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Radiological protection — Characteristics of reference pulsed radiation —

Part 1: Photon radiation

Radioprotection — Caractéristiques des rayonnements pulsés de référence —

Partie 1: Rayonnements photoniques

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Contents

Page

Foreword

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This document was prepared by Technical Committee ISO/TC 85, *Nuclear energy, nuclear technologies, and radiological protection*, Subcommittee SC 2, *Radiological protection*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 430, *Nuclear energy, nuclear technologies, and radiological protection*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This first edition cancels and replaces the first edition of ISO/TS 18090-1:2015, which has been technically revised.

The main changes are as follows:

— clarification of the scope, which covers only the single pulse;

— introduction of examples of other suitable instruments in 4.4.2.

A list of all parts in the ISO 18090 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The specification and determination of the special characteristics required for electronic radiation protection dosemeters to be used in pulsed fields of ionizing radiation have been laid down in International Standards, for example IEC/TS 62743 and IEC/TS 63050. A prerequisite for IEC/TS 63050 is the availability of the required reference fields for pulsed radiation. This document provides the necessary information for such reference fields.

The concept is based on the existing standards for radiation qualities defined in ISO and IEC standards. It only adds the parameters of the pulsed field and gives some guidance for their determination. Therefore, no new radiation qualities are defined, only the link between the parameters for pulsed radiation and the parameters for continuous radiation are given. The main required parameters for pulsed radiation fields are the following[2]:

— radiation pulse duration, t_{pulse};

— radiation pulse air kerma rate, $\dot{K}_{\mathrm{a,pulse}}$;

— air kerma per radiation pulse, $K_{\mathrm{a,pulse}}$;

— for repeated pulses, their pulse repetition frequency, f_{pulse}.

The pulse parameters were determined by using an equivalent trapezoidal radiation pulse, which is equivalent with respect to air kerma and air kerma rate. Reference pulsed radiation is characterized by specified maximum deviations of the given pulse from the equivalent trapezoidal radiation pulse and by requirements concerning the change of radiation quality during the given radiation pulse.

The pulse parameters with respect to the phantom related quantities were determined using conversion coefficients according to ISO 4037 (all parts).

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1 Scope

This document is directly applicable to pulsed X-radiation with pulse duration of 0,1 ms up to 10 s. This range covers the whole range used in medical diagnostics at the time of publication. Some specifications can also be applicable for much shorter pulses; one example is the air kerma of one pulse. Such a pulse can be produced, e.g. by X-ray flash units or high-intensity femtosecond-lasers. Other specifications are not applicable for much shorter pulses; one example is the time-dependent behaviour of the air kerma rate. This cannot be measurable for technical reasons as no suitable instrument is available, e.g. for pulses produced by a femtosecond-laser.

This document specifies the characteristics of reference pulsed radiation for calibrating and testing radiation protection dosemeters and dose rate meters with respect to their response to pulsed radiation. At this point, it is only concerned with the characteristics of single pulses. Single pulses are the most difficult for dosemeters to measure. Determining the dose for repeated pulses is easier, but still more difficult than for continuous radiation, i.e. the performance of the dosemeters when measuring repeated pulses lies between these extremes. The radiation characteristics includes the following:

a) time-dependent behaviour of the air kerma rate of the pulse;

b) time-dependent behaviour of the X-ray tube high voltage during the pulse;

c) uniformity of the air kerma rate within a cross-sectional area of the radiation beam;

d) air kerma of one radiation pulse;

e) air kerma rate of the radiation pulse;

f) repetition frequency.

This document does not define new radiation qualities but uses those radiation qualities specified in existing ISO and IEC standards. Instead, this document gives the link between the parameters for pulsed radiation and the parameters for continuous radiation specifying the radiation qualities. It does not specify specific values or series of values for the pulsed radiation field but specifies only those limits for the relevant pulsed radiation parameters that are required for calibrating dosemeters and dose rate meters and for determining their response depending on the said parameters.

The pulse parameters with respect to the phantom-related quantities were determined using conversion coefficients according to ISO 4037 (all parts). This is possible as the radiation qualities specified in existing ISO and IEC standards are used.

A given reference pulsed X-ray facility is characterized by the parameter ranges over which the full specifications and requirements according to this document are met. Therefore, not all reference pulsed X-ray facilities can produce pulses covering the same parameter ranges.