



SLOVENSKI STANDARD

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Advanced technical ceramics - Monolithic ceramics - General and textural properties -
Part 1: Determination of the presence of defects by dye penetration

Hochleistungskeramik - Monolithische Keramik - Allgemeine und strukturelle
Eigenschaften - Teil 1: Prüfung auf Anwesenheit von Oberflächenfehlern durch
Farbstoffeindringtests

Céramiques techniques avancées - Céramiques monolithiques - Propriétés générales et
texturales - Partie 1: Détermination de la présence de défauts à l'aide d'essai de
ressuage

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English Version

Advanced technical ceramics - Monolithic ceramics - General
and textural properties - Part 1: Determination of the presence of
defects by dye penetration

Céramiques techniques avancées - Céramiques
monolithiques - Propriétés générales et texturales - Partie
1: Détermination de la présence de défauts à l'aide d'essai
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Hochleistungskeramik - Monolithische Keramik -
Allgemeine und strukturelle Eigenschaften - Teil 1: Prüfung
auf Anwesenheit von Oberflächenfehlern durch
Farbstoffeindringtests

This European Standard was approved by CEN on 6 March 2006.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION
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Foreword

This European Standard (EN 623-1:2006) has been prepared by Technical Committee CEN/TC 184 "Advanced technical ceramics", the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2006, and conflicting national standards shall be withdrawn at the latest by October 2006.

This European Standard supersedes EN 623-1:1995, which was prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

EN 623 *Advanced technical ceramics — Monolithic ceramics - General and textural properties* consists of five parts:

Part 1: *Determination of the presence of defects by dye penetration tests*

Part 2: *Determination of density and porosity*

Part 3: *Determination of grain size and size distribution (characterized by the linear intercept method)*

Part 4: *Determination of surface roughness*

Part 5: *Determination of phase volume fraction by evaluation of micrographs*¹

The main changes in the new edition are:

- addition of normative reference to EN ISO 17025;
- modifications to the apparatus specification and test procedures;
- modifications to the test report requirements.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

¹ At the time of publication of this European Standard, Part 5 was a European Pre-standard.

1 Scope

This part of EN 623 specifies qualitative methods for determination of the presence of defects in advanced technical ceramics by dye penetration tests. The results are reported as visual observations of dye penetration.

Three methods are described:

Method A: A fuchsine dye test which is suitable for white or pale-coloured ceramic products, performed using an evacuation test.

Method B: A fluorescent dye test which is suitable particularly for those products where the purple fuchsine has insufficient visual contrast with the ceramic material, performed using a proprietary test kit.

Method C: A fuchsine dye test which is performed by simple immersion in or spraying with a dye solution, suitable for routine testing for major defects.

2 Normative references

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

ENV 1006, *Advanced technical ceramics — Monolithic ceramics — Guidance on the selection of test pieces for the evaluation of properties*

EN ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories (ISO/IEC 17025:2005)*

3 Apparatus

3.1 For method A, evacuating equipment, capable of reducing the pressure to a value not greater than 2 500 Pa, having a means of measuring the pressure.

3.2 Drying oven, capable of maintaining a temperature of 120 °C ± 5 °C.

3.3 Open mesh container, fabricated from ceramic or other non-metallic material, and of size appropriate to the test piece or test pieces (see Clause 4).

3.4 For method B, source of ultraviolet light.

3.5 For method A, air-tight vessel.

3.6 Hand lens or low-power microscope, of magnification up to about 50X.

4 Test pieces

Materials for testing shall be sampled in accordance with the guidance given in ENV 1006. Test pieces should be whole items, or, where this is not possible, fragments of ceramic products in which broken surfaces are exposed. Where required, test pieces should be conditioned to remove absorbed organic material, such as grinding coolant. This may be done by firing in an oxidizing atmosphere to 600 °C ± 50 °C, maintaining this temperature for 2 h. If this treatment leads to annealing or oxidation

of the surface of the test piece, use an alternative treatment, e.g. 2 h at 400 °C ± 50 °C in a vacuum oven.

5 Procedure

5.1 Method A: Fuchsine dye test using evacuation

Place the dry test pieces in the container (3.3) and immerse the container in a fresh solution of fuchsine dye in industrial methylated spirits (ethanol) at a concentration of 16 g/l. contained in an airtight vessel.

NOTE 1 The choice of solvent for the dye may be important in tests on non-oxide materials. Normally for oxides, industrial methylated spirits (ethanol) is adequate, but if problems of wetting arise it is necessary to experiment with different solvents. Necessary precautions in handling solvents should be taken.

Seal the vessel and reduce the pressure to using the evacuating equipment (3.1), until the solution boils. Maintain this reduced pressure for 5 min.

Allow the vessel to return to atmospheric pressure, and remove the test pieces from the solution. Thoroughly wash the test pieces with a warm solution of soap or detergent to remove surface dye.

NOTE 2 Mechanical brushing may be used.

Rinse the test pieces in water, and dry them in air at 120 °C ± 5 °C.

Examine the test pieces under good illumination, by eye, or with a hand lens, or with a low power microscope, according to the size of the features expected.

5.2 Method B: Fluorescent dye test

Place the dry test pieces in the container (3.3) and immerse the container in a solution of fluorescent penetrating fluid, obtained from a dye penetration kit.

NOTE 1 This test is carried out at ambient temperature and pressure.

After 15 min, remove the container from the fluid, remove the excess fluid from the test pieces in accordance with the instructions for the dye kit. Should the instructions specify a developer, follow the procedure so that all surfaces of the test pieces are evenly coated. Examine the test pieces under ultraviolet light (3.4).

NOTE 2 Ultraviolet lamps should be operated in accordance with the manufacturer's safety instructions.

5.3 Method C: Fuchsine dye test using immersion or spraying

For the immersion test, place the test pieces in the container (3.3) and immerse the container in a solution of fuchsine dye in industrial methylated spirits (ethanol) of concentration 16 g/l. See 5.1 Note 1. Alternatively a fuchsine dye testing kit may be used. Agitate the container for at least 30 s and remove from the solution.

For the spraying test, spray the test pieces with fuchsine dye solution prepared as above until all surfaces are well covered. Allow to stand for at least 30 s.

Thoroughly wash the test pieces with a warm solution of soap or detergent to remove surface dye.

NOTE 1 Mechanical brushing may be used.

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Rinse the test pieces in water and dry them in air at $120\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$. If appropriate, apply the dye testing kit developer.

Examine the test pieces under good illumination, by eye, or with a hand lens, or with a low power microscope, according to the size of the features expected.

NOTE 2 This method is not as rigorous as method A, but is generally adequate for inspection of significant cracking or porosity.

6 Examination

The presence of dye coloration after any of the above tests is an indication of penetration via cracks or other defects. The report shall include details of observations as follows:

- a) clearly defined localized or linear penetration showing the presence of discrete surface defects or cracks;

NOTE 1 The presence of dye may be confirmed by breaking the test pieces to observe a cross-section.

NOTE 2 The determination of the presence of small defects ($<50\text{ }\mu\text{m}$) is uncertain and depends on the techniques employed.

- b) general surface absorption;

NOTE 3 Strong surface absorption of dye, especially fuchsine dye (see 5.1) is indicative either of surface porosity in un-machined ceramics only, or of surface damage and microcracking in machined and un-machined ceramics, or both.

- c) no effect.

NOTE 4 If no effect is observed when testing a material for the first time, a check on the ability of the solvent to wet the ceramic is recommended. The solvent should be changed and the test repeated if there is any doubt.

7 Test report

The test report shall be in accordance with the reporting provisions of EN ISO/IEC 17025, and shall include at least the following information:

- a) name and address of the testing establishment;
- b) date of the test;
- c) on each page, a unique report identification and page number;
- d) customer name and address;
- e) reference to this European Standard, i.e. determined in accordance with EN 623-1;
- f) authorising signature;
- g) any deviation from the method described, with appropriate validation, i.e. demonstrated to be acceptable to the parties involved;
- h) description of the test material (material type, manufacturing code, batch number, date of receipt, as appropriate);