

# Flexible cellular polymeric materials - Determination of tear strength

ICS 83.100

## National foreword

This British Standard is the UK implementation of EN ISO 8067:2008. It supersedes BS EN ISO 8067:1995 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PRI/24, Testing of rigid and flexible cellular materials.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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## Flexible cellular polymeric materials - Determination of tear strength (ISO 8067:2008)

Matériaux polymères alvéolaires souples - Détermination de la résistance au déchirement (ISO 8067:2008)

Flexible Polymer-Schaumstoffe - Bestimmung des Weiterreißwiderstands (ISO 8067:2008)

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**WARNING** — Persons using this International Standard should be familiar with normal laboratory practice. This standard does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and to ensure compliance with any national regulatory conditions.

## 1 Scope

This International Standard specifies two methods for the determination of the tear strength of flexible cellular polymeric materials:

- method A, using a trouser test piece;
- method B, using an angle test piece without a nick.

## 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 1923, *Cellular plastics and rubbers — Determination of linear dimensions*

ISO 7500-1, *Metallic materials — Verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Verification and calibration of the force-measuring system*

## 3 Terms and definitions

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

### 3.1

#### tear strength

*R*

maximum force per unit thickness observed when stretching a test piece to rupture

## 4 Apparatus

The tear strength shall be measured on a tensile-testing machine which will indicate the force at which rupture of the test piece takes place. An automatic machine should preferably be used which draws the actual curve, or a stylus or scale should be used having an indicator that remains at the point of maximum force after rupture of the test piece.

The accuracy of the test machine shall be class 2 or better as defined in ISO 7500-1.

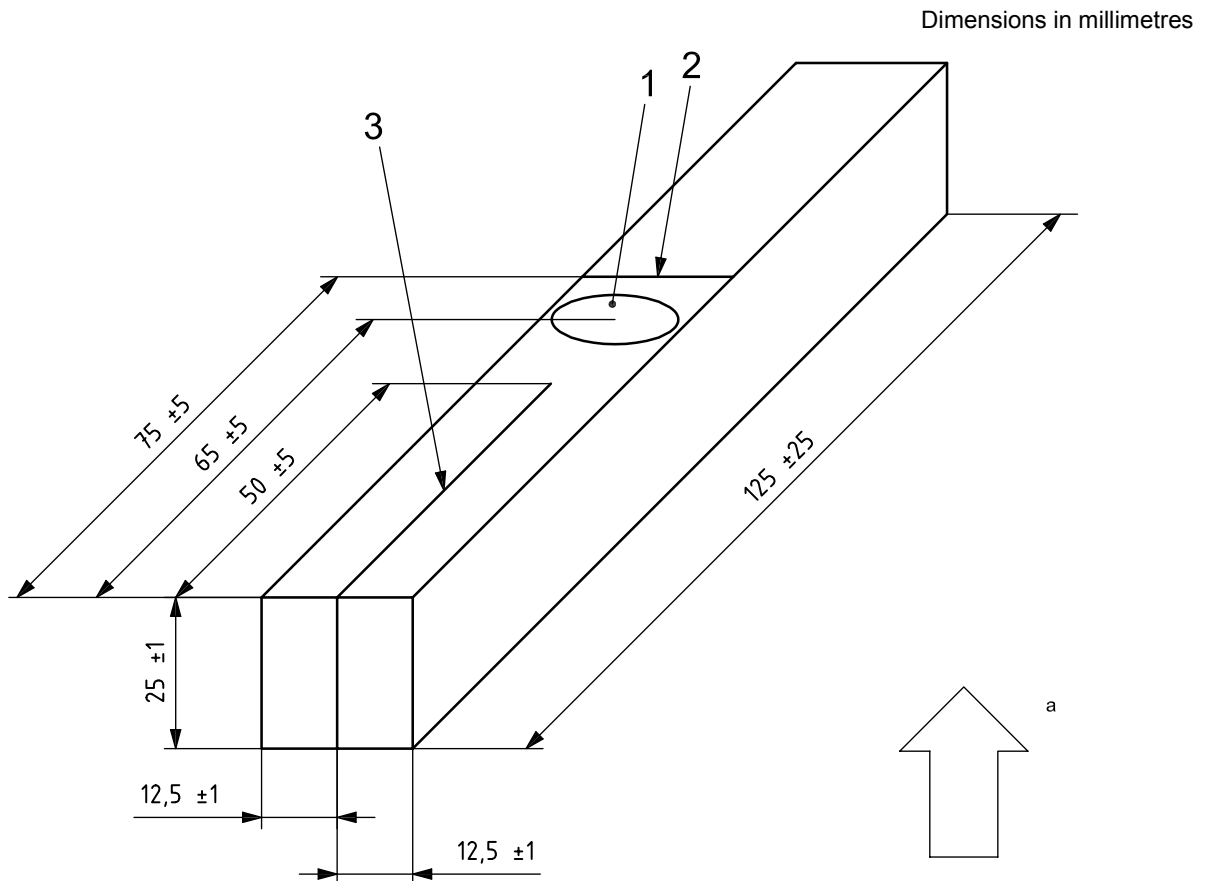
## 5 Test pieces

### 5.1 General

The test pieces shall be free of skin, voids and flow lines. If the material exhibits a predominant direction of cellular structure (orientation of the cells), the trouser test piece shall be taken in such a way that the plane of the cut subsequently made in the test piece (see Figure 1) is parallel to, and the long dimension of the cut perpendicular to, the predominant foam-rise direction and the angle test piece shall be taken in such a way that the plane of the V-shaped side of the test piece (see Figure 3) is parallel to, and the long dimension of the test piece perpendicular to, the predominant foam-rise direction. If this is not possible, the orientation of the long dimension of the cut or the V-shaped side of the test piece with respect to the predominant foam-rise direction shall be stated in the test report.

### 5.2 Trouser test piece for method A

The trouser test piece shall be a rectangular parallelepiped cut from a sheet of material with a band knife or a cutting die. Each test piece shall have the dimensions given in Figure 1 and a 45 mm to 55 mm cut shall be made at one end. The required tear length (25 mm) shall be marked on the test piece. The predominant foam-rise direction for the trouser test piece is indicated by an arrow in Figure 1.



#### Key

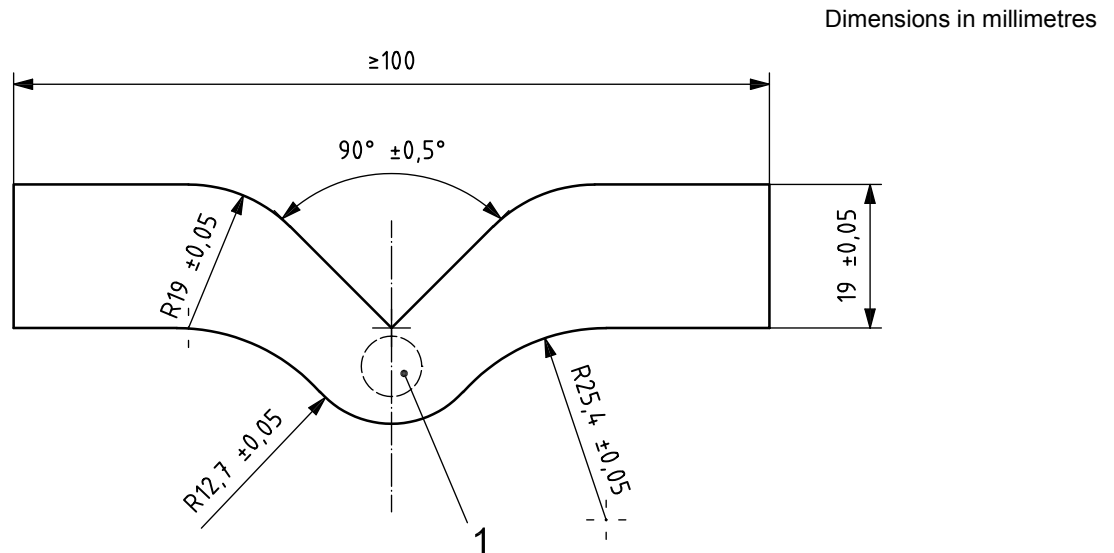
- 1 location of thickness measurement
- 2 mark indicating required tear length
- 3 cut made in test piece

<sup>a</sup> Predominant foam-rise direction.

Figure 1 — Trouser test piece

### 5.3 Angle test piece for method B

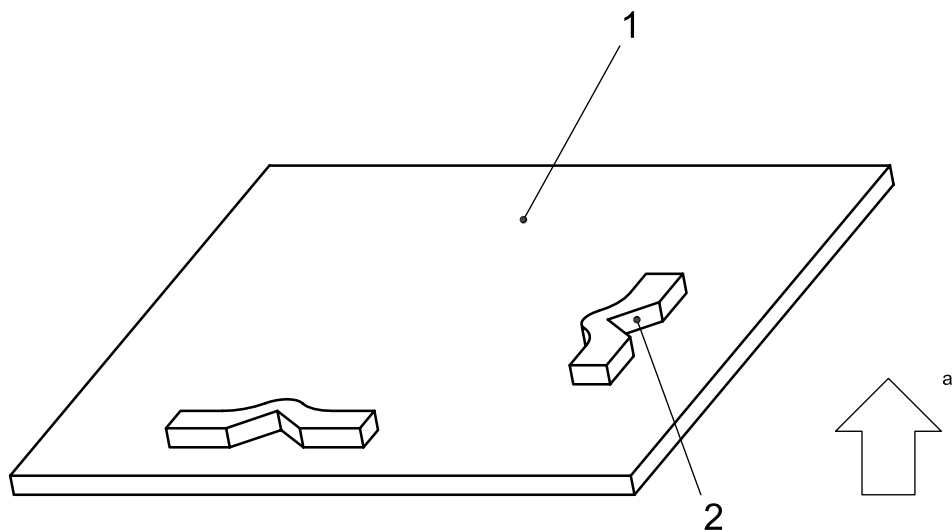
The test piece shall be cut from a sheet of material of thickness 10 mm to 15 mm with a die having the dimensions and shape shown in Figure 2. The predominant foam-rise direction for the angle test piece is indicated in Figure 3.



#### Key

- 1 location of thickness measurement of test piece cut out using die

Figure 2 — Angle test piece die



#### Key

- 1 sheet of material  
2 V-shaped side of test piece  
a Predominant foam-rise direction.

Figure 3 — Predominant foam-rise direction for angle test piece

## **6 Number of test pieces**

Three test pieces shall be tested.

Additional test pieces may be required if the spread of results is too great (see Clause 9) or to compensate for deviation in the progress of the tear (see 8.2).

## **7 Conditioning**

Materials shall not be tested less than 72 h after manufacture, unless it can be demonstrated that the mean results obtained at either 16 h or 48 h after manufacture do not differ by more than  $\pm 10\%$  from those obtained after 72 h, in which case testing is permitted at either 16 h or 48 h, respectively. Prior to the test, the test pieces or the material from which the test pieces are to be cut shall be conditioned for at least 16 h in one of the following atmospheres, unless otherwise specified:

- $(23 \pm 2)^\circ\text{C}$ ,  $(50 \pm 5)\%$  relative humidity;
- $(27 \pm 2)^\circ\text{C}$ ,  $(65 \pm 5)\%$  relative humidity.

This conditioning period may form the final part of or, in the case of testing 16 h after manufacture, the whole of the period following manufacture.

In the case of quality-control tests, test pieces may be taken a shorter time (down to a minimum of 12 h) after manufacture and testing carried out after conditioning for a shorter period (down to a minimum of 6 h) in one of the atmospheres specified above.

It is recommended that, for referee purposes, the test is performed 7 days or more after the cellular material has been manufactured.

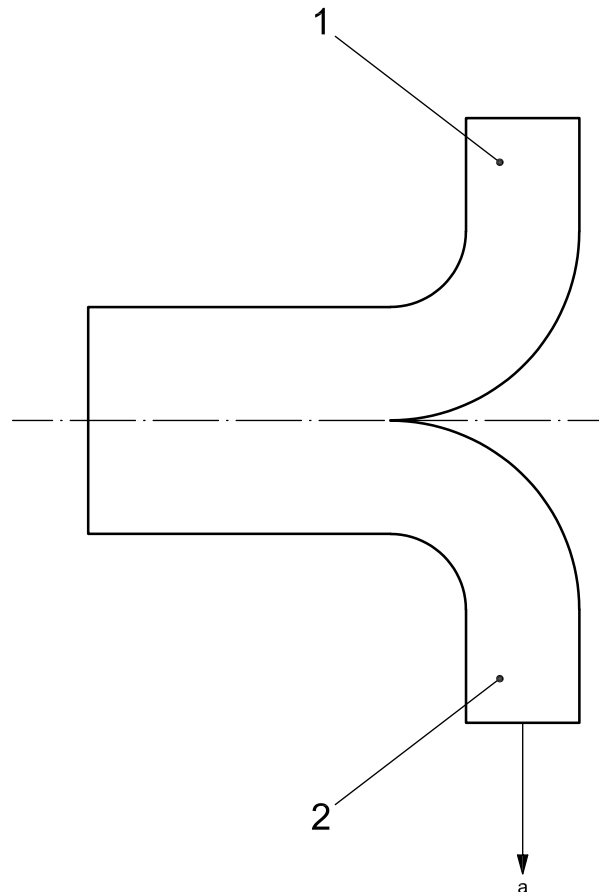
## **8 Procedure**

### **8.1 General**

After conditioning as specified in Clause 7, measure, in accordance with ISO 1923, the thickness of the test piece at the location shown in Figure 1 or Figure 2.

### **8.2 Method A**

**8.2.1** Clamp the test piece in the jaws of the test machine, taking care that the jaws grip the test piece properly. Spread the ends of the test piece so that the force is applied in the direction shown in Figure 4. Start the test machine with a jaw speed of 50 mm/min to 500 mm/min.



**Key**

- 1 held in fixed clamp
- 2 held in moving clamp
- a Direction of applied force.

**Figure 4 — Schematic test arrangement**

**8.2.2** Where necessary in order to keep the cut in the centre of the test piece while tearing, aid it with light application of a sharp blade, for example a single-edged razor blade.

Cutting should be the exception and should be avoided because it could influence the result.

Care should be taken when using blades.

**8.2.3** When the tear has travelled  $(25 \pm 5)$  mm along the test piece, record the maximum force on the dial or scale. If rupture occurs before a length of 20 mm is torn, reject the test piece and take a fresh one.

**8.2.4** For referee purposes, a jaw speed of  $(50 \pm 5)$  mm/min shall be used.

**8.3 Method B**

**8.3.1** Clamp the test piece in the jaws of the test machine, taking care to adjust it so that it is symmetrical, in order that the tension will be distributed uniformly over the cross-section.

**8.3.2** Start the test machine with a jaw speed of 50 mm/min to 500 mm/min and record the maximum force.

**8.3.3** For referee purposes, a jaw speed of  $(500 \pm 50)$  mm/min shall be used.



## **9 Expression of results**

The tear strength  $R$ , expressed in newtons per centimetre (N/cm), is given by the following equation:

$$R = \frac{F}{d} \times 10$$

where

$F$  is the maximum force, in newtons (N), registered on the test machine;

$d$  is the original thickness, in millimetres (mm), of the test piece.

Report the result as the median of the tear strength values calculated for the three test pieces.

If one or more values deviates by more than 20 % from the median, test two additional test pieces and report the median of all five values.

## **10 Test report**

The test report shall include the following information:

- a) a reference to this International Standard;
- b) a description of the material tested and the type of test piece used;
- c) the conditioning used;
- d) the jaw speed used;
- e) the location of the plane of the cut with respect to the predominant rise direction of the cellular structure;
- f) any deviation of the progress of the tear (causing extra test pieces to be tested);
- g) the median value of the tear strength;
- h) the date of testing.

## Annex A (informative)

### Precision comparison for the two types of test piece

#### A.1 Comparative trial

Two types of test piece (the trouser type and the angle type without a nick) were used in the comparative trial.

Two types of flexible polyurethane foam were used:

- sample A: 22 kg/m<sup>3</sup> general-purpose polyether;
- sample B: 32 kg/m<sup>3</sup> high-hardness polyether.

All the test pieces of a given type of foam were taken from the same test sample using a band knife and die-cutting.

Testing was carried out in three laboratories in Japan on two days in different weeks.

The conditioning and test methods were in accordance with this International Standard.

#### A.2 Test results and precision data for each type of test piece

##### A.2.1 General

The test results and the precision data for the two types of test piece are shown in Tables A.1 and A.2.

The precision data in Table A.2 were calculated in accordance with ISO/TR 9272, *Rubber and rubber products — Determination of precision for test method standards*. The precision results given in Table A.2 should not be used for the acceptance or rejection of any group of materials without documentation that the results of this precision evaluation are actually applicable to the particular group of materials tested.

##### A.2.2 Repeatability

The repeatability, or local domain precision, for each type of test piece is given, for each repeatability parameter, by the values in Table A.2. Two test results obtained in the same laboratory (by the proper use of this International Standard) that differ by more than the tabulated values for  $r$ , in measurement units, and  $(r)$ , in percent, should be considered as suspect, i.e. to have come from different populations, and should suggest that some appropriate investigative action be taken.

##### A.2.3 Reproducibility

The reproducibility, or global domain precision, for each type of test piece is given, for each reproducibility parameter, by the values in Table A.2. Two test results obtained in different laboratories (by the proper use of this International Standard) that differ by more than the tabulated values for  $R$ , in measurement units, and  $(R)$ , in percent, should be considered as suspect, i.e. to have come from different populations, and should suggest that some appropriate investigative action be taken.

Table A.1 — Test results

All tear strength values in N/cm

Test lab	Sample A				Sample B			
	Method A <sup>a</sup>		Method B <sup>b</sup>		Method A <sup>a</sup>		Method B <sup>b</sup>	
	Day 1	Day 2	Day 1	Day 2	Day 1	Day 2	Day 1	Day 2
1	4,7	4,9	6,9	6,6	4,8	3,8	6,9	6,2
2	5,0	4,3	6,8	6,7	4,3	3,2	6,2	6,7
3	5,1	4,8	6,5	6,6	4,2	3,9	6,4	6,7
Mean	4,9	4,7	6,7	6,6	4,4	3,6	6,5	6,5
NOTE Test speed = 500 mm/min.								
<sup>a</sup> Trouser test piece.								
<sup>b</sup> Angle test piece without nick.								

Table A.2 — Precision data

Sample (density)	Test method	Mean value N/cm	Within laboratory			Between laboratory		
			$s_r$	$r$	( $r$ )	$s_R$	$R$	( $R$ )
A (22 kg/m <sup>3</sup> )	Method A <sup>a</sup>	4,80	0,325	0,91	19,0	0,275	0,77	16,0
	Method B <sup>b</sup>	6,68	0,136	0,38	5,69	0,150	0,42	6,29
B (32 kg/m <sup>3</sup> )	Method A <sup>a</sup>	4,03	0,625	1,75	43,4	0,520	1,46	36,2
	Method B <sup>b</sup>	6,52	0,375	1,05	16,1	0,271	0,76	11,66
$s_r$ is the within-laboratory standard deviation (in measurement units);								
$r$ is the repeatability (in measurement units);								
( $r$ ) is the repeatability (in percent of mean value);								
$s_R$ is the between-laboratory standard deviation (in measurement units);								
$R$ is the reproducibility (in measurement units);								
( $R$ ) is the reproducibility (in percent of mean value).								
NOTE Test speed = 500 mm/min.								
<sup>a</sup> Trouser test piece.								
<sup>b</sup> Angle test piece without nick.								

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