National Standards Authority of Ireland

IRISH STANDARD

ENV 843-5:1996

ICS 81.060.20

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ADVANCED TECHNICAL CERAMICS - MONOLITHIC CERAMICS - MECHANICAL TESTS AT ROOM TEMPERATURE - PART 5: STATISTICAL ANALYSIS

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English version

Advanced technical ceramics - Monolithic ceramics - Mechanical tests at room temperature - Part 5: Statistical analysis

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CEN

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.

EN 843 consists of five parts:

- Part 1: Determination of flexural strength (EN)
- Part 2: Determination of elastic moduli (ENV)
- Part 3: Determination of subcritical crack growth parameters (ENV)
- Part 4: Vickers, Knoop and Rockwell superficial hardness tests (ENV)
- Part 5: Statistical analysis (ENV)

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

Contents

1 SCOPE

This Pre-standard specifies a method for statistical analysis of ceramic strength data in terms of a two-parameter Weibull distribution using a maximum likelihood estimation technique. It assumes that the data set has been obtained from a series of tests under nominally identical conditions.

> *NOTE: In principle,* Weibull analysis is considered strictly to be valid for the case of linear elastic fracture behaviour to the point of failure, i.e. for a perfectly brittle material, and under conditions in which strength limiting flaws do not interact and in which there is only a single strength-limiting flaw population.
>
> If subcritical crack growth or creep deformation preceding fracture occurs, Weibull analysis can still be applied if the results fit a Weibull distribution, but numerical parameters may change depending on the magnitude of these effects. Since it is impossible to be certain of the degree to which subcritical crack growth or creep deformation has occurred, this Pre-standard permits the analysis of the general situation where crack growth or creep may have occurred, provided that it is recognised that the parameters derived from the analysis may not be the same as those derived from data with no subcritical crack growth or creep.

2 NORMATIVE REFERENCES

This European Pre-standard 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 Pre-standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

ENV 843-1 Advanced technical ceramics - mechanical properties of monolithic ceramics at room temperature - Part 1: flexural strength tests

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

ISO 2602 Statistical interpretation of test results - estimation of the mean - confidence interval

ISO 3534 Statistics - vocabulary and symbols

3 DEFINITIONS

For the purposes of this standard the following definitions apply:

3.1 Flaws

3.1.1 Flaw : An inhomogeneity, discontinuity or structural feature, e.g. a grain boundary, large grain, pore, impurity or crack, in a material which when loaded provides a stress concentration and a risk of mechanical failure.

> NOTE: The term flaw should not be taken as meaning the material is functionally defective, but rather as containing an inevitable microstructural inhomogeneity.

3.1.2 Critical flaw : That flaw acting as the source of failure.

3.1.3 Extraneous flaws : Types of flaw observed in the fracture of test-pieces manufactured for the purposes of a test programme which will not appear in manufactured components, e.g. damage from machining when this process will not be used in the manufacture of components.

3.2 Flaw distributions

3.2.1 Flaw size distribution : A spread of sizes of flaw.

3.2.2 Critical flaw size distribution : A distribution of sizes of critical flaws in a population of tested components.

3.2.3 Compound critical flaw distribution : A flaw distribution which contains more than one type of strength controlling flaw not occurring in a purely concurrent manner (3.2.4). An example is when every test-piece contains flaw type A, and some contain additionally a second independent type B.

3.2.4 Concurrent (competing) critical flaw distribution : A multiple flaw distribution where every test-piece contains representative defects of each independent flaw type which compete with each other to cause failure.

3.2.5 Exclusive critical flaw distribution : A multiple flaw distribution created by mixing and randomizing test-pieces from two or more versions or batches of material where each version contains a single strength-controlling flaw population. Thus each test-piece contains defects exclusively from a single distribution, but the total data set reflects more than one type of strength-controlling flaw.

3.2.6 Competing failure modes : Distinguishably different types of fracture initiation events that result from concurrent (competing) flaw distributions (3.2.4).