

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[SIST EN 993-3:1998](https://standards.iteh.ai/catalog/standards/sist/bf95497f-21db-4ffb-a8b1-a83c51004548/sist-en-993-3-1998)

<https://standards.iteh.ai/catalog/standards/sist/bf95497f-21db-4ffb-a8b1-a83c51004548/sist-en-993-3-1998>

EUROPEAN STANDARD

EN 993-3

NORME EUROPÉENNE

EUROPÄISCHE NORM

May 1997

ICS 81.080.00

Descriptors: refractory materials, shaped refractories, dense shaped refractory products, components, carbon, tests, determination, physical properties, coking, volatile matter, physical tests

English version

Methods of test for dense shaped refractory products - Part 3: Test methods for carbon-containing refractories

Méthodes d'essai pour produits réfractaires façonnés denses - Partie 3: Méthodes d'essai pour réfractaires contenant du carbone

Prüfverfahren für dichte geformte feuerfeste Erzeugnisse - Teil 3: Prüfungen für kohlenstoffhaltige Erzeugnisse

STANDARD PREVIEW
(standards.iteh.ai)

[SIST EN 993-3:1998](https://standards.iteh.ai/catalog/standards/sist/bf95497f-21db-4ffb-a8b1-a83c51004548/sist-en-993-3-1998)

<https://standards.iteh.ai/catalog/standards/sist/bf95497f-21db-4ffb-a8b1-a83c51004548/sist-en-993-3-1998>

This European Standard was approved by CEN on 1997-04-21. 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.

The European Standards exist 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, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart, 36 B-1050 Brussels

Page 2
EN 993-3:1997

Contents

	Page
Foreword	3
1 Scope	4
2 Normative references	4
3 Definitions	4
4 Principle	5
5 Test pieces	5
6 Removal of volatile components	6
7 Determination of carbonization properties	7
8 Physical testing	9
9 Test report	12

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[SIST EN 993-3:1998](https://standards.iteh.ai/catalog/standards/sist/bf95497f-21db-4ffb-a8b1-a83c51004548/sist-en-993-3-1998)

<https://standards.iteh.ai/catalog/standards/sist/bf95497f-21db-4ffb-a8b1-a83c51004548/sist-en-993-3-1998>

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 187 "Refractory products and materials", 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 November 1997, and conflicting national standards shall be withdrawn at the latest by November 1997.

It is closely based on the corresponding International Standard, ISO 10060 'Dense shaped refractory products - Test methods for products containing carbon' published by the International Organization for Standardization (ISO).

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

EN 993 'Methods of test for dense shaped refractory products' consists of 18 Parts.

- Part 1 : Determination of bulk density, apparent porosity and true porosity
- Part 2 : Determination of true density
- Part 3 : Test methods for carbon-containing refractories
- Part 4 : Determination of permeability to gases
- Part 5 : Determination of cold crushing strength
- Part 6 : Determination of modulus rupture at ambient temperatures
- Part 7 : Determination of modulus rupture at elevated temperatures
- Part 8 : Determination of refractoriness-under-load
- Part 9 : Determination of creep in compression
- Part 10 : Determination of permanent change in dimensions on heating
- Part 11 : Determination of resistance to thermal shock (ENV)
- Part 12 : Determination of pyrometric cone equivalent
- Part 13 : Specification for pyrometric cones
- Part 14 : Determination of thermal conductivity (hot wire, cross-array)
- Part 15 : Determination of thermal conductivity (hot wire, parallel)
- Part 16 : Determination of resistance to acids
- Part 17 : Determination of bulk density of granular material (mercury method)
- Part 18 : Determination of bulk density of granular material (water method)

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

1 Scope

This European standard specifies test methods for refractory products based on oxides and which contain carbon. The carbon may be added in an elemental form such as graphite, or as carbonaceous materials such as pitch, tar or resin.

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 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, apparent porosity and true porosity.

EN 993-4 Methods of test for dense shaped refractory products - Part 4 :
Determination of permeability to gases.

prEN 993-5 Methods of test for dense shaped refractory products - Part 5 :
Determination of cold crushing strength

EN 993-6 Methods of test for dense shaped refractory products - Part 6 :
Determination of modulus of rupture at ambient temperature

3 Definitions

For the purposes of this European standard, the following definitions apply:

3.1 pitch-bonded or tar-bonded refractory: An unfired carbon containing refractory shape which is produced by pressing a mixture of graded aggregate and pitch or tar.

3.2 pitch-bonded or tar-bonded tempered refractory: A pitch or tar bonded carbon containing refractory shape which has been heated to a relatively low temperature (up to 800 °C).

3.3 resin-bonded refractory: An unfired carbon containing refractory shape which has been produced by pressing a mixture of graded aggregate and resin.

3.4 resin-bonded tempered refractory: A resin bonded carbon containing refractory shape which has been heated to a relatively low temperature (up to 800 °C):

3.5 pitch-impregnated or tar-impregnated refractory: A carbon containing refractory shape that has been impregnated by liquid pitch or tar after forming.

NOTE: Such a shape may be either a fired product, or the refractory shapes defined in 3.1 to 3.4.

3.6 carbonization: The process of removing volatile components from test-pieces of refractory which has been either bonded or impregnated with carbonaceous materials such as pitch, tar or resin, so as to retain the residual carbon.

3.7 anti-oxidant: Metallic element or other substance added to the shaped products defined in 3.1 to 3.4 in order to improve their resistance to oxidation.

4 Principle

Determination of physical properties of products containing carbon, both before and after the removal of volatile components by carbonization.

STANDARD PREVIEW
(standards.iteh.ai)

5 Test pieces

SIST EN 993-3:1998
<https://standards.iteh.ai/catalog/standards/sist/bf95497f-21db-4ffb-a8b1-a83c51004548/sist-en-993-3-1998>

5.1 Size

Test pieces shall be of the size specified for each individual test method.

NOTE : Where irregularly shaped articles are tested, it may not be possible to obtain the appropriate size. In these cases, any variation of size should maintain a similar test piece volume or geometry; such variations should be reported.

5.2 Preparation

Test pieces shall be cut or drilled from the test brick or block, parallel to the direction of pressing.

NOTE 1 : Materials containing graphite or carbon may exhibit marked anisotropy. For full characterization, samples may additionally be cut to be representative of the three axes at right angles.

Where wet cutting saws or drills are used, test pieces shall be dried using either a blast of warm air or a fan-assisted drying oven with free air flow to all surfaces.

NOTE 2 : Where there is a possibility of softening or evaporation of volatile components, e.g. for pitch-bonded refractories, the temperature should not be greater than 40 °C.

5.3 Water sensitive materials

Water sensitive material which is to be carbonized shall not be brought into contact with water. Water sensitive material which is to be tested at ambient temperature may be prepared wet if it does not remain in contact with water for longer than 30 min, and if during this time no hydration occurs. If these criteria are not met, (e.g. for untempered dolomite) the material shall either be machined dry or by using a non reacting liquid.

6 Removal of volatile components

6.1 General

Some carbon-containing refractories, including the types defined in clause 3, contain volatile components. Carbonization is required for the determination of carbonization properties (see clause 7) and for some further physical testing (see clause 8.2).

6.2 Apparatus

6.2.1 Furnace, gas or electric fired, capable of containing the carbonization box (see 6.2.3), and having a heat capacity such that when it is maintained at 1000 °C, the temperature at the centre of the carbonization box will rise from ambient temperature to 980 °C within 3 h. It is necessary to make sure that the furnace is sufficiently ventilated.

6.2.2 Balance, capable of weighing to within 0,2 g.

6.2.3 Carbonization box and lid, made from heat resisting steel 3 mm thick and suitable for use at 1000 °C. The design and minimum dimensions shall be as shown in figure 1. Either the lid or a side shall contain a central hole allowing a sheathed thermocouple (see 6.2.4) to be inserted. The lid shall also contain a vent hole of diameter 3 mm. In order to avoid oxidation through air draughts, only the vent hole should remain open.

NOTE : When there is deformation of the box and the lid, or where an oxidizing furnace atmosphere is used, oxidation of the contents may occur. In such cases it is recommended to seal the box, for instance with air-set mortar or by using a sand seal into which the lid is placed. When using this latter configuration, a vent hole is not necessary.

6.2.4 Sheathed thermocouple, suitable for measurement to 1000 °C ± 10 °C.

6.2.5 Desiccator, containing silica gel, or phosphorus pentoxide.

6.2.6 Metallurgical coke, of grain size 0,5 mm to 2 mm, which shall be pre-fired in the carbonization box for 2 h at 1000 °C ± 10 °C before use, and then stored under dry conditions.

6.3 Preparation of the carbonization box

Place a layer of metallurgical coke (see 6.2.6), at least 25 mm in depth, on the bottom of the carbonization box (see 6.2.3).

Where required for determination of carbonization properties (see clause 7), weigh each test piece to 0,2 g (m_1).

Place the test pieces on the layer of coke, equidistantly from the sides of the box, in such a way that there is at least 25 mm thickness of coke between the test pieces and the walls of the box (see figures 1a and 1b). Where required, insert blanks of the same size (see 5.2) and of similar chemical composition, to give even spacing within the box. Surround the test pieces with the metallurgical coke, submerging them to a depth of at least 25 mm.

Position the lid as shown in figure 1, and insert the thermocouple (see 6.2.4), positioned centrally with respect to the test pieces.

6.4 Carbonization procedure

Heat the furnace (see 6.2.1) to $1000\text{ °C} \pm 10\text{ °C}$ and maintain at this temperature for 2 h. Place the carbonization box and contents in the hot furnace, whilst maintaining the furnace at $1000\text{ °C} \pm 10\text{ °C}$. Note the time at which the temperature shown on the thermocouple (see 6.2.4) reaches 980 °C (see 6.2.1).

Maintain the furnace at $1000\text{ °C} \pm 10\text{ °C}$ for 2 h after this time.

<https://standards.iteh.ai/catalog/standards/sist/bf95497f-21db-4ffb-a8b1-38770d0c8709/sist-en-993-3-1998>
NOTE : For fine textured products, reproducible results may be obtained only after carbonizing for a longer period, e.g. 5 h. This may be done only by prior agreement between supplier and customer and this fact reported with the test results.

Remove the carbonization box from the hot furnace, allow to cool naturally to 100 °C , as shown by the thermocouple (see 6.2.4) and then transfer the test pieces to the desiccator. Cool the test pieces to room temperature, and remove any coke adhering to the test pieces. If required (see 6.3), weigh each test piece to the nearest 0,2 g (m_2), and record this as the carbonized mass.

7 Determination of carbonization properties

7.1 Test pieces

Test pieces for the determination of the series of carbonization properties given in 7.2 to 7.4 shall be either cubes of side $50\text{ mm} \pm 2\text{ mm}$, or cylinders of diameter and height $50\text{ mm} \pm 2\text{ mm}$.