BS EN 13888-2:2022

BSI Standards Publication

Grouts for ceramic tiles

Part 2: Test methods

bsi.

National foreword

This British Standard is the UK implementation of EN 13888-2:2022. It supersedes BS EN 12808-5:2008, BS EN 12808-1:2008, BS EN 12808-2:2008, BS EN 12808-3:2008 and BS EN 12808-4:2009, which are withdrawn.

The UK participation in its preparation was entrusted to Technical Committee B/539, Ceramic tiles and other rigid tiling.

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

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Fugenmörtel für keramische Fliesen und Platten - Teil 2: Prüfverfahren

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European foreword

This document (EN 13888-2:2022) has been prepared by Technical Committee CEN/TC 67 “Ceramic tiles”, 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of an identical text or by endorsement, at the latest by March 2023, and conflicting national standards shall be withdrawn at the latest by March 2023.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 12808-1:2008, EN 12808-2:2008, EN 12808-3:2008, EN 12808-4:2009 and EN 12808-5:2008.

This document belongs to series EN 13888, *Grouts for ceramic tiles*, which consists of the following parts:

— *Part 1: Requirements, classification, designation, marking and labelling*;

— *Part 2: Test methods*.

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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1 Scope

This document specifies the methods for determining characteristics for grouts used in internal and external installation of ceramic tiles.

This document does not contain performance requirements or recommendations for the design and installation of ceramic tiles.

The following test methods are described:

— Determination of flexural and compressive strength (9.1);

— Determination of water absorption (9.2);

— Determination of shrinkage (9.3);

— Determination of resistance to abrasion (9.4);

— Determination of chemical resistance (9.5).

Grouts for ceramic tiles can also be used for other kinds of tiles (natural and agglomerated stones, etc.), if they do not adversely affect the stones.

WARNING — — This document can involve hazardous materials and operations. It is important that persons using this document are familiar with normal laboratory practice. This document does not purport to address all the safety problems, if any, associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and to ensure compliance with any European and national regulatory conditions.

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 196-1:2016, *Methods of testing cement - Part 1: Determination of strength*

EN 1067, *Adhesives - Examination and preparation of samples for testing*

EN ISO 10545-6, *Ceramic tiles - Part 6: Determination of resistance to deep abrasion for unglazed tiles (ISO 10545-6)*

EN ISO 15605, *Adhesives - Sampling (ISO 15605)*

3 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/

4 Sampling

Take at least 2 kg sample of the grout in accordance with EN ISO 15605 and EN 1067.

5 Test conditions

Standard conditions shall be (23 ± 2) °C and (50 ± 5) % relative humidity and the speed of air in the testing area less than 0,2 m/s.

The tolerance in the time of conditioning for all test specimens shall be as shown in Table 1 below:

Table 1 — Allowed tolerance in testing time for all specimens requiring conditioning

Specimen conditioning time	Allowed tolerance tor testing
6 h	±15 min
7 d	±3 h
14 d	±6 h
21 d	±9 h
28 d	±12 h

Testing shall be performed within the specified time window.

6 Test materials

Condition all test materials for at least 24 h under standard conditions.

The grout to be tested shall be within its shelf life, where this is specified.

7 Mixing of grouts

The amount of water and/or liquid admix required for preparing the cementitious grout shall be as stated by the manufacturer in parts by weight, i.e. liquid to dry powder.

Prepare at least 2 kg of the grout in a mixer of the type described in EN 196-1:2016, 4.4, using the slow speed settings, (140 ± 5) r/min rotation and (62 ± 5) r/min planetary movement.

Carry out the following procedure:

— pour the liquid into the pan;

— scatter the dry powder over the liquid;

— mix for 30 s;

— take out the mixing paddle;

— scrape down the paddle and pan within 1 min;

— put the paddle back in place and mix for 1 min.

Let the grout mature if and as specified in the manufacturer's instructions, and then mix for a further 15 s.

In the case of reaction resin grouts, follow the manufacturer's instructions.

8 Test report

The test report shall provide the following information:

a) number, title and issue of this document;

b) place and date of sampling;

c) type of grout, commercial designation and manufacturer name;

d) identification of the test sample;

e) handling and storage of samples before testing;

f) test conditions;

g) date of testing;

h) amount of water or liquid used for preparing the grout;

i) result of the visual inspection of the specimen before testing;

j) any other factor that could have influenced the result;

k) test results (individual and mean values and mode of failure where required):

   1) flexural and compressive strength;

   2) water absorption;

   3) shrinkage

   4) resistance to abrasion;

   5) chemical resistance.

9 Test methods

9.1 Determination of flexural and compressive strength

9.1.1 Apparatus

9.1.1.1 Three gang mould shall consist of three horizontal compartments so that three prismatic specimens 40 mm x 40 mm x 160 mm can be prepared simultaneously (see EN 196-1:2016, 4.5).

9.1.1.2 Jolting apparatus or jolting table used for the compaction of 40 mm x 40 mm x 160 mm grout specimen, which shall comply with EN 196-1:2016, 4.6.

9.1.1.3 Flexural strength testing machine shall be capable of applying the load with suitable capacity and sensitivity for the test. The machine shall be provided with a flexure device in accordance with EN 196-1:2016, 4.7 (see Figure 1).

9.1.1.4 Compressive strength testing machine shall comply with EN 196-1:2016, 4.8. The test requires the use of a jig (in accordance with EN 196-1:2016, 4.9) to be incorporated in the lower platen; the upper platen receives the load from the machine through an intermediate spherical seating (see Figure 2).

9.1.2 Preparation of test specimens

Mould the specimens immediately after the preparation of the grout, with the mould firmly clamped to the jolting table.

Introduce, using a suitable scoop, the first of two layers of grout into each of the compartments, directly from the mixing bowl. Spread the layer uniformly, then compact using 60 jolts.

Introduce the second layer of grout, level and compact with a further 60 jolts.

Lift the mould gently from the jolting table, strike off excess of material and smooth the surface with a flat trowel. Wipe off the grout left on the perimeter of the mould.

Cover the mould with a glass plate according to EN 196-1.

Place the mould, suitably identified, on a horizontal base in standard conditions, (23 ± 2) °C and (50 ± 5) % R.H.

After 24 h carefully remove the specimen from the mould.

Keep the demoulded prism in standard conditions for 27 d, leaving a clearance of at least 25 mm on all sides.

Prepare three specimens for each grout.

9.1.3 Flexural strength under standard conditions

After conditioning has been completed, place the prism in the testing machine (9.1.1.3) with one side face on the supporting rollers and with the longitudinal axis normal to the support.

Apply the load vertically in accordance with the procedure described in EN 196-1:2016, 9.1.

Keep the prism halves in standard conditions until tested in compression.

9.1.4 Compressive strength under standard conditions

Test the prism halves broken in flexion, by means of the equipment specified in 9.1.1.4 and following the procedure described in EN 196-1:2016, 9.2.

9.1.5 Flexural and compressive strength after freeze-thaw cycles

Prepare the test units in accordance with 9.1.2.

Condition the test units for 6 d in standard conditions and then immerse in water for 21 d before carrying out 25 freeze-thaw cycles, in accordance with the following procedure.

For each freeze-thaw cycle:

— remove the test units from the water and lower the temperature to (–15 ± 3) °C within 2 h ± 20 min;

— maintain the test units at (–15 ± 3) °C for 2 h ± 20 min;

— immerse the test units in water at (20 ± 3) °C and raise the temperature of water to (15 ± 3) °C for at least 2 h ± 20 min.

Repeat the cycle 25 times.

Condition the test units for 3 d in standard conditions after the last cycle and prior to test examine them and record a brief description of surface appearance of the specimen. Determine the flexural strength in accordance with 9.1.3 and the compressive strength in accordance with 9.1.4.

9.1.6 Evaluation of results

9.1.6.1 Flexural strength

The flexural strength (R_f) is calculated from:

$$R_f = \frac{1{,}5\,F_f\,L}{b^3}\,N/mm^2$$

(1)

where

b is the length of the side of the square section of the prism, in millimetres;
F_f is the load applied to the middle of the prism at fracture, in newtons;
L is the distance between the supports, in millimetres.

Calculate the mean of the three determinations to the nearest 0,1 N /mm^2.

9.1.6.2 Compressive strength

The compressive strength (R_c) is calculated from:

$$R_c = \frac{F_c}{1\,600} N / mm^2$$

(2)

where

F_c is the maximum load at fracture, in newtons;
1 600 = 40 mm x 40 mm is the area of the platens or auxiliary plates, in square millimetres.

Calculate the mean of the six results obtained from the test to the nearest 0,1 N / mm^2.

9.1.7 Test report

The information listed in Clause 8, items a) to j) shall be provided plus item k) 1: flexural and compressive strength.

Dimensions in millimetres

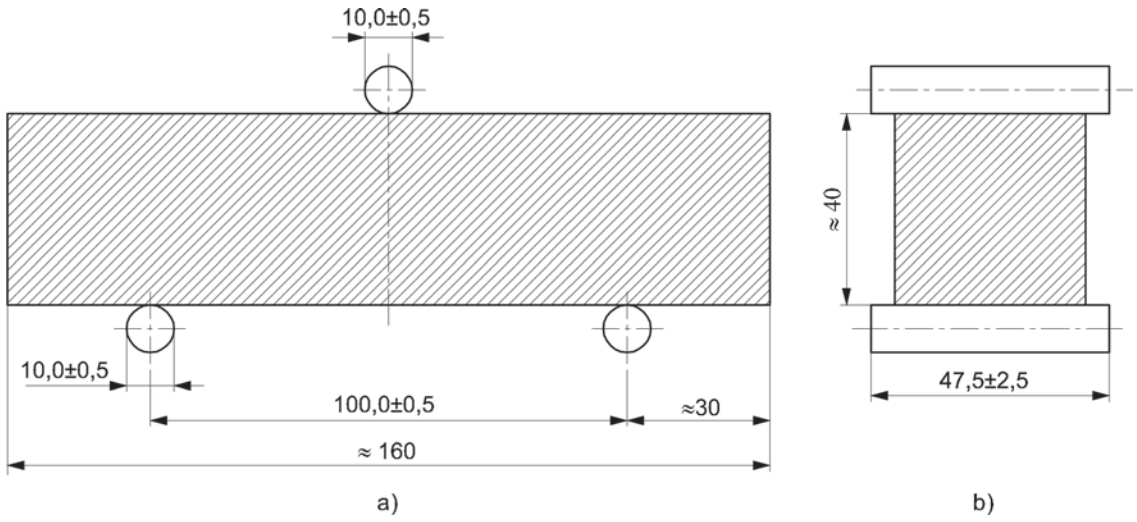
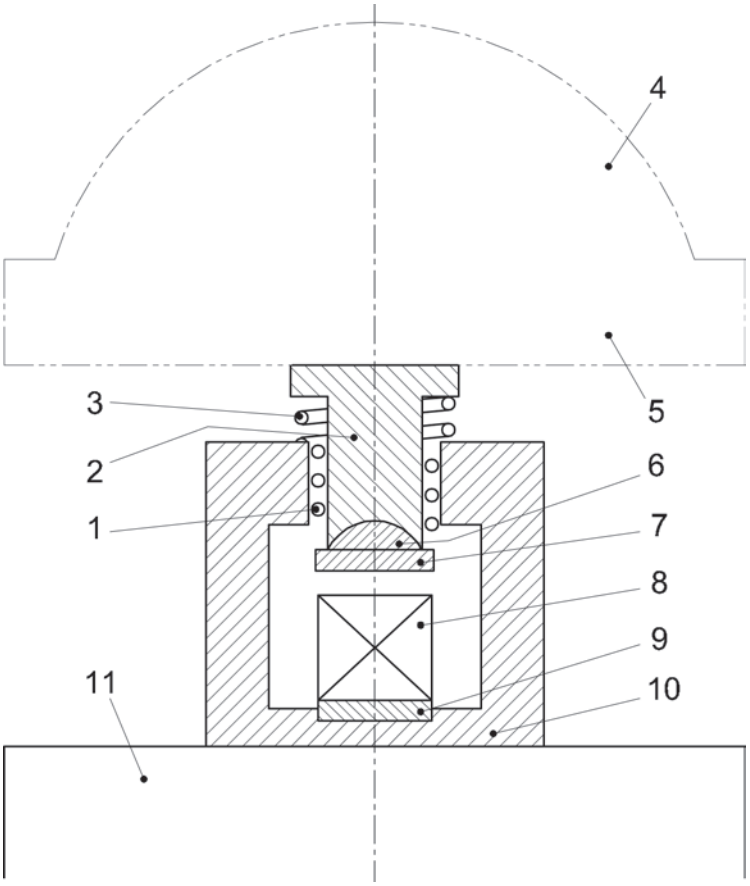


Figure 1 — Arrangement of loading for determination of flexural strength



Key

1 ball bearings
2 sliding assembly
3 return spring
4 spherical seating of machine
5 upper platen of machine
6 spherical seating of the jig
7 upper platen of the jig
8 specimen
9 lower plate
10 lower platen of the jig
11 lower platen of the machine

Figure 2 — Typical jig for compressive strength testing

9.2 Determination of water absorption

9.2.1 Apparatus

9.2.1.1 Three gang mould with ground surfaces, made of steel, used for the preparation of 40 mm x 40 mm x 160 mm prisms, in accordance with EN 196-1:2016, 4.5.

9.2.1.2 Jolting apparatus or jolting table used for the compaction of 40 mm x 40 mm x 160 mm grout specimen, in accordance with EN 196-1:2016, 4.6.

9.2.1.3 Tray with a flat base, large enough to contain three test specimens.

9.2.2 Preparation of test specimens

Insert a 1 mm thick, rigid, plastic (e.g. PTFE) or metal divider into each compartment of the mould, approximately in the middle, parallel to the ends.

Mould the specimens immediately after the preparation of the grout, with the mould firmly clamped to the jolting table.

Introduce, using a suitable scoop, the first of two layers of grout into each of the compartments, directly from the mixing bowl. Spread the layer uniformly, then compact using 60 jolts.

Introduce the second layer of grout, level and compact with a further 60 jolts.

Lift the mould gently from the jolting table, strike off excess of material and smooth the surface with a flat trowel. Wipe off the grout left on the perimeter of the mould. Cover the mould with a glass plate according to EN 196-1.

Place the mould, suitably identified, on a horizontal base in standard conditions, (23 ± 2) °C and (50 ± 5) % R.H.

After 24 h, carefully remove the specimen from the mould.

Keep the demoulded prisms for 27 d in standard conditions, leaving a clearance of at least 25 mm on all sides.

Prepare six specimens for each grout.

9.2.3 Test procedure

After 21 d from specimen preparation, seal the side faces by means of a neutral curing silicone sealant so as to be water impermeable.

After 28 d from specimen preparation, weigh, with 0,1 g precision, each test sample and then place them in the tray with the upper surface down, immersed in water 5 mm to 10 mm deep, taking care to prevent the prism faces from coming in contact with each other.

Maintain the water level constantly by adding water when necessary.

After 30 min, remove the test samples from water, quickly dry them by blotting with a dampened cloth and immediately weigh. Replace in the tray and repeat the procedure after 210 min.

9.2.4 Evaluation and expression of results

Calculate the water absorption, in grams, after 30 min and 240 min of each sample using the following formula:

$$W_{mt} = m_t - m_d \quad (3)$$

where

W_{mt} is the water absorption, in grams;
m_d is the mass of the dry specimen, in grams;
m_t is the mass of the specimen after immersion, in grams.

Determine the mean of the six values.

Discard the values falling outside the range of ± 20 % from the mean value.

If three or more than three values remain, determine the new mean value.

If less than three values remain, repeat the test.

9.2.5 Test report

The information listed in Clause 8, items a) to j) shall be provided plus item k) 2: water absorption.

9.3 Determination of shrinkage

9.3.1 Apparatus

9.3.1.1 Moulds, used to prepare prismatic specimens 40 mm x 40 mm x 160 mm (three-gang mould), with ground surfaces, made of steel, in accordance with EN 196-1. Holes for fitting suitable pins shall be drilled into the ends of the sides of the moulds corresponding to the ends of test specimen (see Figure 3).

Moulds provided with internal dimensions (10 ± 0,5) mm width, (40 ± 0,5) mm depth and (160 ± 1) mm length, to enable three specimens to be prepared simultaneously; either:

1) moulds with horizontal compartments 10 mm x 40 mm x 160 mm (see EN 196-1 in principle); or

2) moulds in accordance with EN 196-1 with horizontal compartments 40 mm × 40 mm × 160 mm and width reducing plastic or metal inserts (9.2.2), two for each mould.

9.3.1.2 Six smooth, rigid, non-absorbent frames (e.g. in polyethylene or PTFE) to be inserted, with dimensions of 40 mm x 160 mm and thickness of 15 mm.

9.3.1.3 Jolting apparatus or jolting table used for the compaction of 10 mm x 40 mm x 160 mm grout specimen; in accordance with EN 196-1.

9.3.1.4 Measuring apparatus that shall consist of a measurement attachment and a base with adjustment screws. The measurement attachment shall be formed either by an analogue or digital gauge, which reads accurately to 0,01 mm, rigidly mounted in a measuring frame (see Figures 4, 5 and 6).

9.3.1.5 Calibration rod or reference rod that shall be used as a standard length against which gauge readings can be tested. The rod shall be made of material having a negligible coefficient of expansion (e.g. Invar).

9.3.2 Preparation of test specimens

Insert two non-absorbent frames at the sides of each compartment of the mould, to reduce the width to 10 mm when using a 40 mm wide mould according to item 2 of 9.3.1.1 (see Figure 3). Apply a thin layer of release agent to the internal faces of the mould.

Mould the specimens immediately after the preparation of the grout, with the mould firmly clamped to the jolting table.

Introduce, using a suitable scoop, the first of two layers of grout into each of the compartments, directly from the mixing bowl. Spread the layer uniformly, then compact using 60 jolts.

Introduce the second layer of grout, level and compact with a further 60 jolts.

Lift the mould gently from the jolting table, strike off excess of material and smooth the surface with a flat trowel.

Wipe off the grout left on the perimeter of the mould. Cover with a glass plate according to EN 196-1.

Place the mould, suitably identified, on a horizontal base in standard conditions, (23 ± 2) °C and (50 ± 5) % R.H.

After 24 h remove carefully the specimen from the mould and determine with the measuring apparatus (9.3.1.4) the length of the specimen (initial reading).

Keep the demoulded prism in standard conditions leaving a clearance of at least 25 mm on all sides.

Prepare three specimens for each grout.

9.3.3 Test procedure

Take the reading of each specimen 27 d ± 12 h after the initial reading.

9.3.4 Evaluation of results

The linear shrinkage is evaluated in mm/m as the mean of three values based on the initial measurement.

9.3.5 Test report

The information listed in Clause 8, items a) to j) shall be provided plus item k) 3: shrinkage.

Dimensions in millimetres

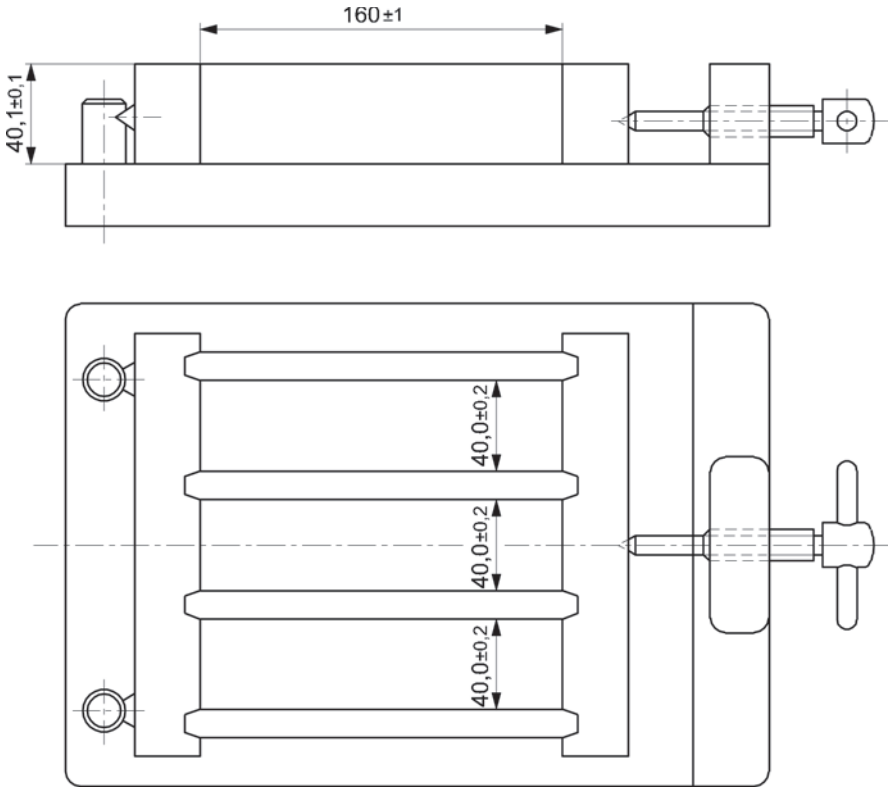
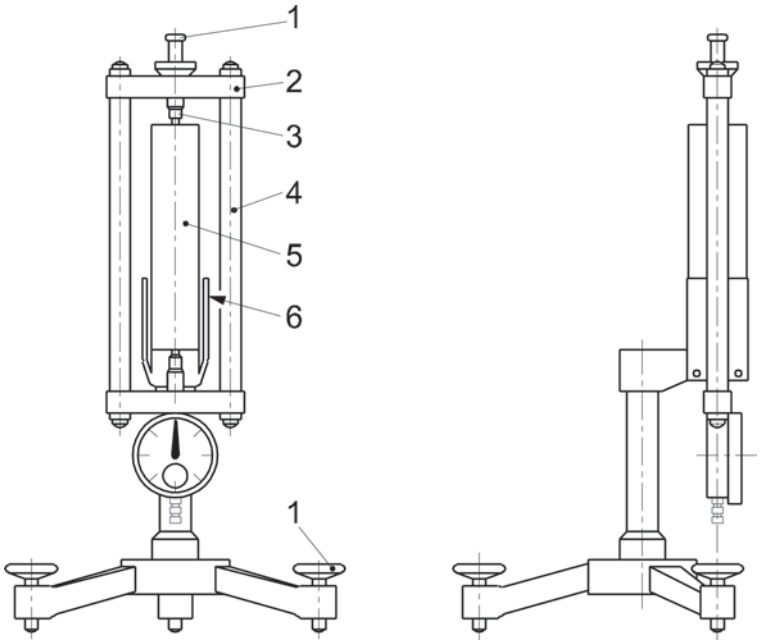


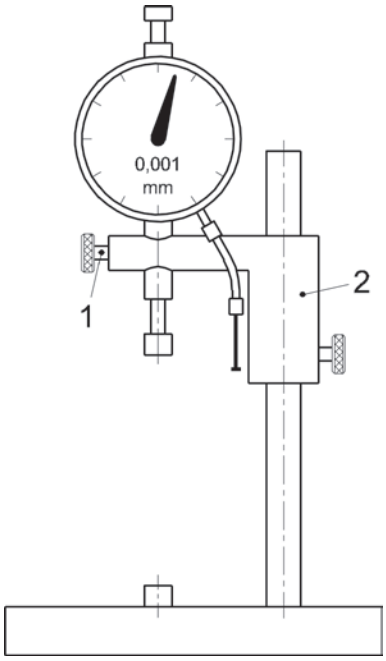
Figure 3 — Typical mould



Key

1 adjustment screw
2 frame
3 measurement stud
4 side rod
5 specimen
6 holder

Figure 4 — Measuring apparatus (type A)

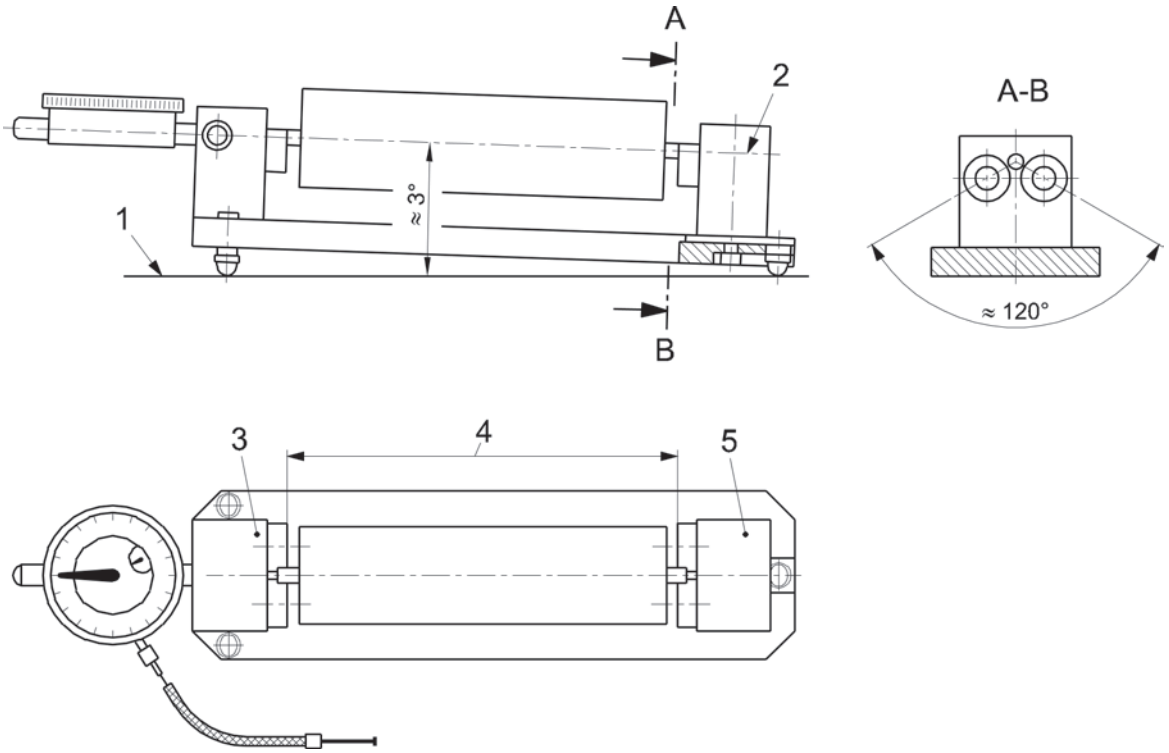


Key

1 stop device

2 holder

Figure 5 — Measuring apparatus (type B)



Key

1 horizontal
2 measuring axis
3 stand 1
4 measuring area (164 to 170) mm
5 stand 2

Figure 6 — Measuring apparatus (type C)

9.4 Determination of resistance to abrasion

9.4.1 Apparatus

9.4.1.1 Abrasion apparatus consisting essentially of a rotating disk, a storage hopper, a test specimen support and a counterweight in accordance with EN ISO 10545-6 (see Figure 7).

9.4.1.2 Abrasive material white fused aluminium oxide of grain size 80 (see EN ISO 10545-6).

9.4.1.3 Measuring gauge capable of measuring to 0,1 mm (see EN ISO 10545-6).

9.4.1.4 Template: a smooth, square, rigid, non-absorbent frame (e.g. in polyethylene or PTFE), with internal dimensions of (100 ± 1) mm x (100 ± 1) mm and thickness of (10 ± 1) mm.

9.4.2 Preparation of test specimens

Place the template over a polyethylene film.

Trowel a sufficient quantity of grout across the template and then screed clean so as to fill neatly and completely the hole in the template. Cover with a glass plate according to EN 196-1. After 24 h, remove the template carefully.

Condition the units according to the test requirements.

Prepare two specimens for each grout sample.

Condition the test units for 27 d in standard conditions: (23 ± 2) °C and (50 ± 5) % R.H.

9.4.3 Test procedure

Place a test specimen in the apparatus, with the trowelled face against the wheel, so that it is tangential against the rotating disc. Ensure that the feed of abrasive material into the grinding zone is uniform at a rate of (200 ± 10) g per 100 revolutions.

Rotate the steel disc for 50 revolutions.

Remove the specimen from the apparatus and measure the chord length of the groove by means of the measuring gauge to the nearest 0,5 mm.

Test each sample in at least two places on its trowelled surface.

9.4.4 Expression of results

The resistance to abrasion is expressed as the volume V of material removed, in cubic millimetres.

This is calculated from the chord length of the groove by means of the expression:

$$V = \left(\frac{\pi\alpha}{180} - \sin\alpha \right) \cdot \frac{h \cdot d^2}{8} \quad (4)$$

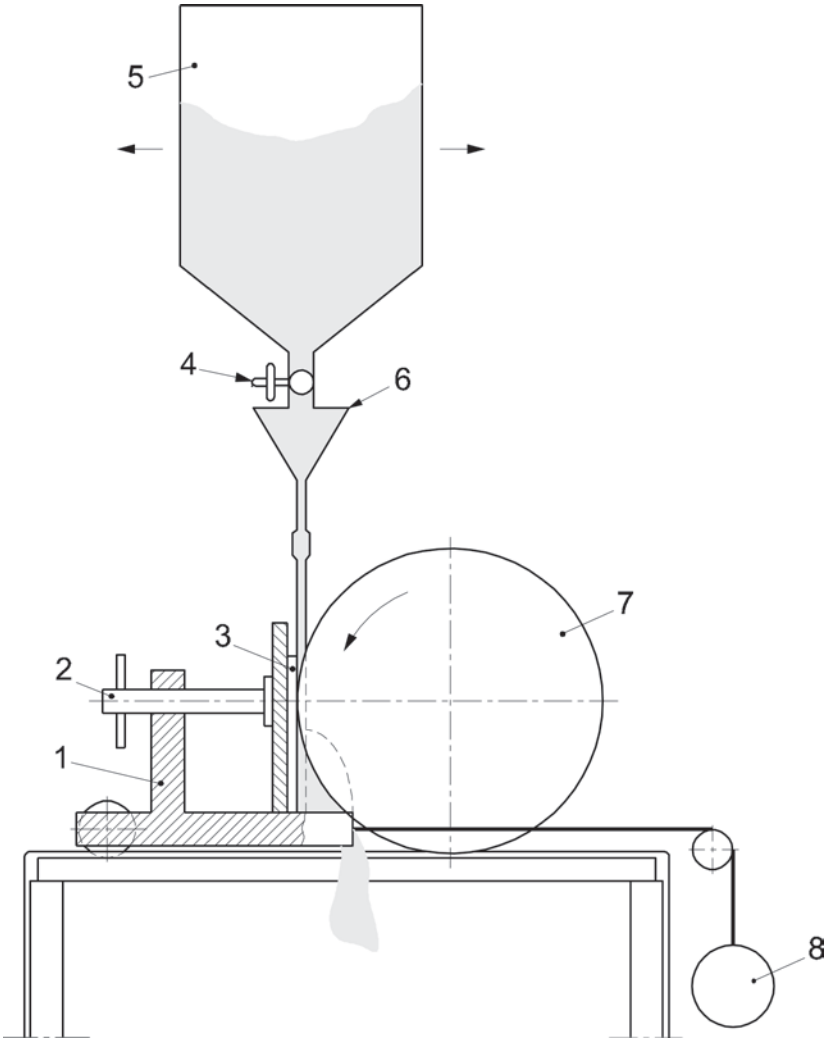
where

sin (α/ 2) = L / d;
d is the diameter of the rotating disc, in millimetres;
h is the thickness of the rotating disc, in millimetres;
α is the angle (in degrees) subtended at the centre of the rotating disc by the chord (see Figure 8);
L is the length of the chord, in millimetres.

Some equivalent values are given in Table 2.

9.4.5 Test report

The information listed in Clause 8, items a) to j) shall be provided plus item k) 4: resistance to abrasion.



Key

1 test specimen clamp
2 fixing screw
3 test specimen
4 valve
5 storage hopper for abrasive material
6 even-flow tunnel
7 steel disc
8 counterweight

Figure 7 — Abrasion apparatus

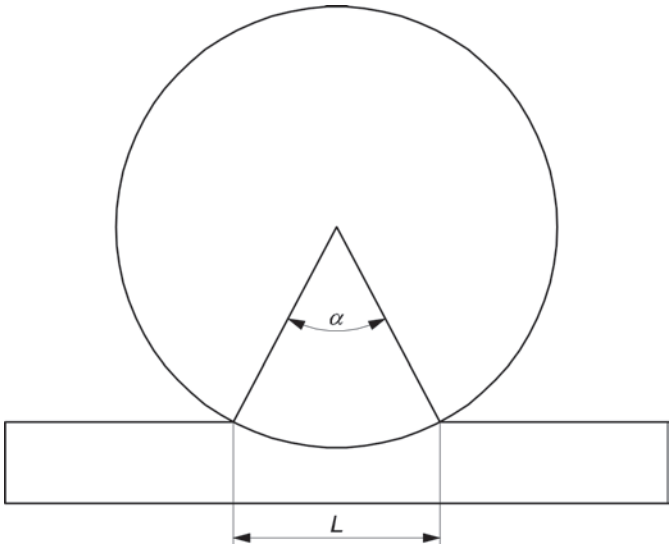


Figure 8 — Definition of chord

Table 2 — Equivalent values

L mm	**V** mm³	**L** mm	**V** mm³	**L** mm	**V** mm³	**L** mm	**V** mm³	**L** mm	**V** mm³
20,0	67	30,0	227	40,0	540	50,0	1 062	60,0	1 851
20,5	72	30,5	238	40,5	561	50,5	1 094	60,5	1 899
21,0	77	31,0	250	41,0	582	51,0	1 128	61,0	1 947
21,5	83	31,5	262	41,5	603	51,5	1 162	61,5	1 996
22,0	89	32,0	275	42,0	626	52,0	1 196	62,0	2 046
22,5	95	32,5	288	42,5	649	52,5	1 232	62,5	2 097
23,0	102	33,0	302	43,0	672	53,0	1 268	63,0	2 149
23,5	109	33,5	316	43,5	696	53,5	1 305	63,5	2 202
24,0	116	34,0	330	44,0	720	54,0	1 342	64,0	2 256
24,5	123	34,5	345	44,5	746	54,5	1 380	64,5	2 310
25,0	131	35,0	361	45,0	771	55,0	1 419	65,0	2 365
25,5	139	35,5	376	45,5	798	55,5	1 459	65,5	2 422
26,0	147	36,0	393	46,0	824	56,0	1 499	66,0	2 479
26,5	156	36,5	409	46,5	852	56,5	1 541	66,5	2 537
27,0	165	37,0	427	47,0	880	57,0	1 583	67,0	2 596
27,5	174	37,5	444	47,5	909	57,5	1 625	67,5	2 656
28,0	184	38,0	462	48,0	938	58,0	1 669	68,0	2 717
28,5	194	38,5	481	48,5	968	58,5	1 713	68,5	2 779
29,0	205	39,0	500	49,0	999	59,0	1 758	69,0	2 842
29,5	215	39,5	520	49,5	1 030	59,5	1 804	69,5	2 906

9.5 Determination of chemical resistance

9.5.1 Apparatus

9.5.1.1 Mould shall be a right cylinder (25 ± 1) mm in diameter by (25 ± 1) mm high. The mould shall be constructed in any manner that allows the formation of the desired test specimen.

Typical moulds consist of a (25 ± 1) mm thick flat plastic board in which (25 ± 1) mm diameter holes have been cut, and to the bottom of which a flat and smooth plastic sheet, at least 6 mm thick, without holes, which is attached by means of screws or any other suitable system. Alternatively, the moulds shall consist of sections of round plastic tubing or pipe, (25 ± 1) mm in inside diameter, and (25 ± 1) mm long, with sufficient wall thickness to be rigid and retain dimensional stability during the moulding operation, and a 6 mm thick flat plastic sheet on which one open end of each section shall be able to be rested.

NOTE The material from which the mould is constructed is chemically inert and has antistick properties. Polyethylene, polypropylene, polytetrafluoroethylene and metal forms having a sintered coating of tetrafluoroethylene polymer have been found satisfactory.

9.5.1.2 Containers

a) Wide mouth jars of sufficient capacity, fitted with plastic or plastic-lined metal screw caps for low temperatures tests involving media of low volatility.

b) Erlenmeyer flasks, of sufficient capacity, fitted with standard-taper-joints and a reflux condenser attachment for use with volatile media.

c) Containers, as described in a) and b), of a suitable inert material for use with media which attack glass.

9.5.1.3 Compression machine, a test machine with suitable capacity and sensitivity for the test and with a variable testing speed. The machine shall be capable of applying the compression load to the specimen through a suitable compression jig designed to provide self-alignment with specimen.

9.5.1.4 Chemical agent shall consist of the media to which the chemical resistant materials are to be exposed in service.

9.5.2 Test specimen

9.5.2.1 Number

The number of specimens required is dependent upon the number of test media to be employed, the number of different temperatures at which testing is performed and the frequency of test intervals. In any case, the test specimen shall consist of sets of a minimum of three cylinders for one medium, at a single temperature and for each test interval. In addition, one set of at least three specimens shall be available for test immediately following the conditioning period, and other sets of at least three, equivalent to the number of test temperatures, for the total test period. Calculate the total number of specimens required as follows:

$$N = n\left(M \cdot T \cdot I\right) + n \cdot T + n \tag{5}$$

where

N is the number of specimens;

n is the number of specimens for a single test;

M is the number of media;

T is the number of test temperatures;

I is the number of test intervals.

9.5.2.2 Dimension

The test units shall be cast right cylinders, (25 ± 1) mm in diameter by (25 ± 1) mm high, with flat smooth faces normal to the axis of the cylinder, prepared in moulds described in 9.5.1.1 and employing no release agent in the mould.

9.5.2.3 Preparation

Mix the components in the ratio specified by the manufacturer's instructions. Blend the parts using a suitable hand tool or machine mixer, ensuring that any ingredients are thoroughly and uniformly mixed.

Place the product in the mould with a spatula, taking care to ensure complete filling of the mould cavity without entrapment of air. Scrape off the excess material with a flat trowel, making the exposed surface as smooth and even as possible. Permit the material to remain in the mould until it has set sufficiently to allow removal without danger of deformation or breakage.

9.5.2.4 Conditioning

Condition the test units for 7 d in standard conditions. After the 7 d, proceed as described in 9.5 on one set of specimens.

9.5.3 Test procedure

Immediately following the conditioning period measure the diameter of all test specimens to the nearest 0,03 mm using a micrometer. Make two measurements at right angles to each other and record the diameter as the average of the two.

Following the diameter measurement weigh all the specimen to the nearest 0,001 g on an analytical balance and record the values. Prior to immersion record a brief description of the colour and surface appearance of the specimen and of colour and transparency of the test medium.

Place the weighed specimen, to be immersed, on their curved sides into the container (9.5.1.2) taking care to prevent the cylinder faces coming in contact with each other. The total number of specimens per container is only limited by the ability of the container to hold the specimen plus the required amount of test medium per specimen.

Add (100 ± 5) ml of the chemical agent for each specimen and place the closed container in a constant-temperature oven adjusted to the required temperature or in a suitably adjusted liquid bath simulating the actual service and exposure as closely as possible. Replace agents that are known to be unstable, as often as necessary, in order to maintain the original chemical composition and concentration, for the planned intervals.

Remove the specimen after 28 d of immersion to determine the chemical attack. If necessary, employ other exposure periods.

Clean the specimen with three quick rinses in cold running tap water and quick dry by blotting with a paper towel between each rinse. After the final blotting allow the specimen to dry for 30 min, resting on its curved surface, weigh to the nearest 0,001 g and measure the diameter of the test specimen as described in 9.1.

Note any indication of surface attack on the specimen, any discoloration of the test specimen and the formation of any sediment.

Determine the compressive strength for one set of specimens:

— immediately after the conditioning period;

— after the exposure period for each chemical agent and each temperature;

— after ageing in air for the total test period at each test temperature.

The elapsed time between the removal of the specimen from the test medium and the compressive test should be uniform for all specimens. Place each specimen in the testing machine with the plane faces of the cylinder in contact with the surface of the compression tool or cage. Apply the load to the specimen at a crosshead movement of (5,5 ± 0,5) mm/min when the machine is running without load. Break the specimen and record the maximum load.

9.5.4 Evaluation and expression of results

9.5.4.1 Mass change

Calculate to the nearest 0,01 % the percentage loss or gain in mass of the specimen during exposure for each examination period as follows:

$$\Delta W = \left[\left(W - C \right) / C \right] \cdot 100 \quad (6)$$

where

ΔW is the mass change, expressed in percentage;
W is the mass of the specimen after immersion, in grams;
C is the mass of the specimen after initial conditioning, in grams.

Determine the mean of the three values or more. A result showing a plus (+) sign shall indicate a gain in mass and a minus (-) sign shall indicate a loss.

9.5.4.2 Diameter change

Calculate to the nearest 0,01 % the percentage change of the diameter of the specimen during exposure for each examination period, taking the diameter after the 7 d conditioning as 100 %.

Change in diameter is given by:

$$\Delta D = \left[\left(D_2 - D_1 \right) / D_1 \right] \cdot 100 \quad (7)$$

where

ΔD is the diameter change, expressed in percentage;
D_2 is the diameter of the specimen after the exposure period, in millimetres;
D_1 is the diameter of the specimen after the initial conditioning, in millimetres.

Determine the mean of three values or more. A result showing a plus (+) sign shall indicate a gain in diameter and a minus (-) sign shall indicate a loss.

9.5.4.3 Change of compressive strength value

Calculate to the nearest 0,01 % the percentage decrease or increase of compressive strength of the specimen during exposure for each examination period, taking the compressive strength after the 7 d conditioning period in standard conditions as 100 %. Calculate the cross-sectional area of the specimen on the diameter value as determined in 9.1.

Change in compressive strength is given by:

$$\Delta S = \left[\left(S_2 - S_1 \right) / S_1 \right] \cdot 100 \quad (8)$$

where

ΔS is the change in compressive strength, in percentage;

S_1 is the load calculated per cross-sectional area of specimen after the conditioning period, in megapascals;

S_2 is the load calculated per cross-sectional area of specimen after the exposure period, in megapascals.

A result showing a plus (+) sign shall indicate a gain in compressive strength and a minus (-) sign shall indicate a loss.

9.5.5 Test report

The test report shall provide the following information:

a) number, title and issue of this document;

b) place, date and time of sampling;

c) type of grout or adhesive, commercial designation and manufacturer name;

d) identification of test sample;

e) handling and storage of samples before testing;

f) exposure conditions to the chemical agent, frequency of change of chemical agent, temperature, etc.;

g) date of test;

h) colour and surface appearance of test units before testing;

i) total duration of the test and the exposure periods, in days. For each exposure period the following data are required:

   — average percentage of diameter change of specimen;

   — average percentage of mass change of specimen;

   — appearance of specimen after immersion (surface cracks, loss of gloss, etching, pitting, softening, etc.);

   — appearance of the test chemical agent (discoloration, sediment, etc.);

   — average percent change in the compressive strength of specimen;

j) any other factor which could have influenced the result.

Bibliography

[1] EN 197-1, *Cement - Part 1: Composition, specifications and conformity criteria for common cements*

[2] EN 459-2, *Building lime - Part 2: Test methods*

[3] EN 12004-1, *Adhesives for ceramic tiles - Part 1: Requirements, assessment and verification of constancy of performance, classification and marking*

[4] EN 14411, *Ceramic tiles - Definition, classification, characteristics, assessment and verification of constancy of performance and marking*

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