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Textiles — Cotton fibres — Evaluation of maturity by the air flow method

Textiles — Fibres de coton — Évaluation de la maturité par la méthode à courant d'air

Reference number
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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.

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.

International Standard ISO 10306 was prepared by Technical Committee ISO/TC 38, *Textiles*, Sub-Committee SC 6, *Fibre testing*.

Annexes A and B form an integral part of this International Standard.

International Organization for Standardization
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Introduction

The term "cotton fibre maturity" is commonly used to signify the relative degree of fibre wall development. The measurement of the relative degree of wall thickening is too laborious for most practical purposes, therefore the determination of the maturity of cotton fibres is done by indirect methods. A microscopic method is described in ISO 4912:1981. This method has been used as a reference method for the industrial evaluation of the maturity of cotton fibres using air flow instruments, which is the object of this standard.

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Textiles — Cotton fibres — Evaluation of maturity by the air flow method

1 Scope

This International Standard specifies a method for the evaluation of the maturity of loose randomized cotton fibres by measuring the resistance to air flow of a plug of cotton fibres under two prescribed conditions. The method is applicable to cotton taken at random from bales. Laps and slivers or other sources of lint cotton may be tested, however results may differ if fibres are taken from bales.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 139:1973, *Textiles — Standard atmospheres for conditioning and testing.*

ISO 1130:1975, *Textile fibres — Some methods of sampling for testing.*

ISO 2403:1972, *Textiles — Cotton fibres — Determination of micronaire value.*

ISO 4912:1981, *Textiles — Cotton fibres — Evaluation of maturity — Microscopic method.*

3 Definitions

For the purposes of this International Standard, the definitions in ISO 4912:1981 and ISO 2403:1972 apply. The following definitions are repeated here for the convenience of the user.

3.1 immature fibre: Fibre which, upon swelling, either assumes a spiral form or lies flat, thinly outlined and almost transparent.

It has a wall thickness of less than one-fourth of the maximum fibre width. [ISO 4912:1981]

3.2 mature fibres: Fibres, the cell walls of which have developed sufficiently so that, upon swelling, they become unconvoluted and almost rod-like in shape.

Such fibres have a wall thickness equal to or greater than one-fourth of the maximum fibre width. [ISO 4912:1981]

3.3 maturity ratio, M**:** Ratio of the degree of wall thickening to a standard degree of thickening selected arbitrarily to equal 0,577. [ISO 4912:1981]

3.4 percent maturity, P_m**:** Average percentage of mature fibres in a sample, based on the total number of fibres. [ISO 4912:1981]

3.5 micronaire value: Measure of the air permeability of a mass of cotton under specified conditions, expressed in terms of an arbitrary scale, the so-called micronaire scale.

The micronaire scale is based on a range of cottons to which micronaire values have been assigned by international agreement. [ISO 2403:1972]

4 Principle

Air is passed through a test specimen consisting of a plug of well-opened randomized cotton fibres. For the same mass of fibres the permeability is measured by two different compressions of the plug. For each compression, air is passed through the plug at a specified rate and the pressure drop across the plug is indicated on a pressure gauge and expressed as the height, in millimetres, of a water column. The pressure drop obtained at low compression of the plug is designated PL and the other, at high compression, is

designated PH. These two pressures may be used to calculate a maturity ratio and fibre linear density or a percentage of mature fibres using appropriate formulae. The micronaire value is determined solely from the PL value.

5 Apparatus and materials

5.1 Balance, of sufficient capacity to weigh the test specimen required for the air flow instrument used, with a sensitivity of better than 0,005 g.

5.2 Air flow instrument (see annex A).

The principal parts comprising the air flow instrument are:

5.2.1 Compression cylinder, with perforated end, of such dimensions that with the specified mass of specimen each cubic centimetre of the cylinder shall contain 0,191 1 g of cotton at low compression and 0,382 1 g of cotton at high compression.

5.2.2 Means of measuring air permeability of the specimen, comprising for example:

a) a suitable air pump;

b) two valves or other means for controlling the flow of air through the specimen or the pressure drop across the specimen in the compression cylinder;

c) means for setting the required rate of air flow through the specimen and a gauge for measuring the air pressure drop across the specimen.

NOTE 1 Details of certain commercially available instruments which comply with this specification are given in annexes A and B to this International Standard. The method of calibration of air flow instruments is described in annex B.

5.3 International calibration cotton standards

Reference cotton used for the calibration of air flow instruments is described in B.2.2.

5.4 Specimen preparation apparatus

Any blending apparatus is considered suitable if it produces randomly oriented samples.

NOTE 2 Apparatus that produces webs of predominantly parallel fibres is not suitable.

6 Atmosphere for conditioning and testing

6.1 Condition test samples in the standard atmosphere for 4 h in moving air or alternatively for 12 h in still air. Preconditioning is not required.

6.2 Weigh and test the specimen in the standard atmosphere for conditioning (see ISO 139:1973).

7 Sampling and number of specimens

The sampling scheme, the number of specimens to be tested and the number of measurements to be made on each specimen will normally be determined by the material specification or will be agreed between the interested parties. In the absence of any instructions, test at least two specimens, making two tests on each. Samples of raw cotton from bales may be taken according to the method described in ISO 1130:1975.

The mass of the test specimens shall be as specified by the manufacturer of the air flow instrument.

8 Procedure

8.1 Before each series of measurements, make the necessary preliminary adjustments appropriate to the instrument in use (see annexes A and B).

8.2 Divide the weighed specimen with the fingers into four to six portions, tease each portion out randomly until about 5 cm to 7 cm in diameter and place each portion successively into the sample holder until the entire specimen is loaded. Carefully insert the first portion so as to fill in the bottom edges of the sample holder by pushing it well into the bottom of the sample holder and outwards to the edges. Take care to insert all the specimen and not to lose any of the fibres. Insert the compression plunger and lock it in its position. Avoid fibres sticking between the cylinder wall and the compression plunger.

8.3 Cause air to flow through the specimen at the appropriate flow rate for the low compression of the plug and after 10 s note the reading, PL, on the pressure scale of the instrument to an accuracy of 1 mm of the water column. Next cause air to flow through the specimen at the appropriate flow rate for the high compression of the plug and after 10 s note the reading, PH, on the pressure scale of the instrument to the same accuracy of 1 mm of the water column.

8.4 Remove the test specimen from the cylinder and reinsert it, reversing the individual portions, and repeat the procedure given in 8.2 and 8.3.

8.5 Repeat the procedure given in 8.2 to 8.4 on a second test specimen taken from the same sample.

If the PL or PH readings of the two successive specimens from the same sample differ by more than 5 %, it is recommended to examine a new specimen from the same sample and to calculate the average readings for all specimens tested.

9 Calculations and expression of results

Average the two readings of each pressure drop, PL and PH, taken for each specimen tested from a sample. Using each pair of average readings, PL and PH, calculate the maturity ratio, M, or the percent maturity, P_m, of each specimen via the appropriate conversion formula (see annex A). Average the readings of pressure drops PL and PH, and average the values calculated for the two specimens tested from a sample.

10 Test report

The test report shall include the following information:

a) reference to this International Standard;

b) the material source and if possible type and/or botanical species;

c) the number of specimens tested, the number of readings per specimen, the number of samples used, and the sampling method;

d) the average of the values measured for PL and PH, the calculated values such as maturity ratio, M, or percent maturity, P_m, and also the equation used;

e) type, make and model of instrument used;

f) date of the test.

Annex A
(normative)

Operation of the air flow instrument "Fineness/Maturity Tester"

A.1 There are several models of "Fineness/Maturity Testers". They vary only in details of construction and operation. Any details of the operation of a particular model which differ from the instructions given in this annex are described in the manufacturer's instructions included with the instrument.

A.2 Fineness/Maturity Tester, Type .....

A.2.1 Turn on the instrument and wait 15 minutes for it to warm up.

A.2.2 Proceed to the different verifications recommended in the manufacturer's manual.

A.2.3 Calibrate the instrument following one of the methods described in annex B.

A.2.4 Carry out the measurements as described in clause 8 of this International Standard.

A.2.5 Using the PL and PH readings, calculate either the maturity ratio or the percent maturity via conversion equation (A.1) or (A.2) respectively.

A.2.5.1 Maturity ratio

$$M = 0{,}247\ PL^{0{,}125}\left(\frac{PL}{PH}\right)^2 \qquad \ldots (A.1)$$

A.2.5.2 Percent maturity

$$P_m = 95{,}0\,\frac{PL}{PH} - 50{,}8 \qquad \ldots (A.2)$$

NOTE 3 PL and PH readings may also be used to calculate the micronaire value using equation (A.3) or linear density using equation (A.4).

$$\text{micronaire value} = 0{,}60 + \frac{850}{PL + 40} \qquad \ldots (A.3)$$

$$\text{linear density (mtex)} = \frac{60\,000}{PL}\left(\frac{PH}{PL}\right)^{1{,}75} \qquad \ldots (A.4)$$

Annex B
(normative)

Method for instrument calibration

B.1 The calibration of air flow instruments is performed by setting the air flow valves to the appropriate air flow rate corresponding to the degree of compression applied to the cotton fibre plug.

B.2 For the calibration of the instrument proceed as follows:

B.2.1 Calibration according to the manufacturer's instructions

Set the air flow control successively for each compression of the plug so that the upper edge of the float comes to rest at the upper setting line on the manometer for the low compression and at the lower setting line on the manometer for the high compression, the test chamber being empty. The air flow is then set to 4 l/min or 1 l/min depending on the degree of compression. In both cases great care should be taken to align the top of the float with the setting line, avoiding parallax. These settings are critical and the readings should be checked at regular intervals during testing.

B.2.2 Recommended calibration method using reference cotton

Set the air flow control successively for each compression of the plug so that the manometer reads predetermined values of pressure drops PL and PH for the reference cotton, the test cylinder being filled with the specified mass of plug taken from the reference cotton used.

NOTE 4 A series of international reference cottons for calibration are available from the Standards Section, Cotton Division, Agricultural Marketing Service, U.S. Department of Agriculture, P.O. Box 17723, Memphis, TN 38112, USA.

Until the International Calibration Cotton Standards Committee takes over the work, the ITMF Working Group on Maturity will provide the standard values PL and PH to be used for reference cottons.