
**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*

iTech Standards
(<https://standards.iteh.ai>)
Document Preview

ISO 28057:2019

<https://standards.iteh.ai/catalog/standards/iso/89e9882e-8a4b-45a4-8fff-9709e1b8d1c3/iso-28057-2019>



iTeh Standards
(<https://standards.iteh.ai>)
Document Preview

ISO 28057:2019

<https://standards.iteh.ai/catalog/standards/iso/89e9882e-8a4b-45a4-8fff-9709e1b8d1c3/iso-28057-2019>



COPYRIGHT PROTECTED DOCUMENT

© ISO 2019

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword	v
Introduction	vi
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Rules for the TLD measurement procedure	9
4.1 Principle of measurement	9
4.2 Measured quantity	9
4.3 Measurement cycle	10
4.3.1 General requirements	10
4.3.2 Sequence of measurement cycles	10
4.3.3 Common passing of the measurement cycles	10
4.3.4 Handling of TL detectors	10
4.3.5 Pre-irradiation annealing	11
4.3.6 Irradiation	11
4.3.7 Post-irradiation annealing	11
4.3.8 Reading	11
4.4 Measurement of the absorbed dose to water	12
4.4.1 Basic formula for the determination of the absorbed dose to water	12
4.4.2 Determination of the background value, M_0	12
4.4.3 Determination of the indicated value, M_i	13
4.4.4 Determination of the individual calibration coefficients, N_i	13
4.4.5 Determination of the correction factors, k_v	15
4.5 Uncertainty of measurement of the absorbed dose	22
4.6 Reusability	23
4.7 Stability check	23
4.8 Staff	23
5 Requirements for the TLD system	23
5.1 General information	23
5.1.1 Classification of the requirements	23
5.1.2 Requirements for operation characteristics	24
5.2 Completeness of the TLD system	24
5.2.1 Technical components	24
5.2.2 Hardware and software components	24
5.2.3 Operating instructions	24
5.2.4 Access to a calibration irradiation device	26
5.3 Requirements for TL detectors	26
5.3.1 Characteristics of TL materials	26
5.3.2 Tailoring of TL materials	26
5.3.3 Reusability of TL detectors	27
5.3.4 Individual variation	27
5.4 Requirements for TL-indicating instruments	28
5.4.1 General remarks	28
5.4.2 Mechanical setup	28
5.4.3 Warm-up time	28
5.4.4 Indication and indication range	28
5.4.5 Background value	28
5.4.6 Overflow indication and effects during evaluation of high doses	28
5.4.7 Test light source	29
5.4.8 Changes in the response	29
5.4.9 Mechanical construction	29
5.4.10 Light shielding	29

5.4.11	Climatic influences	29
5.4.12	Electrical requirements	29
5.4.13	Operational safety and detection of function failure	30
5.4.14	Data output and data backup	32
5.5	Requirements for auxiliary instruments (pre-irradiation annealing device)	32
5.5.1	Pre-irradiation annealing	32
5.5.2	Construction	32
5.5.3	Electrical requirements	32
5.5.4	Operation safety	32
5.5.5	Detection of function failure	33
5.5.6	Indication of the operating state	33
5.6	Requirements for the entire TLD system	33
5.6.1	Minimum measuring ranges	33
5.6.2	Minimum rated ranges of use	33
5.6.3	Ranges of test parameters	34
5.7	Requirements for the calibration irradiation device	35
5.8	Requirements for the accompanying papers	35
5.9	Acceptance tests	35
5.9.1	General requirements	35
5.9.2	Number of TL detectors used	36
5.9.3	Type of TL detectors used	36
Bibliography		37

iTeh Standards
(<https://standards.iteh.ai>)
Document Preview

[ISO 28057:2019](https://standards.iteh.ai/catalog/standards/iso/89e9882e-8a4b-45a4-8fff-9709e1b8d1c3/iso-28057-2019)

<https://standards.iteh.ai/catalog/standards/iso/89e9882e-8a4b-45a4-8fff-9709e1b8d1c3/iso-28057-2019>

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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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.

iTeh Standards
(<https://standards.iteh.ai>)
Document Preview

ISO 28057:2019

<https://standards.iteh.ai/catalog/standards/iso/89e9882e-8a4b-45a4-8fff-9709e1b8d1c3/iso-28057-2019>