

# SVENSK STANDARD

## SS-EN 14791:2017



Fastställt/Approved: 2017-01-23  
Publicerad/Published: 2017-01-26  
Utgåva/Edition: 2  
Språk/Language: engelska/English  
ICS: 13.040; 13.040.40

---

### **Utsläpp och utomhusluft – Bestämning av masskoncentrationen svaveldioxid – Referensmetod**

### **Stationary source emissions – Determination of mass concentration of sulphur oxides – Standard reference method**

This preview is downloaded from [www.sis.se](http://www.sis.se). Buy the entire standard via <https://www.sis.se/std-8024625>

# Standarder får världen att fungera

*SIS (Swedish Standards Institute) är en fristående ideell förening med medlemmar från både privat och offentlig sektor. Vi är en del av det europeiska och globala nätverk som utarbetar internationella standarder. Standarder är dokumenterad kunskap utvecklad av framstående aktörer inom industri, näringsliv och samhälle och befrämjar handel över gränser, bidrar till att processer och produkter blir säkrare samt effektiviserar din verksamhet.*

## Delta och påverka

Som medlem i SIS har du möjlighet att påverka framtida standarder inom ditt område på nationell, europeisk och global nivå. Du får samtidigt tillgång till tidig information om utvecklingen inom din bransch.

## Ta del av det färdiga arbetet

Vi erbjuder våra kunder allt som rör standarder och deras tillämpning. Hos oss kan du köpa alla publikationer du behöver – allt från enskilda standarder, tekniska rapporter och standardpaket till handböcker och onlinetjänster. Genom vår webbtjänst e-nav får du tillgång till ett lättnavigerat bibliotek där alla standarder som är aktuella för ditt företag finns tillgängliga. Standarder och handböcker är källor till kunskap. Vi säljer dem.

## Utveckla din kompetens och lyckas bättre i ditt arbete

Hos SIS kan du gå öppna eller företagsinterna utbildningar kring innehåll och tillämpning av standarder. Genom vår närhet till den internationella utvecklingen och ISO får du rätt kunskap i rätt tid, direkt från källan. Med vår kunskap om standarders möjligheter hjälper vi våra kunder att skapa verklig nytta och lönsamhet i sina verksamheter.

**Vill du veta mer om SIS eller hur standarder kan effektivisera din verksamhet är du välkommen in på [www.sis.se](http://www.sis.se) eller ta kontakt med oss på tel 08-555 523 00.**



# Standards make the world go round

*SIS (Swedish Standards Institute) is an independent non-profit organisation with members from both the private and public sectors. We are part of the European and global network that draws up international standards. Standards consist of documented knowledge developed by prominent actors within the industry, business world and society. They promote cross-border trade, they help to make processes and products safer and they streamline your organisation.*

## Take part and have influence

As a member of SIS you will have the possibility to participate in standardization activities on national, European and global level. The membership in SIS will give you the opportunity to influence future standards and gain access to early stage information about developments within your field.

## Get to know the finished work

We offer our customers everything in connection with standards and their application. You can purchase all the publications you need from us - everything from individual standards, technical reports and standard packages through to manuals and online services. Our web service e-nav gives you access to an easy-to-navigate library where all standards that are relevant to your company are available. Standards and manuals are sources of knowledge. We sell them.

## Increase understanding and improve perception

With SIS you can undergo either shared or in-house training in the content and application of standards. Thanks to our proximity to international development and ISO you receive the right knowledge at the right time, direct from the source. With our knowledge about the potential of standards, we assist our customers in creating tangible benefit and profitability in their organisations.

**If you want to know more about SIS, or how standards can streamline your organisation, please visit [www.sis.se](http://www.sis.se) or contact us on phone +46 (0)8-555 523 00**



Europastandarden EN 14791:2017 gäller som svensk standard. Detta dokument innehåller den officiella engelska versionen av EN 14791:2017.

Denna standard ersätter SS-EN 14791:2005, utgåva 1.

The European Standard EN 14791:2017 has the status of a Swedish Standard. This document contains the official English version of EN 14791:2017.

This standard supersedes the Swedish Standard SS-EN 14791:2005, edition 1.

© Copyright/Upphovsrätten till denna produkt tillhör SIS, Swedish Standards Institute, Stockholm, Sverige. Användningen av denna produkt regleras av slutanvändarlicensen som återfinns i denna produkt, se standardens sista sidor.

© Copyright SIS, Swedish Standards Institute, Stockholm, Sweden. All rights reserved. The use of this product is governed by the end-user licence for this product. You will find the licence in the end of this document.

*Uppllysningar om sakinnehållet i standarden lämnas av SIS, Swedish Standards Institute, telefon 08-555 520 00. Standarder kan beställas hos SIS Förlag AB som även lämnar allmänna uppllysningar om svensk och utländsk standard.*

*Information about the content of the standard is available from the Swedish Standards Institute (SIS), telephone +46 8 555 520 00. Standards may be ordered from SIS Förlag AB, who can also provide general information about Swedish and foreign standards.*

Denna standard är framtagen av kommittén för Utsläpp, SIS/TK 423/AG 05.

Har du synpunkter på innehållet i den här standarden, vill du delta i ett kommande revideringsarbete eller vara med och ta fram andra standarder inom området? Gå in på [www.sis.se](http://www.sis.se) - där hittar du mer information.



EUROPEAN STANDARD

EN 14791

NORME EUROPÉENNE

EUROPÄISCHE NORM

January 2017

ICS 13.040.40

Supersedes EN 14791:2005

English Version

## Stationary source emissions - Determination of mass concentration of sulphur oxides - Standard reference method

Emissions de sources fixes - Détermination de la concentration massique des oxydes de soufre -  
Méthode de référence normalisée

Emissionen aus stationären Quellen - Bestimmung der  
Massenkonzentration von Schwefeloxiden -  
Standardreferenzverfahren

This European Standard was approved by CEN on 26 September 2016.

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. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists 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 CEN-CENELEC Management Centre has the same status as the official versions.

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



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

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

## Contents

Page

European foreword.....	5
1 Scope.....	6
2 Normative references.....	6
3 Terms and definitions .....	7
4 Symbols and abbreviations .....	13
4.1 Symbols.....	13
4.2 Abbreviated terms .....	14
5 Principle .....	14
5.1 General.....	14
5.2 Measuring principle .....	14
6 Description of measuring system.....	15
6.1 Reagents .....	15
6.1.1 General.....	15
6.1.2 Hydrogen peroxide.....	15
6.1.3 Water .....	15
6.1.4 Absorption solution, H <sub>2</sub> O <sub>2</sub> .....	15
6.1.5 Reagents for chromatographic analysis .....	15
6.1.6 Reagent for Thorin analysis .....	16
6.2 Sampling equipment.....	17
6.2.1 General.....	17
6.2.2 Sampling probe .....	17
6.2.3 Filter housing.....	17
6.2.4 Particle filter.....	18
6.2.5 Temperature controller.....	18
6.2.6 Absorbers.....	18
6.2.7 Sample gas pump.....	18
6.2.8 Gas volume meter .....	18
6.3 Analysis equipment.....	19
6.3.1 Ion chromatograph.....	19
6.3.2 Thorin method .....	19
7 Performance characteristics of the SRM.....	20
7.1 General.....	20
7.2 Performance characteristics of the sampling system .....	21
7.3 Performance characteristics of the analysis .....	21
7.3.1 Sources of uncertainty.....	21
7.3.2 Performance criterion of analysis .....	22
7.4 Establishment of the uncertainty budget .....	22
8 Field operation.....	23
8.1 Measurement planning .....	23
8.2 Sampling strategy.....	23
8.2.1 General.....	23
8.2.2 Measurement section and measurement plane.....	23

8.2.3	Minimum number and location of measurement points .....	24
8.2.4	Measurement ports and working platform.....	24
8.3	Assembling the equipment.....	24
8.4	Heating of the sample gas line .....	24
8.5	Leak test.....	24
8.6	Performing sampling.....	25
8.6.1	Introduction of the sampling probe in the duct .....	25
8.6.2	Sampling .....	25
8.6.3	Rinsing of the sampling system and preparation of the samples .....	25
8.7	Measurement series .....	26
8.8	Field blank.....	26
8.9	Absorption efficiency .....	26
8.9.1	General .....	26
8.9.2	Test of absorption efficiency .....	26
9	Analytical procedure .....	27
9.1	General .....	27
9.2	Ion Chromatography method.....	27
9.2.1	General procedure .....	27
9.2.2	Interferences.....	28
9.2.3	Calibration.....	28
9.3	Thorin Method.....	29
9.3.1	Pre-treatment of sample solution before analysis for Thorin method.....	29
9.3.2	General procedure .....	29
9.3.3	Preparation of a chemical blank solution.....	30
9.3.4	Interferents.....	30
10	Expression of results .....	31
11	Equivalence of Thorin and ion chromatography methods.....	33
11.1	General .....	33
11.2	Range.....	33
11.3	Matrix effect.....	33
11.4	Comparison of repeatability and trueness.....	33
12	Equivalence of an alternative method .....	34
13	Measurement report .....	34
Annex A (informative) Validation of the method in the field.....		35
A.1	General .....	35
A.2	Round robin test of analytical methods .....	35
A.3	Field tests.....	36
A.3.1	General .....	36
A.3.2	Characteristics of installations .....	36
A.3.3	Limits of quantification .....	38
A.3.4	Repeatability and reproducibility .....	38
A.3.4.1	General .....	38
A.3.4.2	Repeatability .....	39
A.3.4.3	Reproducibility.....	41
A.3.5	Absorption efficiency .....	42

<b>Annex B (informative) Examples of absorbers.....</b>	<b>43</b>
<b>Annex C (informative) Example of assessment of compliance of standard reference method for SO<sub>2</sub> with requirements on emission measurements .....</b>	<b>44</b>
<b>C.1 Introduction .....</b>	<b>44</b>
<b>C.2 Elements required for the uncertainty determinations .....</b>	<b>44</b>
<b>C.3 Example of an uncertainty calculation .....</b>	<b>44</b>
<b>C.3.1 Specific conditions in the field.....</b>	<b>44</b>
<b>C.3.2 Performance characteristics.....</b>	<b>46</b>
<b>C.3.3 Model equation and application of rule of uncertainty propagation.....</b>	<b>47</b>
<b>C.3.3.1 Concentration of SO<sub>2</sub> .....</b>	<b>47</b>
<b>C.3.3.2 Calculation of the combined uncertainty of <math>V_{m,ref}</math> and <math>C_m</math> .....</b>	<b>48</b>
<b>C.3.3.3 Calculation of sensitivity coefficients .....</b>	<b>48</b>
<b>C.3.3.4 Results of the standard uncertainties calculations.....</b>	<b>49</b>
<b>C.3.4 Estimation of the combined uncertainty .....</b>	<b>52</b>
<b>Annex D (informative) Type of sampling equipment.....</b>	<b>53</b>
<b>Annex E (informative) Example of comparison of repeatability and trueness of Thorin Method and Ion Chromatography Method.....</b>	<b>54</b>
<b>Annex F (informative) Calculation of the uncertainty associated with a concentration expressed on dry gas and at an oxygen reference concentration .....</b>	<b>64</b>
<b>F.1 Uncertainty associated with a concentration expressed on dry gas .....</b>	<b>64</b>
<b>F.2 Uncertainty associated with a concentration expressed at a oxygen reference concentration .....</b>	<b>66</b>
<b>Annex G (informative) Significant technical changes .....</b>	<b>68</b>
<b>Bibliography.....</b>	<b>69</b>



## **European foreword**

This document (EN 14791:2017) has been prepared by Technical Committee CEN/TC 264 "Air quality", the secretariat of which is held by DIN.

This document supersedes EN 14791:2005.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by July 2017, and conflicting national standards shall be withdrawn at the latest by July 2017.

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.

Annex G provides details of significant technical changes between this document and the previous edition.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

## SS-EN 14791:2017 (E)

### 1 Scope

This European Standard specifies the standard reference method (SRM) for the determination of the sulphuric oxide SO<sub>2</sub> in flue gases emitted to the atmosphere from ducts and stacks. It is based on a sampling system and two analytical principles: ion chromatography and the Thorin method.

This European Standard specifies the performance characteristics to be determined and the performance criteria to be fulfilled by measuring systems based on the measurement method. It applies to periodic monitoring and to the calibration or control of automatic measuring systems (AMS) permanently installed on a stack, for regulatory or other purposes.

This European Standard specifies criteria for demonstration of equivalence of an alternative method to the SRM by application of EN 14793:2017.

This European Standard has been validated during field tests on waste incineration, co-incineration and large combustion installations. It has been validated for sampling periods of 30 min in the range of 0,5 mg/m<sup>3</sup> to 2 000 mg/m<sup>3</sup> of SO<sub>2</sub> for an ion-chromatography variant and 5 mg/m<sup>3</sup> to 2 000 mg/m<sup>3</sup> of SO<sub>2</sub> for the Thorin method according to emission limit values laid down in the Directive 2010/75/EU.

NOTE 1 Emission limit values for SO<sub>2</sub> laid down in the Directive 2010/75/EU are in the range of 30 mg/m<sup>3</sup> to 800 mg/m<sup>3</sup>.

The emission limit values of EU Directives are expressed in units of mg/m<sup>3</sup> of SO<sub>2</sub> on dry basis and at standard conditions of 273 K and 101,3 kPa.

NOTE 2 The characteristics of installations, the conditions during field tests and the values of repeatability and reproducibility in the field are given in Annex A.

### 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.

prEN 13284-1:2015, *Stationary source emissions – Determination of low range mass concentration of dust – Part 1: Manual gravimetric method*

EN 14793:2017, *Stationary source emission – Demonstration of equivalence of an alternative method with a reference 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 ISO 14956:2002, *Air quality - Evaluation of the suitability of a measurement procedure by comparison with a required measurement uncertainty (ISO 14956:2002)*

ISO/IEC Guide 98-3:2008, *Uncertainty of measurement — Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

### **3 Terms and definitions**

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

#### **3.1**

##### **standard reference method**

###### **SRM**

reference method prescribed by European or national legislation

[SOURCE: EN 15259:2007]

#### **3.2**

##### **reference method**

###### **RM**

measurement method taken as a reference by convention, which gives the accepted reference value of the measurand

Note 1 to entry: A reference method is fully described.

Note 2 to entry: A reference method can be a manual or an automated method.

Note 3 to entry: Alternative methods can be used if equivalence to the reference method has been demonstrated.

[SOURCE: EN 15259:2007]

#### **3.3**

##### **measurement method**

method described in a written procedure containing all the means and procedures required to sample and analyse, namely field of application, principle and/or reactions, definitions, equipment, procedures, presentation of results, other requirements and measurement report

[SOURCE: EN 14793:2017]

#### **3.4**

##### **alternative method**

###### **AM**

measurement method which complies with the criteria given by this European Standard with respect to the reference method

Note 1 to entry: An alternative method can consist of a simplification of the reference method.

[SOURCE: EN 14793:2017]

#### **3.5**

##### **measuring system**

set of one or more measuring instruments and often other devices, including any reagent and supply, assembled and adapted to give information used to generate measured quantity values within specified intervals for quantities of specified kinds

[SOURCE: JCGM 200:2012]