



**SLOVENSKI STANDARD**  
**SIST-TP CEN/TR 15983:2010**  
**01-april-2010**

---

**Emisije nepremičnih virov - Navodilo za uporabo EN 14181:2004**

Stationary source emissions - Guidance on the application of EN 14181:2004

Emissionen aus stationären Quellen - Leitlinien zur Anwendung der EN 14181:2004

Emissions de sources fixes - Lignes directrices relatives à l'application de l'EN 14181:2004

**(standards.iteh.ai)**

**Ta slovenski standard je istoveten z: CEN/TR 15983:2010**

<https://standards.iteh.ai/catalog/standards/sist/c1beaf15-24d6-4533-8564-7a160a023772/sist-tp-cen-tr-15983-2010>

**ICS:**

13.040.40      Emisije nepremičnih virov      Stationary source emissions

**SIST-TP CEN/TR 15983:2010**

**en**

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

[SIST-TP CEN/TR 15983:2010](#)

<https://standards.iteh.ai/catalog/standards/sist/c1beaf15-24d6-4533-8564-7a160a023772/sist-tp-cen-tr-15983-2010>

TECHNICAL REPORT  
RAPPORT TECHNIQUE  
TECHNISCHER BERICHT

**CEN/TR 15983**

January 2010

---

ICS 13.040.40

English Version

## Stationary source emissions - Guidance on the application of EN 14181:2004

Emissions de sources fixes - Guide d'application de l'EN  
14181:2004

Emissionen aus stationären Quellen - Leitlinien zur  
Anwendung der EN 14181:2004

This Technical Report was approved by CEN on 1 December 2009. It has been drawn up by the Technical Committee CEN/TC 264.

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

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

[SIST-TP CEN/TR 15983:2010](https://standards.iteh.ai/catalog/standards/sist/c1beaf15-24d6-4533-8564-7a160a023772/sist-tp-cen-tr-15983-2010)

<https://standards.iteh.ai/catalog/standards/sist/c1beaf15-24d6-4533-8564-7a160a023772/sist-tp-cen-tr-15983-2010>



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

**Management Centre: Avenue Marnix 17, B-1000 Brussels**

## Contents

Page

Foreword.....	3
Introduction .....	4
1 Scope .....	5
2 Terms and definitions .....	5
3 Symbols and abbreviations .....	9
3.1 Symbols .....	9
3.2 Abbreviations .....	10
4 General guidance on quality assurance and calibration .....	10
4.1 General.....	10
4.2 Regulatory framework and standards for monitoring .....	10
4.3 Roles and responsibilities .....	12
5 Application of QAL1 .....	12
5.1 General.....	12
5.2 AMS which are not yet installed at the plant .....	13
5.3 AMS which are already installed at the plant.....	13
6 Application of QAL2 and AST.....	13
6.1 Tasks within QAL2 and AST .....	13
6.2 Location and monitoring provisions for AMS .....	14
6.3 Management system provisions for AMS .....	14
6.4 Specific issues of the functional tests .....	14
7 Calibration and validation of the AMS .....	16
7.1 Standard reference methods .....	16
7.2 Calibration using an SRM .....	16
7.3 Low-level clusters.....	20
7.4 Peripheral AMS measurements.....	21
7.5 Establishing the calibration function and the test of variability.....	21
7.6 Data points outside the calibration range .....	22
7.7 Calibrating AMS for NO <sub>x</sub> and TOC .....	23
7.8 Significant changes to operating conditions and fuels.....	24
7.9 Significant changes to an AMS .....	24
8 On-going surveillance and quality assurance of AMS (QAL3) .....	25
8.1 The necessity for QAL3.....	25
8.2 Choosing control charts .....	25
8.3 Zero and span measurements.....	26
8.4 Setting parameters for control charts .....	29
Annex A (informative) An example of a procedure for determining outliers .....	31
Annex B (informative) Alternative approaches for dealing with low-level clusters of emissions .....	34
Annex C (informative) $k_v$ values .....	36
Annex D (informative) Shewhart and EWMA control charts .....	37
Bibliography .....	43

## Foreword

This document (CEN/TR 15983:2010) has been prepared by Technical Committee CEN/TC 264 "Air quality", the secretariat of which is held by DIN.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

## iTeh STANDARD PREVIEW (standards.iteh.ai)

[SIST-TP CEN/TR 15983:2010](https://standards.iteh.ai/catalog/standards/sist/c1beaf15-24d6-4533-8564-7a160a023772/sist-tp-cen-tr-15983-2010)

<https://standards.iteh.ai/catalog/standards/sist/c1beaf15-24d6-4533-8564-7a160a023772/sist-tp-cen-tr-15983-2010>

## Introduction

This CEN Technical Report provides supporting guidance on the application of EN 14181:2004. It is based on the growing experiences with EN 14181:2004 throughout the CEN member countries. EN 14181:2004 specifies three levels of quality assurance (QAL), known as QAL1, QAL2 and QAL3 as well as an Annual Surveillance Test (AST). This Technical Report explains the requirements of these levels of quality assurance to achieve a consistent application of EN 14181:2004.

## iTeh STANDARD PREVIEW (standards.iteh.ai)

[SIST-TP CEN/TR 15983:2010](https://standards.iteh.ai/catalog/standards/sist/c1beaf15-24d6-4533-8564-7a160a023772/sist-tp-cen-tr-15983-2010)

<https://standards.iteh.ai/catalog/standards/sist/c1beaf15-24d6-4533-8564-7a160a023772/sist-tp-cen-tr-15983-2010>

## 1 Scope

This CEN Technical Report provides guidance for applying the European Standard EN 14181:2004.

This CEN Technical Report provides guidance only on applying the quality assurance levels QAL1, QAL2 and QAL3 as well as the Annual Surveillance Test (AST).

This CEN Technical Report is an informative document.

## 2 Terms and definitions

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

### 2.1

#### **air quality characteristic**

one of the quantifiable properties relating to an air mass under investigation, for example, concentration of a constituent

[EN 14181:2004, 3.1]

### 2.2

#### **automated measuring system**

##### **AMS**

measuring system permanently installed on site for continuous monitoring of emissions

[EN 14181:2004, 3.2]

NOTE 1 An AMS is the automated application of a monitoring method, which is traceable to a reference method.

NOTE 2 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, moisture removal devices, converters, diluters). This definition also includes testing and adjusting devices that are required for regular functional checks.

### 2.3

#### **calibration function**

linear relationship between the values of the SRM and the AMS with the assumption of a constant residual standard deviation

[EN 14181:2004, 3.3]

NOTE The calibration function is established during QAL2 on stack gases.

### 2.4

#### **competent authority**

organisation which implements the requirements of EU Directives and regulates installations, which must comply with the requirements of applicable European Standards

[EN 15267-1:2009, 3.3]

### 2.5

#### **confidence interval (two-sided)**

when  $T_1$  and  $T_2$  are two functions of the observed values such that,  $\theta$  being a population parameter to be estimated, the probability  $P_r(T_1 \leq \theta \leq T_2)$  is at least equal to  $(1 - \alpha)$  [where  $(1 - \alpha)$  is a fixed number, positive and less than 1], the interval between  $T_1$  and  $T_2$  is a two-sided  $(1 - \alpha)$  confidence interval for  $\theta$

**CEN/TR 15983:2010 (E)**

[EN 14181:2004, 3.5]

**2.6**  
**CUSUM chart**  
 calculation procedure in which the amount of drift and change in precision is compared to the corresponding uncertainty components which are obtained during QAL1

[EN 14181:2004, 3.6]

**2.7**  
**drift**  
 monotonic change of the calibration function over stated period of unattended operation, which results in a change of the measured value

[EN 14181:2004, 3.7]

NOTE This refers to a change in the response of the AMS to a determinant which does not change.

**2.8**  
**emission limit value**  
**ELV**  
 limit value related to the uncertainty requirement

[EN 14181:2004, 3.8]

NOTE For EU Directives it is the daily emission limit value that relates to the uncertainty requirement.

**2.9**  
**extractive AMS**  
 AMS having the detection unit physically separated from the gas stream by means of a sampling system

[EN 14181:2004, 3.9]

(standards.iteh.ai)  
 SIST-TP CEN/TR 15983:2010  
<https://standards.iteh.ai/catalog/standards/sist/c1beaf15-24d6-4533-8564-7a160a023772/sist-tp-cen-tr-15983-2010>

**2.10**  
**instability**  
 change in the measured value comprised of drift and dispersion resulting from the change in the calibration function over a stated period of unattended operation, for a given value of the air quality characteristic

NOTE 1 Drift and dispersion specify the monotonic and stochastic change with time of the output signal, respectively.

NOTE 2 This refers to a change in the response of the AMS to a determinant which does not change.

NOTE 3 Adapted from EN 14181:2004, 3.10.

**2.11**  
**instrument reading**  
 indication of the measured value directly provided by the AMS without using the calibration function

[EN 14181:2004, 3.11]

**2.12**  
**intrinsic uncertainty**  
 uncertainty component originating from the AMS itself, independent of the installation

**2.13**  
**legislation**  
 Directives, Acts, ordinances and regulations

[EN 14181:2004, 3.12]



**2.14****measurand**

particular quantity subject to measurement

[EN 14181:2004, 3.13]

**2.15****measured value**

estimated value of the air quality characteristic derived from an output signal

NOTE 1 This usually involves calculations related to the calibration process and conversion to required quantities.

NOTE 2 Adapted from EN 14181:2004, 3.14.

**2.16****non-extractive AMS**

AMS having the detection unit in the gas stream or in a part of it

[EN 14181:2004, 3.15]

**2.17****outlier**

observation that lies an abnormal distance from other values in a set of data, and therefore has a low probability of being a valid data point

**2.18****period of unattended operation**

maximum admissible interval of time for which the performance characteristics will remain within a predefined range without external servicing, e.g. refill, calibration, adjustment

[EN 14181:2004, 3.16]

<https://standards.iteh.ai/catalog/standards/sist/c1beaf15-24d6-4533-8564-7a160a023772/sist-tp-cen-tr-15983-2010>

**2.19****peripheral AMS or SRM**

measuring system or SRM used to gather the data required to convert the measured values to standard reference conditions, i.e. AMS or SRM for moisture, temperature, pressure and oxygen

[EN 14181:2004, 3.17]

**2.20****precision**

closeness of agreement of results obtained from the AMS for successive zero readings and successive span readings at defined time intervals

[EN 14181:2004, 3.18]

**2.21****reference material**

material simulating a known concentration of the input parameter, by use of surrogates and traceable to national standards

NOTE Surrogates normally used are calibration gasses, gas cells, gratings or filters.

[EN 14181:2004, 3.19]

**CEN/TR 15983:2010 (E)****2.22****response time**

time interval between the instant of a sudden change in the value of the input quantity to an AMS and the time as from which the value of the output quantity is reliably maintained above 90 % of the correct value of the input quantity

[EN 15267-3:2008, 3.31]

**2.23****span reading**

instrument reading of the AMS for a simulation of the input parameter at a fixed elevated concentration

[EN 14181:2004, 3.21]

NOTE 1 This simulation is intended to test the measuring elements of the system, which contribute to its performance.

NOTE 2 The span reading is approximately 80 % of the measurement range.

**2.24****standard conditions**

conditions as given in the EU-directives to which measured values have to be standardised to verify compliance with the emission limit values

[EN 14181:2004, 3.22]

**2.25****standard deviation**

positive square root of: the mean squared deviation from the arithmetic mean divided by the number of degrees of freedom

NOTE The number of degrees of freedom is the number of measurements minus 1.

[EN 14181:2004, 3.23]

**2.26****standard reference method****SRM**

method described and standardised to define an air quality characteristic, temporarily installed on site for verification purposes

NOTE Also known as a reference method.

[EN 14181:2004, 3.24]

**2.27****uncertainty**

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

[EN 14181:2004, 3.25]

**2.28****variability**

standard deviation of the differences of parallel measurements between the SRM and AMS

[EN 14181:2004, 3.26]

**iTeh STANDARD PREVIEW**  
(standards.iteh.ai)

SIST-TP CEN/TR 15983:2010  
<https://standards.iteh.ai/catalog/standards/sist/c1beaf15-24d6-4533-8564-7a160a023772/sist-tp-cen-tr-15983-2010>

**2.29****zero reading**

instrument reading of the AMS on simulation of the input parameter at zero concentration, which tests the measuring elements of the AMS, that contribute to its performance

NOTE Adapted from EN 14181:2004, 3.23.

**3 Symbols and abbreviations****3.1 Symbols**

$a$	intercept of the calibration function
$b$	slope of the calibration function
$C$	mass concentration in milligrams per cubic metre ( $\text{mg}/\text{m}^3$ )
$D_i$	difference between measured SRM value $y_i$ and calibrated AMS value $\hat{y}_i$
$\bar{D}$	average of $D_i$
$E$	emission limit value
$E_{\text{otm}}$	extinction of the optical transmission monitor
$i$	index
$k_v$	test value for the variability test based on a $\chi^2$ -test, with a $\beta$ -value of 50 %, for $N$ numbers of paired measurements
$L$	control limit value
$L_{\text{mp}}$	length of the measurement path in metres (m)
$m_0$	target value (chart centre line)
$n$	number of checks
$N$	number of paired samples in parallel measurements
$P$	percentage value
$R^2$	correlation coefficient
$s_{\text{AMS}}$	standard deviation of the AMS at zero and span level
$s_D$	standard deviation of the differences $D_i$ in parallel measurements
$t_{0,95}$	students $t$ -factor for a confidence level of 95 %
$x_i$	$i^{\text{th}}$ measured signal obtained with the AMS
$y_i$	$i^{\text{th}}$ measured result obtained with the SRM
$\hat{y}_i$	best estimate for the true value, calculated from the AMS measured signal $x_i$ by means of the calibration function
$y_{\text{span}}$	span value
$Z$	critical value in the Grubbs's test
$Z_i$	test value of $i^{\text{th}}$ data pair in the Grubbs's test
$z_i$	weighted average taking the past and the last check into account
$\lambda$	smoothing parameter

**CEN/TR 15983:2010 (E)**

$\mu$	average diameter of the grains in the stack in micrometres ( $\mu\text{m}$ )
$\sigma_0$	uncertainty derived from requirements of legislation

**3.2 Abbreviations**

AMS	automated measuring system
ARL	average run length
AST	annual surveillance test
ELV	emission limit value
EWMA	exponentially weighted moving average
LCL	lower control limit
$\text{NO}_x$	nitrogen oxides
QAL	quality assurance level
SRM	standard reference method
TOC	total organic compounds
UCL	upper control limit

**iTeh STANDARD PREVIEW**  
(standards.iteh.ai)

**4 General guidance on quality assurance and calibration****4.1 General**

[SIST-TP CEN/TR 15983:2010](https://standards.iteh.ai/catalog/standards/sist/c1beaf15-24d6-4533-8564-7a160a023772/sist-tp-cen-tr-15983-2010)  
<https://standards.iteh.ai/catalog/standards/sist/c1beaf15-24d6-4533-8564-7a160a023772/sist-tp-cen-tr-15983-2010>

The role of this Technical Report is to provide guidance on the application of the European Standards EN 14181:2004 on quality assurance of automated measuring systems used for monitoring stationary source emissions and EN 13284-2:2004 on automated measuring systems used for the determination of low range mass concentration of dust at stationary sources. Both European Standards are applicable to industrial plants falling under the European Directives for the incineration of waste (2000/76/EC) and large combustion plants (2001/80/EC), hence referred to as Directives in this Technical Report.

For simplicity, throughout this document, reference to EN 14181:2004 also refers to EN 13284-2:2004.

This Technical Report summarises the requirements of EN 14181:2004 and EN 13284-2:2004, and provides guidance on how to perform each of the required tasks.

**4.2 Regulatory framework and standards for monitoring****4.2.1 Monitoring requirements in the Directives**

The Directives prescribe the use of European Standards for monitoring emissions and calibration of automated measuring systems, or, if European Standards are not available, then the use of ISO, national or other equivalent international standards that provide data of a suitable quality. The standards for monitoring emissions are known as standard reference methods (SRM). Furthermore, the Directives specify overall performance requirements for continuous monitoring through uncertainty allowances expressed as a 95 % confidence interval. EN 14181:2004 presumes that the uncertainty of the AMS is expressed in the applicable Directives as half of the length of a 95 % confidence interval as a percentage  $P$  of the emission limit value  $E$ .

#### 4.2.2 Scope and structure of EN 14181:2004

EN 14181:2004 applies to AMS permanently installed at industrial plants regulated under the Directives. Also EN 14181:2004 applies to the AMS themselves and not the data recording systems used with AMS. The requirements for data acquisition and handling systems will be covered by a separate standard. The scope of EN 14181:2004 applies to complete AMS as defined by EN 15267-3, which includes not just the analyser, but also any sampling systems and other components required to analyse the stack gas and produce a measurement.

Although EN 14181:2004 was developed for application at industrial plants covered by the Directives, it can be applied to industrial plants covered by other EC laws, such as for other types of industrial plants regulated under the Directive 96/61/EC for Integrated Pollution Prevention and Control (IPPC). EN 14181:2004 specifies three quality assurance levels and an annual surveillance test. These are:

- **QAL1** is a procedure to demonstrate that the AMS is suitable for the intended purpose before installation, by meeting required performance standards EN ISO 14956, and the uncertainty allowances specified in EU Directives. Since the publication of EN 14181:2004, CEN has published EN 15267-3 to apply EN ISO 14956 for new AMS.
- **QAL2** includes a set of functional tests to check that the AMS has been installed appropriately, and that the AMS is operating correctly. The functional tests on the AMS are then followed by a procedure to calibrate the AMS, using standard reference methods and then verify whether it still meets the required uncertainty allowances, once installed. QAL2 establishes the traceability of the AMS measured values, to the applicable standard. This provides a demonstration of compliance with legally binding emission limit values.
- **QAL3** is a procedure to maintain and demonstrate the required quality of the AMS during its normal operation by checking the zero and span readings.
- **AST** is a set of functional tests to check the correct operation of the AMS, followed by a procedure to evaluate the AMS to show that it continues to function correctly and the calibration function is still valid.

These quality assurance levels follow a logical sequence to demonstrate the suitability of the AMS, its correct installation, commissioning, and calibration, followed by procedures to ensure a continuing and correct operation (see Figure 1).