SLOVENSKI STANDARD
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Advanced technical ceramics - Monolithic ceramics - Part 1: General practice for undertaking corrosion tests

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Hochleistungskeramik - Monolithische Keramik - Teil 1: Allgemeines zur Durchführung von Korrosionsprüfungen

Céramiques techniques avancées - Céramiques monolithiques - Partie 1: Pratique générale destinée aux essais de corrosion

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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Foreword

This European Prestandard has been prepared by Technical Committee CEN/TC 184 "Advanced technical ceramics", the secretariat of which is held by BSI.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to announce this European Prestandard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This Part of ENV 12923 describes general procedures to be employed when undertaking corrosion tests on advanced technical ceramics. The mechanisms of chemical attack on advanced ceramics are widely varied, and depend on the chemical and phase composition and the phase morphology of the material, as well as the corrosive conditions imposed. For any particular engineering application it is usually necessary to model expected conditions of use in order to obtain quantitative data on ability to withstand the proposed end-use conditions.

This Prestandard is not restricted to specific material types, nor does it prescribe particular test conditions or test period. The actual testing requirements may be very specific, in order to investigate for example the suitability of a range of materials for a given application in which certain specified conditions occur. This Prestandard provides methods for undertaking the assessment of the effect of corrosion, and provides guidance on practical issues related to undertaking the tests.

2 Normative references

This European Prestandard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and in the publications listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Prestandard only when incorporated in it by amendment or revision. For undated references, the latest edition of the publication referred to applies.

EN 623-1 Advanced technical ceramics - general and textural properties of monolithic ceramics - Part 1: Determination of the presence of defects by dye penetration tests

ENV 623-4 Advanced technical ceramics - general and textural properties - Part 4: Determination of surface roughness

ENV 843-1 Advanced technical ceramics - mechanical properties of monolithic ceramics -Part 1: Determination of flexural strength

ENV 843-4 Advanced technical ceramics - mechanical properties of monolithic ceramics -Part 4: Determination of hardness

ENV 1006 Advanced technical ceramics - methods of testing monolithic ceramics - guidance on the sampling and selection of test pieces

EN 45001 General criteria for the operation of testing laboratories

EN 60584-1 Thermocouples - Part 1: Reference tables.

EN 60584-2 Thermocouples - Part 2: Tolerances.

ISO 3611 Micrometer callipers for external measurement.

ISO 6906 Vernier callipers reading to 0,02 mm.

3 Definitions

For the purposes of this Prestandard the following definitions apply:

3.1 Corrosion: The process of degradation induced by chemical attack by a surrounding medium on a ceramic body.

3.2 Oxidation: The process of reaction of a ceramic material with oxygen in the surrounding atmosphere, including any internal reactions as a result of the presence of open porosity or of diffusion of ions to or from the ceramic surface.

4 Significance and use

Advanced technical ceramic materials are widely regarded as being generally resistant to corrosion, and many types find applications in highly corrosive conditions where other materials are not viable. However, this is not always the case, and the selection of the most appropriate material requires some form of assessment to provide assurance that it has adequate resistance to the conditions to which it is to be exposed.

This Prestandard provides a basis for undertaking corrosion tests and details the criteria which might be considered for determining whether attack has taken place and has significant consequences for subsequent use of a material. It does not prescribe particular environments or durations of attack, but provides guidance on the key factors that need to be considered or specified in undertaking tests and gives a general framework for conducting tests in a meaningful manner.

The rate of chemical attack is determined by:

a) The chemical nature, phase composition, phase distribution and degree of continuous porosity in the material;

b) The temperature, pressure, composition, concentration and flow rate of the corroding medium, and whether these are constant or vary with time;

c) The mechanical forces applied to the material in terms of internal stress condition and the degree of surface abrasion or wear due to contact with other surfaces, the presence of abrasive particles or the dissolutioning effect of the corroding medium itself;

d) The period for which the test is performed, because it cannot be assumed that the rate of attack is constant with time. Adjusting test conditions to accelerate the corrosion process and extrapolating corrosion rates to times longer than that of the test should not be done.

These factors need to be carefully selected, clearly specified and reported in any corrosion test.

5 Criteria for determining corrosive attack

Chemical attack is manifest in a number of ways:

a) change of dry mass;

b) change of section thickness;

c) change of colour;

d) penetration of corrodent into the material rendering the surface open porous;

e) development of surface skins of altered composition;

f) development of a surface skin of reaction product;

g) change of surface finish;

h) change in strength;

i) change of hardness and wear or corrosion resistance.

Furthermore, attack may not be linear with time, notably if the diffusion path for corroding species increases with increasing corrosion.

The extent of chemical attack may be ascertained using a number of simple criteria, the most important being:

a) depth of penetration of corrodent;

b) change of mass;

c) change of cross-section;

d) change of strength;

e) change of surface roughness;

f) change of hardness;

g) changes in the chemical composition of the corroding medium.

NOTE: Other situations may exist in which it is desirable to record changes in other properties, for example, thermal conductivity and thermal shock resistance, either whilst immersed in the corroding medium, or after extraction from it. Such methods are not specifically included in this Prestandard, and may require special equipment not covered by this Prestandard. Change of colour may be subjective.

Table 1 summarises the areas of validity of using these criteria for various types of corrosive attack. These criteria apply to passive conditions of corrosion, i.e. not when the component is under an externally applied stress.

Table 1. Appropriateness of methods of assessing the effects of corrosive attack

Test type	Aqueous based corrosion	Corrosion by melts	Corrosion by gases and vapours
1. Penetration	Appropriate	May be appropriate	Appropriate in some cases
2. Change of mass	Appropriate, but sometimes inadequate	Inappropriate	Appropriate if non-slagging
3. Change of cross-section	Not always appropriate when change is small	Appropriate	Appropriate
4. Change of strength	Appropriate	May be appropriate if adherent material is removed	Appropriate if non-slagging; may be appropriate if adherent material is removed.
5. Change of surface roughness	Appropriate for slight corrosion	Usually inappropriate	Usually inappropriate
6. Change of hardness	Appropriate	Usually inappropriate	May be appropriate if non-slagging.
7. Change of corrodent composition	Appropriate	Usually inappropriate	Appropriate

6 Interferences

6.1 Depth of penetration

6.1.1 For materials subjected to corrodents which result in grain boundary attack and penetration of the corrodent, the depth of penetration may be strongly influenced by the microstructural nature of the original test piece surface. Some as-fired surfaces may have better resistance to penetration than bulk microstructures exposed by machining test pieces. When possible, testing should avoid as-fired surfaces unless the testing is specifically to evaluate the performance of such surfaces.