
International Standard 7205

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Radionuclide gauges — Gauges designed for permanent installation

Jauges à radioéléments — Appareils destinés à être installés à poste fixe

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 7205 was prepared by Technical Committee ISO/TC 85, *Nuclear energy*.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

Contents

	Page
1 Scope and field of application	1
2 References	1
3 Definitions	1
4 Classification of gauges	2
5 General considerations	3
6 Classification of gauges according to safety performance	4
7 Test methods	5
8 Gauge codes and markings	7
9 Accompanying documents	8
Bibliography	15

Radionuclide gauges — Gauges designed for permanent installation

1 Scope and field of application

The purpose of this International Standard is to establish the following characteristics for radionuclide gauges designed for permanent installation:

- a) a classification of the gauges and shielding devices;
- b) technical construction and performance requirements for radiation protection when using a radioactive source;
- c) control and test methods to verify the compliance of the gauges with those requirements;
- d) indications to be shown on the gauges.

In addition to the construction requirements above, the gauges shall comply with existing regulations.

This International Standard does not apply to gauges which, because of their design, and due to the nature and the low activity of the sources they contain, are not subject to general rules regarding supply and possession of artificial radionuclides nor does it apply to ion generators (smoke detectors, static eliminators, etc.).

2 References

ISO 361, *Basic ionizing radiation symbol*.

ISO 921, *Nuclear energy glossary*.

ISO 1677, *Sealed radioactive sources — General*.

ISO 2919, *Sealed radioactive sources — Classification*.

ISO 3768, *Metallic coatings — Neutral salt spray test (NSS test)*.

3 Definitions

For the purposes of this International Standard, the definitions given in ISO 921 and the following definitions apply.

3.1 radionuclide gauge; gauge: A control and measuring device activated by the radiation emitted by one or more sealed radioactive sources. It includes a source housing and a detector housing (or a combined source/detector housing).

3.2 source housing: Enclosure containing the radioactive source(s), a source holder and means for attenuating the radiation.

3.3 detector housing: Enclosure containing the radiation detector.

3.4 source/detector housing: Combined source/detector housing forming a rigid assembly, the two units being either coupled or contained in the same enclosure.

3.5 source holder: Device used to support and contain the sealed source.

3.6 useful beam: Radiation passing through the window, aperture, cone or other collimation device of the source housing (sometimes called "primary beam").

3.7 radionuclide gauge for permanent installation: Instrument designed to be installed in a fixed location. The detector housing and the source housing may be fixed or mobile. Mobility is limited and predetermined by the operations involved.

4 Classification of gauges

4.1 Classification on the basis of the mobility of components

Gauges are classified according to two main categories, based on their mobility:

a) Gauges having two components (source housing and detector housing) which are fixed on the structure of the industrial installation involved.

Examples: Certain level gauges, certain thickness gauges.

They are called fixed gauges on permanent installations.

b) Gauges in which at least one of the two components is movable on the structure of the industrial installation where involved.

Examples: Travelling gauges, C-frame gauges.

They are called mobile gauges on permanent installations.

4.2 Classification according to degree of collimation of the beam

Radionuclide gauges for permanent installation belong to one of the categories described in 4.2.1 and 4.2.2, depending on the degree of collimation of the beam radiated by the source housing.

The categories are illustrated in figure 1.

4.2.1 Category A: Gauges with restricted beam

Category A comprises gauges equipped with a device for collimation of radiation from the radioactive source(s), restricting one or more useful beams.

The gauges shall be designed so that radiation within the solid angles formed by the collimator and all points on the active surface of the source are intercepted by the detector housing or any other fixed absorber.

In the case of back-scatter and X-ray fluorescence gauges, interception of primary radiation and back-scattered radiation shall be possible.

4.2.1.1 Sub-category A1

Sub-category A1 comprises those gauges in which the radioactive source, when in the operating position, and the detector restrict a constant volume, i.e. either both parts of the device occupy fixed positions in relation to a fixed point on the installation or both parts constitute one rigid assembly.

Examples: Fixed-value level control and level-indication density gauges, C-frame thickness gauges, fixed thickness gauges, shielded back-scatter gauges.

4.2.1.2 Sub-category A2

Sub-category A2 comprises those gauges in which the radioactive source, when in the operating position, and the detector

restrict a constant volume, the motion of both parts being mutually dependent.

Examples: Level follower or detection level control with varying set-point, thickness gauges also called "travelling gauges".

4.2.1.3 Sub-category A3

Sub-category A3 comprises those gauges in which the movements of the source housing and/or the detector housing on fixed axes are mutually dependent.

Examples: Safety alignment gauges, safety gauges on travelling cranes.

4.2.2 Category B: Gauges without restricted beam

Category B comprises gauges without a collimation device or gauges in which the collimator does not comply with the requirements for category A gauges.

In the case of back-scatter and X-ray fluorescence gauges, interception of the primary radiation and back-scattered radiation is not complete, particularly in the absence of material to be investigated.

4.2.2.1 Sub-category B1

Sub-category B1 comprises those gauges in which the radioactive source, when in the operating position, and the detector(s) occupy fixed positions in relation to one another.

Examples: Neutron moisture gauges, back-scatter gauges without associated shield.

4.2.2.2 Sub-category B2: Ejection equipment

Sub-category B2 comprises those gauges in which the detector occupies a fixed position, the source being ejected to a suitable location for measuring purposes, during the time required for measuring or control.

Examples: Compacting control devices, density gauges used in chemical plants.

4.2.2.3 Sub-category B3

Sub-category B3 comprises those gauges in which the source holder moves inside the installation, depending on parameters to be controlled and measured, and the detector moves on the outside of the installation.

Examples: Position control of a mobile part inside an installation, floats containing a source, safety alignment gauges, safety gauges on travelling cranes.

4.3 Classification as a function of safety performance

See clause 6.

5 General considerations

The source housing and the detector housing shall provide several variable functions according to the category of gauge involved, which all contribute to safety. Such functions, for each sub-category, are shown in table 2.

5.1 Radioactive source

The radioactive source(s) shall be sealed, in accordance with the requirements of ISO 2919.

5.2 Source housing

The source housing shall be designed in such a way that it will comply, for each type of gauge, with the requirements laid down in 5.2.1 to 5.2.4, in accordance with the functions shown in table 2.

5.2.1 Source holder

The fixed or mobile source holder shall

- a) allow for easy positioning of the radioactive source;
- b) provide means for fixing the source properly in order to prevent its loss;
- c) be designed in such a way as to prevent it being dismantled by unqualified persons (for example, by placing it in an enclosure provided with a safety lock or by making it necessary to use a specially designed tool to open it) — in cases where it is impossible to eliminate access to the source holder, the device used for fastening the source in the holder shall at least be fitted with a lead safety seal;
- d) allow for its proper positioning in the source housing under safe radiological and containment conditions;
- e) provide, under normal service conditions, protection of the radioactive source against impacts which could damage it, if no other means are provided in the gauge for such protection;
- f) ensure protection of the radioactive source against attacks of physical or chemical origin
 - under normal service conditions specified by the manufacturer for gauges of sub-categories B2 and B3,
 - when service conditions make it necessary for other sub-categories.

5.2.2 Restriction of useful beam

The source housing in category A gauges shall restrict the useful beam in such a way that for the maximum source-detector distance specified by the manufacturer, the solid angle formed by the centre of the source and the collimator does not extend beyond the detector or its absorbing shields.

If the source housing is designed to accommodate several collimators which form different solid angles, the manufacturer shall indicate, for each, the maximum source-detector distance.

In the case of category B gauges, it is recommended that the source holder be designed in such a way as to reduce sufficiently the dose equivalent rate, outside the useful beam, in a solid angle as required to ensure the protection of the operator.

5.2.3 Shield against ionizing radiation

The source housing of category A gauges shall ensure compliance with the dose equivalent rates corresponding to the proper gauge class (see 6.2 and table 3).

In the case of installations with mobile sources, category B gauges shall include a storage container for the source and the source holder, so that when the radioactive source is not in the measuring position, dose equivalent rates corresponding to the class of gauge involved will be met (see 6.3 and table 3).

The storage container shall form an integral part of the installation in the case of gauges of sub-categories B2 and B3; sub-category B1 gauges are not required to be equipped with an integral storage container.

If the container is constructed with materials which are combustible, oxidizable, easily fusible or volatile, these shall be enclosed in one or more sealed envelopes strong enough to retain their shielding properties under the conditions specified in 7.5.

5.2.4 Shutter for the useful beam

The source housing in category A gauges as well as the storage container in category B gauges, if any, shall be equipped with a device integral with the source housing to intercept the beam, and thus ensure, for the class in question, compliance with the dose equivalent rates laid down in table 3 (see note 2), with the shutter closed.

If this device is remote-controlled or servo-controlled, any defect in the control circuit or the servo-control circuit shall automatically close the device.

The shutters shall be classified, as indicated by the manufacturer on the operating and maintenance instructions provided on the gauge, according to one of the groups described in 5.2.4.1 to 5.2.4.3.

5.2.4.1 Group 1: Shutters for maintenance

This group comprises shutters designed to operate under certain conditions and solely during maintenance or servicing of the gauge or installation.

5.2.4.2 Group 2: Shutters used during operations (start-up/shut-down)

This group comprises shutters designed to operate on start-up and shut-down of the installation in which the gauge is incorporated.