



SLOVENSKI STANDARD

SIST EN 12372:2022

01-maj-2022

Nadomešča:
SIST EN 12372:2007

Preskušanje naravnega kamna - Ugotavljanje upogibne trdnosti s koncentrirano obremenitvijo na sredini razpona

Natural stone test methods - Determination of flexural strength under concentrated load

Prüfverfahren für Naturstein - Bestimmung der Biegefestigkeit unter Mittellinienlast

Méthodes d'essai pour pierres naturelles - Détermination de la résistance à la flexion sous charge centrée

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ICS:

73.020	Rudarstvo in kamnolomsko izkopavanje	Mining and quarrying
91.100.15	Mineralni materiali in izdelki	Mineral materials and products

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EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 12372

March 2022

ICS 91.100.15

Supersedes EN 12372:2006

English Version

Natural stone test methods - Determination of flexural
strength under concentrated load

Méthodes d'essai pour pierres naturelles -
Détermination de la résistance à la flexion sous charge
centrée

Prüfverfahren für Naturstein - Bestimmung der
Biegefestigkeit unter Mittellinienlast

This European Standard was approved by CEN on 10 January 2022.

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

Contents	Page
European foreword	3
1 Scope	4
2 Normative references	4
3 Terms, definitions and symbols	4
3.1 Terms and definitions	4
3.2 Symbols	4
4 Principle	4
5 Apparatus	4
5.1 Balance	4
5.2 Ventilated oven.....	5
5.3 Linear measuring device	5
5.4 Testing machine	5
5.5 Device for applying loads on the specimen by a three-point load	5
5.6 Room.....	5
6 Preparation of the specimens	5
6.1 Sampling.....	5
6.2 Test specimens	5
6.2.1 Surface finish	5
6.2.2 Technological test.....	5
6.2.3 Dimensions.....	5
6.2.4 Tolerance	6
6.2.5 Planes of anisotropy.....	6
6.2.6 Conditioning before testing.....	6
7 Test procedure	6
8 Expression of the results	7
9 Test report	7
Annex A (normative) Statistical evaluation of the test results	13
A.1 General.....	13
A.2 Symbols	13
A.3 Statistical evaluation of test results	13
Annex B (informative) Calculation of flexural strength for off-centre specimen fracture	16
Bibliography	18

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[SIST EN 12372:2022](https://standards.iteh.ai/catalog/standards/sist/1d19-edf9-2107-41d1-ad6a-321effab045e/sist-en-12372-2022)

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European foreword

This document (EN 12372:2022) has been prepared by Technical Committee CEN/TC 246 “Natural stones”, the secretariat of which is held by UNI.

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 2022, and conflicting national standards shall be withdrawn at the latest by September 2022.

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 12372:2006.

In comparison with the previous edition, the following technical modifications have been made:

- inclusion of an informative annex (Annex B) presenting an alternative method for calculation of flexural strength for off-centre specimen fracture.

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.

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

SIST EN 12372:2022

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EN 12372:2022 (E)

1 Scope

This document specifies a test method for determination of flexural strength under a concentrated load for natural stone. Both an identification and a technological product testing procedure are included.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 12390-4, *Testing hardened concrete - Part 4: Compressive strength - Specification for testing machines*

3 Terms, definitions and symbols

3.1 Terms and definitions

No terms and definitions are listed in this document.

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>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.2 Symbols

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

Symbol	Quantity	Unit
F	breaking load	N
L	total length of the specimen	mm
R_{tf}	flexural strength	MPa
V	loading rate	N/s
a	load rate	MPa/s
b	width of the specimen adjacent to the plane of fracture	mm
h	thickness of the specimen adjacent to the plane of fracture	mm
l	distance between the supporting rollers	mm

4 Principle

The principle of this method is to place a specimen on two rollers and to progressively load the specimen in the middle. The breaking load is measured and the flexural strength calculated.

5 Apparatus

5.1 Balance

A balance capable of weighing the specimen with an accuracy of 0,01 % of the mass of the specimen.

5.2 Ventilated oven

A ventilated oven capable of maintaining a temperature of $(70 \pm 5) ^\circ\text{C}$.

5.3 Linear measuring device

A linear measuring device with an accuracy of 0,05 mm.

5.4 Testing machine

A testing machine of appropriate force, in accordance with EN 12390-4 and calibrated according to this document.

5.5 Device for applying loads on the specimen by a three-point load

A device for applying loads on the specimen by a three-point load. It consists of two lower rollers (supporting rollers) and one upper roller (load-applying roller) which shall be centred exactly in the middle between the two supporting rollers (see Figure 1). The distance between the two supporting rollers shall be reported as requested in 6.2.3 and 6.2.4.

5.6 Room

A room which can be maintained at a temperature of $(20 \pm 10) ^\circ\text{C}$.

6 Preparation of the specimens

6.1 Sampling

The sampling is not the responsibility of the test laboratory except where specially requested. At least 10 specimens shall be selected from a homogeneous batch (see also 6.2.5).

6.2 Test specimens

6.2.1 Surface finish

The surface finish of the faces of specimens used as a standard reference shall be sawn, honed or polished (identification test).

6.2.2 Technological test

For the technological test, specimens may be finished products or specimens sawn from slabs or other semi-finished or finished products.

If the surface of a specimen has an applied texture (e.g., flamed, bush hammered, shot blasted), the nature of the applied texture shall be stated in the report.

If a mesh or similar reinforcement has been attached to a specimen, this shall be removed prior to testing or its presence shall be stated in the test report.

The dimensions of the specimens shall be reported.

6.2.3 Dimensions

For stones with a size of the largest grain lower than 25 mm, preferred dimensions are 50 mm × 50 mm × 300 mm with a tolerance of ± 3 mm for each dimension.

EN 12372:2022 (E)

Other dimensions are possible, but shall fulfil the following requirements:

- the thickness h shall be between 25 mm and 100 mm and shall be greater than twice the size of the largest grain in the stone;
- the total length L shall be equal to six times the thickness;
- the width b shall be between 50 mm and three times the thickness ($50 \text{ mm} \leq b \leq 3h$), and it shall not be less than the thickness;
- a tolerance of $\pm 3 \text{ mm}$ for each dimension.

The distance between the supporting rollers l shall be equal to five times the thickness.

6.2.4 Tolerance

The tolerance on the distance between the supporting rollers l shall be $\pm 1 \text{ mm}$.

6.2.5 Planes of anisotropy

If the stone shows planes of anisotropy (e.g. bedding, foliation) the specimens shall be prepared in accordance with at least one of the arrangements shown in Figures 2 to 4 and the direction of the planes of anisotropy shall be marked on each specimen by at least two parallel lines.

If the use of the stone in respect of the direction of the planes of anisotropy is known, the test shall be carried out with the force applied on the face that will be loaded during use.

If the way of use of the stone is not known but the direction of the planes of anisotropy is indicated on the specimens (by means of at least two parallel lines), the test shall be carried out on each of the three arrangements shown in Figures 2 to 4; the total number of specimens will then be 3 times 10.

6.2.6 Conditioning before testing

The specimens shall be dried at $(70 \pm 5) ^\circ\text{C}$ or $(40 \pm 5) ^\circ\text{C}$ to a constant mass.

NOTE 40 °C is considered suitable for marble (EN 12670) geologically defined.

Constant mass is reached when the difference between two weighing carried out $(24 \pm 2) \text{ h}$ apart is no greater than 0,1 % of the first of the two masses.

After drying and prior to testing the specimens shall be stored at $(20 \pm 5) ^\circ\text{C}$ until the thermal equilibrium is reached. After that the test shall be performed within 24 h.

7 Test procedure

Wipe the surface of the rollers clean and remove any loose grits from the faces of the specimen that will be in contact with the rollers.

The specimen is placed centrally on the supporting rollers (see Figures 1 to 4). The loading roller is placed in the middle of the specimen.

The load is increased uniformly at a rate of $(0,25 \pm 0,05) \text{ MPa/s}$ until the specimen breaks.

NOTE 1 The breaking load is rounded to the nearest 10 N and also the place where the fracture occurs is recorded. The width and the thickness of the specimen are measured adjacent to the fracture plane and the dimensions are expressed in millimetres to the nearest 0,1 mm.

NOTE 2 Where the loading rate (V) is needed in N/s the following equation can be used to determine the required rate in N/s:

$$V = \frac{2abh^2}{3l} \quad (1)$$

8 Expression of the results

The flexural strength R_{tf} of each specimen is calculated using the following formula:

$$R_{tf} = \frac{3Fl}{2bh^2} \quad (2)$$

The result shall be expressed in Megapascals to the nearest 0,1 MPa.

If the fracture is 'off centre' situated more than 15 % of the distance between the supporting rollers from the middle of the specimen and/or if it is due to the presence of flaws (veins, fissures, etc.), it shall be mentioned in the test report.

NOTE Information when the failure is 'off centre' is given in Annex B.

9 Test report

The test report shall contain the following information:

- a) unique identification number of the report;
- b) the number, title and date of issue of this document, i.e. EN 12372:2022;
- c) the name and address of the test laboratory and the address where the test was carried out if different from the test laboratory;
- d) the name and address of the client;
- e) it is the responsibility of the client to supply the following information:
 - the petrographic name of the stone;
 - the commercial name of the stone;
 - the country and region of extraction;
 - the name of the supplier;
 - the direction of any existing plane of anisotropy (if relevant to the test) to be clearly indicated on the sample or on each specimen by means of two parallel lines;
 - the name of the person or organization which carried out the sampling;
 - the surface finish of the specimens (if relevant to the test);
- f) the date of delivery of the sample or of the specimens;
- g) the date when the specimens were prepared (if relevant) and the date of testing;
- h) the number of specimens in the sample;

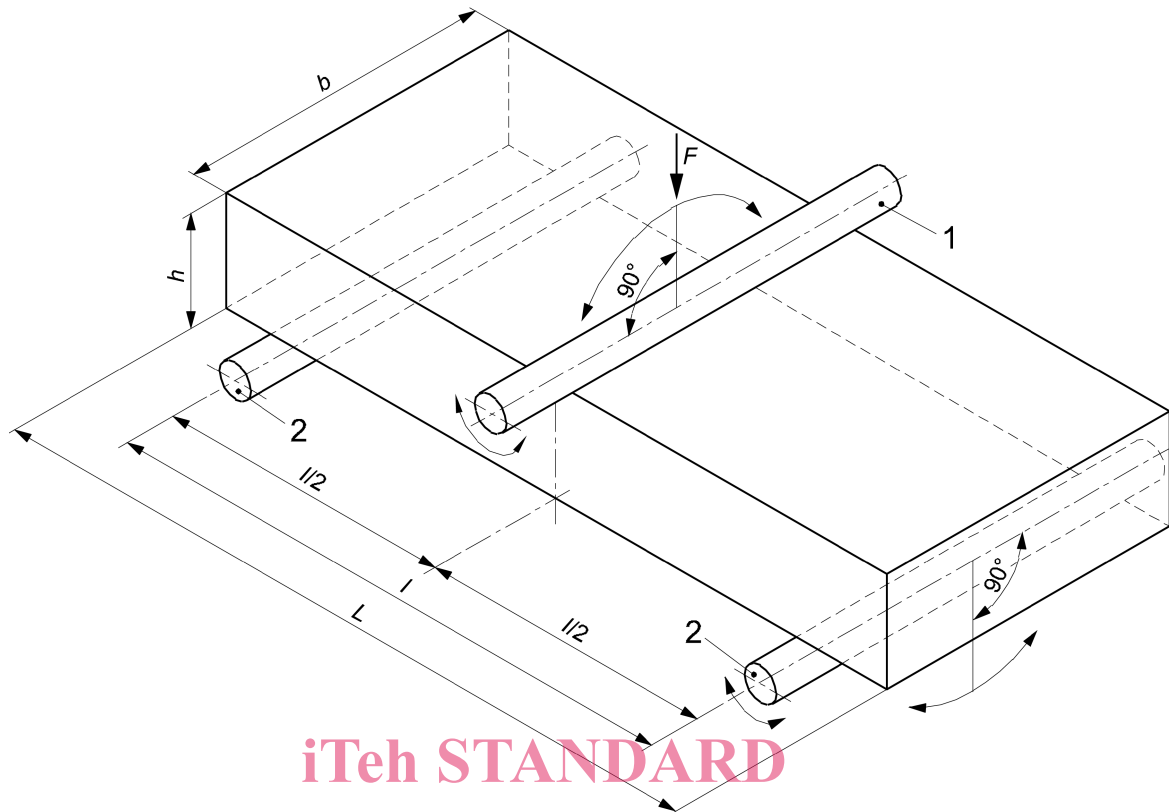
EN 12372:2022 (E)

- i) the dimensions of the specimens;
- j) the surface finish of the specimens;
- k) the rate of loading in Megapascals per second to the nearest 0,05 MPa/s;
- l) for each specimen: the width and thickness adjacent to the fracture plane and the distance between the supporting rollers in millimetres to the nearest 0,1 mm, the orientation of the force relatively to any plane of anisotropy following Figures 2 to 4, the breaking load in newton to the nearest 10 N, the flexural strength in Megapascals to the nearest 0,1 MPa, the location of the fracture and any anomalies observed;
- m) for each relevant direction of loading the mean value \bar{R}_{gf} of the flexural strength, the standard deviations, in Megapascals to the nearest 0,1 MPa and the lower expected value (E) as specified in Annex A;
- n) all deviations from the standard and their justification;
- o) remarks.

The test report shall contain the signature(s) and the role(s) of the responsible(s) for the testing and the date of issue of the report. It shall also state that the report shall not be partially reproduced without written consent of the test laboratory.

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**Key**

- 1 loading roller
- 2 supporting roller

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Figure 1 — Arrangement of loading of test specimen (centre point loading)

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