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Refractory products – Classification of prepared unshaped refractory materials (dense and insulating)

Matériaux réfractaires – Classification des matériaux réfractaires non façonnés préparés (denses et isolants)

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FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO Member Bodies). The work of developing International Standards is carried out through ISO Technical Committees. Every Member Body interested in a subject for which a Technical Committee has been set up 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.

Draft International Standards adopted by the Technical Committees are circulated to the Member Bodies for approval before their acceptance as International Standards by the ISO Council.

Prior to 1972, the results of the work of the Technical Committees were published as ISO Recommendations; these documents are now in the process of being transformed into International Standards. As part of this process, Technical Committee ISO/TC 33 has reviewed ISO Recommendation R 1927 and found it technically suitable for transformation. International Standard ISO 1927 therefore replaces ISO Recommendation R 1927-1971 to which it is technically identical.

ISO Recommendation R 1927 was approved by the Member Bodies of the following countries :

Australia	Greece	South Africa, Rep. of
Austria	Hungary	Sweden
Canada	India	Thailand
Chile	Israel	Turkey
Czechoslovakia	Italy	United Kingdom
Denmark	Korea, Rep. of	U.S.S.R.
Egypt, Arab Rep. of	New Zealand	Yugoslavia
France	Portugal	
Germany	Romania	

No Member Body expressed disapproval of the Recommendation.

The Member Body of the following country disapproved the transformation of ISO/R 1927 into an International Standard :

Germany

Refractory products – Classification of prepared unshaped refractory materials (dense and insulating)

1 SCOPE AND FIELD OF APPLICATION

This International Standard establishes the definition, classification and designation of prepared unshaped refractory materials.

It does not apply to materials that are of the nature of refractory materials but that have only been crushed or granulated.

The designation of prepared unshaped refractory materials is based on

- classification in terms of the nature of the constituents;
- terminology according to type of use and method of placing.

NOTE – The classification of dense shaped refractory products and that of shaped insulating refractory products are given in ISO 1109 and ISO 2245 respectively.

2 DEFINITIONS

2.1 refractory materials: Materials and products other than metals and alloys (although not excluding materials containing a metallic constituent), the refractoriness of which is at least 1 500 °C.

2.2 prepared unshaped refractory materials: Mixtures (see note below) containing one or more refractory constituents and a bond, prepared ready for use, either directly in the condition in which they are supplied or after the addition of a suitable liquid. The refractoriness of the refractory constituent (or constituents) of the mixture shall be at least 1 500 °C.

NOTE – These mixtures may be either dense or insulating; the true porosity of insulating batches, determined on a test piece prepared under the conditions of industrial use and fired at the temperature of use, shall be at least 45 %.

3 CLASSIFICATION

3.1 General principle

Prepared unshaped refractory materials are classified

- in terms of the chemical and mineralogical nature of the major constituent or constituents;
- in terms of the nature of the bond.

3.2 Nature of the major constituents

The subdivisions according to the chemical and mineralogical nature of the major refractory constituents of the mix (see table 1) correspond to the principal divisions in the classification of dense shaped products (see ISO 1109).

TABLE 1 – Classification according to the nature of the major constituents

Subdivisions	Limiting content of principal oxide
High alumina materials, Group 1	$56 \% \leq \text{Al}_2\text{O}_3$
High alumina materials, Group 2	$45 \% \leq \text{Al}_2\text{O}_3 < 56 \%$
Fireclay materials	$30 \% \leq \text{Al}_2\text{O}_3 < 45 \%$
Siliceous fireclay materials	$10 \% \leq \text{Al}_2\text{O}_3 < 30 \%$ $\text{SiO}_2 < 85 \%$
Siliceous materials	$85 \% \leq \text{SiO}_2 < 93 \%$
Silica materials	$93 \% \leq \text{SiO}_2$
Basic materials (magnesia, chrome, forsterite, dolomite, other alkaline earth oxides)	
Special materials (carbon, silicon carbide, zircon, etc.)	

Before any determination of the content of oxides (for example Al_2O_3 , SiO_2 , MgO) of the major constituents, these constituents shall first be separated from the bond (for example by wet screening) and then calcined.

3.3 Nature of the bond

The subdivisions according to the nature of the bond (see table 2) correspond to the different processes of hardening of prepared unshaped refractory materials.

When several bonds are used conjointly, the material is classified in terms of the type of bond that plays the principal part during the placing of the material.

TABLE 2 – Classification according to the nature of the bond

Subdivisions	Process of hardening
Ceramic bond	Hardening only during firing
Hydraulic bond	Setting and hydraulic hardening at room temperature
Chemical (mineral or organic-mineral) bond	Hardening by chemical reaction at room temperature or at some other temperature below that of a ceramic bond
Organic bond	Binding or hardening at room temperature

4 TERMINOLOGY (according to type of use and method of placing)

4.1 General

The types of use of prepared unshaped refractory materials make it possible to distinguish between :

- jointing materials;
- coatings;
- mixes for monolithic construction and for repairs.

4.2 Jointing materials

These materials are applied by trowel or similar instrument, or in some cases by dusting in the joints or by dipping the piece to be bonded.

The chemical and mineralogical nature of the major constituent or constituents shall be compatible with that of the bricks with which these materials are used.

The following types are distinguished :

4.2.1 refractory mortars : Mixtures of finely ground raw materials, delivered dry, containing a ceramic bond.

4.2.2 refractory cements : Mixtures of finely ground raw materials, generally delivered dry, sometimes as a putty, containing a bond other than a ceramic bond (hydraulic, mineral, organic-mineral, organic).

4.3 Coatings

These materials are applied as a thin layer, manually (for example by brushing or trowelling) or by mechanical projection (particularly by spray gun).

The chemical and mineralogical nature of these materials is similar to that of refractory mortars and cements, but their grain size composition is suited to the method of application.

4.4 Mixes for monolithic construction and for repairs

These mixes have a grain size distribution suited to the production of shapes or of monolithic linings of a certain thickness.

The following types are distinguished :

4.4.1 ramming materials : Granular materials that are non-coherent before use, delivered dry or ready for use; they may contain a chemical or an organic bond. They are placed, as delivered or after they have been moistened, by ramming or by compacting, sometimes by hand but more commonly by suitable mechanical devices.

4.4.2 mouldable materials : Mixes that are plastic, delivered unformed ready for use; they may contain a chemical or an organic bond and are placed by hand or by machine ramming.

4.4.3 castables : Mixes that are non-coherent before use, delivered dry, ready to be mixed with water. They contain a hydraulic or a chemical bond and are placed as a mix of variable consistency by casting, vibration, tamping or ramming.

4.4.4 gunning materials : Mixes that are non-coherent before use, conveniently prepared ready, after moistening, for use by mechanical or manual projection. Depending on their other properties they can be assigned to one or other of the three preceding groups.

5 DESIGNATION

The complete designation of a prepared unshaped refractory material shall include the following information :

- type of use;
- the nature of the major refractory constituent;
- nature of the bond;
- condition in which it is delivered;
- method of placing.

Example : High-alumina mouldable refractory for repair work, with mineral bond, to be placed by ramming.

However, it is often possible, while taking account of the classification and terminology set out in this International Standard, to designate a prepared unshaped refractory material more succinctly, yet without ambiguity.

Example : "A fireclay repair material having a hydraulic bond, delivered dry, to be placed by casting" could be designated more simply by the terms "Castable fireclay refractory".

ANNEX

EQUIVALENT TERMS IN FRENCH, ENGLISH, GERMAN, ITALIAN AND SPANISH

Nature of the bond

French	English	German	Italian	Spanish
Liant céramique	Ceramic bond	Keramisches Bindemittel	Legante ceramico	Aglomerante cerámico
Liant hydraulique	Hydraulic bond	Hydraulisches Binde- mittel	Legante idraulico	Aglomerante hidráulico
Liant chimique (minéral ou organico-minéral)	Chemical (mineral or organic-mineral) bond	Mineralisches oder or- ganico-mineralisches Bindemittel	Legante minerale od organico-minerale	Aglomerante orgánico- mineral
Liant organique	Organic bond	Organisches Bindemittel	Legante organico	Aglomerante orgánico

Type of use and method of placing

French	English	German	Italian	Spanish
Coulis réfractaire	Refractory cement ¹⁾ (GB) Refractory mortar ¹⁾ (USA)	Feuerfester Mörtel ¹⁾	Malta refrattaria	Mortero refractario
Ciment réfractaire	Refractory cement ¹⁾ (GB) Refractory mortar ¹⁾ (USA)	Feuerfester Mörtel ¹⁾	Malta di cemento refrattaria	Cemento refractario
Enduit réfractaire Revêtement réfractaire de surface	Refractory coating	Anstrichmasse	Intonaco refrattario Rivestimento refrattario	Recubrimiento refractario Revestimiento refractario superficial
Pisé	Refractory ramming material	Trockene Stampfmasse	Massa per pigiata	Material para apisonar
Mélange plastique	Refractory mouldable material	Plastische Masse ²⁾	Massa plastica	Mezcla plástica
Béton réfractaire	Refractory castable	Feuerbeton	Cemento refrattario ³⁾	Hormigón refractario
Mélange projetable	Refractory gunning material	Spritzmasse	Massa de spruzzare	Mezcla para proyección

1) The same terms are used for "coulis" and "ciment", but the mechanism of hardening is indicated to distinguish between each type. Example : ciment réfractaire durcissant à l'air : air-setting refractory cement/air-setting refractory mortar : Lufterhärtender feuerfester Mörtel.

2) Plastic ramnable material : plastische Stampfmasse.

3) In practice "cemento" means both cement and concrete; when it has been placed it is called "calcestruzzo".

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