



American National Standard
ANSI/HPS N13.3-2013 (R2019)

**Dosimetry for
Criticality Accidents**

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American National Standards Institute, Inc.



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Foreword

(This foreword is not a part of American National Standard ANSI/HPS N13.3-2013 (R2019))

This American National Standard provides criteria for the design, implementation, and operation of a nuclear accident or criticality accident dosimeter system. This standard is specific to the use of any dosimeter system used for the assessment of personnel radiation doses that result from exposure to an accidental nuclear criticality. These criteria are intended as guidelines for the design, implementation, and testing of such systems as part of the emergency preparation program at any facility which has the potential for such accidents. It is not intended to provide any information beyond the assessment of absorbed dose due to a criticality accident. In contrast to routine radiation dose evaluations, the performance of the criticality dosimeter involves not only accuracy and precision, but also a need to provide absorbed dose information in a timely manner.

Changes and improvements that have been incorporated since the last publication of this standard include the requirement that criticality accident dosimetry be treated as a system of components and processes that may include physical dosimeters, analysis of biological materials, and mathematical modeling methods. However, it does not require specific components or processes be incorporated in the system. Instead this standard establishes requirements necessary to ensure the system is capable of providing rapid and accurate assessments of personnel absorbed doses resulting from a criticality accident. These requirements include criteria for system design, application, quality assurance practices, program documentation, training, performance testing, and performance following criticality accident. Emphasis has been placed on the need to make a priori considerations (special considerations) for issues such as orientation, partial-body exposure, neutron and photon energy spectra, and biological dosimetry. The annexes to this standard provide additional useful information applicable to the design and implementation of a criticality dosimetry system.

During the reaffirmation process, a nonsubstantive change was made to Section 2.0, Paragraph 2, Sentence 3 to clarify that other types of photon dosimetry besides TLDs are also acceptable. This change meets the ANSI Essential Requirements for reaffirmations.

Suggestions for the improvement of this standard and the current and future annexes are welcomed. Please send suggestions to the Health Physics Society, 950 Herndon Parkway, Suite 450, Herndon, VA 20170.

Keywords: criticality dosimetry, absorbed dose, threshold detector

Dosimetry for Criticality Accidents

1.0 Introduction

The rapid and accurate assessment of personnel absorbed doses resulting from a criticality accident may be of the utmost importance for exposed individuals and assisting with their medical treatment. Although the probability of a criticality accident occurring has been greatly reduced through improved safety programs, such as detailed in ANSI/ANS-8.1, significant risks still exist. Facilities need to have a dosimetry system capable of providing timely information following such an accident. Dose assessment personnel should use all available resources to ensure that any absorbed dose determinations are as accurate as possible.

The dosimetry system needs to be able to provide accurate absorbed dose determination within the range of possible accident scenarios and dose levels. This standard provides criteria for the quality assurance (QA) and performance of nuclear criticality accident dosimetry systems. In addition, the annexes provide additional information of use to the dosimetrist concerning the general application of accident dosimeters.

ANSI/ANS 8.23 requires a criticality dosimetry system as part of the emergency preparation program at any facility where a criticality accident alarm system (CAAS), per ANSI/ANS-8.3, is in use. CAAS installation implies a nontrivial risk of a criticality accident.

2.0 Scope

This standard is applicable to operations for which there is a potential for a criticality accident involving personnel exposure. This standard provides guidance and requirements using the quantity absorbed dose. The units of absorbed dose are given in SI units of gray (Gy), with the traditional units of rad following in parenthesis. The assessment of quantities other than absorbed dose will not be addressed as these can be determined after a criticality accident by careful spectral analysis and application of conversion coefficients specified by the appropriate regulatory requirements. It should also be noted that the absorbed dose concept is applicable for an acute dose that potentially results in an immediate nonstochastic effect.

Therefore, the quantity absorbed dose is used instead of dose equivalent or other dosimetric quantities. The range of personnel absorbed dose covered by this standard is approximately 0.1 to 10 Gy (10 to 1,000 rad).

This standard provides requirements and performance criteria for implementation and maintenance of a dosimetry system capable of providing personnel absorbed doses in the event of a criticality accident. Such an accident is characterized by the release of large amounts of penetrating prompt radiation. The dosimetry system may include: physical detectors such as activation foils and photon dosimeters (e.g., thermoluminescent dosimeters [TLDs], ion chambers, optically stimulated dosimeters, etc.); biological samples such as blood sodium or live cells for cytogenetics; and analysis capabilities based on models, known geometry effects, and information based on eyewitness reports. The resulting individual absorbed dose estimates are intended to:

- (1) Aid in prioritizing medical attention for affected personnel appropriate to their level of absorbed dose.
- (2) Provide information useful for correlating absorbed doses with biological responses.
- (3) Provide information appropriate for reporting to regulatory agencies and for release to the public.
- (4) Provide information which, when combined with additional analysis, will result in data useful in deriving information for integrated lifetime exposure records.

In cases where dosimetry services are provided by an outside organization or vendor, it is the responsibility of the procuring organization to ensure criteria in this document are met.

3.0 Definitions

Absorbed Dose, D . The quotient of $d\varepsilon$ by dm , where $d\varepsilon$ is the mean energy imparted by ionizing radiation to matter of mass dm . For purposes of this standard, the material is assumed to be tissue. The unit of absorbed dose is joule per kilogram (J kg^{-1}), and its special name is gray (Gy) in the International System of Units (Système international d'unités, SI) or rad in traditional units.