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Monolithic (unshaped) refractory products —

Part 5: Preparation and treatment of test pieces

Produits réfractaires monolithiques (non façonnés) —

Partie 5: Préparation et traitement des éprouvettes

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 1927-5 was prepared by Technical Committee ISO/TC 33, *Refractories*.

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 values of the properties obtained using test pieces are used to assess the homogeneity of monolithic (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 part of ISO 1927, can lead to different values.

Monolithic (unshaped) refractory products —

Part 5:
Preparation and treatment of test pieces

1 Scope

This part of ISO 1927 specifies methods for the preparation and treatment (curing, drying and firing) of test pieces from monolithic (unshaped) refractory materials.

The methods are applicable to dense and insulating castables and to ramming materials with the four types of chemical composition defined in ISO 1927-1.

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

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 1927-1, *Monolithic (unshaped) refractory products — Part 1: Introduction and classification*

ISO 1927-2, *Monolithic (unshaped) refractory products — Part 2: Sampling for testing*

ISO 1927-4, *Monolithic (unshaped) refractory products — Part 4: Determination of consistency of castables*

ISO 10060, *Dense shaped refractory products — Test methods for products containing carbon*

3 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;

Shape D: Length: 160 mm; width: 40 mm; thickness: 40 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 shapes C and D 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, ramming materials, taphole mixes and dry vibration mixes, test pieces with a diameter of 50 mm and height of 50 mm ± 1 mm are permissible and can be prepared using the sand-rammer. Shape C shall be used as the referee shape for inter laboratory testing.

Table 1 — Type of shape for tests

Castables	Dense castables	Max grain size <15 mm		Shape B or C or D	Shape A
			Direct characterization [b]	X	
			Other tests		X
		Max grain size >15 mm	Direct characterization [b]	X [a]	
			Other tests		X
	Insulating castables				X
Ramming materials	Ramming mixes			X	
	Plastics			X	

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

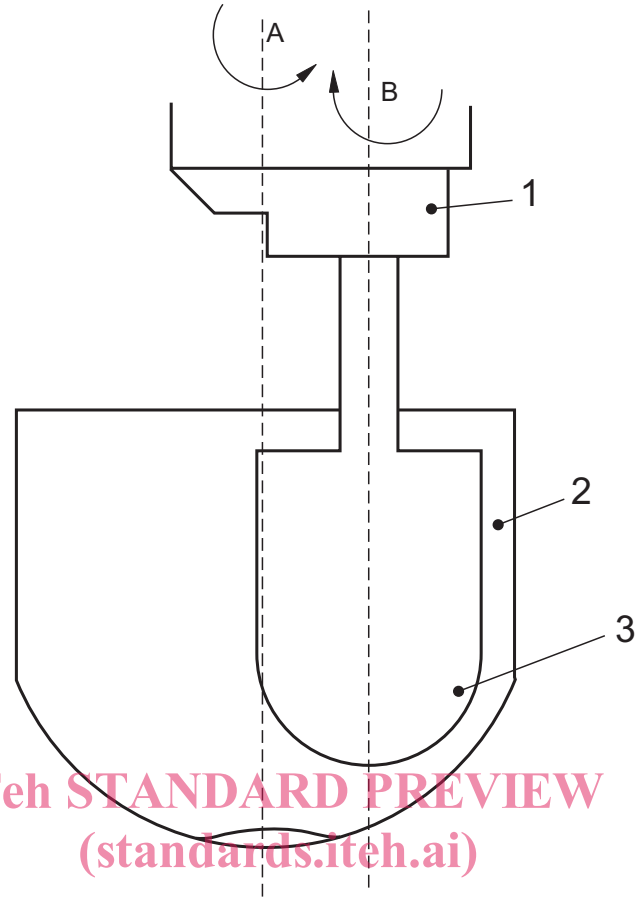
[b] Tests for which results are directly obtained from the bars without size modifications are modulus of rupture, cold compressive strength, and permanent change in dimensions on heating.

4 Apparatus

4.1 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.

4.2 Mixer, comprising the following.

4.2.1 Pan. 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 4.2.2) shall be constructed from a material that does not react with the test material (see Figure 1).



Key

1 Drive
2 Pan
3 Mixing blade

Figure 1 — Principle of the mixer

4.2.2 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 r/min and 65 r/min around axis A (the symmetry axis of the mixing pan), the blade rotating simultaneously in the opposite direction at a speed between 120 r/min and 145 r/min around axis B (symmetry axis of the blade).

For low-intensity mechanical mixing of insulating castables the mixing blade shall revolve at a speed between 15 r/min and 25 r/min around axis A (the symmetry axis of the mixing pan), the blade rotating simultaneously in the opposite direction at a speed between 50 r/min and 80 r/min around axis B (symmetry axis of the blade).

4.3 Vibrating table. The vibrating table shall be flat and horizontal and shall perform only uniaxial vertical vibrations at a frequency of 50 Hz. The table shall be capable of being set at a double amplitude of 0,50 mm (see ISO 1927-1) with an accuracy of ± 0,05 mm for the entire procedure. There shall be an automatic adjustment to the required double amplitude according to the mass of the mould and material.

4.4 Pneumatic rammer. A compressed-air rammer shall have a rammer foot suitable for the width of the mould and have a smooth, flat working surface, i.e. 52 mm × 25 mm for shape B and 62 mm × 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.

4.5 Sand-rammer, consisting of a mould of 50 mm inside diameter, and 140 mm in length, and a 6,67 kg ± 50 g weight sliding on the shaft of the apparatus and arranged to fall a distance of 50 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).

NOTE A more detailed description of this piece of apparatus is given in ISO 1927-3.

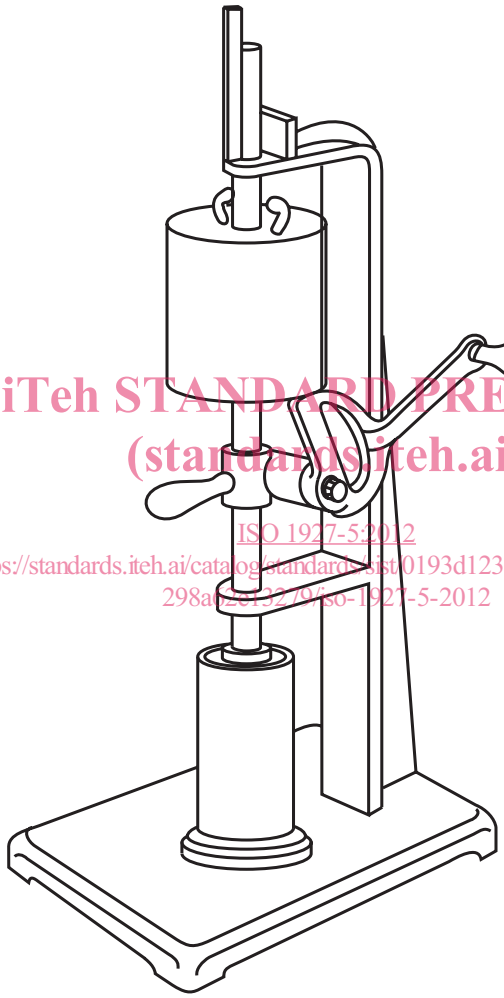


Figure 2 — Sand-rammer for shaping ramming mixes test pieces

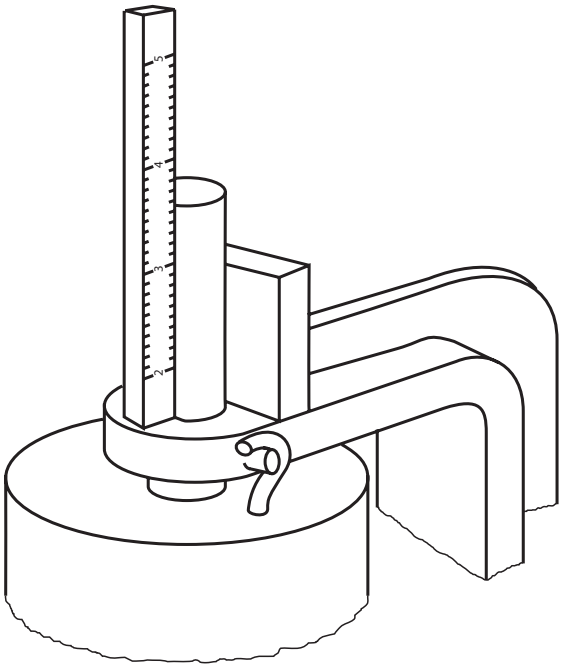


Figure 3 — Modification of sand-rammer for workability test

4.6 Hydraulic-type power 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.

4.7 Trowel, pointing type or stiff-bladed spatula of typical size 150 mm length and 50 mm width.

4.8 Watertight moulds, capable of being dismantled and shall be watertight. They shall be made from a material that does not react with the material to be tested.

For compaction by the 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 × 64 mm (shapes A and C) and 230 mm × 54 mm (shape B) are the horizontal surfaces during the compaction process. A variation of ± 0,5 mm is allowed for these dimensions. If multi-compartment moulds are used, the size of the mould shall be adapted for the number of test pieces prepared and this shall be 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 are slightly oiled.

4.9 Two balances, one capable of weighing up to 25 kg with an accuracy of ± 10 g and the other capable of weighing up to 5 kg with an accuracy of ± 1 g.

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