INTERNATIONAL STANDARD

ISO 1888

Third edition
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Textile glass — Staple fibres or filaments — Determination of average diameter

Verre textile — Fibres discontinues et filaments — Détermination du diamètre moyen

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Foreword

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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 1888 was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 13, *Composites and reinforcement fibres*.

This third edition cancels and replaces the second edition (ISO 1888:1996), in which the minimum overall magnification required for the microscope specified in 2.2.1 and 3.2.1 has been reduced from × 500 to × 400.

Textile glass — Staple fibres or filaments — Determination of average diameter

1 Scope

This International Standard specifies longitudinal-profile and transverse-section methods for determining the average diameter (i.e. the average value of actual diameters) of staple fibres or filaments in a textile glass product.

This diameter must not be confused with the nominal diameter which is used in the designation of yarns and materials manufactured from these yarns and corresponds to the average diameter but rounded to the nearest whole number.

2 Method A: Longitudinal profile

2.1 Principle

Fibres or filaments placed in a liquid medium having a refractive index differing from that of the textile glass are viewed in profile under a microscope and the diameter measured.

2.2 Apparatus

2.2.1 Microscope, equipped with the following:

— An eye-piece with a built-in micrometer graticule, the eye-piece and objective together giving an overall magnification of at least $\times$ 400 and preferably $\times$ 1 000. The resolution of the microscope shall permit measurement to the nearest 0,5 μm or better (see the Note).

— A system permitting lateral and rotational movement of the microscope stage.

— An illumination system.

NOTE This system may be replaced by or used in conjunction with a microprojector on which specimens can be measured using a transparent scale (preferably a curved scale).

The recommended type of microscope is one using plane-polarized light, and an illumination system with a Kohler light source and an Abbe condenser. A green filter may also be used to give better reading accuracy.

2.2.2 Micrometer scale, with 0,01 mm divisions, for calibration of the optical system.

2.2.3 Glass slide (thickness: 1,10 mm to 1,35 mm), and **cover glass** (thickness: 0,16 mm to 0,19 mm). The thickness of the cover glass shall be verified periodically.

2.2.4 Mounting fluid, with a refractive index different (but not too different) from that of the glass under examination. Benzyl alcohol, methyl salicylate, a mixture of one part glycerol and two parts water are adequate media.

2.2.5 Razor blade or **scissors**.

2.2.6 Muffle furnace, capable of maintaining a temperature of 625 °C $\pm$ 25 °C.

2.3 Procedure

2.3.1 It is not always necessary to remove the size from the yarns under examination. Nevertheless, yarns in which the fibres or filaments do not separate from each other in the mounting fluid shall have the size removed by burning off to bare glass at 625 °C in a muffle furnace (2.2.6).

2.3.2 Set up the microscope (2.2.1) with the appropriate optical system and the moving stage. Calibrate the optical system using the micrometer scale (2.2.2).

2.3.3 Prepare the specimen and the specimen holder as follows:

Using a sharp cutting device (see 2.2.5), prepare a specimen of fibres or filaments not exceeding 25 mm in length.

Place the specimen on the glass slide (see 2.2.3).

Separate the fibres or filaments so that they are no longer in a compact bundle, but still essentially parallel to each other.

Using a glass rod, place one drop of mounting fluid (2.2.4) on the slide so that it wets the specimen and cover with a cover glass (see 2.2.3).

2.3.4 Place the slide on the microscope stage and, after adjusting the position of the specimen to obtain a clear, sharp view of the edges of the fibres or filaments, position the slide so that the micrometer graticule in the eyepiece is perpendicular to one of the fibres or filaments.

2.3.5 Move the micrometer graticule from one edge of the fibre or filament to the other edge and note the distance moved.

When using a microprojector (see the Note to 2.2.1), simply measure the distance from edge to edge of the fibre or filament on the transparent scale.

2.3.6 Move the slide around to obtain 25 readings on randomly selected fibres or filaments.

3 Method B: Transverse section

3.1 Principle

A transverse section of a yarn that has been impregnated with resin and cured is viewed under a microscope and the diameter of a given number of fibres or filaments in the yarn is measured.

3.2 Apparatus

3.2.1 Microscope, equipped with the following:

— An eye-piece with a built-in micrometer graticule, the eye-piece and objective together giving an overall magnification of at least × 400 and preferably × 1 000. The resolution of the microscope shall permit measurement to the nearest 0,5 μm or better (see the Note).

— A system permitting lateral and rotational movement of the microscope stage.

— An illumination system.

NOTE This system may be replaced by or used in conjunction with a microprojector on which specimens can be measured using a transparent scale (preferably a curved scale).

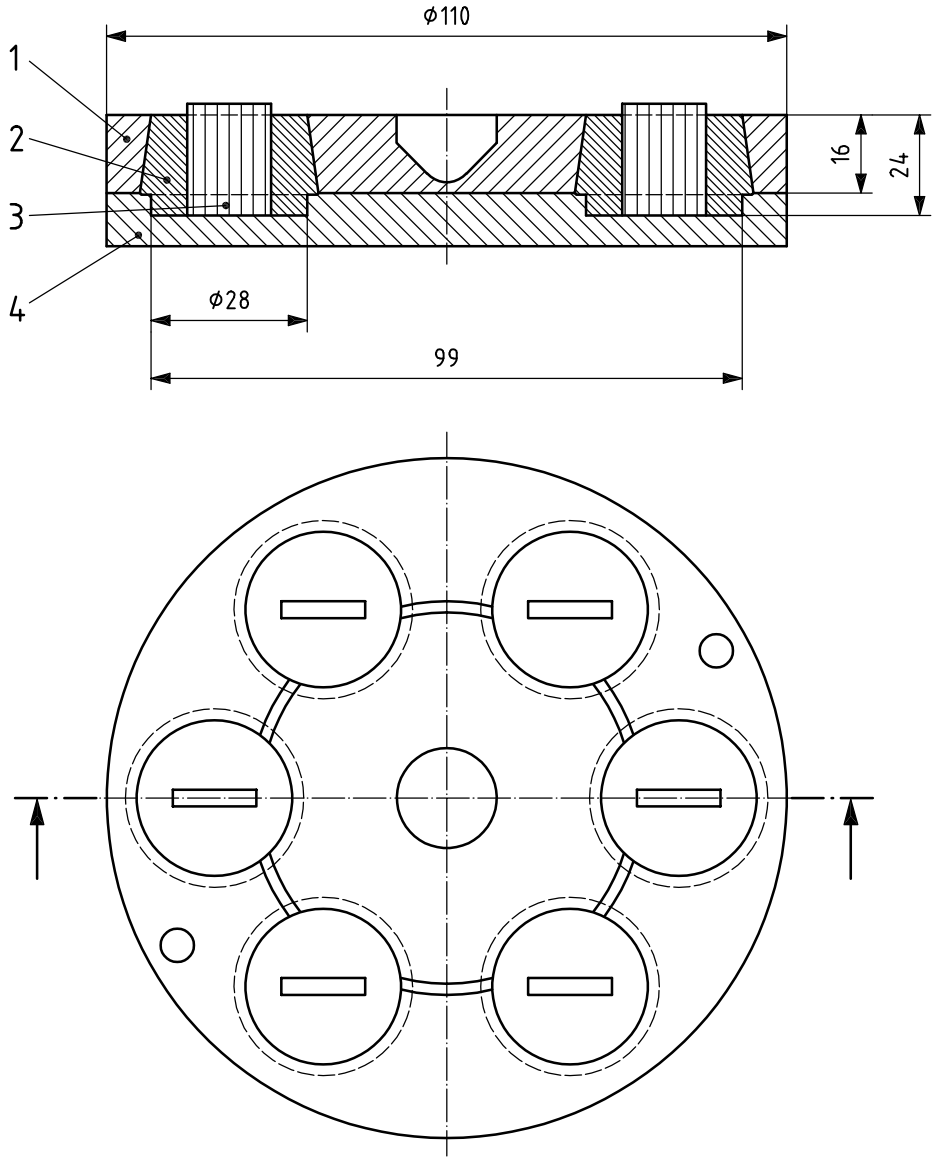
The recommended type of microscope is one using plane-polarized light, and an illumination system with a Kohler light source and an Abbe condenser. A green filter may also be used to give better reading accuracy.

3.2.2 Micrometer scale, with 0,01 mm divisions, for calibration of the optical system.

3.2.3 Impregnation system, with fast-curing polyester or epoxide resin.

3.2.4 Moulding assembly (see Figure 1 for an example).

Dimensions in millimetres



Key

1 sample holder (metal)
2 resin
3 yarn/small plate
4 mould (rubber or silicone elastomer)

Figure 1 — Example of assembly for moulding specimens

3.2.5 Saw, suitable for cutting specimens.

3.2.6 Polishing device.

3.3 Procedure

3.3.1 Preliminary operations

Set up the microscope (3.2.1) with the appropriate optical system and the moving stage. Calibrate the optical system using the micrometer scale (3.2.2).

3.3.2 Preparation of the specimen

Bond a length of the yarn whose fibres or filaments are to be examined to a small plate of suitable material by means of a small amount of resin (3.2.3). Allow the resin to harden.

Place the plate plus yarn into the mould of the moulding device (see 3.2.4) so that it stands vertically. Fill the mould with the prepared resin and allow to cure.

Polish the upper surface of the moulding with the polishing device (3.2.6) until a perfectly flat, smooth surface is obtained.

Remove the moulding and, using the saw (3.2.5), cut a thin disc (about 4 mm thick) from the top of the moulding. This constitutes the specimen to be examined under the microscope.

3.3.3 Location and centering of the specimen

To facilitate the location of the specimen in the field of view, reduce the magnification to a value such as $\times$ 150, for instance. When the specimen has been located, return to the higher magnification and complete centering.

The ends of the glass fibres and filaments will appear as bright discs.

Adjust the illumination to reduce the area of diffused light around each of these discs to a minimum, keeping the light bright enough for the scale to be read easily.

Bring the discs under the micrometer graticule.

3.3.4 Measurements

Move the microscope stage so that one of the graduations of the micrometer graticule is tangential to a disc. Record the number of divisions, estimating to the nearest half-division, corresponding to the diameter of the disc.

NOTE Oval-shaped discs may be observed. These are obliquely cut sections due to the fact that not all the fibres or filaments in the specimen are parallel. These oval discs can be used to determine the diameter providing the smallest dimension is measured, this being the only one that represents the diameter of the filament.

Make diameter measurements on 25 discs taken at random over the specimen. To do this, move the microscope stage across the field of view so that, for each measurement, one of the graduations of the micrometer graticule is tangential to a disc.

If it proves impossible to make 25 measurements in this way, begin again along another axis, avoiding second measurements on the same fibres, until 25 measurements have been obtained.

4 Expression of results

Calculate the arithmetic mean of the 25 measurements and convert this value to micrometres, using the magnification coefficient of the optical system.

Express the result to the nearest 0,5 μm.

5 Test report

The test report shall contain the following information:

a) a reference to this International Standard and the method used (A or B);

b) all details necessary for identification of the yarn examined;

c) a statement to the effect that desizing was carried out, if applicable;

d) the magnification used;

e) the arithmetic mean of the 25 measurements;

f) details of any operation not described in this International Standard, as well as any incident liable to have affected the results.

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