BS EN 14437:2022

BSI Standards Publication

Determination of the uplift resistance of installed clay or concrete tiles for roofing — Roof system test method

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee B/542/1, Slating and tiling.

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

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English Version

Determination of the uplift resistance of installed clay or concrete tiles for roofing - Roof system test method

Détermination de la résistance au soulèvement des tuiles en terre cuite ou en béton mises en œuvre sur la toiture - Méthode d'essai par système de toiture

Bestimmung des Abhebewiderstandes von verlegten Dachziegeln oder Dachsteinen - Prüfverfahren für Dachsysteme

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European foreword

This document (EN 14437:2022) has been prepared by Technical Committee CEN/TC 128 "Roof covering products for discontinuous laying and products for wall cladding", the secretariat of which is held by NBN.

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of an identical text or by endorsement, at the latest by May 2023, and conflicting national standards shall be withdrawn at the latest by May 2023.

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

This document supersedes EN 14437:2004.

In comparison with the previous edition, the following technical modifications have been made: the test method has not changed, but the interpretation of the results includes the introduction of serviceability and ultimate failure loads in accordance with Eurocode EN 1990.

Any feedback and questions on this document should be directed to the users' national standards body. A complete listing of these bodies can be found on the CEN website.

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Introduction

This document gives a test method and failure criteria for determining the uplift resistance of clay or concrete tiles for roofing.

The results of this test may be used to determine the uplift force which can be withstood by the fixing, e.g. to withstand wind force.

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1 Scope

This document specifies a test method to establish the uplift resistance of installed clay or concrete tiles for roofing, complying with the relevant product standard, EN 490 or EN 1304, which are unfixed or mechanically fixed to the substructure.

NOTE The test method has been developed for clay or concrete tiles for roofing, but can apply to other discontinuously laid small elements, such as: slates; fibre cement slates; stones; and, adapted accordingly, to photovoltaic and solar thermal panels.

The test method is applicable to mechanical fixings such as clips, hooks, screws and nails.

The method is not applicable to fixed tiles having fixing patterns with less than every third tile fixed.

The test method is not applicable to under and over tiles. Examples of these tiles are given in Annex F.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp/ui

— IEC Electropedia: available at https://www.electropedia.org/

3.1
discontinuously laid small elements
elements to be used for roof covering and wall cladding which are installed as separate elements and collectively form the roof covering

3.2
roof pitch
angle of elevation in degrees of the rafter from the horizontal

3.3
characteristic value
adopted value derived from a prescribed statistical analysis of a number of test results

3.4
roof system
system that comprises the structure of the battens, mechanical fixings (clips, hooks, nails and screws) as well as the clay and concrete tiles and fittings laid according to their laying specification

3.5
ultimate limit states
states associated with collapse or with other similar forms of structural failure

Note 1 to entry: They generally correspond to the maximum load-carrying resistance of a structure or structural member.

[SOURCE: EN 1990]

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3.6
serviceability limit states
states that correspond to conditions beyond which specified service requirements for a structure or structural member are no longer met

[SOURCE: EN 1990]

4 Symbols and abbreviations

For the purposes of this document, the following symbols and abbreviations apply.

d_{max} the maximum permissible displacement;

F_t force exerted on 16 tiles when one of the failure modes a, b, c, d, or e (9.4.6) occur during a trial test;

L_h the hanging length of the tile;

R_i uplift resistance of 16 tiles in test i;

W_i mean weight of a roofing tile.

Additional symbols and abbreviations are used in the annexes and they are listed and defined at the point of use.

5 Sampling

The tiles, battens and fixings selected shall be representative of the system to be used.

In selecting the number of elements, refer to Clause 7 and Clause 9, taking into consideration the number of fixing patterns.

The specification of the battens can include a reference to a national code of practice.

6 Test conditions

Unless otherwise specified, the roofing tiles, fixings, battens and the test frame shall be conditioned for at least 24 h in an environment of (20 ± 10) °C, and (55 ± 25) % relative humidity, prior to the test. The manner of storage shall not interfere with the free exchange of moisture from or into the materials. The test shall be conducted in the same conditions as the storage.

7 Test material

The test materials shall be randomly chosen from the samples.

8 Apparatus

8.1 Test rig

The test rig consists of a roof structure and auxiliary equipment to exert a force on the clay or concrete tiles for roofing. The roof structure shall have a roof pitch of (45 ± 2)°.

The test rig shall be able to exert a nominally equal uplift force on 16 roofing tiles from a minimum distance of 0,9 m to the surface of the roof covering and at an angle of (90 ± 2)° to the roof structure, at the start of the test.

The test rig shall have sufficient capacity and stiffness for the test as not to influence the test result. The test rig shall be capable of applying an uplift force at a rate of not more than 50 N/s.

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NOTE Annex A includes an example test rig meeting the specification.

8.2 Cables

The uplift force shall be exerted by using a cable. The cable shall be flexible where the force is attached to the tile, such that it minimizes any overturning moment on the connection point, where the force is applied.

8.3 Force measuring device

A calibrated force measuring device shall be used to determine the total uplift force on the 16 roofing tiles (refer to 9.3), having a maximum permissible error in combination with the reading equipment of 1 % of the measured value or 10 N, whichever is larger.

8.4 Monitoring device for displacement of the roofing tiles

A calibrated displacement monitoring device shall be used to determine the displacement of the roofing tiles and shall have a maximum permissible error of 0,5 mm. The displacement monitoring device shall not exert forces larger than 1 % of the uplift force measured on the 16 roofing tiles.

NOTE 1 This can be achieved by rigidly attaching a small flat plate to the measuring head, such that it always contacts the highest point on the roofing tile.

NOTE 2 If serviceability failure occurs before ultimate failure, the monitoring device can be removed to protect it from damage when ultimate failure occurs.

8.5 Measuring device for weight

A calibrated weighing device shall be used to determine the weight of roofing tiles with a maximum permissible error of 1 % of the measured value.

9 Test procedure

9.1 Measurement of the weight

Determine the mean tile weight W_i by measuring at least 10 roofing tiles, after the conditioning described in Clause 6.

9.2 Installation of battens, roofing tiles and fixings

The battens shall be fixed to the test rig in a manner that does not influence the test result.

The roofing tiles shall be installed on the battens in the layout intended to be tested. The overlap of the roofing tiles shall be the maximum specified for the intended use in the codes of practice or by the manufacturer.

The test tiles shall be surrounded by at least 2 courses and 2 columns of identical roofing tiles. The test requires a set of roofing tiles, sufficient to cover at least 8 courses high and 8 columns wide, or at least 1,5 m high and 1,5 m wide, whichever is larger.

NOTE 1 For interlocking single lap clay or concrete tiles, the lowest course on the test rig can be omitted without loss of accuracy of the test result.

The fixings shall be installed representatively of their intended use and shall take account of the layout of the roofing tiles.

NOTE 2 Various fixing patterns might need to be tested, refer to Annex C.

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9.3 Determination of the location of the forces on the test roof

A total of 16 roofing tiles to be lifted shall be selected and placed on the test roof. These 16 roofing tiles shall be located as defined in Annex B. The fixing pattern shall be chosen such that the roofing tile in the lower right corner of the 16 is fixed. Annex C gives examples of suitable fixing patterns.

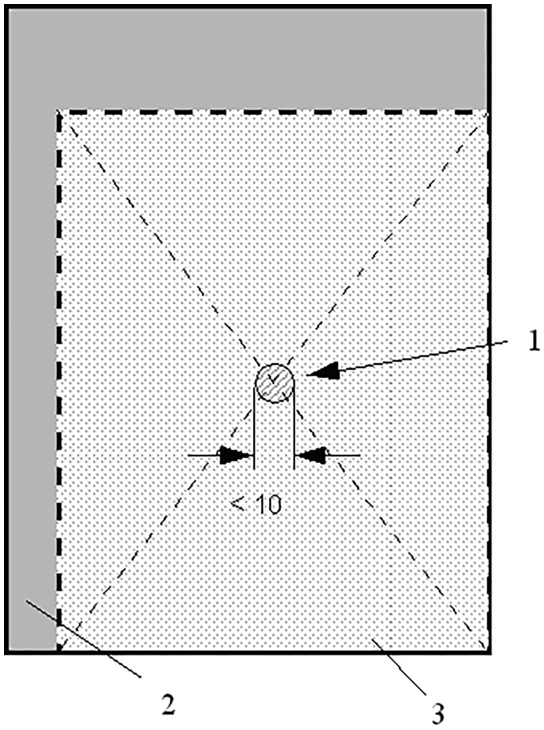
The connection point of the tile is within 5 mm of the centre of the exposed area of the roofing tile, normal to the roof surface (see Figure 1).

The cable may be connected to the tile by feeding the cable through a hole to be made at the location of the connection point and locking the cable at the back side of the roofing tile and may include a load spreading device to prevent an unrepresentative failure mode of the roofing tile.

NOTE Figure 1 shows a typical example of a tile in the centre of the roof, overlapping along its edge and head regions. Some tiles might not have a side lap, e.g. double lap tiles and some single lap verge tiles.

The connection point of beaver tiles in double-lap tiling (see Figure 2a) or crown covering (see Figure 2 b)) should be on the centre line of the tile and at 40 % of the visible length of the tile from the tail of the tile.

Dimensions in millimetres



Key

1 location of connection point
2 overlapped part of tile
3 visible part of tile

Figure 1 — Location of the connection or loading point on a rectangular tile

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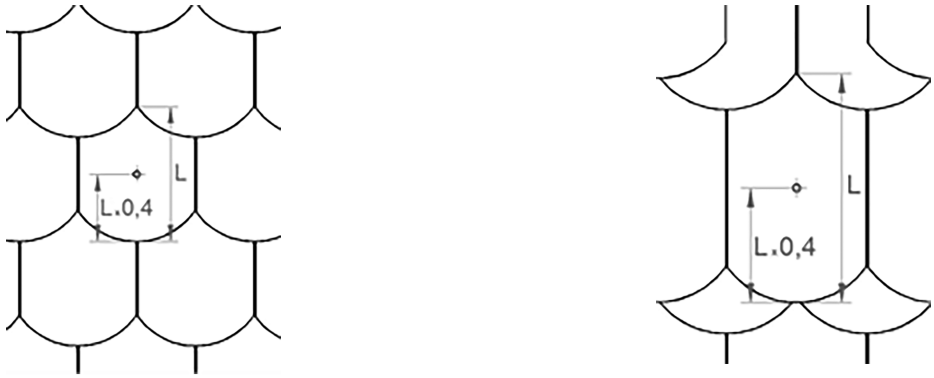

a) b)

Key

L visible length

Figure 2 — Location of the connection point of beaver tiles laid a) double-lap or b) crown covering

9.4 Measurement of the uplift resistance

9.4.1 Calibration of the test equipment

The test equipment shall be calibrated when the equipment is commissioned and periodically in accordance with the frequency of use. Guidance on calibration methods is given in Annex G.

9.4.2 Eliminate the effect of the load bars and cables

Depending on the design of the test rig, the weight of the application frame and cables may be counterbalanced to reduce their effect on the load cell reading.

9.4.3 Trial test

A trial test shall be conducted, where the total force on the 16 roof tiles shall be increased at a rate of less than 50 N/s, until one of the events a, b, c, d or e (specified in 9.4.6) occurs. The maximum total force on the 16 roofing tiles, F_t, shall be measured and the tile showing the largest displacement shall be identified together with the location of the largest displacement on this tile.

If F_t and the other information from a trial test are known from experience, then a trial test need not be carried out.

9.4.4 Test series

For each pattern a series of at least 3 tests and a trial test shall be conducted.

The roofing tiles shall be reinstalled randomly between each test and new fixings shall be used. Any damaged roofing tiles and battens shall be replaced. The tiles shall be installed in a manner that ensures the fixings do not coincide with previous fixing positions within 30 mm.

9.4.5 Application of the force

The total force acting on the 16 roofing tiles shall be increased in a first step of maximum 0,7 F_t and in subsequent steps of maximum 1/20 F_t (see Figure 3). Release the load after a minimum of 5 s. The total force shall be increased at a rate not more than 50 N/s.

The load may show some relaxation during the 5 s pause.

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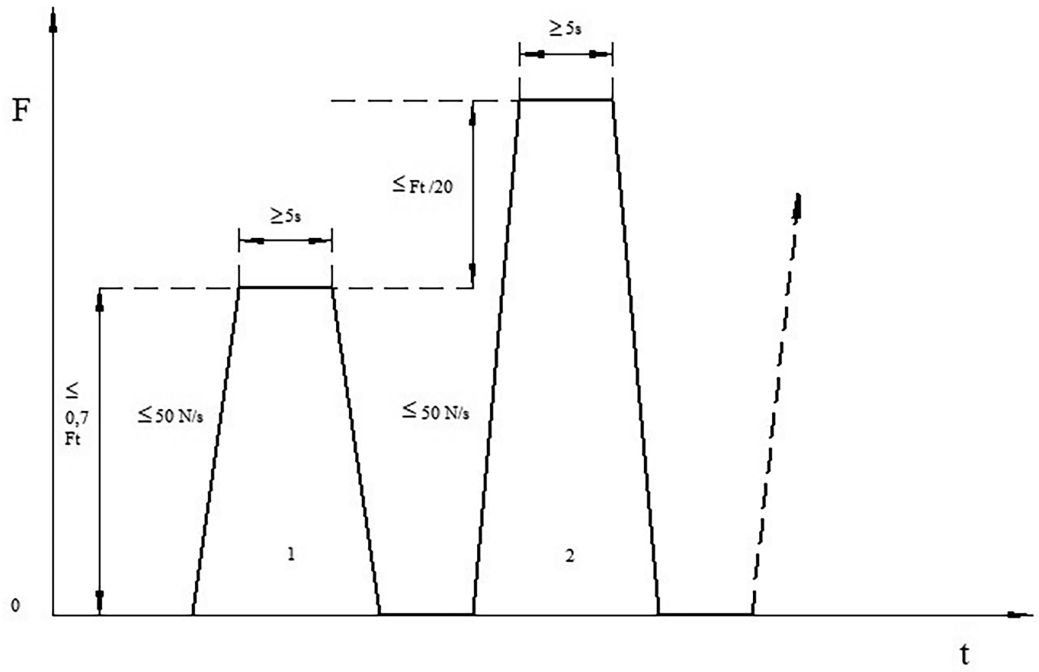
During the loading step the maximum displacement shall be monitored at an angle of (90 ± 2)° to the rafters.



Key

1 step 1 of the series of steps

2 step 2 of the series of steps

F force, N

t time, s

Figure 3 — Application of the force

9.4.6 Determining the maximum uplift resistance

The maximum uplift resistance, R_i, where i is the number of the test, is defined as the total force on the 16 roofing tiles when one of the following events occurs:

a) breakage of the mechanical fixing from tile to batten (ultimate failure);

b) pulling out of the connection of the mechanical fixing of the tile to the batten (ultimate failure);

c) breakage of covering elements (ultimate failure);

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