Advanced technical ceramics – Methods of test for ceramic coatings – Part 9: Determination of fracture strain

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NATIONAL FOREWORD

Käesolev Eesti standard EVS-EN 1071-9:2009 sisaldab Euroopa standardi EN 1071-9:2009 ingliskeelset teksti.	This Estonian standard EVS-EN 1071-9:2009 consists of the English text of the European standard EN 1071-9:2009.
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Advanced technical ceramics - Methods of test for ceramic coatings - Part 9: Determination of fracture strain

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Hochleistungskeramik - Verfahren zur Prüfung keramischer Schichten - Teil 9: Bestimmung der Bruchdehnung

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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Management Centre: Avenue Marnix 17, B-1000 Brussels

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Foreword

This document (EN 1071-9:2009) 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of an identical text or by endorsement, at the latest by January 2010, and conflicting national standards shall be withdrawn at the latest by January 2010.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes CEN/TS 1071-9:2004.

EN 1071 *Advanced technical ceramics – Methods of test for ceramic coatings* consists of the following parts:

— *Part 1: Determination of coating thickness by contact probe profilometer*

— *Part 2: Determination of coating thickness by the crater grinding method*

— *Part 3: Determination of adhesion and other mechanical failure modes by a scratch test*

— *Part 4: Determination of chemical composition by electron probe microanalysis (EPMA)*

— *Part 5: Determination of porosity* [withdrawn]

— *Part 6: Determination of the abrasion resistance of coatings by a micro-abrasion wear test*

— *Part 7: Determination of hardness and Young's modulus by instrumented indentation testing* [withdrawn]

— *Part 8: Rockwell indentation test for evaluation of adhesion*

— *Part 9: Determination of fracture strain*

— *Part 10: Determination of coating thickness by cross sectioning*

— *Part 11: Determination of internal stress by the Stoney formula*

— *Part 12: Reciprocating wear test* [1)]

— *Part 13: Determination of wear rate by the pin-on-disk method* [1)]

Parts 7, 8 and 11 are Technical Specifications. Part 7 was withdrawn shortly after publication of EN ISO 14577-4:2007.

[1)] In preparation at the time of publication of this European Standard.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, 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 the United Kingdom.

Introduction

The fracture strain of a coating is a critical factor often determining the performance of a coated product. Clearly if stressed either directly or due to thermal effects (thermal expansion coefficient mismatch between the coating and substrate) coating cracking can occur if the critical fracture stress/strain is exceeded, and in many cases the effectiveness of the coating will be reduced. For example, corrosion resistant coatings lose their protective character if cracking occurs, and optical coatings become ineffective when cracked. In many cases cracking is the first stage of a much more serious form of failure in which large areas of the coating can spall.

The extent to which coated components can withstand external applied loads is an important property in the application of any coated system, and usually it is necessary to know the failure stress. For calculation of the stress both the fracture strain and Young's modulus of the coating should be known. EN ISO 14577-4 [1], which replaced Technical Specification CEN/TS 1071-7, can be used to measure the Young's modulus by depth sensing indentation, but there are other methods involving flexure and impact excitation that may also be applied [2], [3].

1 Scope

This part of EN 1071 describes a method of measuring the fracture strain of ceramic coatings by means of uniaxial tension or compression tests coupled with acoustic emission to monitor the onset of cracking of the coating. Tensile or compressive strains can also be applied by flexure using four-point bending. Measurements can be made in favourable cases at elevated temperatures as well as at room temperature.

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 10002-1, *Metallic materials – Tensile testing – Part 1: Method of test at ambient temperature*

EN 10002-5, *Metallic materials – Tensile testing – Part 5: Method of testing at elevated temperature*

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

ISO 12106, *Metallic materials – Fatigue testing – Axial-strain-controlled method*

3 Terms and definitions

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

3.1
fracture strain
strain required to create a detectable crack in the coating

NOTE The presence of the crack can be detected using optical or scanning electron microscopy, or indirectly using acoustic emission signals.

3.2
acoustic emission
AE
generation of acoustic signals that are recorded as hits, counts, energy or amplitude

NOTE See Figure 1 for definition of AE signals.

3.3
AE hit
single acoustic event above a set threshold

3.4
AE energy
area of the waveform of an AE hit

3.5
AE amplitude
peak of the waveform of an AE hit