

# INTERNATIONAL STANDARD

# IEC 60405

Second edition  
2003-04

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## Nuclear instrumentation – Constructional requirements and classification of radiometric gauges

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Reference number  
IEC 60405:2003(E)

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Commission Electrotechnique Internationale  
International Electrotechnical Commission  
Международная Электротехническая Комиссия

PRICE CODE

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# INTERNATIONAL ELECTROTECHNICAL COMMISSION

## NUCLEAR INSTRUMENTATION – CONSTRUCTIONAL REQUIREMENTS AND CLASSIFICATION OF RADIOMETRIC GAUGES

### FOREWORD

- 1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the 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, the IEC publishes International Standards. 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. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 60405 has been prepared by IEC technical committee 45: Nuclear instrumentation.

This second edition cancels and replaces the first edition published in 1972. This edition constitutes a technical revision.

The text of this standard is based on the following documents:

FDIS	Report on voting
45/519/FDIS	45/525/RVD

Full information on the voting for the approval of this standard 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 2006. At this date, the publication will be

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- withdrawn;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

A bilingual edition of this standard may be issued at a later date.

## INTRODUCTION

This International Standard is based on ISO 7205 which was published in 1986. It includes excerpts of the requirements specified in ISO 7205 and modifies or supplements them with additional provisions, where required by current needs.

Compared to the first edition of IEC 60405 published in 1972, the following major alterations have been made:

- a) the original classification of gauges in accordance with the activity of the radioactive source has been replaced by a system-oriented and application-oriented classification in accordance with the alignment of the useful beam, the dose equivalent rate (radiation protection classes) and the permissible operating temperature (temperature classes);
- b) safety-relevant requirements and appropriate test methods on the basis of ISO 7205 have been introduced and worded more precisely;
- c) a gauge classification system has been introduced (in line with ISO 7205) with a view to reaching compatibility with international provisions.

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# NUCLEAR INSTRUMENTATION – CONSTRUCTIONAL REQUIREMENTS AND CLASSIFICATION OF RADIOMETRIC GAUGES

## 1 Scope and object

This standard applies to the manufacture and installation of electrical measuring systems and instruments utilizing radioactive sources (radiometric gauges, hereinafter called gauges).

It does not apply to portable gauges which, because of their construction and purposes for use, are intended to be operated as mobile equipment and it does not apply to gauges operated with X-ray tubes, but it can be analogously applicable to these gauges.

The purpose of this standard is to specify constructional requirements for the design of instruments and the radiation protection to be provided in the case of radiometric gauges. In this context, special attention is attached to the stability of the source housing in the event of fire.

## 2 Normative references

The following referenced documents are indispensable for the application 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 61010-1:2001, *Safety requirements for electrical equipment for measurement, control and laboratory use – Part 1: General requirements*

IEC 60476:1993, *Nuclear instrumentation – Electrical measuring systems and instruments utilizing ionizing radiation sources – General aspects*

IEC 60692:1999, *Nuclear instrumentation – Density gauges utilizing ionizing radiation – Definitions and test methods*

IEC 60982:1989, *Level measuring systems utilizing ionizing radiation with continuous or switching output*

IEC 61326:2002, *Electrical equipment for measurement, control and laboratory use – EMC requirements*

IEC 61336:1996, *Nuclear instrumentation – Thickness measurement systems utilizing ionizing radiation – Definitions and test methods*

ISO 361:1975, *Basic ionizing radiation symbol*

ISO 921:1997, *Nuclear energy – Vocabulary*

ISO 2919:1999, *Radiation protection – Sealed radioactive sources – General requirements and classification*

ISO 7205:1986, *Radionuclide gauges – Gauges designed for permanent installation*



### 3 Definitions

For the purposes of this document, the definitions as specified in ISO 921 and IEC 60476 and the following apply.

#### 3.1

##### **radiometric gauge**

control and measuring assembly consisting of at least one radioactive source, at least one detector and the mechanical devices required for non-destructive measurement of a process quantity

#### 3.2

##### **permanently installed radiometric gauge**

radiometric gauge that is permanently installed at the measuring location

NOTE The measuring location may also be situated on mobile equipment (e.g. on a ship or a vehicle). The detector housing and the source housing may be installed both rigidly fixed and movable. The mobility of the system is limited and determined by the purpose for which it was designed.

#### 3.3

##### **sealed source**

radioactive source that is sealed in a solid and inert capsule or is permanently incorporated in solid and inert materials so that dispersion of radioactive substances under normal conditions of use is substantially prevented; one dimension shall be at least 0,2 cm

#### 3.4

##### **source holder**

device used to support and contain the radioactive source

#### 3.5

##### **measuring head**

subassembly comprising one or several radioactive sources and detectors along with compensation sensors, if necessary, and devices that can be used to measure and correct the effects of undesirable influences

NOTE The measuring head may consist of separate source-housing and detector-housing subassemblies and it may include electronic devices for signal processing.

#### 3.6

##### **source housing**

that portion of the measuring head which includes the radioactive source, its holder and primary shielding device and shutter mechanism, if any

#### 3.7

##### **detector housing**

that portion of the measuring head that includes the detector

NOTE This assembly may be incorporated with the source housing, especially in the case of a back-scatter measurement system.

#### 3.8

##### **useful radiation; useful beam**

portion of radiation that is emitted by the radioactive source and used for measurement

#### 3.9

##### **collimation device**

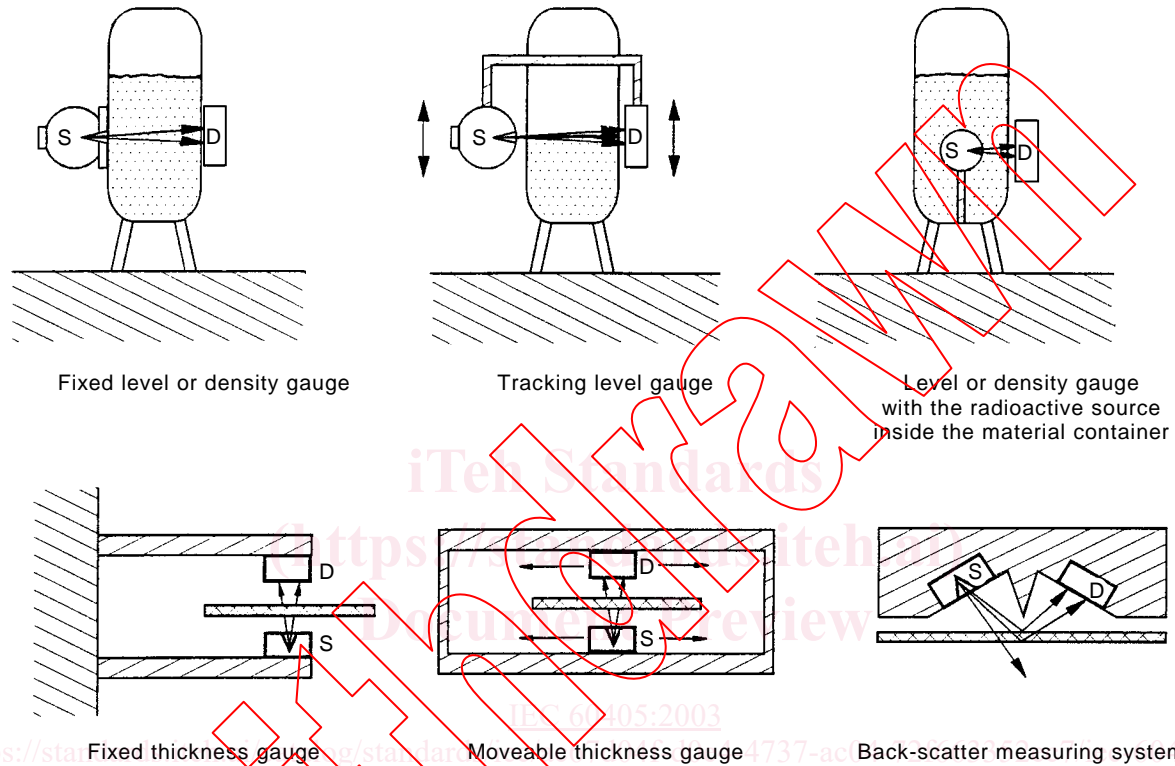
device for restricting the useful radiation in one or more directions

#### 4 Classification of radiometric gauge types

##### 4.1 Category A: Radiometric gauges with restricted beam

Category A comprises gauges equipped with a device for collimation of the radiation, thereby restricting the useful beam.

The gauge shall be designed in such a way that the radiation, except for the useful beam, is attenuated in conformity with the requirements of this standard.



**Key**  
D detector housing  
S source housing

IEC 1278/03

**Figure 1 – Schematic arrangement of Category A gauges**

##### 4.2 Category B: radiometric gauges with omnidirectional beam

Category B comprises gauges without a device for collimation of the radiation in one or more directions of the useful beam or where the alignment does not comply with the requirements of Category A gauges.