

## ISO-7503 EFFICIENCY ( $\epsilon$ ) WORKSHEET (Rev. 0)

### INSTRUMENT/TECHNICIAN DETAILS

Instrument		Detector	2pi efficiency data	
Make	Ludlum	Ludlum	Technician (First, Last)	A. Craig
Model	2360	43-37	Validation (First, Last)	N. Berliner
Unique ID#	145481	PR178371	2 Pi Test Date, YYYY-MM-DD	2016-06-13
Cal. Due, YYYY-MM-DD	2017-05-17			
t <sub>b</sub> - Bkgd. Count Time, min	1.0			
Bkgd. Total Counts (beta)	274.1			
Detector Active Area, cm <sup>2</sup>	582			
Window Areal Density, mg/cm <sup>2</sup>	0.8		Test Site	UNC

### SOURCE DETAILS

Source	Th-230	H-3	C-14	Tc-99	Cl-36	SrY-90
Emission Type	$\alpha$	$\beta^-$	$\beta^-$	$\beta^-$	$\beta^-$	$\beta^-$
Unique ID#	AC-2446	OR-256	AC-2447	AC-2448	AC-2449	AC-2450
Cert. Date, YYYY-MM-DD	2013-07-25	2006-11-01	2013-04-25	2013-04-25	2013-04-25	2013-05-22
Source Active Area, cm <sup>2</sup>	150	100	150	150	150	150
Radioactive Half-life, yrs	75380	12.3	5700	211100	301000	28.8
Cert. Surface Emission Rate (SER), sec <sup>-1</sup>	1080	1110	1260	1830	2480	4500
Decay Corrected (SER), sec <sup>-1</sup>	1080	646	1260	1830	2480	4180
Mean Emission Energy, keV	4667	5.7	49	85	252	565
End-Point Emission Energy, keV	4684	18.6	156	294	710	2280
$\epsilon_s$ - Source Efficiency	0.25	0.25	0.25	0.25	0.50	0.50
t <sub>s</sub> - Source Count Time, min	5	1	1	1	1	1

### TEST DATA (enter gross counts - target >30000, required >10000 counts)

Contact	70,550			28,578	30,297	48,481
+1 cm	1,412			21,227	24,105	37,303
+2 cm	21			15,709	18,644	26,356

### INSTRUMENT EFFICIENCY ( $\epsilon_i$ )

Contact	0.218			0.258	0.202	0.192
+1 cm	0.004			0.191	0.160	0.148
+2 cm	0.000			0.141	0.123	0.104

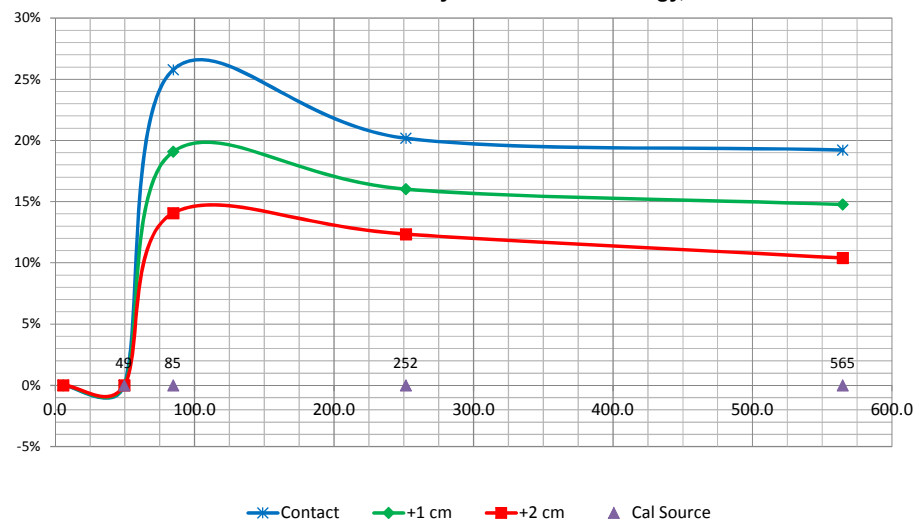
### TOTAL EFFICIENCY ( $\epsilon_t$ )

Contact	0.054			0.064	0.101	0.096
+1 cm	0.0011			0.048	0.080	0.074
+2 cm	0.000			0.035	0.062	0.052

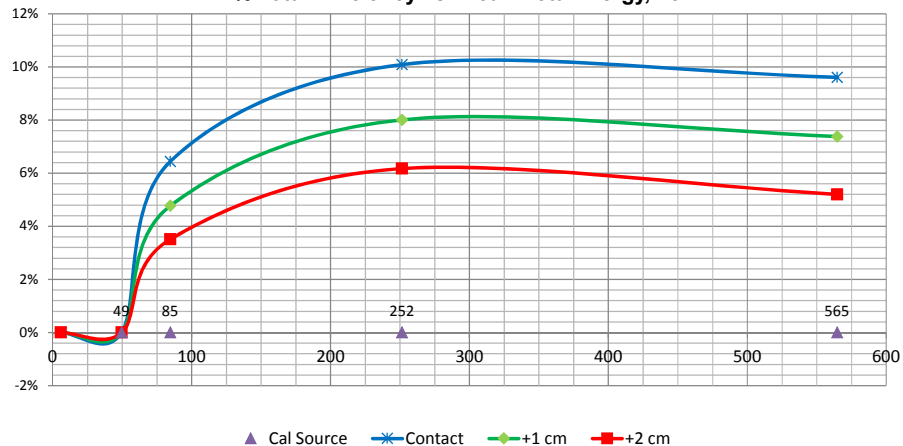
## ISO-7503 EFFICIENCY ( $\epsilon$ ) WORKSHEET

### EFFICIENCY PLOTS

% Instrument Efficiency vs. Mean Beta Energy, keV



% Total Efficiency vs. Mean Beta Energy, keV



## ISO-7503 EFFICIENCY ( $\epsilon$ ) WORKSHEET (Rev. 0)

### INSTRUMENT/TECHNICIAN DETAILS

Instrument		Detector	2pi efficiency data	
Make	Ludlum	Ludlum	Technician (First, Last)	A. Craig
Model	2360	43-93		
Unique ID#	184913	PR199839	Validation (First, Last)	N. Berliner
Cal. Due, YYYY-MM-DD	2017-06-09		2 Pi Test Date, YYYY-MM-DD	2016-06-13
t <sub>b</sub> - Bkgd. Count Time, min	1.0			
Bkgd. Total Counts (beta)	99.4			
Detector Active Area, cm <sup>2</sup>		100	Test Site	UNC
Window Areal Density, mg/cm <sup>2</sup>		1.2		

### SOURCE DETAILS

Source	Th-230	H-3	C-14	Tc-99	Cl-36	SrY-90
Emission Type	$\alpha$	$\beta^-$	$\beta^-$	$\beta^-$	$\beta^-$	$\beta^-$
Unique ID#	AC-2446	OR-256	AC-2447	AC-2448	AC-2449	AC-2450
Cert. Date, YYYY-MM-DD	2013-07-25	2006-11-01	2013-04-25	2013-04-25	2013-04-25	2013-05-22
Source Active Area, cm <sup>2</sup>	150	100	150	150	150	150
Radioactive Half-life, yrs	75380	12.3	5700	211100	301000	28.8
Cert. Surface Emission Rate (SER), sec <sup>-1</sup>	1080	1110	1260	1830	2480	4500
Decay Corrected (SER), sec <sup>-1</sup>	1080	646	1260	1830	2480	4180
Mean Emission Energy, keV	4667	5.7	49	85	252	565
End-Point Emission Energy, keV	4684	18.6	156	294	710	2280
$\epsilon_s$ - Source Efficiency	0.25	0.25	0.25	0.25	0.50	0.50
t <sub>s</sub> - Source Count Time, min	1	1	1	1	1	1

### TEST DATA (enter gross counts - target >30000, required >10000 counts)

Contact	17,509			17,351	39,928	64,924
+1 cm	4,050			13,927	34,385	54,677
+2 cm	37			11,060	28,133	43,949

### INSTRUMENT EFFICIENCY ( $\epsilon_i$ )

Contact	0.405			0.236	0.402	0.388
+1 cm	0.094			0.189	0.346	0.326
+2 cm	0.001			0.150	0.283	0.262

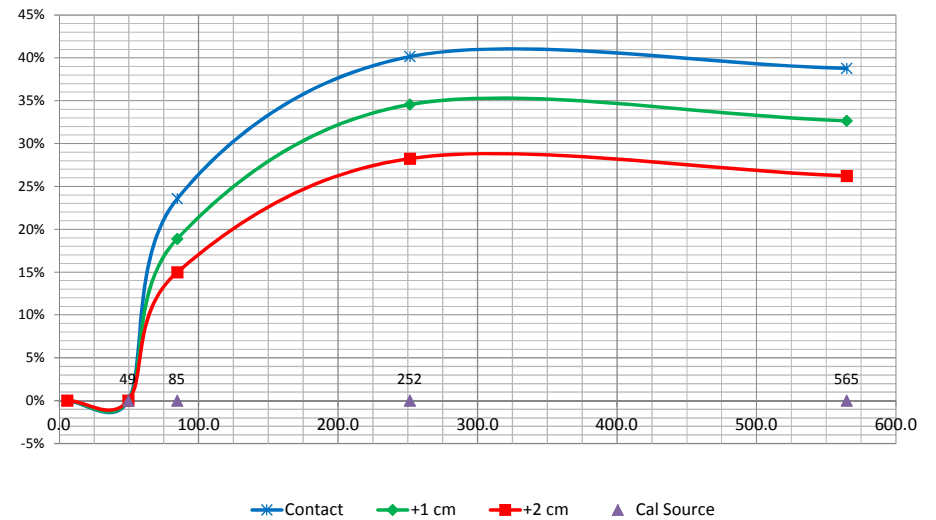
### TOTAL EFFICIENCY ( $\epsilon_t$ )

Contact	0.101			0.059	0.201	0.194
+1 cm	0.023			0.047	0.173	0.163
+2 cm	0.000			0.037	0.141	0.131

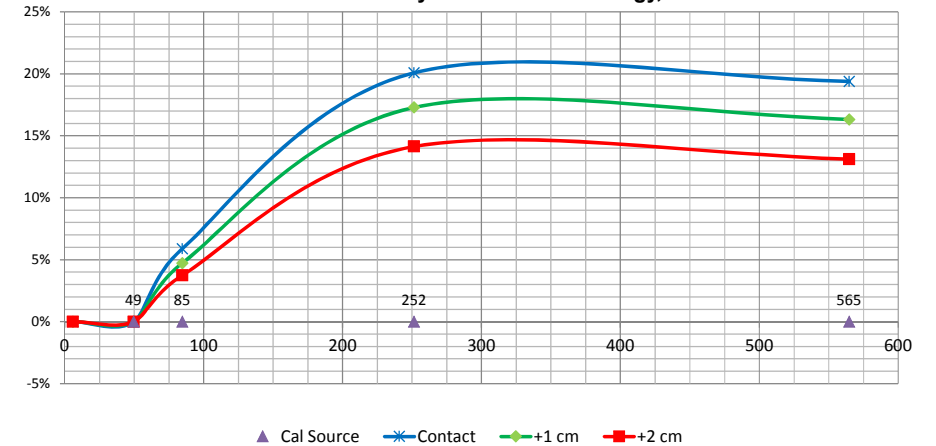
## ISO-7503 EFFICIENCY ( $\epsilon$ ) WORKSHEET

### EFFICIENCY PLOTS

% Instrument Efficiency vs. Mean Beta Energy, keV



% Total Efficiency vs. Mean Beta Energy, keV



## ISO-7503 EFFICIENCY ( $\epsilon$ ) WORKSHEET (Rev. 0)

### INSTRUMENT/TECHNICIAN DETAILS

Instrument		Detector	2pi efficiency data	
Make	Ludlum	Ludlum	Technician (First, Last)	M. Plonski
Model	2224-1	43-93	Validation (First, Last)	
Unique ID#	227246	PR244549	2 Pi Test Date, YYYY-MM-DD	2016-01-22
Cal. Due, YYYY-MM-DD	2016-12-15			
$t_b$ - Bkgd. Count Time, min	1.0			
Bkgd. Total Counts (beta)	117.0			
Detector Active Area, cm <sup>2</sup>	100			
Window Areal Density, mg/cm <sup>2</sup>	1.2		Test Site	EHO

### SOURCE DETAILS

Source	Th-230	H-3	C-14	Tc-99	Cl-36	SrY-90
Emission Type	$\alpha$	$\beta^-$	$\beta^-$	$\beta^-$	$\beta^-$	$\beta^-$
Unique ID#	AC-2446	OR-256	AC-2447	AC-2448	AC-2449	AC-2450
Cert. Date, YYYY-MM-DD	2013-07-25	2006-11-01	2013-04-25	2013-04-25	2013-04-25	2013-05-22
Source Active Area, cm <sup>2</sup>	150	100	150	150	150	150
Radioactive Half-life, yrs	75380	12.3	5700	211100	301000	28.8
Cert. Surface Emission Rate (SER), sec <sup>-1</sup>	1080	1110	1260	1830	2480	4500
Decay Corrected (SER), sec <sup>-1</sup>	1080	660	1260	1830	2480	4220
Mean Emission Energy, keV	4667	5.7	49	85	252	565
End-Point Emission Energy, keV	4684	18.6	156	294	710	2280
$\epsilon_s$ - Source Efficiency	0.25	0.25	0.25	0.25	0.50	0.50
$t_s$ - Source Count Time, min	5	5	5	2	0.5	0.5

### TEST DATA (enter gross counts - target >30000, required >10000 counts)

Contact	81,826		16,917	38,228	21,480	36,623
+1 cm	20,378		11,549	32,019	18,734	30,999
+2 cm	140		7,609	25,055	15,513	25,147

### INSTRUMENT EFFICIENCY ( $\epsilon_i$ )

Contact	0.379		0.065	0.260	0.432	0.433
+1 cm	0.094		0.044	0.217	0.377	0.367
+2 cm	0.001		0.028	0.170	0.312	0.297

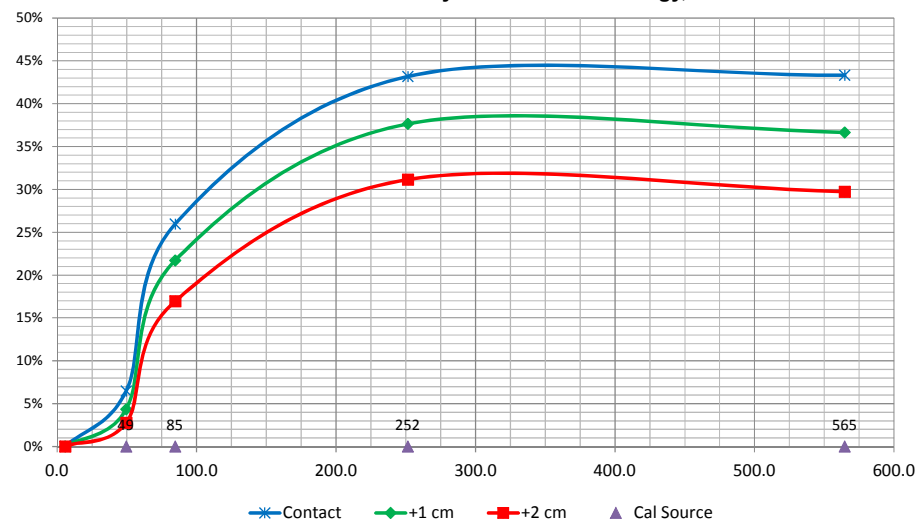
### TOTAL EFFICIENCY ( $\epsilon_t$ )

Contact	0.095		0.016	0.065	0.216	0.217
+1 cm	0.024		0.011	0.054	0.188	0.183
+2 cm	0.000		0.007	0.042	0.156	0.149

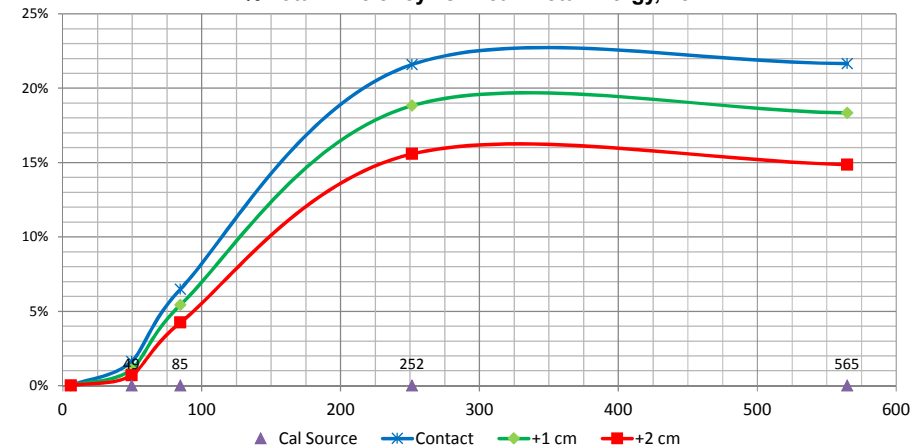
## ISO-7503 EFFICIENCY ( $\epsilon$ ) WORKSHEET

### EFFICIENCY PLOTS

% Instrument Efficiency vs. Mean Beta Energy, keV



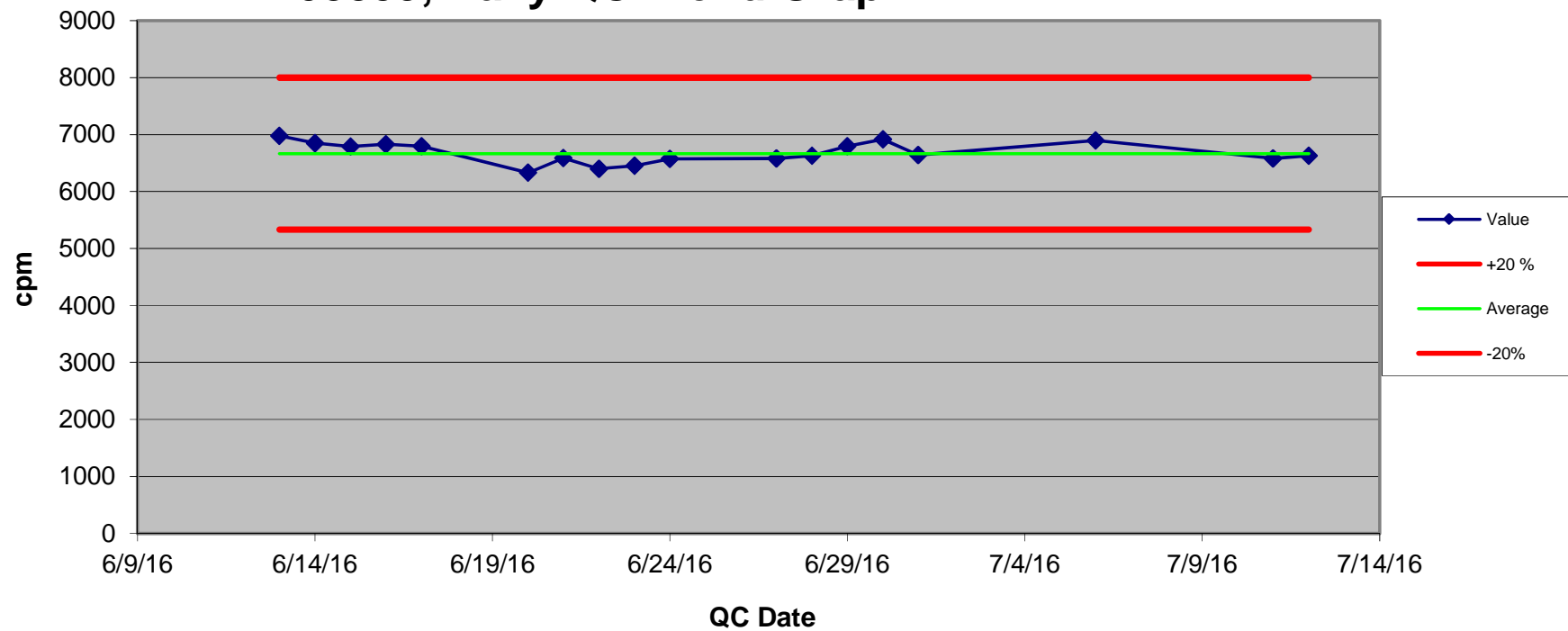
% Total Efficiency vs. Mean Beta Energy, keV



2221 #108859		
QC Daily Source		
Date	Result (cpm)	P/F
6/13/2016	6976	Pass
6/14/2016	6851	Pass
6/15/2016	6786	Pass
6/16/2016	6826	Pass
6/17/2016	6793	Pass
6/20/2016	6329	Pass
6/21/2016	6584	Pass
6/22/2016	6401	Pass
6/23/2016	6450	Pass
6/24/2016	6575	Pass
6/27/2016	6579	Pass
6/28/2016	6630	Pass
6/29/2016	6792	Pass
6/30/2016	6914	Pass
7/1/2016	6643	Pass
7/6/2016	6898	Pass
7/11/2016	6582	Pass
7/12/2016	6630	Pass

2221 #108859		Source Ser. #	
Initial Source Readings		Nuclide	Bkgd
Date	Result (cpm)		
6/13/2016	6322		
6/13/2016	6298		
6/13/2016	6801		
6/13/2016	6810		
6/13/2016	6944		
6/13/2016	6498		
6/13/2016	6732		
6/13/2016	6534		
6/13/2016	6852		
6/13/2016	6857		
	Average		
	6665		

## 2221 #108859, Daily QC Trend Graph



Inst.#108859		
QC Daily Source		
Date	Result (cpm)	P/F
6/13/2016	8,985	Pass
6/14/2016	8,912	Pass
6/15/2016	9,063	Pass
6/16/2016	8,965	Pass
6/17/2016	9,011	Pass
6/18/2016	8,873	Pass
6/20/2016	8,792	Pass
6/21/2016	8,789	Pass
6/22/2016	8,892	Pass
6/23/2016	8,910	Pass
6/24/2016	9,069	Pass
6/27/2016	8,972	Pass
6/28/2016	8,864	Pass
6/29/2016	9,026	Pass
6/30/2016	9,078	Pass
7/1/2016	8,867	Pass
7/6/2016	9,012	Pass
7/11/2016	8,979	Pass
7/12/2016	9,042	Pass

Inst.#108859		Source Ser. #	
Initial Source Readings		Nuclide	Co60
Date	Result (cpm)		
6/13/2016	8,974		
6/13/2016	8,964		
6/13/2016	9,020		
6/13/2016	9,017		
6/13/2016	8,933		
6/13/2016	9,008		
6/13/2016	9,053		
6/13/2016	9,134		
6/13/2016	9,015		
6/13/2016	9,130		
	Average		
	9025		

# CABRERA ALPHA-BETA COUNTING INSTRUMENT (Rev 6)

Counting Instrument:			Ludlum 2929		Detector:		Ludlum 43-10-1		Calibration Date:		5/16/2016								
Serial #:			157320		Serial #:		PR157821		12 month calibration:		OK								
Detector Active Area or Area Covered by Smear (cm <sup>2</sup> ):							100												
	Efficiency (fraction)	Source Nuclide	Source Number	Original Source Activity (DPM)	Source Creation Date	T <sub>1/2</sub> (yr)	Source Decayed Activity	Required MDA (DPM/100cm <sup>2</sup> )	Control Chart & Daily Bkg Count Time	Control Chart & Daily Source- Sample Count Time	Control Chart bkg Average α/β cpm	Control Chart bkg 1 sigma, cpm	Control Chart Source-bkg Average α/β cpm	Control Chart source 1 sigma, cpm					
Alpha	0.3521	Th-230	4098-03	12,800		7.54E+04	12,786	1,000	5	1	0.28	0.21	4084.2	152.85					
Beta	0.1797	Tc-99	4099-03	17,700		2.11E+05	17,693	1,000	5	1	32.72	3.53	2539.6	61.19					
Date	Daily Bkg Counts		Daily Check Source Counts		Daily Bkg Rate (cpm)		Net Daily Source Rate (cpm)		Bkg QC Pass/Fail		Source QC Pass/Fail		MDA α (dpm)	MDA β (dpm)	α MDA OK?	β MDA OK?	H.P. Technician	Technician Initials	
	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta							
6/13/2016	3	166	3,861	2,614	0.6	33.2	3860.4	2580.8	PASS	PASS	PASS	PASS	16.45	132	Yes	Yes	A. Craig	AC	
6/14/2016	2	148	4,134	2,559	0.4	29.6	4133.6	2529.4	PASS	PASS	PASS	PASS	14.99	126	Yes	Yes	A. Craig	AC	
6/15/2016	1	145	4,086	2,625	0.2	29.0	4085.8	2596.0	PASS	PASS	PASS	PASS	13.10	125	Yes	Yes	A. Craig	AC	
6/16/2016	1	135	4,070	2,520	0.2	27.0	4069.8	2493.0	PASS	PASS	PASS	PASS	13.10	121	Yes	Yes	A. Craig	AC	
6/17/2016	2	149	4,213	2,555	0.4	29.8	4212.6	2525.2	PASS	PASS	PASS	PASS	14.99	126	Yes	Yes	A. Craig	AC	
6/20/2016	2	139	4,196	2,613	0.4	27.8	4195.6	2585.2	PASS	PASS	PASS	PASS	14.99	122	Yes	Yes	A. Craig	AC	
6/21/2016	2	157	4,177	2,540	0.4	31.4	4176.6	2508.6	PASS	PASS	PASS	PASS	14.99	129	Yes	Yes	A. Craig	AC	
6/22/2016	1	166	4,092	2,569	0.2	33.2	4091.8	2535.8	PASS	PASS	PASS	PASS	13.10	132	Yes	Yes	A. Craig	AC	
6/23/2016	2	132	4,216	2,547	0.4	26.4	4215.6	2520.6	PASS	PASS	PASS	PASS	14.99	120	Yes	Yes	A. Craig	AC	
6/24/2016	1	161	4,163	2,581	0.2	32.2	4162.8	2548.8	PASS	PASS	PASS	PASS	13.10	131	Yes	Yes	A. Craig	AC	
6/25/2016	1	146	4,192	2,480	0.2	29.2	4191.8	2450.8	PASS	PASS	PASS	PASS	13.10	125	Yes	Yes	N. Berliner	NMB	
6/27/2016	1	140	4,219	2,536	0.2	28.0	4218.8	2508.0	PASS	PASS	PASS	PASS	13.10	123	Yes	Yes	A. Craig	AC	
6/28/2016	1	153	4,292	2,547	0.2	30.6	4291.8	2516.4	PASS	PASS	PASS	PASS	13.10	128	Yes	Yes	A. Craig	AC	
6/29/2016	0	157	4,101	2,621	0.0	31.4	4101.0	2589.6	PASS	PASS	PASS	PASS	8.52	129	Yes	Yes	A. Craig	AC	
6/30/2016	3	145	4,236	2,567	0.6	29.0	4235.4	2538.0	PASS	PASS	PASS	PASS	16.45	125	Yes	Yes	A. Craig	AC	
7/1/2016	0	137	4,144	2,640	0.0	27.4	4144.0	2612.6	PASS	PASS	PASS	PASS	8.52	122	Yes	Yes	A. Craig	AC	
7/5/2016	3	145	4,186	2,615	0.6	29.0	4185.4	2586.0	PASS	PASS	PASS	PASS	16.45	125	Yes	Yes	A. Craig	AC	
7/6/2016	1	153	4,058	2,610	0.2	30.6	4057.8	2579.4	PASS	PASS	PASS	PASS	13.10	128	Yes	Yes	A. Craig	AC	
7/7/2016	0	167	4,216	2,572	0.0	33.4	4216.0	2538.6	PASS	PASS	PASS	PASS	8.52	133	Yes	Yes	A. Craig	AC	
7/8/2016	1	134	4,183	2,632	0.2	26.8	4182.8	2605.2	PASS	PASS	PASS	PASS	13.10	121	Yes	Yes	A. Craig	AC	
7/11/2016	1	141	4,218	2,579	0.2	28.2	4217.8	2550.8	PASS	PASS	PASS	PASS	13.10	123	Yes	Yes	A. Craig	AC	
7/12/2016	2	152	4,192	2,609	0.4	30.4	4191.6	2578.6	PASS	PASS	PASS	PASS	14.99	127	Yes	Yes	A. Craig	AC	
7/13/2016	0	138	4,145	2,658	0.0	27.6	4145.0	2630.4	PASS	PASS	PASS	PASS	8.52	122	Yes	Yes	A. Craig	AC	
7/14/2016	2	151	4,056	2,634	0.4	30.2	4055.6	2603.8	PASS	PASS	PASS	PASS	14.99	127	Yes	Yes	A. Craig	AC	

CABRERA ALPHA-BETA COUNTING INSTRUMENT (Rev 6)

Initial Background and Source Counts for Control Chart								
#	Initial bkg counts				Initial source plus bkg counts			
	Alpha	cpm	Beta	cpm	Alpha	cpm	Beta	cpm
1	3	1	169	34	3,994	3,994	2,639	2,639
2	1	0	157	31	4,212	4,212	2,629	2,629
3	1	0	195	39	4,326	4,326	2,562	2,562
4	2	0	166	33	3,852	3,852	2,600	2,600
5	0	0	164	33	4,020	4,020	2,488	2,488
6	0	0	143	29	4,190	4,190	2,619	2,619
7	1	0	148	30	4,161	4,161	2,518	2,518
8	1	0	143	29	4,095	4,095	2,637	2,637
9	3	1	162	32	3,862	3,862	2,491	2,491
10	2	0	189	38	4,133	4,133	2,540	2,540
Mean		0.28		32.7		4084.5		2572.3
S <sub>(n-1)</sub>		0.21		3.53		152.73		60.20
-3 sigma		-0.36		22.13		3626.31		2391.71
+3 sigma		0.92		43.31		4542.69		2752.89
-2 sigma		-0.15		25.66		3779.04		2451.91
+2 sigma		0.71		39.78		4389.96		2692.69
					Mean-bkg	4084.2		2539.6
					S <sub>(n-1)</sub>	152.85		61.19
				Mean-bkg	-3 sigma	3625.66		2356.00
				Mean-bkg	+3 sigma	4542.78		2723.16
				Mean-bkg	-2 sigma	3778.51		2417.19
				Mean-bkg	+2 sigma	4389.93		2661.97

CABRERA ALPHA-BETA COUNTING INSTRUMENT (Rev 6)

Counting Instrument:			Ludlum 2360		Detector:		Ludlum 43-37		Calibration Date:		5/17/2016								
Serial #:			145481		Serial #:		PR178371		12 month calibration:		OK								
Detector Active Area or Area Covered by Smear (cm <sup>2</sup> ):							582												
	Efficiency (fraction)	Source Nuclide	Source Number	Original Source Activity (DPM)	Source Creation Date	T <sub>1/2</sub> (yr)	Source Decayed Activity	Required MDA (DPM/100cm <sup>2</sup> )	Control Chart & Daily Bkg Count Time	Control Chart & Daily Source- Sample Count Time	Control Chart bkg Average $\alpha/\beta$ cpm	Control Chart bkg 1 sigma, cpm	Control Chart Source-bkg Average $\alpha/\beta$ cpm	Control Chart source 1 sigma, cpm					
Alpha	0.2180	Th-230	5205-04	10,200	8/21/2012	7.54E+04	10,200	5,000	1	1	2.40	1.43	1689.2	116.68					
Beta	0.2580	Tc-99	5649-06	14,300	9/24/2012	2.11E+05	14,300	5,000	1	1	274.10	18.23	2468.5	73.67					
Date	Daily Bkg Counts		Daily Check Source Counts		Daily Bkg Rate (cpm)		Net Daily Source Rate (cpm)		Bkg QC Pass/Fail		Source QC Pass/Fail		MDA $\alpha$ (dpm)	MDA $\beta$ (dpm)	$\alpha$ MDA OK?	$\beta$ MDA OK?	H.P. Technician	Technician Initials	
	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta							
6/14/2016	4	279	1,631	2,695	4.0	279.0	1627.0	2416.0	PASS	PASS	PASS	PASS	9.70	54	Yes	Yes	A. Craig	AC	
6/28/2016	3	301	1,656	2,652	3.0	301.0	1653.0	2351.0	PASS	PASS	PASS	PASS	8.72	56	Yes	Yes	A. Craig	AC	
6/29/2016	2	267	1,712	2,683	2.0	267.0	1710.0	2416.0	PASS	PASS	PASS	PASS	7.55	53	Yes	Yes	A. Craig	AC	
6/30/2016	4	309	1,724	2,697	4.0	309.0	1720.0	2388.0	PASS	PASS	PASS	PASS	9.70	56	Yes	Yes	A. Craig	AC	
7/1/2016	4	279	1,631	2,695	4.0	279.0	1627.0	2416.0	PASS	PASS	PASS	PASS	9.70	54	Yes	Yes	A. Craig	AC	
7/5/2016	1	308	1,653	2,670	1.0	308.0	1652.0	2362.0	PASS	PASS	PASS	PASS	6.03	56	Yes	Yes	A. Craig	AC	
7/6/2016	3	296	1,621	2,655	3.0	296.0	1618.0	2359.0	PASS	PASS	PASS	PASS	8.72	55	Yes	Yes	A. Craig	AC	

CABRERA ALPHA-BETA COUNTING INSTRUMENT (Rev 6)

Initial Background and Source Counts for Control Chart								
#	Initial bkg counts				Initial source plus bkg counts			
	Alpha	cpm	Beta	cpm	Alpha	cpm	Beta	cpm
1	2	2	286	286	1,630	1,630	2,803	2,803
2	4	4	302	302	1,674	1,674	2,754	2,754
3	4	4	259	259	1,628	1,628	2,690	2,690
4	2	2	256	256	1,480	1,480	2,711	2,711
5	1	1	281	281	1,571	1,571	2,760	2,760
6	3	3	273	273	1,787	1,787	2,746	2,746
7	3	3	246	246	1,745	1,745	2,793	2,793
8	0	0	276	276	1,867	1,867	2,847	2,847
9	4	4	298	298	1,751	1,751	2,756	2,756
10	1	1	264	264	1,783	1,783	2,566	2,566
Mean		2.40		274.1		1691.6		2742.6
S <sub>(n-1)</sub>		1.43		18.23		116.46		76.50
-3 sigma		-1.89		219.41		1342.22		2513.11
+3 sigma		6.69		328.79		2040.98		2972.09
-2 sigma		-0.46		237.64		1458.68		2589.61
+2 sigma		5.26		310.56		1924.52		2895.59
					Mean-bkg	1689.2		2468.5
					S <sub>(n-1)</sub>	116.68		73.67
				Mean-bkg	-3 sigma	1339.17		2247.49
				Mean-bkg	+3 sigma	2039.23		2689.51
				Mean-bkg	-2 sigma	1455.85		2321.16
				Mean-bkg	+2 sigma	1922.55		2615.84

CABRERA ALPHA-BETA COUNTING INSTRUMENT (Rev 6)

Counting Instrument:			Ludlum 2360		Detector:		Ludlum 43-93		Calibration Date:		6/9/2016								
Serial #:			184913		Serial #:		PR199839		12 month calibration:		OK								
Detector Active Area or Area Covered by Smear (cm <sup>2</sup> ):							100												
	Efficiency (fraction)	Source Nuclide	Source Number	Original Source Activity (DPM)	Source Creation Date	T <sub>1/2</sub> (yr)	Source Decayed Activity	Required MDA (DPM/100cm <sup>2</sup> )	Control Chart & Daily Bkg Count Time	Control Chart & Daily Source- Sample Count Time	Control Chart bkg Average $\alpha/\beta$ cpm	Control Chart bkg 1 sigma, cpm	Control Chart Source-bkg Average $\alpha/\beta$ cpm	Control Chart source 1 sigma, cpm					
Alpha	0.1013	Th-230	4098-03	12,800		7.54E+04	12,786	5,000	1	1	0.80	1.03	2453.7	84.47					
Beta	0.0589	Tc-99	4099-03	17,700		2.11E+05	17,693	5,000	1	1	99.40	9.75	1781.7	41.14					
Date	Daily Bkg Counts		Daily Check Source Counts		Daily Bkg Rate (cpm)		Net Daily Source Rate (cpm)		Bkg QC Pass/Fail		Source QC Pass/Fail		MDA $\alpha$ (dpm)	MDA $\beta$ (dpm)	$\alpha$ MDA OK?	$\beta$ MDA OK?	H.P. Technician	Technician Initials	
	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta							
6/13/2016	1	97	2,370	1,904	1.0	97.0	2369.0	1807.0	PASS	PASS	PASS	PASS	75.52	829	Yes	Yes	A. Craig	AC	
6/14/2016	1	116	2,373	1,824	1.0	116.0	2372.0	1708.0	PASS	PASS	PASS	PASS	75.52	901	Yes	Yes	A. Craig	AC	
6/15/2016	0	112	2,492	1,886	0.0	112.0	2492.0	1774.0	PASS	PASS	PASS	PASS	29.61	887	Yes	Yes	A. Craig	AC	
6/16/2016	2	109	2,403	1,866	2.0	109.0	2401.0	1757.0	PASS	PASS	PASS	PASS	94.54	875	Yes	Yes	A. Craig	AC	
6/17/2016	2	108	2,392	1,882	2.0	108.0	2390.0	1774.0	PASS	PASS	PASS	PASS	94.54	872	Yes	Yes	A. Craig	AC	
6/20/2016	0	102	2,379	1,891	0.0	102.0	2379.0	1789.0	PASS	PASS	PASS	PASS	29.61	848	Yes	Yes	A. Craig	AC	
6/21/2016	2	115	2,414	1,889	2.0	115.0	2412.0	1774.0	PASS	PASS	PASS	PASS	94.54	898	Yes	Yes	A. Craig	AC	
6/22/2016	1	106	2,463	1,871	1.0	106.0	2462.0	1765.0	PASS	PASS	PASS	PASS	75.52	864	Yes	Yes	A. Craig	AC	
6/23/2016	0	111	2,424	1,893	0.0	111.0	2424.0	1782.0	PASS	PASS	PASS	PASS	29.61	883	Yes	Yes	A. Craig	AC	
6/24/2016	1	114	2,396	1,828	1.0	114.0	2395.0	1714.0	PASS	PASS	PASS	PASS	75.52	894	Yes	Yes	A. Craig	AC	
6/27/2016	1	102	2,406	1,875	1.0	102.0	2405.0	1773.0	PASS	PASS	PASS	PASS	75.52	848	Yes	Yes	A. Craig	AC	
7/7/2016	1	107	2,391	1,871	1.0	107.0	2390.0	1764.0	PASS	PASS	PASS	PASS	75.52	868	Yes	Yes	A. Craig	AC	
7/8/2016	1	118	2,409	1,901	1.0	118.0	2408.0	1783.0	PASS	PASS	PASS	PASS	75.52	909	Yes	Yes	A. Craig	AC	
7/11/2016	1	107	2,466	1,887	1.0	107.0	2465.0	1780.0	PASS	PASS	PASS	PASS	75.52	868	Yes	Yes	A. Craig	AC	
7/12/2016	2	114	2,394	1,889	2.0	114.0	2392.0	1775.0	PASS	PASS	PASS	PASS	94.54	894	Yes	Yes	A. Craig	AC	
7/13/2016	2	116	2,475	1,846	2.0	116.0	2473.0	1730.0	PASS	PASS	PASS	PASS	94.54	901	Yes	Yes	A. Craig	AC	

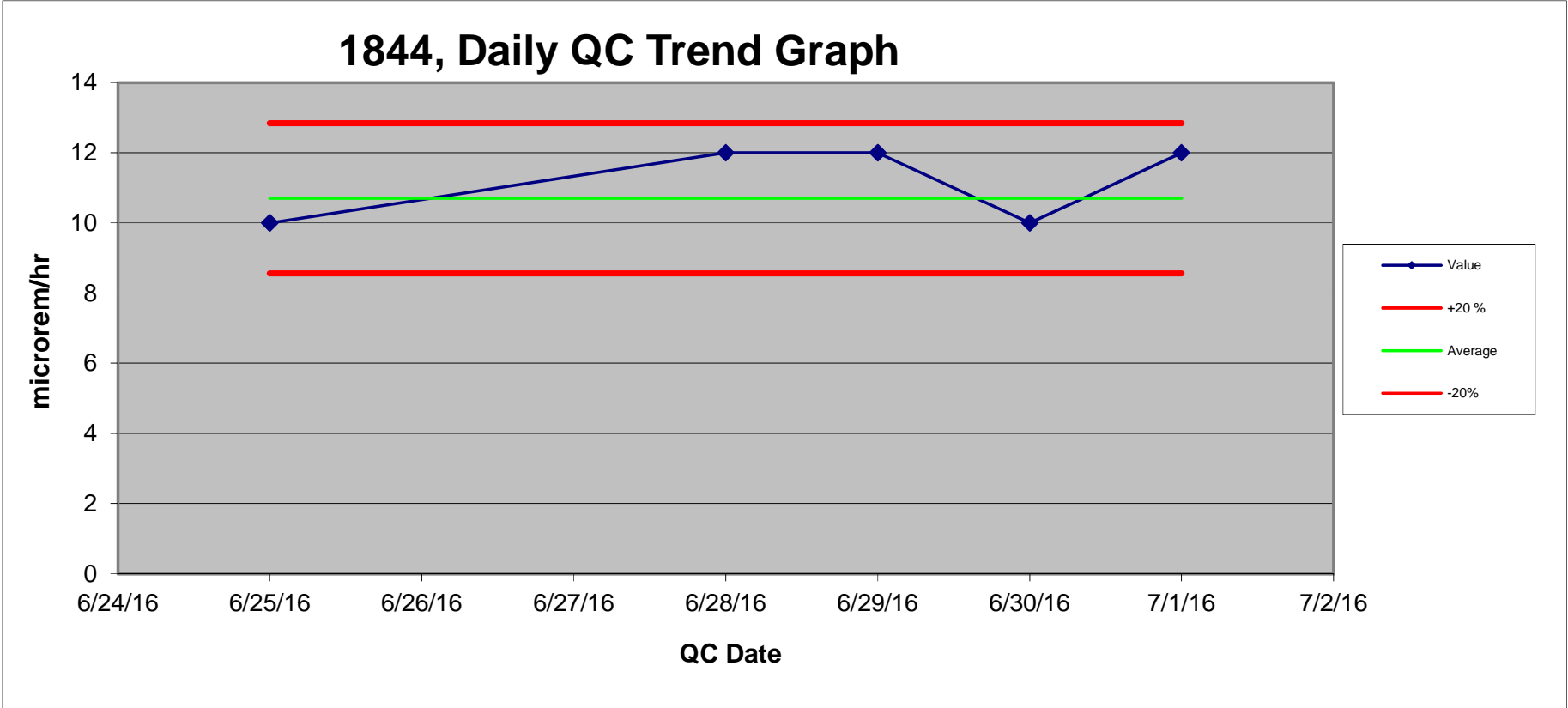
CABRERA ALPHA-BETA COUNTING INSTRUMENT (Rev 6)

Initial Background and Source Counts for Control Chart								
#	Initial bkg counts				Initial source plus bkg counts			
	Alpha	cpm	Beta	cpm	Alpha	cpm	Beta	cpm
1	1	1	105	105	2,400	2,400	1,847	1,847
2	0	0	100	100	2,555	2,555	1,892	1,892
3	3	3	116	116	2,496	2,496	1,850	1,850
4	1	1	104	104	2,572	2,572	1,880	1,880
5	0	0	91	91	2,360	2,360	1,945	1,945
6	0	0	94	94	2,421	2,421	1,878	1,878
7	2	2	80	80	2,319	2,319	1,910	1,910
8	0	0	106	106	2,494	2,494	1,912	1,912
9	1	1	101	101	2,413	2,413	1,873	1,873
10	0	0	97	97	2,515	2,515	1,824	1,824
Mean		0.80		99.4		2454.5		1881.1
S <sub>(n-1)</sub>		1.03		9.75		84.30		35.68
-3 sigma		-2.30		70.14		2201.61		1774.05
+3 sigma		3.90		128.66		2707.39		1988.15
-2 sigma		-1.27		79.89		2285.91		1809.74
+2 sigma		2.87		118.91		2623.09		1952.46
					Mean-bkg	2453.7		1781.7
					S <sub>(n-1)</sub>	84.47		41.14
				Mean-bkg	-3 sigma	2200.29		1658.28
				Mean-bkg	+3 sigma	2707.11		1905.12
				Mean-bkg	-2 sigma	2284.76		1699.42
				Mean-bkg	+2 sigma	2622.64		1863.98

1844		
QC Daily Source		
Date	Result (µrem/hr)	P/F
6/25/2016	10	Pass
6/28/2016	12	Pass
6/29/2016	12	Pass
6/30/2016	10	Pass
7/1/2016	12	Pass

1844		Source Ser. #	
Initial Source Readings		Nuclide	Bkgd
Date	Result (µrem/hr)		
6/25/2016	10		
6/25/2016	9		
6/25/2016	10		
6/25/2016	12		
6/25/2016	13		
6/25/2016	11		
6/25/2016	12		
6/25/2016	10		
6/25/2016	9		
6/25/2016	11		
	Average		
	11		

1844, Daily QC Trend Graph



1844		
QC Daily Source		
Date	Result (µrem/hr)	P/F
6/25/2016	30	Pass
6/28/2016	30	Pass
6/29/2016	40	Pass
6/30/2016	30	Pass
7/1/2016	30	Pass

1844		Source Ser. #	1182
Initial Source Readings		Nuclide	Co-60
Date	Result (µrem/hr)		
6/25/2016	30		
6/25/2016	30		
6/25/2016	40		
6/25/2016	30		
6/25/2016	40		
6/25/2016	40		
6/25/2016	30		
6/25/2016	40		
6/25/2016	40		
6/25/2016	40		
	Average		
	36		

## 1844, Daily QC Trend Graph

