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Introduction

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For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/ Figure/Table/Note	Type of comment	Comment (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



DRAFT International Standard

ISO/DIS 10121-2

Test methods for assessing the performance of gas-phase air cleaning media and devices for general ventilation —

Part 2: Gas-phase air cleaning devices (GPACD)

*Méthodes d'essai pour l'évaluation de la performance des médias
et des dispositifs de filtration moléculaire pour la ventilation
générale —*

Partie 2: Dispositifs de filtration moléculaire (GPACD)

ICS: 91.140.30

This document is circulated as received from the committee secretariat.

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Contents

Page

Foreword	v
Introduction	vi
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Symbols and abbreviated terms	7
4.1 Symbols	7
4.2 Abbreviated terms	8
5 Testing of GPACDs	8
5.1 General	8
5.2 Test setup and normative section of test stand	9
5.3 Raw data, sampling accuracy and normative generation parameters	10
5.4 Test parameters selected between user and supplier	11
5.4.1 General	11
5.4.2 Air flow rate and face velocity	11
5.4.3 Challenge compound	12
5.4.4 Challenge concentration	12
5.4.5 Temperature and relative humidity	12
5.4.6 Test duration	12
5.5 Simplified benchmark setup	12
5.5.1 General	12
5.5.2 Initial removal efficiency test	12
5.5.3 Challenge test concentration	13
5.5.4 GPACDs for VOC tested with toluene	13
5.5.5 GPACDs for acids and bases tested with SO ₂ and NH ₃ , respectively	13
5.5.6 Retentivity test	14
6 Test sequence	14
6.1 General	14
6.2 Conditioning and pressure drop determination	14
6.2.1 Procedure	14
6.2.2 Calculations	15
6.2.3 Reporting and graphs	15
6.3 Initial removal efficiency	15
6.3.1 Procedure (continued from 6.2.1)	16
6.3.2 Calculations	16
6.3.3 Reporting and graphs	17
6.4 Capacity determination	17
6.4.1 Procedure (continued from 6.2.1 or 6.3.1)	17
6.4.2 Calculations	18
6.4.3 Reporting and graphs	19
6.5 Retentivity determination	20
6.5.1 Procedure (continued from 6.4.1)	20
6.5.2 Calculations	20
6.5.3 Reporting and graphs	20
7 Validation of test setup	21
7.1 General	21
7.2 Determination of rise time and decay time	21
7.2.1 Procedure	21
7.2.2 Calculations	21
7.2.3 Reporting and graphs	22
8 Evaluation and report	23
8.1 Test report introduction	23

8.2	Test report example	23
9	Safety features	26
Annex A (normative)	Test equipment requirements, equipment validation and routine operation	28
Annex B (informative)	Challenge compounds, generation sources and analysis techniques	32
Annex C (informative)	Test equipment designs	37
Bibliography		40

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 (see 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 142, *Cleaning equipment for air and other gases*.

This second edition cancels and replaces the first edition (ISO 10121-2: 2013), which has been technically revised.

The main changes are as follows:

- Feedback from the earlier systematic review in 2018 of this standard, doc (ISO/TC142 N058) and from the earlier systematic review in 2019 of the related ISO 10121-1, doc (ISO/TC142 N666) have been considered and included where applicable:
 - terms and definitions have been updated to conform with ISO 29464:2024;
 - the toluene concentration have been adjusted in the simplified benchmark test for initial efficiency and all other challenge concentrations now conform with ISO 10121-1 and ISO 10121-3;
 - test compounds have been reviewed in [Annex B](#) and concentration recommendations have been removed for compounds requiring special attention
- [clauses 5.5.1, 6.2.1, 6.3.1, 6.4, 6.4.1, 6.4.3, 6.5, 6.5.1](#) and [7.2.1](#) have been reworded and clarified. In addition, challenge gas, species or compound have been changed to compound unless a specific gas e.g SO₂ is discussed.
- the formula in [6.3.2](#) have been corrected;

A list of all parts in the ISO 10121 series can be found on the ISO website.

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.

Introduction

There is an increasing use and need for gas-phase filtration in general filtration applications. This demand can be expected to increase rapidly due to the increasing pollution problems in the world together with an increasing awareness that solutions to the problems are available in the form of filtration devices or, phrased more technically, gas-phase air cleaning devices (GPACD). The performance of devices relies to a large extent on the performance of a gas-phase air cleaning media (GPACM) incorporated in the device. Still applications and device performance are often poorly understood by the users and suppliers of such media and devices. Media tests may also be adequate to offer data for real applications if actual low concentrations (< 100 ppb) and longer exposure times (>weeks) can be used in the test, provided that the geometrical configuration, packing density and flow conditions of the small-scale test specimen are equal to those used in the real applications. Such tests are however not included in the scope of ISO 10121. ISO 10121 attempts to increase understanding and communication by supplying a more standardized interface between media suppliers, device suppliers and end users. At present, standards exist for general ventilation in Japan [1] by JIS, automotive filters by ISO, [3] in-duct sorptive media gas-phase air-cleaning devices by ASHRAE [6] and for adsorptive media by ASHRAE [7] and ASTM. [8] No international standard for general filtration exists today.

This document prescribes methods, test equipment, data interpretation and reporting for gas-phase air cleaning devices intended for the removal of gas-phase contamination from air in general ventilation applications.

In addition, information is given in a number of annexes:

- [Annex A](#) describes the normative validation procedure in detail in a tabulated form.
- [Annex B](#) gives a list of possible test compounds, generation sources and suggests suitable analysis equipment for common test compounds in addition to reference techniques given for the simplified benchmark setup in [Clause 5.5](#).
- [Annex C](#) discusses different test stand designs.

A general introduction to molecular filtration and molecular filtration testing can be found in the scientific literature.

The ISO 10121 series consists of three parts.

- ISO 10121-1 covers three different media configurations and aims to provide a standardized interface between media suppliers and producers of air cleaning devices. It may also be used between media suppliers and end customers with regards to loose fill media properties.
- ISO 10121-2 aims to provide a standardized interface between suppliers of air cleaning devices and end customers seeking the most cost-efficient way to employ gas-phase filtration.
- ISO 10121-3 provides a classification system for the specific application of GPACDs in general, ventilation systems for cleaning of outdoor air polluted by local urban sources and/or long-range transboundary air pollution.

Test methods for assessing the performance of gas-phase air cleaning media and devices for general ventilation —

Part 2: Gas-phase air cleaning devices (GPACD)

1 Scope

This document aims to provide an objective test method to estimate the performance of any full size gas filtration device (GPACD) for general filtration regardless of media or technique used in the device. In fact, the goal of this document is to avoid relating the test data to internal parameters altogether. The benefit with this approach is that customers of GPACDs will be able to concentrate on price/performance and suppliers will have access to a normative and objective test standard that will not require the release of proprietary information or reverse engineering of the product.

To ensure objectivity for test equipment suppliers, no specific design of the test apparatus is specified. Instead requirements of apparatus properties and validation tests are specified. However, different design examples in present use are outlined. This document can also be used with technologies such as scrubbers, absorbers, non-sorptive devices or packed columns as long as they fit into the test apparatus, can be meaningfully judged by the test method and are intended for general ventilation applications, both residential and non-residential. Nuclear and military applications are specifically excluded.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 29464:2024, *Cleaning of air and other gases — Vocabulary*

ISO 10121-1, *Test methods for assessing the performance of gas-phase air cleaning media and devices for general ventilation — Gas-phase air cleaning media (GPACM)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in in ISO 29464 and the following apply.

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

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

3.1 absorption

transport and dissolution of one substance into another to form a mixture having the characteristics of a solution

[SOURCE: ISO 29464:2024; 3.5.1]

3.2

adsorbate

molecular compound in gaseous or vapour phase that can be retained by the medium

[SOURCE: ISO 29464:2024; 3.5.3]

3.3

adsorbent

solid material having the ability to retain gases or vapour on its surface through physical or chemical processes

[SOURCE: ISO 29464:2024; 3.5.4]

3.4

adsorbent isotherm

relationship between the amount of a gas physically adsorbed on a surface and the partial pressure of the gas at constant temperature.

3.5

adsorption

process in which the molecules of a gas or vapour adhere by physical or chemical processes to the exposed surfaces of solid substances, both the outer surface and inner pore surface, with which they come into contact

[SOURCE: ISO 29464:2024; 3.5.7]

3.6

breakthrough

amount of gaseous contaminant in the effluent of a GPACD

Note 1 to entry: See "penetration".

3.7

breakthrough vs. time curve

plot of contaminant penetration versus time for a particular challenge concentration and air flow

[SOURCE: ISO 29464:2024; 3.5.12]

3.8

bypass

proportion of the challenge air stream that passes around the GPACD without contacting the media

[SOURCE: ISO 29464:2024; 3.1.5]

3.9

capacity

m_s
amount (mass or moles) of a selected sorbate that can be contained in the filter media of a GPACD at given test conditions, and a specific end point

Note 1 to entry: Capacity can also be negative during desorption.

3.10

challenge concentration

concentration of the test contaminant(s) of interest in the air stream prior to filtration

[SOURCE: ISO 29464:2024; 3.5.16]

3.11

challenge compound

chemical compound that is being used as the contaminant of interest for any given test

[SOURCE: ISO 29464:2024; 3.5.15]

3.12

challenge air stream

test contaminant(s) of interest diluted to the specified concentration(s) of the test prior to filtration

[SOURCE: ISO 29464:2024; 3.5.14]

3.13

channelling

disproportionate or uneven flow of gas through passages of lower resistance due to inconsistencies in the design or production of a GPACD, particularly in packed granular beds

[SOURCE: ISO 29464:2024; 3.5.17]

3.14

chemisorption

chemical adsorption

trapping of gaseous or vapour contaminants on an adsorbent involving chemical reaction on the adsorbent surface

[SOURCE: ISO 29464:2024; 3.5.19]

3.15

concentration

C_n

quantity of one substance dispersed in a defined amount of another

Note 1 to entry: Indices "n" denote location.

[SOURCE: ISO 29464:2024; 3.1.11]

3.16

contaminant

substance (solid, liquid, or gas) that negatively affects the intended use of a fluid

[SOURCE: ISO 29464:2024; 3.1.12]

3.17

decay time

t_{Dn}

time required for the gas contaminant monitoring instrument to record a reduction from an initial value greater than 95 % of the challenge concentration to a final value of less than 5 % of the challenge concentration ($t_{END} - t_{VC}$) at the downstream sampling point for a specific test (n), challenge gas and gas flow after stopping the injection of the contaminant with no GPAC media or device present

[SOURCE: ISO 29464:2024; 3.5.21]

3.18

desorption

process in which adsorbate molecules leave the surface of the adsorbent and re-enter the air stream

Note 1 to entry: Desorption is the opposite of adsorption.

[SOURCE: ISO 29464:2024; 3.5.22]

3.19

diffusor

device that forces the air stream to achieve an even face velocity over the entire cross sectional area of a test duct.

Note 1 to entry: to entry The device may be a perforated plate.

3.20

downstream

area or region into which air flows on leaving an air cleaner

[SOURCE: ISO 29464:2024; 3.1.16]

3.21

removal efficiency vs. time curve

plot of the GPAC medium or device removal efficiency against time over the duration of a challenge test for a particular challenge concentration and air flow

[SOURCE: ISO 29464:2024; 3.5.58]

3.22

removal efficiency vs. capacity curve

plot of the GPACD removal efficiency against the integrated capacity over the duration of a challenge test for a particular challenge concentration and air flow

[SOURCE: ISO 29464:2024; 3.5.56]

3.23

face velocity

volumetric air flow rate divided by nominal air cleaner face area

[SOURCE: ISO 29464:2024; 3.1.20]

3.24

gas

substance whose vapour pressure is greater than the ambient pressure at ambient temperature

[SOURCE: ISO 29464:2024; 3.1.34]

3.25

gas-phase air cleaning device

GPACD

assembly of a fixed size enabling the removal of specific gas- or vapour-phase contaminants

Note 1 to entry: It is normally box shaped or fits into a box of dimensions between 300 × 300 × 300 mm up to approximately 610 × 610 × 610 mm or 2 × 2 × 2 feet.

[SOURCE: ISO 29464:2024; 3.5.34, modified – Note 1 to entry has been modified.]

3.26

GPAC media or device face area

cross-sectional area of the GPAC media or device also including a header frame if so equipped when viewed from the direction of air flow using exact dimensions

[SOURCE: ISO 29464:2024; 3.5.36]

3.27

gas-phase air cleaning medium

GPACM

media or media configuration used for filtering a contaminant

EXAMPLE a porous film or fibrous layer; a bead shaped, granular or pelletized adsorbent (or chemisorbent); a support structure of fabric, foam or monoliths containing adsorbent in the form of small sized particles, granules, spheres or powder; a woven or nonwoven fabric completely made from an adsorbent material

[SOURCE: ISO 29464:2024; 3.5.37]

3.28

initial removal efficiency

efficiency of an unexposed filter or GPACD calculated as soon after the start of a test as is possible

Note 1 to entry: For gas-phase, this should be calculated as soon as a steady reading can be obtained.

3.29

molecular contamination

contamination present in gas or vapour phase in an air stream and excluding compounds in particulate (solid) phase regardless of their chemical nature

[SOURCE: ISO 29464:2024; 3.5.43]

3.30

ppb(v)

parts per billion by volume concentration measure normally used to record ambient levels of outdoor pollution

Note 1 to entry: Units are mm^3/m^3 .

[SOURCE: ISO 29464:2024; 3.5.46]

3.31

ppm(v)

parts per million by volume concentration measure normally used to record ambient levels of outdoor pollution

Note 1 to entry: Units are cm^3/m^3 and ml/m^3 .

[SOURCE: ISO 29464:2024; 3.5.47]

3.32

penetration

P

ratio of contaminant concentration downstream of an air cleaner to the upstream (challenge) concentration

Note 1 to entry: sometimes expressed as a percentage

Note 2 to entry: Penetration (*P*) related to efficiency (*E*) by the expression: $E = (1 - P) \times 100 \%$.

Note 3 to entry: Penetration is related to the decontamination factor (DF) by the expression, $DF = 1/\text{penetration}$

[SOURCE: ISO 29464:2024; 3.1.41]

3.33

physisorption

physical adsorption

attraction of an adsorbate to the surface, both outer surface and inner pore surface, of an adsorbent by physical forces (Van der Waals forces)

[SOURCE: ISO 29464:2024; 3.5.48]

3.34

pore

minute passageways through which fluid may pass or that expose to the fluid stream the internal surfaces of an adsorbent media

[SOURCE: ISO 29464:2024; 3.5.49]

3.35

pressure drop

Δp
difference in pressure between two points in an air flow system at specified conditions, especially when measured across a GPACD

3.36

removal efficiency

E
fraction or percentage of a challenge contaminant that is removed by an air cleaner

[SOURCE: ISO 29464:2024; 3.1.17]

3.37

retentivity

m_r
measure of the ability of an adsorbent or GPACD to resist desorption of an adsorbate

Note 1 to entry: Computed as the residual capacity (fraction remaining) after purging the adsorbent with clean, conditioned air only, following challenge breakthrough.

[SOURCE: ISO 29464:2024; 3.5.63]

3.38

residence time

t_r
relative time that an increment of fluid (or contaminant) is within the boundaries of the medium volume

Note 1 to entry: An example of the medium volume is a bed of granules or a non-woven sheet.

Note 2 to entry: In typical use and in this document, this value neglects the fact that the media and possible support structures occupy a significant portion of the volume of the bed (residence time is calculated as total bed volume/air flow rate)

[SOURCE: ISO 29464:2024; 3.5.62]

3.39

rise time

t_{Rn}
time between initial injection of contaminant and reaching 95 % of the challenge concentration for an empty duct ($t_0 - t_{V0}$) measured at the downstream sampling

Note 1 to entry: Rise time is specific to a particular test, challenge gas and gas flow rate

[SOURCE: ISO 29464:2024; 3.5.42]

3.40

sorbate

molecular compounds that are retained in the adsorbent of the device

Note 1 to entry: The sorbate will refer to both intended compounds like the selected challenge gas in a test or pollution in real service but also any other compound present in the air stream e.g. gases and vapours.

[SOURCE: ISO 29464:2024; 3.5.66]

3.41

sorption

process in which gas or liquid molecules are removed by a GPACD media by absorption or adsorption

[SOURCE: ISO 29464:2024; 3.5.67]

3.42

vapour

substance whose vapour pressure is less than the ambient pressure at ambient temperature, but is present in the gas phase through evaporation or sublimation

[SOURCE: ISO 29464:2024; 3.5.72]

4 Symbols and abbreviated terms

4.1 Symbols

C_U	upstream concentration [ppb, ppm] measured at a position X mm before the device
C_D	downstream concentration [ppb, ppm] measured at a position Y mm after the device
Δp	pressure drop measured over the tested device [Pa]
E_I	initial removal efficiency [%] for the device measured at a low (< 1 ppm) challenge concentration during the initial efficiency test in 6.3
E_C	removal efficiency [%] for the device measured at the challenge concentration selected during the capacity test in 6.4
E_{END}	removal efficiency recorded at stop test time or value agreed between user and supplier [%]
m_r	retentivity [g], [mol]; the amount withheld by the device after ventilating with clean air at the same flow selected during the capacity test until C_D reaches a specified value close to zero.
m_{SEI}	the integrated amount in moles or grams of challenge compound accumulated during the initial efficiency test in Formula (2)
m_{SU}	the integrated amount in moles or gram of challenge compound accumulated during measurement at the upstream position in Formula (3)
m_{SD}	the integrated amount in moles or grams of challenge compound accumulated during measurement at the downstream position in Formula (3)
m_s	the total integrated amount [g], [mol] of challenge compound accumulated during the whole challenge test
p_U	upstream pressure [Pa] measured at a position X mm before the device
p_D	downstream pressure [Pa] measured at a position Y mm after the device
Q	flow used in test (normally the rated flow for the tested device) [m^3/h] measured at a position Z mm after the device
RH_U	upstream relative humidity [%] measured at a position X mm before the device
RH_D	downstream relative humidity [%] measured at a position Y mm after the device
t_0	start time. The time when C_U (contamination concentration upstream) equals the selected challenge concentration for an empty duct
t_{END}	time when a test is stopped. The time when a desired concentration or other termination criteria have been met in any of the prescribed test procedures (agreed between user and supplier)
t_{DC}	decay time for challenge concentration
t_{DE}	decay time for initial efficiency concentration