## APPENDIX E

Instrument and Check Source Calibration Certificates

M	Designer and Manufacturer of Scientific and Industrial Instruments	CERTIFICATE	OF CALIBRATION	LUDLUM M POST OFFICE B 501 OAK STREE SWEETWATER,	EASUREMEN OX 810 PH. 32 ET FAX 1 TEXAS 79556, U.	<b>TS, INC.</b> 25-235-5494 NO. 325-235-4672 S.A.
CUSTOMER	US ARMY CORPS OF ENG	INEERS		ORDER	R NO. 202	00290/378285
Mfg.	Ludium Measurements, Inc.	Model	2360	Serial No.	138251	w
Mfg.	Ludium Measurements, Inc.	Model	43-37-1	Serial No.	PR1363	61
Cal. Date	23-May-12	Cal Due Date	23-May-13 Cal	Interval <u>1 Ye</u>	ar Meterface	202-855
Check mark	applies to applicable inst	and/or detector IAV	W mfg. spec. T. <u>73</u> °F	RH	<u>36</u> % Alt	<u>699.8</u> mm Hg
New In	strument Instrument Recei	ved Within Toler.	+-10% 🗌 10-20% 🗌 Out of Tol	. 🗌 Requiring Rep	oair 🗌 Other-S	ee comments
Mecha F/S Res Audio o Calibrat	inical ck. 🖌 Ma p. ck 📝 Re ck. √ Ala ed in accordance with LMI Sa	eter Zeroed set ck. arm Setting ck. OP 14.8 rev 12/05/89.	<ul> <li>Background Subtract</li> <li>Window Operation</li> <li>Batt. ck. (Min. Volt)</li> <li>Calibrated in accorded</li> </ul>		Input Sens. Lir Geotropism RS-232 Port O 14.9 rev 02/07/9	nearity K ?7.
Instrument Ve	olt Set <u>1600</u> V Readout (2 points) Ref./Inst.	500 / 5	05 v Ref./Inst. 200	,2002	X V	
Firmwa Alpha Beta Th Beta W Overlog Instrum High vo	re Version: 39010 Threshold: 90 mu ineshold: 90 mu indow: 30 mu ad CHeckel 30T vo ent calibrated with a 39 oltage set with detector vo	Tset, Tset, Tcoble.	(EEPROM Setting: User Time: Alpha Alarm: 9 Beta Alarm: 9 A/B Alarm: 9 Model 2360 Date Calibration Date	5) 1,0 999999 99999 99999 99999 5:5/2 Due: 5	3/20/2	3

### COMMENTS:

Pu239 SN:7053 Size:12600cpm, Background:6cpm, Counts:5281cpm, 2pi Eff:41.86% Tc99 SN:5280 Size:58300cpm, Background:1002cpm, Counts:26891cpm, 2pi Eff:44.40% SrY90 SN:5281 Size:69345cpm, Background:1002cpm, Counts:25826cpm, 2pi Eff:35.79%

Samma Calibration: GM detectors positioned perpendicular to source except for M 44-9 in which the front of probe faces source.

$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	RUMENI ER READING* <u>400</u> <u>100</u> <u>400</u> <u>100</u> <u>400</u> <u>100</u> <u>100</u> <u>5) Calibrated Electronically</u> INSTRUMENT METER READING*	5
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Y UO         100         400         100         400         100         400         100         400         100         900         100         900         100         Y00         INSTRUMENT         METER READING*	5
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	100 400 400 100 400 100 100 5) Calibrated Electronically INSTRUMENT METER READING*	-
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	-400 -400 -100 -100 -100 -100 	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	s) Calibrated Electronically IOU IOU INSTRUMENT METER READING*	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	IUU IOO IOO IOO IOU s) Calibrated Electronically INSTRUMENT METER READING*	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	100 400 100 s) Calibrated Electronically INSTRUMENT METER READING*	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	S) Calibrated Electronically I O U INSTRUMENT METER READING*	c
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	s) Calibrated Electronically INSTRUMENT METER READING*	
*Uncertainty within $\pm 10\%$ C.F. within $\pm 20\%$ ALL Range(s) CallReferenceINSTRUMENTINSTRUMENTREFERENCEINSTRUMENTCAL. POINTRECEIVEDMETER READING*CAL. POINTRECEIVEDDigital Readout400kcpm $39986(0)$ $39986(0)$ CallCall40kcpm $3998$ $3998$ CallLog ScaleCall40cpm $400$ $400$ $400$ $400$ $400$ 400cpm $400$ $400$ $400$ $400$ 400cpm $400$ $400$ $400$ $400$	s) Calibrated Electronically INSTRUMENT METER READING*	, <b></b>
REFERENCE     INSTRUMENT     INSTRUMENT     REFERENCE     INSTRUMENT       CAL. POINT     RECEIVED     METER READING*     CAL. POINT     RECEIVED       Digital     400kcpm     39986(0)     39986(0)     Scale       40kcpm     3998     3998     Scale       4kcpm     400     400     400       400cpm     400     400     400	INSTRUMENT METER READING*	
REFERENCEINSTRUMENTINSTRUMENTREFERENCEINSTRUMENTCAL. POINTRECEIVEDMETER READING*CAL. POINTRECEIVEDDigital Readout $400kcpm$ $39986(0)$ $39986(0)$ Scale		k
$\begin{array}{c ccccc} CAL POINT & RECEIVED & METER READING & CAL POINT & RECEIVED \\ \hline Digital Readout & 400kcpm & 39986(o) & 39986(o) \\ \hline 40kcpm & 3998 & 3998 \\ \hline 4kcpm & 400 & 400 \\ \hline 400cpm & 40 & 400 \\ \hline 400cpm & 40 & 40 \\ \hline 40cpm & 40 & 40 \\ \hline \end{array}$		
Readout       400kcpm       59986(0)       39986(0)       scăle         40kcpm       3998       3998		
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		
$ \begin{array}{c} 400 \text{cpm} & 40 \\ \hline 40 \text{cpm} & 40 \\ \hline \end{array} \end{array} $		
40  cpm $(9 ) (9 )$		
Ludium Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type	gy, or to the calibration facilities of atio type of calibration techniques.	
The calibration system conforms to the requirements of ANSI/NCSL 2540-1-1994 and ANSI N323-1978 State of Texas Calibra	Calibration License No. LO-1963	3
Reference Instruments and/or Sources:         73410         1131         781         059         280         60646         70897         Rate	Ra-226 S/N Y982	
Cs-137 Gamma S/N 1162 G112 M565 5105 T1008 T879 E552 E551 720 734 1616 Ne	Neutron Am-241 Be S/N T-30	04
Alpha S/N Beta S/N Other		~ ~ ~
✓ m 500 S/N 190566 Oscilloscope S/N ✓ Multimeter S/N	86250390	
Calibrated By: Jan Zan Date 23-MAY-1	- 12	
Reviewed By: Date 24Mgy12	<b></b>	-
This certificate shall not be reproduced except in full, without the written approval of Ludium Measurements. Inc.       AC Inst.       Passed Dielectric (HONING C22S 10/24/2011)         FORM C22S 10/24/2011       Pageot       Q	ctric (Hi-Pot) and Continuity Tes	st



### Bench Test Data For Detector

Detector	43-37-1	Serial No. PA 136361	Order #.	20200290/37828	5
Customer U	SARMY CORF	S OF ENGINEERS	Alpha Input Sensitivity	90	mV
Counter	2360	Serial No. 138251	Beta Input Sensitivity	Ч	m٧
Count Time	1Minute		Beta Window	<u> </u>	mV
Other			Distance Source to Detector	Surface	

Alpha	Beta	Alpha	Data		•		
5	00		Beta	Alpha	Beta	Alpha	Beta
	8/8	5084	1091	37	25158	3	2/603
6	1002	5281	1354	37	26891	3	25826
Ч	1268	5333	1586	38	27067	9	28900
9	1534	5484	2018	78	25432	58	31340
				<b>,</b> ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			
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	and another the to a summarize the term						
				which is a specific common production of the specific spe			
						Mar Mar Mar and Araba and	<b>.</b>
					1		
	nannannan annaise annaise i Me Phonochail	a and a set of the state of the state of the set of the					
	y g al detector	4 4 1268 9 1534 1534 al detector count rate dec	$\frac{0}{4} = \frac{1268}{1534} = \frac{5333}{5484}$	$\frac{0}{4} = \frac{100 \times 5281}{1268} = \frac{157}{1268} = \frac{1533}{1586} = \frac{1534}{2018} = \frac{1534}{2018} = \frac{1586}{2018} = \frac{100}{2018} $	$\frac{2}{9} \frac{100}{1268} \frac{5333}{5333} \frac{1586}{1586} \frac{38}{38}$ $\frac{9}{1539} \frac{1539}{5989} \frac{5989}{2018} \frac{78}{78}$	$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$

 $\Box$  Gas proportional detector count rate decreased  $\leq$  10% after 5 hour static test using 39" cable and alpha/beta counter.

Signature Asam Asam C4B 03/11/2010 Page 2 of 2 • Servina The

Date 23-119-12

FORM C48 03/11/2010

Serving The Nuclear Industry Since 1962 •



EnergySolutions Services, Inc. 1570 Bear Creek Road Oak Ridge, TN 37830 Phone: (877) 462-4873 Fax: (865) 220-1346

This Certificate will be accompanied by Calibration Charts or Readings where applicable

(	USTOMER	INFORM	MATION		INSTRUMENT INFORMATION					
Customer Nar	ne: Energy <i>Sol</i>	utions Ser	vices, Inc.		Manufacturer: Lu	dlum				
Address: 1570	Bear Creek R	load Oak	Ridge, TN	37830	Model: 2360	Serial Number: 275713				
Contact Name	Tony Riggs				Probe: N/A	Serial Number: N/A				
Customer Pur Number: N	chase Order A	Work Or Number:	rder 201 : <del>2011-110</del>	1-11001 Halantin	Calibration Method: Electronic					
			INST	RUMENT C	ALIBRATION INF	ORMATION				
Instrument	Calibratio	m	Raten Response ( Standard	neter (± 10% of Values)	Calibration Standard Value	Time Base	Tolerances	Sca Resj	ller Donse	
Kange	Standard va	A	s Found	As Left	СРМ	(minutes)	(cpm) ± 2%	As Found	As Left	
X 1	100		100	100	1,000 CPM	0.1	90 - 110	100	100	
X 1	250		250	250	1,000 CPM	0.5	450 - 550	500	500	
X 1	400		400	400	1,000 CPM	1	900 - 1,100	1,002	1,002	
X 10	1,000		1,000	1,000	1,000 CPM	2	1.8K2.2K	2,003	2,003	
X 10	2,500 2		2,500	2,500	1,000 CPM	5	4.5K-5.5K	5,008	5,008	
X 10	4,000		4,000	4,000	1,000 CPM	10	9K-11K	10,015	10,015	
X 100	10,000		10,000	10,000						
X 100	25,000		25,000	25,000						
X 100	40,000		40,000	40,000		**********	48////////////////////////////////////	<u>a,</u>		
X 1000	100,000		100,000	100,000	Calibrat	ed in accorda	nce with OEM T	echnical Man	uat	
X 1000	250,000	:	250,000	250,000				,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		
X 1000	400,000		400,000	400,000						
			S	TATEMEN	T OF CERTIFIC	ATION	n an de Arth	and the second s		
We Certify that the We further certify incurred during sl	the instrument list that our Calibra opment or use of	ed above wa tion Measur [this mstrun	as calibrated coments are u ment).	and inspected p raceable to the 1	rior to shipment and that National Institute of Stan	t it inct all the M idards and Techr	anufacturers publis tology. (We are not	hed operating spo responsible for c	ecifications. lamage	
Instrument	. C.	~> .			0.4.110	y .		210.1		
Calibrated By:	Mita	<u>Sul</u>		Reviewed B *Calibration	y: <u>(1/)</u> u n Due (6mo): /02/29/	12m20 2012	Date: 2	0/30/11		
Calibration Da	ite: 08/30/201	l	re remulator	*Calibratio	n Due (12mo): 08/30	)/2012				

\* Calibration due date is dependant on users regulatory requirements.

# ENERGY SOLUTIONS

		N	lodel:	2360	Seri	al Number	r: <u>275713</u>	Page 2 of 2
	Mð	&TE					Environmental Condition	S
Volt Meter	ID# 947	10023	Cal Due:	10/28/2011	Baron	ieter	ID# 3590	Cal Due: 09/21/11
Pulser	ID# 1	12860	Cal Due:	04/26/2012	Thermo	meter	ID# 3590	Cal Due: 09/21/11
Humidity	1D# 9	58670	Cal Due:	06/07/2012	Temp:	22.4°C	Pressure: 741 mmHg	Humidity: 58%
		·····		Spec	ial Test		·	
ВАТ С	Check		Sat (√) U	nsat ( )		Geotropi	sm Sat	(√) Unsat ( )
LCD Disp	lay Check		Sat (√) Ui	nsat ( )		Audio Ch	eck Sat	(√) Unsat ( )
Mechanic	cal Zero		Sat (√) Ui	nsat ( )		Low BAT	Set Sat	(√) Unsat (_)
Re	set		Sat (√) Ui	nsat ( )				
HV Analo	g Display		Sat (√) Ui	nsat ( )		As Foun	ıd	As Left
	High Voltage Ca	alibratio	n (± 10%)		Alpha Se	nsitivity =	= 125 mv Alpha Ser	nsitivity = 120 mv
Voltage	As	Found	As Left	Beta Ser	sitivity =	3.8 mv Beta Sens	itivity = 3.5 mv	
500	450-550		514	514	Beta Wi	ndow =	32 mv Beta Win	dow = 30 mv
1000	900-1100	ŀ	983	983	Beta Se	etpoints	Pulser counts detected a	$t 3.5 mv \pm 1 mv$ and
1500	1350-1650	1	,490	1,490	Shut On		at 120mv and above.	
H.	V. Set With Det	ector No	t Connected			Overloa	d to be set with detector	to be used
				СОМ	MENTS			
Calibrated in acc	ordance with OI	EM Tech	nnical Manu	al				
See detector cer	rtificate for Hig	gh Volt:	age setting					
**Calibrated with	h 5ft cable**							
Instrument			99 Y				>	~ 1
Calibrated By:	Mt	and	•	Rev	iewed By:	<u> </u>	Julamoo Date:	8/30/11
Calibration Date:	: 08/30/2011			×Ca ×Ca	libration Du	ie (6nfo): ie (12mo):	02/29/2012 : 08/30/2012	

Calibration due date is dependent on users regulatory requirements.



EnergySolutions Instrument Services 1570 Bear Creek Road Oak Ridge, TN 37830 Phone: (877) 462-4873 Email: ISFstaff@energysolutions.com

	<u> </u>	STOMER	INFORMATIC	N	PEUDO	TOR INFORMATION					
Customer Name	Energy.	Solutions In	strument Servi	ces	Manufacturer: Lu	dlum					
Address: 1570 B	ear Creek	Road Oak	Ridge, TN 3783	30	Detector Model: 43-	37A					
Contact Name:	Tony Rig	gs		Serial Number: 093966							
Customer Purch	ase Order		Work Orde	er 011_11 <b>348</b>	Evaluation Method:	Source					
Number: IVA		DET	ECTOR EPHC	TENCY/RESPONSE/PRU	CISION ISPORMATI	Source					
Source Nuclide:	Th <sup>230</sup>	Serial Nu	mber: 119738	Activity: 18.600 dpm	2 Pi Emissions: 8.6	40 Certification Date: 10/20/97					
Paramete	er	As Found	d As Left	Precisio	n Test	CPM					
Count 1		3,852	3,852	Count 1	(Heel)	3,514					
Count 2		3,816	3,816	Count 2 (	Center)	3,681					
Count 3		3,652	3,652	Count 3	(Toe)	3,746					
Count 4		3,773	3,773	Aver	age	3,647					
Count 5		3,594	3,594	Toler	ance	±10%					
Count 6		3,523	3,523	Pass/	Fail	Pass					
Average		3,702	3,702								
Background (	CPM)	14.6	14.6		n an						
Net Count	ts	3,687	3,687	the second se							
2pi Efficien	icy	42.7%	42.7%								
4pi Efficien	icy	19.8%	19.8%								
Low Sar Sour	nple Activ ce #:     N//	vity: A	High S	Sample Activity: ource #: N/A	Dead Time (DT): N/A	Calibration Constant (CC): N/A					
SCA.	CER INF	orvia mo	N. S.		DTHE SECTION OF	RANKS. AND AND A STATE					
<u>Model</u>	<u>Serial N</u>	umber	<u>Due Date</u>	Background (cpm)	<b>Operating Voltage</b>	<u>Threshold</u>					
2360	2757	/13	08/30/2012	14.6	1700V	Alpha (120mV) Beta (3.5-30mV)					
Detector Setu	p Report	YES	NO √	Barcode Report	YES NO √	Voltage Plateau YES √ NO					
5 minute backgro	ound per	formed	Efficiency pe	COMMENTS	5Ft. cable 1 layer	mylar (0.4mg/cm2)					
			STA	TEMENT OF CERTIFIC	ALION						
specifications. We fu damage incurred duri	rther certify	that our Calil tor use of this	valuated for prope bration Measureme s detector).	r operation prior to snipment as ents are traceable to the Nationa	al institute of Standards and	Technology. (We are not responsible for					
Detector	etector										
Certified By:	1. Par	ــــــــــــــــــــــــــــــــــــــ	Reviewed By	: MADi	kinso Date	: 5/30/12					
Certification Date	: 05/30/20	012		*Čertif	ication Due (6mo): 11	/30/2012 //30/2013					
<sup>r</sup> Calibration due da	ite is depen	idant on use	rs regulatory req	uirements.	(x=						



EnergySolutions Instrument Services 1570 Bear Creek Road Oak Ridge, TN 37830 Phone: (877) 462-4873 Email: <u>ISFstaff(a</u> energysolutions.com

This Certificate will be accompanied by Calibration Charts or Readings where applicable

Costomer Name:       EnergySolutions Instrument Services       Manufacturer:       Ludium         Address:       1570 Bear Creek Road Oak Ridge, TN 3780       Detector Model:       43-378         Contact Name:       Tony Riggs       Serial Number:       093966         Customer Purchase Order       Work Order       Evaluation Method:       Source         Number:       2012-12264       Evaluation Method:       Source         Source Nuclide:       Te <sup>29</sup> Serial Number:       09806       Activity: 21,312 dpm       2 PI Emissions:       10,500       Certification Date:       08/0         Parameter       As Found       As Left       Precision Test       CPM       4,533         Count 1       4,539       4,539       Count 1 (Heel)       4,533         Count 2       4,468       Count 2 (Center)       4,530         Count 3       4,429       4,429       Count 3 (Toe)       4,726         Count 4       4,493       4,493       Average       4,600       4,600         Count 5       4,765       4,765       Tolerance       ±10%       4,600         Count 6       4,823       4,823       Pass/Fail       Pass       4,600       4,600         Locount 5       3,872		ં લ	ISTOMER IN	TORMATIC	<b>N</b>	DEDES	IOR INTORNATION					
Address: 1570 Bear Creek Road Oak Ridge, TN 37830       Detector Model: 43-37B         Contact Name: Tony Riggs       Serial Number: 093966         Customer Parchase Order Number: X/A       Vork Order Number: 2012-12264       Serial Number: 093960         Source Nuclide: Te <sup>®</sup> Serial Number: 099068       Activity: 21,312 dpm       2 PI Emissions: 10,500       Certification Date: 08/0         Parameter       As Found       As Left       Precision Test       CPM         Count 1       4,539       4,539       Count 1 (Heel)       4,553         Count 2       4,468       Count 2 (Center)       4,520         Count 3       4,429       4,433       Average       4,600         Count 4       4,433       4,433       Average       4,600         Count 5       4,765       Tolerance       ±10%         Count 5       4,765       Tolerance       ±10%         Average       4,586       Average       ±10%         Average       3,672	Customer Name	: Energy	Solutions Inst	rument Servi	Manufacturer: Ludlum							
Contact Name:     Tony Riggs     Serial Number:     093966       Customer Purchase Order Number:     Work Order Number:     Evaluation Mtbod: Source     Evaluation Mtbod: Source       Source     DETDEC OF AFFEC IPAC ( ARESTONSE HR) = ISTON (NFO)ENTATION     Source       Source     Namber:     099608     Activity: 21,312 dpm     2 PI Emissions: 10,500     Certification Date: 08/0       Parameter     As Found     As Left     Precision Test     CPM       Count 1     4,539     4,539     Count 1 (Heel)     4,553       Count 2     4,468     Count 2 (Center)     4,520       Count 3     4,429     4,429     Count 3 (Toe)     4,726       Count 4     4,493     4,433     Average     4,600       Count 5     4,765     Tolerance     ±10%       Count 6     4,823     4,823     Pass/Fail     Pass       Average     4,586     4,586     Average     4,600       Recount 5     3,872     3,872     7 gitionard in a contant of a (D)	Address: 1570 B	ear Creek	Road Oak R	idge, TN 378	30	Detector Model: 43-37B						
Customer Parchase Order Number: N/A     Work Order Number: 2012-12264     Evaluation Method: Source       Source Nuclide: Tc <sup>97</sup> Serial Number: 099608     Activity: 21,312 dpm     2 P1 Emissions: 10,500     Certification Date: 08/0       Parameter     As Found     As Left     Precision Test     CPM       Count 1     4,539     4,539     Count 1 (Heel)     4,553       Count 2     4,468     4,468     Count 2 (Center)     4,520       Count 3     4,429     4,493     Average     4,660       Count 4     4,493     4,493     Average     4,660       Count 5     4,765     4,765     Tolerance     ±10%       Count 4     4,823     4,823     Pass/Fail     Pass       Average     4,586     4,586     Pass/Fail     Pass       Average     4,586     4,586     Pass/Fail     Pass       Average     3,872     3,872     Cathorated in scorg/Bant/Aight / Ti/b, N1217     Pass       2pi Efficiency     36.9%     36.9%     Pass     Pass       4pi Efficiency     18.2%     18.2%     Pass     Pass       Model     Serial Number     Due Date     Background (cpm)     Operating Voltage       Threshold     Source #: N/A     Source #: N/A     N/A     N/A	Contact Name:	Tony Rig	gs			Serial Number: 093966						
DETECTOR FPRICIPNE VARIATIONS FREE ENDER INFORMATION         Source Nuclide: Te <sup>99</sup> Serial Number: 099608       Activity: 21,312 dpm       2 P1 Emissions: 10,500       Certification Date: 08/0         Parameter       As Found       As Left       Precision       Test       CPM         Count 1       4,539       4,539       Count 1 (Heel)       4,553         Count 2       4,468       Count 2 (Center)       4,520         Count 3       4,429       4,429       Count 3 (Toe)       4,726         Count 4       4,493       4,493       Average       4,600         Count 5       4,765       4,765       Tolerance       ±10%         Count 6       4,823       4,823       Pass/Fail       Pass         Average       4,586       Counts       3,872       3,872       Catherated in a contraine of the 1 Jb WH2?       Catherated in a contraine of the 2 SO o	Customer Purch Number: N/A	ase Order	•	Work Orde Number: 2	er 012-12264	Evaluation Method: Source						
Source Nuclide: Te <sup>59</sup> Serial Number: 099608     Activity: 21,312 dpm     2 P1 Emissions: 10,500     Certification Date: 08/0       Parameter     As Found     As Left     Precision Test     CPM       Count 1     4,539     4,539     Count 1 (Heel)     4,553       Count 2     4,468     4,468     Count 2 (Center)     4,520       Count 3     4,429     4,429     Count 3 (Tee)     4,726       Count 4     4,493     4,493     Average     4,600       Count 5     4,765     4,765     Tolerance     ±10%       Count 6     4,823     4,823     Pass/Fail     Pass       Average     4,586     4,586     Pass     Pass       Average     4,586     4,586     Pass     Pass/Fail     Pass       Average     4,586     4,586     Pass/Fail     Pass     Pass       Average     4,586     4,586     Pass/Fail     Pass     Pass       Average     3,872     3,872     Calibration for scorelapic Arith 11/19/19/123     Pass       2pi Efficiency     18.2%     18.2%     Past/Fride/Frid/Fride/Fride/Fride/Fride/Fride/Frid/Fride/Fride/Fride/F			DETEC	TOR EFFIC	TENCY/RESPONSE/PRE	CISION INFORMATI	on -					
Parameter       As Found       As Left       Precision Test       CPM         Count 1       4,539       4,539       Count 1 (Heel)       4,553         Count 2       4,468       4,468       Count 2 (Center)       4,520         Count 3       4,429       4,429       Count 3 (Toe)       4,726         Count 4       4,493       4,493       Average       4,600         Count 5       4,765       4,765       Tolerance       ±10%         Count 6       4,823       4,823       Pass/Fail       Pass         Average       4,586       4,586       Pass       Pass         Average       4,586       4,586       Pass       Pass       Pass         Average       4,586       4,586       Pass       Pass       Pass         Average       4,586       4,586       Pass       Pass       Pass         Average       3,872       3,872       Calibrated to average and pass       Pass       Pass         4pi Efficiency       18.2%       IB 2.5%       Dead Time (DT):       Calibration Constant (CC):       N/A         Source #:       N/A       Source #:       N/A       Pass       Pass       Pass         2360	Source Nuclide: "	Tc <sup>99</sup>	Serial Numl	per: 099608	Activity: 21,312 dpm	2 Pi Emissions: 10,5	500 Certification Date: 08/08/96					
Count 1       4,539       4,539       Count 1 (Hee)       4,553         Count 2       4,468       4,468       Count 2 (Center)       4,520         Count 3       4,429       4,429       Count 3 (Toe)       4,726         Count 4       4,493       4,493       Average       4,600         Count 5       4,765       4,765       Tolerance       ±10%         Count 6       4,823       4,823       Pass/Fail       Pass         Average       4,586       4,586       4,863       Pass/Fail       Pass         Average       4,586       4,586       4,872       Pass/Fail       Pass         Average       4,586       4,586       4,887       Pass/Fail       Pass         Average       4,586       4,586       Pass/Fail       Pass       Pass         Average       4,586       4,586       Pass/Fail       Pass       Pass         Average       3,872       3,872       Calibratic th acception of an expected by acception of acception acception of acception of acception acception of acce	Paramete	er	As Found	As Left	Precisio	n Test	СРМ					
Count 2       4,468       4,468       Count 2 (Center)       4,520         Count 3       4,429       4,429       Count 3 (Toe)       4,726         Count 4       4,493       4,493       Average       4,600         Count 5       4,765       4,765       Tolerance       ±10%         Count 6       4,823       4,823       Pass/Fail       Pass         Average       4,586       4,586       Pass/Fail       Pass         Average       4,586       4,586       Pass/Fail       Pass         Net Counts       3,872       3,872       1 stiturated in acception constant Consta	Count 1		4,539	4,539	Count 1	(Heel)	4,553					
Count 3       4,429       4,429       Count 3 (Toe)       4,726         Count 4       4,493       4,493       Average       4,600         Count 5       4,765       4,765       Tolerance       ±10%         Count 6       4,823       4,823       Pass/Fail       Pass         Average       4,586       4,586	Count 2		4,468	4,468	Count 2 (	Center)	4,520					
Count 4       4,493       4,493       Average       4,600         Count 5       4,765       4,765       Tolerance       ±10%         Count 6       4,823       4,823       Pass/Fail       Pass         Average       4,586       4,586       Pass/Fail       Pass         Background (CPM)       714.6       714.6       714.6       Pass         Net Counts       3,872       3,872       Catherated in accordance with 1,10% W1/38         2pi Efficiency       36.9%       36.9%       Pass       Pass         4pi Efficiency       18.2%       18.2%       Dead Time (DT):       Catherated in accordance with 1,10% W1/38         Source #: N/A       Source #: N/A       N/A       N/A       N/A         Source #: N/A       Source #: N/A       Dead Time (DT):       Catherated (CC):         Model       Serial Number       Due Date       Background (cpm)       Operating Voltage       Threshold         2360       275713       08/30/2012       714.6       1700 V       Alpha (120mV) Beta (3.5-30m         Detector Setup Report       YES       NO √       Barcode Report       YES       NO √       Voltage Plateau YES √ N         C@MMENTAS       Efficiency performed on contact with 5Ft. cable	Count 3		4,429	4,429	Count 3	(Toe)	4,726					
Count 5       4,765       4,765       Tolerance       ±10%         Count 6       4,823       4,823       Pass/Fail       Pass         Average       4,586       4,586       account 6       Pass         Background (CPM)       714.6       714.6       account 6       account 6       account 6         Net Counts       3,872       3,872       Calthrait 6 in account and 6 with 1 H JP, WI-217       account 6       account 6         2pi Efficiency       36.9%       36.9%       account 6       account 6 </td <td colspan="12">Count 4         4,493         4,493         Average         4,600</td>	Count 4         4,493         4,493         Average         4,600											
Count 6       4,823       4,823       Pass/Fail       Pass         Average       4,586	Count 5         4,765         4,765         Tolerance         ±10%											
Average       4,586       4,586       4,586       4,586         Background (CPM)       714.6       714.6       714.6       714.6         Net Counts       3,872       3,872       Calibrated in accordance with 1 1 N.W123P         2pi Efficiency       36.9%       36.9%       4         4pi Efficiency       18.2%       18.2%       Dead Time (DT): Source #: N/A       Calibration Constant (CC): N/A         Source #: N/A       N/A       Dead Time (DT): N/A       Calibration Constant (CC): N/A         Model       Serial Number       Due Date       Background (cpm)       Operating Voltage       Threshold         2360       275713       08/30/2012       714.6       1700 V       Alpha (120mV) Beta (3.5-30m         Detector Setup Report       YES       NO √       Barcode Report       YES       NO √       Voltage Plateau YES √       No         St ATEMENT OF CERTIFICATION       Efficiency performed on contact with 5Ft. cable       1 layer mylar (0.4mg/cm2)         We Certify that the detector listed above was evaluated for proper operation prior to shipment and that it met all the Manufacturers published operating specifications. We further certify that our Calibration Measurements are traceable to the National Institute of Standards and Technology. (We are not responsible for daman in curved during a certify that our Calibration Measurements are traceable to the National Institute of S	Count 6		4,823	4,823	Pass/J	Fail	Pass					
Background (CPM)       714.6       714.6       714.6         Net Counts       3,872       3,872       Catturated in accontinue with 5 F. JN. WL 392         2pi Efficiency       36.9%       36.9%         4pi Efficiency       18.2%       18.2%         Low Sample Activity: Source #: N/A       Net Counts       Catibration Constant (CC): N/A         Nodel       Serial Number       Due Date       Background (cpm)       Operating Voltage       Threshold         2360       275713       08/30/2012       714.6       1700 V       Alpha (120mV) Beta (3.5-30m         Detector Setup Report       YES       NO √       Barcode Report       YES       NO √       Voltage Plateau YES √       No         S minute background       performed       Efficiency performed on contact with 5Ft. cable       1 layer mylar (0.4mg/cm2)	Average		4,586	4,586								
Net Counts       3,872       3,872       Catherated an accordance with 1 TEIN-W1239         2pi Efficiery       36.9%       36.9%       4         4pi Efficiery       18.2%       18.2%       Dead Time (DT):       Calibration Constant (CC):         Source #:       NA       Source #:       NA       NA         State R PFORMATION       Source #:       NA       Perturbation Constant (CC):         Model       Serial Number       Due Date       Background (cpm)       Operating Voltage       Threshold         2360       275713       08/30/2012       714.6       1700 V       Alpha (120mV) Beta (3.5-30m)         Detector Setup Report       YES       NO √       Barcode Report       YES       NO √       Voltage Plateau YES √       NO         State Certify that the detector listed above was evaluated for proper operation prior to shipment and that it met all the Manufacturers published operating specifications. We further certify that our Calibration Measurements are traceable to the National Institute of Standards and Technology. (We are not responsible for damana incurrent during distance shipment of dates tor)	Background (	CPM)	714.6	714.6		<u>11. 20. 3100</u>						
2pi Efficiency       36.9%       36.9%         4pi Efficiency       18.2%       18.2%         Low Sample Activity: Source #: N/A       N/A       Calibration Constant (CC): N/A         Source #: N/A       N/A       N/A         SCALER IPFORMATION       Dentify TOK INFORMATION       Dentify TOK INFORMATION         Model       Serial Number       Due Date       Background (cpm)       Operating Voltage       Threshold         2360       275713       08/30/2012       714.6       1700 V       Alpha (120mV) Beta (3.5-30m         Detector Setup Report       YES       NO √       Barcode Report       YES       NO √       Voltage Plateau YES √       No         5 minute background performed       Efficiency performed on contact with 5Ft. cable       1 layer mylar (0.4mg/cm2)	Net Coun	ts	3,872	3,872	Calibrated in accordance	e with CTUN-W1-239						
4pi Efficiency       18.2%       18.2%         Low Sample Activity: Source #: N/A       High Sample Activity: Source #: N/A       Dead Time (DT): N/A       Calibration Constant (CC): N/A         Scal DR INFORMATION       Dirt (TOK information)         Model       Serial Number       Due Date       Background (cpm)       Operating Voltage       Threshold         2360       275713       08/30/2012       714.6       1700 V       Alpha (120mV) Beta (3.5-30m)         Detector Setup Report       YES       NO √       Barcode Report       YES       NO √       Voltage Plateau YES √       No         StateMent Is detector listed above was evaluated for proper operation prior to shipment and that it met all the Manufacturers published operating specifications. We further certify that our Calibration Measurements are traceable to the National Institute of Standards and Technology. (We are not responsible formate increased by this detector)	2pi Efficien	icy	36.9%	36.9%								
Low Sample Activity: Source #: N/A       High Sample Activity: Source #: N/A       Dead Time (DT): N/A       Calibration Constant (CC): N/A         Model       Serial Number       Due Date       Background (cpm)       Operating Voltage       Threshold         2360       275713       08/30/2012       714.6       1700 V       Alpha (120mV) Beta (3.5-30m         Detector Setup Report       YES       NO √       Barcode Report       YES       NO √       Voltage Plateau YES √       No         5 minute background       performed       Efficiency performed on contact with 5Ft. cable       1 layer mylar (0.4mg/cm2)         Ve Certify that the detector listed above was evaluated for proper operation prior to shipment and that it met all the Manufacturers published operating specifications. We further certify that our Calibration Measurements are traceable to the National Institute of Standards and Technology. (We are not responsible f damage insured during shipment are used thio theorem.)	4pi Efficien	icy	18.2%	18.2%								
SCAL DR. INFORMATION       Due Date       Background (cpm)       Operating Voltage       Threshold         Model       Serial Number       Due Date       Background (cpm)       Operating Voltage       Threshold         2360       275713       08/30/2012       714.6       1700 V       Alpha (120mV) Beta (3.5-30m         Detector Setup Report       YES       NO √       Barcode Report       YES       NO √       Voltage Plateau       YES √       No         5 minute background       performed       Efficiency performed on contact with 5Ft. cable       1 layer mylar (0.4mg/cm2)       Statement of proper operation prior to shipment and that it met all the Manufacturers published operating specifications. We further certify that our Calibration Measurements are traceable to the National Institute of Standards and Technology. (We are not responsible for an our proper operation groups)	Low Sar Sour	nple Activ ce #: N//	vity: A	High S	n Sample Activity: ource #: N/A	Dead Time (DT): N/A	Calibration Constant (CC): N/A					
Model       Serial Number       Due Date       Background (cpm)       Operating Voltage       Threshold         2360       275713       08/30/2012       714.6       1700 V       Alpha (120mV) Beta (3.5-30m)         Detector Setup Report       YES       NO √       Barcode Report       YES       NO √       Voltage Plateau       YES √       No         5 minute background       performed       Efficiency performed on contact with 5Ft. cable       1 layer mylar (0.4mg/cm2)       No         Vecentify that the detector listed above was evaluated for proper operation prior to shipment and that it met all the Manufacturers published operating specifications. We further certify that our Calibration Measurements are traceable to the National Institute of Standards and rechnology. (We are not responsible of detector)	, SCA	LERIPF	<b>ORMATION</b>	and a start		DETECTORING						
2360       275713       08/30/2012       714.6       1700 V       Alpha (120mV) Beta (3.5-30m)         Detector Setup Report       YES       NO √       Barcode Report       YES       NO √       Voltage Plateau       YES √       No         5 minute background       performed       Efficiency performed on contact with 5Ft. cable       I layer mylar (0.4mg/cm2)       No	Model	<u>Serial N</u>	umber ]	Due Date	Background (cpm)	<b>Operating Voltage</b>	<u>Threshold</u>					
Detector Setup Report       YES       NO √       Barcode Report       YES       NO √       Voltage Plateau       YES √       No         5 minute background       performed       Efficiency performed on contact with 5Ft. cable       1 layer mylar (0.4mg/cm2)       1         STATEMENT OF CERTIFICATION         We Certify that the detector listed above was evaluated for proper operation prior to shipment and that it met all the Manufacturers published operating specifications. We further certify that our Calibration Measurements are traceable to the National Institute of Standards and Technology. (We are not responsible for detector)	2360	2757	713 0	8/30/2012	714.6	1700 V	Alpha (120mV) Beta (3.5-30mV)					
5 minute background performed       Efficiency performed on contact with 5Ft. cable       1 layer mylar (0.4mg/cm2)         STATEMENT OF CERTIFICATION         We Certify that the detector listed above was evaluated for proper operation prior to shipment and that it met all the Manufacturers published operating specifications. We further certify that our Calibration Measurements are traceable to the National Institute of Standards and Technology. (We are not responsible for the proper operation prior to shipment and that it met all the Manufacturers published operating specifications. We further certify that our Calibration Measurements are traceable to the National Institute of Standards and Technology. (We are not responsible for the proper operation)	Detector Setu	p Report	YES	NO √	Barcode Report	YES NO √	Voltage Plateau YES √ NO					
S minute background       performed       Efficiency performed on contact with SFt. cable       I layer mylar (0.4mg/cm2)         STATEMENT OF CERTIFICATION         We Certify that the detector listed above was evaluated for proper operation prior to shipment and that it met all the Manufacturers published operating specifications. We further certify that our Calibration Measurements are traceable to the National Institute of Standards and Technology. (We are not responsible f damage insured during shipment or use of this detector)					COMMENTS							
STATEMENT OF CERTIFICATION We Certify that the detector listed above was evaluated for proper operation prior to shipment and that it met all the Manufacturers published operating specifications. We further certify that our Calibration Measurements are traceable to the National Institute of Standards and Technology. (We are not responsible f damage incurred during shipment or use of this detector)	5 minute backgro	ound per	formed	Efficiency pe	erformed on contact with 5	SFt. cable I layer	mylar (0.4mg/cm2)					
We Certify that the detector listed above was evaluated for proper operation prior to shipment and that it met all the Manufacturers published operating specifications. We further certify that our Calibration Measurements are traceable to the National Institute of Standards and Technology. (We are not responsible f				ST/	TEMENT OF CERTIFIC	ATION						
	We Certify that the d specifications. We fu	etector lister of ther certify	d above was eva that our Calibra	luated for prope tion Measureme	r operation prior to shipment ar ents are traceable to the Nationa	nd that it met all the Manufae al Institute of Standards and	cturers published operating Technology. (We are not responsible for					
Detector	Detector	ng suipmen	a or use of this d	ciccior).								
Certified By: M. Paul' Reviewed By: Jell Dikinso Date: 5/30/12	Certified By: N	N.Pa	Lul'	Reviewed B	y: JeffDiter	nso Date	: 5/30/12					
Certification Date: 05/30/2012	Certification Date	: 05/30/20	012		VV Certifi * Certifi	ication Due (6mo): 11 fication Due (12mo): 05	/30/2012/30/2013					

\* Calibration due date is dependant on users regulatory requirements.



EnergySolutions Instrument Services 1570 Bear Creek Road Oak Ridge, TN 37830 Phone: (877) 462-4873 Email: <u>ISFstaff@energysolutions.com</u>

	<u> </u>	ISPOMERA	NROROMANIN		DETEC	<b>POPULITORMANION</b>						
Customer Name	: Energy.	Solutions Ins	trument Servi	ces	Manufacturer: Lu	dlum						
Address: 1570 B	ear Creek	Road Oak I	Ridge, TN 378.	30	Detector Model: 43	37B						
Contact Name:	Tony Rigg	gs			Serial Number: 09	3966						
Customer Purch	ase Order		Work Ord	er 1012 12264	Evaluation Method:	Evaluation Method:						
Number: N/A		DEFE	(HOR DEED	TINCY A PSPANSE /PRE	L CISION INFORMATI	on source						
Source Nuclide:	C <sup>14</sup>	Serial Num	ber: 010002	Activity: 260 460 dpm	2 Pi Emissions: N	//A Certification Date:						
Paramete	~~ >r	As Found	As Left	Precisio	n Test							
Count 1		25.917	25.917	Count 1	(Heel)	25.671						
Count 2		25.604	25.604	Count 2	(Center)	26.628						
Count 3		26,697	26.697	Count	(Toe)	28,323						
Count 4		25,882	25,882	Aver	age	26,874						
Count 5		28,245	28,245	Toler	ance	±10%						
Count 6		27,953	27,953	Pass/	Fail	Pass						
Average		26,716	26,716									
Background (	CPM)	714.6	714.6	bearse is a		a shekarar						
Net Count	ts	26,002	26,002									
2pi Efficien	icy	N/A	N/A	an da ar		a an start and a start and a start a						
4pi Efficien	icy	10.0%	10.0%									
Low Sar	nple Activ	rity:	High	Sample Activity:	Dead Time (DT):	Calibration Constant (CC):						
SCA		ORMANION			EDFITCIOR MILOR							
Model	Serial N	umber	Due Date	Background (cpm)	Operating Voltage	<u>Threshold</u>						
2360	2757	/13	08/30/2012	714.6	1700 V	Alpha (120mV) Beta (3.5-30mV)						
Detector Setu	p Report	YES	NO √	Barcode Report	YES NO √	Voltage Plateau YES √ NO						
				A CROWNINGS .	San San Debahan							
5 minute backgro	5 minute background performed Efficiency performed on contact with 5Ft. cable 1 layer mylar (0.4mg/cm2)											
		len er	Šta	TEMENT OF CERTIFIC	ATION	and a second second second						
We Certify that the d specifications. We fu	We Certify that the detector listed above was evaluated for proper operation prior to shipment and that it met all the Manufacturers published operating specifications. We further certify that our Calibration Measurements are traceable to the National Institute of Standards and Technology. (We are not responsible for											
Detector	amage incurred during shipment or use of this detector).											
Certified By: N	1.Pa	u'	Reviewed B	y: CellDatei	Date	: 5/3//12						
Certification Date	: 05/30/20	012		*Certif	ication Due (6mo): 11 fication Due (12mo): 05	/30/2012						
Coliberation due de	to in doman	dant on usar	requisitors req		iteriou inter (14mo). Ve	16 V 18 V 26						



EnergySolutions Services, Inc 1570 Bear Creek Road Oak Ridge, TN 37830 Phone: (877) 462-4873 Fax: (865) 220-1346 Email: Isfstaff@energysolutions.com CALIBRATION CERTIFICATE

http://www.energysolutions.com/

	. Cue	<b>TOMER</b>	VGC TH	tion :	Addressed			RUMENT		TION			
Custon	ner Name:	Energy Sc	lutions			Ма	nufacturer:						
	Address:	1570 Bear	Creek Road	d Oak Ridg	je, TN 37830		Model:	2360	S.N.	275	5713		
Cont	act Name:	Tony Rigg	S			Probe: 43-3		7 S.N.	093	3966			
Customer		<u>v</u> vv	Work O	rder									
PO No.:	N	/A	Numb	er: 2	012-12264	Calibrati	on Method:		Sou	urce			
and the second statement of the	nan di wana di Manania di anger di anger		an a	ta hada sa kata	an a		antaria de compañía e emo		and and a start of the start of t	n - Martina Martina Antonio			
			Iso	tope	Sour	ce ID	Certifca	tion Date	Activity	(dpm)	]		
	a So	ource	Pu	-239	019	442	6/1	/92	13,	607			
	βSo	ource	Tc	-99	099	608	8/8	/96	21,	311			
									20. S.				
						a na Mariana da San Andrew Sala a da A			an Kanada ka ka ka ka ka ka ka ka ka	n o chaine a' chain ann an suair ann an suair an	an a		
Operating.	- Hindhe		Roha 🦓										
\$\$\$\$2.53gr \$\$	1 600	10.0	182.0	2 661 0	462.0	22.0	3 719 0	11 29%	0.34%	19 48%	16 60%		
l t	1,625	8.0	250.0	2,886.0	578.0	16.0	4,239.0	12.44%	0.20%	21.15%	18.72%		
	1,650	12.0	335.0	2,999.0	618.0	25.0	4,625.0	10.62%	0.30%	21.95%	20.13%		
	1,675	16.0	501.0	3,080.0	642.0	28.0	4,913.0	5.47%	0.27%	22.52%	20.70%		
SET	1,700	15.0	<b>646.0</b>	3,035.0	743.0	22.0	4,740.0	4.06%	0.17%	22.19%	<b>19.21%</b>		
+	<u>1,725</u> <u>11.0</u> <u>733.0</u> <u>3,058.0</u> <u>761.0</u> <u>22.0</u> <u>4,858.0</u> <u>1.20%</u> <u>0.27%</u> <u>22.39%</u> <u>19.36%</u> <u>1.750</u> <u>18.0</u> <u>846.0</u> <u>3,309.0</u> <u>1.061.0</u> <u>106.0</u> <u>3.954.0</u> <u>8.73%</u> <u>2.83%</u> <u>24.19%</u> <u>14.58%</u>												
	1,750 18.0 846.0 3,309.0 1,061.0 106.0 3,954.0 8.73% 2.83% 24.19% 14.58%												
L						-							
A Second	a faire a fa				EMENT OF			a the second					
We Cert	ify that the in	strument liste	d above was	calibrated	and inspected p	prior to shipm	ent and that it National Insti	met all the M	anufacturers	published op	erating are not		
		and contray the	responsible	for damag	e incurred durin	g shipment o	r use of this ir	istrument).		nology. (Tre	are not		
Commen	ts:												
Calibrated	By: NA	$\mathcal{P}$	L <b>`</b>	P	wowed Ru	01	Inito	in a m	г	ate <sup>,</sup> 5/	20/12		
Januraleu	Jy	· · · ·	-	IXI			Hure	v 1028	L	uto. <u> </u>	JU112		
	Calibra	tion Date:	5	/30/12		0	<sup>'</sup> Calibra	ation Due:	5/	/30/13			



Energy*Solutions* Services, Inc. 1570 Bear Creek Road Oak Ridge, TN 37830 Phone: (877) 462-4873 Fax: (865) 220-1346

This Certificate will be accompanied by Calibration Charts or Readings where applicable

	CUSTOMER IN	FORMATION		INSTRUMENT INFORMATION							
Customer Na	me: EnergySolutio	ns Services, Inc.		Manufacturer: Lu	dlum						
Address: 1570	) Bear Creek Road	Oak Ridge, T	N 37830	Model: 2360	Serial Number: 275724						
Contact Name	e: Tony Riggs			Probe: N/A	N/A Serial Number: N/A						
Customer Pur Number: N	rchase Order   We /A   Nu	ork Order mber: 2011-117	16	Calibration Method: Electronic							
		INST	RUMENT C	ALIBRATION INF	ORMATION		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,				
Instrument	Calibration	Raten Response Standard	neter (± 10% of Values)	Calibration Standard Value	Time Base	Tolerances	Scaler Response				
Kange	Standard value	As Found	As Left	СРМ	(minutes)	(cpm) ± 2%	As Found	As Left			
X 1	100	100	100	1,000 CPM	0.1	90 - 110	99	<b>9</b> 9			
X 1	250	250	250	1,000 CPM	0.5	450 - 550	493	493			
X 1	400	400	400	1,000 CPM	1	900 - 1,100	988	988			
X 10	1,000	1,000	1,000	1,000 CPM	2	1.8K-2.2K	1,979	1,979			
X 10	2,500	2,500	2,500	1,000 CPM	5	4.5K-5.5K	4,948	4,948			
X 10	4,000	4,000	4,000	1,000 CPM	10	9K-11K	9,896	9,896			
X 100	10,000	10,000	10,000								
X 100	25,000	25,000	25,000								
X 100	40,000	40,000	40,000								
X 1000	100,000	100,000	100,000	Calibrated in accordance with OEM Technical Manual							
X 1000	250,000	250,000	250,000								
X 1000	400,000	400,000	400,000								
	STATEMENT OF CERTIFICATION										
We Certify that the We further certify incurred during sl	We Certify that the instrument listed above was calibrated and inspected prior to shipment and that it met all the Manufacturers published operating specifications. We further certify that our Calibration Measurements are traceable to the National Institute of Standards and Technology. (We are not responsible for damage neurred during shipment or use of this instrument).										
Instrument	astrument 1.1										
Calibrated By:	alibrated By: M. Paul' Reviewed By: Car May Date: 10/6/11										
Calibration Da	ite: 10/06/2011		*Calibration *Calibration	1 Due (6mo): 04/06/2 1 Due (12mo): 10/06	2012 /2012						

\* Calibration due date is dependant on users regulatory requirements.



		N	Aodel:	2360	Serial Num	per: 275724				
	м	&TE				Environmental Condition	5			
Volt Meter	ID# 94	710023	Cal Due:	10/28/2011	Barometer	ID# 2551	Cal Due: 10/19/2011			
Pulser	ID#	120935	Cal Due:	09/29/2012	Thermometer	ID# 2551	Cal Due: 10/19/2011			
Humidity	ID#	958670	Cal Due:	06/07/2012	Temp: 21.4 °C	Pressure: 747 mmHg	Humidity: 45%			
				Speci	ial Test					
BAT	Check		Sat (√) U	nsat ( )	Geotro	pism Sat (	(√) Unsat ()			
LCD Disp	olay Check		Sat (√) U	nsat ( )	Audio Check Sat (√) Unsat ()					
Mechani	ical Zero		Sat (√) U	nsat ( )	Low BA	T Set Sat (	√) Unsat ( )			
Re	eset		Sat (√) U	nsat ( )						
HV Analo	og Display		Sat (√) Ui	nsat ( )	As Found As Left					
	High Voltage C	alibratio	n (± 10%)		Alpha Sensitivity	= 128 mv Alpha Sen	sitivity = 120 mv			
Voltage	Tolerance	As	Found	As Left	Beta Sensitivity	= 3.7 mv Beta Sens	itivity = 3.5 mv			
500	450-550		502	502	Beta Window =	30.8 mv Beta Wind	dow = 30 mv			
1000	900-1100	1	,018	1,018	B Beta Setpoints-Pulser counts detected at 3.5mv ± 1mv and shut off at 30mv for beta. For Alpha channel counts detected					
1500	1350-1650	1	,514	1,514	at 120my and above.					
н	.V. Set With Det	ector No	t Connected		Overla	ad to be set with detector	to be used			
				СОММ	MENTS					
Calibrated in acc	cordance with O	EM Tech	nical Manu	al						
See detector ce	rtificate for Hi	gh Volts	age setting							
**Calibrated wit	h 5ft cable**									
Instrument			· · · · · · · · · · · · · · · · · · ·			1.,				
Calibrated By:	Date:	10/6/4								
Calibration Date	: 10/06/2011			*Cal	ibration Due (6mo)	: 04/06/2012	7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7			
Calibration due d	ate 16 denendant o	ON HEATE T	equistory rec	Uurements	WINCON LINE (14110	1				

Page 2 of 2



EnergySolutions Services, Inc 1570 Bear Creek Road Oak Ridge, TN 37830 Phone: (877) 462-4873 Fax: (865) 220-1346 Email: Isfstaff@energysolutions.com

http://www.energysolutions.com/

	CUSTOMER INFORMATION					INSTRUMENT INFORMATION					
Custor	ner Name:	Energy So	lutions			Ma	nufacturer:				
	Address:	1570 Bear	Creek Roac	I Oak Ridge	, TN 37830		Model:	2360	S.N.	275	5724
Cont	tact Name:	Tony Rigg	s				Probe:	43-37	S.N.	092	2501
Customer			Work O	rder							
PU No.:		/A	Numb	er: 20	12-12264	Calibratio	on Method:		500	Jrce	
	Source Information										
				1000	Sour		Cortifeet	tion Date	Activity	(dom)	1
	a Sa	urce	Pu-	·239	019	442	6/1	/92	13.	607	
	βSo	urce	To	-99	099	608	8/8	/96	21,	311	
			Ludlur	n Model 43	i-93 High V	oltage Plate	eau with cr	osstalk	stanta and and an		
Operating	Hìah	Backo	round	Alpha	Source	Beta S	Source	Cros	stalk	Effo	ieńcy
Voltage	Voltage	Alpha	Beta	Alpha	Bela	Alpha	Beta	ατοβ	βtoa	G.	ß
			400.0	0.040.0				0.500/	0.000/	40.000/	10.010/
<b>SET</b>	1,650	6.0	400.0	2,318.0	563.0	/.0	4,457.0	8.50%	0.02%	16.99%	19.04%
JEI	1,075	7.0	445.0	2,527.0	732.0	7.0	4,345.0	15 27%	0.10%	17 98%	18 34%
	1,725	10.0	805.0	2.692.0	1.047.0	12.0	4.629.0	12.82%	0.05%	19.71%	17.94%
							.,				
				STATE	MENT OF	CERTIFIC	ATION				
We Ce	rtify that the ir	strument liste	ed above was	calibrated ar	nd inspected p	prior to shipme	ent and that it	met all the Ma	anufacturers (	oublished ope	erating
specific	ations. We fui	ther certify th	at our Calibra	ation Measure	ments are tra	ceable to the	National Insti-	tute of Standa strument)	rds and Tech	nology. (We a	are not
Commen	ts:		reaponable	, or usingyer		a ambrucur Ot	430 OF 1115 ID	oa uniontj.			
······	~	11				$\sim$				.cl.	
Calibrated	1 By:	ng-	<u>.</u>	Rev	viewed By:	- H	1/ Jukins	10	C	)ate: <u>5/5</u>	\$0/12
	Calibra	tion Date:	_5	/30/12		0.	Calibra	ation Due:	5/	/30/13	



Energy*Solutions* Instrument Services 1570 Bear Creek Road Oak Ridge, TN 37830 Phone: (877) 462-4873 Email: <u>ISF staff@ energy solutions.com</u>

This Certificate will be accompanied by Calibration Charts or Readings where applicable

Customer Name: EnergySoli				DETECTOR INFORMATION			
Customer Name: EnergySolutions Instrument Services				Manufacturer: Ludlum			
Address: 1570 Bear Creek Ro	ad Oak R	idge, TN 3783	30	Detector Model: 43-37B			
Contact Name: Tony Riggs				Serial Number: 092501			
Customer Purchase Order Number: N/A		Work Orde Number: 2	er 012-12264	Evaluation Method:	Source		
	DETEC	TOR EFFIC	IENCY/RESPONSE/PRE	CISION INFORMATION			
Source Nuclide: C <sup>14</sup> Se	rial Numb	er: 010002	Activity: 260,460 dpm	2 Pi Emissions: N	A Certification Date:		
<b>Parameter</b> A	s Found	As Left	Precisio	n Test	СРМ		
Count 1	32,658	32,658	Count 1	(Heel)	32,658		
Count 2	32,097	32,097	Count 2 (	Center)	32,041		
Count 3	32,006	32,006	Count 3	(Toe)	33,092		
Count 4	32,041	32,041	Aver	age	32,597		
Count 5	32,759	32,759	Tolera	ince	±10%		
Count 6	33,092	33,092	Pass/	Fail	Pass		
Average	32,442.2	32,442.2			ana ana ana amin'ny fanana amin'ny fanjara ana amin'ny fana		
Background (CPM)	503	503					
Net Counts	1,939.2	31,939.2		·			
2pi Efficiency	N/A	N/A					
4pi Efficiency	12.3%	12.3%	- -				
Low Sample Activity: <u>Source #: N/A</u>		High Se	Sample Activity: ource #: N/A	Dead Time (DT): N/A	Calibration Constant (CC): N/A		
SCALER INFOR	MATION			DETECTOR INFORM	MATION		
Model Serial Num	<u>per I</u>	Due Date	Background (cpm)	Operating Voltage	<u>Threshold</u>		
2360 275724	1	)/06/2012	503	1675V	Alpha (120mV) Beta (3.5-30mV)		
Detector Setup Report	YES	NO √	Barcode Report	YES NO √	Voltage Plateau YES √ NO		
6 minute hasharan da anter		TARE	COMMENTS	T4 sehis 1 laws			
5 minute background perform	nea	Efficiency pe	rtormed on contact with :	oft. cable – 1 layer	mylar (U.4mg/cm2)		
		STA	TEMENT OF CERTIFIC	ATION			
We Certify that the detector listed ab specifications. We further certify that	We Certify that the detector listed above was evaluated for proper operation prior to shipment and that it met all the Manufacturers published operating specifications. We further certify that our Calibration Measurements are traceable to the National Institute of Standards and Technology. (We are not responsible for						
Detector	ise of this de	nector).		•			
Certified By:		Reviewed By	: SellDa	kinso Date:	5/30/12		
Certification Date: 05/30/2012			*Certifi * Certifi	cation Due (6mo): 11/ ication Due (12mo): 05/	/30/2012 /30/2013		

\* Calibration due date is dependant on users regulatory requirements.



EnergySolutions Instrument Services 1570 Bear Creek Road Oak Ridge, TN 37830 Phone: (877) 462-4873 Email: <u>ISFstaffa energysolutions.com</u>

	CL	JSTOME	R IN	FORMATIO	N	DETECTOR INFORMATION		
Customer Name	: Energy	Solutions	Instr	ument Servi	ces	Manufacturer: Lu	dlum	
Address: 1570 B	ear Creek	Road O	ak Ri	dge, TN 3783	<u> </u>	Detector Model: 43-	37A	
Contact Name:	Tony Rig	gs				Serial Number: 092	2501	
Customer Purch Number: N/A	ase Order			Work Orde Number: 20	er 012-12264	Evaluation Method:	Source	
		DI	ETEC	TOR EFFIC	IENCY/RESPONSE/PRE	CISION INFORMATI	ON	
Source Nuclide:	Th <sup>230</sup>	Serial N	lumb	er: 119738	Activity: 18,600 dpm	2 Pi Emissions: 8,640	/min Certification Date: 10/20/97	
Paramete	er	As Fo	und	As Left	Precisio	on Test	СРМ	
Count 1		2,89	9	2,899	Count 1	(Heel)	2,899	
Count 2		2,92	7	2,927	Count 2	(Center)	2,811	
Count 3		2,81	1	2,811	Count 3	3 (Toe)	2,968	
Count 4		3,02	2	3,022	Aver	age	2,892.7	
Count 5		2,96	8	2,968	Toler	ance	±10%	
Count 6		2,86	4	2,864	Pass/	Fail	Pass	
Average		2,915	.2	2,915.2			a a contract the contract of the contract of	
Background (	CPM)	6.9		6.9				
Net Coun	ts	2,908	.3	2,908.3			· · · · · · · · · · · · · · · · · · ·	
2pi Efficien	icy	33.79	6	33.7%				
4pi Efficien	icy	15.6%	6	15.6%				
Low Sar Sour	nple Activ ce #: N/A	'ity: A		High Se	Sample Activity: ource #: N/A	Dead Time (DT): N/A	Calibration Constant (CC): N/A	
SCA	LER INF	ORMAT	ION			DETECTOR INFORM	AATION	
<u>Model</u>	<u>Serial N</u>	<u>umber</u>	Ē	ue Date	Background (cpm)	Operating Voltage	<u>Threshold</u>	
2360	2757	'24	1(	)/06/2012	6.9	1675V	Alpha (120mV) Beta (3.5-30mV)	
Detector Setu	p Report	Y	ES	NO √	Barcode Report	YES NO √	Voltage Plateau YES √ NO	
Ei		C		1266 4	COMMENTS	5174		
5 minute backgro	ound per	tormed		Efficiency pe	rtormed on contact with	ort. cable - 1 layer	mytar (0.4mg/cm2)	
				STA	TEMENT OF CERTIFIC	CATION		
We Certify that the d specifications. We fu damage incurred duri	etector lister rther certify ng shipmen	d above wa that our C t or use of	is eval alibrat this de	uated for proper ion Measureme stector).	r operation prior to shipment a nts are traceable to the Nation.	nd that it met all the Manufa al Institute of Standards and	cturers published operating Technology. (We are not responsible for	
Detector	$\overline{\Lambda}$				~ ~ /	······································		
Certified By:	ng	1		Reviewed By	: Allaber	niso Date	: 5/30/12	
Certification Date	: 05/30/20	012			*Certif	ication Due (6mo): 11	/30/2012	
<sup>*</sup> Calibration due da	te is deper	dant on u	sers r	egulatory requ	urements.	incustori izue (121110). VJ		



EnergySolutions Instrument Services 1570 Bear Creek Road Oak Ridge, TN 37830 Phone: (877) 462-4873 Email: <u>ISFstaff@energysolutions.com</u>

This Certificate will be accompanied by Calibration Charts or Readings where applicable

CU	CUSTOMER INFORMATION				DETECTOR INFORMATION			
Customer Name: Energy	Solutions Inst	rument Servi	ces	Manufacturer: Ludlum				
Address: 1570 Bear Creek	Road Oak R	idge, TN 3783	30	Detector Model: 43-	Detector Model: 43-37B			
Contact Name: Tony Rigg	gs			Serial Number: 092501				
Customer Purchase Order Number: N/A		Work Orde Number: 20	Evaluation Metbod: 12-12264 Source					
	DETEC	TOR EFFIC	IENCY/RESPONSE/PRE	CISION INFORMATIO	ON			
Source Nuclide: Tc <sup>99</sup>	Serial Numl	oer: 099608	Activity: 21,312 dpm	2 Pi Emissions: 10,500	0/min Certification Date: 08/08/96			
Parameter	As Found	As Left	Precisio	on Test	СРМ			
Count 1	4,820	4,820	Count 1	(Heel)	4,820			
Count 2	4,983	4,983	Count 2 (	Center)	4,922			
Count 3	4,922	4,922	Count 3	(Toe)	5,003			
Count 4	4,767	4,767	Äver	age	4,915			
Count 5	4,857	4,857	Toler	Ance	±10%			
Count 6	5,003	5,003	Pass/	Fail	Pass			
Average	4,892	4,892						
Background (CPM)	503	503			an de la compañía de			
Net Counts	4,389	4,389						
2pi Efficiency	41.8%	41.8%						
4pi Efficiency	20.6%	20.6%						
Low Sample Activ Source #: N/A	ity: N	High S	Sample Activity: ource #: N/A	Dead Time (DT): N/A	Calibration Constant (CC): N/A			
SCALER INFO	ORMATION			DETECTOR INFORM	<b>IATION</b>			
Model Serial N	umber l	<u>Due Date</u>	Background (cpm)	<b>Operating Voltage</b>	Threshold			
2360 2757	24 1	0/06/2012	503	1675V	Alpha (120mV) Beta (3.5-30mV)			
Detector Setup Report	YES	NO √	Barcode Report	YES NO √	Voltage Plateau YES √ NO			
		X7.000 L	COMMENTS					
5 minute background peri	ormed	Efficiency pe	riormed on contact with !	off. cable I layer	mylar (0.4mg/cm2)			
		STA	TEMENT OF CERTIFIC	CATION				
We Certify that the detector listed specifications. We further certify	l above was eva that our Calibra	luated for prope tion Measureme	r operation prior to shipment an nts are traceable to the Nationa	nd that it met all the Manuface Institute of Standards and	cturers published operating Technology. (We are not responsible for			
damage incurred during shipment	or use of this d	etector).						
Detector								
Certified By:		<b>Reviewed By</b>	: All Dula	inso Date	5/30/12			
Certification Date: 05/30/20	12		Certifi     * Certifi     * Certifi	ication Due (6mo): 11/ ication Due (12mo): 05/	/30/2012 /30/2013			

Calibration due date is dependant on users regulatory requirements.

Designer and Manufacturer of Scientific and Industrial Instruments	CERTIFIC	CATE OF CAL	IBRATION	LUDLUN POST OFFIO 501 OAK ST SWEETWAT	I <b>MEASURE</b> CE BOX 810 F REET FER, TEXAS 799	MENTS, II PH. 325-235-54 FAX NO. 325- 556, U.S.A.	<b>NC.</b> 194 -235-4672
CUSTOMER US ARMY CORPS C	F ENG BALTIMORE			ORI	DER NO.	20181694/366	617
	Madel	<u> </u>	10	Serial No	7.4502.6		
Mfg. Ludium Measurements	, Inc Wodel		_19	Ocrial No	<u></u>		
Mfg	Model			Serial No	·		
Cal. Date <u>11-Aug-11</u>	Cal Due Date _	11-Au	ig-12 Cal. In	iterval <u>1</u>	Year Meterfac	ce <u>202-</u>	1070
Check mark vapplies to applicable ins	tr. and/or detector IAW r	nfg. spec.	T74_ °F	RH	<u>41</u> % Alt_	698.8	mm Hg
New instrument instrument R	eceived 🗔 Within To	oler. +-10% 🕅 10-	20% 🗍 Out of Tol.	Requiring R	epair 📋 Othe	r-See commen	its
✓       Mechanical ck.         ✓       F/S Resp. ck         ✓       Audio ck.	<ul> <li>Ճ Meter Zeroed</li> <li>Ճ Reset ck.</li> <li>ጏ Alarm Setting ck.</li> </ul>	☐ Bao ☐ Wir ☑ Bat	ckground Subtract ndow Operation t. ck. (Min. Volt)	VDC	☐ Input Sens. ☑ Geotropism	Linearity	
Calibrated in accordance with LMI	SOP 14.8 rev 12/05/89.		brated in accordance v	VITA LIVII SOP 1	Threshold	•	mV
Instrument Volt Set650V	nput Sens. 30	mV Det. Oper.	V at	mV	Dial Ratio	=	
E LIV Boodout (2 pointe)	f /Inst	1.	V Ref./Ins	t.	1		V
		· ·					
Gamma Calibration: GM detectors positioned	perpendicular to source exce	pt for M 44-9 in which t	he front of probe faces so	urce.			
	REFEREN	ICE					
RANGE/MULTIPLIER	CAL. POIN	41		ADING"		JING	
5000	<u>4000µR/hr</u>		///		4000		
	<u>1000µR/hr</u>	200 - 0			1000	·	
	$400\mu R/nr = 7 \phi$	, soo epus			100		
	$\frac{100\mu R/m}{200\mu R/m} = 38$	000 000			700		
250	200µt/m = <i>50</i> / 100µR/hr	and the			100		
50	7680 com				40		
50	/920 cpm				10		
25	3800 cpm				20		
25	950 cpm		K.		5		
*(Incertainty within + 10% C.F.w	/ithin ± 20%	· · · ·		F	Range(s) Calibra	ted Electroni	cally
		RUMENT	REFERENCE	INSTR	RUMENT	INSTRUMEN	ŧΤ
			CAL POINT	RECE	IVED	METER REA	DING*

	*I Incertainty within + 10%	C.F. within ± 20%	·	· · ·		Range(s)	Calibrated Electronically
Digital	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING* Log Sc	REFERE CAL. PO g ale	NCE INT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Readout							
Ludium Meas other Internati The calibratio	urements, Inc. certifies that the a onal Standards Organization me n system conforms to the require	above instrument has been ca embers, or have been derived ements of ANSI/NCSL Z540-1	librated by standards traceable to the from accepted values of natural phys -1994 and ANSI N323-1978	National Institute of Sical constants or have	Standards and e been derive	d Technology, or to the calib d by the ratio type of calibra State of Texas Ca	bration facilities of ation techniques. Ilibration License No. LO-1963
<b>Referen</b> Cs-137 Ga	ce Instruments and/ mma S/N 1162	or Sources: 734 G112 🖌 M565 🗌 510	410 L 1131 J 78 05 T T1008 T 879 E 5	1059 52E551	] 280 [_] ( ] 720 [_] :	734 1616 [	Neutron Am-241 Be S/N T-304
	ha S/N		Beta S/N		🗆	Other	
⊡ m t	500 S/N949	40	Oscilloscope S/N		🗹	Multimeter S/N	78401031
Calibrate	d By: 5205	57	tron	C	Date/	1-Aug-11	
Reviewe	d By: <u>Rha</u>	Hai	ç	[	Date	Aug U	
This certific FORM C22	ate shall not be reproduced exc A 03/11/2010 Page	ept in full, without the written	approval of Ludium Measurements, In	ic.	AC Inst. Only	Passed Dielectric (	Hi-Pot) and Continuity Test

	4

Designer and Manufacturer of

LUDLUM MEASUREMENTS, INC. POST OFFICE BOX 810 PH. 325-235-5494

Scientific and I Instrume	ndustrial nts	CERTIFICA	ATE OF C.	ALIBRATIC	DN 5 s	01 OAK STE	REET ER, TEXAS 7	FAX NO. 32 9556, U.S.A.	5-235-4672
CUSTOMER US ARMY (	CORPS OF ENG	BALTIMORE				ORD	ER NO	20181691/36	6614-
Mfg. Ludium Meas	urements, Inc.	Mode!		19		Serial No.	253050		
Mfg.		Model		<u></u>		Serial No.			
Cal. Date 11-	Aug-11	Cal Due Date	11	-Aug-12	Cal. Interv	val <u>1</u> Y	<u>ear</u> Meterfa	ace <u>20</u>	2-1070
Check mark vapplies to applied	licable instr. and/o	r detector IAW mf	g. spec.	Т	<u>74</u> °F	RH	<u>38</u> % Alt	698.8	_ mm Hg
New Instrument Inst	rument Received	Within Tole	er. +-10% 📋	10-20% 🗌 O	ut of Tol. 🔲	Requiring Re	epair 🗌 Oth	er-See comme	ents
<ul> <li>✓ Mechanical ck.</li> <li>✓ F/S Resp. ck</li> <li>✓ Audio ck.</li> </ul>	✓ Meter ✓ Reset □ Alarm	Zeroed t ck. setting ck.		Background S Window Opera Batt. ck. (Min.	ubtract ation2 Volt)2	2.2_VDC	☐ Input Sens ☑ Geotropisi	s. Linearity m	
Calibrated in accordance	with LMI SOP 14.8	8 rev 12/05/89.	4	Calibrated in ac	cordance with	LMI SOP 14	.9 rev 02/07/9 Threshold	7.	mV
Instrument Volt Set686	V Input Ser	ıs. <u>29</u> m	V Det. Oper.		_ V at	mV	Dial Ratio	=	
⊢ HV Readout (2 points	s) Ref./Inst		/	V	/ Ref./Inst.		<u> </u>		V
COMMENTS:									
Gamma Calibration: GM detectors	positioned perpendic	ular to source except	for M 44-9 in wh	ich the front of pr	IMENT RE	<u>.</u> C'D	INSTRUME	-NT	
RANGE/MULT	IPLIER	CAL. POINT	· L -	"AS FC	UND READ	DING"	METER RE	ADING*	
5000		4000µR/hr			4100			00	-

		1						
	RANGE/MULTIPI	LIER (	CAL. POINT		"AS FOUND	READING"	METER	READING
	5000	400	0µR/hr	_	410	0		4000
	5000	100	0µR/hr	_	110	0		1000
	500	400	R/hr=76,000 CPM	. ·	395			400
	500	10	0µR/hr	_	95	-		100
	250	200	R/hr = 37.600 ppm	_	210			200
	250	10	DuR/hr	-	110			100
	50	7600	cpm	_	39.5			40
	50	1900	com	_	9.5	-		10
	25	3760	com	_	19.5	•		20
	25	940	cpm	-	4.5			5
	*Uncertainty within ± 10%	C.F. within ± 20%	<u></u>				Range(s) C	alibrated Electronically
	REFERENCE	INSTRUMENT	INSTRUMENT		REFERENC	E IN	STRUMENT	INSTRUMENT
		RECEIVED	METER READING	r	CAL. POINT	· RE	ECEIVED	METER READING*
Digital				Log				
Readout				Scale	·			
	· · · · ·							
	<u> </u>				<u> </u>			
	· · · · · · · · · · · · · · · · · · ·							
Ludium Meas other Internal The calibratic	urements, Inc. certifies that the al tional Standards Organization me on system conforms to the require	oove instrument has bee mbers, or have been der ments of ANSI/NCSL 25	n calibrated by standards traceable ved from accepted values of natura 10-1-1994 and ANSI N323-1978	to the Na I physical	tional Institute of Stan constants or have be	dards and Technolo en derived by the ra Sta	ogy, or to the calibra atio type of calibratio ate of Texas Calib	tion facilities of on techniques. ration License No. LO-1963
Poforor	ce Instruments and/	or Sources:	73410 1131	781	059 28	80 🗌 60646	70897	
Cs-137 Ga	amma S/N 1162 G	112 M565	5105 T1008 T879	 E552	E551 72	20 🗌 734 🗌	] 1616	Neutron Am-241 Be S/N T-304
🗌 Alı	oha S/N		Beta S/N			_ D Other		
🖌 m	500 S/N 9494	40	Oscilloscope S/N			🔄 🖌 Multim	eter S/N	78401031
Calibrate	ed By: 5 cas	- 5	word		Dat	= <u>11-Au</u>	19-11	
Reviewe	ed By:	1 Hi	· .	•	Dat	e <u>11 A</u>	· q 11	
		-	ten energy of a fill under management	nie loc				-Pot) and Continuity Test
This certifi FORM C22	cate shall not be reproduced exce 2A 03/11/2010 Page	of	ten approval of Lucium measureme	ntə, mü.		Only D Faile	ed:	

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Electroplated Alpha Standard

			P.O.# <u>7155</u> P.O.# <u>C/C</u>
Description of Standard:			
Model NoDNS-11	_ Serial No	7241-11	Isotope <u>Th-230</u>
Electroplated on polished	SS disc,	0.79	mm thick.
Total diameter of4.77	cm and an	active diamete:	r of <u>4.45</u> cm.

The radioactive material is permanently fixed to the disc by heat treatment without any covering over the active surface.

### Measurement Method:

The 2pi alpha emission rate was measured using an internal gas flow proportional chamber. Absolute counting of alpha particles emitted in the hemisphere above the active surface was verified by counting above, below, and at the operative voltage. The calibration is traceable to NIST by reference to an NIST calibrated alpha source S/N<u>75322-201</u>

### Measurement Result:

The observed alpha particles emitted from the surface of the disc per minute (cpm) on the calibration date was:

11,300 + 338

The total disintegration rate (dpm) assuming 1.5% backscatter of alpha particles from the surface of the disc, was:

> \_\_\_\_\_ (\_\_\_\_\_0.0100 μCi) 22,200 + 666

The uncertainty of the measurement is \_\_\_\_3\_%, which is the sum of random counting error at the 99% confidence level, and the estimated upper limit of systematic error in this measurement. 11-1

Calibrated by: ART REUST	Reviewed by:
Calibration Technician: Utfue	2 I Q.A. Manager: Jon Juliu
	10/10/2011

Calibration Date: <u>10-03-2011</u>

Reviewed Date:



Electroplated Alpha Standard

S.O.# \_\_\_\_7155 P.O.# \_\_\_\_C/C

### Description of Standard:

Model No. DNS-11	Serial No	o	7242-11	Isotope	<u>Th-230</u>	
Electroplated on polished	SS	disc,_	0.79	mm	thick.	
Total diameter of .4	.77 cm	and an	active diameter	of <u>4.4</u>	5	cm.

The radioactive material is permanently fixed to the disc by heat treatment without any covering over the active surface.

### Measurement Method:

The 2pi alpha emission rate was measured using an internal gas flow proportional chamber. Absolute counting of alpha particles emitted in the hemisphere above the active surface was verified by counting above, below, and at the operative voltage. The calibration is traceable to NIST by reference to an NIST calibrated alpha source S/N\_\_\_\_75322-201\_\_\_

### Measurement Result:

The observed alpha particles emitted from the surface of the disc per minute (cpm) on the calibration date was:

14,600 + 438

The total disintegration rate (dpm) assuming 1.5% backscatter of alpha particles from the surface of the disc, was:

<u>28,800</u> <u>+</u> <u>863</u> (<u>0.0130</u> μCi)

The uncertainty of the measurement is \_\_\_\_\_%, which is the sum of random counting error at the 99% confidence level, and the estimated upper limit of systematic error 2----in this measurement.

Calibrated by:ART REUST	Reviewed by:
Calibration Technician: Afreu	1_ Q.A. Manager: Low John
	10/10/2011

Calibration Date: 10-03-2011 Reviewed Date: 10/10

Source Manufacturing Lab 7021 Pan American Freeway NE Albuquerque, New Mexico 87109-4238 (505) 761-5413 Fax (505) 761-5416

art.reust@eberlineservices.com



Electroplated Alpha Standard

			s.o.#	7155
Description of Standard:			P.O.#	C/C
Sebelipeien er Standard.				
Model No. DNS-11	_ Serial No	7244-11	Isotope	<u>'h-230</u>
Electroplated on polished	<u>SS</u> disc,	0.79	mm t	hick.
Total diameter of 4.77	cm and a	an active diamet	cer of <u>4.45</u>	Cm.
The radioactive material is p any covering over the active	permanently fixed surface.	d to the disc by	y heat treatmen	t without
Measurement Method:				
The 2pi alpha emission rate w chamber. Absolute counting c active surface was verified b The calibration is traceable S/N_75322-201	as measured usi: of alpha particle by counting above to NIST by refe	ng an internal o es emitted in t e, below, and a rence to an NIS	gas flow propor he hemisphere a t the operative T calibrated al	tional bove the voltage. pha source
Measurement Result:				
The observed alpha particles the calibration date was:	emitted from th	e surface of the	e disc per minu	te (cpm) on
12,200	<u>+36</u>	5		
The total disintegration rate the surface of the disc, was:	e (dpm) assuming	1.5% backscatt	er of alpha par	ticles from
24.000	+ 72	20 (	0.0108	μCi)
	<u>·</u>	<u> </u>	010200	
The uncertainty of the measure error at the 99% confidence I in this measurement. Calibrated by: <u>ART REUST</u> Calibration Technician:	rement is <u>3</u> evel, and the e Re	_%, which is the stimated upper stimated upper viewed by:	he sum of rando limit of system $D_{1}$ $D_{2}$ r: M M	m counting atic error
Calibration Date: <u>10-03-</u>	2011	Reviewed Da	te: <u>10/10/2011</u>	<u>Source Manufacturing Lab</u>
			Albuq (50	7021 Pan American Freeway NE Jerque, New Mexico 87109-4238 5) 761-5413 Fax (505) 761-5416

art.reust@eberlineservices.com



Electroplated Beta Standard

S.O.#<u>7156</u> P.O.#<u>C/C</u>

### Description of Standard:

Model No. DNS-12	Serial No	7246-11	Isotope	Tc-99	
Electroplated on polished	SS	disc,	0.79	mm	thick.
Total diameter of 4.77	Ċ	m and an active	diameter of	4.45	cm.

The radioactive material is permanently fixed to the disc by heat treatment without any covering over the active surface.

#### Measurement Method:

#### Measurement Result:

The observed beta count rate from the surface of the disc per minute (cpm) on the calibration date was:

<u>11,500 + 458</u>

The total disintegration rate (dpm) assuming <u>25</u> % backscatter of beta particles from the surface of the disc, was:

<u>18,300</u> <u>+</u> <u>733</u> (<u>0.00826</u> μCi)

The uncertainty of the measurement is 4%, which is the sum of random counting error at the 99% confidence level, and the estimated upper limit of systematic error in this measurement.

	AN C
Calibrated by: ART REUST Re	eviewed by:
Calibration Technician:	Z.A. Manager: Son' Indew
Calibration Date: <u>10-03-2011</u>	Reviewed Date:/0/10/20/1



Electroplated Beta Standard

				S.O.#	<u>/156</u> C/C
Description of Standard:				1.0	
Model No	Serial No	7245-11	Isotope_	<u>Tc-9</u>	9
Electroplated on polished	SS	disc,	0.79		_ mm thick.
Total diameter of <u>4.77</u>	cm a	and an active	diameter of	4.45	cm.

The radioactive material is permanently fixed to the disc by heat treatment without any covering over the active surface.

### Measurement Method:

The 2pi beta emission rate was measured using an internal gas flow proportional chamber. Absolute counting of beta particles emitted in the hemisphere above the active surface was verified by counting above, below, and at the operative voltage. The calibration is traceable to NIST by reference to an NIST calibrated beta source S/N \_\_\_\_\_75323-201\_\_\_.

### Measurement Result:

The observed beta count rate from the surface of the disc per minute (cpm) on the calibration date was:

> 329 6,600 +

The total disintegration rate (dpm) assuming \_ 25\_\_\_% backscatter of beta particles from the surface of the disc, was:

> 10,600 \_\_\_\_\_ + \_\_\_\_527 (\_\_\_\_0.00475 μCi)

The uncertainty of the measurement is \_\_\_\_%, which is the sum of random counting error at the 99% confidence level, and the estimated upper limit of systematic error in this measurement.

Calibrated by: <u>ART REUST</u>

Reviewed by:

Calibration Technician: affect Q.A. Manager:\_

Calibration Date: 10-03-2011 Reviewed Date: 10/10/2011

MS



Electroplated Beta Standard

S.O.#<u>7156</u> P.O.#<u>C/C</u>

Description of Standard:

Model No. DNS-12	_ Serial No	7248-11	Isotope	Tc-99
Electroplated on polished_	SS	disc,	0.79	mm thick.

Total diameter of <u>4.77</u> cm and an active diameter of <u>4.45</u> cm.

The radioactive material is permanently fixed to the disc by heat treatment without any covering over the active surface.

### Measurement Method:

The 2pi beta emission rate was measured using an internal gas flow proportional chamber. Absolute counting of beta particles emitted in the hemisphere above the active surface was verified by counting above, below, and at the operative voltage. The calibration is traceable to NIST by reference to an NIST calibrated beta source S/N \_\_\_\_\_75323-201\_\_\_\_.

### Measurement Result:

The observed beta count rate from the surface of the disc per minute (cpm) on the calibration date was:

10,800 + 430

The total disintegration rate (dpm) assuming <u>25</u>% backscatter of beta particles from the surface of the disc, was:

<u>17,200</u> + <u>688</u> (<u>0.00775</u> μCi)

The uncertainty of the measurement is <u>4</u>%, which is the sum of random counting error at the 99% confidence level, and the estimated upper limit of systematic error in this measurement.

Calibrated by: <u>ART REUST</u> Review	wed by: Malans
Calibration Technician: Uthur	Q.A. Manager: In Julan
Calibration Date: <u>10-03-2011</u>	Reviewed Date: 10 /10 /2011