Australian Standard®

AMBIENT AIR—PARTICULAR MATTER
PART 2—DETERMINATION OF SUSPENDED MATTER EXPRESSED AS EQUIVALENT BLACK SMOKE BY FILTER PAPER SOILING

to be used in conjunction with AS 2509—Determination of acid gases (expressed as sulphur dioxide)

This Australian Standard was prepared by Committee CH/19, Methods for Examination of Air. It was approved on behalf of the Council of the Standards Association of Australia on 12 January 1987 and published on 6 April 1987.

The following interests are represented on Committee CH/19:

Aluminium Development Council
Australian Chemical Industry Council
Australian Institute of Petroleum
Australian Mining Industry Council
Australian Timber Producers Council
Clean Air Society of Australia and New Zealand
Confederation of Australian Industry
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Environment Protection Authority of Victoria
National Association of Testing Authorities, Australia
National Health and Medical Research Council
State Pollution Control Commission, N.S.W.

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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 Part 2 of a series of standards for the determination of suspended particulate matter in ambient air. Other standards in the AS 2724 series are as follows:

Part 1 Determination of Deposited Matter Expressed as Insoluble Solids, Ash, Combustible Matter, Soluble Solids and Total Solids

Part 3 Determination of Total Suspended Particulates (TSP)—High Volume Sampler Gravimetric Method

Part 4* Determination of Light Scattering—Integrating Nephelometer Method

Part 5 Determination of Impinged Matter Expressed as Directional Dirtiness, Background Dirtiness and/or Area Dirtiness—Directional Dust Gauge Method.

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* In course of preparation

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FOREWORD

The method on which this standard is based was developed for the UK National Survey of Air Pollution and appeared as Part 2 of BS 1747 in 1963. That standard was based on a curve relating the darkness of a stain produced on filter paper, after passing a known volume of air through it, to the surface concentration of collected particles. The method was adopted to avoid the use of analytical balances and elaborate weighing techniques necessary for the determination of absolute quantities of smoke, which would have been impractical for many of the large number of bodies co-operating in the survey.

When developing BS 1747, it was found that if surface concentrations on the filter paper (expressed in arbitrary units) were plotted against a darkness index, the curves obtained for smokes collected from a variety of locations were sufficiently close to enable them to be approximated by a single mean curve. This curve was taken as the standard. The relationship was found to be governed not by the mass of material collected but by the surface concentration of black particles contained therein, which were essentially the products of coal combustion. As such black material occurred with widely varying quantities of lighter coloured material, the method could not and cannot be used to determine the absolute concentrations of material on the filter paper or in the smoke sampled. The selection of a single curve for use in the standard effectively established a standard smoke in terms of which concentrations of all other smokes would be expressed.

Although this measurement is being largely superseded by more absolute methods, it is still widely used, particularly in Europe, and has formed a basis of many early epidemiological studies of the effects of air pollution on health. There are also current OECD and WHO standards and guidelines based on this method. For these reasons it was considered worthwhile to publish this standard which incorporates modifications appropriate to Australian conditions.

Suspended matter as measured by this method generally has an equivalent aerodynamic diameter (EAD) of less than about 10 μm. Sources of particles include the combustion of fuels, industrial processes, motor vehicles, burning of vegetation, incineration and natural causes such as windblown dust.

The range of particles collected by this method includes the respirable fraction which is of most concern to health. These particles also affect visibility and soil property.

The procedure for sampling suspended matter using this standard is described in AS 2509. The equivalent concentration of suspended particles in the resultant stain is determined by comparison of light reflectance by the stain with that from a clean filter.

STANDARDS ASSOCIATION OF AUSTRALIA

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1 SCOPE. This Standard sets out a simple method for the determination, by light reflectance, of suspended matter in ambient air expressed as $\mu g/m^3$ equivalent black smoke. The determination is carried out on the material collected on the filter used in AS 2509. Light reflectance is highly dependent on particle colour and size range.

2 APPLICATION. This method is suitable for the determination of suspended particulate matter in atmospheres where carbonaceous material derived from fuel burning is the predominant particulate matter. Such carbonaceous matter is characterized by low reflectance. In general, other particulate matter such as windblown dust and many emissions from industrial processes have much higher reflectance. However, the method can provide a measure of the equivalent black smoke concentration over the sampling period. The determination is carried out on particles collected in accordance with AS 2509, where sampling is normally of 24 h duration to take account of diurnal variations. The method is suitable for atmospheres having an equivalent black smoke concentration between 10 $\mu g/m^3$ and 750 $\mu g/m^3$. Equivalent concentrations of 1 $\mu g/m^3$ and above can be detected using a 24 h sampling period.

3 REFERENCED DOCUMENTS. The following Standards are referred to in this Standard:

AS 2509 Ambient Air—Determination of Acid Gases (Expressed as Sulphur Dioxide)

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

BS 1747 Methods for the Measurement of Air Pollution—Part 2—Determination of Concentration of Suspended Matter.

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 kg/m^3 which exhibits the same aerodynamic behaviour as the particle in question.

4.2 Suspended matter—particles with an EAD of less than approximately 10 μm.

4.3 Reflectance—the light reflectance from a soiled filter paper as measured by a reflectometer on a scale of 0 to 100 where 100 is the reflectance from a clean filter paper as measured by the same reflectometer.

4.4 Darkness index—darkness index is equal to 100 minus the reflectance.

5 PRINCIPLE. Light reflectance from a filter paper on which the particles have been collected is compared with that from a clean filter paper. Generally, reduction in light reflectance is proportional to the concentration of suspended matter. The surface concentration is obtained from the British Smoke Calibration curve (see Fig. 1) relating reflectance to surface concentration. The mass concentration of black smoke is then calculated.

6 APPARATUS.

6.1 Reflectometer. An instrument equipped with a stable light source, preferably having an adjustment for wavelength to yield substantially monochromatic light, and a photoelectric optical system suitable for determining light reflected from paper*. The instrument shall incorporate a scale marked 0 to 100 and be adjustable to read 100 when the reflectance from a clean filter paper is being measured. The instrument shall have a field of view of approximately 12 mm diameter. For convenience, the instrument may be

* An EEL Type 43 Smokestain Reflectometer or Diffusion Systems DS29 Digital Unigalvo have been found to be satisfactory.