Second edition
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Gas analysis — Preparation of calibration gas mixtures using dynamic volumetric methods —

Part 1:
Methods of calibration

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

Partie 1: Méthodes d'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.

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 6145-1 was prepared by Technical Committee ISO/TC 158, *Analysis of gases*.

This second edition cancels and replaces the first edition (ISO 6145-1:1986), in which the estimated uncertainties in the calibration methods and techniques have now been combined in a square-root sum-of-squares manner to form the relative combined standard uncertainty. In comparison with the previous edition the periodic injection has been deleted (limited application).

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

— *Part 1: Methods of calibration*

— *Part 2: Volumetric pumps*

— *Part 4: Continuous injection methods*

— *Part 5: Capillary calibration devices*

— *Part 6: Critical orifices*

— *Part 7: Thermal mass-flow controllers*

— *Part 9: Saturation method*

— *Part 10: Permeation method*

Diffusion will be the subject of a future Part 8 to ISO 6145. Part 3 to ISO 6145, entitled *Periodic injections into a flowing gas*, has been withdrawn.

Introduction

This part of ISO 6145 is one of a series of standards which describes the various dynamic volumetric methods used for the preparation of calibration gas mixtures.

In dynamic volumetric methods a gas, A, is introduced at volume or mass flow rate q_A into a constant flow rate q_B of a complementary gas B. Gas A can be either a pure calibration component, i, or a mixture of i in A.

The volume fraction, $\varphi_{i,M}$ of i in the final calibration gas mixture is given in the following equation:

$$\varphi_{i,M} = \varphi_{i,A} \left(\frac{q_A}{q_A + q_B} \right)$$

where $\varphi_{i,A}$ is the volume or mass fraction of component, i, in the pre-mixed gas A, and is already known from its method of preparation. It is assumed that in this equation, $\varphi_{i,B}$, the concentration of component, i, in gas B, is zero.

The introduction of gas A can be continuous (e.g. permeation tube) or pseudo-continuous (e.g. volumetric pump). A mixing chamber should be inserted in the system before the analyser and is particularly essential in the case of pseudo-continuous introduction. The flow rate of component A is measured either directly in terms of volume or mass, or indirectly by measuring the variation of a physical property.

The dynamic volumetric preparation techniques produce a continuous flow rate of calibration gas mixtures into the analyser but do not generally allow the build-up of a reserve by storage under pressure.

The main techniques used for the preparation of the mixtures are:

a) volumetric pumps;

b) continuous injection;

c) capillary;

d) critical orifices;

e) thermal mass-flow controllers;

f) diffusion;

g) saturation;

h) permeation;

i) electrochemical generation.

In all cases, and most particularly if very dilute mixtures are concerned, the materials used for the apparatus are chosen as a function of their resistance to corrosion and low absorption capacity (usually glass, PTFE or stainless steel). It should, however, be pointed out that the phenomena are less important for dynamic volumetric methods than for static methods.

Numerous variants or combinations of the main techniques can be considered and mixtures of several constituents can also be prepared by successive operations.

Some of these techniques allow calculation of the final concentration of the gas mixture from basic physical information (e.g. mass rates of diffusion, flow through capillaries). However, since all techniques are dynamic and rely on stable flow rates, this part of ISO 6145 emphasizes calibration of the techniques by measurement of the individual flow rates or their ratios, or by determination of the composition of the final mixture.

The uncertainty of the composition of the calibration gas mixture is best determined by comparison with a gas mixture traceable to international standards. Certain of the techniques which may be used to prepare a range of calibration gas mixtures may require several such traceable gas mixtures to verify their performance over that range. The dynamic volumetric technique used has a level of uncertainty associated with it. Information on the final mixture composition depends both on the calibration method and on the preparation technique.