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**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

GB/T 12164.1-2026

Replacing GB/T 12164.1-2008

**Reference beta-particle radiation - Part 1: Methods of
production**
(English Translation)

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Foreword

This document complies with the provisions of GB/T 1.1-2020 "Standardization Work Guidelines Part 1: Structure and Drafting Rules of Standardization Documents".

Drafting.

---Part 1: Generation Method;

---Part 3: Calibration of site and personal dosimeters and determination of their energy and angular responses.

This document supersedes GB/T 12164.1-2008 "beta Reference Radiation Part 1: Methods of Generation" and is consistent with GB/T 12164.1-2008.

Compared to previous versions, aside from structural adjustments and editorial changes, the main technical changes are as follows.

a) New operational utility values have been added, namely the directional dose equivalent $H'(3, \text{ohm})$ at a depth of 3 mm and the personal dose equivalent at a depth of 3 mm.

Quantity $H_p(3)$ (see Chapter 1);

b) The following terms have been removed. absorbed dose, absorbed dose rate, weakly penetrating radiation directional dose equivalent, weakly penetrating radiation ambient dose equivalent, and ICRU group.

More general terms and definitions, such as weaving (see sections 3.1, 3.2, 3.5, 3.6, and 3.8 of the 2008 edition);

c) The technical details of standard test conditions have been added (see 4.1);

d) ^{14}C nuclides that are difficult to obtain and less frequently used in reference radiation have been removed (see Tables 1 and 2 of the 2008 edition);

e) A $^{106}\text{Ru}/^{106}\text{Rh}$ radiometric material was added to the Series 1 reference radiation (with flattened filter) (see Table 3);

f) Added technical content on determining reference radiation characteristics using simulation methods (see 6.1.2);

g) Two energy-attenuated $^{90}\text{Sr}/^{90}\text{Y}$ reference radiation substances were added to the Series 2 reference radiation (see Table 6);

h) "Reference conditions and standard test conditions" have been added (see Appendix B).

This document is equivalent to ISO 6980-1:2023 "Nuclear energy - beta reference radiation - Part 1: Methods of production".

The following minimal editorial changes have been made to this document.

---To harmonize with existing standards, the standard title has been changed to "beta Reference Radiation Part 1: Methods of Generation";

---In the explanation of formula (1) in 6.1.2, the first column is adjusted to two columns, E_{res} and R_{res} , and the second column in the original text is adjusted to a paragraph.

(The original text contained formatting errors);

Please note that some content in this document may involve patents. The issuing organization of this document assumes no responsibility for identifying patents.

This document was proposed and is under the jurisdiction of the National Nuclear Energy

Standardization Technical Committee (SAC/TC58).

Introduction

Beta reference radiation technology is a prerequisite for calibrating beta dosimeters and dose rate meters used for radiation protection and for determining their energy response. Beta dosimeters and dose rate meters...

The calibration and response measurement of the rate meter mainly consist of three steps. First, the basic field at the test point is measured using the method described in ISO 6980-2.

The dose rate refers to the tissue absorption rate at a depth of 0.07 mm (or 3 mm depth) in the tissue equivalent plate mold; secondly, it is determined by applying a conversion factor.

To determine the appropriate operational utility, this coefficient will be correlated with the selected operational utility under the chosen irradiation geometry (reference absorbed dose rate).

Finally, the reference point of the device under test is placed at the test point to calibrate and determine the dosimeter's response. Depending on the type of dosimeter being tested, for...

Personal and location dosimeters are used for irradiation, one on a phantom and the other in free air. For location and personal monitoring of beta radiation, actual operation is typically performed...

The dosage is the directed dose equivalents $H'(0.07; \text{ohm})$ and $H'(3; \text{ohm})$, and the individual dose equivalents $H_p(0.07)$ and $H_p(3)$.

GB/T 12164 "beta Reference Radiation" is applied to beta reference radiation used for calibrating dosimeters and dose rate meters and determining their energy responses.

With the development of domestic nuclear energy, nuclear medicine and radiotherapy, nuclear technology applications, environmental protection and national defense, fields involving radioactivity have become increasingly important.

With the increasing number of applications and users, the use of dosimeters and dose rate meters is increasing significantly, leading to a growing demand for metrological calibration.

The use of beta-reference radiation for calibrating dosimeters and dose rate meters and determining their energy responses has increased significantly in China in recent years.

---Part 1: Generation Methods. The purpose is to standardize the methods for generating reference radiation for calibrating protection level beta dosimeters.

---Part 2: Calibration Basis Related to Fundamental Quantities Characterizing Radiation Fields. The aim is to provide a basis for establishing primary metrological standards for

beta-particles.

The laboratory provides technical guidance.

---Part 3: Calibration of site and personal dosimeters and determination of their energy and angular responses. The aim is to provide a basis for the use of beta-reference dosimeters.

This provides guidance for personnel calibrating radiation protection level dosimeters and dose rate meters and determining their energy and angular responses.

GB/T 12164 (all parts) systematically defines and specifies the relevant technical requirements for beta reference radiation, effectively standardizing this type of radiation.

The performance of metrology equipment effectively improves the accuracy and reliability of dosimeter and dose rate meter calibration results, thereby reducing the cost of dosimeter and dose rate meter calibration.

Technical risks and costs for manufacturers and users.

beta reference radiation Part 1: Generation Method

1 Scope

This document specifies the requirements for the beta reference radiation field generated using a radioactive source. This reference radiation is used to calibrate measurements of $H_p(0.07)$.

Personal and site dosimeters of $H'(0.07; \text{ohm})$, $H_p(3)$, and $H'(3; \text{ohm})$, and their determination as functions of beta-particle energy and incident angle.

The response. The fundamental quantity for beta dosimetry is the absorbed dose rate in a tissue equivalent plate model. This document provides the parameters used to generate the beta reference radiation field.

Examples of the properties of radionuclides and suitable source structures are given, and the maximum residual energy of the beta particle and its application in the ICRU sphere are described.

Method for measuring dose equivalent rate at a depth of 0.07 mm. Maximum beta energy range. 0.22 MeV to 3.6 MeV; corresponding average beta energy.

The dose equivalent range is 0.07 MeV to 1.2 MeV, with a dose equivalence rate ranging from approximately $10 \mu\text{Sv}\cdot\text{h}^{-1}$ to at least $10 \text{ Sv}\cdot\text{h}^{-1}$. Furthermore, some radioactive...

The source dose equivalent rate varies with the incident angle. However, as noted in ICRU report 56[5], the ambient dose used for site monitoring...

The equivalent $H^*(10)$ and the personal dose equivalent $H_p(10)$ for personal monitoring are only applicable to strong penetrating radiation and are not suitable for any beta radiation.