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Cigarettes — Determination of total and dry particulate matter using a routine analytical cigarette- smoking machine — Electrostatic smoke trap method

*Cigarettes — Détermination du condensat de fumée brut et anhydre au moyen d'une machine
à fumer analytique de routine pour cigarettes — Méthode par piégeage électrostatique*

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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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 8453 was prepared by Technical Committee ISO/TC 126, *Tobacco and tobacco products*.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

Cigarettes — Determination of total and dry particulate matter using a routine analytical cigarette-smoking machine — Electrostatic smoke trap method

0 Introduction

The procedure specified in this International Standard is applicable to all types of cigarettes; however, the results obtained from machine smoking of certain types of cigarettes may not be suitable for ranking or consumer information and may reveal the need for further and more adequate information to be made available.

ISO/TC 126 is studying this problem and will try to find a solution which will be taken into account in a future revision of this International Standard.

1 Scope and field of application

This International Standard specifies a method for determining the total and dry particulate matter present in the smoke from cigarettes generated and collected using a routine analytical cigarette-smoking machine equipped with an electrostatic smoke trap.

2 References

ISO 760, *Determination of water — Karl Fischer method (General method)*.

ISO 2971, *Tobacco and tobacco products — Cigarettes and filters — Determination of nominal diameter*.

ISO 3308, *Cigarettes — Routine analytical cigarette-smoking machine — Definitions and standard conditions*.

ISO 3400, *Tobacco and tobacco products — Determination of alkaloids in cigarette smoke condensates — Spectrophotometric method*.

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

ISO 6488, *Tobacco — Determination of water content (Reference method)*.

ISO 6565, *Tobacco and tobacco products — Draw resistance of cigarettes and filter rods — Definitions, standard conditions and general aspects*.

ISO 8243, *Cigarettes — Sampling*.¹⁾

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1 total particulate matter; crude smoke condensate : That portion of the mainstream smoke which is trapped in the smoke trap, expressed as milligrams per cigarette (mg/cig.).

3.2 dry particulate matter; dry smoke condensate : The total particulate matter after deduction of its water content, expressed as milligrams per cigarette (mg/cig.).

3.3 nicotine-free dry particulate matter; nicotine-free dry smoke condensate : The dry particulate matter after deduction of its nicotine alkaloids content, expressed as milligrams per cigarette (mg/cig.).

3.4 clearing puff : Any puff taken after a cigarette has been extinguished.

3.5 smoking process : The use of a smoking machine to smoke one cigarette per port from lighting to final puff.

3.6 smoking run : A combination of smoking processes to produce such smoke from a sample of cigarettes as is necessary for the determination of the smoke components.

3.7 laboratory sample : The cigarettes sent to the laboratory for testing.

3.8 test sample; conditioning sample : The cigarettes selected from the laboratory sample for conditioning prior to tests for particulate matter yield.

3.9 test portion : The conditioned cigarettes smoked for particulate matter yield tests.

4 Principle

Smoking of the test cigarettes in an automatic smoking machine and collection of the mainstream smoke by an electrostatic smoke trap. Gravimetric determination of the mass of

1) At present at the stage of draft.

total particulate matter so collected. Extraction of the total particulate matter from the trap and determination of the water content by Karl Fischer or gas chromatographic methods.

5 Apparatus

Normal laboratory apparatus and in particular the following items:

5.1 Routine analytical cigarette-smoking machine, complying with the requirements of ISO 3308.

5.2 Soap bubble flow meter, range 0 to 50 ml, graduated in 0,1 ml divisions.

5.3 Apparatus for the determination of puff duration and frequency.

5.4 Analytical balance.

5.5 Pressure drop testing equipment.

5.6 Conditioning enclosure, maintained accurately in accordance with the conditions specified in ISO 3402.

5.7 Equipment for the determination of water content.

This can be either Karl Fischer equipment in accordance with ISO 760 or a suitable gas chromatograph (see 8.1 or 8.2).

5.8 Electrostatic smoke trap (see figure), made of an air-tight and chemically inert material, preferably transparent, and consisting of

- 1) precipitation tube;
- 2) holding device for precipitation tube;
- 3) cigarette holder;
- 4) central electrode (positive);
- 5) screw cap;
- 6) seal (e.g. O-ring seal);
- 7) insulating socket;
- 8) outlet for gas phase to suction source;
- 9) earthing coil;
- 10) high voltage inlet (up to 25 kV);
- 11) earthing connection.

The precipitation tube (1) shall be carefully brought to equilibrium with the ambient conditions before inserting into the smoking machine. After it has been inserted into the seal (6) and connected with the earthing coil (9), the high voltage is switched on.

The smoke trap shall be capable of quantitatively retaining at least 99,9 % of the mainstream smoke produced by the cigarette without loss of particulate matter.

To check the efficiency of smoke precipitation by the electrostatic trap, a glass fibre filter shall be attached between the electrostatic smoke trap and the piston. This additional trap shall not retain more than 0,05 % of the total particulate matter.

The smoke trap shall be chosen so that the increase in pressure drop of the assembly does not exceed 250 Pa (2,5 mbar), at a flow rate of 17,5 ml/s when measured after the smoking.

5.9 Apparatus for measuring the angular position of the cigarettes

This instrument shall rest on a horizontal plane of the smoking machine at the level of the smoking ports. It shall consist of a set of calipers, one leg of which is in the horizontal plane; while the other is adjustable so as to be parallel to the cigarettes inserted in the cigarette holders on the smoking machine. By using a protractor, it shall be possible to ensure that the cigarette position with respect to the horizontal plane is in agreement with the standard conditions.

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

5.11 Apparatus for the determination of diameter.

6 Sampling

A laboratory sample, representative of the cigarette type to be sampled, shall be provided by a sampling scheme such as one of those in ISO 8243. This sample will normally contain cigarettes taken from different parts of the population.

For any particular test, for example determination of total particulate matter, it should then be possible to make up the test sample which is required for the test by randomly selecting cigarettes from the different parts of the population represented in the laboratory sample.

7 Determination of total particulate matter

In 7.1 and 7.6 below, the following symbols are used :

N is the number of cigarettes of a given type to be smoked;

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

n is the number of replicate determinations of total particulate matter;

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

P is the total number of packets of cigarettes available;

Q is the total number of cigarettes available (test sample).

7.1 Preparation of the cigarettes for smoking

If N cigarettes of a given type are to be smoked, $C \times N$ cigarettes should be prepared from Q for conditioning and butt marking. The multiplier C is usually at least 1,2 to provide extra cigarettes in case some are damaged. If selection by mass or draw resistance (or any other parameter) is necessary, C will have to be much larger (experience suggests 2,0 to 4,0), depending on the selection process.

The precision normally required generally demands that $N > 100$. This number may be substantially augmented if the