



**International  
Standard**

**ISO 5501-3**

**Tobacco heating systems —  
Definitions and standard conditions  
for aerosol generation and  
collection —**

**Part 3:  
Carbon heated tobacco products  
(cHTPs)**

*Systèmes de chauffage du tabac — Définitions et conditions  
normalisées pour la génération et la collecte d'aérosol —*

*Partie 3: Produits de tabac chauffés par un charbon (PTCc)*

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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 document 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)).

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

A list of all parts in the ISO 5501 series can be found on the ISO website.

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).

## Introduction

Tobacco heating systems (THS) are designed to heat a tobacco substrate, to produce a nicotine-containing aerosol without the combustion of the tobacco substrate. A THS is a combination of a heated tobacco product (HTP) and a tobacco heating device (THD). The HTP part of the THS, is a product containing a tobacco substrate that is designed to be heated and not combusted.

With the emerging development and commercialisation of HTPs, there are a number of different approaches to heating the HTP, categorised as electrically, aerosol and carbon, HTPs; eHTP, aHTP and cHTP, respectively (see ISO 6080).

This document has been developed to define and specify the requirements for a carbon heated tobacco product (cHTP) puffing regime in order to generate and collect aerosol for subsequent analytical measurement in a robust and reproducible manner.

No machine puffing regime can represent all human use behaviour, so dependent on the testing requirement it may be appropriate to test cHTPs differently according to their design, or under conditions of different intensity to reflect the range of human behaviour.

Machine testing is useful to characterize emissions for product development and regulatory purposes and may be used as inputs for product hazard assessment; however, it is not intended to be nor is it valid as a measure of human exposure or risk.

**NOTE** This document is a reference document for ISO standards on tobacco heating systems (e.g. ISO 5501). Regulation and standardisation are independent from each other, and standardisation does not pre-empt regulation.

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# Tobacco heating systems — Definitions and standard conditions for aerosol generation and collection —

## Part 3: Carbon heated tobacco products (cHTPs)

### 1 Scope

This document:

- defines the parameters and specifies the standard conditions for the routine analytical generation and collection of aerosol from carbon heated tobacco products (cHTP);
- specifies technical requirements for the routine analytical puffing machine for cHTP generation and collection of aerosol, termed as “machine” in this document, conforming with the standard conditions stated within [Clause 4](#);

This document does not specify aerosol trapping nor subsequent sample preparation and analytical method of components in the trapped aerosol or the gas phase.

This document is also applicable to products other than defined in [3.14](#) if a specific method references this document.

### 2 Normative references

The following document is 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 6080, *Tobacco heating systems — Vocabulary*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 6080 and the following 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 <https://www.electropedia.org/>

#### 3.1 test atmosphere

atmosphere to which the cHTP is exposed throughout the test

### 3.2

#### **pressure drop**

static pressure difference between the two ends of a pneumatic circuit when it is traversed by an air flow under steady conditions as described in ISO 7210

Note 1 to entry: Although the pressure drop of a device or a pneumatic circuit is defined for a specific set of reference parameters to describe its physical properties, the device could be used for measurements under conditions other than the reference parameters.

[SOURCE: ISO 20778:2018, 3.4]

### 3.3

#### **puff duration**

interval of time, measured in seconds, during which the port of the machine is pneumatically connected to the suction mechanism

[SOURCE: ISO 20778:2018, 3.6]

### 3.4

#### **puff volume**

volume leaving the cHTP and passing through the aerosol trap

### 3.5

#### **puff frequency**

number of puffs in a given time

[SOURCE: ISO 3308:2012, 3.10]

### 3.6

#### **puff profile**

flow rate measured over the time span of the puff at the port of the machine, typically depicted graphically as a function of time

### 3.7

#### **puff number**

number of puffs collected from a cHTP

### 3.8

#### **THS holder**

device for connecting the cHTP to the port of the machine during aerosol generation and collection

### 3.9

#### **aerosol trap**

device for collecting the aerosol from cHTP which is necessary for the determination of specified analytes

### 3.10

#### **port**

aperture of the suction mechanism through which a puff is drawn and to which is attached an aerosol trap

[SOURCE: ISO 3308:2012, 3.16]

### 3.11

#### **compensation**

ability to maintain constant puff volumes and puff profiles when the pressure drop at the port changes

Note 1 to entry: In practice a change of the pressure drop is introduced by the connection of the test product to the machine or the inclusion of an aerosol trap.

[SOURCE: ISO 3308:2012, 3.18]

### 3.12

#### **clearing puff**

puff taken immediately after the cHTP has been removed from the THS holder of the machine

[SOURCE: ISO 3308:2012, 3.23]

### 3.13

#### **termination of collection**

termination of the connection of the cHTP to the suction mechanism after completion of the requested number of puffs

### 3.14

#### **carbon heated tobacco product**

##### **cHTP**

product containing a tobacco substrate that is designed to be heated by smouldering carbon, without combustion of the tobacco substrate in order to produce a nicotine-containing aerosol

Note 1 to entry: cHTP category includes products that have:

- an HTP containing a tobacco substrate that is encapsulated or wrapped in paper or other material;
- heating of the tobacco substrate by smouldering carbon.

Note 2 to entry: cHTP category may include products that have:

- a puff count and/or use duration that is limited by the design of the heated tobacco product (HTP);
- carbon-based heat source where smouldering is initiated by fire.

Note 3 to entry: cHTP category does not include products that are:

- waterpipe tobacco products where tobacco is heated by smouldering carbon.

Note 4 to entry: See NOTE in the Introduction.

Note 5 to entry: An ISO standard, which provides a test method for analysing tobacco heating systems to support the assessment if combustion occurs is under development within ISO/TC 126.

[SOURCE: ISO 6080:2024, 3.2.3]

### 3.15

#### **aerosol collected mass**

##### **ACM**

mass of aerosol collected on an aerosol trapping system from the operation of a THS by a machine

Note 1 to entry: See ISO 4387 for TPM.

## **4 Standard conditions**

### **4.1 Machine pressure drop**

The whole of the flow path between the port of the cHTP aerosol collection system and the suction mechanism shall offer the least possible resistance, and its pressure drop shall not exceed 300 Pa.

### **4.2 Puff duration**

The standard puff duration shall be  $(2,00 \pm 0,02)$  s.

### **4.3 Puff volume**

The standard puff volume shall be  $(55,0 \pm 0,6)$  ml determined at the port of the machine in series with a pressure drop device of  $(1\,000 \pm 50)$  Pa.

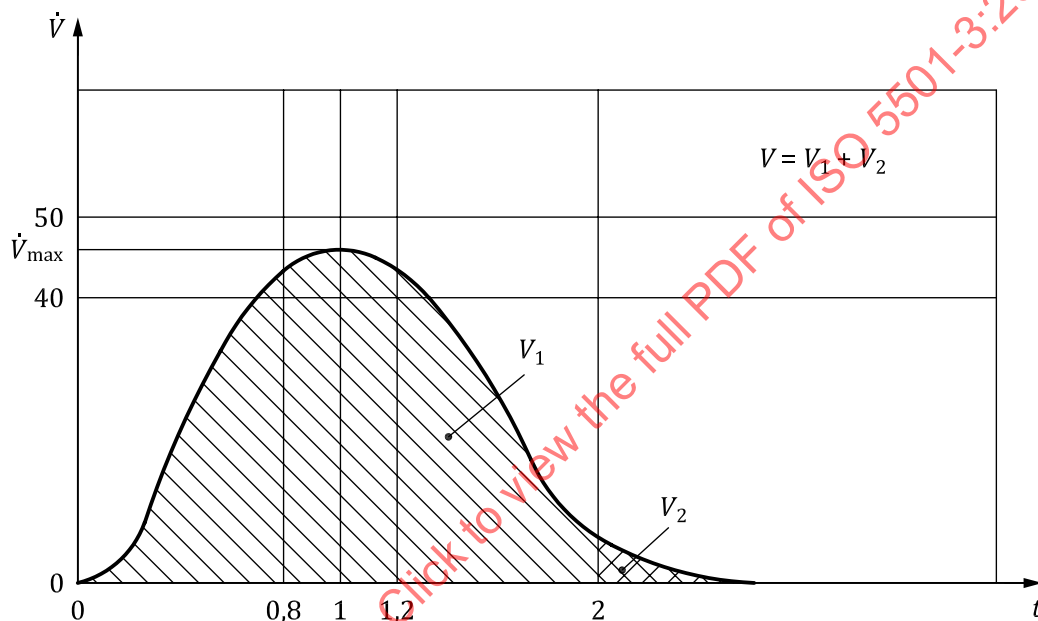
#### 4.4 Puff frequency

The standard puff frequency shall be one puff starting every  $(30,0 \pm 0,5)$  s.

#### 4.5 Puff profile

The puff profile shall be measured with an impedance of  $(1\,000 \pm 50)$  Pa, as specified in 4.3. It shall be shaped as shown in Figure 1 (known as bell-shape profile) with a maximum between 0,8 s and 1,2 s from the start of the puff. The increasing and decreasing parts of the profile shall not have more than one point of inflection each. The maximum flow rate shall be between 40 ml/s and 50 ml/s. At no point shall the direction of flow be reversed.

The standard puff volume  $V$ , with  $V = V_1 + V_2$ , measured in series with a pressure drop device of  $(1\,000 \pm 50)$  Pa shall be  $(55,0 \pm 0,6)$  ml. In one puff duration not less than 95 % of the puff volume shall leave the mouth end of cHTP ( $V_1$ ).



##### Key

$\dot{V}$  volumetric flow, ml/s  
 $t$  time, s

NOTE Puff profile (idealized) according to ISO 20778:2018, 4.4

**Figure 1 — Puff profile (idealized)**

#### 4.6 Puff number

Each individual puff shall be counted and recorded until the collection process is terminated. The machine shall be capable of taking a predetermined number of puffs or allowing operator termination. Please refer to 5.9 and 5.10 for initiation and termination of puffing.

### 5 Specification of the machine

#### 5.1 General

The machine shall comply with the standard conditions (see 4.1 to 4.6).

## 5.2 Operating principle and puff profile

**5.2.1** The machine shall include a device to draw a fixed volume of air (puff) through the cHTP.

**5.2.2** The machine shall produce a bell shape puff profile (see [4.5](#)). A schematic diagram is shown in [Figure 1](#).

**5.2.3** The machine shall be switched on and allowed to warm up on automatic cycling for at least 20 min. With the machine warmed up, check that the puff volume on each channel is in accordance with the standard conditions (see [4.3](#)).

## 5.3 Reliability and compensation

**5.3.1** The machine shall contain devices to control the puff volume, the puff duration, and the puff frequency.

**5.3.2** The machine shall possess the mechanical and electrical reliability necessary to meet the standard conditions regarding these parameters (see [4.1](#) to [4.6](#)) for prolonged periods of testing.

**5.3.3** The machine shall be capable of sufficient compensation.

When the machine has initially been set to give a puff volume of  $(550 \pm 0,6)$  ml without a pressure drop device, a reduction of no more than 2,5 ml shall be observed when the machine is tested with a pressure drop device of 2 kPa.

**5.3.4** The machine shall be capable of taking one or more clearing puffs after the termination of collection as needed in regard to the requirements of analytical methods to measure the aerosol components.

**5.3.5** Each port should have its own puff counter.

## 5.4 THS holder

**5.4.1** The design of the THS holder is such that it shall connect the cHTP to the port of the machine in a leak-free manner and cover 9,0 mm, with a range of 8,0 mm to 9,5 mm, from the mouth end of a cHTP. It shall be impermeable to air and HTP aerosol.

**NOTE** For samples with a diameter between 4,5 mm and 9 mm the cigarette holder described in ISO 3308 can be used without the neoprene washer.

**5.4.2** The product orientation should be horizontal. Some products or analytical methods may require a product orientation other than horizontal. In this case, this should be noted in the reporting documents.

## 5.5 Aerosol traps

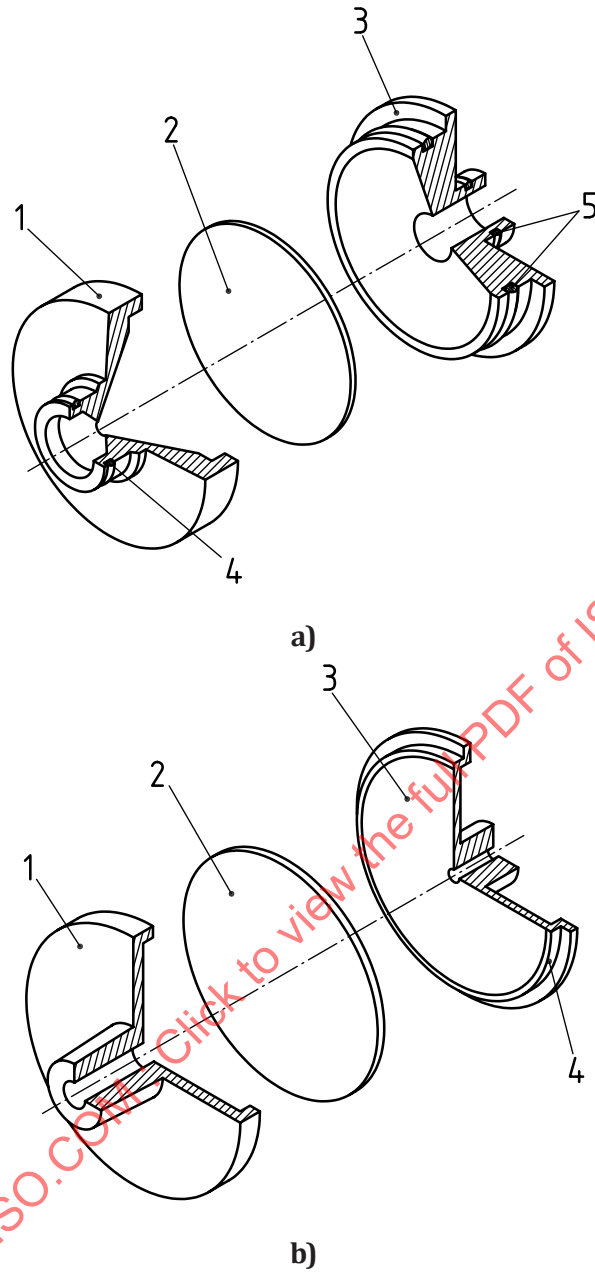
**5.5.1** When the machine is used for collecting aerosol, a trap shall be fitted between the suction source and the cHTP. The type of trap will depend on the purpose for which the aerosol is being collected. The efficiency of aerosol collection by the trap shall be specified in the analytical method. When a filter trap is used for collecting aerosol, it should be comprising the following.

- a) Airtight filter holder and end caps made of a non-hygroscopic and chemically inert material, able to contain a filter disc of glass fibre material 1 mm to 2 mm thick. The rough filter surface shall face the oncoming aerosol. Different designs of aerosol trap can meet this requirement. Depending on the amount of aerosol collected, filter pads with a diameter of 44 mm and 92 mm can be used but other sizes are also available. Two examples are given in [Figure 2](#).

- b) Filter material which shall retain at least 99,9 % of all particles having a diameter equal to or greater than 0,3  $\mu\text{m}$  of a dioctyl phthalate aerosol at a linear air velocity of 140 mm/s. The pressure drop of the filter assembly shall not exceed 900 Pa at this air velocity. The content of binder shall not exceed 5 % as mass fraction. Polyacrylate and polyvinyl alcohol (PVA) have been found to be suitable binders for this material.

**5.5.2** The filter assembly shall be capable of quantitatively retaining the aerosol produced by the cHTP without loss.

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**Key**

- 1 GF holder front
- 2 filter pad
- 3 GF holder back
- 4 "O"-ring seal
- 5 "O"-ring seals

NOTE Examples of glass fibre filter (GF) aerosol traps (schematic) according to ISO 20778:2018, 5.4.7

**Figure 2 — Examples of glass fibre filter (GF) aerosol traps (schematic)**

## 5.6 Sample conditioning and handling

The cHTPs shall be removed from the pack, and conditioned according to ISO 3402 for a minimum of 48 h and a maximum of 10 d.

In the case that cHTPs are presented in resealable packs with user instructions indicating the need to reseal the pack after opening, cHTPs should be temperature equilibrated in sealed packs for a minimum of 48 h and a maximum of 10 d at a conditioning temperature of  $(22 \pm 1) ^\circ\text{C}$ . This period may be changed if the testing laboratory is able to demonstrate that there is no statistically significant influence on yields. cHTPs removed from open packs may be kept in sealed containers for a maximum of 4 h; after this time they should no longer be regarded as suitable for testing and should be discarded. This period may be extended if the testing laboratory is able to demonstrate that there is no statistically significant influence on yields.

## 5.7 Test atmosphere

The test atmosphere shall be applied as described in ISO 3402.

## 5.8 Vent blocking

Vent blocking should be applied to cHTPs only if (a) ventilation holes in the product “filter” section can be occluded in normal use and (b) vent blocking does not compromise the operation of the product.

When vent blocking of the filter ventilation holes is required, this may be accomplished by two approaches:

- a) a modified sample holder which fully occludes the ventilation holes;
- b) the ventilation holes are sealed with tape: a 10 mm to 20 mm wide cellophane tape shall be applied around the entire circumference of the cHTPs with a small overlap, with the tape not extending beyond the mouth end.

## 5.9 Ignition of carbon heat source and initiation of collection

The initiation of collection should be commenced upon ignition of the carbon heat source, and it is recommended that an electrical lighting system is used. The carbon heat source should be ignited with the lighter within 1 mm (but not touching) the carbon heat source. If electrical lighters are used they should be preheated prior to puff initiation.

## 5.10 Termination of collection

Prior to commencement of testing, a pre-test shall be conducted for each product batch or set of samples to determine the puff number to be used when testing a cHTP sample.

In this test, the number of puffs during which the heat source emits light (i.e., glows “red” during puffing) is determined for twenty (20) individual cHTP samples. The puff number to be used for testing is calculated as the average result from the twenty individual cHTP samples, rounded to the next higher integer value, with three (3) additional “residual heat” puffs added in order to ensure any aerosol yielded due to residual heat is captured.

If there is no visible indication of puffing or smouldering from the carbon heat source, puff number may be determined by pre-test, by the following method:

Aerosol collected mass (ACM) shall be determined on a puff-by-puff basis for twenty (20) individual cHTP samples. The final puff is defined by ACM yield falling below 10 % of maximum observed ACM/puff for that sample. The puff number to be used for testing is calculated as the average result from the twenty individual cHTP samples, rounded to the next higher integer value.

Alternative methods for determining final puff may be used provided they have been suitably validated to demonstrate extinguishment of the carbon heat source and absence of further aerosol generation.

## 5.11 Sample failure

If a cHTP sample fails to ignite properly, the carbon heat source detaches, or other product malfunction occurs during the test the result shall be deemed invalid.