



Methods for sampling and analysis of ambient air

Method 19: Ambient air quality data validation and reporting



AS 3580.19:2020

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- National Association of Testing Authorities Australia
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Preface

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee EV-007, Methods for Examination of Air.

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

The objective of this Standard is to provide regulatory and testing bodies with procedures for validating and reporting ambient air quality data and for the subsequent use of invalidated data.

Contents

Preface	ii
Introduction	iv
Section 1 Scope and general	1
1.1 Scope and application.....	1
1.1.1 Scope	1
1.1.2 Application	1
1.2 Normative references	1
1.3 Terms and definitions.....	3
1.4 Abbreviations.....	4
Section 2 Data validation procedures	6
2.1 Data processing stages.....	6
2.2 Station siting criteria.....	6
2.3 Sample handling, storage and archiving.....	6
2.3.1 Sample handling and storage.....	6
2.3.2 Sample archiving.....	8
2.4 Laboratory and field blanks	8
2.5 Data screening.....	9
2.5.1 General.....	9
2.5.2 Manual systems.....	11
2.5.3 Automated systems.....	11
2.6 Data validation.....	11
2.7 Data flags	12
2.8 Calibration, check and maintenance criteria	13
2.8.1 General.....	13
2.8.2 Critical criteria	13
2.8.3 Operational criteria	23
2.8.4 Systematic criteria	31
2.9 Treatment of negative particulate matter data.....	35
Section 3 Data reporting	36
3.1 General.....	36
3.2 Statement of method conformance.....	36
3.3 Data processing.....	36
3.3.1 General.....	36
3.3.2 Calculating averages.....	36
3.3.3 Time and date	37
3.4 Data reporting flags.....	37
3.5 Limits of detection, quantitation and reporting	37
3.6 Significant figures and rounding of data	38
3.7 Metadata.....	38
Section 4 Data retention	40
Bibliography	41

Introduction

Social and community expectations are that air pollutant levels are managed to ensure exposure and environmental risks are minimized. The community expects that published ambient air quality data, either from the regulatory authority or the industry emitting the pollutants, will be accurate, unbiased and obtained with instruments suited to the application.

Air quality impact studies for works/development approval for new facilities rely on mathematical modelling and background air quality data to assess conformance with ambient air quality criteria and, in some instances, to conduct human health risk assessments. Planning authorities rely heavily on the assessment of existing environmental conditions in environment effects/impact statements for major industrial or public works when assessing whether to approve proposed projects.

Documented and uniformly applied data validation and reporting procedures are therefore essential components of any ambient air quality monitoring program.

Australian Standard®

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Section 1 Scope and general

1.1 Scope and application

1.1.1 Scope

This Standard specifies data validation and reporting procedures applicable to the measurement of pollutants in ambient air and road tunnels and to the measurement of meteorological parameters, as described in the AS 3580 and AS/NZS 3580 series of Standards.

1.1.2 Application

This Standard is intended to be used as a companion to the AS 3580 and AS/NZS 3580 series of Standards dealing with ambient air quality measurement by a range of methods. For operational guidance, refer to the relevant Standard in the series for the particular pollutant and monitoring method.

Where there are differences between the requirements contained in a Standard for a particular pollutant and those contained in this Standard, the requirements of this Standard shall take precedence.

1.2 Normative references

The following 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 2706, *Numerical values—Rounding and interpretation of limiting values*

AS 3580.4.1, *Methods for sampling and analysis of ambient air, Method 4.1: Determination of sulfur dioxide—Direct reading instrumental method*

AS 3580.5.1, *Methods for sampling and analysis of ambient air, Method 5.1: Determination of oxides of nitrogen—Direct-reading instrumental method*

AS 3580.6.1, *Methods for sampling and analysis of ambient air, Method 6.1: Determination of ozone—Direct-reading instrumental method*

AS 3580.7.1, *Methods for sampling and analysis of ambient air, Method 7.1: Determination of carbon monoxide—Direct-reading instrumental method*

AS 3580.9.8, *Methods for sampling and analysis of ambient air, Method 9.8: Determination of suspended particulate matter—PM₁₀ continuous direct mass method using a tapered element oscillating microbalance analyser*

AS 3580.9.9, *Methods for sampling and analysis of ambient air, Method 9.9: Determination of suspended particulate matter—PM₁₀ low volume sampler—Gravimetric method*

AS 3580.9.10, *Methods for sampling and analysis of ambient air, Method 9.10: Determination of suspended particulate matter—PM_{2.5} low volume sampler—Gravimetric method*

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

AS/NZS 3580.2.2, *Methods for sampling and analysis of ambient air, Method 2.2: Preparation of reference test atmospheres—Compressed gas method*

AS/NZS 3580.9.3, *Methods for sampling and analysis of ambient air, Method 9.3: Determination of suspended particulate matter—Total suspended particulate matter (TSP)—High volume sampler gravimetric method*

AS/NZS 3580.9.6, *Methods for sampling and analysis of ambient air, Method 9.6: Determination of suspended particulate matter—PM₁₀ high volume sampler with size-selective inlet—Gravimetric method*

AS/NZS 3580.9.7, *Methods for sampling and analysis of ambient air, Method 9.7: Determination of suspended particulate matter—Dichotomous sampler (PM₁₀, coarse PM and PM_{2.5})—Gravimetric method*

AS/NZS 3580.9.11, *Methods for sampling and analysis of ambient air, Method 9.11: Determination of suspended particulate matter—PM₁₀ beta attenuation monitors*

AS/NZS 3580.9.12, *Methods for sampling and analysis of ambient air, Method 9.12: Determination of suspended particulate matter—PM_{2.5} beta attenuation monitors*

AS/NZS 3580.9.13, *Methods for sampling and analysis of ambient air, Method 9.13: Determination of suspended particulate matter—PM_{2.5} continuous direct mass method using a tapered element oscillating microbalance monitor*

AS/NZS 3580.9.14, *Methods for sampling and analysis of ambient air, Method 9.14: Determination of suspended particulate matter—PM_{2.5} high volume sampler with size selective inlet—Gravimetric method*

AS/NZS 3580.9.15, *Methods for sampling and analysis of ambient air, Method 9.15: Determination of suspended particulate matter—Particulate metals high or low volume sampler gravimetric collection—Inductively coupled plasma (ICP) spectrometric method*

AS/NZS 3580.9.16, *Methods for sampling and analysis of ambient air, Method 9.16: Determination of suspended particulate matter—PM₁₀ continuous direct mass method using a tapered element oscillating microbalance monitor incorporating a filter dynamic measurement system (FDMS) unit*

AS/NZS 3580.10.1, *Methods for sampling and analysis of ambient air, Method 10.1: Determination of particulate matter—Deposited matter—Gravimetric method*

AS/NZS 3580.10.2, *Methods for sampling and analysis of ambient air, Method 10.2: Determination of particulate matter—Impinged matter—Gravimetric method*

AS/NZS 3580.11.1, *Methods for sampling and analysis of ambient air, Method 11.1: Determination of methane and non-methane organic compounds in ambient air—Direct-reading instrumental method*

AS/NZS 3580.12.1, *Methods for sampling and analysis of ambient air, Method 12.1: Determination of light scattering—Integrating nephelometer method*

AS/NZS 3580.13.2, *Methods for sampling and analysis of ambient air, Method 13.2: Determination of gaseous and acid-soluble particulate fluorides—Manual, double filter paper sampling*

AS/NZS 3580.14, *Methods for sampling and analysis of ambient air, Method 14: Meteorological monitoring for ambient air quality monitoring applications*

AS/NZS 3580.15, *Methods for sampling and analysis of ambient air, Method 15: Determination of gaseous pollutants in ambient air using differential optical absorption spectrometry (DOAS)—Direct-reading instrument method*

AS/NZS 3580.16, *Methods for sampling and analysis of ambient air, Method 16: Determination of polycyclic aromatic hydrocarbons (PAH)*

AS/NZS 3580.17, *Methods for sampling and analysis of ambient air, Method 17: Determination of gaseous compounds in ambient air—Direct-reading cavity ring-down spectroscopy instrumental method*

AS/NZS 3580.18, *Methods for sampling and analysis of ambient air, Method 18: Measurement of road tunnel air quality*

ISO/IEC Guide 98-3, *Uncertainty of measurement — Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

1.3 Terms and definitions

For the purposes of this Standard the following definitions apply.

1.3.1

calibration

set of operations that establish, under specified conditions, the relationship between the value indicated by a measuring instrument and the corresponding known value of a reference standard

1.3.2

chain of custody

demonstrable possession, movement, handling and location of sample from one point in time until another

1.3.3

check

confirmation of acceptable instrument response, without adjustment

1.3.4

data flag

data qualifier or flag identifies data that may be suspect due to contamination, special events or failure of quality control limits and to assist in data aggregation and assessment

1.3.5

data validation

process used to determine if data are accurate, complete or meet specified criteria

1.3.6

field blank filter

filter not used for sampling, which has been taken into the field, used to assess the effect of field conditions, transport conditions and field operator technique on the weighing procedure

1.3.7

laboratory blank filter

filter not used for sampling, which remains in the laboratory, used to assess the effect of laboratory conditions and balance operator technique on the weighing procedure

1.3.8

limit of detection

LOD

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

1.3.9

limit of quantitation

LOQ

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

1.3.10

limit of reporting

LOR

concentration, equal to or greater than the LOQ ([1.3.9](#)), used for reporting purposes

1.3.11

measurement uncertainty

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

1.3.12**outlier**

result which meets statistical criteria identifying it as an outlier

1.3.13**parts per billion****ppb**

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

1.3.14**parts per million****ppm**

ratio expressing the volume of gaseous pollutant contained in 1 000 000 volumes of atmosphere. Alternatively, it is one million times the ratio of the partial pressure of gaseous pollutant to the pressure of the atmosphere in which it is contained

1.3.15**shall**

indicates that a statement is mandatory

1.3.16**should**

indicates a recommendation

1.3.17**U₉₅**

measurement uncertainty at a confidence interval of 95 % according to ISO/IEC Guide 98-3

1.4 Abbreviations

For the purposes of this Standard the abbreviations shown below apply.

BAM	Beta attenuation monitor
b_{sp}	Particle light scattering coefficient
CRDS	Cavity ring-down spectroscopy
ΔT	Temperature difference
DOAS	Differential optical absorption spectrometry
FDMS	Filter dynamic measurement system
HVS	High volume sampler
LOD	Limit of detection
LOQ	Limit of quantitation
LOR	Limit of reporting
LVS	Low volume sampler
PAH	Polycyclic aromatic hydrocarbons
PM _{coarse}	Particulate matter with an equivalent aerodynamic diameter between 2.5 μm and 10 μm

PM ₁₀	Particulate matter with an equivalent aerodynamic diameter less than 10 µm
PM _{2.5}	Particulate matter with an equivalent aerodynamic diameter less than 2.5 µm
ppb	Parts per billion by volume
ppm	Parts per million by volume
RH	Relative humidity
TEOM	Tapered element oscillating microbalance
TSP	Total suspended particulate matter
U ₉₅	Measurement uncertainty at a confidence interval of 95 %

Section 2 Data validation procedures

2.1 Data processing stages

The stages involved in the processing of air quality and meteorological monitoring data are shown in [Figure 1](#).

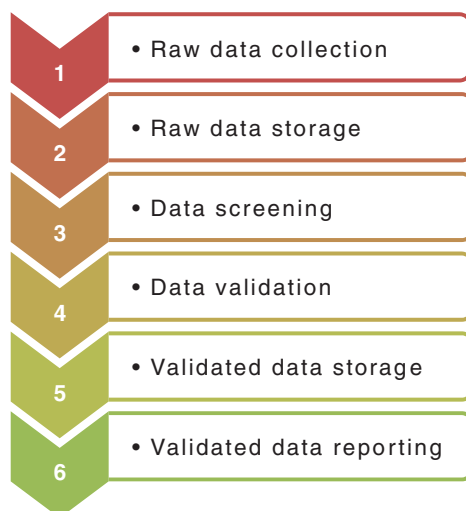


Figure 1 — Data processing stages

2.2 Station siting criteria

AS/NZS 3580.1.1 contains general guidelines for the siting of ambient air quality monitoring equipment, providing siting parameters for a number of air pollutants. AS/NZS 3580.14 contains guidelines for the siting of meteorological monitoring equipment, specifically for ambient air quality monitoring applications.

In practice, an ideal site satisfying all criteria is rarely achieved. Consequently, non-conformance with the provisions of AS/NZS 3580.1.1 and AS/NZS 3580.14 does not invalidate data generated at the monitoring site. Non-conformances shall however be noted in the data report so that a user of the data can make their own assessment on its suitability for their purposes (see [Clause 3.2](#)).

2.3 Sample handling, storage and archiving

2.3.1 Sample handling and storage

Physical ambient air quality samples can be affected by extremes of temperature, ultraviolet light, atmospheric pressure, the presence of other pollutants and physical handling.

For transportation, all samples should be placed in suitable containers to protect from breakage, contamination and loss, and, if the samples have specific temperature requirements, inside a temperature controlled device. Samples should be delivered to the laboratory for analysis as soon as possible after collection, preferably on the same day. Where storage is required, samples shall be stored in accordance with the relevant Standard.

The number of transport containers should be recorded on a chain of custody form, together with identification numbers for all samples. The analytical laboratory should confirm that all listed samples were included in the shipment. In order to verify that sample transport temperatures conform to method requirements, sensors capable of measuring maximum and minimum temperatures should be placed in each shipping container and the resultant data recorded upon sample receipt.

Sample handling and storage requirements for each Standard that entails sample collection, together with the action to be taken if the requirement is not met, shall be as set out in [Table 1](#).

All Standards describing manual particulate matter monitoring methods specify the maximum period between sampling and final filter weighing. Non-conformance with sample storage and handling requirements described in the relevant Standard shall be noted in the data report, together with a data qualifier (flag) noting the actual period between sampling and final weighing, together with an explanation for the non-conformance. However, data shall not be invalidated on this basis.

Where storage requirements specified in the Standard relate to the period between sampling and sample extraction, sampling and subsequent analysis (other than gravimetric) or sample extraction and analysis (e.g. AS/NZS 3580.9.15, AS/NZS 3580.13.2 and AS/NZS 3580.16), non-conformance can result in the data being either flagged or invalidated.

For AS/NZS 3580.9.15 non-conformance with the maximum storage period shall be noted in the data report, with a data flag noting the actual period between sampling and filter extraction and an explanation for the non-conformance.

For AS/NZS 3580.13.2 and AS/NZS 3580.16, non-conformance with the maximum storage periods results in the data being invalidated, unless the reporting organization can provide data which supports an extended storage period (or higher storage temperature in the case of AS/NZS 3580.16), in which case the evidence shall be appended to the data report, together with associated data flags indicating non-conformance with this Standard. For AS/NZS 3580.16, evidence shall include confirmation that the field surrogate compound recoveries are within the specified range (see [Table 5](#)).

Table 1 — Sample handling and storage requirements

Standard	Pollutant	Handling and storage requirements	Action for non-conformance
AS/NZS 3580.9.3	TSP	(a) Remove from sampler within 3 days (b) Maximum 20 days (or 30 days at < 4 °C) between date of sampling and analysis	Data flagged Data flagged
AS/NZS 3580.9.6	PM ₁₀	(a) Remove from sampler within 3 days (b) Maximum 20 days (or 30 days at < 4 °C) between date of sampling and analysis	Data flagged Data flagged
AS/NZS 3580.9.7	PM ₁₀ , PM _{coarse} and PM _{2.5}	(a) Remove from sampler within 14 days (b) Maximum temperature of 25 °C during sample transport (c) Maximum 20 days (or 30 days at < 4 °C) between date of sampling and analysis	Data flagged Data flagged Data flagged
AS 3580.9.9	PM ₁₀	(a) Remove from sampler within 14 days (b) Maximum 20 days (or 30 days at < 4 °C) between date of sampling and analysis	Data flagged Data flagged
AS 3580.9.10	PM _{2.5}	(a) Remove from sampler within 14 days (b) Maximum temperature of 25 °C during sample transport (c) Maximum 20 days (or 30 days at < 4 °C) between date of sampling and analysis	Data flagged Data flagged Data flagged
AS/NZS 3580.9.14	PM _{2.5}	(a) Remove from sampler within 3 days (b) Maximum temperature of 25 °C during sample transport (c) Maximum 20 days (or 30 days at < 4 °C) between date of sampling and analysis	Data flagged Data flagged Data flagged

Table 1 (continued)

Standard	Pollutant	Handling and storage requirements	Action for non-conformance
AS/NZS 3580.9.15	Particulate metals	(a) Remove from sampler within period specified by applicable Standard	Data flagged
		(b) Maximum 6 months between date of sampling and sample extraction	Data flagged
AS/NZS 3580.10.1	Deposited matter	(a) Maximum 30 days between date of sampling and analysis	Data flagged
		(b) Store in cool, dark environment	Data invalidated
AS/NZS 3580.10.2	Impinged matter	(a) Maximum 30 days between date of sampling and analysis	Data flagged
		(b) Store in cool, dark environment	Data invalidated
AS/NZS 3580.13.2	Fluorides	(a) Maximum 2 months between date of sampling and analysis	Data invalidated
		(b) Store in dry, fluoride free environment	Data invalidated
AS/NZS 3580.16	PAH	(a) Remove from sampler within 3 days	Data flagged
		(b) Keep protected from sunlight during transport and storage	Data invalidated
		(c) Maximum temperature of 25 °C during sample transport	Data flagged
		(d) Stored at ≤ 4 °C	Data invalidated
		(e) Maximum 14 days between date of sampling and extraction	Data invalidated
		(f) Maximum 30 days between date of sample extraction and analysis	Data invalidated

2.3.2 Sample archiving

Samples not destroyed during analysis shall be archived in accordance with the laboratory's quality management system, to allow for reanalysis if necessary. As an example, PM₁₀ and PM_{2.5} low volume sampler filters collected in accordance with AS 3580.9.9 and AS 3580.9.10 should be archived for a minimum of five years from the date of collection, stored at a temperature less than 4 °C during the first year.

2.4 Laboratory and field blanks

Australian and Australian/New Zealand Standards describing manual particulate matter monitoring methods require the use of laboratory and field blanks and specify control limits for the variation in blank filter mass between pre- and post-weighing.

In addition to the remedial action and/or root cause analysis required when the laboratory blank limit is exceeded, results for sample filters weighed in the same batch as the errant laboratory blank filter shall be invalidated, unless evidence is provided and reported which clearly and unequivocally demonstrates that the cause of the exceedance was limited in impact to the laboratory blank alone. In this instance, the affected sample filters may be reported, provided they are flagged appropriately (see [Clause 3.4](#)).

In addition to the remedial action and/or root cause analysis required when the field blank limits are exceeded, results reported for sample filters weighed in the same batch as the errant field blank filter can be reported, but shall be flagged appropriately (see [Clause 3.4](#)).

In both instances, the reasons for not meeting the blank control limit criterion shall be investigated, mitigated or justified, and subsequently documented.

2.5 Data screening

2.5.1 General

An initial screening of continuous ambient air quality monitoring data should be conducted on a daily basis taking into consideration, as a minimum, automatically generated data flags and, where relevant, overnight zero and span check data.

If initial data screening indicates a significant instrument response issue, instrument calibration records shall be examined to establish whether data requires invalidation. Instrument calibration and maintenance activities should also be rescheduled with the field technician to minimize data losses.

The objective of the initial data screening process is to detect large systematic errors, with small random errors unlikely to be detected. Graphical indications of systematic errors due to incorrect instrument operation may include:

- (a) A straight line trace for a significant period of time.
- (b) A wide, solid trace indicating excessive noise or spikes in instrument response.
- (c) A long steady increase or decrease.
- (d) A cyclic trace with a repetitive time scale.
- (e) Excessive span or zero drift.
- (f) A trace below the zero baseline.
- (g) Values outside the expected range.

Data associated with any time period during which incorrect instrument operation is suspected shall be investigated further, and invalidated if check or calibration criteria are not met.

Data screening criteria should be developed for each application. Examples of screening criteria for particular pollutants and meteorological parameters which should result in further investigation are provided in [Tables 2](#) and [3](#).

Table 2 — Examples of screening criteria for pollutants

Pollutant	Examples of screening criteria
Ozone (O ₃)	(a) Hourly average concentrations less than –5 ppb or greater than 150 ppb (b) Rate of change greater than 50 ppb per hour (c) Differences between comparative monitoring sites greater than 50 ppb (d) Concentration of co-pollutant that does not vary as expected (NO should decrease as ozone increases)
Oxides of nitrogen (NO _x)	(a) Hourly average NO₂ concentrations less than –2 ppb or greater than 120 ppb (b) NO or NO₂ concentration greater than NO_x concentration (c) Rate of NO₂ concentration change greater than 30 ppb per hour (d) Concentration of co-pollutant that does not vary as expected (NO should decrease as ozone increases)
Carbon monoxide (CO)	(a) Hourly average concentrations less than –0.5 ppm or greater than 10 ppm (b) Rate of change greater than 5 ppm per hour (c) Concurrent differences between comparative monitoring sites greater than 5 ppm (d) Concentration of co-pollutant that does not vary as expected (CO should increase as NO increases)