

Australian Standard<sup>®</sup>

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**AMBIENT AIR—  
PARTICULATE MATTER**

**Part 4—DETERMINATION OF  
LIGHT SCATTERING—  
INTEGRATING  
NEPHELOMETER  
METHOD**

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The following interests are represented on Committee CH/19:

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Australian Chemical Industry Council  
Australian Institute of Petroleum  
Australian Mining Industry Council  
Australian Timber Producers Council  
Clean Air Society of Australia and New Zealand  
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## PREFACE

This Standard was prepared by the Association's Committee on Methods for Examination of Air under the direction of the Chemical Standards Board. It is one in a series of Standards for the determination of particulate matter in ambient air. This Standard sets out a method for dealing with the light scattering produced by fine particles.

Other Standards in the AS 2724 series are as follows:

- AS 2724.1 Determination of Deposited Matter Expressed as Insoluble Solids, Ash, Combustible Matter, Soluble Solids and Total Solids.
- AS 2724.2 Determination of Suspended Matter Expressed as Equivalent Black Smoke by Filter Paper Soiling (Used in Conjunction with AS 2509, Determination of Acid Gases Expressed as Sulphur Dioxide).
- AS 2724.3 Determination of Total Suspended Particulates (TSP)—High Volume Sampler Gravimetric Method.
- AS 2724.5 Determination of Impinged Matter Expressed as Directional Dirtiness, Background Dirtiness and/or Area Dirtiness—Directional Dust Gauge Method.
- AS 2724.6\* Determination of Suspended Particulate Matter (PM<sub>10</sub>)—Size Selective Inlet Method.
- AS 2724.7\* Determination of Suspended Particulate Matter—Dichotomous Sampler Method.

Particles which cause light scattering generally have an equivalent aerodynamic diameter (EAD) of 0.1  $\mu\text{m}$  to 2.5  $\mu\text{m}$ . The particles in this size range 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.

Consideration has been given to the practice of venting the chlorofluorocarbon gas to atmosphere during the instrument calibration procedure. The volumes vented have been found to be insignificant in comparison with the volumes of chlorofluorocarbon gas lost to the atmosphere from air conditioners, refrigerators and some aerosol spray cans.

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\* In course of preparation.

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## STANDARDS ASSOCIATION OF AUSTRALIA

## Australian Standard

## AMBIENT AIR—PARTICULATE MATTER

PART 4: DETERMINATION OF LIGHT SCATTERING—  
INTEGRATING NEPHELOMETER 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.

**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 0.01 to  $10 \times (10^{-4} m^{-1})$ . The method is not designed to measure light scattering due to suspended water droplets (fog).

NOTE: The measuring units used are not SI Units but are those in common usage by regulatory authorities and industry at the time of publication.

**3 REFERENCED DOCUMENTS.** The following Standard is referred to in this Standard:

AS 2922 Ambient Air—Guide for the Siting of Sampling Units.

**4 DEFINITIONS.** For the purpose of this Standard, the following definitions apply.

**4.1 Equivalent aerodynamic diameter (EAD)**—the diameter of a spherical particle of density  $1000 \text{ kg/m}^3$  which exhibits the same aerodynamic behaviour as the particle in question.

**4.2 Fine particles**—atmospheric particles with an EAD within the range of approximately  $0.1 \mu\text{m}$  to  $2.5 \mu\text{m}$ .

**5 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. Further information on light scattering principles is given in Appendix A.

**6 APPARATUS.** 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  $500 \pm 50 \text{ nm}^*$  (see Appendix A). 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  $10^\circ$  to approximately  $170^\circ$ . The principal features of a nephelometer are shown in Figure 1.

The apparatus shall include the following:

- (a) Integrating nephelometer.
- (b) Air sampling pump capable of replacing the air in the sample chamber at a rate of 15 changes/ min.
- (c) Signal conditioning to provide analogue or digital output proportional to the intensity of scattered light.
- (d) A pre-heater to ensure the relative humidity of air sampled is not greater than 60 percent. The temperature of the air sample measured at the instrument outlet shall be maintained at  $15^\circ\text{C}$  to  $25^\circ\text{C}$  above ambient temperature.

## NOTES:

1. 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.
2. Ruby and Waggoner (see Paragraph B4) found a temperature increase in the sample air of about  $37^\circ\text{C}$  on the MRI 1560 (MRI 1590 equivalent) and  $21^\circ\text{C}$  on the MRI 1550. If excessive heating of the sample air is occurring, it is recommended that either the heaters should be operated at a lower voltage or that a temperature controlling circuit should be incorporated.

*Apparatus calibration gas.* Dichlorodifluoromethane (DCDFM), industrial grade.

CAUTION: While DCDFM vapour is not considered to be toxic, a high concentration in a confined space may cause dizziness or suffocation.

**7 SAMPLING.**

**7.1 Location.** Guidelines set out in AS 2922 and the following points shall be considered:

- (a) The inlet to the sampling line should be greater than 1 m from any building or wall and, for ground-based stations, be located between 2 m and 5 m above ground level.
- (b) In urban situations, flat-topped roofs or open areas are convenient locations. These areas should be reasonably distant from traffic, furnace, or incinerator flue emission, or other local sources of pollutants, e.g. air conditioning plant.
- (c) Tests required for specific purposes will dictate special siting requirements for the test instrument, but careful consideration of siting is warranted in all situations.

\* Two suitable commercially available instruments are models 1550 and 1590 manufactured by Belfort Instrument Co. USA (previously known as Meteorology Research Inc.).