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Wool — Determination of mean diameter of fibres — Air permeability method

Laine — Détermination du diamètre moyen des fibres — Méthode perméamétrique

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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 on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT), see the following URL: Foreword — Supplementary information.

The committee responsible for this document is ISO/TC 38, *Textiles*, Subcommittee SC 23, *Fibres and yarns*.

This second edition cancels and replaces the first edition (ISO 1136:1976), which has been technically revised.

Introduction

When a current of air is passed through a uniformly-arranged mass of fibres packed in a chamber with perforated ends, the ratio of air flow to differential pressure is uniquely determined by the total surface area of the fibres, and by various constants. This was predicted from the hydrodynamic equations of Kozeny and others.

For fibres of circular or near-circular cross-section and constant density, such as non-medullated wool, the surface area of a given mass of fibres is proportional to the average fibre diameter. This principle can be utilized to construct apparatus giving an estimate of fibre diameter. Because of its speed and simplicity, the method is particularly suitable for quality control in mill testing laboratories.

Since the method is indirect, the apparatus is first calibrated from wools of known fibre diameter. For this purpose, eight reference slivers have been provided (see Annex E).

It has been shown that the estimate of fibre diameter actually given by the permeability method is $d(1+c^2)$, where d is the average fibre diameter (length biased) measured by the projection microscope, and c is the fractional coefficient of variation. Since c normally lies within comparatively small limits for unblended slivers, it is usual, however, to calibrate the apparatus directly in terms of d.

The method requires that the fibres be reasonably clean and dispersed in a uniform open state, such as card slivers or combed slivers. It is thus unsuitable for raw wool unless first scoured and carded. Some types of wool need special calibrations as described in Annex D.

The preparation of test specimens for measurement is identical with that used for calibration specimens.

This second edition to ISO 1136 is based on the test method IWTO-6-98, drawn up by the International Wool Textile Organization (IWTO).

Wool — Determination of mean diameter of fibres — Air permeability method

1 Scope

This International Standard specifies a method for the determination of the mean diameter of wool fibres, using an apparatus which passes a current of air through a bundle of fibres.

This International Standard is applicable to clean, unmedullated wool fibres dispersed in a uniform, open state. It provides a method particularly suitable for combed slivers. The dichloromethane extractable matter content of the specimen must not exceed 1,0 %. It is applicable to oil-combed slivers after cleaning with an organic solvent.

The method described in this International Standard is less accurate for lambswool and for wool which is appreciably medullated (see Annex D) and heavily dyed wool.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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*

3 Terms and definitions

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

3.1
laboratory sample
conditioned sample of fibres, representative of the bulk, from which the test specimens are weighed out

Note 1 to entry: In many cases, the laboratory sample will consist of one or more short lengths of sliver.

3.2
test specimen
weighed amount of fibre which is packed into the constant volume chamber

4 Principle

A specified mass of fibres to be tested is compressed to a constant volume in a cylindrical chamber with perforated ends to which a flowmeter and a manometer are connected.

The fibres are packed in such a way that they lie predominantly at right angles to the long axis of the chamber. A regulated current of air is then passed through the compressed fibres and the average fibre diameter read off from a scale on the manometer or the flowmeter.

5 Apparatus

5.1 Forms of apparatus

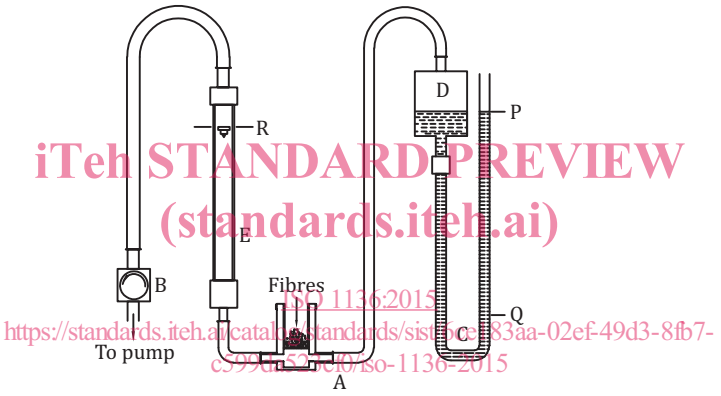
Two alternative forms of apparatus are described: “constant flow” and “constant pressure”. Both forms of apparatus have the same arrangement of parts, as illustrated in Figure 1.

The constant flow apparatus utilizes a specimen mass of 1,5 g; the flowmeter is adjusted to a fixed value and the fibre diameter is read off from the manometer scale. This scale is not linear since the successive intervals, corresponding to 1 µm, decrease with the diameter.

The constant pressure apparatus utilizes a specimen mass of 2,5 g; the manometer is adjusted to a fixed pressure and the fibre diameter is read off from the flowmeter. The constant pressure apparatus gives a nearly linear scale in micrometres. Since less accuracy in weighing the specimen is required, this method has some advantages for mill use.

5.2 Detailed parts

The apparatus consists of the following parts arranged as shown in Figure 1.



Key

A	constant volume chamber
B	air valve
C	manometer
D	reservoir
E	flowmeter
P, Q, R	reference marks

Figure 1 — General arrangement of apparatus

5.2.1 Air valve (B), giving sufficiently fine control of the air supply, such that the lever of the flowmeter or manometer can be quickly adjusted to the working value.

5.2.2 Suction pump, of a type providing a smooth output of at least 30 l/min at 200 mmH_2O with minimal fluctuation of the float of the flowmeter.

A filter to trap any loose fibres may be inserted between the pump and the air valve (B).

NOTE 1 mmH_2O=9 806 65 Pa=9 806 65 N/m^2

5.2.3 Constant volume chamber (A), of brass, hardened steel, or any other suitable metal, comprising the three following parts: the base into which the fibres are packed, the plunger which compresses the fibres, and the screw cap which clamps the plunger to the base.

The finish shall be smooth so that the plunger slides easily into the base without trapping fibres. Suggested dimensions of the constituent elements of the chamber are given in Figure 2.

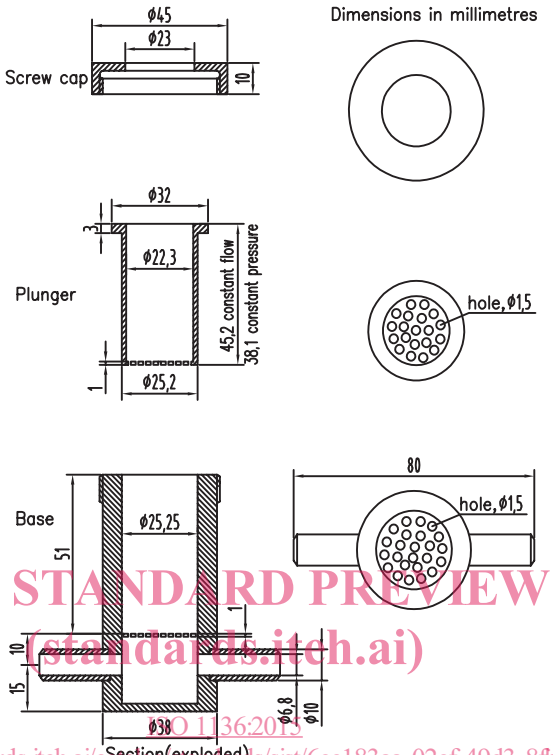


Figure 2 — Suggested dimensions of constant volume chamber (A)

Important dimensions are 22,3–25,2–25,25–42,5 and 38,1 mm.

5.2.4 Manometer (C), made of glass tubing of internal diameter at least 5 mm to reduce surface tension effects.

In both cases, a small amount of dye may be added to the manometer fluid, and where this consists of distilled water, a small trace of chromic acid should be added to give a clear meniscus. A millimetre scale is fixed behind the open limb as described in A.3.1.

5.2.5 Reservoir (D) of the fluid manometer (5.2.4), having the characteristics specified in the following table, and mounted at a sufficient height to give a clear working distance PQ of 350 mm in the open limb of the manometer.

Table 1 — Manometer and flowmeter characteristics

Characteristic	Constant flow	Constant pressure
Minimum diameter of reservoir	150 mm	60 mm
Type of manometer fluid	n-Propyl alcohol	Distilled water
Working range of flowmeter	10 l/min to 20 l/min	5 l/min to 25 l/min

5.2.6 Flowmeter (E), having the characteristics indicated in Table 1.

5.2.7 Rubber tube, connecting the manometer reservoir (D) to the chamber (A), consisting of pressure tubing of small internal diameter to avoid constriction at the bends.

5.2.8 Rubber or plastic tube from the chamber (A) to the flowmeter (E), of internal diameter not less than 6 mm.

The tube shall be as short as possible and shall not be twisted or kinked between calibration of the apparatus and its subsequent use.

5.2.9 Balance, capable of weighing the specimen to an accuracy of ±2 mg for the constant flow method and of ±4 mg for the constant pressure method.

6 Conditioning and testing atmosphere

6.1 The test specimens shall be dried sufficiently and brought to equilibrium and tested in one of the standard atmospheres for testing specified in ISO 139.

NOTE The laboratory sample can be dried in an oven with forced draft circulation or a rapid dryer at between 50 °C to 107 °C. The time required needs to be determined for the specific laboratory situation.

Each laboratory is to carry out investigations on the rate of equilibration, for its particular conditioning system, of wool samples prepared in its specific equipment so that the appropriate conditioning time can be established.

6.2 The tested specimen shall be weighed in the standard atmospheres at the level of accuracy specified in the method.

6.3 If tests are not carried out in the standard atmosphere for testing, the laboratory sample shall be conditioned to equilibrium near the apparatus and the relative humidity of the atmosphere at the time of test noted. The final results shall be corrected by the factors given in Annex C.

NOTE A source of error might occur if the moisture of the specimen changes during test. This could happen if the laboratory sample is allowed insufficient time to attain moisture equilibrium with the testing atmosphere. The minimum time required to ensure conditioning to equilibrium of a length of sliver in an opened-out state in a well-ventilated room is about 60 min.

7 Preparation of test specimens

7.1 Unopened sliver

7.1.1 Cleaning

In general, the laboratory sample shall have a mass of about 8 g and shall first be degreased by rinsing well in two baths each of about 200 ml of petroleum ether before conditioning.

7.1.2 Number of specimens

Unless otherwise specified, test a minimum of two specimens for fibre diameter below 30 µm and a minimum of three specimens for fibre diameter above 30 µm.

7.1.3 Selection of specimens

The specimens shall be taken from different places in the laboratory sample. In the case of balls of sliver, the laboratory sample shall be made up of pieces of sliver from both inside and outside the ball.

7.1.4 Specimen mass

For the constant flow method, the specimen mass shall be 1,5 g ± 0,002 g. For the constant pressure method, the specimen mass shall be 2,5 g ± 0,004 g.

7.1.5 Preparation

For slivers with cut ends, the specimen shall be prepared by cutting off with scissors a length to give as nearly as possible the specimen mass and then making up to the exact mass by adding shorter cut lengths or portions.

For slivers with pulled ends, about five hand draws shall be removed and discarded and the specimens weighed out by taking several successive hand draws.

These two methods of sampling give the same results if carried out properly.

7.2 Opened sliver

7.2.1 Cleaning

The laboratory sample should weigh not less than 10 g, and if it is known to have an oil content not exceeding 1,0 %, the test specimen may be taken from it without cleaning. Otherwise, the sample should first be degreased by rinsing it well in two baths each of about 200 ml of petroleum ether before conditioning.

7.2.2 Preparation

Take from the sample 10 g to 20 g of sliver and deparallelize using a Shirley Analyser or another method to give the laboratory sample.

Pre-condition (see 6.1) and condition the laboratory sample.

For the Shirley Analyser, cut the sliver into lengths of 15 mm to 20 mm before deparallelizing.

Other methods may refer to Shirley Analyser. Laboratories can, according to their own conditions, develop their own method.

7.2.3 Number of specimens

Unless otherwise specified, test a minimum of two specimens, and measurements per test specimen two times.

7.2.4 Selection of specimens

Passing the cut sliver through a Shirley Analyser or other methods thoroughly blends the fibres. Test specimens need not, therefore, be made up from pinches of fibre from different parts of the prepared laboratory sample.

7.2.5 Specimen mass

For the constant flow method, the specimen mass shall be 1,5 ± 0,002 g. For the constant pressure method, the specimen mass shall be 2,5 g ± 0,004 g.