

**Expression of performance of gas analyzers -- Part 7:  
Tuneable semiconductor laser gas analyzers**

## EESTI STANDARDI EESSÕNA

## NATIONAL FOREWORD

See Eesti standard EVS-EN 61207-7:2013 sisaldab Euroopa standardi EN 61207-7:2013 inglisekeelset teksti.	This Estonian standard EVS-EN 61207-7:2013 consists of the English text of the European standard EN 61207-7:2013.
Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas.	This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation.
Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 06.12.2013.	Date of Availability of the European standard is 06.12.2013.
Standard on kättesaadav Eesti Standardikeskusest.	The standard is available from the Estonian Centre for Standardisation.

Tagasisidet standardi sisu kohta on võimalik edastada, kasutades EVS-i veebilehel asuvat tagasiside vormi või saates e-kirja meiliaadressile [standardiosakond@evs.ee](mailto:standardiosakond@evs.ee).

ICS 19.040, 71.040.40

### Standardite reprodutseerimise ja levitamise õigus kuulub Eesti Standardikeskusele

Andmete paljundamine, taastekitamine, kopeerimine, salvestamine elektroonsesse süsteemi või edastamine ükskõik millises vormis või millisel teel ilma Eesti Standardikeskuse kirjaliku loata on keelatud.

Kui Teil on küsimusi standardite autorikaitse kohta, võtke palun ühendust Eesti Standardikeskusega:  
Aru 10, 10317 Tallinn, Eesti; [www.evs.ee](http://www.evs.ee); telefon 605 5050; e-post [info@evs.ee](mailto:info@evs.ee)

### The right to reproduce and distribute standards belongs to the Estonian Centre for Standardisation

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, without a written permission from the Estonian Centre for Standardisation.

If you have any questions about copyright, please contact Estonian Centre for Standardisation:  
Aru 10, 10317 Tallinn, Estonia; [www.evs.ee](http://www.evs.ee); phone 605 5050; e-mail [info@evs.ee](mailto:info@evs.ee)

**Expression of performance of gas analyzers -  
Part 7: Tuneable semiconductor laser gas analyzers  
(IEC 61207-7:2013)**

Expression des performances  
des analyseurs de gaz -  
Partie 7: Analyseurs de gaz laser à semi-  
conducteurs accordables  
(CEI 61207-7:2013)

Angabe zum Betriebsverhalten  
von Gasanalysatoren -  
Teil 7: Gasanalysatoren mit abstimmbaren  
Halbleiterlasern  
(IEC 61207-7:2013)

This European Standard was approved by CENELEC on 2013-10-30. CENELEC 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 CENELEC 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 CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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

**CENELEC**

European Committee for Electrotechnical Standardization  
Comité Européen de Normalisation Electrotechnique  
Europäisches Komitee für Elektrotechnische Normung

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

## Foreword

The text of document 65B/876/FDIS, future edition 1 of IEC 61207-7, prepared by SC 65B "Measurement and control devices" of IEC/TC 65 "Industrial-process measurement, control and automation" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 61207-7:2013.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2014-07-30
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2016-10-30

This Standard is to be used in conjunction with EN 61207-1:2010.

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

## Endorsement notice

The text of the International Standard IEC 61207-7:2013 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following note has to be added for the standard indicated:

ISO 9001	NOTE	Harmonized as EN ISO 9001.
----------	------	----------------------------

## Annex ZA (normative)

### Normative references to international publications with their corresponding European publications

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.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60654-1	1993	Industrial-process measurement and control equipment - Operating conditions - Part 1: Climatic conditions	EN 60654-1	1993
IEC 60654-2 + A1	1979 1992	Operating conditions for industrial-process measurement and control equipment - Part 2: Power	EN 60654-2 <sup>1)</sup>	1997
IEC 60654-3	1983	Operating conditions for industrial-process measurement and control equipment - Part 3: Mechanical influences	EN 60654-3	1997
IEC 60825-1	2007	Safety of laser products - Part 1: Equipment classification and requirements	EN 60825-1	2007
IEC 61207-1	2010	Expression of performance of gas analyzers - Part 1: General	EN 61207-1	2010

<sup>1)</sup> EN 60654-2 includes A1 to IEC 60654-2.

## CONTENTS

FOREWORD.....	3
INTRODUCTION.....	5
1 Scope.....	6
2 Normative references .....	6
3 Terms and definitions .....	7
4 Procedure for specification .....	10
4.1 General.....	10
4.2 In situ analyzers .....	10
4.2.1 Additional operation and maintenance requirements.....	10
4.2.2 Additional terms related to the specification of performance .....	10
4.2.3 Additional limits of uncertainties .....	11
4.3 Extractive analyzers .....	11
4.3.1 Additional operation and maintenance requirements.....	11
4.3.2 Additional terms related to the specification of performance .....	12
4.4 Recommended standard values and range of influence quantities .....	12
4.5 Laser safety .....	12
5 Procedures for compliance testing .....	12
5.1 In situ analyzers .....	12
5.1.1 General .....	12
5.1.2 Apparatus to simulate measurement condition .....	13
5.1.3 Apparatus to generate test gas mixture .....	13
5.1.4 Apparatus to investigate the attenuation induced by opaque dust, liquid droplets and other particles .....	13
5.1.5 Testing procedures.....	14
5.2 Extractive analyzers .....	16
5.2.1 General .....	16
5.2.2 Apparatus to generate test gas mixture .....	16
5.2.3 Testing procedures.....	16
Annex A (informative) Systems of tuneable semiconductor laser gas analyzers .....	18
Annex B (normative) Examples of the test apparatus .....	19
Bibliography.....	23
Figure A.1 – Tuneable semiconductor laser gas analyzers .....	18
Figure B.1 – Example of a test apparatus to simulate measurement condition for across-duct and open-path analyzers.....	19
Figure B.2 – Example of a test apparatus to simulate measurement condition for probe type analyzers .....	19
Figure B.3 – Example of apparatus to generate the test gas mixture .....	20
Figure B.4 – Delay time, rise time and fall time .....	21
Figure B.5 – Example of a grid to simulate the attenuation by the dust in optical path.....	22

## INTRODUCTION

This part of IEC 61207 includes the terminology, definitions, statements and tests that are specific to tuneable semiconductor laser gas analyzers, which utilize tuneable semiconductor laser absorption spectroscopy (TSLAS).

Tuneable semiconductor laser gas analyzers utilize tuneable semiconductor lasers (e.g. diode lasers, quantum cascade lasers, interband cascade lasers) as light sources, whose wavelength covers ultraviolet, visible and infrared part of the electromagnetic spectrum, to detect the absorption spectra and thus determine the concentration of gases to be analyzed. These analyzers may employ different TSLAS techniques such as direct absorption spectroscopy, frequency modulation spectroscopy (FMS), wavelength modulation spectroscopy (WMS), etc. Multi-pass absorption spectroscopy, photoacoustic spectroscopy (PAS), and cavity-enhanced absorption spectroscopy (CEAS) such as cavity-ringdown spectroscopy (CRDS) are also used to take advantage of their high detection sensitivity.

Tuneable semiconductor laser gas analyzers are usually used to measure concentration of small molecule gases, such as oxygen, carbon monoxide, carbon dioxide, hydrogen sulfide, ammonia, hydrogen fluoride, hydrogen chloride, nitrogen dioxide, water vapour etc.

There are two main types of tuneable semiconductor laser gas analyzers: extractive and in situ analyzers. The extractive analyzers measure the sample gas withdrawn from a process or air by a sample handling system. The in situ analyzers measure the gas in its original place, including across-duct, probe and open-path types. Across-duct analyzers either have a laser source and a detector mounted on opposite sides of a duct, or both the laser and the detector are mounted on the same side and a retroreflector on the opposite side of a duct. Probe analyzers comprise a probe mounted into the duct, and the measured gas either passes through or diffuses into the measuring optical path inside the probe. And open-path analyzers measure the gas in an open environment with a hardware approach similar to across duct analyzers (source and detector on opposite sides of the open area or a retroreflector on one side and the source and detector on the opposite side), except the sample is in an open path and not contained in a duct.

NOTE 1 Traditionally, only diode lasers were employed, and thus tuneable diode laser gas analyzers and tuneable diode laser absorption spectroscopy (TDLAS) are widely used terms. However, with the development of laser technology, many other types of semiconductor lasers, such as quantum cascade lasers (QCLs) and interband cascade lasers (ICLs) have been developed and employed in laser gas analyzers. Therefore, the term of semiconductor laser rather than diode laser is used in this standard to reflect this technology advancement.

NOTE 2 Though tuneable semiconductor laser photoacoustic spectroscopy (PAS) is in principle different from absorption spectroscopy typically used in tuneable semiconductor laser gas analyzers, the hardware and data reduction software are almost the same for analyzers utilizing these two spectroscopy technologies, and thus PAS is considered a variant of absorption spectroscopy and this standard also applies to the analyzers based on PAS.

## EXPRESSION OF PERFORMANCE OF GAS ANALYZERS –

### Part 7: Tuneable semiconductor laser gas analyzers

#### 1 Scope

This part of IEC 61207 applies to all aspects of analyzers utilizing TSLAS for the concentration measurement of one or more gas components in a gaseous mixture or vapour.

It applies to analyzers utilizing tuneable semiconductor lasers as sources and utilizing absorption spectroscopy, such as direct absorption, FMS, WMS, multi-pass absorption spectroscopy, CRDS, ICOS, PAS and CEAS techniques, etc.

It applies both to in situ or extractive type analyzers. This standard includes the following, it

- specifies the terms and definitions related to the functional performance of gas analyzers, utilizing tuneable semiconductor laser gas absorption spectroscopy, for the continuous measurement of gas or vapour concentration in a source gas,
- unifies methods used in making and verifying statements on the functional performance of this type of analyzers,
- specifies the type of tests to be performed to determine the functional performance and how to carry out these tests,
- provides basic documents to support the application of the standards of quality assurance with in ISO 9001

#### 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.

IEC 60654-1:1993, *Industrial-process measurement and control equipment – Operating conditions – Part 1: Climatic conditions*

IEC 60654-2:1979, *Operating conditions for industrial-process measurement and control equipment – Part 2: Power*  
Amendment 1:1992

IEC 60654-3:1983, *Operating conditions for industrial-process measurement and control equipment – Part 3: Mechanical influences*

IEC 60825-1:2007, *Safety of laser products – Part 1: Equipment classification and requirements*

IEC 61207-1:2010, *Expression of performance of gas analyzers – Part 1: General*