SLOVENSKI STANDARD
SIST EN 16841-1:2017

01-julij-2017

Zunanji zrak - Določevanje vonja v zunanjem zraku s terenskim pregledom - 1. del: Rastrska metoda

Ambient air - Determination of odour in ambient air by using field inspection - Part 1: Grid method

Außenluft - Bestimmung von Geruchsstoffimmissionen durch Begehungen - Teil 1: Rastermessung

Air ambiant - Détermination de l'exposition aux odeurs par mesures de terrain - Partie 1 : Méthode de la grille

Ta slovenski standard je istoveten z: **EN 16841-1:2016**

ICS:

13.040.20	Kakovost okoljskega zraka	Ambient atmospheres

SIST EN 16841-1:2017 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 16841-1

November 2016

ICS 13.040.20

English Version

Ambient air - Determination of odour in ambient air by using field inspection - Part 1: Grid method

Air ambiant - Détermination de la présence d'odeurs par mesures de terrain - Partie 1 : Méthode de la grille

Außenluft - Bestimmung von Geruchsstoffimmissionen durch Begehungen - Teil 1: Rastermessung

This European Standard was approved by CEN on 10 September 2016.

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Ref. No. EN 16841-1:2016 E

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European foreword

This document (EN 16841-1:2016) 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of an identical text or by endorsement, at the latest by May 2017, and conflicting national standards shall be withdrawn at the latest by May 2017.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

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*

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

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 ou_E/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 odour 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 summarized as follows:

— Part 1 (presented in this document) 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 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 here 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.

1 Scope

This part of the European Standard describes the grid method for the determination of the level of odour exposure in ambient air. It provides a set of instructions for measurement of ambient odour exposure within a defined assessment area, using qualified human panel members, over a sufficiently long period of time to be representative for the meteorological conditions of that location, and hence determine the distribution of the frequency of exposure to odours within the assessment area. The sources of the odorant under study may be located within or outside the assessment area.

The primary application of this European Standard is to provide a common basis for evaluation of exposure to ambient odours in the member states of the European Union. The field of application of this type of measurement is to characterize the level of odour exposure within the study area, in order to assess whether the impact of that exposure on resident population could be a justified cause for annoyance, using exposure criteria. The unit of measurement of the method is the frequency of odour hours for an assessment square, defined by four measurement points as a representative value for odour exposure for local conditions, e.g. local odour sources and the meteorology of that location.

This European Standard does not include:

— the measurement of intensity of ambient odours,

— the measurement of hedonic tone of ambient odours,

— the calculation of odour exposure in specific weather conditions in order to determine the frequency distribution of recognizable odour in an odorant plume,

— 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 to 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
assessment area
area which covers all assessment squares of a grid

Note 1 to entry: The size and shape depend on the objective of the assessment and on the number and type of odorant sources that have an influence on the odour exposure in the area of study.

3.2
assessment square
element of the assessment area, defined by four adjoining measurement points on the grid

Note 1 to entry: Assessment squares are only necessary at locations where an odour assessment is required. These are generally residential areas or stand-alone houses.

3.3
assessor
somebody who participates in odour testing

[SOURCE: EN 13725:2003, 3.1.5]

3.4
field inspection
measuring odours in ambient air using panel members

3.5
field observations coordinator
individual responsible for the correct execution of the field measurement procedure

3.6
field survey
total of single measurements required to characterize an exposure level in an assessment area affected by one or more sources or emitting installations

3.7
grid
all assessment squares of the assessment area

3.8
hedonic tone (of an odour)
degree to which an odour is perceived as pleasant or unpleasant

3.9
measurement duration
time required to conduct a single measurement

Note 1 to entry: The measurement duration for a single measurement is 10 min.

3.10
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.

3.11
measurement point
location where single measurements are carried out

Note 1 to entry: Measurements points are only necessary at locations where an odour assessment is required. These are generally residential areas or stand-alone houses.

3.12
measurement round
measurement points to be inspected by one panel member during one measurement day constitute a measurement round

3.13
observation
assessment of the presence or absence of recognizable odour during a single measurement once. One single measurement consists of 60 observations

Note 1 to entry: A positive observation is given when a recognizable odour is detected.

3.14
odorant
substance whose volatiles can be perceived by the olfactory organ (including nerves)

[SOURCE: ISO 5492:2008, 1.35]

3.15
odour
sensation perceived by means of the olfactory organ in sniffing certain volatile substances

[SOURCE: ISO 5492:2008, 3.18]

3.16
odour detection
to become aware of the sensation resulting from adequate stimulation of the olfactory system

[SOURCE: EN 13725:2003, 3.1.47]

3.17
odour exposure
contact of a human with a defined recognizable odour type, quantified as the amount of odorant(s) available for inhalation at any particular moment

Note 1 to entry: As odours 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 odorant concentration (the recognition limit).

3.18
odour exposure indicator
characteristic of the environment assessed to provide evidence of the occurrence and/or magnitude of human exposure to a specific odour type

Note 1 to entry: It is related to assessment squares and given by the odour hour frequency.

3.19
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: A test result of one single measurement can be positive for more than one distinct odour types.

3.20
odour hour frequency
ratio of positive test results (number of odour hours) to the total number of test results for an assessment square (or in special cases for a measurement point)

3.21
intensity
<sensation> magnitude of the perceived sensation

[SOURCE: ISO 5492:2008, 2.8]

3.22
intensity
<stimulus> magnitude of the stimulus causing the perceived sensation

[SOURCE: ISO 5492:2008, 2.9]

3.23
odour recognition (in ambient air)
odour sensation in ambient air that allows positive identification of the odour type

3.24
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 installations can emit the same odour type

3.25
olfactory
pertaining to the sense of smell

[SOURCE: EN 13725:2003, 3.1.54]

3.26
panel
group of panel members

[SOURCE: EN 13725:2003, 3.1.59]

3.27
panel member
assessor who is qualified to perform field inspections according to subclause 6.2 of this standard

3.28
panel selection
procedure to determine which assessors are qualified as panel members

[SOURCE: EN 13725:2003, 3.1.62]

3.29
percentage odour time
fraction, 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.

3.30
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

3.31
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: One single measurement results in the test result 'odour hour' or 'non-odour hour'.

3.32
survey duration
time (six or twelve months) over which all single measurements are carried out

3.33
survey scale
number of single measurements (52 or 104) conducted during the survey duration

3.34
test result
value of a characteristic obtained by completely carrying out a specific measurement, once

[SOURCE: ISO 5725-1:1994, 3.2, modified]

Note 1 to entry: In this standard a positive test result is an odour hour obtained by a single measurement.

4 Symbols and abbreviations

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

$F_{od,rel,A,i}$	Odour exposure indicator as the relative odour hour frequency per assessment square, specified according to odour type
F_{od}	Odour exposure indicator as the percentage of the odour hour frequency per assessment square of odour hours, specified according to odour type
$L+$	Number of positive observations per single measurement
n_A	Number of odour hours per assessment square
$n_{A,i}$	Number of odour hours per assessment square, specified according to odour type i
n_{MP}	Number of odour hours per measurement point
N	Survey scale (number of measurements per assessment square)
P_{od}	Percentage odour time
Indices	

x_A	Running index of assessment squares
x_i	Running index of surveyed odour type
x_{limit}	Limit value
x_{lo}	Lower limit
x_{MP}	Measurement point
x_{od}	Odour
x_{rel}	Relative frequency
x_{up}	Upper limit

5 Principle of measurement

The grid method is a statistical survey method which is applied over a sufficiently long period of time, to provide a representative map of the exposure to recognizable odour, spatially distributed over the assessment area. These grid measurements are used to determine the distribution of the odour hour frequency for recognizable odours in ambient air in an assessment area under meteorological conditions that are assumed to be representative for the local meteorology (e.g. the last ten years).

The odour hour frequency is an odour exposure indicator, and can be used to assess the exposure to recognizable odour originating from one or many specific odorant source(s) emitting in a particular area of study.

The odour hour frequency is determined for one or more assessment squares, configured as a grid of measurement points. An example is given in Figure 1.

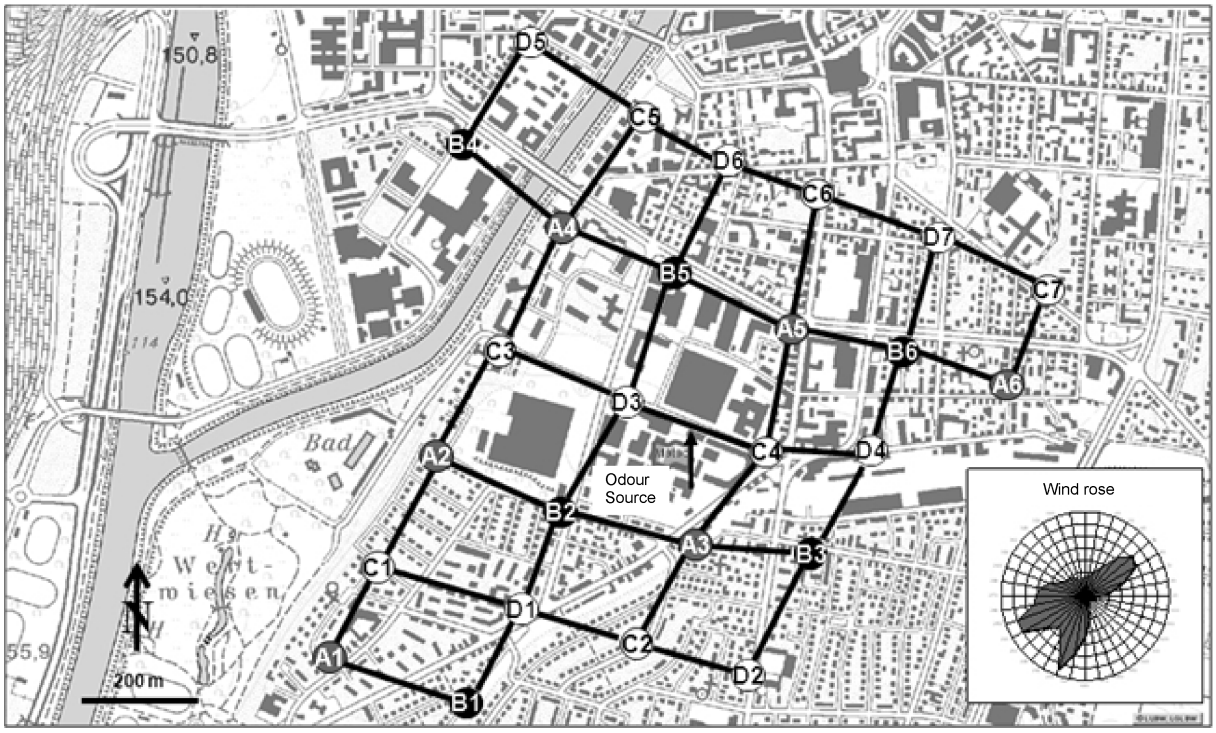

Figure 1 — Example for an assessment area in the surrounding of an odorant source with assessment squares and measurement points

The odour hour frequency for an assessment square is determined by making repeated single measurements by human panel members at the measurement points that define the corners of the assessment square. Each measurement point is measured repeatedly, for example 26 times at regular intervals over a one-year field survey duration. One single measurement results in the test result 'odour hour' or 'non-odour hour'. By summing up the total number of odour hour test results for the four points defining an assessment square, divided by the total number of single measurements conducted at these four measurement points, the odour hour frequency for the assessment square is calculated.

This principle is shown in schematic form in Figure 2.

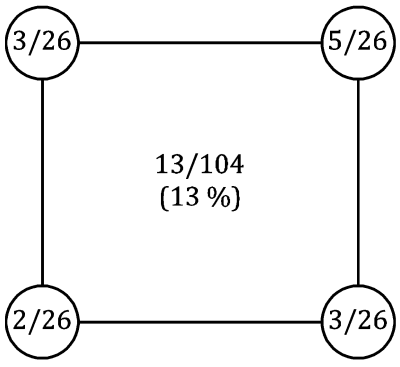

Figure 2 — Schematic representation of the calculation of the odour hour frequency for an assessment square from the combined results obtained for the measurement points at the corners

One single measurement is conducted to determine whether the test result is an 'odour hour' or not. The measurement is conducted by having a human panel member inhale ambient air and smell its odour at 10 s timed intervals, for a total measurement duration of 10 min. In this way 60 individual observations are obtained. Each observation provides an indication of:

— the presence or absence of odour and,

— if an odour is recognized, the odour type.

If a particular odour type reaches or exceeds a percentage odour time of 10 % (i.e. the presence of odour is detected in six or more out of 60 observations), the result is classified as 'odour hour'. This implies that in theory the measurement can result in an 'odour hour' for more than one odour type, although this is rare. The limit of six positive observations to determine the 'odour hour' classification is set by convention.

This provides a map of exposure to a recognizable odour, expressed as odour hour frequency, for a grid of assessment squares. A typical representation of the result for the assessments squares is shown in Figure 3.

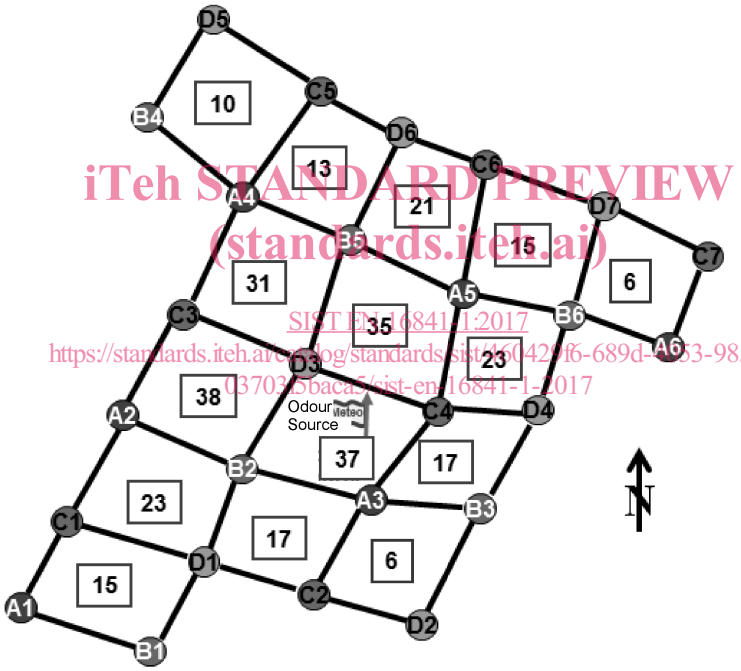

Figure 3 — Example of results of a grid measurement: odour exposure expressed as odour hour frequency in %

The measurements are planned in such a way that in each measurement round only one measurement point of each assessment square is measured. The points are rotated so that after four measurement rounds, all measurement points of an assessment square are covered.

The measurements are planned so that the single measurements are distributed evenly over the survey duration, at almost regular intervals.

To ensure that the odour hour frequency map obtained is representative of the typical meteorological conditions at the location (see 7.2.7), the meteorological conditions for the survey duration are compared to a five to ten year period as recorded at a suitable meteorological station.

The typical survey duration is one year. The meteorological observations obtained for the chosen months have to be comparable with the average conditions over a five to ten year period at a suitable

meteorological station. This is to ensure that the dispersion conditions in the survey duration are representative of the entire year especially if a shorter period of the year is surveyed.

Possible fluctuations or patterns in source emission rates also have to be considered in the measurement planning if possible and/or in the interpretation of the obtained odour exposure.

During the survey duration a dedicated meteorological station is used to record local wind direction and wind speed, which is used to verify the plausibility of the test results at the measurement points.

NOTE 1 In some countries grid measurements are used to assess compliance with air quality criteria for the odour exposure indicator 'odour hour frequency'. This odour exposure indicator can also be used for planning purposes.

NOTE 2 The objective of grid measurements is to measure the odour hour frequency as an odour exposure indicator, but annoyance of residents is not measured. The number of single measurements per assessment square (sample size) is relatively small in a temporal sense but has been demonstrated to be sufficient to map the influence of locally important meteorological factors on the distribution of the odour hour frequency. The results of grid measurements can therefore be used as a reasonable and representative environmental indicator for nuisance potential. The most important meteorological factors driving dispersion are wind direction, wind speed and atmospheric turbulence/stability.

NOTE 3 If there are situations where particular meteorological or emission conditions occur relatively infrequently or where particular meteorological conditions are causing unforeseen annoyance reactions, special consideration should be given to the question whether the result of odour hour frequency obtained is a good and representative environmental indicator for nuisance potential. Some examples of situations where an expert assessment of representativeness would be required are as follows:

a) When regular wind patterns during the day exist, as can be the case in coastal land sea breezes, the situation can arise that a particular location is exposed predictably and with higher probability at a certain time of the day (typically in the early morning or evening, when the wind direction reverses). These exposure events are therefore more likely to correlate with periods when people return home from work and would like to enjoy leisure time. The exposure indicator 'odour hour frequency' may therefore underestimate the potential for nuisance impact on residents at that location in that case.

b) If a source produces short-term peaks in odorant emissions at a particular time of the day (for example because of loading/unloading or cleaning operations), this may lead to a significantly higher odour exposure that occurs only during that limited period of the day at specific locations. It is therefore possible that the odour hour frequency measured by the grid method will not include these events and hence the method will provide an unreliable indication of nuisance potential at that location. If such short-term peaks are known in advance they can be covered by additional measurements (e.g. plume measurements (see Part 2), instrumental measurements of relevant compounds).

c) Under defined terrain and meteorological conditions, 'cold air' flows could occur in the field. It is known that cold air flows may transport odorant emissions over relatively long distances without significant dilution. If these cold air flows occur infrequently, it is possible that they will not be captured by the odour hour frequency measured by the grid method and hence the method will provide an unreliable indication of nuisance potential at that location. If it is known in advance that cold air flows will occur they can be covered by additional measurements (e.g. plume measurements (see Part 2), instrumental measurements of relevant compounds).

d) In very special cases, odour problems could occur if an odour type well-known to the public is replaced by a new odour type because of a change of use of an installation or building. If this new odour type is subjectively associated by the public with stronger impacts it could happen that the annoyance degree increases without an increase of the measured odour exposure.