SLOVENSKI STANDARD
SIST EN 14530:2004

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Zrak na delovnem mestu - Določ evanje delcev iz dizelskih motorjev - Splošne zahteve

Workplace atmospheres - Determination of diesel particulate matter - General requirements

Arbeitsplatzatmosphäre - Bestimmung von teilchenförmigen Emissionen von Dieselmotoren - Allgemeine Anforderungen

Air des lieux de travail - Dosage des matieres particulaires émises par les moteurs diesel - Exigences générales

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13.040.30	Kakovost zraka na delovnem mestu	Workplace atmospheres

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Workplace atmospheres - Determination of diesel particulate matter - General requirements

Air des lieux de travail - Dosage des matières particulaires émises par les moteurs diesel - Exigences générales

Arbeitsplatzatmosphäre - Bestimmung von teilchenförmigen Emissionen von Dieselmotoren - Allgemeine Anforderungen

This European Standard was approved by CEN on 2 February 2004.

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Foreword

This document (EN 14530:2004) has been prepared by Technical Committee CEN/TC 137 “Assessment of workplace exposure to chemical and biological agents”, 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of an identical text or by endorsement, at the latest by October 2004, and conflicting national standards shall be withdrawn at the latest by October 2004.

Annex A is informative.

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

Introduction

Diesel engine exhaust emissions are a complex mixture consisting of gases and vapours such as carbon monoxide, carbon dioxide, sulphur dioxide, nitrogen oxides, aldehydes and hydrocarbons, plus also diesel particulate matter (DPM). DPM is the particulate phase of diesel engine exhaust emissions and contains inorganic components (e.g. sulphates) as well as the ones described in the method. They occur in workplaces where diesel engines operate, especially during tunnel and gallery construction, in freight and transport facilities, in the mining industry and in workshops. The potentially carcinogenic effect of diesel engine exhaust emissions is currently attributed to the particulate phase, especially to those particles that consist of a soot core with associated adsorbed organic compounds. Therefore, these are the components of the total particulate matter that are considered and referred to in this European Standard.

Since the target organ for the carcinogenic effect from DPM is the alveolar lung region, only the respirable fraction as defined in EN 481 is sampled. Since the mass median aerodynamic diameter of DPM is approximately 0,1 µm, sampling this fraction still guarantees complete trapping of all DPM.

NOTE Epidemiological studies from ambient air suggests that there can be other health effects associated with exposure to diesel engine exhaust besides lung cancer.

1 Scope

This European Standard specifies the sampling and analytical requirements for the determination of particulate diesel engine exhaust emissions in workplace atmospheres. Time weighed average mass concentrations are measured for the components of particulate diesel engine exhaust emissions (i.e. OC, EC, TC).

This European Standard enables users to select a procedure to determine occupational exposure to DPM according to a uniform approach and to obtain directly comparable results.

It is the responsibility of users to ascertain that the requirements of EN 482 under the given laboratory conditions are fulfilled.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 481, *Workplace atmospheres — Size fraction definitions for the measurement of airborne particles.*

EN 482: 1994, *Workplace atmospheres — General requirements for the performance of procedures for the measurement of chemical agents.*

EN 689, *Workplace atmosphere — Guidance for the assessment of exposure by inhalation to chemical agents for comparison with limit values and measurement strategy.*

EN 1232, *Workplace atmospheres — Pumps for personal sampling of chemical agents — Requirements and test methods.*

EN 12919, *Workplace atmospheres — Pumps for the sampling of chemical agents with a volume flow rate of over 5 l/min — Requirements and test methods.*

EN 13205: 2001, *Workplace atmospheres — Assessment of performance of instruments for measurement of airborne particle concentrations.*

3 Terms and definitions

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

3.1
components of particulate diesel engine exhaust emissions
organic carbon, elemental carbon and total carbon referred to in this European Standard

NOTE These components are not defined via a specific bonding state of carbon in natural or synthetic substances, but refer to carbon masses determined by performing specific analytical procedures in several subsequent measuring steps. Thus, the components of particulate diesel engine exhaust emissions are directly defined via the analysis procedure.

3.2
organic carbon
OC
organic compounds that can be removed from the soot cores and which are a component of DPM

NOTE It is removed by thermal desorption in an inert gas flow at an appropriate temperature as described in one of the procedures in this European Standard and in a further step is completely converted to carbon dioxide

3.3
elemental carbon
EC
residual soot cores after the organic carbon has been removed

NOTE It is thermally converted to carbon dioxide by heating in an oxygen rich atmosphere at an appropriate temperature as described in one of the procedures in this European Standard.

3.4
total carbon
TC
sum of organic and elemental carbon.

NOTE It can either be determined by summing the components described in 3.2 and 3.3 or by complete conversion to carbon dioxide by direct oxidation of the soot core with its adsorbed organic compounds by means of oxygen or an oxygen rich atmosphere.

3.5
analytical determination
laboratory performed determination of OC, EC, and/or TC in filter samples of the respirable fraction of particles

3.6
recovery rate
ratio of analytically determined value to target value expressed as a percentage

NOTE The recovery rate can be checked using quality control standards which have been used in round robin tests or standards which have been produced using test atmospheres.

3.7
bias (relating to determination of DPM)
consistent deviation of the results of a measurement process from the true value of the air quality characteristic itself

NOTE 1 Adapted from EN 1540: 1998 respectively ISO 6879.

NOTE 2 Because it is not possible to generate a reference atmosphere containing a known concentration of diesel particulate matter no reference value exists. Additionally, there exists no independent analytical procedure for determination of diesel particulate matter. Therefore, in all cases the bias should be considered to be zero.

3.8
overall uncertainty (of a measuring procedure)
quantity used to characterise as a whole the uncertainty of the result given by an apparatus or a measuring procedure

NOTE 1 It is expressed as a percentage, by combination of bias and precision usually according to the formula.

$$\frac{\left|\bar{x} - x_{\text{ref}}\right| + 2s}{x_{\text{ref}}} \times 100$$

where

$\bar{x}$ is the mean value of results of a number n of repeated measurements;

x_{ref} is the true or accepted reference value of concentration;

s is the standard deviation of measurements.

[EN 1540 : 1998]

NOTE 2 For the determination of diesel particulate matter the bias is assumed to be zero (see 3.7). Therefore the overall uncertainty equals to the precision of the overall procedure $\frac{2s}{x_{ref}}$ including sampling and analytical determination. Since there is no reference value for the overall procedure x_{ref} is considered as being the mean of several repetitive measurements. These repetitive measurements should be of high quality originating from diesel aerosol test chamber measurements and interlaboratory studies and should make use of thorough reference materials for the analytical procedure.

NOTE 3 In strict mathematical terms there is no way to combine precision (a variance) and bias (an absolute number). However by occupational hygiene precedent and time honoured convention they have been combined according to the above formula.

3.9
limit of detection
LOD
three times the estimated standard deviation of the mass of the sample, accounting for the double weighing (exposed vs. unexposed) and for the uncertainty associated with any correction blank used

NOTE 1 The value LOD can be used as a threshhold value to assert the presence of a substance with confidence in the method.

[ISO 15767 : 2003]

NOTE 2 See also EN 13890:2002, 3.4.4.

3.10
limit of quantitation
LOQ

ten times the estimated standard deviation of the mass of the sample

NOTE 1 The value LOQ can be used as a threshhold value to assure measurement of a substance accurarely.

[ISO 15767 : 2003]

NOTE 2 See also EN 13890:2002, 3.4.5

4 Abbreviated terms

DPM diesel particulate matter

OC organic carbon

EC elemental carbon

TC total carbon

LOD limit of detection

LOQ limit of quantitation

5 Principle

The respirable fraction of particulate diesel engine exhaust emissions is sampled according to EN 481. OC, EC, or TC are determined by conversion into carbon dioxide and its subsequent analytical determination by a suitable method.

NOTE Various analytical techniques have been demonstrated to be suited. Examples are coulometry, non-dispersive infrared spectroscopy (NDIR) and gas chromatography with flame ionisation detection (GC-FID).

6 Requirements

This clause lists the requirements according to the steps involved in the procedure (particle sampling, analytical determination, measuring procedure and other requirements, see Tables 1 to 4).

The whole analysis procedure shall meet the requirements of EN 482.

Exposure assessment of DPM shall follow the requirements of EN 689.

Table 1 — Particle sampling

No.	Attribute	Requirements	Test methods
6.1.1	particle fraction to be sampled	respirable fraction according to convention in EN 481	see 7.1
6.1.2	accuracy	EN 13205: 2001, 4.2	see 7.2
6.1.3	filter blank values and scattering	use suitable material with regard to blank value level and scattering	see 7.3
6.1.4	flow rate stability	according to EN 1232 and EN 12919	—

Table 2 — Analytical determination

No.	Attribute	Requirements	Test methods
6.2.1	maximum load of DPM on filter	Determine maximum load of DPM on the filter.	see 7.4
6.2.2	limit of detection and limit of quantitation	documented by laboratory	see 7.5.1 and 7.5.2
6.2.3	calibration function	linear over the range of measuring procedure	see 7.6
6.2.4	coefficient of variation of procedure	10% within the range of measuring procedure (LOQ up to maximum load)	see 7.7
6.2.5	recovery rate	95 % to 105 %	see 7.8
6.2.6	instrument blank value	documented by laboratory; constant within 20%	see 7.9

Table 3 — Overall measuring procedure

No.	Attribute	Requirements	Test methods
6.3.1	overall uncertainty	30 % to 50 % according to EN 482	see 7.10
6.3.2	storage	maximum storage time to be determined and documented by the laboratory. (The maximum deviation after storage shall not exceed 5 %.)	see 7.11
6.3.3	field blank values	to be treated like samples, a minimum of three per measuring series is recommended	see 7.12
6.3.4	result unit	results in mg m^{-3}	—
6.3.5	specified measuring range	according to EN 482	—

Table 4 — Other requirements

No.	Attribute	Requirements	Test methods
6.4	sample identification	sample labelling must be unambiguous	—