


Testing and Evaluation Protocol for Alarming Personal Radiation Detectors for Homeland Security

T&E Protocol N42.32, 2010

Version 2.02

Table of Content

1.	Scope.....	1
2.	References.....	1
3.	Compliance Level Information.....	1
4.	Test and evaluation steps	1
5.	Recording test results.....	2
6.	Test report	2
7.	Guidance for testing ANSI N42.42 data format requirements	3
8.	Considerations	3

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 1 of 74

Testing and Evaluation Protocol Alarming Personal Radiation Detectors for use in Homeland Security

1. Scope

This document establishes the protocol for testing alarming personal radiation detectors based on the performance requirements established in ANSI N42.32, “American National Standard Performance Criteria for Alarming Personal Radiation Detectors for Homeland Security.”

2. References

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

[R1] ANSI/IEEE N42.32, “American National Standard Performance Criteria for Alarming Personal Radiation Detectors 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 N42.32 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

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 2 of 74

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, N42.32. 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 rationale 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 rationale to the changes.

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 3 of 74

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 AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 5 of 74


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	<input type="checkbox"/>	<input type="checkbox"/>
Electrical connection schematic	<input type="checkbox"/>	<input type="checkbox"/>
Spare parts list	<input type="checkbox"/>	<input type="checkbox"/>
Troubleshooting guide.	<input type="checkbox"/>	<input type="checkbox"/>
Description and protocol for communication methods of transmitting and receiving data	<input type="checkbox"/>	<input type="checkbox"/>
Contact information for the manufacturer including name, address, telephone #, fax #, email address, etc.	<input type="checkbox"/>	<input type="checkbox"/>
Power supply requirements	<input type="checkbox"/>	<input type="checkbox"/>
Recommended operational parameters such as: detector response and false alarm probability	<input type="checkbox"/>	<input type="checkbox"/>
Complete description of system or unit	<input type="checkbox"/>	<input type="checkbox"/>
Enclosure specification classification	<input type="checkbox"/>	<input type="checkbox"/>
Inclusion of any hazardous material that may require additional regulation	<input type="checkbox"/>	<input type="checkbox"/>
Description of data analysis software and radionuclide identification procedure	<input type="checkbox"/>	<input type="checkbox"/>
Description of operation and performance of the system or unit	<input type="checkbox"/>	<input type="checkbox"/>


Comments:			
Completed by:		Date:	
Reviewed by:		Date:	

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 6 of 74


Controls
N42.32 Data Sheet Section 5.1

Manufacturer:			
Model:		Serial Number:	
Requirement:	Controls shall be clearly identified, easily operable under conditions of expected use, and adequately protected from accidental operation.		
Note:	Comments are required when the requirement is not verified.		


	Verify	
1st Surface	Yes	No
Did the instrument turn off?		
Did the instrument change mode of operation of configuration?		
	Verify	
2nd Surface	Yes	No
Did the instrument turn off?		
Did the instrument change mode of operation of configuration?		
	Verify	
3rd Surface	Yes	No
Did the instrument turn off?		
Did the instrument change mode of operation of configuration?		
	Verify	
4th Surface	Yes	No
Did the instrument turn off?		
Did the instrument change mode of operation of configuration?		
	Verify	
5th Surface	Yes	No
Did the instrument turn off?		
Did the instrument change mode of operation of configuration?		

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 7 of 74


	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 70%;">6th Surface</td> <td colspan="2" style="text-align: center;">Verify</td> </tr> <tr> <td></td> <td style="text-align: center;">Yes</td> <td style="text-align: center;">No</td> </tr> <tr> <td style="text-align: center;">Did the instrument turn off?</td> <td></td> <td></td> </tr> <tr style="background-color: #cccccc;"> <td></td> <td></td> <td></td> </tr> <tr> <td style="text-align: center;">Did the instrument change mode of operation or configuration?</td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> </tr> </table>	6th Surface	Verify			Yes	No	Did the instrument turn off?						Did the instrument change mode of operation or configuration?						
6th Surface	Verify																			
	Yes	No																		
Did the instrument turn off?																				
Did the instrument change mode of operation or configuration?																				
	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 70%;">Controls</td> <td colspan="2" style="text-align: center;">Verify</td> </tr> <tr> <td></td> <td style="text-align: center;">Yes</td> <td style="text-align: center;">No</td> </tr> <tr> <td style="text-align: center;">Are the controls clearly identified?</td> <td></td> <td></td> </tr> <tr style="background-color: #cccccc;"> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> </tr> </table>	Controls	Verify			Yes	No	Are the controls clearly identified?												
Controls	Verify																			
	Yes	No																		
Are the controls clearly identified?																				
Comments:																				
Performed by:		Date:																		
Reviewed by:		Date:																		

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 8 of 74


Documentation				
N42.32 Data Sheet Section 5.2				
Instrument Tested:			Test Equipment Used:	N/A
Date Performed:			S/N:	
Requirement:	<p>10.1 Type test report The manufacturer shall provide a report covering the type tests performed in accordance with the requirements of this standard.</p> <p>10.2 Certificate The manufacturer shall provide a certificate or other documentation containing at least the following information:</p> <ul style="list-style-type: none"> — Contacts for the manufacturer including, but not limited to, name, address, telephone number, fax number, e-mail address, etc. — Type of instrument, detector, and types of radiation the instrument is designed to measure. — Range of exposure rates the instrument is designed to measure. — Reference points and reference orientation for radiation source used for calibration. — Location and dimensions of the sensitive volumes of the detectors. — Response of the instrument to different appropriate radiation energies. — Results of tests for accuracy, linearity, and lower limit of detection. — Weight and dimensions of the instrument. — Power supply (battery) requirements. — Results of tests under environmental conditions. — Results of electrical and mechanical tests. <p>10.3 Operation and maintenance manuals The manufacturer shall supply an operational and maintenance manual containing at least the following information for the user:</p> <ul style="list-style-type: none"> — Operating instructions and restrictions. — Schematic electrical diagrams plus spare parts list and specifications. — Troubleshooting guide. 			
Note: Comments are required when the requirement is not verified.				

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 9 of 74

	Yes	No	
Requirement			
The manufacturer provides report for type test results?			
Verify that manufacturer contact information is available			
Verify that the type of instrument is described in the manual			
Verify that the exposure rate information is available in the manual			
Verify that reference point and reference orientation is describe in manual			
Verify that the location and dimensions of the sensitive volumes of the detectors is describe in the manual			
Verify that the radiation energy region is described in manual			
Verify that information on accuracy, linearity and lower limit of detections			
Verify that information on weight and dimensions of instrument is available			
Verify that information power supply (battery) requirements is available			
Verify that information that test results under environmental conditions is available			
Verify that results of electrical tests are available			
Verify that results of mechanical tests are available			
The manufacturer provides operating instructions?			
The operating manual provides electrical diagrams?			
The operating manual provides list of spare parts?			
The operating manual provides instrument specifications?			
The operating manual provides a troubleshooting guide?			

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 10 of 74


General Requirements				
N42.32 Data Sheet Sections 5.3 to 5.4 and 5.10 to 5.14 and 5.16				
Manufacturer:	<input style="width: 90%;" type="text"/>			
Model:	<input style="width: 60%;" type="text"/>	Serial Number:	<input style="width: 30%;" type="text"/>	
Firmware:	<input style="width: 90%;" type="text"/>			
Requirements:	<p>5.3 Manufacturer, Model and Serial Number The following shall be recorded: manufacturer's name along with the model, serial number and firmware number of the instrument and detector, if separate.</p> <p>5.4 Type of Radiation Detector The following shall be identified and recorded: type of instrument (gamma only or gamma/neutron) and the radiation detector types used (e.g., NaI, CsI, GM).</p> <p>5.10 Size The overall dimensions of the instrument, excluding any clip, retaining device or external alarm, shall not exceed 20 cm in length, 10 cm in width and 5 cm in thickness, unless it is incorporated into another device.</p> <p>5.11 Mass The mass of the complete instrument shall not exceed 400 g.</p> <p>5.12 Reference point marking The instrument shall have reference points on the front or back, and on the side indicating the effective center of the detector. The instrument shall have an additional reference point indicating its orientation with respect to the wearer. The presence of a clip may be used as the reference point to indicate proper orientation.</p> <p>5.13 Clips and lanyards Means shall be provided to securely fix the instrument to the user (for example, a clip, ring, or lanyard), with attention given to the necessary orientation of the detector, alarm type, and display.</p> <p>5.14 Explosive atmospheres The manufacturer shall state as to whether the instrument is certified for use in explosive atmospheres. If certification is claimed, documentation shall be provided. Certification is based on UL-913-2002.</p> <p>5.16 Data Format If the instrument transmits (wireless, infrared, etc) or stores data, the data format shall be in XML. 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 – The data format is defined by ANSI N42.42.</p> <p>Photograph Photograph the instrument and retain the photo in the record.</p>			
Note: Comments are required when the requirement is not verified.				
Instrument Type:	Gamma only:	<input style="width: 40px;" type="text"/>	Gamma/Neutron:	<input style="width: 40px;" type="text"/>
Gamma Detector Type:	<input style="width: 90%;" type="text"/>			
Neutron Detector Type:	<input style="width: 90%;" type="text"/>			
Size:	Width	<input style="width: 40px;" type="text"/>	Length	<input style="width: 40px;" type="text"/>
			Thickness	<input style="width: 40px;" type="text"/> (cm)
Weight:	<input style="width: 90%;" type="text"/> (grams)			

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 11 of 74

	Yes		No
Are the reference points in the front or back and on the side indicated?			
Instrument provides a mean to fix it to user?			
Is the wearing orientation marked?			
Is the instrument is certified for use in explosive atmospheres?			
If certified for use in explosive atmospheres, has documented proof being provided?			
Is compliance based on testing done in accordance with UL-913-2002?			


Data Format			
	Yes	N/A	No
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?			
The data format complies with ANSI N42.42 requirements?			
Did the manufacturer provide proprietary software for data interpretation?			

Record default gamma alarm threshold			
Record default neutron alarm threshold			
Record gamma alarm threshold used during testing			
Record neutron alarm threshold used during testing			
List instrument operating modes:			
Insert Instrument Photograph			
Comments:			
Performed by:			Date:
Reviewed by:			Date:


	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 12 of 74

Displays N42.32 Data Sheet Section 5.5

Instrument Tested: _____	Test Equipment Used: _____																	
Date Performed: _____	S/N: _____																	
Requirement: Radiation levels should be displayed using one or more of the following methods: - Digital Display: The instrument directly displays the measured exposure or dose rate (e.g. $\mu\text{R/h}$, $\mu\text{Gy/h}$, or $\mu\text{Sv/h}$). - Unit-less Display: The instrument displays a numerical value that may be proportional to the exposure or dose rate but is not explicitly reported as the exposure or dose rate. - Non-numerical Display: The instrument displays a non-numerical indication of the intensity of the radiation field (e.g., bar-graph, colored LEDs). The display shall be readable in low light levels (<150 lux) and high light levels (>10000 lux).																		
Note: Comments are required when the requirement is not verified.																		
<table border="1" style="float: right; border-collapse: collapse;"> <thead> <tr> <th rowspan="2"></th> <th colspan="2" style="text-align: center;">Verify</th> </tr> <tr> <th style="text-align: center;">Yes</th> <th style="text-align: center;">No</th> </tr> </thead> <tbody> <tr> <td style="text-align: right;">Is the display backlit?</td> <td style="width: 40px;"></td> <td style="width: 40px;"></td> </tr> <tr> <td style="text-align: right;">Is the display continuously lit?</td> <td></td> <td></td> </tr> <tr> <td style="text-align: right;">Is the display readable in low light level?</td> <td></td> <td></td> </tr> <tr> <td style="text-align: right;">Is the display readable in high light level?</td> <td></td> <td></td> </tr> </tbody> </table>			Verify		Yes	No	Is the display backlit?			Is the display continuously lit?			Is the display readable in low light level?			Is the display readable in high light level?		
	Verify																	
	Yes	No																
Is the display backlit?																		
Is the display continuously lit?																		
Is the display readable in low light level?																		
Is the display readable in high light level?																		
Display	LED _____ LCD _____ Other _____																	
Display type	Unit-less _____ Non-numerical _____ Digital _____ Other _____																	
Display range	_____																	
For Digital or numerical displays record units	Units _____																	
Comments: _____																		
Performed by: _____	Date: _____																	
Reviewed by: _____	Date: _____																	

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 13 of 74


Effective Range of Measurement or Indication									
N42.32 Data Sheet Section 5.6									
Instrument Tested:					Test Equipment Used:				
Serial Number:									
Requirement:					The effective range of measurement or indication shall be specified by the manufacturer and shall be from 5 µR/h to not less than 2 mR/h.				
					The instrument response over the effective range specified by the manufacturer shall be tested.				
Note:					Comments are required when the requirement is not verified.				
								Verify	
								Yes	No
For gammas; is the effective range at least 5 µR/h to 2 mR/h?									
For gammas; what is the effective range of measurement as stated by the manufacturer? (include units)									
For gammas; what is the display range shown by the instrument? (include units)									
For neutrons; what is the effective range of measurement as stated by the manufacturer? (include units)									
For neutrons; what is the display range shown by the instrument? (include units)									
Energy range for gamma:									
Energy range for neutrons:									
Comments:									
Performed by:					Date:				
Reviewed by:					Date:				

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 14 of 74

Functionality Test N42.32 Data Sheet Section 5.7

Manufacturer:					
Model:			Serial Number:		
Requirements:	The instrument shall: <ul style="list-style-type: none"> • Include a display that is easily readable over the required temperature range and under different lighting conditions • Include controls that are user-friendly for routine operation • Be capable of operation if the user is wearing gloves 				
Note:	Comments are required when the requirement is not verified.				

		Yes	No
Controls		(Choose One)	
1	Was the on/off switch easy to find?		
2	Were all the controls labeled?		
3	Were all the labeled controls easy to read/interpret?		
4	Were all the controls easy to operate without gloves?		
5	Could all the controls be operated with gloves?		
Interface		(Choose One)	
6	Was display readable in low light levels?		
7	Was display readable in high light levels?		
8	Did the display contain abbreviations or icons? (If no skip next question)		
9	Were the abbreviations or icons easy to interpret or understand?		

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 15 of 74

		Yes	No
Operation		(Choose One)	
10	Did the instrument convey its state-of-health at start-up, e.g. battery life, detector present and working, memory available, and mode of operation?		
11	Did you have to refer to the instruction manual more than once to complete the test?		
12	Was the menu structure simple and intuitive?		
13	At any time during the test did the instrument prompt you for action?		
14	Did the instrument issue any cautions or warning? (such as alarm, alarm type, over-range and low battery indication) (If no, skip next question)		
15	Did the instrument provide information on the nature of the cautions or warning?		

Test Results - Low Light Levels (<150 lux)

		Yes	No
18	Turn on the instrument and verify that it is working properly (e.g. the battery is charged, the detector is present and working, memory is available)		
19	Calibrate instrument (if necessary)		
20	Make an exposure rate measurement		
21	Turn off the instrument		

Test Results - High Light Levels (>10000 lux)

		Yes	No
22	Turn on the instrument and verify that it is working properly (e.g. the battery is charged, the detector is present and working, memory is available)		
23	Calibrate instrument (if necessary)		
24	Make an exposure rate measurement		
25	Make an identification (of a single radionuclide) and save the data		
26	Turn off the instrument		


Comments:

Performed by:

Date:

Reviewed by:

Date:


	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 16 of 74

Audible Alarm N42.32 Data Sheet Section 5.8

Manufacturer:			
Model:		Serial Number:	
Requirements:	1) The frequency of an audible alarm shall be within the range of 1000 Hz to 4000 Hz. 2) Where an intermittent alarm is provided, the signal interval shall not exceed 2 s. 3) 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). 4) If the audible alarm can be disabled, the instrument shall have a vibration or a visual alarm. It shall not be possible to disable all alarms at the same time.		
Ambient Conditions:	°C	%RH	in HG
Test Equipment:			
Instrument Mode of operation			
Note:	Comments are required when the requirement is not verified.		

Measurement Results

Alarm volume			Frequency		
	dB(A)			Hz	
1			1		
2			2		
3			3		
4			4		
5			5		
6			6		
7			7		
8			8		
9			9		
10			10		
Mean	#DIV/0!	dB(A)	Mean	#DIV/0!	Hz
STD	#DIV/0!	dB(A)	STD	#DIV/0!	Hz
COV %	#DIV/0!		COV %	#DIV/0!	

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 17 of 74

	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)?		
Does the instrument have a vibration or visual alarm?		
Does the instrument have preventive measures for disabling all the alarms?		

Record alarm interval (seconds): _____


Record vibrational frequency: _____

Record visual parameters, if any: _____

Comments:

Performed by: _____ **Date:** _____


Reviewed by: _____ **Date:** _____

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 18 of 74


Vibration Alarm N42.32 Data Sheet Section 5.9

Manufacturer:				
Model:		Serial Number:		
Requirements:	<p>1) If the instrument has a vibration alarm, the vibration alarm shall have sufficient intensity to alert the wearer to an alarm condition.</p> <p>2) The use of soft-sided carrying pouches is discouraged. If a holder is used, there should be a rigid connection between the holder and the instrument such that there is no loss of vibration intensity to the user.</p> <p>3) The intensity of the vibration at the surface of the instrument shall be greater than 0.8 g. The vibration motor used by the instrument should rotate between 9000 and 11000 rpm.</p>			
Note:	Comments are required when the requirement is not verified.			
Ambient Conditions:	°C	%RH	in HG	
Test Equipment:				
Instrument Mode of operation				


Instrument and Motor Verification	Verify	
	Yes	No
Verify that new batteries are installed?		
Motor rotation between 9000 and 11000 rpm?		
What is the motor rpm?		

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 20 of 74

Battery Lifetime				
N42.32 Data Sheet Section 5.15				
Manufacturer:				
Model:			Serial Number:	
Radioactive Source Data:				
Ambient Conditions:	°C	%RH	in HG	
Requirements:	1) Batteries used shall be widely available, not unique to the instrument, and be replaceable in the field without the use of special tools. 2) The batteries shall be capable of powering the instrument in a non-alarm state for 16 hours in a 50 µR/h field. The batteries shall be capable of powering the instrument alarm continuously for 30 minutes. 3) The instrument shall have a low battery indicator.			
Note:	Comments are required when the requirement is not verified.			
Non-alarming test after 16 hours of operation				
	Pre-test response	After 16 hours	Acceptance range:	
			low (-15%) #DIV/0!	
Reading 1			(add units)	
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!		
Standard dev	#DIV/0!	#DIV/0!		
COV %	#DIV/0!	#DIV/0!		


	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 21 of 74

What is the voltage when the low battery indication activates?			
	Yes		No
Was the low battery indication displayed after 16 hours of operation?			
Did the instrument alarm with low battery indicated?			
Did the alarm sound continuously for 30 minutes?			
What was the gamma exposure rate for alarm?			
Are the batteries replaceable without the use of special tools?			
Does the instrument have a low battery indication?			
Specify battery type and number of batteries.			
Comments:			
Performed by:			Date:
Reviewed by:			Date:

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 22 of 74

Rate of False Alarms N42.32 Data Sheet Section 6.2

Manufacturer:				
Model:		Serial Number:		
Requirements:	The false alarm rate for gamma and neutron (when applicable) shall be less or equal than one alarm per 10h when operated in a stable background environment.			
Note:	Comments are required when the requirement is not verified.			
Ambient Conditions:	°C	%RH	in HG	
Gamma Alarm Threshold:		Instrument Mode of operation		
Neutron Alarm Threshold:				
Gamma Background measurement		μR/hr		
Neutron Background measurement		(add units)		
		Yes	No	
For gammas; did the instrument alarm more than once over the test period ?		<input type="checkbox"/>	<input type="checkbox"/>	
If applicable, did the neutron alarm more than once over the test period?		<input type="checkbox"/>	<input type="checkbox"/>	
Record the number of gamma alarms during the test:				
Record the number of neutron alarms during the test:				
Comments:				
Performed by:				Date:
Reviewed by:				Date:

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 23 of 74

Time to Alarm: Photons
N42.32 Data Sheet Section 6.3


Manufacturer:			
Model:		Serial Number:	
Requirement:	<p>The false alarm test shall be completed before this time-to-alarm test. The alarm set point shall be the same as the one used for the false alarm test.</p> <p>The instrument shall alarm in ≤ 2 s after exposure to an increase in the ambient radiation level of 50 $\mu\text{R/h}$ (0.5 $\mu\text{Gy/h}$). The increase in the ambient radiation level shall be over a period of not more than 0.5 s.</p>		
	Note: Comments are required when the requirement is not verified.		

Measurement Results


Background Field (Cs-137)	$\mu\text{R/hr}$	Alarm Threshold	$\mu\text{R/hr}$
Background Field (Am-241)	$\mu\text{R/hr}$		
Background Field (Co-60)	$\mu\text{R/hr}$	Instrument Mode of operation	

Record in table if instrument alarmed or not within 2 seconds. It is expected a Yes/No (y/n) entry for 10 readings

	Cs-137		Am-241		Co-60	
	Time to alarm $\leq 2\text{s}$		Time to alarm $\leq 2\text{s}$		Time to alarm $\leq 2\text{s}$	
	Yes	No	Yes	No	Yes	No
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 24 of 74

				Yes	No		
Did the instrument alarm within 2 seconds for Cs-137?							
Did the instrument alarm within 2 seconds for Am-241?							
Did the instrument alarm within 2 seconds for Co-60?							
Comments:							
Performed by:				Date:			
Reviewed by:				Date:			

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 25 of 74


Time to alarm - Neutron
N42.32 Data Sheet Section 6.4

Manufacturer:				
Model:	Serial Number:			
Requirement:	The instrument shall indicate the presence of neutron radiation when exposed to an unmoderated neutron field. The instrument shall fulfill this condition when tested on a polymethylmethacrylate (PMMA) phantom.			
Note:	Comments are required when the requirement is not verified.			
Ambient Conditions:		°C	%RH	in HG
Test Equipment:				
Source Data:	Instrument Mode of operation			
Background Field		(add units)	Alarm Threshold	(add units)


Measurement Results

Record in table if instrument alarmed or not within 2 seconds. It is expected a Yes/No (y/n) entry for 10 readings


		Cf-252	
		Time to alarm ≤ 2s	
		Yes	No
	1		
	2		
	3		
	4		
	5		
	6		
	7		
	8		
	9		
	10		

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 26 of 74

					Yes	No				
Did the instrument alarm within 2 seconds for neutron?										
Comments:										
Performed by:					Date:					
Reviewed by:					Date:					

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 27 of 74

Detection of gradually increasing gamma radiation levels and Neutron detection				
N42.32 Data Sheet Section 6.5				
Manufacturer:				
Model:		Serial Number:		
Requirement:	<p>The instrument's alarm threshold shall not be affected by slowly increasing radiation levels that may be caused when a wearer is slowly approaching or is being approached by a radiation source.</p> <p>The alarm shall activate within 2 seconds after the instrument reaches the test position.</p>			
Note:	Comments are required when the requirement is not verified.			
Ambient Conditions:		°C		%RH
Test Equipment:				
Source Data:				
Gamma Background Field:		μR/h	Neutron Background Field:	(add units)
Gamma Alarm Threshold:		μR/h	Neutron Alarm Threshold:	(add units)
Instrument Mode of operation				

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 28 of 74

Record in table if instrument alarmed or not within 2 seconds. It is expected a Yes/No (y/n) entry for 10 readings

	Cs-137		Cf-252	
	Time to alarm \leq 2s		Time to alarm \leq 2s	
	Yes	No	Yes	No
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

	Yes	No
Did the instrument alarm within 2 seconds for gamma?		
Did the instrument alarm within 2 seconds for neutron?		

For Cs-137:

Record maximum time to alarm: _____ seconds

Record minimum time to alarm: _____ seconds

For Cf-252:


Record maximum time to alarm: _____ seconds

Record minimum time to alarm: _____ seconds


Comments:

Performed by: _____ **Date:** _____


Reviewed by: _____ **Date:** _____

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 29 of 74


Accuracy - Photons				
N42.32 Data Sheet Section 6.6				
Manufacturer:				
Model:	Serial Number:			
Requirement:	Displayed exposure rates, when provided, shall be within $\pm 30\%$ of the conventionally true value of the applied exposure rate using 137Cs.			
	For unit-less displays, if the manufacturer provides a conversion table to convert the displayed value to an exposure rate the indicated value shall be with $\pm 30\%$ of the applied exposure rate.			
Note:	Comments are required when the requirement is not verified.			
Ambient Conditions:	°C	%RH	in HG	
Test Equipment:				
Source Data:	Instrument Mode of operation			
	Background	$\mu\text{R/h}$	at test location	
	Gamma Alarm Threshold:	$\mu\text{R/h}$		
	Maximum instrument range display	(add unit as applicable to instrument)		
	Calculate 20%, 50%, and 80% of maximum instrument range displayed			

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 31 of 74

Accuracy - Neutrons				
N 42.32 Data Sheet Section 6.7				
Manufacturer:				
Model:	Serial Number:			
Requirement:	NOTE—This test is only required if the neutron indication is displayed in mrem/h (or any subunit of rem or Sv). If the instrument display is in cps or cpm or any other unit, this test is not required.			
	Displayed neutron dose rate, when provided, shall be within $\pm 50\%$ of the conventionally true value of the applied dose rate using 252Cf.			
Note:	Comments are required when the requirement is not verified.			
Ambient Conditions:	°C	%RH	in HG	
Test Equipment:				
Source Data:	Instrument Mode of operation			
	Background	(add units)	at test location	
	Neutron Alarm Threshold:	(add units)		
	Maximum instrument range display	(add unit as applicable to instrument)		
	Calculate 20% , 50% , and 80% of maximum instrument range displayed			


	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 32 of 74

		Rate for 20%	Rate for 50%	Rate for 80%	
Dose rate during test		0.00	0.00	0.00	(add units)
	1				
	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 range:	low (-50%)	0.00	0.00	0.00	
	high (50%)	0.00	0.00	0.00	
Comments:					
Performed by:		Date:			
Reviewed by:		Date:			

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 33 of 74


Over-Range Response N42.32 Data Sheet Section 6.8

Manufacturer:				
Model:		Serial Number:		
Requirement:	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 overrange indication shall be displayed for the duration of the exposure. The instrument shall recover within 1 min when the radiation field is reduced.			
Note:	Comments are required when the requirement is not			
Ambient Conditions:		°C		%RH
				in HG
Test Equipment:				
Source Data:				
Instrument Mode of operation				
Manufacturer-Stated Max Exposure Rate:		mR/h		
Over-Range Test Exposure Rate:		mR/h		
Over-Range Exposure Duration:		min.		

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 34 of 74


	Verify	
	Yes	No
Was an over-range indication displayed?		
Did the instrument recover within 1 minute?		
Did the instrument indication remain at the maximum of the range?		

Recorded recovery time:		
Comments:		
Performed by:		Date:
Reviewed by:		Date:

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 35 of 74


Interfering Ionizing Radiation
N42.32 Data Sheet Section 6.9

Manufacturer:			
Model:		Serial Number:	
Requirement:	If the instrument has a neutron detector, the neutron detector shall be insensitive to photon radiation.		
Note:	Comments are required when the requirement is not verified.		
Ambient Conditions:	°C	%RH	in HG
Test Equipment:			
Source Data:			
Instrument Mode of operation			
			Verify
			Yes No
Did the neutron alarm go off?			
Were neutrons indicated during the exposure?			
If neutrons are indicated, record neutron indication (include units)			
Comments:			
Performed by:		Date:	
Reviewed by:		Date:	


	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 39 of 74

NIST	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 40 of 74


Cf-252 (If applicable)		Measurement Results																		
Neutron Alarm Threshold: _____ (add units)		Source emission during test: n/s																		
pre-test at 22°C	Time in minutes	20 to -20° C				-20 to 20° C				20 to 50° C				50 to 20° C						
		15	30	45	60	15	30	45	60	15	30	45	60	15	30	45	60			
1	(add Units)																			
2																				
3																				
4																				
5																				
6																				
7																				
8																				
9																				
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!	#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!	#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!	#DIV/0!	#DIV/0!
																				Instrument alarmed during the test without additional source?
																				Yes
																				No
																				Instrument alarmed with additional source after the test?
																				Yes
																				No
(± 15%) Acceptance Range: #DIV/0! to #DIV/0! <small>low (-15%) high (+15%)</small>																				
Comments:																				
Performed by:																		Date:		
Reviewed by:																		Date:		


	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 41 of 74

Humidity N42.32 Data Sheet Section 7.3									
Manufacturer: _____									
Model: _____					Serial Number: _____				
Requirement: The instrument shall function correctly over the range of relative humidity from 40% to 93 % RH at 35 °C.									
Note: Comments are required when the requirement is not verified.									
Test Equipment: _____									
Source Data: _____									
Ambient Conditions: _____ in HG									
Instrument Mode of operation _____									
Gamma Alarm Threshold: _____ (add units)									
Neutron Alarm Threshold: _____ (add units)									

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 42 of 74


Measurement Results - Cs-137				
Gamma Alarm Threshold:		μR/h	Exposure rate during test:	
		Nominal		
		40% RH	93% RH	40% RH
		22° C	35° C	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!
				Instrument alarmed during the test without additional source?
				Yes
				No
				Instrument alarmed with additional source after the test?
				Yes
				No
				Acceptance Range
		#DIV/0!	to	#DIV/0!
		low 15%		high 15%

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 43 of 74


	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 44 of 74

Measurement Results - Cf-252				
(If applicable)				
Neutron Alarm Threshold: _____ (add units)		Source emission during test: _____ n/s		
	Nominal	93% RH	40% RH	
	40% RH	35° C	35° C	
	22° 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!
				Instrument alarmed during the test without additional source?
				Yes
				No
				Instrument alarmed with additional source after the test?
				Yes
				No
Acceptance Range				
	#DIV/0!	to	#DIV/0!	
	low 15%		high 15%	
Comments: _____				


Performed by: _____			Date: _____	
Reviewed by: _____			Date: _____	

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 45 of 74


Dust							
N42.32 Data Sheet Section 7.4.2							
Manufacturer:							
Model:				Serial Number:			
Requirement:	<p>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 60° on either side of the vertical shall have no harmful effects.</p>						
Note:	Comments are required when the requirement is not verified.						
Test Equipment:							
Source Data:							
Ambient Conditions:		°C		%RH		in HG	
Instrument Mode of operation							
Gamma Alarm Threshold:				(add units)			
Neutron Alarm Threshold:				(add units)			

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 46 of 74


Measurement Results - Cs-137			
	Pre-Test	Post Test	
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!	
Instrument alarmed with additional source after the test?			
Yes			
No			
Acceptance Range			
	#DIV/0!	to	#DIV/0!
	low 15%		high 15%
			Verify
			Yes
			No
Did dust penetrate the instrument?			
Instrument alarmed during the test without additional source?			

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 47 of 74


If applicable	<u>Measurement Results - Cf-252</u>		
	Pre-Test	Post Test	
	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!
	source after the test?		
	Yes		
	No		
	<u>Acceptance Range</u>		
	#DIV/0!	to	#DIV/0!
	low 15%		high 15%
	Comments:		
	Performed by:		Date:
	Reviewed by:		Date:

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 48 of 74


Moisture									
N42.32 Data Sheet Section 7.4.3									
Manufacturer:									
Model:					Serial Number:				
Requirement:	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 60° on either side of the vertical shall have no harmful effects.								
Note:	Comments are required when the requirement is not verified.								
Test Equipment:									
Source Data:									
Ambient Conditions:		°C		%RH		in HG			
Instrument Mode of operation									
Gamma Alarm Threshold:	(add units)								
Neutron Alarm Threshold:	(add units)								

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 49 of 74

Measurement Results - Cs-137			
	Pre-Test	Post Test	
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!	
Instrument alarmed with additional source after the test?			
Yes			
No			
Acceptance Range			
	#DIV/0! low 15%	to	#DIV/0! high 15%
			Verify
			Yes
			No
Did moisture penetrate the instrument?			
Instrument alarmed during the test without additional source?			


	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 50 of 74

If applicable	Measurement Results - Cf-252		
	Pre-Test	Post Test	
	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!
	Instrument alarmed with additional source after the test?		
	Yes		
	No		
	Acceptance Range		
	#DIV/0! low 15%	to	#DIV/0! high 15%
	Comments:		
	Performed by:		Date:
	Reviewed by:		Date:


	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 51 of 74

Cold Temperature Start Up N42.32 Data Sheet Section 7.5


Manufacturer:							
Model:				Serial Number:			
Requirement:	The instrument shall be able to operate when switched on at the cold temperature limit (-20 °C)						
Note:	Comments are required when the requirement is not verified.						
Test Equipment:							
Source Data:							
Ambient Conditions:		%RH		in HG			
Instrument Mode of operation							
Gamma Alarm Threshold:				(add units)			
Neutron Alarm Threshold:				(add units)			

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 52 of 74


Measurement Results - Cs-137				
Gamma Alarm Threshold:	(add units)	Exposure rate during test:	μR/h	
	Pre-Test Readings at 20 C	Readings at -20 C	(add units)	
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
Mean	#DIV/0!	#DIV/0!		
STD	#DIV/0!	#DIV/0!		
COV %	#DIV/0!	#DIV/0!		
			Instrument alarmed during the test without additional source?	
			Yes	
			No	
			Instrument alarmed with additional source after the test?	
			Yes	
			No	
Acceptance Range				
		to		
#DIV/0!			#DIV/0!	
low 15%			high 15%	

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 53 of 74


If Applicable	Measurement Results - Cf-252		
	Pre-Test Readings at 20 C	Readings at -20 C	
	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!
			Instrument alarmed during the test without additional source?
			Yes
			No
			Instrument alarmed with additional source after the test?
			Yes
			No
	Acceptance Range		
	#DIV/0!	to	#DIV/0!
	low 15%		high 15%
	Comments:		
	Performed by:		Date:
	Reviewed by:		Date:

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 54 of 74


Electrostatic Discharge N42.32 Data Sheet Section 8.1				
Manufacturer:				
Model:		Serial Number:		
Requirement:	The instrument shall not be affected by exposure to electrostatic discharges at intensities of up to 6 kV using the contact discharge technique.			
Note:	Comments are required when the requirement is not verified.			
Ambient Conditions:	°C	% RH	in Hg	
Test Equipment Used:				
Source Data:				
Instrument Mode of operation				
Gamma Alarm Threshold:	(add units)			
Neutron Alarm Threshold:	(add units)			

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 55 of 74


Cs-137									
	Pre-test readings			After 2kV discharge readings	After 4kV discharge readings	After 6kV discharge readings	post-test readings		
1			1					(add units)	
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!		
STD	#DIV/0!		STD	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!		
COV %	#DIV/0!		COV %	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!		
Acceptance range:									
	low (-15%)	#DIV/0!							
	high (+15%)	#DIV/0!							
								Yes	No
Did the instrument alarm as a result of the electrostatic discharge alone?									

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 56 of 74


Cf-252	(If applicable)							
	Pre-test readings		After 2kV discharge readings	After 4kV discharge readings	After 6kV discharge readings	post-test readings		
1		1					(add units)	
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!		
STD	#DIV/0!	STD	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!		
COV %	#DIV/0!	COV %	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!		
	Acceptance range:							
	low (-15%)	#DIV/0!						
	high (+15%)	#DIV/0!						
	Comments:							
	Performed by:			Date:				
	Reviewed by:			Date:				

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 57 of 74

Radio Frequency Field										
N42.32 Data Sheet Section 8.2										
Manufacturer:										
Model:					Serial Number:					
Requirement:	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 50 volts per meter (V/m). When exposed to these RF fields, the instrument shall function correctly. No alarms shall occur as a result of the RF radiation alone.									
Note:	Comments are required when the requirement is not verified.									
Ambient Conditions:				°C				% RH		
Test Equipment Used:										
Source Data:										
Instrument Mode of operation										
Gamma Alarm Threshold:										
Neutron Alarm Threshold:										

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 60 of 74

Magnetic Field					
N42.32 Data Sheet Section 8.3					
Manufacturer:					
Model:			Serial Number:		
Requirement:	When exposed to direct current (DC) magnetic fields in all three mutually orthogonal orientations relative to a 10 gauss (1 mT) magnetic field, the instrument shall function correctly.				
Note:	Comments are required when the requirement is not verified.				
Ambient Conditions:		°C		% RH	in Hg
Test Equipment Used:					
Source Data:					
Instrument Mode of operation					
Gamma Alarm Threshold:					(add units)
Neutron Alarm Threshold:					(add units)

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 61 of 74

NIST	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 62 of 74

With Cs-137		<u>Measurement Results</u>						
		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								(add units)
2								
3								
4								
5								
6								
7								
8								
9								
10								
Mean	#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!	
COV %	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
<u>Acceptance Range</u>								
		Initial Orientation:	#DIV/0! low -15%	to	#DIV/0! high +15%			
		Second Orientation:	#DIV/0! low -15%	to	#DIV/0! high +15%			
		Third Orientation:	#DIV/0! low -15%	to	#DIV/0! high +15%			

With Cf-252		<u>Measurement Results</u>						
		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								(add units)
2								
3								
4								
5								
6								
7								
8								
9								
10								
Mean	#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!	
COV %	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
<u>Acceptance Range</u>								
		Initial Orientation:	#DIV/0! low -15%	to	#DIV/0! high +15%			
		Second Orientation:	#DIV/0! low -15%	to	#DIV/0! high +15%			
		Third Orientation:	#DIV/0! low -15%	to	#DIV/0! high +15%			

NIST	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 63 of 74

Measurement Results						
Without Sources						
Gamma response						
	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!
<u>Acceptance Range</u>						
	Initial Orientation:	#DIV/0! low -15%	to	#DIV/0! high +15%		
	Second Orientation:	#DIV/0! low -15%	to	#DIV/0! high +15%		
	Third Orientation:	#DIV/0! low -15%	to	#DIV/0! high +15%		
Did the instrument alarm as a result of the magnetic field alone?						
	Initial orientation	Yes	No			
	Second orientation					
	Third orientation					
Without Sources						
Neutron response (if applicable)						
	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!
<u>Acceptance Range</u>						
	Initial Orientation:	#DIV/0! low -15%	to	#DIV/0! high +15%		
	Second Orientation:	#DIV/0! low -15%	to	#DIV/0! high +15%		
	Third Orientation:	#DIV/0! low -15%	to	#DIV/0! high +15%		

NIST	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 65 of 74

Radiated Emissions N42.32 Data Sheet Section 8.4

Manufacturer:			
Model:	Serial Number:		
Requirement:	RF emissions from an instrument shall be less than that which can interfere with other equipment located in the area of use. RF emissions when measured at three meters shall be less than:		
	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 the requirement is not verified.		

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

Test Equipment Used:	
-----------------------------	--

Instrument Mode of operation	
-------------------------------------	--


Requirement	Yes	No
Where RF emissions above the limits?		

Provide instrument emission plot if available

Comments:			

Performed by:	Date:
----------------------	--------------

Reviewed by:	Date:
---------------------	--------------

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 66 of 74

Vibration
N42.32 Data Sheet Section 9.1

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 the requirement is not verified.

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

Test Equipment Used: _____

Source Data: _____

Gamma Alarm Threshold: _____ (add units)

Neutron Alarm Threshold: _____ (add units)

Instrument Reading - Cs-137

	Before Vib	After Position A	After Position B	After Position C	
Exposure Rate					(add units)
1					
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!
low (-15%) high (+15%)


Did the unit alarm when exposed to a source after the test?	Position A	Position B	Position C
Yes			
No			

Did the unit alarm due to vibration alone?	Position A	Position B	Position C
Yes			
No			


NIST	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 67 of 74

Instrument Reading - Cf-252

If applicable							
	Before Vib	After Position A	After Position B	After Position C			
Count Rate							
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! low (-15%)	to	#DIV/0! high (+15%)				
Did the unit alarm when exposed to a source after the test?							
	Yes	Position A	Position B	Position C			
	No						
Comments:							
Performed by:				Date:			
Reviewed by:				Date:			

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 68 of 74

Drop Test							
Manufacturer:							
Model:			Serial Number:				
Requirement:	After being subjected to drops on each of its six surfaces from a height of 1.5 m onto a concrete floor, the instrument shall function correctly and alarm at a change in the radiation field.						
Note:	Comments are required when the requirement is not verified.						
Instrument Mode of operation							
Source Data:				Test Equipment Used:			
Ambient Conditions:		Deg C		% RH		in Hg	
Gamma Alarm Threshold:				(add units)			
Neutron Alarm Threshold:				(add units)			
Alarm Indication Results (add units)							
Cs-137			If applicable Cf-252				
Readings	Pre-test Photons	Post-test Photons	(add units)	Readings	Pre-test Neutrons	Post-test Neutrons	(add units)
1				1			
2				2			
3				3			
4				4			
5				5			
6				6			
7				7			
8				8			
9				9			
10				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				Acceptance Range			
#DIV/0!	to	#DIV/0!		#DIV/0!	to	#DIV/0!	
low (-15%)		high (+15%)		low (-15%)		high (+15%)	

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682		
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 69 of 74	

Did the instrument alarmed due to the drop?						
Alarm	Position 1	Position 2	Position 3	Position 4	Position 5	Position 6
Yes						
No						

Did the instrument produced a gamma alarm when exposed to a source after the drop?						
Alarm	Position 1	Position 2	Position 3	Position 4	Position 5	Position 6
Yes						
No						

Did the instrument controls function properly?						
Controls	Position 1	Position 2	Position 3	Position 4	Position 5	Position 6
Yes						
No						

Did the instrument show visible external damage?						
Damage	Position 1	Position 2	Position 3	Position 4	Position 5	Position 6
Yes						
No						

If applicable

Did the instrument produced a neutron alarm when exposed to a source after the drop?						
Alarm	Position 1	Position 2	Position 3	Position 4	Position 5	Position 6
Yes						
No						


Comments:

Performed by:

Date:

Reviewed by:


Date:

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 70 of 74

Impact Test N42.32 Data Sheet Section 9.3						
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. If the instrument has a neutron detector, the instrument's response shall be tested with the ²⁵² Cf source.						
Note: Comments are required when the requirement is not verified.						
Instrument Mode of operation _____						
Source Data: _____			Test Equipment Used: _____			
Ambient Conditions: _____		Deg C	_____	% RH	_____	in Hg
Gamma Alarm Threshold: _____			(add units)			
Neutron Alarm Threshold: _____			(add units)			
Cs-137			If applicable Cf-252			
	Pre-test	Post-test		Pre-test	Post-test	
1			(add units)	1		(add units)
2				2		
3				3		
4				4		
5				5		
6				6		
7				7		
8				8		
9				9		
10				10		
Mean	#DIV/0!	#DIV/0!		Mean	#DIV/0!	#DIV/0!
STD	#DIV/0!	#DIV/0!		STD	#DIV/0!	#DIV/0!
COV %	#DIV/0!	#DIV/0!		COV %	#DIV/0!	#DIV/0!
Acceptance Range	#DIV/0!	to	#DIV/0!	#DIV/0!	to	#DIV/0!
	low (-15%)		high (+15%)	low (-15%)		high (+15%)

NIST	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 71 of 74

Did the instrument alarm during Impact without any source present?							
First Impact	Yes	Impact front	Left side	Impact back	Right side	Top	Bottom
	No						
Second Impact	Yes	Impact front	Left side	Impact back	Right side	Top	Bottom
	No						
Third Impact	Yes	Impact front	Left side	Impact back	Right side	Top	Bottom
	No						
Did the instrument alarm during the post-test with the source present?							
Gammas:	Yes				Neutrons:	Yes	
	No				(if applicable)	No	
Comments:							
Performed by:				Date:			
Reviewed by:				Date:			

	TEST AND EVALUATION PROTOCOL	TEP NO. N42.32	PREPARED BY: DIV682	
	TITLE: Alarming Personal Radiation Detectors for Homeland Security	EFF. DATE 2010-11-09	REV. 2.02	PAGE 72 of 74