SLOVENSKI STANDARD
SIST ISO 25597:2015

01-april-2015

Emisije nepremičnih virov - Določevanje masne koncentracije PM10/PM2,5 v odpadnih plinih s ciklonskimi vzorčevalniki in redčenjem vzorca

Stationary source emissions - Test method for determining PM2,5 and PM10 mass in stack gases using cyclone samplers and sample dilution

Émissions de sources fixes - Méthode d'essai pour la détermination de la concentration en masse de PM 2,5 et PM 10 dans les gaz émis à la cheminée en utilisant des échantillonneurs cyclone et une dilution d'échantillon

Ta slovenski standard je istoveten z: ISO 25597:2013

ICS:

13.040.40	Emisije nepremičnih virov	Stationary source emissions

SIST ISO 25597:2015 en,fr

INTERNATIONAL STANDARD

ISO 25597

First edition
2013-03-15

Corrected version
2015-02-01

Stationary source emissions — Test method for determining PM2,5 and PM10 mass in stack gases using cyclone samplers and sample dilution

Émissions de sources fixes — Méthode d'essai pour la détermination de la concentration en masse de PM 2,5 et PM 10 dans les gaz émis à la cheminée en utilisant des échantillonneurs cyclone et une dilution d'échantillon

Reference number
ISO 25597:2013(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 146, *Air quality*, Subcommittee SC 1, *Stationary source emissions*.

This corrected version of ISO 25597:2013 incorporates the following corrections.

- Clause 4: Corrected the units for v_S, the average stack gas velocity. Deleted the row for "v_S velocity of the stack gas".
- 6.3.2 (last paragraph): Changed 10:1 to 20:1.
- 9.4.4.5: Changed "See C.4" to "See Annex D".
- 9.4.5: Changed "See C.5" to "See E.5".
- 9.8 (last paragraph): Changed "sample container No. 5" to "sample container No. 4d".
- 13.1: Corrected the reference from (ISO 25574:2013) to (ISO 25597:2013).
- C.1: In the first paragraph, changed "use Formula (B.1)" to "use Formula (C.1)". In Formula (C.1), changed the value of the numerator (212,2 replaces 3,056).
- C.2.3: In the note, changed "×1,5" to "× R_{max}".
- E.5.2: Deleted Formula (E.11) and renumbered accordingly.
- E.5.3: Removed "condensable" in the title and in the first line.
- E.5.3: Corrected Formulae (E.12) and (E.13) [formerly called Formulae (E.13) and (E.14)], and the explanations of N and D_F in the underlying where clause.
- E.5.4: Corrected Formulae (E.14) and (E.15) [formerly called Formulae (E.15) and (E.16)].

Introduction

This International Standard provides conventions for the sampling and analysis of stack gas samples from stationary sources by the use of cyclone samplers to separate particulate matter with nominal aerodynamic diameters of 10 µm (PM_{10}) and 2,5 µm ($PM_{2,5}$).

This International Standard provides design guidelines for:

- the use of sampling cyclones, for the measurement of filterable particles;
- the measurement of filterable and condensable particles using the dilution sampling technique.

The dilution sampling technique allows for the capture and measurement of condensable, secondary particulate matter that is similar in characteristics to materials formed when a flue gas exhaust mixes with ambient air. The method is suited for obtaining particulate speciation data useful in local and regional source apportionment studies and health risk assessment studies.

This International Standard provides for the use of two types of sampling train:

a) a basic sampling train to measure filterable particles using sampling cyclones that can distinguish between particle sizes in the range of 2,5 µm and 10 µm;

b) a dilution sampling train that uses in-stack sampling cyclones to measure filterable in particles in the same manner as the basic sampling train as in a), but measures also, condensable particles with additional $PM_{2,5}$ and/or PM_{10} cyclones located after the dilution chamber in the sampling train.

The method using dilution sampling for the formation, collection, and analysis of condensable particulate matter allows for capture of secondary particulate matter that is similar in character to ambient particulate matter. The method is suitable for the collection of source emission data for local and regional source apportionment studies. Particulate speciation data may also be gathered using dilution sampling to provide data for health risk assessment studies.

INTERNATIONAL STANDARD ISO 25597:2013(E)

Stationary source emissions — Test method for determining PM2,5 and PM10 mass in stack gases using cyclone samplers and sample dilution

WARNING — This document does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this document to establish appropriate safety and health practices and to determine the applicability of regulatory limitations prior to use.

Collection of emission samples may require working on stack platforms and other elevated surfaces. Protective clothing (heavy long sleeves and pants, hard hats, and eye protection) should be worn at all times while working in the vicinity of hot surfaces. Insulated gloves should be worn when handling hot probes or accessing stack sampling locations with hot surfaces. Hearing protection should be worn if needed.

Equipment cleaning requires the use of acetone. This work should be performed in a well-ventilated area to minimize fire and worker exposure hazards.

1 Scope

1.1 General

This International Standard specifies procedures for the extraction and measurement of filterable particulate matter from stationary source flue gas samples by:

- the use of cyclone samplers;
- the measurement of condensed particulate matter using dilution sampling technique, which simulates the interaction of stack gas components with the atmosphere as they mix after the stack exit.

This International Standard provides for the use of two types of sampling train.

- Basic sampling train, a basic sampling train to measure filterable particles using sampling cyclones that can distinguish between particle sizes in the range of 2,5 µm and 10 µm. This method is especially suitable for measurements of particle mass concentrations above 50 mg/m^3 as a half-hourly average at standard conditions (293 K, 1 013 hPa, dry gas) and applies to primary particulate matter (PM) emissions equal to or less than an aerodynamic diameter of nominally 10 µm (PM$_{10}$) from stacks or ducts.
- Dilution sampling train, a dilution sampling train that utilizes a dilution chamber that mixes flue gas with conditioned dilution air to simulate the interaction of the stack gas components with ambient air. This simulation process may lead to the condensation of particulate matter that might not otherwise be produced in the basic sampling train. The dilution sampling train uses in-stack sampling cyclones to measure filterable particles in the same manner as the basic sampling train, but in addition, utilizes additional PM$_{2,5}$ and/or PM$_{10}$ cyclones in the sampling train to measure particles formed in the dilution chamber.

This method is intended for the measurement of mass concentrations of particles smaller than 2,5 µm aerodynamic diameter (PM$_{2,5}$) using weighing techniques. The method can be used to measure mass concentrations of particles with aerodynamic diameter smaller than 10 µm aerodynamic diameter (PM$_{10}$) or particles with aerodynamic diameters between 2,5 µm and 10 µm.

In this method, the dilution sampling train can be used in combination with the basic sampling train, using PM$_{10}$ and/or PM$_{2,5}$ depending upon the test objectives. The dilution sampling system is intended for applications where measurement is required of particles similar in characteristics to materials formed when a flue gas exhaust mixes with ambient air.

Particulate matter filter samples collected using dilution sampling can be further analysed to provide chemical composition data that are applicable for developing $PM_{2,5}$ or PM_{10} emission inventories, visibility impact assessments, health risk assessments, and source–receptor studies related to $PM_{2,5}$ and PM_{10} emissions.

This method is not applicable to the determination of ultrafine particles with an aerodynamic diameter of less than 0,1 µm. This method has been applied to emission sources with low moisture and saturated moisture stack gases; however, it is not applicable to effluents where entrained water droplets are present.

NOTE Optionally, with additional equipment, as well as sampling and analytical procedures not described in the method, PM chemical speciation and particle size can be determined by applying ambient air sample collection and analysis methods to the diluted stack samples obtained by using this method. In addition, the concentration of gaseous precursors that can contribute to the formation of particulate matter, e.g. SO_2, NO_x, ammonia, SO_3, HCl, volatile organic comounds (VOCs), can be determined using suitable analytical equipment to measure the diluted samples.

1.2 Limitations

1.2.1 General limitations

It is recognized that there are some combustion processes and situations that can limit the applicability of this International Standard. Where such conditions exist, caution and competent technical judgment are required, especially when dealing with any of the following:

- high-vacuum, high-pressure or high-temperature gas streams above 260 °C;
- fluctuations in velocity, temperature or concentration due to uncontrollable variation in the process;
- gas stratification due to the non-mixing of gas streams.

There are also limitations specific to each sampling technique.

1.2.2 Basic cyclone sampling technique

Stacks with entrained moisture droplets can have droplet sizes larger than the cut sizes for the cyclones. These water droplets normally contain particles and dissolved solids that become PM_{10} and $PM_{2,5}$ following evaporation of the water.

1.2.3 Dilution sampling technique

For dilution sampling, a known limitation of this method concerns the presence of particles in the dilution air at very low concentrations, contributing to measurement background. This can be significant for certain very clean sources, e.g. gas-fired power plants. Dilution air system blanks are necessary when sampling sources with anticipated $PM_{2,5}$ or PM_{10} mass concentrations less than or equal to about 1,0 mg/m^3.

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.

ISO 7708:1995, *Air quality — Particle size fraction definitions for health-related sampling*

ISO 8178-1:2006, *Reciprocating internal combustion engines — Exhaust emission measurement — Part 1: Test-bed measurement of gaseous and particulate exhaust emissions*

ISO 9096, *Stationary source emissions — Manual determination of mass concentration of particulate matter*

ISO 10780, *Stationary source emissions — Measurement of velocity and volume flowrate of gas streams in ducts*

ISO 12039, *Stationary source emissions — Determination of carbon monoxide, carbon dioxide and oxygen — Performance characteristics and calibration of automated measuring systems*

ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

3 Terms and definitions

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

3.1
aerodynamic diameter
diameter of a sphere of density 1 g/cm^3 with the same terminal velocity due to gravitational force in calm air as the particle, under prevailing conditions of temperature, pressure and relative humidity

[SOURCE: ISO 23210:2009,[13] 3.1.1]

3.2
ambient air sample
sample collected for quality assurance purposes by drawing unfiltered ambient air at the stationary source sampling location through the sampling media

3.3
bulk mean gas residence time
actual sample volume flow rate taken at the actual bulk mean temperature of the sample gas flowing through the aging section

3.4
bulk mean temperature
actual bulk mean temperature
mean of the diluted sample gas temperature measured at the entrance and exit of the aging chamber

3.5
condensable particulate matter
particulate matter formed at temperatures below 30 °C due to physical and/or chemical processes

3.6
constant flow rate sampling
withdrawal of a sample from the flue gas at a fixed flow rate through the sampling nozzle

Note 1 to entry: Withdrawal of a sample is chosen at a fixed flow rate to achieve the appropriate cut diameters for particles in the sampling cyclones and 80 % to120 % isokinetic sampling conditions.

3.7
cut-off diameter
aerodynamic diameter where the separation efficiency is 50 %

[SOURCE: ISO 23210:2009,[13] 3.1.2, modified — “of the impactor stage” deleted]

3.8
diluted stack gas
combined stack gas sample and dilution air, after mixing

3.9
dilution air
ambient air that is filtered to remove solid particulate and organic compounds before mixing with a stack gas sample in a dilution sampling system

3.10
dilution factor
DF
one plus dilution ratio

Note 1 to entry: The product of dilution factor and filter sample PM concentration is equal to the in-stack PM concentration.

3.11
dilution ratio
DR
ratio of the dilution air flow rate through a dilution system to the undiluted stack gas sample flow rate through the system

Note 1 to entry: Determined by direct flow measurement or tracer method (ISO 8178-1).

3.12
dilution sampling system
sampling equipment that dilutes stationary source stack gases with filtered ambient air to simulate the mixing and cooling processes in a stack plume

3.13
dilution system blank
quality assurance sample collected by assembling the dilution sampling equipment at the stationary source sampling location and then drawing only dilution air through the dilution system and sampling media

3.14
field blank
sample collected for quality assurance purposes by assembling the dilution sampling equipment at the stationary source sampling location, performing a leak check, and then disassembling the equipment

Note 1 to entry: No stack gas sample passes through the equipment.

3.15
***F*-factor**
ratio of combustion gas volume to heat input determined from fuel composition using combustion calculations

3.16
filter holder assembly
filter holder or cassette that contains the filter media for collecting particulate samples

3.17
filtration temperature
temperature of the diluted sample gas immediately downstream of the filter

[SOURCE: ISO 12141:2002, 3.2, modified — “diluted” inserted]

3.18
flue gas sample
flue gas, extracted from a duct or stack of a stationary source, before dilution, in the application of the method

3.19
isokinetic sampling
sampling at a flow rate such that the velocity and direction of the gas entering the sampling nozzle (v_n) are the same as that of the gas in the duct at the sampling point (v_s)

[SOURCE: ISO 12141:2002, 3.5]

3.20
laboratory blank
conditioned, unsampled filter used to determine any mass change between pre- and post-sampling weighings due to contamination occurring during the sampling

3.21
PM
particulate matter including $PM_{2,5}$, PM_{10}, and/or total suspended particulate matter

3.22
$PM_{2,5}$
particles which pass through a size-selective inlet with a 50 % efficiency cut-off at 2,5 µm aerodynamic diameter

[SOURCE: ISO 23210:2009,[13] 3.1.4]

Note 1 to entry: $PM_{2.5}$ corresponds to the “thoracic convention” as defined in ISO 7708:1995, 6.

3.23
PM_{10}
particles which pass through a size-selective inlet with a 50 % efficiency cut-off at 10 µm aerodynamic diameter

Note 1 to entry: PM_{10} corresponds to the “thoracic convention” as defined in ISO 7708:1995, 7.1.

3.24
coefficient of variation
standard deviation divided by the mean

Note 1 to entry: The coefficient of variation is commonly reported as a percentage.

[SOURCE: ISO 3534-1:2006,[14] 2.38]

3.25
sampling point
specific position in a source vent at which a sample is extracted

3.26
standard pressure
absolute pressure at standard conditions

3.27
standard temperature
absolute temperature at standard conditions

3.28
ultrafine particulate matter
particulate matter with an aerodynamic diameter less than or equal to 0,1 µm

3.29
volatile organic compound
VOC
organic compound present with a vapour pressure below its saturated vapour pressure at ambient air pressure and temperature

3.30
weighing control procedure
quality control procedure utilized for detecting or correcting apparent mass variations due to climatic or environmental changes between pre- and post-sampling weighing series