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**Gas analysis — General quality aspects  
and metrological traceability of  
calibration gas mixtures**

*Analyse des gaz — Aspects généraux sur la qualité et traçabilité des  
mélanges de gaz pour étalonnage*



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## 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.

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 documents 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](http://www.iso.org/directives)).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 158, *Analysis of gases*.

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](http://www.iso.org/members.html).

This first edition of ISO 14167 cancels and replaces ISO/TS 14167:2003, which has been technically revised. The main changes compared to the previous edition are as follows:

- the description of quality assurance aspects has been improved;
- the relationship between ISO/TC 158 standards has been described;
- the metrological traceability and metrological hierarchy of calibration gas mixtures has been elaborated upon.

# Gas analysis — General quality aspects and metrological traceability of calibration gas mixtures

## 1 Scope

This document provides requirements and guidelines on the necessary quality assurance required to produce calibration gas mixtures that are demonstrably stable and comparable. It shows that this is achieved by demonstrating that the composition of the calibration gas mixture is metrologically traceable to the SI.

This document shows that calibration gas mixtures can be prepared according to methods that have measurements that are completely described in SI units. It describes procedures for verifying that the composition of such gas mixtures is correct within the stated measurement uncertainty. Guidance is given as to how to conduct the evaluation of uncertainty in these procedures.

This document also shows how a calibration gas mixture with unknown composition can be calibrated by reference to traceable standard gas mixtures.

This document covers the commonalities and differences of quality management schemes in use by producers of calibration gas mixtures, most notably those described in ISO/IEC 17025 and ISO 17034. These systems lead to gas mixtures with different characteristics, and this document explains these differences and their implications.

Calibration gas mixtures, as prepared and certified for composition in accordance with this document, are used for the calibration of equipment, the performance evaluation of methods, measurement procedures and equipment.

## 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 Guide 30, *Reference materials — Selected terms and definitions*

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

ISO/IEC Guide 98-3/Suppl 1, *Supplement 1 to the Guide to the expression of uncertainty in measurement — Propagation of distributions using a Monte Carlo method*

ISO/IEC Guide 98-3/Suppl 2, *Supplement 2 to the Guide to the expression of uncertainty in measurement — Extension to any number of output quantities*

ISO/IEC Guide 99, *International vocabulary of metrology — Basic and general concepts and associated terms (VIM)*

ISO 6142 (all parts), *Gas analysis — Preparation of calibration gas mixtures*

ISO 6143, *Gas analysis — Comparison methods for determining and checking the composition of calibration gas mixtures*

ISO 6144, *Gas analysis — Preparation of calibration gas mixtures — Static volumetric method*

ISO 6145-1, *Gas analysis — Preparation of calibration gas mixtures using dynamic volumetric methods — Part 1: Methods of calibration*

ISO 6145-2, *Gas analysis — Preparation of calibration gas mixtures using dynamic methods — Part 2: Piston pumps*

ISO 6145-4, *Gas analysis — Preparation of calibration gas mixtures using dynamic volumetric methods — Part 4: Continuous syringe injection method*

ISO 6145-5, *Gas analysis — Preparation of calibration gas mixtures using dynamic volumetric methods — Part 5: Capillary calibration devices*

ISO 6145-6, *Gas analysis — Preparation of calibration gas mixtures using dynamic methods — Part 6: Critical flow orifices*

ISO 6145-7, *Gas analysis — Preparation of calibration gas mixtures using dynamic volumetric methods — Part 7: Thermal mass-flow controllers*

ISO 6145-8, *Gas analysis — Preparation of calibration gas mixtures using dynamic volumetric methods — Part 8: Diffusion method*

ISO 6145-9, *Gas analysis — Preparation of calibration gas mixtures using dynamic volumetric methods — Part 9: Saturation method*

ISO 6145-10, *Gas analysis — Preparation of calibration gas mixtures using dynamic volumetric methods — Part 10: Permeation method*

ISO 6145-11, *Gas analysis — Preparation of calibration gas mixtures using dynamic volumetric methods — Part 11: Electrochemical generation*

ISO 7504, *Gas analysis — Vocabulary*

ISO 12963, *Gas analysis — Comparison methods for the determination of the composition of gas mixtures based on one- and two-point calibration*

ISO 14912, *Gas analysis — Conversion of gas mixture composition data*

ISO 16664, *Gas analysis — Handling of calibration gases and gas mixtures — Guidelines*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 7504, ISO Guide 30 and ISO/IEC Guide 99 apply.

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

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

### 4 Symbols

$i, k$	indices for components in a gas or gas mixture
$j$	index for a parent gas
$M$	molar mass
$m$	mass
$q_m$	mass flow rate
$n$	amount of substance