

International Standard



6349

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Gas analysis — Preparation of calibration gas mixtures — Permeation method

Analyse des gaz — Préparation des mélanges de gaz pour étalonnage — Méthode par perméation

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FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up 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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 6349 was developed by Technical Committee ISO/TC 158, *Analysis of gases*, and was circulated to the member bodies in June 1978.

It has been approved by the member bodies of the following countries :

Belgium	Korea, Rep. of	United Kingdom
Bulgaria	Mexico	USA
Czechoslovakia	Netherlands	USSR
France	Philippines	Yugoslavia
Germany, F.R.	South Africa, Rep. of	
Ireland	Turkey	

No member body expressed disapproval of the document.

Gas analysis — Preparation of calibration gas mixtures — Permeation method

1 SCOPE AND FIELD OF APPLICATION

This International Standard describes the principles of the permeation method, which is a continuous dynamic method, for the preparation of calibration gas mixtures in which the components that it is desired to use generally have a concentration between 10^{-9} and 10^{-5} (by volume), with an achievable accuracy of 2 % of the concentration of the component. (In practice, concentrations may also be expressed in micrograms per cubic metre). In the concentration range considered, it is difficult to maintain the gas mixtures in a stable state; it is therefore necessary to prepare the calibration gas just prior to its use, and to transfer it by the shortest path possible to the place where it is to be used.

2 PRINCIPLE

The principle of the method relies on the permeation of the component which is to be used (SO_2 , NO_2 , NH_3 , etc.) through an appropriate membrane into a flow of carrier gas which constitutes the complementary gas of the mixture obtained. The constituent, in a pure state, is contained in a tube¹⁾ (see clause 3), which is totally or partially swept at a known and controlled flow rate by the complementary gas, which is completely clean, purified and, in particular, free from any trace of the component, and thus becomes charged with molecules having diffused. The complementary gas shall be chosen so as to avoid any interaction with the materials constituting the permeation tube.

The diffusion rate of the substance through the membrane depends upon the substance itself, the nature, constitution and area of the membrane, and the temperature and differences between the partial pressure of the gas inside and outside the tube. These factors can be kept constant by proper operation of the tube.

In the present state of knowledge, no formula is available to describe this phenomenon exactly.

If the diffusion rate is maintained constant, it may be determined by simple weighings at convenient time intervals (methods other than weighing have been proposed in recent literature, mentioned in the bibliography, but are not dealt with in this International Standard). To allow this operation to be carried out, taking account of the various parameters affecting the diffusion rate, it is necessary that

the following requirements be fulfilled for a given tube containing a known substance :

- the tube shall be maintained at a temperature as constant as possible between two weighings;
- the outside of the tube shall be permanently swept by the carrier gas in order to maintain the partial pressure of the constituent under consideration outside the tube at a negligible value;
- the gas pressure inside the tube shall be maintained constant between two weighings, i.e. either the substance shall be partly in the liquid phase or the quantity of the substance in the tube shall be large compared to the mass lost by permeation.

The concentration C of the calibration gas mixture so prepared is a function of the diffusion rate of the tube and the flow rate of the complementary gas. It is given by the formula

$$C = \frac{q_m}{q_v}$$

where

q_m is the permeation rate (mass flow rate) of the calibration component under given conditions;

q_v is the complementary gas flow rate (in appropriate units).

3 EXAMPLE OF APPLYING THE METHOD

3.1 Examples of permeation tubes (see figure 1)

The tube contains a liquid phase and a gaseous phase; the membrane through which the diffusion takes place may be in contact with the liquid phase only, or with the gaseous phase only, or with both. However, unless it has been ascertained that the phase in contact has no effect on the permeation rate, the tube shall be used with the phase in contact identical to that used for the determination of the permeation rate.

1) The word "tube" is used whatever the shape of the vessel. It is also understood (except in 3.3.4) to include the tube contents.