
Emisije nepremičnih virov - Določanje masne koncentracije PCDD/PCDF in dioksinom podobnih PCB - 5. del: Dolgotrajno vzorčenje PCDD/PCDF/PCB

Stationary source emissions - Determination of the mass concentration of PCDDs/PCDFs and dioxin-like PCBs - Part 5: Long-term sampling of PCDDs/PCDFs/PCBs

Emissionen aus stationären Quellen - Bestimmung der Massenkonzentration von PCDD/PCDF und dioxin-ähnlichen PCB - Teil 5: Langzeitprobenahme von PCDD/PCDF/PCB

Émissions de sources fixes - Détermination de la concentration massique en PCDD/PCDF et PCB de type dioxine - Partie 5 : Prélèvement à long-terme de PCDD/PCDF/PCB

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ICS:

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Stationary source emissions - Determination of the mass concentration of PCDDs/PCDFs and dioxin-like PCBs - Part 5: Long-term sampling of PCDDs/PCDFs/PCBs

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Emissionen aus stationären Quellen - Bestimmung der Massenkonzentration von PCDD/PCDF und dioxin-ähnlichen PCB - Teil 5: Langzeitprobenahme von PCDD/PCDF/PCB

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Contents	Page
European foreword.....	5
Introduction	6
1 Scope	8
2 Normative references	8
3 Terms and definitions	9
4 Symbols and abbreviations	11
4.1 General.....	11
4.2 Polychlorinated biphenyls, polychlorinated dibenzodioxins and polychlorinated dibenzofurans.....	12
5 Principle of long-term PCDDs/PCDFs/PCBs sampling.....	13
5.1 General.....	13
5.2 Long-term sampling based on the filter/condenser method.....	13
5.3 Long-term sampling based on the dilution method	14
5.4 Long-term sampling based on the cooled probe method	14
6 Sampling devices and materials	15
6.1 Sampling devices	15
6.1.1 General.....	15
6.1.2 Components for the sampling train.....	15
6.1.3 Automatic controller.....	15
6.1.4 Instrumentation for measuring gas parameters	16
6.2 Materials.....	16
7 Minimum requirements for long-term PCDDs/PCDFs/PCBs sampling methods	16
7.1 Certification of the sampling system.....	16
7.2 Validation of the installation/functioning on each plant to be fulfilled by the plant operator.....	18
7.2.1 Long-term PCDDs/PCDFs/PCBs sampling systems using lab-prepared sample collection units.....	18
7.2.2 Minimum requirements for set-up	19
7.2.3 Minimum requirements for selecting the sampling point	19
7.2.4 Minimum requirements for sampling	20
7.3 Minimum requirements for on-going operations on each plant to be fulfilled at regular time intervals by the plant operator	24
7.3.1 Regular check-up.....	24
7.3.2 Cleaning of components upstream the sample collection unit.....	24
7.3.3 Maintenance.....	25
8 Quality assurance.....	27
8.1 General.....	27
8.2 Quality assurance of sample collection unit.....	27
8.2.1 Leak check	27
8.2.2 Field blank test.....	27
8.3 Quality assurance of sampling volume.....	27
8.3.1 Initial quality assurance	27
8.3.2 Ongoing quality assurance on site	27
8.4 Quality assurance of isokinetic sampling.....	28
8.5 Quality assurance of flue gas conditions (O ₂ content, temperature, pressure, humidity)	28

9	Analytical procedure	29
9.1	General	29
9.2	Extraction of the sample	29
9.3	Clean-up and partitioning of the sample extract	29
9.4	Identification and quantification	32
9.5	Calculation of the recovery rates of the extraction standards	32
9.6	Calculation of results	32
10	Estimation of uncertainty of the method	33
10.1	General	33
10.2	Elements required for the uncertainty determinations	33
10.2.1	Model formula and parameters	33
10.2.2	Expanded uncertainty	35
11	Reporting	35
11.1	Sampling report, analytical report and field blank report	35
11.2	Record keeping every half hour	37
11.3	Interruptions recording	38
	Annex A (normative) Overview of minimum requirements	39
	Annex B (normative) Cleaning procedure	41
	Annex C (normative) Performance criteria and test procedure for certification	43
C.1	General relation to other standards	43
C.2	General requirements	43
C.3	Performance criteria common to all long-term PCDDs/PCDFs/PCBs sampling systems for laboratory testing	43
C.4	Performance criteria common to all long-term PCDDs/PCDFs/PCBs sampling systems for field testing	44
C.5	Reporting of the long-term sampling system certificates	45
	Annex D (informative) Examples of devices and operation for long-term sampling systems	47
D.1	Filter/condenser method	47
D.2	Dilution method	50
D.3	Cooled probe method	53
	Annex E (informative) Fundamentals of isokinetic sampling	57
E.1	General	57
E.2	Error (ϵ) by non-isokinetic sampling depending on particle diameter	58
E.3	Influence of long-term sampling on achieving isokinetic sampling	58
E.4	Procedure	59
E.5	Parameters affecting gas velocity measurement that require regular device calibration and checking	61
	Annex F (informative) Example for the determination of the representative sampling point	64
	Annex G (informative) Estimation of the uncertainty of measured PCDDs/PCDFs/PCBs of the long-term sampling system	68
G.1	General	68
G.2	Analysis of the measurement process and mathematical modelling	68

prEN 1948-5:2026 (E)

G.3	Application of the law of propagation of uncertainties.....	71
G.4	Calculation of type uncertainties.....	71
G.5	Calculation of expanded uncertainty	74
G.6	Example of digital application: measurement of dioxin/furan-concentration	75
Annex H (informative)	Example for calculation of measurement results for standard conditions	81
H.1	General.....	81
H.2	Dry gas volumetric flow rate at standard conditions.....	81
Annex I (normative)	Adaption of the maximum deviation in relation to the PCDDs/PCDFs/PCBs concentration	83
Annex J (informative)	Validation results.....	85
J.1	Prerequisite and assumptions	85
J.2	Results.....	86
J.3	Summary	87
Annex K (informative)	Significant changes between this document prEN 1948-5:2026 and the previous edition CEN/TS 1948-5:2015 in the transfer from TS to EN	88
Bibliography.....		92

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European foreword

This document (prEN 1948-5:2026) 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 CEN/TS 1948-5:2015.

This document has been prepared under a standardization request addressed to CEN by the European Commission. The Standing Committee of the EFTA States subsequently approves these requests for its Member States.

prEN 1948-5:2026 includes several significant technical changes with respect to CEN/TS 1948-5:2015. An informative Annex K has been added in which the technical changes between this document and CEN/TS 1948-5:2015 are listed in detail.

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Introduction

0.1 Background

EN 1948-1, EN 1948-2, EN 1948-3 and EN 1948-4 describe reference methods for the determination of PCDDs/PCDFs/PCBs, whereas this document gives requirements for long-term sampling measurements in connection with the appropriate analytical methods (equivalent method). In contrast to the short-term sampling methods which refers to monitoring the limit value for compliance with emission limit values (ELVs) in Directives, such as Industrial Emission Directive (IED) [10], the long-term sampling is intended to determine the average concentration level during a longer period (see e.g. [12], [13]). EN 1948-5 provides methods for measuring long-term average mass concentrations, but it does not specify its potential use by the competent authority for demonstrating compliance with long-term ELVs.

Long-term sampling methods are not automatic measurement methods and do not provide continuous emission monitoring data (real time display).

Application of EN 1948-2 (extraction), EN 1948-3 (analysis) and EN 1948-4 ('PCBs') in connection with this document are necessary for performing long-term sampling of PCDDs/PCDFs/PCBs.

Currently, in some European Union countries, PCDDs/PCDFs/PCBs long-term sampling is an obligatory measurement for some processes, further countries and processes can or will follow.

In Reference [1] the results of a Type Performance Test for long-term sampling are presented.

0.2 Relationship between this document and the essential requirements of Directive (EU) 2024/1785 amending Directive 2010/75/EU

This document has been prepared under a Standardization Request M/588 / C(2022) 6574 final "Methods for the measurements of emissions into the air of polychlorinated dibenzo-p-dioxins and furans (PCDDs/PCDFs) and dioxin-like polychlorinated biphenyls (PCBs), total gaseous mercury and formaldehyde" given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directives / Regulations Directive (EU) 2024/1785 of the European Parliament and of the Council of 24 April 2024 amending Directive 2010/75/EU of the European Parliament and of the Council on industrial emissions (integrated pollution prevention and control) and Council Directive 1999/31/EC on the landfill of waste.

Essential Requirements of Directive 2010/75/EU

Article 45 Permit conditions

"(2) In addition to the requirements set out in paragraph 1, the permit granted to a waste incineration plant or waste co-incineration plant using hazardous waste shall include the following...

(b) the minimum and maximum mass flows of those hazardous wastes, their lowest and maximum calorific values and their maximum contents of polychlorinated biphenyls, pentachlorophenol, chlorine, fluorine, sulphur, heavy metals and other polluting substances."

Article 48 Monitoring of emissions

"As soon as appropriate measurement techniques are available within the Union, the Commission shall, by means of delegated acts in accordance with Article 76 and subject to the conditions laid down in Articles 77 and 78, set the date from which continuous measurements of emissions into the air of heavy metals and dioxins and furans are to be carried out."

Essential Requirements of Directive (EU) 2024/1785

(36) in Article 48, paragraph 1 is replaced by the following:

"Member States shall ensure that monitoring of emissions is carried out in accordance with Parts 6 and 7 of Annex VI. Emissions to air from waste incineration and co-incineration plants shall also be monitored during other than normal operating conditions. Emissions during start-up and shutdown while no waste

is being incinerated, including emissions of PCDD/F and dioxin-like PCBs, shall be estimated based on measurement campaigns, carried out at regular intervals, such as every three years, carried out during planned start-up or shutdown operations. Emissions of PCDD/F and dioxin-like PCBs shall as far as possible be prevented or minimised.”

Annex VI to Directive 2010/75/EU is amended as follows:

in Part 6, point 1.2 is replaced by the following:

“1.2. Sampling and analysis of all polluting substances including dioxins and furans, as well as the quality assurance of automated measuring systems and the reference measurement methods to calibrate them, shall be carried out in accordance with CEN-standards. If CEN standards are not available, ISO, national or other international standards which ensure the provision of data of an equivalent scientific quality shall apply. This applies also to the quality assurance system of the laboratory performing the sampling and analysis. Automated measuring systems shall be subject to control by means of parallel measurements with the reference methods at least once per year.”

NOTE Other Union legislation might be applicable to the methods falling within the scope of this document.

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1 Scope

This document specifies the long-term sampling of PCDDs/PCDFs/PCBs. There are three different sampling methods, which are based on the three different principles described in EN 1948-1, but partially modified for long-term sampling requirements:

- filter/condenser method;
- dilution method;
- cooled probe method.

Each sampling method is illustrated in detail in Annex D. The sampling methods described in this document are designed for a sampling duration of typically up to four weeks.

Additionally, this document specifies a framework of quality control requirements for any long-term sampling method.

With the methods described, experiences were gained for a concentration range up to 4,0 ng TEQ/m³ at various stationary sources (e.g. waste incinerators, sinter plants, cement kilns).

For complete implementation of the measurement method, the use of EN 1948-2 and EN 1948-3 describing extraction, clean-up, identification, and quantification, respectively, is necessary in order to determine PCDDs/PCDFs. Additionally, EN 1948-4 is necessary for PCBs.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 1948-1:2006, *Stationary source emissions — Determination of the mass concentration of PCDDs/PCDFs and dioxin-like PCBs — Part 1: Sampling of PCDDs/PCDFs*

EN 1948-2:2006, *Stationary source emissions — Determination of the mass concentration of PCDDs/PCDFs and dioxin-like PCBs — Part 2: Extraction and clean-up of PCDDs/PCDFs*

EN 1948-3:2006, *Stationary source emissions — Determination of the mass concentration of PCDDs/PCDFs and dioxin-like PCBs — Part 3: Identification and quantification of PCDDs/PCDFs*

EN 1948-4:2010+A1:2013, *Stationary source emissions — Determination of the mass concentration of PCDDs/PCDFs and dioxin-like PCBs — Part 4: Sampling and analysis of dioxin-like PCBs*

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

EN 15267-1, *Air quality — Assessment of air quality monitoring equipment — Part 1: General principles of certification*

EN 15267-2, *Air quality — Assessment of air quality monitoring equipment — Part 2: Initial assessment of the manufacturer's quality management system and post certification surveillance for the manufacturing process*

EN 15267-3:2023, *Air quality — Assessment of air quality monitoring equipment — Part 3: Performance criteria and test procedures for stationary automated measuring systems for continuous monitoring of emissions from stationary sources*

EN ISO 16911-1, *Stationary source emissions — Manual and automatic determination of velocity and volume flow rate in ducts — Part 1: Manual reference method (ISO 16911-1)*

3 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1

sample collection unit

entity, which is covering and holding different media, including e.g. adsorber, absorber and filter, used to collect the PCDDs/PCDFs/PCBs from the gaseous and particulate phase and it is processed later, after the end of sampling, at a laboratory

3.2

short-term sampling

sampling for a period of 6 to 8 h according to EN 1948-1

3.3

long-term sampling

sampling, continuously performed for an extended period of time compared to short-term sampling, e.g. sampling for one month

3.4

long-term sampling system

a system used for long-term sampling

3.5

measurement report

report, including the relevant details of the sampling report and the analytical report, indicating especially the PCDDs/PCDFs/PCBs concentration

3.6

Field blank report

Report of the field blank test results

3.7

standby

Interruption of the sampling process, due to, e.g. plant shut down, sampling system maintenance or during the changing of sample collection unit

3.8

standardized gas volume

gas volume, quantified at standard conditions of temperature (273,15 K) and pressure (101,3 kPa) on a dry basis, and corrected to a reference concentration of oxygen, if needed

prEN 1948-5:2026 (E)

3.9

isokinetic sampling

sampling, which is performed such that the velocity (magnitude and direction) of the gas entering the sampling nozzle is the same as the velocity of the gas in the duct at the sampling point

3.10

sampling standard

one or more $^{13}\text{C}_{12}$ -labelled PCDD/PCDF/PCB, added before sampling

3.11

extraction standard

one or more $^{13}\text{C}_{12}$ -labelled PCDD/PCDF/PCB, added before extraction and used for calculation of results

3.12

recovery standard

one or more $^{13}\text{C}_{12}$ -labelled PCDD/PCDF/PCB, added after completing the clean-up procedure (EN 1948-2) and before identification and quantification (EN 1948-3), or respectively before analysis (EN 1948-4), as applicable

3.13

type performance test

test, to be performed by an independent test house in a laboratory and on site, to evaluate the conformity of the long-term sampling systems, according to the defined performance criteria, corresponding to the relevant application

3.14

field blank value

concentration value, determined from a sampling collection unit, which was prepared but not used for sampling

Note 1 to entry: The described measurement procedure is employed to ensure that no significant contamination has occurred during all steps of the measurement and to check that the operator can achieve a quantification level adapted to the task.

Note 2 to entry: The field bank value is a calculated value and does not represent a measured concentration.

3.15

accuracy

closeness of agreement between a measured quantity value and a true quantity value of a measurand

[SOURCE: VIM:2012 [3]]

3.16

maintenance interval

maximum allowed time period, within which the performance characteristics will remain in the predefined range without intervention (e.g. cleaning, calibration or adjustment)

3.17

measurement section

region of the flue gas duct, which includes the measurement plane(s)

[SOURCE: EN 15259:2007, 3.12]

3.18**measurement cross section**

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, 3.13]

3.19**availability**

fraction of the total sampling time, during which PCDDs/PCDFs/PCBs were collected in the sample collection unit

3.20**cleaning**

general procedure to remove residues, including particulate matter, from parts of the sampling train which were or will be in contact with the sampled gas

3.21**purging**

operation where clean gas is blown at high flow through the complete sampling train or parts of it in the direction of the stack

Note 1 to entry: Purging is only appropriate when the long-term sampling system is stopped or in stand-by mode.

3.22**backflush**

operation to prevent possible contaminations, where clean gas is blown at low flow through the complete sampling train or parts of it in the opposite direction of the usual sampling flow

3.23**rinsing**

cleaning operation, where parts of the sampling train are cleaned using solvents

3.24**thermal desorption**

non-invasive cleaning operation, where PCDDs/PCDFs/PCBs, which are immobilised by adsorption in probes and/or sampling lines, are transferred to mobile phase using thermal energy

3.25**substitute**

value, which is used to replace a parameter value, in case the parameter value is not available for any reason

Note 1 to entry: A substitute is employed to enable sampling, when sampling cannot be performed without the parameter value.

4 Symbols and abbreviations

For the purposes of this document the following abbreviations apply.

4.1 General

Terms as phrases are described for use in singular form. An 's' following the phrase defines the plural form.

prEN 1948-5:2026 (E)

ELV	emission limit value (singular)
I-TEF	international toxic equivalent factor (for a detailed description see EN 1948-1) (singular)
I-TEQ	international toxic equivalent obtained by weighting the mass determined with the corresponding I-TEF (for a detailed description see EN 1948-1) (singular)
LOQ	lower limit of quantification (singular)
LOD	limit of detection
PU foam	polyurethane foam used as adsorbent
TEF	toxic equivalent, used for WHO-TEF or I-TEF, depending on the relevant use
TEQ	toxic equivalent, used for WHO-TEQ or I-TEQ, depending on the relevant use
ULOQ	upper limit of quantification (singular)
WHO-TEF	toxic equivalent factor proposed by World Health Organization (WHO) (for a detailed description see EN 1948-1)
WHO-TEQ	toxic equivalent obtained by multiplying the mass determined with the corresponding WHO-TEF (for a detailed description see EN 1948-1)
PTFE	Polytetrafluoroethylene
SI	International System of Units

4.2 Polychlorinated biphenyls, polychlorinated dibenzodioxins and polychlorinated dibenzofurans

Terms as phrases are described for use in singular form. An 's' following the phrase defines the plural form.

HpCDD	heptachlorodibenzo-p-dioxin
HpCDF	heptachlorodibenzofuran
HxCDD	hexachlorodibenzo-p-dioxin
HxCDF	hexachlorodibenzofuran
OCDD	octachlorodibenzo-p-dioxin
OCDF	octachlorodibenzofuran
PCDD/PCDF	polychlorinated dibenzo-p-dioxin and/or polychlorinated dibenzofuran
PCDDs/PCDFs	polychlorinated dibenzo-p-dioxins and/or polychlorinated dibenzofurans
PCDD/PCDF/PCB	polychlorinated dibenzo-p-dioxin and/or polychlorinated dibenzofuran and/or polychlorinated biphenyl
PCDDs/PCDFs/PCBs	polychlorinated dibenzo-p-dioxins and/or polychlorinated dibenzofurans and/or polychlorinated biphenyls
PCB	polychlorinated biphenyl
PeCDD	pentachlorodibenzo-p-dioxin
PeCDF	pentachlorodibenzofuran
TCDD	tetrachlorodibenzo-p-dioxin

TCDF

tetrachlorodibenzofuran

5 Principle of long-term PCDDs/PCDFs/PCBs sampling

5.1 General

The long-term sampling of PCDDs/PCDFs/PCBs is the continuous isokinetic sampling of PCDDs/PCDFs/PCBs from a flue gas duct for an extended time period, usually from 24 h up to several weeks. The sample gas flow rate is automatically controlled in the long term sampling system. The PCDDs/PCDFs/PCBs, whether adsorbed on particles or present in the gas phase, are both collected in the sample collection unit of the long-term sampling system. Dependent on the sampling system, the sample collection unit can consist of different compartments, e.g. filters, a condensate flask unit, solid or liquid adsorbents. The long-term sampling systems are based on the following sampling methods, described in EN 1948-1:

- filter/condenser method;
- dilution method;
- cooled probe method.

Schematic representations of the sampling methods according to EN 1948-1 including the modifications for long-term sampling are given in Figure 1, Figure 2, and Figure 3.

The sample collection unit is spiked with a sampling standard so as to determine the sampling recovery rate of the congeners. The sample gas is brought to a temperature specific to the sampling system. The gaseous and particulate PCDDs/PCDFs/PCBs of the sample gas stream are trapped in the sample collection unit at that temperature.

The minimum requirements of the long-term sampling procedure that need to be fulfilled are described in this document. An overview of the minimum requirements that shall be met for the long-term sampling procedure are given in Annex A. Examples of devices and operation of long-term sampling systems are listed in Annex D. The described systems meet the minimum requirements of Clause 7 and Annex A of this document but differ in their approach.

After sampling, the sample collection unit shall be sent to the analytical laboratory for the sample analysis. The necessary safety precautions, e.g. for transport, shall be fulfilled. The data needed for calculations and reporting shall be provided to the responsible reporting entity (e.g. laboratory, service provider, etc.).

WARNING Attention is drawn to the existence of national safety regulations. The PCDDs/PCDFs/PCBs belong to the most toxic chemicals. In addition, working at the sampling site can include exposure to a range of hazards such as poisonous/asphyxiating flue gases and working at heights. Appropriate measures shall be taken to minimize exposure to such hazards. Care shall be taken when transporting samples to avoid their breakage both to prevent contamination and to avoid sample losses.

5.2 Long-term sampling based on the filter/condenser method

Long-term sampling systems based on the filter/condenser method filter the dust at a temperature above the flue gas dew point, but at a maximum of 125 °C and cool down the sample gas to a temperature of about 20 °C before it enters the adsorber as described in EN 1948-1. A higher temperature can be used, if it is demonstrated that the minimum requirements for adsorption efficiency are fulfilled (see 7.1, e) and f) and 7.2.1, d) of this document). The PCDDs/PCDFs/PCBs passing the filter are collected on a suitable adsorption medium. The complete sample collection unit comprises a filter and the cartridge with the adsorbent. The condensate is filtered through the adsorption cartridge and discarded via the condensate flask unit.