



SLOVENSKI STANDARD
oSIST prEN ISO 13137:2021
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Zrak na delovnem mestu - Črpalke za osebno vzorčenje kemičnih in bioloških agentov - Zahteve in preskusne metode (ISO/DIS 13137:2021)

Workplace atmospheres - Pumps for personal sampling of chemical and biological agents - Requirements and test methods (ISO/DIS 13137:2021)

Arbeitsplatzatmosphäre - Pumpen für die personenbezogene Probenahme von chemischen und biologischen Arbeitsstoffen - Anforderungen und Prüfverfahren (ISO/DIS 13137:2021)

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Air des lieux de travail Pompes pour le prélèvement individuel des agents chimiques et biologiques Exigences et méthodes d'essai (ISO/DIS 13137:2021)

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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

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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 of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 146, *Air quality*, Subcommittee SC 2, *Workplace atmospheres*.

This second edition cancels and replaces the first edition (ISO 13137:2013), which has been technically revised. The main changes compared to the previous edition are as follows:

- definitions that appear in ISO 18158 have been removed from this document, with ISO 18158 being added as a reference (replacing references to EN 1540);
- references to EN 482 have been replaced with ISO 20581
- the text has been editorially updated.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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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.

ISO 20581^[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.

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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 $10 \text{ ml} \cdot \text{min}^{-1}$, 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 are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies. ISO 18158, *Workplace air - Terminology*

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 terms and definitions given in ISO 18158 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1

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

3.2

pulsation

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

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4 Type 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 deviates by more than 5% or is 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 1 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](#).

NOTE 2 Among the test parameters described in this section, manufacturers shall test at least parameters including operating time, long-term performance, pulsation of flow rates, time accuracy, and flow rate stability under increasing pressure drop.

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 $5 \text{ l} \cdot \text{min}^{-1}$ and 2,5 kg for sampling pumps with a flow rate above $5 \text{ l} \cdot \text{min}^{-1}$.

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 $(5 \pm 2) \text{ }^\circ\text{C}$. 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 $(5 \pm 2) \text{ }^\circ\text{C}$.

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

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

Pump type	Nominal flow rate range	Flow rate setting
	ml · min ⁻¹	ml · 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 [Annex C](#) describes regular tests that users can perform to maintain pumps and flow meters. These tests are not required for compliance with this document.

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 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.

NOTE Some manufacturing sampling pumps are designed to restart automatically for a number of times after being blocked. In this case, it is acceptable to restart automatically provided that the total time does not exceed 120 ± 10 s.

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.

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

For type P pumps, the pulsation shall not exceed 11 % of the mean flow rate. This is the critical maximum value shown by experiment on several different designs of pumps to not alter the size-separation performance of several different designs of cyclones (References [4], [5] and [6]).

By recording the time curve of the flow rate the pulsation P is given as a percentage of the mean flow rate by [Formula \(1\)](#):

$$P = \frac{\sqrt{\frac{1}{T} \int_0^T [f(t) - \bar{f}]^2 dt}}{\bar{f}} \times 100 \quad (1)$$

where

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

\bar{f} is the mean volumetric flow rate over time T , calculated in litre per minute ($l \cdot \text{min}^{-1}$), 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.

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5.10 Flow rate stability under increasing pressure drop

5.10.1 Pumps with a nominal flow rate range less or equal than $5\,000 \text{ ml} \cdot \text{min}^{-1}$

When set within the nominal flow rate range of the pump, the flow rate shall not deviate by more than $\pm 5\%$ from the initial value on changing the pressure drop within the range specified in [Table 2](#).

The choice of pump is driven by the capability of the pump to pull air across the pressure drop. [Annex D](#) lists measured pressure drops across typical collection substrates, supporting the selection of pump type for a particular sampler. It is not necessary for a P-type or G-type pump to meet every flowrate or pressure drop listed in [Table 2](#). However, the requirement shall be met for the nominal flowrate range specified by the manufacturer.

Table 2 — Required pressure drop range

Pump type	Adjusted flow rate	Required pressure drop range
	$\text{ml} \cdot \text{min}^{-1}$	kPa
P	1 000	0,2 to 4,0
	2 000	0,3 to 4,0
	3 000	0,4 to 4,5
	4 000	0,6 to 5,5
	5 000	0,7 to 5,0

NOTE The upper and lower values specified for the required pressure drop range for type P pumps are typical for an unloaded and heavily loaded filter. The values specified for required pressure drop for type G pumps are typical for one sorbent tube with low flow resistance up to two sorbent tubes in line. See [Annex D](#).