EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 1015-12

February 2000

ICS 91.100.10

English version

Methods of test for mortar for masonry - Part 12: Determination of adhesive strength of hardened rendering and plastering mortars on substrates

Méthodes d'essai des mortiers pour maçonnerie - Partie 12: Détermination de l'adhérence des mortiers d'enduit durcis appliqués sur supports

Prüfverfahren für Mörtel für Mauerwerk - Teil 12: Bestimmung der Haftfestigkeit von erhärteten Putzmörteln

This European Standard was approved by CEN on 24 December 1999.

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

Central Secretariat: rue de Stassart, 36 B-1050 Brussels

Ref. No. EN 1015-12:2000 E

Contents **Page**

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 125 "Masonry", 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of an identical text or by endorsement, at the latest by August 2000, and conflicting national standards shall be withdrawn at the latest by December 2001.

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

1 Scope

This European Standard specifies a method for the determination of the adhesive strength between rendering and plastering mortars and a substrate.

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.

prEN 772-11	Methods of test for masonry units - Part 11 : Determination of water absorption of clay, aggregate concrete, autoclaved aerated concrete, manufactured stone and natural stone masonry units due to capillary action
prEN 998-1	Specification for mortar for masonry - Part 1 : Rendering and plastering mortar with inorganic binding agents
prEN 998-2	Specification for mortar for masonry - Part 2 : Masonry mortar
EN 1015-2	Methods of test for mortar for masonry - Part 2 : Bulk sampling of mortars and preparation of test mortars
EN 1015-3	Methods of test for mortars for masonry - Part 3 : Determination of consistence of fresh mortar (by flow table)
prEN 1015-11	Methods of test for mortars for masonry - Part 11: Determination of flexural and compressive strength of hardened mortar

3 Principle

The adhesive strength is determined as the maximum tensile stress applied by a direct load perpendicular to the surface of the rendering or plastering mortar on a substrate. The tensile load is applied by means of a defined pull-head plate glued to the test area of the mortar surface. The adhesive strength obtained is the quotient between the failure load and the test area.

4 Symbols

f_u	is the adhesive strength, (N/mm^2);
F_u	is the failure load, (N);
A	is the test area of cylindrical specimen, (mm^2).

5 Apparatus

5.1 Truncated conical rings, (see figure 1) made of stainless steel or brass, with internal diameter of 50 mm ± 0,1 mm and 25 mm ± 0,5 mm in height. The minimum thickness of the mould wall shall be 5,0 mm at the top. The external diameter at the base shall be 51 mm ± 0,1 mm.

5.2 Circular pull-head plates, made of stainless steel, with diameter of 50 mm ± 0,1 mm and minimum thickness 10 mm, and with central fitting for connection to the direct pull tensile force apparatus.

Dimensions in millimetres

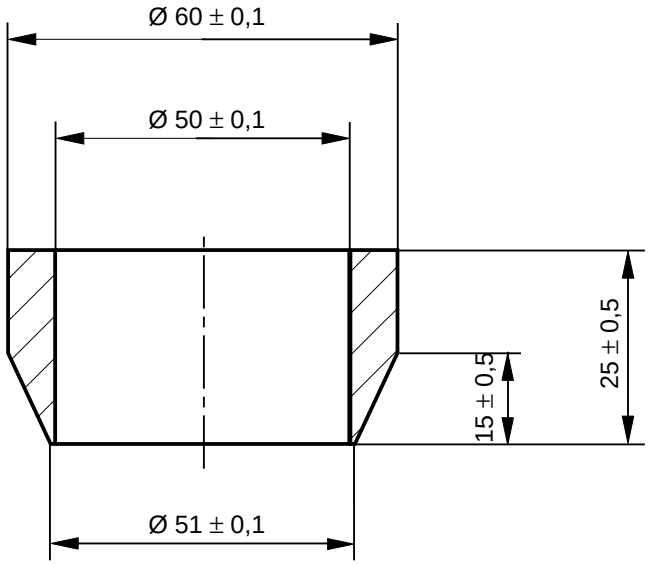


Figure 1 - Sharp-edged, truncated conical ring

5.3 Adhesive based on resin, e.g. epoxy resin or methylmethacrylate resin.

5.4 Core drilling machine, with core drill of nominally 50 mm internal diameter, suitable to cut core samples from hardened mortars and substrates.

5.5 Testing machine for direct pull tensile force test and with suitable capacity and sensitivity for the test as specified in clause 8. It shall be capable of applying the load to the pull-head plate through a suitable fitting that excludes any bending forces. The machine shall comply with the requirements in table 1.

5.6 Storage chamber, capable of maintaining a temperature of 20 °C ± 2 °C and at a relative humidity of 65 % ± 5 %.

Table 1 - Requirements for testing machine

Maximum permissible repeatability of forces as percentage of nominal force %	Maximum permissible mean error of forces as percentage of nominal force %	Maximum permissible error of zero force as percentage of maximum force of range %
2,0	± 2,0	± 0,4

6 Sampling and sample preparation

6.1 General

The fresh mortar for this test shall have a minimum volume of 1,5 l or at least 1,5 times the quantity needed to perform the test, whichever is the greater, and shall either be obtained by reduction of the bulk test sample (see **EN 1015-2**) using a sample divider or by quartering or by preparation from water and the other constituents in the laboratory. Two test samples shall be prepared.

6.2 Laboratory prepared mortars

The length of mixing period shall be measured from the moment all the constituents are introduced into the mixer.

The mortar shall be brought to a defined flow value as specified in **EN 1015-2** determined in accordance with **EN 1015-3** and reported. The test procedure shall not start until at least 10 min after completion of mixing and shall be concluded within the specified workable life of the mortar (preferably within 30 min after completion of mixing), unless otherwise instructed by the manufacturer.

6.3 Mortars, other than laboratory prepared mortars

Ready to use mortars (factory-made wet mortars which are retarded), and pre-batched air-lime/sand wet mortars when not gauged with hydraulic binders, shall be used for specimen preparation within their specified workable life.

Before testing, the batch shall be gently stirred by hand using a trowel or palette knife for 5 - 10 seconds to counteract any false setting etc., but without any additional mixing of the batch.

The flow value of the mortar in the bulk test sample shall determined in accordance with **EN 1015-3** and reported.

7 Preparation and storage of test specimens

7.1 Substrate

For rendering or plastering systems manufactured for a specific background, i.e. clay or calcium silicate masonry units, concrete masonry units, panels or cast in situ concrete, etc., these materials, in an air-dried condition, should be used as test substrates. The water absorption due to capillary action of the units used in the substrate shall be recorded, if known, or tested in accordance with **prEN 772-11** where appropriate.

Where no specific background is prescribed rectangular concrete panels shall be used as substrate, with dimensions not less than 550 mm x 150 mm and 50 mm in thickness. The concrete shall be mixed with a water/cement ratio of 0,55 and using normal graded aggregates with maximum particle size of one third of the concrete panel thickness. The upper surface of the moulded substrate shall be levelled and wood-floated to achieve a suitable surface. Within a period of 6h to 24h lightly brush the surface.

The concrete panels shall have an age of not less than 28 d when applying the plastering or rendering system, the panels being cured under standardized conditions as described in **prEN 1015-11**

Note: Concrete panels as a substrate will normally give conservative adhesive strength values.

7.2 Application

The fresh mortar mix shall be applied to the prescribed substrate according to the manufacturers recommendations and the intended use. The substrate shall be kept vertical during application. Unless otherwise specified the total thickness of the mortar layer shall be 10 mm ± 1 mm.

7.3 Test areas

7.3.1 General

Circular test areas of approximately 50 mm in diameter shall be cut through the mortar layer, either in the fresh mortar according to **7.3.2** or in the hardened mortar according to **7.3.3**. The diameter of the circular test area shall be recorded for each specimen. Five test specimens shall be provided.

7.3.2 Fresh mortar

After application and the initial setting of the mortar layer, the truncated conical rings (5.1), cleaned and lubricated with a thin layer of mineral oil, shall be pressed with their sharp edge, slightly rotating, through the fresh mortar layer until full contact with the substrate is reached. The minimum distance between the rings and the free edges of the rendered substrate, and the free distance between the individual rings, shall be 50 mm.

The rings shall be carefully removed, still slightly rotating, when the substrate is reached. If it is obvious that the adhesion of any of the cut specimens is disturbed during this preparation, another test specimen shall be cut. The specimen shall then be stored as given in **7.4**.

7.3.3 Hardened mortars

After curing of the rendering or plastering mortar, test specimens shall be cut using a core drilling machine (5.4). The core shall be cut to a depth of approximately 2 mm into the substrate. Damaged specimens shall be rejected.

7.4 Storage and curing conditions

When the mortar is sufficiently hard, the rendered specimens shall be enclosed within a sealed, air-tight polyethylene bag and at a temperature of 20 °C ± 2 °C for 7 d. The specimens shall subsequently be removed and stored in air (5.6) at a constant temperature of 20 °C ± 2 °C and at a relative humidity of 65 % ± 5 % for a further 21 d.

8 Procedure

Glue the pull-heads with the adhesive centrally on the test areas, preventing any excess adhesive from bridging the cut around the test areas.

Test the specimens at an age of 28 d immediately after being removed from the storing atmosphere.

Using the testing machine (5.5), apply the tensile load perpendicular to the test area through the pull-head plates (5.2). Apply the load without shock and at a uniform rate. Use a rate such that the stress increases within the range of 0,003 N/(mm^2×s) to 0,100 N/(mm^2×s) according to the expected adhesive strength and so that failure occurs between 20 s and 60 s (see table 2). Record the failure load. Reject any test where the mode of failure is fracture at the adhesive layer between the pull-head plate and the mortar.

Table 2 - Loading rate.

Expected adhesive strength	**Loading rate**
(N/mm^2)	(N/mm^2×s)
< 0,2	0,003-0,010
0,2 - <0,5	0,011 - 0,025
0,5 - 1,0	0,026 - 0,050
> 1,0	0,050-0,100

9 Expression of results

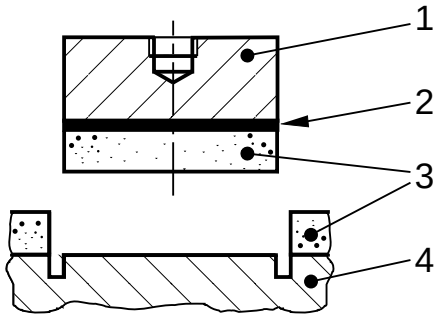
9.1 Adhesive strength

Calculate the individual adhesive strengths from the following formula to the nearest 0,05 N/mm^2 :

$$f_u = \frac{F_u}{A}$$

Calculate the adhesive strength as the mean value from the individual values of the 5 specimens to the nearest 0,1 N/mm^2.

Possible fracture patterns leading to valid results are given in **figures 2** to **4** inclusive. Where fracture patterns occur as shown in **figures 3** and **4** i.e. where there is no failure at the mortar/substrate interface, results shall be considered as lower bound values. These values shall be valid for calculation of the mean value of adhesive strength.



Key

1 Pull-head plate
2 Adhesive layer
3 Mortar
4 Substrate

Figure 2 - Fracture pattern a - Adhesion fracture - Fracture at the interface between mortar and substrate. Test value equals the adhesive strength.

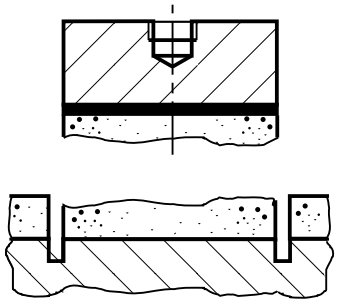


Figure 3 - Fracture pattern b - Cohesion fracture - Fracture in the mortar itself. The adhesive strength is greater than the test value

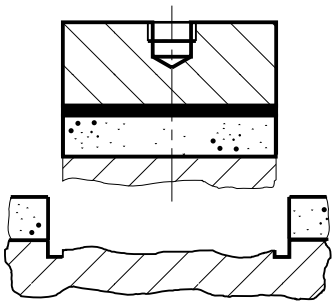


Figure 4 - Fracture pattern c - Cohesion fracture - Fracture in the substrate material. The adhesive strength is greater than the test value.

10 Test report

The test report shall provide the following information:

a) the number, title and date of issue of this European Standard;

b) the place, date and time of taking the bulk test sample;

c) the method used for taking the bulk test sample (if known) and the name of the organization that took it;

d) the type, origin and designation of the mortar by reference to the relevant part of **prEN 998**;

e) preparation method;

f) the type and description of the substrate including the coefficient of water absorption due to capillary action of masonry units (where relevant) comprising the substrate;

g) any specialised treatment of the substrate in accordance with the manufacturer's instructions;

h) the date and time of testing;

i) flow value of test mortar determined in accordance with **EN 1015-3**;

j) details of test specimens including number, dimensions etc., if appropriate;

k) individual values of adhesive strength rounded to the nearest 0,05 N/mm^2 and the mean value rounded to the nearest 0,1 N/mm^2 and description of mode of failure by reference to figures 2 to 4 inclusive;

l) remarks, if any.