BRITISH STANDARD

BS EN 14224:2010

Flexible sheets for waterproofing — Waterproofing of concrete bridge decks and other concrete surfaces trafficable by vehicles — Determination of crack bridging ability

ICS 91.100.50

BSI
British Standards

National foreword

This British Standard is the UK implementation of EN 14224:2010. It supersedes BS EN 14224:2005 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee B/546/9, Bridge deck water proofing.

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

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Flexible sheets for waterproofing - Waterproofing of concrete bridge decks and other concrete surfaces trafficable by vehicles - Determination of crack bridging ability

Feuilles souples d'étanchéité - Systèmes d'étanchéité pour ponts et autres surfaces en béton circulables par les véhicules - Détermination de l'aptitude à ponter les fissures

Abdichtungsbahnen - Abdichtungssysteme für Betonbrücken und andere Verkehrsflächen aus Beton - Bestimmung der Rissüberbrückungsfähigkeit

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Foreword

This document (EN 14224:2010) has been prepared by Technical Committee CEN/TC 254 “Flexible sheets for waterproofing”, the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by November 2010, and conflicting national standards shall be withdrawn at the latest by November 2010.

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1 Scope

This European Standard describes a test method for determining the crack bridging ability of reinforced bitumen sheets used in waterproofing systems on concrete bridge decks and other areas of concrete trafficable by vehicles.

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.

EN 13375:2004, *Flexible sheets for waterproofing — Waterproofing of concrete bridge decks and other concrete surfaces trafficable by vehicles — Specimen preparation*

EN 13416:2001, *Flexible sheets for waterproofing — Bitumen, plastic and rubber sheets for roof waterproofing — Rules for sampling*

EN 14695:2010, *Flexible sheets for waterproofing — Reinforced bitumen sheets for waterproofing of concrete bridge decks and other trafficked areas of concrete — Definitions and characteristics*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 13416:2001, EN 13375:2004, EN 14695:2010 and the following apply.

3.1
crack bridging ability
ability of reinforced bitumen sheets to withstand movements of the crack of the base specimen without deterioration

3.2
crack width
distance between the sides of the crack of the base specimen, measured by monitoring the movement of the base specimen during the test

3.3
nominal curve
input of changes as a function of time which the crack width of the base specimen shall follow during a test

3.4
completely broken
disconnection of the reinforced bitumen sheets above the crack of the base specimen into two completely separated parts

4 Test method

4.1 Principle

After applying the reinforced bitumen sheet(s), a crack is induced in the base specimen at the saw-cut.

The crack bridging ability of reinforced bitumen sheets is determined by periodically varying the crack width within defined limits. The test can be carried out at different temperatures.

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4.2 Apparatus

4.2.1 Temperature controlled chamber, with an accuracy of ± 1 °C, for the test specimens and the loading parts of the testing apparatus during the test.

4.2.2 Testing apparatus, for generating changes in the crack width, able to control and monitor the crack width of the base specimen during the test.

Devices to fix the test specimens onto the testing apparatus shall not influence the sheet(s).

4.2.3 Crack width measuring device, with an accuracy of ± 0,01 mm, to control and monitor the crack width during the test.

4.3 Sampling and preparation of test specimens

4.3.1 Sampling

Samples and test pieces of the reinforced bitumen sheet(s) shall be taken in accordance with EN 13416.

4.3.2 Preparation of test specimens

Test specimens of type 1 and 3 according to EN 13375:2004 with the dimensions of (400 ± 5) mm × (200 ± 2) mm × ≥ 40 mm shall be used (see Figure 1). Test specimen preparation is specified as well as specifications for concrete base specimen in EN 13375.

Test specimens of type 1 are used for waterproofing systems not including an asphalt layer as protection layer. Test specimens of type 3 are used for waterproofing systems including an asphalt layer as protection layer which has the additional function as a waterproofing layer.

If the reinforced bitumen sheets have anisotropic properties, the test specimens shall be prepared in such a manner that the direction with lower elongation is tested.

NOTE The anisotropic behaviour of reinforced bitumen sheets can be observed by the behaviour during the tensile test according to EN 12311-1 if the elongation is different between the two principle directions of the sheet.

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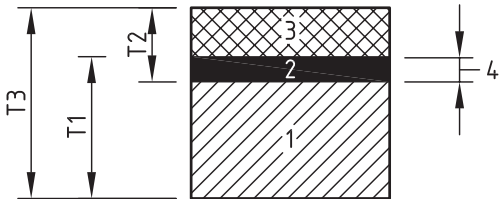
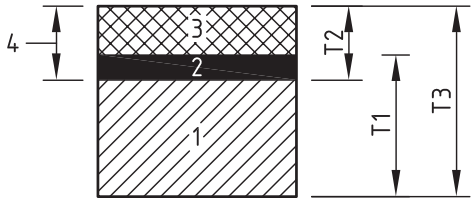


a) Waterproofing system not including an asphalt layer as protection layer



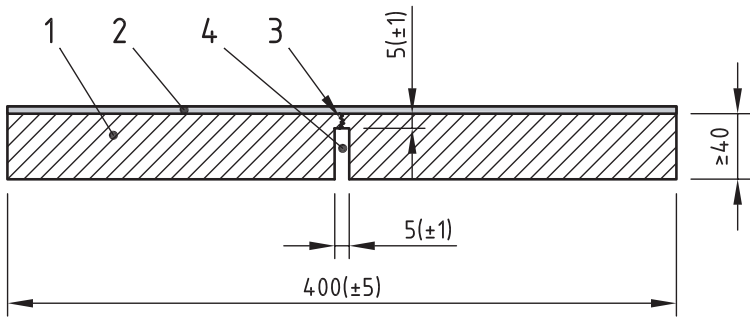
b) Waterproofing system including an asphalt layer as protection layer

Key
1 Base specimen
2 Waterproofing sheet(s)
3 Asphalt layer
4 Waterproofing system
T1 Specimen type 1
T2 Specimen type 2
T3 Specimen type 3

Figure 1 — Cross sections through specimens

For test specimens of type 1 a saw-cut shall be made without damage to the reinforced bitumen sheet(s) in the underside of the base specimens as shown in Figure 2.

Dimensions in millimetres



Key
1 Base specimen
2 Waterproofing layer
3 Induced crack
4 Saw-cut

Figure 2 — Test specimen of type 1 prepared for the test

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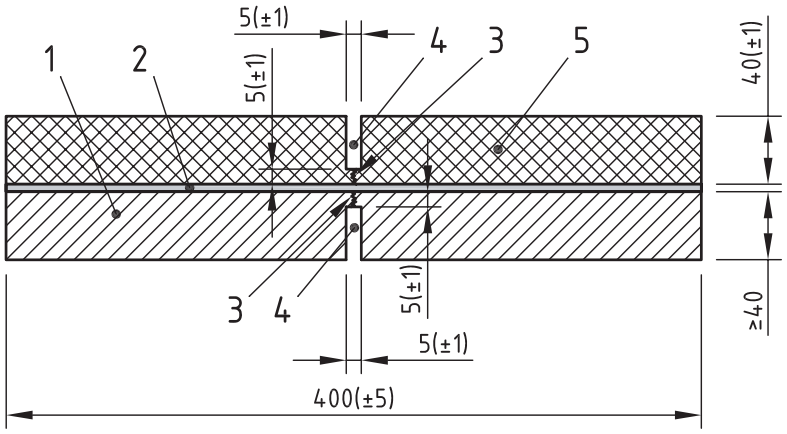
For test specimens of type 3 both the base specimen and the asphalt protection layer shall be provided with a saw-cut to create the predetermined breaking point (see Figure 3).

Dimensions in millimetres



Key
1 Base specimen
2 Waterproofing layer
3 Induced crack
4 Saw-cut
5 Asphalt layer (protection layer)

Figure 3 — Test specimen of type 3 prepared for the test

4.4 Procedure

4.4.1 Number of tests

Three tests shall be carried out for each temperature which is intended to be applied.

4.4.2 Preparation for the test

The crack in the base specimen above the saw cut, or the crack between the saw cuts when the protection layer is present, is produced mechanically in the testing apparatus, see 4.2.2, at the test temperature by introducing a controlled force in such a way that no bending in the test specimen occurs. The crack width shall not exceed 0,10 mm during this procedure.

The test specimen shall be fixed in the testing apparatus in such a way that the relative movement of the test specimen and the apparatus is negligible. The method of attachment in the apparatus shall ensure that the applied force acts in the plane of the tested reinforced bitumen sheet(s). Bending shall be prevented during testing. An example for a loading device is given in Figure 4.

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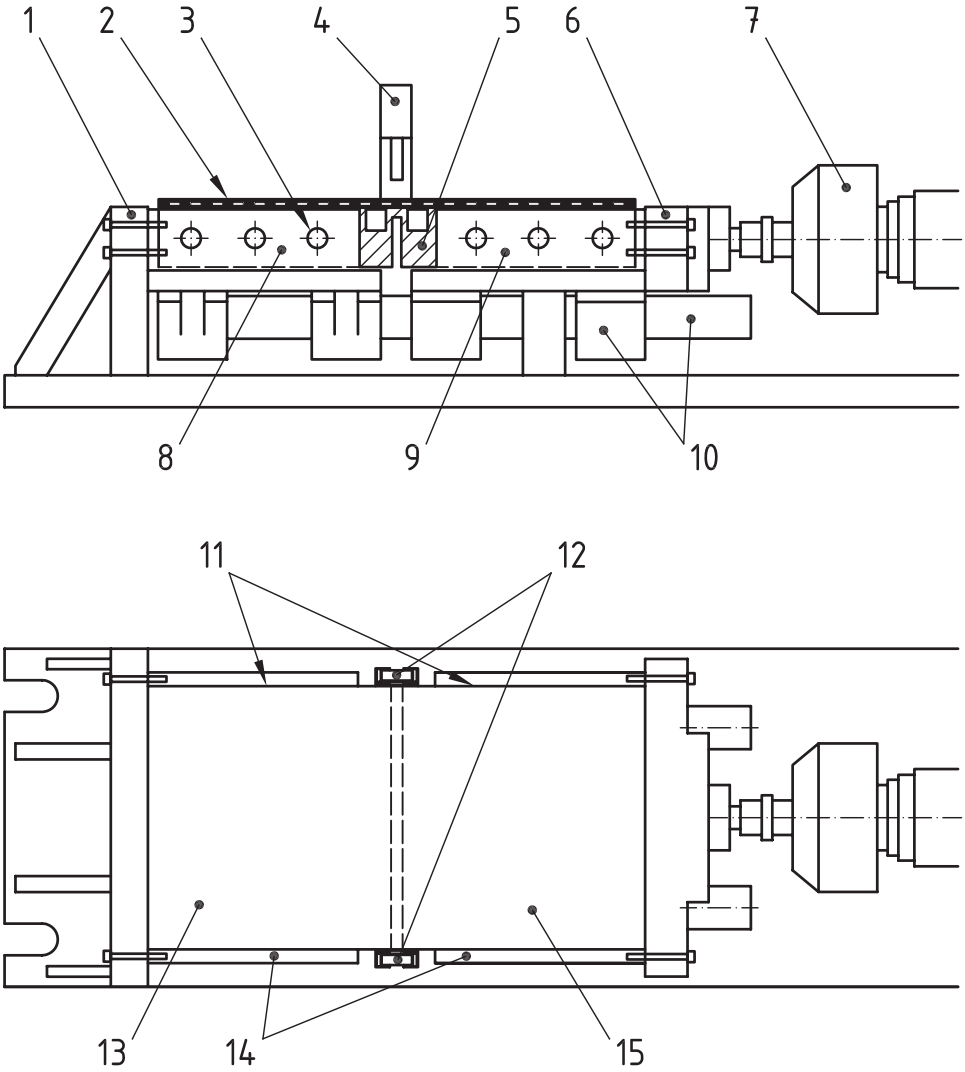


Key

1 End plate
2 Waterproofing sheet
3 Screw hole (for transportation)
4 Position sensor
5 Base specimen
6 Traverse
7 Load cell
8 Fixed part
9 Movable part
10 Track
11 Adhesive
12 Position sensor
13 Test specimen (fixed part)
14 Steel mounting plate
15 Test specimen (movable part)

Figure 4 — Example of loading device

The test equipment shall ensure that the movement of the crack of the base specimen lies within the given limits (change in the crack width) and that fretting and shearing of the crack sides are avoided during the test.

Suitable devices for measuring the crack width (see 4.2), accurate to ± 0,01 mm, shall be mounted on the test specimen on both sides of the crack. These measuring devices shall control the change of the crack width of the base specimen.

4.4.3 Test temperature

The test temperature is chosen according to EN 14695 at one of the following temperatures:

- 30 °C, - 20 °C, - 10 °C or 0 °C with an accuracy of ± 1 °C.

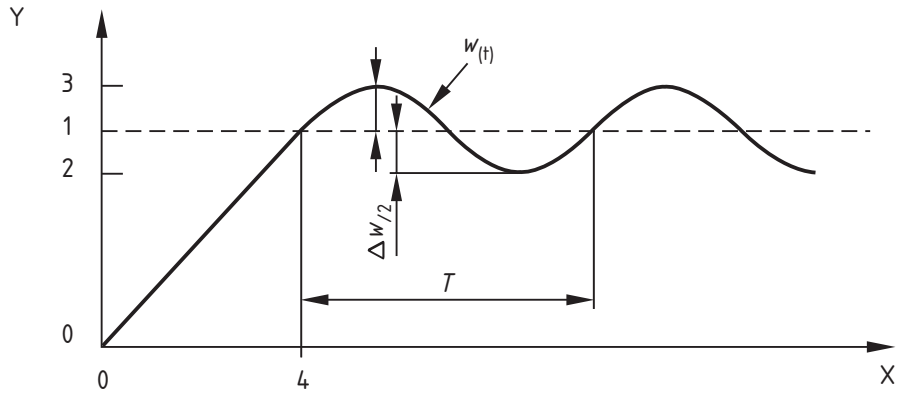
Before testing, the test specimens shall be conditioned at the test temperature for at least 4 h and not longer than 24 h.

4.4.4 Running of the test

The crack shall be opened to a total width of 0,20 mm (mean crack width w_m) including the initial crack width after cracking of the test specimen within 60 s. The cyclic change of the crack width shall commence without time interruption following the nominal curve, which is calculated using Equation (1).

$$w(t) = w_m \pm \frac{\Delta w}{2} \times \sin\left(\frac{2 \times \pi}{T} \times t\right) \quad (1)$$

Figure 5 demonstrates the crack width $w(t)$ depending on the time t.



Key

Δ*w* Amplitude
T Duration of one cycle
1 Mean crack width w_m
2 Minimum crack width w_{min}
3 Maximum crack width w_{max}
4 Commencement of crack cycling
X Time *t*
Y Crack width *w(t)*

Figure 5 — Nominal curve

The test shall be carried out with the frequency f = 1 Hz (T = 1 s), the half crack amplitude $\Delta w/2$ = (0,12 ± 0,02) mm and the mean crack width w_m = (0,20 ± 0,02) mm.

The test shall be carried out until 10 000 test cycles have been reached. It shall be stopped if the reinforced bitumen sheet(s) has (have) completely broken before reaching 10 000 test cycles.

At the end of the test the maximum crack width w_{max} (0,32 ± 0,02) mm shall be fixated before final observations are made.

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4.4.5 Observations during the test

During the test, the test specimen shall be observed at regular intervals. Each event, which could be of significance for the interpretation or evaluation of the crack bridging ability, shall be recorded.

NOTE 1 Such events could be cracks on the underside, debonding, delamination, tears, ripple, reduction of thickness in the crack zone, etc. These events may be recorded by video, photograph, sketch or other methods.

NOTE 2 The number of test cycles may be recorded if the reinforced bitumen sheet(s) has (have) completely broken (see 4.4.4) before reaching 10 000 test cycles.

4.4.6 Observations after the test: watertightness test

When the crack width variation cycles have been completed, the sample shall be reconditioned to ambient temperature at maximum crack width (w_{max}).

A metal or glass cylinder at least 100 mm in diameter and at least 150 mm high shall be centred on the reinforced bitumen sheet(s) above the crack of the base specimen (when testing without asphalt layer) or the asphalt layer (when testing with an asphalt layer). The gaps between the surface and the cylinder shall be sealed with a suitable sealant. When testing with an asphalt layer, the front and rear gaps of the cut in the asphalt surface of the test specimen, as well as the cut in the asphalt surface, shall be sealed with a suitable sealant too.

Pour water into the cylinder (and, when testing with an asphalt layer, into the whole cut in the asphalt) to a height of about 100 mm above the reinforced bitumen sheet(s) and thoroughly check if the test specimen is sufficiently sealed at its end and around the cylinder.

Place a filter paper treated with a moisture indicator under the test specimen, below the cracked area. The moisture indicator shall be a mixture of white (icing) sugar (99,5 %) and methylene blue dye (0,5 %) sieved over a 0,074 mm mesh and dried over calcium chloride in a desiccator.

Pull out the paper after (24 ± 0,5) h and visually examine if any coloration has occurred in it.

4.5 Results

4.5.1 Expression of results

The test temperature at which all three test specimens pass the watertightness test shall be expressed as the manufacturer's limiting value.

4.5.2 Precision

Precision data is not available.

4.6 Test report

The test report shall contain at least the following information:

a) all details necessary to identify the product tested;

b) reference to this European Standard (EN 14224) and any deviation from the method specified;

c) information about sampling and preparation of the test specimen in accordance with 4.3;

d) information about the procedure and observations in accordance with 4.4;

e) test results as indicated in 4.5;

f) date of the test;

g) structure of the waterproofing system including waiting times, consumption and application technique;

h) test temperature;

i) testing direction of the reinforced bitumen sheet(s);

j) all observations and events as indicated in 4.4.5.

Bibliography

[1] EN 12311-1, *Flexible sheets for waterproofing — Part 1: Bitumen sheets for roof waterproofing — Determination of tensile properties*

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