



Designer and Manufacturer
of
Scientific and Industrial
Instruments

CERTIFICATE OF CALIBRATION

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.

CUSTOMER CABRERA SERVICES ORDER NO. 20213890/386488
Mfg. Ludlum Measurements, Inc. Model 2929 Serial No. 171590
Mfg. Ludlum Measurements, Inc. Model 43-10-1 Serial No. PR174813
Cal. Date 3-Jan-13 Cal Due Date 3-Jan-14 Cal. Interval 1 Year Meterface 202-014

Check mark applies to applicable instr. and/or detector IAW mfg. spec. T. 73 °F RH 36 % Alt 698.8 mm Hg

New Instrument Instrument Received Within Toler. +/-10% 10-20% Out of Tol. Requiring Repair Other-See comments

Mechanical ck. Window Operation

Audio ck.

Meter Zeroed Alpha Sensitivity 175 mV Beta Sensitivity 4 mV Beta Window 50 mV

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 875 V = 3.50 on High Voltage dial. High Voltage set with detector connected.

HV Readout (2 points) Ref./Inst. 500 / 501 V Ref./Inst. 2000 / 2002 V

COMMENTS:

See attachments for efficiencies

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

Alpha Channel Digital Readout	REFERENCE CAL POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
	<u>400K cpm</u>	<u>39992 (0)</u>	<u>39992 (0)</u>
	<u>40K cpm</u>	<u>3999</u>	<u>3999</u>
	<u>4K cpm</u>	<u>400</u>	<u>400</u>
	<u>400 cpm</u>	<u>40</u>	<u>40</u>
	<u>40 cpm</u>	<u>4</u>	<u>4</u>

Beta/Gamma Channel Digital Readout	REFERENCE CAL POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
	<u>400K cpm</u>	<u>39988 (0)</u>	<u>39988 (0)</u>
	<u>40K cpm</u>	<u>3998</u>	<u>3998</u>
	<u>4K cpm</u>	<u>400</u>	<u>400</u>
	<u>400 cpm</u>	<u>40</u>	<u>40</u>
	<u>40 cpm</u>	<u>4</u>	<u>4</u>

*Uncertainty within ± 10% C.F. within ± 20%

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/INCSL Z540-1-1994 and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: 73410 1131 781 059 280 60646 70897 Ra-226 S/N Y982
Cs-137 Gamma S/N 1162 G112 M565 5105 T1008 T879 E552 E551 720 734 1616 Neutron Am-241 Be S/N T-304
 Alpha S/N Th230 SN:E121495 Beta S/N Tc99 SN:5280, SrY90 SN:5281 Other _____
 m 500 S/N 190566 Oscilloscope S/N _____ Multimeter S/N 86250390

Calibrated By: [Signature] Date 3-Jan-13

Reviewed By: [Signature] Date 4 Jan 13

This certificate shall not be reproduced except in full, without the written approval of Ludlum Measurements, Inc.

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



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Bench Test Data For Detector

Detector 43-10-1 Serial No. PR174813 Order # 20213890/386488
 Customer CABRERA SERVICES Alpha Input Sensitivity 175 mV
 Counter 2929 Serial No. 171590 Beta Input Sensitivity 4 mV
 Count Time 1Minute Beta Window 50 mV
 Other _____ Distance Source to Detector TRAY

High Voltage	Background		Isotope <u>Th230</u> Size <u>19800dpm</u>		Isotope <u>Sr90</u> Size <u>97319dpm</u>		Isotope <u>Ni63</u> Size <u>277841dpm</u>		Isotope <u>Tc99</u> Size <u>93200dpm</u>	
	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta
825	0	59	6742	1246	7	45001	2	1541	35	26165
850	0	58	6826	1057	21	43811	1	3276	34	28399
875	0	59	6785	1157	74	41588	2	5534	39	31269
900	0	66	6885	1268	229	38911	4	8883	34	32675
925	1	80	6928	1448	443	35451	2	12001	34	33167

- 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 *Jan F...* Date 3-5-13

Attachment

Efficiencies taken with 2929 SN:171590 & 43-10-1 SN:PR174813

Th230 SN:E121495

Size: 10100cpm,
Background: 0cpm, Counts: 6785cpm
2pi Eff: 67.17%,

Tc99 SN:5280

Size: 58300cpm,
Background: 59cpm, Counts: 31269cpm
2pi Eff: 53.53%,

SrY90 SN:5281

Size: 68123cpm,
Background: 59cpm, Counts: 42588cpm
2pi Eff: 62.42%,

Ni63 SN:4017

Size: 138920cpm,
Background: 59cpm, Counts: 5534cpm
2pi Eff: 3.94%,

Attachment

Efficiencies taken with 2929 SN:171590 & 43-10-1 SN:PR174813

Th230 SN:E121495

Size: 19800dpm,
Background: 0cpm, Counts: 6785cpm
4pi Eff: 34.26%,

Tc99 SN:5280

Size: 93200dpm,
Background: 59cpm, Counts: 31269cpm
4pi Eff: 33.48%,

SrY90 SN:5281

Size: 97319dpm,
Background: 59cpm, Counts: 41588cpm
4pi Eff: 42.67%,

Ni63 SN:4017

Size: 277841dpm,
Background: 59cpm, Counts: 5534cpm
4pi Eff: 1.97%,