Australian/New Zealand Standard™

Methods for sampling and analysis of ambient air

Method 12.1: Determination of light scattering—Integrating nephelometer 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 2724.4—1987, *Ambient air—Particulate matter*, Part 4: *Determination of light scattering—Integrating nephelometer method*.

This is one in a series of Standards for the determination of particulate matter in ambient air (refer to AS 3580.9). The objective of this Standard is to provide a method for dealing with the light scattering produced by fine particles.

Most light scattering is derived from particles less than 2.0 μm. These particles affect visibility and are of concern to health. Some common sources of such particles are combustion processes including motor vehicle emissions, incineration, and some industrial processes.

Chlorofluorocarbon calibration gas has been replaced with 1,1,1,2,3,3,3-heptafluoropropane (FM-200)*. FM-200 is classified as safe to humans, based on present known technology, and has zero ozone-depleting potential and low global warming potential†.

Chlorofluorocarbon gas can still be used for calibrations, however supplies are now limited due to the Montreal Protocol (as revised) and the ANZECC Revised Strategy for Ozone Protection in Australia 1994.

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.

METHOD

1 SCOPE

This Standard sets out a continuous, direct-reading, instrumental method for determining the light-scattering attributable to the presence of particulate matter in a sample of ambient air. The light scattering coefficient as measured by this Standard is an indicator of the perceived visual degradation caused by suspended particles in the air.

---

* FM-200 is manufactured by Great Lakes Chemical Corp. in USA. It can be purchased from fire extinguishing companies.

† Biviano-Dinges, G.D., (1997), 'Non Ozone-Depleting Calibration Gas for Integrating Nephelometers' *Clean Air*. Vol. 32, May 1998, No. 2 pp29-32.

Standards Australia
STANDARDS NEW ZEALAND Paerewa Aotearoa

2 APPLICATION

The method applies to the determination of the light scattering coefficient of particles in the ambient atmosphere, when the particle light-scattering coefficient (b_{sp}) is within the range 1.0 to 1000 Mm^{-1}. The method is not designed to measure light scattering due to suspended water droplets (fog).

3 REFERENCED DOCUMENT

The following Standard is referred to in this Standard:

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

4 PRINCIPLE

A sample stream of ambient air is heated to maintain the relative humidity at less than 60 percent, to reduce the light scattering effects of suspended water droplets and absorbed water on particles. The sample is then continuously drawn through an integrating nephelometer where the light scattering coefficient of the sample is measured.

NOTE: Further information on light scattering principles is given in Appendix A.

5 APPARATUS

5.1 Integrating nephelometer

The integrating nephelometer is a direct reading instrument which measures the light-scattering coefficient of a sample of air. The sample is drawn through a light-proof housing where it is illuminated by a diffuse visible light source and the intensity of the scattered light is measured. The response is sensitive to the spectral characteristics of the instrument. Suitable instruments have a spectral response centred at 500 ±50 nm. As light scattering is a function of the scattering angle the internal optical geometry of the instrument is arranged so that the response of the detector is proportional to the light scattering integrated over all scattering angles. In practice, physical limitations dictate that the integration angle is from approximately 10° to approximately 170°. The principal features of a nephelometer are shown in Figure 1.

The apparatus should include the following:

(a) Integrating nephelometer.

(b) An air sampling pump that provides an adequate flow rate to minimize the impact of self heating of the air and ensure the sample is representative of the measurand.

NOTE: For example, a flow rate of 15 changes per minute minimum is considered appropriate for the Model 1550 nephelometer.

(c) Signal conditioning to provide analogue or digital output proportional to the intensity of scattered light.

(d) A pre-heater and relative humidity sensor to ensure the relative humidity of air sampled is not greater than 60 percent. The temperature of the air sample measured at a point representative of the air in the scattering chamber shall be maintained at not more than 25°C above ambient temperature.

NOTES:

1 The relative humidity should be measured at a point representative of the air in the scattering chamber.

2 The readings obtained using a nephelometer depend on its internal optical geometry, the spectral characteristics of the light source and the spectral response of the light sensor. Hence the readings obtained using different nephelometers are not comparable unless they are of equivalent optical geometry and spectral characteristics.