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

GB/T 12162.1-2025

Replacing GB/T 12162.1-2000

**X and gamma reference radiation for calibrating dosimeters and dose rate meters
and for determining their response as a function of photon energy - Part 1:
Radiation characteristics and production methods
(English Translation)**

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References

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.

This document is Section 1 of GB/T 12162 "X and gamma reference radiation for calibrating dosimeters and dose rate meters and determining their energy response".

GB/T 12162 has been published in four parts.

---Part 1: Radiation Characteristics and Generation Methods;

---Part 2: Dosimetry for Radiation Protection in the Energy Ranges of 8keV to 1.3MeV and 4MeV to 9MeV;

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

---Part 4: Calibration of site and personal dosimeters in low-energy X-ray reference radiation fields.

This document replaces GB/T 12162.1-2000 "X and gamma reference radiation for calibrating dosimeters and dose rate meters and determining their energy response".

"Radiation Part 1: Radiation Characteristics and Generation Methods", compared with GB/T 12162.1-2000, mainly differs in structure and editorial changes.

The technological changes are as follows.

- a) The concepts of a matched reference radiation field and a characteristic reference radiation field were added (see 4.1.1);
- b) Verification of the matched reference radiation field has been added (see 4.5);
- c) Parameters such as high pressure, filter purity, and thickness tolerance limits from nominal values have been added, and these limits are consistent with the volume used.

Model is limited (see Tables 7 and 8);

- d) The upper limit of the X-ray reference radiation of the filtered beam was changed from 300 kV to 400 kV (see Tables 3-6, 2000 edition).

Tables 3-7);

- e) R-Ni and R-Ti in ²⁴¹Am, fluorescence radiation, and high-energy gamma radiation have been removed (see Chapter 5, 6.2.1, and 2000 edition).

7.2.3).

This document is equivalent to ISO 4037-1:2019 Radiation protection for the calibration of dosimeters and dose rate meters and for the determination of their energy response.

And gamma reference radiation, Part 1: Radiation characteristics and generation methods.

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

---The standard title has been changed to "X and gamma Reference Radiation for Calibration of Dosimeters and Dose Rate Meters and Determination of Their Energy Response, Part 1" Part 1: Radiation Characteristics and Generation Methods.

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

Establishing X-ray and gamma-ray reference radiation is a prerequisite for calibrating dosimeters and dose rate meters and determining their energy responses; therefore, it is necessary to specify the corresponding radiation.

Field and measurement methods.

GB/T 12162 "X and gamma reference radiation for calibrating dosimeters and dose rate

meters and determining their energy response" is applicable to...

For calibrating dosimeters and dose rate meters and determining their energy response using X and gamma reference radiation, with the development of domestic nuclear energy, nuclear medicine and radiotherapy, the development of nuclear technology applications, environmental protection, and national defense has led to a continuous increase in the number of locations and applications involving radioactivity, and the demand for dosimeters and dose rates has also grown.

The use of instruments is increasing significantly, and the accompanying demand for metrological calibration is also growing. Therefore, calibration of dosimeters and dose rate meters and determination of their energy are crucial.

The response to X and gamma reference radiation has increased significantly in China in recent years.

GB/T 12162 "X and gamma reference radiation for calibrating dosimeters and dose rate meters and determining their energy response" is proposed to consist of 4 parts.

constitute.

---Part 1: Radiation Characteristics and Generation Methods. The purpose is to define the radiation characteristics and generation methods of three sets of six series of reference radiation.

Methods include continuous filtering of X-ray radiation in the energy range of approximately 8 keV to 330 keV, and filtering of X-ray radiation in the energy range of 600 keV to 1.3 MeV.

Gamma radiation emitted by radionuclides in the energy range, and photon radiation generated by accelerators in the energy range of 4 MeV to 9 MeV.

Radiation; according to the usage method of the conversion coefficient from air kerma to operational practical quantity, the "matching reference radiation" and "table radiation" are specified respectively.

"Reference radiation" guides the establishment of a reference radiation field for calibrating dosimeters and dose rate meters and determining their energy responses.

---Part 2: Dosimetry for Radiation Protection in the energy ranges of 8 keV to 1.3 MeV and 4 MeV to 9 MeV. Purpose the document specifies the methods and procedures for determining reference radiation dosimetry values of 8keV~1.3MeV and 4MeV~9MeV, providing guidance for their application.

Air kerma in the approximate energy ranges of 8keV to 1.3MeV and 4MeV to 9MeV, and above 1μGy/h.

Determination of reference radiation standard values.

---Part 3: Calibration of site dosimeters and personal dosimeters and determination of their

energy and angular responses. The purpose is to specify...

Methods and requirements for personal and regional dosimeter calibration, as well as conversion coefficients from air kerma to operational quantities, to guide the use of...

Calibration of dosimeters and personal dosimeters for personal and location monitoring in radiation protection.

---Part 4: Calibration of site and personal dosimeters in low-energy X-ray reference radiation fields, with the aim of specifying the calibration of dosimeters below 30 keV.

Special requirements for the calibration of personal and regional dosimeters in low-energy X-ray reference radiation fields, providing guidance for the calibration of site dosimeters (rate meters) and personal dosimeters.

Calibration of the rate meter in low-energy photon reference radiation and determination of its energy response and angular response.

GB/T 12162 (all parts) systematically defines and specifies the technical requirements for X-ray and gamma 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.

The technical risks and costs for manufacturers.

Used for calibrating dosimeters and dose rate meters and determining its energy response X and gamma reference radiation Part 1: Radiation Characteristics and Generation Methods

1 Scope

This document describes the radiation characteristics of X and gamma reference radiation used to calibrate protective level dosimeters and dose rate meters according to operational usage.

and the method of generation.

This document applies to reference radiation fields with an air kerma rate of not less than 1 $\mu\text{Gy}\cdot\text{h}^{-1}$.

This document does not apply to air kerma rates below this lower limit where special consideration is required for (natural) background radiation.

The radiometric properties specified in Chapters 4 through 6 provide ample publicly available information to define matching or characterize reference fields, enabling the determination of radiometric properties relative to phantom phases.