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Ceramic tiles —

Part 23: Determination of elastic modulus for glazed and unglazed ceramic tiles, substrate and glaze layer

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Foreword

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This document was prepared by Technical Committee ISO/TC 189, *Ceramic tile*.

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Ceramic tiles —

Part 23:
Determination of elastic modulus for glazed and unglazed ceramic tiles, substrate and glaze layer

1 Scope

This document specifies a testing method for determining the elastic modulus of glazed and unglazed ceramic tiles, substrate and glaze layer at ambient temperature by three-point bending tests. This document also specifies procedures for test specimen preparation, test modes, load rates, data collection and reporting.

This test method can be used for material research, quality control, characterization and design data-generation purposes of ceramic tiles with a plate shape. See Annex A for more information. This method is not applicable to the ceramic tiles with profiled structures from which the test specimen cannot be machined.

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 3611, *Geometrical product specifications (GPS) — Dimensional measuring equipment — Design and metrological characteristics of micrometers for external measurements*

ISO 7500-1, *Metallic materials — Calibration and verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Calibration and verification of the force-measuring system*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology 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/

3.1
elastic modulus
ratio of stress to strain within the linear elastic range

3.2
modulus ratio
ratio of the glaze modulus to the substrate modulus

3.3
thickness ratio
ratio of the glaze thickness to the substrate thickness

3.4
substrate
remaining part after removing the glaze layer for the glazed ceramic tile

4 Principle

The elastic modulus of glazed or unglazed ceramic tiles can be evaluated using three-point bending tests. The difference between the modulus of glazed and unglazed test specimens is related to the elastic modulus of the glaze layer. The modulus of the glaze layer shall be calculated using the measured modulus of glazed and unglazed test specimens. Therefore, if the elastic modulus of the glaze layer is required to be measured, two types of test specimens (glazed and unglazed) shall be previously used to measure their respective moduli. The unglazed test specimens can be obtained by grinding off the glaze layer of the glazed specimens.

If only the elastic modulus of the ceramic tile is required to be measured, the tile shall be processed into test specimens for three-point bending testing; it is not necessary to prepare two types (glazed or unglazed) of specimen. The elastic modulus of tiles shall be tested, but the modulus of the glaze layer can be tested depends on requirement.

5 Apparatus

5.1 Testing machine

A suitable testing machine capable of applying a uniform crosshead speed and in accordance with ISO 7500-1 shall be used. The loading speed should be constant. The measuring error shall be 1 % or lower.

5.2 Data acquisition

An analogue chart recorder or digital data collection system should be used. The error of the recording system shall be 1 % or lower. The minimum data collection frequency shall be 15 Hz. A response frequency of 50 Hz is considered adequate.

5.3 Dimensional measuring devices

The dimensions of the test specimen shall be measured using a Vernier calliper in accordance with ISO 3611 and with a precision of 0,02 mm or a higher accuracy, or other calibrated measuring device providing the same or higher measurement accuracy. The thickness of the glaze layer shall be measured by using a calibrated optical microscope with magnification of 1 000 times or higher. Deflection shall be measured using a calibrated electronic micrometre with a precision of at least 0,001 mm or better, or another measuring device that provides the same or better measurement accuracy.

NOTE The glaze layer of the provided ceramic tile samples can be composed of two parts: engobed glaze and transparent protective glaze. The two parts are regarded as a whole, thus the measured elastic modulus of the glaze layer is in fact the equivalent modulus of the composite glazes.

6 Test specimens

6.1 Test specimen size

The geometrical dimensions of unglazed and glazed test specimens are displayed in Figure 1. The test specimens shall be 300 mm long and 30 mm wide. For tiles with a thickness greater than 10 mm, the thickness of the test specimen shall be 10 mm after the back grooves are ground off. For tiles with a thickness equal to or less than 10 mm, the thickness of the test specimen shall be equal to the thickness of the tiles after the back grooves are ground off (see Figure B.2). If the thickness of the prepared test specimen is less than 5 mm, the corresponding width and length shall also be smaller, hence 20 mm width and 220 mm length (for 200 mm span) are recommended. For glazed tiles, the thickness ratio, h/H, shall be larger than 1/100. If the h/H ratio is less than 1/100 for the tiles with thin glaze layer, the back surface of the test specimens shall