Advanced technical ceramics - Monolithic ceramics - General and textural properties - Part 3: Determination of grain size and size distribution (characterized by the Linear Intercept Method)

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EESTI STANDARDI EESSÕNA **NATIONAL FOREWORD**

Käesolev Eesti standard EVS-EN 623-3:2002 sisaldab Euroopa standardi EN 623-3:2001 ingliskeelset teksti. Käesolev dokument on jõustatud 16.01.2002 ja selle kohta on avaldatud teade Eesti standardiorganisatsiooni ametlikus väljaandes. Standard on kättesaadav Eesti standardiorganisatsioonist.	This Estonian standard EVS-EN 623-3:2002 consists of the English text of the European standard EN 623-3:2001. This document is endorsed on 16.01.2002 with the notification being published in the official publication of the Estonian national standardisation organisation. The standard is available from Estonian standardisation organisation.

Käsitlusala: This Part of EN 623 describes manual methods of making measurements for the determination of mean linear intercept grain size of advanced technical ceramics using photomicrographs of polished and etched test pieces.	**Scope:** This Part of EN 623 describes manual methods of making measurements for the determination of mean linear intercept grain size of advanced technical ceramics using photomicrographs of polished and etched test pieces.

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Võtmesõnad: füüsikalised omadused, keraamika, määramine, tekstuur, tera suurus

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Advanced technical ceramics

Monolithic ceramics – General and textural properties

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

Céramiques techniques avancées – Méthodes d'essai pour céramiques monolithiques – Propriétés générales et texturales – Part 3: Détermination de la taille des grains

Hochleistungskeramik – Monolithische Keramik – Allgemeine und strukturelle Eigenschaften – Teil 3: Bestimmung der Korngröße und der Korngrößenverteilung (Linienschnittverfahren)

This European Standard was approved by CEN on 2001-04-19.

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Management Centre or to any CEN member.

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CEN

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Europäisches Komitee für Normung

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Contents

Foreword

This European Standard 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 November 2001, and conflicting national standards shall be withdrawn at the latest by November 2001.

This European Standard supersedes ENV 623-3:1993.

Annexes A, B, C, D, E, F and G are informative.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: 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 EN 623 describes manual methods of making measurements for the determination of mean linear intercept grain size of advanced technical ceramics using photomicrographs of polished and etched test pieces. This is not the true mean grain diameter, but a somewhat smaller parameter representing the average path length of a line drawn across a two-dimensional section. The relationship to true grain dimensions depends on grain shape and degree of microstructural anisotropy. This standard contains two methods, A and B.

Method A applies to single-phase ceramics, and to ceramics with a principal crystalline phase and a glassy grain-boundary phase of less than about 5% by volume for which intercept counting suffices. Method B applies to ceramics with more than about 5% by volume of pores or secondary phases, or ceramics with more than one major crystalline phase where individual intercept lengths are measured, which can optionally be used to create a size distribution. This latter method allows the pores or phases to be distinguished and the mean linear intercept size for each to be calculated separately.

NOTE A method of determining volume fraction(s) of secondary phase(s) is under development as ENV 623-5; this will provide a means of determining whether Method A or Method B should be applied in borderline cases.

Some users of this standard may wish to apply automatic or semiautomatic image analysis to micrographs or directly captured microstructural images This is permitted by this standard provided that the technique employed simulates the manual method (see clause 4 and 8.4).

2 Normative references

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

amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

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

EN ISO/IEC 17025 General requirements for the competence of testing and calibration laboratories (ISO/IEC 17025:1999)

3 Terms and definitions

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

3.1
grain size

size of the distinct crystals in a material, and for the purposes of this method of test, that of the primary or major phase.

3.2
mean linear intercept grain size

the average value of the distance between grain boundaries as shown by randomly positioned lines drawn across a micrograph or other image of the microstructure.

4 Significance and use

The mean grain size and the distribution of grain sizes of a ceramic material play an important role in determining many properties, and thus grain size characterization is an important tool for ensuring consistency of manufacture. There are many measures of grain size and/or shape, but the linear intercept method provides the simplest possible method from a two dimensional section through the material. However, it must be recognised that the numerical value obtained for the mean linear intercept size is somewhat smaller than most other measures of grain size because intercepts can cross grains at any position, and not necessarily along the largest axis. The relationship between mean linear intercept size and a true three-dimensional grain size is not simple, and depends on the grain shape and the average number of facets.

NOTE Annex A contains a bibliography of sources dealing with stereology and methods of sizing three-dimensional objects.

This Standard provides a simple method of measuring intercept distances in single-phase materials based on counting the number of intersections along given lengths of randomly orientated and positioned lines or randomly positioned circles drawn onto a micrograph of a suitably sectioned, polished and etched test-piece. The length of lines crossing large pores residing at grain boundaries can be ignored, thus eliminating any bias that porosity may introduce, but small pores within grains should be ignored. In materials which contain more than one phase, the phases may be continuous or as isolated grains. It may be necessary to characterize the different phases separately. The principal purpose of this standard is to permit characterization of the major phases. The same intercept principle as for single-phase materials