



Designer and Manufacturer
of
Scientific and Industrial
Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.

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865-270-8962
Lenoir City, TN 37771, U.S.A.

CUSTOMER CABRERA SERVICES

ORDER NO. 20205600/381488

Mfg. Ludlum Measurements, Inc. Model 2224-1 Serial No. 271564
 Mfg. Ludlum Measurements, Inc. Model 43-93 Serial No. 299623
 Cal. Date 14-Aug-12 Cal Due Date 14-Aug-13 Cal. Interval 1 Year Meterface 202-848

Check mark applies to applicable instr. and/or detector IAW mfg. spec. T. 74 °F RH 39 % Alt 698.8 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 850 V Input Sens. see comments mV Det. Oper. 850 V at see comments mV Threshold Dial Ratio = mV

HV Readout (2 points) Ref./Inst. 500 / 500 V Ref./Inst. 1500 / 1004 V

COMMENTS:

Input Sens.: Alpha:120mv Beta:3.5mv Beta Window:30mv Firmware:390094 Overload set to simulate light leak.
cal'd w. 75 5' cable

Eff: Th230: sn: E121495, ACT: 19, 800dpm, Background: 2cpm, Sourcecount: 4, 296cpm, EFF: 21.68% 4π
 ACT: 10, 100cpm, Background: 2cpm, Sourcecount: 4, 296cpm, EFF: 42.51% 2π
 Tc99: sn: 5279, ACT: 28, 800dpm, Background: 289cpm, Sourcecount: 8, 153cpm, EFF: 27.30% 4π
 ACT: 18, 000cpm, Background: 289cpm, Sourcecount: 8, 153cpm, EFF: 43.68% 2π
 Sr90Y90: sn: 4016, ACT: 35, 156dpm, Background: 289cpm, Sourcecount: 13, 780cpm, 38.78% 4π
 ACT: 24, 609cpm, Background: 289cpm, Sourcecount: 13, 780cpm, 54.82% 2π
 Ni63: sn: 4017, ACT: 278, 591dpm, Background: 289cpm, Sourcecount: 2, 421cpm, EFF: 0.76% 4π
 ACT: 139, 295cpm, Background: 289cpm, Sourcecount: 2, 421cpm, EFF: 1.53% 2π

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	800k cpm	<i>N/A</i>	<u>800</u>	
x1000	200k cpm		<u>200</u>	
x100	80k cpm		<u>800</u>	
x100	20k cpm		<u>200</u>	
x10	8k cpm		<u>800</u>	
x10	2k cpm		<u>200</u>	
x1	800 cpm		<u>800</u>	
x1	200 cpm		<u>200</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*
Digital Readout	<i>N/A</i>	<u>799986</u>	Log Scale		
800kcpm		<u>7998</u>			
80kcpm		<u>8000</u>			
8kcpm		<u>800</u>			
800cpm		<u>80</u>			
80cpm					

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: 059 280 720 734 781 1131 1616 1696 5105 5717CO 5719CO
 60646 70897 73410 E551 E552 G112 M565 S-394 S-1054 T-304 T879 T10081 T10082 Y982

Alpha S/N Beta S/N Other
 m 500 S/N 130362 Oscilloscope S/N Multimeter S/N 78401031

Calibrated By: Scott S. [Signature] Date 14-Aug-12

Reviewed By: Paul H. [Signature] Date 15 Aug 12

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



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Bench Test Data For Detector

Detector 43-93 Serial No. PR299623 Order # 20205600/381488
 Customer CABRERA SERVICES Alpha Input Sensitivity 120 mV
 Counter 2224-1 Serial No. 271564 Beta Input Sensitivity 3.5 mV
 Count Time 1Minute Beta Window 30 mV
 Other H.V. Sct W-Ts 43-93 connected. Distance Source to Detector SurfFace

High Voltage	Background		Isotope <u>Th239</u> Size <u>19800cpm</u>		Isotope <u>Tc99</u> Size <u>28800cpm</u>		Isotope <u>Sr90Y90</u> Size <u>35,156cpm</u>		Isotope <u>M.63</u> Size <u>278,591cpm</u>	
	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta
<u>800</u>	<u>1</u>	<u>206</u>	<u>3337</u>	<u>581</u>	<u>6</u>	<u>6884</u>	<u>2</u>	<u>10007</u>	<u>1</u>	<u>1105</u>
<u>825</u>	<u>2</u>	<u>228</u>	<u>4066</u>	<u>677</u>	<u>7</u>	<u>7204</u>	<u>4</u>	<u>13051</u>	<u>1</u>	<u>1462</u>
<u>850</u>	<u>2</u>	<u>289</u>	<u>4246</u>	<u>1053</u>	<u>16</u>	<u>8153</u>	<u>7</u>	<u>13780</u>	<u>2</u>	<u>2421</u>
<u>875</u>	<u>3</u>	<u>315</u>	<u>4387</u>	<u>1158</u>	<u>21</u>	<u>8457</u>	<u>16</u>	<u>14819</u>	<u>2</u>	<u>3667</u>

- 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 *[Handwritten Signature]* Date 14-Aug-12