International Standard

ISO 816

Rubber, vulcanized — Determination of tear strength of small test pieces (Delft test pieces)

Caoutchouc vulcanisé — Détermination de la résistance au déchirement des petites éprouvettes (éprouvettes de Delft)

Second edition — 1983-12-01
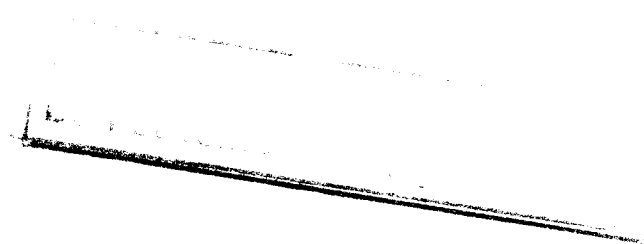
ISO 816-1983 (E)

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been authorized 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.

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 816 was developed by Technical Committee ISO/TC 45, *Rubber and rubber products*.

This second edition was submitted directly to the ISO Council, in accordance with clause 6.11.2 of part 1 of the Directives for the technical work of ISO. It cancels and replaces the first edition (i.e. ISO 816-1976), which had been approved by the member bodies of the following countries :

Australia	France	Netherlands
Austria	Germany, F.R.	New Zealand
Brazil	Hungary	Poland
Bulgaria	India	Spain
Canada	Israel	Switzerland
Chile	Italy	United Kingdom
Colombia	Japan	USSR
Czechoslovakia	Korea, Rep. of	Yugoslavia

The member bodies of the following countries had expressed disapproval of the document on technical grounds :

Sweden
USA

Rubber, vulcanized — Determination of tear strength of small test pieces (Delft test pieces)

1 Scope and field of application

This International Standard specifies a method for the determination of the tear strength of small test pieces (Delft test pieces) of vulcanized rubbers.

NOTE — The test does not necessarily give results agreeing with those given by the method described in ISO 34, *Rubber, vulcanized — Determination of tear strength (trouser, angle and crescent test pieces)*.

2 References

ISO 471, *Rubber — Standard temperatures, humidities and times for the conditioning and testing of test pieces.*

ISO 1826, *Rubber, vulcanized — Time-interval between vulcanization and testing — Specification.*

ISO 4648, *Rubber, vulcanized — Determination of dimensions of test pieces and products for test purposes.*

ISO 5893, *Rubber and plastics test equipment — Tensile, flexural and compression types (constant rate of traverse) — Description.* [1]

3 Principle

Measurement of the force required to tear across the width of a small test piece containing a slit in the centre. (The slit and the test piece are cut in one operation.)

4 Apparatus

4.1 Tensile testing machine, complying with the requirements of ISO 5893, capable of measuring force with an accuracy corresponding to grade B, as defined in ISO 5893, and with a rate of traverse of the moving grip of 500 ± 50 mm/min.

The capacity of the test machine shall be such that the force required to cause tearing of the test piece will be not less than 15 % or more than 85 % of that capacity.

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

4.2 Die, for cutting the test piece.

The construction of the die and of the knife which cuts the slit is shown in figures 3 and 4.

4.3 Micrometer gauge, complying with the requirements of ISO 4648 and having a circular foot approximately 6 mm in diameter, which exerts a pressure of 20 kPa. [2]
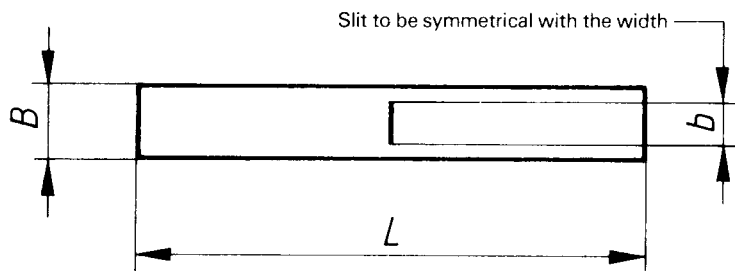
4.4 Travelling microscope.

5 Test piece

5.1 Shape and dimensions

The test piece shall be rectangular and shall conform to the shape of the die shown in figure 1.

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1) At present at the stage of draft.

2) 1 kPa = 1 kN/m^2

Dimensions of test piece

Dimension		mm
L	Length	60
B	Width	$9,0 \pm 0,1$
b	Slit length	$5,0 \pm 0,1$

Figure 1 — Test piece

The test pieces shall be cut from a sheet by punching with the die (4.2), using a single blow of a mallet or (preferably) a single stroke of a press. The rubber may be wetted with water or a soap solution, and shall be supported on a sheet of slightly yielding material (for example leather, rubber belting or cardboard) on a flat rigid surface.

The tear strength is particularly susceptible to grain effects in vulcanized rubber. Normally, all test pieces are prepared with the grain at right angles to their length, but in cases where grain effects are significant and are to be evaluated, two sets of test pieces shall be cut from the sheet, one at right angles to the grain and the other parallel to the grain.

The thickness, d, of the test pieces shall be $2,0 \pm 0,2$ mm.

5.2 Measurement of dimensions

Measure the thickness of the test piece by method A1 of ISO 4648. Take at least three gauge readings in the region of the slit. If an odd number of readings is taken, the middle value shall be used. If an even number of readings is taken, the average value of the middle two readings shall be used. No reading shall deviate by more than 2 % from the value to be used. For comparative purposes the thickness of any test piece shall not vary by more than 10 % from the mean thickness of all the test pieces.

Variations occur in the length of the slit and in the total width of the test piece when the same die is used to prepare test pieces from rubber of different hardnesses. Moreover, the slit may not be uniform throughout its depth, but may be wider on one surface. One test piece shall therefore be cut out with the die and used for measuring the width to be torn. This test piece shall be cut through with a razor blade in the plane of the slit, and the cut surfaces (width on either side of the slit) shall be measured with a travelling microscope. The slit in the plane of the thickness of the test piece has the curvature shown in figure 2, and an attempt shall be made to compensate for this curvature when measuring the width on either side of the slit.
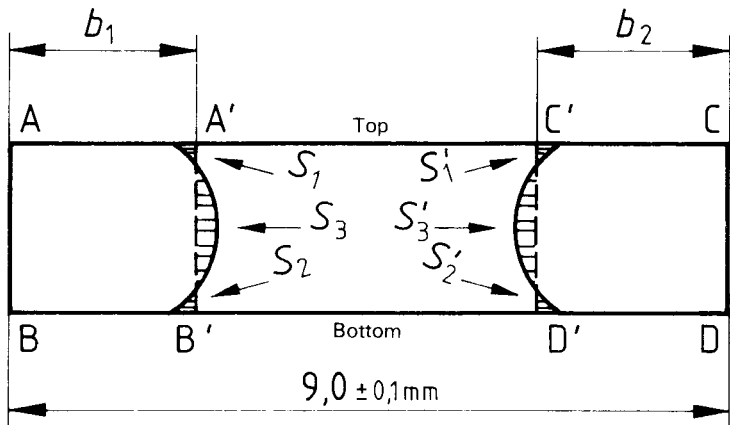

Figure 2 — Detail of slit of Delft tear test piece

Take as the left-hand width, b_1, which is the distance from the line AB to an imaginary line A'B' which is situated so that the total area $(S_1 + S_2) = S_3$.

Similarly, on the right-hand side an imaginary line C'D' shall be so situated that the total are $(S'_1 + S'_2) = S'_3$, and b_2 is the width.

The total width outside the slit (i.e. the rubber to be torn) is then $b_1 + b_2 = b_3$. This is the width which shall be assumed for the portion of the test piece to be torn.

5.3 Number

At least three and preferably six test pieces shall be tested.

5.4 Time interval between vulcanization and testing

The time between vulcanization and testing shall be in accordance with ISO 1826.

6 Temperature of test

The test shall normally be carried out at a standard laboratory temperature as specified in ISO 471; some rubbers have markedly lower tear strengths at elevated temperature, and hence tests may also have to be carried out at higher temperatures, 100 °C being a useful temperature.

7 Procedure

Mount the test piece in the testing machine so that the free length between the points of contact of the grips on the test piece is 30 mm, i.e. each grip will be 15 mm from the slit. Stretch the test piece in the testing machine. Do not interrupt the stretching before the test piece breaks. Note the maximum force reached during the tearing.

8 Expression of results

The tearing force depends on the thickness of the test piece and the width of the rubber to be torn, and the result shall be expressed as the force necessary to tear a test piece of standard width and thickness. This value, F_0, in newtons, is given by the equation

$$F_0 = \frac{8\,F}{b_3\,d}$$

where

F is the force, in newtons, required to tear the test piece;

b_3 is the width, in millimetres, of rubber torn in the test piece (see 5.2);

d is the thickness, in millimetres, of the test piece.

Take as the result the average of the middle two values if the number of test pieces is even, or the middle value if the number of test pieces is odd, the various results being arranged in order of increasing value. If only three test pieces are tested, the individual results shall be given.

9 Test report

The test report shall contain the following information :

a) a reference to this International Standard;

b) the identification of the sample;

c) the tear strength, calculated according to clause 8;

d) the temperature of test;

e) the direction of grain in the test piece.
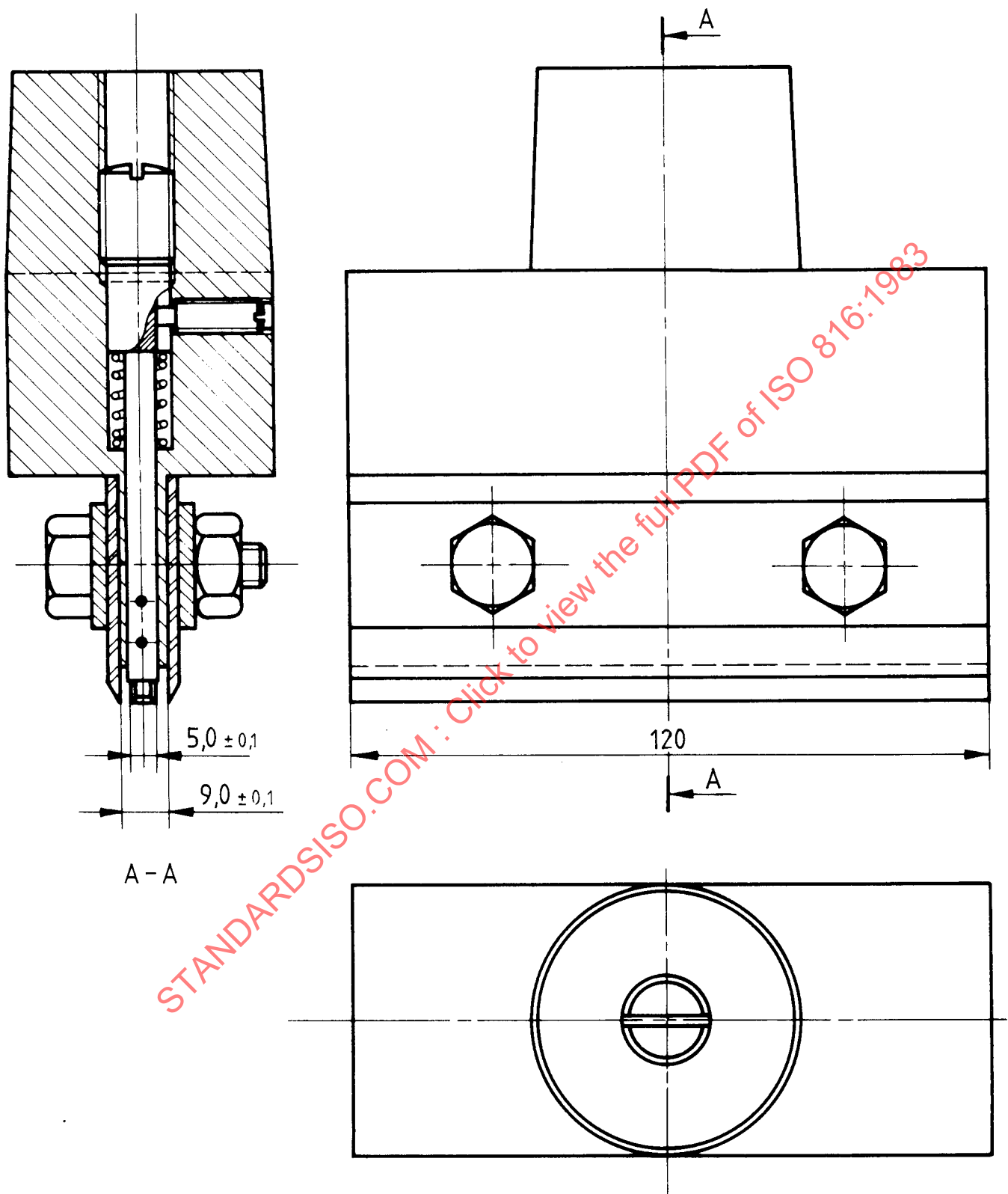
Dimensions in millimetres

5,0 ± 0,1

9,0 ± 0,1

A – A

120

Figure 3 — Die for Delft tear test piece