

American National Standard Performance Specifications for Health Physics Instrumentation—Portable Instrumentation for Use in Extreme Environmental Conditions

National Committee on Radiation Instrumentation, N42
accredited by the American National Standards Institute

Secretariat

The Institute of Electrical and Electronics Engineers, Inc.

Reaffirmed January 4, 2005
Approved September 7, 1989

American National Standards Institute

Abstract: ANSI N42.17C-1989 *American National Standard Performance Specifications for Health Physics Instrumentation—Portable Instrumentation for Use in Extreme Environmental Conditions*, describes the minimum acceptable performance criteria for health physics instrumentation for use under extreme environmental conditions for monitoring ionizing radiation fields. This standard supplements the basic performance specifications for portable health physics instrumentation presented in ANSI N42.17A-1989. Included in ANSI N42.17C are testing methods to be used to establish the acceptability of each type of instrumentation.

Copyright © 1990 by

The Institute of Electrical and Electronics Engineers, Inc.

345 East 47th Street, New York, NY 10017-2394, New York, NY

Copyright © 1998 IEEE All Rights Reserved

American National Standard

An American National Standard implies a consensus of those substantially concerned with its scope and provisions. An American National Standard is intended as a guide to aid the manufacturer, the consumer, and the general public. The existence of an American National Standard does not in any respect preclude anyone, whether he has approved the standard or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standard. American National Standards are subject to periodic review and users are cautioned to obtain the latest editions.

CAUTION NOTICE: This American National Standard may be revised or withdrawn at any time. The procedures of the American National Standards Institute require that action be taken to reaffirm, revise, or withdraw this standard no later than five years from the date of publication. Purchasers of American National Standards may receive current information on all standards by calling or writing the American National Standards Institute.

Foreword

(This Foreword is not a part of ANSI N42.17C-1989, American National Standard Performance Specifications for Health Physics Instrumentation—Portable Instrumentation for Use in Extreme Environmental Conditions.)

This standard is the responsibility of the Accredited Standards Committee N42 on Radiation Instrumentation. Committee N42 delegated the development of the standard to its Subcommittee N42.1. Drafts were reviewed by Committee N42, Subcommittee N42.1, and other interested parties, and the comments received were utilized in producing the standard as finally approved and discussed. Performance criteria contained in this standard were tested for applicability under the standard was approved by Committee N42 letter ballot of February 6, 1989.

At the time it approved this standard, the Accredited Standards Committee on Radiation Instrumentation, N42, had the following members:

Louis Costrell, Chair
Sue Vogel, Administrative Secretary

American Conference of Governmental Industrial Hygienists	Jesse Lieberman
Battelle Pacific Northwest Laboratories	Jack M. Selby
Health Physics Society	J. B. Horner Kuper
	Jack M. Selby (<i>Alt.</i>)
Institute of Electrical and Electronics Engineers	Louis Costrell
	David C. Cook (<i>Alt.</i>)
	Julian Forster (<i>Alt.</i>)
	Anthony J. Spurgin (<i>Alt.</i>)
Lawrence Berkeley Laboratory	Lee J. Wagner
Lawrence Livermore National Laboratory	Paul L. Phelps
Nuclear Suppliers Association	Kenneth F. Sinclair
Oak Ridge National Laboratory	Hugh R. Brashear
UCLA Center for the Health Sciences	James E. McLaughlin
US Department of the Army	Edward Groeber
US Department of Commerce, National Institute of Standards and Technology	Louis Costrell
US Department of Energy	Gerald Goldstein
US Federal Emergency Management Agency	Carl R. Siebentritt
US Nuclear Regulatory Commission	Edward C. Wenzinger, Sr.
Members-at-Large	Joseph G. Bellian
	David C. Cook
	Ernesto A. Corte
	John M. Gallagher
	Dick A. Mack
	Edward J. Vallario

At the time this standard was approved, Subcommittee N42.1 had the following members:

Jack M. Selby, Chair

J. G. Bellian
Edmond Goodale

J. D. Henderson
R. L. Kathren
William Klein

H. W. Patterson
C. R. Siebentritt

The working group for this standard had the following members:

J. M. Selby, *Chair*
K. L. Swinth, *Vice Chair*

B. V. Anderson*
J. G. Bellian
M. V. Federline†
J. A. Flanigan
D. M. Fleming
J. A. Jones*

J. N. Little
R. B. Neel
G. J. Oliver
R. D. Terry
R. P. Ulman
C. K. Brown‡

A. L. Cucchiara‡
L. M. Earls‡
J. G. Flaherty‡
R. L. Kathren‡
J. L. Kenoyer‡

*Deceased

†Replaced by another NRC representative

‡Consultant

The following persons were on the balloting committee that approved this document for submission to the Accredited Standards Committee N42:

J. G. Bellian
H. R. Brashear
D. C. Cook
L. Costrell
J. Forster
J. M. Gallagher

G. Goldstein
E. Groeber
J. B. Horner Kuper
J. Lieberman
D. A. Mack
J. E. McLaughlin
J. M. Selby

C. R. Siebentritt
K. F. Sinclair
A. J. Spurgin
E. J. Vallario
L. J. Wagner
E. C. Wenzinger, Sr.

CLAUSE	PAGE
1. Scope	1
1.1 Introduction	1
1.2 References	2
2. Definitions	2
3. General Test Procedures	5
3.1 Applicability of Tests	5
3.2 Standard Test Conditions	5
3.3 Statistical Fluctuations	5
4. General Characteristics	7
4.1 General	7
4.2 Markings	7
4.3 Operability of Controls	8
4.4 Battery Power	8
4.5 Battery Power Indicator	9
5. Electronic and Mechanical Requirements and Test	9
5.1 Check Circuits	9
5.2 Stability	9
5.3 Response Time	10
5.4 Line Noise Susceptibility	11
6. Radiation Response	11
6.1 Accuracy, Precision Energy Dependence	11
6.2 High-Energy Photons	12
7. Interfering Responses	12
7.1 NonIonizing Electromagnetic Radiations	12
8. Environmental Factors	13
8.1 Temperature	13
8.2 Extreme Temperature Shock (Method 1)	13
8.3 Temperature Shock (Method 2)	14
8.4 Humidity and Temperature	14
8.5 Mechanical Shock	15
8.6 Vibration	15
8.7 Ambient Pressure	15
8.8 Condensing Atmospheres	16
8.9 Instrument Durability	16
8.10 Radiation Resistance	16
8.11 Drop Test	17
8.12 Moisture Exposure (Rain)	17
8.13 Moisture Exposure (Fog)	17

CLAUSE	PAGE
9. Documentation	18
9.1 Type Test Report.....	18
9.2 Certificate.....	18
9.3 Operation and Maintenance Manual	18
Annex A (Informative).....	19

American National Standard Performance Specifications for Health Physics Instrumentation—Portable Instrumentation for Use in Extreme Environmental Conditions

1. Scope

This standard establishes minimum acceptable performance criteria for health physics instrumentation for use in ionizing radiation fields under extreme environmental conditions. Included are testing methods to establish the acceptability of each type of instrumentation. This standard does not specify which instruments or systems are required, nor does it consider the number of specific applications of such instruments. This standard supplements the basic performance requirements for health physics instrumentation as specified in ANSI N42.17A [2].¹ Specifications in this standard are expected to be called for by the user as required and should not be considered as general specifications.

1.1 Introduction

The object of this standard is to provide basic performance requirements for instruments used for radiation protection of personnel under extreme environmental conditions. The standard includes performance testing criteria for use in generic (type) tests of new instrument models.

As used in this standard, health physics instrumentation provides direct readout of dose or dose equivalent, rate,² or activity per unit area (i.e., effective probe area). Personnel dosimeters, instruments designed to be used as individual or personal monitors or warning devices, environmental monitoring instruments, and air monitors are outside the scope of this standard. Special purpose instrumentation, such as emergency post-accident radiological monitors, may also fall under the scope of one or more related ANSI standards, and this standard is intended to supplement rather than replace these. In general, health physics instrumentation is considered to cover the dose (equivalent) rate range of 0.1 mrad/h to 1000 rad/h (10^6 Gy/h to 10 Gy/h); 0.1 mrem/h to 1000 rem/h (10^6 Sv/h to 10 Sv/h); or activity per unit area

¹The numbers in brackets correspond to those of the references listed in 1.2.

²Until conversion to SI units is complete, readout of exposure (R) or exposure rate (R/h) will be considered acceptable for exposure to photon radiation.

ranges for surface contamination monitors of 50 dpm/cm² to 10- dpm/cm² (0.83 Bq/cm² to 167 Bq/cm²) for beta/ photon radiation and 1dpm/cm² to 10- dpm/cm² (0.02 aq/cm² to 167 Bq/cm² for alpha radiation.

This standard specifies general characteristics; general test procedures; radiation characteristics; and electrical, mechanical, safety and environmental characteristics. Throughout this standard, three verbs have been used to indicate the degree of rigor intended for each specific criterion. The word *shall* is used to denote a requirement, and the word *should* to denote a recommendation, and the word *may* to denote a permissible practice.

Requirements and testing criteria to be used for the evaluation of occupational-type air monitoring instrumentation are discussed in ANSI N42.17B-1989 [3]. Requirements and testing criteria related to evaluation of portable radiation protection instrumentation under normal environmental conditions are covered in ANSI N42.17A-1989 [2].

1.2 References

The following publications shall be used in conjunction with this standard. When standards in this document are referred to, the latest revision shall apply.

- [1] ANSI N13.4-1971 (R1983), Specification of Portable X- or Gamma-Radiation Survey Instruments.³
- [2] ANSI N42.17A-1989, Performance Specifications for Health Physics Instrumentation—Portable Instrumentation.
- [3] ANSI N42.17B-1989, Performance Specifications for Health Physics Instrumentation—Occupational Airborne Radioactivity Monitoring Instrumentation.
- [4] ANSI/IEEE C62.41-1980, IEEE Guide for Surge Voltages in Low-Voltage ac Power Circuits.⁴
- [5] IEC Publication 68-2-27 (1987), Part 2, Test Ea and Guidance: Shock.⁵
- [6] IEC Publication 278:1968, Documentation to be Supplied With Electronic Measuring Apparatus.
- [7] Mil-Std 810D, 31 Jul 1983, Environmental Test Methods and Engineering Guidelines.⁶

2. Definitions

For the purpose of this document, the following definitions apply:

acceptable source: Source of radiation listed in the appropriate reference source table.

acceptance testing: Evaluation or measurement of the operational status of selected performance characteristics to verify that certain stated specifications and contractual requirements are met.

accuracy: The degree of agreement of the observed value with the conventionally true value of the quantity being measured. Accuracy includes linearity, zero drift, and hysteresis.

adjust: To alter the response by means of a variable built-in control such as a potentiometer.

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

³ANSI publications are available from the Sales Department, American National Standards Institute, 1430 Broadway, New York, NY 10018.

⁴ANSI/IEEE publications are available from the Institute of Electrical and Electronics Engineers, Service Center, 445 Hoes Lane, Piscataway, NJ 08855-1331, or the Sales Department, American National Standards Institute, 1430 Broadway, New York, NY 10018.

⁵IEC publications are available from the Sales Department, American National Standards Institute, 1430 Broadway, New York, NY 10018.

⁶Mil-Std publications are available from Global Engineering Documents, 1990 M Street, NW Suite 400, Washington DC 20036.