



Designer and Manufacturer
of
Scientific and Industrial
Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.

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

231 Sam Rayburn Parkway
865-270-8962
Lenoir City, TN 37771, U.S.A.

CUSTOMER CABRERA SERVICES

ORDER NO. 20205329/381338

Mfg. Ludlum Measurements, Inc. Model 2224-1 Serial No. 271539

Mfg. Ludlum Measurements, Inc. Model 43-93 Serial No. PR291930

Cal. Date 16-Aug-12 Cal Due Date 16-Aug-13 Cal. Interval 1 Year Meterface 202-783

Check mark applies to applicable instr. and/or detector IAW mfg. spec. T. 74 °F RH 45 % Alt 696.8 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 725 V Input Sens. 725 mV Det. Oper. 725 V at comments mV Threshold Dial Ratio = mV

HV Readout (2 points) Ref./Inst. 500 / 502 V Ref./Inst. 1500 / 1510 V

COMMENTS:

Efficiencies for Th230, Sr90Y90, Tc99, and Ni63 are as follows in 4pi:

Th230: act.3,220dpm ct. 710cpm -Bg1 ct.709cpm 22%
Sr90Y90: act.35,151dpm ct.12,910cpm -Bg226 ct.12,684cpm 36%
Tc99: act.33,200dpm ct.6910cpm -Bg226 ct.6,684cpm 20%
Ni63: act.278,580dpm ct.661cpm -Bg226 ct.435cpm 0.156% 4Pi

FIRMWARE:390092

Alpha Sensitivity:120mv Instrument calibrated with 5' cable.

Beta Sensitivity:3.5mv H.V. set with detector disconnected.

Beta Window:30mv

Overload set to simulate a light leak with Am-241 91mdpm.

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

see a Attach mod for cam Et (2pi)

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
X1000	400kcpm	400	400
X1000	100kcpm	100	100
X100	40kcpm	400	400
X100	10kcpm	100	100
X10	4kcpm	400	400
X10	1kcpm	100	100
X1	400cpm	400	400
X1	100cpm	100	100

*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	400819	400819			
40kcpm	40091	40091			
4kcpm	4010	4010			
400cpm	400	400			
40cpm	40	40			

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 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 PU-239 #2928 Beta S/N TC-99 #5296 Sr90 #4016 Other

m 500 S/N 238275 Oscilloscope S/N Multimeter S/N 70602489

Calibrated By: [Signature] Date 16-Aug-12

Reviewed By: [Signature] Date 20 Aug 12



Designer and Manufacturer
of
Scientific and Industrial
Instruments

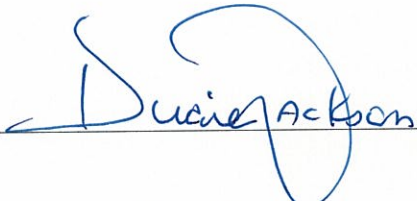
LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 325-235-5494
501 OAK STREET FAX NO. 325-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

Bench Test Data For Detector

Detector 43-93 Serial No. PR 291930 Order # 20205329/381338
 Customer CABRERA SERVICES Alpha Input Sensitivity 120 mV
 Counter 2224-1 Serial No. 271539 Beta Input Sensitivity 3.5 mV
 Count Time 1Minute Beta Window 30 mV
 Other _____ Distance Source to Detector Surface

High Voltage	Background		Isotope <u>Pu-239</u> Size <u>25.2Kdpm</u>		Isotope <u>Tc-99</u> Size <u>33,200dpm</u>		Isotope <u>Sr90/Y90</u> Size <u>35,150dpm</u>	
	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta
<u>700</u>	<u>1</u>	<u>203</u>	<u>5479</u>	<u>358</u>	<u>9</u>	<u>5821</u>	<u>1</u>	<u>11689</u>
* <u>725</u>	<u>0</u>	<u>226</u>	<u>5719</u>	<u>508</u>	<u>11</u>	<u>6909</u>	<u>2</u>	<u>12910</u>
<u>750</u>	<u>1</u>	<u>300</u>	<u>5808</u>	<u>683</u>	<u>12</u>	<u>8083</u>	<u>7</u>	<u>13261</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  Date 16-Aug-12

" Attachment "

(2 Pi) CPM Efficiencies for M-2241-1/43-93

TH-230 act.1630cpm ct.709cpm 43% 2pi

TC-99 act.20.7kcpm ct.6,684cpm 32% 2Pi

Sr90y90 act.24,605cpm ct.12,684cpm 52% 2Pi

Ni-63 act.139,290cpm ct.435cpm 0.31% 2Pi TH-230