

# Australian/New Zealand Standard™

AS/NZS 4323.4:2009

## Stationary source emissions

### Method 4: Area source sampling—Flux chamber technique

#### PREFACE

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

It is Part 4 in a series of Standards that provides methods for the sampling and analysis of stationary source emissions. The objective of this Standard is to provide parties interested in the sampling and monitoring of stationary source emissions with a flux chamber sampling technique for the determination of atmospheric contaminant emission rates from area sources, in particular, the determination of odour and hazardous air pollutants.

Area sources include:

- (a) Landfill surfaces (e.g. working face, soil/compost/synthetic cover, clay capped and revegetated) of various ages.
- (b) Sewage treatment plant surfaces (e.g. inlet channels, primary sedimentation tanks, aeration tanks, activated sludge tanks, clarifiers, sludge lagoons, sludge drying beds, facultative lagoons, anaerobic lagoons and dissolved air flotation tanks).
- (c) Composting surfaces (e.g. raw material stockpiles, compost windrows and final product stockpiles).
- (d) Sub-surface contaminated groundwater sources (e.g. floating petroleum layer affecting surface emissions).
- (e) Industrial sources (e.g. waste storage/disposal, sumps, surface spills, wastewater treatment plant surfaces and effluent disposal areas).
- (f) Agricultural sources (e.g. feed lots, animal waste containments, crop preparation and residual crop treatment).
- (g) Contaminated/remediation sites.

The assessment of environmental impacts associated with area sources relies on the ability to accurately measure the rate of atmospheric contaminants emitted from various liquid and solid surfaces.

For odour impact assessments, these sources have historically been difficult to quantify, partly due to the variability in odour analysis techniques (dynamic dilution olfactometry) used, prior to the publication of AS/NZS 4323.3, *Stationary source emissions, Part 3: Determination of odour concentration by dynamic olfactometry*, and, more importantly, due to the range of sampling methods used in determining the area source emission rate. Techniques have included emission isolation flux chambers, wind tunnels, 'witches hats', source enclosures and downwind sampling/modelling techniques.

AS/NZS 4323.3, while confirming the importance of odour sampling methodology, especially for area sources, excluded consideration of sampling, hence the need for a separate Standard.

The term 'informative' has been used in this Standard to define the application of the appendix to which it applies. An 'informative' appendix is only for information and guidance.

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## METHOD

### 1 SCOPE

This Standard sets out area source sampling protocols to be followed when using a flux chamber for the determination of odour or other atmospheric contaminants. The method provides a measure of area source odour and atmospheric contaminant flux emission rate, in units of  $\text{ou.m}^3/\text{m}^2.\text{s}$  and  $\text{g}/\text{m}^2.\text{s}$ , respectively.

NOTE: Some indirect measurement techniques are described in Appendix A, however, they are for information only and do not form part of this Standard.

### 2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

ISO

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

NATA

Technical Note 8—In-situ calibration of barometers

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

US EPA

Measurement of gaseous emission rates from land surfaces using an emission-isolation flux chamber. User's guide, EPA Contract No. 68-02-3889, Radian Corporation, February 1986

### 3 DEFINITIONS

For the purpose of this Standard, the following definitions apply:

#### 3.1 Area source

A liquid or solid surface which emits odour or other inorganic or organic atmospheric contaminants.

#### 3.2 Flux chamber

An enclosure device consisting of an open cylindrical base, a sweep air supply line, perforated sweep air distribution system, outlet line and flotation device (for liquid surfaces), as a minimum.

#### 3.3 Flux emission rate

The atmospheric contaminant emission rate per unit surface area.

#### 3.4 Odour

Organoleptic attribute perceptible by the olfactory organ on sniffing certain volatile substances.

### 3.5 Sweep air

Air used to sweep the isolated solid or liquid surface and mix with the generated atmospheric contaminants. Sweep air should be dry, organic-free air equal to or better than commercial zero grade (less than 1 ppm total hydrocarbons as methane).

### 3.6 $U_{95}$

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

## 4 PRINCIPLE

Gaseous emissions are collected from an isolated surface area using a flux chamber. The surface gaseous emissions are swept through the flux chamber and outlet line, at a known sweep air flow rate. The atmospheric contaminants of interest are sampled from the chamber exit gases, either continuously or discretely.

The flux emission rate is calculated based on the surface area isolated, the sweep air flow rate and the atmospheric contaminant concentration measured.

Flux chamber designs are based on continuous stirred tank reactor theory.

## 5 APPARATUS

### 5.1 Enclosure device

The enclosure device shall be of a design such as a US EPA emission isolation flux chamber (US EPA, 1986).

NOTE: The US EPA flux chamber is described in Appendix B.

Available validation studies have been restricted to non-aerated surfaces. The apparatus on which the majority of data has been published, and extensive validation studies conducted, is the US EPA emission isolation flux chamber.

The assumption for flux chamber measurements is that the determined emission rate is representative of the total area source, both spatially and temporally. It is also assumed that the test procedure itself does not significantly influence the emission rate of the source under investigation. For this reason the apparatus used shall have undergone validation studies to establish appropriate equipment test protocols.

Flux chamber designs are based on continuous stirred tank reactor theory. Consequently the introduced sweep air is well mixed with the surface emissions to air. The sweep air flow rate is much greater than the source emission flow rate (assumed to be zero under normal circumstances). The relatively low flow rates allow the use of compressed air cylinders as the source of sweep air.

The flux chamber shall be constructed from stainless steel or other suitably inert material (e.g. US EPA flux chamber acrylic dome).

When an alternative enclosure device design to the US EPA emission isolation flux chamber is used, it shall have undergone similar validation studies. The effect of changes in the following chamber operating parameters on method accuracy and atmospheric contaminant recovery efficiency shall be evaluated, as a minimum, to enable the establishment of the following optimal operating parameters:

- (a) Sweep air flow rate/velocity.
- (b) Static pressure.
- (c) Insertion depth.
- (d) Sample collection rate.

If a flux chamber is considered to be equivalent to the US EPA emission isolation flux chamber, data shall be available to demonstrate that theoretical and measured residence times shall agree within 2.5%.

All such apparatus shall meet the following criteria:

- (i) Materials of construction are odour free and easily cleaned.
- (ii) Materials of construction minimize gaseous phase adsorption.
- (iii) Recoveries from standards are essentially 100%.
- (iv) Precision is typically better than 70% relative standard deviation.
- (v) Accuracy is typically better than 30%.
- (vi) System blank concentrations are less than the required area source sampling protocol method limit of detection, or less than the method limit of detection in the case of odour.

## 5.2 Flow rate control device

A device that has one or more adjustment controls, to vary the flow rate of sweep air through the enclosure device.

## 5.3 Flow rate measurement device

### 5.3.1 Traceable reference standard flow measuring device

With a  $U_{95}$  of  $\pm 2\%$  at the operating flow rate.

### 5.3.2 A traceable transfer standard flow measuring device

With a  $U_{95}$  of  $\pm 5\%$  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 two yearly basis.

## 5.4 Temperature measurement device

A traceable thermometer with a  $U_{95}$  of  $\pm 0.5^\circ\text{C}$  and a resolution of  $0.1^\circ\text{C}$ . The thermometer shall be checked against a reference standard thermometer at  $0^\circ\text{C}$  (ice point), or at one point in the working range, on a six monthly basis (NATA Technical Note 19).

## 5.5 Static pressure measurement device

An inclined liquid manometer, or equivalent (e.g. an electronic manometer, or a diaphragm-type pressure differential sensor with a direct reading gauge), capable of measuring pressure differentials down to 2 Pa with a  $U_{95}$  of  $\pm 2$  Pa.

## 5.6 Barometer

A traceable barometer with a  $U_{95}$  of  $\pm 0.5$  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, 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).

## 5.7 Timing device

A stopwatch or other timing device, capable of measuring elapsed time with a  $U_{95}$  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.