



Designer and Manufacturer  
of  
Scientific and Industrial  
Instruments

CERTIFICATE OF CALIBRATION

**LUDLUM MEASUREMENTS, INC.**  
501 Oak Street 10744 Dutchtown Road  
325-235-5494 865-392-4601  
Sweetwater, TX 79556, U.S.A. Knoxville, TN 37932, U.S.A.

CUSTOMER CABRERA SERVICES ORDER NO. 20280903/429686

Mfg. Ludlum Measurements, Inc. Model 2224-1 Serial No. 227246

Mfg. Ludlum Measurements, Inc. Model 43-93 Serial No. PR244549

Cal. Date 22-Dec-15 Cal Due Date 22-Dec-16 Cal. Interval 1 Year Meterface 202-848

Check mark  applies to applicable instr. and/or detector IAW mfg. spec. T. 74 °F RH 21 % Alt 704.0 mm Hg

- New Instrument
- Mechanical ck.
- F/S Resp. ck.
- Audio ck.
- Calibrated in accordance with LMI SOP 14.8
- Instrument Received
- Within Toler. +-10%
- Meter Zeroed
- Reset ck.
- Alarm Setting ck.
- 10-20%
- Background Subtract
- Window Operation
- Batt. ck. (Min. Volt) 2.2 VDC
- Out of Tol.
- Requiring Repair
- Input Sens. Linearity
- Geotropism
- Other-See comments
- Calibrated in accordance with LMI SOP 14.9

Instrument Volt Set 925 V Input Sens. Comments mV Det. Oper. 925 V at Comments mV Threshold Dial Ratio = mV

HV Readout (2 points) Ref./Inst. 500 / 497 V Ref./Inst. 1500 / 1510 V

**COMMENTS:**

Alpha Threshold: 120mv  
Beta Threshold: 3.5mv  
Beta Window: 30mv  
Firmware: 390094  
Overload set to simulate light leak.  
TH-230 #121495 act. 19,800cpm ct. 3,561cpm Bg0 <sup>18</sup> 20% 4Pi  
TC-99 #5279 act. 28,800dpm ct. 5,850cpm Bg149 20% 4Pi

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	800kcpm	800	800
X1000	200kcpm	200	200
X100	80kcpm	800	800
X100	20kcpm	200	200
X10	8kcpm	800	800
X10	2kcpm	200	200
X1	800cpm	800	800
X1	200cpm	200	200

\*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*
800kcpm	800452	800452			
80kcpm	80220	80220			
8kcpm	8009	8009			
800cpm	800	800			
80cpm	80	80			

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 S/N:  059  2171CP  2261CP  720  734  781  1131  1616  1696  1909  1916CP  5105  5717CO  
 5719CO  60646  70897  73410  E552  G112  M555  S-394  S-1054  T10081  T10082 Neutron Am-241 Be S/N:  T-304 Ra-226 S/N:  Y982

Alpha S/N \_\_\_\_\_  Beta S/N \_\_\_\_\_  Other \_\_\_\_\_

m 500 S/N 238275  Oscilloscope S/N \_\_\_\_\_  Multimeter S/N 70602478

Calibrated By: Duane Jackson Date 22 Dec 15

Reviewed By: [Signature] Date 30 Dec 15

AC Inst. Only	<input type="checkbox"/> Passed Dielectric (Hi-Pot) and Continuity Test
	<input type="checkbox"/> Failed:



Designer and Manufacturer  
of  
Scientific and Industrial  
Instruments

**LUDLUM MEASUREMENTS, INC.**

501 Oak Street  
325-235-5494  
Sweetwater, TX 79556, U.S.A.

10744 Dutchtown Road  
865-392-4601  
Knoxville, TN 37932, U.S.A.

*Bench Test Data For Detector*

Detector 43-93 Serial No. PR 244549 Order # 20280903/429686  
 Customer CABRERA SERVICES Alpha Input Sensitivity 120 mV  
 Counter 2224-1 Serial No. 227246 Beta Input Sensitivity 3.5 mV  
 Count Time 1Minute Beta Window 30 mV  
 Other \_\_\_\_\_ Distance Source to Detector Surface

High Voltage	Background		Isotope <u>Po-239</u> Size <u>25.2Kcpm</u>		Isotope <u>Tc-99</u> Size <u>28.8Kcpm</u>		Isotope <u>Sr90/Y90</u> Size <u>90.607Kcpm</u>	
	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta
900	0	128	4811	509	6	4886	1	25317
* 925	0	149	5260	540	4	5850	1	29398
950	0	210	5574	722	7	6657	2	32888
975	0	281	5592	970	7	7205	5	33620

- 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 *[Handwritten Signature]* Date 22-Dec-15