
**Gas analysis — Preparation of
calibration gas mixtures using
dynamic methods —**

Part 2:
Piston pumps

*Analyse des gaz — Préparation des mélanges de gaz pour étalonnage
à l'aide de méthodes volumétriques dynamiques —*

Partie 2: Pompes à piston



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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. www.iso.org/directives

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 158, *Analysis of gases*.

This second edition cancels and replaces the first edition (ISO 6145-2:2001), which has been technically revised. The main objective of this revision is to extend the first edition for calculating the composition in volume and amount-of-substance fractions from the displacement volumes of piston pumps. Appropriate measurement functions and guidance on uncertainty evaluation are given for the mixing of real gases at unequal operational conditions of the piston pumps.

ISO 6145 consists of the following parts, under the general title *Gas analysis — Preparation of calibration gas mixtures using dynamic methods*:

- *Part 1: Methods of calibration*
- *Part 2: Volumetric pumps*
- *Part 4: Continuous syringe injection method*
- *Part 5: Capillary calibration devices*
- *Part 6: Critical orifices*
- *Part 7: Thermal mass-flow controllers*
- *Part 8: Diffusion method*
- *Part 9: Saturation method*
- *Part 10: Permeation method*
- *Part 11: Electrochemical generation*

ISO 6145-3, entitled *Periodic injections into a flowing gas stream*, has been withdrawn.

Gas analysis — Preparation of calibration gas mixtures using dynamic methods —

Part 2: Piston pumps

1 Scope

ISO 6145 comprises a series of International Standards dealing with various dynamic methods used for the preparation of calibration gas mixtures. This part of ISO 6145 describes a method and preparation system using piston pumps. The mixture composition and its associated uncertainty are based on calibration of the piston pumps by dimensional measurements.

The calibration gas mixtures prepared using this method consist of two or more components, prepared from pure gases or other gas mixtures using gas-mixing pumps. Such gas-mixing pumps contain at least two piston pumps, each driven with a defined ratio of strokes, and appropriate accessories for gas feeding and mixture homogenization.

This part of ISO 6145 is applicable only to mixtures of gaseous or totally vaporized components including corrosive gases, as long as these components neither react with each other nor with the wetted surfaces of the mixing pump. The use of gas mixtures as parent gases is covered as well. Multi-component gas mixtures and multi-step dilution procedures are included in this International Standard as they are considered to be special cases of the preparation of two-component mixtures.

This part of ISO 6145 describes a method of preparing calibration gas mixtures whose composition is expressed in volume fractions. The necessary equations and associated uncertainty evaluation to express the gas composition in amount-of-substance fractions are given in [Annex A](#).

With this method, provided that sufficient quality assurance and control measures are taken, calibration gas mixtures can be prepared with a relative expanded uncertainty of 0,5 % (coverage factor $k = 2$) in the volume fraction. Numerical examples showing that under specified conditions smaller uncertainties are attainable are given in [Annexes B](#) through [D](#).

Using this method, dilution ratios of 1:10 000 can be achieved in discrete increments. Lower fractions (down to 1×10^{-8}) can be achieved by multi-stage dilution or by the use of gas mixtures as input gases. Final mixture flow rates of 5 l/h to 500 l/h can be realized depending on the equipment used.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 7504, *Gas analysis — Vocabulary*

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

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

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