

**APPENDIX E: INSTRUMENTATION QUALITY CONTROL AND CALIBRATION
DATA**

(Provided on Accompanying Compact Disc)

CABRERA ALPHA-BETA COUNTING INSTRUMENT (Rev 5)

Initial Background and Source Counts for Control Chart									Trial MDA Calculator		
#	Initial bkg counts				Initial source plus bkg counts				Sample Count Time (min)	α	β
	Alpha	cpm	Beta	cpm	Alpha	cpm	Beta	cpm	1		
1	5	5	286	286	3211	3211	2455	2455	Bkg Count Rate (cpm)	0.1	
2	4	4	269	269	3121	3121	2427	2427	Bkg Count Time (min)	1	
3	5	5	311	311	3084	3084	2543	2543	Counter Efficiency	0.178539	0.124156
4	4	4	271	271	3043	3043	2417	2417	MDCR (cpm)	4.471333	#DIV/0!
5	6	6	284	284	3222	3222	2518	2518	MDA (dpm)	25.04404	#DIV/0!
6	6	6	317	317	3139	3139	2502	2502			
7	7	7	284	284	3077	3077	2431	2431			
8	4	4	302	302	3149	3149	2457	2457			
9	7	7	289	289	3135	3135	2408	2408			
10	6	6	326	326	3116	3116	2508	2508			
Mean		5.40		293.9		3129.7		2466.6			
S _(n-1)		1.17		19.29		56.04		47.61			
-3 sigma		1.88		236.03		2961.59		2323.76			
+3 sigma		8.92		351.77		3297.81		2609.44			
-2 sigma		3.05		255.32		3017.62		2371.38			
+2 sigma		7.75		332.48		3241.78		2561.82			
					Mean-bkg	3124.3		2172.7			
					S _(n-1)	55.91		36.99			
				Mean-bkg	-3 sigma	2956.56		2061.74			
				Mean-bkg	+3 sigma	3292.04		2283.66			
				Mean-bkg	-2 sigma	3012.47		2098.73			
				Mean-bkg	+2 sigma	3236.13		2246.67			
						3206		2169			
						3117		2158			
						3079		2232			
						3039		2146			
						3216		2234			
						3133		2185			
						3070		2147			
						3145		2155			
						3128		2119			
						3110		2182			

CABRERA ALPHA-BETA COUNTING INSTRUMENT (Rev 5)

Initial Background and Source Counts for Control Chart									Trial MDA Calculator		
#	Initial bkg counts				Initial source plus bkg counts				Sample Count Time (min)	α	β
	Alpha	cpm	Beta	cpm	Alpha	cpm	Beta	cpm	1		
1	3	3	123	123	3294	3294	4346	4346	Bkg Count Rate (cpm)	0.1	
2	0	0	99	99	3309	3309	4166	4166	Bkg Count Time (min)	1	
3	3	3	111	111	3233	3233	4344	4344	Counter Efficiency	0.186505	0.237969
4	1	1	106	106	3298	3298	4305	4305	MDCR (cpm)	4.471333	#DIV/0!
5	0	0	118	118	3303	3303	4266	4266	MDA (dpm)	23.97434	#DIV/0!
6	2	2	110	110	3326	3326	4223	4223			
7	2	2	119	119	3212	3212	4318	4318			
8	0	0	108	108	3248	3248	4281	4281			
9	0	0	115	115	3211	3211	4274	4274			
10	0	0	120	120	3214	3214	4250	4250			
Mean		1.10		112.9		3264.8		4277.3			
S _(n-1)		1.29		7.43		45.55		55.60			
-3 sigma		-2.76		90.61		3128.16		4110.49			
+3 sigma		4.96		135.19		3401.44		4444.11			
-2 sigma		-1.47		98.04		3173.71		4166.09			
+2 sigma		3.67		127.76		3355.89		4388.51			
					Mean-bkg	3263.7		4164.4			
					S _(n-1)	45.46		51.87			
				Mean-bkg	-3 sigma	3127.32		4008.78			
				Mean-bkg	+3 sigma	3400.08		4320.02			
				Mean-bkg	-2 sigma	3172.78		4060.65			
				Mean-bkg	+2 sigma	3354.62		4268.15			
						3291		4223			
						3309		4067			
						3230		4233			
						3297		4199			
						3303		4148			
						3324		4113			
						3210		4199			
						3248		4173			
						3211		4159			
						3214		4130			

CABRERA ALPHA-BETA COUNTING INSTRUMENT (Rev 5)

Initial Background and Source Counts for Control Chart									Trial MDA Calculator		
#	Initial bkg counts				Initial source plus bkg counts				Sample Count Time (min)	α	β
	Alpha	cpm	Beta	cpm	Alpha	cpm	Beta	cpm	1		
1	0	0	171	171	2519	2519	5156	5156	Bkg Count Rate (cpm)	0.1	
2	0	0	147	147	2503	2503	5227	5227	Bkg Count Time (min)	1	
3	1	1	173	173	2562	2562	5148	5148	Counter Efficiency	0.142663	0.28585
4	1	1	194	194	2386	2386	5259	5259	MDCR (cpm)	4.471333	#DIV/0!
5	1	1	146	146	2406	2406	5111	5111	MDA (dpm)	31.3419	#DIV/0!
6	1	1	180	180	2533	2533	5179	5179			
7	0	0	195	195	2489	2489	5212	5212			
8	1	1	187	187	2645	2645	5222	5222			
9	0	0	177	177	2424	2424	5106	5106			
10	3	3	188	188	2506	2506	5161	5161			
Mean		0.80		175.8		2497.3		5178.1			
S _(n-1)		0.92		17.45		77.47		50.99			
-3 sigma		-1.96		123.44		2264.88		5025.13			
+3 sigma		3.56		228.16		2729.72		5331.07			
-2 sigma		-1.04		140.89		2342.35		5076.12			
+2 sigma		2.64		210.71		2652.25		5280.08			
					Mean-bkg	2496.5		5002.3			
					S _(n-1)	77.38		47.06			
				Mean-bkg	-3 sigma	2264.37		4861.12			
				Mean-bkg	+3 sigma	2728.63		5143.48			
				Mean-bkg	-2 sigma	2341.75		4908.18			
				Mean-bkg	+2 sigma	2651.25		5096.42			
						2519		4985			
						2503		5080			
						2561		4975			
						2385		5065			
						2405		4965			
						2532		4999			
						2489		5017			
						2644		5035			
						2424		4929			
						2503		4973			

CABRERA ALPHA-BETA COUNTING INSTRUMENT (Rev 5)

Initial Background and Source Counts for Control Chart									Trial MDA Calculator		
#	Initial bkg counts				Initial source plus bkg counts				Sample Count Time (min)	α	β
	Alpha	cpm	Beta	cpm	Alpha	cpm	Beta	cpm	1		
1	7	7	604	604	2366	2366	3743	3743	Bkg Count Rate (cpm)	0.1	
2	4	4	544	544	2292	2292	3785	3785	Bkg Count Time (min)	1	
3	3	3	576	576	2320	2320	3746	3746	Counter Efficiency	0.132851	0.181168
4	6	6	538	538	2424	2424	3584	3584	MDCR (cpm)	4.471333	#DIV/0!
5	5	5	570	570	2315	2315	3769	3769	MDA (dpm)	33.65668	#DIV/0!
6	3	3	549	549	2314	2314	3747	3747			
7	5	5	521	521	2308	2308	3711	3711			
8	3	3	545	545	2366	2366	3855	3855			
9	3	3	563	563	2305	2305	3611	3611			
10	7	7	533	533	2284	2284	3696	3696			
Mean		4.60		554.3		2329.4		3724.7			
S _(n-1)		1.65		24.29		43.04		80.00			
-3 sigma		-0.34		481.42		2200.27		3484.70			
+3 sigma		9.54		627.18		2458.53		3964.70			
-2 sigma		1.31		505.71		2243.31		3564.70			
+2 sigma		7.89		602.89		2415.49		3884.70			
					Mean-bkg	2324.8		3170.4			
					S _(n-1)	42.71		80.23			
				Mean-bkg	-3 sigma	2196.66		2929.70			
				Mean-bkg	+3 sigma	2452.94		3411.10			
				Mean-bkg	-2 sigma	2239.37		3009.94			
				Mean-bkg	+2 sigma	2410.23		3330.86			
						2359		3139			
						2288		3241			
						2317		3170			
						2418		3046			
						2310		3199			
						2311		3198			
						2303		3190			
						2363		3310			
						2302		3048			
						2277		3163			

CABRERA ALPHA-BETA COUNTING INSTRUMENT (Rev 5)

Initial Background and Source Counts for Control Chart									Trial MDA Calculator		
#	Initial bkg counts				Initial source plus bkg counts				Sample Count Time (min)	α	β
	Alpha	cpm	Beta	cpm	Alpha	cpm	Beta	cpm	1		
1	14	14			2816	2816			Bkg Count Rate (cpm)	0.1	
2	10	10			2740	2740			Bkg Count Time (min)	1	
3	11	11			2692	2692			Counter Efficiency	0.159224	0
4	9	9			2839	2839			MDCR (cpm)	4.471333	#DIV/0!
5	11	11			2916	2916			MDA (dpm)	28.08206	#DIV/0!
6	6	6			2883	2883					
7	12	12			2970	2970					
8	13	13			2908	2908					
9	20	20			2638	2638					
10	9	9			2576	2576					
Mean		11.50		#DIV/0!		2797.8		#DIV/0!			
S _(n-1)		3.75		#DIV/0!		130.95		#DIV/0!			
-3 sigma		0.25		#DIV/0!		2404.96		#DIV/0!			
+3 sigma		22.75		#DIV/0!		3190.64		#DIV/0!			
-2 sigma		4.00		#DIV/0!		2535.91		#DIV/0!			
+2 sigma		19.00		#DIV/0!		3059.69		#DIV/0!			
					Mean-bkg	2786.3		#DIV/0!			
					S _(n-1)	131.84		#VALUE!			
				Mean-bkg	-3 sigma	2390.77		#DIV/0!			
				Mean-bkg	+3 sigma	3181.83		#DIV/0!			
				Mean-bkg	-2 sigma	2522.61		#DIV/0!			
				Mean-bkg	+2 sigma	3049.99		#DIV/0!			
						2802		#VALUE!			
						2730		#VALUE!			
						2681		#VALUE!			
						2830		#VALUE!			
						2905		#VALUE!			
						2877		#VALUE!			
						2958		#VALUE!			
						2895		#VALUE!			
						2618		#VALUE!			
						2567		#VALUE!			



Cabrera Services, Inc.

Instrumentation Logbook
For

Project# 06-3070.02

NEW HAVEN DEPOT CHARACTERIZATION

Instrument # 1

DAILY FIELD LOG

Instrument QC

 units are cpm or ur/hr

Make	Model	S/N	Probe	S/N	DOC						
Ludlum	2221	218559	44-20	PK 215468	8/19/06						
Bkgd Count	Source Count	Source #1 ID	Source #2 ID	Source #3 ID	CDD						
		CS-137 #7									
Date	10/19/06										
Initial QC's	1	2	3	4	5	6	7	8	9	10	Tech
Bkgd	14383	14343	14522	14480	13802	14062	13856	13914	13871	14074	
Source #1	176844	176997	178133	177205	177097	177692	177158	177621	177452	177190	
Source #2											
Source #3											

Daily QC's						
Date	Bkgd	Source #1 (CS-137) $\alpha/\beta/\lambda$	Source #2 () $\alpha/\beta/\lambda$	Source #3 () $\alpha/\beta/\lambda$	Battery OK	Tech
10/19/06	14383 14245	176976			Yes / No	
10/20/06	14343 14074	177677			Yes / No	
					Yes / No	
10/23/06	13992	170612			<u>Yes</u> / No	DA
10/24/06	14010	169416			Yes / No	
10/25/06	14157	181883			Yes / No	
10/26/06	14745	178301			<u>Yes</u> / No	DK
10/27/06	17243 ¹⁵⁴⁸⁸ _{DK}	172435			<u>Yes</u> / No	DK
10/30/06	15319	180896			<u>Yes</u> / No	DK
10/31/06	14162	176195			<u>Yes</u> / No	DK
11/1/06	15268	177228			<u>Yes</u> / No	DK
11/2/06	15219	181940			<u>Yes</u> / No	DK
					Yes / No	
					Yes / No	
					Yes / No	
					Yes / No	

Instrument # 2

DAILY FIELD LOG

Instrument QC

 units are cpm or ur/hr

Make	Model	S/N	Probe	S/N	DOC						
Lodlum	2221	97841	44-20	PR172518	6/5/06						
Bkgd Count	Source Count	Source #1 ID	Source #2 ID	Source #3 ID	CDD						
1 min	1 min	CS-137	N/A	N/A	6/5/07						
Date	10-19-06										
Intial QC's	1	2	3	4	5	6	7	8	9	10	Tech
Bkgd	13934	13741	13755	13603	14023	13636	13843	13875	13817	13761	JM
Source #1	17052	170175	169929	170143	169929	169906	170239	170473	169981	170226	"
Source #2	N/A										→
Source #3	N/A										→

Daily QC's						
Date	Bkgd	Source #1 (CS137) α / β / λ	Source #2 () α / β / λ	Source #3 () α / β / λ	Battery OK	Tech
10-19-06	13976	170135			Yes / No	GB
10-20-06	13572	186314			Yes / No	GB
10-23-06	13648	169533			Yes / No	DA
10-24-06	13735 13735	181290			Yes / No	DA
10-25-06	13707	179835			Yes / No	GB
10-26-06	14620	182176			Yes / No	DK
10-27-06	15078	172511			Yes / No	DK
10-30-06	15022	180063			Yes / No	DK
10-31-06	13960	178406			Yes / No	DK
11-2-06	15038	177977			Yes / No	DK
11-3-06	13809	179140			Yes / No	GB
					Yes / No	
					Yes / No	
					Yes / No	
					Yes / No	

Instrument # 3

DAILY FIELD LOG

Instrument QC

 units are cpm or ur/hr

Make	Model	S/N	Probe	S/N	DOC						
Ludlum	2221	216473	44-20	PR220900	6/19/06						
Bkgd Count	Source Count	Source #1 ID	Source #2 ID	Source #3 ID	CDD						
↓ mkr	↓ mkr	Cs-137	N/A	N/A	0/19/07						
Date	10-19-06										
Intial QC's	1	2	3	4	5	6	7	8	9	10	Tech
Bkgd	14035	14256	14063	14012	14275	14283	14144	14146	14398	14047	JDM
Source #1	175074	177496	177043	177022	176233	176795	177202	177162	176958	177180	"
Source #2	N/A										→
Source #3	N/A										→

Daily QC's						
Date	Bkgd	Source #1 (CS137) α/β/λ	Source #2 () α/β/λ	Source #3 () α/β/λ	Battery OK	Tech
10/19/06	14225	17772 179772			Yes / No	Jm
10/20/06	13980	177531			Yes / No	Jm
10/23/06	13995	184729			Yes / No	GB
10/24/06	13793	183575			Yes / No	GB
10/25/06	14589	177235			Yes / No	DA
10/26/06	14931	186172			Yes / No	DK
10/27/06	15072	174948			Yes / No	DK
10/30/06	15391	175316			Yes / No	DK
10/31/06	14025	174452			Yes / No	DK
11/5/06	15093	175792			Yes / No	DA
					Yes / No	
					Yes / No	
					Yes / No	
					Yes / No	
					Yes / No	
					Yes / No	

Instrument # 4

DAILY FIELD LOG
Instrument QC

units are cpm or ur/hr

Make	Model	S/N	Probe	S/N	DOC						
Ludlum	3	135696	44-9	PK145224	5/3/06						
Bkgd Count	Source Count	Source #1 ID	Source #2 ID	Source #3 ID	CDD						
N/A	N/A	3973-02 N/A	3975-02	N	5/3/07						
Date	10/20/06										
Initial QC's	1	2	3	4	5	6	7	8	9	10	Tech
Bkgd											
Source #1	2200	2100	2000	2200	2300	2000	2300	2100	2250	2300	GB
Source #2	2600	2500	2700	2600	2600	2800	2500	2600	2700	2700	GB
Source #3											

no need for α

Daily QC's						
Date	Bkgd	Source #1 (Tk-234) α / β / λ	Source #2 (Tk-234) α / β / λ	Source #3 (Tc-99) α / β / λ	Battery OK	Tech
10/20/06		N/A	2100	2800	Yes / No	JDY
10/23/06			2200	2700	Yes / No	GB
10/24/06			Not Required	2600	Yes / No	GB
10/25/06				2700	Yes / No	GB
10/26/06				2800	Yes / No	DK
10/27/06				2600	Yes / No	DK
10/30/06				2600	Yes / No	DK
10/31/06				2700	Yes / No	DK
11/1/06				2600	Yes / No	DK
11-2-06				2700	Yes / No	DK
11-6-06				2650	Yes / No	GB
11-7-06				2700	Yes / No	DK
11-8-06				2600	Yes / No	DK
11-9-06				2700	Yes / No	DK
11-13-06				2600	Yes / No	DK
11-14-06				2700	Yes / No	DK

Instrument # 5

Instrument # 6

Make	Model	S/N	Probe	S/N	DOC						
Ludlum 2929	2929	100830	43-10-1	PR 207049	1/9/06						
Bkgd Count	Source Count	Source #1 ID	Source #2 ID	Source #3 ID	CDD						
20	4	Tk-230	Tc-99	N/A	1/9/07						
Date	10/19/06										
Intial QC's	1	2	3	4	5	6	7	8	9	10	Tech
Bkgd	2/1053	0/1007	0/970	4/969	3/964	2/961	1/900	1/1001	3/1056	1/964	GB
Source #1	25008	25116	25248	24924	24764	25564	25304	24604	25368	25116	GB
Source #2	19936	19876	19820	20064	20252	20344	20576	20604	19628	20264	GB
Source #3	N/A										→

Daily QC's						
Date	Bkgd	Source #1 (Tk-230) α/β/λ	Source #2 (Tc-99) α/β/λ	Source #3 (N/A) α/β/λ	Battery OK	Tech
10/23/06	4/1002	25004	19936	N/A	Yes/No N/A	GB
10/24/06	1/1001	25048	20032		Yes/No	GB
10/25/06	3/961	25145	20096		Yes/No	GB
10/26/06	4/1014	24877	20160		Yes/No	GB
10/27/06	2/1042	25142	19822		Yes/No	DK
10/30/06	2/1007	25208	20327		Yes/No	GB
10/31/06	3/978 3/976	25092	20234		Yes/No	GB
11/1/06	3/978	24921	19922		Yes/No	GB
11/2/06	3/1059	24986	20138		Yes/No	GB
11/3/06	3/977	24858	20201		Yes/No	GB
11/6/06	3/1014	24998	20559		Yes/No	GB
11/7/06	3/1021 3/1002	24798 ²⁴⁹⁹³	20158 ¹⁹⁸⁰³		Yes/No	GB
11/8/06	1/1021	24798	20158		Yes/No	GB
11/9/06	1/988	24660	19723		Yes/No	GB
11/13/06	4/1013 ^{GB}	24946	19515		Yes/No	GB
11/14/06	4/1000 ⁹²⁴	24774	19655		Yes/No	GB

Instrument # 7

DAILY FIELD LOG
Instrument QC

units are cpm or ur/hr

Make	Model	S/N	Probe	S/N	DOC
LUDLUM	2224-1	162420	43-89	171381	11/23/05
Bkgd Count	Source Count	Source #1 ID	Source #2 ID	Source #3 ID	CDD
/ MIN.	/ MIN	N/A	Th-230 w	TC-99 B	11/23/06

Date	10/20+27/06										
Intial QC's	1	2	3	4	5	6	7	8	9	10	Tech
Bkgd	5 286	4 269	5 311	4 271	6 284	6 317	7 284	4 302	7 289	6 326	DK
Source #1	N/A										
Source #2	3211	3121	3084	3043	3222	3139	3077	3149	3135	3116	DK
Source #3	3398	3294	3247	3217	3363	3287	3218	3245	3154	3394	DK
	2455	2427	2543	2417	2518	2502	2431	2457	2408	2508	DK

Daily QC's						
Date	Bkgd β	Source #1 () $\alpha/\beta/\lambda$	Source #2 () $\alpha/\beta/\lambda$	Source #3 () $\alpha/(\beta)/\lambda$	Battery OK	Tech
10/27/06	5 316	N/A		3158	2480	Yes/No DK
10/31/06	4 3 286 ²⁷⁶ 316			3153	2381 2492	Yes/No DK
11/1/06	4 263			3169	2524 2459	Yes/No DK
11-2-06	7 301			3154	2482	Yes/No DK
11-3-06	4 284			3188	2417	Yes/No DK
11-5-06	5 294			3151	2513	Yes/No DA
11-7-06	7 292			3182	2281 2481	Yes/No DK
11-8-06	4 8 290			3295 3037	2442	Yes/No DK
11-9-06	4 313			3268 3170	2390 2442	Yes/No DK
11-13-06	5 287			3184	2406	Yes/No DK
11-14-06	5 304			3217	2428	Yes/No DK
11-15-06	5 321			3203	2426	Yes/No DK
11-16-06	4 330			3106	2549	Yes/No DK
						Yes/No
						Yes/No
						Yes/No

Instrument # 8

DAILY F O D LOG
Instrument QC

122018
~~122013~~

units are cpm or ur/hr

Make	Model	S/N	Probe	S/N	DOC						
Calum	2224	116257	PR 43-68	PR 241287	9/8/06						
Bkgd Count	Source Count	Source #1 ID	Source #2 ID	Source #3 ID	CDD						
1	1	Th-230	Tc-99	N/A	9-08-07						
Date	10/6/06										
Intial QC's	1	2	3	4	5	6	7	8	9	10	Tech
Bkgd	123	99	111	106	118	110	119	108	115	120	1H
Source #1	3294	3309	3233	3298	3303	3326	3212	3248	3211	3214	1H
Source #2	4346	4166	4344	4305	4266	4223	4318	4281	4274	4250	1H
Source #3											

Daily QC's						
Date	Bkgd	Source #1 (Th-230) α / β / λ	Source #2 (Tc-99) α / β / λ	Source #3 () α / β / λ	Battery OK	Tech
* 11/7/06	1/194	3177	4087		Yes / No	1H
11/8/06	0/116	3341	4213		Yes / No	1H
11/9/06	1/113	3328	4306		Yes / No	B.G.
11/13/06	0/167	3301	4360		Yes / No	B.G.
11-14-06	0/103	3330	4339		Yes / No	B.G.
11-15-06	0/112	3289	4372		Yes / No	B.G.
11-16-06	0/127	3267	4236		Yes / No	B.G.
					Yes / No	
					Yes / No	
					Yes / No	
					Yes / No	
					Yes / No	
					Yes / No	
					Yes / No	
					Yes / No	
					Yes / No	

Project#: 06-3070.02 Name: Greg Bright

* Question for Bkgd beta and failed Beta source count. Reason - used one QC sheet with different formulas which said ^{excel} beta should be $100 \times \frac{C_{beta}}{C_{total}}$

Instrument # 9

Instrument # 10

Instrument # 11



CERTIFICATE OF CALIBRATION

CUSTOMER CABRERA SERVICES ORDER NO. 252136/300508

Mfg. Ludlum Measurements, Inc. Model 2360 Serial No. 184938

Mfg. Ludlum Measurements, Inc. Model 43-37 Serial No. PR-178371

Cal. Date 23-Mar-06 Cal Due Date 23-Mar-07 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 709.8 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) VDC Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

Calibrated in accordance with LMI SOP 14.8 rev 12/05/89.

Instrument Volt Set 1675 V

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

Firmware Version: 39010N27 (EEPROM Settings)

Alpha Threshold: 90 User Time: 001.0

Beta Threshold: 4 Alpha Alarm: 0.50000

Beta Window: 40 Beta Alarm: 0.50000

Overload Checked but not set A/B Alarm: 0.50000

Instrument calibrated with a 5' cable. Model 2360 Date: 03/23/2006

High voltage set with detector Disconnected Calibration Date Due: 03/23/2007

COMMENTS:

4pi efficiencies (see plateau for details)

Pc-99sn:5279-04 ≈ 31.1 % Sr90Y90sn:4016 ≈ 23.8 %

Ni-63sn:4017 ≈ 4.8 % Th-230 sn:121495 ≈ 20.7 %

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	400 kcpm	400	400
X1000	100 kcpm	90	90
X100	40 kcpm	400	400
X100	10 kcpm	95	95
X10	4 kcpm	400	400
X10	1 kcpm	95	95
X1	400 cpm	400	400
X1	100 cpm	90	90

*Uncertainty within ± 10% C.F. within ± 20% Range(s) Calibrated Electronically

REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
400 kcpm	40059 (0)	40059 (0)			
40 kcpm	9956 (L)	9956 (L)			
4 kcpm	4006 (L)	4006 (L)			
400 cpm	996 (L)	996 (L)			
40 cpm	40 (L)	40 (L)			

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 S105 T1008 T879 E552 E551 720 734 1616 Neutron Am-241 Be S/N T-304

Alpha S/N Th-230 sn:121495 Beta S/N Sr90Y90sn:4016 / Ni-63sn:4017 Other

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

Calibrated By: Charles Whisk Date 23 Mar 06

Reviewed By: Michael J Show Date 24 -Mar-06



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Revised 9 May 06 By CS

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-178371 Order #. 252136/300508
 Customer CABRERA SERVICES Alpha Input Sensitivity 90 mV
 Counter 2360 Serial No. 184938 Beta Input Sensitivity 4 mV
 Count Time 1 Minute Beta Window 40 mV
 Other w 1.5' cable Distance Source to Detector Surface

High Voltage	Background		Isotope <u>Th 230</u> Size <u>19800 dpm</u>		Isotope <u>NI-63</u> Size <u>291364 dpm</u>		Isotope <u>Sr 90Y90</u> Size <u>59453 dpm</u>	
	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta
1625	3	248	3569	1345	3	11715	3	9856
1650	3	347	3772	1490	3	13272	0	12383
- 1675	1	394	4099	1660	6	14487	7	14567
1700	4	571	4073	1873	2	15589	13	16253
1725	4	731	4250	1996	3	15129	50	18101

- 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 Shisk Date 23 Mar 06



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CERTIFICATE OF CALIBRATION

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CUSTOMER CABRERA SEVICES ORDER NO. 257311/303297

Mfg. Ludlum Measurements, Inc. Model 2224 Serial No. 183048

Mfg. Ludlum Measurements, Inc. Model 43-68 Serial No. PR-161781

Cal. Date 14-Jun-06 Cal Due Date 14-Jun-07 Cal. Interval 1 Year Meterface 202-783

check mark applies to applicable instr. and/or detector IAW mfg. spec. T. 71 °F RH 51 % Alt 700.8 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

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 1650 V Input Sens. Comments mV Det. Oper. 1650 V at Comments mV Threshold Dial Ratio = mV

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

COMMENTS:

Alpha threshold=120mv
Beta threshold=3.5mv
Beta window=50mv
Overload was checked but not set.
High voltage set with detector disconnected.
Firmware#390063
Calibrated with a 5' cable.

Eff. Th230 sn:1495 ,Eff. ≈ 23 % 4pi
Eff. Tc99 sn:5296-04 ,Eff. ≈ 26 % 4pi
Eff. Ni-63 sn:4017 ,Eff. ≈ 6.4 % 4pi
Eff. Sr90y90sn:4016 ,Eff. ≈ 30 % 4pi

See plateau for details.

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	<u>400</u>	<u>400</u>
x1000	100kcpm	<u>100</u>	<u>100</u>
x100	40kcpm	<u>400</u>	<u>400</u>
x100	10kcpm	<u>100</u>	<u>100</u>
x10	4kcpm	<u>400</u>	<u>400</u>
x10	1kcpm	<u>100</u>	<u>100</u>
x1	400cpm	<u>400</u>	<u>400</u>
x1	100cpm	<u>100</u>	<u>100</u>

*Uncertainty within ± 10% C.F. within ± 20%

ALL Range(s) Calibrated Electronically

REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	Log Scale	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
400kcpm	<u>39974 (0)</u>	<u>39974 (0)</u>				
40kcpm	<u>3997 L</u>	<u>3997 L</u>				
4kcpm	<u>399</u>	<u>399</u>				
400cpm	<u>40 S</u>	<u>40 S</u>				
40cpm	<u>4</u>	<u>4</u>				

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 Th230sn:1495 Beta S/N Tc99sn:5296-04/Ni-63sn:4017/Sr90y90sn:4016 Other

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

Calibrated By: Charles Risk Date 14 Jun 06

Reviewed By: WJ Date 14 Jun 06

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



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SWEETWATER, TEXAS 79556, U.S.A.

Bench Test Data For Detector

Detector 43-68 Serial No. PR-1161781 Order # 257311/303297
 Customer CABRERA SEVICES Alpha Input Sensitivity 120 mV
 Counter 2224 Serial No. 183048 Beta Input Sensitivity 3.5 mV
 Count Time 1Minute Beta Window 50 mV
 Other w/5' cable Distance Source to Detector Surface

High Voltage	Background		Isotope <u>Tc 99</u> Size <u>33200 dpm</u>		Isotope <u>Sr 90Y90</u> Size <u>59120 dpm</u>		Isotope <u>NI-63</u> Size <u>290757 dpm</u>	
	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta
1550	0	149	6	10450	3	14688	2	19433
1575	3	198	12	11008	3	16889	2	2115
1600	3	247	19	10912	17	18070	3	20362
1625	1	289	91	10145	73	18773	3	19818
- 1650	3	330	369	9034	296	18250	4	19026
1675	9	359	776	7809	762	16490	79	16736

- 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 Ash Date 14 Jun 06



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Bench Test Data For Detector

Detector 43-68 Serial No. PR-161781 Order # 257311/303297
 Customer CABRERA SEVICES Alpha Input Sensitivity 120 mV
 Counter 2224 Serial No. 183048 Beta Input Sensitivity 3.5 mV
 Count Time 1Minute Beta Window 50 mV
 Other w/5' cable Distance Source to Detector Surface

Isotope Th230 Isotope Isotope
 Size 19800 dpm Size Size
 Alpha Beta Alpha Beta Alpha Beta Alpha Beta

High Voltage	Background		Isotope		Isotope		Isotope	
	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta
1550	0	149	3668	1533				
1575	3	198	3882	1579				
1600	3	247	4068	1553				
1625	1	289	4251	1361				
-1650	2	320	4523	1259				
1675	9	359	4526	1114				

- 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 14 Jun 06



Duratek Instrument Services
628 Gallaher Road
Kingston, TN 37763
Phone: (865) 376-8337
Fax: (865) 376-8331

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

CUSTOMER INFORMATION		INSTRUMENT INFORMATION	
Customer Name: Duratek Instrument Services		Manufacturer: Ludlum	
Address: 628 Gallaher Road, Kingston, TN 37763		Model: 2224	Serial Number: 116257
Contact Name: Tony Riggs		Probe: N/A	Serial Number: N/A
Customer Purchase Order Number: N/A	Work Order Number: 2006-03971	Calibration Method: Electronic	

INSTRUMENT CALIBRATION INFORMATION

Instrument Range	Calibration Standard Value	Ratemeter Response		Calibration Standard Value	Tolerances (cpm) ± 2%	Scaler Response	
		As Found	As Left			As Found	As Left
X 1	100	100	100	40	40	40	40
X 1	200	200	200	400	392-408	400	400
X 1	400	400	400	4,000	3,920-4,080	4,000	4,000
X 10	1,000	1,000	1,000	40,000	39.2K-40.8K	40,001	40,001
X 10	2,000	2,000	2,000	400,000	392K-408K	400,014	400,014
X 10	4,000	4,000	4,000				
X 100	10,000	10,000	10,000				
X 100	20,000	20,000	20,000				
X 100	40,000	40,000	40,000				
X 1000	100,000	100,000	100,000				
X 1000	200,000	200,000	200,000				
X 1000	400,000	400,000	400,000				

STATEMENT OF CERTIFICATION

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 incurred during shipment or use of this instrument).

Instrument		Reviewed By: <i>Jeff Dabson</i> Date: 9/8/06
Calibrated By: <i>Mike Paul</i>		Calibration Due: 09/08/07
Calibration Date: 09/08/06		

Model: 2224Serial Number: 116257

M&TE				Environmental Conditions			
Volt Meter	ID#	TW12662	Cal Due: 02/23/07	Barometer	ID# 2551	Cal Due: 10/13/06	
Pulser	ID#	101500	Cal Due: 09/28/06	Thermometer	ID# 2551	Cal Due: 10/13/06	
Humidity	ID#	958670	Cal Due: 03/29/07	Temp: 23.2 °C	Pressure: 742mHg	Humidity: 57%	
Special Test							
Geotropism		Sat (✓) Unsat ()		As Found		As Left	
Audio Check		Sat (✓) Unsat ()		Alpha Sensitivity= 150mv		Alpha Sensitivity= 120mv	
Mechanical Zero		Sat (✓) Unsat ()		Beta Sensitivity= 4.5mv		Beta Sensitivity= 3.5mv	
Reset		Sat (✓) Unsat ()		Beta Window= 35mv		Beta Window= 30mv	
HV Analog Display		Sat (✓) Unsat ()		See detector sheet for proper High Voltage setting			
Batt. Ck. (Min. Volt 2.2VDC)		Sat (✓) Unsat ()		Overload Not Set		Overload Not Set	
High Voltage Calibration				H.V. Set With Detector Not Connected			
Voltage	Tolerance	As Found	As Left				
500	450-550	489	489				
1000	900-1100	1,013	1,013				
1500	1350-1650	1,531	1,531				
COMMENTS							
Calibrated with 5ft. Cable				Calibrated in accordance with OEM Technical Manual			
Instrument							
Calibrated By: <i>Mike Paul</i>		Reviewed By: <i>Jeff Dubois</i>		Date: 9/8/06			
Calibration Date: 09/08/06		Calibration Due: 09/08/07					



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CERTIFICATE OF CALIBRATION

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SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER CABRERA SERVICES ORDER NO. 261302/304997

Mfg. Ludlum Measurements, Inc. Model 2929 Serial No. 163827

Mfg. Ludlum Measurements, Inc. Model 43-10-1 Serial No. PR-171322

Cal. Date 16-Aug-06 Cal Due Date 16-Aug-07 Cal. Interval 1 Year Meterface 202-014

check mark applies to applicable instr. and/or detector IAW mfg. spec. T. 74 °F RH 45 % Alt 700.8 mm Hg

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

Mechanical ck. Window Operation

Audio ck.

Meter Zeroed Alpha Sensitivity 175 mV Beta Sensitivity 4 mV Beta Window 50 mV

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 875 V = 3.58 on High Voltage dial. High Voltage set with detector connected.

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

COMMENTS:

ff. for Ni63 ≈ 1.5 %4pi, Source count= 4396cpm - 55cpm background
Source size=290415dpm

ff. for Th230 ≈ 39.5 %4pi, Source count= 1742cpm - 1cpm background
Source size=4400dpm

ff. for Tc99 ≈ 33.5 %4pi, Source count= 7641cpm - 55cpm background
Source size=22600dpm

ff. for Sr90Y90 ≈ 48.6 %4pi, Source count= 55421cpm - 55cpm background/source size=113749dpm

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

Calibrated Hv. with detector connected.

Alpha Channel Digital Readout	REFERENCE CAL POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
	400K cpm	40021 (0)	40021 (0)
	40K cpm	4002	4002
	4K cpm	400	400
	400 cpm	40	40
	40 cpm	4	4

Beta/Gamma Channel Digital Readout	REFERENCE CAL POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
	400K cpm	40019 (0)	40019 (0)
	40K cpm	4002	4002
	4K cpm	400	400
	400 cpm	40	40
	40 cpm	4	4

Uncertainty within ± 10% C.F. within ± 20%

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.

This 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:

Is-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 Th230 SN: 5020-03 Beta S/N Tc99 SN: NI-EV/Sr90Y90 SN: 5281-04 Other _____

m 500 S/N 50800 Oscilloscope S/N _____ Multimeter S/N 83990502

Calibrated By: Charles Disk Date 16 Aug 06

Reviewed By: W. J. Allen Date 16 Aug 06

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



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SWEETWATER, TEXAS 79556, U.S.A.

Bench Test Data For Detector

Detector 43-10-1 Serial No. PR-171322 Order #. 261302/304997
 Customer CABRERA SERVICES Alpha Input Sensitivity 175 mV
 Counter 2929 Serial No. 163827 Beta Input Sensitivity 4 mV
 Count Time 1Minute Beta Window 50 mV
 Other _____ Distance Source to Detector Tray

High Voltage	Background		Isotope <u>Th 230</u> Size <u>4400 dpm</u>		Isotope <u>Tc 99</u> Size <u>226.00 dpm</u>		Isotope <u>Sr 90Y90</u> Size <u>113749 dpm</u>	
	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta
825	0	49	1671	157	4	6321	2	56478
850	0	52	1684	215	2	6777	2	56274
875	1	55	1742	257	4	7641	17	55421
900	0	64	1768	294	3	8183	52	53324
925	0	85	1701	341	0	8852	156	51049

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

Signature Charles Disk Date 16 Aug 06



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CERTIFICATE OF CALIBRATION

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CUSTOMER CABRERA SERVICES ORDER NO. 257115/303187

Mfg. Ludlum Measurements, Inc. Model 2221 Serial No. 218559
Mfg. Ludlum Measurements, Inc. Model 44-20 Serial No. PR215468
Cal. Date 19-Aug-06 Cal Due Date 19-Aug-07 Cal. Interval 1 Year Meterface 202-159

check mark applies to applicable instr. and/or detector IAW mfg. spec. T. 73 °F RH 43 % Alt 700.8 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) 4.4 VDC
 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 Input Sens Comments mV Det. Oper Comments V at Comments mV Threshold Dial Ratio 100 = 10 mV

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

COMMENTS:

Peak settings
High Voltage: 687V
Threshold dial: 642
Window dial: 40
Window Position: "IN"
Resolution for Cs137: ~8.7%

Gross Counts
1050V
100(10mv)
n/a
"OUT"
n/a

Model 2221 currently set for Gross Counts
High voltage set with detector connected.

Firmware: 2610280^{HTT}

Calibrated with 5 foot cable.

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*
X 1K	400kcpm	<u>400</u>	<u>400</u>
X 1K	100kcpm	<u>100</u>	<u>100</u>
X 100	40kcpm	<u>400</u>	<u>400</u>
X 100	10kcpm	<u>100</u>	<u>100</u>
X 10	4kcpm	<u>400</u>	<u>400</u>
X 10	1kcpm	<u>100</u>	<u>100</u>
X 1	400cpm	<u>400</u>	<u>400</u>
X 1	100cpm	<u>100</u>	<u>100</u>

*Uncertainty within ± 10% C.F. within ± 20% ALL Range(s) Calibrated Electronically

REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
400kcpm	<u>40215(6)</u>	<u>40215(6)</u>	500kcpm	<u>450 K</u>	<u>450K</u>
40kcpm	<u>4013(6)</u>	<u>4013(6)</u>	50kcpm	<u>50 K</u>	<u>50K</u>
4kcpm	<u>402(6)</u>	<u>402(6)</u>	5kcpm	<u>5 K</u>	<u>5K</u>
400cpm	<u>40(6)</u>	<u>40(6)</u>	500cpm	<u>500</u>	<u>500</u>
40cpm	<u>4(6)</u>	<u>4(6)</u>	50cpm	<u>55</u>	<u>55</u>

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. This 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:

Is-137 Gamma S/N 1162 G112 M585 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 57881 Oscilloscope S/N _____ Multimeter S/N 56110559R

Calibrated By: Michael J. Shover Date 19-Aug-06
Reviewed By: W.R.H. Date 21 Aug 06

CERTIFICATE OF CALIBRATION

CUSTOMER CABRERA SERVICES ORDER NO. 257193/303229

Mfg. Ludlum Measurements, Inc. Model 2221 Serial No. 216473
Mfg. Ludlum Measurements, Inc. Model 44-20 Serial No. PR220900

Cal. Date 19-Jun-06 Cal Due Date 19-Jun-07 Cal. Interval 1 Year Meterface 202-159

Check mark applies to applicable instr. and/or detector IAW mfg. spec. T. 71 °F RH 47 % Alt 700.8 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) 4.4 VDC
 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 Input Sens. Comments mV Det. Oper. Comments V at Comments mV Threshold Dial Ratio 100 = 10 mV
 HV Readout (2 points) Ref./Inst. 500 / 499 V Ref./Inst. 2000 / 2004 V

COMMENTS:

Peak settings
High Voltage: 715 ✓
Threshold dial: 642
Window dial: 40
Window Position: "IN"
Resolution for Cs137: ~9.2%
Calibrated using 30 inch cable.
5ft + 17"

Model 2221 currently set for Peak settings
Firmware: 261028
High voltage set
with detector connected.

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*
X 1K	400kcpm	<u>400</u>	<u>400</u>
X 1K	100kcpm	<u>100</u>	<u>100</u>
X 100	40kcpm	<u>400</u>	<u>400</u>
X 100	10kcpm	<u>100</u>	<u>100</u>
X 10	4kcpm	<u>400</u>	<u>400</u>
X 10	1kcpm	<u>100</u>	<u>100</u>
X 1	400cpm	<u>400</u>	<u>400</u>
X 1	100cpm	<u>100</u>	<u>100</u>

*Uncertainty within ± 10% C.F. within ± 20% ALL Range(s) Calibrated Electronically

REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
400kcpm	<u>40168(6)</u>	<u>40168(6)</u>	500kcpm	<u>500K</u>	<u>500K</u>
40kcpm	<u>4014(6)</u>	<u>4014(6)</u>	50kcpm	<u>50K</u>	<u>50K</u>
4kcpm	<u>401(6)</u>	<u>401(6)</u>	5kcpm	<u>5K</u>	<u>5K</u>
400cpm	<u>40(6)</u>	<u>40(6)</u>	500cpm	<u>500</u>	<u>500</u>
40cpm	<u>4(6)</u>	<u>4(6)</u>	50cpm	<u>55</u>	<u>55</u>

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. This 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:

Is-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 AM-241 ≈ 0.79uCi
 m 500 S/N 57881 Oscilloscope S/N Multimeter S/N 56110559R

Calibrated By: Michael J. Shaw Date 19-June-06
Reviewed By: W. J. Ellis Date 20 June 06



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 CABRERA SERVICES ORDER NO. 256202 / 302712

Mfg. Ludlum Measurements, Inc. Model 2221 Serial No. 97841

Mfg. Ludlum Measurements, Inc. Model 44-20 Serial No. PR-172518

Cal. Date 5-Jun-06 Cal Due Date 5-Jun-07 Cal. Interval 1 Year Meterface 202-159

Check mark applies to applicable instr. and/or detector IAW mfg. spec. T. 74 °F RH 35 % Alt 697.8 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) 4.4 VDC
 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 Input Sens. Comments mV Det. Oper. Comments V at Comments mV Threshold Dial Ratio 100 = 10 mV

HV Readout (2 points) Ref./Inst. 500 / 498 V Ref./Inst. 2000 / 1995 V

COMMENTS:

Peak Settings Gross Counts Firmware: 26 10 27
 High Voltage: 704V 1050V
 Threshold: 642 100 (10mV) Overload checked but not set.
 Window: 40 N/A HV set w/detector connected.
 IN Position: "IN" "OUT" Instrument currently set for Gross Counts.

Resolution for Cs137 ≈ 9.82%

Calibrated using 12' C-cable.

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*
X 1K	400kcpm	390	400
X 1K	100kcpm	97	100
X 100	40kcpm	390	400
X 100	10kcpm	97	100
X 10	4kcpm	390	400
X 10	1kcpm	97	100
X 1	400cpm	390	400
X 1	100cpm	97	100

*Uncertainty within ± 10% C.F. within ± 20%

ALL Range(s) Calibrated Electronically

REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	Log Scale	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
400kcpm	39983 (0)	39983 (0)		500kcpm	500K	550K
40kcpm	3995	3995		50kcpm	45K	50K
4kcpm	400	400		5kcpm	4.5K	5K
400cpm	40	40		500cpm	450	500
40cpm	4	4		50cpm	55	55

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 an International Standards Organization member, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques.

State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources:

s-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 Am241 ≈ 0.83 μCi
 m 500 S/N 81084 Oscilloscope S/N Multimeter S/N 78401030

Calibrated By: Sebasti Caballas Date 05-Jun-06

Reviewed By: WJ Rhiani Date 6 June 06



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 43-89 Serial No. PR171381 Order #. 246337/297322
 Customer CABRERA SERVICES Alpha Input Sensitivity 120 mV
 Counter 2224-1 Serial No. 162420 Beta Input Sensitivity 3.5 mV
 Count Time 1 Minute Beta Window 30 mV
 Other _____ Distance Source to Detector Surface

High Voltage	Background		Isotope <u>Tc99</u> Size <u>28,800cpm</u>		Isotope <u>Sr90Y90</u> Size <u>120,000cpm</u>		Isotope <u>Ni63</u> Size <u>305,000cpm</u>	
	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta
625	3	78	9	1577	5	17885	6	90
650	3	145	16	2664	1	24227	4	163
675	3	201	14	3798	7	30111	6	358
700	7	292	13	4816	12	34204	7	825

- 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 Scott Thomas Date 23-NOV-05



Bench Test Data For Detector

Detector 43-89 Serial No. PR171381 Order #. 246337/297322
 Customer CABRERA SERVICES Alpha Input Sensitivity 120 mV
 Counter 2224-1 Serial No. 162420 Beta Input Sensitivity 3.5 mV
 Count Time 1 Minute Beta Window 30 mV
 Other _____ Distance Source to Detector Surface

High Voltage	Background		Isotope <u>Th230</u> Size <u>5,390cpm</u>		Isotope _____ Size _____		Isotope _____ Size _____	
	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta
625	3	78	726	125				
650	3	145	822	197				
675	3	201	877	298				
700	7	292	872	417				

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

Signature Scott Strom Date 23-NOV-05



Designer and Manufacturer
of
Scientific and Industrial
Instruments

CERTIFICATE OF CALIBRATION

LOUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-46
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER CABRERA SERVICES ORDER NO. 254788 / 301922
Mfg. Ludlum Measurements, Inc. Model 3 Serial No. 135696
Mfg. Ludlum Measurements, Inc. Model 44-9 Serial No. PR145224
Cal. Date 3-May-06 Cal Due Date 3-May-07 Cal. Interval 1 Year Meterface 202-002

Check mark applies to applicable instr. and/or detector IAW mfg. spec. T. 74 °F RH 39 % Alt 698.8 mm H

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
 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 900 V Input Sens. 34 mV Det. Oper. 900 V at 34 mV Threshold Dial Ratio =

HV Readout (2 points) Ref./Inst. / V Ref./Inst. / V

COMMENTS:

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*
X 100	400kcpm	4K	4K
X 100	100kcpm	1K	1K
X 10	40kcpm	4K	4K
X 10	10kcpm	1K	1K
X 1	4kcpm	4K	4K
X 1	1kcpm	1K	1K
X 0.1	400cpm	4K	4K
X 0.1	100cpm	1K	1K

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		

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 technique if the calibration system conforms to the requirements of ANSI/NCCL Z540-1-1994 and ANSI N323-1978 State of Texas Calibration License No. LO-19

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-3

Alpha S/N Beta S/N Other

m 500 S/N 189509 Oscilloscope S/N Multimeter S/N 71300492

Calibrated By: Wendell J. Thomas Date 3-MAY-06
Reviewed By: Michel J. Thomas Date 3-May-06

This certificate shall not be reproduced except in full, without the written approval of Ludlum Measurements, Inc.

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



Designer and Manufacturer
of
Scientific and Industrial
Instruments

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-46
SWEETWATER, TEXAS 79556, U.S.A.

CONVERSION CHART

Customer CABRERA SERVICES Date 3-May-06 Order #. 254788 / 301922

Model 3 Serial No. 135696 Detector Model 44-9 Serial No. PR145224

Source C5137, 1162, E552 High Voltage 900 v

Input Sensitivity 34 mV

Reference Point	"As Found" Readings (CPM):		After Adjustment Readings (CPM):	
	Meter Reading	Range/Scale	Meter Reading	Range/Scale
150 mR/hr	4.2 K	X 100	4.2 K	X 100
50 mR/hr	2 K	X 100	2 K	X 100
15 mR/hr	0.7 K	X 100	0.7 K	X 100
5 mR/hr	2.1 K	X 10	2.1 K	X 10
1.5 mR/hr	0.55 K	X 10	0.55 K	X 10
1.0 mR/hr	3 K	X 1	3 K	X 1

Signature: Wendell Williams Date 3-MAY-06

CERTIFICATE OF CALIBRATION

CUSTOMER CABRERA SERVICES ORDER NO. 247655/298001

Mfg. Bicron Model MICRO REM Serial No. C853 F

Mfg. _____ Model _____ Serial No. _____

Cal. Date 22-Dec-05 Cal Due Date 22-Dec-06 Cal. Interval 1 Year Meterface 0-200µrem

Check mark applies to applicable instr. and/or detector IAW mfg. spec. T. 73 °F RH 23 % Alt 705.8 mm H

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) _____ VDC

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 _____ V Input Sens. _____ mV Det. Oper. _____ V at _____ mV Threshold Dial Ratio _____ =

HV Readout (2 points) Ref./Inst. _____ / _____ V Ref./Inst. _____ / _____ V

COMMENTS:

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	150 mR/hr	160	150
x1000	50 mR/hr	50	51
x100	15 mR/hr	155	150
x100	5 mR/hr	50	50
x10	1500 µR/hr	160	150
x10	500 µR/hr	52	50
x1	150 µR/hr	160	150
x1	100 µR/hr	95	95
x0.1	15 µR/hr	150	150
x0.1			

*Uncertainty within ± 10% C.F. within ± 20%

Range(s) Calibrated Electronically

REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING

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 technique. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978. State of Texas Calibration License No. LO-19

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-3

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

m 500 S/N _____ Oscilloscope S/N _____ Multimeter S/N _____

Calibrated By: Duane Jackson Date 22-Dec-05

Reviewed By: W. B. B. B. B. Date 23 Dec 05

CERTIFICATE OF CALIBRATION (AIR SAMPLER)



RSA Laboratories, Inc.

21 Pendleton Drive, P.O. Box 61
Hebron, Connecticut 06248
(860) 228-0721 Fax (860) 228-4402

Customer and Contact: **Cabrera Services, Inc., Attn: Larry Pawlus (860) 289-1885**
Customer Address: **809 Main Street, East Hartford, CT 06108**

Inst. Mfr. **F&J Specialty Products**
Reference Inst. **F&J Venturi D-812**

Inst. Model **LV-1**

Inst. s/n **2591**
Inst. s/n **2541**

Cal. Date **14 March 2006**

Due Date **14 March 2007**

Cal. Interval **1 year**

Barometric Press: Actual **29.30** in. Hg

Corrected to: **28.86** in. Hg

Temperature: Actual **70°F**

Corrected to: **69.7°F**

Filters Used: Particulate Charcoal/silver zeolite Other:

Measurement	Air Sampler Flow Rate (LPM)	Ref. Inst. Flow Rate (LPM)	Percent Deviation
1	19.30	18.67	-3.42
2	38.61	36.35	-6.22
3	48.26	45.19	-6.80
4	57.91	54.03	-7.18
5	77.22	70.73	-9.17
6			
7			
8			
9			
10			
11			
12			

****Average percent deviation across the range = -6.56**

This is to certify that RSA Laboratories, Inc. of Hebron, Connecticut, has on this date certified this air sampler to be within the accuracy specified above. The Reference Flow Device bears Letters of Certification traceable to the National Institute of Science and Technology. RSA Laboratories, Inc. ID# 10400.

Calibrated by: **Kurt D. Newton**

Date: **14 March 2006**

CERTIFICATE OF CALIBRATION

(AIR SAMPLER)

Facility: RSA Laboratories, Inc. Customer: Cabrera Services, Inc.

Air Sampler Model F&J LV-1

Air Sampler Serial No. 2591

Calibrator Model F&J Venturi D-812

Calibrator Serial No. 2541

Measurement	AIR SAMPLER						CALIBRATOR		
	Inlet Temp. (°F)	Inlet Press (In-Hg)	Gauge Press (In-Hg)	Indicated Flow (LPM)	Temp/Press Correction Factor	Corrected Flow (LPM)	Indicated Flow (LPM)	Temp/Press Correction Factor	Corrected Flow (LPM)
1	69.7	28.86	1	20	0.965	19.30	19	0.982	18.67
2	69.7	28.86	1	40	0.965	38.61	37	0.982	36.35
3	69.7	28.86	1	50	0.965	48.26	46	0.982	45.19
4	69.7	28.86	1	60	0.965	57.91	55	0.982	54.03
5	69.7	28.86	1	80	0.965	77.22	72	0.982	70.73
6									
7									
8									
9									
10									
11									
12									

$$\text{Air Sampler Temp/Press Corr Factor} = \sqrt{\frac{530^{\circ}\text{R}}{\text{Inlet temp } (^{\circ}\text{F}) + 460^{\circ}\text{R}} \times \frac{(\text{Inlet Press} - \text{Gauge Press})}{29.92 \text{ in. Hg}}}$$

$$\text{Calibrator Temp/Press Corr Factor} = \sqrt{\frac{530^{\circ}\text{R}}{\text{Inlet temp } (^{\circ}\text{F}) + 460^{\circ}\text{R}} \times \frac{\text{Inlet Press}}{29.92 \text{ in. Hg}}}$$

$$\% \text{ Deviation} = \frac{\text{Corrected Flow} - \text{Sampler Flow}}{\text{Corrected Flow}} \times 100$$

$$\text{Corrected Flow} = (\text{Indicated Flow}) \times (\text{Temp/Press Corr Factor})$$

Calibrated by: Kurt D. Newton Date: 14 March 2006

CERTIFICATE OF CALIBRATION (AIR SAMPLER)



RSA Laboratories, Inc.

21 Pendleton Drive, P.O. Box 61
Hebron, Connecticut 06248
(860) 228-0721 Fax (860) 228-4402

Customer and Contact: **Cabrera Services, Inc., Attn: Larry Pawlus (860) 289-1885**
Customer Address: **809 Main Street, East Hartford, CT 06108**

Inst. Mfr. **F&J Specialty Products**
Reference Inst. **F&J Venturi D-812**

Inst. Model **LV-1**

Inst. s/n **2773**
Inst. s/n **2541**

Cal. Date **14 March 2006**

Due Date **14 March 2007**

Cal. Interval **1 year**

Barometric Press: Actual **29.30** in. Hg
Temperature: Actual **70°F**

Corrected to: **28.86** in. Hg
Corrected to: **69.5°F**

Filters Used: Particulate Charcoal/silver zeolite Other:

Measurement	Air Sampler Flow Rate (LPM)	Ref. Inst. Flow Rate (LPM)	Percent Deviation
1	19.31	19.65	1.75
2	38.62	37.34	-3.42
3	48.27	46.18	-4.52
4	57.92	55.02	-5.27
5	77.23	72.71	-6.22
6			
7			
8			
9			
10			
11			
12			

****Average percent deviation across the range = -3.54**

This is to certify that RSA Laboratories, Inc. of Hebron, Connecticut, has on this date certified this air sampler to be within the accuracy specified above. The Reference Flow Device bears Letters of Certification traceable to the National Institute of Science and Technology. RSA Laboratories, Inc. ID# 10399.

Calibrated by: **Kurt D. Newton**

Date: **14 March 2006**

CERTIFICATE OF CALIBRATION

(AIR SAMPLER)

Facility: RSA Laboratories, Inc. Customer: Cabrera Services, Inc.

Air Sampler Model F&J LV-1
 Calibrator Model F&J Venturi D-812

Air Sampler Serial No. 2773
 Calibrator Serial No. 2541

AIR SAMPLER							
Measurement	Inlet Temp. (°F)	Inlet Press (In-Hg)	Gauge Press (In-Hg)	Indicated Flow (LPM)	Temp/Press Correction Factor	Corrected Flow (LPM)	Indicated Flow (LPM)
1	69.5	28.86	1	20	0.965	19.31	20
2	69.5	28.86	1	40	0.965	38.62	38
3	69.5	28.86	1	50	0.965	48.27	47
4	69.5	28.86	1	60	0.965	57.92	56
5	69.5	28.86	1	80	0.965	77.23	74
6							
7							
8							
9							
10							
11							
12							

$$\text{Air Sampler Temp/Press Corr Factor} = \sqrt{\frac{530^{\circ}\text{R}}{\text{Inlet temp } (^{\circ}\text{F}) + 460^{\circ}\text{R}}} \times \frac{(\text{Inlet Press} - \text{Gauge Press})}{29.92 \text{ in. Hg}} \quad \% \text{ Deviation} = \dots$$

$$\text{Calibrator Temp/Press Corr Factor} = \sqrt{\frac{530^{\circ}\text{R}}{\text{Inlet temp } (^{\circ}\text{F}) + 460^{\circ}\text{R}}} \times \frac{\text{Inlet Press}}{29.92 \text{ in. Hg}} \quad \text{Corrected Flow} = (\text{Indic} \dots)$$

Calibrated by: Kurt D. Newton  Date: 14 March 2006



CERTIFICATE OF CALIBRATION

Electroplated Alpha Standard

S.O.# 3863
P.O.# 02-055

Description of Standard:

Model No. DNS-11 Serial No. 3973-02 Isotope Th-230

Electroplated on polished SS disc, 0.79 mm thick.

Total diameter of 4.77 cm 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 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 2393/91.

Measurement Result:

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

8,860 + 265

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

17,500 + 523 (0.00786 μ Ci)

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.

Calibrated by: ART REUST Reviewed by: [Signature]

Calibration Technician: [Signature] Q.A. Representative: [Signature]

Calibration Date: 4-29-2002 Reviewed Date: 4-29-02



CERTIFICATE OF CALIBRATION

Electroplated Beta Standard

S.O.# 3863
P.O.# 02-055

Description of Standard:

Model No. DNS-12 Serial No. 3975-02 Isotope Tc-99

Electroplated on polished SS disc, 0.79 mm thick.

Total diameter of 4.77 cm 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 2148/90.

Measurement Result:

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

11,000 + 441

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

17,700 + 706 (0.00796 μ Ci)

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.

Calibrated by: ART REUST

Reviewed by: [Signature]

Calibration Technician: [Signature]

Q.A. Representative: [Signature]

Calibration Date: 4-25-2002

Reviewed Date: 4-29-02



Duratek Instrument Services
 628 Gallaher Road
 Kingston, TN 37763
 Phone: (865) 376-8337
 Fax: (865) 376-8331

**CALIBRATION
 CERTIFICATE**

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

CUSTOMER INFORMATION			DETECTOR INFORMATION		
Customer Name: Duratek Instrument Services			Manufacturer: Ludlum		
Address: 628 Gallaher Rd Kingston, TN 37763			Detector Model: 43-37A		
Contact Name: Tony Riggs			Serial Number: 092501		
Customer Purchase Order Number: N/A		Work Order Number: 2006-03612	Evaluation Method: Source		
DETECTOR EFFICIENCY/RESPONSE/PRECISION INFORMATION					
Source Nuclide: Th ²³⁰		Serial Number: 119709	Activity (dpm): 2,442	Certification Date: 10/14/97	
Parameter	As Found	As Left	Precision Test		CPM
Count 1	510	510	Count 1 (Heel)		510
Count 2	501	501	Count 2 (Center)		519
Count 3	519	519	Count 3 (Toe)		507
Count 4	517	517	Average		512
Count 5	507	507	Tolerance		±10%
Count 6	557	557	Pass/Fail		Pass
Average	518.5	518.5			
Background (CPM)	6.4	6.4			
Net Counts	512.1	512.1			
Efficiency	21.0%	21.0%			
Low Sample Activity: Source #: N/A		High Sample Activity: Source #: N/A		Dead Time (DT): N/A	Calibration Constant (CC): N/A
SCALER INFORMATION			DETECTOR INFORMATION		
Model	Serial Number	Due Date	Background (cpm)	Operating Voltage	Threshold
2221	86286	12/06/2006	6.4	1300V	40 = 4mV
Detector Setup Report		YES NO <input checked="" type="checkbox"/>	Barcode Report		YES NO <input checked="" type="checkbox"/>
			Voltage Plateau		YES <input checked="" type="checkbox"/> NO
COMMENTS					
Calibrated in accordance with CP-IN-WI-239 10 minute background performed			Efficiency performed on contact with 6Ft. cable		
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 damage incurred during shipment or use of this detector).					
Detector					
Certified By:		Reviewed By:		Date: 11/9/06	
Certification Date: 3/16/2006			Certification Due: 3/16/2007		

BACKGROUND PLATEAU 43-37 S/N: 092501 3/16/2006

900	0
950	0
1000	0
1050	0
1100	2
1150	1
1200	3
1250	1
<u>1300</u>	<u>1</u>
1350	2
1400	3
1450	3
1500	4
1550	42
1600	74
1650	147
1700	278
1750	593
1800	819
1850	925
1900	1040
1950	1147

ALPHA PLATEAU Th230 #119708 2,610DPM

900	0
950	0
1000	0
1050	0
1100	69
1150	381
1200	495
1250	458
<u>1300</u>	<u>486</u>
1350	552
1400	506
1450	529
1500	537

BETA PLATEAU Tc99 #119718 20,520DPM

1400	7
1450	19
1500	186
1550	799
1600	1789
1650	2748
1700	3885
1750	5042
1800	5292
1850	5246
1900	5590
1950	5816

AK



Duratek Instrument Services
 628 Gallaher Road
 Kingston, TN 37763
 Phone: (865) 376-8337
 Fax: (865) 376-8331

**CALIBRATION
 CERTIFICATE**

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

CUSTOMER INFORMATION				DETECTOR INFORMATION	
Customer Name: Duratek Instrument Services				Manufacturer: Ludlum	
Address: 628 Gallaher Rd Kingston, TN 37763				Detector Model: 43-37B	
Contact Name: Tony Riggs				Serial Number: 092501	
Customer Purchase Order Number: N/A		Work Order Number: 2006-03612		Evaluation Method: Source	
DETECTOR EFFICIENCY/RESPONSE/PRECISION INFORMATION					
Source Nuclide: Tc ⁹⁹		Serial Number: 119718		Activity (dpm): 20,520	
				Certification Date: 10/14/97	
Parameter	As Found	As Left	Precision Test		CPM
Count 1	5548	5548	Count 1 (Heel)		5405
Count 2	5405	5405	Count 2 (Center)		5538
Count 3	5502	5502	Count 3 (Toe)		5466
Count 4	5538	5538	Average		5469.7
Count 5	5588	5588	Tolerance		±10%
Count 6	5466	5466	Pass/Fail		Pass
Average	5507.8	5507.8			
Background (CPM)	830	830			
Net Counts	4677.8	4677.8			
Efficiency	22.8%	22.8%			
Low Sample Activity: Source #: N/A		High Sample Activity: Source #: N/A		Dead Time (DT): N/A	Calibration Constant (CC): N/A
SCALER INFORMATION			DETECTOR INFORMATION		
Model	Serial Number	Due Date	Background (cpm)	Operating Voltage	Threshold
2221	86286	12/06/2006	830	1850V	40 = 4mV
Detector Setup Report		YES NO ✓	Barcode Report		YES NO ✓
			Voltage Plateau		YES ✓ NO
COMMENTS					
Calibrated in accordance with CP-IN-WI-239 10 minute background performed			Efficiency performed on contact with 6Ft. cable		
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 damage incurred during shipment or use of this detector).					
Detector					
Certified By: <i>[Signature]</i>		Reviewed By: <i>[Signature]</i>		Date: 11/9/06	
Certification Date: 3/16/2006			Certification Due: 3/16/2007		

900	0
950	0
1000	0
1050	0
1100	2
1150	1
1200	3
1250	1
1300	1
1350	2
1400	3
1450	3
1500	4
1550	42
1600	74
1650	147
1700	278
1750	593
1800	819
1850	925

~~1900~~ 1040

1950 1147

ALPHA PLATEAU Th230 #119708 2,610DPM

900	0
950	0
1000	0
1050	0
1100	69
1150	381
1200	495
1250	458
1300	486
1350	552
1400	506
1450	529
1500	537

BETA PLATEAU Tc99 #119718 20,520DPM

1400	7
1450	19
1500	186
1550	799
1600	1789
1650	2748
1700	3885
1750	5042
1800	5292
1850	5246
1900	5590
1950	5816

PL

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Fax: (865) 376-8331

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

CUSTOMER INFORMATION		INSTRUMENT INFORMATION	
Customer Name: Duratek Instrument Services		Manufacturer: Ludlum	
Address: 628 Gallaher Road, Kingston, TN 37763		Model: 2221	Serial Number: 86286
Contact Name: Tom Scott		Probe: N/A	Serial Number: N/A
Customer Purchase Order Number: N/A	Work Order Number: 2005-03393	Calibration Method: Electronic	

INSTRUMENT CALIBRATION INFORMATION

Instrument Range	Calibration Standard Value CPM	Ratemeter Response		Calibration Standard Value CPM	Time Base (min)	Tolerances (cpm) ± 10%	Scaler Response	
		As Found	As Left				As Found	As Left
X 1	100	100	100	1,000 CPM	.1	90 – 110	100	100
X 1	250	250	250	1,000 CPM	.2	180 – 220	198	198
X 1	400	390	400	1,000 CPM	.5	450 – 550	497	497
X 10	1,000	1,000	1,000	1,000 CPM	1	900 – 1,100	994	994
X 10	2,500	2,450	2,500	1,000 CPM	2	1.8K–2.2K	1,987	1,987
X 10	4,000	3,900	4,000	1,000 CPM	5	4.5K-5.5K	4,968	4,968
X 100	10,000	10,000	10,000					
X 100	25,000	24,000	25,000					
X 100	40,000	39,000	40,000					
X 1000	100,000	100,000	100,000					
X 1000	250,000	240,000	250,000					
X 1000	400,000	380,000	400,000					

STATEMENT OF CERTIFICATION

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 incurred during shipment or use of this instrument).

Instrument	
Calibrated By: <i>M. Paul</i>	Reviewed By: <i>Ronnie G. Deelt</i> Date: <i>12-6-05</i>
Calibration Date: 12/06/05	Calibration Due: 12/06/06

Model: 2221Serial Number: 86286

M&TE				Environmental Conditions					
Volt Meter	Due Date:	03/30/06	ID	TW12663	D-812	Due Date:	04/19/06	ID:	2816
Pulser	Due Date:	09/28/06	ID	101500	Humidity	Due Date:	03/22/06	ID:	958670
Timer	Due Date:	02/16/06	ID	22226011	Temp: 24.2 °C	Pressure: 746 mmHg	Humidity: 18%		
INSTRUMENT CALIBRATION INFORMATION									
Special Test									
Geotropism	Sat (✓) Unsat ()			Hold			Sat (✓) Unsat ()		
BAT > 4.5	Sat (✓) Unsat ()			Volume Test			Sat (✓) Unsat ()		
Mechanical Zero	Sat (✓) Unsat ()			Audio Divide			Sat (✓) Unsat ()		
Digital Zero	Sat (✓) Unsat ()			Window Switch			Sat (✓) Unsat ()		
Count	Sat (✓) Unsat ()			Lamp			Sat (✓) Unsat ()		
High Voltage Calibration									
Voltage	Tolerance ± 2%			As Found			As Left		
400	392-408			405			405		
1,000	980-1,020			1,003			1,003		
1,500	1,470-1,530			1,502			1,502		
1,900	1,862-1,932			1,901			1,901		
Threshold/Gain Calibration (Desired Ratio <u>10</u> mV/100)									
Input	As Found Value		As Found Ratio (mV/100)		As Left Value		As Left Ratio (mV/100)		
10	86		11.6		94		10.6		
20	182		11.0		201		10.0		
30	278		10.8		306		9.8		
40	373		10.7		417		9.6		
Logmeter Scale Linearity Check									
Input	±20% Tolerance		As Found		As Left				
LOG	400		320-480		400		400		
LOG	4,000		3,200-4,800		4,000		4,000		
LOG	40,000		32,000-48,000		37,500		37,500		
LOG	400,000		320,000-480,000		375,000		375,000		
COMMENTS									
Calibrated in accordance with the OEM Technical Manual									
Instrument									
Calibrated By: <u>M. Paul</u>					Reviewed By: <u>[Signature]</u>			Date: <u>12-6-05</u>	
Calibration Date: 12/06/05					Calibration Due: 12/06/06				

DAILY QUALITY CONTROL REPORT

New Haven Depot Characterization – Project No. 06-3070.02 Task 20

This field report shall be completed each day that field activities are performed at the New Haven Site. Attach an additional sheet of paper, if necessary, to adequately complete each required entry.

JMC PM: <u>Bill Metcalf</u>	Precipitation: <u>On and off showers (in afternoon)</u>
Cabrera PM: <u>John Eberlin</u>	Wind: <u>East to west, 5 mph</u>
Temperature: <u>High 47, low 34</u>	

SUBCONTRACTORS ON SITE (Identify subcontractors onsite by company name):

N/A

WORK PERFORMED (Briefly describe project tasks that were performed. Reference appropriate logs if details necessary)

Joe W. and Dave K. performed sampling remainder of 7A locations. Greg B. located Class 2 points and emailed data to Boriana for review.

PROJECT SCHEDULE (Describe impact of day's work, if any, on overall project schedule):

Tasks 1,2, and 4 are complete. Remainder of bias samples to be sent offsite Friday (task 3). On schedule or ahead of schedule as of now.

PROBLEMS, NON-CONFORMANCES, CORRECTIVE ACTIONS, NOTIFICATIONS (Describe any hazards, injuries, regulatory or procedural issues, items of non-compliance, etc. Identify individuals contacted as a result of these items. Include name/title/organization/time contacted/and a summary of content of discussion):

N/A

SITE VISITORS, CONTACTS (Identify any non-project personnel that visited the site or made contact with project personnel. Include names/titles/organizations/time of contact/ and any other pertinent details of the conversation):

DQCR prepared by:

Print Name	Signature	Title
Greg Bright		Field Site Manager

DAILY QUALITY CONTROL REPORT
New Haven Depot Characterization – Project No. 06-3070.02 Task 20

This field report shall be completed each day that field activities are performed at the New Haven Site. Attach an additional sheet of paper, if necessary, to adequately complete each required entry.

JMC PM: Bill Metcalf _____ **Precipitation:** N/A _____
Cabrera PM: John Eberlin _____ **Wind:** From the east 5 mph _____
 _____ **Temperature:** High 60, low 45 _____

SUBCONTRACTORS ON SITE (Identify subcontractors onsite by company name):

Ian Harris and Bill Gardener

WORK PERFORMED (Briefly describe project tasks that were performed. Reference appropriate logs if details necessary)

Derrick A and Ian H. scan walls in 211, while Bill G., and Dave K. scan walls in 212. After they finish those surveys, both teams start surveying in Building 213. Greg B. enters data into data sheets and counts smears.

PROJECT SCHEDULE (Describe impact of day's work, if any, on overall project schedule):

Tasks 1-5 and 13 are complete. Task 14 is nearly complete, just building surveys are needed. Now focusing on scans in warehouses.

PROBLEMS, NON-CONFORMANCES, CORRECTIVE ACTIONS, NOTIFICATIONS (Describe any hazards, injuries, regulatory or procedural issues, items of non-compliance, etc. Identify individuals contacted as a result of these items. Include name/title/organization/time contacted/and a summary of content of discussion):

Heard from Airgas that smaller tanks of P-10 gas are coming tomorrow.

SITE VISITORS, CONTACTS (Identify any non-project personnel that visited the site or made contact with project personnel. Include names/titles/organizations/time of contact/ and any other pertinent details of the conversation):

DQCR prepared by:

Print Name	Signature	Title
Greg Bright		Field Site Manager

New Haven Project Duplicate data analysis.

Dup SU ¹	Dup Component	Dup Result (pCi/g)	Dup TPU ² (pCi/g)	SU ¹	Component	Result (pCi/g)	TPU ² (pCi/g)	NAD ³ = 1.96	>NAD ³ ?
SU4-77-SS-S-1	Actinium 228	1.15 +/- 0.34		SU4-77-SS-S-0	Actinium 228	0.94 +/- 0.2		0.53	
SU4-77-SS-S-1	Bismuth 214	1.94 +/- 0.32		SU4-77-SS-S-0	Bismuth 214	1.61 +/- 0.27		0.79	
SU4-77-SS-S-1	Cesium 137	0.39 +/- 0.11		SU4-77-SS-S-0	Cesium 137	0.268 +/- 0.08		0.90	
SU4-77-SS-S-1	Lead 212	1.09 +/- 0.2		SU4-77-SS-S-0	Lead 212	1.05 +/- 0.18		0.15	
SU4-77-SS-S-1	Lead 214	2.07 +/- 0.29		SU4-77-SS-S-0	Lead 214	1.79 +/- 0.25		0.73	
SU4-77-SS-S-1	Potassium 40	17.7 +/- 3.2		SU4-77-SS-S-0	Potassium 40	17 +/- 2.9		0.16	
SU4-77-SS-S-1	Radium (226)	1.94 +/- 0.32		SU4-77-SS-S-0	Radium (226)	1.61 +/- 0.27		0.79	
SU4-77-SS-S-1	Thallium 208	0.356 +/- 0.099		SU4-77-SS-S-0	Thallium 208	0.335 +/- 0.091		0.16	
SU4-77-SS-S-1	Thorium 232	1.15 +/- 0.34		SU4-77-SS-S-0	Thorium 232	0.94 +/- 0.2		0.53	
				SU4-77-SS-S-0	Thorium 234	1.25 +/- 0.42			
SU4-77-SS-S-1	Uranium 235	0.08 +/- 0.32		SU4-77-SS-S-0	Uranium 235	0.03 +/- 0.23		0.13	
SU4-77-SS-S-1	Uranium 238	1.72 +/- 0.8		SU4-77-SS-S-0	Uranium 238	1.25 +/- 0.42		0.52	
SU4-77-SB-S-1	Actinium 228	1.06 +/- 0.29							
SU4-77-SB-S-1	Bismuth 212	0.82 +/- 0.41							
SU4-77-SB-S-1	Bismuth 214	1.7 +/- 0.31		SU4-77-SB-S-0	Bismuth 214	1.23 +/- 0.28		1.13	
SU4-77-SB-S-1	Lead 212	1.2 +/- 0.21		SU4-77-SB-S-0	Lead 212	0.98 +/- 0.2		0.76	
SU4-77-SB-S-1	Lead 214	1.91 +/- 0.26		SU4-77-SB-S-0	Lead 214	1.23 +/- 0.21		2.03	X
SU4-77-SB-S-1	Potassium 40	21.4 +/- 3.5		SU4-77-SB-S-0	Potassium 40	19.3 +/- 3.5		0.42	
SU4-77-SB-S-1	Radium (226)	1.7 +/- 0.31		SU4-77-SB-S-0	Radium (226)	1.23 +/- 0.28		1.13	
SU4-77-SB-S-1	Thallium 208	0.366 +/- 0.098		SU4-77-SB-S-0	Thallium 208	0.4 +/- 0.12		0.22	
SU4-77-SB-S-1	Thorium 232	1.06 +/- 0.29		SU4-77-SB-S-0	Thorium 232	1.02 +/- 0.5		0.07	
SU4-77-SB-S-1	Uranium 235	0.002 +/- 0.28		SU4-77-SB-S-0	Uranium 235	0.15 +/- 0.31		0.35	
SU4-77-SB-S-1	Uranium 238	1.6 +/- 1.1		SU4-77-SB-S-0	Uranium 238	1.5 +/- 1.1		0.06	
SU4-82-SS-S-1	Actinium 228	1.15 +/- 0.33		SU4-82-SS-S-0	Actinium 228	0.89 +/- 0.38		0.52	
				SU4-82-SS-S-0	Bismuth 212	0.66 +/- 0.4			
SU4-82-SS-S-1	Bismuth 214	1.35 +/- 0.25		SU4-82-SS-S-0	Bismuth 214	1.46 +/- 0.26		0.30	
				SU4-82-SS-S-0	Cesium 137	0.156 +/- 0.069			
SU4-82-SS-S-1	Lead 212	0.81 +/- 0.17		SU4-82-SS-S-0	Lead 212	0.92 +/- 0.16		0.47	
SU4-82-SS-S-1	Lead 214	1.46 +/- 0.22		SU4-82-SS-S-0	Lead 214	1.61 +/- 0.23		0.47	
SU4-82-SS-S-1	Potassium 40	13.1 +/- 2.6		SU4-82-SS-S-0	Potassium 40	15 +/- 2.7		0.51	
SU4-82-SS-S-1	Radium (226)	1.35 +/- 0.25		SU4-82-SS-S-0	Radium (226)	1.46 +/- 0.26		0.30	
SU4-82-SS-S-1	Thallium 208	0.315 +/- 0.095		SU4-82-SS-S-0	Thallium 208	0.332 +/- 0.093		0.13	
SU4-82-SS-S-1	Thorium 232	1.15 +/- 0.33		SU4-82-SS-S-0	Thorium 232	0.89 +/- 0.38		0.52	
SU4-82-SS-S-1	Uranium 235	-0.17 +/- 0.29		SU4-82-SS-S-0	Uranium 235	0.04 +/- 0.24		0.56	
SU4-82-SS-S-1	Uranium 238	0.9 +/- 0.97		SU4-82-SS-S-0	Uranium 238	1.88 +/- 0.95		0.72	
SU4-82-SB-S-1	Actinium 228	1.21 +/- 0.27		SU4-82-SB-S-0	Actinium 228	1.27 +/- 0.42		0.12	
SU4-82-SB-S-1	Bismuth 214	1.55 +/- 0.29		SU4-82-SB-S-0	Bismuth 214	1.44 +/- 0.32		0.25	
SU4-82-SB-S-1	Lead 212	1.02 +/- 0.19		SU4-82-SB-S-0	Lead 212	1.03 +/- 0.21		0.04	
SU4-82-SB-S-1	Lead 214	1.51 +/- 0.22		SU4-82-SB-S-0	Lead 214	1.48 +/- 0.25		0.09	
SU4-82-SB-S-1	Potassium 40	21.4 +/- 3.6		SU4-82-SB-S-0	Potassium 40	20.8 +/- 3.8		0.11	
SU4-82-SB-S-1	Radium (226)	1.55 +/- 0.29		SU4-82-SB-S-0	Radium (226)	1.44 +/- 0.32		0.25	
SU4-82-SB-S-1	Thallium 208	0.315 +/- 0.095		SU4-82-SB-S-0	Thallium 208	0.42 +/- 0.12		0.69	
SU4-82-SB-S-1	Thorium 232	1.21 +/- 0.27		SU4-82-SB-S-0	Thorium 232	1.27 +/- 0.42		0.12	
SU4-82-SB-S-1	Uranium 235	0.41 +/- 0.3		SU4-82-SB-S-0	Uranium 235	-0.26 +/- 0.33		1.50	
SU4-82-SB-S-1	Uranium 238	1.2 +/- 1		SU4-82-SB-S-0	Uranium 238	0.3 +/- 1.2		0.58	
SU4-86-SS-S-1	Actinium 228	1.12 +/- 0.25							
SU4-86-SS-S-1	Bismuth 214	1.62 +/- 0.28		SU4-86-SS-S-0	Bismuth 214	1.25 +/- 0.29		0.92	
SU4-86-SS-S-1	Cesium 137	0.266 +/- 0.087							
SU4-86-SS-S-1	Lead 212	0.99 +/- 0.18		SU4-86-SS-S-0	Lead 212	1 +/- 0.21		0.04	
SU4-86-SS-S-1	Lead 214	1.6 +/- 0.23		SU4-86-SS-S-0	Lead 214	1.06 +/- 0.2		1.77	

New Haven Project Duplicate data analysis.

Dup SU ¹	Dup Component	Dup Result (pCi/g)	Dup TPU ² (pCi/g)	SU ¹	Component	Result (pCi/g)	TPU ² (pCi/g)	NAD ³ = 1.96	>NAD ³ ?
SU4-86-SS-S-1	Potassium 40	20.5 +/- 3.4		SU4-86-SS-S-0	Potassium 40	17.9 +/- 3.4		0.54	
SU4-86-SS-S-1	Radium (226)	1.62 +/- 0.28		SU4-86-SS-S-0	Radium (226)	1.25 +/- 0.29		0.92	
SU4-86-SS-S-1	Thallium 208	0.372 +/- 0.097		SU4-86-SS-S-0	Thallium 208	0.33 +/- 0.11		0.29	
SU4-86-SS-S-1	Thorium 232	1.12 +/- 0.25		SU4-86-SS-S-0	Thorium 232	1.44 +/- 0.62		0.48	
SU4-86-SS-S-1	Uranium 235	0.51 +/- 0.27		SU4-86-SS-S-0	Uranium 235	0.33 +/- 0.33		0.42	
SU4-86-SS-S-1	Uranium 238	1.29 +/- 0.65		SU4-86-SS-S-0	Uranium 238	1.5 +/- 1.2		0.15	
SU4-86-SB-S-1	Actinium 228	1.28 +/- 0.27		SU4-86-SB-S-0	Actinium 228	1.49 +/- 0.37		0.46	
SU4-86-SB-S-1	Bismuth 214	1.77 +/- 0.31		SU4-86-SB-S-0	Bismuth 214	1.64 +/- 0.33		0.29	
SU4-86-SB-S-1	Lead 212	1.13 +/- 0.21		SU4-86-SB-S-0	Lead 212	1.06 +/- 0.21		0.24	
SU4-86-SB-S-1	Lead 214	1.52 +/- 0.24		SU4-86-SB-S-0	Lead 214	1.87 +/- 0.28		0.95	
SU4-86-SB-S-1	Potassium 40	21.9 +/- 3.7		SU4-86-SB-S-0	Potassium 40	20.7 +/- 3.8		0.23	
SU4-86-SB-S-1	Radium (226)	1.77 +/- 0.31		SU4-86-SB-S-0	Radium (226)	1.64 +/- 0.33		0.29	
SU4-86-SB-S-1	Thallium 208	0.52 +/- 0.13		SU4-86-SB-S-0	Thallium 208	0.4 +/- 0.11		0.70	
SU4-86-SB-S-1	Thorium 232	1.28 +/- 0.27		SU4-86-SB-S-0	Thorium 232	1.49 +/- 0.37		0.46	
SU4-86-SB-S-1	Uranium 235	0.16 +/- 0.32		SU4-86-SB-S-0	Uranium 235	0.14 +/- 0.35		0.04	
SU4-86-SB-S-1	Uranium 238	1.1 +/- 1.1		SU4-86-SB-S-0	Uranium 238	2 +/- 1.2		0.55	
SU4-87-SS-S-1	Actinium 228	1.11 +/- 0.24		SU4-87-SS-S-0	Actinium 228	1.16 +/- 0.27		0.14	
SU4-87-SS-S-1	Bismuth 214	1.62 +/- 0.29		SU4-87-SS-S-0	Bismuth 214	1.26 +/- 0.26		0.92	
SU4-87-SS-S-1	Cesium 137	0.236 +/- 0.081		SU4-87-SS-S-0	Cesium 137	0.139 +/- 0.072		0.90	
SU4-87-SS-S-1	Lead 210	2.6 +/- 1.1							
SU4-87-SS-S-1	Lead 212	1.22 +/- 0.21		SU4-87-SS-S-0	Lead 212	1.22 +/- 0.21		0.00	
SU4-87-SS-S-1	Lead 214	1.57 +/- 0.23		SU4-87-SS-S-0	Lead 214	1.69 +/- 0.24		0.36	
SU4-87-SS-S-1	Potassium 40	21.5 +/- 3.5		SU4-87-SS-S-0	Potassium 40	19.5 +/- 3.3		0.42	
SU4-87-SS-S-1	Radium (226)	1.62 +/- 0.29		SU4-87-SS-S-0	Radium (226)	1.26 +/- 0.26		0.92	
SU4-87-SS-S-1	Thallium 208	0.44 +/- 0.11		SU4-87-SS-S-0	Thallium 208	0.48 +/- 0.12		0.25	
SU4-87-SS-S-1	Thorium 232	1.11 +/- 0.24		SU4-87-SS-S-0	Thorium 232	1.16 +/- 0.27		0.14	
SU4-87-SS-S-1	Uranium 235	0.02 +/- 0.26		SU4-87-SS-S-0	Uranium 235	0.07 +/- 0.25		0.14	
SU4-87-SS-S-1	Uranium 238	0.72 +/- 0.42		SU4-87-SS-S-0	Uranium 238	1.2 +/- 1		0.44	
SU4-87-SB-S-1	Actinium 228	1.19 +/- 0.29		SU4-87-SB-S-0	Actinium 228	1.36 +/- 0.34		0.38	
SU4-87-SB-S-1	Bismuth 214	1.4 +/- 0.28		SU4-87-SB-S-0	Bismuth 214	1.14 +/- 0.27		0.67	
SU4-87-SB-S-1	Lead 212	1.15 +/- 0.22		SU4-87-SB-S-0	Lead 212	1.05 +/- 0.21		0.33	
SU4-87-SB-S-1	Lead 214	1.62 +/- 0.26		SU4-87-SB-S-0	Lead 214	1.13 +/- 0.21		1.47	
SU4-87-SB-S-1	Potassium 40	19.4 +/- 3.6		SU4-87-SB-S-0	Potassium 40	17.6 +/- 3.4		0.36	
SU4-87-SB-S-1	Radium (226)	1.4 +/- 0.28		SU4-87-SB-S-0	Radium (226)	1.14 +/- 0.27		0.67	
SU4-87-SB-S-1	Thallium 208	0.37 +/- 0.11		SU4-87-SB-S-0	Thallium 208	0.38 +/- 0.12		0.06	
SU4-87-SB-S-1	Thorium 232	1.19 +/- 0.29		SU4-87-SB-S-0	Thorium 232	1.36 +/- 0.34		0.38	
SU4-87-SB-S-1	Uranium 235	0.06 +/- 0.33		SU4-87-SB-S-0	Uranium 235	-0.13 +/- 0.3		0.43	
SU4-87-SB-S-1	Uranium 238	1.61 +/- 0.86		SU4-87-SB-S-0	Uranium 238	2.5 +/- 1.3		0.57	
				SU5-98-SS-S-0	Actinium 228	1.18 +/- 0.29			
SU5-98-SS-S-1	Bismuth 214	1.47 +/- 0.28		SU5-98-SS-S-0	Bismuth 214	1.42 +/- 0.28		0.13	
SU5-98-SS-S-1	Cesium 137	0.166 +/- 0.078							
SU5-98-SS-S-1	Lead 212	1.04 +/- 0.2		SU5-98-SS-S-0	Lead 212	0.95 +/- 0.19		0.33	
SU5-98-SS-S-1	Lead 214	1.7 +/- 0.25		SU5-98-SS-S-0	Lead 214	1.62 +/- 0.25		0.23	
SU5-98-SS-S-1	Potassium 40	22.5 +/- 3.9		SU5-98-SS-S-0	Potassium 40	22.1 +/- 3.8		0.07	
SU5-98-SS-S-1	Radium (226)	1.47 +/- 0.28		SU5-98-SS-S-0	Radium (226)	1.42 +/- 0.28		0.13	
SU5-98-SS-S-1	Thallium 208	0.38 +/- 0.11		SU5-98-SS-S-0	Thallium 208	0.49 +/- 0.13		0.65	
SU5-98-SS-S-1	Thorium 232	1.21 +/- 0.48		SU5-98-SS-S-0	Thorium 232	1.18 +/- 0.29		0.05	
SU5-98-SS-S-1	Uranium 235	-0.04 +/- 0.31		SU5-98-SS-S-0	Uranium 235	-0.11 +/- 0.29		0.16	
SU5-98-SS-S-1	Uranium 238	2.1 +/- 1.2		SU5-98-SS-S-0	Uranium 238	1.7 +/- 1.2		0.24	
SU5-98-SB-S-1	Actinium 228	1.07 +/- 0.23		SU5-98-SB-S-0	Actinium 228	1.22 +/- 0.25		0.44	

New Haven Project Duplicate data analysis.

Dup SU ¹	Dup Component	Dup Result (pCi/g)	Dup TPU ² (pCi/g)	SU ¹	Component	Result (pCi/g)	TPU ² (pCi/g)	NAD ³ = 1.96	>NAD ³ ?
SU5-98-SB-S-1	Bismuth 212	1.12 +/- 0.48							
SU5-98-SB-S-1	Bismuth 214	1.43 +/- 0.27		SU5-98-SB-S-0	Bismuth 214	1.5 +/- 0.28		0.18	
SU5-98-SB-S-1	Lead 212	1.33 +/- 0.23		SU5-98-SB-S-0	Lead 212	1.32 +/- 0.23		0.03	
SU5-98-SB-S-1	Lead 214	1.8 +/- 0.25		SU5-98-SB-S-0	Lead 214	1.75 +/- 0.25		0.14	
SU5-98-SB-S-1	Potassium 40	22.4 +/- 3.6		SU5-98-SB-S-0	Potassium 40	21.7 +/- 3.6		0.14	
SU5-98-SB-S-1	Radium (226)	1.43 +/- 0.27		SU5-98-SB-S-0	Radium (226)	1.5 +/- 0.28		0.18	
SU5-98-SB-S-1	Thallium 208	0.359 +/- 0.097		SU5-98-SB-S-0	Thallium 208	0.48 +/- 0.12		0.78	
SU5-98-SB-S-1	Thorium 232	1.07 +/- 0.23		SU5-98-SB-S-0	Thorium 232	1.22 +/- 0.25		0.44	
SU5-98-SB-S-1	Thorium 234	1.01 +/- 0.43							
SU5-98-SB-S-1	Uranium 235	0.28 +/- 0.28		SU5-98-SB-S-0	Uranium 235	0.2 +/- 0.26		0.21	
SU5-98-SB-S-1	Uranium 238	1.01 +/- 0.43		SU5-98-SB-S-0	Uranium 238	1.02 +/- 0.45		0.02	
SU5-99-SS-S-1	Actinium 228	1.16 +/- 0.29							
SU5-99-SS-S-1	Bismuth 214	1.46 +/- 0.3		SU5-99-SS-S-0	Bismuth 214	1.46 +/- 0.28		0.00	
SU5-99-SS-S-1	Cesium 137	0.138 +/- 0.073							
SU5-99-SS-S-1	Lead 212	1.19 +/- 0.23		SU5-99-SS-S-0	Lead 212	1.12 +/- 0.22		0.22	
SU5-99-SS-S-1	Lead 214	1.65 +/- 0.26		SU5-99-SS-S-0	Lead 214	1.55 +/- 0.26		0.27	
SU5-99-SS-S-1	Potassium 40	21.5 +/- 3.8		SU5-99-SS-S-0	Potassium 40	19.2 +/- 3.5		0.45	
SU5-99-SS-S-1	Radium (226)	1.46 +/- 0.3		SU5-99-SS-S-0	Radium (226)	1.46 +/- 0.28		0.00	
SU5-99-SS-S-1	Thallium 208	0.29 +/- 0.1		SU5-99-SS-S-0	Thallium 208	0.46 +/- 0.12		1.09	
SU5-99-SS-S-1	Thorium 232	1.16 +/- 0.29		SU5-99-SS-S-0	Thorium 232	0.96 +/- 0.48		0.36	
SU5-99-SS-S-1	Uranium 235	0.18 +/- 0.33		SU5-99-SS-S-0	Uranium 235	0.07 +/- 0.31		0.24	
SU5-99-SS-S-1	Uranium 238	1.4 +/- 1.2		SU5-99-SS-S-0	Uranium 238	1.3 +/- 1.2		0.06	
SU5-99-SB-S-1	Actinium 228	1.29 +/- 0.3		SU5-99-SB-S-0	Actinium 228	1.18 +/- 0.29		0.26	
SU5-99-SB-S-1	Bismuth 214	1.71 +/- 0.31							
SU5-99-SB-S-1	Lead 212	1.28 +/- 0.22		SU5-99-SB-S-0	Bismuth 212	1.3 +/- 0.51		0.04	
SU5-99-SB-S-1	Lead 214	1.93 +/- 0.27		SU5-99-SB-S-0	Bismuth 214	1.42 +/- 0.27		1.34	
				SU5-99-SB-S-0	Lead 212	1.06 +/- 0.2			
				SU5-99-SB-S-0	Lead 214	1.68 +/- 0.26			
SU5-99-SB-S-1	Potassium 40	17.8 +/- 3.2		SU5-99-SB-S-0	Potassium 40	20.8 +/- 3.6		0.62	
SU5-99-SB-S-1	Radium (226)	1.71 +/- 0.31		SU5-99-SB-S-0	Radium (226)	1.42 +/- 0.27		0.71	
SU5-99-SB-S-1	Thallium 208	0.45 +/- 0.12		SU5-99-SB-S-0	Thallium 208	0.42 +/- 0.11		0.18	
SU5-99-SB-S-1	Thorium 232	1.29 +/- 0.3		SU5-99-SB-S-0	Thorium 232	1.18 +/- 0.29		0.26	
SU5-99-SB-S-1	Uranium 235	0.001 +/- 0.33		SU5-99-SB-S-0	Uranium 235	0.11 +/- 0.32		0.24	
SU5-99-SB-S-1	Uranium 238	0.5 +/- 1.1		SU5-99-SB-S-0	Uranium 238	1.2 +/- 1.1		0.45	
SU5-102-SS-S-1	Actinium 228	1.1 +/- 0.25		SU5-102-SS-S-0	Actinium 228	0.92 +/- 0.29		0.47	
SU5-102-SS-S-1	Bismuth 214	1.4 +/- 0.25		SU5-102-SS-S-0	Bismuth 214	1.47 +/- 0.3		0.18	
SU5-102-SS-S-1	Cesium 137	0.245 +/- 0.085		SU5-102-SS-S-0	Cesium 137	0.198 +/- 0.08		0.40	
SU5-102-SS-S-1	Lead 212	1.17 +/- 0.2		SU5-102-SS-S-0	Lead 212	1.08 +/- 0.21		0.31	
SU5-102-SS-S-1	Lead 214	1.42 +/- 0.21		SU5-102-SS-S-0	Lead 214	1.58 +/- 0.26		0.48	
SU5-102-SS-S-1	Potassium 40	22.4 +/- 3.6		SU5-102-SS-S-0	Potassium 40	19.2 +/- 3.4		0.65	
SU5-102-SS-S-1	Radium (226)	1.4 +/- 0.25		SU5-102-SS-S-0	Radium (226)	1.47 +/- 0.3		0.18	
SU5-102-SS-S-1	Thallium 208	0.34 +/- 0.098		SU5-102-SS-S-0	Thallium 208	0.37 +/- 0.11		0.20	
SU5-102-SS-S-1	Thorium 232	1.1 +/- 0.25		SU5-102-SS-S-0	Thorium 232	0.92 +/- 0.29		0.47	
SU5-102-SS-S-1	Uranium 235	-0.06 +/- 0.24		SU5-102-SS-S-0	Uranium 235	0.15 +/- 0.32		0.53	
SU5-102-SS-S-1	Uranium 238	2.8 +/- 1		SU5-102-SS-S-0	Uranium 238	1.2 +/- 1.1		1.08	
SU5-102-SB-S-1	Actinium 228	1.05 +/- 0.24		SU5-102-SB-S-0	Actinium 228	1.2 +/- 0.32		0.38	
SU5-102-SB-S-1	Bismuth 214	1.24 +/- 0.25		SU5-102-SB-S-0	Bismuth 214	1.57 +/- 0.3		0.85	
SU5-102-SB-S-1	Lead 212	0.91 +/- 0.18		SU5-102-SB-S-0	Lead 212	1.13 +/- 0.21		0.80	
SU5-102-SB-S-1	Lead 214	1.29 +/- 0.22		SU5-102-SB-S-0	Lead 214	1.54 +/- 0.24		0.77	
SU5-102-SB-S-1	Potassium 40	17.8 +/- 3.2		SU5-102-SB-S-0	Potassium 40	22.2 +/- 3.7		0.90	

New Haven Project Duplicate data analysis.

Dup SU ¹	Dup Component	Dup Result (pCi/g)	Dup TPU ² (pCi/g)	SU ¹	Component	Result (pCi/g)	TPU ² (pCi/g)	NAD ³ = 1.96	>NAD ³ ?
SU5-102-SB-S-1	Radium (226)	1.24 +/- 0.25		SU5-102-SB-S-0	Radium (226)	1.57 +/- 0.3		0.85	
SU5-102-SB-S-1	Thallium 208	0.42 +/- 0.11		SU5-102-SB-S-0	Thallium 208	0.317 +/- 0.094		0.71	
SU5-102-SB-S-1	Thorium 232	1.05 +/- 0.24		SU5-102-SB-S-0	Thorium 232	1.2 +/- 0.32		0.38	
SU5-102-SB-S-1	Uranium 235	0.03 +/- 0.3		SU5-102-SB-S-0	Uranium 235	0.11 +/- 0.32		0.18	
SU5-102-SB-S-1	Uranium 238	0.4 +/- 1		SU5-102-SB-S-0	Uranium 238	1 +/- 1.1		0.40	
SU5-115-SS-S-1	Actinium 228	1.51 +/- 0.55		SU5-115-SS-S-0	Actinium 228	1 +/- 0.22		0.86	
				SU5-115-SS-S-0	Bismuth 212	0.93	0.44		
SU5-115-SS-S-1	Bismuth 214	1.37 +/- 0.26		SU5-115-SS-S-0	Bismuth 214	1.27 +/- 0.24		0.28	
SU5-115-SS-S-1	Cesium 137	0.213 +/- 0.075		SU5-115-SS-S-0	Cesium 137	0.199 +/- 0.07		0.14	
SU5-115-SS-S-1	Lead 212	0.97 +/- 0.19		SU5-115-SS-S-0	Lead 212	1.19 +/- 0.2		0.80	
SU5-115-SS-S-1	Lead 214	1.6 +/- 0.25		SU5-115-SS-S-0	Lead 214	1.7 +/- 0.24		0.29	
SU5-115-SS-S-1	Potassium 40	23 +/- 3.8		SU5-115-SS-S-0	Potassium 40	21.2 +/- 3.4		0.35	
SU5-115-SS-S-1	Radium (226)	1.37 +/- 0.26		SU5-115-SS-S-0	Radium (226)	1.27 +/- 0.24		0.28	
SU5-115-SS-S-1	Thallium 208	0.38 +/- 0.11		SU5-115-SS-S-0	Thallium 208	0.39 +/- 0.1		0.07	
SU5-115-SS-S-1	Thorium 232	1.51 +/- 0.55		SU5-115-SS-S-0	Thorium 232	1 +/- 0.22		0.86	
				SU5-115-SS-S-0	Thorium 234	0.98 +/- 0.41			
SU5-115-SS-S-1	Uranium 235	0.02 +/- 0.31		SU5-115-SS-S-0	Uranium 235	0.12 +/- 0.26		0.25	
SU5-115-SS-S-1	Uranium 238	1.3 +/- 1.1		SU5-115-SS-S-0	Uranium 238	0.98 +/- 0.41		0.27	
SU5-116-SS-S-1	Actinium 228	1.13 +/- 0.25		SU5-116-SS-S-0	Actinium 228	1.1 +/- 0.26		0.08	
SU5-116-SS-S-1	Bismuth 214	1.53 +/- 0.27		SU5-116-SS-S-0	Bismuth 214	1.73 +/- 0.29		0.50	
SU5-116-SS-S-1	Cesium 137	0.175 +/- 0.077		SU5-116-SS-S-0	Cesium 137	0.104 +/- 0.065		0.70	
SU5-116-SS-S-1	Lead 212	1.23 +/- 0.21		SU5-116-SS-S-0	Lead 212	1.16 +/- 0.2		0.24	
SU5-116-SS-S-1	Lead 214	1.65 +/- 0.25		SU5-116-SS-S-0	Lead 214	1.76 +/- 0.26		0.30	
SU5-116-SS-S-1	Potassium 40	22.7 +/- 3.7		SU5-116-SS-S-0	Potassium 40	22.6 +/- 3.6		0.02	
SU5-116-SS-S-1	Radium (226)	1.53 +/- 0.27		SU5-116-SS-S-0	Radium (226)	1.73 +/- 0.29		0.50	
SU5-116-SS-S-1	Thallium 208	0.342 +/- 0.098		SU5-116-SS-S-0	Thallium 208	0.39 +/- 0.1		0.34	
SU5-116-SS-S-1	Thorium 232	1.13 +/- 0.25		SU5-116-SS-S-0	Thorium 232	1.1 +/- 0.26		0.08	
SU5-116-SS-S-1	Thorium 234	1.49 +/- 0.48							
SU5-116-SS-S-1	Uranium 235	0.03 +/- 0.26		SU5-116-SS-S-0	Uranium 235	0.15 +/- 0.25		0.33	
SU5-116-SS-S-1	Uranium 238	1.49 +/- 0.48		SU5-116-SS-S-0	Uranium 238	1.19 +/- 0.96		0.28	

NOTES:

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| <p>Sample Locations are in the format SU#-WW-XX-Y-Z, where SU = Survey Unit #, WW = Location, XX = SS or SB (Surface Soil or Subsurface Soil), Y = S or B (Systematic or Bias), and Z = 0 or 1 (Normal or Duplicate Sample)</p> <p>1) (Surface Soil or Subsurface Soil), Y = S or B (Systematic or Bias), and Z = 0 or 1 (Normal or Duplicate Sample)</p> <p>2) TPU = Total Propagated Uncertainty</p> <p>3) NAD = Normalized Absolute Difference</p> |
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