

Unshaped refractory products —

Part 7: Tests for preformed shapes

ICS 81.080

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National foreword

This Draft for Development is the English language version of ENV 1402-7:1998.

This publication is not to be regarded as a British Standard.

It is being issued in the Draft for Development series of publications and is of a provisional nature because it is considered that further experience is required in its application before it is converted into a British Standard. It should be applied on this provisional basis, so that information and experience of its practical application may be obtained.

Comments arising from the use of this Draft for Development are requested so that UK experience can be reported to the European organization responsible for its conversion to a European Standard. A review of this publication will be initiated 2 years after its publication by the European organization so that a decision can be taken on its status at the end of its three-year life. The commencement of the review period will be notified by an announcement in *Update Standards*.

According to the replies received by the end of the review period, the responsible BSI Committee will decide whether to support the conversion into a European Standard, to extend the life of the prestandard, or to withdraw it. Comments should be sent in writing to the Secretary of BSI Subcommittee RPI/1/1, Sampling and physical testing of refractory materials, at 389 Chiswick High Road, London, W4 4AL, giving the document reference and clause number and proposing, where possible, an appropriate revision of the text.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled “International Standards Correspondence Index”, or by using the “Find” facility of the BSI Standards Electronic Catalogue.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the ENV title page, pages 2 to 18 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

This Draft for Development, having been prepared under the direction of the Sector Board for Materials and Chemicals, was published under the authority of the Standards Board and comes into effect on 15 September 1998

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Amendments issued since publication

Amd. No.	Date	Comments

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This European Prestandard (ENV) was approved by CEN on 1 July 1998 as a prospective standard for provisional application.

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.

CEN members are required to announce the existence of this ENV in the same way as for an EN and to make the ENV available promptly at national level in an appropriate form. It is permissible to keep conflicting national standards in force (in parallel to the ENV) until the final decision about the possible conversion of the ENV into an EN is reached.

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CEN

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

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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 seven Parts:

- *Part 1: Introduction and definitions;*
- *Part 2: Sampling;*
- *Part 3: Characterization as received;*
- *Part 4: Consistency testing;*
- *Part 5: Preparation and treatment of test pieces;*
- *Part 6: Determination of properties of test pieces;*
- *Part 7: Tests on pre-formed shapes.*

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.

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1 Scope

This European Prestandard specifies methods for the testing of as-delivered pre-formed shapes. It applies to shapes fabricated from dense and insulating castables and mouldable materials (plastics and ramming mixes) as defined in ENV 1402-1.

NOTE Acceptance values for the individual test methods described should be agreed between the parties involved.

2 Normative references

This European Prestandard incorporates, by dated or undated references, 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 — Introduction and definitions*.

ENV 1402-6, *Unshaped refractory products — Determination of properties of test pieces*.

3 Definitions

For the purposes of this European Prestandard the following definitions apply:

3.1 corner defect

a missing corner, defined by the three dimensions a , b and c as indicated in Figure 1

3.2 edge defect

a missing edge, defined by the three dimensions, e , f , and g as indicated in Figure 2

3.3 crater

a clearly defined hole in the surface of a shape whose parameters, i.e. maximum diameter, minimum diameter and depth, can be measured

NOTE Its origin can be a bubble produced during manufacture.

3.4 hairline cracks

fine cracks visible on the surface of a shape whose length can be measured and whose width is less than or equal to 0,2 mm. See Figure 3

3.5 surface crazing

a network of hairline cracks confined to the surface of the shape. See Figure 3

3.6 open cracks

cracks or tears on the surface whose length is more than 10 mm and whose width is more than 0,2 mm. See Figure 3

3.7 protrusions and indentations

imperfections that can occur during fabrication or firing, if applicable

3.8 fins

a thin layer of material on the face of a shape that projects beyond the edge

3.9 segregation

separation of aggregate and fines during fabrication to leave a honeycomb appearance and/or a layer of excess fines

3.10 friability

crumbly texture due to poor consolidation and/or mould leakage

3.11 warpage

the deviation of a plane surface from being flat

4 Principle

Testing of pre-formed shapes by qualitative and/or quantitative methods. These methods are of two types:

- a) **Inspection by attributes** (evaluation of the integrity of a refractory shape by visual inspection of cracks or other surface defects and by conformance to dimensional tolerances);
- b) **Inspection by variables** (evaluation of the quality of a refractory shape by determining physical properties using appropriate destructive or non-destructive test methods).

NOTE It is not obligatory to use all the test methods described in this European Prestandard when determining the quality of a pre-formed shape.

5 Apparatus

5.1 Linear measuring devices, steel tape and/or callipers in accordance with the tolerance required and conforming to an accuracy twice the intended accuracy of the measurement.

NOTE Where possible, linear tolerances less than 1 mm should be measured with callipers. Steel tape measurements are accurate to the millimetre (0,5 mm can be estimated) whereas callipers are accurate to 0,1 mm.

5.2 Steel straightedge, at least 5 mm thick and of sufficient length to span the diagonal of the largest shape to be measured.

5.3 Two steel measuring wedges, which shall be either:

- a) type 1, at least 50 mm in length and 10 mm in thickness at one end, of uniform cross section for a length of at least 10 mm from that end and then tapering to zero thickness at the other end (see for example Figure 4a), or
- b) type 2, up to 160 mm in length with an even taper from 4 mm to zero (see for example Figure 4b).

Each wedge shall be graduated and numbered along the slope to show the thickness of the wedge between the base and the slope in increments of either 0,5 mm (type 1) or 0,1 mm (type 2).

5.4 Graticule, with 0,1 mm graduations and/or feeler gauges of an appropriate size and accuracy to be used for the measurement of crack width. If necessary, the gauges can be replaced by measuring wedges of appropriate accuracy.

5.5 Sliding bevel, for the measurement of angles.

5.6 Depth gauge calibrated in millimetres of depth, having a probe of 3 mm diameter.

5.7 Breakage defect sizer, with a slot uncovering 2 mm on both surfaces, for determination of minimum defect sizes for corner and edge defects, according to Figure 5.

NOTE 1 One breakage defect sizer can be used together with a steel straightedge for the measurement of corner defects (see 6.5). Two breakage defect sizers can be used together with a linear measuring device for the measurement of edge defects (see 6.6).

NOTE 2 A breakage defect sizer permits an objective definition of the point of departure for the measurement of the size of a broken edge.

5.8 Balance, capable of measuring to an accuracy of 1 %.

5.9 Ultrasonic pulse velocity measuring equipment.

5.10 Equipment for determining the resonant frequency by mechanical shock.

5.11 Rebound hammer.

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

5.13 Furnace, capable of operating at $1\text{ }050\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$.

6 Inspection by attributes

6.1 Preparation of the test piece

The shape of the test piece shall be prepared by first measuring any protrusions or indentations. Any protrusions or indentations shall be removed by light abrasion.

6.2 Measurement of dimensions

Linear dimensions shall be measured by means of a linear measuring device (see 5.1), and unless otherwise agreed, shall be measured to the nearest 0,5 mm.

6.3 Measurement of angles

Angles shall be measured by adjusting the sliding bevel to fit the shape (see Figure 12) and the angle determined by use of a protractor (see Figure 13).

6.4 Measurement of warpage

For a concave surface, place the straightedge on edge across a diagonal of the surface being tested, insert a wedge at the point of maximum warpage (ensuring that the reading is not affected by raised imperfections on the castable surface) and record the maximum obtainable reading to the nearest 0,5 mm at the point of contact between the wedge and the straightedge.

For a convex surface, insert a wedge at each end of the straightedge and perpendicular to it as shown in Figure 6. Adjust the wedges, to a position not more than 15 mm from the corner of the shape, so that equal readings are obtained from each of them, making certain that contact is maintained by the straightedge at the point of maximum convexity. Record the readings to the nearest 0,5 mm.

The expression of results can be given as a ratio of warpage, W , in per cent, according to the formula:

$$W = \frac{100h}{l} \quad (1)$$

where:

l is the length of the diagonal of the surface being tested, in millimetres;

h is the reading of the amount of warpage, in millimetres.