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Bidis — Determination of total and nicotine-free dry particulate matter using a linear routine analytical smoking machine

Bidis — Détermination de la matière particulaire totale et de la matière particulaire anhydre et exempte de nicotine au moyen d'une machine à fumer analytique de routine

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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 on 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*.

Introduction

A bidi (also spelt as beedi) is a hand-made smoking article made by rolling the tobacco filler consisting of air-cured, sun-cured and/or other suitable tobacco variety in Tendu (*Diospyrus* spp.) or Ashriti (*Bauhinia* spp.) leaf. The wrapper leaf is a forest product. Bidis are either conical or cylindrical in shape available in various lengths from 55 mm to 90 mm. Nearly 50 % of the weight of a bidi is contributed by the non-tobacco leaf wrapper.

A conical bidi is completely closed at the broad end (lighting end) by folding and tucking in the wrapper while the flattened narrow end (mouth end) is partly closed and is secured with a thread or any other means to prevent unfolding of the wrapper.

A filter bidi will have a filter plug on one end while the lighting end will be completely closed by folding and tucking in the wrapper leaf.

The components of bidis (tobacco filler and non-tobacco wrapping leaf) are natural products which cause intrinsic variability in bidis. The variability is further increased by the way these components are put together to produce a bidi.

Bidis form an important segment of smoking articles on a global level, are consumed in a large number of countries and hence an International Standard on the analysis of bidi smoke is justified.

The method allows bidis to be smoked on a routine analytical linear smoking machine using a strictly controlled set of parameters and collection of total particulate matter from smoke for further analysis. Thus, it enables the determination of nicotine-free dry particulate matter (NFDPM) and nicotine in bidis, when smoked by this procedure, to be compared and ranked on the basis of machine yield.

Experience and knowledge gained from the use of analytical cigarette-smoking machines have highlighted a need to specify certain requirements, which are addressed in this document.

No machine smoking regime can represent all human smoking behaviour:

— machine smoking testing is useful to characterize bidi 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 misuse of testing using ISO standards.

Bidis — Determination of total and nicotine-free dry particulate matter using a linear routine analytical smoking machine

WARNING — The use of this document can involve hazardous materials, operations and equipment. This document does not purport to address all the safety problems associated with its use. It is the responsibility of the user of this document to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

1 Scope

This document specifies methods for the determination of total particulate matter and for the subsequent determination of nicotine-free dry particulate matter present in the smoke from bidis generated and collected using a routine analytical smoking machine.

The smoking method described is suitable for routine analytical smoking machines which are equipped with a suitable bidi holder complying with the requirements of 5.8. The method is equally suitable for rotary machines after due validation.

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 3308:2012, *Routine analytical cigarette-smoking machine — Definitions and standard conditions*

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

ISO 4387:2000, *Cigarettes — Determination of total and nicotine-free dry particulate matter using a routine analytical smoking machine*

ISO 10315, *Cigarettes — Determination of nicotine in smoke condensates — Gas-chromatographic method*

ISO 10362-1, *Cigarettes — Determination of water in smoke condensates — Part 1: Gas-chromatographic method*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 3308, ISO 3402 and ISO 4387 and the following apply.

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

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

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1
butt length
length of unburnt bidi remaining at the moment when the smoking is stopped

[SOURCE: ISO 3308:2012, 3.2, modified — “cigarette” has been replaced by “bidi”.]

3.2
puff volume
volume leaving the butt end of a bidi and passing through the *smoke trap* (3.7)

[SOURCE: ISO 3308:2012, 3.8, modified — "cigarette" has been replaced by "bidi".]

3.3
puff number
number of puffs necessary to smoke a bidi to a specified *butt length* (3.1)

[SOURCE: ISO 3308:2012, 3.9, modified — "cigarette" has been replaced by "bidi".]

3.4
puff frequency
number of puffs in a given time

[SOURCE: ISO 3308:2012, 3.10]

3.5
puff termination
termination of the connection of the port to the suction mechanism

[SOURCE: ISO 3308:2012, 3.11]

3.6
bidi holder
device for holding the mouth end of a bidi during smoking

[SOURCE: ISO 3308:2012, 3.14, modified — "cigarette" has been replaced by "bidi".]

3.7
smoke trap
device for collecting such part of the smoke from a sample of bidis as is necessary for the determination of specified smoke components

[SOURCE: ISO 3308:2012, 3.15, modified — "cigarette" has been replaced by "bidi".]

3.8
channel
element of a smoking machine consisting of one or more *bidi holders* (3.6), one trap and a means of drawing a puff through the trap

[SOURCE: ISO 3308:2012, 3.17, modified — "cigarette" has been replaced by "bidi".]

3.9
mainstream smoke
all smoke which leaves the butt end of a bidi during the *smoking process* (3.13)

[SOURCE: ISO 3308:2012, 3.20, modified — "cigarette" has been replaced by "bidi".]

3.10
total particulate matter
crude smoke condensate
TPM
that portion of the *mainstream smoke* (3.9) which is trapped in the *smoke trap* (3.7), expressed as milligrams per bidi

[SOURCE: ISO 4387:2000, 3.1, modified — "cigarette" has been replaced by "bidi".]

3.11
dry particulate matter
dry smoke condensate
DPM
total particulate matter (3.10) after deduction of its water content, expressed as milligrams per bidi

[SOURCE: ISO 4387:2000, 3.2, modified — “cigarette” has been replaced by “bidi”.]

3.12
nicotine-free dry particulate matter
nicotine-free dry smoke condensate
NFDPM
dry particulate matter (3.11) after deduction of its nicotine content, expressed as milligrams per bidi

[SOURCE: ISO 4387:2000, 3.3, modified — “cigarette” has been replaced by “bidi”.]

3.13
smoking process
use of a smoking machine to smoke bidis from lighting to final puff

[SOURCE: ISO 4387:2000, 3.4, modified — “cigarette” has been replaced by “bidi”.]

3.14
smoking run
specific *smoking process* (3.13) to produce such smoke from a sample of bidis as is necessary for the determination of the smoke components

[SOURCE: ISO 4387:2000, 3.5, modified — “cigarettes” has been replaced by “bidis”.]

3.15
bidi laboratory sample
bidi sample received in the laboratory for inspection or testing

[SOURCE: ISO 4387:2000, 3.6, modified — the term “laboratory sample” has been replaced by “bidi laboratory sample” and the definition has been revised.]

3.16
bidi conditioning sample
bidis taken randomly from the laboratory sample for conditioning prior to selection and tests

[SOURCE: ISO 4387:2000, 3.8, modified — the term “conditioning sample” has been replaced by “bidi conditioning sample” and the definition has been revised.]

3.17
bidi test sample
bidis for test selected by mass and length from the conditioned *bidi laboratory sample* (3.15)

[SOURCE: ISO 4387:2000, 3.7, modified — the term “test sample” has been replaced by “bidi test sample” and the definition has been revised.]

3.18
bidi test portion
group of selected and marked bidis prepared for a single determination and which is a random sample from the test sample

[SOURCE: ISO 4387:2000, 3.9, modified — the term “test portion” has been replaced by “bidi test portion” and the definition has been revised.]

4 Principle

Bidis are conditioned and then selected by mass and length. The selected bidis are smoked on a routine analytical smoking machine with simultaneous collection of total particulate matter on a glass fibre filter pad fitted in a smoke 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 smoking regime/protocol is maintained as specified in ISO 4387 except for the puff frequency which is changed to two puffs per minute and only two bidis are smoked per smoke trap to avoid overload of the filter pad. This puff frequency is necessary as bidis extinguish if not puffed frequently. The mass of total particulate matter so collected on each trap is determined gravimetrically. The total particulate matter is extracted from the trap for the determination of the water and nicotine contents by gas chromatography.

In laboratories that are not in a position to use gas chromatographic methods, reference should be made to ISO 3400 for the determination of total nicotine alkaloids in smoke condensates by spectrometric method, and the determination of water in smoke condensate should be performed by the method described in ISO 10362-2. In such cases, values obtained for nicotine and water in smoke condensate may be used with the addition of a note in the expression of the result.

NOTE 1 ISO 3308 and ISO 4387 deal with the routine analytical smoking machine and smoking cigarettes on a smoking machine, respectively. Most of the requirements given in ISO 3308 and ISO 4387 are equally applicable to bidi smoking. Any laboratory familiar with cigarette smoke analysis will be able to adopt these standards for bidi smoke analysis by judiciously substituting cigarettes with bidis in these standards as appropriate.

NOTE 2 ISO 3308 and ISO 4387 employ a cigarette holder for smoking cigarettes on a routine analytical smoking machine. However, in case of smoking bidis on a smoking machine, a bidi holder (5.8) is required in place of the cigarette holder due to the bidi's unusual shape and the size of its mouth end.

5 Apparatus

The usual laboratory apparatus and, in particular, the following items.

5.1 Routine analytical cigarette-smoking machine.

5.2 Soap bubble flow meter, graduated at 35 ml to an accuracy of ±0,2 ml and with a resolution of 0,1 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.

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

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

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

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

5.8 Bidi holder, a device for holding the mouth end of a bidi during smoking.

The outer surface of the bidi is uneven and irregular and the mouth end is narrow and elliptical, hence a special holder is required. The bidi holder shall ensure a leak-proof hold of the mouth end of a bidi for smoking on the smoking machine. The bidi holder shall cover 9,0 mm, with a range of 8,0 mm to 9,5 mm, from the butt end of a bidi and shall be impermeable to smoke components and to air.

The bidi holder shall also be provided with devices for attaching it to the standard filter holder and in turn to the smoking port of the smoking machine so that the bidi holder is held rigidly and that no air enters the smoke trap and no smoke is lost from the smoke trap during smoking. The axis of the holder shall be within 0° to +5° of the horizontal and the holder shall ensure that the bidi is held within ±5° of the holder axis.

Bidi holders complying with these requirements are available commercially for smoking machines. The user instructions provided by the suppliers shall be followed for preparing the bidi holder, assembling the smoke trap and inserting the bidi into the holder.

An example of a bidi holder suitable for linear smoking machines is given in Annex A for information.

5.9 Glass fibre filter pads. It is recommended to choose the size of the glass fibre filter pads in relation to the mass of collected smoke condensate in accordance with ISO 3308.

The pads shall be conditioned in the test atmosphere specified in ISO 3402 for at least 12 h before use.

6 Preparation of bidi test portion for smoking

6.1 Conditioning of bidi laboratory sample

A sufficient number of bidis randomly drawn from the laboratory sample is conditioned as specified in 6.4.1.

6.2 Selection of conditioned bidis

6.2.1 General

The test sample bidis shall be selected from the conditioned sample (6.1) based on both mean mass and mean length.

Due to the inherent high variability in the bidi length and mass, it is necessary to select bidis on length and mass to achieve reproducible results in the total particulate matter collected.

6.2.2 Selection by mass

6.2.1.1 Weigh individually 100 bidis taken randomly from the conditioned laboratory sample (6.1) to the nearest 1 mg and calculate the mean mass and SD.

6.2.1.2 Bidis are then selected from the conditioned sample (6.1) on the basis of mean mass ±30 mg.

6.2.3 Selection by length of mass selected bidis (6.2.1)

6.2.2.1 Measure individually the length of 100 bidis taken randomly from the conditioned laboratory sample (6.1) to an accuracy of 0,5 mm and calculate the mean length and SD.

6.2.2.2 Bidis, already selected on a mass basis (6.2.1.2), are further selected on the basis of mean length ±2 mm.

Bidis selected on mass and length basis will constitute the test sample for smoking and will be stored in the conditioning atmosphere (6.4.1).