

Appendix E

Calibration Sheets and Performance Checks

Radiation Safety
Routine Operability of Field Instruments

DAILY INSTRUMENT RESPONSE CHECK
Form RS-013.0-3

SITE: WRAMC

Date: 11/9/2011

For Month of: Nov/Dec

Instrument Information	
Type/Serial #:	L2360/141321
Probe/Serial #:	44-110/258430
Calibration Due Date:	23-Oct-12

Source Information		
Isotope	H-3	Fe-55
Serial Number	TY 849	N/A
2 π emission rate	10,320	N/A

DATE	TIME	BACKGROUND CPM		SOURCE CPM		COMMENTS	Tech Initials
		Alpha	Beta	H-3	Fe-55		
11/25/2011	6:30	N/A	203	5839	738131	Initial Set up	ALR
11/28/2011	6:30	N/A	188	6424	676716		ALR
11/29/2011	6:30	N/A	177	4944	607079		ALR
11/30/2011	6:30	N/A	204	6303	767316		ALR
12/1/2011	6:30	N/A	233	6605	804321		ALR
12/2/2011	6:30	N/A	215	6053	760542		ALR
12/5/2011	6:30	N/A	221	5984	712057		ALR
12/6/2011	6:30	N/A	196	4935	646817		ALR
12/7/2011	6:30	N/A	232	6287	678190		ALR
12/8/2011	6:30	N/A	203	4755	738675		ALR
12/9/2011	6:30	N/A	173	6027	760641		ALR
12/12/2011	6:30	N/A	191	6390	746916		ALR
12/13/2011	6:30	N/A	175	6138	733530		ALR
12/14/2011	6:30	N/A	173	6145	668898		ALR
12/15/2011	6:30	N/A	221	4825	830987		ALR
12/16/2011	6:30	N/A	209	5563	599930		ALR
12/19/2011	6:30	N/A	226	5951	631588		ALR
12/20/2011	6:30	N/A	220	4604	854717		ALR
12/21/2011	6:30	N/A	219	5375	743574		ALR
12/22/2011	6:30	N/A	224	5573	770727		ALR
12/23/2011	6:30	N/A	197	5709	641661		ALR
12/27/2011	6:30	N/A	188	4875	676063		ALR
12/28/2011	6:30	N/A	202	4823	696020		ALR
12/29/2011	6:30	N/A	233	5520	754679		ALR
2/3/2012	5:30	N/A	194	4522	783291		ALR

Mean from form RS-013.0-1

Background

202.75

Beta

Mean from form RS-013.0-1

Source

5535.1 H-3

738130.9

Fe-55

Background Acceptance Limits			
M-20%	162	M+20%	243

Beta

Source Acceptance Limits			
M-20%	4428.08	M+20%	6642.12
M-20%	590505	M+20%	885757

H-3

Fe-55

Reviewed by:



Date:

2/3/2012

Radiation Safety
Routine Operability of Field Instruments

DAILY INSTRUMENT RESPONSE CHECK
Form RS-013.0-3

SITE: WRAMC **Date:** 11/9/2011 **For Month of:** Nov/Dec

Instrument Information	
Type/Serial #:	L2360/253258
Probe/Serial #:	43-68/148454
Calibration Due Date:	23-Oct-12

Source Information		
Isotope	Th-230	Tc-99
Serial Number	A2-743	A2-771
2 π emission rate	17,608	28,509

DATE	TIME	BACKGROUND CPM		SOURCE CPM		COMMENTS	Tech Initials
		Alpha	Beta	Alpha	Beta		
11/9/2011	6:30	0.9	111	4746	9236	Initial Set up	ALR
11/10/2011	6:30	1	131	5187	9680		ALR
11/14/2011	6:30	0	108	4490	9907		ALR
11/15/2011	6:30	1	107	4664	10465		ALR
11/16/2011	6:30	1	123	3858	7584		ALR
11/17/2011	6:30	0	103	5587	9368		ALR
11/18/2011	6:30	0	91	5288	9152		ALR
11/21/2011	6:30	1	93	4936	9852		ALR
11/22/2011	6:30	2	122	5201	9681		ALR
11/23/2011	6:30	1	130	4922	8902		ALR
11/25/2011	6:30	0	116	3903	10367		ALR
11/28/2011	6:30	1	126	5159	9748		ALR
11/29/2011	6:30	1	115	4707	9028		ALR
11/30/2011	6:30	0	118	5012	9089		ALR
12/1/2011	6:30	0	120	5673	7912		ALR
12/2/2011	6:30	1	113	5659	9938		ALR
12/5/2011	6:30	1	103	3975	8627		ALR
12/6/2011	6:30	0	123	4932	9877		ALR
12/7/2011	6:30	2	99	5127	8521		ALR
12/8/2011	6:30	0	117	3967	7414		ALR
12/9/2011	6:30	1	114	4221	10136		ALR
12/12/2011	6:30	1	101	5482	10641		ALR
12/13/2011	6:30	0	112	3981	9348		ALR
12/14/2011	6:30	0	123	5223	9032		ALR
12/15/2011	6:30	0	109	4987	8216		ALR

Mean from form RS-013.0-1
Background

0.9	Alpha
110.55	Beta

Mean from form RS-013.0-1
Source

4745.55	Alpha
9235.85	Beta

Background Acceptance Limits

M-2 σ	-0.80	M+2 σ	2.60	Alpha
M-20%	88	M+20%	133	Beta

Source Acceptance Limits

M-20%	3796	M+20%	5695	Alpha
M-20%	7389	M+20%	11083	Beta

Reviewed by: 

Date: 2/15/2011

DAILY INSTRUMENT RESPONSE CHECK

Form RS-013.0-3

For Month of: Nov/Dec

Source Information		
Isotope	Th-230	Tc-99
Serial Number	A2-743	A2-771
2 π emission rate	17,608	28,509

Date: 2/3/2012

Radiation Safety
Routine Operability of Field Instruments

DAILY INSTRUMENT RESPONSE CHECK
Form RS-013.0-3

SITE: WRAMC

Date: 11/9/2011

For Month of: Nov/Dec

Instrument Information	
Type/Serial #:	L2360/253258
Probe/Serial #:	43-37/265544
Calibration Due Date:	23-Oct-12

Source Information		
Isotope	Th-230	Tc-99
Serial Number	A2-743	A2-771
2 π emission rate	17,608	28,509

DATE	TIME	BACKGROUND CPM		SOURCE CPM		COMMENTS	Tech Initials
		Alpha	Beta	Alpha	Beta		
11/9/2011	6:30	12	254.5	3784.7	5492.6	Initial Set up	ALR
11/10/2011	6:30	10	236	3620	5922		ALR
11/14/2011	6:30	14	269	4134	4549		ALR
11/15/2011	6:30	7	227	3939	5622		ALR
11/16/2011	6:30	7	279	3636	5515		ALR
11/17/2011	6:30	9	283	3704	5367		ALR
11/18/2011	6:30	12	234	3535	5673		ALR
11/21/2011	6:30	11	254	3498	5672		ALR
11/22/2011	6:30	17	266	3543	5653		ALR
11/23/2011	6:30	15	227	3521	5793		ALR
11/28/2011	6:30	10	279	3825	5539		ALR
11/29/2011	6:30	5	237	3602	6165		ALR
11/30/2011	6:30	6	246	3743	6416		ALR
12/1/2011	6:30	17	287	4358	6180		ALR
12/2/2011	6:30	9	265	3613	4973		ALR
12/5/2011	6:30	7	296	3404	6342		ALR
12/6/2011	6:30	15	292	3398	5669		ALR
12/7/2011	6:30	15	262	3937	6109		ALR
12/8/2011	6:30	10	229	3300	4609		ALR
12/9/2011	6:30	15	252	4314	4800		ALR
12/12/2011	6:30	8	290	3764	5285		ALR
12/13/2011	6:30	9	234	3141	6377		ALR
12/14/2011	6:30	6	281	3242	5998		ALR
12/15/2011	6:30	9	267	4116	6424		ALR
12/16/2011	6:30	14	292	4302	5051		ALR

Mean from form RS-013.0-1
Background

12	Alpha
254.5	Beta

Mean from form RS-013.0-1
Source

3784.7	Alpha
5492.6	Beta

Background Acceptance Limits

M-20%	4.69	M+20%	19.31	Alpha
M-20%	204	M+20%	305	Beta

Source Acceptance Limits

M-20%	3028	M+20%	4542	Alpha
M-20%	4394	M+20%	6591	Beta

Reviewed by: 

Date: 12/16/2011

Radiation Safety
Routine Operability of Field Instruments

DAILY INSTRUMENT RESPONSE CHECK
Form RS-013.0-3

SITE: WRAMC **Date:** 11/9/2011 **For Month of:** Nov/Dec

Instrument Information	
Type/Serial #:	L2360/253258
Probe/Serial #:	43-37/265544
Calibration Due Date:	23-Oct-12

Source Information		
Isotope	Th-230	Tc-99
Serial Number	A2-743	A2-771
2 π emission rate	17,608	28,509

DATE	TIME	BACKGROUND CPM		SOURCE CPM		COMMENTS	Tech Initials
		Alpha	Beta	Alpha	Beta		
12/19/2011	6:30	15	226	3521	5047		ALR
12/20/2011	6:30	18	237	3138	6443		ALR
12/21/2011	6:30	12	225	3728	6449		ALR
12/22/2011	6:30	7	289	4098	5636		ALR
12/23/2011	6:30	6	248	4184	5929		ALR
12/27/2011	6:30	9	284	3165	5083		ALR
12/28/2011	6:30	16	291	3536	5994		ALR
12/29/2011	6:30	18	267	3230	4665		ALR
2/3/2012	5:30	5	263	3640	5415		ALR

Mean from form RS-013.0-1
Background

12	Alpha
254.5	Beta

Mean from form RS-013.0-1
Source

3784.7	Alpha
5492.6	Beta

Background Acceptance Limits

M-20%	4.69	M+20%	19.31	Alpha
M-20%	204	M+20%	305	Beta

Source Acceptance Limits

M-20%	3028	M+20%	4542	Alpha
M-20%	4394	M+20%	6591	Beta

Reviewed by: 

Date: 2/3/2012

Radiation Safety
Routine Operability of Field Instruments

DAILY INSTRUMENT RESPONSE CHECK
Form RS-013.0-3

SITE: WRAMC

Date: 11/9/2011

For Month of: Nov/Dec

Instrument Information	
Type/Serial #:	L2360/253237
Probe/Serial #:	43-68/216834
Calibration Due Date:	23-Oct-12

Source Information		
Isotope	Th-230	Tc-99
Serial Number	A2-743	A2-771
2 π emission rate	17,608	28,509

DATE	TIME	BACKGROUND CPM		SOURCE CPM		COMMENTS	Tech Initials
		Alpha	Beta	Alpha	Beta		
11/9/2011	6:30	1	59	5016	7674	Initial Set up	ALR
11/10/2011	6:30	0	51	4818	8316		ALR
11/14/2011	6:30	1	65	4695	7009		ALR
11/15/2011	6:30	1	48	5238	7115		ALR
11/16/2011	6:30	0	68	4751	6687		ALR
11/17/2011	6:30	1	68	4348	8587		ALR
11/18/2011	6:30	1	68	3875	6340		ALR
11/21/2011	6:30	1	67	3956	7016		ALR
11/22/2011	6:30	1	63	5510	7993		ALR
11/23/2011	6:30	1	55	4998	6499		ALR
11/25/2011	6:30	0	63	4776	7155		ALR
11/28/2011	6:30	1	50	5352	8564		ALR
11/29/2011	6:30	1	65	4683	7525		ALR
11/30/2011	6:30	1	70	4871	6857		ALR
12/1/2011	6:30	1	60	4257	7676		ALR
12/2/2011	6:30	2	49	5218	6511		ALR
12/5/2011	6:30	2	62	5515	8094		ALR
12/6/2011	6:30	1	60	5034	6273		ALR
12/7/2011	6:30	1	63	5193	5957		ALR
12/8/2011	6:30	1	70	4324	7783		ALR
12/9/2011	6:30	1	51	4862	6948		ALR
12/12/2011	6:30	2	51	4909	6544		ALR
12/13/2011	6:30	1	51	3869	8591		ALR
12/14/2011	6:30	0	54	4851	6783		ALR
12/15/2011	6:30	1	62	5220	7822		ALR

Mean from form RS-013.0-1
Background

0.6	Alpha
59.35	Beta

Mean from form RS-013.0-1
Source

4672	Alpha
7338.4	Beta

Background Acceptance Limits				
M-2s	-0.76	M+2s	1.96	Alpha
M-20%	47	M+20%	71	Beta

Source Acceptance Limits				
M-20%	3738	M+20%	5606	Alpha
M-20%	5871	M+20%	8806	Beta

Reviewed by: 

Date: 12/15/2011

DAILY INSTRUMENT RESPONSE CHECK
Form RS-013.0-3

Instrument Information	
Type/Serial #:	L2360/253237
Probe/Serial #:	43-68/216834
Calibration Due Date:	23-Oct-12

[illegible]

4671.95	Alpha
7338.35	Beta

Source Acceptance Limits				
M-20%	3738	M+20%	5606	Alpha
M-20%	5871	M+20%	8806	Beta

Date: 2/3/2012

Eckert & Ziegler
Nuclitec GmbH

Gieselweg 1
38110 Braunschweig
Germany

Tel. +49 5307 932-0
Fax +49 5307 932-293

31 October 2011

CERTIFICATE

No. 147418 – TY 849

for a Sealed Radioactive Source

Source Type: Beta Wide Area Reference Source

Product code	TRR05011
Drawing	VZ-1370-001
Dimensions of active surface	Ø 50 mm
Overall dimensions	Ø 60 mm x 3 mm
Source no.	TY 849
Nuclide	Tritium

Technical Data

Activity	10 kBq (nominal)
Beta surface emission rate	172 s^{-1} in 2π steradian
Uncertainty* of beta surface emission rate	6 %
Reference date	19 October 2011
Traceability*	Defined on page 2

Leakage and Contamination Test/s

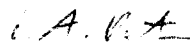
Test method/s*	I
Test/s passed on	26 October 2011

Additional Information

ISO classification*	C.34645
Remark	Ref: PO#2425/SO#20632 End user Reference PO#DISSANAYAKE28SEP11

* see page 2 for explanation

Eckert & Ziegler
Nuclitec GmbH


Production Manager

Explanations for Certificates (Page 2 of Certificates)

Uncertainty

The reported uncertainty is based on standard uncertainty multiplied by a coverage factor $k = 2$, providing a level of confidence of approximately 95 %. (ISO Guide, 1995)

Traceability

This certificate documents the traceability of measurement results to national standards, standard measuring equipment and methods for the realisation of physical units of measurement according to the International System of Units (SI). Traceability is defined as 'the property of a result of a measurement whereby it can be related to appropriate standards, generally international or national standards, through an unbroken chain of comparisons'.

Eckert & Ziegler Nuclitec GmbH has been accredited as DKD (Deutscher Kalibrierdienst) calibration laboratory by the Physikalisch-Technische Bundesanstalt (PTB) and is authorized to issue reference sources which are traceable to national standards held at the PTB in Germany. Because of the European co-operation for Accreditation (EA) mutual recognition agreement the certificates are also accepted by all EA-members (e. g. UKAS).

This product complies with the requirements for traceability to NIST specified in the American National Standard "Traceability of Radioactive Sources to the NIST and Associated Instrument Quality Control (ANSI N42.22-1995)". As a requirement for the ANSI N42.22-1995 **Eckert & Ziegler Nuclitec GmbH** participates in the NEI/NIST Measurements Assurance Program of the Nuclear Power Industry.

Air Kerma Rate

The air kerma rate of a source with an activity A is the sum of the initial kinetic energies of all charged particles created by photons, released per volume element of air and per unit of time.

Leakage and Contamination Tests

Stringent tests for leakage are an essential feature of radioactive sources production. They are based on ISO 9978. Some standard methods used for testing radiation sources are listed below.

Wipe Test I

The source is wiped with a swab or tissue, moistened with ethanol or water, the activity removed is measured.
Limit: 200 Bq, USA: 5 nCi

Immersion Test II

The source is immersed in a suitable liquid at 50 °C for at least 4 hours and the activity removed is measured.
Limit: 200 Bq, USA: 5 nCi

Bubble Test III

The source is immersed in water or a suitable liquid and the pressure in the vessel reduced to 13 kPa (100 mm Hg). No bubbles must be observed.

ISO Classification

The International Organization for Standardization (ISO) has proposed a system of classification of sealed radioactive sources based on safety requirements for typical uses (see ISO 2919 and ANSI N43.6-1997). This system provides a manufacturer of sealed radioactive sources with a set of tests to evaluate the safety of his products. It also assists a user of such sealed sources to select types which suit the application he has in mind. The tests to which specimen sources are subjected are listed in the following table.

Classification of sealed source performance standard according to ISO 2919 and ANSI N43.6-1997

Test	Class 1	2	3	4	5	6	X
Temperature	No test	- 40 °C (20 min) + 80 °C (1 h)	- 40 °C (20 min) + 180 °C (1 h)	- 40 °C (20 min) + 400 °C (1 h) and thermal shock 400 °C to 20 °C	- 40 °C (20 min) + 600 °C (1 h) and thermal shock 600 °C to 20 °C	- 40 °C (20 min) + 800 °C (1 h) and thermal shock 800 °C to 20 °C	Special test
External Pressure	No test	25 kPa absolute	25 kPa absolute to 2 MPa absolute	25 kPa absolute to 7 MPa absolute	25 kPa absolute to 70 MPa absolute	25 kPa absolute to 170 MPa absolute	
Impact	No test	50 g from 1 m	200 g from 1 m	2 kg from 1 m	5 kg from 1 m	20 kg from 1 m	
Vibration	No test	3 x 10 min 25 – 500 Hz at 5 g peak amplitude	3 x 10 min 25 – 50 Hz at 5 g peak amplitude and 50 – 90 Hz at 0.635 mm amplitude peak to peak and 90 – 500 Hz at 10 g peak amplitude	3 x 30 min 25 – 80 Hz at 1.5 mm amplitude peak to peak and 80 – 2000 Hz at 20 g peak amplitude			
Puncture	No test	1 g from 1 m	10 g from 1 m	50 g from 1 m	300 g from 1 m	1 kg from 1 m	

Special Applications

No test programme can cover all possible combinations of environments to which a source may be exposed. Users should therefore consult our experts before using sources in potentially adverse environments.

IAEA Special Form

'Special Form' is a test specification for sealed sources given in the IAEA transport regulations (IAEA TS-R-1). It is used in determining the maximum acceptable activities for various types of transport containers. If nothing else is stated, the reference date is identical with the date of manufacture.

Quality Assurance System

The quality assurance system of **Eckert & Ziegler Nuclitec GmbH** was certified by Lloyd's Register Quality Assurance (LRQA) according to ISO 9001:2000 and according to ISO 13485:2003 for medical devices. Isotrak products meet the requirements of 10CFR50 Appendix B.

NRC Advice

Radioactive Material - not for human use - introduction into foods, beverages, cosmetics, drugs, or medicinals, or into products manufactured for commercial distribution is prohibited - exempt quantities should not be combined



Eckert & Ziegler
Nuclitec

RSO, Inc.

P.O. Box 1450
Laurel, MD 20725
(301) 953-2482

RSO Job No. 9447

Certificate of Calibration

ISSUED TO: Tidewater, Inc.
7161 Columbia Gateway Dr.
Columbia, MD 21046

INSTRUMENT: LUDLUM
MODEL: 3
TYPE: RATEMETER
SN: 175521

CONTACT: Claude Wiblin
PHONE: (410) 997-4458

PO NO:CALL FOR CC

RSO, Inc. certifies that on 05/25/2011 the above described instrument was calibrated using a radioactive source to determine the efficiency for a specific radionuclide(s) and using electronically generated pulse for the linearity. Pulsed using Ludlum 500-2, S/N 159110.

The results are tabulated below. Calibration is traceable to NIST.

Calibration Data					
RANGE		EXPECTED	OBSERVED		C.F.
X	0.1	100	100	cpm	1.00
		500	500	cpm	1.00
X	1	1000	1000	cpm	1.00
		5000	5000	cpm	1.00
X	10	10000	10000	cpm	1.00
		50000	50000	cpm	1.00
X	100	100000	100000	cpm	1.00
		500000	500000	cpm	1.00
C.F. AVERAGE					1.00

Probe type(s)		Probe1: PANGM		Probe2:		Probe3:			
MODEL	SER#	WINDOW	GEOMETRY	VOLT	ISOTOPE 1 EFF.(%)	ISOTOPE 2 EFF.(%)	ISOTOPE 3 EFF.(%)	ISOTOPE 4 EFF.(%)	
44-9	PR183775	FIXED	CONTACT	904	Tc99 13	Cs137 30			

Note: "As found" condition +/- 20% of expected values unless indicated.

INSTRUMENT CHECKS

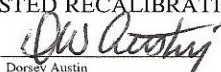
BATTERY CHECK: NORMAL
CHECK SOURCE 1: N/A READING:
CHECK SOURCE 2: N/A READING:

ENVIRONMENTAL

TEMP: 25°C
PRESS: 750 mmHg
HUMID: 58 %

THE SUGGESTED RECALIBRATION DATE FOR THIS INSTRUMENT IS **05/25/2012**

Calibrated By:


Dorsey Austin

Reviewed By:



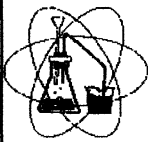
Cal Date: 05/25/2011

Maryland License MD-33-021-01

11026

CERTIFICATE OF CALIBRATION

(URSA-II MCA)



RSA Laboratories

19 Pendleton Drive, PO Box 61
Hebron, Connecticut 06248
860/228-0487 Fax 860/228-4402

Customer and Contact: Tidewater, Inc. Attn: Byron Bland 410/991-8878
Customer Address: 7161 Columbia Gateway Drive, Suite C, Columbia, MD 21046

Inst. Mfr. & Model URSA-II MCA
Cal Date 23 November 2011

Inst. Type Multi-channel analyzer
Due Date 23 November 2012

Inst. s/n 200124
Cal. Interval 1 year

Comments:

This MCA is currently used with Alpha Spectra FIDLER #050307AY1 and Ludlum Model 44-10 #186962

High Voltage:

Set Point (V)	Measured (V)	% Error
1500	1500	0
1000	1000	0
500	500	0
0	0	0

Fine Gain Linearity (Input1):

Coarse Gain	Fine Gain	Pulse Height (mV)	Expected Peak Chn	Observed Peak Chn	%Error
x2	x0.25	1800	n/a	508	n/a
x2	x0.50	1800	1016	1008	-0.8
x2	x0.75	1800	1524	1510	-0.9
x2	x1.00	1800	2032	2014	-0.9

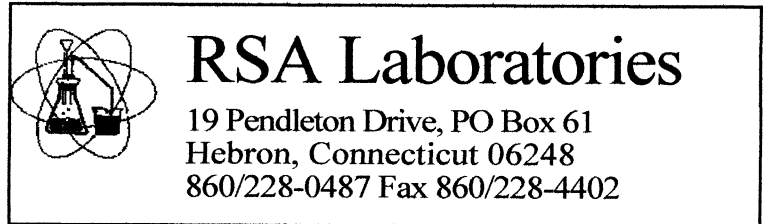
Fine Gain Linearity (Input 2):

Coarse Gain	Fine Gain	Pulse Height (mV)	Expected Peak Chn	Observed Peak Chn	%Error
x2	x0.25	1800	n/a	483	n/a
x2	x0.50	1800	966	961	-0.5
x2	x0.75	1800	1449	1440	-0.6
x2	x1.00	1800	1932	1921	-0.6

Coarse Gain Linearity:

Coarse Gain	Fine Gain	Pulse Height (mV)	Expected Peak Chn	Observed Peak Chn	%Error
x2	x0.50	1000	n/a	533	n/a
x2	x0.50	2000	1066	1055	-1.0
x2	x0.50	3000	1599	1572	-1.7
x4	x0.50	1000	n/a	1057	n/a
x4	x0.50	2000	2144	2073	-3.31
x4	x0.50	3000	3171	3134	-1.2
x15	x0.703	100	n/a	517	n/a
x15	x0.703	200	1034	1030	-0.4
x15	x0.703	300	1551	1562	0.7
x35	x0.703	100	n/a	1007	n/a
x35	x0.703	200	2014	2045	1.5
x35	x0.703	300	3021	3060	1.3
x125	x1.0	14	n/a	376	n/a
x125	x1.0	28	749	760	1.4
x125	x1.0	42	1125	1161	3.2
x250	x1.0	14	n/a	740	n/a
x250	x1.0	28	1480	1520	2.7
x250	x1.0	42	2220	2256	1.6

CERTIFICATE OF CALIBRATION (URSA-II MCA)



Pulse Rate:

Using 500mV pulse, MCA Coarse Gain x2, MCA Fine Gain x1.00

Input Rate (cpm)	Expected (counts/60 sec)	Observed (counts/60 sec)	% Error
40	40	10	0
400	400	400	0
4000	4000	4002	0.1
40,000	40,000	40,046	0.1
400,000	400,000	389,487	-2.6
1,000,000	1,000,000	976,195	-2.3

Threshold:

MCA Coarse Gain x2, MCA Fine Gain x 1 ,00 using 50mV pulse at 1000 cpm. Pulses begin accumulating at —52 mV.

All ranges were calibrated electronically.

Sources used: n/a

RSA Laboratories Log 1D# RSAL091123-1. Instrument indicates within $\pm 10\%$ of calibration points unless otherwise indicated. RSA Laboratories certifies that the above instrument has been calibrated with standards traceable to the National Institute of Standards and Technology, or have been derived from accepted standards of natural physical constants, or have been derived by the ratio-type of calibration techniques.

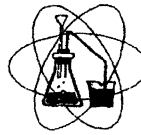
Paul R. Steinmeyer

Calibrated by:

Paul R. Steinmeyer

Date: 23 November 2011
Page 2 of 2

CERTIFICATE OF CALIBRATION (SCINTILLATION DETECTOR)



RSA Laboratories

19 Pendleton Drive, PO Box 61
Hebron, Connecticut 06248
860/228-0487 Fax 860/228-4402

Customer and Contact: Tidewater, Inc. Attn: Byron Bland 410/991-8878
Customer Address: 7161 Columbia Gateway Drive, Suite C, Columbia, MD 21046

Inst. Mfr. & Model URSA-II Inst. Type MCA
Det. Mfr. & Model Alpha Spectra 20DT063QB2/5B Det. Type NaI FIDLER

Inst. s/n 200124
Det s/n 050307AY1
Cal. Interval 1 year

Pre-calibration Checks:

- | | | | |
|--|--|--|------------------------------------|
| <input checked="" type="checkbox"/> Contamination Survey | <input type="checkbox"/> Battery Check | <input type="checkbox"/> Slow Response Check | <input type="checkbox"/> Det Volts |
| <input checked="" type="checkbox"/> Mechanical Check | <input type="checkbox"/> Audio Check | <input checked="" type="checkbox"/> Window Operation | |
| <input type="checkbox"/> Meter Zero | <input type="checkbox"/> Reset Check | <input type="checkbox"/> Plateau Check | <input type="checkbox"/> Threshold |
| <input type="checkbox"/> Geotropism Check | <input type="checkbox"/> Fast Response Check | <input type="checkbox"/> Alarm Set | |

☐ Pulse Generator s/n 106400

☐ Oscilloscope s/n 171-04928

☐ Voltmeter s/n 57410002

Comments: Settings used are as follows:

High Voltage	Threshold	Shaping Time	Signal Polarity	Coarse Gain	Fine Gain	Overall gain
925 V	20 mV	1 μ Sec	Negative	x125	x0.660	x82.520

CHALLENGE ISOTOPE/ENERGY	INSTRUMENT INDICATION
Lu-176/8 keV	Chn 85
Am-241/13.9 keV	Chn 150
Cs-137/32.89 keV	Chn 285
Lu-176/55 keV	Chn 498
Am-241/59.54 keV	Chn 540
Lu-176/202 keV	Chn 1680
Lu-176/307 keV	Chn 2485

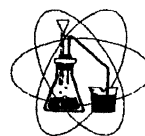
No ranges were calibrated electronically.

- ☒ Sources used: ^{137}Cs s/n PRS02
☒ Sources used: ^{241}Am s/n 47
☒ Sources used: ^{176}Lu s/n 219

RSA Laboratories Log ID# 091123-5. Instrument indicates within $\pm 10\%$ of calibration points unless otherwise indicated. RSA Laboratories certifies that the above instrument has been calibrated with standards traceable to the National Institute of Standards and Technology, or have been derived from accepted standards of natural physical constants, or have been derived by the ratio-type of calibration techniques.

Calibrated by: Paul R. Steinmeyer Paul R. Steinmeyer

CERTIFICATE OF CALIBRATION (SCINTILLATION DETECTOR)



RSA Laboratories

19 Pendleton Drive, PO Box 61
Hebron, Connecticut 06248
860/228-0487 Fax 860/228-4402

Customer and Contact: **Tidewater, Inc. Attn: Byron Bland 410/991-8878**
Customer Address: **7161 Columbia Gateway Drive, Suite C, Columbia, MD 21046**

Inst. Mfr. & Model **URSA-II**
Det. Mfr. & Model **Ludlum 44-10**

Inst. Type **MCA**
Det. Type **2x2 NaI**

Inst. s/n **200124**
Det s/n **186962**
Cal. Interval **1 year**

Pre-calibration Checks:

- ☒ Contamination Survey
- ☒ Mechanical Check
- ☐ Meter Zero
- ☐ Geotropism Check

- ☐ Battery Check
- ☐ Audio Check
- ☐ Reset Check
- ☐ Fast Response Check

- ☐ Slow Response Check
- ☒ Window Operation
- ☐ Plateau Check
- ☐ Alarm Set

- ☐ Det Volts
- ☐ Threshold

☐ Pulse Generator s/n 106400

☐ Oscilloscope s/n 171-04928

☐ Voltmeter s/n 57410002

Comments: Settings for use with PC software are as follows:

High Voltage	Threshold	Shaping Time	Signal Polarity	Coarse Gain	Fine Gain	Overall gain
900 V	50 mV	1 μ Sec	Negative	x35	x0.680	x23.789

Exposed to 344 μ R/h Cs-137 beam, detector showed 770 cpm/ μ R/h

CHALLENGE ISOTOPE/ENERGY	INSTRUMENT INDICATION
Am-241/59.54 keV	Chn 128
Lu-176/202 keV	Chn 410
Lu-176/307 keV	Chn 628
Cs-137/662 keV	Chn 1305
Co-60/1173.2	Chn 2290
Co-60/1332.5	Chn 2597

No ranges were calibrated electronically.

- ☒ Sources used: ¹³⁷Cs s/n PRS02
- ☒ Sources used: ²⁴¹Am s/n 47
- ☒ Sources used: ¹⁷⁶Lu s/n 219
- ☒ Sources used: ⁶⁰Co s/n 0810-1

RSA Laboratories Log ID# 091123-6. Instrument indicates within $\pm 10\%$ of calibration points unless otherwise indicated. RSA Laboratories certifies that the above instrument has been calibrated with standards traceable to the National Institute of Standards and Technology, or have been derived from accepted standards of natural physical constants, or have been derived by the ratio-type of calibration techniques.

Calibrated by:

Paul R. Steinmeyer

Attachment

M2360 S/N:141321 43-68 SN:PR148456

Th230 SN:E121495 Size:19800dpm, Counts:3996cpm, Background:2cpm, 4pi Eff:20.17%
Tc99 SN:5280 Size:93200dpm, Counts:27278cpm, Background:209cpm, 4pi Eff:29.04%
C14 SN:1476 Size:229767dpm, Counts:23670cpm, Background:209cpm, 4pi Eff:10.21%

M2360 SN:141321 43-37SN:PR265540

Th230 SN:E121495 Size:19800dpm, Counts:3695cpm, Background:4cpm, 4pi Eff:18.64%
Tc99 SN:5280 Size:93200dpm, Counts:28857cpm, Background:800cpm, 4pi Eff:30.10%
C14 SN:1476 Size:229767dpm, Counts:23005cpm, Background:800cpm, 4pi Eff:9.66%

M2360 SN:141321 44-110SN:PR258430

H3 SN:306 Size:2035dpm, Counts:769cpm, Background:119cpm, 4pi Eff:31.94%

M2360 S/N:253237 43-68 SN:PR216834

Th230 SN:E121495 Size:19800dpm, Counts:3864cpm, Background:2cpm, 4pi Eff:19.50%
Tc99 SN:5280 Size:93200dpm, Counts:27869cpm, Background:147cpm, 4pi Eff:29.74%
C14 SN:1476 Size:229767dpm, Counts:23792cpm, Background:147cpm, 4pi Eff:10.29%

M2360 SN:253237 43-37SN:PR128625

Th230 SN:E121495 Size:19800dpm, Counts:3999cpm, Background:2cpm, 4pi Eff:20.18%
Tc99 SN:5280 Size:93200dpm, Counts:29777cpm, Background:679cpm, 4pi Eff:31.22%
C14 SN:1476 Size:229767dpm, Counts:25798cpm, Background:679cpm, 4pi Eff:10.93%

M2360 SN:253237 44-110SN:PR258430

H3 SN:306 Size:2035dpm, Counts:708cpm, Background:133cpm, 4pi Eff:25.25%

M2360 S/N:253258 43-68 SN:PR148454

Th230 SN:E121495 Size:19800dpm, Counts:3957cpm, Background:5cpm, 4pi Eff:19.95%
Tc99 SN:5280 Size:93200dpm, Counts:29394cpm, Background:262cpm, 4pi Eff:31.25%
C14 SN:1476 Size:229767dpm, Counts:22331cpm, Background:262cpm, 4pi Eff:9.60%

M2360 SN:253258 43-37SN:PR265544

Th230 SN:E121495 Size:19800dpm, Counts:3879cpm, Background:4cpm, 4pi Eff:19.57%
Tc99 SN:5280 Size:93200dpm, Counts:28860cpm, Background:462cpm, 4pi Eff:28.43%
C14 SN:1476 Size:229767dpm, Counts:26959cpm, Background:462cpm, 4pi Eff:11.53%

M2360 SN:253258 44-110SN:PR268333

H3 SN:306 Size:2035dpm, Counts:936cpm, Background:155cpm, 4pi Eff:38.37%

RSO, Inc.
P.O. Box 1450
Laurel, MD 20725
(301) 953-2482

RSO Job No. 9549

Certificate of Calibration

ISSUED TO: Tidewater, Inc.
7161 Columbia Gateway Dr.
Columbia, MD 21046

INSTRUMENT: LUDLUM
MODEL: 2241-2
TYPE: SCALER/RATEMETER
SN: 178651

CONTACT: Claude Wiblin
PHONE: (410) 997-4458

PO NO: 1155-100

RSO, Inc. certifies that on 08/05/2011 the above described instrument was calibrated using a radioactive source to determine the efficiency for a specific radionuclide(s) and using electronically generated pulse for the linearity. Pulsed using Ludlum 500-2, S/N 159110.

The results are tabulated below. Calibration is traceable to NIST.

Calibration Data			
RANGE	EXPECTED	OBSERVED	C.F.
	30	30 cpm	1.00
	70	70 cpm	1.00
	300	300 cpm	1.00
	700	698 cpm	1.00
	3000	2990 cpm	1.00
	7000	6979 cpm	1.00
	30000	29900 cpm	1.00
	70000	69791 cpm	1.00
	300000	299000 cpm	1.00
	700000	697000 cpm	1.00
		C.F. AVERAGE	1.00

P1 & P2 setup parameters are set to the same values.

CC = 100 -2; DT = 0000 -6s. Alert set to 60,000 cpm. Alarm set to 600,000 cpm.

Probe type(s) Probe1: SCINTILLATOR

Probe2:

Probe3:

MODEL	SER#	WINDOW	GEOMETRY	VOLT	ISOTOPE 1	EFF.(%)	ISOTOPE 2	EFF.(%)	ISOTOPE 3	EFF.(%)	ISOTOPE 4	EFF.(%)
44-10	PR188340	NONE	CONTACT	900	Cs137	15						

Note: "As Found" condition +/- 20% of Expected values unless indicated.

INSTRUMENT CHECKS

BATTERY CHECK: NORMAL

CHECK SOURCE 1: N/A READING:

CHECK SOURCE 2: N/A READING:

ENVIRONMENTAL

TEMP: 26°C

PRESS: 757 mmHg

HUMID: 36 %

THE SUGGESTED RECALIBRATION DATE FOR THIS INSTRUMENT IS 08/05/2012

Calibrated By:

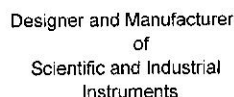
Dorsey Austin

Reviewed By:

Cal Date: 08/05/2011

Maryland License MD-33-021-01

11279



LUDLUM MEASUREMENTS, INC.

POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER BOEING ENVIRONMENTAL

ORDER NO. 20168392/358957

Mfg. Ludlum Measurements, Inc. Model 19 Serial No. 180302

Mfg. _____ Model _____ Serial No. _____

Cal. Date	18-Jan-11	Cal Due Date	18-Jan-12	Cal. Interval	1 Year	Meterface	202-016
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Check mark ☒ applies to applicable instr. and/or detector IAW mfg. spec. T. 75 °F RH 20 % Alt 698.8 mm Hg

☐ New Instrument Instrument Received ☐ Within Toler. $\pm 10\%$ ☒ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments☒ Mechanical ck. ☒ Meter Zeroed ☐ Background Subtract ☐ Input Sens. Linearity☒ F/S Resp. ck ☒ Reset ck. ☐ Window Operation ☒ Geotropism

☒ Audio ck. ☐ Alarm Setting ck.

☐ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☒ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

Instrument Volt Set	950	V	Input Sens.	34	mV	Det. Oper.		V at		mV	Threshold Dial Ratio	=		mV
---------------------	-----	---	-------------	----	----	------------	--	------	--	----	----------------------	---	--	----

☒ HV Readout (2 points) Ref./Inst. 500 / 15/A V Ref./Inst. 1000 / 15/A V

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

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
5000	4000 μ R/hr	3600 μ R/hr	4000 μ R/hr
5000	1000 μ R/hr	980	1000
500	400 μ R/hr = 67600 cpm	360	400
500	100 μ R/hr	98	100
250	200 μ R/hr = 33200 cpm	180	200
250	100 μ R/hr	80	100
50	6760 cpm	36	40
50	1690 cpm	10	10
25	3320 cpm	18	25
25	830 cpm	4	5

*Uncertainty within $\pm 10\%$ C.F. within $\pm 20\%$

X50,X25 Range(s) Calibrated Electronically

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*		REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout	_____	_____	_____	Log Scale	_____	_____	_____
	_____	_____	_____		_____	_____	_____
	_____	_____	_____		_____	_____	_____
	_____	_____	_____		_____	_____	_____
	_____	_____	_____		_____	_____	_____

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978

State of Texas Calibration License

State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: ☐ 73410 ☐ 1131 ☐ 781 ☐ 059 ☐ 280 ☐ 60646 ☐ 70897

Cs-137 Gamma S/N ☐ 1162 ☐ G112 ☒ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☒ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-304

☐ Alpha S/N _____ ☐ Beta S/N _____ ☐ Other _____

☒ m 500 S/N 50800 ☐ Oscilloscope S/N ☒ Multimeter S/N 83990502

Calibrated By: Charles Asst Date 18 Jan 11

Reviewed By: Rhonda Harris Date 18 Jan 11

This certificate shall not be reproduced except in full, without the written approval of Ludlum Measurements, Inc.
FORM C22A 03/11/2010 Page 1 of 1

AC Inst. ☐ Passed Dielectric (Hi-Pot) and Continuity Test
Only ☐ Failed:

RSO, Inc.
P.O. Box 1450
Laurel, MD 20725
(301) 953-2482

RSO Job No. 9549

Certificate of Calibration

ISSUED TO: Tidewater, Inc.
7161 Columbia Gateway Dr.
Columbia, MD 21046

INSTRUMENT: LUDLUM
MODEL: 2929
TYPE: SCALER/43-10
SN: 176108

CONTACT: Claude Wiblin
PHONE: (410) 997-4458

PO NO: 1155-100

RSO, Inc. certifies that on 07/26/2011 the above described instrument was calibrated using a radioactive source to determine the efficiency for a specific radionuclide(s) and using electronically generated pulse for the linearity. Pulsed using Ludlum 500-2, S/N 159110.

The results are tabulated below. Calibration is traceable to NIST.

Calibration Data				
RANGE	EXPECTED	OBSERVED	C.F.	
SCALER	30	30 cpm	1.00	
	70	70 cpm	1.00	
	300	300 cpm	1.00	
	700	700 cpm	1.00	
	3000	3000 cpm	1.00	
	7000	7000 cpm	1.00	
	30000	30000 cpm	1.00	
	70000	70000 cpm	1.00	
	300000	300000 cpm	1.00	
	700000	700000 cpm	1.00	
		C.F. AVERAGE	1.00	

Note: High Voltage dial set to 3.45.

Probe type(s)		Probe1: SCINTILLATOR			Probe2:				Probe3:			
MODEL	SER#	WINDOW	GEOMETRY	VOLT	ISOTOPE 1	EFF.(%)	ISOTOPE 2	EFF.(%)	ISOTOPE 3	EFF.(%)	ISOTOPE 4	EFF.(%)
44-10-1	PR181905	FIXED	CONTACT	870	C14	18	Tc99	19	Th230	35		

Note: "As found" condition +/- 20% of expected values unless indicated.

INSTRUMENT CHECKS

BATTERY CHECK: NORMAL
CHECK SOURCE 1: N/A READING:
CHECK SOURCE 2: N/A READING:

ENVIRONMENTAL

TEMP: 24°C
PRESS: 746 mmHg
HUMID: 50 %

THE SUGGESTED RECALIBRATION DATE FOR THIS INSTRUMENT IS 07/26/2012

Calibrated By:

Dorsey Austin
Dorsey Austin

Reviewed By:

Rae

Cal Date: 07/26/2011

REPORT # A

Maryland License MD-33-021-01

11278



Designer and Manufacturer
of
Scientific and Industrial
Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A. 20159902
20139509/341499

CUSTOMER TIDEWATER INC COLUMBIA MD

ORDER NO. 253258

Mfg. Ludlum Measurements, Inc. Model 2380 Serial No. 253258
Mfg. Ludlum Measurements, Inc. Model 43-68 Serial No. PR-216834
Cal. Date 26-Aug-09 Cal Due Date 26-Aug-10 Cal. Interval 1 Year Meterface 202-855

Check mark ☒ applies to applicable instr. and/or detector IAW mfg. spec. T 75 °F RH 20 % Alt 699.8 mm Hg

- ☐ New Instrument Instrument Received ☒ Within Toler. $\pm 10\%$ ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments
- ☒ Mechanical ck. ☒ Meter Zeroed ☐ Background Subtract ☐ Input Sens. Linearity
☐ F/S Resp. ck. ☒ Reset ck. ☒ Window Operation ☒ Geotropism
☒ Audio ck. ☐ Alarm Setting ck. ☒ Batt. ck. (Min. Volt) 2.2 VDC ☐ RS-232 Port OK
☒ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☐ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

Instrument Volt Set See Comments

☒ HV Readout (2 points) Ref./Inst. 500 515 V Ref./Inst. 1500 1500 V

Firmware Version: 39010-24

Alpha Threshold: 120 mv

Beta Threshold: 4 mv

Beta Window: 50 mv

Overload Checked but not set.

Instrument calibrated with a 39" cable.

High voltage set with detector disconnected

(EEPROM Settings)

User Time: 1.0

Alpha Alarm: 99999

Beta Alarm: 1900

A/B Alarm: 1800

Model 2380 Date: 8/26/09

Calibration Date Due: 8/26/10

COMMENTS:

See Attachment for Efficiencies.

Operating voltage for 43-68 = 1550v

Operating voltage for 44-110 = 1450v

Currently set for 44-110 operation.

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

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
x1000	400kcpm	400	400
x1000	100kcpm	95	95
x100	40kcpm	400	400
x100	10kcpm	95	95
x10	4kcpm	400	400
x10	1kcpm	100	100
x1	400kcpm	400	400
x1	100kcpm	100	100

*Uncertainty within $\pm 10\%$ C.F. within $\pm 20\%$

ALL Range(s) Calibrated Electronically

REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout	400kcpm	39944 (0)	Log Scale		
	40kcpm	3995			
	4kcpm	399			
	400cpm	40			
	40cpm	4			

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques.
The calibration system conforms to the requirements of ANSI/NCCL 2540-1-1994 and ANSI N323-1975. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: ☐ S-394/1122 ☐ 1131 ☐ 781 ☐ 059 ☐ 280 ☐ 60646
Ca-137 Gamma S/N ☐ 1162 ☐ G112 ☐ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-304

☒ Alpha S/N Th230sn 1495 ☒ Beta S/N Tc99sn: NI-EV, C14sn: J137-S/ ☐ Other

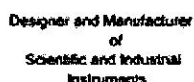
☒ m 500 S/N 50800 ☐ Oscilloscope S/N ☒ Multimeter S/N 83990502

Calibrated By: Charles Lusk Date: 26 Aug 09

Reviewed By: Diane Farn Date: 28 Aug 09

This certificate shall not be reproduced except in full, without the written approval of Ludlum Measurements, Inc.
FORM C228 10/15/2008

AC Inst. ☐ Passed Dielectric (Hi-Pot) and Continuity Test
Only ☐ Failed



LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5484
501 OAK STREET FAX NO. 325-235-4872
SWEETWATER, TEXAS 79556 U.S.A.

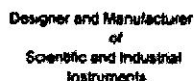
Detector	43-68	Serial No.	PR-214834	Order #.	20139509/341499
Customer	TIDEWATER INC COLUMBIA MD			Alpha Input Sensitivity	120 mV
Counter	2360	Serial No.	253258	Beta Input Sensitivity	4 mV
Count Time	1Minute			Beta Window	50 mV
Other	Calibrated w/39" cable			Distance Source to Detector	Surface

[illegible]

- | | |
|--|--|
| <input type="checkbox"/> Gas Proportional detector count rate decreased | ≤ 10% after 15 hour static test using 39" cable. |
| <input checked="" type="checkbox"/> Gas proportional detector count rate decreased | < 10% after 5 hour static test using 39" cable and alpha/beta counter. |

Signature

Date 26 Aug 09



LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556 U.S.A.

Detector 44-110 Serial No. PR-268333
 Customer TIDEWATER INC COLUMBIA MD Order # 20139509/341499
 Counter 2360 Serial No. 253258 Counter Input Sensitivity 4 mV
 Count Time 1 minute Distance Source to Detector Surface
 Other Calibrated w/ .39" cable

[illegible]

Signature

Date _____

ATTACHMENT

Detector: 43-68 sn:PR-216834

Eff. For Th230sn: 1495, Eff. \approx 20% \pm 4pi, Source count \approx 4091cpm - 3cpm background
Source size= 19800dpm

Eff. For C14 sn: 1131-51, Eff. \approx 8.8% \pm 4pi, Source count \approx 22160cpm - 178cpm background
Source size= 247191dpm

Detector: 44-110 sn:~~PR-253258~~^{CS} PR-248333

Eff. For C14 sn: 1131-51, Eff. \approx 6.2% \pm 4pi, Source count \approx 15701cpm - 284cpm background
Source size= 247191dpm

Header 1: Chesapeake Nuc
Header 2: SN: 253258
Header 3: SN: PR216834
Header 4:
Header 5:
Header 6:
Location:

Calibration Due Date: 08/26/2010
Model 2360 Date: 08/26/2009
Model 2360 Time: 11:34:13 AM

Logged Samples: 0

User PC Scaler Count Time: 0.1 minutes

Alpha Ratemeter Alarm Setpoint: 999999
Beta Ratemeter Alarm Setpoint: 1900
Alpha + Beta Ratemeter Alarm Setpoint: 1800

Alpha Scaler Alarm Setpoint: 999999
Beta Scaler Alarm Setpoint: 999999
Alpha + Beta Scaler Alarm Setpoint: 999999



of
Scientific and Industrial
Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER TIDEWATER INC

ORDER NO. 20144239/344319

Mfg. Ludlum Measurements, Inc. Model 2360

Serial No. 253258

Mfg. Ludlum Measurements, Inc. Model 43-37

Serial No. PR-265544

Cal. Date 20-Nov-09 Cal Due Date 20-Nov-10 Cal. Interval 1 Year Meterface 202-855

Check mark ☒ Applies to applicable instr. and/or detector IAW mfg. spec. T. 75 °F RH 20 % Alt 701.8 mm Hg

☐ New Instrument ☐ Instrument Received ☒ Within Toler. +10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☒ Mechanical ck. ☒ Meter Zeroed ☐ Background Subtract ☐ Input Sens. Linearity

☐ F/S Resp. ck. ☒ Reset ck. ☒ Window Operation ☒ Geotropism

☒ Audio ck. ☐ Alarm Setting ck. ☒ Batt. ck. (Min. Volt) 2.2 VDC ☐ RS-232 Port OK

☒ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☐ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

Instrument Volt Set 1575 V

☒ HV Readout (2 points) Ref./Inst. 500 / 500 V Ref./Inst. 1500 / 1500 V

Firmware Version: 39010-24

(EEPROM Settings)

Alpha Threshold: 100 mV

User Time: 1.0

Beta Threshold: 4 mV

Alpha Alarm: 999999

Beta Window: 40 mV

Beta Alarm: 999999

Overload checked but not set

A/B Alarm: 999999

Instrument calibrated with a 39" cable.

Model 2360 Date: 11/20/09

High voltage set with detector disconnected

Calibration Date Due: 11/20/10

COMMENTS:

Eff. for Tc99sn: NI-EV $\approx 43\%$ 2p.

Eff. for C14 sn: 1131-51 $\approx 17.5\%$ 2p.

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

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
x1000	400kcpm	400	400
x1000	100kcpm	100	100
x100	40kcpm	400	400
x100	10kcpm	100	100
x10	4kcpm	400	400
x10	1kcpm	100	100
x1	400kcpm	400	400
x1	100kcpm	100	100

*Uncertainty within $\pm 10\%$ C.F. within $\pm 20\%$

ALL Range(s) Calibrated Electronically

REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout			Log Scale		
400kcpm	37825 (D)	37825 (D)			
40kcpm	3783	3783			
4kcpm	378	378			
400cpm	40	40			
40cpm	4	4			

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques.

The calibration system conforms to the requirements of ANSI/NCSS Z540-1-1994 and ANSI N323-1978

State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources:

☐ S-394/1122 ☐ 1131 ☐ 781 ☐ 059 ☐ 280 ☐ 60646

Cs-137 Gamma S/N ☐ 1162 ☐ G112 ☐ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-304

☒ Alpha S/N Pu239sn:8744 ☒ Beta S/N Tc99sn:NI-EV, C14 sn: 1131-51 ☐ Other

☒ m 500 S/N 50800 ☐ Oscilloscope S/N ☒ Multimeter S/N 83990502

Calibrated By: Charles Ash Date 20 Nov 09

Reviewed By: Rhonda Hain Date 20 Nov 09



Designer and Manufacturer
of
Scientific and Industrial
Instruments

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

Bench Test Data For Detector

Detector 43-37 Serial No. PR-265544 Order # 20144239/344319
Customer TIDEWATER INC Alpha Input Sensitivity 100 mV
Counter 2360 Serial No. 253258 Beta Input Sensitivity 4 mV
Count Time 1Minute Beta Window 40 mV
Other _____ Distance Source to Detector Surface

High Voltage	Background		Isotope <u>Pu 239</u> Size <u>186000cpm</u>		Isotope <u>Tc 99</u> Size <u>14100cpm</u>		Isotope <u>C14</u> Size <u>123592cp</u>	
	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta
1525	3	209	65583	3387	4	4578	2	16792
1550	3	275	70758	3630	2	5391	3	19295
- 1575	3	304	74898	3671	7	6359	4	22007
1600	9	431	80235	4066	4	7331	5	23924

- ☐ Gas Proportional detector count rate decreased $\leq 10\%$ after 15 hour static test using 39" cable.
☒ Gas proportional detector count rate decreased $\leq 10\%$ after 5 hour static test using 39" cable and alpha/beta counter.

Signature

Charles Dick

Date

20 Nov 08

Header 1: exterior

Header 2: a-b

Header 3: 2360 #253258

Header 4: 43-37#PR265544

Header 5:

Header 6:

Location: window

Calibration Due Date: 11/20/2010

Model 2360 Date: 11/20/2009

Model 2360 Time: 11:01:32 AM

Logged Samples: 0

User PC Scaler Count Time: 2.5 minutes

Alpha Ratemeter Alarm Setpoint: 999999

Beta Ratemeter Alarm Setpoint: 999999

Alpha + Beta Ratemeter Alarm Setpoint: 999999

Alpha Scaler Alarm Setpoint: 999999

Beta Scaler Alarm Setpoint: 999999

Alpha + Beta Scaler Alarm Setpoint: 999999



Designer and Manufacturer
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CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER TIDEWATER INC

ORDER NO. 20186800/369511

Mfg. Ludlum Measurements, Inc. Model 2360

Serial No. 253258

Mfg. Ludlum Measurements, Inc. Model 43-68

Serial No. PR 148454

Cal. Date 23-oct-11 Cal Due Date 23-oct-12 Cal. Interval 1 Year Meterface 202-855

Check mark ☒ applies to applicable instr. and/or detector IAW mfg. spec. T. 73 °F RH 34 % Alt 699.8 mm Hg

☐ New Instrument ☐ Instrument Received ☒ Within Toler. +10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☒ Mechanical ck. ☒ Meter Zeroed ☐ Background Subtract ☐ Input Sens. Linearity

☐ F/S Resp. ck. ☒ Reset ck. ☒ Window Operation ☐ Geotropism

☒ Audio ck. ☒ Alarm Setting ck. ☒ Batt. ck. (Min. Volt) 2.2 VDC ☒ RS-232 Port OK

☒ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☐ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

Instrument Volt Set Comments V

☒ HV Readout (2 points) Ref./Inst. 500 / 510 V Ref./Inst. 2000 / 1998 V

Firmware Version: 39010-24

(EEPROM Settings)

Alpha Threshold: 100 mV

User Time: 1.0

Beta Threshold: 4 mV

Alpha Alarm: 999999

Beta Window: 40 mV

Beta Alarm: 999999

Overload checked BUT NOT SET

A/B Alarm: 999999

Instrument calibrated with a 5FT cable.

Model 2360 Date: 10/23/2011

High voltage set with detector NOT CONNECTION

Calibration Date Due: 10/23/2012

COMMENTS:

HV for 43-68: 1575V
HV for 43-37: 1575V
HV for 44-110: 1600V

Currently set at 1575V

See ATTACHMENT FOR RFF.

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

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
x1000	400k cpm	400	400
x1000	100k cpm	100	100
x100	40k cpm	400	400
x100	10k cpm	100	100
x10	4k cpm	400	400
x10	1k cpm	100	100
x1	400 cpm	400	400
x1	100 cpm	100	100

*Uncertainty within $\pm 10\%$ C.F. within $\pm 20\%$

ALL Range(s) Calibrated Electronically

REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout					
400kcpm	39978(0)	39978(0)			
40kcpm	3998	3998			
4kcpm	400	400			
400cpm	40	40			
40cpm	4	4			

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCCL Z540-1-1994 and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources:

Cs-137 Gamma S/N ☐ 1162 ☐ G112 ☐ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 60646 ☐ 70897 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-304

☐ Alpha S/N ☐ Beta S/N ☐ Other

☒ m 500 S/N 190566 ☐ Oscilloscope S/N ☒ Multimeter S/N 86250390

Calibrated By: Jam F.

Date 23-oct-11

Reviewed By: Rhonda H.

Date 25 Oct 11



Designer and Manufacturer
of
Scientific and Industrial
Instruments

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

Bench Test Data For Detector

Detector 43-68 Serial No. PR 148454 Order # 20186800/369511
Customer TIDEWATER INC
Counter 2360 Serial No. 253258 Alpha Input Sensitivity 100 mV
Count Time 1 Minute Beta Input Sensitivity 4 mV
Other _____ Beta Window 40 mV
Distance Source to Detector Surface

High Voltage	Background		Isotope <u>Th230</u> Size <u>19800 dpm</u>		Isotope <u>Tc99</u> Size <u>93200 dpm</u>		Isotope <u>C14</u> Size <u>229767 dpm</u>	
	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta
1525	1	144	3260	1256	36	26997	2	22225
1550	2	199	3573	1389	28	29128	2	23072
1575	5	262	3957	1346	27	29394	2	22331
1600	4	321	4317	1407	28	30064	2	25922

- ☐ Gas Proportional detector count rate decreased \leq 10% after 15 hour static test using 39" cable.
☒ Gas proportional detector count rate decreased \leq 10% after 5 hour static test using 39" cable and alpha/beta counter.

Signature *Jaron Lu*

Date 23-oct-11



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501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

Bench Test Data For Detector

Detector 43-37 Serial No. PR 265544 Order #. 20186800/369511
Customer TIDEWATER INC Alpha Input Sensitivity 100 mV
Counter 2360 Serial No. 253258 Beta Input Sensitivity 4 mV
Count Time 1 Minute Beta Window 40 mV
Other _____ Distance Source to Detector Surface

High Voltage	Background		Isotope <u>Th230</u> Size <u>19800dpm</u>		Isotope <u>Tc99</u> Size <u>93200dpm</u>		Isotope <u>C14</u> Size <u>229767dpm</u>	
	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta
1550	3	247	3444	1482	42	22719	6	23917
1575	4	462	3879	1796	38	28860	13	26959
1600	4	681	4240	2072	36	32583	2	29188

- ☐ Gas Proportional detector count rate decreased \leq 10% after 15 hour static test using 39" cable.
☒ Gas proportional detector count rate decreased \leq 10% after 5 hour static test using 39" cable and alpha/beta counter.

Signature Jana F Date 23-Oct-11



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501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

Bench Test Data For Detector

Detector 44-110 Serial No. PR 268333 Order # 20186800/369511
Customer TIDEWATER INC Alpha Input Sensitivity 100 mV
Counter 2360 Serial No. 253258 Beta Input Sensitivity 4 mV
Count Time 1 Minute Beta Window 40 mV
Other _____ Distance Source to Detector Surface

High Voltage	Background		Isotope <u>H3</u> Size <u>2035dpm</u>		Isotope <u>Tc99</u> Size <u>93200dpm</u>		Isotope _____ Size _____	
	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta
1550	1	63	2	614	24	31408		
1575	1	119	2	759	35	34647		
1600	1	155	1	936	34	35045		
1625	1	202	3	952	100	33598		
1650	1	234	3	1033	528	31036		

- ☐ Gas Proportional detector count rate decreased $\leq 10\%$ after 15 hour static test using 39" cable.
☒ Gas proportional detector count rate decreased $\leq 10\%$ after 5 hour static test using 39" cable and alpha/beta counter.

Signature

Jan Fe

Date

23-oct-11

Header 1: BKG-Source

Header 2:

Header 3: 2360 #253258

Header 4: 43-68sn#148454

Header 5:

Header 6:

Location: VAPH

Calibration Due Date: 10/23/2012

Model 2360 Date: 10/23/2011

Model 2360 Time: 03:00:09 PM

Logged Samples: 0

User PC Scaler Count Time: 1.0 minutes

Alpha Ratemeter Alarm Setpoint: 999999

Beta Ratemeter Alarm Setpoint: 999999

Alpha + Beta Ratemeter Alarm Setpoint: 999999

Alpha Scaler Alarm Setpoint: 999999

Beta Scaler Alarm Setpoint: 999999

Alpha + Beta Scaler Alarm Setpoint: 999999



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CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.

POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER TIDEWATER INC

ORDER NO. 20186800/369511

Mfg. Ludlum Measurements, Inc. Model 2360

Serial No. 253237

Mfg. Ludlum Measurements, Inc. Model 43-68

Serial No. PR216834

Cal. Date 24-Oct-11 Cal Due Date 24-Oct-12 Cal. Interval 1 Year Meterface 202-855

Check mark ☒ applies to applicable instr. and/or detector IAW mfg. spec. T. 73 °F RH 34 % Alt 701.8 mm Hg

☐ New Instrument ☐ Instrument Received ☒ Within Toler. ☐ +-10% ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

- | | | | |
|--|---|---|--|
| <input checked="" type="checkbox"/> Mechanical ck. | <input checked="" type="checkbox"/> Meter Zeroed | <input type="checkbox"/> Background Subtract | <input type="checkbox"/> Input Sens. Linearity |
| <input type="checkbox"/> F/S Resp. ck. | <input checked="" type="checkbox"/> Reset ck. | <input checked="" type="checkbox"/> Window Operation | <input type="checkbox"/> Geotropism |
| <input checked="" type="checkbox"/> Audio ck. | <input checked="" type="checkbox"/> Alarm Setting ck. | <input checked="" type="checkbox"/> Batt. ck. (Min. Volt) <u>2.2</u> VDC | <input checked="" type="checkbox"/> RS-232 Port OK |
| <input checked="" type="checkbox"/> Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. | | <input type="checkbox"/> Calibrated in accordance with LMI SOP 14.9 rev 02/07/97. | |

Instrument Volt Set Comments V

☒ HV Readout (2 points) Ref./Inst. 500 / 502 V Ref./Inst. 2000 / 2008 V

Firmware Version: 39010-24

(EEPROM Settings)

Alpha Threshold: 100 mV

User Time: 1.0

Beta Threshold: 4 mV

Alpha Alarm: 999999

Beta Window: 40 mV

Beta Alarm: 999999

Overload CHECKED BUT NOT SET.

A/B Alarm: 999999

Instrument calibrated with a 5ft cable.

Model 2360 Date: 10/24/2011

High voltage set with detector NOT CONNECTED

Calibration Date Due: 10/24/2012

COMMENTS:

HV for 43-68: 1525V Currently set at 1525V
HV for 43-37: 1625V
HV for 44-110: 1600V See ATTACHMENT For EFF.

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

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
x1000	400k cpm	400	400
x1000	100k cpm	100	100
x100	40k cpm	400	400
x100	10k cpm	100	100
x10	4k cpm	400	400
x10	1k cpm	100	100
x1	400 cpm	400	400
x1	100 cpm	100	100

*Uncertainty within $\pm 10\%$ C.F. within $\pm 20\%$

ALL Range(s) Calibrated Electronically

REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout	400kcpm	39986(0)	Log Scale		
	40kcpm	3998			
	4kcpm	400			
	400cpm	40			
	40cpm	4			

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources:

Cs-137 Gamma S/N ☐ 73410 ☐ 1131 ☐ 781 ☐ 059 ☐ 280 ☐ 60646 ☐ 70897
☐ 1162 ☐ G112 ☐ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-304

☐ Alpha S/N ☐ Beta S/N ☐ Other

☒ m 500 S/N 190566 ☐ Oscilloscope S/N ☒ Multimeter S/N 86250390

Calibrated By: Jamie Fa

Date 24-Oct-11

Reviewed By: Rhonda H

Date 25 Oct 11



Designer and Manufacturer
of
Scientific and Industrial
Instruments

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

Bench Test Data For Detector

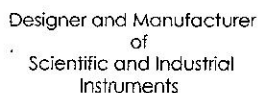
Detector 43-68 Serial No. PR 216834 Order # 20186800/369511
Customer TIDEWATER INC
Counter 2360 Serial No. 253237
Count Time 1 Minute
Other _____ Distance Source to Detector Surface

High Voltage	Background		Isotope <u>TH 230</u> Size <u>19800 dpm</u>		Isotope <u>Tc 99</u> Size <u>93200 dpm</u>		Isotope <u>C 14</u> Size <u>22971 dpm</u>	
	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta
1500	3	93	3755	1227	39	24714	2	21899
1525	2	147	3864	1315	41	27869	1	23792
1550	1	185	4100	1308	35	29151	3	23393
1575	2	264	4200	1241	101	28194	29	21743

- ☐ Gas Proportional detector count rate decreased $\leq 10\%$ after 15 hour static test using 39" cable.
- ☒ Gas proportional detector count rate decreased $\leq 10\%$ after 5 hour static test using 39" cable and alpha/beta counter.

Signature *Dawn F...*

Date 24 Oct 11



LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

Detector 43-37 Serial No. PR128625

Order #. 20186800/369511

Customer TIDEWATER INC

Alpha Input Sensitivity 700 mV

Counter 2360 Serial No. 253237

Beta Input Sensitivity 4 mV

Count Time 1 Minute

Beta Window 40 mV

Other _____ Distance Source to Detector Surface

☐ Gas Proportional detector count rate decreased $\leq 10\%$ after 15 hour static test using 39" cable.

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

Signature _____

Date _____



Designer and Manufacturer
of
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POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

Bench Test Data For Detector

Detector 44-110 Serial No. PR 268330

Order #. 20186800/369511

Customer TIDEWATER INC

Alpha Input Sensitivity 100 mV

Counter 2360 Serial No. 253237

Beta Input Sensitivity 4 mV

Count Time 1 Minute

Beta Window 40 mV

Other _____ Distance Source to Detector Surface

High Voltage	Background		Isotope <u>H3</u> Size <u>2035dpm</u>		Isotope <u>Te99</u> Size <u>93200dpm</u>		Isotope _____ Size _____	
	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta
1550	2	91	1	444	27	31690		
1575	3	104	0	544	47	33885		
1600	2	133	0	708	64	33841		
1625	1	194	18	851	261	33178		
1650	6	224	33	892	1023	30391		

☐ Gas Proportional detector count rate decreased $\leq 10\%$ after 15 hour static test using 39" cable.

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

Signature [Signature]

Date 24 Oct 11

Header 1: Tidewater

Header 2: Brooks 175E

Header 3: 2360 #253237

Header 4:

Header 5: 43-37SN/128625

Header 6:

Location:

Calibration Due Date: 10/24/2012

Model 2360 Date: 10/24/2011

Model 2360 Time: 02:38:40 PM

Logged Samples: 0

User PC Scaler Count Time: 1.0 minutes

Alpha Ratemeter Alarm Setpoint: 999999

Beta Ratemeter Alarm Setpoint: 999999

Alpha + Beta Ratemeter Alarm Setpoint: 999999

Alpha Scaler Alarm Setpoint: 999999

Beta Scaler Alarm Setpoint: 999999

Alpha + Beta Scaler Alarm Setpoint: 999999



Designer and Manufacturer
of
Scientific and Industrial
Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.

POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER TIDEWATER INC

ORDER NO. 20186800/369511

Mfg. Ludlum Measurements, Inc. Model 2360

Serial No. 141321

Mfg. Ludlum Measurements, Inc. Model 43-68

Serial No. PR148456

Cal. Date 24-Oct-11 Cal Due Date 24-Oct-12 Cal. Interval 1 Year Meterface 202-855

Check mark ☒ applies to applicable instr. and/or detector IAW mfg. spec. T. 73 °F RH 34 % Alt 701.8 mm Hg

☐ New Instrument ☐ Instrument Received ☐ Within Toler. $\pm 10\%$ ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair ☐ Other-See comments

☒ Mechanical ck. ☒ Meter Zeroed ☐ Background Subtract ☐ Input Sens. Linearity
☐ F/S Resp. ck. ☒ Reset ck. ☒ Window Operation ☐ Geotropism
☒ Audio ck. ☒ Alarm Setting ck. ☒ Batt. ck. (Min. Volt) 2.2 VDC ☒ RS-232 Port OK
☐ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☐ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

Instrument Volt Set Comments V

☒ HV Readout (2 points) Ref./Inst. 500 / 505 V Ref./Inst. 2000 / 2005 V

Firmware Version: 39010-20

(EEPROM Settings)

Alpha Threshold: 100 mV

User Time: 1.0

Beta Threshold: 4 mV

Alpha Alarm: 999999

Beta Window: 40 mV

Beta Alarm: 999999

Overload Checked But Not Set.

A/B Alarm: 999999

Instrument calibrated with a 5FT cable.

Model 2360 Date: 10/24/2011

High voltage set with detector NOT CONNECTED.

Calibration Date Due: 10/24/2012

COMMENTS:

HV for 43-68: 1550V Currently set at 1550V

HV for 43-37: 1625V

HV for 44-110: 1600V

See ATTACHMENT FOR EFF.

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

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
x1000	400k cpm	400	400
x1000	100k cpm	100	100
x100	40k cpm	400	400
x100	10k cpm	100	100
x10	4k cpm	400	400
x10	1k cpm	100	100
x1	400 cpm	400	400
x1	100 cpm	100	100

*Uncertainty within $\pm 10\%$ C.F. within $\pm 20\%$

ALL Range(s) Calibrated Electronically

REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout	400kcpm	39974(0)	Log Scale		
	40kcpm	3998			
	4kcpm	400			
	400cpm	40			
	40cpm	4			

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other international Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978 State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources:

Cs-137 Gamma S/N ☐ 1162 ☐ G112 ☐ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-304

☐ Alpha S/N ☐ Beta S/N ☐ Other

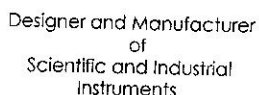
☒ m 500 S/N 190566 ☐ Oscilloscope S/N ☒ Multimeter S/N 86250390

Calibrated By: Jana F.

Date 24.OCT.11

Reviewed By: Robert H.

Date 25 OCT 11



501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.



Designer and Manufacturer
of
Scientific and Industrial
Instruments

LUDLUM MEASUREMENTS, INC.

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SWEETWATER, TEXAS 79556, U.S.A.

Bench Test Data For Detector

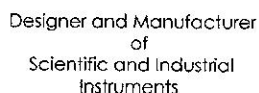
Detector 43-37 Serial No. PN 265540 Order # 20186800/369511
Customer TIDEWATER INC
Counter 2360 Serial No. 141321 Alpha Input Sensitivity 100 mV
Count Time 1 Minute Beta Input Sensitivity 4 mV
Other _____ Beta Window 40 mV
Distance Source to Detector Surface

High Voltage	Background		Isotope <u>Th230</u> Size <u>19810dpm</u>		Isotope <u>Tc99</u> Size <u>93200dpm</u>		Isotope <u>C14</u> Size <u>229767dpm</u>	
	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta
1575	2	523	3229	1583	20	25904	2	22781
1600	4	600	3453	1748	24	28216	3	23762
1625	4	800	3695	1921	22	28857	4	23005
1650	8	1079	3841	1985	31	26785	7	20517

- ☐ Gas Proportional detector count rate decreased \leq 10% after 15 hour static test using 39" cable.
☒ Gas proportional detector count rate decreased \leq 10% after 5 hour static test using 39" cable and alpha/beta counter.

Signature Jason F.

Date 24-Oct-11



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SWEETWATER, TEXAS 79556, U.S.A.

Detector 44-110 Serial No. PR 258430

Order #. 20186800/369511

Customer TIDEWATER INC

Alpha Input Sensitivity 100 mV

Counter 2360 Serial No. 141321

Beta Input Sensitivity 4 mV

Count Time 1 Minute

Beta Window 40 mV

Other _____ Distance Source to Detector Surface

☐ Gas Proportional detector count rate decreased $\leq 10\%$ after 15 hour static test using 39" cable.

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

Signature

Date _____

Header 1: sull C14

Header 2: 43-93 PR235487

Header 3: 2360 #141321

Header 4:

Header 5:

Header 6:

Location: VAPH

Calibration Due Date: 10/24/2012

Model 2360 Date: 10/24/2011

Model 2360 Time: 03:30:42 PM

Logged Samples: 0

User PC Scaler Count Time: 1.0 minutes

Alpha Ratemeter Alarm Setpoint: 999999

Beta Ratemeter Alarm Setpoint: 999999

Alpha + Beta Ratemeter Alarm Setpoint: 999999

Alpha Scaler Alarm Setpoint: 999999

Beta Scaler Alarm Setpoint: 999999

Alpha + Beta Scaler Alarm Setpoint: 999999