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Ceramic tiles —

Part 13: Determination of chemical resistance

Carreaux et dalles céramiques —

Partie 13: Détermination de la résistance chimique

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/TC 189, *Ceramic tile*.

This second edition cancels and replaces the first edition (ISO 10545-13:1995), which has been technically revised.

A list of all parts in the ISO 10545 series can be found on the ISO website.

Ceramic tiles —

Part 13:
Determination of chemical resistance

1 Scope

This document specifies a test method for determining the chemical resistance of ceramic tiles at room temperature. The method is applicable to all types of ceramic tiles.

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.

ISO 3585, *Borosilicate glass 3.3 — Properties*

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:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

4 Principle

Subjection of the test specimens to the action of the test solutions and visual determination of attack after a defined period.

5 Aqueous test solutions

5.1 Household chemicals

Ammonium chloride solution, 100 g/l.

5.2 Swimming pool salts

Sodium hypochlorite solution, 20 mg/l, prepared from technical grade sodium hypochlorite solution 5 % (W/V).

5.3 Acids and alkalis

5.3.1 Low concentrations (L)

a) Hydrochloric acid solution, 3 % (V/V), prepared from concentrated hydrochloric acid (ρ = 1,19 g/ml).

b) Citric acid solution, 100 g/l.

c) Potassium hydroxide solution, 30 g/l.

5.3.2 High concentrations (H)

a) Hydrochloric acid solution, 18 % (V/V), prepared from concentrated hydrochloric acid (ρ = 1,19 g/ml).

b) Lactic acid solution, 5 % (V/V) prepared from 85 % lactic acid.

c) Potassium hydroxide solution, 100 g/l.

For special cases, other test solutions may, upon agreement by the parties concerned, be tested using the procedure specified in this document. For these cases, no requirement is applicable.

6 Apparatus

6.1 Vessel with a lid, made of borosilicate glass 3.3 (ISO 3585) or any other suitable material.

6.2 Cylinder of borosilicate glass 3.3 (ISO 3585) or any other suitable material having a lid or an opening for filling.

6.3 Drying oven, capable of being operated at (110 ± 5)°C.

Microwave, infrared or other drying systems allowing shorter drying times may be used provided that it has been determined that the same results are obtained.

6.4 Chamois lather.

6.5 White cloth, made of cotton or flax.

6.6 Sealing material (for example, plasticine).

6.7 Balance, accurate to 0,05 g.

6.8 Pencil, of HB hardness (or equivalent).

NOTE For more information, see ISO 9177-2[1].

6.9 Electric lamp, of 40 W, white inside (for example, siliconized).

7 Test specimens

7.1 Number of test specimens

The minimum number of test specimens is reported in Table 1. Test specimens shall be representative of the sample. Where tiles have different colours or decorative effects on parts of the surface, care should be taken to include all distinctive parts.

Table 1 — Number of test specimens

Tile Maximum area, A (cm^2)	Total nº of test specimens (tiles)
$200 < A \leq 3\,600$	3
$A > 3\,600$	3
When A is ≤200 cm^2, the total no of test specimens (tiles) should be sufficient to cover an area of 200 cm^2.	

7.2 Size of test specimens

Use undamaged test specimens which may be either whole tiles or parts of tiles.

For procedure with partial immersion, cut a square test specimen (50 mm × 50 mm) from each tile under test.

7.3 Preparation of test specimens

Thoroughly clean the surface with a suitable solvent, for example, ethanol. Do not use test specimens with surface defects.

8 Procedure

8.1 Application of test solutions

Dry each test specimens in the drying oven (6.3) maintained over 105 °C ± 5 °C during at least 2 h and then cool them until they reach room temperature. Test specimens shall be tested not later than 3 h after they have reached room temperature.

Apply a uniform layer of the sealing material (6.6) 3 mm thick to the rim of the cylinder (6.2). Turn the cylinder upside down onto a fresh part of the proper surface and seal around the rim. Pour the test solution through the inlet to a height of (20 ± 1) mm.

If it is not practical to maintain a constant level of solution, immerse the test specimens vertically to a depth of 25 mm in the vessel (6.1) containing the test solution. Cover with the lid (6.1).

The test solution shall be all of those listed in 5.1, 5.2 and 5.3.1; if required, the test solutions listed in 5.3.2 may be used.

Maintain the test assembly at (20 ± 5) °C.

For testing the resistance to household chemicals, swimming pool salts and citric acid, maintain the test solutions in contact with the test specimen for 24 h. Remove the cylinder and clean the proper surface with a suitable solvent to completely remove the sealing material. When the procedure by partial immersion is used, maintain the test solutions in contact with the test specimens for 24 h, then remove the test specimens.

For testing the resistance to hydrochloric acid, lactic acid and potassium hydroxide, maintain the test solution in contact with the test specimen for a total of (96 ± 1) h. Ensure that the level of the test solution does not change. Replace the test solution after (48 ± 1) h. After more (48 ± 1) h, remove the cylinder and clean the surface with a suitable solvent to completely remove the sealing material.

When the procedure by partial immersion is followed, maintain the test solutions in contact with the test specimens for (96 ± 1) h, then remove the test specimens.

Thoroughly rinse the specimens under running water for a period of 10 min to remove any residual testing solution. If needed, clean the surface with a soft bristle brush to remove test solutions.

Dry each test specimens in the drying oven maintained over 105 °C ± 5 °C and cool to room temperature before evaluation.

8.2 Determination of class

8.2.1 General

In order to assess whether the pencil test (described in 8.2.2.2) is applicable, draw several lines with the pencil (6.8) on untreated parts of the proper face of the tile and attempt to remove the marks with a wet cloth (6.5).

If the pencil marks cannot be removed, the classification system of Figure 1 is not applicable and these tiles shall be reported as "Normal classification not possible". An alternative visual classification is provided for these tiles in 8.2.3.

8.2.2 Normal classification

For tiles passing the pencil test, carry out the operations described in 8.2.2.1, 8.2.2.2 and 8.2.2.3 and apply the classification system indicated in Figure 1.

8.2.2.1 Visual examination

Examine the proper surface that has been tested from all angles from a standard distance of 25 cm and under a minimum artificial illumination of 300 lx ± 10 lx, with the naked eye or with spectacles if usually worn, for any difference in appearance from a untreated surface, for example, for change in colour, reflection, surface texture or the development of brilliance. After examination, if there is no visible effect, perform the pencil test described in 8.2.2.2. If there is a visible effect, perform the reflection test described in 8.2.2.3.

8.2.2.2 Pencil test

Draw several lines with the pencil (6.8) both on the surface under test and on the untreated surface. Attempt to remove the pencil lines with the wet cloth (6.5). If the pencil marks are removed from the treated surface, the surface corresponds to class A. If they are not removed, the surface corresponds to class B.

8.2.2.3 Reflection test

Hold the tile so that the image of the lamp (6.9) is reflected on the untreated surface. The angle of incidence of the light upon the surface shall be approximately 45° and the distance between the tile and the light source shall be (350 ± 100) mm. The criterion of judgement shall be the sharpness of the reflection and not the brightness of the surface. Position the tile so that the image falls simultaneously on both treated and untreated parts and determine whether it is any less clear on the treated part. This test cannot be applied to certain proper surfaces, in particular, those which are dull. In this case, the procedure reported in 8.2.3 shall be used. If the reflection is clear, the surface corresponds to class B. If the reflection is blurred, the surface corresponds to class C.

8.2.3 Alternative visual classification

For tiles failing the pencil test and reported as "Normal classification not possible", carry out the operations described below and apply the classification system indicated in Figure 2.

Examine the surface that has been tested from all angles from a standard distance of 25 cm and under a minimum artificial illumination of 300 lx ± 10 lx, with the naked eye or with spectacles if usually worn, for any difference in appearance from a untreated surface, for example, for change in reflection or the development of brilliance. Use the following classification.

8.2.3.1 For test solutions listed in 5.1 and 5.2

Class A(V): No visible effect

Class B(V): Discernable visible change in appearance

Class C(V): Partial or complete loss of the original surface appearance

NOTE (V) signifies “visual classification”.

8.2.3.2 For test solutions listed in 5.3.1

Class LA(V): No visible effect

Class LB(V): Discernable change in appearance

Class LC(V): Partial or complete loss of the original surface appearance

8.2.3.3 For test solutions listed in 5.3.2

If, as agreed, test solutions listed in 5.3.2 have been used, tiles are divided into the following classes:

Class HA(V): No visible effect

Class HB(V): Discernable change in appearance

Class HC(V): Partial or complete loss of the original surface appearance

9 Test report

The test report shall include the following information:

a) a reference to this document, i.e. ISO 10545-13;

b) a description of the tiles;

c) the procedure followed: contact on proper surface or partial immersion;

d) the test solutions used;

e) the results obtained from the procedure described in 8.2;

f) the classification for each test solution and for each test specimen.

Table 2 — Example of preparation of test solutions

Test solution	Reagent source	Amount of reagent required for test solution	Distilled water required for test solution
Ammonium chloride, 100 g/l	99,5 % ammonium chloride	100 g	Required to prepare 1 l of test solution
Citric acid solution, 100 g/l	99,5% citric acid	100 g	Required to prepare 1 l of test solution
Sodium hypochlorite solution, 20 mg/l	Technical grade sodium hypochlorite solution, 5 % (W/V)	0,4 mg	999,6 ml
Lactic acid, 5 % (V/V)	85 % lactic acid	50 ml	950 ml
Hydrochloric acid solution, 3 % (V/V)	38 % hydrochloric acid	30 ml	970 ml
Hydrochloric acid solution, 18 % (V/V)	38 % hydrochloric acid	180 ml	820 ml
Potassium hydroxide solution, 30 g/l	90 % potassium hydroxide	33,33 g	Required to prepare 1 l of test solution
Potassium hydroxide solution, 100 g/l	90 % potassium hydroxide	111 g	Required to prepare 1 l of test solution

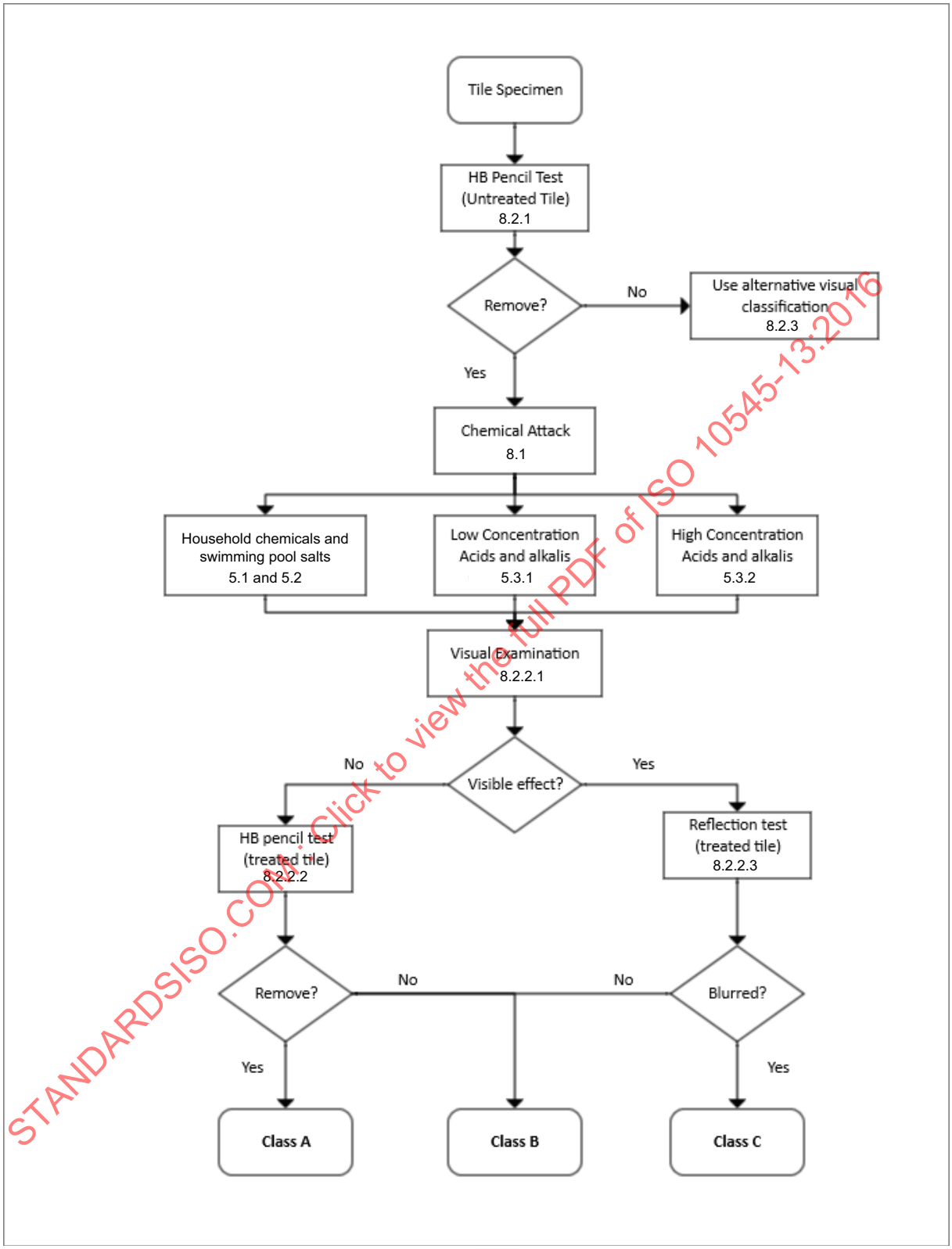

Figure 1 — Classification for the chemical resistance of ceramic tiles — Normal classification