SLOVENSKI STANDARD
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Emisije nepremiļnih virov - Doloļevanje nizkih masnih koncentracij prahu - 2. del: Avtomatski merilni sistemi

Stationary source emissions - Determination of low range mass concentration of dust - Part 2: Automated measuring systems

Emissionen aus stationären Quellen - Ermittlung der Staubmassenkonzentration bei geringen Staubkonzentrationen - Teil 2: Automatische Messeinrichtungen

Emissions de sources fixes - Détermination de faibles concentrations en masse de poussieres - Partie 2: Systemes automatiques de mesure

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Stationary source emissions - Determination of low range mass concentration of dust - Part 2: Automated measuring systems

Emissions de sources fixes - Détermination de la faible concentration en masse de poussières - Partie 2: Systèmes automatiques de mesure

Emissionen aus stationären Quellen - Ermittlung der Staubmassenkonzentration bei geringen Staubkonzentrationen - Teil 2: Automatische Messeinrichtungen

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COMITÉ EUROPÉEN DE NORMALISATION
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Contents

Foreword

This document (EN 13284-2:2004) 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of an identical text or by endorsement, at the latest by March 2005, and conflicting national standards shall be withdrawn at the latest by March 2005.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative bibliography, which is an integral part of this document.

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Introduction

This document describes the quality assurance procedures related to Automated Measuring Systems (AMS) for the determination of dust in flue gas, in order to meet the uncertainty requirements on measured values given by regulations, e.g. EC Directives ([1], [2]), national or other legislation.

This document is only applicable in conjunction with the general document on quality assurance of AMS described in EN 14181, and provides indications which are specific to dust measurements.

The calibration and validation of dust AMS are performed by parallel measurements with the reference manual gravimetric method described in EN 13284-1.

1 Scope

This document specifies specific requirements on automated measuring systems (AMS) for dust monitoring. It is derived from EN 14181 which is the general document on the quality assurance of AMS. It is only applicable in conjunction with EN 14181.

This document specifies test criteria for the QAL1 and specific requirements for QAL2, QAL3 and AST for dust AMS used for proving that the dust emissions from a source are compliant with emission limits below 50 mg/m^3 (standard conditions) in ducted gaseous streams. This document is applicable by direct correlation with the standard reference method (SRM) described in EN 13284-1.

This document is primarily developed for emissions from waste incinerators. From a technical point of view, it may be applied to other processes, for which measurement at an emission limit is required with defined uncertainty.

2 Normative references

The following referenced documents are indispensable for the application 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 13284-1:2001, *Stationary source emissions - Determination of low range mass concentration of dust - Part 1: Manual gravimetric method.*

EN 14181:2004, *Stationary source emissions – Quality assurance of automated measuring systems.*

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

EN ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories (ISO/IEC 17025:1999).*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 13284-1:2001 and EN 14181:2004 and the following apply.

3.1
dust
particles, of any shape, structure or density, dispersed in the gas phase at the sampling point conditions which may be collected by filtration under specified conditions after representative sampling of the gas to be analysed, and which remain upstream of the filter and on the filter after drying under specified conditions

[EN 13284-1:2001]

3.2
automated measuring system (AMS)
measuring system permanently installed on site for continuous monitoring of emissions

NOTE 1 An AMS is a method which is traceable to a reference method.

NOTE 2 Apart from the analyser, an AMS includes facilities for taking samples (e.g. sample probe, sample gas lines, flow meters, regulators, delivery pumps) and for sample conditioning (e.g. dust filter, moisture removal devices, converters, diluters). This definition also includes testing and adjusting devices that are required for regular functional checks.

[EN 14181:2004]

NOTE 3 For the purpose of this document, AMS means automated dust measuring system.

3.3
cross sensitivity
response of the AMS to determinants other than dust concentration

NOTE Cross sensitivity can be caused for example by particle characteristics (including size, material type, electric charge, shape and moisture content), flow gas conditions (including velocity) and gas composition (including water vapour, water droplets).

3.4
emission limit value (ELV)
limit value related to the uncertainty requirement

NOTE For the EU directives [1] and [2] it is the daily emission value that relates to the uncertainty requirement.

3.5
linearity (lack of fit)
systematic deviation, within the range of application, between the accepted value of a reference material applied to the measuring system and the corresponding output signal from the AMS

NOTE Test for linearity is described in Annex B of EN 14181:2004.

3.6
limit of detection
minimum value of the measurand for which the measuring system is not in the basic state, with a stated probability

NOTE The basic state is usually represented by zero reference material.

3.7
period of unattended operation
maximum interval of time for which the performance characteristics remain within a predefined range without external servicing, e.g. refill, calibration, adjustment

3.8
reproducibility under field conditions (r)
measure of the agreement between two identical measuring systems applied in parallel in field tests at a level confidence of 95 % using the standard deviation of the difference of the paired measurements:

$$r = t_{n-1;\,0,95} \times s_{\mathrm{D}}$$

$$s_{\mathrm{D}} = \sqrt{\frac{\sum_{i=1}^{n} \left(x_{1,i} - x_{2,i}\right)^2}{2n}}$$

where

r is the reproducibility under field conditions;

$t_{n-1;\,0,95}$ is the two-sided Students t-factor at a confidence level of 95 % with a number of degrees of freedom n–1;

s_{D} is the standard deviation of the difference of paired measurements;

$x_{1,i}$ is the ith measurement result of the first measuring system;

$x_{2,i}$ is the ith measurement result of the second measuring system;

n is the number of parallel measurements

NOTE The reproducibility under field conditions is calculated from the half-hour averaged output signals during the three-month period.

3.9
Standard Reference Method (SRM)
method described and standardised to define an air quality characteristic, temporarily installed on site for verification purposes

[EN 14181:2004]

NOTE For the purposes of this document, the SRM is specified in EN 13284-1.

4 Principle

This document is derived from the general document on the quality assurance of AMS (EN 14181). It shall be applied in conjunction with that document. This document only deals with the specific aspects related to dust monitoring.

According to EN 14181, three different levels of quality assurance are defined, designated as Quality Assurance Levels (QAL). These levels cover the suitability of an AMS for its measuring task (QAL1), the validation of the AMS following its installation (QAL2), the control of the AMS during its ongoing operation on an industrial plant (QAL3). An annual Surveillance Test (AST) is also defined.

5 AMS performance criteria for QAL1

The performance of the AMS shall be assessed in a suitability test referred to as QAL1. Suitability tests for an AMS are usually carried out within the framework of certification or type approval procedures. The suitability test comprises a separate laboratory test and a three-month field test in a typical application.

The requirements for the tests used in QAL1 are given in Table 1. These requirements shall be used until general requirements on AMS are specified in a European Standard on AMS certification.

The manufacturer shall ensure that the delivered AMS has the same characteristics as the tested devices.

Table 1 – QAL1 performance criteria

LABORATORY TESTS	
Zero and span check	shall be documented by the manufacturer and assessed during QAL1 to be appropriate for QAL3
Reference materials	shall be documented by the manufacturer and assessed during QAL1 to be appropriate for AST
Automatic compensation of zero and span drift, if provided	shall be documented by the manufacturer and assessed during QAL1; if used as part of QAL3, the AMS shall indicate compensation beyond specified limits
Linearity (lack of fit)	shall be less than ± 4 % of ELV and checked by use of reference materials (also to be applied in AST)
Detection limit	shall be less than 2 % of ELV
Influence of physical environment, such as: - temperature - electrical supply - ambient light - optical alignment - vibrations - pressure	shall have an individual and total combined influence less than 2 % of ELV within the range of variations defined by the manufacturer; shall be documented by the manufacturer and validated during QAL1
Cross sensitivity (process condition) such as: - ambient light - particle material - particle sizes - particle shapes - velocity - electrical charge - gaseous components including water vapour - droplets	shall be documented by the manufacturer and validated during QAL1
FIELD TESTS (3 months)	
Calibration function	shall pass the variability test defined in QAL2; the range of testing should be 3 times the ELV
Reproducibility under field test conditions	shall be less than 3 % of ELV
Zero and span drifts	shall be less than 3 % of ELV
Availability and period of unattended operation	to be assessed during QAL1

It shall be proven by use of EN ISO 14956 that the total uncertainty of the measured results obtained by the AMS meets the specifications for uncertainty stated in the applicable regulations. This total uncertainty is calculated by summing all the relevant uncertainty components arising from the individual performance characteristics in an appropriate manner. The AMS suitability shall be evaluated for the plant specific conditions taking into account the anticipated variations of the physical environment and interferences.

6 AMS location

The AMS shall be located in such a way that the gas sample which is monitored has a representative content of the particulate matter.

NOTE The location should be chosen taking into account the manufacturer recommendations. It may depend on the AMS principle of detection.

The AMS shall be located in such a way that there is minimum interference with the SRM and vice versa.

The working platform(s) for the AMS shall provide an easy and safe access to the AMS in order to allow frequent inspection and quality assurance procedure implementation.

The working platform for the SRM shall comply with the requirements of Annex A of EN 13284-1:2001 related to the manual gravimetric method.

7 Calibration and validation of the AMS (QAL2)

7.1 General

The AMS should be serviced just before the calibration according to the manufacturer's recommendations.

NOTE 1 It is recommended to include the service report as an appendix to the calibration report.

The AMS shall be calibrated and validated in accordance with EN 14181.

However, in the case where all measured results are below 30 % of the ELV and approval has been given by the competent authority, the number of measurements may be reduced to 5 measurements over 3 days. The total SRM sampling time shall be at least 7 h and 30 min (which is equal to 15 times 30 min) (see Annex B). If some of the measurements are above 30 % of the ELV, the calibration shall be extended to at least 15 valid measurements.

NOTE 2 Reducing the number of measurements and increasing the individual SRM sampling time leads to a better quantification of very low dust concentrations.

NOTE 3 Annex A shows an example of the application of QAL2.

7.2 Calibration procedure

7.2.1 Parallel measurements with SRM

The standard reference method (SRM) used shall be in accordance with EN 13284-1. The testing laboratory, which performs the SRM measurements, shall have an accredited quality assurance system according to EN ISO/IEC 17025 or shall be approved directly by the competent authority.

As stated in EN 13284-1, if rinsing is required to recover the deposits upstream of the filter of the sampling equipment (see 8.5 and 10.5 of EN 13284-1), rinsing shall be performed after each measurement (SRM result and AMS reading) and not only after each measurement series.