SLOVENSKI STANDARD
SIST EN 14790:2017

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Emisije nepremičnih virov - Določevanje vodne pare v odvodnikih - Standardna referenčna metoda

Stationary source emissions - Determination of the water vapour in ducts - Standard reference method

Emissionen aus stationären Quellen - Bestimmung von Wasserdampf in Leitungen - Standardreferenzverfahren

Emissions de sources fixes - Détermination de la vapeur d'eau dans les conduits - Méthode de référence normalisée

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Stationary source emissions - Determination of the water vapour in ducts - Standard reference method

Emissions de sources fixes - Détermination de la vapeur d'eau dans les conduits - Méthode de référence normalisée

Emissionen aus stationären Quellen - Bestimmung von Wasserdampf in Kanälen - Standardreferenzverfahren

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European foreword

This document (EN 14790:2017) has been prepared by Technical Committee CEN/TC 264 “Air quality”, the secretariat of which is held by DIN.

This document supersedes EN 14790:2005.

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of an identical text or by endorsement, at the latest by July 2017, and conflicting national standards shall be withdrawn at the latest by July 2017.

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

Annex E provides details of significant technical changes between this document and the previous edition.

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1 Scope

This European Standard specifies the standard reference method (SRM) based on a sampling system with a condensation/adsorption technique to determine the water vapour concentration in the flue gases emitted to atmosphere from ducts and stacks.

This European Standard specifies the performance characteristics to be determined and performance criteria to be fulfilled by measuring systems based on the measurement method. It applies to periodic monitoring and to the calibration or control of automated measuring systems (AMS) permanently installed on a stack, for regulatory or other purposes.

This European Standard specifies criteria for demonstration of equivalence of an alternative method to the SRM by application of EN 14793:2017.

This European Standard is applicable in the range of water vapour content from 4 % to 40 % as volume concentrations and of water vapour mass concentration from 29 g/m³ to 250 g/m³ as a wet gas, although for a given temperature the upper limit of the method is related to the maximum pressure of water in air or in the gas.

In this European Standard all the concentrations are expressed at standard conditions (273 K and 101,3 kPa).

NOTE 1 For saturated conditions the condensation/adsorption method is not applicable. Some guidance is given in this European Standard to deal with flue gas when droplets are present.

This European Standard has been validated during field tests on waste incineration, co-incineration and large combustion plants. It has been validated for sampling periods of 30 min in the volume concentration range of 7 % to 26 %.

NOTE 2 The characteristics of installations, the conditions during field tests and the values of repeatability and reproducibility in the field are given in Annex A.

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 1911, *Stationary source emissions - Determination of mass concentration of gaseous chlorides expressed as HCl - Standard reference method*

EN 14791:2017, *Stationary source emissions — Determination of mass concentration of sulphur oxides — Standard reference method*

EN 14793:2017, *Stationary source emission – Demonstration of equivalence of an alternative method with a reference method*

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

ISO/IEC Guide 98-3:2008, *Uncertainty of measurement — Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

3 Terms and definitions

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

3.1
standard reference method
SRM
reference method prescribed by European or national legislation

[SOURCE: EN 15259:2007]

3.2
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 can be used if equivalence to the reference method has been demonstrated.

[SOURCE: EN 15259:2007]

3.3
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]

3.4
alternative method
AM
measurement method which complies with the criteria given by this European Standard with respect to the reference method

Note 1 to entry: An alternative method can consist of a simplification of the reference method.

[SOURCE: EN 14793:2017]

3.5
measuring system
set of one or more measuring instruments and often other devices, including any reagent and supply, assembled and adapted to give information used to generate measured quantity values within specified intervals for quantities of specified kinds

[SOURCE: JCGM 200:2012]

3.6
automated measuring system
AMS
entirety of all measuring instruments and additional devices for obtaining a result of measurement

Note 1 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, if applicable, for commissioning.

Note 2 to entry: The term "automated measuring system" (AMS) is typically used in Europe. The term "continuous emission monitoring system" (CEMS) is also typically used in the UK and USA.

[SOURCE: EN 15267-4:2017]

3.7
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 systems (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: In case of manual methods the applicable reference can be reference materials used as calibration standards to establish the relationship between the output signal of the analytical device and the reference values.

Note 3 to entry: Calibration should not be confused with adjustment of a measuring system.

3.8
measurand
particular quantity subject to measurement

[SOURCE: EN 15259:2007]

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.

3.9
measurement site
place on the waste gas duct in the area of the measurement plane(s) consisting of structures and technical equipment, for example working platforms, measurement ports, energy supply

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

[SOURCE: EN 15259:2007]

3.10
measurement plane
plane normal to the centre line of the duct at the sampling position

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

[SOURCE: EN 15259:2007]

3.11
measurement port
opening in the waste gas duct along the measurement line, through which access to the waste gas is gained

Note 1 to entry: Measurement port is also known as sampling port or access port.

[SOURCE: EN 15259:2007]

3.12
measurement line
line in the measurement plane along which the measurement points are located, bounded by the inner duct wall

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

[SOURCE: EN 15259:2007]

3.13
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]

3.14
absorber
device in which water vapour is absorbed

3.15
droplets
small liquid particles of condensed water vapour or water liquid in the flue gas (e.g. coming from a scrubber)

Note 1 to entry: In adiabatic equilibrium conditions, droplets could arise only if a gas stream is saturated with water.

3.16
dew point
temperature below which the condensation of water vapour begins at the given pressure condition of the flue gas

3.17
vapour pressure
pressure of water in vapour form

3.18
performance characteristic
one of the quantities (described by values, tolerances, range) assigned to equipment in order to define its performance

3.19
repeatability in the laboratory
closeness of the agreement between the results of successive measurements of the same measurand carried out under the same conditions of measurement

Note 1 to entry: Repeatability conditions include:

— same measurement method;

— same laboratory;

— same measuring system, used under the same conditions;

— same location;

— repetition over a short period of time.

Note 2 to entry: Repeatability can be expressed quantitatively in terms of the dispersion characteristics of the results.

Note 3 to entry: In this European Standard the repeatability is expressed as a value with a level of confidence of 95 %.

3.20
repeatability in the field
closeness of the agreement between the results of simultaneous measurements of the same measurand carried out with two sets of equipment under the same conditions of measurement

Note 1 to entry: These conditions include:

— same measurement method;

— two sets of equipment, the performances of which are fulfilling the requirements of the measurement method, used under the same conditions;

— same location;

— implemented by the same laboratory;

— typically calculated on short periods of time in order to avoid the effect of changes of influence parameters (e.g. 30 min).

Note 2 to entry: Repeatability can be expressed quantitatively in terms of the dispersion characteristics of the results.

Note 3 to entry: In this European Standard the repeatability under field conditions is expressed as a value with a level of confidence of 95 %.

3.21
reproducibility in the field
closeness of the agreement between the results of simultaneous measurements of the same measurand carried out with several sets of equipment under the same conditions of measurement

Note 1 to entry: These conditions include:

— same measurement method;

— several sets of equipment, the performances of which are fulfilling the requirements of the measurement method, used under the same conditions;

— same location;

— implemented by several laboratories.

Note 2 to entry: Reproducibility can be expressed quantitatively in terms of the dispersion characteristics of the results.

Note 3 to entry: In this European Standard the reproducibility under field conditions is expressed as a value with a level of confidence of 95 %.

3.22
uncertainty
parameter associated with the result of a measurement, that characterises the dispersion of the values that could reasonably be attributed to the measurand

3.23
standard uncertainty
u
uncertainty of the result of a measurement expressed as a standard deviation

3.24
combined uncertainty
u_c
standard uncertainty attached to the measurement result calculated by combination of several standard uncertainties according to the principles laid down in ISO/IEC Guide 98-3 (GUM)

3.25
expanded uncertainty
U
quantity defining a level of confidence about the result of a measurement that may be expected to encompass a specific fraction of the distribution of values that could reasonably be attributed to a measurand

$$U = k \times u_c$$

Note 1 to entry: In this European Standard, the expanded uncertainty is calculated with a coverage factor of $k = 2$, and with a level of confidence of 95 %.

Note 2 to entry: The expression overall uncertainty is sometimes used to express the expanded uncertainty.

3.26
uncertainty budget
calculation table combining all the sources of uncertainty according to EN ISO 14956 or ISO/IEC Guide 98-3 in order to calculate the combined uncertainty of the method at a specified value

4 Symbols and abbreviations

4.1 Symbols

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

C	measured volume concentration
C_w	water vapour mass concentration on dry basis
h_m	measured water vapour content on wet basis expressed as volume concentration
k	coverage factor
m_w	mass of water vapour trapped in the trapping system
M_w	molecular weight of water, 18,01534 g/mol rounded to 18 g/mol
p_m	absolute pressure at the gas volume meter
$p_s(T_m)$	saturation vapour pressure of water at the temperature T_m of the gas volume meter
p_{ref}	standard pressure, 101,3 kPa
s_R	reproducibility standard deviation
$s_{r,limit}$	maximum allowable repeatability standard deviation
T_i	ith temperature reading
T_m	mean absolute temperature of the sampled gas at the gas volume meter
T_{ref}	standard temperature, 273 K
u	standard uncertainty
u_c	combined uncertainty
U	expanded uncertainty
V_1	gas volume reading from the gas volume meter at the beginning of the sampling period, at actual conditions of temperature, pressure and humidity
V_2	gas volume reading from the gas volume meter at the end of the sampling period, at actual conditions of temperature, pressure and humidity
V_m	difference between the readings at the gas volume meter at the beginning and at the end of the sampling period
$V_{m,ref}$	measured dry gas volume, corrected to standard conditions
V_{mol}	molar volume at standard conditions, in m^3/mol at p_{ref} and T_{ref}