



Designation: D8559 – 24

Standard Specification for Ambient Outdoor Air Quality Sensors and Sensor-Based Instruments for Portable and Fixed-Point Measurement¹

This standard is issued under the fixed designation D8559; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers performance criteria for ambient outdoor air quality sensors based on the evaluation described in Practice D8406.

1.2 This specification does not apply to sensors or instruments that remotely measure atmospheric pollutants using open path, lidar, or imaging technology.

1.3 This specification is for sensors that alone or in combination measure outdoor criteria pollutants in ambient air: particulate matter (PM_{2.5} and PM₁₀), sulfur dioxide (SO₂), ozone (O₃), carbon monoxide (CO), or nitrogen dioxide (NO₂) at concentrations that are relevant to public health.

1.4 Evaluation is to be performed by a competent entity able to demonstrate that it operates in conformity with internationally accepted test laboratory quality standards such as ISO/IEC 17025. Normally, it is expected that the entity undertaking the performance evaluation under Practice D8406 will perform the evaluation according to this specification.

1.5 *Units*—The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

¹ This specification is under the jurisdiction of ASTM Committee D22 on Air Quality and is the direct responsibility of Subcommittee D22.03.02 on Ambient Atmospheres, Fenceline and Special Monitoring.

Current edition approved March 1, 2024. Published March 2024. DOI: 10.1520/D8559-24.

2. Referenced Documents

2.1 ASTM Standards:²

D1356 Terminology Relating to Sampling and Analysis of Atmospheres

D1914 Practice for Conversion Units and Factors Relating to Sampling and Analysis of Atmospheres

D8406 Practice for Performance Evaluation of Ambient Outdoor Air Quality Sensors and Sensor-based Instruments for Portable and Fixed-point Measurement

E456 Terminology Relating to Quality and Statistics

2.2 Other Standards:

40 CFR Part 53 Ambient Air Monitoring Reference and Equivalent methods³

CEN TS 17660-1 Air Quality – Performance evaluation of air quality sensor systems – Part 1: Gaseous pollutants in ambient air⁴

Directive 2008/50/EC Ambient Air Quality and Cleaner Air for Europe⁵

EN14625 Ambient air – Standard method for the measurement of the concentration of ozone by ultraviolet photometry⁴

ISO/IEC 17025 Testing and calibration laboratories⁶

3. Terminology

3.1 *Definitions*—For definitions of terms used in this specification, refer to Terminologies D1356 and E456, and Practice D8406.

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from United States Environmental Protection Agency (EPA), William Jefferson Clinton Bldg., 1200 Pennsylvania Ave., NW, Washington, DC 20460, <http://www.epa.gov>.

⁴ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

⁵ Available from Council of the Eur-LEX, www.eur-lex.europa.eu/eli/dir/2008/50/oj.

⁶ Available from International Organization for Standardization (ISO), ISO Central Secretariat, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, <http://www.iso.org>.

4. Significance and Use

4.1 This specification establishes performance criteria for ambient outdoor air quality sensors based on the results obtained from their evaluation, according to Practice **D8406**. These criteria can be used to inform decisions about the suitability of air quality sensors for different types of air quality monitoring.

4.2 This specification consists of three levels of performance designated as Class 1, Class 2, and Class 3. Class 1 is the highest level of performance and Class 3 is the lowest. Class 1 is set at a level that approaches the performance criteria for reference grade continuous ambient air quality instruments in standards such as EN14625 and 40 CFR Part 53. This is intentional and reflects the rapid improvement in performance exhibited by air quality sensors over the past few years. An air sensor user should consider what class is appropriate for their specific air sensor application.

4.3 This specification has similarities to CEN TS 17660-1 which also has three performance classes. However, the CEN TS 17660-1 protocol was specifically developed to support the requirements of Directive 2008/50/EU which defines data quality objectives for indicative measurements and for objective estimation. This specification is expected to have wider application. Furthermore, CEN TS 17660-1 only applies to air quality gas sensors whereas this specification assesses the performance of both gas and particles sensors, according to Practice **D8406**.

5. Performance Requirements

5.1 The performance criteria for each of the classes of sensor performance is given in **Annex A1**. The results for the two sensors tested according to Practice **D8406** shall be averaged for each test and the average used to determine the performance class for each test.

5.1.1 For measurement conversion factors to SI units, see Practice **D1914**.

5.2 The air quality sensor classification shall be determined and reported for the laboratory and field test results independently.

5.2.1 The laboratory test classification is the lowest classification achieved in the tests.

5.2.2 The field test classification is the lowest classification achieved across the two test sites.

5.2.3 If the sensor fails to meet the laboratory or field specification for the lowest Class 3, then the class shall be designated as Class N (no classification).

5.2.4 The overall classification result shall be reported as Class X.Y where X is the laboratory test classification and Y is the field test classification. For example, Class 1.2 indicates Class 1 was achieved in the laboratory test and Class 2 was achieved in the field test.

5.2.5 If the sensor system measures multiple pollutants, each pollutant measurement will be given an independent classification.

6. Reporting

6.1 The test laboratory shall prepare the test report which shall contain:

6.1.1 The Practice **D8406** test report upon which the designated classification of the air quality sensor is based.

6.1.2 The classification result according to the format described in **5.2**.

6.1.3 Device manufacturer and supplier and an unambiguous identification of the sensor model and serial number (if available).

7. Keywords

7.1 air; atmosphere; class; dust; ozone; performance; sensor; specification

ANNEX

(Mandatory Information)

A1. PERFORMANCE SPECIFICATIONS

A1.1 Please refer to Practice **D8406** for more information on the laboratory and field test parameters listed in the following tables.

A1.2 Specification for CO

A1.2.1 Test result shall be less than the performance criterion for the class, unless otherwise stated.

A1.3 Specification for O₃, NO₂, SO₂

A1.3.1 Test result shall be less than the performance criterion for the class, unless otherwise stated.

A1.4 Specification for PM_{2.5} and PM₁₀

A1.4.1 Test result shall be less than the performance criterion for the class, unless otherwise stated.