SLOVENSKI STANDARD
SIST ENV 1402-5:2000

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Neoblikovani ognjevzdržni izdelki - 5. del: Priprava vzorcev za preskus

Unshaped refractory products - Part 5: Preparation and treatment of test pieces

Ungeformte feuerfeste Erzeugnisse - Teil 5: Herstellung und Behandlung von Probekörpern

Produits réfractaires non façonnés - Partie 5: Préparation et traitement des éprouvettes

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81.080 Ognjevzdržni materiali Refractories

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Produits réfractaires non façonnés - Partie 5: Préparation et traitement des éprouvettes

Ungeformte feuerfeste Erzeugnisse - Teil 5: Herstellung und Behandlung von Probekörpern

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The period of validity of this ENV is limited initially to three years. After two years the members of CEN will be requested to submit their comments, particularly on the question whether the ENV can be converted into a European Standard.

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

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

Contents

Foreword

This European Prestandard has been prepared by Technical Committee CEN/TC 187 "Refractory products and materials", the secretariat of which is held by BSI.

ENV 1402 'Unshaped refractory products' consists of eight Parts:

Part 1 : Introduction and definitions
Part 2 : Sampling for testing
Part 3 : Characterization as received
Part 4 : Determination of consistency of castables
Part 5 : Preparation and treatment of test pieces
Part 6 : Measurement of physical properties
Part 7 : Tests on pre-formed shapes
Part 8 : Determination of complementary properties

The values of the properties obtained using these test-pieces are used to assess the homogeneity of unshaped materials. They are reference values which do not necessarily correspond with those obtained in industrial applications. Other methods of test-piece preparation or treatment, which differ from those specified by this standard, can lead to different values.

Repeatability and reproducibility data are not available, but may be given in a subsequent edition.

CEN/TC 187 approved this European pre-standard by resolution No 4 during its sixth meeting held in Paris, 93-10-06.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to announce this European Prestandard: 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 Part of ENV 1402 specifies methods for the preparation and treatment (curing, drying and firing) of test pieces from unshaped refractory materials. The dimensions of the test pieces are specified.

The methods are applicable to dense and insulating castables and to mouldable materials (plastics and ramming mixes) with the four types of chemical composition defined in ENV 1402-1.

2 Normative references

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

ENV 1402-1 :	Unshaped refractory products - Part 1 : Introduction and definitions
ENV 1402-2 :	Unshaped refractory products - Part 2 : Sampling for testing
ENV 1402-4 :	Unshaped refractory products -Part 4 : Determination of consistency of castables
EN 993-3 :	Methods of test for dense shaped refractory products - Part 3 : Test methods for carbon-containing refractories
EN 1094-4 :	Insulating refractory products - Part 4 : Determination of bulk density and true porosity

3 Principle

The dimensions of the test pieces are stated and the preparation of the mixture, compaction methods, storage and post-treatment of the test pieces are described.

4 Dimensions of test pieces

Shape A: Length: 230 mm; width: 114 mm; thickness: 64 mm
Shape B: Length: 230 mm; width: 64 mm; thickness: 54 mm
Shape C: Length: 230 mm; width: 64 mm; thickness: 64 mm

The width of the test piece as tested shall correspond to the height during preparation. The vibration of the test piece during preparation shall be recorded, and for shape C the compaction surface shall be marked for reference. The selection of test pieces for each type of material shall be as given in table 1, except that for basic dense castables and mouldables, test pieces with a diameter of 50 mm and height of 50 mm ± 1 mm are permissible. Shape C shall be used as the referee shape.

Table 1: Type of shape for tests

(C) Castables	(DC) Dense Castables	Main Grain Size <15 mm		Shape B or C	Shape A
			Direct characterization [2]	X	
			Other tests		X
		Main Grain Size >15 mm	Direct characterization [2]	X [1]	
			Other tests		X
	(IC) Insulating castables				X
(M) Mouldables	(RM) Ramming mixes			X	
	(PM) Plastics			X	

[1] For these materials, shapes B and C are prepared by cutting from shape A.

[2] Test for which results are directly obtained from the bars without size modifications are modulus of rupture, cold compressive strength, and permanent change in dimensions on heating.

5 Apparatus

5.1 Separator

A riffle sampler, suitable for use with the maximum particle size of the product, or a shovel for the quartering method. The riffle separation shall be at least 2,5 times the maximum grain size.

5.2 Mixer

5.2.1 Pan.

See figure 1. The pan shall be symmetrical around axis A and shall have a capacity of 15 l to 30 l. Both the pan and the mixing blade (see 5.2.2) shall be constructed from a material that does not react with the test material.

5.2.2 Mixing blade.

The shape of the mixing blade shall be adapted to the internal dimensions of the pan. The radius swept shall be such that the distance between the blade and the wall of the pan and the space between the blade and the bottom of the pan are at least as large as the maximum grain size of the material. For products with a maximum grain size of 6 mm or less, the distance between the blade and the wall shall be 6 mm. For products with larger grain sizes (up to 25 mm), the blade is used in a manner such that the distance to the wall of the pan is 25 mm.

The mixing blade shall revolve at a speed between 40 min^{-1} and 65 min^{-1} around axis A (the symmetry axis of the mixing pan), the blade rotating simultaneously in the opposite direction at a speed between 120 min^{-1} and 145 min^{-1} around axis B (symmetry axis of the blade).

5.3 Vibrating table

The vibrating table shall be flat and horizontal and shall perform only uniaxial vertical vibrations at frequency of 50 Hz. The table shall be capable of being set at a double amplitude of 0,75 mm for regular castables (RCC) and of 0,50 mm for deflocculated castables (DCC) (see ENV 1402-1) with an accuracy of ± 0,05 mm for the entire procedure. There shall be an automatic adjustment to the required double amplitude despite the weight of the mould.

5.4 Pneumatic rammer

A compressed-air rammer, with the rammer foot suitable for the width of the mould and having a smooth, flat working surface, i.e. 52 mm x 25 mm for shape B and 62 mm x 25 mm for shape C.

The mass of the rammer and the frequency of ramming shall be chosen in order to obtain a prescribed green bulk density, which shall be reported in the test report.

5.5 Sand rammer

An apparatus known as a 'sand-rammer' or an 'AFS-sand-rammer', consisting of a mould 50 mm or 50,8 mm in inside diameter, and 140 mm or 120,6 mm in length, a 6,35 kg or 6,4 kg weight sliding on the shaft of the apparatus and arranged to fall a distance of 50 mm or 50,8 mm before engaging a collar attached to the shaft. At the lower end of the shaft there is a plunger, the diameter of which is about 0,3 mm smaller than the inside diameter of the mould (see figures 2 and 3).

5.6 Power press

A hydraulic type press, equipped with suitable moulds for forming test pieces of the required size. The press shall be capable of applying a minimum of 10 MPa pressure to the moulded face.

NOTE : The power press should only be used for shaping test pieces from plastics.

5.7 Trowel

Pointing type or stiff-bladed spatula with a typical size of 150 mm length and 50 mm width.

5.8 Moulds

Moulds, which are capable of being dismantled and are watertight. They shall be made from a material that does not react with the material to be tested.

For compaction by pneumatic rammer, the moulds shall be rigid so that they do not warp during ramming.

NOTE 1 : Steel or similar material is recommended, to withstand the stroke of the rammer.

The internal measurements of the moulds are determined by the dimensions of the test pieces. The surfaces 230 mm x 64 mm (shapes A and C) and 230 mm x 54 mm (shape B) are the horizontal surfaces during the compaction process. A variance of ± 0,5 mm is allowed for these dimensions. If multi-compartment moulds are used, the size of the mould shall be adapted with the number of test pieces prepared and is indicated in the test report.

In order to overfill the mould, an overfill ring is required for all unshaped materials. This ring shall taper slightly upwards. For castables, it can at the same time serve as a clamp to the vibrating table. The mould, the overfill ring and the clamp shall have sufficient rigidity to ensure that only the induced vibrations and the required frequency and amplitude will occur.

NOTE 2 : It is recommended that all internal surfaces of the mould should be slightly oiled before filling.

5.9 Balances

Balances, capable of weighing up to 25 kg, with an accuracy of ± 10 g, up to 5 kg with an accuracy of ± 1 g and up to 500 g with an accuracy of ± 0,1 g.

5.10 Steel lath

Steel lath of typical size 500 mm x 30 mm x 5 mm, used for scraping off overfill after casting.

5.11 Humidity cabinet

Humidity cabinet, capable of maintaining a relative humidity of 90 % or greater, and of controlling the temperature between 18 °C and 22 °C.

5.12 Drying oven

Drying oven, fan-assisted and having openings to enable efficient ventilation.

5.13 Firing furnace

Electric or gas fired furnace for firing to 1700 °C with a temperature distribution over the hot zone of ± 10 K. The heating rate shall be programmable.

Electric firing shall be used as the referee method.

5.14 Stopwatch or stopclock

5.15 Thermometer

5.16 Silicon carbide box

Silicon carbide box with cover, with dimensions such that it is capable of containing 2 or 4 test pieces (shape B or C) with the same distances (= 25 mm) between the test pieces and the wall. The box is filled with metallurgical coke (0,5 mm to 2 mm)

NOTE : The wall thickness should be as thin as possible and the thermal conductivity as high as possible to minimize the temperature gradient.

6 Preparation of castable test pieces

6.1 Dense castables (DC)

6.1.1 Preparation of the material for shaping

Reduce the amount of material to the required quantity with the riffle sampler or the shovel (see 5.1) in order to obtain the desired batch size for testing and thoroughly mix before use. The batch size depends on the number of test pieces to be prepared. The number of test pieces to be prepared shall be chosen in accordance with ENV 1402-2.

In cases where several components are supplied separately, mix each material first carefully by itself, then mix all carefully together. Before the shaping of test pieces, maintain the material for testing at a temperature between 18 °C and 22 °C for 24 h.

Water or a special mixing liquid (necessary for the mix and supplied by the manufacturer) can be used for mixing. When water is used, pure mains water with a maximum degree of hardness of 30° is used, and its temperature maintained between 18 °C and 22 °C.

Determine the amount of liquid either by a consistency test in accordance with ENV 1402-4, or use the amount stipulated by the manufacturer. Pour the amount of the dry material required into the mixer and mix for 30 s for homogenization. Add the liquid with an accuracy of 0,1 g per 100 g of dry substance. After having made a crater in the centre of the material, pour the liquid progressively into the crater and start the mixer. Add the remaining liquid in less than 1 min. Note the relation, *E*, between the quantity of water and the quantity of dry material (in ml/g).

Mix the batch for between 2 min and 6 min, according to the manufacturer's instructions. If necessary, switch the mixer off after 2 min mixing time, in order to scrape off the adhering material at the edges of the mixer.

Note the temperature of the batch before shaping.

6.1.2 Shaping of test pieces

6.1.2.1 Compaction by vibration

The mix prepared in accordance with the instructions in 6.1.1 is compacted by vibration. The total time for the preparation of the mix and for making the test pieces shall not exceed 10 min.

Fill the mould in twice with its overfill ring, vibrate the mix according to the time and the double amplitude as indicated in table 2. During the initial vibration, add material to the mould so that the level of material reaches the top of the overfill ring, and continue the vibration to its completion.