

Advanced technical ceramics — Methods of test for ceramic coatings —

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

ICS 81.060.30

National foreword

This Draft for Development is the English language version of ENV 1071-6:2002.

This publication is not to be regarded as a British Standard.

It is being issued in the Draft for Development series of publications and is of a provisional nature because it is considered that further experience is required in its application before it is converted to a European and hence British Standard. It should be applied on this provisional basis, so that information and experience of its practical application may be obtained.

Comments arising from the use of this Draft for Development are requested so that UK experience can be reported to the European organization responsible for its conversion into a European Standard. A review of this publication will be initiated 2 years after its publication by the European organization so that a decision can be taken on its status at the end of its three-year life. The commencement of the review period will be notified by an announcement in *Update Standards*.

According to the replies received by the end of the review period, the responsible BSI Committee will decide whether to support the conversion into a European Standard, to extend the life of the prestandard or to withdraw it. Comments should be sent in writing to the Secretary of BSI Technical Committee RPI/13, Advanced technical ceramics, at 389 Chiswick High Road, London W4 4AL, giving the document reference and clause number and proposing, where possible, an appropriate revision of the text.

A list of organizations represented on this committee can be obtained on request to its secretary.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the *BSI Catalogue* under the section entitled “International Standards Correspondence Index”, or by using the “Search” facility of the *BSI Electronic Catalogue* or of British Standards Online.

This Draft for Development, having been prepared under the direction of the Materials and Chemicals Sector Policy and Strategy Committee, was published under the authority of the Standards Policy and Strategy Committee on 2 October 2002

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Advanced technical ceramics - Methods of test for ceramic coatings - Part 6: Determination of the abrasion resistance of coatings by a micro-abrasion wear test

Céramiques techniques avancées - Méthodes d'essai pour revêtements céramiques - Partie 6: Détermination de la résistance à l'abrasion des revêtements par essai de micro-usure

Hochleistungskeramik - Verfahren zur Prüfung keramischer Schichten - Teil 6: Bestimmung des Abriebwiderstands von Schichten durch eine Mikroabriebprüfung

This European Prestandard (ENV) was approved by CEN on 28 April 2002 as a prospective standard for provisional application.

The period of validity of this ENV is limited initially to three years. After two years the members of CEN will be requested to submit their comments, particularly on the question whether the ENV can be converted into a European Standard.

CEN members are required to announce the existence of this ENV in the same way as for an EN and to make the ENV available promptly at national level in an appropriate form. It is permissible to keep conflicting national standards in force (in parallel to the ENV) until the final decision about the possible conversion of the ENV into an EN is reached.

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

Management Centre: rue de Stassart, 36 B-1050 Brussels

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Foreword

This document ENV 1071-6:2002 has been prepared by Technical Committee CEN/TC 184 "Advanced technical ceramics", the secretariat of which is held by BSI.

EN 1071 'Advanced technical ceramics - Methods of test for ceramic coatings' consists of 7 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

Part 5: Determination of porosity

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 depth sensing indentation

This standard includes an informative annex A and a bibliography.

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, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

1.1 This part of ENV 1071 describes a method of measuring the abrasive wear rate of ceramic coatings by means of a micro-abrasion wear test based on the well known crater grinding technique used for film thickness determination – see ENV 1071-2.

1.2 The method can provide data on both film and substrate wear rates, either by performing two separate tests or by careful analysis of the data from a single test series.

1.3 The test method may be applied to samples with planar or non-planar surfaces but the analysis described in clause 11 applies only to flat samples. For non-planar samples a more complicated analysis, possibly requiring the use of numerical methods, is required.

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 the publications are 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 (including amendments).

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

ENV 1071-2, *Advanced technical ceramics – Methods of test for ceramic coatings – Part 2: Determination of coating thickness by the crater grinding method*.

ISO GUM, *Guidance on the expression of uncertainty in measurement*.

ISO 3290, *Rolling bearings – Balls – Dimensions and tolerances*.

3 Terms and definitions

For the purposes of this European Prestandard, the term and definition given below applies.

3.1

abrasive wear rate (also called abrasive wear coefficient)

volume of material removed in unit sliding distance under a normal contact load of 1 N

4 Significance and use

Although few protective coatings are subject to single wear processes, the abrasive wear resistance of such coatings can play a decisive role in their performance. Hence knowledge of the abrasive wear resistance of ceramic coatings can help in the proper selection of coatings for applications where abrasion plays a major part in their degradation. Although techniques exist to measure the abrasive wear behaviour of bulk materials and thick films (see Bibliography), these techniques are not easily applied to thin films and are difficult to interpret when used on curved surfaces.

The purpose of this ENV is to provide a method for measuring the abrasion resistance of both thin and thick coatings and of bulk materials. The test can be carried out on flat surfaces or surfaces with a known radius of curvature, and requires only a few mm² of sample. However, the analysis described in clause 11 applies only to flat samples and is applicable to homogeneous single layer coatings only; errors may occur if the test is used on inhomogeneous coatings. By proper treatment of the results, as indicated in 11.2, where the test produces penetration of the coating it can provide abrasion coefficients for both coating and substrate from a single test series.

Although the test is designed to enable quantitative measurement of wear coefficients, it can be adapted as a quality control test for use on real components.

5 Principle

In the test, a ball is rotated whilst being pressed against the sample and an abrasive slurry is fed into the contact zone. A spherical depression is produced and the size of this depression is measured. Where perforation of the coating has not occurred, the wear rate of the coating can be obtained from a single crater. When perforation of the coating occurs, by making a series of these craters and measuring the size of the scar dimensions, the wear rate of both the coating and the substrate can be calculated.