Australian/New Zealand Standard™

Methods for sampling and analysis of ambient air

Method 9.13: Determination of suspended particulate matter—$PM_{2.5}$ continuous direct mass method using a tapered element oscillating microbalance monitor

PREFACE

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

The objective of this Standard is to provide regulatory and testing bodies with a standard method for continuously monitoring suspended particulate matter changes of particles less than 2.5 micrometres in diameter ($PM_{2.5}$) in ambient air, providing near real time measurement of average particle concentration.

The requirements for instruments found to be suitable for using this method are given in the United States Environmental Protection Agency (US EPA) Title 40, Part 53 of the Code of Federal Regulations (40 CFR Part 53)—*Ambient Air Monitoring Reference and Equivalent Methods, Subpart B—Procedures for Testing Performance Characteristics of Automated Methods*. Elements of this Standard have been drawn from the September 2009 document *Standard Operating Procedure for the Continuous Measurement of Particulate Matter, Thermo Scientific TEOM® 1405-DF Dichotomous Ambient Particulate Monitor with FDMS®, Federal Equivalent Method EQPM-0609-182 for $PM_{2.5}$* prepared for the US EPA by Sonoma Technology, Inc.

FOREWORD

This Standard sets out the operational requirements for the continuous determination of $PM_{2.5}$ in ambient air using a tapered element oscillating microbalance (TEOM) monitor incorporating a filter dynamic measurement system (FDMS) unit. The FDMS unit provides a representative determination of the particulate matter mass concentration as it exists in the ambient air by accounting for both non-volatile and volatile particulate matter components.

The TEOM monitor offers continuous operation, providing near real-time measurements for assessment and study of the temporal changes in ambient suspended particulate matter.

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To minimize the contribution of liquid water to measured particle mass, TEOM monitors operating without FDMS units typically condition the incoming sample aerosol to 50°C prior to and during its measurement to provide constant sampling conditions. These conditions can result in loss of volatile and semi-volatile particulate species. At sampling locations with a high proportion of volatile and semi-volatile particulate species, the correlation between measurements using a time-integrated non-FDMS TEOM monitor and a co-located manual gravimetric filter method (e.g. AS 3580.9.10, *Methods for sampling and analysis of ambient air*, Method 9.10: *Determination of suspended particulate matter—$PM_{2.5}$ low volume sampler—Gravimetric method*) may vary. This variability is more pronounced for $PM_{2.5}$ particles than for PM_{10} or larger particles, due to the fact that $PM_{2.5}$ particles typically comprise a greater proportion of volatile and semi-volatile species.

The FDMS unit utilizes a diffusion dryer to lower the sample stream relative humidity, allowing sample aerosol conditioning at a lower temperature (typically 30°C). In addition, the FDMS unit alternately directs the sample flow either to the sample collection filter (the base cycle) or through a separate purge filter maintained at 4°C prior to passing through the sample collection filter (the reference cycle). Measurements obtained during the reference cycle provide an estimate of the volatile losses that occur during sampling of particle-laden air, and are used to derive an ambient particle mass concentration that accounts for volatile component losses that occur during sampling.

Suspended particulate matter measured by this method includes particles with an equivalent aerodynamic diameter of less than 2.5 μm, as passed by a particle size separator ($PM_{2.5}$). $PM_{2.5}$ has been statistically associated with certain human health end points, including daily mortality, hospital admissions and exacerbation of asthma. $PM_{2.5}$ emission sources include industrial processes, fuel combustion, burning of vegetation, incineration and natural causes such as windblown dust and salt laden air. Combustion processes tend to contribute more $PM_{2.5}$ than non-combustion sources. Important anthropogenic sources include domestic wood heaters and motor vehicles (especially diesel fuelled vehicles).

METHOD

1 SCOPE

This Standard sets out a method for the continuous determination of $PM_{2.5}$ particulate matter in ambient air using a tapered element oscillating microbalance (TEOM) monitor incorporating a filter dynamic measurement system (FDMS) unit. The method can provide a measure of average particle concentration over periods from 1 hour to 24 hours. The rolling 1-hour average is updated every 6 minutes, whereas the rolling 24-hour average mass concentration is updated every 60 minutes on the hour. Results are normally reported as 24-hour, time-integrated average values.

2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS/NZS

3580	Methods for sampling and analysis of ambient air	
3580.1.1	Method 1.1:	Guide to siting air monitoring equipment
3580.14	Part 14:	Meteorological monitoring for ambient air quality monitoring applications

Environment Protection & Heritage Council
National Environment Protection (Ambient Air Quality) Measure, Technical Paper No. 5, Data Collection and Handling