SLOVENSKI STANDARD
kSIST prEN 843-6:2009

01-april-2009

Sodobna tehniļ na keramika - Mehanske lastnosti monolitske keramike pri sobni temperaturi - 6. del: Vodilo za fraktografsko raziskavo

Advanced technical ceramics - Mechanical properties of monolithic ceramics at room temperature - Part 6: Guidance for fractographic investigation

Hochleistungskeramik - Mechanische Eigenschaften monolithischer Keramik bei Raumtemperatur - Teil 6: Leitlinie für die fraktographische Untersuchung

Céramiques techniques avancées - Propriétés mécaniques des céramiques monolithiques à température ambiante - Partie 6: Guide pour l'analyse fractographique

Ta slovenski standard je istoveten z: **prEN 843-6**

ICS:

81.060.30	Sodobna keramika	Advanced ceramics

kSIST prEN 843-6:2009 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

FINAL DRAFT
prEN 843-6

January 2009

ICS 81.060.30

Will supersede CEN/TS 843-6:2004

English Version

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Ref. No. prEN 843-6:2009: E

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Foreword

This document (prEN 843-6:2009) has been prepared by Technical Committee CEN/TC 184 “Advanced technical ceramics”, the secretariat of which is held by BSI.

This document is currently submitted to the Unique Acceptance Procedure.

EN 843 *Advanced technical ceramics – Mechanical properties of monolithic ceramics at room temperature* consists of six parts:

Part 1: *Determination of flexural strength*

Part 2: *Determination of Young's modulus, shear modulus and Poisson's ratio*

Part 3: *Determination of subcritical crack growth parameters from constant stressing rate flexural strength tests*

Part 4: *Vickers, Knoop and Rockwell superficial hardness*

Part 5: *Statistical analysis*

Part 6: *Guidance for fractographic investigation*

Annexes A to E are informative.

This document includes a Bibliography.

1 Scope

This Part of EN 843 contains guidelines to be adopted when evaluating the appearance of the fracture surface of an advanced technical ceramic. The purpose in undertaking this procedure can be various, for example, for material development or quality assessment, to identify normal or abnormal causes of failure, or as a design aid.

NOTE Not all advanced technical ceramics are amenable to fractography. In particular, coarse-grained ceramics can show such rough surfaces that identifying the fracture origin may be impossible. Similarly, porous materials, especially those of a granular nature, tend not to fracture in a continuous manner, making analysis difficult.

2 Normative references

The following referenced documents are indispensable for the application 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.

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

3 Terms and definitions

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

3.1 General terms

3.1.1
crack
distinct microstructural discontinuity arising during or after manufacture caused by the action of thermal and/or mechanical stress and leading to the generation of new surfaces which do not completely separate

3.1.2
flaw
inhomogeneity which, through stress concentration, can act as a strength defining feature

NOTE The term flaw used in this sense does not imply that the component is defective.

3.1.3
fracture
process of propagation of a crack through a test-piece or component

3.1.4
fracture origin
source from which failure commences

3.2 Terms classifying inherently volume-distributed fracture origins

3.2.1
agglomerate
unintentional microstructural inhomogeneity usually of altered density, for example a cluster of grains of abnormal size, particles, platelets or whiskers, resulting from non-uniformity in processing

3.2.2
compositional inhomogeneity
local variations in chemical composition, usually manifest as agglomerates (3.2.1), or as areas denuded of or enriched in dispersed phases, or as changes in grain size

3.2.3
delamination
generally planar crack within a material arising from the method of manufacture

3.2.4
inclusion
discrete inhomogeneity, usually as a result of inorganic contamination by a foreign body not removed during firing

3.2.5
large grain
grain which is of abnormally large size as a result of poor particle size control or accelerated grain growth, and which can act as a flaw (3.1.2)

3.2.6
pore
cavity or void within a material, which may be isolated or continuously interconnected with others

3.2.7
porous region
zone of enhanced porosity, usually three-dimensional in nature and resulting from inhomogeneity or organic contamination in processing

3.2.8
porous seam
zone of enhanced porosity, usually linear or planar in nature and resulting from inhomogeneity or organic contamination in processing

3.3 Terms classifying inherently surface-distributed fracture origins

3.3.1
chip
small flake of material removed from a surface or an edge of an item or its fracture surface

3.3.2
handling damage
scratches, chips or other damage resulting from contact between items, test-pieces or fracture surfaces, not present normally

3.3.3
machining damage
result of removal of small chips (see 3.3.1) or the formation of scratches at, or cracks near, the surface resulting from abrasive removal of material

3.3.4
open pore
void connected to the external surface, usually by virtue of machining

3.3.5
pit
surface depression or surface connected shallow pore, usually resulting from manufacturing conditions or interaction with the external environment

3.4 Terms classifying features on fracture surfaces

3.4.1
fracture lines
ridges or troughs running approximately parallel to the direction of propagation of a crack front, usually in the hackle (3.4.2) region

NOTE In some cases, particularly with materials with low fracture toughness, additional lines can be found on fracture surfaces resulting from interactions of the crack with free surfaces or other features, including so-called Wallner lines, arrest lines, wake hackle, etc. Definitions of such terms can be found in ASTM C1256 (see reference [1] in the Bibliography).

3.4.2
hackle
region of rough fracture outside the mirror (3.4.3) and mist (3.4.4) regions, often with ridges or troughs emanating radially from the fracture origin (3.1.4)

3.4.3
mirror
area of a fracture surface, usually approximately circular (or semicircular for near-edge fracture origins) and immediately surrounding a fracture origin (3.1.4), which is relatively flat and featureless compared with regions further removed from the fracture origin

NOTE Not all materials or fractures show obvious fracture mirrors. They tend to be visible most clearly in high-stress, accelerating fractures from small flaws.

3.4.4
mist
halo around the outer region of the mirror (3.4.3) where the roughness is enhanced with a texture elongated in the direction of fracture

NOTE The mist region is most clearly seen in glasses, glass-ceramics or ceramics with very fine grain sizes which produce smooth surfaces on fracture.

4 Significance and use

Fractography is recommended as a routine diagnostic aid to the interpretation of fracture tests on test-pieces or of failures in components. Observation of the macroscopic features of fragments, such as cracks and their relative disposition, chips and scratches, provides information about the likely directions of stressing. Observation of intermediate scale features on the fracture surface, such as the shape of hackle (3.4.2) and fracture lines (3.4.1) give indications of the approximate position of the fracture origin (3.1.4). Microscopic observations give information on the nature of the fracture origin, and thus may provide evidence of the reasons for fracture.

The accumulation of additional information about the conditions of fracture (stresses, forces, temperature, time under stress, likelihood of impact, etc.) is highly desirable for achieving justifiable conclusions.

5 Apparatus

5.1 Preparation and cleaning facilities

5.1.1 ***Cutting wheel,*** for large specimens. A diamond-bladed saw.

NOTE This is needed to cut small samples for microscope observation, particularly in the scanning electron microscope