

**SLOVENSKI STANDARD
SIST EN 1094-4:1998****01-april-1998**

Toplotnoizolacijski ognjevzdržni izdelki - 4. del: Ugotavljanje prostorninske mase in prave poroznosti

Insulating refractory products - Part 4: Determination of bulk density and true porosity

Feuerfeste Erzeugnisse für Isolationszwecke - Teil 4: Bestimmung der Rohrdichte und Gesamtporosität geformter Erzeugnisse

Produits réfractaires isolants - Méthodes d'essai - Partie 4: Détermination de la masse volumique apparente et de la porosité réelle

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EUROPEAN STANDARD

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August 1995

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English version

**Insulating refractory products - Part 4:
Determination of bulk density and true porosity**

Produits réfractaires isolants - Méthodes
d'essai - Partie 4: Détermination de la masse
volumique apparente et de la porosité réelle

Feuerfeste Erzeugnisse für Isolationszwecke -
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Foreword

This European Standard has been prepared by the Technical Committee CEN/TC 187 "Refractory products and materials", of which the secretariat 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of an identical text or by endorsement, at the latest by February 1996, and conflicting national standards shall be withdrawn at the latest by February 1996.

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

Reproducibility and repeatability data are not available, but may be given in a subsequent edition.

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EN 1094 'Insulating refractory products' consists of seven Parts:

- Part 1 : Terminology for ceramic fibre products
- Part 2 : Classification of shaped products
- Part 3 : Classification of ceramic fibre products
- Part 4 : Determination of bulk density and true porosity of shaped products
- Part 5 : Determination of cold crushing strength of shaped products
- Part 6 : Determination of permanent change in dimensions on heating of shaped products
- Part 7 : Methods of test for ceramic fibre products (ENV)

1 Scope

This Part of EN 1094 specifies a method of determination of the bulk density and true porosity of shaped insulating refractory products.

2 Normative references

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

EN 993-1 Methods of test for dense shaped refractory products
Part 1 : Determination of bulk density and apparent porosity

EN 993-2 Methods of test for dense shaped refractory products
Part 2 : Determination of true density

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3 Definitions

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For the purposes of this Part of EN 1094, the following definitions apply.

3.1 bulk density, ρ_b : The ratio of the mass of the dry material of a porous body to its bulk volume.

3.2 bulk volume, V_b : The sum of the volumes of the solid material, the open pores and the closed pores in a porous body.

NOTE : The roughness of the surface limits the accuracy of definition of the bulk volume and, in consequence, the bulk density. Also, the notion of bulk density becomes less precise when the volume of the sample diminishes below certain limits or when its texture (size of pores and grains) is too coarse.

3.3 true density, ρ_t : The ratio of the mass of the solid material of a porous body to its true volume.

3.4 true volume : The volume of the solid material in a porous body.

3.5 open pores : Those pores that are penetrated by the immersion liquid in the test specified in EN 993-1.

NOTE : These pores are, in principle, all those that are connected with the atmosphere, either directly or via one another. Here also the roughness of the surface imposes a limit to the accuracy of the definition of the volume of the open pores.

3.6 closed pores : Those pores that are not penetrated by the immersion liquid in the test specified in EN 993-1.

3.7 true porosity, π_t : The ratio of the total volume of the open pores and the closed pores in porous body to its bulk volume.

3.8 shaped insulating product : A shaped product having a true porosity of not less than 45 % (v/v).

4 Principle

The mass of a dry test piece of a specified geometrical form is determined by weighing and the dimensions are measured. From these values and from the true density of the material, (determined by the method specified in EN 993-2, the volume, bulk density and true porosity are determined by calculation.

NOTE : The method of immersion in a liquid and determination of the mass of the test piece when immersed and when soaked is not suitable for insulating refractory products because of their very open texture, which can lead to series errors in the determination of the mass of the test piece when soaked.

The precision of the results does not require any correction to be made for the fact that weighing is carried out in air, not in a vacuum.

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5 Apparatus

5.1 Callipers, graduated in 0,5 mm, or flat metal rule, graduated in 0,5 mm and having a square at one end which can be fitted to the edge of the test piece.

5.2 Drying oven, capable of being controlled at $(110 \pm 5) ^\circ\text{C}$.

5.3 Balance, with an accuracy of $\pm 0,1$ g.

5.4 Desiccator.

6 Test pieces

6.1 The number of items (for example, bricks or blocks) to be tested shall be determined by agreement between the interested parties.

6.2 If several items are tested, the same number of test pieces shall be taken from each item, so as to facilitate statistical calculation.

NOTE : The number of test pieces per item should be the subject of agreement between the interested parties.

6.3 The test pieces shall be rectangular with plane and parallel surfaces. The volume of each test piece shall be not less than 500 cm³ and no dimension of a test piece shall be less than 50 mm. The faces of each test piece shall be precisely formed to obtain a parallelepiped. For the purposes of this test, the test piece shall be considered to be a parallelepiped if, for each pair of opposite faces, the four measurements made along the centre lines of the faces that separate them do not differ by more than 1,0 mm.

6.4 In the case of insulating bricks that have been finished by sawing, the whole brick may be used as a test piece, provided that the faces are plane and parallel, the parallelism tolerance being as specified in 6.3.

7 Procedure

7.1 Using the callipers or the flat metal rule (see 5.1), measure the three principal dimensions (length l , breadth b , the thickness d) of each test piece to within 0,5 mm. The measurements shall be made at the centre line of each face (i.e. four times for each dimension) and the mean of the four measurements shall be noted for each of the three dimensions.

7.2 Dry the test pieces carefully in the drying oven (see 5.2), controlled at (110 ± 5) °C, allow to cool to ambient temperature in the desiccator (see 5.4), and weigh each test piece to the nearest 0,1 g.

7.3 Repeat the drying, cooling and weighing operations until constant mass is reached, i.e. until two successive weighings made before and after at least 2 h in the drying oven do not differ by more than 0,1 %.

7.4 Determine the true density in accordance with EN 993-2.

8 Expression of results

8.1 The bulk volume V_b of the test piece is given, in cubic centimetres, by the equation

$$V_b = lbd$$

where l , b and d are the length, breadth and thickness, respectively, in centimetres, of the test piece.

8.2 The bulk density ρ_b of the test piece is given, in grams per cubic centimetre, by the equation

$$\rho_b = \frac{m}{V_b}$$

where

m is the dry mass, in grams;
 V_b is the bulk volume, in cubic centimetres.