

Ambient air - Standard method for the measurement of the concentration of carbon monoxide by non-dispersive infrared spectroscopy

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

| | |
|--|---|
| <p>See Eesti standard EVS-EN 14626:2024 sisaldab Euroopa standardi EN 14626:2024 ingliskeelset teksti.</p> <p>Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas.</p> <p>Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 18.12.2024.</p> <p>Standard on kättesaadav Eesti Standardimis- ja Akrediteerimiskeskusest.</p> | <p>This Estonian standard EVS-EN 14626:2024 consists of the English text of the European standard EN 14626:2024.</p> <p>This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation and Accreditation.</p> <p>Date of Availability of the European standard is 18.12.2024.</p> <p>The standard is available from the Estonian Centre for Standardisation and Accreditation.</p> |
|--|---|

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

ICS 13.040.20

Standardite reprodutseerimise ja levitamise õigus kuulub Eesti Standardimis- ja Akrediteerimiskeskusele. Andmete paljundamine, taastekitamine, kopeerimine, salvestamine elektroonsesse süsteemi või edastamine ükskõik millises vormis või millisel teel ilma Eesti Standardimis- ja Akrediteerimiskeskuse kirjaliku loata on keelatud.

Kui Teil on küsimusi standardite autorikaitse kohta, võtke palun ühendust Eesti Standardimis- ja Akrediteerimiskeskusega: Koduleht www.evs.ee; telefon 605 5050; e-post info@evs.ee

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

If you have any questions about copyright, please contact Estonian Centre for Standardisation and Accreditation: Homepage www.evs.ee; phone +372 605 5050; e-mail info@evs.ee

English Version

Ambient air - Standard method for the measurement of the concentration of carbon monoxide by non-dispersive infrared spectroscopy

Air ambiant - Méthode normalisée de mesurage de la concentration en monoxyde de carbone par spectroscopie à rayonnement infrarouge non dispersif

Außenluft - Messverfahren zur Bestimmung der Konzentration von Kohlenmonoxid mit nicht-dispersiver Infrarot-Photometrie

This European Standard was approved by CEN on 11 November 2024.

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, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and United Kingdom.



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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

| Contents | Page |
|--|-------------|
| European foreword..... | 5 |
| 1 Scope | 6 |
| 2 Normative references | 7 |
| 3 Terms and definitions | 8 |
| 4 Abbreviated terms | 13 |
| 5 Principle | 13 |
| 5.1 General..... | 13 |
| 5.2 Measuring principle..... | 13 |
| 5.3 Type testing..... | 14 |
| 5.4 Field operation and quality control..... | 14 |
| 6 Sampling | 15 |
| 6.1 General..... | 15 |
| 6.2 Sampling location..... | 15 |
| 6.3 Sampling system..... | 15 |
| 6.3.1 Construction..... | 15 |
| 6.3.2 Particle filter..... | 16 |
| 6.3.3 Loss of carbon monoxide..... | 16 |
| 6.3.4 Conditioning..... | 16 |
| 6.4 Control and regulation of sample flow rate..... | 16 |
| 6.5 Sampling pump for the manifold..... | 17 |
| 7 Analyser equipment | 17 |
| 7.1 General..... | 17 |
| 7.2 Details about analyser equipment..... | 17 |
| 7.3 Pressure measurement..... | 17 |
| 7.4 Flow rate indicator..... | 17 |
| 7.5 Sampling pump for the analyser..... | 18 |
| 7.6 Particle filter..... | 18 |
| 8 Type testing of carbon monoxide analysers | 18 |
| 8.1 General..... | 18 |
| 8.2 Relevant performance characteristics and performance criteria..... | 19 |
| 8.3 Design change..... | 23 |
| 8.4 Procedures for determination of the performance characteristics during the laboratory test..... | 23 |
| 8.4.1 General..... | 23 |
| 8.4.2 Test conditions..... | 23 |
| 8.4.3 Response time..... | 26 |
| 8.4.4 Short-term drift..... | 28 |
| 8.4.5 Repeatability standard deviation..... | 28 |
| 8.4.6 Lack of fit of linearity of the calibration function..... | 29 |
| 8.4.7 Sensitivity coefficient to sample gas pressure..... | 30 |
| 8.4.8 Sensitivity coefficient to the sample gas temperature..... | 31 |
| 8.4.9 Sensitivity coefficient to the surrounding temperature..... | 31 |
| 8.4.10 Sensitivity coefficient to electrical voltage..... | 32 |
| 8.4.11 Interferents..... | 33 |
| 8.4.12 Averaging test..... | 34 |

| | | |
|-----------------------|---|----|
| 8.4.13 | Difference sample/calibration port..... | 35 |
| 8.5 | Determination of the performance characteristics during the field test..... | 36 |
| 8.5.1 | General | 36 |
| 8.5.2 | Selection of a monitoring station for the field test..... | 36 |
| 8.5.3 | Operational requirements | 37 |
| 8.5.4 | Long-term drift | 38 |
| 8.5.5 | Reproducibility standard deviation under field conditions | 39 |
| 8.5.6 | Period of unattended operation..... | 39 |
| 8.5.7 | Period of availability of the analyser..... | 39 |
| 8.6 | Expanded uncertainty calculation for type testing | 40 |
| 9 | Field operation and ongoing quality control..... | 41 |
| 9.1 | General | 41 |
| 9.2 | Suitability evaluation | 41 |
| 9.2.1 | General | 41 |
| 9.2.2 | Analyser for a monitoring station or task..... | 41 |
| 9.3 | Initial installation | 43 |
| 9.4 | Ongoing quality assurance/quality control | 43 |
| 9.4.1 | General | 43 |
| 9.4.2 | Frequency of calibrations, checks and maintenance..... | 44 |
| 9.5 | Calibration of the analyser | 47 |
| 9.5.1 | General | 47 |
| 9.5.2 | Calibration gases..... | 48 |
| 9.5.3 | Data adjustment function | 48 |
| 9.5.4 | Testing the sampling system | 48 |
| 9.5.5 | Treatment of data after exceedance of performance criteria | 50 |
| 9.6 | Checks..... | 52 |
| 9.6.1 | Zero and span checks | 52 |
| 9.6.2 | Lack-of-fit..... | 53 |
| 9.6.3 | Testing the sampling system | 54 |
| 9.7 | Maintenance | 56 |
| 9.7.1 | Change of particle filters | 56 |
| 9.7.2 | Maintenance of sampling system..... | 56 |
| 9.7.3 | Change of consumables as applicable | 56 |
| 9.7.4 | Preventive/routine maintenance of components of the analyser..... | 56 |
| 9.8 | Data handling and data reports..... | 56 |
| 9.9 | Measurement uncertainty | 57 |
| 10 | Expression of results | 57 |
| 11 | Test reports and documentation | 58 |
| 11.1 | Type testing | 58 |
| 11.2 | Field operation | 59 |
| 11.2.1 | Suitability evaluation | 59 |
| 11.2.2 | Documentation | 59 |
| 11.2.3 | Ambient air quality data reports | 60 |
| Annex A (normative) | Test of lack-of-fit | 61 |
| A.1 | Establishment of the regression line..... | 61 |
| A.2 | Calculation of the residuals of the averages | 61 |
| Annex B (informative) | Sampling equipment | 63 |
| Annex C (informative) | Schematics of non-dispersive infrared spectrometer..... | 65 |
| Annex D (informative) | Manifold testing..... | 67 |
| D.1 | Procedure for applying test gas..... | 67 |

| | | |
|------------------------------|---|------------|
| D.2 | Procedure for the cross test | 68 |
| D.2.1 | General | 68 |
| D.2.2 | Initial stage | 68 |
| D.2.3 | Stage 1 | 69 |
| D.2.4 | Stage 2 | 69 |
| D.2.5 | Data Processing | 69 |
| D.2.6 | Evaluation | 69 |
| Annex E (normative) | Type testing | 71 |
| E.1 | Type testing and uncertainty calculation | 71 |
| E.1.1 | Type testing | 71 |
| E.1.2 | Uncertainty calculation | 71 |
| E.2 | Type testing Requirement a) | 71 |
| E.3 | Type testing Requirement b) | 73 |
| E.3.1 | General | 73 |
| E.3.2 | Calculation of standard uncertainties | 76 |
| E.3.3 | Example calculation | 83 |
| E.4 | Type testing Requirement c) | 85 |
| E.5 | Type testing Requirement d) | 85 |
| E.5.1 | General | 85 |
| E.5.2 | Combined standard uncertainty | 87 |
| E.5.3 | Absolute expanded uncertainty | 87 |
| E.5.4 | Relative expanded uncertainty | 88 |
| E.5.5 | Calculation of standard uncertainties | 88 |
| E.5.6 | Example calculation | 90 |
| Annex F (informative) | Calculation of uncertainty in field operation at the 8-hour limit value ... | 92 |
| F.1 | General | 92 |
| F.2 | Combined standard uncertainty | 92 |
| F.3 | Standard uncertainties | 93 |
| F.3.1 | General | 93 |
| F.3.2 | Influence quantities | 94 |
| F.3.3 | Interferents | 97 |
| F.3.4 | Averaging effect | 98 |
| F.3.5 | Reproducibility under field conditions | 98 |
| F.3.6 | Long-term drift at zero | 98 |
| F.3.7 | Long-term drift at level of the 8-hour limit value | 98 |
| F.3.8 | Zero gas | 99 |
| F.3.9 | Calibration gas | 99 |
| F.3.10 | Difference sample/calibration port | 99 |
| F.4 | Example calculation | 100 |
| Annex G (informative) | Test stand for the test point "sensitivity coefficient of sample gas pressure" | 102 |
| Annex H (informative) | Significant changes | 104 |
| Bibliography | | 105 |

European foreword

This document (EN 14626:2024) has been prepared by Technical Committee CEN/TC 264 “Air quality, the secretariat of which is held by DIN.

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 June 2025, and conflicting national standards shall be withdrawn at the latest by June 2025.

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

This document will supersede EN 14626:2012.

In comparison with the previous edition, the technical modifications made are listed in Annex H of this document.

Any feedback and questions on this document should be directed to the users’ national standards body. A complete listing of these bodies can be found on the CEN website.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: 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, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

1 Scope

This document specifies a continuous measurement method for the determination of the concentration of carbon monoxide present in ambient air based on the non-dispersive infrared spectroscopic measuring principle. This document describes the performance characteristics and sets the relevant minimum criteria required to select an appropriate non-dispersive infrared spectroscopic analyser by means of type testing. It also includes the evaluation of the suitability of an analyser for use in a specific fixed site in order to meet data quality requirements (see Annex I of Directive 2008/50/EC [1] for additional information) and requirements during sampling, calibration and quality assurance for use.

The method is applicable to the determination of the mass concentration of carbon monoxide present in ambient air up to 100 mg/m³ of carbon monoxide. This concentration range represents the certification range for type testing.

NOTE 1 Other ranges can be used depending on the levels present in ambient air.

NOTE 2 When the standard is used for other purposes than for measurements required by Directive 2008/50/EC, the ranges and uncertainty requirements might not apply.

The method covers the determination of ambient air concentrations of carbon monoxide in locations classified as rural areas, urban-background areas, and for sampling points influenced by traffic or industrial sources.

The results are expressed in mg/m³ (at 20 °C and 101,3 kPa).

NOTE 3 100 mg/m³ of CO corresponds to 86 µmol/mol of CO.

This document contains information for different groups of users.

Clause 5 to Clause 7 and Annex B, Annex C and Annex D contain general information about the principles of carbon monoxide measurement by non-dispersive infrared spectroscopic analyser and sampling equipment.

Clause 8 and Annex E are specifically directed towards test houses and laboratories that perform type testing of carbon monoxide analysers. These sections contain information about:

- type testing conditions, test procedures and test requirements;
- analyser performance requirements;
- evaluation of the type testing results;
- evaluation of the associated uncertainty of the measurement performed by the carbon monoxide analyser based on the type testing results.

Clause 9 to Clause 11 and Annex F are directed towards monitoring networks performing the practical measurements of carbon monoxide in ambient air. These sections contain information about:

- initial installation of the analyser in the monitoring network and acceptance testing;
- ongoing quality assurance/quality control;
- calculation and reporting of measurement results;

— evaluation of the uncertainty to the measurement results under practical monitoring conditions.

This document represents an evolution of earlier editions (EN 14626:2005 and EN 14626: 2012).

NOTE 4 Analysers type tested prior to the publication of this document can still be used for regulated monitoring purposes. As newer versions of analysers tested under this document become available, discontinue the use of older reference analysers.

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 15267-1, *Air quality - Assessment of air quality monitoring equipment - Part 1: General principles of certification*

EN 15267-2, *Air quality - Assessment of air quality monitoring equipment - Part 2: Initial assessment of the manufacturer's quality management system and post certification surveillance for the manufacturing process*

EN ISO 6142-1, *Gas analysis — Preparation of calibration gas mixtures — Gravimetric method (ISO 6142-1)*

EN ISO 6143, *Gas analysis — Comparison methods for determining and checking the composition of calibration gas mixtures (ISO 6143)*

EN ISO 6144, *Gas analysis — Preparation of calibration gas mixtures — Static volumetric methods (ISO 6144)*

EN ISO 6145-6, *Gas analysis — Preparation of calibration gas mixtures using dynamic volumetric methods — Part 6: Critical flow orifices (ISO 6145-6)*

EN ISO 6145-7, *Gas analysis — Preparation of calibration gas mixtures using dynamic volumetric methods — Part 7: Thermal mass-flow controllers (ISO 6145-7)*

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

ISO 19229:2019, *Gas analysis — Purity analysis and the treatment of purity data*