

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

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**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)

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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- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2016-10-30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 -<br>Part 1: Climatic conditions     | EN 60654-1               | 1993        |
| IEC 60654-2<br>+ A1 | 1979<br>1992 | Operating conditions for industrial-process measurement and control equipment -<br>Part 2: Power                 | EN 60654-2 <sup>1)</sup> | 1997        |
| IEC 60654-3         | 1983         | Operating conditions for industrial-process measurement and control equipment -<br>Part 3: Mechanical influences | EN 60654-3               | 1997        |
| IEC 60825-1         | 2007         | Safety of laser products -<br>Part 1: Equipment classification and requirements                                  | EN 60825-1               | 2007        |
| IEC 61207-1         | 2010         | Expression of performance of gas analyzers -<br>Part 1: General  | EN 61207-1               | 2010        |

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

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## 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*