INTERNATIONAL STANDARD

ISO 10059-2

First edition
2003-12-15

Dense, shaped refractory products — Determination of cold compressive strength —

Part 2: Test with packing

Produits réfractaires façonnés denses — Détermination de la résistance à la compression à température ambiante —

Partie 2: Essai avec intercalaires

Reference number
ISO 10059-2:2003(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

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 10059-2 was prepared by Technical Committee ISO/TC 33, *Refractories*.

ISO 10059 consists of the following parts, under the general title *Dense, shaped refractory products — Determination of cold compressive strength*:

— *Part 1: Referee test without packing*

— *Part 2: Test with packing*

Dense, shaped refractory products — Determination of cold compressive strength —

Part 2: Test with packing

1 Scope

This part of ISO 10059 specifies a method for the determination of the cold compressive strength of dense shaped refractory products as an alternative to that described in ISO 10059-1.

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*

ISO 5017, *Dense shaped refractory products — Determination of bulk density, apparent porosity and true porosity*

3 Terms and definitions

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

3.1
cold compressive strength
maximum load (applied under specified conditions at room temperature) divided by the area over which the load is applied, that a refractory will withstand before failure occurs

3.2
dense, shaped refractory product
refractory with specific dimensions, having a true porosity of less than 45 % when measured in accordance with ISO 5017

4 Principle

A test piece of known dimensions is subjected, under specified conditions, to an increasing compressive load until it fails, i.e., when it cannot support a further increase in load. Each load-bearing face of the test piece is separated from the platens of the loading device by a single sheet of packing material. The cold compressive strength is calculated from the maximum load indicated at failure and the mean cross-sectional area over which the load is applied.

5 Significance and use

The test described in this part of ISO 10059 is intended for routine and quality control testing purposes rather than to yield ultimate or true values of cold compressive strength. For true values of cold crushing strength, the method described in ISO 10059-1 should be used.

NOTE 1 Results obtained by this method using different size test pieces may not be directly comparable.

NOTE 2 The method described in this part of ISO 10059 may yield results which are not directly comparable with those obtained following the method described in ISO 10059-1.

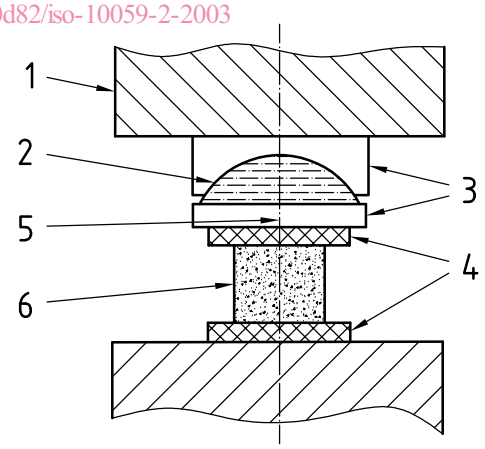
6 Apparatus

6.1 Mechanical or hydraulic compression testing machine, fitted with a measuring device capable of measuring the load exerted on the test piece to within ± 2 %.

The machine shall be capable of increasing the stress rate at 1,0 MPa/s ± 0,1 MPa/s, until the test piece is unable to support the load. One platen of the machine shall function on a seating that will compensate for small deviations from parallelism between the platen and the test piece.

The area of the upper platen shall not be greater than 100 cm^2 when used for test pieces whose maximum load-bearing face dimension (e.g., diameter or side length, see 7.2) is nominally 50 mm. A testing machine whose dimensions do not comply with the above requirements of seating and size can be used in conjunction with an ancillary adapter, such as shown in Figures 1 and 2, placed centrally between the platens of the machine. The platen(s) of the adapter shall have a thickness of at least 10 mm.

The lower platen of the machine shall be marked so as to facilitate placing the test piece (or adapter) at its centre (e.g. by scribing concentric circles on the lower platen).

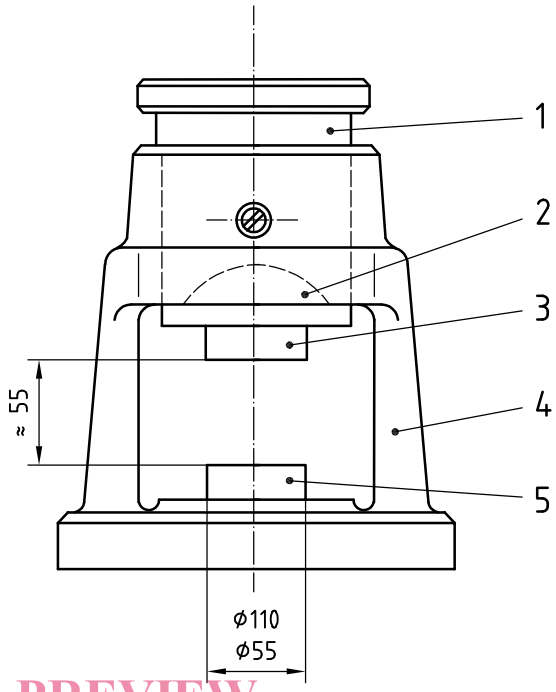


Key

1 platen of testing machine
2 spherical seat
3 spherical bearing block
4 cellulose fibre board
5 centre of spherical surface
6 test specimen

Figure 1 — Example of ancillary adapter incorporating spherical seating block

Dimensions in millimetres



Key

1 cylindrical ram for transmitting load to test piece
2 ball seating
3 upper platen
4 rigid frame
5 lower platen

Figure 2 — Example of ancillary adapter incorporating spherical seating block and small platens for testing small test pieces (dimensions in millimetres)

6.2 Vernier callipers, in accordance with ISO 3599 for the measurement of test pieces.

6.3 Set square.

6.4 Feeler gauges.

6.5 Drying oven, capable of being controlled to 110 °C ± 5 °C.

6.6 Cellulose fibre board (e.g., non-corrugated paperboard or cardboard) with a thickness of between 3 mm and 7 mm. The thickness and density of the board used in the test shall be measured and included in the test report.

7 Test pieces

7.1 A single test piece shall be taken from a standard brick test item, or a test item equal to or less than 2 000 cm^3, or two test pieces from shapes of a significantly larger volume.

NOTE The number of test items should be in accordance with an agreed sampling plan. A minimum of five test pieces is recommended.

7.2 The size of the test pieces shall be one of the following:

a) cylinders, 50 mm ± 2 mm in height and 50 mm ± 2 mm in diameter;

b) cubes, 50 mm ± 2 mm side length;

c) cubes, 75 mm ± 2 mm side length;

d) half a standard brick, (e.g. 114 mm × 114 mm × 76 mm or 114 mm × 114 mm × 64 mm).

NOTE Where the size of the test items do not allow the above sizes, the largest possible cylinders (with the height nominally equal to the diameter) or cubes may be used. However, test pieces smaller than 10 times the largest grains in the material may not be used.

7.3 Test pieces shall be cut or cored from the test items so that the load applied during testing is in the same direction as the forming pressure during manufacture, where this is known. The original position of the test pieces in the test items shall be noted. Test pieces containing cracks or visible defects on any of the surfaces shall be discarded and this shall be reported.

7.4 Test pieces shall be cut or cored from test items so that the load-bearing faces are as parallel as possible and the test pieces are as perpendicular to the loading direction as possible.

7.5 The parallelism of the test pieces shall be checked by four measurements of the height at the extremities of two perpendicular diameters for a cylinder, or for a cube, along the four edges between the load-bearing faces. The difference between any two of these measurements shall not exceed 2 % of the height.

7.6 The perpendicularity shall be checked by placing a test piece on a plane surface and using the set square (6.3) placed against the sides of the test piece at four positions corresponding to the height measurements. No gap between the side of the test piece and the set square shall exceed 2 % of the height when measured with the feeler gauges (6.4).

7.7 The prepared test pieces shall be dried to constant mass at 110 °C ± 5 °C by placing them in the drying oven (6.5). They shall then be cooled to ambient temperature and protected from moisture until the start of the test.

8 Procedure

8.1 Measure two perpendicular diameters or medians of each load-bearing face of a test piece to the nearest 0,1 mm using the callipers (6.2). From these four measurements, calculate the mean initial cross-sectional area, A_o.

8.2 Place the test piece centrally between the platens of the testing machine (6.1) or ancillary adapter, interposing a single sheet of cellulose fibre board (6.6) between the platens and each load-bearing face of the test piece. The board shall extend a minimum of 12,7 mm beyond the edges of the load-bearing faces of the test piece.

8.3 Select the load-measuring range so that the expected load at failure is greater than 10 % of the load range.

8.4 Apply the load smoothly and continuously, increasing the stress at a rate of 1,0 MPa/s ± 0,1 MPa/s until the test piece fails, i.e. it is unable to support the load. Record the maximum load indicated.

NOTE The load may be applied manually or automatically.

9 Expression of results

The cold compressive strength of the test piece, σ, expressed in megapascals, is given by the expression:

$$\sigma = \frac{F_{max}}{A_o}$$

where

F_{max} is the maximum load recorded, expressed in newtons;

A_o is the mean initial cross-sectional area in square millimetres, of the test piece over which the load is applied.

The result, σ, shall be given to three significant figures.

10 Test report

The test report shall include the following information:

a) all information necessary for identification of the sample tested, including the designation of the material tested (manufacturer, size, quality etc.);

b) reference to this International Standard, i.e. ISO 10059-2:2003;

c) results of the test calculated as specified in Clause 9; including the results of the individual determinations and their mean i.e.:

   1) the individual value of strength for each test piece;

   2) the mean value of strength for each item, where different from that given in 1);

   3) the mean value of strength for the batch sampled;

d) number of items tested;

e) number of test pieces cut from each item;

f) board thickness and density;

g) size of the test pieces (see 7.2);

h) location of the test piece(s) in the item and the relationship to the direction of pressing (see 7.3);

i) location of any defective test pieces (see 7.3);

j) name of the testing establishment;

k) any deviations from the specified procedure;

l) any unusual features (anomalies) observed during the test;

m) date of the test.