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Refractory products — Determination of refractoriness under load — Differential method with rising temperature

Produits réfractaires — Détermination de l'affaissement sous charge — Méthode différentielle avec élévation de la température

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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 1893 was prepared by Technical Committee ISO/TC 33, *Refractories*.

This third edition cancels and replaces the second edition (ISO 1893:2005), which has been technically revised. The main changes are corrections to the figures and improvements in the description of the calculation procedure given in 8.2.

Refractory products — Determination of refractoriness under load — Differential method with rising temperature

1 Scope

This International Standard specifies a method for determining the deformation of dense and insulating shaped refractory products, when subjected to a constant load under conditions of progressively rising temperature (or refractoriness under load), by a differential method. The test may be carried out up to a maximum temperature of 1 700 °C.

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 3599, *Vernier callipers reading to 0,1 and 0,05 mm*

IEC 60584-1, *Thermocouples — Part 1: References tables*

IEC 60584-2, *Thermocouples — Part 2: Tolerances*

3 Terms and definitions

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

3.1
refractoriness under load
measure of the behaviour of a refractory material subjected to the combined effects of load, rising temperature and time

4 Principle

A cylindrical test piece is subjected to a specified constant compressive load and heated at a specified rate of temperature increase until a prescribed deformation or subsidence occurs. The deformation of the test piece is recorded as the temperature increases, and the temperatures corresponding to specified proportional degrees of deformation are determined.

5 Apparatus

5.1 Loading device

5.1.1 General

The loading device shall be capable of applying a load centred on the common axis of the loading column, the test piece and the supporting column, and directed vertically along this axis at all stages of the test. The loading device consists of the items given in 5.1.2 to 5.1.4.

A constant compressive load is applied in a downward direction from above the test piece which is resting directly or indirectly on a fixed base. The deformation of the test piece is measured by a device that passes either through the loading device or through an intermediate base.

The text and Figures 1 and 2 show the measuring device passing through the base but, by interchanging the bored column and refractory plate with the unbored column and plate, the measuring device may pass through the loading device, as in Figure 3.

Although both arrangements are within the scope of this International Standard, it is preferable that the measuring device be positioned below the assembly, as shown in Figure 2. The reasons for this are outlined in Annex A.

5.1.2 Fixed column

The fixed column shall be at least 45 mm in external diameter and with an axial bore (see 5.1.5).

5.1.3 Moving column

The moving column shall be at least 45 mm in external diameter.

NOTE Arrangements can be made for the moving column to be fixed to the furnace, and the combination of furnace and column then forms the moveable loading device.

5.1.4 Two discs

The two discs shall be 5 mm to 10 mm thick, at least 50,5 mm in diameter and not less than the actual diameter of the test pieces, and shall be made of an appropriate refractory material compatible with the material under test.

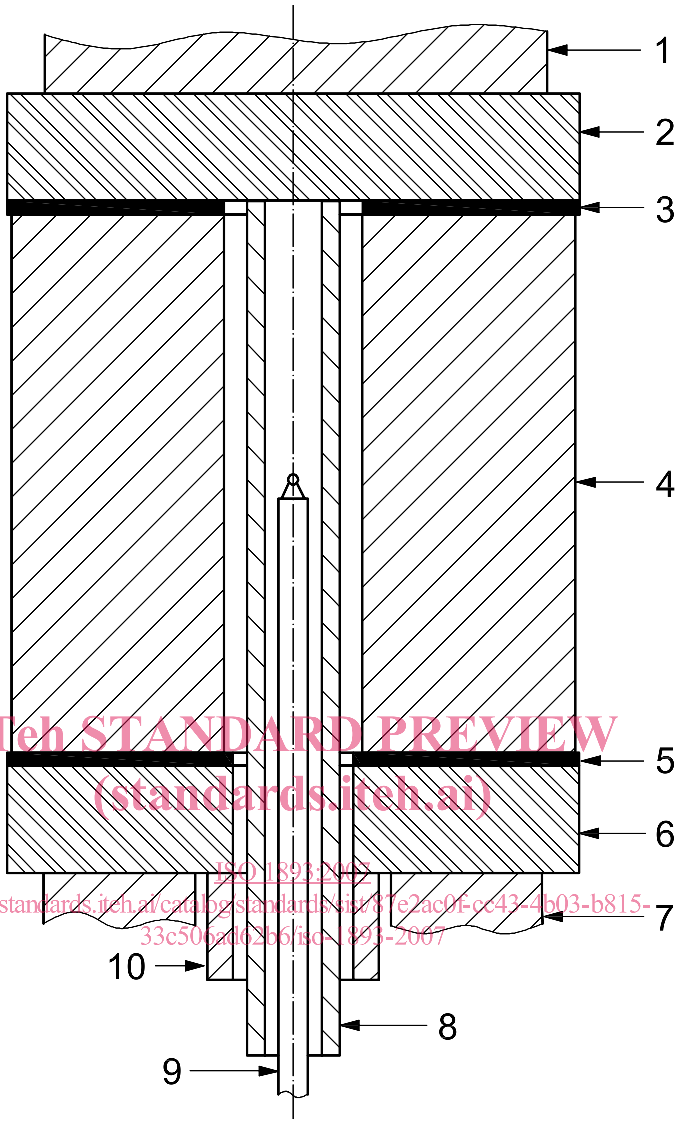
EXAMPLES High-fired mullite or alumina for alumino-silicate products or magnesia or spinel for basic products.

These discs are placed between the test piece and the fixed and moving columns. The disc placed between the test piece and the fixed column (in the arrangement shown in Figure 2) or between the test piece and the moving column (in the arrangement shown in Figure 3) shall have a central bore (see 5.1.5). The ends of the fixed and moving columns shall be plane and perpendicular to their axes; the faces of each disc shall be plane and parallel. If a chemical reaction is expected between the discs and the test piece, a platinum or platinum/rhodium foil (0,2 mm thick) shall be placed between them.

5.1.5 Layout

The arrangement of the two columns, the two discs, the platinum or platinum/rhodium foil if used, and the test piece is shown in Figure 1, which also shows typical diameters of the bores in the fixed column and the disc between them.

Dimensions in millimetres



Key

1 moving column (5.1.3), ∅ ext. 45 min.

2 upper disc (5.1.4), ∅ ext. 50,5 min.

3 Pt-Rh foil, ∅ ext. 50,5*, ∅ int. 12

4 test piece (6.1), ∅ ext. 50 ± 0,5, ∅ int. 12 min., 13 max.

5 Pt-Rh foil, ∅ ext. 50,5*, ∅ int. 10

6 lower disc (5.1.4), ∅ ext. 50,5 min., ∅ int. 10

7 fixed column (5.1.2), ∅ ext. 45 min., ∅ int. 20 min.

8 inner alumina tube (5.3.2), ∅ ext. 8*, ∅ int. 5*

9 central thermocouple (5.4.1)

10 outer alumina tube (5.3.1), ∅ ext. 15*, ∅ int. 10

NOTE Typical dimensions are marked with an asterisk (*).

Figure 1 — Example of an arrangement of test piece, columns, discs and tubes

5.1.6 Load

The columns and the discs shall be capable of withstanding the applied load up to the final test temperature without significant deformation. There shall be no reaction between the discs and the loading system. The material from which the discs are made shall have a T_1 value greater than, or equal to, the temperature at which the test material has a T_5 value (see 8.5).

5.2 Furnace

A furnace (preferably with its axis vertical) shall be used, capable of raising the temperature of the test piece to the final test temperature at the specified rate (see 7.3) in an atmosphere of air. The temperature of the region of the furnace occupied by the test piece, when at a stable temperature above 500 °C, shall be uniform around the test piece (12,5 mm above and below) to within ± 20 °C; this shall be verified by carrying out tests using the thermocouples located at different points on the curved surface of the test piece.

The furnace design should be such that the whole of the column assembly can be easily reached, either by movement of the supporting column or, if access into the furnace is restricted, by movement of the furnace itself. The assembly should be such that the test piece and loading column stand vertically and coaxial with the support column when unrestrained.

5.3 Measuring device

The measuring device shall consist of the items specified below.

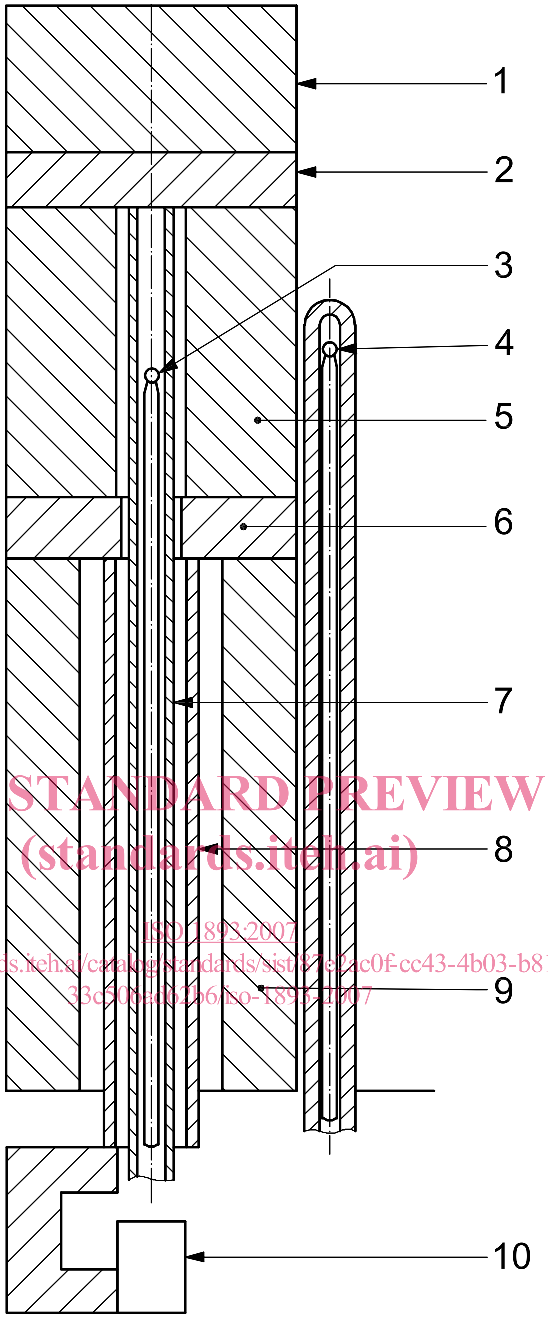
5.3.1 Outer alumina tube, placed inside the fixed column to abut on the lower side of the lower disc and free to move within the fixed column (see also 5.3.3).

5.3.2 Inner alumina tube, placed inside the outer alumina tube and passing through the bores in the lower disc and in the test piece to abut on the lower face of the upper disc, and free to move within the outer alumina tube, the lower disc and the test piece (see also 5.3.3).

5.3.3 The alumina tubes shall be capable of withstanding, without significant distortion, the load imposed on them by the measuring instrument at all temperatures up to the final test temperature.

The two possible arrangements of the two tubes, the two discs and test pieces are shown in Figure 2 and Figure 3. Where the measuring instrument is mounted above the test piece, as shown in Figure 3, adequate precautions should be taken to protect the instrument from the effects of heat rising from the furnace.

5.3.4 Appropriate measuring instrument (for example a dial-gauge or length transducer connected to an automatic recording system), fixed to the end of the outer tube (5.3.1) and actuated by the inner tube (5.3.2). The sensitivity of the measuring device shall be at least 0,005 mm.



Key

1 moving column
2 upper disc
3 central thermocouple
4 control thermocouple
5 test piece
6 lower disc
7 inner alumina tube
8 outer alumina tube
9 fixed column
10 measuring instrument

Figure 2 — Test apparatus — Measuring instrument below test piece