

AS 3580.6.1:2023



STANDARDS
Australia



Methods for sampling and analysis of ambient air

**Method 6.1: Determination of ozone — Direct-reading
instrumental method**



AS 3580.6.1:2023

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- ACT Health
- Australian Aluminium Council
- Australian Industry Group
- Australian Institute of Refrigeration Air Conditioning and Heating
- Clean Air Society of Australia & New Zealand
- Department of Environment and Science, Qld
- Department of Planning, Industry and Environment, NSW
- Department of Water and Environmental Regulation, WA
- Environment Protection Authority, Vic.
- National Association of Testing Authorities Australia
- RMIT University

Additional Interests

- Environment Canterbury (NZ)
- International Accreditation New Zealand
- Ministry for the Environment New Zealand

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Methods for sampling and analysis of ambient air

Method 6.1: Determination of ozone — Direct-reading instrumental method

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Preface

This Standard was prepared by Joint Standards Australia/Standards New Zealand Committee EV-007, Methods for Examination of Air, to supersede AS 3580.6.1:2016.

After consultation with stakeholders in both countries, Standards Australia and Standards New Zealand decided to develop this document as an Australian Standard rather than an Australian/New Zealand Standard.

The objective of this document is to provide regulatory and testing bodies with a standard method for continuously monitoring ozone in ambient air, typically by ultraviolet (UV) photometry with standard reference photometers acting as primary standards for a number of national and international ozone monitoring networks, including Australia. When measured by UV photometry, ozone concentrations are ultimately anchored to the value of the ozone absorption cross section at a wavelength of 254 nm.

A review of all measurements of the absorption (Hodges, J.T. et al., 2019) provided a consensus value 1.23 % lower than the historically used value of $308.32 \text{ atm}^{-1} \text{ cm}^{-1}$. Consequently, the major change in this edition is alignment with the Bureau International des Poids et Mesures (BIPM) proposed value for the ozone absorption cross-section of $304.39 \text{ atm}^{-1} \text{ cm}^{-1}$ with a standard uncertainty of $0.94 \text{ atm}^{-1} \text{ cm}^{-1}$ at 254 nm for measurements in ambient air (BIPM, 2022).

Other changes in this edition are as follows:

- (a) Alignment with current technology and to ensure consistency and uniformity across the different methods used in other gaseous pollutant continuous monitoring Standards.
- (b) Provision of an essential reference to AS 3580.19.

The requirements for instruments found to be suitable for using this method are given in the United States Environmental Protection Agency (US EPA) Code of Federal Regulations, Title 40 Protection of Environment, Part 53 Ambient Air Monitoring Reference and Equivalent Methods (40 CFR 53), Subpart B Procedures for Testing Performance Characteristics of Automated Methods for SO₂, CO, O₃ and NO₂.

The terms “normative” and “informative” are used in Standards to define the application of the appendices to which they apply. A “normative” appendix is an integral part of a Standard, whereas an “informative” appendix is only for information and guidance.

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Introduction

Ozone (O_3) is a gas that is formed when oxides of nitrogen react with volatile organic compounds in the presence of sunlight. The volatile organic compounds that react to form ozone originate from sources such as motor vehicle exhaust, oil refining, printing, petrochemicals, lawn mowing, aviation, bushfires and burning off, as well as emissions from vegetation.

Australian Standard®

Methods for sampling and analysis of ambient air

Method 6.1: Determination of ozone — Direct-reading instrumental method

1 Scope

This document sets out a method for determining ozone in ambient air using a direct-reading instrument. The method applies to the determination of ozone in ambient air within a nominal concentration range 0 to 500 ppb by volume (0 to approximately 1 100 µg/m³ at 0 °C and 101.3 kPa). Modern instruments enable measurement over an expanded range, if required.

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.

NOTE Documents for informative purposes are listed in the Bibliography.

AS 3580.19, *Methods for sampling and analysis of ambient air, Method 19: Ambient air quality data validation and reporting*

AS/NZS 3580.1.1, *Methods for sampling and analysis of ambient air, Method 1.1: Guide to siting air monitoring equipment*

BIPM, *Units and values for the ozone absorption cross section at 253.65 nm (air) with appropriate significant digits and rounding for use in documentary standards*, Davis R.S. et al, Rapport BIPM-2022/02, 10 March 2022

US EPA 40 CFR 53 Subpart B, Code of Federal Regulations, Title 40 Protection of Environment, Part 53 Ambient Air Monitoring Reference and Equivalent Methods, Subpart B Procedures for Testing Performance Characteristics of Automated Methods for SO₂, CO, O₃ and NO₂

3 Terms and definitions

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

3.1

fall time

time interval, after a step decrease in input concentration, between initial instrument response and 95 % of final instrument response

3.2

full scale

FS

nominated maximum concentration for which an instrument has been calibrated

Note 1 to entry: The full scale is selected to cover the normal range of values expected in the sampling environment.

3.3

interference equivalent

positive or negative instrument response caused by a substance other than the one being measured

3.4

lag time

time interval between a step change in input concentration and the first observable corresponding change in instrument response

3.5**level 1 calibration**

two-point instrument calibration using a reference test atmosphere which includes adjustment of instrument gain or zero

3.6**level 1 check**

two-point instrument check using a reference test atmosphere which does not include adjustment of instrument gain or zero

3.7**level 2 check**

simple check of an instrument's response

Note 1 to entry: These checks may be performed using non-certified test atmospheres (e.g. ozone generators).

3.8**limit of detection****LOD**

lowest concentration of a pollutant that is detectable with a given confidence level

3.9**linearity**

deviation of an instrument's output from a linear best fit line when subjected to varying reference test atmospheres

3.10**may**

indicates the presence of an option

3.11**measurement uncertainty**

non-negative parameter characterizing the dispersion of the values being attributed to a measurand based on the information used

3.12**noise**

spontaneous, short duration deviations in instrument output, about the mean output, which are not caused by input concentration changes

Note 1 to entry: Noise level is determined as the standard deviation about the mean and is expressed in concentration units.

3.13**parameter**

one of the characteristics related to an air sample

Note 1 to entry: A parameter may include concentration of constituent or other quantifiable property (e.g. wind speed, temperature).

3.14**parts per billion****ppb**

ratio expressing the volume of gaseous pollutant contained in 1 000 000 000 volumes of atmosphere

Note 1 to entry: It may also be expressed in terms of nanomoles per mole (nmol/mol) as the values are identical. Alternatively, it is one thousand million times the ratio of the partial pressure of gaseous pollutant to the pressure of the atmosphere in which it is contained.

3.15**precision**

variation about the mean of repeated measurements of the same pollutant concentration on the same instrument, expressed as one standard deviation about the mean

3.16**proficiency audit**

evaluation process used to measure the performance or effectiveness of a measurement system, including analysis and validation

3.17**range**

nominal minimum and maximum concentrations that a method is capable of measuring

Note 1 to entry: The nominal range is specified by the lower and upper range limits in concentration units (e.g. 0 to 500 ppb).

3.18**reference test atmosphere**

test atmosphere containing a known concentration of pollutant

3.19**rise time**

time interval, after a step increase in input concentration, between initial instrument response and 95 % of final instrument response

3.20**shall**

indicates that a statement is mandatory

3.21**should**

indicates a recommendation

3.22**span drift**

percentage change in instrument response to an on-scale pollutant concentration over a period of continuous unadjusted operation

3.23**stable response**

instrument response that does not vary more than 1 % of the full scale range over a 5 min period

3.24 **U_{95}**

estimate of expanded uncertainty at a confidence interval of 95 %

Note 1 to entry: Refer to ISO/IEC Guide 98-3 and ISO 20988 for further information.

3.25**zero drift**

percentage change in instrument response to a zero pollutant concentration over a period of continuous unadjusted operation