UDC 678.4/678.7 : 620.172

Ref. No. : ISO/R 816-1968 (E)

ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION

R 816

DETERMINATION OF TEAR STRENGTH OF SMALL TEST PIECES OF VULCANIZED RUBBERS (DELFT TEST PIECES)

1st EDITION
September 1968

Printed in Switzerland

Also issued in French and Russian. Copies to be obtained through the national standards organizations.

BRIEF HISTORY

The ISO Recommendation R 816, *Determination of tear strength of small test pieces of vulcanized rubbers (Delft test pieces)*, was drawn up by Technical Committee ISO/TC 45, *Rubber*, the Secretariat of which is held by the British Standards Institution (BSI).

Work on this question by the Technical Committee led, in 1962, to the adoption of a Draft ISO Recommendation.

In November 1963, this Draft ISO Recommendation (No. 630) was circulated to all the ISO Member Bodies for enquiry. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies :

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

Three Member Bodies opposed the approval of the Draft :

France
Sweden
U.S.A.

The Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided, in September 1968, to accept it as an ISO RECOMMENDATION.

ISO Recommendation R 816 September 1968

DETERMINATION OF TEAR STRENGTH OF SMALL TEST PIECES OF VULCANIZED RUBBERS (DELFT TEST PIECES)

1. SCOPE

This ISO Recommendation describes a method for the determination of tear strength of small test pieces of vulcanized rubbers using the Delft test pieces.

2. PRINCIPLE OF METHOD

The test consists of measuring 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 should be cut in one operation. The test does not necessarily give results agreeing with those given by the method using the crescent test piece.*

3. APPARATUS

The test piece should be stretched in a tensile testing machine capable of a substantially constant rate of traverse of the moving grip. This rate should be 500 ± 50 mm/min.

The capacity of the test machine should be such that the force required to cause tearing of the test piece will be not less than 15 % nor 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 inertia-less (for example, electronic or optical transducer type) dynamometer gives results which are free from these effects and is therefore to be preferred.

4. TEST PIECE

4.1 Dimensions of standard test piece

The test piece should be rectangular and should conform to the shape of the die shown in Figure 1 below.

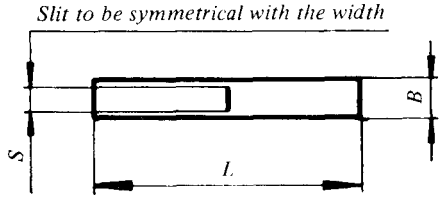

FIG. 1 – Die

Dimensions of test piece

Dimensions	mm
L Length	60
B Width	9.0 ± 0.1
S Slit	5.0 ± 0.1

* See ISO Recommendation R 34, *Determination of tear strength of vulcanized natural and synthetic rubbers (crescent test piece).*

The test piece should be cut from a sheet by punching with the die, 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 should be supported on a sheet of slightly yielding material (for example, leather, rubber belting or cardboard) on a flat rigid surface. The construction of the die and of the knife which cuts the slit is shown in Figure 2 and Figure 3 .

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 should be cut from the sheet, one at right angles to the grain and the other parallel to the grain.

The thickness of the test pieces should be 2.0 ± 0.2 mm.

4.2 Measurement of test piece

The thickness of the test piece should be measured by means of a micrometer gauge having a pressure foot approximately 6 mm in diameter which exerts a pressure of 0.2 bar on the rubber. Take at least three gauge readings in the region of the slit. If an odd number of readings is taken, the middle value should be used. If an even number of readings is taken, the average value of the middle two readings should be used. No reading should deviate by more than 2 % from the value to be used. For comparative purposes the thickness of any test piece should not vary by more than 10 % from the mean thickness of all the test pieces.

There are variations 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. The slit is also not uniform throughout its depth, but may be wider on one surface. One test piece should therefore be cut out with the die and used for measuring the width to be torn. This test piece should be cut through with a razor blade in the plane of the slit and the cut surfaces (width on either side of the slit) should be measured with a travelling microscope. The slit in the plane of the thickness of the test piece has the curvature shown in Figure 4, and an attempt should be made to compensate for this curvature when measuring the width on either side of the slit.

Take as the left hand width the length Z_1, which is the distance from the line AB to an imaginary line A'B' which is situated so that the total area $(O_1 + O_2) = O_3$.

Similarly on the right hand side an imaginary line C'D' should be so situated that the total area $(P_1 + P_2) = P_3$, and Z_2 is the width.

The total width outside the slit (i.e., the rubber to be torn) is then $(Z_1 + Z_2) = W_2$. This is the width which should be assumed for the portion of the test piece to be torn.

4.3 Number of test pieces

Test at least three and preferably six test pieces.

4.4 *Conditioning of test pieces*

Condition the test pieces for at least 16 hours at a standard laboratory temperature immediately before test. The time after vulcanization before test should not exceed 6 days. The standard laboratory temperature should be 20 ± 2 °C, 23 ± 2 °C or 27 ± 2 °C, the same temperature being used throughout any one test or series of tests intended to be comparable.

5. TEMPERATURE OF TEST

The test should normally be carried out at a standard laboratory temperature; 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.

6. 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.

7. 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 is expressed as the force necessary to tear a test piece of standard width and thickness. This value is stated in units of force, F :

$$F = \frac{L \times W_1 \times t_1}{W_2 \times t_2}$$

where

L is the force, expressed in newtons, required to tear the actual test piece;

W_1 is the width of rubber to be torn in a standard test piece = 4 mm;

W_2 is the width, expressed in millimetres, of rubber torn in the actual test piece;

t_1 is the thickness of a standard test piece = 2 mm;

t_2 is the thickness, expressed in millimetres, of the actual test piece.

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

8. TEST REPORT

The test report should include the following :

(*a*) the tear strength, determined as described above;

(*b*) the temperature of test;

(*c*) the direction of grain in the test piece.

Dimensions in millimetres

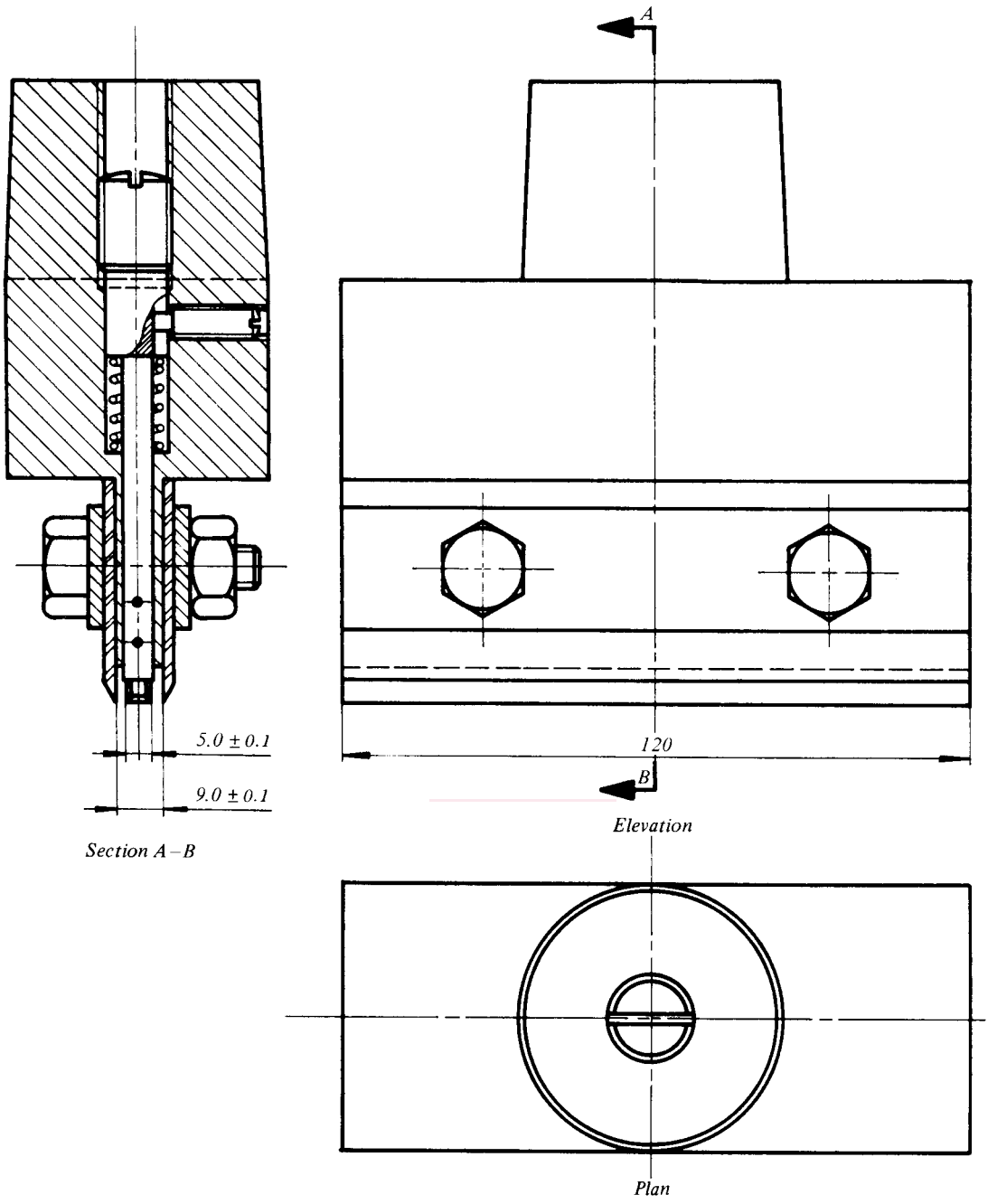

FIG. 2 – **Die for Delft tear test piece**

Dimensions in millimetres

Enlarged detail of cutting edge of the die for the test piece

Enlarged details of small knife for cutting slit

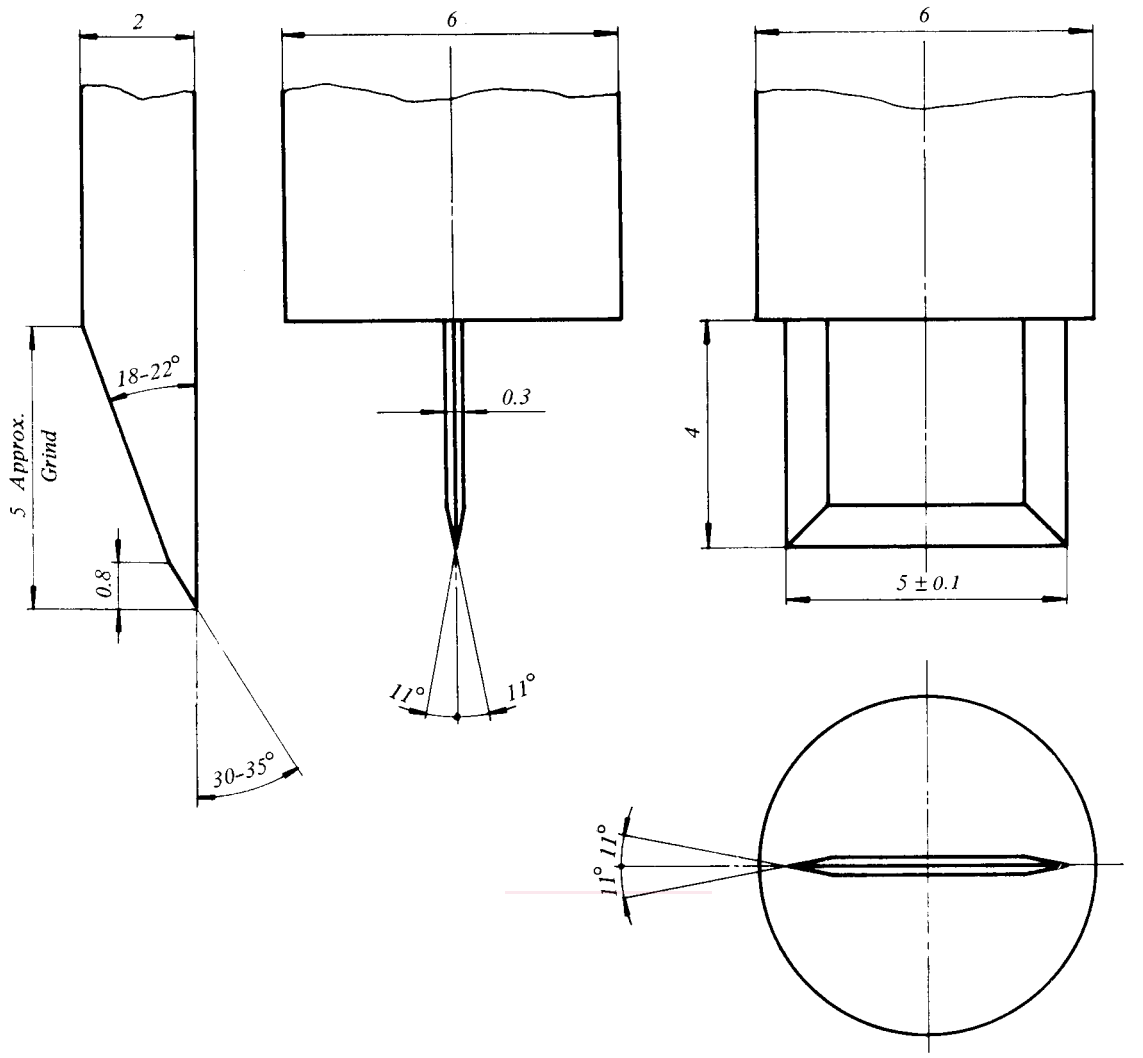

FIG. 3 – **Enlarged details of Delft tear test piece die cutting edges**

Dimensions in millimetres

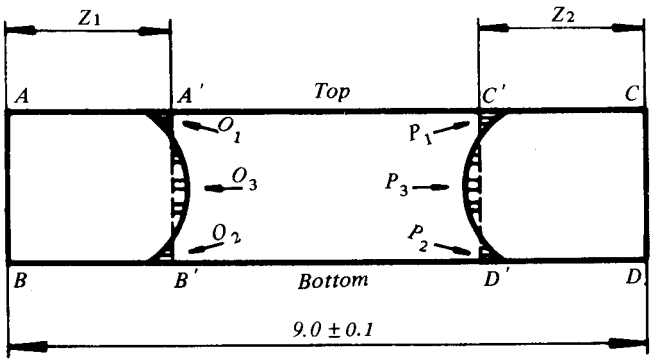

FIG. 4 – **Detail of slit of Delft tear test piece**