PD IEC TS 63050:2019



BSI Standards Publication

Radiation protection instrumentation – Dosemeters for pulsed fields of ionizing radiation



National foreword

This Published Document is the UK implementation of IEC TS 63050:2019.

The UK participation in its preparation was entrusted to Technical Committee NCE/2, Radiation protection and measurement.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

© The British Standards Institution 2019 Published by BSI Standards Limited 2019

ISBN 978 0 580 97381 9

ICS 13.280

Compliance with a British Standard cannot confer immunity from legal obligations.

This Published Document was published under the authority of the Standards Policy and Strategy Committee on 30 November 2019.

Amendments/corrigenda issued since publication

Date 7

Text affected



IEC TS 63050

Edition 1.0 2019-10

TECHNICAL SPECIFICATION



Radiation protection instrumentation – Dosemeters for pulsed fields of ionizing radiation

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ICS 13.280

ISBN 978-2-8322-7421-7

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FO	REWO	RD	4	
INT	RODU	CTION	6	
1	Scop	e	8	
2	Norm	ative references	9	
3	Term	s and definitions, abbreviated terms and symbols, quantities and units	9	
	3.1	Terms and definitions	9	
:	3.2	Abbreviated terms and symbols	.11	
;	3.3	Quantities and units	. 12	
4	Gene	eral test procedure	. 12	
4	4.1	Nature of test	. 12	
	4.2	Reference conditions and standard test conditions	.12	
5	Gene	eral requirements	.13	
;	5.1	Summary of requirements	.13	
ł	5.2	Parameters required to be known of the pulsed radiation field	.13	
;	5.3	Parameters required to be determined of the dosemeter	.13	
;	5.4	Criteria for suitability of a dosemeter in pulsed radiation fields	.13	
	5.4.1	General	. 13	
	5.4.2	Requirements	. 14	
	5.4.3	Method of test and interpretation of the results	.14	
4	5.5	Mechanical characteristics	. 14	
	5.6	Requirements for the documentation	. 14	
6	Radia	ation detection requirements	.14	
	6.1	General	. 14	
	6.2	Maximum measurable dose rate value, $\dot{H}_{\rm meas,max}$.14	
	6.2.1	Requirements	. 14	
	6.2.2	Method of test	. 15	
	6.2.3	Interpretation of the results	.16	
	6.3	Pulse dose rate overload alarm	. 17	
	6.3.1	General	. 17	
	6.3.2	Requirements	. 17	
	6.3.3	Method of test	. 17	
	6.3.4	Interpretation of the results	. 17	
	6.4	Overload and pulse dose rate overload alarm	. 17	
	6.4.1	Requirements	. 17	
	6.4.2	Method of test	. 17	
	6.4.3	Interpretation of the results	.18	
7	Envir	onmental requirements	. 18	
8	Mech	anical requirements	. 18	
9	Elect	romagnetic requirements	. 18	
10	Docu	mentation	. 19	
	10.1	Operation and maintenance manual	.19	
	10.2	Type test report	. 19	
Anr	nex A (informative) Parameter values for typical workplaces where pulsed radiation	a .	
000	urs	· · · · · · · · · · · · · · · · · · ·	.21	
Annex B (informative) Typical examples of test results for 6.2.2.1 and 6.2.2.2				

IEC TS 63050:2019 © IEC 2019 - 3 -	
Bibliography	23
Figure B.1 – Typical test results for an electronic personal dosemeter using radiation pulses with constant dose rate and various pulse durations, i.e. varying dose equivalents per radiation pulse	22
Figure B.2 – Typical test results for three personal dosemeters using radiation pulses with constant dose of 1 mSv and various pulse durations, i.e. various pulse dose equivalent rates	22
Table 1 – Abbreviated terms and symbols	12
Table 2 – Reference conditions and standard test conditions for tests using pulsed radiation	19
Table 3 – Characteristics of dosemeters used in pulsed fields of ionizing radiation	20
Table A.1 – Parameter values for workplaces where pulsed radiation occurs	21

INTERNATIONAL ELECTROTECHNICAL COMMISSION

RADIATION PROTECTION INSTRUMENTATION – DOSEMETERS FOR PULSED FIELDS OF IONIZING RADIATION

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

The main task of IEC technical committees is to prepare International Standards. In exceptional circumstances, a technical committee may propose the publication of a Technical Specification when

- the required support cannot be obtained for the publication of an International Standard, despite repeated efforts, or
- the subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard.

Technical Specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC 63050, which is a technical specification, has been prepared by subcommittee 45B: Radiation protection instrumentation, of IEC technical committee 45: Nuclear instrumentation.

IEC TS 63050:2019 © IEC 2019 - 5 -

The text of this Technical Specification is based on the following documents:

Draft TS	Report on voting
45B/903/DTS	45B/925A/RVDTS

Full information on the voting for the approval of this Technical Specification can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

The specification and determination of the special characteristics required for dosemeters to be used in pulsed fields of ionizing radiation have been excluded from all standards for direct reading personal and environmental dosemeters issued before 2015 for radiation protection purposes. These standards only specify characteristics for continuous radiation. This Technical Specification provides the necessary information for the measurement of one single radiation pulse, which is the most difficult situation to be measured. The characteristics of a dosemeter for repeated pulses is expected to be better than for one single radiation pulse with the same parameters but worse than for continuous radiation, i.e., in between of the characteristics for these two extreme conditions.

The concept is similar to the concept used for other influence quantities, e.g., radiation energy. The workplace is characterized by the parameter range occurring at that workplace, i.e., in the case of energy the expected possible values of radiation energy. It can then be determined if the dosemeter under consideration can be used. The required parameters for a workplace where pulsed radiation occurs are:

- the maximum dose rate during the radiation pulse, H_{pulse,max}, occurring at the workplace,
- the maximum dose per radiation pulse, $H_{pulse,max}$, occurring at the workplace,
- the minimum radiation pulse duration, t_{pulse.min}, occurring at the workplace, and
- the range of the pulse repetition frequency, f_{pulse} , occurring at the workplace.

The instrument parameters to be determined during type test of the dosemeter are:

- the maximum measurable dose rate in the pulse, $H_{\text{meas max}}$,
- the maximum measurable dose in the pulse, $H_{\text{meas.max}}$,
- the minimal pulse duration, $t_{meas,min}$, and
- the range for the pulse repetition frequency, $f_{\text{meas.min}}$ to $f_{\text{meas.max}}$.

NOTE These parameters may be inter-related depending on the detector used.

In principle, the parameters resulting from the type test could be determined using continuous radiation fields if the detector is connected to simple, linear and straight forward electronics. But nearly any dosemeter exhibits one or more of the following properties. It:

- has a finite dead time,
- uses internal range switching,
- uses software to correct for known deficiencies, e.g., the dead time or the radiation energy,
- uses special, proprietary algorithms,
- adjusts the measurement cycle time, T_{cycle} , to the dose rate, G_{dose} , measured by the dosemeter,
- mitigates the effect of EMC-pulses and mechanical drops.

All these properties could affect the results when determining the characteristics for pulsed radiation fields by using continuous radiation fields. The conclusion is that measurements using pulsed radiation fields are required for testing of dosemeters.

As a help to the user to judge whether or not the dosemeter under consideration can be used, Table A.1 in the informative Annex A gives some parameter values for typical workplaces where pulsed radiation occurs. They are based on the knowledge available in 2019 and may change with the next generation of pulsed radiation generating equipment. IEC TS 63050:2019 © IEC 2019

This Technical Specification is a generalized version of IEC TS 62743 and not limited to dosemeters using pulse counting techniques. This Technical Specification might replace IEC TS 62743 in the future. This Technical Specification contains much 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 next years this experience will be gained and then maintenance of this publication could lead to an International Standard.

RADIATION PROTECTION INSTRUMENTATION – DOSEMETERS FOR PULSED FIELDS OF IONIZING RADIATION

1 Scope

This document applies to all types of dosemeters, irrespective of the type of radiation intended to be measured. Tests according to this document determine whether a single radiation pulse can be measured correctly even if the dosemeter is in the internal state relevant for measuring background or environmental radiation. The characteristics of the dosemeter for repeated pulses is expected to be better than for one single radiation pulse with the same parameters but worse than for continuous radiation, i.e., in between of the characteristics for these two extreme conditions.

The pulsed radiation source is characterized by the parameters:

- the maximum dose rate during the radiation pulse, $H_{pulse,max}$, occurring at the workplace,
- the maximum dose per radiation pulse, $H_{pulse,max}$, occurring at the workplace,
- the minimum radiation pulse duration, $t_{pulse,min}$, occurring at the workplace, and
- the range of the pulse repetition frequency, f_{pulse} , occurring at the workplace.

Annex A gives some parameter values for typical workplaces where pulsed radiation occurs.

This document considers the pulsation of the radiation field as an additional influence quantity like particle energy and direction of radiation incidence. Therefore, the tests described are additional to all the tests in the instrument specific standards.

This document describes methods to determine the following characteristic parameters of the dosemeters:

- the maximum measurable dose rate in the pulse, $H_{\text{meas.max}}$,
- the maximum measurable dose in the pulse, $H_{\text{meas,max}}$,
- the minimal pulse duration, t_{meas,min}, and
- the range for the pulse repetition frequency, $f_{meas,min}$ to $f_{meas,max}$.

NOTE These parameters may be inter-related depending on the detector used.

It is applicable to photon radiation but basically can be adapted to all types of radiation for which a suitable pulsed reference field is available. The term dose is used in this document in the sense of dose equivalent, but the requirements can also be adapted to air kerma, exposure or other quantities expressing the amount of radiation.

The parameter pulse repetition frequency, f_{pulse} , is included in the testing procedures, but for this inclusion additional work has to be done. Especially, reference fields for radiation conditions in surrounding fields of accelerators are missing (high pulse repetition frequency, ultra-short pulses).