Testing and Evaluation Protocol for Portable Radiation Detection Instrumentation for Homeland Security

T&E Protocol N42.33, 2010

Version 2.02

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Testing and Evaluation Protocol for Portable Radiation Detection Instrumentation for Homeland Security

1. Scope

This document establishes the protocol for testing alarming personal radiation detectors based on the performance requirements established in ANSI N42.33, "American National Standard for Portable Radiation Detection Instrumentation for Homeland Security."

2. References

This protocol shall be used in conjunction with the following documents:

[R1] ANSI N42.33, "American National Standard for Portable Radiation Detection Instrumentation for Homeland Security."

[R2] ANSI/IEEE N42.42, "Data Format Standard for Radiation Detectors Used for Homeland Security."

[R3] NIST Handbook 150:2006, NVLAP Procedures and General Requirements

[R4] NIST Handbook 150-23:2007 (DRAFT) NVLAP Radiation Detection Instruments

3. Compliance Level Information

Instrument under test might meet all the requirements listed in the ANSI/IEEE N42.33 standard. Therefore, different agencies developed documents describing the compliance levels required for particular applications of the instruments under test. An example of such compliance level requirements is those required by the Graduated Rad/Nuc Detector Evaluation and Reporting (GRaDER) program. For this program, information can be found in the "Compliance Level for GRaDER Instrument Performance" document located at http://www.dhs.gov/GRaDER .

4. Test and evaluation steps

It is recommended that testing laboratories perform the tests listed in this protocol in the following order:

- Check all items listed in the general requirements
- Perform the radiological tests
- Perform the temperature and humidity tests
- Perform the entire electrical and electromagnetic test except the Electrostatic Discharge (ESD) test
- Perform the impact and the vibration tests
- Perform the moisture and dust test
- Perform the ESD test
- Perform the drop test, as required

Excel template sheets are provided by NIST to the testing laboratory to guarantee that all data required is being provided in the test report.

5. Recording test results

This Test and Evaluation protocol contains data sheets that shall be used to record and report all test results. Each data sheet is associated with a specific section(s) of the referenced ANSI standard, N42.33. An electronic version of the data sheets is provided in the form of spreadsheets that may be used to record and report the results of the tests. These spreadsheets were verified and validated (V&V) using Microsoft Excel 2007 (compatibility mode).

Instrument status shall be recorded on the "Test Summary" sheet as testing is performed. The comment section in each data sheet shall be used to record changes to the test requirements and methods listed in the ANSI standard. The comment section shall also include the rational of the changes.

6. Test report

A test report summarizing the results of the test shall include the following sections:

a. Laboratory equipment information:
   1. Identify all participating laboratory facilities. Include points of contact names, mailing address, telephone number, and electronic mail addresses.
   2. Identify the tests performed in the different facilities.
   3. List all supporting equipment name, model number and last day of calibration used for each test.

b. Test equipment information :
   1. Include manufacturer name, instrument model, instrument serial number, software and firmware version identification, and last day of calibration.
   2. List the operating modes and parameter setting of the instrument and accessory kit(s) used in each test.

c. Data sheets:
   1. The data sheets listed in this document shall be completed and provided as part of the report.
   2. Include changes to the ANSI standard test requirements or methods and rational to the changes.

7. Guidance for testing ANSI N42.42 data format requirements

The standard associated with this Test and Evaluation Protocol requires verification that an output data file is created that complies with ANSI/IEEE N42.42 standard requirements. The range of complexity of the N42.42 compliant instrument output file is extremely broad. Data output files from these instruments are simple files that can be checked manually using a text editor such as Notepad or WordPad. These files can also be verified using additional tools. In principle, all data output files that meet ANSI N42.42 can be verified manually using a text editor as these files are XML files. File reading software, such as Altova XMLSpy® 2009 Standard Edition can also be used for manual viewing and validating of structure and content.

N42.42 schemas can be used to validate the file format as specified in the ANSI/IEEE N42.42 standard. These schemas are available at the NIST web site **http://physics.nist.gov/Divisions/Div846/Gp4/ANSIN4242/xml.html**.

There are several XML validators that can be used to verify the XML structure of the N42.42 compliant instrument output file. Examples of these validators can be found at **http://www.xmlvalidation.com/** or http://validator.w3.org/.

8. Considerations

The standard establishes exposure rates for test in Roentgen per hour (R/h). When testing instruments that read in rem per hour, the test field shall be in rem/h instead of R/h. Refer to the “Units and Uncertainties” section in the standard for additional information.

Test Summary Sheet
ANSI N42.33

Manufacturer:

Model:

	Serial#		Serial#		Serial#	
Test Number	Date	Status	Date	Status	Date	Status
5.2						
5.3						
5.4						
5.5						
5.6						
5.7						
5.8						
5.9						
5.10						
5.11						
5.12						
6.2						
6.3						
6.4						
6.5						
6.6						
7.1						
7.2						
7.3						
7.4.2						
7.4.3						
7.5						
8.1						
8.2						
8.3						
8.4						
8.5						
9.1						
9.2						
9.3						
10.0						

Comments:

Pre-Test
Data Sheet and Report

Instrument:

Model: **Serial Number:**

Date Performed: **Test Location:**

Requirement: Verify that the manufacturer supplied an operation and maintenance manual containing the information listed below.

Note: Comments are required when the requirement is not verified.

Test Results

Requirement	Yes		No
Operating instructions and restrictions	☐		☐
Electrical connection schematic	☐		☐
Spare parts list	☐		☐
Troubleshooting guide.	☐		☐
Description and protocol for communication methods of transmitting and receiving data	☐		☐
Contact information for the manufacturer including name, address, telephone #, fax #, email address, etc.	☐		☐
Power supply requirements	☐		☐
Recommended operational parameters such as: detector response and false alarm probability	☐		☐
Complete description of system or unit	☐		☐
Enclosure specification classification	☐		☐
Inclusion of any hazardous material that may require additional regulation	☐		☐
Description of data analysis software and radionuclide identification procedure	☐		☐
Description of operation and performance of the system or unit	☐		☐

Comments:

Completed by: **Date:**

Reviewed by: **Date:**

Sections 5.2 - Manufacturer, Model, and Serial number
Test Data and Report

Manufacturer: _____

Model: _____ **Serial Number:** _____

Requirements: The following shall be recorded: manufacturer's name along with the model, serial number, and firmware number of the instrument and detector, if separate.

Note: Comments are required when the requirement is not verified.

	Firmware Number
Firmware number of the instrument :	
Firmware number of the detector:	

Comments: _____

Completed by: _____ **Date:** _____

Reviewed by: _____ **Date:** _____

Sections 5.3 - Radiation Detector Type
Test Data and Report

Manufacturer: _____

Model: _____ **Serial Number:** _____

Requirements: The following shall be identified and recorded: radiation detector types used (e.g., NaI, CsI, GM).

Note: Comments are required when the requirement is not verified.

	Type Detector
Recorded radiation detector type (e.g., NaI, CsI, GM) :	

Comments: _____

Completed by: _____ **Date:** _____

Reviewed by: _____ **Date:** _____

Section 5.4 - Exposure Rate Range
Test Data and Report

Manufacturer: _____

Model: _____ **Serial Number:** _____

Requirement: The instrument shall have an operating range from 5 µR/h (0.05 µGy/hr) to at least 10 mR/h (0.1 mGy/h).

Note: Comments are required when the requirement is not verified.

	Verify	
	Yes	No
Does the stated range meet the requirement?		
What is the stated response range of the instrument?		(add units)

Comments: _____

Performed by: _____ **Date:** _____

Reviewed by: _____ **Date:** _____

Sections 5.5 - Functionality Test
Test Data and Report

Manufacturer: _____

Model: _____ **Serial Number:** _____

Requirements: The instrument shall include:
1. A display that is easily readable under different lighting conditions,
2. Controls that are user-friendly for routine operation,
3. A menu structure that is simple and easy to be followed intuitively,
4. The capability to operate if the user is wearing gloves, and
5. A display that provides the user with an instantly recognizable indication of the fact that the magnitude of radiation present has increased and/or exceeded the alarm set point

Note: Comments are required when the requirement is not verified.

Ambient Conditions: _____ °C _____ %RH _____ in HG

Test Equipment Used: _____

Source Data: _____

Controls	Yes	No
Was the on/off switch easy to find?		
Were all the controls labeled?		
Were all the labeled controls easy to read/interpret?		
Were controls designed to minimize the possibility of accidental operation?		

Display	Yes	No
Was brightness/contrast adjustable, either manually or automatically, to compensate for light levels?		
Was the display readable in low light levels (<150 lux)?		
Was the display readable in high light levels (>10,000 lux)?		
Did the display contain abbreviations or icons? (If no skip next question)		
Were the abbreviations or icons easy to interpret or understand?		
Was the time and date displayed?		

Operation	Yes	No
Did the instrument convey its state-of-health at start-up, e.g., battery life, detector present and working, memory available?		
Was the menu structure simple and intuitive?		
Were all the controls easy to operate without gloves?		
Could all the controls be operated with gloves?		

Describe the technique used to convey an increase in the radiation level and the alarm indication:	

Comments: _____

Completed by: _____ **Date:** _____

Reviewed by: _____ **Date:** _____

Sections 5.6 - Audible Alarm
Test Data and Report

Manufacturer:

Model: **Serial Number:**

Requirements: The frequency of an audible alarm shall be within the range of 1000 Hz to 4000 Hz.

Where an intermittent alarm is provided, the signal interval shall not exceed 2 s.

The A-weighted alarm volume at a distance of 30 cm from the alarm source shall be at least 85 dB(A) and shall not exceed 100 dB(A).

If the audible alarm can be shut off or disabled, the instrument shall have a visual alarm and may have a vibration alarm. It shall not be possible to disable or shut off all alarms at the same time.

Note: Comments are required when the requirement is not verified.

Ambient Conditions: °C %RH in HG

Test Equipment Used:

Source Data:

	Verify	
	Yes	No
Is the alarm frequency within 1000 to 4000 Hz?		
Where an intermittent alarm is provided, is the interval less than 2 seconds?		
Is the alarm volume at a distance of 30 cm within 85 dB(A) and 100 dB(A)?		
If the audible alarm can be disabled, does the instrument have a vibration or visual alarm?		
Does the instrument have preventive measures for disabling all the alarms?		

Comments:

Completed by: **Date:**

Reviewed by: **Date:**

Sections 5.7 - Vibration Alarms
Test Data and Report

Manufacturer: _____

Model: _____ **Serial Number:** _____

Requirements: If the instrument has a vibration alarm, the vibration alarm shall have sufficient intensity to alert the user to an alarm condition.

It is recommended that the instrument incorporate a DC motor that rotates from 9000 rpm to 11 000 rpm and that the intensity of the vibration at the handle or wherever the instrument is carried shall be at least 0.8 g.

Note: Comments are required when the requirement is not verified.

Ambient Conditions: _____ °C _____ %RH _____ in HG

Test Equipment Used: _____

Measurement Results

Intensity

	g
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

	(Choose One) Yes	No
Was each intensity at least 0.8 g?		

Motor frequency: _____ rpm

Comments: _____

Completed by: _____ **Date:** _____

Reviewed by: _____ **Date:** _____

Sections 5.8 - Mass
Test Data and Report

Manufacturer:

Model: **Serial Number:**

Requirements: Instruments shall be less than 3.0 kg (6.6 lbs).

Note: Comments are required when the requirement is not verified.

Ambient Conditions: ____ °C ____ %RH ____ in HG

Test Equipment Used:

	Verify	
	Yes	No
Is the mass less than 3 kg?		
What is the mass (grams)?		

Comments:

Completed by: **Date:**

Reviewed by: **Date:**

Sections 5.9 - Reference Point Marking
Test Data and Report

Manufacturer:

Model: **Serial Number:**

Requirements: The instrument shall have reference points on both the front, or back, and side of the instrument indicating the effective center of the detector.

Note: Comments are required when the requirement is not verified.

	Verify	
	Yes	No
Are the reference points marked on the front or back and side indicating the effective center of the detector?		

Comments:

Completed by: **Date:**

Reviewed by: **Date:**

Section 5.10 - Explosive Atmospheres
Test Data and Report

Manufacturer:

Model: **Serial Number:**

Requirements: The manufacturer shall state as to whether the instrument is certified for use in explosive atmospheres. Certification is based on UL-913-2002[B3].

Note: Comments are required when the requirement is not verified.

	Verify	
	Yes	No
Is the instrument certified for explosive atmospheres		
If certified, has documented proof been provided		
Is compliance based on testing done in accordance with UL-913-2002?		

Comments:

Completed by: **Date:**

Reviewed by: **Date:**

Sections 5.11 - Batteries
Test Data and Report

Manufacturer:

Model: **Serial Number:**

Requirements: Batteries used shall be widely available, shall not be unique to the instrument, and shall be replaceable in the field without the use of special tools.

The batteries shall be capable of powering the instrument for 16 h in a non-alarm state.

The instrument shall have a low battery indicator.

Note: Comments are required when the requirement is not verified.

Ambient Conditions: °C %RH in HG

Test Equipment Used:

Source Data:

	Pre-test response	After 16 hours	Acceptance range			With Low Battery Indicated
			low (-15%)	#DIV/0!		
Reading 1						
Reading 2			high (15%)	#DIV/0!		
Reading 3						
Reading 4						
Reading 5						
Reading 6						
Reading 7						
Reading 8						
Reading 9						
Reading 10						
Average	#DIV/0!	#DIV/0!			Average	#DIV/0!
Standard dev	#DIV/0!	#DIV/0!				
COV %	#DIV/0!	#DIV/0!				

Specify battery type

	Yes	No
Are the batteries replaceable without the use of special tools?		
Did the instrument operate properly for 16 hours?		
Did the alarm function after 16 hours?		
What is the voltage when the low battery indication activates?		volts
	Yes	No
Was the response with low battery indicated within 15% of the response with new batteries?		

Comments: _____

Completed by: _____ Date: _____

Reviewed by: _____ Date: _____

Sections 5.12 - Data Format
Test Data and Report

Manufacturer: _____

Model: _____ **Serial Number:** _____

Requirements: If the instrument transmits (wire, wireless, infrared, etc.) or stores data, the data format shall be in XML and comply with ANSI N42.42 requirements. Consideration should be given to data security when using wireless data transfer techniques. When used, wireless techniques shall have the ability to be encrypted.

The transfer protocol and format shall be fully described in the technical manual and be freely distributable.

Note: Comments are required when the requirement is not verified.

Ambient Conditions: _____ °C _____ %RH _____ in HG

Test Equipment Used: _____

Source Data: _____

Describe the data transfer technique _____

	Verify		
	Yes	No	NA
Does the monitor have the ability to transfer data to an external device?			
Is the transmission bi-directional?			
Is the transfer based on commonly available technology? (e.g. Ethernet, wireless, USB, RS-232)			
If the transfer is wireless, does it have the ability to encrypt the data?			
Is the transfer protocol described in the technical manual?			
Is the data format described in the technical manual?			
Is the data format in XML?			
Does the data format comply with ANSI N42.42 requirements?			
Did the manufacturer provide proprietary software for data interpretation?			

Comments: _____

Completed by: _____ Date: _____

Reviewed by: _____ Date: _____

Sections 6.2 - Accuracy
Test Data and Report

Manufacturer: _____

Model: _____ **Serial Number:** _____

Requirements: Under standard test conditions with calibration controls adjusted according to the instructions of the manufacturer, the relative error of indication of the instrument shall not exceed ± 30 % over the entire effective range of exposure rates.

Note: Comments are required when the requirement is not verified.

Ambient Conditions: _____ °C _____ %RH _____ in HG

Test Equipment Used: _____

Source Data: _____

Instrument maximum measurement range: _____ mR/h

Measurement Results - Instruments

	Exposure rate values					
	0.10	mR/h	5.00	mR/h	0.00	mR/h
1		mR/h		mR/h		mR/h
2		mR/h		mR/h		mR/h
3		mR/h		mR/h		mR/h
4		mR/h		mR/h		mR/h
5		mR/h		mR/h		mR/h
6		mR/h		mR/h		mR/h
7		mR/h		mR/h		mR/h
8		mR/h		mR/h		mR/h
9		mR/h		mR/h		mR/h
10		mR/h		mR/h		mR/h
Mean	#DIV/0!	mR/h	#DIV/0!	mR/h	#DIV/0!	mR/h
Acceptance Range	0.07	0.13	3.50	6.50	0.00	0.00
	- 30%	+ 30%	- 30%	+ 30%	- 30%	+ 30%

Test Results

Are the results within ±30% ?	Yes	No
0.1 mR/h		
5 mR/h		
80 % of maximum range		

Comments: _____

Completed by: _____ **Date:** _____

Reviewed by: _____ **Date:** _____

Sections 6.3 - Photon Energy Response
Test Data and Report

Manufacturer:

Model: **Serial Number:**

Requirements: The instrument shall respond to photon radiation between 60 keV and 1.33 MeV. The response shall be within ±50% of the applied exposure rate normalized to ^{137}Cs.

Note: Comments are required when the requirement is not verified.

Ambient Conditions: °C %RH in HG

Test Equipment Used:

Source Data:

Background reading: (add units)

Measurement Results

	^{241}Am	^{60}Co	^{137}Cs	
Applied Exposure Rates				
				(add units)
Instrument Readings				
1				(add units)
2				
3				
4				
5				
6				
7				
8				
9				
10				
Mean	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	
Std dev	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	
COV %	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	

Acceptance ranges			
low (- 50%)	0.00	0.00	0.00
high (+ 50%)	0.00	0.00	0.00

Test Results

Was the response within ± 50 % of the applied exposure rate?

	^{241}Am	^{60}Co	^{137}Cs
Yes			
No			

Comments:

Completed by: **Date:**

Reviewed by: **Date:**

Sections 6.4 - Response Time
Test Data and Report

Manufacturer: _____

Model: _____ **Serial Number:** _____

Requirements: When the instrument is subjected to an increase in exposure rate, the display shall indicate the new exposure rate within five seconds of the change.

Note: Comments are required when the requirement is not verified.

Ambient Conditions: _____ °C _____ %RH _____ in HG

Test Equipment Used: _____

Source Data: _____

Measurement Results

Background Field: _____ µR/h Reference Field Reading during testing: _____

Trial #	Instrument Reading after 5 s
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

Acceptance Range		
low (- 50 %)	0.00	µR/h
high (+ 50 %)	0.00	µR/h

	Yes	No
Was each of the instrument readings within ±50% of the new exposure rate within 5 s of the change?		

Comments: _____

Completed by: _____ **Date:** _____

Reviewed by: _____ **Date:** _____

Section 6.5 Variation of Response with Angle of Incidence of Radiation Test Data and Report

Manufacturer:

Model: **Serial Number:**

Requirements: The instrument's response at angles of up to ± 45° with respect to 0° incidence in horizontal and vertical orientations shall agree to within ± 30 % of the response from 0° incidence.

Note: Comments are required when the requirement is not

Ambient Conditions: °C %RH in HG

Test Equipment Used:

Source Data:

^{241}Am

	Vertical Plane			Horizontal Plane		
	Position A 0 Degree	Position B -45 Degree	Position C 45 Degree	Position A 0 Degree	Position B -45 Degree	Position C 45 Degree
Mean	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Std Dev	#DIV/0!			#DIV/0!		
COV %	#DIV/0!			#DIV/0!		

Acceptance Range		Acceptance Range	
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
- 30 %	+ 30 %	- 30 %	+ 30 %

	Yes	No
Was each mean response within ± 30 % of the applied exposure rate of the response from 0° incidence?		

^{137}Cs

	Vertical Plane			Horizontal Plane		
	Position A 0 Degree	Position B -45 Degree	Position C 45 Degree	Position A 0 Degree	Position B -45 Degree	Position C 45 Degree
Mean	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Std Dev	#DIV/0!			#DIV/0!		
COV %	#DIV/0!			#DIV/0!		

Acceptance Range		Acceptance Range	
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
- 30 %	+ 30 %	- 30 %	+ 30 %

	Yes	No
Was each mean response within ± 30 % of the applied exposure rate of the response from 0^o incidence?		

Comments: _____

Performed by: _____ **Date:** _____

Reviewed by: _____ **Date:** _____

Sections 6.6 - Over-Range Response
Test Data and Report

Manufacturer: _____

Model: _____ **Serial Number:** _____

Requirements: When exposed to an exposure rate that is two times the maximum exposure rate specified by the manufacturer, the indication of the instrument shall remain at the maximum of that range, and an overload indication shall be displayed for the duration of the exposure.

Note: Comments are required when the requirement is not verified.

Ambient Conditions: _____ °C _____ %RH _____ in HG

Test Equipment Used: _____

Source Data: _____

Measurement Results

Manufacturer-Stated Max Exposure Rate: _____ mR/h

Over-Range Test Exposure Rate: _____ mR/h

Over-Range Exposure Duration: _____ min.

	Verify	
	Yes	No
Was an over-range indication displayed?		
The instrument indication remained at the maximum of the range?		
The over-range indication was displayed for the duration of the exposure?		

Comments: _____

Completed by: _____ **Date:** _____

Reviewed by: _____ **Date:** _____

Sections 7.1 - Temperature
Test Data and Report

Manufacturer: _____

Model: _____ **Serial Number:** _____

Requirements: The instrument shall function correctly at temperatures from –20 ºC to +50 ºC. Relative humidity shall be within the range specified in Table 1, Standard Test Conditions

Note: Comments are required when the requirement is not verified.

Test Equipment Used: _____

Source Data: _____

Measurement Results - ^{137}Cs

	22° C as read	30° C as read	40° C as read	50° C as read	10° C as read	0° C as read	-10° C as read	-20° C as read
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
Mean	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
STD	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
COV %	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

		Was the mean reading within the acceptance range?
	Yes	
	No	

		Did instrument alarm due to the temperature test alone?
	Yes	
	No	

(± 15%) Acceptance Range: #DIV/0! (-15%) to #DIV/0! (+ 15 %)

Comments: _____

Completed by: _____ **Date:** _____

Reviewed by: _____ **Date:** _____

Section 7.2 Temperature Shock

Test Data and Report

Manufacturer: _____

Model: _____ **Serial Number:** _____

Requirement: The instrument shall be fully functional within 30 min of exposure to rapid temperature changes from 22 °C to –20°C, –20°C to 22 °C, 22 °C to 50 °C, and 50 °C to 22 °C with each change being made in less than 5 min. Relative humidity shall be within the range specified in Table 1.

Note: Comments are required when the requirement is not verified.

Test Equipment Used: _____

Source Data: _____

Measurement Results

	pre-test at 22°C		22 to 50° C				50 to 22° C				22 to -20° C				-20 to 22° C			
			15	30	45	60	15	30	45	60	15	30	45	60	15	30	45	60
1		1																
2		2																
3		3																
4		4																
5		5																
6		6																
7		7																
8		8																
9		9																
10		10																
Mean	#DIV/0!	Mean	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
STD	#DIV/0!	STD	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
COV %	#DIV/0!	COV %	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Was the mean reading within the acceptance range?		Yes																
		No																
Did instrument alarm due to the temperature test alone?		Yes																
		No																

(± 15%) Acceptance Range: #DIV/0! (low 15%) to #DIV/0! (high 15%)

Comments: _____

Completed by: _____ **Date:** _____ **Reviewed by:** _____ **Date:** _____

Sections 7.3 - Humidity
Test Data and Report

Manufacturer: _____

Model: _____ **Serial Number:** _____

Requirements: The instrument shall function correctly over the range of relative humidity from 40% to 93% RH at 35 ºC.

Note: Comments are required when the requirement is not verified.

Test Equipment Used: _____

Source Data: _____

Measurement Results - ^{137}Cs

	Nominal 40% RH 22° C	93% RH 35° C	40% RH 35° C	
1				(add units)
2				
3				
4				
5				
6				
7				
8				
9				
10				
Mean	#DIV/0!	#DIV/0!	#DIV/0!	
STD	#DIV/0!	#DIV/0!	#DIV/0!	
COV %	#DIV/0!	#DIV/0!	#DIV/0!	

Were the results within tolerance?	**Yes**		
	No		
Did any alarms occur from humidity exposure alone?	**Yes**		
	No		

Acceptance Range

#DIV/0!	to	#DIV/0!
low 15%		high 15%

Comments: _____

Completed by: _____ **Date:** _____

Reviewed by: _____ **Date:** _____

Sections 7.4.2 - Moisture and Dust Protection, Dust Test Data and Report

Manufacturer:

Model: **Serial Number:**

Requirements: The instrument case design shall meet the requirements stated for IP code 53 (see IEC 60529), which means that the instrument shall be protected from the ingress of dust and spraying water. For IP53, the ingress of dust is not totally prevented, but dust shall not penetrate in a quantity to interfere with satisfactory operation of the instrument or to impair safety, and water sprayed at an angle up to 60º on either side of the vertical direction shall have no harmful effects.

Note: Comments are required when a test requirement is not verified.

Ambient Conditions: °C %RH in HG

Test Equipment Used:

Source Data:

	Pre-Test Response	Post Test Response	
1			(add units)
2			
3			
4			
5			
6			
7			
8			
9			
10			
Mean	#DIV/0!	#DIV/0!	
STD	#DIV/0!	#DIV/0!	
COV %	#DIV/0!	#DIV/0!	

Acceptance Range

#DIV/0!	to	#DIV/0!
low 15%		high 15%

Was the post-test response within the acceptance range?	**Yes**	
	No	
Did any alarms occur from dust exposure alone?	**Yes**	
	No	

	Verify Yes	Verify No
Did dust penetrate the instrument to the extent where operation could be impacted?		
Did the alarm function after the test?		

Comments:

Completed by: **Date:**

Reviewed by: **Date:**

Sections 7.4.3 - Moisture and Dust Protection, Moisture Test Data and Report

Manufacturer:

Model: **Serial Number:**

Requirements: The instrument case design shall meet the requirements stated for IP code 53 (see IEC 60529), which means that the instrument shall be protected from the ingress of dust and spraying water. For IP53, the ingress of dust is not totally prevented, but dust shall not penetrate in a quantity to interfere with satisfactory operation of the instrument or to impair safety, and water sprayed at an angle up to 60º on either side of the vertical direction shall have no harmful effects.

Note: Comments are required when a test requirement is not verified.

Ambient Conditions: °C %RH in HG

Test Equipment Used:

Source Data:

	Pre-Test Response	Post Test Response	
1			(add units)
2			
3			
4			
5			
6			
7			
8			
9			
10			
Mean	#DIV/0!	#DIV/0!	
STD	#DIV/0!	#DIV/0!	
COV %	#DIV/0!	#DIV/0!	

Acceptance Range

#DIV/0!	to	#DIV/0!
low 15%		high 15%

Was the post-test response within the acceptance range?	**Yes**	
	No	
Did any alarms occur from water exposure alone?	**Yes**	
	No	

	Yes	**No**
Did water penetrate the instrument?		
Did the alarm function after the test?		

Comments:

Completed by: **Date:**

Reviewed by: **Date:**

Sections 7.5 - Cold Temperature Start Up Test Data and Report

Manufacturer:

Model: **Serial Number:**

Requirements: The instrument shall be able to operate when switched on at the cold temperature limit (-20 ºC).

Note: Comments are required when a test requirement is not verified.

Test Equipment Used:

Source Data:

	Pre-Test Readings	Readings at - 20 ºC	
1			(add units)
2			
3			
4			
5			
6			
7			
8			
9			
10			
Mean	#DIV/0!	#DIV/0!	
STD	#DIV/0!	#DIV/0!	
COV %	#DIV/0!	#DIV/0!	

Acceptance Range

#DIV/0!	to	#DIV/0!
low 15%		high 15%

Were the results within the acceptance range?	**Yes**	
	No	
Did the alarm function normally at -20 ºC?	**Yes**	
	No	

Comments:

Completed by: **Date:**

Reviewed by: **Date:**

Section 8.1 Electrostatic Discharge
Test Data and Report

Manufacturer: _____

Model: _____ **Serial Number:** _____

Requirements: During exposure to electrostatic discharges at intensities of up to 6 kV using the contact discharge technique, the instrument shall function correctly. No alarms shall occur as a result of the electrostatic discharge alone.

Note: Comments are required when a test requirement is not _____

Ambient Conditions: _____ °C _____ % RH _____ in Hg

Test Equipment Used: _____

Source Data: _____

Exposure or Count Rate Response

	Pre-Test Response
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
Mean	#DIV/0!
STD	#DIV/0!
COV%	#DIV/0!

Gamma Response

	2 kV	4 kV	6 kV	
1				(add units)
2				
3				
4				
5				
6				
7				
8				
9				
10				
Mean	#DIV/0!	#DIV/0!	#DIV/0!	
STD	#DIV/0!	#DIV/0!	#DIV/0!	
COV%	#DIV/0!	#DIV/0!	#DIV/0!	

Acceptance Range

#DIV/0!	to	#DIV/0!
low (-15%)		high (+15%)

Were the results within the acceptance range?

	2 kV	4 kV	6 kV
Yes			
No			

Did the instrument alarm during testing?

Yes			
No			

Comments: _____

Performed by: _____ **Date:** _____

Reviewed by: _____ **Date:** _____

Section 8.2 Radio Frequency Susceptibility
Test Data and Report

Manufacturer: _____

Model: _____ **Serial Number:** _____

Requirements: The instrument shall not be affected by radio frequency (RF) fields over the frequency range of 80 MHz to 2.5 GHz at an intensity of 10 volts per meter (V/m). No alarms shall occur as a result of the RF radiation alone.

Note: Comments are required when a test requirement is not verified.

Ambient Conditions: _____ °C _____ %RH _____ In. Hg

Test Equipment Used: _____

Frequency Scan Observations Without Sources

Were susceptibilities observed?			
Yes		No	

Did the unit alarm during testing?			
Yes		No	

With ^{137}Cs

	Nominal No RF Response	
1		(add units)
2		
3		
4		
5		
6		
7		
8		
9		
10		
Mean	#DIV/0!	
STD	#DIV/0!	
COV%	#DIV/0!	

Source Data:

Acceptance Range

#DIV/0!	to	#DIV/0!
low (-15%)		high (+15%)

Frequency Scan Observations with Sources

Were susceptibilities observed?			
Yes		No	

Comments:

Completed by: **Date:**

Reviewed by: **Date:**

Sections 8.3 - Magnetic Fields
Test Data and Report

Manufacturer:

Model: **Serial Number:**

Requirements: The instrument should be fully functional when exposed to a constant DC magnetic field in three mutually orthogonal orientations relative to a 10 Gauss magnetic field.

Note: Comments are required when a test requirement is not verified.

Ambient Conditions: °C %RH in HG

Test Equipment Used:

Source Data:

Measurement Results Without Sources

	Orientation					
	Initial		Second		Third	
	Yes	No	Yes	No	Yes	No
Did the instrument alarm during the test?						
Did the instrument display spurious indications?						

Observations:

Measurement Results With Cs-137

	Initial Orientation		Second Orientation		Third Orientation	
	Nominal Zero Intensity	10 Gauss (DC)	Nominal Zero Intensity	10 Gauss (DC)	Nominal Zero Intensity	10 Gauss (DC)
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
Mean	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**
STD	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**
COV%	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**

Acceptance Range

Initial Orientation:	**#DIV/0!**	to	**#DIV/0!**	
Second Orientation:	**#DIV/0!**	to	**#DIV/0!**	
Third Orientation:	**#DIV/0!**	to	**#DIV/0!**	
	low -15%		high +15%	

Comments: _____

Completed by: _____ **Date:** _____

Reviewed by: _____ **Date:** _____

Section 8.4 Conducted Immunity
Test Data and Report

Manufacturer:

Model: **Serial Number:**

Requirements: The instrument should not be affected by RF fields that can be conducted onto the instrument through an external conducting cable. Instruments that do not have at least one external conducting cable are excluded.

Note: Comments are required when a test requirement is not verified.

Ambient Conditions: °C %RH In. Hg

Test Equipment Used:

Frequency Scan Observations Without Sources

Were susceptibilities observed?			
Yes		No	

Did the unit alarm during testing?			
Yes		No	

With Cs-137 Source

	Nominal No RF Response	
1		(add units)
2		
3		
4		
5		
6		
7		
8		
9		
10		
Mean	#DIV/0!	
STD	#DIV/0!	
COV%	#DIV/0!	

Source Data: _____

Acceptance Range

#DIV/0!	to	#DIV/0!
low (-15%)		high (+15%)

Frequency Scan Observations with Sources

Were susceptibilities observed?			
Yes		No	

Comments: _____

Completed by: _____ **Date:** _____

Reviewed by: _____ **Date:** _____

Section 8.5 Radiated Emissions
Test Data and Report

Manufacturer: _____

Model: _____ **Serial Number:** _____

Requirement: The emission limits when measured at three meters from the instrument shall be less than what is shown below (Table 2):

Emission Frequency Range (MHz)	Field Strength (micro volts/meter)
30 – 88	100
88 – 216	150
216 – 960	200
Above 960	500

Note: Comments are required when a test requirement is not verified.

Ambient Conditions: _____ °C _____ %RH _____ in HG

Test Equipment Used: _____

Source Data: _____

	Yes	No
Were RF emissions above the limits?		

Comments: _____

Performed by: _____ **Date:** _____

Reviewed by: _____ **Date:** _____

Section 9.1 Vibration
Test Data and Report

Manufacturer:

Model: **Serial Number:**

Requirement: The instrument shall withstand exposure to vibrations associated with the operation of handheld or hand-carried equipment. The physical condition and functionality of the instrument shall not be affected by exposure (e.g.: solder joints shall hold, nuts and bolts shall not come loose).

Note: Comments are required when a test requirement is not verified.

Ambient Conditions: °C %RH in HG

Test Equipment Used:

Source Data:

	Pretest	After Position A	After Position B	After Position C	
1					(add units)
2					
3					
4					
5					
6					
7					
8					
9					
10					
Mean	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
STD	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
COV%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	

Acceptance Range

#DIV/0!	to	#DIV/0!
-15%		15%

Did the alarm function normally after the test?			
	Position A	Position B	Position C
Yes			
No			

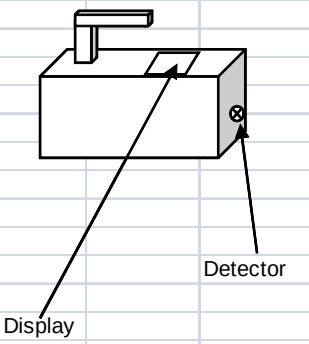
Post Test Observations

Comments: _____

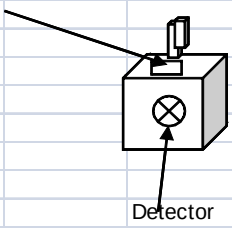
Performed by: _____ **Date:** _____

Reviewed by: _____ **Date:** _____

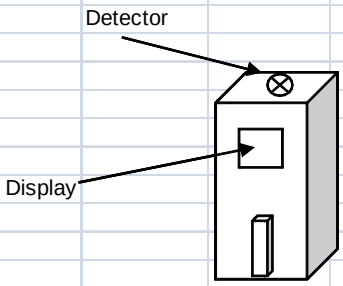
Position A



Position B



Position C:



Section 9.2 - Mechanical Shock
Test Data and Report

Manufacturer:

Model: **Serial Number:**

Requirement: The instrument shall withstand exposure to 10 shock pulses of 50 g peak acceleration, each applied for a nominal 18 ms in each of three mutually orthogonal axes. The physical condition of instruments shall not be affected by these shocks (e.g., solder joints shall hold; nuts and bolts shall not come loose).

Note: Comments are required when a test requirement is not verified.

Ambient Conditions: °C %RH in HG

Test Equipment Used:

Source Data:

	Pretest	After Position A	After Position B	After Position C		Acceptance Range		
1					(add units)			
2								
3								
4								
5								
6								
7								
8								
9								
10								
Mean	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!	to	#DIV/0!
STD	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!		-15%		15%
COV%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!				

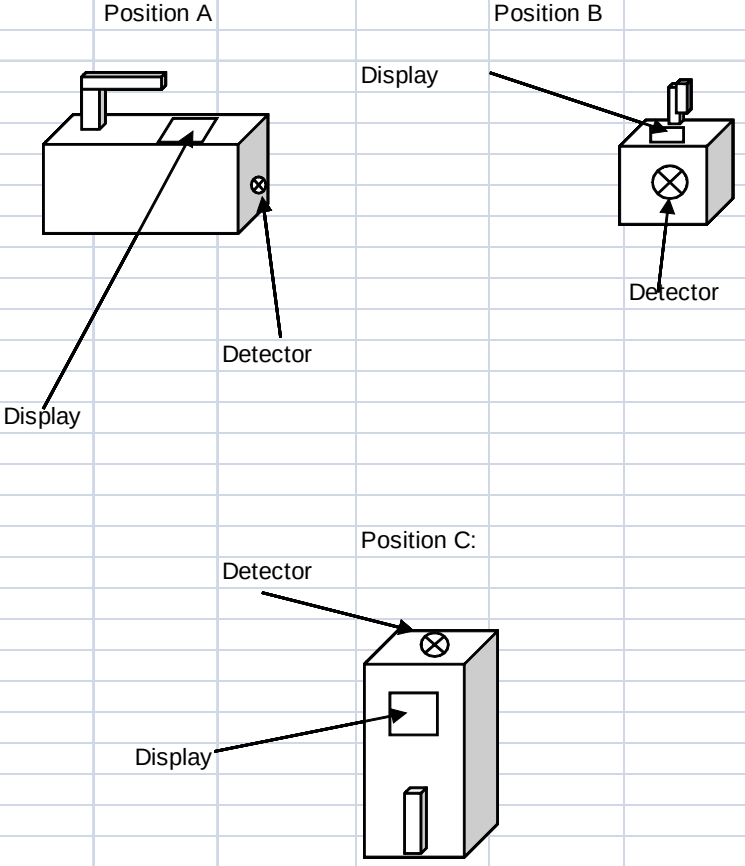
Did the alarm function normally after the test?			
	Position A	Position B	Position C
Yes			
No			

Post Test Observations

Comments:

Performed by: **Date:**

Reviewed by: **Date:**



Section 9.3 Impact (Microphonics)
Test Data and Report

Manufacturer:

Model: **Serial Number:**

Requirement: The instrument's response shall be unaffected by microphonic conditions such as those that may occur from low intensity impacts from sharp contact with hard surfaces.

Note: Comments are required when a test requirement is not verified.

Ambient Conditions: °C %RH in HG

Test Equipment Used:

Source Data:

With Sources

	Pretest Response		Impact Number	Side No. 1	Side No. 2	Side No. 3	Side No. 4	Side No. 5	Side No. 6	
				Readings After Each Impact						
1		(add units)	1							(add units
2			2							
3			3							
4										
5										
6										
7										
8										
9										
10										
Mean	#DIV/0!									
STD	#DIV/0!									
COV%	#DIV/0!									

Acceptance Range

#DIV/0! to **#DIV/0!**

low (-15 %) high (+15 %)

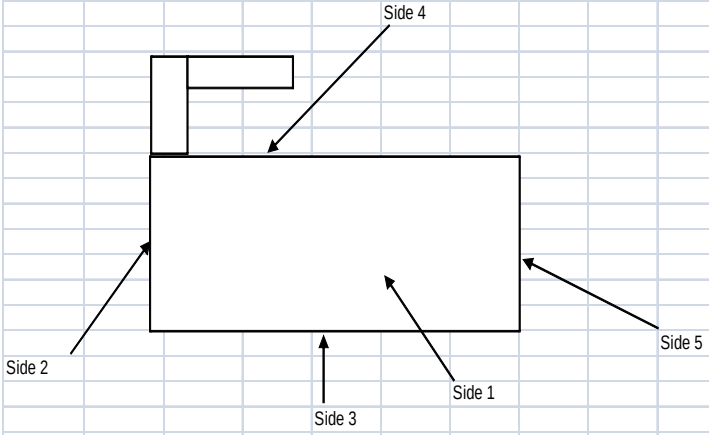
Measurement Results Without Sources

	Side No. 1		Side No. 2		Side No. 3		Side No. 4		Side No. 5		Side No. 6	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Did the gamma response remain stable during the test?												
Did the instrument alarm during the test?												
Did the instrument display spurious indications?												

Comments: _____

Completed by: _____ Date: _____

Reviewed by: _____ Date: _____



Note: Side 6 is opposite to Side 1.

Sections 10 - Documentation
Test Data and Report

Manufacturer:

Model: **Serial Number:**

Requirements: 10.1 Type test report
The manufacturer shall provide a report covering the type tests performed in accordance with the requirements of this standard.
10.2 Certificate
The manufacturer shall provide a certificate or other documentation containing at least the following information: (Requirements in data collection section)

Note: Only one data sheet per model is required. Comments are required when a test requirement is not verified.

Requirement	Yes	No
Did the manufacturer provide a report on the tests performed?		
Was contact information provided in the manual?		
Did the manual describe the type of detector?		
Was the exposure rate range defined in the manual?		
Were the reference point and reference orientations described?		
Was information provided about the location and dimensions of sensitive volume of detectors?		

Was information provided regarding the wall thickness and materials?		
Was information provided regarding energy response?		
Was information provided angle of incidence response?		
Was information on accuracy, linearity and lower limit of detections provided?		
Was the weight and dimensions provided?		
Did the manual contain information about battery requirements?		
Were results under environmental conditions provided?		
Were results of electrical tests provided?		
Were results of mechanical tests provided?		
Did operation instructions contain schematic electrical diagrams?		
Did operation instructions contain spare parts?		
Did operation instructions contain specifications?		
Did operation instructions contain troubleshooting guide?		

Comments: _____

Completed by: _____ **Date:** _____

Reviewed by: _____ **Date:** _____