

**Tile adhesive for marble, granite, ceramic
and porcelain — Cement based —
Specification**

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**Tile adhesive for marble, granite, ceramic
and porcelain — Cement based —
Specification**

Public Review Draft

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Foreword

This Kenya standard was prepared by the Cement Technical Committee under the guidance of the Civil Engineering Industry Standards Committee and it is in accordance with the procedures of the Kenya Bureau of Standards.

This standard on tile adhesive complements already existing standards on cement and was found necessary following technological development on cement based tile adhesive.

Tile adhesive has wide application as it can be used to fix tiles on any surface including glass. The product is flexible and does not shrink or crack due to physical, thermal and moisture movement or temperature changes. Above all, it prevents crazing and shedding of tiles. It is recommended to use tile grout to fill tile joints once tile adhesive has been used to fix tiles to prevent seeping of water underneath the tiles.

In the preparation of this Standard, reference was made to the following sources:

Athi River Mining Ltd.

KS 1530, Adhesives for use with ceramic tiles — specification.

KS EA 18 – 1, Cement — specification.

BS EN 12004:2001, Adhesive for tiles — Definitions and specifications.

Acknowledgement is hereby made for the assistance derived from these sources.

Compliance with a Kenya Standard does not of itself confer immunity from legal obligations.

Warning:

This draft Kenya standard should not be used as a Kenya standard until it has undergone all the required standards development procedures.

Tile adhesive for marble, granite, ceramic and porcelain — Cement based — Specification

1 Scope

This Kenya Standard specifies performance requirements and test methods for cement based adhesive compounds which produce tough and high performance bonding on marble, granite, cement and porcelain tiles.

2 Normative references

The following referenced documents are indispensable in the application of this standard

KS EAS 18 -1, *Cement — Specification*

KS EAS 148-1, *Testing of cements – Pt 1: Physical methods*

KS 1530, *Adhesives for use with ceramic tiles — Specifications*

KS 1738-1, *Specification for ceramic floor and wall tiles – Part 1: Definitions, classification, characteristics and marking*

KS 2167-1, *Adhesives and grouts for tiles - Testing method – Pt 1: Determination of transverse deformation for cementitious adhesives and grouts.*

KS 2167-7, *Adhesives and grouts for tiles - Testing method – Pt 7: — Concrete slabs for testing*

KS 2167-8, *Adhesives and grouts for tiles - Testing method – Pt 8: — Determination of slip for adhesives*

KS 2167-9, *Adhesives and grouts for tiles - Testing method – Pt 9: — Determination of shear adhesion strength of dispersion adhesives*

KS 2167-10, *Adhesives and grouts for tiles - Testing method – Pt 10: — Determination of wetting capability for adhesives*

KS 2167-11, *Adhesives and grouts for tiles - Testing method – Pt 11: — Determination of tensile adhesion strength for cementitious adhesives*

KS 2167-12, *Adhesives and grouts for tiles - Testing method – Pt 12: — Determination of shear adhesion strength of reaction resin adhesives*

ISO 9001, *Quality Management Systems*

3 Terms and definitions

For the purposes of this standard the following definitions shall apply.

3.1

tile adhesive

an inorganic Portland cement polymer material modified with aggregate particles and chemicals in the interfacial zone capable of fastening two other materials together by means of surface attachment

3.2

cement

as defined in KS EAS 18 -1:2001, cement is a hydraulic binder, i.e. a finely ground inorganic material which, when mixed with water, forms a paste which sets and hardens by means of hydration reactions and processes and which, after hardening, retains its strength and stability even under water.

Building material made by grinding calcined limestone and clay to fine powder, which can be mixed with water and poured to set as a solid mass or used as an ingredient in making mortar or concrete

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3.3

marble

a natural stone product quarried from the earth. It gets a distinctive shine from the polishing process it goes through. Available in multiple finishes and a wide variety of colours

3.4

granite

a natural stone denser than marble. Granite is molten lava that never rose above the surface of the earth. It is extremely durable and holds a polish. Available in polished, honed or flamed (rough) surfaces

3.5

porcelain

a hard, white, translucent ceramic made by firing a pure clay and then glazing it with variously colored fusible materials

3.6

ceramic

refers to the range of materials created by firing clay at a high temperature. In the context of mosaics, this would include traditional ceramic tiles, pottery, and terracotta. Unglazed ceramic tends to be porous and brittle, but *cinca* (a high-fired unglazed porcelain) is very hardwearing and water resistant. Technically, brick is also a ceramic material.

3.7

tile

a thin, flat or convex slab of marble, granite or porcelain material, laid in rows to cover walls, floors, and roofs.

3.7.1

glazed tile

a tile that has an impervious facial finish composed of glassy ceramic materials fused to the surface of the tile.

3.7.2

unglazed tile

a hard, dense tile of uniform composition. No glaze

3.7.3

field tile

the primary tile used to cover a wall or floor

3.7.4

wall and floor tiles

tiles made out of ceramic (see KS 1738-1) or natural and agglomerated stones

3.7.5

floor tile

a ceramic tile or natural stone tile durable enough to withstand traffic, abrasion

3.7.6

wall tile

glazed tile with a body suitable for interior use. Not expected to withstand excessive impact or be subject to freezing/thawing conditions.

3.8**listel or listello**

a decorative border, primarily for walls

3.9**monocottura**

method of producing tile by a single firing in which body and glazes are fired in kilns at temperatures over 2000 degrees

3.10**mosaics**

ceramic, porcelain, glass, metal or stone tile less than six square inches. May come in squares, octagons, hexagons or random shapes mounted for ease of installation

3.11**notched trowel**

a small hand tool with a handle and flat plate, used for scooping and spreading tile adhesive



Figure 1: Notched trowel

3.12**thin bed method**

method used for installing tiles onto a plane surface with an adhesive. The adhesive is usually applied with a trowel to obtain a layer and then combed with a notched trowel to achieve the right thickness and planarity.

3.13**fixing surface**

plane rigid surface upon which the tile is fixed

3.14**cementitious adhesive (CG)**

mixture of hydraulic binding agents, aggregates, and organic additives, which is mixed with water or liquid admix just before use

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3.15

tools and working methods

3.15.1

notched trowel

toothed tool, which makes it possible to apply the adhesive as a series of ribs of a uniform thickness onto the fixing surface and/or the reverse face of the tile

3.15.2

application to one surface only, “notched trowel” or “floating” method

adhesive applied only to the fixing surface, usually with a trowel to obtain a uniform layer and then combed with a notched trowel (see 3.18.1). The tiles are then fixed before a film forms on the surface of the adhesive

3.15.3

application to both surfaces , “floating and buttering” method

adhesive applied to the fixing surface and to the reverse of the tiles. The combined layer of adhesive does not exceed the maximum recommended thickness. The tiles are then fixed before a film forms on the surface of the adhesive.

3.16

Application properties

3.16.1

shelf life

time of storage under stated conditions during which an adhesive may be expected to maintain its working properties

3.16.2

maturing time

interval between the time when the cementitious adhesive is mixed and the time when it is ready for use

3.16.3

pot-life

maximum time interval during which the adhesive can be used after mixing

3.16.4

open time

maximum interval after application at which tiles can be embedded in the applied adhesive and meet the specified tensile adhesion strength requirement, which is measured following

3.16.5

wetting capability

ability of a combed adhesive layer to wet the tile, which is measured following KS 2167-10

3.16.6

slip

downward movement of a tile applied to a combed adhesive layer on a vertical or inclined surface, which is measured following KS 2167-8

3.16.7

adjustability

maximum time interval after which the tile’s position in the adhesive layer can be adjusted without significant loss of adhesion strength

3.17**final properties****3.17.1****adhesion strength**

maximum strength per unit surface area which can be measured by shear or tensile testing. It is measured following KS 2167-11, KS 2167-9 or KS 2167-12 depending on the type of adhesive

3.17.2**deformability**

capacity of a hardened adhesive to be deformed by stresses between the tile and the fixing surface without damage to the installed surface

3.17.3**transverse deformation**

deflection recorded at the centre when a beam of hardened adhesive is subjected to three point loading, used to evaluate the deformability of the adhesive It is measured following KS 2167-1.

3.18**failure pattern****3.18.1****adhesion failure (AF-S or AF-T)**

when failure occurs at the interface between adhesive and substrate (concrete slab) the notation AF-S is used; when it occurs between tile and adhesive the notation AF-T is used and in both cases the test values equal the adhesion strength – (see Figure B.1 and Figure B.2 in annex B). In some cases failure may occur in the adhesive layer between the tile and the pull-head plate. In this case the notation BT is used, (see Figure B.3), and the adhesion strength is greater than the test value. The test should preferably be repeated.

3.18.2**cohesive failure within the adhesive (CF-A)**

when failure occurs within the adhesive layer, see Figure B.4

3.18.3**cohesive failure in the substrate or in the tile (CF-S or CF-T)**

when failure occurs within the substrate the notation CF-S is used (see Figure B.5); when it happens within the body of the tile the notation CF-T is used (see Figure B.6). In this case the strength of the adhesive is greater than the test value.

3.19**fundamental characteristics**

characteristics that an adhesive must absolutely have

3.20**optional characteristics****3.20.1****additional characteristics**

characteristics for specific service conditions where enhanced levels of performance are required

3.20.2**special characteristics**

characteristics of the adhesive which provide further information about its general performance

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4 Designation/Classification

Tile adhesive shall be classified into two different types/ formulations in accordance with intended application as specified in Table 1. Normal setting and fast setting adhesives.

5 General requirements

5.1 Application

Tile adhesive shall be capable of application by a notched trowel and shall contain no lumps or foreign matter.

NOTE The tiles need not be wetted prior to the application of the adhesive.

5.2 Storage/stability

Tile Adhesive shall be stored in a cool and moisture free atmosphere In accordance with the manufacturer's instructions.

5.3 Requirements

5.3.1 The adhesives, both normal setting and fast setting, shall comply with the requirements specified in Table 1.

5.3.2 The optional characteristics are for special service conditions.

5.3.3 For the characteristics of wetting capability (measured in accordance with KS 2167-10) and transverse deformation (measured in accordance with KS 2167-1) there are no limit values, but it is left to the producer to declare the values to provide further information.

5.3.4 The amount of water and/or liquid admix required for preparing the cementitious adhesive shall be the same for all tests.

Table 1 — Requirements for cementitious adhesives

FUNDAMENTAL CHARACTERISTICS		
Characteristics for normal setting adhesives		
Characteristic	Requirement	Test Method
Initial tensile adhesion strength	$\geq 0.5 \text{ N/mm}^2$	KS 2167-11
Tensile adhesion strength after water immersion	$\geq 0.5 \text{ N/mm}^2$	
Tensile adhesion strength after heat ageing	$\geq 0.5 \text{ N/mm}^2$	
Tensile adhesion strength after freeze thaw cycles	$\geq 0.5 \text{ N/mm}^2$	
Open time: tensile adhesion strength	$\geq 0.5 \text{ N/mm}^2$ after not less than 20 min	Annex A
Characteristics for fast setting adhesives		
Characteristic	Requirement	Test Method
Early tensile adhesion strength	$\geq 0.5 \text{ N/mm}^2$	Ks 2167-11
Open time: tensile adhesion strength	$\geq 0.5 \text{ N/mm}^2$ after not less than 10 min	Annex A
All other requirements as tested for normal setting adhesives		
OPTIONAL CHARACTERISTICS		
Special characteristics		
characteristics	Requirement	Test Method
Slip	$\geq 0.5 \text{ mm}$	KS 2167-8
Additional characteristics		
Characteristic	Requirement	Test Method
High Initial tensile adhesion strength	$\geq 1 \text{ N/mm}^2$	KS 2167-11
High Tensile adhesion strength after water immersion	$\geq 1 \text{ N/mm}^2$	
High Tensile adhesion strength after heat ageing	$\geq 1 \text{ N/mm}^2$	
High Tensile adhesion strength after freeze thaw cycles	$\geq 1 \text{ N/mm}^2$	
Extended open time: tensile adhesion strength	$\geq 0.5 \text{ N/mm}^2$ after not less than 30 min	Annex A

6 Dimensional requirements

The notched trowel thicknesses for adhesives shall comply with the dimensional requirements specified in Table 2 for the various sizes and types of tiles indicated.

Table 2 — Dimensional requirements

inches mm	4 x 4	6 x 6	10 x 10	12 x 12	16 x 16
	100 x 100	150 x 150	250 x 250	300 x 300	400 x 400
Tile type	Notched trowel bed thickness mm				
Ceramic	3	3	6	9	12
natural stone/ Quarry tile	3	6	9	12	12
Concrete/ Terrazzo	3	6	9	12	12
Mosaic/Glass	3	3	6	9	12
Porcelain/ Vitrified	3	3	6	9	12
Marble/Granite	6	6	9	9	15
Brick	6	6	9	9	15

7 Physical requirements

7.1 The adhesives shall be of high bonding strength that ensures permanent installation and shall meet the test requirements specified in Table 3.

Table 3 — Test requirements

Compressive strength N/mm ²		Flexural Strength N/mm ²		Absorption	Drying Shrinkage
7 days	28 days	7 days	28 days	7 days	28 days
≥ 5.5 %	≥ 9	≥ 1.5	≥ 2.0	25%	1%

8 Evaluation of conformity

8.1 Principle

The scheme for the evaluation of conformity includes the following tasks:

- initial tests;
- factory production control (FPC);
- registration and traceability.

NOTE Manufacturers having a Quality System complying with ISO 9001 are assumed to meet the requirements related to Factory Production Control systems by including this standard in their Quality System.

8.2 Criteria of conformity

Batch testing shall be carried out to control the quality of the adhesive in accordance with Table 1 and requirements for physical tests specified in clause 7. A batch is defined as one production lot from a single mix, which may be dispatched in a number of smaller bags.

9 Packaging and marking

Tile adhesive shall be suitably packed in 25 kg or 50 kg bags. Each package shall be clearly labelled with the following information:

- i) The manufacturer's name and/or trade mark
- ii) Nominal content by mass
- iii) The batch number
- iv) Number of this standard
- v) Type of Adhesive
- vi) Country of origin
- vii) The month and year in which the batch was manufactured, and statement to the effect that the adhesive has a shelf life of 12 months, when stored in unopened bags in accordance with manufacturer's instructions.
- viii) Precautionary instructions for use when affixing tiles.
- ix) The safety precaution that "For the safety and health of those working with cementitious materials, it is advised that adequate protective gear (clothing, gloves, boots, etc) should be used"
- x) A warning that freshly tiled floor using tile adhesive should not be exposed to any traffic or use in any manner for a duration specified by the manufacturer.

NOTE In the designation of a adhesive, information about special properties can be included when the product is intended for use in specific applications.

This information shall be marked on the packaging and/or on the product's technical data sheet.

This does not remove the requirement that all manufacturers claiming compliance with this standard shall state declared values for the properties of their products, when required.

Annex A
(normative)

Determination of open time

A 1 Scope

This test method determines the open time of ceramic tile adhesives.

It is applicable to all ceramic tile adhesives for internal or external tile installations on walls and floors.

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

NOTE Ceramic tile adhesives may also be used for other types of tiles (natural and agglomerated stones, etc), where these do not adversely affect the stones.

A 2 Sampling

Take a 2 kg sample of the adhesive.

A 3 Test conditions

Standard conditions shall be (23 ± 2) °C and (50 ± 5) % R.H. and the air circulation in the testing area less than 0.2 m/s.

A 4 Test materials

Condition all test materials (adhesive, etc.) for at least 24 h under standard conditions. The adhesive to be test shall be within its shelf life, where this is specified.

A 5 Ceramic tiles

The tiles shall be checked prior to conditioning to ensure that they are new, clean, and dry. In addition they shall meet the following conditions:

- Type PI: Porous body tile complying with KS 1738-1,
- water absorption (15 ± 3) % by mass,
- with plane adhering surface, cut to facial dimensions of (50 ± 1) mm x (50 ± 1) mm.

A 6 Concrete slab

The concrete slab shall conform to KS 2167-7.

A 7 Apparatus

A 7.1 A weight of less than 50 mm x 50 mm cross-sectional area, capable of exerting a force of (20 ± 0.05) N.

A 7.2 Pull-head plates, square, metallic, with dimensions of (50 ± 1) mm x (50 ± 1) mm and a minimum thickness of 10 mm with a suitable fitting for connection to the test machine.

A 7.3 A 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.

A 8 Mixing of adhesive

The amount of water and/or liquid admix required for preparing the adhesive shall be as stated by the adhesive manufacturer in parts by weight, i.e. liquid to dry powder (if a range of values is given, the average shall be used).

Prepare a minimum quantity of 2 kg of the adhesive in a mixer of the type described in of KS EAS 148-1, clause 3.2.2.3, using the speed settings (140 ± 5) rotations per minute and (62 ± 5) rotations per minute 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.
- replace the paddle and mix for 1 min.

Let the adhesive mature in accordance with the adhesive manufacturer's instructions, and then mix for a further 15 s.

In the case of ready-to-use dispersion adhesives or reaction resin adhesives, the manufacturer's instructions shall be followed.

A 9 Procedure

Apply a thin layer of the adhesive, mixed in accordance with B.8 to the concrete slab with a straight edge trowel. Then apply a thicker layer and comb with a notched trowel having 6 mm x 6 mm notches at 12 mm centres for cementitious adhesives and 4 mm x 4 mm notches at 8 mm centres for dispersion adhesives and reaction resin adhesives.

Hold the trowel 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, 10, 20 and 30 min place at least ten test tiles of type PI, 50 mm apart, on the adhesive and load each tile with (20 ± 0.05) N for 30 s.

After 27 days storage under standard conditions, bond the pull-head plates (see 6.2) to the tiles with a suitable high strength adhesive (e.g. epoxide 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.

A 10 Evaluation and expression of results

A 10.1 The individual tensile adhesion strengths are quoted to 0.1 N/mm² using the following formula:

$$A_s = L/A$$

Where,

A_s is the individual tensile adhesion strength in N/mm²;

L is the total tensile load in N;

A is the bonding area in mm² (2 500 mm²).

A 10.2 The tensile adhesion strength for each time interval is determined as follows:

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- determine the mean of the ten values;
- discard the values falling out of the range of $\pm 20\%$ of the mean value;
- if five or more values remain, determine the new mean.
- Determine the mode of failure of the test units (see KS EN 1322).

A 10.3 The open time, in minutes, is the maximum time interval at which the adhesive meets the tensile adhesion strength requirement defined in KS 1530.

A 11 Test report

The test report shall provide the following information:

- i) number, title and issue of this Kenya Standard;
- ii) the place and date of sampling;
- iii) type of adhesive, commercial designation and manufacturer's name;
- iv) identification of test sample;
- v) handling and storage of samples before testing;
- vi) test conditions;
- vii) date of testing;
- viii) amount of water or liquid used for preparing the adhesive;
- ix) test results (individual and mean values and the mode of failure);
- x) open time in minutes;
- xi) any other factor that could have influenced the result

Annex B
(normative)
Failure patterns

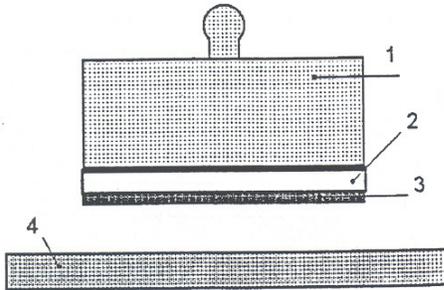


Figure B.1

Adhesive failure between adhesive and substrate
(AF-S)

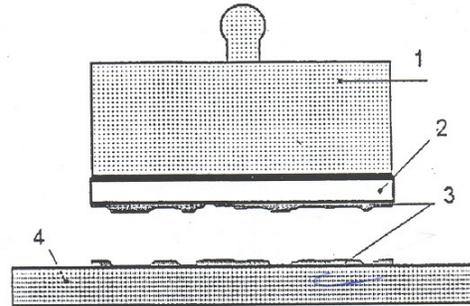


Figure B.4

Cohesive failure within the adhesive
(CF-A)

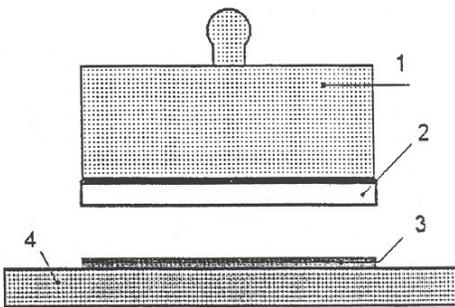


Figure B.2

Adhesive failure between tile and adhesive
(AF-T)

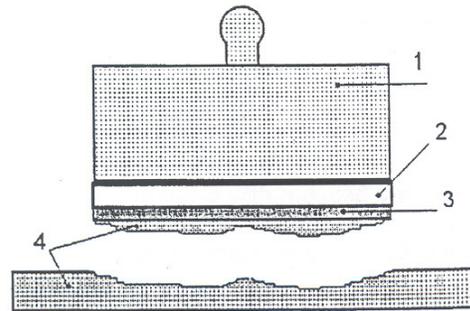


Figure B.5

Cohesive failure within the substrate
(CF-S)

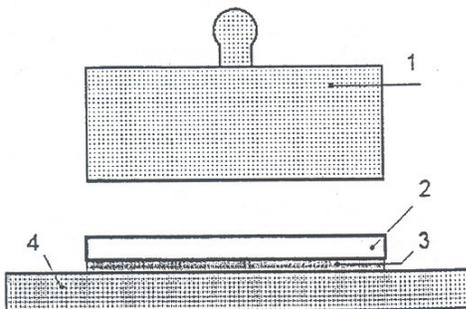


Figure B.3

Adhesive failure between tile & pull head plate
(BT)

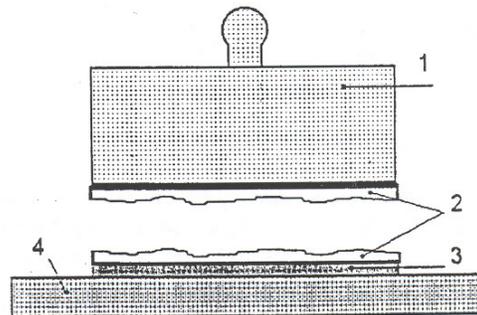


Figure B.6

Cohesive failure within the tile
(CF-T)

Key

- 1 Pull head plate
- 2 Tile
- 3 Adhesive
- 4 Substrate (Concrete slab)

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