

Lockheed Environmental Systems & Technologies Co.  
Lockheed Analytical Services  
975 Kelly Johnson Drive Las Vegas, Nevada 89119-3705  
Telephone 702-361-0220 800-582-7605 Facsimile 702-361-8146

LK6496  
0045290

LOCKHEED MARTIN 

March 25, 1996

Ms. Joan Kessner  
Bechtel Hanford, Inc.  
P.O. Box 969  
1022 Lee Boulevard  
Richland, WA 99352



RE: Log-in No.: L6496  
Quotation No.: Q400000-B  
SAF: B96-048  
Document File No.: 0222596  
WHC Document File No.: 331  
SDG No.: LK6496

The attached data report contains the analytical results of samples that were submitted to Lockheed Analytical Services on 22 February 1996.

The temperature of the cooler upon receipt was 2°C. Sample containers received agree with the chain-of-custody documentation. Sample containers were received intact. Samples designated for nitrate, nitrite, and phosphate analysis by method 300.0 were not received in time to meet the analytical holding time requirements.

The case narratives included in the following attachments provide a detailed description of all events that occurred during sample preparation, analysis, and data review specific to the samples and analytical methods requested.

A list of data qualifiers, chain-of-custody forms, sample receiving checklist, and log-in report are also enclosed representing the samples received within this group.

If you have any questions concerning the analysis or the data please call Kathleen M. Hall at (509) 375-4741.

0003

**Lockheed Analytical Services**

Log-in No.: L6496  
Quotation No.: Q400000-B  
SAF: B96-048  
Document File No.: 0222596  
WHC Document File No.: 331  
SDG No.: LK6496

" I certify that this data package is in compliance with the SOW, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hard copy data package has been authorized by the Laboratory Manger or a designee, as verified by the following signature."

Sincerely,

A handwritten signature in black ink, appearing to read "Kathleen M. Hall" with a stylized flourish at the end.

Kathleen M. Hall  
Client Services Representative

cc: Client Services  
Document Control

**CASE NARRATIVE  
 INORGANIC NON METALS ANALYSES  
 WATER**

The routine calibration and quality control analyses performed for this batch include as applicable: initial and continuing calibration verification, initial and continuing calibration blanks, method blank(s), laboratory control sample(s), matrix spike sample(s), and duplicate sample(s).

**Preparation and Analysis Requirements**

- One water sample was received for LK6496 and analyzed in batch 222 bh for selected analytes as requested on the chain of custody. Quality control analysis was performed on the following samples:

Client ID	LAL #		Method
BOHOV4	L6496-3	MS, DUP	300.0 Chloride, Nitrate as Nitrogen, Nitrite as Nitrogen, Orthophosphate and Sulfate
	L6496-4	MS, DUP	353.2 Nitrate-Nitrite-Nitrogen
	L6496-5	MS, DUP	9030 Sulfide
	L6496-6	MS, DUP	350.1 Ammonia

**Holding Time Requirements**

- All samples were analyzed within the method-specific holding times with the following exception of Method 300.0 Nitrate as Nitrogen, Nitrite as Nitrogen and Method 353.2 Nitrate-Nitrite-Nitrogen. The associated samples are flagged with an "H".

**Method Blanks**

- The concentration levels of all the requested analytes in the method blank were below the reporting detection limits.

**Internal Quality Control**

- All Internal Quality Control were within acceptance limits.

Kay McCann  
 Prepared By

March 1, 1996  
 Date

**CASE NARRATIVE  
INORGANIC METALS ANALYSES  
WATERS AND FILTERED WATER**

The routine calibration and quality control analyses performed for this batch include as applicable: instrument tune (ICP/MS only), initial and continuing calibration verification, initial and continuing calibration blanks, method blank(s), laboratory control sample(s), ICP interference check samples (ICP only), serial dilutions, analytical (post-digestion) spike samples, matrix spike (predigestion) sample(s), duplicate sample(s).

**Preparation and Analysis Requirements**

All samples were received on February 22, 1996. The samples were logged in as L6496 and were prepared and analyzed in batches 222 bhT for total metals and 222 bhD for dissolved metals.

**Holding Time Requirements**

- All samples were analyzed within the method-specific holding times.

**Method Blanks**

- The concentration levels of all the requested analytes in the method blank were below the reporting detection limits.

**Internal Quality Control**

- All Internal Quality Control were within acceptance limits with the following exception: The matrix spike recovery for aluminum (157%) was outside of acceptance limits for batch 222 bhT. The recovery based on the LCS (108.1%) supports that the analytical system was operating within control limits.

Shellee McGrath  
Prepared By

March 25, 1996  
Date

## **CASE NARRATIVE RADIOCHEMICAL ANALYSES**

The routine calibration and quality control (QC) analyses performed for this batch include as applicable: instrument calibration, initial and continuing calibration verification, quench monitoring standards, instrument background analysis, method blanks, yield tracer, laboratory control samples, matrix spike samples, and duplicate samples.

NOTE: Chemical recoveries and minimum detectable activities (MDAs), where applicable, can be found on the calculation and preparation sheets of the attached raw data for each method.

### **Holding Time Requirements**

All holding times were met.

### **Gas Proportional Counter**

#### *Analytical Method Gross Alpha/Beta*

The gross alpha/beta analysis was performed using standard operating procedure (SOP), LAL-91-SOP-0060. The samples were analyzed in workgroup 34110. The instrument calibration verification met criteria. The method blank was within QC criteria. The laboratory control sample (LCS) and matrix spike (MS) recoveries were within QC criteria. The duplicate (DUP) recoveries were within QC criteria. The MDA exceeded the reporting detection limit due to residue weight limitations forcing a volume reduction. The associated samples are flagged with a "C" qualifier. No re-analyses were performed.

#### *Analytical Method Strontium-90*

The strontium-90 analysis was performed using SOP, LAL-91-SOP-0196. The samples were analyzed in workgroup 34046. The instrument calibration verification met criteria. The method blank was within QC criteria. The LCS recovery was within QC criteria. The DUP recoveries were within QC criteria. No re-analyses were performed.

**Lockheed Analytical Services**

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**Liquid Scintillation Counter**

*Analytical Method Carbon-14*

The carbon-14 analysis was performed using SOP, LAL-93-SOP-0209. The samples were analyzed in workgroup 34132. The instrument calibration verification met criteria. The method blank was within QC criteria. The LCS and MS recoveries were within QC criteria. The DUP recoveries were within QC criteria. The quench value was within curve limitations. No re-analyses were performed.

*Analytical Method Tritium*

The tritium analysis was performed using SOP, LAL-91-SOP-0066. The samples were analyzed in workgroup 34127. The instrument calibration verification met criteria. The method blank was within QC criteria. The LCS and MS recoveries were within QC criteria. The DUP recoveries were within QC criteria. The quench value was within curve limitations. No re-analyses were performed.

Yvonne M. Jacoby  
Prepared By

March 13, 1996  
Date

LOCKHEED ANALYTICAL SERVICES  
 LOGIN CHAIN OF CUSTODY REPORT (1n01)  
 Mar 11 1996, 02:41 pm

Login Number: L6496  
 Account: 596 Bechtel Hanford, Inc. \* Richland, WA  
 Project: BECHTEL-HANFORD Bechtel Hanford Project

Laboratory Sample Number	Client Sample Number	Collect Date	Receive Date	Due PR Date
L6496-1 TEMP 2 Location: 156-017 Water 1 S SCREENING	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-96
		Hold:18-AUG-96		
* L6496-2 TEMP 2 Location: 156RAD1-04 Water 1 S 6010 ICP METALS Water 1 S 6010 ICP TRACE	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-96
		Hold:18-AUG-96		
		Hold:18-AUG-96		
L6496-3 TEMP 2 Location: RFG10-101B Water 1 S 300.0 CHLORIDE Water 1 S 300.0 NITRATE Water 1 S 300.0 NITRITE Water 1 S 300.0 PHOSPHATE Water 1 S 300.0 SULFATE	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-96
		Hold:19-MAR-96		
		Hold:22-FEB-96		
		Hold:22-FEB-96		
		Hold:22-FEB-96		
		Hold:19-MAR-96		
L6496-4 TEMP 2 Location: RFG10-101B Water 1 S 353.2 NITRATE	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-96
		Hold:19-MAR-96		
L6496-5 TEMP 2 Location: 156V-I030 Water 1 S 9030 SULFIDE	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-96
		Hold:27-FEB-96		
L6496-6 TEMP 2 Location: RFG10-101B Water 1 S 350.1 NH3/N	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-96
		Hold:19-MAR-96		
L6496-7 TEMP 2 Location: EXPENDED Water 1 S GR ALP/BETA LAL-0060 Water 1 S SR-90 LAL-0196	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-96
		Hold:18-AUG-96		
		Hold:18-AUG-96		
L6496-8 TEMP 2 Location: 156-023D	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-96

LOCKHEED ANALYTICAL SERVICES  
 LOGIN CHAIN OF CUSTODY REPORT (Ln01)  
 Mar 11 1996, 02:41 pm

Login Number: L6496  
 Account: 596 Bechtel Hanford, Inc. \* Richland, WA  
 Project: BECHTEL-HANFORD Bechtel Hanford Project

Laboratory Sample Number	Client Sample Number	Collect Date	Receive Date	Due PR Date
L6496-9 TEMP 2 Location: 156-023D	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-96
L6496-10 TEMP 2 Location: 156-023D	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-96
L6496-11 TEMP 2 Location: 156-023D	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-96
L6496-12 TEMP 2 Location: 155	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-96
Water	1 S C-14 LAL-0209	Hold:18-AUG-96		
Water	1 S TRITIUM(H3) LAL-0066	Hold:18-AUG-96		
* L6496-13 TEMP 2 Location: 156RAD1-04	BOHOV5	20-FEB-96	22-FEB-96	28-MAR-96
Filt H2O	15 S 6010 ICP METALS	Hold:18-AUG-96		
Filt H2O	15 S 6010 ICP TRACE	Hold:18-AUG-96		
L6496-14 Location:	REPORT TYPE	22-FEB-96	22-FEB-96	28-MAR-96
Water	1 S EDD - DISK DEL.			
Water	1 S INORG TYPE 2 RPT			
Water	1 S RAD RPT TYPE 2			

\* ADDED 6010 ICP TRACE FOR PURPOSE  
 OF ANALYSIS

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

*R. Callahan*  
 3-11-96

001

02225

LOCKHEED ANALYTICAL SERVICES  
 LOGIN CHAIN OF CUSTODY REPORT (ln01)  
 Feb 22 1996, 07:07 pm

Login Number: L6496  
 Account: 596 Bechtel Hanford, Inc. \* Richland, WA  
 Project: BECHTEL-HANFORD Bechtel Hanford Project

Laboratory Sample Number	Client Sample Number	Collect Date	Receive Date	Due PR Date
L6496-1 TEMP 2 Location: 157 Water 1 S SCREENING	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-96
		Hold:18-AUG-96		
L6496-2 TEMP 2 Location: 157 Water 1 S 6010 ICP METALS	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-96
		Hold:18-AUG-96		
L6496-3 TEMP 2 Location: 157 Water 1 S 300.0 CHLORIDE Water 1 S 300.0 NITRATE Water 1 S 300.0 NITRITE Water 1 S 300.0 PHOSPHATE Water 1 S 300.0 SULFATE	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-96
		Hold:19-MAR-96		
		Hold:22-FEB-96		
		Hold:22-FEB-96		
		Hold:22-FEB-96		
		Hold:19-MAR-96		
L6496-4 TEMP 2 Location: 157 Water 1 S 353.2 NITRATE	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-9
		Hold:19-MAR-96		
L6496-5 TEMP 2 Location: 157 Water 1 S 9030 SULFIDE	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-9
		Hold:27-FEB-96		
L6496-6 TEMP 2 Location: 157 Water 1 S 350.1 NH3/N	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-9
		Hold:19-MAR-96		
L6496-7 TEMP 2 Location: 157 Water 1 S GR ALP/BETA LAL-0060 Water 1 S SR-90 LAL-0196	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-9
		Hold:18-AUG-96		
		Hold:18-AUG-96		
L6496-8 TEMP 2 Location: 157	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-9

LOCKHEED ANALYTICAL SERVICES  
 LOGIN CHAIN OF CUSTODY REPORT (ln01)  
 Feb 22 1996, 07:07 pm

Login Number: L6496  
 Account: 596 Bechtel Hanford, Inc. \* Richland, WA  
 Project: BECHTEL-HANFORD Bechtel Hanford Project

Laboratory Sample Number	Client Sample Number	Collect Date	Receive Date	Due PR Date
L6496-9 TEMP 2 Location: 157	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-96
L6496-10 TEMP 2 Location: 157	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-96
L6496-11 TEMP 2 Location: 157	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-96
L6496-12 TEMP 2 Location: 157	BOHOV4	20-FEB-96	22-FEB-96	28-MAR-96
Water 1	S C-14 LAL-0209	Hold:18-AUG-96		
Water 1	S TRITIUM(H3) LAL-0066	Hold:18-AUG-96		
L6496-13 TEMP 2 Location: 157	BOHOV5	20-FEB-96	22-FEB-96	28-MAR-96
Filt H2O 15	S 6010 ICP METALS	Hold:18-AUG-96		
L6496-14 Location:	REPORT TYPE	22-FEB-96	22-FEB-96	28-MAR-96
Water 1	S EDD - DISK DEL.			
Water 1	S INORG TYPE 2 RPT			
Water 1	S RAD RPT TYPE 2			

Signature: Paula Davis

Date: 2-22-96

0015

0223546

Bechtel Hanford, Inc.

CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST

L 6496

Page 1 of 1

Data Turnaround  
 Priority  
 Normal

Collector <i>H. Rizzo / B. Rehrig</i>	Company Contact Bob Raidl	Telephone (509) 372-9641
Project Designation 100-HR-3 Groundwater Sampling, Round 10, Phase 2	Sampling Location 100 D	SAF No. B96-048
Ice Chest No. <i>5M6-189</i>	Field Logbook No. <i>EL-1289</i>	Method of Shipment Federal Express
Shipped To Lockheed	Offsite Property No. <i>W96-0-0640-30</i>	Bill of Lading/Air Bill No. <i>2904651461</i>

Possible Sample Hazards/Remarks	Preservation	HNO <sub>3</sub>	Cool 4°C	H <sub>2</sub> SO <sub>4</sub>	*1	H <sub>2</sub> SO <sub>4</sub>	HNO <sub>3</sub>	Cool 4°C	Cool 4°C		HNO <sub>3</sub>
		Type of Container	G	G	P/G	P	P/G	P/G	G	P/G	
	No. of Container(s)	1	1	1	1	1	5	1	1		1
Special Handling and/or Storage Maintain samples between 2°C and 6°C.	Volume	500mL	500mL	500mL	1L	1L	1L	1L	20mL		500mL
SAMPLE ANALYSIS	ICP Metals (Unfiltered)	Anions (IC) - Cl, SO <sub>4</sub> , NO <sub>2</sub> , NO <sub>3</sub> , PO <sub>4</sub>	NO <sub>2</sub> - NO <sub>3</sub>	Sulfide	Ammonia	Gross Alpha, Gross Beta, Sr-90	Tritium, C-14	Activity Scan		ICP Metals (Filtered)	

Sample No.	Matrix*	Date Sampled	Time Sampled									
BOHOV4	W	<i>2-20-96</i>	<i>1115</i>	<i>&gt;</i>	<i>&gt;</i>	<i>∞</i>	<i>∞</i>	<i>∞</i>	<i>∞</i>	<i>X</i>	<i>Y</i>	
BOHOV5	W	<i>2-20-96</i>	<i>1115</i>									<i>X</i>

CHAIN OF POSSESSION	Sign/Print Names	SPECIAL INSTRUCTIONS *1 ZnAc + NaOH	Matrix* S = Soil SE = Sediment SO = Solid SL = Sludge W = Water O = Oil A = Air DS = Drum Solids DL = Drum Liquids T = Tissue WI = Wipe L = Liquid V = Vegetation X = Other
Relinquished By <i>R. F. ...</i>	Date/Time <i>1500</i>	Received By <i>Bob Raidl</i>	Date/Time <i>1500</i>
Relinquished By <i>Bob Rehrig</i>	Date/Time <i>0800</i>	Received By <i>Bob Rehrig</i>	Date/Time <i>2-20-96</i>
Relinquished By <i>Bob Rehrig</i>	Date/Time <i>2-21-96</i>	Received By	Date/Time
Relinquished By	Date/Time	Received By	Date/Time

LABORATORY SECTION	Received By <i>Bob Rehrig</i>	Title <i>Sample Custodian</i>	Date/Time <i>2-22-96/0845</i>
FINAL SAMPLE	Disposal Method	Disposed By	Date/Time

01016

Environmental Restoration Contractor **ERC Team**  
**Interoffice Memorandum**

Job No. 22192  
Written Response Required: NO  
CCN: N/A  
OU: 100-HR-3  
TSD: N/A  
ERA: N/A  
Subject Code: 5850

N128

TO: W. S. Thompson N3-06 DATE: November 28, 1995  
R. F. Raidl H9-03

COPIES: J. E. Parsons X0-23 FROM: S. K. De Mers  
F. G. Zwiesler X0-23 Radiological Controls  
T. L. Lafreniere X0-23 T7-05/373-1913

SUBJECT: 1995 Phase 2, Round 10 sampling for 100-HR-3

There is no need to perform total activities prior to offsite shipment to NRC licensed labs of samples taken from the attached list of wells.

All wells listed in the attachment were reviewed for radiological content based on the previous 4 years of sampling data. No well listed has a  $\beta$  activity in excess of 100,000 pCi/l (<.1 uCi/sample based on a 1 liter sample size) nor any  $\alpha$  activity in excess of 10,000 pCi/l (<.01 uCi/l based on a 1 liter sample). All wells show activities < 2,000 pCi/gm (< 2 nCi/gm D.O.T. limit). The highest activity in recent samples is 44,000 pCi/l  $\beta(H^3)$  and 10 pCi/l  $\alpha$ .

Radiological monitoring during sampling will only be required if the wells are located in radiological areas or if the wells themselves are labeled with radiological stickers. Monitoring requirements for down hole work such as pump removal will be determined based on the history of each well on a case by case basis.

Attachment - 1995 Phase 2, Round 10 well list for 100 HR-3  
skd

**100-HR-3 GROUNDWATER SAMPLING, PHASE 2, ROUND 10**

199-D5-13  
199-D8-4  
199-D8-5  
199-D8-6  
199-D2-5  
199-D2-6  
199-D5-12  
199-D5-14  
199-D5-15  
199-D5-16  
199-D5-17  
199-D5-18  
199-D5-19  
199-D5-20  
199-D8-3  
199-D8-53  
199-D8-54A  
199-D8-54B  
199-D8-55  
699-91-46A  
699-93-48A  
699-96-49  
699-97-51A  
699-101-48A  
199-H4-9

# SAMPLE CHECK-IN LIST

Date/Time Received: 2-22-96-0900 SDG#: n/a

Work Order Number: n/a SAF #: B96-048.

Shipping Container ID: Sml-159 Chain of Custody #: n/a

- 1. Custody Seals on shipping container intact? Yes  No
- 2. Custody Seals dated and signed? Yes  No
- 3. Sample temperature 20
- 4. Vermiculite/packing materials is Wet  Dry
- 5. Each sample is in a plastic bag? Yes  No
- 6. Sample holding times exceeded? Yes  No

7. Samples have: <input type="checkbox"/> tape <input type="checkbox"/> hazard labels <input checked="" type="checkbox"/> custody seals <input type="checkbox"/> appropriate sample labels
8. Samples are: <input checked="" type="checkbox"/> in good condition <input type="checkbox"/> leaking <input type="checkbox"/> broken <input type="checkbox"/> have air bubbles

9. Is the information on the COC and Sample bottles in agreement?  
Yes  No

Notes: n/a

Sample Custodian/Laboratory: Paula Jones / LHS Date: 2-22-96  
Telephoned To: Kathleen Hall On 2-22-96 By Paula Jones  
rec'd 2-22-96

# LOCKHEED MARTIN



## Sample Login Login Review Checklist

Lot Number L6496

The login review should be conducted by that person logging in the samples as well as a peer. Please use this checklist to ensure that such reviews occur in a uniform basis. Please sign and date below to verify that a login review has occurred. This checklist should be affixed to each login package prior to distribution.

For effective login review, at a minimum, five reports from the login process are required. These are the COC (or equivalent), the login COC report, the sample summary report, the sample receiving checklist, and the login quotation. Before beginning review, ensure that these five components are available. Jobs with single component samples, the sample summary report may be omitted.

### SAMPLE SUMMARY REPORT

	<u>YES</u>	<u>NO</u>	<u>N/A</u>	<u>Comment</u>
1. Are all sample ID's correct?	X	—	—	_____
2. Are all samples present?	X	—	—	_____
3. Are all matrices indicated correctly?	X	—	—	_____
4. Are all analyses on the COC logged in for the appropriate samples?	X	—	—	_____
5. Are all analyses logged in for the correct container?	X	—	—	_____
6. Are samples logged in according to LAS batching procedures?	X	—	—	_____

### LOGIN CHAIN OF CUSTODY

	<u>YES</u>	<u>NO</u>	<u>N/A</u>	<u>Comment</u>
1. Are the collect, receive, and due dates correct for every sample?	X	—	—	_____
2. Have all appropriate comments been indicated in the comment section?	X	—	—	_____

### SAMPLE RECEIVING CHECKLIST

	<u>YES</u>	<u>NO</u>	<u>N/A</u>	<u>Comment</u>
1. Are all discrepancies between the COC and the login noted (if applicable)?	—	—	X	_____

Paul D. Jones  
primary review signature

2-22-96  
date

Michael  
secondary review signature

2-22-96 002  
date

028859

Lockheed Analytical Services  
Sample Receiving Checklist

298 4651 461

Page 1 of

Client Name: *Westinghouse*

Job No. *L6496*

Cooler ID: *1117*

COOLER CONDITION UPON RECEIPT

Temperature of cooler upon receipt: *20*

temperature of temp. blank upon receipt:

	Yes	No	* Comments/Discrepancies
custody seals intact	<i>X</i>		
chain of custody present	<i>X</i>		
blue ice (or equiv.) present/frozen	<i>X</i>		
rad survey completed	<i>X</i>		

SAMPLE CONDITION UPON RECEIPT

	Yes	No	* Comments/Discrepancies
all bottles labeled	<i>X</i>		
samples intact	<i>X</i>		
proper container used for sample type	<i>X</i>		
sample volume sufficient for analysis	<i>X</i>		
proper pres. indicated on the COC	<i>X</i>		
VOA's contain headspace			<i>not</i>
are samples bi-phasic (if so, indicate sample ID'S):			<i>not</i>

MISCELLANEOUS ITEMS

	Yes	No	* Comments/Discrepancies
samples with short holding times	<i>X</i>		<i>nitrites/nitrates</i>
samples to subcontract			<i>not</i>

ADDITIONAL COMMENTS/DISCREPANCIES

Completed by / date: *Paul O'Connell 2-22-96*

Sent to the client (date/initials):

\*\* Client's signature upon receipt:

Notes: \* = contact the appropriate CSR of any discrepancies immediately upon receipt

\*\* = please review this information and return via facsimile to the appropriate CSR (702) 361-8146

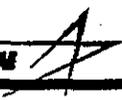
0285

003

Lockheed Analytical Laboratory  
 SAMPLE SUMMARY REPORT (su02)  
 Bechtel Hanford, Inc. \* Richland, WA

Client Sample Number	LAL Sample Number	SDG Number	Matrix	Method
BOHOV4 -	L6496-1		Water	SCREENING -
	L6496-2		Water	6010 ICP METALS
	L6496-3		Water	300.0 CHLORIDE -
	L6496-3		Water	300.0 NITRATE -
	L6496-3		Water	300.0 NITRITE -
	L6496-3		Water	300.0 PHOSPHATE
	L6496-3		Water	300.0 SULFATE -
	L6496-4		Water	353.2 NITRATE -
	L6496-5		Water	9030 SULFIDE -
	L6496-6		Water	350.1 NH3/N -
	L6496-7		Water	GR ALP/BETA LAL
	L6496-7		Water	SR-90 LAL-0196
L6496-12		Water	C-14 LAL-0209 -	
L6496-12		Water	TRITIUM(H3) LAL	
BOHOV5 -	L6496-13		Filt H2O	6010 ICP METALS
REPORT TYPE ✓	L6496-14		Water	EDD - DISK DEL
	L6496-14		Water	INORG TYPE 2 RI
	L6496-14		Water	RAD RPT TYPE 2

0022  
 077556



**NON-METALS**

**WATER**

LOCKHEED ANALYTICAL SERVICES

Sample Results

Client Sample ID: B0H0V4	Date Collected: 20-FEB-96
Matrix: Water	Date Received: 22-FEB-96
Percent Solids: N/A	

Constituent	Units	Method	Result	Project Reporting Limit	Data Qualifier(s)	Date Analyzed	LAS Batch ID	LAS Sample ID
Chloride	mg/L	300.0	5.6	0.020		23-FEB-96	34057	L6496-3
Nitrate-N	mg/L	300.0	0.52	0.020	H	23-FEB-96	34059	L6496-3
Nitrite-N	mg/L	300.0	< 0.002	0.010	HU	23-FEB-96	34058	L6496-3
Ortho Phosphate	mg/L	300.0	0.033	0.10	HB	26-FEB-96	34060	L6496-3
Sulfate	mg/L	300.0	65.	0.10		23-FEB-96	34061	L6496-3
Ammonia Nitrogen	mg/L	350.1	0.12	0.050		28-FEB-96	34062	L6496-6
Nitrate-Nitrite-Nitrogen	mg/L	353.2	0.54	0.050		26-FEB-96	34063	L6496-4
Sulfide	mg/L	9030	< 0.60	3.0	U	24-FEB-96	34098	L6496-5

LOCKHEED ANALYTICAL SERVICES

Sample Results

Client Sample ID: BOH0V4	Date Collected: 20-FEB-96
Matrix: Water	Date Received: 22-FEB-96
Percent Solids: N/A	

Constituent	Units	Method	Result	MDE	RDL	Data Qual	Dilution	Date Analyzed	LAS Batch ID	LAS Sample ID
ALUMINUM, TOTAL	mg/L	6010 A	0.089	0.027	0.20	BN*	1	15-MAR-96	34692	L6496-2
BARIUM, TOTAL	mg/L	6010 A	0.093	0.016	0.20	B	1	15-MAR-96	34692	L6496-2
BERYLLIUM, TOTAL	mg/L	6010 A	< 0.0010	0.0010	0.0050	U	1	15-MAR-96	34692	L6496-2
CADMIUM, TOTAL	mg/L	6010 A	< 0.0040	0.0040	0.0050	U	1	15-MAR-96	34692	L6496-2
CALCIUM, TOTAL	mg/L	6010 A	43.	0.013	5.0		1	15-MAR-96	34692	L6496-2
CHROMIUM, TOTAL	mg/L	6010 A	0.016	0.0030	0.010		1	15-MAR-96	34692	L6496-2
COBALT, TOTAL	mg/L	6010 A	< 0.0040	0.0040	0.050	U	1	15-MAR-96	34692	L6496-2
COPPER, TOTAL	mg/L	6010 A	0.0039	0.0030	0.025	B	1	15-MAR-96	34692	L6496-2
IRON, TOTAL	mg/L	6010 A	0.070	0.0050	0.10	B	1	15-MAR-96	34692	L6496-2
MAGNESIUM, TOTAL	mg/L	6010 A	17.	0.041	5.0		1	15-MAR-96	34692	L6496-2
MANGANESE, TOTAL	mg/L	6010 A	0.065	0.0010	0.015		1	15-MAR-96	34692	L6496-2
NICKEL, TOTAL	mg/L	6010 A	< 0.014	0.014	0.040	U	1	15-MAR-96	34692	L6496-2
POTASSIUM, TOTAL	mg/L	6010 A	11.	0.40	5.0		1	15-MAR-96	34692	L6496-2
SILVER, TOTAL	mg/L	6010 A	< 0.0030	0.0030	0.010	U	1	15-MAR-96	34692	L6496-2
SODIUM, TOTAL	mg/L	6010 A	35.	0.040	5.0		1	15-MAR-96	34692	L6496-2
VANADIUM, TOTAL	mg/L	6010 A	0.035	0.0040	0.050	B	1	15-MAR-96	34692	L6496-2
ZINC, TOTAL	mg/L	6010 A	0.018	0.0030	0.020	B	1	15-MAR-96	34692	L6496-2
Antimony	mg/L	6010 A	< 0.0020	0.0020	0.060	U	1	21-MAR-96	34695	L6496-2
Arsenic	mg/L	6010 A	0.0050	0.0020	0.010	B	1	21-MAR-96	34695	L6496-2
Lead	mg/L	6010 A	< 0.0010	0.0010	0.0030	U	1	21-MAR-96	34695	L6496-2
Selenium	mg/L	6010 A	< 0.0030	0.0030	0.0050	U	1	21-MAR-96	34695	L6496-2
Thallium	mg/L	6010 A	0.0045	0.0030	0.010	B	1	21-MAR-96	34695	L6496-2

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LOCKHEED ANALYTICAL SERVICES

Sample Results

Client Sample ID: BOH0V5	Date Collected: 20-FEB-96
Matrix: Filt H2O	Date Received: 22-FEB-96
Percent Solids: N/A	

Constituent	Units	Method	Result	MDL	RDL	Data Qual	Dilution	Date Analyzed	LAS Batch ID	LAS Sample ID
ALUMINUM, DISSOLVED	mg/L	6010 A	0.030	0.027	0.20	B	1	15-MAR-96	34696	L6496-13
BARIUM, DISSOLVED	mg/L	6010 A	0.083	0.016	0.20	B	1	15-MAR-96	34696	L6496-13
BERYLLIUM, DISSOLVED	mg/L	6010 A	< 0.0010	0.0010	0.0050	U	1	15-MAR-96	34696	L6496-13
CADMIUM, DISSOLVED	mg/L	6010 A	< 0.0040	0.0040	0.0050	U	1	15-MAR-96	34696	L6496-13
CALCIUM, DISSOLVED	mg/L	6010 A	38.	0.013	5.0		1	15-MAR-96	34696	L6496-13
CHROMIUM, DISSOLVED	mg/L	6010 A	0.0041	0.0030	0.010	B	1	15-MAR-96	34696	L6496-13
COBALT, DISSOLVED	mg/L	6010 A	< 0.0040	0.0040	0.050	U	1	15-MAR-96	34696	L6496-13
COPPER, DISSOLVED	mg/L	6010 A	0.0034	0.0030	0.025	B	1	15-MAR-96	34696	L6496-13
IRON, DISSOLVED	mg/L	6010 A	0.020	0.0050	0.10	B	1	15-MAR-96	34696	L6496-13
MAGNESIUM, DISSOLVED	mg/L	6010 A	15.	0.041	5.0		1	15-MAR-96	34696	L6496-13
MANGANESE, DISSOLVED	mg/L	6010 A	0.058	0.0010	0.015		1	15-MAR-96	34696	L6496-13
NICKEL, DISSOLVED	mg/L	6010 A	< 0.014	0.014	0.040	U	1	15-MAR-96	34696	L6496-13
POTASSIUM, DISSOLVED	mg/L	6010 A	9.6	0.40	5.0		1	15-MAR-96	34696	L6496-13
SILVER, DISSOLVED	mg/L	6010 A	< 0.0030	0.0030	0.010	U	1	15-MAR-96	34696	L6496-13
SODIUM, DISSOLVED	mg/L	6010 A	31.	0.040	5.0		1	15-MAR-96	34696	L6496-13
VANADIUM, DISSOLVED	mg/L	6010 A	0.030	0.0040	0.050	B	1	15-MAR-96	34696	L6496-13
ZINC, DISSOLVED	mg/L	6010 A	0.031	0.0030	0.020		1	15-MAR-96	34696	L6496-13
Antimony	mg/L	6010 A	< 0.0020	0.0020	0.060	U	1	21-MAR-96	34697	L6496-13
Arsenic	mg/L	6010 A	0.0037	0.0020	0.010	B	1	21-MAR-96	34697	L6496-13
Lead	mg/L	6010 A	< 0.0010	0.0010	0.0030	U	1	21-MAR-96	34697	L6496-13
Selenium	mg/L	6010 A	< 0.0030	0.0030	0.0050	U	1	21-MAR-96	34697	L6496-13
Thallium	mg/L	6010 A	0.0042	0.0030	0.010	B	1	21-MAR-96	34697	L6496-13

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LOCKHEED ANALYTICAL SERVICES

RAD DATA REPORT (ra01)

Bechtel Hanford, Inc. \* Richland, WA

Bechtel Hanford Project (Project BECHTEL-HANFORD)

Client Sample ID: B0H0V4

LAL Sample ID: L6496-7

Date Collected: 20-FEB-96

Date Received: 22-FEB-96

Matrix: Water

Login Number: L6496

Constituent	Analyzed	Batch	Activity	Error	MDA	DataQual	Units
Gross Alpha	07-MAR-96	GR ALP/BETA LAL-0060_34110	3.7	2.6	3.7	C	pCi/L
Gross Beta	07-MAR-96	GR ALP/BETA LAL-0060_34110	8.7	2.6	3.5		pCi/L
Total radio-strontium	27-FEB-96	SR-90 LAL-0196_34046	0.42	0.58	0.98		pCi/L

LOCKHEED ANALYTICAL SERVICES

RAD DATA REPORT (ra01)

Bechtel Hanford, Inc. \* Richland, WA

Bechtel Hanford Project (Project BECHTEL-HANFORD)

Client Sample ID: B0H0V4

LAL Sample ID: L6496-12

Date Collected: 20-FEB-96

Date Received: 22-FEB-96

Matrix: Water

Login Number: L6496

Constituent	Analyzed	Batch	Activity	Error	MDA	Data Qual	Units
C-14	28-FEB-96	C-14 LAL-0209_34132	28.	85.	110		pCi/L
H-3	09-MAR-96	TRITIUM(H3) LAL-0066_34127	0	170	220		pCi/L

# LOCKHEED ANALYTICAL LABORATORY

## SAMPLE PREPARATION LOG FOR GROSS ALPHA/BETA ANALYSIS

LAL-91-SOP-0060

Date Prep Started : 3/6/96  
 Workgroup Number : GR ALP/BETA LAL-0060 34110

Matrix : Water  
 Prep Due Date : 03/19/96

CLIENT SAMPLE ID	LAL ID	QC	CHILD LAL ID	pH <2	ALOT VOL (L)	PLANCHET TARE WT (grams)	PLANCHET GROSS WT (grams)	SAMPLE WEIGHT (grams)	COMMENTS
L6496-7	34110DUP1	1 DUP1	34110-01	2	<del>210</del>	8.5960	8.6655	.160	
Lab Ctrl Sample	34110LCS1	2 LCS1	34110-02		.250	8.6593	8.6987		
Method Blank	34110MBB	3 MBB1	34110-03		.250	8.5704	8.5704		
L6496-7	34110MS1	4 MS1	34110-04		<del>210</del>	8.5175	8.5915	.160	
BOHOV4	L6496-7	5 SMP1,M	34110-05		<del>210</del>	8.5728	8.6463	.160	
		6							
		7							
		8							
		9							
		10							
		11							
		12							
		13							
		14							
		15							
		16							
		17							
		18							
		19							
		20							
		21							
		22							
		23							
		24							
LCS Volume & RefDate	1.0 mL		8/1/90	MS Volume & RefDate	1.0 mL		1/5/96	Prep Anlst:	GD
LCS Nuclide	Am-241		Sr-90	MS Nuclide	Am-241		Sr-90	Start Date	3/6/96
LCS Activity	9.81 pCi/mL		120 pCi/mL	MS Activity	8.40 pCi/mL		8.37 pCi/mL	Count Anlst	
LCS ID #	95-721-13-1			MS ID #	94-677-93-1				

Balance Number : 40020046 ( ) Pipette Number : 71008 ( )  
 LCS added by : GD  
 Witnessed by : NA

Comments : Did not have enough sample

Analyst : [Signature] Checked by : [Signature] Cnt Rm Custody/Date : SV 3-6-96 V95224

# LOCKHEED ANALYTICAL LABORATORY

## SAMPLE PREPARATION LOG FOR GROSS ALPHA/BETA ANALYSIS

LAL-91-SOP-0060

Date Prep Started : 3/6/96  
 Workgroup Number : GR ALP/BETA LAL-0060 34110

Matrix : Water  
 Prep Due Date : 03/19/96

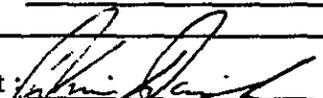
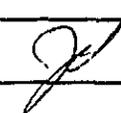
CLIENT SAMPLE ID	LAL ID	QC	CHILD LAL ID	pH <2	ALQT VOL (L)	PLANCHET TARE WT (grams)	PLANCHET GROSS WT (grams)	SAMPLE WEIGHT (grams)	COMMENTS		
L6496-7	34110DUP1	1 DUP1	34110-01	2	0.160	8.5900	8.6655	0.0755			
Lab Ctrl Sample	34110LCS1	2 LCS1	34110-02	2	0.250	8.6593	8.6987	0.0394			
Method Blank	34110MBB	3 MBB1	34110-03	2	0.250	8.5704	8.5704	0.0000			
L6496-7	34110MS1	4 MS1	34110-04	2	0.160	8.5175	8.5915	0.0740			
BOHOV4	L6496-7	5 SMP1,M	34110-05	2	0.160	8.5728	8.6463	0.0735			
		6									
		7									
		8									
		9									
		10									
		11									
		12									
		13									
		14									
		15									
		16									
		17									
		18									
		19									
		20									
		21									
		22									
		23									
		24									
LCS Volume & RefDate		1.0 mL; 08/01/90			MS Volume & RefDate		1.0 mL; 01/05/96		Prep Anlst	CD	
LCS Nuclide		Am-241		Sr-90		MS Nuclide		Am-241	Sr-90	Start Date	3/6/96
LCS Activity		9.8 pCi/mL		12.0 pCi/mL		MS Activity		8.4 pCi/mL	8.4 pCi/mL	Count Anlst	
LCS ID #		95-721-13-1			MS ID #		94-677-93-1				

Balance Number : 40020046 ( )

Pipette Number : 71008 ( )

LCS added by: CD  
 Witnessed by : NA

Comments : \_\_\_\_\_

Analyst :  Checked by : 

003





# CERTIFICATE OF CALIBRATION

## ALPHA STANDARD SOLUTION

Radionuclide	Am-241	Customer: LOCKHEED ENGINEERING & SCIENCES Co.
Half Life:	432.7 ± 0.5 years	P.O.No.: 06LAB1245
Catalog No.:	7241	Reference Date: November 1 1991 12:00 PST.
Source No.:	388-100-1	Contained Radioactivity: 0.997 μCi.

### Description of Solution

a. Mass of solution:	5.0007	grams.
b. Chemical form:	AmCl <sub>3</sub> in 0.5N HCl	
c. Carrier content:	None added	
d. Density:	1.0077	gram/ml @ 20°C.

### Radioimpurities

None detected

### Radioactive Daughters

None detected

### Radionuclide Concentration

0.1994 μCi/gram.

### Method of Calibration

Weighed aliquots of the solution were assayed using a liquid scintillation counter.

### Uncertainty of Measurement

a. Systematic uncertainty in instrument calibration:	±2.0%
b. Random uncertainty in assay:	±0.7%
c. Random uncertainty in weighing(s):	±0.0%
d. Total uncertainty at the 99% confidence level:	±2.7%

### NIST Traceability

This calibration is implicitly traceable to the National Institute of Standards and Technology.

### Notes

1. Nuclear data were taken from "Table of Isotopes", Seventh Edition, edited by Virginia S. Shirley.
2. IPL participates in an NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials. (As in NRC Regulatory Guide 4.15)



**ISOTOPE PRODUCTS LABORATORIES**

1800 No. Keystone Street.,

Burbank, California 91504

(818) 843 - 7000

*Gay A. Moore*  
QUALITY CONTROL

# CERTIFICATE OF CALIBRATION

## BETA STANDARD SOLUTION

Radionuclide	Sr-90	Customer: LOCKHEED ENGINEERING & SCIENCES Co.
Half Life:	28.5 ± 0.2 years	P.O.No.: 06LAB1245
Catalog No.:	7090	Reference Date: November 1 1991 12:00 PST.
Source No.:	388-99-2	Contained Radioactivity: 1.018 $\mu$ Ci.
<b>Description of Solution</b>		
a. Mass of solution:	5.0012	grams.
b. Chemical form:	SrCl <sub>2</sub> in 0.1N HCl	
c. Carrier content:	None added	
d. Density:	0.9996	gram/ml @ 20°C.
<b>Radioimpurities</b>		
	None (Y-90 daughter in equilibrium)	
<b>Radioactive Daughters</b>		
	Y-90 daughter in equilibrium	
<b>Radionuclide Concentration</b>		
	0.203	$\mu$ Ci/gram.

### Method of Calibration

Weighed aliquots of the solution were assayed using a liquid scintillation counter.

### Uncertainty of Measurement

- |  |        |
|--|--------|
| a. Systematic uncertainty in instrument calibration: | ± 1.5% |
| b. Random uncertainty in assay:                      | ± 0.5% |
| c. Random uncertainty in weighing(s):                | ± 0.0% |
| d. Total uncertainty at the 99% confidence level:    | ± 2.0% |

### NIST Traceability

This calibration is implicitly traceable to the National Institute of Standards and Technology.

### Notes

1. Nuclear data were taken from "Table of Isotopes", Seventh Edition, edited by Virginia S. Shirley.
2. IPL participates in an NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials. (As in NRC Regulatory Guide 4.15)



**ISOTOPE PRODUCTS LABORATORIES**

1800 No. Keystone Street,

Barboursville, California 91504

(818) 843-7000

*Mary A. Milmore*  
QUALITY CONTROL

0089

## SECONDARY/WORKING LEVEL STANDARD DILUTION RECORD

### Dilution Source Information

Isotope: Am-241 <sup>(432.7yr)</sup> ; Sr/Y 90 <sup>(29.1yr)</sup> MS

Parent <sup>Logbook</sup> Barcode Number: 92-353-81-1 ; 94-0677-92-1

Vendor or Certificate I.D. # of Parent Standard: \_\_\_\_\_

Diluted Source Logbook I.D. #: see ABOVE

Balance Verification?: Yes

Diluent Used: 1 M HNO<sub>3</sub>

### Dilution

\*Diluent: 1 M HNO<sub>3</sub> + 10 ml Sr Carrier (10mg/ml)

\*Density of diluent (g/ml): 1.0290 g/ml

a: Parent Specific Activity: Am-241 Sr/Y-90 \*  
1002.4 ; 1000.2 pCi/g @ 1/5/96

b: Amount of Source Transferred: 4.070 ; 4.065 g

c: Total amount of Dilution: 500.01 g

d: Total Volume of Dilution: 514.5 ml

e: Activity of Dilution (a \* b / c): Am-241 Sr/Y-90  
8.16 8.13 pCi/g @ 1/5/96

f: Activity of Dilution (a \* b / d): 8.40 8.37 pCi/ml

Dilution Logbook I.D. #: 94-0677-93-1

\* Sr/Y-90 in equilibrium. Activity reported = known Sr 90 activity \* 2.

Prepared By: J. C. Moul Preparation Date: 1/5/96

Reviewed By: Joe Hutchinson Review Date: 1/5/96

\*If the diluent remains unchanged from the diluent used for the dilution source, then a weight dilution of a volume unit source can be performed without a density conversion. If the diluent changes, a weighted proportion density conversion is necessary.

Head and Understood By

Signed

Date

Signed

Date

0090

## INITIAL STANDARD DILUTION RECORD

Standard Information:	
Isotope: <u>Sr-90</u>	Vendor: <u>IPL</u>
Activity of Standard Received: <u>1.018</u> <del>5.0012</del> <u>uCi</u>	Vendor I.D. #: <u>—</u>
Weight of Standard Received (g): <u>5.0012</u> g	LAL I.D. #: <u>AA0049</u>
Standard Activity (pCi/g): <u>2.036E5</u> pCi/g	NIST Traceable? <u>Yes</u>
Half-life in Years or Days: <u>29.1</u> yrs	Certificate #: <u>388-99-2</u>
Reference Date: <u>11/1/91</u>	Receiver's Name: <u>FREE</u>
	Date Received: <u>12/91</u>

Primary Dilution	
Balance Verification?:	<u>Yes</u>
Diluent Used:	<u>1 M HNO<sub>3</sub> (1.0290 g/ml)</u>
a: Decay Corrected Standard Activity (pCi/g):	<u>1.844 E5</u> pCi/g @ <u>1/5/96</u>
b: Weight of the Source Transferred (g):	<u>4.949</u> g
c: Total diluted weight (g):	<u>100.01</u> g
d: Total Diluted Volume (mL)	<u>97.19</u> mL
e: Activity of Dilution by Weight (pCi/g) [a * b / c]:	<u>9125.0</u> pCi/g @ <u>1/5/96</u>
f: Calculated Density of Solution (g/ml) [c / d]:	<del>9389.8</del> <u>1.0290</u> g/mL
g: Activity of Dilution by Volume (pCi/mL) [e * f]:	<u>9389.8</u> pCi/mL
h. Dilution Logbook I.D. #:	<u>94-0677-91-1</u>
Prepared By: <u>A. J. Maul</u>	Preparation Date: <u>1/5/96</u>
Reviewed By: <u>Joe Hutchison</u>	Review Date: <u>1/5/96</u>
Purity/Cross Check Performed By: _____	Check Date: _____

Signed

Date

Signed

Date

0091

## SECONDARY/WORKING LEVEL STANDARD DILUTION RECORD

### Dilution Source Information

Isotope: Sr-90

Parent Barcode Number: AA0049

Vendor or Certificate I.D. # of Parent Standard: 94-0677-91-1 388-59-2

Diluted Source Logbook I.D. #: 94-0677-91-1

Balance Verification?: Yes

Diluent Used: 1.0 M HNO<sub>3</sub>

### Dilution

\*Diluent: 1.0 M HNO<sub>3</sub>

\*Density of diluent (g/ml): 1.0290 g/ml

a: Parent Specific Activity: 9125.0 pCi/g @ 1/5/96

b: Amount of Source Transferred: 6.012 g

c: Total amount of Dilution: 109.70 g

d: Total Volume of Dilution: 106.61 ml

e: Activity of Dilution (a \* b / c): 500.09 pCi/g 1/5/96

f: Activity of Dilution (a \* b / d): 514.6 pCi/ml

Dilution Logbook I.D. #: 94-0677-92-1

Prepared By: G. J. ArnoldPreparation Date: 1/5/96Reviewed By: Joe HutchinsonReview Date: 1/6/96

\*If the diluent remains unchanged from the diluent used for the dilution source, then a weight dilution of a volume unit source can be performed without a density conversion. If the diluent changes, a weighted proportion density conversion is necessary.

Read and Understood By

Signed

Date

Signed

Date

0092

Certs #	Calib	Exp.	Ref #	Vendor	Prep In	Withd In
Parent Ref.	Certs. Date	Date				
388-100-1	Nov 1, 1991	5/6/92	9-0225-641	IPL	JK	JK

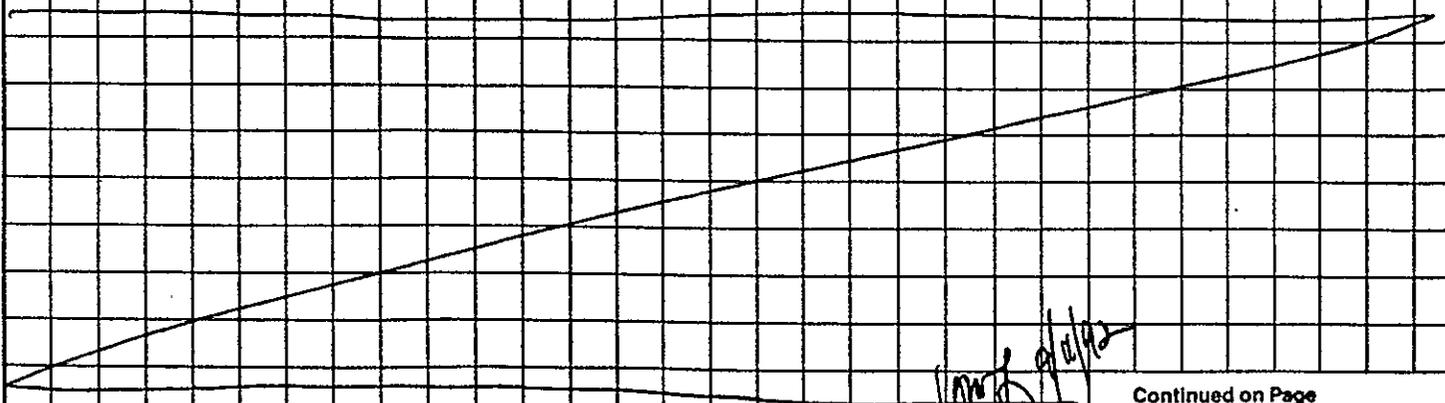
Item #	Preparation Date	Final Conc	Final Conc	Bar Code
1	5/6/92	9,800 $\mu\text{Ci}$	0.997 $\mu\text{Ci}$	AA0030
		$\frac{1}{5}$	$\frac{1}{5}$	
		0.1994 $\mu\text{Ci/g}$	0.1994 $\mu\text{Ci/g}$	

The entire standard was transferred to a 100-ml volumetric V.F. and the <sup>241</sup>Am was diluted to 100ml with 0.5N HCl.

68.4902	164.01 g std + dilution
43.5665 g wt. V.F.	63.57 g V.F.
<u>4.9237 g std</u>	<u>100.44 g diluted std</u>

Activity Std =  $0.1994 \mu\text{Ci/g} \times 4.9237 \text{ g std}$   
 $\frac{100.44 \text{ g dilution}}{100.44 \text{ g dilution}}$

Density 0.5N HCl = 1.003598 g/ml  $\Rightarrow 0.0097748 \mu\text{Ci/g} \times 1.003598 \text{ g/ml}$   
 $= 0.0098 \mu\text{Ci/g}$   $= 0.009810 \mu\text{Ci/g}$   
 or  $= 9,800 \text{ pCi/g}$   $= 9810 \text{ pCi/ml}$



Continued on Page

Read and Understood By

Joe Anderson  
Signed

5/11/92  
Date

J. A. K.  
Signed

0093  
2/13/92  
Date

PROJECT Am-241 / 1.6" dia. filter & LCS

Continued From Page \_\_\_\_\_

### ISOTOPE DILUTION RECORD

*Agne W.*  
*4-9-93*

Isotope: Am-241

Secondary/Working Level Dilution

Date: 4-9-93 Preparer's Name: A. Wong

Pipet Check / Balance Wt. Check Done

Diluted Source ID (log#): 91-225-60-1

Diluent used: 0.5N HCl

A: Source activity: 21700 dpm/g (9774.8 pCi/g)

B: Amount of source transferred: 10.3235 g

C: Total amount of dilution: 100.1029 g

D: Activity of dilution (A\*B/C): 2237.90 dpm/g

E: Density of Diluent: 1.0010 g/ml

\* F: Activity by volume (D\*E): 2240.14 dpm/ml

Dilution Log Book ID: ~~92-325~~<sup>rw</sup> 92-353-81-1

Reviewed by: [Signature] Date: 4/9/93

1.6" diameter filter LCS in Gamma Spec (in petri dish and sealed) 955 5/18/93

Prepared by Nle Van Nguyen 5/10/93 - cut Whittman Glass Micro-fiber filter paper (originally 3" dia) in 1.6" dia - pipetted on filter

<sup>137</sup>Cs LA-0199- 0.200 ul \* 975.18 pCi/ul = 195.0 pCi (≅ 197.8 pCi 4-2-91)

<sup>60</sup>Co LA-0225-89-1 0.200 ul \* 110.36 pCi/ul = 22.07 pCi (≅ 259.1 pCi 4-2-91)

(same pipette amounts as p.805)

Read and Understood By

Agnes Wong  
Signed

4-9-93  
Date

[Signature]  
Signed

5-18-93  
Date

009

## SECONDARY/WORKING LEVEL STANDARD DILUTION RECORD

### Dilution Source Information

Isotope:	<u>Am-241 and Sr-90</u>
Parent Barcode Number	<u>AA0030      AA0046</u> <u>Am-241      IPL 388-100-1</u>
Vendor or Certificate I.D. # of Parent Standard:	<u>Sr-90      NIST SRM 4219G</u> <u>Am-241      91-0225-60-1</u>
Diluted Source Logbook I.D. #:	<u>Sr-90      91-0225-30-2</u>
Balance Verification?:	<u>Yes</u>
Diluent Used:	<u>0.1N HNO<sub>3</sub></u>

### Dilution

*Diluent:	<u>0.1N HNO<sub>3</sub> + 42mg Sr(NO<sub>3</sub>)<sub>2</sub>/mL</u>
*Density of diluent (g/ml):	<u>NA</u>
a: Parent Specific Activity:	<u>Am-241      9810 pCi/mL</u> <u>Sr-90      6000 pCi/mL m 8/1/90</u>
b: Amount of Source Transferred:	<u>Am-241      0.5 mL</u> <u>Sr-90      0.5 mL</u>
c: Total amount of Dilution:	<u>500 <math>\frac{mL}{g}</math></u>
d: Total Volume of Dilution:	<u>500 mL</u>
e: Activity of Dilution (a * b / c):	<u>NA</u>
f: Activity of Dilution (a * b / d):	<u>Am-241      9.81 pCi/mL</u> <u>Sr-90      12 pCi/mL m 8/1/90</u>
Dilution Logbook I.D. #:	<u>95-721-13-1</u>
Prepared By: <u>Joe Hutchinson</u>	Preparation Date: <u>8/23/95</u>
Reviewed By: <u>Joe Moad</u>	Review Date: <u>8/24/95</u>

\*If the diluent remains unchanged from the diluent used for the dilution source, then a weight dilution of a volume unit source can be performed without a density conversion. If the diluent changes, a weighted proportion density conversion is necessary.

Read and Understood By

Signed \_\_\_\_\_

Date \_\_\_\_\_

Signed \_\_\_\_\_

Date \_\_\_\_\_

0095

# CERTIFICATE OF CALIBRATION ALPHA STANDARD SOLUTION

Radionuclide	Am-241	Customer:	LOCKHEED ENGINEERING & SCIENCES Co.
Half Life:	432.7 ± 0.5 years	P.O.No.:	06LAB1245
Catalog No.:	7241	Reference Date:	November 1 1991 12:00 PST.
Source No.:	388-100-1	Contained Radioactivity:	0.997 $\mu$ Cl.

**Description of Solution**

a. Mass of solution:	5.0007	grams.
b. Chemical form:	AmCl <sub>3</sub> in 0.5N HCl	
c. Carrier content:	None added	
d. Density:	1.0077	gram/ml @ 20°C.

**Radioimpurities** None detected

**Radioactive Daughters** None detected

**Radionuclide Concentration** 0.1994  $\mu$ Cl/gram.

**Method of Calibration**

Weighed aliquots of the solution were assayed using a liquid scintillation counter.

**Uncertainty of Measurement**

- |  |        |
|--|--------|
| a. Systematic uncertainty in instrument calibration: | ± 2.0% |
| b. Random uncertainty in assay:                      | ± 0.7% |
| c. Random uncertainty in weighing(s):                | ± 0.0% |
| d. Total uncertainty at the 99% confidence level:    | ± 2.7% |

**NIST Traceability**

This calibration is implicitly traceable to the National Institute of Standards and Technology.

**Notes**

1. Nuclear data were taken from "Table of Isotopes", Seventh Edition, edited by Virginia S. Shirley.
2. IPL participates in an NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials. (As in NRC Regulatory Guide 4.15)



**ISOTOPE PRODUCTS LABORATORIES**  
 1800 No. Keystone Street.,  
 Burbank, California 91504  
 (818) 843 - 7000

*Ray A. Moore*  
**QUALITY CONTROL**

0096

Certs # Parent Ref.	Calib Certs. Date	Exp. Date	Ref #	Vendor	Prep In	Witness In
388-100-1	Nov 1, 1991	5/6/92	91-0225-641	IPL	JH	JH
Item #	Preparation Date	Final Conc.	Initial Conc.	Bar Code		
1	5/6/92	9,800 pCi/g	0.9974 pCi/g	AA0030		
			in 50g 0.1994 pCi/g			

The entire standard was transferred to a 100-ml volumetric V.F. and the ~~sample~~ <sup>Std. A#</sup> was diluted to 100 mL with 0.5N HCl.

68.4902  
 43.5665 g wt. V.F.  
 4.9237 g std

164.01 g std + dilution  
 63.57 g V.F.  
 100.44 g diluted std

$$\text{Activity Std} = \frac{0.1994 \mu\text{Ci/g} \times 4.9237 \text{ g of std}}{100.44 \text{ g dilution}}$$

$$\begin{aligned} \text{Density } 0.5\text{N HCl} &= 1.003598 \text{ g/ml} & \Rightarrow & 0.0097748 \mu\text{Ci/g} \times 1.003598 \text{ g/ml} \\ &= 0.00980 \mu\text{Ci/g} & & = 0.009810 \mu\text{Ci/g} \\ \text{or} &= 9,800 \text{ pCi/g} & & = 9810 \text{ pCi/ml} \end{aligned}$$

Continued on Page \_\_\_\_\_

Read and Understood By

0097

J. H. Johnson  
Signed

5/11/92  
Date

J. H. Johnson  
Signed

2/13/92  
Date



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WHICH IS BEING MAILED TO YOU UNDER  
SEPARATE COVER.

AA002  
✓

## National Institute of Standards & Technology

# Certificate

### Standard Reference Material 4919-G Radioactivity Standard

Radionuclide	Strontium-90
Source identification	4919-G
Source description	Solution in NIST borosilicate-glass ampoule <sup>(1)</sup> *
Solution composition	Strontium-90 plus yttrium-90 plus approximately 95 $\mu\text{g}$ each of non-radioactive strontium and yttrium per gram of 1-molar hydrochloric acid <sup>(2)</sup>
Mass	Approximately 5.0 grams
Radioactivity concentration	$4.514 \times 10^3 \text{ Bq g}^{-1}$
Reference time	1200 EST August 1, 1990
Overall uncertainty	1.05 percent <sup>(3)</sup>
Photon-emitting impurities	None observed <sup>(4)</sup>
Alpha-particle-emitting impurities	None observed <sup>(5)</sup>
Half life	$28.5 \pm 0.2 \text{ years}$ <sup>(6)</sup>
Measuring instrument	$4\pi\beta$ liquid-scintillation counter

This standard reference material was prepared in the Center for Radiation Research, Ionizing Radiation Division, Radioactivity Group, Dale D. Hoppes, Group Leader.

Gaithersburg, MD 20899  
January, 1991

William P. Reed, Acting Chief  
Office of Standard Reference Materials

\*Notes on back

0099

CERT # Parent Cert #	Calibration cert date	Expiration Date	Reference #	VENDOR	PREP INITIALS	WTR'S INITIALS
SRM # 4919-6	1000 Aug 1, 1990	10.2-93	SRM #4919-6A 91-0199-63	NIST		
ITEM #	Preparation DATE	Final Concentration	INITIAL Concentration			
✓	<del>1000 EST 8/1/89</del> 1000 EST 8/1/89 Aug 1, 1990	<del>600.685</del> 600.685	4.514 x 10 <sup>3</sup> Bq/g			

9/10/91

Radioisotope = SR-90

SOURCE # 4919-6

SOURCE description # Solution in NIST Borosilicate glass ampule

Composition # SR-90 + Y-90 plus approximately  
95 mg of non radioactive SR and  
yttrium per gram of 1 molar HCl.

MASS

approximately 5.0 grams

Radioactivity conc

4.514 x 10<sup>3</sup> Bq/g

Reference time =

1000 EST Aug 1, 1990

T<sub>1/2</sub> =

28.5 to 29 years

10/2/91 Preparation

1/ weighing

100.0 ml v.f + standard of SR-90 in ampule

= 65.2000

100.0 ml v.f (empty) (g) = 60.2814

Difference of mass (g) + w. = 4.9186

2/ Calculations =

$$4.514 \times 10^3 \text{ Bq/g} \times 4.9186 \text{ g} = 22,202.5604 \text{ Bq}$$

$$22,202.5604 \text{ Bq} \times 0.7027 \text{ Pci/Bq} = 600.68.5979 \text{ Pci}$$

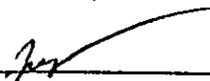
(STD dup Aug 1, 1990) Continued on Page

Transferred 11-19-91 Perfect

(Referred from LAL 605-0199 pg 63)

Read and Understood By

0099

  
Signed

 11/19/91  
Date

  
Signed

 12/4/91  
Date

**STRONTIUM-90**  
**LAL-91-SOP-0196**

# LOCKHEED ANALYTICAL LABORATORY

## SAMPLE PREPARATION LOG FOR STRONTIUM ANALYSIS

TOTAL RADIOSTRONTIUM - LAL-91-SOP-0196

Date Prep Started : 0-27-96

Matrix : Water

WorkGroup : SR-90 LAL-0196 34046

Prep Due Date : 02/27/96

CUSTOMER ID	PARENT LAL ID	NO	QC	CHILD LAL ID	ALIQOT VOLUME (g or L)	SR CARRIER (mL)	YTTRIUM SEP DATE	YTTRIUM SEP TIME	PLANCHET TARE WT (grams)	PLANCHET GROSS WT (grams)	* RESIDUE WEIGHT (grams)	COMMENTS
L6428-2	34046DUP1	1	DUP1	34046-01	500 ml	0.5	2-27-96	18:20	6.85880	6.86856		
Lab Ctrl Sample	34046LCS1	2	LCS1	34046-02	↓	↓	↓	18:20	6.86980	6.87845		
Method Blank	34046MBB	3	MBB1	34046-03	↓	↓	↓	18:20	6.877470	6.88442		
BOH6L5	L6428-2	4	SMP1	34046-04	↓	↓	↓	18:20	6.83943	6.84896		
BOHOV4	L6496-7	5		34046-05	↓	↓	↓	18:20	6.84333	6.85310		
		6										
		7										
		8										
		9										
		10										
		11										
		12										
		13										
		14										
		15										
		16										
		17										
		18										
		19										
		20										
		21										
		22										
		23										
		24										

Conc & Vol of Carrier : 0.01225g / 0.5ml ; 0.5ml  
 Carrier Exp Date : 9-30-96  
 Carrier ID# : 94-658-20

Act & Vol of LCS : 26.78 pCi/ml 1.0 ml  
 LCS Ref Date : 8-1-94  
 LCS ID# : 94-677-44-1

Prep Anlst : AW  
 Start Date : 2-27-96  
 Count Anlst : \_\_\_\_\_

Balance Number : 40020021 (✓)  
 \_\_\_\_\_ ( )

Pipette Number : 139746 (✓)  
134488 (✓)

Carrier and LCS added by : AW 2-27-96  
 Witnessed by : CSM 2-27-96

Comments : \_\_\_\_\_

Analyst : AW 2-27-96

Checked by : [Signature]

Cnt Rm Custody/Date : AW 2-27-96

# LOCKHEED ANALYTICAL LABORATORY

SAMPLE PREPARATION LOG FOR STRONTIUM ANALYSIS

TOTAL RADIOSTRONTIUM - LAL-91-SOP-0196

Date Prep Started : 2/27/96

Matrix : Water

WorkGroup : SR-90 LAL-0196 34046

Prep Due Date : 02/27/96

CUSTOMER ID	PARENT LAL ID	NO	QC	CHILD LAL ID	ALIQVOT VOLUME (L)	SR CARRIER (mL)	YTTRIUM SEP DATE	YTTRIUM SEP TIME	PLANCHET TARE WT (grams)	PLANCHET GROSS WT (grams)	RESIDUE WEIGHT (grams)	COMMENTS
L6428-2	34046DUP1	1	DUP1	34046-01	0.5	0.5	2/27/96	18:20	6.8588	6.86856	0.00976	
Lab Ctrl Sample	34046LCS1	2	LCS1	34046-02	0.5	0.5	2/27/96	18:20	6.8698	6.87845	0.00865	
Method Blank	34046MBB	3	MBB1	34046-03	0.5	0.5	2/27/96	18:20	6.8747	6.88442	0.00972	
BOH6L5	L6428-2	4	SMP1	34046-04	0.5	0.5	2/27/96	18:20	6.83943	6.84896	0.00953	*
BOH0V4	L6496-7	5		34046-05	0.5	0.5	2/27/96	18:20	6.84333	6.85316	0.00983	
		6										
		7										
		8										
		9										
		10										
		11										
		12										
		13										
		14										
		15										
		16										
		17										
		18										
		19										
		20										
		21										
		22										
		23										
		24										
Conc&Vol of Carrier		24.50 mg/mL; 0.5 mL			Act & Vol of LCS		26.78 pCi/mL; 1.0 mL			Prep Anlst		AW
Carrier Exp Date		30-Sep-96			LCS Ref Date		01-Apr-94			Start Date		2/27/96
Carrier ID#		94-658-20			LCS ID#		94-677-44-1			Count Anlst		LV

Balance Number : 40020021 ( )

Pipette Number : 139746 ( )  
134488 ( )

Carrier and LCS added by: AW  
Witnessed by : DSM 2/27/96

Comments :

010

Analyst : SY FOR AW  
DATA ENTRY

Checked by : 

Cnt Rm Custody\Date : \_\_\_\_\_

V98024



# STANDARDS



THIS IS A PHOTOCOPY OF THE CERTIFICATE  
WHICH IS BEING MAILED TO YOU UNDER  
SEPARATE COVER.

HA0046  
✓

# National Institute of Standards & Technology

## Certificate

### Standard Reference Material 4919-G Radioactivity Standard

Radionuclide	Strontium-90
Source identification	4919-G
Source description	Solution in NIST borosilicate-glass ampoule <sup>(1)*</sup>
Solution composition	Strontium-90 plus yttrium-90 plus approximately 95 $\mu\text{g}$ each of non-radioactive strontium and yttrium per gram of 1-molar hydrochloric acid <sup>(2)</sup>
Mass	Approximately 5.0 grams
Radioactivity concentration	$4.514 \times 10^3 \text{ Bq g}^{-1}$
Reference time	1200 EST August 1, 1990
Overall uncertainty	1.05 percent <sup>(3)</sup>
Photon-emitting impurities	None observed <sup>(4)</sup>
Alpha-particle-emitting impurities	None observed <sup>(5)</sup>
Half life	$28.5 \pm 0.2 \text{ years}$ <sup>(6)</sup>
Measuring instrument	$4\pi\beta$ liquid-scintillation counter

This standard reference material was prepared in the Center for Radiation Research, Ionizing Radiation Division, Radioactivity Group, Dale D. Hoppes, Group Leader.

Gaithersburg, MD 20899  
January, 1991

William P. Reed, Acting Chief  
Office of Standard Reference Materials

\*Notes on back

0105

### NOTES

- (1) Approximately five milliliters of solution. Ampoule specifications:

body diameter	16.5 ± 0.5 mm
wall thickness	0.60 ± 0.04 mm
barium content	less than 2.5 percent
lead oxide content	less than 0.02 percent
other heavy elements	trace quantities

- (2) Solution density is 1.014 ± 0.002 g/mL at 21.5 °C.

- (3) The overall uncertainty was formed by taking three times the quadratic combination of standard deviations of the mean, or approximations thereof, for the following:

a) liquid-scintillation measurements	0.01 percent
b) gravimetric measurements	0.05 percent
c) dead time	0.10 percent
d) background	0.01 percent
e) detection efficiency	0.30 percent
f) decay-scheme data	0.10 percent
g) half life	0.01 percent
h) radionuclidic impurities	0.10 percent

- (4) The limit of detection for photon-emitting impurities is:

$$0.01 \gamma \text{ s}^{-1}\text{g}^{-1} \text{ between } 50 \text{ and } 1900 \text{ keV.}$$

- (5) The limit of detection for alpha-particle-emitting impurities is:

$$0.05 \alpha \text{ s}^{-1}\text{g}^{-1}.$$

- (6) NCRP Report No. 58, 2nd Edition, February 1985, p. 365.

For further information please contact Dr. Larry Lucas at (301) 975-5546.

NOTES ON THE USE  
OF  
STANDARD REFERENCE MATERIAL 4919G, STRONTIUM-90

The activity of the strontium-90 in the ampoule is given per gram of solution. If transfers are made by volume, the density given on the certificate can be used to compute the activity per unit volume. The activity given is the strontium-90 activity only. Because the strontium-90 is in equilibrium with its yttrium-90 daughter, which is also a beta-particle emitter, the activity given should be doubled to get the corresponding total beta-particle-emission rate.

If the solution is to be used for making quantitative sources, it should be kept tightly sealed so that evaporation, and the consequent change in the radioactivity concentration, is minimized. Glass containers are best for storage.

Dilute solutions of strontium-90 are often assayed by liquid-scintillation counting. We recommend that carrier solution containing approximately 1 mg of non-radioactive strontium be added first to the liquid-scintillation cocktail. We typically use a carrier solution containing 4 mg of strontium per mL of 0.5- molar hydrochloric acid. When 0.25 mL of this solution is added to 10 mL of emulsion-type liquid-scintillation cocktail, the resulting 1 mg of strontium per vial is generally sufficient to prevent the radioactive strontium-90 from plating out on the vial walls. A set of liquid-scintillation vials that cover a range of sample-solution masses should be prepared and monitored over several days to ensure that the efficiency is constant.

The beta-particle counting efficiency will be somewhat less than unity. A correction for the loss of low-energy beta particles can be computed using the integral-discriminator-extrapolation technique (G. Goldstein, Nucleonics 23 (1965) 67) or using the liquid-scintillation efficiency-tracing technique with tritium (B.M. Coursey et al, Int. J. Radiat. Isotopes 37 (1986) 403).

The activity concentration given on the certificate is as of 1200 hours Eastern Standard Time, August 9, 1990. To convert from EST to your local time, the table given below can be used.

**TO CONVERT FROM EST TO:**

<b>EDT</b>	<b>Add</b>	<b>1 hour</b>
<b>CDT</b>	<b>Same as EST</b>	
<b>CST</b>	<b>Subtract</b>	<b>1 hour</b>
<b>MDT</b>	<b>Subtract</b>	<b>1 hour</b>
<b>MST</b>	<b>Subtract</b>	<b>2 hours</b>
<b>PDT</b>	<b>Subtract</b>	<b>2 hours</b>
<b>PST</b>	<b>Subtract</b>	<b>3 hours</b>
<b>UTC</b>	<b>Add</b>	<b>5 hours</b>

ISOTOPE VOLUME DILUTION RECORD

AA0046

Isotope: Sr-90 Vendor: NIST Reference Date: 1200 EST 8-1-79  
 Total Activity: NA Vendor ID: SRM 4919-G Receive Date: 10-30-1991  
 Total wt.(g) ~5.0g NIST traceable Y/N Cert # 4919-G t<sub>1/2</sub> 28.5 ± 0.2 years  
 Activity UNITS/g 4.514 × 10<sup>3</sup> Bq converted to dpm/g 2.708 × 10<sup>5</sup> Receiver's Name Jimmy Moral

PRIMARY DILUTION: Prepared by volume

Date: 11/19/91 Preparer's Name: Nee Van Nuyen  
 a: Decay corrected activity: 2.708 × 10<sup>5</sup> dpm/g (\* if <100yr decay correct to preparation date)  
 b: Wt. of Volumetric: 60.2814 g Balance wt check done   
 c: Wt. Volumetric + source: 65.2000 g Diluent: 1M HCl  
 d: Wt. of source transferred (c-b): 4.9186 g e: Wt. of diluent + source: N/A g  
 f: Vol. of diluent + source: 100 mL g: Activity of dilution (a\*d/e): N/A dpm/g  
 h: Density (e/f): N/A g/mL i: Activity by volume (g\*h): 13321.54 dpm/mL  
 Dilution Log Book ID: 91-225-30-1 (SRM 4919G-A) 6000.69 pCi/m

Working Level Dilution: Prepared by volume

Date: 5-6-92 Preparer's Name: Joe Hutchinson  
 A: Decay corrected activity: 6000.69 pCi/mL ⇒ corrected activity 5757.65 dpm/mL (\* if <100yr decay correct to preparation date)  
 B: Wt. of Volumetric: N/A g Balance wt check done   
 C: Wt. Volumetric + source: N/A g Diluent: 0.1N HNO<sub>3</sub>  
 D: Wt. of source transferred: N/A g E: Wt. of diluent + source: N/A g  
 F: Vol. of source transferred: 1 mL G: Vol. of diluent + source: 250 mL  
 H: Activity of dilution (A\*F/E): N/A dpm/g I: Density (E/G): N/A g/mL  
 I: Activity by volume (A\*F/G), (H\*I) or (A\*D/E): ~~23.0~~ 46.0 pCi/mL

Dilution Log Book ID: 91-225-63

Log Book Transfer Reviewed by: [Signature] Date: 4/7/93

↓ pCi  
 23.0 dpm/mL Sr-90  
 23.0 dpm/mL Y-90

## SECONDARY/WORKING LEVEL STANDARD DILUTION RECORD

Dilution Source Information	
Isotope:	<u>Sr-90</u>
Parent Barcode Number	<u><del>Yes NA</del> AA0046</u>
Vendor or Certificate I.D. # of Parent Standard:	<u>SRM 4919-G</u>
Diluted Source Logbook I.D. #:	<u>91-225-30-1</u>
Balance Verification?:	<u>Yes</u>
Diluent Used:	<u>1 M HCl</u>
<u>Ref Date 8/1/90</u>	

Dilution	
*Diluent:	<u>1 M HCl</u>
*Density of diluent (g/ml):	<u>NA</u> g/ml
a: Parent Specific Activity:	<u>6000.69</u> $\frac{\text{pCi/ml}}{\text{pCi/g}}$ on <u>8/1/90</u>
b: Amount of Source Transferred:	<u>0.5033</u> g
c: Total amount of Dilution:	<u>124.4545</u> g
d: Total Volume of Dilution:	<u>NA</u> ml
e: Activity of Dilution (a * b / c):	<u>24.27</u> $\frac{\text{pCi/g} \cdot \text{g}}{\text{g}}$ $\frac{\text{pCi}}{\text{mL}}$
f: Activity of Dilution (a * b / d):	<u>24.27</u> pCi/ml
Dilution Logbook I.D. #:	<u>94-0677-20-1</u>
Prepared By: <u>Joe Hitchman</u>	Preparation Date: <u>12/6/94</u>
Reviewed By: <u>James Wong</u>	Review Date: <u>12-5-94</u>
<small>*If the diluent remains unchanged from the diluent used for the dilution source, then a weight dilution of a volume unit source can be performed without a density conversion. If the diluent changes, a weighted proportion density conversion is necessary.</small>	

KLVD 5/31/77  
ACSR81  
RIS

U.S. Environmental Protection Agency  
Environmental Monitoring Systems Laboratory-Las Vegas  
Nuclear Radiation Assessment Division

Calibration Certificate

Description

Principal radionuclide **Strontium-90** Half-life **28.6 years**

Nominal activity **27** **nano** curies

Nominal volume **5** ml in ampoule/bottle number **94003-1**

Measurement Activity of principal radionuclide

Activity per gram of this solution

**5.40** **nano** curies of **Strontium-90**

at 0400 hours PST on **April 1, 1994**

Activity of daughter radionuclide

The principal activity was accompanied at the quoted time by

**5.40** **nano** curies Per gram

of the daughter nuclide **Yttrium-90**

Total mass of this solution

**Approximately 5.0** grams

Method of measurement

The activity of the primary solution was measured by liquid scintillation counting.

The activity of the dilution was measured by liquid scintillation counting.

Useful Life

This radionuclide has decayed through **0.0** half lives since it was obtained by EMSL-LV

We recommend that this solution should not be used after **August 1994**

This dilution was prepared for the 1994 ASTM Collaborative Study of a test method for the determination of Sr-90 in water.

110  
C81E

**Purity**

The manufacturer states that activities other than that of the principal nuclide and of its daughter nuclides, if any, were estimated/known to be:

- (1)  less than  % of the principal activity  
(2)  less than  % of the principal activity  
(3)  less than  % of the principal activity

The activity of impurity (1) is not (2) is not (3) is not included in the quoted figures of the principal activity.

**Random Errors**

The precision of this standard was such that the certified value of the radioactive concentration of the principal activity had a standard error (sm) not greater than  $\pm 0.1\%$  (The 99.7% confidence limits are given by  $t(sm)$  where  $t$  is obtained from the student  $t$  factor for the degree of freedom ( $n-1$ )).

The maximum uncertainty due to the assessable systematic errors (dilution, counting, and known uncertainty of the standard) is obtained by the separate arithmetic summation of the positive and negative systematic error ( $+\delta - \delta'$ ). These have been estimated not to exceed

$+3.8\%$  or  $-3.8\%$

the overall uncertainty (often called accuracy) is an estimate of the possible divergence of the quoted result from the true value. It is a combination of random error  $[t(sm)]$  at the 99.7% confidence limits and the worst case estimate of the systematic errors ( $+\delta, -\delta'$ ). The overall uncertainty is therefore calculated on the basis of  $+ [t(sm) + \delta], - [t(sm) + \delta']$  and is  $+4.0\%$ ,  $-4.0\%$  of the quoted radioactive concentration.

**Decay Schemes**

This standardization is based on the following assumptions of the principle nuclide, its daughter nuclides and impurities (no allowance for error in these assumptions or the assumption of quoted half-life have been included in the statement of accuracy above).

Strontium-90 decays 100 percent by beta emission to yttrium-90. Yttrium-90 also decays 100 percent by beta emission.

**Chemical Composition of Solution**

Carrier content per gram of solution:  
30 micrograms strontium

Other components:  
0.1 M HCl

Preservative:

**Remarks**

Date Certificate Prepared April 26, 1994

Approval Signature Paul B. Fahn 011

Sr-90

# INITIAL STANDARD DILUTION RECORD

### Standard Information:

Isotope:	<u>Sr-90</u>	Vendor:	<u>EPA</u>
Activity of Standard Received:	<u><math>2.7 \times 10^4</math> uCi</u>	Vendor I.D. #	<u>94003-1</u>
Weight of Standard Received (g):	<u>50 g</u>	LAL I.D. #:	<u>AC5281</u>
Standard Activity (pCi/g):	<u><math>5.4 \times 10^3</math> pCi/g</u>	NIST Traceable ?	<u>yes</u>
Half-life in Years or Days:	<u>28.6 yrs</u>	Certificate #:	<u>94003-1</u>
Reference Date:	<u>4-1-1994</u>	Receiver's Name:	<u>K. Free</u>
		Date Received:	<u>5-3-94</u>

### Primary Dilution

Balance Verification?:	<u>yes</u>
Diluent Used:	<u>0.1M HCl</u>
a: Decay Corrected Standard Activity (pCi/g):	<u><math>5.4 \times 10^3</math> pCi/g</u>
b: Weight of the Source Transferred (g):	<u>4.9670 g</u>
c: Total diluted weight (g):	<u>49.91 g</u>
d: Total Diluted Volume (mL)	<u>50 mL</u>
e: Activity of Dilution by Weight (pCi/g) (a * b / c):	<u>537.4 pCi/g</u>
f: Calculated Density of Solution (g/mL) (c / d):	<u>0.9982 g/mL</u>
g: Activity of Dilution by Volume (pCi/mL) (e * f):	<u>536.44 pCi/mL</u>
h. Dilution Logbook I.D. #:	<u><del>93-474-81-1</del> <sup>93-474-82-1</sup> CP47/95</u>
Prepared By: <u>Agnes Wong</u>	Preparation Date: <u>6-15-94</u>
Reviewed By: <u>Joe Hutchison</u>	Review Date: <u>6/30/94</u>
Purity/Cross Check Performed By: _____	Check Date: _____

*Agnes Wong*

Signed

Date

Signed

Date

0112

### SECONDARY/WORKING LEVEL STANDARD DILUTION RECORD

Dilution Source Information	
Isotope:	<u>Sr-90</u>
Ref. <u>4-1-94</u> Parent Barcode Number	<u>AC5281</u>
Vendor or Certificate I.D. # of Parent Standard:	<u>EPA 94003 - 1</u>
Diluted Source Logbook I.D. #:	<u>93-474 - 82 - 1</u>
Balance Verification?:	<u>Yes</u>
Diluent Used:	<u>0.1 M HCl</u>

Dilution	
*Diluent:	<u>0.1 M HCl</u>
*Density of diluent (g/ml):	<u>N/A</u>
a: Parent Specific Activity:	<u>536.44 pCi/ml</u>
b: Amount of Source Transferred:	<u>5.0018 g</u>
c: Total amount of Dilution:	<u>100.20 g</u>
d: Total Volume of Dilution:	<u>N/A</u>
e: Activity of Dilution (a * b / c):	<u>N/A</u>
f: Activity of Dilution (a * b / d):	<u>26.78 pCi/ml</u>
Dilution Logbook I.D. #:	<u>94-677-44 - 1</u>
Prepared By: <u>Dynes Wong</u>	Preparation Date: <u>3-2-95</u>
Reviewed By: <u>Joe H. H.</u>	Review Date: <u>3/3/95</u>

\*If the diluent remains unchanged from the diluent used for the dilution source, then a weight dilution of a volume unit source can be performed without a density conversion. If the diluent changes, a weighted proportion density conversion is necessary.

**CARBON-14**  
**LAL-93-SOP-0209**

# LOCKHEED ANALYTICAL LABORATORY <sup>200</sup>

## SAMPLE PREPARATION WORKSHEET FOR C-14 ANALYSIS

SOP-0209

Prep Start Date : \_\_\_\_\_  
 WorkGroup : C-14 LAL-0209 34132

Matrix : Water  
 Prep Due Date : 14-Mar-96

CUSTOMER ID	PARENT LAL ID	NO	QC	VIAL LAL ID	FLASK + WET SOIL (grams)	FLASK EMPTY (grams)	WET SOIL NET WT. (grams)	FLASK + DRY SOIL (grams)	DRY SOIL NET WT. (grams)	DISTILLED VOLUME (L)	ALIQUOT VOLUME (L)	COMMENTS
L6496-12	34132DUP1	1		34132-01							.01	
Lab Ctrl Sample	34132LCS1	2		34132-02								
Method Blank	34132MBB	3		34132-03								
L6496-12	34132MS1	4		34132-04								
BOHOV4	L6496-12	5		34132-05								
		6										
		7										
		8										
		9										
		10										
		11										
		12										
		13										
		14										
		15										
		16										
		17										
		18										
		19										
		20										
		21										
		22										
		23										
		24										
Conc & Vol of MS		1 mL 26.1 pCi/mL		Conc & Vol of LCS		1 mL 26.1 pCi/mL		Prep Analyst		MJ		
MS Ref Date		11/15/92		LCS Ref Date		11/15/92		Start Date		2/27/96		
C-14 MS ID#		94-677-18-1		C-14 LCS ID#		94-677-18-1		Count Analyst				

Balance Number : \_\_\_\_\_ ( )  
 \_\_\_\_\_ ( )

Pipette : \_\_\_\_\_ ( )  
 \_\_\_\_\_ ( )

MS and LCS added by : MJ  
 Witnessed by :                     

Comments : ~~Cocktail - 5 mL CarboSorb/15 mL Hiionic Fluor; vial 20 mL poly.~~ DIRECT SPIKE 10 mL Sample + 10 mL of Ultima Gold

0115

Analyst :                     

Checked by :                     

Cnt Rm Custody/Date : SV 2-27-96

# LOCKHEED ANALYTICAL LABORATORY

## SAMPLE PREPARATION WORKSHEET FOR C-14 ANALYSIS

SOP-0209

Prep Start Date : 2/27/96

WorkGroup : C-14 LAL-0209 34132

Matrix : Water

Prep Due Date : 14-Mar-96

CUSTOMER ID	PARENT LAL ID	NO	QC	VIAL LAL ID	FLASK + WET SOIL (grams)	FLASK EMPTY (grams)	WET SOIL NET WT. (grams)	FLASK + DRY SOIL (grams)	DRY SOIL NET WT. (grams)	DISTILLED VOLUME (L)	ALICUOT VOLUME (L)	COMMENTS
L6496-12	34132DUP1	1	DUP1	34132-01							0.01	
Lab Ctrl Sample	34132LCS1	2	LCS1	34132-02							0.01	
Method Blank	34132MBB	3	MBB1	34132-03							0.01	
L6496-12	34132MS1	4	MS1	34132-04							0.01	
BOHOV4	L6496-12	5	SMP1	34132-05							0.01	
		6										
		7										
		8										
		9										
		10										
		11										
		12										
		13										
		14										
		15										
		16										
		17										
		18										
		19										
		20										
		21										
		22										
		23										
		24										
Conc & Vol of MS	26.10 pCi/mL; 1.0 mL			Conc & Vol of LCS	26.10 pCi/mL; 1.0 mL			Prep Analyst	MY			
MS Ref Date	15-Nov-92			LCS Ref Date	15-Nov-92			Start Date	2/27/96			
C-14 MS ID#	94-677-18-1			C-14 LCS ID#	94-677-18-1			Count Analyst	LV			

Balance Number : \_\_\_\_\_ ( )

Pipette : \_\_\_\_\_ ( )

MS and LCS added by: MY

Witnessed by: CD

Comments : Cocktail - 5 mL CarboSorb/15 mL HionicFluor; vial 20 mL poly.

0116

Analyst : Dr. For MY

Checked by : [Signature]

Cnt Rm Custody/Date : \_\_\_\_\_

V95224



# STANDARDS

# CERTIFICATE OF CALIBRATION BETA STANDARD SOLUTION

AA0114

Radionuclide	C-14	Customer:	LOCKHEED ENVIRONMENTAL
Half Life:	5730 ± 40 years	P.O.No.:	06LAB2959
Catalog No.:	7014	Reference Date:	November 15 1992 12:00 PST.
Source No.:	407-124-2	Contained Radioactivity:	1.093 μCi
		Contained Radioactivity:	40.4 kBq

### Description of Solution

a. Mass of solution:	5.0242	grams.
b. Chemical form:	Benzoic Acid Carboxy-C-14 in 0.1N NaOH	
c. Carrier content:	None added	
d. Density:	1.002	g/ml @ 20°C.

Radioimpurities None detected

Radioactive Daughters None

Radionuclide Concentration 0.218 μCi/g

### Method of Calibration

Weighed aliquots of the solution were assayed using a liquid scintillation counter.

### Uncertainty of Measurement

- a. Systematic uncertainty in instrument calibration: ± 1.8%
- b. Random uncertainty in assay: ± 0.5%
- c. Random uncertainty in weighing(s): ± 1.0%
- d. Total uncertainty at the 99% confidence level: ± 2.2%

### NIST Traceability

This calibration is implicitly traceable to the National Institute of Standards and Technology.

### Notes

1. Nuclear data were taken from "Table of Radioactive Isotopes", edited by Virginia S. Shirley, 1986.
2. IPL participates in an NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.15).



**ISOTOPE PRODUCTS LABORATORIES**  
 1800 North Keystone Street  
 Burbank, California 91504  
 (818) 843 - 7000

*Anna V. Uman*  
 \_\_\_\_\_  
**QUALITY CONTROL**  
 \_\_\_\_\_  
 Nov. 17, 1992  
 \_\_\_\_\_  
**Date Signed**

**ISOTOPE WEIGHT DILUTION RECORD**

Isotope: C-14 Vendor: IPL  
 Total Received Activity: 1.093  $\mu$ Ci Vendor ID: 407-124-2  
 Wt. Received: 5.024 g. NIST Traceable  Cert. # Implicitly  
 Activity in Units/g: .2175  $\mu$ Ci/g Reference Date: 11-15-92  
 Activity converted (dpm/g): 482,954 dpm/g Receive Date: 11/18/92  
 Half-life (Yrs or days)  $t_{1/2}$  = 5730  $\pm$  40 years Receiver's Name: Jimmy Morales

**PRIMARY DILUTION:**

Balance wt. check done

a: Source activity: 482,954 dpm/g \* (if  $t_{1/2}$  = <100yr decay to prep. date)  
 b: Wt. of Source transferred: 4.90951 g  
 Diluent used: 0.1 N<sub>2</sub>O<sub>4</sub>  
 c: Total diluted weight: 116.53 g  
 d: Activity of dilution (a\*b/c): 20,347 dpm/g  $\pm$  2.2%  
 e: Calculated density of solution: 1.052 g/mL (4M HNO<sub>3</sub> = 1.1294  $\pm$  .0007 g/mL)  
 f: Activity by volume = (d\*e): 20,388 dpm/mL  
 Dilution Log Book ID: LAL-93-474-23-1 ✓  
 Preparation Date: 10/27/93 Preparer's Name: MY

**SECONDARY OR WORKING LEVEL DILUTION**

Balance wt. check done

Log Book ID of source being diluted: \_\_\_\_\_  
 a: Source activity: \_\_\_\_\_ dpm/g \* (if  $t_{1/2}$  = <100yr decay to prep. date)  
 b: Wt. of Source transferred: \_\_\_\_\_ g  
 Diluent used: \_\_\_\_\_  
 c: Total diluted weight: N/A g  
 d: Activity of dilution (a\*b/c): \_\_\_\_\_ dpm/g  
 e: Calculated density of solution: \_\_\_\_\_ g/mL (4M HNO<sub>3</sub> = 1.1294  $\pm$  .0007 g/mL)  
 f: Activity by volume = (d\*e): \_\_\_\_\_ dpm/mL  
 Dilution Log Book ID: \_\_\_\_\_

MAS  
Signed

10/27/93  
Date

Revised Signed

0120  
Date

# INITIAL STANDARD DILUTION RECORD

Standard Information:			
Isotope:	C-14	Vendor:	Isotope Product
Activity of Standard Received:	1.09 uCi	Vendor I.D. #	
Weight of Standard Received (g):	5.0242 g	LAL I.D. #:	AA0114
Standard Activity (pCi/g):	2.17E+05 pCi/g	NIST Traceable ?	Yes
Half-life in Years or Days:	5730 yrs	Certificate #:	407-124-2
Reference Date:	11/15/92	Preparer's Name:	Mark Young
		Date Received:	11/18/92

Primary Dilution:	
Balance Verification?:	Yes
Diluent Used:	0.1 N NaOH
a: Decay Corrected Standard Activity (pCi/g):	2.17E+05 pCi/g
b: Weight of the Source Transferred (g):	4.90951 g
c: Total diluted weight (g):	116.53 g
d: Total Diluted Volume (mL)	116.3 mL
e: Activity of Dilution by Weight (pCi/g) [a * b / c]:	9.139E+03 pCi/g
f: Calculated Density of Solution (g/ml) [c / d]:	1.0020 g/mL
g: Activity of Dilution by Volume (pCi/mL) [e * f]:	9.157E+03 pCi/mL
h. Dilution Logbook I.D. #:	<b>LAL-93-0474-23-1</b>
Prepared By: _____	Preparation Date: <u>10/27/93</u>
Reviewed By: _____	Review Date: _____
Purity/Cross Check Performed By: _____	Check Date: _____

## SECONDARY/WORKING LEVEL STANDARD DILUTION RECORD

Dilution Source Information	
Isotope:	<u>C-14</u>
Parent Barcode Number	<u>AA0114</u>
Vendor or Certificate I.D. # of Parent Standard:	<u>407-124-2</u>
Diluted Source Logbook I.D. #:	<u>LAL-93-0474-23-1</u>
Balance Verification?:	<u>Yes</u>
Diluent Used:	<u>0.1 N NaOH</u>

Dilution	
*Diluent:	<u>Nanopure w/ 1 mg/ml formaldehyde</u>
*Density of diluent (g/ml):	<u>1.0006</u> g/ml
a: Parent Specific Activity:	<u>9.14E+03</u> pCi/g
b: Amount of Source Transferred:	<u>0.70</u> g
c: Total amount of Dilution:	<u>250.14</u> g
d: Total Volume of Dilution:	<u>250</u> ml
e: Activity of Dilution [a * b / c]:	<u>2.57E+01</u> pCi/g
f: Activity of Dilution (a * b / d):	<u>2.58E+01</u> pCi/ml
Dilution Logbook I.D. #:	<u>LAL-94-0677-18-1</u>
Prepared By: <u>Agnes Wong</u>	Preparation Date: <u>11/19/94</u>
Preparer Signature: _____	
Reviewed By: _____	Review Date: _____
Reviewer Signature: _____	
<small>*If the diluent remains unchanged from the diluent used for the dilution source, then a weight dilution of a volume unit source can be performed without a density conversion. If the diluent changes, a weighted proportion density conversion is necessary.</small>	

AA0114

### SECONDARY/WORKING LEVEL STANDARD DILUTION RECORD

Dilution Source Information	
Isotope:	C-14
Parent Barcode Number	AA0114
Vendor or Certificate I.D. # of Parent Standard:	
Diluted Source Logbook I.D. #:	93-474-23-1
Balance Verification?:	yes
Diluent Used:	DDI water in 1mg/ml formaldehyde

Dilution	
*Diluent:	Nanopure water with 1mg/ml formaldehyde
*Density of diluent (g/ml):	N/A g/ml
a: Parent Specific Activity:	9267.27 <del>20,388</del> <sup>11-19-94</sup> pCi/g pCi/ml
b: Amount of Source Transferred:	0.7046 g
c: Total amount of Dilution:	250.14 g
d: Total Volume of Dilution:	N/A ml
e: Activity of Dilution (a * b / c):	N/A pCi/g
f: Activity of Dilution (a * b / d):	26.10 pCi/ml
Dilution Logbook I.D. #:	94-677-18-1 ✓
Prepared By:	Dagmar Wong
Preparation Date:	11-19-94
Reviewed By:	Joe Hultman
Review Date:	12/16/94
*If the diluent remains unchanged from the diluent used for the dilution source, then a weight dilution of a volume unit source can be performed without a density conversion. If the diluent changes, a weighted proportion density conversion is necessary.	

**TRITIUM**  
**LAL-91-SOP-0066**

# LOCKHEED ANALYTICAL LABORATORY

## SAMPLE PREPARATION WORKSHEET FOR H-3 ANALYSIS

SOP-0066

Prep Start Date : 3/8/96

Matrix : Water

WorkGroup : TRITIUM(H3) LAL-0066 34127

Prep Due Date : 19-Mar-96

CUSTOMER ID	PARENT LAL ID	NO	QC	VIAL LAL ID	FLASK + WET SOIL (grams)	FLASK EMPTY (grams)	WET SOIL NET WT. (grams)	FLASK + DRY SOIL (grams)	DRY SOIL NET WT. (grams)	DISTILLED VOLUME (L)	ALiquOT VOLUME (L)	COMMENTS
L6496-12	34127DUP1	1		34127-01						.056	.010	
Lab Ctrl Sample	34127LCS1	2		34127-02						↓	↓	
Method Blank	34127MBB	3		34127-03						↓	↓	
L6496-12	34127MS1	4		34127-04						.051	↓	50 mL Sample, 1 mL MS
BOHOV4	L6496-12	5		34127-05						.050	↓	
		6										
		7										
		8										
		9										
		10										
		11										
		12										
		13										
		14										
		15										
		16										
		17										
		18										
		19										
		20										
		21										
		22										
		23										
		24										
Conc & Vol of MS	226.2 pCi/ml		1.0 mL		Conc & Vol of LCS		4690 pCi/L	50 mL		Prep Analyst		CP
MS Ref Date	2/6/96				LCS Ref Date		6/3/92			Start Date		3/8/96
H-3 MS ID#	94-677-98-1				H-3 LCS ID#		721-17-1			Count Analyst		

Balance Number : \_\_\_\_\_ ( )

Pipette : 71008 ( )

MS and LCS added by : CP

Witnessed by : NR

Comments : Cocktail - Packard Ultima Gold XR; vial - 20 mL poly.

0125

Analyst : [Signature]

Checked by : [Signature]

Cnt Rm Custody/Date : [Signature] 3/8/96

V95224

# LOCKHEED ANALYTICAL LABORATORY

## SAMPLE PREPARATION WORKSHEET FOR H-3 ANALYSIS

SOP-0066

Prep Start Date : 3/8/96

Matrix : Water

WorkGroup : TRITIUM(H3) LAL-0066 34127

Prep Due Date : 19-Mar-96

CUSTOMER ID	PARENT LAL ID	NO	QC	VIAL LAL ID	FLASK + WET SOIL (grams)	FLASK EMPTY (grams)	WET SOIL NET WT. (grams)	FLASK + DRY SOIL (grams)	DRY SOIL NET WT. (grams)	DISTILLED VOLUME (L)	ALIQUOT VOLUME (L)	COMMENTS
L6496-12	34127DUP1	1	DUP1	34127-01							0.01	
Lab Ctrl Sample	34127LCS1	2	LCS1	34127-02							0.01	
Method Blank	34127MBB	3	MBB1	34127-03							0.01	
L6496-12	34127MS1	4	MS1	34127-04							0.01	1ml MS added to
BOHOV4	L6496-12	5	SMP1	34127-05							0.01	50ml MSS then distilled.
		6										
		7										
		8										
		9										
		10										
		11										
		12										
		13										
		14										
		15										
		16										
		17										
		18										
		19										
		20										
		21										
		22										
		23										
		24										
Conc & Vol of MS		226.20 pCi/mL; 1.0 mL			Conc & Vol of LCS		4.69 pCi/mL; 10.0 mL			Prep Analyst		CD
MS Ref Date		06-Feb-96			LCS Ref Date		03-Jun-92			Start Date		3/8/96
H-3 MS ID#		94-677-98-1			H-3 LCS ID#		95-721-17-1			Count Analyst		LV

Balance Number : \_\_\_\_\_ ( )  
 \_\_\_\_\_ ( )

Pipette : 71008 \_\_\_\_\_ ( )  
 \_\_\_\_\_ ( )

MS and LCS added by: CD  
 Witnessed by : \_\_\_\_\_

Comments : Cocktail - Packard Ultima Gold XR; vial - 20 mL poly.

0100

Analyst : Sr for CD  
 DATA ENTRY

Checked by : [Signature]

Cnt Rm Custody/Date : \_\_\_\_\_

V95224



# STANDARDS

RECEIVED  
1125195  
RKC

U.S. Environmental Protection Agency  
Environmental Monitoring Systems Laboratory-Las Vegas  
Nuclear Radiation Assessment Division

Calibration Certificate

Description

Principal radionuclide  Half-life

Nominal activity   curies

Nominal volume  ml in ampoule/bottle number

Measurement Activity of principal radionuclide

Activity per gram of this solution

curies of

at 0400 hours PST on

Activity of daughter radionuclide

The principal activity was accompanied at the quoted time by

Per gram

of the daughter nuclide

Total mass of this solution

grams

Method of measurement

The activity of the primary solution and this dilution were measured by liquid scintillation counting.

Counting efficiencies for both standardizations were determined by counting solutions directly traceable to the National Institute of Standards & Technology (NIST).

Useful Life

This radionuclide has decayed through  half lives since it was obtained by EMSL-LV

We recommend that this solution should not be used after

0129



U.S. DEPARTMENT OF COMMERCE  
National Institute of Standards & Technology  
Gaithersburg, MD 20899

## REPORT OF TRACEABILITY

U.S. Environmental Protection Agency  
Environmental Monitoring Systems Laboratory  
Las Vegas, Nevada

Radiónuclide            Hydrogen-3  
Source identification    2606-1, prepared by EMSL  
Source description     Liquid in 5-mL flame-sealed glass ampoule  
Source mass            Approximately 5.0 grams  
Source composition     Hydrogen-3 in water  
Reference time         0700 EST June 3, 1992

	<u>NIST DATA</u>	<u>EMSL DATA</u>
Radioactivity concentration	810.5 Bq g <sup>-1</sup>	810.3 Bq g <sup>-1</sup>
Expanded uncertainty	0.64 percent <sup>(1,2)*</sup>	4.3 percent <sup>(3)</sup>
Photon-emitting impurities	None observed <sup>(4)</sup>	None observed
Measuring instrument	4 $\pi$ $\beta$ liquid-scintillation counters calibrated with SRM 4926D	Liquid-scintillation counting
Half life	12.43 $\pm$ 0.05 years <sup>(5)</sup>	
Difference from NIST		-0.05 percent <sup>(6)</sup>

For the Director,

J.M. Robin Hutchinson, Acting Group Leader  
Radioactivity Group  
Physics Laboratory

Gaithersburg, MD 20899  
January 1994

\*Notes on next page

0130

## INITIAL STANDARD DILUTION RECORD

Standard Information:			
Isotope:	<u>H-3</u>	Vendor:	<u>EPA</u>
Activity of Standard Received:	<u>.11</u> uCi	Vendor I.D. #	<u>2/7/95</u>
Weight of Standard Received (g):	<u>5</u> g	LAL I.D. #:	<u>AC5299</u>
Standard Activity (pCi/g):	<u>21.9</u> <sup>nCi/g</sup> <del>pCi/g</del>	NIST Traceable?	<u>Yes</u>
Half-life in Years or Days:	<u>12.43</u> yrs	Certificate #:	<u>2606-1</u>
Reference Date:	<u>0400, 6/3/92</u>	Receiver's Name:	<u>Kevin Free</u>
		Date Received:	<u>1/25/95</u>

Primary Dilution			
Balance Verification?:		<u>Yes</u>	
Diluent Used:	<u>EPA</u>	<u>Distilled ASTM Type II Water (Dead Water)</u>	
a: Decay Corrected Standard Activity (pCi/g):		<u>21.9</u> <sup>nCi/g</sup> <del>pCi/g</del>	<u>on 6/3/92</u>
b: Weight of the Source Transferred (g):		<u>4.939</u>	<u>g</u>
c: Total diluted weight (g):		<u>49.377</u>	<u>g</u>
d: Total Diluted Volume (mL)		<u>50</u> <sup>2/7/95</sup> <del>49.5</del>	<u>mL</u>
e: Activity of Dilution, by Weight (pCi/g) [a * b / c]:		<u>2190</u>	<u>pCi/g</u>
f: <sup>Known</sup> <del>Calculated</del> Density of Solution (g/mL) [c / d]:		<u>0.99777</u>	<u>g/mL</u>
g: Activity of Dilution by Volume (pCi/mL) [e * f]:		<u>2190</u>	<u>pCi/mL on 6/3/92</u>
h. Dilution Logbook I.D. #:	<u>C. Pennewitz</u>	<u>LAL-95-0721-1</u>	
Prepared By:	<u>J. Hutchinson</u>	Preparation Date:	<u>2/7/95</u>
Reviewed By:	<u>Joe Hutchinson</u>	Review Date:	<u>2/7/95</u>
Purity/Cross Check Performed By:		Check Date:	<u>0131</u>

C. Pennewitz  
2/7/95

Signed

Date

CP5/8/95

Signed

Date

## SECONDARY/WORKING LEVEL STANDARD DILUTION RECORD

### Dilution Source Information

Isotope: H-3 LCS

Parent Barcode Number: AC5299 (exp. 2/97)

Vendor or Certificate I.D. # of Parent Standard: 2606-1 REF 6/3/92

Diluted Source Logbook I.D. #: 95-725-1

Balance Verification?: Yes

Diluent Used: Deep water

9-Q.M.L.

### Dilution

\*Diluent: Deep well water

\*Density of diluent (g/ml): 0.9977 g/ml

a: Parent Specific Activity: 2190 pCi/g ml

b: Amount of Source Transferred: 7 ml 12 ml <sup>g/y</sup> Glass class "A" pipet

c: Total amount of Dilution: 5600 ml <sup>g/y</sup>

d: Total Volume of Dilution: 5600 ml ml

e: Activity of Dilution (a \* b / c): ~~2.74~~ 4.69 pCi/g ml

f: Activity of Dilution (a \* b / d): ~~2.74~~ 4.69 pCi/ml EXPIRES 2/97

Dilution Logbook I.D. #: 95-0721-17-1

Prepared By:

Q.M.L.

Preparation Date:

2/1/96

Reviewed By:

Walt G. Hill

Review Date:

2/1/96

\*If the diluent remains unchanged from the diluent used for the dilution source, then a weight dilution of a volume unit source can be performed without a density conversion. If the diluent changes, a weighted proportion density conversion is necessary.

Read and Understood By

0132

Signed

Date

Signed

Date

CERT #	Calibration or cert date	Expiration date	Reference #	VENDOR	PREP	WITNESS
Parent Ref #					FUNDS	FUNDS
4927D-B	Jan 1 1989	Aug 30 1993	4927D-C	NIST		
4927D-A			91-0199-5			
ITEM #	precipitation Date	Final Concentration	Initial Concentration			
1	Aug 30 1993	3211-4-91 362.998 Bq/ml 57031.8110 Bq/ml	500,348.1105 Bq/ml			

pipet 10 ml into 100 ml vol FLASK  

$$\frac{500,348.1105 \text{ Bq/ml} \times 10 \text{ ml}}{100 \text{ ml}} = 50,034.8110 \text{ Bq/ml}$$

$$= 50.0348 \text{ Ci/ml}$$

~~SRM 4370-A made from original conc - pp 11-491~~  
~~18,515.8986 Bq/ml = 51 = 362.9980 Bq/ml - pp 10-4-91~~

(Reference page #5 LAL LOG -0199)

CERT #	Calibration or cert date	Expiration date	Reference #	VENDOR	
Parent Ref #					
4927D-A	Jan 1 1989	Aug 30 1993 11-14-91 sep 3 1993	4927D-A2	NIST	
ITEM #	precipitation Date	Final Concentration	Initial Concentration		
2	SEP 3-1991	362.9980 Bq/ml	18,512.8986 Bq/ml		

$$\frac{18,512.8986 \text{ Bq/ml}}{362.9980} \times 27.027 = 13,512.8986 \text{ Bq/ml}$$

$$= 9,810.746 \text{ Bq/ml}$$

$$= 9.81 \text{ NCi/ml}$$

(Reference page 7 LAL LOG 0199)

Continued on Page

Transferred 11-5-91 from previous

Read and Understood By

[Signature]  
Signed

11/19/91  
Date

[Signature]  
Signed

12/4/91  
Date

97 → C.M.J.

SECONDARY/WORKING LEVEL  
STANDARD DILUTION RECORD

Dilution Source Information	
Isotope:	H-3 MS
Parent Barcode Number	91-0225-8-1 EXP. 8/21/96
Vendor or Certificate I.D. # of Parent Standard:	-
Diluted Source Logbook I.D. #:	91-0225-8-1
Balance Verification?:	NA
Diluent Used:	Deep water

Dilution	
*Diluent:	Deep well water
*Density of diluent (g/ml):	1 g/ml
a: Parent Specific Activity:	33937.3 pCi/ml pCi/g $\frac{1.37 \times 10^6}{55.5}$ @ 2/6/96
b: Amount of Source Transferred:	1.0 g
c: Total amount of Dilution:	150 g $\frac{1.5 \times 10^2}{1.0}$
d: Total Volume of Dilution:	150 ml
e: Activity of Dilution (a * b / c):	226.2 pCi/ml pCi/g $\frac{1.37 \times 10^6}{55.5}$ Pipet # 139746
f: Activity of Dilution (a * b / d):	226.2 pCi/ml @ 2/6/96
Dilution Logbook I.D. #:	94-0677-98-1
Prepared By: <u>J. C. Muel</u>	Preparation Date: <u>2/29/96</u>
Reviewed By: <u>Joe Hutchinson</u>	Review Date: <u>2/29/96</u>

\*If the diluent remains unchanged from the diluent used for the dilution source, then a weight dilution of a volume unit source can be performed without a density conversion. If the diluent changes, a weighted proportion density conversion is necessary.

Read and Understood By

0134

Signed

Date

Signed

Date