SLOVENSKI STANDARD
kSIST-TS FprCEN/TS 18040:2024

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Emisije nepremičnih virov - Določanje masne koncentracije formaldehida - Avtomatska metoda

Stationary source emissions - Determination of the mass concentration of formaldehyde - Automatic method

Emissionen aus stationären Quellen - Bestimmung der Massenkonzentration von Formaldehyd - Automatisches Verfahren

Émissions de sources fixes - Détermination de la concentration massique en formaldéhyde - Méthode automatique

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Stationary source emissions - Determination of the mass concentration of formaldehyde - Automatic method

Émissions de sources fixes - Détermination de la concentration massique de formaldéhyde - Méthode automatique

Emissionen aus stationären Quellen - Bestimmung der Massenkonzentration von Formaldehyd - Automatisches Verfahren

This draft Technical Specification is submitted to CEN members for Vote. It has been drawn up by the Technical Committee CEN/TC 264.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (FprCEN/TS 18040:2023) has been prepared by Technical Committee CEN/TC 264 “Air quality”, the secretariat of which is held by DIN.

This document is currently submitted to the Vote on TS.

Introduction

Formaldehyde is a carcinogenic pollutant that is generated in different industrial sectors, like energy industries (combustion plants (e.g. for wood and gas), combustion engines (gas engines and turbines), chemical industry (e.g. formaldehyde production), food industry (e.g. smoking plants), wood industry (e.g. production of wood-based panels or wood pellets) and thus contained in emissions of these processes.

The manual reference method for the measurement of formaldehyde emissions is specified in CEN/TS 17638 [1]. This method is based on the absorption of sampled gas in water and the subsequent analysis of the aqueous samples by spectrophotometry or HPLC.

The results of manual methods and the automatic method showed good agreement for exhaust gas of combustion engines fuelled with biogas [2; 3]. A full equivalence test has not been carried out so far.

1 Scope

This document specifies a measurement method based on an automatic method for determination of the mass concentration of formaldehyde in ducts and stacks emitting to the atmosphere. It specifies the sampling and gas conditioning system. Furthermore, it specifies the characteristics to be determined and the performance criteria to be fulfilled by portable automated measuring systems (P-AMS) using appropriate techniques to measure formaldehyde.

This method is intended for intermittent monitoring of formaldehyde emissions as well as for the calibration and validation of automated formaldehyde measuring systems.

The analyser is calibrated using test gases produced by a test gas generator.

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.

EN 15259:2007, *Air quality - Measurement of stationary source emissions - Requirements for measurement sections and sites and for the measurement objective, plan and report*

EN 15267-4:2017, *Air quality - Certification of automated measuring systems - Part 4: Performance criteria and test procedures for automated measuring systems for periodic measurements of emissions from stationary sources*

EN ISO 14956:2002, *Air quality - Evaluation of the suitability of a measurement procedure by comparison with a required measurement uncertainty (ISO 14956:2002)*

3 Terms and definitions

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

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

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

3.1
ambient temperature
temperature of the air around the measuring system

[SOURCE: EN 16429:2021] [4]

3.2
automated measuring system
AMS
entirety of all measuring instruments and additional devices for obtaining a result of measurement

Note 1 to entry: The term “automated measuring system” applies to stationary and portable AMS.

Note 2 to entry: Apart from the actual measuring device (the analyser), an AMS includes facilities for taking samples (e.g. probe, sample gas lines, flow meters and regulator, delivery pump) and for sample conditioning (e.g. dust filter, pre-separator for interferents, cooler, converter). This definition also includes testing and adjusting devices that are required for functional checks and QAL3 procedures and, if applicable, for commissioning.

Note 3 to entry: The term “automated measuring system” (AMS) is typically used in Europe. The terms “continuous emission monitoring system” (CEMS) and “continuous ambient-air-quality monitoring system” (CAM) are also typically used in the UK and USA.

[SOURCE: EN 15267-1:2023] [5]

3.3
calibration
set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring method or measuring system, and the corresponding values given by the applicable reference

Note 1 to entry: In case of automated measuring system (AMS) permanently installed on a stack, the applicable reference is the standard reference method (SRM) used to establish the calibration function of the AMS.

Note 2 to entry: Calibration should not be confused with adjustment of a measuring system.

[SOURCE: EN 16429:2021] [4]

3.4
drift
difference between two zero (zero drift) or span readings (span drift) at the beginning and at the end of a measuring period

[SOURCE: EN 16429:2021] [4]

3.5
emission limit value
ELV
limit value given in regulations such as EU Directives, ordinances, administrative regulations, permits, licences, authorisations or consents

Note 1 to entry: ELV can be stated as concentration limits expressed as half-hourly, hourly and daily averaged values, or mass flow limits expressed as hourly, daily, weekly, monthly or annually aggregated values.

Note 2 to entry: ELV is mostly stated at standard conditions for dry gas and at a reference oxygen concentration.

3.6
influence quantity
quantity that is not the measurand but that affects the result of the measurement

Note 1 to entry: Influence quantities are e.g. presence of interfering gases, ambient temperature, pressure of the gas sample.

3.7
interference
negative or positive effect upon the response of the measuring system, due to a component of the sample that is not the measurand

3.8
lack of fit
systematic deviation, within the measurement range, between the accepted value of a reference material applied to the measuring system and the corresponding result of measurement produced by the calibrated measuring system

Note 1 to entry: In common language lack of fit is often called "linearity" or "deviation from linearity". Lack of fit test is often called "linearity test".

[SOURCE: EN 15267-4:2017]

3.9
measurand
particular quantity subject to measurement

Note 1 to entry: The measurand is a quantifiable property of the stack gas under test, for example mass concentration of a measured component, temperature, velocity, mass flow, oxygen content and water vapour content.

[SOURCE: EN 15259:2007]

3.10
measurement method
method described in a written procedure containing all the means and procedures required to sample and analyse, namely field of application, principle and/or reactions, definitions, equipment, procedures, presentation of results, other requirements and measurement report

[SOURCE: EN 14793:2017] [6]

3.11
measurement plane
plane normal to the centreline of the duct at the sampling position

Note 1 to entry: Measurement plane is also known as sampling plane.

[SOURCE: EN 15259:2007]

3.12
measurement point
position in the measurement plane at which the sample stream is extracted or the measurement data are obtained directly

Note 1 to entry: Measurement point is also known as sampling point.

[SOURCE: EN 15259:2007]

3.13
performance characteristic
quantity assigned to an instrument in order to define its performance

3.14
portable automated measuring system
P-AMS
automated measuring system which is in a condition or application to be moved from one to another measurement site to obtain measurement results for a short measurement period

Note 1 to entry: The measurement period is typically 8 h for a day.

Note 2 to entry: The P-AMS can be configured at the measurement site for the special application but can be also set-up in a van or mobile container. The probe and the sample gas lines are installed often just before the measurement task is started.

[SOURCE: EN 15267-1:2023] [5]

3.15
reference method
RM
measurement method taken as a reference by convention, which gives the accepted reference value of the measurand

Note 1 to entry: A reference method is fully described.

Note 2 to entry: A reference method can be a manual or an automated method.

Note 3 to entry: Alternative methods may be used if equivalence to the reference method has been demonstrated.

[SOURCE: EN 15259:2007]

3.16
response time
duration between the instant when an input quantity value of a measuring instrument or measuring system is subjected to an abrupt change between two specified constant quantity values and the instant when a corresponding indication settles within specified limits around its final steady value

Note 1 to entry: The response time is also referred to as the 90 % time.

Note 2 to entry: The response time is by convention the time taken for the output signal to pass from 0 % to 90 % of the final variation of indication.

[SOURCE: EN 15267-4:2017]

3.17
span gas
test gas used to adjust and check a specific point on the response line of the measuring system

Note 1 to entry: This concentration is often chosen around 80 % of the upper limit of the range or around the emission limit value.

[SOURCE: EN 16429:2021] [4]

3.18
standard reference method
SRM
reference method prescribed by European or national legislation

[SOURCE: EN 15259:2007]

3.19
uncertainty
parameter associated with the result of a measurement, that characterises the dispersion of the values that could reasonably be attributed to the measurand

[SOURCE: ISO/IEC Guide 98-3:2008] [7]

3.20
standard uncertainty
uncertainty of the result of a measurement expressed as a standard deviation

[SOURCE: ISO/IEC Guide 98-3:2008] [7]

3.21
expanded uncertainty
quantity defining a level of confidence about the result of a measurement that could be expected to encompass a specific fraction of the distribution of values that could reasonably be attributed to a measurand

[SOURCE: ISO/IEC Guide 98-3:2008] [7]

Note 1 to entry: The interval about the result of measurement is established for a level of confidence of 95 %.

3.22
combined standard uncertainty
standard uncertainty of the result of a measurement when that result is obtained from the values of a number of other quantities, equal to the positive square root of a sum of terms, the terms being the variances or covariances of these other quantities weighted according to how the measurement result varies with changes in these quantities

[SOURCE: ISO/IEC Guide 98-3:2008] [7]

3.23
uncertainty budget
statement of a measurement uncertainty, of the components of that measurement uncertainty, and of their calculation and combination

[SOURCE: JCGM 200:2012] [8]

4 Principle

4.1 General

This document specifies a method for the determination of the mass concentration of formaldehyde in ducts and stacks emitting to atmosphere by means of an automatic analyser using optical techniques. A number of performance characteristics with associated minimum performance criteria and an expanded uncertainty of the method are given. Requirements and recommendations for quality assurance and quality control are given for measurements in the field (see Table 1 in 8.3).

4.2 Measuring principle

The analyser is combined with an extractive sampling system and a gas conditioning system. A representative sample of gas is taken from the stack with a sampling probe and conveyed to the analyser through the sampling line and gas conditioning system. The formaldehyde concentration can be measured, for example, by optical absorption, where the attenuation of light passing through the sample is related to the concentration via the Lambert-Beer law and calibration.

Calibration is carried out via vaporization of formaldehyde solution of known concentration into the gas phase. Certified test gases in gas cylinders or test gases produced via permeation tubes may, in principle, also be used as calibration gases. However, there is still a lack of experience for their successful application within the scope of this document.

Other species in the stack such as water, carbon dioxide and some hydrocarbons absorb radiation at similar wavelengths to formaldehyde and may cause interference, resulting in bias in the measured value. The effects of interference may be suppressed or compensated in terms of the physical design of the P-AMS and/or the processing of the recorded signals. Hence, the concentration of each potential interferent in the stack (particularly water and carbon dioxide) and if this is within the concentration range used in the P-AMS interference testing in accordance with EN 15267-4 is an important consideration.

5 Sampling system

5.1 General

The P-AMS shall be used only in the field of gas matrices tested during its characterization according to EN 15267-4.

A representative volume is extracted from the flue gas for a fixed period of time. A filter removes the dust in the sampled volume before the sample is conditioned and passes to the analyser. Two different sampling and conditioning configurations can be used in order to avoid uncontrolled water vapour condensation in the measuring system. These configurations are:

— Configuration 1: maintaining the temperature of the sampling line at a minimum value (one option: 180 °C) up to the heated analyser (see 5.4.1).

— Configuration 2: dilution with dry, clean ambient air or nitrogen of the sampled gas (see 5.4.2). Components upstream of the point of dilution shall be heated (one option: 180 °C). Heating is not required post the dilution point.

All parts of the sampling equipment upstream of the analyser shall be made of materials that do not react with or adsorb formaldehyde.

Conditions and layout of the sampling equipment contribute to the expanded uncertainty. In order to minimize this contribution performance criteria for the sampling equipment and sampling conditions are given.

5.2 Sampling probe

In order to access the representative measurement point(s) of the measurement plane, probes of different lengths and inner diameters may be used. The design and configuration of the probe used shall ensure the residence time of the sample gas within the probe is minimized in order to reduce the response time of the measuring system. The probe shall be heated (see 5.1).

5.3 Filter

The filter shall be made of an inert material (e.g. glass-fibre, sintered ceramic, stainless steel or PTFE-fibre) with an appropriate pore size. Use a heated filter (see 5.1) appropriate to the dust loading that shall be changed or cleaned periodically depending on the dust loading at the sampling site. Overloading of the particle filter could increase the pressure drop in the sampling line. If a filter is placed downstream of a dilution system, heating is not required.

5.4 Sampling line

5.4.1 General

The sampling line shall be heated up to the gas conditioning system, where required (see 5.1). It shall be made of a suitable material that does not react with or adsorb formaldehyde (e.g. PTFE, PFA, Viton®, stainless steel).