Activity (kBq/g)) * (conversion dpm to kBq) / Density (g/mL)/ (Dilution Vol) = Parent Activity (dpm/g)

(4.6634 g) * (43.75 kBq/g) * (60000 dpm/kBq) / (100 mL) = 122414.2500 dpm/mL

(4.6634 g) * (43.75 kBq/g) * (60000 dpm/kBq) / (1.0012 g/mL) / (100 mL) = 122273.3377 dpm/g

Secondary Standards

Prep Date	Preparer	Mass Primary	Dilution (mL)	Code	Conc dpm/mL	Verification Date	Expiration Date
08/26/2003	Angela Johnson	1.9909	100	0299-E	2434.34 dpm/mL	11/04/2004	11/04/2005
08/26/2003	Angela Johnson	1.9872	100	0299-F	2429.82 dpm/mL	08/26/2004	08/26/2005
04/05/2005	Amanda Fehr	5.0018	250	0299-G	2446.3471 dpm/mL	04/02/2008	04/02/2009

GEL Laboratories LLC
Version 1.0 9/18/2000

 8/4/09

Verification for Ra-226 Standard 0299-G

4/2/2008 D. Roy	Isotope	Detector CPM	BKG CPM	NET CPM	Detector Eff	Standard Mass. Used (G)	Source DPM/G
	0299-G N1	2536.9600	52.4000	2484.5600	1.917186	0.5057	2562.667649
	0299-G N2	2520.2500	52.4000	2467.8500	1.917186	0.5056	2545.935781
	0299-G N3	2532.5000	52.4000	2480.1000	1.917186	0.5042	2565.677715
Mean Value (Counting) =	2558.093715		**104.944421**	**Pass**		Average =	2558.093715
Stdev =	10.63610098		0.00415782	**Rule 3 (Pass/Fail)**			

Certificate Value =	2437.6	dpm/mL
Lower Limit =	2536.821513	dpm/mL
Upper Limit =	2579.365917	dpm/mL
Rule 1 Pass/Fail	**Fail**	***exception taken due to full recovery of standard**
Two sigma =	21.27220197	dpm/mL
10 % of Mean =	255.8093715	dpm/mL
Rule 2 (Pass/Fail)	**Pass**	

Verification Rules

Rule 1 = The certificate value (NOT including any uncertainty) shall lie within the 95% confidence interval determined from the mean and two sigma standard deviation of the three measurements

Rule 2 = The two sigma value used for the 95% confidence interval shall not exceed 10% of the mean value of the three verification measurements.

Rule 3 = The determined mean value shall be within 10% of the certificate value.

The analyst prepared three standard verification sources for Ra-226 source 0299-G by transferring portions of the standard into tared glass liquid scintillation vials. One mL of DI Water and ten mLs of Ready Gel liquid scintillation cocktail was added to each vial and the vials were shaken to mix. A Blank vial was prepared in a similar fashion using 1 mL of DI water and 10 mL of Ready Gel cocktail. The standard verification vials and Background source were dark adapted for two hours and counted on LSC Gold for Radium source standard verification. The Ra-226 efficiency calibration which was used for verification calculations was performed on 4/02/08 using source 0024-A (Ra-226). Calibration data is recorded in this logbook under Ra-226 0024. Each verification source calculation was performed as follows:

Source dpm/g = (A - B)/(C)(D)

where:

A = Ver. source cpm,
B = BKG cpm,
C = System efficiency, (cpm/dpm), and
D = mass used for standard verification.

RAD SOP M-001

4/9/08

Mary Sr. Adam 4/9/08

David Roy 4/10/08

ID: TOTAL ACTIVITY

2 APR 2008 22:17

USER:11 COMMENT:GOLD

PRESET TIME :	5.00						
DATA CALC :	CPM	H#	:YES	SAMPLE REPEATS:	1	PRINTER	: STD
COUNT BLANK :	NO	IC#	: NO	REPLICATES :	1	RS232	:EDIT
TWO PHASE :	NO	AQC	: NO	CYCLE REPEATS :	1	DISK	: OFF
SCINTILLATOR:	LIQUID	LUMEX	:YES	LOW SAMPLE REJ:	0		
LOW LEVEL :	NO	HALF LIFE CORRECTION DATE:				none	

CHAN: 0.0 - 990.0 %ERROR: 2.00 FACTOR: 1.000000 BKG. SUB: 0
CHAN: 0.0 - 1000.0 %ERROR: 2.00 FACTOR: 1.000000 BKG. SUB: 0

	SAM NO	POS	TIME MIN	H#	WIND1 CPM	WIND1 %ERROR	WIND2 CPM	WIND2 %ERROR	LUMEX %	ELAPSED TIME
0024-A	1	13-1	5.00	111.9	48.60	12.86	51.60	12.48	0.89	5.59
	2	13-2	0.40	114.1	25475.00	1.98	25475.00	1.98	0.00	6.94
	3	13-3	0.40	114.3	25432.50	1.98	25432.50	1.98	0.00	8.34
	4	13-4	0.45	114.1	24786.67	1.89	24786.67	1.89	0.00	9.80
0299-G	5	13-5	5.00	112.3	52.40	12.36	54.80	12.08	0.57	15.89
	6	13-6	3.95	121.6	2536.96	2.00	2538.23	2.00	0.07	20.89
	7	13-7	4.00	120.4	2520.25	1.99	2523.00	1.99	0.05	25.97
	8	13-8	4.00	120.0	2532.50	1.99	2534.25	1.99	0.05	31.04

Sample Count Start Time:	2 Apr 2008 22:28:46		
Data Capture Date:	4/2/2008 22:34:01		
User Filename:	S11040213-5A.WK1		
	U11040213-1A.WK1		
Spectrum Type	Log Counts		
User Number:	11		
User Id:	TOTAL ACTIVITY		
User Comment:	GOLD		
Isotope Name:	14C		
Scintillator:	LIQUID		
Sample, Rack-Pos, Time:	5	13-5	5.00
H#, Total Counts:	112.3	66	
Start, End, X-Axis:	0	990	Channel Number

DM 4/10/08

LH 8/4/09

Sample Count Start Time:	2 Apr 2008 22:34:49		
Data Capture Date:	4/2/2008 22:39:04		
User Filename:	S11040213-6A.WK1		
	U11040213-1A.WK1		
Spectrum Type	Log Counts		
User Number:	11		
User Id:	TOTAL ACTIVITY		
User Comment:	GOLD		
Isotope Name:	14C		
Scintillator:	LIQUID		
Sample, Rack-Pos, Time:	6	13-6	3.95
H#, Total Counts:	121.6	7906	
Start, End, X-Axis:	0	990	Channel Number

Sample Count Start Time:	2 Apr 2008 22:39:51		
Data Capture Date:	4/2/2008 22:44:07		
User Filename:	S11040213-7A.WK1		
	U11040213-1A.WK1		
Spectrum Type	Log Counts		
User Number:	11		
User Id:	TOTAL ACTIVITY		
User Comment:	GOLD		
Isotope Name:	14C		
Scintillator:	LIQUID		
Sample, Rack-Pos, Time:	7	13-7	4.00
H#, Total Counts:	120.4	7901	
Start, End, X-Axis:	0	990	Channel Number

4/10/08

8/4/09

Sample Count Start Time:	2 Apr 2008 22:44:55		
Data Capture Date:	4/2/2008 22:49:12		
User Filename:	S11040213-8A.WK1		
	U11040213-1A.WK1		
Spectrum Type	Log Counts		
User Number:	11		
User Id:	TOTAL ACTIVITY		
User Comment:	GOLD		
Isotope Name:	14C		
Scintillator:	LIQUID		
Sample, Rack-Pos, Time:	8	13-8	4.00
H#, Total Counts:	120.0	7908	
Start, End, X-Axis:	0	990	Channel Number

General Engineering Laboratories
Verification Source Preparation Sheet

Applicable SOP Number: GL-RAD-A-007

Isotope: Rn222

Date Standards Prepared: 2/22/06

Cocktail Type Used: Mineral Oil Scintilator

Standard ID: 0299-G

Matrix of Vial/Planchett: 10 mL DI water
10 mL Mineral Oil

Amount Used (g or mL): ~~0.5~~ 0.1

Standard Activity (DPM/g or mL): 2446.3471

Type of Scintillation Vial: glass

Reference Date: 12/15/99

Pipette ID Used: 3158763

Expiration Date: 12/15/06

Balance ID Used: N/A

Residue/Carrier Agent: N/A

Quenching Agent: N/A

	Standard Number	Quenching Vol (uL)/ Residue Volume(mL)	Initial Wt. (g)	Final Wt. (g)	Net Wt. (mg)
	1				
	2				
	3				
	4				
	5				
	6				
	7				
	8				
	9				
	10				
	11				

Prepared By: Amanda L. Fehr Date: 2/22/06

Reviewed By: [illegible] Date: 3/30/06

Rev 1 RLM 9/10/97

[illegible] 3/4/09

GEL Laboratories
2040 Savage Road, Charleston, SC 29407
(843)556-8171

Liquid Scintillation Counter Calibration Package

Method: Rn-222

Instrument Color Code: Green

	Included/ Acceptable	Comments
Part 1: Efficiency determination		
1 Efficiency spreadsheet (eff pts, graph, trendline equation)	✓	
2 Verification Spreadsheet (recoveries 90%-110%)	✓	
3 Applicable portion of Machines.XLS	✓	
4 Raw Data and spectra	✓	
5 Window, Low Level and Lumex settings	✓	
Part 2. Documentation for Calibration Source		
1 Vendor Certificate	✓	
2 Standard Traceability Log (from LIMS)	✓	
3 Verification of Source	✓	
4 Source preparation sheet	✓	
5 Efficiency standard precision check		NA
Part 3. Documentation for Verification Source		
1 Vendor Certificate	✓	
2 Standard Traceability Log (from LIMS)	✓	
3 Verification of Source	✓	
4 Source preparation sheet	✓	
5 Efficiency standard precision check		NA
Part 4. Enter into LIMS		
1 Alpha LIMS instrument calibration updated	✓	

Primary Review of Package L Linch

Secondary Review of Package [illegible]

Effective Date: 10/12/09

Rev 7 SSC 8/3/09

Radon 222 Calibration

Instrument	Green

Standard Information from prep sheet	
Isotope	Ra-226
Serial Number	0024-A
Isotope Halflife (days)	584400
Reference Date	9/10/1997
Ref. Act. (DPM/mL)	131439.80
Amount of Std. (mL)	0.1

Std #	Start Count Time	Quench Number	RAW CPM	BKG	RAW CPM-BKG	Nominal DPM	EFF.
1	10/10/09 4:22	57.90	47024.00	10.87	47013.13	13075.35867	3.59555
2	10/10/09 4:23	58.90	47980.00	10.87	47969.13	13075.35866	3.66867
3	10/10/09 4:24	58.60	46192.00	10.87	46181.13	13075.35864	3.53192
4	10/10/09 4:26	57.60	45868.00	10.87	45857.13	13075.35863	3.50714
5	10/10/09 4:27	60.10	47952.00	10.87	47941.13	13075.35862	3.66653
6	10/10/09 4:28	59.30	44980.00	10.87	44969.13	13075.3586	3.43923
7	10/10/09 4:30	57.00	44196.00	10.87	44185.13	13075.35859	3.37927
8	10/10/09 4:31	58.30	45140.00	10.87	45129.13	13075.35857	3.45146
9	10/10/09 4:32	58.60	47596.00	10.87	47585.13	13075.35856	3.63930
10	10/10/09 4:34	58.00	44972.00	10.87	44961.13	13075.35854	3.43862
11	10/10/09 4:35	57.40	44808.00	10.87	44797.13	13075.35853	3.42607

Copy into Machines.xls	
Cal Date	08/03/09
Min H#	0.0
Max H#	0.0
A0	3.52215913E+00
A1	0.00000000E+00
A2	0.00000000E+00
A3	0.00000000E+00
A4	0
A5	0
Geometry	MINERAL OIL/10ML SAMPLE
Exp Date	08/31/10
Low Level	y
Eff Error	0.007920
Window1 LL	600
Window1 UL	875
Window2 LL	0
Window2 UL	1000

Radon 222 Verification

Standard Information from prep sheet	
Isotope	Ra-226
Serial Number	0299-G
Isotope Halflife (days)	584400
Reference Date	12/15/1999
Ref. Act. (DPM/mL)	2446.35
Amount of Std. (mL)	0.1

Std #	Start Count Time	Quench Number	Raw CPM	BKG	BKG Corrected CPM	Calculated EFF.	Standard DPM	Measured DPM	Recovery %
1	10/10/09 4:53	60.00	938.60	10.87	927.73	3.5222	243.60	263.40	108.13%
2	10/10/09 5:05	60.30	937.10	10.87	926.23	3.5222	243.60	262.97	107.95%
3	10/10/09 5:17	59.40	939.25	10.87	928.38	3.5222	243.60	263.58	108.20%
4	10/10/09 5:29	59.30	926.85	10.87	915.98	3.5222	243.60	260.06	106.76%
5	10/10/09 5:40	58.10	946.04	10.87	935.17	3.5222	243.60	265.51	109.00%
6	10/10/09 5:52	58.30	914.61	10.87	903.74	3.5222	243.60	256.59	105.33%
7	10/10/09 6:04	57.90	926.57	10.87	915.70	3.5222	243.60	259.98	106.73%
8	10/10/09 6:16	58.40	914.70	10.87	903.83	3.5222	243.60	256.61	105.34%
9	10/10/09 6:29	58.20	929.54	10.87	918.67	3.5222	243.60	260.83	107.07%
10	10/10/09 6:41	59.80	895.00	10.87	884.13	3.5222	243.60	251.02	103.05%

	Calibration Coeffs
a0	3.52215913E+00
a1	0.00000000E+00
a2	0.00000000E+00
a3	0.00000000E+00

LH 10/12/09

Green	Rn-222
Cal Date	10/10/09
Min H#	0.0
Max H#	0.0
A0	3.52215913E+00
A1	0.00000000E+00
A2	0.00000000E+00
A3	0.00000000E+00
A4	0
A5	0
Geometry	10ML MINERAL OIL/10ML SAMPLE
Exp Date	10/31/10
Low Level	y
Eff Error	0.007920
Window1 LL	600
Window1 UL	875
Window2 LL	0
Window2 UL	1000

Khidr12/09

ID:RN222 DONTUSE 10 OCT 2009 04:36

USER:16 COMMENT:GREEN

PRESET TIME :	15.00						
DATA CALC :	CPM	H#	:YES	SAMPLE REPEATS:	1	PRINTER	:EDIT
COUNT BLANK :	NO	IC#	: NO	REPLICATES :	1	RS232	:EDIT
TWO PHASE :	NO	AQC	: NO	CYCLE REPEATS :	1	DISK	: OFF
SCINTILLATOR:	LIQUID	LUMEX	: NO	LOW SAMPLE REJ:	0	RWM LIST	: OFF
LOW LEVEL :	YES	HALF LIFE CORRECTION DATE:				none	

CHAN: 600.0 - 875.0 %ERROR: 2.00 FACTOR: 1.000000 BKG. SUB: 0
CHAN: 300.0 - 900.0 %ERROR: 2.00 FACTOR: 1.000000 BKG. SUB: 0

ALPHA-BETA DISCRIMINATION: NO

SAM NO	POS	TIME MIN	H#	WIND1 CPM	WIND1 %ERROR	WIND2 CPM	WIND2 %ERROR	LUMEX %	ELAPSED TIME
1	23-1	0.25	57.9	47024.00	1.84	52056.00	1.75	0.00	0.85
2	23-2	0.25	58.9	47980.00	1.83	53160.00	1.73	0.00	2.18
3	23-3	0.25	58.6	46192.00	1.86	51012.00	1.77	0.00	3.52
4	23-4	0.25	57.6	45868.00	1.87	50848.00	1.77	0.00	4.88
5	23-5	0.25	60.1	47952.00	1.83	52924.00	1.74	0.00	6.22
6	23-6	0.25	59.3	44980.00	1.89	49852.00	1.79	0.00	7.56
7	23-7	0.25	57.0	44196.00	1.90	48852.00	1.81	0.00	8.92
8	23-8	0.25	58.3	45140.00	1.88	49952.00	1.79	0.00	10.25
9	23-9	0.25	58.6	47596.00	1.83	52516.00	1.75	0.00	11.59
10	23-10	0.25	58.0	44972.00	1.89	49820.00	1.79	0.00	12.92
11	23-11	0.25	57.4	44808.00	1.89	49796.00	1.79	0.00	14.30
12	23-12	15.00	58.6	10.87	15.67	21.93	11.03	0.21	30.50
MISSING SAMPLE									
15	57-3	10.70	60.0	938.60	2.00	1055.33	1.88	0.00	42.45
16	57-4	10.70	60.3	937.10	2.00	1048.79	1.89	0.01	54.43
17	57-5	10.65	59.4	939.25	2.00	1056.81	1.89	0.01	66.24
18	57-6	10.80	59.3	926.85	2.00	1035.46	1.89	0.01	78.20
19	57-7	10.60	58.1	946.04	2.00	1052.36	1.89	0.01	89.97
20	57-8	10.95	58.3	914.61	2.00	1023.11	1.89	0.01	102.10
21	57-9	10.80	57.9	926.57	2.00	1033.89	1.89	0.01	114.07
22	57-10	10.95	58.4	914.70	2.00	1019.18	1.89	0.01	126.28
23	57-11	10.80	58.2	929.54	2.00	1038.52	1.89	0.01	138.25
24	57-12	11.20	59.8	895.00	2.00	1003.75	1.89	0.01	150.73

Lhaichop

Sample Count Start Time:	10 Oct 2009 04:22:13		
Data Capture Date	10 Oct 2009 04:22:47		
User Filename	S16101023-1A.XLS		
	U16101023-1A.XLS		
Spectrum Type	Log Counts		
User Number	16		
User Id	RN222 DONTUSE		
User Comment	GREEN		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	1	23-1	0.25
H#, Total Counts:	57.9	13383	
ISO1 - Start, End, Counts:	0	990	13383
ISO2 - Start, End, Counts:	0	990	13383

L Wolizka

Sample Count Start Time:	10 Oct 2009 04:23:33		
Data Capture Date	10 Oct 2009 04:24:08		
User Filename	S16101023-2A.XLS		
	U16101023-1A.XLS		
Spectrum Type	Log Counts		
User Number	16		
User Id	RN222 DONTUSE		
User Comment	GREEN		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	2	23-2	0.25
H#, Total Counts:	58.9	13689	
ISO1 - Start, End, Counts:	0	990	13689
ISO2 - Start, End, Counts:	0	990	13689

LL 10/12/09

Sample Count Start Time:	10 Oct 2009 04:24:53		
Data Capture Date	10 Oct 2009 04:25:28		
User Filename	S16101023-3A.XLS		
	U16101023-1A.XLS		
Spectrum Type	Log Counts		
User Number	16		
User Id	RN222 DONTUSE		
User Comment	GREEN		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	3	23-3	0.25
H#, Total Counts:	58.6	13142	
ISO1 - Start, End, Counts:	0	990	13142
ISO2 - Start, End, Counts:	0	990	13142

10/12/09

Sample Count Start Time:	10 Oct 2009 04:26:15		
Data Capture Date	10 Oct 2009 04:26:49		
User Filename	S16101023-4A.XLS		
	U16101023-1A.XLS		
Spectrum Type	Log Counts		
User Number	16		
User Id	RN222 DONTUSE		
User Comment	GREEN		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	4	23-4	0.25
H#, Total Counts:	57.6	13056	
ISO1 - Start, End, Counts:	0	990	13056
ISO2 - Start, End, Counts:	0	990	13056

LL 10/12/09

Sample Count Start Time:	10 Oct 2009 04:27:35		
Data Capture Date	10 Oct 2009 04:28:10		
User Filename	S16101023-5A.XLS		
	U16101023-1A.XLS		
Spectrum Type	Log Counts		
User Number	16		
User Id	RN222 DONTUSE		
User Comment	GREEN		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	5	23-5	0.25
H#, Total Counts:	60.1	13659	
ISO1 - Start, End, Counts:	0	990	13659
ISO2 - Start, End, Counts:	0	990	13659

10/12/09

Sample Count Start Time:	10 Oct 2009 04:28:56		
Data Capture Date	10 Oct 2009 04:29:31		
User Filename	S16101023-6A.XLS		
	U16101023-1A.XLS		
Spectrum Type	Log Counts		
User Number	16		
User Id	RN222 DONTUSE		
User Comment	GREEN		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	6	23-6	0.25
H#, Total Counts:	59.3	12833	
ISO1 - Start, End, Counts:	0	990	12833
ISO2 - Start, End, Counts:	0	990	12833

10/12/09

Sample Count Start Time:	10 Oct 2009 04:30:17		
Data Capture Date	10 Oct 2009 04:30:52		
User Filename	S16101023-7A.XLS		
	U16101023-1A.XLS		
Spectrum Type	Log Counts		
User Number	16		
User Id	RN222 DONTUSE		
User Comment	GREEN		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	7	23-7	0.25
H#, Total Counts:	57.0	12580	
ISO1 - Start, End, Counts:	0	990	12580
ISO2 - Start, End, Counts:	0	990	12580

LL 10/2/09

Sample Count Start Time:	10 Oct 2009 04:31:37		
Data Capture Date	10 Oct 2009 04:32:12		
User Filename	S16101023-8A.XLS		
	U16101023-1A.XLS		
Spectrum Type	Log Counts		
User Number	16		
User Id	RN222 DONTUSE		
User Comment	GREEN		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	8	23-8	0.25
H#, Total Counts:	58.3	12845	
ISO1 - Start, End, Counts:	0	990	12845
ISO2 - Start, End, Counts:	0	990	12845

10/12/09

Sample Count Start Time:	10 Oct 2009 04:32:57		
Data Capture Date	10 Oct 2009 04:33:32		
User Filename	S16101023-9A.XLS		
	U16101023-1A.XLS		
Spectrum Type	Log Counts		
User Number	16		
User Id	RN222 DONTUSE		
User Comment	GREEN		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	9	23-9	0.25
H#, Total Counts:	58.6	13524	
ISO1 - Start, End, Counts:	0	990	13524
ISO2 - Start, End, Counts:	0	990	13524

Lh 10/12/09

Sample Count Start Time:	10 Oct 2009 04:34:17		
Data Capture Date	10 Oct 2009 04:34:51		
User Filename	S16101023-10A.XLS		
	U16101023-1A.XLS		
Spectrum Type	Log Counts		
User Number	16		
User Id	RN222 DONTUSE		
User Comment	GREEN		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	10	23-10	0.25
H#, Total Counts:	58.0	12783	
ISO1 - Start, End, Counts:	0	990	12783
ISO2 - Start, End, Counts:	0	990	12783

LMid12/09

Sample Count Start Time:	10 Oct 2009 04:35:40		
Data Capture Date	10 Oct 2009 04:36:15		
User Filename	S16101023-11A.XLS		
	U16101023-1A.XLS		
Spectrum Type	Log Counts		
User Number	16		
User Id	RN222 DONTUSE		
User Comment	GREEN		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	11	23-11	0.25
H#, Total Counts:	57.4	12854	
ISO1 - Start, End, Counts:	0	990	12854
ISO2 - Start, End, Counts:	0	990	12854

10/12/09

Sample Count Start Time:	10 Oct 2009 04:37:07		
Data Capture Date	10 Oct 2009 04:52:24		
User Filename	S16101023-12A.XLS		
	U16101023-1A.XLS		
Spectrum Type	Log Counts		
User Number	16		
User Id	RN222 DONTUSE		
User Comment	GREEN		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	12	23-12	15.00
H#, Total Counts:	58.6	444	
ISO1 - Start, End, Counts:	0	990	444
ISO2 - Start, End, Counts:	0	990	444

LHio/12/09

Sample Count Start Time:	10 Oct 2009 04:53:22		
Data Capture Date	10 Oct 2009 05:04:24		
User Filename	S16101057-3A.XLS		
	U16101023-1A.XLS		
Spectrum Type	Log Counts		
User Number	16		
User Id	RN222 DONTUSE		
User Comment	GREEN		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	15	57-3	10.70
H#, Total Counts:	60.0	11739	
ISO1 - Start, End, Counts:	0	990	11739
ISO2 - Start, End, Counts:	0	990	11739

LL.10/20/09

Sample Count Start Time:	10 Oct 2009 05:05:21		
Data Capture Date	10 Oct 2009 05:16:22		
User Filename	S16101057-4A.XLS		
	U16101023-1A.XLS		
Spectrum Type	Log Counts		
User Number	16		
User Id	RN222 DONTUSE		
User Comment	GREEN		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	16	57-4	10.70
H#, Total Counts:	60.3	11633	
ISO1 - Start, End, Counts:	0	990	11633
ISO2 - Start, End, Counts:	0	990	11633

LL 10/26/09

Sample Count Start Time:	10 Oct 2009 05:17:12		
Data Capture Date	10 Oct 2009 05:28:11		
User Filename	S16101057-5A.XLS		
	U16101023-1A.XLS		
Spectrum Type	Log Counts		
User Number	16		
User Id	RN222 DONTUSE		
User Comment	GREEN		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	17	57-5	10.65
H#, Total Counts:	59.4	11655	
ISO1 - Start, End, Counts:	0	990	11655
ISO2 - Start, End, Counts:	0	990	11655

Lhio12b9

Sample Count Start Time:	10 Oct 2009 05:29:01		
Data Capture Date	10 Oct 2009 05:40:08		
User Filename	S16101057-6A.XLS		
	U16101023-1A.XLS		
Spectrum Type	Log Counts		
User Number	16		
User Id	RN222 DONTUSE		
User Comment	GREEN		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	18	57-6	10.80
H#, Total Counts:	59.3	11584	
ISO1 - Start, End, Counts:	0	990	11584
ISO2 - Start, End, Counts:	0	990	11584

LL 01/26/09

Sample Count Start Time:	10 Oct 2009 05:40:59		
Data Capture Date	10 Oct 2009 05:51:55		
User Filename	S16101057-7A.XLS		
	U16101023-1A.XLS		
Spectrum Type	Log Counts		
User Number	16		
User Id	RN222 DONTUSE		
User Comment	GREEN		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	19	57-7	10.60
H#, Total Counts:	58.1	11520	
ISO1 - Start, End, Counts:	0	990	11520
ISO2 - Start, End, Counts:	0	990	11520

LL 10/12/09

Sample Count Start Time:	10 Oct 2009 05:52:46		
Data Capture Date	10 Oct 2009 06:04:02		
User Filename	S16101057-8A.XLS		
	U16101023-1A.XLS		
Spectrum Type	Log Counts		
User Number	16		
User Id	RN222 DONTUSE		
User Comment	GREEN		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	20	57-8	10.95
H#, Total Counts:	58.3	11621	
ISO1 - Start, End, Counts:	0	990	11621
ISO2 - Start, End, Counts:	0	990	11621

LH 10/12/09

Sample Count Start Time:	10 Oct 2009 06:04:53		
Data Capture Date	10 Oct 2009 06:16:00		
User Filename	S16101057-9A.XLS		
	U16101023-1A.XLS		
Spectrum Type	Log Counts		
User Number	16		
User Id	RN222 DONTUSE		
User Comment	GREEN		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	21	57-9	10.80
H#, Total Counts:	57.9	11534	
ISO1 - Start, End, Counts:	0	990	11534
ISO2 - Start, End, Counts:	0	990	11534

Lhio12b9

Sample Count Start Time:	10 Oct 2009 06:16:57		
Data Capture Date	10 Oct 2009 06:28:14		
User Filename	S16101057-10A.XLS		
	U16101023-1A.XLS		
Spectrum Type	Log Counts		
User Number	16		
User Id	RN222 DONTUSE		
User Comment	GREEN		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	22	57-10	10.95
H#, Total Counts:	58.4	11561	
ISO1 - Start, End, Counts:	0	990	11561
ISO2 - Start, End, Counts:	0	990	11561

10/12/09

Sample Count Start Time:	10 Oct 2009 06:29:04		
Data Capture Date	10 Oct 2009 06:40:12		
User Filename	S16101057-11A.XLS		
	U16101023-1A.XLS		
Spectrum Type	Log Counts		
User Number	16		
User Id	RN222 DONTUSE		
User Comment	GREEN		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	23	57-11	10.80
H#, Total Counts:	58.2	11615	
ISO1 - Start, End, Counts:	0	990	11615
ISO2 - Start, End, Counts:	0	990	11615

10/12/09

Sample Count Start Time:	10 Oct 2009 06:41:09		
Data Capture Date	10 Oct 2009 06:52:41		
User Filename	S16101057-12A.XLS		
	U16101023-1A.XLS		
Spectrum Type	Log Counts		
User Number	16		
User Id	RN222 DONTUSE		
User Comment	GREEN		
Isotope Name	14C		
Scintillator	LIQUID		
Sample, Rack-Pos, Time:	24	57-12	11.20
H#, Total Counts:	59.8	11642	
ISO1 - Start, End, Counts:	0	990	11642
ISO2 - Start, End, Counts:	0	990	11642

10/12/09

Amersham International plc
Amersham Laboratories

0024

[redacted]

NAMAS
CALIBRATION
No 0146

[redacted]

Description	Principal radionuclide:	Radium-226	Product code: RAY.44
			Solution number: R4/131/58
Measurement	Reference time:	1200 GMT on 10 September 1997	
	Radioactive concentration of radium-226:	43.85	kilobecquerels per gram of solution
	which is equivalent to:	1.185	microcuries per gram of solution
	Mass of solution:	5.0357	grams
	Total activity of radium-226:	220.8	kilobecquerels
	which is equivalent to:	5.968	microcuries
	Recommended half life:	1600.00	years

Method of measurement:
The activity of the solution was measured in a high pressure re-entrant ionisation chamber calibrated with a large number of absolutely standardised solutions.

Accuracy

Overall uncertainty in the radioactive concentration quoted above: ± 3.7 %

Random uncertainty: ± 0.7 % Systematic uncertainty: ± 3.0 %

The limits of overall uncertainty were taken as the arithmetic sum of the uncertainty due to random variations, calculated at the 99.7% confidence level, and the estimated systematic uncertainties in the measurement.

Radionuclidic Purity

The estimated activities of any radioactive impurities found by high-resolution gamma ray spectrometry, or in any other examination of the solution, are listed below expressed as percentages of the activity of the principal radionuclide at the reference time.

Chemical Composition.

Carrier free in 0.5M HCl

Remarks

At the reference date radium-226 was shown to be in radioactive equilibrium with its daughter nuclides down the decay chain to polonium-214 and thallium-210, the precursors of lead-210. The ionisation chamber was calibrated using a standard supplied by the National Institute of Standards and Technology, Washington DC, USA.

This product meets the quality assurance requirements of the NRC Regulatory Guide 4.15 for achieving implicit NIST traceability as defined in NCRP 58 (1985).

RC-S-021-097

Approved Signatory

Lhio 12/99

Standard Traceability Log Rad

Source Material Info	
Parent Code:	0024
Prepared By:	Richard Kinney
Carrier Conc:	0.5 M HCL
Reference Date:	09/10/1997
Ampoule Mass (g):	5.0357 g
Uncertainty:	+/- 3.7 %
LogBook No:	RC S 021 097

A Solution Material Info	
Isotope:	Radium-226
Prepared By:	Angela Johnson
Prep Date:	01/22/1999
Verification Date:	01/23/2008
Expiration Date:	04/09/2010
Primary Code:	0024-A
Dilution(mL):	100 mL
Mass of Parent(g):	4.9958 g
Density(g/mL):	1.0044
Balance ID:	38080204

Calculations Converting parent activity to dpm/mL|dpm/g

(Mass of parent(g)) * (Parm Activity (kBq/g)) * (conversion dpm to kBq) / (Dilution Vol) = Parent Activity (dpm/mL)
(Mass of parent(g)) * (Parm Activity (kBq/g)) * (conversion dpm to kBq) / Density (g/mL)/ (Dilution Vol) = Parent Activity (dpm/g)
(4.9958 g) * (43.85 kBq/g) * (60000 dpm/kBq) / (100 mL) = 131439.4980 dpm/mL
(4.9958 g) * (43.85 kBq/g) * (60000 dpm/kBq) / (1.0044 g/mL) / (100 mL) = 130865.9326 dpm/g

Secondary Standards

Prep Date	Preparer	Mass Primary	Dilution (mL)	Code	Conc dpm/mL	Verification Date	Expiration Date
03/02/2000	Angela Johnson	10.5724	100	0024-D	13834.1 dpm/mL	02/10/2005	02/10/2006
08/23/2002	Angela Johnson	8.0371	100	0024-G	10516.626 dpm/mL	02/10/2004	02/10/2005

GEL Laboratories LLC
Version 1.0 9/18/2000

Verification for Ra-226 Standard 0024-A 09

M. Aders	**Isotope**	**Value**	**Uncertainty**
4/13/2009	0024-A	5930.765	106.9965
	0024-A	5563.022	98.7976
	0024-A	5699.674	104.7832
Mean Value (Counting) =	5731.153	97.29	**Pass**
Stdev =	185.8813485		**Rule 3 (Pass/Fail)**
Target =	5891.04		
Lower Limit =	5359.390736		
Upper Limit =	6102.91613		
Rule 1 Pass/Fail	**Pass**		
Two sigma =	371.762697		
10 % of Mean =	573.1153433		
Rule 2 (Pass/Fail)	**Pass**		

Rule 1 = The certificate value (NOT including any uncertainty) shall lie within the 95% confidence interval determined from the mean and two sigma standard deviation of the three measurements
Rule 2 = The two sigma value used for the 95% confidence interval shall not exceed 10% of the mean value of the three verification measurements.
Rule 3 = The determined mean value shall be within 5% of the certificate value.

The analyst prepared three standard verification sources for Ra-226 source 0024-A by transferring portions of the degassed standard into tared glass liquid scintillation vials. Ten mL of DI Water and 10 mL mineral oil was added to each vial and the vials were shaken to mix. A Blank vial was prepared in a similar fashion using 10 mL of DI water and 10 mL of mineral oil. The standard verification vials and Background source were dark adapted for two hours and counted on LSC Green using source standard verification. Each verification source calculation was performed as follows:

Source dpm/g = (A - B)/(C)(D)

where:

A = Ver. source cpm,
B = BKG cpm,
C = System efficiency, (cpm/dpm), and
D = mass used for standard verification.

Reference RAD SOP M-001

General Engineering Laboratories
Calibration Source Preparation Sheet

Applicable SOP Number: GL-RAD-A-007

Isotope: Rn-222

Date Standards Prepared: 2/22/06

Cocktail Type Used: Mineral Oil Scintillato

Standard ID: 0024-A

Matrix of Vial/Planchett: 10 mL DI water
10 mL Mineral Oil

Amount Used (g or (ml)): 0.1

Standard Activity (DPM/g or (ml)): 131439.4980

Type of Scintillation Vial: glass

Reference Date: 9/10/97

Pipette ID Used: 1429303

Expiration Date: 12/15/06

Balance ID Used: N/A

Residue/Carrier Agent: N/A

Quenching Agent: N/A

	Standard Number	Quenching Vol (uL)/ Residue Volume(mL)	Initial Wt. (g)	Final Wt. (g)	Net Wt. (mg)
	c1				
	c2				
	c3				
	c4				
	c5				
	c6				
	c7				
	c8				
	c9				
	c10				
	c11				

3/2/06

Prepared By: Amanda L. Fehr Date: 2/22/06

Reviewed By: [illegible] Date: 3/30/06

Rev 1 RLM 9/10/97

10/12/09

Rec'd 8-21-00

Nycomed Amersham plc
Amersham Laboratories

0299

[redacted]

NAMAS
CALIBRATION
No. 0146

[redacted]

ISSUED BY:	Nycomed Amersham plc Radiation & Radioactivity Calibration Laboratory Amersham Laboratories White Lion Road Amersham Buckinghamshire HP7 9LL	ISSUED FOR:	AEA Technology plc Isotrak Amersham Laboratories White Lion Road Amersham Buckinghamshire HP7 9LL

Description Principal radionuclide: Radium-226

Product code: RAY44
Solution number: R4/131/89

Measurement Reference time: 1200 GMT on 15 December 1999

Nuclear data Nuclear data quoted on this certificate are taken from the Joint European File, Version 2.2.

Expression of uncertainties The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k = 2.00, which for a *t*-distribution with $\nu_{eff} = \infty$ effective degrees of freedom corresponds to a coverage probability of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

Unless indicated, all other uncertainties are expressed at the confidence level associated with one standard uncertainty.

The format used for the uncertainties in the values of radionuclidic purity is illustrated in the following examples;

6.5(21)	=	6.5 ± 2.1
6.54(21)	=	6.54 ± 0.21
6.543(21)	=	6.543 ± 0.021

Approved Signatory

Date of issue 17th December 1999

Nycomed Amersham

Standard Traceability Log Rad

Source Material Info	
Parent Code:	0299
Prepared By:	Angela Johnson
Carrier Conc:	0.5 M HCL
Reference Date:	12/15/1999
Ampoule Mass (g):	5.0368 g
Uncertainty:	+/- 2.5 %
LogBook No:	RC S 027 128

A Solution Material Info	
Isotope:	Radium-226
Prepared By:	Angela Johnson
Prep Date:	09/15/2000
Verification Date:	01/23/2008
Expiration Date:	01/23/2009
Primary Code:	0299-A
Dilution(mL):	100 mL
Mass of Parent(g):	4.6634 g
Density(g/mL):	1.0012
Balance ID:	

Calculations Converting parent activity to dpm/mL|dpm/g

(Mass of parent(g)) * (Parm Activity (kBq/g)) * (conversion dpm to kBq) / (Dilution Vol) = Parent Activity (dpm/mL)
(Mass of parent(g)) * (Parm Activity (kBq/g)) * (conversion dpm to kBq) / Density (g/mL)/ (Dilution Vol) = Parent Activity (dpm/g)
(4.6634 g) * (43.75 kBq/g) * (60000 dpm/kBq) / (100 mL) = 122414.2500 dpm/mL
(4.6634 g) * (43.75 kBq/g) * (60000 dpm/kBq) / (1.0012 g/mL) / (100 mL) = 122273.3377 dpm/g

Secondary Standards

Prep Date	Preparer	Mass Primary	Dilution (mL)	Code	Conc dpm/mL	Verification Date	Expiration Date
08/26/2003	Angela Johnson	1.9909	100	0299-E	2434.34 dpm/mL	11/04/2004	11/04/2005
08/26/2003	Angela Johnson	1.9872	100	0299-F	2429.82 dpm/mL	08/26/2004	08/26/2005
04/05/2005	Amanda Fehr	5.0018	250	0299-G	2446.3471 dpm/mL	04/02/2008	04/02/2009

GEL Laboratories LLC
Version 1.0 9/18/2000

Rhio/12/09

Verification for Ra-226 Standard 0299-G

4/2/2008	Isotope	Detector CPM	BKG CPM	NET CPM	Detector Eff	Standard Mass. Used (G)	Source DPM/G
D. Roy	0299-G N1	2536.9600	52.4000	2484.5600	1.917186	0.5057	2562.667649
	0299-G N2	2520.2500	52.4000	2467.8500	1.917186	0.5056	2545.935781
	0299-G N3	2532.5000	52.4000	2480.1000	1.917186	0.5042	2565.677715
						Average =	2558.093715
Mean Value (Counting) =	2558.093715		**104.944421**	**Pass**			
Stdev =	10.63610098		0.00415782	**Rule 3 (Pass/Fail)**			

Certificate Value =	2437.6	dpm/mL
Lower Limit =	2536.821513	dpm/mL
Upper Limit =	2579.365917	dpm/mL
Rule 1 Pass/Fail	**Fail**	***exception taken due to full recovery of standard**
Two sigma =	21.27220197	dpm/mL
10 % of Mean =	255.8093715	dpm/mL
Rule 2 (Pass/Fail)	**Pass**	

Verification Rules

Rule 1 = The certificate value (NOT including any uncertainty) shall lie within the 95% confidence interval determined from the mean and two sigma standard deviation of the three measurements

Rule 2 = The two sigma value used for the 95% confidence interval shall not exceed 10% of the mean value of the three verification measurements.

Rule 3 = The determined mean value shall be within 10% of the certificate value.

The analyst prepared three standard verification sources for Ra-226 source 0299-G by transferring portions of the standard into tared glass liquid scintillation vials. One mL of DI Water and ten mLs of Ready Gel liquid scintillation cocktail was added to each vial and the vials were shaken to mix. A Blank vial was prepared in a similar fashion using 1 mL of DI water and 10 mL of Ready Gel cocktail. The standard verification vials and Background source were dark adapted for two hours and counted on LSC Gold for Radium source standard verification. The Ra-226 efficiency calibration which was used for verification calculations was performed on 4/02/08 using source 0024-A (Ra-226). Calibration data is recorded in this logbook under Ra-226 0024. Each verification source calculation was performed as follows:

Source dpm/g = (A - B)/(C)(D)

where:

A = Ver. source cpm,
B = BKG cpm,
C = System efficiency, (cpm/dpm), and
D = mass used for standard verification.

RAD SOP M-001

4/10/09

4/10/08

General Engineering Laboratories
Verification Source Preparation Sheet

Applicable SOP Number: GL-RAD-A-007

Isotope: Rn222

Date Standards Prepared: 2/22/06

Cocktail Type Used: Mineral Oil Scintilator

Standard ID: 0299-G

Matrix of Vial/Planchett: 10 mL DI water
10 mL Mineral Oil

Amount Used (g or mL): ~~0.5~~ 0.1

Standard Activity (DPM/g or mL): 2446.3471

Type of Scintillation Vial: glass

Reference Date: 12/15/99

Pipette ID Used: 3158763

Expiration Date: 12/15/06

Balance ID Used: N/A

Residue/Carrier Agent: N/A

Quenching Agent: N/A

	Standard Number	Quenching Vol (uL)/ Residue Volume(mL)	Initial Wt. (g)	Final Wt. (g)	Net Wt. (mg)
	1				
	2				
	3				
	4				
	5				
	6				
	7				
	8				
	9				
	10				
	11				

Prepared By: Amanda L. Lehr Date: 2/22/06

Reviewed By: [illegible] Date: 3/3/06

Rev 1 RLM 9/10/97

[illegible] 10/12/09

Continuing Calibration Data

Liquid Scintillation Counter Checks for 9-JUL-2010

Short Name	Parmname	Run Time	Count Time	Counts	CPM	Stdev	Status	Comments
LSCBLUE	Carbon-14	02:45	.95		42149	0.54		
	Carbon-14	02:47	1		42015	-0.19		
	Tritium	02:48	.85		61648	-1.5		
	Tritium	02:49	.85		61871	-1.1		
	BKG	02:51	30		21	-1.2		
	BKG	03:22	30		21	-0.54		
LSCBROWN	Carbon-14	04:10	1		42173	-0.5		
	Carbon-14	04:11	.95		42310	0.14		
	Tritium	04:13	.85		61712	-1.6		
	Tritium	04:15	.85		61990	-0.61		
	BKG	04:17	30		23	0.78		
	BKG	04:48	30		23	-0.23		
LSCGOLD	Carbon-14	02:51	.95		42983	-1.5		
	Carbon-14	02:52	.95		43101	-1		
	Tritium	02:54	.75		83128	-2		
	Tritium	02:55	.75		82624	-2.9		
	BKG	02:57	30		21	1.1		
	BKG	03:27	30		18	-2.2		
LSCGREEN	Carbon-14	02:51	.95		42131	-0.05		
	Carbon-14	02:52	.95		42223	0.41		
	Tritium	02:54	.9		58282	-2.9		
	Tritium	02:55	.9		58851	-1.2		
	BKG	02:57	30		20	-0.21		
	BKG	03:28	30		23	2.86		
LSCORANGE	Carbon-14	13:42	1.01245		98701	1.17		
	Tritium	13:46	1.012333		132129	0.31		
	BKG	14:18	30.01243		11	-0.6		
	Carbon-14	14:20	1.012433		98363	0.21		
	Tritium	14:21	1.012433		131919	-0.2		
	BKG	14:52	30.01243		12	1.09		
LSCPINK	Carbon-14	01:37	1.012433		93542	-0.21		
	Tritium	01:40	1.012433		55568	-0.04		

	BKG	02:13	30.01243	7.25	-0.34	
	Carbon-14	02:14	1.012433	93476	-0.38	
	Tritium	02:16	1.012433	55022	-0.62	
	BKG	02:46	30.01243	7.55	0.11	
	Carbon-14	11:43	1.012433	92966	-1.7	
	Tritium	11:46	1.012333	55447	-0.17	
	BKG	12:19	30.01243	7.12	-0.54	
	Carbon-14	12:20	1.012433	93437	-0.48	
	Tritium	12:22	1.012433	54601	-1.1	
	BKG	12:52	30.01243	8.13	1	
	Carbon-14	13:16	1.012433	93629	0.02	
	Tritium	13:19	1.012433	56048	0.46	
	BKG	13:52	30.01243	7.59	0.18	
	Carbon-14	13:53	1.012433	93500	-0.32	
	Tritium	13:55	1.012433	56059	0.47	
	BKG	14:25	30.01243	8.84	2.08	
	Carbon-14	16:08	1.01245	93997	1	
	Tritium	16:12	1.012333	55816	0.22	
	BKG	16:44	30.01243	7.93	0.69	
	Carbon-14	16:46	1.012433	93337	-0.75	
	Tritium	16:47	1.012433	55518	-0.1	
	BKG	17:30	30.01442	6.88	-0.91	
LSCPURPLE	Carbon-14	03:12	.55	93103	-4	~~Outside Three Sigma~~ JP 7/13/10
	Carbon-14	03:12	.55	94418	-0.71	cleared by rerun
	Tritium	03:13	.95	65304	-1.7	
	Tritium	03:15	.95	65240	-1.9	
	BKG	03:17	30	28	-0.93	
	BKG	03:47	30	28	-0.82	
LSCRED	Carbon-14	03:01	.95	42144	-0.75	
	Carbon-14	03:02	.95	42307	-0.02	
	Tritium	03:04	.8	64856	-1.7	
	Tritium	03:05	.8	64228	-3.5	~~Outside Three Sigma~~ JP 7/13/10
	BKG	03:07	30	25	3	cleared by rerun
	BKG	03:37	30	23	1.22	
	Carbon-14	10:21	.95	42380	0.32	
	Carbon-14	10:22	.95	42632	1.46	
	Tritium	10:24	.8	64863	-1.7	
	Tritium	10:25	.8	64677	-2.2	

	BKG	10:27	30	24	1.87
	BKG	10:58	30	21	-0.87
LSCSILVER	Carbon-14	02:31	.45	95847	1.1
	Carbon-14	02:32	.45	94869	-1.2
	Tritium	02:33	.8	69023	-1.6
	Tritium	02:34	.8	69056	-1.5
	BKG	02:35	30	26	1.2
	BKG	03:06	30	24	-0.3
LSCYELLOW	Carbon-14	02:29	1.717	97263	-1.3
	Carbon-14	02:32	1.733	96907	-3
	Tritium	02:34	2.117	127631	-1
	Tritium	02:37	2.133	126962	-2.4
	BKG	02:40	30	13	-2
	BKG	03:11	30	13	-0.8

Reviewed by Lynnette Pace

Date 7/13/10

GEL Laboratories LLC

Liquid Scintillation Counter Checks for 12-JUL-2010

Short Name	Parmname	Run Time	Count Time	Counts	CPM	Stdev	Status	Comments
LSCBLUE	Carbon-14	04:18	1		41866	-1		
	Carbon-14	04:20	1		42031	-0.1		
	Tritium	04:22	.85		62166	-0.61		
	Tritium	04:23	.85		62173	-0.59		
	BKG	04:25	30		21	-1.1		
	BKG	04:55	30		20	-2.2		
LSCBROWN	Carbon-14	04:32	1		41856	-2		
	Carbon-14	04:34	.95		42261	-0.09		
	Tritium	04:36	.85		61652	-1.8		
	Tritium	04:37	.85		61788	-1.3		
	BKG	04:39	30		22	-0.54		
	BKG	05:10	30		22	-0.47		
LSCGOLD	Carbon-14	04:25	.95		43396	0.24		
	Carbon-14	04:26	.95		43324	-0.07		
	Tritium	04:28	.75		82967	-2.3		
	Tritium	04:29	.75		83532	-1.3		
	BKG	04:31	30		19	-1.3		
	BKG	05:01	30		20	0.22		
LSCGREEN	Carbon-14	03:24	1		41901	-1.2		
	Carbon-14	03:25	.95		42554	2.05		
	Tritium	03:27	.9		58907	-1		
	Tritium	03:29	.9		58748	-1.5		
	BKG	03:30	30		22	1.46		
	BKG	04:01	30		22	2.48		
LSCORANGE	Carbon-14	04:34	1.01245		97990	-0.86		
	Tritium	04:37	1.012433		131477	-1.3		
	BKG	05:10	30.01243		11	-0.95		
	Carbon-14	05:11	1.012433		97930	-1		
	Tritium	05:12	1.01235		132427	1.04		
	BKG	05:43	30.01243		12	0.25		
LSCPINK	Carbon-14	04:29	1.01245		93931	0.82		
	Tritium	04:32	1.01235		56192	0.61		

	BKG	05:05	30.01243	9.07	2.43
	Carbon-14	05:06	1.01245	94325	1.86
	Tritium	05:08	1.012433	56251	0.67
	BKG	05:38	30.01243	7.62	0.22
LSCPURPLE	Carbon-14	10:16	.55	94918	0.55
	Carbon-14	10:17	.55	94043	-1.6
	Tritium	10:18	.95	65915	-0.07
	Tritium	10:19	.95	65456	-1.3
	BKG	10:21	30	29	0.33
	BKG	10:52	30	30	0.62
LSCRED	Carbon-14	04:26	.95	42457	0.67
	Carbon-14	04:28	.95	42699	1.76
	Tritium	04:29	.8	65292	-0.48
	Tritium	04:30	.8	64738	-2.1
	BKG	04:32	30	23	1.28
	BKG	05:03	30	23	1.25
LSCSILVER	Carbon-14	04:29	.45	95716	0.79
	Carbon-14	04:29	.45	95525	0.34
	Tritium	04:30	.75	69801	0.49
	Tritium	04:31	.75	69883	0.71
	BKG	04:33	30	23	-2.1
	BKG	05:04	30	24	-0.96
LSCYELLOW	Carbon-14	04:27	1.717	97492	-0.31
	Carbon-14	04:29	1.733	97181	-1.7
	Tritium	04:32	2.117	127457	-1.4
	Tritium	04:35	2.133	126800	-2.8
	BKG	04:38	30	14	0.86
	BKG	05:09	30	14	0.86
	Carbon-14	08:24	1.717	97225	-1.5
	Carbon-14	08:26	1.717	97435	-0.56
	Tritium	08:29	2.133	126897	-2.6
	Tritium	08:32	2.133	127348	-1.6
	BKG	08:35	30	14	0.86
	BKG	09:06	30	14	-0.05

Reviewed by Stephanie Pare

Date 7/13/10

GEL Laboratories LLC

Background and Efficiency Data

● Denotes Outlier

● Denotes Outlier

Quality Control Charts

Data used for LSC Liquids 14-JUL-2010

Radon-222 BLANK: Limits LCL = 0 UCL = .1

Batch ID	Samp ID	Run Date	Status	Value	Deviation	Units	Mean	LCL	LWL	UWL	UCL	Stdev
967258	1202076014	19-MAR-2010 22:52	DONE	0	-0.26	pCi/mL	00	-0.045	-0.029	0.04	0.05	0.02
968204	1202078478	23-MAR-2010 19:24	DONE	0	0.2	pCi/mL	00	-0.045	-0.029	0.04	0.05	0.02
968303	1202078708	23-MAR-2010 20:28	DONE	0	-0.26	pCi/mL	00	-0.045	-0.029	0.04	0.05	0.02
968961	1202080315	24-MAR-2010 19:46	DONE	0	0.98	pCi/mL	00	-0.045	-0.029	0.04	0.05	0.02
968842	1202079948	24-MAR-2010 20:50	DONE	0	-0.27	pCi/mL	00	-0.045	-0.029	0.04	0.05	0.02
969311	1202081133	25-MAR-2010 19:38	DONE	0	-2	pCi/mL	00	-0.045	-0.029	0.04	0.05	0.02
969700	1202082146	26-MAR-2010 19:19	DONE	0	1.1	pCi/mL	00	-0.045	-0.029	0.04	0.05	0.02
970058	1202082955	29-MAR-2010 14:36	DONE	0	-0.67	pCi/mL	00	-0.045	-0.029	0.04	0.05	0.02
970475	1202083969	30-MAR-2010 23:53	DONE	0	-0.27	pCi/mL	00	-0.045	-0.029	0.04	0.05	0.02
970477	1202083973	31-MAR-2010 01:29	DONE	0	-2	pCi/mL	00	-0.045	-0.029	0.04	0.05	0.02
970839	1202084974	01-APR-2010 01:09	DONE	0	-0.02	pCi/mL	00	-0.045	-0.029	0.04	0.05	0.02
971267	1202086034	01-APR-2010 23:26	DONE	0	-0.63	pCi/mL	00	-0.045	-0.029	0.04	0.05	0.02
972847	1202089822	07-APR-2010 17:40	DONE	0	-1	pCi/mL	00	-0.045	-0.029	0.04	0.05	0.02
973312	1202090932	08-APR-2010 21:18	DONE	0	1.2	pCi/mL	00	-0.045	-0.029	0.04	0.05	0.02
974603	1202094120	13-APR-2010 22:30	DONE	0	-0.68	pCi/mL	00	-0.045	-0.029	0.04	0.05	0.02
975286	1202095814	15-APR-2010 21:39	DONE	0	0.7	pCi/mL	00	-0.045	-0.029	0.04	0.05	0.02
975561	1202096481	16-APR-2010 18:27	DONE	0	0.55	pCi/mL	00	-0.045	-0.029	0.04	0.05	0.02
976372	1202098554	20-APR-2010 20:29	DONE	0	0.82	pCi/mL	00	-0.045	-0.029	0.04	0.05	0.02
976828	1202099677	21-APR-2010 23:22	DONE	0	-0.63	pCi/mL	00	-0.045	-0.029	0.04	0.05	0.02
977370	1202100756	22-APR-2010 22:21	DONE	0	-0.82	pCi/mL	00	-0.045	-0.029	0.04	0.05	0.02
977678	1202101490	23-APR-2010 20:33	DONE	0	0.56	pCi/mL	00	-0.045	-0.029	0.04	0.05	0.02
978565	1202103618	27-APR-2010 22:30	DONE	0	-0.08	pCi/mL	00	-0.045	-0.029	0.04	0.05	0.02
978981	1202104623	28-APR-2010 21:57	DONE	0	0.71	pCi/mL	00	-0.045	-0.029	0.04	0.05	0.02
979717	1202106349	29-APR-2010 21:22	DONE	0	1.2	pCi/mL	00	-0.045	-0.029	0.04	0.05	0.02
980337	1202107710	03-MAY-2010 22:34	DONE	0	-0.02	pCi/mL	00	-0.045	-0.029	0.04	0.05	0.02
981849	1202111217	07-MAY-2010 07:17	DONE	0	-1	pCi/mL	00	-0.045	-0.029	0.04	0.05	0.02
982817	1202113774	11-MAY-2010 22:52	DONE	0	0.34	pCi/mL	00	-0.045	-0.029	0.04	0.05	0.02
983453	1202115457	12-MAY-2010 04:05	DONE	0	0.18	pCi/mL	00	-0.045	-0.029	0.04	0.05	0.02
983787	1202116236	13-MAY-2010 01:15	DONE	0	-1	pCi/mL	00	-0.045	-0.029	0.04	0.05	0.02
984139	1202117009	13-MAY-2010 23:13	DONE	0	-0.27	pCi/mL	00	-0.045	-0.029	0.04	0.05	0.02
984715	1202118127	17-MAY-2010 05:13	DONE	0	2.7	pCi/mL	00	-0.045	-0.029	0.04	0.05	0.02
985996	1202121045	20-MAY-2010 19:37	DONE	0	1.4	pCi/mL	00	-0.045	-0.029	0.04	0.05	0.02
988956	1202128071	27-MAY-2010 18:25	DONE	0	-0.51	pCi/mL	00	-0.045	-0.029	0.04	0.05	0.02
989508	1202129294	01-JUN-2010 19:29	DONE	0	1.7	pCi/mL	00	-0.045	-0.029	0.04	0.05	0.02
991377	1202133731	05-JUN-2010 17:53	DONE	0	-0.68	pCi/mL	00	-0.045	-0.029	0.04	0.05	0.02
992256	1202135973	09-JUN-2010 06:40	DONE	0	0.46	pCi/mL	00	-0.045	-0.029	0.04	0.05	0.02
993157	1202138140	10-JUN-2010 20:58	DONE	0	-0.56	pCi/mL	00	-0.045	-0.029	0.04	0.05	0.02
1000953	1202157537	09-JUL-2010 16:42	DONE	0	-0.86	pCi/mL	00	-0.045	-0.029	0.04	0.05	0.02
1001621	1202159127	09-JUL-2010 22:07	DONE	0	0.53	pCi/mL	00	-0.045	-0.029	0.04	0.05	0.02

Radon-222 DUP: Limits LCL = 0 UCL = 20

Batch ID	Samp ID	Run Date	Status	Value	Deviation	Units	Mean	LCL	LWL	UWL	UCL	Stdev
968204	1202078479	23-MAR-2010 19:40	DONE	0	-0.5	percent	9.81	0	-29	48.9	20.0	19.6
968303	1202078709	23-MAR-2010 20:44	DONE	2	-0.39	percent	9.81	0	-29	48.9	20.0	19.6
968961	1202080316	24-MAR-2010 20:02	DONE	47	1.9	percent	9.81	0	-29	48.9	20.0	19.6
968842	1202079949	24-MAR-2010 21:06	DONE	0	-0.5	percent	9.81	0	-29	48.9	20.0	19.6

969311	1202081134	25-MAR-2010 19:54	DONE	0	-0.5	percent	9.81	0	-29	48.9	20.0	19.6
969700	1202082147	26-MAR-2010 19:35	DONE	42	1.7	percent	9.81	0	-29	48.9	20.0	19.6
970058	1202082956	29-MAR-2010 14:52	DONE	0	-0.5	percent	9.81	0	-29	48.9	20.0	19.6
970475	1202083970	31-MAR-2010 00:09	DONE	0	-0.5	percent	9.81	0	-29	48.9	20.0	19.6
970477	1202083974	31-MAR-2010 01:46	DONE	0	-0.5	percent	9.81	0	-29	48.9	20.0	19.6
970839	1202084975	01-APR-2010 01:25	DONE	0	-0.5	percent	9.81	0	-29	48.9	20.0	19.6
971267	1202086035	01-APR-2010 23:42	DONE	50	2	percent	9.81	0	-29	48.9	20.0	19.6
972847	1202089823	07-APR-2010 17:56	DONE	2	-0.38	percent	9.81	0	-29	48.9	20.0	19.6
973312	1202090933	08-APR-2010 21:34	DONE	10	00	percent	9.81	0	-29	48.9	20.0	19.6
974603	1202094121	13-APR-2010 22:46	DONE	16	0.3	percent	9.81	0	-29	48.9	20.0	19.6
975286	1202095815	15-APR-2010 21:56	DONE	0	-0.5	percent	9.81	0	-29	48.9	20.0	19.6
975561	1202096482	16-APR-2010 18:43	DONE	2	-0.4	percent	9.81	0	-29	48.9	20.0	19.6
976372	1202098555	20-APR-2010 20:46	DONE	17	0.35	percent	9.81	0	-29	48.9	20.0	19.6
976828	1202099678	21-APR-2010 23:38	DONE	0	-0.5	percent	9.81	0	-29	48.9	20.0	19.6
977370	1202100757	22-APR-2010 22:37	DONE	0	-0.5	percent	9.81	0	-29	48.9	20.0	19.6
977678	1202101491	23-APR-2010 20:49	DONE	0	-0.48	percent	9.81	0	-29	48.9	20.0	19.6
978565	1202103619	27-APR-2010 22:46	DONE	0	-0.5	percent	9.81	0	-29	48.9	20.0	19.6
978981	1202104624	28-APR-2010 22:13	DONE	97	4.5	percent	9.81	0	-29	48.9	20.0	19.6
979717	1202106350	29-APR-2010 21:38	DONE	0	-0.5	percent	9.81	0	-29	48.9	20.0	19.6
980337	1202107711	03-MAY-2010 22:50	DONE	0	-0.5	percent	9.81	0	-29	48.9	20.0	19.6
981849	1202111218	07-MAY-2010 07:33	DONE	0	-0.5	percent	9.81	0	-29	48.9	20.0	19.6
982817	1202113775	12-MAY-2010 02:05	DONE	5	-0.27	percent	9.81	0	-29	48.9	20.0	19.6
982817	1202113776	12-MAY-2010 04:07	DONE	19	0.45	percent	9.81	0	-29	48.9	20.0	19.6
983453	1202115458	12-MAY-2010 04:21	DONE	0	-0.5	percent	9.81	0	-29	48.9	20.0	19.6
983787	1202116237	13-MAY-2010 01:31	DONE	5	-0.24	percent	9.81	0	-29	48.9	20.0	19.6
984139	1202117010	13-MAY-2010 23:29	DONE	10	0.01	percent	9.81	0	-29	48.9	20.0	19.6
984715	1202118128	17-MAY-2010 05:29	DONE	0	-0.5	percent	9.81	0	-29	48.9	20.0	19.6
985996	1202121046	20-MAY-2010 19:53	DONE	1	-0.47	percent	9.81	0	-29	48.9	20.0	19.6
988956	1202128072	27-MAY-2010 18:41	DONE	0	-0.5	percent	9.81	0	-29	48.9	20.0	19.6
989508	1202129295	01-JUN-2010 19:45	DONE	0	-0.5	percent	9.81	0	-29	48.9	20.0	19.6
991377	1202133732	05-JUN-2010 18:24	DONE	3	-0.37	percent	9.81	0	-29	48.9	20.0	19.6
992256	1202135974	09-JUN-2010 06:57	DONE	12	0.09	percent	9.81	0	-29	48.9	20.0	19.6
993157	1202138141	10-JUN-2010 21:14	DONE	0	-0.5	percent	9.81	0	-29	48.9	20.0	19.6
1000953	1202157538	09-JUL-2010 17:13	DONE	32	1.1	percent	9.81	0	-29	48.9	20.0	19.6
1001621	1202159128	09-JUL-2010 22:24	DONE	13	0.17	percent	9.81	0	-29	48.9	20.0	19.6

Radon-222 LCS: Limits LCL = 75 UCL = 125

Batch ID	Samp ID	Run Date	Status	Value	Deviation	Units	Mean	LCL	LWL	UWL	UCL	Stdev
966794	1202074887	22-MAR-2010 14:32	DONE	112	1.4	percent	100	75.0	83.3	117	125	8.33
968303	1202078710	27-MAR-2010 09:01	DONE	78	-3	percent	100	75.0	83.3	117	125	8.33
969311	1202081136	29-MAR-2010 05:09	DONE	102	0.28	percent	100	75.0	83.3	117	125	8.33
968204	1202078481	29-MAR-2010 22:27	DONE	102	0.25	percent	100	75.0	83.3	117	125	8.33
969700	1202082149	29-MAR-2010 23:15	DONE	95	-0.6	percent	100	75.0	83.3	117	125	8.33
968842	1202079950	29-MAR-2010 23:48	DONE	99	-0.17	percent	100	75.0	83.3	117	125	8.33
968961	1202080318	30-MAR-2010 00:37	DONE	101	0.1	percent	100	75.0	83.3	117	125	8.33
970058	1202082958	01-APR-2010 18:26	DONE	103	0.38	percent	100	75.0	83.3	117	125	8.33
970477	1202083976	02-APR-2010 04:09	DONE	107	0.84	percent	100	75.0	83.3	117	125	8.33
970475	1202083971	02-APR-2010 04:56	DONE	111	1.3	percent	100	75.0	83.3	117	125	8.33
970839	1202084977	03-APR-2010 06:01	DONE	110	1.2	percent	100	75.0	83.3	117	125	8.33
971267	1202086037	05-APR-2010 05:01	DONE	105	0.61	percent	100	75.0	83.3	117	125	8.33

972847	1202089825	11-APR-2010 14:23	DONE	107	0.88	percent	100	75.0	83.3	117	125	8.33
973312	1202090935	11-APR-2010 14:24	DONE	90	-1	percent	100	75.0	83.3	117	125	8.33
974603	1202094123	16-APR-2010 16:01	DONE	107	0.86	percent	100	75.0	83.3	117	125	8.33
975561	1202096484	19-APR-2010 10:10	DONE	109	1.1	percent	100	75.0	83.3	117	125	8.33
975286	1202095817	19-APR-2010 10:58	DONE	109	1.1	percent	100	75.0	83.3	117	125	8.33
976372	1202098557	23-APR-2010 08:01	DONE	106	0.75	percent	100	75.0	83.3	117	125	8.33
976828	1202099680	24-APR-2010 07:24	DONE	98	-0.29	percent	100	75.0	83.3	117	125	8.33
977678	1202101493	26-APR-2010 18:55	DONE	107	0.85	percent	100	75.0	83.3	117	125	8.33
977370	1202100759	27-APR-2010 10:32	DONE	101	0.07	percent	100	75.0	83.3	117	125	8.33
978565	1202103621	30-APR-2010 03:16	DONE	102	0.26	percent	100	75.0	83.3	117	125	8.33
978981	1202104626	01-MAY-2010 17:11	DONE	99	-0.15	percent	100	75.0	83.3	117	125	8.33
979717	1202106352	02-MAY-2010 18:35	DONE	94	-0.7	percent	100	75.0	83.3	117	125	8.33
980337	1202107713	06-MAY-2010 03:55	DONE	110	1.2	percent	100	75.0	83.3	117	125	8.33
981849	1202111220	10-MAY-2010 06:54	DONE	107	0.78	percent	100	75.0	83.3	117	125	8.33
982817	1202113777	14-MAY-2010 10:43	DONE	115	1.8	percent	100	75.0	83.3	117	125	8.33
983453	1202115460	14-MAY-2010 19:39	DONE	118	2.1	percent	100	75.0	83.3	117	125	8.33
984139	1202117012	17-MAY-2010 08:55	DONE	115	1.8	percent	100	75.0	83.3	117	125	8.33
984715	1202118130	18-MAY-2010 00:59	DONE	102	0.21	percent	100	75.0	83.3	117	125	8.33
983787	1202116239	19-MAY-2010 06:13	DONE	99	-0.08	percent	100	75.0	83.3	117	125	8.33
985996	1202121048	23-MAY-2010 21:41	DONE	113	1.5	percent	100	75.0	83.3	117	125	8.33
988956	1202128074	31-MAY-2010 06:14	DONE	113	1.5	percent	100	75.0	83.3	117	125	8.33
989508	1202129297	04-JUN-2010 09:35	DONE	99	-0.12	percent	100	75.0	83.3	117	125	8.33
991377	1202133734	09-JUN-2010 01:01	DONE	114	1.6	percent	100	75.0	83.3	117	125	8.33
992256	1202135976	14-JUN-2010 06:19	DONE	105	0.66	percent	100	75.0	83.3	117	125	8.33
993157	1202138143	14-JUN-2010 06:26	DONE	114	1.6	percent	100	75.0	83.3	117	125	8.33
1000953	1202157540	11-JUL-2010 22:15	DONE	106	0.77	percent	100	75.0	83.3	117	125	8.33
1001621	1202159130	12-JUL-2010 08:47	DONE	103	0.35	percent	100	75.0	83.3	117	125	8.33

Radon-222 RER: Limits LCL = 0 UCL = 3

Batch ID	Samp ID	Run Date	Status	Value	Deviation	Units	Mean	LCL	LWL	UWL	UCL	Stdev
942156	1202016820	15-JAN-2010 16:58	DONE	1.9	2	dec	0.53	0	-0.866	1.94	3.00	0.7
972884	1202089944	10-MAR-2010 01:04	DONE	0.23	-0.44	dec	0.53	0	-0.866	1.94	3.00	0.7
963652	1202067388	11-MAR-2010 11:58	DONE	0.31	-0.32	dec	0.53	0	-0.866	1.94	3.00	0.7
964261	1202068674	11-MAR-2010 22:44	DONE	0.09	-0.63	dec	0.53	0	-0.866	1.94	3.00	0.7
965705	1202072239	11-MAR-2010 22:44	DONE	0.09	-0.63	dec	0.53	0	-0.866	1.94	3.00	0.7
965846	1202072642	16-MAR-2010 21:33	DONE	0.26	-0.4	dec	0.53	0	-0.866	1.94	3.00	0.7
967258	1202076015	19-MAR-2010 23:08	DONE	0.41	-0.17	dec	0.53	0	-0.866	1.94	3.00	0.7
968303	1202078709	23-MAR-2010 20:44	DONE	0.05	-0.69	dec	0.53	0	-0.866	1.94	3.00	0.7
968842	1202079949	24-MAR-2010 21:06	DONE	0.63	0.13	dec	0.53	0	-0.866	1.94	3.00	0.7
970475	1202083970	31-MAR-2010 00:09	DONE	00	-0.76	dec	0.53	0	-0.866	1.94	3.00	0.7
1000953	1202157538	09-JUL-2010 17:13	DONE	1.9	2	dec	0.53	0	-0.866	1.94	3.00	0.7

Radon-222 SPIKE: Limits LCL = 75 UCL = 125

Batch ID	Samp ID	Run Date	Status	Value	Deviation	Units	Mean	LCL	LWL	UWL	UCL	Stdev
966794	1202074886	24-MAR-2010 10:43	DONE	120	2.3	percent	100	75.0	83.3	117	125	8.33
965846	1202072644	25-MAR-2010 03:41	DONE	116	1.9	percent	100	75.0	83.3	117	125	8.33
968842	1202079951	27-MAR-2010 07:07	DONE	121	2.6	percent	100	75.0	83.3	117	125	8.33
969311	1202081135	29-MAR-2010 04:53	DONE	101	0.07	percent	100	75.0	83.3	117	125	8.33
968204	1202078480	29-MAR-2010 22:10	DONE	102	0.22	percent	100	75.0	83.3	117	125	8.33
969700	1202082148	29-MAR-2010 22:59	DONE	92	-1	percent	100	75.0	83.3	117	125	8.33

968961	1202080317	30-MAR-2010 00:21	DONE	96	-0.51	percent	100	75.0	83.3	117	125	8.33
968303	1202078715	30-MAR-2010 14:46	DONE	117	2	percent	100	75.0	83.3	117	125	8.33
970477	1202083975	02-APR-2010 03:53	DONE	104	0.49	percent	100	75.0	83.3	117	125	8.33
970475	1202083972	03-APR-2010 05:33	DONE	99	-0.14	percent	100	75.0	83.3	117	125	8.33
970839	1202084976	03-APR-2010 05:45	DONE	108	0.97	percent	100	75.0	83.3	117	125	8.33
970058	1202082957	03-APR-2010 09:33	DONE	109	1.1	percent	100	75.0	83.3	117	125	8.33
971267	1202086036	05-APR-2010 04:45	DONE	100	0.05	percent	100	75.0	83.3	117	125	8.33
972847	1202089824	11-APR-2010 14:07	DONE	103	0.3	percent	100	75.0	83.3	117	125	8.33
973312	1202090934	11-APR-2010 14:07	DONE	88	-1	percent	100	75.0	83.3	117	125	8.33
974603	1202094122	16-APR-2010 15:45	DONE	104	0.48	percent	100	75.0	83.3	117	125	8.33
975561	1202096483	19-APR-2010 09:54	DONE	105	0.65	percent	100	75.0	83.3	117	125	8.33
975286	1202095816	19-APR-2010 10:42	DONE	118	2.1	percent	100	75.0	83.3	117	125	8.33
976372	1202098556	23-APR-2010 07:45	DONE	98	-0.2	percent	100	75.0	83.3	117	125	8.33
976828	1202099679	24-APR-2010 07:08	DONE	100	0.04	percent	100	75.0	83.3	117	125	8.33
977678	1202101492	26-APR-2010 18:39	DONE	107	0.88	percent	100	75.0	83.3	117	125	8.33
977370	1202100758	27-APR-2010 10:15	DONE	102	0.28	percent	100	75.0	83.3	117	125	8.33
978565	1202103620	30-APR-2010 03:00	DONE	96	-0.43	percent	100	75.0	83.3	117	125	8.33
978981	1202104625	01-MAY-2010 16:55	DONE	103	0.3	percent	100	75.0	83.3	117	125	8.33
979717	1202106351	02-MAY-2010 18:19	DONE	97	-0.36	percent	100	75.0	83.3	117	125	8.33
980337	1202107712	06-MAY-2010 03:39	DONE	106	0.74	percent	100	75.0	83.3	117	125	8.33
981849	1202111219	10-MAY-2010 06:37	DONE	104	0.44	percent	100	75.0	83.3	117	125	8.33
983453	1202115459	17-MAY-2010 17:20	DONE	129	3.4	percent	100	75.0	83.3	117	125	8.33
984715	1202118129	18-MAY-2010 00:42	DONE	99	-0.16	percent	100	75.0	83.3	117	125	8.33
984139	1202117011	19-MAY-2010 05:25	DONE	109	1.1	percent	100	75.0	83.3	117	125	8.33
983787	1202116238	19-MAY-2010 05:57	DONE	101	0.06	percent	100	75.0	83.3	117	125	8.33
985996	1202121047	23-MAY-2010 21:25	DONE	110	1.2	percent	100	75.0	83.3	117	125	8.33
988956	1202128073	31-MAY-2010 05:58	DONE	112	1.4	percent	100	75.0	83.3	117	125	8.33
989508	1202129296	04-JUN-2010 09:19	DONE	101	0.07	percent	100	75.0	83.3	117	125	8.33
991377	1202133733	09-JUN-2010 00:45	DONE	112	1.5	percent	100	75.0	83.3	117	125	8.33
992256	1202135975	14-JUN-2010 06:02	DONE	102	0.2	percent	100	75.0	83.3	117	125	8.33
993157	1202138142	14-JUN-2010 06:10	DONE	112	1.4	percent	100	75.0	83.3	117	125	8.33
1000953	1202157539	11-JUL-2010 21:59	DONE	110	1.3	percent	100	75.0	83.3	117	125	8.33
1001621	1202159129	12-JUL-2010 08:30	DONE	102	0.28	percent	100	75.0	83.3	117	125	8.33

Generated 07/14/2010

LCS Recovery Radon-222

SPIKE Recovery Radon-222

RER Radon-222

BLANK Result Radon-222

● Denotes Outlier

● Denotes Outlier

Standards Data

ANALYTICS

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0638

CERTIFICATE OF CALIBRATION
Standard Radionuclide Source

67519-278

Ra-226 5 mL Liquid in Flame Sealed Vial

This standard radionuclide source was prepared gravimetrically from a calibrated master solution. The master solution was calibrated using a germanium gamma spectrometer system.

Radionuclide purity and calibration were checked using a germanium gamma spectrometer system. 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 participation in a Measurements Assurance Program as described in USNRC Reg. Guide 4.15, Revision 1, February 1979.

ISOTOPE:	Ra-226
ACTIVITY (dps):	2.353 E4
HALF-LIFE:	1.600 E3 years
CALIBRATION DATE:	January 23, 2004 12:00 EST
RELATIVE EXPANDED UNCERTAINTY (k=2):	3.3%

Impurities: γ-impurities (other than decay products) <0.1%

5.01065 grams 0.1M HCl solution with 50 μg/g Ba carrier.

P O NUMBER 3231RD, Item 5

SOURCE PREPARED BY: M. D. Currie
M. D. Currie, Radiochemist

Q A APPROVED: 1/26/04

RC-S-037-037a

Information about your session

Standard Traceability Log Rad

Source Material Info	
Parent Code:	0638
Prepared By:	Amanda Fehr
Carrier Conc:	0.1M HCl
Reference Date:	01/23/2004
Ampoule Mass (g):	5.01065 g
Uncertainty:	+/- 3.3 %
LogBook No:	RC-S-037-037

A Solution Material Info			
Isotope:	Radium-226		
Prepared By:	Amanda Fehr		
Prep Date:	01/16/2006		
Verification Date:	03/18/2010		
Expiration Date:	03/18/2011		
Primary Code:	0638-A		
Dilution(mL):	100 mL		
Mass of Parent(g):	4.8398 g		
Density(g/mL):	1.0266	Balance ID:	38080204

Calculations Converting parent activity to dpm/mL|dpm/g

(Mass of parent(g)) * (Parm Activity (dps)) * (conversion dpm to dps) / (Ampoule Mass(g) *(Dilution Vol)) = Parent Activity (dpm/mL)
(Mass of parent(g)) * (Parm Activity (dps)) * (conversion dpm to dps) / Density / (Ampoule Mass (g) * (Dilution Vol)) = Parent Activity (dpm/g)
(4.8398 g) * (23530 dps) * (60 dpm/dps) / (5.01065 g * 100 mL) = 13636.6133 dpm/mL
(4.8398 g) * (23530 dps) * (60 dpm/dps) / (1.0266 g/mL)/ (5.01065 g * 100 mL) = 13282.9676 dpm/g

Secondary Standards

Prep Date	Preparer	Mass Primary	Dilution (mL)	Code	Conc dpm/mL	Verification Date	Expiration Date
01/17/2006	Amanda Fehr	2.1041	100	0638-B	279.0211 dpm/mL	01/17/2007	01/17/2008
07/17/2006	Mary Aders	2.1313	100	0638-C	282.6281 dpm/mL	07/26/2006	07/26/2007
03/28/2007	Daniel Roy	2.1025	100	0638-D	279.2744 dpm/ml	04/08/2007	04/08/2008
03/28/2007	Daniel Roy	45.468	250	0638-E	2415.7999 dpm/ml	04/08/2010	04/08/2011
12/18/2007	Daniel Roy	2.014	100	0638-F	267.519 dpm/ml	02/02/2009	02/02/2010
02/12/2008	Daniel Roy	.5004	100	0638-G	66.468 dpm/ml	03/18/2010	03/18/2011
07/23/2008	Daniel Roy	5.0607	250	0638-H	268.8845 dpm/ml	07/17/2009	07/17/2010
09/28/2009	Angela Johnson	4.052	200	0638-I	269.113 dpm/mL	09/28/2009	09/28/2010

Verification for Ra-226 Standard 0638-E 10

G. Ramsay	**Isotope**	**Value**	**Uncertainty**
4/8/2010	0638-E	1134.617	21.9642
	0638-E	1066.158	20.7372
	0638-E	1098.519	21.3216

Mean Value (Counting) =	1099.765	101.33	**Pass**
Stdev =	34.24640148		**Rule 3 (Pass/Fail)**

Target =	1085.28
Lower Limit =	1031.271994
Upper Limit =	1168.2576
Rule 1 Pass/Fail	**Pass**
Two sigma =	68.49280295
10 % of Mean =	109.9764797
Rule 2 (Pass/Fail)	**Pass**

Rule 1 = The certificate value (NOT including any uncertainty) shall lie within the 95% confidence interval determined from the mean and two sigma standard deviation of the three measurements
Rule 2 = The two sigma value used for the 95% confidence interval shall not exceed 10% of the mean value of the three verification measurements.
Rule 3 = The determined mean value shall be within 5% of the certificate value.

The analyst prepared three standard verification sources for Ra-226 source 0638-E by transferring portions of the degassed standard into tared glass liquid scintillation vials. Ten mL of DI Water and 10 mL mineral oil was added to each vial and the vials were shaken to mix. A Blank vial was prepared in a similar fashion using 10 mL of DI water and 10 mL of mineral oil. The standard verification vials and Background source were dark adapted for two hours and counted on LSC Green using source standard verification. Each verification source calculation was performed as follows:

Source dpm/g = (A - B)/(C)(D)
where:
A = Ver. source cpm,
B = BKG cpm,
C = System efficiency, (cpm/dpm), and
D = mass used for standard verification.

Reference RAD SOP M-001

4/12/10 4/9/10

Runlogs

Instrument Run Log

Instrument Type: LSC **Batch ID: 1001621**

Sample ID	Sample Type	Analyst	Instrument	Run Date	Status	Geometry	Calibration Date
256152001	SAMPLE	KXK2	LSCGREEN	09-JUL-10 20:47	DONE	10ML MINERAL OIL/10ML SAMPLE	12-OCT-09 00:00
256152002	SAMPLE	KXK2	LSCGREEN	09-JUL-10 21:03	DONE	10ML MINERAL OIL/10ML SAMPLE	12-OCT-09 00:00
256152003	SAMPLE	KXK2	LSCGREEN	09-JUL-10 21:19	DONE	10ML MINERAL OIL/10ML SAMPLE	12-OCT-09 00:00
256152004	SAMPLE	KXK2	LSCGREEN	09-JUL-10 21:35	DONE	10ML MINERAL OIL/10ML SAMPLE	12-OCT-09 00:00
256152005	SAMPLE	KXK2	LSCGREEN	09-JUL-10 21:51	DONE	10ML MINERAL OIL/10ML SAMPLE	12-OCT-09 00:00
1202159127	MB	KXK2	LSCGREEN	09-JUL-10 22:07	DONE	10ML MINERAL OIL/10ML SAMPLE	12-OCT-09 00:00
1202159128	DUP	KXK2	LSCGREEN	09-JUL-10 22:24	DONE	10ML MINERAL OIL/10ML SAMPLE	12-OCT-09 00:00
1202159129	MS	KXK2	LSCRED	12-JUL-10 08:30	DONE	10ML MINERAL OIL/10ML SAMPLE	28-JUL-09 00:00
1202159130	LCS	KXK2	LSCRED	12-JUL-10 08:47	DONE	10ML MINERAL OIL/10ML SAMPLE	28-JUL-09 00:00