INTERNATIONAL STANDARD

ISO 13137

First edition
2013-10-15

Workplace atmospheres — Pumps for personal sampling of chemical and biological agents — Requirements and test methods

Air des lieux de travail — Pompes pour le prélèvement individuel des agents chimiques et biologiques — Exigences et méthodes d'essai

Reference number
ISO 13137:2013(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

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.

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, 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.

The committee responsible for this document is ISO/TC 146, *Air quality*, Subcommittee SC 2, *Workplace atmospheres*.

Introduction

Many different methods are used to determine the concentration of chemical and biological agents in workplace air. Many of these methods involve the use of a pump and sampler connected by a flexible tube. Air is drawn through the sampler and chemical and biological agents are trapped, e.g. on a filter, sorbent tube or long-term detector tube, or in a gas washing bottle. In personal sampling, the pump and sampler are attached to the worker so as to collect chemical and biological agents in the breathing zone.

The volume of air drawn by the pump during the sampling period is one of the quantities in the calculation of the concentration of the chemical and biological agents in air. Therefore, the volume of air sampled should be determined accurately and, in order to facilitate this, the flow rate should be maintained within acceptable limits throughout the sampling period. For particle size selective sampling, the short-term fluctuation of the flow rate should also be maintained within acceptable limits in order to ensure that the sampler exhibits the required collection characteristics.

EN 482[1] specifies general performance criteria for methods for measuring the concentration of chemical and biological agents in workplace air. These performance criteria include maximum values of expanded uncertainty that are not to be exceeded under prescribed laboratory conditions. In addition, the performance criteria should also be met under a wider variety of environmental influences, representative of workplace conditions. The contribution of the sampling pump to measurement uncertainty should be kept to a minimum.

This International Standard is intended to enable manufacturers and users of personal sampling pumps to adopt a consistent approach to, and provide a framework for, the assessment of the specified performance criteria. Manufacturers are urged to ensure that pumps meet the requirements laid down in this International Standard, including environmental influences which can be expected to affect performance.

Workplace atmospheres — Pumps for personal sampling of chemical and biological agents — Requirements and test methods

1 Scope

This International Standard specifies performance requirements for battery powered pumps used for personal sampling of chemical and biological agents in workplace air. It also specifies test methods in order to determine the performance characteristics of such pumps under prescribed laboratory conditions.

This International Standard is applicable to battery powered pumps having a nominal volume flow rate above 10 ml · min^{-1}, as used with combinations of sampler and collection substrate for sampling of gases, vapours, dusts, fumes, mists and fibres.

This International Standard is primarily intended for flow-controlled pumps.

2 Normative references

The following referenced 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.

IEC 60079-0, *Explosive atmospheres — Part 0: Equipment — General requirements*

IEC 61000-6-1, *Electromagnetic compatibility (EMC) — Part 6-1: Generic standards — Immunity for residential, commercial and light-industrial environments*

IEC 61000-6-3, *Electromagnetic compatibility (EMC) — Part 6-3: Generic standards — Emission standard for residential, commercial and light-industrial environments*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
biological agent
bacteria, viruses, fungi and other micro-organisms or parts of them and their associated toxins, including those which have been genetically modified, cell cultures or endoparasites which are potentially hazardous to human health

Note 1 to entry: Dusts of organic origin, e.g. pollen, flour dust and wood dust, are not considered to be biological agents and are therefore not covered by this definition.

[SOURCE: EN 1540:2011,[2] definition 2.1.1]

3.2
chemical agent
any chemical element or compound on its own or admixed as it occurs in the natural state or as produced, used, or released, including release as waste, by any work activity, whether or not produced intentionally and whether or not placed on the market

[SOURCE: EN 1540:2011,[2] definition 2.1.2]

3.3
airborne particles
fine matter, in solid or liquid form, dispersed in air

Note 1 to entry: Smoke, fume, mist and fog consist of airborne particles.

[SOURCE: EN 1540:2011,[2] definition 2.2.3]

3.4
air sampler
sampler
device for separating chemical and/or biological agents from the surrounding air

Note 1 to entry: Air samplers are generally designed for a particular purpose, e.g. for sampling gases and vapours or for sampling airborne particles.

[SOURCE: EN 1540:2011,[2] definition 3.2.1, modified — synonyms placed on separate lines]

3.5
personal sampler
sampler, attached to a person, that collects gases, vapours or airborne particles in the breathing zone to determine exposure to chemical and/or biological agents

[SOURCE: EN 1540:2011,[2] definition 3.2.2]

3.6
personal sampling
process of (air) sampling carried out using a personal sampler

[SOURCE: EN 1540:2011,[2] definition 3.3.3]

3.7
breathing zone
space around the nose and mouth from which breath is taken

Note 1 to entry: Technically the breathing zone corresponds to a hemisphere (generally accepted to be 30 cm in radius) extending in front of the human face, centred on the midpoint of a line joining the ears. The base of the hemisphere is a plane through this line, the top of the head and the larynx. This technical description is not applicable when respiratory protective equipment is used.

[SOURCE: EN 1540:2011,[2] definition 2.4.5]

3.8
sorbent tube
device, usually made of metal or glass, containing a collection substrate such as a sorbent or a support impregnated with reagent

Note 1 to entry: Some sorbent tubes are intended for use as active samplers and some as passive samplers.

[SOURCE: EN 1540:2011,[2] definition 3.2.5]

3.9
pressure drop
<sampling train> difference between ambient pressure and the pressure at the inlet of the pump, for a constant volume flow rate setting

Note 1 to entry: The pressure drop, sometimes referred to as back pressure, is measured across the sampler, the collection substrate and the tubing.

3.10
flow-controlled pump
pump with nominally constant flow rate provided by an automatic flow control system

3.11
nominal flow rate range
range of volume flow rate values, adjustable at the pump, at which the manufacturer claims that the pump can operate at a constant flow rate up to the maximum value of the required pressure drop range for the operating time

3.12
operating time
period during which the pump can be operated at specified flow rate and pressure drop without recharging or replacing the battery

3.13
pulsation
short-term relative variation of volume flow rate at a given flow rate

4 Types of pump

Sampling pumps are classified according to their intended use as follows:

— type P: pumps for personal sampling of airborne particles;

— type G: pumps for personal sampling of gases and vapours.

NOTE 1 Type P pumps can be used for personal sampling of gases and vapours as long as they comply with the type G pump requirements.

NOTE 2 For types of pump mechanism and control system. see Annex A.

5 Requirements

5.1 Features

The pump shall have the following features:

a) an automatic control which keeps the volume flow rate nominally constant;

b) a means to reduce the likelihood of unintentional or unauthorized adjustment of any pump control, such that it is concealed beneath a cover, can only be actuated with the aid of a tool or requires specialized knowledge for operation;

c) either a malfunction indicator which, following completion of sampling, indicates that the air flow has been reduced or interrupted during sampling, or an automatic cut-out which stops the pump if the flow rate is reduced or interrupted;

d) a fuse or resettable breaker which interrupts the current in the electrical circuit of the pump in the case of excessive current drain;

e) a filter which prevents particles from being drawn into the mechanism of the pump;

f) a means to secure the pump on a person (integrated or available as an accessory).

NOTE Some pumps use internal sensors to provide atmospheric, pressure and air flow data. Information on the use of these sensors is given in Annex B.

5.2 Mass

The mass of the pump, including batteries and integral holders, shall not exceed 1,2 kg for sampling pumps with a flow rate of less or equal than 5 $l \cdot min^{-1}$ and 2,5 kg for sampling pumps with a flow rate above 5 $l \cdot min^{-1}$.

5.3 Design safety

The outer case of the pump shall be so designed that there are no sharp corners or other uncomfortable protruding parts.

5.4 Operating time

The operating time shall be at least 1 h and should preferably be greater than 8 h. This applies to the complete nominal flow rate range against the pressure drops as specified in Table 4 at (5 ± 2) °C.

NOTE The capacity of a battery increases with temperature. Therefore, the test is performed towards the lower end of the temperature range in which the pump is likely to be used.

For the duration of the operating time, the flow rate shall not deviate by more than 5 % from the initial value.

The manufacturer shall report, in the instructions for use, the operating time at the specified pressure drop according to 5.10 for the flow rates given in Table 1 at (5 ± 2) °C.

Table 1 — Flow rates for reporting by the manufacturer of the operating time

Pump type	Nominal flow rate range	Flow rate setting
	$ml \cdot min^{-1}$	$ml \cdot min^{-1}$
P	≤5 000	2 000
		Maximum value of the nominal flow rate range of the pump
	>5 000	Minimum value of the nominal flow rate range of the pump
		Maximum value of the nominal flow rate range of the pump
G	≤300	50
		Maximum value of the nominal flow rate range of the pump
	>300	300
		Maximum value of the nominal flow rate range of the pump
NOTE For regular user tests to maintain pumps and flow meters, see Annex C.		

5.5 Start-up and long-term performance

During operation of the pump at (5 ± 2) °C and in the range from 20 °C to 25 °C, the flow rate shall not deviate by more than 5 % from the value measured at the start of the determination of the long-term performance.

5.6 Short-term interruption of air flow

When the air flow is fully blocked, the pump shall cut out or the malfunction indicator activate. The pump may try to restart automatically after the airflow is becoming blocked. If the air flow is blocked for more than (120 ± 10) s, the pump shall not restart automatically or the malfunction indicator shall remain activated until reset.

5.7 Temperature dependence

When the flow rate is set within the temperature range from 20 °C to 25°C in accordance with 7.7, it shall not deviate by more than 5 % after cooling down the sampling train to (5 ± 2) °C within about 2 h and running for a period of (60 ± 1) min when the temperature is changed to the next (fixed) value within the range from 5 °C to 40 °C as stated in 7.7.3.

5.8 Mechanical strength

The general function of the pump shall not be impaired by shock treatment (see 7.8). No mechanical damage or electrical defect shall occur.

After shock treatment, the flow rate measured shall not deviate by more than 5 % from the value measured prior to shock treatment.

5.9 Pulsation of flow rate (for type P pumps only)

For type P pumps, the pulsation shall not exceed 10 % of the flow rate.

By recording the time curve of the flow rate the pulsation P is given by Formula (1):

$$P = \frac{\sqrt{\frac{1}{T}\int_0^T \left[f(t) - \bar{f}\right]^2 \mathrm{d}t}}{\bar{f}} \times 100 \tag{1}$$

where

$f(t)$ is the volume flow rate over time t, in litre per minute ($l \cdot min^{-1}$), calculated from the measurement of velocity;

$\bar{f}$ is the mean volume flow rate over time T, calculated in litre per minute ($l \cdot min^{-1}$), from the measurement of velocity;

t is the time, in seconds (s);

T is the time period of pulsation, in seconds (s).

The quantity $f(t)$ is not necessarily the absolute air flow, but shall have a direct linear relationship to the flow rate.

NOTE P can be measured in several ways. See 7.9 for examples.

5.10 Flow rate stability under increasing pressure drop

5.10.1 Pumps with a nominal flow rate range less or equal than 5 000 ml · min^{-1}

When set within the nominal flow rate range of the pump, the flow rate shall not deviate by more than ±5 % from the initial value on changing the pressure drop within the range specified in Table 2.

5.10.2 Pumps with a nominal flow rate range above 5 000 ml · min^{-1}

When set within the nominal flow rate range of the pump, the flow rate shall not deviate by more than ±5 % from the initial value on changing the pressure drop within the nominal pressure drop range specified by the pump manufacturer.

5.11 Timer accuracy

If the pump has an internal timer, the indicated time shall not deviate by more than ±0,5 % from that of a calibrated timer.

5.12 Electromagnetic compatibility

The pump shall meet the requirements for electromagnetic compatibility according to IEC 61000-6-1 and IEC 61000-6-3.