ICS 13.280 SLOVENSKÁ TECHNICKÁ NORMA August 2021

STN	**Klinické dozimetre Dozimetre s pevnými termoluminiscenčnými detektormi žiarenia fotónov a elektrónov v rádioterapii (ISO 28057: 2019)**	**STN EN ISO 28057 40 3913**

Clinical dosimetry - Dosimetry with solid thermoluminescence detectors for photon and electron radiations in radiotherapy (ISO 28057:2019)

Táto norma obsahuje anglickú verziu európskej normy.
This standard includes the English version of the European Standard.

Táto norma bola oznámená vo Vestníku ÚNMS SR č. 07/21

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EN ISO 28057

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ICS 13.280

Supersedes EN ISO 28057:2018

English Version

Clinical dosimetry - Dosimetry with solid thermoluminescence detectors for photon and electron radiations in radiotherapy (ISO 28057:2019)

Dosimétrie clinique - Dosimétrie avec détecteurs thermoluminescents solides pour les rayonnements de photons et d'électrons en radiothérapie (ISO 28057:2019)

Dosimetrie mit Festkörper - Thermolumineszenzdetektoren für Photonen- und Elektronenstrahlung in der Strahlentherapie (ISO 28057:2019)

This European Standard was approved by CEN on 18 January 2021.

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European foreword

The text of ISO 28057:2019 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 EN ISO 28057:2021 by Technical Committee CEN/TC 430 "Nuclear energy, nuclear technologies, and radiological protection" the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by August 2021, and conflicting national standards shall be withdrawn at the latest by August 2021.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

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Endorsement notice

The text of ISO 28057:2019 has been approved by CEN as EN ISO 28057:2021 without any modification.

INTERNATIONAL STANDARD

ISO 28057

Second edition
2019-07

Clinical dosimetry — Dosimetry with solid thermoluminescence detectors for photon and electron radiations in radiotherapy

Dosimétrie clinique — Dosimétrie avec détecteurs thermoluminescents solides pour les rayonnements de photons et d'électrons en radiothérapie

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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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For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 85, *Nuclear energy, nuclear technologies, and radiological protection*, Subcommittee SC 2, *Radiological protection*.

This second edition cancels and replaces the first edition (ISO 28057:2014), which has been technically revised.

— The clause on terms and definitions and the clause on rules for TLD measurement procedures, including quality assurance measurements at clinical accelerators, have been complemented and sharpened to ensure the safe application of TL dosimetry in the radiation therapy of cancer.

— Batch dependent changes of the k_Q values have been correlated with the simultaneously occurring mass density variations of TL discs (see 4.4.5.5).

— The response of TL materials to the neutrons, occurring within and around photon beams in megavoltage radiotherapy due to the photonuclear effect and eventually generating considerable components of the indicated values, has been dealt with in more detail (see 4.4.5.5).

— It is high-lighted that the k_E values of clinical electron beams are energy independent (see 4.4.5.5).

— Recent experimental results concerning the contribution of “intrinsic effects” to the response of TL detectors have been considered (see 4.4.5.5).

— The French title and the numbering of some subclauses of 5.4 have been corrected; Table 9 has been equipped with a heading.

Introduction

The thermoluminescence dosimetry (TLD) with lithium fluoride (LiF) detectors has several advantages, in particular:

— small volumes of the detectors;

— applicability to continuous and pulsed radiation;

— fair water equivalency of the detector material;

— few correction factors needed for absorbed dose determinations.

The main disadvantage of thermoluminescence (TL) detectors is that, prior to each dosimetry application, they have to be regenerated by a pre-irradiation annealing procedure. Unfortunately, it is not possible to restore the former response of the detectors perfectly by this annealing. Provided, however, that all detectors of a production batch always undergo the same thermal treatment, one can at least determine the mean alteration of the response of these detectors, with sufficiently small fluctuations of the individually indicated values. From this mean alteration, a correction factor can be derived.

The essential aim of this document is to specify the procedures and to carry out corrections which allow one to achieve

a) a repeatability of the indicated value within a fraction of a percent[17] and thus;

b) a total uncertainty of measurement (including the calibration steps tracing to the primary standards) of a few percent, as in ionization chamber dosimetry[18][31][25][61][62].

The specifications in this document comprise special terms used in TLD, rules for the measurement technique, and requirements for the measurement system. The defined requirements and the testing techniques can, in whole or in part, serve as a basis for stability checks and acceptance tests. The TLD procedures described in this document can be used for photon radiation within the energy range from 20 keV to 50 MeV, including photon brachytherapy, and for electron radiation within the energy range from 4 MeV to 25 MeV, excluding beta radiation brachytherapy. In order to achieve the repeatability and total uncertainty stated above, this document is applicable in the dose range above 1 mGy. The upper limit of the minimum measuring range is in the order of magnitude of 10 Gy to 100 Gy. In clinical dosimetry, TL detectors are applied taking into account the requirements of high spatial resolution, i.e. in the study of the dose distributions with high gradients occurring in small stereotactic radiation fields and around brachytherapy sources. The other common application is the measurement of dose distributions in large absorbers, e.g. geometrical or tissue equivalent phantoms, either within the radiation field or in its periphery. A further usage is the quality assurance of clinical dosimetry by postal dose intercomparison[1][2][10][12][20][22][26][27][55].

The role of this document is not to anticipate national or international codes of practice in clinical dosimetry, neither for external beam therapy, brachytherapy, whole-body irradiation, mammography, nor dose measurements outside the treatment field or radiation protection of the staff. The authors of this document are well aware of the wide spectrum of the methods of clinical dosimetry, in which TL dosimetry is merely occupying a small sector. But within this framework, this document provides reliable concepts and rules for good practice for the application of TLD methods. The items covered include the terms and definitions, the rules for TLD measurement procedures, and the requirements on the TLD system; this document addresses medical physicists as well as instrument producers. Notably, the numerical examples given are valid for the TL detector materials and products stated in the publications referred to, and tests may be necessary to check whether they apply to TLD materials of other producers. The practical examples given, e.g. for the TL probe calibration conditions and for the numerical values of correction factor, k_Q, accounting for the dependence of the detector response on radiation quality, Q, are not conceived to be pre-emptive in relation to more general standards of the methods of clinical dosimetry or dose intercomparisons. Rather, this document provides access to the reliable application of TLD methods based upon the published results of worldwide development.

The long-standing experience in the clinical usage of TLD, expressed in a set of valuable textbooks, protocols, and recommendations[6][13][25][28][29][42][43][61][62][54], has been accounted for.

INTERNATIONAL STANDARD **ISO 28057:2019(E)**

Clinical dosimetry — Dosimetry with solid thermoluminescence detectors for photon and electron radiations in radiotherapy

1 Scope

This document describes rules for the procedures, applications, and systems of thermoluminescence dosimetry (TLD) for dose measurements according to the probe method. It is particularly applicable to solid "TL detectors", i.e. rods, chips, and microcubes, made from LiF:Mg, Ti or LiF:Mg, Cu, P in crystalline or polycrystalline form. It is not applicable to LiF powders because their use requires special procedures. The probe method encompasses the arrangement, particularly in a water phantom or in a tissue-equivalent phantom, of single TL detectors or of "TL probes", i.e. sets of TL detectors arranged in thin-walled polymethyl methacrylate (PMMA) casings.

The purpose of these rules is to guarantee the reliability and the accuracy indispensable in clinical dosimetry when applied on or in the patient or phantom. This document applies to dosimetry in teletherapy with both photon radiation from 20 keV to 50 MeV and electron radiation from 4 MeV to 25 MeV, as well as in brachytherapy with photon-emitting radionuclides. These applications are complementary to the use of ionization chambers.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60601-1, *Electromedical equipment — Part 1: General instructions pertaining to safety*

IEC 61000-4-2, *Electromagnetic compatibility (EMV) — Part 4-2: Test and measurement procedure — Test of immunity against static electric discharges*

IEC 61000-4-3, *Electromagnetic compatibility (EMC) — Part 4-3: Testing and measurement techniques — Radiated, radio-frequency, electromagnetic field immunity test*

IEC 61000-4-4, *Electromagnetic compatibility (EMC) — Part 4-4: Testing and measurement techniques — Electrical fast transient/burst immunity test*

IEC 61000-4-5, *Electromagnetic compatibility (EMC) — Part 4-5: Testing and measurement techniques — Surge immunity test*

IEC 61000-4-6, *Electromagnetic compatibility (EMC) — Part 4-6: Testing and measurement techniques — Immunity to conducted disturbances, induced by radio-frequency fields*

IEC 61000-4-8, *Electromagnetic compatibility (EMC) — Part 4-8: Testing and measurement techniques — Power frequency magnetic field immunity test*

IEC 61000-4-11, *Electromagnetic compatibility (EMC) — Part 4-11: Testing and measurement techniques — Voltage dips, short interruptions and voltage variations immunity tests*

IEC 61187, *Electrical and electronic measuring equipment — Documentation*

