



American National Standard Performance Criteria for Backpack-Based Radiation-Detection Systems Used for Homeland Security

STANDARDS

Accredited by the American National Standards Institute

Developed by the
National Committee on Radiation Instrumentation, N42

ANSI N42.53-2021
(Revision of ANSI N42.53-2013)

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Secretariat

Institute of Electrical and Electronics Engineers, Inc.

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Abstract: The operational and performance requirements for backpack-based radiation-detection systems (BRDs) used in homeland security applications are specified in this standard. BRDs are typically worn by the user during operations to detect and possibly identify radiological and nuclear material.

Keywords: ANSI N42.53, backpack-based radiation-detection systems

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Introduction

This introduction is not part of ANSI -2021, American National Standard Performance Criteria for Backpack-Based Radiation-Detection Systems Used for Homeland Security.

This standard is the responsibility of the Accredited American Standards Committee on Radiation Instrumentation, N42. The standard was approved on N42 letter ballot.

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1. Overview

1.1 Scope

This standard specifies the basic performance requirements for backpack-based radiation-detection systems (BRDs) used in homeland security applications. BRDs consist of a body worn detection assembly that may be carried in a backpack, vest, or shoulder bag, and a wired or wireless user interface/display. BRDs shall detect gamma radiation and may include neutron detection and/or the identification of gamma-ray emitting radionuclides.

1.2 Purpose

This standard establishes the radiological performance and testing requirements and those requirements associated with the expected electrical, mechanical, and environmental conditions while in use.

2. Normative references

The following referenced documents are indispensable for the application of this document (i.e., they must be understood and used, so each referenced document is cited in text and its relationship to this document is explained). For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments or corrigenda) applies.

ANSI N42.42, American National Standard Data Format for Radiation Detectors Used for Homeland Security.¹

IEC 60529, Degrees of protection provided by enclosures (IP Code).²

IEC 62706, Radiation protection instrumentation – Recommended climatic, electromagnetic and mechanical performance requirements and methods of tests.

MIL-STD-810, Department of Defense Test Method Standard: Environmental Engineering Considerations and Laboratory Tests.³

¹ ANSI N42 publications are available from The Institute of Electrical and Electronics Engineers (<https://standards.ieee.org/>).

² IEC publications are available from The International Electrotechnical Commission (<https://www.iec.ch>) and the American National Standards Institute (<https://www.ansi.org/>).

³ MIL publications are available from the U.S. Department of Defense (<https://www.dsp.dla.mil/>).

3. Definitions, acronyms, and abbreviations

3.1 Definitions

For the purposes of this document, the following terms and definitions apply. The *IEEE Standards Dictionary Online* should be consulted for terms not defined in this clause.⁴

acceptance test: Evaluation or measurement of performance characteristics to verify that certain stated specifications and contractual requirements are met.

accuracy: The degree of agreement between the observed value and the conventionally accepted true value of the quantity being measured.

alarm: An audible, visual, or other signal activated when the instrument reading or response exceeds a preset value or falls outside of a preset range.

NOTE 1—A verified alarm is an alarm that can be repeated under the same conditions and configurations, either by the same BRD or when two or more BRDs can reproduce the alarm under the same conditions and configurations.

NOTE 2—An unverified alarm is an alarm that cannot be repeated.

alarm adjudication: The process of identifying, with reasonable certainty, the type or nature of material or device that set off an alarm and assessing the potential threat that the material might pose with corresponding implications for the need to take further action.

calibration: A set of operations under specified conditions that establishes the relationship between values indicated by a measuring instrument or measuring system and the conventionally true values of the quantity or variable being measured.

check source: A not-necessarily calibrated source that is used to confirm the continuing functionality of an instrument.

coefficient of variation (COV): Ratio of the standard deviation, s , to the arithmetic mean, $\bar{x}$, of a set of n measurements, x_i , given by the following equation:

$$V = \frac{s}{\bar{x}} = \frac{1}{\bar{x}} \sqrt{\frac{\sum (x_i - \bar{x})^2}{n-1}}$$

confidence indication: An indication provided by the instrument of the reliability assigned to the determined identification.

detection assembly: Enclosure that contains the detectors and associated electronic devices.

detector: A device or component designed to produce a quantifiable response to ionizing radiation, normally measured electronically.

exposure: A measure of ionization produced in air by x-ray or gamma-ray radiation.

NOTE—The special unit of exposure rate is the roentgen per hour, abbreviated in this standard as R/h.

⁴ *IEEE Standards Dictionary Online* is available at: <http://dictionary.ieee.org>. An IEEE Account is required for access to the dictionary, and one can be created at no charge on the dictionary sign-in page.

false alarm: Alarm *not* caused by a radioactive source under the specified background conditions.

fluence rate (flux density): The number of particles that interact with a defined cross-sectional area of a sphere (cm²) over a defined period time (s).

NOTE—May also be the number of particles from the source that traverse a cross sectional area at the face of the detector.

indication: Displayed signal from the instrument to the user conveying information such as scale or decade, functional status, or malfunction.

influence quantity: Quantity that may have a bearing on the result of a measurement without being the subject of the measurement.

instrument: A complete system consisting of one or more assemblies designed to quantify one or more characteristics of ionizing radiation or radioactive material.

monitoring: To continuously indicate the state or condition of a system or assembly.

NOTE—May also be used to describe the real-time measurement of radioactivity or radiation levels.

radioactive material: Material where one or more constituents exhibit radioactivity (radioactive decay). In this standard, radioactive material includes special nuclear material unless otherwise specifically noted.

reading: The indicated or displayed value.

standard deviation: The positive square root of the variance.

standard test conditions: The range of values of a set of influence quantities under which a calibration or a measurement of response is carried out.

test: A procedure whereby the instrument, circuit, or component is evaluated.

type test: Initial test of two or more production instruments made to a specific design to show that the design meets defined specifications.

uncertainty: The estimated bounds of the deviation from the conventionally true value, generally expressed as a percent of the mean, ordinarily taken as the square root of the sum of the squares of two components: 1) random errors that are evaluated by statistical means and 2) systematic errors that are evaluated by other means.

3.2 Acronyms and abbreviations

BRD	backpack-based radiation-detection system
COV	coefficient of variation
DU	depleted uranium
ESD	electrostatic discharge
HEU	highly enriched uranium
ICRU	International Commission on Radiation Units and Measurements
NIST	National Institute of Standards and Technology
NORM	naturally occurring radioactive material
PMMA	poly methyl methacrylate