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Determination of fineness of flax fibres — Permeametric methods

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FOREWORD

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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.

International Standard ISO 2370 was drawn up by Technical Committee ISO/TC 38, *Textiles.*

It was approved in December 1971 by the Member Bodies of the following countries :

Australia	Hungary	Spain
Belgium	India	Sweden
Brazil	Iran	Switzerland
Bulgaria	Ireland	Thailand
Canada	Israel	Turkey
Czechoslovakia	Japan	United Kingdom
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France	Poland	U.S.S.R.
Germany	South Africa, Rep. of	

No Member Body expressed disapproval of the document.

Determination of fineness of flax fibres — Permeametric methods

0 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 :

— In the first place, a difficulty arises 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.

— A second difficulty which also results from the constitution of the substance, lies in the fact that the separation of the fibrous elements is a delicate operation.

Taking these difficulties into account, "permeametric" methods based on the Kozeny equation (see Appendix Y) seem most suitable for measuring the fineness of bast.

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies two permeametric methods for the determination of the fineness of flax fibres :

— a reference method, with two compressions, using a test piece of parallel fibres (section 4);

— a simplified method, with one compression, using a test piece of fibres distributed "at random" (section 5).

These methods apply to the various forms possible for flax fibres :

— long strands, broken strands, all kinds of tow and at all stages of manufacture of these substances.

2 REFERENCES

ISO/R 139, *Standard atmospheres for conditioning and testing textiles.*

ISO/R 1130, *Methods of fibre sampling for testing.*

3 DEFINITIONS

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

3.1 wads of fibres (forming the test piece) : A fibrous mass introduced into the centre channel of a cylindrical casing and on which the measurement will be made.

In the reference method, the fibrous elements forming the wad are placed parallel to the axis of the casing.

In the simiplified method, the fibrous mass is introduced into a chamber so that the fibres forming the wad are placed at random.

In both methods it is essential that the density of the filling is as regular as possible.

3.2 resistance R of a wad of fibres (forming the test piece) to the passage of air in laminar flow : Quotient of depression ΔP (cN/cm^2) produced by the wad of fibres to flow Q (cm^3/s) passing through it :

$$R = \frac{\Delta P}{Q} \ (cN \cdot s/cm^5)$$

If Δh is the difference in level in centimetres (read at the vertical) of a water gauge, one can write :

$$R = \frac{\rho \, \Delta h}{Q}$$

Numerically resistance R will be equal to $\frac{0{,}98 \, \Delta h}{Q}$ (being given that the density of water $\rho = 1 \ g/cm^3$ and the acceleration due to gravity, $g = 9{,}8 \ m/s^2$).

3.3 specific surface A of a wad of fibres (forming the test piece) : Quotient of the total side surface of the constituent fibrous elements by their volume, expressed in square centimetres per cubic centimetre (cm^2/cm^3).

3.4 index of specific surface A' of wad of fibres (forming the test piece) : Index defined by the equation[1] :

$$A' = A\sqrt{\mu k}$$

where

A is the specific surface of the wad;

μ is the viscosity of the air;

k is a dimensionless empirical factor of proportionality.

4 CONDITIONING AND TEST ATMOSPHERE

Weighing and measuring must be carried out in one of the normal atmospheres for conditioning and testing of textiles, defined in ISO/R 139, on test pieces previously conditioned in the same atmosphere.

5 REFERENCE METHOD (with two compressions)

5.1 Principle

Measuring the resistance to the passage of air of a wad of parallel fibres of given mass placed successively in two casings of well determined size but different diameters; then deduction from the two values found of the index of the specific surface of the wad and the density of the fibres (either by calculation or by using a graph) which characterize the fineness of the fibres.

NOTE – If it is usual for certain fibres to take on a well determined density, experience shows that such is not the case with flax fibres, which is why it is necessary to measure the density of the fibre at the same time as the specific surface index.

5.2 Sampling

Samples must be representative of a batch.

Various methods of sampling fibres for tests are given in ISO/R 1130.

5.3 Test pieces

5.3.1 *Shape and mass of test pieces*

The test piece must consist of a stub of parallel fibres about 80 mm long, having a mass between 2,8 and 3,2 g, depending on the substance.

5.3.2 *Preparation of test pieces*

5.3.2.1 Scutched or hackled flax

If the substance consists of scutched flax (green, retted) or line flax, cut as necessary from the handful (for example top, middle, bottom) stubs some 80 mm long and take the mass needed for the test.

5.3.2.2 Flax tow in wads

Carry out carding to make the fibres parallel; this is done by using hand carding machines (see the Annex).

5.3.2.3 Slivers or rovings

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

5.4 Apparatus

The apparatus shown in Figure 1 must include :

5.4.1 *A chamber C,* into which the casing containing the parallel fibres is placed. The edge of this casing, fitted with a flexible joint, comes against the edge of C and is retained there by a threaded cap D having a circular opening.

5.4.2 *A gauge M,* formed by a tube with variable tilt with a maximum depression reading of 250 – 50 – 25 or 12,5 mm according to the tilt. One of the ends is open to the air and the other connected to the chamber C as shown in Figure 1.

5.4.3 *A bottle F,* containing water which flows out through an opening in a stainless steel tube S of given dimensions and giving, in the test conditions specified below, a flow rate of 1,5 to 1,6 cm^3/s.

5.4.4 *Auxiliary items :* E is an anti-dust device, R (not shown) is a large capacity tank enabling previously filtered water to be fed in. It is closed by a tap during the measuring. The chamber C is connected to the bottle F (passing through E) by a tube immersed in the water of the bottle and such that the distance between its end and that of the outgoing tube is about 100 to 150 mm. When there is no wad in C, the flow is stopped by closing C with a rubber cork.

5.4.5 *The casings,* 10 mm high and with diameters of 10 and 11 mm (to the nearest 10 μm) respectively.

5.4.6 *A circular sharp blade,* mounted on a rapidly rotating axle.

5.5 Procedure

5.5.1 *Graduating the apparatus (determining the ratio between difference in level read on the gauge and the flow)*

The apparatus having been filled with distilled water (level that of cork in bottle F), place into C a wad of reference material (see Appendix Z). Screw on the cover of chamber

1) See Appendix Y.

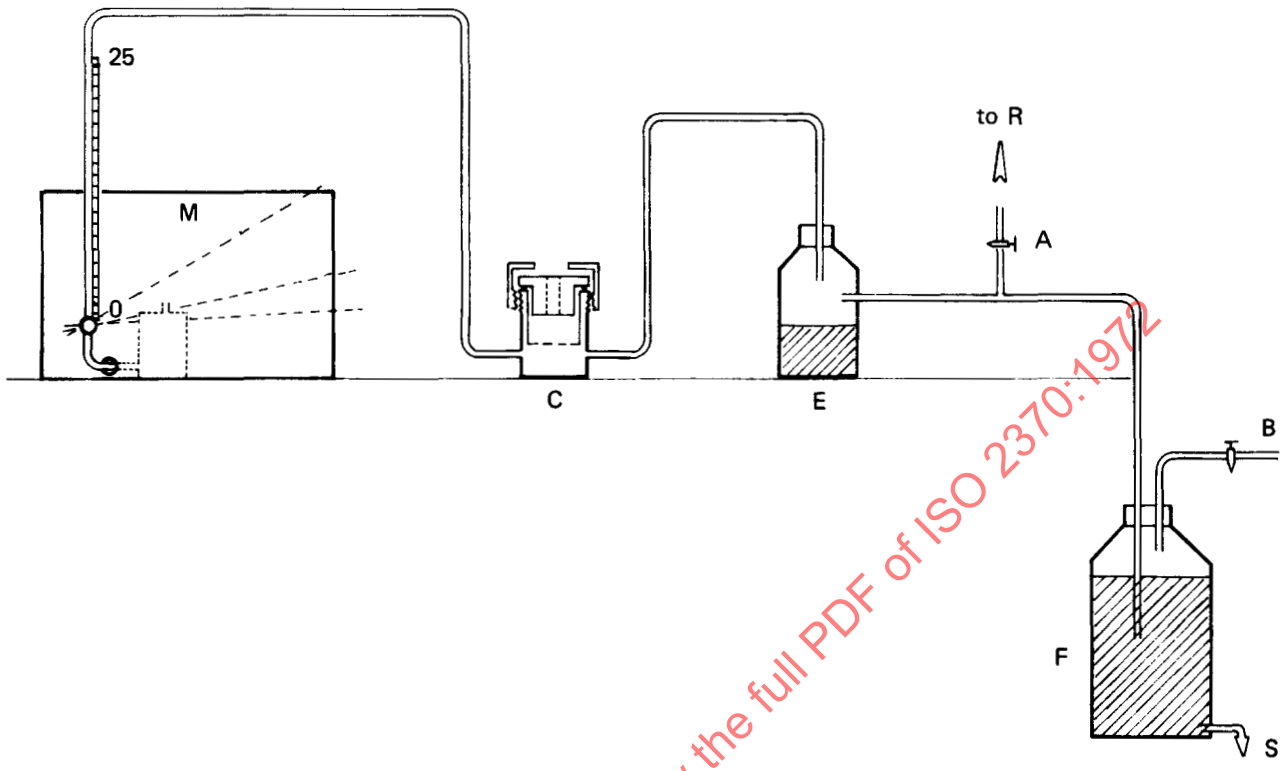

FIGURE 1 – **Test apparatus**

C. Open tap B and leave the flow rate of the water to even out (1 to 2 min). Read the difference in level Δh on the gauge and measure the flow. This measurement is carried out by determining to within 1 mg the mass of the water collected in a calibrated vessel during a sufficient period of time, for example 1 min.

Repeat this operation with wads of other reference substances and note the corresponding differences in level Δh. Failing any reference substance, use a system of capillary tubes to replace chamber C.

From the values of Δh thus noted and those of the corresponding flow Q, calculate the values of resistance R for each operation ($R = \frac{\Delta h}{Q}$) and draw the calibration graph of the apparatus.

5.5.2 *Measuring resistance R_1*

Introduce parallel fibres of flax (stripped, line roving) or prepared parallel fibres (tow) in 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 must also rotate at a slower speed.

The apparatus having been filled with distilled water (level that of cork in bottle F) introduce the casing into chamber C and screw on the cover.

Open tap B and allow the flow of air to settle (1 to 2 min). Read the difference in level Δh_1 on the gauge and deduce resistance R_1 by means of the calibration graph.

5.5.3 *Measuring resistance R_2*

Withdraw the casing of chamber C, and place on the 11 mm diameter casing so that 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.

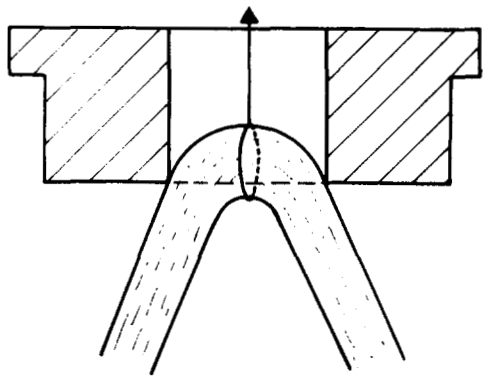

FIGURE 2 – **Introducing the fibres into the casing**

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. Then, make a second measurement of difference in level (Δh_2) proceeding as described in 5.5.2. Deduce from this new measurement the resistance R_2 by means of the calibration graph.

Dimensions in millimetres

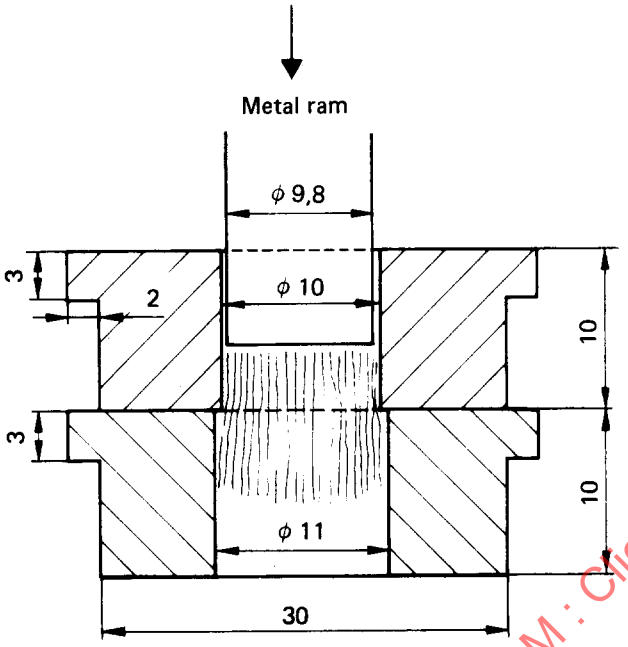

FIGURE 3 – **Transferring the wad of fibres**

5.5.4 *Determination of the mass of the wad of fibres*

Extract the wad of fibres from the casing and determine its mass to the nearest milligram.

5.6 Calculation and expression of results

Calculate the specific surface index A' and density ρ of the flax fibre by means of the formulae :

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

$$\rho = m\,\frac{R_1^{1/3} - R_2^{1/3}}{C_1 R_1^{1/3} - C_2 R_2^{1/3}}$$

where

$C_1 = L\omega_1$

$C_2 = L\omega_2$

$C = \sqrt{L\,(\omega_2 - \omega_1)^3}$

L is the height of both casings (10 mm);

ω_1 is the section of 1st casing (diameter 10 mm);

ω_2 is the section of 2nd casing (diameter 11 mm);

m is the mass of wad.

The two equations A' in terms of R_1, R_2 and of ρ in terms of m, R_1, R_2 are represented graphically. This gives A' and ρ immediately when the values of R_1, R_2 and m are known.

Only the parameter A' is characteristic of the fineness; nevertheless, the determination of the value of ρ is of use as it provides supplementary information on the quality of the flax.

6 SIMPLIFIED METHOD (WITH ONE COMPRESSION)

6.1 Principle

Determining the value of the difference in level produced in a manometric tube with 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 characterizes 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,
- 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 must be representative of the batch.

Various methods of sampling fibres for tests are given in ISO/R 1130.

6.3 Test pieces

6.3.1 *Shape and mass of test pieces*

The test piece shall consist of a mass of fibres of mass equal to 1,2 g ± 1 mg.

6.3.2 *Preparation of test pieces*

6.3.2.1 Scutched or line flax

Take tufts of this substance in handfuls.

Subdivide these fractions 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, in several pinches, a slightly greater quantity approximately than the mass of the test piece.

6.3.2.3 Preparation of 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 homogenise. Then, from this very spread out waste, adjust the mass of the test piece to the value specified.

6.3.4 *Number of test pieces*

Five test pieces are generally sufficient.

6.4 Apparatus

The apparatus (shown schematically in Figure 4) must include :

6.4.1 *An air tap* above a suction pump, with a regular flow of water of at least 500 cm^3/s.

6.4.2 *A graduated flowmeter* from 0 to 500 cm^3/s.

6.4.3 *A cylindrical measuring chamber* with strictly accurate dimensions as shown in Figure 5.

6.4.4 *A liquid level gauge* with scale graduated in millimetres. 1 000 mm of 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 low specific mass and volatility is isopropyl alcohol.

6.4.5 *A bottle* of 1 000 ml with two nozzles, lagged with about 15 g of glass wool to ensure cleanliness of the air.

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

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

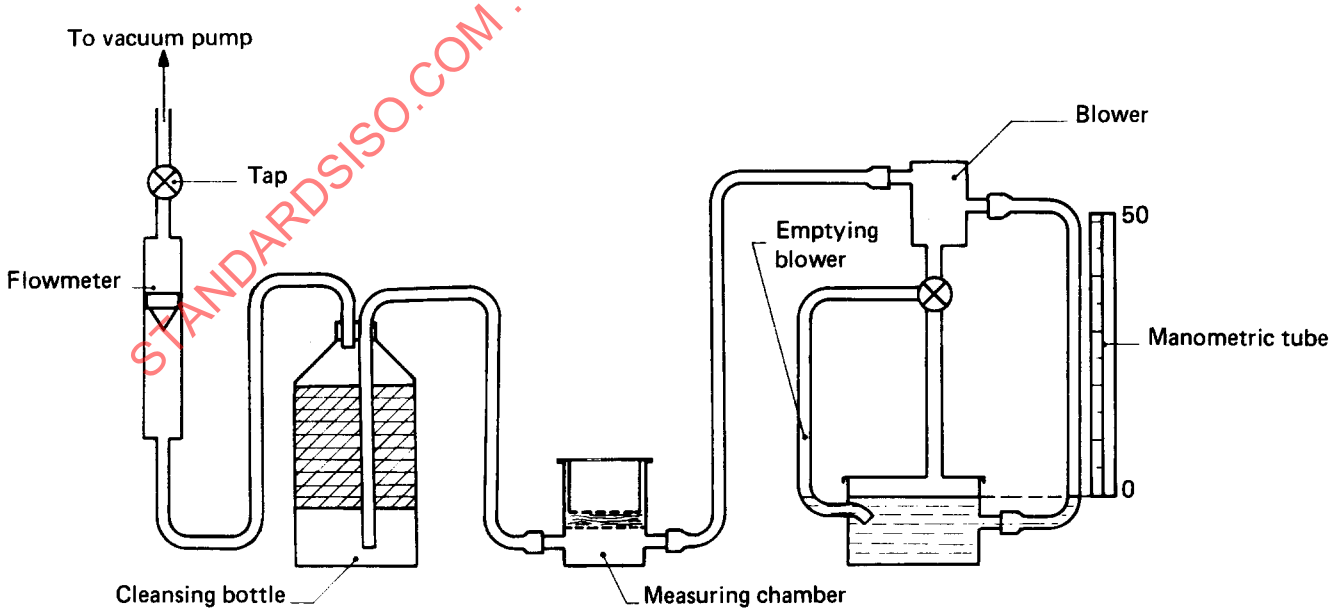

FIGURE 4 — **Test apparatus**

Dimensions in millimetres

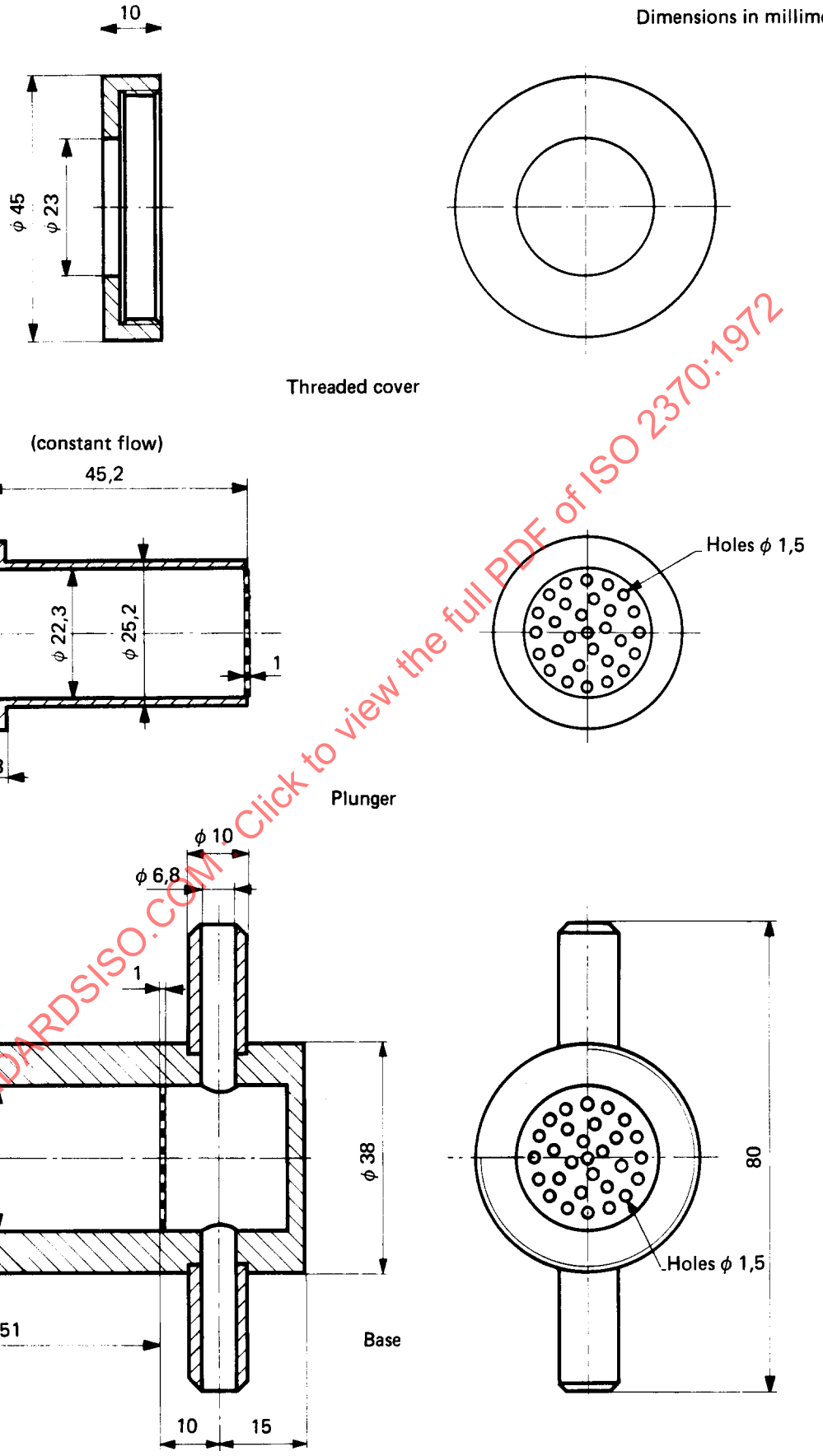

FIGURE 5 – **Measuring chamber with constant volume A**

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

Screw on the cover until the tightening reference marks coincide.

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 Calculation and expression of results

Take the average of the three gauge readings carried out on each test piece.

The index of the fineness of the flax fibres is given by the average results obtained for the five test pieces.

Express the result in centimetres rounded to one decimal place.

NOTE – Comparative studies have been undertaken with the aim of comparing the results obtained by the permeametric method and those furnished by the gravimetric method, with the aim of expressing the results systematically, not as an index of specific surface or an index of fineness, but in linear density expressed in decitex.

At the date of publication of this International Standard, work has not been sufficiently advanced to permit the inclusion of a conversion table.

7 TEST REPORT

The test report shall include the following particulars :

a) a reference to this International Standard;

b) the standard atmosphere used (temperate or tropical);

c) the results obtained;

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

e) any possible incidents which may have affected the results.