

# TECHNICAL REPORT



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## Radiation protection instrumentation – Determination of uncertainty in measurement

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**RADIATION PROTECTION INSTRUMENTATION –  
DETERMINATION OF UNCERTAINTY IN MEASUREMENT**

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IEC 62461, which is a technical report, has been prepared by subcommittee 45B: Radiation protection instrumentation, of IEC technical committee 45: Nuclear instrumentation.

This second edition of IEC TR 62461 cancels and replaces the first edition, published in 2006, and constitutes a technical revision. The main changes with respect to the previous edition are as follows:

- add to the analytical method for the determination of uncertainty the Monte Carlo method for the determination of uncertainty according to supplement 1 of the Guide to the Expression of uncertainty in measurement (GUM S1), and
- add a very simple method to judge whether a measured result is significantly different from zero or not based on ISO 11929.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
45B/783/DTR	45B/813/RVD

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

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

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

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- withdrawn,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

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

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## INTRODUCTION

The ISO/IEC Guide 98-3:2008, *Uncertainty of measurement – Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)* as well as its Supplement 1:2008, *Propagation of distributions using a Monte Carlo method (GUM S1)*, are general guides to assess the uncertainty in measurement. This Technical Report lays emphasis on their application in the area of radiation protection and serves as a practical introduction to the GUM and its supplement 1 (GUM S1).

The process of determining the uncertainty delivers not only a numerical value of the uncertainty; in addition it produces the best estimate of the quantity to be measured which may differ from the indication of the instrument. Thus, it can also improve the result of the measurement by using information beyond the indicated value of the instrument, e.g. the energy dependence of the instrument.

## RADIATION PROTECTION INSTRUMENTATION – DETERMINATION OF UNCERTAINTY IN MEASUREMENT

### 1 Scope

This Technical Report gives guidelines for the application of the uncertainty analysis according to ISO/IEC Guide 98-3:2008 (GUM describing an analytical method for the uncertainty determination) and its Supplement 1:2008 (GUM S1 describing a Monte Carlo method for the uncertainty determination) for measurements covered by standards of IEC Subcommittee 45B. It does not include the uncertainty associated with the concept of the measuring quantity, e. g., the difference between  $H_p(10)$  on the ISO water slab phantom and on the person.

This Technical Report explains the principles of the ISO/IEC Guide 98-3:2008 (GUM), its Supplement 1:2008 (GUM S1) and the special considerations necessary for radiation protection at an example taken from individual dosimetry of external radiation. In the informative annexes, several examples are given for the application on instruments, for which SC 45B has developed standards.

This Technical Report is supposed to assist the understanding of the ISO/IEC Guide 98-3:2008 (GUM), its Supplement 1: 2008 (GUM S1), and other papers on uncertainty analysis. It cannot replace these papers nor can it provide the background and justification of the arguments leading to the concept of the ISO/IEC Guide 98-3:2008 (GUM) and its Supplement 1:2008 (GUM S1).

Finally, this Technical Report gives a very simple method to judge whether a measured result is significantly different from zero or not based on ISO 11929.

For better readability the correct terms are not always used throughout this technical report. For example, instead of “random variables of a quantity” only the “quantity” itself is stated.

### 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.

IEC 60050 (all parts): *International Electrotechnical Vocabulary* (available at <http://www.electropedia.org>)

ISO/IEC Guide 98-3:2008, *Uncertainty of measurement – Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

ISO/IEC Guide 98-3, Supplement 1:2008, *Uncertainty of measurement – Part 3: Guide to the expression of uncertainty in measurement (GUM:1995) – Propagation of distributions using a Monte Carlo method*