BS EN 1109:2013

BSI Standards Publication

Flexible sheets for waterproofing — Bitumen sheets for roof waterproofing — Determination of flexibility at low temperature

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National foreword

This British Standard is the UK implementation of EN 1109:2013. It supersedes BS EN 1109:2000 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee B/546, Flexible sheets for waterproofing and water vapour control.

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

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Flexible sheets for waterproofing - Bitumen sheets for roof waterproofing - Determination of flexibility at low temperature

Feuilles souples d'étanchéité - Feuilles d'étanchéité de toiture bitumineuses - Détermination de la souplesse à basse température

Abdichtungsbahnen - Bitumenbahnen für Dachabdichtungen - Bestimmung des Kaltbiegeverhaltens

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Management Centre: Avenue Marnix 17, B-1000 Brussels

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Foreword

This document (EN 1109:2013) has been prepared by Technical Committee CEN/TC 254 “Flexible sheets for waterproofing”, the secretariat of which is held by NEN.

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of an identical text or by endorsement, at the latest by October 2013, and conflicting national standards shall be withdrawn at the latest by October 2013.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 1109:1999.

The significant change made since this previous version is:

— the change of the coolant to be used.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

This European Standard is intended for the characterisation and/or classification of bitumen sheets as manufactured or supplied before use. The test method relates exclusively to products, or to their components where appropriate, and not to waterproofing systems of such products and installed in the works.

This test is intended to be used in conjunctions within the relevant European products specifications for bitumen flexible sheets for waterproofing.

The test for flexibility at a low temperature is intended to determine the susceptibility to cracking of the bituminous coating on a sheet when bent under specified conditions. The test result is dependent on the type of coating, on the thickness of the sheet, type and position of the reinforcement and the behaviour of the surface material. The use of the test results directly to compare the performance of coatings in sheets of different composition is strictly limited because of the influence of parameters which have not been quantified. Only the results from sheets with the same composition can be used to compare the performance directly.

The test primarily serves to characterise bitumen sheets. It can be used to evaluate the change in the cold bending behaviour during artificial ageing. It is not safe to relate the test results to the actual performance to be expected at low temperatures in service.

Compared to EN 1109:1999, in this new version of EN 1109 one type of coolant is described, which will give more reliable results.

1 Scope

This European Standard specifies the determination of flexibility of bitumen sheets at low temperatures. The test can be carried out on the upper or lower face of the sheet either at a predetermined temperature or successively at different temperature steps to determine the cold bending temperature which represents a limiting temperature. Therefore, the test can be used to confirm a minimum cold bending temperature for a product or to determine the specific cold bending temperature for the product e.g. to determine the change of these properties as a result of artificial ageing.

In the case of sheets with the same bituminous compound on both sides and where the reinforcement is placed in the cross section visually closer to the upper surface, the test is performed on the bottom face only.

If the upper surface is covered with a non-woven (e.g. tissue, fleece etc.) or metal facing, the test is performed on the bottom side only.

If the sheet on the upper surface is covered with permanent light surface protection and where the reinforcement is placed in the cross section visually closer to the upper surface, the test is performed on the bottom side only.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

3 Terms and definitions

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

3.1
flexibility
ability of bitumen sheet test specimens to be bent under specified conditions without cracking

3.2
cold bending temperature
lowest temperature at which bitumen sheet test specimens can be bent around specified mandrel without cracking

3.3
crack
fissure in the coating of the bitumen sheet extending to the reinforcement or completely through unreinforced sheets

4 Principle

The test specimens taken from the test sample are bent through an angle of 180° in a mechanical bending apparatus immersed in a coolant.

After bending, the test specimens are examined for the presence of cracks in the coating.

5 Apparatus

The construction and method of operation of the apparatus are shown in Figure 1. The apparatus consists of two non-rotating cylinders (20 ± 0,1) mm in diameter and a cylindrical or semi-cylindrical bending mandrel (30 ± 0,1) mm in diameter, capable of moving upwards and placed between them. The distance *a* between the cylinders is adjustable so that the distance between the cylinders and the bending mandrel can be adjusted to the thickness of the sheet.

The bending part of the apparatus is immersed in a thermostatic bath, the temperature of which can be controlled between +20 °C and –40 °C to the nearest 0,5 °C.

The coolant used shall be

— down to -25°C: a mixture of ethylene glycol (CH_2OHCH_2OH)/water (volume ratio 1:1);

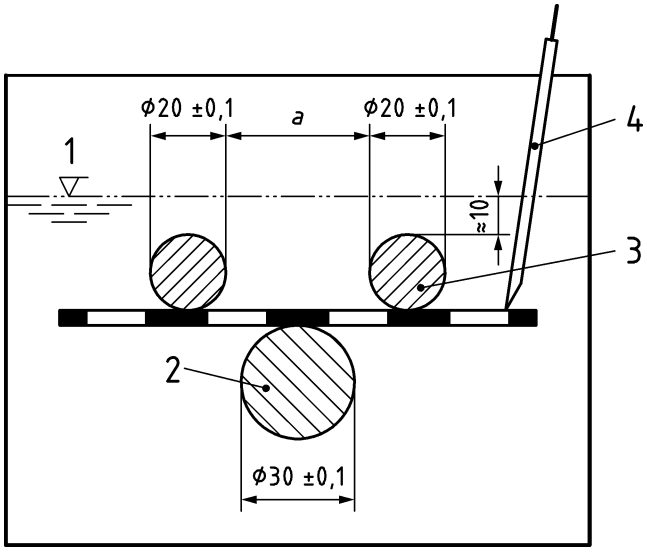
— below –25 °C: a mixture of ethanol/water (volume ratio 2:1).

For elastomeric modified bitumen sheets, the mixture of ethanol/water (volume ratio 2:1) can be used at any temperature. To check the test temperature, an additional thermometer capable of measuring to 0,5 °C is required; its thermo sensor shall be placed in the test medium at the same level as the test specimen.

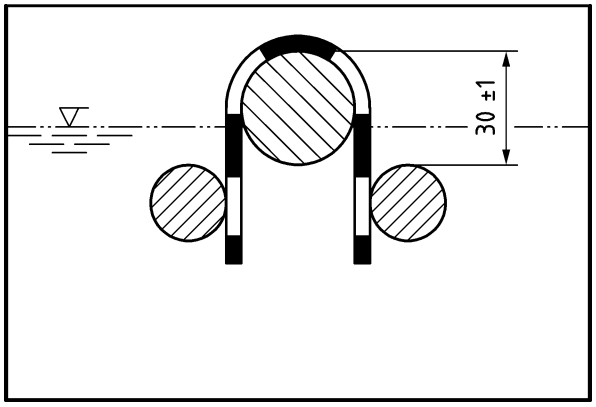
To position the test specimens in the test liquid so that they are flat and completely immersed for conditioning, suitable removable holding devices shall be used. The holding devices should be capable of taking at least five test specimens of a series.

For the test, the bending mandrel is raised from below against the test specimen at a speed 360 mm/min so that the test specimen is bent through an angle of 180°. The electronic control system shall ensure that the travel speed is maintained at (360 ± 40) mm/min at each phase of the bending process and at each temperature.

Cracks are detected by visual inspection without any optical aids by the person carrying out the test. To permit an accurate assessment, the travel path is defined in such a way that the test specimen projects out of the coolant at the end of the procedure. The travel section shall be limited by suitably set limit switches.



a) — Beginning of bending



b) — End of bending

Key

1 coolant
2 bending mandrel
3 fixed cylinder
4 thermosensor

Figure 1 — Principle of test apparatus and bending process

6 Sampling

Test samples shall be taken in accordance with EN 13416.

Rectangular test specimens with dimensions of (140 ± 1) mm $\times$ (50 ± 1) mm as required by the tests described in 8.3 or 8.4 are taken from the test sample uniformly over the width of the sheet and with the larger dimension in the longitudinal direction of the sheet. The test specimens shall not be taken within approximately 150 mm of the edges of the sheet. The test specimens shall be numbered consecutively, beginning from one edge of the sheet, and the lower face of the sheet shall be marked.

7 Preparation of test specimens

Any protective film/foil shall be removed, preferably by applying a self adhesive tape to it at ambient temperature, cooling the test specimen to approximately the presumed cold bending temperature and then pulling the adhesive tape from the test specimen. Alternatively or additionally, the film can be removed by means of a compressed air jet (maximum pressure approximately 5 bar, nozzle diameter approximately 0,5 mm).

It is not permitted to remove the film/foil using heat (e.g. a gas flame).

The test specimens shall then be conditioned prior to the test for at least 4 h at (23 ± 2) °C on a flat support so that they do not touch each other. There can be no adhesive connection with the support. Where necessary, a sheet of siliconised paper can be used. Loose surface granules shall be removed before by hand by gentle tapping.

8 Procedure

8.1 Preparation of apparatus

Prior to beginning the series of tests, the distance *a* (see Figure 1) between the cylinders shall be adjusted to the thickness of the test specimen so that it is approximately 32 mm plus twice the thickness of the test specimen. The apparatus is then placed in the refrigerant bath so that the top of the cylinders is approximately 10 mm beneath the surface of the coolant. The bending mandrel is then in the bottom position.

8.2 Conditioning of test specimens

After the specified test temperature in the coolant has been reached to the nearest 0,5 °C, the test specimens are inserted into the holding device at the height of the cylinders so that coolant freely circulates around them. The test specimens are conditioned for 1 h ± 5 min in the coolant from the time when the temperature of the coolant is restored. The thermo sensor positioned approximately level with the test specimens is used for checking the temperature of the coolant.

Then the test specimens are tested as described in 8.3 or 8.4.

8.3 Flexibility at a specified temperature

Two series of five test specimens are conditioned as described in 8.2 at the specified test temperature, which is intended to be a whole number. One series will be used for testing the upper face, if applicable, and the other for the lower face. They are tested as follows.

The test specimens are placed successively between the bending mandrel and cylinders with the face to be tested uppermost. The bending mandrel is then set in motion pushing upwards against the test specimens at a speed of (360 ± 40) mm/min so that the test specimens are bent uniformly around it. The travel shall stop (30 ± 1) mm above the cylinders (see Figure 1). The surface of the test specimens shall be projecting clearly out of the coolant, otherwise the fluid level shall be lowered accordingly.

Within 10 s after the completion of the bending procedure, the test specimen, which is still kept between the bending mandrel, is examined under a suitable light source for any cracks using the naked eye without additional optical aids.

A crack exists if one or more fissures in the coating extend to the reinforcement or completely through unreinforced sheets. All five test specimens in a series are tested immediately after each other. If the dimensions of the apparatus are adequate, simultaneous testing of several test specimens is allowed.

8.4 Determination of cold bending temperature

If the cold bending temperature of a bitumen sheet is to be determined (e.g. to show changes resulting from artificial ageing), then the following procedure shall be carried out using the test described in 8.3.

The range of the (unknown) cold bending temperature shall be determined initially by tests on individual test specimens in steps of 6 °C, starting at the expected cold bending temperature. The test temperatures in each case therefore are always in multiples of 6 °C (e.g. -12 °C, -18 °C, -24 °C etc.).

Therefore, starting with the maximum temperature step leading to breakage, there follows a closer determination into 2 °C steps on series of five test specimens for the lower face of the sheet. This step-by-step change of the test temperature by 2 °C each time shall be continued until at least four of the five test specimens tested immediately after each other in one series has no crack.

This temperature step is designated as the cold bending temperature and represents the result of the test.

9 Recording of results, evaluation and precision of test method

9.1 Result of flexibility at a specified temperature

The test described in 8.3 is passed if at least four of the five test specimens have no crack on the tested face of the sheet at the specified temperature. The result of the test of the upper face, if applicable and lower face shall be indicated separately.

9.2 Results when determining cold bending temperature

When determining the cold bending temperature, if at least four of the five test specimens have successfully passed the test as described in 8.4 at one temperature step, this is the cold bending temperature for the lower

face of the sheet tested. The results of the tests of the upper face, if applicable and lower face shall be indicated separately.

NOTE The upper face and lower faces of the bitumen sheets can have different cold bending temperatures.

9.3 Precision of the measuring method

9.3.1 General

The precision values of EN 1109:1999 were determined by an initial international interlaboratory test conducted according to ISO 5725-1; they related only to sheets with reinforcement and polymer-modified coatings and the coolants defined within EN 1109:1999. The precision values of this test method with the alternative coolant are not determined. But based on a limited interlaboratory test it is expected that with the coolant described within this European Standard better precision values can be achieved.

9.3.2 Repeatability EN 1109:1999

— repeatability standard deviation of results: $\sigma_r = 1{,}2$ °C

— confidence interval (95 %) of a result: $q_r = 2{,}3$ °C

— repeatability limit (difference between two results): $r = 3$ °C

9.3.3 Reproducibility EN 1109:1999

— reproducibility standard deviation of results: $\sigma_R = 2{,}2$ °C

— confidence interval (95 %) of a result: $q_R = 4{,}4$ °C

— reproducibility limit (different between two results): $R = 6$ °C

10 Test report

The test report shall include at least the following information:

a) all details necessary to identify the product tested;

b) reference to this European Standard, and any deviation from it;

c) information on sampling in accordance with Clause 6;

d) details of preparation of the test specimens in accordance with Clause 7;

e) type of coolant used;

f) test results in accordance with 9.1 or 9.2;

g) date of the test.

Bibliography

[1] ISO 5725-1, *Accuracy (trueness and precision) of measurement methods and results — Part 1: General principles and definitions*

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