BRITISH STANDARD

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1402-1:2003

Unshaped refractory products —

Part 1: Introduction and classification

The European Standard EN 1402-1:2003 has the status of a British Standard

ICS 01.040.81; 81.080

National foreword

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Summary of pages

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Unshaped refractory products - Part 1: Introduction and classification

Produits réfractaires non façonnés - Partie 1: Introduction et classification

Ungeformte feuerfeste Erzeugnisse - Teil 1: Einführung und Klassifizierung

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EUROPÄISCHES KOMITEE FÜR NORMUNG

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

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Contents

Foreword

This document (EN 1402-1:2003) 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of an identical text or by endorsement, at the latest by April 2004, and conflicting national standards shall be withdrawn at the latest by April 2004.

This document supersedes ENV 1402-1:1994.

EN 1402 "*Unshaped refractory products*" consists of eight parts:

— *Part 1: Introduction and classification*

— *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*

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, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

The general objective of this part of EN 1402 is to define, with as much accuracy as possible, the control of unshaped refractory products with special reference to:

a) quality control;

b) checking the conformity of the delivery as compared with claimed properties;

c) the control of batch homogeneity;

d) the final control of linings.

Properties are unavoidably influenced by industrial placing as a result of the equipment, environmental conditions and often by specific site conditions (target date, location). Quality control and final control of lining should not be considered in the same documents, since the former requires accuracy and clean operative methods while the latter requires the control of the placing.

Unshaped refractory products used in industrial linings are not fired, so that firing which results from use creates complicated conditions that make control difficult. The main points to be mentioned are:

i) the temperature gradient, the consequence of which is a property gradient;

ii) the level of maximum temperature reached on the hot face directly depends on the working temperature of the equipment;

iii) the life of the equipment may be numbered in hours or in years.

It should be noted that properties measured in the laboratory frequently do not reflect the properties of the material when installed.

1 Scope

This part of this European Standard defines terms relating to unshaped refractory products and establishes the classification for the various types of products.

Raw materials and crushed or granulated refractory materials which do not contain any binder are excluded.

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 (including amendments).

EN 1094-4, *Insulating refractory products - Part 4: Determination of bulk density and true porosity.*

EN 1402-6, *Unshaped refractory products - Part 6: Measurement of physical properties*.

ISO 565, *Test sieves - Metal wire cloth, perforated metal plate and electroformed sheet - Nominal sizes of openings*.

3 3Terms and definitions

For the purposes of this European Standard, the following terms and definitions apply.

3.1
unshaped refractory materials
mixtures which consist of an aggregate and a bond or bonds, prepared ready for use either directly in the condition in which they are supplied or after the addition of one or more suitable liquids

NOTE 1 They can contain metallic, organic or ceramic fibre material.

NOTE 2 These mixtures are either dense or insulating. Insulating mixtures are those whose true porosity is not less than 45 % when determined in accordance with EN 1094-4, using a test piece fired to specified conditions.

3.2
pre-formed shapes
shapes made from unshaped refractory materials, cast or moulded and pre-treated by the manufacturer, so that they can be directly placed in service

NOTE They may have a thermal pre-treatment.

4 Product types and methods of placement

4.1 Refractory castables

4.1.1 General

Mixtures of refractory aggregates and bond(s), mainly supplied dry and used after the addition and mixing with water or another liquid. They are placed by casting with vibration, by casting without vibration (self-flowing), by rodding, by shotcreting or when necessary by tamping. The bond is formed and hardening takes place without heating.

4.1.2 Regular castable

Hydraulically bonded refractory castable containing cement but without deflocculant.

4.1.3 Deflocculated castable

Hydraulically bonded refractory castable containing cement, a minimum of 2 % by weight of ultra fine particles (less than one micron) and at least one deflocculating agent.

This type is in turn sub-divided into the four categories given in Table 1.

Table 1 — Categories of deflocculated cement castable

Category	Content (%) CaO	
	Min	Max
Medium cement castable (MCC)	> 2,5	-
Low cement castable (LCC)	> 1,0	≤ 2,5
Ultra low cement castable (ULCC)	> 0,2	≤ 1,0
No cement castable (NCC)	0	≤ 0,2

4.1.4 Chemically bonded castable

Refractory castable containing one or more chemical bonds (see 3.3) which cause hardening.

4.2 Refractory gunning materials

Mixtures of refractory aggregates and bond(s), specially prepared for placing by pneumatic or mechanical projection.

They may be either:

a) castables (see 4.1) (dense or insulating) which are supplied dry and used after the addition of water during or before gunning;

b) plastics (see 4.3.2) which are especially designed for gunning under high air pressure with special equipment, and are normally delivered in a ready to use state.

According to the type of bond, a further distinction is made between hydraulically bonded, chemically bonded and ceramic bonded gunning materials.

4.3 Refractory ramming materials

4.3.1 Refractory ramming mixes

Materials which are non-coherent before use, made up of refractory aggregates, bond(s) and if necessary liquid(s). According to the type of product, the main bond may be ceramic, chemical (inorganic or organic-inorganic) or organic.

The materials are used as delivered or after the addition of liquid(s) and placed by ramming (manual or mechanical) or vibration. They harden under the action of heat above ambient temperature.

4.3.2 Plastic refractory materials

Materials which are coherent and ready for use, with a plastic consistency, made up of refractory aggregates, bond(s) and liquid(s). According to the type of product, the main bond may be ceramic, chemical (inorganic or organic-inorganic) or organic.

The materials are supplied in soft, pre-formed blocks or slices and placed by ramming (manual or mechanical). Installation without shuttering is possible. They harden under the action of heat above ambient temperature.

Plastic refractory materials have indices of workability (see EN 1402-3) of greater than 14 after stabilization.

4.4 Refractory jointing materials

Materials intended for laying and jointing bricks or blocks by trowelling, grouting in the joints, or dipping the brick or block to be bonded. They are mixtures of fine refractory aggregates and bond(s), supplied in the dry state or mixed with water ready for use. There are two main types:

a) heat setting jointing materials, which harden at elevated temperature by chemical or ceramic bonds,

b) air setting jointing materials, which harden at ambient temperature by chemical or hydraulic bonds.

4.5 Other unshaped refractory products

4.5.1 Dry mixes

These materials are specially designed to be placed in the dry state by vibration, “vibrocompaction” or ramming. During placing they reach a maximum compaction and it becomes possible to remove the former either before or after heating. They may include a temporary bond but are eventually ceramic bonded.

4.5.2 Injection mixes

These materials are specially designed to be injected by a pump, using pressures of between 10 bar and 200 bar. They may be supplied ready to use, or may require mixing.

4.5.3 Coatings

Mixture of fine refractory aggregates and bond(s), supplied ready for use with a higher water or other liquid content than materials for placing or jointing. The principal bond may be ceramic, hydraulic, chemical (inorganic or organic-inorganic) or organic. The mixtures are applied manually (with a brush or trowel), by pneumatic or mechanical projection, or by spraying.

4.5.4 Taphole mixes

Materials which are ready for use, having a plastic consistency and made up of refractory aggregates, bond(s) and liquid(s). After firing the materials are mainly carbon bonded.

NOTE These materials are specially designed to fill blast furnace tap holes.

5 Type of chemical composition

5.1 Alumina-silica products

Alumina-silica products consisting mainly of aggregates of alumina, silica, and alumino-silicates.

5.2 Basic products

Basic products, consisting mainly of aggregates of magnesia, doloma, magnesiachrome, chrome ore and spinel.

5.3 Special products

Special products, consisting mainly of oxide or non-oxide aggregates other than those given in 5.1 and 5.2.

NOTE These can include silicon carbide, silicon nitride, zircon and zirconia.

5.4 Carbon-containing products

Carbon-containing products, consisting mainly of aggregates from 5.1, 5.2 or 5.3, and including more than 1 % carbon.

6 Classification

6.1 Basis of classification

Unshaped refractory products shall be classified according to the following three criteria:

1) type of product and method of placement;

2) main raw material base;

3) classification temperature.

6.2 Type of products and method of placement

See clause 4 and Figures 1 and 2.

6.3 Main raw material

Unshaped refractories shall be classified by their principal raw material when it is greater than or equal to 50 % or by their main raw materials when each of these raw material is less than 50 %.

Examples for raw materials are given in the following list, which is not exclusive:

Alumina	Fused mullite
Andalusite	Fused silica
Bauxite	Fused spinel
Calcined clay	Fused white alumina
Calcined flintclay	Magnesite
Carbon	Olivine
Chrome ore	Quartz
Dolomite	Silicon carbide
Expanded clay	Sintered alumina
Expanded perlite	Sintered mullite
Expanded vermiculite	Sintered spinel
Fused brown alumina	Zirconia
	Zirconium silicate

6.4 Classification temperature

Unshaped refractories shall be classified according to their classification temperatures which are shown in Tables 2 and 3. The criterion is the total linear change after firing. This classification is applicable to all unshaped refractories of which test pieces can be made and pre-fired according to EN 1402-5.

Table 2 — Dense shaped refractories classification temperatures

Not applicable
1 200 °C
1 300 °C
1 400 °C
1 500 °C
1 600 °C
1 700 °C
> 1 700 °C

The classification temperature is that at which the total linear change, determined in accordance with EN 1402-6,

is:

for all type of castables : less than 1,5 % shrinkage;

for shotcreting refractories : less than 1,5 % shrinkage;

for gunning refractories : less than 1,5 % shrinkage;

for ramming mixes : less than 2 % shrinkage;

for plastic refractories : less than 2 % shrinkage.

Table 2 — Insulating unshaped refractories classification temperature

Not applicable
900 °C
1 000 °C
1 100 °C
1 200 °C
1 300 °C
1 400 °C
1 500 °C
1 600 °C
1 700 °C
> 1 700 °C

The classification temperature for unshaped, insulating refractories is that at which the total linear change, determined in accordance with EN 1402-6, is:

for castables : less than 1,5 % shrinkage;

for gunning refractories : less than 1,5% shrinkage.

7 Designation of an unshaped refractory material

The designation of an unshaped refractory material shall include the three criteria of classification given in 6.1, without any predefined priority.

Some examples of designations are:

— dense LCC bauxite castable, rodding or self flow, class 1 600 °C;

— dense chemically bonded magnesite castable, vibration;

— lightweight hydraulically bonded insulating castable based on expanded clay, casting, rodding or gunning – class 1 100 °C;

— dense ULCC castable, tabular alumina based, vibration – class 1 700 °C;

— plastic ramming material, based on andalusite – class 1 600 °C;

— gunning material, calcined clay based, chemically bonded ramming mix, class 1 500 °C;

— dry mix based on white fused alumina, ceramic bonded, class 1 700 °C;

— jointing material, ready to use, based on silicon carbide, chemically bonded;

— taphole mix, based on andalusite, resin bonded;

— dense ULCC castable for vibrating, based on alumina/carbon/SiC, classification temperature 1 600 °C.

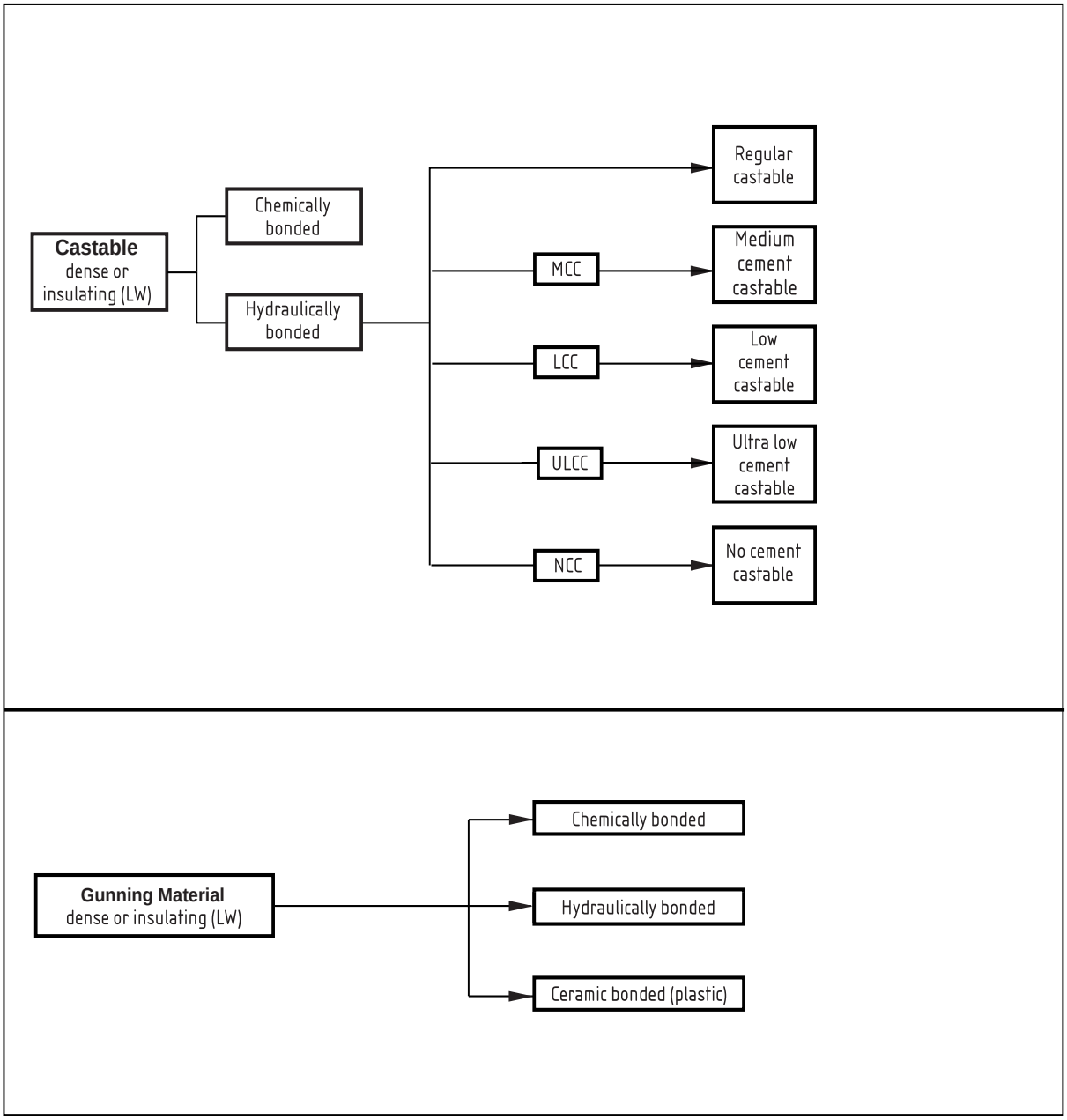

Figure 1 — Type of products

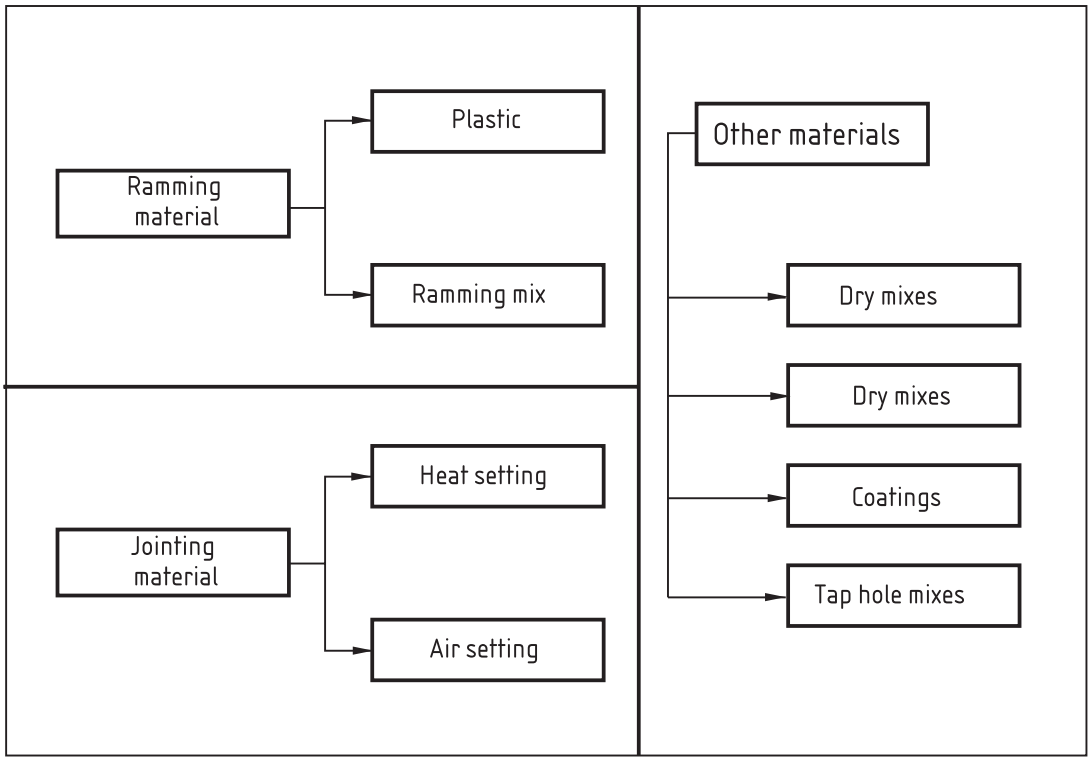

Figure 1 — (*concluded*)

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EN 1402-5, *Unshaped refractory products - Part 5: Preparation and treatment of test pieces*.

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W4 4AL