SLOVENSKI STANDARD
kSIST-TS FprCEN/TS 17198:2018

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Emisije nepremičnih virov - PEMS - Uporabnost, izvedba in zagotavljanje kakovosti

Stationary source emissions - Predictive Emission Monitoring Systems (PEMS) - Applicability, execution and quality assurance

Vorhersagendes System für die Überwachung der Emissionen (PEMS) - Anwendbarkeit, Handhabung und Qualitätssicherung

Systèmes prédictifs de suivi des émissions atmosphériques - Applicabilité, mise en oeuvre et assurance qualité

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Stationary source emissions - Predictive Emission Monitoring Systems (PEMS) - Applicability, execution and quality assurance

Systèmes prédictifs de suivi des émissions atmosphériques - Applicabilité, mise en oeuvre et assurance qualité

Emissionen aus stationären Quellen - Vorhersagende Systeme für die Überwachung der Emissionen (PEMS) - Eignung, Anwendung und Qualitätssicherung

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

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

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European foreword

This document (FprCEN/TS 17198:2017) 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 Vote on TS.

Introduction

Predictive emission monitoring systems (PEMS) are used for continuous monitoring of emissions at stationary sources as an alternative and/or backup for automated measuring systems (AMS). PEMS define the relationship between a number of characteristic process parameters of an emission source and the corresponding emission concentration. If the characteristic process parameters are continuously monitored it is possible with a PEMS to continuously determine the emission concentration of the emission source.

PEMS are deduced using process data and, where required, emission data from the emission source. Using these data the PEMS is modelled. PEMS contains an emissions model and a sensor validation system for quality assurance of incoming process data.

PEMS are plant-specific emission monitoring systems and vary as regards to methodology and design:

— relational models (emission concentration as a function of one or more process parameters): theoretical or empirical relations that are fitted to a plant-specific emission data set;

— nonlinear statistical models, e.g. neural network models, or other multiple regression techniques.

Where a component or process is specifically stated, the reference is provided as an example.

The range of application of PEMS is limited to plants with well-defined fuels and operating conditions, using inherent emission control systems. If multiple fuels are used all fuel variations are reflected in the emission model. Using inherent emission control systems means not having a downstream emission abatement system.

PEMS is illustrated in Figure 1. It consists of:

— PEMS software, which is certified according to an EN 15267 procedure, with the exceptions stated in this Technical Specification;

— PEMS emissions model, which is documented by a QAL1 and validated by a QAL2 procedure according to EN 14181, with the exceptions stated in this Technical Specification;

— PEMS sensor validation system, which is documented by a QAL1 and validated by a QAL2 procedure according to EN 14181, with the exceptions stated in this Technical Specification.

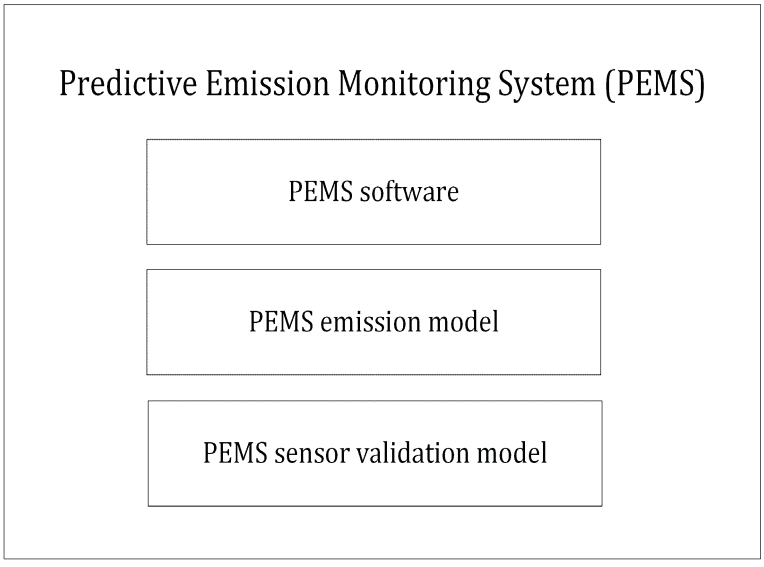

Figure 1 — Predictive emission monitoring system

PEMS software used for building, operating and quality assuring PEMS is illustrated in Figure 2.

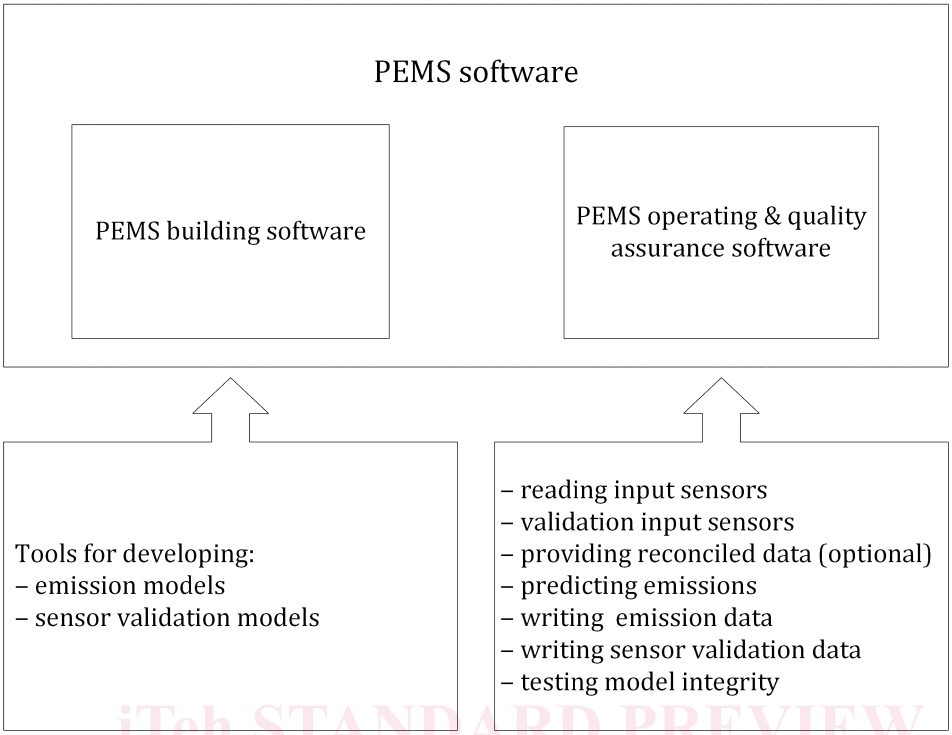

Figure 2 — PEMS software

This Technical Specification does not provide requirements for PEMS hardware. If the PEMS requires specific hardware, relevant standards for certification of PEMS hardware are used.

1 Scope

This Technical Specification gives requirements for the certification of PEMS software and for the performance and quality assurance for a PEMS to prove suitability for its measuring task and to ensure that the PEMS continues to perform within the specified performance during operation of the PEMS.

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 14181, *Stationary source emissions — Quality assurance of automated measuring systems*

EN 15267-1:2009, *Air quality — Certification of automated measuring systems — Part 1: General principles*

EN 15267-2:2009, *Air quality — Certification of automated measuring systems — Part 2: Initial assessment of the AMS manufacturer's quality management system and post certification surveillance for the manufacturing process*

EN 15267-3, *Air quality — Certification of automated measuring systems — Part 4: Performance criteria and test procedures for automated measuring systems for periodic measurements of emissions from stationary sources*

EN 15267-4, *Air quality — Certification of automated measuring systems — Part 3: Performance criteria and test procedures for automated measuring systems for monitoring emissions from stationary sources*

CEN/TS 15675, *Air quality — Measurement of stationary source emissions — Application of EN ISO/IEC 17025:2005 to periodic measurements*

EN ISO 14956, *Air quality — Evaluation of the suitability of a measurement procedure by comparison with a required measurement uncertainty (ISO 14956)*

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

VDI 4201 *Part 1:2010*, *Performance criteria on automated measuring and electronic data evaluation systems for monitoring emissions — Digital interface — General requirements*

VDI 4201 *Part 2:2014*, *Performance criteria on automated measuring and electronic data evaluation systems for monitoring emissions — Digital interface — Specific requirements for Profibus*

VDI 4201 *Part 3:2012*, *Performance criteria on automated measuring and electronic data evaluation systems for monitoring emissions — Digital interface — Specific requirements for Modbus*

VDI 4201 *Part 4:2012*, *Performance criteria on automated measuring and electronic data evaluation systems for monitoring emissions — Digital interface — Specific requirements for OPC*

3 Terms and definitions

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

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

- IEC Electropedia: available at http://www.electropedia.org/

- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
automated measuring system
AMS
measuring system permanently installed on site for continuous monitoring of emissions or measurement of peripheral parameters

Note 1 to entry: An AMS is a method which is traceable to a reference method.

Note 2 to entry: Apart from the analyser, an AMS includes facilities for taking samples (e.g. sample probe, sample gas lines, flow meters, regulators, delivery pumps) and for sample conditioning (e.g. dust filter, water vapour removal devices, converters, diluters). This definition also includes testing and adjusting devices that are used for regular functional checks.

3.2
certification
confirmation of certain characteristics of an object provided by some form of external review or audit

3.3
certification body
body operating a product certification system or body accredited to the EN ISO/IEC 17021 series for the certification of quality management systems

3.4
emission model
model describing the relation between process parameters (input sensors) and predicted emissions for a specific plant using the PEMS software

3.5
emission model integrity test
test procedure detailed in 6.5 analysing the integrity of the emission model

3.6
Predictive Emission Monitoring System
PEMS
continuous emission determination system for a plant by using relationships and/or models of the emission with corresponding continuously available process parameters (input parameters)

3.7
PEMS input sensor
process parameter used as an input for the PEMS

3.8
PEMS manufacturer
manufacturer of plant specific PEMS, using PEMS software

3.9
PEMS operating envelope
defined range of PEMS inputs for which an emission model is established during PEMS building

Note 1 to entry: Operating envelope reflects all plant operating conditions and external influences incorporated in the PEMS. Emission data generated from parameter inputs that are beyond the operating envelope are not considered quality-assured.

3.10
PEMS reproducibility
measure of the agreement between two PEMS designed using two time-distinctive data sets, both covering the intended operating envelope of the PEMS, (as far as reasonably possible), applied in parallel in field tests at a level of confidence of 95 % using the standard deviation of the difference of the paired measurements

Note 1 to entry: The reproducibility is calculated from the half hour averaged output signals (raw values) during the six-month field test.

3.11
PEMS software
software used for building, operating and quality assuring PEMS, certifiable according to this Technical Specification, including manuals describing procedures for designing, testing, operating and maintaining emission models and sensor validation models

3.12
predicted versus actual
systematic deviation between the values predicted by the emission model, based on the data used to build the PEMS, and the measured emission values included in the same data

3.13
prediction cycle
time period between two consecutive PEMS outputs

3.14
process parameter
physical variable of the (combustion) process in the plant

Note 1 to entry: For example temperature, fuel throughput, air throughput.

3.15
quality assurance
determination and control of the quality of the PEMS

3.16
reconciled data
substitute data from an alternative sensor or data generated by the sensor validation system

3.17
sensor validation model
model describing the relation between process parameters (inputs for the sensor validation system) and a PEMS input sensor for a specific plant

3.18
sensor validation system
quality assurance system for indicating defective and drifting PEMS input sensors for a specific plant using the PEMS software

Note 1 to entry: Sensor validation systems can incorporate systems for generating reconciled data.

3.19
validation of a PEMS
QAL2 procedure following EN 14181 with the exceptions of this Technical Specification

3.20
validation range
range over which the PEMS has been validated under the QAL2 procedure

4 Symbols and abbreviations

4.1 Symbols

c_{PEMS}	concentration range of the PEMS
$C_m\ (i)$	concentration measured in the field of the i^{th} value pair
$C_p\ (i)$	the concentration predicted by the PEMS of the i^{th} value pair
n	number of data pairs
s	standard deviation
u_c	is the standard uncertainty of the calculated sensor
u_i	standard uncertainty of the instrument
$u_{i(1)}$	standard uncertainty of instrument 1
$u_{i(2)}$	standard uncertainty of instrument 2
u_{input}	standard uncertainty due to deviations in the PEMS input sensors
u_{model}	standard uncertainty of the emission model
u_n	standard uncertainty of the normalized sensor
u_{other}	standard uncertainty due to parameters not included in the PEMS
u_{PEMS}	standard uncertainty of the PEMS
U_{PEMS}	relative expanded uncertainty of the PEMS
$u_{P/T}$	standard uncertainty related to the pressure and temperature normalization
$u_{(1)}$	standard uncertainty of sensor 1
$u_{(2)}$	standard uncertainty of sensor 2
x	input value of the calibration function
X	actual measured value
y	output value of the calibration function

Y	predicted value
Δ_i	deviation between the emission concentration measured in the field and the concentration predicted by the PEMS of the i^{th} value pair
Δ_{m}	mean of the relative deviations
$\frac{\delta_{\text{c}}}{\delta_{\text{i}(1)}}$	deviation of the calculated sensor due to a deviation of instrument 1
$\frac{\delta_{\text{c}}}{\delta_{\text{i}(2)}}$	deviation of the calculated sensor due to a deviation of instrument 2
$\frac{\delta_{\text{PEMS}}}{\delta_{(1)}}$	deviation of the PEMS due to a deviation of sensor 1
$\frac{\delta_{\text{PEMS}}}{\delta_{(2)}}$	deviation of the PEMS due to a deviation of sensor 2

4.2 Abbreviations

AMS	automated measuring system
AST	annual surveillance test
DAHS	data acquisition and handling system
ELV	emission limit value
MIT	emission model integrity test
PEMS	predictive emission monitoring system
PIS	PEMS input sensor
QAL	quality assurance level
QAL1	first quality assurance level
QAL2	second quality assurance level
QAL3	third quality assurance level
SRM	standard reference method
SV	sensor validation

5 Certification requirements for PEMS software

5.1 General

The certification requirements will come in force upon completion of a validation project for the certification of PEMS software and the availability of the certification service for PEMS software on the market.

PEMS software, including procedures for designing, operating and maintaining emission models and sensor validation models shall be certified in accordance with the provisions of the EN 15267 series of standards with the following deviations:

— where “AMS” is mentioned, it shall be substituted with “PEMS software”;

— where “manufacturing of AMS” is mentioned, it shall be understood as writing internal testing and validation of the PEMS software;

— EN 15267-1 is applicable with the deviations given in 5.2 of this Technical Specification;

— EN 15267-2 is applicable with the deviations given in 5.3 of this Technical Specification;

— EN 15267-3 is not applicable and shall be substituted by the requirements given in 5.4 of this Technical Specification.

The PEMS manufacturer (i.e. user of the PEMS software for developing plant specific PEMS) shall be certified in accordance with the provisions of EN 15267-2 with the following deviations:

— where ‘AMS’ is mentioned it shall be substituted by ‘PEMS’;

— where ‘AMS certificate’ is mentioned it shall be substituted by ‘PEMS software certificate’;

— EN 15267-2:2009, 3.1 (AMS definition) shall be replaced by the PEMS software definition in this Technical Specification;

— EN 15267-2:2009, 3.12, NOTE 2 shall be deleted;

— EN 15267-2:2009, 4.2.2 line 2 shall be deleted;

— EN 15267-2:2009, 4.2.3 line 4 and 5 shall be deleted;

— EN 15267-2:2009, 9.1 last line shall be deleted.

5.2 Relation to EN 15267-1

EN 15267-1:2009, 3.1 (AMS definition) shall be replaced by the PEMS software definition in this Technical Specification.

EN 15267-1:2009, 6.2 (reference to roles and responsibilities of the manufacturer) shall be replaced by:

The PEMS software manufacturer shall submit the PEMS software for certification to the relevant body together with two different sample emission models, including sensor validation system. Both PEMS are describing the emission of the industrial process used for field testing. The two emission models and sensor validation systems are designed using two time-distinctive data sets, collected at identical plant operating conditions (as far as reasonably possible). Both emission models shall use identical input sensors.

5.3 Relation to EN 15267-2

EN 15267-2:2009, 3.1 (AMS definition) shall be replaced by the PEMS software definition in this Technical Specification.

EN 15267-2:2009, 7.3 (reference to design changes) shall be replaced by:

The manufacturer shall document all changes in the PEMS software, including the influence on the PEMS output. Changes shall be recertified according to EN 15267-2 and archived in an auditable manner for the next EN 15267-2 audit.

If the changes in the PEMS software are implemented to a PEMS in operation, this documentation shall also be submitted to the customer (plant where the PEMS is in operation) and to the relevant authorities, having approved the PEMS.

If the changes in the PEMS software are implemented to a PEMS in operation, the PEMS shall be retested in accordance with the requirements of EN 15267-2 and according to this Technical Specification by an accredited test laboratory to ensure that the changed PEMS fulfil the requirements of quality assurance under all relevant conditions.

5.4 Certification of PEMS software – performance criteria and test procedures

5.4.1 Introduction

5.4.1.1 General

EN 15267-3 is written for instrumental AMS and not applicable for PEMS software. Performance criteria and test procedures for PEMS software are given in this section.

5.4.1.2 Certification stages

PEMS software certification is based on the following four sequential stages:

— performance testing of PEMS software;

— initial assessment of the PEMS software manufacturer's quality management system;

— certification;

— post certification surveillance.

5.4.1.3 Processes

Performance testing of the PEMS software is performed using duplicate PEMS developed for an industrial process with variable emission levels and process input. It is the responsibility of the PEMS software manufacturer in conjunction with the PEMS manufacturer to ensure that the PEMS software performs adequately on other processes to which it is applied.

NOTE PEMS software manufacturer and PEMS manufacturer can be different entities or one entity.

5.4.1.4 Performance

A combination of laboratory and field testing is detailed within this Technical Specification. Laboratory testing is designed to assess whether the PEMS software can meet relevant performance criteria while operated off-line under controlled conditions. Field testing is designed to assess whether duplicate PEMS, built, operated and quality-assured with the PEMS software, can continue to work and meet the relevant performance criteria in a real application (online testing). Field testing is carried out on an industrial process that allows testing of the performance characteristics specified below.

The main performance requirements are:

— PEMS software functionality under laboratory conditions:

  — of PEMS building software;

  — of PEMS operating and quality assurance software;

— PEMS software performance under field conditions:

  — functionality of the PEMS;

  — performance of the PEMS against the requirements of this Technical Specification;