
**Vapour products — Routine analytical
vaping machine — Definitions and
standard conditions**

*Produits de vapotage — Machine à vapoter pour analyses de contrôle
— Définitions et conditions normalisées*

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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).

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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*, Subcommittee SC 3, *Vape and vapour 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

Vapour products are devices intended for human use, most of which contain electronic components which vaporize a liquid to generate an aerosol carried by the air drawn through the device by the user. The devices are designed either as a single piece or as modular, multiple component products, for disposable, rechargeable and/or refillable use. In some cases, proprietary cartridges, pre-filled with liquid, are replaced. Their use, often described as vaping, has grown substantially in recent years and there are now regulations in place in a number of national and international jurisdictions requiring the measurement of constituents of the aerosol produced by the devices.

This document has been developed to define and specify the requirements of machines used in laboratories to draw air through the devices in order to generate aerosol for subsequent analytical testing in a robust and reproducible manner.

There is a very wide range of vapour products available to consumers and limited reliable data describing how they are used. The available data demonstrates significant intra- and inter-consumer variation in behaviour. Consequently, no machine vaping regime can represent all human vaping behaviour. As reliable data describing human vaping behaviour become available it may be appropriate to test devices 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 device 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. Communication of machine measurements to consumers can result in misunderstandings about differences in exposure and risk across devices.

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Vapour products — Routine analytical vaping machine — Definitions and standard conditions

1 Scope

This document:

- defines the parameters and specifies the standard conditions for a vaping machine for vapour products (as defined in [3.1](#));
- specifies technical requirements for the machine for routine analytical vaping, conforming with the standard conditions stated within [Clause 4](#);
- does not specify the vapour product, the vapour product operation or the liquid to be used;
- does not specify the means for aerosol trapping, subsequent sample preparation or analyses of components in the trapped aerosol.

2 Normative references

There are no normative references in this document.

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 product

device intended for human use, which normally contains electronic components that vaporize a liquid to generate an aerosol carried by the air drawn through the device by the user

Note 1 to entry: This document covers products following the above definition. This includes products described as electronic nicotine delivery systems (ENDS), e-cigarettes, e-cigars, e-shisha, e-pipes and other related product categories. These products could be designed either as single pieces or as modular, multiple component products for disposable, rechargeable and/or refillable use. In some cases, proprietary cartridges, pre-filled with liquid, are replaced.

3.2

puff activation

function necessary to start the aerosol generation process in the product under test, which should be synchronized to the start of the puff duration

3.3

puff volume

volume drawn by the machine at the mouth end of the vapour product

3.4

puff duration

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

3.5

puff period

time between the start of one puff and the start of the subsequent puff

3.6

puff number

number of puffs applied to the vapour product

3.7

puff termination

termination of the connection of the vapour product to the suction mechanism

3.8

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

3.9

clearing puff

puff taken immediately after the sample has been removed from the port of the machine

3.10

vapour product holder

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

3.11

aerosol stream

aerosol which leaves the mouth-end of the vapour product during aerosol generation

3.12

aerosol trap

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

3.13

port

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

3.14

**activation time
pre-heating time**

variable time period supported by the vaping machine and programmable by the operator according to the requirements of the product under test

3.15

termination of aerosol generation

point at which an activated product under test ceases to produce detectable quantities of aerosol for any reason (e.g. product failure, discharged battery, exhausted liquid reservoir)

3.16**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.

3.17**test atmosphere**

atmosphere to which a vapour product is exposed throughout the test

3.18**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.

4 Standard conditions**4.1 Puff volume**

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

4.2 Puff duration

The standard puff duration shall be $3 \text{ s} \pm 0,1 \text{ s}$.

4.3 Puff period

The standard puff period shall be one puff starting every $30 \text{ s} \pm 0,5 \text{ s}$.

4.4 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.

4.5 Puff profile

The puff profile shall be of approximate rectangular shape, measured at the port of the machine with a pressure drop device of $1\,000 \text{ Pa} \pm 50 \text{ Pa}$. 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 maximum flow rate shall be $18,3 \text{ ml/s} \pm 1,8 \text{ ml/s}$ (see [Figure 1](#)).

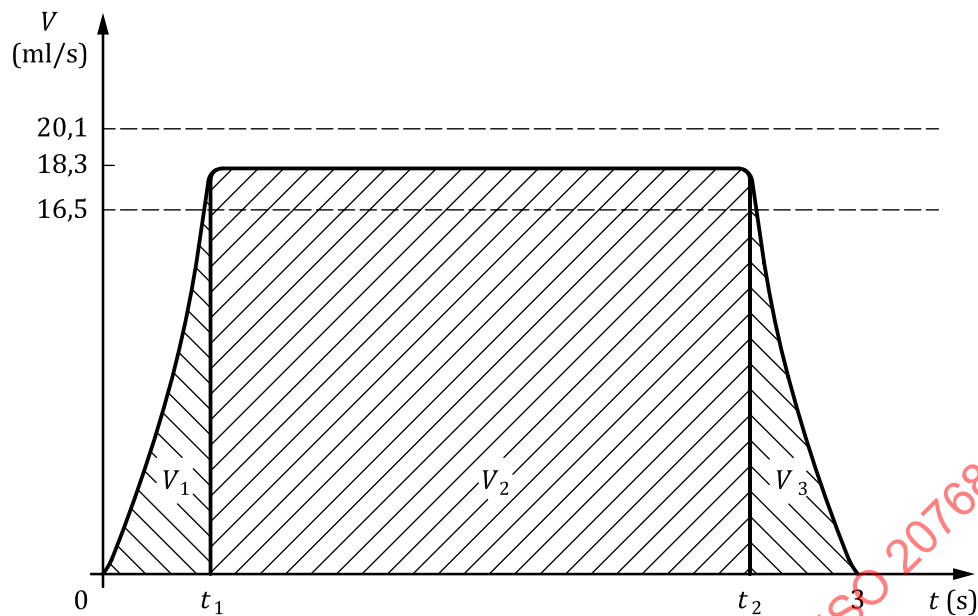


Figure 1 — Puff profile (idealized)

5 Specification of the suction source

5.1 General

The machine shall conform with the standard conditions (see 4.1 to 4.5).

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 vapour product.

5.2.2 The machine shall produce a rectangular shaped puff profile (see 4.5). A schematic diagram is shown in Figure 1.

5.3 Reliability and compensation

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

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 4.5) for prolonged periods of testing.

5.3.3 The machine shall be capable of sufficient compensation (see 3.18).

When the machine has initially been set to give a puff volume of 55 ml without a pressure drop device, a reduction of no more than 3 ml shall be observed when the machine is tested with a pressure drop device of 3 kPa.

5.3.4 The machine shall be capable of taking one or more clearing puffs (see 3.9) after the termination of the aerosol generation and collection process as needed in regards to the requirements of analytical methods to measure the aerosol components.

5.3.5 Each port shall have its own puff counter.

5.4 Vapour product holder

The design of the holder is such that it shall connect the vapour product to the port of the machine in a leak-free manner. It shall be impermeable to air and vapour product aerosol.

No specific orientation of the product during testing is specified within this method. Some products or analytical methods will require a product orientation other than horizontal. This should be taken into account in the machine design.

NOTE For cylindrical vapour products with a diameter between 4,5 and 9 mm, the cigarette holder described in ISO 3308 can be used without the polychloroprene washer.

5.5 Aerosol traps

When the machine is used for collecting aerosol, a trap shall be fitted between the suction source and the product. 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.

5.6 Puff activation

If the aerosol generation process of the vapour product is started other than by drawing the puff, an additional activation mechanism shall be used that activates the product and is synchronized to the puff. The activation shall not start later than 0,1 s after starting the puff, shall continue for the duration of the puff, and shall not be stopped later than 0,1 s after puff termination.

Some products will require a pre-heating time (activation time) for proper function. In this case, follow the user instructions of the product and note this in the reporting documents.

5.7 Termination of aerosol generation and collection process

The machine shall be capable of terminating and/or interrupting the aerosol generation and collection process after a predefined number of puffs.

If the test requires exhaustion of the liquid or full discharge of the battery, the termination of the aerosol collection process could be done by the operator observing the process. Alternatively, the termination of the aerosol collection process could be done by an aerosol stream sensor located between the product and the aerosol trap. The sensor shall be positioned as close as possible to the product. When the end-point of aerosol generation is determined, the machine shall continue the started puff and then stop the aerosol generation and collection process, subject to any requirement for one or more clearing puffs.

NOTE 1 Checking any indicator built into the vapour product is not an appropriate confirmation of aerosol generation. The indicator could fail for several reasons while the product is still producing aerosol or it could falsely indicate the production of aerosol.

NOTE 2 The observation of the aerosol generation process by the operator could be done in different ways. One option is the direct visual observation by the operator, requiring that the vapour product holder is connected via a transparent (e.g. glass) tube to the port of the machine. Another possibility is to monitor the weight loss of the product or the weight gain of the traps used during the aerosol collection process. This will require the development and validation of specific laboratory methods.

5.8 Test atmosphere

The test atmosphere shall be kept within the range 15 °C to 25 °C, and between 40 % RH and 70 % RH. The variation in temperature and relative humidity of the test atmosphere during machine preparation and testing shall be kept within the following limits:

— temperature: ± 2 °C;