International Standard

ISO 20041-2

First edition
2025-09

Tritium and carbon-14 activity in gaseous effluents and gas discharges of nuclear installations —

Part 2: Determination of tritium and carbon-14 activities sampled by bubbling technique

Activité du tritium et du carbone 14 dans les effluents gazeux et les rejets gazeux des installations nucléaires —

Partie 2: Détermination de l'activité du tritium et du carbone 14 prélevés par la technique du barbotage

Reference number
ISO 20041-2:2025(en)

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Published in Switzerland

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Foreword

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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 document 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).

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This document was prepared by Technical Committee ISO/TC 85, *Nuclear energy, nuclear technologies, and radiological protection*, Subcommittee SC 2, *Radiological protection.*

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Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

Discharges from nuclear installations are subject to regulatory requirements established by various regulatory bodies. Rigorous control of the discharges is implemented within the framework of water and air discharge permits. In particular, this involves making measurements of the physical, chemical and radioactivity characteristics in the gaseous and liquid effluents. The decommissioning of these nuclear installations also generates liquid and gaseous effluents that should be characterized and quantified before their discharge.

Tritium and carbon-14 are usually present in the gaseous effluents of nuclear power plants and other types of nuclear installations. ISO 2889[1] presents the methods and provisions for sampling airborne substances from the exhaust stacks of nuclear facilities. The provisions defined therein cover all physical forms of the materials present in gaseous effluents: aerosol particles, vapours and gases. These provisions are more restrictive for radioactive aerosol measurements, given greater possibilities of losses in the transport lines. However, in the gaseous effluents of nuclear facilities, tritium and carbon-14 are present in gas or vapour forms as multiple chemical compounds, which requires adapting the provisions of ISO 2889[1]. Furthermore, ISO 2889:2023[1] only deals with tritium and carbon-14 sample collection in Annexes H and K.

Therefore, the ISO 20041 series go further by addressing, in detail, the provisions specific to sampling methods, sample preparation and calculations for determining the tritium and carbon-14 activities. ISO 20041-1[9] covers the sampling methods or techniques for tritium and carbon-14. This document covers activity analysis of tritium and carbon-14 sampled emissions by the bubbling technique.

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Tritium and carbon-14 activity in gaseous effluents and gas discharges of nuclear installations —

Part 2: Determination of tritium and carbon-14 activities sampled by bubbling technique

1 Scope

The objective of this document is to characterize the gaseous effluents tritium and carbon-14 generated by nuclear facilities during operation and decommissioning and occurring in the same chemical species as hydrogen and carbon, e. g. as water vapour (HTO), hydrogen gas (HT, TT), carbon dioxide ($^{14}CO_2$), carbon monoxide (^{14}CO), methane (CH_3T, $^{14}CH_4$). It concerns measurements on samples that are representative of a certain volume stream or volume of discharge during a given period of time and of the corresponding volume discharged. The result is therefore expressed in becquerels.

This document applies to samples that were obtained by sampling methods according to ISO 20041-1[9] and describes

— analysis methods for the determination of tritium and carbon-14 activities by liquid scintillation counting, and

— calculation methods to determine the tritium activities discharged as tritiated water vapour (HTO) and tritium in other chemical compounds (non-HTO) as well as carbon-14 activities discharged as carbon dioxide ($^{14}CO_2$) and carbon-14 in other chemical compounds (non-$^{14}CO_2$).

This document does not apply to tritium and carbon-14 activity concentrations in the environmental air, e.g. in the vicinity of nuclear installations.

The accountability rules of the activities discharged necessary for the establishment of regulatory reports do not fall within the scope of this document and are the responsibility of the regulatory bodies.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

ISO 19361, *Measurement of radioactivity — Determination of beta emitters activities — Test method using liquid scintillation counting*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

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