



OHM Remediation
Services Corp.

A Subsidiary of OHM Corporation

11-Mar-97

Mr. Kevin Reilly
Defense National Stockpile Center
8725 John J. Kingman Road
Fort Belvoir, Va. 22060-6223

Dear Kevin

The following information is in response to the letter dated January 30, 1997 from Mr. Dominick A. Orlando, Project Manager, low-level Waste and Decommission Projects Branch, Division of Waste Management, Office of Nuclear Material Safety and Safeguard, US Nuclear Regulatory Commission to Kevin Reilly.

As indicated by the memo contained in this package, Mr. Wayne Gaul has provided the requested calibration data and answers to the remaining questions. OHM has, in the past, responded to questions from the NRC on behalf of the DLA. The existing project funds are exhausted. Any additional request for information or additional question pertaining to the Curtis Bay Project will have to be considered cost growth and handled through the Change Order process.

Sincerely

Phillip J. Malich (for Pete Wells)
OHM Project Manager

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PDR ADOCK 04000341
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DEFENSE LOGISTICS AGENCY
DEFENSE NATIONAL STOCKPILE CENTER
8725 JOHN J. KINGMAN ROAD, SUITE 3339
FT. BELVOIR, VIRGINIA 22060-6223



IN REPLY
REFER TO

DNSC-ME

MAR 18 1997

Mr. Dominick A. Orlando
Project Manager
Division of Low Level Waste Management and Decommissioning
U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, MD 20852

Dear Mr. Orlando:

Per our recent discussion, we have gathered the responses to your last remaining questions. Enclosed for your review is information and clarifications you requested.

I have included two copies of this information. One for NRC and one for the MDE.

Should you have any questions please feel free to contact me on (703) 767-6522.

Sincerely,

F. KEVIN REILLY
Environmental Protection
Specialist

NL 10/1

160056





OHM Remediation Services Corp.
Nuclear Services Division

To: Stan Hodges
From: Wayne Gaul
Date: March 14, 1997
Subject: Response to Curtis Bay Depot Questions

Reference: Letter from Mr. Dominick A. Orlando, Project Manager, Low-Level Waste and Decommissioning Projects Branch, Division of Waste Management, Office of Nuclear Material Safety and Safeguards, US Nuclear Regulatory Commission to Kevin Reilly, dated January 30, 1997.

This is in response to the questions asked in the referenced letter.

1. The calibration data for the equipment used for survey activities is attached.
2. The four point block average of 0 dpm/100 cm² is correct and represents data from points that were recorded as 0 dpm/100 cm² because after subtracting background the reading was negative and at that time in the project negative numbers were not recorded. Therefore the results represent four areas where, once background was subtracted, the results for all four places were less than background and 0 was recorded. Four zeros divided by four, result in a four point average of 0 dpm/100 cm².
3. Activity levels such as this were treated as an activity below the guideline value of 1000 dpm/100 cm² because "The limit for activity on a building or structure surface is three times the guideline value, when averaged over an area of 100 cm²." From NUREG/CR 5849 Section 8.5.2 • Buildings or Structures. Any activity level greater than 1000 dpm/100 cm² (number without adding the associated error) was remediated regardless of being less than three times the guideline value.
4. Large area detectors were used in a scaler mode, with a fixed count time, to determine the average dpm/100 cm². The count time was determined from calculations that required the minimum detectable activity to be less than the guideline value. This was also dependent on background. The large probe size was corrected to correlate to an area of 100 cm².

CERTIFICATION OF CALIBRATION

Instrument ESP-1 / SPA-3Serial Number 1645/5676 \ 1101Type of Source Cs-137 10mCi S/N 733
MP-2 S/N 192
FLUKE 8010A S/N 4530050

Range	Calibration Point	Reading
<u>CNT/MIN</u>	<u>0.5 mR/hr</u>	<u>5.78+05 CNT/MIN</u>
<u>CNT/MIN</u>	<u>1.0 mR/hr</u>	<u>1.11+06 CNT/MIN</u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>
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This probe is energy dependent. If direct readout in mR/hr is desired, the ESP/SPA-3 should be calibrated using gamma radiation with energy comparable to that being measured.

Calibration Constant 1.00+00High Voltage 9.75+01 VoltsDead Time (Sec.) 7.18-06Input Sensitivity 10 mvOverrange 3.66+06 CNT/MIN

Calibration sources used have calibration traceable to the N.I.S.T.

Date JAN 10 1995

Signature

Victor M. JohnsonEIS
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3P.O. Number 7301722EIS
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CERTIFICATION OF CALIBRATION

Instrument ESP-1 / AL-3-7

Serial Number 1506/15170/11193

S/N 6913 S/N 7188

Type of Source Pu-239 S/N 7189 S/N 7190

FLUKE 8010A S/N 5255024

MP-2 S/N 400

Range	Calibration Point	Reading
<u>CNT/MIN</u>	<u>1,300 cpm (2π)</u>	<u>4.34+02 CNT/MIN (33.3%)</u>
<u>CNT/MIN</u>	<u>12,700 cpm (2π)</u>	<u>4.90+03 CNT/MIN (38.6%)</u>
<u>CNT/MIN</u>	<u>155,000 cpm (2π)</u>	<u>5.91+04 CNT/MIN (38.1%)</u>
<u>CNT/MIN</u>	<u>1,184,000 cpm (2π)</u>	<u>4.79+05 CNT/MIN (40.5%)</u>
_____	_____	_____
_____	_____	_____

On the Calibration Constant is 1.00, the 2 pi counting efficiency is:

Reading X 100 = Per Cent Efficiency
Calibration Point CPM (2 pi)

Calibration Constant 1.00+00

High Voltage 1.20+03

Dead Time (Sec.) 1.20-05

Input Sensitivity 10 mV

Overrange N/A

Calibration sources used have calibration traceable to the N.I.S.T.

Date JUL 25 1994

Signature Kenneth A. Per

P.O. Number 7301722

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7-25-94

CERTIFICATION OF CALIBRATION

Instrument ESP-1 / LUDLUM 44-10

Serial Number 2477/11221/PRO60362/
11065

Type of Source Cs-137 10mCi S/N-733
MP-2 S/N 739
FLUKE 8010A S/N 5740119

Range	Calibration Point	Reading
<u>CNT/MIN</u>	<u>.5 mR/hr</u>	<u>6.07+05 CNT/MIN</u>
<u>CNT/MIN</u>	<u>1 mR/hr</u>	<u>1.21+06 CNT/MIN</u>
<u></u>	<u></u>	<u></u>
<u></u>	<u></u>	<u></u>
<u></u>	<u></u>	<u></u>
<u></u>	<u></u>	<u></u>

This probe is energy dependent. If direct readout in mR/hr is desired, the ESP should be calibrated using gamma radiation with energy comparable to that being measured.

Calibration Constant 1.00+00

High Voltage 8.50+02 volts

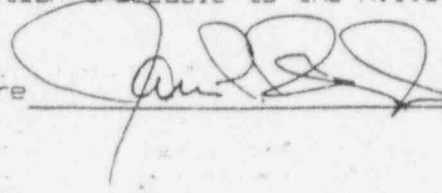
Dead Time (Sec.) 1.15-05

Input Sensitivity 10 mv

Overrange 4.14+06 CNT/MIN

Calibration sources used have calibration traceable to the N.I.S.T.

Date AUG 16 1994

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CERTIFICATION OF CALIBRATION

Instrument ESP-1 / SPA-3

Serial Number 2312/11085/1120

Type of Source CS-137 10mCi S/N-733
MP-2 S/N-733
FLUKE 800A S/N-5740119

Range	Calibration Point	Reading
<u>CNT/MIN</u>	<u>.5 mR/hr</u>	<u>6.25±05 CNT/MIN</u>
<u>CNT/MIN</u>	<u>1 mR/hr</u>	<u>1.23±06 CNT/MIN</u>

The SPA-3 probe is energy dependent. If direct readout in mR/hr is desired, the ESP/SPA-3 should be calibrated using gamma radiation with energy comparable to that being measured.

Calibration Constant 1.00±00 High Voltage 7.50±02 V

Dead Time (Sec.) 9.63-06 Input Sensitivity 10 mV

Ovrange 3.94±06 CNT/MIN

Calibration sources used have calibration traceable to the N.I.S.T.

Date MAY 24 1994

Signature *[Signature]*

P.O. Number 7301722



CERTIFICATION OF CALIBRATION

Instrument ESP-1 / SPA-3

Serial Number 2479/11223 / 11188

Type of Source Cs-137 10mCi S/N 733
MP-2 S/N 192
FLUKE 8020B S/N 4005114

Range	Calibration Point	Reading
<u>μR/hr</u>	<u>.2 mR/hr</u>	<u>2.03+02 μR/hr</u>
<u>μR/hr</u>	<u>.5 mR/hr</u>	<u>5.12+02 μR/hr</u>
<u>μR/hr</u>	<u>1 mR/hr</u>	<u>1.00+03 μR/hr</u>
<u>μR/hr</u>	<u>2 mR/hr</u>	<u>2.01+03 μR/hr</u>

This probe is energy dependent. If direct readout in mR/hr is desired, the ESP/SPA-3 should be calibrated using gamma radiation with energy comparable to that being measured.

Calibration Constant 8.10+10 High Voltage 9.03+02 Volts

Dead Time (sec.) 9.50-06 Input Sensitivity 10 mV

Overrange 2.86+03 μR/hr

Calibration sources used have calibration traceable to the N.I.S.T.

Date NOV 21 1994

Signature

Victor M. Johnson

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P.O. Number 7301722

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CERTIFICATION OF CALIBRATION

Instrument ESP-1 / SPA-3

Serial Number 2479/11223 / 11188

Type of Source Cs-137 10mCi S/N 733

MP-2 S/N 192

FLUKE 8020B S/N 4005114

Range	Calibration Point	Reading
<u>μR/hr</u>	<u>.2 mR/hr</u>	<u>2.03+02 μR/hr</u>
<u>μR/hr</u>	<u>.5 mR/hr</u>	<u>5.12+02 μR/hr</u>
<u>μR/hr</u>	<u>1 mR/hr</u>	<u>1.00+03 μR/hr</u>
<u>μR/hr</u>	<u>2 mR/hr</u>	<u>2.01+03 μR/hr</u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>

This probe is energy dependent. If direct readout in mR/hr is desired, the ESP/SPA-3 should be calibrated using gamma radiation with energy comparable to that being measured.

Calibration Constant 8.10+10

High Voltage 9.03+02 Volts

Dead Time (Sec.) 9.50-06

Input Sensitivity 10 mV

Overrange 2.86+03 μR/hr

Calibration sources used have calibration traceable to the N.I.S.T.

Date NOV 21 1994

Signature

Victor M. Johnson

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P.O. Number 7301722

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CERTIFICATION OF CALIBRATION

Instrument ESP-1 / AC-3-7Serial Number 2209/5738/1527Type of Source Pu-239 S/N 6913 S/N 7188
S/N 7189 S/N 7190Fluke 8010A S/N 5255024MP-2 S/N 400

Range	Calibration Point	Reading
<u>CNT/MIN</u>	<u>1,300 cpm (2π)</u>	<u>4.83 ± 02 CNT/MIN (37.1%)</u>
<u>CNT/MIN</u>	<u>12,700 cpm (2π)</u>	<u>4.76 ± 03 CNT/MIN (37.5%)</u>
<u>CNT/MIN</u>	<u>155,000 cpm (2π)</u>	<u>5.63 ± 04 CNT/MIN (36.3%)</u>
<u>CNT/MIN</u>	<u>1,184,000 cpm (2π)</u>	<u>4.53 ± 05 CNT/MIN (38.3%)</u>

When the Calibration Constant is 1.00, the 2 pi counting efficiency is:

$$\frac{\text{Reading}}{\text{Calibration Point CPM (2 pi)}} \times 100 = \text{Per Cent Efficiency}$$
Calibration Constant 1.00 ± 00High Voltage 1.10 ± 03Dead Time (Sec.) 1.20 - 05Input Sensitivity 10 mVOverrange N/A

Calibration sources used have calibration traceable to the N.I.S.T.

Date JUL 25 1994Signature Kenneth J. P.EIS
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4P.O. Number 7301722

7-25-94

CERTIFICATION OF CALIBRATION

Instrument ESP-2 / HP-270

Serial Number 1252/11955 / 01110

10mCi S/N 733

Type of Source Cs-137 10 Ci S/N 375

MP-2 S/N 174

FLUKE 8010A S/N 2650076

Range	Calibration Point	Reading
<u>mR/hr</u>	<u>2 mR/hr</u>	<u>2.05+00 mR/hr</u>
<u>mR/hr</u>	<u>20 mR/hr</u>	<u>2.00+01 mR/hr</u>
<u>mR/hr</u>	<u>200 mR/hr</u>	<u>1.89+02 mR/hr</u>
<u>mR/hr</u>	<u>2 R/hr</u>	<u>2.02+03 mR/hr</u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>
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Calibration Constant 7.00+07

High Voltage 8.97+02 Volts

Dead Time (Sec.) 9.80-05

Input Sensitivity 10 mV

Overrange 4.19+03 mR/hr

Calibration sources used have calibration traceable to the N.I.S.T.

Date FEB 9 1995

Signature [Signature]



P.O. Number 7302117



CERTIFICATION OF CALIBRATION

Instrument ESP-2 / HP-260

Serial Number 1252/11955 / 00558

Type of Source SrY-90 S/N 544,7620

Cs-137 10mCi S/N 733

10 Ci S/N 375

MP-2 S/N 174

FLUKE 8010A S/N 2650076

Range	Calibration Point	Reading
<u>CNT/MIN</u>	<u>8350 CPM (2π)</u>	<u>6.58+03 CNT/MIN(78.8%)</u>
<u>CNT/MIN</u>	<u>22200 CPM (2π)</u>	<u>1.94+04 CNT/MIN(87.4%)</u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>
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When the Calibration Constant is 1.00, the 2 π counting efficiency is:

Reading X 100 = Per Cent Efficiency
Calibration Point CPM (2 π)

Calibration Constant 1.00+00

High Voltage 8.97+02 volts

Dead Time (Sec.) 5.06-05

Input Sensitivity 10 mV

Overrange 4.95+06 CNT/MIN

Calibration sources used have calibration traceable to the N.I.S.T.

Date FEB 9 1995

Signature [Signature]

P.O. Number

7302117



CERTIFICATION OF CALIBRATION

Instrument ESP-2 / AC-3-8

Serial Number 1252/11955 / 11280

Type of Source Pu-239 S/N 6913,7188

7189,7190

MP-2 S/N 174

PLUKE 8010A S/N 2650C76

Range	Calibration Point	Reading
<u>CNT/MIN</u>	<u>1,300 CPM (2π)</u>	<u>2.76+02 CNT/MIN (21.2%)</u>
<u>CNT/MIN</u>	<u>12,800 CPM (2π)</u>	<u>2.81+03 CNT/MIN (22.0%)</u>
<u>CNT/MIN</u>	<u>156,000 CPM (2π)</u>	<u>3.49+04 CNT/MIN (22.4%)</u>
<u>CNT/MIN</u>	<u>1,198,000 CPM (2π)</u>	<u>2.82+05 CNT/MIN (23.5%)</u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>

When the Calibration Constant is 1.00, the 2 π counting efficiency is:

$\frac{\text{Reading}}{\text{Calibration Point CPM (2}\pi\text{)}} \times 100 = \text{Per Cent Efficiency}$

Calibration Constant 1.00+00

High Voltage 8.51+02 Volts

Dead Time (Sec.) 1.00-05

Input Sensitivity 10 mV

Overrange N/A

Calibration sources used have calibration traceable to the N.I.S.T.

Date FEB 9 1995

Signature [Signature]



P.O. Number 7302117



CERTIFICATION OF CALIBRATION

Instrument BSP-2 / BP-250Serial Number 995 / 11257 / 11229

7620,

Type of Source SiY-90 S/N 8-544

Cs-137 10mCi S/N 733

10 Ci S/N 375

MP-2 S/N 126

FLUKE 8010A S/N 2435022

Range	Calibration Point	Reading
<u>CNT/MIN</u>	<u>8,350 CPM (2σ)</u>	<u>5.05+03 CNT/MIN (60.5%)</u>
<u>CNT/MIN</u>	<u>22,200 CPM (2σ)</u>	<u>1.36+04 CNT/MIN (61.3%)</u>

When the Calibration Constant is 1.00, the 2 σ counting efficiency is:

Reading $\times 100$ = Per Cent Efficiency
Calibration Point CPM (2 σ)

Calibration Constant 1.00+00High Voltage 8.97+02 VoltsDead Time (Sec.) 6.40-05Input Sensitivity 10 mVOverrange 4.75+06 CNT/MIN

Calibration sources used have calibration traceable to the N.I.S.T.

Date FEB 9 1995Signature Scott A. HulseP.O. Number 7302117

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 Thermo Instrument
 Systems Inc.

CERTIFICATION OF CALIBRATION

Instrument ESP-2 / HP-270Serial Number 995 / 11257 / 1048

10mCi S/N 733

Type of Source Cs-137 10 Ci S/N 375

MF-2 S/N 126

FLUKE 8010A S/N 2435022

Range	Calibration Point	Reading
<u>mR/hr</u>	<u>2 mR/hr</u>	<u>2.08+00 mR/hr</u>
<u>mR/hr</u>	<u>20 mR/hr</u>	<u>1.95+01 mR/hr</u>
<u>mR/hr</u>	<u>200 mR/hr</u>	<u>1.90+02 mR/hr</u>
<u>mR/hr</u>	<u>2 R/hr</u>	<u>2.07+03 mR/hr</u>

Calibration Constant 6.50+07High Voltage 8.97+02 voltsDead Time (Sec.) 9.50-05Input Sensitivity 10 mVOverrange 3.38+03 mR/hr

Calibration sources used have calibration traceable to the N.I.S.T.

Date FEB 9 1995Signature [Signature]P.O. Number 7302117

A subsidiary of
Thermo Instrument
Systems Inc.

Eberline Instrument Corporation

CERTIFICATION OF CALIBRATION

Instrument ESR-2 / AC-3-8Serial Number 995 / 11257 / 11258Type of Source Pu-239 S/N 6213.7188
7189.7190

MP-2 S/N 126

FLUKE 8010A S/N 2435022

Range	Calibration Point	Reading
<u>CNT/MIN</u>	<u>1,300 CPM (2pi)</u>	<u>2.60+02 CNT/MIN (20.0%)</u>
<u>CNT/MIN</u>	<u>12,800 CPM (2pi)</u>	<u>2.51+03 CNT/MIN (19.6%)</u>
<u>CNT/MIN</u>	<u>156,000 CPM (2pi)</u>	<u>3.00+04 CNT/MIN (19.2%)</u>
<u>CNT/MIN</u>	<u>1,198,000 CPM (2pi)</u>	<u>2.44+05 CNT/MIN (20.4%)</u>

When the Calibration Constant is 1.00, the 2 pi counting efficiency is:

$$\frac{\text{Reading}}{\text{Calibration Point CPM (2 pi)}} \times 100 = \text{Per Cent Efficiency}$$
Calibration Constant 1.00+00High Voltage 1.15+03 VoltsDead Time (Sec.) 1.00-05Input Sensitivity 10 mVOverrange N/A

Calibration sources used have calibration traceable to the N.I.S.T.

Date FEB 9 1995Signature Robert G. ShultsP.O. Number 7302117

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Systems Inc.

CERTIFICATION OF CALIBRATION

Instrument ESP-2 / HP-290

Serial Number 995/11257/1049

Type of Source CS-137 ^{10 mCi S/N-733}
^{10 Ci S/N-375}
^{1000 Ci S/N-371}

MP-2 SW-739

FWKE 8010A S/N-5740119

Range	Calibration Point	Reading
<u>R/hr</u>	<u>.005 R/hr</u>	<u>4.80-03 R/hr</u>
<u>R/hr</u>	<u>.05 R/hr</u>	<u>4.95-02 R/hr</u>
<u>R/hr</u>	<u>.5 R/hr</u>	<u>5.01-01 R/hr</u>
<u>R/hr</u>	<u>5 R/hr</u>	<u>5.04+00 R/hr</u>
<u>R/hr</u>	<u>50 R/hr</u>	<u>5.01+01 R/hr</u>

Calibration Constant 4.93 +06

High Voltage 5.46 +02 VDC

Dead Time (Sec.) 1.49 -05

Input Sensitivity 10 mV

Overrange 5.51 +01 R/hr

Calibration sources used have calibration traceable to the N.I.S.T.

Date JUN 10 1994

Signature [Signature]

P.O. Number 7301722

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CERTIFICATION OF CALIBRATION

Instrument ESP-2/AC-3-7Serial Number 995/11257/11258

6913, 7188

Type of Source Pu-239 S/N - 7189, 7190MP-2 S/N - 739FLUKE 8010A S/N - 5740119

Range	Calibration Point	Reading
<u>CNT/MIN</u>	<u>1300 CPM (2π)</u>	<u>5.17±0.2 CNT/MIN (39.8%)</u>
<u>CNT/MIN</u>	<u>12,700 CPM (2π)</u>	<u>5.08±0.3 CNT/MIN (40.0%)</u>
<u>CNT/MIN</u>	<u>155,000 CPM (2π)</u>	<u>6.08±0.4 CNT/MIN (39.2%)</u>
<u>CNT/MIN</u>	<u>1,184,000 CPM (2π)</u>	<u>4.87±0.5 CNT/MIN (41.1%)</u>

When the Calibration Constant is 1.00, the 2 pi counting efficiency is:

Reading X 100 = Per Cent Efficiency
Calibration Point CPM (2 pi)

Calibration Constant 1.00±0.00 High Voltage 1.05±0.3 VDCDead Time (Sec.) 1.00-05 Input Sensitivity 10 mVOverrange N/A

Calibration sources used have calibration traceable to the N.I.S.T.

Date JUN 10 1994Signature [Signature]

P.O. Number

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CERTIFICATION OF CALIBRATION

Instrument ESP-2 / HP-270Serial Number 995/11257/1048
10 mCi SW-733Type of Source Cs-137 10 Ci SW-375

MP-2 SW-739

FLUKE 8010A SW-5740119

Range	Calibration Point	Reading
<u>mR/hr</u>	<u>2 mR/hr</u>	<u>2.14+00 mR/hr</u>
<u>mR/hr</u>	<u>20 mR/hr</u>	<u>2.00+01 mR/hr</u>
<u>mR/hr</u>	<u>200 mR/hr</u>	<u>1.91+02 mR/hr</u>
<u>mR/hr</u>	<u>2 R/hr</u>	<u>2.01+03 mR/hr</u>

Calibration Constant 6.53+07High Voltage 8.97+02 VDCDead Time (Sec.) 9.18 -05Input Sensitivity 10 mVOverrange 4.06+03

Calibration sources used have calibration traceable to the N.I.S.T.

Date JUN 10 1994Signature [Signature]P.O. Number 7301722EIS
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CERTIFICATION OF CALIBRATION

Instrument E-2 / HP-210AL

Serial Number 995/11257/11259

Type of Source Sr-90 S/N-7620, S-544
10 mCi S/N-733
Cs-137 10 Ci S/N-375
MP-2 S/N-739
FLUKE 8010A S/N-5740119

Range	Calibration Point	Reading
<u>CNT/MIN</u>	<u>8,600 CPM (2π)</u>	<u>5.38+03 CNT/MIN (62.6%)</u>
<u>CNT/MIN</u>	<u>22,400 CPM (2π)</u>	<u>1.45+04 CNT/MIN (64.7%)</u>

When the Calibration Constant is 1.00, the 2 pi counting efficiency is:

Reading X 100 = Per Cent Efficiency
Calibration Point CPM (2 pi)

Calibration Constant 1.00 +00 High Voltage 8.97+02 VDC

Dead Time (Sec.) 7.70-05 Input Sensitivity 10 mV

Overrange 4.60+06 CNT/MIN

Calibration sources used have calibration traceable to the N.I.S.T.

Date JUN 10 1994

Signature [Signature]

P.O. Number 7301722

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CERTIFICATION OF CALIBRATION

Instrument ESP-2 / HP-270

Serial Number 1497/00695 / 02214

10mCi S/N 733

Type of Source Cs-137 10 Ci S/N 375

MP-2 S/N 174

FLUKE 8010A S/N 2650076

Range	Calibration Point	Reading
mR/hr	2 mR/hr	2.05+00 mR/hr
mR/hr	20 mR/hr	2.00+01 mR/hr
mR/hr	200 mR/hr	1.89+02 mR/hr
mR/hr	2 R/hr	2.02+03 mR/hr

Calibration Constant 6.45+07

High Voltage 8.97+02 Volts

Dead Time (Sec.) 9.80-05

Input Sensitivity 10 mV

Overrange 4.07+03 mR/hr

Calibration sources used have calibration traceable to the N.I.S.T.

Date DEC 7 1994

Signature [Signature]



P.O. Number 7301722



CERTIFICATION OF CALIBRATION

Instrument ESP-2 / HP-260

Serial Number 1497/00695 / 02213

Type of Source SrY-90 S/N 544,7620

Cs-137 10mCi S/N 733

10 Ci S/N 375

MP-2 S/N 174

FLUKE 8010A S/N 2650076

Range	Calibration Point	Reading
<u>CNT/MIN</u>	<u>8350 CPM (2π)</u>	<u>5.26+03 CNT/MIN(63.0%)</u>
<u>CNT/MIN</u>	<u>22200 CPM (2π)</u>	<u>1.44+04 CNT/MIN(64.9%)</u>

When the Calibration Constant is 1.00, the 2π counting efficiency is:

Reading X 100 = Per Cent Efficiency
Calibration Point CPM (2π)

Calibration Constant 1.00+00 High Voltage 8.97+02 volts

Dead Time (Sec.) 6.20-05 Input Sensitivity 10 mV

Overrange 4.82+06 CNT/MIN

Calibration sources used have calibration traceable to the N.I.S.T.

Date DEC 7 1994

Signature [Signature]

EIS
TEST
5

P.O. Number 7301722

12-0-94
C.C.

CERTIFICATION OF CALIBRATION

Instrument ESP-2 / AC 3-7

Serial Number 1497/00695 / 02215

Type of Source Pu-239 S/N 6913,7188

7189,7190

MP-2 S/N 174

FLUKE 8010A S/N 2650076

Range	Calibration Point	Reading
CNT/MIN	1,300 CPM (2 π)	5.14+02 CNT/MIN(39.5%)
CNT/MIN	12,800 CPM (2 π)	4.96+03 CNT/MIN(38.8%)
CNT/MIN	156,000 CPM (2 π)	6.09+04 CNT/MIN(39.0%)
CNT/MIN	1,198,000 CPM (2 π)	4.80+05 CNT/MIN(40.1%)

When the Calibration Constant is 1.00, the 2 π counting efficiency is:

Reading X 100 = Per Cent Efficiency
 Calibration Point CPM (2 π)
 Calibration Constant 1.00+00 High Voltage 1.18+03 Volts
 Dead Time (Sec.) 1.00-05 Input Sensitivity 10 mV
 Overrange N/A

Calibration sources used have calibration traceable to the N.I.S.T.

Date DEC 7 1994

Signature

EIS
TEST
5

P.O. Number 7301722

CERTIFICATION OF CALIBRATION

Instrument ESP-2 / HP-270

Serial Number 825 / 1105 / 2266

10mCi S/N 733

Type of Source Cs-137 10 Ci S/N 375

MP-2 S/N 126

FLUKE 8010A S/N 2435022

Range	Calibration Point	Reading
<u>mR/hr</u>	<u>2 mR/hr</u>	<u>2.05+00 mR/hr</u>
<u>mR/hr</u>	<u>20 mR/hr</u>	<u>1.94+01 mR/hr</u>
<u>mR/hr</u>	<u>200 mR/hr</u>	<u>1.95+02 mR/hr</u>
<u>mR/hr</u>	<u>2 R/hr</u>	<u>2.05+03 mR/hr</u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>

Calibration Constant 6.50+07 High Voltage 8.97+02 Volts

Dead Time (Sec.) 1.05-04 Input Sensitivity 10 mV

Overrange 3.69+03 mR/hr

Calibration sources used have calibration traceable to the N.I.S.T.

Date SEP 21 1994 Signature Kott G. Guss

P.O. Number 7301722



EIS
Q.C.
9-21-94

CERTIFICATION OF CALIBRATION

Instrument ESP-2 / AC-3-7

Serial Number 825 / 1105 / 5675

Type of Source Pu-239 S/N 6913,7188
7189,7190

MP-2 S/N 126

FLUKE 8010A S/N 2435022

Range	Calibration Point	Reading
<u>CNT/MIN</u>	<u>1,300 CPM (2pi)</u>	<u>5.01+02 CNT/MIN(38.6%)</u>
<u>CNT/MIN</u>	<u>12,800 CPM (2pi)</u>	<u>4.93+03 CNT/MIN(38.5%)</u>
<u>CNT/MIN</u>	<u>156,000 CPM (2pi)</u>	<u>6.12+04 CNT/MIN(39.2%)</u>
<u>CNT/MIN</u>	<u>1,198,000 CPM (2pi)</u>	<u>4.85+05 CNT/MIN(40.5%)</u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>

When the Calibration Constant is 1.00, the 2 pi counting efficiency is:

Reading X 100 = Per Cent Efficiency
Calibration Point CPM (2 pi)

Calibration Constant 1.00+00

High Voltage 1.15+03 Volts

Dead Time (Sec.) 1.20-05

Input Sensitivity 10 mV

Overrange N/A

Calibration sources used have calibration traceable to the N.I.S.T.

Date SEP 21 1994

Signature Kott G. Shue



P.O. Number 7301722

9-29-94
 1

CERTIFICATION OF CALIBRATION

Instrument ESP-2 / HP-210T

Serial Number 825 / 1105 / 11191

1045/92

Type of Source SrY-90 S/N 1147/92

Cs-137 10mCi S/N 733

10 Ci S/N 375

MP-2 S/N 126

FLUKE 8010A S/N 2435022

Range	Calibration Point	Reading
<u>CNT/MIN</u>	<u>8,460 CPM (2π)</u>	<u>4.67+03 CNT/MIN(55.2%)</u>
<u>CNT/MIN</u>	<u>25,900 CPM (2π)</u>	<u>1.43+04 CNT/MIN(55.2%)</u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>

When the Calibration Constant is 1.00, the 2 π counting efficiency is:

$$\frac{\text{Reading}}{\text{Calibration Point CPM (2 } \pi \text{)}} \times 100 = \text{Per Cent Efficiency}$$

Calibration Constant 1.00+00

High Voltage 8.97+02 Volts

Dead Time (Sec.) 7.50-05

Input Sensitivity 10 mV

Overrange 4.60+06 CNT/MIN

Calibration sources used have calibration traceable to the N.I.S.T.

Date SEP 21 1994

Signature Kott G. Shull



P.O. Number 7301722



CERTIFICATION OF CALIBRATION

Instrument ESP-2 / HP-270Serial Number 1496 / 699 / 1525

10mCi S/N 733

Type of Source Cs-137 10 Ci S/N 375

MP-2 S/N 174

FLUKE 8010A S/N 2650076

Range	Calibration Point	Reading
<u>mR/hr</u>	<u>2 mR/hr</u>	<u>2.05+00 mR/hr</u>
<u>mR/hr</u>	<u>20 mR/hr</u>	<u>2.01+01 mR/hr</u>
<u>mR/hr</u>	<u>200 mR/hr</u>	<u>2.06+02 mR/hr</u>
<u>mR/hr</u>	<u>2 R/hr</u>	<u>2.02+03 mR/hr</u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>

Calibration Constant 6.15+07High Voltage 8.97+02 VoltsDead Time (Sec.) 8.60-05Input Sensitivity 10 mVOverrange 4.40+03 mR/hr

Calibration sources used have calibration traceable to N.I.S.T.

Date 7-19-95Signature [Signature]P.O. Number 7302117

CERTIFICATION OF CALIBRATION

Instrument ESP-2 / HP-260

Serial Number 1496 / 699 / 1426

Type of Source SrY-90 S/N 544.7620

Cs-137 10mCi S/N 733

10 Ci S/N 375

MP-2 S/N 174

FLUKE 8010A S/N 2650076

Range	Calibration Point	Reading
<u>CNT/MIN</u>	<u>8.350 CPM (2π)</u>	<u>4.69+03 CNT/MIN(56.2%)</u>
<u>CNT/MIN</u>	<u>22.200 CPM (2π)</u>	<u>1.22+04 CNT/MIN(55.0%)</u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>

When the Calibration Constant is 1.00, the 2π counting efficiency is:

Reading X 100 = Per Cent Efficiency
Calibration Point CPM (2π)

Calibration Constant 1.00+00 High Voltage 8.97+02 volts

Dead Time (Sec.) 6.95-05 Input Sensitivity 10 mV

Overrange 4.70+06 CNT/MIN

Calibration sources used have calibration traceable to N.I.S.T.

Date 7-19-95 Signature [Signature]

P.O. Number 7302117



RAS-1 DATA SHEET

I. Record Data

RAS-1 S/N 0686 / 11212 Atmospheric Pressure(P) 30.19 in. HG.Mass Flowmeter Model AHL-5 S/N 7476Date of Calibration 5/19/94

1 Indicated Flow (lpm)	2 Vacuum Guage (in.HG)	3 Mass Flow (scfm)	4 Corection Factor from II Below	5 Corrected Flow(lpm) From III Below	6 Ratio <u>5</u> <u>3</u>
30	<u>2.00</u>	<u>1.02</u>	<u>.97</u>	<u>1.03</u>	<u>1.01</u>
50	<u>4.00</u>	<u>1.58</u>	<u>.94</u>	<u>1.66</u>	<u>1.05</u>
70	<u>7.00</u>	<u>2.00</u>	<u>.88</u>	<u>2.18</u>	<u>1.09</u>

II. Calculate Correction Factor(cf) and record in column 4.

$$CF = \sqrt{\frac{P - \text{Vacuum Guage}}{29.92}}$$

III. Calulate Corrected Flow and record in column 5.

$$lpm = \frac{\text{Indicated Flow 1.} \times \text{Correction factor 4.}}{28.32}$$

Test Performed By [Signature] Date: 6-16-95Quality Control By Alice Lyon Date: 6-16-95Purchase Order # 7302117

CERTIFICATION OF CALIBRATION

Instrument ESP-2 / AC-3.7Serial Number 1496 / 699 / 1439Type of Source Pu-239 S/N 6913.7188
7189.7190

MP-2 S/N 174

FLUKE 8010A S/N 2650076

Range	Calibration Point	Reading
<u>CNT/MIN</u>	<u>1.300 CPM (2π)</u>	<u>4.82+02 CNT/MIN(37.1%)</u>
<u>CNT/MIN</u>	<u>12.800 CPM (2π)</u>	<u>4.65+03 CNT/MIN(36.3%)</u>
<u>CNT/MIN</u>	<u>156.000 CPM (2π)</u>	<u>5.79+04 CNT/MIN(37.1%)</u>
<u>CNT/MIN</u>	<u>1.198.000 CPM (2π)</u>	<u>4.62+05 CNT/MIN(38.6%)</u>
<u> </u>	<u> </u>	<u> </u>

When the Calibration Constant is 1.00, the 2 π counting efficiency is:

$$\frac{\text{Reading}}{\text{Calibration Point CPM (2}\pi\text{)}} \times 100 = \text{Per Cent Efficiency}$$

Calibration Constant 1.00+00 High Voltage 1.25+03 VoltsDead Time (Sec.) 1.00-05 Input Sensitivity 10 mVOverrange N/A

Calibration sources used have calibration traceable to N.I.S.T.

Date 7-19-95 Signature [Signature]P.O. Number 7302117EIS
TEST
57-20-95
EIS
7

CERTIFICATION OF CALIBRATION

Instrument ESP-2 / HP-270

Serial Number 1496 / 699 / 1525

10mCi S/N 733

Type of Source Cs-137 10 Ci S/N 375

MP-2 S/N 126

FLUKE 8010A S/N 2435022

Range	Calibration Point	Reading
<u>mR/hr</u>	<u>2 mR/hr</u>	<u>2.08+00 mR/hr</u>
<u>mR/hr</u>	<u>20 mR/hr</u>	<u>1.95+01 mR/hr</u>
<u>mR/hr</u>	<u>200 mR/hr</u>	<u>1.95+02 mR/hr</u>
<u>mR/hr</u>	<u>2 R/hr</u>	<u>2.05+03 mR/hr</u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>

Calibration Constant 6.70+07

High Voltage 8.97+02 Volts

Dead Time (Sec.) 9.70-05

Input Sensitivity 10 mV

Overrange 3.85+03 mR/hr

Calibration sources used have calibration traceable to the N.I.S.T.

DEC 21 1994

Date

Signature

Robert A. Dues



P.O. Number

7301722

12-29-94

CERTIFICATION OF CALIBRATION

Instrument ESP-2 / AC-3-7

Serial Number 1496 / 699 / 1439

Type of Source Pu-239 S/N 6913, 7188

7189, 7190

MP-2 S/N 126

FLUKE 8010A S/N 2435022

Range	Calibration Point	Reading
<u>CNT/MIN</u>	<u>1,300 CPM (2pi)</u>	<u>5.03+02 CNT/MIN(38.7%)</u>
<u>CNT/MIN</u>	<u>12,800 CPM (2pi)</u>	<u>4.91+03 CNT/MIN(38.4%)</u>
<u>CNT/MIN</u>	<u>156,000 CPM (2pi)</u>	<u>6.10+04 CNT/MIN(39.1%)</u>
<u>CNT/MIN</u>	<u>1,198,000 CPM (2pi)</u>	<u>4.81+05 CNT/MIN(40.2%)</u>

When the Calibration Constant is 1.00, the 2 pi counting efficiency is:

Reading X 100 = Per Cent Efficiency
Calibration Point CPM (2 pi)

Calibration Constant 1.00+00 High Voltage 1.30+03 Volts

Dead Time (Sec.) 1.00-05 Input Sensitivity 10 mV

Overrange N/A

Calibration sources used have calibration traceable to the N I S T.

Date DEC 21 1994

Signature Scott G. Luss

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14

P.O. Number 7301722

1222-94
1

CERTIFICATION OF CALIBRATION

Instrument ESP-2/AC-3-7

Serial Number 1495/702/1437

Type of Source Pu-239 S/N 8318, 8319
MP-2 S/N-739
FLUKE 8024B S/N-4335223

Range	Calibration Point	Reading
<u>CNT/MIN</u>	<u>1,430 CPM (2π)</u>	<u>5.30 ± 0.2 CNT/MIN (37.1%)</u>
<u>CNT/MIN</u>	<u>15,800 CPM (2π)</u>	<u>5.84 ± 0.3 CNT/MIN (36.9%)</u>
<u>CNT/MIN</u>	<u>134,000 CPM (2π)</u>	<u>5.00 ± 0.4 CNT/MIN (37.3%)</u>
<u>CNT/MIN</u> [†]	<u>1,117,000 CPM (2π)</u>	<u>4.29 ± 0.5 CNT/MIN (88.4%)</u>

When the Calibration Constant is 1.00, the 2 pi counting efficiency is:

Reading X 100 = Per Cent Efficiency
Calibration Point CPM (2 pi)

Calibration Constant 1.00 ± 0.0

High Voltage 1.10 ± 0.3 VDC

Dead Time (Sec.) 1.00 - 0.5

Input Sensitivity 10 mV

Overrange N/A

Calibration sources used have calibration traceable to the N.I.S.T.

Date MAY 9 1994

Signature [Signature]

P.O. Number 7301722

EIS
TEST
2

5-96-1

CERTIFICATION OF CALIBRATION

Instrument ESP-2 / HP-260

Serial Number 1495/702/1430

Type of Source SrY-90 S/N-7620,5-544

10 mCi S/N-733

Cs-137 10 Ci S/N-375

MR-2 S/N-739

FLUKE 8024B S/N-4335223

Range	Calibration Point	Reading
<u>CNT/MIN</u>	<u>8,600 CPM (2π)</u>	<u>5.54±03 CNT/MIN (64.4%)</u>
<u>CNT/MIN</u>	<u>22,400 CPM (2π)</u>	<u>1.51±04 CNT/MIN (67.4%)</u>

When the Calibration Constant is 1.00, the 2 pi counting efficiency is:

$\frac{\text{Reading}}{\text{Calibration Point CPM (2 pi)}} \times 100 = \text{Per Cent Efficiency}$

Calibration Constant 1.00 ± 00

High Voltage 8.97±02 VDC

Dead Time (Sec.) 6.28 - 05

Input Sensitivity 10 mV

Overrange 4.79 ± 06 CNT/MIN

Calibration sources used have calibration traceable to the N.I.S.T.

Date MAY 9 1994

Signature [Signature]

EIS
TEST
2

P.O. Number

7301722

5-9

CERTIFICATION OF CALIBRATION

Instrument ESP-2 / HP-270

Serial Number 1495/702/1434

Type of Source 16 mCi S/N-733
Cs-137 10 Ci S/N-375

MP-2 S/N-739

FLUKE 8024B S/N-4335223

Range	Calibration Point	Reading
<u>mR/hr</u>	<u>2 mR/hr</u>	<u>2.16 ± 0.0 mR/hr</u>
<u>mR/hr</u>	<u>20 mR/hr</u>	<u>2.00 ± 0.1 mR/hr</u>
<u>mR/hr</u>	<u>200 mR/hr</u>	<u>1.91 ± 0.2 mR/hr</u>
<u>mR/hr</u>	<u>2 R/hr</u>	<u>2.00 ± 0.3 mR/hr</u>

Calibration Constant 6.41 ± 0.7

High Voltage 8.97 ± 0.2 VDC

Dead Time (Sec.) 9.54 - 0.5

Input Sensitivity 10 mV

Overrange 4.08 ± 0.3 mR/hr

Calibration sources used have calibration traceable to the N.I.S.T.

Date MAY 9 1994

Signature

James E. [Signature]

P.O. Number 7301722



CERTIFICATION OF CALIBRATION

Instrument ESP-2 / HP-270

Serial Number 1499 / 703 / 1431

10mCi S/N 733

Type of Source Cs-137 10 Ci S/N 375

MP-2 S/N 126

FLUKE 8010A S/N 2435022

Range	Calibration Point	Reading
<u>mR/hr</u>	<u>2 mR/hr</u>	<u>2.03+00 mR/hr</u>
<u>mR/hr</u>	<u>20 mR/hr</u>	<u>1.90+01 mR/hr</u>
<u>mR/hr</u>	<u>200 mR/hr</u>	<u>1.93+02 mR/hr</u>
<u>mR/hr</u>	<u>2 R/hr</u>	<u>2.00+03 mR/hr</u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>

Calibration Constant 6.25+07

High Voltage 8.97+02 Volts

Dead Time (Sec.) 9.45-05

Input Sensitivity 10 mV

Overrange 4.20+03 mR/hr

Calibration sources used have calibration traceable to N.I.S.T.

Date 9-14-95

Signature *Robert C. Lueb*



P.O. Number 7302117

9-14-95

CERTIFICATION OF CALIBRATION

Instrument ESP-2 / HP-260Serial Number 1499 / 703 / 1428Type of Source SrY-90 S/N 544.7620Cs-137 10mCi S/N 73310 Ci S/N 375MP-2 S/N 126FLUKE 8010A S/N 2435022

Range	Calibration Point	Reading
<u>CNT/MIN</u>	<u>8.350 CPM (2π)</u>	<u>5.03+03 CNT/MIN(60.2%)</u>
<u>CNT/MIN</u>	<u>22.200 CPM (2π)</u>	<u>1.33+04 CNT/MIN(59.9%)</u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>

When the Calibration Constant is 1.00, the 2 π counting efficiency is:
$$\frac{\text{Reading}}{\text{Calibration Point CPM (2}\pi\text{)}} \times 100 = \text{Per Cent Efficiency}$$
Calibration Constant 1.00+00 High Voltage 8.97+02 voltsDead Time (Sec.) 9.45-05 Input Sensitivity 10 mVOverrange 4.69+06 CNT/MIN

Calibration sources used have calibration traceable to the N.I.S.T.

Date 9-14-95Signature *Scott A. Dull*P.O. Number 73021179-14-95

CERTIFICATION OF CALIBRATION

Instrument ESP-2 / AC-3-7

Serial Number 1499 / 703 / 1436

Type of Source Pu-239 S/N 8318.8319
8320.8321

MP-2 S/N 126

FLUKE 8010A S/N 2435022

Range	Calibration Point	Reading
<u>CNT/MIN</u>	<u>1.420 CPM (2π)</u>	<u>5.56+02 CNT/MIN(39.2%)</u>
<u>CNT/MIN</u>	<u>15.800 CPM (2π)</u>	<u>6.02+03 CNT/MIN(38.1%)</u>
<u>CNT/MIN</u>	<u>134.000 CPM (2π)</u>	<u>5.14+04 CNT/MIN(38.4%)</u>
<u>CNT/MIN</u>	<u>1.117.000 CPM (2π)</u>	<u>4.40+05 CNT/MIN(39.4%)</u>
<u> </u>	<u> </u>	<u> </u>

When the Calibration Constant is 1.00, the 2π counting efficiency is:

$$\frac{\text{Reading}}{\text{Calibration Point CPM (2π)}} \times 100 = \text{Per Cent Efficiency}$$

Calibration Constant 1.00+00

High Voltage 1.25+03 Volts

Dead Time (Sec.) 1.00-05

Input Sensitivity 10 mV

Overrange N/A

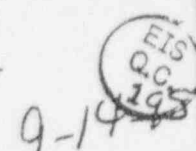
Calibration sources used have calibration traceable to the N.I.S.T.

Date 9-14-95

Signature *Detla A. Lill*



P.O. Number 7302117



CERTIFICATION OF CALIBRATION

Instrument Codium Model 2220/47-65

Serial Number 50063/11017/11093790/757

Type of Source MP-2 7/126
Fluke 8020A 7/12371753

Range	Calibration Point	Reading
<u>606</u>	<u>400 gpm</u>	<u>400 gpm</u>
<u>606</u>	<u>100 gpm</u>	<u>100 gpm</u>
<u>606</u>	<u>4 Kipm</u>	<u>4 Kipm</u>
<u>606</u>	<u>1 Kipm</u>	<u>1 Kipm</u>
<u>606</u>	<u>40 Kipm</u>	<u>40 Kipm</u>
<u>606</u>	<u>10 Kipm</u>	<u>10 Kipm</u>
<u>606</u>	<u>400 Kipm</u>	<u>400 Kipm</u>
<u>606</u>	<u>100 Kipm</u>	<u>100 Kipm</u>

Calibration sources used have calibration traceable to the N.I.S.T.

Date MAR 9 1994

Signature Scott A. Smith



P.O. Number 7301722

3-9-94

CERTIFICATION OF CALIBRATION

Instrument Ludlum Model 2220/43-65

Serial Number 50063/11017/PK073790/957

Type of Source MP-2 5/126
Fluor 8020A 4N 2371753

Range	Calibration Point	Reading
<u>X1</u>	<u>400cpm</u>	<u>400cpm</u>
<u>X1</u>	<u>100cpm</u>	<u>100cpm</u>
<u>X10</u>	<u>4Kcpm</u>	<u>4Kcpm</u>
<u>X10</u>	<u>1Kcpm</u>	<u>1Kcpm</u>
<u>X100</u>	<u>40Kcpm</u>	<u>40Kcpm</u>
<u>X100</u>	<u>10Kcpm</u>	<u>10Kcpm</u>
<u>X1K</u>	<u>400Kcpm</u>	<u>400Kcpm</u>
<u>X1K</u>	<u>100Kcpm</u>	<u>100Kcpm</u>

Calibration sources used have calibration traceable to the N.I.S.T.

Date MAR 9 1994

Signature

Scott A. Gull



P.O. Number

7301722

30-94
1

CERTIFICATION OF CALIBRATION

Instrument Ludlum Model 2220/42-65

Serial Number 50063/11017/PC093790/957

Type of Source MP-2 $\frac{5}{8}$ 126
FluKa 8020A $\frac{5}{8}$ 2371753
Pu-237 $\frac{5}{8}$ 8319

Time (In Minutes)	Calibration Point	Reading
<u>.1</u>	<u>1 Kcpm</u>	<u>100 counts</u>
<u>.5</u>	<u>1 Kcpm</u>	<u>500 counts</u>
<u>1</u>	<u>1 Kcpm</u>	<u>1,000 counts</u>
<u>1</u>	<u>15,500 cpm (2T)</u>	<u>6,918 counts (43.8%)</u>

Calibration sources used have calibration traceable to the N.I.S.T.

Date MAR 9 1994

Signature Robert A. Glick



P.O. Number 7301722



CERTIFICATION OF CALIBRATION

Instrument LUDLUM 2223 / 44-10

Serial Number 48403 / 5707 / 1242

Type of Source MP-2 S/N 126
FLUKE 8010A S/N 2435022

Range	Calibration Point	Reading
<u>X1</u>	<u>400 CPM</u>	<u>400 CPM</u>
<u>X1</u>	<u>100 CPM</u>	<u>100 CPM</u>
<u>X10</u>	<u>4K CPM</u>	<u>4K CPM</u>
<u>X10</u>	<u>1K CPM</u>	<u>1K CPM</u>
<u>X100</u>	<u>40K CPM</u>	<u>40K CPM</u>
<u>X100</u>	<u>10K CPM</u>	<u>10K CPM</u>
<u>X1000</u>	<u>400K CPM</u>	<u>400K CPM</u>
<u>X1000</u>	<u>100K CPM</u>	<u>100K CPM</u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>

Calibration sources used have calibration traceable to the N.I.S.T.

Date MAY 08 1993

Signature

Kath A. Devell



P.O. Number 7302117

5/29/93

CERTIFICATION OF CALIBRATION

Instrument LUDLUM 2220 / 44-10

Serial Number 48403 / 5707 / 1242

Type of Source MP-2 S/N 126
FLUKE 8010A S/N 2435022
Cs-137 S/N 733

Time (In Minutes)	Calibration Point	Reading
<u>.1</u>	<u>1k CPM</u>	<u>100 COUNTS</u>
<u>.5</u>	<u>1k CPM</u>	<u>500 COUNTS</u>
<u>1</u>	<u>1k CPM</u>	<u>1000 COUNTS</u>
<u>1</u>	<u>.2 R/hr</u>	<u>211,728 CPM</u>
<u>HIGH VOLTAGE = 1000 Volts</u>		<u>THRESHOLD = 100</u>

Calibration sources used have calibration traceable to the N.I.S.T.

Date MAY 08 1995

Signature *Scott A. Dues*



P.O. Number 7302117

5/18/95

CERTIFICATION OF CALIBRATION

Instrument LUDLUM 2220 / 44-10Serial Number 48403 / 5707 / 1242Type of Source MP-2 S/N 126
FLUKE 8010A S/N 2435022

Range	Calibration Point	Reading
<u>LOG</u>	<u>400 CPM</u>	<u>400 CPM</u>
<u>LOG</u>	<u>100 CPM</u>	<u>100 CPM</u>
<u>LOG</u>	<u>4K CPM</u>	<u>4K CPM</u>
<u>LOG</u>	<u>1K CPM</u>	<u>1K CPM</u>
<u>LOG</u>	<u>40K CPM</u>	<u>40K CPM</u>
<u>LOG</u>	<u>10K CPM</u>	<u>10K CPM</u>
<u>LOG</u>	<u>400K CPM</u>	<u>400K CPM</u>
<u>LOG</u>	<u>100K CPM</u>	<u>100K CPM</u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>

Calibration sources used have calibration traceable to the N.I.S.T.

Date MAY 08 1995

Signature

Robert A. DullP.O. Number 73021175-8-95



Designer and Manufacturer
of
Scientific and Industrial
Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 915-235-5494
501 OAK STREET FAX NO. 915-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER RUST FEDERAL SERVICE

ORDER NO. 210508

Ig. Ludlum Measurements, Inc. Model 2221

Serial No. 97290

Mfg. Ludlum Measurements, Inc. Model 44-10

Serial No. PR080577

Cal. Date 01/30/95 Cal Due Date 07/30/95 Cal. Interval 6 Months Meterface 202-159

Check mark ☒ applies to applicable instr. and/or detector IAW mfg. spec. T. 71 °F RH 25 % Alt 713.8 mm Hg

☐ New Instrument ☐ Instrument Received ☐ Within Toler. $\pm 10\%$ ☒ 10-20% ☐ Out of Tol. ☐ Requiring Repair

☒ 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) 4.4 VDC

Instrument Volt Set Comments V Input Sens. Comments mV Del. Ope. Comments V at Comments mV Threshold Dial Ratio 100 = 4 mV

☒ HV Readout (2 points) Ref./Inst. 500 / 1 500 V Ref./Inst. 1996 / 1 2000 V

COMMENTS:

Firmware: #261010
Settings for 44-10:
*8.45% Resolution for Cs137
Peak voltage= 641v. (with detector connected)
Peak settings:
Threshold dial : 642
Window dial: 40; Window="ON"
10mv. setting for gross counts only.

Settings for 43-37:
Alpha HV : 1250v.
Beta HV : 1700v.
HV currently set for 43-37
at 1250v. Calibrated w/39" cable.

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*
X 1K	400kcpm	395	400
X 1K	100kcpm	95	100
X 100	40kcpm	395	400
X 100	10kcpm	95	100
X 10	4kcpm	395	400
X 10	1kcpm	95	100
X 1	400cpm	395	400
X 1	100cpm	95	100

*Uncertainty within $\pm 10\%$ C.F. within $\pm 20\%$

ALL Range(s) Calibrated Electronically

REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout			Log Scale		
400kcpm	40037(0)	40037(0)	500kcpm	450K	500K
40kcpm	4008(0)	4008(0)	50kcpm	45K	50K
4kcpm	400(0)	400(0)	5kcpm	4.25K	4.5K
400cpm	40(0)	40(0)	500cpm	475	500
40cpm	4(0)	4(0)	50cpm	50	50

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 MIL-STD-45662A and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources:

Cs-137 Gamma S/N ☐ 1.62 ☐ G112 ☐ M565 ☐ S105 ☐ T1008 ☐ T879

☐ Neutron Am-241 Be S/N T-304

☒ Alpha S/N 4337.Pv239* ☒ Beta S/N 443-68-2.C14*443-68-3A.Tc99 ☒ Other Am241 ~1.59uCi

☒ m 500 S/N 79956 ☐ Oscilloscope S/N ☒ Multimeter S/N 53801574

Calibrated By: Elias Chavez Date 1-30-95

Reviewed By: Jimmie Fleming Date 1-30-95

Bench Test Data For Detector

Detector 44-10 Serial No. PR 080577

Customer RUST FEDERAL SERVICE

Order #. 210508

Counter 2221 Serial No. 97290

Counter Input Sensitivity 10 mV

Count Time 0.1 min

Distance Source to Detector Surface

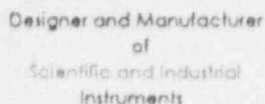
Other 10mV = 250 on Threshold dial

[illegible]

Signature Elio Chavez

Date 1-30-95

QZ



LUDITM MEASUREMENTS, INC.
POST OFFICE BOX 310 PH. 915-235-5494
501 OAK STREET FAX NO. 915-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

Detector 43-37 Serial No. PR 092634

Customer RUST FEDERAL SERVICE

Order # 210508

Counter 2221 Serial No. 97290

Counter Input Sensitivity 4 mV

Count Time 6 sec. SOURCE / 60 sec. BACKGROUND

Distance Source to Detector Surface

Other $4 \text{ mV} = 100$ on threshold dial.

High Voltage Background Isotope Pu 239 Isotope Tc 99 Isotope Ci 4 Isotope _____
Size 15700cm Size 0.00997µCi Size 0.0962µCi Size _____

Signature Elias Chavez Date 1-30-95



Designer and Manufacturer
of
Scientific and Industrial
Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.

POST OFFICE BOX 810 PH. 915-235-5494

501 OAK STREET FAX NO. 915-235-4672

SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER RUST FEDERAL SERVICE

ORDER NO. 210508

Mfg. Ludlum Measurements, Inc. Model 2221

Serial No. 97290

Mfg. Ludlum Measurements, Inc. Model 44-10

Serial No. PR080577

Cal. Date 01/30/95 Cal Due Date 07/30/95 Cal. Interval 6 Months Meterface 202-159

Check mark ☒ applies to applicable instr. and/or detector IAW mfg. spec. 1. 71 °F RH 25 % Alt 713.8 mm Hg

☐ New Instrument ☐ Instrument Received ☐ Within Toler. $\pm 10\%$ ☒ 10-20% ☐ Out of Tol. ☐ Requiring Repair

☒ 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) 4.4 VDC

Instrument Volt Set Comments V input Sens. Comments mV Det. Oper. Comments V at Comments mV Threshold Dial Ratio 100 = 4 m

☒ HV Readout (2 points) Ref./Inst. 500 / 500 V Ref./Inst. 1996 / 2000 V

COMMENTS:

Firmware: #261010

Settings for 44-10:

*8.45% Resolution for Cs137

Peak voltage= 641v. (with detector connected)

Peak settings:

Threshold dial : 642

Window dial: 40; Window="ON"

10mv. setting for gross counts only.

Settings for 43-37:

Alpha HV : 1250v.

Beta HV : 1700v.

HV currently set for 43-37

at 1250v. Calibrated w/39" cable.

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*
X 1K	400kcpm	395	400
X 1K	100kcpm	95	100
X 100	40kcpm	395	400
X 100	10kcpm	95	100
X 10	4kcpm	395	400
X 10	1kcpm	95	100
X 1	400cpm	395	400
X 1	100cpm	95	100

*Uncertainty within $\pm 10\%$ C.F. within $\pm 20\%$

ALL Range(s) Calibrated Electronically

REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
400kcpm	40037(0)	40037(0)	500kcpm	450K	500K
40kcpm	4008(0)	4008(0)	50kcpm	45K	50K
4kcpm	400(0)	400(0)	5kcpm	4.25K	4.5K
400cpm	40(0)	40(0)	500cpm	475	500
40cpm	4(0)	4(0)	50cpm	50	50

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 MIL-STD-4562A and ANSI N323-1978. State of Texas Calibration License No. LO-196

Reference Instruments and/or Sources:

Cs-137 Gamma S/N ☐ 1162 ☐ G112 ☐ M565 ☐ 5105 ☐ T1008 ☐ T879

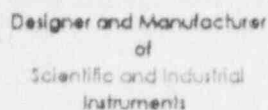
☐ Neutron Am-241 Be S/N T-3

☒ Alpha S/N 4337 Pu239* ☒ Beta S/N 443-68-2C14*443-68-3A Ic99 ☒ Other Am241 ~1.59uCi

☒ m 500 S/N 79956 ☐ Oscilloscope S/N ☒ Multimeter S/N 53801574

Calibrated By: Elias Chaver Date 1-30-95

Reviewed By: Jimmie Fleming Date 1-30-95



LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 915-235-5494
501 OAK STREET FAX NO. 915-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

Detector 44-10 Serial No. PK 000571

Customer RUST FEDERAL SERVICE

Order #. 210508

Counter 2221 Serial No. 97290

Counter Input Sensitivity 10 mV

Count Time 0.1 min

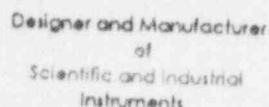
Distance Source to Detector Surface

Other 10mV = 250 on Threshold line

[illegible]

Signature _____

Date _____



LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 915-235-5494
501 OAK STREET FAX NO. 915-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

Bench Test Data For Detector

Other 4mv = 100 on threshold dial

Date 1-30-95



Designer and Manufacturer
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LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 915-235-5494
501 OAK STREET FAX NO. 915-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

Bench Test Data For Alpha Detector

Detector 43-65 Serial No. PR078783

Customer RUST FEDERAL SERVICES

Order #. 211565/211710

Counter 2221 Serial No. 63769

Counter Input Sensitivity 10 mV

Count Time 1 minute background, 0.1 min source Distance Source to Detector Surface

Isotope Pu-239 #8743, 128044 Other _____



Alpha Scintillation Detector

43-4/43-44 HV Adjust for Altitude

Altitude	High Voltage
Sea Level	2050 V
1000 foot	2025 V
2000 foot	2000 V
3000 foot	1975 V
4000 foot	1950 V
5000 foot	1925 V
6000 foot	1900 V
7000 foot	1875 V

HV Plateau	Background	Source Count
<u>600</u>	<u>0</u>	<u>413</u>
<u>650</u>	<u>0</u>	<u>525</u>
<u>700</u>	<u>0</u>	<u>557</u>
<u>750</u>	<u>0</u>	<u>563</u>
<u>800</u>	<u>0</u>	<u>554</u>
<u>850</u>	<u>0</u>	<u>549</u>
<u>900</u>	<u>1</u>	<u>625</u>

Operating Voltage Set at 750 V

Air Proportional	43-5	<u>43-65</u>	Background	Meter Reading	Range/Scale
	Toe	L/S*	<u>0</u>	<u>541</u>	<u>0.1 min</u>
	Center	Center	<u>0</u>	<u>563</u>	"
	Heel	Other**	<u>0</u>	<u>550</u>	"

☒ Uniformity ($\pm 10\%$)

Average Efficiency 43 %

- * Least Sensitive Position (Heel of Detector)
- ** Opposite Least Sensitive Position (Top of Detector)

Signature Michael Moe

Date 3-21-95



Designer and Manufacturer
of
Scientific and Industrial
Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 915-235-5494
501 OAK STREET FAX NO. 915-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER RUST FEDERAL SERVICES ORDER NO. 211565 / 211710

g. Ludlum Measurements, Inc. Model 2221 Serial No. 68769

Mfg. Ludlum Measurements, Inc. Model 44-10 / 43-65 Serial No. PR060362 / PR078783

Cal. Date 03/21/95 Cal Due Date 09/21/95 Cal. Interval 6 Months Meterface 202-159

Check mark ☒ applies to applicable instr. and/or detector IAW mfg. spec. T. 73 °F RH 33 % Alt 706.8 mm Hg

☐ New Instrument ☐ Instrument Received ☒ Within Toler. $\pm 10\%$ ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair

☒ 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) 4.4 VDC

Instrument Volt Set Comments V Input Sens. 10 mV Det. Oper. Comments V at 10 mV Threshold Dial Ratio 100 = 10 mV

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

COMMENTS:

44-10 HV = 1150 V.
43-65 HV = 750 V.

Firmware: 261010

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	400 K cpm	400	400
x1000	100 K cpm	100	100
x100	40 K cpm	400	400
x100	10 K cpm	100	100
x10	4 K cpm	400	400
x10	1 K cpm	100	100
x1	400 cpm	400	400
x1	100 cpm	100	100

*Uncertainty within $\pm 10\%$ C.F. within $\pm 20\%$

ALL Range(s) Calibrated Electronically

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*		REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout	400 K cpm	400681	400681	Log Scale	500 K cpm	500K	500K
	40 K cpm	40071	40071		50 K cpm	50K	50K
	4 K cpm	4009	4009		5 K cpm	5K	5K
	400 cpm	401	400		500 cpm	500	500
	40 cpm	40	40				

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 MIL-STD-45662A and ANSI N323-1978. State of Texas Calibration License No. 10-1963

Reference Instruments and/or Sources:

Cs-137 Gamma S/N ☐ 1162 ☐ G112 ☐ M565 ☐ S105 ☐ T1008 ☐ T879

☐ Neutron Am-241 Be S/N T-304

☒ Alpha S/N Pu-239 #8743 ☐ Beta S/N Other Am-241 5.5uCi

m 500 S/N 63893 ☐ Oscilloscope S/N 57770262 ☒ Multimeter S/N 57770262

Calibrated By: Michael Moore Date 3-21-95

Reviewed By: Jimmie Fleming Date 3-22-95

Bench Test Data For Detector

Detector 44-10 Serial No. PRD60362

Customer RUST FEDERAL SERVICES

Order #. 211565 / 211710

Counter 2221 Serial No. 68769

Counter Input Sensitivity 10 mV

Count Time 0.1 minute

Distance Source to Detector 4 cm ~~10 cm~~ mm

Other 12% resolution for Cs 137

[illegible]

Signature Michael "Moore"

Date 3-21-95



Designer and Manufacturer
of
Scientific and Industrial
Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 915-235-5494
501 OAK STREET FAX NO. 915-235-1122
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER RUST FEDERAL SERVICES ORDER NO. 207766

Ludlum Measurements, Inc. Model 2221 Serial No. 68769

Mfg. Ludlum Measurements, Inc. Model 44-10 Serial No. PR 092053

Cal. Date 08/23/94 Cal Due Date 02/23/95 Cal. Interval 6 Months Meterface 202-159

Check mark ☒ applies to applicable Instr. and/or detector IAW mfg. spec. T. 75 °F RH 45 % Alt 704.8 mm Hg

☐ New Instrument ☐ Instrument Received ☒ Within Toler. $\pm 10\%$ ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair

☒ Mechanical ck. ☒ Meter Zeroed ☐ Background Subtract ☒ Input Sens. Linearity

☒ F/S Resp. ck. ☒ Reset ck. ☒ Window Operation

☒ Audio ck. ☐ Alarm Setting ck. ☒ Batt. ck. (Min. Volt) 4.4 VDC

Instrument Volt Set Comments V Input Sens. Comments mV Det. Oper. Comments V at Comments mV Threshold Dial Ratio 100 = 4 mV

☒ HV Readout (2 points) Ref./Inst. 500 / 500 V Ref./Inst. 2013 / 2000 V

COMMENTS:

44-10 HV = ^{950V}~~1250V~~ with det connected at 10 mV or 250 on threshold
43-68 HV = alpha 1250V at 4 mV
Beta 1700V at 4 mV \rightarrow or 100 on threshold
cold with a 39°C cable

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*
X 1K	400 K cpm	400	400
X 1K	100 K cpm	100	100
X 100	40 K cpm	400	400
X 100	10 K cpm	100	100
X 10	4 K cpm	400	400
X 10	1 K cpm	100	100
X 1	400 cpm	400	400
X 1	100 cpm	100	100

*Uncertainty within $\pm 10\%$ C.F. within $\pm 20\%$

ALL Range(s) Calibrated Electronically

REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout			Log Scale		
400 K cpm	400151	400151	500 K cpm	495K	495K
40 K cpm	40014	40014	50 K cpm	50K	50K
4 K cpm	4002	4002	5 K cpm	5K	5K
400 cpm	400	400	500 cpm	500	500
40 cpm	40	40	50 cpm	50	50

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 MIL-STD-45662A and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources:

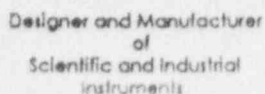
Cs-137 Gamma S/N ☐ 1162 ☐ G112 ☐ M565 ☐ S105 ☐ T1008 ☐ T879 ☐ Neutron Am-241 Be S/N T-304

☒ Alpha S/N Pu239 #8743 ☒ Beta S/N C-14, 159uCl ☒ Other Cs137 5uCl, Am241 5.5uCl

☐ 500 S/N 63893 ☐ Oscilloscope S/N ☒ Multimeter S/N 57770262

Calibrated By: Michael Moore Date 8-23-94

Reviewed By: James Fleming Date 8-23-94



LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 915-235-5494
501 OAK STREET FAX NO. 915-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

Detector 44-10 Serial No. PR092053

Customer RUST FEDERAL SERVICES

Order #. 207766

Counter 2221 Serial No. 68769

Counter Input Sensitivity 44 Comments 10 mV

Count Time 0.1 min

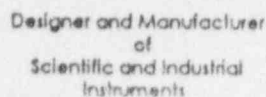
Distance Source to Detector 4cm

Other 12.7 % resolution for Co 137

Signature Michael Mox

Date 8-23-94

97



LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 915-235-5494
501 OAK STREET FAX NO. 915-235-4672
SWEETWATER, TEXAS 79556 U.S.A.

Detector 43-68 Serial No. PRDA0863

Customer RUST FEDERAL SERVICES

Order #. 207766

Counter 2221 Serial No. 68769

Counter Input Sensitivity ^{mm} Comments mV

Count Time 1 min background, 0.1 min source Distance Source to Detector surface

Other 900 input 50cc/min

Signature Michael Moe

Date 8-23-94

CERTIFICATION OF CALIBRATION

Instrument LUDLUM 2221Serial Number 94951 / 953Type of Source MP-2 S/N 174
FLUKE 8010A S/N 2650076

Range	Calibration Point	Reading
<u>X1</u>	<u>400 CPM</u>	<u>400 CPM</u>
<u>X1</u>	<u>100 CPM</u>	<u>100 CPM</u>
<u>X10</u>	<u>4K CPM</u>	<u>4K CPM</u>
<u>X10</u>	<u>1K CPM</u>	<u>1K CPM</u>
<u>X100</u>	<u>40K CPM</u>	<u>40K CPM</u>
<u>X100</u>	<u>10K CPM</u>	<u>10K CPM</u>
<u>X1000</u>	<u>400K CPM</u>	<u>400K CPM</u>
<u>X1000</u>	<u>100K CPM</u>	<u>100K CPM</u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>

Calibration sources used have calibration traceable to N.I.S.T.

Date 7-18-95Signature [Signature]P.O. Number 7302117

CERTIFICATION OF CALIBRATION

Instrument LUDLUM 2221


Serial Number 94951 / 953

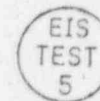
Type of Source Mf-2 S/N 174
FLUKE 8010A S/N 2650076

Range	Calibration Point	Reading
<u>LOG</u>	<u>400 CPM</u>	<u>400 CPM</u>
<u>LOG</u>	<u>100 CPM</u>	<u>100 CPM</u>
<u>LOG</u>	<u>4K CPM</u>	<u>4K CPM</u>
<u>LOG</u>	<u>1K CPM</u>	<u>1K CPM</u>
<u>LOG</u>	<u>40K CPM</u>	<u>40K CPM</u>
<u>LOG</u>	<u>10K CPM</u>	<u>10K CPM</u>
<u>LOG</u>	<u>400K CPM</u>	<u>400K CPM</u>
<u>LOG</u>	<u>100K CPM</u>	<u>100K CPM</u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>
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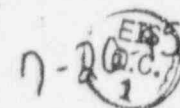
Calibration sources used have calibration traceable to N.I.S.T.

Date 7-18-95

Signature 



P.O. Number 7302117



CERTIFICATION OF CALIBRATION

Instrument LUDLUM 2221 / 44-10

Serial Number 94951/953 / PR060411/11067

Type of Source MP-2 S/N 174
FLUKE 8010A S/N 2650076
Cs-137 10mCi S/N 733

Time (In Minutes)	Calibration Point	Reading
<u>.1</u>	<u>1k CPM</u>	<u>100 COUNTS</u>
<u>.2</u>	<u>1k CPM</u>	<u>200 COUNTS</u>
<u>.5</u>	<u>1k CPM</u>	<u>500 COUNTS</u>
<u>1</u>	<u>1k CPM</u>	<u>1.000 COUNTS</u>
<u>2</u>	<u>1k CPM</u>	<u>2.001 COUNTS</u>
<u>5</u>	<u>1k CPM</u>	<u>5.001 COUNTS</u>
<u>10</u>	<u>1k CPM</u>	<u>10.002 COUNTS</u>
<u>1</u>	<u>.2 mR/hr</u>	<u>225.290 COUNTS</u>
<u>HIGH VOLTAGE = 850 Volts THRESHOLD = 80 = 10 mV</u>		

Calibration sources used have calibration traceable to N.I.S.T.

Date 7-18-95

Signature [Signature]

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P.O. Number 7302117

7-18-95
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Eberline Instrument Corporation

CERTIFICATION OF CALIBRATION

Instrument LUDLUM MODEL 2201/43-65

Serial Number 94951/953/PRO94650/1232

Type of Source MP-2 S/N-739
FLUKE 8010A S/N-5740119

Range	Calibration Point	Reading
<u>LOG</u>	<u>40C CPM</u>	<u>400 CPM</u>
<u>LOG</u>	<u>100 CPM</u>	<u>100 CPM</u>
<u>LOG</u>	<u>4K CPM</u>	<u>4K CPM</u>
<u>LOG</u>	<u>1K CPM</u>	<u>1K CPM</u>
<u>LOG</u>	<u>40K CPM</u>	<u>40K CPM</u>
<u>LOG</u>	<u>10K CPM</u>	<u>10K CPM</u>
<u>LOG</u>	<u>400K CPM</u>	<u>400K CPM</u>
<u>LOG</u>	<u>100K CPM</u>	<u>100K CPM</u>

Calibration sources used have calibration traceable to the N.I.S.T.

Date MAY 24 1994

Signature 

P.O. Number 7301722

ETS
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5-27-94
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A subsidiary of
Thermo Instrument
Systems Inc.

Eberline Instrument Corporation

CERTIFICATION OF CALIBRATION

Instrument LUDWIG MODEL 2221/43-65

Serial Number 94951/453/PRO94050/1232

Type of Source MP-2 S/N-739
FWKE 800A S/N-5740119

Range	Calibration Point	Reading
<u>.1</u>	<u>1K CPM</u>	<u>100 counts</u>
<u>.2</u>	<u>1K CPM</u>	<u>200 counts</u>
<u>.5</u>	<u>1K CPM</u>	<u>500 counts</u>
<u>1</u>	<u>1K CPM</u>	<u>1000 counts</u>
<u>2</u>	<u>1K CPM</u>	<u>2001 counts</u>
<u>5</u>	<u>1K CPM</u>	<u>5001 counts</u>
<u>10</u>	<u>1K CPM</u>	<u>10002 counts</u>

Calibration sources used have calibration traceable to the N.I.S.T.

Date MAY 24 1994

Signature [Signature]

P.O. Number 7301722

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A subsidiary of
**Thermo Instrument
 Systems Inc**

CERTIFICATION OF CALIBRATION

Instrument LUDLUM MODEL 2221/43-65

Serial Number 94951/953/PC094650/1232

Type of Source MP-2 S/N-739

Pu-239 S/N-7188

FLUKE 8010A S/N-5740119

Range	Calibration Point	Reading
<u>X1</u>	<u>400 CPM</u>	<u>400 CPM</u>
<u>X1</u>	<u>100 CPM</u>	<u>100 CPM</u>
<u>X10</u>	<u>4K CPM</u>	<u>4K CPM</u>
<u>X10</u>	<u>1K CPM</u>	<u>1K CPM</u>
<u>X100</u>	<u>40K CPM</u>	<u>40K CPM</u>
<u>X100</u>	<u>10K CPM</u>	<u>10K CPM</u>
<u>X1K</u>	<u>400K CPM</u>	<u>400K CPM</u>
<u>X1K</u>	<u>100K CPM</u>	<u>100K CPM</u>
<u>X100</u>	<u>12,700 CPM (2M)</u>	<u>6,348 CPM (49.9%)</u>

Calibration sources used have calibration traceable to the N.I.S.T.

Date MAY 24 1994

Signature [Signature]



P.O. Number 7301722



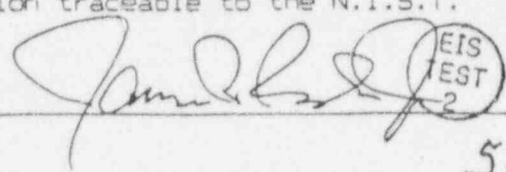
A subsidiary of
Thermo Instrument
Systems Inc.

CERTIFICATION OF CALIBRATION

Instrument LUDLUM MODEL 2221/43-65Serial Number 94951/953/PRO94650/1232Type of Source NIP-2 S/N-739FLUKE 8010A S/N-5740119

Range	Calibration Point	Reading
<u>LOG</u>	<u>400 CPM</u>	<u>400 CPM</u>
<u>LOG</u>	<u>100 CPM</u>	<u>100 CPM</u>
<u>LOG</u>	<u>4K CPM</u>	<u>4K CPM</u>
<u>LOG</u>	<u>1K CPM</u>	<u>1K CPM</u>
<u>LOG</u>	<u>40K CPM</u>	<u>40K CPM</u>
<u>LOG</u>	<u>10K CPM</u>	<u>10K CPM</u>
<u>LOG</u>	<u>400K CPM</u>	<u>400K CPM</u>
<u>LOG</u>	<u>100K CPM</u>	<u>100K CPM</u>

Calibration sources used have calibration traceable to the N.I.S.T.

Date MAY 24 1994Signature 

P.O. Number

7301722EIS
TEST
25-24-94
1

CERTIFICATION OF CALIBRATION

Instrument LUDLUM MODEL 2221/43-65

Serial Number 94951/953/PRO94650/1232

Type of Source MP-2 S/N-739

FWKE 806A S/N-5740119

Range	Calibration Point	Reading
<u>.1</u>	<u>1K CPM</u>	<u>100 counts</u>
<u>.2</u>	<u>1K CPM</u>	<u>200 counts</u>
<u>.5</u>	<u>1K CPM</u>	<u>500 counts</u>
<u>1</u>	<u>1K CPM</u>	<u>1000 counts</u>
<u>2</u>	<u>1K CPM</u>	<u>2001 counts</u>
<u>5</u>	<u>1K CPM</u>	<u>5001 counts</u>
<u>10</u>	<u>1K CPM</u>	<u>10,002 counts</u>

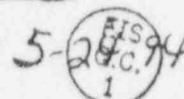
Calibration sources used have calibration traceable to the N.I.S.T.

Date MAY 24 1994

Signature [Signature]

P.O. Number

7301722



CERTIFICATION OF CALIBRATION

Instrument LUDLUM MODEL 2221/43-65

Serial Number 94951/953/PR094650/1232

Type of Source MP-2 S/N-739

Pu-239 S/N-7188

FLUKE 8010A S/N-5740119

Range	Calibration Point	Reading
<u>X1</u>	<u>400 CPM</u>	<u>400 CPM</u>
<u>X1</u>	<u>100 CPM</u>	<u>100 CPM</u>
<u>X10</u>	<u>4K CPM</u>	<u>4K CPM</u>
<u>X10</u>	<u>1K CPM</u>	<u>1K CPM</u>
<u>X100</u>	<u>40K CPM</u>	<u>40K CPM</u>
<u>X100</u>	<u>10K CPM</u>	<u>10K CPM</u>
<u>X1K</u>	<u>400K CPM</u>	<u>400K CPM</u>
<u>X1K</u>	<u>100K CPM</u>	<u>100K CPM</u>
<u>X100</u>	<u>12,700 CPM (2π)</u>	<u>6,348 CPM (49.9%)</u>

Calibration sources used have calibration traceable to the N.I.S.T.

Date MAY 24 1994

Signature [Signature]

P.O. Number 7.301722



CERTIFICATION OF CALIBRATION

Instrument Ludlum Model 2221/43-37

Serial Number 97276 / R038130 / 1230 / 11020

Type of Source MP-2 5/8 126
Fluke 5010A 5/8 2435022

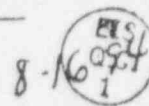
Range	Calibration Point	Reading
<u>x1</u>	<u>400cpm</u>	<u>400cpm</u>
<u>x1</u>	<u>100cpm</u>	<u>100cpm</u>
<u>x10</u>	<u>4Kcpm</u>	<u>4Kcpm</u>
<u>x10</u>	<u>1Kcpm</u>	<u>1Kcpm</u>
<u>x100</u>	<u>40Kcpm</u>	<u>40Kcpm</u>
<u>x100</u>	<u>10Kcpm</u>	<u>10Kcpm</u>
<u>x1K</u>	<u>400Kcpm</u>	<u>400Kcpm</u>
<u>x1K</u>	<u>100Kcpm</u>	<u>100Kcpm</u>

Calibration sources used have calibration traceable to the N.I.S.T.

Date AUG 16 1994 Signature Robert A. Shaw



P.O. Number 7301722



CERTIFICATION OF CALIBRATION

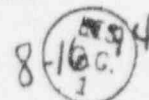
Instrument Ludlum Model 2221/43-37Serial Number 97276/HK038130/1230/11020Type of Source MF-2 5N 126Fiske 8010A 5N 2435022

Range	Calibration Point	Reading
<u>Col</u>	<u>400 gM</u>	<u>400 gM</u>
<u>Col</u>	<u>100 gM</u>	<u>100 gM</u>
<u>Col</u>	<u>4 K gM</u>	<u>4 K gM</u>
<u>Col</u>	<u>1 K gM</u>	<u>1 K gM</u>
<u>Col</u>	<u>40 K gM</u>	<u>40 K gM</u>
<u>Col</u>	<u>10 K gM</u>	<u>10 K gM</u>
<u>Col</u>	<u>400 K gM</u>	<u>400 K gM</u>
<u>Col</u>	<u>100 K gM</u>	<u>100 K gM</u>

Calibration sources used have calibration traceable to the N.I.S.T.

Date AUG 16 1994Signature Scott A. Shull

P.O. Number

7301722

CERTIFICATION OF CALIBRATION

Instrument Cudlum Model 2221/43-37Serial Number 97276/1K038130/1230/11020Type of Source MP-2 Pu 126Fiske 8010A Pu 2435022 Pu -237 Pu 8319

Time (In Minutes)	Calibration Point	Reading
<u>.1</u>	<u>1Kcpm</u>	<u>100 COUNTS</u>
<u>.2</u>	<u>1Kcpm</u>	<u>200 COUNTS</u>
<u>.5</u>	<u>1Kcpm</u>	<u>500 COUNTS</u>
<u>1</u>	<u>1Kcpm</u>	<u>1,000 COUNTS</u>
<u>2</u>	<u>1Kcpm</u>	<u>2,000 COUNTS</u>
<u>5</u>	<u>1Kcpm</u>	<u>5,001 COUNTS</u>
<u>10</u>	<u>1Kcpm</u>	<u>10,002 COUNTS</u>
<u>1</u>	<u>15,800cpm (2M)</u>	<u>4,958 COUNTS (31.4%)</u>
	<u>HIGH VOLTAGE = 1400 VOLTS</u>	

Calibration sources used have calibration traceable to the N.I.S.T.

Date AUG 16 1994Signature Scott A. Gull

P.O. Number

7301722

CERTIFICATION OF CALIBRATION

Instrument Ludlum Model 2221/43-37

Serial Number 94947/738/12090881/740/2225

Type of Source MP-2 5/N 126

Range	Calibration Point	Reading
<u>X1</u>	<u>400cpm</u>	<u>400cpm</u>
<u>X1</u>	<u>100cpm</u>	<u>100cpm</u>
<u>X10</u>	<u>4Kcpm</u>	<u>4Kcpm</u>
<u>X10</u>	<u>1Kcpm</u>	<u>1Kcpm</u>
<u>X100</u>	<u>40Kcpm</u>	<u>40Kcpm</u>
<u>X100</u>	<u>10Kcpm</u>	<u>10Kcpm</u>
<u>X1K</u>	<u>400Kcpm</u>	<u>400Kcpm</u>
<u>X1K</u>	<u>100Kcpm</u>	<u>100Kcpm</u>

Calibration sources used have calibration traceable to the N.I.S.T.

Date JUL 25 1994

Signature Kolt A. Dull



P.O. Number 7301722



CERTIFICATION OF CALIBRATION

Instrument Ludlum Model 2221/43-37

Serial Number 94947/738/AR09088/740/2225

Type of Source MP-2 8x126

Range	Calibration Point	Reading
<u>LoG</u>	<u>400cpm</u>	<u>400cpm</u>
<u>LoG</u>	<u>100cpm</u>	<u>100cpm</u>
<u>LoG</u>	<u>4Kcpm</u>	<u>4Kcpm</u>
<u>LoG</u>	<u>1Kcpm</u>	<u>1Kcpm</u>
<u>LoG</u>	<u>40Kcpm</u>	<u>40Kcpm</u>
<u>LoG</u>	<u>10Kcpm</u>	<u>10Kcpm</u>
<u>LoG</u>	<u>400Kcpm</u>	<u>400Kcpm</u>
<u>LoG</u>	<u>100Kcpm</u>	<u>100Kcpm</u>

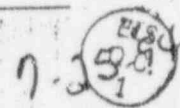
Calibration sources used have calibration traceable to the N.I.S.T.

Date JUL 25 1994

Signature [Signature]



P.O. Number 7301722



CERTIFICATION OF CALIBRATION

Instrument Ludlum Model 2221/43-37

Serial Number 94947/738/1209081/740/2225

Type of Source MF-2 S/N 126

Fluke 8010A S/N 2435022

CS-137 S/N L-075

Time (In Minutes)	Calibration Point	Reading
<u>.1</u>	<u>1 Kcpm</u>	<u>100 COUNTS</u>
<u>.2</u>	<u>1 Kcpm</u>	<u>200 COUNTS</u>
<u>.5</u>	<u>1 Kcpm</u>	<u>500 COUNTS</u>
<u>1</u>	<u>1 Kcpm</u>	<u>1,000 COUNTS</u>
<u>2</u>	<u>1 Kcpm</u>	<u>2,000 COUNTS</u>
<u>5</u>	<u>1 Kcpm</u>	<u>5,001 COUNTS</u>
<u>10</u>	<u>1 Kcpm</u>	<u>10,002 COUNTS</u>
<u>1</u>	<u>196,758 DPM</u>	<u>58,425 COUNTS (29.7%)</u>

Calibration sources used have calibration traceable to the N.I.S.T.

Date JUL 25 1994

Signature Kott G. Gues



P.O. Number 7301722





Designer and Manufacturer
of
Scientific and Industrial
Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.

POST OFFICE BOX 810 PH. 915-235-5494

501 OAK STREET FAX NO. 915-235-4672

SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER RUST FEDERAL SERVICES ORDER NO. 208264

J. Ludlum Measurements, Inc. Model 2221 Serial No. 94947

Mfg. Ludlum Measurements, Inc. Model 43-37 / SPA-3 Serial No. Comments

Cal. Date 09/19/94 Cal Due Date 03/19/95 Cal. Interval 6 Months Meterface 202-159

Check mark ☒ applies to applicable Instr. and/or detector IAW mfg. spec. T. 75 °F RH 45 % Alt 708.8 mm Hg

☐ New Instrument ☐ Instrument Received ☐ Within Toler. $\pm 10\%$ ☒ 10-20% ☐ Out of Tol. ☐ Requiring Repair
☒ Mechanical ck. ☒ Meter Zeroed ☐ Background Subtract ☒ Input Sens. Linearity
☒ F/S Resp. ck. ☒ Reset ck. ☒ Window Operation
☒ Audio ck. ☐ Alarm Setting ck. ☒ Batt. ck. (Min. Volt) 4.4 VDC

Instrument Volt Set Comments V Input Sens. Comments mV Det. Oper. Comments V at Comments mV Threshold Dial Ratio 100 = 4 mV

☒ HV Readout (2 points) Ref./Inst. 498 / 500 V Ref./Inst. 2000 / 2000 V

COMMENTS:

43-37 alpha HV = 1250 V @ 4mV. SN-PR090880

43-37 beta HV = 1750 V @ 4mV.

SPA-3 HV = 1750 V @ 10mV. SN-11023

General 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*
X 1K	400 K cpm	400	400
X 1K	100 K cpm	100	100
X 100	40 K cpm	400	400
X 100	10 K cpm	100	100
X 10	4 K cpm	400	400
X 10	1 K cpm	100	100
X 1	400 cpm	400	400
X 1	100 cpm	100	100

*Uncertainty within $\pm 10\%$ C.F. within $\pm 20\%$

ALL Range(s) Calibrated Electronically

REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout	400 K cpm	40003	Log Scale	500 K cpm	500K
	40 K cpm	40031		50 K cpm	50K
	4 K cpm	4004		5 K cpm	5K
	400 cpm	400		500 cpm	500
	40 cpm	40		50 cpm	50

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 MIL-STD-45662A and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources:

Ci-137 Gamma S/N ☐ 1162 ☐ G112 ☐ M565 ☐ S105 ☐ T1008 ☐ T879

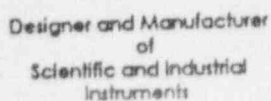
☐ Neutron Am-241 Be S/N T-304

☒ Alpha S/N Pu239 #8743 ☒ Beta S/N C-14, 159uCl ☒ Other Cs-137 5uCl, Am241 5.5uCl

☒ m 500 S/N 63893 ☐ Oscilloscope S/N ☒ Multimeter S/N 57770262

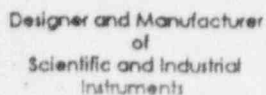
Calibrated By: Michael May Date 9-19-94

Reviewed By: James Fleming Date 9-19-94



LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 915-235-494
501 OAK STREET FAX NO. 915-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

97



LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 915-235-5494
501 OAK STREET FAX NO. 915-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

Detector SPA-3 Serial No. 11023

Customer RUST FEDERAL SERVICES

Order #. 208264

Counter 2221 Serial No. 94947

Counter Input Sensitivity _____ Comments _____ mV

Count Time 0.1 min Distance Source to Detector 4 cm

Other 250 on threshold = 10 mV

High Voltage _____ Isotope Am-241 Isotope _____ Isotope _____ Isotope _____
Background _____ Size 5.5-6 Size _____ Size _____ Size _____

Signature Michael Moore

Date 9-19-94

CERTIFICATION OF CALIBRATION

Instrument LUDLUM 2221 / SPA-3

Serial Number 94947 / 738 / 11023

Type of Source MP-2 S/N 126
FLUKE 8010A S/N 5740119

Range	Calibration Point	Reading
LOG	400 PM	400 CPM
LOG	100 CPM	100 CPM
LOG	4K CPM	4K CPM
LOG	1K CPM	1K CPM
LOG	40K CPM	40K CPM
LOG	10K CPM	10K CPM
LOG	400K CPM	400K CPM
LOG	100K CPM	100K CPM

Calibration sources used have calibration traceable to the N.I.S.T.

Date APR 10 1995

Signature *Robert G. Lue*



P.O. Number 7302117



CERTIFICATION OF CALIBRATION

Instrument LU DLUM 2221 / SPA-3

Serial Number 94947 / 738 / 11023

Type of Source MP-2 S/N 126
FLUKE 8010A S/N 5740119

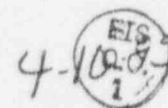
Range	Calibration Point	Reading
<u>Y1</u>	<u>400 PM</u>	<u>400 CPM</u>
<u>X1</u>	<u>100 CPM</u>	<u>100 CPM</u>
<u>X10</u>	<u>4K CPM</u>	<u>4K CPM</u>
<u>X10</u>	<u>1K CPM</u>	<u>1K CPM</u>
<u>X100</u>	<u>40K CPM</u>	<u>40K CPM</u>
<u>X100</u>	<u>10K CPM</u>	<u>10K CPM</u>
<u>X1000</u>	<u>400K CPM</u>	<u>400K CPM</u>
<u>X1000</u>	<u>100K CPM</u>	<u>100K CPM</u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>

Calibration sources used have calibration traceable to the N.I.S.T.

APR 10 1995

Date Signature *Scott G. Jones* 

P.O. Number 7302117



CERTIFICATION OF CALIBRATION


Instrument LU DLUM 2221 / SPA-3

Serial Number 94947 / 738 / 11023


Type of Source MP-2 S/N 126
FLUKE 8010A S/N 5740119
Cs-137 10mCi S/N 733

Time (In Minutes)	Calibration Point	Reading
<u>.1</u>	<u>1k CPM</u>	<u>100 COUNTS</u>
<u>.2</u>	<u>1k CPM</u>	<u>200 COUNTS</u>
<u>.5</u>	<u>1k CPM</u>	<u>500 COUNTS</u>
<u>1</u>	<u>1k CPM</u>	<u>1,000 COUNTS</u>
<u>2</u>	<u>1k CPM</u>	<u>2,000 COUNTS</u>
<u>5</u>	<u>1k CPM</u>	<u>5,000 COUNTS</u>
<u>10</u>	<u>1k CPM</u>	<u>10,001 COUNTS</u>
<u>1</u>	<u>.2 mR/hr</u>	<u>223,444 COUNTS</u>
<u>HIGH VOLTAGE = 1300 Volts</u>		<u>THRESHOLD = 10 mV</u>

Calibration sources used have calibration traceable to the N.I.S.T.

Date APR 10 1995 Signature Scott A. Gull 

P.O. Number 7302117

4-10-95


CERTIFICATION OF CALIBRATION

Instrument LUDLUM 2221

Serial Number 94965 / 952

Type of Source MP-2 S/N 126
FLUKE 8010A S/N 2435022

Range	Calibration Point	Reading
<u>X1</u>	<u>400 CPM</u>	<u>400 CPM</u>
<u>X1</u>	<u>100 CPM</u>	<u>100 CPM</u>
<u>X10</u>	<u>4K CPM</u>	<u>4K CPM</u>
<u>X10</u>	<u>1K CPM</u>	<u>1K CPM</u>
<u>X100</u>	<u>40K CPM</u>	<u>40K CPM</u>
<u>X100</u>	<u>10K CPM</u>	<u>10K CPM</u>
<u>X1000</u>	<u>400K CPM</u>	<u>400K CPM</u>
<u>X1000</u>	<u>100K CPM</u>	<u>100K CPM</u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>

Calibration sources used have calibration traceable to N.I.S.T.

Date 8-15-95 Signature *Bolt A. Dull*



P.O. Number 7302117



CERTIFICATION OF CALIBRATION

Instrument LUDLUM 2221Serial Number 94965 / 952Type of Source MP-2 S/N 126
FLUKE 8010A S/N 2435022

Range	Calibration Point	Reading
<u>LOG</u>	<u>400 CPM</u>	<u>400 CPM</u>
<u>LOG</u>	<u>100 CPM</u>	<u>100 CPM</u>
<u>LOG</u>	<u>4K CPM</u>	<u>4K CPM</u>
<u>LOG</u>	<u>1K CPM</u>	<u>1K CPM</u>
<u>LOG</u>	<u>40K CPM</u>	<u>40K CPM</u>
<u>LOG</u>	<u>10K CPM</u>	<u>10K CPM</u>
<u>LOG</u>	<u>400K CPM</u>	<u>400K CPM</u>
<u>LOG</u>	<u>100K CPM</u>	<u>100K CPM</u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>

Calibration sources used have calibration traceable to N.I.S.T.

Date 8-15-95Signature *Scott A. Dull*P.O. Number 73021178-16-95

CERTIFICATION OF CALIBRATION

Instrument LUDLUM 2221 / 43-37

952 / 735


Serial Number 94965 / PR090880Type of Source MP-2 S/N 126

FLUKE 8010A S/N 2435022

Cs-137 S/N L-075

Time (In Minutes)	Calibration Point	Reading
<u>.1</u>	<u>1k CPM</u>	<u>100 COUNTS</u>
<u>.2</u>	<u>1k CPM</u>	<u>200 COUNTS</u>
<u>.5</u>	<u>1k CPM</u>	<u>500 COUNTS</u>
<u>1</u>	<u>1k CPM</u>	<u>1.000 COUNTS</u>
<u>2</u>	<u>1k CPM</u>	<u>2.000 COUNTS</u>
<u>5</u>	<u>1k CPM</u>	<u>5.001 COUNTS</u>
<u>10</u>	<u>1k CPM</u>	<u>10.002 COUNTS</u>
<u>1</u>	<u>192.321 CPM(2m)</u>	<u>58.525 COUNTS (30.4%)</u>
<u>HIGH VOLTAGE = 1750 Volts THRESHOLD = 100 = 4 mV</u>		

Calibration sources used have calibration traceable to the N.I.S.T.

Date 8-15-95 Signature Scott A. Lue P.O. Number 7302117

8/21/95

CERTIFICATION OF CALIBRATION

Instrument UDLUM 2221 / 43-20

952 / 1102

Serial Number 94965 / PR091226

Type of Source MP-2 S/N 126

FLUKE 8010A S/N 2435022

Cs-137 S/N L-075

Time (In Minutes)	Calibration Point	Reading
<u>.1</u>	<u>1k CPM</u>	<u>100 COUNTS</u>
<u>.2</u>	<u>1k CPM</u>	<u>200 COUNTS</u>
<u>.5</u>	<u>1k CPM</u>	<u>500 COUNTS</u>
<u>1</u>	<u>1k CPM</u>	<u>1.000 COUNTS</u>
<u>2</u>	<u>1k CPM</u>	<u>2.000 COUNTS</u>
<u>5</u>	<u>1k CPM</u>	<u>5.001 COUNTS</u>
<u>10</u>	<u>1k CPM</u>	<u>10.002 COUNTS</u>
<u>1</u>	<u>192.321 CPM (2π)</u>	<u>56.756 COUNTS (29.5%)</u>
HIGH VOLTAGE = 1750 Volts THRESHOLD = 100 = 4 mV		

Calibration sources used have calibration traceable to N.I.S.T.

Date 8-15-95

Signature *Scott A. Shuck*

P.O. Number 7302117

8016 95
114



Designer and Manufacturer
of
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CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 915-235-5494
501 OAK STREET FAX NO. 915-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER RUST FEDERAL SERVICE

ORDER NO. 210508

g. Ludlum Measurements, Inc. Model 2221

Serial No. 94983

Mfg. Ludlum Measurements, Inc. Model 43-65

Serial No. RN010429

Cal. Date 01/30/95 Cal Due Date 07/30/95 Cal. Interval 6 Months Meterface 202-159

Check mark ☒ applies to applicable Instr. and/or detector IAW mfg. spec. T. 71 °F RH 25 % Alt 713.8 mm Hg

☐ New Instrument ☐ Instrument Received ☐ Within Toler. $\pm 10\%$ ☐ 10-20% ☐ Out of Tol. ☒ Requiring Repair

☒ Mechanical ck.

☒ Meter Zeroed

☐ Background Subtrac

☒ Input Sens. Linearity

☒ F/S Resp. ck.

☒ Reset ck.

☒ Window Operation

☒ Geotropism

☒ Audio ck.

☐ Alarm Setting ck.

☒ Batt. ck. (Min. Volt) 4.4 VDC

Instrument Volt Set Comments V Input Sens. Comments mV Det. Oper. Comments V at Comments mV Threshold Dial Ratio 100 = 4 mV

☒ HV Readout (2 points) Ref./Inst. 499 / 500 V Ref./Inst. 1999 / 2000 V

COMMENTS:

Firmware: #261010

High voltage for 43-65 set with detector connected.

High voltage for 43-37 as follows:

Alpha : 1250v.

Beta : 1750v.

High voltage currently set for 43-37 at 1250v.

Calibrated using 39" cable.

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*
X 1K	400kcpm		400
X 1K	100kcpm		100
X 100	40kcpm		400
X 100	10kcpm		100
X 10	4kcpm		400
X 10	1kcpm		100
X 1	400cpm		400
X 1	100cpm		100

*Uncertainty within $\pm 10\%$ C.F. within $\pm 20\%$

ALL Range(s) Calibrated Electronically

REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout			Log Scale		
400kcpm		40016(6)	500kcpm		450K
40kcpm		4002(0)	50kcpm		47.5K
4kcpm		400(2)	5kcpm		4.5K
400cpm		40(0)	500cpm		500
40cpm		4(0)	50cpm		50

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 MIL-STD-45662A and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources:

Cs-137 Gamma S/N ☐ 1162 ☐ G112 ☐ M565 ☐ S105 ☐ T1008 ☐ T879

☐ Neutron Am-241 Be S/N T-304

☒ Alpha S/N 4337-Pu239*1619-Ih230 ☒ Beta S/N 443-68-2.C14*443-68-3A.Ic99 ☒ Other Am241 31.59uCi

☒ m 500 S/N 79956 ☐ Oscilloscope S/N ☒ Multimeter S/N 53801574

Calibrated By: Eliot Chawley Date 1-30-95

Reviewed By: Jimmie Fleming Date 1-31-95



Designer and Manufacturer
of
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CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 915-235-5494
501 OAK STREET FAX NO. 915-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER RUST FEDERAL SERVICES ORDER NO. 207766

G. Ludlum Measurements, Inc. Model 2221 Serial No. 94965

Mfg. Ludlum Measurements, Inc. Model 44-10 Serial No. PR093054

Cal. Date 08/23/94 Cal Due Date 02/23/95 Cal. Interval 6 Months Meterface 202-159

Check mark ☒ applies to applicable instr. and/or detector IAW mfg. spec. T. 75 °F RH 45 % Alt 704.8 mm Hg

☐ New Instrument Instrument Received ☒ Within Toler. $\pm 10\%$ ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair

☒ Mechanical ck. ☒ Meter Zeroed ☐ Background Subtract ☒ Input Sens. Linearity

☒ F/S Resp. ck. ☒ Reset ck. ☒ Window Operation

☒ Audio ck. ☐ Alarm Setting ck. ☒ Batt. ck. (Min. Volt) 4.4 VDC

Instrument Volt Set Comments V Input Sens. Comments mV Det. Oper. Comments V at Comments mV Threshold Dial Ratio 100 = 4 m

☒ HV Readout (2 points) Ref./Inst. 500 / 500 V Ref./Inst. 2010 / 2000 V

COMMENTS:

44-10 HV = 1250V with det. connected at 10mV or 250 on threshold

43-68 HV = Alpha 1250V at 4mV > or 100 on threshold
Beta 1250V at 4mV

calibrated using a 39" c cable.

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*
X 1K	400 K cpm	400	400
X 1K	100 K cpm	100	100
X 100	40 K cpm	400	400
X 100	10 K cpm	100	100
X 10	4 K cpm	400	400
X 10	1 K cpm	100	100
X 1	400 cpm	400	400
X 1	100 cpm	100	100

*Uncertainty within $\pm 10\%$ C.F. within $\pm 20\%$

ALL Range(s) Calibrated Electronically

REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout	400 K cpm	400108	Log Scale	500 K cpm	
	40 K cpm	40017		50 K cpm	
	4 K cpm	4002		5 K cpm	
	400 cpm	401		500 cpm	
	40 cpm	40		50 cpm	

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 MIL-STD-45662A and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources:

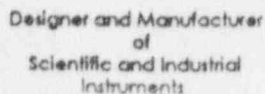
Cs-137 Gamma S/N ☐ 1162 ☐ G112 ☐ M565 ☐ S105 ☐ T1008 ☐ T879 ☐ Neutron Am-241 8e S/N T-304

☒ Alpha S/N Pu239 #8743 ☒ Beta S/N C-14 159uCl ☒ Other Cs137 5uCl Am241 5.5uCl

m 500 S/N 63893 ☐ Oscilloscope S/N ☒ Multimeter S/N 57770262

Calibrated By: Michael More Date 8-23-94

Reviewed By: Jimmi Fleming Date 8-23-94



SWEETWATER, TEXAS 79556, U.S.A.

Bench Test Data For Detector

Detector 43-68 Serial No. PR092635

Customer RUST FEDERAL SERVICES

Order #. 207766

Counter 2221 Serial No. 94965

Counter Input Sensitivity _____ Comments _____ mV

Count Time 1 min background, 0.1 min source Distance Source to Detector

Other _____

[illegible]

Signature Michael Mone

Date 8-23-94

Q Z



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CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 915-235-5494
501 OAK STREET FAX NO. 915-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER RUST FEDERAL SERVICE ORDER NO. 210508
g. Ludlum Measurements, Inc. Model 2221 Serial No. 94983
Mfg. Ludlum Measurements, Inc. Model 43-65 Serial No. RN010429
Cal. Date 01/30/95 Cal Due Date 07/30/95 Cal. Interval 6 Months Meterface 202-159

Check mark ☒ applies to applicable instr. and/or detector IAW mfg. spec. T. 71 °F RH 25 % Alt 713.8 mm Hg

☐ New Instrument ☐ Instrument Received ☐ Within Toler. $\pm 10\%$ ☐ 10-20% ☐ Out of Tol. ☒ Requiring Repair
☒ 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) 4.4 VDC

Instrument Volt Set Comments V Input Sens. Comments mV Del. Oper. Comments V at Comments mV Threshold Dial Ratio 100 = 4 mV

☒ HV Readout (2 points) Ref./Inst. 499 / 500 V Ref./Inst. 1999 / 2000 V

COMMENTS:

Firmware: #261010
High voltage for 43-65 set with detector connected.
High voltage for 43-37 as follows:
Alpha : 1250v.
Beta : 1750v.
High voltage currently set for 43-37 at 1250v.
Calibrated using 39" cable.

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*
X 1K	400kcpm	N/A	400
X 1K	100kcpm		100
X 100	40kcpm		400
X 100	10kcpm		100
X 10	4kcpm		400
X 10	1kcpm		100
X 1	400cpm		400
X 1	100cpm		100

*Uncertainty within $\pm 10\%$ C.F. within $\pm 20\%$

ALL Range(s) Calibrated Electronically

REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout			Log Scale		
400kcpm	N/A	40016(0)	500kcpm	N/A	450K
40kcpm		4002(0)	50kcpm		47.5K
4kcpm		400(2)	5kcpm		4.5K
400cpm		40(0)	500cpm		500
40cpm		4(0)	50cpm		50

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 MIL-STD-45662A and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources:

Cs-137 Gamma S/N ☐ 1162 ☐ G112 ☐ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ Neutron Am-241 Be S/N T-304
☒ Alpha S/N 4337.Pu239*1619.Th230 ☒ Beta S/N 443-68-2C14*443-68-3A.Tc99 ☒ Other Am241 21.59uCi EC
☒ m 500 S/N 79956 ☐ Oscilloscope S/N ☒ Multimeter S/N 53801574

Calibrated By: Elvis Chavez Date 1-30-95

Reviewed By: Jimmie Thomas Date 1-31-95



Designer and Manufacturer
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LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 915-235-5494
501 OAK STREET FAX NO. 915-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

Bench Test Data For Alpha Detector

Detector 43-65 Serial No. ELPR RN010429
Customer RUST FEDERAL SERVICE Order # 210508
Counter 2221 Serial No. 94983 Counter Input Sensitivity 10 mV
Count Time 60 SEC. SOURCE / 60 SEC. BACKGROUND Distance Source to Detector Surface
Isotope 1619 Th230.3442cpm Other 10mV = 250 on Threshold dial

43-4/43-44 HV Adjust for Altitude

Altitude	High Voltage
Sea Level	2050 V
1000 foot	2025 V
2000 foot	2000 V
3000 foot	1975 V
4000 foot	1950 V
5000 foot	1925 V
6000 foot	1900 V
7000 foot	1875 V

Alpha Scintillation Detector

HV Plateau	Background	Source Count
500	0	89
550	0	154
600	0	158
650	0	157
700	0	158

Operating Voltage Set at 600 V

Air Proportional	43-5	43-65	Background	Meter Reading	Range/Scale
	Toe	L/S*	0	168	---
	Center	Center	0	158	---
	Heel	Other**	0	158	---

☒ Uniformity (± 10%)

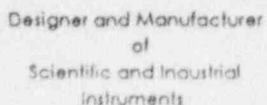
Average Efficiency 46.7 %

* Least Sensitive Position (Heel of Detector)

** Opposite Least Sensitive Position (Top of Detector)

Signature Elior Chavez

Date 1-30-95



LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 915-235-5494
501 OAK STREET FAX NO. 915-235-4672
SWEETWATER, TEXAS 79556 U.S.A.

Detector 43-37 Serial No. PR090881

Customer RUST FEDERAL SERVICE

Order # 210508

Counter 2221 Serial No. 94983

Counter Input Sensitivity 4 mV

Count Time 6 sec. SOURCE / 60 sec. BACKGROUND

Distance Source to Detector 1000 cm

Other $4 \text{ mV} = 100$ on Threshold dial.

[illegible]

Signature _____

Date _____

CERTIFICATION OF CALIBRATION

Instrument Ludlum Model 2221/42-37

Serial Number 94983/12090880

Type of Source MP-2 $\frac{5}{8}$ " 126
Fluor Font 5/2435022

Range	Calibration Point	Reading
<u>LoG</u>	<u>400cpm</u>	<u>400cpm</u>
<u>LoG</u>	<u>100cpm</u>	<u>100cpm</u>
<u>LoG</u>	<u>4Kcpm</u>	<u>4Kcpm</u>
<u>LoG</u>	<u>1Kcpm</u>	<u>1Kcpm</u>
<u>LoG</u>	<u>40Kcpm</u>	<u>40Kcpm</u>
<u>LoG</u>	<u>10Kcpm</u>	<u>10Kcpm</u>
<u>LoG</u>	<u>400Kcpm</u>	<u>400Kcpm</u>
<u>LoG</u>	<u>100Kcpm</u>	<u>100Kcpm</u>

Calibration sources used have calibration traceable to the N.I.S.T.

Date MAY 24 1994

Signature Scott G. Dine



P.O. Number 7301722

5-24-94

CERTIFICATION OF CALIBRATION

Instrument Ludlum Model 2221/43-37

Serial Number 94983/1K0908P0

Type of Source MP-2 5/8 126
F10K 8010A 5V 2435022

Time (In Minutes)	Calibration Point	Reading
<u>.1</u>	<u>1 KcpM</u>	<u>100 COUNTS</u>
<u>.2</u>	<u>1 KcpM</u>	<u>200 COUNTS</u>
<u>.5</u>	<u>1 KcpM</u>	<u>500 COUNTS</u>
<u>1</u>	<u>1 KcpM</u>	<u>1000 COUNTS</u>
<u>2</u>	<u>1 KcpM</u>	<u>2000 COUNTS</u>
<u>5</u>	<u>1 KcpM</u>	<u>5000 COUNTS</u>
<u>10</u>	<u>1 KcpM</u>	<u>10,002 COUNTS</u>

Calibration sources used have calibration traceable to the N.I.S.T.

Date MAY 24 1994

Signature Scott A. Gull



P.O. Number

7301722

5 14 94
G.C.
1

CERTIFICATION OF CALIBRATION

Instrument Ludlum Model 2221/43-37

Serial Number 94953/PRO90880

Type of Source MP-2 $\frac{1}{4}$ N 126
Fiske 800A-41 2435022
CS-137 $\frac{3}{4}$ L-075

Range	Calibration Point	Reading
<u>X1</u>	<u>400cpm</u>	<u>400cpm</u>
<u>X1</u>	<u>100cpm</u>	<u>100cpm</u>
<u>X10</u>	<u>4Kcpm</u>	<u>4Kcpm</u>
<u>X10</u>	<u>1Kcpm</u>	<u>1Kcpm</u>
<u>X100</u>	<u>40Kcpm</u>	<u>40Kcpm</u>
<u>X100</u>	<u>10Kcpm</u>	<u>10Kcpm</u>
<u>X1K</u>	<u>400Kcpm</u>	<u>400Kcpm</u>
<u>X1K</u>	<u>100Kcpm</u>	<u>100Kcpm</u>
<u>X1K</u>	<u>197,744 DPM(4T)</u>	<u>57,637cpm (29.1%)</u>

Calibration sources used have calibration traceable to the N.I.S.T.

Date MAY 24 1994

Signature Scott A. Dill



P.O. Number 7301722





Designer and Manufacturer
of
Scientific and Industrial
Instruments

LUDLUM MEASUREMENTS, INC.

POST OFFICE BOX 810 PH. 915-235-5494

501 OAK STREET FAX NO. 915-235-4672

SWEETWATER, TEXAS 79556, U.S.A.

Bench Test Data For Alpha Detector

Detector 43-65 Serial No. RN010429

Customer RUST FEDERAL SERVICES

Order #. 208264

Counter 2221 Serial No. 94983

Counter Input Sensitivity 10 ~~Comments~~ mV

Count Time 1 min background, 0.1 min source

Distance Source to Detector surface

Isotope Pu239 #8743 Other 250 on threshold = 10mV



Alpha Scintillation Detector

43-4/43-44 HV Adjust for Altitude

Altitude	High Voltage
Sea Level	2050 V
1000 foot	2025 V
2000 foot	2000 V
3000 foot	1975 V
4000 foot	1950 V
5000 foot	1925 V
6000 foot	1900 V
7000 foot	1875 V

HV Plateau	Background	Source Count
<u>500</u>	<u>0</u>	<u>259</u>
<u>550</u>	<u>0</u>	<u>529</u>
<u>600</u>	<u>0</u>	<u>568</u>
<u>650</u>	<u>0</u>	<u>591</u>
<u>700</u>	<u>1</u>	<u>583</u>

Operating Voltage Set at 600 V

Air Proportional	43-5	<u>43-65</u>	Background	Meter Reading	Range/Scale
	Toe	L/S*	<u>0</u>	<u>560</u>	<u>0.1 min</u>
	Center	Center	<u>0</u>	<u>568</u>	<u>"</u>
	Heel	Other**	<u>0</u>	<u>557</u>	<u>"</u>

☒ Uniformity ($\pm 10\%$)

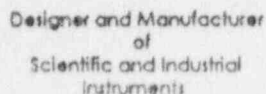
Average Efficiency 43.9 %

* Least Sensitive Position (Heel of Detector)

** Opposite Least Sensitive Position (Top of Detector)

Signature Michael Moore

Date 9-19-94



LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 915-235-5494
501 OAK STREET FAX NO. 915-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

Bench Test Data For Detector

Detector 43-37 Serial No. AR 090881

Customer RUST FEDERAL SERVICES

Order #. 208264

Counter 2221 Serial No. 94983

Counter Input Sensitivity Comments mV

Count Time 1 min background, 0.1 min sample

Distance Source to Detector surface

Other gas input 50 cc/min

[illegible]

Signature Michael Moore

Date 9-19-94



Designer and Manufacturer
of
Scientific and Industrial
Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.

POST OFFICE BOX 810 PH. 915-235-5494

501 OAK STREET FAX NO. 915-235-4672

SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER RUST FEDERAL SERVICES

ORDER NO. 208264

Model 2221

Serial No. 94983

Mfg. Ludlum Measurements, Inc. Model 43-37 / 43-65

Serial No. Comments

Cal. Date 09/19/94 Cal Due Date 03/19/95 Cal. Interval 6 Months Meterface 202-159

Check mark ☒ applies to applicable instr. and/or detector IAW mfg. spec. T. 75 °F RH 45 % Alt 708.8 mm Hg

☐ New Instrument ☐ Instrument Received ☒ Within Toler. $\pm 10\%$ ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair

☒ Mechanism ☒ Meter Zeroed ☐ Background Subtract ☒ Input Sens. Uncertainty

☒ F/S Resp. ☒ Reset ck. ☒ Window Operation

☒ Audio ck. ☐ Alarm Setting ck. ☒ Batt. ck. (Min. Volt) 4.4 VDC

Instrument Volt Set Comments V Input Sens. Comments mV Det. Oper. Comments V at Comments mV Threshold Dial Ratio 100 = 4 mV

☒ HV Readout (2 points) Ref./Inst. 499 / 500 V Ref./Inst. 2000 / 2000 V

COMMENTS:

43-37 alpha HV = 14.50 V @ 4mV. SN-PR090881

43-37 beta HV = 17.50 V @ 4mV. "

43-65 HV = 600 V @ 10mV. SN-~~PR01203~~ RA D10417

mm

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*
X 1K	400 Kcpm	400	400
X 1K	100 "	100	100
X 100	40 "	400	400
X 100	10 "	100	100
X 10	4 "	400	400
X 10	1 "	100	100
X 1	400 cpm	400	400
X 1	100 "	100	100

*Uncertainty within $\pm 10\%$ C.F. within $\pm 20\%$

All

Range(s) Calibrated Electronically

REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout			Log Scale		
400 Kcpm	400113	400113	500 Kcpm	495K	495K
40 "	40002	40002	50K "	50K	50K
4 "	4000	400	5K "	5K	5K
400 cpm	400	400	500 cpm	500	500
40 "	40	40	50 "	50	50

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 MIL-STD-45642A and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources:

Cs-137 Gamma S/N ☐ 1162 ☐ G112 ☐ M565 ☐ S105 ☐ T1008 ☐ T879

☐ Neutron Am-241 Be S/N T-304

☒ Alpha S/N Pu239 #8743 ☒ Beta S/N C-14, 152uCl ☒ Other Cs-137 5uCl

☒ m 500 S/N 63893 ☐ Oscilloscope S/N ☒ Multimeter S/N 57770262

Calibrated By: Michael Moe Date 9-19-94

Reviewed By: Jimmy Fleming Date 9-19-94

CERTIFICATION OF CALIBRATION

Instrument LUDLUM 2221 / 44-10Serial Number 68780/11064 / PR010442/5708Type of Source MP-2 S/N 174

FLUKE 8010A S/N 2650071

Cs-137 10mCi S/N 733

Time
(In Minutes)

Calibration Point

<u>.1</u>	<u>1k CPM</u>	
<u>.2</u>	<u>1k CPM</u>	
<u>.5</u>	<u>1k CPM</u>	
<u>1</u>	<u>1k CPM</u>	<u>1</u>
<u>2</u>	<u>1k CPM</u>	<u>2</u>
<u>5</u>	<u>1k CPM</u>	<u>5</u>
<u>10</u>	<u>1k CPM</u>	<u>10</u>
<u>1</u>	<u>.2 mR/hr</u>	<u>222</u>

HIGH VOLTAGE = 775 Volts

THRESHOLD = 212 =

Calibration sources used have calibration traceable to 1

Date 7-18-95 Signature [Signature]P.O. Number 7302117

CERT

Inst

Serial

Type

Range

<u>X1</u>
<u>Y1</u>
<u>X10</u>
<u>X10</u>
<u>X100</u>
<u>X100</u>
<u>X1000</u>
<u>X1000</u>

Calibration source

Date 7-18-95P.O. Number 73

CERTIFICATION OF CALIBRATION

Instrument LUDLUM 2221 / 44-10Serial Number 68780/11064 / PR010442/5708Type of Source MP-2 S/N 174

FLUKE 8010A S/N 2650076

Cs-137 10mCi S/N 733

Time (In Minutes)	Calibration Point	Reading
<u>.1</u>	<u>1k CPM</u>	<u>100 COUNTS</u>
<u>.2</u>	<u>1k CPM</u>	<u>200 COUNTS</u>
<u>.5</u>	<u>1k CPM</u>	<u>500 COUNTS</u>
<u>1</u>	<u>1k CPM</u>	<u>1.000 COUNTS</u>
<u>2</u>	<u>1k CPM</u>	<u>2.001 COUNTS</u>
<u>5</u>	<u>1k CPM</u>	<u>5.001 COUNTS</u>
<u>10</u>	<u>1k CPM</u>	<u>10.002 COUNTS</u>
<u>1</u>	<u>.2 mR/hr</u>	<u>222.970 COUNTS</u>
<u>HIGH VOLTAGE = 775 Volts THRESHOLD = 212 = 10 mV</u>		

Calibration sources used have calibration traceable to N.I.S.T.

Date 7-18-95Signature [Signature]P.O. Number 7302117

CERTIFICATION OF CALIBRATION

Instrument LUDLUM 2221Serial Number 68780 / 11064Type of Source MP-2 S/N 174
FLUKE 8010A S/N 2650076

Range	Calibration Point	Reading
<u>X1</u>	<u>400 CPM</u>	<u>400 CPM</u>
<u>Y1</u>	<u>100 CPM</u>	<u>100 CPM</u>
<u>X10</u>	<u>4K CPM</u>	<u>4K CPM</u>
<u>X10</u>	<u>1K CPM</u>	<u>1K CPM</u>
<u>X100</u>	<u>40K CPM</u>	<u>40K CPM</u>
<u>X100</u>	<u>10K CPM</u>	<u>10K CPM</u>
<u>X1000</u>	<u>400K CPM</u>	<u>400K CPM</u>
<u>X1000</u>	<u>100K CPM</u>	<u>100K CPM</u>

Calibration sources used have calibration traceable to N.I.S.T.

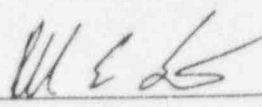
Date 7-18-95Signature [Signature]EIS
TEST
5P.O. Number 73021177-20-95
EIS
TEST
5

CERTIFICATION OF CALIBRATION

Instrument LUDDLUM 2221Serial Number 68780 / 11064Type of Source MP-2 S/N 174
FLUKE 8010A S/N 2650076

Range	Calibration Point	Reading
<u>LOG</u>	<u>400 CPM</u>	<u>400 CPM</u>
<u>LOG</u>	<u>100 CPM</u>	<u>100 CPM</u>
<u>LOG</u>	<u>4K CPM</u>	<u>4K CPM</u>
<u>LOG</u>	<u>1K CPM</u>	<u>1K CPM</u>
<u>LOG</u>	<u>40K CPM</u>	<u>40K CPM</u>
<u>LOG</u>	<u>10K CPM</u>	<u>10K CPM</u>
<u>LOG</u>	<u>400K CPM</u>	<u>400K CPM</u>
<u>LOG</u>	<u>100K CPM</u>	<u>100K CPM</u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>

Calibration sources used have calibration traceable to N.I.S.T.

Date 7-18-95Signature P.O. Number 7302117

CERTIFICATION OF CALIBRATION

Instrument LUDLUM MODEL 2221/43-37

Serial Number 91942/739/Pr090882/741

Type of Source MP 2 S/N 400

FLUKE 8010A S/N 5255024

Cs-137 88 nCi S/N L-075

Range	Calibration Point	Reading
<u>X 1</u>	<u>400 cpm</u>	<u>400 cpm</u>
<u>X 1</u>	<u>100 cpm</u>	<u>100 cpm</u>
<u>X 10</u>	<u>4K cpm</u>	<u>4K cpm</u>
<u>X 10</u>	<u>1K cpm</u>	<u>1K cpm</u>
<u>X 100</u>	<u>40K cpm</u>	<u>40K cpm</u>
<u>X 100</u>	<u>10K cpm</u>	<u>10K cpm</u>
<u>X 1K</u>	<u>400K cpm</u>	<u>400K cpm</u>
<u>X 1K</u>	<u>100K cpm</u>	<u>100K cpm</u>
<u>X 1K</u>	<u>196,481 dpm (4TT)</u>	<u>57,853 cpm</u>

Calibration sources used have calibration traceable to the N.I.S.T.

Date AUG 29 1994

Signature Kenneth O. P.

P.O. Number 7301722



CERTIFICATION OF CALIBRATION

Instrument LVOLUM MODEL 2221/43-37Serial Number 91942/739/PR090882/741Type of Source MP-2 S/N 400
FLUKE 8010A S/N 5255024

Range	Calibration Point	Reading
<u>50-500K</u>	<u>400 cpm</u>	<u>400 cpm</u>
<u>50-500K</u>	<u>100 cpm</u>	<u>100 cpm</u>
<u>50-500K</u>	<u>4K cpm</u>	<u>4K cpm</u>
<u>50-500K</u>	<u>1K cpm</u>	<u>1K cpm</u>
<u>50-500K</u>	<u>40K cpm</u>	<u>40K cpm</u>
<u>50-500K</u>	<u>10K cpm</u>	<u>10K cpm</u>
<u>50-500K</u>	<u>400K cpm</u>	<u>400K cpm</u>
<u>50-500K</u>	<u>100K cpm</u>	<u>100K cpm</u>

Calibration sources used have calibration traceable to the N.I.S.T.

Date AUG 29 1994Signature Kenneth D. P.EIS
TEST
4

P.O. Number

7301722

8-29-94

CERTIFICATION OF CALIBRATION

Instrument LUDLUM MODEL 2221/43-37

Serial Number 91942/739/PRO90882/741

Type of Source MP-2 S/N 400

Time (In Minutes)	Calibration Point	Reading
<u>0.1</u>	<u>1000 cpm</u>	<u>100 COUNTS</u>
<u>0.2</u>	<u>1000 cpm</u>	<u>200 COUNTS</u>
<u>0.5</u>	<u>1000 cpm</u>	<u>500 COUNTS</u>
<u>1</u>	<u>1000 cpm</u>	<u>1000 COUNTS</u>
<u>2</u>	<u>1000 cpm</u>	<u>2000 COUNTS</u>
<u>5</u>	<u>1000 cpm</u>	<u>5001 COUNTS</u>
<u>10</u>	<u>1000 cpm</u>	<u>10,002 COUNTS</u>

Calibration sources used have calibration traceable to the N.I.S.T.

Date AUG 29 1994

Signature Kenneth P.

P.O. Number 7301722



CERTIFICATION OF CALIBRATION

Instrument LUDLUM 2221 / 43-37

739 / 741

Serial Number 91942 / PR090892

Type of Source MP-2 S/N 126

FLUKE 8010A S/N 2435022

Cs-137 S/N L-075

Time (In Minutes)	Calibration Point	Reading
<u>.1</u>	<u>1k CPM</u>	<u>100 COUNTS</u>
<u>.2</u>	<u>1k CPM</u>	<u>200 COUNTS</u>
<u>.5</u>	<u>1k CPM</u>	<u>500 COUNTS</u>
<u>1</u>	<u>1k CPM</u>	<u>1,000 COUNTS</u>
<u>2</u>	<u>1k CPM</u>	<u>2,000 COUNTS</u>
<u>5</u>	<u>1k CPM</u>	<u>5,001 COUNTS</u>
<u>10</u>	<u>1k CPM</u>	<u>10,003 COUNTS</u>
<u>1</u>	<u>195,258 DPM(4π)</u>	<u>55,461 COUNTS (28.4%)</u>

Calibration sources used have calibration traceable to the N.I.S.T.

Date DEC 7 1994

Signature Scott A. Dull



P.O. Number 7301722

12

CERTIFICATION OF CALIBRATION

Instrument LUDLUM 2221 / 43-37

739 / 741

Serial Number 91942 / PRO90882

Type of Source MP-2 S/N 126

FLUKE 8010A S/N 2435022

Range	Calibration Point	Reading
LOG	400 CPM	400 CPM
LOG	100 CPM	100 CPM
LOG	4K CPM	4K CPM
LOG	1K CPM	1K CPM
LOG	40K CPM	40K CPM
LOG	10K CPM	10K CPM
LOG	400K CPM	400K CPM
LOG	100K CPM	100K CPM

Calibration sources used have calibration traceable to the N.I.S.T.

Date DEC 7 1994

Signature

Scott A. Shaw



P.O. Number

1301722

12-

CERTIFICATION OF CALIBRATION

Instrument LUDLUM 2221 / 43-37

737 / 41

Serial Number 91942 / PR090882

Type of Source MP-2 S/N 126

FLUKE 8010A S/N 2435022

Range	Calibration Point	Reading
X1	400 CF	400 CPM
X1	100 CPM	100 CPM
X10	4K CPM	4K CPM
X10	1K CPM	1K CPM
X100	40K CPM	40K CPM
X100	10K CPM	10K CPM
X1000	400K CPM	400K CPM
X1000	100K CF	100K CPM

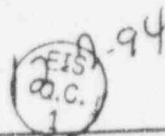
Calibration sources used have calibration traceable to the N.I.S.T.

Date DEC 7 1994

Signature Kott A. Lue



P.O. Number 7301722



CERTIFICATION OF CALIBRATION

Instrument LUDDLUM 2221 / 43-37
739 / 741

Serial Number 91942 / PR090882

Type of Source MP-2 S/N 126
PLUKE 8010A S/N 2435022

Range	Calibration Point	Reading
X1	400 CPM	400 CPM
X1	100 CPM	100 CPM
X10	4K CPM	4K CPM
X10	1K CPM	1K CPM
X100	40K CPM	40K CPM
X100	10K CPM	10K CPM
X1000	400K CPM	400K CPM
X1000	100K CPM	100K CPM

Calibration sources used have calibration traceable to the N.I.S.T.

Date MAY 22 1995

Signature

Robert G. Lueb



P.O. Number

7302117

5-22-95

CERTIFICATION OF CALIBRATION

Instrument LUCLUM 2221 / 43-37

739 / 741

Serial Number 91942 / PR090882

Type of Source MP-2 S/N 126

FLUKE 8010A S/N 2435022

Range	Calibration Point	Reading
LOG	400 CPM	400 CPM
LOG	100 CPM	100 CPM
LOG	4K CPM	4K CPM
LOG	1K CPM	1K CPM
LOG	40K CPM	40K CPM
LOG	10K CPM	10K CPM
LOG	400K CPM	400K CPM
LOG	100K CPM	100K CPM

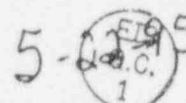
Calibration sources used have calibration traceable to the N.I.S.T.

Date MAY 22 1995

Signature *Kath A. Dwee*



P.O. Number 7302117



CERTIFICATION OF CALIBRATION

Instrument LUDDLUM 2221 / 43-37

739 / 741

Serial Number 91942 / PR090882

Type of Source MP-2 S/N 126

FLUKE 8010A S/N 2435022

Cs-137 S/N L-075

Time (In Minutes)	Calibration Point	Reading
<u>.1</u>	<u>1k CPM</u>	<u>100 COUNTS</u>
<u>.2</u>	<u>1k CPM</u>	<u>200 COUNTS</u>
<u>.5</u>	<u>1k CPM</u>	<u>500 COUNTS</u>
<u>1</u>	<u>1k CPM</u>	<u>1,000 COUNTS</u>
<u>2</u>	<u>1k CPM</u>	<u>2,000 COUNTS</u>
<u>5</u>	<u>1k CPM</u>	<u>5,001 COUNTS</u>
<u>10</u>	<u>1k CPM</u>	<u>10,002 COUNTS</u>
<u>1</u>	<u>193,344 CPM(2π)</u>	<u>54,430 COUNTS (28.2%)</u>
<u>HIGH VOLTAGE = 1800 Volts</u>		<u>THRESHOLD = 100 = 4 mV</u>

Calibration sources used have calibration traceable to the N.I.S.T.

Date MAY 22 1995

Signature Scott A. Green

P.O. Number 7302117

5-28-95
1

Scaler Instrument Check - Reliability Factor

Project Name/# Curtis Bay/ 7941006
 Instrument/# Ludlum 2221/#91942
 Probe Type/# Ludlum 43-37/#090882

Date/Time 8/24/95 9:46
 Source type/activity Cs-137/8680DPM
 Technician Stephen M. Beck S

Total counts	Difference From Average Counts	Square Of The Difference	
1,274	26.50	702.25	Observed Standard
1,320	72.50	5256.25	Deviation- 38.90
1,204	-43.50	1892.25	
1,278	30.50	930.25	Square Root Avg. Cts. 35.32
1,257	9.50	90.25	
1,200	-47.50	2256.25	Reliability
1,233	-14.50	210.25	Factor (RF)- 1.10 *
1,264	16.50	272.25	
1,242	-5.50	30.25	* Acceptable Range 0.64 - 1.22
1,203	-44.50	1980.25	Investigate At 0.50 - 0.64 or 1.22 - 1.40
Total	Average Counts	Total	Unsatisfactory At < 0.50 or > 1.40
12475	1247.50	13620.50	

Radcon Review: 

Date: 8/24/95

Scaler Instrument Check - Reliability Factor

Project Name/# Curtis Bay/ 7941006
 Instrument/# Ludlum 2221/#91942
 Probe Type/# 43-37/#090882

Date/Time 9/7/95 16:25
 Source type/activity Cs-137/8680 DPM
 Technician T.Hansen

Total counts	Difference From Average Counts	Square Of The Difference	
1,226	-24.20	585.64	Observed Standard
1,227	-23.20	538.24	Deviation- 35.20
1,218	-32.20	1036.64	
1,261	10.80	116.64	Square Root Avg. Cts. 35.36
1,218	-32.20	1036.84	
1,259	8.80	77.44	Reliability
1,289	38.80	1505.44	Factor (RF)- 1.00 *
1,327	76.80	5898.24	
1,232	-18.20	331.24	* Acceptable Range 0.64 - 1.22
1,245	-5.20	27.04	Investigate At 0.50 - 0.64 or 1.22 - 1.40
Total	Average Counts	Total	Unsatisfactory At < 0.50 or > 1.40
12502	1250.20	11153.60	

Radcon Review: 

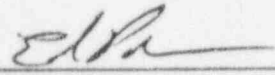
Date: 9/7/95

Scaler Instrument Check - Reliability Factor

Project Name/# Curtis Bay/ 7941006
 Instrument/# Ludlum 2221/#91942
 Probe Type/# 43-37/#090882

Date/Time 9/14/95 1:44
 Source type/activity Cs-137/8680 DPM
 Technician S. Beck

Total counts	Difference From Average Counts	Square Of The Difference		
1,282	37.00	1369.00	Observed Standard	
1,187	-58.00	3364.00	Deviation-	38.50
1,263	18.00	324.00		
1,235	-10.00	100.00	Square Root Avg. Cts.	35.28
1,287	41.00	1764.00		
1,198	-47.00	2209.00	Reliability	
1,199	46.00	2116.00	Factor (RF)-	1.09 *
1,288	43.00	1849.00		
1,259	14.00	196.00	* Acceptable Range 0.64 - 1.22	
1,252	7.00	49.00	Investigate At 0.50 - 0.64 or	
			1.22 - 1.40	
Total	Average Counts	Total	Unsatisfactory At < 0.50 or	
12450	1245.00	13340.00	> 1.40	

Radcon Review: 

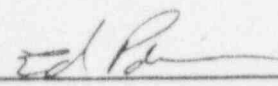
Date: 9/14/95

Scaler Instrument Check - Reliability Factor

Project Name/# Curtis Bay/ 7941006
 Instrument/# Ludlum 2221/#91942
 Probe Type/# 43-37/#090882

Date/Time 9/13/95 8:21
 Source type/activity Cs-137/8680 dpm
 Technician S. Beck T. Hansen

Total counts	Difference From Average Counts	Square Of The Difference	
1,208	13.30	176.89	Observed Standard
1,169	-25.70	660.49	Deviation- 34.37
1,187	-7.70	59.29	
1,156	-38.70	1497.69	Square Root Avg. Cts. 34.56
1,252	57.30	3283.29	
1,205	10.30	106.09	Reliability
1,153	-41.70	1738.89	Factor (RF)- 0.99 *
1,235	40.30	1624.09	
1,218	23.30	542.89	* Acceptable Range 0.64 - 1.22
1,164	-30.70	942.49	Investigate At 0.50 - 0.64 or 1.22 - 1.40
Total	Average Counts	Total	Unsatisfactory At < 0.50 or > 1.40
11947	1194.70	10632.10	

Radcon Review: 


Date: 9/13/95

Scaler Instrument Check - Reliability Factor

Project Name/# Curtis Bay/ 7941006
 Instrument/# Ludlum 2221/#91942
 Probe Type/# 43-37/#090882

Date/Time 9/21/95 16:20
 Source type/activity cs-137/8680
 Technician J. Brown

Total counts	Difference From Average Counts	Square Of The Difference	
1,189	-41.10	1689.21	Observed Standard
1,280	49.90	2490.01	Deviation- 31.43
1,258	27.90	778.41	
1,171	-59.10	3492.81	Square Root Avg. Cts. 35.07
1,231	0.90	0.81	
1,228	-2.10	4.41	Reliability
1,230	-0.10	0.01	Factor (RF)- 0.90 *
1,248	17.90	320.41	
1,240	9.90	98.01	* Acceptable Range 0.64 - 1.22
1,226	-4.10	16.81	Investigate At 0.50 - 0.64 or 1.22 - 1.40
Total	Average Counts	Total	Unsatisfactory At < 0.50 or > 1.40
12301	1230.10	8890.90	

Radcon Review: 

Date: 9/21/95



CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.

501 OAK ST./PO BOX 810

SWEETWATER, TX 79558

915/235-5494

Ludlum Model 19

CUSTOMER Rust Federal Services Inc ORDER NO 205662

Cal. Date 4-18-94 Cal. Due Date 4-18-95 Cal. Interval 1YR

Serial No 95501 Meterface 16

Check Mark (✓) applies to applicable instrument in accordance with manufacturers specifications.

Temperature 72 °F Relative Humidity 20 % Alt 708.8 mm Hg ☐ New Instrument

☒ Mech. ck. ☒ F/S Resp. ck. ☒ Zero Reset ck. ☒ Audio ck. ☒ Meter Zeroed

☒ Bat. ck. (min volt) 2.2 VDC Instrument Voltage setting 724 V Input sensitivity 33 mV

Repair Instrument Received: ☐ Within Tolerance + -10% ☐ 10-20% ☐ Out Toler. ☒ Requiring Repair

COMMENTS:

RANGE	REFERENCE CAL POINT	INSTRUMENT METER READING*	INSTRUMENT REC'D "AS FOUND READING"
5000	4000 uR/hr	<u>4000</u>	
5000	1000 uR/hr	<u>1050</u>	
500	400 uR/hr = <u>78000 cpm</u>	<u>400</u>	
500	100 uR/hr = <u>20600 "</u>	<u>100</u>	<u>N/A</u>
250	200 uR/hr = <u>38300 "</u>	<u>200</u>	
250	100 uR/hr = <u>19700 "</u>	<u>105</u>	
50	<u>7800 "</u>	<u>40</u>	
50	<u>2060 "</u>	<u>10</u>	
25	<u>3830 "</u>	<u>20</u>	
25	<u>1970 "</u>	<u>10</u>	

Ranges Calibrated Electronically: 50, 25

*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 MIL. STD 45662A and ANSI N323- 1978.

Source used: ¹³⁷Cesium s/n M565/T879

TX License No. LO 1963

Model 500 s/n 101499 Oscilloscope s/n 7090252 Multimeter s/n A25832

Calibrated by: Connie Tomlinson Date 4-18-94

Reviewed by: Jimmie Fleming Date 4-18-94



Designer and Manufacturer
of
Scientific and Industrial
Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 915-235-5494
501 OAK STREET FAX NO. 915-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER RUST FEDERAL SRVS

ORDER NO. 209045

g. Ludlum Measurements, Inc. Model 19 Serial No. 95501

Mfg. _____ Model _____ Serial No. _____

Cal. Date 11/14/94 Cal Due Date 05/14/95 Cal. Interval 6 Months Meterface 202-016

Check mark ☒ applies to applicable Instr. and/or detector IAW mfg. spec. T. 74 °F RH 65 % Alt 706.8 mm Hg

☐ New Instrument ☐ Instrument Received ☒ Within Toler. $\pm 10\%$ ☐ 10-20% ☐ Out of Tol. ☐ Requiring Repair

☒ 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

Instrument Volt Set 723 V Input Sens. 34 mV Det. Oper. _____ V at _____ mV Threshold Dial Ratio _____ = _____ mV

☐ HV Readout (2 points) Ref./Inst. _____ / _____ V Ref./Inst. _____ / _____ V

COMMENTS:

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*
5000	4000 uR/hr	3900	4000
5000	1000 uR/hr	950	995
500	400 uR/hr = 65200 cpm	370	400
500	100 uR/hr	90	100
250	200 uR/hr = 31900 "	185	200
250	100 uR/hr	90	100
50	6520 cpm	36	40
50	1630 cpm	etc - 89	10
25	3190 cpm	18.5	20
25	790 cpm	4.5	5

*Uncertainty within $\pm 10\%$ C.F. within $\pm 20\%$

50, 25 Range(s) Calibrated Electronically

REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout			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 MIL-STD-45662A and ANSI N325-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources:

Cs-137 Gamma S/N ☐ 1162 ☐ G112 ☐ M565 ☐ S105 ☐ T1008 ☒ T879

☐ Neutron Am-241 Be S/N T-304

☐ Alpha S/N _____ ☐ Beta S/N _____ ☐ Other _____

☒ m 500 S/N 79956 ☒ Oscilloscope S/N 7090296 ☒ Multimeter S/N 53801574

Calibrated By: Eliot Chavira Date 11-14-94

Reviewed By: Jimmi Fleming Date 11-14-94



Designer and Manufacturer
of
Scientific and Industrial
Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 915-235-5494
501 OAK STREET FAX NO. 915-235-4672
SWEETWATER, TEXAS 79556, U.S.A

CUSTOMER RUST FEDERAL SRVS ORDER NO. 212237

Ludlum Measurements, Inc. Model 19 Serial No. 91484

Cal. Date 04/24/95 Cal Due Date 10/24/95 Cal. Interval 6 Months Meterface 202-016

Check mark ☒ applies to applicable instr. and/or detector IAW mfg. spec. T. 73 °F RH 28 % Alt 707.8 mm Hg

☐ New Instrument ☐ Instrument Received ☐ Within Toler. +10% ☐ 10-20% ☐ Out of Tol. ☒ Requiring Repair

☒ 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

Instrument Volt Set 976 V Input Sens. 41 mV Det. Oper. V at mV Threshold Dial Ratio = mV

☐ HV Readout (2 points) Ref./Inst. / V Ref./Inst. / V

COMMENTS:

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*
5000	4000uR/hr		4000
5000	1000uR/hr		1000
500	400uR/hr = 73600 cpm		400
500	100uR/hr		100
250	200uR/hr = 36000 cpm		200
250	100uR/hr		100
50	7360 cpm		40
50	1840 cpm		10
25	3600 cpm		20
25	900 cpm		5

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

50.25 Range(s) Calibrated Electronically

REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout			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 MIL-STD-45462A and ANSI N323-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources:

Cs-137 Gamma S/N ☐ 1162 ☐ G112 ☐ M565 ☐ S105 ☐ T1008 ☒ T879 ☐ Neutron Am-241 Be S/N T-304

☐ Alpha S/N ☐ Beta S/N ☐ Other

m 500 S/N 79956 ☒ Oscilloscope S/N 7090296 ☒ Multimeter S/N 53801574

Calibrated By: Elias Chavez Date 4-24-95

Reviewed By: Michael Mave Date 4-24-95

CERTIFICATION OF CALIBRATION

Instrument LUDLUM MODEL 19

Serial Number 91484 / 948

Type of Source Cs-137 10mCi S/N 733
MP-2 S/N 126
FLUKE 8010A S/N 2435022

Range	Calibration Point	Reading
<u>25</u>	<u>4k CPM</u>	<u>17.5 μR/hr</u>
<u>50</u>	<u>8k CPM</u>	<u>35 μR/hr</u>
<u>250</u>	<u>40k CPM</u>	<u>175 μR/hr</u>
<u>250</u>	<u>.2 mR/hr</u>	<u>200 μR/hr</u>
<u>500</u>	<u>80k CPM</u>	<u>350 μR/hr</u>
<u>500</u>	<u>.4 mR/hr</u>	<u>400 μR/hr</u>
<u>500</u>	<u>.2 mR/hr</u>	<u>200 μR/hr</u>
<u>5000</u>	<u>4 mR/hr</u>	<u>4000 μR/hr</u>
<u>5000</u>	<u>1 mR/hr</u>	<u>1100 μR/hr</u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>

Calibration sources used have calibration traceable to the N.I.S.T.

Date DEC 7 1994

Signature *Robert J. Hall*



P.O. Number 7301722

12-dec-1994
1

CERTIFICATION OF CALIBRATION

Instrument LUDLUM MODEL 19

Serial Number 82702/11952

Type of Source Cs-137 10mCi S/N 733

MP-2 S/N 739

FLUKE 8010A S/N 5740119

Range	Calibration Point	Reading
25	4k CPM	18.5 uR/hr
50	8k CPM	37 uR/hr
250	40k CPM	185 uR/hr
250	.2 mR/hr	200 uR/hr
500	80k CPM	370 uR/hr
500	.4 mR/hr	400 uR/hr
500	.2 mR/hr	200 uR/hr
5000	4 mR/hr	4000 uR/hr
5000	1 mR/hr	1100 uR/hr

Calibration sources used have calibration traceable to the N.I.S.T.

Date AUG 16 1994

Signature *[Signature]*

EIS
TEST
2

P.O. Number 7301722

8-16-94
EIS
P.O. 7301722

CERTIFICATION OF CALIBRATION

Instrument Codium Model 19 MICRO R METER

Serial Number 91571

Type of Source CS-137 10MG 1/4 733

MP-2 1/4 126

Fuka 8010A 1/4 2435022

Range	Calibration Point	Reading
<u>25 NR/HR</u>	<u>4 KCPM</u>	<u>16.5 NR/HR</u>
<u>50 NR/HR</u>	<u>8 KCPM</u>	<u>33 NR/HR</u>
<u>250 NR/HR</u>	<u>.2 MR/HR</u>	<u>200 NR/HR</u>
<u>250 NR/HR</u>	<u>40 KCPM</u>	<u>165 NR/HR</u>
<u>500 NR/HR</u>	<u>.4 MR/HR</u>	<u>400 NR/HR</u>
<u>500 NR/HR</u>	<u>.2 MR/HR</u>	<u>200 NR/HR</u>
<u>500 NR/HR</u>	<u>80 KCPM</u>	<u>330 NR/HR</u>
<u>5000 NR/HR</u>	<u>4 MR/HR</u>	<u>4000 NR/HR</u>
<u>5000 NR/HR</u>	<u>1 MR/HR</u>	<u>1100 NR/HR</u>

Calibration sources used have calibration traceable to the N.I.S.T.

Date APR 8 1994

Signature Scott G. Giese



P.O. Number 7301722

418254



Designer and Manufacturer
of
Scientific and Industrial
Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
POST OFFICE BOX 810 PH. 915-235-5491
501 OAK STREET FAX NO. 915-235-4672
SWEETWATER, TEXAS 79556, U.S.A.

CUSTOMER RUST FEDERAL SERVICES ORDER NO. 207766

Ludlum Measurements, Inc. Model 19 Serial No. 54806

Mfg. _____ Model _____ Serial No. _____

Cal. Date 08/23/94 Cal Due Date 02/23/95 Cal. Interval 6 Months Meterface 202-016

Check mark ☒ applies to applicable instr. and/or detector IAW mfg. spec. T. 75 °F RH 45 % Alt 704.8 mm Hg

- ☐ New Instrument ☐ Instrument Received ☐ Within Toler. $\pm 10\%$ ☐ 10-20% ☒ Out of Tol. ☐ Requiring Repair
- ☒ Mechanical ck. ☒ Meter Zeroed ☐ Background Subtract ☐ Input Sens. Linearity
- ☒ F/S Resp. ck. ☒ Reset ck. ☐ Window Operation
- ☒ Audio ck. ☐ Alarm Setting ck. ☒ Batt. ck. (Min. Volt) 2.2 VDC

Instrument Volt Set 667 V Input Sens. 40 mV Def. Oper. _____ V at _____ mV Threshold Dial Ratio _____ = _____ mV

☐ HV Readout (2 points) Ref./Inst. _____ / _____ V Ref./Inst. _____ / _____ V

COMMENTS:

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*
5000	4000 uR/hr	3400	4000
5000	1000 uR/hr	900	1050
500	400 uR/hr = 71500 cpm	270	400
500	100 uR/hr	75	105
250	200 uR/hr = 35700 cpm	140	200
250	100 uR/hr	150	105
50	7150 cpm	30	40
50	1780 cpm	6	10
25	3570 cpm	14	20
25	892 cpm	448.5	5

*Uncertainty within $\pm 10\%$ C.F. within $\pm 20\%$

50, 25 Range(s) Calibrated Electronically

REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout			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 MIL-STD-45662A and ANSI N325-1978. State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources:

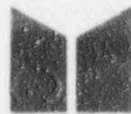
Cs-137 Gamma S/N ☐ 1162 ☐ G112 ☒ M565 ☐ S105 ☐ T1008 ☐ T879 ☐ Neutron Am-241 Be S/N T-304

☐ Alpha S/N _____ ☐ Beta S/N _____ ☐ Other _____

m 500 S/N 63893 ☒ Oscilloscope S/N 0717442 ☒ Multimeter S/N 57770262

Calibrated By: Michael Moore Date 8-23-94

Reviewed By: Jimmie Fleming Date 8-23-94



METROSONICS

CALIBRATION REPORT

Model Number

Instrument

Serial Number

HS-360

HEAT STRESS
MONITOR

1895

This certifies that the above named instrument conforms to the specifications indicated in Metrosonics, Inc. published specifications at the date of purchase.

Calibration has been accomplished on the above-named instrument by comparison with standards maintained at Metrosonics, Inc. laboratory in Rochester, New York. The accuracy and stability of all standards maintained by Metrosonics, Inc. are traceable to national standards maintained by the National Institute of Standards and Technology.

Date Calibrated: 8-11-94

Recalibration Due Date: 8-11-95

Certified By:

William Bures
Customer Service Technician



CALIBRATION REPORT

Model Number

HS-360

Instrument

HEAT STRESS
MONITOR

Serial Number

1845

This certifies that the above named instrument conforms to the specifications indicated in Metrosonics, Inc. published specifications at the date of purchase.

Calibration has been accomplished on the above-named instrument by comparison with standards maintained at Metrosonics, Inc. laboratory in Rochester, New York. The accuracy and stability of all standards maintained by Metrosonics, Inc. are traceable to national standards maintained by the National Institute of Standards and Technology.

Date Calibrated: 8-11-94

Recalibration Due Date: 8-11-95

Certified By:

William Brown
Customer Service Technician

Certificate of Calibration



The following equipment was calibrated with instrumentation whose accuracies are traceable to the National Institute of Standards and Technology.

MODEL: 2700 CA12B1

SERIAL NUMBER: HU2040010, U2030141

CALIBRATION DATE: 5 AUG 94

CALIBRATED BY:

A handwritten signature in dark ink, appearing to be "L. J. [unclear]", written over the "CALIBRATED BY:" label.

QUEST TECHNOLOGIES, 510 S. WORTHINGTON ST., OCONOMOWOC, WI 53066 800/245-0779 414/567-9157 FAX 414/567-4047

Certificate of Calibration



QUESTTM
TECHNOLOGIES

The following equipment was calibrated with instrumentation whose accuracies are traceable to the National Institute of Standards and Technology.

MODEL: 2700 CA-VZB

SERIAL NUMBER: HU2040010, U2030141

CALIBRATION DATE: 5 AUG 94

CALIBRATED BY:

QUEST TECHNOLOGIES, 510 S. WORTHINGTON ST., OCONOMOWOC, WI 53066 800/245-0779 414/567-9157 FAX 414/567-4047

Certificate of Calibration



The following equipment was calibrated with instrumentation whose accuracies are traceable to the National Institute of Standards and Technology (formerly NBS).

MODEL: 2700, CA-12A

SERIAL NUMBER: HU2040009, U2030140

CALIBRATION DATE: 27-July-93

CALIBRATED BY: *mf*

William J. Nielsen

WILLIAM J. NIELSEN
STANDARDS ENGINEER

QUEST ELECTRONICS

510 S. WORTHINGTON ST., OCONOMOWOC, WI 53066

414/567-9157

CERTIFICATION OF CALIBRATION

Instrument BROWN ANALYST/A100

Serial Number 80926/1220/81938/1221

Type of Source MP-2 S/N 126
Pi-239 S/N 7123, 7124
7125, 6226
FLUX 8010A S/N 2435022

Range	Calibration Point	Reading
<u>X1</u>	<u>400cpm</u>	<u>400cpm</u>
<u>X1</u>	<u>100cpm</u>	<u>100cpm</u>
<u>X10</u>	<u>4Kcpm</u>	<u>4Kcpm</u>
<u>X10</u>	<u>1Kcpm</u>	<u>1Kcpm</u>
<u>X100</u>	<u>40Kcpm</u>	<u>40Kcpm</u>
<u>X100</u>	<u>10Kcpm</u>	<u>10Kcpm</u>
<u>X1000</u>	<u>400Kcpm</u>	<u>400Kcpm</u>
<u>X1000</u>	<u>100Kcpm</u>	<u>100Kcpm</u>
<u>X1</u>	<u>290cpm(27)</u>	<u>187cpm</u>
<u>X10</u>	<u>3,480cpm(27)</u>	<u>1,954cpm</u>
<u>X100</u>	<u>45,600cpm(27)</u>	<u>25,380cpm</u>
<u>X1000</u>	<u>298,000cpm(27)</u>	<u>157,310cpm</u>

Calibration sources used have calibration traceable to the N.I.S.T.

Date JUL 1 1994

Signature [Signature]



P.O. Number 7301722



CERTIFICATION OF CALIBRATION

Instrument BICKON ANALYST/A100

Serial Number B512E/1288/B187B/1289

Type of Source MP-2 5/4 126

Pu-239 5/4 7123, 7124,

7125, 6226

Fluor 8010A 5/4 2435022

Range	Calibration Point	Reading
<u>X1</u>	<u>400cpm</u>	<u>400cpm</u>
<u>X1</u>	<u>100cpm</u>	<u>100cpm</u>
<u>X10</u>	<u>4Kcpm</u>	<u>4Kcpm</u>
<u>X10</u>	<u>1Kcpm</u>	<u>1Kcpm</u>
<u>X100</u>	<u>40Kcpm</u>	<u>40Kcpm</u>
<u>X100</u>	<u>10Kcpm</u>	<u>10Kcpm</u>
<u>X1000</u>	<u>400Kcpm</u>	<u>400Kcpm</u>
<u>X1000</u>	<u>100Kcpm</u>	<u>100Kcpm</u>
<u>X1</u>	<u>292cpm(27)</u>	<u>210cpm</u>
<u>X10</u>	<u>3,480cpm(27)</u>	<u>1,856cpm</u>
<u>X100</u>	<u>45,600cpm(27)</u>	<u>24,043cpm</u>
<u>X1000</u>	<u>298,000cpm(27)</u>	<u>149,460cpm</u>

Calibration sources used have calibration traceable to the N.I.S.T.

Date JUL 1 1994

Signature Scott G. Zelt



P.O. Number

7301722



CERTIFICATION OF CALIBRATION

Instrument ALPHA-5A

Serial Number 621 / 11010

Type of Source MP-2 S/N 174

FLUKE 8010A S/N 2650076

Th-230 S/N 34704

Range	Calibration Point	Reading
<u>1-10K</u>	<u>10 CPM</u>	<u>10 CPM</u>
<u>1-10K</u>	<u>100 CPM</u>	<u>100 CPM</u>
<u>1-10K</u>	<u>1K CPM</u>	<u>1K CPM</u>
<u>1-10K</u>	<u>10K CPM</u>	<u>10K CPM</u>

Calibration sources used have calibration traceable to the N.I.S.T.

Date JUL 11 1994

Signature [Signature]



P.O. Number 7301722



CERTIFICATION OF CALIBRATION

Instrument ALPHA-5A

Serial Number 621/11010

Type of Source MP-2 S/N 400
FLUKE 8010A S/N 5255024

Range	Calibration Point	Reading
<u>1-10k CPM</u>	<u>10 CPM</u>	<u>10 CPM</u>
<u>1-10k CPM</u>	<u>100 CPM</u>	<u>100 CPM</u>
<u>1-10k CPM</u>	<u>1k CPM</u>	<u>1k CPM</u>
<u>1-10k CPM</u>	<u>10k CPM</u>	<u>10k CPM</u>

Calibration sources used have calibration traceable to the N.I.S.T.

Date DEC 21 1994

Signature Kenneth P.

P.O. Number 7301722



12-29-94

ALPHA-5 / RAP-1 DATA SHEET

I. Record Data

ALPHA-5 S/N 621/11010 Atmospheric Pressure(P) 30.26 in. HG.
 RAP-1 S/N 792 / 1415
 Mass Flowmeter Model AHL-5 S/N 7476
 Date of Calibration 5/19/94

1 Indicated Flow (lpm)	2 Mass Flow (scfm)	3 Corection Factor from II Below	4 Corrected Flow(lpm) From III Below	5 Ratio $\frac{4}{2}$
30	<u>1.00</u>	<u>1.01</u>	<u>1.07</u>	<u>1.07</u>
50	<u>1.55</u>	<u>1.01</u>	<u>1.78</u>	<u>1.15</u>
70	<u>2.10</u>	<u>1.01</u>	<u>2.50</u>	<u>1.19</u>

II. Calculate Correction Factor(cf) and record in column 4.

$$CF = \sqrt{\frac{P}{29.92}}$$

III. Calulate Corrected Flow and record in column 5.

$$lpm = \frac{\text{Indicated Flow 1.} \times \text{Correction factor 3.}}{28.32}$$

Test Performed By Kenneth Pie

Date: DEC 21 1994

Quality Control By Alice Lyon

Date: DEC 21 1994

P.O.# 7301722

RAS-1 DATA SHEET

I. Record Data

RAS-1 S/N 791 / 812 Atmospheric Pressure (P) 29.73 in. HG.
 Mass Flowmeter Model AHL-5 S/N 7476
 Date of Calibration 5/19/94

1 Indicated Flow (lpm)	2 Vacuum Guage (in.HG)	3 Mass Flow (scfm)	4 Corection Factor from II Below	5 Corrected Flow(lpm) From III Below	6 Ratio $\frac{5}{3}$
30	<u>2.50</u>	<u>.95</u>	<u>.95</u>	<u>1.01</u>	<u>1.06</u>
50	<u>3.50</u>	<u>1.50</u>	<u>.94</u>	<u>1.66</u>	<u>1.11</u>
70	<u>5.00</u>	<u>2.10</u>	<u>.91</u>	<u>2.25</u>	<u>1.07</u>

II. Calculate Correction Factor(cf) and record in column 4.

$$CF = \sqrt{\frac{P - \text{Vacuum Guage}}{29.92}}$$

III. Calulate Corrected Flow and record in column 5.

$$\text{lpm} = \frac{\text{Indicated Flow l.} \times \text{Correction factor 4.}}{28.32}$$

Test Performed By *Robert L. Lee*

Date: MAY 19 1995

Quality Control By *Alice G. G.*

Date: MAY 19 1995

P.O. #7302117

Eberline Instrument Corporation

RAS-1 DATA SHEET

I. Record Data

RAS-1 S/N 791/816 Atmospheric Pressure (P) 29.60 in. HG.
 Mass Flowmeter Model AHL-5 S/N 7475
 Date of Calibration 5/19/94

1 Indicated Flow (lpm)	2 Vacuum Gauge (in. HG)	3 Mass Flow (scfm)	4 Correction Factor from II Below	5 Corrected Flow (lpm) From III Below	6 Ratio <u>5</u> <u>3</u>
30	<u>4.25</u>	<u>1.00</u>	<u>.92</u>	<u>.97</u>	<u>.97</u>
50	<u>6.50</u>	<u>1.55</u>	<u>.88</u>	<u>1.55</u>	<u>1.00</u>
70	<u>7.40</u>	<u>2.00</u>	<u>.86</u>	<u>2.13</u>	<u>1.07</u>

II. Calculate Correction Factor (cf) and record in column 4.

$$CF = \sqrt{\frac{P - \text{Vacuum Gauge}}{29.92}}$$

III. Calculate Corrected Flow and record in column 5.

$$\text{lpm} = \text{Indicated Flow l.} \times \text{Correction factor 4.}$$

28.32

Test Performed By [Signature]

Date: FEB 21 1995

Quality Control By [Signature]

Date: FEB 21 1995

P.O. # 7302117

RAS-1 DATA SHEET

I. Record Data

RAS-1 S/N 0686 / 01229 Atmospheric Pressure(P) 30.19 in. HG.Mass Flowmeter Model AHL-5 S/N 7476Date of Calibration 5/19/94

1 Indicated Flow (lpm)	2 Vacuum Guage (in.HG)	3 Mass Flow (scfm)	4 Corection Factor from II Below	5 Corrected Flow(lpm) From III Below	6 Ratio <u>5</u> <u>3</u>
30	<u>2.00</u>	<u>1.02</u>	<u>.97</u>	<u>1.03</u>	<u>1.01</u>
50	<u>5.50</u>	<u>1.48</u>	<u>.91</u>	<u>1.61</u>	<u>1.09</u>
70	<u>8.50</u>	<u>1.92</u>	<u>.85</u>	<u>2.10</u>	<u>1.09</u>

II. Calculate Correction Factor(cf) and record in column 4.

$$CF = \sqrt{\frac{P - \text{Vacuum Guage}}{29.92}}$$

III. Calculate Corrected Flow and record in column 5.

$$\text{lpm} = \frac{\text{Indicated Flow l.} \times \text{Correction factor 4.}}{28.32}$$

Test Performed By [Signature] Date: 6-16-95Quality Control By Alice Yen Date: 6-16-95Purchase Order # 7302117

RAS-1 DATA SHEET

I. Record Data

RAS-1 S/N 1293 / 02271 Atmospheric Pressure (P) 29.83 in. HG.

Mass Flowmeter Model AHL-5 S/N 7476

Date of Calibration 5/19/94

1 Indicated Flow (lpm)	2 Vacuum Guage (in.HG)	3 Mass Flow (scfm)	4 Corection Factor from II Below	5 Corrected Flow (lpm) From III Below	6 Ratio <u>5</u> 3
30	<u>4.00</u>	<u>0.95</u>	<u>.93</u>	<u>.99</u>	<u>1.04</u>
50	<u>6.00</u>	<u>1.45</u>	<u>.89</u>	<u>1.57</u>	<u>1.08</u>
70	<u>8.25</u>	<u>1.95</u>	<u>.85</u>	<u>2.10</u>	<u>1.08</u>

II. Calculate Correction Factor (cf) and record in column 4.

$$CF = \sqrt{\frac{P - \text{Vacuum Guage}}{29.92}}$$

III. Calculate Corrected Flow and record in column 5.

$$\text{lpm} = \frac{\text{Indicated Flow} \times \text{Correction factor}}{28.32}$$

Test Performed By Scott A. Dull Date: APR 26 1995

Quality Control By Alice Lynn Date: APR 26 1995

P.O. # 7302117

RAS-1 DATA SHEET

I. Record Data

RAS-1 S/N 0389/11216 Atmospheric Pressure(P) 29.98 in. HG.

Mass Flowmeter Model AHL-5 S/N 7476

Date of Calibration 6/27/95

1 Indicated Flow (lpm)	2 Vacuum Guage (in.HG)	3 Mass Flow (scfm)	4 Corection Factor from II Below	5 Corrected Flow(lpm) From III Below	6 Ratio <u>5</u> <u>3</u>
30	<u>2.00</u>	<u>1.00</u>	<u>0.97</u>	<u>1.03</u>	<u>1.03</u>
50	<u>4.00</u>	<u>1.55</u>	<u>0.93</u>	<u>1.64</u>	<u>1.06</u>
70	<u>6.80</u>	<u>2.05</u>	<u>0.88</u>	<u>2.18</u>	<u>1.06</u>

II. Calculate Correction Factor(cf) and record in column 4.

$$CF = \sqrt{\frac{P - \text{Vacuum Guage}}{29.92}}$$

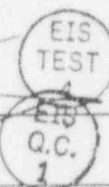
III. Calulate Corrected Flow and record in column 5.

$$lpm = \frac{\text{Indicated Flow} \times \text{Correction factor}}{28.32}$$

Test Performed By [Signature] Date: 8-2-95

Quality Control By Alice Yan Date: 8-2-95

Purchase Order # 7302117



8-2-95

CERTIFICATION OF CALIBRATION

Instrument RM-20-1 / HP-210AL

Serial Number 2063/00708 / 15457

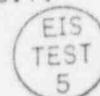
Type of Source MP-2 S/N 174
FLUKE 8010A S/N 2650076
Cs-137 10mCi S/N 733

Range	Calibration Point	Reading
X1	400 CPM	400 CPM
X1	100 CPM	100 CPM
X10	4k CPM	4k CPM
X10	1k CPM	1k CPM
X100	40k CPM	40k CPM
X100	10k CPM	10k CPM
X1k	400k CPM	400k CPM
X1k	100k CPM	100k CPM
X100	10 mR/hr	37k CPM

Calibration sources used have calibration traceable to the N.I.S.T.

Date NOV 11 1994

Signature [Signature]



P.O. Number 7301722



State of New York Department of Environmental Conservation

CERTIFICATION OF CALIBRATION

Instrument RM-20-1 / HP-210AL

Serial Number 2063/00708 / 15457

Type of Source MR-2 S/N 174

FULKE 5010A S/N 2650076

Cs-137 10mCi S/N 733

Range	Calibration Point	Reading
<u>X1</u>	<u>400 CPM</u>	<u>400 CPM</u>
<u>X1</u>	<u>100 CPM</u>	<u>100 CPM</u>
<u>X10</u>	<u>4k CPM</u>	<u>4k CPM</u>
<u>X10</u>	<u>1k CPM</u>	<u>1k CPM</u>
<u>X100</u>	<u>40k CPM</u>	<u>40k CPM</u>
<u>X100</u>	<u>10k CPM</u>	<u>10k CPM</u>
<u>X1k</u>	<u>400k CPM</u>	<u>400k CPM</u>
<u>X1k</u>	<u>100k CPM</u>	<u>100k CPM</u>
<u>X100</u>	<u>10 mR/hr</u>	<u>37k CPM</u>

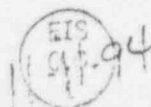
Calibration sources used have calibration traceable to the N.I.S.T.

Date NOV 11 1994

Signature [Signature]



P.O. Number 7301722




CERTIFICATION OF CALIBRATION

Instrument RM-20-1 / HP-260Serial Number 1892 / 11107 / 11272Type of Source MP-2 S/N 126
FLUKE 8010A S/N 2435022
Cs-137 10mCi S/N 733

Range	Calibration Point	Reading
<u>X1</u>	<u>400 CPM</u>	<u>400 CPM</u>
<u>X1</u>	<u>100 CPM</u>	<u>100 CPM</u>
<u>X10</u>	<u>4k CPM</u>	<u>4k CPM</u>
<u>X10</u>	<u>1k CPM</u>	<u>1k CPM</u>
<u>X100</u>	<u>40k CPM</u>	<u>40k CPM</u>
<u>X100</u>	<u>10k CPM</u>	<u>10k CPM</u>
<u>X1k</u>	<u>400k CPM</u>	<u>400k CPM</u>
<u>X1k</u>	<u>100k CPM</u>	<u>100k CPM</u>
<u>X100</u>	<u>10 mR/hr</u>	<u>36k CPM</u>

Calibration sources used have calibration traceable to the N.I.S.T.

Date FEB 2 1995 Signature Don G. Lull P.O. Number 73021172-2615
1

CERTIFICATION OF CALIBRATION

Instrument RM-20-1/HP-210T

Serial Number 2071/709/1411

Type of Source MP-3 S/N-739

Cs-137 10mCi S/N-733

FLUKE 8010A S/N-574119

Range	Calibration Point	Reading
<u>X1</u>	<u>400 CPM</u>	<u>400 CPM</u>
<u>X1</u>	<u>100 CPM</u>	<u>100 CPM</u>
<u>X10</u>	<u>4K CPM</u>	<u>4K CPM</u>
<u>X10</u>	<u>1K CPM</u>	<u>1K CPM</u>
<u>X100</u>	<u>40K CPM</u>	<u>40K CPM</u>
<u>X100</u>	<u>10K CPM</u>	<u>10K CPM</u>
<u>X1K</u>	<u>400K CPM</u>	<u>400K CPM</u>
<u>X1K</u>	<u>100K CPM</u>	<u>100K CPM</u>
<u>X100</u>	<u>10 mR/hr</u>	<u>36K CPM</u>

Calibration sources used have calibration traceable to the N.I.S.T.

Date MAY 24 1994

Signature James R. R. R.

P.O. Number 7301722

EIS
TEST
2

5-24-94

CERTIFICATION OF CALIBRATION

Instrument PM-20-1 / HP-260

Serial Number 2071 / 709 / 634

Type of Source MP-2 S/N 126
FLUKE 8010A S/N 2435022
Cs-137 10mCi S/N 733

Range	Calibration Point	Reading
<u>X1</u>	<u>400 CPM</u>	<u>400 CPM</u>
<u>X1</u>	<u>100 CPM</u>	<u>100 CPM</u>
<u>X10</u>	<u>4k CPM</u>	<u>4k CPM</u>
<u>X10</u>	<u>1k CPM</u>	<u>1k CPM</u>
<u>X100</u>	<u>40k CPM</u>	<u>40k CPM</u>
<u>X100</u>	<u>10k CPM</u>	<u>10k CPM</u>
<u>X1k</u>	<u>400k CPM</u>	<u>400k CPM</u>
<u>X1k</u>	<u>100k CPM</u>	<u>100k CPM</u>
<u>X100</u>	<u>10 mR/hr</u>	<u>34k CPM</u>

Calibration sources used have calibration traceable to the N.I.S.T.

Date DEC 21 1994

Signature *Scott G. Zull*



P.O. Number 7301722

12-21-94
 EIC
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CERTIFICATION OF CALIBRATION

Instrument RM-20-1 / HP-260Serial Number 1830 / 05735 / 01429Type of Source MP-2 S/N 174
FLUKE 8010A S/N 2650076
Cs-137 10 mCi S/N 733

Range	Calibration Point	Reading
<u>X1</u>	<u>400 CPM</u>	<u>400 CPM</u>
<u>X1</u>	<u>100 CPM</u>	<u>100 CPM</u>
<u>X10</u>	<u>4k CPM</u>	<u>4k CPM</u>
<u>X10</u>	<u>1k CPM</u>	<u>1k CPM</u>
<u>X100</u>	<u>40k CPM</u>	<u>40k CPM</u>
<u>X100</u>	<u>10k CPM</u>	<u>10k CPM</u>
<u>X1k</u>	<u>400k CPM</u>	<u>400k CPM</u>
<u>X1k</u>	<u>100k CPM</u>	<u>100k CPM</u>
<u>X100</u>	<u>10 mR/Hr</u>	<u>39k CPM</u>

Calibration sources used have calibration traceable to N.I.S.T.

Date 7-18-95Signature [Signature]7-20-95P.O. Number 7302117

CERTIFICATION OF CALIBRATION

Instrument RM-20-1 / HP-260

Serial Number 2065 / 707 / 2210

Type of Source MP-2 S/N 126

FLUKE 8010A S/N 2435022

Cs-137 10 mCi S/N 733

Range	Calibration Point	Reading
<u>X1</u>	<u>400 CPM</u>	<u>400 CPM</u>
<u>X1</u>	<u>100 CPM</u>	<u>100 CPM</u>
<u>X10</u>	<u>4k CPM</u>	<u>4k CPM</u>
<u>X10</u>	<u>1k CPM</u>	<u>1k CPM</u>
<u>X100</u>	<u>40k CPM</u>	<u>40k CPM</u>
<u>X100</u>	<u>10k CPM</u>	<u>10k CPM</u>
<u>X1k</u>	<u>400k CPM</u>	<u>400k CPM</u>
<u>X1k</u>	<u>100k CPM</u>	<u>100k CPM</u>
<u>X100</u>	<u>10 mR/Hr</u>	<u>34k CPM</u>

Calibration sources used have calibration traceable to the N.I.S.T.

Date 6-22-95

Signature *Robert L. Lueb*



P.O. Number 7302117

6-22-95

CERTIFICATION OF CALIBRATION

Instrument RM-20-1 / HP-260

Serial Number 1154 / 11014 / 11110

Type of Source MP-2 S/N 174

FLUKE 8010A S/N 2650076

Cs-137 10 mCi S/N 733

Range	Calibration Point	Reading
<u>X1</u>	<u>400 CPM</u>	<u>400 CPM</u>
<u>X1</u>	<u>100 CPM</u>	<u>100 CPM</u>
<u>X10</u>	<u>4k CPM</u>	<u>4k CPM</u>
<u>X10</u>	<u>1k CPM</u>	<u>1k CPM</u>
<u>X100</u>	<u>40k CPM</u>	<u>40k CPM</u>
<u>X100</u>	<u>10k CPM</u>	<u>10k CPM</u>
<u>X1k</u>	<u>400k CPM</u>	<u>400k CPM</u>
<u>X1k</u>	<u>100k CPM</u>	<u>100k CPM</u>
<u> </u>	<u> </u>	<u> </u>
<u>X100</u>	<u>10 mR/Hr</u>	<u>34k CPM</u>
<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>

Calibration sources used have calibration traceable to N.I.S.T.

Date 7-18-95

Signature [Signature]



P.O. Number 7302117



CERTIFICATION OF CALIBRATION

Instrument RM-15 / HP-260Serial Number 183 / 11268 / 15593Type of Source MP-2 S/N 126
FLUKE 8010A S/N 2435022
Cs-137 10mCi S/N 733

Range	Calibration Point	Reading
<u>X1</u>	<u>400 CPM</u>	<u>400 CPM</u>
<u>X1</u>	<u>100 CPM</u>	<u>100 CPM</u>
<u>X10</u>	<u>4k CPM</u>	<u>4k CPM</u>
<u>X10</u>	<u>1k CPM</u>	<u>1k CPM</u>
<u>X100</u>	<u>40k CPM</u>	<u>40k CPM</u>
<u>X100</u>	<u>10k CPM</u>	<u>10k CPM</u>
<u>X1k</u>	<u>400k CPM</u>	<u>400k CPM</u>
<u>X1k</u>	<u>100k CPM</u>	<u>100k CPM</u>
<u>X100</u>	<u>10 mR/hr</u>	<u>38,000 CPM</u>

Calibration sources used have calibration traceable to the N.I.S.T.

Date MAY 19 1995Signature Rett A. DuceP.O. Number 73021175-15-95
P.O. 1

CERTIFICATE OF CALIBRATION

CALIBRATION SOURCE ID #: 0993MGF.RSS01

Reference Date & Time: September 1, 1993 1200EST

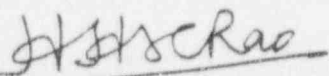
Source Description: Mylar covered 47 mm Filter paper - activity distributed over the filter paper.

RADIO- NUCLIDE	HALFLIFE (Days)	ACTIVITY LEVEL * * (nCi/gm)	TOTAL UNCERTAINTY	PRINCIPAL EMISSION (% INTENSITY)
Am-241	433 y	3.03	10%	59.9 (35.9)
Cd-109	1.2667	104.67	3.07%	88.0341 (3.6)
Co-57	271.77	3.56	3.08 %	122.0612 (85.5) 136.4730 (10.69)
Te-123m	119.7	2.65	3.09%	158.989 (84.4)
Cr-51	27.704	15.96	3.05%	320.084 (9.83)
Sn-113	115.09	11.54	3.06%	391.690 (64)
Sr-85	64.84	8.81	3.04%	513.996 (99.27)
Cs-137	30.0	17.54	3.07%	661.660 (85.21)
Y-88	106.61	19.99	3.05%	898.065 (92.7) 1836.077 (99.35)
Co-60	5.271	17.92	3.10%	1173.237 (99.90) 1332.501 (99.98)

* Certificate revised on September 20, 1993

Method of Verification: Activity of the source was verified using Gamma Spectrometry.

Method of Calibration: This source was prepared using standard solution traceable to National Institute of Standards and Technology. The solution was gravimetrically transferred to the 47 mm glass fiber filter paper, dried and sealed between mylar film. The source was calibrated using a high purity Germanium detector. The energy vs. efficiency curve of the detector was established using NIST traceable standard solution and verified through ongoing Intercomparison crosscheck program with USEnvironmental Protection Agency and National Institute of Standards and Technology.



Radiochemistry Laboratory

9-20-93

Date:

TMA

Thermo Analytical Inc.

TMA/Eberline

7021 Pan American Hwy. NE

Albuquerque, NM 87109

(505) 345-3451

CERTIFICATE OF CALIBRATION**Electroplated Alpha Standard**S.O. # C-01290 129420
P.O. # HR-3960 N444687**Description of Standard:**Model No. DNS-11 Serial No. 12066 Isotope Thorium 230
Electroplated on polished SS disc, 0.79 mm thick.Total diameter of 4.77 cm and an active diameter of 4.45 cm.

Radioactive material permanently fixed to the disc by heat treatment, without any covering over the active surface.

Measurement Method:

The 2 π alpha emission rate was measured using an internal gas flow proportional chamber. Absolute counting of alpha particles emitted in the hemisphere above the active surface was verified by counting above, below and at the operating voltage. The calibration is traceable to NBS by reference to an NBS calibrated alpha source. Intercomparisons testings between EAC-NBS show an agreement within 0.2%.

Measurement Result:

The total number of alpha particles emitted from the surface of the disc per minute (cpm) on the calibration date was

6,850 340

The total disintegration rate (dpm) assuming 1.5% backscatter of alpha particles from the surface of the disc, was

13,700 700 (0.00617 uCi)The uncertainty of the measurement is 5 % which is the sum of random counting error at the 99% confidence level and the estimated upper limit of systematic error in this measurement.Calibrated by: Jim ArellanoReviewed by: Charles Gonzales(print)
(signature)(print)
(signature)Calibration Date: May 13, 1987Date: May 13, 1987

Note: It is recommended that this source be recertified on an annual basis.



Thermo Analytical Inc.

TMA/Eberline Albuquerque Laboratory

7021 Pen American Hwy. NE

Albuquerque, NM 87109

(505) 345-3487

CERTIFICATE OF CALIBRATION

Electroplated Beta Standard

S.O. # S-01712

P.O. # HR5848

Description of Standard:

Model No. DHS-12

Serial No. 859/89

Isotope Technetium-99

Electroplated on polished SS disc, 0.79 mm thick.

Total diameter of 4.77 cm and an active diameter of 4.45 cm

Radioactive material permanently fixed to the disc by heat treatment without any covering over the active surface.

Measurement Method:

The ^{99}Tc beta emission rate was measured using an internal gas flow proportional chamber. Absolute counting of beta particles emitted in the hemisphere above the active surface was verified by counting above, below and at the operating voltage. The calibration is traceable to NBS by reference to an NBS calibrated beta source. Intercomparisons testing between EAC-NBS show an agreement within 0.3%.

Measurement Result:

The total number of beta particles emitted from the surface of the disc per minute (cpm) on the calibration date was:

13,600 + 408

The total disintegration rate (dpm) assuming 25% backscatter of beta particles from the surface of the disc, was:

21,800 + 653 (0.00980 uCi)

The uncertainty of the measurement is 3% which is the sum of random counting error at the 99% confidence level and the estimated upper limit of systematic error in this measurement.

Calibrated by Gloria Madrid

Reviewed by Kathy Dendahl

(print)

(print)

Gloria Madrid
(signature)

Kathy Dendahl
(signature)

Calibration Date: February 24, 1989

Date: February 24, 1989

Note: It is recommended that this source be recertified on an annual basis.

CERTIFICATE OF CALIBRATION

CUSTOM MIXED GAMMA STANDARD

SERIAL NUMBER A1609

Reference Date October 1, 1993 at 1200 PST

RADIONUCLIDE (<u>HALF-LIFE</u>) ¹	ACTIVITY <u>LEVEL</u>	TOTAL UNCERTAINTY (<u>±</u>)	PRINCIPAL EMISSIONS keV ¹ (<u>% INTENSITY</u>)	PHOTONS/ <u>SECOND</u>
Cd-109 (1.2665 years)	294.7 nCi	3.32%	88.0341 (3.6)	405.6
Co-57 (271.77 days)	21.33 nCi	3.26%	122.0612 (85.5) 136.4730 (10.69)	674.8 84.4
Te-123m (119.7 days)	14.59 nCi	3.31%	158.989 (84.0)	453.6
Cr-51 (27.704 days)	379.2 nCi	3.23%	320.084 (9.83)	1379.0
Sn-113 (115.09 days)	53.70 nCi	3.27%	391.690 (64.0)	1271.6
Sr-85 (64.84 days)	74.59 nCi	3.22%	513.996 (99.27)	2739.8
Cs-137 (30.0 years)	39.72 nCi	3.34%	661.660 (85.21)	1252.1
Y-88 (106.61 days)	117.3 nCi	3.24%	898.065 (92.7) 1836.077 (99.35)	4023.6 4314.5
Co-60 (5.271 years)	53.36 nCi	3.34%	1173.237 (99.90) 1332.501 (99.9824)	1972.4 1974.0

SOURCE DESCRIPTION

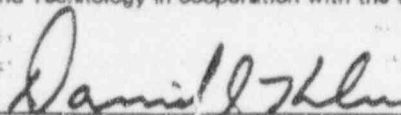
The activity is uniformly distributed in 500 ml of an epoxy matrix with a density of 1.5 g/cc and cast in a customer supplied Marinelli beaker.

METHOD OF CALIBRATION

Mixed nuclide solutions are prepared by dispensing gravimetric aliquots of individual, or mixtures of, calibrated nuclide solutions into a master batch. Aliquots of the master batch were then gravimetrically transferred to the soil equivalent matrix, uniformly mixed then transferred to the Marinelli beaker.

The nuclide solutions were calibrated using a high purity Germanium detector energy vs. efficiency curve established and verified through ongoing intercomparisons with the National Institute of Standards and Technology. This standard is indirectly (implicitly) traceable to the National Institute of Standards and Technology.

North American Scientific, Inc. actively participates in the Radioactivity Measurements Assurance Program conducted by the National Institute of Standards and Technology in cooperation with the U.S. Council for Energy Awareness.


Calibration Laboratory

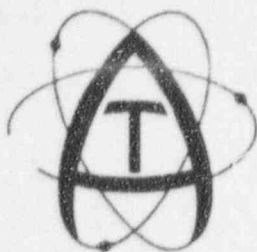
9.24.93
Date

REFERENCES

- (1) Table of Radioactive Isotopes, 7th edition, 1986.

• LEAK TEST CERTIFICATION ON REVERSE •

North American Scientific, Inc. 7435 Greenbush Ave., North Hollywood, CA 91605 (818) 503-9201 Fax (818) 503-0764



ATLAN-TECH, INC.

1345 HEMBREE ROAD, ROSWELL, GA 30076 P.O. BOX 2267-30077
(404) 442-1067, FAX (404) 442-8445

SOURCE CERTIFICATE

Standard Radionuclide Source

Source No.: 1292-CWM-MBW-01

Reference Date & Time: 10/1/92 12:00 EST

Water Equivalent in 500 mL Marinelli Beaker

This standard was prepared using aliquots from two radionuclide standard sources traceable to the National Institute of Standards and Technology. The gravimetrically measured aliquots used were 0.4331 grams for the mixed gamma standard and 0.0417 grams for the Americium standard. The following table is a summary of the pertinent information for each isotope contained in this source.

Isotope	Half-Life (days)	Standard Source Activity (uCi/gm)	Mass of Standard Used (grams)	Source Activity (uCi)	Total Uncertainty %
Cd-109	464.00	7.899e-01	0.4331	3.421e-01	4.9
Co-57	270.27	1.937e-02	0.4331	8.388e-03	4.5
Ce-139	137.60	1.088e-02	0.4331	1.771e-02	4.3
Hg-203	46.60	4.192e-02	0.4331	1.816e-02	4.5
Ir-113	115.70	5.006e-02	0.4331	2.168e-02	4.4
Cs-137	11019.59	3.528e-02	0.4331	1.528e-02	4.9
Co-60	1925.23	5.112e-02	0.4331	2.214e-02	4.5
Y-88	106.60	1.043e-01	0.4331	4.517e-02	4.6
Am-241	157753	1.209e+00	0.0417	5.040e-02	0.85

Reviewed by:

Jim Obrien

Laboratory Services Group Manager