

Installation of monolithic refractories —

Part 1: Code of practice for installation by casting

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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/8, upon which the following bodies were represented:

- British Ceramic Research Ltd.
- British Metallurgical Plant Constructors' Association
- British Steel Industry
- Coke Oven Managers' Association
- Combustion Engineering Association
- Department of trade and Industry
- Energy Industries Council
- Engineering Equipment and Materials Users' Association
- Institute of Refractories Engineers
- METCON
- National Federation of Master Steeplejacks and Lightning Conductor Engineers
- Refractories Association of Great Britain
- Refractory Contractors' Association

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The following BSI references relate to the work on this standard:
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Foreword

This Part of BS 7335 was prepared under the direction of the Refractory Products Standards Policy Committee. A code of practice for installation by gunning has also been published as BS 7335-2.

The purpose of this code of practice is to advise on good or recommended practice before, during and after installation of monolithic refractories. Nothing in the code should be taken as a specification for either the materials or their installation.

Assessed capability. Users of this British Standard are advised to consider the desirability of assessment and registration of a supplier's quality systems against the appropriate Part of BS 5750 by a third party certification body.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 14, 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 code of practice describes good practice for working procedures in the installation of refractory linings by casting techniques. The code is specifically concerned with the casting of replacement linings, using refractory materials bonded by calcium aluminate cement. Major repairs, involving the removal of old panels of the lining back to the shell, are also covered.

Recommendations for ensuring accordance with the agreed design are included where appropriate.

The casting of linings for steel chimneys is specifically described in BS 4207.

NOTE 1 Because of the complex nature of most applications of refractory castables, the manufacturer's written instructions should always take precedence over any guidance information contained herein. The application of castables with low cement levels is not included.

NOTE 2 The titles of the publications referred to in this standard are listed on the inside back cover.

2 Definitions

For the purposes of this code of practice, the definitions given in BS 3446-1 apply, together with the following.

2.1

normal cement content

mixes with a cement content of greater than 10 % by mass, which develop their strength by hydration, without the incorporation of small quantities of electrolytes or other materials

2.2

low cement content

mixes which have less than 10 % by mass of cement and contain very small amounts of soluble compounds whose effect is to enhance the strength developed in the finished cast body

2.3

air line

a pipe, usually of flexible synthetic rubber, through which compressed air is conveyed to an item of equipment

2.4

material hose

a pipe, usually of flexible synthetic rubber, through which mixed castable is conveyed to a point of installation

2.5

panel

a section of lining divided from its surroundings. This division may be created by casting one panel against another after the first has set, or it may be separated by a small gap to allow for movement of one panel relative to the other

2.6

gauging water

the amount of water required to correctly mix the castable material

2.7

anchor

a device for retaining a castable in position in a wall, roof or floor. Anchors may be made of ceramic or metallic material

2.8

hanger

a metallic device used for fixing (usually loosely) a ceramic anchor in position

3 Planning

NOTE The installation should be planned in detail, in advance, so that work on site can proceed quickly and efficiently. The checklist in 3.1 to 3.18 is given as an aid in drawing up such a plan.

3.1 The safety requirements of the site should be considered, taking guidance where necessary from appropriate British Standards (see 7.9) and publications by the Health and Safety Executive.

3.2 The extent of the job and the time available should be determined so that the required rate of installation may be calculated and an appropriate schedule for casting prepared. Allowance should be included for any preparation of the unit which may be necessary, including the fixing of anchors, fixing forms and any intermediate drying-out which may be required.

3.3 The number of men required to be able to place each panel of the lining continuously and correctly in the allocated time should be established. An evaluation should be made to ensure that the proposed number of men can work in the space available and that the castable material can be conveyed to the installation point, placed and densified within the working time for the material being used.

3.4 The material storage conditions and duration should be evaluated so that suitable packaging, for example hermetically sealed drums and paper sacks, may be agreed. If possible castable material should be ordered well in advance and a schedule for delivery to site should be agreed so that the material arrives on site just prior to installation.

3.5 A water supply of appropriate quality, capacity and temperature should be provided.

3.6 Materials handling and waste disposal facilities should be provided as appropriate for the materials and equipment involved.

3.7 The type of formwork, screed boards, formwork retention systems, scaffolding and staging required to achieve the planned installation should be determined, and prepared and positioned prior to commencement of refractories installation.

3.8 Mixers, vibrators, other compacting equipment, conveying equipment and hoses, appropriate for the planned installation rate, should be provided.

3.9 Suitable electrical power supplies should be arranged, with due regard to voltage, frequency, current and phase requirements. Artificial lighting should be provided at all work areas and access points, if necessary.

3.10 A compressed air supply may be necessary for the conveyance of material or for the equipment used to ensure proper compaction of the castable. Existing site supplies of compressed air may be adequate in some cases but provision of an independent compressor is recommended to ensure that air supply is not lost as a result of out of area activities. Whatever source of compressed air is used a suitable moisture trap or drying system should be included to prevent damage to motor units.

3.11 If necessary, auxiliary heating or cooling should be arranged, for example space heating or water cooling of the shell of the unit to be lined.

3.12 The optimum siting of the various items of equipment for efficient operation should be decided.

3.13 A suitable welding procedure for anchors or hangers should be agreed.

3.14 The size of panels to be cast and sequence of panel installation should be decided, if not specified in the unit design. If the size and shape of the unit is suitable, square panels of 1 m to 2 m sides are usually employed.

3.15 If not already designated (in a working drawing), the refractories manufacturer/supplier or the furnace designer should be consulted regarding the type and spacing of joints between panels, and the type and spacing of anchors.

3.16 The curing and drying out procedure to be adopted should be agreed (see clauses 11 and 12). In multi-layer linings, the need for drying out between installation of successive layers should be considered.

3.17 If required, a quality control procedure should be agreed for incoming materials (see clause 5) and/or for the cast lining, samples taken from them or samples fabricated simultaneously with them (see clause 13).

3.18 If required, the quality of workmanship and the efficiency of the equipment may be assessed at the commencement of the operation.

4 Personnel

Operations directly involved in installation by casting are as follows:

- a) mixing;
- b) movement;
- c) placement;
- d) compaction;
- e) finishing;
- f) demoulding;
- g) curing.

Depending on the size and difficulty of the job, it is possible that some of these activities can be carried out by the same man, or a team may be required to execute one single activity.

5 Castable materials

5.1 Quality control

These recommendations are concerned with the quality of the castable material as tested prior to installation. The quality of the cast lining, which depends on both the quality of the castable material and on the method of installation, is described in clause 13.

Any problem associated with the castable material will be compounded by time and expense if it remains undetected until after installation, particularly if it causes failure on commissioning or in service. It is therefore recommended that acceptable limits for appropriate properties of the castable material should be agreed between the parties concerned, and that supplies of the castable material should be sampled and tested to ensure that the agreed requirements are met. The following options may be considered for quality control of supplies of castable material.

- a) It may be agreed between the parties concerned that the quality control procedures of the refractories manufacturer/supplier are adequate, particularly where an accredited quality assurance scheme is operated. (See BS 5750).
- b) A scheme of sampling and testing specific to the job in hand may be agreed between the parties concerned. (See, for example, the sampling scheme and testing procedures in BS 1902-7.)