

English Version

**Radiological protection - Characteristics of reference
pulsed radiation - Part 1: Photon radiation (ISO/TS 18090-
1:2015)**

Radioprotection - Caractéristiques des champs de
rayonnement pulsés de référence - Partie 1: Radiation
de photons (ISO/TS 18090-1:2015)

Strahlenschutz - Eigenschaften gepulster
Referenzstrahlung - Teil 1: Photonenstrahlung (ISO/TS
18090-1:2015)

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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European foreword

The text of ISO/TS 18090-1:2015 has been prepared by Technical Committee ISO/TC 85 "Nuclear energy, nuclear technologies, and radiological protection" of the International Organization for Standardization (ISO) and has been taken over as CEN ISO/TS 18090-1:2019 by Technical Committee CEN/TC 430 "Nuclear energy, nuclear technologies, and radiological protection" the secretariat of which is held by AFNOR.

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Endorsement notice

The text of ISO/TS 18090-1:2015 has been approved by CEN as CEN ISO/TS 18090-1:2019 without any modification.

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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The committee responsible for this document is ISO/TC 85, *Nuclear energy, nuclear technologies, and radiological protection*, Subcommittee SC 2, *Radiological protection*.

ISO/TS 18090 consists of the following parts, under the general title *Radiological protection — Characteristics of reference pulsed radiation*:

— *Part 1: Photon radiation*

Introduction

The specification and determination of the special characteristics required for radiation protection dosimeters to be used in pulsed fields of ionizing radiation have been excluded from all International Standards for personal and environmental dosimeters issued so far. Due to the increased use of pulsed radiation in medicine and industry, such International Standards are currently under development. A prerequisite for such International Standards is the availability of the required reference fields for pulsed radiation. This Technical Specification 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:

- radiation pulse duration, t_{pulse} ;
- radiation pulse air kerma rate, $\dot{K}_{\text{a,pulse}}$;
- air kerma per radiation pulse, $K_{\text{a,pulse}}$;
- for repeated pulses, their 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).

This publication contains information for which worldwide experience is not available at the date of its development. Therefore, it was decided to publish it as a Technical Specification. It is expected that within the following years, experience will be gained and the maintenance of this Technical Specification could lead to an International Standard.

Radiological protection — Characteristics of reference pulsed radiation —

Part 1: Photon radiation

1 Scope

This part of ISO/TS 18090 is directly applicable to pulsed X-radiation with pulse duration of 0,1 ms up to 10 s. This covers the whole range used in medical diagnostics at the time of publication. Some specifications may also be applicable for much shorter pulses; one example is the air kerma of one pulse. Such a pulse may 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 may not be measurable for technical reasons as no suitable instrument is available, e.g. for pulses produced by a femtosecond-laser.

This part of ISO/TS 18090 specifies the characteristics of reference pulsed radiation for calibrating and testing radiation protection dosimeters and dose rate meters with respect to their response to pulsed radiation. 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 part of ISO/TS 18090 does not define new radiation qualities. Instead, it uses those radiation qualities specified in existing ISO and IEC standards. This part of ISO/TS 18090 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 dosimeters 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 part of ISO/TS 18090 are met. Therefore, not all reference pulsed X-ray facilities can produce pulses covering the same parameter ranges.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 4037-1:1996, *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*

ISO 4037-2:1997, *X and gamma reference radiation for calibrating dosimeters and dose rate meters and for determining their response as a function of photon energy — Part 2: Dosimetry for radiation protection over the energy ranges from 8 keV to 1,3 MeV and 4 MeV to 9 MeV*

IEC 60050-395:2014, *International Electrotechnical Vocabulary — Part 395: Nuclear instrumentation: Physical phenomena, basic concepts, instruments, systems, equipment and detectors*

IEC 61267:2005, *Medical diagnostic X-ray equipment — Radiation conditions for use in the determination of characteristics*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-395:2014 and the following apply.

3.1 air kerma per radiation pulse

$K_{a, \text{pulse}}$

air kerma value of one radiation pulse at a point in the photon radiation field

3.2 continuous radiation

<in area and individual dosimetry> ionizing radiation with a constant dose rate at a given point in space for time intervals longer than 10 s

3.3 dose equivalent per radiation pulse

H_{pulse}

dose equivalent value of one radiation pulse at a point in the photon radiation field

3.4 equivalent trapezoidal radiation pulse

trapezoidal radiation pulse that is considered to be equivalent to the given radiation pulse

3.5 field uniformity

F_{uni}

uniformity of the air kerma distribution determined across a defined area

$$F_{\text{uni}} = 1 - \frac{K_{a, \text{pulse, max}} - K_{a, \text{pulse, min}}}{0,5 \times (K_{a, \text{pulse, max}} + K_{a, \text{pulse, min}})}$$

where

$K_{a, \text{pulse, max}}$ is the maximum air kerma value attributed to one radiation pulse occurring across the defined area;

$K_{a, \text{pulse, min}}$ is the minimum air kerma value attributed to one radiation pulse occurring across the defined area.

Note 1 to entry: The defined area can be the whole beam diameter or only parts of it, e.g. those covered by the dosimeter under test.

Note 2 to entry: Full field uniformity is equivalent to $F_{\text{uni}} = 1$. No field uniformity, that is a variation of $K_{a, \text{pulse}}$ between 0 and $K_{a, \text{pulse, max}}$, is equivalent to $F_{\text{uni}} = 0$.