

## 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

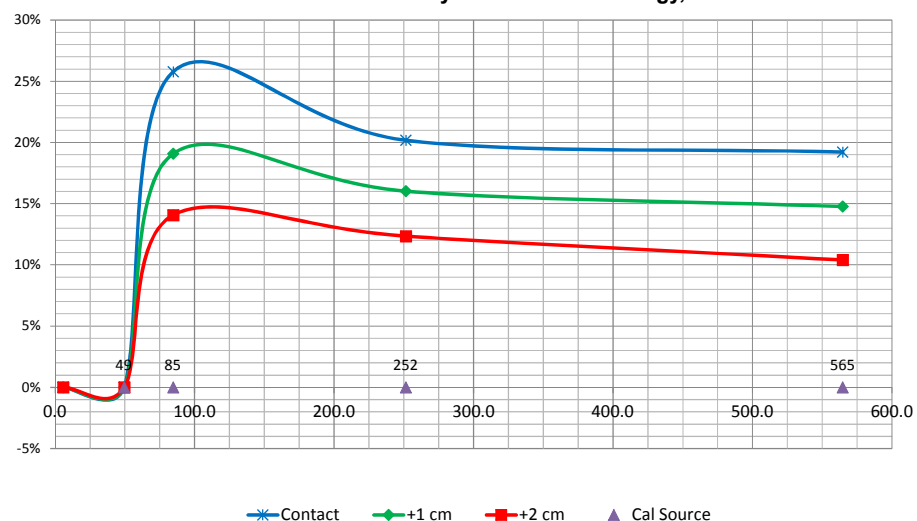
### TOTAL EFFICIENCY ( $\epsilon_t$ )

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

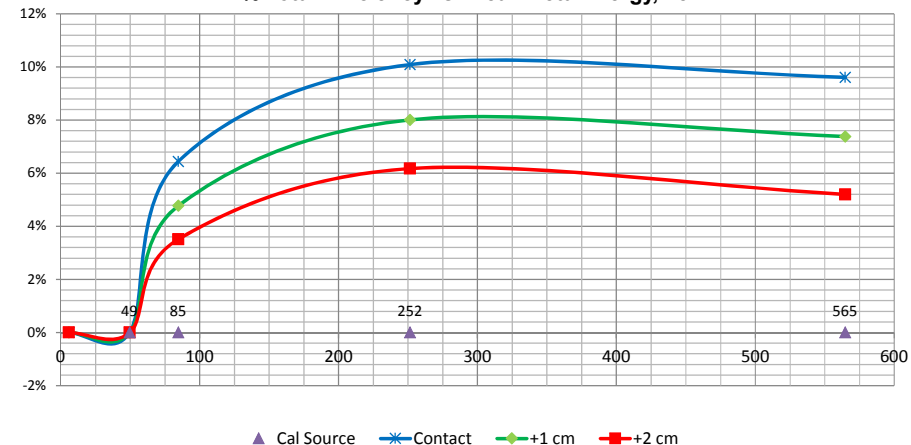
## ISO-7503 EFFICIENCY ( $\epsilon$ ) WORKSHEET

### 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

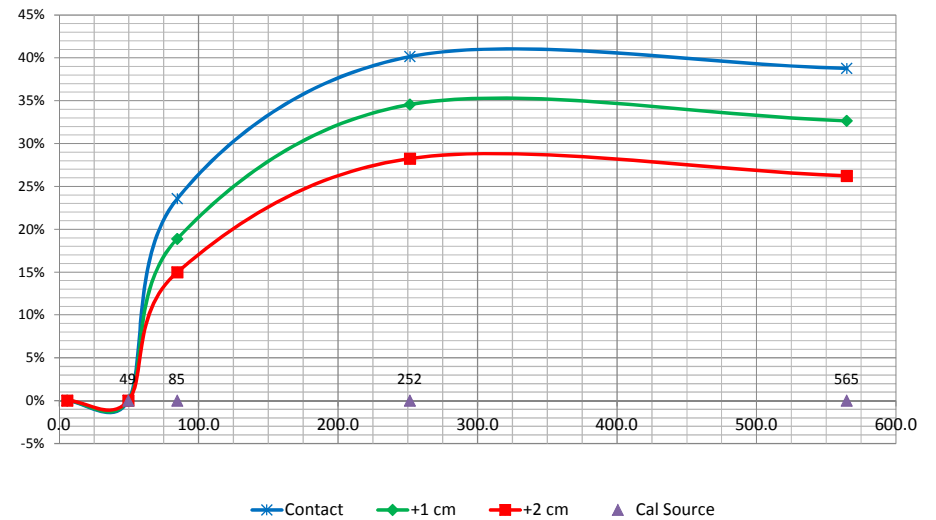
### TOTAL EFFICIENCY ( $\epsilon_t$ )

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

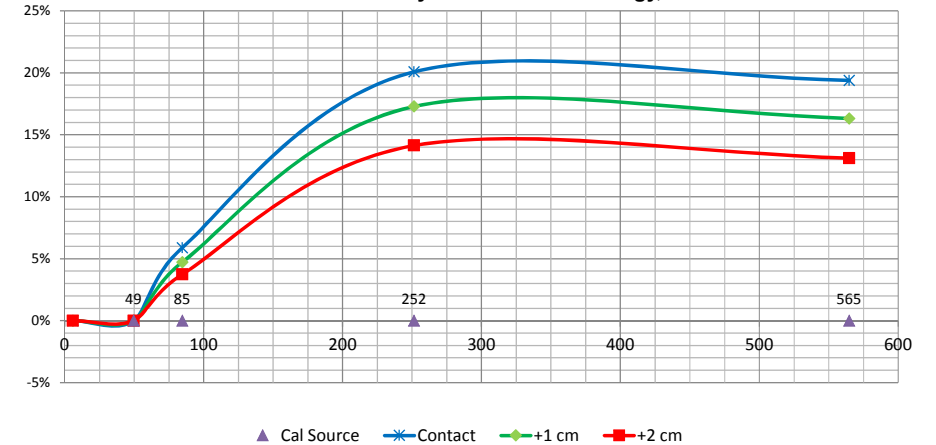
## ISO-7503 EFFICIENCY ( $\epsilon$ ) WORKSHEET

### 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

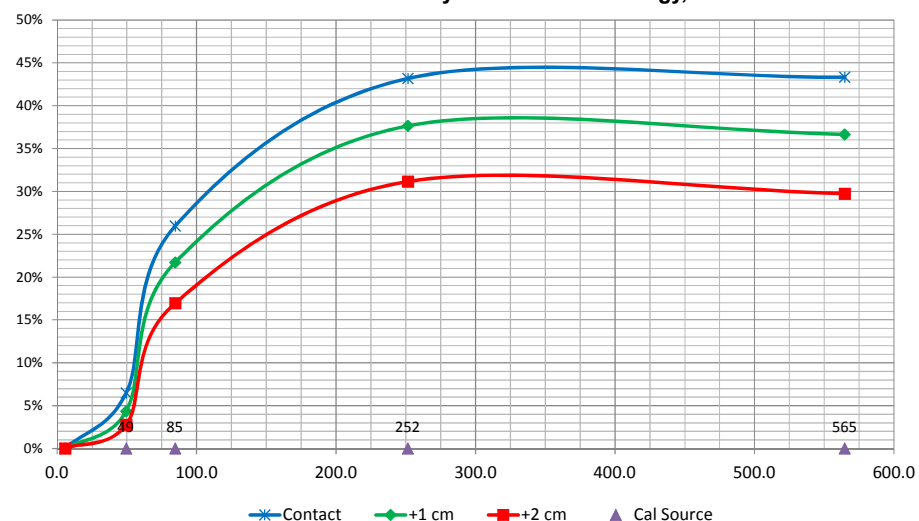
### TOTAL EFFICIENCY ( $\epsilon_t$ )

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

