



**SLOVENSKI STANDARD**  
**SIST EN 491:1998**

**01-april-1998**

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**Betonski strešniki in fazonski kosi - Preskusne metode**

Concrete roofing tiles and fittings - Test methods

Dach- und Formsteine aus Beton - Prüfungsverfahren

Tuiles et accessoires en béton - Méthodes d'essai

**Ta slovenski standard je istoveten z: EN 491:1994**

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**ICS:**

91.060.20	Strehe	Roofs
91.100.30	Beton in betonski izdelki	Concrete and concrete products

**SIST EN 491:1998**

**en**

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EUROPEAN STANDARD

EN 491:1994

NORME EUROPÉENNE

EUROPÄISCHE NORM

March 1994

UDC 692.415.3-4:691.32-4:666.972:620.1

Descriptors: Roof, roofing, roofing tiles, concrete, tests, length, width, flatness, mass, flexural strength, water-tightness, freeze-thaw resistance

English version

**Concrete roofing tiles and fittings - Test methods**

Tuiles et accessoires en béton - Méthodes d'essais - Dach- und Formsteine aus Beton - Prüfungsverfahren

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European Committee for Standardization  
Comité Européen de Normalisation  
Europäisches Komitee für Normung

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## Foreword

This European Standard has been prepared by the Technical Committee CEN/TC 128 "Roof covering products for discontinuous laying", the secretariat of which is held by ON.

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of an identical text or by endorsement, at the latest by September 1994, and conflicting national standards shall be withdrawn at the latest by September 1994.

According to the CEN/CENELEC Internal Regulations, the following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom.

## 2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 490:1994 Concrete roofing tiles and fittings - Product specification

## 3 Definitions and symbols

### 3.1 Definitions

For the purposes of this standard, the definitions given in EN 490:1994 apply.

## 3.2 Symbols

$l_1$	:	hanging length of a tile as defined in figure 1.1
$l_2, l_3$	:	hanging edge lengths of a tile as defined in figure 1.2
$c_w$	:	nominal cover width of one tile
$c_{wc}$	:	cover width closed up value of 10 tiles
$c_{wd}$	:	cover width drawn out value of 10 tiles
$d$	:	profile depth of a tile
$F$	:	mean value of the maximum loads
$F_c$	:	characteristic transverse strength of tiles
$F_i$	:	transverse strength of an individual tile
$n$	:	sample size
$s_d$	:	estimated standard deviation

## 4 Test methods

## 4.1 Hanging length and squareness of regular front edge tiles

## 4.1.1 Tiles with nominally constant hanging length

Hang the tile at an angle of 20 ° to 70 ° on a steel batten (see figure 1.a). After having removed any burrs and/or other irregularities, measure from the top face of the batten to the lower front edge of the tile at the sides (see figure 1.b). Record the values  $l_2$  and  $l_3$  to the nearest millimetre and calculate the average per tile  $l_1$  to the nearest millimetre.

## 4.1.2 Tiles with regularly varying hanging length

Hang the tile at an angle of 20 ° to 70 ° on a steel batten (see figure 1.a). After having removed any burrs and/or other irregularities, measure to the nearest millimetre from the top face of the batten to the lowest point of the tile (see figure 1.c). Record the measured value  $l_1$  to the nearest millimetre.

## 4.2 Cover width

## 4.2.1 Interlocking tiles

Hang or lay eleven tiles of the same nominal cover width with their locks fitting well, in the manner specified by the manufacturer.

Taking care that the interlocking parts of the tiles do not lift or disengage, pull the tiles apart to their maximum coverage. Measure to the nearest millimetre and record the drawn-out value  $c_{wd}$  over 10 tiles (see figure 2.1).

Taking care that the interlocking parts of the tiles do not lift or disengage, push the tiles together to their minimum coverage. Measure to the nearest millimetre and record the closed up value  $c_{wc}$  over 10 tiles (see figure 2.2).

Calculate to the nearest 0,1 mm either:

- a) the average drawn out value  $c_{wd}/10$  and the average closed up value  $c_{wc}/10$ ; or
- b) the average cover width  $(c_{wd} + c_{wc})/20$ .

#### 4.2.2 Non-interlocking tiles

Hang or lay 10 tiles of the same nominal cover width on a batten in the manner specified by the manufacturer.

Push the tiles together. Measure to the nearest millimetre and record the width of the 10 tiles.

Calculate to 0,1 mm the average cover width.

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#### 4.3 Flatness <https://standards.iteh.ai/catalog/standards/sist/d0eee82d-936a-4d1fb5a4-b09b56437dc4/sist-en-491-1998>

Place the tile on a flat level surface or two co-planer flat metal bars with the nibs projecting, as shown in figure 3. Hold the tile to ensure that the head of the tile is in contact with the surface.

Using a steel bar with a diameter of 3 mm or  $c_w/100$  mm to the nearest millimetre which ever is the greater, check whether any gap between the lower front edge of the tile and the measuring surface at any nominal contact point without lifting the tile, is greater than specified value.

Record the results for each tile tested.

#### 4.4 Mass

Condition the tiles to be tested at 15 °C to 30 °C and at a minimum of 40 % relative humidity for at least 24 h in such a manner that air is free to circulate to all sides of each tile.

Weigh each tile to at least the nearest 25 g. Record the values measured and calculate the average mass of the tiles, in the sample to the nearest 10 g.

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## 4.5 Transverse Strength

### 4.5.1 Conditioning of tiles

Store the tiles to be tested at 15 °C to 30 °C, at a minimum of 40 % relative humidity for at least 24 hours, in such a manner that air is free to circulate to all sides of each tile.

### 4.5.2 Test machine details

The test machine shall have two lower rounded metal bearers in a horizontal plane whose centres are spaced at 2/3 of the hanging length of the tile to be tested, and a single rounded metal upper bearer positioned centrally between the two lower bearers (see figure 4.a). The rounded part of the bearers shall have a radius of 10 mm to 20 mm. The bearers shall have a minimum width of 20 mm. The upper bearer and the bearer nearest the tail of the tile shall be free to pivot perpendicularly to their long axis. The length of the bearers shall be not less than the width of the tile to be tested.

The test machine shall be calibrated such that the indicated value shall be within + 3 % of the true value.

NOTE: Useful information may be found in OIML International Recommendation Number 65 (see annex A).

### 4.5.3 Procedure [SIST EN 491:1998](#)

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#### 4.5.3.1 Measurement of profile depth $d$ [SIST EN 491:1998](#)

If the manufacturer's declared value of  $d$  is less than 20 mm, measure the profile depth of each tile in the sample and calculate the average value for the sample (see figure 5).

#### 4.5.3.2 Positioning the tile in the machine

Place the tile to be tested with the top surface uppermost on the lower bearers of the test machine so that the centre line of the hanging length is midway between the lower bearers (see figure 4). If the tile is not stable in this position (e.g. the tile rests in or on a water-lock) move the tile a distance specified by the manufacturer to ensure stable bearing, in the direction that brings the tile hanging nibs nearer to the bearer.

When compared to the fixed lower bearer, the angle of the upper bearer shall be not greater than 10 °. Packing pieces with a flat top shall be used as necessary to achieve this (see figure 6). The packing pieces shall be no wider than the diameter of the rounded part of the lower bearers.

With plain and flat tiles, place an elastomeric pad between the upper bearer and the tile (see figure 4).



With profiled tiles, arrange a contoured packing block between the upper bearer and the tile (see figure 4). The contoured packing block shall be made of hardwood or metal or moulded with plaster. The contoured packing block shall be  $(20 \pm 1)$  mm wide. Where the contoured packing block is made of hardwood or metal, place an elastomeric pad between the contoured packing piece and the tile.

The elastomeric pad shall be in length at least the width of the tile, not less than 20 mm wide and  $10 \text{ mm} \pm 5 \text{ mm}$  thick with a hardness of  $(50 \pm 10)$  Shore A.

The tile shall be placed so that the underlock (if applicable) is not loaded, and in such a way that the load can be applied centrally on the cover width (see figure 6).

NOTE: For quality control purposes the test may be carried out without the use of the elastomeric pad and contoured packing block.

#### 4.5.3.3 Load Application

Apply the load through the upper bearer at a rate not exceeding 6 500 N/min until failure occurs.

#### 4.5.4 Recording of test results

Record the maximum load of each tile to the nearest 10 N. When calculating the total load, include the weight of the packing pieces used on the top surface if they exceed 5 N.

#### 4.5.5 Characteristic transverse strength

Calculate to the nearest 10 N, the characteristic transverse strength:

$$F_c = \bar{F} - 1,64s_d$$

where:

$$s_d = \sqrt{\frac{\sum (F_i - \bar{F})^2}{n-1}}$$

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Alternatively, compare the value  $F_i$  of each tile to the appropriate characteristic transverse strength requirement in table 1 of EN490:1994 and record the number of tiles with values less than the required value.

#### 4.6 Impermeability

##### 4.6.1 Conditioning

Store the tile or valley tile to be tested at 15 °C to 30 °C, at a minimum of 40 % relative humidity for at least 20 h, in such a manner that air is free to circulate to all sides of each tile or valley tile.

##### 4.6.2 Procedure

Seal an impermeable frame on or around the tile or valley tile such that no more than 15 mm from the perimeter is covered (see figure 7). In the case of interlocking tiles with an underlock width of 30 mm or more, the seal width shall be not more than half of the width of the underlock on that side.

Where functional openings such as fixing holes are present, seal these with an impermeable material.

Hold the tile or valley tile to within 10° of the horizontal. Pour water on to the tile or valley tile to a level of 10 mm to 15 mm above the highest point, place the test sample above a suitable device for detecting falling drops of water and store at 15 °C to 30 °C and at least 40 % relative humidity for 20 h ± 5 min.

NOTE: Examples of suitable detection methods are illustrated in figure 7.

Record whether or not drops of water have fallen from the underside of the tile or valley tile during the period of 20 h ± 5 min.

#### 4.7 Freeze-thaw resistance

##### 4.7.1 Test specimen

Test whole tiles at least 28 days old.

##### 4.7.2 Apparatus

Freeze chamber with an air mixing device, capable of achieving the cycle characteristics given in 4.7.4 and an immersion tank.

NOTE: The test may be performed either with an automatic apparatus or by manual means.

#### 4.7.3 Conditioning of tiles

Place the tiles in the immersion tank containing water at  $20\text{ °C} \pm 5\text{ °C}$  for 3 days. Remove the tiles and wipe off excess surface water with a damp cloth.

#### 4.7.4 Procedure

Immediately after conditioning the tiles, place them vertically in the freeze chamber. To provide free circulation of air, position the tiles such that:

- the distance between any two tiles is  $\geq 40\text{ mm}$ ;
- the distance between the vertical faces of the chamber and tile faces is  $\geq 100\text{ mm}$ ;
- the distance between the bottom of the chamber and the lower end of the tiles is  $\geq 30\text{ mm}$ ;
- the distance between the top of the chamber and the upper end of the tiles is  $\geq 100\text{ mm}$ ;

When a frame is used to hold the tiles in position during the test, construct it in such a manner that the free circulation of air is not restricted.

One complete freeze/thaw cycle consists of a cooling phase, a freezing phase and a thawing phase.

To cool the tiles, reduce the air temperature in the freeze chamber to  $-20\text{ °C} \pm 5\text{ °C}$  within  $2\text{ h} \pm 30\text{ min}$ .

NOTE: Where tiles are placed into a precooled chamber, it may be necessary to use ballast to achieve the specified rate of cooling.

To freeze the tiles, maintain the air at  $-20\text{ °C} \pm 5\text{ °C}$  for  $1\text{ h} 15\text{ min} \pm 15\text{ min}$ .

To thaw the tiles, immerse the tiles in water for 1 h to 2 h immediately after the freezing phase. The final temperature of the water shall be  $20\text{ °C} \pm 5\text{ °C}$ .

Interruption of the cycles is only permitted at the end of the thawing phase and the tiles shall remain immersed. Each interruption shall not exceed 96 h. Record all interruptions that exceed 24 h.

On completion of 25 freeze-thaw cycles store the tiles for seven days at  $15\text{ °C}$  to  $30\text{ °C}$  and at a minimum of 40 % relative humidity, then test for impermeability in accordance with 4.6.