BS EN 16841-2:2016

BSI Standards Publication

Ambient air — Determination of odour in ambient air by using field inspection

Part 2: Plume method

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee EH/2/3, Ambient atmospheres.

A list of organizations represented on this committee can be obtained on request to its secretary.

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European foreword

This document (EN 16841-2:2016) has been prepared by Technical Committee CEN/TC 264 "Air quality", the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by May 2017, and conflicting national standards shall be withdrawn at the latest by May 2017.

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EN 16841, *Ambient air - Determination of odour in ambient air by using field inspection* consists of the following parts:

— *Part 1: Grid method*

— *Part 2: Plume method*

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Introduction

Part 1 (grid method) and Part 2 (plume method) of this European Standard describe methods for direct assessment of odours in ambient air.

This European Standard supplements the dynamic olfactometry method described in EN 13725 which is generally only suitable for measurement of odour emissions 'at source'. As the practical lower detection limit is typically ≥ 10 ouE/m^3, EN 13725 cannot be applied to directly determine odour exposure in the field (i.e. measure faint odours at the concentration where they can just be recognized).

The methods for measuring odour presented in this European Standard make direct use of odour perception, the effect of odorants on the human sense of smell. The standard involves the use of qualified human panel members in the field to directly assess the presence of recognizable odours in ambient air, and provide data that can be used to characterize odour exposure in a defined assessment area. The standard presents two key approaches as summarized as follows:

— Part 1 describes a grid method which uses direct assessment of ambient air by panel members to characterize odour exposure in a defined assessment area.

— Part 2 (presented in this document) describes a plume method to characterize the presence of odour by determining the extent of the downwind odour plume of a source.

Although the ultimate application of this method is in monitoring the risk of exposure to odours and the resulting odour annoyance, there is no direct relation between the presence of recognizable odours and the occurrence of odour annoyance. The process leading to odour annoyance being experienced by an individual or a community is highly complex. Additional investigations are necessary to establish a link between odour exposure and the risk of odour annoyance, which is profoundly influenced by odour exposure frequency, by the type and hedonic tone of the odour perceived, and by the characteristics of those exposed to the odour (the receptor). The relationship between odour exposure and annoyance is not within the scope of this European Standard.

The sensory methods described are only suitable for the assessment of odour in ambient air. They are not suitable for the assessment of substances that cannot be detected by sensory methods, in particular when these substances may cause health effects not directly related to their perceived smell.

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1 Scope

This part of the European Standard describes the plume method for determining the extent of recognizable odours from a specific source using direct observation in the field by human panel members under specific meteorological conditions.

The plume method involves the determination of the presence or absence (YES/NO) of recognizable odours in and around the plume originating from a specific odorant emission source, for a specific emission situation and under specific meteorological conditions (specific wind direction, wind speed and boundary layer turbulence). The unit of measurement is the presence or absence of recognizable odours at a particular location downwind of a source. The extent of the plume is assessed as the transition of absence to presence of recognizable odour.

The primary application of this standard is to provide a common basis for the determination of the odour plume extent in the member states of the European Union.

The results are typically used to determine a plausible extent of potential exposure to recognizable odours, or to estimate the total emission rate based on the plume extent, using reverse dispersion modelling.

The field of application of this European Standard includes the determination of the extent of the recognizable odour plume downwind from a source, under specific meteorological conditions (e.g. wind direction, wind speed, turbulence, etc. (see 7.3.2).

This European Standard does not include:

— the measurement of intensity of ambient odours;

— the measurement of hedonic tone of ambient odours;

— the measurement of the odour exposure in ambient air over a longer time period in an assessment area;

— the calculation of estimated source emission rate from plume assessment using reverse dispersion modelling.

An overview of the interaction between existing odour exposure assessment methods is given in Annex A including grid method (Part 1), plume method (Part 2) and olfactometry according EN 13725.

2 Normative references

The following 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.

EN 13725:2003, *Air quality - Determination of odour concentration by dynamic olfactometry*

3 Terms and definitions

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

3.1
sensory adaptation
temporary modification of the sensitivity of a sense organ due to continued and/or repeated stimulation

Note 1 to entry Adaptation can also occur as a result of a gradually increasing stimulation.

[SOURCE: ISO 5492:2008, 2.6, modified – Added Note 1 to entry.]

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3.2
assessor
somebody who participates in odour testing

[SOURCE: EN 13725:2003, 3.1.5]

3.3
crossing (for the dynamic plume method)
series of single measurements by a panel member starting at an odour absence point, crossing the plume direction more or less at a right angle towards an odour absence point on the other side of the plume direction

Note 1 to entry: The crossing shall cover similar distances at each side of the plume direction.

Note 2 to entry: When a crossing does not yield odour presence points it shall start at a distance similar to the estimated maximum plume width.

3.4
experienced panel member
panel member with the necessary experience to make valid observations for the dynamic method according to 6.2.2

Note 1 to entry: To become an experienced panel member a panel member shall participate at least five times in a measurement cycle with at least three different odour types.

3.5
European odour unit
amount of odorant(s) that, when evaporated into 1 cubic metre of neutral gas at standard conditions, elicits a physiological response from a panel (detection threshold) equivalent to that elicited by one European Reference Odour Mass (EROM), evaporated in one cubic metre of neutral gas at standard conditions

[SOURCE: EN 13725:2003, 3.1.19]

3.6
field inspection
measuring odours in ambient air using panel members

3.7
field observations coordinator
individual responsible for the correct execution of the field measurement procedure

3.8
field survey
total of measurement sessions required to characterize an exposure level (see part 1 grid method) or plume extent (see part 2 plume method) in an area under study affected by one or more sources or emitting facilities

3.9
hedonic tone (of an odour)
degree to which an odour is perceived as pleasant or unpleasant

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3.10
intensity
<sensation> magnitude of the perceived sensation

[SOURCE: ISO 5492:2008, 2.8]

3.11
intensity
<stimulus> magnitude of the stimulus causing the perceived sensation

[SOURCE: ISO 5492:2008, 2.9]

3.12
intersection line
intersection line is a line perpendicular to the plume direction along which panel members are placed for the stationary plume method

3.13
maximum plume reach
maximum distance downwind where an odour type can be perceived and recognized (under defined meteorological conditions)

3.14
maximum plume reach estimate
distance along the plume direction between the source and the point halfway from the furthest intersection line or crossing where odour presence points were recorded and the first intersection line or crossing where only odour absence points were recorded

3.15
measurement cycle
procedure of consecutive field observations required to determine the odour plume extent once, conducted by a panel under defined meteorological conditions

3.16
measurement leader
individual responsible for the quality assurance of the measurement

Note 1 to entry: The measurement leader can be the same person as the field observations coordinator.

3.17
measurement point
location where single measurement(s) are carried out

3.18
measurement session
set of consecutive measurement cycles conducted with one panel on the same day

3.19
odorant
substance whose volatiles can be perceived by the olfactory organ (including nerves)

[SOURCE: ISO 5492:2008, 1.35]

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3.20
odour
sensation perceived by means of the olfactory organ in sniffing certain volatile substances

[SOURCE: ISO 5492:2008, 3.18]

3.21
odour absence point
measurement point at which the odour under study is not perceived and recognized as a result of a single measurement

Note 1 to entry: See also: odour presence point.

3.22
odour detection
to become aware of the sensation resulting from adequate stimulation of the olfactory system

[SOURCE: EN 13725:2003, 3.1.47]

3.23
odour exposure
contact of a human with a defined odour type, quantified as the amount of odorant(s) available for inhalation at any particular moment

Note 1 to entry: As odorants have no effect below the detection limit of the human subject, exposure to recognizable odours may be characterized as the frequency of occurrence of concentrations above a certain odour concentration (the recognition limit).

3.24
odour hour
odour hour is obtained by a single measurement when the percentage odour time reaches or exceeds 10 % by convention

Note 1 to entry: Only relevant for the stationary method.

Note 2 to entry: A test result of one single measurement can be positive for more than one distinct odour type.

3.25
odour presence point
measurement point at which the odour under study is perceived and recognized as a result of a single measurement

Note 1 to entry: See also: odour absence point.

3.26
odour recognition (in ambient air)
odour sensation in ambient air that allows positive identification of the odour type

3.27
odour type
odour that can be recognized and assigned to a certain installation or source

Note 1 to entry: Odour types are defined specifically for one survey. One installation can emit more than one odour type. Several facilities can emit the same odour type.

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3.28
olfactory
pertaining to the sense of smell

[SOURCE: EN 13725:2003, 3.1.54]

3.29
panel
group of panel members

[SOURCE: EN 13725:2003, 3.1.59]

3.30
panel member
assessor who is qualified to perform field inspections according to 6.2

Note 1 to entry: See also: experienced panel member.

3.31
panel selection
procedure to determine which assessors are qualified as panel members

[SOURCE: EN 13725:2003, 3.1.62]

3.32
percentage odour time
quotient, expressed as a percentage, of positive observations for one or more odour types made for one single measurement

Note 1 to entry: One single measurement consists of 60 observations.

Note 2 to entry: Only relevant for the stationary method.

3.33
observation
assessment of the presence or absence of recognizable odour during a single measurement

3.34
plume direction
line from the source in the mean direction of dispersion projected to ground level

Note 1 to entry: The plume direction is typically derived from the wind direction.

3.35
plume extent
shape of the plume delineated by a smoothed interpolation polyline through the transition points, the source location and the location determined by the maximum plume reach estimate

3.36
plume extent area
surface area enclosed by a smoothed interpolation polyline through the transition points, the source location and the location determined by the maximum plume reach estimate

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3.37
plume width
distance between two transition points perpendicular to the plume direction

3.38
quality assurance
all those planned and systematic actions necessary to provide adequate confidence that a product, process or service will satisfy given requirements for quality

3.39
single measurement
procedure to obtain recorded observations at a given moment at a given measurement point necessary to determine absence or presence of recognizable odour

Note 1 to entry: For the stationary plume method one single measurement results in the test result 'odour hour' or 'non-odour hour'.

Note 2 to entry: For the stationary plume method the absence or presence is determined based on the observed percentage odour time over a defined single measurement duration. For the dynamic plume method the absence or presence is based on the direct and instantaneous observation of recognizable odour or the lack of it.

3.40
single measurement duration
time required to conduct a single measurement

Note 1 to entry: The single measurement duration is 10 min (60 observations) for a stationary plume method. A single measurement duration of at least ten minutes is required in order to obtain a representative statement with at least 80 % certainty on the odour situation within an hour [1]. The single measurement duration for the dynamic plume method is the duration of one inhalation (one observation).

3.41
sniffing unit
minimal amount of odorant(s), present into 1 cubic meter of air, that generates a response of recognition of a certain odour type by an experienced panel member, under field conditions

3.42
test result
value of a characteristic obtained by carrying out a specific test method

[SOURCE: ISO 5725-1]

Note 1 to entry: In this European Standard the test result for a single measurement is the presence or absence of recognizable odour.

3.43
transition point
point halfway between the last absence point and the first presence point at the limit of the recognizable odour plume under investigation

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4 Symbols and abbreviations

For the purposes of this document, the following symbols and abbreviations apply.

L_+	Number of positive observations per measurement cycle and measurement point
L_M	Monin-Obukhov Length in m
ou_E	European odour unit
P_{od}	Percentage odour time
R	Total number of assessments per measurement cycle
su	Sniffing unit (see Annex G)
z_0	roughness length in m

5 Principle of plume extent measurement

The plume method is used to determine the extent of the area where the odour plume originating from a specific odorant source or an odorant emitting installation can be perceived and recognized, under specific meteorological and specific operating conditions.

The odour plume extent is described by points where a transition from absence to presence of the recognizable odour under investigation, occurs.

The results are typically used to determine a plausible extent of potential exposure to recognizable odours, or to estimate the total emission rate using reverse dispersion modelling. The plume extent measurement is particularly useful as a starting point for estimating emission rates for diffuse odorant sources where sampling at source is impracticable.

Panel members are used to determine the presence or absence of the specific odour under investigation at different points downwind of a source under well-defined meteorological conditions.

These conditions are chosen to ensure that the extent of the plume is well defined. The meteorological conditions during the field observations are measured and recorded.

Typically, the measurement is repeated to reduce uncertainty to an acceptable level. In this way variability due to random variations in meteorological conditions, panel member performance and odorant emission is averaged out. There are two versions of observation methods for plume measurement in this standard:

— stationary plume method (see 8.2),

— dynamic plume method (see 8.3).

Using the stationary method, the panel members are located at specific intervals along intersection lines perpendicular to the plume direction. Several panel members are positioned at intervals along each intersection line to cover the estimated width of the recognizable plume. Each panel member determines the percentage odour time in the course of one single measurement. If the result of a single measurement reaches a percentage odour time < 10 %, the odour is considered as being absent; at higher values the odour is present. Single measurements at one intersection line are conducted simultaneously; intersection lines at different distances from the source are assessed subsequently

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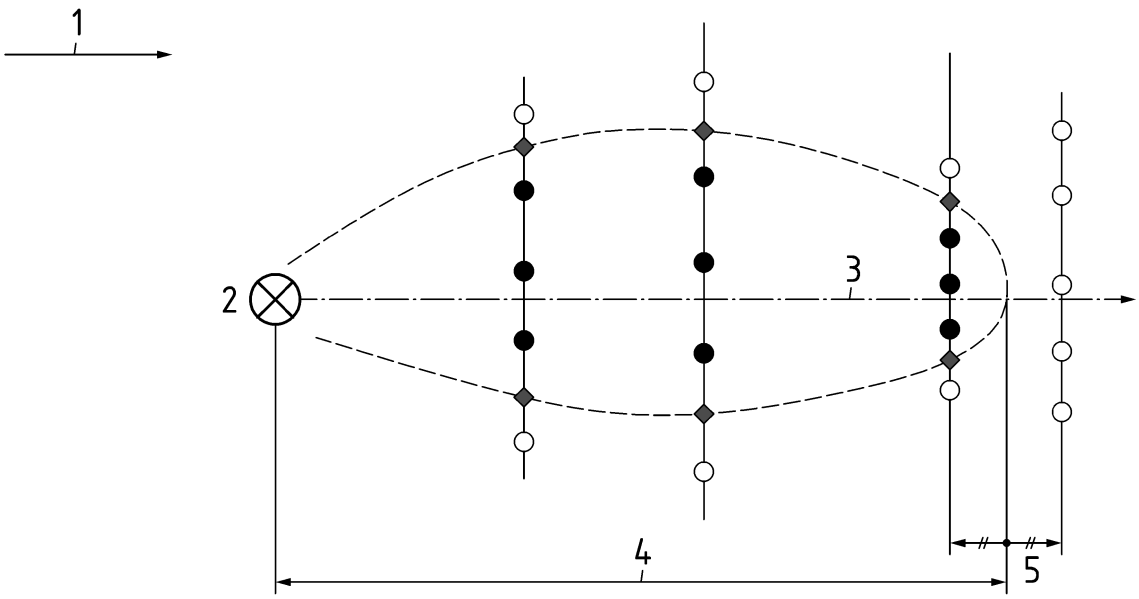
assuming that the relevant meteorological conditions remain the same. At least one intersection line has to be at sufficient distance to ensure that no recognizable odour is present at any measurement point to be able to determine the maximum plume reach estimate.



Key

● single measurement: odour presence point

○ single measurement: odour absence point

◆ transition point

| intersection lines

plume extent

1 wind direction

2 source

3 plume direction

4 maximum odour plume reach estimate

5 equal distance between the last intersection line with and the one without recognizable odour

Figure 1 — Schematic diagram of an example of stationary plume measurement

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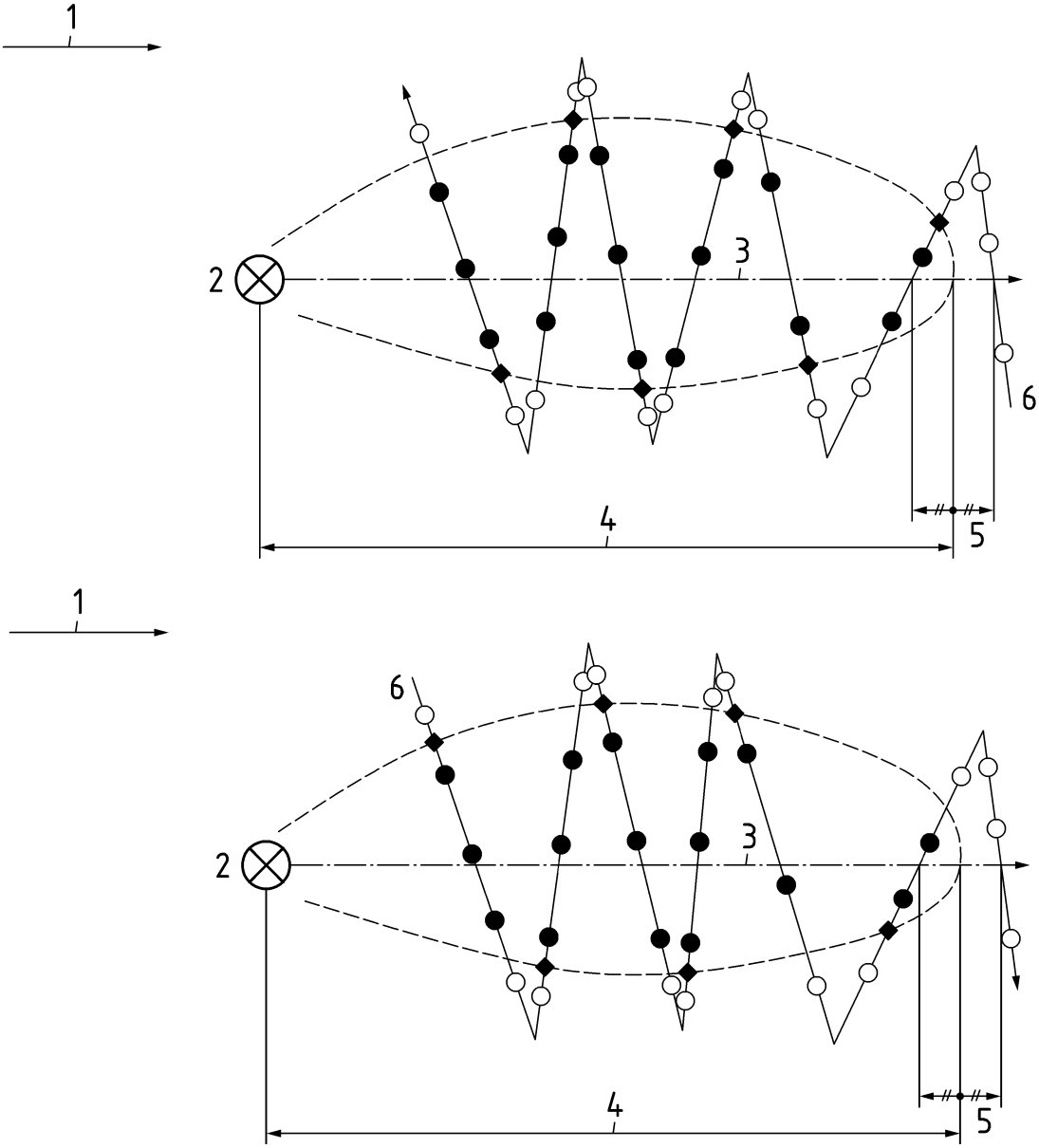

Key

●	single measurement: odour presence point
○	single measurement: odour absence point
◆	transition point
	Crossings
	plume extent
1	wind direction
2	source
3	plume direction
4	maximum odour plume reach estimate
5	equal distance between the furthest crossing with and the one without recognizable odour
6	start of measurement

Figure 2 — Schematic diagrams of an example of dynamic plume measurement; in the first drawing the measurement commences moving towards the source; in the second drawing the measurement commences from the source

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