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Monolithic (unshaped) refractory products —

Part 1: Introduction and classification

Produits réfractaires (non façonnés) monolithiques —

Partie 1: Introduction et classification

Reference number
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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 1927-1 was prepared by Technical Committee ISO/TC 33, *Refractories*.

ISO 1927-1 cancels and replaces ISO 1927:1984, which has been technically revised.

ISO 1927 consists of the following parts, under the general title *Monolithic (unshaped) refractory products* — :

— *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*

Introduction

The general objective of this part of ISO 1927 is to define, with as much accuracy as possible, the control of monolithic (unshaped) refractory products with special reference to the following:

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.

Monolithic (unshaped) refractory products used in industrial linings are generally not fired, so that the high temperatures which result from use create firing which results from use creates complicated conditions that make control difficult. The main points to be mentioned are:

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

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

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

NOTE Properties measured in the laboratory frequently do not reflect the properties of the material when installed.

Monolithic (unshaped) refractory products —

Part 1: Introduction and classification

1 Scope

This part of ISO 1927 defines terms relating to monolithic (unshaped) refractory products and establishes a classification for the various types of product.

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

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

3 Terms and definitions

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

3.1
monolithic (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 ISO 5016, using a test piece fired to specified conditions.

3.2
pre-formed shapes
shapes made from monolithic (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.

3.3
nature of the bond
bond depending on the hardening process of the different materials

NOTE 1 The bond may be

— a hydraulic bond with setting and hydraulic hardening at ambient temperature,

— a ceramic bond with hardening by sintering during firing,

— a chemical bond (inorganic or organic-inorganic) with hardening by chemical, but not hydraulic, reaction at ambient temperature or at a temperature lower than that of a ceramic bond, or

— an organic bond with binding or hardening at ambient temperature or at higher temperatures.

NOTE 2 When several bonds are used together, the bond is designated according to the nature of that bond which plays the principal part during the hardening.

3.4
granulometric class
mesh width of the finest sieve (ISO 565) through which at least 95 % by mass of the material passes

3.5
yield by volume
mass of material as delivered which is necessary to place one cubic metre of material, expressed in tonnes to the nearest 1 %

3.6
deflocculating agent
soluble compound (usually an electrolyte) which, when added even in very small quantities, will reduce the water content to form dispersed suspensions of solid powders in liquid media

4 Product types and methods of placement

4.1 Refractory castables

4.1.1 General

These are 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 or other hydraulic binder, a minimum of 2 % by mass of ultra-fine particles (less than one micron) and at least one deflocculating agent.

This type is in turn subdivided into the four categories given in Table 1.

NOTE If significant lime content is introduced by other raw materials, this may be marked in the data sheet separately and has to be neglected when the type of deflocculated castable is defined.

Table 1 — Categories of deflocculated 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
By definition, deflocculated cement castables contain at least one deflocculant and ultra-fine particles.		

4.1.4 Chemically bonded castable

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

4.2 Refractory gunning materials

These are mixtures of refractory aggregates and bond(s), specially prepared for placing by pneumatic or mechanical projection which may be either:

a) a hydraulical bond mix (see 4.1) (dense or insulating) which is supplied dry and used after the addition of water during or before gunning;

b) a ceramic bond mix (see 4.3.2) which is especially designed for gunning under high air pressure with special equipment, and is normally delivered in a ready-to-use state;

c) a chemical bond (inorganic or organic-inorganic) with hardening by a chemical, but not hydraulic, reaction at ambient temperature or at a temperature lower than that of a ceramic bond;

d) an organic bond with binding or hardening at ambient temperature or at higher temperatures.

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

These are materials that 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

These are materials that 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.

4.4 Refractory jointing materials

These are 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 monolithic (unshaped) refractory products

4.5.1 Dry mixes

These are materials that are specially designed for the placement 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 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

These are materials that 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 consist mainly of alumina, silica and alumino-silicates.

5.2 Basic products

Basic products consist mainly of magnesia, doloma, calcia, magnesiachrome, chrome ore and spinel.

5.3 Special products

Special products consist mainly of oxides or non-oxides 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 consist mainly of aggregates from 5.1, 5.2 or 5.3, and include more than 1 % carbon.

6 Classification

6.1 General

Monolithic (unshaped) refractory products shall be classified according to the following three criteria:

1) type of product and method of placement (Clause 4);
2) main raw material base (6.2);
3) classification temperature (6.3).

6.2 Main raw material

Monolithic (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	Ziconia
	Zirconium silicate

6.3 Classification temperature

Monolithic (unshaped) refractories shall be classified according to their classification temperatures, which are shown in Tables 2 and 3. The criterion is the total permanent linear change after firing. This classification is applicable to all monolithic (unshaped) refractories of which test pieces can be made.

Table 2 — Classification temperatures for monolithic (unshaped) dense refractory products

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 is:

— for all types of castables: 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 3 — Insulating monolithic (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 (monolithic) insulating refractories is that at which the total linear change is:

— for castables: less than 1,5 % shrinkage;

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

7 Designation of a monolithic (unshaped) refractory material

The designation of a monolithic (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;

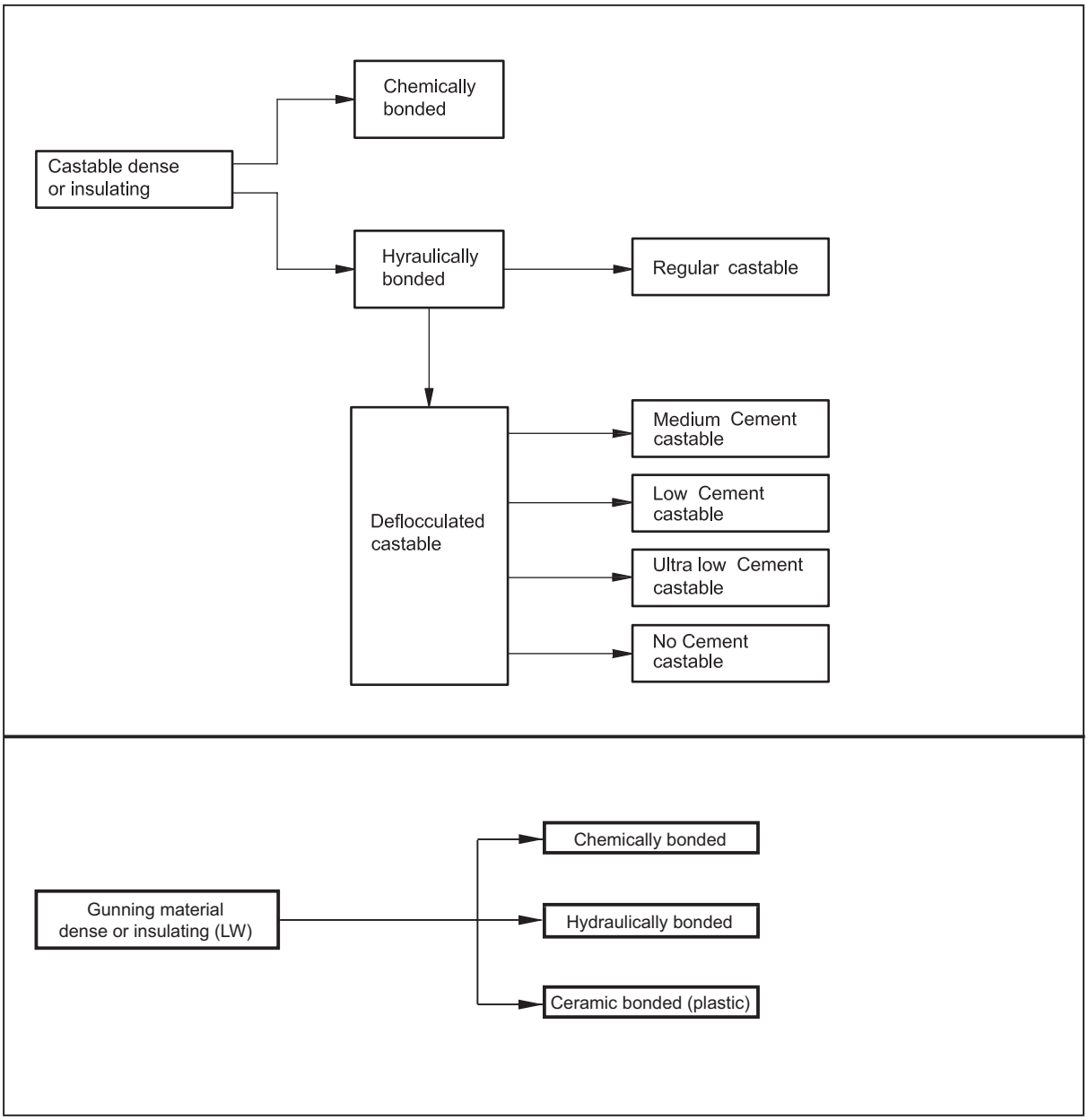
— gunning material, calcined clay based, chemically bonded ramming mix, class 1 500 °C;

— 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.



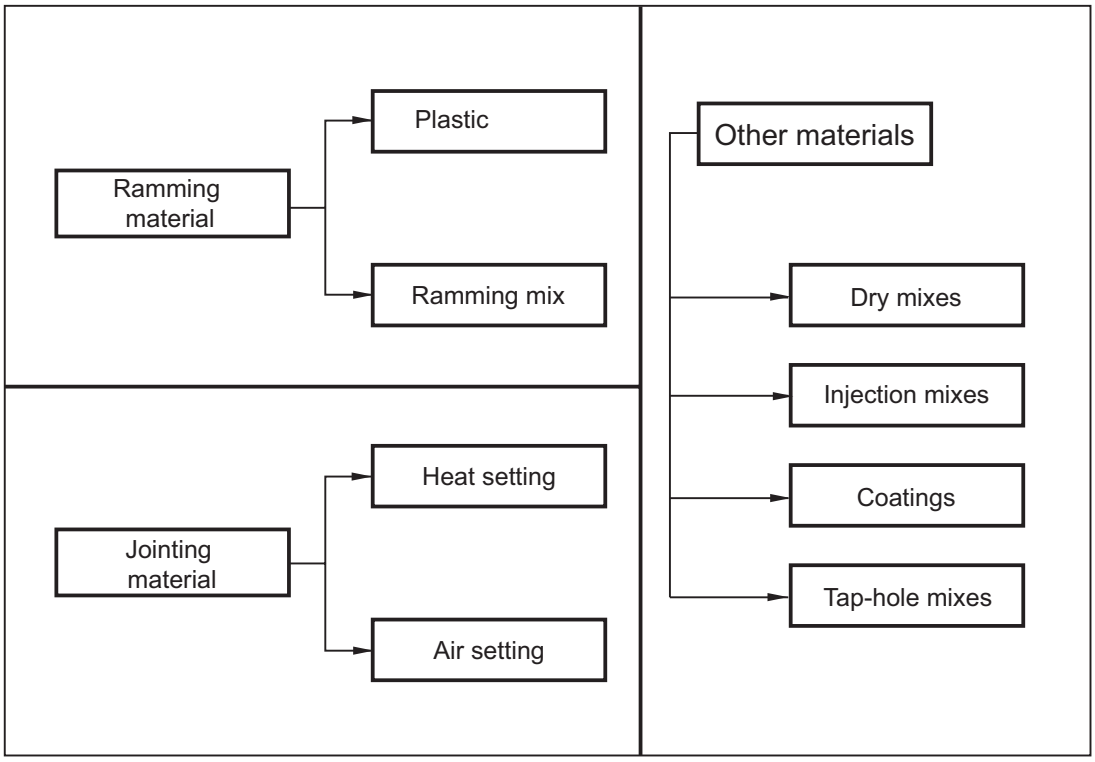


Figure 1 — Types of product

Bibliography

[1] ISO 1927-3, *Monolithic (unshaped) refractory products — Part 3: Characterization as received*

[2] ISO 1927-5, *Monolithic (unshaped) refractory products — Part 5: Preparation and treatment of test pieces*

[3] ISO 1927-6, *Monolithic (unshaped) refractory products — Part 6: Measurement of physical properties*

[4] ISO 5016, *Shaped insulating refractory products — Determination of bulk density and true porosity*

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