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**Water pipe tobacco — Determination  
of carbon monoxide in the vapour  
phase of water pipe tobacco smoke —  
NDIR method**

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 126, *Tobacco and tobacco products*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

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# Water pipe tobacco — Determination of carbon monoxide in the vapour phase of water pipe tobacco smoke — NDIR method

## 1 Scope

This document specifies a method for the determination of carbon monoxide (CO) in the vapour phase of water pipe tobacco smoke.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3402, *Tobacco and tobacco products — Atmosphere for conditioning and testing*

ISO 22486, *Water pipe tobacco smoking machine — Definitions and standard conditions*

ISO/TS 22487, *Water pipe tobacco — Determination of total collected matter and nicotine using a water pipe tobacco smoking machine*

## 3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at <https://www.iso.org/obp>

— IEC Electropedia: available at <http://www.electropedia.org/>

### 3.1

#### **vapour phase**

portion of smoke, which passes the smoke trap during smoking in accordance with ISO/TS 22487 using a machine conforming to ISO 22486

## 4 Principle

Smoking of water pipe tobacco in accordance with the procedures given in ISO/TS 22487. Collection of the vapour phase of the water pipe tobacco smoke and measurement of the carbon monoxide using a non-dispersive infrared (NDIR) analyser calibrated for carbon monoxide. Calculation of the amount of carbon monoxide per water pipe tobacco test portion.

## 5 Apparatus

Usual laboratory apparatus and, in particular, the following items.

**5.1 Routine analytical water pipe tobacco smoking machine and accessories**, complying with the requirements of ISO 22486.

**5.2 Vapour-phase collection system**, which can be fitted to the water pipe smoking machine. The use of the system shall ensure collection of all the vapour phase (normally vented to atmosphere) to be stored in a previously evacuated container for subsequent sampling through an NDIR analyser.

The collection system shall not cause interference with the normal performance of the smoking machine and the consequent determination of total particulate matter and nicotine.

The impermeability of the vapour phase collecting device to a vapour phase shall be checked with a vapour phase containing a volume fraction of 4 % to 6 % of CO. The CO concentration shall be measured directly after filling the previously evacuated vapour phase-collecting device. After a period of not less than 2 h, the measured value of CO concentration in the vapour phase in the device shall not differ by more than a volume fraction of 0,2 % from the value expected from the first determination.

When a bag is used as the vapour phase-collecting device, it shall be large enough to avoid the final pressure of its contents exceeding the ambient atmospheric pressure. The volume of the bag should also be no greater than twice the volume of the vapour phase collected at atmospheric pressure. In practice, the collection of the vapour phase from 175 puffs requires a bag volume of 120 l to 185 l.

It can be inconvenient to collect all of the vapour phase generated from a single smoked test portion in one single 120 l bag. Other possibilities exist and may be considered for inclusion in this document.

- a) Use two or more smaller bags, which are changed at the same time as the TCM collection pad is changed after every 35 puffs. The practical bag size for this option is roughly 30 l; at least two bags are required. Both are evacuated prior to commencement of the smoking process. The first bag is filled during the first 35 puffs, then removed for analysis and re-evacuated while the next bag is in use and so on. A modified version of [Formulae \(1\) and \(2\)](#) given in [Clause 8](#) are required in order to combine the partial vapour phase concentrations measured during each bag fill.
- b) Use a constant flow gas splitting system to deliver a known fraction of the total vapour phase to an appropriate-sized collection bag. A ratio 20:1 splitting system requires a 10 l bag (connected to the low flow output of the splitter) to collect the vapour phase output for a complete smoked test portion. The vapour phase from the high flow output of the splitter is routed directly to the waste smoke exhaust system. The contents of the collection bag are then analysed in the normal way. The relative volumes of the split sample are not required; the [Formula \(1\)](#) or [Formula \(2\)](#) in [Clause 8](#) only needs the total volume which is the puff volume time the number of puffs. This system works correctly provided that the vapour phase sample is homogeneous at the entrance to the splitter and that the split flows remain at a constant ration throughout the smoking process.
- c) The vapour phase for a single puff only is collected, analysed and disposed of on a puff by puff basis. The CO is calculated on the basis of mg per puff and the total CO per sample is the sum of the mass for all puffs.

**5.3 Non-dispersive infrared (NDIR) analyser**, selective and calibrated for the measurement of carbon monoxide in vapours.

Analysers are available from several manufacturers and should have a suitable measurement range. The sampling rate should be between 0,5 l/min and 5 l/min. The analyser shall have a precision of 0,1 % CO, a linearity of 0,1 % CO and a repeatability of 0,2 % CO, under conditions of constant temperature and pressure. In terms of volume fractions its response to 10 % CO<sub>2</sub> shall not exceed 0,05 % as CO. Its response to 2 % water vapour shall not exceed 0,05 % as CO.

**5.4 Heating device**, effecting flameless electric heating, as defined in ISO 22486.

**5.5 Barometer**, capable of measuring atmospheric pressures to the nearest 0,1 kPa.

**5.6 Thermometer**, capable of measuring temperature to the nearest 0,1 °C.