

# Australian/New Zealand Standard™

## Methods for sampling and analysis of ambient air

### Method 10.1: Determination of particulate matter—Deposited matter—Gravimetric method

#### PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee EV-007, Methods for Examination of Air, to supersede AS/NZS 3580.10.1:2003.

The objective of this Standard is to provide regulatory and testing bodies with a Standard method for determining deposited matter that rapidly settles from the air. The objective of this revision is to add Appendix A which sets out a procedure for determining the mass deposition rate of metals present in the deposited matter.

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

Particulate matter sampled by this method is predominantly dust particles which, because of their size, rapidly settle from the air. This dust can be a nuisance by soiling property in the vicinity of its point of emission. Some common sources of such particles are minerals processing, bulk materials handling, surface mining operations, industrial processes, unsealed roads, incineration and natural causes such as wind-blown dust.

This method is used primarily to establish long-term trends and to investigate localized dustfall.

This procedure has been widely used in Australia for over 40 years and, during this time, extensive data has been collected. Data collected using this method is not directly comparable with data obtained by other deposit gauge methods.

Depending on the situation, the metal content of the deposited matter can be of interest. Metals occur naturally in soil and rocks and can be released into the air as particulate matter through weathering, mining activities and wind-blown dust. Anthropogenic sources of particulate metals include minerals processing, incineration and combustion of fuels containing metals. Some metals, upon inhalation or ingestion, can lead to a range of health effects such as cancer, neurotoxicity and reproductive toxicity.

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## METHOD

### 1 SCOPE

This Standard sets out a method for the sampling of particulate matter that is deposited from the atmosphere, and procedures for the gravimetric determination of the mass deposition rate of insoluble solids, ash, combustible matter, soluble solids and total solids from ambient air.

The method provides an estimate of the mean surface concentration of deposited matter settling from the air over a sampling period, typically one month. Particulate matter deposition rates of 0.1 g/m<sup>2</sup> month and above may be determined using a monthly sampling period.

The sample obtained by the sampling procedure specified may be subjected to physical or chemical analysis. A method to determine deposition rates for metals present in deposited matter is provided in Appendix A of this Standard.

### 2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

#### AS

- 1152 Specification for test sieves
- 2162 Verification and use of volumetric apparatus
- 2162.1 Part 1: General—Volumetric glassware
- 2164 Laboratory glassware—One-mark volumetric flasks
- 2166 Laboratory glassware—One-mark pipettes

#### AS/NZS

- 3580 Methods for sampling and analysis of ambient air
- 3580.1.1 Part 1.1 Guide to siting air monitoring equipment
- 3580.9.15 Method 9.15 Determination of suspended particulate matter—Particulate metals high or low volume sampler gravimetric collection—Inductively coupled plasma (ICP) spectrometric method

### 3 DEFINITIONS

For the purpose of this Standard, the definitions below apply.

#### 3.1 Ash

The mass of that portion of the insoluble matter remaining after combustion.

#### 3.2 Combustible matter

The mass of that portion of the insoluble matter lost during combustion.

#### 3.3 Constant mass

Within  $\pm 1$  mg of the previous mass.

#### 3.4 Deposited matter

Particles which are collected in a deposit gauge (see Clause 6.1) and which pass through a 1 mm mesh sieve complying with AS 1152.

#### 3.5 Insoluble matter

The mass of the insoluble portion of the deposited matter.

### 3.6 Soluble matter

The mass of the soluble portion of the deposited matter.

### 3.7 Total solids

The mass of the particulate matter deposited in a deposit gauge.

### 3.8 $U_{95}$

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

## 4 PRINCIPLE

Over a given sampling period, particles that settle from the ambient air are collected in a vessel and retained together with any rainwater. The sample is passed through a sieve to remove any extraneous matter (e.g. leaves, insects) and the sieved sample containing the deposited matter is transferred to a filtration apparatus. The insoluble and soluble materials are separated by filtration and the mass of the dried insoluble solids is gravimetrically determined.

The ash and combustible matter content are determined by loss on ignition of the insoluble solids. Soluble solids are determined from the filtrate. The total solids are obtained by the addition of the insoluble solids and the soluble solids. The mass deposition rate of deposited matter is then calculated from the mass of solids obtained, the funnel cross-sectional area and the exposure period.

## 5 REAGENTS

### 5.1 General requirements

Only reagents of recognized analytical grade and distilled water or water of an equivalent purity shall be used.

### 5.2 Copper sulfate solution

Dissolve 7.8 g of copper sulfate pentahydrate ( $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ ) in water and dilute to 1 L in a volumetric flask.

## 6 APPARATUS

### 6.1 Deposit gauge

A deposit gauge (see Figure 1) consists of a  $150 \pm 10$  mm diameter glass funnel (nominal angle of cone sides  $60^\circ$ ) and a glass collection bottle. The internal diameter of the funnel stem shall be sufficient to permit passage of particulate matter during washing. The funnel is supported firmly in the neck of a wide-mouth, glass bottle of a suitable size, preferably of a minimum volume of 4 L, by means of a rubber or plastic stopper with a groove or outlet pipe to allow water overflow under excessive rainfall conditions. The funnel diameter shall be known to the nearest millimetre when used in the calculation of results.

#### NOTES:

- 1 The size of the bottle should be selected after consideration of the expected rainfall over the sampling period.
- 2 The funnel diameter is determined by taking the mean of two measurements (at right angles to each other) of the internal diameter of the funnel.
- 3 Stoppers should preferably be constructed from a non-reactive, non-friable substance and should be replaced when ageing is evident.
- 4 Plastic funnels or bottles should not be used.

## 6.2 Lid

A tight-fitting lid for sealing the deposit gauge collection bottle shall be used during transport. It shall be made of an impermeable material that does not react with the expected constituents of the collected deposited matter.

## 6.3 Stand

The stand supports the deposit gauge such that the horizontal plane of the funnel is  $2.0 \pm 0.2$  m above ground level. The stand shall be sufficiently sturdy to prevent any noticeable sway and ensure the funnel aperture plane is maintained in a horizontal position. A typical stand is illustrated in Figure 2. The stand generally incorporates a container or beaker to protect the bottle contents from sunlight which has the potential to accelerate algal growth. This container or beaker should be provided with a drainage hole at the base to prevent rainwater build-up.

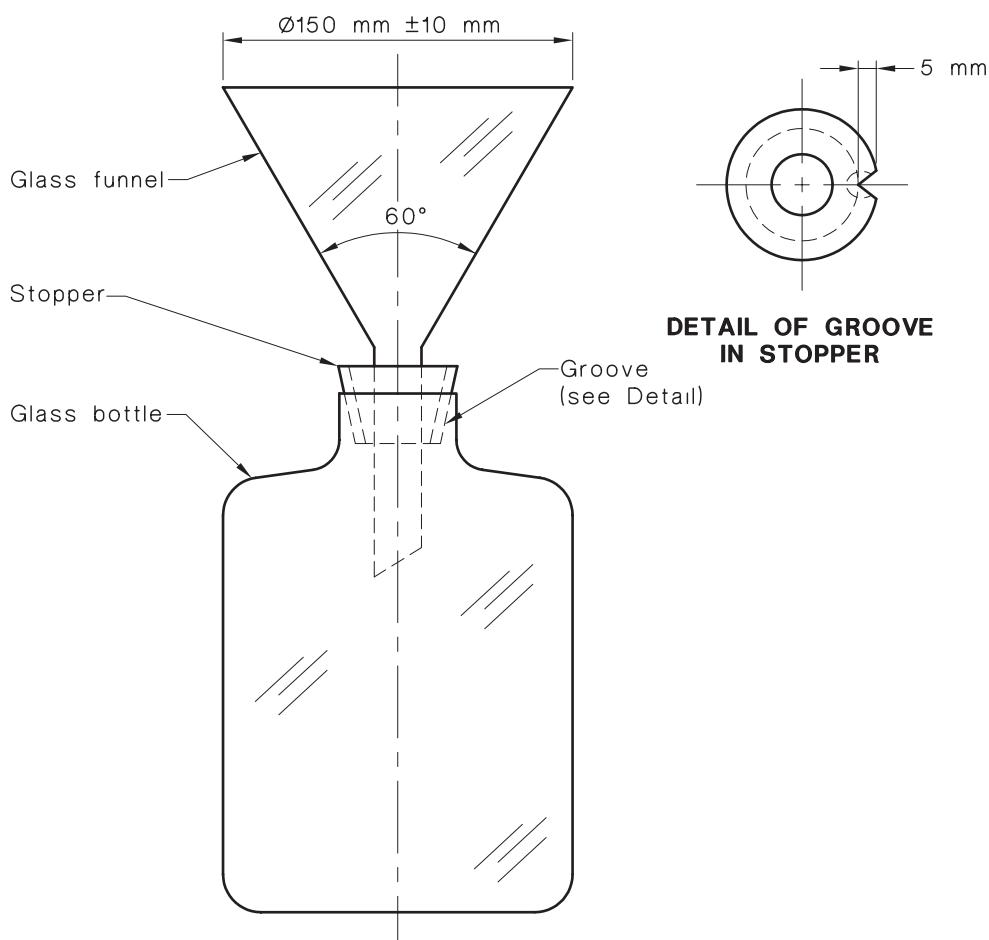


FIGURE 1 TYPICAL STANDARD DEPOSIT GAUGE

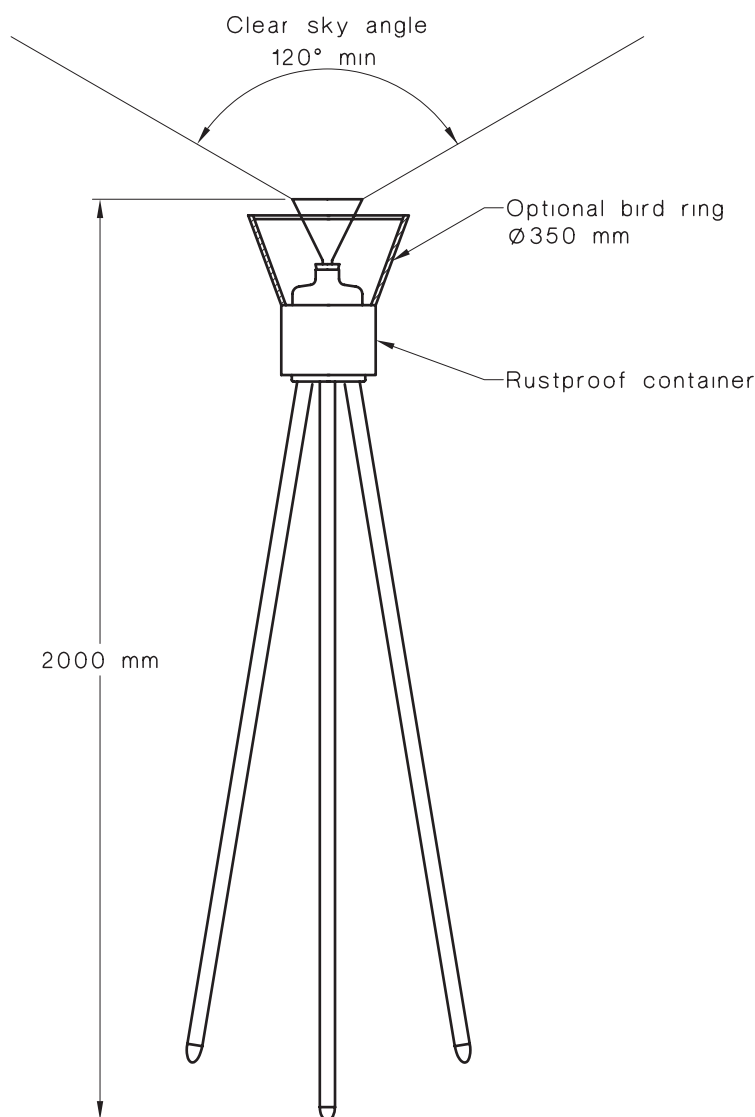


FIGURE 2 TYPICAL STAND WITH DEPOSIT GAUGE

#### 6.4 Bird ring (optional)

The bird ring (see Figure 2) shall be of inert and corrosion-resistant metal wire (having a diameter of 4 mm to 6 mm) and of suitable design to prevent birds perching on the funnel.

#### 6.5 Glassware

Grade A volumetric glassware shall be used throughout. Volumetric flasks shall comply with AS 2164, and pipettes shall comply with AS 2166. Use of volumetric glassware shall comply with AS 2162.1.

All beakers, flasks, evaporating dishes and crucibles (including filters) shall be uniquely numbered to ensure traceability of each sample as it proceeds through the analysis process.

#### 6.6 Filtration apparatus

Silica crucibles with porous filter bases (porosity 3) or Gooch crucibles of porcelain, silica or alundum with filter pads of equivalent retention are acceptable for separation of the insoluble fraction from the soluble fraction. Alternatively, Buchner funnels with an appropriate filter pad of glass, quartz or ashless filter paper and membrane filters may be used.

NOTE: Consideration should be given to the hygroscopic nature of the filter.

The choice of filter apparatus is based on the difficulty of filtering the deposited material and any further analysis of collected material required.

### 6.7 Test sieve

The test sieve shall have a 1 mm aperture and comply with AS 1152.

### 6.8 Filter cutter

If required, a means of cutting filter pads without contamination shall be used. Suitable cutters include ceramic knives or scissors.

## 7 SAMPLING

### 7.1 Location

The sampling site should be selected in accordance with the guidelines given in AS/NZS 3580.1.1.

### 7.2 Positioning of the gauge

The height of the funnel aperture above the surface of the immediate surrounding area shall be  $2 \pm 0.2$  m. It is important that the funnel aperture plane is horizontal.

### 7.3 Period of exposure

For routine monitoring programs, the period of exposure is typically  $30 \pm 2$  days.

### 7.4 Procedure

#### 7.4.1 Preparation of deposit gauge

Washing agents that do not attack the inside surface of the deposit gauge and lid shall be used to clean the deposit gauge bottle. After cleaning, the deposit gauge bottle shall be rinsed with water in order to remove any remaining extraneous matter and residual washing agent. Pipette 10.0 mL of copper sulfate solution (see Clause 5.2) into the deposit gauge bottle so as to prevent algal growth in the deposit gauge. Tightly seal the bottle. The gauge and prepared assembly should be packed for transport to the sampling site.

#### 7.4.2 Gauge exchange

Deposit gauges should be changed on the first day of each month or as near as possible to the first day of each month. Where a gauge has overflowed soluble matter cannot be determined. The volume of liquid in the gauge should be recorded as it gives an indication of the rainfall for the exposure period.

At the end of the exposure period, the gauge exchange procedure shall be as follows:

- (a) Wash any deposited matter adhering to the inside of the funnel into the deposit gauge bottle using a minimum volume of distilled water from a wash bottle.  
NOTE: A brush or rubber policeman may be used to dislodge any foreign/particulate matter adhering to the internal surface of the funnel.
- (b) Remove the funnel and attached stopper and seal the bottle with a lid. Identify the bottle with a label detailing the site location, period of exposure and funnel diameter to the nearest millimetre. Return the bottle to the laboratory for analysis.
- (c) Insert the clean funnel with attached stopper into a fresh bottle containing algicide and leave exposed for the next sampling period.
- (d) Ensure that the funnel is firmly held in the neck of the bottle and that the funnel aperture plane is horizontal.

### 7.4.3 Storage

During storage, deposit gauges shall be tightly sealed and kept in a cool, dark environment to prevent the growth of algae, fungi and other micro-organisms. Analysis of the deposited matter should be performed at the earliest opportunity and completed within 30 days of collection.

## 8 PROCEDURE FOR SAMPLE ANALYSIS

### 8.1 Determination of total solids

#### 8.1.1 General

Total solids shall be determined by either of the procedures in this Clause (8.1).

#### 8.1.2 Procedure 1

The procedure shall be as follows:

- (a) Pass the contents of the deposit gauge bottle into a beaker or flask through a 1 mm test sieve (see Clause 6.7), ensuring that all particulate matter is washed out.
- (b) Transfer the remaining particles adhering to the internal surface of the deposit gauge into the beaker or flask, with the aid of a rubber policeman, and small quantities of water. Evaporate the contents of the vessel on a hotplate to a volume of approximately 30 mL and then transfer the contents to an evaporating dish which has been dried at 105°C for 1 h, cooled in a desiccator and weighed ( $m_1$ ).

#### NOTES:

- 1 It may be necessary to carry out the evaporation in several stages if the total volume of rainwater and washings are large.
  - 2 For rapidity, provided that no material is lost, vacuum distillation, a vacuum oven or a sand bath may be used as alternatives to the hotplate.
- (c) Evaporate the contents of the evaporating dish on a steam bath or hotplate to near dryness and transfer to a drying oven. Dry at 105 ± 5°C for 1 h, cool in a desiccator and weigh. Repeat the drying, cooling and weighing process until the dish and its contents are at a constant mass and record the mass ( $m_2$ ).
  - (d) Place the evaporating dish on a hotplate, add approximately 50 mL of water and heat gently for 30 min to redissolve soluble solids, then proceed to Clause 8.2.2(d) or Clause 8.2.3(d), as applicable for the determination of insoluble solids.

#### 8.1.3 Procedure 2

Determine the insoluble solids according to Clause 8.2 and soluble solids according to Clause 8.4. The sum of these two fractions comprises the total solids.

### 8.2 Determination of insoluble solids

#### 8.2.1 General

If the deposit gauge bottle contains a large volume of water (rainfall plus washings from Clause 7.4.2(a)), filter the contents of the bottle through the filtration apparatus (see Clause 6.6) until approximately 400 mL remains, taking care not to disturb the deposit.

Determine insoluble solids by either of the procedures in this Clause (8.2).

If soluble solids are to be determined then ashless filters shall be used.

#### NOTES:

- 1 The filter details, i.e. type, porosity and grade, should be recorded.
- 2 This filtrate is required for the determination of soluble solids (as described in Clause 8.4.3(b)) and should be retained if determination of soluble solids is required.