

Methods of testing

Refractory materials —

Part 11: Refractory mortars and putties

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Refractory Products Standards Policy Committee (RPM/-) to Technical Committee RPM/1, upon which the following bodies were represented:

- British Ceramic Research Ltd.
- British Steel Industry
- Engineering Equipment and Materials Users' Association
- Refractories Association of Great Britain
- Refractory Contractors' Association
- Society of Glass Technology

The following bodies were also represented in the drafting of the standard, through subcommittees and panels:

- British Cement Association
- British Metallurgical Plant Constructors' Association

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Foreword

This Part of BS 1902 has been prepared under the direction of the Refractory Products Standards Policy Committee.

The series of test methods given in this Part of BS 1902 is suitable for refractory mortars used for jointing bricks, including hydraulic, air-setting and heat-setting mortars, and for refractory putty which is used for small-scale sealing and patching of structures. It should be emphasized that not every test method given is suitable for every type of material, and limitations are given in the titles and descriptive principles for each method.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 16, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

This Part of BS 1902 describes methods of test for determining physical and chemical properties of refractory mortars used in construction with refractory bricks and shapes, and for refractory putties, which include sealants and patching materials.

NOTE The titles of the publications referred to in this standard are listed on the inside back cover.

2 Designation

References to methods in other Sections of BS 1902 are given by the appropriate method designation, e.g. method 1902-403 refers to the method described in BS 1902-4.3.

3 Definitions

For the purposes of this Part of BS 1902 the definitions given in BS 3446 apply.

4 Properties as supplied and received

4.1 Preparation of test sample

4.1.1 *Sampling of dry mortar delivered in packages*

Where the mortar is supplied in packages of 50 kg or less, individual samples (increments) shall be taken by emptying the material in the package and thoroughly mixing it on a clean, dry surface. The sample shall be reduced to the appropriate test sample quantity either by cone and quartering in accordance with BS 3406-1 or by riffle sampling in accordance with BS 812-103.

NOTE This method for taking samples is the same as is used for dry unshaped refractories used in monolithic construction (see BS 1902-7.1).

Where the mortar is supplied in containers of more than 50 kg, the manufacturer shall take samples representative of the batch before the material is put into the containers, under the supervision of, or with the approval of, the representatives of the other contracting party(ies), and the samples shall be delivered for testing in separate containers.

4.1.2 *Sampling of mortar supplied wet*

Ready-mixed mortars shall be sampled by emptying the entire contents of the container in which the mortar is supplied into another container of larger capacity and mixing the mortar thoroughly. The wet mixture shall then be sampled by use of a ladle.

NOTE An example of a suitable ladle is given in Figure 1.

4.1.3 *Sampling of refractory putty*

Refractory putty shall be sampled by using a sampling tube, not less than 40 mm in diameter and of sufficient length to permit taking a subsample from the top to the bottom of the mass being sampled.

The subsamples shall be taken from at least four separate places, evenly distributed throughout the mass of the material.

4.2 Moisture content and chemical analysis

For mortars supplied dry, take a sample of approximately 250 g, in accordance with 4.1.1. Weigh to the nearest 0.01 g and dry to constant mass in an oven at 110 ± 5 °C.

For mortars and refractory putties supplied wet, take a sample of approximately 50 g, in accordance with 4.1.2 or 4.1.3. Samples of putty shall have a maximum thickness of 13 mm. Weigh to the nearest 0.01 g and dry to constant mass in an oven at 110 ± 5 °C.

For both types, remove the sample from the oven, cool, place in a desiccator, and reweigh to the same accuracy. Calculate the moisture content as a percentage of the original mass, to the nearest 0.1 %.

Use the dried samples to determine the chemical composition of the mortars in accordance with the methods given in BS 1902-2 or BS 1902-9.

4.3 Sieve analysis

4.3.1 *Principle*

The analysis is carried out by passing the material through a series of sieves of progressively decreasing aperture, so that it is divided into fractions that are defined by the apertures of the sieves used. One of the three methods given in 4.3.3 to 4.3.5 is used. Wet sieving gives more reproducible results than dry sieving, but the latter method is included as some products contain hydratable components that do not permit the use of wet methods.

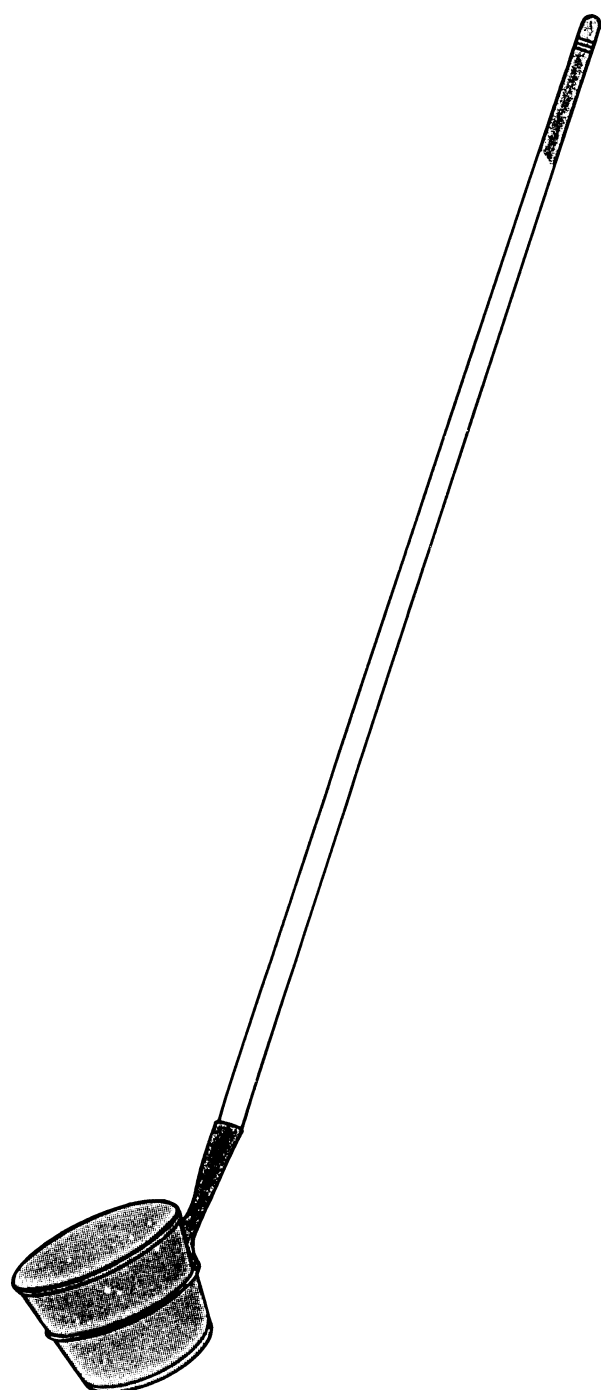
4.3.2 *Apparatus*

4.3.2.1 *Test sieves and receiver*, complying with BS 410, and 200 mm in diameter.

4.3.2.2 *Sieve brush*

4.3.2.3 *Drying oven*, which is fan assisted and which has openings to enable efficient ventilation.

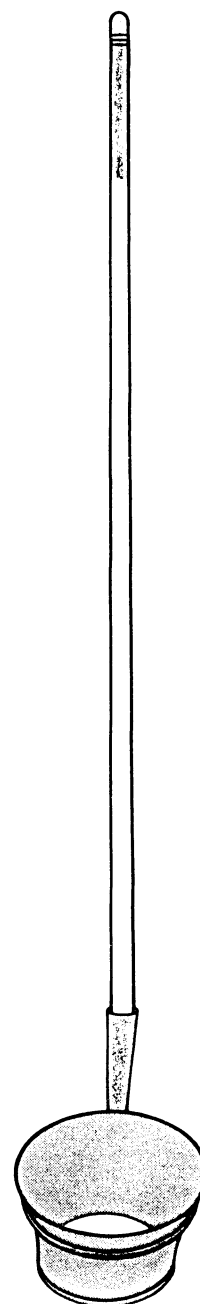
4.3.2.4 *Watch glasses*, 150 mm in diameter.



(a) Side view

Approximate dimensions of sampling ladle:

diameter	75 mm
depth of ladle	75 mm
handle length	450 mm



(b) Front view

Figure 1 — Example of suitable ladle for sampling of wet mortar

4.3.2.5 Balance, capable of weighing to an accuracy of ± 0.01 g.

4.3.2.6 Mechanical stirrer, suitable for mixing 2 L of aqueous suspension.

4.3.2.7 Mechanical sieve shaking device

4.3.2.8 Large evaporating dish

4.3.3 Wet sieve analysis of dry mortar

Ensure that the sieves are dry and clean before use.

Take a sample (see 4.1.1) of at least 50 g of mortar, dry in the oven at 110 ± 5 °C to constant mass, cool and weigh to 0.01 g (M_1). Place the sample of mortar in a beaker containing approximately 2 L of water and a suitable dispersing agent (e.g. sodium hexametaphosphate) and stir mechanically. When dispersion is obtained, wash the entire contents of the beaker on the finest mesh sieve, which is placed in a sink. Carry out any further washing using a rubber tube attached to a tap, until the water running through the sieve is clear.

After washing, transfer the material retained on the sieve to a large evaporating dish.

NOTE 1 This transference may be achieved by means of a wash bottle.

NOTE 2 If the material is caked and/or adhering to the sieve this procedure should be regarded as showing the presence of hydratable material and the test abandoned. The method in 4.3.5 should be used.

Dry the dish and contents at 110 ± 5 °C to constant mass.

NOTE 3 Some mortars may contain organic materials, e.g. pitch particles, and these mortars should be dried at a temperature below that where any softening occurs.

Remove the sample from the dish and weigh to 0.01 g (M_2). Place the nest of required sieves on the mechanical shaking device, with the coarsest at the top and the finest and the receiver at the bottom, and sieve the sample for 20 min. Where difficulties arise with the mechanical shaking device, for example when fine powders adhere to the upper sieve, lightly brush over the sieve to assist the transfer of screenable material into the next sieve before emptying for weighing. Use of this brushing procedure shall be reported. Remove the sieves from the shaking device. Empty the contents of the coarsest sieve on to clean paper, transfer to the balance and weigh to 0.01 g (M_R , where R is the sieve size). Repeat this process for the other sieves in the nest.

Calculate the percentage fraction for each sieve size (R) from the equation:

$$\text{percentage retained on mesh} = \frac{M_R}{M_1} \times 100$$

Calculate the percentage fines passing through the finest sieve from the equation:

$$\begin{aligned} \text{percentage passing through finest mesh} \\ = \frac{M_1 - M_2}{M_1} \times 100 \end{aligned}$$

4.3.4 Wet sieve analysis of ready-mixed mortar and refractory putty

Determine the percentage moisture content of the mortar (m) by drying at 110 ± 5 °C, using the method given in 4.2.

Take a second sample (see 4.1.2 or 4.1.3) of at least 50 g, place on a dried watch glass of mass W_1 , and weigh to 0.01 g (W_2). Place the finest of the sieves, without a receiver, in a sink and wash the mortar on to it, using copious amounts of water so that all the mortar is transferred on to the sieve and none remains on the watch glass. Wash the mortar on the sieve using a rubber tube attached to the tap until the water that runs through the sieve is clear. If after extensive washing the material does not break down into its component particles, take a second sample of the mortar, treat with a dispersant as described in 4.3.3, and repeat the procedure.

After washing the mortar on the finest sieve, continue the test as described in 4.3.3.

Calculate the grading of the mortar from the equations:

$$M_1 = (W_2 - W_1) - \frac{(W_2 - W_1) \times m}{100}$$

$$\text{percentage retained on mesh} = \frac{M_R}{M_1} \times 100$$

$$\begin{aligned} \text{percentage passing through finest sieve} \\ = \frac{M_1 - M_2}{M_1} \times 100 \end{aligned}$$

where

M_1 is the mass of dry material (in g);

M_2 is the mass of dry material (in g) retained by the finest sieve;

M_R is the mass of dry material (in g) retained by the sieve of mesh size R .

NOTE The total of the fractions could be less than 100 % because of losses of very fine material during the various operations of the analysis.