

ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION

R 528

REFRACTORY PRODUCTS

DETERMINATION OF PYROMETRIC CONE EQUIVALENT (REFRACTORINESS)

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BRIEF HISTORY

The ISO Recommendation R 528, *Refractory Products—Determination of Pyrometric Cone Equivalent (Refractoriness)*, was drawn up by Technical Committee ISO/TC 33, *Refractories*, the Secretariat of which is held by the British Standards Institution (BSI).

Work on this question by the Technical Committee began in 1953 and led, in 1962, to the adoption of a Draft ISO Recommendation.

In March 1963, this Draft ISO Recommendation (No. 567) was circulated to all the ISO Member Bodies for enquiry. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies:

Australia	Germany	Romania
Austria	Hungary	Spain
Chile	Italy	Sweden
Czechoslovakia	Japan	United Kingdom
Denmark	Netherlands	U.S.A.
France	Portugal	

Two Member Bodies opposed the approval of the Draft:

India
U.S.S.R.

The Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided, in November 1966, to accept it as an ISO RECOMMENDATION.

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REFRACTORY PRODUCTS

DETERMINATION OF PYROMETRIC CONE EQUIVALENT (REFRACTORINESS)

1. SCOPE

This ISO Recommendation deals with the determination of the pyrometric cone equivalent (refractoriness) of refractory materials. Its useful range of application depends on the availability of suitable pyrometric cones.

2. PRINCIPLE

In this determination, test pieces of refractory materials or products are raised in temperature alongside pyrometric cones, and their behaviour is compared under the conditions specified below.

NOTE. — Pyrometric cones are manufactured for estimating the effect of temperature on silica, aluminosilicate and aluminous products having regard to their composition. Consequently, the refractoriness test described below is only fully correct when these products are concerned.

3. APPARATUS

3.1 Vertical or horizontal furnace

The vertical or horizontal furnace to be used for this determination consists of a cylindrical chamber of at least 80 mm useful diameter or a rectangular chamber having minimum dimensions of 60 mm in height and 100 mm in width. This furnace should be capable of reaching a test temperature in accordance with the rate specified in clause 5.2.1.

The atmosphere in the furnace should be such as to have no reducing action on the pyrometric cones or the test pieces*.

In the test conditions, the difference in temperature between the coldest spot and the hottest spot of the space occupied by the stand, the test pieces and the pyrometric cones should not exceed 10 °C (approximately $\frac{1}{2}$ cone). The uniformity of temperature should be established from time to time. (The uniformity can be measured by means of thermocouples, but it is also possible to use pyrometric cones.)

In the case of a flame-heated furnace, the pyrometric cones and the test pieces should be protected from any direct action of the flames and any turbulence from the hot gases.

3.2 Pyrometric cones

The pyrometric cones are blunt-tipped skew triangular pyramids with sharp edges, of the shape shown in Figure 1. Their conventional temperatures of collapse at the rate of heating specified in clause 5.2.1 and when mounted at the angle specified in clause 5.1.1 should be indicated by the manufacturers.

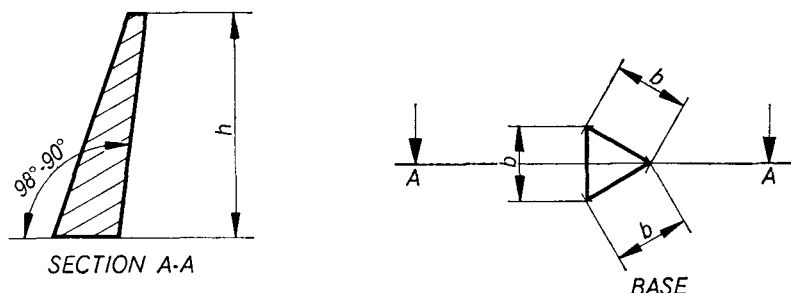


FIG. 1. — Pyrometric cones

* Certain furnaces (e.g. Tammann furnaces or certain types of furnaces fired with hydrocarbon gas and oxygen) are not suitable for this test because of the high content of reducing gases or water vapour in their atmospheres; the atmosphere of the furnace should be such as not to attack the cones or the test pieces.

3.3 Stand for the pyrometric cones and test pieces

The stand for the pyrometric cones and the test pieces consists, depending on the type of furnace, of a rectangular plate or disk of refractory material having adequately plane and parallel faces; the refractory stand and the refractory cement used should not react with either the pyrometric cones or the test pieces at the test temperature.

In order to overcome any tendency to irregular temperature distribution in the furnace, it may be convenient to arrange for relative motion to take place between the furnace walls and the stand, e.g. by rotating the latter, during the determination.

4. TEST PIECES

4.1 The test pieces should have a geometrically similar shape to the pyrometric cones and an equal or greater height, between the limits 29 and 35 mm. The ratio of the height to the edge of base should be 3.55 ± 0.15 .

4.2 The test pieces from shaped or unshaped (see clauses 4.2.1 and 4.2.2) refractory products should preferably be cut; alternatively, they should be moulded, if necessary. The test pieces should be moulded when raw materials are being tested.

4.2.1 *Cut test pieces for shaped refractory products* (bricks and shapes).

4.2.1.1 The test pieces should be cut straight from the material with a saw and dressed with a grinding wheel; the "skin" of baked material is removed.

4.2.1.2 It is advisable to remove a rectangular prism of about $15 \text{ mm} \times 15 \text{ mm} \times 40 \text{ mm}$ and, if the refractory has a coarse or friable texture, it is advisable to impregnate it with a suitable resin giving less than 0.5 per cent ash (e.g. Canada balsam); this piece is then cut and dressed.

4.2.2 *Cut test pieces for unshaped refractory materials* (plastic refractories, ramming materials, refractory cements, refractory concretes etc.).

The test pieces should be cut from pieces that have been previously shaped and baked in accordance with the instructions for the conditions of use. The baking temperature should be mentioned in the test report.

4.2.3 *Moulded test pieces for shaped refractory products, unshaped refractory materials* (e.g. mouldables and castables) and raw materials.

4.2.3.1 50 g of a ground sample (passing a sieve of 0.5 mm mesh opening) prepared in accordance with the general standards on sampling are taken; the extracted material is ground in an agate mortar until it entirely passes a sieve of mesh opening $0.2 \pm 0.01 \text{ mm}$; it is sieved frequently in order to avoid an excess of very fine powder. (The amount of material passing a sieve of mesh opening $0.1 \pm 0.005 \text{ mm}$ should in general be less than about 50 per cent, except in the case of raw materials containing a larger percentage of fines as received.)

4.2.3.2 Crushing and subsequent grinding should be carried out so as to avoid the introduction of extraneous material. The material is mixed carefully.

4.2.3.3 The powder is kneaded with water to which, if the material is lean, an organic binder having a maximum of 0.5 per cent ash is added; if the material reacts with water, some other suitable liquid should be used.

4.2.3.4 The test pieces are moulded in a suitable mould. Test pieces prepared from raw materials which are subject to considerable modification during the reheating should be stabilized by baking before making the refractoriness test; in particular in the case of clays, they should be calcined at about 1000°C . After calcination, the test pieces should comply with the requirements of clause 4.1.