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Third edition
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Textiles — Determination of fineness of flax fibres — Permeametric methods

Textiles — Détermination de la finesse des fibres de lin — Méthodes perméamétriques

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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 www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 38, *Textiles*, Subcommittee SC 23, *Fibres and yarns*.

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.

This third edition cancels and replaces the second edition (ISO 2370:1980), which has been technically revised. The main changes compared to the previous edition are as follows:

— addition of the third method for the determination of the fineness of flax fibres as Clause 7, "Constant pressure method";

— deletion of Annex C and Annex D.

Introduction

Fineness can be considered as a vital characteristic of flax. However, because of their special structure, the measurement of the fineness of such fibres presents a difficult problem.

Whereas cotton, wool, man-made fibres, etc., form individual fibres of a given dimension and are easily separated one from the other, flax fibres form, after retting and scutching, fibre strands. These consist of a certain number of ultimate fibres, bound together more or less imperfectly by pectic substances which give certain fibres a branching form. During the spinning operations, these fibre strands are progressively divided without such a process ending in the complete separation into ultimate fibres.

In these conditions, determination of the fineness of flax fibres presents the following difficulties.

— Difficulty from the continuous alteration of the amount of division of the substance during the spinning. One cannot therefore refer to fineness as such, but only to fineness corresponding to a state consecutive to a given operation. It will therefore always be necessary to specify the state in which the substance is found when making any measurement.

— Difficulty, from the fact that the separation of the fibrous elements is a delicate operation, which also results from the constitution of the substance.

Taking these difficulties into account, “permeametric” methods seem most suitable for measuring the fineness of bast.

Textiles — Determination of fineness of flax fibres — Permeametric methods

1 Scope

This document specifies three permeametric methods for the determination of the fineness of flax fibres.

— Constant flow method, with two compressions, using a test piece of parallel fibres (see Clause 5);

— Simplified constant flow method, with one compression, using a test piece of fibres distributed "at random" (see Clause 6);

— Constant pressure method, with one compression, using a test piece of fibres distributed "at random" (see Clause 7).

This document is applicable to the various forms possible for flax fibres, i.e. long strands, broken strands, all kinds of tow and at all stages of manufacture of these substances.

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 139, *Textiles — Standard atmospheres for conditioning and testing*

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

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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
wad of fibre
fibrous mass introduced into the centre channel of a cylindrical casing forming the test piece and on which the measurement will be made

Note 1 to entry: In the constant flow method, the fibrous elements forming the wad are placed parallel to the axis of the casing. In the simplified constant flow method and constant pressure method, the fibrous mass is introduced into a chamber so that the fibres forming the wad are placed at random. In all three methods, it is essential that the density of the filling is as regular as possible.

3.2
resistance of a wad of fibres to the passage of air in laminar flow
R
quotient of the depression ΔP (hPa) produced by the *wad of fibres* (3.1) to flow Q (cm^3/s) passing through it

Note 1 to entry: It is expressed in $hPa \cdot s/cm^3$.

3.3
specific surface of a wad of fibres
A
quotient of the total side surface of the constituent fibrous elements by their volume

Note 1 to entry: It is expressed in cm^2/cm^3.

3.4
index of specific surface of a wad of fibres
A'
arithmetic product of the specific surface (A) and the square root of the product of the viscosity of the air (μ) and a dimensionless empirical factor of proportionality (k)

3.5
index of fineness standard
IFS
index of fineness determined by a conventional method (gravimetric method) on reference lots

Note 1 to entry: Itis relatively close to values expressed by the Tex system.

Note 2 to entry: Compensation is permitted for the fact that the fineness of flax fibres cannot be defined in an absolute manner.

4 Conditioning and test atmosphere

Weighing and measuring shall be carried out in the standard atmosphere for conditioning and testing of textiles, defined in ISO 139, on test pieces previously conditioned in the same atmosphere.

5 Constant flow method

5.1 Principle

Measurement of the resistance to the passage of air of a wad of parallel fibres of given mass placed successively in two casings of specified size but different diameters, then, from the two values obtained, deduction of the index of specific surface of the wad and the density of the fibres, which characterize the fineness of the fibres.

5.2 Sampling

Samples shall be representative of a batch.

Sampling shall be carried out by one of the methods given in ISO 1130.

5.3 Test pieces

5.3.1 Requirement

The test piece shall consist of a stub of parallel fibres about 80 mm ± 1 mm long, having a mass between 2,8 g and 3,2 g, depending on the material. Five test pieces shall be prepared for each sampling.

5.3.2 Preparation

5.3.2.1 Scutched or hackled flax

Cut from the desired place (for example top, middle, bottom) stubs 80 mm ± 1 mm long.

5.3.2.2 Flax tow

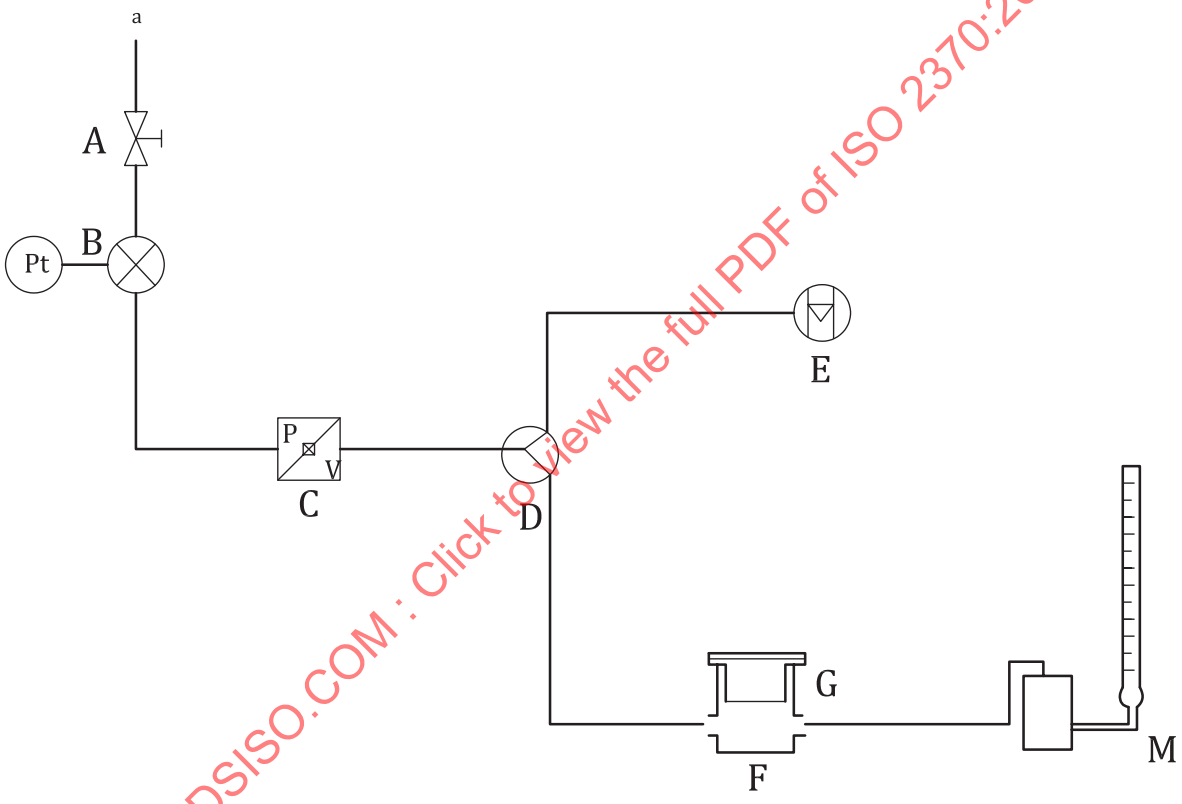
Carry out carding to make the fibres parallel by using hand carding machines as specified in Annex A. Cut from the middle stubs 80 mm ± 1 mm long.

5.3.2.3 Slivers

Take, at intervals, sections about 80 mm ± 1 mm long. Bring together the various stubs and take the mass required for the test.

5.4 Apparatus

5.4.1 Apparatus, shown in Figure 1.



Key

A	air tap	E	output meter
B	gauge	F	measuring chamber
C	butterfly valve for output control	G	threaded cap
D	three-way tap	M	manometer
a	To compressor.		

Figure 1 — Apparatus for the constant flow method

5.4.1.1 Air tap, A, below an air chamber (minimum pressure 0,15 MPa) fed by a compressor or by a general dry compressed air line.

5.4.1.2 Gauge, B, graduated from 0 MPa to 0,2 MPa, with a control device.

5.4.1.3 Butterfly valve for output control, C, (0,15 cm^3/s to 0,85 cm^3/s).

5.4.1.4 Three-way tap, D.

5.4.1.5 Soap bubble output meter, E, or any other apparatus permitting precise measurement of low output.

5.4.1.6 Measuring chamber, F, into which the casing containing the parallel fibres is placed. The edge of this casing, fitted with a supple joint, comes against the edge of F and is retained there by a threaded cap G.

5.4.1.7 Threaded cap, G, having a circular opening.

5.4.1.8 Water manometer, M, formed by a tube with variable tilt permitting readings of maximum depression corresponding to 250 mm, 50 mm, 25 mm and 12,5 mm, according to the tilt. One of the ends is open to the air and the other connected to the chamber F.

5.4.2 Casings, 10 mm high and with diameters of 10 mm and 11 mm (to the nearest 10 µm) respectively.

5.4.3 Circular sharp blade, mounted on a rapidly rotating axle.

5.4.4 Balance, with a resolution of 0,01 g.

5.5 Procedure

5.5.1 Determination of output

Adjust the output controlled by butterfly valve C to 0,50 $cm^3/s \pm 0,01\ cm^3/s$. Determine the exact output before each series of measurements. For this purpose:

— leave the apparatus connected to the flow for 30 min to obtain a stationary flow, the initial pressure being controlled at 0,1 MPa;

— open the three-way tap, D, in the direction of the output meter. Determine the time necessary for a bubble to obtain a predetermined level corresponding to 50 cm^3. Take the mean of five measurements.

The butterfly valve, C, permits maintenance of the output at a constant value, even in the case of variation of the initial pressure or the counter pressure.

5.5.2 Measurement of resistance, R_1

Introduce the parallel fibres of flax(scutched, hackled) or prepared parallel fibres (tow or slivers) into the channel of the 10 mm diameter casing, as shown in Figure 2. Cut the fibres which stick out of the channel using the rapidly rotating sharp circular blade; during this operation, the casing shall rotate at a slower speed.

Start the apparatus, introduce the casing into the chamber and screw on the cover, G. After stabilization of the pressure, read the height Δh_1 on the manometer and deduce the resistance R_1, using the Formula (1).

$$R_1 = \frac{\rho g \Delta h_1}{Q_1} \tag{1}$$

where

R_1 is the resistance of a wad of fibres to the passage of air in laminar flow by using 10 mm diameter casing, in hPa·s/cm^3;

ρ is the density of water, 1 g/cm^3;

g is the acceleration due to gravity, considered as equal to 981 cm/s^2;

Δh_1 is the difference in level, in cm;

Q_1 is the flow, in cm^3/s.

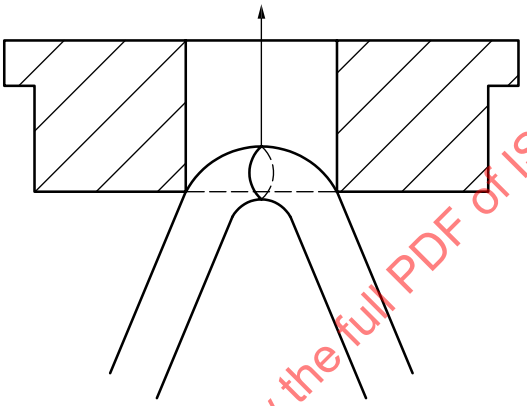


Figure 2 — Introducing the fibres into the casing

5.5.3 Measurement of resistance, R_2

Withdraw the casing from the chamber. Place it on the 11 mm diameter casing, so that the axes coincide, and push the wad of fibres into this second casing as shown in Figure 3, using a metal ram of 9,8 mm diameter. This transfer of the wad will inevitably create preferential channels. It is essential to eliminate these by the following manual operation; with the casing in the left hand, submit the fibre wad to a transverse vibration between the thumb and second finger of the right hand.

Make a second measurement of the manometric height (Δh_2), proceeding as indicated in 5.5.2. Deduce from this new measurement the resistance R_2, using the Formula (2).

$$R_2 = \frac{\rho g \Delta h_2}{Q_2} \tag{2}$$

where

R_2 is the resistance of a wad of fibres to the passage of air in laminar flow by using 11 mm diameter casing, in hPa·s/cm^3;

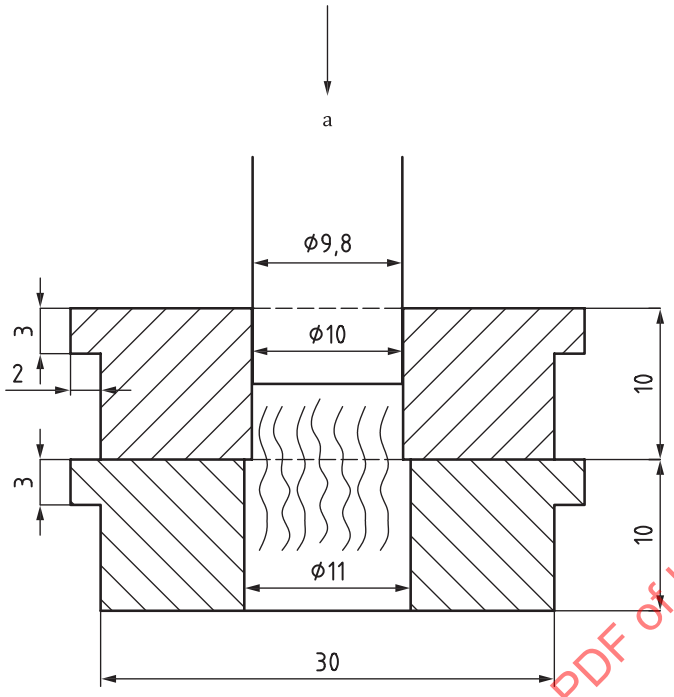
ρ is the density of water, 1 g/cm^3;

g is the acceleration due to gravity, considered as equal to 981 cm/s^2;

Δh_2 is the difference in level, in cm;

Q_2 is the flow, in cm^3/s.

Dimensions in millimetres



Key

a Metal ram.

Figure 3 — Transferring the wad of fibres

5.6 Control of apparatus functioning

lt is recommended that two gauges be used for regular control of the apparatus and verification that it is in good working condition. These gauges consist of pieces of metal, of external dimensions equal to those of the casings used for the introduction of the fibres, with a central hole.

The diameter of the central hole of one of the disks shall be chosen to give a reading corresponding to approximately 1/3 of the measurement scale of the manometer, when the disk is placed in the apparatus, the latter being used as when a measurement of fineness is made, but without fibre in the chamber.

The diameter of the central hole of the second disk shall be chosen to give a reading corresponding to approximately 2/3 of the measurement scale of the manometer.

About once per day, place the gauges in the apparatus, passing air through the central hole only, and note the corresponding reading.

The variations in these readings should not exceed, depending on the gauges used, 2 mm or 4 mm of the scale. This procedure forms a useful and rapid check of the functioning of the apparatus.

5.7 Calculation and expression of results

Calculate the specific surface index A' using Formulae (3) to (6):

$$C_1 = H\omega_1 \tag{3}$$

$$C_2 = H\omega_2 \tag{4}$$

$$C = \sqrt{H\left(\omega_2 - \omega_1\right)^3} \tag{5}$$

$$A' = A\sqrt{\mu k} = C \times \frac{{R_1}^{1/2} \times {R_2}^{1/2}}{\left(C_1 {R_1}^{1/3} - C_2 {R_2}^{1/3}\right)\sqrt{{R_1}^{1/3} - {R_2}^{1/3}}} \tag{6}$$

where

H is the height of both casing (1,0 cm);

ω_1 is the section of the first casting (diameter 1,0 cm), in cm^2;

ω_2 is the section of the second casting (diameter 1,1 cm), in cm^2;

A is the specific surface of the wad, in cm^2/cm^3;

A' is the index of specific surface;

μ is the dynamic viscosity of air ($1{,}81 \times 10^7$ cN·s/cm^2);

k is the empirical factor of proportionality without dimensions;

R_1, R_2 are the resistances, in hPa·s/cm^3.

Measure the rest of test pieces according to 5.5.2 and 5.5.3. Take the mean value of the index of specific surface A' of five test pieces, and round off to the second place of decimal. The parameter A' is characteristic of the fineness; however, by convention, the value of A' shall be used as described in Annex B to enable the results to be expressed as an index of fineness standard, IFS. Express the result to one decimal place.

6 Simplified constant flow method

6.1 Principle

Determination of the difference in level produced in a manometric tube by the passage of air through a wad of fibres placed randomly in a casing of known size.

The value of this difference in level Δh relates to the fineness of the fibre.

NOTE Neglecting the variations of density of the fibres, one can consider that

— with a single compression,

— with a constant flow, and

— with a test piece of constant mass,

the measurement of the difference in level Δh is sufficient index to judge the fineness of the flax fibres.

6.2 Sampling

The sample shall be representative of the batch.

Sampling shall be carried out by one of the methods given in ISO 1130.

6.3 Test pieces

6.3.1 Requirement

The test piece shall consist of a mass of fibres of mass equal to 1,2 g ± 0,01 g. Five test pieces shall be prepared for each sampling.

6.3.2 Preparation

6.3.2.1 Scutched or line flax

Take sections of these materials from the hanks.

Subdivide these sections into uncut strips by pinching the fibres in the middle and separating them out crossways. Take a mass slightly greater than that of the test piece. Repeat this operation for each of the test pieces.

6.3.2.2 Raw tow or waste flax

Divide the sample into the number of parts required. From each, take a slightly greater quantity than the mass of the test piece in several pinches.

6.3.2.3 Sliver or roving

Starting from one end, eliminate the first tufts taken with the fingers; then take, in successive clumps, lengthways, the quantity necessary to form a test piece.

With the roving, proceed in the same way after unwinding. Avoid shortening the fibres and, in particular, avoid using scissors.

6.3.3 Determination of the mass of the test pieces

Before determining the mass of the test pieces, remove knots, open out wide and homogenize. Then, form this very spread out web, adjust the mass of the test piece to the value specified.

6.4 Apparatus

6.4.1 Apparatus, shown in Figure 4.

6.4.1.1 Air tap above a suction pump, with a regular flow of water of at least 500 cm^3/s.

6.4.1.2 Flowmeter, graduated from 0 cm^3/s to 500 cm^3/s.

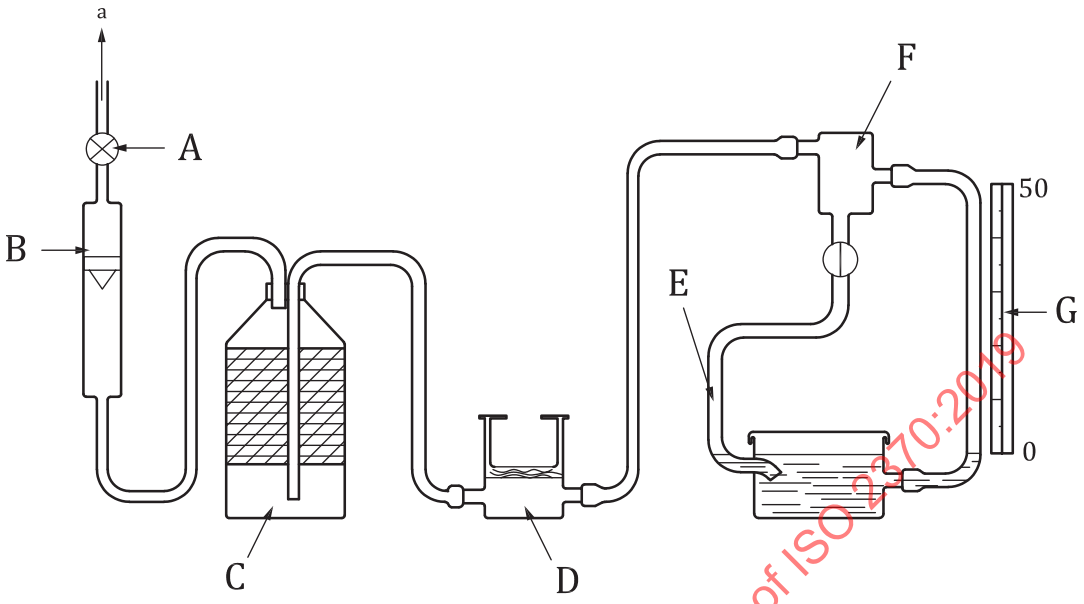
6.4.1.3 Cylindrical measuring chamber with strictly accurate dimensions as shown in Figure 5.

6.4.1.4 Liquid level gauge, with scale graduated in millimetres to a height of 1 000 mm; the tube is immersed in a wide section tank compared to that of the tube, so that the level barely alters. The liquid selected for its density and low volatility is propan-2-ol.

6.4.1.5 Bottle, of capacity 1 000 ml, with two nozzles, lagged with about 15 g of glass wool to ensure cleanliness of the air.

These different parts shall be connected by flexible piping, absolutely hermetically sealed, and without constriction.

6.4.2 Balance, with a resolution of 0,01 g.

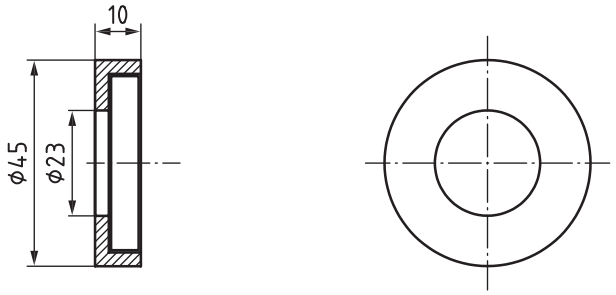


Key

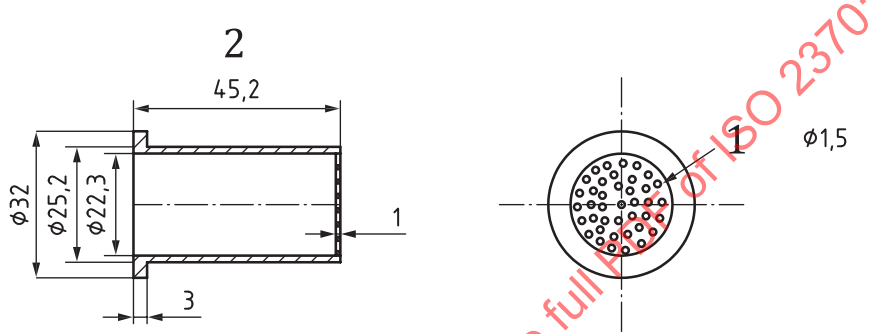
A tap
B flow meter
C cleansing bottle
D measuring chamber
E emptying blower
F blower
G manometric tube
a To vacuum pump.

Figure 4 — Apparatus for the simplified constant flow method

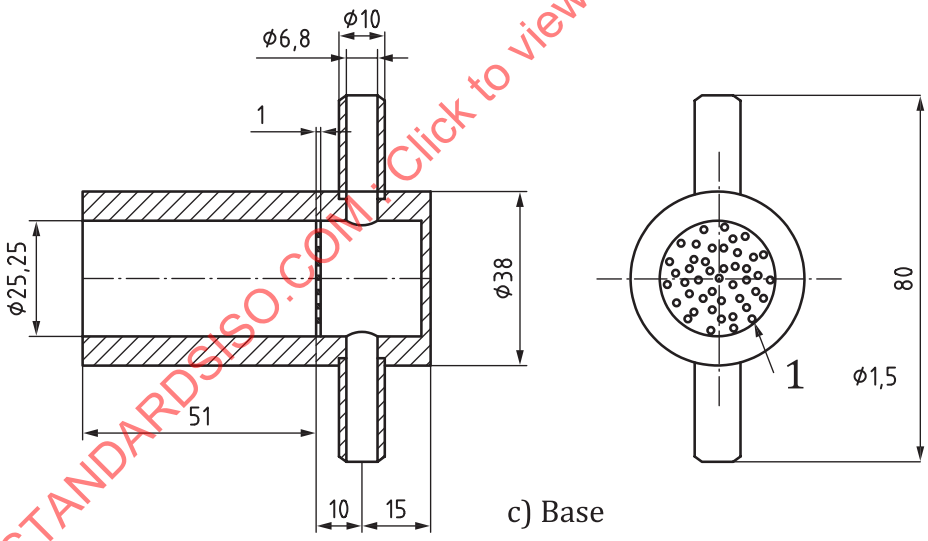
Dimension in millimetres



a) Threaded cover



b) Plunger



c) Base

Key

1 holes

2 constant flow

Figure 5 — Measuring chamber with constant volume A

6.5 Procedure

Start up the pump and adjust the air flow to 250 cm^3/s by means of the tap. Check the "Zero" on the gauge and adjust if necessary.

Introduce into the chamber of the equipment, as evenly as possible, the previously weighed test piece, containing randomly oriented or fully disoriented fibres, ensuring a homogeneous filling

density. Compress the fibre slightly with the fingers, then introduce the plunger which completes the compression.

Screw on the cover until the flange of the plunger makes contact with its seat in the chamber; this condition is imperative in order to define correctly the volume occupied by the specimen.

After about 10 s, if necessary, regulate the air flow to 250 cm^3/s and read the difference in level Δh_1 on the gauge.

Then withdraw the test piece, open again with the fingers, turn 180° around its horizontal axis and put again into the chamber for a new operation. Again read the difference in level Δh_2.

Repeat this operation and carry out a third reading of the difference in level Δh_3.

6.6 Control of apparatus functioning

lt is recommended that two gauges be used for regular control of the apparatus and verification that it is in good working condition. These gauges consist of pieces of metal, of diameter equal to the internal diameter of the constant volume chamber, with a central hole. Each disk presents one side which rests, when in use, on the upper annular part of the constant volume chamber.

The diameter of the central hole of one of the disks shall be chosen to give a reading of approximately 1/3 of the measurement scale of the manometer, when the disk is placed on the apparatus, the latter being used as when a measurement of fineness is made, but without fibre in the chamber.

The diameter of the central hole of the second disk shall be chosen to give a reading corresponding to approximately 2/3 of the measurement scale of the manometer.

About once per day, place the gauges in the apparatus, passing air through the central hole only, and note the corresponding readings.

The variations in these readings should not exceed, depending on the gauges being used, 2 mm or 3 mm of the scale. This procedure forms a useful and rapid check of the functioning of the apparatus, especially in respect of the penetration of air into it.

6.7 Calculation and expression of results

Take the mean value Δh of the three readings of difference in level Δh_1, Δh_2, Δh_3 obtained for each specimen.

Calculate the mean h of the Δh values obtained for the five specimens. Express the result in centimetres to two decimal place.

The parameter h is characteristic of the fineness; however, by convention, the value of h shall be used as described in Annex B to enable the results to be expressed as an index of fineness standard, IFS. Express the result to one decimal place.

7 Constant pressure method

7.1 Principle

Determination of the passage of air through a wad of fibres placed randomly in a casing of known size when the difference in level produced in a manometric tube reaches to a specified value.

The value of air flow (Q) through a wad of fibres relates to the fineness of the fibre.

7.2 Sampling

The sample shall be representative of the batch.

Sampling shall be carried out by one of the methods given in ISO 1130.

7.3 Test pieces

7.3.1 Requirement

The test piece shall consist of a mass of fibres of mass equal to 2,5 g ± 0,01 g. Five test pieces shall be prepared for each sampling.

7.3.2 Preparation

7.3.2.1 Scutched or line flax

Take sections of these materials from the hanks.

Subdivide these sections into uncut strips by pinching the fibres in the middle and separating them out crossways. Take a mass slightly greater than that of the test piece. Repeat this operation for each of the test pieces.

7.3.2.2 Raw tow or waste flax

Divide the sample into the number of parts required. From each, take a slightly greater quantity than the mass of the test piece in several pinches.

7.3.2.3 Sliver or roving

Starting from one end, eliminate the first tufts taken with the fingers; then take, in successive clumps, lengthways, the quantity necessary to form a test piece.

With the roving, proceed in the same way after unwinding. Avoid shortening the fibres and, in particular, avoid using scissors.

7.3.3 Determination of the mass of the test pieces

Before determining the mass of the test pieces, remove knots, open out wide and homogenize. Then, form this very spread out web, adjust the mass of the test piece to the value specified.

7.4 Apparatus

7.4.1 Apparatus, shown in Figure 4.

7.4.2 Balance, with a resolution of 0,01 g.

7.5 Procedure

Start up the pump and adjust the air flow to zero.

Introduce into the chamber of the equipment, as evenly as possible, the previously weighed test piece, containing randomly oriented or fully disoriented fibres, ensuring a homogeneous filling density. Compress the fibre slightly with the fingers, then introduce the plunger which completes the compression.

Screw on the cover until the flange of the plunger makes contact with its seat in the chamber; this condition is imperative in order to define correctly the volume occupied by the specimen.

Open slowly the switch of flowmeter until the difference in level produced in the manometric tube increases to 18 cm. Stabilize for 30 sec, read the air flow ΔQ_1 on the flowmeter.

Then withdraw the test piece, open again with the fingers, turn 180° around its horizontal axis and put again into the chamber for a new operation. Again read the air flow ΔQ_2.

Repeat this operation and carry out a third reading of the air flow ΔQ_3.

7.6 Control of apparatus functioning

lt is recommended that two gauges be used for regular control of the apparatus and verification that it is in good working condition. These gauges consist of pieces of metal, of diameter equal to the internal diameter of the constant volume chamber, with a central hole. Each disk presents one side which rests, when in use, on the upper annular part of the constant volume chamber.

The diameter of the central hole of one of the disks shall be chosen to give a reading of approximately 1/3 of the measurement scale of the manometer, when the disk is placed on the apparatus, the latter being used as when a measurement of fineness is made, but without fibre in the chamber.

The diameter of the central hole of the second disk shall be chosen to give a reading corresponding to approximately 2/3 of the measurement scale of the manometer.

About once per day, place the gauges in the apparatus, passing air through the central hole only, and note the corresponding readings.

The variations in these readings should not exceed, depending on the gauges being used, 2 mm or 3 mm of the scale. This procedure forms a useful and rapid check of the functioning of the apparatus, especially in respect of the penetration of air into it.

7.7 Calculation and expression of results

Take the mean value ΔQ of the three readings of the air flow ΔQ_1, ΔQ_2, ΔQ_3 obtained for each specimen.

Calculate the mean Q of the ΔQ values obtained for the five specimens. Express the result in cubic centimetres per second to two decimal place.

The parameter Q is characteristic of the fineness; however, by convention, the value of Q shall be used as described in Annex B to enable the results to be expressed as an index of fineness standard, IFS. Express the result to one decimal place.

8 Test report

The test report shall include the following information:

a) a reference to this document, i.e. ISO 2370:2019;

b) the standard atmosphere used;

c) the method of measurement used;

d) the results obtained;

e) details of any operations not included in the method used;

f) any possible incidents which may have affected the results;

g) any deviations from the procedure;

h) the date of the test.

Annex A
(normative)

Carding of flax tow in wads

A.1 Apparatus

The apparatus shown in Figure A.1 comprises:

— a fixed portion B, placed on a horizontal table, consisting of a small board to which is fastened a piece of card clothing.

— a moving portion A, held in the hand at m, consisting of a small board provided with a piece of card clothing on which the pins are arranged in such a fashion that when A is applied to B and the operator draws A towards himself, a carding action results.

The card clothing on B has attached to it a guiding System S, preventing interlocking of the pins on A and B and keeping their points about 2 mm to 3 mm apart.

The two vertical members S' constrain portion B, assuring guidance of portion A.

Figure A.1 shows how the pins are arranged and indicates their characteristics.

A.2 Procedure

A.2.1 Alignment by carding

A.2.1.1 Take 13 g to 15 g of flax tow and spread it on portion B of the apparatus. Engage A on B at the back end and slide A by pulling it towards oneself until it disengages; at this moment the material is divided into two parts. Repeat the movement until the majority of the fibres on B are parallel.

A.2.1.2 Lift the material adhering to portion A and place this web A on the table. Lift the material adhering to portion B and place this web B on the fixed portion B after rotation through 180° around the longitudinal axis of the apparatus. Carry out the carding process as described in A.2.1.1.

A.2.1.3 Two new webs are obtained:

— BB (produced from web B and adhering to B) treated on both sides. Carding is finished for this web.

— BA (produced from web B and adhering to A). In certain cases, the straightening is sufficient at this stage and the carding of BA is not necessary.

A.2.1.4 In other cases, place the web BA on the portion B, with the side treated by part A turned towards the pins of portion B. Carry out the carding process as described in A.2.1.1. This carding gives two new webs BAB and BAA.

A.2.1.5 Take web A (see A.2.1.2) and repeat the procedures undertaken on web B.

The following six webs are thus obtained: "BB", "BAB", "BAA", "AB", "AAB" and "AAA".