INTERNATIONAL STANDARD

ISO 20779

First edition
2018-10

Cigarettes — Generation and collection of total particulate matter using a routine analytical smoking machine with an intense smoking regime

Cigarettes — Génération et collecte de la matière particulaire totale au moyen d'une machine à fumer analytique de routine avec un régime de fumage intense

Reference number
ISO 20779:2018(E)

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Published in Switzerland

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Foreword

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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 the following URL: 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

Historically, a set of ISO standards have been developed to specify the requirements of analytical cigarette smoking machines and their use for the quantitative determination of a number of cigarette smoke constituents [such as total particulate matter (TPM), nicotine-free dry particulate matter, water, nicotine or benzo[a]pyrene] with a unique standard smoking regime. The description of this smoking regime is provided in ISO 3308.

Later, requirements to provide smoke constituents data with an intense smoking regime, different from the ISO 3308 smoking regime, originated from different countries and the Conferences of the Parties to the Framework Convention on Tobacco Control, resulting in a need to specify the conditions for the use of the intense smoking regime on analytical cigarette-smoking machines. The specifications for the use of the intense smoking regime on analytical cigarette-smoking machines are provided in ISO 20778.

This document is the result of the work performed by ISO/TC 126, comprising experts from members and liaison organizations, including WHO. Elaboration of this document took into account practical work conducted in the framework of a collaborative study involving 35 laboratories (published as Technical Report ISO/TR 19478-1 and ISO/TR 19478-2). It provides specifications for the generation and collection of TPM using analytical cigarette smoking machines with an intense smoking regime.

No machine smoking regime can represent all human smoking behaviour:

— it is recommended that cigarettes also be tested under conditions of a different intensity of machine smoking than those specified in this document;

— machine smoking testing is useful to characterize cigarette emissions for design and regulatory purposes, but communication of machine measurements to smokers can result in misunderstandings about 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.

Cigarettes — Generation and collection of total particulate matter using a routine analytical smoking machine with an intense smoking regime

1 Scope

This document specifies a method for the generation and collection of total particulate matter (TPM) present in the smoke from cigarettes using a routine analytical smoking machine with an intense smoking regime. It is not applicable to the determination of water or nicotine-free dry particulate matter when using the extraction procedure specified in ISO 4387:2000, 7.9.1 or the subsequent measurement of water specified in ISO 10362-1 or ISO 10362-2.

NOTE The type of analytical smoking machine used could impact the mass of TPM collected on the smoke trap. This might be due to either incomplete collection or evaporation of water and other volatile compounds from the smoke trap.

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 2971, *Cigarettes and filter rods — Determination of nominal diameter — Method using a non-contact optical measuring apparatus*

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

ISO 4387, *Cigarettes — Determination of total and nicotine-free dry particulate matter using a routine analytical smoking machine*

ISO 8243, *Cigarettes — Sampling*

ISO 20778, *Cigarettes — Routine analytical cigarette-smoking machine — Definitions and standard conditions with an intense smoking regime*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 4387 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 http://www.electropedia.org/

3.1
smoking run
specific smoking process to produce such smoke from a sample of cigarettes as is necessary for the generation and collection of the smoke components

[SOURCE: ISO 4387:2000, 3.5, modified]

3.2
monitor test piece
sample produced for a specific test purpose, validated to fulfil requirements within specified tolerances and intended to be used for laboratory purposes only and labelled to clearly indicate that it is not for human use

Note 1 to entry: A monitor test piece is a sample taken from a batch of cigarettes that show the greatest homogeneity with regard to their physical, chemical and smoke yield characteristics.

[SOURCE: ISO 16055:2012, 3.1]

4 Principle

The test cigarettes are sampled then conditioned. The test cigarettes are smoked on an analytical smoking machine with simultaneous collection of TPM in a glass fibre filter trap. If used, the consistency of the laboratory smoking process and subsequent analytical procedures are controlled by using monitor test pieces specified in ISO 16055. The mass of the TPM (expressed as milligrams per cigarette) so collected is determined gravimetrically if needed. The TPM is extracted from the trap and might be used for the subsequent determination of smoke constituents.

5 Apparatus

Normal laboratory apparatus and, in particular, the following items:

5.1 Routine analytical cigarette-smoking machine, conforming to the requirements of ISO 20778.

5.2 Soap bubble flow meter, graduated at 55 ml to an accuracy of ± 0,6 ml and with a resolution of 0,2 ml.

5.3 Apparatus for the determination of puff duration and frequency.

5.4 Analytical balance, suitable for measuring to the nearest 0,1 mg.

NOTE The weighing of filter pad holders can be affected by static electricity, necessitating the use of an antistatic device.

5.5 Conditioning enclosure, maintained under the conditions specified in ISO 3402.

5.6 Length-measuring device, suitable for measuring to the nearest 0,5 mm.

5.7 Device for the determination of diameter, in accordance with ISO 2971.

5.8 Smoke trap sealing device, end caps made from a non-hygroscopic and chemically inert material.

5.9 Gloves, made of cotton, or the non-talc surgical type.

5.10 Tape, 10 mm to 20 mm-wide cellophane tape or equivalent material.

NOTE The tape is not needed if cigarette holders with an integrated ventilation blocking function are used.

5.11 Modified cigarette holder, specially designed for intense smoking on an analytical cigarette-smoking machine, as specified in ISO 20778.

6 Sampling

A laboratory sample shall be taken by a sampling scheme such as one of those given in ISO 8243.

This sample will normally contain cigarettes taken from different parts of the population. Make up the test sample required for the test by randomly selecting cigarettes from the different parts of the population represented in the laboratory sample.

7 Generation and collection of total particulate matter

7.1 Preparation of the cigarettes for smoking

7.1.1 General

If N cigarettes of a given type are to be smoked, $C \times N$ cigarettes shall be prepared from Q cigarettes for conditioning and butt marking.

The symbols used in Clause 7 are as follows:

N is the number of cigarettes of a given type to be smoked, resulting from sampling at one point in time or from a sub-period sample;

C is a multiplying factor, of value greater than 1, to allow for loss due to damage or selection procedures between initial sampling and smoking;

Q is the total number of cigarettes available (laboratory sample);

n is the number of replicate determinations of TPM;

q is the number of cigarettes smoked into the same trap;

P is the total number of packets of cigarettes available.

The multiplier C is usually at least 1,2 to provide extra cigarettes in case some are damaged and for optional tests (see 7.6). If selection by mass or draw resistance (or any other parameter) is necessary, C will have to be much larger (experience suggests 2 to 4) depending on the selection process.

The precision normally required generally demands that $80 \leq N \leq 100$. This number may be considerably augmented if the variability of the sample is high; on the contrary, in certain comparisons made of homogeneous samples, this number may be reduced. It may also be reduced when N represents a sub-period sample. N shall never be less than 20 when 10 cigarettes are smoked per trap, or less than 21 when three cigarettes are smoked per trap.

It is necessary for 20 cigarettes to be smoked when 10 cigarettes are smoked per trap, thus providing a replicate analysis and data replication.

The N cigarettes to be smoked will be tested in $n = N/q$ collections if q cigarettes are smoked into one trap. As far as possible these n collections should correspond to different test portions of the test sample. Selection of each test portion will depend upon the form of the test sample.

If the number of cigarettes to be smoked is specified in a determination method, it should be referred to.

7.1.2 Selection of test portions from a bulk of Q cigarettes

If the test sample is in the form of a single bulk, consisting of Q cigarettes, $C \times N$ cigarettes shall be selected at random so that every cigarette has an equal probability of being selected.

7.1.3 Selection of test portions from *P* packets

If the test sample consists of P packets, the selection procedure depends upon the number of cigarettes in each packet (Q/P) compared with q.

If $Q/P \geq C \times q$, select a test portion by choosing a single packet at random, then randomly select $C \times q$ cigarettes from that packet.

If $Q/P < C \times q$, select the smallest number of packets (k) such that

$$\frac{Q \times k}{P} \geq C \times q$$

and randomly choose an equal (or as near equal as possible) number of cigarettes from each packet to form the test portion of $C \times q$ cigarettes.

7.1.4 Duplicate test portions

Provided that the test sample is sufficiently large ($\geq 2C \times N$), a duplicate set of n test portions should be reserved. In this event the parallel selection of a test portion and its duplicate would seem sensible. In this case the two selection conditions of 7.1.3 would need to be changed to $Q/P \geq 2C \times q$ and $Q/P < 2C \times q$.

7.2 Marking the butt length

7.2.1 Standard butt length

The standard butt length to which cigarettes shall be marked shall be the greatest of the following three lengths:

— 23 mm,

— length of filter +8 mm, or

— length of overwrap +3 mm,

where the overwrap is defined as any wrapper applied to the mouth end of the cigarette, and the length of the filter is defined as the total length of the cigarette minus the length of the tobacco portion.

NOTE Butt length is defined in ISO 20778 as the length of unburnt cigarette remaining at the moment when smoking is stopped.

7.2.2 Measurement of length of filter

The length of filter as defined in 7.2.1 shall be the mean value of 10 filter plugs taken from the laboratory sample, measured to an accuracy of 0,5 mm. Express the mean to the nearest 0,5 mm.

NOTE In some instances it can be necessary to measure more than 10 cigarettes. When the variation in filter length can be demonstrated to be well controlled, a smaller number of measurements might be sufficient.

7.2.3 Measurement of length of overwrap

The length of overwrap as defined in 7.2.1 shall be the mean value of 10 overwraps taken from the laboratory sample, measured to an accuracy of 0,5 mm. Express the mean to the nearest 0,5 mm.

NOTE In some instances it can be necessary to measure more than 10 cigarettes. When the variation in overwrap length can be demonstrated to be well controlled, a smaller number of measurements might be sufficient.

