INTERNATIONAL STANDARD

ISO 3341

Third edition
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Textile glass — Yarns — Determination of breaking force and breaking elongation

Verre textile — Fils — Détermination de la force de rupture et de l'allongement à la rupture en traction

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Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 734 10 79
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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

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 International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 3341 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 3341:1984), which has been technically revised.

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Textile glass — Yarns — Determination of breaking force and breaking elongation

1 Scope

1.1 This International Standard specifies a method for the determination of the tensile breaking force and elongation at break of glass yarns taken from packages.

1.2 The method is applicable to various types of glass yarn (single, folded, cabled, strands, structures without twist, rovings, etc.). It is basically intended for single, folded and cabled glass yarns having a diameter of less than 2 mm, or a linear density lower than 2 000 tex, taken from packages. Heavier yarns may be also tested providing the test conditions are acceptable to all interested parties.

1.3 The method is not applicable to glass yarns which, in equilibrium with the standard atmosphere and under a pre-tension of 5 mN/tex, are elongated by more than 0,5 %. Such yarns can be tested using a lower pre-tension (for example 2,5 mN/tex or 1 mN/tex), acceptable to all interested parties. This would occur mainly when dealing with staple-fibre yarns.

NOTE 1 Though the determination may be run on beamed yarn or on yarns taken from fabrics, the results must be considered as indicative only.

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NOTE 2 This test method is primarily intended for material characterization and quality control. Fibre-to-fibre abrasion and other factors such as insufficiently uniform tension (catenary) will increase variability and generate low test values. This will consequently impede accurate correlation between performance of the yarns and end use applications. Extreme care should be taken in considering this method for specification purposes.

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NOTE 3 Though this International Standard provides the possibility of determining the elongation at break, this practice is not recommended, however. Indeed, a correct assessment of the elongation will only be obtained using an extensometer; it will not be obtained by measuring the distance traversed by the moving clamp. On the other hand, experience shows that the use of an extensometer is quite delicate and often causes damage to the specimen.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 291:1997, *Plastics — Standard atmospheres for conditioning and testing*.

ISO 1889:1997, *Reinforcement yarns — Determination of linear density*.

3 Terms and definitions

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

3.1
breaking force
the force (or load) required to break the test specimen in a tensile test carried to rupture, usually expressed in newtons

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3.2
breaking strength
the tensile breaking force per unit linear density of the unstrained specimen, usually expressed in newtons/tex

3.3
elongation
the increase produced by a tensile force in the gauge length of a specimen, expressed either in units of length, for example millimetres, or as a percentage of the gauge length, in which case it is called “percentage elongation”

3.4
gauge length
the length, including any non-linear portions, of a test specimen under the prescribed pre-tension, measured from nip to nip of the jaws of the clamps in their starting positions

3.5
package
a length of one or more yarns in a form suitable for handling, storage or transport

NOTE Packages may be unsupported or wound in various patterns on bobbins, cops, cones, pins, flanged bobbins or tubes.

4 Principle

4.1 The breaking force and the elongation at break are determined by elongating a specimen by suitable mechanical means until rupture. Elongation at a specified force, or alternatively the force at a specified elongation, may also be determined if required.

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4.2 The value of the breaking force per unit linear density of the yarn, i.e. the breaking strength, may also be calculated if requested.

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5 Apparatus

5.1 Tensile-testing machine

5.1.1 The method is designed for test machines with constant rate of elongation (CRE). If other machines, such as constant rate of loading (CRL) or constant rate of traverse (CRT), are used, the results will be different from those obtained with the reference CRE machine.

In cases of dispute, results obtained on a CRE machine shall prevail.

All test machines shall include

a) a pair of suitable clamps to grip the specimen;

b) means for elongating the specimen;

c) a mechanism which will indicate or record the load applied to the specimen and the corresponding elongation.

An autographic recorder is desirable for recording the elongation corresponding to a specified force. The inertia of the recording system shall be sufficiently low to avoid distortion of the force-elongation curve.

5.1.2 The maximum error in the indicated force, at any point in the range in which the machine is used, shall not exceed 1 % of the true force. The error in the indicated clamp separation shall not exceed 1 mm.

5.1.3 The design of the clamps is critical to obtaining correct breaks and consistent results. The clamps shall be capable of holding the specimens without slippage and without visible damage and shall be designed so that breaks do not occur within 10 mm of the jaws.

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Typical commercially available test machines have either flat or radiussed clamps, and the results obtained can vary from one type to the other.

Figure 1 shows examples of the two types of clamp.

For the radiussed clamps, the radius r shall be comprised between 12 mm and 25 mm for yarns with a linear density lower than 500 tex, and between 25 mm to 45 mm for yarns or rovings with a higher linear density.

The two faces of the grips which hold the specimen shall be protected or covered with adhesive tape so as to maintain the yarn correctly in position without damaging it.

5.1.4 The test machine shall be adjusted to give a constant rate of extension of 200 mm/min $\pm$ 20 mm/min. However, the initial setting of the moving clamp can be specific to the clamp type.

Typical nominal gauge lengths are

500 mm for flat clamps;

250 mm to 350 mm for radiussed clamps.

The gauge length for the machine used shall be noted in the test report.

WARNING — Since the results obtained may differ depending upon the type of clamp used, comparison of results from different laboratories will be valid only if the same type of clamp and the same gauge length are used.

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6 Conditioning

Condition the elementary units[1)] to be tested in one of the standard atmospheres specified in ISO 291 for at least 6 h.

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7 Specimens

7.1 Number of specimens

Unless otherwise specified, test 10 specimens from each elementary unit. Each specimen is selected successively along the yarn separated by a maximum of 3 m of yarn.

If stipulated in the specification or by the person ordering the test, the test (made with 10 specimens) may be performed at specific locations within the elementary units to be tested.

7.2 Selection of specimens

If necessary, remove the outer layer of yarn to ensure that the yarn tested is undamaged.

When taking specimens, unwind the yarn in such a way that

— no damage is caused to the yarns;

— no closed loops or knots are formed;

— no significant change in twist is produced.

The product specification and also the test report shall indicate the method of unwinding (overend or tangential runout).

1) As defined in ISO 1886:1990, *Reinforcement fibres — Sampling plans applicable to received batches*, the elementary unit is the smallest normally commercially available entity of a given product.

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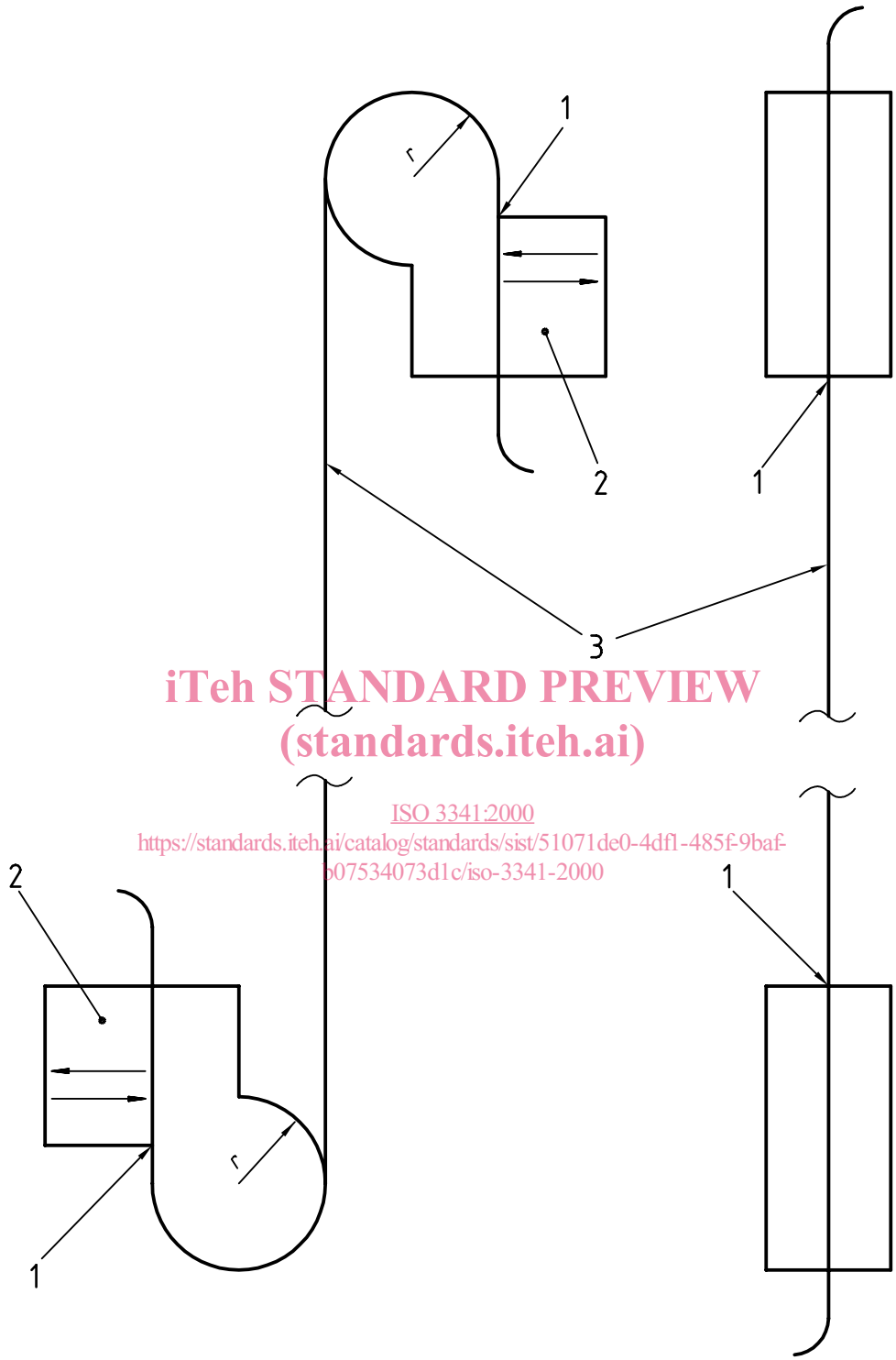

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Key

1 Specimen-fixation point (end of gauge length)
2 Moving grip
3 Test specimen

Figure 1 — Examples of suitable radiussed and flat clamps

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8 Procedure

8.1 General

While the determination of the breaking force is generally stipulated in the product specification, the elongation at break is not necessarily required. If the elongation at break is not needed, the operator is not required to take related instructions into account.

8.2 Determination

8.2.1 After conditioning as specified in clause 6, secure a test specimen in the clamps, ensuring that the specimen is aligned parallel with the force to be applied. Do not touch the specimen anywhere within the gauge length (portion between clamps) with bare hands. When the clamps are closed, the specimen shall be straight.

8.2.2 If the test machine has a pre-tensioning capability, apply to the specimen a pre-tension of 5 mN/tex $\pm$ 2,5 mN/tex, calculated from the nominal linear density of the yarn. If the application of the pre-tension increases the specimen length by more than 0,5 %, this test method may not be applicable (see 1.3).

In cases of dispute, the test shall be performed on a machine which has the required pre-tensioning capability.

8.2.3 Set the moving clamp in motion. After the specimen breaks, record the breaking force and the elongation at the breaking force. Return the moving clamp to its zero position and remove the broken specimen.

8.2.4 Repeat the determination on the remaining specimens.

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8.2.5 Disregard any results obtained with specimens that slip in the jaws, or that break in the jaws or within 10 mm of the jaws. If the number of results discarded exceeds 10 % of the number of specimens tested, the clamps shall be readjusted. If necessary, the specimens shall be held by indirect clamping (using e.g. capstan clamps). In these conditions, the elongation values measured are not comparable with those obtained with direct-clamping jaws.

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9 Expression of results

9.1 Breaking force

For each set of 10 specimens, calculate, in newtons, the arithmetic mean of the breaking force. This value, expressed to one significant figure, is the result for the elementary unit tested.

If the determination was repeated within the same package, the results shall be reported in the way specified in the product specification or by the person ordering the test.

9.2 Elongation at break

If this property was requested, calculate for each set of 10 specimens the arithmetic mean, in millimetres, of the elongation at break, expressed as a percentage of the gauge length.

The resulting value, expressed to one significant figure, is the result for the elementary unit.

9.3 Breaking strength

If requested, the breaking strength can be calculated, in newtons per tex, from the breaking load determined by the present method and the linear density of the glass yarns, as determined by the method given in ISO 1889. The calculated value shall be quoted to one significant figure.

For this calculation, use the result calculated for the elementary unit rather than those obtained for each specimen.

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