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**Tobacco and tobacco products — Non-destructive determination of strips density variation ratio in case — Ionizing radiation method**

*Tabac et produits du tabac — Détermination non destructive de la variation de densité des strips en caisse — Méthode par radiations ionisantes*

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Published in Switzerland

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 12030 was prepared by Technical Committee ISO/TC 126, *Tobacco and tobacco products*, Subcommittee SC 2, *Leaf tobacco*.

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## Introduction

The density variation ratio (DVR) is one of the significant factors that influence tobacco aging and primary processing (see Reference [1]). For example, the phenomena of oil loss, caking or even carbonization is easy to take place in an aging process because of the larger DVR. The block of strips, which has a larger DVR, is difficult to loosen in a conditioning cylinder. The larger DVR can lead to deterioration of taste and quality of cigarette and hence it is important to detect DVR of strips still in its case (i.e. before introducing it into a primary processing stream).

The standard method for detecting DVR of strips in case, used at present, is based on “9-point Static Detection” (see Reference [2]). This method results in damage to strips, being applicable for only off-line measurements and needing longer testing time. A non-destructive method, on the other hand, would be quicker, amenable to both off-line and on-line measurements and would result in no damage to strips and hence has been a subject of analytical research and development.

X-rays can easily penetrate the strips' case and their intensity correlates to the density of the material they pass through, which would be a strips column in the case. The ionizing method has been widely used in many other areas (see IEC 60692<sup>[3]</sup>) and IEC has developed relevant standards for safe X-ray apparatus (see IEC 60405<sup>[4]</sup>). The X-ray apparatus used in the proposed method complies with these International Standards and can therefore be considered to be a completely safe radiation source.

Thus the ionizing radiation (X-ray attenuation) method retains the advantages of a non-destructive method for measurement of density of strips in the case, is amenable for on-line as well off-line measurements, is quick, safe and relatively inexpensive. The present proposal elaborates on its application for measurement of density of strips in the case.

There are more possibilities of measuring the density variation ratio in case. Any system with the same accuracy can be used.

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# Tobacco and tobacco products — Non-destructive determination of strips density variation ratio in case — Ionizing radiation method

## 1 Scope

This International Standard specifies a method for determining density variation ratio (DVR) of strips in the case.

## 2 Normative references

The following referenced documents are indispensable for the application 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 6488, *Tobacco and tobacco products — Determination of water content — Karl Fischer method*

ISO 16632, *Tobacco and tobacco products — Determination of water content — Gas-chromatographic method*

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## 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

### 3.1

#### **non-destructive determination**

determination without any damage to the objects under study

### 3.2

#### **density variation ratio**

#### **DVR**

relative standard deviation of the strips density in case

## 4 Principle

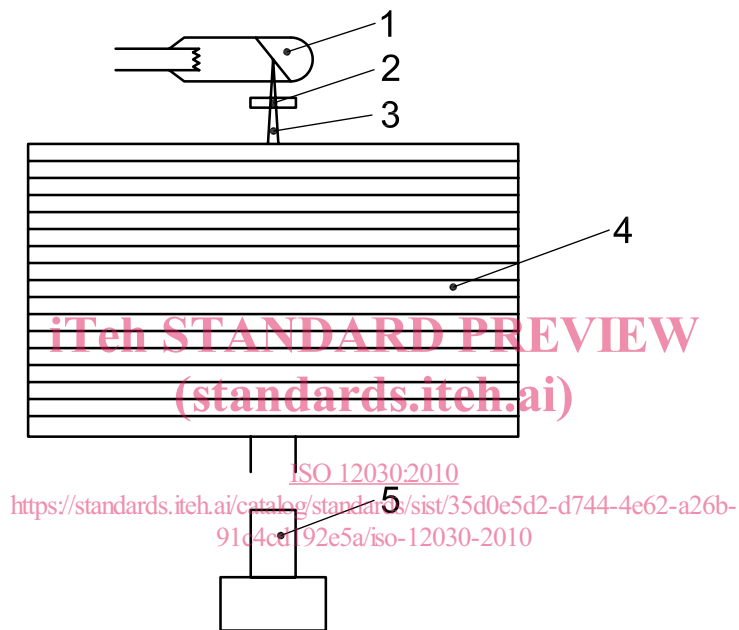
The X-rays penetrate the tobacco strips in the case and lose their intensity depending on the density of the strips. The measured intensity of X-rays can thus be related to strips density according to Equation (1).

$$\rho = -\frac{1}{U_m \times d} \ln \frac{I_i}{I_0 \times B} \quad (1)$$

where

- $\rho$  is the strips density;
- $\mu_m$  is the mass attenuation coefficient;
- $d$  is the thickness of strips (case height);
- $I_i$  is the intensity of X-rays after penetrating strips column;
- $I_0$  is the initial intensity of X-rays;
- $B$  is the scattering factor.

The principle is illustrated in Figure 1.



**Key**

- |                    |                |
|--------------------|----------------|
| 1 X-ray source     | 4 strips case  |
| 2 collimation hole | 5 NaI detector |
| 3 X-ray beam       |                |

**Figure 1 — Principle of measurement**

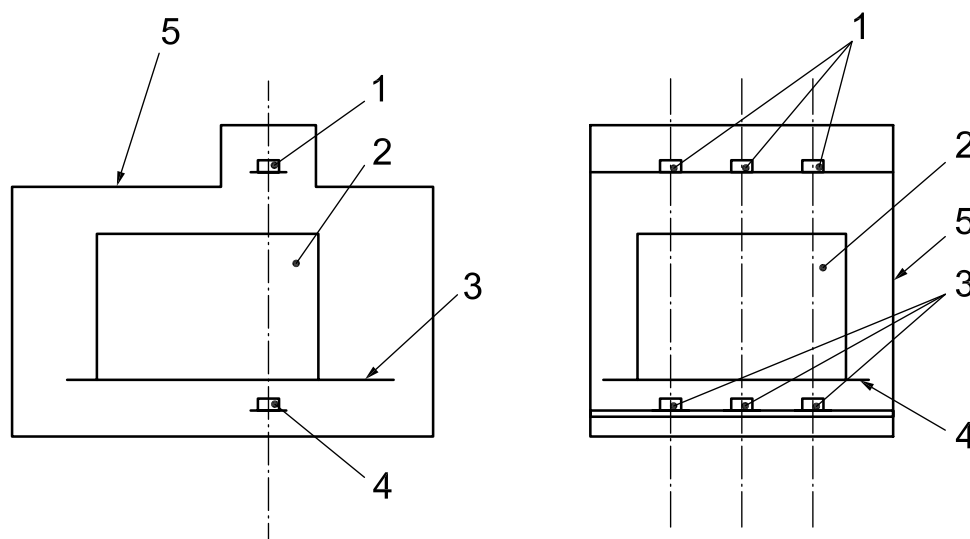
**5 Apparatus**

**5.1 X-ray apparatus**, complying with the following requirements. See Figure 2.

- a) main components: one or three pairs of X-ray-producing tubes and X-ray detectors (see Annex B);
- b) resolution: at least 1 kg/m<sup>3</sup> for strips density;
- c) scope: 100 kg/m<sup>3</sup> to 600 kg/m<sup>3</sup> for strips density;
- d) zero-drift: not more than 1 % over 24 h period;
- e) output: density value of nine different detecting spots,  $\rho_1, \rho_2 \dots \rho_9$ ; DVR value;
- f) safety requirement: maximum X-ray dose of 2,5 µSv/h at 1,0 m distance.



## 5.2 Analytical balance, with an accuracy of $\pm 0,1$ g.



### Key

- 1 X-ray-producing device
- 2 strips case
- 3 X-ray detector
- 4 conveyer belt
- 5 radiation shield

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Figure 2 — Schematic diagram of X-ray apparatus

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## 6 Procedure

### 6.1 Sampling

#### 6.1.1 On-line determination

Every strips case shall be subjected to density determination.

#### 6.1.2 Off-line determination

The recommended sampling rate for strips cases to be subjected for density determination is 2 %. If the total number of cases is less than 100, at least two cases representing the entire lot shall be subjected to density determination.

### 6.2 Experimental protocol

The main components of the instrument are the X-ray sources (5.1) with one or three pairs of X-ray-producing tubes and sensitive X-ray detectors. The X-ray-producing tubes emit X-rays constantly and the X-ray detector measures the intensity of the X-rays after they have passed through strips column in the strips case. The density determination device is fixed over a conveyor belt that carries the strips case. The number and location of detecting spots is given in 6.3.

The density value of nine different detection spots is determined as a first result, and then the DVR value is calculated.