



FLIR Radiation, Inc.
100 Midland Road
Oak Ridge, TN 37830
Tel.: (865) 220 8700 ext.101
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License Number 41-25639-01E

Jack Foster
Chief Licensing Branch
State Agreements & Industrial Safety Branch
Division of Materials Safety and State Agreements
Office of federal and State Materials and
Environmental Management Programs
U.S. NRC
Washington, D.C. 20555-0001

Dated: August 31st, 2011

Reference our license number 41-25639-01E for incorporating an exempt source into the radHUNTER product for internal calibration purposes in accordance with § 32.14 and § 30.15 (a) (9):

Attention: Mr. Jack Foster

Dear Mr. Foster

Some applications for the radHUNTER product may require the use of a different source for internal calibration (example a location where Cesium-137 is present in the natural background radiation). We are therefore requesting that a maximum of 80 nanoCurie exempt Manganese-54 sealed source be used as an alternative option for certain models of radHUNTER products.

We are also requesting that the Manganese-54 or Cesium-137 sealed source be positioned on the side of the detector PMT versus the end of the detector. Due to the geometry of the detector, the measured peak energy depends greatly upon the position of the source. Changing the position of the source will greatly enhance instrument performance.

Due to the new proposed position of the source, it would also necessary to slightly increase the activity of the Cesium-137 source to 25 nanoCurie. Therefore we are requesting that the maximum activity of the exempt Cesium-137 sealed source to be used in the radHUNTER product be increased to a maximum of 25 nanoCurie.

As each source would not contain more than one exempt quantity set forth in § 30.71, Schedule B and each instrument would only contain one exempt quantity, we would be in full compliance with § 30.15 (a) (9) (i) and § 30.15 (a) (9) (ii).

DESCRIPTION OF PRODUCTS:

The radHUNTER instruments are a family of hand-held, digital gamma spectrometers.

Each handheld is able to rapidly locate, accurately measure and precisely identify sources or contaminations from gamma radiation. The instruments also have the ability to detect X-ray sources as well as the presence of neutrons in the radiation field via an optional neutron detector.

The scintillation detector used in each of these products is either a NaI(Tl) or LaBr₃ (Ce³⁺), depending upon the model. We are also looking into other variations of scintillation detectors available.

The Cesium-137 or Manganese-54 source would be used for purposes of internal calibration and peak stabilization. The internal calibration would be performed after powering up the instrument and any other time when prompted by the user. After the instrument has performed its internal calibration, the instrument would stabilize off the Cesium-137 or Manganese-54 source. By incorporating an extremely low activity exempt Cesium-137 or Manganese-54 source into the product enables accurate peak stabilization regardless of change of environmental conditions. Therefore the instrument can be used immediately to search, locate and identify gamma sources with precise accuracy.

The drawing of the radHUNTER (radHunter A2 NRC A-04.pdf) is attached.

INSTRUMENT SPECIFICATIONS:

Information was submitted with the previous application dated 05/02/11.

SEALED EXEMPT SOURCE:

Isotope:	Cesium-137
Nominal activity:	maximum 25 nanoCurie
Chemical and/or Physical Form:	Cesium Chloride
Encapsulation:	Laminated

Isotope:	Manganese-54
Nominal activity:	maximum 80 nanoCurie
Chemical and/or Physical Form:	Cesium Chloride
Encapsulation:	Laminated

The Cesium-137 and Manganese-54 sources are manufactured by Spectrum Techniques, Inc. A copy of the U.S. NRC license from Spectrum Techniques, Inc. was submitted with the previous application dated 03/29/11 (License number 41-23845-01E).

Sources are wipe/leak tested by Spectrum Techniques, Inc. A certificate of compliance is provided with each source which remains with the product when shipped. A sample of the "Certificate of Compliance" was submitted with the previous application dated 03/29/11.

Spectrum Techniques, Inc. provides a U.S. NRC, DOT and IATA brochure which includes information set forth under § 32.19. A copy was submitted with the previous application dated 03/29/11. A copy of the brochure will be shipped with the product.

DETAILS OF CONSTRUCTION:

The sealed Cesium-137 or Manganese-54 exempt source would be attached to the upper side of the detector PMT by double sided TESA 64621 adhesive tape. In addition to the double sided adhesive tape, approximately 1 ½ x 3" inches, 23-FEP clear adhesive tape would be placed over the Cesium-137 source to provide additional protection against accidental submersion of the products in water. The tape has a strong adhesive that can withstand environmental conditions beyond the products operating range. The housing is constructed from aluminum to prevent any damage to the internal components including the Cesium-137 or Manganese-54 source. Work instruction "wi-5010-radhunter-source-assembly" provides instructions on source assembly.

LABELING:

Information was submitted with the previous application dated 03/29/11.

FACILITIES AND EQUIPMENT:

Information was submitted with the previous application dated 03/29/11.

STORAGE OF PRODUCTS:

Information was submitted with the previous application dated 03/29/11.

PERSONNEL DOSIMETRY:

Information was submitted with the previous application dated 03/29/11.

TRAINING:

Information was submitted with the previous application dated 03/29/11.

RADIATION PROTECTION PROGRAM:

Information was submitted with the previous application dated 05/02/11.

SHIPPING OF INSTRUMENTS WITH EXEMPT SOURCES:

Information was submitted with the previous application dated 03/29/11.

QUALITY ASSURANCE AND CONTROL:

Information was submitted with the previous application dated 03/29/11.

EVALUATION OF METHOD OF ATTACHMENT:

Drop test from 1 meter

Information was submitted with the previous application dated 03/29/11.

Environmental Tests

Although information was submitted with the previous application dated 05/02/11, additional testing was completed to determine reliability of method of attachment of source. Preparation for testing....A Cesium-137 source was attached to the radHUNTER detector housing in accordance with work instruction, "wi-5010-radhunter source assembly". However for testing purposes, the detector was not assembled into the radHUNTER housing.

Test 1 – Submersion of detector in water for 24 hours

The radHUNTER detector was submerged in water for 24 hours. Although the radHUNTER detector was not fully submerged, the section of the detector with the Cesium-137 source attached was fully submerged in water.



Results: The 23-FEP adhesive tape remained in place and tape showed no signs of damage.
Test 2 – Temperature at +60°C for 24 hours

The radHUNTER detector was placed in an environmental chamber that was programmed with the following profile:

- Start - Stabilize at 20°C for 1 hour
- Change 20°C to 30°C in 1 hour
- Hold at 30°C for an hour
- Change 30°C to 40°C in 1 hour
- Hold at 40°C for an hour
- Change 40°C to 50°C in 1 hour
- Hold at 50°C for an hour
- Change 50°C to 60°C in 1 hour
- **Hold at 60°C for 24 hours**
- Change 60°C to 50°C in 1 hour
- Hold at 50°C for an hour
- Change 50°C to 40°C in 1 hour
- Hold at 40°C for an hour
- Change 40°C to 30°C in 1 hour
- Hold at 30°C for an hour
- Change 30°C to 20°C in 1 hour
- Finish - Hold at 20°C for 1 hour

Test was performed in the production environmental chamber.



Results: The 23-FEP adhesive tape remained in place and showed no signs of damage.

Test 3 – Temperature at -30°C for 24 hours

The radHUNTER detector was placed in an environmental chamber that was programmed with the following profile:

- Start - Stabilize at 20°C for 1 hour
- Change 20°C to 10°C in 1 hour
- Hold at 10°C for an hour
- Change 10°C to 0°C in 1 hour
- Hold at 0°C for an hour
- Change 0°C to -10°C in 1 hour
- Hold at -10°C for an hour
- Change -10°C to -20°C in 1 hour
- Hold at -20°C for an hour
- Change -20°C to -30°C in 1 hour
- **Hold at -30°C for 24 hours**
- Change -30°C to -20°C in 1 hour
- Hold at -20°C for an hour
- Change -20°C to -10°C in 1 hour
- Hold at -10°C for an hour
- Change -10°C to 0°C in 1 hour
- Hold at 0°C for an hour
- Change 0°C to 10°C in 1 hour
- Hold at 10°C for an hour
- Change 10°C to 20°C in 1 hour
- Finish - Hold at 20°C for an hour

Test was performed in the production environmental chamber.



Results: The 23-FEP adhesive tape remained in place and showed no signs of damage.

Test 4 – Temperature Shock for 24 hours

The radHUNTER detector was placed in an environmental chamber that was programmed with the following profile:

- Start - Stabilize at 20°C for 1 hour
- Change 20°C to 60°C in 5 minutes
- Hold at 60°C for an hour
- Change 60°C to 20°C in 5 minutes
- Hold at 20°C for an hour
- Change 20°C to -20°C in 5 minutes
- Hold at -20°C for an hour
- Finish - Change -20°C to 20°C in 5 minutes

Test was performed in the production environmental chamber.

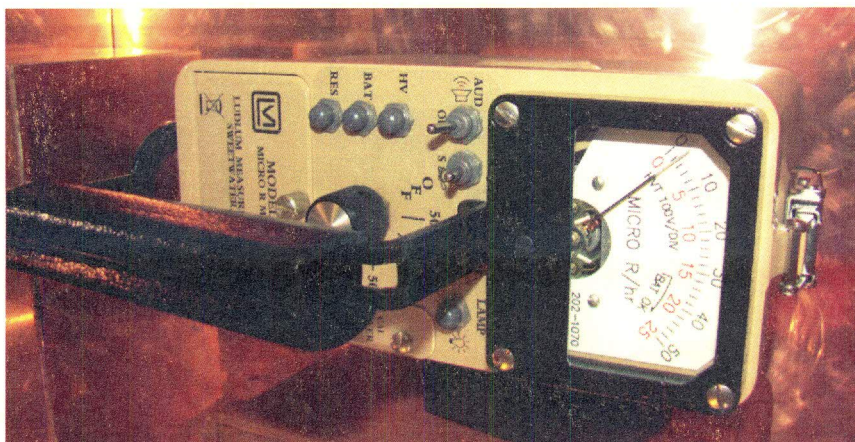


Results: The 23-FEP adhesive tape remained in place and showed no signs of damage.

EVALUATION OF POTENTIAL RADIATION EXPOSURE:

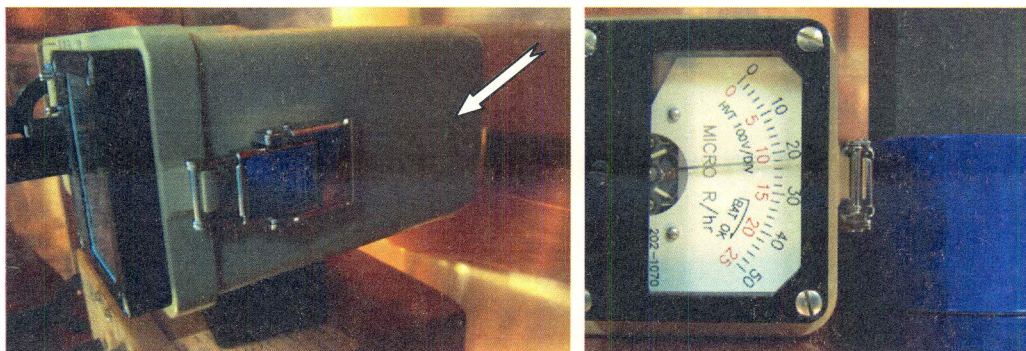
Measurements:

All measurements were taken with a calibrated Micro-R Ludlum model 19 survey meter serial number 265219. This survey meter was calibrated on the 25th August, 2011. Certificate of calibration is attached. All testing was done in a lead chamber lined with tin and copper. The measured background in the lead chamber was between 1-2 micro R/hr. The background was subtracted from the results recorded.



Test 1 – Dose equivalent at side of radHUNTER end cap (closest point to source):

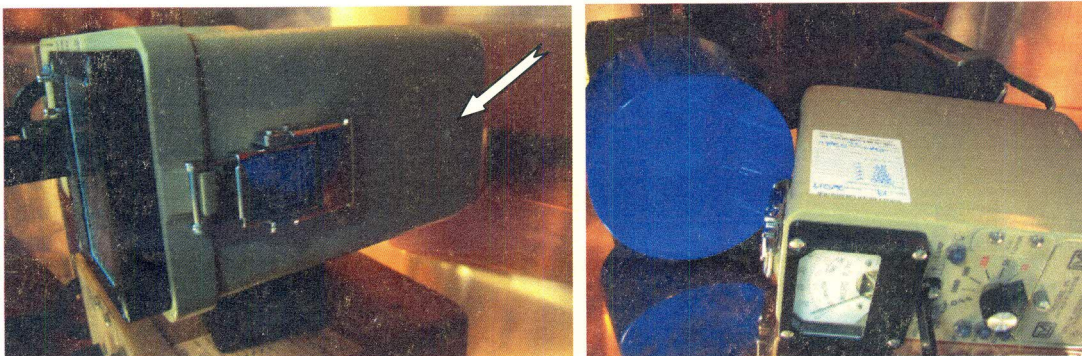
- A 25nanoCurie, Cesium-137 source was attached to the radHUNTER detector in accordance with work instruction “wi-5010-radhunter-source-assembly”.
- The Micro-R meter (marking on instrument to indicate center point of detection) was placed against the side of the detector (center point of Cesium-137 source) for an accurate reading. The reading from the Micro-R meter was recorded in the chart below this section.



- This test was performed again with 4 other samples of 25nanoCurie, Cesium-137 source. Readings were recorded in the chart below this section.
- This test was performed again with 5 samples of 80nanoCurie, Manganese-54 source. Readings were recorded in the chart below this section.

Test 2 – Dose equivalent at upper section of radHUNTER handle:

- A 25nanoCurie, Cesium-137 source was attached to the radHUNTER detector in accordance with work instruction “wi-5010-radhunter-source-assembly”.
- The Micro-R meter (marking on instrument to indicate center point of detection) was placed against the side of the detector end cap (center point of Cesium-137 source) for an accurate reading. The reading from the Micro-R meter was recorded in the chart below this section.



- This test was performed again with 4 other samples of 25nanoCurie, Cesium-137 source. Readings were recorded in the chart below this section.
- This test was performed again with 5 samples of 80nanoCurie, Manganese-54 source. Readings were recorded in the chart below this section.

radHUNTER family					
Source Sample Numbers	Source 1	Source 2	Source 3	Source 4	Source 5
	Dose Rate (μ R/hr)				
Test 1 (25nCi, Cesium-137)	12	11	13	11	12
Test 2 (25nCi, Cesium-137)	ND	ND	ND	ND	ND
Test 1 (80nCi, Manganese-54)	54	59	65	55	58
Test 2 (80nCi, Manganese-54)	1	ND	1	ND	1

** ND...not detectable

Theoretical calculations:

Dose Rate Estimation Method

Software: MCNP5 version 1.51

Method: Flux-to-dose rate conversion factors from ICRP-21 (Appendix H2 of MCNP5 Manual Vol.2)

CEA tables 2006: http://www.nucleide.org/DDEP_WG/Nuclides/Cs-137_tables.pdf

radHUNTER family – 25nanoCurie, Cesium-137 source	
Position	Dose Rate (µrem/hr)
Surface of product closest to source	16.1
Closest position of hand when holding product (6 inches from source)	0.2
1 foot from source	0.06

radHUNTER family – 80nanoCurie, Manganese-54 source	
Position	Dose Rate (µrem/hr)
Surface of product closest to source	74
Closest position of hand when holding product (6 inches from source)	0.97
1 foot from source	0.29

Summary:

The radHUNTER product is designed so that when in use the intrinsic source is usually at least 1 foot away from the person handling the product. The hand holding the product would be approximately 6 inches or further from the source, but the detector, housing and electronics would provide shielding to minimize dose to the hands. At a distance of 1 foot from the source the effective dose is <1micro rem/hr.

ROCORD AND REPORTS OF TRANSFER:

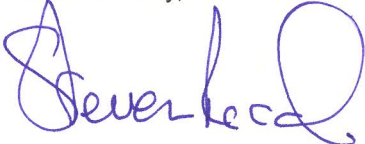
In accordance with § 32.16, FLIR Radiation, Inc. will maintain records of transfer of radioactive material. The records will identify, by name and address, each person to whom radioactive material was transferred. We will file a report file with the Director of the Office of Federal and State Materials and Environmental Management Programs, attention: Document Control Desk/Exempt Distribution by no later than January 31 of each year. This report will include the information as specified in § 32.16.

SUMMARY OF ATTACHMENTS:

- radHUNTER drawing "radHunter A2 NRC A-04".
- Work instruction "wi-5010-radhunter-source-assembly".
- Certificate of Calibration for Micro-R Ludlum model 19 survey meter serial number 265219.

I hope that we have provided you with adequate information. However, should you need any further information to assist in your review, please do not hesitate to contact me.

Yours sincerely,



Steven Read
RSO

CC Juergen Stein (General Manager)



Document #: WI 5010

Revision: Rev 2

Title: Incorporating a source into a radHUNTER product

1.0 Purpose

- 1.1 This work instruction explains how to incorporate a Cesium-137 or Manganese-54 source into the radHUNTER product.

2.0 Scope

- 2.1 Applies to the radHUNTER product

3.0 Responsibility

- 3.1 Radiation Safety Officer is responsible for writing the procedures and ensuring they are accurate.
3.2 Radiation Safety Officer is responsible for training technicians to carry out the tasks outlined in this work instruction.
3.3 Technician is responsible for ensuring that the instructions are followed through.
3.4 Radiation Safety Officer is responsible for carrying out regular inspections. Records of all surveys/inspections shall be kept on file in the Radiation Safety Office.

4.0 Requirements

- 4.1 radHUNTER parts.
4.2 Cesium-137 or Manganese-54 source. The activity of source would be based upon the model (refer to work order).
4.3 Wipe test certificate for Cesium-137 source. The certificate must remain with the product documentation.
4.4 2 inch x ½ inch (approximately) piece of double sided adhesive tape (part number 103190).
4.5 3 inch x 1 ½ inch (approximately) 23-FTP adhesive tape (part number 103256)

5.0 Definitions (Optional)

6.0 Procedure-Process-Work Instruction

6.1 Safety

- 6.1.1 This equipment must be operated in accordance with local health and safety procedures.

6.1.2 Electrical:

- 6.1.2.1 Observe anti-static precautions in accordance with local controlled procedures.

6.1.3 Radiation:

- 6.1.3.1 All radioactive sources when not in use must be stored in the approved storage area.
6.1.3.2 Personnel working with radioactive materials must be trained.
6.1.3.3 To minimize exposure consider 'Time', Distance' and 'Shielding' (ALARA - As Low As Reasonably Achievable).
6.1.3.4 Personnel monitors must be worn.

- 6.1.3.5 Care and security in accordance with U.S. NRC Regulations, State Tennessee Regulations and FLIR Radiation, Inc. Radiation Protection program must be observed.**
- 6.1.3.6 When handling the Cesium-137 or Manganese-54 source, handle it from the edge to minimize exposure.**

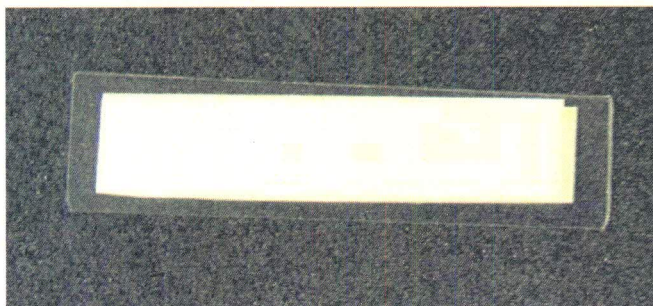
6.2 Assembly of Cesium-137 or Manganese-54 source (The following must done at the final stage of the assembling process to minimize exposure):

- 6.2.1** Sign out the source from the storage facility (before removing the source from stock, ensure that the activity noted on the source is the required amount...maximum 25nCi for Cesium-137 or 80nCi for Manganese-54). Enter details in log (example below). Keep the wipe test certificate for the source with product.

Radionuclide	Activity (nCi)	Source - Date of Manufacturer	Product Name	Product Serial Number	Date Signed Out	Name	Signature
Cs-137	15	1/31/2011	radHUNTER	123456-123456	2/1/2011	Read	

- 6.2.2** Cut approximately a 2 inch x ½ inch piece of double sided adhesive tape.

- 6.2.3** Attached the double sided adhesive tape on the back side of the source.



- 6.2.4** Remove backing to double-sided adhesive tape and attach the source to the detector using the appropriate tooling.



- 6.2.5** Cut a 3 inch x 1 ½ inch (approximately) piece of 23-FEP adhesive tape and place central over the source. Ensure that the 23-FEP adhesive tape is firmly attached to the source and the detector.



- 6.2.6** Complete assembly of product according to the applicable ISO work instructions.



7.0 Records:

- 7.1** Radioactive sources log

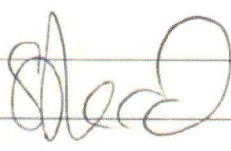
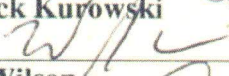
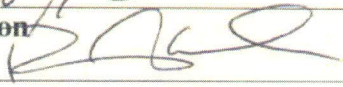
8.0 References:

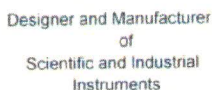
- 8.1** U.S. NRC Regulations
- 8.2** U.S. NRC license 41-25639-01E
- 8.3** State Tennessee Regulations
- 8.4** State Tennessee license R-01097-B14
- 8.5** FLIR Radiation, Inc. Radiation Protection Program

9.0 Revision History:

Rev.	Date	QCN #	Comment
0	03/10/2011	N/A	Initial Release
1	04/28/2011	0201	Added section 6.2.5. This tape protects the Cesium-137 source from accidental submersion in water.
2	08/29/2011	0205	Added Manganese-54 source as an option and increased activity of Cesium-137 source

10.0 Approvals:

Radiation Safety Officer: Steven Read 	Date: 08/29/2011
Production Manager: Nick Kurowski 	Date: 08/29/2011
Quality Manager: Rick Wilson 	Date: 08/29/2011



LUDLUM MEASUREMENTS, INC.

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

CUSTOMER FLIR RADIATION, INC.

ORDER NO. 20182886/367309

Mfg. Ludlum Measurements, Inc. Model 19 Serial No. 265219

Mfg. _____ Model _____ Serial No. _____

Cal. Date	25-Aug-11	Cal Due Date	25-Aug-12	Cal. Interval	1 Year	Meterface	202-1070
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Check mark ☒ applies to applicable instr. and/or detector IAW mfg. spec. T. 72 °F RH 25 % Alt 701.8 mm Hg

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

☒ Mechanical ck. ☒ Meter Zeroed ☐ Background Subtract ☐ Input Sens. Linearity
☐ ☐ ☐ ☒ Gas Flow Control☒ F/S Resp. ck ☒ Reset ck. ☐ Window Operation ☒ Geotropism

☒ Audio ck. ☐ Alarm Setting ck. ☒ Batt. ck. (Min. Volt) 2.2 VDC

☐ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☒ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97. Threshold

Instrument Volt Set 575 V Input Sens. 28 mV Det. Oper. _____ V at _____ mV Threshold Dial Ratio _____ = _____

☒ HV Readout (2 points) Ref./Inst. 500 / 498 V Ref./Inst. 1500 / 1505 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	4000
5000	1000uR/hr	1000	1000
500	400uR/hr = 75500 gpm	400	400
500	100uR/hr	100	100
250	200uR/hr = 37800 gpm	200	200
250	100uR/hr	100	100
50	7550 cpm	40	40
50	1880 cpm	10	10
25	3780 cpm	20	20
25	940 cpm	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 ANSI/NCSL 2540-1-1994 and ANSI N323-1978

State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: ☐ 73410 ☐ 1131 ☐ 781 ☐ 059 ☐ 280 ☐ 60646 ☐ 70897
Cs-137 Gamma S/N ☐ 1162 ☐ G112 ☒ M565 ☐ 5105 ☐ T1008 ☐ T879 ☐ E552 ☐ E551 ☐ 720 ☐ 734 ☐ 1616 ☐ Neutron Am-241 Be S/N T-304

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

☒ m 500 S/N 238275 ☐ Oscilloscope S/N _____ ☒ Multimeter S/N 70602489

Calibrated By: C. Juan A. Koun Date 25 Aug-11

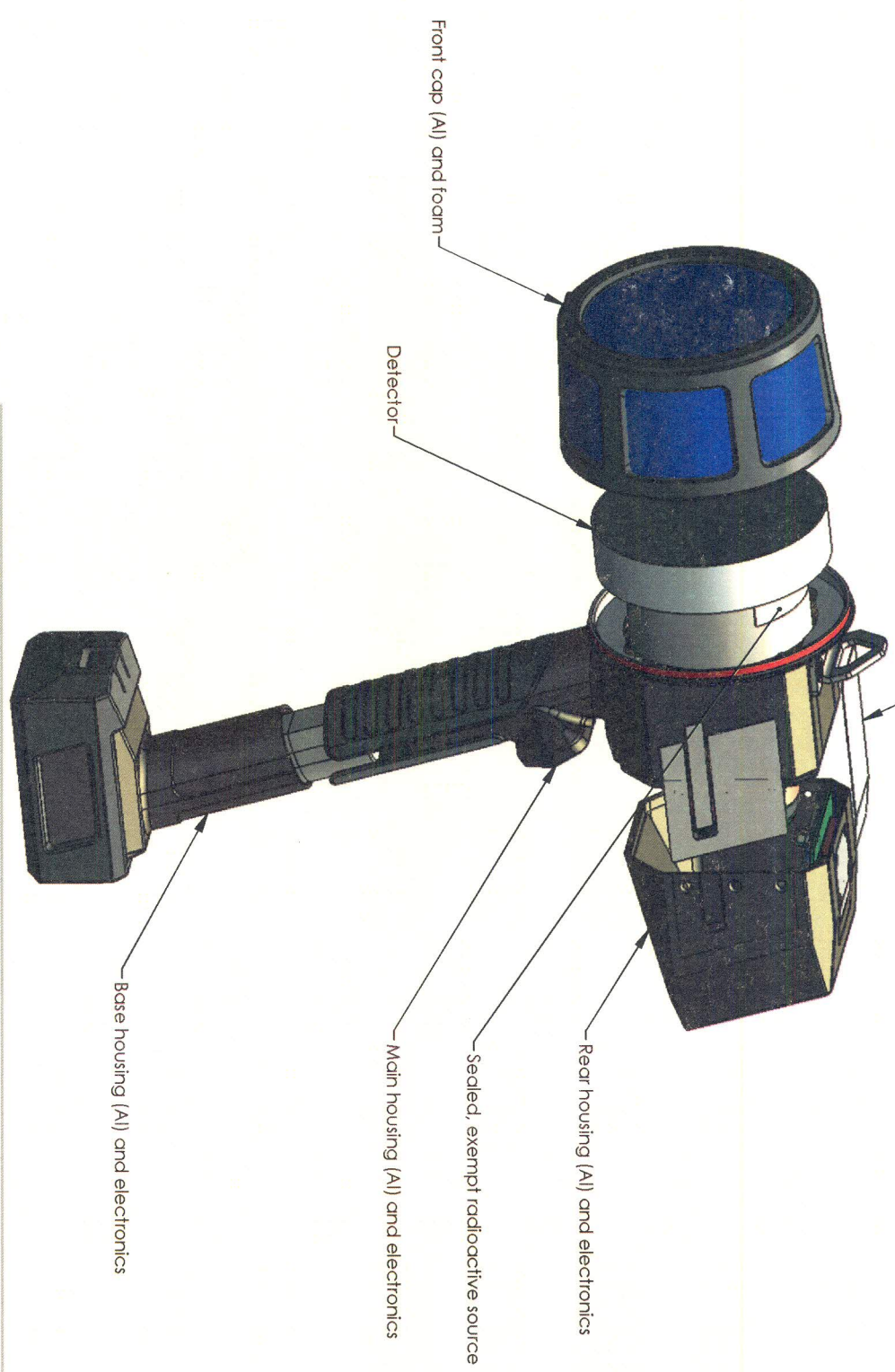
Reviewed By: Phad H Date 2 Aug 11

This certificate shall not be reproduced except in full, without the written approval of Ludlum Measurements, Inc.
FORM C22A 03/11/2010 Page 1 of 1

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



Product label
(including radioactive material warning information)

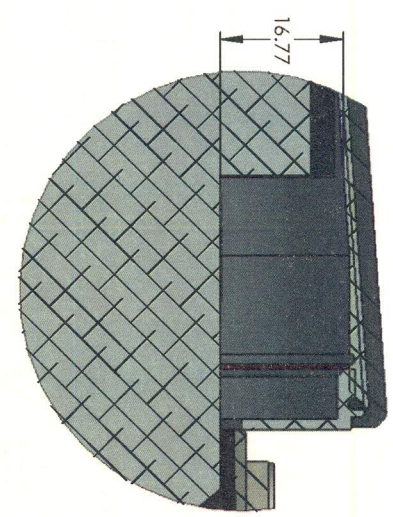
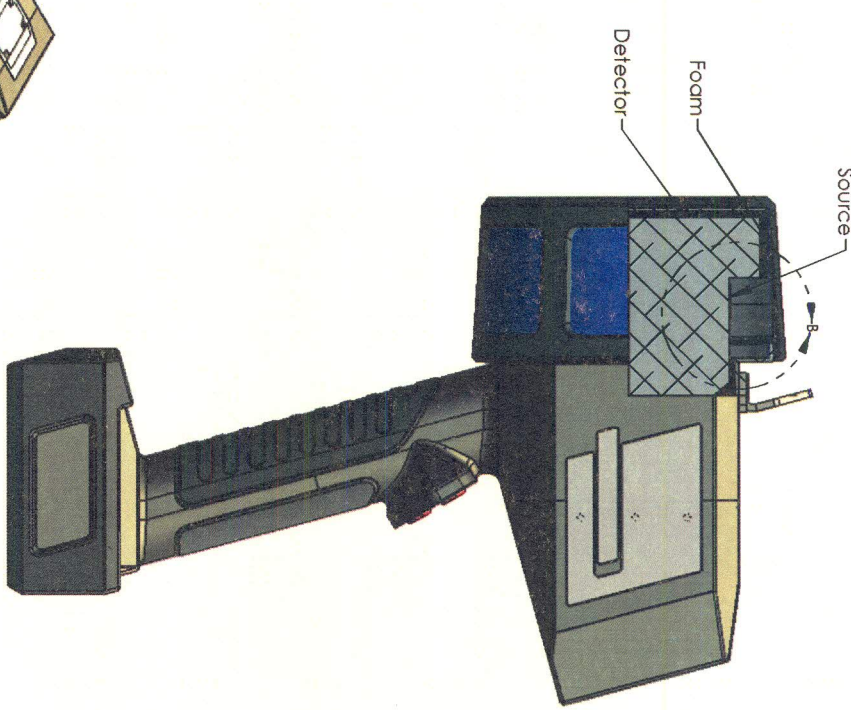


REVISIONS				Various
ZONE	REV.	NUMBER	DATE	APPROVED

PROPRIETARY AND CONFIDENTIAL		UNLESS OTHERWISE SPECIFIED:	
THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF ICX Inc.. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF ICX Inc. IS PROHIBITED.		REMOVE BURRS AND SHARP EDGES: 0.50 mm MAX.	
		FILLETS & RADII: 0.50 mm MAX.	
		MACHINE SURFACES FLAT WITHIN 0.05 mm/mm	
		OTHER SURFACES FLAT WITHIN 0.10 mm/mm	
MATERIAL:		NAME	INIT. DATE
A1 - Housing		J. Predmore	3/31/11
FINISH:		J. Predmore	3/31/11
Powder coat		S. Reed	3/31/11
APPLICATION		APPD	
DO NOT SCALE DRAWING		APPD	
TITLE:		radHunter A2 Series	

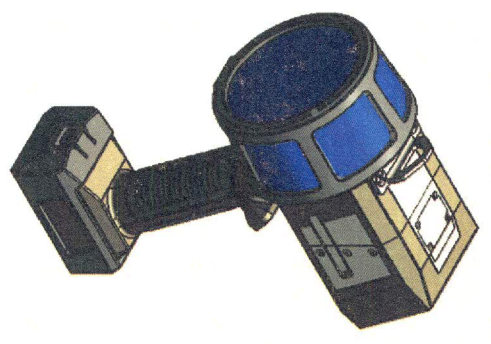
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Extraordinary Protection
FLIR Radiation, Inc.
100 Midland Rd.
Oak Ridge, TN, 37830
Tel.: 865-220-8700
Fax: 865-813-0437

SIZE	DWG. NO.:	REV.
A	radHunter A2 NRC	A-04
SCALE:	ICX P/N: Various	SHEET 1 OF 2



DETAIL B
SCALE: 1:1

Source Mechanical Detail



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				FILLETS & RADII: 0.50 mm MAX.			
				MACHINE SURFACES FLAT WITHIN 0.05 mm/mm			
				OTHER SURFACES FLAT WITHIN 0.10 mm/mm			
				ANGULAR: ±1.0° STANDARD FINISH: 3			
MATERIAL:				NAME	INIT.	DATE	
A1 - Housing				DRWN	J. Predmore	3/31/11	
FINISH:				CHKD	J. Predmore	3/31/11	
Powder coat				APPD	S. Read	3/31/11	
NEXT ASSY				USED ON			
APPLICATION				DO NOT SCALE DRAWING			
TITLE:				radHunter A2 Series			
SIZE				DWG. NO.:			
A				radHunter A2 NRC			
SCALE:				ICX P/N: Various			
SHEET 2 OF 2				REV.			
A-04							

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Oak Ridge, TN, 37830
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Oak Ridge TN 37830
USA

1 865 220 8700
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09/01/2011



001400



ZIP 37830

011010004404

Attention: Mr. Jack Foster

Chief Licensing Branch

State Agreements & Industrial Safety Branch

Division of Materials Safety and State Agreements

Office of Federal and State Materials and

Environmental Management Programs

U.S. NRC

Washington, D.C. 20555-0001

Traci - opened.

YM

1822