

BS EN ISO 13162:2015



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Water quality — Determination of carbon 14 activity — Liquid scintillation counting method (ISO 13162:2011)

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National foreword

This British Standard is the UK implementation of EN ISO 13162:2015. It is identical to ISO 13162:2011.

The UK participation in its preparation was entrusted to Technical Committee EH/3, Water quality.

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.

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English Version

Water quality - Determination of carbon 14 activity - Liquid
scintillation counting method (ISO 13162:2011)

Qualité de l'eau - Détermination de l'activité volumique du
carbone 14 - Méthode par comptage des scintillations en
milieu liquide (ISO 13162:2011)

Wasserbeschaffenheit - Bestimmung der Aktivität von
Kohlenstoff-14 - Verfahren mit dem
Flüssigszintillationszähler (ISO 13162:2011)

This European Standard was approved by CEN on 30 July 2015.

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European foreword

The text of ISO 13162:2011 has been prepared by Technical Committee ISO/TC 147 “Water quality” of the International Organization for Standardization (ISO) and has been taken over as EN ISO 13162:2015 by Technical Committee CEN/TC 230 “Water analysis” the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by February 2016, and conflicting national standards shall be withdrawn at the latest by February 2016.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

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Endorsement notice

The text of ISO 13162:2011 has been approved by CEN as EN ISO 13162:2015 without any modification.

Contents

Page

Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Symbols, definitions, units, and abbreviations	2
4 Principle	2
5 Reagents and equipment	3
5.1 Reagents	3
5.2 Equipment	4
6 Sampling and samples	5
6.1 Sampling	5
6.2 Sample storage	5
7 Procedure	5
7.1 Sample preparation	5
7.2 Preparation of the sources to be measured	5
7.3 Counting procedure	6
7.4 Calibration and verification	6
7.5 Measurement conditions	6
8 Expression of results	7
8.1 General	7
8.2 Calculation of activity concentration	7
8.3 Decision threshold	8
8.4 Detection limit	8
8.5 Confidence limits	9
8.6 Calculations using the activity per mass	9
9 Test report	9
Annex A (informative) Numerical applications	11
Annex B (informative) Internal standard method	13
Annex C (informative) Extraction of total carbon: precipitate counting	15
Annex D (informative) Extraction of total carbon: absorption counting	18
Bibliography	21

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 13162 was prepared by Technical Committee ISO/TC 147, *Water quality*.

Introduction

The carbon 14 (^{14}C) present in the environment is of natural origin and man made. As a result of atmospheric nuclear weapon testing, emissions from nuclear engineering installations, and the application and processing of isotopes, relatively large amounts of ^{14}C have been released into the environment. Due to the substantial proportion of ^{14}C in the human internal dose contribution, monitoring of ^{14}C activity concentrations in the environment is necessary in order to follow its circulation in the hydrosphere and biosphere. ^{14}C is the second radionuclide ($\sim 3\,500\text{ Bq}$) to contribute to the human body natural radioactivity, behind ^{40}K ($\sim 6\,000\text{ Bq}$).

Water quality — Determination of carbon 14 activity — Liquid scintillation counting method

WARNING — Persons using this International Standard should be familiar with normal laboratory practice. This standard does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and to ensure compliance with any national regulatory conditions.

IMPORTANT — It is absolutely essential that tests conducted according to this International Standard be carried out by suitably trained staff.

1 Scope

This International Standard specifies the conditions for the determination of ^{14}C activity concentration in samples of environmental water or of ^{14}C -containing water using liquid scintillation counting.

The method is applicable to the analysis of any organic molecule soluble in water that is well mixed with the scintillation cocktail. It does not apply to micelles or “large” particles (lipids, fulvic acid, humic acid, etc.) that are inadequately mixed with the scintillation cocktail and the water. Some beta energy is lost without any excitation of the scintillation cocktail and the results are underestimated. The method is not applicable to the analysis of organically bound ^{14}C , whose determination requires additional chemical processing (such as chemical oxidation, combustion).

It is possible to determine ^{14}C activity concentrations below 10^6 Bq l^{-1} without any sample dilution.

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.

ISO 5667-1, *Water quality — Sampling — Part 1: Guidance on the design of sampling programmes and sampling techniques*

ISO 5667-3, *Water quality — Sampling — Part 3: Preservation and handling of water samples*

ISO 11929, *Determination of the characteristic limits (decision threshold, detection limit and limits of the confidence interval) for measurements of ionizing radiation — Fundamentals and application*

ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

ISO 80000-10, *Quantities and units — Part 10: Atomic and nuclear physics*

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

3 Symbols, definitions, units, and abbreviations

For the purposes of this document, the symbols, definitions, units, and abbreviations defined in ISO 80000-10, ISO 11929, ISO/IEC Guide 98-3 and the following apply.

A	Activity of the calibration source, in becquerels
c_A	Activity concentration, in becquerels per litre
c_A^*	Decision threshold, in becquerels per litre
$c_A^\#$	Detection limit, in becquerels per litre
$c_A^<, c_A^>$	Lower and upper limits of the confidence interval, in becquerels per litre
f_q	Quench factor
m	Mass of test sample, in kilograms
r_0	Background count rate, in reciprocal seconds
r_g	Sample count rate, in reciprocal seconds
r_s	Count rate of the calibration sample, in reciprocal seconds
t_0	Background counting time, in seconds
t_g	Sample counting time, in seconds
t_s	Counting time of the calibration sample, in seconds
U	Expanded uncertainty, calculated by $U = k u(c_A)$ with $k = 1, 2, \dots$, in becquerels per litre
$u(c_A)$	Standard uncertainty associated with the measurement result, in becquerels per litre
V	Volume of test sample, in litres
α	Activity per mass, in becquerels per kilogram
$\beta_{\max}$	Maximum energy for the beta emission, in kiloelectronvolts
ε	Detection efficiency
ρ	Mass density of the sample, in kilograms per litre

4 Principle

The scintillation phenomenon results from interaction of ionizing radiation with solvents and compounds exhibiting fluorescence (scintillators). Both solvents and scintillators constitute the scintillation cocktail. The scintillation mixture is achieved by adding the scintillation cocktail to the test sample in order to obtain a homogeneous mixture.

The test sample is mixed with the scintillation cocktail in a counting vial to obtain a homogeneous medium. Electrons emitted by ^{14}C transfer their energy to the scintillation medium. Molecules excited by this process return to their ground state by emitting photons that are detected by photodetectors.

The electric pulses emitted by the photodetectors are amplified, sorted (in order to remove random events) and analysed by the electronic systems and the data analysis software. The count rate of these electric pulses allows the determination of the test sample activity, after correcting for the background count rate and detection efficiency.