

Ambient air - Standard method for the measurement of the concentration of ozone by ultraviolet photometry

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

<p>See Eesti standard EVS-EN 14625:2024 sisaldab Euroopa standardi EN 14625:2024 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 14625:2024 consists of the English text of the European standard EN 14625:2024.</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

EUROPEAN STANDARD

EN 14625

NORME EUROPÉENNE

EUROPÄISCHE NORM

December 2024

ICS 13.040.20

Supersedes EN 14625:2012

English Version

Ambient air - Standard method for the measurement of the concentration of ozone by ultraviolet photometry

Air ambiant - Méthode normalisée de mesurage de la concentration en ozone par photométrie U.V.

Außenluft - Messverfahren zur Bestimmung von Ozon in Luft mit dem UV-Verfahren

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.....	8
1 Scope	9
2 Normative references	10
3 Terms and definitions	10
4 Abbreviated terms	16
5 Principle	16
5.1 General	16
5.2 Measuring principle	16
5.3 Type testing	17
5.4 Field operation and quality control	18
6 Sampling	18
6.1 General	18
6.2 Sampling location	19
6.3 Sampling system	19
6.3.1 Construction	19
6.3.2 Particle filter	19
6.4 Loss of ozone	20
6.5 Control and regulation of sample flow rate	20
6.6 Sampling pump for the manifold	20
7 Analyser equipment	20
7.1 General	20
7.2 Ultraviolet absorption cell	21
7.3 Ultraviolet source lamp	21
7.4 UV detector	21
7.5 Ozone-specific scrubber	21
7.6 Switching valve	21
7.7 Temperature indicator	22
7.8 Pressure indicator	22
7.9 Flow rate indicator	22
7.10 Sampling pump for the analyser	22
7.11 Internal ozone span source	22
7.12 Particle filter	22
8 Type testing of ultraviolet photometric ozone analysers	22
8.1 General	22
8.2 Relevant performance characteristics and performance criteria	23
8.3 Design change	27
8.4 Procedures for determination of the performance characteristics during the laboratory test	27
8.4.1 General	27
8.4.2 Test conditions	27
8.4.3 Response time	29
8.4.4 Short-term drift	31
8.4.5 Repeatability standard deviation	32
8.4.6 Lack of fit of linearity of the calibration function	32
8.4.7 Sensitivity coefficient to sample gas pressure	33

8.4.8	Sensitivity coefficient to sample gas temperature	34
8.4.9	Sensitivity coefficient to the surrounding temperature.....	34
8.4.10	Sensitivity coefficient to electrical voltage.....	35
8.4.11	Interferents.....	36
8.4.12	Averaging test	36
8.4.13	Difference sample/calibration port.....	37
8.4.14	Residence time in the analyser.....	38
8.5	Determination of the performance characteristics during the field test.....	38
8.5.1	General	38
8.5.2	Selection of a monitoring station for the field test.....	38
8.5.3	Operational requirements	39
8.5.4	Long-term drift.....	40
8.5.5	Reproducibility standard deviation under field conditions	40
8.5.6	Period of unattended operation.....	41
8.5.7	Period of availability of the analyser.....	41
8.6	Type testing and uncertainty calculation	42
9	Field operation and ongoing quality control.....	42
9.1	General	42
9.2	Suitability evaluation	43
9.2.1	General	43
9.2.2	Analyser for a monitoring station or task.....	43
9.3	Initial installation	44
9.4	Ongoing quality assurance/quality control	46
9.4.1	General	46
9.4.2	Frequency of calibrations, checks and maintenance.....	47
9.5	Calibration of the analyser	50
9.5.1	General	50
9.5.2	Calibration gases.....	51
9.5.3	Data adjustment function	51
9.5.4	Testing the sampling system	51
9.5.5	Treatment of data after exceedance of performance criteria	53
9.6	Checks	55
9.6.1	Zero and span checks	55
9.6.2	Lack of fit.....	56
9.6.3	Testing the sample manifold	57
9.7	Maintenance	58
9.7.1	Change of particle filters.....	58
9.7.2	Maintenance of sampling system.....	58
9.7.3	Change of consumables as applicable	58
9.7.4	Preventive/routine maintenance of components of the analyser.....	58
9.8	Data handling and data reports.....	59
9.9	Measurement uncertainty	59
10	Expression of results	59
11	Test reports and documentation	60
11.1	Type testing	60
11.2	Field operation	61
11.2.1	Suitability evaluation	61
11.2.2	Documentation	61
11.2.3	Ambient air quality data reports	61
Annex A (normative)	Test of lack of fit	63
A.1	Establishment of the regression line.....	63

A.2	Calculation of the residuals of the averages.....	64
Annex B (informative) Sampling equipment.....		65
Annex C (informative) Ultraviolet photometric analyser.....		67
Annex D (informative) Manifold testing		69
D.1	Procedure for applying test gas	69
D.2	Procedure for the cross test	70
D.2.1	General.....	70
D.2.2	Initial stage	70
D.2.3	Stage 1	71
D.2.4	Stage 2	71
D.2.5	Data Processing	71
D.2.6	Evaluation	71
Annex E (normative) Type testing.....		73
E.1	Type testing and uncertainty calculation.....	73
E.1.1	Type testing.....	73
E.1.2	Uncertainty calculation.....	73
E.2	Type testing Requirement a)	73
E.3	Type testing Requirement b).....	75
E.3.1	General.....	75
E.3.2	Calculation of standard uncertainties	78
E.3.2.1	General.....	78
E.3.2.2	Repeatability at zero.....	78
E.3.2.3	Repeatability at the hourly alert threshold value of ozone	78
E.3.2.4	Lack of fit.....	79
E.3.2.5	Influence quantities	79
E.3.2.5.1	..... General	79
E.3.2.5.2	..... Sample gas pressure.....	80
E.3.2.5.3	..... Sample gas temperature	80
E.3.2.5.4	..... Surrounding temperature	80
E.3.2.5.5	..... Electrical voltage.....	81
E.3.2.5.6	..... Water vapour	81

E.3.2.5.7.....	Other interferents.....	82
E.3.2.5.8.....	Averaging effect.....	83
E.3.2.5.9.....	Calibration gas.....	83
E.3.2.5.10.....	Difference sample/calibration port.....	83
E.3.3	Example calculation.....	84
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.....	87
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 hourly alert threshold value.....	92
F.1	General.....	92
F.2	Combined standard uncertainty.....	92
F.3	Standard uncertainties.....	93
F.3.1	General.....	93
F.3.1.1	Introduction.....	93
F.3.1.2	Repeatability at zero.....	93
F.3.1.3	Repeatability at the hourly alert threshold value.....	93
F.3.1.4	Lack of fit.....	93
F.3.2	Influence quantities.....	94
F.3.2.1	General.....	94
F.3.2.2	Sample gas pressure.....	94
F.3.2.3	Sample gas temperature.....	94
F.3.2.4	Surrounding temperature.....	95
F.3.2.5	Electrical voltage.....	96
F.3.3	Interferents.....	96
F.3.3.1	General.....	96
F.3.3.2	Water vapour.....	96
F.3.3.3	Other interferents.....	97
F.3.4	Averaging effect.....	97

F.3.5	Reproducibility under field conditions	97
F.3.6	Long-term drift at zero	97
F.3.7	Long-term drift at level of the hourly alert threshold value	98
F.3.8	Zero gas	98
F.3.9	Calibration gas	98
F.3.10	Difference sample/calibration port	98
F.4	Example calculation	99
Annex G (informative)	Calculation of uncertainty in field operation at the 8-hour target value	101
G.1	General	101
G.2	Combined standard uncertainty	101
G.3	Standard uncertainties	102
G.3.1	General	102
G.3.1.1	Introduction	102
G.3.1.2	Repeatability at zero	102
G.3.1.3	Repeatability at the 8-hour target value	103
G.3.1.4	Lack of fit	103
G.3.2	Influence quantities	103
G.3.2.1	General	103
G.3.2.2	Sample gas pressure	104
G.3.2.3	Sample gas temperature	104
G.3.2.4	Surrounding temperature	105
G.3.2.5	Electrical voltage	105
G.3.3	Interferents	106
G.3.3.1	General	106
G.3.3.2	Water vapour	106
G.3.3.3	Other interferents	107
G.3.4	Averaging effect	108
G.3.5	Zero gas	108
G.3.6	Calibration gas	108
G.3.7	Difference sample/calibration port	108
G.3.8	Reproducibility under field conditions	108
G.3.9	Long-term drift at zero	109
G.3.10	Long-term drift at level of the 8-hour target value	109
G.4	Example calculation	110
Annex H (informative)	Test stand for the test point "sensitivity coefficient of sample gas pressure"	112

Annex I (informative) Significant changes..... 113
Bibliography 114

This document is a preview generated by EVS

European foreword

This document (EN 14625:2024) 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 supersedes EN 14625:2012.

In comparison with the previous edition, the technical modifications listed in Annex I of this document have been made.

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 concentrations of ozone present in ambient air based on the ultraviolet photometric measuring principle. This document describes the performance characteristics and sets the relevant minimum criteria required to select an appropriate ultraviolet photometric 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 the 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 concentration of ozone present in ambient air up to 500 $\mu\text{g}/\text{m}^3$. This concentration range represents the certification range for ozone for type testing.

NOTE 1 Other ranges may be used for measurement systems applied at rural locations monitoring ecosystems.

NOTE 2 When this document is used for other purposes than Directive 2008/50/EC, the ranges and uncertainty requirements may not apply.

The method covers the determination of ambient air concentrations of ozone in zones classified as rural areas, urban and urban-background areas.

The results are expressed in $\mu\text{g}/\text{m}^3$ (at 20 °C and 101,3 kPa).

NOTE 3 500 $\mu\text{g}/\text{m}^3$ of O_3 corresponds to 250 nmol/mol of O_3 at 20 °C and 101,3 kPa.

This document contains information for different groups of users.

Clause 5 to Clause 7 and Annex B and Annex C contain general information about the principles of ozone measurement by ultraviolet photometric analyser and sampling equipment.

Clause 8 and Annex E are specifically directed towards test houses and laboratories that perform type testing of ozone 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 ozone analyser based on the type testing results.

Clause 9 to Clause 11 and Annex F and Annex G are directed towards monitoring networks performing the practical measurements of ozone 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 of measurement results under practical monitoring conditions.

This document represents an evolution of earlier editions (EN 14625:2005 and EN 14625:2012).

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

EN ISO 6145-7, *Gas analysis - Preparation of calibration gas mixtures using dynamic 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, *Gas analysis - Purity analysis and the treatment of purity data*

3 Terms and definitions

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

3.1

adjustment of a measuring system

set of operations carried out on a measuring system so that it provides prescribed indications corresponding to given values of a quantity to be measured

Note 1 to entry: Types of adjustment of a measuring system include zero adjustment of a measuring system, offset adjustment, and span adjustment (sometimes called gain adjustment).

Note 2 to entry: Adjustment of a measuring system should not be confused with calibration, which is a prerequisite for adjustment.

Note 3 to entry: In the context of this document, adjustment is performed on measurement data rather than on the analyser.

[SOURCE: JCGM 200:2012 (VIM) [2]]

3.2

alert threshold

level beyond which there is a risk to human health from brief exposure for the population as a whole and at which immediate steps are to be taken by the Member States

[SOURCE: Council Directive 2008/50/EC [1]]