

**Advanced technical ceramics -
Monolithic ceramics. Mechanical
properties at room temperature - Part 2:
Determination of Young's modulus,
shear modulus and Poisson's ratio**

Advanced technical ceramics - Monolithic ceramics.
Mechanical properties at room temperature - Part 2:
Determination of Young's modulus, shear modulus
and Poisson's ratio

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

<p>Käesolev Eesti standard EVS-EN 843-2:2007 sisaldab Euroopa standardi EN 843-2:2006 ingliskeelset teksti.</p> <p>Käesolev dokument on jõustatud 29.01.2007 ja selle kohta on avaldatud teade Eesti standardiorganisatsiooni ametlikus väljaandes.</p> <p>Standard on kättesaadav Eesti standardiorganisatsioonist.</p>	<p>This Estonian standard EVS-EN 843-2:2007 consists of the English text of the European standard EN 843-2:2006.</p> <p>This document is endorsed on 29.01.2007 with the notification being published in the official publication of the Estonian national standardisation organisation.</p> <p>The standard is available from Estonian standardisation organisation.</p>
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<p>Käsitlusala: This part of EN 843 specifies methods for determining the elastic moduli, specifically Young's modulus, shear modulus and Poisson's ratio, of advanced monolithic technical ceramics at room temperature. This European Standard prescribes four alternative methods for determining some or all of these three parameters: A The determination of Young's modulus by static flexure of a thin beam in three- or four-point flexure. B The determination of Young's modulus by forced longitudinal resonance, or Young's modulus, shear modulus and Poisson's ratio by forced flexural and torsional resonance, of a thin beam. C The determination of Young's modulus, shear modulus and Poisson's ratio from the time-of-flight of an ultrasonic pulse. D The determination of Young's modulus from the fundamental natural frequency of a struck bar (impulse excitation method). All the test methods assume the use of homogeneous test pieces of linear elastic materials.</p>	<p>Scope: This part of EN 843 specifies methods for determining the elastic moduli, specifically Young's modulus, shear modulus and Poisson's ratio, of advanced monolithic technical ceramics at room temperature. This European Standard prescribes four alternative methods for determining some or all of these three parameters: A The determination of Young's modulus by static flexure of a thin beam in three- or four-point flexure. B The determination of Young's modulus by forced longitudinal resonance, or Young's modulus, shear modulus and Poisson's ratio by forced flexural and torsional resonance, of a thin beam. C The determination of Young's modulus, shear modulus and Poisson's ratio from the time-of-flight of an ultrasonic pulse. D The determination of Young's modulus from the fundamental natural frequency of a struck bar (impulse excitation method). All the test methods assume the use of homogeneous test pieces of linear elastic materials.</p>
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Võtmesõnad:

English Version

Advanced technical ceramics - Mechanical properties of
monolithic ceramics at room temperature - Part 2: Determination
of Young's modulus, shear modulus and Poisson's ratio

Céramiques techniques avancées - Propriétés mécaniques
des céramiques monolithiques à température ambiante -
Partie 2: Détermination du module d'Young, du module de
cisaillement et du coefficient de Poisson

Hochleistungskeramik - Mechanische Eigenschaften
monolithischer Keramik bei Raumtemperatur - Teil 2:
Bestimmung des Elastizitätsmoduls, Schubmoduls und der
Poissonzahl

This European Standard was approved by CEN on 11 November 2006.

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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Foreword

This document (EN 843-2:2006) 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 June 2007, and conflicting national standards shall be withdrawn at the latest by June 2007.

This document supersedes ENV 843-2:1995.

EN 843 *Advanced technical ceramics — Mechanical properties of monolithic ceramics at room temperature* comprises 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*

At the time of publication of this Revision of Part 2, Part 6 was available as a Technical Specification.

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

1 Scope

This part of EN 843 specifies methods for determining the elastic moduli, specifically Young's modulus, shear modulus and Poisson's ratio, of advanced monolithic technical ceramics at room temperature. This European Standard prescribes four alternative methods for determining some or all of these three parameters:

- A The determination of Young's modulus by static flexure of a thin beam in three- or four-point flexure.
- B The determination of Young's modulus by forced longitudinal resonance, or Young's modulus, shear modulus and Poisson's ratio by forced flexural and torsional resonance, of a thin beam.
- C The determination of Young's modulus, shear modulus and Poisson's ratio from the time-of-flight of an ultrasonic pulse.
- D The determination of Young's modulus from the fundamental natural frequency of a struck bar (impulse excitation method).

All the test methods assume the use of homogeneous test pieces of linear elastic materials.

NOTE 1 Not all ceramic materials are equally and linearly elastic in tension and compression, such as some porous materials and some piezoelectric materials.

With the exception of Method C, the test assumes that the test piece has isotropic elastic properties. Method C may be used to determine the degree of anisotropy by testing in different orientations.

NOTE 2 An ultrasonic method for dealing with anisotropic materials (ceramic matrix composites) can be found in ENV 14186 [1]. An alternative to Method D for isotropic materials using disc test pieces is given in Annex A.

NOTE 3 At high porosity levels all of the methods except Method C may become inappropriate. The methods are only suitable for a maximum grain size (see EN 623-3), excluding deliberately added whiskers, of less than 10 % of the minimum dimension of the test piece.

NOTE 4 The different methods given in this European Standard can produce slightly different results on the same material owing to differences between quasi-isothermal quasi-static and quasi-adiabatic dynamic conditions. In addition, the calculation routines for different methods have different origins and different potential uncertainties which have not been rigorously evaluated in producing this European Standard. Some information is given in Annex B (see also reference [2]).

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 623-2, *Advanced technical ceramics — Monolithic ceramics — General and textural properties — Part 2: Determination of density and porosity*

EN 623-3, *Advanced technical ceramics — Monolithic ceramics — General and textural properties — Part 3: Determination of grain size and size distribution (characterized by the Linear Intercept Method)*

EN 623-4, *Advanced technical ceramics — Monolithic ceramics — General and textural properties — Part 4: Determination of surface roughness*

EN 843-1:2006, *Advanced technical ceramics — Mechanical properties of monolithic ceramics at room temperature — Part 1: Determination of flexural strength*

EN ISO 463, *Geometrical Product Specifications (GPS) — Dimensional measuring equipment — Design and metrological characteristics of mechanical dial gauges (ISO 463:2006)*

EN ISO 7500-1, *Metallic materials — Verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Verification and calibration of the force-measuring system (ISO 7500-1:2004)*

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

ISO 3611, *Micrometer callipers for external measurement*

ISO 6906, *Vernier callipers reading to 0,02 mm*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 843-1:2006 and the following apply.

- 3.1
Young's modulus**
stress required in a material to produce unit strain in uniaxial extension or compression
- 3.2
shear modulus**
shear stress required in a material to produce unit angular distortion
- 3.3
Poisson's ratio**
negative value of the ratio of lateral strain to longitudinal strain in an elastic body stressed longitudinally
- 3.4
static elastic moduli**
elastic moduli determined in a quasi-isothermal condition by stressing statically or quasistatically
- 3.5
dynamic elastic moduli**
elastic moduli determined non-quasistatically, i.e. under quasi-adiabatic conditions, such as in the resonant, ultrasonic pulse or impulse excitation methods

4 Method A: Static flexure method

4.1 Principle

Using three- or four-point flexure of a thin beam test piece, the elastic distortion is measured, from which Young's modulus may be calculated according to thin-beam equations.