



SLOVENSKI STANDARD
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Specification for ceramic and glass insulating materials - Part 2: Methods of test (IEC 60672-2:1980)

Specification for ceramic and glass insulating materials -- Part 2: Methods of test

Bestimmung für Keramik- und Glas-Isolierstoffe -- Teil 2: Prüfverfahren

Spécification pour matériaux isolants à base de céramique ou de verre -- Partie 2: Méthodes d'essai

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SPECIFICATION FOR CERAMIC AND GLASS INSULATING
 MATERIALS
 PART 2: METHODS OF TEST

Spécification pour matériaux
 isolants à base de céramique ou
 de verre
 Deuxième partie: Méthodes d'essai

Bestimmung für Keramik- und
 Glas-Isolierstoffe
 Teil 2: Prüfverfahren

BODY OF THE HD

The Harmonization Document consists of:

- IEC 672-2 (1980) ed 1; IEC/SC-15C, not appended

This Harmonization Document was approved by CENELEC on 1986-09-10.

The English and French versions of this Harmonization Document are provided by the text of the IEC publication and the German version is the official translation of the IEC text. The German translation is available.

According to the CENELEC Internal Regulations the CENELEC member National Committees are bound:

to announce the existence of this Harmonization Document at national level by or before 1987-03-15

to publish their new harmonized national standard by or before 1987-09-15

to withdraw all conflicting national standards by or before 1987-09-01.

Harmonized national standards are listed on the HD information sheet, which is available from the CENELEC National Committees or from the CENELEC Central Secretariat.

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Spécification pour matériaux isolants à base de céramique ou de verre

Deuxième partie: Méthodes d'essai

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Specification for ceramic and glass insulating materials

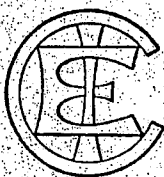
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Key words: ceramic and glass
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INTERNATIONAL ELECTROTECHNICAL COMMISSION

SPECIFICATION FOR CERAMIC AND GLASS
INSULATING MATERIALS

Part 2: Methods of test

FOREWORD

- 1) The formal decisions or agreements of the IEC on technical matters, prepared by Technical Committees on which all the National Committees having a special interest therein are represented, express, as nearly as possible, an international consensus of opinion on the subjects dealt with.
- 2) They have the form of recommendations for international use and they are accepted by the National Committees in that sense.
- 3) In order to promote international unification, the IEC expresses the wish that all National Committees should adopt the text of the IEC recommendation for their national rules in so far as national conditions will permit. Any divergence between the IEC recommendation and the corresponding national rules should, as far as possible, be clearly indicated in the latter.

PREFACE

This standard has been prepared by Sub-Committee 15C: Specifications, of IEC Technical Committee No. 15: Insulating Materials.

A first draft was discussed at the meeting held in Stockholm in 1977. As a result of this meeting, a draft, Document 15C(Central Office)87, was submitted to the National Committees for approval under the Six Months' Rule in January 1979.

The National Committees of the following countries voted explicitly in favour of publication:

Austria	Italy
Belgium	Japan
Canada	Norway
China	Poland
Czechoslovakia	South Africa (Republic of)
Denmark	Switzerland
Egypt	Turkey
France	Union of Soviet
Germany	Socialist Republics

Other IEC publications quoted in this standard:

- Publications Nos. 93: Methods of Test for Volume Resistivity and Surface Resistivity of Solid Electrical Insulating Materials.
- 212: Standard Conditions for Use Prior to and During the Testing of Solid Electrical Insulating Materials.
- 243: Recommended Methods of Test for Electric Strength of Solid Insulating Materials at Power Frequencies.
- 250: Recommended Methods for the Determination of the Permittivity and Dielectric Dissipation Factor of Electrical Insulating Materials at Power, Audio and Radio Frequencies including Metre Wavelengths.
- 345: Method of Test for Electrical Resistance and Resistivity of Insulating Materials at Elevated Temperatures.

SPECIFICATION FOR CERAMIC AND GLASS INSULATING MATERIALS

Part 2 : Methods of test

INTRODUCTION

This standard is one of a series which deals with ceramic and glass insulating materials.

The series will consist of three parts:

1. Definitions and classifications.
2. Methods of test.
3. Individual materials.

1. Scope

This standard is applicable to ceramic, glass and glass-ceramic materials to be used for electrical insulation purposes.

This Part 2 of the standard specifies methods of test. It is intended to provide results typical of the material from which the test specimens are processed; the limitations imposed by the method of forming and processing are also discussed.

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2. General notes on tests

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2.1 Test specimens

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This standard is intended to define the characteristics of the material from which the test specimens are processed under identical conditions and in sufficient numbers. It is emphasized however that results from the specimens are affected by the method of forming and this should as far as possible be the method used in the manufacture of production parts.

The method for processing the test specimens shall be specified.

All numerical values determined according to these test methods apply only to the test specimens prescribed. They cannot be extended to test specimens and ceramic products of other shapes and dimensions or of other types of manufacture.

The minimum number of test specimens for each test is stated in the following Table I and in the relevant sub-clauses for the different test methods.

Notes on toughened-glass test specimens

The thermal pre-stressed state of glass depends on the following factors:

- thermal expansion below and above transformation range;
- viscosity/temperature relation;

— thermal diffusivity =
$$\frac{\text{thermal conductivity}}{\text{specific heat capacity} \cdot \text{bulk density}}$$

TABLE I
Characteristics and number of test specimens

Clause	Tests	Test specimens	
		Shape and dimensions (mm)	Minimum number
3	Fuchsine porosity	Ceramics: fragments	3
		Glass: no test	—
4	Bulk density Open (apparent) porosity	Ceramics: fragments	3
		Glass: no test	—
5	Flexural strength	Rods with length: 120 or 60 Cross-section circular: $\varnothing 10$ Cross-section flattened circular: (See Figure 4, page 37) Cross-section square bars: (See Figure 5, page 37)	5
6	Modulus of elasticity	As for flexural strength (Clause 5)	3
7	Mean coefficient of linear expansion	Rods or bars with dimensions appropriate to the apparatus used	2
8	Specific heat capacity	Depending on apparatus used	2
9	Thermal conductivity	Cylinders or plates with dimensions adapted to the apparatus used	2
10	Resistance to thermal shock	As for flexural strength (Clause 5)	Method A: 5 for each determination of flexural strength Method B: 5
11	Transformation temperature	Rods of dimensions appropriate to the apparatus used	2
12	Electric strength	Disks $\varnothing 80$, thickness 2.5 or disks as in Figure 6, page 38	5
13	Withstand voltage	Disks (see Figure 6)	5
14	Relative permittivity and dissipation factor	Disks, according to IEC Publication 250	3
15	Volume resistivity in terms of temperature	Disks, according to IEC Publication 345	2

- elastic properties;
- starting temperature of cooling;
- heat transfer coefficient;
- thickness and form of glass product.

As a result of the last factor, specimens from the same glass but of different shape and thickness have different tempering levels although they are tempered under the same conditions.

Consequently it is impossible to have a special test specimen which represents properties of toughened products of other shapes and thicknesses. Therefore physical properties of thermally tempered glass products which show corresponding dependence on the tempering state can be determined only on the product itself, and it is recommended that this procedure be adopted whenever possible. This applies especially to properties such as flexural strength, resistance to thermal shock, volume resistivity and dissipation factor.

2.2 Presentation of results

The test report shall include the following:

- a) identification of the material;
- b) date of test;
- c) the test performed;
- d) the preparation, shape and dimensions of the test specimens and the number tested;
- e) the central value as result.

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3. Fuchsine porosity (liquid absorption)

This test is not applicable to glass materials with the exception of sintered glass.

3.1 Test apparatus

Any suitable apparatus may be used.

3.2 Test specimens

Fragments of ceramics shall be used. The unglazed area of test specimens shall be not less than 75% of the total area.

3.3 Method of test

The fragments of ceramic shall be immersed in a 1% solution of fuchsine in alcohol (1 g of fuchsine per 100 g of methylated spirits), the solution being maintained at a pressure of at least 15 MPa for a period such that the product of pressure in megapascals and the time expressed in hours, shall be not less than 180.

The fragments shall be taken from the solution, washed in water, dried and broken.

3.4 Expression of results

The freshly fractured surfaces shall be examined using normal vision for any sign of penetration of the dyestuff. The surfaces shall show no penetration. Penetration of dye into small cracks produced

when initially preparing fragments shall not be taken into consideration. The test shall be made on at least three test specimens.

4. Bulk density and open (apparent) porosity

4.1 Test apparatus

This test needs the following apparatus:

- a hydrostatic balance (a balance suitable for determining the weight of a specimen suspended in a liquid);
- a gas-tight vessel (bell-jar or desiccator) connected to a suitable vacuum pump;
- an oven for drying test specimens.

4.2 Test specimens

The test specimens shall consist of at least three fragments of total mass between 50 g and 80 g. Chips liable to become detached during further handling should be eliminated and any dust should be carefully removed by brushing under a water jet.

4.3 Methods of test

Method A — Vacuum test

Dry the test specimen in an oven heated to a temperature of 115 ± 5 °C up to constant mass m_o . Then carry out soaking of the test specimen in a vacuum as follows:

Place the test specimen in a suitable container inside a vacuum vessel which is provided with a means for admitting liquid, a connection to a suitable vacuum pump and a means of measuring pressure (vacuum). Close the vessel and evacuate it to a pressure of 2 to 3×10^3 Pa and maintain this for 5 min. Admit freshly boiled distilled water at about 23 ± 2 °C to the specimen container until the test specimen is covered, and continue evacuation for a further 5 min. After this period admit air to the vessel and remove the test specimen. Boil it in distilled water for 30 min. For low porosity (1 %) it is recommended that test specimens should be left to stand in distilled water for not less than 6 h.

Method B — Boiling test

After determining the mass of the dry test specimen, place it in a vessel on a wide-mesh brass netting located 1 cm from the bottom. Cover with distilled water, bring to the boil for 30 min and allow to cool to ambient temperature.

Whichever method is used, weigh each specimen when suspended in distilled water at about 23 °C (m_w). Wipe each specimen lightly with a damp cloth to remove surface water only and reweigh in air (m_h).

4.4 Expression of results

The bulk density (ρ_a) and open (apparent) porosity (P_a) are given by the following formulae:

$$\rho_a = \frac{m_o \cdot \rho_w}{m_h - m_w} \quad P_a = \frac{m_h - m_o}{m_h - m_w} 100$$