

International Standard



6145/3

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Gas analysis — Preparation of calibration gas mixtures — Dynamic volumetric methods — Part 3 : Periodic injections into a flowing gas stream

*Analyse des gaz — Préparation des mélanges de gaz pour étalonnage — Méthodes volumétriques dynamiques — Partie 3 :
Injections périodiques dans un flux gazeux*

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Foreword

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International Standard ISO 6145/3 was prepared by Technical Committee ISO/TC 158, *Analysis of gases*.

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Gas analysis — Preparation of calibration gas mixtures — Dynamic volumetric methods — Part 3 : Periodic injections into a flowing gas stream

1 Scope and field of application

This International Standard constitutes part 3 of ISO 6145, which deals with the various dynamic volumetric techniques used for the preparation of calibration gas mixtures.

It describes the periodic injection techniques which enable a concentration range of each component of between 10^{-6} and 10^{-2} with 1 % variability to be obtained. The concentration is expressed as a volume ratio (V/V).

2 Reference

ISO 6145/1, *Gas analysis — Preparation of calibration gas mixtures — Dynamic volumetric methods — Part 1: Methods of calibration*.

3 Principle of the method

3.1 Operating principle

Complementary gas B flows continuously through the system. At regular time intervals, a volume V of gas B is replaced by an equivalent volume of gas A.

A gas B (complementary gas) flows at a flow rate q in a tube T. A means is provided at a point P for periodically withdrawing a small sample of volume V of gas B and injecting an identical volume of gas A (the component for calibration) in place of gas B (figure 1), such that the flow rate is unchanged. The volume V_A of gas A together with gas B goes to a mixing chamber of volume V_0 where the mixture is made homogeneous.

3.2 Area of validity

Volume V_0 shall be large compared with the volume delivered by the component B during the time t between two successive injections. In practice, the following relationship shall be fulfilled:

$$3q_B \cdot t < V_0$$

Gases A and B shall be at the same pressure and temperature.

3.3 Principle of calculation

At a rate of n injections per minute of volume V , the mean flow volume ratio of gas A is $q_A = n \cdot V$, and the rate can be expressed as

$$C = \frac{\text{flow rate of gas A}}{\text{full flow rate}} = \frac{q_A}{q} = \frac{n \cdot V}{q}$$

4 Practical example

Figure 2 shows a practical example of a plug cock arrangement. Figures 3 and 4 show the schematic representation of the operation of a plug cock.

The cock is arranged so that the four plug holes are always communicating two by two (a and c, or b and d) forming a single passage of volume V . A synchronous motor drives the plug within its housing, and the motor is fed by a pulse generator. Each pulse causes the plug to perform a half turn in x seconds, at a constant rotational speed, and it rests between pulses.

In position 1, the plug is at rest while gas B is bypassed into the mixing chamber through check valves and the component for calibration (gas A) is drawn through the bubbler. After a given period of time (adjustable), the cock is turned by one-half of a revolution. The time is a function of the desired volume ratio and sets the value of n (number of pulses per unit time).

During movement of the cock to position 2, gas B passes through s, while gas A fills volume V expelling gas B, the pressure being limited by the action of the bubbler.

As the plug moves to position 3, volume V (now filled with gas A) is entrained by gas B into the mixing chamber. At the same time, gas A is drawn over the bubbler.

When the pulse terminates, the plug rests at position 4, equivalent to position 1.

5 Operating conditions of the example

The injection system (see figure 2) is supplied with gas A and is supplied with gas B by circuit 1 of pump P.