



SLOVENSKI STANDARD

SIST EN 725-11:2007

01-januar-2007

BUXca Yý U.

SIST ENV 725-11:2000

GcXcVbUHM b] bU_YfUa]_U!`DfYg_i gbY`a YrcXY`nU_YfUa] bY`dfUý_Y!`%&`XY.
8c`c Ub`Y`n[cý Yj Ub`U`df]`bUfUj bYa `g]bhfUb1

Advanced technical ceramics - Methods of test for ceramic powders - Part 11:
Determination of densification on natural sintering

Hochleistungskeramik - Prüfverfahren für keramische Pulver - Teil 11: Bestimmung der
Verdichtungsverhaltens bei natürlichem Sinterbrand

(standards.iteh.ai)

Céramiques techniques avancées - Méthodes d'essai pour poudres céramiques - Partie
11: Détermination de la densification lors du frittage naturel

<https://standards.iteh.ai/catalog/standards/sist/b60f3161-4b26-4cf8-803b-3c8446b9b95c/sist-en-725-11-2007>

Ta slovenski standard je istoveten z: **EN 725-11:2006**

ICS:

81.060.30

Sodobna keramika

Advanced ceramics

SIST EN 725-11:2007

en

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[SIST EN 725-11:2007](https://standards.iteh.ai/catalog/standards/sist/b60f3161-4b26-4cf8-803b-3c8446b9b95c/sist-en-725-11-2007)

<https://standards.iteh.ai/catalog/standards/sist/b60f3161-4b26-4cf8-803b-3c8446b9b95c/sist-en-725-11-2007>

English Version

Advanced technical ceramics - Methods of test for ceramic
powders - Part 11: Determination of densification on natural
sintering

Céramiques techniques avancées - Méthodes d'essai pour
poudres céramiques - Partie 11: Détermination de la
densification lors du frittage naturel

Hochleistungskeramik - Prüfverfahren für keramische
Pulver - Teil 11: Bestimmung der Verdichtungsverhaltens
bei natürlichem Sinterbrand

This European Standard was approved by CEN on 25 May 2006.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

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.

CEN members are the national standards bodies of 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.

<https://standards.iteh.ai/catalog/standards/sist/b60f3161-4b26-4cf8-803b-3c8446b9b95c/sist-en-725-11-2007>



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

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

Contents

Page

Foreword.....	3
1 Scope	4
2 Normative references	4
3 Principle.....	4
4 Terms, symbols and units	5
5 Apparatus	5
6 Test pieces	6
7 Heating conditions.....	6
8 Procedure	6
9 Expression of results	6
10 Test report	7

iTeh STANDARD PREVIEW (standards.iteh.ai)

[SIST EN 725-11:2007](https://standards.iteh.ai/catalog/standards/sist/b60f3161-4b26-4cf8-803b-3c8446b9b95c/sist-en-725-11-2007)

<https://standards.iteh.ai/catalog/standards/sist/b60f3161-4b26-4cf8-803b-3c8446b9b95c/sist-en-725-11-2007>

Foreword

This document (EN 725-11:2006) 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 December 2006, and conflicting national standards shall be withdrawn at the latest by December 2006.

This document supersedes ENV 725-11:1993.

EN 725 *Advanced technical ceramics — Methods of test for ceramic powders* was prepared in Parts as follows:

- Part 1: *Determination of impurities in alumina*
- Part 2: *Determination of impurities in barium titanate*
- Part 3: *Determination of oxygen content of non-oxides by thermal extraction*
- Part 4: *Determination of oxygen content in aluminium nitride by XRF analysis*
- Part 5: *Determination of particle size distribution*
- Part 6: *Determination of specific surface area (withdrawn)*
- Part 7: *Determination of absolute density (withdrawn)*
- Part 8: *Determination of tapped bulk density*
- Part 9: *Determination of un-tapped bulk density*
- Part 10: *Determination of compaction properties*
- Part 11: *Determination of densification on natural sintering*
- Part 12: *Chemical analysis of zirconia*

Parts 6 and 7 of the series were superseded in 2005 by EN ISO 18757 and EN ISO 18753 respectively

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 725 describes a method for determining the densification of ceramic powders on natural sintering, without the application of any external pressure. The method is applicable to pure oxides, mixtures of oxides and solid solutions. Inorganic sintering additives may be used where their presence is reported.

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 623-2:1993, *Advanced technical ceramics — Monolithic ceramics — General and textural properties — Part 2: Determination of density and porosity*

EN 725-10, *Advanced technical ceramics — Methods of test for ceramic powders — Part 10: Determination of compaction properties*

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*

iTeh STANDARD PREVIEW
(standards.iteh.ai)

3 Principle

Measurements are made of the mass, dimensions and density of a compacted piece of ceramic powder, before and after sintering through thermal treatment. The results depend on the maximum temperature and the density after compaction, and are expressed as a function of these two main parameters.

4 Terms, symbols and units

Terms, symbols and units are given in Table 1.

Table 1 — Terms, symbols and units

Term	Symbol	Unit
Mass before sintering	M_a	kg
Mass after sintering	M	kg
Volume before sintering	V_a	m ³
Volume after sintering	V	m ³
Apparent density before sintering	d_a	kg/m ³
Apparent density after sintering	d	kg/m ³
Theoretical density	d_{th}	kg/m ³
Largest dimension of sample before sintering	L_a	m
Largest dimension of sample after sintering	L	m
Relative mass variation at the end of the sintering	$\frac{\Delta M}{M_a}$	-
Relative volume variation at the end of the sintering	$\frac{\Delta V}{V_a}$	-
Relative density variation at the end of the sintering	$\frac{\Delta d}{d_a}$	-
Relative length variation (shrinkage) at the end of the sintering	$\frac{\Delta L}{L_a}$	-
Sintering temperature	T	K

These characteristics are linked by the following relations:

$$d_a = \frac{M_a}{V_a} \qquad \frac{\Delta M}{M_a} = \frac{(M - M_a)}{M_a} \qquad \frac{\Delta d}{d_a} = \frac{(d - d_a)}{d_a}$$

$$d = \frac{M}{V} \qquad \frac{\Delta V}{V_a} = \frac{(V - V_a)}{V_a} \qquad \frac{\Delta L}{L_a} = \frac{(L - L_a)}{L_a}$$

5 Apparatus

5.1 Furnace, having a hot zone large enough to accommodate the required size and number of test pieces, and capable of maintaining the test temperature (T) so that the maximum temperature variation in the hot zone is 10 K. The furnace shall allow a constant heating rate, which can be controlled to within 2 K/h.

The furnace heating elements, thermal insulation and kiln furniture shall be selected to be chemically compatible with the test pieces, avoiding both surface reaction and generation of vapour pressure. The kiln furniture used to support the test pieces should be a sintered piece of the test material.

5.2 Balance, capable of weighing at least 10 g with an accuracy of $\pm 0,005$ g.

5.3 Micrometer, conforming to ISO 3611, or other suitable measuring device for measuring the dimensions of the compacts with an accuracy of $\pm 0,001$ mm.

6 Test pieces

Prepare the test pieces in accordance with EN 725-10, making at least three pieces at each of the compacting pressures selected from those given in EN 725-10.

7 Heating conditions

7.1 Selection of test temperatures

Measurements shall be made over a range of test temperatures. The lower limit of the range is defined as the temperature at which the relative density (d/d_{th}) is approximately 0,9. The higher limit is defined as either

- the temperature at which the onset of de-densification resulting from grain growth is observed; or
- the temperature at which a substantial loss of mass is recorded.

The temperature range shall be at least 100 K.

NOTE Preliminary tests may be used to define the temperature range, in which case the thermal cycle specified in 7.2 should be used.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

7.2 Thermal cycle

[SIST EN 725-11:2007](https://standards.iteh.ai/catalog/standards/sist/b60f3161-4b26-4cf8-803b-3c8446b9b95c/sist-en-725-11-2007)

The rates of heating shall be as follows: <https://standards.iteh.ai/catalog/standards/sist/b60f3161-4b26-4cf8-803b-3c8446b9b95c/sist-en-725-11-2007>

- from room temperature to 600 °C at 60 K/h;
- from 600 °C to the test temperature at 180 K/h.

The test temperature shall be maintained for 1 h. Cooling is normally achieved by switching off the heating in the furnace, but may be controlled when required, in which case the rates of cooling shall be reported.

8 Procedure

8.1 Measure the mass M_a , and the dimensions of each test piece. Designate the largest dimension as L_a . Calculate the density d_a from the mass and dimensions in accordance with EN 725-10.

8.2 Carry out the heat treatment on the test pieces in accordance with 7.2.

8.3 Re-measure the mass (M) and the dimensions of each test piece. Designate the largest dimension L . Calculate the density (d) from the mass and dimensions in accordance with EN 623-2:1993, Method 2.

9 Expression of results

Report the results of sintering in three expressions as follows (see clause 4).