SLOVENSKI PREDSTANDARD

OSIST prEN 15058:2004

december 2004

Emisije nepremičnih virov - Referenčna metoda določevanja ogljikovega monoksida z nedisperzivno infrardečo metodo

Stationary source emissions - Reference method for the determination of carbon monoxide in emission by means of the non-dispersive infrared method

ICS 13.040.40

Referenčna številka
OSIST prEN 15058:2004(en;fr;de)

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

DRAFT
prEN 15058

October 2004

ICS

English version

Stationary source emissions - Reference method for the determination of carbon monoxide in emission by means of the non-dispersive infrared method

Emissions de sources fixes - Méthode de référence pour la détermination du monoxyde de carbone à l'émission au moyen d'une méthode infra-rouge non dispersive

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 Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Warning : This document is not a European Standard. It is distributed for review and comments. It is subject to change without notice and shall not be referred to as a European Standard.

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

Management Centre: rue de Stassart, 36 B-1050 Brussels

Ref. No. prEN 15058:2004: E

Contents

Page

Foreword ... 3

1 Scope ... 4

2 Normative references ... 4

3 Terms and definitions ... 5

4 Principle ... 9

5 Description of measuring equipment - Sampling and sample gas conditioning systems ... 10

6 Analyser equipment ... 11

7 Determination of the characteristics of the method : analyser, sampling and conditioning line ... 12

8 Field operation ... 15

9 Ongoing quality control ... 17

10 Expression of results ... 18

11 Evaluation of the method in the field ... 19

12 Equivalency with an alternative method ... 19

13 Test report ... 19

Annex A (informative) Schematics of non-dispersive infrared spectrometer ... 21

Annex B (informative) Example of assessment of compliance of non-dispersive infrared method for CO with requirements on emission measurements ... 23

B.1 General ... 23

B.2 Process of uncertainty estimation ... 23

B.2.1 Determination of model function ... 23

B.2.2 Quantification of uncertainty components ... 23

B.2.3 Calculation of the combined uncertainty ... 23

B.3 Specific conditions in the site ... 24

B.4 Performance characteristics of the method ... 25

B.5 Calculation of standard uncertainty of concentration values given by the analyser ... 25

B.5.1 Model equation and application of rule of uncertainty propagation ... 26

B.5.2 CO measurement ... 26

B.5.3 Results of uncertainty calculation ... 28

B.6 Conversion in mg/m^3 ... 29

B.7 Evaluation of the compliance with the required measurement quality ... 29

Annex C (normative) Evaluation of the method in the field ... 30

C.1 General ... 30

C.2 Characteristics of installations ... 30

C.3 Repeatability and reproducibility in the field ... 31

Annex D (informative) Procedure of correction of data from drift effect ... 34

Annex E (informative) Relationship with EU Directives ... 35

Bibliography ... 36

Foreword

This document (prEN 15058:2004) 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 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).

1 Scope

This European Standard specifies the reference method for sampling, and determining carbon monoxide content in ducts and stacks emitting to atmosphere. It describes the Non Dispersive Infra-Red (NDIR) analytical technique, including the sampling system and sample gas conditioning system, to determine CO in flue gases. This European Standard is the reference method for periodic monitoring and for calibration or control of Automatic Measuring Systems (AMS) permanently installed on a stack, for regulatory purposes or others. To be used as the reference method, it is necessary to demonstrate that the performance characteristics of the method are lower than the performance criteria defined in this European standard and that the overall uncertainty of the method is less than ± 6 % relative at the daily Emission Limit Value (ELV).

Note When the NDIR method is used for AMS, refers to EN 14181 and other relevant standards provided by CEN TC 264.

It is necessary for anybody who would like to use an Alternative Method instead of this Standard Reference Method to work out the demonstration of the equivalence according to the Technical Specification TS 14793, providing that his capability to carry out this demonstration is officially recognised by his national accreditation body or law.

This reference method has been evaluated during field tests on waste incineration, co-incineration installations and large combustion plants. It has been validated for CO concentrations with sampling periods of 30 min in the range of 0 mg/m^3 – 400 mg/m^3 for large combustion plants and 0 mg/m^3 - 740 mg/m^3 for waste and co-incineration, according to daily emission limit values laid down in the following Council Directives :

— Council Directive 2001/80/EC on the limitation of emissions of certain pollutants into the air from large combustion plants

— Council Directive 2000/76/EC on waste incineration plants.

The limit values of EU directives are expressed in mg/m^3, on dry basis and at the reference conditions of 273 K and 101,3 kPa.

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 concentrations of dust – Part 1: Manual gravimetric method

TS 14793:2004, Stationary source emission - Intra-laboratory validation procedure for an alternative method compared to a reference method

ENV 13005: 1999, Guide to the expression of uncertainty in measurement

EN/ISO 14956: 2002, Air Quality – Evaluation of the suitability of a measurement method by comparison with a stated measurement uncertainty

ISO 5725-2: 1994, Accuracy (trueness and precision) of measurement methods and results - Part 2: Basic methods for the determination of the trueness of a standard measurement method

ISO 5725-6: 1994, Accuracy (trueness and precision) of measurement methods and results - Part 6 : Use in practice of accuracy values

ISO/DIS 9169, Air quality – Definition and quantification of performance characteristics of measuring systems under predetermined and imposed conditions.

ISO 11095:1996, Linear calibration using reference materials

VIM: 1994, International vocabulary of basic and general terms in metrology

3 Terms and definitions

For the purposes of this European Standard the following terms and definitions apply.

3.1
adjustment (of a measuring system)
operation of bringing a measuring system into a state of performance suitable for its use

[VIM 4.30]

3.2
ambient temperature
temperature of the air around the measuring system

3.3
automatic measuring system (AMS)
automatic measuring system producing a continuous output signal upon continuous interaction with the sample gas characteristics

3.4
calibration
statistical relationship between values of the measurand indicated by the measuring system (AMS) and the corresponding values given by the standard reference method (SRM) used during the same period of time and giving a representative measurement on the same sampling plane.

Note The result of calibration permits to establish the relationship between the values of the SRM and the AMS (calibration function).

3.5
drift
difference between two zero (zero drift) or span readings (span drift) at the beginning and at the end of a measuring period

3.6
emission limit value (ELV)
emission limit value according to EU Directives on the basis of 30 minutes, 1 hour or 1 day

3.7
influence quantity
quantity that is not the measurand but that affects the result of the measurement

[adapted VIM 2.7]

Note Examples:

— ambient temperature

— atmospheric pressure

— presence of interfering gases in the flue gas matrix

— pressure of the gas sample

3.8
interference
a negative or positive effect upon the response of the measuring system, due to a component of the sample that is not the measurand

3.9
lack of fit
systematic deviation within the range of application between the measurement result obtained by applying the calibration function to the observed response of the measuring system measuring test gases and the corresponding accepted value of such test gases

Note 1 Lack of fit may be a function of the measurement result.

Note 2 The expression “ lack of fit” is often replaced in everyday language by "linearity" or "deviation from linearity".

3.10
measurand
particular quantity subject to measurement

[VIM 2.6]

3.11
measuring system
complete set of measuring instruments and other equipment assembled to carry out specified measurements

[VIM 4.5]

3.12
performance characteristic
one of the quantities (described by values, tolerances, range…) assigned to equipment in order to define its performance

3.13
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 Repeatability conditions include:

— the same measurement procedure

— the same laboratory

— the same measuring instrument, used under the same conditions

— the same location

— repetition over a short period of time

Note 2 Repeatability may be expressed quantitatively in terms of the dispersion characteristics of the results

In this European Standard the repeatability is expressed as a value with a level of confidence of 95%.

[VIM 3.6]

3.14
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 These conditions include :

- the same measurement procedure
- two sets of equipment, the performance of which fulfils the requirements of the reference method, used under the same conditions
- the 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 repeatability may be expressed quantitatively in terms of the dispersion characteristics of the results.

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

3.15
reproducibility in the field
closeness of the agreement between the results of simultaneous measurements of the same measurand carried out using several sets of equipment under the same conditions of measurement

Note 1 These conditions are called field reproducibility conditions and include :

- the same measurement procedure
- several sets of equipment, the performance of which fulfils the requirements of the reference method, used under the same conditions
- the same location

- implemented by several laboratories

Note 2 Reproducibility may be expressed quantitatively in terms of the dispersion characteristics of the results.

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

3.16
residence time in the measuring system
the time period for the sampled gas to be transported from the inlet of the probe to the inlet of the measurement cell

3.17
response time
time interval between the instant when a stimulus is subjected to a specified abrupt change and the instant when the response reaches and remains within specified limits around its final steady value

Note By convention time taken for the output signal to pass from 0 % to 90 % of the final change

[VIM 5.17]

3.18
sampling location
specific area close to the sampling plane where the measurement devices are set up

3.19
sampling plane
plane normal to the centreline of the duct at the sampling position

[EN 13284-1]

3.20
sampling point
specific position on a sampling line at which a sample is extracted

[EN 13284-1]

3.21
span gas
test gas used to adjust and check a specific point on the response line of the measuring system

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

3.22
standard reference method (SRM)
measurement method recognised by experts and taken as a reference by convention, which gives, or is presumed to give, the accepted reference value of the concentration of the measurand (3.10) to be measured

3.23
uncertainty
parameter associated with the result of a measurement, that characterises the dispersion of the values that could reasonably be attributed to the measurand

3.23.1
standard uncertainty u
uncertainty of the result of a measurement expressed as a standard deviation u

3.23.2
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

$U = k \cdot u$

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

3.23.3
combined uncertainty u_c
standard uncertainty u_c attached to the measurement result calculated by combination of several standard uncertainties according to GUM.

3.23.4
overall uncertainty U_c
expanded combined standard uncertainty attached to the measurement result calculated according to GUM

$U_c = k \cdot u_c$

3.24
uncertainty budget
calculation table combining all the sources of uncertainty according to EN/ISO 14956 or ENV 13005 in order to calculate the overall uncertainty of the method at a specified value

4 Principle

4.1 General

This European standard describes the reference method for sampling, and determining carbon monoxide (CO) con in ducts and stacks emitting to atmosphere by means of an automatic analyser using Non Dispersive Infra-Red (NDIR) absorption principle. The specific components and the requirements for the sampling system and the NDIR analyser are described. A number of performance characteristics with associated minimum performance criteria are given for the analyser. These performance characteristics and the overall uncertainty of the method shall meet the performance criteria given in this European Standard. Requirements and recommendations for quality assurance and quality control are given for measurements in the field (see table 1 in 7.2).

4.2 Measuring principle

CO concentration is measured with use of non-dispersive infrared methods. The attenuation of infrared light passing through a sample cell is a measure of the concentration of CO in the cell, according to the Lambert-Beer law. Not only CO but also most hetero-atomic molecules absorb infrared light, in particular water and CO_2 have broad bands that can interfere with the measurement of CO. Different technical solutions have been developed to suppress cross-sensitivity, instability and drift in order to design automatic monitoring systems with acceptable properties. For instance :

— measuring IR absorption of a specific wavelength (4,7 µm for CO);

— dual-cell monitors, using a reference cell filled with clean air (compensation for drift);

— gas filter correlation, “measuring” over a range of wavelengths.

Special attention shall be paid to infrared radiation absorbing gases such as water vapour, carbon dioxide, nitrous oxide and hydrocarbons.

NDIR analysers are 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 values from the analyser are recorded and/or stored by means of electronic data processing.

The concentration of carbon monoxide is measured in volume/volume units (if the analyser is calibrated using a volume/volume standard). The final results for reporting are expressed in milligrams per cubic meter using standard conversion factors (see 10).