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Australian Standard®

WORKPLACE ATMOSPHERES—METHOD FOR SAMPLING AND GRAVIMETRIC DETERMINATION OF RESPIRABLE DUST

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Aluminium Development Council
Australian Chemical Industry Council
Australian Institute of Occupational Hygienists
Australian Institute of Petroleum Ltd
Australian Mining Industry Council
Bureau of Steel Manufacturers of Australia
Clean Air Society of Australia and New Zealand
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PREFACE

This Australian Standard was prepared by the Association's Committee on Methods for Examination of Workplace Atmospheres under the direction of the Chemical Standards Board.

Most industrial dusts contain particles of a wide range of sizes. The behaviour, deposition and fate of any particular particle after entry into the human respiratory system and the response that it elicits depend on the nature and size of the particle. Occupational hygiene practice currently differentiates between two fractions of dust, namely 'respirable' and 'inspirable'.

In 1983, ISO (Technical Report ISO/TR 7708—1983(E)) proposed definitions for 'respirable' and 'inspirable' dust. The ISO term 'conventionalized alveolar fraction of inspirable particles' corresponds to 'respirable' dust as defined in this Standard. Work has also been done by ACGIH in this area (see Reference 4).

Acknowledgement is made of the following publications which provided assistance in the drafting of this Standard:

United Kingdom Health & Safety Executive: Occupational Medicine and Hygiene Laboratory MDHS14—Methods for the Determination of Hazardous Substances, May 1986 'General Methods for the Gravimetric Determination of Respirable and Total Inhalable Dust'.

Australian National Health & Medical Research Council: 'Methods for Measurement of Quartz in Respirable Airborne Dust by Infra-red Spectroscopy and X-Ray Diffractometry', October 1984.

CONTENTS

STANDARDS ASSOCIATION OF AUSTRALIA

Australian Standard

WORKPLACE ATMOSPHERES— METHOD FOR SAMPLING AND GRAVIMETRIC DETERMINATION OF RESPIRABLE DUST

1 SCOPE. This Standard sets out a method for the collection and gravimetric determination of respirable dust in workplace atmospheres. This method does not consider the measurement of 'inspirable' dust.

2 APPLICATION. This procedure is used to assess personal exposure by sampling in a worker's breathing zone.

Whilst the method only allows for personal sampling, it can be used to assist in controlling the occupational environment by means of static samples. However, static samples shall not be used to evaluate health risks unless a specific method indicates otherwise.

NOTES:

1. The limit of detection is determined primarily by the length of the sampling period and the sensitivity and precision of the weighing procedure used for the collected sample. These factors should be chosen to ensure that the limit of detection is at least one order of magnitude lower than the appropriate occupational exposure standard.
2. For additional analyses (such as quartz or metal fume) other factors such as filter type and treatment should be taken into account.

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

AS 2380.7	Electrical Equipment for Explosive Atmospheres—Explosion-protection Techniques. Part 7: Intrinsic Safety i.
AS 2430	Classification of Hazardous Areas. Part 1: Explosive Gas Atmospheres. Part 2: Combustible Dusts.
ISO TR 7708	Air Quality—Particle Size Fraction Definitions for Health Related Sampling.

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

4.1 Breathing zone—a hemisphere of 300 mm radius extending in front of the face and measured from the mid-point of a line joining the ears.

4.2 Equivalent aerodynamic diameter (EAD)—the diameter of a spherical particle of unit density (1000 kg/m^3) which exhibits the same aerodynamic behaviour as the particle in question.

4.3 Pulsation ratio—the ratio of peak-to-peak flow rates to the average flow rate (References 1 and 2).

4.4 Respirable dust—the definition of 'respirable' dust is that adopted by the British Medical Research Council (BMRC) and the recommendation of the Pneumoconiosis Conference held in Johannesburg in 1959 (Reference 7). This recommendation states that the respirable fraction is defined by a sampling efficiency curve (see Table 1) which depends on the settling velocity of the particle and which passes through the following points:

Effectively 100 percent efficiency at 1 μm and below, 50 percent efficiency at 5 μm and zero efficiency for particles of 7 μm and upwards; all sizes refer to equivalent aerodynamic diameters (see Clause 4.2). This sampling efficiency curve is often referred to as the 'Johannesburg curve', and practical devices exist which sample according to this curve.

TABLE 1
RESPIRABLE MASS FRACTION

Particle equivalent aerodynamic diameter μm	Respirability %
0	100
1	98
2	92
3	82
4	68
5	50
6	28
7	0

5 PRINCIPLE. Airborne concentrations of dust in the workplace are determined by passing a measured volume of air through a filter of predetermined mass. By reweighing the filter at the end of the sampling period, the quantity of material collected is determined by difference.

To separate the respirable fraction, a miniature cyclone separator is commonly used prior to the filter.

6 APPARATUS.

6.1 Sampling systems. The essential features of a sampling system are a filter (on which the sample is collected) and a pump for drawing the air through the filter. The filter shall be secured in a holder that prevents air from leaking around the edge of the filter. The filter shall be preceded by a suitable size-selector.

In personal sampling instruments, the filter holder/size selector is an integral unit that is located within the worker's breathing zone and this is connected to the pump unit (worn on a belt or in a pocket) by flexible tubing.

6.2 Personal sampling. The respirable fraction shall be collected by using a device conforming to the British Medical Research Council deposition curve. Such devices include the BCIRA (British Cast Iron Research Association) (Higgins and Dewell, Reference 5) and Simpeds (Safety in Mines Research Establishment Personal Dust Sampler, Reference 6) miniature cyclones (see Figure 1). The use of plastics cassettes should be avoided due to electrostatic charge and leakage problems. A pump unit for use with such a sampler shall be capable of maintaining a smooth flow rate of 1.9 ±0.1 L/min throughout the sampling period.