
**Water pipe tobacco smoking
machine — Definitions and standard
conditions**

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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).

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).

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.

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.

Introduction

In the early 21st century, the habit of water pipe smoking has spread worldwide especially among young people. Formerly smoked mainly in Asia and Northern Africa, water pipe smoking has now spread in European countries and the US. In this light, it is necessary to set up an International Standard for the machine smoking of water pipe tobacco. Certain requirements, which are addressed in this document, are based on experience and knowledge gained from the use of analytical water pipe tobacco smoking machines. This is intended to lead to a better understanding of the products used and contribute to better consumer information.

Although charcoal is typically used for water pipe smoking in the method described in this document, the water pipe tobacco is heated by means of an electrical heater. This was decided in order to eliminate the unpredictable influence of different types of charcoal on the measurement result. Nevertheless, there is a general need to include this important aspect in a separate method, for example, in view of the determination of CO.

No machine smoking regime can represent all human smoking behaviour.

- Machine smoking testing is useful to characterize water pipe tobacco emissions for design and regulatory purposes, but communication of machine measurements to smokers can result in misunderstandings about differences in exposure and risk across brands.
- Smoke emission data from machine measurements may be used as inputs for product hazard assessment, but they are not intended to be nor are they valid as measures of human exposure or risks. Communicating differences between products in machine measurements as differences in exposure or risk is a misuse of testing using ISO standards.

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Water pipe tobacco smoking machine — Definitions and standard conditions

1 Scope

This document

- defines smoking parameters and specifies the standard conditions to be provided for the routine analytical machine smoking of water pipe tobacco, where the water pipe tobacco sample is electrically heated only and not combusted;
- specifies the requirements for a routine analytical smoking machine complying with the standard conditions.

This document is only applicable for water pipe tobacco used in devices known as “arghile”, “hookah”, “nargile” or “shisha” in which tobacco is heated, not combusted. Other types of water pipe tobacco that are used in other devices such as “Chinese water pipe” are not covered.

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 4796-2, *Laboratory glassware — Bottles — Part 2: Conical neck bottles*

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

test atmosphere

atmosphere to which a sample or test piece is exposed throughout the test

Note 1 to entry: It is characterized by specified values for one or more of the following parameters: temperature, relative humidity and pressure, which are kept within the specified tolerances.

Note 2 to entry: The test may be carried out either in the laboratory or in a special chamber termed the “test chamber”, or in the conditioning chamber, the choice depending on the nature of the test piece and on the test itself. For example, close control of the test atmosphere may not be necessary if the change in properties of the test piece is insignificant over the test period.

[SOURCE: ISO 3402:1999, 2.3, modified — Note 3 to entry has been omitted.]

3.2

restricted smoking

condition that exists when the connection tube of a water pipe is closed to the atmosphere between successive puffs

3.3

pressure drop

static pressure difference between the two ends of a pneumatic circuit when it is traversed by an air flow under steady conditions in which the measured volumetric flow, under standard conditions, at the output end is nominally 204 ml/s

Note 1 to entry: The pressure drop has to be determined with the required amount of water filled in the bottle and the *smoke trap* (3.13) connected.

3.4

puff duration

interval of time during which the flow path of a water pipe is pneumatically connected to the suction mechanism

3.5

puff volume

volume leaving the water pipe and passing through the *smoke trap* (3.13) for a single *puff duration* (3.4)

Note 1 to entry: The volume flow is determined with the water pipe connected.

3.6

puff number

number of puffs necessary to smoke a sample of water pipe tobacco

3.7

puff frequency

number of puffs in a given time

3.8

puff termination

termination of the connection of the water pipe to the suction mechanism

3.9

puff profile

flow rate measured at the inlet of the *smoke trap* (3.13) connected to the suction source and depicted graphically as a function of time

3.10

dead volume

volume of air which exists between the *head* (3.12) of a water pipe and the suction mechanism

3.11

water pipe tobacco holder

device for holding the water pipe tobacco during smoking

3.12

head

device holding the *water pipe tobacco holder* (3.11) and connecting it to the suction tube

3.13

smoke trap

device for collecting such part of the smoke from a sample of water pipe tobacco as is necessary for the determination of specified smoke components

3.14

port

aperture of the suction mechanism through which a puff is drawn and to which is attached a *smoke trap* (3.13)

3.15**compensation**

ability to maintain constant *puff volumes* (3.5) and *puff profiles* (3.9) when the *pressure drop* (3.3) at the *port* (3.14) changes

3.16**mainstream smoke**

smoke which leaves the mouth end of the water pipe during the smoking process

3.17**sidestream smoke**

all smoke which leaves a *head* (3.12) of a water pipe during the smoking process other than from the head end connected to suction tube

3.18**plate**

device positioned under the water pipe *head* (3.12) to collect falling particles from the water pipe tobacco during smoking

3.19**wind shield**

cylindrical device to protect the water pipe tobacco *head* (3.12) and holder against *ambient air flow* (3.21) during smoking

3.20**clearing puff**

puff taken after the water pipe tobacco has been removed from the *water pipe tobacco holder* (3.11)

3.21**ambient air flow**

air flow around the water pipe *head* (3.12) and holder during the smoking process

4 Standard conditions**4.1 Machine pressure drop**

The whole of the flow path between the head of the water pipe and the suction mechanism shall offer the least possible resistance, and its pressure drop shall not exceed 1 500 Pa.

4.2 Puff duration

The standard puff duration shall be 2,6 s $\pm$ 0,1 s.

4.3 Puff volume

The standard puff volume shall be 530 ml $\pm$ 10 ml.

4.4 Puff frequency

The standard puff frequency shall be 3 puffs per minute with one puff starting every 20 s $\pm$ 0,5 s measured over 10 consecutive puffs.

4.5 Puff profile

The puff profile shall be of rectangular shape, measured at the inlet of the puff generator with a pressure drop of 1 500 Pa $\pm$ 50 Pa. The volume V_1 plus V_3 of the increasing and decreasing parts of the profile shall not exceed 10 % of the total puff volume $V_1 + V_2 + V_3$. The flow rate between t_1 and t_2 shall be 215 ml/s $\pm$ 25 ml/s in average (see [Figure 1](#)).

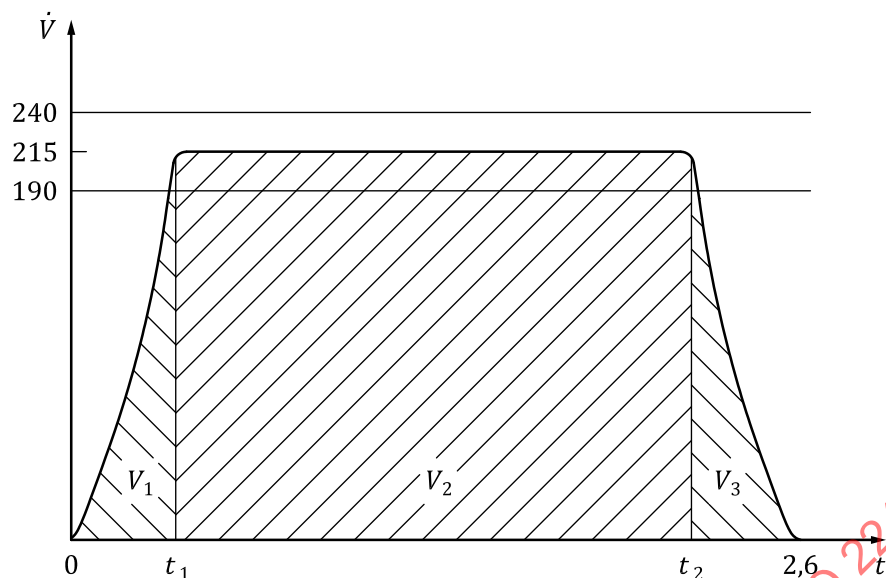


Figure 1 — Puff profile (idealized)

4.6 Restricted smoking

An analytical smoking machine for water pipe tobacco shall fulfil the conditions for restricted smoking.

4.7 Puff number

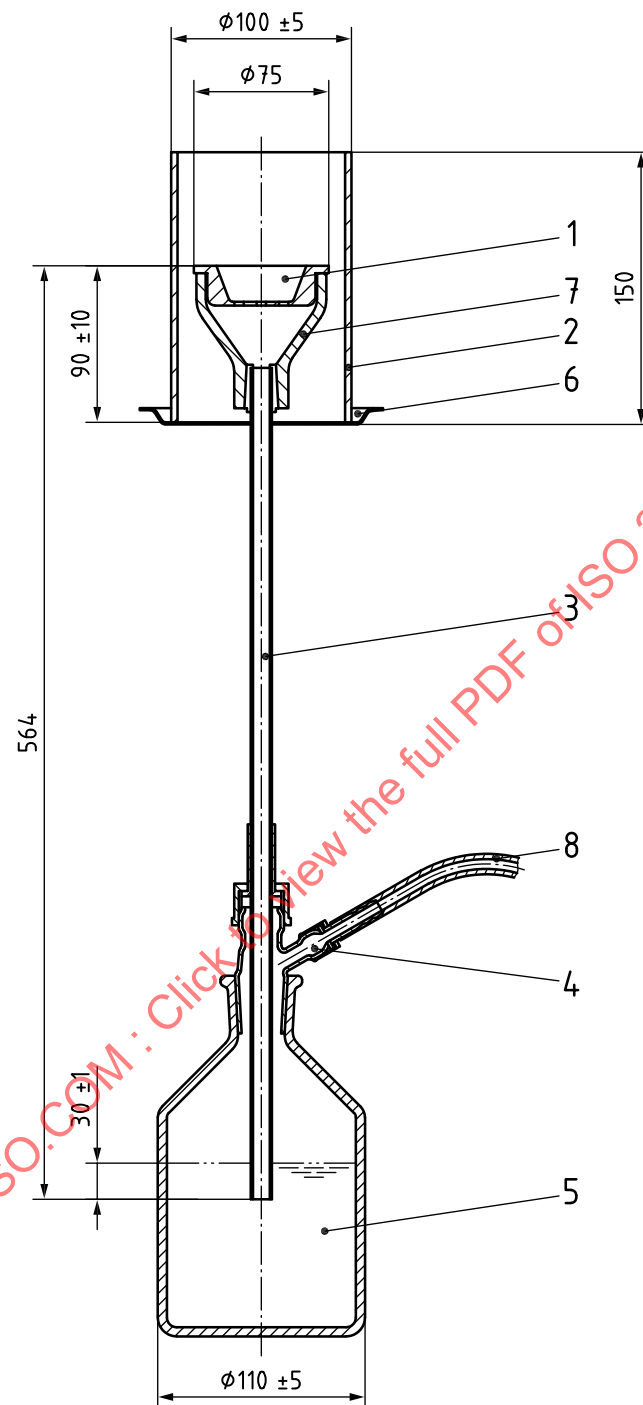
Each individual puff shall be counted and recorded until the total puff number is reached.

5 Specification of the water pipe

5.1 General

The main components of the water pipe are the bottle, the connection device, the suction tube, the head with plate, wind shield and the water pipe tobacco holder. A schematic description with key dimensions is given in [Figure 2](#).

Dimensions in millimetres



Key

- | | | | |
|---|---------------------------|---|-----------------|
| 1 | water pipe tobacco holder | 5 | bottle |
| 2 | wind shield | 6 | plate |
| 3 | suction tube | 7 | head |
| 4 | connection device | 8 | connection tube |

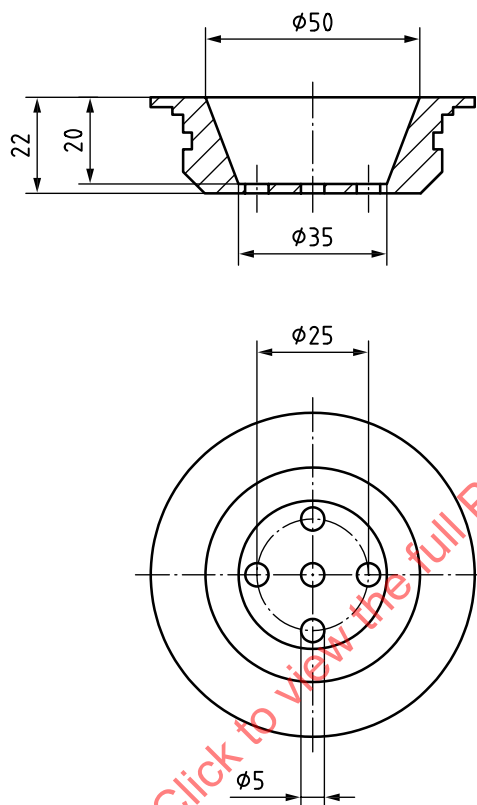
Figure 2 — Water pipe (schematic)

5.2 Water pipe tobacco holder

The design of the standard water pipe tobacco holder is such that it can hold approximately 25 ml. It shall be made of anodized aluminium or ceramics. The dimensions are given in [Figure 3](#).

NOTE Specific analysis can require different materials for the water pipe tobacco holder.

Dimensions in millimetres

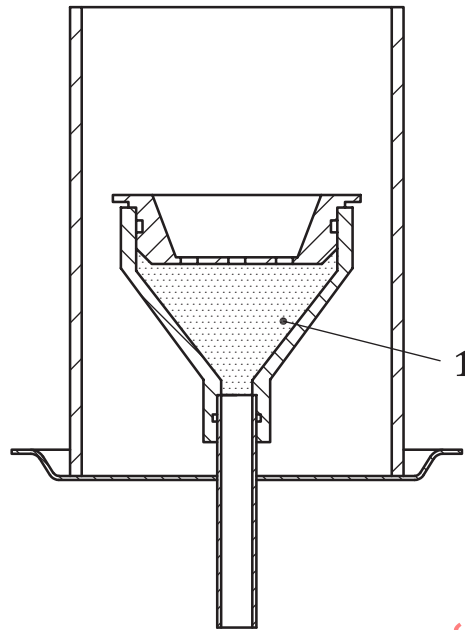


NOTE Dimensional details: tolerance of $\pm 0,1$ mm.

Figure 3 — Water pipe tobacco holder

5.3 Water pipe head

The water pipe head (see [Figure 4](#)) is the connecting element between the water pipe tobacco holder and the suction tube. It shall be made of a heat resistant material, such as ceramics. The use of metals should be avoided to prevent heat transfer from the water pipe tobacco holder that may influence the smoking process. The dead volume of the head (V_{head}) should be between 65 ml and 75 ml.

**Key**1 V_{head} **Figure 4 — Water pipe head (schematic)****5.4 Bottle**

A bottle as specified in ISO 4796-2 and a filling capacity of 1 000 ml is required for the water pipe.

5.5 Suction tube

For stability reasons, it is recommended to use stainless steel for the tube. The inner diameter should be $10 \text{ mm} \pm 0,1 \text{ mm}$ with a wall thickness of $1 \text{ mm} \pm 0,1 \text{ mm}$. A machined marking $30 \text{ mm} \pm 1 \text{ mm}$ from the lower end is helpful for adjustment of the tube's position with regards to the water level filled into the bottle. The total length should be $500 \text{ mm} \pm 2 \text{ mm}$.

Adjust the suction tube equivalent to the water level ($30 \text{ mm} \pm 1 \text{ mm}$).

5.6 Plate and wind shield position

The plate shall be placed in a horizontal plane between 80 mm and 100 mm below the plane of the top of the water pipe tobacco holder.

A wind shield (preferably made of glass) with an inner diameter of $100 \text{ mm} \pm 5 \text{ mm}$ should extend above the water pipe tobacco holder by 60 mm to 70 mm. The wind shield shall not have direct contact to the water pipe tobacco holder during the smoking process.

5.7 Connection tube

For the connection between the water pipe and the smoke trap, a tube made of Tygon^{TM1)} or similar material with an inner diameter of $8 \text{ mm} \pm 1 \text{ mm}$ and a total length of $100 \text{ cm} \pm 2 \text{ cm}$ shall be used.

NOTE Silicone was found not to be suitable, because of nicotine adsorption.

1) Tygon is a trademark of Saint Gobain Performance Plastics Corporation and an example of a suitable product available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of this product.

5.8 Heating device

For reproducible smoking conditions, an electrical heating device (see [Figure 5](#)) shall be used. The heating device shall be designed in a way that no significant pressure drop is added to the smoking process. It shall cover at least 90 % of the tobacco surface. The surface of the heating device faced to the tobacco shall have a distance of 1 mm to 1,5 mm to the upper surface of the water pipe tobacco holder.

The heating power shall be adjusted to generate a constant core temperature of the heating device of $280\text{ }^{\circ}\text{C} \pm 10\text{ }^{\circ}\text{C}$. A preheating time of 5 min shall be set to heat up the tobacco before the first puff is generated.

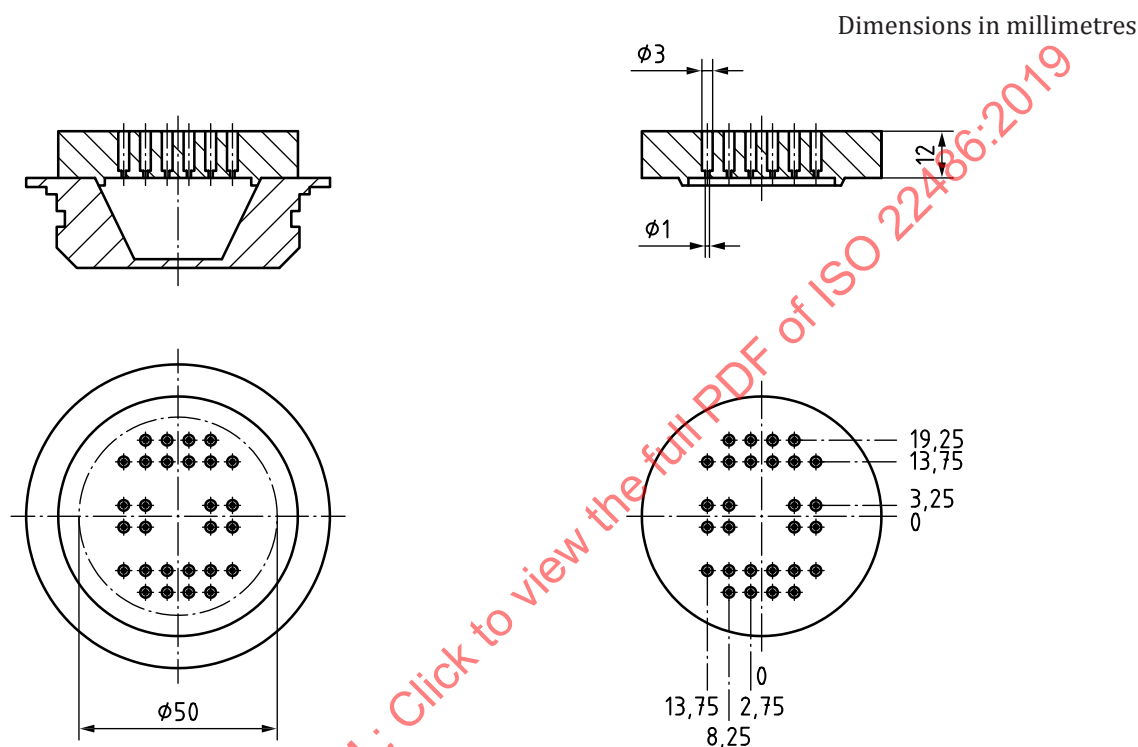


Figure 5 — Heating device (schematic drawing with dimensions)

6 Specification of the suction source

6.1 General

The smoking machine shall comply with the standard conditions (see [4.1](#) to [4.7](#)) and the specific conditions given in [5.1](#) to [5.8](#).

6.2 Operating principle and puff profile

6.2.1 The machine shall include a device to draw a fixed volume of air (puff) through the water pipe tobacco (see [4.3](#)). A schematic diagram is shown in [Figure 1](#).

6.2.2 The machine shall produce a rectangular shaped puff profile (see [4.5](#)).

6.2.3 The machine shall be a restricted smoker (i.e. fulfil the conditions for restricted smoking, see [3.2](#) and [4.6](#)).