BS ISO 13007-2:2010

BSI Standards Publication

Ceramic tiles — Grouts and adhesives

Part 2: Test methods for adhesives

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National foreword

This British Standard is the UK implementation of ISO 13007-2:2010.

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

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Ceramic tiles — Grouts and adhesives —

Part 2: Test methods for adhesives

Carreaux céramiques — Mortiers de joints et colles —

Partie 2: Méthodes d'essai pour les colles

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

ISO 13007-2 was prepared by Technical Committee ISO/TC 189, *Ceramic tiles*.

This second edition cancels and replaces the first edition (ISO 13007-2:2005), which has been technically revised. It also incorporates the Technical Corrigendum ISO 13007-2:2005/Cor.1:2007.

ISO 13007 consists of the following parts, under the general title *Ceramic tiles — Grouts and adhesives*:

— *Part 1: Terms, definitions and specifications for adhesives*

— *Part 2: Test methods for adhesives*

— *Part 3: Terms, definitions and specifications for grouts*

— *Part 4: Test methods for grouts*

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Ceramic tiles — Grouts and adhesives —

Part 2:
Test methods for adhesives

1 Scope

This part of ISO 13007 describes methods for determining characteristics for adhesives used in the installation of ceramic tiles. The test methods described are the following:

a) determination of open time;

b) determination of slip;

c) determination of shear adhesion strength;

d) determination of tensile adhesion strength;

e) determination of transverse deformation;

f) determination of chemical resistance.

2 Normative references

The following referenced documents are indispensable for the application of this part of ISO 13007. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 13006, *Ceramic tiles — Definitions, classification, characteristics and marking*

ISO 13007-1, *Ceramic tiles — Grouts and adhesives — Part 1: Terms, definitions and specifications for adhesives*

3 General test conditions and procedures

3.1 Sampling

A representative sample of at least 2 kg shall be used.

3.2 Test conditions

Standard test 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. Other test conditions may be specified in Clause 4. The tolerance in the time of conditioning for all test specimens shall be as shown in Table 1.

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Table 1 — Allowable tolerance window for testing time

Sample conditioning time[a]	Allowed tolerance for testing[b]
24 h	±0,5 h
7 days	±3 h
14 days	±6 h
21 days	±9 h
28 days	±12 h

[a] Testing shall be performed within the specified time window.

[b] Allowed tolerance in testing time for all samples requiring conditioning.

3.3 Test materials

Condition all test materials, including water for at least 24 h under standard conditions. The adhesive under test shall be within its shelf life, if this is specified.

3.3.1 Ceramic tiles

The tiles shall be checked prior to conditioning to ensure that they are unused, clean and dry. The type of tile shall be as specified under the specific test procedures given in Clause 4.

3.4 Mixing procedures

3.4.1 Cementitious adhesives — C

The amount of water and liquid admix, or one or the other, required for preparing the adhesive shall be as stated by the manufacturer in mass fraction, i.e. liquid to dry powder (in the case where a range of values is given, the average shall be used).

Using a minimum quantity of 2 kg of the powder and the recommended quantity of liquid, prepare the adhesive in a mixer of the planetary type using the slow speed settings (140 ± 5) r/min and (62 ± 5) r/min planetary movement (see Figures 1 and 2).

Carry out the following procedure:

a) pour the liquid into the pan;

b) scatter the dry powder over the liquid;

c) mix for 30 s;

d) take out the mixing paddle;

e) scrape down the paddle and pan within 1 min;

f) replace the paddle and mix for 1 min.

If required by the adhesive manufacturer's instructions, let the adhesive mature as specified and then mix for an additional 15 s.

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3.4.2 Dispersion adhesive — D, Reaction resin adhesive — R

If ready-to-use dispersion adhesives or reaction resin adhesives are used, the manufacturer's instructions shall be followed.

3.5 Test substrate

3.5.1 Concrete test substrate

The mandatory concrete test substrate shall be (40 ± 5) mm thick, have a moisture content of less than 3 % mass fraction and have a water absorption at the surface after 4 h of testing in range of 0,5 cm^3 to 1,5 cm^3. The cohesive strength, as referenced in A.4.3, shall be at least 1,5 N/mm^2. A method of manufacturing a suitable concrete test slab and the procedures for measuring the cohesive strength and surface water absorption is given in Annex A.

3.5.2 Other substrates

Other substrates may be used upon agreement, if the substrate is recommended for ceramic tile application by the adhesive manufacturer. To demonstrate compatibility with other optional substrates, the adhesive shall be applied to the selected substrate in accordance with the open time test method (4.1). When the result of $\geqslant$ 0,5 N/mm^2 is achieved or cohesive failure occurs in the substrate, the requirement is considered satisfied.

3.6 Failure patterns

3.6.1 Adhesion failure — AF-S or AF-T

Failure occurs at the interface between adhesive and substrate (AF-S) or between tile and adhesive (AF-T). The test value equals the adhesive strength [see Figure 3 a) and b)]. In some cases, failure can occur in the adhesive layer between the tile and the pull-head plate (BF) [see Figure 3 c)]. In this case, the adhesive strength is greater than the test value, and the test should be repeated.

3.6.2 Cohesive failure within the adhesive — CF-A

Failure occurs within the adhesive layer [see Figure 3 d)].

3.6.3 Cohesive failure in the substrate or in the tile — CF-S or CF-T

The failure occurs within the substrate (CF-S) [see Figure 3 e)] or within the body of the tile (CF-T) [see Figure 3 f)]. In this case, the strength of the adhesive is greater than the test value.

The modes of failure may be a combination of any of the above. An approximate percentage of each shall be recorded.

3.7 Test report

3.7.1 General

The test report shall specify the following:

a) reference to this part of ISO 13007, i.e. ISO 13007-2:2010;

b) date of test;

c) type of adhesive, commercial designation and manufacturer's name;

d) source, date obtained and complete identification of test sample;

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e) handling and storage of samples before testing;

f) test conditions;

g) amount of water or liquid used for preparing adhesive;

h) any other factor that could have affected the result;

i) test results (individual and mean values and mode of failure, if required).

3.7.2 Test results of cementitious and dispersion adhesives

The test report shall specify the following:

a) open time;

b) slip;

c) shear adhesion strength;

d) adhesion strength;

e) deformation.

3.7.3 Test results of chemical resistance

The test report shall specify the following:

a) test conditions;

b) change in colour and surface appearance during the test;

c) total duration of the test and the exposure periods.

4 Test methods

4.1 Determination of open time

4.1.1 General

Open time shall be tested following the general test conditions and procedures given in Clause 3 and the following specific instructions.

4.1.2 Test materials

4.1.2.1 **Ceramic tiles**, Group BIII, belonging to porous body tile, complying with ISO 13006 of water absorption (15 ± 3) % mass fraction, cut to facial dimensions of (50 ± 1) mm × (50 ± 1) mm, with a thickness in the range of 7 mm to 10 mm and a profile back pattern less than 0,25 mm deep.

4.1.2.2 **Test substrate**, made of concrete, conforming to the requirements given in 3.5.1.

4.1.3 Apparatus

4.1.3.1 **Test mass**, of less than 50 mm × 50 mm cross-sectional area, capable of exerting a uniform force of (20 ± 0,05) N.

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4.1.3.2 **Pull-head plates**, consisting of square metallic plates, with dimensions of (50 ± 1) mm and a minimum thickness of 10 mm with a suitable fitting for connection to the test machine.

4.1.3.3 **Test machine**, for direct pull tensile force test and with suitable capacity and sensitivity for the test. The machine shall be capable of applying the load to the pull-head plate at the rate of (250 ± 50) N/s through a suitable fitting that does not exert any bending force.

4.1.4 Procedure

Apply a thin layer of the adhesive, mixed in accordance with 3.4.1, to the concrete slab with a straight edge trowel. Then apply a thicker layer and comb with a notched trowel having 6 mm × 6 mm notches at 12 mm centres. The trowel shall be held at an angle of approximately 60° to the substrate at a right angle to one edge of the slab and drawn across the slab parallel to that edge (in a straight line).

After 5 min, 10 min, 20 min, 30 min or more, place at least 10 test tiles 50 mm apart, on the adhesive within 30 s: place tiles on no more than 4 ribs for all adhesives. Load each tile with (20 ± 0,05) N for 30 s.

After 27 days of storage under standard conditions, bond the pull-head plates to the tiles with a suitable high strength adhesive (e.g. epoxy adhesive).

After a further 24 h storage under standard conditions, determine the tensile adhesion strength of the adhesive by applying a force increasing at a constant rate of (250 ± 50) N/s.

4.1.5 Evaluation and expression of results

The individual tensile adhesion strengths are quoted to 0,1 N/mm^2 using Equation (1):

$$S_a = \frac{F}{A} \tag{1}$$

where

S_a is the individual tensile adhesion strength, in newtons per square millimetre;

F is the total tensile load, in newtons;

A is the bonding area, in square millimetres (2 500 mm^2).

The tensile adhesion strength for each time interval is determined as follows:

a) determine the mean of the 10 values;

b) discard the values falling out of the range of ±20 % of the mean value;

c) if five or more values remain, determine the new mean;

d) if less than five values remain, repeat the test;

e) determine the mode of failure of the test units (see 3.6).

The open time, in minutes, is the maximum time interval at which the adhesive meets the tensile adhesion strength requirement defined in ISO 13007-1 for open time.

4.1.6 Test report

The information listed in 3.7.1, list items a) to i), shall be provided plus 3.7.2, list item a) (open time in minutes).

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4.2 Determination of slip

4.2.1 General

Slip shall be tested following the general test conditions and procedures given in Clause 3 and the following specific instructions.

4.2.2 Test materials

4.2.2.1 **Ceramic tiles**, belonging to Group BI_a, fully vitrified in accordance with ISO 13006 with a water absorption $\leqslant$ 0,5 % mass fraction, unglazed, with plain adhering surface and with facial dimensions of (100 ± 1) mm × (100 ± 1) mm and mass of (200 ± 10) g and a thickness in the range of 8 mm to 10 mm.

4.2.2.2 **Concrete test substrate**, conforming to requirements given in 3.5.

4.2.3 Apparatus

4.2.3.1 **Steel straight edge**.

4.2.3.2 **Clamps**.

4.2.3.3 **Masking tape**, 25 mm wide.

4.2.3.4 **Spacers**, two (25 ± 0,5) mm × (25 ± 0,5) mm × (10 ± 0,5) mm thick spacers made from stainless steel.

4.2.3.5 **Mass**, capable of exerting a force of (50 ± 0,1) N with a cross-sectional area of less than (100 ± 1) mm × (100 ± 1) mm.

4.2.3.6 **Vernier calliper**, accurate to 0,01 mm.

4.2.4 Procedure

Secure the steel straight edge at the top of the concrete substrate such that its bottom edge is horizontal when the slab is raised to its vertical position. Position 25 mm-wide masking tape immediately below the steel straight edge and apply a thin layer of the adhesive to the concrete slab with a straight-edge trowel.

Apply a thicker layer of adhesive to the surface of the concrete substrate such that it just overlaps the bottom edge of the masking tape. Comb the adhesive at right angles to the straight edge with a notched trowel having 6 mm × 6 mm notches at 12 mm centres.

Hold trowel at an angle of 60° to the substrate and parallel to the straight edge.

Immediately remove the masking tape, position 25 mm spacers (or the spacing bar) as shown against the straight edge and after 2 min place a type BI_a tile against the spacers, as shown in Figure 4, and load with a mass of (50 ± 0,1) N for (30 ± 5) s.

Remove the spacers and measure the gap between the straight edge and the tile with the Vernier caliper to within ±0,1 mm. Immediately and carefully lift the slab into a vertical position. After (20 ± 2) min re-measure the gap, as before, at its maximum point. The maximum slip of the tile under its own mass is the difference between the two readings.

Carry out the test for each of three tiles, for each adhesive. Report the results in millimetres and the mean value.

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4.2.5 Test report

The information listed in 3.7.1, list items a) to i), shall be provided plus 3.7.2, list item b): slip in mm (individual and mean values).

4.3 Determination of shear adhesion strength — D, R

4.3.1 General

Shear adhesion strength shall be tested following the general test conditions and procedures given in Clause 3 and the following specific instructions.

4.3.2 Test materials and apparatus

4.3.2.1 **Ceramic tiles**, of the following specification.

a) Dispersion adhesives (D) — Group BIII, glazed porous body tiles in accordance with ISO 13006; with water absorption (15 ± 3) % mass fraction, with facial dimensions of (108 ± 1) mm × (108 ± 1) mm and a thickness in the range of 7 mm to 10 mm and a profile back pattern less than 0,25 mm thick.

b) Reaction resin adhesives (R) — Group BI_a, fully vitrified tiles in accordance with ISO 13006; with water absorption ⩽ 0,2 % mass fraction, unglazed with plane adhering surface and with facial dimensions of (100 ± 1) mm × (100 ± 1) mm.

4.3.2.2 **Template**, comprising a smooth non-absorbent frame (e.g. polytetrafluoroethylene), in accordance with Figure 5 for D adhesives and Figure 7 for R adhesives.

4.3.2.3 **Spacers**, of 0,8 mm in diameter, and approximately 40 mm long.

4.3.2.4 **Mass**, of less than 100 mm × 100 mm cross-sectional area, capable of exerting a uniform force of (70 ± 0,15) N.

4.3.2.5 **Test machine**, with suitable capacity and sensitivity for the test and with a variable testing speed. The machine shall be capable of applying the load to the tile through a suitable jig.

4.3.2.6 **Shear test jig**, suitable for use to transfer into shear from the compression or tensile load exerted by the testing machine. Examples of suitable jigs are shown in Figures 9 and 10.

4.3.2.7 **Air circulating oven**, capable of controlling the temperature to within ±3 °C.

4.3.3 Procedure

Each test unit shall be prepared with two Group BIII tiles for D adhesives or Group BI_a tiles for R adhesives.

Draw a straight line on the adhering side of one tile 6 mm from the tile edge (to serve as a guide for overlapping the tile as explained as follows).

Place the template (see Figures 5 and 7) over the unglazed back of the first test tile. Trowel sufficient adhesive across the template and then screed it clean such as to neatly and completely fill the holes in the template. Carefully remove the template vertically (see Figures 6 and 8).

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Place spacer rods at each corner of the first tile, approximately 20 mm over the tile. After 2 min, place a second standard test tile over the coated tile, offset to provide an overlap between tiles with displacement of 6 mm, using the previously scribed line as a guide and ensuring that the edges of the tiles are parallel (see Figure 6 for D adhesives and Figure 8 for R adhesives).

Place the test units on a plane surface and carefully load with (70 ± 0,15) N for 3 min. After removing the mass, carefully remove the spacer rods, without disturbing the relative position of the tiles in the test units. A total of 10 test units is required per conditioning.

4.3.4 Adhesion strength — D, R

4.3.1.1 Condition 10 test units in standard test conditions (see 3.2); 7 days for R adhesives or 14 days for D adhesives.

4.3.1.2 After conditioning has been completed, place the test units in a shear test jig and apply a shear force by moving the crosshead at a speed of (5 ± 0,5) mm/min until failure occurs. Report the results in newtons.

4.3.5 Adhesion strength after water immersion — D, R

Condition 10 test units in standard conditions (see 3.2) for 21 days for adhesives (D2) or 7 days for accelerated drying adhesives (D2A) and reaction resin adhesives (R). Then immerse in water at (23 ± 2) °C 21 days for reaction resin adhesives or 7 days for dispersion adhesives (D2; D2A). Remove the units and wipe with a cloth. Test them as described in 4.4.4.2.

Report the results in newtons.

NOTE This test is only for those dispersion adhesives used in internal installations subject to wet conditions.

4.3.6 Adhesion strength after heat ageing — D

Condition 10 test units in standard conditions (see 3.2) for 14 days and then place them in an air-circulating oven at (70 ± 2) °C for a further 14 days, ensuring that air is free to circulate around each test unit.

Condition the units for a further 24 h in standard conditions and test them as described in 4.3.4.

Report the results in newtons.

4.3.7 Adhesion strength at elevated temperature — D

Use the procedure described in 4.3.6, but test the tile adhesion 1 min after removal of test unit from air circulating oven.

Report the results in newtons.

4.3.8 Adhesion strength after thermal shock — R

After conditioning 10 test units in standard conditions for 7 days, place the test pieces in a water bath maintained at (23 ± 2) °C for 30 min and then in a (100 ± 2) °C water bath for a further 30 min.

Repeat the cycle for a total of four times and then place the test pieces in the (23 ± 2) °C bath for approximately 30 min for cooling.

Remove each test piece from the water, wipe off the excess water and test as described in 4.3.4.

Report the results in newtons.

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