BRITISH STANDARD

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13948:2007

Flexible sheets for waterproofing — Bitumen, plastic and rubber sheets for roof waterproofing — Determination of resistance to root penetration

The European Standard EN 13948:2007 has the status of a British Standard

ICS 91.100.50

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British Standards

National foreword

This British Standard is the UK implementation of EN 13948:2007.

The UK participation in its preparation was entrusted by Technical Committee B/546, Flexible sheets for waterproofing and water vapour control, to Subcommittee B/546/2, Plastics and rubber sheets.

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

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Feuilles souples d'étanchéité - Feuilles d'étanchéité de toiture, bitumineuses, plastiques et élastomères - Détermination de la résistance à la pénétration des racines

Abdichtungsbahnen - Bitumen-, Kunststoff- und Elastomerbahnen für Dachabdichtungen - Bestimmung des Widerstandes gegen Durchwurzelung

This European Standard was approved by CEN on 23 May 2007.

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Foreword

This document (EN 13948:2007) 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of an identical text or by endorsement, at the latest by December 2007, and conflicting national standards shall be withdrawn at the latest by December 2007.

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Introduction

This European Standard has been prepared by the Technical Committee CEN/TC 254 to determine the resistance to root penetration of flexible sheets for roof waterproofing.

This European Standard is based on a method developed by the Association FLL (Forschungsgesellschaft Landschaftsentwicklung Landschaftsbau (http://www.f-l-l.de/english.html), Bonn, Germany).

1 Scope

This European Standard specifies a method to determine the resistance of roof waterproofing sheets to root penetration.

This European Standard relates exclusively to sheets. It is not possible to test a system comprising several different sheets.

This European Standard does not contain any evaluation of the sheet to be tested in respect of its environmental requirements.

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 13037, *Soil improvers and growing media — Determination of pH*

EN 13038, *Soil improvers and growing media — Determination of electrical conductivity*

EN 13651, *Soil improvers and growing media — Extraction of calcium chloride/DTPA (CAT) soluble nutrients*

3 Terms and definitions

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

3.1
root penetration
roots that have grown into and/or through the surface or joints of a sheet under test where the underground parts of the plants have actively created cavities and thus damaged the sheet

4 Principle

The protection against root penetration of a sheet is tested in containers where the sheet is under exposure to roots under specified conditions.

The test specimens of the sheet are installed in 6 test containers. The sheet shall have four wall corner joints, two base corner joints and one central T joint (see Figure 2). Additionally there shall be two control containers without sheets providing a comparison of the vitality of the plants in the test and control containers throughout the whole test period.

The containers receive a layer of growing substrate and a dense covering of vegetation. This produces a high growing pressure from the roots, emphasised by a limited amount of fertiliser and a moderate watering.

The test and control containers are exposed in a climate-controlled greenhouse, in which the parameters having an influence on the growing of the plants can be controlled.

The growing period is 2 years as this period is the minimum time necessary to obtain reliable results.

After the testing period, the growing substrate is taken away and the behaviour of the test samples is assessed to observe if any root penetration has occurred.

5 Apparatus

5.1 Greenhouse

The greenhouse shall be capable of regulating the temperature and ventilation. The minimum of the internal temperature shall be (18 ± 2) °C in the daytime and (16 ± 2) °C at night. The greenhouse shall be ventilated when the internal temperature reaches (22 ± 2) °C. A temperature exceeding 35 °C should be avoided.

NOTE The natural light conditions in Central Europe associated with the indicated temperatures give favourable conditions for the growth of the test plants throughout the year. No shading of the plants in summer or artificial light in winter is necessary. In the case where the tests are performed under significant different light conditions (i.e. North or South of Europe), the light and the shading may be adapted in order to allow the plants to grow properly.

Each 800 mm × 800 mm container requires an area of approximately 2 m², taking into account the requirements for clearance as specified in 7.2.

5.2 Test and control containers

6 test containers and 2 control containers are needed for testing one single sheet.

The inside dimensions of the test containers shall be at least 800 mm × 800 mm × 250 mm. It may be necessary, for installation purposes, to have larger containers. The containers shall be fitted with transparent bases to allow the observation of the roots, which may have passed through the sheet during the testing period, without taking away the growing substrate. The base shall be blacked out (with a foil for example) to avoid the growing of algae in the moisture layer. For the water supply to the moisture layer, the containers shall have a filler pipe, pointing obliquely upwards, with a diameter of 35 mm, ending near the base tray (see Figure 1).

Dimemsions in millimeters

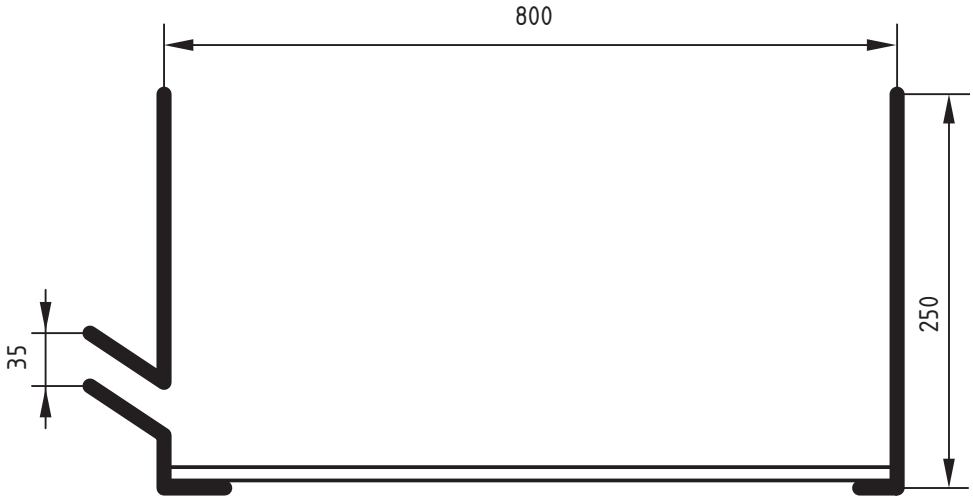


Figure 1 — Construction of container

5.3 Moisture layer

A layer of coarse mineral granulates shall be placed on the transparent bases of the containers. It shall be permanently kept moist to encourage the roots to draw down onto the transparent base, in order to observe any early penetration of the roots

This layer shall be composed of expanded slate/clay (grain fraction 8/16) of a quality suitable for use in hydroponics systems. When determined in accordance with EN 13038, the expanded slate/clay shall have an electrical conductivity of < 15,0 mS/m.

5.4 Pressure distribution layer

In order to achieve a uniform distribution of the pressure, a fleece or woven material, ≥ 170 g/m² and chemically compatible with the sheet to be tested, shall be placed directly under the sheet onto the moisture layer.

5.5 Growing substrate

A mixture of homogeneous materials of identified quality available permanently at all of the test sites. It shall be structurally stable and show a favourable water/air rate and weak base fertiliser content for optimal development of the roots of the test plants.

The growing substrate shall be a blend of:

— 70 % by volume of barely decomposed peat which shall have an electrical conductivity of < 8,0 mS/m when determined according to EN 13038 and a pH 4,0 ± 1,0 when determined according to EN 13037;

— 30 % by volume of expanded slate/clay (grain fraction 8/16) complying with the requirements as specified in 5.3.

The growing substrate shall be in direct contact with the test sample.

5.6 Fertiliser

5.6.1 Basic fertilisers (to be mixed with the growing substrate)

a) Fertiliser suitable for substrates, containing N (nitrogen), P (phosphorus), K (potassium) and Mg (magnesium). The fertiliser shall be poor in chloride (containing less than 0,5 % Cl).

Composition and amount of the fertiliser shall be adapted to requirements to substrate (see 7.1).

b) Fertiliser suitable for substrates, containing the trace nutrients iron (Fe), copper (Cu), molybdenum (Mo), manganese (Mn), boron (B) and zinc (Zn). For the trace nutrient fertiliser use the amount recommended by the manufacturer.

5.6.2 Slow working coated fertiliser (to be used during the testing period)

Fertiliser effective for 6 months to 8 months containing (15 ± 5) % N, (7 ± 3) % P and (15 ± 5) % K.

The amount of the slow working fertiliser shall be adapted to the need of 5 g N per application to a 800 mm × 800 mm container.

5.7 Tensiometer

For the control of the watering, one tensiometer per container, measuring range from 0 hPa to -600 hPa shall be used.

5.8 Test plants

The following test plant shall be used:

Pyracantha coccinea 'Orange Charmer' - firethorn, in 2 l container, height (70 ± 10) cm.

4 test plants per 800 mm × 800 mm container shall be installed.

When selecting the test plants, ensure that there is uniformly strong growth of the plants.

The test plants in the test containers shall, on average, have at least 80 % of the average vitality (height, stem diameter) of the plants in the control containers throughout the whole testing period.

5.9 Water quality for irrigation

The water used for irrigation shall have:

a) electrical conductivity < 70 mS/m;

b) bicarbonate (HCO_3) (3 ± 1) me/l;

c) sulfate (SO_4) < 250 mg/l;

d) chloride (Cl) < 50 mg/l;

e) sodium (Na) < 50 mg/l;

f) nitrate (NO_3) < 50 mg/l.

NOTE me = milliequivalent; 1 me = 1 millimol adjusted for electron charge.

The water quality may be ascertained by contacting the appropriate water supplier.

6 Sampling of test specimens

A reference sample shall be taken from the sheet before and after the test. The sample taken shall have at least one joint and a surface of at least 1 m^2. The reference sample shall be stored at temperatures between (15 ± 10) °C in a dark a dry room at the place (e.g. testing laboratory) where the test is conducted.

In order to be able to identify the tested product clearly, the following information shall be ascertained at the beginning of the test:

a) name of the product;

b) intended use;

c) type of material;

d) thickness of waterproofing layer (effective thickness for plastic and rubber sheets);

e) product design/structure;

f) year of manufacture;

g) installation method at test site (overlap, joint technique, jointing agent, type of joint seal, cover strip over joints, special corner and angle joints);

h) addition of radicidal agents (e.g. root retardant).

NOTE Where the sheet is being tested by a third party, the manufacturer should supply a copy of the installation instructions (with date of validity) to the testing organization.

7 Procedure

7.1 Preparation of growing substrate

The pH value of the substrate consisting of peat and expanded slate/clay (see 5.5) shall be adjusted to pH (6,2 ± 0,8) by adding calcium carbonate ($CaCO_3$).

The required amount can be determined from the following procedure:

a) take 5 samples of well mixed growing substrate per 1 l;

b) moisten the samples with tap water;

c) add different amounts of calcium carbonate (4 g, 5 g, 6 g, 7 g, and 8 g) to the individual samples;

d) place each samples in a plastic bag, seal and label;

e) store the samples in the bag for 3 days at a temperature of (20 ± 5) °C;

f) determine pH according to EN 13037;

g) extrapolate the amount of calcium carbonate that led to the desired pH value in the 1 l sample to the total volume of growing substrate.

The basic fertiliser, as given in 5.6.1, shall be mixed homogeneously with the substrate.

A sample of the homogeneously mixed substrate shall then be taken to determine pH in accordance with EN 13037, electrical conductivity in accordance with EN 13038 and the nitrogen, phosphorus and potassium in accordance with EN 13651.

The substrate shall have:

a) pH (6,5 ± 0,8);

b) electrical conductivity < 30 mS/m;

c) N (nitrogen) (100 ± 50) mg/l;

d) P (phosphorus) (40 ± 20) mg/l;

e) K (potassium) (100 ± 50) mg/l.

7.2 Preparation and installation of the test containers

The different layers shall be placed in the containers in the following order (from the bottom to the top): the moisture layer, the protection layer, the test specimen of the sheet, the growing substrate layer.

The moisture layer shall be placed directly on the transparent base to a uniform thickness of (50 ± 5) mm.

The protective fleece shall be cut to appropriate dimensions and placed directly onto the moisture layer.

The test specimen shall be installed in the containers at the place where the test is conducted in the following way:

a) the test pieces shall be cut by the test applicant from the samples with dimensions that allow the installation in the test containers;

b) the jointing and installation of the test pieces shall be carried out by the test applicant in accordance with the manufacturer's installation instructions. Each specimen shall have four wall corner joints, two base corner joints and one central T joint according to Figure 2. The sheet shall be pulled up to the edge of the test container at the wall.

Different jointing techniques may be combined in the test set-up as long as the objective is to obtain homogeneous material joints (e.g. solvent welding or hot air welding). These types of jointing are regarded as being equivalent. However, combinations of glue-free joints and joints with glue or joint with two different kinds of glue are not regarded as being equivalent and require a separate test sequence.

Dimensions in millimetres

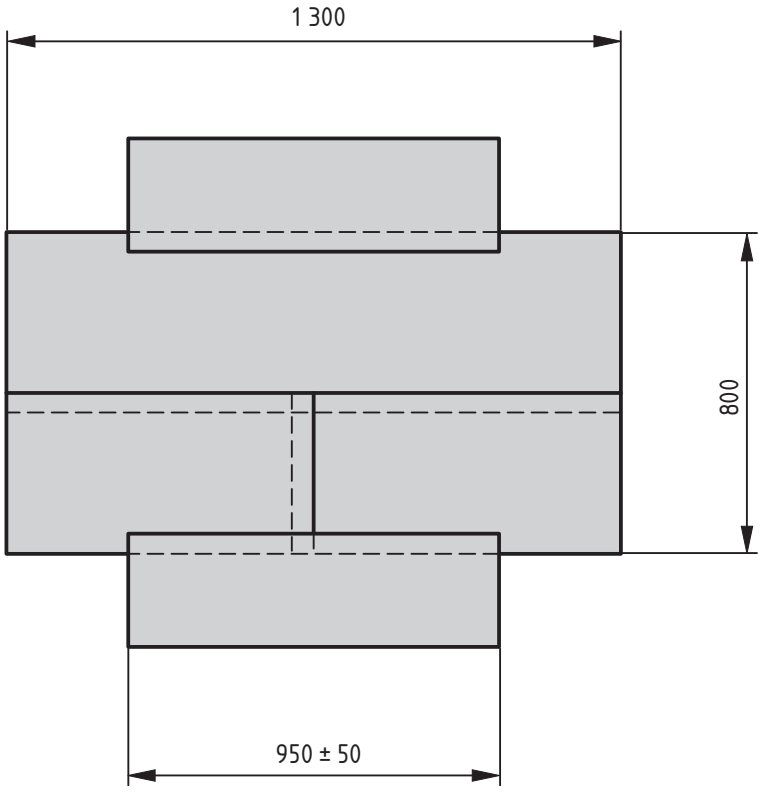


Figure 2 — Arrangement of the joints of the test specimen

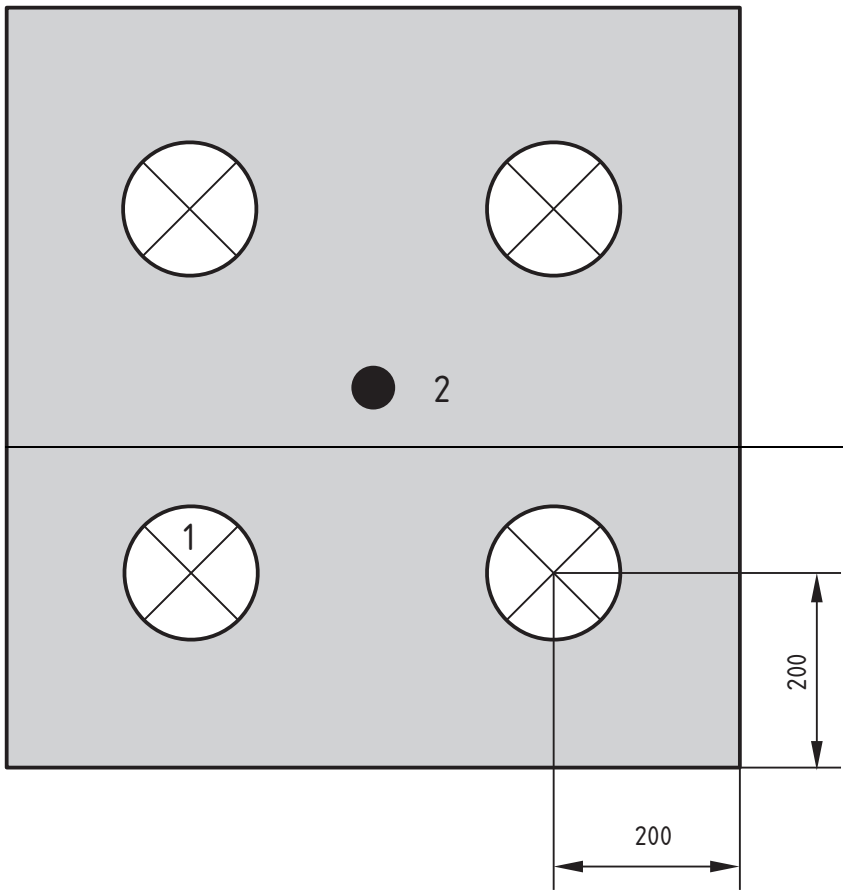
After installation of the test specimen of the sheet, place a uniform thickness of (150 ± 10) mm of the growing substrate.

Plant the test plants evenly distributed over the whole surface of the container (see Figure 3). In larger containers, if required, increase the number of test plants in order to obtain at least the same density of vegetation (at least 6 plants/m²).

The shank of the tensiometer shall be placed into the growing substrate in such a way that the measurement is made in the lower area of the growing substrate. The tensiometer shall be placed at an equal distance from the plants (see Figure 3).

Place the containers on stands in order to enable inspection for root penetration during the testing period. A minimum clearance of 0,4 m shall be ensured around the containers. The test containers and the control containers shall be arranged at random in the greenhouse.

Dimensions in millimetres



Key

1 test plant

2 tensiometer

Figure 3 — Position of the test plants and the tensiometer in the growing substrate for an 800 mm × 800 mm container

7.3 Preparation and installation of the control containers

Prepare the test containers in accordance with 7.2, excluding the sheet to be tested i.e. place the growing substrate directly onto the protective layer.

7.4 Care of the plants

The moisture of the substrate shall be adjusted in accordance with the requirements of the plants by watering from the top. The moisture (suction tension) shall be verified using the tensiometer. The substrate should be watered if the tension drops below a value of – (350 ± 50) hPa. The watering shall be regulated in such a way that the suction tension in the substrate is around 0 hPa. The whole substrate shall be evenly wet (particular attention should be paid to the edges). A sustained excess of water at the bottom of the substrate shall be avoided.

The moisture layer shall be kept wet by sufficient watering once a week using the filler pipe in the container.

A slow working fertiliser in accordance with 5.6.2 shall be applied at 6 months intervals, with the first taking place 3 months after planting.

Where appropriate, any extraneous non-test plant growth and dead plant material shall be removed.

Test plants which die during the first three months of the test shall be replaced. As the developing roots of the surviving plants should not be disturbed replacement of plants is only allowed during the first three months of the testing period.

The test plants shall not be cut back, however, it is permitted to cut back obstructing side shoots on the paths between the containers.

Suitable plant protection measures shall be taken in the event of pest infestation.

If more than 25 % of the test plants die during the test, the test will be invalid.

8 Expression of results

8.1 General

Not to be evaluated as root penetration, but to be mentioned in the test report are:

a) roots that have grown ≤ 5 mm into the surface or joint of sheets containing radicidal agents (root retardants) as the root retardant effect cannot develop until after the roots have penetrated. In order to facilitate this kind of evaluation, these sheets shall be clearly defined as “containing radicides” by the manufacturer at the beginning of the test,

b) roots that have grown into the surface of products consisting of several layers (e.g. bitumen sheets with copper foil carrier or PVC sheet with polyester non-woven carrier) if the layer providing the penetration protection has not been damaged. In order to facilitate this kind of evaluation, this layer shall be clearly defined by the manufacturer at the beginning of the test;

c) roots that have grown into the joint seals (without damaging the joint). A joint seal is considered to be either fluid material pressed out from the joint during welding or a liquid material applied to secure the joint flange.

8.2 During the test

Every 6 months, verify whether root penetration has occurred by observing the moisture layer through the transparent base tray on the 6 test containers.

When root penetration in the containers is observed, the test applicant should be informed. At this time the test may be stopped.

Every year the growth of the test plants in each test and control container shall be determined by recording the height of the plants and stem diameter at a height of (20 ± 2) cm. In addition the vitality of the test plants shall be assessed. Plant damage (such as growth deformation, leaf discoloration etc.) shall be recorded separately.

8.3 At the end of the test

The test applicant should be informed of the date of the final inspection, to allow his participation.

The final inspection shall include the noting of any root penetration into and through the sheet (see Clause 3) and their number in every test container. Give these indications separately for the plain surface and the joints of the sheet.

A sheet is regarded as being resistant to root penetration if no root penetrations have occurred in any of the test containers after completion of the test period. A condition of this is that the plants in the test containers have shown on average at least 80 % of the average growth (height, stem diameter) of the plants in the control containers throughout the whole test period.

Photographs shall record exemplarily the root resistance of plain surface and joints of the test specimen. In the other case when the tested sheet is penetrated by roots the damages shall be documented by photographs.

Reference samples of the sheet shall be taken and stored according to Clause 6.

The development of the test plants shall be described according to 8.1.

9 Precision of test method

The precision is not specified.

10 Test report

The test report shall include at least the following information:

a) all details necessary to identify the product tested in accordance with Clause 6;

b) reference to this European Standard, i.e. EN 13948;

c) information on sampling in accordance with Clause 6;

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

e) test results in accordance with Clause 8;

f) general evaluation of the tested sheet in accordance with 8.3;

g) any information in accordance with 8.1;

h) date and location of the test(s).

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