

American National Standard Performance Criteria for Mobile and Transportable Radiation Monitors Used for Homeland Security

Accredited by the American National Standards Institute

Sponsored by the
National Committee on Radiation Instrumentation, N42

IEEE
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USA

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American National Standards Institute

Secretariat

Institute of Electrical and Electronics Engineers, Inc.

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Abstract: The operational and performance requirements for transportable and/or mobile radiation monitors used in homeland security applications are specified in this standard. Transportable radiation monitors are designed to be transported to a location and used for a specific task or for a specified period of time and do not require permanent mounting platforms. Mobile monitors are those monitors that are typically in operation on a platform that is in motion.

Keywords: ANSI N42.43, mobile radiation monitors, transportable radiation monitors

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Introduction

This introduction is not part of ANSI N42.43-2016, American National Standard Performance Criteria for Mobile and Transportable Radiation Monitors 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 September–October 2006.

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1. Overview

1.1 Scope

This standard specifies the performance requirements and tests for transportable and mobile radiation monitors that detect and identify radionuclides, and when provided, indicate the presence of neutron radiation. *Transportable radiation monitors* are designed to be transported to a location and used for a specific task or for a specified period of time; they do not require permanent mounting platforms; may be mounted to a vehicle such as a trailer; and are only used when the vehicle is stationary. *Mobile radiation monitors* are typically in operation on a platform that is in motion but that can also be used while stationary. Mobile monitors may be mounted in vehicles including, for example, trailers.

1.2 Purpose

This standard specifies the operational and performance requirements for transportable and mobile radiation monitors used in homeland security applications. Operational requirements established by this standard include radiation detection and radionuclide identification, and those requirements associated with the expected electrical, mechanical, and environmental conditions while in transit and when deployed. The tests described in this standard provide a means to help ensure that a monitor meets the requirements stated.

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 Standard for Radiation Detectors Used for Homeland Security.¹

ASTM B152, Standard Specification for Copper Sheet, Strip, Plate, and Rolled Bar.²

FCC Part 15, Code of Federal Regulations, Title 47, Part 15 (47 CFR 15).

IAEA Safety Guide No. RS-G-1.9, Categorization of Radioactive Sources.

IEC 60068-2-1, Environmental testing—Part 2-1: Tests—Test A: Cold.³

IEC 60068-2-2, Environmental testing—Part 2-2: Tests—Test B: Dry heat.

IEC 60068-2-11, Basic environmental testing procedures—Part 2-11: Tests—Test Ka: Salt mist.

IEC 60068-2-18, Environmental testing—Part 2-18: Tests—Test R and guidance: Water.

IEC 60068-2-64, Environmental testing—Part 2-64: Tests—Test Fh: Vibration, broadband random and guidance.

IEC 60068-2-66, Environmental testing—Part 2: Test methods—Test Cx: Damp heat, steady state (unsaturated pressurized vapour).

IEC 60068-2-68, Environmental testing—Part 2-68: Tests—Test L: Dust and sand.

IEC 61000-4-2, Electromagnetic compatibility (EMC)—Part 4-2: Testing and measurement techniques—Electrostatic discharge immunity test.

IEC 61000-4-3, Electromagnetic compatibility (EMC)—Part 4-3: Testing and measurement techniques—Radiated, radio-frequency, electromagnetic field immunity test.

IEC 62438, Radiation protection instrumentation—Mobile instrumentation for the measurements of photon and neutron radiation in the environment.

IEC 62706, Radiation protection instrumentation—Environmental, electromagnetic and mechanical performance requirements.

ISO 4037-3, X and gamma reference radiation for calibrating dosimeters and dose rate meters and for determining their response as a function of photon energy—Part 3: Calibration of area and personal dosimeters and the measurement of their response as a function of energy and angle of incidence.⁴

¹ The ANSI N42 publications included in this clause are available from The Institute of Electrical and Electronics Engineers, 445 Hoes Lane, Piscataway, NJ 08855-1331, USA (<http://standards.ieee.org/>).

² ASTM publications are available from the American Society for Testing and Materials (<http://www.astm.org/>).

³ IEC publications are available from the International Electrotechnical Commission (<http://www.iec.ch/>). IEC publications are also available in the United States from the American National Standards Institute (<http://www.ansi.org/>).

⁴ ISO publications are available from the ISO Central Secretariat (<http://www.iso.org/>). ISO publications are also available in the United States from the American National Standards Institute (<http://www.ansi.org/>).

3. Definitions and acronyms

3.1 Definitions

For the purposes of this standard, the following terms and definitions apply. *IEEE Standards Dictionary Online* should be consulted for terms not defined in this clause.⁵

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.

area monitor: A radiation monitor that is designed to detect increases in the ambient radiation level within an area either surrounding the detection assembly or adjacent to the detection assembly.

calibrate: To adjust and/or determine the response or reading of a device relative to a series of conventionally true values.

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.

coefficient of variation (COV): The square root of the variance, s^2 , divided by the mean value of n , the number of readings, multiplied by 100.

coverage factor: Numerical factor used as a multiplier of the combined standard uncertainty in order to obtain an expanded uncertainty.

detector: A device or component designed to produce a quantifiable response to ionizing radiation.

detection zone: Area where radiation measurement takes place for the purposes of detection or identification.

effective range of measurement: Range of measurements within which the requirements of this standard are met.

evaluation distance: The distance between a test source and the exterior face(s) of the monitor unit(s) used during a trial which corresponds to the surface of the detection assembly.

exposure rate: The 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.⁶

false alarm: Alarm caused by something other than an increase in measured radiation level or identification of a radionuclide.

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

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

⁵ *IEEE Standards Dictionary Online* is available at: <http://ieeexplore.ieee.org/xpls/dictionary.jsp>.

⁶ Notes in text, tables, and figures of a standard are given for information only and do not contain requirements needed to implement this standard.

mobile monitor: A monitor that is typically in operation on a platform that is in motion.

monitoring: Means provided to continuously indicate the state or condition of a system or assembly.

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

monitor: Radiation-detection system that measures radiation intensity, compares it to alarm criteria, and produces an alarm if the measured radiation intensity exceeds the criteria.

radioactive material: In this standard, radioactive material includes both special nuclear and other radioactive material unless otherwise specifically noted.

range: All values between the detection threshold and the detection limit.

reading: The indicated or displayed value.

reference point: The position on or within a detection assembly or detector used to set measurement distances or test placement.

response time: For this standard, the time required to update the display or integrate counts obtained from a radiation source.

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 or monitors made to a specific design to show that the design meets defined specifications.

transportable monitor: A monitor that can be transported to a location and used without requiring a permanent mounting platform.

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 square of two components: 1) random errors that are evaluated by statistical means; and 2) systematic errors that are evaluated by other means.

variance (s^2): A measure of dispersion, which is the sum of the squared deviation of observations from their mean divided by one less than the number of observations (n).

$$s^2 = \frac{1}{n-1} \sum_{i=1}^n (x_i - \bar{x})^2$$

3.2 Acronyms

COV coefficient of variation

GMT Geiger Mueller tube

GPS	global positioning system
HDPE	high-density polyethylene
HPGe	high-purity germanium
NaI	sodium iodide
PVT	polyvinyl toluene
RH	relative humidity
SNM	special nuclear material

4. General considerations

4.1 Introduction

Unless otherwise specified in an individual step, tests enumerated in this standard may be used as part of a type test. Certain tests may be considered as acceptance tests by agreement between the user and manufacturer.

4.2 Meeting performance specifications

Obtaining operating performance that meets or exceeds the specifications stated in this standard depends upon proper set up, establishing appropriate operating parameters, providing security for the monitor, maintaining calibration, implementing a suitable response-testing and maintenance program, auditing compliance with quality requirements, and providing proper training for operating personnel.

4.3 Units and measurements

For the purposes of this standard the radiological unit of exposure rate, roentgen per hour (R/h), is used. Radiation test fields may be established through measurement or calculation. Radiation test fields established by measurement shall be made using devices traceable to NIST or an equivalent recognized organization. The device used to establish radiation test fields should measure exposure rate. Conversion coefficients shall be applied (see ISO 4037-3) if using a device that measures ambient dose-equivalent rate or other dose-rate quantity. When radiation fields are determined through calculation, the technique used shall be described in the test record.

Other than ambient background, measured radiation test fields shall be determined at an uncertainty of $\pm 20\%$ with a coverage factor (k) of 1.

Measurement of test fields for climatic, dynamic, and electromagnetic conditions shall be made using equipment traceable to NIST or an equivalent organization.