SLOVENSKI STANDARD
SIST EN 13284-2:2018

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Emisije nepremičnih virov - Določevanje nizkih masnih koncentracij prahu - 2. del: Zagotavljanje kakovosti avtomatskih merilnih sistemov

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

Emissionen aus stationären Quellen - Ermittlung der Staubmassenkonzentration bei geringen Staubkonzentrationen - Teil 2: Qualitätssicherung für automatische Messeinrichtungen

Émissions de sources fixes - Détermination de la faible concentration en masse de poussières - Partie 2 : Assurance qualité des systèmes automatiques de mesure

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13.040.40	Emisije nepremičnih virov	Stationary source emissions

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English Version

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

Émissions de sources fixes - Détermination de faibles concentrations en masse de poussières - Partie 2 : Assurance qualité des systèmes de mesurage automatisés

Emissionen aus stationären Quellen - Ermittlung der Staubmassenkonzentration bei geringen Staubkonzentrationen - Teil 2: Qualitätssicherung für automatische Messeinrichtungen

This European Standard was approved by CEN on 11 September 2017.

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

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European foreword

This document (EN 13284-2:2017) 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of an identical text or by endorsement, at the latest by May 2018, and conflicting national standards shall be withdrawn at the latest by May 2018.

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.

This document supersedes EN 13284-2:2004.

This document is Part 2 of the EN 13284 series:

— EN 13284-1, *Stationary source emissions — Determination of low range mass concentration of dust — Part 1: Manual gravimetric method*;

— EN 13284-2, *Stationary source emissions — Determination of low range mass concentration of dust — Part 2: Quality assurance of automated measuring systems*.

Annex G provides details of significant technical changes between this European Standard and the previous edition.

According to the CEN-CENELEC Internal Regulations, the national standards organizations 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, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

This document describes the quality assurance procedures related to automated measuring systems (AMS) for the determination of dust in waste gas, in order to meet the uncertainty requirements on measured values given by regulations, e.g. EU Directives ([1]), national or other legislation.

This document is derived from EN 14181, which specifies general procedures for establishing quality assurance levels (QAL) for automated measuring systems (AMS) installed on industrial plants for the determination of the waste gas components and other waste gas parameters. It amends EN 14181 and provides guidance specific to dust measurements. It is only applicable in conjunction with EN 14181.

The calibration and validation of dust AMS is based on parallel measurements with the manual gravimetric standard reference method (SRM) described in EN 13284-1.

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

1 Scope

This European Standard specifies requirements for the calibration and validation (QAL2), the ongoing quality assurance during operation (QAL3) and the annual surveillance test (AST) of automated measuring systems (AMS) used for monitoring dust emissions from stationary sources to demonstrate compliance with emission limit values (ELV) below 50 mg/m³ at standard conditions. It specifically deals with measurements in wet gases and at low concentrations.

This document is derived from EN 14181 and is only applicable in conjunction with EN 14181.

This document is applicable by direct correlation with the standard reference method (SRM) described in EN 13284-1.

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 13284-1:2017, *Stationary source emissions — Determination of low range mass concentration of dust —Part 1: Manual gravimetric method*

EN 14181:2014, *Stationary source emissions — Quality assurance of automated measuring systems*

EN 15267-3, *Air quality — Certification of automated measuring systems — Part 3: Performance criteria and test procedures for automated measuring systems for monitoring emissions from stationary sources*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 13284-1:2017 and EN 14181:2014 apply.

4 Symbols and abbreviations

4.1 Symbols

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

a	intercept of the calibration function
$\hat{a}$	best estimate of a
b	slope of the calibration function
$\hat{b}$	best estimate of b
c	slope of the quadratic term of the calibration function
d	particle diameter
$\overline{D}$	average of differences D_i
e	error
E	emission limit value
h	absolute water vapour content (by volume)
i	counter

N	number of measurements
k_v	test parameter
o	oxygen content in dry gas (by volume)
o_s	oxygen standard condition
p	difference between the static pressure of the sample gas and the standard pressure
P	percentage value
R^2	coefficient of determination
s_D	standard deviation of the differences D_i
t	Celsius temperature
t_{cycle}	total measurement cycle of a discontinuously measuring AMS
t_{sample}	sample period of a discontinuously measuring AMS
U_{max}	maximum permissible expanded uncertainty
x_i	i^{th} AMS measured signal at AMS measuring conditions
$\bar{x}$	average of AMS measured signals
y_i	i^{th} SRM measured value
$\bar{y}$	average of SRM measured values
$y_{i,s}$	i^{th} SRM measured value at standard conditions
y_s	SRM measured value at standard conditions
$y_{s,min}$	lowest SRM measured value at standard conditions
$y_{s,max}$	highest SRM measured value at standard conditions
$\hat{y}_i$	best estimate for the "true value", calculated from the AMS measured signal x_i by means of the calibration function
$\hat{y}_{i,s}$	best estimate for the "true value", calculated from the AMS measured signal x_i by means of the calibration function at standard conditions
Δy_{max}	difference between the maximum and minimum SRM measured value at standard conditions
σ_0	standard deviation associated with the uncertainty derived from requirements of legislation

4.2 Abbreviations

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

AMS	automated measuring system
AST	annual surveillance test
ELV	emission limit value
QAL	quality assurance level
QAL1	first quality assurance level

QAL2 second quality assurance level

QAL3 third quality assurance level

SRM *s*tandard reference method

5 Principle

The general principles of quality assurance of AMS laid down in EN 14181 shall also be applied to automated dust measuring systems. The amendments specific to these AMS are specified in the following.

6 Calibration and validation of the AMS (QAL2)

6.1 General

The AMS shall be calibrated and validated in accordance with EN 14181 with the modifications specified in 6.2 to 6.8.

NOTE 1 Annex A shows an example of the application of QAL2 for an automated dust measuring system.

Extractive dust measuring systems shall be configured before calibration.

NOTE 2 Annex B provides information on the configuration of extractive dust measuring systems.

6.2 Functional test

Functional tests are performed to ensure that the AMS is working according to the specifications and to check the active measurement components of the AMS to ensure they are not unduly influenced by dust contamination.

The linearity test including the zero and span checks shall be carried out with surrogate reference materials, which have been approved as part of the performance test according to EN 15267-3.

If the zero point is used to establish the calibration function according to EN 14181:2014, 6.4.3, Method b), a zero dust-offset test shall be performed to prove that the AMS gives a reading at or below detection limit (as demonstrated in QAL1) at a zero concentration. The test results shall be presented in the calibration report.

6.3 Parallel measurements with the SRM

6.3.1 General

According to EN 14181 at least 15 parallel measurements shall be performed with the AMS and SRM in order to calibrate and validate the AMS by use of an independent method. The measurements shall be performed at normal operation of the plant.

The SRM used shall be applied in accordance with EN 13284-1.

The number of parallel measurements may be reduced to a minimum of 5 valid measurements over 3 days, if all SRM measured results are expected to be below the maximum permissible uncertainty for the AMS measured values and approval is given by the competent authority. The total SRM sampling time shall be at least 7,5 h, which is equal to 15 times 30 min (see Annex C). The sampling duration shall be the same for all parallel measurements.

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

6.3.2 Increasing the dust concentration

The dust concentrations are often close to zero compared to the ELV, if the dust cleaning equipment of the plant is operating normally. The calibration range can be extended in some cases by increasing the dust concentration. This can be achieved by e.g. changing the plant load, lowering the efficiency of the gas cleaning equipment, or by injecting dust of the same physical properties and ensuring homogeneous concentration across the measurement planes of the AMS and the SRM (see Annex D). The approach shall be agreed by both the plant operator and the competent authority and be fully documented in the calibration report.

Increasing the dust concentration can lead to changes in the dust characteristics and can influence the calibration function of AMS, which are cross-sensitive to particle size (e.g. optical devices). In these cases, a linear and a quadratic calibration function shall be calculated, and the most adequate calibration function shall be used (see 6.4.3).

NOTE Calculation of a quadratic calibration function is described in Annex E.

If the calibration range can be extended, then at least 15 parallel measurements shall be conducted in the extended calibration range in the following way:

— at least 5 measurements are performed in the normal operation range of the plant (i.e. at very low concentration);

— at least 5 measurements are performed at the upper limit of the extended calibration range;

— at least 5 measurements are performed at a dust concentration intermediate to these levels.

6.3.3 SRM measured values below the limit of quantification

If the mass concentrations measured by the SRM are below the limit of quantification of the SRM, the procedures in Annex F may be used for the configuration of the AMS if agreed by the competent authority.

6.3.4 Semi-volatiles

When calibrating an AMS for dust, it is of importance that the AMS is measuring the same concentration as the simultaneously operated SRM. Emissions of some processes can contain semi-volatiles, also referred to as condensable compounds, which can be in particulate form at low temperature and in gaseous form at higher temperature. In such a case, the measured dust concentration depends on the temperature. This can have a disturbing effect on the calibration, if the sampling temperature of the AMS (i.e. waste gas temperature for insitu AMS) differs from the conventional temperature for the SRM measurement of usually 160 °C.

The conventional temperature for the SRM measurement shall be selected during the planning of the measurements taking into account the plant process conditions, the AMS measuring temperature and the dew point of the gas.

The SRM sampling temperature shall not exceed the conventional temperature for the SRM measurement.

The semi-volatile particulate effect shall be detected and accounted for by the following procedure:

— dry the collected dust at the conventional temperature for the SRM measurement and weigh the samples;

— re-dry the collected dust at 160 °C, and re-weigh the samples.

Both results shall be presented in the calibration report.

6.4 Data evaluation

6.4.1 Preparation of data

6.4.1.1 Automatic recording of AMS output signals

The AMS output signal to be recorded may be analogue and/or digital. The AMS should be configured to have a minimum output signal of at least 5 times the detection limit and an output range which is large enough to gather readings with sufficient resolution.

In cases of an analogue output, the instantaneous AMS output signal shall be automatically recorded during the parallel measurements in order to be electronically averaged.

If it is proven that calibration curves do not change by switching from one range of the AMS to another, it may be calibrated in one range and used afterwards in another. This is in accordance with this standard if the functional test has been carried out with the linearity test in both ranges showing the same response irrespective of the range used. The test shall be carried out with surrogates (e.g. optical filters) representing at least two concentrations covered by two consecutive overlapping ranges. This shall be documented in the functional test report and recorded in the calibration report.

NOTE If a plant runs at very low concentrations, it can be advantageous to calibrate at increased dust concentrations (see 6.3.2), in which case the dust concentration can be considerable higher than during normal operation, e.g. being calibrated in the range up to the daily ELV, e.g. 10 mg/m^3, but running in normal operation, e.g. below 1 mg/m^3. In this case the AMS can be calibrated in one range, and afterwards be switched back to a lower range for normal operation.

Measures shall be taken to prevent AMS self-checks during SRM sampling.

6.4.1.2 Data sampling

6.4.1.2.1 Continuously measuring AMS

Recording intervals of data provided by an analogue output shall not exceed 25 % of the chosen AMS averaging time. Recording intervals and averaging times shall be reported in the calibration report.

6.4.1.2.2 Discontinuously measuring AMS

Discontinuously measuring AMS are characterized by a total measurement cycle of the AMS, t_{cycle}, and a sample period, t_{sample}. The ratio t_{sample} / t_{cycle} should be larger than 90 %.

A ratio t_{sample} / t_{cycle} less than 90 % may be used, if there is no rapid change in the mass concentration of dust. These situations shall be approved by the competent authority.

The SRM measurement shall start at the beginning of a new AMS total measurement cycle and shall be performed for a complete number of measurement cycles.

6.4.2 Selection of data points from automated SRM

Since the dust SRM is a manual method, EN 14181:2014, 6.4.2 does not apply.

6.4.3 Establishing the calibration function

The calibration function shall be established on the basis of the data obtained by the parallel measurements for the conventional temperature for the SRM measurement.

If semi-volatiles are present (see 6.3.4) and if not specified otherwise by regulations then the calibration function corresponding to the 160 °C drying temperature shall be used provided that the variability test is passed. Otherwise the calibration function from the lower drying temperature may be used, provided the variability test is passed. This shall be included in the calibration report.