
**Environmental tobacco smoke —
Estimation of its contribution to respirable
suspended particles — Determination of
particulate matter by ultraviolet absorbance
and by fluorescence**

*Fumée de tabac ambiante — Estimation de sa contribution aux particules
respirables suspendues dans l'air — Détermination de la matière
particulaire par absorption dans l'ultraviolet et par fluorescence*



Reference number
ISO 15593:2001(E)

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 15593 was prepared by Technical Committee ISO/TC 126, *Tobacco and tobacco products*.

Annex A of this International Standard is for information only.

Introduction

Environmental tobacco smoke (ETS) is an aerosol consisting of vapour and particulate phase components. Due to the nature of the two aerosol phases, they rarely correlate well, and an accurate assessment of ETS levels in indoor air requires determining good tracers of both phases. Among the attributes of an ideal ETS tracer, one critical characteristic is that the tracer should “remain in a fairly consistent ratio to the individual contaminant of interest or category of contaminants of interest (e.g. suspended particulates) under a range of environmental conditions” (see reference [1]).

NOTE The bibliography gives full references to the literature cited. References to the literature are given in the text for information for the user of this International Standard.

Ultraviolet particulate matter (UVP) and fluorescent particulate matter (FPM) fulfil this requirement, staying in a constant ratio to respirable suspended particles (RSP) from tobacco smoke under a variety of ventilation conditions and sampling durations. In contrast, nicotine (a component of the ETS aerosol vapour phase) does not remain in a consistent ratio to ETS particulate matter (ETS-PM) (see reference [2]).

RSP, a necessary indicator of overall air quality, emanates from many sources, such as combustion processes (including tobacco smoke), atmospheric dust, talc, insecticide dusts, viruses, bacteria, etc. (see reference [3]). Consequently, RSP is an inappropriate tracer of ETS levels present in any environment. Studies have shown that in most indoor spaces where smoking is permitted without restriction, 50 % or less of the RSP (on average) is attributable to tobacco smoke (see references [4] to [7]). The test methods described in this International Standard have been used effectively to reduce the uncontrollable bias inherent in the use of RSP as a tracer of ETS (see references [4] to [6], and [8] to [13]).

Because the measured spectral properties are not unique to ETS-PM, these methods will always be a conservative measure (i.e. an overestimation) of the contribution of ETS to indoor RSP. Combustion sources are known to add significantly to the UVP measure (see reference [14]). FPM is considered to be less prone to, but not free from, interferences. As a result, these methods provide only an indication, and not the absolute level, of the contribution of ETS to indoor RSP due to the potential presence of unquantifiable interferences.

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Environmental tobacco smoke — Estimation of its contribution to respirable suspended particles — Determination of particulate matter by ultraviolet absorbance and by fluorescence

1 Scope

This International Standard specifies methods for the sampling and determination of respirable suspended particles (RSP) for the estimation of the RSP fraction attributable to environmental tobacco smoke (ETS).

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 648, *Laboratory glassware — One-mark pipettes*.

ISO 1042, *Laboratory glassware — One-mark volumetric flasks*.

ISO 3696, *Water for analytical use — Specification and test methods*.

3 Terms, definitions and abbreviated terms

For the purposes of this International Standard, the following terms and definitions apply.

3.1

environmental tobacco smoke

ETS

mixture of aged and diluted exhaled mainstream smoke and aged and diluted sidestream smoke

3.2

respirable suspended particles

RSP

particles which, when captured by a size-selective sampling device, conform to a collection efficiency curve with a median cut point at an aerodynamic diameter of 4,0 µm

NOTE See ISO 7708 [15].

3.3

ultraviolet particulate matter

UVPM

estimation of the contribution of ETS particulate matter to RSP obtained by comparing the ultraviolet absorbance of the RSP sample with that of a surrogate standard

3.4

fluorescent particulate matter

FPM

estimation of the contribution of ETS particulate matter to RSP obtained by comparing the fluorescence intensity of the RSP sample with that of a surrogate standard

3.5

environmental tobacco smoke particulate matter

ETS-PM

particulate phase of ETS

3.6

surrogate standard

chemical whose concentration has been related quantitatively to a known concentration in the solution of ETS-PM

EXAMPLES 2,2',4,4'-Tetrahydroxybenzophenone (THBP) for UVPM; scopoletin for FPM.

4 Principle

A known volume of air is drawn through an inertial impactor or cyclone separating at 4,0 µm, thus separating the respirable suspended particles (RSP) from the total suspended particulate matter. It is then drawn through a filter cassette containing a polytetrafluoroethylene (PTFE) membrane filter. The RSP are collected on the filter, followed by gravimetric determination of the mass of RSP so collected. The RSP are extracted from the filter for the determination of UVPM and FPM by absorbance and fluorescence measurements, respectively, using high-performance liquid chromatography (HPLC) apparatus.

If HPLC apparatus is not available, absorbance and fluorescence may be measured by a spectrometer with the addition of a note in the expression of results.

5 Limits and detection

The methods specified in this International Standard allow the estimation of RSP content to within the following limits. At a sampling rate of 2 l/min over 1 h, the UVPM test method shows limits of detection (LOD) and quantification (LOQ) of 2,5 µg/m³ and 8,3 µg/m³, respectively. Under the same conditions, the FPM method shows an LOD and LOQ of 1,4 µg/m³ and 4,7 µg/m³, respectively.

6 Reagents

All reagents shall be of recognized analytical grade. Water shall be in accordance with at least grade 3 of ISO 3696.

6.1 Methanol, HPLC grade.

6.2 2,2',4,4'-Tetrahydroxybenzophenone (THBP), of minimum purity 99 %.

6.3 Scopoletin, of minimum purity 95 %.

6.4 Glycerol, of minimum purity 99,5 %.

6.5 Helium, of minimum purity 99,995 %.

6.6 UVPM surrogate standard solutions

Store all standard solutions in low-actinic borosilicate glass screw-cap jars in a refrigerator (at about 4 °C) when not in use. Prepare fresh standards from THBP at least every 12 months.