

Australian/New Zealand Standard™

Methods for sampling and analysis of ambient air

Method 9.9: Determination of suspended particulate matter—PM₁₀ low volume sampler—Gravimetric method

PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee EV-007, Methods for Examination of Air as an Australian/New Zealand Standard. This standard method deals with the determination of suspended particulate matter with an equivalent aerodynamic diameter (EAD) of less than approximately 10 µm (PM₁₀). This is one in a series of Standards for the determination of particulate matter in ambient air.

The objective of this Standard is to provide regulatory and testing bodies with a standard method for determining suspended particulate matter with an equivalent aerodynamic diameter of less than 10 µm utilizing a low volume sampler and size selective inlet.

AS 2922, *Ambient air—Guide for the siting of sampling units*, is referenced in this Standard. AS 2922 is currently being revised by the Committee and will be renumbered and published as AS/NZS 3580.1.1. When this occurs this Standard will be amended.

The procedure described in this Standard involves batch sampling and the gravimetric determination of PM₁₀, and is based on the United States Code of Federal Regulations, Title 40, Chapter 1, Part 50 Appendix J, *Reference method for the determination of particulate matter as PM₁₀ in the atmosphere*.

The term ‘normative’ has been used in this Standard to define the application of the appendix to which it applies. A ‘normative’ appendix is an integral part of a Standard.

FOREWORD

Suspended particulate matter measured by this method includes particles with an equivalent aerodynamic diameter (EAD) of less than 10 µm, as passed by a size selective inlet (PM₁₀). Particles with EAD of 10 µm and less are classified as respirable and hence may affect health. Particles larger than 10 µm generally have nuisance and aesthetic impacts only. PM₁₀ emission sources include industrial processes, fuel combustion, burning of vegetation, incineration and natural causes such as wind blown dust and salt laden air.

METHOD

1 SCOPE

This Standard sets out the gravimetric determination of PM₁₀ in ambient air utilizing low volume sequential and non-sequential samplers equipped with size selective inlets. The method provides a measure of mean concentration of PM₁₀ in units of micrograms per cubic metre (µg/m³), normally sampled over a 24 h period.

This method may be used to collect particle samples for subsequent physical or chemical analysis.

NOTE: Sampling is normally of 24 h duration to average out diurnal variations. Provided that the mass of the filter is determined under carefully controlled laboratory conditions, mean concentrations of 5 µg/m³ (3 L/m sample flow rate) and greater may be determined based on a 24 h sampling period.

2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS

2922* Ambient air—Guide for the siting of sampling units

AS ISO/IEC

17025 General requirements for the competence of testing and calibration laboratories

AS/NZS

3760 In-service safety inspection and testing of electrical equipment

ISO

Guide to the expression of uncertainty in measurement (ISO GUM)

EN

12341 Air quality. Determination of the PM₁₀ fraction of suspended particulate matter. Reference method and field test procedure to demonstrate reference equivalence of measurement methods

US EPA

US Code of Federal Regulations—Environment Protection Agency 40 CFR, Chapter I, Part 50, Appendix J and Parts 53.4 to 53.43 inclusive

NATA

Technical Note 8—In-situ calibration of barometers

Technical Note 13—Users check of balance calibration

Technical Note 19—Liquid-in-glass thermometers—Selection, use and calibration checks

3 DEFINITIONS

For the purpose of this Standard the following definitions apply:

3.1 Equivalent aerodynamic diameter (EAD)

The diameter of a spherical particle of unit density (1 g/m³) which exhibits the same aerodynamic behaviour as the particle in question.

* AS 2922 is being revised. It is proposed to be re-numbered as AS/NZS 3580.1.1.

3.2 Field blank filter

A filter not used for sampling, which has been taken into the field. The filter is handled as a sample filter, including placing it in the sampler filter holder, and removing it, except the sampler is not in operation during this time. A field blank filter is used to assess the effect of field conditions, transport conditions and field operator technique on the weighing procedure.

3.3 Laboratory blank filter

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

3.4 PM₁₀

Atmospheric suspended particulate matter having an EAD of less than approximately 10 µm, which is passed by a size selective inlet having performance characteristics as defined in United States Code of Federal Regulations: Title 40, Chapter 1, Part 50, Appendix J or equivalent.

NOTE: One of the performance characteristics referred to is that there is a 50% collection efficiency of particles of 10 ± 0.5 µm EAD.

3.5 U95

A measurement of uncertainty at a confidence interval of 95% according to ISO GUM.

4 PRINCIPLE

An air sampler draws ambient air at a constant flow rate through a size selective inlet. Size selective inlets designed for low volume air samplers require a specific flow rate usually between 3.0 and 16.7 L/min to achieve the correct aerodynamic particle size cut-point.

Each sample filter is weighed before and after sampling to determine the mass of the collected particles.

5 APPARATUS

5.1 PM₁₀ sampler (see Appendix A)

5.1.1 Sample inlet (incorporating rain cap and insect screen)

5.1.2 Downtube

5.1.3 Size selective inlet (impaction plate(s) or sharp cut cyclone)

5.1.4 Filter holder

5.1.5 Low volume sampler (incorporating pump, flow rate control, flow rate measurement, timer and enclosure)

5.2 Filters

No commercially available filter medium is ideal in all respects for all samplers. Certain types of filters may not be suitable for use with some samplers, particularly under heavy loading conditions (high mass concentration), because of high or rapid increase in the filter flow resistance that would exceed the capability of the samplers flow control device. The filter selected shall have a specified collection efficiency of at least 99.95% for particles of 0.3 µm EAD.

The filters shall be free from pinholes and other defects (see Clause 5.6).

NOTE: Where the collected sample is to be used for other determinant(s), the filter should be selected to ensure minimum interference to such determinant(s). Preferred filters are 37 mm or 47 mm diameter PTFE coated glass fibre, PTFE (with a support ring), or polycarbonate filters. Membrane filters should have a maximum pore size of 2 microns.

5.3 Micro balance

An analytical balance with a minimum resolution of 1 µg. Single point checks shall be conducted on a monthly basis, repeatability checks on a six monthly basis and a full calibration every three years (NATA Technical Note 13).

5.4 Static eliminator

An alpha particle source (Americium 241 of 4×10^5 Bq activity, or Polonium 210 of 2×10^7 Bq activity), or a high voltage static elimination unit, is required to neutralise any static charge on the filters prior to weighing. The alpha particle source shall be renewed when found to be ineffective (typically 1 to 2 years).

NOTE: A licence from your national radiation laboratory may be required to operate and dispose of an alpha particle source.

5.5 Flow meter

A traceable reference standard flow measuring device (e.g. calibrated bubble meter or calibrated gas meter) with U95 of $\pm 2\%$ at the operating flow rate. The swept volume for a bubble meter shall be calibrated by weighing the equivalent volume of water displaced.

A traceable transfer standard flow measuring device (e.g. electronic piston meter, electronic bubble meter or flow meter), with a U95 of $\pm 2\%$ at the operating flow rate, may be used for field applications. The transfer standard device shall be calibrated against a reference standard device on a biennial basis.

5.6 Light-table

A light-table to check filters for pinholes or other defects.

5.7 Thermometer

A traceable thermometer with U95 of $\pm 0.5^\circ\text{C}$ and a resolution of 0.1°C . The thermometer shall be checked against a reference thermometer at 0°C (ice point), or at one point in the working range, on a six monthly basis (NATA Technical Note 19).

5.8 Timing device

A stopwatch or other timing device capable of measuring elapsed time (typically greater than or equal to a period of 15 seconds), with a U95 of $\pm 1\%$ and a resolution of 0.1 second. The timing device shall be checked against the recorded time signal, over a minimum period of one hour, on a six monthly basis.

5.9 Barometer

A traceable barometer with a U95 of ± 0.5 kPa. The barometer shall be checked on a six-monthly basis, at one point against barometric pressure measured at an appropriately located meteorological station (NATA Technical Note 8).

Alternatively, a barometric pressure may be determined from measurements taken at an appropriately located meteorological station, with the pressure corrected for differences in elevation between the sampling site and the meteorological station (NATA Technical Note 8).

5.10 Relative humidity and temperature measuring device

A device for measuring and recording the relative humidity (U95 of $\pm 5\%$) and temperature (U95 of $\pm 1^\circ\text{C}$) of the filter conditioning environment, at intervals not exceeding 15 mins.

The relative humidity device shall be checked on a six monthly basis, at one point.