SLOVENSKI STANDARD
oSIST prEN 14790:2015

01-januar-2015

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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Ta slovenski standard je istoveten z: **prEN 14790**

ICS:

13.040.40	Emisije nepremičnih virov	Stationary source emissions

oSIST prEN 14790:2015 **en,fr,de**

2003-01.Slovenski inštitut za standardizacijo. Razmnoževanje celote ali delov tega standarda ni dovoljeno.

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

DRAFT
prEN 14790

October 2014

ICS 13.040.40

Will supersede EN 14790:2005

English Version

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

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

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

This draft European Standard was established by CEN in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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

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Contents

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Foreword

This document (prEN 14790:2014) 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 CEN Enquiry.

This document will supersede EN 14790:2005.

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

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https://standards.iteh.ai/catalog/standards/sist/749bd80d-ebe4-4577-82f5-6234628677d1/sist-en-14790-2017

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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 prEN 14793.

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/m^3 to 250 g/m^3 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 evaluated 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.

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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*

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

prEN 14793:2014, *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
absorber
device in which water vapour is absorbed

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3.2
dew point
temperature below which the condensation of water vapour begins at the given pressure condition of the flue gas

3.3
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.

3.4
measurand
particular quantity subject to measurement

[SOURCE: JCGM 200:2012]

3.5
measurement series
several successive measurements carried out on the same measurement plane and at the same process operating conditions

3.6
measurement plane
plane normal to the centre line of the duct at the sampling position

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

[SOURCE: EN 15259]

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3.7
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]

3.8
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]

3.9
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]

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3.10
standard reference method
SRM
reference method prescribed by European or national legislation

[SOURCE: EN 15259:2007]

3.11
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 procedure;

— same laboratory;

— same sampling equipment, used under the same conditions;

— same location;

— repetition over a short period of time.

Note 2 to entry: Repeatability may 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 %.

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[SOURCE: JCGM 200:2012]

3.12
repeatability in the field
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https://standards.iteh.ai/catalog/standards/sist/749bd80d-ebe4-4377-82f5-
closeness of the agreement between the results of simultaneous measurements of the same measurand carried out with two equipments under the same conditions of measurement

Note 1 to entry: These conditions include:

— same measurement procedure;

— two equipments, the performances of which are fulfilling the requirements of the reference 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 %.

oSIST prEN 14790:2015

3.13
reproducibility in the field
closeness of the agreement between the results of simultaneous measurements of the same measurand carried out with several equipments under the same conditions of measurement

Note 1 to entry: These conditions include:

— same measurement procedure;

— several equipments, the performances of which are fulfilling the requirements of the reference 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 %.

3.14
uncertainty
parameter associated with the result of a measurement, that characterises the dispersion of the values that could reasonably be attributed to the measurand

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3.15
standard uncertainty
u
uncertainty of the result of a measurement expressed as a standard deviation

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3.16
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)

SIST EN 14790:2017
https://standards.iteh.ai/catalog/standards/sist/749bd80d-ebe4-4577-82f5-6234628677d1/sist-en-14790-2017

3.17
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

$$U = k \times u$$

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.

3.18
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

3.19
vapour pressure
pressure of water in vapour form

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4 Measuring principle

4.1 General

This European Standard describes the standard reference method (SRM) for determining the water-vapour content emitted to atmosphere from ducts and stacks. The specific components and the requirements for the measuring system are described. A number of performance characteristics, together with associated performance criteria are specified for the measurement method (see Table 1 in 6). The expanded uncertainty of the method shall meet the specifications given in this European Standard.

The method described hereafter is appropriate when the flue gas is free of droplets.

Within the scope of this European Standard, it is assumed that gas streams in stacks or ducts are more or less in adiabatic (thermodynamic) equilibrium. In those conditions, droplets can arise only if a gas stream is saturated with water. When no droplets are present in the gas stream, the gas stream is then assumed to be unsaturated with water. A gas sample is extracted at a constant rate from the stack. The water vapour of that sample is subsequently trapped by adsorption or by condensation plus adsorption; the mass of the vapour is then determined by weighing the mass gain of the trapping system.

When droplets are present in the gas stream, the implementation of the method described in this European Standard leads to an overestimation of the water vapour content. If the measured value is equal to or higher than the expected value shown in the table in Annex B for saturated conditions at the temperature and pressure of the flue gas, that means that the presence of droplets can lead to biased results; such results shall be rejected.

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In such cases, the evidence suggests that the gas stream is saturated with water vapour. Under these conditions, the method is abridged to a determination of the gas temperature. Then, the water vapour concentration is calculated from the theoretical mass of water vapour per unit of standard gas volume at liquid-gas equilibrium, given the actual temperature, pressure and composition of the gas stream.

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4.2 Adsorption or condensation/adsorption method

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A measured quantity of sampled gas is extracted from the gas stream through a trapping system, which meets the specifications of efficiency (see 8.4.2). The mass gain of the trapping system is measured in order to determine the mass or the volumic water vapour content, on the basis of the volume sampled.

4.3 Temperature method

This method applies when gases are water saturated.

A temperature probe is placed in the gas stream saturated with water vapour, until it reaches equilibrium. The amount of water vapour present in the gas is subsequently derived from the temperature, using a water liquid-gas equilibrium chart or table (see Annex B).

5 Description of measuring equipment

5.1 General

A known volume of flue gas is extracted representatively from a duct or chimney during a certain period of time at a controlled flow rate. A filter removes the dust in the sampled volume; thereafter the gas stream is passed through a trapping system. It is important that all parts of the sampling equipment upstream of the trapping system are heated and that the components shall not react with or absorb water vapour (e.g. stainless steel, borosilicate glass, quartz glass, PTFE or titanium are suitable materials).

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An example of suitable sampling trains is shown in Annex C. The user can choose between a trapping system made up with either:

— adsorption system (Figure B.1); or

— condensation and an adsorption system (Figure B.2).

The choice shall be made to fulfil the efficiency that is required in 8.4.2.

5.2 Sampling probe

In order to reach the 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 minimised in order to reduce the response time of the measuring system.

NOTE 1 The probe can be marked before sampling in order to demonstrate that the measurement points in the measurement plane have been reached.

The sampling probe shall be surrounded by a heating jacket capable of producing a controlled temperature of at least 120 °C and 20 °C higher than the (acid) dew point of gases and shall be protected and positioned using an outer tube.

NOTE 2 It is possible to perform the sampling of SO_2 and water vapour simultaneously with the same probe (without nozzle providing no droplets are present).

NOTE 3 It is possible to perform the sampling of HCl and water vapour simultaneously with the same probe (without nozzle providing no droplets are present).

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5.3 Filter housing

The filter housing shall be made of materials inert to water vapour and shall have the possibility to be connected with the probe thereby avoiding leaks.

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The filter housing may be located either:

— in the duct or chimney, mounted directly behind the entry nozzle (in-stack filtration); or

— outside the duct or chimney, mounted directly behind the suction tube (out-stack filtration).

The filter holder shall be connected to the probe without any cold path between the two.

NOTE In special cases where the sample gas temperature is greater than 200 °C, the heating jacket around the sampling probe, filter holder and connector fine may be omitted. However the temperature in the sampled gas just after the filter housing should not fall below the acid dew point temperature.

5.4 Particle filter

Particle filters and filter housings of different designs may be used, but the residence time of the sample gas should be minimised.

5.5 Trapping system

The trapping system shall be made up with:

— adsorption system; or

— condensation and an adsorption system.

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a) When using the adsorption system alone, it shall consist of at least one cartridge, impinger or absorber, filled with a suitable drying agent, for example: coloured silica gel.

b) Condensation and adsorption system shall consist of two stages:

   1) the first one shall be a condensation stage with an optional cooling system;

   2) the second one shall be an adsorption stage as described in a).

The temperature at the outlet of the condensation system shall be as low as possible.

The efficiency of the sampling system shall be checked according to the procedure described in 8.4.2.

NOTE The trapping efficiency can be increased by increasing the residence time of sampled gases in the trapping system and/or by improving the efficiency of the cooling system. The sampled volume should be sufficient to reach an appropriate accuracy of the measurement (see 5.8 and 6).

Condensation of water shall be avoided in all parts of the sampling system that are not weighed.

5.6 Cooling system (optional)

Any kind of cooling system may be used to condense water vapour in the sampled flue gas (e.g. crushed ice or cryogenic system).

5.7 Sampling pump

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A leak-free pump capable of drawing sample gas at a set flow-rate is required.

NOTE 1 A rotameter (optional) could make easier the adjustment of the nominal sampling flow-rate.

NOTE 2 A small surge tank can be used between the pump and rotameter to eliminate the pulsation effect of the diaphragm pump on the rotameter.

SIST EN 14790:2017
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NOTE 3 A regulating valve (optional) would also be useful for adjusting the sample gas flow-rate.

5.8 Gas volume meter

Two variants of gas volume meter may be used:

— dry-gas volume meter; or

— wet-gas volume meter.

a) Gas volume meter (wet or dry) shall have a relative uncertainty not exceeding 2,0 % of the measured volume (actual conditions).

   The gas volume meter shall be equipped with a temperature measuring device with an uncertainty of calibration less than 2,5 K and shall be associated to an absolute pressure measurement with an uncertainty of calibration less than 1,0 %.

b) When using a dry gas volume meter, a condenser and/or a gas drying system shall be used which can achieve a residual water vapour content of less than 10,0 g/m^3 (equivalent to a dew point of 10,5 °C or a volume content $\chi(H_2O)$ = 1,25 %).

NOTE For example, a glass cartridge or adsorption bottle packed with silica gel (1 mm to 3 mm particle size) which has been previously dried at least at 110 °C for at least 2 h.

When using a wet gas volume meter, a correction shall be applied for water vapour, using the table in Annex B.