INTERNATIONAL STANDARD

ISO 34-1

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Rubber, vulcanized or thermoplastic — Determination of tear strength —

Part 1: Trouser, angle and crescent test pieces

Caoutchouc vulcanisé ou thermoplastique — Détermination de la résistance au déchirement —

Partie 1: Éprouvettes pantalon, angulaire et croissant

Reference number
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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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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 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 34-1 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 2, *Testing and analyses*.

This second edition cancels and replaces the first edition (ISO 34-1:1994), of which it constitutes a minor revision (a number of corrections have been made in Figure 2). It also incorporates the Technical Corrigendum ISO 34-1:1994/Cor.1:1999.

ISO 34 consists of the following parts, under the general title *Rubber, vulcanized or thermoplastic — Determination of tear strength*:

— *Part 1: Trouser, angle and crescent test pieces*

— *Part 2: Small (Delft) test pieces*

Rubber, vulcanized or thermoplastic — Determination of tear strength —

Part 1:
Trouser, angle and crescent test pieces

1 Scope

This part of ISO 34 specifies three test methods for the determination of the tear strength of vulcanized and thermoplastic rubber, namely

— Method A, using a trouser test piece;

— Method B, using an angle test piece, with or without a nick of specified depth;

— Method C, using a crescent test piece with a nick.

The value of tear strength obtained depends on the shape of the test piece, speed of stretching and temperature of test. It may also be susceptible to grain effects in rubber.

Method A: Using a trouser test piece

Method A, using the trouser test piece, is preferred because it is not sensitive to the length of the cut, unlike the other two test pieces in which the nick has to be very closely controlled. In addition, the results obtained are more easily related to the fundamental tear properties of the material and are less sensitive to modulus effects (provided that the leg extension is negligible) and the rate of propagation of the tear is directly related to the rate of grip separation. With some rubbers, the propagation of tear is not smooth (knotty tear), and analysis of results may be difficult.

Method B, procedure (a): Using an angle test piece without nick

This test is a combination of tear initiation and propagation. Stress is built up at the point of the angle until it is sufficient to initiate a tear and then further stresses propagate this tear. However it is only possible to measure the overall force required to rupture the test piece, and, therefore, the force cannot be resolved in two components producing initiation and propagation.[1]

Method B, procedure (b): Using an angle test piece with nick

This test measures the force required to propagate a nick already produced in the test piece. The rate of propagation is not directly related to the jaw speed.[2]

Method C: Using a crescent test piece

This test also measures the force required to propagate a nick already produced in the test piece and the rate of propagation is not related to the jaw speed.

NOTE A separate method for the determination of the tear strength of small test pieces of rubber (Delft test pieces) is specified in ISO 34-2.[3]

2 Normative references

The following referenced documents are indispensable for the application 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 471:1995, *Rubber — Temperatures, humidities and times for conditioning and testing*

ISO 3383:1985, *Rubber — General directions for achieving elevated or subnormal temperatures for test purposes*

ISO 4648:1991, *Rubber, vulcanized or thermoplastic — Determination of dimensions of test pieces and products for test purposes*

ISO 5893:2002, *Rubber and plastics test equipment — Tensile, flexural and compression types (constant rate of traverse) — Specification*

ISO 6133:1998, *Rubber and plastics — Analysis of multi-peak traces obtained in determinations of tear strength and adhesion strength*

ISO/TR 9272:1986, *Rubber and rubber products — Determination of precision for test method standards*

3 Terms and definitions

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

3.1

trouser tear strength

median force, calculated in accordance with ISO 6133, required to propagate a cut in a specified trouser-shaped test piece by tearing, divided by the thickness of the test piece, the force acting in a direction substantially in the plane of the cut

3.2

unnicked angle tear strength

maximum force required to rupture a specified angle-shaped test piece, divided by the thickness of the test piece, the force acting in a direction substantially along the length of the test piece

3.3

nicked angle or crescent tear strength

maximum force required to cause a nick cut in a specified angle- or crescent-shaped test piece to extent by tearing of the rubber, divided by the thickness of the test piece, the force acting in a direction substantially normal to the plane of the nick

4 Principle

The test consists in measuring the force required to tear a specified test piece, in continuation of the cut or nick already produced in the test piece or, in the case of method B, procedure (a), completely across the width of the test piece.

The tearing force is applied by means of a tensile testing machine, operated without interruption at a constant rate of traverse until the test piece breaks. Dependent upon the method employed, the maximum or median force achieved is used to calculate the tear strength.

No correlation between data obtained by the alternative test pieces is implied.

5 Apparatus

5.1 Dies

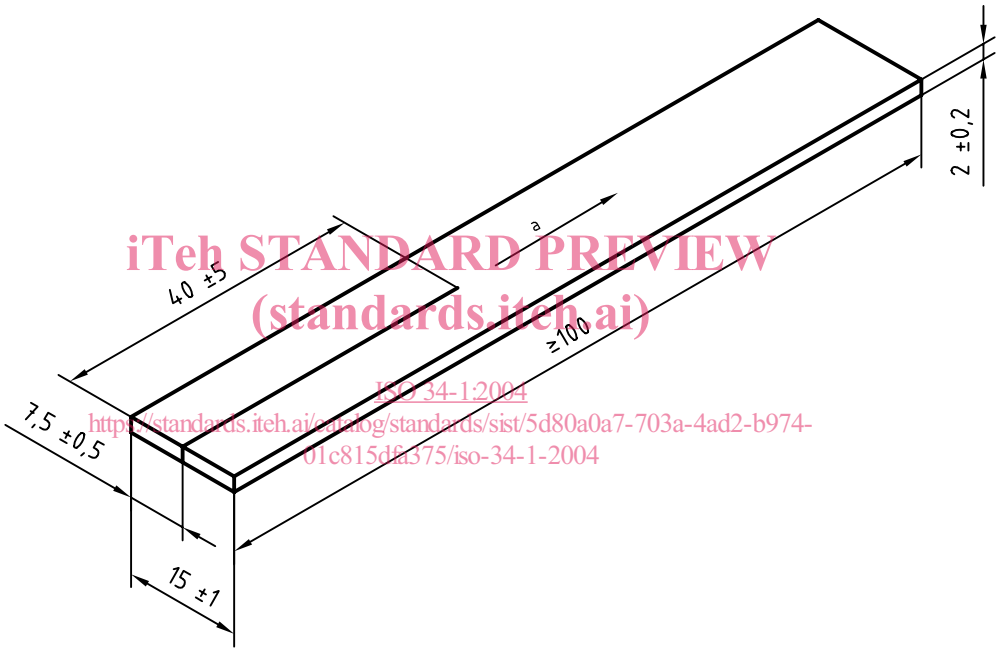
5.1.1 The die used for cutting trouser test pieces shall have the outline dimensions (length and width) shown in Figure 1.

5.1.2 The die used for cutting angle test pieces shall have the dimensions shown in Figure 2.

5.1.3 The die used for cutting crescent test pieces shall have the dimensions shown in Figure 3.

5.1.4 The cutting edges of the dies shall be kept sharp and free from ragged edges. Care shall be taken that the cutting edges are perpendicular to the other surfaces of the die and have a minimum of concavity.

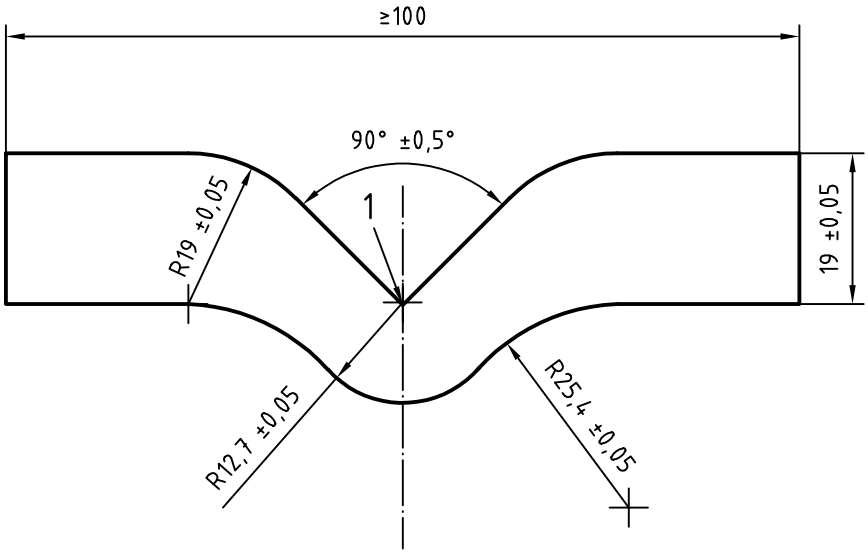
Dimensions in millimetres



[a] Direction of cut

Figure 1 — Trouser test piece die

Dimensions in millimetres

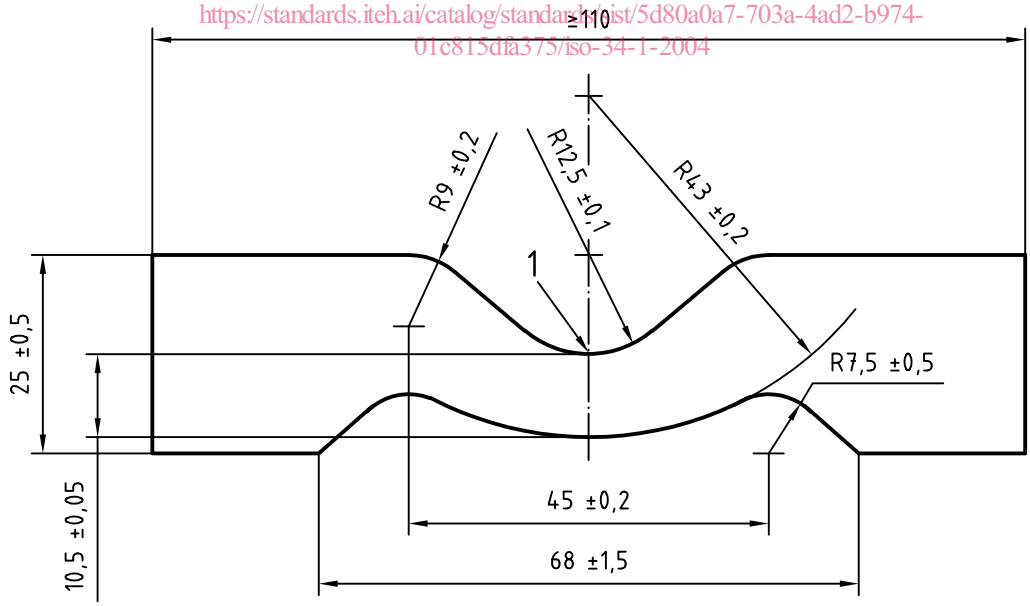


Key

1 location of nick for method B, procedure (b)

Figure 2 — Angle test piece die

Dimensions in millimetres



Key

1 location of nick

Figure 3 — Crescent test piece die

5.2 Nick cutter

A sharp razor blade or a sharp knife free from ragged edges shall be used for producing a cut or a nick in the test piece.

The apparatus for introducing the nick required for the nicked angle or crescent test piece shall be as follows.

Means shall be provided for clamping the test piece firmly, especially in the region where the nick is to be introduced. The cutting tool, consisting of a razor blade or similar blade, shall be clamped in a plane perpendicular to the major axis of the test piece, and positioned so as to introduce the nick in the appropriate place. The blade clamping device shall permit no lateral movement and shall be fitted in guides to enable the blade to be moved across the test piece with its edge remaining perpendicular to the plane of the test piece. Alternatively, the blade may be fixed and the test piece arranged to move in an analogous manner. Means shall be provided for fine adjustment of the depth of the nick. The adjustment of the position of the blade holder and/or clamped test piece shall be determined for each blade by cutting one or two preliminary nicks and measuring these with the aid of a microscope. The blade shall be wetted with water or soap solution prior to nicking.

NOTE A suitable apparatus for nicking tear test pieces has been described in detail in the literature.[4]

To check that the depth of the nick is within the specified limits (see 6.4), any suitable means may be used, for example an optical projection apparatus. A convenient arrangement is a microscope giving at least $\times 10$ magnification fitted with a travelling stage suitably illuminated. The eyepiece is fitted with a graticule or crosswire by which to record the travel of the stage and test piece through a distance equal to the depth of the nick. The travel of the stage is calibrated with a stage micrometer.

Alternatively, a travelling microscope may be used.

The apparatus shall have an accuracy of measurement of 0,05 mm.

5.3 Testing machine

The machine shall conform to the requirements of ISO 5893, to an accuracy corresponding to grade B.

It shall be capable of registering the applied forces within 2 % during the test while maintaining the specified constant rate of separation of the jaws of 100 mm/min $\pm$ 10 mm/min for the trouser test piece and 500 mm/min $\pm$ 50 mm/min for the angle and crescent test pieces. A low-inertia machine having autographic force-recording facilities is essential when using the trouser test piece.

NOTE Inertia (pendulum) type dynamometers are apt to give results which differ from each other because of frictional and inertial effects. A low-inertia (for example electronic- or optical-transducer) type dynamometer gives results which are free from these effects and is therefore to be preferred.

5.4 Grips

The machine shall be provided with a type of grip which tightens automatically as the tension increases and exerts a uniform pressure across the widened end of the test piece. Each grip shall incorporate a means for positioning so that the test pieces are inserted symmetrically and in axial alignment with the direction of the pull. The depth of insertion shall be such that the test piece is adequately gripped, within the parallel-sides portion, when testing angle and crescent test pieces. Trouser test pieces shall be inserted in the grips in accordance with Figure 4.